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Report of the Working Group on the Celtic Seas Ecoregion (WGCSE)

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Copenhagen, Denmark

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Contents

1 General

The report has no Executive Summary.

2 Data and Methods

A discussion of historical data available is discussed in Section 2.1 to 2.5 of WGNSDS 2008 and Section 1.3 of WGSSDS 2008 (ICES, 2008a,b). There have been no substantive changes to available data or work up methodologies this year. The methods employed by the WG are described in each stock annex and Sections 2.6 to 2.11 of WGNSDS 2008 and Section 1.4 of WGSSDS 2008 (ICES, 2008a,b).

Biological sampling levels by country and stock are summarised in Table 2.1. The sampling levels for 2008 are, in general, similar to those in 2007. Deficiencies in sampling (if any) are discussed in the relevant stock section.

References

ICES. 2010. Report of the Working Group on the Assessment of Northern Shelf Demersal Stock (WGNSDS), 15–21 May 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:08. 756 pp.

ICES. 2010. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 26 June–5 July 2007, ICES Headquarters, Copenhagen. ICES CM 2007/ACFM:28. 675 pp.

2.1 MSY estimation for fin-fish stocks

The general approach of WGCSE is outlined as follows: WGCSE used ADMB to explore the S-R, fishery selection, and growth potential data for fin-fish stock where assessment data were available. Based on an analysis of the uncertainty of the estimated parameters, the AICc value and the coefficient of variation the fits and estimates from various S-R models (Beverton and Holt, Ricker and smooth hockey stick) the most plausible S-R relationships were used for the estimation of F_{MSY}. In many cases the F_{MSY} estimates were equally well determined by each model but often differing S-R models result in differed in the absolute values.

Where this was the case WGCSE concluded that as result of the equivalence in the precision of the estimates determined from each model fit, no definitive value of F_{MSY} can be defined. In such cases the range of estimated fishing mortalities should be used as the basis for the management advice for the stock. For example fishing mortalities in the range 0.19–0.36 are consistent with maximising long-term yield for plaice in VIIfg, no value in the range is considered more appropriate than any other. The advice could be framed using the maximum of this range as an upper bound for F_{msy}. In the example of plaice VIIfg the ICES MSY framework implies that fishing mortality be reduced to 0.36 or lower.

2.2 MSY estimation for *Nephrops* stocks

The different *Nephrops* stocks (Functional Units, FUs) for which ICES delivers advice cover a wide range of fisheries including single, twin, triple and even quadruple trawls, creeling (potting), with activity covering inshore and offshore grounds. The timing of these fisheries varies, which due to the different emergence patterns of the different sexes due to moulting and egg-brooding, leads to very different relative exploitation rates (between the sexes) in different FUs. Local ecosystem type is also highly variable with a range of *Nephrops* densities, different composition and density of organisms competing for space as well as different assemblages of predators. Ground types also cover a wide range including large contiguous sediment beds, fragmented patches of suitable sediment in rocky areas, shallow sea-lochs and patches of mud on relatively deep shelf-edges. Given these differences in fishery and ecology it is inevitable that estimates of the exploitation rate leading to long-term MSY will vary between the FUs, the difficulty for scientists is how to estimate these rates given the inherent difficulty in assessing crustacean stocks, for which no practical method routine of age determination is available. Some assessments take the observed length frequency data and slice it into age-classes according to the von Bertalanffy growth parameters. These numbers-at-age are then taken forward into standard stock-assessment packages. This practice was ceased in 2005 within this Group due to concerns over both the reliability of reported landings in some FUs (particularly the UK fisheries) and the use of the 'pseudo' age-structured data in an age-based assessment. As a result of this, no dynamic population model is fitted to the data and consequently there are no estimates of spawning stock and recruitment which are fundamental to the determination of F_{msy} and proxies for F_{msy} must therefore be sought. WKFrame (ICES 2010) made several recommendations for defining F_{msy} proxies where no direct estimation of F_{msy} was possible (i.e. for stocks for which there is no analytic assessment, but length- or age-structured catch data are available). The suggested approach focused on per-recruit analysis with the following guidelines:

- Use input parameters which reflects the current situation (selection and discard ogive, maturity and weight-at-age/length)
- If there is clear peak at low F in the YPR analysis and no evidence of recruitment dependence on biomass, then F_{max} may be an appropriate proxy.
- Where $F_{max,}$ is undefined then $F_{0.1}$ might be considered as a 'lower bound' to the range of F suitable for F_{msy}, as it is assumed to be low risk.
- Spawning biomass per recruit analysis should be routinely evaluated in addition to YPR. There is not a single level of % SPR that is optimal for all stocks and the proposal for F_{msy} should include some consideration of life history. Further studies by Clark (1991; 1993) concluded that F35% and higher were robust proxies for F_{msy}, considering uncertainty in stock–recruitment functions and or recruitment variability.
- Conduct a sensitivity analysis to the input parameters and consider the variability of estimates over time.

Within the Celtic sea areas, assessment of *Nephrops* stocks falls into three categories, those with TV surveys, those monitored by lpue/mean size and those with only landing information. Only for those stocks with TV surveys is the catch advice determined by an exploitation rate, advice for the other stocks is based on changes to landings. For those stocks with a TV survey, the Harvest Rates (removals divided by abundance as estimated by the TV survey) associated with fishing at $F_{0.1}$ and F_{max} were estimated at the 2009 benchmark meeting WKNeph (ICES 2009). In response to the recommendations of WKFrame, estimates of $F_{35\%SpR}$ and the corresponding Harvest Rate have also been determined and these estimates typically lie between the estimates of $F_{0.1}$ and F_{max}. Suggestions for a TV-abundance based proxy for $B_{trigger}$ have been made on the basis of the lowest observed TV-abundance (median survey value) *unless* the stock has shown signs of stress at a higher TV-abundance in which case this value becomes $B_{trigger}$.

The remaining challenge is determining which F_{msy} proxy is appropriate for which stock and this becomes an exercise in expert judgment based upon knowledge of the fishery and the ecosystem. The implications for exploitation rate can vary considerably depending upon which proxy is chosen ($F_{0.1}$, $F_{35\%SpR}$ or F_{max}) and whether to account for the differences in relative exploitation rate between the sexes. Given that there is often a distinct difference in the exploitation rate between the two sexes (males>females) it is usually impossible to simultaneously achieve the target fishing mortality on both sexes (i.e. the stock cannot be fished such that both the male and female YPRs are maximised simultaneously). The following text table shows the F-multipliers required to achieve various F_{msy} proxies for the sexes of a typical *Nephrops* stock (FU 8 in this example), the Harvest Rates which correspond to those F multipliers and the resulting level of spawner-per-recruit expressed as a percentage of the virgin level.

		FBAR(20–40 MM)			HR (%)	SPR (%)		
		Fmult	Male	Female		Male	Female	Combined
$F_{0.1}$	Male	0.2	0.13	0.06	7.47	42.33	64.50	51.72
	Female	0.43	0.29	0.13	14.23	22.96	44.80	32.21
	Combined	0.24	0.16	0.07	8.75	37.29	60.04	46.92
F_{max}	Male	0.36	0.24	0.11	12.31	26.94	49.50	36.49
	Female	0.81	0.54	0.24	23.38	12.11	28.95	19.24
	Combined	0.46	0.31	0.14	15.03	21.55	43.02	30.64
F35%SpR	Male	0.27	0.18	0.08	9.67	34.13	57.04	43.83
	Female	0.63	0.42	0.19	19.28	15.79	34.96	23.91
	Combined	0.39	0.26	0.12	13.15	25.10	47.38	34.53

The yield-per-recruit and spawner-per-recriut plots for this stock are shown in Figure 2, emphasizing the disparity in f-multipliers required to achieve F_{max}. The general tradition in fisheries science is to concentrate on the mortality on females because in a freely distributing population, one male should be able to fertilise several females and therefore a higher exploitation rate on males should not affect spawning potential. *Nephrops* are slightly different in that the adults have a fairly limited range of movement (100's of metres) and therefore very low densities of males could result in sperm limitation. Ensuring that the fishing mortality target on males is not exceeded will usually result in an under-utilisation of the females, but due to the faster growth rate of males the under-utilisation of total yield is not likely to be large. The alternative, of trying to achieve F_{msy} on females, carries a potentially serious risk to the production of future recruits and may result in very high exploitation of males. A the use of a combined F_{msy} (or proxy thereof) would obviously deliver higher long-term yield than either of the two separate sex values but the implication for male stock level should be noted. The Working Group suggested that a combined sex F_{msy} proxy should be considered appropriate *provided* that the resulting percentage of virgin spawner-per-recruit for males does not fall below 20%. In such a case the male F_{msy} proxy should be picked over the combined proxy.

In cases where recruitment rates are typically low and/or highly variable then a more cautious F_{msy} proxy would be appropriate as the stock may have reduced resilience to periods of poor recruitment and in this case $F_{0.1}$ is recommended. Conversely where recruitment rates are considered to be regularly high and the stock appears to have supported a harvest rate at or above $F_{max,}$ (or in the case of a short TV time-series a particular landing level) without showing signs of recruitment overfishing, then F_{max} is recommended. In all other cases F35%SpR should deliver high long-term yield with a low probability of recruitment overfishing and is recommended as the "default" value.

In order to assist communication of the decision process the following bullet list is suggested as a standard checklist for describing the rationale behind the choice of a particular F_{msy}.

- Describe the absolute density. *Is it high (i.e. >1 per m²), medium (i.e. 1.0–0.2 per m²) or low (i.e. <0.2 per m²)*
- Variability in density. *Is there large interannual variability, spatial complexity?*
- Understanding of biological parameters. *Is the growth rate particularly fast or slow, high or low estimates of natural mortality?*
- Fishery timing and operation. *Is there a strong seasonal pattern leading to different exploitation rates on the sexes, does this pattern vary much between years?*
- Observed Harvest Rate or landings compared to stock status. *Is the harvest rate consistently around or above F_{max}? Have landings been stable? Have the indicators of stock status shown signs of difficulty?*

Accompanying this text should be a table listing the F_{msy} proxies F_{max}, $F_{35\%SpR}$ and $F_{0.1}$ for males and females, the Harvest Rates they correspond to along with the implied %spawner-per-recruit for males and females.

Following changes to UK legislation in 2006 the reliability of UK landings data is considered to have significantly improved (representing ~80% of the landings). Provided that this is both true and continues into the future, assessment scientists will eventually have data which could be used to parameterise dynamic stock assessment models which in turn will enable estimation of F_{msy} directly rather than have to rely upon proxies thereof. Until this point the decision of which F_{msy} proxy is suitable for which FU will inherently be a subjective process but the process outlined above should provide sufficient justification to support the decision.

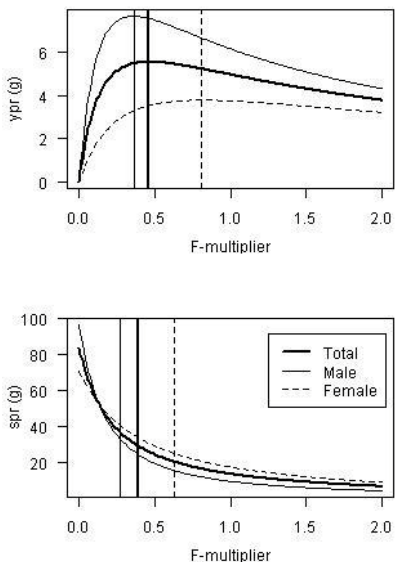

Figure 2.1. Yield-per-recruit and spawning–stock biomass-per recruit for males, females (dotted line) and combined (bold) with F_{max} and $F_{35\%spr}$ reference points.

Table 2.1. Biological sampling levels by stock and country.

Table 2.1 Biological sampling levels by stock and country		Cod					Whiting				Nephrops									Plaice					Sole					Haddock				Megrim		Anglerfish			
		VIa	VIb	VIIa	VIIb,c	VIIe–k	VIIb,c	VIIe–k	VIa	VIIa	FU11	FU12	FU13	FU14	FU15	FU16	FU17	FU19	FU 20-22	VIIa	VIIb,c	VIIe	VIIf,g	VII h-k	VIIa	VIIb,c	VIIe	VIIf,g	VII h-k	VIIb–k	VIa	VIb	VIIa	VIa	VIb	IIa	IVa & III	VIa	VIb
Belgium	No. lengths (landings)			103		119		1,721		437										10,260		751	3,889		12,084		1,942	8,281											
	No. ages (landings)			96		118		293		142										641		32	495		1,155		0	790											
	No. samples (landings)*			5		4		4		5										13		2	11		16		2	12											
	No. lengths (discards)			192		253		6,649		11,422										24,357		32	7,271		3,641		11	1,005											
	No. ages (discards)			171		172		291		319										332		26	218		173		11	88											
	No. samples (discards)'			5		4		4		5										5		2	4		5		2	4											
UK E&W	No. lengths (landings)			732		7,394		1,171		0				5,334						9,957		23,368	6,666	0	1,133		12,839	5,909	2,196	1,171									
	No. ages (landings)			91		1,064		146		0										2,375		2,319	832	13	1,059		2,410	2,228	523	146									
	No. samples (landings)*			20		225		9		0				22						73		212	50	0	15		130	30	21	9									
	No. lengths (discards)			0		794		24,424		1,956				239						16,487		22,271	12,702	380	47		9,556	8,389	910	24,424									
	No. ages (discards)			0		0		0		0										0		0	0	0	0		0	0	0	0									
	No. samples (discards)'			5		96		96		11				10						11		67	25	4	11		67	25	4	96									
UK Northern Ireland	No. lengths (landings)																																						
	No. ages (landings)																																						
	No. samples (landings)*																																						
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
France	No. lengths (landings)					19,837		6,346											9,257			1,190					7,511			6,481									
	No. ages (landings)					1,070		1,115											0			0					0			1,267									
	No. samples (landings)*					154		68											28			12					14			71									
	No. lengths (discards)					2,314		521											19,412			77					131			380									
	No. ages (discards)					0		0											0			0					0			0									
	No. samples (discards)'					115		29											14			27					29			29									
Spain	No. lengths (landings)															2,225																							
	No. ages (landings)																																						
	No. samples (landings)*															5																							
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
Ireland	No. lengths (landings)	106	0	468	61	976	451	1,462	299	354	0	0	0	0	10,490	11,956	6,236	7,601	9,248	513	331	0	311	0	239	42	0	119	0	480	0	0	239	463	181	0	0	182	93
	No. ages (landings)	302	32	1,032	76	4,686	2,061	12,539	1,182	1,810										3,230	1,493	0	5,369	0	2,724	986	0	2,700	0	5,131	44	0	2,724	2,479	500	0	0	1,128	545
	No. samples (landings)*	14	1	40	9	119	23	109	11	14	0	0	0	0	28	2	17	16	33	39	20	0	64	0	28	14	0	49	0	79	1	0	28	18	3	0	0	13	3
	No. lengths (discards)	7	0	116	2	588	1,640	8,985	147	5,431	0	0	0	0	11,167	0	7,037	0	12,563	1,042	774	0	938	346	14	12	0	9	4	16,793	73	732	807	264	68	0	0	32	47
	No. ages (discards)	0	0	0	0	179	229	555	39	128										82	149	0	116	133	0	0	0	3	3	1,030	0	36	41	35	28	0	0	0	25
	No. samples (discards)*	44	26	55	222	437	222	437	44	55	0	0	0	0	28	0	17	0	32	55	222	0	175	262	55	222	0	175	262	659	44	26	55	44	26	0	0	44	26
	No. lengths (catches)																																						
	No. ages (catches)																																						
	No. samples (catches)*																																						
UK Scotland	No. lengths (landings)	1,318	343						9,131		28,506	35,615	17,571																		9,131	4,208		2,401	0			2,142	231
	No. ages (landings)	448	217						1,130																						1,130	339		229	0			339	62
	No. samples (landings)*	22	5						34		54	55	35																		34	12		22	0			22	3
	No. lengths (discards)	914	69						3,776		3,451	6,549	7,833																		4,304	5,534		835	1,673			42	295
	No. ages (discards)	514	3						402																						447	6		0	0			0	0
	No. samples (discards)'	17	2						15		17	23	22																		17	2							
Norway	No. lengths (landings)																																						
	No. ages (landings)																																						
	No. samples (landings)*																																						
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
Russian Federation	No. lengths (landings)																																						
	No. ages (landings)																																						
	No. samples (landings)*																																						
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						
Denmark	No. lengths (landings)																																						
	No. ages (landings)																																						
	No. samples (landings)*																																						
	No. lengths (discards)																																						
	No. ages (discards)																																						
	No. samples (discards)'																																						

3.1 West of Scotland overview

There is no overview.

3.2 Cod in Subarea VIa

Cod in Division VIa is included in the EU long-term management plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008). An update assessment was conducted this year by the WG.

ICES advice applicable to 2009

Exploitation boundaries in relation to existing management plans

The management plan is not explicit about the level of reduction in the catch when the stock is below $B_{lim.}$ Furthermore, due to the uncertainty in the level of fishing mortality, ICES is not in a position to give quantitative forecasts. Simulations conducted in 2006 showed that fishing should be closed for 3 years in order to bring SSB above B_{lim}.

Exploitation boundaries in relation to precautionary considerations

Given the low SSB and low recruitments in recent years, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach.

ICES advice applicable to 2010

Single stock exploitation boundaries

ICES evaluated the long-term management plan and has not yet been able to confirm that it is precautionary. Considering the options below, ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that no fishing should take place on cod in Division VIa.

Exploitation boundaries in relation to existing management plans

Due to the uncertainty in the level of fishing mortality, ICES is not in a position to give quantitative forecasts. Given the stock status it is likely that the stock will fall into the category defined in Article 9.a of the plan which implies a 25% TAC reduction.

Exploitation boundaries in relation to precautionary considerations

Given the low SSB and low recruitments in recent years, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach.

3.2.1 General

Stock definition and the management unit

General information about the stock can be found in the Stock Annex and an overview of the fisheries West of Scotland can be found in Section 3.1. The assessment unit is VIa and a TAC is set for ICES Areas VIa and Vb (EC waters). The 2009 and 2010 TACs for cod in the management unit were 240 t and 240 t respectively.

Management applicable to 2009 and 2010

The minimum landing size of cod in the human consumption fishery in this area is 35 cm. Before 2009 a TAC was set for ICES Subarea VI and EC and international waters of ICES Subareas XII and XIV and Subdivision Vb1. From 2009 a TAC for VIa and Vb1 was given.

TAC for 2009

Species: Cod *Gadus morhua*		Zone: VI; EC waters of Vb; EC and international waters of XII and XIV (COD/561214)
Belgium	0	
Germany	4	
France	48	
Ireland	68	
United Kingdom	182	
EC	302	
TAC	302	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Special conditions

Within the limits of the abovementioned quotas, no more than the quantities given below may be taken in the ICES zones specified

	VIa; EC waters of Vb (COD/*5BC6A)
Belgium	0
Germany	4
France	38
Ireland	54
United Kingdom	144
EC	240

TAC for 2010

Species: Cod *Gadus morhua*		Zone: VIa; EU and international waters of Vb east of 12° 00' W (COD/5B6A-C)
Belgium	0	
Germany	4	
France	38	
Ireland	53	
United Kingdom	145	
EU	240	
TAC	240	Analytical TAC

Technical measures applicable to the West of Scotland, including those associated with the cod recovery plan in force in 2008 (Council Regulation No. 423/2004), the cod long-term management plan in force from 2009 (Council Regulation No. 1342/2008) and the Restrictions on fishing for cod, haddock and whiting in ICES Zone VI contained in Council Regulation No. 43/2009 (Annex III paragraph 6), are described in Section 3.1.

The fishery in 2009

Cod is believed to be no longer targeted in any fisheries now operating in ICES Division VIa. The table of official landings statistics is given in Table 3.2.1. This indicates the full TAC was not taken, however, the catch information provided to ICES for the assessment give landings close to the TAC (Table 3.2.2).

Because of restrictive TACs, seasonal/spatial closures of the fishery, and effort restrictions based on bycatch composition the probability of misreporting and underreporting of cod in the past is considered to have been high. From 2006 the Registration of Buyers and Sellers legislation in the UK and Sales Notes management system in Ireland are considered to have reduced to low levels underreporting (see Section 3.1). Area misreporting, however, is still believed to take place in the UK. Area misreporting will, for example, see cod caught in VIa declared as taken from the Faroe region or ICES Area IVa. The UK and Irish legislation introduced in 2006 is also believed responsible for a significant increase in discards starting in 2006. Since 2006, the estimated weight of discards has exceeded landings (Table 3.2.2), and discarding has taken place over an increased range of age groups (Tables 3.2.6 and 3.2.7 and Figure 3.2.1). Discard numbers as a percentage of catch numbers-at-age for 2009 are shown in the following text table:

AGE	1	2	3	4	5	6	7+
% catch discarded	99.8	95.7	94.8	82.1	0.0	88.0	0.0

The absolute level of numbers discarded from the 2005 year class at age 1 in 2006 through to age 4 in 2009 have been high relative to the same age class from adjacent cohorts (Table 3.2.6). Estimates of catches (landings plus discards) derived from observer programme and logbook data are almost seven times higher than reported landings.

Tables and figures of total effort by the fleets operating in Division VIa can be found in Section 3.1.

3.2.2 Data

An overview of the data provided and used by the WG is provided in the following text table:

	COMMERCIAL DATA				SURVEY DATA			
	Landings		Discards		cpue at age			
	No. at age	Wght. at age	No. at age	Wght. at age	ScoGFS-1Q	ScoGFS-4Q	IreGFS	IGFS
Available	1978–2009 Ages : 1–7+	1978–2009 Ages : 1–7+	1978–2009 Ages : 1–7+	1978–2009 Ages : 1–7+	1985–2010 Ages : 1–7	1996–2009 Ages : 0–8	1993–2002 Ages : 0–3	2003–2009 Ages : 0–3
Used	1978–1994 Ages : 1–7+	1978–2009 Ages : 1–7+	1978–1994 Ages : 1–7+	1978–2009 Ages : 1–7+	1985–2010 Ages : 1–6	NOT USED	NOT USED	NOT USED

A plot of log catch curve gradient derived from commercial catch data (landings plus discards) is shown in Figure 3.2.2. The trend in gradients over time appear fairly consistent between the age ranges considered (2–5, 2–4 and 3–5) except for the most recent two cohorts (2004 and 2005 cohorts). The implication from the figure is of an increasing rate of mortality for cohorts spawned during the 1990s, a considerable reduction in mortality for the 2002, 2003 and 2004 cohorts, but a return to a higher mortality rate for the 2005 cohort. Landings and discard data numbers-at-age are, however, only included in the assessment up to 1994 because of concerns over deteriorating quality of landings data.

Annual mean weights-at-age in landings, discards and catch are given in Tables 3.2.5, 3.2.7 and 3.2.9. Weights-at-age for the stock are still required to obtain biomass estimates and so the full series of stock weights are used. Figure 3.2.1 shows the mean weights-at-age in the landings and discards. There is no evidence of a trend in weight-at-age for ages 1 and 2 for VIa cod landings, but some evidence of a gradual long-term decline at age 3 and above. Mean weight-at-age of discarded fish at age 2 has increased in recent years.

Raised discard numbers-at-age are given in Table 3.2.6. Discards for the international fleet were raised from Scottish observations (see also the Stock Annex) Observer coverage in 2009 (number of trips) is detailed in the following text table:

	AREA VI		
Year	Other trawlers	*Nephrops* trawlers	Total
2008	9	8	17
2009	10	22	32

Increased discards from 2006 are considered an indicator of the combined effect of restrictive quotas and new regulation. The larger 2005 cohort can be tracked through the discards. A consequence of the current assessment model configuration-discard proportions modelled for ages one and two only and discard information not used after 1994-is that the change in discarding practices from 2006 as shown in Tables 3.2.2 and 3.2.6 have no influence on the final assessment.

All available survey data are given in Table 3.2.3, with the data used in the assessment highlighted in bold. Survey descriptions are given in the stock annex. Figure 3.2.3 shows cpue by survey haul from 2009 for the ScoGFS-4Q and IGFS surveys and from 2010 for the ScoGFS-1Q survey. The data from the Scottish surveys show cpue or ages 1+, that from the Irish survey a proxy for fish at ages 1+ (fish at lengths >23 cm). The quarter four surveys show catches of cod in the northern part of the region (north Minches and north of 58.5 degrees N) and in the southern part of the region (off the north coast of Ireland and along the shelf edge south of 56 degree N) but mostly zero returns in the intervening latitudes. This pattern has been relatively consistent over the years 2007–2009. Since 2000 the ScoQ1 survey has caught very few cod in the southern region especially west of 7 degrees west (see also Figure A9.3 in the Stock Annex).

Figure 3.2.4 shows log catch curves for the ScoGFS-1Q survey. It shows a strong “hook” at the younger ages, with abundance at age two often higher than at age one. The index of the 2005 year class has, however; also increased from age 2 to age 3 and the survey’s ability to track recent cohorts is poor due to the low abundance and catch rates.

Values for natural mortality (0.2 for all ages and years) and the proportion of fish mature-at-age are unchanged from the last meeting. The proportion of F and M acting before spawning is set to zero.

A study by the sea mammal research unit (SMRU) on seal predation has indicated that seal predation on cod probably constitutes significant natural mortality over and above values assumed in the assessment. A working document looking at the significance of seal predation to perceptions of the VIa cod stock was submitted to WGNSDS_08 and work is ongoing for incorporation into the VIa cod benchmark. Any increase in predation mortality would be incorporated into estimates of total mortality by the stock assessment model.

A plot of log catch curve gradient derived from the ScoGFS-1Q data is shown in Figure 3.2.5. For cohorts after 1995 index values of zero have sometimes been recorded at age five. For the age ranges considered (2–5, 2–4 and 3–5) this means the slope has not always been fitted to data from all the ages indicated. There is little consistancy in results between age ranges chosen and this appears to worsen after the 1995 or 1996 cohort. The series for ages 2–5 seems more stable than the others in this later period. In contrast to the commercial data the result for the 2005 cohort shows a large decline in mortality rate on this cohort. Overall, information on mortality trends from all survey series (including the ScoGFS-1Q) appears weak wich results in wide confidence bands around the mortality signal.

3.2.3 Historical stock development

This update assessment uses a TSA run as outlined in the Stock Annex.

Model settings and input parameter settings for the final run are given in Table 3.2.10 and final parameter estimates from the TSA run are given in Table 3.2.11, alongside final run estimates for VIa cod from previous WGs. Standardised prediction errors at age from the update assessment run (which can be interpreted as residuals) are shown in Figure 3.2.7 (landings), Figure 3.2.8 (discards) and Figure 3.2.9 (ScoGFS-1Q). Errors within ±2 are considered reasonable. No prediction errors against the 2010 survey data fall outside of ±2 such that no data points for this year were down-weighted. Table 3.2.11 shows final parameter estimates have remained very consistent over the last four assessments.

It is important to note that the assessment is based on survey estimates of mortality with corresponding population abundance. Whilst the assumed natural mortality rate (M=0.2) is excluded from the estimates of 'fishing mortality', unallocated removals from the stock due to the fishery or other sources are not and are therefore also included in the estimates of 'fishing mortality' used in the forecast. The WG consider the mortality outputs from TSA not to represent F at age but rather estimated total mortality that can not be accounted for by the standard value used for natural mortality. These mortality estimates are here referred to as 'Z-0.2'. For management purposes, however, this combined mortality would still need to fall below the level of F_{lim}, as higher levels of mortality over and above M are considered to have led to stock decline in the early 1980s.

Table 3.2.12 gives the TSA population numbers-at-age and Table 3.2.13 gives their associated standard errors. Estimated Z-0.2 at age is given in Table 3.2.14 and standard errors on the log of this mortality are given in Table 3.2.15. Full summary output is given in Table 3.2.16.

A summary plot for this run is shown in Figure 3.2.6. The disparity between the estimated removals compared to the supplied commercial catch data is clear. Figure 3.2.16 shows the ratio between the estimated removals and observed catch. The disparity has reduced since the largest values in 2004 and 2005 but the lower limit of the confidence intervals on the estimated removals are still above the line showing a 1:1 ratio.

From Figure 3.2.6 there is a noticeable long-term downward trend in recruitment although the value for the 2005 year class is the highest value since the 1996 year class and that for the 2008 year class the second highest in that same period. SSB increased in 2007 and the estimates for 2008 and 2009 are similar to that for 2007 reflecting a maturing of the 2005 year class but SSB is still well below B_{lim}. Mean Z-0.2 is above F_{lim} and comparable to values since 1995.

Retrospectives for the final assessment run are shown in Figure 3.2.10. This figure also shows lines at ± 2 se (approximate 95% confidence limits) around the run using all years of data. Retrospective bias is small with respect to SSB. With respect to recruitment the run terminating in 2006 sits on the lower confidence limit while that terminating in 2005 falls just outside of this limit. Higher levels of Z-0.2 from the run terminating in 2005 appear untypically high but fall within the confidence limits for this metric. The confidence interval for mean Z-0.2 is wide, reflecting uncertainty in estimation of mean Z-0.2 when that estimation is based on the age structure present in survey data.

The TSA estimated stock–recruit relationship is shown in Figure 3.2.11. It includes the data point of the 1986 year class which from inspection of Figure 3.2.11 appears an outlier.

The precautionary approach plot for this stock is given in Figure 3.2.12. It shows clearly how the stock has moved and remained in the zone indicating reduced reproductive capacity and (substituting Z-0.2 for F) unsustainable removals

Comparison with last year's assessment

Compared to last year's assessment SSB in 2008 has been revised up from 6488 t to 6585 t while the estimate of mean Z-0.2 has risen from 0.88 to 0.91. The estimate of recruitment in 2008 is revised up from 3.3 million to 3.9 million. The estimate of SSB in 2009 from this update assessment is 5166 t with a s.e. of 804 t. The short-term forecast from last year's assessment predicted SSB in 2009 at 5490 t which is less than one s.e. difference from the update assessment. Figure 3.2.10 shows these revisions represent comparatively small retrospective adjustments.

3.2.4 Short-term stock projections

A short-term projection was made using WGFRANSW following the procedure outlined in the Stock Annex.

Estimating recruiting year-class abundance

The recruitment values (000 fish) used in the forecast are given in the following table:

Year	TSA	STF
2010	7062 (ScoGFS-1Q)	7062 (ScoGFS-1Q)
2011	5545 (Ricker)	4697 (GM 99-08)
2012		4697 (GM 99-08)

Three-year means of the Z-0.2 estimates were taken to represent *status quo* mortality. At previous assessment meetings the *status quo* mortality was used in the intermediate and TAC years. The cod long-term management plan introduced in 2009 (Council Regulation No. 1342/2008, article 6, paragraph 4), however, directs that forecasts "assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year." The TAC for 2010 remained unchanged compared to 2009 but fishing effort (kWdays) was either reduced by 25% or vessels were incorporated in schemes designed to achieve a 25% reduction in mortality. Although not considered a measure of F the *status quo* Z-0.2 was reduced by 25% for the intermediate year in the forecast (2010). The management options table from this first run showed SSB to be below B_{lim} at the start of 2011. Following article 6, paragraph 2(a) of the new cod management plan *status quo* Z-0.2 was reduced by a further 25% for 2011 with the aim of producing more representative detailed tables.

Input data to the short-term projection are shown in Table 3.2.17. Management options from the forecast are shown in Table 3.2.18 and detailed tables of catch numbers-at-age are shown in Table 3.2.19.

A plot of the short-term forecast is shown in Figure 3.2.13. Results from sensitivity analysis from this forecast are shown in Figure 3.2.14 and probability profiles in Figure 3.2.15. It is emphasized again that the outputs from the forecasting software include figures labeled as "H-cons" do not refer to the human consumption fishery but in the present application refer to all removals over and above the losses due to the assumed natural mortality rate of M=0.2. These values will include estimates of unallocated fishery removals that may be due to misreporting, or additional natural mortality not encompassed by the standard value of M=0.2. The WG recommends that these forecasts are not used to determine a future TAC using the procedure specified in Article 7 of the long-term management plan for cod, as it is not possible to determine figures for unallocated fishery removals to deduct from the forecasted total removals to calculate the TAC for 2011.

Estimates of SSB corresponding to the different levels of the Z-0.2 mortality should, however, remain appropriate. From Table 3.2.18 it can be seen that an assumption of zero removals in 2011 give an estimate of SSB in 2012 between B_{lim} and B_{pa}. From Figure 3.2.15 the probability of SSB in 2012 being above B_{pa} is zero.

3.2.5 MSY explorations

ICES has previously defined the following PA reference points:

REFERENCE POINT	TECHNICAL BASIS
Bpa = 22 000 t	Previously set at 25 000 t, which was considered a level at which good recruitment is probable. This has since been reduced to 22 000 t due to an extended period of stock decline.
Blim = 14 000 t	Smoothed estimate of Bloss (as estimated in 1998).
Fpa = 0.6	Consistent with Bpa.
Flim = 0.8	F values above 0.8 led to stock decline in the early 1980s.

To derive an F_{MSY} estimate the srmsymc package was employed. The same input data files as used for the short-term forecast were used. An alternative run using 10 year means for stock weights-at-age and mortality-at-age showed there to be little sensitivity to the averaging period used. Figure 3.2.17 shows the three stock–recruit relationships fitted by the package; Ricker, Beverton–Holt and smooth hockey stick. Models were fitted using 1000 MCMC re-samples. For all three stock–recruit relationships all re-samples allowed F_{MSY} and Fcrash values to be determined. As such, there was no basis to reject any of the recruitment models as unsuitable for this stock. For each of the stock–recruit relationships (SRR) Figures 3.2.18 to 3.2.20 show box plots of F_{MSY} and Fcrash together with the values of Fpa and Flim. For the Ricker and Beverton–Holt SRR the estimated value of Fcrash is very close to Flim. For the smooth hockey stick SRR Fcrash is estimated between Flim and Fpa. For all three SRR the current level of Z-02 is higher than the median Fcrash value. Also the value of F_{MSY} is well defined and considerably lower than Fpa for all three SRR. The level of removals possible at the estimated F_{MSY} is poorly defined however. Circles showing the data points show values of Z-0.2 repeatedly in excess of the upper percentile for Fcrash. As expected removals and SSB have declined such that values for both are now inside confidence limits for these metrics at the estimated Z-0.2 mortality rates.

Figure 3.2.21 shows estimation of yield-per-recruit. Fmax is well defined for this stock. Comparison of Fmax to F_{MSY} estimated using the three SRRs (Figures 3.2..17–19) shows F_{MSY} estimated as lower than Fmax for the Beverton–Holt model, equal for the smooth hockey stick and higher than Fmax in the Ricker model reflecting the downward slope of the stock–recruit relationship at higher SSBs.

In conclusion mortalities from removals in the range 0.17 to 0.33 are consistent with F_{MSY}.

3.2.6 Management plans

Cod in VIa is included in Council Regulation No. 1342/2008 establishing a long-term plan for cod stocks and fisheries exploiting those stocks. The plan and its evaluation by ICES were addressed by WGCSE 2009.

3.2.7 Uncertainties and bias in assessment and forecast

Figure 3.2.22 shows a comparison of SSB, recruitment-at-age one and mean Z-0.2 (ages2–5) estimates produced by final run assessments between this year's assessment and assessments going back to 2001.

Landings

Since the early 1990s the most significant problem with assessment of this stock is with commercial data. Incorrect reporting of landings-species and quantity and management area-is known to have occurred and directly affects the perception of the stock. Figure 3.2.23 shows a summary plot for a run of the model where landings and discards data have been included for the years 2006–2009 (post UK 'Buyers and Sellers' and Irish 'Sales Notes' legislation, see Section 3.2.1) as well as the years prior to 1995. The commercial data has a greater precision than the survey and its inclusion in the latter years of the time-series has a strong influence on the model fit. However, the model can determine for precision but not bias. Discards at ages 3 and 4 are not being taken into account, and discard rates for theses age classes have been in excess of 80% in recent years (see 'Discards' below), nor is area misreporting. Signals of high mortality on younger ages from the survey-possibly an indicator of high predation (see 'Biological factors' below) have little influence on the model fit. Figure 3.2.23 indicates little or no misreporting in the mid to late 1990s, a period where the reliability of commercial data is already of concern. The Working Group concluded that without further investigation into the discard modelling and predation, the inclusion of the 2006–2009 catch data in the assessment could not be justified.

Effort

Commercial effort data for Division VIa from the Scottish fleets is considered very uncertain and was not used in the assessment.

Discards

In the current set-up used for this assessment discard information is removed for the same years for which landings data is removed. The increase in discards at ages one and two since 2006 is not therefore able to influence the fit of discard parameters. Furthermore, the TSA model for VIa cod is formulated to only consider discards at ages one and two. Discards have also been recorded at older ages since 2006 and if this continues in future years, re-inclusion of discard data would probably require modification of the model to fit discard proportions across more ages.

Available discard estimates are calculated mainly from the Scottish sampling programme. The method used is to sample on a stratified basis, then raise by some auxiliary variable to, initially, total strata discards, and ultimately international discards. These estimates are prone to bias. An alternative method of raising discard data using the same raw data, and which reduces estimation bias, is being applied and tested on data from both the Northern Shelf and North Sea regions before the resulting revised data is released to assessment working groups. Data using the new method was not available for this year's assessment.

Surveys

The survey used for this assessment changed vessel and tow duration in 1999. Although a correction has been made based on comparative tows, there will be an additional variance associated with this correction factor which will affect the survey index. The current spatial aggregation of the survey (weighted arithmetic mean) can result in hauls catching large numbers of fish having a strong influence on index values (as was the case in the ScoGFS-1Q in 2008). This in turn can cause a 'noisy' set of indices that can lead to high prediction errors from TSA (residuals form other models) and downweighting of data points. The current weighting of strata (weighting by number of valid hauls) is also not consistent between years leading to further increase in the overall estimation of survey variance. Ways of compiling the survey that can better incorporate extreme values, including new post stratification and strata weightings, are currently under investigation and are proposed for consideration at a future data compilation workshop.

Biological factors

Assumptions on mean weight-at-length and mean maturity-at-age have remained unchanged for a long period. However, biological responses of cod in VIa as a localised species to high exploitation and low population numbers are so far unknown to the Working Group. Estimates of high predation consumption of cod relative to total stock biomass have raised concerns that natural mortality of cod at younger ages may be significantly greater than the standard value of 0.2 currently assumed and will have changed significantly over the period of the historical assessment.

Forecasts

Short-term forecasts are sensitive to the estimation of *status quo* mean fishing mortality. The WG considers mortality estimates arising from an assessment heavily or wholly based on survey data are poorly estimated and therefore noisy and sensitive to survey catchability. In addition, in the case of VIa cod only one survey-series has been considered sufficiently long and self-consistent for use in assessment.

Natural mortality on cod at some or all ages is considered to have become greater than can be accommodated by the standard natural mortality figure of M=0.2. It is also possibly subject to a persistent upward trend. As a consequence, mortality outputs from TSA (or any model reliant on survey data) are not considered to represent a fishing mortality F at age for recent years in the time-series but rather estimates, (referred to here as 'Z-0.2'), of total mortality that cannot be accounted for by the standard value used for natural mortality. It is not possible to determine the proportion of the mortality caused by fishing and therefore not possible to partition F into landings and discard F. Until a better estimate of natural mortality can be determined short-term forecasts are only appropriate for considering the SSB corresponding to the different levels of the Z-0.2 mortality.

3.2.8 Recommendation for next Benchmark

The following table includes work on known problems with the current assessment package. Work prior to a benchmark assessment would also include comparison of the current assessment method with alternative methods.

PROBLEM	SOLUTION	EXPERTISE NECESSARY	SUGGESTED TIME
Misreporting of landings. Unknown level prevents adjustment of reported catch and inclusion in assessment.	Analysis of VMS data in comparison to landings declarations to estimate the degree of area misreporting.	Requires someone familiar with VMS analysis (plus provision of trip specific landings declarations).	Work possible in 2010.
Bias in discard estimates	Adoption of new discard raising methodology.	New discard raising methodology being developed as part of a PhD project.	PhD unlikely to be finished before 2012.
Inappropriate modelling of discards within TSA model	Revision of TSA to allow fitting of discards at higher ages.	Requires someone familiar TSA routines.	Work scheduled for 2010.
Variance and bias in survey index	Adoption of new aggregation methods to form final indices from haul by haul data, (combinations of new post stratification, weighting of strata and/or adoption of statistical approaches such as fitting of GAM or delta distribution models). Inclusion of additional surveys (ScoQ4GFS and IGFS). ScoGFS-4Q indices to be formed in same manner as ScoGFS-1Q after conclusion of above project. Addition of new survey effort and/or revision of survey design.	Work being undertaken as a Marine Scotland Science research project.	Project due for completion in 2011. Comparison with existing assessment setup (single survey) possible in 2011 (after conclusion of above project). Anglerfish survey records cod numbers at length, now has 5 years of data and cpue indices can be formed. Data from charter surveys in 2009 available. A random stratified design for the Scottish surveys is under consideration. Possible implementation in 2011.
Uncertainty in natural mortality (level and trend) because of unquantified predation from large and increasing seal population.	Revision of TSA to allow inclusion of different fleets, (this in turn allows estimates of age specific consumption of cod by seals to be input as if from an additional fleet).	Requires someone familiar with TSA routines.	Method for estimating age specific consumption of cod by seals presented at 2008 ICES ASC. Work to adjust TSA scheduled for 2010.

3.2.9 Management considerations

The fishery is managed by a combination of TAC, area closures, technical measures and effort restrictions. These have not been effective in controlling catches which are estimated to be almost seven times greater than the TAC. Despite considerable reductions in fishing effort over the past decade, the stock structure is still truncated with few older fish present. The 25% effort reduction imposed as part of the cod long-term management plan in 2009 has not been reflected in the latest estimate of Z-0.2.

Although the UK 'Buyers and Sellers' and Irish 'Sales Notes' legislation is considered to have reduced underreporting from 2006, discard data shows increased discards at ages one and two and a change in discard practices such that fish are discarded at older ages. In 2009 discards as a percentage of catch were over 90% for ages 1 to 3 and over 80% at age 4 showing the legislation has controlled landings rather than catch. There are also reports of continued area misreporting.

Mortality estimates arising from an assessment heavily or wholly based on survey data are poorly estimated and therefore noisy and sensitive to survey catchability. In contrast, historical trends in spawning biomass and recruitment appear to be robust measures of stock dynamics.

Population estimates using the ScoGFS-1Q survey data indicated the 2005 year class to be the biggest within the last decade and the 2008 year-class to be of similar strength. Both discards at higher ages and area misreporting reduce the potential for these year classes to contribute to increases in SSB. It is important good observer coverage is conducted in Division VIa to record discard trends in future and that work is done to estimate area misreporting (comparing declared landings to VMS data).

Cod is taken in mixed demersal fisheries, and in Division VIa is now regarded as a bycatch species. To greatly reduce cod catch would likely result in having to greatly reduce harvesting of other stocks such as haddock, whiting and anglerfish. It is also important the bycatch from the *Nephrops* fleet is closely monitored (including discard observations). The STECF Report (STECF-SGMOS-09-05) assessing effort and catch of fishing regimes subject to fishing effort limitations shows trawl gear vessels targeting finfish (TR1 gear) to take roughly 80% of cod catch and the *Nephrops* fleet (TR2 gear) to take 15–20% of cod catch in ICES area VIa (Table 6.5.4.1 page 215) ICES note that the majority of TR2 vessels operating in VIa are now exempt from the effort control element of 1342/2008.

The EU cod long-term management plan, (Council Regulation No. 1342/2008) is complemented by a system of fishing effort limitation and in waters west of Scotland landings composition restrictions. For vessels of length 15 m and over operating west of a management line shown in Figure 3.2.24 effort is restricted to a lesser degree. Figure 3.2.24 also shows locations of fishing activity using TR1 gear (from VMS data) linked to cod landings in 2009, (Scottish vessels and vessels landing into Scotland). Fishing pings associated with the day entered in logbooks against cod landings have been aggregated. It can be seen a large proportion of the effort falls outside of the cod management area. If cod landings recorded in logbooks are assigned to VMS fishing pings by using the declared ICES rectangle in the logbooks the distribution of retained cod catches is as shown in Figure 3.2.25. Summing the landings gives annual totals of 55.8 tonnes inside the management line, 106.6 tonnes elsewhere in VIa in 2009. The landings composition restrictions do not restrict discards. Data provided to ICES shows discards to have increased as a proportion of catch in 2009.

Article 7 (paragraph 1) of the current management plan requires TACs to be calculated after removal of quantities of discards and fish corresponding to other sources of cod mortality caused by fishing. The current assessment of VIa cod is considered to estimate a mortality that is a combination of mortality from fishing and natural mortality not accounted for by the standard long-term input value. As such mortality from landings, discards and other causes due to fishing cannot be defined.

A report by the Sea Mammal Research unit (SMRU, 2006) gives estimates of cod consumed by grey seals to the west of Scotland and although highly uncertain, the estimates suggest predation mortality on cod is greater than can be accommodated by the standard value of natural mortality used for gadoid species in ICES Division VIa. It has not been possible using an update assessment to quantify the level of mortality caused by seal predation. This is proposed for a benchmark assessment, (see Section 3.2.9).

The values of mean Z-0.2 from the current assessment are estimates of mortality over and above M i.e. mortality from fishing plus non fishing mortality which can not be encompassed within the standard value for natural mortality. For management purposes this combined mortality would still need to fall below the level of Flim, as higher levels of mortality over and above M are considered to have led to stock decline.

Table 3.2.1. Cod in Division VIa. Official catch statistics in 1985–2009, as reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Belgium	48	88	33	44	28	-	6	-	22	1	2	+	11	1	+	+	2	+
Denmark	-	-	4	1	3	2	2	3	2	+	4	2	-	-	+	-	-	-
Faroe Islands	-	-	-	11	26	-	-	-	-	-	-	-	-	-	-	-	-	-
France	7411	5096	5044	7669	3640	2220	2503	1957	3047	2488	2533	2253	956	714*	842*	236	391	208
Germany	66	53	12	25	281	586	60	5	94	100	18	63	5	6	8	6	4	+
Ireland	2564	1704	2442	2551	1642	1200	761	761	645	825	1054	1286	708	478	223	357	319	210
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-
Norway	204	174	77	186	207	150	40	171	72	51	61	137	36	36	79	114*	40*	88
Spain	28	-	-	-	85	-	-	-	-	-	16	+	6	42	45	14	3	11
UK (E., W., N.I.)	260	160	444	230	278	230	511	577	524	419	450	457	779	474	381	280	138	195
UK (Scotland)	8032	4251	11 143	8465	9236	7389	6751	5543	6069	5247	5522	5382	4489	3919	2711	2057	1544	1519
UK																		
Total landings	18 613	11 526	19 199	19 182	15 426	11 777	10 634	9017	10 475	9131	9660	9580	6992	5671	4289	2767	2439	2231

Country	2003	2004	2005	2006	2007	2008	2009*
Belgium							
Denmark							
Faroe Islands		2	0	0.8	12	1	
France	172	91	107	100.7	92	82	
Germany	+			2	2	1	0
Ireland	120	34	27.9	18	70	58.2	24.4
Netherlands	-						0
Norway	45	10	17	30	30	65	18
Spain	3						
UK (E., W., N.I.)	79	46	25		21	6	
UK (Scotland)	879	413	243		260	232	
UK				332.1			120
Total landings	1298	596	419.9	483.6	487	445.2	162.4

*** Preliminary.**

Table 3.2.2. Cod in Division VIa. Landings, discards and catch estimates 1978–2009, as used by the WG. Values are totals for fish over the ages 1 to 7+.

Year	Landings	Discards	Catch
1978	13521	3678	17199
1979	16087	54	16141
1980	17879	996	18875
1981	23866	520	24386
1982	21510	1652	23162
1983	21305	2026	23331
1984	21271	635	21906
1985	18608	8812	27420
1986	11820	1201	13022
1987	18975	8767	27742
1988	20413	1217	21629
1989	17171	2833	20004
1990	12176	326	12503
1991	10926	917	11843
1992	9086	2897	11983
1993	10315	192	10507
1994	8929	186	9115
1995	9438	257	9696
1996	9425	87	9513
1997	7033	354	7387
1998	5714	423	6137
1999	4201	98	4298
2000	2977	607	3584
2001	2347	224	2571
2002	2242	169	2412
2003	1241	49	1291
2004	540	75	615
2005	479	57	535
2006	463	478	940
2007	525	2104	2629
2008	451	909	1360
2009	222	1401	1623

Table 3.2.3. Cod in Division VIa. Survey data made available to the WG. Data used in update run are highlighted in bold. For ScoGFS-1Q, numbers are standardised to catch-rate per 10 hours.

ScoGFS-1Q	Scottish west coast groundfish survey							
1985	2010							
1	1	0	0.25					
1	7							
10	1.5	23.7	8.6	13.6	3.9	2.5	1.2	1985
10	1.5	6.9	26.8	5.6	7.3	2.5	1.9	1986
10	57.4	16.2	15.3	22.8	3.0	2.8	0.0	1987
10	0.0	64.9	14.2	3.4	2.1	0.7	0.2	1988
10	4.5	7.2	45.1	8.6	1.9	0.5	0.8	1989
10	2.0	24.6	4.1	14.7	4.2	1.6	0.8	1990
10	4.8	5.4	17.4	5.2	13.4	2.8	0.5	1991
10	7.3	11.5	5.4	7.6	3.4	2.3	0.5	1992
10	1.7	38.2	12.7	1.7	1.4	1.1	0.0	1993
10	13.6	14.7	25.1	5.8	1.0	0.0	0.0	1994
10	6.4	23.8	14.0	16.5	1.2	1.9	0.7	1995
10	2.8	20.9	24.1	4.1	2.8	1.3	0.0	1996
10	11.1	7.7	11.6	7.9	4.2	4.7	1.0	1997
10	2.8	30.9	5.3	8.7	3.7	0.6	2.0	1998
10	1.5	8.2	8.2	1.4	3.2	0.5	0.5	1999
10	13.3	5.4	6.9	1.3	0.0	0.4	0.0	2000
10	2.7	18.4	5.7	13.2	19.5	1.1	1.6	2001
10	5.3	4.3	10.6	2.6	0.5	3.0	0.0	2002
10	2.7	16.7	2.0	4.7	1.8	0.7	0.4	2003
10	5.7	3.0	5.6	2.3	1.7	0.0	0.0	2004
10	1.3	1.5	1.2	0	0	0.4	0	2005
10	2.2	1.9	1.1	0.3	0	0	0.3	2006
10	2.1	18.8	3.4	1.2	0	0.6	0	2007
10	0.8	2.1	44.2	6.3	0.8	0	0	2008
10	1.8	2.6	2.3	0.4	0	0	0	2009
10	4.6	16.2	3.7	1.0	0.7	0	0	2010

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. For IreGFS, effort is given as minutes towed, numbers are in units.

IREGFS		IRISH GROUNDFISH SURVEY		
1993	2002			
1	1	0.75	0.79	
0	3			
1849	0.0	312.0	49.0	13.0
1610	20.0	999.0	56.0	13.0
1826	78.0	169.0	142.0	69.0
1765	0.0	214.0	89.0	18.0
1581	6.0	565.0	31.0	10.0
1639	0.0	83.0	53.0	6.0
1564	0.0	24.0	14.0	3.0
1556	0.0	124.0	4.0	1.0
755	3.0	82.0	28.0	2.0
798	0.0	50.6	2.2	1.2

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. For ScoGFS-4Q, numbers are standardised to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardising.

SCOGFS-4Q			QUARTER 4 SCOTTISH GROUND FISH SURVEY							
1996	2009									
1	1	0.75	1.00							
0	8									
10	0	1	14	5	3	1	0	0	0	1996
10	1	11	2	1	1	1	0	0	0	1997
10	+	15	9	1	0	0	0	0	0	1998
10	2	4	6	9	1	0	0	0	0	1999
10	0	16	3	0	0	0	0	0	0	2000
10	1	2	9	1	1	0	0	0	0	2001
10	1	10	3	7	1	0	0	0	0	2002
10	1	2	11	3	1	0	0	0	0	2003
10	0	5	4	0	+	0	0	0	0	2004
10	+	2	3	0	1	+	0	0	0	2005
10	0	17	6	1	1	0	0	0	0	2006
10	0	12.0	20.0	1.3	0.6	0	0.3	0	0	2007
10	2	8	5	7	1	0	0	0	0	2008
10	2	14	4	1	1	+	0	0	0	2009

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. For IGFS, effort is given as minutes towed, numbers are in units. Values for 2007 are revised compared to last year's assessment.

IGFS	Irish West Coast groundfish					
2003	2009					
1	1	0.79	0.92			
0	4					
1127	0	10	11	0	0	2003
1200	0	24	10	1	0	2004
960	63	13	7	0	2	2005
1510	0	95	12	0	0	2006
1173	0	161	12	0	1	2007
1135	0	23	24	4	0	2008
1378	1	75	4	5	0	2009

Table 3.2.4. Cod in Division VIa. Landings-at-age (thousands).

YEAR	AGE						
	1	2	3	4	5	6	7+
1966	384	2883	629	999	825	78	52
1967	261	2571	3705	670	442	264	67
1968	333	1364	3289	1838	215	171	151
1969	64	1974	1332	1943	759	149	170
1970	256	1176	1638	571	476	153	74
1971	254	1903	550	841	240	201	95
1972	735	2891	1591	409	501	108	110
1973	1015	1524	1442	583	161	193	104
1974	843	2318	778	1068	288	72	102
1975	1207	1898	1187	533	325	90	35
1976	970	3682	1467	638	256	215	56
1977	1265	1314	1639	624	269	87	79
1978	723	1761	999	695	286	97	75
1979	929	1612	2125	682	342	134	69
1980	1195	3294	2001	796	191	77	37
1981	461	7016	3220	904	182	29	20
1982	1827	1673	3206	1189	367	111	33
1983	2335	4515	1118	1400	468	148	60
1984	2143	2360	2564	448	555	185	59
1985	1355	5069	1269	1091	140	167	79
1986	792	1486	2055	411	191	40	30
1987	7873	4837	988	905	137	56	26
1988	1008	8336	2193	278	210	39	20
1989	2017	1082	3858	709	113	69	33
1990	513	4024	432	924	170	23	11
1991	1518	1728	1805	188	266	70	23
1992	1407	1868	575	720	69	58	24
1993	328	3596	1050	131	183	24	36
1994	942	1207	1545	280	56	51	20
1995	753	2750	700	630	70	15	11
1996	341	2331	1210	247	204	31	13
1997	1414	1067	989	281	66	62	7
1998	310	3318	293	174	57	16	9
1999	132	884	1047	64	48	24	9
2000	765	532	211	231	15	12	13
2001	96	1241	155	63	52	3	4
2002	337	340	522	41	13	14	4
2003	62	516	85	107	6	2	1
2004	44	92	85	11	26	2	1
2005	31	121	43	37	7	6	0.5
2006	17	91	72	21	13	2	1
2007	5	165	62	33	3	3	2
2008	0.07	27	88	16	10	1	2
2009	2	10	9	30	4	1	0.1

Table 3.2.5. Cod in Division VIa. Mean weight-at-age in landings (kg).

YEAR	AGE						
	1	2	3	4	5	6	7+
1966	0.730	1.466	3.474	5.240	4.868	8.711	9.250
1967	0.681	1.470	2.906	4.560	6.116	7.394	8.058
1968	0.745	1.776	2.766	4.721	6.304	7.510	8.278
1969	0.860	1.284	2.821	4.259	6.169	6.374	7.928
1970	0.595	0.955	2.533	4.678	6.016	7.120	8.190
1971	0.674	1.046	2.536	4.167	6.023	6.835	8.100
1972	0.609	1.192	2.586	4.417	6.226	7.585	8.538
1973	0.597	1.181	2.784	4.601	5.625	7.049	8.611
1974	0.611	1.103	2.834	4.750	6.144	7.729	9.339
1975	0.603	1.369	3.078	5.302	6.846	8.572	10.328
1976	0.616	1.397	3.161	5.005	6.290	8.017	9.001
1977	0.629	1.160	2.605	4.715	6.269	7.525	9.511
1978	0.630	1.373	3.389	5.262	7.096	8.686	9.857
1979	0.693	1.373	2.828	4.853	6.433	7.784	9.636
1980	0.624	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.550	1.166	2.839	4.923	7.518	9.314	10.328
1982	0.692	1.468	2.737	4.749	6.113	7.227	9.856
1983	0.583	1.265	2.995	4.398	6.305	8.084	9.744
1984	0.735	1.402	3.168	5.375	6.601	8.606	10.350
1985	0.628	1.183	2.597	4.892	6.872	8.344	9.766
1986	0.710	1.211	2.785	4.655	6.336	8.283	9.441
1987	0.531	1.312	2.783	4.574	6.161	7.989	10.062
1988	0.806	1.182	2.886	5.145	6.993	8.204	9.803
1989	0.704	1.298	2.425	4.737	7.027	7.520	9.594
1990	0.613	1.275	2.815	4.314	7.021	9.027	11.671
1991	0.640	1.095	2.618	4.346	6.475	8.134	10.076
1992	0.686	1.293	2.607	4.268	6.190	7.844	10.598
1993	0.775	1.316	2.940	4.646	6.244	7.802	8.409
1994	0.644	1.292	2.899	4.710	6.389	8.423	8.409
1995	0.606	1.148	2.857	4.956	6.771	8.539	9.505
1996	0.667	1.221	2.738	5.056	6.892	8.088	10.759
1997	0.595	1.210	2.571	4.805	6.952	7.821	9.630
1998	0.605	1.061	2.264	4.506	6.104	8.017	9.612
1999	0.691	1.039	2.194	4.688	6.486	8.252	9.439
2000	0.689	1.261	2.457	4.126	6.666	7.917	8.392
2001	0.654	0.988	2.679	4.568	5.860	7.741	9.386
2002	0.668	1.140	2.330	4.841	6.175	7.192	9.548
2003	0.671	1.016	2.312	3.854	6.220	8.075	8.839
2004	0.609	1.027	2.194	4.396	6.003	8.258	9.678
2005	0.776	1.172	2.624	4.118	4.908	6.753	10.240
2006	0.656	1.169	2.236	3.822	6.172	7.796	11.1
2007	0.476	0.976	2.512	4.285	6.491	7.733	8.810
2008	0.557	1.195	2.943	4.775	6.329	7.957	8.471
2009	1.048	1.960	2.916	4.743	5.853	8.171	8.646

Table 3.2.6. Cod in Division VIa. Discard dataset from Scottish & Irish sampling programmes, ages 1–7, years 1978–2008. Data from 1978–2001 raised from Scottish sampling only; later data raised from Scottish sampling and Irish sampling when available (2004 & 2005 to date).

Discards at age (thousands)							
Year	Age						
	1	2	3	4	5	6	7
1978	8904	1203	0	0	0	0	0
1979	11	119	0	0	0	0	0
1980	2758	0	0	0	0	0	0
1981	289	1475	0	0	0	0	0
1982	5264	2	0	0	0	0	0
1983	7371	1005	0	0	0	0	0
1984	2117	10	0	0	0	0	0
1985	43508	3122	0	0	0	0	0
1986	4483	10	0	0	0	0	0
1987	52582	159	0	0	0	0	0
1988	714	3256	0	0	0	0	0
1989	8443	25	0	0	0	0	0
1990	1835	158	0	0	0	0	0
1991	3255	319	0	0	0	0	0
1992	12498	143	2	0	0	0	0
1993	595	51	0	0	0	0	0
1994	773	2	0	0	0	0	0
1995	1111	126	0	0	0	0	0
1996	233	86	0	0	0	0	0
1997	1074	27	0	0	0	0	0
1998	472	837	3	0	0	0	0
1999	283	16	0	0	0	0	0
2000	2081	53	0	0	0	0	0
2001	216	373	0	0	0	0	0
2002	508	32	0	0	0	0	0
2003	77	38	8	0	0	0	0
2004	232	21	0	0	0	0	0
2005	108	20	0	0	0	0	0
2006	1242	48	25	2	3	1	0.1
2007	627	1651	56	42	3	3	0
2008	89	133	368	1	0	0	0
2009	883	219	160	138	0	7	0

Table 3.2.7. Cod in Division VIa. Discard dataset from Scottish & Irish sampling programmes, ages 1–7, years 1978–2006. Data from 1978–2001 raised from Scottish sampling only; later data raised from Scottish sampling and Irish sampling when available (2004 & 2005 to date).

Mean weight-at-age in discards (kg)							
Year	Age						
	1	2	3	4	5	6	7
1978	0.37	0.321	0	0	0	0	0
1979	0.276	0.43	0	0	0	0	0
1980	0.361	0	0	0	0	0	0
1981	0.135	0.326	0	0	0	0	0
1982	0.314	0.392	0	0	0	0	0
1983	0.223	0.374	0	0	0	0	0
1984	0.298	0.435	0	0	0	0	0
1985	0.178	0.346	0	0	0	0	0
1986	0.267	0.305	0	0	0	0	0
1987	0.166	0.37	0	0	0	0	0
1988	0.296	0.283	0	0	0	0	0
1989	0.332	0.59	0	0	0	0	0
1990	0.132	0.454	0	0	0	0	0
1991	0.245	0.351	0	0	0	0	0
1992	0.22	1.03	2.382	0	0	0	0
1993	0.239	0.812	3.723	0	0	0	0
1994	0.24	0.365	0	0	0	0	0
1995	0.203	0.256	0	0	0	0	0
1996	0.226	0.389	0	0	0	0	0
1997	0.321	0.328	0	0	0	0	0
1998	0.23	0.367	0.59	0	0	0	0
1999	0.294	0.299	0	0	0	0	0
2000	0.28	0.421	0	0	0	0	0
2001	0.248	0.417	0	0	0	0	0
2002	0.263	1.021	0	0	0	0	0
2003	0.272	0.57	0.39	0	0	0	0
2004	0.258	0.581	0	0	0	0	0
2005	0.285	0.501	0	0	0	0	0
2006	0.259	1.291	2.649	3.499	6.24	5.581	11.122
2007	0.198	0.940	3.016	4.453	5.018	10.627	0
2008	0.220	0.976	2.046	4.047	7.937	0	0
2009	0.261	1.312	2.248	3.324	0	6.448	0

Table 3.2.8. Cod in Division VIa. Total catch-at-age (thousands).

YEAR	AGE						
	1	2	3	4	5	6	7+
1978	9627	2965	999	695	286	97	75
1979	940	1731	2125	682	342	134	69
1980	3953	3294	2001	796	191	77	37
1981	749	8491	3220	904	182	29	20
1982	7091	1676	3206	1189	367	111	33
1983	9706	5520	1118	1400	468	148	60
1984	4260	2371	2564	448	555	185	59
1985	44863	8191	1269	1091	140	167	79
1986	5275	1495	2055	411	191	40	30
1987	60456	4996	988	905	137	56	26
1988	1722	11592	2193	278	210	39	20
1989	10459	1107	3858	709	113	69	33
1990	2348	4182	432	924	170	23	11
1991	4773	2047	1805	188	266	70	23
1992	13905	2011	577	720	69	58	24
1993	923	3647	1050	131	183	24	36
1994	1715	1209	1545	280	56	51	20
1995	1864	2877	700	630	70	15	11
1996	574	2417	1210	247	204	31	13
1997	2488	1094	989	281	66	62	7
1998	783	4155	296	174	57	16	9
1999	415	900	1047	64	48	24	9
2000	2846	585	211	231	15	12	13
2001	312	1614	155	63	52	3	4
2002	845	372	522	41	13	14	4
2003	139	554	93	107	6	2	1
2004	267	113	85	11	26	2	1
2005	139	141	43	37	7	6	0.5
2006	1259	139	97	23	15	2	1
2007	632	1816	118	75	5	7	2
2008	89	160	456	18	10	1	2
2009	885	229	168	168	4	8	0.1

Table 3.2.9. Cod in Division VIa. Mean weight-at-age (kg) in total catch.

YEAR	AGE						
	1	2	3	4	5	6	7+
1978	0.389	0.946	3.389	5.262	7.096	8.686	9.857
1979	0.688	1.308	2.828	4.853	6.433	7.784	9.636
1980	0.440	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.390	1.020	2.839	4.923	7.518	9.314	10.328
1982	0.411	1.467	2.737	4.749	6.113	7.227	9.856
1983	0.310	1.103	2.995	4.398	6.305	8.084	9.744
1984	0.518	1.398	3.168	5.375	6.601	8.606	10.350
1985	0.191	0.864	2.597	4.892	6.872	8.344	9.766
1986	0.334	1.205	2.785	4.655	6.336	8.283	9.441
1987	0.213	1.282	2.783	4.574	6.161	7.989	10.062
1988	0.595	0.929	2.886	5.145	6.993	8.204	9.803
1989	0.404	1.282	2.425	4.737	7.027	7.520	9.594
1990	0.237	1.244	2.815	4.314	7.021	9.027	11.671
1991	0.371	0.979	2.618	4.346	6.475	8.134	10.076
1992	0.267	1.274	2.606	4.268	6.190	7.844	10.598
1993	0.430	1.309	2.940	4.646	6.244	7.802	8.409
1994	0.462	1.291	2.899	4.710	6.389	8.423	8.409
1995	0.365	1.109	2.857	4.956	6.771	8.539	9.505
1996	0.487	1.191	2.738	5.056	6.892	8.088	10.759
1997	0.477	1.188	2.571	4.805	6.952	7.821	9.630
1998	0.379	0.921	2.248	4.506	6.104	8.017	9.612
1999	0.420	1.025	2.194	4.688	6.486	8.252	9.439
2000	0.390	1.186	2.457	4.126	6.666	7.917	8.392
2001	0.372	0.856	2.679	4.568	5.860	7.741	9.386
2002	0.424	1.130	2.330	4.841	6.175	7.192	9.548
2003	0.450	0.986	2.15	3.854	6.220	8.075	8.839
2004	0.314	0.945	2.194	4.396	6.003	8.258	9.678
2005	0.395	1.078	2.624	4.118	4.908	6.753	10.240
2006	0.264	1.211	2.341	3.797	6.184	7.031	11.103
2007	0.200	0.943	2.752	4.380	5.729	9.166	8.810
2008	0.220	1.013	2.219	4.731	6.371	7.957	8.471
2009	0.262	1.340	2.283	3.577	5.853	6.654	8.646

Table 3.2.10. Cod in Division VIa. TSA parameter settings for the assessment run.

PARAMETER	SETTING	JUSTIFICATION
Age of full selection.	am = 4	Based on inspection of previous XSA runs.
Multipliers on variance matrices of measurements.	Blandings(a) = 2 for ages 6, 7+ Bsurvey(a) = 2 for age 1, 5, 6	Allows extra measurement variability for poorly-sampled ages.
Multipliers on variances for fishing mortality estimates.	H(1) = 4	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points (implemented by multiplying the relevant q by 9)	Landings: age 2 in 1981 and 1987, age 7 in 1989. Discards: age 1 in 1985 and 1992, age 2 in 1998. Survey: age 1 in 2000, age 2 in 1993, age 6 in 1995. Ages 4, 5, 6 in 2001 (the latter are from a single large haul, 24 fish > 75 cm in 30 mins.). Age 3 in 2008 (large haul near 4W line)	Large values indicated by exploratory prediction error plots.
Discards	Discards are allowed to evolve over time constrained by a trend. Ages 1 and 2 are modelled independently.	
Recruitment.	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta1$ S exp($-\eta2$ S), where S is the spawning stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes.	The 1986 year class was large, and recruitment at age 1 in 1987 is not well modelled by the Ricker recruitment model. Instead, N(1, 1980) is taken to be normally distributed with mean 5$\eta1$ S exp($-\eta2$ S). The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966-1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is again assumed to be constant.	

Table 3.2.11. Cod in Division VIa. TSA parameter estimates for 2002–2004, 2006–2009 assessments and final assessment presented this year. No final assessment using TSA was conducted in 2005. Run 3 from 2004 used a similar approach to this year's assessment.

Parameter	*Notation*	Description	2002 WG	2003 WG	2004 WG Run 3	2006 WG	2007 WG	2008 WG	2009WG	2010WG
Initial fishing mortality	*F* (1, 1978)	Fishing mortality-at-age *a* in year *y*	0.03	0.64	0.64	0.6378	0.6337	0.6366	0.6373	0.6334
	F (2, 1978)		0.25	0.62	0.57	0.5333	0.5889	0.5803	0.5797	0.5853
	F (4, 1978)		0.67	0.82	0.66	0.5743	0.6879	0.5888	0.5886	0.5955
Survey selectivities	Φ(1)	Survey selectivity-at-age *a*	0.83	0.33	0.47	0.6275	0.5425	0.4746	0.4809	0.4791
	Φ(2)		4.41	1.98	3.19	3.5857	3.7292	3.2855	3.3317	3.3463
	Φ(4)		18.28	10.65	14.92	15.9096	14.1997	14.0472	13.7891	13.6507
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.10	0.04	0.07	0.0947	0.0741	0.0846	0.0850	0.0834
	σ_U	Persistent changes in selection (age effect in F)	0.10	0.06	0.03	0.0242	0.0507	0.00	0.00	0.0057
	σ_V	Transitory changes in the year effect in fishing mortality	0.00	0.07	0.10	0.0844	0.0984	0.1120	0.1117	0.1144
	σ_Y	Persistent changes in the year effect in fishing mortality	0.16	0.07	0.00	0.0425	0.00	0.00	0.00	0.00
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.24	0.00	0.00	0.1224	0.2374	0.2276	0.2498	0.2275
	σ_β	Persistent changes in survey catchability	0.00	0.45	0.00 (f)	0.00 (f)	0.00 (f)	0.00 (f)	0.00(f)	0.00(f)

Parameter	*Notation*	Description	2002 WG	2003 WG	2004 WG Run 3	2006 WG	2007 WG	2008 WG	2009WG	2010WG
Measurement standard deviations	$\sigma_{landings}$	Standard error of landings-at-age data	0.12	0.13	0.10	0.0935	0.0891	0.0892	0.0889	0.0897
	$\sigma_{discards}$	Standard error of discards-at-age data	n/a	0.94	1.42	1.2669	1.367	1.3756	1.3681	1.3819
	σ_{survey}	Standard error of survey data	0.36	0.56	0.35	0.3887	0.364	0.3875	0.3930	0.3926
Discards	$\sigma_{logit\ p}$	Transitory trends in discarding	n/a	0.30	0.00	0.00	0.00	0.00	0.00	0.00
	$\sigma_{persistent}$	Persistent trends in discarding	n/a	0.16	0.68	0.5735	0.6742	0.7032	0.6959	0.7112
Recruitment	η_1	Ricker parameter (slope at the origin)	0.82	0.62	0.80	0.6584	0.7882	0.9634	0.8913	1.0233
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.03	0.003	0.01	0.0049	0.0124	0.0203	0.0177	0.0223
	cv_{rec}	Coefficient of variation of recruitment data	0.36	0.56	0.49	0.4184	0.5116	0.5627	0.5530	0.5671

Tabele 3.2.12. Cod in Division VIa. TSA population numbers-at-age (millions).

YEAR	AGE						
	1	**2**	**3**	**4**	**5**	**6**	**7+**
1978	20.5672	9.4801	2.5819	1.4145	0.5274	0.1602	0.1300
1979	28.3269	10.1966	4.2357	1.1249	0.5277	0.1860	0.1000
1980	31.0962	13.7576	4.3554	1.3395	0.2795	0.1205	0.0600
1981	10.5034	16.3109	6.1920	1.8093	0.4951	0.1000	0.0655
1982	25.7117	5.1062	6.8386	2.3878	0.6802	0.1912	0.0598
1983	15.4779	12.0399	2.1641	2.5890	0.8554	0.2395	0.0888
1984	24.0547	6.0868	4.5504	0.7565	0.8460	0.2782	0.1023
1985	12.3570	12.0726	2.2218	1.4568	0.2280	0.2285	0.1106
1986	19.1694	4.2428	3.8769	0.6899	0.3258	0.0632	0.0784
1987	59.8868	9.8640	1.7519	1.3639	0.2271	0.1029	0.0464
1988	6.0555	16.8212	3.6523	0.5509	0.3553	0.0664	0.0422
1989	19.7253	2.4807	5.4805	1.1630	0.1862	0.1076	0.0346
1990	6.3566	8.7653	0.9425	1.4928	0.3405	0.0555	0.0404
1991	11.1191	2.9277	3.4216	0.3637	0.4826	0.1211	0.0348
1992	17.3426	4.5392	0.9635	1.1371	0.1240	0.1482	0.0478
1993	7.1597	8.1772	1.8265	0.3055	0.3407	0.0417	0.0664
1994	15.0998	3.3037	3.2895	0.6068	0.1089	0.1130	0.0367
1995	12.6504	7.5079	1.4766	1.3010	0.2290	0.0403	0.0559
1996	4.9338	5.9165	3.0450	0.5375	0.4540	0.0792	0.0332
1997	17.6711	2.0668	2.2954	1.0416	0.1786	0.1524	0.0372
1998	8.7168	7.9998	0.7721	0.7837	0.3351	0.0581	0.0617
1999	4.9317	3.8497	3.0104	0.2524	0.2497	0.1062	0.0382
2000	10.2059	2.1109	1.4767	1.0174	0.0805	0.0799	0.0463
2001	3.2490	4.6891	0.8363	0.5251	0.3455	0.0271	0.0425
2002	8.7484	1.3206	1.7704	0.2796	0.1677	0.1137	0.0224
2003	1.6749	3.8883	0.4857	0.5895	0.0892	0.0538	0.0437
2004	3.8522	0.5549	1.4034	0.1579	0.1818	0.0271	0.0302
2005	5.3315	1.3827	0.1543	0.4346	0.0457	0.0546	0.0172
2006	11.0528	2.3017	0.4484	0.0359	0.1298	0.0134	0.0215
2007	2.4881	5.0325	0.9110	0.1568	0.0118	0.0434	0.0116
2008	3.8602	1.1427	2.0370	0.3307	0.0534	0.0040	0.0188
2009	10.3900	1.6939	0.4316	0.6614	0.1028	0.0164	0.0071
2010*	7.0617	4.6992	0.6510	0.1447	0.2094	0.0325	0.0075
2011*	5.5452	3.2290	1.8545	0.2279	0.0477	0.0692	0.0132
GM(78-09)	10.2398	4.5723	1.8231	0.6630	0.2184	0.0734	0.0427

***2010 and 2011 values are TSA-derived projections of population numbers.**

Table 3.2.13. Cod in Division VIa. Standard errors on TSA population numbers-at-age (millions).

Year	Age						
	1	2	3	4	5	6	7+
1978	2.9004	0.542	0.1236	0.0845	0.0511	0.0299	0.022
1979	2.1581	0.5551	0.1765	0.0605	0.0448	0.0306	0.0192
1980	2.5842	0.787	0.2327	0.0973	0.0313	0.027	0.0197
1981	1.1827	1.2187	0.3394	0.1007	0.0375	0.0138	0.0126
1982	2.1817	0.3662	0.3827	0.1356	0.038	0.0147	0.0046
1983	1.5714	0.9024	0.1161	0.1641	0.0652	0.0245	0.0089
1984	1.7581	0.5346	0.2854	0.051	0.0713	0.0351	0.0135
1985	1.4787	0.8001	0.1501	0.114	0.0232	0.0374	0.0187
1986	1.4828	0.3271	0.237	0.0522	0.041	0.0114	0.0174
1987	10.0221	0.6542	0.1017	0.0959	0.0219	0.019	0.0091
1988	1.1223	1.5986	0.1928	0.0376	0.0356	0.0109	0.0088
1989	2.0397	0.1831	0.4723	0.076	0.0142	0.0158	0.0065
1990	1.1508	0.4923	0.0528	0.1315	0.0286	0.0071	0.0068
1991	1.5709	0.2207	0.1963	0.0199	0.0426	0.0131	0.004
1992	1.645	0.3177	0.0701	0.0769	0.0088	0.0191	0.0063
1993	1.0106	0.5082	0.1268	0.0254	0.0326	0.0047	0.0083
1994	2.8386	0.3567	0.2952	0.0684	0.0114	0.0171	0.0048
1995	2.9409	1.4858	0.2242	0.1918	0.0405	0.0071	0.0103
1996	2.0263	1.3183	0.6213	0.0947	0.0803	0.0164	0.0064
1997	3.9615	0.8032	0.5352	0.2414	0.0371	0.032	0.0083
1998	2.5372	1.7829	0.31	0.1995	0.0906	0.0149	0.0154
1999	1.8973	1.0928	0.7211	0.109	0.0728	0.0341	0.0107
2000	2.8374	0.742	0.4285	0.2624	0.0371	0.0266	0.0151
2001	1.4578	1.1992	0.2789	0.1555	0.0912	0.0127	0.013
2002	2.3693	0.5209	0.4738	0.098	0.0559	0.0332	0.0076
2003	1.2616	0.9991	0.1904	0.1722	0.0339	0.02	0.014
2004	1.6895	0.3931	0.3834	0.0649	0.061	0.0121	0.0104
2005	1.1902	0.582	0.1321	0.133	0.022	0.0218	0.0066
2006	1.6272	0.4218	0.2006	0.0412	0.0442	0.0075	0.0089
2007	0.8158	0.6822	0.1575	0.0661	0.0132	0.015	0.0045
2008	1.1189	0.3177	0.3179	0.0554	0.022	0.0044	0.0061
2009	2.0027	0.4693	0.1238	0.137	0.0226	0.0077	0.0029
2010*	2.2547	0.8797	0.183	0.0444	0.0514	0.0087	0.0031
2011*	3.2228	1.1214	0.3972	0.0692	0.0158	0.0195	0.0038
GM(78-09)	1.8593	0.6196	0.2262	0.0903	0.0355	0.0160	0.0092

***2010 and 2011 values are standard errors on TSA-derived projections of population numbers.**

Table 3.2.14. Cod in Division VIa. TSA estimates for mortality-at-age.

YEAR	AGE						
	1	2	3	4	5	6	7+
1978	0.5165	0.612	0.6337	0.7597	0.7869	0.7865	0.782
1979	0.5606	0.7057	0.8686	1.0037	0.9785	0.9673	0.9523
1980	0.4527	0.6323	0.6798	0.7792	0.7986	0.7789	0.7717
1981	0.4741	0.6644	0.7537	0.7514	0.6814	0.7251	0.7355
1982	0.5913	0.6611	0.764	0.8231	0.8428	0.8368	0.8427
1983	0.673	0.7499	0.8415	0.9025	0.909	0.9441	0.9546
1984	0.5568	0.7539	0.8862	0.9578	1.0229	0.9799	0.9569
1985	0.7785	0.9089	0.9323	1.1425	1.0269	1.1062	1.0897
1986	0.4898	0.6775	0.8192	0.8925	0.8911	0.8861	0.8612
1987	0.7925	0.8041	0.9279	1.0716	1.0034	1.0076	1.0071
1988	0.6324	0.7781	0.9291	0.8839	0.962	0.9407	0.9265
1989	0.6145	0.7588	0.9695	1.0065	0.999	1.0216	1.0069
1990	0.5596	0.7336	0.7515	0.9073	0.834	0.8184	0.808
1991	0.6758	0.8563	0.8914	0.8765	0.9606	0.9712	0.9868
1992	0.5488	0.7103	0.9082	0.9892	0.8902	0.8768	0.898
1993	0.5754	0.7106	0.8945	0.8312	0.9002	0.8852	0.8785
1994	0.4987	0.6015	0.7262	0.7738	0.7933	0.7806	0.7951
1995	0.5603	0.7022	0.8104	0.8529	0.862	0.8637	0.8645
1996	0.6054	0.7412	0.8656	0.9014	0.8919	0.9059	0.9069
1997	0.593	0.7509	0.8683	0.9265	0.9177	0.9151	0.9192
1998	0.61	0.7638	0.8854	0.9348	0.9374	0.9346	0.9344
1999	0.616	0.7558	0.8799	0.9344	0.9332	0.9318	0.931
2000	0.5779	0.7245	0.8343	0.8768	0.8861	0.8883	0.8877
2001	0.622	0.7596	0.8781	0.9313	0.913	0.9262	0.927
2002	0.6065	0.7593	0.8836	0.9319	0.9305	0.9268	0.9302
2003	0.6454	0.7875	0.9013	0.9598	0.9625	0.957	0.9574
2004	0.6774	0.8039	0.9354	0.9886	0.9813	0.9836	0.9818
2005	0.6398	0.8204	0.9482	1.0003	0.998	0.9927	0.9925
2006	0.5303	0.7204	0.8528	0.9079	0.895	0.8973	0.8963
2007	0.5837	0.7045	0.7972	0.8793	0.8825	0.8745	0.8753
2008	0.623	0.7778	0.9177	0.9626	0.9634	0.961	0.9591
2009	0.5769	0.7583	0.8891	0.95	0.949	0.9397	0.9385
2010*	0.5825	0.7298	0.8495	0.9088	0.9074	0.908	0.9059
2011*	0.5854	0.7317	0.8488	0.9045	0.9045	0.9045	0.9045
GM(78-09)	0.5911	0.7362	0.8500	0.9113	0.9087	0.9094	0.9079

***Estimates for 2010 and 2011 are TSA projections.**

Table 3.2.15. Cod in Division VIa. Standard errors of TSA estimates for log mortality-at-age.

YEAR	AGE						
	1	**2**	**3**	**4**	**5**	**6**	**7+**
1978	0.194	0.0997	0.0638	0.0641	0.0768	0.0909	0.0921
1979	0.2021	0.1017	0.0583	0.0565	0.0681	0.0867	0.0897
1980	0.1983	0.1004	0.0632	0.064	0.0686	0.0876	0.0907
1981	0.2057	0.0892	0.0603	0.0627	0.0741	0.0901	0.0933
1982	0.1998	0.0937	0.0633	0.0652	0.079	0.0907	0.0979
1983	0.1755	0.0851	0.0601	0.0625	0.0744	0.0881	0.0928
1984	0.1961	0.0943	0.0617	0.0633	0.0709	0.0876	0.0927
1985	0.1834	0.0775	0.0629	0.0593	0.0746	0.0845	0.0906
1986	0.2082	0.0913	0.0635	0.066	0.0736	0.0926	0.0908
1987	0.1783	0.0911	0.0596	0.0598	0.078	0.0891	0.0944
1988	0.2053	0.0761	0.0577	0.065	0.0712	0.0941	0.0953
1989	0.1882	0.0846	0.0641	0.0609	0.0735	0.0857	0.0964
1990	0.2013	0.0711	0.0645	0.0657	0.0742	0.0906	0.0926
1991	0.1949	0.0691	0.0612	0.0636	0.0703	0.0873	0.0947
1992	0.1926	0.0769	0.064	0.065	0.0792	0.0881	0.0954
1993	0.205	0.0837	0.0758	0.0773	0.0867	0.0996	0.0976
1994	0.2159	0.1201	0.1131	0.1167	0.123	0.1236	0.1238
1995	0.2335	0.1432	0.1383	0.1385	0.1393	0.14	0.14
1996	0.2343	0.1432	0.1383	0.1386	0.1392	0.1399	0.1399
1997	0.2306	0.1456	0.1395	0.1393	0.14	0.1407	0.1408
1998	0.2341	0.1438	0.1408	0.1394	0.1401	0.1408	0.1409
1999	0.2349	0.1464	0.1405	0.1412	0.141	0.1417	0.1418
2000	0.2348	0.1477	0.143	0.1422	0.1428	0.1429	0.1429
2001	0.2338	0.145	0.1411	0.1399	0.1406	0.1413	0.1413
2002	0.2318	0.1465	0.1401	0.1405	0.1408	0.1414	0.1415
2003	0.2337	0.1441	0.1418	0.1399	0.1406	0.1413	0.1413
2004	0.2274	0.1462	0.139	0.1398	0.1402	0.1409	0.141
2005	0.2347	0.1469	0.1427	0.1408	0.1417	0.1423	0.1424
2006	0.2364	0.149	0.1438	0.1432	0.1431	0.1437	0.1438
2007	0.2345	0.1467	0.1428	0.1425	0.1428	0.1431	0.1432
2008	0.2367	0.1478	0.1406	0.1409	0.1419	0.1424	0.1425
2009	0.2372	0.1491	0.1438	0.1431	0.1431	0.1439	0.144
2010*	0.2426	0.1525	0.1479	0.1467	0.1468	0.1467	0.1468
2011*	0.2432	0.153	0.1484	0.1473	0.1473	0.1473	0.1473
GM(78-09)	0.2132	0.1114	0.0933	0.0941	0.1021	0.1122	0.1147

***Estimates for 2010 and 2011 are standard errors of TSA projections of log *F*.**

Table 3.2.16. Cod in Division VIa. TSA summary table. "Obs." denotes sum-of-products of numbers and mean weights-at-age, not reported caught, landed and discarded weight. * Estimates for 2010, 2011 are TSA projections.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean Z-0.2 (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment at age 1 (millions)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	13.5205	13.2371	0.5744	3.6808	3.3066	0.8232	17.2013	17.3151	1.1717	0.6981	0.0313	26.0472	0.7585	39.5885	1.5141	20.5672	2.9004
1979	16.0887	15.7626	0.6491	0.0541	4.1523	0.7446	16.1427	26.7454	1.9934	0.8891	0.0353	28.5038	0.7836	56.0786	1.9405	28.3269	2.1581
1980	17.8789	17.2852	0.7873	0.9958	3.3932	0.8168	18.8747	23.9142	1.67	0.7225	0.0321	31.7783	1.0837	56.3863	1.9947	31.0962	2.5842
1981	23.8646	22.1158	1.3599	0.5198	0.9604	0.2967	24.3843	24.1205	1.4454	0.7127	0.0306	38.0061	1.2457	52.5513	1.8389	10.5034	1.1827
1982	21.5108	23.2089	1.0177	1.6539	2.3873	0.7303	23.1647	25.8644	1.5172	0.7727	0.0351	37.4586	1.1842	54.2507	1.7096	25.7117	2.1817
1983	21.3052	20.9504	0.9072	2.0195	1.6127	0.4626	23.3247	22.7346	1.2486	0.8507	0.0351	32.0595	1.0713	44.1324	1.5278	15.4779	1.5714
1984	21.2717	19.866	0.9578	0.6355	2.5622	0.6473	21.9071	24.3711	1.5578	0.9052	0.0384	29.9251	1.1271	48.4828	1.7927	24.0547	1.7581
1985	18.6071	17.6551	0.7976	8.8246	1.2902	0.3571	27.4317	17.3705	1.0091	1.0026	0.0401	22.0667	0.8829	30.2487	1.1673	12.357	1.4787
1986	11.8201	11.5845	0.6335	1.1998	1.6942	0.4097	13.0199	13.654	0.8917	0.8201	0.0361	18.4836	0.7472	28.8433	1.0713	19.1694	1.4828
1987	18.9705	18.1209	0.9572	8.7876	3.8839	1.3967	27.7581	20.9097	2.1193	0.9518	0.0408	19.6954	0.7284	39.2358	2.4639	59.8868	10.0221
1988	20.4133	18.5944	1.2724	1.133	0.8416	0.2962	21.5462	18.6539	1.3792	0.8883	0.0352	23.4725	1.0034	36.0528	1.8434	6.0555	1.1223
1989	17.1693	15.079	1.008	2.818	2.1561	0.6608	19.9873	17.1484	1.3328	0.9335	0.0388	21.0412	1.0995	32.3916	1.5729	19.7253	2.0397
1990	12.1755	11.9236	0.624	0.3141	0.3747	0.1339	12.4896	12.3494	0.7421	0.8066	0.0331	17.7548	0.711	24.8666	0.9577	6.3566	1.1508
1991	10.9267	10.7992	0.518	0.9095	0.8923	0.3199	11.8362	11.621	0.7487	0.8962	0.0348	15.2345	0.572	21.9853	0.9106	11.1191	1.5709
1992	9.0862	8.9169	0.4212	2.9024	1.3508	0.3727	11.9886	9.9895	0.6294	0.8745	0.0382	12.4568	0.4944	20.2179	0.8023	17.3426	1.645
1993	10.3142	10.421	0.4486	0.1846	0.7424	0.2303	10.4988	11.5173	0.6327	0.8341	0.0466	14.6149	0.623	23.5798	1.0602	7.1597	1.0106
1994	8.9279	9.1473	0.4347	0.1863	1.115	0.3715	9.1142	11.1747	0.8437	0.7237	0.0684	15.232	1.0902	25.5879	1.9444	15.0998	2.8386
1995	9.4385	11.0937	1.6807	0.258	0.893	0.3261	9.6965	12.5075	1.8966	0.8069	0.0942	16.8305	1.9405	26.0435	2.9493	12.6504	2.9409
1996	9.4267	11.6635	1.9608	0.086	0.451	0.2381	9.5127	12.5554	2.1394	0.85	0.0991	17.6804	2.3307	24.6382	3.298	4.9338	2.0263
1997	7.0336	9.3234	1.8496	0.3537	1.9584	0.7845	7.3872	12.1106	2.2333	0.8658	0.1021	14.1484	2.2096	24.5775	3.4726	17.6711	3.9615
1998	5.7139	8.9386	1.8062	0.4175	0.7832	0.3607	6.1314	9.6408	1.8246	0.8803	0.1037	11.9602	1.8971	19.0419	2.8589	8.7168	2.5372
1999	4.201	7.8799	1.6423	0.0879	0.5422	0.302	4.2889	8.6041	1.7502	0.8758	0.1043	11.7733	2.0251	16.6666	2.7623	4.9317	1.8973
2000	2.9771	6.6338	1.5307	0.6049	0.9827	0.4766	3.582	7.7634	1.5832	0.8304	0.1003	10.1766	1.8245	15.8646	2.5979	10.2059	2.8374
2001	2.347	6.2757	1.3139	0.2093	0.3406	0.2216	2.5563	6.4685	1.3211	0.8705	0.1029	9.0463	1.5097	12.4965	2.0788	3.249	1.4578
2002	2.2426	5.2256	1.3194	0.1662	0.8379	0.4228	2.4089	6.4057	1.3719	0.8763	0.1038	7.7447	1.4298	12.7508	2.1734	8.7484	2.3693
2003	1.2411	4.6288	1.0572	0.0458	0.2299	0.2159	1.2869	4.888	1.1215	0.9028	0.1066	6.5379	1.1806	9.277	1.7771	1.6749	1.2616
2004	0.5402	3.4961	0.9264	0.0718	0.3838	0.2587	0.612	3.8611	0.9652	0.9273	0.1089	5.2231	1.0778	7.1158	1.4919	3.8522	1.6895
2005	0.5114	2.7972	0.9723	0.0406	0.5699	0.301	0.552	3.3943	0.8753	0.9417	0.1124	3.6816	0.8905	6.5584	1.3334	5.3315	1.1902
2006	0.4545	2.8355	1.125	0.4777	0.9806	0.4914	0.9323	3.6305	0.7261	0.844	0.1023	3.5726	0.7107	7.9794	1.1192	11.0528	1.6272
2007	0.5242	4.0165	0.7486	2.0833	0.2933	0.341	2.6076	4.3412	0.6996	0.8159	0.098	5.8786	0.7359	9.0067	1.053	2.4881	0.8158
2008	0.4501	5.3011	0.9146	0.9084	0.3331	0.2001	1.3585	4.6258	0.7249	0.9054	0.1076	6.5852	0.8233	8.6242	1.0585	3.8602	1.1189
2009	0.222	5.1478	1.9255	1.3803	0.9711	0.5292	1.6023	4.5052	0.7821	0.8866	0.1073	5.1661	0.8043	9.1197	1.2551	10.39	2.0027
2010*	NA	5.437	1.3105	NA	0.6782	0.5094	NA	5.1319	0.8588	0.8489	0.1061	6.2265	0.921	10.5334	1.5072	7.0617	2.2547
2011*	NA	6.0727	1.4229	NA	0.5207	0.433	NA	5.6055	1.1157	0.8474	0.1064	7.6133	1.3545	11.2068	2.1134	5.5452	3.2228
Min	0.2220	2.7972	0.4212	0.0406	0.2299	0.1339	0.5520	3.3943	0.6294	0.6981	0.0306	3.5726	0.4944	6.5584	0.8023	1.6749	0.8158
GM	5.4059	9.5484	0.9713	0.5336	1.0035	0.3980	6.9774	10.8065	1.1878	0.8520	0.0604	13.8848	1.0511	21.7514	1.6610	10.2398	1.8593
AM	10.0367	11.2477	1.0669	1.3753	1.3521	0.4544	11.4121	12.9611	1.2796	0.8551	0.0689	16.8699	1.1436	26.3825	1.7935	13.7427	2.1385
Max	23.8646	23.2089	1.9608	8.8246	4.1523	1.3967	27.7581	26.7454	2.2333	1.0026	0.1124	38.0061	2.3307	56.3863	3.4726	59.8868	10.0221

Table 3.2.17. Cod in Division VIa. Inputs to short-term predictions from TSA run. Mean weights assumed from final 3 years. Note: Text is presented as it was output from WGFRANSW but data referred to as that for the human consumption fishery should be regarded as that for removals in addition to the assumed value of natural mortality.

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	7061	0.32	WS1	0.23	0.14
N2	4699	0.19	WS2	1.10	0.19
N3	651	0.28	WS3	2.42	0.12
N4	144	0.31	WS4	4.23	0.14
N5	209	0.24	WS5	5.98	0.06
N6	32	0.27	WS6	7.93	0.16
N7	7	0.41	WS7	8.64	0.02
H.cons selectivity			Weight in the HC catch		
sH1	0.59	0.04	WH1	0.23	0.14
sH2	0.75	0.05	WH2	1.10	0.19
sH3	0.87	0.07	WH3	2.42	0.12
sH4	0.93	0.05	WH4	4.23	0.14
sH5	0.93	0.05	WH5	5.98	0.06
sH6	0.93	0.05	WH6	7.93	0.16
sH7	0.92	0.05	WH7	8.64	0.02
Natural mortality			Proportion mature		
M1	0.20	0.10	MT1	0.00	0.10
M2	0.20	0.10	MT2	0.52	0.10
M3	0.20	0.10	MT3	0.86	0.10
M4	0.20	0.10	MT4	1.00	0.10
M5	0.20	0.10	MT5	1.00	0.00
M6	0.20	0.10	MT6	1.00	0.00
M7	0.20	0.10	MT7	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF10	0.75	0.05	K10	1.00	0.10
HF11	0.56	0.05	K11	1.00	0.10
HF12	1.00	0.05	K12	1.00	0.10
Recruitment in 2011 and 2012					
R11	4696	0.62			
R12	4696	0.62			

Proportion of F before spawning = .00

Proportion of M before spawning = .00

Stock numbers in 2010 are TSA survivors.

Table 3.2.18. Cod in Division VIa. Results of short-term forecasts from TSA run. Management options. Note: Text is presented as it was output from WGFRANSW but data referred to as that for the human consumption fishery should be regarded as that for removals in addition to the assumed value of natural mortality.

	Year							
	2010	2011						
Mean F Ages								
H.cons 2 to 5	0.65	0.00	0.17	0.35	0.52	0.70	0.87	1.04
Effort relative to 2009								
H.cons	0.75	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	10.53	12.79	12.79	12.79	12.79	12.79	12.79	12.79
SSB at spawning time	6.23	9.03	9.03	9.03	9.03	9.03	9.03	9.03
Catch weight (,000t)								
H.cons	4.25	0.00	1.75	3.25	4.52	5.61	6.54	7.34
Biomass in year.... 2012								
Total 1 January		22.69	19.57	16.90	14.63	12.69	11.03	9.62
SSB at spawning time		18.57	15.82	13.48	11.49	9.80	8.36	7.14

	Year							
	2010	2011						
Effort relative to 2009								
H.cons	0.75	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.15	0.17	0.17	0.17	0.17	0.17	0.17	0.17
SSB at spawning time	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Catch weight								
H.cons	0.16	0.00	0.20	0.17	0.17	0.16	0.16	0.16
Biomass in year.... 2012								
Total 1 January		0.19	0.19	0.19	0.20	0.20	0.20	0.21
SSB at spawning time		0.18	0.19	0.19	0.19	0.19	0.20	0.20

Table 3.2.19. Cod in Division VIa. Results of short-term forecasts from TSA run. Detailed tables. Note: Text is presented as it was output from WGFRANSW but data referred to as that for the human consumption fishery should be regarded as that for removals in addition to the assumed value of natural mortality.

```
          Detailed forecast tables.

 Forecast for year 2010

 F multiplier H.cons=0.75


       Populations     Catch number

 +----+----------+   +--------+-------+

 | Age| Stock No. |   | H.Cons |  Total|

 +----+----------+   +--------+-------+

 |   1|       7062|   |    2321|   2321|

 |   2|       4699|   |    1844|   1844|

 |   3|        651|   |     285|    285|

 |   4|        145|   |      67|     67|

 |   5|        209|   |      97|     97|

 |   6|         33|   |      15|     15|

 |   7|          8|   |       3|      3|

 +----+----------+   +--------+-------+

 |  Wt|         11|   |       4|      4|

 +----+----------+   +--------+-------+


 Forecast for year 2011

 F multiplier H.cons=0.56

       Populations     Catch number

 +----+----------+   +--------+-------+

 | Age| Stock No. |   | H.Cons |  Total|

 +----+----------+   +--------+-------+

 |   1|       4697|   |    1218|   1218|

 |   2|       3700|   |    1159|   1159|

 |   3|       2197|   |     776|    776|

 |   4|        278|   |     104|    104|

 |   5|         59|   |      22|     22|

 |   6|         85|   |      32|     32|

 |   7|         16|   |       6|      6|

 +----+----------+   +--------+-------+

 |  Wt|         13|   |       4|      4|

 +----+----------+   +--------+-------+
```

Tabele 3.2.20. Cod in Division VIa. Output from srmsymc ADMB package.

Stock name									
Cod-6a									
Sen filename									
sum_and_sen_files/codvia10runspalyhf075hf0563.sen									
pf, pm									
0	0								
Number of iterations									
1000									
Simulate variation in Biological parameters									
TRUE									
SR relationship constrained									
TRUE									
Ricker									
1000/1000 Iterations resulted in feasible parameter estimates									
	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.83	0.35	107615.00	33631.40	0.77	0.32	0.86	1.22E-05	64.52
Mean	0.79	0.34	248654.55	80885.39	0.78	0.38	0.93	1.45E-05	
5%ile	0.59	0.26	42534.56	16130.92	0.61	0.05	0.68	1.73E-06	
25%ile	0.69	0.30	64432.03	23129.35	0.70	0.18	0.80	7.03E-06	
50%ile	0.78	0.33	94637.85	32832.15	0.77	0.35	0.90	1.35E-05	
75%ile	0.88	0.37	176432.50	56775.68	0.85	0.53	1.04	2.02E-05	
95%ile	1.03	0.42	692590.35	217198.55	0.97	0.82	1.32	3.16E-05	
CV	0.17	0.15	3.43	3.41	0.14	0.65	0.21	0.65	

Table 3.2.20. (cont): Cod in Division VIa. Output from srmsymc ADMB package.

BEVERTON–HOLT

1000/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.85	0.18	401035.00	66296.50	0.39	1.31	53828.10	60405.70	64.48
Mean	0.83	0.17	830128.89	113018.89	0.54	1.41	91481.79	119568.27	
5%ile	0.59	0.11	110359.80	21448.08	0.07	1.10	18394.14	11822.00	
25%ile	0.70	0.15	195133.00	35526.05	0.28	1.26	28078.33	26150.93	
50%ile	0.79	0.17	322891.50	55212.35	0.48	1.40	44006.65	47156.45	
75%ile	0.91	0.19	630754.50	96558.98	0.76	1.55	76202.40	97400.13	
95%ile	1.15	0.21	2769898.00	341061.90	1.15	1.78	298192.60	417604.45	
CV	0.25	0.21	2.78	1.97	0.65	0.15	2.22	2.75	

Smooth hockeystick

1000/1000 Iterations resulted in feasible parameter estimates									
	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.75	0.22	135085.00	27314.90	0.45	1.54	0.37	26047.10	64.56
Mean	0.70	0.21	173441.36	30090.20	0.47	1.58	0.38	26727.73	
5%ile	0.53	0.13	68545.05	17722.69	0.37	0.99	0.30	16778.00	
25%ile	0.62	0.19	98326.80	23808.10	0.42	1.33	0.34	22442.08	
50%ile	0.69	0.22	129465.50	28856.20	0.46	1.58	0.37	26719.35	
75%ile	0.77	0.24	171332.00	34618.58	0.50	1.87	0.41	31474.53	
95%ile	0.89	0.27	306434.25	46886.99	0.58	2.17	0.47	36539.60	
CV	0.16	0.22	1.38	0.31	0.16	0.23	0.16	0.23	

Per recruit								
	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.18	0.15	0.14	0.22	7.10	1.44	0.60	0.80
Mean	0.16	0.14	0.13	0.21	8.70	1.51		
5%ile	0.06	0.05	0.06	0.13	3.97	1.07		
25%ile	0.14	0.12	0.12	0.19	5.23	1.27		
50%ile	0.17	0.14	0.14	0.22	6.48	1.47		
75%ile	0.20	0.17	0.16	0.24	8.31	1.66		
95%ile	0.23	0.19	0.18	0.27	15.11	2.16		
CV	0.31	0.31	0.28	0.22	1.36	0.22		

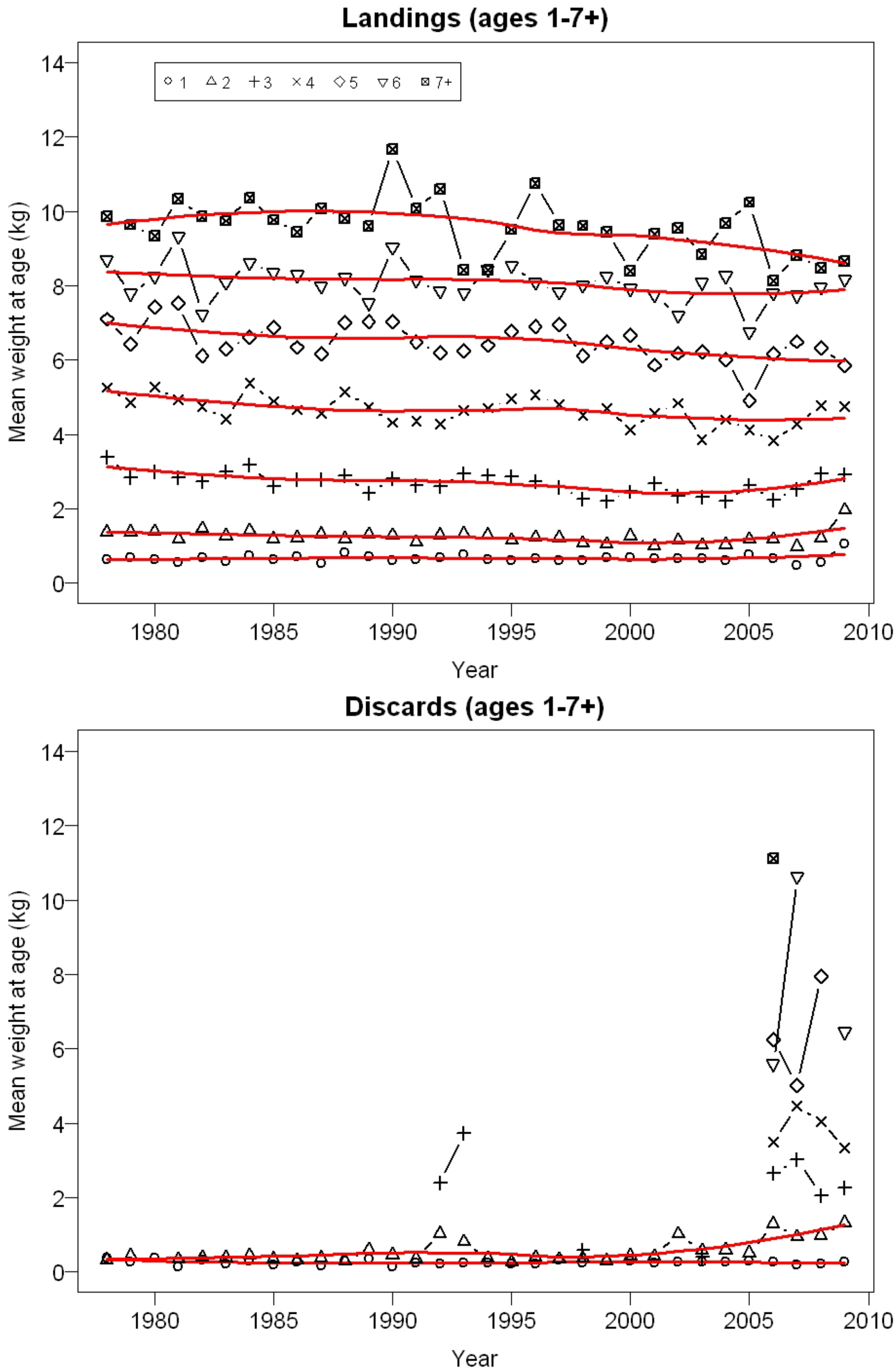

Figure 3.2.1. Cod in Division VIa. Mean weights-at-age in landings and discards. A Loess smoother has been fitted to the data at each age, with a span including three quarters of the data points.

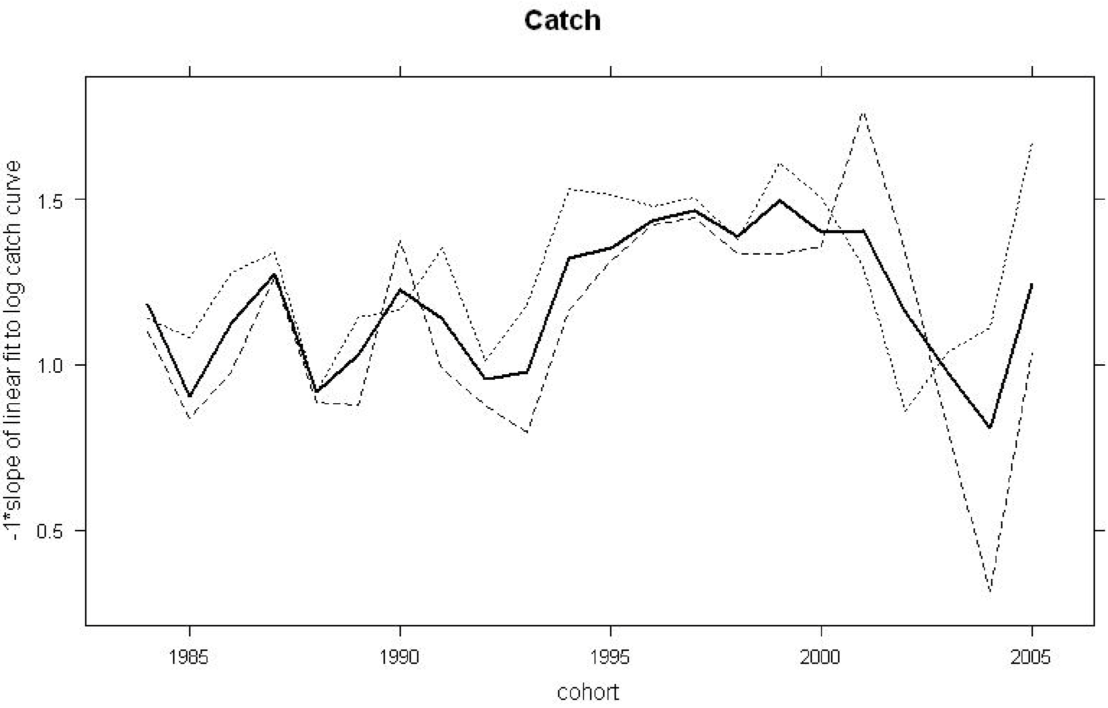

Figure 3.2.2. Cod in Division VIa. Log catch (landings + discards) curve gradient plot using WG commercial catch-at-age data. Solid line shows time-series of gradient of linear fit to curve over the age range 2–5, dashed line over the ages 2–4 and dotted line over the ages 3–5. An increasing value indicates increasing mortality.

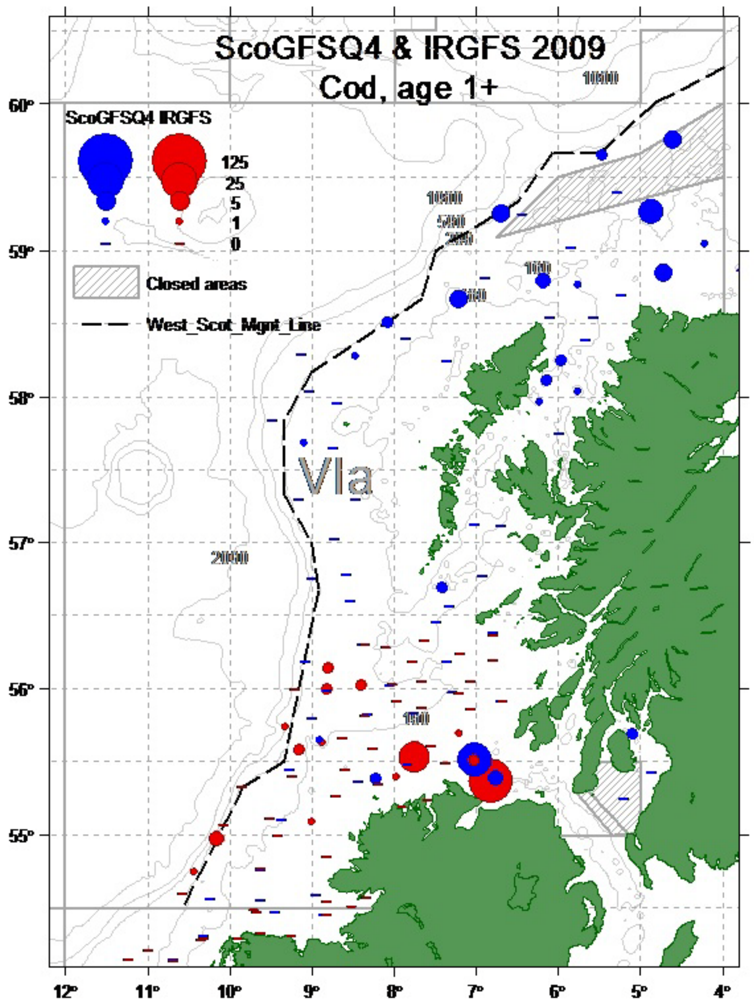

Figure 3.2.3. Cod in Division VIa. Cpue numbers for fish aged at 1+ by ICES statistical rectangle resulting from quarter four surveys. Scottish quarter four ground fish survey (ScoGFS-4Q) and Irish ground fish survey (IGFS). Numbers are standardised to 30 minutes towing. Irish Survey values are for fish >23 cm in length (proxy for age 1+).

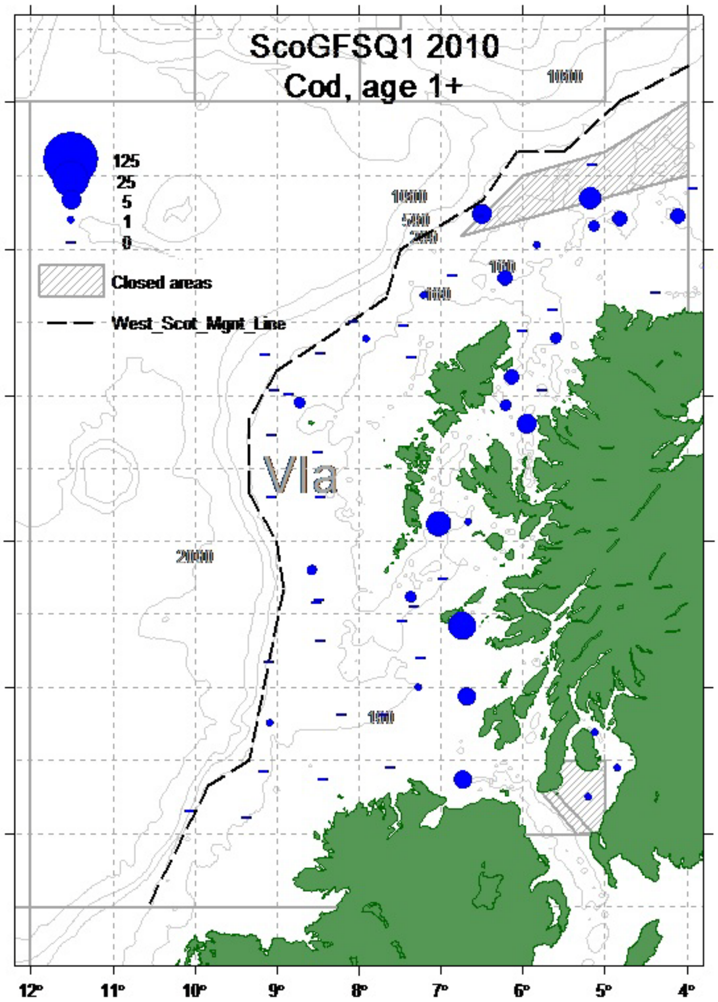

Figure 3.2.3. cont. Cod in Division VIa. Cpue numbers for fish aged at 1+ by ICES statistical rectangle resulting from Scottish quarter one survey (ScoGFS-1Q). Numbers are standardised to 30 minutes towing.

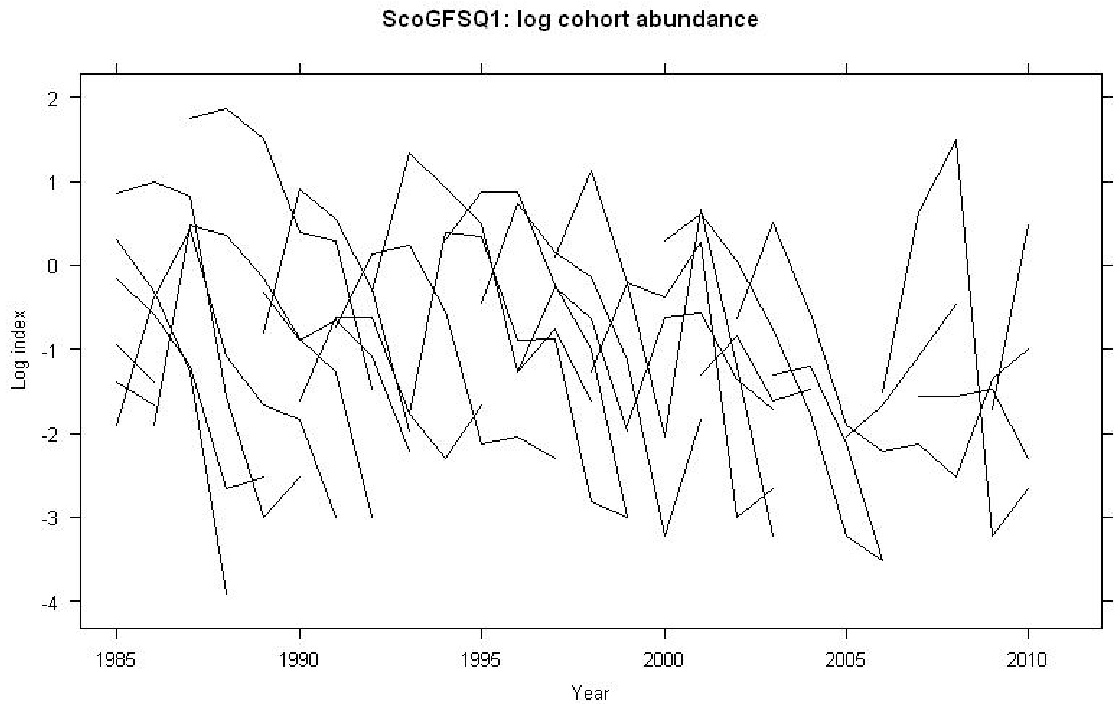

Figure 3.2.4. Cod in Division VIa. Log catch curves from Scottish quarter one ground fish survey (ScoGFS-1Q); ages 1–6.

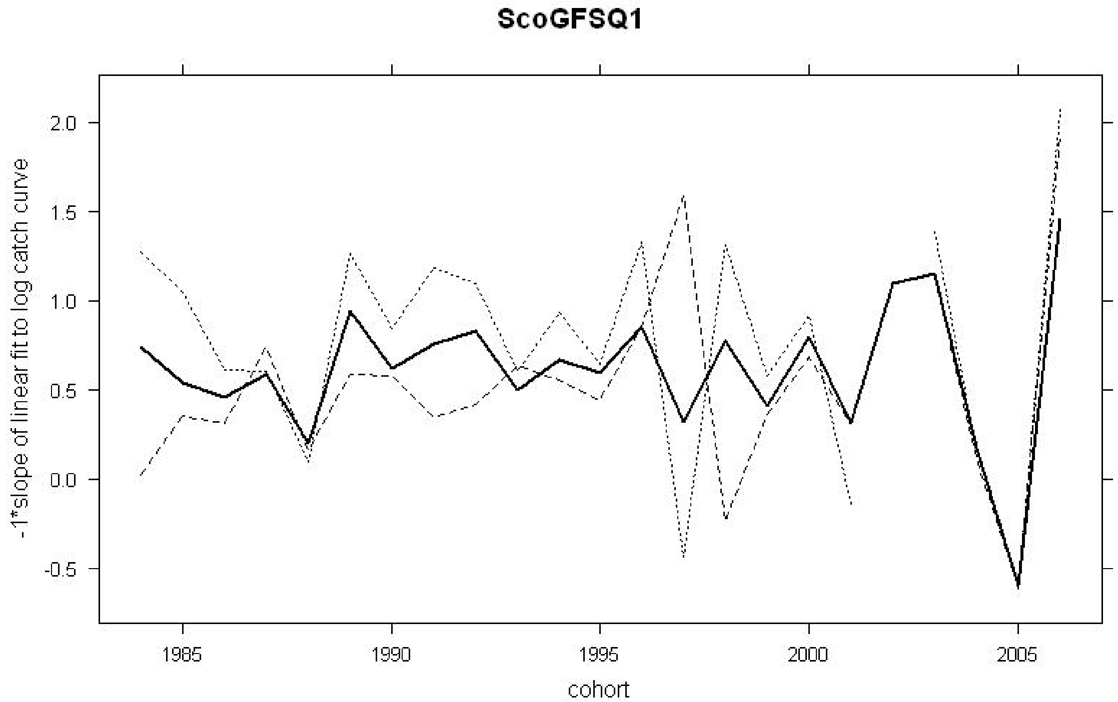

Figure 3.2.5. Cod in Division VIa. Log catch curve gradient plot using ScoGFS-1Q index data. Solid line shows time series of gradient of linear fit to curve over the age range 2–5, dashed line over the ages 2–4 and dotted line over the ages 3–5. An increasing value indicates increasing mortality.

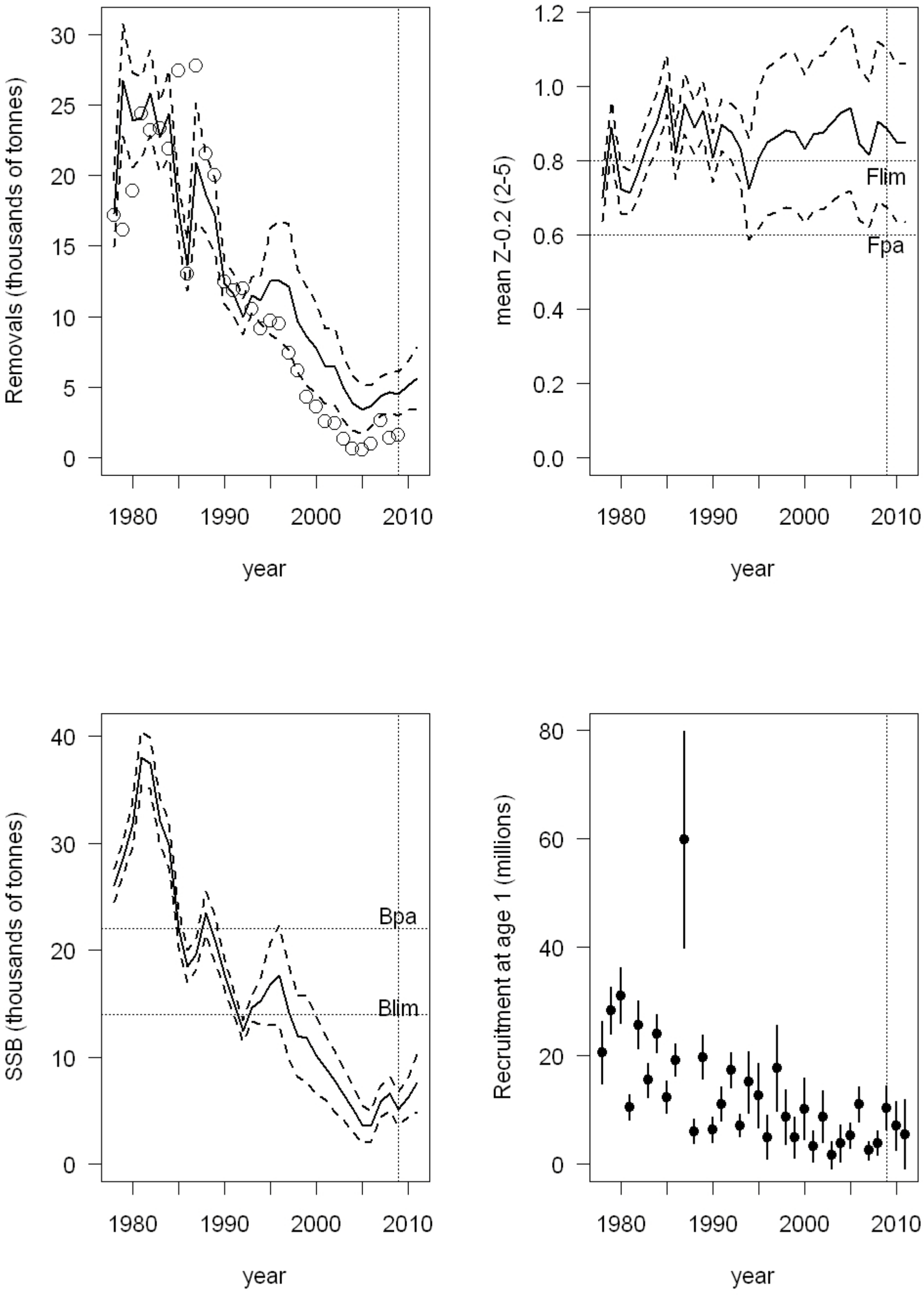

Figure 3.2.6. Cod in Division VIa. Summary plot of TSA update run. (landings & discard data excluded from 1995 onward). Solid line in top left frame indicates removals resulting from mortality over and above M=0.2; open circles represent reported catch. Solid line in top right frame indicates mortality over and above M=0.2. Dashed lines show ± 2 s.e. (approx 95% confidence interval).

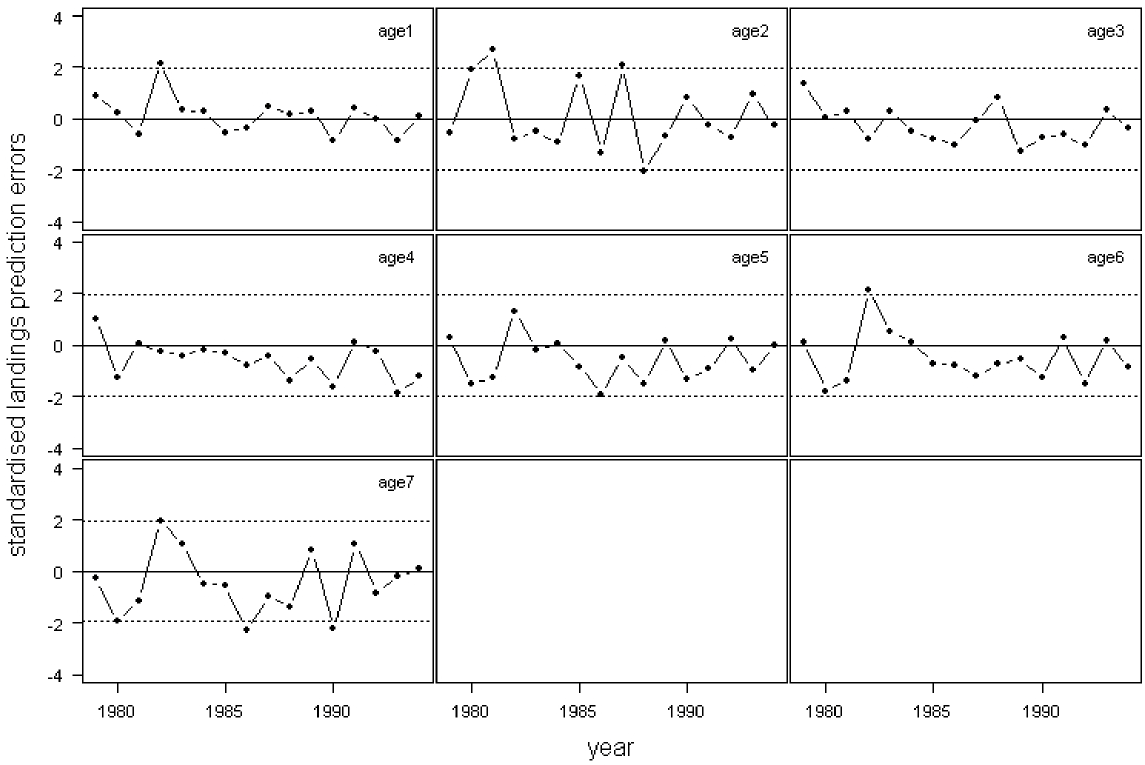

Figure 3.2.7. Cod in Division VIa. TSA final run. Standardised prediction errors at age plots for landings.

Figure 3.2.8. Cod in Division VIa. TSA final run. Standardised prediction errors at age plots for discards.

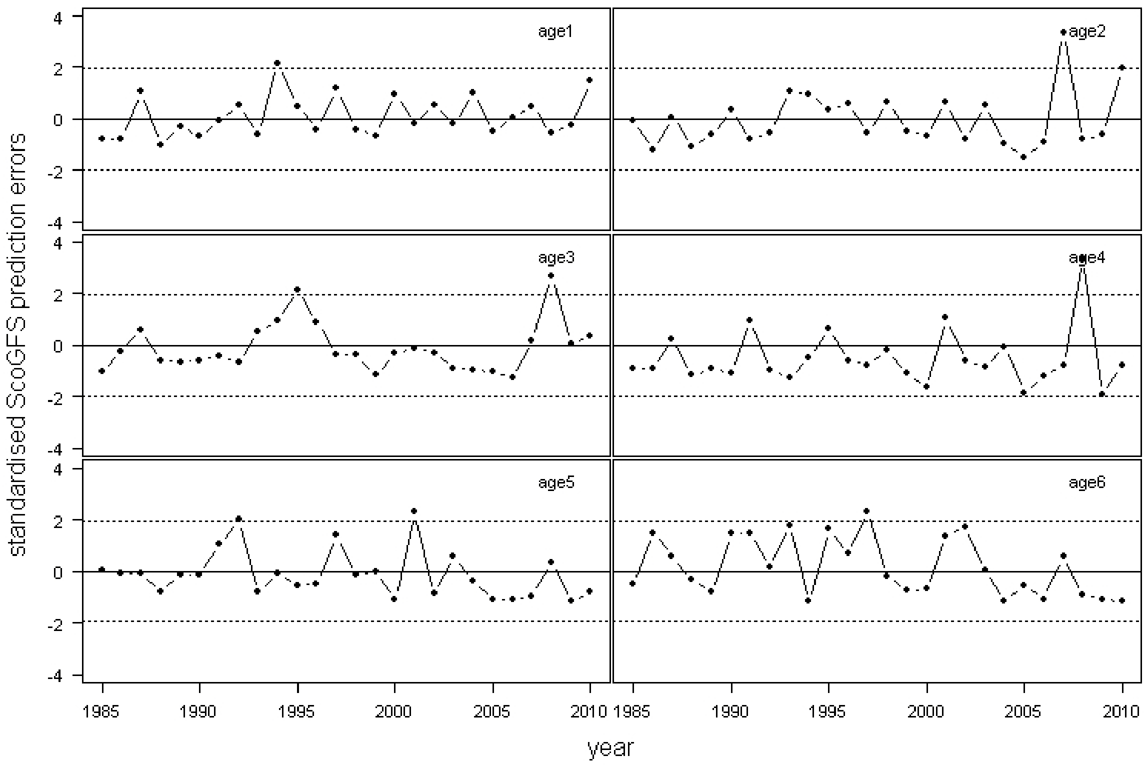

Figure 3.2.9. Cod in Division VIa. TSA run. Standardised prediction errors at age plots for ScoGFS-1Q.

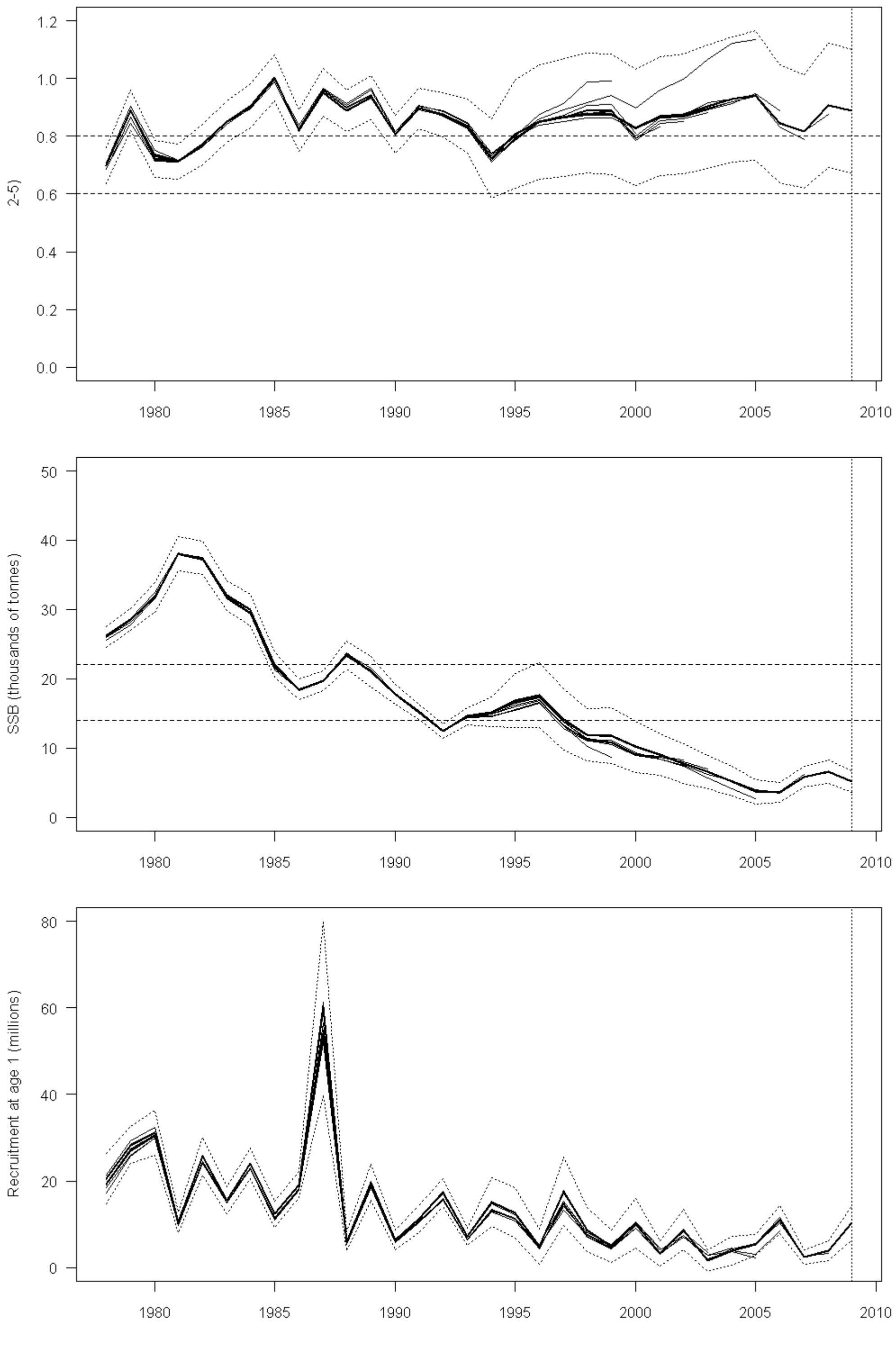

Figure 3.2.10. Cod in Division VIa. Retrospective plots of TSA run. Biological reference points are given by horizontal dashed lines. Confidence intervals for the run using all years of data are shown by dotted lines.

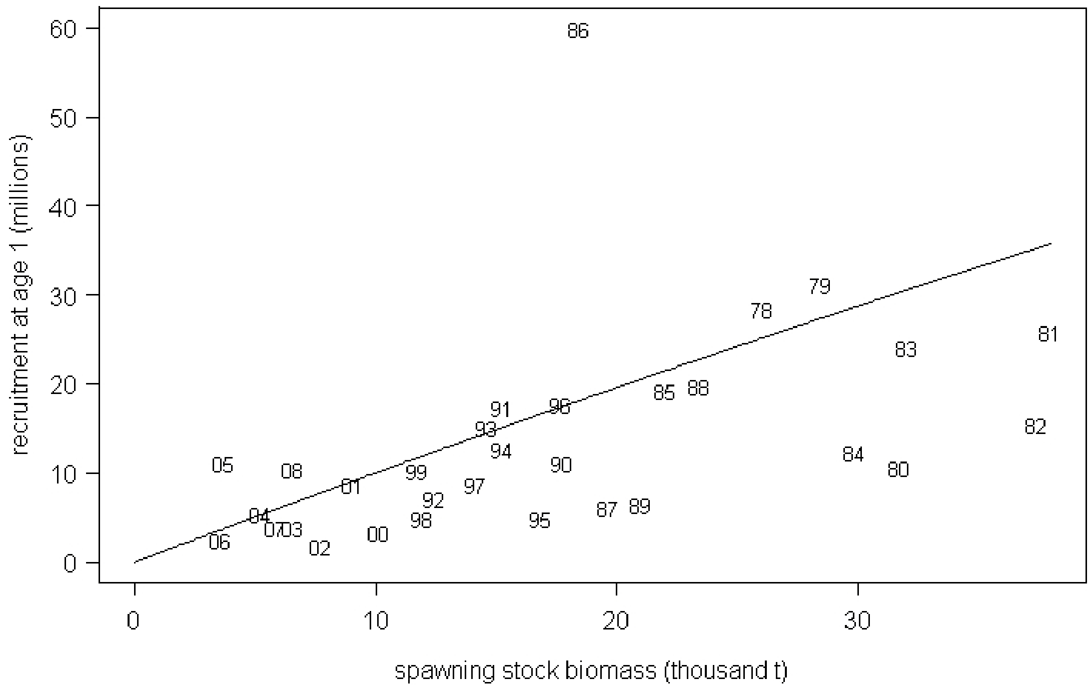

Figure 3.2.11. Cod in Division VIa. TSA final run. Stock–recruit relationship. Numbers indicate year class.

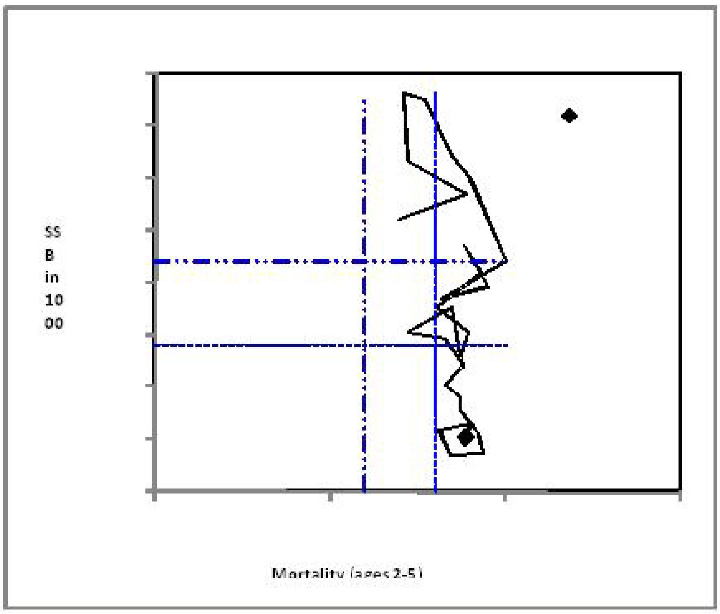

Figure 3.2.12. Cod in Division VIa. Precautionary approach plot. Mortality is all mortality over and above the fixed natural mortality value of 0.2 (referred to as 'Z-0.2').

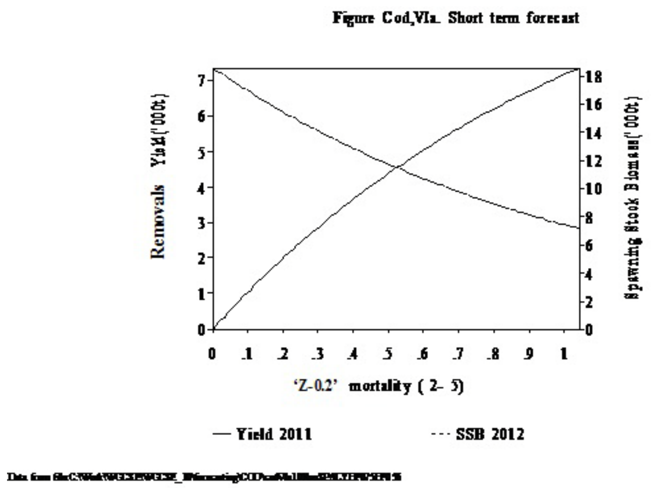

Figure 3.2.13. Cod in Division VIa. Short-term forecast. Figure shows mortality from all sources that is over and above M=0.2 and associated removals.

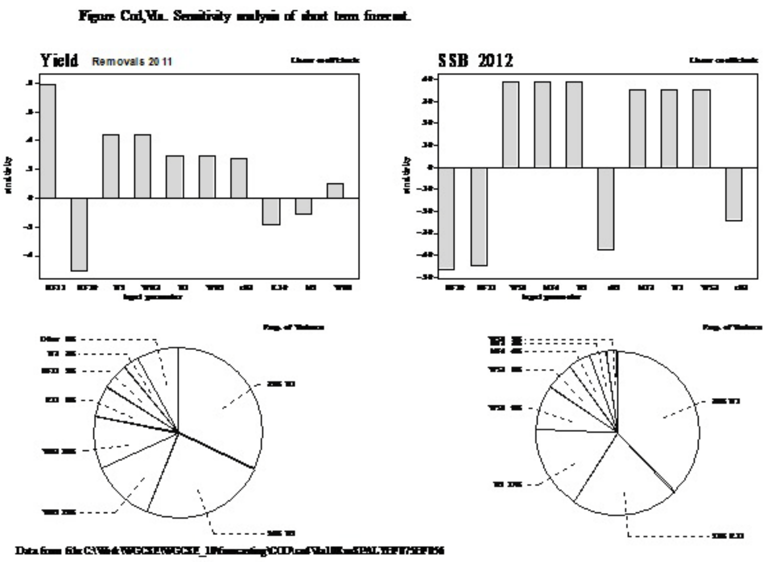

Figure 3.2.14. Cod in Division VIa. Sensitivity analysis of short-term forecast. Removals are associated with mortality from all sources over and above M=0.2.

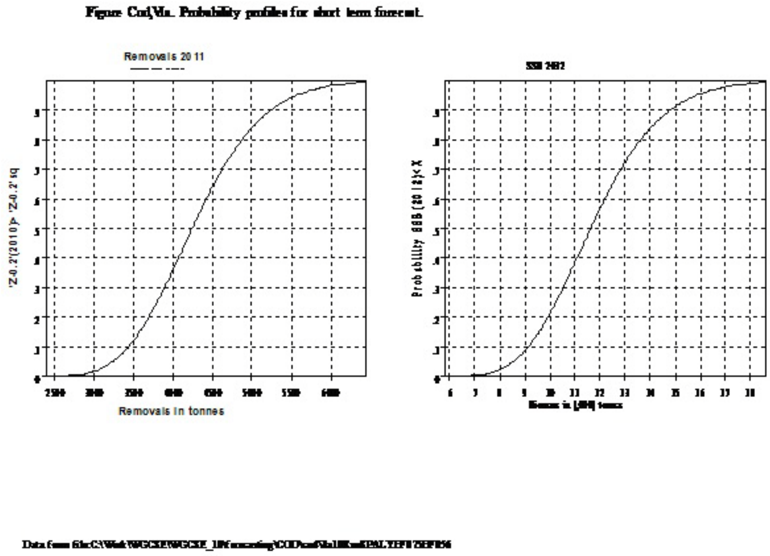

Figure 3.2.15. Cod in Division VIa. Probability profiles for short-term forecast. Removals are associated with mortality from all sources over and above M=0.2.

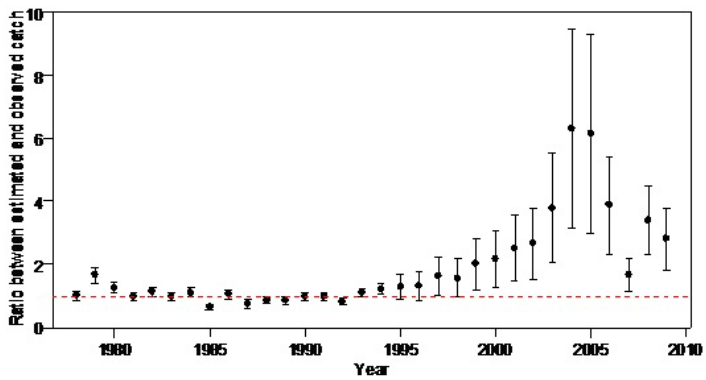

Figure 3.2.16. Cod in Division VIa. Ratio of estimated to observed catch using TSA. Bars show ± 2 s.e. TSA excludes catch data from 1995 to 2008 inclusive. The 'catch' resulting from TSA is considered removals from both fishing and natural mortality over and above M=0.2.

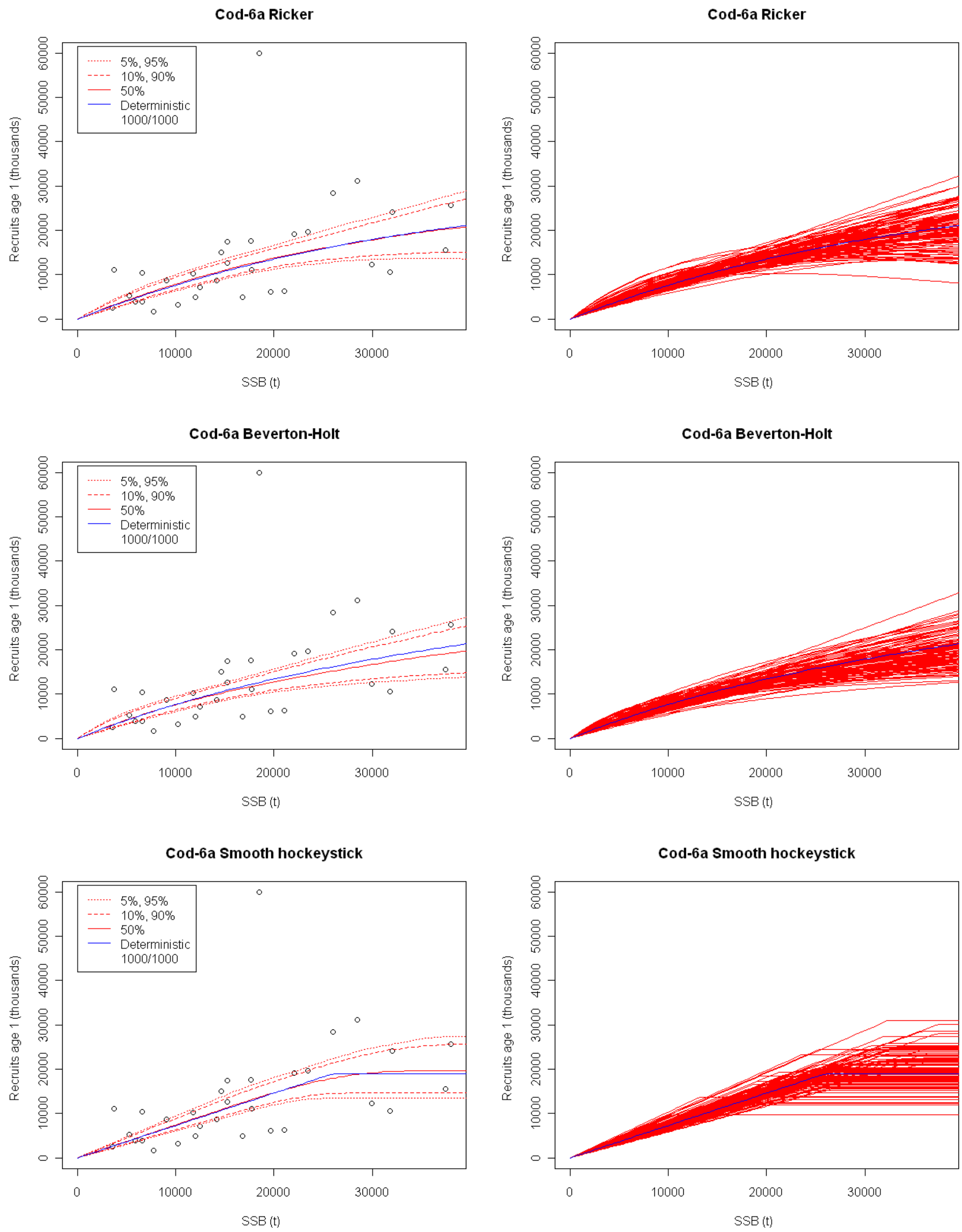

Figure 3.2.17. Cod in Division VIa. Stock–recruit relationships fitted by srmsymc package. Models were fitted using 1000 MCMC re-samples. Left-hand panels illustrate confidence intervals. Right-hand panels present curves plotted from the first 100 re-samples for illustration. The blue line indicates a deterministic estimate, separate from the MCMC chain. The legends for each recruitment model show it was possible to converge on a value of FMSY and Fcrash for all 1000 iterations in each case.

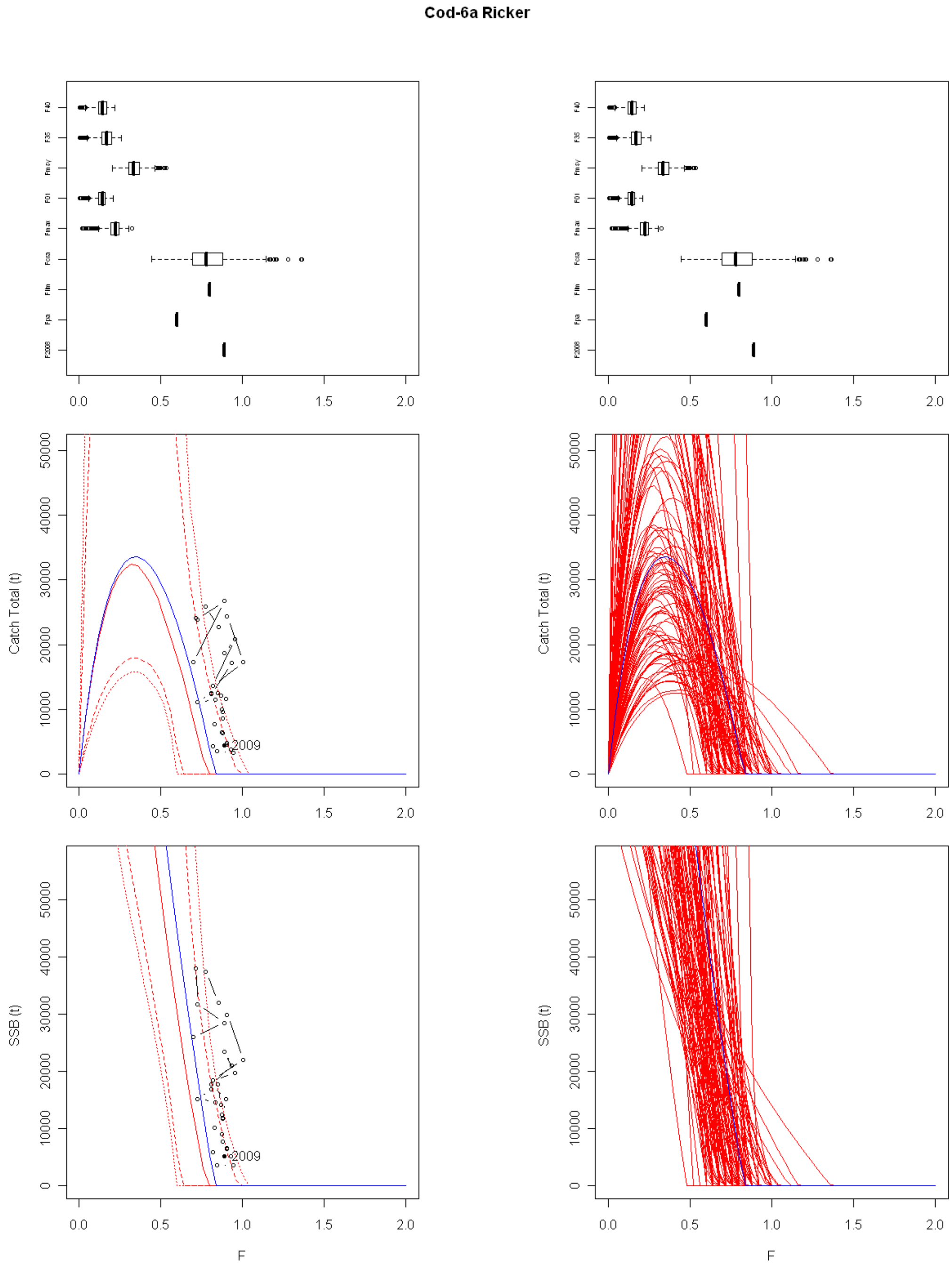

Figure 3.2.18. Cod in Division VIa. srmsymc package. Estimation of F reference points and equilibrium yield and SSB against mortality using Ricker recruitment model. For yield and SSB plots left-hand panels illustrate confidence intervals. Right-hand panels present curves plotted from the first 100 re-samples for illustration. The blue line indicates a deterministic estimate, separate from the MCMC chain. Circles show data points with the most recent year labelled. For VIa cod the model has been run using total removals over and above natural mortality, i.e. the x-axis represents Z-0.2.

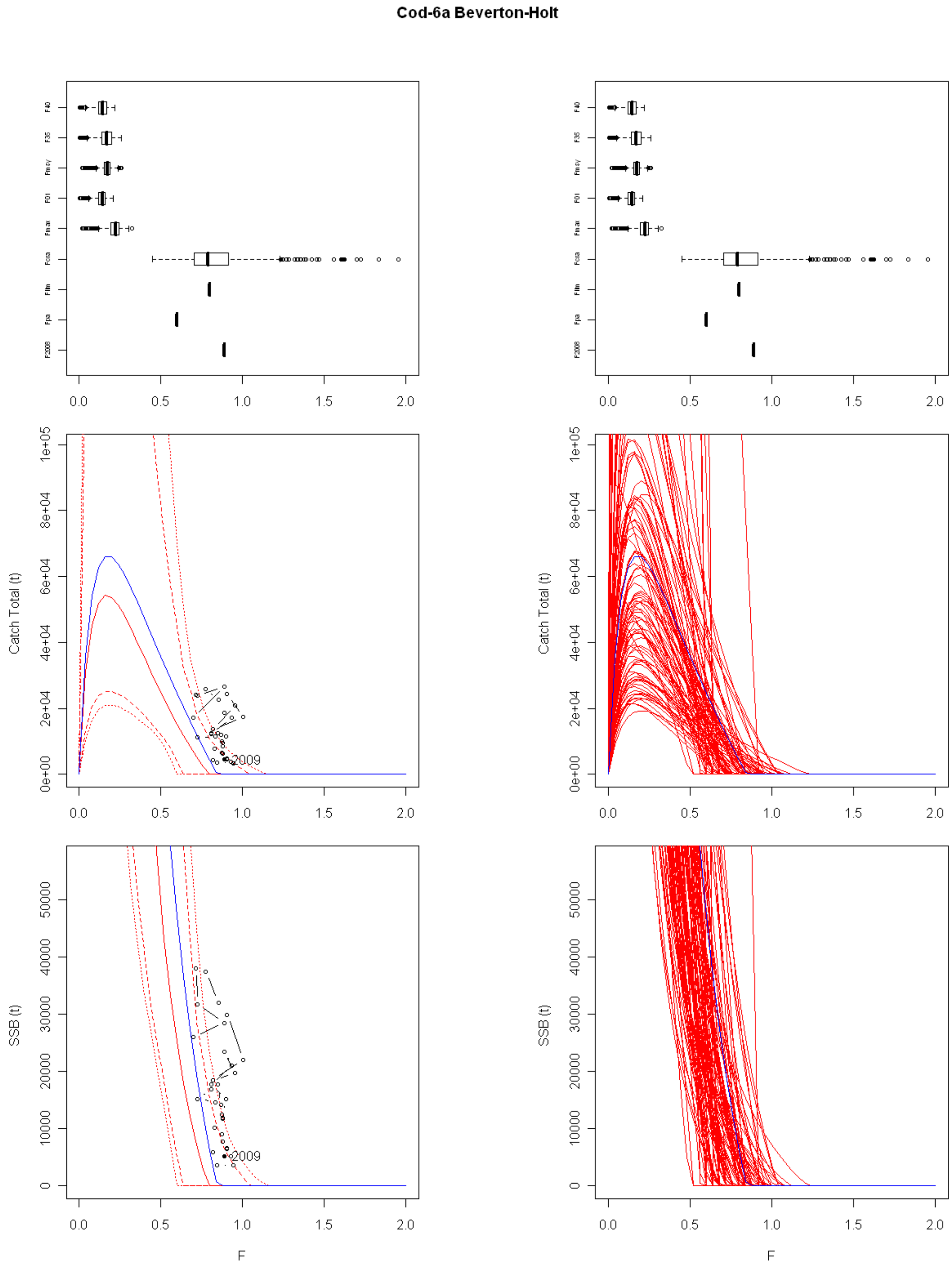

Figure 3.2.19. Cod in Division VIa. srmsymc package. Estimation of F reference points and equilibrium yield and SSB against mortality using Beverton–Holt recruitment model. For yield and SSB plots left-hand panels illustrate confidence intervals. Right-hand panels present curves plotted from the first 100 re-samples for illustration. The blue line indicates a deterministic estimate, separate from the MCMC chain. Circles show data points with the most recent year labelled. For VIa cod the model has been run using total removals over and above natural mortality, i.e. the x-axis represents Z-0.2.

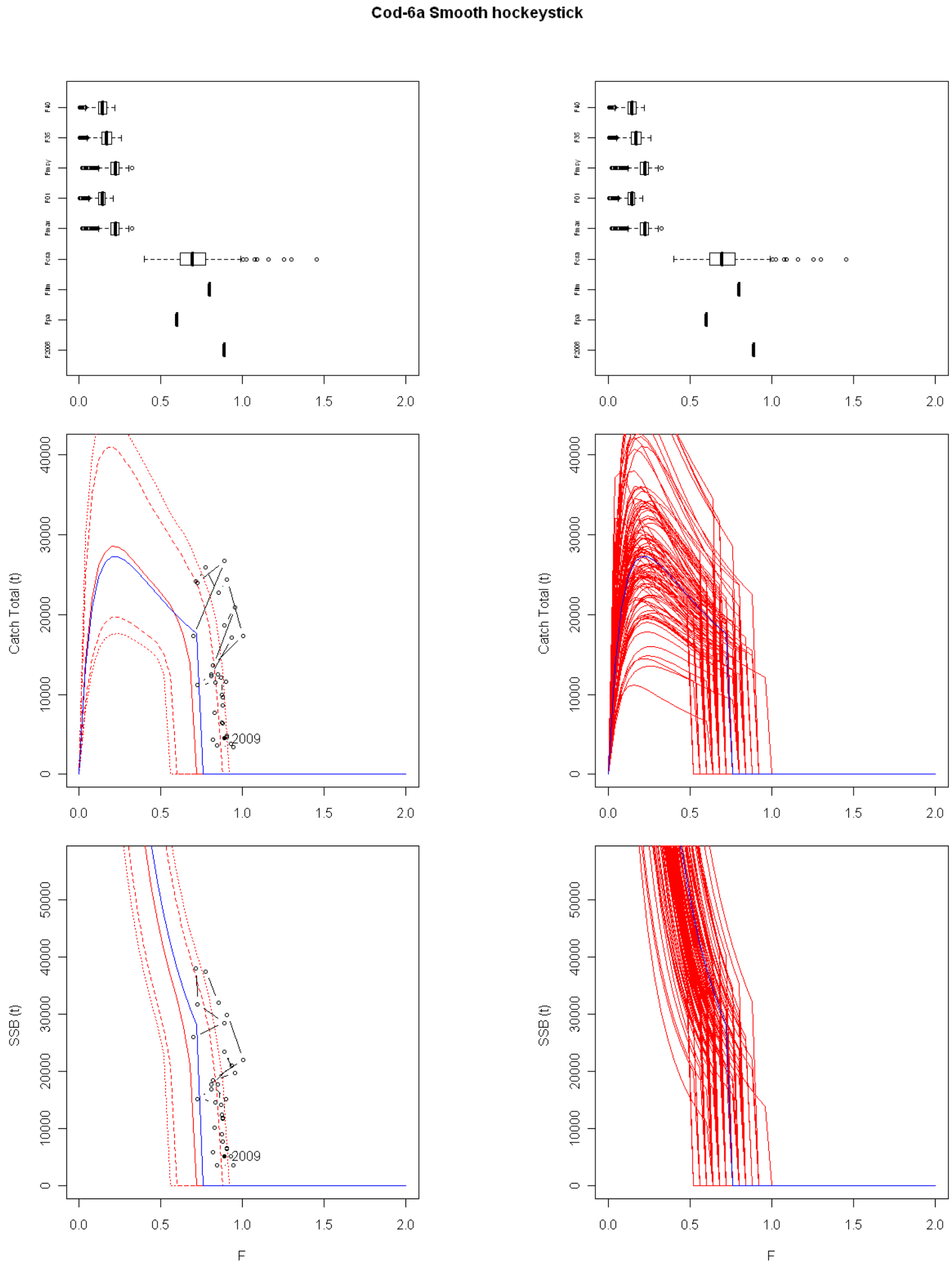

Figure 3.2.20. Cod in Division VIa. srmsymc package. Estimation of F reference points and equilibrium yield and SSB against mortality using smooth hockey stick recruitment model. For yield and SSB plots left-hand panels illustrate confidence intervals. Right-hand panels present curves plotted from the first 100 re-samples for illustration. The blue line indicates a deterministic estimate, separate from the MCMC chain. Circles show data points with the most recent year labelled. For VIa cod the model has been run using total removals over and above natural mortality, i.e. the x-axis represents Z-0.2.

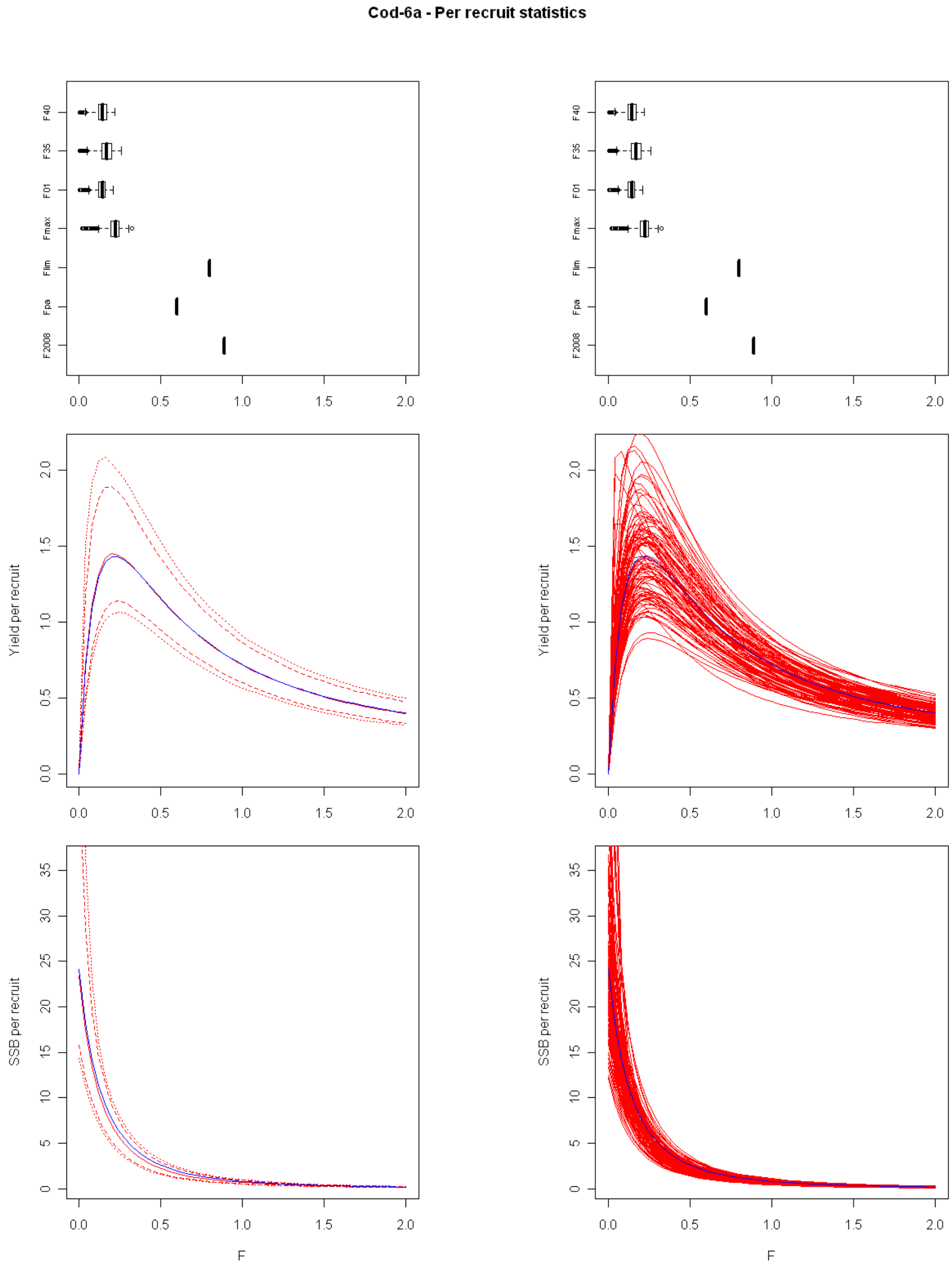

Figure 3.2.21. Cod in Division VIa. srmsymc package. F reference points and yield-per-recruit and SSB-per-recruit against mortality. For VIa cod the model has been run using total removals over and above natural mortality, i.e. the x-axis represents Z-0.2.

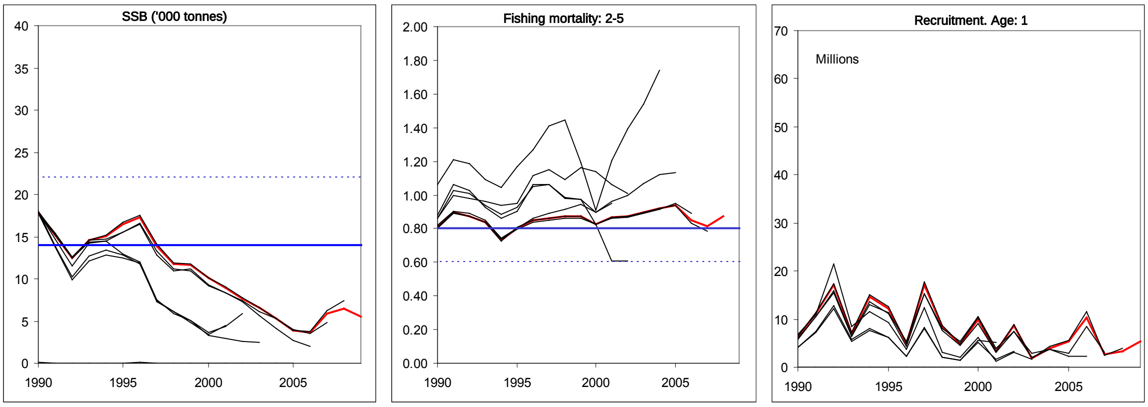

Figure 3.2.22. Cod in Division VIa. Comparison of SSB, recruitment-at-age one and mean F (2–5) estimates produced by final run assessments between this year's assessment and assessments going back to 2001.

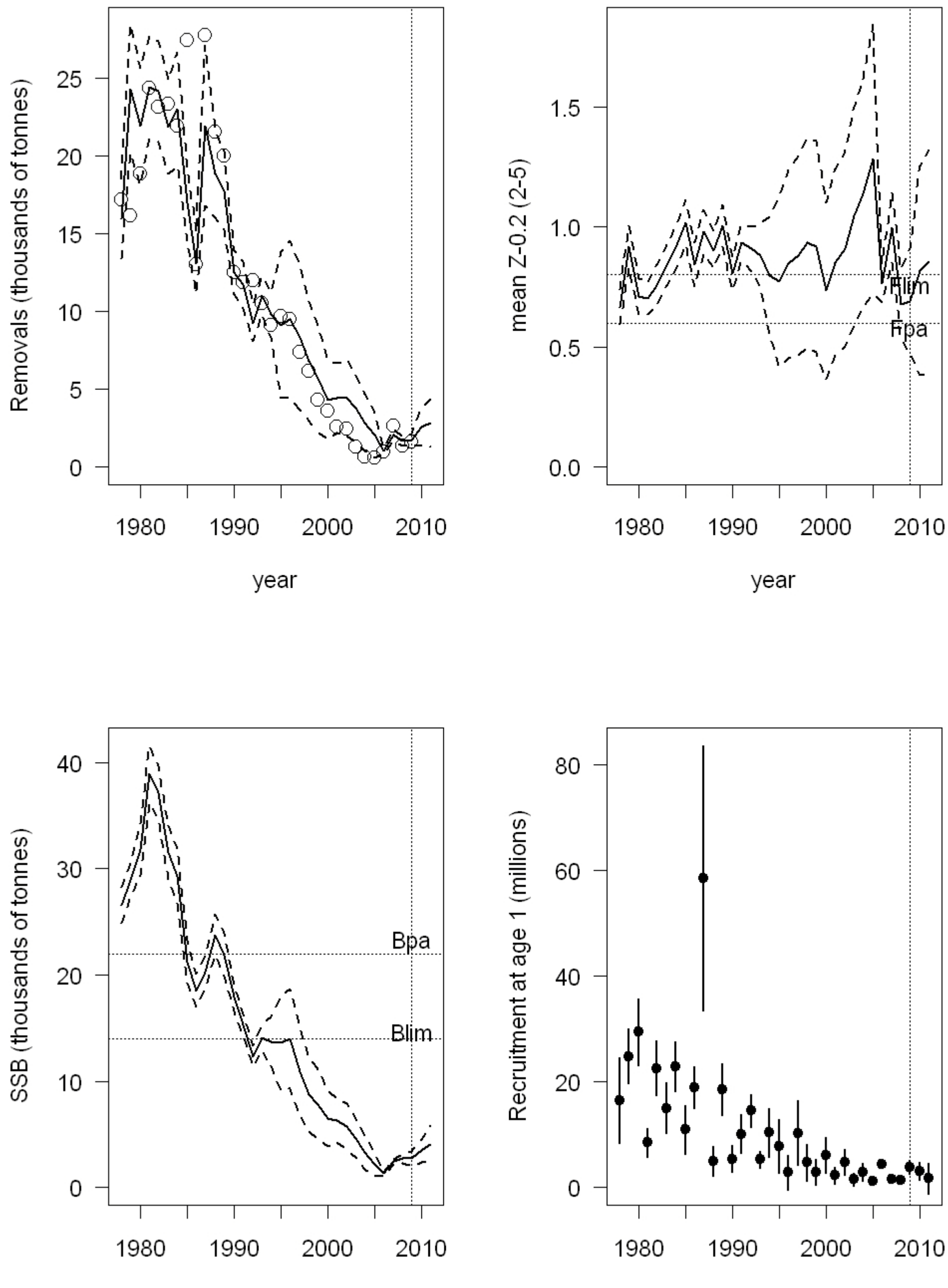

Figure 3.2.23. Cod in Division VIa. Summary plot of TSA run where landings & discard data excluded from 1995–2005. Solid line in top left frame indicates removals resulting from mortality over and above M=0.2; open circles represent reported catch. Solid line in top right frame indicates mortality over and above M=0.2. Dashed lines show ± 2 s.e. (approx 95% confidence interval).

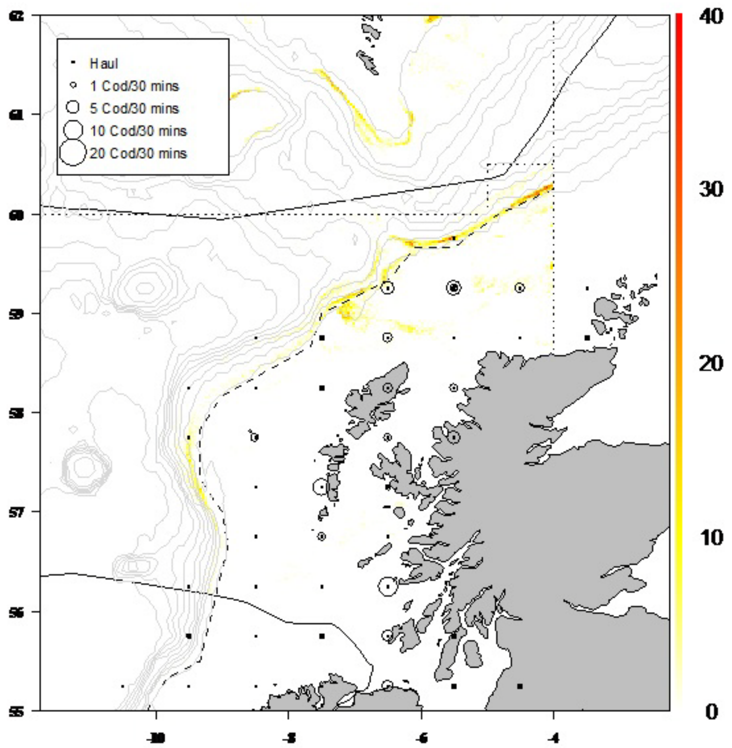

Figure 3.2.24. Scottish (and other EU landing into Scotland) VMS data on fishing activity using TR1 gear (VMS pings per square n.m.) associated with cod landings from daily logbook entries (colour scale). Overlaid are ScoGFS-1Q survey cpues centred on the statistical rectangle sampled. Dashed lines show ICES divisions, the broken line represents the cod management line and the solid line shows the limits of the UK EEZ, highlighting the extent of EU waters in Subdivision Vb. Depth contours are at 200 m intervals.

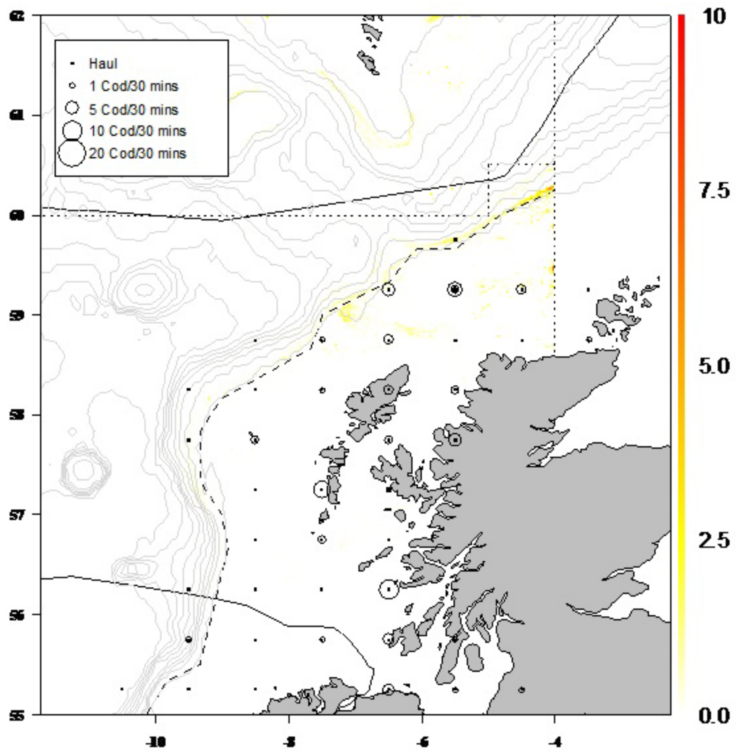

Figure 3.2.25. Scottish (and other EU landing into Scotland) cod landings from daily logbook entries allocated to VMS fishing pings (colour scale). Vessels using TR1 gear. Overlaid are ScoGFS-1Q survey cpues centred on the statistical rectangle sampled. Dashed lines show ICES divisions, the broken line represents the cod management line and the solid line shows the limits of the UK EEZ, highlighting the extent of EU waters in Subdivision Vb. Depth contours are at 200 m intervals.

3.3 Haddock in Division VIa

Type of assessment in 2010

The stock assessment of VIa haddock in 2010 is an update of last year's assessment with the TSA model, using catch data up to 1994 and tuning data from two Scottish groundfish surveys. In this year's assessment catch data were also included for the period 2006–2009 as these were thought to be recent years where sufficiently reliable catch data were available. See Section 3.3.2 for further explanation.

ICES advice applicable to 2009

The form of ICES' advice changed in 2003 to take more account of the mixed nature of the fisheries exploiting haddock. Management of haddock since then has been considered as part of wider concerns in the Celtic Sea and West of Scotland ecosystem.

The advice relating to the single-stock exploitation boundary for 2009 was:

"*Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects:*

The current fishing mortality (2007) is estimated to be 0.56, which is above the rate expected to lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits

Even in the absence of fishing the stock is not expected to be rebuilt to B_{pa}."

ICES advice applicable to 2010

The advice relating to the single-species exploitation boundary for 2009 was:

"*Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects:*

The current fishing mortality (2008) is estimated to be 0.46, which is above the rate expected to lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits:

In the absence of fishing, the stock is expected to be rebuilt close to B_{pa} in the short term."

Following a request to evaluate a management plan for haddock in VIa:

"*ICES advises that a harvest rule with a target fishing mortality of 0.3 and a TAC constraint of ±15% is consistent with the precautionary approach (high probability of SSB being above B_{lim} by 2015 and beyond). In addition, simulations suggest that this harvest rule has the best chance, among those tested, of producing a combination of low risk to biomass and high cumulative yield, thus it conforms with the goal of achieving long-term maximum sustainable yield from the stock.*

The harvest rule was tested for several combinations of target fishing mortality (0.2, 0.3, 0.4) and interannual variation in TAC (±15%, ±20%, ±25%)."

Note that the statement above refers to a management plan where, when SSB is below B_{lim}, the fishing mortality should be 0.1. Subsequent evaluations are being carried out for a management plan where the TAC constraint is ±25% whether above or below B_{lim}.

3.3.1 General

Stock description and management units

A TAC relating to this stock is in place for EU and international waters of ICES management Areas Vb and VIa and the assessment is carried out using data from VIa. The basis for the stock assessment area is described in the Stock Annex.

The agreed minimum landing size for haddock in Division VIa is 30 cm. There is no formal management plan currently in place. Further regulations implemented for the west of Scotland, including technical measures associated with the cod recovery plan and the UK Registration of Buyers and Sellers regulation, are described in the overview section for this management area (Section 3.1).

The following table summarises EC TACs applied for haddock in Division VIa during 2009.

Species: Haddock *Melanogrammus aeglefinus*		**Zone:** EC waters of Vb and VIa (HAD/5BC6A.)
Belgium	4	
Germany	5	
France	194	
Ireland	576	
United Kingdom	2 737	
EC	3 516	
TAC	3 516	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

Values are tonnes.

The following table summarises EC TACs applied for haddock in Division VIa during 2010.

Species: Haddock *Melanogrammus aeglefinus*		**Zone:** EU and international waters of Vb and VIa (HAD/5BC6A.)
Belgium	3	
Germany	4	
France	147	
Ireland	438	
United Kingdom	2 081	
EU	2 673	
TAC	2 673	Analytical TAC

Values are tonnes.

Fishery in 2009

Official (reported) landings for each country participating in the fishery are given in Table 3.3.1. Vessels operating in the fishery are mainly Scottish and Irish and the amount of quota allocated to different countries reflects this.

Uptake of quota is given here and is calculated from the official landings as a proportion of the EC allocated quota for each country. No country took up its full allocated quota in 2009, although uptake was higher than in 2008. Uptake of quota has generally been low in recent years (e.g. ~73% in 2006; ~51% in 2007; ~45% in 2008 and ~79% in 2009). Discards data that are reported are dealt with in the following section.

Country	TAC 2009	Official landings*	% uptake of quota
Belgium	4	0	0%
Germany	5	0	0%
France	194	124	64%
Ireland	576	297	52%
UK	2737	2361	86%
EC	3516	2782	79%

Values of TAC (Total Allowable Catch) and landings are in tonnes.

*** The official landings provided to the WG for 2009 are preliminary at time of writing in 2010.**

3.3.2 Data

An overview of the data that have been provided to the WG is given in Section 2, including sampling levels by country for this stock. The reliability of catch data for this stock was a concern for several years, due to issues such as misreporting or underreporting and associated unaccounted discarding. It became impossible to quantify the extent of unallocated removals, leading to the use at the 2006 meeting of a modified TSA assessment method which did not use catch data after 1994.

Recent changes in regulations and fleet behaviour have improved the quality of catch data, which is now thought to be more representative of the true catch. The UK Registration of Buyers and Sellers Regulations are likely to have reduced or largely eliminated underreported landings. Information from the Compliance section of Marine Scotland suggests that approximately 60 tonnes of haddock were misreported out of Area VIa in 2009 (<3% of the officially reported UK(Scotland) landings). There has been a significant reduction in effort in Division VIa (STECF 2009) and the TAC in recent years does not appear to be restrictive for this fishery, diminishing the incentive to underreport landings.

Landings

Official landings as reported to ICES and estimated by the WG are provided in Table 3.3.1.

Catch-at-age data

Total catch-at-age data (landings and discards) are given in Table 3.3.2., while catch-at-age data and mean weights-at-age for each catch component (landings and discards) are given in Tables 3.3.3–3.3.7. The full available year and age range are given for completeness: however, it should be noted that commercial catch data before 1978 are not used in the assessment, as the split of total catch into landings and discards was hypothetical prior to that time. The countries that provide data, including sampling levels achieved, are listed in Table 2.1.

Discards

WG estimates of discards are based on data collected in the Scottish and Irish discard programmes; raised by weighted average to the level of the total international discards (Table 3.3.4.). Discards data from Scotland were raised from 17 sampled trips in 2009, spread evenly across each quarter. Irish discards data were raised from three trips: adequate coverage given the lower amount of effort by Irish vessels.

Biological

Weights-at-age

The estimated weights-at-age for the total catch in Division VIa are given in Table 3.3.5. These are calculated as weighted averages of the corresponding weights-at-age in landings and discards: the latter are given in Tables 3.3.6.and 3.3.7. Weights-at-age in the stock are assumed to be equal to the weights-at-age in the total catch, in the absence of a sufficiently long time-series of survey-based weight measurements. The weights-at-age time-series are also plotted in Figures 3.3.1–3.3.3. These show that weights-at-age in landings (and, by extension, catch and stock) for fish aged 3 and older have declined considerably over the last ~20 years. The weights-at-age of younger fish have increased in 2009. Weights-at-age in discards are relatively constant. The supplied data for fish weights-at-age 1 in 2009 in Irish landings was 460 g. This was thought to be high in comparison to fish at age 1 in recent years and also with fish at age 2 in 2009. This datum was replace with a mean of the most recent three years of Irish fish weights at age 1, to give an estimate of 344 g. It was noted that haddock are likely to grow faster in the southern area of Division VIa, where Irish fishing vessels are most likely to operate.

Natural mortality and maturity

Natural mortality was assumed to be 0.2 for all ages and years, and maturity was assumed to be as follows:

Age	1	2	3+
Proportion mature	0.00	0.57	1.0

Proportions of F and M before spawning were both set to 0.0, in order to generate abundance (and hence SSB) estimates dated to January 1st.

Surveys

Research vessel surveys

Four research-vessel survey series are available for the assessment of haddock in Division VIa as given in the following table:

Survey	Years available	Ages available	Ages used
Scottish groundfish Q1	1985–2010	1–8	1–7
Scottish groundfish Q4	1996–2009	0–7	1–7
Irish groundfish survey	1993–2002	0–8	-
New Irish groundfish survey	2003–2009	0–10	-

The reports of the 2006 meeting of the WG (WGNSDS 2006) and the 2007 meeting of the IBTS WG (IBTSWG 2007) explored available survey data in detail. Both ScoGFS

Q1 and Q4 were first accepted for use in the 2006 assessment, and this practice has been continued in subsequent years. The IreGFS series was not considered further due to problems with internal consistency (ICES-WGNSDS 2006). The new IRGFS series has seven years of data and can be considered for tuning purposes at the next benchmark assessment.

All survey series available for tuning the assessment are given in Table 3.3.8, with the data that were used in the final assessment indicated in bold type. Plots of the spatial distribution of the ScoGFS Q1 and Q4 survey mean catch rates per ICES statistical rectangle by age class are given in the Stock Annex.

Commercial cpue

Commercial catch-effort series

The available commercial effort and lpue data for this stock are indicated in the Stock Annex.

3.3.3 Historical stock development

The model used for this assessment is the state space model TSA, with data from two research vessel surveys (1978–2010) and with catch data included 1978–1994 and 2006–2009, corresponding to the time periods when catch data are thought to be reliable. The model is run using a custom made Fortran 90 programme (see Stock Annex). Outputs from the TSA assessment are shown in Figures 3.3.4–3.3.10 and Tables 3.3.10–3.3.14.

The reliability of catch data for haddock was a concern for several years, and since it was not possible to quantify the extent of unallocated removals, this lead, at the 2006 meeting, to the use of a modified TSA assessment method which did not use catch data after 1994. This remained the accepted assessment method for the 2007–2009 meetings. In 2010, measurable improvements in the reliability of catch data (Section 3.3.2) led the WG to question the continued discrepancy between the prediction of landings by the model and the reported catches after 2005. Furthermore, while the assessment was primarily survey based, the uncertainty around estimates of F was appreciable, and the estimate was not coming down in years when evidence of reduced effort indicated a probable reduction in F.

The re-inclusion of catch data has been implemented with TSA in previous assessments for which this model is used. For example, catch data were re-included in the assessment of VIa cod at the 1997 meeting of the Working Group for the Assessment of Northern Shelf Demersal Stocks (WGNSDS, 1997). The catch data for cod were re-included in following assessments, but were removed again subsequently because of more recent concerns over reported landings for that stock. See Section 3.2.

Final update assessment

The assessment in 2010 was an update, including data indicated in the table below, which summarises the data ranges used in recent assessments.

Data	2006 assessment	2007 assessment	2008 assessment	2009 assessment	2010 assessment
Catch data	Years: 1978–1994 Ages: 1–8+	Years: 1978–1994 Ages: 1–8+	Years: 1978–1994 Ages: 1–8+	Years: 1978–1994 Ages: 1–8+	Years: 1978–1994 and 2006-2009 Ages: 1–8+
Survey: ScoGFS Q1	Years: 1985–2006 Ages: 1–7	Years: 1985–2007 Ages 1–7	Years: 1985–2008 Ages 1–7	Years: 1985–2009 Ages 1–7	Years: 1985–2010 Ages 1–7
Survey: ScoGFS Q4	Years: 1996–2005 Ages: 1–5	Years: 1996–2006 Ages 1–7	Years: 1996–2007 Ages 1–7	Years: 1996–2008 Ages 1–7	Years: 1996–2009 Ages 1–7
Survey: IGFS	Not used	Not used	Not used	Not used	Not used

Table 3.3.9 shows the evolution of the corresponding TSA parameter estimates since 2003.

Standardised prediction errors from the assessment model are shown in Figures 3.3.5 (landings), 3.3.6 (discards), 3.3.7 (ScoGFS Q1) and 3.3.8 (ScoGFS Q4). TSA is a state space model, and these prediction errors are an analogous (but not completely equivalent) diagnostic tool to residuals of fits from other stock assessment models. The small, negative prediction errors for the landings and discards in the period 2006–2009 at various ages show that the model is predicting landings and discards to be slightly higher than observed data. Generally the prediction errors do not show a pattern persisting for longer than 5 years. The only cases where this occurs are for age 1 of the ScoGFS Q1 index (Figure 3.3.7) where in 2010 the pattern is beginning to reverse. The magnitude of these (age 1 ScoGFS) prediction errors is relatively small (ranging from -0.9 to -1.6). A similar, inconsequential, pattern is seen in the fit to the ScoGFS Q4 index (Figure 3.3.8). None of the prediction errors are of a magnitude or show a pattern which would invalidate the model fit. Negative prediction errors in the survey indices at age 1 indicate lower than expected recruitments in recent years.

Previous assessments have applied a down-weighting to certain data points, based on the TSA prediction errors. These are described here. A notable prediction error occurred in the ScoGFS Q4 in 2007 at age 2 (the 2005 year class). This was due to a large index value in this survey year at that age (which was common to many hauls): the model setting, $q_{catch}(age=2, year=2007)$ was altered (multiplied by 9.0 in the appropriate model settings) in order to decrease the influence of this extreme value (an adjustment recommended in Fryer 2001 which has been applied previously to several age/year data points). A prediction error from the ScoGFS Q1 in 2009 (age 4) was also down weighted according to the same procedure. No further down-weighting was applied in 2010.

There is a poor relationship between stock size (SSB) and recruitment for this stock, with large values for recruitment possible at small stock sizes and small recruitments possible at large stock sizes (Figure 3.3.9). The TSA stock-recruit plot is shown in Figure 3.3.9.

Estimated and observed discard rates (proportions-at-age) are shown in Figure 3.3.10. The discard model fits are good for the years when catch data are included (1978–1994 and 2006–2009) and also most other years. The observed proportions deviate slightly in 2003–2005.

TSA estimates a discard ogive for every year. However, when there are no catch data, the estimated ogive will simply be some weighted average of the discard ogives in neighbouring years. So, when several years of catch data are omitted, the estimated discard ogives in this period will hardly change at all because there are no new data included from which to produce a new estimate. From 2006, when the catch data are re-included, the model is able to much better estimate the discard ogive (Figure 3.3.10).

Retrospective analysis

Most retrospective bias in this stock assessment (see Figure 3.3.11) is thought to be caused by mismatch between catch and survey data (WGMG 2007), and as only survey data are used in the TSA model between 1995 and 2005 the retrospective pattern observed in F is not surprising. There is also a pattern in SSB estimates during the 1990s, and this is likely to correspond to a period when neither survey used in the assessment was able to track year-class strength well.

Comparison with previous year's assessment

The 2009 VIa haddock assessment estimated F in 2008 at 0.46 and SSB (January 1st 2008) at 30 436 tonnes. The current assessment has revised these figures, to a fishing mortality of 0.38 in 2008 and an SSB (January 2008) as 22 114 tonnes (27% decrease). Recruitment in 2008 has been revised from 6.6 million to 7.8 million (~18% increase).

The estimate of SSB in January 2009 from this assessment is 16 818 tonnes with a standard error of 1615 tonnes (~10%). Last year's assessment put this figure at 20 271 tonnes.

The current assessment's estimate of SSB (for January 2010) is 13 337 tonnes. The short-term forecast from last year's assessment predicted SSB in 2010 to be at 15 400 tonnes. This is a difference of 2063 tonnes (~13% decrease in the estimate).

State of the stock

The state of the stock is summarised in Figure 3.3.4 and Table 3.3.14.

The final estimates for the stock in 2009 are:

$F_{(2\text{-}6)}$ = 0.30

SSB = 16 818 t

Based on the most recent estimates of SSB in 2010 (13 336 tonnes, $<B_{lim}$) ICES classifies the stock as being at risk of reduced reproductive capacity.

Based on the most recent estimate of fishing mortality in 2009 (0.30, $<F_{pa}$) ICES classifies the stock as being harvested sustainably.

Summaries from the final assessment, including, total removals, landings, discards, recruitment, mean F and SSB are given in Figure 3.3.4, while corresponding estimates and standard errors are presented in Tables 3.3.10 and 3.3.11 (population abundance), Tables 3.3.12 and 3.3.13 (fishing mortality), and Table 3.3.14 (stock summary). Mean $F_{2\text{-}6}$ is estimated to have risen to just above F_{pa} (0.5) during 2003–2007, subsequently falling below 0.5 in 2008, and remaining below F_{pa} in 2009. A sequence of low recruitments led to a fall in SSB from the peak in 2003. The assessment estimates that SSB has been below B_{pa} since 2005. The most recent estimate of recruitment, from the 2010 Quarter 1 Scottish Groundfish survey (the 2009 year class) is higher than in the last three years, but is probably below the long-term average.

Uncertainty in fitted and observed catches increases from 1995–2005 (Figure 3.3.4), which is the period when the landings and discards are excluded from the model and the survey data is used for estimation. Catch data tend to have more precision than survey data and although both survey used in the assessment have been seen to track year-class strength well, the survey data are more "noisy" (show greater variability) than the catch data. Therefore, when the catch is included in the later part of the time-series (2006–2009) the confidence intervals of the estimates are seen to reduce.

The difference between observed and predicted catch represents unaccounted removals, amounting to about 10% of the landings by 2006–2009. The reported catch in 2009 is within the bounds of error of the estimated catch. This is thought to reflect beneficial effects of management regulations and changes in fleet behaviour since 2006, and is supported by anecdotal information from the fishing industry. For example, there has been great effort reduction by the whitefish otter trawler fleet in Division VIa and the TAC does not appear to be restrictive for this fishery, diminishing the incentive to under-report landings. Information from the Compliance section of Marine Scotland put estimates of area misreporting out of VIa at approximately 60 tonnes in 2009. Given that total landings were 2800 tonnes for 2009 this represents 2% of the estimate of unallocated removals. The remaining 8% of these unallocated removals (~224 tonnes), still within the bounds of error of the assessment model estimate, could represent (in unknown proportions) uncertainty in the estimate of misreporting and associated unreported discards, or natural mortality not accounted for by the assessment model's assumed value of 0.2.

3.3.4 Short-term projections

Recruitment estimates

The TSA assessment model provides estimates of recruitment for the forecast years 2010 and 2011. The value for 2010 (that is, the 2009 year class at age 1) is based largely on the ScoGFS Q1 datum for 2010 (along with a degree of time-series smoothing), and as it is based on observations it is appropriate to use it in the forecast. The value for 2011 (that is, the 2010 year class at age 1) is not generated directly by data, but rather the underlying Ricker stock–recruit model that is included by TSA (Figure 3.3.9) as part of the overall model fit. As with the assessment of last year, a long-term (1978–2009) geometric mean is used for subsequent years (2012). The recruitment values used in the forecast are given in the following table:

YEAR	TSA	GM (78-09)
2010	41 994 (~ ScoGFS)	
2011	76 211 (Ricker)	
2012	-	75 905

There is close agreement between the TSA-generated recruitment estimates, and the indices from the two surveys (see Figure 3.3.12).

TSA produces short-term forecasts as part of every standard model run. The model will also forecast fishing mortality rates. It does so by iterating forward the time-series model that had been fitted to historical data. These forecast mortalities therefore retain the time-series characteristics of the preceding data. Although the TSA estimates are likely to follow a pattern of damped oscillation towards an eventual steady state, the WG preferred to use standard tools (i.e. MFDP) as the basis for the forecast. The procedure used instead of TSA's built in procedure is described below.

The time-series at age of fishing mortality estimate is shown in Figure 3.3.13, along with the mean F over ages 2–6. As with last year's assessment, a three-year mean fishing-mortality selection pattern was used in the forecast. Figure 3.3.14 compares a simple three-year mean, the most recent estimate (2009), and TSA-generated selection patterns.

The forecasts presented in this Section have been given as forecasts of total removals, split subsequently into removals due to landings, discards and unallocated removals (other than those assumed to be due to current estimates of natural mortality) respectively. As highlighted previously, the assessment is survey-based from 1995 to 2005 and can only estimate total removals during this period. The difference between reported and estimated catches represents unallocated removals, reflecting our uncertainty in natural mortality and a certain amount of likely area-misreporting. In the period when the assessment is survey based only the estimated amount of unallocated removals is appreciable. The 1999 year class of haddock was strong, and survey estimates of that year class would have contributed to high model estimates of predicted catch between 2002 and 2005 (Figure 3.3.4).

The WG considered that the most appropriate level of discarding to use in the forecast was a mean of the last three years. It is not possible to know what discarding practices will be in the immediate future, although since the incoming 2009 year class has been estimated to be at appreciable numbers by the Scottish and Irish groundfish surveys in Q4 2009 and by the Scottish groundfish survey in Q1 2010, it is likely that some amount of discarding will occur. The is no strong trend in discard behaviour in the last three years so taking a 3-year mean is the most unbiased approach. For the short-term forecast, the assumption is that this input F remains constant.

The final key issue for the forecast is that of weights-at-age, and in particular, the slow growth observed in recent year classes. Figure 3.3.15 demonstrates this with linear models fitted to cohort-based mean weights-at-age data. A number of recent year classes appear to be growing more slowly than has been the case in the more distant past. As with last year, linear models were used as the basis for predictions for those cohorts with sufficient data (Table 3.3.15), with the small change that the models were fit using data from age 0–8+, as this slightly improved precision (Jaworski, WD12).

Table 3.3.16 presents the inputs to the short-term forecast. Outputs from the forecast are given in Tables 3.3.17 (management options) and Figures 3.3.16 (sensitivity analysis), 3.3.17 (probability profiles) and 3.3.18 (short-term forecast). Figure 3.3.16 shows the sensitivity of the forecast to the various input parameters; indicating that numbers at age 1 in 2010 and recruitment in 2011 are responsible for a large proportion of the variance associated with the forecast. Figure 3.3.17 shows probability profiles for the forecast, indicating the probability of F being greater than F(*status quo*) in 2011 with increasing rates of total removals (left figure) and the probability of SSB being below reference biomass (e.g. reference points, B_{pa}, B~~lim~~) in 2011. This figure indicates that there is over 90% probability that SSB will be below B_{pa} in 2012. Figure 3.3.18 shows a summary of the forecast results, indicating how SSB is projected to change with increasing rate of removals, under fishing mortality between 0–0.45.

Results of the forecast at *status quo F* are summarised in the following table:

YEAR	REMOVALS (000 T)	SSB (000 T)
2010	5.35	13.7
2011	6.06	13.6
2012	-	19.9

At the *status quo* rate of removals, and given assumptions about growth and recruitment, the most recent estimate of SSB (2010) is below B_{lim} and is forecast to increase in 2011 and 2012, primarily due to the most recent estimate of recruitment in 2010 being relatively high compared to those of four out of five of the most recent years.

3.3.5 MSY evaluations

ICES changed the basis of its advice in 2010, with estimates of F_{msy} being introduced. A package developed for the purpose (srmsymc) was run, using the current year's .sum and .sen files as inputs. The method used is described in Section 2.2. The current assessment puts FMSY in the range, 0.19–0.35 (Figures 3.3.19–3.3.22 and Table 3.3.18). These estimates came from fits of the Beverton–Holt (0.19), Ricker (0.31) and Smooth Hockey Stick (0.35) stock–recruit models. There were high coefficients of variation for the three stock–recruitment models used as the basis for the analysis. Furthermore, the Akaike information criterion (AIC), often used to determine statistical model fit, was almost the same for each stock–recruit model. This reflects the poor relationship between stock and recruitment, allowing the three models to be fit to stock and recruit data with comparable uncertainty. For each stock–recruit model a high (>950 out of 1000) number of model simulations were accepted by the package.

3.3.6 Biological reference points

ICES has defined the following reference points for this stock.

Reference point	Technical basis
Bpa = 30,000 t	Blim*1.4
Blim = 22,000 t	Lowest observed SSB when reference point was establised (1998)
Fpa = 0.5	High probablity of avoiding SSB falling below Bpa in the long term
Flim	Not defined

3.3.7 Management Plans

There is no agreed management plan currently in place for this stock. ICES has evaluated a proposed management plan, the details of which can be found at:

http://www.ices.dk/committe/acom/comwork/report/2010/Special Requests/EC haddock management

3.3.8 Uncertainties and bias in assessment and forecast

Quality of the assessment

Landings and discards

Quotas for haddock in Division VIa appear to have started to become restrictive in or around 1995. Anecdotal evidence suggests that these and other strict management measures led to increasing unreliability of landings data from the commercial fleets prosecuting the fishery from 1995 to 2005. The approach taken by this WG from 2006 onwards was to assess the stock using a modified TSA model which did not include catch data from 1995 onwards, and which thus modelled removals rather than catches. During the period when the catch is not included (1994–2005) the discard ogives estimated by the model are weighted averages of those of neighbouring years. This results in little change in the estimated discard ogive in the years when the catch is excluded and an observable discrepancy between the model's discard ogive and the reported discards proportions in 2003–2005.

Effort

Currently commercial cpue or lpue data cannot be used in the assessment with any confidence. The assessment is therefore primarily survey-based, with landings and discards data used prior to 1995.

Surveys

A survey-based assessment can only be as good as the surveys on which it is based. The Scottish groundfish survey series appear to have good internal consistency and to track cohorts well, with the exception of a period during the mid-1990s. Concerns remain over the apparent differences in catchability of young fish between the Scottish and Irish components of IBTS (ICES-IBTSWG 2007). Any survey is likely to become less reliable when stock abundance declines, and this issue needs to be revisited in the near future for haddock and many other stocks.

This assessment is survey based for the years 1995–2005. Re-including catch data for 2006–2009 has resulted in narrower confidence intervals for estimates of F, SSB, and catch components (landings, discards and total removals). Some uncertainty remains over the unallocated component of removals and how this could be divided between removals caused by natural mortality and removals related to fishing (for example, escape mortality and area misreporting).

Weights-at-age

In this assessment, simple linear growth models have been fitted to cohort weights-at-age data and used to generate weights-at-age in the forecast. These models fit reasonably well, but this approach is quite simplistic and may be missing important growth characteristics such as variable growth within a cohort. This may lead to greater uncertainty in the forecast.

Model formulation

Models such as the modified TSA used this year, based largely on survey data, are becoming the *de facto* standard in several ICES assessments for which problems have existed with commercial catch data (see this report, and also WGNSSK 2006). Other examples include BADAPT and SURBA. While these types of models are essential in order to address data problems, it needs to be borne in mind that there are two main problems with such approaches. Firstly, survey data are based on far fewer samples, and are therefore more variable than catch data. It is therefore likely that precision is sacrificed (to a certain extent) to reduce bias. Secondly, a survey-based assessment estimates removals from the stock and total mortality, rather than landings and fishing mortality, and is therefore more difficult to use as the basis of quota advice than corresponding catch-based approaches. It is therefore thought to be appropriate to re-include catch data when they become more reliable, and investigations have indicated that this has been the case in the years 2006–2009.

Stock connectivity

There is uncertainty concerning the stock definition and hence the degree of connectivity between the VIa haddock stock and the North Sea haddock stock. Since these stocks are currently assessed separately, it is possible that the two stock assessments are both affected by uncertainties in catch data relating to area misreporting.

3.3.9 Recommendations for next benchmark

Some ways of addressing these issues are proposed here. All aspects are considered important and the proposed time frame would be to work on these in 2011–2012. Continuing the work on management plan development is also important.

Landings and discards

There should be a full analysis of the precision and bias of catch-at-age data. Although catch data between 2006–2009 are thought to represent a large proportion of the true catch, further analysis would help to put a clearer estimate on the uncertainty of this. Measures such as the UK Registration of Buyers and Sellers legislation seem to have greatly improved the reliability of commercial landings data for the last three years. The reported catches from 2006 onwards are within the bounds of error of the estimated catch.

Effort

A VMS-based analysis of lpue could help to address the concern that currently commercial cpue or lpue data cannot be used in the assessment. With the increased requirement for vessels to operate with VMS it is likely that the quality of effort data will improve. This will lead to an improved time-series of effort data in the future but still leaves the uncertainties regarding the earlier years in the time-series.

Surveys

As the time-series lengthens, an analysis of the new IGFS should take place in order to check the quality and consistency of this survey for tuning purposes and hence decide on its inclusion in the assessment.

Weights-at-age

The growth characteristics of this haddock stock are very variable, and seem to be strongly driven by cohort effects rather than year effects: that is, early life-history events determine the subsequent growth potential of each cohort. Work is underway at Marine Scotland (Aberdeen) and elsewhere to develop improved models of growth, and it is hoped that these will improve stock forecasts in the future. Consideration of using stock weights from the survey, instead of the estimated weights-at-age could also be addressed at a benchmark assessment.

Other modelling

Growth modelling could help with forecasts of mean weights-at-age. It may also be of interest to use bioeconomic models to address questions to do with feedbacks between quota, uptake of quota and strong drivers of quota uptake and fishers' behaviour, for example, fuel price.

Other assessment models could be considered where information from the age structure of the catch data could be incorporated in the assessment for the years where the catch data are currently excluded (1995–2005).

The WG recommends that this stock should be benchmarked with the North Sea haddock stock in 2011.

3.3.10 Management considerations

This stock is at a low level of biomass, with recruitment impaired in four of the five most recent years. An agreed long-term management plan, which takes into account the recruitment characteristics of this stock, is needed.

The fishery for haddock is limited to vessels from mainly Scotland and Ireland. Uptake of quota was low, and hence TAC was not limiting, in both 2008 and 2009. Discarding, however, remained high in these two years, accounting for 32% of estimated total catch in 2008 and 39% of estimated total catch in 2009.

Reallocation of effort from Division VIa into other ICES areas and switching between mesh categories may also be significant. While there has been a general decline in the haddock fishery in Division VIa, both Irish and Scottish sources suggest that there is an increasing focus in the corresponding Division VIb (Rockall) fishery. In addition, a few Scottish fishermen are testing the viability of using paired gear (both seine and trawl) at Rockall: if this proves successful, then there is the distinct possibility that effective effort in Division VIb will increase considerably. This fishery is particularly attractive given the lack of effort restrictions in the area.

Table 3.3.1. Haddock in Division VIa. Nominal landings, as officially reported to ICES and estimated by the WG.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	8	9	-	9	1	7	1	-	1	3	2	2	1
Denmark	+	+	+	+	-	1	-	1	1	-	-	-	-
Faroe Is	-	13	-	1	-	-	-	-	-	-	-	-	-
France	3001	13 352	8632	7612	761	1132	753	671	445	270	394	788	282
Germany	4	4	15	1	2	9	19	14	2	1	1	2	1
Ireland	2731	2171	773	710	700	911	746	1406	1399	1447	1352	1054	677
Norway	54	74	46	12	72	40	7	13	16	21	28	18	70
Spain	-	-	-	-	-	-	-	1	-	-	2	4	-
UK (E&W)[3]	114	235	164	137	132	155	254	322	448	493	458	315	199
UK (N. Ire)	35								...	...	…	...	…
UK (Scot.)	15 151	19 940	10 964	8434	5263	10 423	7421	10 367	10 790	10 352	12 125	8630	5933
UK (total)													
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-
Total reported	21 098	23 781	12 825	10 065	6932	12 678	9201	12 794	13 102	12 587	14 360	10 813	7163
WG estimates	21 136	16 688	10 135	10 557	11 350	19 060	14 243	12 368	13 453	12 874	14 401	10 430	6952

1Preliminary.

2Includes Divisions Vb(EC) and VIb.

31989–2005 N. Ireland included with England and Wales.

n/a = Not available.

WG estimates refers to the sum-of-products of landings and weights-at-age provided to the WG, rather than the estimated removals produced in the final assessment.

Table 3.3.1. Continued. Haddock in Division VIa. Nominal landings, as officially reported to ICES and estimated by the WG.

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009[1]
Belgium	2	-	-	+	-	-	-	-	-
Denmark	-	-	+	-				-	-
Faroe Is.	-	-	-	4	-	1	2	-	1
France	160	151	183	173	273	291	211	85	124
Germany	1	+	-	-	1	7	-	1	-
Ireland	744	672	497	194	152	526	759	879	297
Norway	32	30	23	4	21	17	16	28	18
Spain	4	4	5	-	47	44	5	-	-
UK (E&W)3	201	237	107	93	42	19	193	-	2
UK (N. Ire)	…	…	…	…	…	…	…	-	8
UK (Scot.)	5886	5988	4582	2909	2025	4928	2587	-	2351
UK (total)							-	1769	2380
Netherlands	-	-	-	1	-	-	-	-	-
Total reported	7030	7082	5397	3378	2561	5833	3773	2762	2695
WG estimates	6731	7097	5334	3199	3148	5723	3702	2801	2800

1Preliminary.

2Includes Divisions Vb(EC) and VIb.

31989–2005 N. Ireland included with England and Wales.

n/a = Not available.

WG estimates refers to the sum-of-products of landings and weights-at-age provided to the WG, rather than the estimated removals produced in the final assessment.

Table 3.3.2. Haddock in Division VIa. Total catch-at-age numbers (000s). Values used in the final assessment are boxed.

YEAR	AGE								
	0	1	2	3	4	5	6	7	8
1965	451	1059	1341	72461	6816	294	274	174	11
1966	5953	1595	529	1113	47431	1926	64	32	57
1967	40122	19185	19332	951	265	24979	400	9	14
1968	27	129418	38393	3079	356	681	14063	727	43
1969	2742	84	160706	10260	1434	268	379	4576	191
1970	17189	6317	519	95114	2770	173	89	145	585
1971	6604	71481	3915	3328	79966	545	127	7	20
1972	14215	20713	85141	2718	2336	53823	504	50	19
1973	19589	47387	16907	19477	258	1222	33193	150	32
1974	63698	68837	11562	10757	6317	83	447	11463	104
1975	6849	179349	34957	3339	3350	1882	95	98	3454
1976	4227	24337	72330	15224	1588	1491	868	21	7
1977	4552	13109	3468	35948	5705	680	495	308	28
1978	57	15942	2095	971	24357	2938	351	247	338
1979	5697	70070	17282	1865	470	9863	833	114	145
1980	13	22729	21927	5636	922	143	3082	229	22
1981	764	251	83911	20697	1768	194	39	822	39
1982	136	15492	5019	73676	8167	898	108	272	288
1983	2084	14524	20233	6040	36122	3398	597	41	194
1984	269	98976	8626	12910	6242	22790	2449	371	43
1985	155	22820	78922	4667	4184	1789	11189	964	84
1986	2979	8127	11235	45367	1823	916	449	2611	344
1987	1498	89021	16824	10150	23857	1452	1116	642	1818
1988	7582	10007	58414	7598	4185	9255	428	235	177
1989	3773	5010	3420	25724	2755	1556	3634	255	84
1990	437	37247	5856	1884	12158	871	279	519	48
1991	8921	36924	21991	1259	834	5132	412	283	410
1992	4332	51840	18971	11331	565	236	1577	157	37
1993	2196	43659	60785	20763	4669	306	219	915	70
1994	2843	19484	32638	21527	5671	1579	76	175	237
1995	7692	17580	15759	23599	6865	1472	387	34	111
1996	10249	33344	39812	6641	10225	3663	1007	324	23
1997	2984	23843	10507	21550	2178	2668	870	259	59
1998	2058	11421	18001	8032	15116	1352	1036	377	124
1999	6898	6179	18055	11569	3004	4919	579	452	96
2000	5709	50142	6642	8596	4213	1055	1104	205	133
2001	11818	11023	33496	2432	3666	1521	533	314	65
2002	1362	16427	12394	32248	833	714	549	238	144
2003	3861	6972	5592	6848	12830	222	209	70	34
2004	2727	15159	6506	2384	3839	6706	286	101	26
2005	3965	7190	6202	3700	2116	2669	2704	57	42
2006	817	16031	4831	3844	3801	3109	2731	2750	33
2007	257	1777	15850	2897	1725	2428	811	904	478
2008	1840	2409	2330	4421	587	609	868	255	185
2009	2012	4977	433	427	6651	510	334	253	78

Table 3.3.2. Continued. Haddock in Division VIa. Total catch-at-age numbers (000s). Values used in the final assessment are boxed.

Year	Age						
	9	10	11	12	13	14	15+	8+
1965	6	6	0	0	0	0	0	24
1966	0	0	0	0	0	0	0	57
1967	4	0	0	0	0	0	0	19
1968	9	0	0	0	0	0	0	52
1969	9	0	0	0	0	0	0	200
1970	13	2	0	0	0	0	0	600
1971	175	16	0	0	0	0	0	212
1972	0	67	0	0	0	0	0	86
1973	6	125	0	0	0	0	0	163
1974	34	31	0	1	4	0	0	174
1975	72	8	0	0	0	0	0	3534
1976	1103	4	0	5	0	0	0	1119
1977	11	259	5	0	0	0	0	304
1978	7	17	211	3	0	0	0	575
1979	28	3	1	42	1	0	0	221
1980	5	21	3	0	4	0	0	54
1981	14	2	2	1	0	1	0	60
1982	31	12	1	0	0	0	0	332
1983	195	40	15	0	0	0	0	444
1984	44	73	3	0	0	0	0	162
1985	4	8	56	4	0	0	1	157
1986	38	7	15	1	3	0	0	409
1987	326	20	15	9	3	12	0	2203
1988	935	45	3	1	3	2	0	1167
1989	87	437	56	1	1	0	0	666
1990	22	12	2	0	0	0	0	85
1991	24	11	5	6	0	0	1	457
1992	108	25	0	0	0	0	0	169
1993	107	44	25	1	2	0	0	250
1994	17	16	9	1	0	0	0	279
1995	90	2	0	0	0	0	0	203
1996	40	12	4	0	0	0	0	80
1997	1	7	1	0	0	0	0	67
1998	45	2	4	1	0	0	0	175
1999	12	2	1	2	1	0	0	115
2000	21	1	0	0	0	0	0	156
2001	25	11	0	3	0	0	0	104
2002	18	9	0	0	0	0	0	172
2003	12	10	0	0	0	0	0	56
2004	6	2	2	0	0	0	0	37
2005	5	1	1	0	0	0	0	48
2006	26	5	0	0	1	0	0	65
2007	6	0	0	0	0	0	0	485
2008	122	0	0	0	0	0	0	307
2009	41	31	0	0	0	0	0	151

Table 3.3.3. Haddock in Division VIa. Landings-at-age numbers (000s). Values used in the final assessment are boxed.

YEAR	AGE								
	0	1	2	3	4	5	6	7	8
1965	0	33	463	60967	6753	294	274	174	11
1966	0	58	175	1082	46902	1926	64	32	57
1967	0	595	6136	782	262	24979	400	9	14
1968	0	3665	12439	2573	354	681	14063	727	43
1969	0	3	45819	8766	1423	268	379	4576	191
1970	0	169	170	78402	2747	173	89	145	585
1971	0	1925	1149	2665	78909	545	127	7	20
1972	0	576	26700	2225	2312	53823	504	50	19
1973	0	1252	5301	16109	256	1222	33193	150	32
1974	0	1706	3318	8625	6261	83	447	11463	104
1975	0	4629	10534	2735	3315	1882	95	98	3454
1976	0	745	22563	12358	1571	1491	868	21	7
1977	0	451	1317	29456	5645	680	495	308	28
1978	0	1030	1006	813	23620	2912	344	247	338
1979	0	2068	10448	1761	468	9810	833	114	145
1980	0	2505	12871	5341	915	143	3082	229	22
1981	0	200	20553	15695	1768	194	39	822	39
1982	0	250	1342	46283	8004	898	108	272	288
1983	0	568	4917	4585	34659	3387	597	41	194
1984	0	3341	4386	10754	5959	20352	2449	371	43
1985	0	939	19434	4437	4112	1782	11031	964	84
1986	0	603	4812	26770	1823	916	449	2611	344
1987	0	4254	7388	9206	23551	1452	1116	642	1818
1988	0	847	20687	6873	4091	9205	428	235	177
1989	0	927	1414	18417	2744	1556	3633	255	84
1990	0	787	3198	1342	9450	848	279	519	48
1991	0	2145	10578	1217	834	5131	412	283	410
1992	0	691	10194	10010	553	236	1575	157	37
1993	0	745	15008	15975	4594	290	219	910	70
1994	0	1017	6326	15037	5240	1484	76	175	237
1995	0	540	3669	12774	6483	1472	387	34	111
1996	0	437	9457	4968	8626	3622	1007	324	23
1997	0	883	2831	16921	2125	2638	870	259	59
1998	0	1345	7129	5675	13387	1352	1036	377	124
1999	0	346	5501	7159	2960	4864	493	452	96
2000	0	759	2507	5864	3841	1054	1090	205	133
2001	0	245	8535	1822	3523	1393	533	314	65
2002	0	177	1227	13557	691	707	549	199	144
2003	0	21	1029	2150	8809	221	206	69	34
2004	0	14	245	804	1819	4071	286	100	26
2005	0	7	287	792	1252	1212	2018	57	42
2006	0	67	567	1513	2300	2504	2259	2192	33
2007	0	34	842	1121	1429	2394	778	855	478
2008	0	21	297	2718	546	584	752	254	161
2009	0	4	57	188	3912	485	286	207	78

Table 3.3.3. Continued. Haddock in Division VIa. Landings-at-age numbers (000s). Values used in the final assessment are boxed.

YEAR	AGE						
	9	10	11	12	13	14	15+	8+
1965	6	6	0	0	0	0	0	24
1966	0	0	0	0	0	0	0	57
1967	4	0	0	0	0	0	0	19
1968	9	0	0	0	0	0	0	52
1969	9	0	0	0	0	0	0	200
1970	13	2	0	0	0	0	0	600
1971	175	16	0	0	0	0	0	212
1972	0	67	0	0	0	0	0	86
1973	6	125	0	0	0	0	0	163
1974	34	31	0	1	4	0	0	174
1975	72	8	0	0	0	0	0	3534
1976	1103	4	0	5	0	0	0	1119
1977	11	259	5	0	0	0	0	304
1978	7	17	211	3	0	0	0	575
1979	28	3	1	42	1	0	0	221
1980	5	21	3	0	4	0	0	54
1981	14	2	2	1	0	1	0	60
1982	31	12	1	0	0	0	0	332
1983	195	40	15	0	0	0	0	444
1984	44	73	3	0	0	0	0	162
1985	4	8	56	4	0	0	1	157
1986	38	7	15	1	3	0	0	409
1987	326	20	15	9	3	12	0	2203
1988	935	45	3	1	3	2	0	1167
1989	87	437	56	1	1	0	0	666
1990	22	12	2	0	0	0	0	85
1991	24	11	5	6	0	0	1	457
1992	108	25	0	0	0	0	0	169
1993	107	44	25	1	2	0	0	250
1994	17	16	9	1	0	0	0	279
1995	90	2	0	0	0	0	0	203
1996	40	12	4	0	0	0	0	80
1997	1	7	1	0	0	0	0	67
1998	45	2	4	1	0	0	0	175
1999	12	2	1	2	1	0	0	115
2000	21	1	0	0	0	0	0	156
2001	25	11	0	3	0	0	0	104
2002	18	9	0	0	0	0	0	172
2003	11	10	0	0	0	0	0	55
2004	6	2	2	0	0	0	0	37
2005	5	1	1	0	0	0	0	48
2006	26	5	0	0	1	0	0	65
2007	6	0	0	0	0	0	0	485
2008	122	0	0	0	0	0	0	283
2009	41	31	0	0	0	0	0	151

Table 3.3.4. Haddock in Division VIa. Discards-at-age numbers (000s). Values used in the final assessment are boxed.

YEAR	AGE								
	0	1	2	3	4	5	6	7	8
1965	451	1026	877	11494	63	0	0	0	0
1966	5953	1537	354	31	529	0	0	0	0
1967	40122	18590	13196	169	3	0	0	0	0
1968	27	125753	25954	506	3	0	0	0	0
1969	2742	81	114887	1493	11	0	0	0	0
1970	17189	6148	348	16712	23	0	0	0	0
1971	6604	69556	2766	663	1057	0	0	0	0
1972	14215	20137	58442	494	24	0	0	0	0
1973	19589	46135	11607	3368	2	0	0	0	0
1974	63698	67131	8244	2132	56	0	0	0	0
1975	6849	174721	24423	604	35	0	0	0	0
1976	4227	23593	49767	2866	17	0	0	0	0
1977	4552	12658	2152	6492	59	0	0	0	0
1978	55	14911	1090	157	738	27	7	0	0
1979	5697	68002	6833	104	2	53	0	0	0
1980	13	20224	9057	295	7	0	0	0	0
1981	764	51	63359	5002	0	0	0	0	0
1982	136	15241	3678	27393	163	0	0	0	0
1983	2084	13957	15316	1456	1464	12	0	0	0
1984	269	95634	4240	2156	284	2438	0	0	0
1985	155	21882	59488	231	71	6	159	0	0
1986	2979	7524	6423	18597	0	0	0	0	0
1987	1498	84767	9436	944	306	0	0	0	0
1988	7582	9160	37727	725	95	49	0	0	0
1989	3773	4083	2007	7308	11	0	1	0	0
1990	437	36460	2658	542	2708	23	0	0	0
1991	8921	34779	11413	42	0	1	0	0	0
1992	4331	51148	8776	1322	12	0	2	0	0
1993	2196	42914	45777	4787	74	16	0	5	0
1994	2843	18467	26312	6490	432	94	0	0	0
1995	7692	17040	12090	10825	382	0	0	0	0
1996	10249	32907	30354	1674	1599	41	0	0	0
1997	2984	22961	7676	4629	53	30	0	0	0
1998	2058	10075	10872	2357	1728	0	0	0	0
1999	6898	5834	12554	4410	44	54	86	0	0
2000	5709	49383	4136	2731	372	1	14	0	0
2001	11818	10778	24961	611	143	128	0	0	0
2002	1362	16250	11168	18692	142	8	0	39	0
2003	3861	6951	4564	4697	4021	2	2	1	0
2004	2727	15146	6261	1580	2021	2635	0	1	0
2005	3965	7184	5915	2908	864	1457	686	0	1
2006	817	15964	4263	2331	1501	605	471	557	0
2007	257	1743	15008	1775	296	34	33	48	0
2008	1840	2388	2033	1703	41	25	116	1	24
2009	2012	4972	376	239	2740	25	48	46	0

Table 3.3.4. Continued. Haddock in Division VIa. Discards-at-age numbers (000s). Values used in the final assessment are boxed.

YEAR	AGE						
	9	10	11	12	13	14	15+	8+
1965	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	1
2006	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	24
2009	0	0	0	0	0	0	0	0

Table 3.3.5. Haddock in Division VIa. Weights-at-age (kg) in total catch. Values used in the final assessment are boxed.

YEAR	AGE								
	0	1	2	3	4	5	6	7	8
1965	0.04	0.16	0.242	0.412	0.692	0.916	1.041	1.249	1.517
1966	0.04	0.162	0.251	0.555	0.572	1.041	1.125	1.325	1.522
1967	0.04	0.16	0.266	0.569	0.573	0.667	1.177	1.844	1.611
1968	0.04	0.159	0.264	0.567	0.823	0.731	0.811	1.43	1.903
1969	0.04	0.158	0.243	0.526	0.916	1.042	1.024	0.999	1.569
1970	0.04	0.161	0.23	0.368	0.812	1.283	1.262	1.043	1.342
1971	0.04	0.16	0.248	0.341	0.546	1.04	1.313	1.651	1.426
1972	0.04	0.16	0.249	0.38	0.53	0.546	0.984	1.499	1.538
1973	0.04	0.159	0.251	0.384	0.597	0.512	0.571	1.185	1.706
1974	0.04	0.159	0.248	0.368	0.527	0.764	0.685	0.798	1.142
1975	0.04	0.159	0.26	0.428	0.581	0.832	1.027	1.001	1.009
1976	0.04	0.159	0.256	0.459	0.592	0.831	1.095	1.585	1.084
1977	0.04	0.161	0.274	0.406	0.684	0.8	1.128	1.337	1.117
1978	0.068	0.134	0.278	0.388	0.516	0.827	1.045	1.152	1.399
1979	0.032	0.182	0.325	0.457	0.73	0.777	1.04	1.491	1.944
1980	0.077	0.134	0.319	0.572	0.719	0.998	0.985	1.143	1.565
1981	0.082	0.252	0.245	0.467	0.887	0.975	1.376	1.294	1.347
1982	0.038	0.157	0.273	0.376	0.746	1.126	1.539	1.549	1.514
1983	0.05	0.178	0.282	0.461	0.557	1.002	1.37	1.716	1.558
1984	0.059	0.149	0.319	0.456	0.688	0.667	1.087	1.392	2.075
1985	0.019	0.138	0.268	0.486	0.636	0.802	0.868	1.272	1.277
1986	0.064	0.182	0.27	0.362	0.637	0.903	1.115	1.043	1.418
1987	0.028	0.168	0.27	0.418	0.566	0.88	1.105	1.25	1.147
1988	0.085	0.17	0.254	0.444	0.562	0.704	1.027	1.28	1.279
1989	0.052	0.226	0.301	0.402	0.625	0.749	0.894	1.115	1.465
1990	0.073	0.112	0.355	0.445	0.534	0.891	1.108	1.28	1.823
1991	0.058	0.184	0.297	0.547	0.618	0.678	0.931	1.053	1.091
1992	0.05	0.133	0.321	0.437	0.766	0.892	0.932	1.407	1.493
1993	0.037	0.108	0.277	0.458	0.65	0.861	0.898	1.022	1.514
1994	0.031	0.169	0.253	0.405	0.611	0.698	0.929	0.959	0.909
1995	0.03	0.149	0.274	0.354	0.553	0.833	0.978	1.322	1.059
1996	0.047	0.128	0.243	0.404	0.462	0.645	0.75	0.754	1.122
1997	0.048	0.153	0.263	0.394	0.614	0.73	0.925	1.057	0.921
1998	0.089	0.164	0.283	0.382	0.502	0.689	0.802	0.951	1.006
1999	0.035	0.172	0.255	0.365	0.494	0.611	0.729	0.84	1.067
2000	0.053	0.127	0.27	0.361	0.447	0.572	0.719	0.84	0.749
2001	0.05	0.112	0.242	0.403	0.432	0.514	0.657	0.808	1.029
2002	0.048	0.118	0.208	0.307	0.521	0.606	0.632	0.636	0.81
2003	0.036	0.124	0.239	0.282	0.382	0.652	0.648	0.908	0.945
2004	0.033	0.112	0.189	0.29	0.313	0.373	0.541	0.715	0.782
2005	0.053	0.103	0.198	0.295	0.451	0.429	0.525	1.163	0.916
2006	0.024	0.155	0.254	0.326	0.388	0.471	0.496	0.563	1.242
2007	0.060	0.115	0.219	0.331	0.404	0.456	0.550	0.593	0.682
2008	0.022	0.113	0.245	0.367	0.492	0.570	0.619	0.708	0.770
2009	0.048	0.135	0.252	0.357	0.410	0.570	0.633	0.630	0.897

Table 3.3.5. Continued. Haddock in Division VIa. Weights-at-age (kg) in total catch. Values used in the final assessment are boxed.

YEAR	AGE						
	9	10	11	12	13	14	15+	8+
1965	1.92	1.833	0	0	0	0	0	1.713
1966	0	0	0	0	0	0	0	1.522
1967	2.355	0	0	0	0	0	0	1.786
1968	2.516	0	0	0	0	0	0	2.005
1969	2.065	0	0	0	0	0	0	1.590
1970	1.791	1.213	0	0	0	0	0	1.352
1971	1.466	2.042	0	0	0	0	0	1.506
1972	0	1.551	0	0	0	0	0	1.548
1973	2.202	1.52	0	0	0	0	0	1.581
1974	1.319	1.229	0	0.833	0.89	0	0	1.183
1975	1.19	2.523	0	0	0	0	0	1.016
1976	1.243	1.806	0	1.679	0	0	0	1.246
1977	1.394	1.339	1.593	0	0	0	0	1.325
1978	2.126	1.376	1.208	1.627	0	0	0	1.338
1979	1.735	1.569	1.781	1.119	1.59	0	0	1.754
1980	1.632	1.879	2.862	0	1.482	0	0	1.747
1981	1.366	1.314	1.785	1.587	0	1.677	0	1.379
1982	1.738	2.068	1.543	0	0	0	0	1.555
1983	1.556	1.555	1.999	0	0	0	0	1.572
1984	1.882	1.417	1.864	0	0	0	0	1.724
1985	1.695	2.014	2.152	2.741	0	0	4.141	1.694
1986	1.517	1.832	1.925	1.504	2.635	0	0	1.463
1987	1.149	1.851	2.774	3.04	2.828	2.664	0	1.182
1988	0.879	1.618	0.99	3.424	3.994	4.15	0	0.984
1989	1.357	0.949	1.388	2.807	3.008	0	0.429	1.110
1990	1.682	2.288	1.964	2.506	0	0	0	1.860
1991	1.755	3.29	2.17	1.343	0	0	2.869	1.201
1992	1.564	2.18	0	0	0	0	0	1.639
1993	1.21	1.578	2.304	1.8	2.405	0	0	1.483
1994	1.243	1.319	1.961	2.43	0	0	0	0.992
1995	0.94	1.953	1.996	2.492	0	0	0	1.020
1996	1.163	1.046	1.141	0	3.167	0	0	1.137
1997	2.024	1.63	2.252	0	3.033	0	0	1.020
1998	1.064	2.488	2.585	3.322	2.591	0	0	1.077
1999	1.465	1.465	3.246	1.993	2.954	2.829	0	1.172
2000	1.186	1.262	0	2.168	0	0	0	0.813
2001	0.975	1.089	3.361	0.597	0	0	0	1.015
2002	1.995	0.916	0	2.698	0	0	0	0.939
2003	1.232	1.393	2.682	0	0	0	0	1.086
2004	0.853	1.396	3.976	0	0	0	0	0.988
2005	1.467	2.084	3.491	2.275	0	0	0	1.018
2006	1.182	1.682	2.675	0	3.889	5.471	0	1.294
2007	0.825	2.160	2.270	0	0	0	0	0.685
2008	0.911	2.494	2.109	0	0	0	0	0.827
2009	1.042	1.233	1.874	0	0	0	0	1.008

Table 3.3.6. Haddock in Division VIa. Weights-at-age (kg) in landings. Values used in the final assessment are boxed.

Year	Age								
	0	1	2	3	4	5	6	7	8
1965	0.000	0.273	0.295	0.440	0.695	0.916	1.041	1.249	1.517
1966	0.000	0.315	0.324	0.563	0.575	1.041	1.125	1.325	1.522
1967	0.000	0.285	0.374	0.635	0.576	0.667	1.177	1.844	1.611
1968	0.000	0.259	0.367	0.627	0.827	0.731	0.811	1.430	1.903
1969	0.000	0.199	0.314	0.570	0.921	1.042	1.024	0.999	1.569
1970	0.000	0.348	0.261	0.389	0.817	1.283	1.262	1.043	1.342
1971	0.000	0.295	0.328	0.360	0.549	1.040	1.313	1.651	1.426
1972	0.000	0.285	0.325	0.406	0.532	0.546	0.984	1.499	1.538
1973	0.000	0.259	0.329	0.408	0.599	0.512	0.571	1.185	1.706
1974	0.000	0.264	0.328	0.393	0.530	0.764	0.685	0.798	1.142
1975	0.000	0.277	0.365	0.465	0.585	0.832	1.027	1.001	1.009
1976	0.000	0.251	0.345	0.504	0.596	0.831	1.095	1.585	1.084
1977	0.000	0.307	0.370	0.437	0.689	0.800	1.128	1.337	1.117
1978	0.000	0.257	0.353	0.419	0.524	0.832	1.060	1.152	1.399
1979	0.000	0.269	0.386	0.467	0.732	0.779	1.040	1.491	1.944
1980	0.000	0.251	0.373	0.587	0.722	0.998	0.985	1.143	1.565
1981	0.000	0.289	0.357	0.502	0.887	0.975	1.376	1.294	1.347
1982	0.000	0.285	0.369	0.452	0.754	1.126	1.539	1.549	1.514
1983	0.000	0.479	0.424	0.518	0.568	1.004	1.370	1.716	1.558
1984	0.000	0.273	0.388	0.486	0.705	0.713	1.087	1.392	2.075
1985	0.000	0.283	0.346	0.494	0.641	0.803	0.875	1.272	1.277
1986	0.000	0.294	0.373	0.440	0.637	0.903	1.115	1.043	1.418
1987	0.000	0.276	0.337	0.435	0.570	0.880	1.105	1.250	1.147
1988	0.000	0.310	0.338	0.462	0.567	0.706	1.027	1.280	1.279
1989	0.000	0.372	0.406	0.468	0.625	0.749	0.894	1.115	1.462
1990	0.000	0.335	0.443	0.532	0.618	0.908	1.108	1.280	1.823
1991	0.000	0.287	0.382	0.556	0.618	0.678	0.931	1.053	1.091
1992	0.000	0.310	0.384	0.461	0.777	0.892	0.932	1.407	1.493
1993	0.000	0.313	0.395	0.509	0.655	0.889	0.898	1.026	1.514
1994	0.000	0.280	0.352	0.454	0.633	0.723	0.929	0.959	0.909
1995	0.000	0.293	0.375	0.415	0.567	0.833	0.978	1.322	1.059
1996	0.000	0.285	0.363	0.445	0.492	0.649	0.750	0.754	1.122
1997	0.000	0.275	0.365	0.425	0.621	0.735	0.925	1.057	0.921
1998	0.000	0.265	0.331	0.416	0.524	0.689	0.802	0.951	1.006
1999	0.000	0.313	0.353	0.420	0.496	0.614	0.820	0.840	1.067
2000	0.000	0.265	0.347	0.410	0.465	0.572	0.724	0.840	0.749
2001	0.000	0.243	0.332	0.457	0.439	0.538	0.657	0.808	1.029
2002	0.000	0.254	0.321	0.383	0.566	0.608	0.632	0.691	0.810
2003	0.000	0.240	0.311	0.389	0.428	0.654	0.651	0.917	0.946
2004	0.000	0.253	0.329	0.394	0.391	0.448	0.541	0.718	0.782
2005	0.000	0.270	0.358	0.415	0.542	0.596	0.594	1.167	0.921
2006	0.000	0.291	0.348	0.392	0.437	0.508	0.527	0.621	1.242
2007	0.000	0.248	0.357	0.398	0.423	0.458	0.558	0.605	0.682
2008	0.000	0.275	0.378	0.418	0.505	0.578	0.666	0.709	0.823
2009	0.000	0.344	0.361	0.467	0.488	0.581	0.687	0.691	0.897

Table 3.3.6. Continued. Haddock in Division VIa. Weights-at-age (kg) in landings. Values used in the final assessment are boxed.

YEAR	AGE						
	9	10	11	12	13	14	15+	8+
1965	1.920	1.833	0.000	0.000	0.000	0.000	0.000	1.713
1966	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.522
1967	2.355	0.000	0.000	0.000	0.000	0.000	0.000	1.786
1968	2.516	0.000	0.000	0.000	0.000	0.000	0.000	2.005
1969	2.065	0.000	0.000	0.000	0.000	0.000	0.000	1.590
1970	1.791	1.213	0.000	0.000	0.000	0.000	0.000	1.352
1971	1.466	2.042	0.000	0.000	0.000	0.000	0.000	1.506
1972	0.000	1.551	0.000	0.000	0.000	0.000	0.000	1.548
1973	2.202	1.520	0.000	0.000	0.000	0.000	0.000	1.581
1974	1.319	1.229	0.000	0.833	0.890	0.000	0.000	1.183
1975	1.190	2.523	0.000	0.000	0.000	0.000	0.000	1.016
1976	1.243	1.806	0.000	1.679	0.000	0.000	0.000	1.246
1977	1.394	1.339	1.593	0.000	0.000	0.000	0.000	1.325
1978	2.126	1.376	1.208	1.627	0.000	0.000	0.000	1.338
1979	1.735	1.569	1.781	1.119	1.590	0.000	0.000	1.754
1980	1.632	1.879	2.862	0.000	1.482	0.000	0.000	1.747
1981	1.366	1.314	1.785	1.587	0.000	1.677	0.000	1.379
1982	1.738	2.068	1.543	0.000	0.000	0.000	0.000	1.555
1983	1.556	1.555	1.999	0.000	0.000	0.000	0.000	1.572
1984	1.882	1.417	1.864	0.000	0.000	0.000	0.000	1.724
1985	1.695	2.014	2.152	2.741	0.000	0.000	4.141	1.694
1986	1.517	1.832	1.925	1.504	2.635	0.000	0.000	1.463
1987	1.149	1.851	2.774	3.040	2.828	2.664	0.000	1.182
1988	0.879	1.618	0.990	3.424	3.994	4.150	0.000	0.984
1989	1.357	0.948	1.388	2.807	3.008	0.000	0.429	1.109
1990	1.682	2.288	1.964	2.506	0.000	0.000	0.000	1.860
1991	1.755	3.290	2.170	1.343	0.000	0.000	2.869	1.201
1992	1.564	2.180	0.000	0.000	0.000	0.000	0.000	1.639
1993	1.210	1.578	2.304	1.800	2.405	0.000	0.000	1.483
1994	1.243	1.319	1.961	2.430	0.000	0.000	0.000	0.992
1995	0.940	1.953	1.996	2.492	0.000	0.000	0.000	1.020
1996	1.163	1.046	1.141	0.000	3.167	0.000	0.000	1.137
1997	2.024	1.630	2.252	0.000	3.033	0.000	0.000	1.020
1998	1.064	2.488	2.585	3.322	2.591	0.000	0.000	1.077
1999	1.465	1.465	3.246	1.993	2.954	2.829	0.000	1.172
2000	1.186	1.262	0.000	2.168	0.000	0.000	0.000	0.813
2001	0.975	1.089	3.361	0.597	0.000	0.000	0.000	1.015
2002	1.995	0.916	0.000	2.698	0.000	0.000	0.000	0.939
2003	1.253	1.395	2.682	0.000	0.000	0.000	0.000	1.091
2004	0.853	1.396	3.976	0.000	0.000	0.000	0.000	0.988
2005	1.467	2.084	3.491	2.275	0.000	0.000	0.000	1.023
2006	1.182	1.682	2.675	0.000	3.889	5.471	0.000	1.294
2007	0.825	2.160	2.270	0.000	0.000	0.000	0.000	0.685
2008	0.911	2.494	2.109	2.966	0.000	0.000	0.000	0.862
2009	1.042	1.233	1.874	0.000	3.002	0.000	0.000	1.011

Table 3.3.7. Haddock in Division VIa. Weights-at-age (kg) in discards. Values used in the final assessment are boxed.

YEAR	AGE								
	0	1	2	3	4	5	6	7	8
1965	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1966	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1967	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1968	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1969	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1970	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1971	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1972	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1973	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1974	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1975	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1976	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1977	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1978	0.059	0.125	0.208	0.231	0.259	0.265	0.308	0.000	0.000
1979	0.032	0.180	0.230	0.272	0.266	0.303	0.000	0.000	0.000
1980	0.077	0.120	0.243	0.287	0.334	0.000	0.000	0.000	0.000
1981	0.082	0.106	0.209	0.360	0.000	0.000	0.000	0.000	0.000
1982	0.038	0.155	0.238	0.247	0.363	0.000	0.000	0.000	0.000
1983	0.050	0.165	0.237	0.283	0.298	0.536	0.000	0.000	0.000
1984	0.059	0.145	0.248	0.303	0.331	0.278	0.000	0.000	0.000
1985	0.019	0.132	0.242	0.326	0.362	0.423	0.353	0.000	0.000
1986	0.064	0.173	0.193	0.248	0.000	0.000	0.000	0.000	0.000
1987	0.028	0.163	0.218	0.247	0.281	0.000	0.000	0.000	0.000
1988	0.085	0.157	0.208	0.279	0.331	0.341	0.000	0.000	0.000
1989	0.052	0.193	0.226	0.237	0.491	0.961	1.423	0.000	2.572
1990	0.073	0.108	0.250	0.228	0.242	0.268	0.000	0.000	0.000
1991	0.058	0.178	0.218	0.278	0.000	0.263	0.000	0.000	0.000
1992	0.050	0.130	0.247	0.258	0.242	0.000	0.947	0.000	0.000
1993	0.037	0.105	0.238	0.287	0.382	0.348	0.000	0.430	0.000
1994	0.031	0.163	0.229	0.291	0.337	0.304	0.000	0.000	0.000
1995	0.030	0.144	0.243	0.281	0.310	0.000	0.000	0.000	0.000
1996	0.047	0.126	0.206	0.282	0.300	0.317	0.000	0.000	0.000
1997	0.048	0.148	0.226	0.283	0.340	0.317	0.000	0.000	0.000
1998	0.089	0.151	0.251	0.298	0.337	0.000	0.000	0.000	0.000
1999	0.035	0.163	0.213	0.276	0.318	0.311	0.206	0.000	0.000
2000	0.053	0.125	0.223	0.257	0.259	0.625	0.337	0.000	0.000
2001	0.050	0.109	0.211	0.243	0.254	0.245	0.000	0.000	0.000
2002	0.048	0.117	0.196	0.253	0.305	0.456	0.000	0.358	0.000
2003	0.036	0.123	0.223	0.233	0.282	0.462	0.439	0.496	0.591
2004	0.033	0.112	0.183	0.237	0.242	0.256	0.000	0.411	0.000
2005	0.053	0.103	0.190	0.262	0.320	0.290	0.322	0.416	0.493
2006	0.024	0.154	0.241	0.284	0.313	0.318	0.348	0.336	0.000
2007	0.060	0.113	0.211	0.288	0.314	0.336	0.368	0.373	0.000
2008	0.022	0.112	0.226	0.287	0.322	0.389	0.312	0.458	0.419
2009	0.048	0.134	0.235	0.271	0.298	0.362	0.309	0.356	0.000

Table 3.3.7. Continued. Haddock in Division VIa. Weights-at-age (kg) in discards. Values used in the final assessment are boxed.

Year	Age							
	9	10	11	12	13	14	15+	8+
1965	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1966	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1967	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1968	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1969	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1970	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1977	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1985	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1988	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.000	3.048	0.000	0.000	0.000	0.000	0.000	2.810
1990	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1992	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.432	0.689	0.000	0.000	0.000	0.000	0.000	0.493
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.493
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.419
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3.3.8. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

ScoGFS Q1

Year	Age								
	1	2	3	4	5	6	7	8	Total
1985	1104	4085	68	80	141	388	27	1	5893
1986	753	1669	1877	17	14	47	90	5	4467
1987	5518	446	460	690	25	34	25	67	7198
1988	571	3610	303	112	246	10	4	8	4856
1989	178	488	1701	98	49	69	5	1	2588
1990	2577	87	54	296	26	6	36	3	3082
1991	1591	1763	92	25	184	9	4	15	3668
1992	3618	1193	321	12	13	28	6	1	5191
1993	5371	5922	675	167	0	2	18	2	12 155
1994	1151	2300	787	126	39	3	1	8	4407
1995	7112	1074	1697	485	65	30	10	4	10 473
1996	4401	3742	315	456	125	20	11	3	9070
1997	4262	2018	1915	147	151	53	2	1	8548
1998	5034	2720	616	562	40	64	19	7	9055
1999	941	2989	687	168	128	15	11	2	4939
2000	7936	553	440	97	13	20	1	3	9060
2001	3421	5762	143	146	34	16	6	1	9528
2002	2339	3246	5293	56	70	24	9	3	11 037
2003	2650	1696	1449	1874	23	34	18	4	7744
2004	1397	2765	869	1199	609	11	3	5	6853
2005	573	633	1402	351	512	402	5	3	3878
2006	633	892	539	397	156	170	51	2	2838
2007	99	2019	296	121	192	82	89	65	2898
2008	86	113	1094	98	84	71	13	15	1558
2009	42	113	147	1445	29	43	63	7	1882
2010	706	111	26	71	452	23	4	9	1393

Table 3.3.8. Continued. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

ScoGFS Q4

	Age								
Year	0	1	2	3	4	5	6	7	Total
1996	2907	761	656	70	137	57	24	6	1711
1997	3713	1359	282	151	25	26	14	4	1861
1998	399	1640	486	148	137	17	33	5	2466
1999	4670	366	574	267	92	68	11	18	1396
2000	2959	4231	147	191	59	25	5	3	4661
2001	3083	2219	3563	48	138	22	12	2	6004
2002	2943	1709	1770	2841	34	50	24	8	6436
2003	293	2023	965	1470	639	28	17	3	5145
2004	542	574	1068	410	649	524	5	9	3239
2005	286	419	409	410	223	309	87	1	1858
2006	19	543	233	162	281	79	100	40	1438
2007	125	69	1392	109	128	90	48	45	1881
2008	14	117	78	835	74	94	63	29	1290
2009	335	68	161	343	551	44	35	26	1228

IreGFS

	Effort	Age									
Year	(hours)	0	1	2	3	4	5	6	7	8	Total
1993	2130	143	2493	5691	1606	693	29	112	56	35	10715
1994	1865	76	1237	3538	3303	367	187	13	18	66	8729
1995	2026	967	3104	1149	4152	1663	187	149	29	14	10447
1996	2008	192	2536	3688	2155	627	254	126	45	24	9455
1997	1879	2900	8289	636	532	375	294	45	8	3	10182
1998	1936	96	1098	1538	1353	192	84	75	15	49	4404
1999	1914	7985	1028	1967	1530	679	237	118	25	34	5618
2000	1878	1454	8865	569	691	484	183	32	30	0	10854
2001	965	1951	2728	3548	136	187	151	36	4	0	6790
2002	796	6618	2541	2768	1788	67	90	32	5	2	7293

Table 3.3.8. Continued. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

IRGFS													
	Effort	**Age**											
Year	**(hours)**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	Total
2003	1127	207	7588	2382	839	355	22	30	7	0	3	2	11 228
2004	1200	86	2163	3322	1281	941	957	60	10	21	0	0	8755
2005	960	233	1160	767	778	315	87	3	0	0	1	0	3111
2006	1510	313	207	1027	381	1337	543	130	59	0	0	0	3684
2007	1173	320	979	1049	346	689	101	64	69	1	0	0	3298
2008	1135	76	2052	562	645	74	196	169	31	14	0	0	3742
2009	1378	744	535	919	309	328	76	187	61	6	0	0	2422

Table 3.3.9. Haddock in Division VIa. TSA parameter estimates from this year's assessment, along with those from previous assessments for comparison. * = fixed parameter.

PARAMETER	NOTATION	DESCRIPTION	2003	2004	2005	2006	2007	2008	2009	2010
Initial fishing mortality	F (1, 1978)	Fishing mortality at age a in year y	0.42	0.28	0.26	0.23	0.25	0.40	0.40	0.43
	F (2, 1978)		0.67	0.5	0.51	0.50	0.56	0.71	0.70	0.81
	F (4, 1978)		0.53	0.51	0.51	0.51	0.52	0.56	0.57	0.59
Survey selectivities	Φ(1)		3.99	2.25	2.35	2.49	2.58	2.60	2.58	3.11
ScoGFS Q1	Φ(2)	ScoGFS Q1 survey selectivity at age a	4.84	2.71	2.45	2.55	3.01	3.07	3.01	3.34
	Φ(4)		2.1	1.51	2.11	2.19	2.04	1.92	1.94	2.24
Survey selectivities	Φ(1)		-	-	-	1.99	1.62	1.77	1.75	2.24
ScoGFS Q4	Φ(2)	ScoGFS Q4 survey selectivity at age a	-	-	-	1.99	1.76	1.88	1.84	2.22
	Φ(4)		-	-	-	2.25	2.39	2.61	2.64	3.44
Fishing mortality standard deviations	σF	Transitory changes in overall F	0.00	0.11	0.10	0.10	0.12	0.20	0.20	0.19
	σU	Persistent changes in selection (age effect in F)	0.05	0.04	0.01	0.00	0.09	0.03	0.03	0.05
	σV	Transitory changes in the year effect in F	0.27	0.23	0.22	0.23	0.23	0.33	0.35	0.26
	σY	Persistent changes in the year effect in F	0.00	0.14	0.09	0.09	0.07	0.00	0.00	0.15
Survey catchability standard deviations	σΩ1	Transitory changes in ScoGFS Q1 catchability	0.00	0.08	0.18	0.30	0.19	0.12	0.12	0.27
	σβ1	Persistent changes in ScoGFS Q1 catchability	0.14	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
	σΩ2	Transitory changes in ScoGFS Q4 catchability	-	-	-		0.16	0.20	0.19	0.21
	σβ2	Persistent changes in ScoGFS Q4 catchability	-	-	-		0.00*	0.00*	0.00*	0.00*
Measurement coefficients of variation	cv landings	Coefficent of variation of landings-at-age data	0.22	0.25	0.23	0.20	0.20	0.24	0.25	0.28
	cv discards	Coefficent of variation of discards-at-age data	0.51	0.43	0.45	0.42	0.41	0.54	0.54	0.59
	cv survey	Coefficent of variation of ScoGFS Q1 survey data	0.40	0.34	0.53	0.57	0.33	0.35	0.36	0.41
	cv survey	Coefficent of variation of ScoGFS Q4 survey data	-	-	-	0.57	0.22	0.34	0.35	0.51

Table 3.3.9. Continued. Haddock in Division VIa. TSA parameter estimates from this year's assessment, along with those from previous assessments for comparison. * = fixed parameter.

Parameter	Notation	Description	2003	2004	2005	2006	2007	2008	2009	2010
Discard curve parameters	σP	Transitory changes in overall discard proportion	0.50	0.19	0.20	0.19	0.18	0.20	0.20	0.00
	σα1	Transitory changes in discard-ogive intercept	0.00	0.15	0.02	0.00	0.14	0.00	0.00	0.01
	σν1	Persistent changes in discard-ogive intercept	0.26	0.21	0.22	0.21	0.32	0.26	0.25	0.29
	σα2	Transitory changes in discard-ogive slope	0.34	0.01	0.03	0.21	0.23	0.22	0.23	0.40
	σν2	Persistent changes in discard-ogive slope	0.02	0.61	0.43	0.23	0.002	0.000	0.000	0.00
Trend parameters	θν1	Trend parameter for discard-ogive intercept	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
	θν2	Trend parameter for discard-ogive slope	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
Recruitment	η1	Ricker parameter (slope at the origin)	9.10	9.63	9.71	9.73	9.06	11.35	11.08	9.62
	η2	Ricker parameter (curve dome occurs at 1/η2)	0.33	0.29	0.31	0.29	0.30	0.35	0.35	0.39
	cv rec	Coefficent of variation of recruitment curve	0.52	0.89	0.89	0.90	0.62	0.60	0.61	0.69

Table 3.3.10. Haddock in Division VIa. Estimates of population abundance (in thousands) from the final TSA run.

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	70152	7863	2533	59405	4443	626	463	1016
1979	148478	42687	3868	1113	22687	1500	232	561
1980	451131	84749	17041	1560	417	7555	465	255
1981	63077	300652	43940	6859	588	183	2976	282
1982	71998	43048	181310	22186	3427	295	96	1621
1983	44841	49441	25964	100081	11362	1793	151	907
1984	307976	27502	26548	11833	45177	5090	782	472
1985	72879	189959	11804	9940	4875	19744	2079	510
1986	58508	41641	95027	5161	4071	2201	7919	1108
1987	245833	38991	23105	48687	2556	2070	1166	4561
1988	20765	138867	14681	8171	16865	821	647	1965
1989	18186	10465	60424	5381	2838	5869	301	935
1990	93427	9224	4257	23830	1931	929	1907	404
1991	124036	57775	3423	1786	9692	779	385	934
1992	167262	69017	23743	1272	689	3497	292	483
1993	161499	109314	33574	9895	527	313	1471	335
1994	56927	99162	41312	9985	2990	147	81	519
1995	184980	30799	48872	16918	3750	1139	60	231
1996	100407	112926	14615	21685	6502	1567	441	116
1997	119655	56585	50732	5890	8117	2249	626	196
1998	129373	66750	22666	17932	1926	2786	636	238
1999	27416	72524	27916	8532	4924	695	1071	253
2000	456691	15879	31645	11404	3088	1332	273	512
2001	166094	251386	5983	10380	3266	937	258	211
2002	95068	109918	132767	2731	3806	1261	389	157
2003	108188	65557	68786	79895	1311	1884	718	271
2004	39439	66424	32480	35010	26527	377	610	237
2005	29217	25094	35577	16913	16252	10706	127	328
2006	84889	17602	12459	15186	6326	6428	3049	146
2007	19210	53588	8863	6384	6162	2617	2762	1099
2008	7769	12209	33781	4591	3073	2699	1290	1687
2009	7902	5152	7439	21374	2377	1677	1379	1545
2010*	41994	5447	3269	4980	12417	1341	963	1603
2011*	76211	28875	3363	1995	2562	6477	691	1322

***Estimates for 2010 and 2011 are TSA forecasts.**

Table 3.3.11. Haddock in Division VIa. Standard errors of estimates of population abundance (in thousands) from the final TSA run.

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	8678	740	313	409	1212	225	146	345
1979	16206	4471	313	146	2440	604	126	202
1980	42779	9038	2489	189	79	1411	313	128
1981	5753	27493	5581	1207	106	47	794	180
1982	8459	3715	17299	2845	587	59	27	441
1983	6750	5621	2139	9133	1356	298	34	226
1984	43293	3658	2822	754	3392	505	119	85
1985	8532	21270	1652	1426	545	2220	370	91
1986	6348	4463	10668	641	544	321	1401	227
1987	35798	3862	2702	5433	286	261	190	778
1988	4646	16935	1574	1074	2070	120	147	383
1989	4420	1654	7306	667	406	881	62	201
1990	11828	1857	638	3238	274	182	452	114
1991	13891	7065	593	225	1173	108	79	201
1992	17194	6591	2969	198	80	514	54	99
1993	18958	11191	3015	1180	64	36	235	54
1994	12901	12954	4426	1044	341	14	14	86
1995	28169	7453	8225	3053	657	217	13	56
1996	21886	19664	3442	4077	1368	265	94	32
1997	23382	12263	9887	1163	1453	437	89	36
1998	23243	12732	4755	3596	339	377	112	42
1999	9858	13446	5276	1503	1127	95	137	42
2000	106685	5383	6771	2152	566	398	33	71
2001	25574	50684	1777	2083	566	147	69	49
2002	17011	14298	21528	463	528	130	44	26
2003	16480	10991	8676	11966	212	220	52	31
2004	7314	10410	5332	4888	4473	79	97	50
2005	4525	4033	5728	2617	2220	1775	20	46
2006	7918	2077	1280	1850	622	597	364	24
2007	3331	4655	1287	673	727	252	251	128
2008	3277	1907	3600	724	314	324	118	189
2009	9414	2229	1220	2530	441	191	165	191
2010*	31715	6795	1576	937	1873	299	125	230
2011*	52696	21983	4226	1003	695	1595	209	316

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.12. Haddock in Division VIa. Estimates of fishing mortality from the final TSA run.

	AGE							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.269	0.350	0.610	0.771	0.774	0.741	0.717	0.730
1979	0.359	0.694	0.703	0.787	0.863	0.826	0.837	0.835
1980	0.199	0.463	0.630	0.750	0.611	0.686	0.674	0.656
1981	0.184	0.295	0.485	0.490	0.490	0.443	0.500	0.483
1982	0.159	0.270	0.365	0.469	0.448	0.465	0.477	0.449
1983	0.315	0.419	0.311	0.407	0.448	0.464	0.458	0.503
1984	0.283	0.606	0.753	0.684	0.612	0.690	0.703	0.672
1985	0.354	0.490	0.623	0.686	0.595	0.714	0.652	0.633
1986	0.182	0.390	0.461	0.471	0.445	0.417	0.464	0.470
1987	0.372	0.758	0.839	0.854	0.926	0.963	0.885	0.857
1988	0.436	0.632	0.803	0.857	0.855	0.799	0.807	0.831
1989	0.431	0.654	0.726	0.819	0.895	0.914	0.913	0.903
1990	0.282	0.755	0.664	0.685	0.691	0.654	0.689	0.690
1991	0.353	0.689	0.777	0.736	0.818	0.767	0.828	0.779
1992	0.198	0.447	0.657	0.661	0.542	0.619	0.604	0.582
1993	0.286	0.708	0.932	0.936	0.860	1.005	0.941	0.964
1994	0.417	0.491	0.681	0.768	0.759	0.692	0.780	0.746
1995	0.294	0.545	0.612	0.755	0.670	0.747	0.720	0.724
1996	0.372	0.600	0.700	0.786	0.860	0.718	0.846	0.809
1997	0.388	0.720	0.840	0.895	0.822	1.063	1.070	0.959
1998	0.381	0.674	0.773	1.089	0.793	0.757	1.083	0.922
1999	0.342	0.626	0.695	0.833	1.018	0.736	0.725	0.844
2000	0.390	0.802	0.909	1.047	0.975	1.418	1.101	1.119
2001	0.211	0.448	0.635	0.777	0.643	0.678	0.996	0.764
2002	0.170	0.266	0.319	0.538	0.504	0.363	0.509	0.483
2003	0.292	0.506	0.451	0.874	1.045	0.926	1.369	0.928
2004	0.253	0.426	0.453	0.551	0.708	0.889	0.759	0.720
2005	0.311	0.498	0.652	0.777	0.724	1.057	1.067	0.894
2006	0.236	0.473	0.467	0.696	0.682	0.644	0.874	0.719
2007	0.251	0.261	0.443	0.531	0.613	0.505	0.643	0.579
2008	0.186	0.294	0.256	0.452	0.405	0.467	0.462	0.447
2009	0.154	0.244	0.201	0.342	0.373	0.355	0.447	0.362
2010*	0.175	0.282	0.294	0.465	0.451	0.463	0.464	0.462
2011*	0.175	0.285	0.295	0.467	0.467	0.467	0.467	0.467

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.13. Haddock in Division VIa. Standard errors of estimates of log fishing mortality from the final TSA run.

	Age							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**
1978	0.266	0.180	0.180	0.153	0.174	0.204	0.218	0.212
1979	0.234	0.167	0.150	0.169	0.158	0.188	0.216	0.212
1980	0.293	0.183	0.184	0.162	0.191	0.179	0.217	0.220
1981	0.291	0.199	0.176	0.182	0.191	0.214	0.213	0.228
1982	0.278	0.188	0.172	0.171	0.183	0.204	0.229	0.211
1983	0.232	0.163	0.172	0.157	0.171	0.189	0.218	0.206
1984	0.368	0.167	0.153	0.142	0.154	0.193	0.214	0.218
1985	0.234	0.172	0.173	0.160	0.172	0.179	0.213	0.218
1986	0.277	0.180	0.174	0.177	0.183	0.197	0.213	0.222
1987	0.261	0.138	0.149	0.138	0.143	0.179	0.209	0.196
1988	0.270	0.165	0.146	0.148	0.151	0.185	0.212	0.204
1989	0.282	0.180	0.164	0.151	0.158	0.172	0.214	0.209
1990	0.263	0.166	0.182	0.166	0.170	0.189	0.208	0.218
1991	0.244	0.163	0.174	0.154	0.155	0.185	0.213	0.206
1992	0.270	0.169	0.167	0.167	0.170	0.186	0.216	0.214
1993	0.264	0.146	0.126	0.134	0.136	0.185	0.196	0.213
1994	0.299	0.234	0.218	0.195	0.203	0.239	0.252	0.250
1995	0.451	0.319	0.297	0.278	0.280	0.278	0.301	0.301
1996	0.443	0.298	0.301	0.276	0.271	0.273	0.272	0.295
1997	0.419	0.275	0.257	0.244	0.238	0.240	0.213	0.270
1998	0.425	0.277	0.268	0.238	0.242	0.243	0.227	0.273
1999	0.455	0.290	0.281	0.262	0.255	0.251	0.213	0.278
2000	0.439	0.282	0.253	0.242	0.242	0.241	0.196	0.268
2001	0.439	0.292	0.274	0.251	0.257	0.250	0.240	0.279
2002	0.463	0.303	0.298	0.273	0.268	0.258	0.214	0.283
2003	0.424	0.276	0.269	0.229	0.218	0.218	0.193	0.261
2004	0.469	0.300	0.295	0.266	0.260	0.256	0.238	0.285
2005	0.446	0.270	0.225	0.183	0.182	0.186	0.192	0.234
2006	0.302	0.192	0.183	0.159	0.149	0.150	0.164	0.216
2007	0.311	0.217	0.204	0.169	0.165	0.160	0.158	0.218
2008	0.317	0.229	0.236	0.192	0.184	0.172	0.173	0.225
2009	0.332	0.263	0.264	0.214	0.215	0.191	0.210	0.240
2010*	0.558	0.431	0.429	0.405	0.404	0.404	0.405	0.405
2011*	0.582	0.463	0.461	0.438	0.438	0.438	0.438	0.438

***Estimates for 2009 and 2010 are TSA forecasts.**

Table 3.3.14. Haddock in Division VIa. Stock summary from final TSA run. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield. "Pred." are TSA estimates, and "SE" denotes standard errors. *Estimates for 2010 and 2011 are TSA projections.

Year	Landings (tonnes)			Discards (tonnes)			Total catches (tonnes)			Mean F(2-6)		SSB (tonnes)		TSB (tonnes)		Recruitment (000s at age 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	17178	18986	1836	2327	2227	569	19505	21164	1983	0.65	0.07	39101	1183	49408	1675	70152	8678
1979	14820	15719	1844	13857	9679	2155	28678	25890	3078	0.77	0.07	30974	2355	64042	4155	148478	16206
1980	12759	13352	1739	4715	12994	3130	17474	27828	4253	0.63	0.07	35115	2820	107401	7015	451131	42779
1981	18233	18262	2659	15048	11990	2662	33281	30749	4461	0.44	0.05	73728	4997	121309	7705	63077	5753
1982	29635	26511	4057	10063	5979	1301	39698	31005	4161	0.40	0.05	98368	7050	114733	7193	71998	8459
1983	29405	26348	3378	6787	5211	1034	36192	31423	3611	0.41	0.04	91221	5613	105174	5871	44841	6750
1984	30012	28127	2537	16343	12203	4140	46355	39554	5366	0.67	0.06	62780	2983	112542	7349	307976	43293
1985	24393	24454	2664	17444	13435	2886	41837	37188	4603	0.62	0.06	65580	4342	97512	6724	72879	8532
1986	19561	20039	2809	7153	4246	895	26714	22951	3002	0.44	0.05	60041	4577	75525	4950	58508	6348
1987	27012	29160	3015	16193	13486	3725	43205	42635	5163	0.87	0.07	54615	3814	100544	7473	245833	35798
1988	21136	21785	2466	9536	8684	2026	30672	30137	3806	0.79	0.07	46703	3311	65402	5094	20765	4646
1989	16688	18552	2596	2981	2826	735	19669	20734	2784	0.80	0.08	38211	3304	43675	3577	18186	4420
1990	10135	11276	1689	5387	2944	739	15522	13274	1837	0.69	0.07	22435	2092	34383	2655	93427	11828
1991	10557	10064	1138	8691	9355	2041	19248	19983	2723	0.76	0.07	21574	1628	51813	3778	124036	13891
1992	11350	9482	1185	9163	7798	1446	20513	18012	2197	0.59	0.06	29046	2019	60707	3774	167262	17194
1993	19060	17672	1814	16811	14156	2266	35871	31760	3088	0.89	0.08	41789	2628	72328	4592	161499	18958
1994	14243	12069	1650	11098	11492	2388	25342	23827	3123	0.68	0.11	39929	3181	60337	5342	56927	12901
1995	12368	13458	3880	8552	10319	3553	20920	23481	6342	0.67	0.16	35986	5067	67096	7911	184980	28169

Continued on next page.

Table 3.3.14. Continued. Haddock in Division VIa. Stock summary from final TSA run. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield. "Pred." are TSA estimates, and "SE" denotes standard errors. *Estimates for 2010 and 2011 are TSA projections.

Year	Landings (tonnes)			Discards (tonnes)			Total catches (tonnes)			Mean F(2–6)		SSB (tonnes)		TSB (tonnes)		Recruitment (000s at age 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1996	13453	13322	3998	11364	12192	3775	24817	25742	6920	0.73	0.17	37416	5295	62091	8232	100407	21886
1997	12874	15680	4406	6470	12906	3914	19344	29612	7009	0.87	0.17	40998	5911	65680	8351	119655	23382
1998	14401	12214	3421	5535	13435	4069	19936	26674	6579	0.82	0.16	32835	4620	62221	7731	129373	23243
1999	10430	9438	2869	4891	8359	2630	15321	18598	4716	0.78	0.17	29680	4074	42351	5918	27416	9858
2000	6952	10023	2973	7899	20164	8914	14851	30681	10305	1.03	0.20	22344	3650	82240	14996	456691	106685
2001	6731	7468	2843	6657	18812	6369	13389	27749	8695	0.64	0.13	44261	7767	89001	13798	166094	25574
2002	7097	9155	3615	8880	9695	3090	15977	18365	4969	0.40	0.09	58826	7431	79937	8532	95068	17011
2003	5334	23301	5907	4104	11820	3432	9438	33355	6388	0.76	0.14	61898	6163	81986	7094	108188	16480
2004	3199	13306	3641	4380	6125	1896	7579	17267	4243	0.61	0.13	38256	4320	48062	5116	39439	7314
2005	3148	15803	3427	3546	4911	1462	6694	17847	3477	0.74	0.11	34023	3702	39171	3954	29217	4525
2006	5723	7178	958	5161	5109	1019	10884	11885	1415	0.59	0.06	20580	1263	35621	1978	84889	7918
2007	3735	4315	515	4009	3279	629	7745	7544	922	0.47	0.05	18834	1131	26096	1590	19210	3331
2008	2792	3885	489	1285	1960	495	4077	5998	869	0.37	0.05	22114	1729	24283	1936	7769	3277
2009	2709	3629	568	1676	1036	359	4385	4487	628	0.30	0.05	16818	1615	18430	2368	7902	9414
2010*	NA	4026	1262	NA	1182	832	NA	5140	1770	0.39	0.14	13377	2156	19018	5131	41994	31715
2011*	NA	3023	1002	NA	2829	1775	NA	5774	2463	0.40	0.16	12726	4374	24904	9259	76211	52696
Min	2709	3629		1285	1036		4077	4487		0.30	0.00	16818		18430		7769	
GM	11007	13292		6695	7410		18293	21610		0.63	0.00	38575		61218		75905	
AM	13660	15126		8063	9026		21723	23981		0.65	0.00	42690		67534		117290	
Max	30012	29160		17444	20164		46355	42635		1.03	0.00	98368		121309		456691	

Table 3.3.15. Haddock in Division VIa. Mean weights-at-age in total catches (or stock) and forecasted weights-at-age in 2008. Forecasts in this table are based on either of simple three year means or linear model projections: those that were used in the forecasts are shaded and boxed: simple three year means were used for the younger ages (1–2) and linear model projections for the older ages (3–8+). The weights for the 1999 year-class are highlighted in red.

		AGE								
	Year	0	1	2	3	4	5	6	7	8+
	1999	0.035	0.172	0.255	0.365	0.494	0.611	0.729	0.840	1.172
	2000	0.053	0.127	0.270	0.361	0.447	0.572	0.719	0.840	0.813
	2001	0.050	0.112	0.242	0.403	0.432	0.514	0.657	0.808	1.015
	2002	0.048	0.118	0.208	0.307	0.521	0.606	0.632	0.636	0.939
	2003	0.036	0.124	0.239	0.282	0.382	0.652	0.648	0.908	1.086
	2004	0.033	0.112	0.189	0.290	0.313	0.373	0.541	0.715	0.988
	2005	0.053	0.103	0.198	0.295	0.451	0.429	0.525	1.163	1.018
	2006	0.024	0.155	0.254	0.326	0.388	0.471	0.496	0.563	1.294
	2007	0.060	0.115	0.219	0.331	0.404	0.456	0.550	0.593	0.685
	2008	0.022	0.113	0.245	0.367	0.492	0.570	0.619	0.708	0.827
	2009	0.048	0.135	0.252	0.357	0.410	0.570	0.633	0.630	1.008
arithmetic mean	**2010**	**0.043**	**0.121**	0.239	0.352	0.435	0.532	0.600	0.644	0.840
linear model	**2010**			**0.248**	**0.391**	**0.481**	**0.516**	**0.702**	**0.754**	**0.749**
	yr class in 2010	2010	2009	2008	2007	2006	2005	2004	2003	2002
	CV	0.450	0.097	0.069	0.048	0.103	0.128	0.063	0.078	0.216

Table 3.3.16. Haddock in Division VIa. Inputs to short-term forecasts.

Label	Value	CV	Label	Value	CV
Number-at-age			**Stock weight**		
N1	41994	0.76	WS1	0.121	0.10
N2	5447	1.25	WS2	0.239	0.07
N3	3269	0.48	WS3	0.352	0.05
N4	4980	0.19	WS4	0.435	0.10
N5	12417	0.15	WS5	0.532	0.13
N6	1341	0.22	WS6	0.600	0.06
N7	963	0.13	WS7	0.644	0.08
N8	1603	0.14	WS8	0.749	0.22
Removals selectivity			**Removals weights**		
sH1	0.197	0.17	WH1	0.121	0.10
sH2	0.266	0.43	WH2	0.239	0.07
sH3	0.300	0.39	WH3	0.352	0.05
sH4	0.442	0.28	WH4	0.435	0.10
sH5	0.464	0.31	WH5	0.532	0.13
sH6	0.442	0.21	WH6	0.600	0.06
sH7	0.517	0.40	WH7	0.644	0.08
sH8	0.463	0.29	WH8	0.749	0.22
Natural mortality			**Prop.mature.**		
M1	0.2	0.1	MT1	0	0.1
M2	0.2	0.1	MT2	0.57	0.1
M3	0.2	0.1	MT3	1	0.1
M4	0.2	0.1	MT4	1	0
M5	0.2	0.1	MT5	1	0
M6	0.2	0.1	MT6	1	0
M7	0.2	0.1	MT7	1	0
M8	0.2	0.1	MT8	1	0
Relative effort			**Year effect for M**		
'HF09'	1	0.08	'K09'	1	0.1
'HF10'	1	0.08	'K10'	1	0.1
'HF11'	1	0.08	'K11'	1	0.1
Recruitment					
'R11'	76211	0.39			
'R12'	75905	1.48			
Prop. F before spawning	0				
Prop. M before spawning	0				

Stock numbers in 2010 are TSA survivors.

Table 3.3.17. Haddock in Division VIa. Catch forecast output and estimates of coefficient of variation (CV) from linear analysis. Catch included 1978–1994 and 2006–2009.

	Year: 2010	Year: 2011							2011: Fsq	M.Plan	F0.1	MSY BH	MSY R	MSY HS
Mean F Ages														
H.cons 2 to 6	0.38	0.00	0.08	0.15	0.23	0.31	0.38	0.46	0.38	0.30	0.20	0.19	0.31	0.35
Effort relative to 2009														
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	1.00	0.78	0.52	0.50	0.80	0.91
Biomass														
Total 1 January	19.4	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
SSB at spawning time	13.7	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Catch weight (,000t)														
Total removals	5.35	0.00	1.37	2.66	3.87	5.00	6.06	7.06	6.06	4.89	3.40	3.28	5.00	5.59
H.cons Landings	2.82	0.00	0.72	1.4	2.04	2.64	3.20	3.73	3.20	2.58	1.79	1.73	2.64	2.95
Discards	2.00	0.00	0.51	0.99	1.45	1.87	2.26	2.64	2.26	1.83	1.27	1.22	1.87	2.09
Unallocated	0.53	0.00	0.14	0.26	0.38	0.49	0.60	0.70	0.60	0.48	0.34	0.32	0.49	0.55
Biomass in year.... 2012														
Total 1 January		42.6	40.8	39.1	37.5	36.0	34.6	33.3	34.6	36.2	38.1	38.3	36.0	35.2
SSB at spawning time		26.7	25.2	23.7	22.4	21.1	19.9	18.8	19.9	21.3	22.9	23.1	21.1	20.5

	Year: 2010	Year: 2011							2011					
Effort relative to 2009														
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	1.00	0.78	0.52	0.50	0.80	0.91
Est. Coeffs. of Variation														
Biomass														
Total 1 January	0.23	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
SSB at spawning time	0.13	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Catch weight														
(Removals)	0.21	0.00	0.46	0.31	0.28	0.27	0.26	0.26	0.26	0.27	0.29	0.29	0.27	0.26
Biomass in year.... 2012														
Total 1 January		0.39	0.40	0.41	0.42	0.44	0.45	0.46	0.45	0.44	0.42	0.42	0.44	0.44
SSB at spawning time		0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.32	0.31	0.31	0.32	0.32

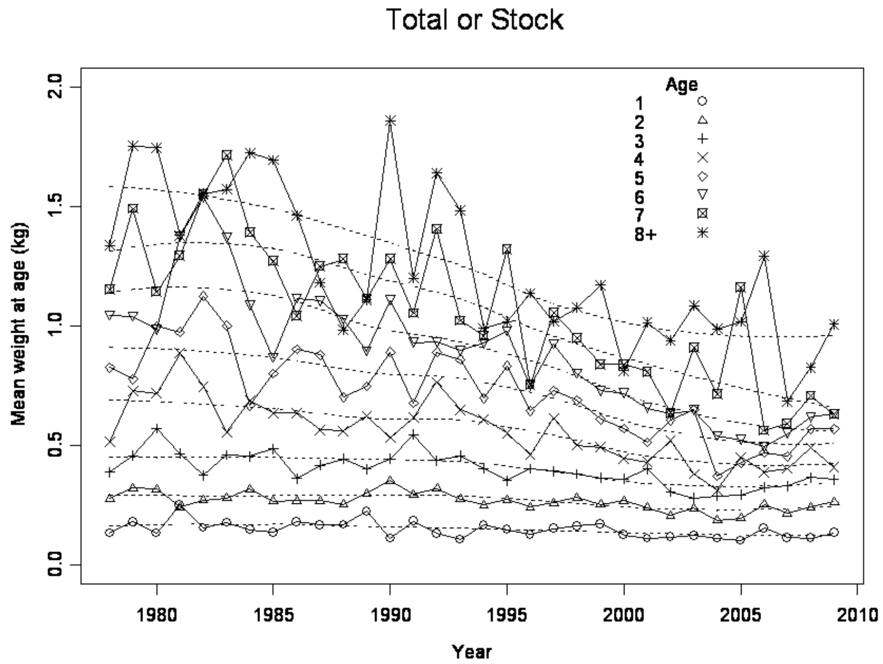

Figure 3.3.1. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (also used for stock weights). Dotted lines show loess smoothers fitted through each time-series at age. For clarity, only ages 1–8+ are shown here.

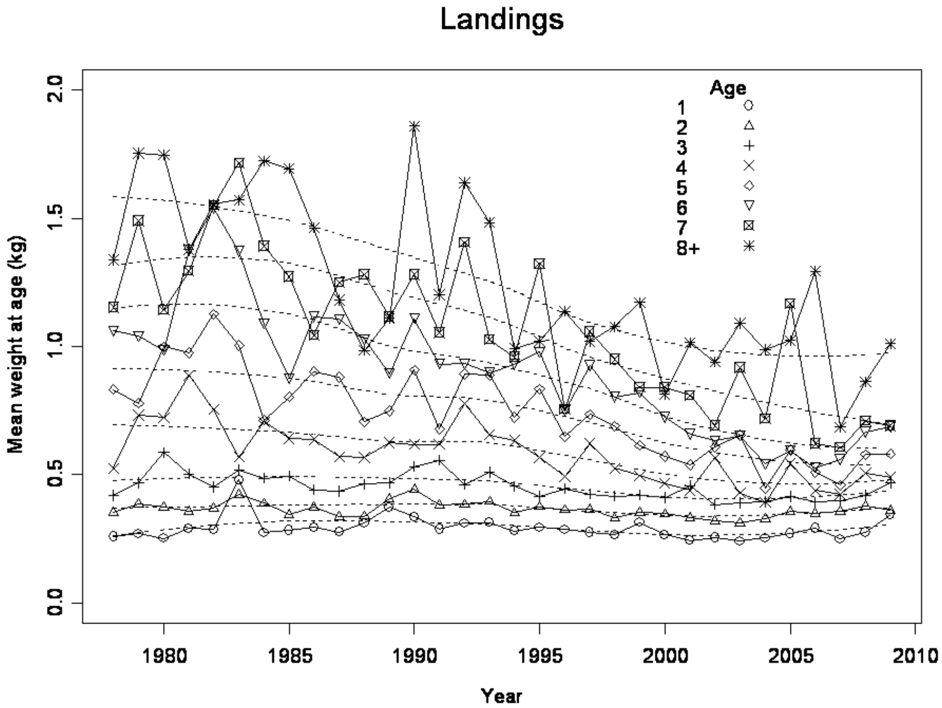

Figure 3.3.2. Haddock in Division VIa. Mean weights-at-age (kg) in landings. Dotted lines show Loess smoothers fitted through each time-series at age. For clarity, only ages 1–8+ are shown here.

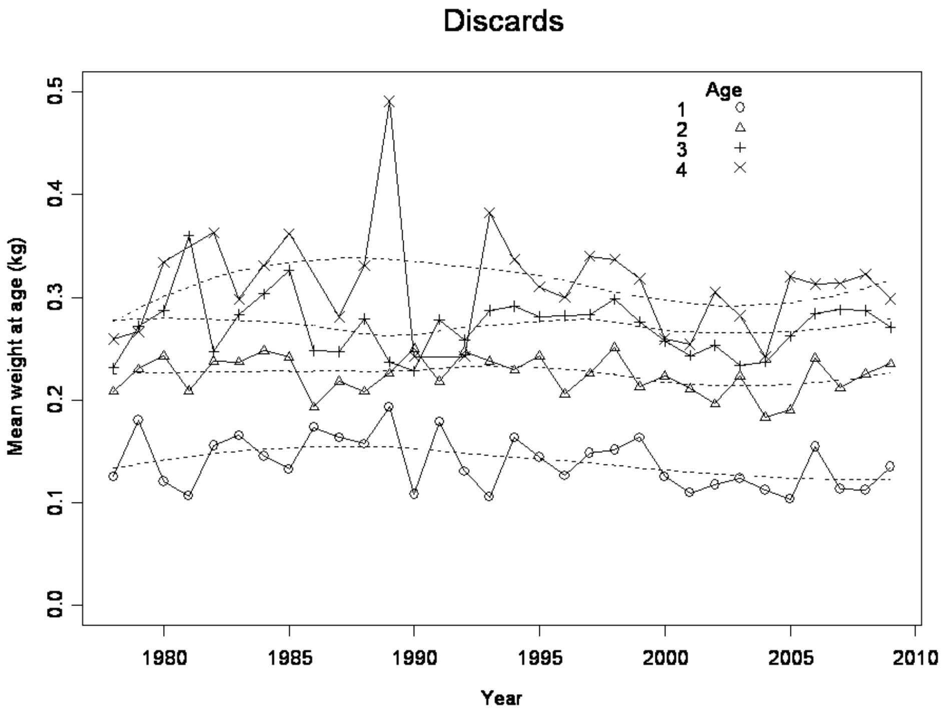

Figure 3.3.3. Haddock in Division VIa. Mean weights-at-age (kg) in discards. Dotted lines show Loess smoothers fitted through each time-series at age. For clarity, only ages 1–4 are shown here.

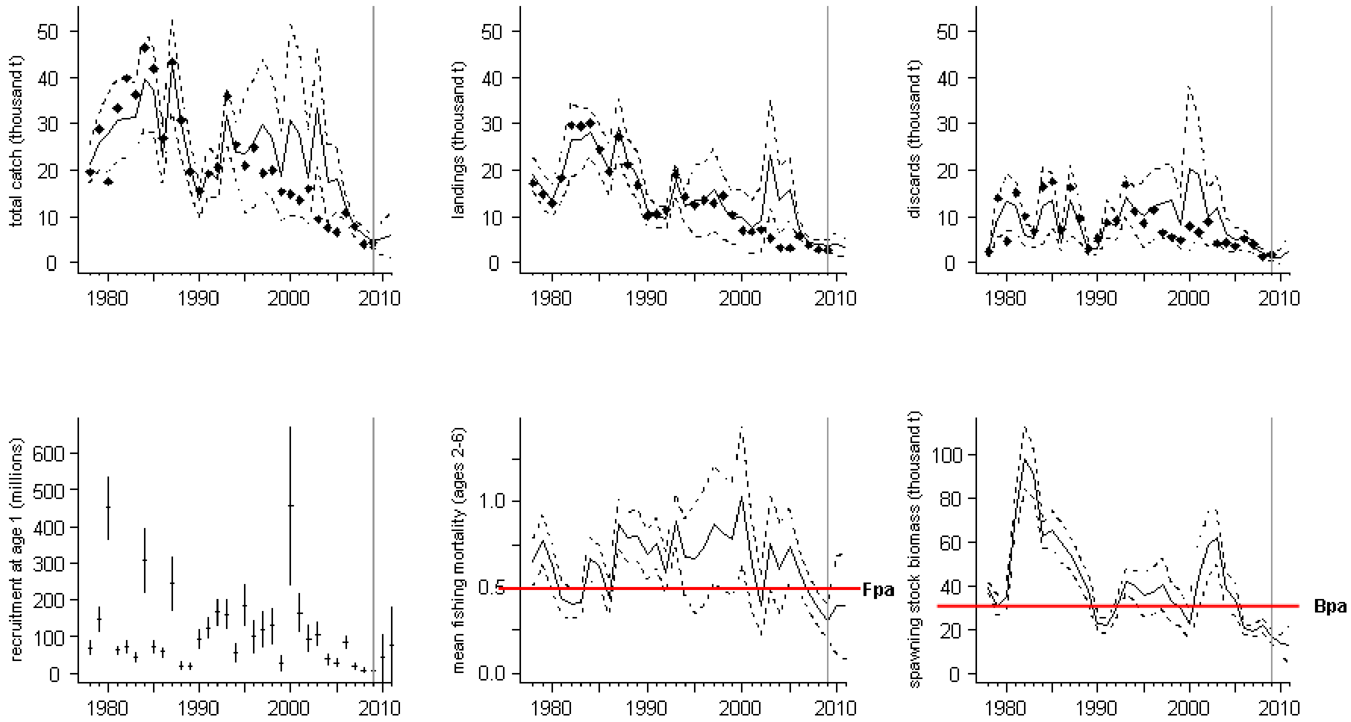

Figure 3.3.4. Haddock in Division VIa. TSA stock summaries from the final run with catch data included 1978–1994 and 2006–2009. Estimates are plotted with approximate point-wise 95% confidence bounds. Dots indicate observed values for catch, landings and discards. The vertical line in each plot delineates the last year of the historical assessment (2009): estimates to the right of these vertical lines are TSA-based forecasts.

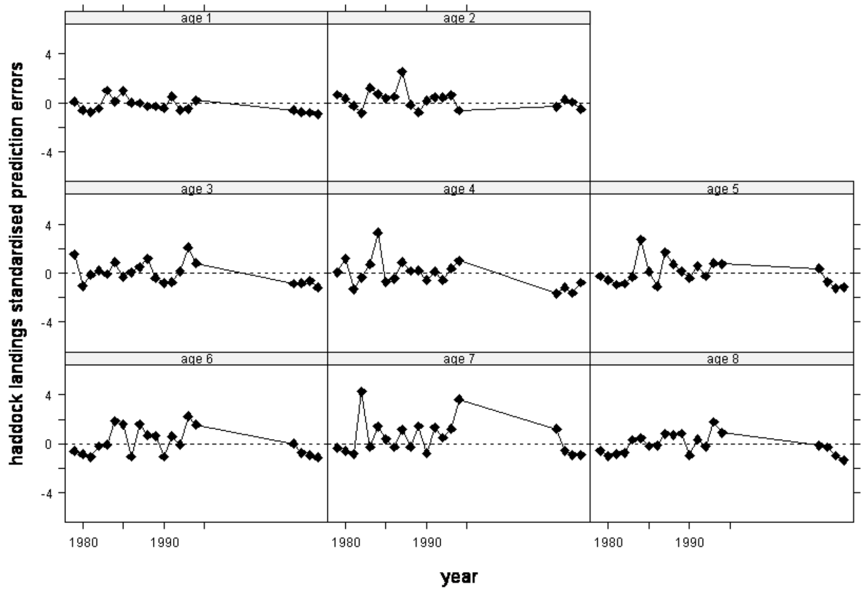

Figure 3.3.5. Haddock in Division VIa. Standardised landings prediction errors from the final TSA run.

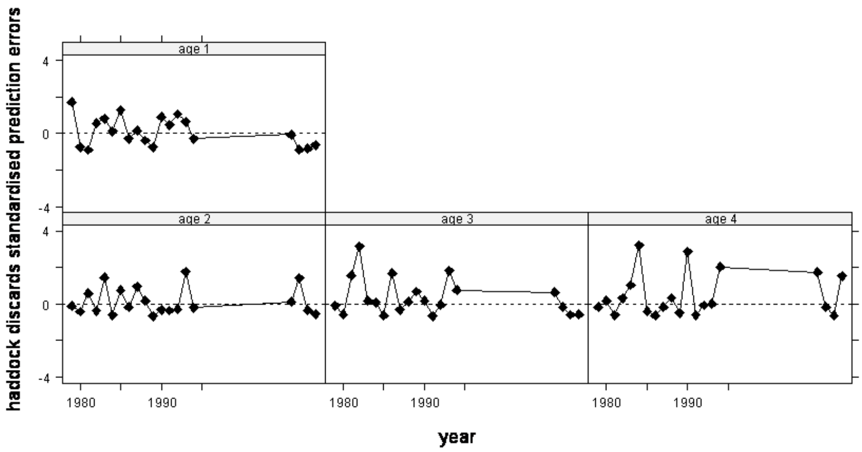

Figure 3.3.6. Haddock in Division VIa. Standardised discards prediction errors from the final TSA run.

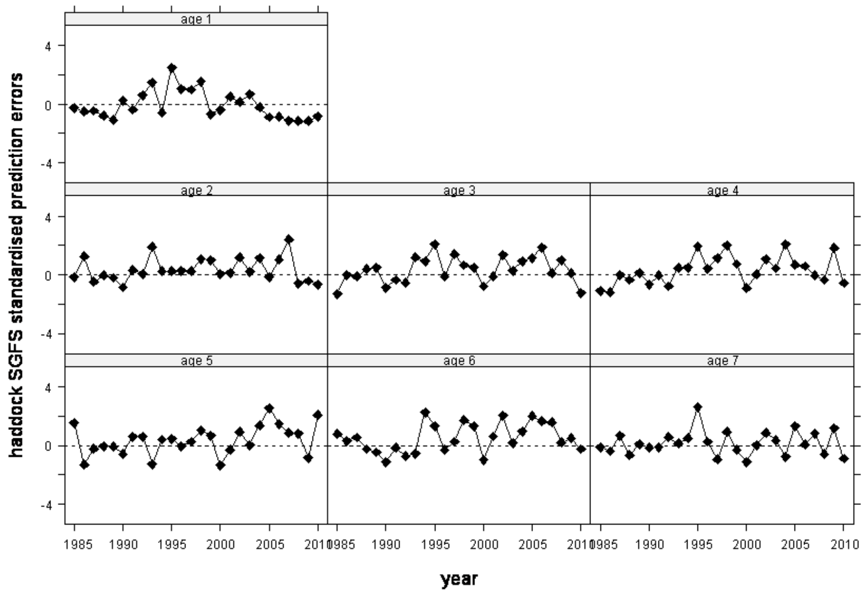

Figure 3.3.7. Haddock in Division VIa. Standardised ScoGFS Q1 prediction errors from the final TSA run.

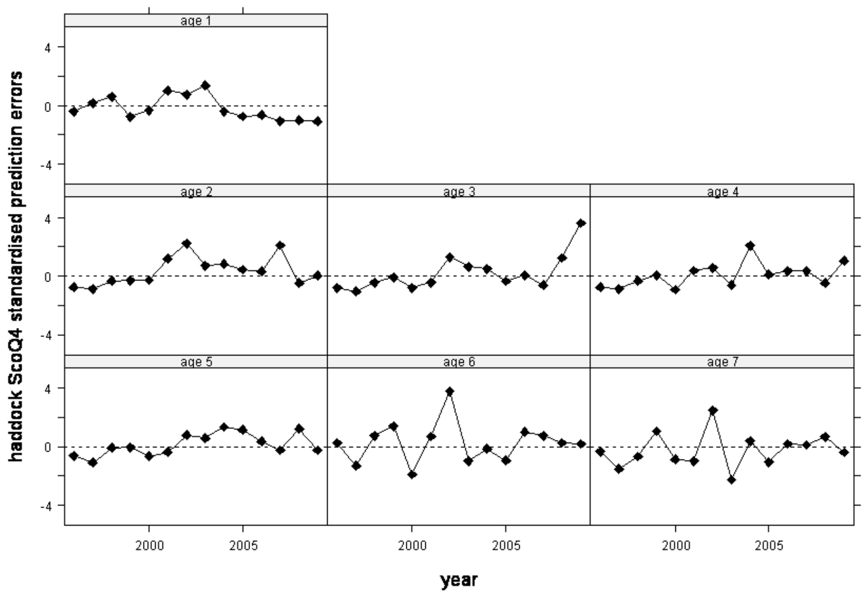

Figure 3.3.8. Haddock in Division VIa. Standardised ScoGFS Q4 prediction errors from the final TSA run.

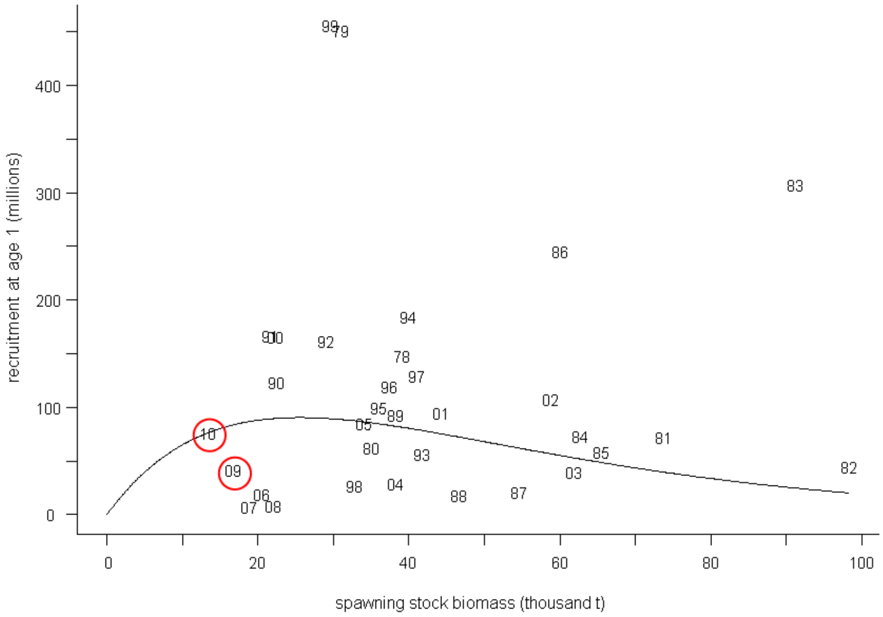

Figure 3.3.9. Haddock in Division VIa. Stock–recruit plot from the final TSA run, points labelled as year classes. Predicted recruitments are circled: for the 2008 year-class recruiting in 2009 (using ScoGFS Q1 data); and the 2009 year-class recruiting in 2010 (based on the underlying Ricker model).

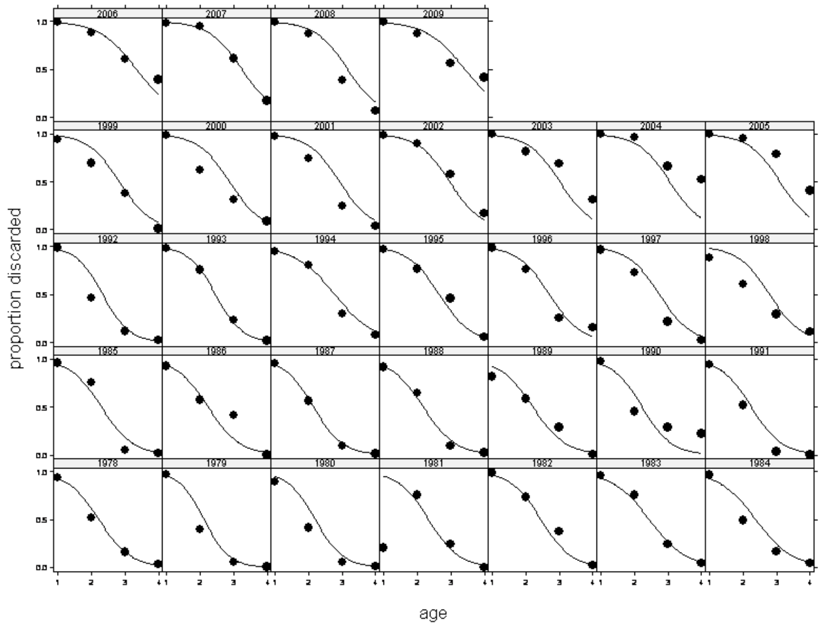

Figure 3.3.10. Haddock in Division VIa. Fitted (lines) and observed (dots) discard proportions-at-age from the final TSA run.

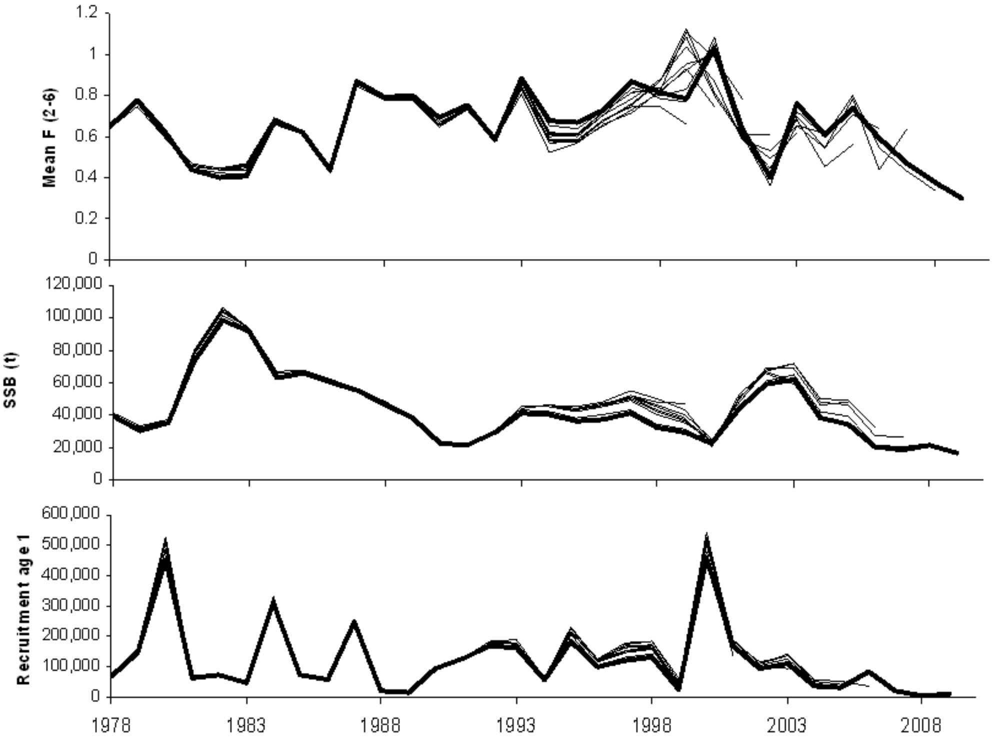

Figure 3.3.11. Haddock in Division VIa. Estimates of Mean $F_{2\text{-}6}$, SSB and recruitment from retrospective TSA runs.

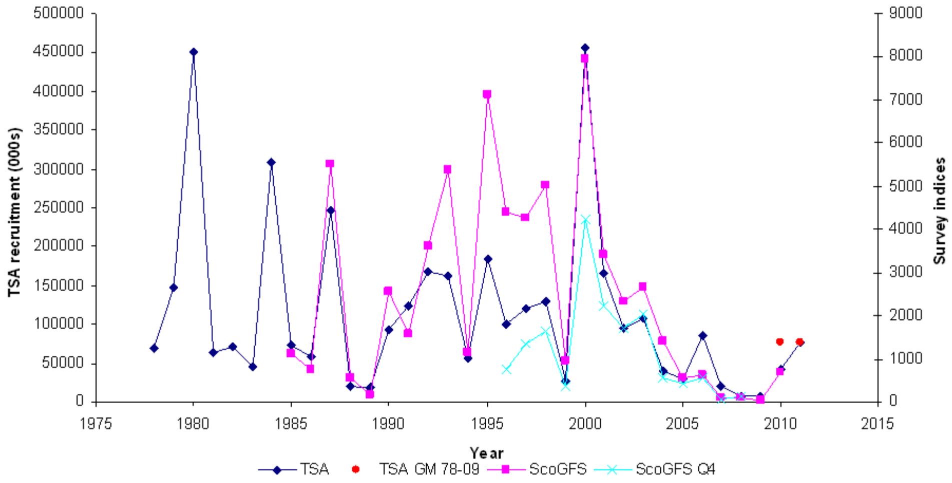

Figure 3.3.12. Haddock in Division VIa. Time-series of recruitment-at-age 1 from the final TSA assessment, along with the long-term (1978–2009) geometric mean and the age-1 indices from the Q1 and Q4 ScoGFS survey-series.

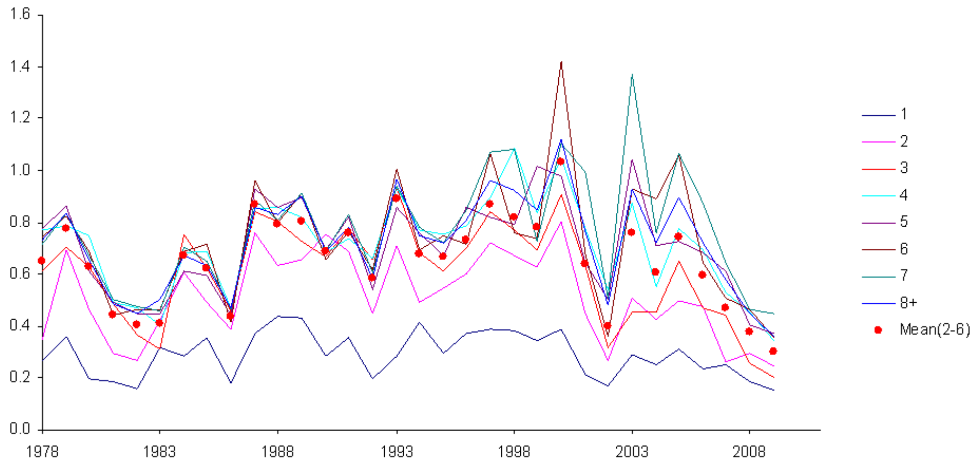

Figure 3.3.13. Haddock in Division VIa. Time-series of estimated fishing mortality-at-age, along with the mean over ages 2–6.

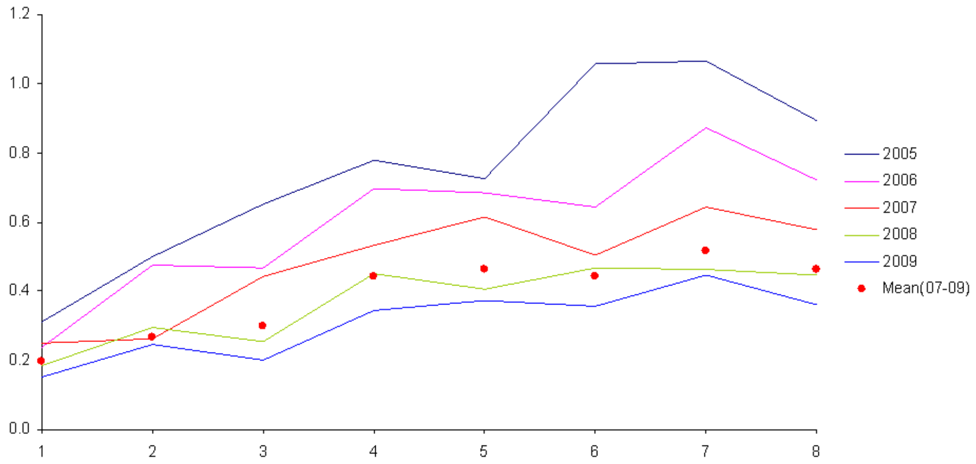

Figure 3.3.14. Haddock in Division VIa. Candidates for fishing mortality-at-age in short-term forecasts. Lines labelled 2005, 2006, 2007, 2008, 2009 indicate the TSA estimates for those years. Points marked 2009 TSA and 2010 TSA show the TSA-generated forecast values from the final assessment.

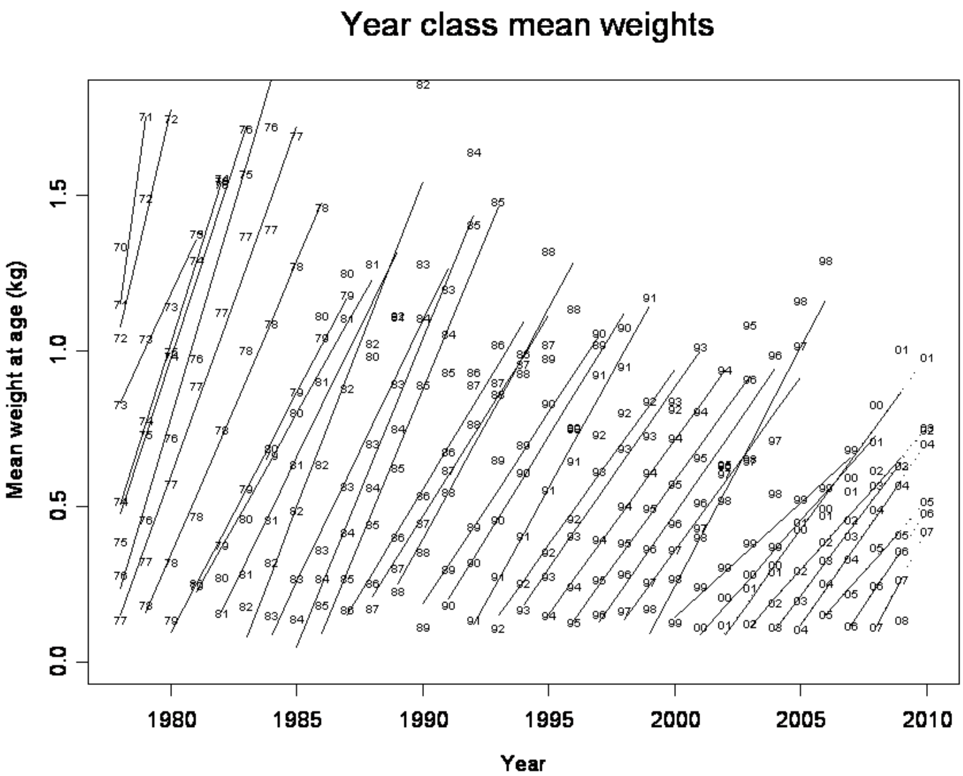

Figure 3.3.15. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (or stock), tracked by year class with a linear model fit. Predicted weights in 2010 based on linear model fits indicated with the dotted lines.

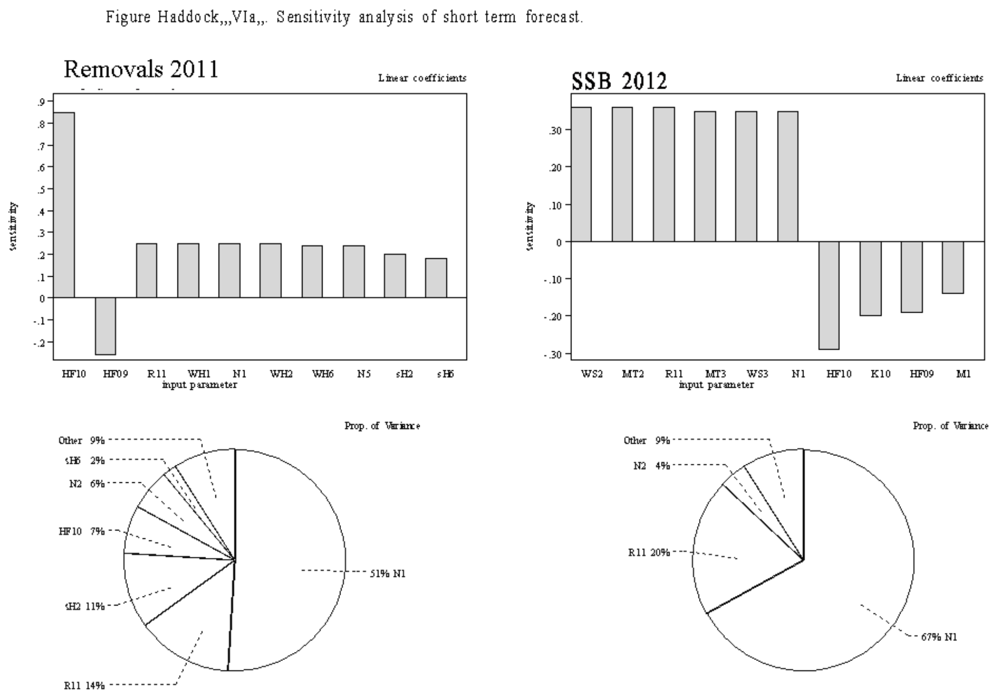

Figure 3.3.16. Haddock in Division VIa. Sensitivity analysis of short-term forecast.

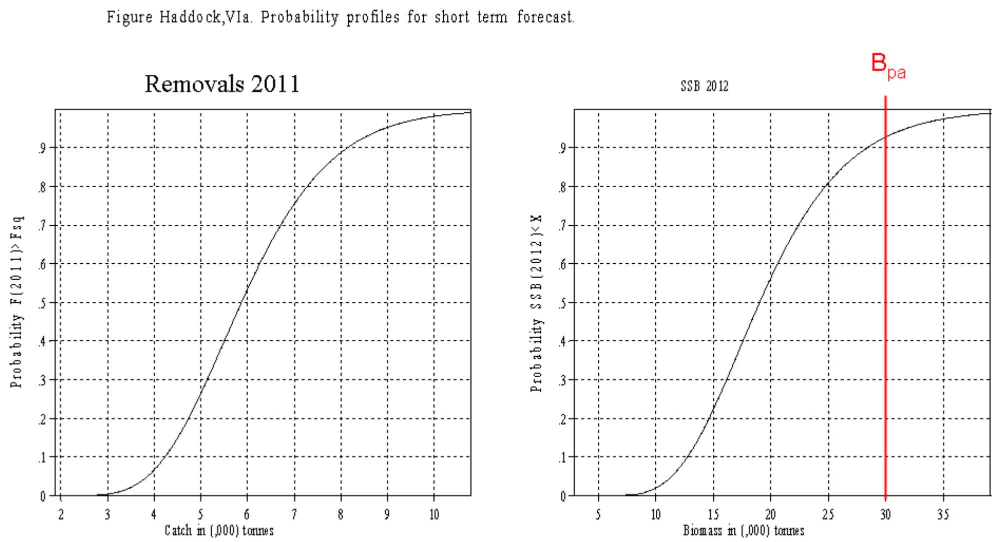

Figure 3.3.17. Haddock in Division VIa. Probability profiles for short-term forecast.

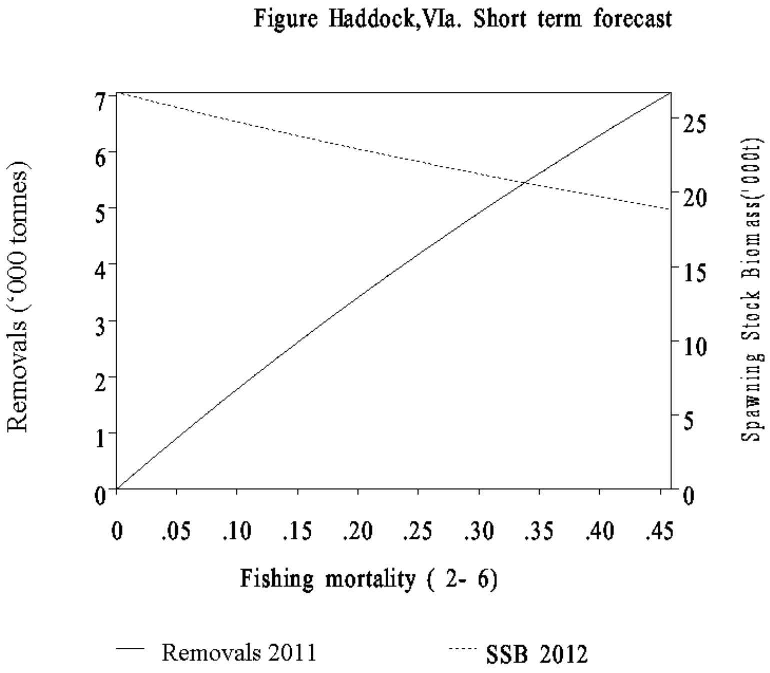

Figure 3.3.18. Haddock in Division VIa. Summary of short-term forecast.

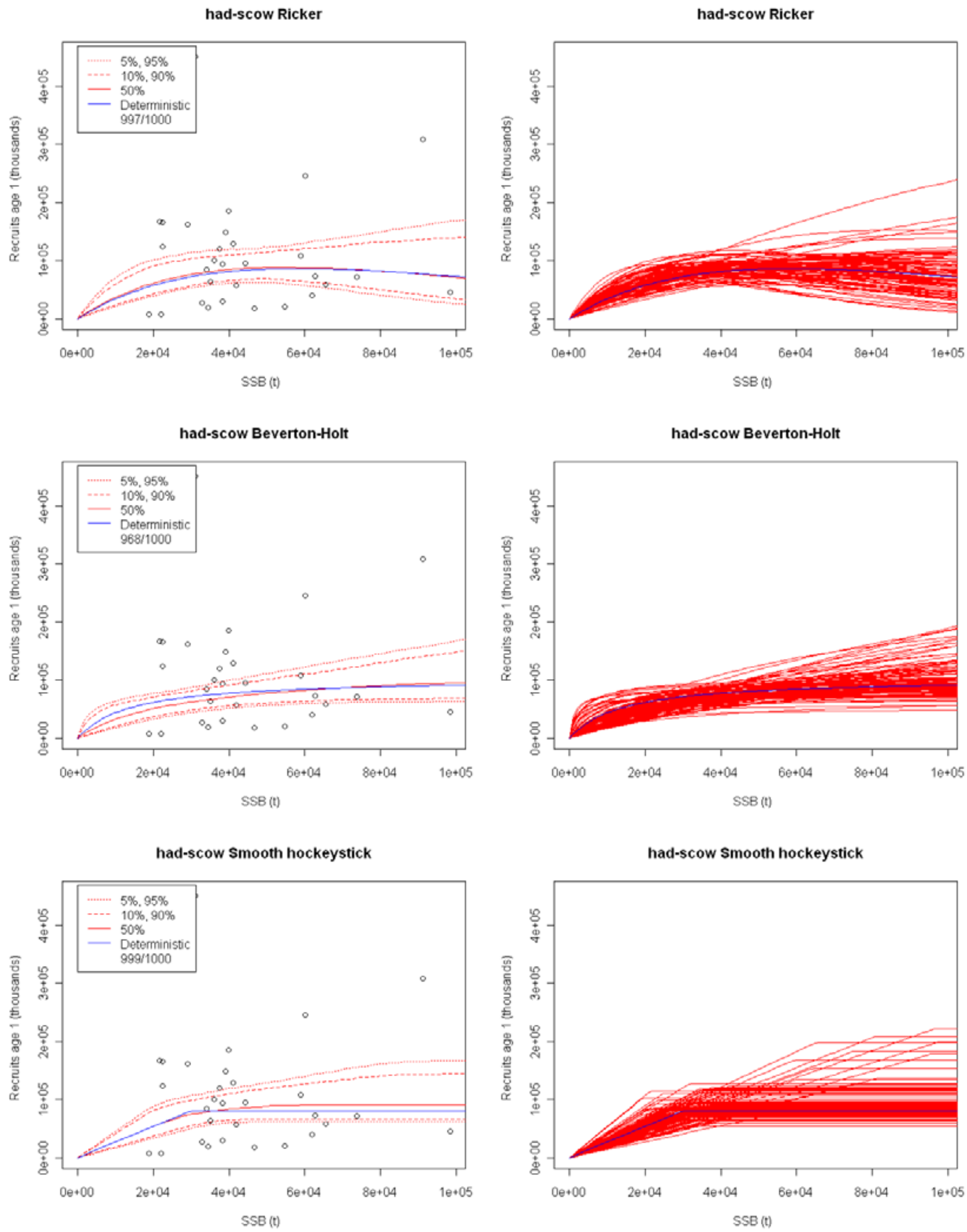

Figure 3.3.19. Model fits from FMSY exploration based on the 2010 assessment.

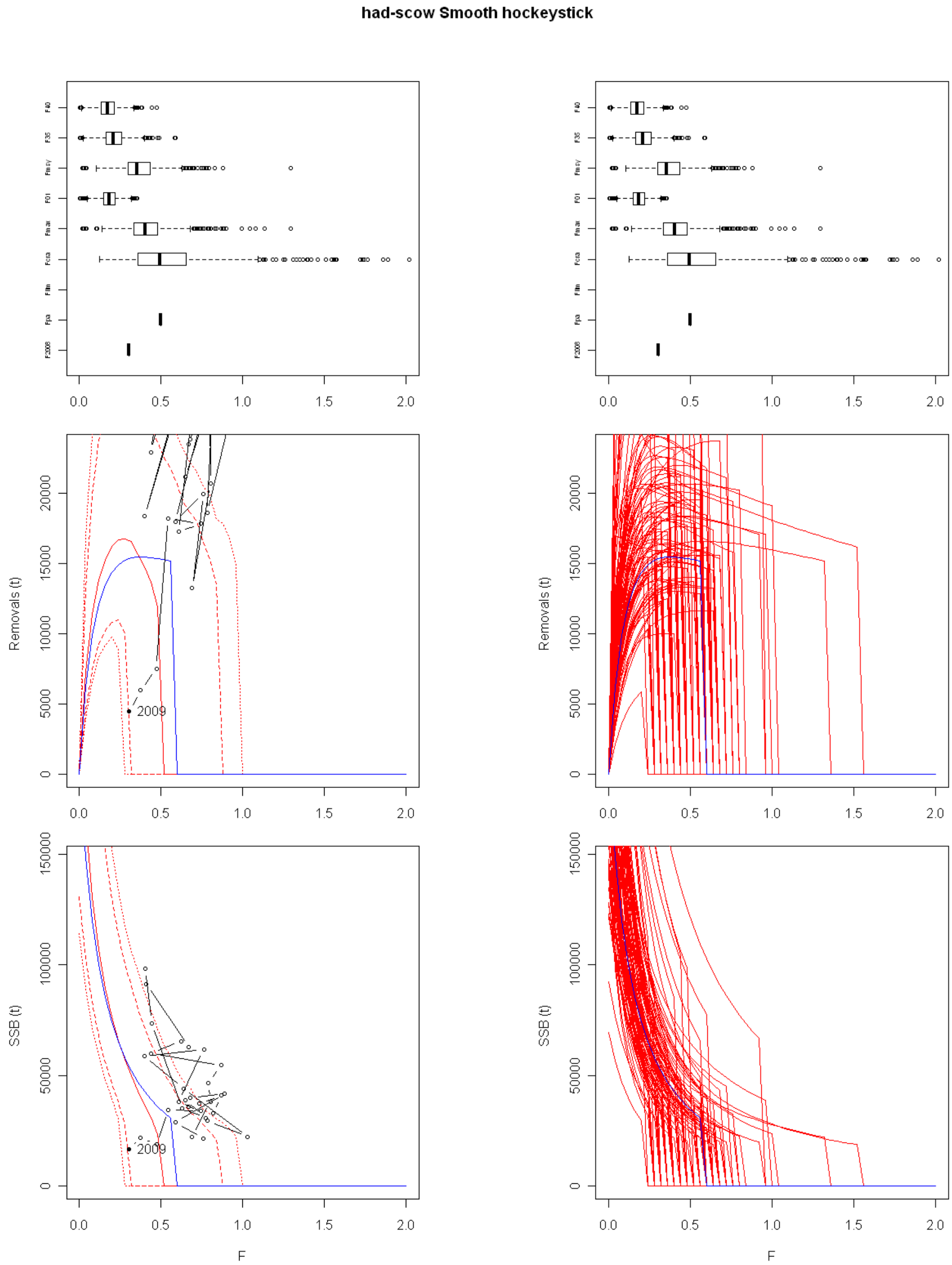

Figure 3.3.20. Estimates of FMSY and other reference points based on the Smooth Hockey stick stock–recruitment relationship.

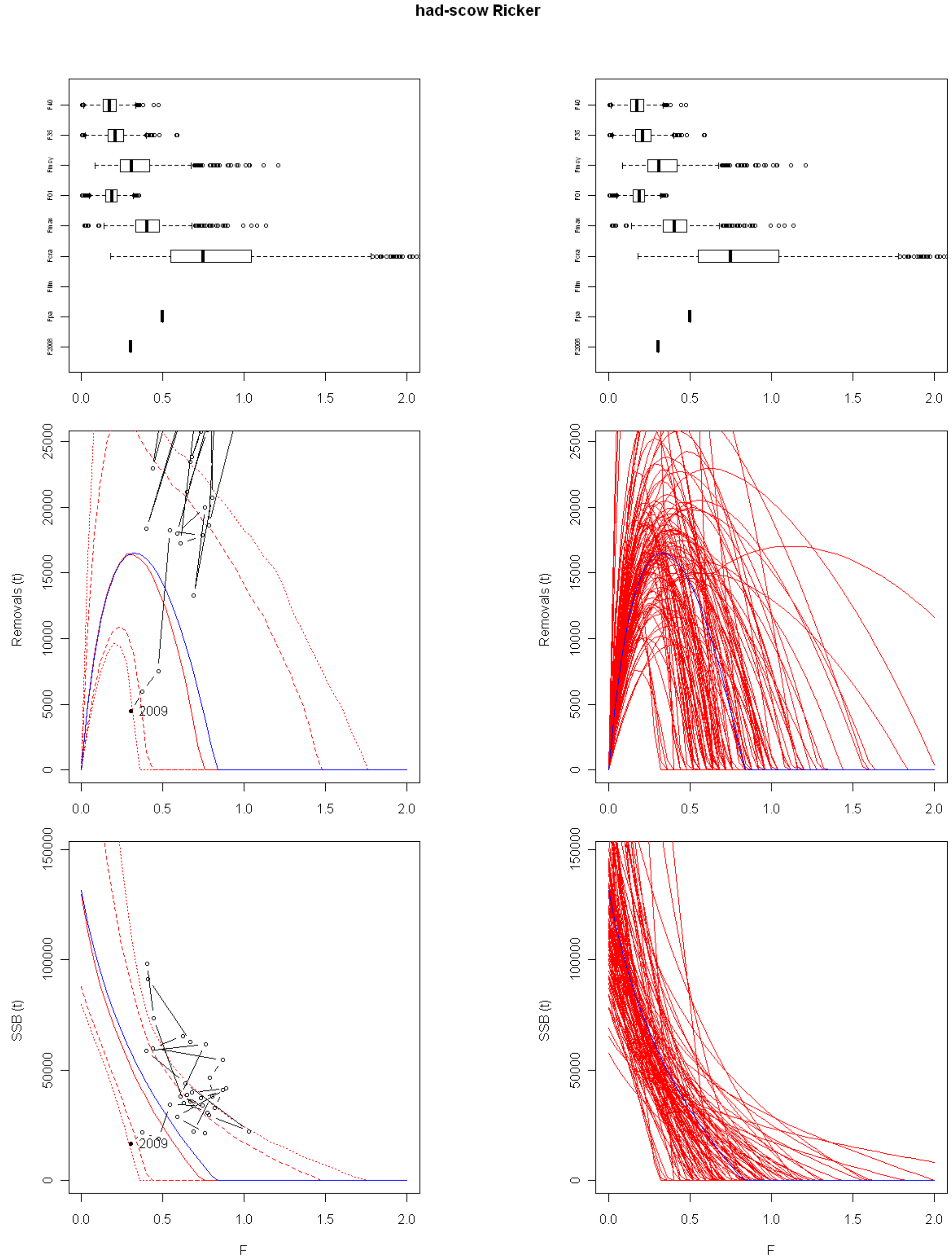

Figure 3.3.21. Estimates of FMSY and other reference points based on the Ricker stock–recruitment function.

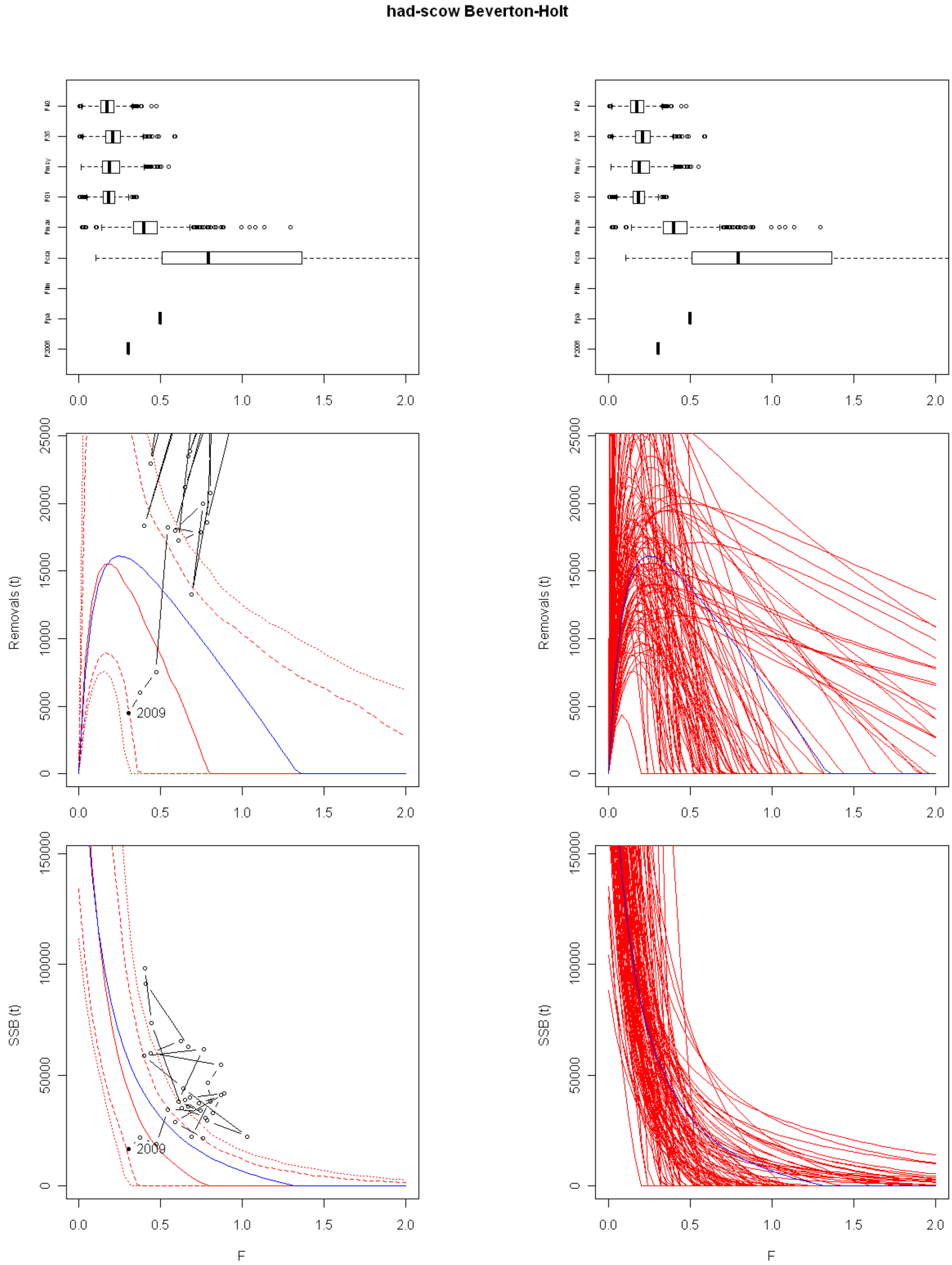

Figure 3.3.22. Estimates of FMSY and other reference points based on the Beverton and Holt stock–recruit function.

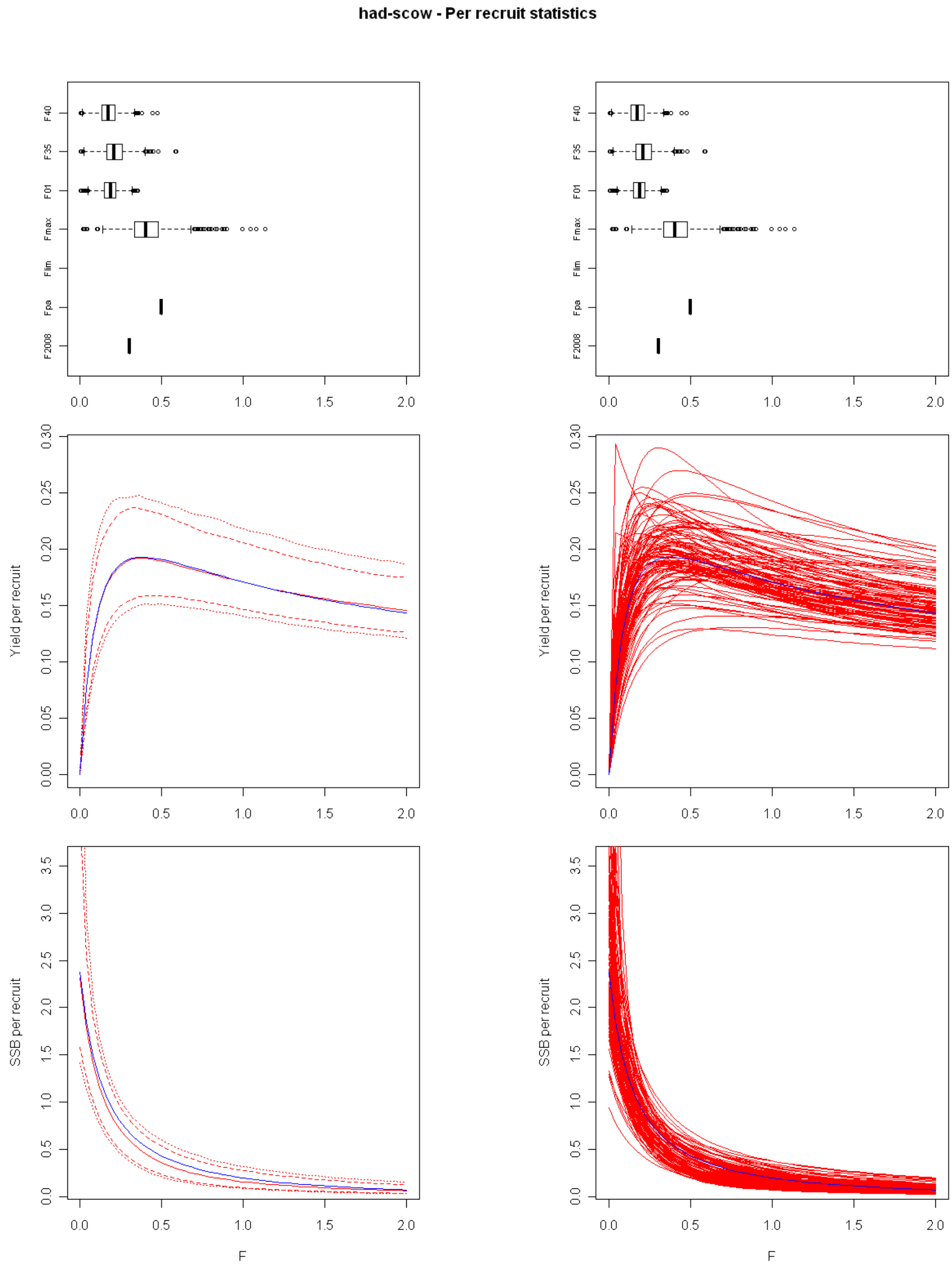

Figure 3.3.23. Reference points, yield-(removals) per-recruit and SSB per recruit analyses.

3.4. Whiting in Subarea VIa

Type of assessment in 2010

As agreed at this year's meeting of ACOM, assessment is being updated for whiting in Division VIa this year, following two years (2008 and 2009) when no advice was provided. Earlier, ACFM review groups (RGNSDS) highlighted the various data problems associated with this stock; including noisy survey data and discard data which need to be reworked. Their conclusion in 2006 was that:

> Until revised Scottish discards are available and Irish discards included, a formal analytic assessment is not possible for this stock.

The assessment presented by the WG this year is therefore based only on survey data which is the same approach as that adopted in the 2007 assessment.

ICES advice applicable to 2009 and 2010

In 2006, the ICES Advice for 2007 in terms of single stock exploitation boundaries was as follows:

> *Exploitation boundaries in relation to precautionary limits*

"*Given that SSB is estimated at the lowest observed level and total mortality at the highest level over the time period, catches in 2007 should be reduced to the lowest possible level.*"

The Advice given since then has been the same (see Table with the ICES Advice during 2001–2010 below).

3.4.1 General

Stock description

General information is now located in the Stock Annex.

Management applicable to 2009 and 2010

The TAC for whiting is set for ICES Subareas VI, XII and XIV and EU and international waters of ICES Subdivision Vb, and for 2010 was as shown below:

Species: Whiting *Merlangius merlangus*		Zone: VI; EU and international waters of Vb; international waters of XII and XIV (WHG/561 214)
Germany	3	
France	53	
Ireland	129	
United Kingdom	246	
EU	431	
TAC	431	Analytical TAC

The following table summarises ICES advice and actual management applicable for whiting in Division VIa during 2001–2010:

Year	Single species exploitation (tonnes)	Basis for single species	TAC for Vb, VI, XII, XIV (tonnes)	% change in F associated with TAC[1]
2001	< 4200	Reduce F below F_{pa}	4000	-40%
2002	< 2000	SSB > B_{pa} in short term	3500	-40%
2003	-	SSB > B_{pa} in short term	2000	-60%
2004	-	SSB > B_{pa} in 2005	1600	(no assessment)
2005	-	-	1600	(assessment in relative trends only)
2006	-	-	1360	(assessment in relative trends only)
2007	0	Reduce catches to lowest possible level	1020	(assessment in relative trends only)
2008	0	Reduce catches to lowest possible level	765	(no assessment)
2009	0	Reduce catches to lowest possible level	574	(no assessment)
2010	0	Reduce catches to lowest possible level	431	(assessment in relative trends only)

[1] Based on F-multipliers from forecast tables.

The minimum landing size for whiting in Division VIa is 27 cm.

Fishery in 2009

A description of the fisheries on the west of Scotland is given in Section 3.1.

Tables and figures of total effort to 2006 by the fleets operating in Division VIa can be found in Section 16 of the Report of WGNSDS 2007.

Anecdotal information from the fishing industry suggests that the number of vessels targeting whiting continues to be very low. However, the recent low TACs combined with increased interest in bigger whiting (driven by good prices) has resulted in an increasing uptake of the whiting quota. The quota for UK vessels in 2009 was slightly exceeded (by 9%, compared to 84% and 49% of the quota taken up in 2008 in 2007, respectively, with post regulation quota swaps not being taken into account). Total landings in 2009 were 488 t, up slightly from 2008 (Table 3.4.1). These are above the lowest recorded landings of 2005, but continue to be far below the long-term average.

The total estimated international catch of ages 1–7+ in 2009 was 905 t of which approximately 417 t were discards (Table 3.4. 2). An additional 417 t of 0-gp fish were also estimated to be discarded. Although both the catch and discards in 2009 were higher than those in 2007 and 2008, they are still the third lowest in the respective time-series.

Mandatory introduction of larger square mesh panels for the Nephrops fleet in 2008 may be partially responsible for the relatively low catch and discards of whiting in

Division VIa. Despite the increase in discards in 2009, discarding is expected to remain low or to decline in subsequent years following the mandatory increase in mesh size to 120 mm for vessels fishing in the mixed demersal fishery in 2009.

3.4.2 Data

Landings

Total landings, as officially reported to ICES in 1965–2009, are shown in Figure 3.4. 1. There have been concerns that the quality of landings data is deteriorating, giving a possible reason for the different stock dynamics implied by the commercial fleet and the annual survey (ScoGFS) in recent years (see Section 5.1.6.1.3 in the 2005 WG Report). The introduction of UK and Irish legislation requiring registration of all fish buyers and sellers may mean that the reported landings from 2006 onwards are more representative of actual landings.

Details on nations which supply data and sampling levels are given in Table 2.1. Age distributions were estimated from market samples. Annual numbers-at-age in the landings are given in Table 3.4.3. Annual mean weights-at-age in the landings are given in Table 3.4.6 and shown in Figure 3.4.2.

Discards

Annual numbers-at-age in the discards are given in Table 3.4.4. Annual mean weights-at-age in the discards are given in Table 3.4.7 and shown in Figure 3.4.2.

This year, WG estimates of discards are based on data collected in the Irish and Scottish discard programme (raised by weighted average to the level of the total international discards). Discard age compositions from Scottish and Irish samples have been applied to unsampled fleets. Work is underway to revise the Scottish discard estimates with an aim to reduce bias and increase precision. Such revisions are particularly important for the estimation of total catch for this stock which has very high discards across a wide age range. A working document set out the methodology of this work at the 2004 meeting of WGNSDS (Fryer and Millar, 2004).

Biological

Annual numbers-at-age in the total catch are given in Table 3.4.5. Annual mean weights-at-age in the total catch are given in Table 3.4.8. As in previous meetings, the catch mean weights-at-age were also used as stock mean weights-at-age (see Stock Annex).

Values for natural mortality (0.2 for all ages and years) and the proportion of fish mature-at-age (knife-edged at age 2 for all years) are unchanged from the last assessment. Also as in the 2007 assessment, the proportion mature before spawning and the proportion fished before spawning are both set to be zero.

Surveys

Four research survey indices for whiting in VIa were also available:

- Scottish west coast groundfish survey (ScoGFSQ1): ages 1–7, years 1985–2010.
- Irish west coast groundfish survey (IreGFS): ages 0–5, year 1993–2002.
- Scottish fourth-quarter west coast groundfish survey (ScoGFSQ4): ages 0–8, years 1996–2009.

- Irish groundfish survey (IRGFS): ages 0–6; years 2003–2009.

For the Scottish surveys, a new vessel and gear were used from 1999. The catch rates as presented are corrected for the change in vessel and gear. The basis for the correction is comparative trawl haul data (Zuur et al., 2001). The Irish quarter four survey was discontinued in 2003 and has been replaced by a new survey. The replacement survey (IRGFS) has been running for seven years. The Scottish quarter four survey was presented for the first time to WGNSDS 2005.

The survey-series are described in the Report of the 2009 IBTSWG and also in the Stock Annex. For all survey series, the oldest age given represents a true age, rather than a plus group. The survey indices are shown in Table 3.4.9 with data used in the final assessment highlighted in bold. The sum over ages 1–7 of the Scottish fourth-quarter west coast groundfish survey indices amounted to 64% and the sum of the Scottish first-quarter west coast groundfish survey indices to 60% of the average in the respective time-series. Both sums were a two-fold increase over the previous year. The spatial distribution of cpue from the two Scottish surveys in 2009 and 2010 have been provided in the Stock Annex.

Commercial cpue

Four commercial catch-effort dataseries were available to the WG including:

- Scottish light trawlers (ScoLTR): ages 1–7, years 1965–2005;
- Scottish seiners (ScoSEI): ages 1–6, years 1965–2005;
- Scottish Nephrops trawlers (ScoNTR): ages 1–6, years 1965–2005;
- Irish Otter Trawlers (IreOTB); ages 1–7, years 1995–2005.

Given the problems with non-mandatory effort reporting in the UK (described further in the report of WGNSSK for 2000, ICES CM 2001/ACFM:07), these cpue series have not been used for a number of years and are not presented in the Report. They are retained in the Stock Annex.

3.4.3 Historical stock development

The assessment is based only on survey data and is conducted using SURBA.

Data screening and exploratory runs

Software used: SURBA 3.0

Model Options chosen: one or two tuning series used in one run

Input data types and characteristics:

- ScoGFSQ1: lambda=1, equal catchabilities at age, ages 1–6, all available years, mean Z range 2–4
- ScoGFSQ4: lambda=1, equal catchabilities at age, ages 1–6, all available years, mean Z range 2–4

Software used: FLXSA 2.0

Input data types and characteristics:

- Catch data, ages 1–7+, years 1965–2009,
- ScoGFSQ1: lambda=1, equal catchabilities at age, ages 1–6, years 1995–2009.

Owing to uncertainties in catch-at-age data the WG only used commercial catch data to provide stock weights-at-age for this year's assessment.

Of the four survey-series available, only the two Scottish surveys were considered further. The new Irish survey (IRGFS) is relatively short (7 years data) to give useful information on stock trends while the Irish west coast groundfish survey (IreGFS) has been discontinued. In addition, the sub-sampling protocol of the IreGFS was altered mid-way through the survey and therefore there are doubts about the consistency of this series. The Irish series were therefore not considered further.

A comparison of scaled (standardised to z-scores) survey indices (from ScoGFSQ1 & ScoGFSQ4) at age show similar trends for most ages (up to age 5, Figure 3.4.3).

Log mean-standardised survey indices by year class and by year and scatter-plots of indices within year classes are shown in Figures 3.4.4, 3.4.5 and 3.4.6. The year-class plots for both surveys are quite noisy and the ability of these surveys to reliably track year-class strength is generally poor. In addition, some of the correlations for the older ages in the ScoGFSQ1 scatterplot are negative, while the equivalent plots of the ScoGFSQ4 survey show very scattered data points. Age 0 in ScoGFSQ4 appears to be a particularly poor measure of year-class strength (little evidence of positive correlation) and is therefore excluded in further analysis of this survey. There are no marked year effects. The log catch curves for these surveys along with those for the catch are shown in Figure 3.4.7. The curves for both ScoGFSQ1 and ScoGFSQ4 are relatively linear and not very noisy, and show a fairly steep and consistent drop in abundance.

The trawl survey data (ScoGFSQ1 and ScoGFSQ4) for West of Scotland whiting were extensively analysed at WGNSDS 2005–2007 using both SURBA 2.2 and SURBA 3.0 to look at consistency of output using a variety of age ranges, smoothing parameter values, relative catchabilities and weighting factors. Initial single fleet SURBA runs this year therefore used the model settings that were chosen in 2007 with the extension of the age range for ScoGFS4 to 1–6 (as compared to ages 1–5 in the 2007 runs). This year only SURBA (version 3.0) was used to carry out the survey-based analysis; FLSURBA could not be run due to incompatibility of its available versions with the recent R versions (in 2007, both SURBA and FLSURBA were run).

The summary output of mean Z (2–4), recruitment and biomass from the SURBA run for ScoGFSQ1 is shown in Figure 3.4.8 with the residuals illustrated in Figure 3.4.9. Model residuals are large for some age classes in some years, but with the exception of age 1, do not show any particular trends or non-randomness. Little systematic retrospective bias is apparent in the stock trends although the estimates for recruitment show some variability (Figure 3.4.10). The mean Z (2–4) estimates from this run show large fluctuations over the examined period. Choosing larger values for the smoothing parameter (lambda) smoothed out the fluctuations in mean Z, but the runs showed much worse retrospective patterns (not shown).

The WG had some difficulty in applying the SURBA model to the ScoGFSQ4 survey in the 2007 runs. These problems were also present this year. The summary output for a run with the settings given above is shown in Figure 3.4.11 and the residuals in Figure 3.4.3.12. Some trends are similar to those obtained with the ScoGFSQ1 data. For total mortality, the trends are similar during 1996–2006 and after 2006, the trends are different. Model residuals are noisy, but show no particular trends or non-randomness. No retrospective plots could be produced as some values were extremely high. The ScoGFSQ4 survey is a relatively short time series (in comparison to ScoGSQ1), without particularly good internal consistency or strong year-class signals and this may be the reason for the poor retrospective performance.

Since the two surveys appear to be implying consistent stock trends over some periods, a multifleet SURBA was also explored. The output was similar to that obtained with ScoGFSQ1 survey (not shown), but the residuals were noisy and over the year range when data are available from both surveys (1996–2009), there were some obvious problems with the model fit: virtually all residuals for the ScoGFSQ1 survey were negative while those for the ScoGFSQ4 survey were positive (not shown). The multifleet SURBA run was therefore not considered further.

In addition to SURBA runs, XSA was carried out with the ScoGFSQ1 survey. Despite the lack of independent discard estimates for the pre-1978 period, the whole catch data series (1965–2009) was used in the XSA run. The best performance was observed with the tuning series trimmed to 1995–2009. The output from XSA was compared with the SURBA run (for ScoGFSQ1) outputs, both being mean-standardised over the period 1995–2009 (Figure 3.4.13). There are substantial differences between the two outputs in the early period (from the mid-1980s to the mid-1990s), and there is more agreement between them from the mid-1990s onwards. Both models indicate a decline in mortality to low levels from 2004 to around the lowest in the time-series.

Final update assessment

The SURBA run using ScoGFSQ1 data for ages 1–6 is presented as the final assessment run given that it shows less retrospective problems than the ScoGFSQ4 survey. The SURBA model settings for the final run are given below:

Software used: SURBA 3.0

Model Options chosen: one tuning-series used

Input data types and characteristics:

- ScoGFSQ1: lambda=1, equal catchabilities at age, ages 1–6, all available years, mean Z range 2–4

These settings are the same as in the 2007 assessment. The output file from this run is given in Table 3.4.10. Trends in Z, recruitment and SSB from this run are shown in Figure 3.4.8. The residuals are shown in Figure 3.4.9 and the retrospective in Figure 3.4.10. The level of SSB estimated in 2010 remains low and is comparable with that in 2009. Recruitment is estimated to have been very low in recent years, but the estimate for 2010 shows a considerable increase (by a factor of five) compared to 2009. Mean Z shows a decline from 2004 with relatively stable (though uncertain) levels in the recent years.

3.4.4 Short-term projections

No short-term predictions were made by this WG.

3.4.5 Medium-term projections

Stochastic medium-term predictions were not made at this WG because the assessment is considered only to be indicative of stock trends.

3.4.6 MSY explorations

No catch-based assessment was presented at the WG this year. The general lack of clear trends for the stock prevents using the final run output as the basis for advice.

3.4.7 Biological reference points

ICES considers that B_{lim} is 16 000 t and B_{pa} be set at 22 000 t. ICES proposes that F_{lim} is 1.0 and F_{pa} be set at 0.6.

The Working Group attempted a yield-per-recruit analysis with the output from the final SURBA run (Figure 3.4.14). $F_{0.1}$ was estimated at around 0.3 and F_{max} at around 0.5, but it is unclear how stable these estimates are in the long term. The WG considers that yield-per-recruit F reference points are not applicable due to the uncertainty in historical stock trends.

3.4.8 Management plans

There are no specific management objectives or a management plan for this stock, but a plan is under development.

3.4.9 Uncertainties and bias in the assessment and forecast

The most significant problem with assessment of this stock is with commercial data. Incorrect reporting of landings (species and quantity) is known to occur and directly affects the perception of the stock. XSA is strongly influenced by estimated total catch data. Thus a survey-based assessment was used.

The survey data and commercial catch data contain different signals concerning the stock. The data since the mid-1990s are fairly consistent to conduct a catch-at-age analysis tuned with survey data. However, due to the discrepancy present in the earlier period, the Working Group considers that it is not possible to evaluate the current state of the stock with reference to precautionary reference points. A similar problem has been present in the North Sea whiting stock (as reported by WGNSSK 2010). Three potential sources of this discrepancy were identified for the North Sea stock, and they may apply to whiting in VIa as well: bias in catch estimates, changes in survey catchability or changes in natural mortality due to predation or regime shift (WGNSSK 2010).

Long-term information on the historical yield and catch composition indicates that the present stock size is low. The current assessment indicates (as the assessment carried out in 2007 did) that the stock is historically at a very low level. Total mortality has been declining over the past few years, but the most recent trends are unclear. The sum of the Scottish west coast groundfish survey indices (both in quarter one and quarter four) is also low, but shows an increase from 2008 onwards. The persistence of this trend should be verified in subsequent assessments.

3.4.10 Recommendation for next Benchmark

Catch-based assessment may potentially be a reliable basis for determining the status of the whiting stock in VIa. Currently, the main problem is the discrepancy between survey and catch data prior to 1995. Unless this discrepancy can be resolved, truncating the catch data from 1995 may be an option, which proved satisfactory in exploratory XSA runs carried out at this working group. Given the new legislation on reporting landings, the quality of landings data is likely to continue to improve.

The potential for improvement in the quality of survey data needs to be investigated. The issue of changes in survey catchability needs to be addressed. The location of sampling stations may be reconsidered to better match the distribution of commercial landings.

3.4.11 Management considerations

Recruitment during the 1990s appears to have been high while more recently, it has been below average. There is an indication of a stronger 2009 year class following historically low recruitment of 2006 to 2008 year classes.

This year's assessment estimates SSB to remain at a low level, only marginally higher than the SSB observed in 2006–2008. Total mortality also remains low with uncertain developments. The perception of the state of this stock (as estimated from this assessment) appears not to have changed much, except for recruitment, from last year.

Whiting are caught in mixed fisheries with cod and haddock in VIa. Management of whiting will be strongly linked to that for cod for which there is an ongoing recovery plan (Council Regulation (EC) 1342/2008). There have also been several technical conservation measures introduced in the VIa gadoid fishery in recent years including the mandatory increases in mesh size to 120 mm.

Whiting are caught mainly as a bycatch species and there are no targeted fisheries for this stock, making direct management difficult. Whiting are caught and heavily discarded in small meshed fisheries for *Nephrops*. Any management measures which may result in a shift of vessels to these smaller mesh sizes will therefore result in a worse exploitation pattern and higher discards.

3.4b Whiting in Subarea VIb

Officially reported landings are given in Table 3.5.1.

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Table 3.4.1. Nominal landings (t) of WHITING in Division VIa, 1989–2009, as officially reported **to ICES.**

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	1	-	+	-	+	+	+	-	1	1	+	-	-	-	-	+	-	-	-	-	-
Denmark	1	+	3	1	1	+	+	+	+	-	-	-	-	-	+	+	-	-	-	-	-
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+
France	199	180	352	105	149	191	362	202	108	82	300	48	52	21	11	6	9	7	1	3	1
Germany	+	+	+	1	1	+	-	+	-	-	+	-	-	-	-	-	-	+	1	-	-
Ireland	1,315	977	1,200	1,377	1,192	1,213	1,448	1,182	977	952	1,121	793	764	577	568	356	172	196	56	69	125
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Spain	-	-	-	-	-	-	1	-	1	2	+	-	2	-	-	-	-	-	-	-	-
UK (E, W & NI)	44	50	218	196	184	233	204	237	453	251	210	104	71	73	35	13	5	2	1	-	-
UK (Scot.)	6,109	4,819	5,135	4,330	5,224	4,149	4,263	5,021	4,638	3,369	3,046	2,258	1,654	1,064	751	444	103	178	424	-	-
UK (total)																				369	360
Total landings	7,669	6,026	6,908	6,010	6,751	5,786	6278	6642	6178	4657	4677	3203	2543	1735	1365	819	289	383	484	441	488

* Preliminary.

1989–2009 N. Ireland included with England and Wales.

Table 3.4.2. Whiting in Division VIa. Annual weight and numbers caught, years 1978–2009.

Year	Weight (tonnes)			Numbers (thousands)		
	Total	Human consumption	Discards	Total	Human consumption	Discards
1978	20452	14677	5775	93932	54369	39563
1979	20163	17081	3082	77794	61393	16401
1980	15108	12816	2292	57131	44562	12569
1981	16439	12203	4236	72113	46067	26046
1982	20064	13871	6193	87481	47883	39598
1983	21980	15970	6010	79114	49359	29755
1984	24118	16458	7660	125708	50218	75490
1985	23560	12893	10667	124683	43166	81517
1986	13413	8454	4959	64495	31273	33222
1987	18666	11544	7122	103485	41221	62264
1988	23136	11352	11784	141314	40681	100633
1989	11599	7531	4068	54633	26876	27757
1990	10036	5643	4393	42927	19201	23726
1991	12006	6660	5346	63112	25103	38009
1992	15396	6004	9392	86903	22266	64637
1993	15373	6872	8501	68351	23246	45105
1994	14771	5901	8870	87881	20060	67821
1995	13657	6076	7581	77932	18763	59169
1996	14058	7156	6902	71396	22329	49067
1997	11192	6285	4907	50459	19250	31209
1998	10476	4631	5845	56583	14387	42196
1999	7734	4613	3121	38260	15970	22290
2000	9715	3010	6705	78815	10118	68697
2001	4850	2438	2412	20802	8477	12325
2002	3829	1709	2120	25179	5765	19414
2003	2936	1356	1580	15403	4124	11279
2004	3437	811	2626	21749	2571	19178
2005	1239	341	898	6154	1051	5103
2006	1326	380	946	12988	1049	11939
2007	849	484	365	4879	1145	3734
2008	617	443	174	3085	1232	1853
2009	905	488	417	18038	1115	16923
Min	617	341	174	3085	1049	1853
GM	8207	4274	3484	44149	13944	26484
AM	11972	7067	4905	60399	24197	36203
Max	24118	17081	11784	141314	61393	100633

Table 3.4.3. Whiting in Division VIa. Landings-at-age (thousands).

	1	2	3	4	5	6	7+
1965	6938	6085	43530	4803	388	103	22
1966	1685	10544	2229	28185	1861	186	52
1967	5169	26023	10619	697	14574	789	143
1968	7265	16484	9239	3656	324	5036	368
1969	873	25174	8644	2566	1206	118	2333
1970	730	6423	28065	3241	670	214	550
1971	2387	8617	4122	34784	1338	240	223
1972	16777	12028	4013	1363	14796	793	148
1973	14078	36142	5592	1461	357	4292	310
1974	9083	51036	10049	1166	180	52	849
1975	14917	16778	36318	2819	281	57	245
1976	8500	46421	15757	17423	1508	66	57
1977	16120	13376	25144	3127	4719	292	24
1978	17670	18175	6682	9400	941	1433	68
1979	6334	34221	13282	3407	3488	276	384
1980	11650	11378	14860	4155	1244	1085	190
1981	3593	24395	11297	4611	1518	452	201
1982	2991	5783	29094	6821	2043	803	348
1983	3418	7094	8040	22757	6070	1439	540
1984	7209	12765	8221	4387	14825	1953	858
1985	4139	19520	8574	3351	1997	4764	822
1986	2674	14824	9770	2653	532	291	529
1987	6430	13935	13988	5442	837	330	259
1988	1842	20587	9638	6168	1949	290	207
1989	2529	5887	11889	4767	1266	468	71
1990	3203	8028	2393	4009	1326	204	37
1991	3294	8826	10046	1208	1391	286	51
1992	2695	9440	4473	4782	396	373	106
1993	1051	10179	6293	2673	2738	163	147
1994	909	4889	9158	3607	712	715	69
1995	215	4322	6516	5654	1397	376	282
1996	990	5410	7675	5052	2461	583	157
1997	877	3658	8514	4316	1441	338	106
1998	840	3504	4277	3698	1442	338	288
1999	1013	6131	4546	2040	1774	355	112
2000	484	2952	4211	1570	485	328	89
2001	461	3271	2630	1567	401	131	16
2002	62	1624	3018	799	227	23	13
2003	170	710	1111	1673	347	111	2
2004	54	724	543	521	622	78	29
2005	28	276	455	140	99	45	7
2006	82	139	369	260	61	113	24
2007	187	168	255	326	132	27	50
2008	6	265	394	336	152	55	24
2009	59	216	254	430	100	44	13

Table 3.4.4. Whiting in Division VIa. Discards-at-age (thousands).

	1	2	3	4	5	6	7+
1965	17205	4968	11437	531	14	2	0
1966	4322	8946	515	3317	79	3	0
1967	12237	20791	2674	84	629	12	1
1968	16394	12612	2137	377	13	82	3
1969	1983	20494	2093	292	51	2	26
1970	1776	6704	7494	382	33	4	0
1971	5505	6719	969	3906	57	4	1
1972	39192	8930	850	152	610	14	1
1973	30521	26995	1225	147	14	77	2
1974	23101	40590	2362	123	7	1	7
1975	37295	13541	8485	310	12	1	0
1976	24891	35812	3360	1940	63	1	0
1977	48148	8675	5432	301	212	5	0
1978	27942	10505	889	206	1	20	0
1979	3450	10722	1619	533	76	0	0
1980	2376	6172	3206	651	156	9	0
1981	1017	22014	2763	148	101	4	0
1982	17837	4577	15938	1189	55	1	0
1983	15069	8173	1964	4271	176	102	0
1984	68241	3951	1085	572	1577	59	4
1985	59783	17426	3134	663	61	446	3
1986	10459	20085	2491	117	6	2	61
1987	46876	13689	1518	180	1	0	0
1988	46421	51395	2472	292	54	0	0
1989	17778	3660	5796	401	111	11	0
1990	16406	5791	860	571	95	3	0
1991	30355	2874	4432	173	140	36	0
1992	46463	15041	2224	908	0	0	0
1993	14618	22281	5966	921	1317	0	2
1994	39697	18403	7775	1634	183	125	4
1995	28557	20921	8483	961	246	0	0
1996	28620	14617	4398	1395	18	1	18
1997	18182	9037	3431	466	93	0	0
1998	31183	7304	2418	991	184	51	64
1999	13623	7256	933	369	79	29	0
2000	63789	3556	1206	117	15	14	0
2001	5514	5861	738	208	4	0	0
2002	14166	3235	1749	130	124	8	1
2003	9331	1107	427	371	34	7	2
2004	14667	3557	536	305	107	4	2
2005	2923	1578	534	37	19	7	4
2006	9784	852	1000	256	36	11	2
2007	995	1077	308	64	4	3	0
2008	806	638	142	162	51	41	0
2009	6926	112	72	49	16	3	0

Table 3.4.5. Whiting in Division VIa. Total catch-at-age (thousands).

	1	2	3	4	5	6	7+
1965	24143	11054	54967	5334	402	105	22
1966	6007	19490	2744	31502	1940	189	53
1967	17406	46814	13293	781	15204	801	144
1968	23659	29096	11376	4034	337	5118	372
1969	2856	45668	10737	2858	1257	120	2358
1970	2506	13128	35559	3623	703	218	550
1971	7891	15336	5090	38690	1395	245	224
1972	55969	20958	4863	1514	15406	807	149
1973	44599	63137	6817	1608	371	4369	313
1974	32185	91625	12412	1289	188	53	856
1975	52213	30319	44804	3129	293	58	245
1976	33392	82233	19117	19363	1571	67	57
1977	64268	22051	30576	3428	4931	297	24
1978	45612	28680	7571	9606	942	1452	68
1979	9784	44943	14901	3940	3565	276	384
1980	14026	17551	18065	4806	1400	1093	190
1981	4610	46409	14060	4758	1618	456	201
1982	20829	10360	45032	8010	2098	804	348
1983	18487	15266	10004	27029	6246	1541	540
1984	75450	16716	9306	4959	16403	2011	863
1985	63922	36946	11708	4014	2058	5210	825
1986	13133	34909	12260	2770	539	293	591
1987	53305	27624	15506	5621	839	330	259
1988	48263	71982	12110	6460	2002	290	207
1989	20307	9547	17685	5168	1377	479	71
1990	19609	13819	3252	4580	1421	208	37
1991	33648	11700	14478	1381	1531	322	51
1992	49158	24481	6697	5691	396	373	106
1993	15669	32460	12259	3594	4055	163	149
1994	40606	23292	16933	5241	896	840	73
1995	28772	25243	14999	6615	1643	377	283
1996	29611	20027	12073	6447	2479	584	175
1997	19059	12695	11946	4782	1534	338	106
1998	32023	10808	6695	4689	1626	389	352
1999	14636	13387	5479	2408	1853	384	112
2000	64273	6508	5417	1687	500	343	89
2001	5975	9132	3368	1775	405	131	17
2002	14228	4859	4767	929	351	32	13
2003	9501	1817	1538	2044	381	119	4
2004	14721	4281	1079	825	730	82	31
2005	2951	1854	988	178	118	53	11
2006	9865	991	1369	516	97	124	26
2007	1182	1245	563	390	136	29	50
2008	812	903	536	498	203	96	24
2009	6985	328	325	478	116	47	13

Table 3.4.6. Whiting in Division VIa. Landings weights-at-age (kg).

	1	2	3	4	5	6	7+
1965	0.218	0.249	0.308	0.452	1.208	0.72	0.778
1966	0.238	0.243	0.325	0.374	0.61	0.72	0.828
1967	0.204	0.24	0.319	0.424	0.412	0.639	0.821
1968	0.206	0.263	0.366	0.444	0.554	0.538	0.735
1969	0.178	0.223	0.335	0.5	0.57	0.649	0.63
1970	0.205	0.203	0.274	0.382	0.519	0.619	0.683
1971	0.209	0.247	0.276	0.316	0.426	0.551	0.712
1972	0.211	0.258	0.345	0.368	0.426	0.494	0.638
1973	0.196	0.235	0.362	0.479	0.485	0.532	0.666
1974	0.193	0.215	0.317	0.444	0.591	0.641	0.584
1975	0.209	0.245	0.305	0.471	0.651	0.615	0.717
1976	0.201	0.242	0.309	0.361	0.497	0.687	0.856
1977	0.2	0.244	0.296	0.392	0.431	0.629	0.819
1978	0.199	0.235	0.286	0.389	0.516	0.549	0.612
1979	0.218	0.232	0.306	0.404	0.536	0.678	0.693
1980	0.172	0.242	0.33	0.42	0.492	0.595	0.817
1981	0.192	0.228	0.289	0.382	0.409	0.409	0.547
1982	0.184	0.22	0.276	0.352	0.505	0.513	0.526
1983	0.216	0.249	0.28	0.34	0.409	0.494	0.51
1984	0.216	0.259	0.313	0.371	0.412	0.458	0.458
1985	0.185	0.238	0.306	0.402	0.43	0.461	0.538
1986	0.174	0.236	0.294	0.365	0.468	0.482	0.499
1987	0.188	0.237	0.304	0.373	0.511	0.52	0.576
1988	0.176	0.215	0.301	0.4	0.483	0.567	0.6
1989	0.171	0.22	0.279	0.348	0.459	0.425	0.555
1990	0.225	0.251	0.324	0.359	0.417	0.582	0.543
1991	0.199	0.22	0.291	0.354	0.391	0.442	0.761
1992	0.193	0.23	0.288	0.349	0.388	0.397	0.51
1993	0.186	0.242	0.314	0.361	0.412	0.452	0.474
1994	0.161	0.217	0.29	0.371	0.451	0.482	0.483
1995	0.19	0.225	0.296	0.381	0.469	0.473	0.528
1996	0.195	0.245	0.288	0.365	0.483	0.526	0.569
1997	0.198	0.245	0.297	0.384	0.522	0.629	0.661
1998	0.215	0.236	0.301	0.364	0.438	0.5	0.646
1999	0.181	0.225	0.28	0.365	0.44	0.524	0.594
2000	0.205	0.241	0.298	0.336	0.419	0.488	0.617
2001	0.173	0.234	0.303	0.37	0.395	0.376	0.595
2002	0.213	0.257	0.304	0.363	0.464	0.65	0.707
2003	0.228	0.264	0.309	0.362	0.374	0.436	0.717
2004	0.193	0.251	0.295	0.345	0.382	0.403	0.342
2005	0.189	0.261	0.313	0.378	0.44	0.482	0.356
2006	0.221	0.292	0.319	0.394	0.455	0.528	0.567
2007	0.215	0.280	0.349	0.418	0.498	0.598	0.660
2008	0.274	0.245	0.322	0.384	0.514	0.530	0.653
2009	0.328	0.347	0.437	0.479	0.470	0.519	0.595

Table 3.4.7. Whiting in Division VIa. Discard weights-at-age (kg).

	1	2	3	4	5	6	7+
1965	0.122	0.177	0.213	0.249	0.287	0.303	0.287
1966	0.122	0.178	0.212	0.248	0.29	0.297	0.286
1967	0.122	0.178	0.213	0.248	0.29	0.295	0.289
1968	0.128	0.179	0.213	0.249	0.291	0.298	0.287
1969	0.121	0.178	0.214	0.249	0.29	0.295	0.285
1970	0.121	0.175	0.213	0.249	0.29	0.299	0.284
1971	0.12	0.177	0.211	0.248	0.29	0.299	0.284
1972	0.121	0.177	0.213	0.248	0.289	0.301	0.281
1973	0.123	0.176	0.215	0.252	0.288	0.301	0.285
1974	0.119	0.177	0.214	0.25	0.285	0.299	0.288
1975	0.119	0.176	0.213	0.25	0.286	0.301	0.278
1976	0.116	0.177	0.213	0.249	0.288	0.3	0.28
1977	0.118	0.177	0.214	0.249	0.289	0.299	0.282
1978	0.135	0.167	0.199	0.288	0.32	0.238	0
1979	0.173	0.188	0.208	0.215	0.281	0	0
1980	0.14	0.179	0.208	0.22	0.271	0.386	0
1981	0.108	0.16	0.195	0.298	0.286	0.295	0
1982	0.096	0.18	0.209	0.243	0.283	0.44	0
1983	0.141	0.186	0.228	0.237	0.267	0.267	0
1984	0.087	0.199	0.246	0.26	0.259	0.303	0.227
1985	0.102	0.191	0.237	0.286	0.326	0.312	0.316
1986	0.092	0.17	0.196	0.245	0.258	0.33	0.263
1987	0.085	0.182	0.233	0.249	0.225	0	0
1988	0.076	0.143	0.203	0.227	0.262	0	0
1989	0.099	0.177	0.205	0.209	0.294	0.305	0
1990	0.124	0.171	0.214	0.219	0.237	0.264	0
1991	0.085	0.169	0.205	0.223	0.226	0.281	0
1992	0.109	0.173	0.219	0.227	0	0	0
1993	0.118	0.197	0.225	0.242	0.256	0	0.436
1994	0.087	0.157	0.22	0.283	0.297	0.253	0.299
1995	0.075	0.154	0.189	0.246	0.278	0.597	0.493
1996	0.095	0.18	0.203	0.229	0.302	0.421	0.26
1997	0.112	0.182	0.221	0.235	0.243	0.422	0.819
1998	0.098	0.179	0.225	0.254	0.282	0.264	0.245
1999	0.077	0.168	0.217	0.205	0.266	0.268	0
2000	0.075	0.164	0.203	0.233	0.282	0.25	0
2001	0.094	0.154	0.196	0.203	0.381	0	0
2002	0.073	0.162	0.212	0.245	0.24	0.295	0.276
2003	0.077	0.177	0.231	0.242	0.213	0.3	0.278
2004	0.086	0.186	0.236	0.246	0.304	0.349	0.314
2005	0.088	0.149	0.223	0.214	0.315	0.292	0.373
2006	0.046	0.197	0.235	0.295	0.322	0.518	0.362
2007	0.059	0.159	0.225	0.226	0.334	0.794	0.266
2008	0.075	0.211	0.286	0.301	0.397	0.222	0.304
2009	0.051	0.288	0.227	0.262	0.248	0.253	0

Table 3.4.8. Whiting in Division VIa. Total catch weights-at-age (kg).

	1	2	3	4	5	6	7+
1965	0.15	0.217	0.288	0.432	1.177	0.712	0.776
1966	0.155	0.213	0.304	0.361	0.597	0.713	0.824
1967	0.146	0.212	0.298	0.405	0.407	0.634	0.817
1968	0.152	0.227	0.337	0.426	0.544	0.534	0.731
1969	0.138	0.203	0.311	0.474	0.559	0.643	0.626
1970	0.145	0.189	0.261	0.368	0.508	0.613	0.683
1971	0.147	0.216	0.264	0.309	0.42	0.547	0.71
1972	0.148	0.223	0.322	0.356	0.421	0.491	0.636
1973	0.146	0.21	0.336	0.458	0.477	0.528	0.663
1974	0.14	0.198	0.297	0.426	0.579	0.636	0.581
1975	0.145	0.214	0.288	0.449	0.636	0.61	0.717
1976	0.138	0.214	0.292	0.35	0.489	0.679	0.854
1977	0.139	0.218	0.281	0.379	0.425	0.624	0.816
1978	0.16	0.21	0.276	0.387	0.516	0.545	0.612
1979	0.202	0.222	0.295	0.378	0.531	0.678	0.693
1980	0.167	0.22	0.308	0.393	0.467	0.593	0.817
1981	0.173	0.196	0.271	0.379	0.401	0.408	0.547
1982	0.109	0.202	0.252	0.336	0.499	0.513	0.526
1983	0.155	0.215	0.27	0.324	0.405	0.479	0.51
1984	0.099	0.245	0.305	0.358	0.397	0.453	0.457
1985	0.107	0.216	0.288	0.383	0.427	0.448	0.537
1986	0.109	0.198	0.274	0.36	0.466	0.481	0.474
1987	0.097	0.21	0.297	0.369	0.51	0.52	0.576
1988	0.08	0.164	0.281	0.392	0.477	0.567	0.6
1989	0.108	0.204	0.255	0.337	0.446	0.422	0.555
1990	0.14	0.217	0.295	0.342	0.405	0.577	0.543
1991	0.096	0.207	0.265	0.338	0.376	0.424	0.761
1992	0.114	0.195	0.265	0.33	0.388	0.397	0.51
1993	0.123	0.211	0.271	0.331	0.361	0.452	0.474
1994	0.089	0.17	0.258	0.344	0.419	0.448	0.474
1995	0.076	0.166	0.235	0.361	0.44	0.473	0.528
1996	0.098	0.198	0.257	0.336	0.482	0.526	0.537
1997	0.116	0.2	0.275	0.369	0.505	0.629	0.661
1998	0.101	0.197	0.274	0.341	0.42	0.469	0.573
1999	0.084	0.194	0.269	0.34	0.433	0.504	0.593
2000	0.076	0.199	0.277	0.329	0.415	0.478	0.617
2001	0.1	0.183	0.28	0.35	0.395	0.376	0.589
2002	0.074	0.194	0.27	0.346	0.385	0.554	0.685
2003	0.08	0.211	0.287	0.34	0.36	0.427	0.526
2004	0.086	0.197	0.266	0.308	0.371	0.4	0.34
2005	0.089	0.166	0.264	0.344	0.42	0.455	0.362
2006	0.047	0.21	0.258	0.345	0.406	0.527	0.551
2007	0.084	0.175	0.281	0.387	0.494	0.616	0.659
2008	0.076	0.221	0.312	0.357	0.484	0.397	0.649
2009	0.053	0.327	0.391	0.457	0.440	0.500	0.572

Table 3.4.9. Whiting in Division VIa. Available survey tuning-series. Data used in final run are highlighted in bold. For ScoGFSQ1 and ScoGFSQ4, numbers are standardised to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardising.

SCOGFSQ1: Scottish Groundfish Sruvey - Effort in hours – Numbers-at-age								
	Effort	Age						
Year	(hours)	1	2	3	4	5	6	7
1985	10	3140	1792	380	85	23	156	18
1986	10	1456	1526	403	68	10	9	10
1987	10	6938	1054	584	143	36	2	1
1988	10	567	3469	653	189	42	5	1
1989	10	910	505	586	237	48	3	0
1990	10	1818	572	122	216	61	4	1
1991	10	3203	277	298	22	39	9	1
1992	10	4777	1597	410	517	56	18	0
1993	10	5532	6829	644	91	30	11	2
1994	10	6614	2443	1487	174	56	15	6
1995	10	5598	2831	1160	370	70	17	32
1996	10	9384	2238	635	341	135	30	5
1997	10	5663	2444	1531	355	102	17	4
1998	10	9851	1352	294	195	50	14	1
1999	10	6125	4952	489	103	16	1	0.4
2000	10	12862	471	152	34	10	11	0
2001	10	4653	1954	242	41	8	1	1
2002	10	5542	1028	964	86	15	1	1
2003	10	6934	746	436	300	32	2	4
2004	10	5888	1566	189	131	44	9	1
2005	10	1308	723	183	35	8	11	2
2006	10	1441	466	282	77	0.3	3	0.6
2007	10	614	522	127	75	16	3	2
2008	10	593	127	77	26	8	3	0
2009	10	906	387	103	105	20	9	7
2010	10	3523	340	108	52	40	4	3

IR-WCGFS : Irish West Coast GFS (VIa) - Effort in minutes – Numbers-at-age							
	Effort	Age					
Year	(min)	0	1	2	3	4	5
1993	2130	14403	32643	11419	1464	231	13
1994	1865	264	11969	4817	2812	78	57
1995	2026	34584	5609	6406	734	186	80
1996	2008	376	7457	3551	374	232	5
1997	1879	1550	13865	8207	1022	524	50
1998	1936	1829	4077	3361	663	121	5
1999	1914	3337	3059	1965	322	11	12
2000	1878	682	10102	2126	109	109	4
2001	965	1118	5201	2903	149	70	3
2002	796	594	8247	9348	820	280	0

Table 3.4.9 (continued).

	IRGFS: Irish groundfish survey - Effort in minutes – Numbers-at-age							
	Effort	Age						
Year	(min)	0	1	2	3	4	5	6
2003	1127	1101	12886	2894	512	290	102	1
2004	1200	6924	3114	1312	104	35	16	1
2005	960	910	2228	1126	91	5	4	0
2006	1510	99	1055	921	214	27	3	0
2007	1173	138	1989	2380	722	169	251	122
2008	1135	24	4342	1328	573	243	123	36
2009	1378	16906	1430	989	325	68	21	41

	ScoGFSQ4 : Quarter four Scottish groundfish survey - Effort in hours – Numbers-at-age									
	Effort	Age								
Year	(hours)	0	1	2	3	4	5	6	7	8
1996	10	5154	1908	1116	570	188	51	6	1	0
1997	10	8001	2869	951	323	160	46	12	1	0
1998	10	1852	2713	1124	149	100	20	1	0	+
1999	10	8203	2338	582	141	33	24	1	1	0
2000	10	4434	4055	789	160	9	7	1	0	0
2001	10	9615	1957	1420	155	40	12	2	0	0
2002	10	14658	1591	621	479	30	9	5	0	0
2003	10	9932	3446	567	338	83	27	4	0	0
2004	10	5923	1758	940	83	57	62	1	0	0
2005	10	2297	308	318	76	9	4	0.9	0.7	0
2006	10	415	296	140	101	35	8	3	0.5	0
2007	10	1894	434	326	99	83	48	0.6	0	0
2008	10	2297	208	78	110	28	24	4	0	+
2009	10	4833	236	178	50	58	12	6	6	0

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Table 3.4.10. Whiting in Division VIa. Summary of SURBA indices of abundance-at-age, SSB and total mortality Z, based on data from ScoGFSQ1.

Abundance-at-age						
	Age					
Year	1	2	3	4	5	6
1985	4.2996	1.4001	0.3581	0.0572	0.0332	0.168
1986	3.8295	1.41	0.3844	0.096	0.0114	0.007
1987	5.471	1.5089	0.4789	0.1279	0.0249	0.0031
1988	1.1208	2.1348	0.5067	0.1576	0.0327	0.0067
1989	1.7406	0.3821	0.613	0.1422	0.0331	0.0073
1990	1.2266	0.6442	0.1207	0.1895	0.0336	0.0082
1991	2.3483	0.523	0.2398	0.0441	0.0551	0.0102
1992	6.2786	1.5213	0.3161	0.1436	0.0235	0.03
1993	6.4522	3.1594	0.6861	0.1405	0.053	0.009
1994	5.1234	2.9258	1.2629	0.2696	0.0446	0.0176
1995	9.5743	2.2293	1.1149	0.4727	0.0807	0.0139
1996	6.8752	3.9321	0.7944	0.3897	0.1301	0.0233
1997	6.4495	2.5035	1.2188	0.2409	0.0901	0.0317
1998	8.2413	1.7058	0.5356	0.2534	0.035	0.014
1999	6.7661	1.8202	0.2961	0.09	0.0284	0.0042
2000	12.5175	1.4611	0.3078	0.0484	0.0097	0.0033
2001	4.0362	3.184	0.2988	0.0611	0.0067	0.0014
2002	1.8512	1.4346	0.9596	0.0881	0.0136	0.0016
2003	5.7885	0.725	0.4838	0.3172	0.0226	0.0037
2004	5.0915	1.8547	0.1937	0.1262	0.0609	0.0046
2005	1.5242	1.1384	0.3266	0.033	0.0144	0.0075
2006	1.3751	0.3631	0.2157	0.06	0.0041	0.0019
2007	0.5253	0.5093	0.1148	0.0668	0.0142	0.001
2008	0.5412	0.187	0.1538	0.0339	0.0149	0.0034
2009	0.7465	0.2983	0.0937	0.0761	0.0143	0.0065
2010	3.4327	0.3921	0.1414	0.0438	0.0299	0.0058

Table 3.4.10 (continued).

Stock summary						
Year	Rec		SSB	TSB	Mean Z(2–4)	
	Est	SElog	Est	Est	Est	SE
1985	4.3	0.347	0.517	0.977	1.409	0.27
1986	3.83	0.312	0.428	0.845	1.177	0.206
1987	5.471	0.309	0.521	1.057	1.189	0.202
1988	1.121	0.315	0.574	0.663	1.36	0.199
1989	1.741	0.313	0.3	0.488	1.256	0.199
1990	1.227	0.311	0.258	0.43	1.077	0.2
1991	2.348	0.297	0.212	0.439	0.549	0.203
1992	6.279	0.303	0.449	1.158	0.868	0.201
1993	6.452	0.305	0.922	1.709	0.999	0.201
1994	5.123	0.306	0.943	1.399	1.051	0.2
1995	9.574	0.307	0.848	1.575	1.124	0.2
1996	6.875	0.31	1.184	1.858	1.276	0.201
1997	6.449	0.322	0.99	1.738	1.68	0.199
1998	8.241	0.331	0.59	1.423	1.908	0.197
1999	6.766	0.333	0.478	1.053	1.937	0.195
2000	12.517	0.327	0.398	1.349	1.73	0.197
2001	4.036	0.311	0.688	1.091	1.307	0.2
2002	1.851	0.307	0.574	0.711	1.184	0.201
2003	5.788	0.315	0.41	0.873	1.438	0.2
2004	5.091	0.333	0.48	0.918	1.893	0.198
2005	1.524	0.334	0.296	0.432	1.813	0.197
2006	1.375	0.319	0.155	0.22	1.255	0.2
2007	0.525	0.340	0.155	0.199	1.305	0.200
2008	0.541	0.358	0.110	0.151	0.753	0.202
2009	0.746	0.419	0.178	0.218	0.813	0.243
2010	3.433	0.562	0.175	0.419	0.957	0.114

Table 3.5.1. Nominal landings (t) of Whiting in Division VIb, 1989–2009, as officially reported **to ICES.**

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	32	10	4	23	3	1	-	-	10		2	3	3	104	16	23	23
Spain	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
UK (E.& W, NI)	16	6	1	5	10	2	5	26	49	20	+	+	-	-	-	-	-	-	-	-	-
UK (Scotland)	18	482	459	283	86	68	53	36	65	23	44	58	4	7	11	1	1	1	1	…	…
UK (all)																				8	12
Total	34	488	460	288	128	80	62	85	117	44	44	58	14	7	13	4	4	105	17	31	35

* Preliminary.

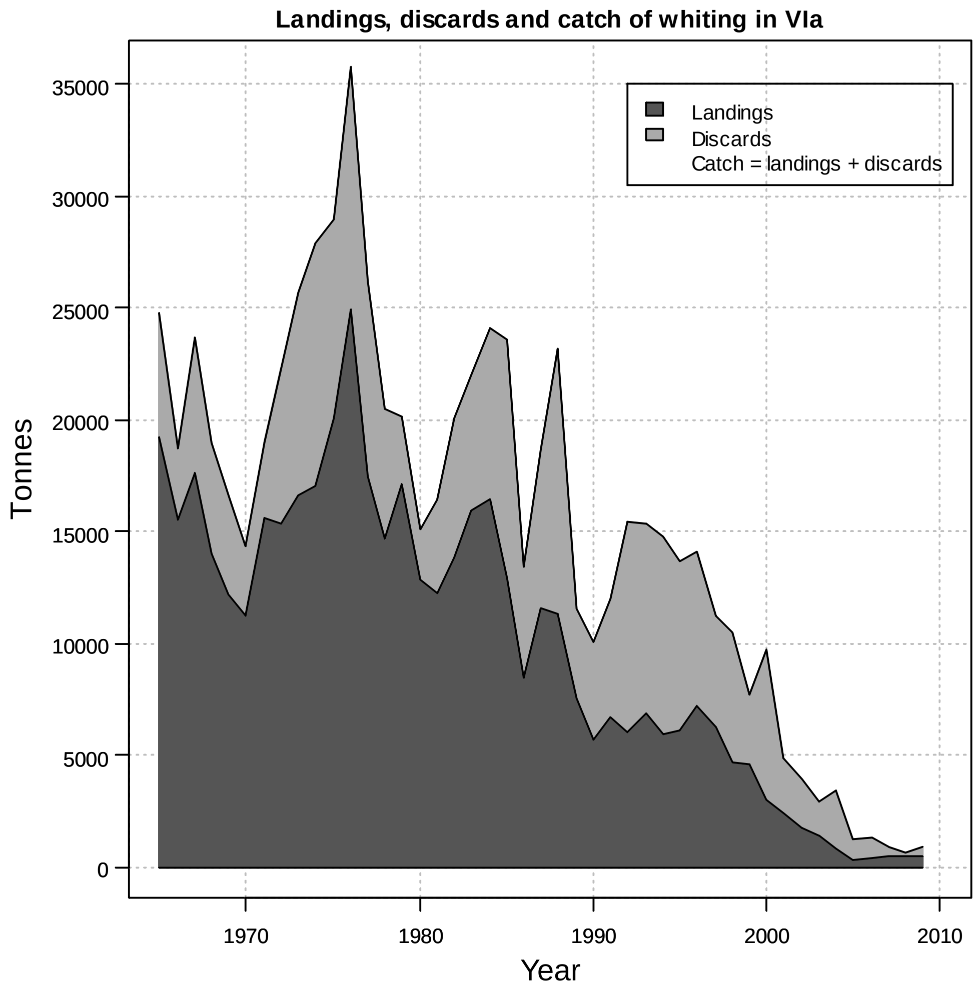
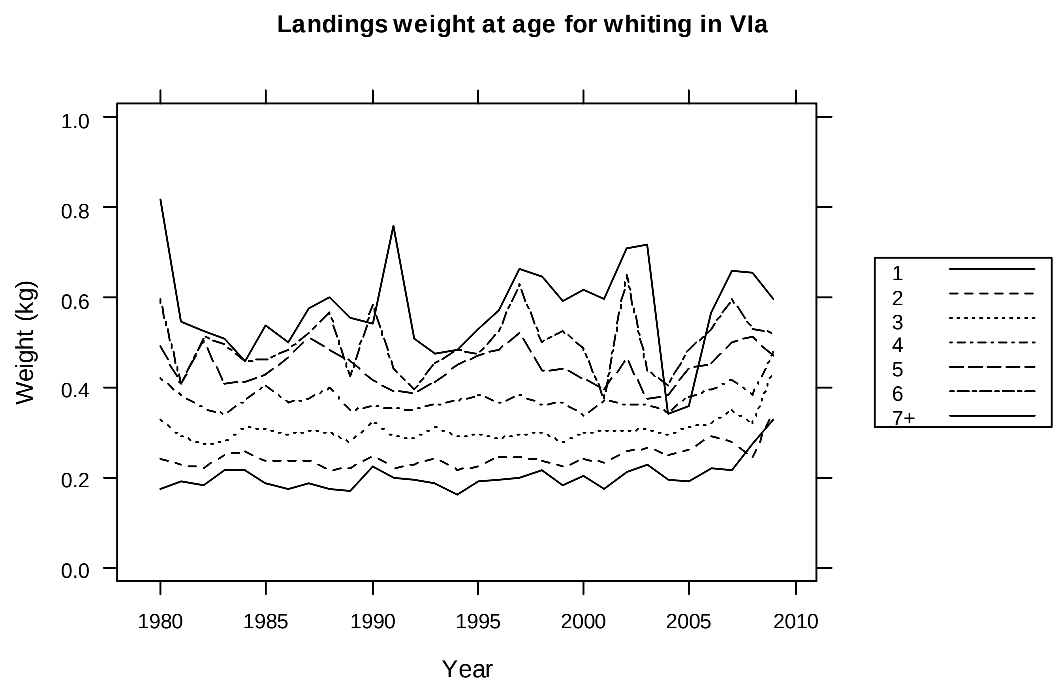


Figure 3.4.1. Landings, discards and catch (in tonnes) of whiting in Division VIa, as officially reported to ICES.



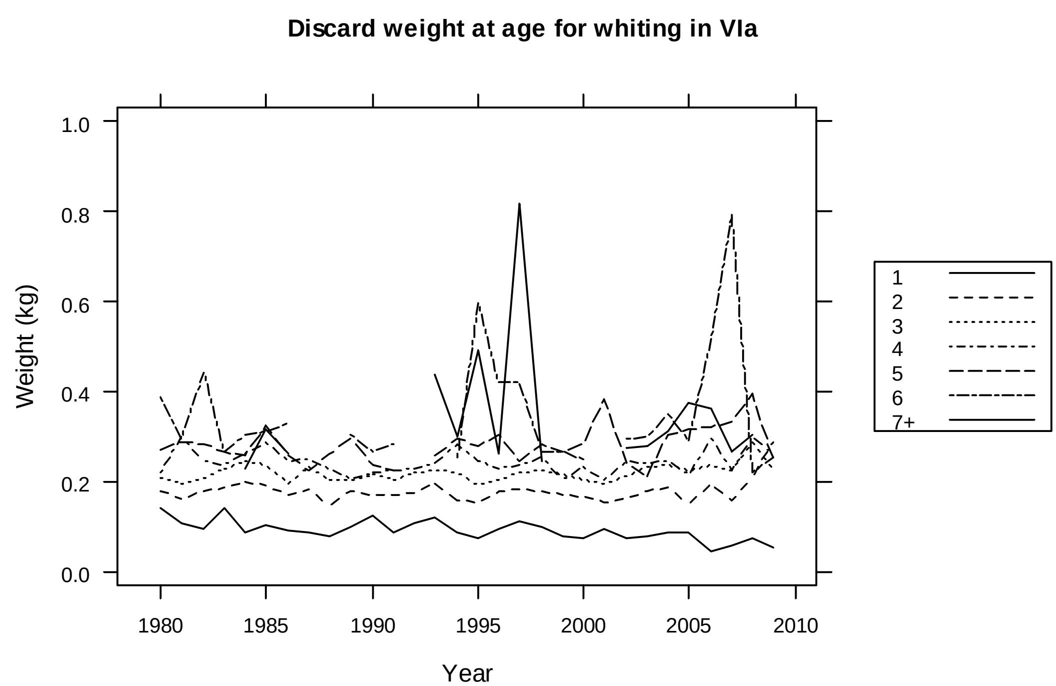


Figure 3.4.2. Whiting in Division VIa. Mean weights-at-age in the landings (upper panel) and discards (lower panel).

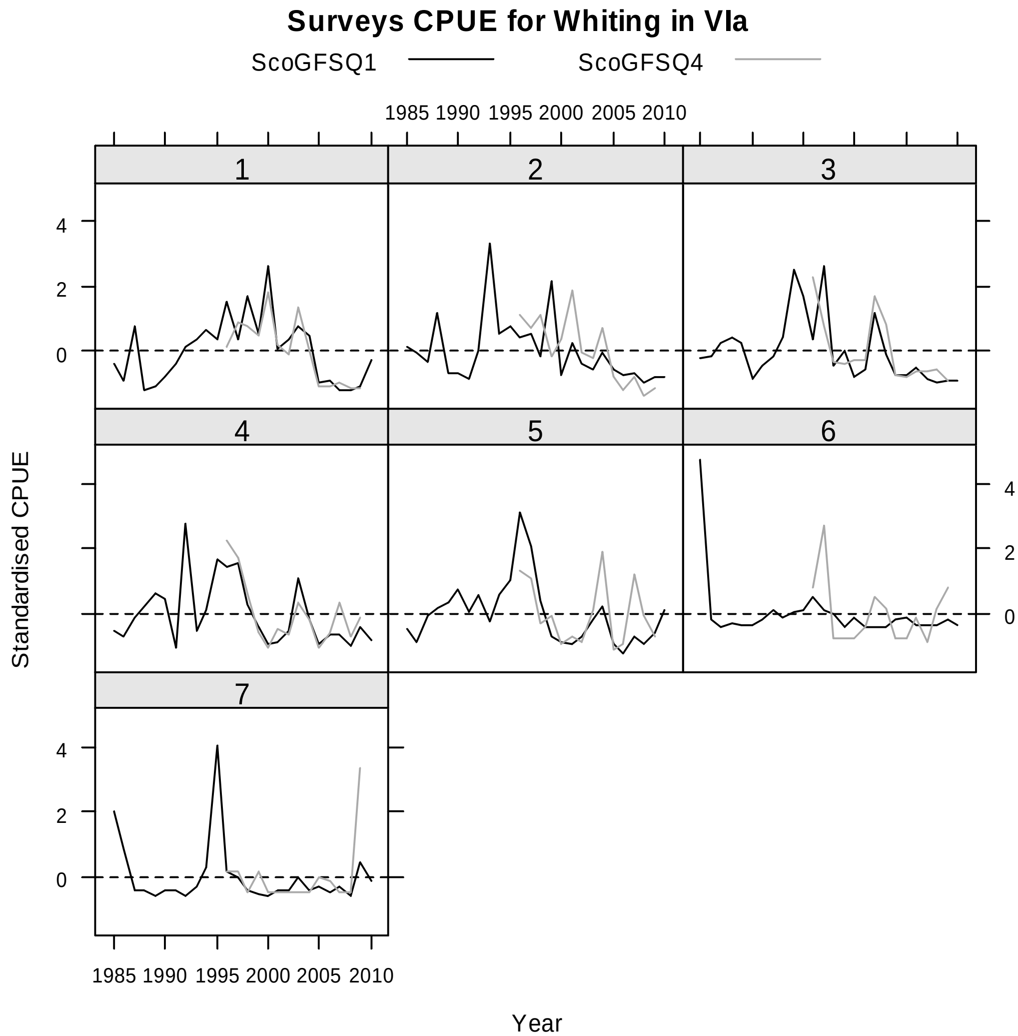


Figure 3.4.3. Whiting in Division VIa. Comparison of scaled survey indices from ScoGFSQ1 and ScoGFSQ4.

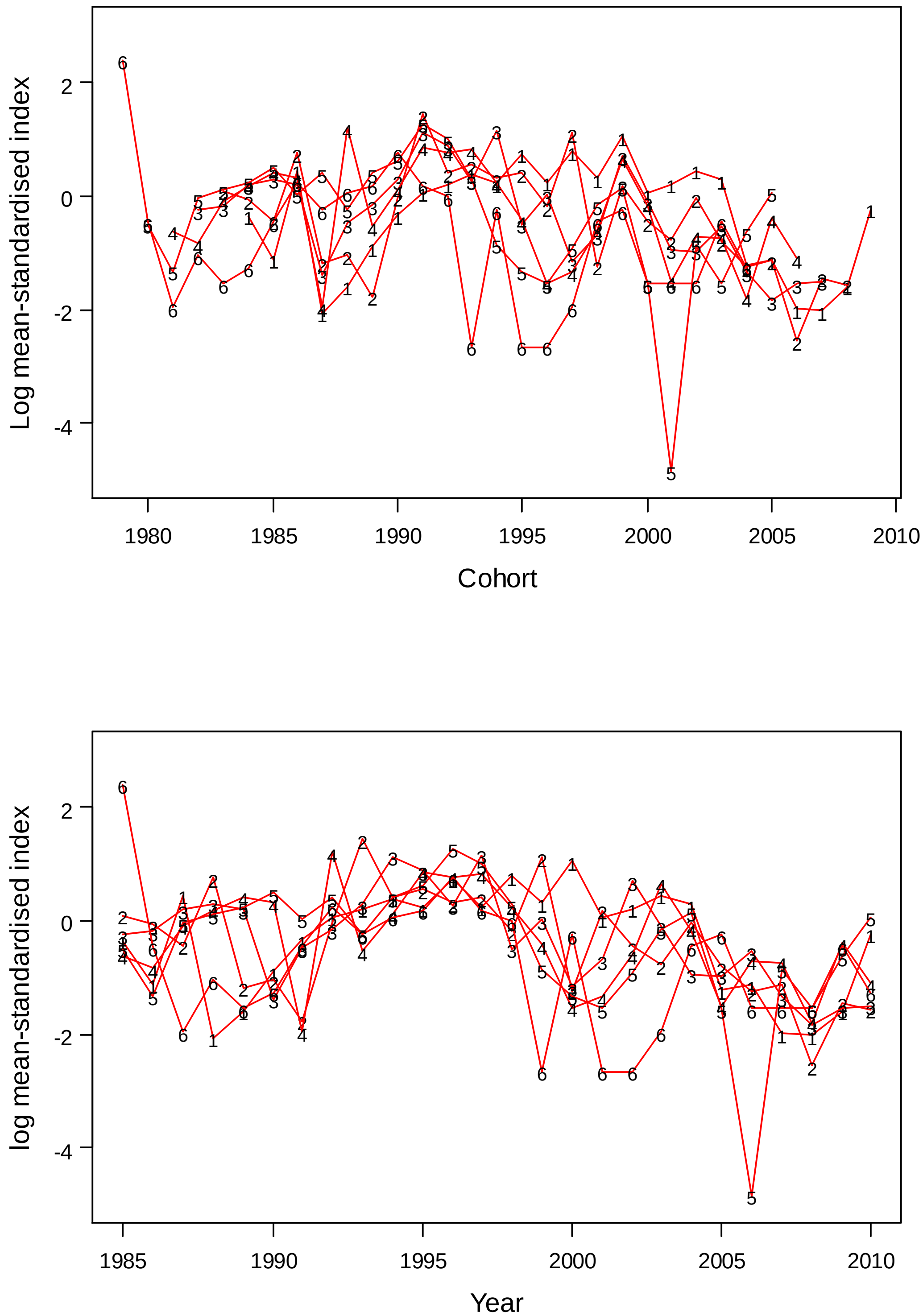


Figure 3.4.4. Whiting in Division VIa. Log mean standardised survey index for each age by cohort (upper panel) and year (lower panel) in ScoGFSQ1.

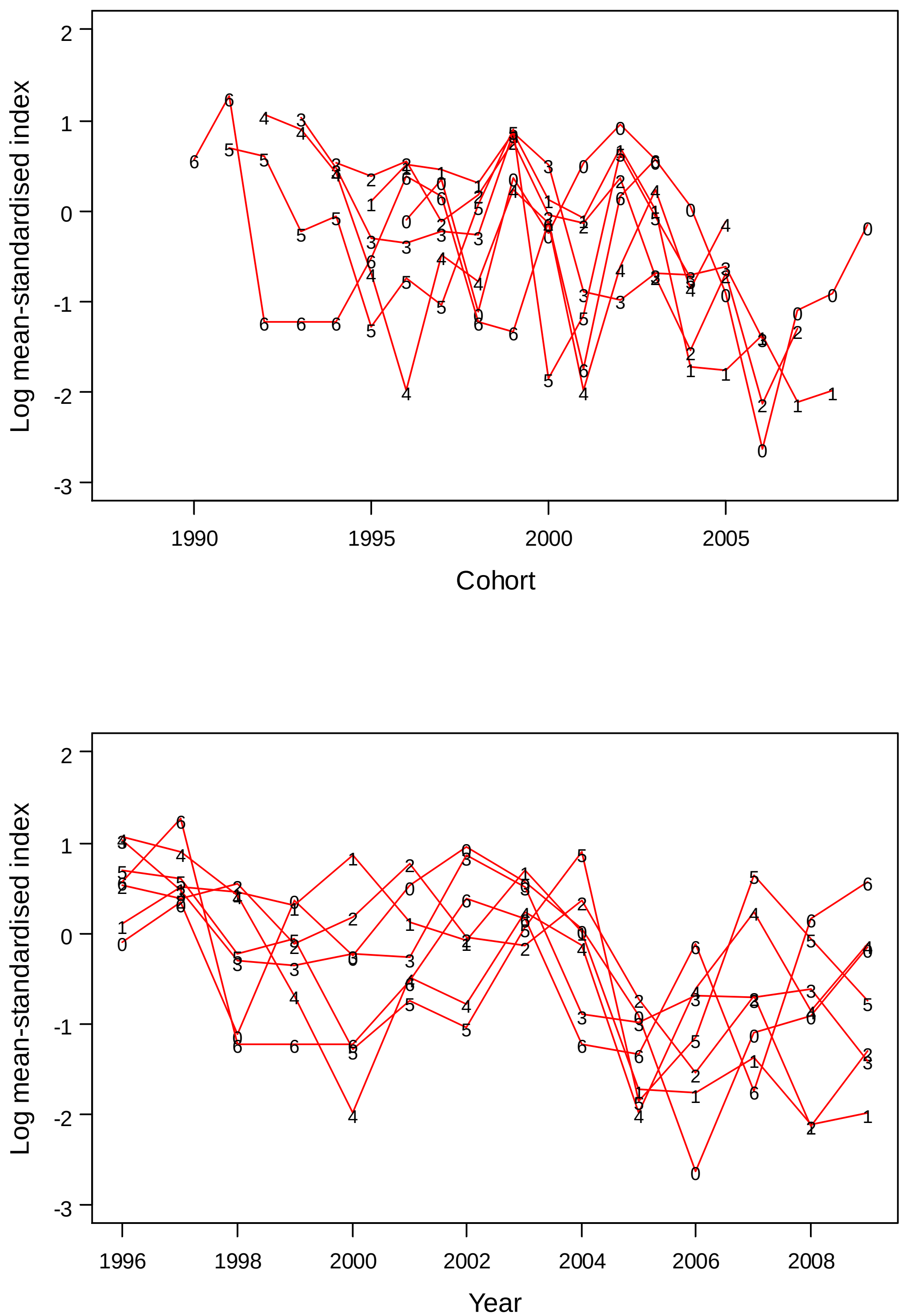
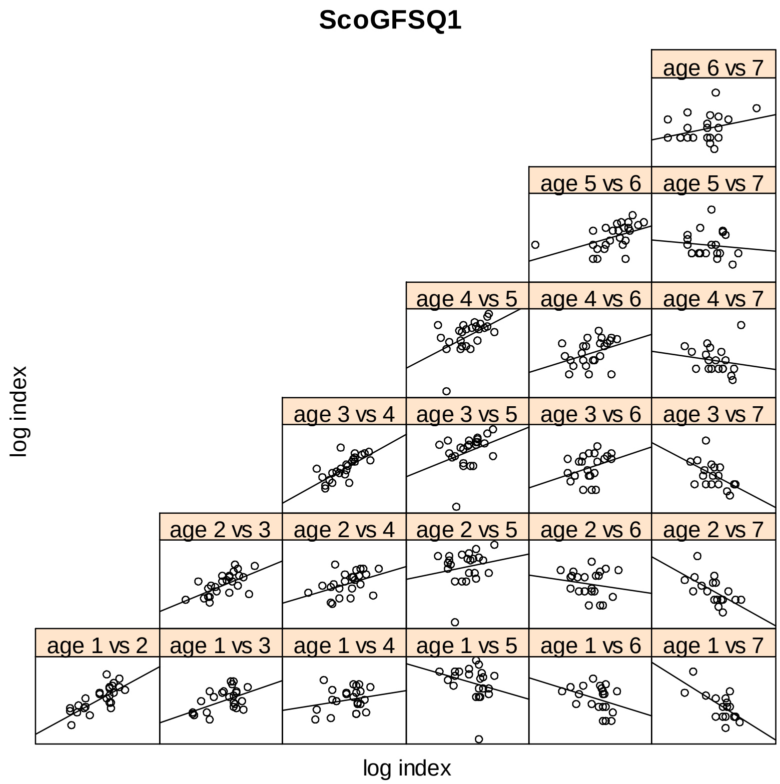


Figure 3.4.5. Whiting in Division VIa. Log mean standardised survey index for each age by cohort (upper panel) and year (lower panel) in ScoGFSQ4.



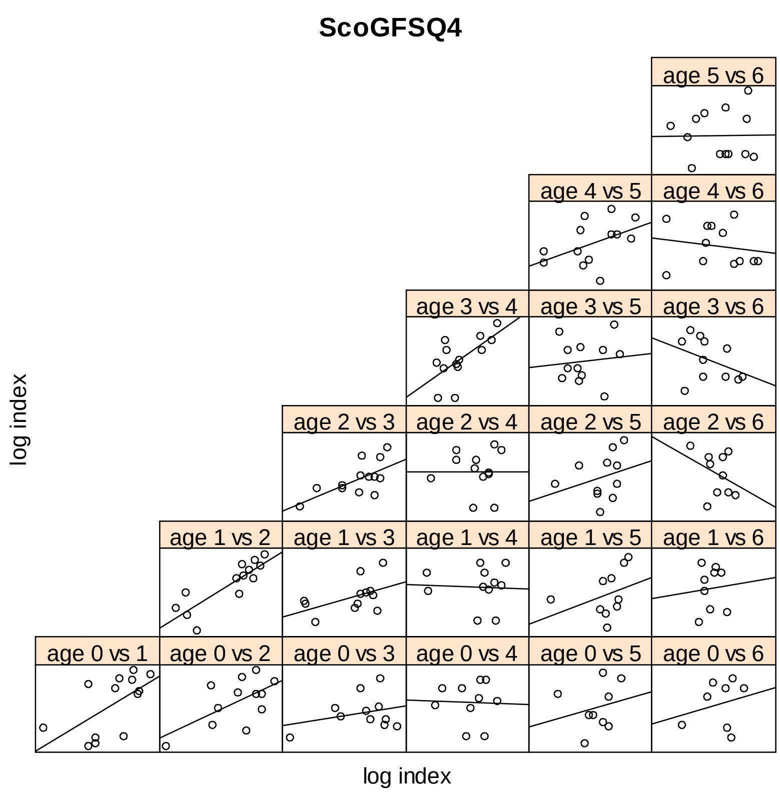


Figure 3.4.6. Whiting in Division VIa. Comparative scatterplots at age for Scottish groundfish surveys, ScoGFSQ1 and ScoGFSQ4.

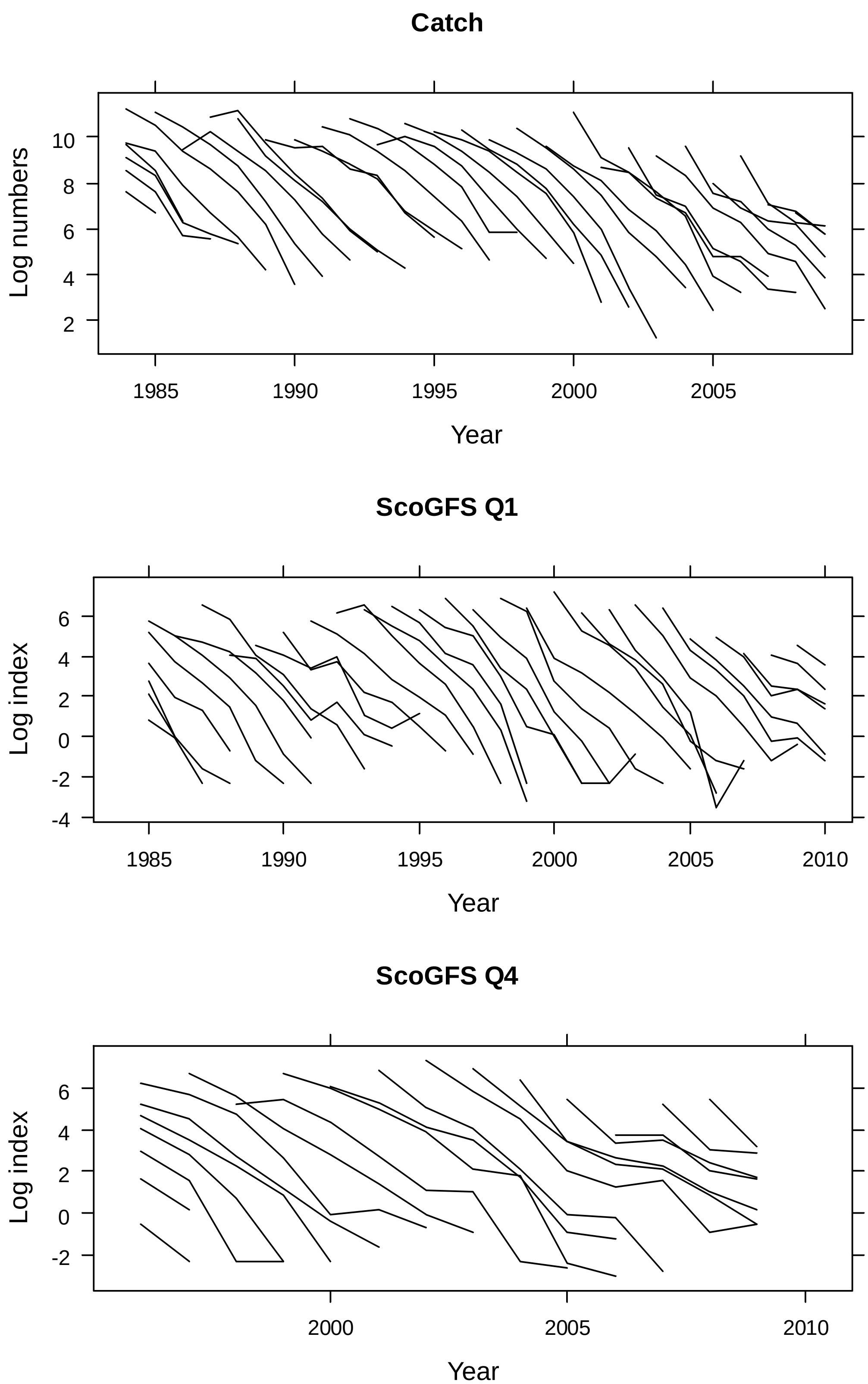


Figure 3.4.7. Whiting in Division VIa. Log catch curves from the catch (ages 1–7) and the two Scottish groundfish surveys, ScoGFSQ1 (ages 1–7) and ScoGFSQ4 (ages 0–7).

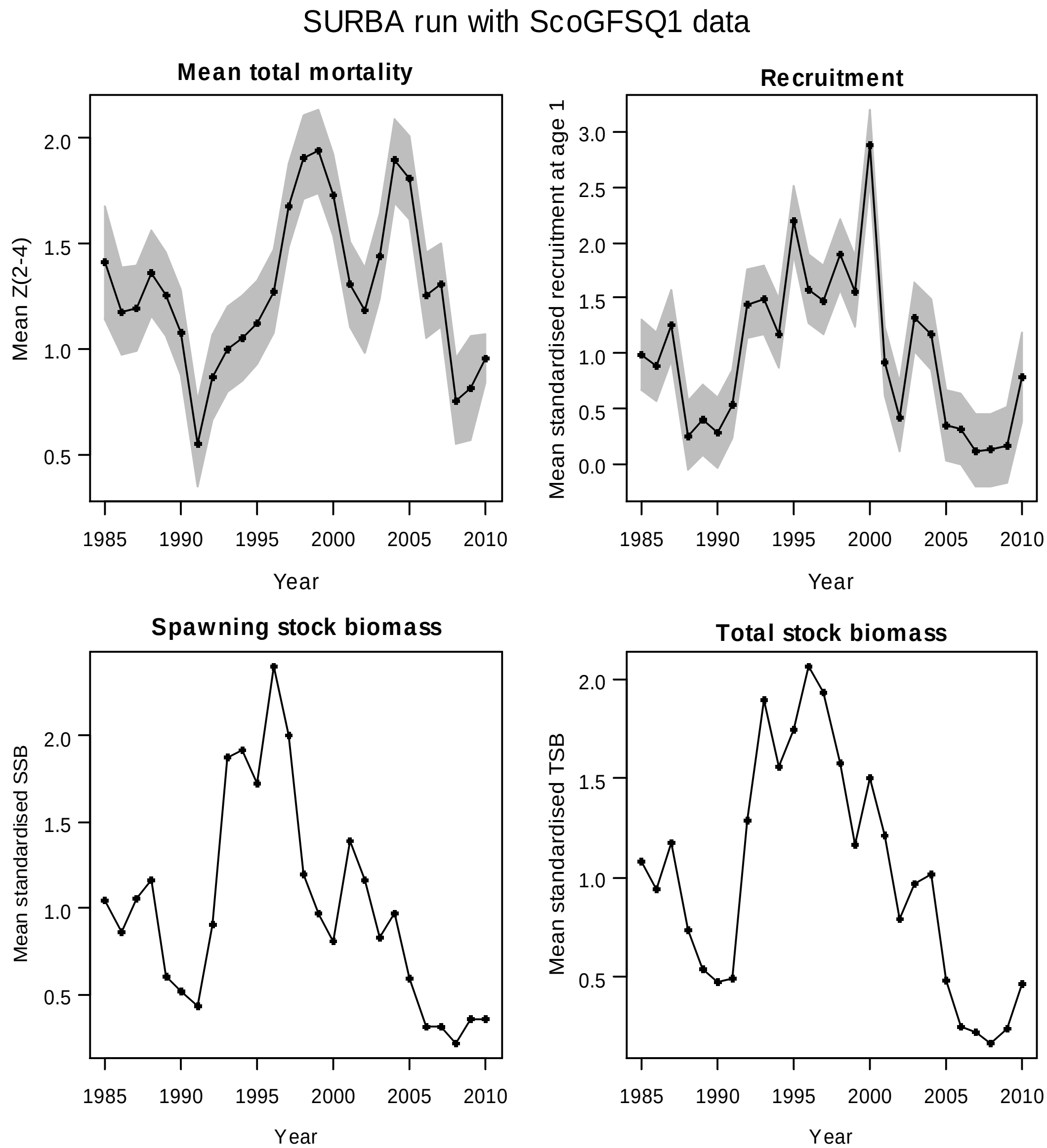


Figure 3.4.8. Whiting in Division VIa. Results of SURBA run using ScoGFSQ1 data. Mean total mortality estimates are given as absolute; biomass and recruitment are mean-standardised. Mean total mortality and recruitment are shown with +/- standard errors.

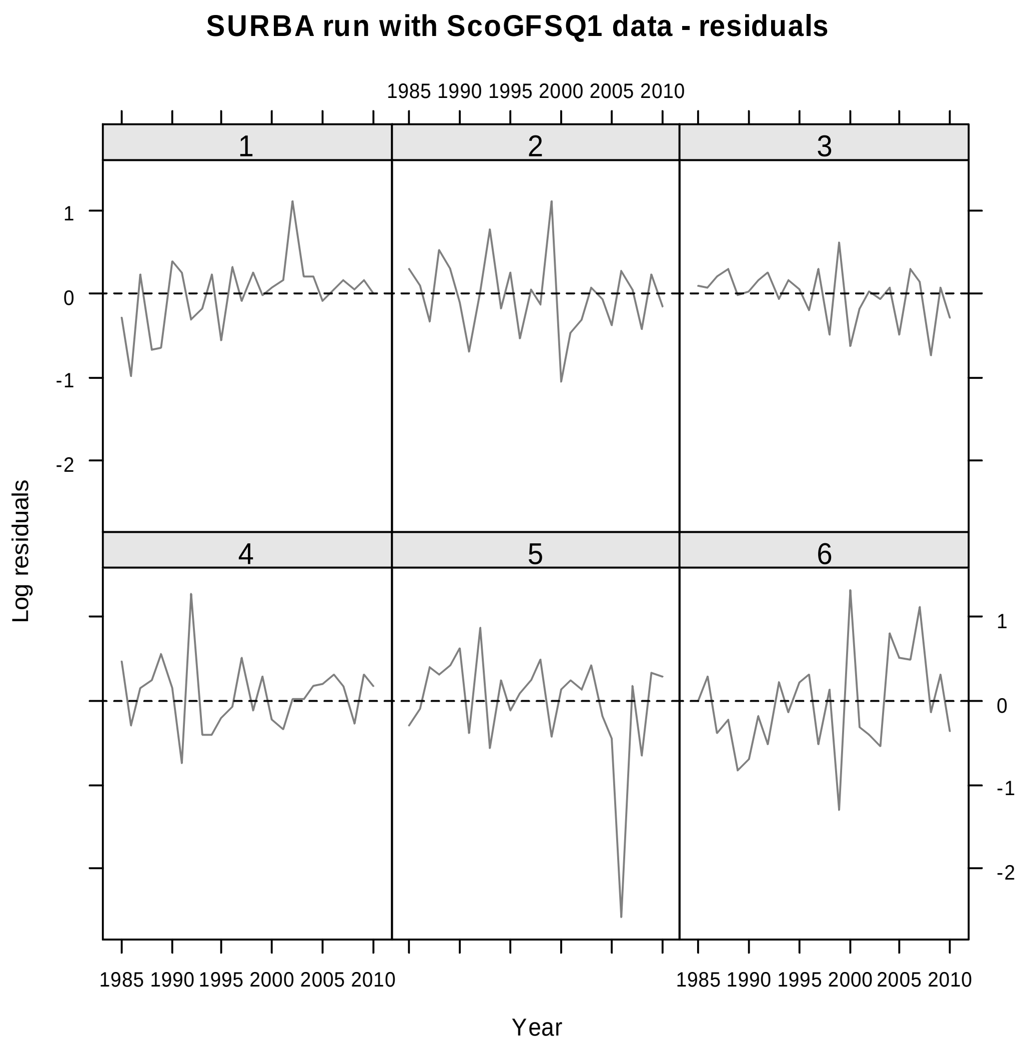


Figure 3.4.9. Whiting in Division VIa. Residuals by age from SURBA run using ScoGFSQ1 data.

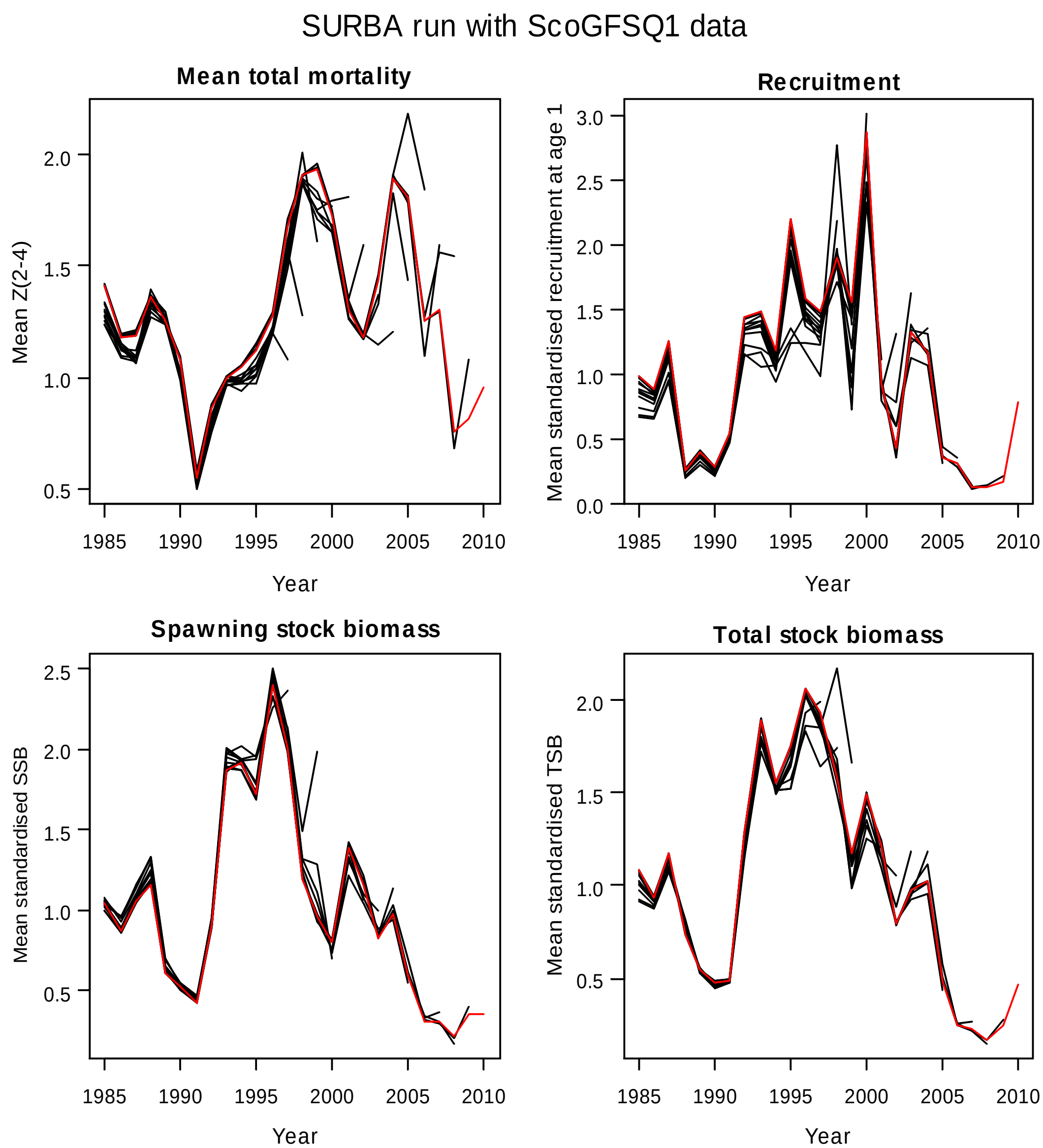


Figure 3.4.10. Whiting in Division VIa. Retrospective plots of SURBA run using ScoGFSQ1 data.

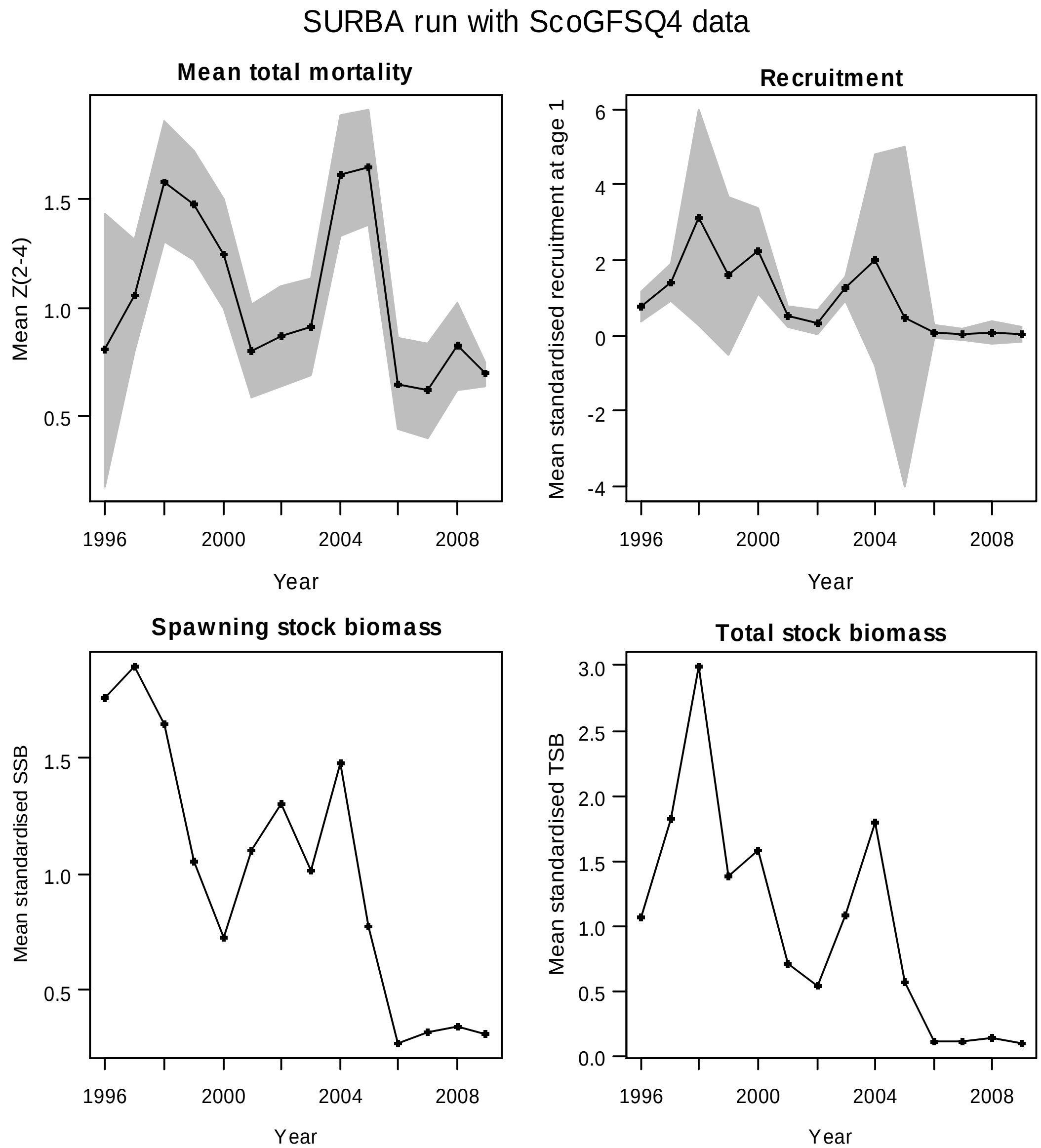


Figure 3.4.11. Whiting in Division VIa. Results of SURBA run using ScoGFSQ4 data. Mean total mortality estimates are given as absolute; biomass and recruitment are mean-standardised. Mean total mortality and recruitment are shown with +/- standard errors.

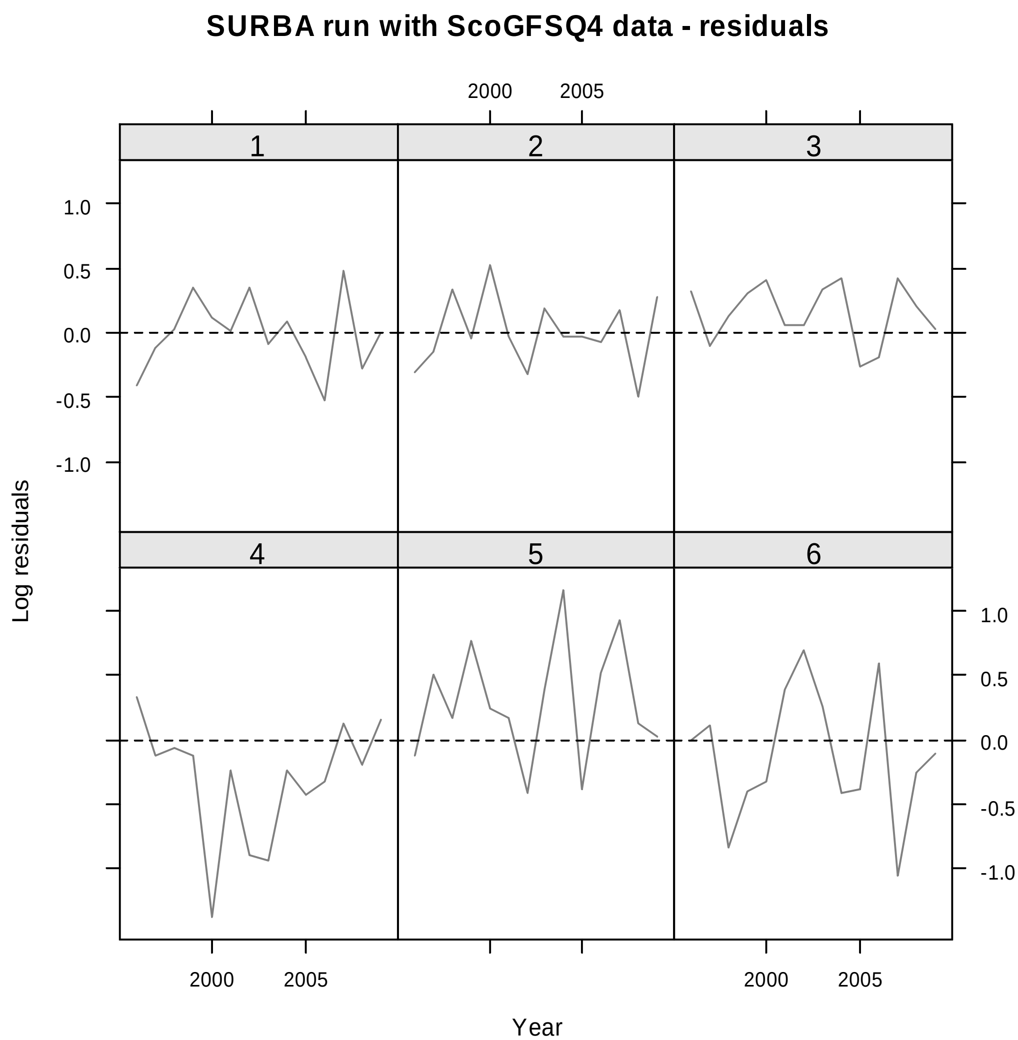


Figure 3.4.12. Whiting in Division VIa. Residuals by age from SURBA run using ScoGFSQ4 data.

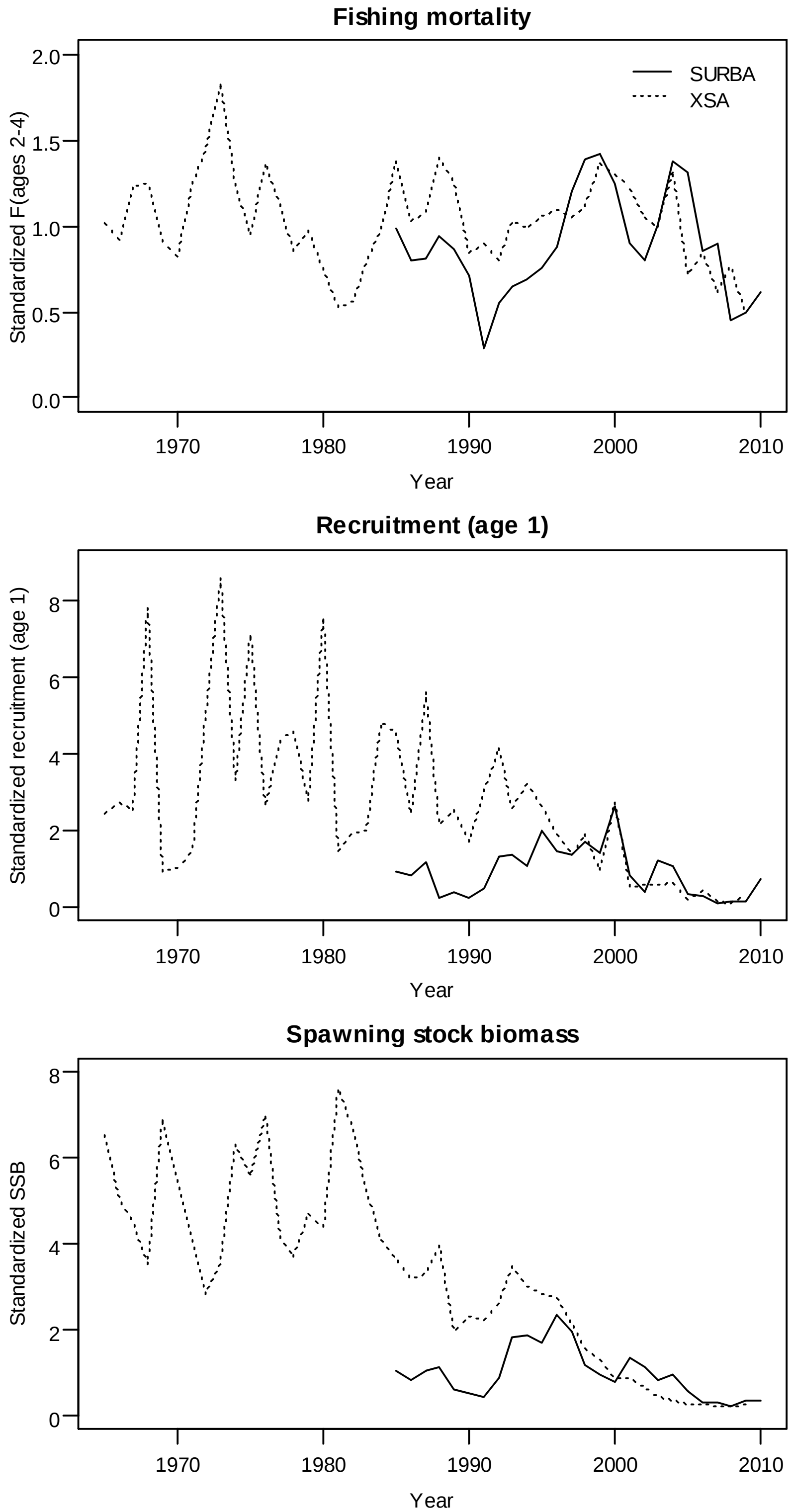


Figure 3.4.13. Whiting in Division VIa. Comparison of trends based assessment final run outputs (SURBA) with VPA assessment (XSA) estimates. Fishing mortality, recruitment and SBB are mean-standardised over the period 1995–2009 (the length of the tuning-series used in XSA).

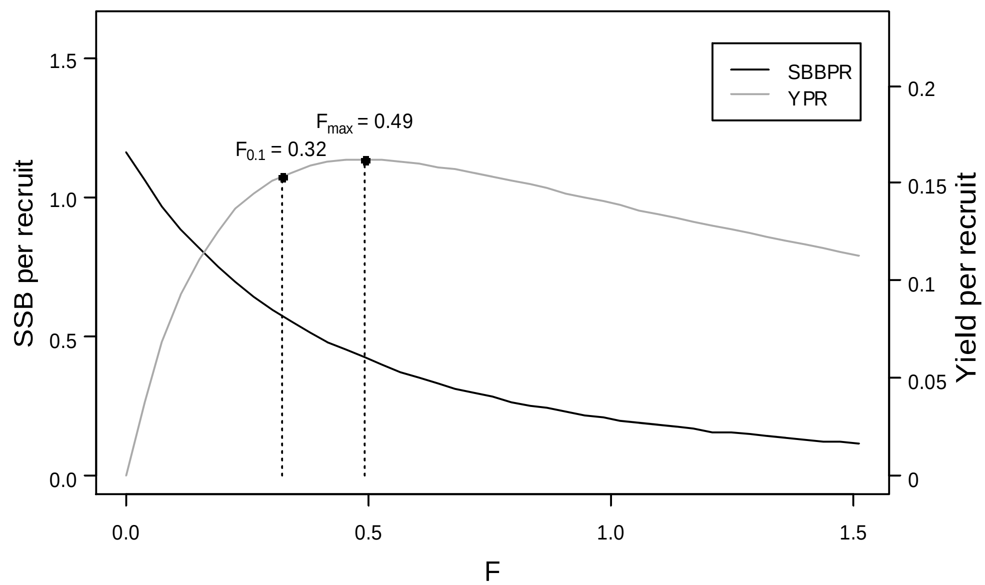


Figure 3.4.14. Whiting in Division VIa. Yield-per-recruit analysis with the output from the final SURBA run.

3.5 North Minch, FU11

Nephrops stocks have previously been identified by WGNEPH on the basis of population distribution, and defined as separate Functional Units. The Functional Units (FU) are defined by the groupings of ICES statistical rectangles given in Table 3.5.1 and illustrated in Figure 3.5.1. The Functional Unit is the level at which the WG collects fishery data (quantities landed and discarded, fishing effort, cpues and lpues, etc.) and length distributions, and at which it performs assessments.

There are three Functional Units in Division VIa, the level at which EU management of *Nephrops* currently takes place. Nominal landings as reported to ICES, along with WG estimates of landings are presented in Tables 3.5.2 and 3.5.3 respectively. Landings are also made from outside the Functional Units, from statistical rectangles where small pockets of suitable sediment exist, these are generally small amounts. There are no Functional Unit in Division VIb and only very small quantities of *Nephrops* are landed.

Type of assessment in 2010

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WK*NEPH*, 2009) and described in Section 2.2.

3.5.1 Ecosystem aspects

The North Minch Functional Unit 11 at the northern end of the west coast of Scotland (Figure 3.5.1).

Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the North Minch Functional Unit these substrates are distributed according to prevailing hydrographic and baythmetric conditions. The area is characterised by numerous islands of varying size and sea lochs occur along the mainland coast. These topographical features create a diverse habitat with complex hydrography and a patchy distribution of soft sediments. The North Minch exhibits the most patchy ground amongst west coast FUs. Very soft sediments are found in the southeast while coarser sandy muds prevail to the north and west. Figure 3.5.7 shows the distribution of sediment in the area.

Further information on ecosystem aspects can be found in the Stock Annex.

3.5.2 The fishery in 2009

The fishery in 2009 was generally similar to previous years with a fleet of mainly smaller trawlers working 1–4 day trips from the main ports of Lochinver, Ullapool, Stornaway and Gairloch. The largest part of the North Minch fleets continued to be based at Stornaway, made up of mostly smaller vessels, currently six single rigged trawlers and six muti-rigged trawlers, all but one are around 15 m length. The Barra fleet is more nomadic as the fishing grounds are more exposed which forces the fleet to find shelter on the east side of the North Minch. The Barra vessels are generally bigger than the Stornoway fleet, being all over 15 m in length. Although several vessels have been sold or left the fleet in recent years, the remainder have continued to fish the same pattern as always, most trawlers landing daily or every second day. In 2009 mesh size regulation went up from 80 to 90 mm. In the winter of 2009, high fuel prices and poor catches has resulted in boats not going out to fish. Under the west coast emergency measures a square meshed panel of 120 mm was also required (Council Reg. (EU) 43/2009).

Little if any marketable fish bycatch was reported by the boats fishing in the North Minch, this was confirmed during *Nephrops* discard trips on board North Minch boats.

Further general information on the fishery can be found in the Stock Annex.

3.5.3 ICES advice in 2009

The ICES conclusions in 2009 in relation to State of the Stock were as follows:

"The stock is being exploited unsustainably. The UWTV survey indicates that the population has declined by around 40% over the past two years from a previous time-series high in 2006. Harvest ratios in this period were above the values associated with high long term yield and low risk of stock depletion."

The ICES advice for 2009 (Single-stock exploitation boundaries) was as follows:

"The current fishery appears sustainable. Therefore, ICES recommends that *Nephrops* fisheries should not be allowed to increase relative to the past two years (2006–2007). This corresponds to landings of no more than 4100 tonnes for the North Minch stock."

The ICES advice for 2010 (Single-stock exploitation boundaries) was as follows:

"ICES advises on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Rate for *Nephrops* fisheries should be less than $F_{0.1}$. This corresponds to landings less than 972 t for the North Minch stock."

3.5.4 Management

Management is at the ICES subarea level as described at the beginning of Section 3.5.

3.5.5 Assessment

Conclusions of the Review of the 2009 assessment

"RG agrees with the WG on the assessment and feels it follows the protocol described in the Stock Annex. The short-term projection gives various harvest rates and this should be used to assign the TAC. The idea of fishing at a level above F_{max} is unsettling and should be avoided especially for a stock that utilizes such a basic assessment."

Approach in 2010

The assessment in 2010 is based on a combination of examining trends in fishery indicators and underwater TV using an extensive data-series for the North Minch.

The assessment of *Nephrops* and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG (WK*NEPH* 2009) and is described in Section 2.2. The provision of advice in 2010 develops the process defined by the Benchmark WG and described in Section 3.5 and attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES in 2010 (see Section 2.2). Intersessional work carried out by participants of the Benchmark and involving collaboration between WGNSSK and WGCSE is described in the working papers.

Previous TV based assessments have derived predicted landings by applying a harvest rate approach to populations described in terms of length compositions from the trawl component of the fishery. Creel fishing is an important component of the North Minch fishery and landings from creel vessels have risen since the mid-1990s having been at a stable level since then. Given that creels operate across similar areas to those of the trawl fishery, this year's assessment is performed using combined length compositions from trawl and creels.

Data available

An overview of the data provided and used by the WG is shown in Table 2.1.

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are shown in Table 3.5.2; these relate to the whole of VI of which the North Minch is a part. Landings by gear category for FU11 provided through national laboratories are presented in Table 3.5.5. Landings from this fishery are only reported from Scotland. A variety of gear types make landings of *Nephrops*. Total reported landings in 2009 were 3497 tonnes, consisting of 2858 tonnes landed by trawlers and 613 tonnes landed by creel vessels.

Given the concerns about the previously presented Scottish effort data (due to non-mandatory recording of hours fished in recent years) and following recommendations made by the RG, effort data in terms of days absent were presented to the WG. Reported effort by all Scottish *Nephrops* trawlers has shown a decreasing trend since 2002, (Figures 3.5.3 and 3.5.4).

The introduction of the "buyers and sellers" regulations in the UK in 2006 however, have led to increased reliability in the reported landings. Combined together, these observations imply that interpretation of lpue and cpue series is likely to be difficult and the increase in lpue after 2005 is probably reflecting the increase in reported landings rather than a change in stock abundance.

Males consistently make the largest contribution to the landings, although the sex ratio does seem to vary (79% males in 2009) (Figure 3.5.4). This is likely to be due to the varying seasonal pattern in the fishery and associated relative catchability (due to different burrow emergence behaviour) of male and female *Nephrops*. This occurs because males are available throughout the year and the fishery is also prosecuted in all quarters. Females on the other hand are mainly taken in the summer when they emerge after egg hatching.

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 2000. Discarding rates in this FU average around 20% by number in the last five years It is likely that some *Nephrops* survive the discarding process, an estimate of 25% (Guéguen, J. and Chareau, A., 1975; Sangster *et al*., 1997; Wileman *et al*., 1999) survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard rate adjusted for survivorship estimated at the Benchmark Workshop was 19.9 % (3 year average) and this value is used in the provision of landings options for 2011.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available from Scotland and these sampling levels are shown in Table 3.5.4. Although assessments based on detailed catch analysis are not presently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.5.5 shows a series of annual length frequency distributions for the period 1979 to 2009. Catch (removals) length compositions are shown for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) shows no evidence of reductions in relative numbers of larger animals.

The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings (trawl only) shown in Figure 3.5.3 and Table 3.5.6. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) is also quite stable through time up to 2009 where a slight drop can be observed for both males and females which may possibly indicate a good recruitment in this area. This result should however be interpreted with some caution since some inconsistent data was found in the length frequency distribution for the second quarter, when the catchability of females typically increases. To compensate for this, a fill-in from the others quarters was applied.

Mean weight in the landings is shown in Figure 3.5.6 and Table 3.5.9 and this also shows no systematic changes over the time-series.

Natural mortality, maturity-at-age and other biological parameters

Biological parameter values are included in the Stock Annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1994 (missing surveys in 1995 and 1997). Underwater television surveys of *Nephrops* burrow numbers and distributions, reduce the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows.

The numbers of valid stations used in the final analysis in each year are shown in Table 3.5.8. On average, 38 stations have been considered valid each year, and then raised to the estimated area of the ground available for *Nephrops*- 1775 km^2. In the 2009 TV survey there were fewer stations covering the usual strata (and therefore fewer used for the abundance calculation) because a number of exploratory stations were surveyed on the basis of newly available VMS data which indicated fishing activity in additional areas.

Data analyses

Exploratory analyses of survey data

A re-working of the UWTV survey abundances for Division VIa were presented to the *Nephrops* Benchmark Workshop (WK*NEPH*) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the Report of that workshop. The revised abundance estimates for FU11 from 1999 onwards were presented for the first time at WGCSE 2009 and are slightly higher than the previous values due to the field of view being smaller than previously calculated.

Table 3.5.7 shows the basic analysis for the three most recent TV surveys conducted in FU11. The table includes estimates of abundance and variability in each of the strata adopted in the stratified random approach.

Figure 3.5.7 shows the distribution of stations in recent TV surveys (2004–2009), with the size of the symbols reflecting the *Nephrops* burrow density. Abundance is generally higher in the soft and intermediate sediments located to the south west and north east of the ground, however in previous years there has also been large abundances found on the coarser sediment type in the northeast of the. Table 3.5.8 and Figure 3.5.7 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates.

VMS plots (Figure 3.5.9) have shown fishing effort extends outside of the present survey area for FU11, which would imply an underestimate of stock biomass in this area. Further work needs to be done on the area estimate as the VMS data becomes more available.

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WK*NEPH* (ICES, 2009). A number of potential biases were highlighted including those due to edge effects, species burrow mis-identification and burrow occupancy. The cumulative bias correction factor estimated for FU11 was 1.33 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 33%.

Final Assessment

The underwater TV survey is presented as the best available information on the North Minch *Nephrops* stock. The surveys provide a fishery independent estimate of *Nephrops* abundance. The details of the 2009 survey is shown in Table 3.5.7 and compared with the 2007 and 2008 outcome. At present it is not possible to extract any length or age structure information from the survey and it therefore only provides information on abundance over the area of the survey.

The 2009 TV survey data presented at this meeting shows that the abundance has increased slightly compared with 2008 (15%) to the same level obtained for 2007 but the confidence limits overlap for the past three years.

The TV survey results reported here do not cover the sea loch areas adjacent to the main North Minch grounds and should therefore be considered underestimates of the overall biomass. The sea lochs support a significant but unknown percentage of the creel fishery. This issue is discussed further under quality of assessment.

3.5.6 Historic stock trends

The TV survey estimates of abundance for *Nephrops* in the North Minch suggest that historically the population increased until 2003 at which time it has fluctuated around the maximum value until 2006 when it declined for two years before a slight increase in 2009. The recently observed decrease has left stocks at a similar abundance to those seen in 2002 but not as low as previous to this. The bias adjusted abundance estimates from 1999–2009 (the period over which the survey estimates have been revised) are shown in Table 3.5.10. The stock is estimated to now be at 729 million individuals (bias adjusted values).

Table 3.5.10 also shows the estimated harvest ratios over this period. These range from 7–32%. It is likely that prior to 2006, the estimated harvest ratios may not be representative of actual harvest ratios due to under-reporting of landings).

3.5.7 MSY considerations

A number of potential F_{msy} proxies are obtained from the per-recruit analysis for *Nephrops* and these are discussed further in Section 2.2 of this report. The analysis assumes the same input parameters (exploitation, discard ogive and biological parameters) as used at the Benchmark meeting in 2009. The complete range of the per-recruit F_{msy} proxies is given in the text table below and the process for choosing an appropriate F_{msy} proxy is described in Section 2.2.

All F_{msy} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

For this FU, the absolute density observed on the UWTV survey is intermediate (based on the guideline categories suggested in Section 2.2) with an average of just over 0.55 m^{-2} suggesting the stock may have a medium productivity capability. Historical harvest ratios in this FU have been above that equivalent to fishing at F_{max} and landings have been relatively stable in the last thirty years. $F_{35\%SpR}$ (combined between sexes) is also estimated to be at F_{max}. For these reasons, the Working Group considered that **F35%SpR (combined between sexes) deliver high long-term yield with a low probability of recruitment overfishing and therefore is chosen as a proxy for F_{msy}.**

		Fbar(20–40 mm)				SPR (%)		
		Fmult	M	F	HR (%)	M	F	T
$F_{0.1}$	M	0.20	0.14	0.05	7.4	39.7	69.2	50.6
	F	0.65	0.44	0.15	19.8	13.0	38.0	22.2
	T	0.24	0.16	0.06	8.7	34.6	65.0	45.8
F_{max}	M	0.36	0.24	0.08	12.2	24.3	54.4	35.4
	F	1.49	1.01	0.34	37.2	4.7	18.2	9.6
	T	0.52	0.35	0.12	16.6	16.7	44.2	26.8
$F_{35\%SpR}$	M	0.24	0.16	0.06	8.7	34.6	65.0	45.8
	F	0.73	0.49	0.17	21.7	11.4	34.9	20.0
	T	**0.37**	**0.25**	**0.09**	**12.5**	**23.6**	**53.7**	**34.7**

The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance) is calculated as 330 million individuals.

3.5.8 Landings forecasts

A prediction of landings in 2011 based on principles established at the Benchmark Workshop WK*NEPH* (ICES 2009) and using the revised approach based on various proxies for F_{MSY} (Dobby, 2009) outlined in the introductory Section 2.2 was made for the North Minch. The landings prediction for 2011 at the F_{msy} proxy harvest ratio is 1939 tonnes. Since current harvest rate is above the F_{msy} proxy, the transition scheme towards the ICES MSY framework applies and would result in a landings estimate of 3118 tonnes for 2011.

The inputs to the landings forecast were as follows:

Mean weight in landings (07–09) = 24.2 g

Discard rate (by number) = 12.1%

Survey bias = 1.33

	Harvest rate	Survey Index (adjusted)	Implied fishery	
			Retained number	Landings (tonnes)
F_{msy}	12.5%	729	80	1939
$F_{msy\ transition}$	20.1%	729	129	3118
$F_{0.1(M)}$	7.4%	729	47	1148
$F_{0.1(T)}$ / $F_{35\%SpR(M)}$	8.7%	729	56	1350
$F_{max\ (M)}$	12.2%	729	78	1893
$F_{35\%SpR(T)}$	12.5%	729	80	1939
$F_{max\ (T)}$	16.6%	729	106	2575
F_{2009}	22.0%	729	141	3413

$F_{0.1(M,T)}$: Harvest ratio equivalent to fishing at a level associated with 10% of the slope at the origin on the male or combined sex YPR curve.

$F_{35\%SPR(M,T)}$: Harvest ratio equivalent to fishing at a rate which results in male or combined SPR equal to 35% of the unfished level.

$F_{max\ (M,\ T)}$: Harvest ratio equivalent to fishing at a rate which maximises the male or combined YPR.

A discussion of F_{msy} reference points for *Nephrops* is provided in Section 2.2.

3.5.9 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks.

3.5.10 Unceratinties in the assessment and forecast

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the fishery adequately. In this assessment combined trawl and creel length compositions are used to account for the fact that the creel fishery accounts for over 17% of the landings, increasingly operates over similar areas to trawling, and exhibits a length composition composed of larger animals.

There were concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers was introduced and the reliability began to improve. Because of this the final assessment adopted is independent of official statistics. Harvest ratios since 2006 are also considered more reliable due to more accurate landings data reported under new legislation. Incorporation of creel length compositions has also improved estimates of harvest ratios.

Underwater TV surveys have been conducted for this stock since 1994, with a continual annual series available since 1998. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are quite small for this functional unit. There is a gap of 18 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three year average (2005–2007) of discard rate (adjusted to account for some survival of discarded animals) has been used in the calculation of catch options. The recent observed discard rate shows a large decline in discards in 2007 and 2008 coincident with a drop in survey abundance but a return to former levels in 2009.

The cumulative bias estimates for FU11 are largely based on expert opinion (See Annex). The precision of these bias corrections cannot yet be characterised.

The overall area of the ground is estimated by contoured sediment data. New VMS data linked to landings (through interrogation of the Scottish FIN system) suggests that not all areas are being considered in the current UWTV approach and as such, the absolute abundance estimate for this ground is likely to be an underestimate. Figure 3.5.9 illustrates differences between the British Geological Survey based sediment approach to estimating area and the activity of >15 m trawlers; inclusion of smaller vessels would likely further modify this. Work is in progress to refine the area estimate.

3.5.11 Status of the stock

The perception of the state of the stock has not changed substantially since the assessment in 2008. The evidence from the TV survey suggests that the population is stable, but at a lower level than that evident from 2003–2006 and the 14% increase observed in 2009 is within the confidence limits for the past two years. The calculated harvest ratio in 2009 (dead removals/TV abundance) is above the values associated with high long-term yield and low risk depletion.

3.5.12 Management considerations

The WG, ACFM and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level and management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort were compatible and in line with the scale of the resource.

Creel fishing takes place in this area but overall effort by this fleet in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the North Minch and STECF estimates that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation Credits scheme and west coast emergency measures include the implementation of larger meshed square meshed panels (120 mm) and real time closures to avoid cod.

The implementation of buyers and sellers legislation in the UK in 2006 is improving the reliability of fishery statistics but the transition period is accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.5.13 References

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Table 3.5.1. *Nephrops* Functional Units and descriptions by statistical rectangle.

Functional Unit	Stock	Division	ICES Rectangles
11	North Minch	VIa	44–46 E3–E4
12	South Minch	VIa	41–43 E2–E4
13	Clyde	VIa	39–40 E4–E5
14	Irish Sea East	VIIa	35–38E6; 38E5
15	Irish Sea West	VIIa	36E3; 35–37 E4–E5; 38E4

Table 3.5.2. Nominal catch (tonnes) of *Nephrops* in Division VIa and VIb, 1980–2009, as officially reported to ICES. There are no Functional Units in ICES Division VIb but occasional small landings are made.

Via Official Landings

	France	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	UK	TOTAL
1980	5	1	-	-	7,422	-	7,428
1981	5	26	-	-	9,519	-	9,550
1982	1	1	-	1	9,000	-	9,003
1983	1	1	-	11	10,706	-	10,719
1984	3	6	-	12	11,778	-	11,799
1985	1	1	28	9	12,449	-	12,488
1986	8	20	5	13	11,283	-	11,329
1987	6	128	11	15	11,203	-	11,363
1988	1	11	7	62	12,649	-	12,730
1989	-	9	2	25	10,949	-	10,985
1990	-	10	4	35	10,042	-	10,091
1991	-	1	-	37	10,458	-	10.496
1992	-	10	-	56	10,783	-	10,849
1993	-	7	-	191	11,178	-	11,376
1994	3	6	-	290	11,047	-	11,346
1995	4	9	3	346	12,527	-	12,889
1996	-	8	1	176	10,929	-	11,114
1997	-	5	15	133	11,104	-	11,257
1998	-	25	18	202	10,949	-	11,194
1999	-	136	40	256	11,078	-	11,510
2000	1	130	69	137	10,667	-	11,004
2001	9	115	30	139	10,568	-	10,861
2002	-	117	18	152	10,225	-	10,512
2003	-	145	12	81	10,450	-	10,688
2004	-	150	6	267	9,941	-	10,364
2005	-	153	17	153	7,616	-	7,939
2006	-	133	1	255	13,432	-	13,821
2007	-	155	-	2,088	14,120	-	16,363
2008	-	56	1	419	14,795	-	15,271
2009*	-	56	-	-	-	12,634	12,690

* figures are provisional.

VIb Official Landings

	France	Germany	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK- Scotland	TOTAL
1980	-	-	-	-	-	-	0
1981	-	-	-	-	-	-	0
1982	-	-	-	-	-	-	0
1983	-	-	-	-	-	-	0
1984	-	-	-	-	-	-	0
1985	-	-	-	-	-	-	0
1986	-	-	-	8	-	-	8
1987	-	-	-	18	11	-	29
1988	-	-	-	27	4	-	31
1989	-	-	-	14	-	-	14
1990	-	-	-	10	1	-	11
1991	-	-	-	30	-	-	30
1992	-	-	-	2	4	1	7
1993	-	-	-	2	6	9	17
1994	-	-	-	5	16	5	26
1995	1	-	-	2	26	1	30
1996	-	6	-	5	65	5	81
1997	-	-	1	3	88	23	115
1998	-	-	1	6	46	7	60
1999	-	-	-	5	2	5	12
2000	2	-	8	3	4	4	21
2001	1	-	1	14	2	7	25
2002	1	-	-	7	3	7	18
2003	-	-	1	5	6	18	30
2004	-	-	-	2	7	13	22
2005	3	-	1	1	5	7	17
2006	-	-	-	-	1	3	4
2007	-	-	-	2	-	-	2
2008	-	-	-	-	-	-	0
2009*	-	-	-	-	-	-	0

* figures are provisional.

Table 3.5.3. ***Nephrops*****, Total** ***Nephrops*** **landings (tonnes) by Functional Unit plus Other rectangles, 1981–2009.**

YEAR	FU11	FU12	FU13	OTHER	TOTAL
1981	2861	3651	2968	39	9519
1982	2799	3552	2623	27	9001
1983	3196	3412	4077	34	10719
1984	4144	4300	3310	36	11790
1985	4061	4008	4285	104	12458
1986	3382	3484	4341	89	11296
1987	4083	3891	3007	257	11238
1988	4035	4473	3665	529	12702
1989	3205	4745	2812	212	10974
1990	2544	4430	2912	182	10068
1991	2792	4442	3038	255	10527
1992	3560	4237	2805	248	10849
1993	3192	4455	3342	344	11332
1994	3616	4415	2629	441	11101
1995	3656	4680	3989	460	12785
1996	2871	3995	4060	239	11165
1997	3046	4345	3618	243	11252
1998	2441	3730	4843	157	11171
1999	3257	4051	3752	438	11498
2000	3246	3952	3419	421	11038
2001	3259	3992	3182	420	10853
2002	3440	3305	3383	397	10525
2003	3268	3879	3171	433	10751
2004	3135	3868	3025	403	10431
2005	2984	3841	3423	254	10502
2006	4160	4554	4778	241	13733
2007	3968	5451	6656	259	16334
2008	3799	5347	5921	162	15229
2009*	3497	4267	4405	171	12340

*** provisional.**

Table 3.5.4. ***Nephrops*****. Sampling levels all FUs in VIa.**

IMS DATA ONLY	2007	2008	2009*
No. *Nephrops* Samples	126	119	144
No. *Nephrops* measured	119 962	68 309	81 692
DISCARD DATA ONLY	**2007**	**2008**	**2009***
No. *Nephrops* Samples	22	24	18
No. Marketable *Nephrops* measured	NA	45 251	32 663
No. Discards Measured	14 630	15 975	17 833

*** 2009 is not directly comparable with previous years given that sampling levels shown are aggregated for all gears while sampling numbers for 2007 and 2008 include only** ***Nephrops*** **trawl and Creel fishing.**

Table 3.5.5. *Nephrops*, North Minch (FU11), Nominal Landings of *Nephrops*, 1981–2009.

	UK Scotland			
Year	*Nephrops* trawl	Other trawl	Creel	Total
1981	2320	170	371	2861
1982	2323	105	371	2799
1983	2784	95	317	3196
1984	3449	161	534	4144
1985	3236	117	708	4061
1986	2642	203	537	3382
1987	3458	143	482	4083
1988	3449	149	437	4035
1989	2603	112	490	3205
1990	1941	134	469	2544
1991	2228	125	439	2792
1992	2978	150	432	3560
1993	2699	85	408	3192
1994	2916	246	454	3616
1995	2940	184	532	3656
1996	2355	147	369	2871
1997	2553	102	391	3046
1998	2023	67	351	2441
1999	2791	56	410	3257
2000	2695	28	523	3246
2001	2651	41	567	3259
2002	2775	79	586	3440
2003	2607	44	617	3268
2004	2400	25	710	3135
2005	2267	18	699	2984
2006	3446	17	697	4160
2007	3362	16	590	3968
2008	3230	12	557	3799
2009	2858	26	613	3497

*** provisional   na = not available**

**** There are no landings by other countries from this FU**

Table 3.5.6. ***Nephrops*****, North Minch (FU11): Mean sizes (CL mm) above and below 35 mm of male and female** ***Nephrops*** **in Scottish catches and landings, 1981–2009.**

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	30.2	29.3	30.6	30.2	39.2	37.6
1982	29.8	28.6	30.1	29.0	39.8	37.4
1983	29.0	27.6	29.1	27.5	40.0	37.8
1984	28.5	28.0	28.5	28.1	39.2	37.4
1985	27.9	27.5	27.9	27.5	40.0	37.5
1986	29.5	28.4	29.7	28.6	39.1	37.6
1987	29.6	29.0	29.9	29.6	39.8	37.9
1988	29.9	29.5	30.3	30.1	38.9	38.0
1989	29.0	29.0	29.2	29.2	40.1	38.9
1990	29.3	28.6	29.8	28.9	39.1	38.1
1991	30.3	29.1	30.6	29.5	39.4	39.1
1992	29.3	28.0	29.7	28.3	39.6	38.3
1993	29.4	27.9	29.5	28.0	38.7	38.3
1994	28.1	27.0	29.4	28.3	39.5	38.8
1995	27.7	27.7	28.6	29.0	40.0	38.2
1996	29.5	29.4	30.2	30.2	40.0	38.7
1997	29.1	28.4	29.9	28.8	39.4	38.0
1998	29.8	28.8	30.6	29.3	39.6	38.4
1999	28.9	28.2	30.1	29.1	39.4	37.5
2000	29.9	28.6	30.4	29.0	39.4	37.8
2001	29.4	28.1	30.3	28.8	39.8	38.2
2002	29.2	28.4	30.4	29.5	39.7	38.3
2003	29.0	28.3	30.3	29.6	39.2	37.8
2004	29.6	28.9	30.4	29.5	40.3	38.8
2005	28.4	27.8	30.1	30.0	39.4	37.8
2006	29.0	27.4	30.5	28.9	39.1	38.2
2007	30.0	28.3	30.0	28.2	40.3	38.7
2008	29.6	28.3	30.1	28.8	40.0	38.5
2009	27.9	25.1	28.9	25.3	39.4	38.3

*** provisional   na = not available.**

Table 3.5.7. ***Nephrops*, North Minch (FU11): Results by stratum of the 2007–2009 TV surveys. Note that stratification was based on a series of arbitrary rectangles (U, V, W, X).**

Stratum	Area (km^2)	Number of Stations	Mean burrow density ($no./m^2$)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
2007 TV survey							
U	656	14	0.53	0.11	348	3475	0.407
V	425	9	0.70	0.12	296	2328	0.273
W	563	9	0.25	0.07	142	2319	0.272
X	131	4	0.92	0.10	121	412	0.048
Total	1775	36			907*	8534	1
2008 TV survey							
U	656	13	0.36	0.05	233	1511	0.255
V	425	10	0.59	0.05	250	827	0.140
W	563	13	0.40	0.14	225	3511	0.592
X	131	5	1.07	0.02	140	78	0.013
Total	1775	41			848	5927	1
2009 TV survey							
U	656	9	0.39	0.03	255	1476	0.174
V	425	6	0.60	0.08	255	2251	0.266
W	563	8	0.54	0.12	306	4644	0.549
X	131	3	1.17	0.02	153	93	0.011
Total	1775	26			969	8464	1

***Note: abundance estimates for these years based on figures prior to the 2009 revision of the dataseries. Differences between these figures and the revised figures shown on Table 3.5.8 are small.**

Table 3.5.8. ***Nephrops*****, North Minch (FU11): Results of the 1994–2009 TV surveys.**

Year	Number of valid stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1994	41	0.38	665	99
1995		No survey		
1996	38	0.25	439	62
1997		No survey		
1998	38	0.41	728	103
1999	36	0.36	644	119
2000	39	0.53	946	109
2001	56	0.50	886	108
2002	37	0.61	1084	121
2003	41	0.80	1420	171
2004	38	0.80	1420	142
2005	41	0.70	1249	133
2006	30	0.81	1429	134
2007	36	0.55	978	122
2008	41	0.48	848	127
2009	26	0.55	969	184

Table 3.5.9. ***Nephrops*****, North Minch (FU11–13): Mean weight in the landings.**

Year	FU11	FU12	FU13
1990	21.31	19.90	24.21
1991	25.28	21.65	20.57
1992	21.58	24.01	25.08
1993	20.70	21.16	29.40
1994	23.38	24.88	25.22
1995	22.16	21.87	19.14
1996	26.63	23.02	21.60
1997	21.62	23.28	24.14
1998	23.57	22.09	18.04
1999	21.49	23.60	16.74
2000	22.77	24.81	19.54
2001	23.15	21.44	19.06
2002	23.03	23.60	15.82
2003	22.86	24.48	18.59
2004	21.45	24.02	18.31
2005	23.62	23.53	17.46
2006	21.97	23.15	18.66
2007	21.68	21.43	18.53
2008	21.15	21.41	16.05
2009	22.18	21.07	18.10
Mean (07–09)	21.67	21.30	17.56

Table 3.5.10. *Nephrops*, North Minch (FU11): Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	484	3257	0.16	0.34
2000	711	3246	0.07	0.20
2001	666	3259	0.12	0.21
2002	815	3440	0.18	0.19
2003	1068	3268	0.19	0.14
2004	1068	3135	0.13	0.13
2005	939	2984	0.32	0.15
2006	1074	4160	0.30	0.21
2007	735	3968	0.07	0.24
2008	638	3799	0.11	0.27
2009	729	3497	0.20	0.22

***harvest rates previous to 2006 are unreliable.**

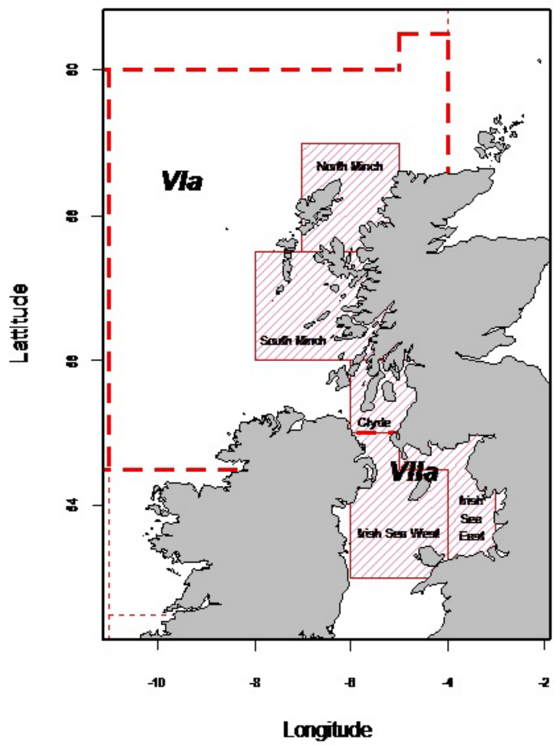

Figure 3.5.1. ***Nephrops*** **Functional Units in VIa and VIIa. North Minch (FU11), South Minch (FU12), Clyde (FU13), Irish Sea East (FU14) and Irish Sea West (FU15).**

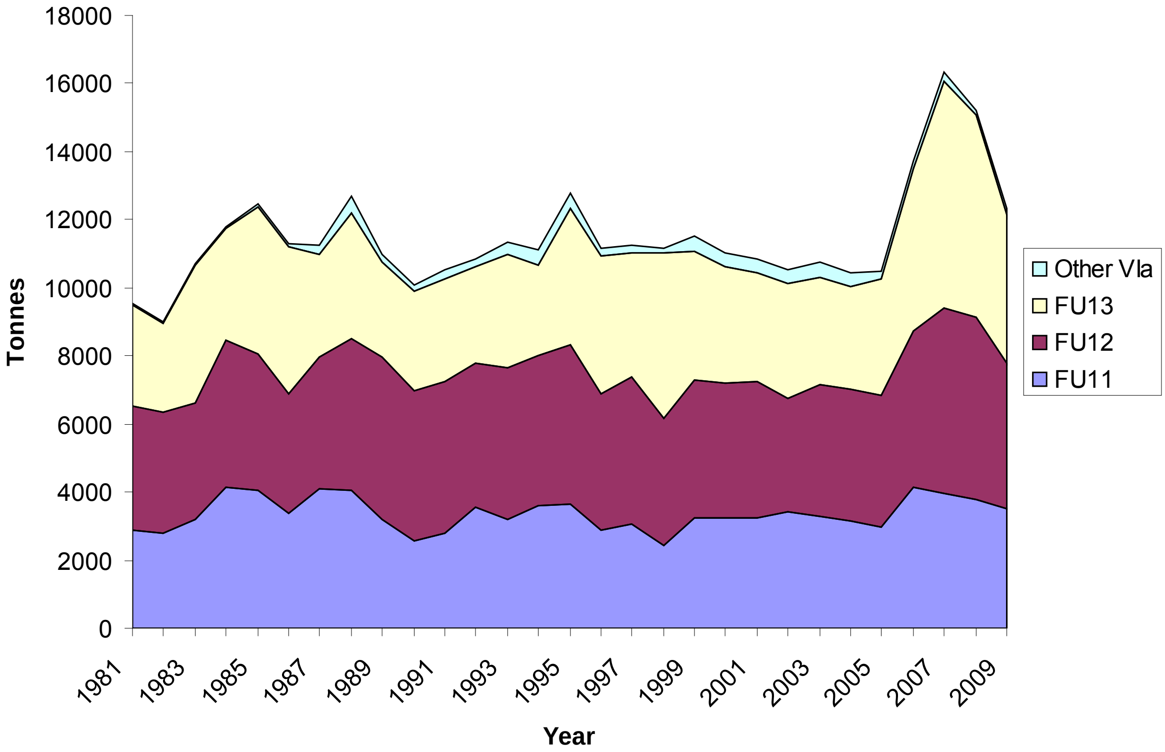

Figure 3.5.2. *Nephrops* in Division VIa. Landing (thousands tonnes) by FU and Other rectangles.

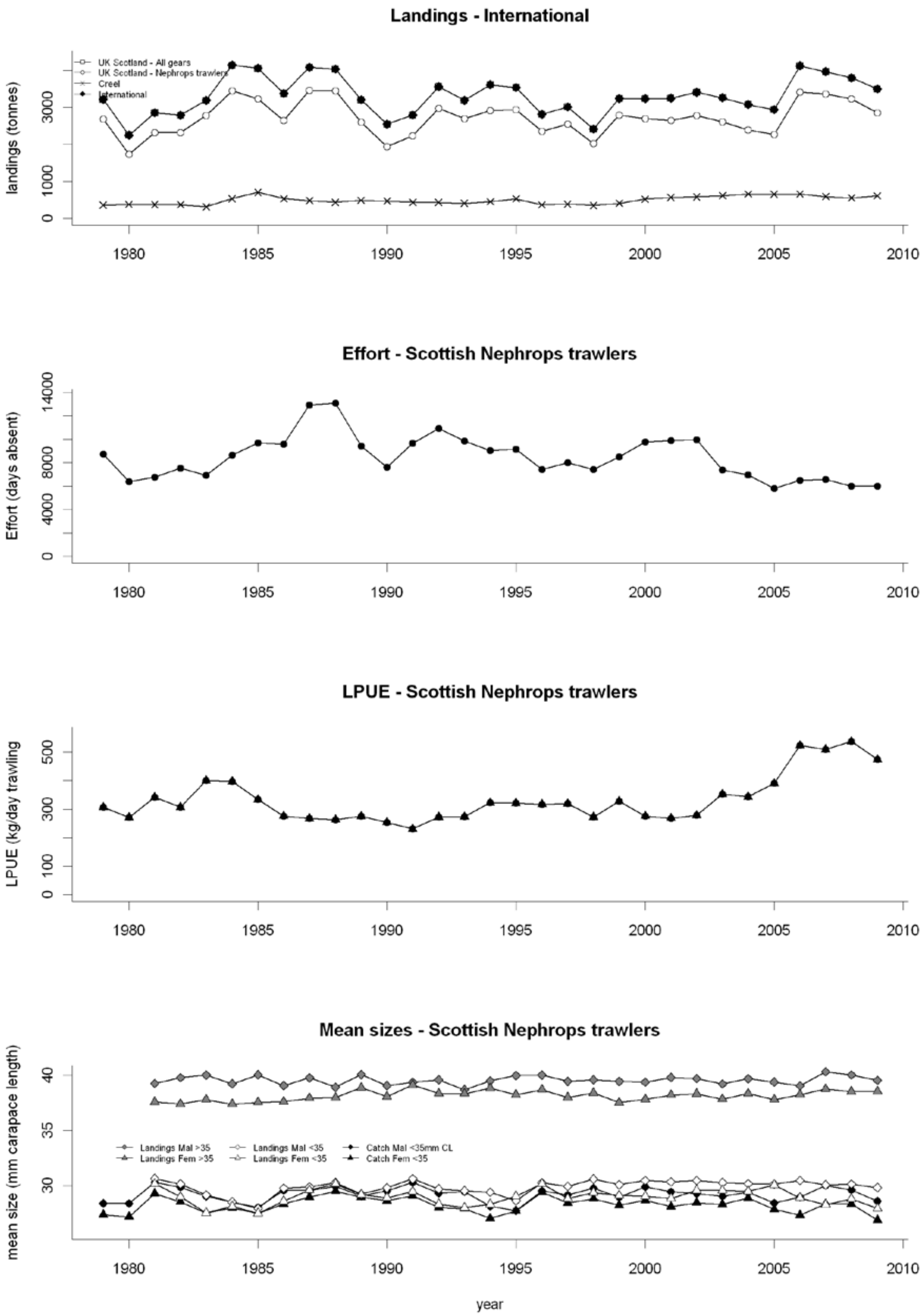

Figure 3.5.3. *Nephrops*, North Minch (FU11), Long-term landings, effort, lpue and mean sizes.

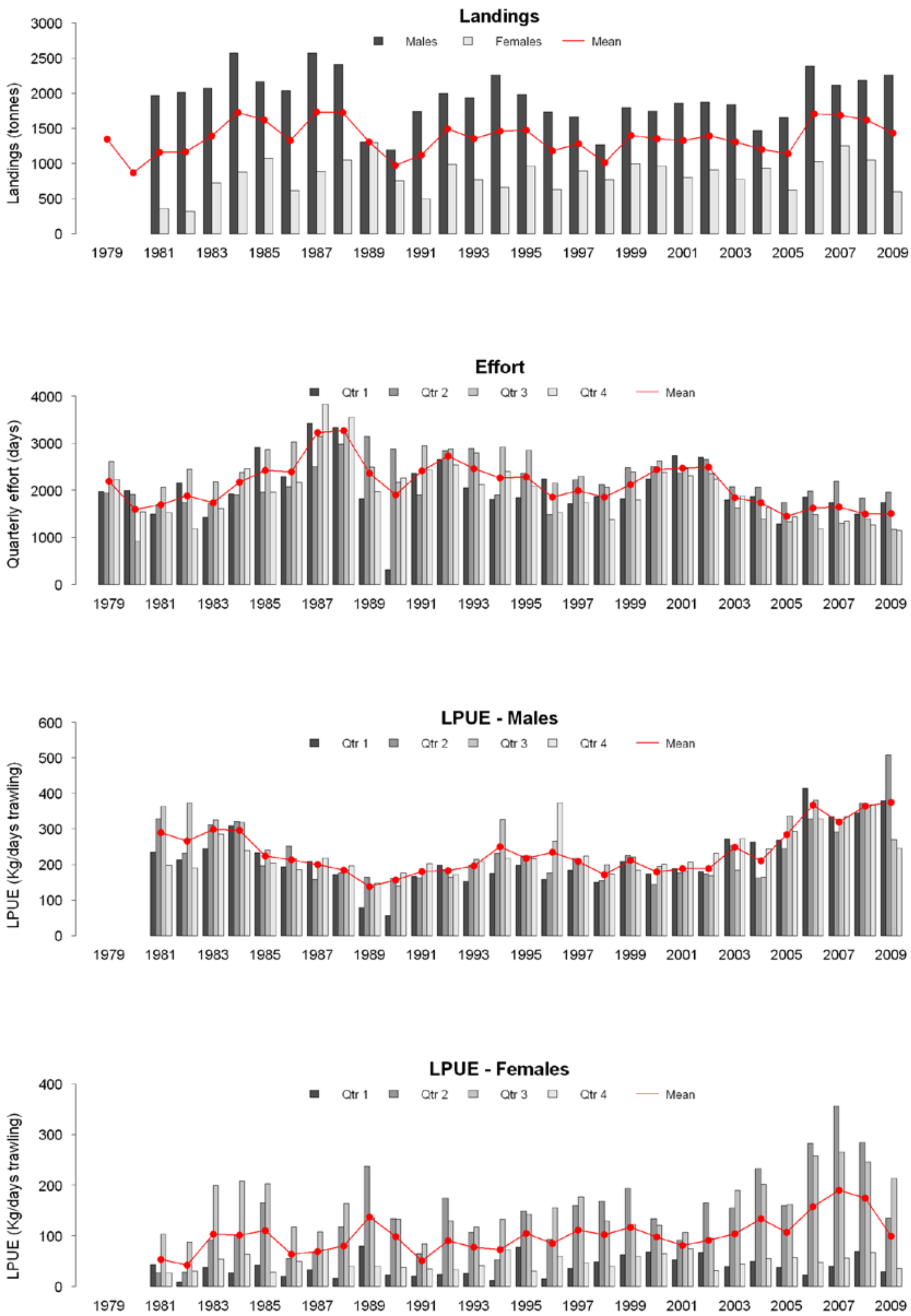

Figure 3.5.4. ***Nephrops*****, North Minch (FU11), Landings, effort and lpues by quarter and sex from Scottish** ***Nephrops*** **trawlers.**

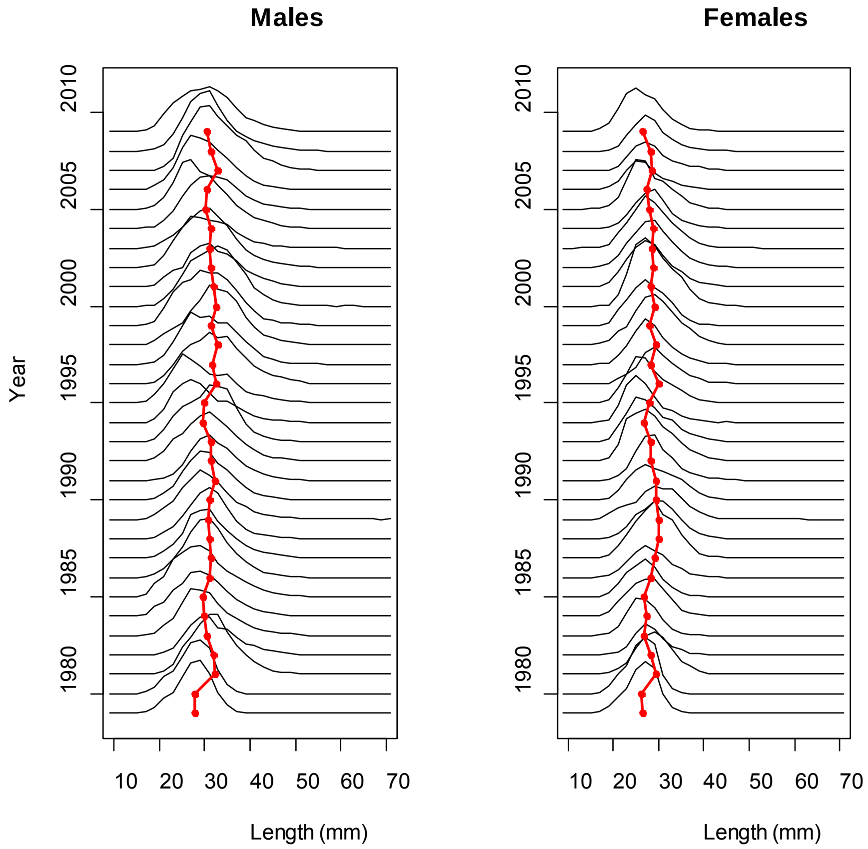

Figure 3.5.5. ***Nephrops*****, North Minch (FU11), Catch length frequency distribution and mean sizes (red line) for *Nephrops* in the North Minch, 1979–2009.**

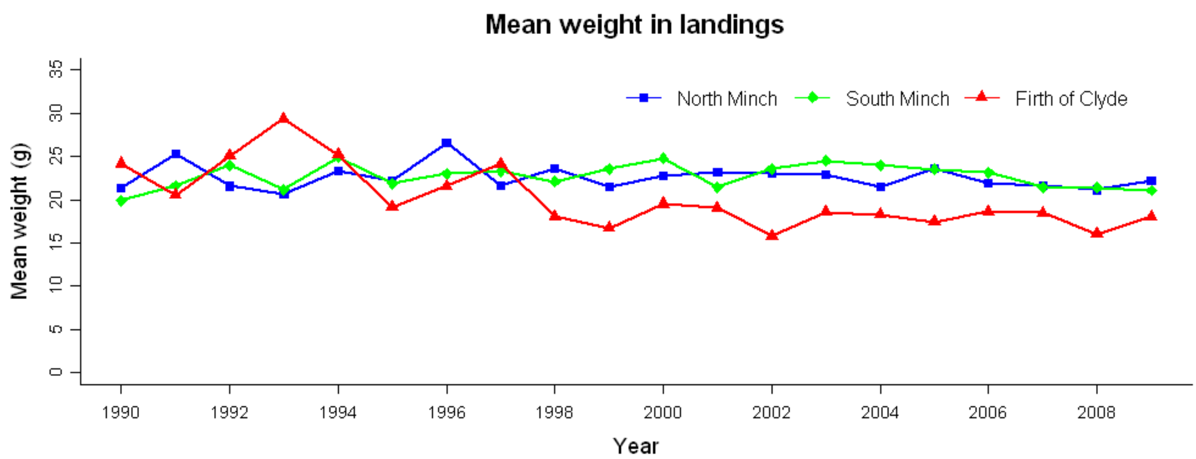

Figure 3.5.6. ***Nephrops*****, (FU11–13), individual mean weight in the landings from 1990–2009 (from Scottish market sampling data).**

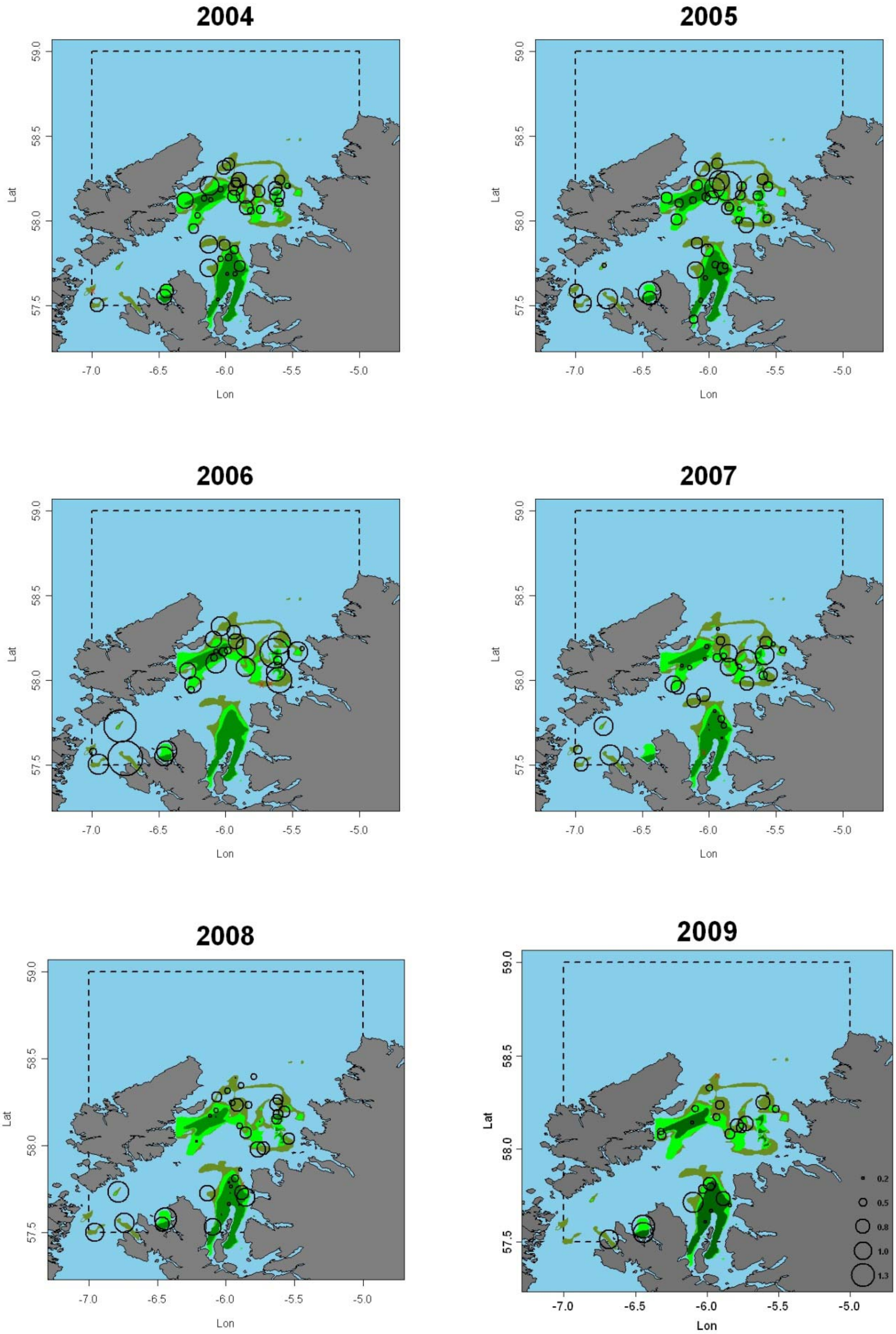

Figure 3.5.7. ***Nephrops*****, North Minch (FU11), TV survey station distribution and relative density (burrows/m²), 2004–2009. Shaded green and brown areas represent areas of suitable sediment for** ***Nephrops*****. Bubbles in these figures are all scaled the same. Red crosses represent zero observations.**

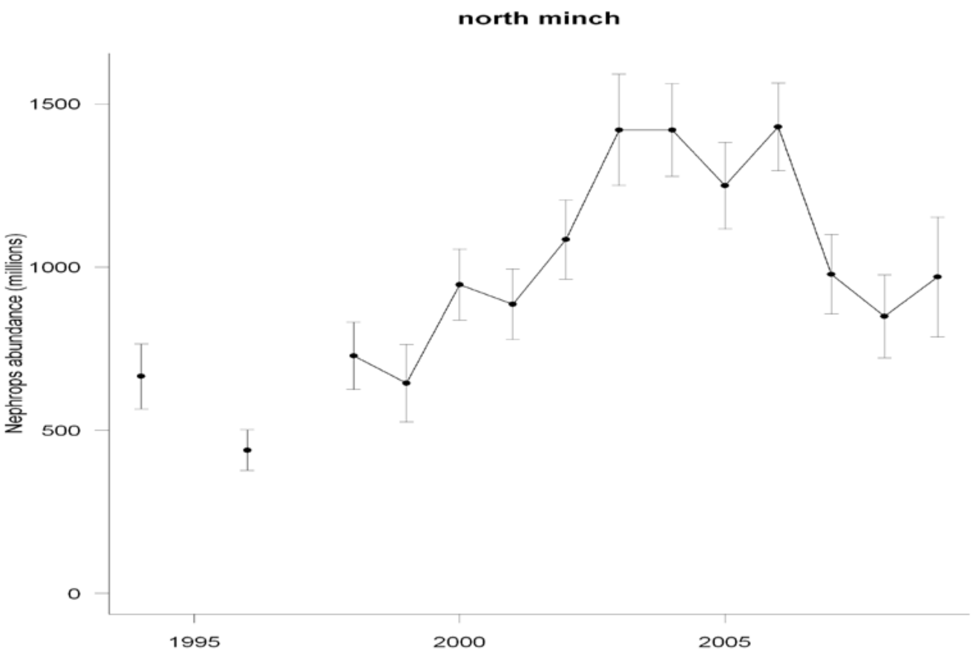

Figure 3.5.8. ***Nephrops*****, North Minch (FU11), Time-series of revised TV survey abundance estimates (not adjusted for bias), with 95% confidence intervals, 1994–2009 (no survey 1995 and 1997).**

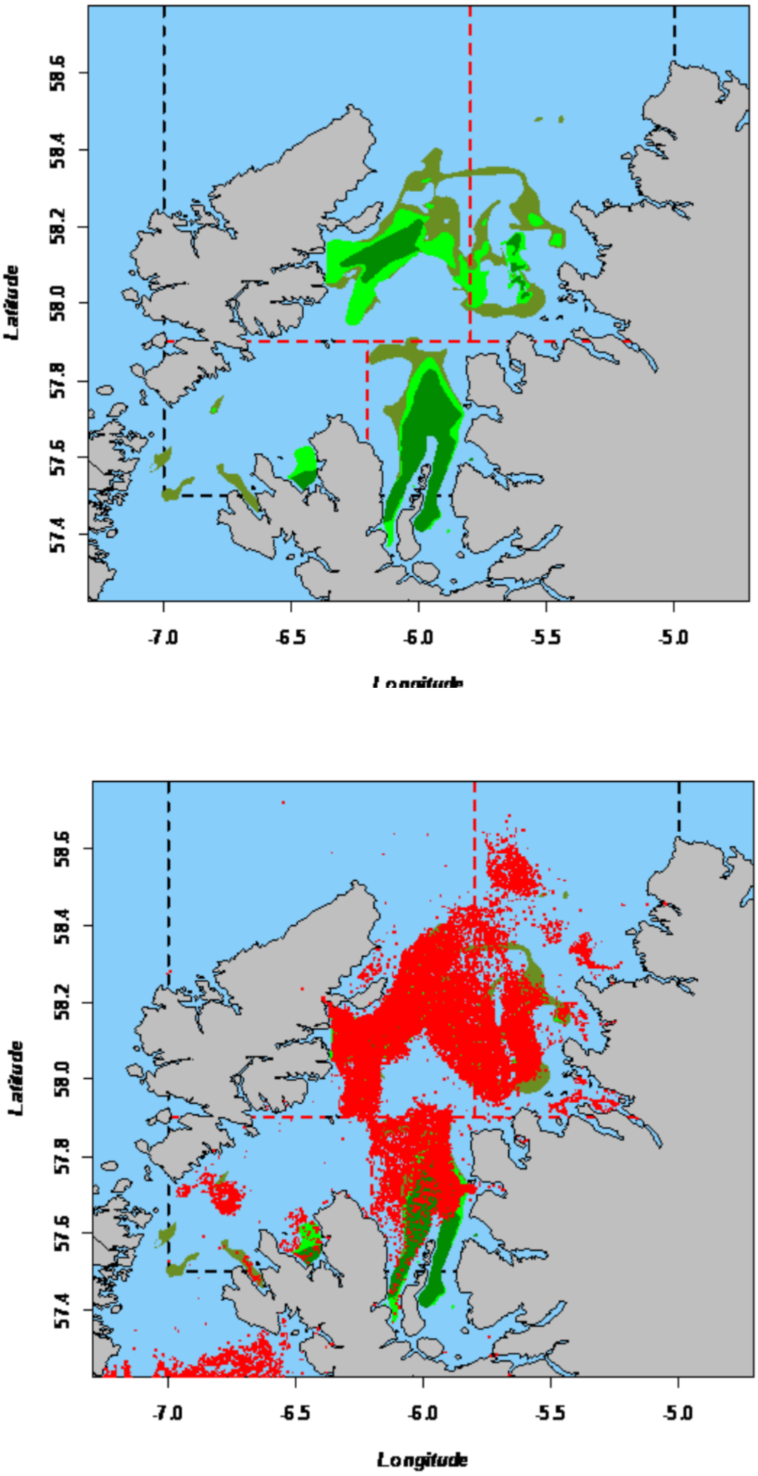

Figure 3.5.9. ***Nephrops*****, North Minch (FU11), comparison of area of** ***Nephrops*** **ground defined by BGS sediment distribution (upper plot) and by distribution of VMS pings (shown in red) recorded from** ***Nephrops*** **trawlers >15 m length (lower panel).**

3.6 South Minch, FU12

Type of assessment in 2010

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in Section 2.2.

3.6.1 Ecosystem aspects

The South Minch Functional Unit 12 is located mid way down the west coast of Scotland (Figure 3.5.1).

Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the South Minch Functional Unit these substrates are distributed according to prevailing hydrographic and baythmetric conditions. The area is characterised by numerous islands of varying size and sea lochs occur along the mainland coast. These topographical features create a diverse habitat with complex hydrography and a patchy distribution of soft sediments. A more continuous extensive area of sediment suitable for *Nephrops* occurs further offshore to the southwest. Figure 3.6.4 shows the distribution of sediment in the area.

Additional information on ecosystem aspects can be found in the Stock Annex.

3.6.2 The fishery in 2009

Two distinct fleets continued to operate in the South Minch during 2009, landing into the two main ports of Oban and Mallaig. Inshore, a large fleet of smaller vessels including creel boats operated throughout the year, whilst some larger twin riggers fished slightly further afield. 90% of boats are thought to fish for *Nephrops* at some time. Around 15 to 20 vessels are resident to Mallaig throughout the year. The local fleet has declined over the years. Approximately ten of these vessels are 'day boats', and approximately five are 17–19 m long twin riggers. Trips were typically of 1–3 days usually operating within about two hours steaming distance.

Traditionally east coast vessels (mainly twin riggers from Fraserburgh) visit Mallaig in March or April, but in the last years there was a significant reduction in effort from visiting vessels. During the winter months, fishing activity is severely reduced in the South Minch due to the weather and small boats are often restricted to trawling in the sheltered sea-lochs. There is increasing overlap of the areas exploited by trawl and creel fishing (This is described further in the quality of assessment section illustrate the extent of trawling by some vessels). Boats on the west coast of Scotland are operating in accordance with the Scottish Conservation Credits Scheme and during 2009 were also required to fit 120 mm square meshed panels in accordance with the west coast emergency measures (Council Reg. (EU) 43/2009).

3.6.3 ICES advice for 2009 and 2010

ICES advice for *2009* based on Exploitation boundaries in relation to precautionary considerations was as follows:

"The current fishery appears sustainable. Therefore, ICES recommends that *Nephrops* fisheries should not be allowed to increase relative to the past two years (2006–2007). This corresponds to landings of no more than 5000 tonnes for the South Minch stock."

ICES advice for 2010 based on Single-stock exploitation boundaries was as follows:

"ICES advises on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Rate for *Nephrops* fisheries should not exceed F_{2008}. This corresponds to landings of no more than 4126 t for the South Minch stock."

3.6.4 Management applicable in 2009 and 2010

Management applicable to this stock is included in management for Division VIa as a whole, and is described in Section 3.5.1.

3.6.5 Assessment

No specific concerns were raised in relation to the assessment method or data during the review of the 2009 assessment.

Approach in 2010

The assessment in 2010 is based on a combination of examining trends in fishery indicators and underwater TV using an extensive data series for the South Minch FU12.

The assessment of *Nephrops* through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in the Stock Annex.

The provision of advice in 2010 develops the process defined by the Benchmark WG. Section 2.2 outlines the WG approach to integrate WKFRAME recommendations in the provision of F_{MSY} proxies for *Nephrops*. The approach was developed based on intersessional work carried out by participants of the Benchmark and involving collaboration between WGNSSK and WGCSE.

Previous TV based assessments have derived predicted landings by applying a harvest rate approach to populations described in terms of length compositions from the trawl component of the fishery. Creel fishing is important in the South Minch and increasingly operates across similar areas to the trawl fishery. For this reason the assessment is performed using combined length compositions from these fisheries.

Data available

An overview of the data provided and used by the WG is shown in Table 2.1.

Commerical catch and effort data

Official catch statistics (landings) reported to ICES are shown in Table 3.5.2. These relate to the whole of VIa of which the South Minch is a part. Landings for FU12 provided through national laboratories are presented in Table 3.6.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, with low levels reported from the rest of the UK in the mid-1990s, and low levels more recently reported for Ireland. Total international reported landings in 2009 was 4282 tonnes, consisting of 3347 tonnes landed by trawlers and 900 tonnes landed by creel vessels. These estimates for total landings show a reduction from the high values in the previous two years to landings more typical of the late 1980s. The high landings of 2006–2008 are thought to have arisen through a combination of good recruitment in the mid-2000s feeding into the fished population, increased catching opportunities and to the introduction of the "buyers and sellers" regulations in the UK in 2006 which have increased the reliability of landings information. Landings from creel vessels have remained relatively stable over the last four years, at close to 1000 tonnes, the highest level in the time-series.

Reported effort (given in days fished rather than hours since this is thought to be more reliable).by all Scottish *Nephrops* trawlers has fluctuated without trend in the most recent years after reaching a peak in the early 1990s. (Figures 3.6.1 and 3.6.2).

Sex ratio in the South Minch shows some variation but males consistently make the largest contribution to the annual landings. This occurs because males are available throughout the year and the fishery is also prosecuted in all quarters. Females on the other hand are mainly taken in the summer when they emerge after egg hatching (Figure 3.6.2).

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 2000. Discarding rates average around 21% by number in this FU (Table 3.6.5).

Studies (Guéguen, J. and Chareau, A., 1975; Sangster *et al*., 1997; Wileman *et al*., 1999) suggest that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard rate adjusted to account for some survival was estimated at the Benchmark Workshop (WK*NEPH* 2009) to be 16.7% (taking a three year average 2005–2007) and according to the agreed benchmark protocol this value is used in the provision of landings options for 2011.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available from Scotland and these sampling levels are shown in Table 3.5.4. Length compositions for the creel fishery are of landings only since the small numbers of discards survive well and are not considered to be removed from the population. Although assessments based on detailed catch analysis are not currently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.6.3 shows a series of annual length frequency distributions for the period 1979 to 2009. Catch (removals) length compositions are shown for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) shows no evidence of reductions in relative numbers of larger animals.

The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings shown in Figure 3.6.1 and Table 3.6.2. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) is also quite stable through time.

Mean weight in the landings is shown in Figure 3.5.6 and Table 3.5.9 and this also shows no systematic changes over the time-series.

Natural mortality, maturity-at-age and other biological parameters

Biological parameter values are included in the Stock Annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1995. Underwater television surveys of *Nephrops* burrow number and distribution, reduce the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows.

The numbers of valid stations used in the final analysis in each year are shown in Table 3.6.4. On average, 35 stations have been considered valid each year, and then raised to a stock area of 5072 km^2. In 2009 station numbers were the second lowest in the time-series, owing to time constraints on the RV survey and the presence of creels at a number of the planned station locations.

Data analyses

Exploratory analyses of survey data

Full details of the UWTV approach can be found in the Stock Annex and the Report of (WK*NEPH*) in 2009 (ICES, 2009).

A re-working of the UWTV survey abundance series for Division VIa was presented to the *Nephrops* Benchmark Workshop (WK*NEPH*) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the report of that workshop. The revised abundance estimates for FU12 from 1999 onwards were presented for the first time at WGCSE 2009 and are slightly higher than the previous values due to the field of view being smaller than previously calculated.

Table 3.6.3 shows the basic analysis for the three most recent TV surveys conducted in FU12. The table includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. Due to the fact only one station was surveyed in the mud sediment type in 2008, it was not possible to calculate a sample variance for this area in the usual way. Instead an average of the three previous years was taken. Results in 2009 were typical of previous years.

Figure 3.6.4 shows the distribution of stations in recent TV surveys (2004–2009), with the size of the symbol reflecting the *Nephrops* burrow density. The most recent survey suggests higher abundance in the southeast part of the functional unit.. Table 3.6.4 and Figure 3.6.5 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates.

The review of the use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WK*NEPH* (ICES, 2009). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative bias correction factor estimated for FU12 was 1.32 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 32%.

Final assessment

The underwater TV survey is presented as the best available information on the South Minch (FU12) *Nephrops* stock. This survey provides a fishery independent estimate of *Nephrops* abundance. The details of the 2009 survey is shown in Table 3.6.3 and compared with the 2007 and 2008 outcomes. At present it is not possible to extract any length or age structure information from the survey and it therefore only provides information on abundance over the area of the survey.

The 2009 TV survey data presented at this meeting shows that the abundance is more or less the same as in 2008, although the confidence limits are quite large around the estimate.

The TV survey results reported here do not cover the sea loch areas adjacent to the main South Minch grounds and should therefore be considered underestimates of the overall abundance. The sea lochs support an unknown but significant part of both the trawl and creel fishery. This issue is discussed further under quality of assessment.

3.6.6 Historic stock trends

The TV survey estimates of abundance for *Nephrops* in the South Minch show that the population has fluctuated without obvious trend over the period of the survey. The recently observed upturn gives an abundance which is just below the long-term average (2200 million animals). The bias adjusted abundance estimates from 1999–2009 (the period over which the survey estimates have been revised) is shown in Table 3.6.5. The stock is estimated to now be at 2035 million individuals as shown in Table 3.6.4.

Table 3.6.5 also shows the estimated harvest ratios over this period. These range from 7–27% over this period. (It is likely that prior to 2006, the harvest ratios are underestimates of the actual harvest ratios due to under-reporting of landings).

3.6.7 MSY considerations

A number of potential F_{msy} proxies are obtained from the per-recruit analysis for *Nephrops* and these are discussed further in Section 2.2 of this report. The analysis assumes the same input parameters (exploitation, discard ogive and biological parameters) as used at the Benchmark meeting in 2009. The complete range of the per-recruit F_{msy} proxies is given in the table below and the process for choosing an appropriate F_{msy} proxy is described in Section 2.2. Note that all F_{msy} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

For this FU, the absolute density observed on the UWTV survey is intermediate (average of just over 0.43 m^{-2}) suggesting the stock has moderate productivity. In addition, the fishery in this area has been in existence since the 1960s and the population has been studied numerous times (Afonso-Dias, 1998; Howard and Hall, 1983). Historical harvest ratios in this FU have been variable but generally around the $F_{35\%SpR}$. **The WG concluded that combined sex $F_{35\%SpR}$ is an appropriate F proxy for South Minch FU12 *Nephrops*.** This is slightly below F_{max} in males and is predicted to result in about 27% SPR for males; in excess of the 20% considered precautionary lower bound outlined in Section 2.2.

		Fbar(20-40 mm)			HR (%)	SPR (%)		
		Fmult	M	F		M	F	T
$F_{0.1}$	M	0.22	0.13	0.06	7.8	40.9	60.8	48.5
	F	0.44	0.27	0.12	13.8	23.8	43.7	31.4
	T	0.25	0.15	0.07	8.7	37.4	57.7	45.2
F_{max}	M	0.42	0.25	0.12	13.3	24.8	44.8	32.5
	F	1.1	0.67	0.31	26.8	9.9	23.6	15.2
	T	0.54	0.33	0.15	16.1	19.8	38.7	27.1
$F_{35\%SpR}$	M	0.28	0.17	0.08	9.6	34.5	54.9	42.3
	F	0.64	0.39	0.18	18.3	16.9	34.8	23.8
	T	**0.38**	**0.23**	**0.11**	**12.3**	**27.0**	**47.3**	**34.8**

The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance) is calculated as 1016 million individuals.

3.6.8 Landings forecasts

A landings prediction for 2011 was made for the South Minch (FU12) using the approach agreed at the Benchmark Workshop and outlined in the Section 2.2. The text table below shows landings predictions at various harvest ratios, including a selection of those equivalent to the per-recruit reference points discussed in Section 2 of this report and the harvest ratio in 2009 using the input parameters agreed at WK*NEPH* (ICES 2009). The landings prediction for 2011 at the F_{msy} proxy harvest ratio considered appropriate for the South Minch (i.e. 12.3%) is 3809 tonnes. Since current harvest rate is above the F_{msy} proxy, the transition scheme towards the ICES MSY framework applies and would result in a landings estimate of 3995 tonnes for 2011.

The inputs to the landings forecast were as follows:

Mean weight in landings (07–09) = 23.8 g

Discard rate (by number) = 15.7%

Survey bias = 1.32.

	Harvest rate	Survey Index (adjusted)	Implied fishery	
			Retained number	Landings (tonnes)
F_{msy}	12.3%	1542	160	3809
$F_{msy\ transition}$	12.9%	1542	168	3995
$F_{0.1(M)}$	7.8%	1542	101	2416
$F_{0.1(T)}$	8.7%	1542	113	2694
$F_{35\%SpR(M)}$	9.6%	1542	125	2973
$F_{35\%SpR(T)}$	12.3%	1542	160	3809
F_{2009}	13.0%	1542	169	4026
$F_{max\ (M)}$	13.3%	1542	173	4119
$F_{max\ (T)}$	16.1%	1542	209	4986

$F_{0.1(M,T)}$: Harvest ratio equivalent to fishing at a level associated with 10 % of the slope at the origin on the male or combined sex YPR curve.

$F_{35\%SPR(M,T)}$: Harvest ratio equivalent to fishing at a rate which results in male or combined SPR equal to 35% of the unfished level.

$F_{max\ (M,\ T)}$: Harvest ratio equivalent to fishing at a rate which maximises the male or combined YPR.

A discussion of F_{msy} reference points for *Nephrops* is provided in Section 2.2.

3.6.9 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks.

3.6.10 Quality of assessment and forecast

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the trawl fishery adequately. In this assessment combined trawl and creel length compositions are used to account for the fact that the creel fishery accounts for over 20% of the landings, increasingly operates over similar areas to trawling, and exhibits a length composition composed of larger animals.

There are concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers was introduced and the reliability began to improve. Because of this the final assessment adopted is independent of official statistics. Incorporation of creel length compositions has also improved estimates of harvest ratios.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are on average greater during the most recent years, when abundance estimates have been slightly higher. The overlap of confidence intervals makes it difficult to determine which population changes are significant. Results suggest the population has fluctuated without trend.

There is a gap of 18 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated.

The cumulative bias estimates for FU12 are largely based on expert opinion (See Annex). The precision of these bias corrections cannot yet be characterised.

The survey should be considered as a minimum estimate. Overall area of the ground is estimated by contoured sediment data. New VMS data linked to landings (from queries of the Scottish FIN database) suggest that not all areas are being considered in the current UWTV approach and as such, the absolute abundance estimate for this ground is likely to be an underestimate. Figure 3.6.6 illustrates differences between the British Geological Survey based sediment approach to estimating area and the activity of >15 m trawlers– inclusion of smaller vessels would likely further modify this. Work is in progress to refine the area estimate.

The landings forecast for 2011 (equivalent to fishing at $F_{35\%SpR}$) is 4009 tonnes. This is very close to the reported landings in 2009. In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings (which in this case are very stable) and the discard rates also arise. A three year average (2005–2007) of discard rate (adjusted to account for some survival of discarded animals) have been used in the calculation of catch options. The recent observed discard rate has however shown a 50% decline in 2009.

3.6.11 Status of the stock

The UWTV survey indicates that the population declined from a record high in 2004 to record low in 2007 but is at a higher level again in 2009. The stable mean sizes in the length compositions of catches (of individuals >35 mm CL) and recent fall in estimated harvest ratios (removals/TV abundance) to the equivalent of the F_{MSY} proxy suggests that the stock is now being exploited sustainably.

3.6.12 Management considerations

The WG, ACFM and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could confer controls to ensure effort and catch were in line with resources available.

Creel fishing takes place in this area but overall effort in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the South Minch and STECF continues to estimate that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation Credits scheme and the West of Scotland emergency measures (Council Reg. (EU) 43/2009), include the implementation of larger meshed square meshed panels (120 mm) and real time closures to avoid cod.

The implementation of buyers and sellers legislation in the UK in 2006 is improving the reliability of fishery statistics but the transition period is accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.6.13 References

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Table 3.6.1. *Nephrops*, South Minch (FU12), Nominal Landings of *Nephrops*, 1981–2009, as officially reported.

	UK Scotland						
Year	*Nephrops* trawl	Other trawl	Creel	Sub-total	Other UK	Ireland	Total
1981	2965	254	432	3651	0	0	3651
1982	2925	207	420	3552	0	0	3552
1983	2595	361	456	3412	0	0	3412
1984	3228	478	594	4300	0	0	4300
1985	3096	424	488	4008	0	0	4008
1986	2694	288	502	3484	0	0	3484
1987	2927	418	546	3891	0	0	3891
1988	3544	364	555	4463	10	0	4473
1989	3846	338	561	4745	0	0	4745
1990	3732	262	436	4430	0	0	4430
1991	3597	341	503	4441	1	0	4442
1992	3479	208	549	4236	1	0	4237
1993	3608	193	649	4450	5	0	4455
1994	3743	265	404	4412	3	0	4415
1995	3442	716	508	4666	14	0	4680
1996	3107	419	468	3994	1	0	3995
1997	3519	331	492	4342	3	1	4345
1998	2851	340	538	3729	0	0	3730
1999	3165	359	513	4037	0	14	4051
2000	2939	312	699	3950	0	2	3952
2001	2823	393	767	3983	0	9	3992
2002	2234	315	742	3291	0	14	3305
2003	2812	203	858	3873	0	6	3879
2004	2865	104	880	3849	0	19	3868
2005	2810	46	953	3809	1	31	3841
2006	3569	19	922	4510	9	35	4554
2007	4436	8	958	5402	19	30	5451
2008	4432	5	895	5332	2	13	5347
2009	3347	20	900	4267	4	11	4282

*** provisional   na = not available.**

Table 3.6.2. *Nephrops*, South Minch (FU12): Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish catches and landings, 1981–2009.

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	28.2	26.4	29.6	27.5	41.5	38.0
1982	27.8	27.1	28.7	28.8	41.7	41.3
1983	28.6	26.5	29.3	27.6	39.5	37.6
1984	27.9	26.3	28.4	27.0	39.8	38.0
1985	27.9	27.5	28.6	28.5	40.0	37.6
1986	28.4	27.9	29.3	28.9	39.5	37.3
1987	28.3	26.6	29.2	28.1	39.8	37.6
1988	29.3	27.7	30.4	29.7	39.5	38.6
1989	28.6	28.1	29.8	29.4	39.5	38.4
1990	28.0	27.5	29.3	29.0	39.4	38.5
1991	29.4	27.5	29.9	27.9	39.0	38.5
1992	29.6	28.6	31.0	29.8	39.5	38.0
1993	29.0	27.8	30.0	28.5	39.5	38.0
1994	29.8	28.0	30.8	29.2	39.3	38.1
1995	29.5	28.2	30.0	28.4	39.4	38.0
1996	28.9	28.5	30.4	29.8	39.9	38.1
1997	29.3	28.7	30.6	29.6	39.8	37.8
1998	28.6	27.6	30.4	28.7	39.1	38.0
1999	28.6	27.7	30.0	29.5	39.4	38.3
2000	28.9	28.3	30.9	30.0	39.7	38.5
2001	27.7	27.3	29.7	28.8	39.6	38.1
2002	29.1	27.8	30.4	29.0	39.5	38.8
2003	29.0	28.1	30.4	29.5	39.8	38.4
2004	28.8	28.1	30.1	29.8	39.5	38.8
2005	28.1	27.8	30.4	29.5	39.8	38.6
2006	29.2	28.0	30.5	28.8	39.5	38.1
2007	29.7	28.2	29.9	28.2	40.0	38.3
2008	28.6	27.5	29.4	28.5	39.6	38.1
2009	28.7	27.8	29.7	28.6	40.0	38.3

*** provisional   na = not available.**

Table 3.6.3. ***Nephrops*** **South Minch (FU12). Results by stratum of the 2007–2009 TV surveys. Note that stratification was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).**

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
2007 TV Survey							
M	303	3	0.21	0.01	65	372	0.008
SM	2741	15	0.30	0.07	822	33184	0.727
MS	2028	21	0.24	0.06	490	12092	0.265
Total	5072	39			1377*	45647	1
			2008 TV Survey				
M	303	1	0.58	0.05	176	4593	0.037
SM	2741	18	0.45	0.19	1227	78145	0.636
MS	2028	14	0.36	0.14	718	40157	0.327
Total	5072	33			2121*	122895	1
			2009 TV Survey				
M	303	2	0.135	0.004	41	186	0.001
SM	2741	13	0.447	0.207	906	65406	0.373
MS	2028	10	0.397	0.146	1088	109660	0.626
Total	5072	25			2035	175252	1

***Note: abundance estimates for these years based on figures prior to the 2009 revision of the dataseries. Differences between these figures and the revised figures shown on Table 3.6.4 are small.**

Table 3.6.4. ***Nephrops*****, South Minch (FU12): Results of the 1995–2009 TV surveys.**

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	33	0.30	1520	331
1996	21	0.38	1945	700
1997	36	0.28	1434	244
1998	38	0.38	1916	306
1999	37	0.28	1433	343
2000	41	0.48	2447	460
2001	47	0.53	2689	606
2002	31	0.49	2507	749
2003	25	0.56	2847	998
2004	38	0.67	3377	625
2005	33	0.57	2914	977
2006	36	0.48	2436	789
2007	39	0.26	1341	205
2008	33	0.42	2123	548
2009	25	0.40	2035	837

Table 3.6.5. *Nephrops*, South Minch (FU12): Adjusted TV survey abundance, landings, discard rate proportion by number) and estimated harvest rate.

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	1086	4051	0.15	0.16
2000	1854	3952	0.19	0.09
2001	2037	3992	0.28	0.11
2002	1899	3305	0.18	0.07
2003	2157	3879	0.21	0.08
2004	2558	3868	0.24	0.07
2005	2208	3841	0.26	0.08
2006	1845	4554	0.14	0.11
2007	1016	5451	0.22	0.27
2008	1608	5347	0.25	0.17
2009	1542	4282	0.12	0.13

***harvest rates previous to 2006 are unreliable**

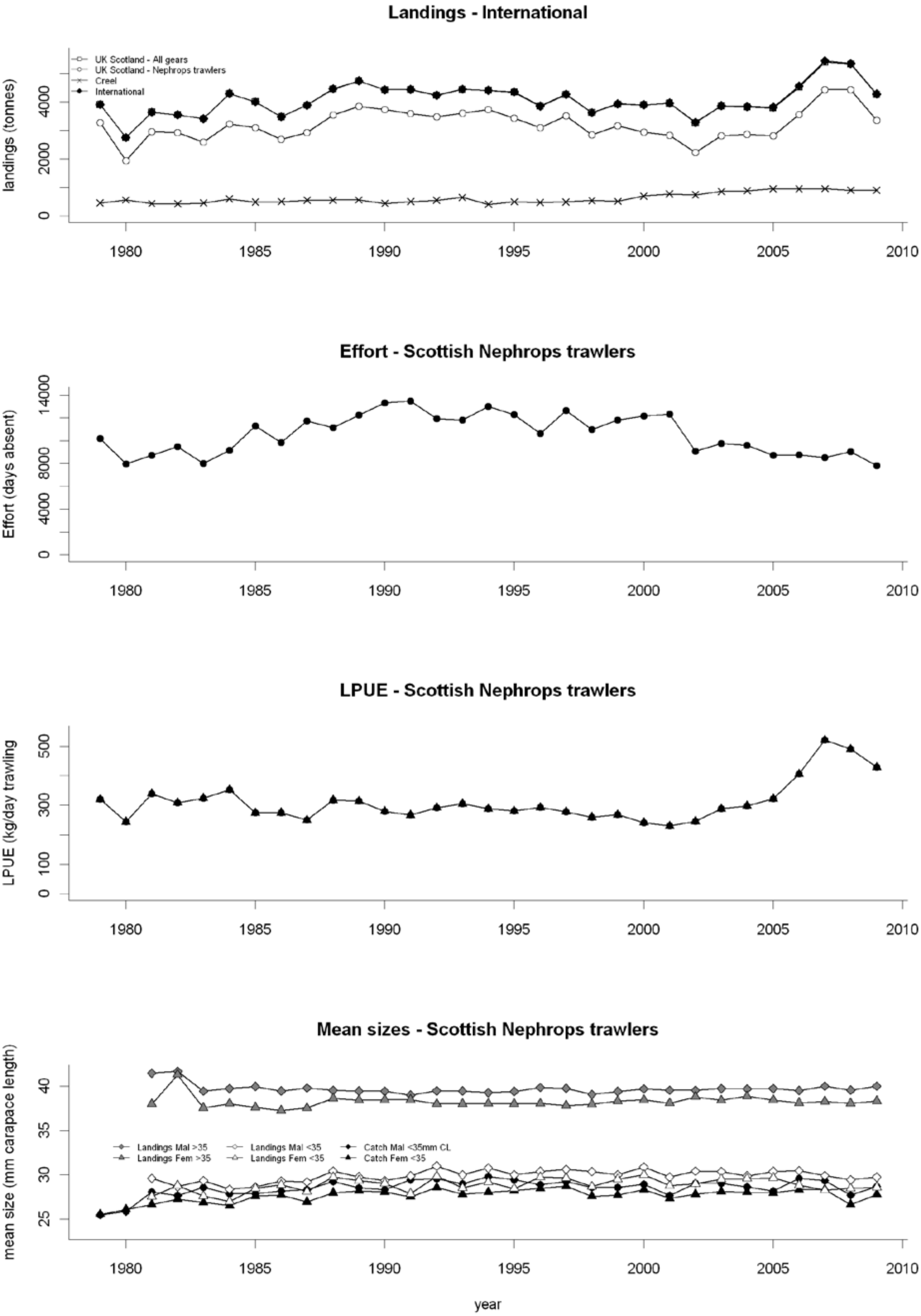

Figure 3.6.1. ***Nephrops*, South Minch (FU12), Long-term landings, effort, lpue and mean sizes.**

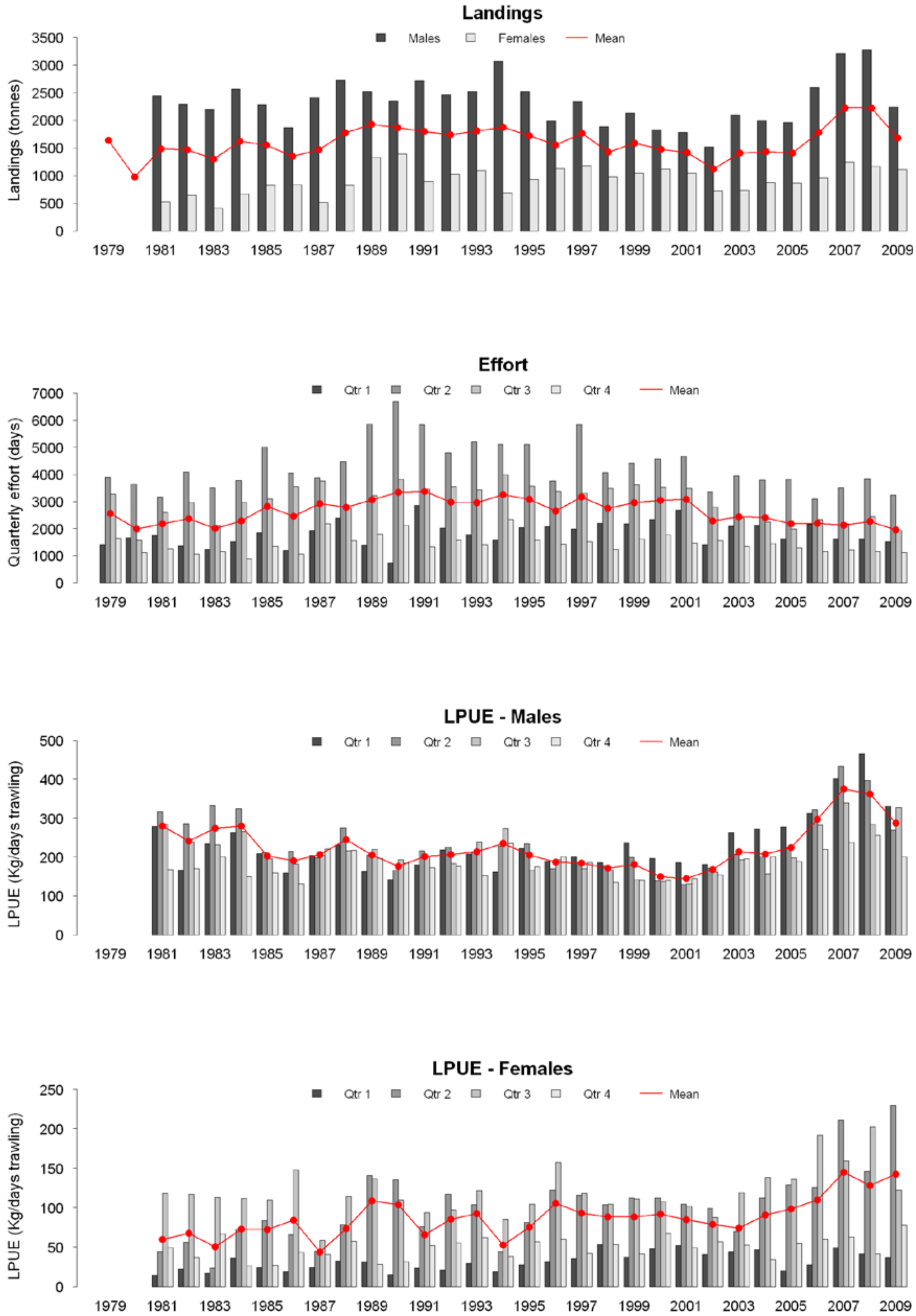

Figure 3.6.2. ***Nephrops*****, South Minch (FU12), Landings, effort and lpues by quarter and sex from Scottish *Nephrops* trawlers.**

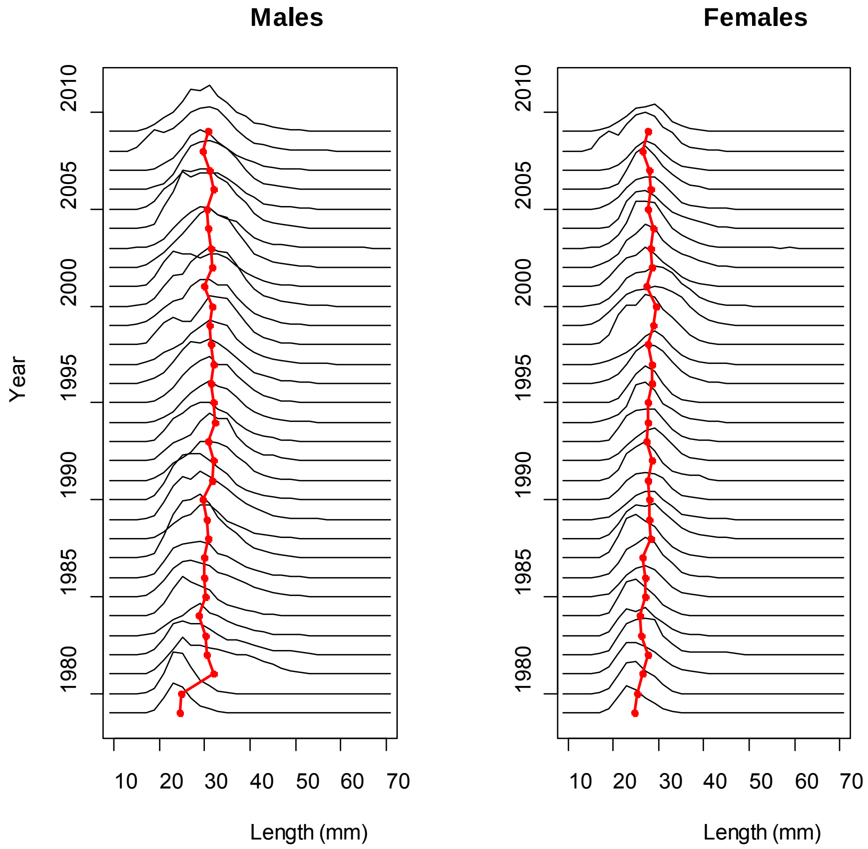

Figure 3.6.3. *Nephrops*. South Minch (FU12). Catch length frequency distribution and mean sizes (red line) for *Nephrops* in the South Minch, 1979–2009.

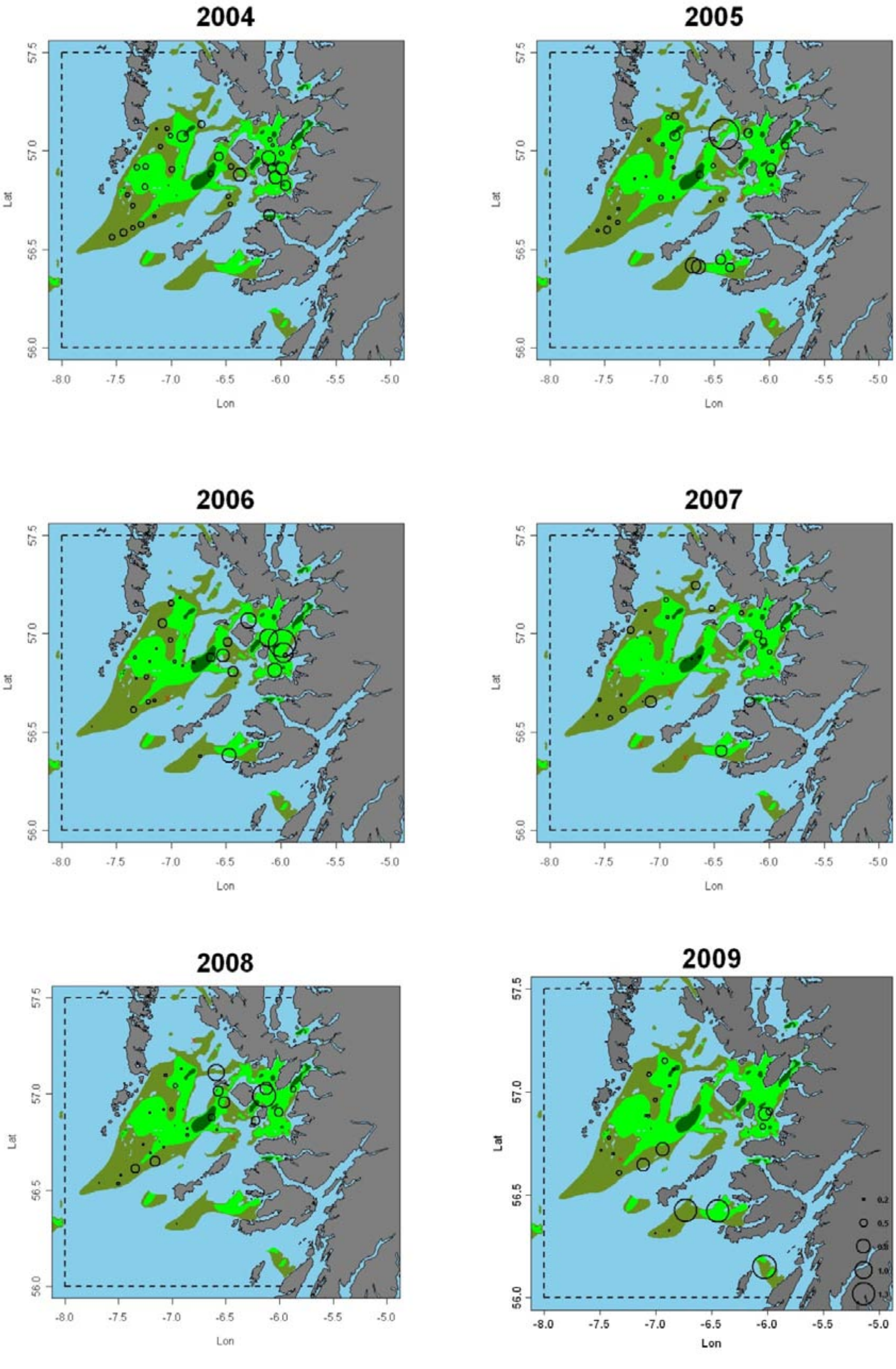

Figure 3.6.4. ***Nephrops*****, South Minch (FU12), TV survey station distribution and relative density (burrows/m²), 2004–2009. Shaded green and brown areas represent areas of suitable sediment for** ***Nephrops*****. Bubbles in this figure are all scaled the same. Red crosses represent zero observations.**

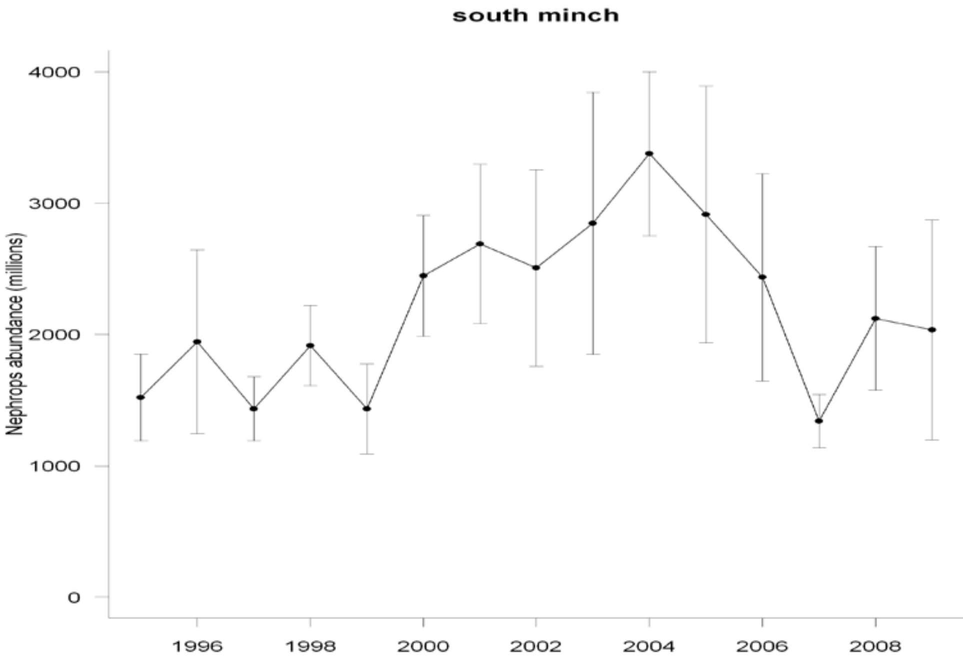

Figure 3.6.5. ***Nephrops*****, South Minch (FU12), Time-series of revised TV survey abundance estimate (not adjusted for bias), with 95% confidence intervals, 1995–2009.**

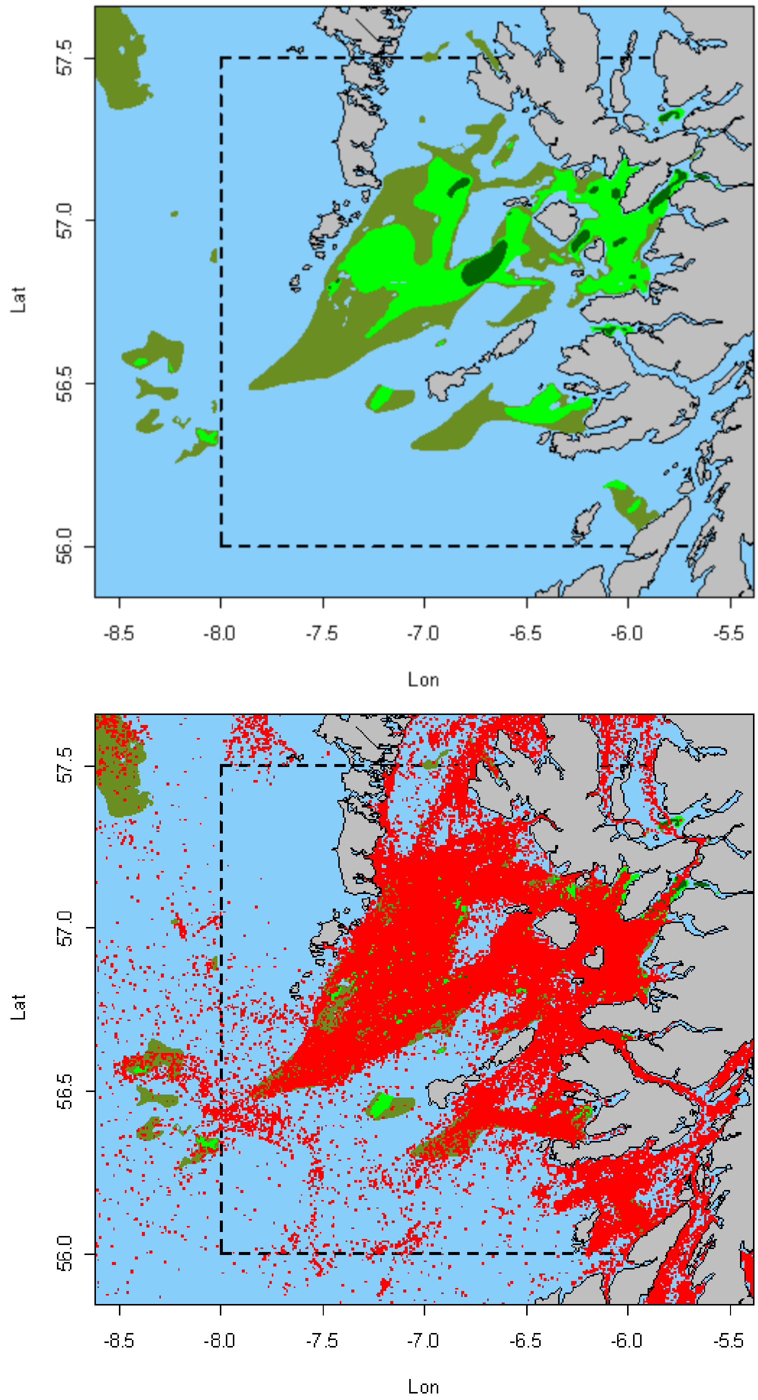

Figure 3.6.6. ***Nephrops*, South Minch (FU12), comparison of area of *Nephrops* ground defined by BGS sediment distribution (upper plot) and by distribution of VMS pings (shown in red) recorded from *Nephrops* trawlers >15 m length (lower panel).**

3.7 Clyde, FU13

Type of assessment in 2010

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG and described in Section 2.2.

3.7.1 Ecosystem aspects

The Clyde FU comprises two distinct patches in the Firth of Clyde and the Sound of Jura, to the east and west of the Mull of Kintyre respectively. The hydrography of the two subareas differs with the Sound of Jura characterised by stronger tidal currents and the Firth of Clyde exhibiting features of a lower energy environment with a shallow entrance sill.

Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the two patches these substrates are distributed according to prevailing hydrographic and baythmetric conditions. The available area of suitable sediment is smaller in the Sound of Jura, occupying only the deepest parts of the Sound, while in the Firth of Clyde these sediments predominate.

Additional information on ecosystem aspects can now be found in the Stock Annex.

3.7.2 The fishery in 2009

Around 35 Trawlers ranging from 9.9 m to 20 m operated in the Clyde during 2009. Vessels were all using 80 mm codends with 120 mm minimum square mesh panels, in line with west coast emergency measures conditions (Council Reg. (EU) 43/2009).The most significant landings were made at the main Clyde landing ports of Troon, Girvan, Largs on the East side of the Clyde and Campbelltown, Tarbert, and Carradale on the west side of the Clyde. Almost all of the Clyde *Nephrops* fleet fish daily trips. Vessels in the Clyde tend to stick the same gear type but traditionally some will swap between *Nephrops* and scallop gear during the year. Fishing in the Clyde was generally steady through the year although there is a dip in catches during April and May. At the end of the summer, a large number of local skippers complained about the large number of jellyfish in the nets. In common with other years a small bycatch of fish was taken in the Clyde consisting mainly of cod, hake and whiting.

A few Northern Irish boats fish the Clyde at varying times of the year according to weather and catch rates. These boats fish mainly for tails, landing into Campbeltown or Troon.

Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night as are vessels greater than 21 m in length. An increasing number of creel boats operate in the Clyde. Creeling activity now takes place quite widely in the northern parts of the Firth operating on some of the same grounds but often taking place during the weekend trawling ban. Only about a third of creelers operated throughout the year, the rest prosecuted a summer fishery.

There were numerous problems for the fleet during 2009, including poor catches, poor prices, high fuel prices and lack of crew. The recession played a part with the markets and this meant poor prices for catches. The tail market was the most affected with buyers clearing out frozen stock before restocking.

3.7.3 ICES advice for 2009 and 2010

The ICES conclusions in 2009 in relation to State of the Stock were as follows:

"The stock is being exploited unsustainably. The current harvest rate is well above F_{max}. The UWTV survey indicates that the population has been at a relatively high level since 2003 except for 2007."

The ICES advice for 2009 (Exploitation boundaries in relation to precautionary considerations):

"The current fishery appears sustainable. Therefore, ICES recommends that the Nephrops fisheries should not be allowed to increase relative to the past two years (2006–2007). This corresponds to landings of no more than 5700 tonnes for the Firth of Clyde stock."

The ICES advice for 2010 (Single-stock exploitation boundaries) was as follows:

"ICES advises on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Rate for *Nephrops* fisheries should not exceed F_{max}. This corresponds to landings of no more than 3855 t for the Firth of Clyde stock."

3.7.4 Management applicaple to 2009 and 2010

Management is at the ICES subarea level as described at the beginning of Section 3.5. In 2009, ICES again reiterated its advice that *Nephrops* stocks should be managed at the FU level.

3.7.5 Assessment

The Review of the 2009 assessment concluded as follows:

"RG agrees with the WG on the assessment and feels it follows the protocol described in the Stock Annex. The short-term projection gives various harvest rates and this should be used to assign the TAC. The idea of fishing at a level above F_{max} is unsettling and should be avoided especially for a stock that utilizes such a basic assessment."

Approach in 2010

The assessment in 2010 is based on a combination of examining trends in fishery indicators and underwater TV using an extensive dataseries for the Firth of Clyde component of FU13. For the first time an attempt is also made to use the more limited UWTV data available for the Sound of Jura subarea.

The assessment of *Nephrops* through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG and described in Section 2.2.

The provision of advice in 2010 develops the process defined by the Benchmark WG and described in Section 2.2 and attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES in 2010. Intersessional work carried out by participants of the Benchmark and involving collaboration between WGNSSK and WGCSE is described in the working papers, etc.

Previous TV based assessments have derived predicted landings by applying a harvest rate approach to populations described in terms of length compositions from the trawl component of the fishery. In recent years, creel fishing has become more important in the Firth of Clyde and operates across similar areas to the trawl fishery. For this reason the assessment is performed using combined length compositions.

Data available

An overview of the data provided and used by the WG is shown in Table 2.1.

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are shown in Table 3.7.1. These relate to the whole of VIa of which the Clyde FU is a part. Landings statistics for FU13 provided through national laboratories are presented in Table 3.7.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, although the remainder of the UK also contributed about 6% in 2009; landings from Northern Ireland form the main part of this. Total international reported landings decreased markedly in 2009 but remain well above the average for the time-series (~3712 tonnes), and consisted of 4303 tonnes landed by trawlers (Scottish and other UK) and 190 tonnes landed by creel vessels. Creel landings have increased in the most recent years but remain at a low level compared to other methods and to the creel fisheries elsewhere on the west coast of Scotland.

Table 3.7.2 shows the split in landings between the two subareas comprising FU13. Most of the landings are presently taken from the Firth of Clyde subarea with only about 2% from the Sound of Jura. Earlier in the time-series the Sound of Jura contributed as much a 20%. The decline has occurred through a progressive reduction in fishing activity in the area. The main reason for this is probably related to the size composition in the population which is characterised by small *Nephrops* (Bailey and Chapman, 1983) whereas the market has increasingly favoured larger whole animals.

The introduction of the "buyers and sellers" regulation in the UK in 2006 has led to increased reliability in the reported landings.

Uncertainities over the accuracy of the effort data emerged just prior to the WG. In an effort to improve reliability, effort was extracted and expressed in terms of days fished (since the logbook field for hours is not mandatory). Preliminary examination of the new effort-series showed a marked discontinuity around 1995 with a large and inexplicable drop in effort in days. Further investigation revealed that at this time the process of recording days effort in the split rectangle region of the Clyde changed. This will require some additional work to establish if a reliable series can be reinstated. For the present, long-term trends in effort and lpue/cpue are not reported here. It is not thought however, that the change has affected the intra-annual, quarterly patterns of effort and lpue and these have been included.

Sex ratio in the Firth of Clyde shows some variation but males consistently make the largest contribution to the annual landings. This occurs because males are available throughout the year and the fishery is also prosecuted in all quarters. Females on the other hand are mainly taken in the summer when they emerge after egg hatching. (Figure 3.7.2).

Discarding of undersized and unwanted *Nephrops* occurs in the Firth of Clyde fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 2000. Discarding rates are high in this FU and average around 31% by number in this FU since 1999. In 2009, discard rates were estimated to be higher than average at 39% by number (Table 3.7.8).

Studies (Guéguen, J. and Chareau, A., 1975; Sangster *et al.*, 1997; Wileman *et al.*, 1999) suggest that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard rate adjusted to account for some survival was estimated at the benchmark workshop to be 18.6% (taking a 3 year average 2005–2007) and according to the agreed benchmark protocol this value is used in the provision of landings options for 2011. This relatively low figure is due to a large drop in discarding in 2006, possibly as a result of reduced recruitment in this year that led to the low TV survey abundance estimate in 2007.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available for the Firth of Clyde from Scotland and these sampling levels are shown in Table 3.5.4. Length compositions for the creel fishery are of landings only since the small numbers of discards survive well and are not considered to be removed from the population. Sampling of length compositions in the Sound of Jura is more infrequent and only limited data are available. Although assessments based on detailed catch analysis are not presently considered advisable, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.7.3 shows a series of annual Firth of Clyde length frequency distributions for the period 1979 to 2009. Catch (removals) length compositions are shown for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) shows no evidence of reductions in relative numbers of larger animals.

The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings shown in Figure 3.7.1 and Table 3.7.3. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) is also quite stable through time, although in the most recent year the mean size of females in the catch below 35 mm has decreased quite markedly, suggesting possible good recruitment.

Mean weight in the Firth of Clyde landings is shown in Figure 3.5.6 and Table 3.5.9 and this also shows no systematic changes over the time-series.

Natural mortality, maturity at age and other biological parameters

Biological parameter values are included in the Stock Annex.

Research vessel data

Underwater TV surveys are available for both subareas since 1995 although the Sound of Jura has been sampled more infrequently. Underwater television surveys of *Nephrops* burrow number and distribution reduce the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows.

The UWTV in the Firth of Clyde subarea is carried out using a stratified random approach. The numbers of valid stations used in the final analysis in each year are shown in Table 3.7.4. On average, 37 stations have been considered valid each year, and then raised to the estimated area of the ground available for *Nephrops*- 2080 km^2 based on contoured superficial sediment information (British Geological Surveys).

The number of valid stations in the Sound of Jura is shown in Table 3.7.6.

Data analyses

Exploratory analyses of survey data

Full details of the UWTV approach can be found in the Stock Annex and the Report of (WK*NEPH*) in 2009 (ICES, 2009).

A re-working of the UWTV survey abundance series for Division VIa was presented to the *Nephrops* Benchmark Workshop (WK*NEPH*) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the Report of that workshop. The revised abundance estimates for FU13 from 1999 onwards were presented for the first time at WGCSE 2009 and are slightly higher than the previous values due to the field of view being smaller than previously calculated.

Table 3.7.4 shows the basic analysis for the most recent TV surveys conducted in the Firth of Clyde. The table includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. The areas of all sediment types (mud, muddy sand and sandy mud) in this region are very similar and as such the number of stations surveyed in each sediment type is also similar. Basic analysis for the Sound of Jura is shown in Table 3.7.6.

Figure 3.7.4 shows the distribution of stations in recent TV surveys (2004–2009) across FU13 (the two distinct subareas can be clearly seen) with the size of the symbols reflecting the *Nephrops* burrow density. Table 3.7.5 and Figure 3.7.5 show the time-series estimated abundance for the TV surveys in the Firth of Clyde, with 95% confidence intervals on annual estimates. Similar information for the Sound of Jura is shown in Table 3.7.7 and Figure 3.7.6.

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WK*NEPH* (ICES, 2009). A number of potential biases were highlighted including those due to edge effects, species burrow mis-identification and burrow occupancy. The cumulative bias correction factor estimated for the Firth of Clyde was 1.19 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 19%. A review of the Sound of Jura biases has not so far been carried out; biases are here assumed to be similar to the Firth of Clyde.

Final Assessment

The underwater TV surveys are presented as the best available information on the stocks of *Nephrops* in the two subareas of FU13. The surveys provide fishery independent estimates of *Nephrops* abundance. The details of the 2009 Firth of Clyde survey are shown in Table 3.7.4 and compared with the 2007 and 2008 outcome. The details of the 2009 Sound of Jura survey are shown in Table 3.7.6. At present it is not possible to extract any length or age structure information from the survey and it therefore only provides information on abundance over the area of the survey.

The 2009 TV survey data presented at this meeting shows that the abundance in the Firth of Clyde has dropped slightly but remains at the upper end of the values observed throughout the time-series. Confidence limits are quite high for this stock.

The 2009 TV survey data presented at this meeting shows that the abundance in the Sound of Jura is similar to the previous estimate in 2007.

The TV survey results reported here do not cover the sea loch areas adjacent to the main Firth of Clyde and Sound of Jura areas and should therefore be considered underestimates of the overall biomass. This issue is discussed further under quality of assessment.

3.7.6 Historic stock trends

The TV survey estimates of abundance for *Nephrops* in the Firth of Clyde suggest that the population increased until the mid-2000s implying a sustained period of increased recruitment. Following this, abundance has declined and fluctuated around the values previously observed in the early 2000s just prior to the maximum. The bias adjusted abundance estimates from 1999–2009 (the period over which the survey estimates have been revised) is shown in Table 3.7.8. The latest bias adjusted stock estimate is 1499 million individuals.

Table 3.7.8 also shows the estimated harvest ratios over this period. These range from 12–51% over this period. (It is unlikely that prior to 2006, the estimated harvest ratios are representative of actual harvest ratios due to under-reporting of landings).

Results for the Sound Jura are sparser and are associated with large confidence intervals particularly in 2002 and 2006. Table 3.7.9 summarises the bias adjusted estimates of abundance and harvest rates where available.

3.7.7 MSY considerations

A number of potential F_{msy} proxies are obtained from the per-recruit analysis for *Nephrops* and these are discussed further in Section 2.2 of this report. The analysis assumes the same input parameters (exploitation, discard ogive and biological parameters) as was used at the Benchmark meeting in 2009. The complete range of the per-recruit F_{msy} proxies for the Firth of Clyde sub area is given in the table below and the process for choosing an appropriate F_{msy} proxy is described in Section 2.2. Note that all F_{msy} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

For the Firth of Clyde subarea of this FU, the absolute density observed on the UWTV survey is generally high (average of over 0.8 m^{-2} for entire series and around 1.0 m^{-2} for the last five years suggesting the stock has relatively high productivity. In addition, the fishery in this area has been in existence since the 1960s and the population and biological parameters have been studied numerous times (Bailey and Chapman, 1983; Tuck *et al*., 1997; Tuck *et al*., 1999). Historical harvest ratios in this FU have been generally high at or above $F_{max.}$. **An appropriate F_{msy} proxy is considered therefore to be the total population F_{max} which is predicted to deliver an $F_{35\%SpR}$ of about 22% for males**; considered precautionary for this species (See Section 2.2).

		Fbar(20-40 mm)				SPR (%)		
		Fmult	M	F	HR (%)	M	F	T
$F_{0.1}$	M	0.17	0.15	0.06	8.7	40.2	66.8	49.1
	F	0.43	0.37	0.14	21.1	16.2	40.7	24.4
	T	0.19	0.16	0.06	9.7	36.9	64.0	45.9
F_{max}	M	0.27	0.23	0.09	13.6	27.0	54.4	36.2
	F	0.71	0.61	0.24	34.0	8.3	26.5	14.3
	T	0.33	0.28	0.11	16.4	21.9	48.6	30.8
$F_{35\%SpR}$	M	0.21	0.18	0.07	10.7	34.0	61.4	43.1
	F	0.53	0.46	0.18	25.7	12.4	34.6	19.8
	T	0.29	0.25	0.10	14.5	25.1	52.4	34.2

The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance) is calculated as 579 million individuals.

Yield-per-recruit analysis is not yet available for the Sound of Jura subarea of this FU and so proxies from the Firth of Clyde (shown in the table above) are used to provide a first approach. The absolute density observed on the UWTV survey is generally high (average of about 0.8 m^{-2} over the time-series and around 1 m^{-2} over the last five years) suggesting the stock has relatively high productivity. A number of studies have investigated biology and the area is acknowledged as having high abundance for many years. However, the time-series of TV data is more fragmented and sampling is at a relatively low level; confidence intervals are larger. The fishery in this area has been in existence since the 1960s but in recent times has operated at a low level and harvest ratios in this FU have been low **An appropriate F_{msy} proxy is considered therefore to be the total population $F_{35\%SpR}$ which is predicted to deliver an $F_{35\%SpR}$ of about 25% for males**; above the level considered precautionary for this species (See Section 2.2).

The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance) has not been defined but is expected to be below 200 million individuals.

3.7.8 Landings forecasts

Landings prediction for 2011 were made for the Firth of Clyde and Sound of Jura subareas of the Clyde FU13 using the approach agreed at WK*NEPH* 2009 and outlined in the Section 2.2 The tables below shows landings predictions at various harvest ratios, including a selection of those equivalent to the per-recruit reference points discussed in Section 2 of this report and the harvest ratio in 2009 using the input parameters agreed at WK*NEPH* (ICES 2009). The landings prediction for 2011 at the F_{msy} proxy harvest ratio considered appropriate for the Firth of Clyde (i.e. 16.4%) is 2804 tonnes. There is a transition stage as the current harvest ratio is above the F_{msy} proxy in 2011 this gives landings of 4121 t.

For the Sound of Jura subarea, the landings prediction for 2011 at the F_{msy} proxy harvest ratio of 14.5% is 515 t. There is no transition stage since the current position is below the F_{msy} proxy.

The inputs to the landings forecast for the Firth of Clyde and Sound of Jura were as follows:

Mean weight in landings in Firth of Clyde (07–09) = 17.8 g

Mean weight in landings in Sound of Jura (07–09) = 22.1 g

Discard rate (by number) = 36.0%

Survey bias = 1.19 (as calculated at WK*NEPH* 2009).

Firth of Clyde

	Harvest rate	Survey Index (adjusted)	Implied fishery Retained number	Landings (tonnes)
F_{msy}	16.4%	1499	157	2804
$F_{msy\ transition}$	24.1%	1499	231	4121
$F_{0.1(M)}$	8.7%	1499	83	1488
$F_{0.1(T)}$	9.7%	1499	93	1659
$F_{35\%SpR(M)}$	10.7%	1499	103	1830
$F_{max\ (M)}$	13.6%	1499	130	2325
$F_{35\%SpR(T)}$	14.5%	1499	139	2479
$F_{max\ (T)}$	16.4%	1499	157	2804
F_{2009}	26.0%	1499	249	4446

Sound of Jura

	Harvest rate	Survey Index (adjusted)	Implied fishery Retained number	Landings (tonnes)
F_{msy}	14.5%	251	23	515
F_{2009}	2.0%	251	3	71
$F_{0.1(M)}$	8.7%	251	14	309
$F_{0.1(T)}$	9.7%	251	16	344
$F_{35\%SpR(M)}$	10.7%	251	17	380
$F_{max\ (M)}$	13.6%	251	22	483
$F_{35\%SpR(T)}$	14.5%	251	23	515
$F_{max\ (T)}$	16.4%	251	26	582

$F_{0.1(M,T)}$: Harvest ratio equivalent to fishing at a level associated with 10 % of the slope at the origin on the male or combined sex YPR curve.

$F_{35\%SPR(M,T)}$: Harvest ratio equivalent to fishing at a rate which results in male or combined SPR equal to 35% of the unfished level.

$F_{max\ (M,\ T)}$: Harvest ratio equivalent to fishing at a rate which maximises the male or combined YPR.

A discussion of F_{msy} reference points for *Nephrops* is provided in Section 2.2.

3.7.9 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks.

3.7.10 Uncertainties in the assessment and forecast

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in the Firth of Clyde subarea fishery since 1990, and is considered to represent the fishery adequately. Sampling in the Sound of Jura is sparser.

There are concerns over the accuracy of historical landings and effort data and because of this the final assessment adopted is independent of official statistics.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are stable throughout the series and relatively low compared with other FUs in VIa. There is a gap of 18 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three year average (2005–2007) of discard rate (adjusted to account for some survival of discarded animals) has been used in the calculation of catch options. Discard rates have fluctuated over the time-series but have been stable in the last two years. Mean weight has also fluctuated somewhat over the time-series. These uncertainties are not taken into account in the forecast.

The cumulative bias estimates for FU13 Clyde and Jura component is largely based on expert opinion (See Annex). The precision of these bias corrections cannot yet be characterised.

The survey should be considered as a minimum estimate. The overall area of the ground is estimated by contoured sediment data. New VMS data linked to landings suggests the area covered by the current UWTV is slightly smaller than the area covered by fishing activity and especially in the sea lochs. Figure 3.7.7 illustrates differences between the British Geological Survey based sediment approach to estimating area and the activity of >15 m trawlers; inclusion of smaller vessels would likely further modify this. Work is in progress to refine the area estimate.

The landings forecast for 2011 (based on a transition value for the Firth of Clyde subarea and F_{msy} for the Sound of Jura subarea is almost 5806 tonnes. This is an increase on the reported landings in 2009 but below the peak values of 2007 and 2008.

3.7.11 State of stock

The perception of the state of the stock in the Firth of Clyde has not changed substantially since the assessment in 2008. The evidence from the TV survey suggests that the population is stable and the 15% decrease observed in 2009 is within the confidence limits for the past two years. The calculated harvest ratio in 2009 (dead removals/TV abundance) is above the values associated with high long-term yield and low risk depletion.

3.7.12 Management considerations

The WG, ACFM and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could confer controls to ensure effort and catch were in line with resources available. In this FU the two subareas imply that additional controls may be required to ensure that the landings taken in each subarea are in line with the landings advice. There is a need to reduce discards in this FU.

Creel fishing takes place in part of this area although the relative scale of the fishery is smaller than in the Minches. Overall effort in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the Firth of Clyde and STECF estimates that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation credits scheme and west coast emergency measures, include the implementation of larger meshed square meshed panels (120 mm). A seasonal closure (early spring) in the southwest part of the Firth of Clyde is in place to protect spawning cod although *Nephrops* vessels are derogated to fish in those parts where mud sediments are distributed.

The implementation of buyers and sellers legislation in the UK in 2006 is improving the reliability of fishery statistics but the transition period is accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.7.13 Other *Nephrops* populations within Division VIa

Nephrops fisheries also take place outside the Functional Units in Subdivision VIa, although they represent a low proportion of the reported landings (Table 3.5.3). Over the time-series, average landings have been just over 250 t and in recent 10 years, just over 300 t. An allowance for this activity is required in the final landings advice for 2011. The main areas of activity are the Stanton Bank (to the west of the South Minch, Figure 3.6.6) and areas of suitable sediment along the shelf edge and slope to the west of the Hebrides.

3.7.14 Stanton Bank

Underwater TV surveys were not conducted in Stanton Bank in 2008.

3.7.15 Shelf-edge west of Scotland

Marine Scotland Science has taken the opportunity of using the Scotia deep-water surveys conducted in 2000, 2002 and 2004 to conduct preliminary underwater TV work on the *Nephrops* populations along the shelf-edge. These TV runs are carried out during the night (when the vessel is not required for fishing). It is hoped that this can continue as an annual survey.

To date, successful survey runs have been conducted to a depth of 635 m, observing *Nephrops* burrows at a range of locations along the shelf-edge and slope. Observed densities have been very low (average 0.04 m^{-2}) compared to shelf stocks on the west coast and in the North Sea (typically 0.2–0.9 m^{-2}), although the animals on the shelf-edge are considerably larger than those found on the shelf. Forecasts of landings based on TV surveys were not attempted for this area.

3.7.16 References

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Table 3.7.1. *Nephrops*, Clyde (FU13), Nominal Landings of *Nephrops*, 1981–2009, as officially reported.

Year	UK Scotland				Other UK	Total **
	Nephrops trawl	Other trawl	Creel	Sub-total		
1981	2498	404	66	2968	0	2968
1982	2373	171	79	2623	0	2623
1983	3890	120	53	4063	14	4077
1984	3069	154	77	3300	10	3310
1985	3921	293	64	4278	7	4285
1986	4074	175	79	4328	13	4341
1987	2859	80	65	3004	3	3007
1988	3507	108	43	3658	7	3665
1989	2577	184	35	2796	16	2812
1990	2732	122	24	2878	34	2912
1991	2845	145	25	3015	23	3038
1992	2532	246	10	2788	17	2805
1993	3199	110	5	3314	28	3342
1994	2503	49	28	2580	49	2629
1995	3767	132	26	3925	64	3989
1996	3880	111	27	4018	42	4060
1997	3486	44	25	3555	63	3618
1998	4539	81	40	4660	183	4843
1999	3475	29	38	3542	210	3752
2000	3143	63	76	3282	137	3419
2001	2889	67	94	3050	132	3182
2002	3074	53	105	3232	151	3383
2003	2954	20	117	3091	80	3171
2004	2659	18	90	2767	258	3025
2005	3166	14	95	3275	148	3423
2006	4446	0	0	4534	244	4778
2007	6129	0	0	6129	366	6495
2008	5291	29	182	5502	416	5918
2009*	4277	26	190	4493	283	4776

*** provisional ** Total also includes Rep. of Ireland.**

Table 3.7.2. ***Nephrops,*** **Clyde (FU13), Nominal Landings of *Nephrops*, in each of the subareas (Firth of Clyde and Sound of Jura 1981–2009, as officially reported.**

Year	UK		
	Firth of Clyde	Sound of Jura	All sub-areas
1981			2968
1982			2623
1983			4077
1984			3310
1985			4285
1986			4341
1987			3007
1988			3665
1989			2812
1990			2912
1991			3038
1992			2805
1993	2766	576	3342
1994	2094	535	2629
1995	3690	299	3989
1996	3673	387	4060
1997	3132	486	3618
1998	4372	471	4843
1999	3424	328	3752
2000	3230	189	3419
2001	2980	202	3182
2002	3349	34	3383
2003	3153	18	3171
2004	2975	50	3025
2005	3387	36	3423
2006	4717	61	4778
2007	6397	98	6495
2008	5840	78	5918
2009*	4684	92	4776
* provisional na = not available			

Table 3.7.3. ***Nephrops*****, Clyde (FU13): Firth of Clyde subarea. Mean sizes (CL mm) above and below 35 mm of male and female** ***Nephrops*** **in Scottish trawl catches and landings, 1981–2009.**

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	28.4	27.3	30.2	29.3	40.3	39.3
1982	28.2	26.4	29.9	29.0	39.9	40.1
1983	27.9	26.7	29.3	28.5	40.8	39.5
1984	27.0	25.9	28.0	26.8	40.9	39.6
1985	27.1	26.1	28.1	27.2	39.8	39.3
1986	27.1	26.0	27.9	27.1	40.5	39.0
1987	28.5	26.5	29.6	28.3	39.4	40.0
1988	28.1	27.0	30.6	29.5	41.2	40.1
1989	26.9	26.9	30.2	30.0	41.6	39.8
1990	27.4	26.2	30.4	29.5	40.1	39.8
1991	28.6	27.1	29.2	28.2	39.3	40.3
1992	29.6	28.8	30.1	29.2	39.9	41.1
1993	29.6	29.7	31.4	30.9	40.4	39.9
1994	26.4	27.0	29.4	29.4	40.8	39.2
1995	27.2	25.8	28.7	27.6	40.3	39.8
1996	28.8	28.0	30.0	29.1	38.6	40.4
1997	27.9	26.9	30.0	29.2	40.0	40.3
1998	25.9	25.2	28.4	27.9	38.9	39.1
1999	26.5	25.3	28.5	27.3	39.0	39.5
2000	28.3	27.7	29.3	28.6	38.7	39.1
2001	27.4	26.8	29.5	28.7	39.0	39.6
2002	27.5	25.6	28.4	26.4	39.0	39.4
2003	27.2	25.9	29.1	27.9	39.2	38.6
2004	27.1	26.5	28.4	27.6	39.2	39.5
2005	28.0	26.7	29.2	27.9	38.7	38.1
2006	28.7	27.1	29.0	27.3	40.0	38.7
2007	27.0	26.7	29.1	29.2	39.1	38.6
2008	27.2	25.2	28.6	26.6	39.1	38.2
2009	26.9	25.3	29.3	26.4	39.4	39.0

*** provisional   na = not available.**

Table 3.7.4. ***Nephrops*****, Clyde (FU13): Firth of Clyde subarea. Results by stratum of the 2007–2009 TV surveys. Note that stratification was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).**

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
				2007 TV survey			
M	717	12	0.65	0.05	464	2344	0.159
SM	699	11	0.57	0.15	401	6553	0.445
MS	665	17	0.76	0.22	505	5812	0.395
Total	2081	40			1371*	14709	1
				2008 TV survey			
M	717	15	0.88	0.21	629	7345	0.173
SM	699	11	0.90	0.55	628	24502	0.575
MS	665	12	1.28	0.29	848	10732	0.252
Total	2081	38			2105	42579	1
				2009 TV survey			
M	717	16	0.741	0.049	531	1583	0.102
SM	699	11	0.705	0.178	469	7150	0.459
MS	665	12	1.122	0.168	784	6842	0.439
Total	2081	39			1784	15575	1

***Note: abundance estimates for these years based on figures prior to the 2009 revision of the dat series. Differences between these figures and the revised figures shown on Table 3.7.5 are small.**

Table 3.7.5. ***Nephrops*****, Clyde (FU13): Firth of Clyde subarea. Results of the 1995–2009 TV surveys.**

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	29	0.33	689	210
1996	38	0.54	1113	288
1997	31	0.68	1426	312
1998	38	0.720	1502	254
1999	39	0.532	1107	344
2000	40	0.807	1679	293
2001	39	0.850	1768	319
2002	36	0.899	1870	343
2003	37	1.039	2162	347
2004	32	1.127	2344	437
2005	44	1.121	2331	342
2006	43	1.050	2203	306
2007	40	0.705	1467	260
2008	38	1.012	2105	346
2009	39	0.86	1784	250

Table 3.7.6. *Nephrops,* Clyde (FU13): Sound of Jura subarea. Results by stratum of the 2009 TV surveys. Note that stratification was based on a series of sediment strata.

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance
2009 TV survey							
M	90	2	0.62	0.02	56	66	0.040
SM	142	5	1.18	0.28	168	1127	0.681
MS	150	5	0.50	0.10	75	463	0.279
Total	382	12			299	1656	1

Table 3.7.7. *Nephrops,* Clyde (FU13): Sound of Jura subarea. Results of the 1995–2009 TV surveys.

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	7	0.50	190	69
1996	10	0.53	204	31
1997	no surveys			
1998				
1999				
2000				
2001	13	0.85	324	90
2002	9	1.24	474	199
2003	12	0.81	309	81
2004	no survey			
2005	11	0.94	360	100
2006	10	1.34	512	160
2007	10	0.80	304	69
2008	no survey			
2009	12	0.78	299	81

Table 3.7.8. *Nephrops*, Clyde (FU13): Firth of Clyde subarea. Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	930	3752	0.30	0.31
2000	1411	3419	0.22	0.15
2001	1486	3182	0.33	0.15
2002	1571	3383	0.19	0.16
2003	1817	3171	0.45	0.15
2004	1970	3025	0.52	0.15
2005	1959	3423	0.27	0.12
2006	1851	4778	0.18	0.16
2007	1233	6495	0.53	0.51
2008	1769	5918	0.37	0.29
2009	1499	4776	0.39	0.26

***harvest rates previous to 2006 are unreliable.**

Table 3.7.9. *Nephrops*, Clyde (FU13): Sound of Jura subarea. Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

	Adjusted survey (millions)	Landings (tonnes)	Discard rate (%)	Harvest ratio*
1999	No Survey	328		No Survey
2000	No Survey	189		No Survey
2001	13	202		
2002	9	34		
2003	12	18		
2004	No Survey	50	0.4	No Survey
2005	303	36	0.4	0.01
2006	430	61	0.4	0.02
2007	255	98	0.4	0.03
2008	No Survey	78	0.4	No Survey
2009	251	92	0.4	0.02

***harvest rates previous to 2006 are unreliable.**

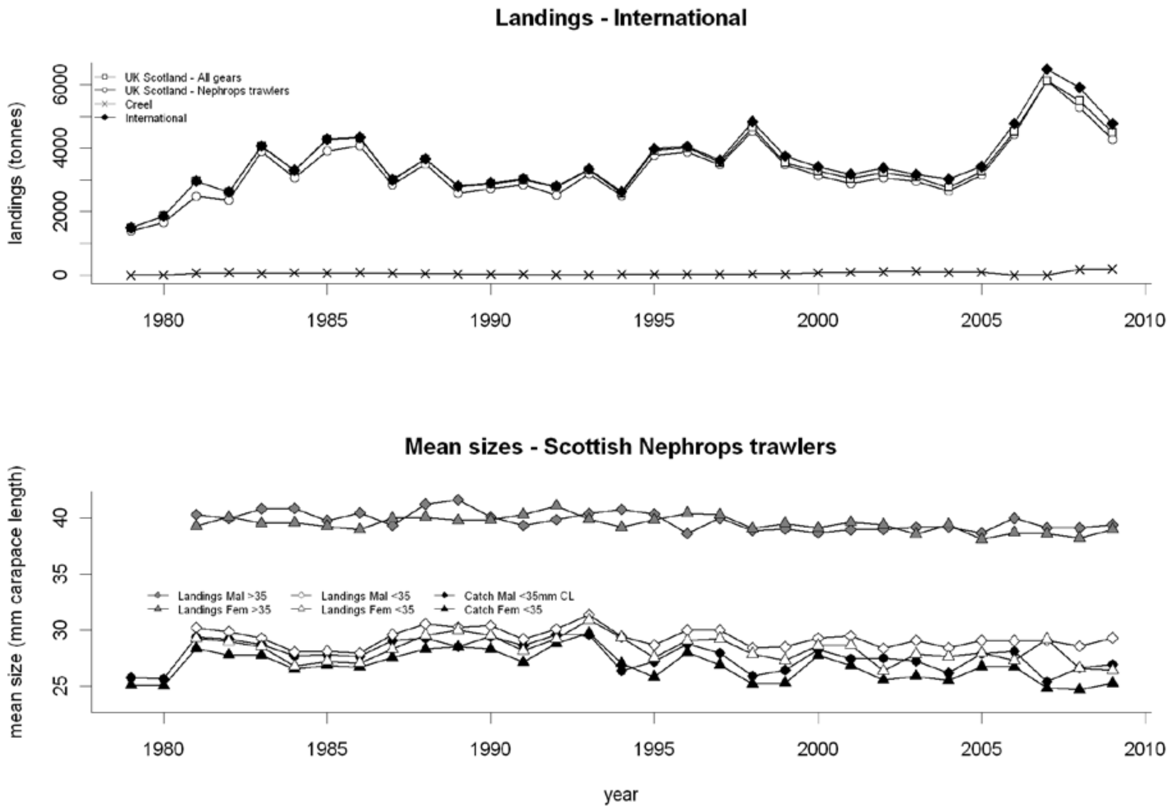

Figure 3.7.1. ***Nephrops*, Clyde (FU13): Long-term landings, and mean sizes (Firth of Clyde subarea only).**

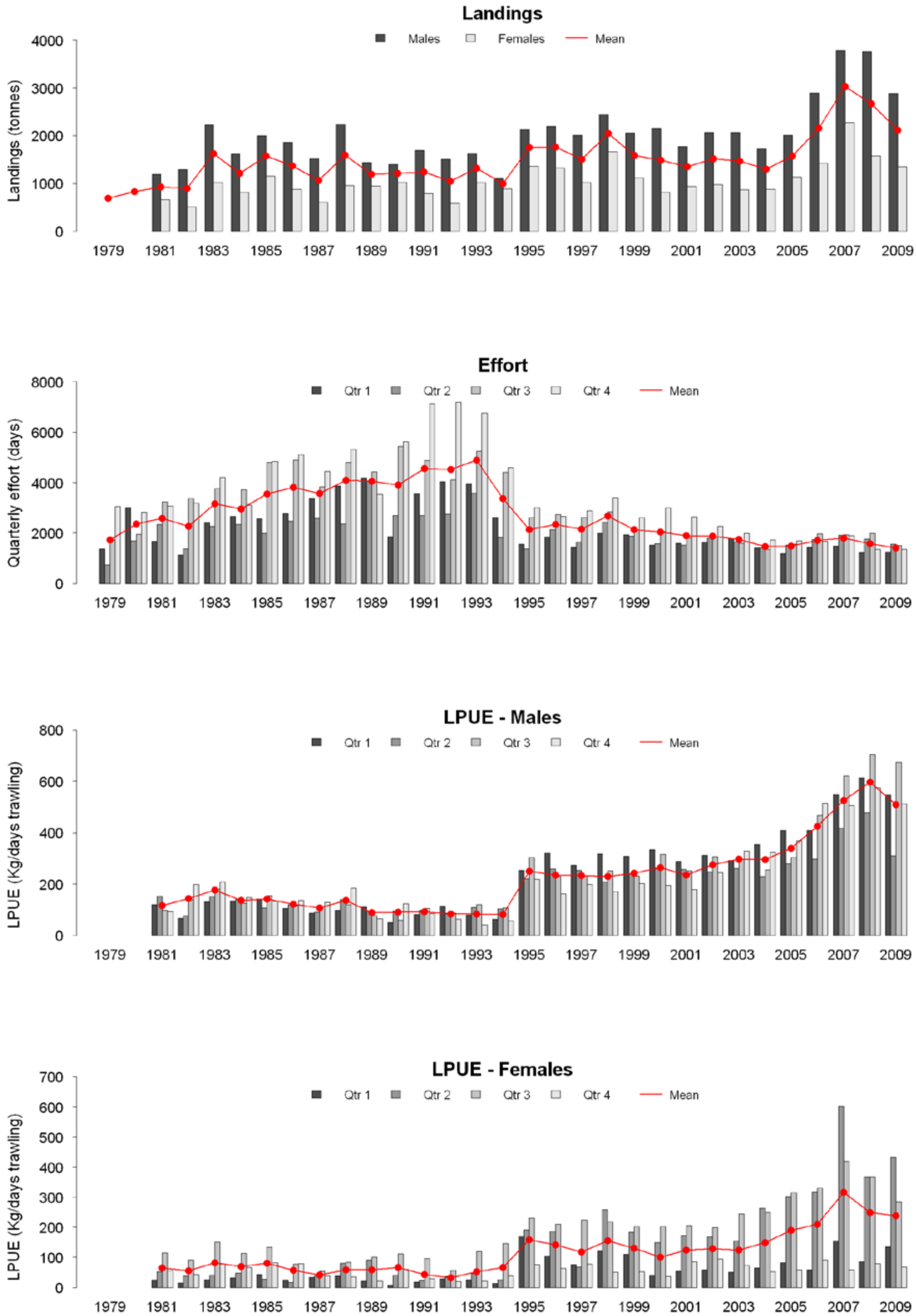

Figure 3.7.2. ***Nephrops*****, Clyde (FU13), Firth of Clyde subarea, Landings, effort and lpues by quarter and sex from Scottish** ***Nephrops*** **trawlers.**

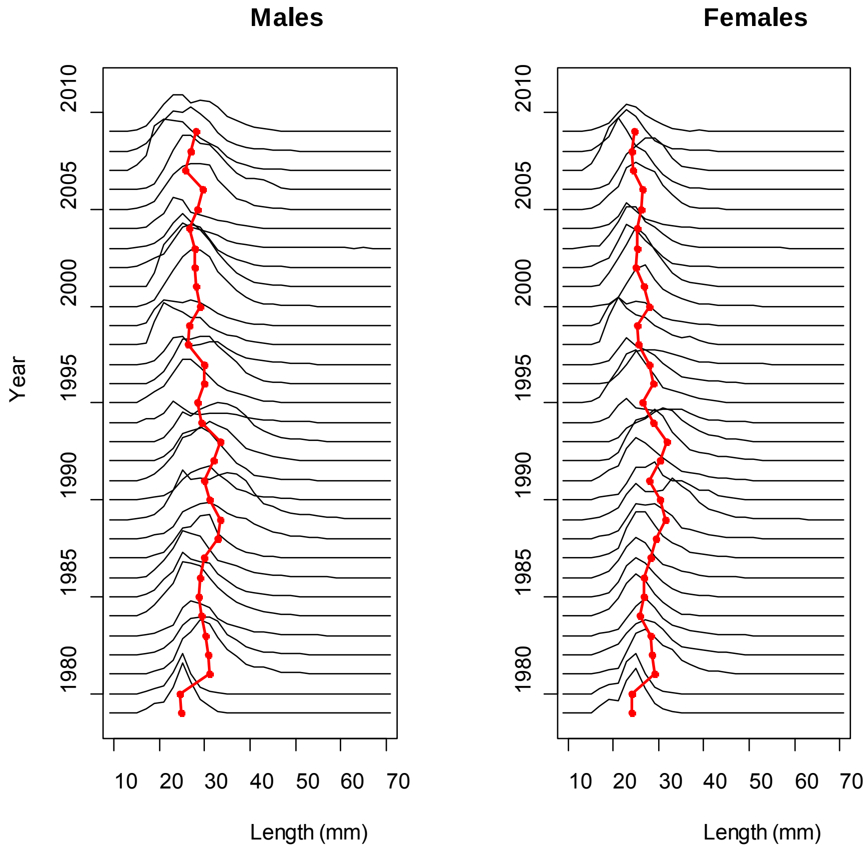

Figure 3.7.3. ***Nephrops*****, Clyde (FU13), Catch length frequency distribution and mean sizes (red line) for** ***Nephrops*** **in the Firth of Clyde, 1979–2009.**

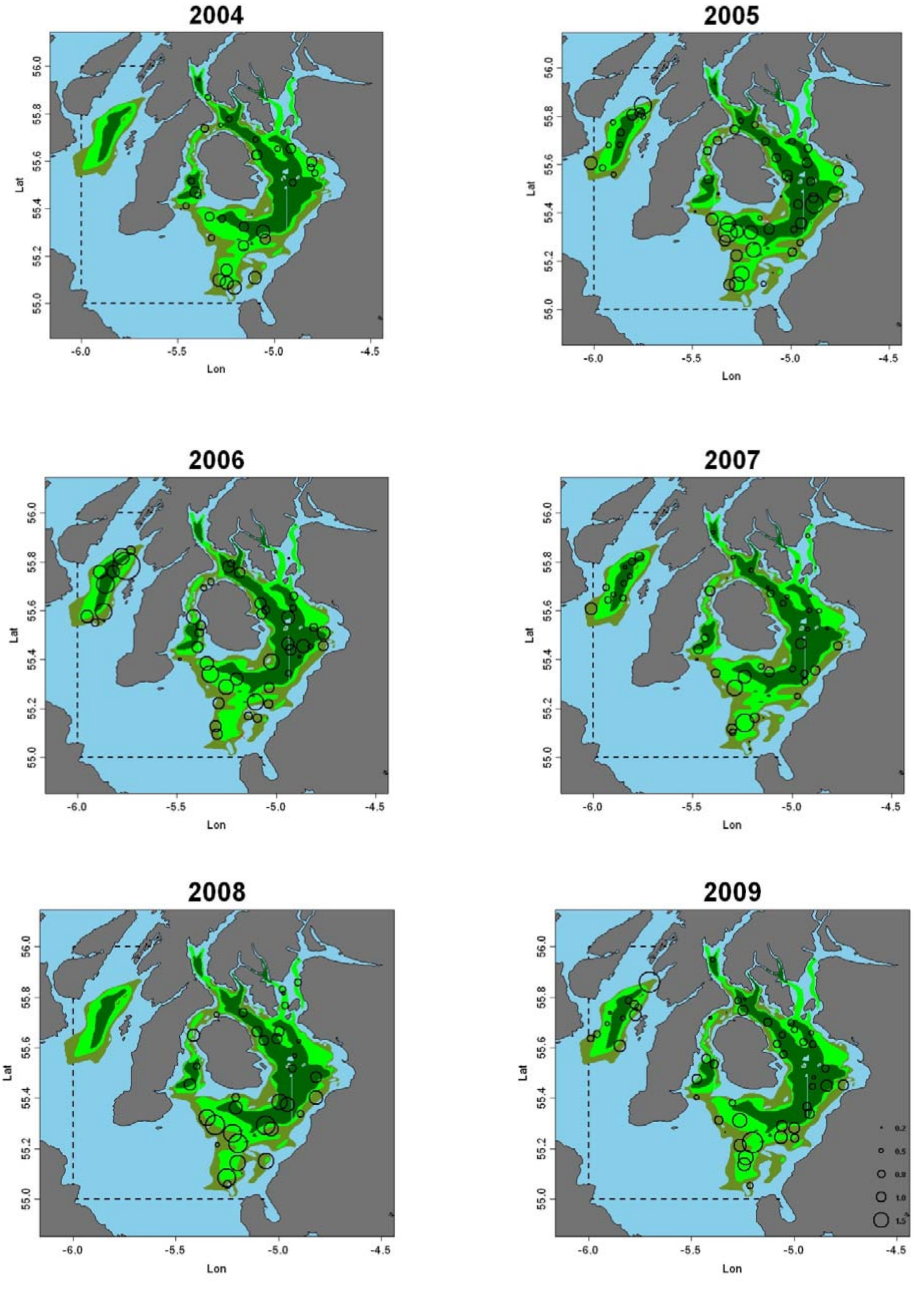

Figure 3.7.4. ***Nephrops*****, Clyde (FU13), TV survey station distribution and relative density (burrows/m²) for Firth of Clyde and Sound of Jura subareas, 2004–2009. Sound of Jura located to the east. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles scaled the same. Red crosses represent zero observations.**

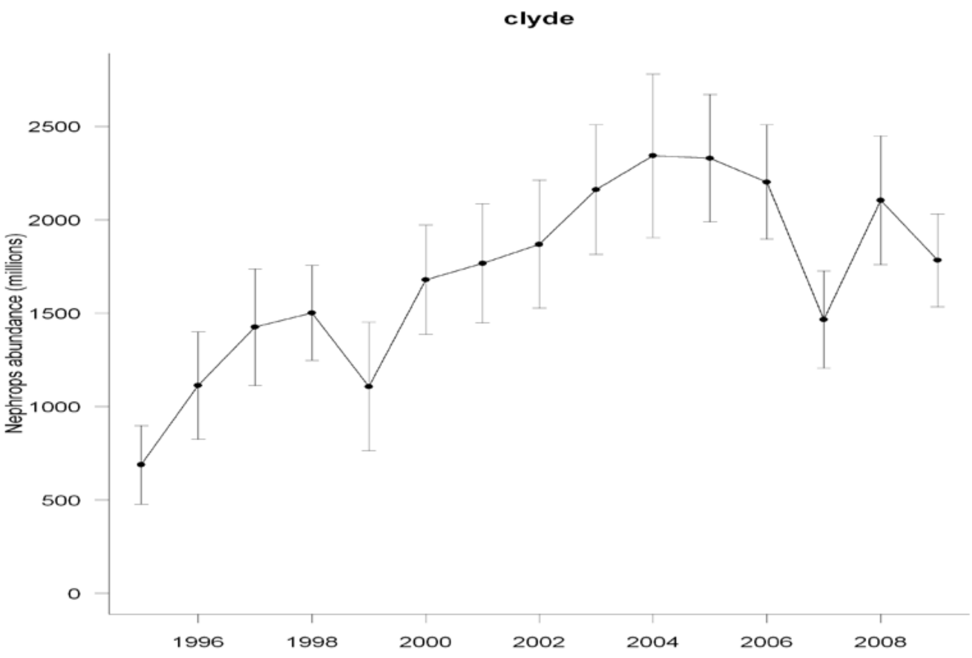

Figure 3.7.5. ***Nephrops*, Clyde (FU13): Firth of Clyde subarea. Time-series of revised TV survey abundance estimates (not adjusted for bias), with 95% confidence intervals.**

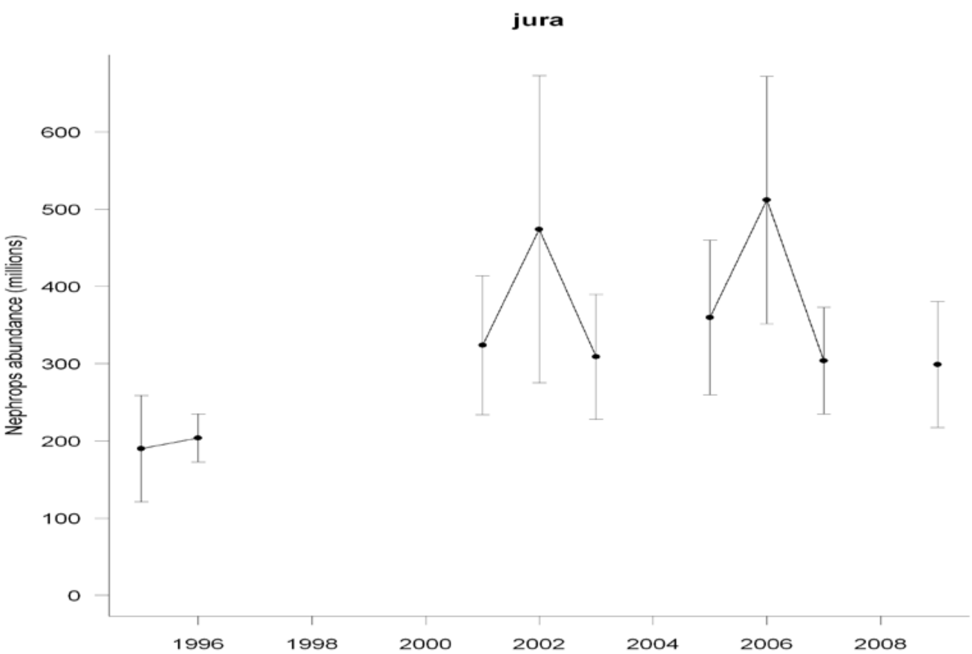

Figure 3.7.6. ***Nephrops*, Clyde (FU13): Sound of Jura subarea, Time-series of TV survey abundance estimates with 95% confidence intervals.**

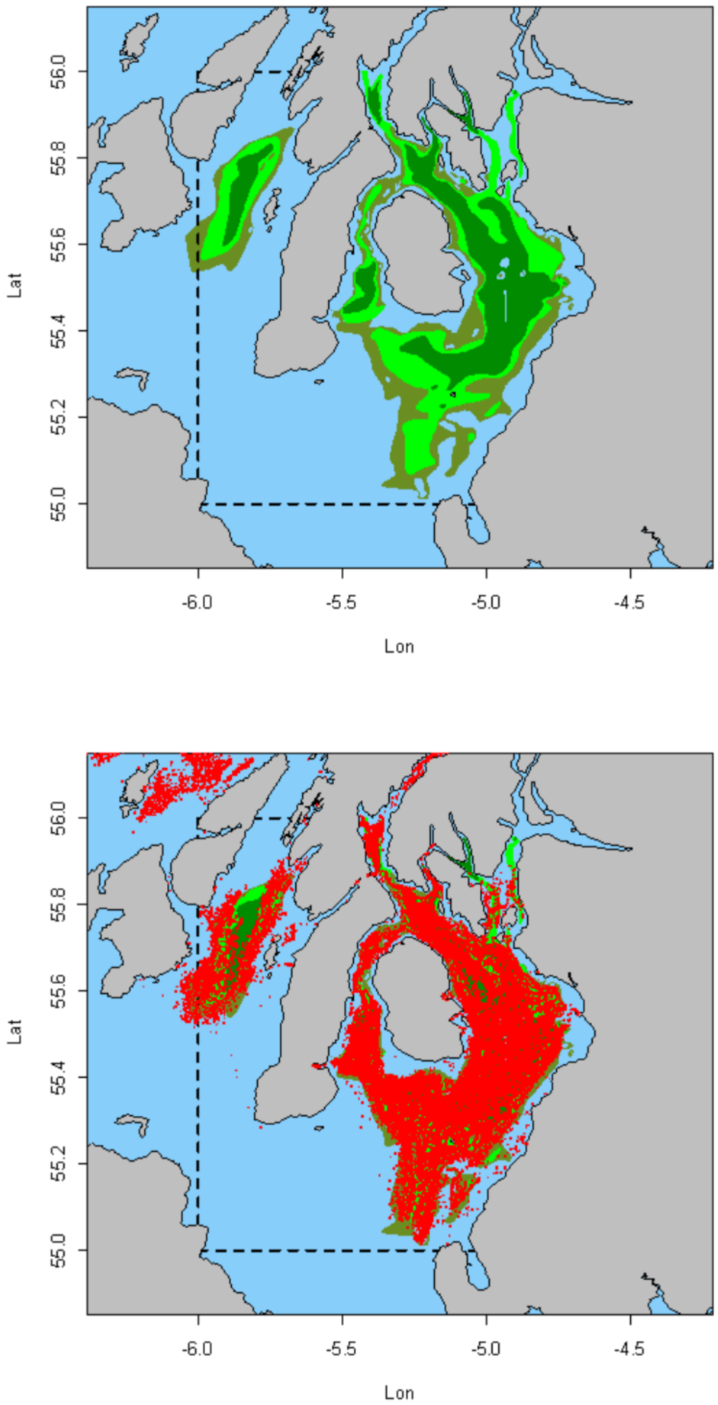

Figure 3.7.7. *Nephrops*, Clyde (FU13), Comparison of area of *Nephrops* ground defined by BGS sediment distribution (upper plot) and by distribution of VMS pings (shown in red) recorded from *Nephrops* trawlers >15 m length (lower panel).

4.1 Rockall Area overview

There is no overview section.

4.2 Cod in Division VIb

Officially reported nominal landings are shown in Table 4.2.1 and Figure 4.2.1. Lpue results from the Irish otter trawl fleet are also presented in Figure 4.2.2. Figure 4.2.2 shows a large decline in lpue between 1995 and 2003 followed by relatively stable values at a level much lower than at the start of the time-series. No analytical assessment of this stock has been carried out.

Table 4.2.1. Cod in Division VIb (Rockall). Official catch statistics (nominal landings).

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	18	-	1	-	31	5	-	-	-	1	-	-
France	9	17	5	7	2	-	-	-	-	-	-	-
Germany	-	3	-	-	3	-	-	126	2	-	-	-
Ireland	-	-	-	-	-	-	400	236	235	472	280	477
Norway	373	202	95	130	195	148	119	312	199	199	120	92
Portugal	-	-	-	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-
Spain	241	1200	1219	808	1345	-	64	70	-	-	-	2
UK (E. & W. & N.I.)	161	114	93	69	56	131	8	23	26	103	25	90
UK (Scotland)	221	437	187	284	254	265	758	829	714	322	236	370
Total	1,023	1,973	1,600	1,298	1,886	549	1,349	1,596	1,176	1,097	661	1,031

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Faroe Islands	-	-	-	-	n/a	n/a	n/a				
France	-	-	-	-	+	+*	1			0.08	
Germany	10	22	3	11	1	-	-				
Ireland	436	153	227	148	119	40	18	11	7	12	22.7
Norway	91	55*	51*	85*	152*	89	28	25	23	7	7
Portugal	-	5	-	-	-	-	-				
Russia	-	-	-	-	7	26	-				
Spain	5	1	6	4	3	1		6			
UK (E. & W. & N.I.)	23	20	32	22	4	2	2	3			
UK (Scotland)	210	706	341	389	286	176	67	57	45	43	
UK											28.7
Total	775	962	660	659	572	334	115	102	75	62	58.4

Country	2007	2008	2009*
Faroe Islands	-		
France	-		
Germany	-		
Ireland	24	40.7	20.4
Norway	12	11	25
Portugal	-		
Russia	-		1
Spain	-		
UK (E. & W. & N.I.)			
UK (Scotland)	26		
UK		41.3	47.8
Total	62	93.0	94.2

*** Preliminary**

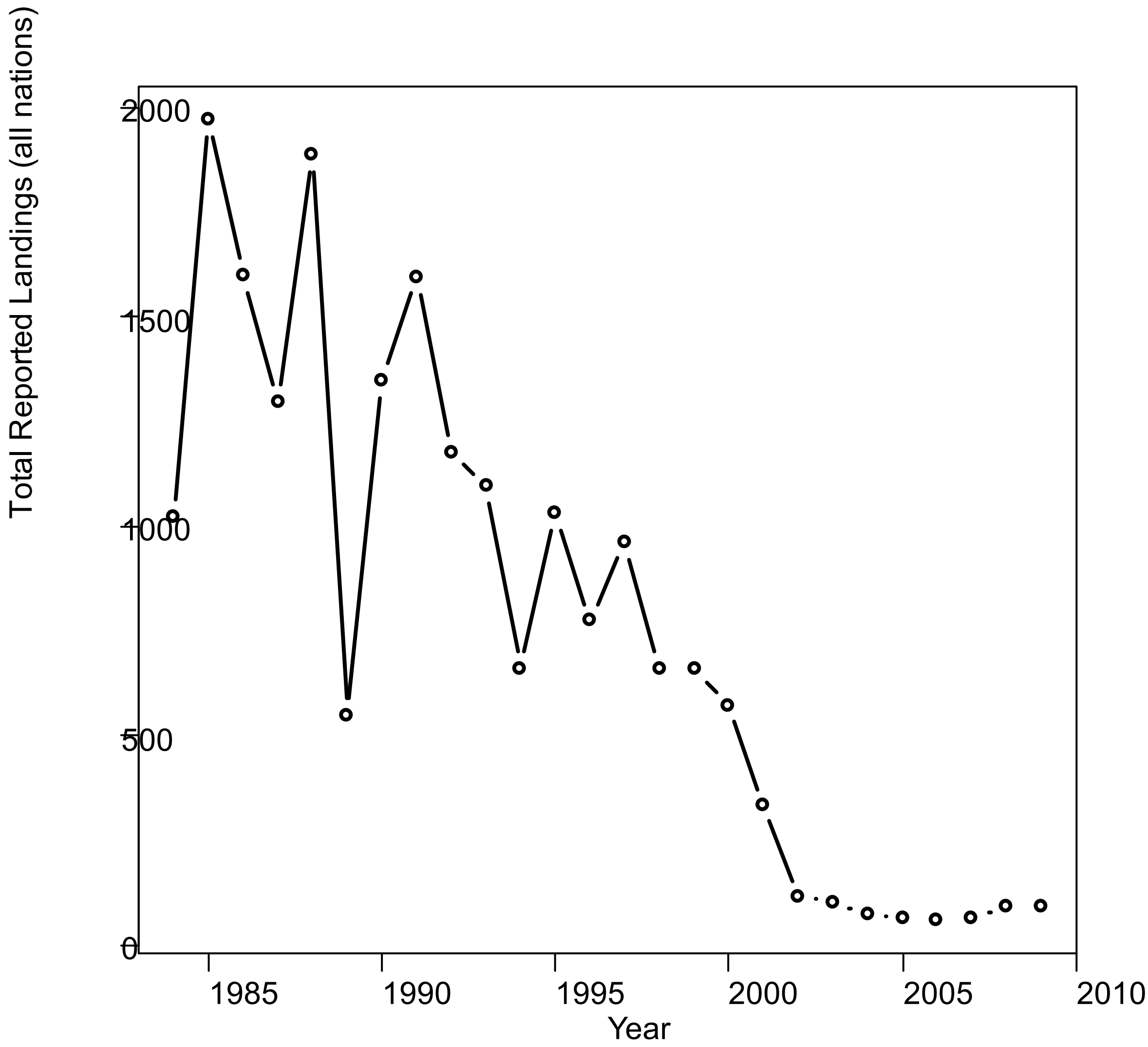

Figure 4.2.1. Cod in Division VIb. Total official nominal landings (all nations combined), 1984-2009.

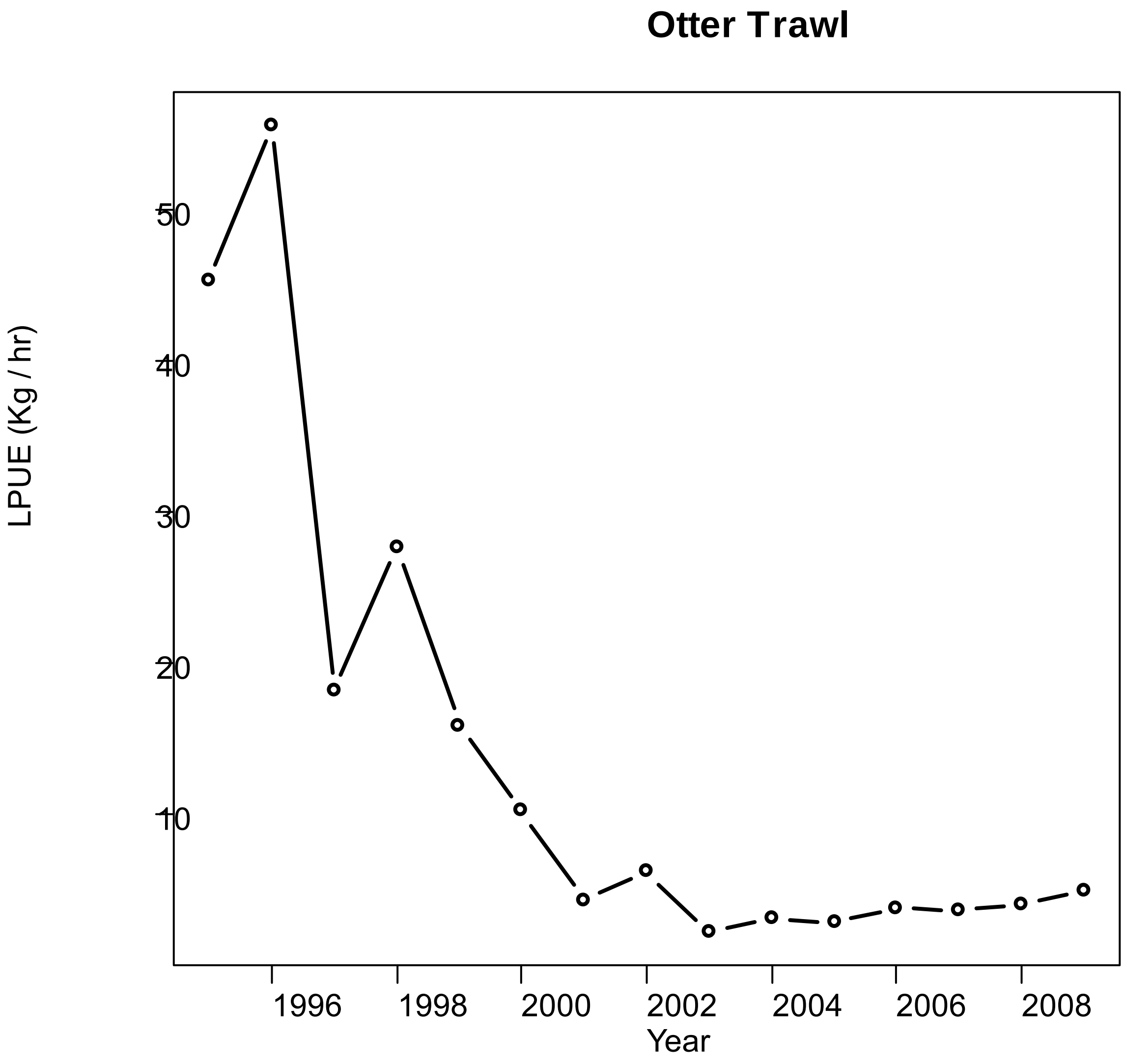

Figure 4.2.2. Cod in Division VIb. Lpue from Irish Otter trawl fleet, 1995-2009.

4.3 Haddock in Division VIb (Rockall)

Type of assessment in 2010: Update assessment

The assessment of the haddock stock in Division VIb is based on catch-at-age and one survey index (Scottish Groundfish Survey) and conducted using the XSA method. Discarding occurs in part of the fishery. Discards have been estimated and used in the assessment. In 2005, WGNSDS, on the recommendation of RGNSDS, adopted a new assessment approach, which allows modelling of the total catch (including discards) of the Irish, Scottish and Russian fleets (for details see Stock Annex). The same approach has been used in the annual assessment since 2005. The current assessment is an update of the last year assessment.

ICES advice applicable to 2009

The ICES advice for 2009 in terms of single-stock exploitation boundaries was as follows:

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

"Fishing mortality around $F_{0.1}$ (0.21) can be considered as a candidate target reference point consistent with taking high long-term yields and achieving a low risk of depleting the productive potential (< 5%). The present fishing mortality (0.25) is above the candidate reference point."

Exploitation boundaries in relation to precautionary limits

"Fishing mortality should be less than F_{pa}, corresponding to total catches less than 9740 t in 2009. Landings should be less than 6470 t in 2009."

Conclusion on exploitation boundaries

"In the present situation with a stock that is well above B_{pa} and fishing mortality below F_{pa} there is little gain to the long-term yield by increasing fishing mortality above current levels. ICES therefore recommends to limit catches to 6490 t in 2009 and landings to 4330 t."

ICES advice applicable to 2010

The ICES advice for 2010 in terms of single-stock exploitation boundaries was as follows:

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

"Fishing mortality around $F_{0.1}$ (0.18) can be considered as a candidate target reference point consistent with taking high long-term yields and achieving a low risk of depleting the productive potential (< 5%). The present fishing mortality (0.23) is above the candidate reference point and below F_{pa}."

Exploitation boundaries in relation to precautionary limits

"Fishing mortality should be less than F_{pa}, corresponding to total catches less than 7090 t in 2010. Assuming that current discarding practices will be continued, landings should be less than 5480 t in 2010."

Considering the option below ICES advises that there is little gain on the long-term yield by increasing fishing mortality above current levels. ICES therefore recommends limiting catches and landings in 2010 to 4280 t and 3330 t, respectively.

4.3.1 General

Stock description and management units

The haddock stock at Rockall is an entirely separate stock from that on the continental shelf of the British Isles. Since 2004, the EU TAC for haddock in VIb has been included with Divisions XII and XIV. For details of the earlier management units see Stock Annex.

Management applicable to 2009 and 2010

The EU TAC for VIb, XII and XIV was set at 5879 t in 2009 (a 15% reduction compared to TAC for 2008).

The TAC for 2010 was set at 4997 t (a 15% reduction compared to TAC for 2009) and is shown below:

Species:	Haddock *Melanogrammus aeglefinus*	**Zone:**	EU and international waters VIb, XII and XIV (HAD/6B1214)
Belgium	11		
Germany	13		
France	551		
Ireland	393		
United Kingdom	4 029		
EU	4 997		
TAC	4 997		Analytical TAC

The ICES advice, agreed TAC for EU waters, and WG estimates of landings during 2002–2010 are summarised below. All values are in tonnes.

YEAR	CATCHES CORRESPONDING TO ICES ADVICE (VIB)	BASIS	AGREED TAC	WG LANDINGS
2002	< 1,300	Reduce F below 0.2	1300[a]	3336
2003	-	Lowest possible F	702[a]	6242
2004	-	Lowest possible F	702[b]	6445
2005	-	Lowest possible F	702[b]	5179
2006	-	Lowest possible F	597[b]	2765
2007	< 7100	Reduce F below F_{pa}	4615[b]	3349
2008	< 10640[c]	Keep F below F_{pa}	6916[b]	4221
2009	< 4300[d]	No long-term gains in increasing F	5879[b]	3814
2010	< 3300[d]	Little gain on the long-term yield by increasing F	4997	

[a] TAC was set for Divisions VIa and VIb (plus Vb1, XII and XIV) combined with restrictions on quantity that can be taken in Vb and VIa. The quantity shown here is the total area TAC minus the maximum amount which is allowed to be taken from Vb and VIa.

[b] In 2004, the EU TAC for Division VI was split and the VIb TAC for haddock was included with XII and XIV. This value is the TAC for VIb, XII and XIV.

[c] Total catch, including landings and discards.

[d] Only landings.

The minimum landing size of haddock taken by EU vessels at Rockall is 30 cm. There is no minimum landing size for haddock taken by non-EU vessels in international waters.

In order to protect the pre-recruit stock, the International Waters component of the statistical rectangle 42D5 has been closed for fishing since 2001 and its EU component, since 2002 (see Stock Annex). The protected area (the whole rectangle) is referred to as Rockall Haddock Box. In order to protect cold-water corals, three further areas (North West Rockall, Logachev Mounds and West Rockall Mounds) were closed since January 2007 (see Stock Annex). A new area to protect cold-water corals (Empress of British Banks) was established by the NEAFC in 2007.

Fishery in 2009

Nominal landings for 2009 and previous years as reported to ICES are given in Table 4.3.1.

Russian fishery in 2009

In 2009, the fishery took place in September for only 7 days. 1 or 2 trawlers were engaged in the fishery (Table 4.3.2). Haddock accounted for 80–90% of the catch.

The vessels operated in the international waters at depths between 200 and 400 m. The total haddock catch was 55 t (Table 4.3.2), 53 t being taken by trawls and 2 t by longlines. This was a sharp decline compared to 1669 t taken in 2008.

Scottish fishery in 2009

The number of Scottish vessels fishing for haddock and the number of trips made to Rockall declined substantially from 2000 onwards (WD6 to WGNSDS 2004). The declining trend was reversed in 2007. The number of vessels in increased from 22 in 2007 to 28 in 2008, and 37 in 2009.

The officially reported effort (in hours fishing) has varied over the past few years. However, these estimates are unreliable as reporting hours fishing is not mandatory for Scottish vessels and are not reported here for 2008 and 2009. Also, it is not known to what extent any variation in effort reflects changes in targeting haddock. Total Scottish demersal landings in VIb in 2009 are estimated to be 4585 t, of which 2951 t were haddock. The latter was an increase by 66% compared to the haddock catch in 2008 (Tables 4.3.1, 4.3.3). Other important target species included anglerfish (*Lophius* spp.), saithe, ling and megrim.

The UK landings and effort data included only Scottish vessels in 2009.

Irish fishery in 2009

Landings totalling 352 t were reported from Irish otter trawlers in 2009 (over a two-fold decrease from 721 t in 2008; Table 4.3.1). Most landings and effort were reported for Quarter 2 (Table 4.3.4).

Norwegian fishery in 2008

The Norwegian demersal fleet fishing on the Rockall Bank consisted mainly of longliners and targeted mainly ling and tusk. Haddock constituted the bycatch in this fishery. All catch of haddock was taken in Quarters 3 and 4. In 2009, Norwegian landings of haddock amounted to 71 t which was a two-fold increase compared to 2008, and was within the catch range for the periods 2001–2005 and 2007–2009 (32–84 t).

4.3.2 Data

Landings

Nominal landings as reported to ICES are given in Table 4.3.1, along with Working Group estimates of total estimated landings. Reported international landings of Rockall haddock in 1991–2005 varied between 4000 and 6000 t, except for 2001–2002, when they decreased down to about 2300–3000 t. In 2006, they were also low at 2760 t, but increased to 3348 t in 2007 and 4221 t in 2008. In 2009, international landings decreased to 3237 t.

Revisions to official catch statistics for previous years are also shown in Table 4.3.1.

Anecdotal evidence suggests that misreporting of haddock from Rockall has occurred historically (which may have led to discrepancies in assessment), but a quantitative estimation of the degree of misreporting is not possible.

Age composition and mean weight-at-age of Scottish and Irish landings were obtained from port sampling.

Age composition and mean weight-at-age of Russian landings were obtained by observers onboard commercial fishing vessels. In 2002, there was no sampling of the Russian catch and therefore the length composition for that year had to be estimated (for estimation details, see Stock Annex). In 2009, the Russian catch was down to 55 t and there was no sampling. The age composition in the Russian catch in 2009 was assumed to be the same as in the Scottish catches including discards.

Observer data from commercial vessels are also available for Norwegian landings for 2006–2009.

Discards

Discarding by EC fleets is significant and therefore the assessment of the stock is done based on the total catch (landings+ discards). On Russian vessels, the whole catch of haddock is kept onboard and therefore, total catch is equivalent to landings.

Haddock discards onboard Scottish and Irish vessels were in some years determined directly, while in other years, indirect estimates of discards were done (for details of the estimation of discards see Stock Annex).

The analysis of the discard data collected by Scottish scientists in 1999 and 2001 indicated that only a relatively small proportion of fish taken aboard is landed (Figure 4.3.1). The direct estimates from the Scottish trawlers in 1985, 1999 and 2001 showed a higher proportion of discards of small haddock: from 12 to 75% by weight (Table 4.3.5) and up to 80–90% of catch abundance. Discard trips in 1995, 1997, 1998, 2000 and 2001 showed that discarding by Irish fishing vessels is variable with a mean rate of 30% (Table 4.3.6).

Discard data were also obtained by Irish scientists from discard trips in 2007–2009. They showed that 52, 87 and 63% of the catch in numbers, respectively, was discarded. The range of discarded sizes was 19–43 cm (mean 30 cm) (Table 4.3.7). It should be noted that these estimates are based on very few trips (1, 2 and 3 for 2007, 2008 and 2009 respectively) and should therefore be treated with caution.

The proportion of fish discarded from Scottish and Irish catches at different sizes may be determined and modelled using a logistic curve. Calculations where the discard curve was applied agree well with the results of size composition measurements from Scottish vessels in 1999 and 2001 and from the combined 1995–2002 Irish discard trips (see Stock Annex).

Russian vessels retain all haddock and therefore there is no need to calculate discards (see Stock Annex).

There are some Scottish discards data for 2009, but their quality is very poor. Only six fish were measured, at age 4 and length 28–33 cm.

Biological

There was no change in biological parameters compared to the 2009 assessment (see Stock Annex).

Surveys

There is only one abundance index available for VPA assessment of this stock from the Scottish survey (Figure 4.3.2). The survey is conducted in about 40 standard trawl stations. However, the survey area varied along with the number of stations in different years and survey covers only part of the currently known distribution area of haddock (see Stock Annex).

The distribution of sampling stations has slightly varied over time (Figure 4.3.2). The stations located in the southwest were not sampled every year and area what was covered by survey considerably differed in same years. Survey data were standardized for exploratory run in 2009. The stations which were located in the southwest were excluded from calculation. VPA was run with the old and new standardized indices (Tables 4.3.8, 4.3.9).

The Russian trawl-acoustic survey conducted in 2005 provided information on the stock size and biomass of the haddock stock, both in the EU zone and in international waters. The acoustic survey yielded a biomass estimate of 60 000 t and an abundance estimate of 225.9 million (for the details see Stock Annex). No such survey has been conducted in subsequent years.

Commercial cpue

Commercial cpue series are available for Scottish trawlers, light trawlers, seiners, Irish otter trawlers and Russian trawlers fishing in Division VIb. The effort data for these five fleets are shown in Figure 4.3.3 and Table 4.3.10. Commercial cpue series for the different fleets are shown in Figure 4.3.4.

In 2005–2009, the Russian effort in bottom fishery (in hours and number of vessels/days) decreased due to economic reasons (Figure 4.3.4). Haddock catches varied accordingly with the changes in fishing effort. In 2006–2007, cpue in the Russian haddock fishery (mainly with trawlers of tonnage class 10) increased compared to previous years. In 2008–2009, it slightly decreased (with trawlers of class 8 and 9 only). The dynamics of catch per unit of effort for vessels agrees of tonnage class 10 agreed well with year-to-year variations in total biomass of haddock (Figure 4.3.5).

The effort data from the Scottish fleets are known to be unreliable due to changes in the practices of effort recording and non-mandatory effort reporting (see the Report of WGNSSK 2000, CM 2001/ACFM:07, for further details). It is unknown what proportion of Scottish and Irish effort was applied directly to the haddock fishery. The apparent effort increase may just be the result of more exact reporting of effort due to VMS, but another suggestion is that it arises from restrictive ‘days at sea’ in other areas (VIa and IV). Working at Rockall keeps ‘days at sea’ elsewhere intact (the years in question do correspond to the introduction of the days at sea legislation) and it is possible that vessels are either working extra days in VIb or they are simply reporting extra days from VIb. Despite the uncertainty about the fishing effort, the lpue for the Scottish fleet increased considerably in 2007 and 2008 compared to previous years (Figure 4.3.4).

The Irish otter trawl effort series indicated low values between 2002 and 2005 with the lowest value in 2004. In 2006–2008, the effort increased considerably, but declined in 2009 (Figure 4.3.3). The lpue showed an increase in 2007–2009 (Figure 4.3.4).

The WG decided that the commercial cpue and lpue data, which do not include discards and have not been corrected for changes in fishing power despite known changes in vessel size, engine power, fish-finding technology and net design, were unsuitable for catch-at-age tuning.

Other relevant data

The Irish Fisheries Board (BIM) and the Marine Institute recently conducted a collaborative series of surveys to assess the length structure of haddock at various locations on the Rockall Bank and tested the selectivity of a number of codend configurations, which are typically used by the Irish fleets.

The selectivity of gears with different mesh sizes was also investigated at Rockall by Russian scientists.

4.3.3 Historical stock development

Model used:

The assessment is based on catch-at-age data and one survey index (Scottish Groundfish Survey) and conducted using the XSA method.

Software used:

The same software was used as in the last year's assessment (XSA from Lowestoft suite of VPA programs).

Model Options chosen:

Settings for the final XSA assessment did not change compared to the previous assessment (see Stock Annex) and were as follows:

Assessment model: XSA

Tuning indices: one survey index (SCOGFS)

Time-series weights: none

Catchability dependent for ages < 4

Regression type: C

Q plateau: 5

Shrinkage stand. error: 1.0

Shrinkage age-year: 4 years, 3 ages

Minimum stand. error: 0.3

Plus group: 7+

F_{bar}: 2–5

Input data types and characteristics:

There were no changes in data types and characteristics compared to the previous assessment:

Year range: 1991–2009

Age range: 1–7+

For tuning data the following year and age ranges were used:

Year range: 1991–2009

Age range: 1–6

Data screening

Figures 4.3.6 and 4.3.7 and Table 4.3.11 show landings, discards and total catch by number and weight. Landings, discards and total catch-at-age by number are shown in Tables 4.3.12–4.3.14.

Mean weights-at-age in total catch, landings, discards and stock are shown in Tables 4.3.15–4.3.18. The mean weights-at-age in the stock are assumed to be the same as the catch weights. The temporal dynamics of haddock mean weights-at-age in the total catch (including discards) and in the stock are shown in Figure 4.3.8. Mean weights-at-age in total catch were higher in 2008–2009 compared to 2007. This increase was observed in the Scottish landings and in the Russian catches in 2008 also.

The landings of haddock aged 1 were not large and it was hard to consider the catch of fish in this age group. The results from Scottish and Irish investigations showed that the abundance in discards exceeded that of landings. Discarded fish are, primarily, haddock aged 1–2 (see Tables 4.3.1 and 4.3.2 in Stock Annex). Figures of log catch by age show that these values are much less variable when discards are included

(Figures 4.3.9–4.3.14). Data on catches, landings and discards-at-age are given in Tables 4.3.12–4.3.14.

The Scottish trawl survey was the only survey index available to the Working Group. Plots of log cpue by age, year and year class are shown in Figures 4.3.15–4.3.17.

A SURBA 3.0 run was carried out to analyse the survey data. Previous working groups have concluded that the first three years of the survey should not be used in assessments and that age 0 data were a poor indicator of year-class strength. Here, the runs were actually conducted using the survey data from 1991 onwards to be consistent with the period over which the catch-at-age assessment could be run (the settings: lambda = 1.0, reference age = 3). A summary of the results are shown in Figure 4.3.18. SSB shows a declining trend from 1995, an increase in 2003–2004 and a general decrease in the subsequent years. The estimates of the temporal component of F are very noisy, but indicate a steep decline since 2000. Retrospective analysis showed consistent estimation of SSB and F (2–5) (Figure 4.3.18a).

Comparative scatter plots of log index-at-age are shown in Figure 4.3.18b. The survey shows relatively good internal consistency in tracking year-class strength through time.

Final Update Assessment

Exploratory runs

Two survey indices were used for XSA runs: old and new standardized indices. Both had rather small residuals in runs with data to 2008 (Figures 4.3.19–4.3.20 and Tables 4.3.19–4.3.20). However, tuning had not converged for the run with old original indices. In 2008 during the Scottish survey the age samples were collected by the Russian scientists. Indices for 2008 were calculated also with use of this age key also and tuning was converged in run with this indexes. However, the Russian age key is absent for 2009 and were used original 2009 indices. Standardization of indices on square covered by survey has allowed reducing log residuals for last year's especially.

However, including 2009 data negatively affected the quality of the assessment.

Tuning converged for a run with new standardized indices. However, log residuals for age 5 were high (Figure 4.3.21). There is a good correlation for other age classes. Big residuals in this assessment are the result of the strong year class 2005 and very poor year classes 2006–2009 (Table 4.3.21). The results of this assessment are presented in Table 4.3.22.

Tuning did not converge for a run with old original survey indices and log residuals for age 5 were high but less compare to new indices (Table 4.3.23, Figure 4.3.22,). There is a good correlation for all age classes (Table 4.3.23).

For comparison, Figure 4.3.23 shows SSB, recruitment at age 1 and mean F (2–5) estimates in the present assessment and assessments in which standardized survey indices were used. These estimates are rather consistent for the two index-series.

Final run

In the final run, old original indices were used. The diagnostics file of the final XSA run is given in Table 4.3.23. Adjusted survey cpue against XSA population estimates are shown in Figures 4.3.24–4.3.25. The analysis of residuals and retrospective analysis (Figures 4.3.21–4.3.22, 4.3.26) shows that applying the chosen parameters for XSA (as done in 2005–2009 assessments) improves the residual patterns compared to other exploratory settings. However, there are still same trends apparent in the log catchability residuals. The results of the retrospective analysis conducted by the Working Group in 2002 and 2003 indicated that using shrinkage values of more than 0.5 improved the retrospective curves and showed convergence. In this year's analysis, only 18 years data were available for the retrospective analysis, but a good year-to-year consistency was obtained. Dynamics of fishing mortality-at-age are presented in Figure 4.3.27. The final XSA results are given in Tables 4.3.24–4.3.26. The final XSA and SURBA results are compared in Figure 4.3.28. The SURBA estimates are more variable, but there is a good overall consistency between estimates by the two methods.

Summary plots from the final XSA assessment are shown in Figure 4.3.29.

Comparison with previous assessments

XSA was conducted with the same basic assumptions and setup as last year's assessment. Perceptions of the stock have not changed. Figure 4.3.30 shows, for comparison, SSB, recruitment at age 1 and mean F (2–5) estimates in the present assessment and assessments going back to 2001. The estimates from this year's assessment are reasonably consistent with the assessments carried out in previous years. Estimates of fishing mortality for 2009 have been revised upwards by 78%, and SSB has been revised upwards by 1% (Figure 4.3.30).

State of the stock

Based on this year's estimate of SSB and fishing mortality in 2009, the stock can be considered as having full reproductive capacity and that it is harvested sustainably. Spawning biomass has generally increased in recent years as a result of the 2001 and 2005 year classes. SSB has been above B_{pa} since 2003. But SSB reduced in 2009. Fishing mortality was above F_{pa} throughout most of the time-series but declined in 2005 and has remained below F_{pa} since then.

Statistical catch-at-age analysis (SCAA)

For Statistical catch-at-age analysis, StatCam model was used (J. Brodziak, 2005). VPA and SCAA used identical survey and catch data. For StatCam runs two scenarios were used. First scenario-non-parametric model, second-parametric model.

StatCam model shows good conformity between observed and predicted survey index and catch biomass. Log residuals were less 0.4 for total survey index (Figures 4.3.31–4.3.32).

StatCam summary plots are shown in Figure 4.3.33.

Both Statistical catch-at-age analysis and VPA results show a similar tendency for the SSB dynamics. However, the assessment of the stock size depends on the choice of the model. SSB and TSB plots from the XSA and SCAA assessment are compared in Figure 4.3.34.

4.3.4 Short-term projections

Estimating year-class abundance

The abundance index for age 0 in the 2009 survey was low (Figure 4.3.35). VPA abundance for age 1 has been highly correlated with age 0 indices over most of the time-series (from 1993 onwards, Figure 4.3.36). The recruitment (age 1) in 2010 was therefore estimated using RCT3 regression (Shepherd, 1997) relating survey indices to stock abundance.

For forecasting recruitment (age 1) in 2011 and thereafter, a geometric mean was used for 1991–2007.

The input data for the short-term forecast can be found in Table 4.3.27. *Status quo* fishing mortality is taken as a 3-year mean of the values over the period 2007–2009. Three year mean values were also used for stock weights and catch weights.

For forecasting discards and landings, the proportion of discards/landings-at-age in 1999–2009 was used, (Tables 4.3.11–4.3.14, Figure 4.3.37). The results obtained from the forecast (including discards) are given in Tables 4.3.27–4.3.29. The short-term forecast is also shown in Figure 4.3.38.

The sensitivity analysis of forecast is shown in Figures 4.3.39. There is a high probability of SSB in 2012 being below B_{pa} and F_{sq}.

Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes are shown in Table 4.3.30.

4.3.5 Medium-term projection

Medium-term projections were conducted using the Marlab software. There appears to be little or no relationship between spawning biomass and recruitment levels at age 1 and no attempt to fit a stock–recruitment relationship to these data has been made. Particularly high discard rates result in very poor estimation of both the overall level and the inter-annual variability of recruitment. Significant year-to-year fluctuations of recruit abundance can be seen, and that the link between adult haddock biomass and abundance of survived fingerlings and yearlings is absent. In the years when biomass is at high levels, poor year classes are often observed. So in 2001, when the stock was low, one of the most abundant year classes appeared. Strong year classes appear on average once every 4–5 years, although the available time-series is relatively short. SSB has been higher than B_{pa} in recent years but recruitment for the last four years has been low which may be a consequence of rising temperature. With F_{sq} = 0.25 for landings (total F_{sq}=0.34), there is a 30% probability of SSB falling below B_{pa} in the long term (See Figures 4.3.40–4.3.42).

4.3.6 Biological reference points

Precautionary approach reference points

Biological reference points for this stock are given below:

B_{lim}: 6,000 t (lowest observed SSB)

B_{pa}: 9,000 t (B_{loss} × 1.4)

F_{pa}: 0.4 (by analogy with other haddock stocks).

Figure 4.3.43 shows the stock in 2009 to be above B_{pa} and below F_{pa}.

Yield-per-recruit analysis

The stock–recruitment scatter plot is shown in Figure 4.3.44. Yield-per-recruit results, long-term yield and SSB (conditional on the current exploitation pattern) are shown in Figure 4.3.45. *Status quo* F (0.34) is approximately 18% lower than F_{max} (0.40) and twice as high as $F_{0.1}$ (0.16).

MSY evaluation

MSY estimates were evaluated using the srmsymc ADMB package. The number of stock and recruit pairs for this stock is fairly limited and these also show a relatively wide dynamic range. Yield and F_{bar} refer to total catch including landings and discards. Figures 4.3.46–4.3.50 show box plots of F_{msy} and F_{crash} as well as F_{pa} and F_{lim}. The deterministic fit lies outside the 5–95% percentiles for the Beverton and Holt S-R model which is therefore rejected. The hockey-stick breakpoint is poorly defined as us the Ricker curve. The Ricker model suggests that F_{msy} is above current F. The Ricker model assumes impaired recruitment at high stock levels and therefore arrives at higher F_{msy} than the other models. This level of F_{msy} overlaps with the confidence limits of F_{crash}. The yield plots for all three models suggest that MSY is relatively well defined although the absolute level of yield is highly uncertain and that current fishing mortality is close to F_{msy} estimate based on the underlying data.

Given the high CVs on all F parameters the WG concluded that the underlying data do not support the provision of absolute estimates of F_{msy} but that current F was close that expected to deliver long-term equilibrium yield.

4.3.7 Management plans

There is a need for an internationally agreed management plan. This would require a management strategy evaluation to identify an appropriate F_{MSY} target. Such a plan should involve extensive collaboration between stakeholders, scientists and management authorities in both the design and the monitoring of conservation measures. Management measures in the haddock fishery could be a combined application of TAC and limits of fishing efforts and should include effective control and enforcement measures. It would be beneficial to develop and introduce into fisheries practice measures aimed at minimising exploitation of juveniles.

In 2008–2009 the Russian Federation and the European Community have had consultations to develop a fisheries management plan. The report of the scientific working group was presented to the Delegations in 2009. It was recognised that the report contained all the relevant available data on the state of the stock and identified the issues, which would require continued cooperation between the Parties both at scientific and management levels.

In 2004, an ICES Expert Group met to deal with a request for advice from the EU and Russia concerning Rockall haddock management plans. They concluded that the lack of alternative assessment approaches precluded the identification of potential alternative limits to exploitation that may be useful to long-term management. In addressing this term of reference the Expert Group considered alternative approaches to management.

The 2004 Expert Group acknowledged that the Precautionary Approach requires that management be implemented in data poor situations. The Expert Group considered that the principles of the Precautionary Approach may have application to Rockall haddock provided the implementation considers the particular biology of the target species and the way it is exploited. For Rockall haddock the Expert Group considered that the fishing mortality should not be allowed to expand. Adoption of a TAC may actually allow increased fishing mortality if the stock is declining or there is significant unreported catch. Moreover, application of TACs implies that there is a simple relationship between a recorded landing of a species and the effort exerted on that species. Such an assumption is unlikely to be true for Rockall haddock. Furthermore, there are ways of evading TACs including misreporting, high grading and discarding. In the case of Rockall haddock these may occur to a large extent due to the remote nature of the fishery and the processing of catches at sea by some fleets. The Expert Group concluded that effort regulation rather than TACs may be a better means of controlling fishing mortality on Rockall haddock in the long term but that TAC regulation could be used in the future if more objective and accurate biological and fishery information are routinely provided (ICES CM 2004/ACFM:33). In circumstances where population is dominated by small individuals and differences in length of older and younger age groups are not great, the effectiveness of using selective properties of trawl gear is very low. Comparison of the discard practices of the national fleets operating at Rockall indicate that an increase of minimum mesh size (as was the case in 1991) does not result in considerable reduction of the proportion of small individuals in catches, however catch rates are decreased. ACFM 2007 was unable to forecast discards and include them in TAC, and as a result, there were no recommendations on allowable landings. ACOM 2008 recommended applying TAC to landings only.

4.3.8 Uncertainties and bias in assessment and forecast

The WG considers that the long-term trends in the XSA assessment and survey biomass estimates/indices are probably indicative of the general stock trends. However, F is considered to be poorly estimated due to the following sources of uncertainty in the current assessment:

1) The method of estimating discards from survey data, although considered appropriate, is likely to be the main source of error.

2) There are concerns over the accuracy of landings statistics from Rockall in earlier years.

3) Historically, there is poor agreement between survey and XSA estimates of population numbers during some periods. This may be related to potential inaccuracies in the landings statistics.

4) In 1999 the gear and tow duration were changed on the Scottish survey. There were no calibrations done to assess possible impacts on catchability for this survey.

5) The XSA assessment shows trends in catchability, even if reduced by weak shrinkage.

6) The XSA assessment diagnostics give quite large standard errors on survivors estimates (0.3–0.4) and there are often quite different values given by ScoGFS, F-shrinkage and P-shrinkage.

The WG considers that a longer series of more accurate landings, discards (for non-Russian fleets) and survey data will be necessary to overcome these deficiencies.

The survey covers only part of the currently known distribution area of haddock that raises uncertainty of an assessment.

There are concerns about the ability to forecast future catches and landings given substantial changes in national composition of the fleets operating at Rockall. A substantial change in TAC may lead to big changes in discarding practices. The Working Group previously presented forecast for total catch. However, with increased EU catches with discards, this approach is no longer considered appropriate. The present forecast predicts future catches disaggregated into landings and discard components.

The WG makes the following reservations about the forecast:

1) The future fleet composition at Rockall is very uncertain.
2) Discard proportion has varied considerably over time (Figure 4.3.37). However, no major changes in the pattern of discards-at-age have been observed since 1999, although this is based on few observations. Therefore, average proportions for 1999–2009 were used and it is assumed that these values will also apply for 2010–2012.

4.3.9 Recommendation for next Benchmark

The main conclusion of WGCSE is that and time-series of improved landings and discard data is needed before progress can be made towards the next benchmark assessment of this stock.

Because the survey covers only part of the currently known distribution area of haddock, it is necessary to use other available survey data for the assessment of this stock.

It is recommended to make the analysis of an opportunity of using of new models of an estimation including statistical catch-at-age analysis which will improve quality of assessment.

It would be beneficial to develop and introduce standardization methods for reading of age for haddock.

No timeframe for the next benchmark could be proposed at this stage.

4.3.10 Management considerations

Current fishing mortality is close to that which is expected to deliver long-term equilibrium yield. SSB in 2011 is higher than a B_{pa} but the incoming recruitment for the last four years has been low and SSB is predicted to decline at current fishing mortality. Fishing at F_{pa} in 2011 would result in a 26% reduction in SSB by 2012.

Fishing mortality levels have historically been high but have decreased since 2005. The fishing mortality has decreased for small individuals (age 1 and 2) since 2001. Survey-based indices of SSB indicate that the stock was at a historical low in 2002, but have increased since.

The forecast predicts future catches disaggregated into landing and discard components. The discard ratio is around 47% in 1991–2009 and 34% in the recent period (1999–2009). Some countries land the whole catch while others discard part of the catch. For countries which discard part of the catch the discard rate in the past was as high as 52–87% by numbers by results of discards trips. It would be beneficial to develop and introduce into fisheries practice measures aimed at preventing discards of haddock. Elaboration of such measures complies with recommendations under the UNGA Resolution 61/105 that urges states to take action to reduce or eliminate fish discards (UNGA Resolution 61/105, 2007, Chapter VIII, item 60).

In 2004–2009, the analytical methods of stock estimation were improved, the new data on biology and distribution were obtained, a trawl acoustic survey was carried out and the biomass of haddock from the Rockall Bank was estimated. The results from these investigations allow us to draw the following conclusions:

1) Due to the appearance of above-average year-classes in 2000–2001, the haddock stock has increased over the past few years. This is corroborated by Russian fishery statistics, biological research data, analytical calculations and Trawl Acoustic Survey in March 2005.

2) The 2005 year-class is also a strong one. It has grown to a catchable size and will enhance the fishable stock over the next few years.

3) It would be beneficial to conduct the ground fish/trawl-acoustic survey annually. An annual trawl survey covering the whole of the distributional area may improve the assessment of the stock status.

4) Discarding and the use of small-mesh gear have historically resulted in significant mortality of small haddock.

5) Regulation measures applied for haddock fishery encourage discards. Changes in the level of fishing mortality will not improve the situation as it will still be difficult to present forecasts both for discards and landings, and consequently for fishing mortality rates. Furthermore, there are ways of evading recommended fishing mortality including misreporting, high grading and discarding.

6) It would be beneficial to develop and introduce into fisheries practice measures aimed at preventing discards of undersized haddock.

7) General management issues aimed at maintaining a healthy stock of Rockall haddock, such as changes in landing size, changes in mesh size, use of square mesh and headline panels, licenses to fishing and closed areas, are currently being discussed through ongoing negotiations between EU and the Russian Federation.

4.3.11 References

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Table 4.3.1. Nominal catch (tonnes) of haddock in Division VIb, 1991–2009, as officially reported to ICES.

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009[1]
Faroe Islands	-	-	-	-	-	-	-	-	-	n/a	n/a	-	-	-	-	2	2	16	-
France	…[2]	…[2]	…[2]	…[2]	…[2]	-	-	-		5	2	-	1	-	-	-	-	-	-
Iceland	-	-	-	-	-	-	-	-	167	-	-	-	-	-	-	-	-	-	-
Ireland	640	571	692	956	677	747	895	704	1,021	824	357	206	169	19	105	41	338	721	352
Norway	69	47	68	75	29	24	24	40	61	152	70	49	60	32	33	123	84	36	71
Portugal	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-
Russian Federation	-	-	-	-	-	-	-	-	458	2,154	630	1,630	4,237	5,844	4,708	2,154	1,282	1669	55
Spain	187	51	-	-	28	1	22	21	25	47	51	7	19	-	-	5	-	-	-
UK (E, W & NI)	165	74	308	169	318	293	165	561	288	36	-	-	56	-	-	-	-	-	-
UK (Scotland)	4,792	3,777	3,045	2,535	4,439	5,753	4,114	3,768	3,970	2,470	1,205	1,145[3]	1,607	411[3]	332[3]	440[3]	1,643[3]	1,779[3]	2,951[3]
Total	5,853	4,520	4,113	3,735	5,491	6,818	5,220	5,098	5,990	5,688	2,315	3,037	6,148	6,306	5,178	2,765	3,349	4,221	3,429
Unallocated catch	-198	800	671	1,998	-379	-543	-591	-599	-851	-357	-279	299	94	139	1	0	0	0	-192
WG estimate	5,655	5,320	4,784	5,733	5,112	6,275	4,629	4,499	5,139	5,331[4]	2,036[4]	3,336[4]	6.242[4]	6,445	5,179	2,765	3,349	4,221	3,237

[1] Preliminary.

[2] Included in Division VIa.

[3] Includes Scotland, England, Wales and NI landings

[4] includes the total Russian catch

n/a = not available.

Table 4.3.2. Details of Russian fleet operations in fishery for the haddock on the Rockall Bank (Division VIb) in 2009 (preliminary data).

Month	Tonnage class	Number of vessel/days	Catch of haddock, tonnes
			Total
September	9	7	55
Total			55

Table 4.3.3. Details of UK fleet operations in fishery for the haddock on the Rockall Bank (Division VIb) in 2009 (preliminary data).

Month	Country	Gear type	Catch in tonnes	
			Total	Catch per vessel/day
February	Scotland	OTB	147.6	18.5
March	Scotland	OTB	586.4	26.7
	Scotland	OTT	7.3	7.3
April	Scotland	OTB	1031.3	30.3
	Scotland	OTT	24.0	12.0
	Scotland	PTB	142.5	17.8
May	Scotland	OTB	315.5	12.1
	Scotland	OTT	40.1	8.0
	Scotland	PTB	40.1	6.7
June	Scotland	OTB	149.6	8.8
	Scotland	OTT	69.7	7.0
July	Scotland	OTB	60.2	5.5
	Scotland	OTT	7.1	2.4
August	Scotland	OTB	52.4	7.5
September	Scotland	OTB	80.7	8.1
		OTT	10.9	10.9
October	Scotland	OTB	70.3	7.0
November	Scotland	OTB	52.1	7.4
		OTT	11.9	5.9
December	Scotland	OTB	53.7	17.9
Total			2951.3	

OTB – bottom otter trawl, OTT – otter twin trawl, PTB – bottom pair trawl, SSC – Scottish seines.

Table 4.3.4. Details of Irish fleet operations in fishery for the haddock on the Rockall Bank (Otter Trawl. Division VIb) in 1995–2009 (preliminary data).

Year	Landings (t)	Effort (hr*1000)	LPUE (kg/h)
1995	839.99	9.14	91.88
1996	866.66	7.22	120.05
1997	830.99	7.17	115.91
1998	646.08	7.46	86.59
1999	973.64	8.68	112.17
2000	706.23	9.88	71.46
2001	300.47	7.24	41.48
2002	178.34	2.63	67.91
2003	155.93	4.56	34.23
2004	19.00	2.23	8.50
2005	103.54	3.84	26.93
2006	39.02	5.90	6.61
2007	340.84	6.59	51.73
2008	698.29	9.74	71.69
2009	349.44	4.35	80.26

Table 4.3.5. Details of Scottish discard trips in the Rockall area (Newton *et al.*, 2003).

Trip no.	Date	Gear	No. of hauls	Hours fished	% (by weight) haddock landed of catch	% (by weight) discarded of haddock
1	May 85	Heavy Trawl	20	89.08	74	17.3
2	Jun 85	Heavy Trawl	28	127.17	74	18.6
3	Jun 99	Heavy Trawl	21	110.83	41	74.9
4	Apr 01	Heavy Trawl	11	47.33	96	12.4
5	Jun 01	Heavy Trawl	35	163.58	58	47.5
6	Aug 01	Heavy Trawl	26	130.08	31	69.7

Table 4.3.6. Landings and Discards haddock estimates at Rockall from discard observer trips conducted aboard Irish vessels between 1995 and 2001, and from an observer trip aboard the MFV (February–March 2000). (ICES CM 2004/ACFM:33).

	FAT/ KBG/ 00/4	FAT/ KBG/ 01/12	FAT/ KBG/ 95/1	FAT/ KBG/ 95/2	FAT/ KBG/ 97/7	FAT/ KBG/ 97/8	FAT/ KBG/ 98/4	Feb 2000	Discard rate
Landing	3021	942	12727	6893	14258	25866	23805	4400	
Discards	1864	926	1146	1893	6625	17926	3687	6200	
% discarded	38.16	49.57	8.26	21.54	31.72	40.90	13.40	58.49	27%

Table 4.3.7. Discards and retained catch haddock (number per trip) by Irish discard trips in the Rockall area in 2007–2009.

Year	2007		2008		2009	
Length (cm)	Discards	Retained Catch	Discards	Retained Catch	Discards	Retained Catch
19	1.3					
22	1.6		14.8			
23	4.6		66.2			
24	7.3		183.8			
25	22.7		576.9		15.6	
26	54.2		1424.9		30.4	
27	104.6		3024.6		25.2	
28	256.9		6274.7		228.2	
29	386.5	7.9	7193.3		180.6	
30	533.4	17.6	7813.5	13.9	573.2	9.9
31	462.6	47.2	7573.7	40.6	1338.1	9.9
32	298.8	88.3	4639.0	77.8	1762.8	57.8
33	227.3	99.4	3664.7	126.8	2256.5	235.9
34	120.8	139.2	2391.8	277.4	1496.5	397.3
35	78.3	118.8	1590.1	503.6	656.6	614.8
36	27.4	187.0	871.7	580.5	423.5	567.1
37	26.1	139.8	280.3	640.9	66.9	526.8
38	24.3	142.7	78.3	581.9	57.4	421.4
39	3.4	162.5	206.6	443.0	23.1	346.9
40	8.7	119.4	37.5	535.6		281.4
41	1.3	133.8	5.2	310.7		197.9
42	4.6	133.1	5.2	334.7		155.7
43	3.2	109.3		333.5		195.1
44		118.6		291.1		201.7
45		97.9		253.6		149.9
>45 cm		574.5	0.0	1791.2	0.0	1001.7
Total	2659.9	2436.9	47916.8	7136.8	9134.4	5371.3
Discard rate, %	52.2		87.0		63.0	

Table 4.3.8. Haddock in VIb. Old tuning data available from the Scottish groundfish survey conducted in September.

HADDOCK WGNSDS 2008 ROCKALL
101
SCOGFS (Numbers per 10 hours fishing at Rockall)
1991 2009
1 1 0.66 0.75
0 6

1	14458	16398	4431	683	315	228	37	64	3
1	20336	44912	14631	3150	647	127	200	4	32
1	15220	37959	15689	3716	1104	183	38	73	21
1	23474	13287	11399	4314	969	203	30	12	4
1	16923	16971	6648	5993	1935	483	200	16	0
1	33578	19420	5903	1940	1317	325	69	6	1
1	28897	10693	2384	538	292	281	71	9	1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	10178	9969	2410	708	279	172	90	64	32
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	31813	7455	521	284	154	39	14	12	14
1	11704	20925	2464	173	105	65	20	10	15
1	2526	10114	10927	1656	138	97	100	26	6
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	24452	4082	920	1506	2107	231	33	13	7
1	3570	18715	2562	256	1402	1694	349	16	6
1	558	2671	6019	570	254	516	367	28	2
1	85	560	966	3813	182	41	282	249	49
1	132	139	323	488	1651	40	9	54	17

Table 4.3.9. Haddock in VIb. Standardized tuning data available from the Scottish groundfish survey conducted in September.

HADDOCK WGCSE 2010 ROCKALL
101
SCOGFS
1991 2009

1	1	0.66	0.75						
0	6								
1	14838	16830	4548	701	323	234	38	66	2
1	10347	22748	7489	1614	331	65	103	2	16
1	16268	36664	15653	3867	1156	193	40	76	22
1	22921	12509	10893	4210	956	200	31	13	3
1	17650	16775	6011	5155	1699	430	176	14	-1
1	33586	19424	5908	1945	1324	329	69	6	1
1	28910	10697	2395	544	299	295	76	11	1
-1	-1	-1	-1	-1	-1	-1	-1	-1	
1	10138	8773	2372	706	265	169	94	60	21
-1	-1	-1	-1	-1	-1	-1	-1	-1	
1	31808	7425	520	285	154	39	14	12	4
1	11703	20925	2463	172	105	65	20	10	15
1	2526	10114	10928	1656	138	97	101	26	6
-1	-1	-1	-1	-1	-1	-1	-1	-1	
1	24450	4078	920	1509	2105	233	35	12	8
1	1675	8890	1561	158	815	973	200	10	5
1	558	2671	6019	570	254	516	367	28	-1
1	84	222	378	3401	1217	371	164	76	82
1	134	125	286	445	1546	38	8	54	17

Table 4.3.10. Details of Scottish and Irish effort (in hours) in 1985–2009 (preliminary data)

	Scottish fleet			Irish fleet
Year	SCOTRL*	SCOLTR*	SCOSEI*	IROTB*
1985	8421	3081	1677	
1986	7465	4783	507	
1987	8786	9737	402	
1988	12450	5521	261	
1989	10161	11946	1411	
1990	3249	5335	4552	
1991	2995	11464	6733	
1992	2402	9623	3948	
1993	1632	11540	1756	
1994	2305	15543	399	
1995	1789	13517	1383	9142
1996	1627	17324	952	7219
1997	563	16096	1061	7169
1998	1332	12263	456	7461
1999	11336	9424	456	8680
2000	12951	8586	80	9883
2001	7838	1037	42	7244
2002	8304	1100	0	2626
2003	15000	500	50	4618
2004	15200	300	50	2070
2005	7788	32	0	2693
2006	9990	231	0	5903
2007	4534	319	44	6589
2008	2497	1016	82	9740
2009	NA	NA	NA	4354

SCOTRL* – Scottish Heavy Trawl , SCOLTR* – Scottish Light Trawl , SCOSEI* – Scottish Seine, IROTB* – Irish bottom otter trawl.

Table 4.3.11. Haddock in VIb International landings, discards and total catch.

	Num (*1000)			Weight, tonnes		
Year	Landings	Discards	Total Catch1	Landings	Discards	Total Catch[1]
1991	12302	65832	78134	5656	13228	18884
1992	11418	55964	67383	5321	11871	17192
1993	8767	44656	53423	4781	9853	14634
1994	11400	46628	58028	5732	11023	16755
1995	11784	35467	47251	5587	9168	14756
1996	14066	41506	55572	7072	9356	16428
1997	9965	26980	36945	5167	5894	11061
1998	9034	47831	56865	4986	10862	15848
1999	12930	52881	65811	5356	11062	16418
2000	15999	26033	42031	5444	6609	12053
2001	5361	9222	14583	2123	1535	3658
2002	11167	21899	33066	3117	4152	7270
2003	24409	25087	49496	5969	5521	11490
2004	22705	3989	26694	6437	883	7321
2005	19505	1877	21382	5191	505	5696
2006	9605	1667	11272	2756	386	3142
2007	8936	12261	21197	3348	2242	5590
2008	10209	7603	17812	4221	2100	6320
2009	6709	4765	11474	3237	1557	4794

[1] Landings and discards.

Table 4.3.12. Haddock in VIb. International catch (landings and discards) numbers (*10[3])-at-age.

At 16/05/2010 13:00

Terminal Fs derived using XSA (With F shrinkage)

Catch number at age (start of year) Numbers*10**-3

	YEAR	1991	1992	1993	1994	1995	1996	1997
	AGE							
	1	21186	16084	11178	8170	2749	12096	9957
	2	33847	24711	19375	20623	9831	18811	10535
	3	15189	18584	15494	17868	21584	10911	5388
	4	5341	5361	4938	8209	9756	9612	4098
	5	1704	1761	1617	2449	2464	3299	5002
	6	346	676	461	476	787	751	1758
	+gp	522	206	359	232	79	92	206
0	TOT/	78134	67383	53423	58028	47251	55572	36945

Catch number at age (start of year) Numbers*10**-3

	YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	AGE												
	1	14224	17282	8222	7667	13363	6576	932	1061	2880	1491	476	223
	2	19807	21949	12581	1961	11119	23606	4112	3723	1475	9829	2207	707
	3	10173	12203	10697	1815	4536	14559	10282	7420	1626	3605	11437	1237
	4	4763	5499	4917	1018	2445	2063	9212	8124	2414	1503	1291	8046
	5	3740	3419	2050	1038	898	1285	1386	753	2291	2213	507	495
	6	2767	2684	1498	484	260	925	296	109	436	1816	964	263
	+gp	1391	2776	2066	601	444	483	474	193	151	741	930	504
0	TOT/	56865	65811	42031	14583	33066	49496	26694	21382	11273	21197	17812	11474

Table 4.3.13. Haddock in VIb. International landings numbers (*10[3])-at-age.

Run title : HADDOCK LANDISC 2007 ROCKALL

At 16/05/2010 13:00

Terminal Fs derived using XSA (With F shrinkage)

Landings number at age (start of year) Numbers*10**-3

	YEAR	1991	1992	1993	1994	1995	1996	1997
	AGE							
	1	87	86	28	30	1	2	0
	2	6807	3642	1919	1160	146	5149	319
	3	3011	5624	4740	5299	5205	1861	2102
	4	1344	964	1157	3665	4791	4149	2155
	5	558	580	489	1040	1319	2347	3658
	6	32	364	144	66	279	473	1540
	+gp	464	160	290	141	43	85	192
0	TOT/	12302	11418	8767	11400	11784	14066	9965

Landings number at age (start of year) Numbers*10**-3

	YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	AGE												
	1	4	245	33	399	657	920	197	887	2344	31	17	5
	2	392	2600	3445	941	2983	8103	1765	2835	768	1220	749	11
	3	1815	2994	5081	1232	3998	11001	9502	6866	1290	2709	6191	244
	4	1340	1972	3006	752	2111	1846	9119	7913	2356	1074	1164	5243
	5	1898	1228	1295	988	809	1188	1364	725	2269	1539	479	460
	6	2284	1600	1176	470	217	878	286	98	428	1623	761	261
	+gp	1301	2291	1963	579	392	475	472	182	150	740	848	486
0	TOT/	9034	12930	15999	5361	11167	24409	22705	19505	9605	8936	10209	6709

Table 4.3.14. Haddock in VIb. International discards numbers (*10³)-at-age.

Run title : HADDOCK LANDISC 2007 ROCKALL

At 16/05/2010 13:00

Terminal Fs derived using XSA (With F shrinkage)

Discards number at age (start of year) Numbers*10**-3

	YEAR	1991	1992	1993	1994	**1995***	1996	**1997***
	AGE							
	1	21099	15998	11151	8140	**2748**	12094	**9957**
	2	27040	21069	17456	19464	**9685**	13662	**10216**
	3	12178	12961	10755	12570	**16379**	9051	**3286**
	4	3998	4397	3781	4545	**4965**	5463	**1944**
	5	1146	1181	1128	1409	**1145**	952	**1344**
	6	313	312	317	410	**508**	278	**218**
	+gp	58	46	69	91	**36**	7	**15**
0	TOT/	65832	55964	44656	46628	**35467**	41506	**26980**

Discards number at age (start of year) Numbers*10**-3

	YEAR	1998	**1999***	2000	**2001***	2002	2003	2004	2005	2006	2007	2008	2009
	AGE												
	1	14220	**17037**	8189	**7268**	12706	5655	735	174	536	1459	458	218
	2	19415	**19348**	9136	**1019**	8136	15503	2346	888	707	8610	1458	696
	3	8357	**9209**	5616	**583**	539	3558	781	554	336	896	5246	993
	4	3423	**3526**	1912	**266**	334	217	93	210	58	429	128	2803
	5	1842	**2191**	755	**50**	89	97	22	28	22	674	28	35
	6	483	**1084**	322	**15**	43	48	10	11	8	193	203	2
	+gp	91	**485**	103	**21**	51	8	2	11	1	0	82	18
0	TOT/	47831	**52881**	26033	**9222**	21899	25087	3989	1877	1667	12261	7603	4765

*** data calculated using estimates from discard observer trips.**

Table 4.3.15. Haddock in VIb. International catch (landings and discards) weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.142	0.240	0.291	0.378	0.469	0.414	0.679
1992	0.133	0.239	0.318	0.362	0.423	0.567	0.844
1993	0.137	0.238	0.334	0.400	0.493	0.503	0.874
1994	0.153	0.233	0.319	0.420	0.469	0.477	0.721
1995	0.118	0.222	0.309	0.401	0.501	0.460	0.843
1996	0.136	0.278	0.314	0.395	0.553	0.575	0.763
1997	0.136	0.240	0.322	0.382	0.512	0.634	0.944
1998	0.141	0.250	0.308	0.354	0.436	0.546	0.662
1999	0.138	0.208	0.272	0.334	0.379	0.483	0.618
2000	0.189	0.250	0.267	0.321	0.382	0.451	0.707
2001	0.133	0.257	0.320	0.416	0.432	0.521	0.713
2002	0.135	0.239	0.237	0.325	0.509	0.580	0.753
2003	0.153	0.203	0.256	0.350	0.384	0.424	0.753
2004	0.147	0.198	0.244	0.294	0.444	0.609	0.753
2005	0.114	0.197	0.235	0.311	0.459	0.600	0.806
2006	0.093	0.198	0.245	0.329	0.441	0.595	0.787
2007	0.114	0.186	0.266	0.296	0.387	0.497	0.569
2008	0.199	0.241	0.291	0.437	0.571	0.669	0.932
2009	0.248	0.288	0.339	0.391	0.668	0.513	1.005

Table 4.3.16. Haddock in VIb. International landings weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.302	0.402	0.444	0.592	0.724	0.963	0.704
1992	0.136	0.366	0.455	0.658	0.612	0.759	0.954
1993	0.305	0.402	0.503	0.701	0.830	0.820	0.972
1994	0.314	0.356	0.452	0.558	0.638	1.224	0.890
1995	0.377	0.311	0.414	0.479	0.640	0.699	1.236
1996	0.327	0.436	0.501	0.487	0.627	0.709	0.783
1997	-	0.315	0.401	0.444	0.564	0.661	0.973
1998	0.256	0.344	0.494	0.517	0.542	0.591	0.678
1999	0.274	0.338	0.390	0.440	0.505	0.601	0.665
2000	0.272	0.404	0.379	0.407	0.473	0.513	0.740
2001	0.274	0.426	0.383	0.518	0.426	0.518	0.677
2002	0.240	0.422	0.416	0.541	0.565	0.649	0.818
2003	0.100	0.164	0.246	0.351	0.388	0.423	0.758
2004	0.142	0.172	0.241	0.293	0.446	0.617	0.754
2005	0.103	0.184	0.230	0.310	0.461	0.614	0.824
2006	0.084	0.167	0.223	0.327	0.440	0.598	0.789
2007	0.096	0.238	0.275	0.322	0.450	0.523	0.570
2008	0.125	0.197	0.302	0.444	0.583	0.752	0.984
2009	0.300	0.346	0.420	0.416	0.692	0.512	1.020

Table 4.3.17. Haddock in VIb. International discards weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.142	0.199	0.253	0.306	0.345	0.358	0.478
1992	0.133	0.217	0.258	0.298	0.330	0.342	0.464
1993	0.137	0.220	0.260	0.307	0.346	0.359	0.462
1994	0.153	0.226	0.263	0.308	0.345	0.356	0.458
1995	0.118	0.220	0.276	0.325	0.341	0.329	0.379
1996	0.136	0.218	0.276	0.326	0.370	0.348	0.524
1997	0.136	0.238	0.272	0.312	0.372	0.442	0.568
1998	0.141	0.248	0.267	0.291	0.327	0.336	0.436
1999	0.139	0.212	0.255	0.288	0.313	0.318	0.410
2000	0.189	0.267	0.289	0.311	0.330	0.334	0.462
2001	0.135	0.247	0.294	0.344	0.412	0.440	0.495
2002	0.137	0.254	0.308	0.335	0.398	0.338	0.367
2003	0.161	0.223	0.287	0.342	0.337	0.440	0.510
2004	0.148	0.218	0.282	0.343	0.324	0.371	0.469
2005	0.171	0.240	0.298	0.357	0.387	0.473	0.506
2006	0.132	0.233	0.334	0.420	0.495	0.435	0.435
2007	0.115	0.179	0.239	0.232	0.244	0.280	0.406
2008	0.202	0.264	0.279	0.370	0.351	0.358	0.392
2009	0.247	0.287	0.319	0.343	0.360	0.662	0.593

Table 4.3.18. Haddock VIb. Stock weights-at-age (kg).

	1	2	3	4	5	6	7
1991	0.142	0.240	0.291	0.378	0.469	0.414	0.679
1992	0.133	0.239	0.318	0.362	0.423	0.567	0.844
1993	0.137	0.238	0.334	0.400	0.493	0.503	0.874
1994	0.153	0.233	0.319	0.420	0.469	0.477	0.721
1995	0.118	0.222	0.309	0.401	0.501	0.460	0.843
1996	0.136	0.278	0.314	0.395	0.553	0.575	0.763
1997	0.136	0.240	0.322	0.382	0.512	0.634	0.944
1998	0.141	0.250	0.308	0.354	0.436	0.546	0.662
1999	0.138	0.208	0.272	0.334	0.379	0.483	0.618
2000	0.189	0.250	0.267	0.321	0.382	0.451	0.707
2001	0.133	0.257	0.320	0.416	0.432	0.521	0.713
2002	0.135	0.239	0.237	0.325	0.509	0.580	0.753
2003	0.153	0.203	0.256	0.350	0.384	0.424	0.753
2004	0.147	0.198	0.244	0.294	0.444	0.609	0.753
2005	0.114	0.197	0.235	0.311	0.459	0.600	0.806
2006	0.093	0.198	0.245	0.329	0.441	0.595	0.787
2007	0.114	0.186	0.266	0.296	0.387	0.497	0.569
2008	0.199	0.241	0.291	0.437	0.571	0.669	0.932
2009	0.248	0.288	0.339	0.391	0.668	0.513	1.005

Table 4.3.19. Regression statistics. Old survey indexes. Run to year 2008.

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log
1	0.61	3.239	5.19	0.84	15	0.28	-1.48
2	0.68	2.07	4.77	0.77	15	0.37	-2.04
3	0.57	4.136	5.79	0.88	15	0.25	-2.51

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.67	1.763	4.76	0.69	15	0.41	-2.58
5	0.88	0.566	3.42	0.62	15	0.52	-2.72
6	0.98	0.294	2.82	0.95	15	0.21	-2.72
1							

Table 4.3.20. Regression statistics. Standardized survey indexes. Run to year 2008.

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.53	3.671	6.02	0.83	15	0.29	-1.64
2	0.54	4.036	6.09	0.86	15	0.25	-2.21
3	0.49	5.4	6.47	0.89	15	0.2	-2.61

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.6	2.926	5.26	0.8	15	0.27	-2.56
5	0.98	0.1	2.72	0.57	15	0.51	-2.57
6	1.04	-0.536	2.43	0.94	15	0.22	-2.62

Table 4.3.21. XSA diagnostics in assessment of Haddock in VIb. Exploratory runs with standardized survey index.

Lowestoft VPA Version 3.1

14/05/2010 20:40

Extended Survivors Analysis

HADDOCK LANDISC 2009 ROCKALL

CPUE data from file had6b.tun

Catch data for 19 years. 1991 to 2009. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SCOGFS	1991	2009	0	6	0.66	0.75

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 10 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 5

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 4 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 29 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.387	0.118	0.15	0.173	0.075	0.047	0.043	0.081	0.051	0.031
2	0.851	0.148	0.251	0.429	0.156	0.476	0.085	0.202	0.166	0.1
3	1.022	0.27	0.598	0.609	0.336	0.464	0.394	0.306	0.383	0.132
4	1.233	0.232	0.714	0.607	1.044	0.486	0.267	0.787	0.171	0.512
5	1.231	0.986	0.33	1.103	1.156	0.203	0.243	0.42	0.68	0.091
6	1.272	1.204	0.724	0.676	0.838	0.235	0.173	0.309	0.326	0.958

Table 4.3.21 cont.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2000	2.83E+04	2.43E+04	1.85E+04	7.67E+03	3.20E+03	2.30E+03
2001	7.61E+04	1.58E+04	8.48E+03	5.44E+03	1.83E+03	7.65E+02
2002	1.06E+05	5.54E+04	1.11E+04	5.30E+03	3.53E+03	5.59E+02
2003	4.58E+04	7.48E+04	3.53E+04	5.01E+03	2.12E+03	2.08E+03
2004	1.43E+04	3.15E+04	3.98E+04	1.57E+04	2.24E+03	5.77E+02
2005	2.57E+04	1.09E+04	2.21E+04	2.33E+04	4.53E+03	5.76E+02
2006	7.57E+04	2.01E+04	5.52E+03	1.14E+04	1.17E+04	3.03E+03
2007	2.11E+04	5.94E+04	1.51E+04	3.05E+03	7.13E+03	7.54E+03
2008	1.06E+04	1.59E+04	3.97E+04	9.10E+03	1.14E+03	3.83E+03
2009	8.19E+03	8.25E+03	1.11E+04	2.22E+04	6.28E+03	4.71E+02

Estimated population abundance at 1st Jan 2010

0.00E+00	6.50E+03	6.11E+03	7.93E+03	1.09E+04	4.69E+03

Taper weighted geometric mean of the VPA populations:

4.68E+04	3.74E+04	2.29E+04	1.10E+04	4.45E+03	1.69E+03

Standard error of the weighted Log(VPA populations) :

0.8212	0.7205	0.619	0.5841	0.6538	0.8684

1

Log catchability residuals.

Fleet : SCOGFS

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.26	-0.12	-0.01	0.01	0.25	0.39	-0.1	99.99	0.31
2	-0.34	0.07	0.42	-0.03	0.19	0.35	-0.16	99.99	-0.14
3	-0.3	-0.1	0.39	0.2	0.06	0.04	-0.45	99.99	-0.08
4	-0.17	-0.08	0.51	0.47	0.67	-0.05	-1.13	99.99	-0.37
5	0.25	-0.46	0.71	-0.33	0.88	0.09	-0.64	99.99	-0.29
6	0.07	0.12	0.03	-0.06	0.14	-0.1	-0.34	99.99	-0.11

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	99.99	-0.37	-0.14	0.32	99.99	0.36	-0.3	0.34	-0.31	-0.37
2	99.99	-0.29	-0.5	0.24	99.99	0.6	0.15	-0.02	-0.5	-0.05
3	99.99	0.11	-0.32	-0.12	99.99	0.23	0.24	-0.04	0.09	0.05
4	99.99	-0.81	-0.82	-0.57	99.99	0.53	0.15	0.66	0.7	0.29
5	99.99	-0.38	-0.99	0.46	99.99	-0.05	0.45	0.44	2.13	-2.27
6	99.99	-0.38	-0.05	0.22	99.99	0.14	0.18	-0.03	-0.15	-0.63

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6
Mean Log	-2.4536	-2.63	-2.63
S.E(Log q	0.5981	0.9524	0.2374

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.54	4.972	5.96	0.89	16	0.3	-1.76
2	0.64	3.267	5.21	0.86	16	0.33	-2.23
3	0.59	4.466	5.6	0.9	16	0.23	-2.59

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.79	1.051	3.86	0.65	16	0.47	-2.45
5	2.33	-1.616	-5.04	0.1	16	2.1	-2.63
6	0.94	0.94	2.98	0.94	16	0.22	-2.69

Table 4.3.21 cont.

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2008

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimatec F
SCOGFS	4482	0.362	0	0	1	0.717	0.044
P shrinka	37378	0.72				0.186	0.005
F shrinka	3527	1				0.097	0.056

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
6502	0.31	0.65	3	2.111	0.031

1

Age 2 Catchability dependent on age and year class strength

Year class = 2007

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimatec F
SCOGFS	5072	0.255	0.134	0.52	2	0.789	0.119
P shrinka	22901	0.62				0.152	0.028
F shrinka	2434	1				0.058	0.233

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
6113	0.23	0.36	4	1.571	0.1

Age 3 Catchability dependent on age and year class strength

Year class = 2006

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimatec F
SCOGFS	8027	0.187	0.223	1.19	3	0.851	0.13
P shrinka	10989	0.58				0.111	0.097
F shrinka	2350	1				0.038	0.389

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
7934	0.18	0.2	5	1.111	0.132

Table 4.3.21. cont.

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimatec F
SCOGFS	10703	0.178	0.113	0.64	4	0.925	0.519
F shrinka	13516	1				0.075	0.431

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
10892	0.18	0.1	5	0.551	0.512

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimatec F
SCOGFS	5109	0.174	0.294	1.69	5	0.95	0.084
F shrinka	942	1				0.05	0.389

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
4693	0.17	0.31	6	1.776	0.091

1

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2003

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimatec F
SCOGFS	109	0.233	0.32	1.37	5	0.85	1.16
F shrinka	852	1				0.15	0.246

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
148	0.25	0.44	6	1.785	0.958

Table 4.3.22 Haddock in VIb. Exploratory runs with standardized survey indices. Summary tables.

Run title : HADDOCK LANDISC 2004 ROCKALL

At 14/05/2010 20:41

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE									
1	0.2395	0.1763	0.1046	0.1404	0.0506	0.2404	0.1663	0.2429	0.4975
2	0.6045	0.4869	0.3337	0.2858	0.2503	0.5689	0.3413	0.579	0.7302
3	0.8944	0.8137	0.6547	0.5909	0.5497	0.4872	0.3121	0.6533	0.8919
4	0.9229	0.9761	0.5237	0.9121	0.7705	0.5084	0.3397	0.5034	0.9381
5	0.5677	0.9437	0.9402	0.5394	0.7898	0.653	0.5468	0.5994	0.8525
6	0.5893	0.4622	0.6974	0.8236	0.3295	0.5937	0.9156	0.6766	1.2715
+gp	0.5893	0.4622	0.6974	0.8236	0.3295	0.5937	0.9156	0.6766	1.2715
0 FBAR 2	0.7474	0.8051	0.6131	0.5821	0.5901	0.5544	0.385	0.5838	0.8531

Table 8 Fishing mortality (F) at age

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR **-**
AGE											
1	0.3866	0.118	0.1499	0.1729	0.0748	0.0467	0.0429	0.0812	0.0508	0.0305	0.0542
2	0.8514	0.1479	0.2509	0.4292	0.1556	0.4764	0.0847	0.2019	0.166	0.0996	0.1558
3	1.0221	0.27	0.5984	0.609	0.3357	0.464	0.394	0.3065	0.3827	0.1319	0.2737
4	1.233	0.2316	0.7136	0.6071	1.0442	0.4861	0.2673	0.7873	0.1706	0.5119	0.49
5	1.2315	0.9864	0.3296	1.1033	1.1562	0.203	0.2428	0.4203	0.6797	0.0912	0.3971
6	1.2724	1.2042	0.7235	0.6763	0.8377	0.2347	0.1734	0.3094	0.3258	0.9585	0.5312
+gp	1.2724	1.2042	0.7235	0.6763	0.8377	0.2347	0.1734	0.3094	0.3258	0.9585	
0 FBAR 2	1.0845	0.409	0.4731	0.6871	0.6729	0.4074	0.2472	0.429	0.3498	0.2086	

Table 4.3.22. cont.

Run title : HADDOCK LANDISC 2010 ROCKALL

At 14/05/2010 20:41

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE									
1	109945	109958	124345	68946	61567	62555	71834	72897	48729
2	82461	70846	75473	91690	49056	47919	40270	49803	46813
3	28398	36887	35645	44261	56409	31269	22211	23438	22854
4	9795	9506	13385	15164	20070	26653	15728	13310	9985
5	4347	3186	2933	6491	4987	7604	13125	9168	6587
6	858	2017	1015	938	3099	1853	3240	6220	4122
+gp	1281	610	781	451	308	224	374	3087	4169
0 TOTAl	237084	233012	253576	227940	195495	178076	166783	177924	143259

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 91-**	AMS
AGE													
1	28342	76112	106080	45772	14290	25683	75748	21121	10600	8188	0	56592	66113
2	24258	15765	55378	74759	31525	10856	20068	59412	15944	8248	6502	42952	49785
3	18467	8477	11133	35279	39848	22090	5519	15095	39748	11057	6113	23140	26899
4	7669	5441	5298	5011	15710	23321	11372	3048	9097	22195	7934	10662	12380
5	3200	1830	3533	2125	2235	4527	11743	7126	1135	6279	10892	4728	5573
6	2299	765	559	2081	577	576	3026	7542	3832	471	4693	1739	2399
+gp	3102	928	940	1072	909	1014	1045	3055	3672	887	426		
0 TOTAl	87338	109317	182921	166098	105095	88068	128521	116399	84029	57325	36561		
1													

Table 4.3.22. cont.

Run title : HADDOCK LANDISC 2010 ROCKALL
At 14/05/2010 20:41
Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECI Age 1	TOTALBI	TOTSPBI	LANDINC	YIELD/SSI	FBAR 2- 5
1991	109945	50632	15230	5655	0.3713	0.7474
1992	109958	49734	18178	5320	0.2926	0.8051
1993	124345	54896	19898	4784	0.2404	0.6131
1994	68946	56217	24305	5733	0.2359	0.5821
1995	61567	47817	29662	5587	0.1884	0.5901
1996	62555	47617	25788	7075	0.2744	0.5544
1997	71834	41722	22288	5166	0.2318	0.385
1998	72897	44097	21368	4984	0.2332	0.5838
1999	48729	33077	16615	5221	0.3142	0.8531
2000	28342	23266	11845	4558	0.3848	1.0845
2001	76112	21001	6827	1918	0.2809	0.409
2002	106080	34747	7191	2571	0.3575	0.4731
2003	45772	35470	13290	5961	0.4485	0.6871
2004	14290	24713	16370	6400	0.3909	0.6729
2005	25683	20724	15658	5191	0.3315	0.4074
2006	75748	23913	12895	2759	0.214	0.2472
2007	21121	26620	13162	3348	0.2544	0.429
2008	10600	28128	22176	4205	0.1896	0.3498
2009	8188	22160	17754	3173	0.1787	0.2086
Arith. Mean	60143	36134	17395	4716	0.2849	0.5622
0 Units	(Thousan	(Tonnes)	(Tonnes)	(Tonnes)		

Table 4.3.23. XSA diagnostics in assessment of Haddock in VIb. Final run with old survey indices.

Lowestoft VPA Version 3.1

4/06/2010 9:33

Extended Survivors Analysis

HADDOCK LANDISC 2004 ROCKALL

CPUE data from file had6b.tun

Catch data for 19 years. 1991 to 2009. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SCOGFS	1991	2009	0	6	0.66	0.75

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 10 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 5

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 4 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 180 iterations

Total absolute residual between iterations
179 and 180 = .01111

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.038	0.0975	0.1319	0.423	0.214	0.9048
Iteration **	0.0377	0.097	0.1313	0.4226	0.2086	0.901

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.385	0.111	0.144	0.152	0.075	0.067	0.039	0.081	0.05	0.038
2	0.844	0.147	0.232	0.409	0.134	0.474	0.125	0.184	0.165	0.097
3	1.01	0.266	0.593	0.541	0.313	0.38	0.391	0.504	0.337	0.131
4	1.218	0.227	0.697	0.597	0.809	0.437	0.203	0.777	0.338	0.423
5	1.208	0.952	0.32	1.041	1.11	0.133	0.209	0.29	0.661	0.209
6	1.304	1.132	0.667	0.645	0.725	0.217	0.106	0.255	0.198	0.901

Table 4.3.23 cont.

1
XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2000	2.85E+04	2.44E+04	1.86E+04	7.72E+03	3.23E+03	2.27E+03
2001	8.09E+04	1.59E+04	8.58E+03	5.55E+03	1.87E+03	7.90E+02
2002	1.10E+05	5.93E+04	1.12E+04	5.38E+03	3.62E+03	5.91E+02
2003	5.15E+04	7.78E+04	3.85E+04	5.07E+03	2.20E+03	2.15E+03
2004	1.43E+04	3.62E+04	4.23E+04	1.84E+04	2.28E+03	6.35E+02
2005	1.82E+04	1.09E+04	2.59E+04	2.54E+04	6.70E+03	6.16E+02
2006	8.23E+04	1.39E+04	5.55E+03	1.45E+04	1.34E+04	4.80E+03
2007	2.12E+04	6.48E+04	1.01E+04	3.07E+03	9.71E+03	8.90E+03
2008	1.09E+04	1.60E+04	4.41E+04	4.98E+03	1.16E+03	5.94E+03
2009	6.65E+03	8.46E+03	1.11E+04	2.58E+04	2.91E+03	4.89E+02

Estimated population abundance at 1st Jan 2010

0.00E+00	5.27E+03	6.32E+03	8.01E+03	1.39E+04	1.98E+03

Taper weighted geometric mean of the VPA populations:

4.63E+04	3.75E+04	2.30E+04	1.11E+04	4.64E+03	1.93E+03

Standard error of the weighted Log(VPA populations) :

0.8688	0.7471	0.6533	0.6353	0.69	0.9267

1

Log catchability residuals.

Fleet : SCOGFS

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.33	0.26	0.01	-0.03	0.2	0.34	-0.19	99.99	0.3
2	-0.44	0.54	0.46	0.01	0.22	0.32	-0.29	99.99	-0.24
3	-0.38	0.27	0.37	0.23	0.2	0.01	-0.55	99.99	-0.14
4	-0.17	0.62	0.4	0.49	0.83	0	-1.11	99.99	-0.28
5	-0.13	0.29	0.73	-0.36	1.03	0.18	-0.54	99.99	-0.13
6	0.07	0.21	0	-0.09	0.14	-0.14	-0.34	99.99	-0.07

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	99.99	-0.55	-0.21	0.11	99.99	0.57	-0.04	0.16	-0.13	-0.48
2	99.99	-0.57	-0.71	0.2	99.99	0.39	0.71	-0.17	-0.12	-0.32
3	99.99	-0.04	-0.48	-0.27	99.99	-0.01	0.39	0.36	0.05	-0.01
4	99.99	-0.78	-0.81	-0.54	99.99	0.46	0.45	0.69	-0.43	0.19
5	99.99	-0.29	-0.89	0.52	99.99	-0.37	0.98	0.18	0.03	-1.23
6	99.99	-0.33	-0.01	0.29	99.99	0.13	0.36	-0.1	0	-0.46

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6
Mean Log	-2.4997	-2.7645	-2.7645
S.E(Log q	0.605	0.6314	0.2276

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.6	4.267	5.24	0.89	16	0.32	-1.58
2	0.73	1.911	4.33	0.79	16	0.44	-2.07
3	0.65	3.023	5.13	0.84	16	0.31	-2.5

Ages with q independent of year class strength and constant w.r.t. time.

Table 4.3.23 cont.

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2008

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	3233	0.393	0	0	1	0.69	0.06
P shrinka	37472	0.75				0.199	0.005
F shrinka	3298	1				0.111	0.059

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
5273	0.33	0.77	3	2.349	0.038

1

Age 2 Catchability dependent on age and year class strength

Year class = 2007

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	5178	0.291	0.092	0.32	2	0.756	0.117
P shrinka	23026	0.65				0.171	0.027
F shrinka	2381	1				0.073	0.238

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
6316	0.26	0.38	4	1.472	0.097

Age 3 Catchability dependent on age and year class strength

Year class = 2006

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	8222	0.21	0.074	0.35	3	0.836	0.128
P shrinka	11120	0.64				0.117	0.096
F shrinka	2235	1				0.047	0.406

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
8010	0.2	0.16	5	0.804	0.131

Table 4.3.23 cont.

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	13927	0.2	0.061	0.3	4	0.919	0.421
F shrinka	13102	1				0.081	0.442

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
13859	0.2	0.05	5	0.256	0.423

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	2079	0.201	0.345	1.72	5	0.916	0.195
F shrinka	1165	1				0.084	0.325

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
1980	0.2	0.3	6	1.505	0.209

1

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2003

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SCOGFS	125	0.235	0.177	0.75	5	0.857	1.064
F shrinka	817	1				0.143	0.255

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
164	0.25	0.35	6	1.413	0.901

Table 4.3.24. Haddock in VIb. Final runs with old survey indices. Fishing mortality+at+age.

Run title : HADDOCK LANDISC 2010 ROCKALL

At 4/06/2010 9:34

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE									
1	0.238	0.1758	0.1048	0.14	0.0507	0.2401	0.1661	0.2422	0.4954
2	0.5889	0.4825	0.3323	0.2864	0.2495	0.5699	0.3407	0.5778	0.7266
3	0.8877	0.7718	0.6442	0.5871	0.5516	0.4849	0.3129	0.6515	0.8882
4	0.9072	0.9576	0.4742	0.8803	0.7608	0.5114	0.3373	0.5054	0.9322
5	0.3655	0.9037	0.8954	0.458	0.7287	0.6364	0.5523	0.5926	0.8594
6	0.5353	0.2404	0.6347	0.7356	0.2589	0.5093	0.8655	0.6894	1.2334
+gp	0.5353	0.2404	0.6347	0.7356	0.2589	0.5093	0.8655	0.6894	1.2334
0 FBAR 2	0.6873	0.7789	0.5865	0.553	0.5726	0.5506	0.3858	0.5818	0.8516

Table 8 Fishing mortality (F) at age

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR
AGE											
1	0.3847	0.1106	0.1445	0.1521	0.0746	0.0667	0.0394	0.0809	0.0496	0.0377	0.0561
2	0.8444	0.1469	0.2321	0.4085	0.134	0.4742	0.1245	0.1835	0.1653	0.097	0.1486
3	1.0099	0.2663	0.593	0.5409	0.3126	0.38	0.3911	0.504	0.3373	0.1313	0.3242
4	1.218	0.2267	0.6971	0.5972	0.8087	0.4371	0.203	0.7769	0.3378	0.4226	0.5125
5	1.2083	0.9516	0.3204	1.0406	1.1101	0.1326	0.2093	0.2903	0.6613	0.2086	0.3867
6	1.3039	1.1315	0.6673	0.6451	0.7252	0.2174	0.1057	0.2554	0.1975	0.901	0.4513
+gp	1.3039	1.1315	0.6673	0.6451	0.7252	0.2174	0.1057	0.2554	0.1975	0.901	
0 FBAR 2	1.0702	0.3979	0.4606	0.6468	0.5914	0.356	0.232	0.4387	0.3754	0.2149	
1											

Table 4.3.25 Haddock in VIb. Final runs with old survey indices. Stock number (*10³)-at-age.

Run title : HADDOCK LANDISC 2010 ROCKALL

At 4/06/2010 9:34

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE									
1	110559	110271	124127	69118	61492	62624	71921	73089	48886
2	84052	71349	75728	91512	49197	47858	40327	49875	46970
3	28530	38190	36056	44470	56263	31384	22161	23485	22912
4	9898	9615	14452	15501	20241	26534	15822	13269	10023
5	6150	3271	3021	7364	5263	7744	13027	9246	6554
6	921	3494	1085	1010	3814	2079	3355	6139	4185
+gp	1377	1060	835	487	380	252	388	3047	4236
0 TOT/	241489	237250	255304	229462	196649	178474	167002	178149	143765

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 91-**	AMST 91-**
AGE													
1	28453	80937	109783	51514	14339	18178	82314	21196	10855	6648	0	56520	66988
2	24387	15855	59328	77791	36226	10896	13923	64787	16005	8457	5273	43000	50592
3	18596	8582	11207	38513	42330	25939	5552	10065	44149	11107	6316	23132	27308
4	7717	5546	5384	5071	18358	25353	14523	3074	4978	25798	8010	11095	12964
5	3231	1869	3620	2195	2285	6695	13407	9707	1157	2907	13859	5176	6156
6	2272	790	591	2151	635	616	4801	8904	5945	489	1980	1959	2755
+gp	3064	961	995	1109	1002	1086	1660	3610	5708	922	470		
0 TOT/	87718	114540	190907	178344	115175	88765	136180	121342	88798	56328	35908		
1													

Table 4.3.26 Haddock in VIb. Final run with old survey indices. Summary table.

Run title : HADDOCK LANDISC 2004 ROCKALL

At 4/06/2010 9:34

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RE Age 1	TOTALE	TOTSPE	LANDIN	YIELD/S	FBAR 2-
1991	110559	52117	16245	5655	0.3481	0.6873
1992	110271	51603	19884	5320	0.2675	0.7789
1993	124127	55617	20589	4784	0.2324	0.5865
1994	69118	56880	24983	5733	0.2295	0.553
1995	61492	48391	30213	5587	0.1849	0.5726
1996	62624	47827	26005	7075	0.2721	0.5506
1997	71921	41803	22343	5166	0.2312	0.3858
1998	73089	44105	21331	4984	0.2336	0.5818
1999	48886	33219	16703	5221	0.3126	0.8516
2000	28453	23341	11867	4558	0.3841	1.0702
2001	80937	21797	6957	1918	0.2757	0.3979
2002	109783	36340	7340	2571	0.3503	0.4606
2003	51514	37897	14224	5961	0.4191	0.6468
2004	14339	27162	17881	6400	0.3579	0.5914
2005	18178	22484	18266	5191	0.2842	0.356
2006	82314	26625	16213	2759	0.1702	0.232
2007	21196	28290	13823	3348	0.2422	0.4387
2008	10855	30998	24981	4205	0.1683	0.3754
2009	6648	21056	16972	3173	0.187	0.2149
Arith. Mean	60858	37240	18254	4716	0.2711	0.5438
0 Units	(Thousar	(Tonnes	(Tonnes	(Tonnes)		
1						

Table 4.3.27 Haddock in VIb. Input data to short-term forecast (Data from final run with old survey indices).

MFDP version 1a
Run: had10
Time and date: 19:08 04,06,2010
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2010

Age	N	M	Mat	PF	PM	SWt
1	7181	0.2	0	0	0	0.187
2	5273	0.2	0	0	0	0.239
3	6316	0.2	1	0	0	0.299
4	8010	0.2	1	0	0	0.374
5	13859	0.2	1	0	0	0.542
6	1980	0.2	1	0	0	0.56
7	470	0.2	1	0	0	0.836

Catch

Age	Sel	CWt	DSel	DCWt
1	0.0112	0.173	0.0449	0.188
2	0.0496	0.26	0.099	0.243
3	0.2113	0.332	0.1129	0.279
4	0.4041	0.394	0.1084	0.315
5	0.326	0.575	0.0607	0.318
6	0.3963	0.595	0.055	0.433
7	0.4274	0.858	0.0239	0.464

2011

Age	N	M	Mat	PF	PM	SWt
1	56520	0.2	0	0	0	0.187
2	.	0.2	0	0	0	0.239
3	.	0.2	1	0	0	0.299
4	.	0.2	1	0	0	0.374
5	.	0.2	1	0	0	0.542
6	.	0.2	1	0	0	0.56
7	.	0.2	1	0	0	0.836

Catch

Age	Sel	CWt	DSel	DCWt
1	0.0112	0.173	0.0449	0.188
2	0.0496	0.26	0.099	0.243
3	0.2113	0.332	0.1129	0.279
4	0.4041	0.394	0.1084	0.315
5	0.326	0.575	0.0607	0.318
6	0.3963	0.595	0.055	0.433
7	0.4274	0.858	0.0239	0.464

2012

Age	N	M	Mat	PF	PM	SWt
1	56520	0.2	0	0	0	0.187
2	.	0.2	0	0	0	0.239
3	.	0.2	1	0	0	0.299
4	.	0.2	1	0	0	0.374
5	.	0.2	1	0	0	0.542
6	.	0.2	1	0	0	0.56
7	.	0.2	1	0	0	0.836

Catch

Age	Sel	CWt	DSel	DCWt
1	0.0112	0.173	0.0449	0.188
2	0.0496	0.26	0.099	0.243
3	0.2113	0.332	0.1129	0.279
4	0.4041	0.394	0.1084	0.315
5	0.326	0.575	0.0607	0.318
6	0.3963	0.595	0.055	0.433
7	0.4274	0.858	0.0239	0.464

Input units are thousands and kg - output in tonnes

Table 4.3.28. Haddock in VIb. Short-term forecast.

MFDP version 1a
Run: had10
Time and date: 19:08 04,06,2010
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2010

		Catch	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
16501	13898	1	0.2478	3762	0.0953	752

2011								2012	
		Catch	Landings		Discards				
Biomass	SSB	FMult	FBar	Yield	FBar	Yield		Biomass	SSB
21922	10024	0	0	0	0	0		33739	12110
.	10024	0.1	0.0248	361	0.0095	101		33198	11631
.	10024	0.2	0.0496	707	0.0191	200		32678	11173
.	10024	0.3	0.0743	1039	0.0286	297		32177	10733
.	10024	0.4	0.0991	1358	0.0381	391		31695	10312
.	10024	0.5	0.1239	1664	0.0476	484		31231	9908
.	10024	0.6	0.1487	1958	0.0572	575		30785	9522
.	10024	0.7	0.1734	2241	0.0667	663		30355	9152
.	10024	0.8	0.1982	2512	0.0762	750		29940	8797
.	10024	0.9	0.223	2773	0.0857	836		29541	8456
.	10024	1	0.2478	3023	0.0953	919		29156	8130
.	10024	1.1	0.2725	3264	0.1048	1001		28785	7818
.	10024	1.2	0.2973	3495	0.1143	1081		28427	7518
.	10024	1.3	0.3221	3717	0.1238	1160		28082	7231
.	10024	1.4	0.3469	3931	0.1334	1237		27750	6956
.	10024	1.5	0.3716	4136	0.1429	1313		27429	6692
.	10024	1.6	0.3964	4334	0.1524	1387		27119	6439
.	10024	1.7	0.4212	4523	0.1619	1460		26820	6197
.	10024	1.8	0.446	4706	0.1715	1532		26531	5964
.	10024	1.9	0.4707	4882	0.181	1603		26252	5741
.	10024	2	0.4955	5051	0.1905	1672		25982	5527

Input units are thousands and kg - output in tonnes

Table 4.3.29. Haddock in VIb. Detailed short-term forecast output.

MFDP version 1a
Run: had10
Time and d 6 2010
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

Year:		2010	F multiplie	1	Fleet1 HC	0.2478	Fleet1 DF	0.0953					
	Catch												
Age	F		CatchNos	Yield	DF	DCatchNo	DYield	StockNos	Biomass	SSNos(Ja	SSB(Jan)	SSNos(ST	SSB(ST)
	1	0.0112	71	12	0.0449	284	53	7181	1343	0	0	0	0
	2	0.0496	221	57	0.099	441	107	5273	1260	0	0	0	0
	3	0.2113	1039	345	0.1129	555	155	6316	1888	6316	1888	6316	1888
	4	0.4041	2315	912	0.1084	621	196	8010	2996	8010	2996	8010	2996
	5	0.326	3418	1965	0.0607	636	202	13859	7512	13859	7512	13859	7512
	6	0.3963	577	343	0.055	80	35	1980	1109	1980	1109	1980	1109
	7	0.4274	148	127	0.0239	8	4	470	393	470	393	470	393
Total			7788	3762		2626	752	43089	16501	30635	13898	30635	13898

Year:		2011	F multiplie	1	Fleet1 HC	0.2478	Fleet1 DF	0.0953					
	Catch												
Age	F		CatchNos	Yield	DF	DCatchNo	DYield	StockNos	Biomass	SSNos(Ja	SSB(Jan)	SSNos(ST	SSB(ST)
	1	0.0112	558	97	0.0449	2239	421	56520	10569	0	0	0	0
	2	0.0496	233	61	0.099	465	113	5559	1328	0	0	0	0
	3	0.2113	612	203	0.1129	327	91	3721	1113	3721	1113	3721	1113
	4	0.4041	1081	426	0.1084	290	91	3739	1398	3739	1398	3739	1398
	5	0.326	969	557	0.0607	180	57	3928	2129	3928	2129	3928	2129
	6	0.3963	2245	1336	0.055	312	135	7708	4316	7708	4316	7708	4316
	7	0.4274	401	344	0.0239	22	10	1277	1068	1277	1068	1277	1068
Total			6099	3023		3835	919	82452	21922	20374	10024	20374	10024

Year:		2012	F multiplie	1	Fleet1 HC	0.2478	Fleet1 DF	0.0953					
	Catch												
Age	F		CatchNos	Yield	DF	DCatchNo	DYield	StockNos	Biomass	SSNos(Ja	SSB(Jan)	SSNos(ST	SSB(ST)
	1	0.0112	558	97	0.0449	2239	421	56520	10569	0	0	0	0
	2	0.0496	1832	476	0.099	3657	889	43750	10456	0	0	0	0
	3	0.2113	645	214	0.1129	345	96	3923	1173	3923	1173	3923	1173
	4	0.4041	637	251	0.1084	171	54	2203	824	2203	824	2203	824
	5	0.326	452	260	0.0607	84	27	1834	994	1834	994	1834	994
	6	0.3963	636	379	0.055	88	38	2185	1223	2185	1223	2185	1223
	7	0.4274	1471	1262	0.0239	82	38	4685	3916	4685	3916	4685	3916
Total			6232	2939		6666	1563	115099	29156	14829	8130	14829	8130

Input units are thousands and kg - output in tonnes

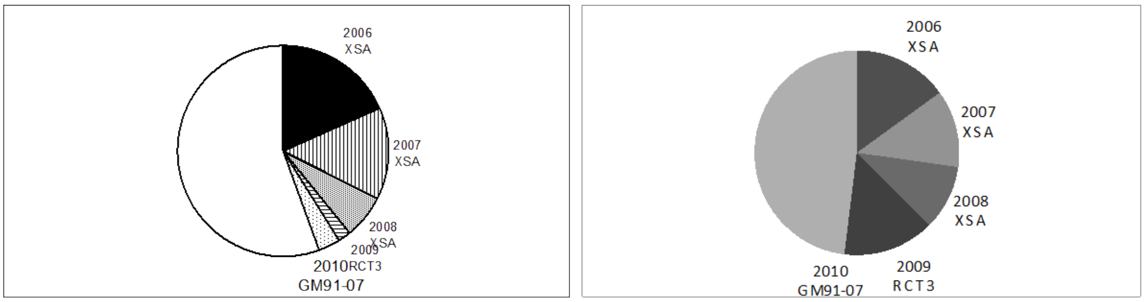
Table 4.3.30. Haddock VIb. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 1 year-olds	21196	10855	6648	7181	56520
Source	XSA	XSA	XSA	RCT3	GM91-07
Status Quo F:					
% in 2010 landings	24.2	9.2	1.5	0.3	-
% in 2011 landings	18.4	14.1	6.7	2.0	3.2
% in 2010 SSB	21.6	13.6	0.0	0.0	-
% in 2011 SSB	21.2	13.9	11.1	0.0	0.0
% in 2012 SSB	15.0	12.2	10.1	14.4	0.0

GM : geometric mean recruitment

Haddock VIb : Year-class % contribution to

a) 2011 landings **b) 2012 SSB**



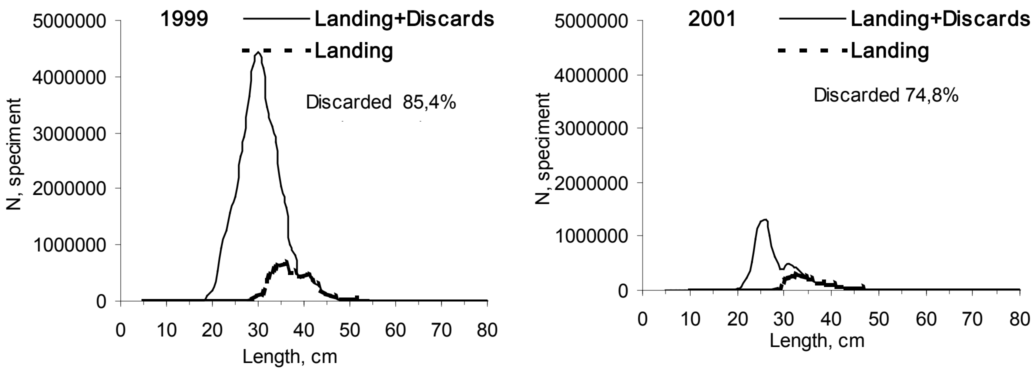


Figure 4.3.1. Length distribution and quantity of haddock lifted onboard and landings by Scottish trawlers in 1999 and 2001 (unpublished data, Newton, 2004).

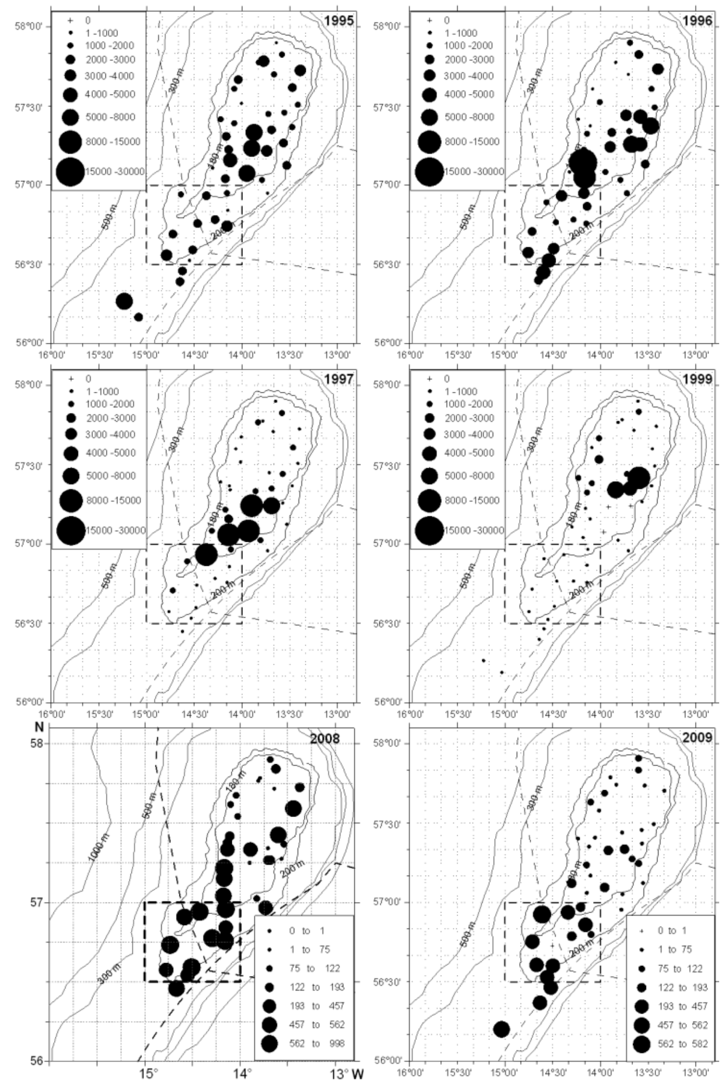


Figure 4.3.2. Distribution of haddock (catch per 30 minutes) on the Rockall Bank in 1995–1999 and 2008–2009 from the Scottish trawl survey.

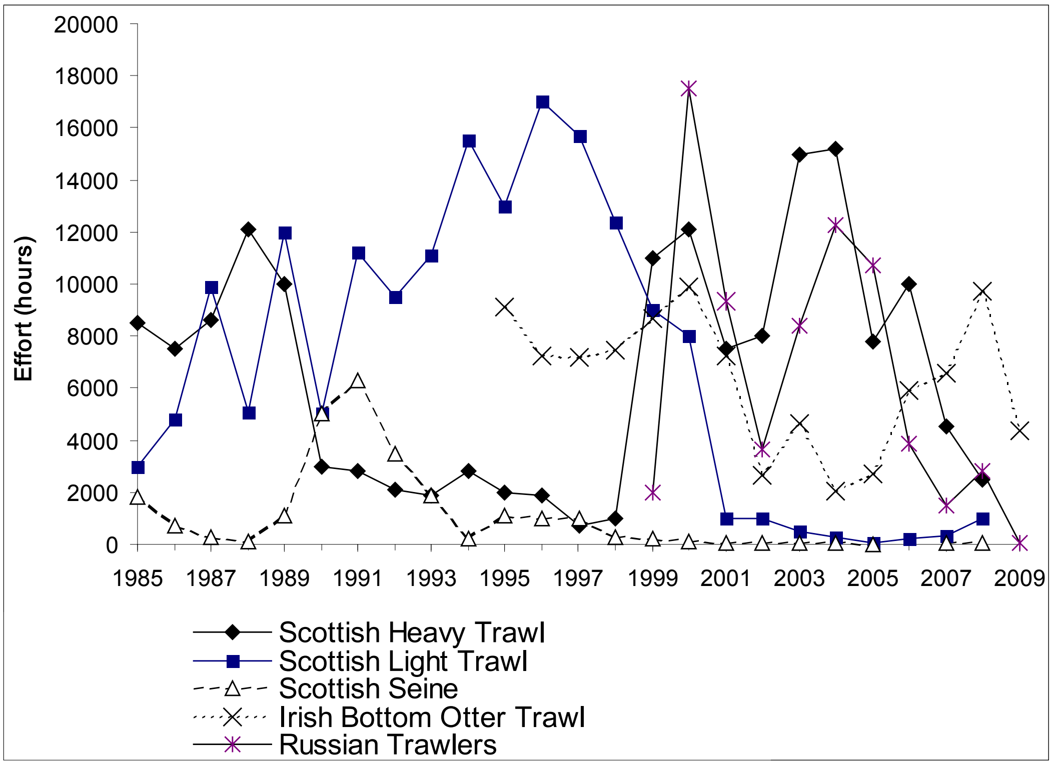


Figure 4.3.3. Rockall haddock in VIb. Scottish, Irish and Russian effort in 1985–2009.

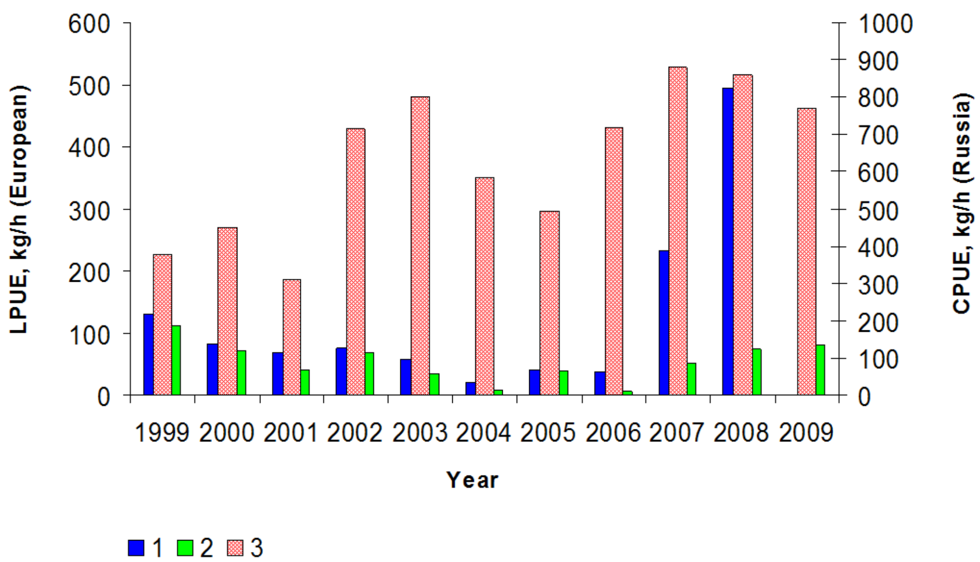


Figure 4.3.4. Lpue and cpue of the fleets fishing for Rockall haddock. Note that Scottish and Irish effort data are not reliable because reporting is not mandatory.

1 – Scottish lpue (all gears)

2 – Irish trawlers lpue

3 – Cpue of Russian trawlers (BMRT type, tonnage class 10 in 1999–2007, and tonnage class 9 in 2008–2009).

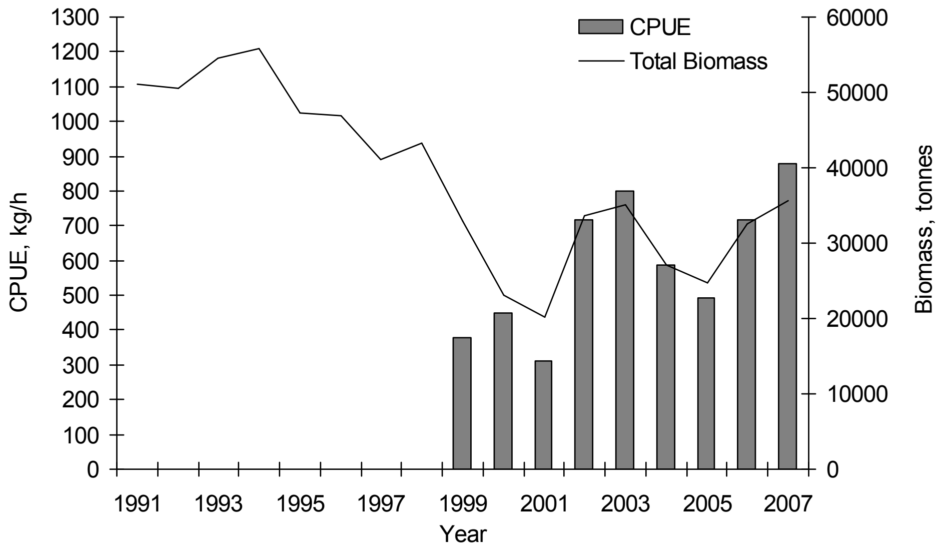


Figure 4.3.5. Dynamics of haddock total biomass (ICES, 2008a; ICES, 2008b) and directed fishing efficiency (t per a trawling hour) for tonnage class 10 vessels in 1999–2007.

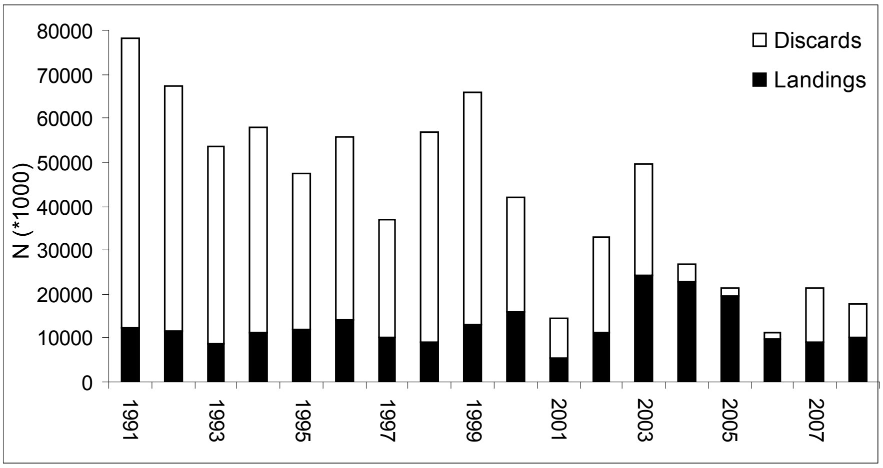


Figure 4.3.6. Total landings and discards of Rockall haddock ('000 individuals).

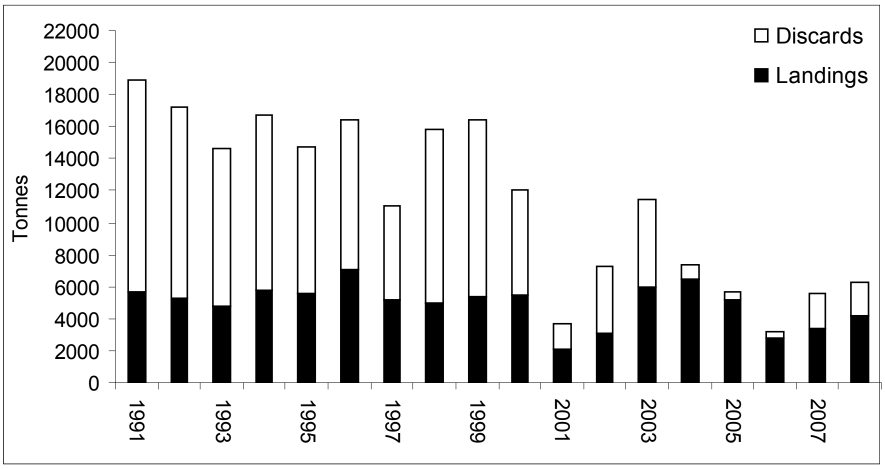
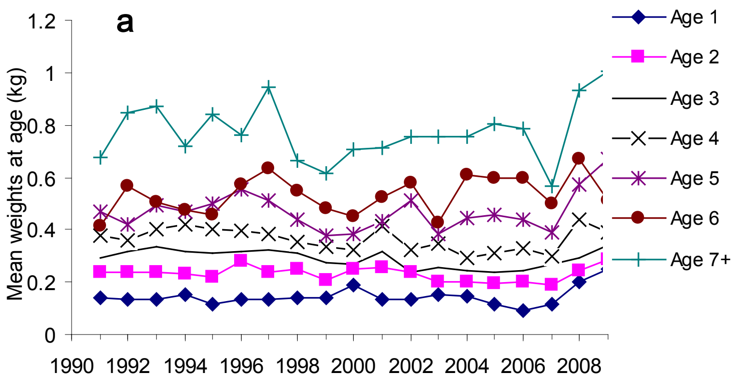


Figure 4.3.7. Total landings and discards of Rockall haddock (tonnes).



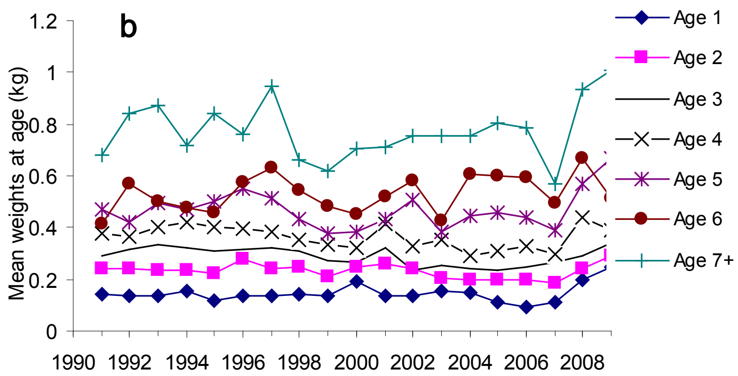


Figure 4.3.8. Haddock in VIb. Mean weights-at-age a) in catch and b) in stock.

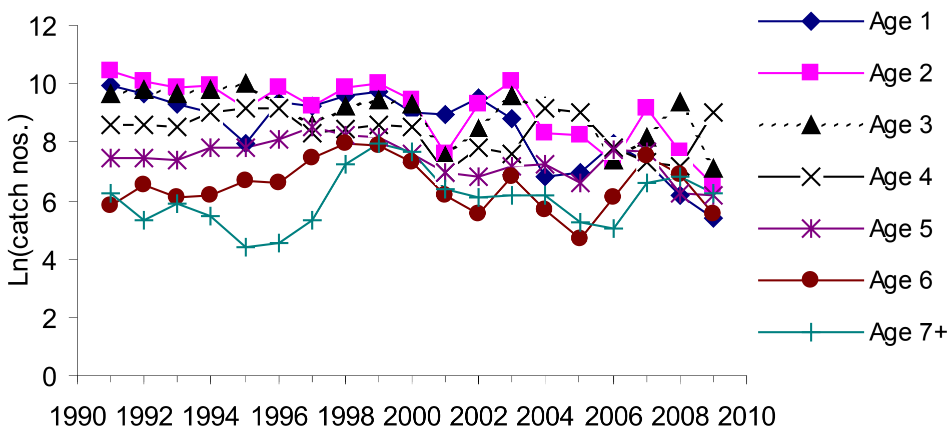


Figure 4.3.9. Haddock in VIb. Log catch (with discards in numbers)-at-age by year.

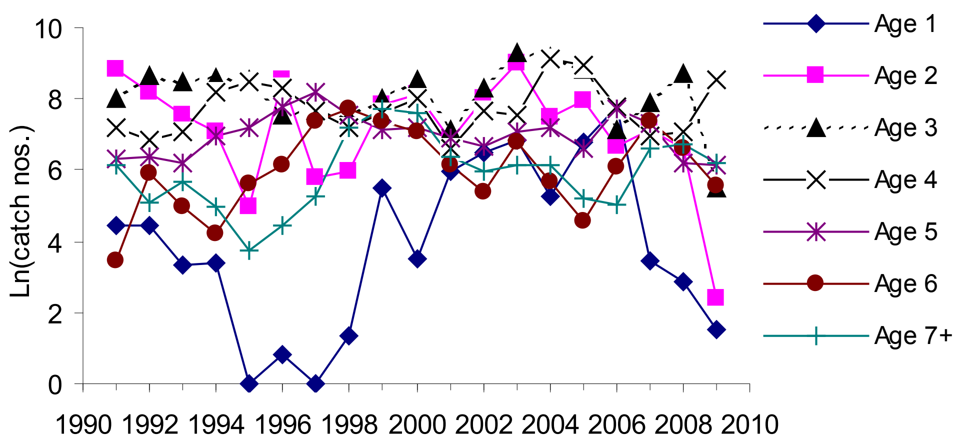


Figure 4.3.10. Haddock in VIb. Log landings (in numbers)-at-age by year.

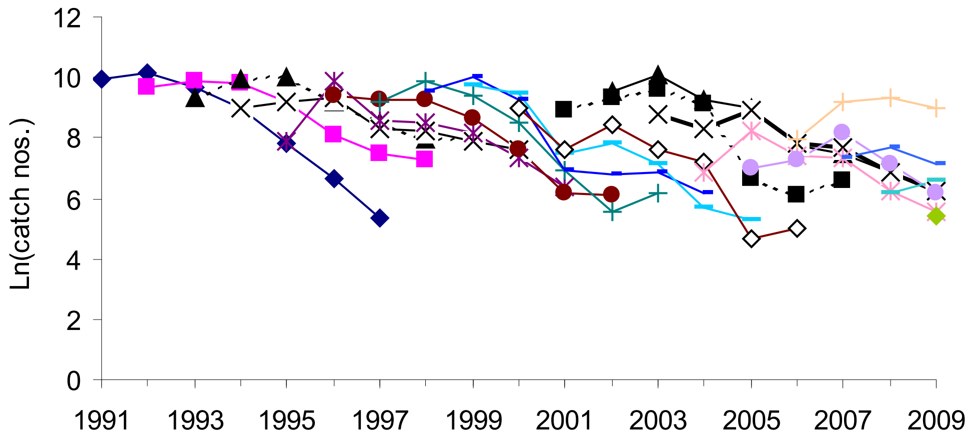


Figure 4.3.11. Haddock in VIb. Log catch (with discards, in numbers)-at-age by year class.

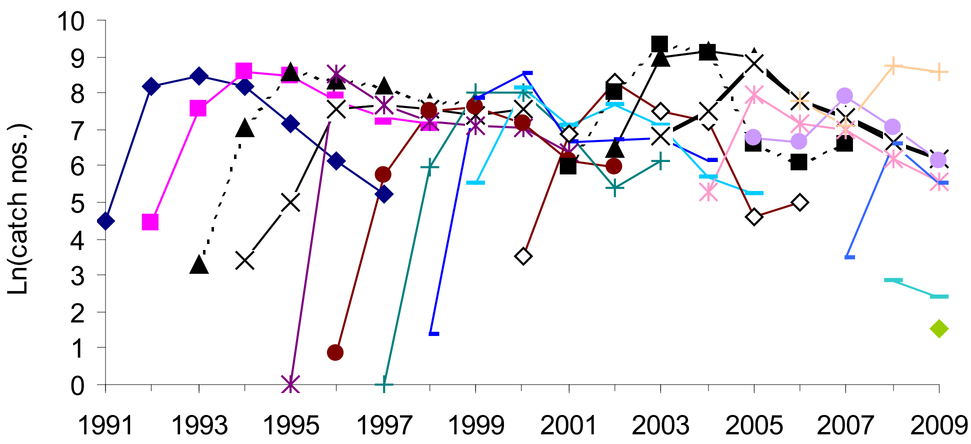


Figure 4.3.12. Haddock in VIb. Log landings (without registered discards, in numbers)-at-age by year class.

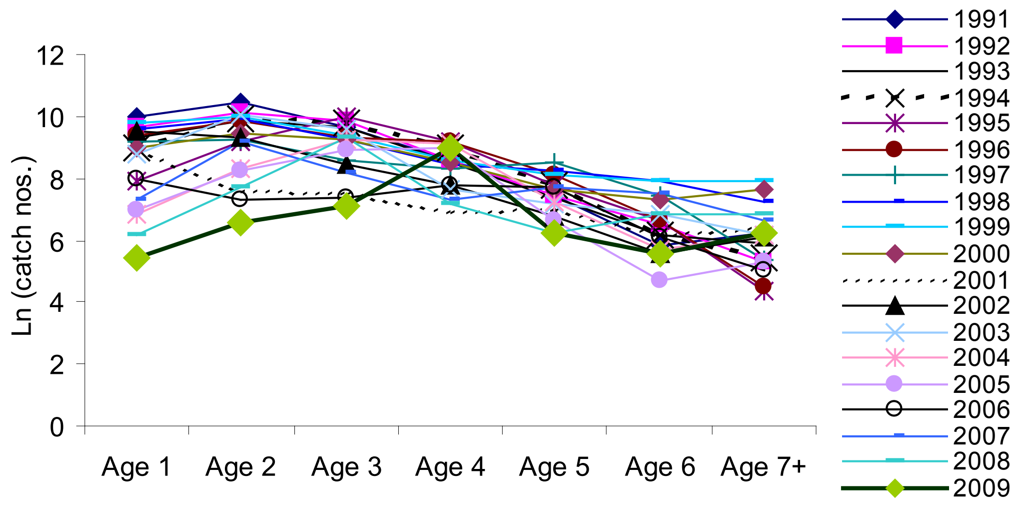


Figure 4.3.13. Haddock in VIb. Catch curves (with registered discards).

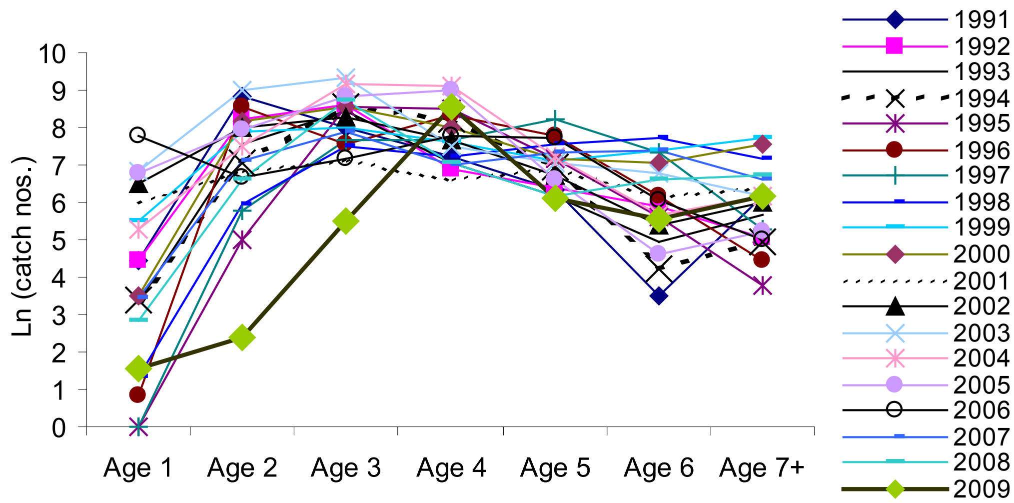


Figure 4.3.14. Haddock in VIb. Catch curves (landings without registered discards).

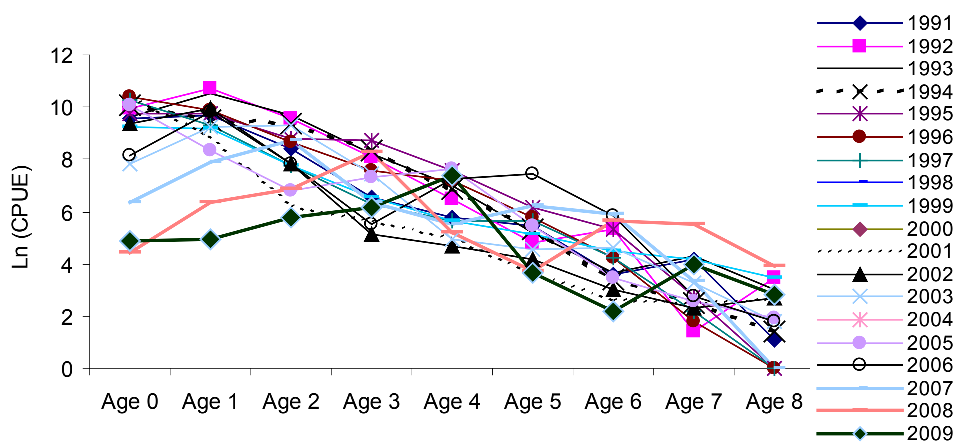


Figure 4.3.15. Haddock in VIb. Log survey cpue at age by year.

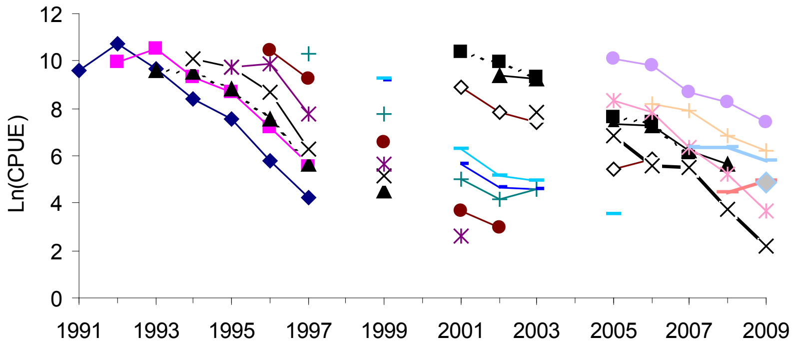


Figure 4.3.16. Haddock in VIb. Log survey cpue by year class.

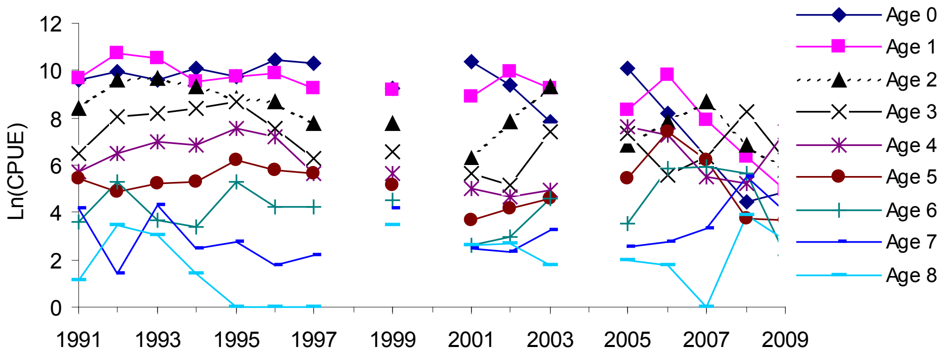


Figure 4.3.17. Haddock in VIb. Log survey cpue at age.

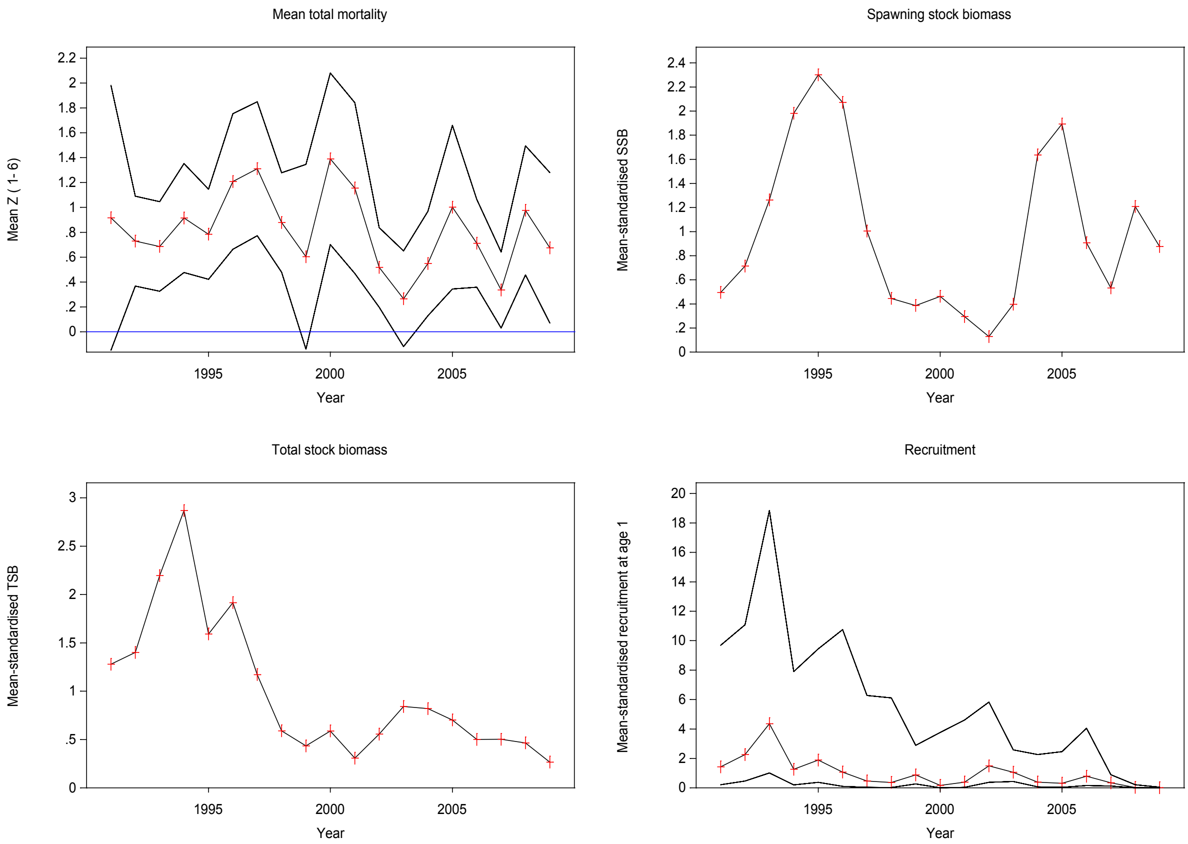


Figure 4.3.18. SURBA analysis for Rockall haddock.

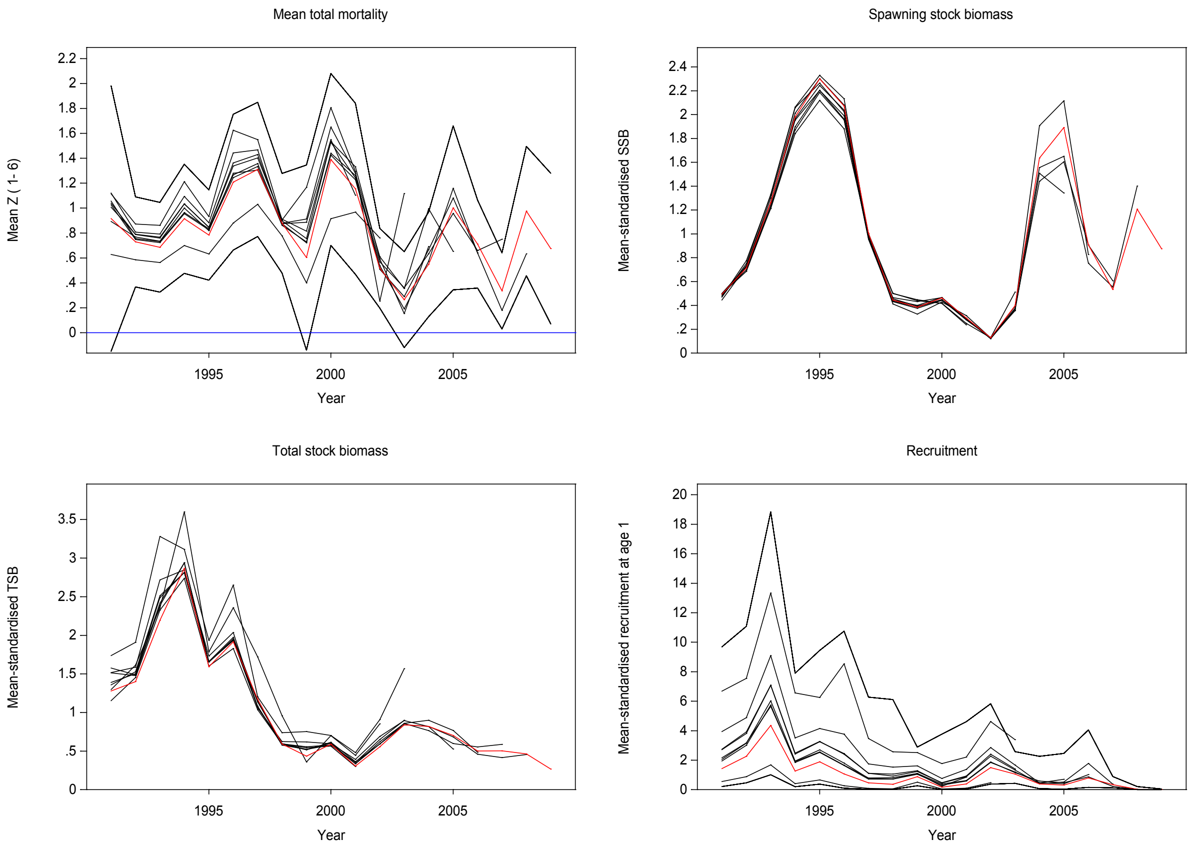


Figure 4.3.18a. SURBA analysis for Rockall haddock. Retrospective plots.

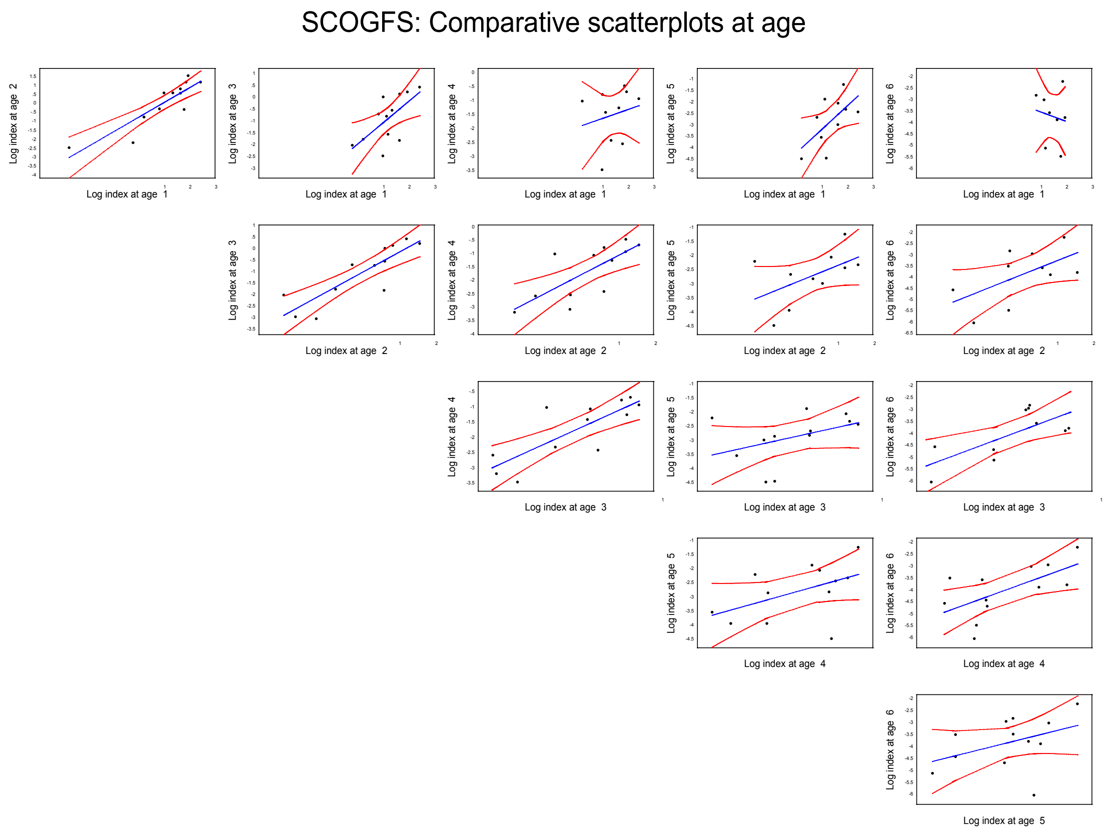


Figure 4.3.18b. SURBA analysis for Rockall haddock. Pairwise plots of age.

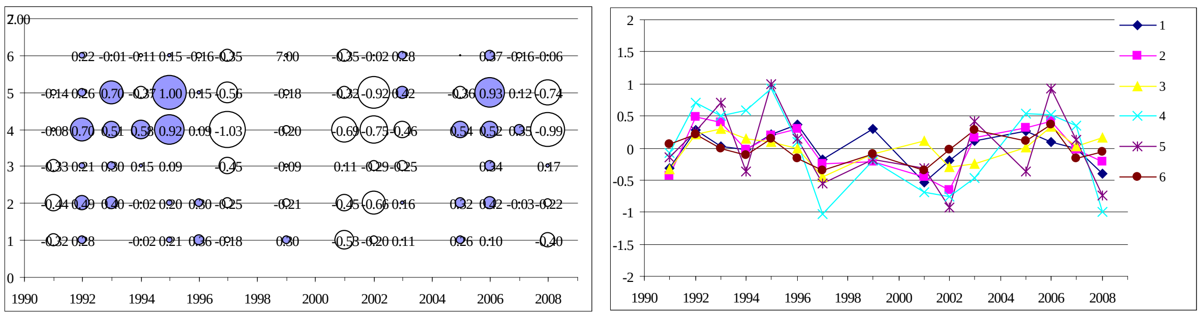


Figure 4.3.19. Haddock in VIb. Log catchability residual plots (shrinkage 1.0). XSA run: catchability dependent on stock size at ages < 4. XSA run to 2008. Old survey indices data.

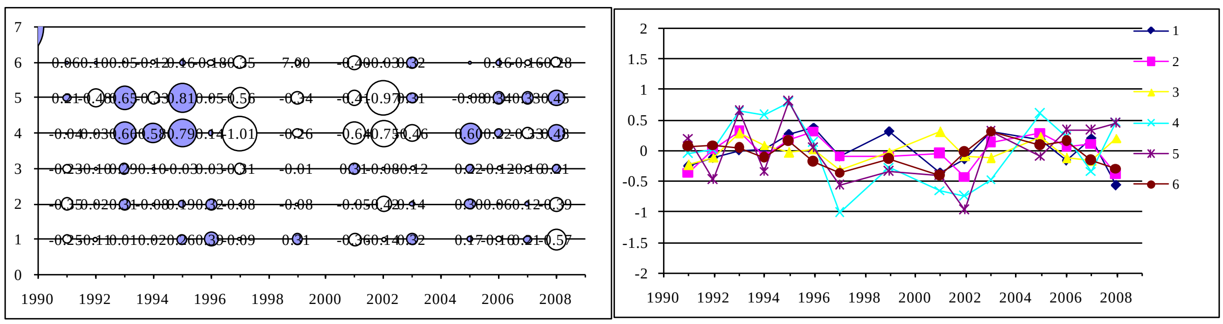


Figure 4.3.20. Haddock in VIb. Log catchability residual plots (shrinkage 1.0). XSA run: catchability dependent on stock size at ages <4. XSA run to 2008. Standardized survey indices data.

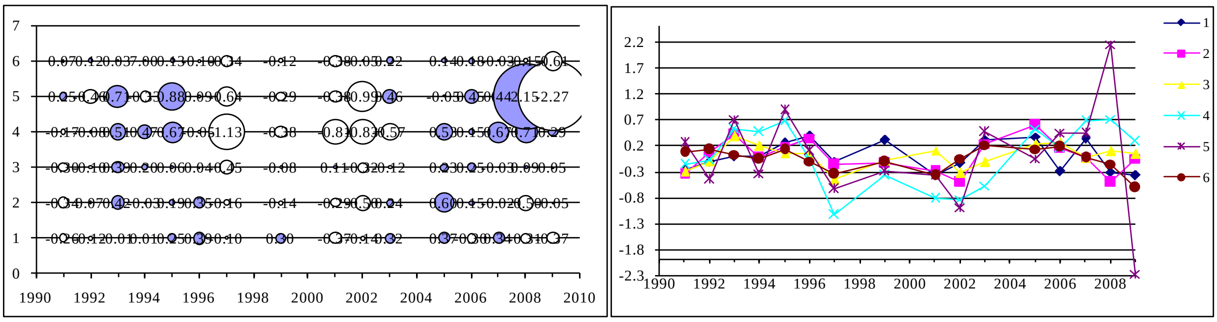


Figure 4.3.21. Haddock in VIb. Log catchability residual plots (shrinkage 1.0). Final XSA: catchability dependent on stock size at ages <4. XSA run to 2009. Standardized survey indices data.

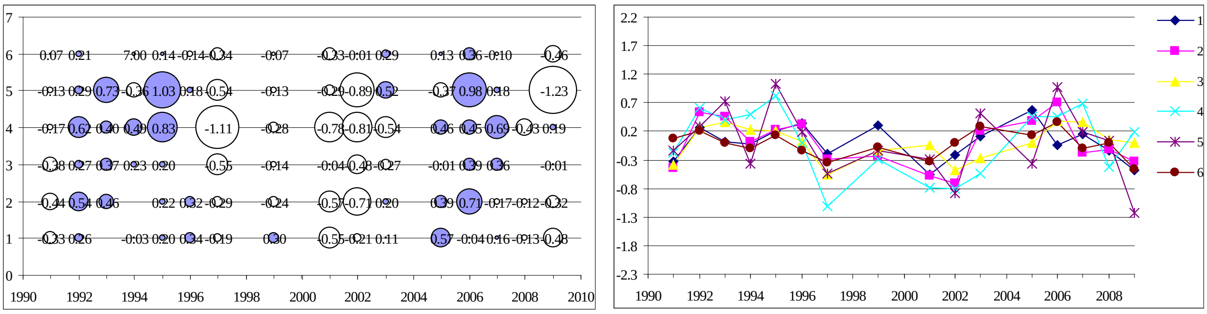


Figure 4.3.22. Haddock in VIb. Log catchability residual plots (shrinkage 1.0). Final XSA: catchability dependent on stock size at ages <4. XSA run to 2009. Old survey indices data.

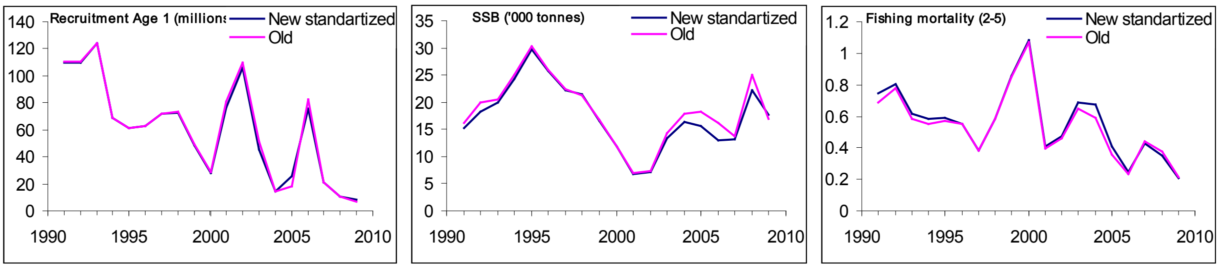


Figure 4.3.23. Haddock in VIb. Comparison of the final assessment (in red) with the assessment in which were used standardized survey indices (in blue).

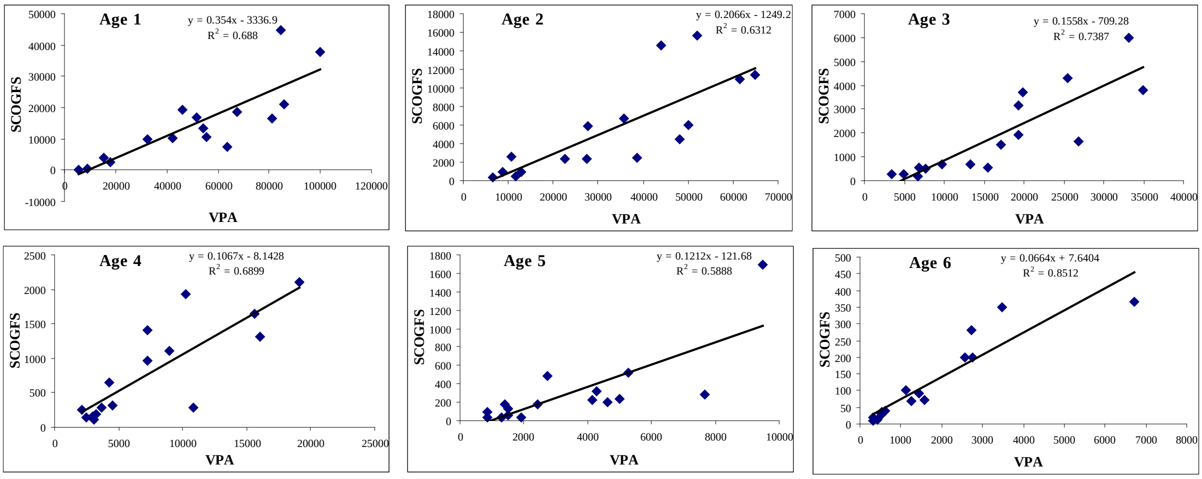


Figure 4.3.24. Haddock in VIb. Adjusted Scottish groundfish survey cpue from the final XSA run plotted against VPA numbers (shrinkage 1.0)-at-age. Catchability dependent on stock size at ages <4.

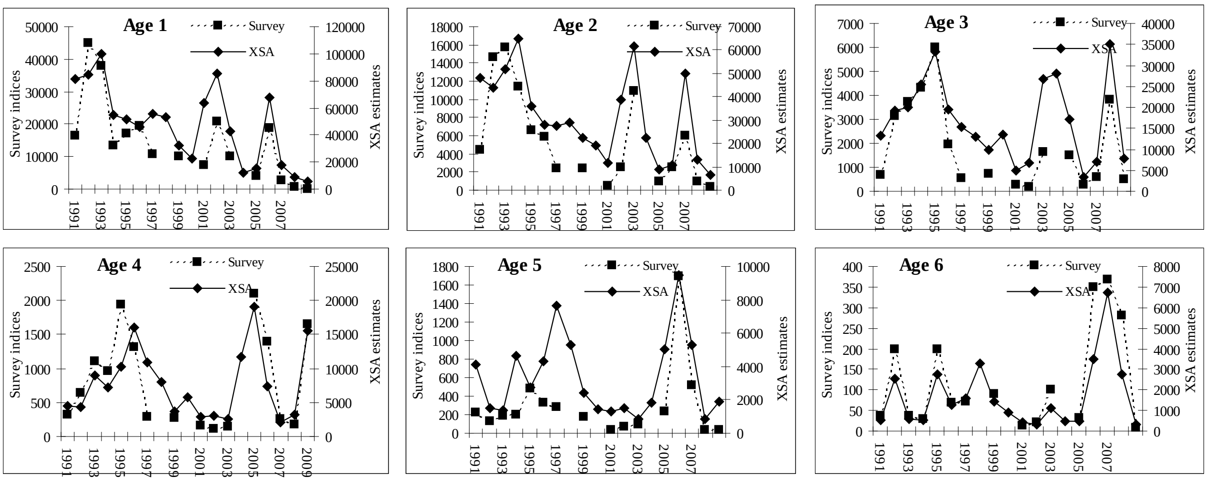


Figure 4.3.25. Haddock in VIb. Survey indices and XSA estimates (shrinkage 1.0)-at-age. Final XSA: catchability dependent on stock size at ages <4.

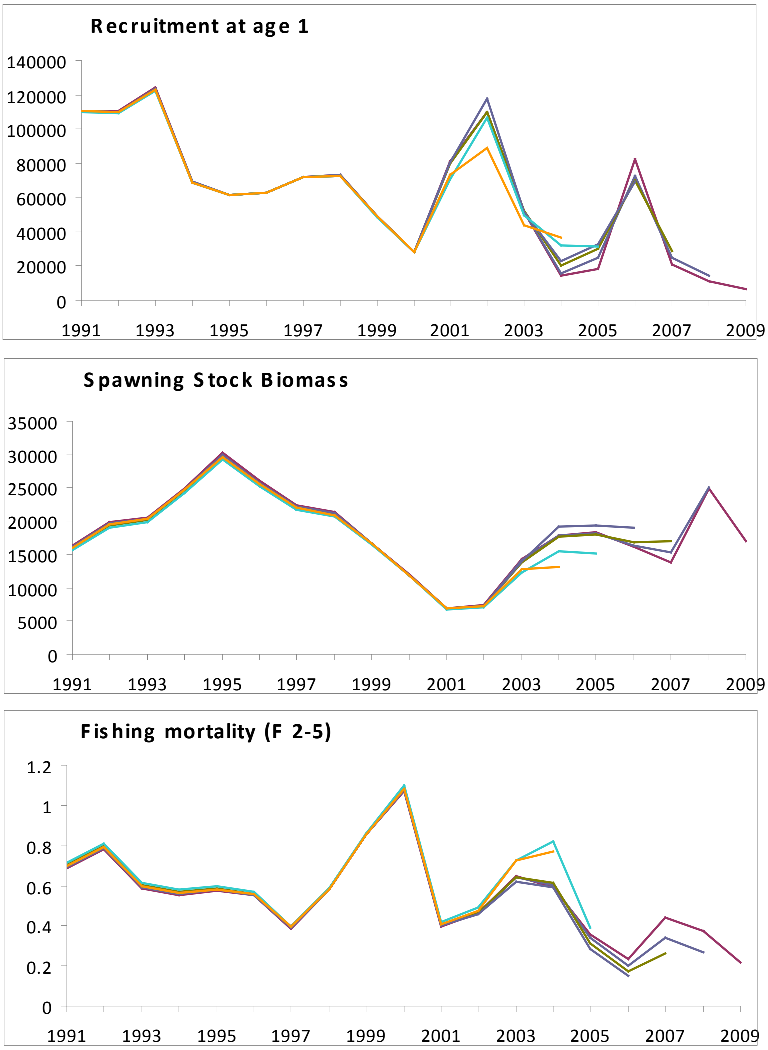


Figure 4.3.26. Haddock in VIb. Retrospective analyses (F shrinkage 1.0).

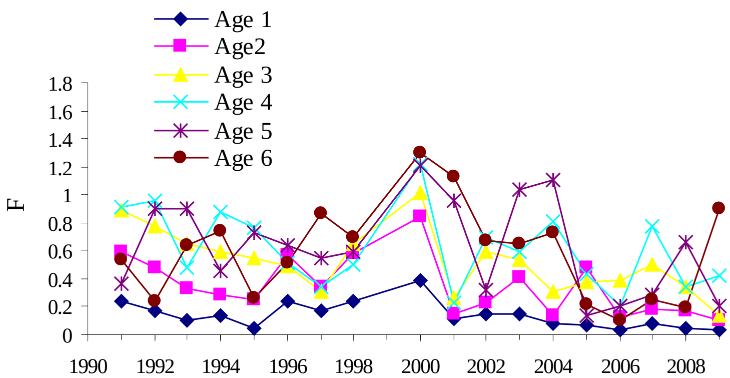


Figure 4.3.27. Haddock in VIb. F at age (F shrinkage 1.0).

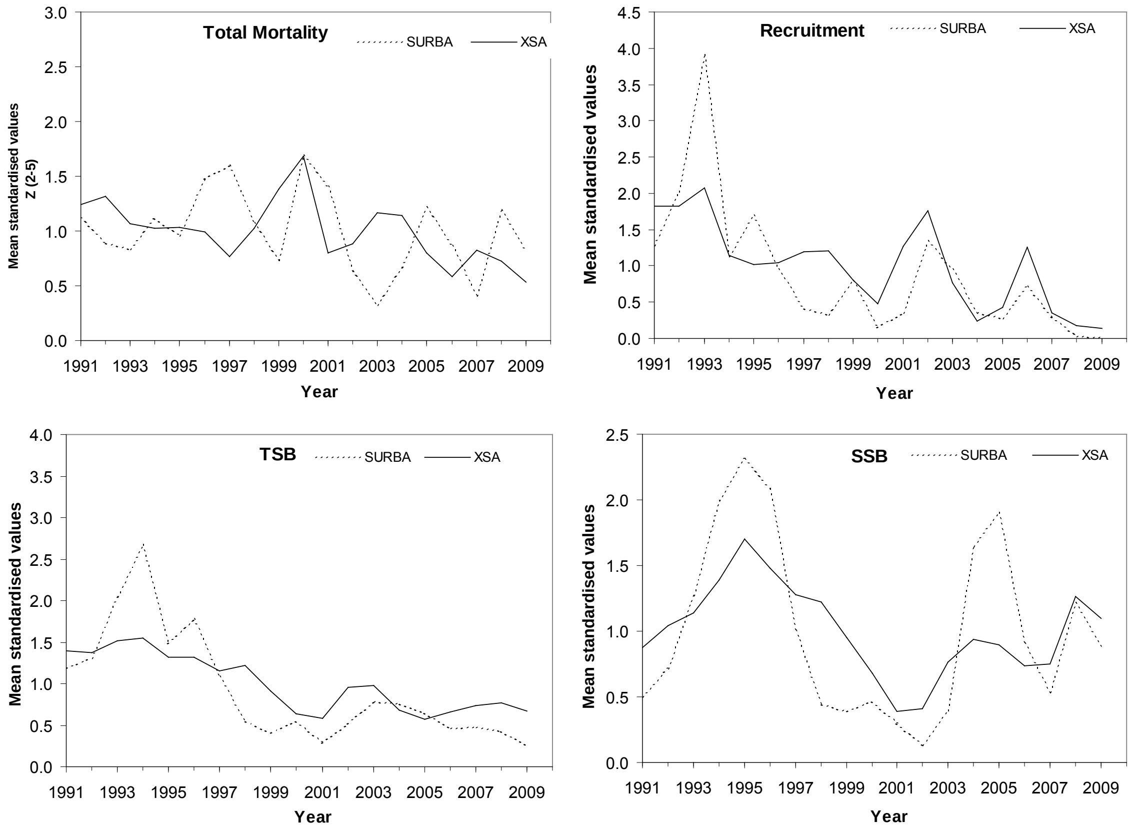


Figure 4.3.28. Haddock in VIb. XSA and SURBA analyses.

Figure 4.3.29. Haddock in VIb. Summary plots.

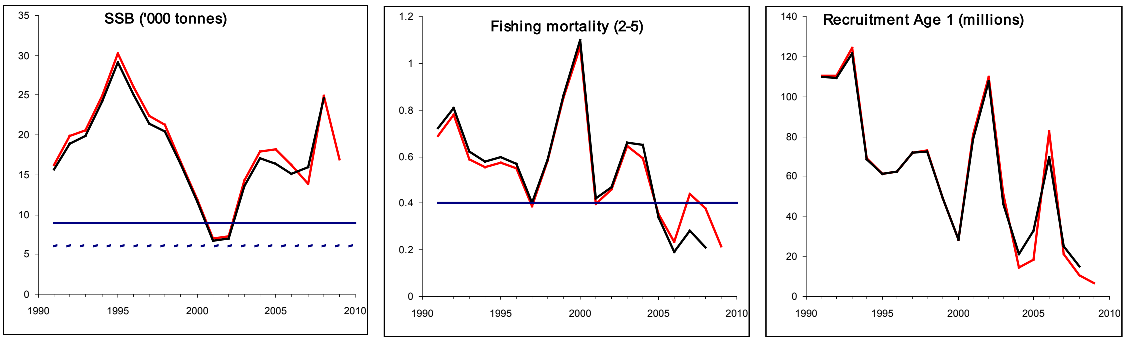


Figure 4.3.30. Haddock in VIb. Comparison of the current assessment (in red) with the previous one (in black).

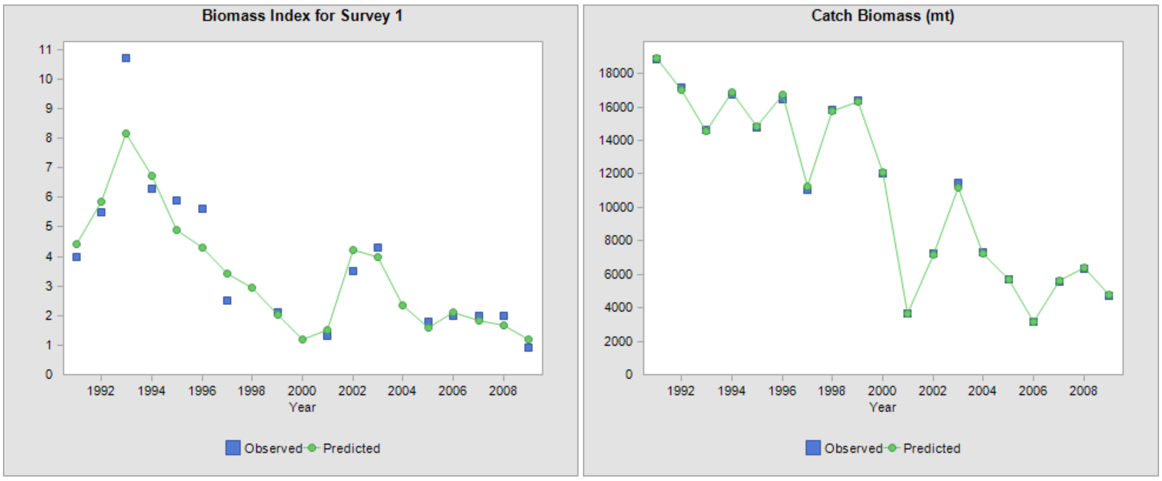


Figure 4.3.31. Haddock in VIb. Comparison observed and predicted by StatCam survey index and catch biomass . Scenario 2.

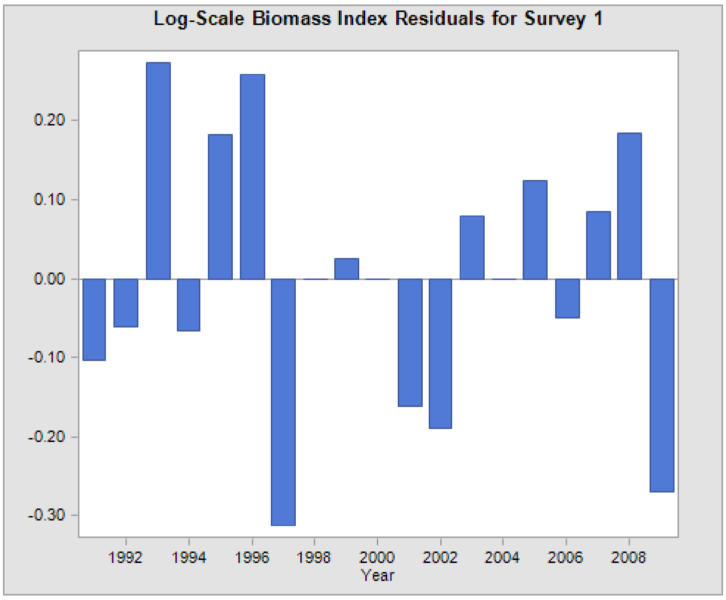


Figure 4.3.32. Haddock in VIb. Log catchability residuals plot for survey biomass index. Scenario 2 of Statcam run.

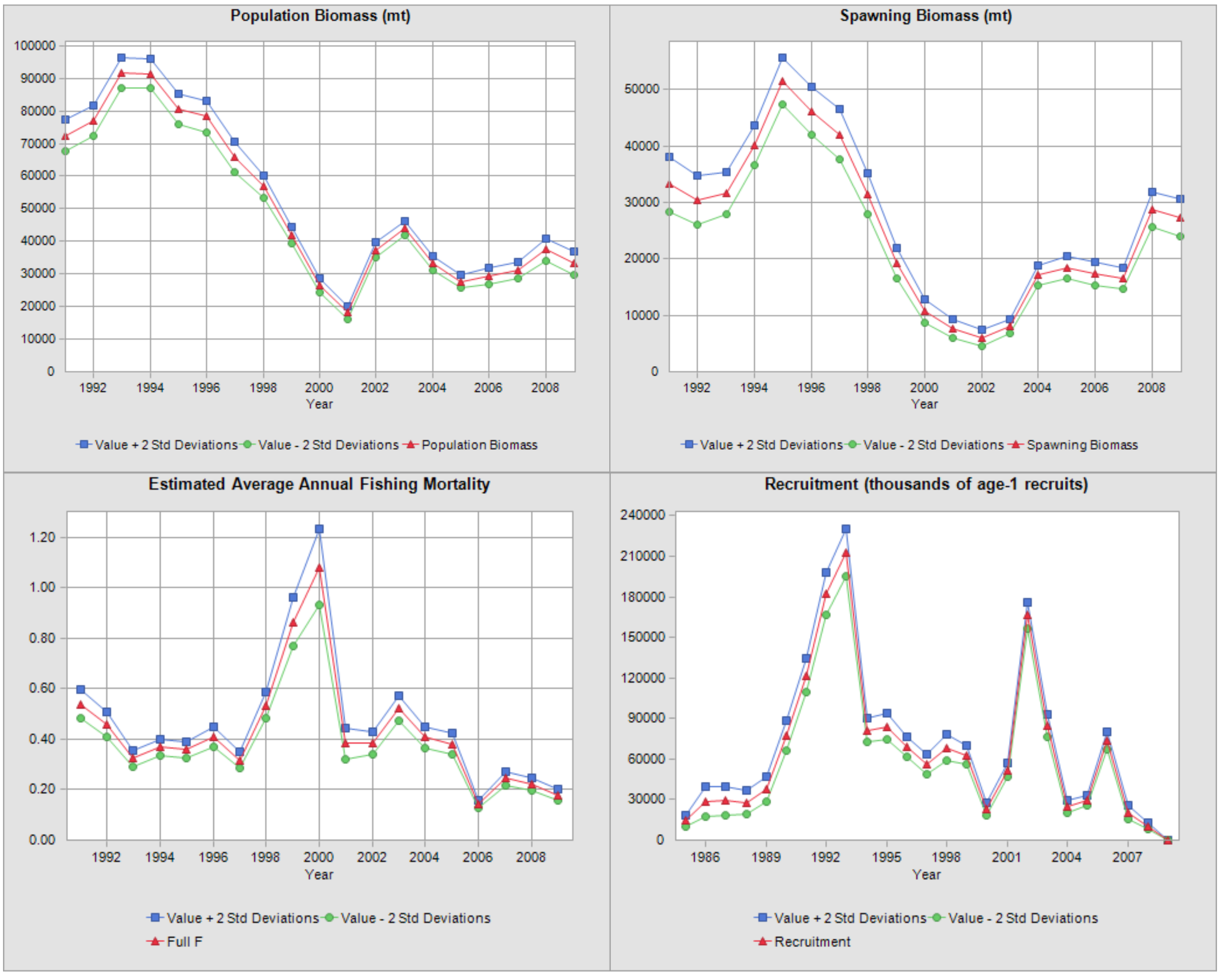


Figure 4.3.33. Haddock in VIb. Population biomass, SSB, fishin mortality and recruitment by Statcam estimation. Scenario 2.

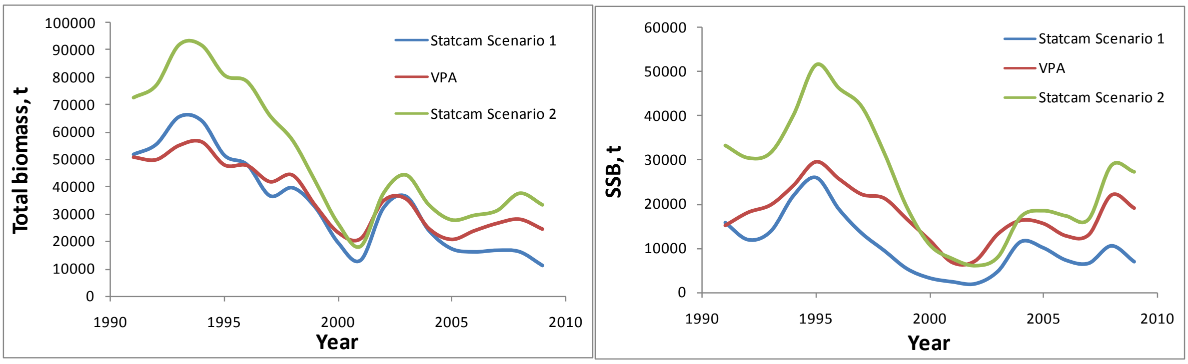


Figure 4.3.34. Haddock in VIb. Comparison of VPA assessment with the statistical catch-at-age model StatCam assessment.

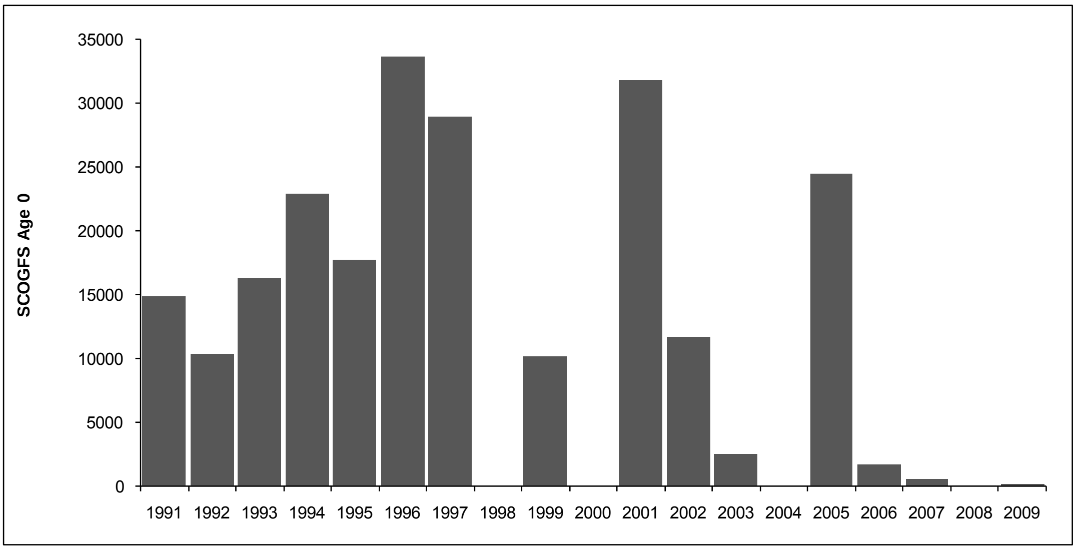


Figure 4.3.35. Haddock in VIb. Scottish Groundfish survey indices of haddock at age 0.

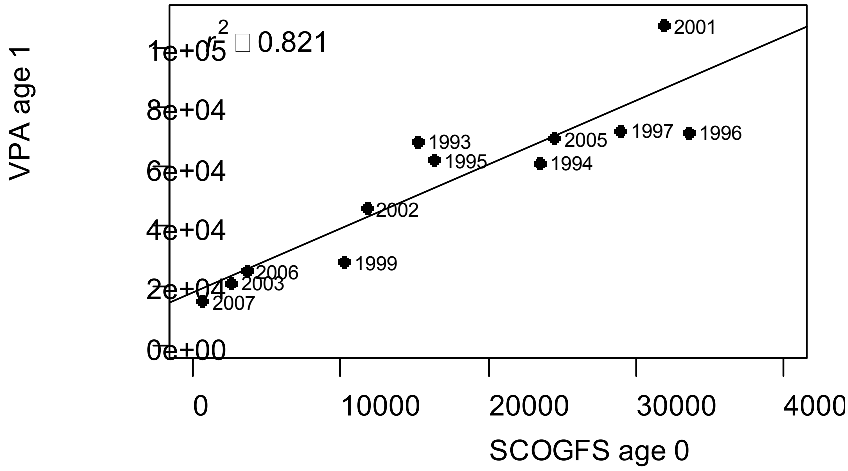


Figure 4.3.36. Haddock in VIb. VPA numbers-at-age 1 from XSA plotted against Scottish Groundfish survey indices of haddock at age 0.

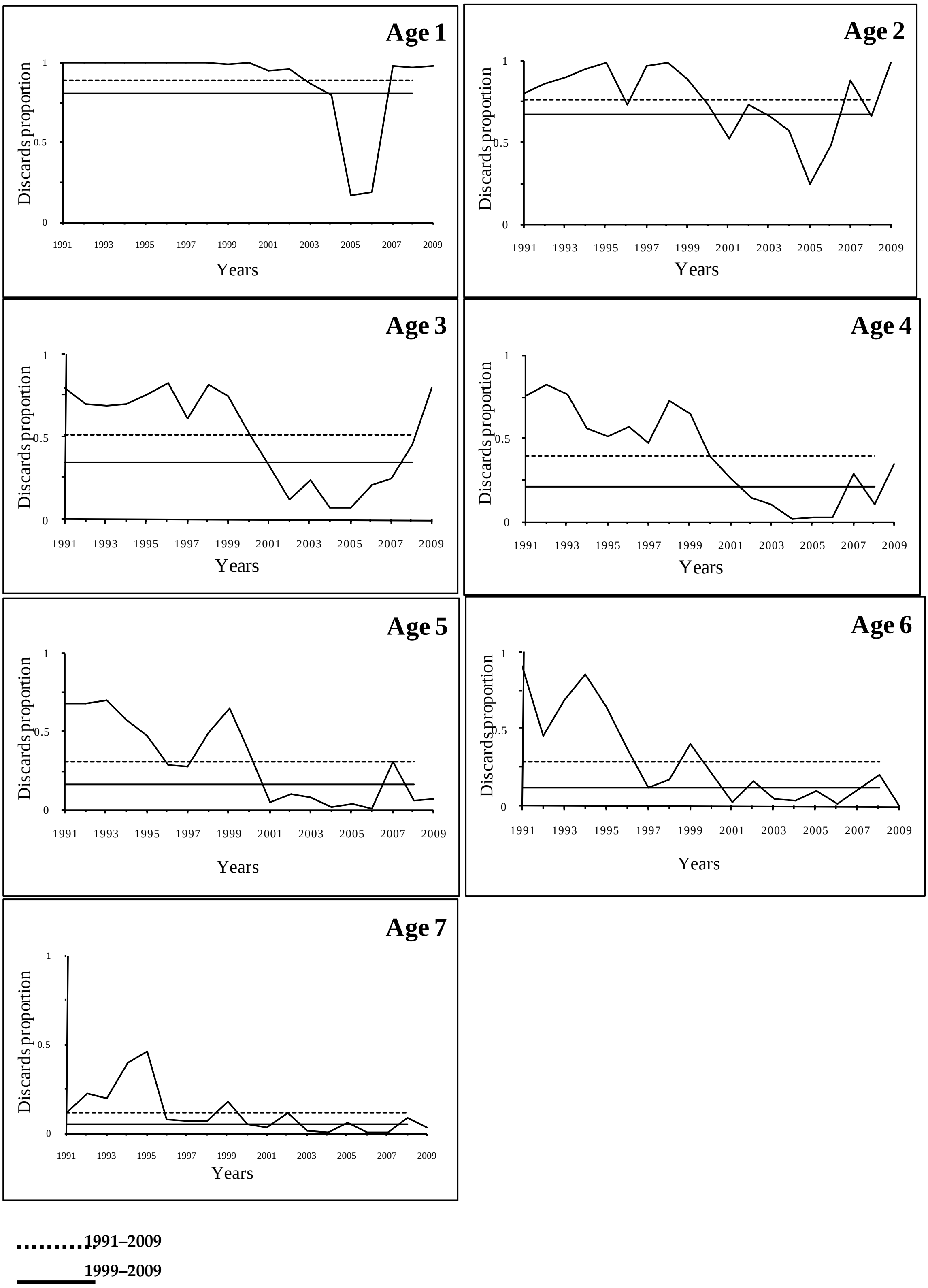


Figure 4.3.37. Haddock in Division VI b. Discard proportion-at-age by year and mean discard proportion-at-age for two periods, 1991–2009 and 1999–2009.

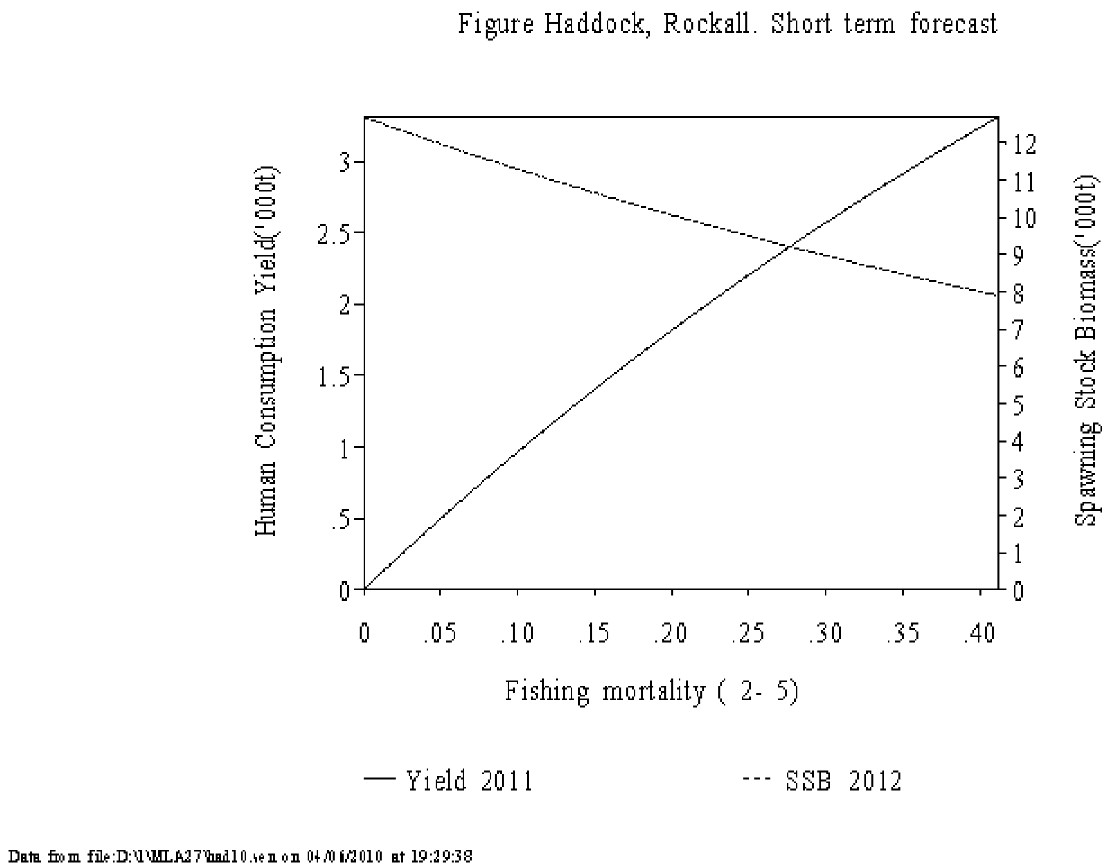


Figure 4.3.38. Haddock in VIb. Short-term forecast.

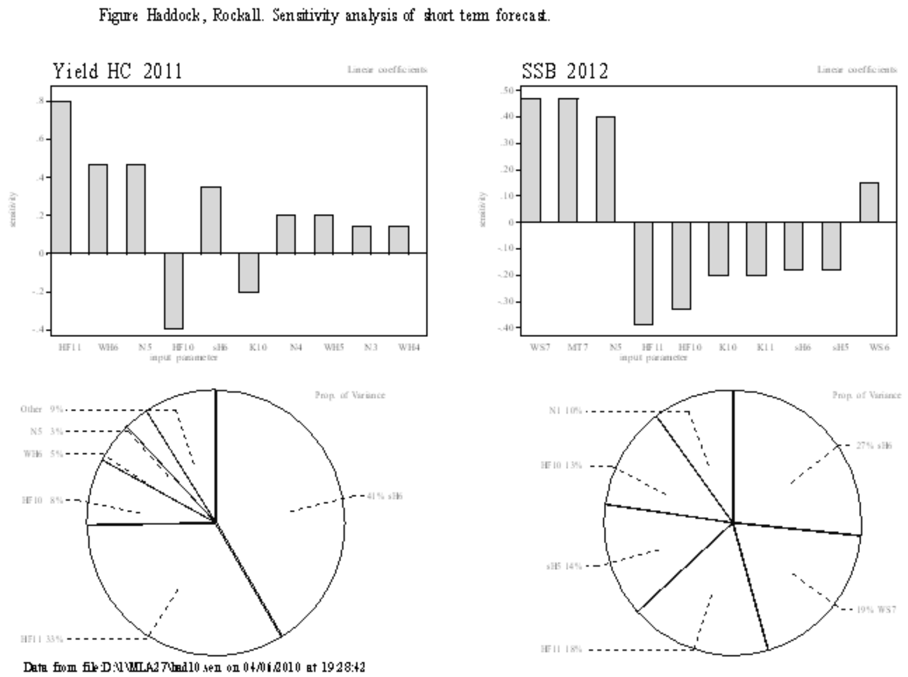


Figure 4.3.39. Haddock in VIb. Delta plots from selectivity analysis.

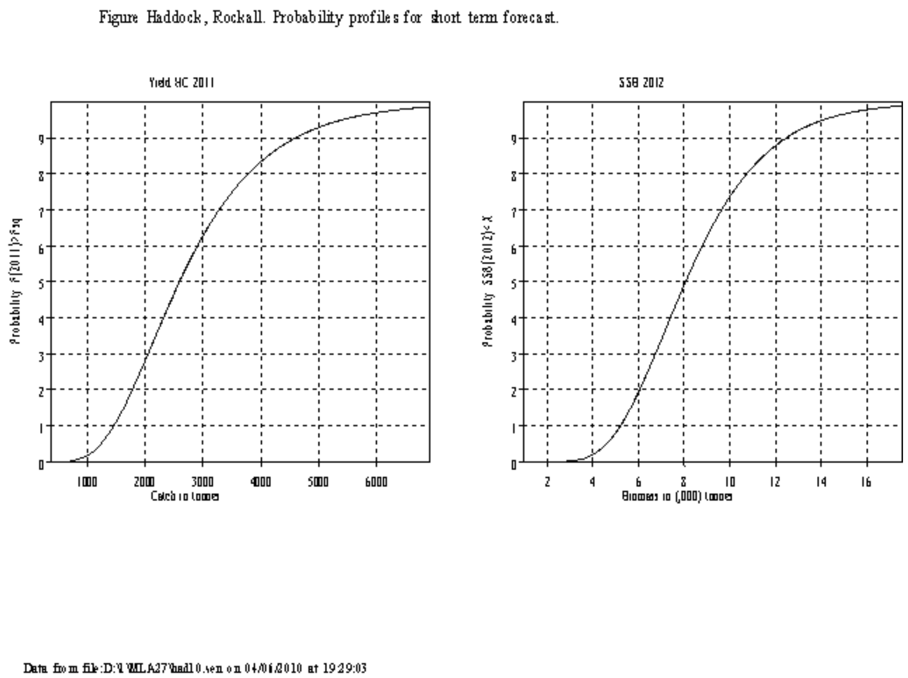


Figure 4.3.40. Haddock in VIb. Probability plots for yield in 2011 and SSB in 2012.

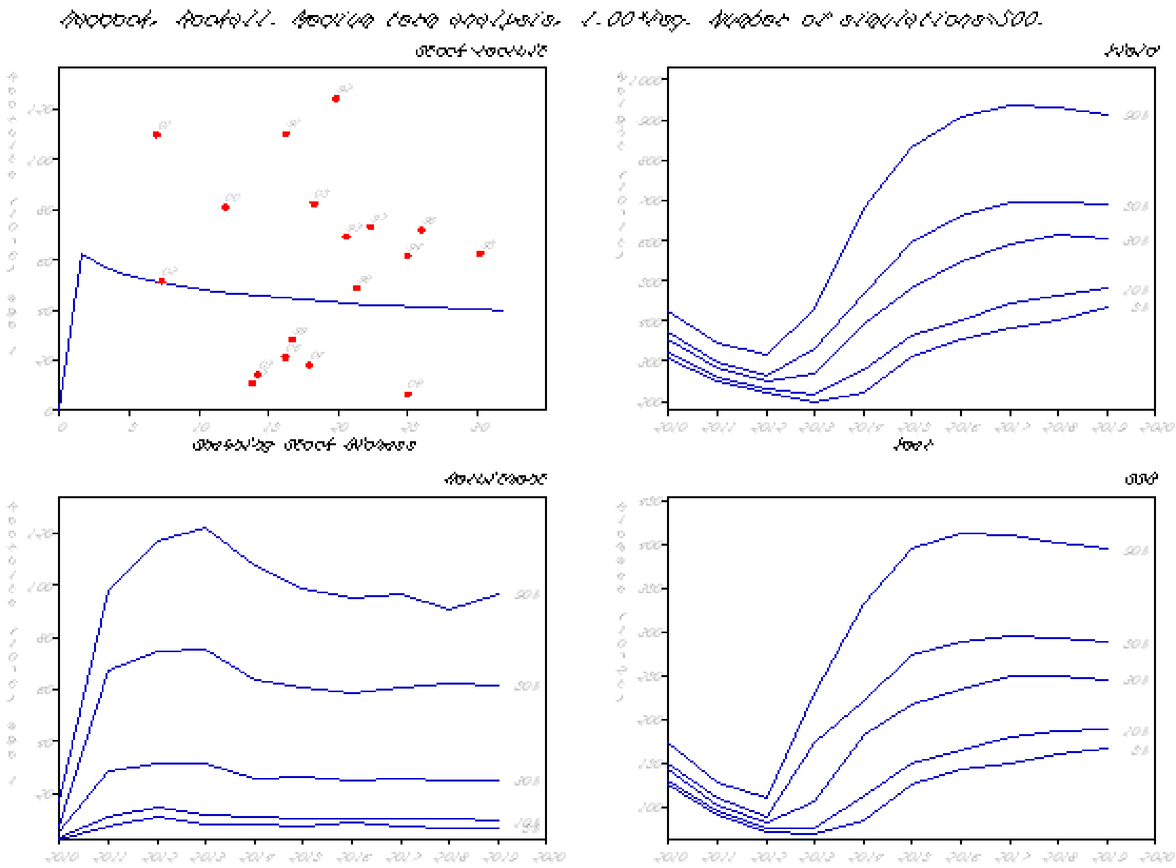


Figure 4.3.41. Haddock VIb. Medium-term analysis.

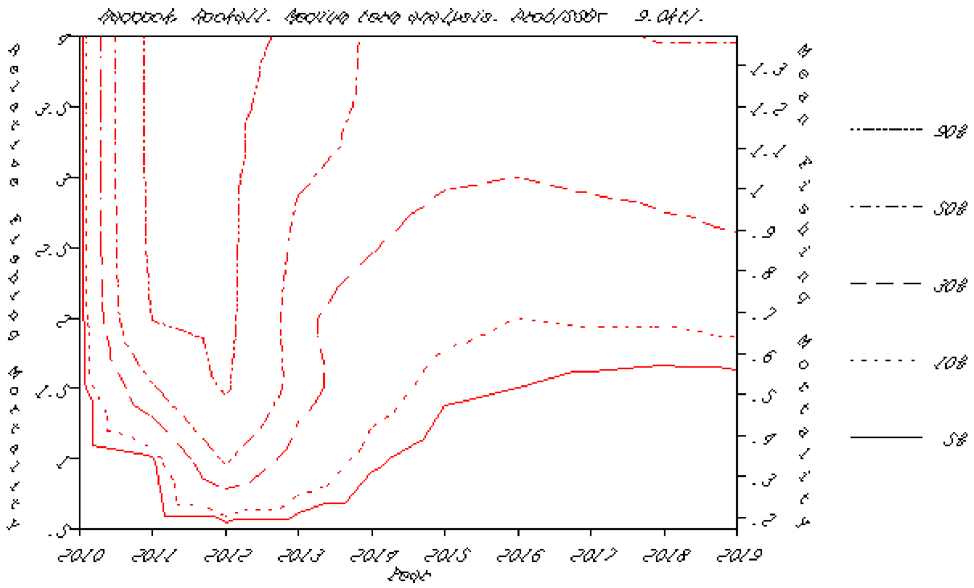


Figure 4.3.42. Haddock VIb. Medium-term analysis.

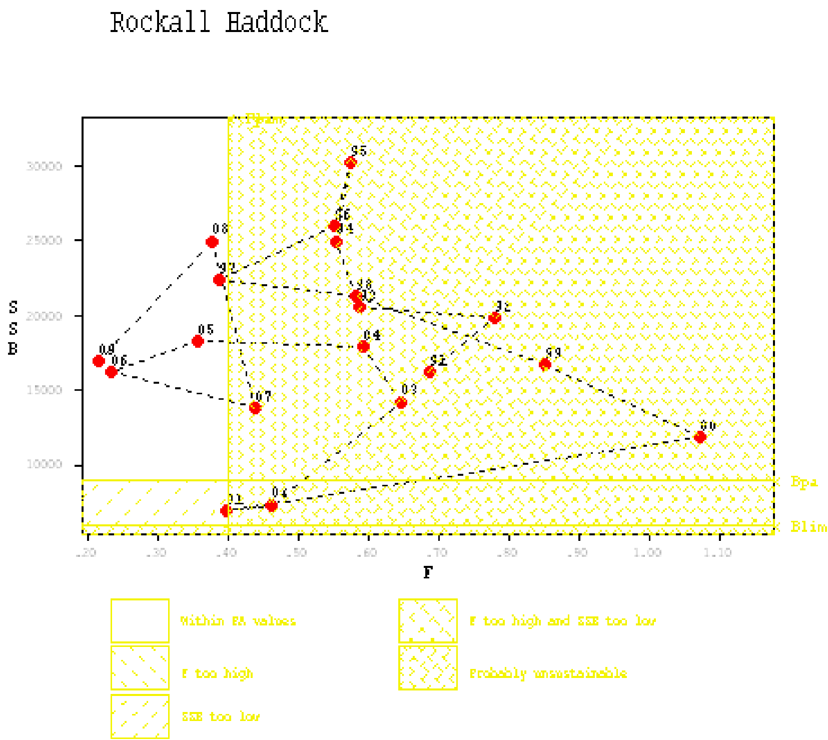


Figure 4.3.43. Haddock in VIb. Biological reference points.

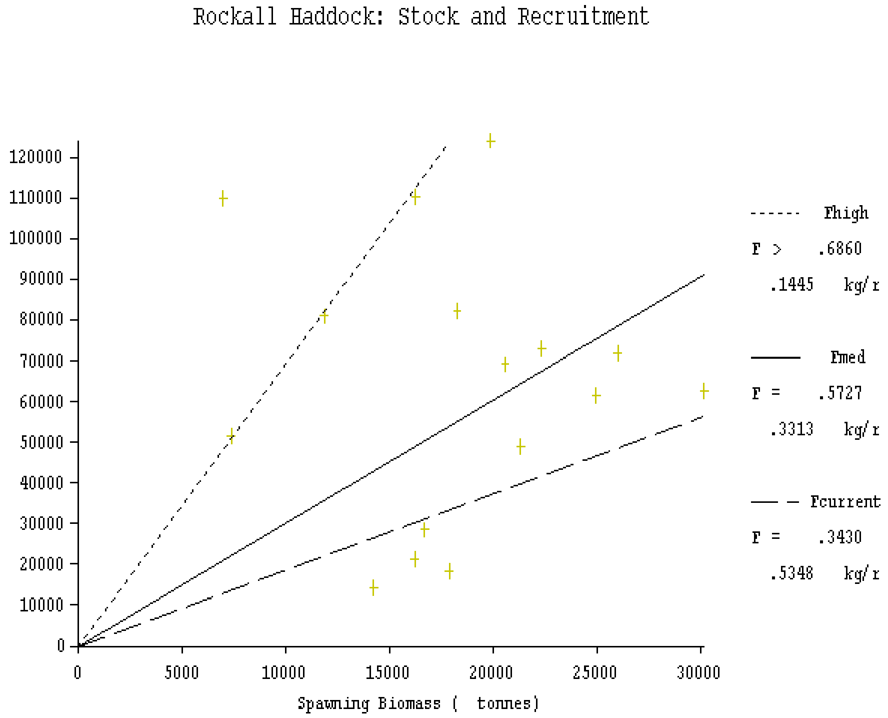


Figure 4.3.44. Haddock in VIb. SSB and recruitment.

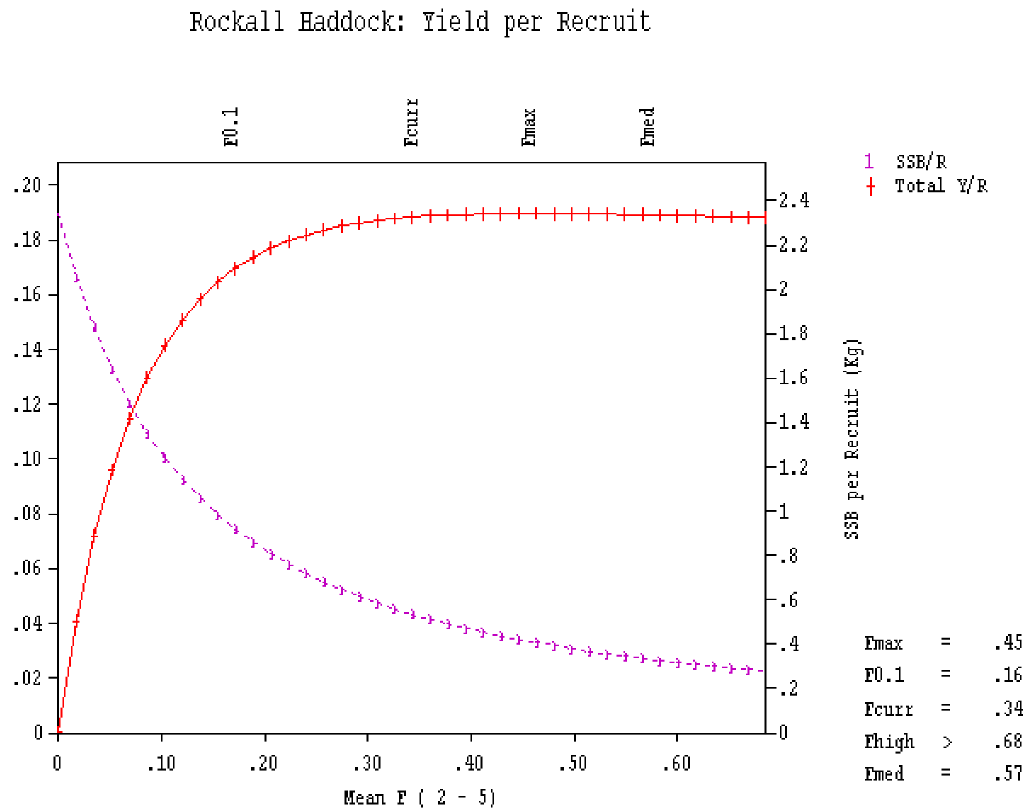


Figure 4.3.45. Haddock in VIb. Yield-per-recruit.

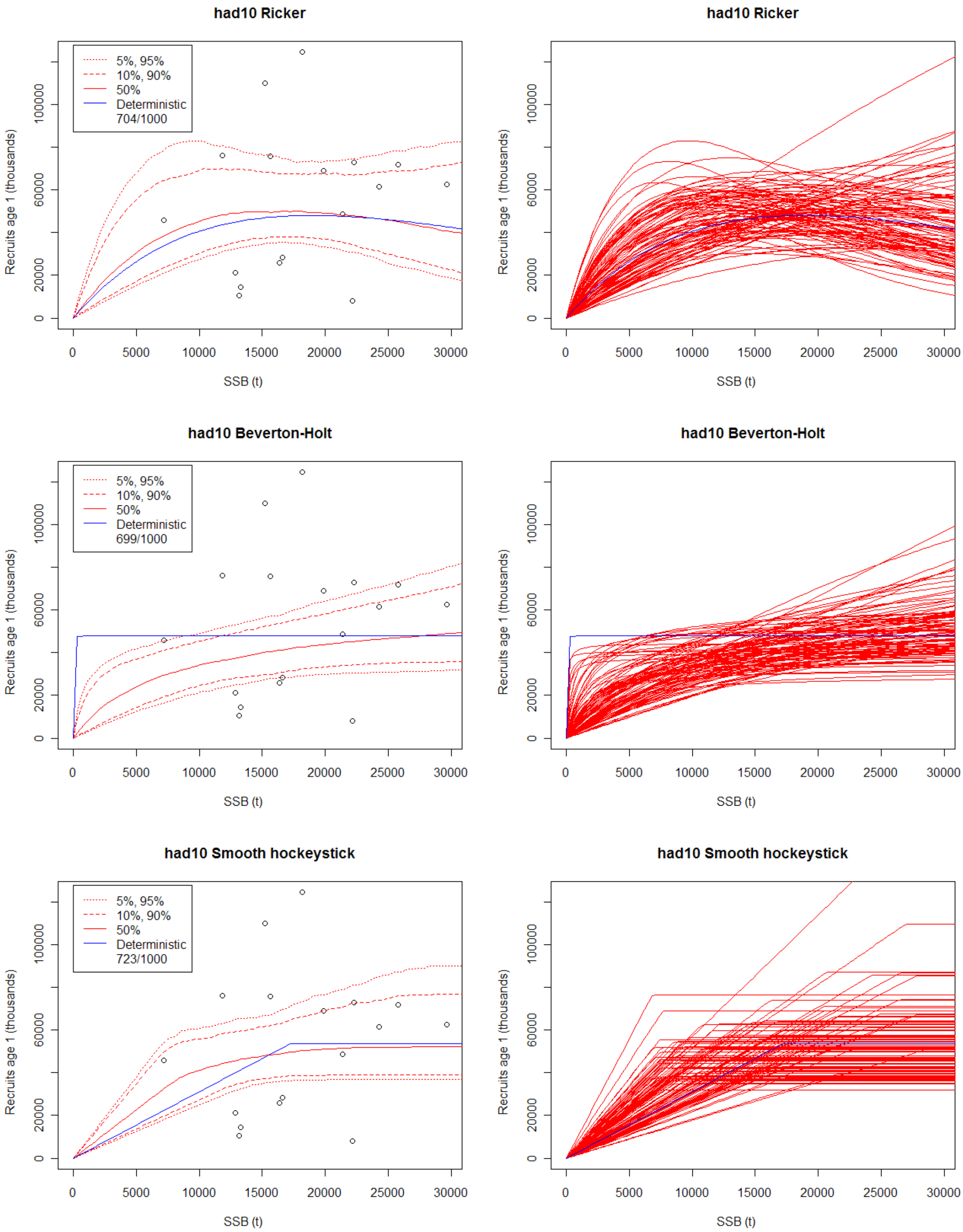


Figure 4.3.46. Haddock in VIb. Fitted stock–recruit relationships with 1000 MCMC re-samples. The left-hand plots show the deterministic fit (blue) as well as the confidence intervals from converged estimates of F_{msy} (red). Right-hand panels show the fits from the first 100 converged MCMC re-samples for illustration. The legends show the number of converged values for F_{msy} from 1000 re-samples.

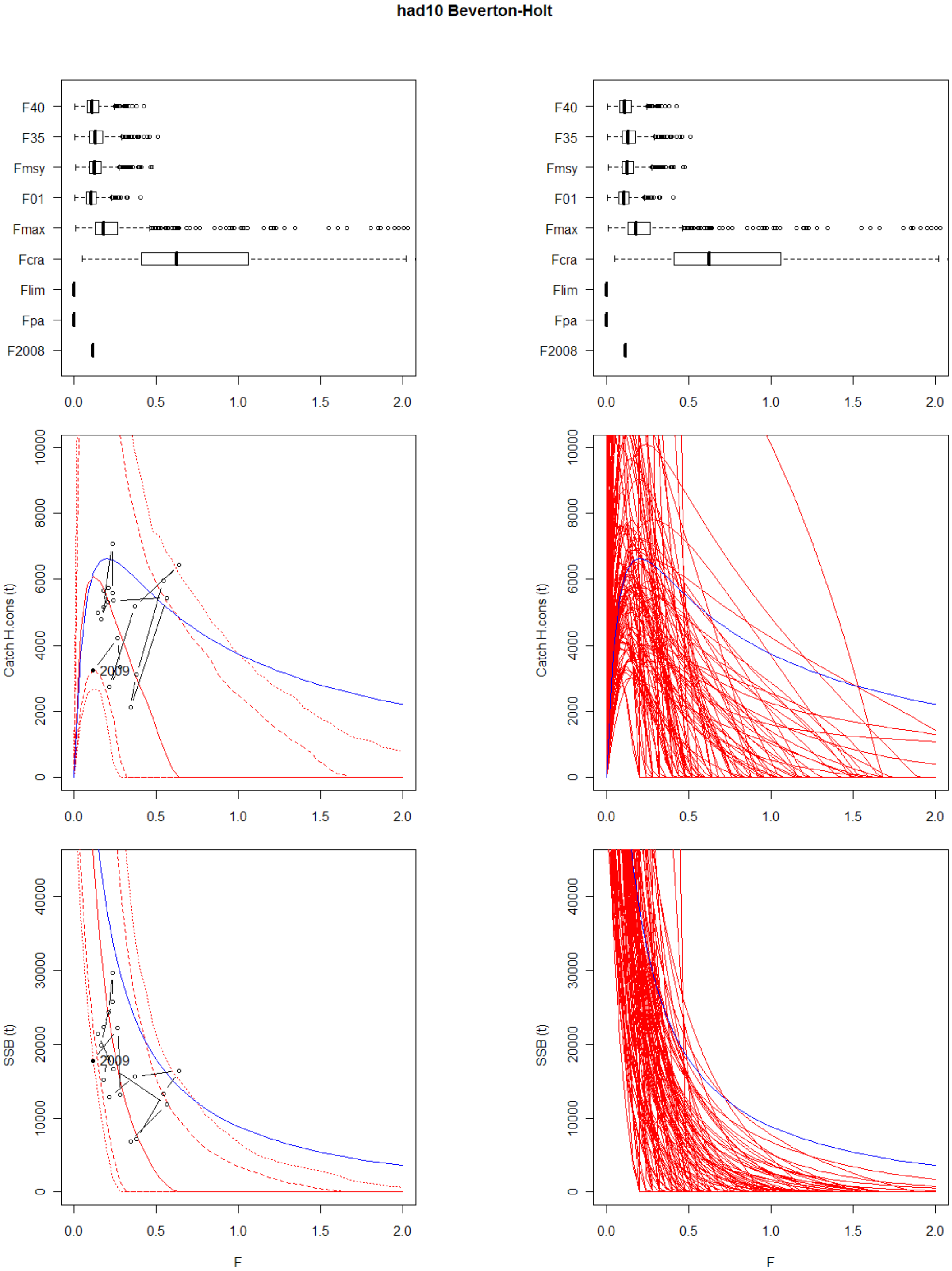


Figure 4.3.47. Haddock in VIb. Estimates of F reference points and equilibrium yield and SSB against mortality using a Beverton and Holt recruitment model. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals of the converged estimates (red) and the right hand plots show the fit for the first 100 re-samples for illustration. The top two plots are identical.

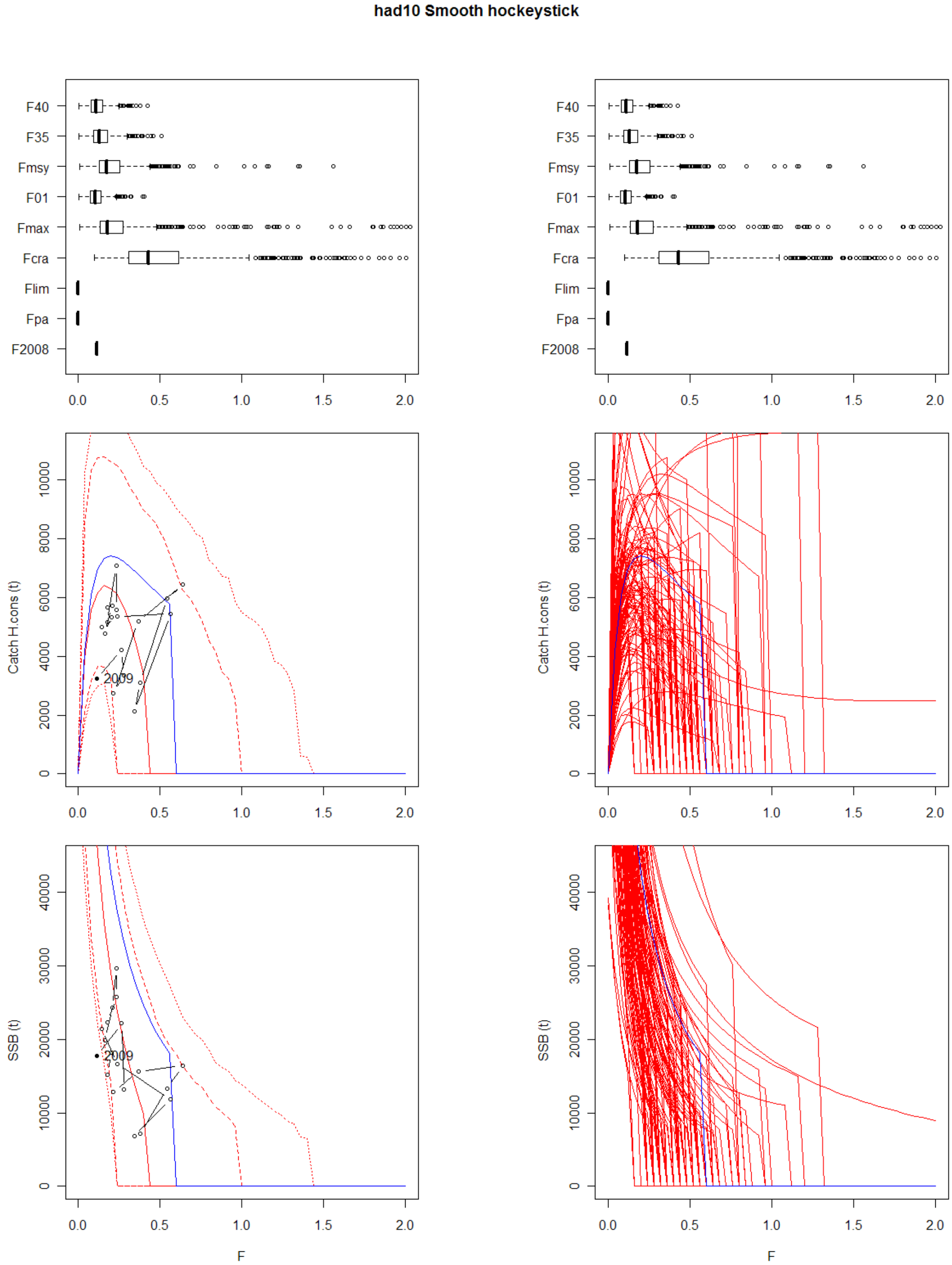


Figure 4.3.48. Haddock in VIb. Estimates of F reference points and equilibrium yield and SSB against mortality using a hockey stick recruitment model. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals of the converged estimates (red) and the right hand plots show the fit for the first 100 re-samples for illustration. The top two plots are identical.

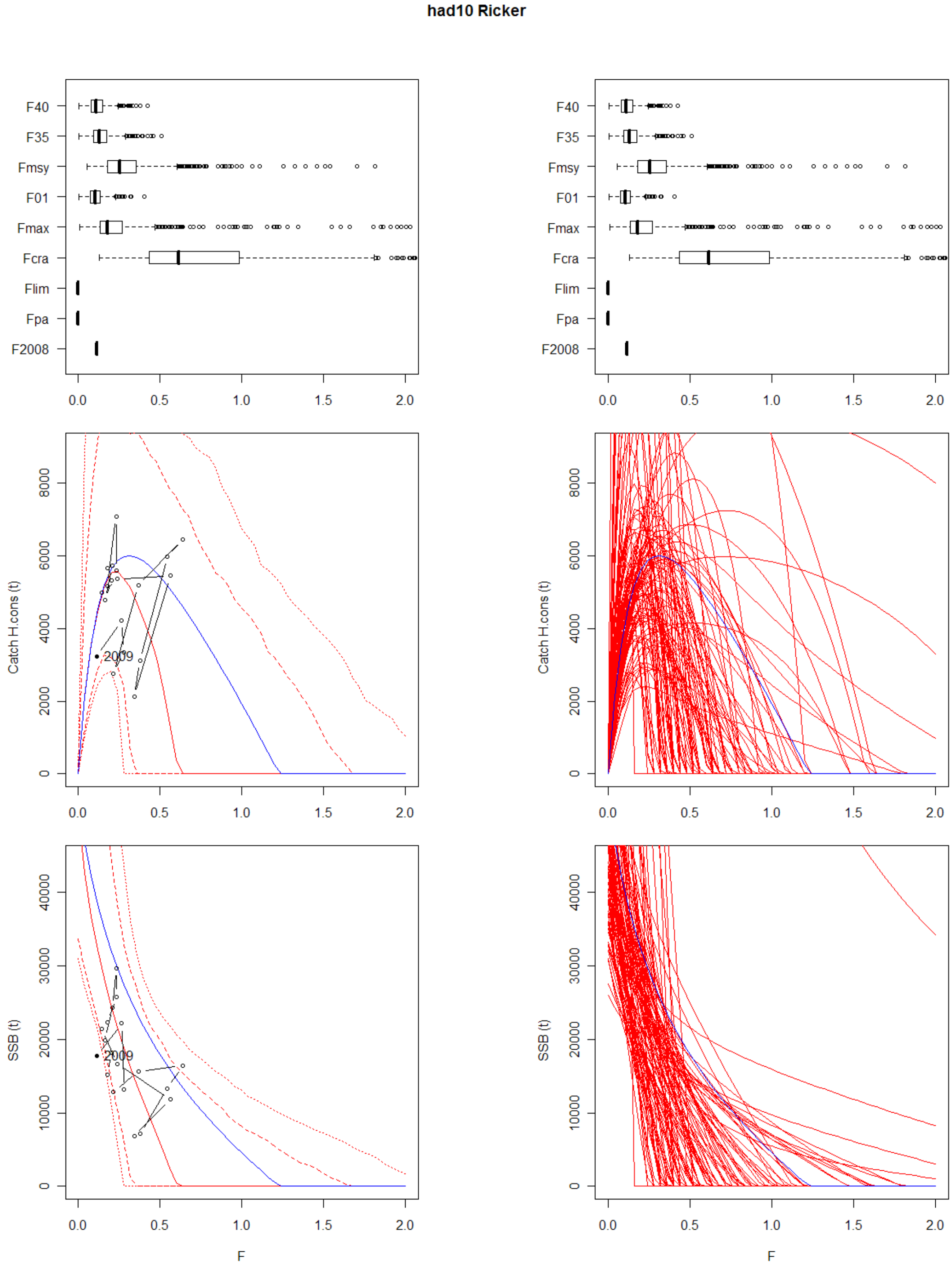


Figure 4.3.49. Estimates of F reference points and equilibrium yield and SSB against mortality using a Ricker recruitment model. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals of the converged estimates (red) and the right hand plots show the fit for the first 100 re-samples for illustration. The top two plots are identical.

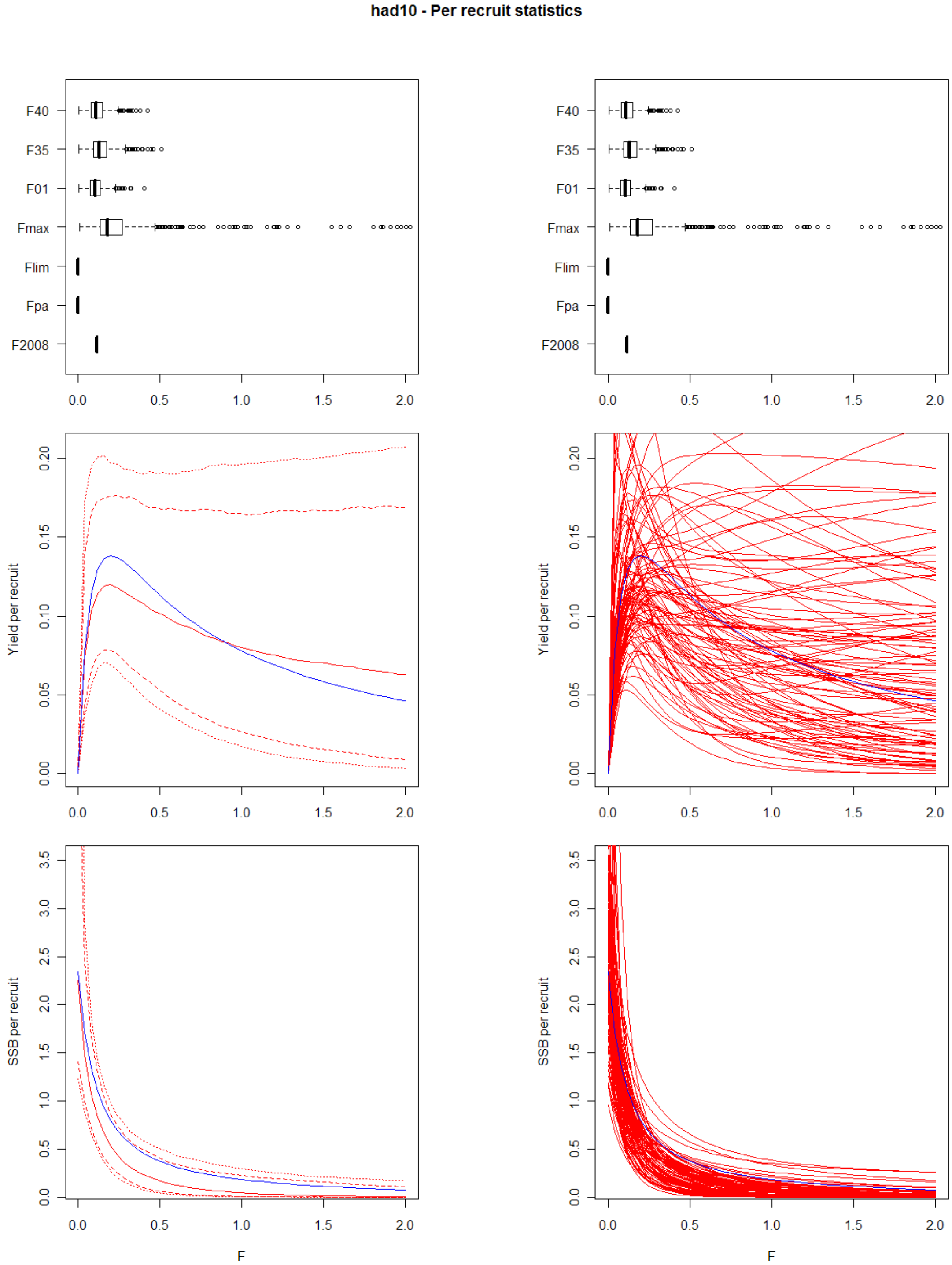


Figure 4.3.50. Fitted of F reference points and equilibrium yield and SSB. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals (red) and the right hand plots show the fit for the first 100 iterations. The top two plots are identical.

5.1 Northern Shelf overview

There is no overview.

5.2 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIa, IIIa, Subarea IV and VI

The WGNSDS considered the stock structure of anglerfish on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. However, for the purposes of reporting, anglerfish in IIa is treated in a separate section (5.2.2) from anglerfish on the northern shelf (Div. IIIa, Subarea IV and VI, Section 5.2.1), but the advice refers to both.

5.2.1 Anglerfish in Division IIIa, Subarea IV and VI

There has been no assessment of the anglerfish stock on the northern shelf since 2003. Recent ACFM review groups have highlighted the generally poor data for this stock and the need to continue with the recently instigated data collection schemes (both survey and commercial data) in order to obtain time-series of sufficient length. Since 2005, an annual science- industry partnership survey has been conducted by the Scottish, and in some years, Irish institutes: updates to these survey data are presented this year, along with updates to catch and effort data where available.

ICES advice applicable to 2009 and 2010

The ICES advice for 2009 (Single Stock Exploitation Boundaries) was as follows:

"The new data available for this stock do not change the perception of the stock and do not give reason to change the advice from 2007. The advice for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: The effort in fisheries that catch anglerfish should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycatch fish.
In addition, ICES offers the following considerations: Following ICES suggestions in 2005 a number of initiatives were instigated covering anglerfish in Division IVa and Subarea VI:

- *dedicated Scottish and Irish scientific anglerfish surveys which are coordinated to involve the use of both research vessels and commercial fishing vessels;*
- *a Scottish tallybook scheme (linked to a longer time-series of personal diaries);*
- *increased observer coverage (short-term initiative in 2006).*

Data are currently being gathered, with improvements to both industry-related data and surveys covering Subarea VI and part of the North Sea. There are currently 3 years of survey-derived absolute abundance estimates and 2 complete years of Scottish tallybook data providing commercial catch data."

The ICES advice for 2010 (Single Stock Exploitation Boundaries) was as follows:

"ICES advises on the basis of precautionary considerations that the effort in fisheries that catch anglerfish should not be allowed to increase."

5.2.1.1 General

Stock description and management units

For the purposes of this section, the anglerfish stock on the Northern Shelf is considered to occur in Divisions IIa, IIIa (Skagerrak and Kattegat), Subarea IV (the North Sea) and Subarea VI (West of Scotland plus Rockall). Anglerfish in the North Sea and

Skagerrak/Kattegat were considered by this Working Group for the first time in 1999. In 2004, the WG was asked to consider the stock structure of anglerfish on a wider Northern European scale and despite a lack of conclusive evidence to indicate a single stock, anglerfish in IIa was included in the ToR at subsequent WG meetings.

Management of Northern Shelf anglerfish is based on separate TACs for the North Sea area and West of Scotland area. The following Table summarises ICES advice and actual management applicable for Northern Shelf anglerfish during 2003–2008.

Year	Single stock exploitation boundary	Basis	West of Scotland			North Sea		
			TAC[4)]	% change in F associated with TAC	WG landings	TAC[5)]	% change in F associated with TAC	WG landings
2003	<67001)	Reduce F below F_{pa}	3180	49% reduction	4126	7000	49% reduction	8268
2004	<88002)	Reduce F below F_{pa} [2)]	3180	48% reduction	3296	7000	48% reduction	9027
2005	-	No effort increase[2)]	4686	-	n/a	10314	-	n/a
2006	-	No effort increase[2)]	4686	-	n/a	10314	-	n/a
2007	-	No effort increase[2)]	5155	-	n/a	11345	-	n/a
2008	-	No effort increase[3)]	5155	-		11345	-	
2009	-	No effort increase[3)]	5567	-		11345	-	
2010	-	No effort increase[3)]	5567	-		11345	-	

All values in tonnes.

[1)] Advice for Division IIIa, Subarea IV and Subarea VIa combined.

[2)] Advice for Division IIIa, Subarea IV and Subarea VI combined.

[3)] Advice for Division IIa, Division IIIa, Subarea IV and Subarea VI combined.

[4)] TAC applies to Vb(EC), VI, XII and XIV.

[5)] TAC applies to IIa & IV (EC)

Although there is no minimum landing size for this species, there is an EU minimum weight of 500 g for marketing purposes (EC Regulation 2406/96).

An additional quota of 1540 t is also available for EU vessels fishing in the Norwegian zone of Subarea IV in 2010.

The fishery in 2009

A description of the fisheries on the northern shelf is given in Section 5.1 above.

UK (Scottish) vessels account for 47% of the reported anglerfish landings from the Northern Shelf area. The Danish and Norwegian fleets are the next most important exploiters of this stock in the North Sea while French vessels take the majority of the landings from the West of Scotland followed by the UK and Ireland.

The official landings by area are given in Table 5.2.1 and the breakdown by country in Tables 5.2.2–4. In 2009, total [officially reported] landings (16 539 t) were lower than in 2008 (17 300). This was largely due to a reduction in [officially reported] landings in Division VIa and IVa by the UK (Table 5.2.2). Total officially reported landings of anglerfish from the Northern Shelf are shown in Figure 5.2.1. During the 1970s landings were fairly stable at around 9000 t, but from about 1983 they increased steadily to a peak of over 35 000 t in 1996, and then declined rapidly during the following five years. However, any subsequent declines in reported landings may have been due to restrictive TACs and are not necessarily representative of actual landings. The overall trend in landings is driven by the landings from the Northern North Sea and West of Scotland. Together these two areas account on average for approximately 80% of the total landings over 1973–2009.

Uptake of EC quota, based on the officially reported landings was as follows:

	TAC[1]	Landings	Uptake (%)	TAC			Landings	Uptake (%)
	VI	VI		IV (Norwegian)	IIa & IV	IIa & IV (total)	IIa & IV (total)	
Belgium	200	0	0	47	401	448	139	31
Denmark		0		1189	884	2073	1693	82
France	2462	2289	93		82	82	0	0
Germany	228	211	93	19	432	451	233	52
Ireland	557	419[2]	75				0	
Netherlands	193	0	0	17	303	320	53	17
Spain	214	0	0				0	
Sweden		0			10	10	27	270
UK (total)	1713	2065	121	278	9233	9511	8172	86
Total	5567	4936	89	1550	11 345	12 895	10 317	80

[1]TAC applies to VI, Vb(EC), and international waters of XII and XIV.

[2] Provisional

Catches in Division IIIa are not regulated: Table 5.2.4 shows the official landings which came to a total of 548 t in 2009. The landings by fleet for Denmark and Norway are given in Figures 5.2.2 and 5.2.3 respectively. The Irish fleet is dominated by demersal trawlers and so it is not shown here.

5.2.1.2 Data

Landings

The TACs for both the West of Scotland and North Sea areas were reduced substantially in 2003 and 2004, and at previous WGs it has been highlighted that these reductions would likely imply an increased incentive to mis-report landings and increase discarding unless fishing effort was reduced accordingly (Section 6.4.6, ICES WGNSDS 2003). Anecdotal information from the fishery in 2003 to 2005 appeared to suggest that the TACs were particularly restrictive in these years. The official statistics for these years are, therefore, likely to be particularly unrepresentative of actual landings. The introduction of UK & Irish legislation requiring registration of all fish buyers and sellers (See Section 1.7) may mean that the total reported landings from 2006 onwards are more representative of actual total landings.

In the meantime, collation of an international landings-at-age dataset is being hampered by the different approaches to age determination by the institutes which could provide these data. It has been proposed by ICES PGCCDBS that this be addressed using an anglerfish ageing exchange to be held in 2011.

The absence of a TAC for Subarea IV prior to 1999, means that before 1999, landings in excess of the TAC in other areas were likely to be misreported into the North Sea. In 1999, a precautionary TAC was introduced for North Sea anglerfish, but unfortunately for current and future reporting purposes, the TAC was set in accord with recent catch levels from the North Sea which includes a substantial amount misreported from Subarea VI. The area misreporting practices have thus become institutionalised and the statistical rectangles immediately east of the 4°W boundary (E6 squares) have accounted for a disproportionate part of the combined VIa/North Sea catches of anglerfish. The Working Group historically (prior to 2005) provided estimates of the actual Division VIa landings by adjusting the reported data for Division VIa to include a proportion of the landings declared from Division IVa in the E6 ICES statistical rectangles. This adjustment has been adapted to include landings declared from the whole of Area VI. Details of how the correction has been applied are given in the Stock Annex. Scottish officially reported landings adjusted for area misreporting are shown along with landings from Ireland, Denmark, France and Norway in Figure 5.2.4. Due to ongoing technical problems associated with changes to the Marine Scotland database and lack of landings data provided to the Working Group by some of the major nations exploiting the fishery, WG estimates of the actual Division VIa and IVa landings have not been calculated for recent years (2005–2008).

The corrected spatial distribution of anglerfish landings shows a typical pattern, with most landings being taken from the area around Shetland and also the area to the west of Scotland close to the shelf edge. Some landings, associated with the *Nephrops* fishery, are taken from the Fladen ground in the middle of the northern North Sea. A substantial amount of landings were taken from Rockall. The spatial distribution of Danish landings shows the typical pattern of higher landings around the Norwegian deeps. The Irish fishery in 2008 landed principally from the west coast of Ireland and in the south of Division VIa, with some landings from Rockall.

Consideration should be given in future to examining the distribution of landings combined with vessel monitoring system (VMS) data, perhaps using a kilowatt fishing hours metric to produce spatial distributions of lpue.

Commercial catch-effort data

Scotland

Reliable effort data (in terms of hours fished) are not available from the Scottish trawl fleets due to changes in the practices of effort recording and non-mandatory recording of hours fished in recent years. Further details can be found in Section B4 of the Stock Annex and the Report of the 2000 WGNSSK (ICES, 2001). Effort data in terms of days fished are available from official logbooks and these data are presented by gear in the report of WGNSDS 2007. However, given the uncertainties associated with the official landings from the recent past, no attempt has been made to use these data to calculate an lpue series and they have not been updated this year.

Attempts have recently been made to obtain more reliable data on catch and effort from the Scottish anglerfish fishery. In 2005, an analysis of data collated from the personal diaries of Scottish skippers operating across the Northern Shelf was presented to this WG (ICES, 2006 and Bailey *et al.*, 2004). Following recommendations made by ACFM that this data collection scheme should be continued and extended, in 2006, Marine Scotland Science (in consultation with the fishing industry) established a monkfish tallybook project. A fuller description and analysis of these data can be found in the WGNSDS 2008 Report and Dobby *et al*. (2008). However, at present there are problems in the scheme in terms of falling participation levels (four vessels in 2008; two vessels in 2009): this is unlikely to give a representative picture of the fishery and so updates of these data are not included.

Ireland

Trends in official landings, effort in hours fished) from the Irish otter trawl fleets (OTB) operating in Division VIa and VIb are shown in Table 5.2.7 and Figure 5.2.5. This fleet is responsible for the majority of the landings from the south of Division VIa. Landings and effort data from the other fleets (1995–2006) are available in the Stock Annex. The Irish lpues from logbooks are shown in Figure 5.2.5. The time-series show increasing trends in (particularly) Division VIa in recent years. However, it is not clear whether such trends are indicative of stock trends as such increases in lpue could also be due to changes in targeting behaviour due to reductions in fishing opportunities for other species and changes in reporting practices.

Denmark

Danish logbook data for anglerfish landings and corresponding effort by main fishery in the North Sea and IIIA for the period 2000–2009 are shown in Table 5.2.5. Figure 5.2.6 and Table 5.2.8 show the fluctuations in lpue for anglerfish in mixed demersal fisheries and the shrimp fishery (small meshed). Of particular relevance is the series for the mixed demersal trawl fisheries in the North Sea including *Nephrops* trawls as these are where most anglerfish is taken (Table 5.2.5). Note the upwards trend, especially from 2003 to 2004 for all fisheries and the subsequent stabilisation in lpue. A time-series, 1997–2008, corrected for increase in fishing power for the shrimp trawl lpue indicates a declining trend over the time-series (Figure 5.2.6). There has been an increase in overall effort in 2008 and 2009 (Table 5.2.5 B).

Anecdotal information from Danish fishermen suggests that this apparent levelling off in lpue is due to the TAC constraints on the Danish fishery in the Norwegian EEZ since 2005, which was not in evidence in previous years. Although catch rates are not declining, the TAC constraints and possible technological creep currently render it problematic to use these logbook based lpues as indicators of stock abundance.

Norway

Available logbook data from Norwegian trawlers have been examined for the possibility of establishing a cpue time-series for anglerfish. However, several problems were encountered in the dataset, and it is still considered insufficient for providing any reliable information on trends in stock abundance.

Six gillnetters have been included in a self-sampling scheme established along the Norwegian coast within IVa and IIIa. Detailed information about effort and catch will be provided through this scheme, and will potentially be valuable in future assessments of anglerfish in this area.

Other countries

No effort data were available for the Spanish and French fleets operating in Subarea VI.

Research vessel surveys

At previous meetings of this WG it has been concluded that the traditional groundfish surveys are ineffective at catching anglerfish and do not provide a reliable indication of stock size. As a result of this conclusion, and the urgent requirement for fishery-independent data, Marine Scotland Science, began a new joint science/industry survey in 2005. This is a targeted anglerfish survey using commercial gear. In 2006, 2007 and 2009, Ireland also participated extending the anglerfish survey to cover the remaining part of VIa (from $54^0 30'$ to $56^0 39'$) and, in 2006 and 2007, into ICES Areas VIIb,c,j. Further details of the survey including information on design, sampling, gear and vessel were recently considered by ICES WKAGME and are available in ICES (2009).

Results from previous surveys, as described in previous Working Group reports, did not take into account certain errors in the estimation process. In addition to reporting the results of the 2009 surveys, new abundance and biomass estimates are now provided for the 2005–2009 surveys (summarised in Table 5.2.9) with the appropriate error and its propagation (see WD 5, Fernandes, 2010 and WD 6, Yuan *et al*., 2009). The estimates presented this year, represent the best available knowledge to date from the five surveys carried out (2005–2009) and as such they take into account the following factors:

1) herding of anglerfish by the trawl doors and sweeps;

2) escapes of fish under the trawl footrope;

3) anglerfish abundance and biomass in the southern part of Area VI not covered in 2005 and 2008;

4) visual counts of anglerfish in areas closed to trawling at Rockall;

5) variability due to

  5.1) sampling

  5.2) missing ages

  5.3) herding (based on experimental data)

  5.4) footrope escapes (based on experimental data)

The estimates currently do not take account of the following:

1) areas in the central and southern North Sea (eastern part of ICES Division IVa and all of IVb and IVc);

2) areas inaccessible to the trawl in Division VIa.

Methods to account for these factors are under development.

The 2009 survey took place in April: the sample locations for (n = 206) are illustrated in Figure 5.2.7 as the number density (number per square kilometre) and Figure 5.2.8 as the weight density (kilograms per square kilometre) of anglerfish. The highest densities of anglerfish occurred close to the 200 m contour in the northern and western areas, including the northern North Sea (particularly by weight). Very high densities were found on the east coast of the Rockall plateau. The results of the survey are presented in Table 5.2.9. The total estimate for the whole northern shelf in 2009 was 35 800 t with 95% confidence limits of 28 600 to 44 700 tonnes. The Relative Standard Errors for the Scottish components were 12.1 % and 14.5% for abundance and biomass respectively for the Northern shelf. The incomplete survey in ICES Area IV gave a slightly lower biomass of 17 100 t than the largely complete survey estimate in ICES Area VI of 18 700 t. The estimates-at-age (Figure 5.2.9) indicate that despite corrections for catchability, which largely affect the smaller, younger fish, there is still an issue with catchability which is unaccounted for. It should also be noted that ageing of anglerfish is still uncertain. The last angler (*Lophius* spp.) otolith exchange took place in 2001 and the last black-bellied angler (*L. budegassa*) otolith exchange took place in 2004. Landa *et al.* (2008), however, noted that previously used ageing criteria are not accurate. There is ongoing research to establish if a new protocol should be established when using illicia to estimate age. Full exchanges of otoliths and illicia are therefore recommended for 2011, when new ageing criteria are expected (ICES 2010).

The time-series estimates indicate that biomass increased in most areas from 2005 to 2008, but decreased in 2009, whereas abundance was stable in 2005–2007 and has since declined (Table 5.2.9 and Figure 5.2.10). The estimates of abundance of anglerfish from the surveys from 2005–2009 are in line with previous attempts to quantify their abundance (ICES 2004): the last assessment estimated the total stock biomass to be just under 37 000 t in 2002. There are still several factors which make the survey estimates likely to be underestimates or minimum estimates. Firstly, although experiments have been carried out to estimate escapes from under the footrope, and a model applied to account for this component of catchability, the estimates of younger anglerfish (ages 0–3) still look to be underestimated (Figure 5.2.9). This could be due to either a net selectivity issue, or an availability [to the trawl] issue, as it is known that younger fish occur in shallower water (Hislop *et al*., 2001). Methods to compensate for these additional catchability and availability factors are being considered by developing a survey based assessment model. Secondly, the area considered was not complete. Although only a small part of ICES Area VI was missed, quite a large part of ICES Area IV was not surveyed (Figure 5.2.8). Although repeated requests have been made to countries with an interest in the anglerfish fishery to consider participating, no other countries have done so, with the exception of the Irish who participated in 2006, 2007 and 2009. The problem is, therefore, being tackled by an examination of data from the International Bottom Trawl survey. If a relationship can be found between the IBTS survey data and the data from the anglerfish survey where they overlap, then abundance estimates in the southern North Sea could be derived by interpolation where there is only IBTS data. These methods are currently under development (see ICES WKAGME 2009).

5.2.1.3 Historical stock development

There has been no assessment of this stock since the length based assessment presented in ICES (2004). This indicated a total stock size of approximately 36 590 t in 2002.

The estimates of abundance of anglerfish from the surveys from 2005–2009 are in line with these previous attempts to quantify their abundance. There are still several factors which make the survey estimates likely to be underestimates or minimum estimates (see above).

5.2.1.4 Short-term projections

In the absence of an age based assessment, there are no short-term projections for this stock.

The European Commission's Consultation on Fishing Opportunities for 2010 (COM(2009) 224), sets out an approach to set the TACs in cases where scientific advice on an appropriate catch level is provided, but a quantified stock assessment calculation is not available, usually for reasons of uncertain data quality.

Subarea	Period	avg survey biomass (tonnes)	% change	TAC change	2010 TAC*	2011 TAC
IV	2005–2007	23,210				
	2008–2009	23,365	+1	NA		
VI	2005–2007	20,265				
	2008–2009	21,192	+5	NA		
VIa	2005–2007	12,548				
	2008–2009	10,306	-18	NA		
VIb	2005–2007	7,717				
	2008–2009	10,886	+41	+15	3711	4453

***2010 TACs are set according to ICES Subareas: the proportion of biomass in Subarea VI attributed to Division VIb was used to apportion the Subarea VI TAC into an allocation for VIb.**

Anglerfish will come under this "Category 6 to 9" grouping of stocks in 2010. The Table above shows the outcome of applying the Commission's rules 4 and 5 of Annex III for Category 6 to 9 based on the survey data from 2008 compared to the outcome (actual TAC in 2009).

In terms of setting the TAC for 2011, this needs to be based on the 2010 survey which has recently been completed: The data from the 2010 survey should be considered along with other ICES' survey updates later on in the year.

5.2.1.5 MSY evaluations

In terms of the status of F in relation to F_{msy} there are two major uncertainties. The first is the value of F_{msy}. Previous WG have considered that the fishing mortality corresponding to 35% of the unfished SSB/R could be an approximation of $\mathbf{F}_{MSY}$: this is what F_{pa} was set to ($\mathbf{F}_{35\%SPR}$ = F_{pa} = 0.30). Another suitable proxy might be $F_{0.1}$, which like $\mathbf{F}_{35\%SPR}$, would be derived from a yield-per-recruit analysis. However, as yet no assessment is available to determine the fishing mortality [selection] pattern which is required for a Y/R analysis. The second uncertainty is the current level of fishing mortality, where, in the absence of an assessment, this is also unknown. However, if the ageing of anglerfish in the surveys described above is assumed to be accurate and the survey is sampling the population in an unbiased way then a provisional estimate of total mortality (Z) from abundance curves would be approximately 0.6. Given an assumed natural mortality of 0.15 (as used in past assessments) this would imply an F at about 0.45. The last time a yield-per-recruit was carried out (ICES 2004), $F_{0.1}$ was estimated at 0.12 and $F_{35\%SPR}$ was 0.12. F_{pa} for this stock was based on an earlier estimate of $F_{35\%SPR}$ at 0.3. Even with the various uncertainties expressed, it seems likely that this stock is, therefore, being exploited at a fishing mortality in excess of F_{msy}.

5.2.1.6 Biological reference points

	Type	Value	Technical basis
Precautionary approach	B_{lim}	Not defined	There is currently no biological basis for defining B_{lim}
	B_{pa}	Not defined	
	F_{lim}	Not defined	There is currently no biological basis for defining F_{lim}
	F_{pa}	0.30	$F_{35\%SPR}$ = 0.30. This fishing mortality corresponds to 35% of the unfished SSB/R. It is considered to be an approximation of F_{MSY}.
Targets	F_y	Not defined	

(unchanged since 1998).

5.2.1.7 Management plans

There is no management plan for this stock.

5.2.1.8 Uncertainties and bias in assessment and forecast

This WG has previously attempted assessments of the anglerfish stock(s) within its remit using a number of different approaches. As yet none have proved entirely satisfactory. The catch-at-length analysis used in previous years appears to have addressed a number of the suspected problems with the data due to the rapid development of the fishery, and has also provided a satisfactory fit to the catch-at-length distribution data. However, since 2003, the WG has been unable to present an analytic assessment due to the lack of reliable fishery and insufficient survey information, and in addition it is not known to what extent the dynamic pool assumptions of the traditional assessment model are valid for anglerfish.

Commercial data

For a number of years the WG has expressed concerns over the quality of the commercial catch-at-length data because of:

- Accuracy of landings statistics due to species and area misreporting.
- Lack of information on total catch and catch composition of gillnetters operating on the continental slope to the north west of the British Isles (See the Stock annex for further details of this fishery).

However, the introduction of legislation on buyers and sellers registration in the UK and Ireland since 2006 may mean that the reported landings for 2006 onwards are more reliable.

The recent Scottish tallybook scheme has been implemented as part of a long-term approach to provide better information on the fishery. Although the time-series of data is currently short, the scheme did have the potential to deliver relatively extensive information on spatial and depth distribution of catch rates provided that participation remains high. In addition to total catch rate information, the fishermen were also asked to provide information on landings by size category, discards, catches of mature females and bycatches of other species. However, participation in this scheme has fallen significantly and is now hampered by data sensitivities associated with the compliance of fishery regulations. The tally book programme is likely to be terminated as a result.

Survey data

In addition to obtaining estimates of abundance from swept area methods (and in future a times-series of data for use in survey based assessments), a visual count method is being developed at Marine Scotland Science to provide alternative estimates of anglerfish density. It is also anticipated that the new Scottish-Irish science/industry survey will provide further useful information on the biology and stock structure of anglerfish. So far, a total of 48 live anglerfish have been tagged with data storage tags on the Marine Scotland Science surveys which if and when recovered will provide information on the vertical migration, depth distribution and temperature regime of individuals (recently, a tag has been returned from a fish which was tagged in 2005; these data are currently being retrieved from the tag manufacturer). Tagging carried out on the Irish survey (800 ribbon tags) should also provide information on movement of anglerfish.

In 2006, 2007 and 2009 Ireland extended the survey area to include the more southerly regions of the Northern Shelf stock of anglerfish area not covered by the Scottish survey. However the participation of other nations in a collaborative survey to include coverage of waters in the east and south of the North Sea would be invaluable.

Biological information

Knowledge of the biology of anglerfish is improving. Some of the basic biological parameters used in the assessments, such as mean weight-at-age in the stock, are now becoming available from the industry science surveys. Difficulties still remain in finding mature females. However, recent studies by Laurenson *et al*. (2005; 2008) carried out whilst observing the fishery, have obtained similar growth parameters and maturity ogives to those previously used. A further discussion of the biology can be found in the Stock Annex.

In addition, ageing has not been validated and should still be regarded as uncertain. An ageing exchange is due to be carried out in 2011.

Stock structure

Currently, anglerfish on the Northern Shelf are split into Subarea VI (including Vb(EC), XII and XIV) and the North Sea (& IIa (EC)) for management purposes. However, genetic studies have found no evidence of separate stocks over these two regions (including Rockall) and particle-tracking studies have indicated interchange of larvae between the two areas (Hislop *et al*., 2001). So, at previous WGs, assessments have been made for the whole Northern Shelf area combined. In fact, both microsatellite DNA analysis (O'Sullivan *et al*., 2005) and particle tracking studies carried out as part of EC 98/096 (Anon, 2001) also suggested that anglerfish from further south (Subarea VII) could also be part of the same stock.

Following the recent expansion of the anglerfish fishery in ICES Divisions IIa and V, in 2004 the WG group was asked to consider the stock structure on the wider Northern European scale (Section 16 of the WGNSDS_{2004} Report). It was concluded that there was currently insufficient information to conclusively define new stock areas for assessment and further co-ordinated work is still required. Given the request to also assess anglerfish in Division IIa and that there may be an extension to include ICES Division V in the near future, the likely spatial disaggregation of the stock (drift of larvae and possible migration of mature fish back into deeper water) means that any assessment model would need to be spatially structured, possibly supported by assessments for each of the stock units separately. Given the problems with data quality associated with Northern Shelf anglerfish, the WG wishes to highlight fundamentals required for a wider area assessment:

- Accurate information on the spatial distribution of catch and effort;
- Data on movement and migration of mature and immature individuals; and,
- An internationally co-ordinated, dedicated anglerfish survey over the wider Northern European area to include waters further east. Currently the Scottish-Irish survey provides a biomass estimate for the whole of VIa, but there is only partial coverage of the North Sea. The survey should be expanded to cover the entire distribution of the stock and this would require the participation of other nations.

5.2.1.9 Recommendations for the next benchmark

ICES has previously advised a two-stage approach for management of the anglerfish fishery. The first stage was to substantially improve the quality and quantity of data collected in the fishery while maintaining exploitation at its current level. It has stated that this was expected to take at least five years to establish useable time-series. The second stage would then be to use these data to examine alternative management approaches and harvest control rules. The data collection stage of this process is ongoing and an assessment approach is in preparation. WGCSE 2010 considers that significant progress towards assessment has been made for this stock which is still on track for a benchmark meeting in 2012.

The biological data associated with the anglerfish surveys should be evaluated and compared with existing estimates (e.g. maturity-at-age, growth rates, length distributions, sex ratios and species compositions). There are still uncertainties about the validity of age readings of anglerfish: this will be addressed by an age determination exchange and workshop. Depending on the outcome of this workshop, the catch-at-age data should then be evaluated for use in any assessment.

Irrespective of any ageing concerns, the survey estimates have underestimated the younger ages. This is in spite of the recent incorporation of a correction to account for escapes of small fish under the footrope of the survey trawl, which clearly has not accounted for all small fish. Some developments of the latter bias correction are still possible; however, it seems likely that a survey based assessment model could also be developed to determine the absolute abundance of the total population.

A number of recommendations were made at ICES WKAGME for the improvement of the anglerfish surveys. Some of these have been addressed and other will be addressed in the coming year in advance of the Benchmark. These include: improving the survey design in the light of previous estimates of density (allocation of samples to strata); providing estimates for the two species separately so that they may be incorporated separately in any assessment model (for cohort tracking for example); incorporating better procedures for [the few] missing ages; accounting for areas not surveyed in the North Sea using IBTS data; and improving the estimates of footrope escapes.

Finally, it should be stressed that, to date, efforts to extrapolate estimates of abundance into areas that have not been surveyed (southern North Sea and Subarea IIIa) have not proved particularly successful. Additional participation of nations with an interest in this fishery should be encouraged before the next Benchmark. In 2009 only

Scotland and Ireland participated in this survey and in 2010 only Scotland was able to conduct a survey.

5.2.2 Anglerfish in Division IIa

The WGNSDS considered the stock structure on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. Anglerfish in IIa is therefore treated in this separate chapter.

Type of assessment in 2010

No assessment was performed.

ICES advice applicable to 2009 and 2010

The ICES advice for 2010 (Single Stock Exploitation Boundaries) was as follows, and applies to Subarea VI, Subarea IV, Division IIIa and Division IIa:

ICES advises on the basis of precautionary considerations that the effort in fisheries that catch anglerfish should not be allowed to increase.

5.2.2.1 General

Stock description and management units

The WGNSDS considered the stock structure on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. Anglerfish in IIa is therefore treated in this separate chapter.

Fishery in 2009

There has been an expansion of the fishery in recent years. This is largely due to a northward expansion of the Norwegian gillnet fishery. Norway is by far the largest exploiter of the IIa fishery accounting for over 95% of official landings. UK is now the next most important exploiter in this area, with landings of approximately 2.5% of the total reported to ICES (Table 5.2.10). The coastal gillnetting accounts for 85–90% of the landings, while 4–6% is taken as bycatch in different offshore gillnet fisheries (Table 5.2.11).

No TAC is given for Division IIa, Norwegian waters. Catches of anglerfish in Division IIa, EC waters are taken as a part of the TAC for Subarea IV. The Norwegian fishery is regulated through:

- A prohibition against targeting anglerfish with other fishing gear than 360 mm gillnets. A discard ban on anglerfish regardless of size.
- A maximum of 10% bycatch of anglerfish in the shrimp trawl fishery, maximum 20% bycatch of anglerfish in the trawl and Danish seine fishery.
- 48 hours maximum soak time in the gillnet fishery.
- A maximum of 500 gillnets (each net being 27.5 m) per vessel.
- A closure of the gillnet fishery from 1 March to 20 May. This closure period was expanded to 20 December to 20 May in the areas north of N 65^{o} in 2008 and this area was expanded southwards to N 64^{o} in 2009.

5.2.2.2 Data

Landings

The official landings for each country are shown in Table 5.2.10. Landings in 2008 as reported to ICES for the total Division IIa were 4447 t, which is 300 t higher than the year before. No information suggests that the official landing figures from Norway give a biased estimate of the actual landings.

Discards

The absence of a TAC in Norwegian waters probably reduces the incentive to under-report landings. Anecdotal evidence from the industry, observer trips and data from the self-sampling-fleet suggest that a small percentage of the catch (not marketable) is discarded. This happens when the soaking time is too long, mostly due to bad weather. Data are not adequate for estimating discard levels yet.

Biological

Length distributions are available from the directed gillnetting during the period 1992–2009, but data is lacking 1997–2001 (Figure 5.2.11). The length data indicates a decrease in mean length of 15–20 cm occurred during the period without length samples. The mean length has increased somewhat during the last five years, but is still below the level seen during the 1990s (Figure 5.2.12). One third of the anglerfish measured during the 1990s were above 100 cm, this proportion was between 1–6% for the early 2000s and 14–17 % in 2006–2009. For 2006–2009, some length data from anglerfish caught as bycatch in other fisheries are presented in Figure 5.2.13.

Surveys

Anglerfish appears in demersal trawl surveys along the Norwegian shelf, but in very low numbers. There has been a change in the surveys, going from single species to multispecies surveys, during recent years. The procedures for data collection on anglerfish have varied and, at present, no time-series from surveys in Division IIa yields reliable information on the abundance of anglerfish.

Commercial cpue

Reliable effort data are not available from the Norwegian gillnetters due to non-mandatory effort recording. In late 2005, ten gillnetters were included in a self-sampling scheme established along the Norwegian coast within Division IIa. Detailed information about effort and catch is provided through this scheme, and will potentially be valuable in future assessments of anglerfish in this area. The time-series was examined prior to WGCSE 2010, and this revealed some data quality problems which have to be solved before any further analysis.

5.2.2.3 Historical stock development

Anglerfish in Division IIa have never been assessed quantitatively and it is not possible to describe the historical stock development.

5.2.2.4 Management considerations

The WG notes the apparent changes in size composition in anglerfish caught in the gillnet fishery. If the selectivity in the gillnets has been stable, this could be interpreted as an altering of the size spectrum in the stock. As the information on trends in effort is lacking for the main fishery, it remains unclear whether the increased landings last year might reflect an increased abundance in the area. Time-series on effort and catch by length should be established to facilitate future analytical assessments of this stock. The possibility of establishing a survey, similar to the one being carried out for the Northern Shelf area, should also be considered for Division IIa.

5.2.2.5 References

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Table 5.2.1. Anglerfish on the Northern Shelf (IIIa, IV & VI). Total official landings by area (tonnes).

	IIIa	IVa	IVb	IVc	VIa	VIb	Total
1973	140	2085	575	41	9221	127	12189
1974	202	2737	1171	39	3217	435	7801
1975	291	2887	1864	59	3122	76	8299
1976	641	3624	1252	49	3383	72	9021
1977	643	3264	1278	54	3457	78	8774
1978	509	3111	1260	72	3117	103	8172
1979	687	2972	1578	112	2745	29	8123
1980	652	3450	1374	175	2634	200	8485
1981	549	2472	752	132	1387	331	5623
1982	529	2214	654	99	3154	454	7104
1983	506	2465	1540	181	3417	433	8542
1984	568	3874	1803	188	3935	707	11075
1985	578	4569	1798	77	4043	1013	12078
1986	524	5594	1762	47	3090	1326	12343
1987	589	7705	1768	66	3955	1294	15377
1988	347	7737	2061	95	6003	1730	17973
1989	334	7868	2121	86	5729	313	16451
1990	570	8387	2177	34	5615	822	17605
1991	595	9235	2522	26	5061	923	18362
1992	938	10209	3053	39	5479	1089	20807
1993	843	12309	3144	66	5553	681	22596
1994	811	14505	3445	210	5273	777	25021
1995	823	17891	2627	402	6354	830	28927
1996	702	25176	1847	304	6408	602	35039
1997	776	23425	2172	160	5330	899	32762
1998	626	16857	2088	78	4506	900	25055
1999	660	13326	1517	24	4284	1401	21212
2000	602	12338	1617	31	3311	1074	18973
2001	621	12861	1832	21	2660	1309	19304
2002	667	11048	1244	21	2280	718	15978
2003	478	8523	847	20	2493	643	13004
2004	519	8987	851	15	2453	671	13496
2005	458	8424	688	5	3019	958	13552
2006	423	10338	685	3	2785	916	15150
2007	433	10632	749	4	3352	1260	16430
2008	486	11038	769	5	3373	1630	17300
2009	548	10286	752	8	3178	1767	16539
Min	140	2085	575	3	1387	29	5623
Max	938	25176	3445	402	9221	1767	35039
Average	564	8768	1601	82	4010	773	15798

Table 5.2.2. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

Anglerfish in Division VIa (West of Scotland)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	3	2	9	6	5	-	5	2	-	-	+	+	-	+	-	-	-	-	-
Denmark	1	3	4	5	10	4	1	2	1	+	+	.	+	+	-	-	-	-	+
Faroe Is.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3	2	1	
France	1,910	2,308	2,467	2,382	2,648	2,899	2,058	1,634	1,814	1,132	943	739	1,212	1,191	1,392	1,314	1763	1746	1928
Germany	1	2	60	67	77	35	72	137	50	39	11	3	27	39	39	1	-	54	79
Ireland	250	403	428	303	720	717	625	749	617	515	475	304	322	219	356	392	470	295	328
Netherlands	-	-	-	-	-	-	27	1	-	-	-	-	-	-	-	-	-	-	
Norway	6	14	8	6	4	4	1	3	1	3	2	1	+	+	1	1	1	2	-
Spain	7	11	8	1	37	33	63	86	53	82	70	101	196	110	82	76	3	174	
UK(E,W&NI)	270	351	223	370	320	201	156	119	60	44	40	32	31	30	20	24	42	5	
UK(Scot.)	2,613	2,385	2,346	2,133	2533	2,515	2,322	1,773	1,688	1,496	1,119	1,100	705	862	1,127	974	1,071	1096	
UK (total)																			876
Total	5,061	5,479	5,553	5,273	6,354	6,408	5,330	4,506	4,284	3,311	2,660	2,280	2,493	2,453	3,019	2,785	3,352	3,373	3,211
Unallocated	296	2,638	3,816	2,766	5,112	11,148	7,506	5,234	3,799	3,114	2,068	1,882	985	1,938					
As used by WG	5,357	8,117	9,369	8,039	11,466	17,556	12,836	9,740	8,083	6,425	4,728	4,162	3,478	4,391					

***Preliminary.**

Table 5.2.2 contd. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

Anglerfish in Division VIb (Rockall)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Estonia	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-		
Faroe Is.	-	2	-	-	-	15	4	2	2	-	1	-	-	-	-	-	-	1	
France	-	-	29	-	-	-	1	1	…1	48	192	43	191	175	293	224	327	327	361
Germany	-	-	103	73	83	78	177	132	144	119	67	35	64	66	77	72	222	0	132
Ireland	272	417	96	135	133	90	139	130	75	81	134	51	26	13	35	53	70	76	91
Norway	18	10	17	24	14	11	4	6	5	11	5	3	6	5	4	6	7	5	9
Portugal	-	-	-	-	-	-	-	+	429	20	18	8	4	19	63	-	-	-	
Russia	-	-	-	-	-	-	-	-	-	-	1	-	-	2	4	1	1	35	
Spain	333	263	178	214	296	196	171	252	291	149	327	128	59	43	34	36	12	85	
UK(E,W&NI)	99	173	76	50	105	144	247	188	111	272	197	133	133	54	93	46	146	5	
UK(Scot)	201	224	182	281	199	68	156	189	344	374	367	317	160	294	355	478	475	1096	
UK (total)																			1189
Total	923	1089	681	777	830	602	899	900	1401	1074	1309	718	643	671	958	916	1260	1630	1767
Unallocated									-9	17	-178	-47	145	121					
As used by WG	923	1,089	681	777	830	602	899	900	1392	1091	1131	671	788	792					

*Preliminary.

Total Anglerfish in Sub-area VI (West of Scotland and Rockall)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2008	2009*
Total official	5,984	6,568	6,234	6,050	7,184	7,010	6,229	5,406	5,685	4,385	3,969	2,998	3,136	3,124	3,977	3,701	5,003	4,945
Total ICES	6,280	9,206	10,050	8,816	12,296	18,158	13,735	10,640	9,475	7,516	5,859	4,833	4,266	5,183				

***Preliminary.**

Table 5.2.3. Nominal landings (t) of Anglerfish in the North Sea, as officially reported to ICES.

Northern North Sea (IVa)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	2	9	3	3	2	8	4	1	5	12	-	8	1	-	-	-	-	-	
Denmark	1,245	1265	946	1,157	732	1,239	1,155	1,024	1,128	1,087	1,289	1,308	1,523	1,538	1,379	1,311	961	1,071	1,356
Faroes	1	-	10	18	20	-	15	10	6	.	2	+	3	11	22	2	+	-	
France	124	151	69	28	18	7	7	3*	181*	8	9	8	8	8	4	7	13	13	
Germany	71	68	100	84	613	292	601	873	454	182	95	95	65	20	84	173	186	344	216
Netherlands	23	44	78	38	13	25	12	-	15	12	3	8	9	38	13	14	14	12	6
Norway	587	635	1,224	1,318	657	821	672	954	1,219	1,182	1,212	928	769	999	880	1,005	831	860	859
Sweden	14	7	7	7	2	1	2	8	8	78	44	56	8	6	5	5	20	67	21
UK(E,	129	143	160	169	176	439	2,174	668	781	218	183	98	104	83	34	99	303	13	
UK	7,039	7,887	9,712	11,683	15,658	22,344	18,783	13,319	9,710	9,559	10,024	8,539	6,033	6,284	6,003	7,722	8304	8,658	
UK (total)																			7,828
Total	9,235	10,209	12,309	14,505	17,891	25,176	23,425	16,857	13,326	12,338	12,861	11,048	8,523	8,987	8,424	10,338	10,632	11,038	10,286

*** Preliminary.**

Table 5.2.3 continued. Nominal landings (t) of Anglerfish in the North Sea as officially reported to ICES.

Central North Sea (IVb)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	357	538	558	713	579	287	336	371	270	449	579	435	180	260	207	138	179	181	133
Denmark	345	421	347	350	295	225	334	432	368	260	251	255	191	274	237	276	173	237	337
Faroes	-	-	2	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	
France	-	1	-	2	-	-	-	-*	…1*	-	-	-	-	+	-	-	-	-	
Germany	4	2	13	15	10	9	18	19	9	14	9	17	11	11	9	14	12	22	17
Ireland													1	-	-	-	-	-	
Netherlands	285	356	467	510	335	159	237	223	141	141	123	62	42	25	31	33	61	58	47
Norway	17	4	3	11	15	29	6	13	17	9	15	10	12	22	16	14	24	15	21
Sweden	-	-	-	3	2	1	3	3	4	3	2	9	2	1	4	4	6	9	6
UK(E, W&NI)	669	998	1,285	1,277	919	662	664	603	364	423	475	236	167	120	96	108	122	105	
UK (Scotland)	845	733	469	564	472	475	574	424	344	318	378	210	241	138	88	98	172	142	
UK (total)																			191
Total	2,522	3,053	3,144	3,445	2,627	1,847	2,172	2,088	1,517	1,617	1,832	1,244	847	851	688	685	749	769	752

*** Preliminary**

Table 5.2.3 continued. Nominal landings (t) of Anglerfish in the North Sea as officially reported to ICES.

Southern North Sea (IVc)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	13	12	34	37	26	28	17	17	11	15	15	16	9	5	4	3	3	4	6
Denmark	2	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-		
France	-	-	-	-	-	-	-	10	-	+	-	+	-	-	-	-	-	+	
Germany	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	+
Netherlands	5	10	14	20	15	17	11	15	10	15	6	5	1	-	1	-	1	1	
Norway	-	-	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	-	1
UK(E&W&NI)	6	17	18	136	361	256	131	36	3	1	-	-	10	3	-	-	-	…	
UK (Scotland)	-	-	-	17	-	3	1	+	+	+	-	-	-	7	-	-	-	…	
UK (Total)																		+	1
Total	26	39	66	210	402	304	160	78	24	31	21	21	20	15	5	3	4	5	8

*** Preliminary.**

Total North Sea

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Total	11,783	13,301	15,519	18,162	20,920	27,327	25,757	19,023	14,867	13,986	14,714	12,313	9,390	9,853	9,117	11,026	11,385	11,812	11,046
WG estimate	10,566	11,728	13,078	15,432	15,794	16,240	18,217	14,027	11,719	11,564	12,677	10,334	8,273	9,027					
Unallocated	-1,217	-1,573	-2,441	-2,730	-5,126	-11,087	-7,540	-4,996	-3,148	-2,422	-2,037	-1,979	-1,117	-826					

*** Preliminary.**

Table 5.2.4. Nominal landings (t) of Anglerfish in Division IIIa, 1991–2009, as officially reported to ICES.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	15	48	34	21	35	-	-	-	-	-	-	-	-	-	-	-	-	-	
Denmark	493	658	565	459	312	367	550	415	362	377	375	369	215	311	274	227	255	287	372
Germany	-	-	1	-	-	1	1	1	2	1	-	1	-	1	1	2	1	1	1
Netherlands							-	-	-	-	-	.	3	4	4	3	1	3	
Norway	64	170	154	263	440	309	186	177	260	197	200	242	189	130	100	137	132	144	134
Sweden	23	62	89	68	36	25	39	33	36	27	46	55	71	73	79	54	44	51	41
Total	595	938	843	811	823	702	776	626	660	602	621	667	478	519	458	423	433	486	548

***Preliminary.**

Tables 5.2.5. Total Danish Anglerfish landings (tonnes) and effort (days fishing) by fishery.

A. Landings by fishery (from logbook data)

Year		North Sea				North Sea			IIIa		tons			IIIa	IIIa & IV
	Other gear	Beam trawls	dem trawl	*Neph* trawl	ind trawl	Shrimp trawl	total	Other gear	Beam trawls	dem trawl	*Neph* trawl	ind trawl	Shrimp trawl	total	total
2000	52	88	1066	16	68	56	1347	61	47	116	140	0	13	377	1724
2001	52	18	1343	7	67	53	1540	44	18	86	211	4	11	375	1915
2002	41	59	1269	86	53	55	1563	35	41	116	162	1	15	371	1934
2003	28	40	1508	59	30	42	1707	27	4	27	147	1	10	217	1924
2004	57	45	1525	91	42	50	1809	31	13	40	189	0	37	311	2120
2005	14	48	1412	96	26	17	1612	18	5	104	136	0	9	272	1884
2006	9	8	1454	96	10	9	1587	10	1	107	105	0	3	227	1814
2007	11	24	1020	67	10	2	1134	15	10	123	97	0	9	255	1389
2008	18	33	1160	86	2	8	1306	27	8	91	145	0	17	288	1594
2009	43	24	1454	163	1	9	1693	19	4	83	243	1	22	372	2065

B. Effort by fishery (from logbook data)

Year					Total Danish effort in IV (days)	North Sea						Total Danish effort in IIIA (days)	IIIa		IIIa & IV
	Other gear	Beam trawls	dem trawl	*Neph* trawl	ind trawl	Shrimp trawl	total	Other gear	Beam trawls	dem trawl	*Neph* trawl	ind trawl	Shrimp trawl	total	total
2000	695	787	6297	285	808	1102	9974	316	410	962	2173	5	227	4092	14066
2001	780	250	8164	182	1039	1137	11552	315	267	775	2916	31	219	4522	16074
2002	676	537	7415	741	1155	1025	11548	297	356	1054	2570	18	210	4505	16053
2003	309	445	7917	711	528	810	10720	174	62	328	1983	7	188	2742	13462
2004	522	419	6212	448	517	606	8725	309	165	211	2638	3	135	3462	12186
2005	166	401	6075	443	240	263	7589	141	92	517	1991	3	154	2898	10487
2006	174	96	5912	543	125	154	7004	99	43	539	1403	2	52	2139	9143
2007	108	191	3805	361	106	36	4607	117	139	744	1244	0	181	2424	7031
2008	189	191	3978	469	38	104	4968	185	51	690	2031	1	397	3356	8325
2009	414	215	4823	443	14	166	6076	178	45	821	3027	15	582	4668	10744

Table 5.2.6. Anglerfish in IV and IIIa. Norwegian landings (tonnes) by fishery in 2005–2008 and preliminary data from 2009.

Fleet	2005 Div IIIa	2005 Div IVa	2006 Div IIIa	2006 Div IVa	2007 Div IIIa	2007 Div IVa	2008 Div IIIa	2008 Div IVa	009 Div IIIa	2009 Div IVa
Coastal gillnetting	61	526	103	696	87	574	97	554	90	481
Offshore gillnetting	1	16	+	19	+	32	+	24	+	21
Coastal shrimp trawling	22	50	25	46	26	36	27	35	30	29
Offshore dem trawling	5	102	+	142	8	154	12	206	6	265
Offshore shrimp trawling	3	68	5	66	8	39	7	32	6	40
Other gears	7	119	3	36	3	24	+	24	2	23
Total	100	880	137	1,005	132	860	144	875	134	859

Table 5.2.7. Anglerfish in Subarea VI. Landings, effort and lpue from the Irish OTB fleet.

Year	Hours (VIa)	Kw.Days (VIa)	Hours VIb)	kw.Days (VIb)	Landings (VIa)	Landings (VIb)	LPUE (VIa_Hours)	LPUE (VIa kw.days)	LPUE (VIb_Hours)	LPUE (VIb kw.days)
1995	56863	1408312	9029	599053	655	114	11.52	0.47	12.63	0.019
1996	60960	1388902	7219	469212	624	74	10.24	0.45	10.25	0.022
1997	63159	1462368	7169	377836	587	93	9.29	0.40	12.97	0.025
1998	57398	1343782	7337	403310	558	99	9.72	0.42	13.49	0.024
1999	54075	1348480	8680	437920	449	64	8.30	0.33	7.37	0.019
2000	52847	1325585	9883	613229	410	62	7.76	0.31	6.27	0.013
2001	47224	1320179	7232	593467	315	93	6.67	0.24	12.86	0.011
2002	35016	1007965	2626	217918	276	41	7.88	0.27	15.61	0.036
2003	39211	1536279	4543	478464	314	26	8.01	0.20	5.72	0.017
2004	35217	1279049	2234	205349	210	13	5.96	0.16	5.82	0.029
2005	30748	1075974	3844	216991	351	35	11.42	0.33	9.11	0.053
2006	28014	1031169	5903	464965	386	53	13.78	0.37	8.98	0.030
2007	25373	911973	6589	548392	467	69	18.41	0.51	10.47	0.034
2008	17327	630615	9740	n/a	295	78	17.03	0.47	8.01	n/a
2009	17107.5		4354		331.632	91	19.39		20.90	

Landings in tonnes

Lpue estimates on '000 hours fished or '000 kw.days

Table 5.2.8. Danish lpue (Kg/day) for anglerfish. Official logbook records and for shrimp trawl adjusted for increasing fishing power (technological creep).

		North sea (IV) & Skagerrak (IIIa)		North sea (IV) & Skagerrak (IIIa)	
Year	Lpue, nominal (unadjusted)		Relative lpue, nominal (unadjusted)		Relative lpue, adjusted for increasing fishing power
	Dem. Trawl + *Neph* trawl	Shrimp trawl	Dem. Trawl + *Neph* trawl	Shrimp trawl	Shrimp trawl
1996	176.1	91.0	1.03	1.49	2.82
1997	170.6	61.0	1.00	1.00	1.00
1998	176.6	59.4	1.03	0.97	1.27
1999	163.5	62.3	0.96	1.02	0.95
2000	132.2	49.0	0.77	0.80	0.73
2001	131.7	45.3	0.77	0.74	0.67
2002	135.3	54.5	0.79	0.89	0.62
2003	156.4	49.4	0.92	0.81	0.47
2004	194.3	75.4	1.14	1.24	0.54
2005	188.3	55.4	1.10	0.91	0.24
2006	205.6	54.4	1.20	0.89	0.09
2007	208.1	45.0	1.22	0.74	0.09
2008	202.5	42.6	1.19	0.70	0.20
2009	211.5	39.7	1.24	0.65	-

Table 5.2.9. Abundance (millions of individuals) and biomass (thousands of tonnes) estimates from the 2005–2009 Northern shelf anglerfish surveys by ICES area and division.

	Abundance (millions)					Biomass (thousand tonnes)				
ICES Subarea/Division	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Subarea IV (partial)	14.201	13.603	15.608	12.582	8.287	19.059	21.998	28.572	29.671	17.058
Division VIa	12.201	10.985	8.859	7.719	5.15	14.266	12.222	11.157	14.381	6.232
Division VIb	2.049	3.174	4.142	3.924	3.536	5.948	6.676	10.526	9.311	12.461
Subarea VI	14.249	14.159	13.000	11.643	8.686	20.214	18.898	21.683	23.692	18.693
Northern Shelf (partial)	28.451	27.762	28.608	24.225	16.973	39.273	40.896	50.256	53.363	35.751

Table 5.2.10. Nominal catch (t) of Anglerfish in Division IIa, 1993–2009, as officially reported to ICES.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	+	+	+	+	+	+	+	+	2	+	-	1	-	-
Faroes	+	+	+	+	+	+	+	-	1	1	2	5	11	4
France	-	-	-	-	-	-	+	-	-	-	-	-	-	1
Germany	2	3	1	4	20	53	4	17	65	59	55	70	55	-
Norway	3,044	1,026	526	893	576	1,488	1,731	2,952	3,552	2,000	2,404	2,906	2,649	4,253
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Sweden	-	-	-	+	+	+	+	+	+	-	-	-	-	-
UK (total)	1	2	74	15	5	7	6	30	2	10	15	18	19	86
Total	3,047	1,031	601	912	601	1,548	1,741	2,999	3,622	2,070	2,476	2,999	2,672	4,341

Table 5.2.10. continued.

	2007	2008	2009*
Denmark	-	-	+
Faroes	7	4	
France	-	-	
Germany	-	-	-
Norway	4,455	3,999	4,289
Portugal	-	2	6
Russia	-	-	-
Sweden	-	-	-
UK (total)	115	138	152
Total	4,577	4,143	4,447

***Preliminary.**

Table 5.2.11. Anglerfish in IIa. Norwegian landings (tonnes) by fishery in 2005–2008 and preliminary data for 2009.

Fleet	2005	2006	2007	2008	2009
Coastal gillnetting	2,301	3,723	4,039	3,574	3,934
Offshore gillnetting	115	261	204	240	172
Offshore dem trawling	77	71	52	26	28
Coastal Danish seine	54	54	63	75	68
Other gears	102	144	98	84	87
Total	2,649	4,253	4,456	3,999	4,289

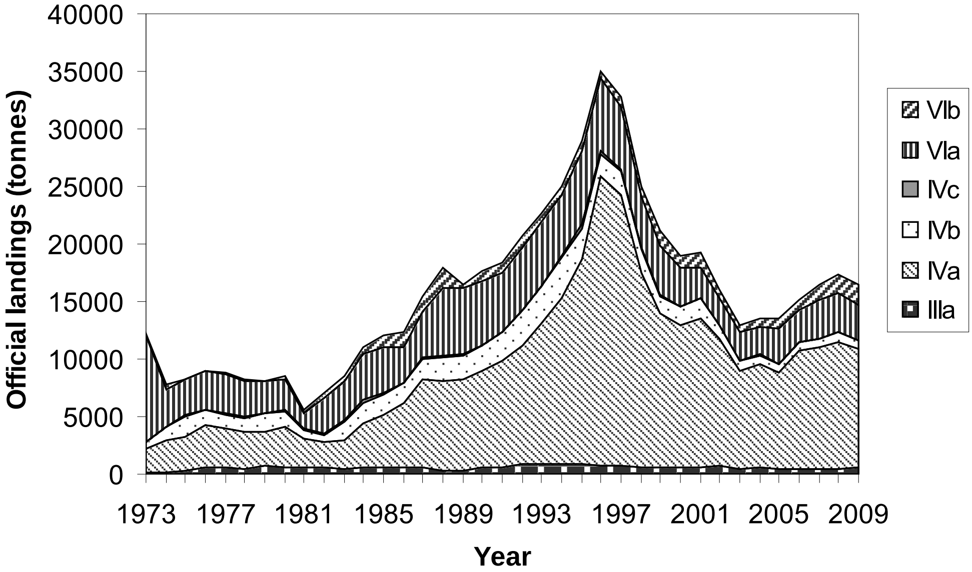
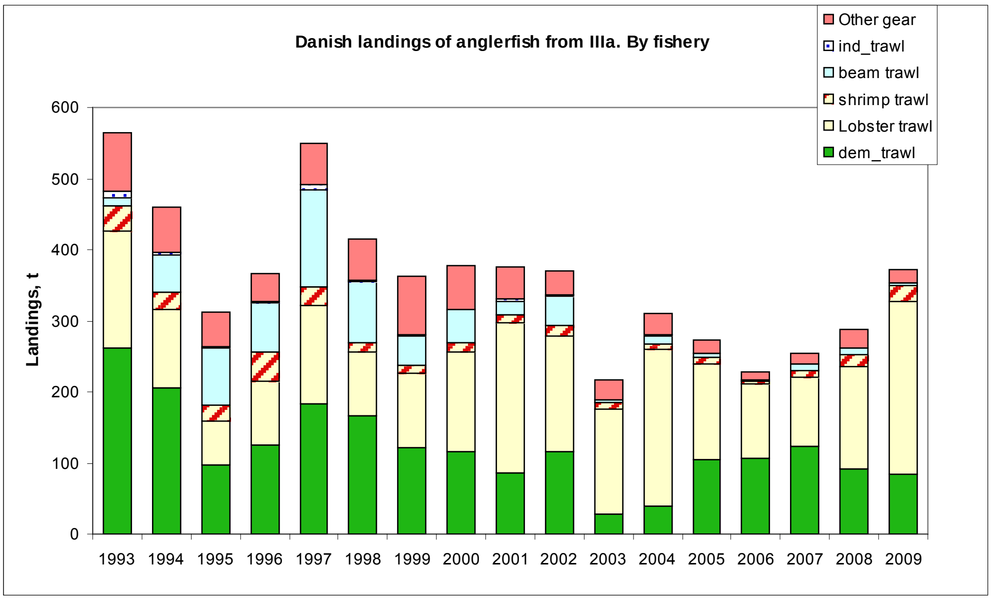


Figure 5.2.1. Northern Shelf anglerfish. Officially reported landings by ICES area.



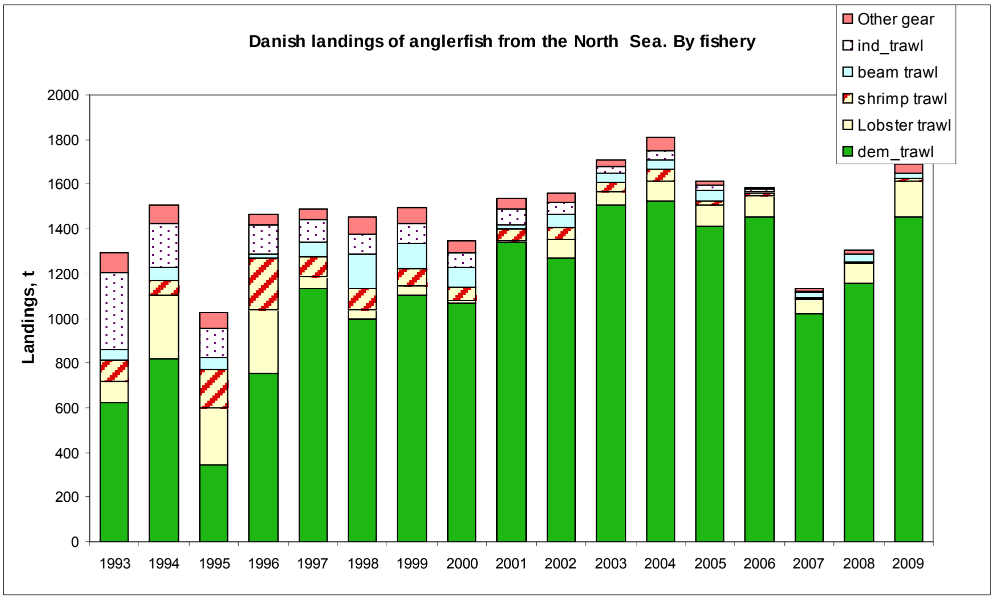


Figure 5.2.2. Danish landings of Anglerfish by fishery in the North Sea (top) and Division IIIa (bottom).

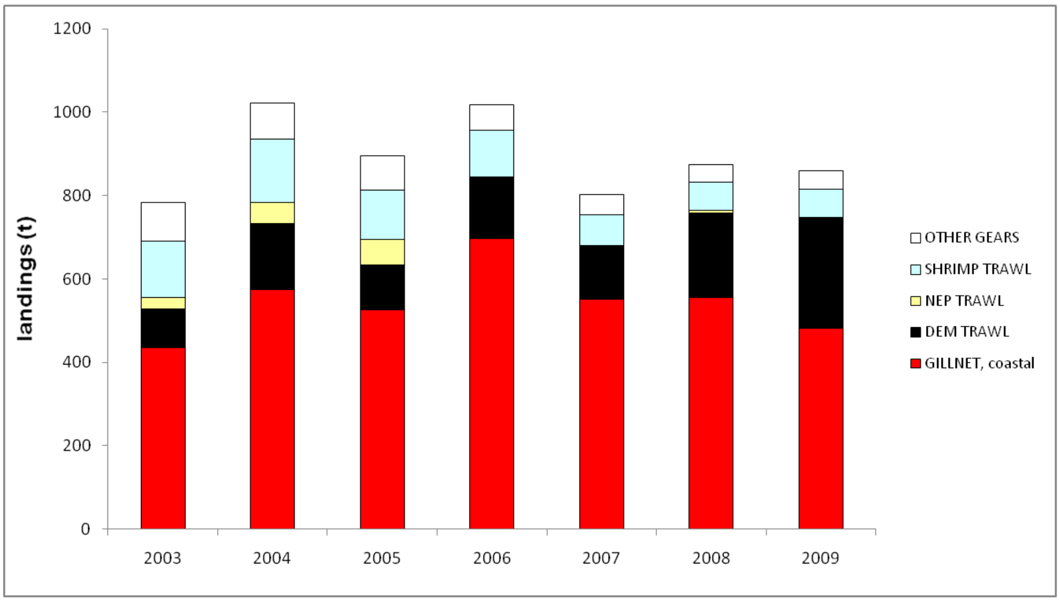


Figure 5.2.3. Anglerfish in Division IVa. Norwegian landings by fleet from 2003–2009.

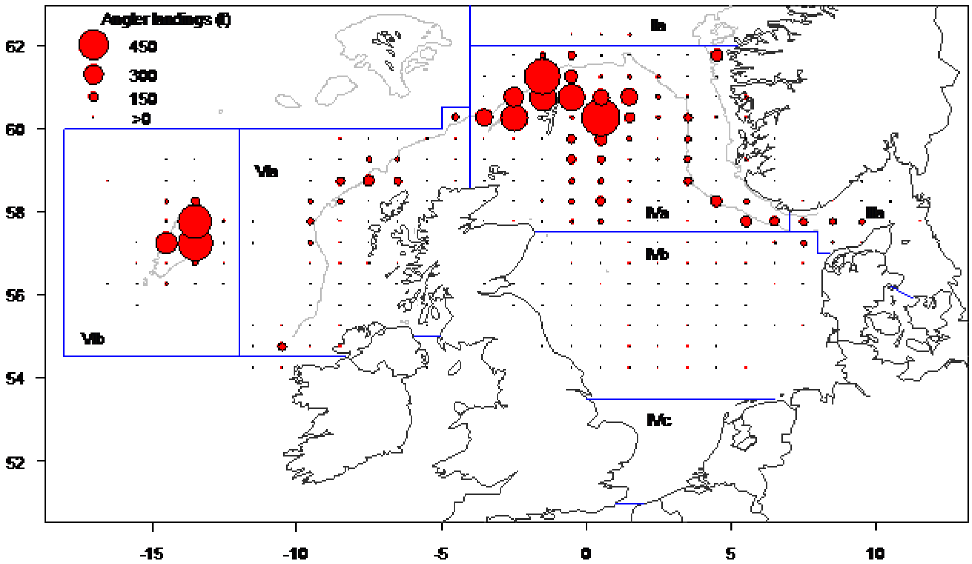


Figure 5.2.4. Map of the European Northern Shelf showing the distribution of reported landings of anglerfish for 2009 from Scotland, Ireland, Denmark, France and Norway. The red circles are centred on each ICES rectangle and the area of each circle is proportional to the landings in tonnes (according to the legend). The data have been corrected according to certain assumptions about area misreporting (see Stock Annex).

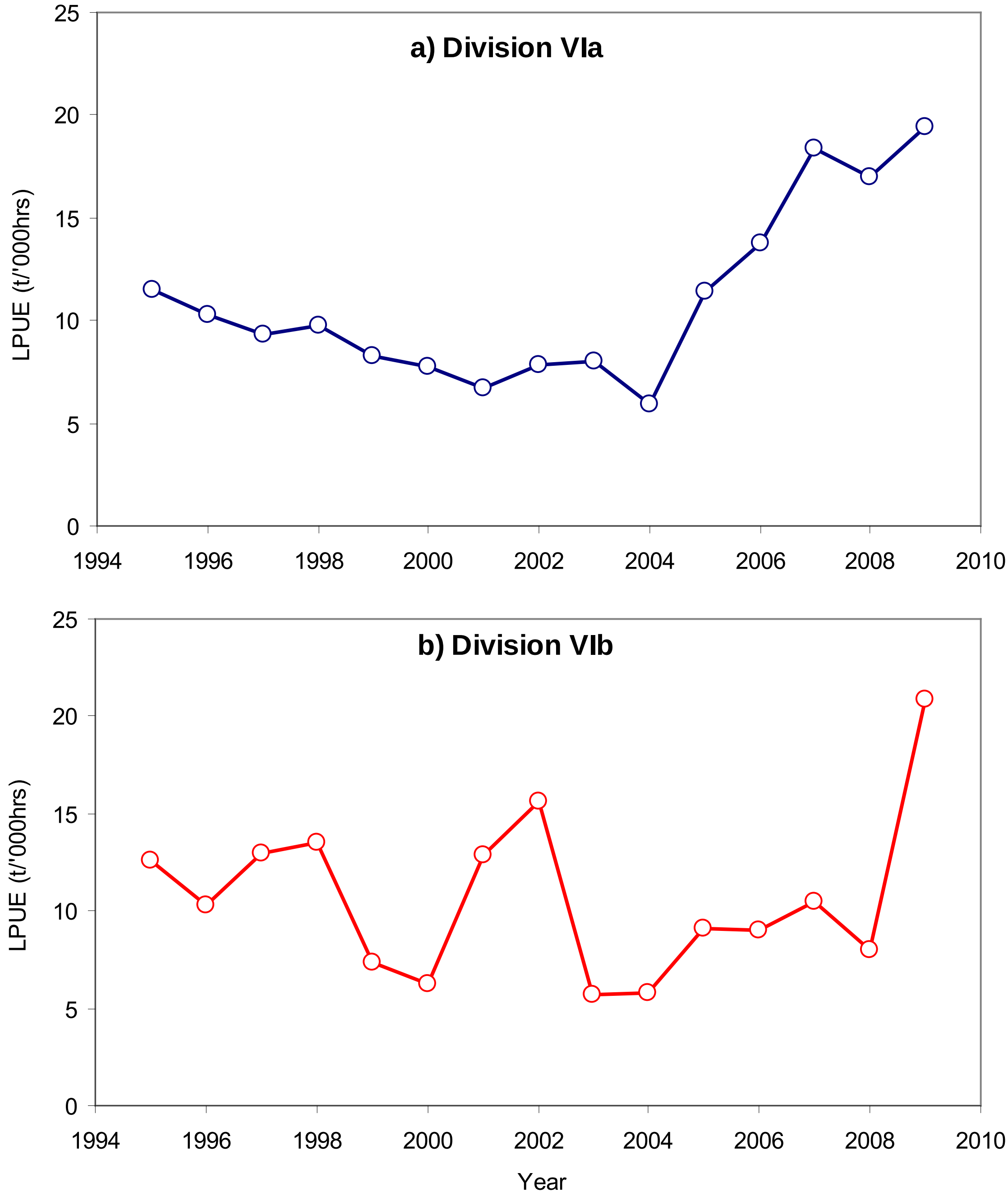


Figure 5.2.5. Lpue for the Irish otter trawl fleet with effort in hours fished for a) Division VIa, and b) Division VIb.

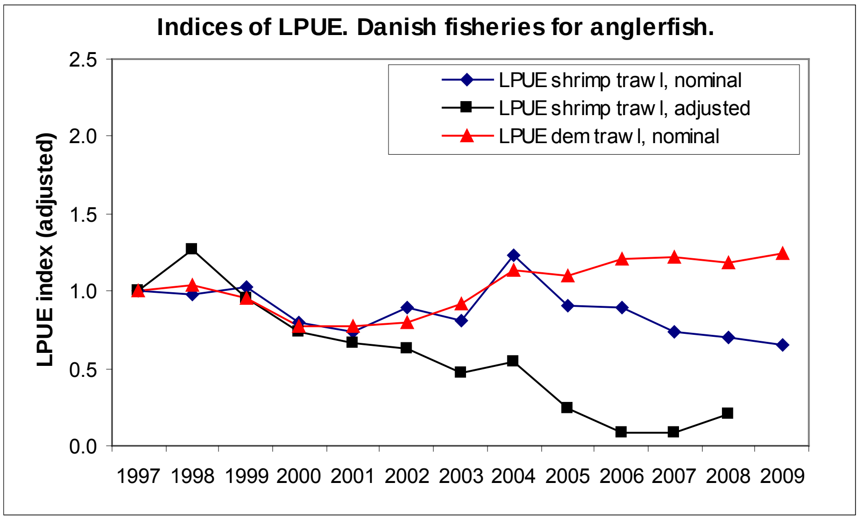


Figure 5.2.6. Anglerfish in the North Sea & Division IIIa. Danish lpue by demersal trawl and shrimp trawl, relative to 1997. Based on nominal logbook records as well as development in gear and engine power (shrimp trawl).

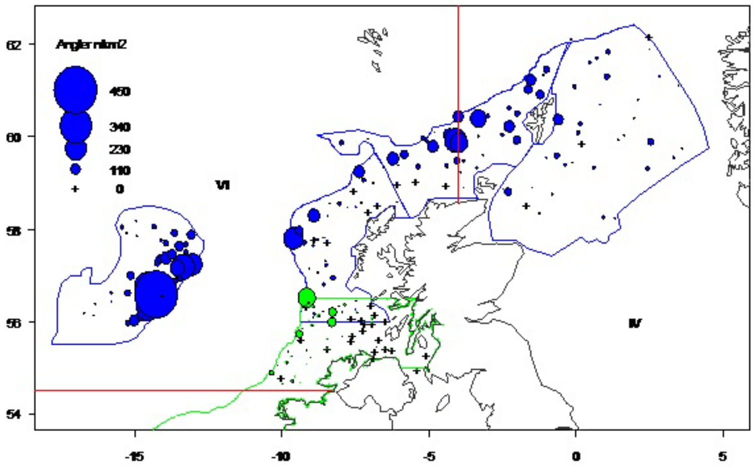


Figure 5.2.7. Map of the northern continental shelf around Scotland showing the number density of anglerfish during the 2009 surveys. Each circle is centred on the sample location and circle size is proportional to the number density in n/km[2] according to the legend (top left). Blue circles represent trawl based densities based on Scottish surveys; green symbols Irish surveys. Trawl densities in this figure account for herding but not footrope escapes. The red lines separate the ICES subareas indicated by roman numerals: IV (east) and VI (west).

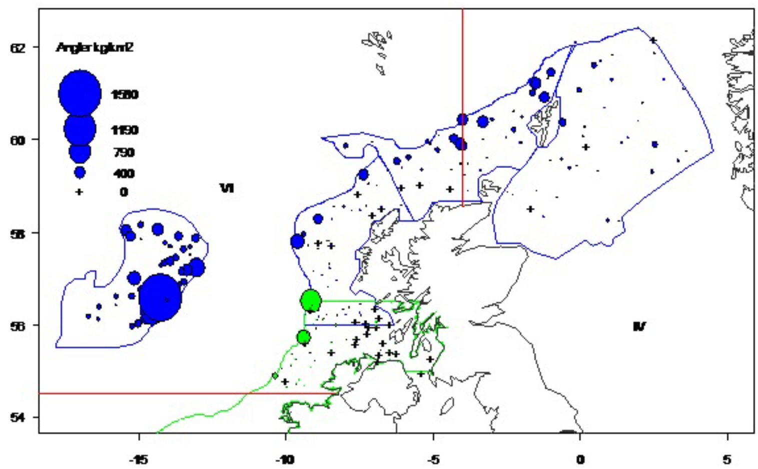


Figure 5.2.8. Map of the northern continental shelf around Scotland showing the weight density of anglerfish during the 2009 anglerfish survey. Each circle is centred on the sample location and circle size is proportional to weight density in kg/km² according to the legend. Blue circles represent trawl based densities based on Scottish surveys; green circles Irish surveys. Trawl densities in this figure account for herding but not footrope escapes. The red lines separate the ICES subareas indicated by roman numerals: IV (east) and VI (west).

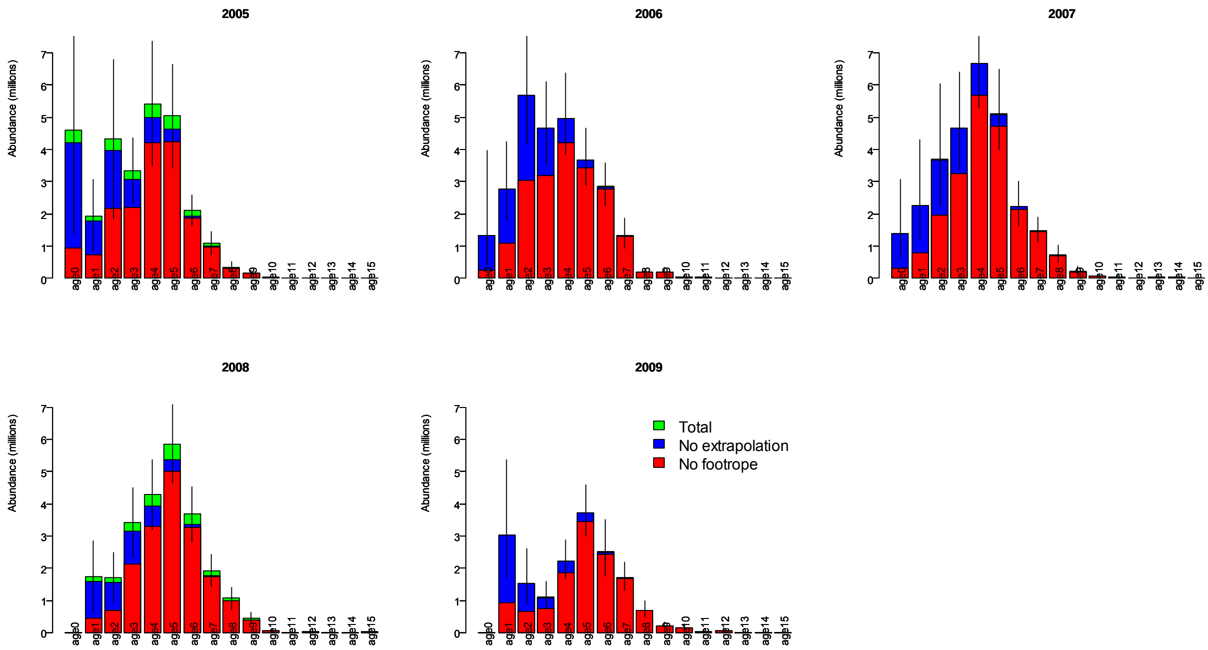


Figure 5.2.9. Estimates of total abundance-at-age for each of the anglerfish surveys 2005–2009. Red bars indicate estimates prior to correction for footrope escapes; blues bars include the latter correction; green bars indicate an additional correction for the unsurveyed part of ICES Division VIa based on data when the area was surveyed by the Irish. Error bars are 95% confidence intervals.

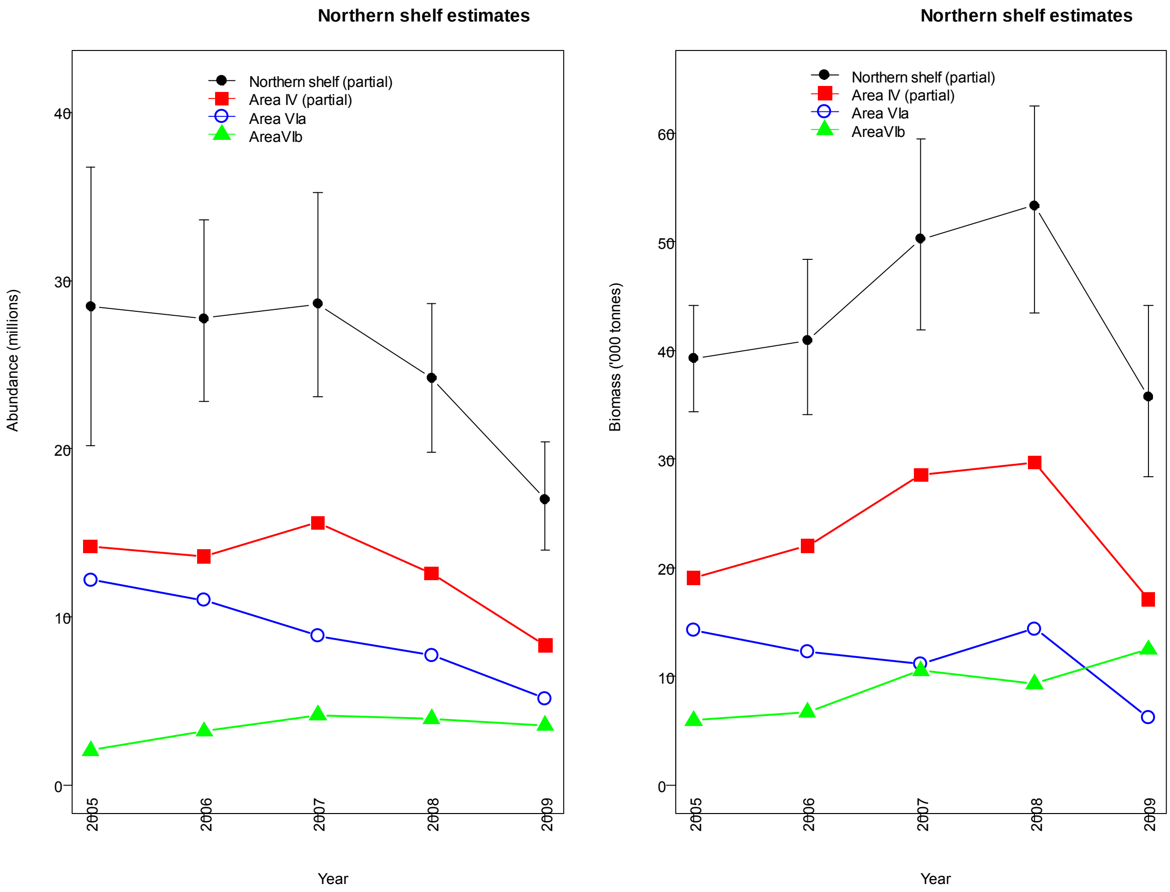


Figure 5.2.10. Estimates of total abundance (left) and biomass (right) of anglerfish for the Northern shelf (black filled circles), with confidence intervals derived from variance estimates of the Scottish surveys. Estimates are also provided for ICES Subarea IV (red filled squares), Division VIa (blue open circles) and Division VIb (green filled triangles). Confidence limits for 2005 biomass are provisional.

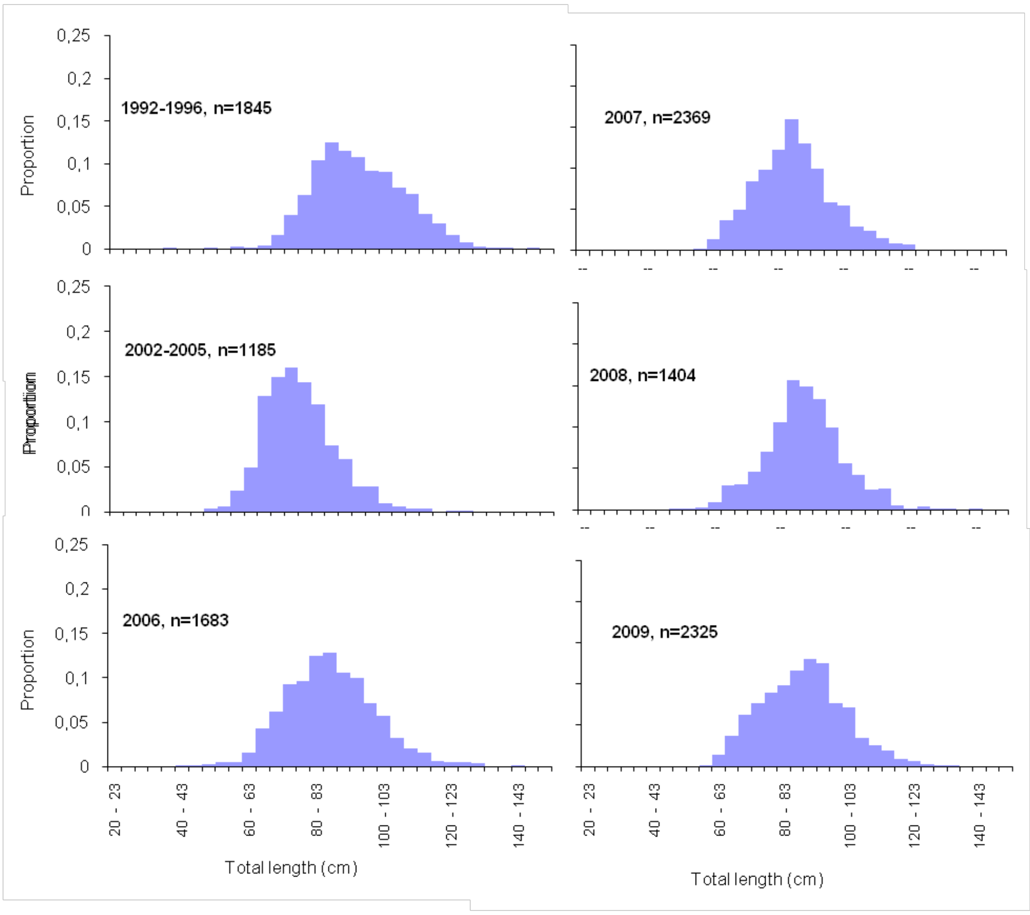


Figure 5.2.11. Anglerfish in IIa. Length distributions for anglerfish caught in the directed coastal gillnetting in Division IIa during 1992–2009. Note that data are lacking for 1997–2001.

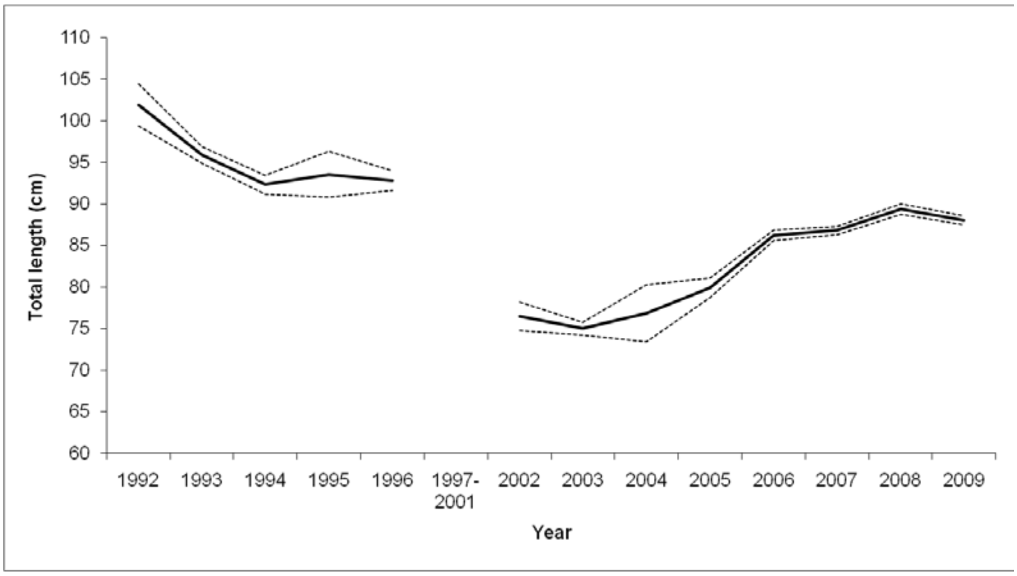


Figure 5.2.12. Anglerfish in IIa. Mean lengths for anglerfish caught in the directed coastal gillnetting in Division IIa during 1992–2009, dotted lines represents ±2SE of the mean. Note that data are lacking for 1997–2001.

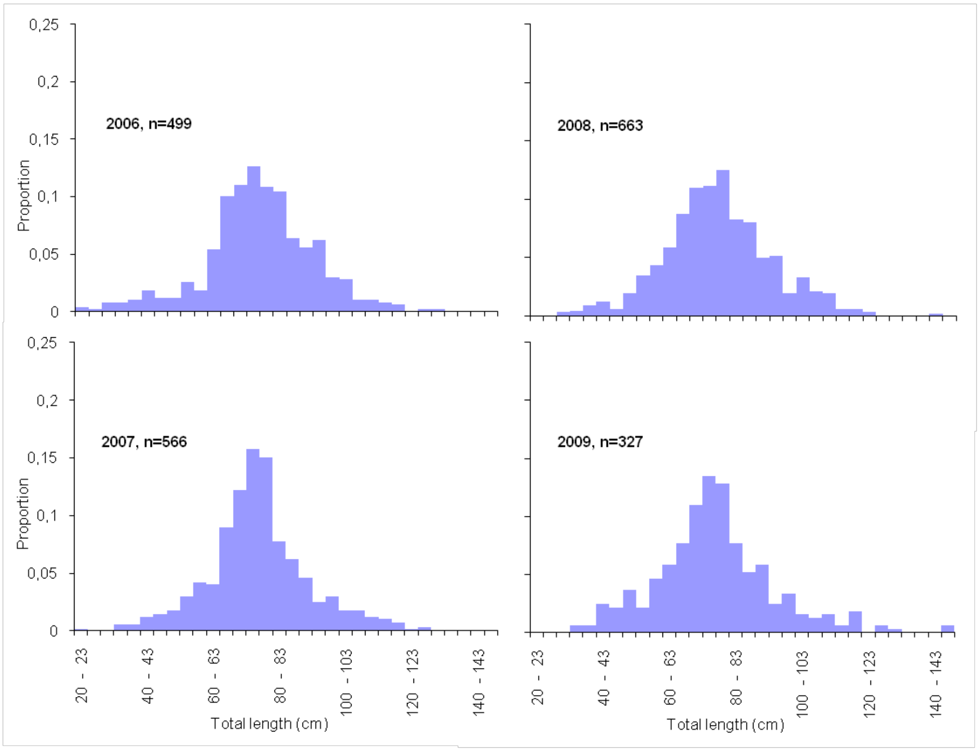


Figure 5.2.13. Anglerfish in IIa. Length distribution for anglerfish caught as bycatch by other gears (offshore gillnetting and longlining) in Division IIa in 2006–2009.

5.3 Megrim in Division IV and VI

Type of assessment in 2010

ICES has not conducted an analytical assessment of this stock since 1999. Megrim continues to be a monitored stock and a benchmark analysis will be required before an assessment can be presented. Based on the recommendation of WGNSDS (2008), WGCSE now also considers megrim in IVa and IIa.

ICES advice applicable to 2009

The new landings, cpue, and survey data available for this stock do not change the perception of the stock and do not give reason to change the advice from 2007. The advice on this stock for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: Catches should be based on the recent average (2004 2006), about 1400 t. This includes landings in Division VIa and VIb and unallocated landings in Subarea IV.

ICES advice applicable to 2010

ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that the effort in fisheries that catch megrim should not be allowed to increase.

5.3.1 General

Stock description and management units

Megrim stock structure is uncertain and historically the Working Group has considered megrim populations in VIa and VIb as separate stocks. The review group questioned the basis for this in 2004. Data collected during an EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the West of Scotland' showed significantly different growth parameters and significant population structure difference between megrim sampled in VIa and VIb (Anon, 2001). Spawning fish occur in both areas but whether these populations are reproductively isolated is not clear. As noted by WGNSDS (2008), megrim in IVa has historically not been considered by ICES and WGNSDS (2008). Since 2009 data from IV and IIa are now included in this report and work is underway to collect international catch and weight-at-age data for IV as well as VI.

Species:	Megrims *Lepidorhombus* spp.	Zone:	EU waters of IIa and IV (LEZ/2AC4-C)
Belgium	5		
Denmark	5		
Germany	5		
France	29		
The Netherlands	23		
United Kingdom	1 690		
EU	1 757		
TAC	1 757		Precautionary TAC

Species:	Megrims *Lepidorhombus* spp.	Zone:	VI; EU and international waters of Vb; international waters of XII and XIV (LEZ/561 214)
Spain	350		
France	1 364		
Ireland	399		
United Kingdom	966		
EU	3 079		
TAC	3 079		Precautionary TAC

Fishery in 2009

The introduction of the Cod Long-Term Management Plan (EC Regulation 1342/2008) and additional emergency measures applicable to VIa in 2009 (EC Regulation 43/2009, annex III 6) has impacted on the amount of effort deployed and increased the gear selectivity pattern of the main otter trawl fleets. Figure 5.3.1 shows the effort pattern for the main fleets catching megrim in VIa. Additionally, EC regulation 43/2009 has effectively prohibited the use of mesh sizes <120 mm for vessels targeting fish, which had been used particularly by the Irish fleet up to that point, the resultant rapid decline in effort for this category can be seen in Figure 5.3.1. Effort associated with the French fleet has continued to decline while the decline in both the Irish and Scottish TR1 fleets (120 mm mesh) appears to have stabilized. Note that 2009 data is only available for the Irish fleets. The increase in mesh size (from 100 to 120 mm) has also impacted on the retention length of megrim, increasing L50 from 28 cm to 42 cm, an increase of almost 50% (Figure 5.3.2).

Fishing effort in IV for the main Scottish otter fleet (TR1) have stabilized since the large effort reductions observed in previous years, effort levels associated with this mesh band have fallen by 64% since 2000. Following the increases in Irish effort in subdivision VIb from 2004–2008, effort in 2009 has declined significantly (Figure 5.3.3). There is anecdotal information from the Scottish industry that since the introduction of the Conservation Credits Scheme in Area IV, those vessels have responded with increasing focus on anglerfish and megrim in both IVa and VIa.

Based on landings data presented to the Working Group, only 53% of the overall TAC for VI, EC waters of Vb and international waters of XII and XIV was used. It should be noted that no landings data were made available to the Working Group by

Spain or France therefore the uptake during 2009 will be higher, while historically, France only utilizes ~10% of its available quota, Spanish uptake has been ~80%.

2009 TAC for VI, EC waters of Vb and international waters of XII and XIV.

	TAC	WG Landings	% TAC uptake[1]
Spain	318	nr	nr
France	1240	nr	nr
Ireland	363	236[2]	65%
United Kingdom	878	1131	129%
EC Total	2799	1380	53%

***nr – not reported to the Working Group**

[1] – post regulation quota swaps have not been taken into account

[2] Provisional figures

The uptake of the TAC for ICES Division IV and IIa was 99%. Landings data was only received from the UK, which holds 93% of the TAC.

2009 TAC for EC IV and IIa.

	TAC	WG landings	% TAC uptake[1]
Belgium	5	1.6	32%
Denmark	4	nr	
Germany	4	4	100%
France	26	nr	
Netherlands	21	2	10%
UK	1537	1476	96%
EC	1597	1483	93%

[1] – post regulation quota swaps have not been taken into account

5.3.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

It has not been possible to construct full international catch numbers-at-age for the past few years. Data from 2005 to 2007 are required from the UK (VI and IV), France (IV) and Spain (VI). Catch numbers and weights-at-age from 1993 to present have been presented by Ireland (with the exception of 2007 due to lack of market access). Intersessional work is currently underway to construct a full international dataset, with the aim of benchmarking VI and IV megrim in 2010 (see Section 5.3.6).

Landings

Official landings data for each country together with Working Group best estimates of landings from VIa and VIb and are shown in Table 5.3.1 and landings from IV in Table 5.3.2. The distributions of landings by statistical rectangle from 2007 to 2009 are shown in Figure 5.3.4. The WG best estimates of landings are those supplied by stock coordinators of the various countries and differ from the official statistics in some years. These were supplied for VIa by Ireland and Scotland in 2009. Due to national database problems, France were unable to provide 2009 landings data. Landings have increased in recent years and are more in line with historical trends.

Catches of megrim comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the Working Group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al*., 1995; Anon, 2001). It is not clear to the WG whether landings of other countries are accurately partitioned by megrim species. Megrim are caught in association with anglerfish by some fleets and are area-misreported along with anglerfish. As with anglerfish, the reported Subarea VI landings have been adjusted to the Working Groups estimate of catch by including landings declared from Subarea IV in the ICES statistical rectangles immediately east of the 4 degree W line (see anglerfish Annex 5.2 for a detailed methodology). Area-misreporting peaked in 1996 and 1997 when around 50% of the estimated Working Group landings for Division VIa were area-misreported. This year this correction process has not been conducted. There are indications that more recently the process has reversed. Laurenson and MacDonald (2008) note that in more recent years that megrim TAC in the North Sea has become more restrictive and anecdotal evidence suggest that megrim catches from IV are misreported as coming from Subdivision VI. Therefore, because of conflicting information on the potential direction of area-misreporting, megrim landings at a statistical rectangle level has not been adjusted.

Discards

Discard data were only made available by Ireland. Discard data from the otter trawl fleet were available for VIa. A mean discard rate of 6% by weight and 22% by number is observed, although this is based on data from a limited number of trips (three) and only 44 individual hauls. Laurenson and MacDonlad (2008) note that while discarding of megrim below minimum landing size is low (<1%), discarding of legal sized fish was much higher at 22% over the six observed trips. This is attributed to low market price for small grades and bruised fish, resulting in high grading of catches on length/quality reasons to maximise the value of a restrictive quota.

Surveys

In 2005, Scotland initiated a new industry–science partnership survey to provide an absolute abundance estimate for anglerfish (see Section 5.2). Five surveys have been carried out to date and these cover the main distribution of the anglerfish fishery. The survey is also considered to have greater spatial coverage for megrim and as such is recommended by WKAGME (2008) as the main source of data of megrim relative abundance for the Northern Shelf. Currently, five years of data are available (2005–2009) as data from the 2010 survey are not yet available, but the time-series will be updated as soon as this becomes available (summer 2010).

For the five years of survey data available, the sample locations and the density of megrim are illustrated in Figure 5.3.5 as numbers (number per square kilometre) and in Figure 5.3.6, as weight (kilograms per square kilometre). The highest densities of megrim occurred close to the 200 m contour in the northern and western areas, and on the eastern slopes of the Rockall plateau; high densities were also present in the northern North Sea.

The results of the survey are presented in Table 5.3.3. The abundance and biomass time-series are given in Figures 5.3.7 and 5.3.8 respectively. The increase in abundance and biomass on the Northern Shelf from 2005 to 2009 was 39% and 25% respectively: In each case, over 50% of this abundance and biomass was contained in Subarea IV (North Sea).

Using the ration of the average abundance estimate from the first two years of the time-series with the last two years in line with the method proposed by the EC for setting TACs for category six stocks, gives an increase in relative biomass of 25% for the entire survey area (Table 5.3.4). Split by area, the biomass estimates increase by 28 and 23% for ICES Area VI and IV (partial coverage) respectively. It should be noted that the confidence intervals, particularly for IV are very broad (Figure 5.3.8) and it is not possible to say with any certainty whether this increase is significant. The confidence estimates for Area VI are narrower and the trend shown in Figure 5.3.7 would indicate that biomass has increased, but has levelled out in the latter part of the time-series.

Commercial cpue

Logarithmic lpues for Scottish, French and Irish vessels split by mesh bands corresponding to gear groups TR1 (>100 mm) and TR2 (>70<100 mm) as defined by 1342/2008 are available for both VIa and IV (France and Scotland only) (the last available year) based on data presented to SGMOS 09-05 (Part 2) and from 2003 to 2009 for Ireland (VIa only). These are presented in Figure 5.3.9.The commercial lpues are also contrasted with the anglerfish logarithmic cpues for comparison. Between 2005 and 2007, both the commercial lpues and the survey cpues trends are reasonable consistent across fleets with all showing generally positive increases, with the exception of the Irish TR2 fleet. It should be noted that the IRE TR2 fleet has been discontinued due to the prohibition of mesh sizes <120 mm for vessels targeting fish (EC regulation 43/2008). Since 2007, the lpues for both the SCO TR1 and FR TR1 fleets show a dramatic increase as has the IRE TR2 since 2008. These signals give a much stronger positive signal than the survey-series during this period. It is not possible to determine how much this could be attributed to changes in megrim abundances or changes in targeting behaviour, but there reasons to suspect that there has been significant changes in targeting behaviour. Over the period, there have been reduced fishing opportunities for other species (e.g. cod) and reduced effort allocations inside the West of Scotland management line, particularly affecting Scottish and Irish vessels; this may have resulted in increased targeting of anglerfish and megrim to the west of the management line, where effort opportunities are far less constrained.

Logarithmic lpues for two Scottish commercial fleets (SCO TR1 and SCO TR2) in Area IV from 2003 to 2008 are given in Figure 5.3.10. These are also contrasted with the log transformed indices from the anglerfish survey. The trends between the two commercial lpue indices are consistent and show a positive trend during the past few years. However, the survey cpue is more variable and doesn't appear to follow the commercial lpues. Care should be taken in interpreting the commercial lpue's given possible shifts in targeting behaviour.

Lpue data for Division VIb is only available for Irish vessels. In 2009, lpue has declined steadily between 2004 and 2008, but has increased marginally in 2009 (Figure 5.3.11) .Irish effort has also continued to decline in recent years and current OTB effort in kW days has declined by 58% since 2003. No effort data is available for either France of UK, who combined have 76% of the TAC.

5.3.3 Historical stock development

No analytical assessment has been agreed for this stock since 1999.

State of the stock

The state of the stock is unknown.

5.3.4 Short-term projections

There is no accepted analytical assessment for this stock.

5.3.5 Biological reference points

Precautionary approach reference points

No precautionary reference points have been defined for this stock.

Yield-per-recruit analysis

It was not possible to define $F_{0.1}$ and F_{max} values for this stock due to the lack of international catch-at-age data and recent changes in fleet selectivity due to likely changes in targeting behaviour and recent changes in mesh selectivity, which, if fully implemented, will result in a significant change in age selectivity of the gear.

5.3.6 Uncertainties and bias in assessment and forecast

There is no accepted analytical assessment for this stock.

5.3.7 Recommendation for next Benchmark

In its porposals for benchmarks for 2010 and 2011, ICES notes that for Megrim in Subareas VI and IV:

> Could be considered at the same time as megrim in Divisions VII–k and VII-Iabd. However, there may still remain major issues with data. Many of the data and assessment problems are similar for Megrim in VI and IV i.e. discards, tuning fleets, consistency in the catch-at-age data, poorly known migrations, complicated life histories. It would be very important to benchmark the assessments in both areas at the same time.
>
> In advance of a benchmark in 2011 it is first necessary to construct international catch numbers/weights-at-length and age for the main fleets engaged in the fishery. For megrim in VI, this requires data from Ireland, UK, France and Spain and for megrim in IV, from the UK. Effort data for the main fleets engaged in both the VI and IV megrim fisheries are required to provide a time-series of trends in commercial lpue in both VI and IV. Progress should be reviewed by WGCSE 2010 at which point the viability of a benchmark process in 2011 should be confirmed.

Data requirements

International landings numbers and weights-at-length and age for the main fleets engaged in the fishery. For megrim in VI, this requires data from Ireland, UK, France and Spain and for megrim in IV, from the UK.

Effort data for the main fleets engaged in both the VI and IV megrim fisheries are required to construct potential commercial tuning fleets in both VI and IV.

Fishery independent survey indices disaggregated by sex for quarter 1 and 4 surveys in Subdivisions VI and IV.

5.3.8 Management considerations

The TAC in VI has not been fully utilised. However, the uptake rate is country specific, with full uptake being reported by some member states. Partial quota by individual member states may be an artefact of reduction in effort rather than reflective of a reduction in biomass. Data from the anglerfish survey indicates similar abundance in 2009 as observed in 2010 in Subdivision VI. The TAC in IV has been fully utilised and the data from the anglerfish survey indicate a decrease in biomass in the last year of the time-series, although confidence bands are large. Data from the 2009 survey provides a five year times-series, which is now sufficiently long to apply the EC communication to ICES (Comm 2009 224) regarding Category six stocks.

References

Laurenson, C. and MacDonald, P. 2008. Collection of fisheries and biological data on megrim in ICES Subarea IVa. Scottish Industry Science Partnership Report No 05/08.

Table 5.3. 1. Megrim in Subarea VIa (upper) and VIb (lower). Nominal catch (t) of Megrim West of Scotland and Rockall, as officially reported to ICES and WG best estimates of landings.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
France	398	455	504	517	408	618	462	192	172	0	135	252	79	92	50	48	53	104	92	
Ireland	317	260	317	329	304	535	460	438	433	438	417	509	280	344	278	156	221	191	172	188
Netherlands	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
Spain	91	48	25	7	1	24	22	87	111	83	98	92	89	98	45	69	52	5	149	
UK - Eng+Wales+N.Irl.	25	167	392	298	327	322	156	123	65	42	20	7	14	13	17	10	0	8	6	
UK – Scotland	1093	1223	887	896	866	952	944	954	841	831	754	770	643	558	469	269	336	658	868	953
UK																				
Offical Total	1924	2154	2125	2047	1907	2451	2044	1795	1622	1394	1424	1630	1105	1105	859	552	662	966	1287	1131
Unallocated	286	278	424	674	786	1047	2010	1477	1083	1254	823	843	723	537	469	9	213	n/a	8	
As used by WG	2210	2432	2549	2721	2693	3498	4054	3272	2705	2648	2247	2473	1828	1642	1328	561	875	1301	1545	
Area Misreported landings	339	338	466	735	871	1126	2062	1556	1156	1066	868	829	731	544	421	n/a	212	478	250	
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
France	-	-	-	-	-	-	-	-	-	.	4	<0.5	<0.5	-	-	-	-	-		
Ireland	196	240	139	128	176	117	124	141	218	127	167	176	87	83	43	68	95	87	68	48
Spain	363	587	683	594	574	520	515	628	549	404	427	370	120	93	71	88	59	19	84	
UK - Eng+Wales+N.Irl.	19	14	53	56	38	27	92	76	116	57	57	42	41	74	42	19	9	.		
UK - England & Wales	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	1	
UK - Scotland	226	204	198	147	258	152	112	164	208	278	309	236	207	382	372	207	181	.	141	178
UK																				
Offical Total	804	1045	1073	925	1046	816	843	1009	1091	866	964	824	455	632	528	382	344	106	294	226
Unallocated																				
As used by WG																				

Table 5.3.2. Megrim in Subarea IV and IIa. Nominal catch (t) of Megrim North Sea, as officially reported to ICES and WG best estimates of landings.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	4	3	2	7	2	7	5	3	5	4	10	2	5	3	-	-	2	6	3	2
Denmark	2	1	4	6	1	2	7	5	18	21	29	52	8	11	7	1	6	11	31	
France	-	-	36	25	27	24	14	16	14	.	7	5	6	11	9	3	4	18	21	
Germany	.	6	3	4	1	2	1	2	4	1	3	1	-	2	2	4	7	16	5	4
Germany, Fed. Rep. of	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	.		
Netherlands	24	28	27	30	28	26	9	20	30	26	20	11	9	7	11	19	22	20	3	2
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	1	1	4	
Spain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.		
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
UK - Eng+Wales+N.Irl.	17	9	47	8	19	44	4	3	5	4	2	2	3	1	1	1	9	17		
UK - England & Wales	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	
UK - N. Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
UK - Scotland	1126	1169	1372	1736	2000	2193	3221	3091	2628	2121	2044	1854	1675	1235	1130	958	1340	1436	1526	
UK																				1476
Official total	1176	1216	1491	1816	2078	2298	3261	3140	2704	2177	2115	1927	1706	1271	1160	986	1391	1525	1599	1753
As used by WG	837	878	1025	1081	1207	1172	1199	1584	1548	1111	1247	1098	975	727	739	n/a	1179	1047	1349	
Area Misreported landings	339	338	466	735	871	1126	2062	1556	1156	1066	868	829	731	544	421	n/a	212	478	250	

Table 5.3.3. Estimates of megrim abundance and biomass from Scottish-Irish anglerfish surveys

	Abundance (millions)					Biomass (tonnes)				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Area IV (partial)	11.7	11	14.8	18.9	13	4652	3629	5509	6953	4361
Area VI	5.5	9.3	13.8	14.4	15	2444	3127	4258	4063	4321
Northern Shelf (partial)	17.2	20.3	28.6	33.3	28	7096	6757	9766	11016	8673

Table 5.3.4. Changes in relative megrim abundance and biomass from Scottish-Irish anglerfish surveys based on percentage changes in mean abundance and biomass from the first three years of the survey relative to the mean of the last two years.

	Abundance		Biomass		Abundance	Biomass
	Mean 05–07	Mean 08/09	Mean 05/07	Mean 08/09	Percentage	Change
Area IV (partial)	12.50	15.95	4597	5657	28%	23%
Area VI	9.53	14.70	3276	4192	54%	28%
Northern Shelf (partial)	22.03	30.65	7873	9845	39%	25%

Figure 5.3.1. Fishing effort in ICES Division VIa for Irish, French and Scottish vessels by mesh category.

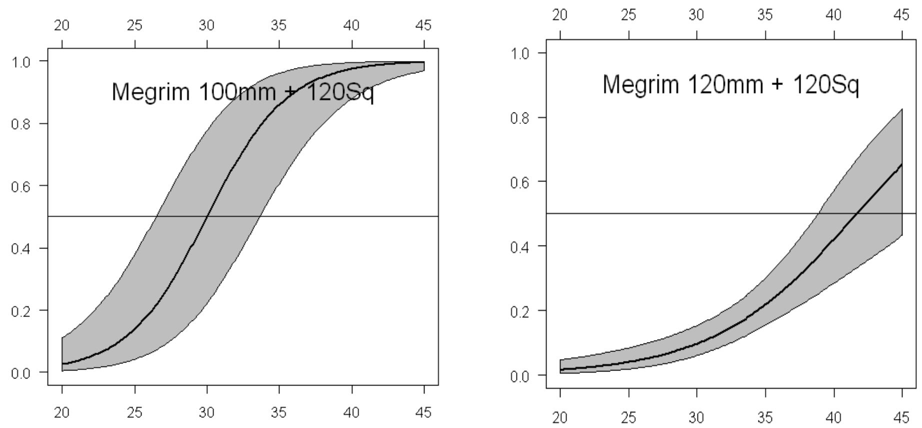


Figure 5.3.2. Change in selection profile of megrim associated with the increase in mesh size from 100 mm (left) to 120 mm (right) associated with the introduction of emergency measures in VIa (EC regulation 43/2009).

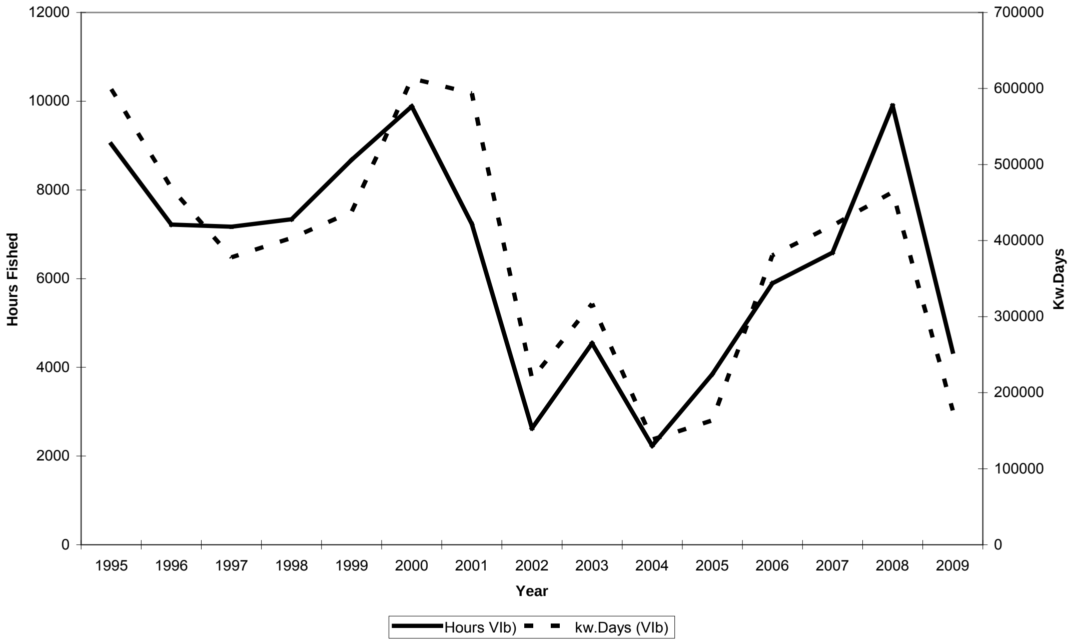


Figure 5.3.3. Irish Otter trawl effort in ICES Subdivision VIb (Rockall) expressed in both effort hours and kw.days.

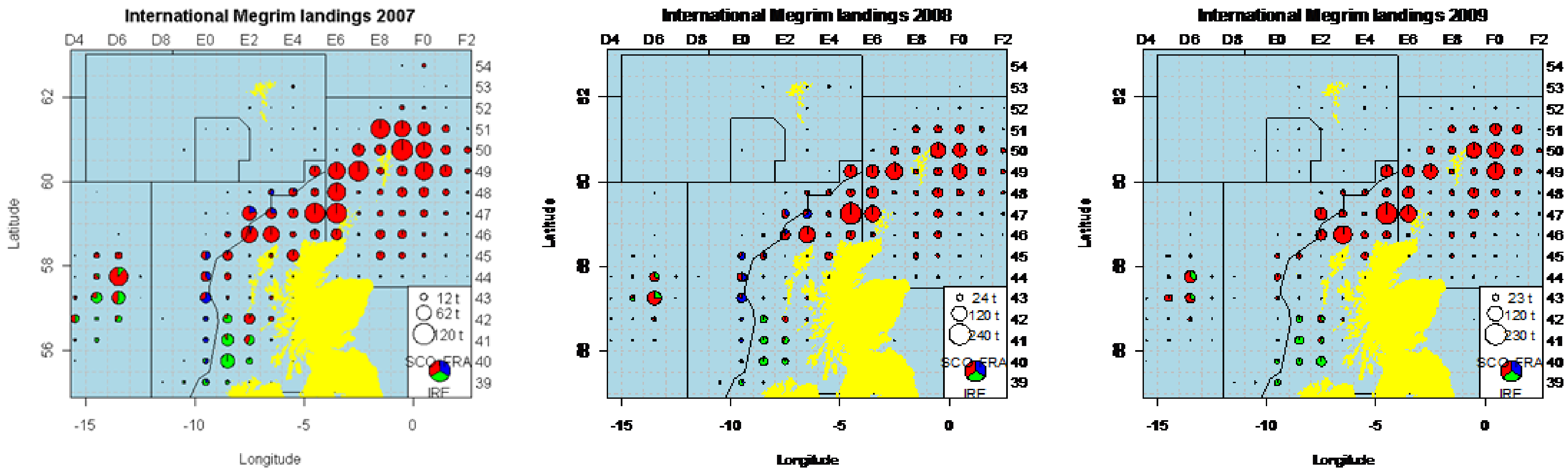


Figure 5.3.4. International megrim landing by ICES statistical rectangle for ICES Divisions VIa, VIb and IVa for 2007–2009. Note that no French data was available for 2009.

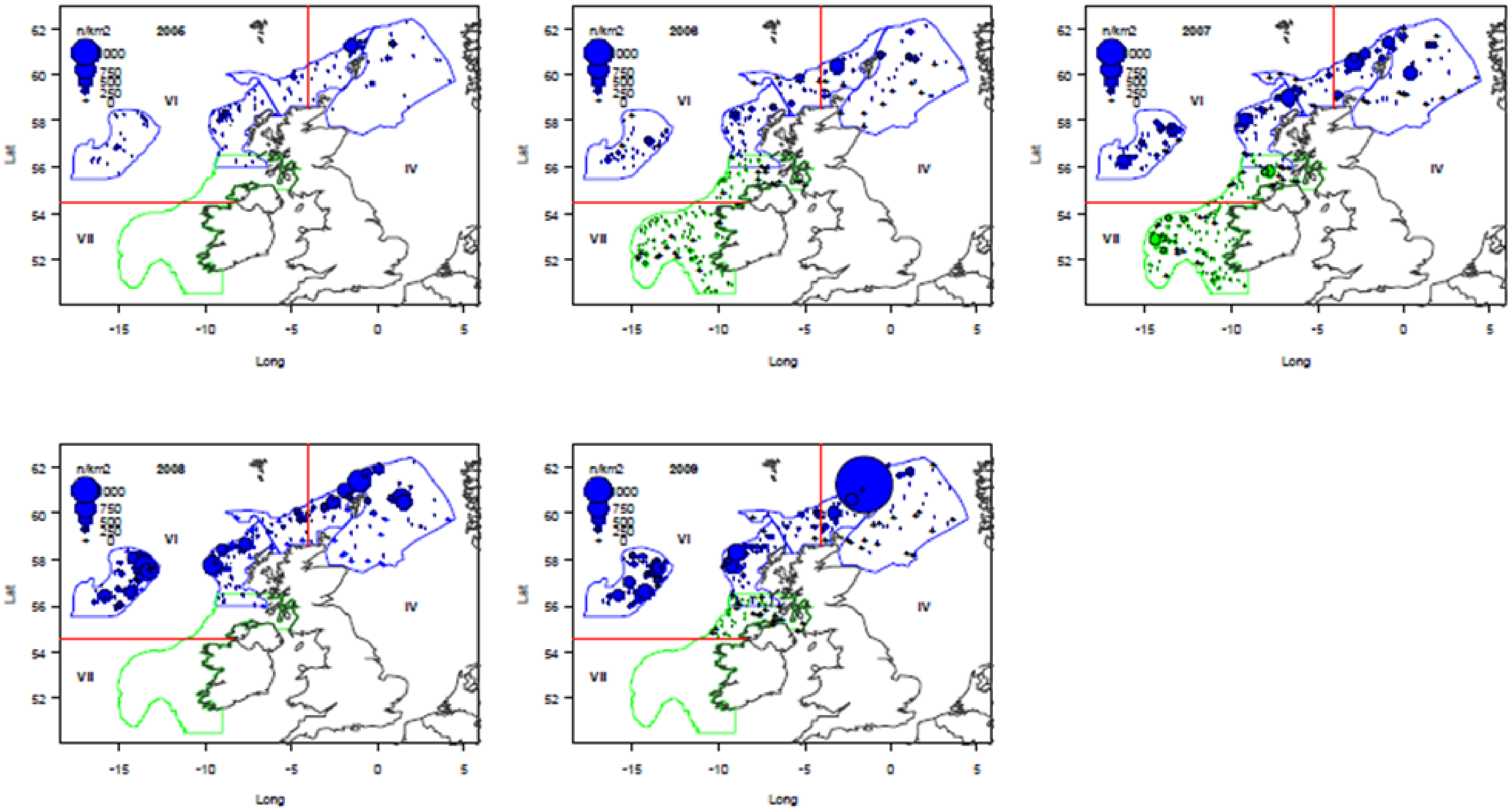


Figure 5.3.5 Maps of the northern continental shelf around the British Isles showing the number density of megrim caught during the anglerfish surveys 2005-2009. Each circle (blue for Scottish surveys; green for Irish surveys) is centred on the sample location and the size of the circle is proportional to the number density in n/km2according to the legend (top left). The red lines indicate the position of the borders between the main ICES sub-areas (labeled with Roman numerals).

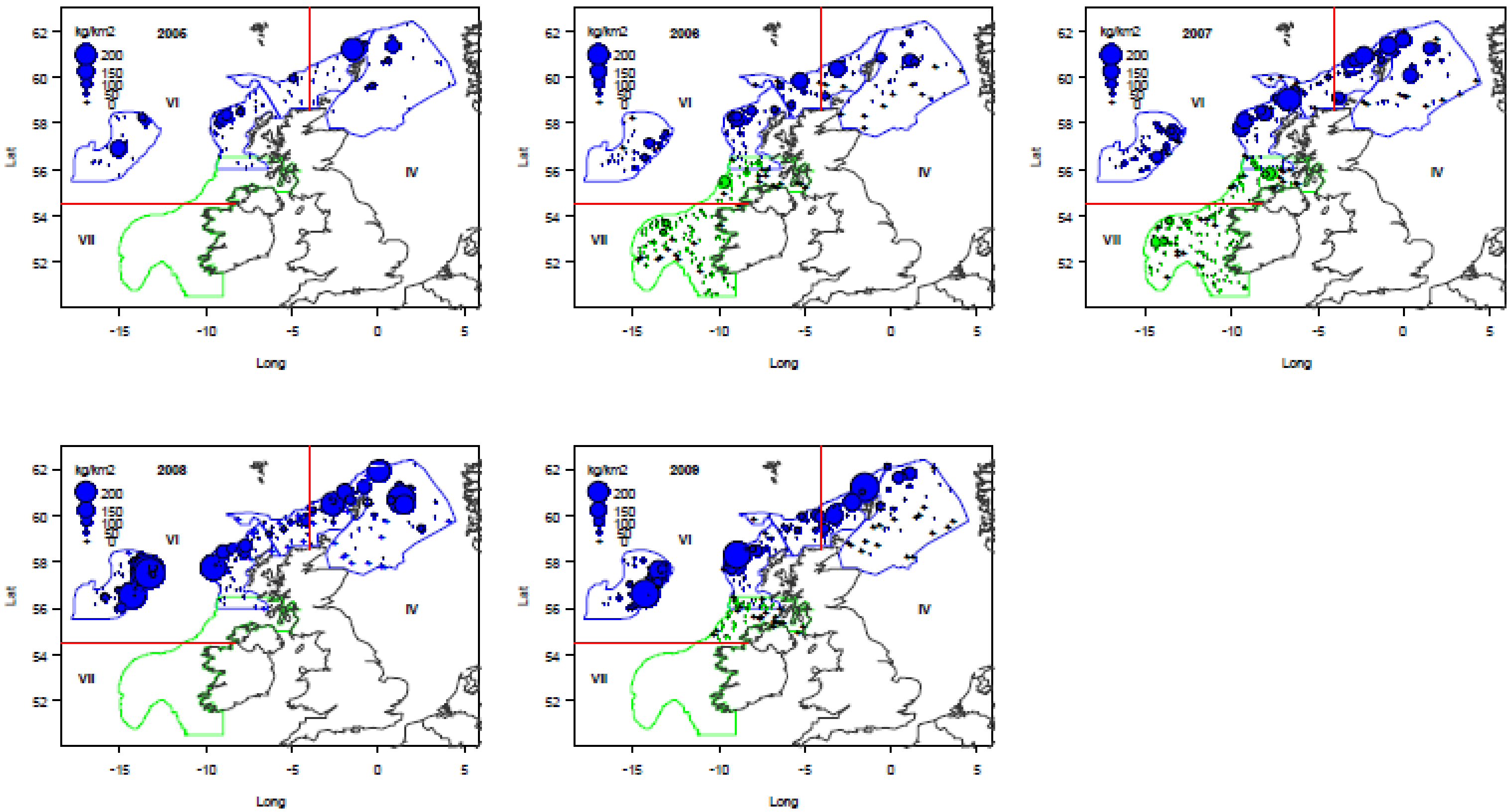


Figure 5.3.6. Maps of the northern continental shelf around the British Isles showing the weight density of megrim during the anglerfish surveys 2005–2009. Each circle (blue for Scottish surveys; green for Irish surveys) is centred on the sample location and the size of the circle is proportional to the weight density in kg/km² according to the legend (top left). The red lines indicate the position of the borders between the main ICES subareas (labelled with Roman numerals).

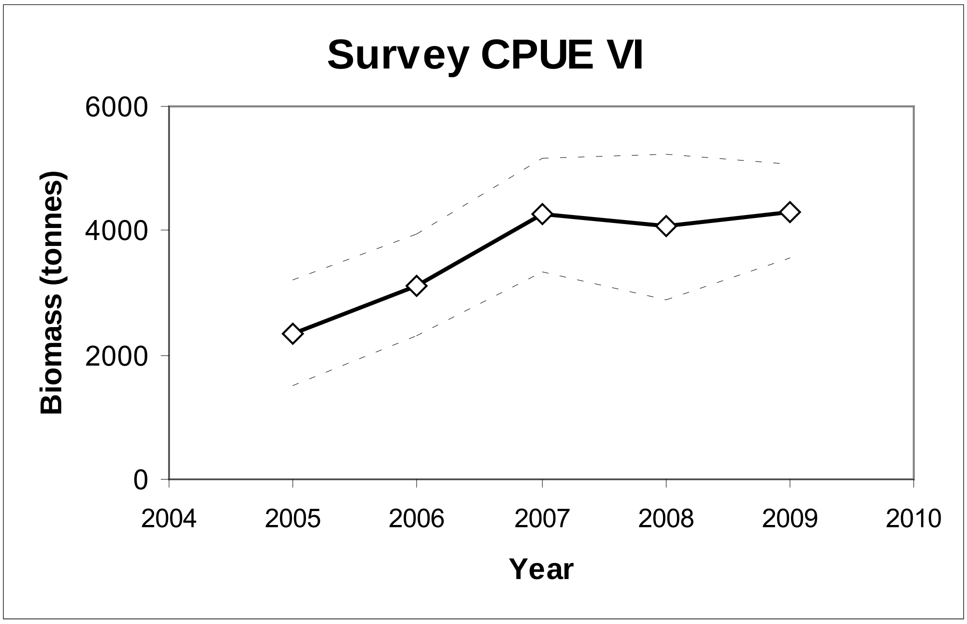


Figure 5.3.7. Relative change in ICES Division VI megrim biomass with 95% confidence intervals from the 2005–2009 anglerfish survey.

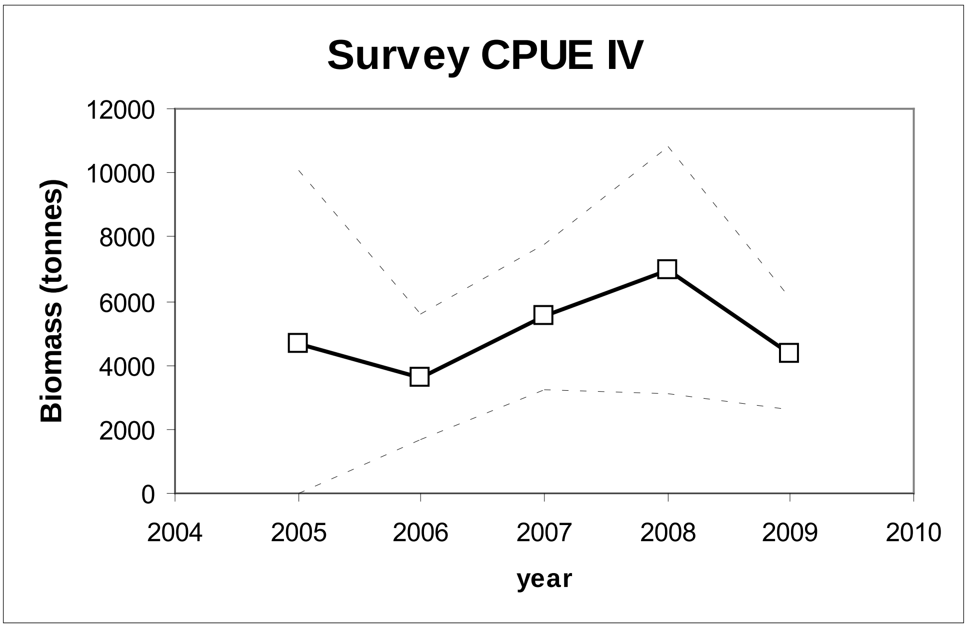


Figure 5.3.8. Relative change in ICES Division IV (partial coverage) megrim biomass with 95% confidence intervals from the 2005–2009 anglerfish survey.

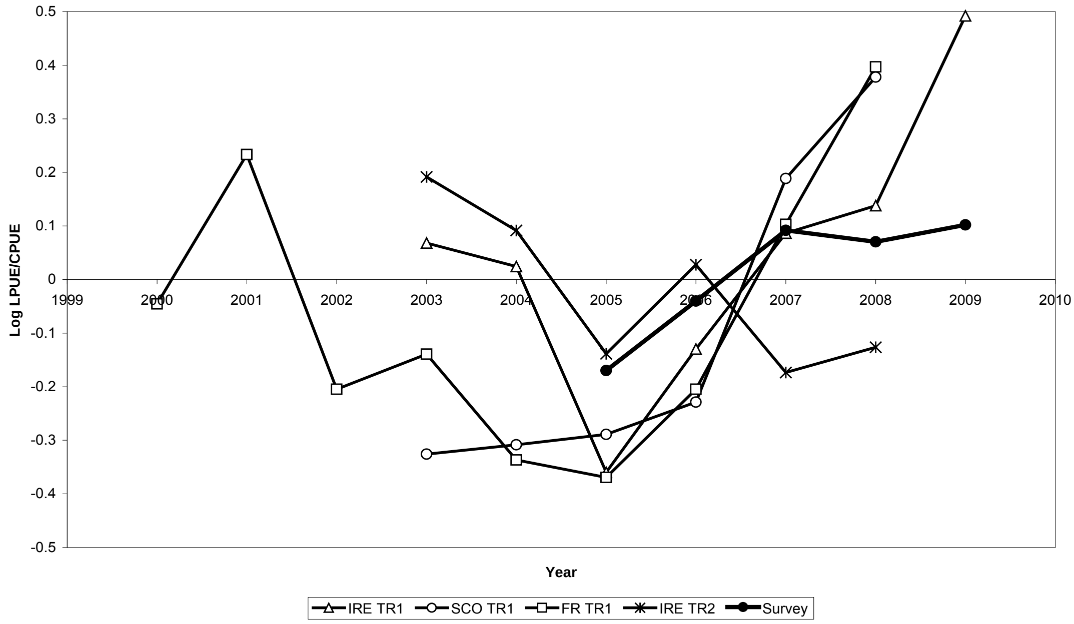


Figure 5.3.9. Change in commercial Log lpue and survey (Area VI) cpue relative to long-term average for Megrim in VIa (Area VI for survey).

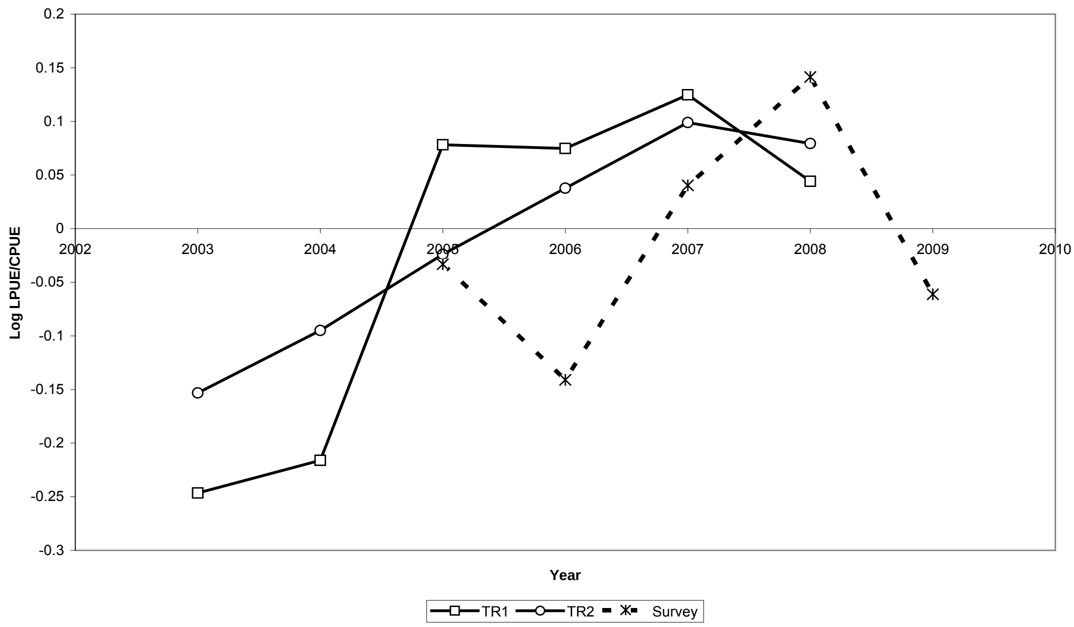


Figure 5.3.10. Change in commercial Log lpue and survey cpue relative to long-term average for Megrim in IV.

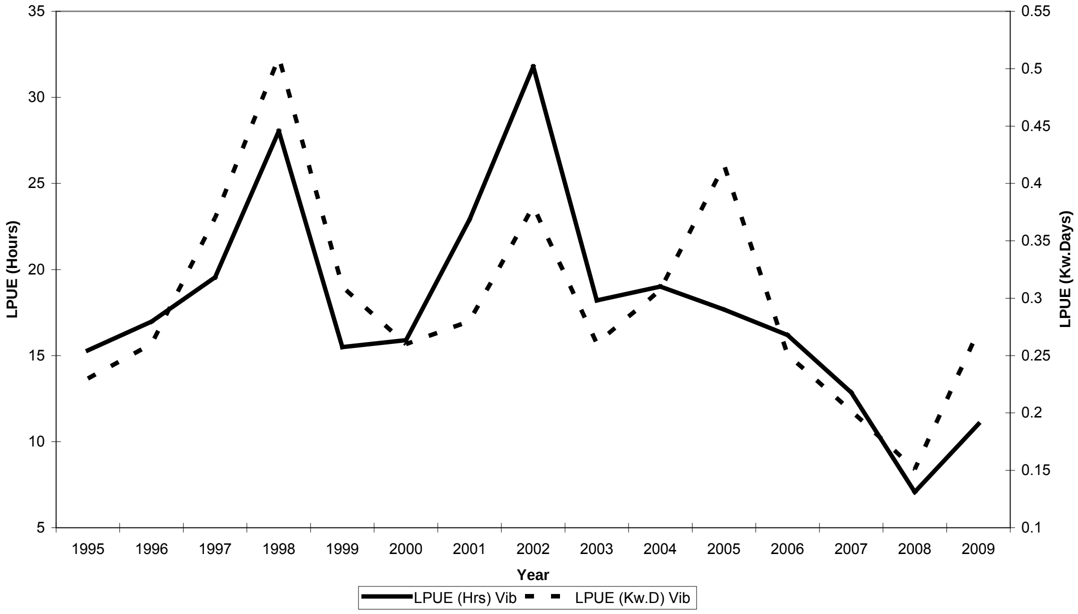


Figure 5.3.11. Megrim lpue trends for Irish otter trawlers from ICES Subdivision VI.

6.1 Irish Sea overview

There is no overview.

6.2 Cod in VIIa

Type of assessment

This is an update assessment. The assessment has not yet been included in ICES benchmarking process.

ICES advice applicable to 2009

"Because the existing recovery plan does not include the elements or measures necessary to rebuild the stock at the current SSB (well below B_{lim}), ICES continues to advise on exploitation boundaries in relation to precautionary limits and recommends that the fisheries for cod be closed until an initial recovery of the cod SSB has been proven. Any catches that are taken in 2008 will prolong the recovery to B_{pa}."

ICES advice applicable to 2010

"ICES has evaluated the long-term management plan and found it not precautionary. … ICES continues to advise on exploitation boundaries in relation to precautionary limits and recommends that the fisheries for cod be closed until an initial recovery of the cod SSB has been proven. Any catches that are taken in 2010 will prolong the recovery to B_{pa}."

6.2.1 General

Stock description and management units

The stock and the management unit are both ICES Division VIIa (Irish Sea).

Management applicable to 2009 and 2010

TACs and quotas set for 2009

Species: Cod *Gadus morhua*		Zone: VIIa (COD/07A.)
Belgium	12	
France	33	
Ireland	592	
The Netherlands	3	
United Kingdom	259	
EC	899	
TAC	899	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TACs and quotas set for 2010

Species: Cod *Gadus morhua*		Zone: VIIa (COD/07A.)
Belgium	9	
France	25	
Ireland	444	
The Netherlands	2	
United Kingdom	194	
EU	674	
TAC	674	Analytical TAC

Management of cod is by TAC, days-at-sea limits and technical measures. Technical regulations in force in the Irish Sea, including those associated with the cod recovery plan since 2000, are described in Section 6.1.

Fishery in 2009

Landings of cod in 2009 (Table 6.2.1) were the lowest recorded. The percentage landed into Northern Ireland remained at approximately 80% (Table 6.2.2), the majority taken by whitefish otter trawlers and *Nephrops* trawlers. The percentages landed into southern Ireland, Belgium and UK (England and Wales) in 2009 also remained very similar to 2008 values at roughly 13%, 4% and 3% respectively. Irish fleets experienced elevated catch rates of cod in the Celtic Sea off SE Ireland in 2009, and 193 tonnes of cod landings incorrectly reported as taken in VIIa were re-allocated to the Celtic Sea. WG landings figures in 2009 were 52% of the TAC, and have been at around 50% of the TAC since 2004.

6.2.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1 in the WGCSE Report.

Fishery landings

The input data on fishery landings and age compositions are split into three periods (Figure 6.2.4):

1) 1968–1990. Landings in this period, provided to ICES by stock coordinators from all countries, were assumed to be accurate and were used directly as the input data for the assessment.

2) 1991–1999. TAC reductions in this period caused substantial misreporting of cod landings into several major ports in one country, mainly species misreporting. Landings into these ports were estimated based on observations of cod landings by different fleet sectors during regular port visits (see Stock Annex). For other national landings, the WG figures provided to ICES stock coordinators were used, as in period (1).

3) 2000 onwards. Cod recovery measures were considered to have caused greater problems with estimation of fishery removals than in period (2). The ICES WG landings data provided by stock coordinators for all countries, as in period (1) were input to B-Adapt and the annual total removals (in excess of the assumed M) were estimated within the assessment model.

The annual numbers-at-age landed, total landed weight, and the mean weights-at-age in the landings by age class, are given in Tables 6.2.2–6.2.4 and Figures 6.2.1–6.2.4. Previous WG's have shown there are no long-term trends in catch weights-at-age from 1982 onwards. However, weights-at-age prior to 1982 are fixed at constant values lower than estimated for subsequent years, leading to sums-of-products errors, and weights-at-ages 7+ are becoming patchy for the last few years (Figure 6.2.1). Given these problems, and the likelihood of further deterioration in the quality of the older aged fish, revision of historical catch-at-age data and associated weights is needed.

The catch-at-age data were screened using separable VPA (reference age 3; terminal F = 1.5; S = 1.0; default year and age weighting). The data continue to show a persistent change in residuals for log catch ratios at ages 1–2 after 1991 (Figure 6.2.5). Outliers at age 5–6 in 2003/2004 and age 1–2 in 2006/2007 are not associated with any obvious anomalies in any national dataset and reflect small catches and sample sizes.

Discards data

No discards data are included in the assessment. Suitable discards estimates are not available prior to the mid-1990s and are not complete for many subsequent years. Available data indicates that discarding has historically been mainly a function of MLS and therefore mainly restricted to catches of <1-gp cod. This pattern continued in 2009 for the Irish and UK (NI) data, but although 11 trips were sampled on UK (E&W) vessels no cod were caught to sample (Figures 6.2.6 and 6.2.7 and Table 6.2.5). Historical F and recruitment for 1-gp cod are therefore underestimated, but it has not been possible yet to compile a matrix of international fleet-raised discards estimates by year and age for use in assessments. Discards data should be fully evaluated in any future benchmark assessment.

Biological data

The assessment uses constant values of M=0.2 (all ages) and combined-sex proportion mature values of 0 at age 1, 0.38 at age 2 and 1.0 for older ages (see Stock Annex for derivation).

Survey data used in assessment

The surveys used in the assessment are described in the Stock Annex, and the series are updated in Table 6.2.6.

Internal consistency of survey data

The survey data during spring each year are of critical importance for tuning the B-Adapt and estimating catch bias because adult cod are better represented than during the autumn surveys. The data for these surveys were screened by fitting the SURBA model using settings described in the Stock Annex, and examining the diagnostic plots. The NIGFS-Mar and ScoGFS-1Q surveys do not exhibit any marked year-effects, and appear to track year-class variations with good consistency (Figure 6.2.8). Strong positive residuals at age 1 are noted for 1994–1996 in the SURBA model fit for NIGFS-Mar (Figure 6.2.8, bottom panels).

Consistency between survey-series

The three series of summer–autumn 0-gp indices used in the update B-Adapt assessment do not consistently follow the trends in year-class effects from the SURBA model applied to the NIGFS-Mar and ScoGFS-1Q data (Figure 6.2.9). Whilst the surveys give similar signals for some year classes, there are some years (e.g. 2004–2005 and 2001) where the series diverge noticeably. The NIGFS-Mar and ScoGFS-1Q SURBA models provide very similar trends in year-class strength.

Commercial cpue

Commercial cpue data are available for this stock but are not currently used in the assessment.

Other relevant data

Table 6.2.6 includes indices of abundance from the UK Fisheries Science Partnership (www. cefas.co.uk/fsp). These are not used in the update assessment and have not yet been evaluated through any benchmarking process, although are presented as supporting evidence (WD 10). The SSB trends from the UK Fisheries Science Partnership trawl surveys support the trends given by the NIGFS-1Q survey from 2004 onwards (Figure 6.2.10).

A Cefas Q4 IBTS trawl survey-series covering the Irish Sea and Celtic Sea in November commenced in 2004. Cod abundance indices will be provided from this survey in future.

The latest in a series of cod SSB estimates from applications of the annual egg production method, using gene probes to identify early-stage cod eggs, are available for 2008 (WD 11). Further estimates will become available from surveys in 2010. These will be evaluated in future benchmark assessments.

6.2.3 Historical stock development

Deviations from Stock Annex

The assessment does not deviate from the procedure used last year and described in the Stock Annex.

Software used and model options chosen

The B-Adapt method is described in the Stock Annex. Software version B-Adapt-F.exe (13/5/06) was used to allow estimation of removals bias from 2000 onwards.

Model settings for the update assessment are given in Table 6.2.7. B-Adapt can use survey data for the year after the last year of catch data, and in this assessment the survey indices for NIGFS-Mar in 2010 are used. An input F-multiplier for 2010 is required for adjusting the survey indices to the start of the year. In view of the new cod recovery measures which involved a 25% reduction in cod TAC in 2010, an F-multiplier of 0.75 was applied in 2010.

Input data types and characteristics

New data added to the update B-Adapt assessment are the fishery landings data for 2009, the NIGFS-Mar survey data for 2010 and the NIGFS-Oct, UK (BTS-3Q) and NIMIK 0-gp indices for 2009. The update B-Adapt assessment follows the same procedure as in the 2009 assessment by including the sample-based estimates of landings at three major ports from 1991–1999, whilst estimating removals in excess of the assumed natural mortality rate in subsequent years. The sample based estimates of landings for 2000–2002 and 2005 provide a comparison with the B-Adapt removals estimates.

Data screening

Screening of input catch and survey data is described in Section 6.2.2.

Final update assessment: diagnostics

The diagnostics of the update B-Adapt run are given in Table 6.2.8. Note that these are from the non-bootstrap application of the model. The catchability residuals from the update assessment are given in Figure 6.2.11. A trend in catchability residuals for 2–4 year old cod exists in the first five years of the NIGFS-Mar survey-series. This is not reflected in the SURBA residuals shown in Figure 6.2.8. In contrast, the three positive values at age 1 in 1994–1996 in NIGFS-Mar B-Adapt residuals are evident in the SURBA analysis, indicating a change in survey selectivity.

Final update assessment: Retrospective analysis

The estimation of catch bias in B-Adapt effectively removes survey catchability trends from 2000 onwards, and the assessment therefore exhibits no retrospective bias (Figure 6.2.13).

Final update assessment: long term trends

The population numbers and F at age from the update B-Adapt assessment are given in Tables 6.2.9 and 6.2.10, and the VPA summary data are given in Table 6.2.11. These are the point estimates from the non-bootstrap option. The long-term trends in landings, F, SSB and recruitment are shown in Figure 6.2.14, using the bootstrap option to give 5th and 95th percentiles from 1000 boot-strap runs selecting randomly from the survey catchability residuals. Note that the 50th percentiles differ slightly from the point estimates from the non-bootstrap option.

The B-Adapt estimates of total removals for 2000–2009 (in excess of the WG landings figures and natural mortality M=0.2) may represent unaccounted discards, landings and additional natural mortality. The B-Adapt estimates of total removals (including unaccounted removals) were close to the WG landings figures including sample-based estimates for 2000 and 2001, but the 90% confidence limits of the B-Adapt estimates for 2002 and 2005 lie just above the WG landings estimates.

The recruitment trends from B-Adapt are very similar to the indices from SURBA for the NIGFS-Mar and ScoGFS-1Q surveys (Figure 6.2.15), indicating that the historical trends are well captured by the survey and fishery age-composition data. The SURBA and B-Adapt indices of SSB indicate very low SSB since 2005, and continued high total mortality rates. Given the highly truncated age composition in the stock, and the internal procedure in SURBA for estimating recent Z, the SURBA trends in Z are probably poorly estimated.

In order to investigate the sensitivity of this assessment to the B-Adapt estimates of total removals, another assessment was conducted using the same software and settings, but without estimating the bias. Figure 6.2.12 presents the results. Although the values of SSB and recruitment are lower without the estimated additional removals, both assessment runs indicate that recent SSB and recruitment both have been at historic lows in recent years. Trends in F_{bar} are reasonably consistent between the model runs.

Comparison with previous assessments

The retrospective analysis (Figure 6.2.13) provides a comparison with the results of the assessment carried out in 2009. The current assessment is a direct update without any changes to procedures or data. The current assessment is very consistent with the previous assessment.

The state of the stock

The spawning–stock biomass has declined ten-fold since the late 1980s and is suffering reduced reproductive capacity (SSB < B_{lim} of 6000 t).

The fishing mortality estimates since 1988 have remained above the F_{lim} value of F=1.0 and the stock has therefore been harvested unsustainably over this period.

Fishing mortality throughout the assessment period has been well above the candidate reference points ($\mathbf{F}_{max}$ and $\mathbf{F}_{0.1}$) associated with high long-term yields and a low risk of depleting the productive potential of the stock.

Recruitment has been below average for the past seventeen years. The 2002 to 2008 year classes are amongst the smallest on record and all lie below a segmented regression line fitted to the stock–recruit data, indicating lower than expected recruitment given the SSB estimates (Figure 6.2.16). The 2009 data show increased recruitment compared the recent period of poor recruitment, but still below the long-term average. Preliminary indications suggest the 2009 year class to be of similar magnitude to the 2000–2001 year classes. This recruitment is some way above the segmented regression line on Figure 6.2.16, and thus indicates a higher than expected recruitment given the estimated SSB. The estimated breakpoint in the regression is close to the B_{pa} of 10 000 t.

6.2.4 Short-term predictions

Due to the inability to identify the source of the bias in removals estimates from B-Adapt assessment, and the relationship between future TACs and total removals, detailed short-term catch forecasts have not been given for this stock for several years. The update B-Adapt assessment, including a 25% F reduction in 2010, indicates a 300% increase in SSB between 2010 and 2011. This is a consequence of the high 2009 recruitment entering the spawning stock, after numerous years of very weak recruitment.

SSB percentile	2008	2009	2010	2011
5th	1262	889	500	1258
25th	1518	1083	631	1821
50th	1728	1238	744	2249
75th	1981	1418	873	2874
95th	2363	1685	1083	4028

6.2.5 Medium-term projections and MSY evaluation

Medium-term projections

Medium-term projections are carried out to look at the possible future trends in the stock in response to changes in total mortality. The contribution of the fishery to the total removals estimates over and above reported landings is unknown.

Estimating recruiting year-class strength

Following the recommendation from RGNSDS (2007) that bootstrapping the 1992–2006 recruitment estimates may have led to overoptimistic forecasts, 2002 was chosen as the starting year for this assessment's medium-term projections.

The stock–recruit plot (Figure 6.2.16) shows that from 2002 to 2008 the recruitment estimates were well below the segmented regression line, but well above it in 2009. As we do not yet know whether the increase in 2009 is the start of a period of higher recruitment or a one-off high value, two sets of forecasts have been run, one using the year range 2002 to 2009 (including the higher 2009 value) and the other being a more pessimistic view using only the lower (and more recently typical) values seen between 2002 to 2008.

Year	Year class	Source	Number at age 0 ('000)
2007	2007	B-Adapt (point estimate)	384
2008	2008	B-Adapt (point estimate)	574
2009	2009	B-Adapt (point estimate)	3742
2010	2010	Bootstrap 2002–2008 y.c.: (50th percentile)	1192[1]
		GM (2002–2008 y.c.)	1040
2010	2010	Bootstrap 2002–2009 y.c.: (50th percentile)	1262[1]
		GM (2002–2009 y.c.)	1221

[1] Average of 50th percentiles over 10-year B-Adapt projection

Scenarios examined

The mortality rate due to removals in excess of the assumed natural mortality of M=0.2 is referred to below as F*. Four medium-term stochastic projections were carried out using the bootstrap option in B-Adapt:

1) Zero F* from 2010 onwards with recruitment estimated from model estimates for the year classes observed from 2002–2008.

2) Zero F* from 2010 onwards with recruitment estimated from model estimates for the year classes observed from 2002–2009.

3) 25% reduction in F* per year until F* attains the value of F=0.4 adopted by the Commission as the long-term management objective. Recruitment es-

timated from model estimates for the year classes observed from 2002–2008.

4) 25% reduction in F* per year until F* attains the value of F=0.4 adopted by the Commission as the long-term management objective. Recruitment estimated from model estimates for the year classes observed from 2002–2009.

Projections 3 and 4 represent annual reductions in F* equivalent to reductions in F that Management Plan may seek to achieve through annual 25% reductions in TAC. However, the bootstrap procedure does not simulate any additional variability and risk associated with limits on inter-annual TAC variability, or any changes in discarding or compliance.

The removals figures generated in the projection implicitly include the level of removals bias estimated by B-Adapt for 2009 in each simulation. It is currently not possible to attribute these to any actual losses not accounted for in the model inputs, or to any remaining bias due to incorrect assumptions in the B-Adapt implementation.

Model inputs

Model inputs were as follows:

- *Number of simulations*: 1000:
- *Recruitment from 2010 onwards*: bootstrapped in each simulation from model estimates for the year classes described in the scenarios examined section.
- *Status quo F*: B-Adapt F(2-4) for 2009 in each simulation.
- *Intermediate year assumption*: To allow for a potential reduction in F* in 2010 associated with the 25% TAC reduction, an F-multiplier of 0.75 was applied in 2010.

Results

Reducing F* to zero from 2010 onwards allows a high probability of recovery of SSB to above B_{pa} by 2015 (Figures 6.2.17 and 6.2.18) regardless of recruitment scenarios, with the more optimistic 02–09 recruitment model having 99% probability compared to 98% probability for the 02–08 recruitment.

A stepwise reduction in F* by 25% per year (until the year when the 50th percentile of F* reaches 0.40) is more dependent on the recruitment range used in the model (Figures 6.2.19 and 6.2.20). The 02–08 range results in a 26% probability of SSB > B_{lim} by 2015 and zero probability of achieving B_{pa}, with the 02–09 range showing a 46% probability of SSB > B_{lim} by 2015 and 10% probability of achieving $B_{pa.}$

MSY evaluations

The results for the MSY evaluation are presented in Table 6.2.12 and Figures 6.2.21–6.2.25. Given the uncertainty in the F estimation for the most recent years in this stock, only data up to 2005 was used. The AIC values are similar for each curve, the smooth hockey stick has the lowest value but the difference between values is small relative to the scale and there is no clear appropriate model selection based on this statistic.

The Fcrash values for Ricker (1.63) and Beverton–Holt (1.68) are very similar with the Hockey stick model showing a lower value (1.21), and all values are some way above the current F_{lim} (1.0). The lower 5th percentile of the Fcrash distribution is very close to F_{pa} (0.72) for the Hockey stick (0.74), but higher for the Ricker (0.91) and Beverton–Holt (0.88).

For both the Ricker and Beverton–Holt curves, one of the ADMB parameters is well-defined (13% c.v.), while the other is poorly determined (41–43% c.v.). In the case of the Beverton–Holt curve, both unscaled parameters are very poorly determined (>500% c.v.s), highlighting the importance of re-parameterisation of the usual Beverton–Holt formulation prior to estimation. In contrast, both smooth hockey stick parameters are well determined with c.v.s of 14% and 20%. Although B_{msy} levels are very poorly determined in all three cases (c.v.s ranging from 130% to 480%), and MSY in the case of Ricker and Beverton–Holt (c.v.s of 110–520%), the corresponding F_{msy} level is reasonably well determined for all three models, with c.v.s ranging from 27% to 36%, and median values ranging from 0.25 to 0.54. The Ricker curve provides the highest and most precisely determined F_{msy} value, and is also regarded as the most biologically plausible model for cod, given that cod are cannibalistic. However, the fit of the stock–recruit curves (AIC values) and corresponding estimates of precision for parameters (stock–recruit and F_{msy}) does not exclude any of the models from being considered, and F_{msy} values from all three models are therefore presented.

Conclusion

The models used do not included uncertainty due to ecosystem effects and multi-species interactions affecting growth, maturity and natural mortality and therefore the stock trajectory estimated at low fishing mortality rates is considered to be highly uncertain. The assessment for this stock does not currently include discards information, and although the model estimates unallocated removals in excess of natural mortality from the year 2000 onwards, this cannot be attributed to any particular mortality source. The assessment therefore incorporates discard mortality from 2000 onwards, but not before. The available data suggests that discarding of Irish Sea cod is predominantly an effect of the MLS, and thus affects the recruiting fish. Recruit estimates for this stock are therefore uncertain.

F_{msy} estimates are reasonably well determined for all three models and these models cannot be distinguished based on the current data. Consequently the definition of F_{msy} for the Irish Sea cod stock is dependent on whether it is considered that recruitment will be reduced or either remain constant or continue to increase at high stock abundance; the choice between the Ricker on the one hand and the smooth hockey stick and Beverton–Holt models on the other. The Ricker curve is the most plausible based on biological considerations, but until more data are collated at high stock abundance the recruitment dynamics at high stock abundance will be uncertain.

Consequently a definitive F_{msy} value cannot be determined for Irish Sea cod based on the current information. On the basis of the three models that have equally plausible fits to the stock and recruit estimates, a range of 0.25–0.54 would be considered consistent with F_{msy} for Irish Sea cod.

6.2.6 Biological reference points

The current precautionary reference points for Irish Sea cod are given below:

Precautionary approach (unchanged since 1998)

Blim	6000 t	B_{pa}	10 000 t
Flim	1.00	F_{pa}	0.72

6.2.7 Management plans

The Irish Sea cod management plan, as described in Council Regulation (EC) 1342/2008 was evaluated independently by ICES in 2009 using the approach adopted in AGCREMP 2008 and found to be not consistent with the ICES Precautionary Approach (WGCSE 2009).

The long-term target for the management plan is a fishing mortality of 0.4, based on the EU-Norway negotiated target for North Sea cod. This target is within F_{msy} range for Irish Sea cod, and well below the current estimates of total removals mortality in excess of M=0.2.

6.2.8 Uncertainties and bias in assessment and forecast

Landings data

The quality of the commercial landings and catch-at-age data for this stock deteriorated in the 1990s following reductions in the TAC without associated control of fishing effort. The Working Group has, since the 1990s, attempted to overcome this problem by incorporating sample-based estimates of landings from three major ports in the WG landings figures. The data for this method have become more limited since 2003, and the WG uses the B-Adapt modelling approach to estimate subsequent removals from 2000 onwards. The unaccounted removals figures given by B-Adapt could potentially include components due to increased natural mortality and discarding as well as misreported landings or catches from the stock taken outside VIIa, albeit distributed according to the age composition in the landings.

The French landings data used in 2009 are provisional and subject to change in at the next assessment (Table 6.2.2). This data accounts for less than 1% of the 2009 landings (~3 tonnes).

Discarding

Estimates of discards are patchy for Irish Sea cod, although more comprehensive sampling is now required through the EU Data Collection Framework. Discarding has historically been mainly at age 1, and the absence of raised estimates of discarding for all fleets will result in under-estimation of historical F at age 1. Strict controls on catch reporting following the introduction of the Registration of Fish Buyers and Sellers regulations has resulted in documented increases in discarding of cod above the MLS off the west of Scotland and in the Celtic Sea (see Sections 3.2 and 7.2). This could also occur in the Irish Sea, although observer data in 2008–2009 provided no evidence for this. Compliance with catch composition rules for some fleets could also result in increased discarding of cod. Implementation of unbiased sampling schemes to estimate discarding with adequate precision is likely to be of increasing importance for this stock to prevent further deterioration in fishery catch data.

Surveys

The Irish Sea has relatively good survey coverage up to 2010. The surveys in general give consistent signals of fish abundance-at-age. All survey data except the UK(BTS-3Q) indicate a severe depletion of the SSB during a 7-year run of very poor recruitment followed by a larger recruitment in 2009. The UK(BTS-3Q) survey does not show this improved recruitment in 2009, but the data only represent a small area of the Irish Sea and may not be representative of the Irish Sea as a whole. The UK Fisheries-Science Partnership surveys of the Irish Sea cod spawning grounds in spring 2005–2010 (not in the assessment), carried out using commercial trawlers, indicated a widespread distribution of cod mostly at low density but with some localized aggregations (Figure 6.2.26, WGCSE 2010 WD10). The time-series of SSB indices shows a downward trend similar to that shown by NIGFS-1Q which is used in the assessment (Figure 6.2.10), and the highly truncated age composition of cod in the FSP surveys supports the ICES assessment, indicating continuing high mortality rates. Estimates of cod SSB from applications of the annual egg production method, although slightly higher than the B-Adapt estimates, are still below B_{lim} and show a similar trend in SSB to the assessment (Figure 6.2.27).

Model formulation

The B-Adapt estimates of removals bias continue to vary around relatively high values of 2.0–3.0 despite more accurate catch reporting and lack of evidence for significant discarding of cod above MLS. There could potentially be unaccounted losses from other sources, for example due to fishery catches taken outside VIIa during seasonal migrations, a gradual shift in distribution to areas beyond VIIa, or increases in natural mortality. The estimates of bias could also be influenced by any remaining non-randomness of survey catchability or outlying values, or by incorrect assumptions in the model (e.g. constant survey catchability, removals bias not age-dependent). For this reason, the absolute values of the estimated unallocated removals should not be over-interpreted. There is currently no evidence from surveys and fishery age compositions of a significant improvement in age structure that could be caused by management measures. The interpretation in B-Adapt is that there continues to be a relatively large unaccounted-for removal of fish from the stock, but unfortunately there is currently very little direct evidence to evaluate the potential source(s) of this and how much is due to fishing in VIIa or elsewhere.

Stock structure and migrations

The VIIa commercial fishery for cod extends into the North Channel, particularly for vessels using mid-water trawls. It is not clear if the cod in this region belong to the Irish Sea stock, the nearby Clyde stock which exhibits dense aggregations of adult fish during spring in the area covered by the Clyde closure, or to other VIa cod populations. Incorrect allocation of catches to stocks could lead to biases in the assessments.

Tagging of cod off Greencastle on the north coast of Ireland (O Cuaig and Officer, 2007), and more limited tagging on UK Fisheries Science Partnership surveys (Armstrong *et al*., WD2 to WGNSDS 2007), have demonstrated movements of cod between Division VIa and VIIa. Most recaptures in VIIa from cod tagged in VIa have come from the North Channel and in or near the deep basin in the western Irish Sea that is a southward extension of the North Channel. The research surveys used for tuning the VIIa cod assessment cover only the western and eastern Irish Sea, and do not extend into the deeper water of the North Channel, where large catches of cod were made by mid-water trawlers in the 1980s and 1990s.

Recently more Irish Sea cod mark and recapture experiments, and electronic data storage tag (DST) results have been collected and analysed (Bendall *et al*., 2009). These results show not only spring/summer migrations of cod out of the Irish Sea into the North Channel and VIa, but also migrations south through the deeper channel into the Celtic Sea. This work is continuing and a further 150 cod have been tagged with DST's in the Irish Sea and Celtic Sea in 2010.

Historical tagging studies have also shown more limited movements of cod between spawning components in the western and eastern Irish Sea, for which the migrations tend to be in a north-south direction. STECF Subgroup SGRST (2005, Appendix 4) concluded that management of the Irish Sea stock on the basis of substock assessment regions would be difficult in practice, particularly the separation of catches when the stock units are mixed. Further tagging and genetics studies are required to investigate stock structure, seasonal movements and mixing in VIIa and neighbouring areas.

6.2.9 Recommendations for next benchmark assessment

Year	Candidate stocks	Supporting justification and comment(s)	Indicated expertise necessary at the benchmark meeting
2012?	Western waters cod stocks (Area VI and VII excl VIId).	Cod stocks in Divisions VI and VII comprise an assemblage of metapopulations with varying degrees of mixing. Fishing effort, predation and other environmental drivers including climate change impact the populations in different ways across the range of the stocks. The stocks have proved difficult to assess due to data deficiencies and an inability to demonstrate responses to changes in fishing effort and other management controls. Improved management advice may benefit more from quantifying the spatial dynamics of cod in relation to spatial variations in fishing and other pressures than by trying to refine the current modelling approaches applied to the current stock definitions and management units. To make progress towards this, an initial Data Workshop is proposed to collate and interpret existing and new data on cod stock structure and mixing, distribution patterns, spatial variations in size/age structure and biological characteristics as well as pressures including predation, fishing and climate. Such analyses will be facilitated by high-resolution spatial data on fishery catches and effort by metier using VMS, rectangle data, employing GIS methods. It will be necessary to develop an international database holding spatially resolved data sets (landings, discards, effort, size/age/biological data, surveys, environmental variables) and data manipulation routines to allow evaluation of the effect on the assessments of altering the stock unit definition. Data on cod movement parameters will be required to allow development of operating models for testing assessment and management procedures and ultimately developing and testing spatially disaggregated assessment models. New data sets e.g. on discarding, biology, predation, surveys and fishing effort/cpue would be evaluated. The Data Workshop would build on and review the outcomes of a major UK collaborative programme on cod stock structure and spatial dynamics, which will be completed in 2011. The ensuing Benchmark Assessment workshop would evaluate the appropriateness of current assessment methods in the light of the Data Workshop outcomes, and explore alternative approaches as candidates for providing management advice. This could potentially include changes to the spatial units for assessment or the development of spatially disaggregated assessment models including mixing coefficients.	

6.2.10 Management considerations

A number of emergency and cod recovery plan measures have been introduced since 2000 to conserve Irish Sea cod. These include a spawning closure since 2000 and effort control since 2003. There have also been several vessel decommissioning schemes. As it has not been possible to provide analytical catch forecasts in recent years, the TAC has been reduced by 15–20% annually since 2006 and by 25% since 2009. These measures may have prevented a further increase in fishing mortality of cod or may have resulted in some reduction in fishing mortality. However, the current assessment does not provide sufficiently robust estimates of fishing mortality to allow the possible changes to be determined.

Although recent recruitment patterns appear well estimated in the assessment, the problem of inaccurate landings and discards estimates makes it difficult to estimate the absolute value and recent trends in fishing mortality. However, all sources of information on age composition in the stock, from the fishery as well as surveys using research vessels and chartered commercial vessels, indicates a continued paucity of cod older than four years of age in the Irish Sea indicating a continued very high mortality rate. Possible causes of this include:

- TACs have not restricted catches as intended. Substantial underreporting of landings is known to have occurred since the 1990s, although there is some indication that this is reduced since 2006. However the assessment continues to indicate a large unaccounted removal of fish. The relative contribution of fishing to this has not been identified;
- The effort reductions have not been sufficient, although considerable effort reductions have been observed in some fleets (particularly vessels using >100 mm mesh);
- Cod continues to be taken in mixed demersal fisheries (particularly for haddock, sole and *Nephrops*);
- Time and area closures have not been sufficient to lead to rebuilding of this stock;
- Other non-fishery causes, such as increased natural mortality, have increased over time.

It is difficult to reconcile the large apparent mortality rate and unaccounted removals in recent years with the reduction in fishing effort by whitefish trawlers (shown by STECF Subgroup SGMOS (2009) and Gerritsen (WD4)), the very low abundance of cod, and the evidence for more accurate catch reporting since the introduction of the Registration of Buyers and Sellers.

The scientific evaluation of the revised cod Management Plan (Council Regulation (EC) 1342/2008) indicates that it may not be sufficiently precautionary to allow rebuilding of the Irish Sea cod stock to a level where it can regain historical productivity by 2015 (see WGCSE 2009 Report, Section 9.2). The probability of recovery of the cod stock will be increased by measures to eliminate discards of cod which historically have mainly comprised undersized fish.

A closure of the western Irish Sea spawning grounds for cod from mid February to end of April has been in place since 2000, with an extension to the eastern Irish Sea in 2000. The closure was reviewed in 2007 by STECF SGMOS-07-03. On the basis of the information available, SGMOS-07-03 was unable to determine the extent to which the closure has reduced fishing mortality to a lower value than would otherwise have occurred, through protection of adult cod during spawning or influencing changes in fishing effort in the different fleets. SGMOS advised that a comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required to evaluate the cod closure.

Surveys of cod eggs in the Irish Sea in 2008 involving the UK and Ireland indicated that half of the spawning took place in areas not included in the spring spawning closure, indicating that the design of the closure may no longer be optimal (Figure 6.2.26 and WD 11). The spawning closure encompassed most of the spawning in the western Irish Sea although spawning commenced earlier in the east. Preliminary estimates of spawning–stock biomass of cod based on the annual egg production and estimates of fecundity and sex ratio are 2230 t (RSE 43%) in the western Irish Sea, 2658 t (RSE 25%) in the eastern Irish Sea and 4860 t (RSE 18%) for the whole Irish Sea (Figure 6.2.27**)**. The update B-Adapt assessment provides an SSB estimate of 1801 t for the Irish Sea in 2008, roughly 40% of the egg production estimate. Although the estimates vary both methods give SSB below B_{lim}, and both indicate drops in SSB from early years values (years 1995 and 2000 for the egg survey). Further estimates of cod SSB from this method will become available in 2011 from surveys carried out in 2010.

References

Bendall, V. Ó Cuaig, M. Schön, PJ. Hetherington, S, Armstrong, M. Graham, N. Righton, D. 2009. Spatio-temporal dynamics of Atlantic cod (*Gadus morhua*) in the Irish and Celtic Sea: results from a collaborative tagging programme. ICES CM 2009/J:06, 35 pp.

Table 6.2.1. Nominal landings (t) of COD in Division VIIa as officially reported to ICES, and figures used by ICES.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009[1]
Belgium	187	142	183	316	150	60	283	318	183	104	115	60	67	26	19
France	166	148	268	269	n/a	53	74	116	151	29	35	18[2]	17[2]	3	-
Ireland	1,414	2,476	1,492	1,739	966	455	751	1,111	594	380	220	275[2]	608[2]	643	2485
Netherlands	-	25	29	20	5	1	-	-	-						
Spain	-	-	-	-	-	-	-	-	14	-	-				
UK (England, Wales & NI)	2,330	2,359	2,370	2,517	1,665	799	885	1,134	505	646	594	591[2]	423[2]	545	389
UK (Isle of Man)	22	27	19	34	9	11	1	7	7	5	n/a	n/a	n/a	n/a	n/a
UK (Scotland)	414	126	80	67	80	38	32	29	23	15	3	6[2]	2[2]	n/a	n/a
Total	4,533	5,303	4,441	4,962	2,875	1,417	2,026	2,715	1,477	1,179	967	950	1,091	1217	656
Unallocated	54	-339	1,418	356	1,909	-143	226	-20	-192	-107	-57	-110	-389	-556	-188
Total as used by WG	4587[3]	4964[3]	58593	5318[3]	4784[3]	1274[4]	2252[4]	2695[4]	1285[4]	1072[4]	910[4]	840[4]	702[4]	661[4]	468

[1]Preliminary. [2]Revised. n/a = not available [3] includes sample-based estimates of landings into three ports [4] based on official data only. [5]Estimate due to incorrect submission to ICES.

Table 6.2.2. Cod in VIIa. Working Group figures for annual landings by country since 2000.

(a) WG landings (tonnes)											
Year	NI	E&W	Scotland	Ireland	France	Belgium	Isle of Man	Netherlands	Total	TAC	%uptake
2000	638	156	39	321	52	56	11	0	1273	2100	61
2001	697	209	32	645	361	300	8	0	2251	2100	107
2002	983	171	39	953	251	294	1	2	2695	3200	84
2003	381	118	32	415	145	187	7	0	1285	1950	66
2004	539	103	15	271	37	103	5	0	1072	2150	50
2005	523	72	4	168	31	108	3	0	910	2150	42
2006	552	32	6	172	17	59	3	0	840	1828	46
2007	396	27	2	191	18	66	2	0	702	1462	48
2008	523	22	1	85	3	27	1	0	662	1199	55
2009*	375	15	0	55	3	19	1	0	468	899	52
(b) Percentage of annual total											
Year	NI	E&W	Scotland	Ireland	France	Belgium	Isle of Man	Netherlands	Total		
2000	50.1	12.3	3.0	25.2	4.1	4.4	0.9	0.0	100		
2001	31.0	9.3	1.4	28.6	16.1	13.3	0.4	0.0	100		
2002	36.5	6.4	1.5	35.4	9.3	10.9	0.0	0.1	100		
2003	29.7	9.2	2.5	32.3	11.3	14.6	0.6	0.0	100		
2004	50.3	9.6	1.4	25.2	3.5	9.6	0.4	0.0	100		
2005	57.5	7.9	0.5	18.5	3.5	11.8	0.3	0.0	100		
2006	65.7	3.8	0.7	20.4	2.0	7.1	0.3	0.0	100		
2007	56.5	3.8	0.3	27.2	2.5	9.5	0.3	0.0	100		
2008	78.9	3.4	0.2	12.8	0.5	4.0	0.2	0.0	100		
2009*	80.1	3.1	0.0	11.7	0.6	4.1	0.3	0.0	100		

*** French data is provisional for 2009.**

Table 6.2.3. Cod in VIIa. Landings numbers-at-age used in the update B-Adapt assessment.

	Age							
Year	0	1	2	3	4	5	6	7+
1968	0	364	1563	1003	456	177	28	2
1969	0	882	1481	1050	269	186	76	37
1970	0	1317	1385	352	204	163	52	19
1971	0	2739	2022	904	144	67	39	12
1972	0	789	3267	824	250	58	39	20
1973	0	2263	1091	1783	430	173	60	21
1974	0	530	3559	557	494	131	46	28
1975	0	1699	642	1407	294	249	95	22
1976	0	1135	3007	363	500	61	79	25
1977	0	816	511	1233	163	218	31	40
1978	0	687	1092	310	311	39	47	18
1979	0	1762	1288	608	127	164	38	33
1980	0	2533	2797	729	243	49	51	4
1981	0	1299	3635	1448	244	99	23	24
1982	0	345	2284	1455	557	102	57	22
1983	0	814	932	751	499	154	27	19
1984	0	1577	1195	439	240	161	56	19
1985	0	1218	2105	703	158	84	51	26
1986	0	974	2248	699	203	64	33	32
1987	0	4323	1793	841	252	75	19	24
1988	0	2792	4734	702	263	71	27	11
1989	0	582	2163	1886	231	86	21	16
1990	0	710	1075	545	372	70	23	7
1991	0	1973	1408	442	127	98	15	7
1992	0	1375	1243	664	132	42	46	3
1993	0	223	2907	403	119	16	6	7
1994	0	749	569	848	68	20	9	1
1995	0	498	1283	180	163	7	3	3
1996	0	317.6	1112.8	700.3	38.3	38.8	4.4	1.7
1997	0	523.2	1148.8	500.6	212.5	16.5	11.5	4.5
1998	0	204.4	1926.1	335.1	79.9	28	6.5	1.2
1999	0	69.6	842.8	871.1	65.7	21.2	6.2	0.3
2000	0	289	176	107	50	4	1	0.2
2001	0	338	841	53	13	9	0.3	2
2002	0	196	564	405	7	2	2	1
2003	0	45	439	93	35	1	0.1	0.03
2004	0	68	101	158	21	6	1.9	0.6
2005	0	42	224	62	33	5	0.7	0.2
2006	0	14	142	112	16	8.2	3.2	0.2
2007	0	49	205	56	11	0.5	0.4	0
2008	0	13.7	165.7	87.1	9.4	2.7	0.1	0.02
2009	0	19.7	53.2	65.5	16.9	2.9	0.4	0

Table 6.2.4. Cod in VIIa. Mean weights-at-age in the landings (used for stock and catch).

	Age							
Year	0	1	2	3	4	5	6	7+
1968	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1969	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1970	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1971	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1972	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1973	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1974	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1975	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1976	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1977	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1978	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1979	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1980	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1981	0	0.61	1.66	3.33	5.09	6.19	6.76	8.3
1982	0	1.01	1.524	3.488	5.573	7.592	8.697	10.18
1983	0	0.995	1.842	3.988	5.964	7.966	9.306	10.925
1984	0	0.679	1.813	3.808	5.865	7.475	9.818	10.748
1985	0	0.783	2.023	4.244	5.825	7.5	8.81	9.504
1986	0	0.805	1.825	3.862	5.855	7.391	8.116	9.471
1987	0	0.713	2.161	3.91	6.41	7.821	9.888	10.658
1988	0	0.607	1.563	3.756	5.668	8.017	9.749	10.208
1989	0	0.936	1.846	3.223	5.408	6.571	8.256	11.052
1990	0	0.842	1.938	3.572	5.277	7.531	8.398	12.699
1991	0	0.856	1.637	3.542	5.419	6.39	8.507	10.397
1992	0	0.813	1.964	3.993	5.975	6.923	8.509	11.1
1993	0	0.847	1.706	3.666	5.675	7.365	9.486	10.761
1994	0	0.798	1.923	3.608	6.08	7.68	8.272	11.258
1995	0	0.9	1.84	4	5.791	8.452	8.712	9.56
1996	0	0.98	1.625	3.256	5.298	7.721	8.836	12.256
1997	0	0.846	1.937	3.624	5.291	6.115	8.672	11.263
1998	0	0.925	1.647	3.729	5.371	7.033	8.833	12.155
1999	0	0.853	1.624	3.179	5.505	7.517	10.137	12.618
2000	0	0.851	1.985	3.573	5.138	7.148	8.528	7.692
2001	0	0.99	1.823	4.149	5.606	7.332	8.471	9.667
2002	0	0.942	1.836	3.439	5.727	7.708	9.639	10.761
2003	0	1.205	1.662	3.287	5.425	10.198	10.308	13.696
2004	0	1.112	2.202	3.634	6.505	7.638	8.937	7.572
2005	0	0.913	1.938	3.514	5.318	7.739	7.94	12.237
2006	0	0.826	1.843	3.666	4.709	6.393	7.562	12.236
2007	0	0.832	1.852	3.781	5.347	7.991	10.038	0
2008	0	0.894	1.586	3.543	6.001	7.573	9.723	8.123
2009	0	1.097	2.006	3.458	5.314	7.1	6.815	0

Table 6.2.5. Cod in VIIa. Estimates of numbers discarded in 1996–2009. Data are numbers ('000 fish) discarded by each fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Sampling scheme (a) provides independent self-sampling estimates for the UK(NI) *Nephrops* fishery also covered by observer data in schemes (b) and (d). An asterisk indicates years/fleets where the data are raised to the trip level rather than to the entire fleet.

a) Self sampling scheme: N.Ireland single trawl Nephrops vessels. Estimates are extrapolated to all N.Ireland vessels catching *Nephrops* (single and twin trawl)

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1	2004	2005	2006	2007	2008	2009
Age	43 trips	39 trips	48 trips	39 trips	44 trips	43 trips	35 trips	8 trips	0 trips	0 trips	0 trips	0 trips		
0	56	3	0	70	32	4	0	0						
1	82	63	14	83	397	31	22	0						

(b) Observer scheme: N.Ireland vessels catching *Nephrops* (single trawl only) (*not raised to fleet level – no. of fish)

	1996	1997	1998	1999 Q3-4	2000 Q1-3	2001 Q1	2002	2003	2004	2005	2006 Q3-4*	2007 Q1-4	2008 Q1-4	2009 Q1-4
Age	0 trips	0 trips	0 trips	4 trips	6 trips	1 trip	0 trips	0 trips	0 trips	0 trips	9 trips *	29 trips	55 trips	30 trips
0				0	0	0					19	5.0	2.5	50.0
1				0	53	0					7	15.2	2.7	8.7
2												0.6	0.7	0.3

(c) Observer scheme: N.Ireland midwater trawl

	1996	1997 Q2-4	1998 Q1-3	1999 Q3-4	2000 Q1	2001 Q1	2002	2003	2004	2005	2006	2007	2008	2009
Age	0 trips	n/a	n/a	5 trips	4 trips	2 trips	0 trips	0 trips	0 trips	0 trips	0 trips	0 trips	1 trip	1 trip
0		0	0	1.6	0	0							0	0
1		17	4	0	0.8	0							0.45	0.03
2		0.5	2	0	0	0							0	0.03

(d) Observer scheme: N.Ireland twin trawl (*not raised to fleet level – no. of fish)

	1996	1997 Q2-4	1998 Q1-3	1999 Q4	2000 Q1-4	2001 Q1	2002	2003	2004	2005	2006 Q3-4*	2007 Q1-4	2008 Q1-4	2009 Q1-4
Age	0 trips	n/a	n/a	1 trips	10 trips	2 trips	0 trips	0 trips	0 trips	0 trips	incl. with single Nephrops trawls	14 trips	16 trips	18 trips
0		12	0	12	33	0						0.8	2.8	172.2
1		19	38	1	45	0						12.5	12.9	17.9
2		0.2	13	0	0	0						0.1	0.2	0.0

Table 6.2.5. Continued.

(e) Observer scheme: Republic of Ireland otter trawlers (*not raised to fleet level – total no. of fish for trips sampled)

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1-4	2004 Q1-4	2005 Q1-4	2006 Q1-4	2007 Q1-4	2008 Q1-4	2009 Q1-4
Age	8 trips *	8 trips *	7 trips *	4 trips *	10 trips *	2 trips *	1 trip *	9 trips *	11 trips *	8 trips *	5 trips *	15 trips *	18 trips*	12 trips
0	52	301	0	8	2320	58	124	0	3213	8268	774	0	0	107
1	374	333	202	16	798		176	0	2577	632	150	691	441	8
2	6	87	0	0	10		0	0	598	0	0	0	0	0

(f) Observer scheme: UK(E&W) Demersal otter trawl

	1996	1997	1998	1999	2000 Q1-2	2001 Q1,2,4	2002 Q1,3,4	2003 Q1,2,4	2004 Q1-4	2005 Q1,2	2006	2007	2008	2009
Age	0 trips	0 trips	0 trips	0 trips	21 trips	8 trips	4 trips	4 trips	7 trips	4 trips				
0					0	0	0	0	0	0	see comment 1			
1					38.91	9.21	3.43	0.6	17.71	1.26				
2					0.05	4.46	0	0.62	0.81	0.36				

(g) Observer scheme: UK(E&W) Nephrops trawl

	1996	1997	1998	1999	2000	2001 Q1,2	2002 Q3,4	2003 Q2	2004 Q1-3	2005 Q2	2006	2007	2008	2009
Age	0 trips	0 trips	0 trips	0 trips	0 trips	8 trips	3 trips	2 trips	7 trips	1 trip				
0						0	0	0	0.03	0	see comment 1			
1						3.09	0.03	0	0.24	0				
2						0.7	0	0	0	0				

(h) Observer scheme: UK(E&W) Danish anchor seine

	1996	1997	1998	1999	2000	2001 Q2	2002 Q3	2003	2004 Q3	2005	2006	2007	2008	2009
Age	0 trips	0 trips	0 trips	0 trips	0 trips	2 trips	1 trip	0 trips	1 trip					
0						0	0		0		see comment 1			
1						0	0		0					

(i) Observer scheme: UK(E&W) beam trawl

	1996	1997	1998	1999	2000 Q2	2001	2002 Q1	2003	2004	2005 Q4	2006	2007	2008	2009
Age	0 trips	0 trips	0 trips	0 trips	1 trip	0 trips	1 trip	0 trips	0 trips	2 trips				
0					0		0			0	see comment 1			
1					4.34		0.54			0				

comment 1 UK data for 2006-2009 available to WGNSDS/WGCSE as length compositions only, for combined gears

Table 6.2.6. Cod in VIIa: survey indices. Approximate relative standard errors for age groups used in the assessment are given for UK(NI) groundfish surveys. Years/ages used in assessments are in bold.

ScoGFS :Scottish spring groundfish survey of the Irish Sea — Numbers per 10 Hours Fishing

Feb-March

Survey	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+
1996	**3**	**31**	**44**	**7**	9	0	0
1997	**22**	**29**	**15**	**13**	2	0	1
1998	**5**	**81**	**27**	**5**	1	0	0
1999	**7**	**33**	**93**	**15**	5	0	0
2000	**51**	**6**	**11**	**16**	0	1	0
2001	**28**	**56**	**1**	**1**	4	0	0
2002	**13**	**18**	**37**	**1**	1	0	0
2003	**8**	**69**	**18**	**9**	0	0	0
2004	**8**	**11**	**49**	**0**	3	0	0
2005	**1**	**25**	**8**	**9**	1	0	0
2006	**2**	**5**	**11**	**0**	2	0	0

ScoGFS :Scottish autumn groundfish survey of the Irish Sea — Numbers per 10 Hours Fishing

October

Survey	0-gp	1-gp	2-gp	3-gp	4-gp
1997	3	28	19	1	2
1998	0	8	42	5	0
1999	164	2	24	6	2
2000	24	136	4	0	0
2001	0	0	7	0	0
2002	0	18	15	9	0
2003	2	0	27	0	0
2004	2	12	5	5	0
2005	3	8	25	2	0

NI-GFS March groundfish survey — Numbers per 3-miles (approx. 1-h tow) — RSE = approximate relative standard error

Survey	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+	RSE(1gp)	RSE(2gp)	RSE(3gp)	RSE(4gp)
1992	23.257	5.005	1.965	0.248	0.000	0.031	0.017	0.58	0.36	0.26	0.40
1993	**1.381**	**6.488**	**0.446**	**0.104**	0.014	0.028	0.000	0.67	0.22	0.25	0.39
1994	**13.804**	**1.097**	**1.203**	**0.084**	0.014	0.000	0.000	0.48	0.35	0.21	0.35
1995	**7.007**	**3.862**	**0.200**	**0.108**	0.000	0.010	0.000	0.30	0.25	0.41	0.39
1996	**11.061**	**3.293**	**1.117**	**0.014**	0.088	0.000	0.013	0.62	0.18	0.21	1.00
1997	**5.373**	**4.158**	**0.667**	**0.214**	0.014	0.000	0.000	0.32	0.21	0.21	0.38
1998	**1.694**	**7.692**	**0.569**	**0.120**	0.000	0.000	0.000	0.21	0.16	0.30	0.53
1999	**0.495**	**2.531**	**2.419**	**0.153**	0.028	0.000	0.000	0.27	0.20	0.15	0.43
2000	**6.296**	**1.011**	**0.346**	**0.330**	0.000	0.023	0.000	0.36	0.13	0.31	0.44
2001	**4.067**	**5.614**	**0.184**	**0.058**	0.040	0.000	0.000	0.29	0.15	0.39	0.42
2002	**6.622**	**2.533**	**3.335**	**0.000**	0.000	0.011	0.000	0.59	0.19	0.38	-
2003	**0.739**	**10.792**	**1.041**	**0.327**	0.037	0.030	0.058	0.32	0.21	0.30	0.26
2004	**2.170**	**1.720**	**0.886**	**0.054**	0.044	0.000	0.000	0.57	0.30	0.21	0.40
2005	**0.635**	**2.251**	**0.294**	**0.280**	0.183	0.000	0.000	0.56	0.29	0.60	0.64
2006	**1.700**	**1.308**	**0.583**	**0.025**	0.000	0.000	0.011	0.52	0.26	0.37	0.71
2007	**1.644**	**1.244**	**0.306**	**0.051**	0.000	0.000	0.000	0.41	0.21	0.38	0.66
2008	**0.407**	**2.172**	**0.130**	**0.052**	0.042	0.010	0.000	0.46	0.32	0.39	0.66
2009	**1.440**	**0.590**	**0.330**	**0.090**	0.000	0.000	0.000	0.60	0.23	0.26	0.68
2010	**10.221**	**2.090**	**0.147**	**0.023**	0.000	0.000	0.000	0.59	0.22	0.34	0.66

NI-GFS October groundfish survey — Numbers per 3-miles (approx. 1-h tow) — RSE = approximate relative standard error

Survey	0-gp	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+	RSE(0gp)	RSE(1gp)	RSE(2gp)
1992	**0.579**	11.094	0.501	0.476	0.086	0.000	0.000	0.000	0.58	0.36	0.28
1993	**7.808**	5.532	1.464	0.008	0.000	0.000	0.000	0.034	0.43	0.84	0.34
1994	**19.962**	16.725	0.254	0.104	0.000	0.000	0.000	0.000	0.28	0.43	0.42
1995	**7.886**	12.068	0.333	0.000	0.000	0.000	0.000	0.000	0.55	0.91	0.38
1996	**14.813**	4.866	0.501	0.065	0.000	0.000	0.000	0.000	0.42	0.50	0.30
1997	**4.204**	13.222	0.972	0.000	0.000	0.000	0.000	0.000	0.45	0.41	0.40
1998	**0.370**	3.765	1.639	0.057	0.000	0.000	0.000	0.000	0.38	0.36	0.37
1999	**20.225**	0.585	0.325	0.095	0.000	0.000	0.000	0.000	0.34	0.68	0.43
2000	**7.242**	3.016	0.020	0.000	0.000	0.000	0.000	0.000	0.36	0.33	1.00
2001	**8.411**	5.068	1.099	0.000	0.000	0.000	0.000	0.000	0.45	0.35	0.35
2002	**0.897**	4.879	0.377	0.125	0.000	0.000	0.000	0.000	0.86	0.58	0.55
2003	**2.759**	1.614	0.294	0.000	0.000	0.000	0.000	0.000	0.48	0.66	0.63
2004	**4.437**	5.790	0.237	0.000	0.000	0.000	0.000	0.000	0.30	0.48	0.75
2005	**8.245**	7.061	1.077	0.173	0.029	0.000	0.000	0.000	0.52	0.89	0.62
2006	**1.170**	1.302	0.015	0.066	0.000	0.000	0.000	0.000	0.45	0.53	1.00
2007	**0.068**	0.870	0.000	0.030	0.000	0.000	0.000	0.000	0.66	0.80	-
2008	**0.190**	0.170	0.170	0.000	0.000	0.000	0.000	0.000	0.57	1.00	1.00
2009	**5.356**	2.136	0.061	0.000	0.000	0.000	0.000	0.000	0.33	0.76	1.00

Table 6.2.6. continued.

Irish GFS. Irish groundfish survey of the Irish Sea. RV Celtic Explorer — Total nos. per survey

October	0-gp	1-gp	2-gp	3-gp	4-gp	5-gp	6-gp	7+
2003	16	29	31	3	1	0		
2004	23	74	7	2	0			

UK Fishery Science Partnership western Irish Sea pelagic trawl survey (mean nos. per hour) SSB index = kg/hr

Feb-March	0-gp	1-gp (revised)	2-gp	3-gp	4-gp	5-gp	6-gp	7+	SSB index
2004		-	-	-	-	-	-	-	13.29
2005		0.000	0.427	1.409	0.990	0.084	0.025	0.035	12.01
2006		0.003	0.536	2.815	0.427	0.104	0.010	0.007	8.26
2007		0.008	0.611	1.322	0.585	0.055	0.058	0.029	11.78
2008		0.003	0.221	0.824	0.147	0.084	0.020	0.019	3.93
2009		0.009	0.171	1.152	0.377	0.099	0.018	0.012	5.37
2010		0.000	0.735	0.452	0.467	0.130	0.023	0.003	4.30

UK Fishery Science Partnership eastern Irish Sea otter trawl survey (mean nos. per hour) SSB index = kg/hr

Feb-March	0-gp	1-gp (revised)	2-gp	3-gp	4-gp	5-gp	6-gp	7+	SSB index
2005		0.06	4.02	0.25	0.38	0.004	0.01	0	5.97
2006		0.83	0.77	0.67	0.007	0.042	0	0.001	3.31
2007		0.59	1.43	0.09	0.08	0	0	0	1.77
2008		0.01	1.80	0.32	0.02	0.03	0.003	0.01	2.60
2009		0.50	0.36	0.21	0.09	0.01	0.004	0.00	1.58
2010		0.98	0.65	0.03	0.04	0.01	0.000	0.00	0.84

ENG BTS-Sept beam trawl survey. No. per 100km

September Survey	0-gp (revised)
1991	
1992	
1993	**22**
1994	**30**
1995	**40**
1996	**29**
1997	**32**
1998	**2**
1999	**49**
2000	**37**
2001	**24**
2002	**7**
2003	**9**
2004	**22**
2005	**41**
2006	**6**
2007	**4**
2008	**7**
2009	**6**

NIMIKNET pelagic 0-gp index

May-June Survey	0-gp
1994	**57.4**
1995	**6.9**
1996	**66.3**
1997	**5.7**
1998	**0.1**
1999	**26.2**
2000	**6.1**
2001	**9.6**
2002	**3.4**
2003	**3.2**
2004	**25.8**
2005	**11.4**
2006	**9.0**
2007	**0**
2008	**0.8**
2009	**23.6**

Table 6.2.7. B-Adapt model settings for update run in 2010. Same settings as in 2009.

Setting	Values
Plus group	5-plus
Fbar range	2–4 (arithmetic mean)
Year range for tuning VPA	1992 onwards
Surveys after final year of catch data used.	Yes; Fmult = 0.75 for 2010 WGCSE
VPA model or cohort analysis used	v (exact)
First age with constant catchability	Entered as 0 for all tuning fleets
q-plateau	Entered as 3 for all tuning fleets
Tapered time weighting applied	No
Number of missing catch multipliers	10 for WGCSE 2010 (bias estimated from 2000 onwards)
No. ages for terminal F mean, and scaling factor for mean	ages = 1; scaling factor = 1.0; arithmetic mean (i.e. F(4) = F(3))
Constraint on F or catch? Stiffness weight (λ)	Constrain F; λ = 1.0
Prior weighting of fleets	None
Output tables	VPA output table 16 (not SOP corrected)

Table 6.2.8. Selected diagnostics from update B-Adapt (not bootstrap run).

Lowestoft VPA Program

26/05/2010 11:04

Adapt Analysis

"IRISH SEA COD WGCSE 2010 COMB PLUSGROUP"

CPUE data from file cod7tun.txt

Catch data for 42 years : 1968 to 2009. Ages 0 to 5+

Fleet	First year	Last year	First age	Last age	Alpha	Beta
NIGFSMAR(1-4gp)	1993	2010	1	4	0.25	0.35
ScoGFS-Q1 Survey (No	1996	2010	1	4	0.25	0.35
NIGFSOCT(0 2-gp)	1992	2010	0	0	0.83	0.88
ENGBTS-Sept	1993	2010	0	0	0.75	0.79
NIMIKNET	1994	2010	0	0	0.38	0.46

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Fleet	PowerQ ages<x	QPlateau ages>x
NIGFSMAR(1-4gp)	0	3
ScoGFS-Q1 Survey (No	0	3
NIGFSOCT(0 2-gp)	0	3
ENGBTS-Sept	0	3
NIMIKNET	0	3

Catchability independent of stock size for all ages

Bias estimation :

Bias estimated for the final 10 years.

Oldest age F estimates in 1968 to 2010 calculated as 1.000 * the mean F of ages 3- 3

Total F penalty applied lambda = 1.000

Individual fleet weighting not applied

INITIAL SSQ =	1866.72552
PARAMETERS =	14
OBSERVATIONS =	207

SSQ =	96.2695
QSSQ =	90.25171
CSSQ =	6.01779
IFAIL =	0
IFAILCV = 0	

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	0	0	0	0	0	0	0	0	0	0
1	0.141	0.239	0.15	0.205	0.157	0.126	0.043	0.149	0.135	0.114
2	1.172	0.733	1.243	1.108	0.77	0.789	1.133	0.932	1.088	0.924
3	1.867	1.587	1.736	1.438	1.475	1.197	2.232	1.58	1.605	1.806
4	1.867	1.587	1.736	1.438	1.475	1.197	2.232	1.58	1.605	1.806

Population numbers (Thousands)

YEAR \ AGE	0	1	2	3	4
2000	3.98E+03	4.63E+03	5.28E+02	2.59E+02	1.21E+02
2001	4.65E+03	3.26E+03	3.29E+03	1.34E+02	3.28E+01
2002	1.23E+03	3.81E+03	2.10E+03	1.30E+03	2.24E+01
2003	2.07E+03	1.01E+03	2.68E+03	4.97E+02	1.87E+02
2004	1.27E+03	1.70E+03	6.74E+02	7.26E+02	9.65E+01
2005	1.49E+03	1.04E+03	1.19E+03	2.56E+02	1.36E+02
2006	1.24E+03	1.22E+03	7.50E+02	4.42E+02	6.32E+01
2007	3.84E+02	1.01E+03	9.58E+02	1.98E+02	3.88E+01
2008	5.74E+02	3.14E+02	7.14E+02	3.09E+02	3.33E+01
2009	3.74E+03	4.70E+02	2.25E+02	1.97E+02	5.08E+01

Table 6.2.8. Continued.

Estimated population abundance at 1st Jan 2010

0.00E+00	3.06E+03	3.43E+02	7.30E+01	2.65E+01

Taper weighted geometric mean of the VPA populations:

4.21E+03	3.46E+03	2.39E+03	8.86E+02	2.34E+02

Standard error of the weighted Log(VPA populations) :

0.8863	0.8861	0.7892	0.8034	1.046

Log population residuals (unweighted).

Fleet : NIGFSMAR(1-4gp)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-1.8478	-1.2984	-1.5606	-1.5606
S.E(Log q)	0.554	0.3494	0.4746	0.7574

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.85	1.064	2.7	0.76	17	0.4674	-1.85
2	1.11	-0.899	0.65	0.82	17	0.39009	-1.3
3	0.9	0.629	2	0.74	17	0.43675	-1.56
4	1.25	-0.714	1.06	0.36	16	0.92825	-1.76

Fleet : ScoGFS-Q1 Survey (No

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4
Mean Log q	-5.4514	-3.7801	-2.8281	-2.8281
S.E(Log q)	0.8646	0.44	0.6657	0.9355

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.82	0.53	5.85	0.48	11	0.73155	-5.45
2	0.79	1.311	4.54	0.81	11	0.33397	-3.78
3	0.65	2.129	4.03	0.8	11	0.37031	-2.83
4	0.93	0.257	2.34	0.66	9	0.62988	-2.18

Fleet : NIGFSOCT(0 2-gp)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0
Mean Log q	-1.8198
S.E(Log q)	0.9899

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.54	3.79	4.49	0.81	18	0.40086	-1.82

Fleet : ENGBTS-Sept

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0
Mean Log q	-4.7801
S.E(Log q)	0.731

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	1.25	-0.899	4.06	0.46	17	0.91942	-4.78

Table 6.2.8. Continued.

Fleet : NIMIKNET

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0
Mean Log q	-5.6152
S.E(Log q)	1.2769

Year		Est.Landings	Landings	Bias
	1968	9779	8541	
	1969	9834	7991	
	1970	6831	6426	
	1971	9549	9246	
	1972	10710	9234	
	1973	12968	11819	
	1974	11955	10251	
	1975	10650	9863	
	1976	10557	10247	
	1977	8173	8054	
	1978	5556	6271	
	1979	7430	8371	
	1980	10534	10776	
	1981	13858	14907	
	1982	13503	13381	
	1983	10183	10015	
	1984	8274	8383	
	1985	10442	10483	
	1986	9819	9852	
	1987	12891	12894	
	1988	14166	14168	
	1989	12781	12751	
	1990	7400	7379	
	1991	7074	7095	
	1992	7715	7735	
	1993	7551	7555	
	1994	5404	5402	
	1995	4587	4587	
	1996	4962	4964	
	1997	5858	5859	
	1998	5309	5318	
	1999	4785	4784	
	2000	2434	1274	1.912
	2001	4196	2252	1.866
	2002	6623	2695	2.454
	2003	4879	1285	3.779
	2004	3539	1072	3.289
	2005	2427	910	2.659
	2006	2772	840	3.306
	2007	1822	702	2.606
	2008	1743	662	2.635
	2009	1096	468	2.342

Parameters

Age		Survivors	s.e log est
	0	3063.51189	0.37111
	1	343.0568	0.33601
	2	72.98631	0.46768
	3	26.48076	0.50358

Year		Multiplier	s.e log est
	33	1.91165	0.22951
	34	1.86609	0.24785
	35	2.4543	0.23212
	36	3.77883	0.23988
	37	3.28894	0.24589
	38	2.6592	0.24153
	39	3.30645	0.22181
	40	2.60634	0.25001
	41	2.63492	0.25579
	42	2.34227	0.28337

Variance covariance matrix

0.13772	0.01232	0.00955	0.00584	0.00931	0.0106	0.01043	0.00995	0.00953	0.0095	0.00962	0.01055	0.01131	0.01183
0.01232	0.1129	0.016	0.00776	0.00907	0.01029	0.01014	0.0097	0.00952	0.00957	0.00906	0.00764	0.00546	0.02419
0.00955	0.016	0.21873	-0.00351	0.00868	0.00984	0.0097	0.00931	0.00934	0.00923	0.00835	0.00457	0.01507	0.00003
0.00584	0.00776	-0.00351	0.25359	0.00845	0.00956	0.00879	0.00859	0.00922	0.00902	0.00788	0.00494	-0.00322	0.00918
0.00931	0.00907	0.00868	0.00845	0.05267	0.01689	0.00801	0.00784	0.00903	0.00966	0.00974	0.00948	0.00912	0.00895
0.0106	0.01029	0.00984	0.00956	0.01689	0.06143	0.01708	0.00687	0.00799	0.01017	0.01105	0.01088	0.01041	0.01016
0.01043	0.01014	0.0097	0.00879	0.00801	0.01708	0.05388	0.01798	0.00778	0.00797	0.00971	0.01038	0.0101	0.0098
0.00995	0.0097	0.00931	0.00859	0.00784	0.00687	0.01798	0.05754	0.0168	0.0073	0.00723	0.00908	0.00956	0.00949
0.00953	0.00952	0.00934	0.00922	0.00903	0.00799	0.00778	0.0168	0.06046	0.01916	0.00621	0.00648	0.00824	0.00914
0.0095	0.00957	0.00923	0.00902	0.00966	0.01017	0.00797	0.0073	0.01916	0.05833	0.01532	0.00585	0.00611	0.00788
0.00962	0.00906	0.00835	0.00788	0.00974	0.01105	0.00971	0.00723	0.00621	0.01532	0.0492	0.01752	0.00797	0.00665
0.01055	0.00764	0.00457	0.00494	0.00948	0.01088	0.01038	0.00908	0.00648	0.00585	0.01752	0.06251	0.02099	0.00776
0.01131	0.00546	0.01507	-0.00322	0.00912	0.01041	0.0101	0.00956	0.00824	0.00611	0.00797	0.02099	0.06543	0.02633
0.01183	0.02419	0.00003	0.00918	0.00895	0.01016	0.0098	0.00949	0.00914	0.00788	0.00665	0.00776	0.02633	0.0803

Table 6.2.9. Cod in VIIa. Point estimates of population numbers-at-age from the update B-Adapt assessment.

Population numbers (Thousands)

YEAR	0	1	2	3	4	5+
1968	6512	3424	3710	1600	727	330
1969	8506	5332	2475	1640	420	467
1970	15131	6964	3571	711	412	473
1971	5239	12388	4516	1684	268	220
1972	13883	4289	7680	1891	574	269
1973	3107	11366	2802	3367	812	480
1974	11055	2544	7270	1317	1168	485
1975	3533	9051	1606	2777	580	722
1976	5103	2893	5881	740	1020	336
1977	5529	4178	1353	2135	282	500
1978	12082	4527	2686	650	652	218
1979	14196	9892	3087	1222	255	472
1980	7923	11623	6513	1376	459	196
1981	3461	6487	7238	2832	477	286
1982	5264	2833	4142	2685	1028	334
1983	7879	4310	2009	1359	903	362
1984	7922	6451	2796	813	444	437
1985	6350	6486	3864	1221	274	280
1986	18442	5199	4214	1290	375	238
1987	8743	15099	3380	1448	434	203
1988	3803	7158	8481	1170	438	182
1989	4904	3113	3361	2732	335	178
1990	5648	4015	2025	835	570	153
1991	8751	4624	2648	701	201	190
1992	1709	7165	2022	914	182	125
1993	5110	1399	4629	553	163	40
1994	3699	4184	945	1212	97	43
1995	3121	3028	2751	268	243	19
1996	5793	2555	2031	1107	61	71
1997	2105	4743	1806	672	285	44
1998	881	1723	3411	460	110	49
1999	5656	721	1227	1080	81	34
2000	3985	4630	528	259	121	13
2001	4652	3263	3293	134	33	29
2002	1234	3808	2104	1295	22	16
2003	2074	1010	2685	497	187	6
2004	1269	1698	674	726	97	39
2005	1491	1039	1189	256	136	24
2006	1236	1221	750	442	63	46
2007	384	1012	958	198	39	3
2008	574	314	714	309	33	10
2009	3742	470	225	197	51	10
2010	0	3064	343	73	26	8

Table 6.2.10. Cod in VIIa. Point estimates of fishing mortality-at-age from the update B-Adapt assessment. Figures for 2010 are the values assumed for a 25% reduction in F in the intermediate year.

YEAR	AGE						
	0	1	2	3	4	5+	F(2-4)
1968	0	0.1245	0.6164	1.1369	1.1369	1.1369	0.963
1969	0	0.2008	1.0472	1.1811	1.1811	1.1811	1.136
1970	0	0.233	0.5517	0.7749	0.7749	0.7749	0.701
1971	0	0.2782	0.6705	0.8767	0.8767	0.8767	0.808
1972	0	0.2259	0.6247	0.6456	0.6456	0.6456	0.639
1973	0	0.2469	0.5547	0.8585	0.8585	0.8585	0.757
1974	0	0.26	0.7623	0.6196	0.6196	0.6196	0.667
1975	0	0.2311	0.5744	0.8021	0.8021	0.8021	0.726
1976	0	0.5602	0.8133	0.7642	0.7642	0.7642	0.781
1977	0	0.2416	0.5331	0.9863	0.9863	0.9863	0.835
1978	0	0.1826	0.5873	0.734	0.734	0.734	0.685
1979	0	0.2179	0.6082	0.7804	0.7804	0.7804	0.723
1980	0	0.2736	0.6328	0.859	0.859	0.859	0.784
1981	0	0.2485	0.7917	0.8135	0.8135	0.8135	0.806
1982	0	0.1439	0.9146	0.8898	0.8898	0.8898	0.898
1983	0	0.2327	0.7052	0.9181	0.9181	0.9181	0.847
1984	0	0.3124	0.6286	0.8856	0.8856	0.8856	0.800
1985	0	0.2312	0.8971	0.9813	0.9813	0.9813	0.953
1986	0	0.2306	0.868	0.8895	0.8895	0.8895	0.882
1987	0	0.3768	0.8607	0.9951	0.9951	0.9951	0.950
1988	0	0.5559	0.9327	1.0518	1.0518	1.0518	1.012
1989	0	0.23	1.1921	1.3668	1.3668	1.3668	1.309
1990	0	0.2162	0.8614	1.223	1.223	1.223	1.102
1991	0	0.6272	0.8635	1.1493	1.1493	1.1493	1.054
1992	0	0.2369	1.0973	1.5234	1.5234	1.5234	1.381
1993	0	0.1927	1.1402	1.5382	1.5382	1.5382	1.406
1994	0	0.2192	1.0585	1.4063	1.4063	1.4063	1.290
1995	0	0.1995	0.7104	1.2894	1.2894	1.2894	1.096
1996	0	0.1471	0.9054	1.1553	1.1553	1.1553	1.072
1997	0	0.1295	1.167	1.6127	1.6127	1.6127	1.464
1998	0	0.1399	0.9502	1.5319	1.5319	1.5319	1.338
1999	0	0.1124	1.3541	1.9876	1.9876	1.9876	1.776
2000	0	0.1408	1.1723	1.8672	1.8672	1.8672	1.636
2001	0	0.2388	0.7329	1.5873	1.5873	1.5873	1.303
2002	0	0.1497	1.2433	1.7357	1.7357	1.7357	1.572
2003	0	0.2047	1.1075	1.4385	1.4385	1.4385	1.328
2004	0	0.1565	0.7698	1.4748	1.4748	1.4748	1.240
2005	0	0.1259	0.7888	1.1974	1.1974	1.1974	1.061
2006	0	0.0427	1.1332	2.2325	2.2325	2.2325	1.866
2007	0	0.1495	0.9317	1.5804	1.5804	1.5804	1.364
2008	0	0.1353	1.0879	1.6051	1.6051	1.6051	1.433
2009	0	0.1145	0.9239	1.8062	1.8062	1.8062	1.512

Table 6.2.11. Cod in VIIa. Summary data from the update B-Adapt assessment. "B-Adapt removals" are the estimated total removals from 2000 onwards in excess of removals due to the assumed natural mortality rate.

Summary (without SOP correction)

Year	Recruits age 0 (thousands)	Total biomass (t)	Spawning stock biomass (t)	Input landings (t)	B-Adapt removals (t)	FBAR 2- 4
1968	6512	19351	13444	8541		0.9634
1969	8506	18040	12241	7991		1.1365
1970	15131	17709	9785	6426		0.7005
1971	5239	23476	11271	9246		0.808
1972	13883	26393	15873	9234		0.6386
1973	3107	30044	20227	11819		0.7572
1974	11055	27155	18121	10251		0.6671
1975	3533	25060	17886	9863		0.7262
1976	5103	21465	13647	10247		0.7806
1977	5529	16614	12673	8054		0.8352
1978	12082	14188	8662	6271		0.6851
1979	14196	19638	10426	8371		0.723
1980	7923	26103	12310	10776		0.7836
1981	3461	29723	18317	14907		0.8062
1982	5264	27025	20249	13381		0.8981
1983	7879	21842	15260	10015		0.8471
1984	7922	18773	11249	8383		0.7999
1985	6350	21980	12055	10483		0.9532
1986	18442	20979	12026	9852		0.8823
1987	8743	28289	12995	12894		0.9503
1988	3803	26056	13492	14168		1.0121
1989	4904	21061	14300	12751		1.3086
1990	5648	14540	8725	7379		1.1025
1991	8751	13177	6531	7095		1.0541
1992	1709	15518	7231	7735		1.3814
1993	5110	12376	6295	7555		1.4055
1994	3699	10460	5995	5402		1.2903
1995	3121	10439	4575	4587		1.0964
1996	5793	10298	5747	4964		1.072
1997	2105	11795	5614	5859		1.4641
1998	881	9888	4810	5318		1.338
1999	5656	6769	4918	4784		1.7764
2000	3985	6630	2040	1274	1.912	1.6356
2001	4652	10194	3242	2252	1.866	1.3025
2002	1234	12179	6197	2695	2.454	1.5715
2003	2074	8389	4405	1285	3.779	1.3282
2004	1269	6949	4140	1072	3.289	1.2398
2005	1491	5067	2690	910	2.659	1.0612
2006	1236	4623	2757	840	3.306	1.8661
2007	384	3600	1658	702	2.606	1.3642
2008	574	2784	1801	662	2.635	1.4327
2009	3742	1987	1192	468	2.342	1.5121
Average (1968-2009)	5754	16158	9454	7066	2.685	1.0942

Table 6.2.12. Cod VIIa : Estimates of biomass and fishing mortality reference levels derived from the fit of three stock and recruit relationships and the yield-per-recruit F_{msy} proxies.

Stock name
Cod VIIa
Sen filename
codviia.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
971/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	1.82	0.57	22731	11242	0.78	0.69	0.94	0.00	78.86
Mean	1.88	0.56	32311	14620	0.80	0.67	0.96	0.00	
5%ile	0.91	0.35	14354	7624	0.64	0.22	0.64	0.00	
25%ile	1.25	0.45	18967	9788	0.72	0.48	0.80	0.00	
50%ile	1.63	0.54	23850	11721	0.79	0.66	0.92	0.00	
75%ile	2.26	0.65	31879	14553	0.86	0.85	1.10	0.00	
95%ile	3.73	0.84	66037	26736	0.98	1.14	1.40	0.00	
CV	0.46	0.27	1.32	1.10	0.13	0.41	0.24	0.41	

Beverton-Holt
922/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	1.93	0.27	67633	17521	0.67	1.28	12077.10	12108.80	79.72
Mean	1.93	0.24	169949	29096	0.68	1.33	20432.23	28075.58	
5%ile	0.88	0.12	31945	9301	0.23	1.07	6961.25	4039.37	
25%ile	1.26	0.20	50861	13369	0.47	1.21	9205.57	7871.53	
50%ile	1.68	0.25	74698	17667	0.68	1.32	11891.70	12532.45	
75%ile	2.37	0.29	122226	26686	0.88	1.44	17385.50	22701.85	
95%ile	3.87	0.36	354280	54120	1.17	1.63	36099.99	60958.19	
CV	0.48	0.31	4.85	5.25	0.43	0.13	5.42	7.09	

Smooth hockeystick
997/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	1.29	0.38	33581	11734	0.54	0.99	0.33	10186.80	76.49
Mean	1.36	0.36	55050	12815	0.56	1.04	0.34	10624.59	
5%ile	0.74	0.14	20209	8067	0.44	0.76	0.27	7754.99	
25%ile	0.97	0.28	28227	10494	0.50	0.90	0.30	9241.65	
50%ile	1.21	0.36	35922	12276	0.55	1.01	0.33	10404.80	
75%ile	1.59	0.43	47836	14611	0.60	1.13	0.37	11630.70	
95%ile	2.47	0.58	99557	19006	0.69	1.42	0.42	14588.56	
CV	0.44	0.36	1.76	0.28	0.14	0.20	0.14	0.20	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.24	0.20	0.19	0.38	5.01	1.75	0.4	0.72
Mean	0.23	0.19	0.18	0.36	7.85	1.82		
5%ile	0.05	0.04	0.05	0.14	3.04	1.27		
25%ile	0.16	0.13	0.14	0.28	4.16	1.54		
50%ile	0.23	0.19	0.18	0.36	5.18	1.75		
75%ile	0.29	0.24	0.22	0.43	6.73	2.05		
95%ile	0.38	0.32	0.29	0.58	13.87	2.59		
CV	0.43	0.43	0.39	0.36	1.72	0.23		

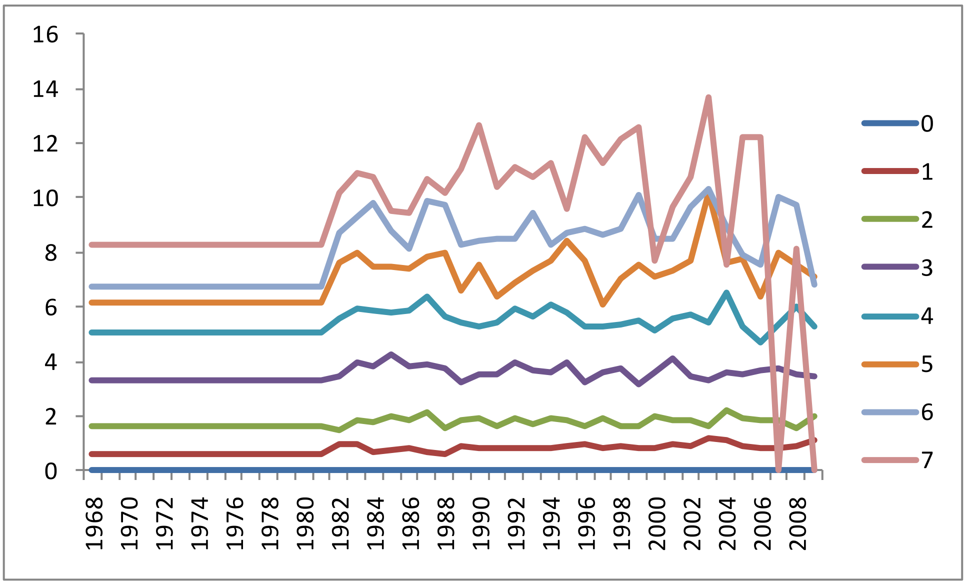


Figure 6.2.1. Cod in VIIa. Catch weights-at-age (same as stock weights).

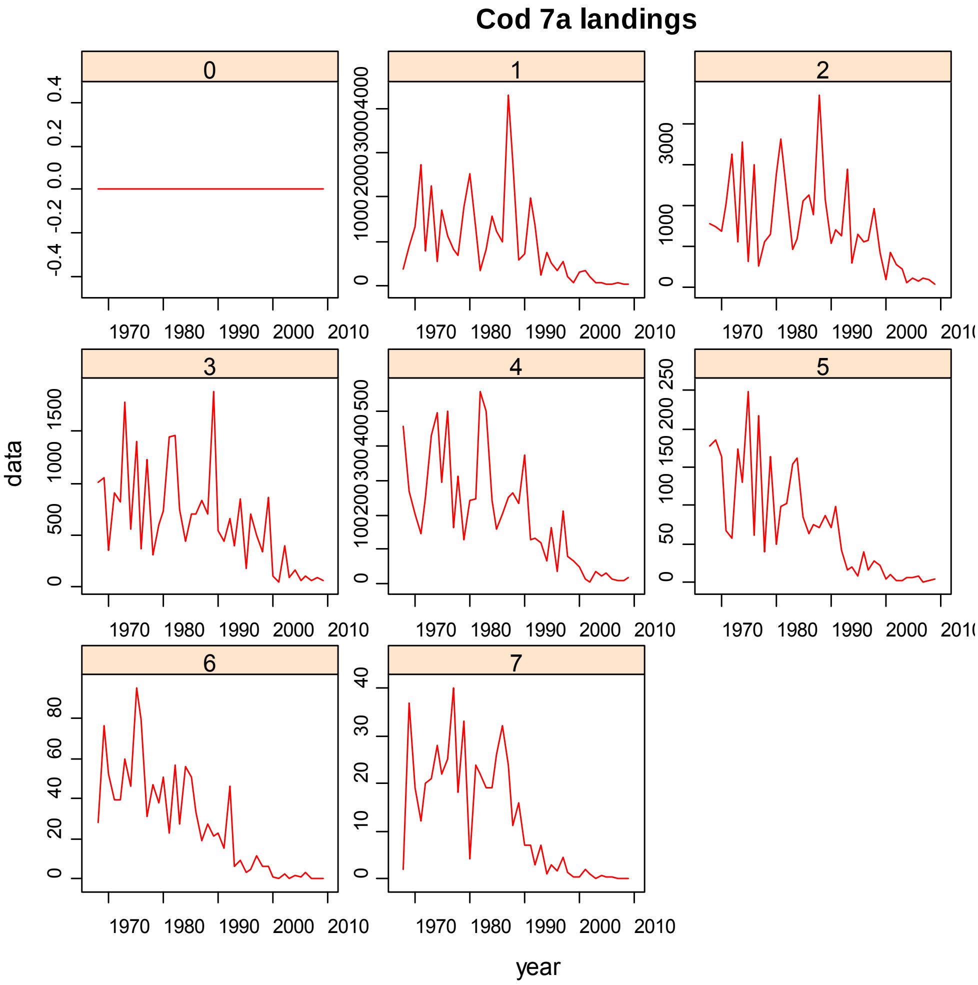


Figure 6.2.2. Cod in VIIa. Landings number-per-age.

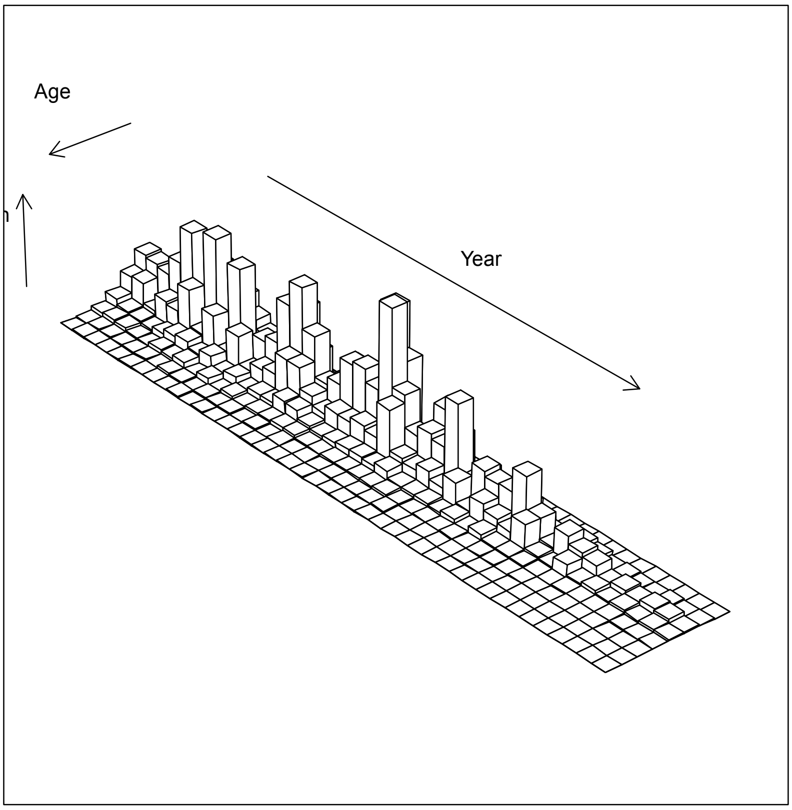


Figure 6.2.3. Cod in VIIa. Landings-per-age as 3D bars.

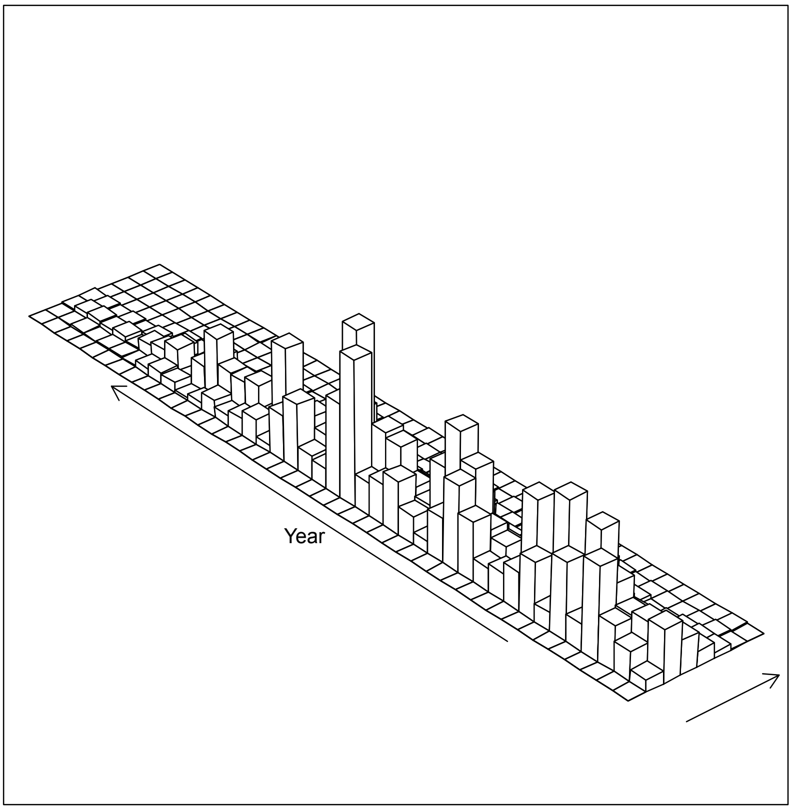


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Figure 6.2.3b. Cod in VIIa. Landings-per-age as 3D bars alternative perspective.

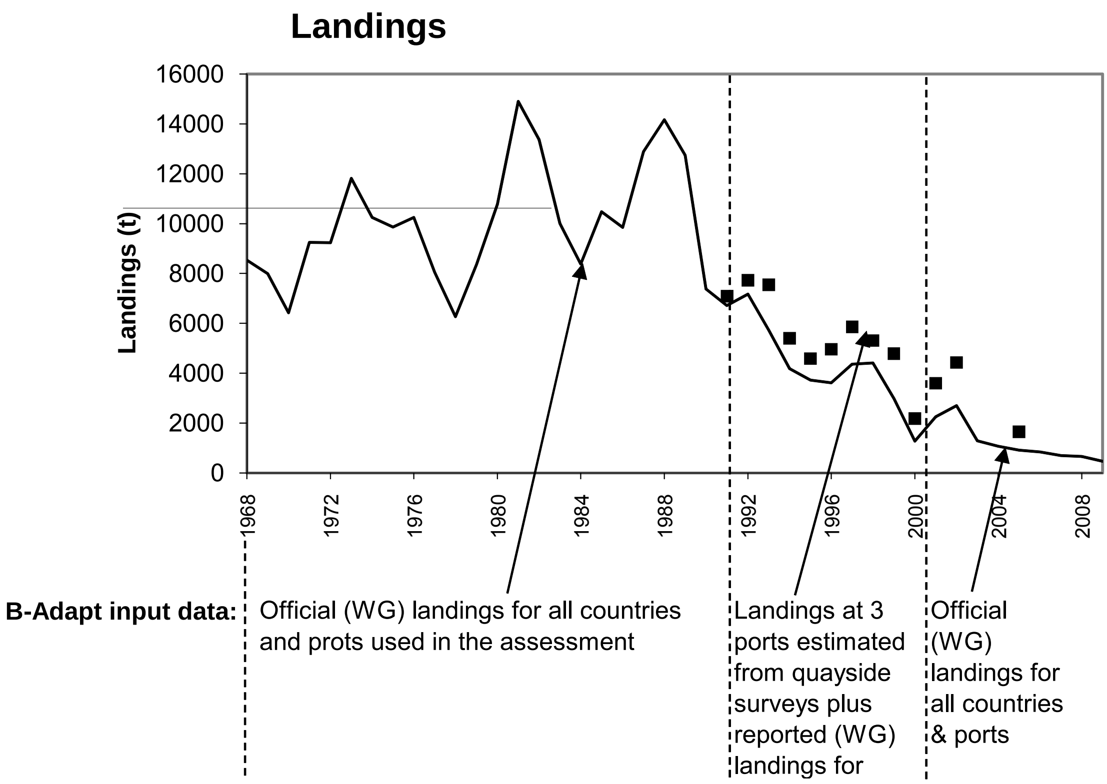


Figure 6.2.4. Cod in VIIa. Landings data used in the B-Adapt assessment.

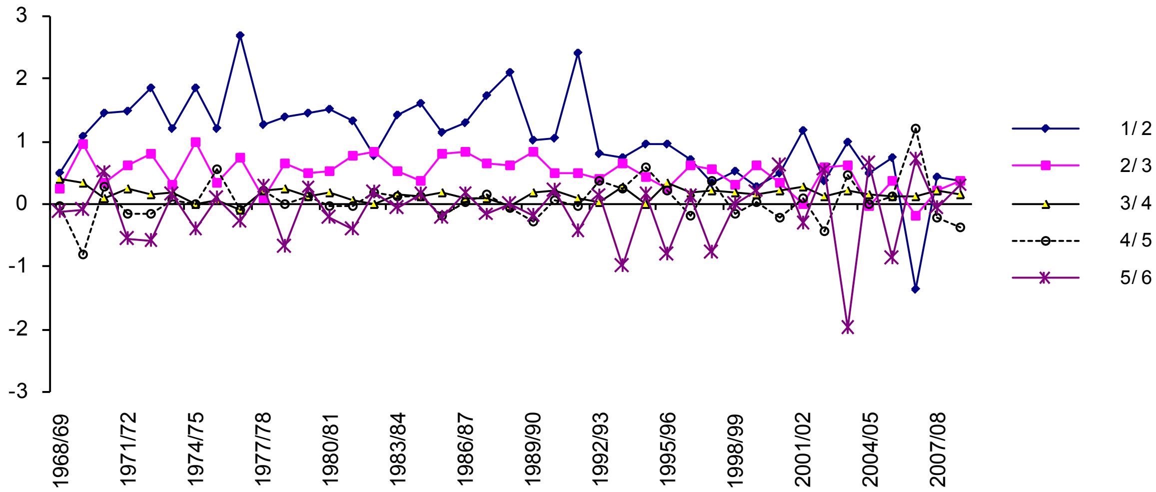
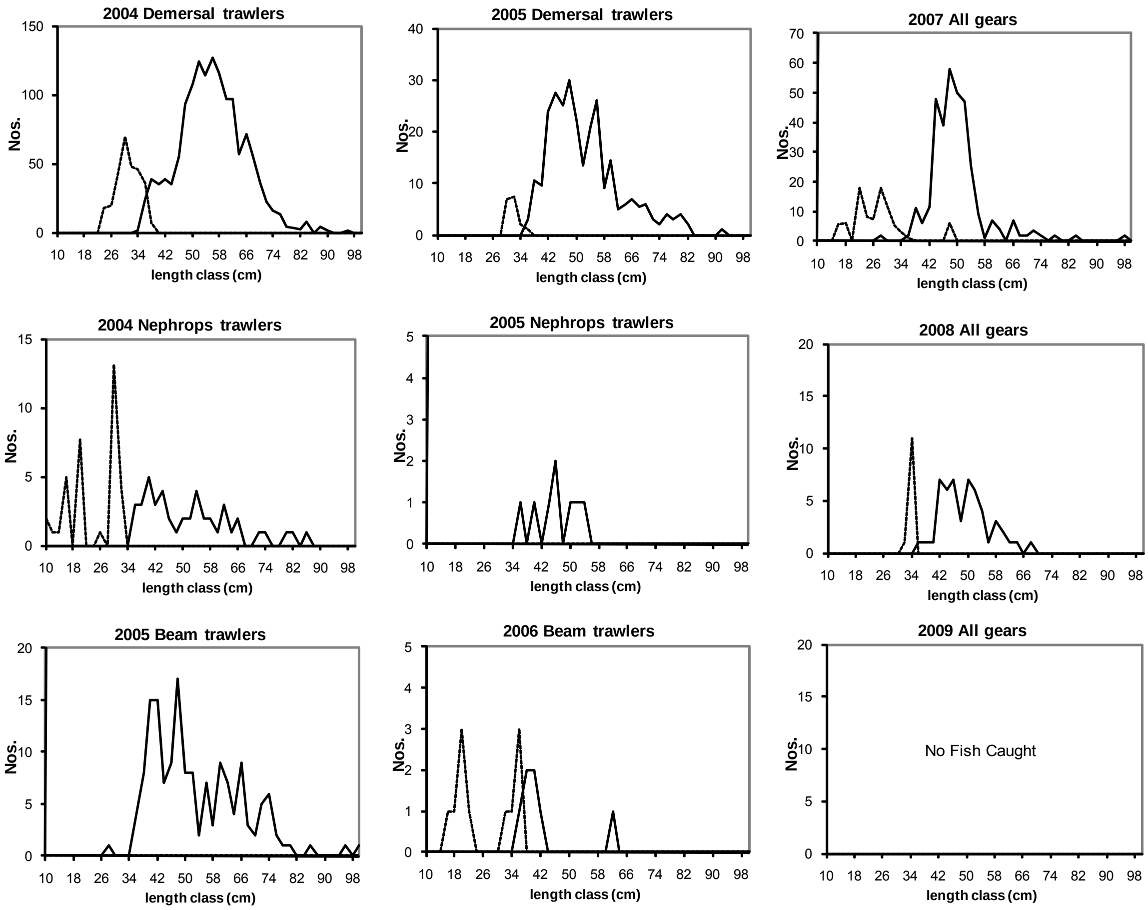


Figure 6.2.5. Cod in VIIa. Separable VPA residuals.



Number of trips sampled

	Demersal	Nephrops	Beam	All
2004	7	7	0	14
2005	4	2	2	8
2006	3	1	1	5
2007				26
2008				29
2009				11

Figure 6.2.6. Cod in VIIa. Length frequencies of retained and discarded cod recorded by observers on UK (E&W) fishing vessels in 2004–2009 (nos. for observed trips).

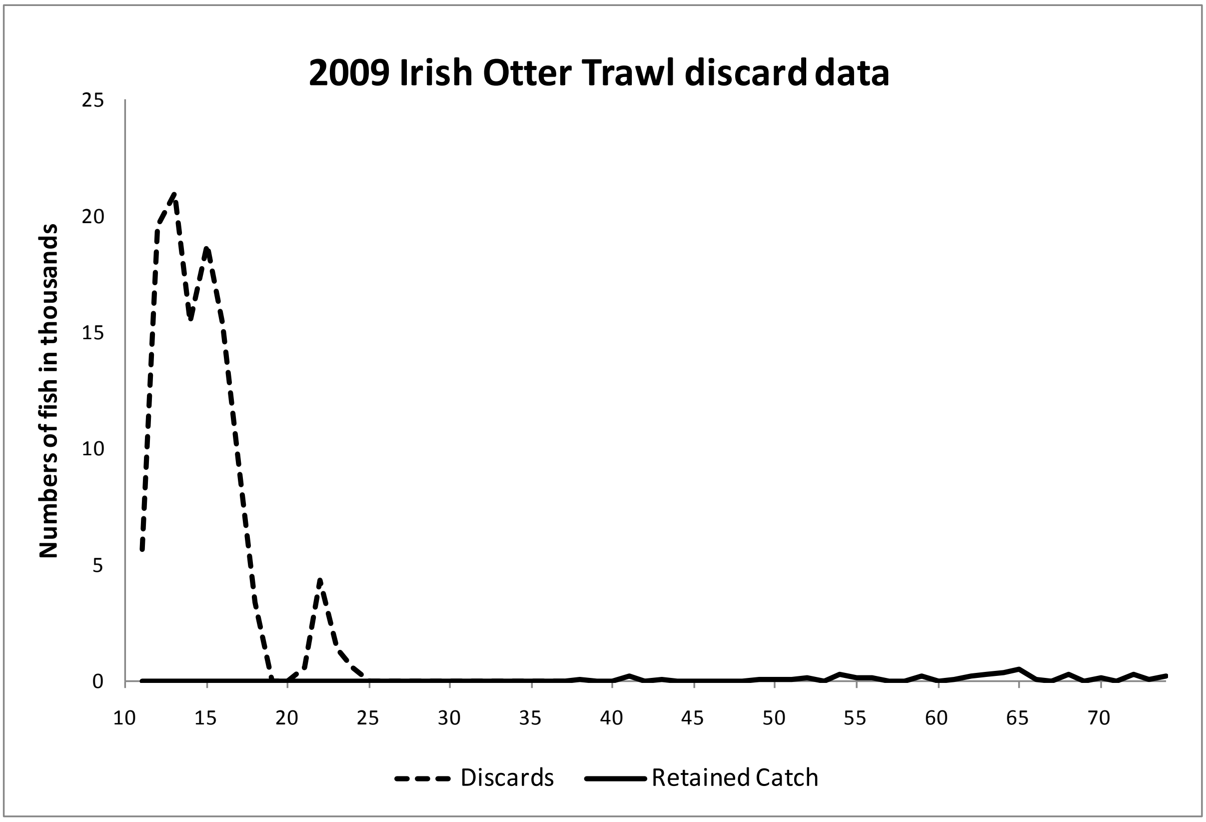


Figure 6.2.7. Cod in VIIa. Length frequencies of retained and discarded cod recorded by observers on Irish otter trawl vessels in 2009, raised to fleet level (no. trips sampled = 12).

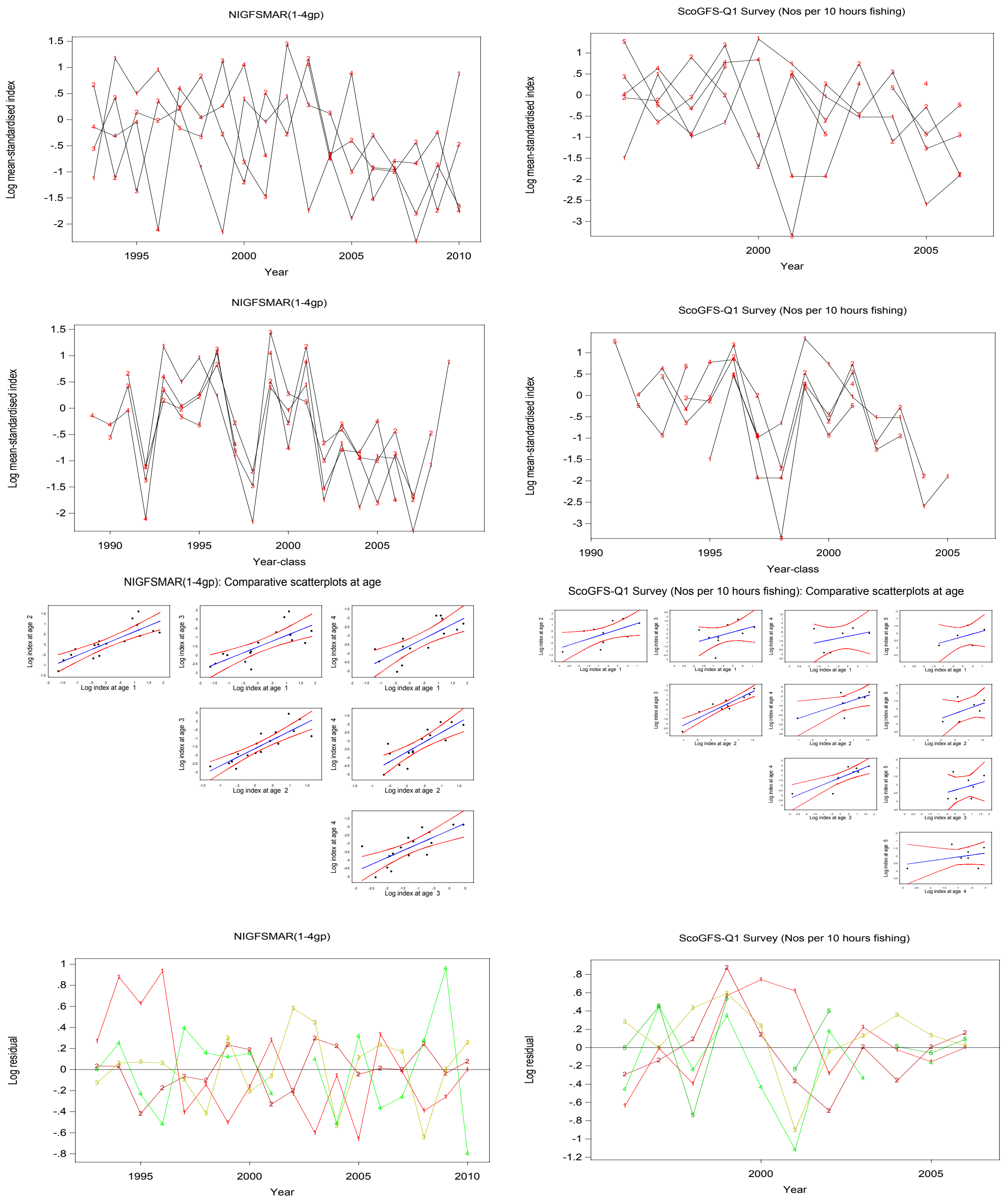


Figure 6.2.8. Cod in VIIa. Log survey indices for NIGFS-Mar and ScoGFS-Q1 trawl surveys by year and year class; comparative scatterplots of indices within year classes, and residuals from Surba model fits.

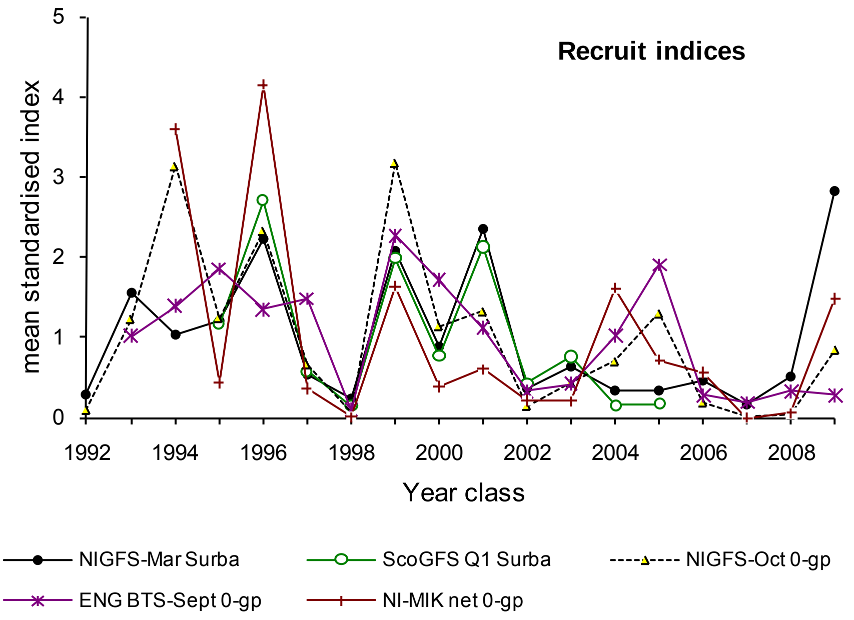


Figure 6.2.9. Cod in VIIa. Consistency between trends in year-class strength estimated from SURBA analysis of NIGFS-Mar and ScoGFS-Q1 surveys and the other 0-gp indices used in the assessment.

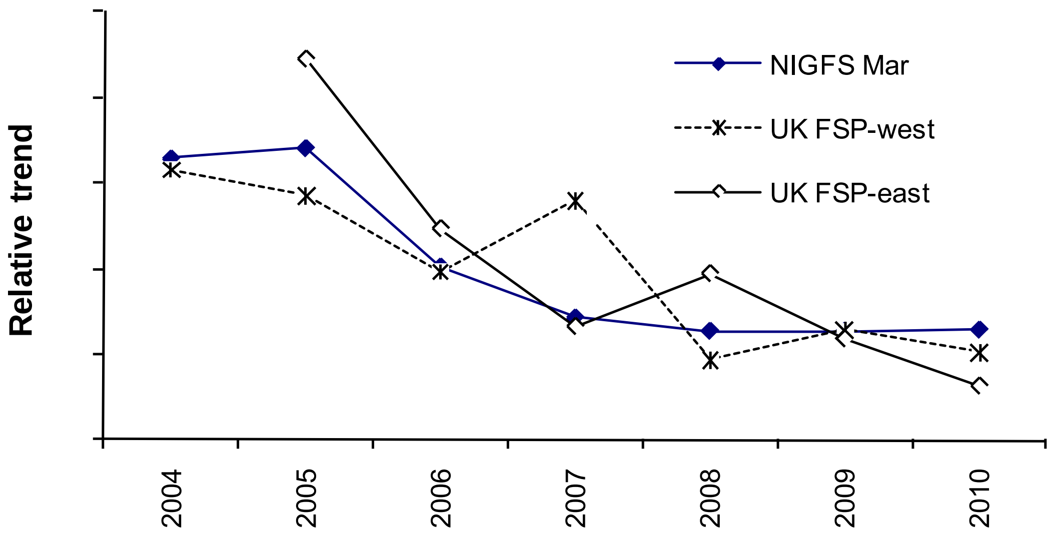


Figure 6.2.10. Trends in empirical SSB indices from 2004 onwards from the NIGFS-Mar compared with equivalent indices from UK Fisheries Science Partnership surveys of the western and eastern Irish Sea in February–March.

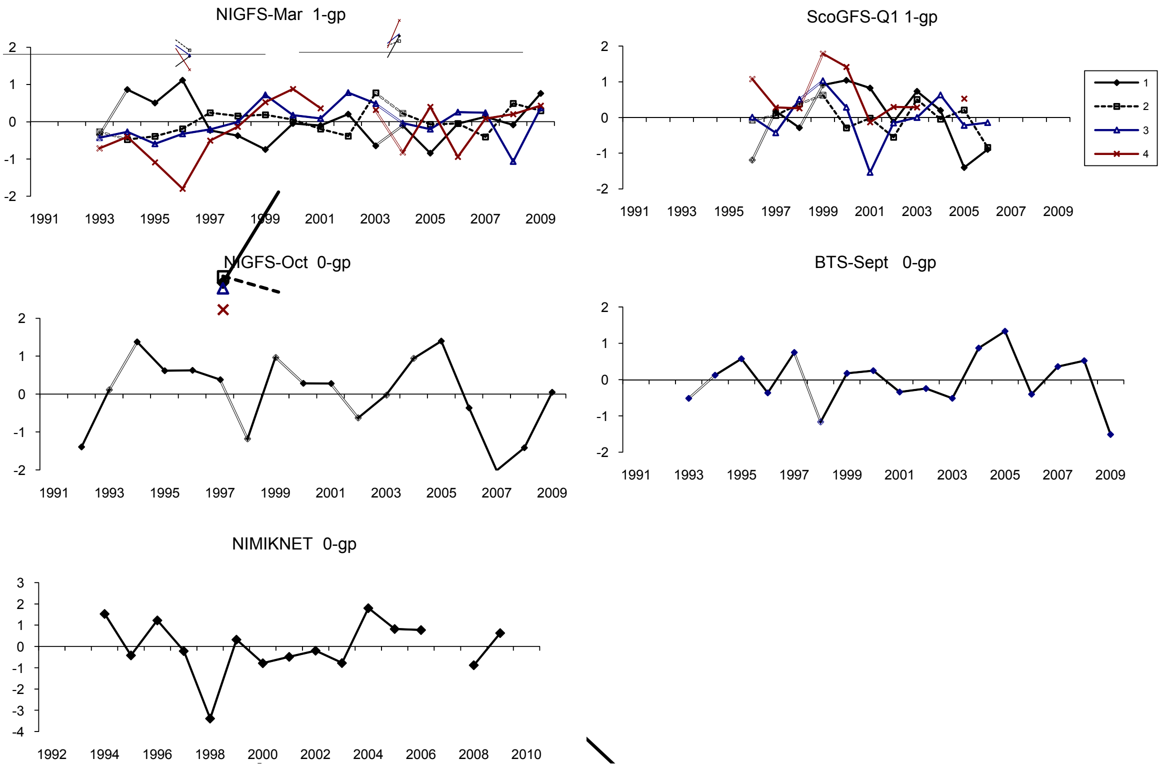


Figure 6.2.11. Cod in VIIa: Catchability residuals from the update B-Adapt run (non-bootstrap option).

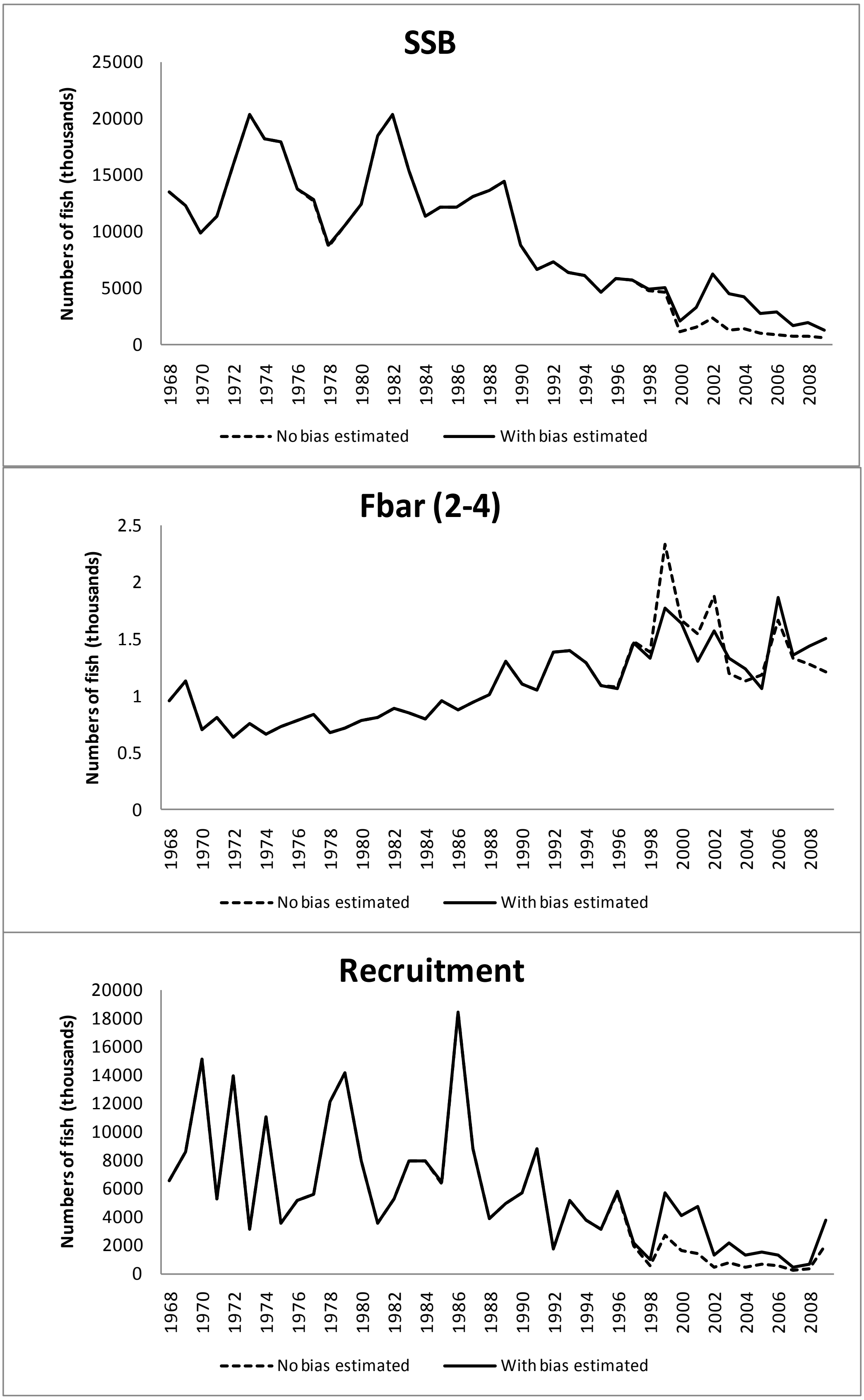


Figure 6.2.12. Comparison plots for non-bootstrap B-Adapt cod assessments with and without the bias estimated.

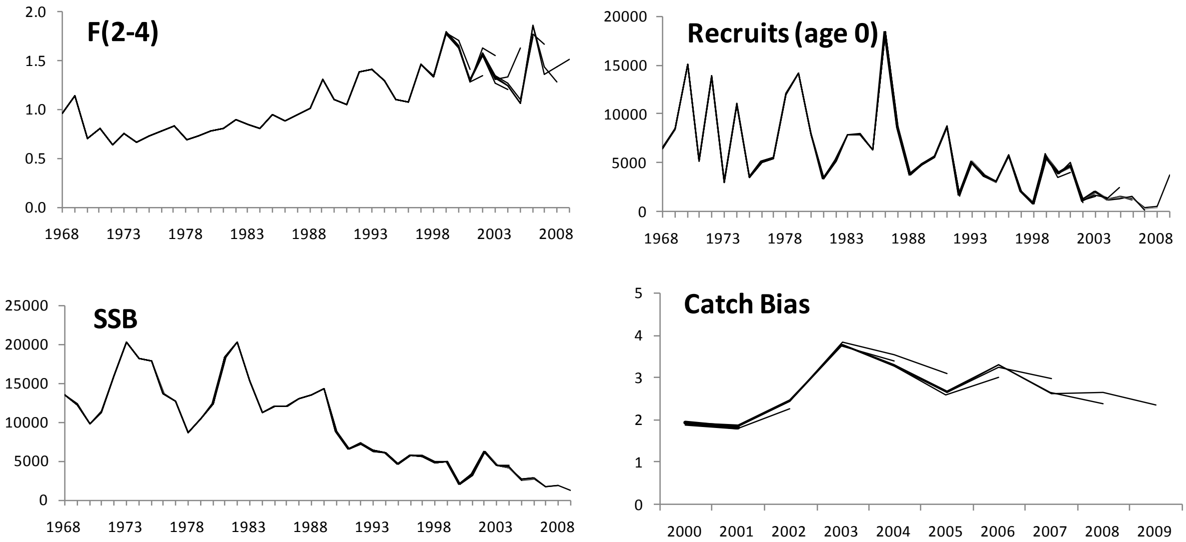


Figure 6.2.13. Retrospective plots for B-Adapt cod assessment. All runs use the non-bootstrap option and therefore give point estimates rather than bootstrap 50th percentiles.

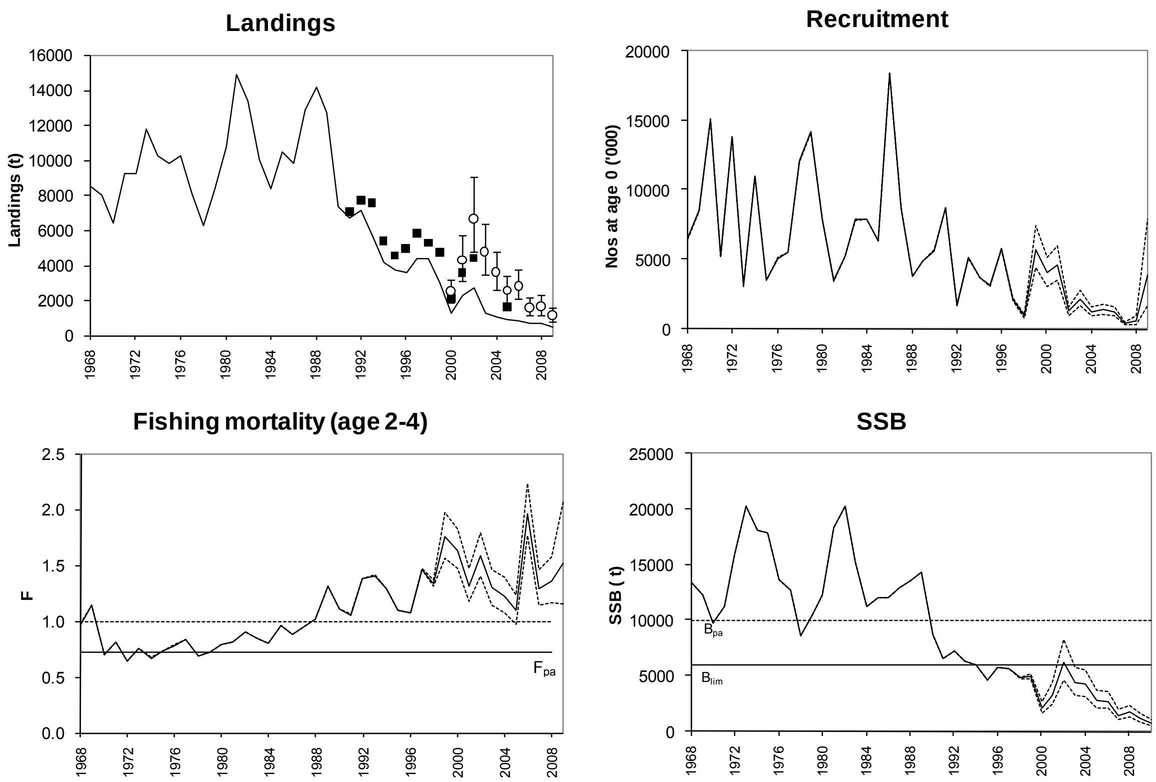


Figure 6.2.14. Stock summary plot from update B-Adapt run. Continuous line on landings plot is the reported landings; filled squares are landings in 1991–2002 and 2005 including sample-based estimates at three ports; open circles with 90% confidence intervals are total removals estimates (in excess of assumed natural mortality) from B-Adapt. Dotted lines on plots are 5th and 95th bootstrap percentiles.

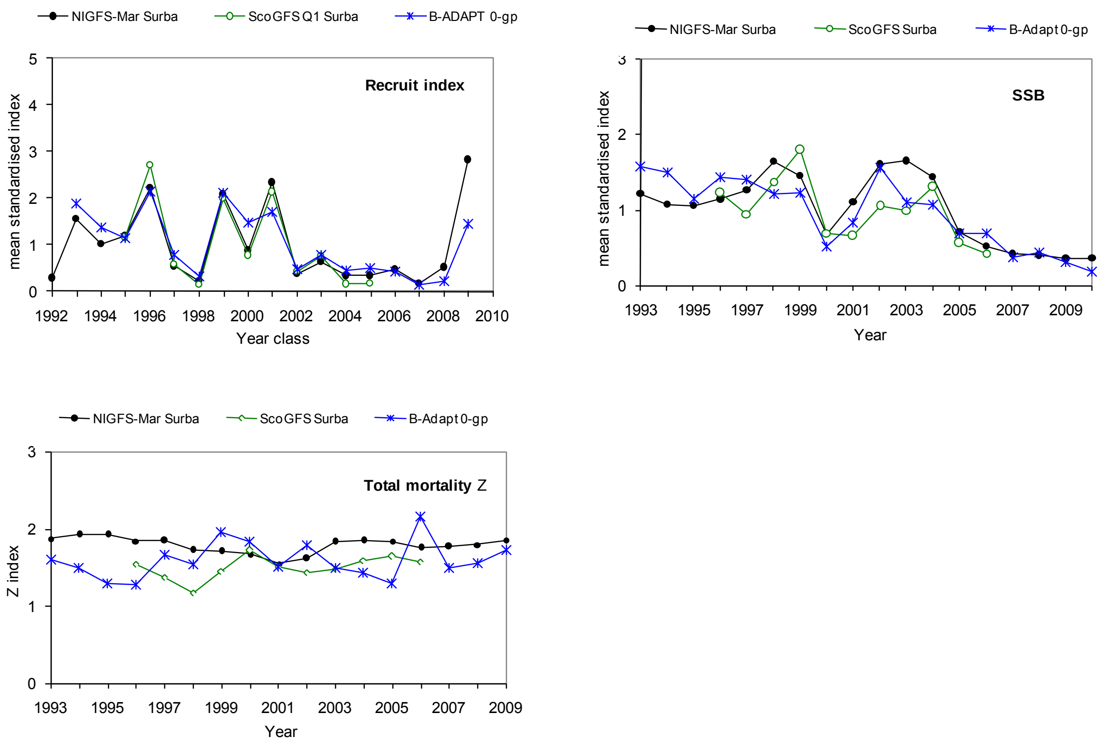


Figure 6.2.15. Cod in VIIa: comparison of updated B-ADAPT stock trends with indices of recruitment, SSB and fishing mortality from SURBA runs with NIGFS-Mar and ScoGFS-Q1 surveys. The B-Adapt estimates of F have been increased by M=0.2 to give Z indices comparable with the SURBA values.

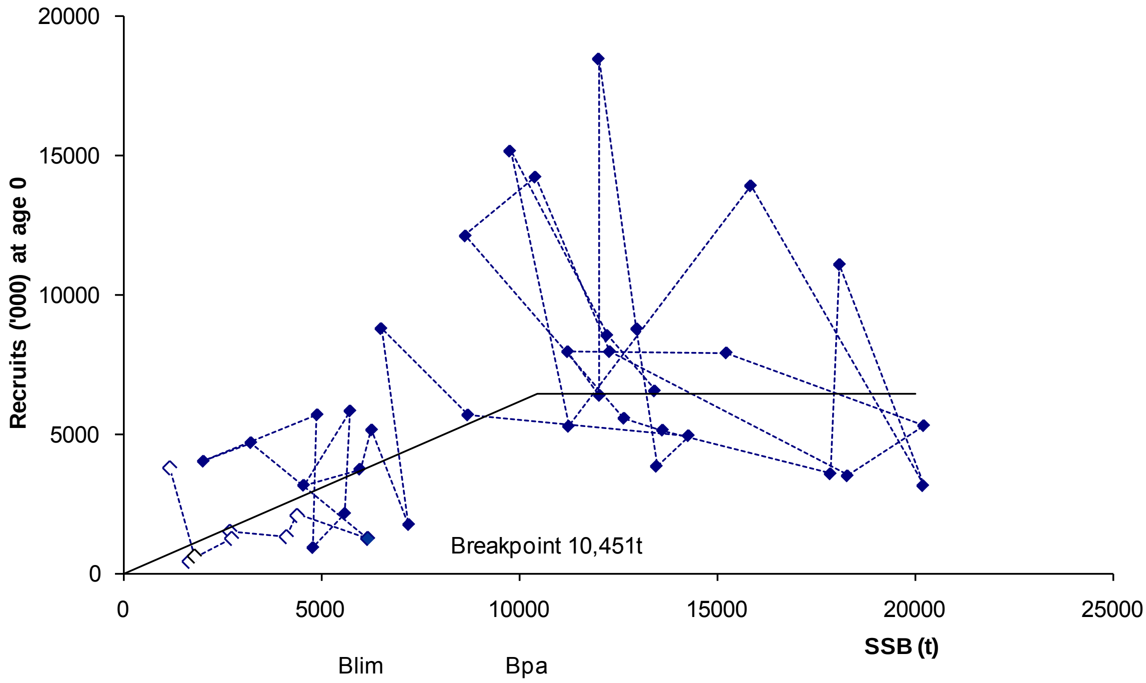


Figure 6.2.16. Cod in VIIa. Stock–recruit data with segmented regression model fitted assuming log-normal variability in recruitment. The most recent 7 year classes are indicated by open symbols.

Fbar(2-4)	Year		
Percentile	2010	2011	2012
0.05	0.86	0.00	0.00
0.25	1.00	0.00	0.00
0.5	1.14	0.00	0.00
0.75	1.28	0.00	0.00
0.95	1.54	0.00	0.00

SSB	Year		
Percentile	2010	2011	2012
0.05	500	1258	4083
0.25	631	1822	6358
0.5	744	2249	8238
0.75	873	2873	10645
0.95	1082	4027	15458

Removals	Year		
Percentile	2010	2011	2012
0.05	660	0	0
0.25	812	0	0
0.5	934	0	0
0.75	1071	0	0
0.95	1365	0	0

P(SSBYear > Blim)			
2010	2011	2013	2015
0.00	0.00	0.97	1.00

P(SSBYear > Bpa)			
2010	2011	2013	2015
0.00	0.00	0.74	0.98

Zero F projection
25% F reduction in 2010
Recruitment 2002 - 2008

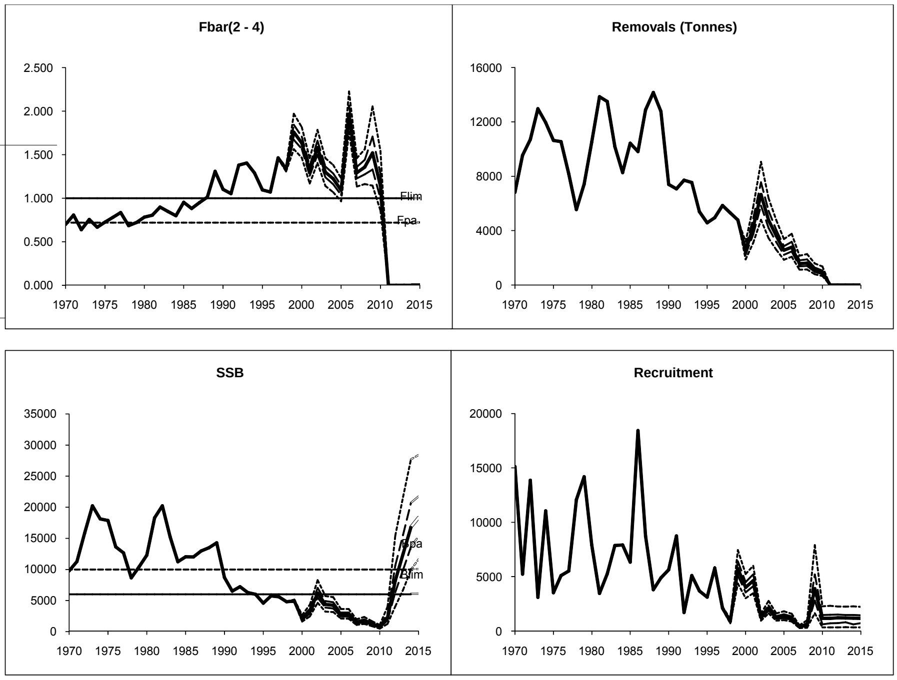


Figure 6.2.17. Cod in VIIa. Projection to 2015 based on the update B-Adapt assessment, assuming 25% F reduction in 2010 and zero F in subsequent years. Recruitment is bootstrapped from the 2002–2008 year classes. Percentiles of F, SSB and removals, and probability of SSB>B$_{lim}$, are tabulated for selected years.

Fbar(2-4)	Year		
Percentile	2010	2011	2012
0.05	0.86	0.00	0.00
0.25	1.00	0.00	0.00
0.5	1.14	0.00	0.00
0.75	1.28	0.00	0.00
0.95	1.54	0.00	0.00

SSB	Year		
Percentile	2010	2011	2012
0.05	500	1258	4276
0.25	631	1822	6393
0.5	744	2249	8440
0.75	873	2873	10967
0.95	1082	4027	15849

Removals	Year		
Percentile	2010	2011	2012
0.05	660	0	0
0.25	812	0	0
0.5	934	0	0
0.75	1071	0	0
0.95	1365	0	0

P(SSBYear > Blim)			
2010	2011	2013	2015
0.00	0.00	0.98	1.00

P(SSBYear > Bpa)			
2010	2011	2013	2015
0.00	0.00	0.77	0.99

Zero F projection
25% F reduction in 2010
Recruitment 2002 - 2009

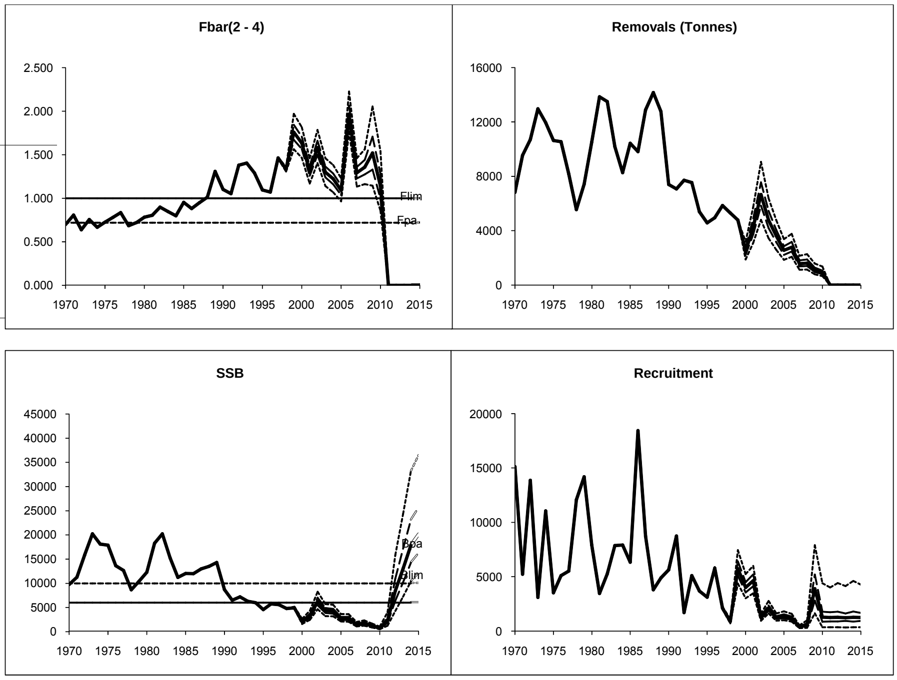


Figure 6.2.18. Cod in VIIa. Projection to 2015 based on the update B-Adapt assessment, assuming 25% F reduction in 2010 and zero F in subsequent years. Recruitment is bootstrapped from the 2002–2009 year classes. Percentiles of F, SSB and removals, and probability of SSB>B_{lim}, are tabulated for selected years.

Fbar(2-4)	Year		
Percentile	2010	2011	2012
0.05	0.86	0.64	0.48
0.25	1.00	0.75	0.56
0.5	1.14	0.86	0.64
0.75	1.28	0.96	0.72
0.95	1.54	1.16	0.87

SSB	Year		
Percentile	2010	2011	2012
0.05	500	1258	2206
0.25	631	1822	3552
0.5	744	2249	4626
0.75	873	2873	6049
0.95	1082	4027	8727

Removals	Year		
Percentile	2010	2011	2012
0.05	660	1124	1283
0.25	812	1647	1892
0.5	934	2147	2442
0.75	1071	2737	3120
0.95	1365	4069	4412

P(SSBYear > Blim)			
2010	2011	2013	2015
0.00	0.00	0.17	0.26

P(SSBYear > Bpa)			
2010	2011	2013	2015
0.00	0.00	0.01	0.00

25 % reduction in T to F=0.4
Recruitment 2002 - 2008

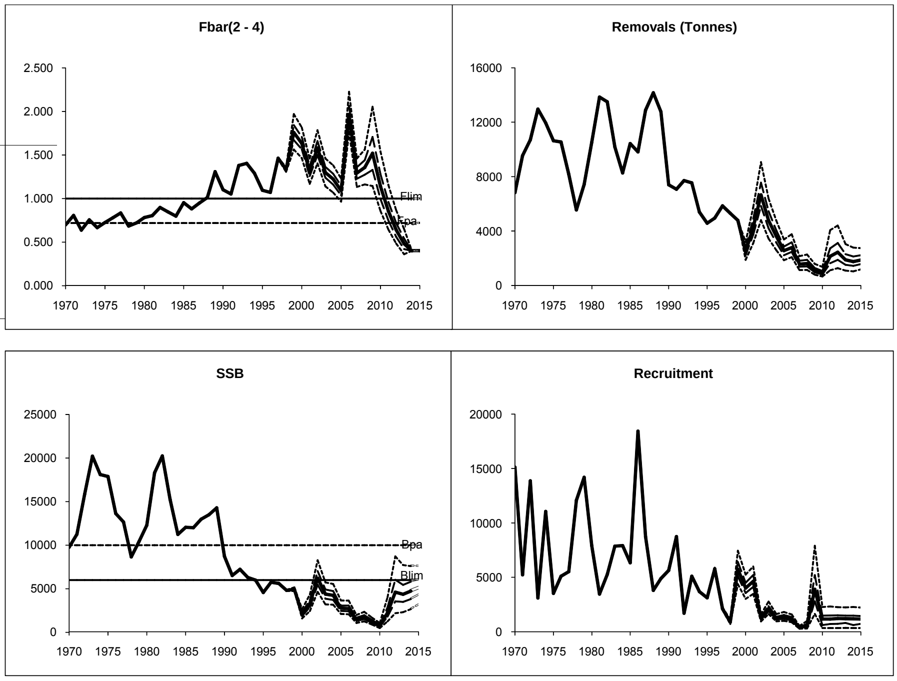


Figure 6.2.19. Cod in VIIa. Projection to 2015 based on the update B-Adapt assessment, assuming 25% annual F reduction in 2010 until the year when median F reaches a value of 0.4. Recruitment is bootstrapped from the 2002–2008 year classes. Percentiles of F, SSB and removals, and probability of SSB>B_{lim}, are tabulated for selected years.

Fbar(2-4)	Year		
Percentile	2010	2011	2012
0.05	0.86	0.64	0.48
0.25	1.00	0.75	0.56
0.5	1.14	0.86	0.64
0.75	1.28	0.96	0.72
0.95	1.54	1.16	0.87

SSB	Year		
Percentile	2010	2011	2012
0.05	500	1258	2318
0.25	631	1822	3630
0.5	744	2249	4754
0.75	873	2873	6355
0.95	1082	4027	9342

Removals	Year		
Percentile	2010	2011	2012
0.05	660	1137	1360
0.25	812	1666	1969
0.5	934	2154	2565
0.75	1071	2764	3332
0.95	1365	4100	4897

P(SSBYear > Blim)			
2010	2011	2013	2015
0.00	0.00	0.27	0.46

P(SSBYear > Bpa)			
2010	2011	2013	2015
0.00	0.00	0.04	0.10

25 % reduction in F to F=0.4
Recruitment 2002 - 2009

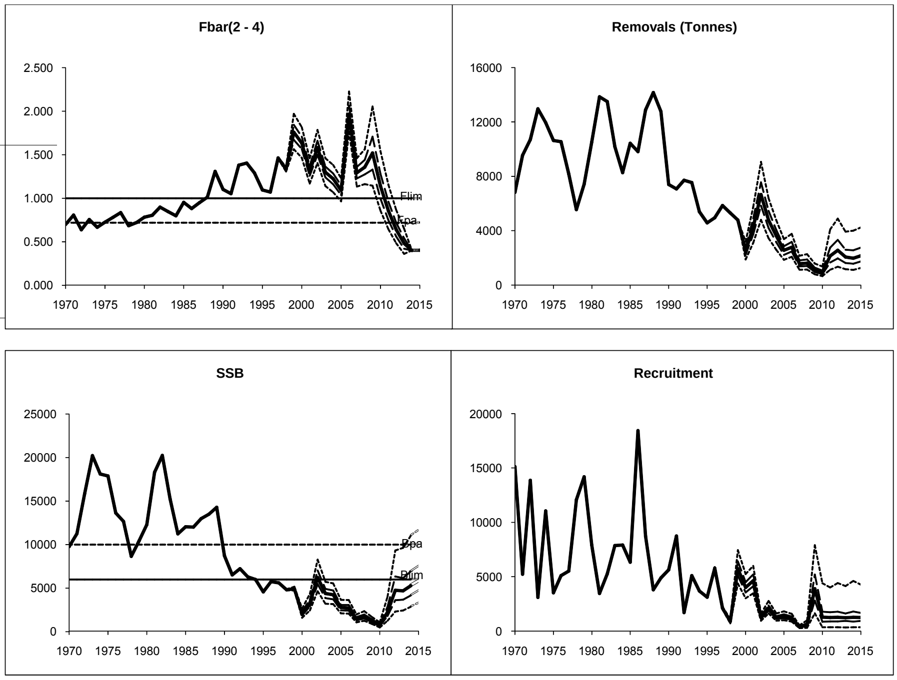


Figure 6.2.20. Cod in VIIa. Projection to 2015 based on the update B-Adapt assessment, assuming 25% annual F reduction in 2010 until the year when median F reaches a value of 0.4. Recruitment is bootstrapped from the 2002–2009 year classes. Percentiles of F, SSB and removals, and probability of SSB>B_{lim}, are tabulated for selected years.

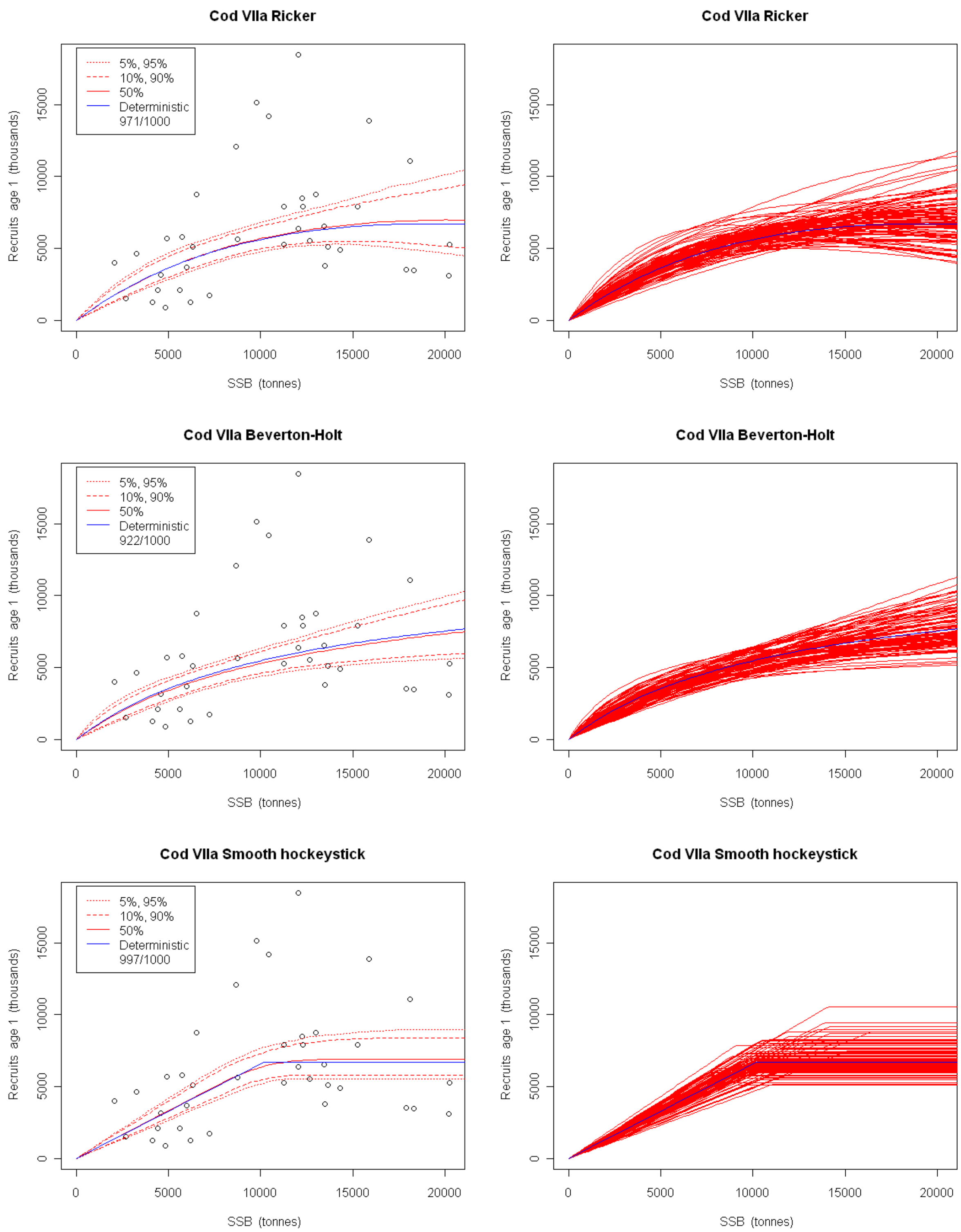


Figure 6.2.21. Cod in VIIa. Stock and recruit relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{msy}. Right hand panels : curves plotted from the first 100 MCMC re-samples with converged F_{msy} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

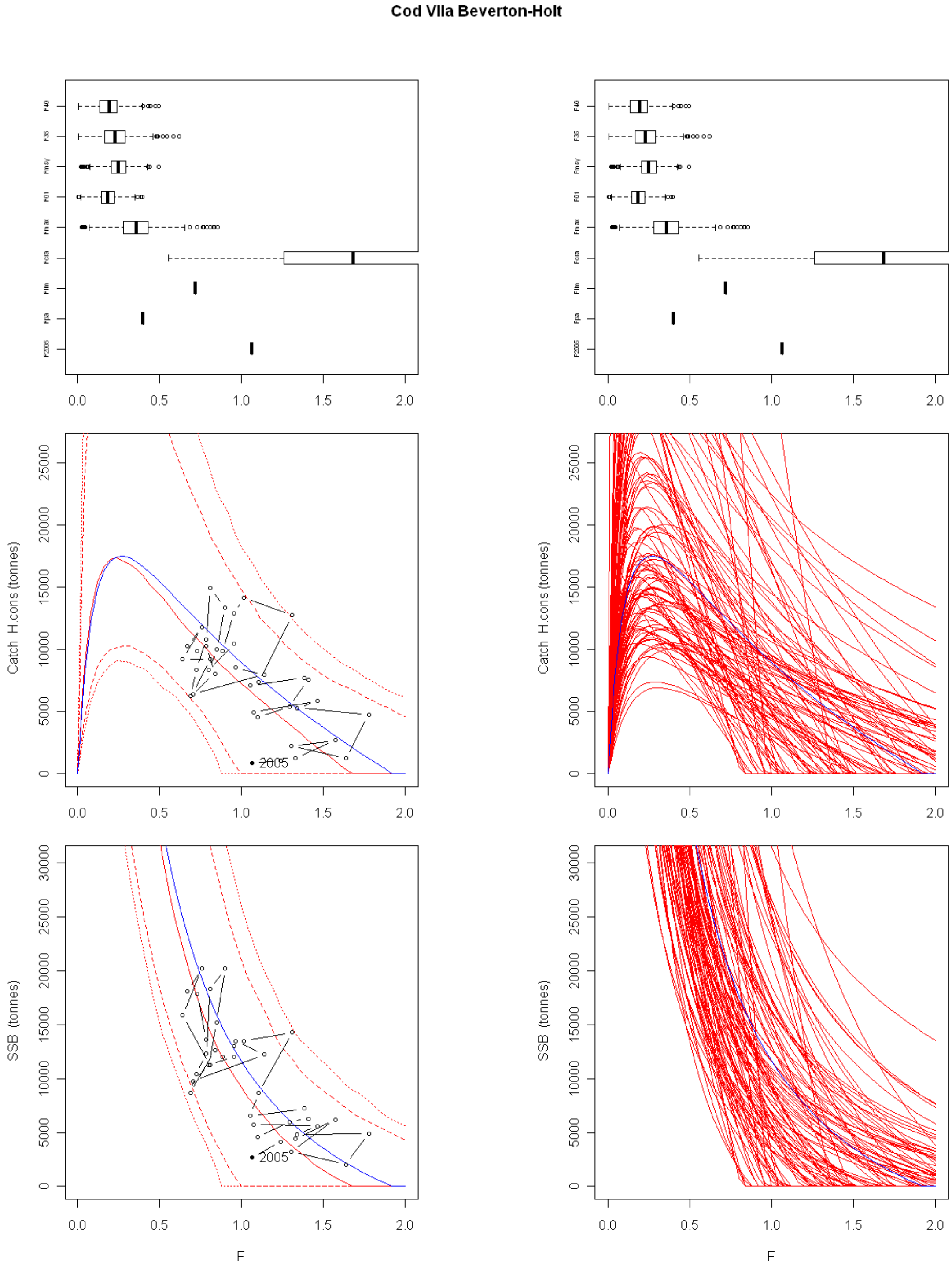


Figure 6.2.22. Cod in VIIa. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Beverton and Holt stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

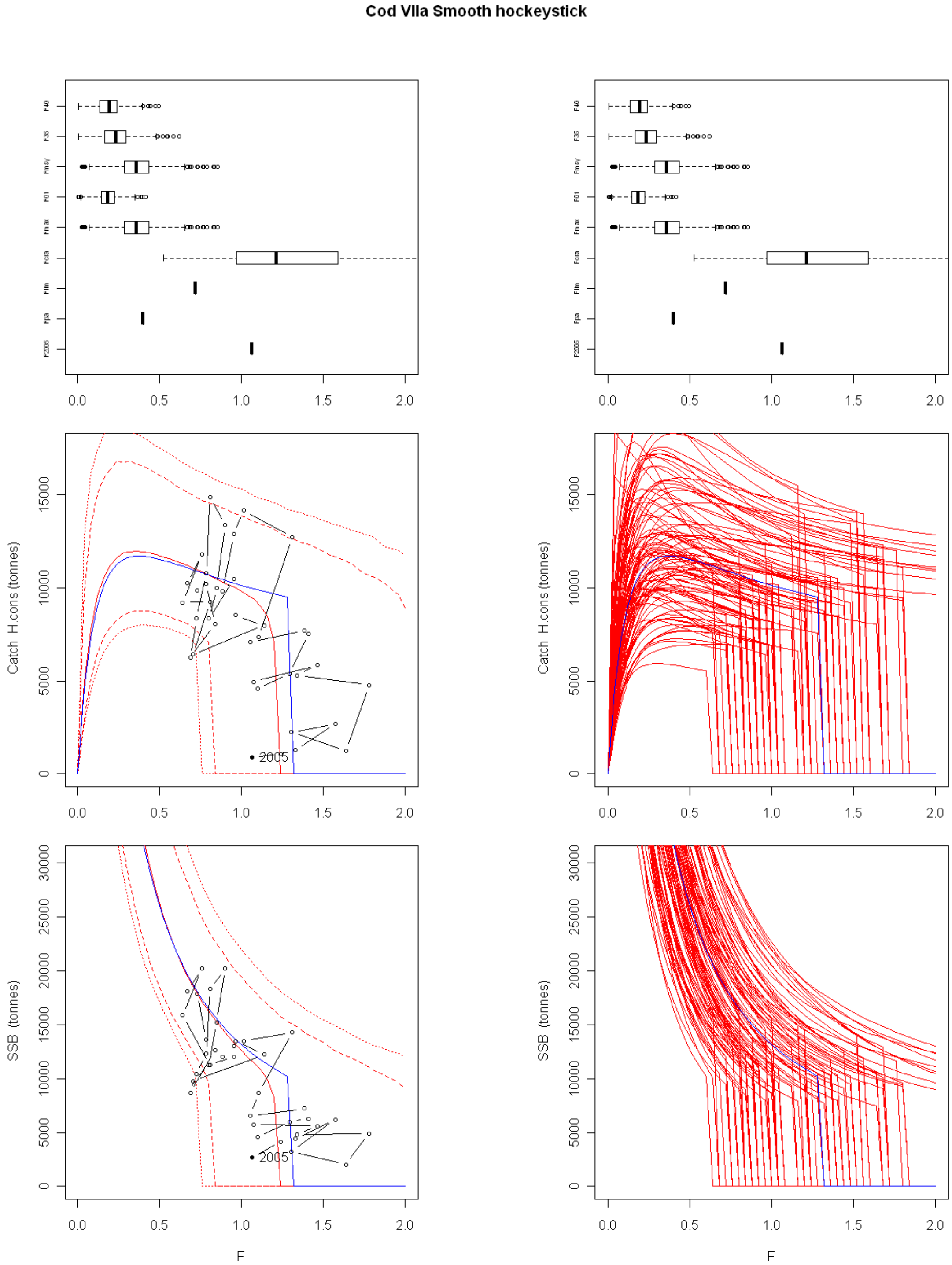


Figure 6.2.23. Cod in VIIa. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using a Hockeystick stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

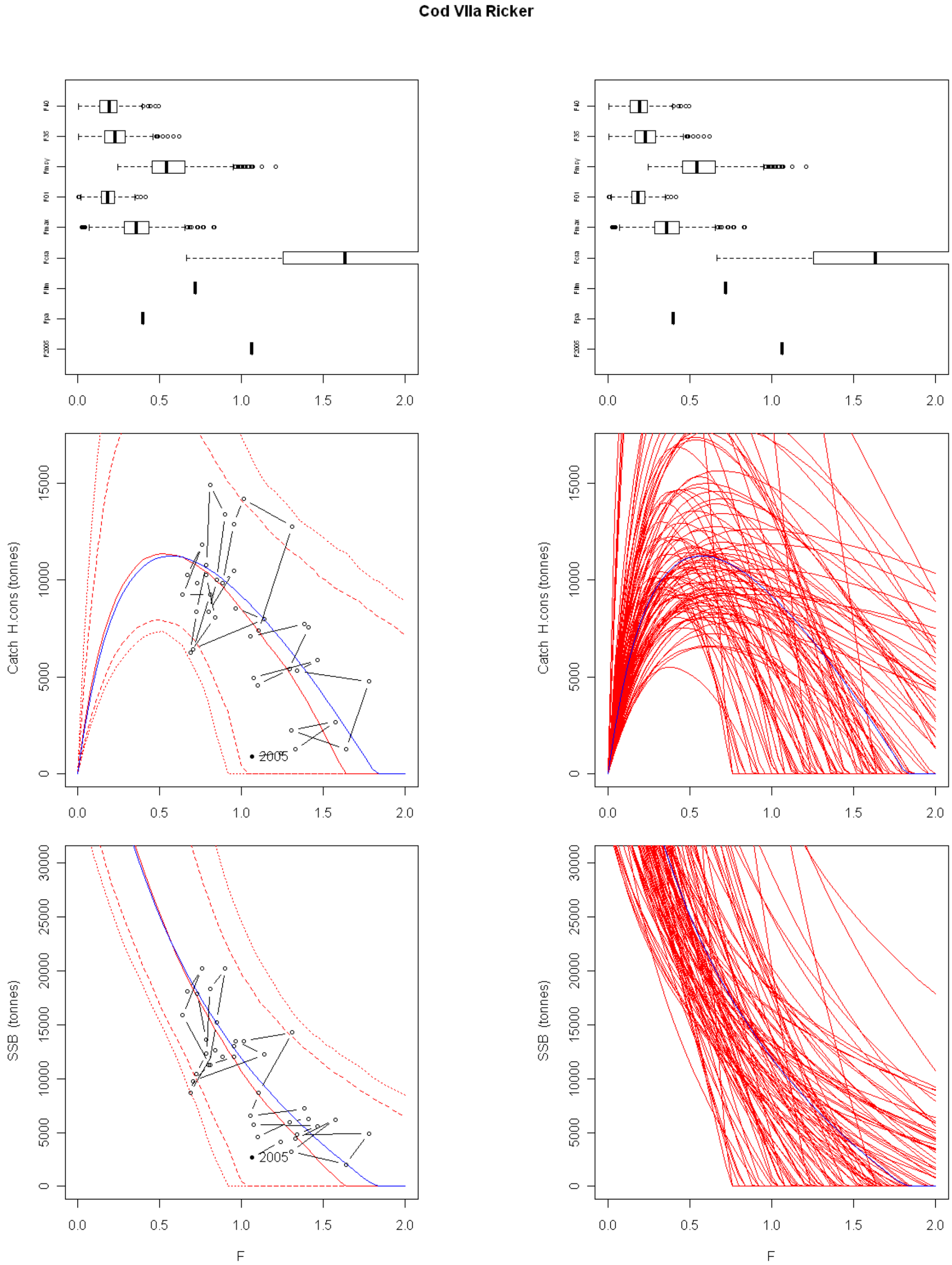


Figure 6.2.24. Cod in VIIa. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Ricker stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

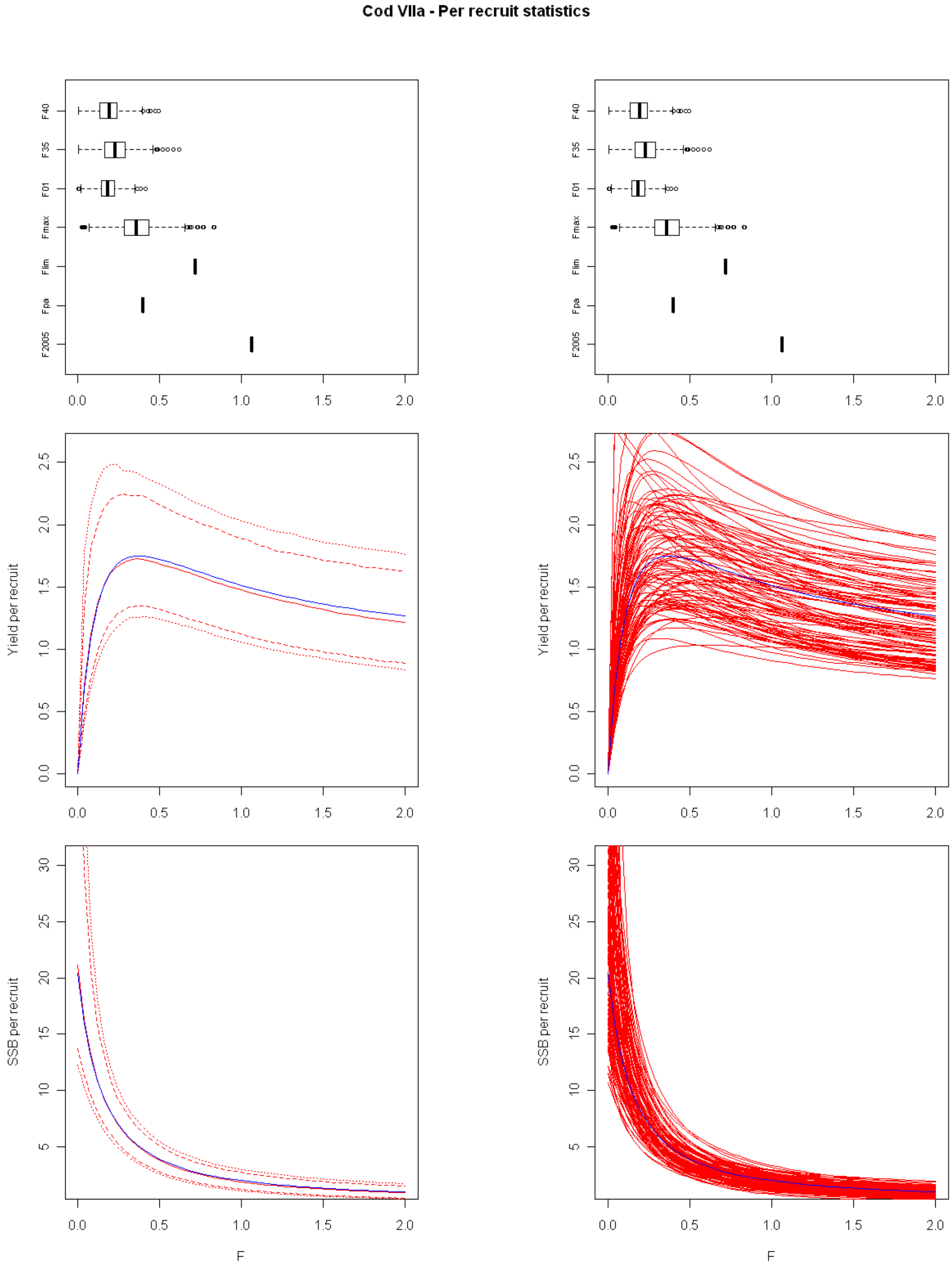


Figure 6.2.25. Cod in VIIa. Fitted yield-per-recruit F reference points, yield-per-recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric resampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.

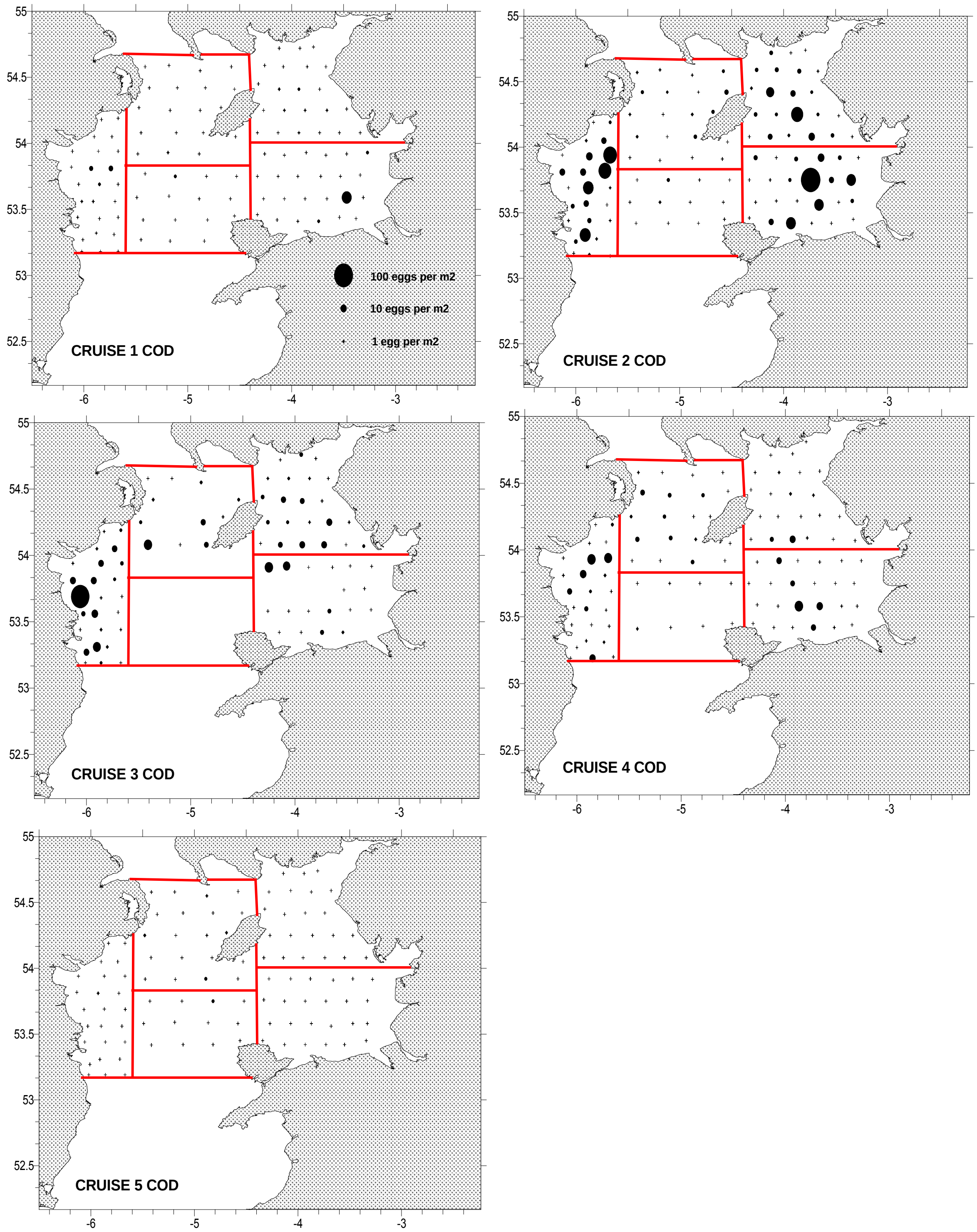


Figure 6.2.26. Cod in VIIa. Annual Egg Production Method (AEPM) distribution of Stage 1 cod eggs during 2008. Station positions are marked with crosses, and the stratum boundaries are indicated.

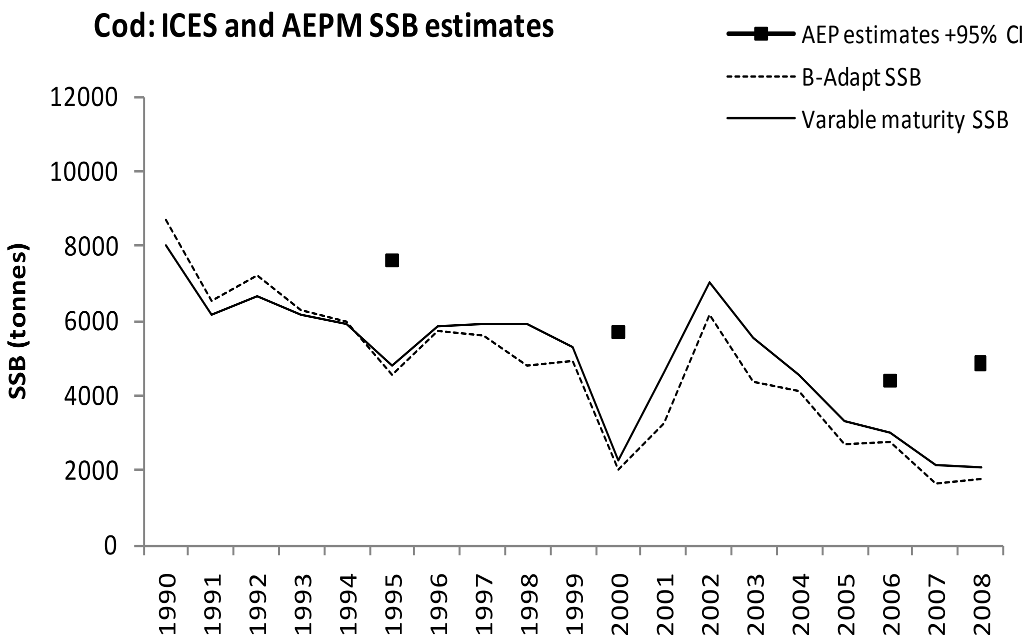


Figure 6.2.27. Cod in VIIa. Time-series of Annual Egg Production Method (AEPM) estimates of SSB (+ 2 SE) relative to ICES estimates (ICES, 2009). "B-Adapt SSB" is the series given by ICES (2009). "Variable maturity SSB" is the ICES estimates adjusted to reflect a time-series of maturity from the AFBI groundfish surveys (see WD11).

6.3 Haddock in Division VIIa

Type of assessment

The Working Group performed an update assessment for this stock in 2010.

ICES advice applicable to 2009

The advice from ICES for 2009, under single-stock exploitation boundaries, was as follows:

> Exploitation boundaries in relation to precautionary limits: The available information is inadequate to evaluate spawning–stock or fishing mortality relative to precautionary reference points. SSB is increasing and recent recruitments appear to be above average. ICES recommends that fishing effort should not be allowed to increase.

ICES advice applicable to 2010

> The state of the stock is uncertain. Stock trends indicate an increase in SSB over the time-series but a decrease in 2008. Recruitment in the last two years appears to be below average. Total mortality appears relatively stable. ICES advises on the basis of precautionary considerations that there should be no increase in effort relative to 2009.

6.3.1 General

Stock descriptions and management units

The stock and management units are both ICES Division VIIa (Irish Sea).

Management applicable to 2009 and 2010

Management measures include TAC and effort restrictions as well as technical measures. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod recovery plan.

TAC regulations for 2009 and 2010 are given below:

2009

Species: Haddock *Melanogrammus aeglefinus*		**Zone:** VIIa (HAD/07A.)
Belgium	23	
France	103	
Ireland	617	
United Kingdom	681	
EC	1 424	
TAC	1 424	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

2010

Species: Haddock *Melanogrammus aeglefinus*		**Zone:** VIIa (HAD/07A.)
Belgium	23	
France	103	
Ireland	617	
United Kingdom	681	
EU	1 424	
TAC	1 424	Precautionary TAC

The minimum landing size for haddock in the Irish Sea is 30 cm.

Fishery in 2009

The characteristics of the fishery are described in the Stock Annex. An overview of the fisheries in the Irish Sea is given in Section 6.1.

The fishery in 2009 was prosecuted by the same fleets and gears as in recent years, with directed fishing prevented inside the cod closure in spring. The targeted white-fish fishery that developed during the 1990 using semi-pelagic trawls, continued to decline during 2009.

The reported uptake of TAC has been poor since 2004, with the exception of 2007. The estimated percentage uptake of UK, Irish and Belgium vessels in 2009 were 68% (estimated 460 t of 681 t quota), 60% (372 t of 617 t) and 29% (7 t of 23 t), respectively. For these figures, quota swaps have, however, not been taken into account. No French landings were reported to the Working Group.

Table 6.3.1 gives nominal landings of haddock from the Irish Sea (Division VIIa) as reported by each country to ICES since 1984.

6.3.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1. The landings of the fleets sampled by quarter comprise 70% of the international total in

2009. No sampling information is available for some of the smaller fleets contributing to the international landings.

Landings

Table 6.3.2 gives the long-term trend of nominal landings of haddock from the Irish Sea (Division VIIa) as reported to ICES since 1972, together with Working Group estimates. The 1993–2005 WG estimates (excl. 2003) include sampled-based estimates of landings into a number of Irish Sea ports. Sampled-based evidence suggests that WG estimates are close to reported landings since 2006.

The methods for estimating quantities and composition of haddock landings from VIIa, used in previous years, are described in the Stock Annex (Annex 6.3). The series of numbers-at-age in the international commercial landings is given in Table 6.3.3. Sampling levels were not considered adequate to derive catch age compositions in 2003. The time-series mean weight-at-age in the landings is given Table 6.3.4.

Discards

The series of the Irish and Northern Irish discard data, raised to the number of trips, were updated. Discard numbers-at-age for the different sampled fleets are given in Table 6.3.5. The proportions of discards-by-age for the different sampled fleets are given in Table 6.3.6. There are various issues relating to the reliability of the data, which needs to be addressed at the next benchmark assessment for this stock.

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the Stock Annex (Annex 6.3). Sampling levels have increased in recent years, but the highly variable. The very large estimates of discarding for *Nephrops* fleets observed by previous WG are still evident.

Biological data

The derivation of biological parameters and variables is described in the Stock Annex Natural mortality was assumed as 0.2 for all ages and years, and proportion mature knife-edged at age 2 for all years.

There is evidence for a decline in mean length of adult haddock over time (Figure 6.3.1), which needs to be reflected in the stock weights-at-age. Since 2001 the WG calculated stock weights by fitting a von Bertalanffy growth curve to all available survey estimates of mean length-at-age in March, described in the Stock Annex 6.3. The procedure was updated this year using NIGFS-Mar and quarter one commercial landings data for 2008. The time-series of length–weight parameters indicate a reduction in expected weight-at-length since 1996 (see Stock Annex for historical data):

	Length–weight parameters		Expected weight–at–length	
Year	A	B	30 cm	40 cm
2005	0.00489	3.174	238	593
2006	0.00506	3.165	239	595
2007	0.00469	3.194	244	612
2008	0.00523	3.159	242	601
2009	0.00431	3.224	249	629
2010	0.00413	3.238	250	635

The following parameter estimates were obtained (last year's estimates in parentheses):

Mean LI_{yc} = 80.3 cm (80.5); K = 0.191 (0. 191); t_0 = -0.418 (-0. 419)

Year-class effects giving estimates of asymptotic length relative to the mean were as follows (2008 and 2009 data were combined as there is only one observation for the 2009 year-class):

Year class	Effect	Year class	Effect
1990	1.230	2000	0.973
1991	1.168	2001	1.000
1992	1.099	2002	0.962
1993	1.114	2003	0.905
1994	1.128	2004	0.834
1995	1.100	2005	0.858
1996	1.012	2006	0.854
1997	0.988	2007	0.898
1998	1.000	2008/2009	0.923
1999	0.954		

The year-class effects show a smooth decline from the mid-1990s coincident with the rapid growth of the stock and may represent density-dependent growth effects, although other environmental factors may contribute. The close fit of the model to observed length-at-age data is shown by year class in Figure 6.3.1. The resultant stock weights-at-age are given in Table 6.3.7.

Surveys

The survey data considered in the assessment for this stock are given in Table 6.3.8. Survey-series for haddock available to the Working Group are described in the Stock Annex for 7a haddock. The following age-structured abundance indices were used in the assessment:

- UK (NI) groundfish survey (NIGFS) in March (age classes 1 to 5, years 1992–2010).

Additional age-structured abundance indices, that provided auxiliary information, are available from the following sources:

- UK (NI) groundfish survey (NIGFS) in October (age classes 0 to 3; years 1991 to 2009).
- UK (NI) Methot-Isaacs Kidd (MIK) net survey in June (age 0; years 1994–2009).
- UK Fishery Science Partnership (FSP) Irish Sea roundfish survey, 2004–20010(www.cefas.co.uk/fsp)
- UK Irish Sea Annual Egg Production Method survey (AEPM), 2006–2008 (Armstrong *et al.*, WD11).

The relative abundance indices are plotted against time in Figure 6.3.2. Surveys give similar signals for all ages (0–4). The two 0-group indices indicate increased recruitment in 2009 after two years of below average recruitment. Strong year classes were evident for all age groups in all surveys, indicating that the different surveys were capturing the prominent year-class signals in this stock (Figure 6.3.3). Correlation between survey indices by age is positive for all surveys and show high consistency within each fleet, but patchy consistency between the fleets (Stock Annex 6.3). The indices from the UK FSP survey ((Armstrong *et al.*, WD10) in the western Irish Sea also show similar year class signals to the other survey-series, but are noisy with obvious year effects (Figure 6.3.2). Haddock SSB estimates derived from an annual egg production method in the Irish Sea show a similar increase from 2006–2008 as the SURBA estimates from NIGFS-Mar data (Figure 6.3.4). The international landings-at-age (excl. 2003) show similar patterns of year-class variation to the surveys (Figure 6.3.2), giving confidence in the combined ability of the surveys to track year classes through time. The signal from the landings-at-age data is, however, much reduced since 2004.

The empirical trend in SSB from both the NIGFS series show the growth in SSB in the mid-1990s, a decline to 2000 and a subsequent variable trend (Figure 6.3.5). In recent years, both surveys show a marked increasing trend in SSB from 2005–2007 and then a decreasing trend to 2009 (diverging considerably in 2008).

Commercial cpue

Commercial cpue data are available for this stock but are not currently used in the assessment.

Other relevant data

An IBTS-coordinated UK trawl survey started in the Irish Sea in November/December 2004. Survey index data from this survey have not yet been provided to the Working Group.

6.3.3 Historical stock development

Deviation from Stock Annex

The assessment presented is the single fleet SURBA analysis, using only the NIGFS-Mar survey. The assessment does not deviate from the procedure used last year, as described in the Stock Annex.

SURBA 3.0 was used for the assessment and model settings (similar to last year's assessment) are given below:

	WGCSE 2010
Year range:	1992–2010
Age range:	1–5
Catchability:	1.0 at all ages
Age weighting	1.0 at all ages
Smoothing (Lambda):	1.0
Cohort weighting:	not applied
Reference age	2
Survey used	NIGFS-Mar

Data screening

Screening of internal and between survey consistency is described in Section 6.3.2.

Final update assessment

SURBA model residuals (log-population indices) for the NIGFS-Mar survey show noisy residuals (Figure 6.3.6). Residuals show some evidence of year effects in older ages in some years. The age 2 residual pattern from the NIGFS-Mar survey continue to show a better pattern than the other ages. The NIGFS-Mar survey model show quite large retrospective patterns in SSB (Figure 6.3.6) during the early 2000s, probably related to an overestimation of the 2001 year class. There are also large retrospective patterns in mortality estimates, highlighting the difficulty in estimating mortality for this stock.

The trends in Z, SSB and recruitment for the assessment using the NIGFS-Mar survey data, and the model residuals are given in Figures 6.3.7 and 6.3.8. The SURBA fitted numbers-at-age and total mortality-at-age given in Table 6.3.9. The SURBA index of Z generally follows the much noisier empirical estimates. Both the empirical and SURBA estimates of SSB give a similar increasing trend from 2005–2008 followed by in decrease since 2009. The recruitment estimates at age 1 indicate an above average recruitment in 2009, following two years of poorer recruitment. In general, the SURBA results capture similar year-class dynamics than observed from the raw survey indices (Figure 6.3.2).

Comparison with previous assessments

The perception of the stock has not changed since last year's assessment. Figure 6.3.9 compares the relative trends between the SURBA fitted estimates from this year's to last year's assessment. The two series show similar trends. The most recent SSB estimate indicates that the stock has decline further since last year. The relative SSB estimate for 2010 is below the series average.

State of the stock

Stock trends indicate an increase in SSB over the time-series. SSB trend is declining since 2008. The stock is characterised by highly variable recruitment. The model indicates above average recruitment for the 2009 year class after below average recruitment for the 2007 and 2008 year classes. Total mortality remains stable.

6.3.4 Short-term projections

No short-term forecast has been performed for this stock. This year the WG projected the SSB for 2011 using the 2010 survey information. Since maturity for the stock is considered as knife-edge at age 2, all the age classes that will comprise the 2011 SSB are already represented by the 2010 quarter one survey index. SSB for 2011 was projected using an average of the last three years total mortality from the SURBA model, a three year average of stock weights (2008–2010) and 10-year geometric mean recruitment.

The projected SSB trend is illustrated in Figure 6.3.10, indicating a stabilisation of the decreasing trend in SSB. SURBA fitted recruitment estimates are also compared to recruitment from the 0-gp indices (NIGF-Oct and NIMIK), indicating that the model estimates might overestimate the strength of the 2007 and 2008 year classes, suggesting that the projected SSB might also be an overestimate.

6.3.5 MSY evaluations

MSY evaluations were performed on a very limited dataset. Input data were taken from the last accepted catch-at-age assessment in 2002 from the ICES network (similar input data to the yield-per-recruit analysis presented in Table 6.3.11). The analysis was performed using the srmsymc ADMB package. Recent assessments were based on survey data only due to the uncertainty with catch-at-age data. This evaluation is based on this historical catch-at-age data, including the underlying problems with the accuracy of the data.

The three stock–recruit relationships fitted by srmsymc are illustrated in Figure 6.3.11. The high uncertainty around these fits reflects the shortage of information within the limited dataseries to inform any stock–recruit relationship. The data are very noisy with relatively high rejection rates for the Ricker and Beverton–Holt models. Mathematically there is very little to distinguish between the three models, based on the AIC values that indicate equal fits (Table 6.3.10). F reference points are poorly defined with wide distributions and very high levels of uncertainty (cv values are high for all three models). F_{msy} values falls within the range of F_{crash} in all cases (Table 6.3.10).

Stock–recruit relationships are generally poorly defined for haddock stocks. These models assume a positive relationship between spawning–stock size and recruitment. However, haddock is characterised by sporadic high recruitment even at low spawning–stock levels making any relationship difficult to define. Recent trends within the Irish Sea haddock stock showed that an increase in spawning–stock biomass is dependent on these impulses of high recruitment, i.e. recruit–stock. Density-dependent growth is also evident by year class, which will have an effect on the overall yield of large year classes. This all makes an evaluation for the stock at equilibrium very difficult.

The Working Group is thus unable to provide absolute values for F_{msy} or F_{msy} proxies, as there are insufficient data to derive absolute estimates of F_{msy} with any degree of precision.

There are some additional considerations in relations to exploitation levels to maximise long-term yield, which might indicate that current F might be above F_{msy}:

- The stock has a high growth rate with considerable growth potential. Estimates of 0-gp and 1-gp discards are high, thus any improvement in the selectivity pattern would result in increased future yield.
- The age structure is narrow and is not recovering despite a significant decrease in overall effort from the mid-water pelagic fleet.

6.3.6 Biological reference points

Precautionary approach reference points

There is currently no biological basis for defining appropriate reference points, in view of the rapid expansion of the stock size over a short period (ACFM, October 2002). ACFM (2007) proposed that F_{pa} be set at 0.5 by association with other haddock stocks, however, the Working Group no longer considers an F_{pa} value determined in association with other haddock stocks as appropriate. The absolute level of F in this stock at present is poorly known.

Yield and biomass-per-recruit

Yield-per-recruit (YPR) and SSB per recruit (SPR) for the Irish Sea stock were calculated by the 2004 WGNSDS, conditional on the exploitation pattern for landings in 2000–2002 given for ages 0 to 5+ by XSA, using MFYPR software. Long-term (1993–2003) catch weights and stock weights-at-age were used. Input data are given in Table 6.3.11, and the summary output is given in Table 6.3.12. The YPR and SPR curves are plotted in Figure 6.3.13. The deterministic output from this model is, however, highly uncertain. Figure 6.3.12 illustrates the uncertainty in the yield-per-recruit curve. Any estimate from the analysis is highly uncertain (high cv values in Table 6.3.10) implying poorly defined F reference point as well as the absolute level of yield.

6.3.7 Management plans

There is no specific management plan for haddock in the Irish Sea. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod management plan (Council Regulation (EC) 1342/2008).

6.3.8 Uncertainties and bias in assessment and forecast

This assessment is based on survey trends only as recent levels of catch are uncertain. After a period of poor sampling of landings for length and age, the sampling levels and coverage since 2007 are adequate to allow compilation of catch-at-age data. Discard sampling levels also increased significantly in the last three years. The highly variable and very large estimates of discarding for this fleet observed by previous WG are still evident. Historical landings data for this stock are uncertain, but sample-based estimates of landings suggest that the accuracy of officially reported landings has improved substantially since 2006. The recent catch-at-age data (2003–2006) are still considered too inaccurate, due to poor sampling information, to form the basis for a traditional analytical assessment based on catch-at-age data.

The narrow age range in the haddock stock and the resulting low numbers caught at older ages in the surveys restricted the number of age classes that could be used in the model. This and the differences in catchability-at-age between surveys make the total mortality difficult to estimate. The survey data used in the assessment are quite consistent both internally and between fleets, probably due to the very large data contrast between year-class strengths as well as the restricted distribution of the stock. The recruitment pattern for this stock since the early 1990s is relatively well established and can be tracked fairly consistently through both the surveys and commercial catches. Hence it can be established with some confidence how, qualitatively, the catch and stock is likely to be impacted in the short term by recent year classes.

Knowledge of basic biology of Irish Sea haddock is expanding through data on growth, maturity and distribution obtained during trawl surveys. Patterns of movement within the Irish Sea and between the Irish Sea and surrounding areas are poorly understood, and it is assumed that the Irish Sea stock is essentially self-sustaining at present. Trends in length and weight-at-age in the stock over time are apparent and reduced growth appears to have coincided with the growth of the stock. This may represent density-dependent growth effects (although other environmental factors may contribute) that will affect any forecast and lead to overoptimistic forecast estimates unless correctly predicted.

The projected survey estimate of biomass should only be used for interpreting trends rather than a relative estimate. F/Z is poorly estimated and currently unknown. The problem is with using Z-M as a proxy for F in the SURBA-based assessment, when total mortality from the model is poorly defined. The SURBA Z-values are only a relative measure and do not mean anything unless the catchability-at-age in the survey(s) are quantified. The SURBA Z-values cannot be taken as an absolute, which makes effort based management very difficult, especially measured against a non-stock specific reference point. The additional recruitment survey indices indicate similar above average recruitment in the last year, giving confidence in the higher recruitment indicated by the current survey based assessment. The NIGFS-Oct survey has good internal consistency (see Stock Annex) and both 0-gp indices appear to indicate relative year-class strength well historically (Figure 6.3.2 and 6.3.3).

The perception of the stock from this year's assessment does not differ qualitatively from that obtained last year.

6.3.9 Recommendations for next benchmark assessment

The primary concern with this stock is that recent catch-at-age data are considered inaccurate to form the basis for a traditional analytical assessment based on catch-at-age data. This has been attributed to poor sampling information, which has improved in the last two years. The absence of reliable discard estimates is also serious deficiency that must be addressed if management is to be based on catch-at-age analysis. Levels of discard sampling have increased substantially in the last three years and reliable discards-at-age matrix could be formulated over the next few years.

The problems in terms of generating reliable catch-at-age numbers for this stock are not likely to be solved in the short term. Furthermore, with the sharp decline in whitefish directed effort in the Irish Sea, sampling opportunities for haddock from landings, are not likely to improve.

6.3.10 Management considerations

Following decades of very low recruitment and biomass as indicated by very low fishery catches, this stock grew substantially in the 1990s following sudden pulses of recruitment, and has gone from a minor bycatch species to one of the most economically valuable target species in the Irish Sea. Since the mid-1990s the haddock population in the Irish Sea is experiencing one of the largest and most sustained period of growth. The recruitment signals are clearly revealed by surveys, but the steep age profile in the catches and the resultant dependence of the fishery on highly variable recent year classes means that catch and SSB forecasts will be uncertain. The prevention of directed fishing for haddock during the cod closures in 2000–2010, other than during limited fishing experiments, should have curtailed the directed fisheries on mature haddock that occur in spring.

EU has adopted a long-term plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008). The long-term management plan for cod implemented in the Irish Sea from 2008 will affect catches of species caught in related fisheries, including haddock. The current directed fishery for haddock in the Irish Sea is likely to generate bycatches of cod in the same area.

Sampling schemes since the 1990s have shown high rates of discarding of haddock less than 3 years old and variable discarding of 3-year-olds in fisheries using 70–89 mm mesh nets. Samples from whitefish vessels since the introduction of 100+ mm mesh and other recent technical measures are too few to form a basis for evaluation of discards in that fleet. Discard rates could be reduced by using more selective fishing gears in the small mesh fisheries. The decline in growth rate might also result in discarding occurring at progressively older ages. However, any measures to reduce discards will result in increased future yield.

Current TAC management measures are not responsive enough considering the dynamic nature of changes in stock abundance. Under the assumption of constant effort, the increase in abundance from 2005–2008, created increased catch opportunities. During this period the TAC remained relatively constant and resulted in increased discarding of older fish (particularly in 2007). The TAC for 2009 was increased based on the increasing trend of stock abundance, in spite of evidence of weaker recruitment and possible decreasing abundance.

Landings data have not been used in the assessment. Landings data for this stock are uncertain because of species misreporting, which has been estimated from quayside observations in one country only. Restrictive quotas for some countries caused extensive misreporting during the 1990s prior to the introduction of a separate TAC allocation for the Irish Sea. Estimates of misreporting have been included in the estimates of landings, except for 2003. The recent implementation of buyers and sellers legislation has improved the quality of the landings data since 2006.

Under the EU policy for setting TACs, the Irish Sea haddock stock would be classified as a category 9 stock (i.e. state of stock is unknown, but trends based assessment indicates decrease in SSB). The guidelines require firstly an evaluation of current levels of F in relation to F_{MSY}, if a MSY proxy is available. Current F estimates are considered uncertain and unreliable. Survey biomass estimates in the last two years are >20% lower than the survey biomass estimates in the previous three years. This category would result in a decrease TAC of 15%.

Table 6.3.1. Nominal landings (t) of haddock in Division VIIa, 1984–2009, as officially reported to ICES. (Working Group figures are given in Table 6.3.2).

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	3	4	5	10	12	4	4	1	8	18
France	38	31	39	50	47	n/a	n/a	n/a	73	41
Ireland	199	341	275	797	363	215	80	254	251	252
Netherlands	-	-	-	-	-	-	-	-	-	-
UK (England & Wales)[1]	29	28	22	41	74	252	177	204	244	260
UK (Isle of Man)	2	5	4	3	3	3	5	14	13	19
UK (N. Ireland)	38	215	358	230	196	…	…	…	…	…
UK (Scotland)	78	104	23	156	52	86	316	143	114	140
Total	387	728	726	1,287	747	560	582	616	703	730

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Belgium	22	32	34	55	104	53	22	68	44	20
France	22	58	105	74	86	n/a	49	184	72	146
Ireland	246	320	798	1,005	1,699	759	1,238	652	401	229
Netherlands	-	-	1	14	10	5	2	-	-	-
UK (England & Wales)[1]	301	294	463	717	1,023	1,479	1,061	1,238	551	248
UK (Isle of Man)	24	27	38	9	13	7	19	1	-	-
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	66	110	14	51	80	67	56	86	47	31
Total	681	841	1,453	1,925	3,015	2,370	2,447	2,229	1,115	674

Country	2004	2005	2006	2007	2008	2009
Belgium	15	22	23	30	15	7*
France	20	36	20	11	6	-*
Ireland	296	139	184	477	319	317*
Netherlands	-	-		-	-	-
UK (England & Wales)[1]	421	344	419	559	521	
UK (Isle of Man)	-	-	-	-	1	
UK (N. Ireland)	…	…	…	…	…	…
UK (Scotland)	9	6	9	1	17	
United Kingdom						458*
Total	761	547	655	1078	879	782*

***Preliminary.**

[1]1989–2008 Northern Ireland included with England and Wales.

n/a = not available.

Table 6.3.2. Haddock in VIIa. Total international landings of haddock from the Irish Sea, 1972–2009, as officially reported to ICES. Working Group figures, assuming 1972–1992 official landings to be correct, are also given. The 1993–2005 WG estimates include sampled-based estimates of landings at a number of Irish Sea ports. Landings in tonnes live weight.

Year	Official landings	WG landings
1972	2204	2204
1973	2169	2169
1974	683	683
1975	276	276
1976	345	345
1977	188	188
1978	131	131
1979	146	146
1980	418	418
1981	445	445
1982	303	303
1983	299	299
1984	387	387
1985	728	728
1986	726	726
1987	1287	1287
1988	747	747
1989	560	560
1990	582	582
1991	616	616
1992	703	656
1993	730	813
1994	681	1043
1995	841	1753
1996	1453	3023
1997	1925	3391
1998	3015	4902
1999	2370	4129
2000	2447	1380
2001	2229	2498
2002	1115	1972
2003	674	n/a
2004	761	1278
2005	547	699
2006	655	647
2007	1078	1066
2008	879	872
2009	n/a	838

Table 6.3.3. Haddock in VIIa: catch numbers-at-age.

Catch numbers-at-age	Numbers*10**-3																
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE																	
0	0	0	0	0	0	0	0	0	0	0	n/a	0	0	0	0	0	0
1	94	30	1341	109	1285	100	91	459	597	120	n/a	54	38	7	13	111	92
2	1250	123	1322	4619	700	6427	519	915	2263	632	n/a	203	523	340	918	391	587
3	18	861	107	735	2411	292	4462	238	1116	1853	n/a	751	133	631	695	802	682
4	1	3	222	16	203	539	49	374	80	196	n/a	76	219	74	141	239	183
+gp	1	2	5	30	16	35	72	28	127	28	n/a	97	43	78	52	67	56
0 TOTALNUM	1364	1019	2997	5509	4615	7393	5193	2014	4183	2829	n/a	1181	956	1130	1819	1610	1600
TONSLAND	813	1043	1753	3023	3391	4902	4129	1380	2498	1971	n/a	1278	699	647	1066	872	838
SOPCOF %	100	100	100	100	95	100	100	97	100	100	n/a	100	99	100	100	100	100

Table 6.3.4. Haddock in VIIa: catch weights-at-age.

Catch weights-at-age (kg)																	
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE																	
0	0	0	0	0	0	0	0	0	0	0	n/a	0	0	0	0	0	0
1	0.351	0.346	0.361	0.346	0.348	0.19	0.325	0.329	0.3	0.279	n/a	0.401	0.273	0.244	0.240	0.300	0.306
2	0.596	0.56	0.545	0.474	0.592	0.53	0.416	0.474	0.452	0.357	n/a	0.519	0.417	0.354	0.440	0.377	0.426
3	1.688	1.103	0.898	0.917	1.002	1.13	0.802	0.786	0.859	0.749	n/a	1.007	0.697	0.505	0.638	0.534	0.507
4	2.52	2.73	1.983	2.034	1.349	2	2.064	1.573	1.243	1.361	n/a	1.940	1.256	0.872	0.786	0.743	0.778
+gp	2.52	2.522	2.178	2.682	1.955	2.55	2.854	2.365	1.869	2.107	n/a	2.544	2.268	1.841	1.987	1.261	1.265
0 SOPCOFAC	0.9995	1.0008	1.0007	1.0029	0.9465	0.9958	0.9996	0.9675	1.0002	0.9991							

Table 6.3.5. Haddock in VIIa: Estimates of Irish Sea haddock discards 1995–2009. Data are numbers (‘000 fish) discarded by the fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Tables (b) and (d) represent estimates from limited observer sampling of N.Ireland vessels also included within the self-sampling estimates for N.Ireland trawlers catching *Nephrops* (Table (a)). Table (f) is the total for sampled fleets and quarters, excluding missing quarters or fleets. Table (e) is the revised figures supplied to the 2005 WG.

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1	2004	2005	2006	2007	2008	2009
Age	43 trips	39 trips	48 trips	39 trips	44 trips	43 trips	35 trips	8 trips						
0	4485	100	1552	1274	110	1083	851	0	n/a	n/a	n/a	n/a		
1	229	1209	318	342	2384	140	1073	62	n/a	n/a	n/a	n/a		
2	179	88	210	69	253	199	37	28	n/a	n/a	n/a	n/a		
3	0	0	0	0	0	0	11	0	n/a	n/a	n/a	n/a		

(b) Observer scheme: N.Ireland vessels catching *Nephrops* (single trawl only) (*not raised to fleet level – no. of fish)

	1999 Q3-4	2000 Q1-3	2001 Q1	2006 Q3-4*	2007 Q1-4	2008 Q1-4	2009 Q1-4
Age	4 trips	6 trips	1 trip	9 trips	29 trips	55 trips	30 trips
0	2185	210	0	8391	901	625	1609
1	22	280	1677	809	1553	295	284
2	0	57	1593	60	681	124	101
3	0	0	0	15	74	16	23
4	0	0	0	0	0	1	0

(c) Observer scheme: N.Ireland midwater trawl

	1997 Q2-4	1998 Q1-3	1999 Q3-4	2000 Q1	2001 Q1	2008 Q4	2009 Q2
Age	n/a	n/a	5 trips	4 trips	2 trips	1 trip	1 trip
0	0	0	68	0	0	0	0
1	178	316	96	20	0.4	7	1
2	19	1342	35	83	19	15	39
3	4	0	2	5	0	2	19

(d) Observer scheme: N.Ireland twin trawl (*not raised to fleet level – no. of fish)

	1997 Q2-4	1998 Q1-3	1999 Q4	2000 Q1-4	2001 Q1	2006 Q3-4*	2007 Q1-4	2008 Q1-4	2009 Q1-4
Age	n/a	n/a	1 trips	10 trips	2 trips	2 trip	14 trips	16 trips	18 trips
0	34	4	26	10	0	363	369	676	3219
1	284	205	3	13	3	59	275	183	315
2	6	382	0	10	19	9	77	70	600
3	0.5	0	0	0	0	0	9	6	200
4	0	0	0	0	0	0	0	0	1

Table 6.3.5. (Continued)

(e) Observer scheme: Republic of Ireland otter trawlers

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1-4	2004 Q1-4	2005 Q1-4	2006 Q1-4	2007 Q1-4	2008 Q1-4	2009 Q1-4
Age	8 trips	8 trips	7 trips	4 trips	10 trips	2 trips	1 trip	9 trips	11 trips	8 trips	5 trips	16 trips	18 trips	18 trips
0	3808	165	565	87	182	5349	47	1169	5663	776	3966	1122	322	5759
1	713	11396	1973	58	2193	7354	31	1747	6566	2350	10140	8735	1226	5654
2	297	303	3564	59	580	140	0	1178	2301	996	3856	3995	783	334
3	0	0	0	0	0	15	0	10	225	120	132	435	44	72
4	0	0	0	0	0	0	0	0	0	0	0	1	2	0

(f) Total for sampled fleets and quarters: NI self sampling scheme (a); NI midwater trawl (c); ROI otter trawl (e)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Age	51 trips	n/a	n/a	48 trips	58 trips	47 trips	36 trips	17 trips	n/a	n/a	n/a	n/a	n/a	n/a
0	8293	265	2117	1429	292	47	36	17	n/a	n/a	n/a	n/a	n/a	n/a
1	942	12783	2607	496	4597	6432	898	1169	n/a	n/a	n/a	n/a	n/a	n/a
2	476	410	5116	163	916	7494	1104	1809	n/a	n/a	n/a	n/a	n/a	n/a
3	0	4	0	2	5	358	37	1206	n/a	n/a	n/a	n/a	n/a	n/a
4	0	0	0	0	0	15	11	10	n/a	n/a	n/a	n/a	n/a	n/a

revised

Table 6.3.6. Haddock in VIIa: Proportion by number-at-age discarded by sampled fleets.

		Proportion discarded			
Fleet	Period	age 0	age 1	age 2	age 3
Mid-water trawl	Q2-Q4 1997		0.93	0.37	0.02
Mid-water trawl	Q1-Q3 1998		0.99	0.16	0.00
Mid-water trawl	Q3-Q4 1999	1.00	0.79	0.31	0.00
Mid-water trawl	Q1 2000		1.00	0.44	0.04
Mid-water trawl	Q1 2001		1.00	0.30	
Mid-water trawl	Q4 2008	1.00	0.97	0.90	0.30
Mid-water trawl	Q2 2009		-	0.44	0.14
Single *Nephrops*	Q3-Q4 1999	1.00	0.94		
Single *Nephrops*	Q1-Q3 2000	1.00	0.97	0.45	
Single *Nephrops*	Q1 2001		1.00	0.49	
Single *Nephrops*	Q3-Q4 2006	1.00	1.00	0.96	0.50
Single *Nephrops*	Q1-Q4 2007	1.00	1.00	0.94	0.79
Single *Nephrops*	Q1-Q4 2008	1.00	0.99	0.78	0.18
Single *Nephrops*	Q1-Q4 2009	1.00	1.00	0.88	0.46
Twin trawl	Q2-Q4 1997	1.00	1.00	0.61	0.04
Twin trawl	Q1-Q3 1998	1.00	1.00	0.76	0.00
Twin trawl	Q4 1999	1.00	1.00		
Twin trawl	Q1 – Q4 2000	1.00	0.96	0.28	
Twin trawl	Q1 2001		1.00	0.12	
Twin trawl	Q3-Q4 2006	1.00	1.00	0.81	0.00
Twin trawl	Q1-Q4 2007	1.00	1.00	0.91	0.63
Twin trawl	Q1-Q4 2008	1.00	0.95	0.50	0.05
Twin trawl	Q1-Q4 2009	1.00	0.99	0.95	0.75
OTB	Q1-Q4 2007	1.00	1.00	0.93	0.65
OTB	Q1-Q4 2008	1.00	0.97	0.90	0.17
OTB	Q1-Q4 2009	1.00	1.00	0.62	0.24

Table 6.3.7. Haddock in VIIa: stock weights-at-age.

Stock weights-at-age (kg)																		
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE																		
0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
1	0.095	0.083	0.085	0.083	0.070	0.060	0.057	0.048	0.051	0.056	0.050	0.041	0.032	0.035	0.034	0.041	0.044	0.039
2	0.425	0.342	0.352	0.365	0.361	0.257	0.228	0.232	0.204	0.218	0.233	0.201	0.167	0.130	0.144	0.142	0.170	0.186
3	1.073	0.977	0.792	0.796	0.873	0.749	0.567	0.514	0.551	0.476	0.489	0.515	0.462	0.383	0.302	0.326	0.332	0.395
4	1.794	2.043	1.709	1.318	1.436	1.388	1.292	0.967	0.929	0.979	0.798	0.816	0.904	0.801	0.682	0.517	0.589	0.586
+gp	2.589	3.062	3.149	2.513	2.171	2.033	2.149	1.976	1.633	1.494	1.429	1.202	1.269	1.373	1.298	1.060	0.875	0.916

Table 6.3.8. Haddock in VIIa: Available tuning data (file name: h7ani.tun).

```
IRISH SEA haddock,2010 WG,ANON,COMBSEX,TUNING DATA(effort, nos at age)
104
NIGFS March
1992 2010
1 1 0.21 0.25
1 5
       1   1525    23     0     0   0  0
       1    139   569    31     0   0  0
       1    644    58   183     0   0  0
       1  24823   437     0    43   0  0
       1   1065  3743    67     3   1  0
       1  25118   474  1457    44   0  2
       1   3913  8694    70   105   1  0
       1   6058   680  2072    16  11  0
       1  14028  1853    64   147   2  3
       1   3277  6990   770    40  20  0
       1  28755   842  1059    78   1  0
       1   6966 14162   341   356  26  0
       1  19945  2379  2206    45  35  0
       1  24488  6454   406   234  13  2
       1  13444 12721  2194    91  33  0
       1  20918 11325  3661   240  16 11
       1   7480 12009  2559   495  48  0
       1   9345  3888  2877   163  37  5
       1  17058  1765   524   239  26  1
```

Fleets below not included in assessment

```
NIGFS Oct
1991 2009
1 1 0.83  0.88
0 3
        1   15780      70      0      0  0  0  0
        1     124     784    151      0  0  0  0
        1    4462     101    375      3  0  0  0
        1   56683    1137     12     79  0  0  1
        1    1661   10153     74      0  5  0  0
        1  143300    1167   1480     13  0  0  0
        1   16400   39680    174     98  1  0  0
        1   41820    1243   3778     22  3  4  0
        1   80674    2835     71    145  0  1  0
        1    6545    8598    763     31 39  0  0
        1   75017    2003   2742    311  0 20  0
        1   15116   10501     86    365  0  0  0
        1   53922    7125   3008     59 79  0  0
        1   70337   14413   1261    649  0  0  0
        1   47030   12962   1743     59  8  0  0
        1   35748   10788   3607    392 52  0  0
        1    9654    9804   4050   1057 41  0  0
        1    9037    4880   2242    277 24  0  0
        1   45869    4269    951    459 29 12  3

MIK net May/June
1994 2009
1 1 0.38 0.47
0 0
        1     47000
        1      1700
        1     47800
        1     14500
        1      2500
        1     15400
        1      1700
        1     17100
        1      1200
        1      4250
        1     25970
        1      8250
        1     40240
        1      3820
        1      6638
        1     18540
```

Table 6.3.9. Haddock in VIIa: SURBA 3.0 fitted numbers-at-age, total mortality-at-age, SSB and Z using the NIGFS-Mar survey data.

Numbers-at-age						Total mortality-at-age				
	Age					Age				
Year	1	2	3	4	5	1	2	3	4	5
1992	0.357	0.013	0	0	0	0.667	0.662	1.110	1.359	1.359
1993	0.056	0.183	0.007	0	0	0.850	0.844	1.416	1.733	1.733
1994	0.399	0.024	0.079	0.002	0	1.019	1.011	1.697	2.077	2.077
1995	5.815	0.144	0.009	0.014	0	1.346	1.335	2.240	2.742	2.742
1996	0.455	1.514	0.038	0.001	0.001	0.917	0.909	1.526	1.868	1.868
1997	9.260	0.182	0.610	0.008	0	1.270	1.260	2.114	2.588	2.588
1998	0.740	2.601	0.052	0.074	0.001	1.253	1.243	2.086	2.553	2.553
1999	2.919	0.211	0.751	0.006	0.006	1.208	1.199	2.012	2.463	2.463
2000	5.612	0.872	0.064	0.100	0.001	1.110	1.101	1.849	2.263	2.263
2001	1.234	1.849	0.290	0.010	0.010	1.238	1.228	2.061	2.523	2.523
2002	6.885	0.358	0.541	0.037	0.001	0.819	0.813	1.364	1.670	1.670
2003	2.141	3.035	0.159	0.138	0.007	1.008	1.000	1.678	2.054	2.054
2004	6.912	0.781	1.117	0.030	0.018	1.128	1.119	1.878	2.299	2.299
2005	10.369	2.237	0.255	0.171	0.003	1.108	1.099	1.844	2.257	2.257
2006	6.795	3.425	0.746	0.040	0.018	0.946	0.939	1.575	1.928	1.928
2007	9.745	2.638	1.340	0.154	0.006	0.986	0.978	1.642	2.010	2.010
2008	3.354	3.635	0.992	0.259	0.021	1.223	1.214	2.037	2.493	2.493
2009	2.847	0.987	1.080	0.129	0.021	1.285	1.275	2.140	2.619	2.619
2010	6.209	0.788	0.276	0.127	0.009	1.165	1.156	1.940	2.374	2.374

Stock summary						
Year	Recruits (age 1)	log SE (rec)	SSB	TSB	Z(2-3)	SE (Z)
1992	0.357	0.360	0.006	0.040	0.886	0.379
1993	0.056	0.294	0.085	0.090	1.130	0.273
1994	0.399	0.265	0.088	0.122	1.354	0.213
1995	5.815	0.285	0.083	0.577	1.788	0.185
1996	0.455	0.246	0.586	0.624	1.218	0.209
1997	9.260	0.261	0.610	1.258	1.687	0.178
1998	0.740	0.259	0.811	0.855	1.664	0.174
1999	2.918	0.257	0.494	0.661	1.606	0.173
2000	5.612	0.250	0.333	0.602	1.475	0.176
2001	1.234	0.266	0.563	0.626	1.645	0.175
2002	6.885	0.237	0.373	0.759	1.088	0.180
2003	2.140	0.247	0.905	1.012	1.339	0.180
2004	6.912	0.253	0.778	1.061	1.499	0.176
2005	10.369	0.253	0.650	0.981	1.471	0.174
2006	6.795	0.244	0.788	1.026	1.257	0.178
2007	9.745	0.253	0.897	1.229	1.310	0.180
2008	3.354	0.281	0.995	1.133	1.625	0.177
2009	2.847	0.321	0.621	0.746	1.707	0.180
2010	6.209	0.397	0.339	0.581	1.548	0.110

Table 6.3.10. Haddock VIIa: Estimates of biomass and fishing mortality reference levels derived from the fit of three stock and recruit relationships and the yield-per-recruit F_{msy} proxies.

Stock name
Had-7a
Sen filename
had-7a.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
767/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	1.45	0.46	4629	2523	1.15	0.30	4.04	0.00022	34.25
Mean	1.36	0.55	7784	4833	1.70	0.44	8.15	0.00033	
5%ile	0.44	0.21	1594	1414	0.74	0.07	2.29	5.00E-05	
25%ile	0.72	0.33	2507	2195	1.07	0.24	3.65	0.00018	
50%ile	1.07	0.47	3441	2778	1.42	0.42	5.49	0.00031	
75%ile	1.68	0.65	5575	3732	2.02	0.60	8.96	0.00044	
95%ile	3.36	1.22	17254	8047	3.43	0.93	21.81	0.0007	
CV	0.67	0.62	4.86	5.25	0.61	0.61	1.13	0.61	

Beverton-Holt
813/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	2.80	0.29	7030	2580	0.44	0.80	7964	1111	34.12
Mean	1.15	0.20	58936	9346	0.45	1.31	41130	22121	
5%ile	0.31	0.07	2363	848	0.05	0.63	3484	153	
25%ile	0.51	0.14	4913	1657	0.22	0.89	5903	1014	
50%ile	0.82	0.19	9186	2574	0.38	1.12	9186	2705	
75%ile	1.46	0.25	19246	4389	0.59	1.45	16093	6579	
95%ile	3.15	0.36	129006	17393	1.00	2.31	70557	40158	
CV	0.82	0.43	7.6	8.4	1.27	0.80	11.25	13.45	

Smooth hockeystick
918/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.87	0.41	5359	2661	0.49	0.92	1.27	2727	34.55
Mean	0.90	0.38	10384	3359	0.60	0.99	1.56	2941	
5%ile	0.33	0.14	2439	1534	0.30	0.49	0.78	1439	
25%ile	0.50	0.28	3943	2304	0.43	0.66	1.13	1960	
50%ile	0.69	0.37	5546	3010	0.56	0.95	1.45	2797	
75%ile	1.04	0.47	8645	4073	0.71	1.30	1.85	3830	
95%ile	2.05	0.66	22638	6218	1.06	1.64	2.76	4840	
CV	0.77	0.42	2.44	0.48	0.41	0.38	0.41	0.38	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.24	0.20	0.20	0.41	0.77	0.38	0	0
Mean	0.20	0.17	0.18	0.39	1.20	0.39		
5%ile	0.05	0.04	0.05	0.15	0.39	0.28		
25%ile	0.15	0.12	0.14	0.29	0.55	0.34		
50%ile	0.20	0.17	0.19	0.38	0.71	0.38		
75%ile	0.26	0.22	0.23	0.48	0.97	0.44		
95%ile	0.34	0.29	0.29	0.67	2.20	0.55		
CV	0.44	0.43	0.39	0.43	2.06	0.22		

Table 6.3.11. Haddock in VIIa: Input for yield/Recruit.

MFYPR version 2a
Run: Had7a_2004WG_yield
Had7a_2004WG_yieldMFYPR Index file 11/05/2004
Time and date: 10:55 13/05/2004
Fbar age range: 2-4

Age	M	Mat	PF	PM	SWt	Sel	CWt
0	0.2	0	0	0	0.000	0.000	0.000
1	0.2	0	0	0	0.061	0.140	0.322
2	0.2	1	0	0	0.302	0.544	0.492
3	0.2	1	0	0	0.754	1.118	0.967
4	0.2	1	0	0	1.377	1.057	1.814
5	0.2	1	0	0	2.259	1.057	2.308

Weights in kilograms

Table 6.3.12. Haddock in VIIa: Yield-per-recruit output table.

MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	5.8695	3.6979	5.8200	3.6979	5.8200
0.1000	0.0906	0.2211	0.3492	4.4167	3.5229	2.5980	3.4733	2.5980	3.4733
0.2000	0.1813	0.3298	0.4658	3.8781	2.4296	2.0593	2.3801	2.0593	2.3801
0.3000	0.2719	0.3951	0.5037	3.5564	1.8139	1.7377	1.7644	1.7377	1.7644
0.4000	0.3626	0.4390	0.5098	3.3412	1.4279	1.5225	1.3783	1.5225	1.3783
0.5000	0.4532	0.4709	0.5022	3.1861	1.1681	1.3674	1.1186	1.3674	1.1186
0.6000	0.5439	0.4952	0.4888	3.0683	0.9843	1.2496	0.9347	1.2496	0.9347
0.7000	0.6345	0.5146	0.4735	2.9752	0.8490	1.1564	0.7995	1.1564	0.7995
0.8000	0.7252	0.5305	0.4580	2.8993	0.7464	1.0805	0.6969	1.0805	0.6969
0.9000	0.8158	0.5438	0.4431	2.8358	0.6666	1.0171	0.6170	1.0171	0.6170
1.0000	0.9065	0.5552	0.4293	2.7818	0.6030	0.9631	0.5535	0.9631	0.5535
1.1000	0.9971	0.5651	0.4167	2.7350	0.5515	0.9163	0.5019	0.9163	0.5019
1.2000	1.0878	0.5739	0.4052	2.6939	0.5090	0.8751	0.4594	0.8751	0.4594
1.3000	1.1784	0.5817	0.3947	2.6573	0.4733	0.8386	0.4238	0.8386	0.4238
1.4000	1.2691	0.5887	0.3853	2.6245	0.4431	0.8057	0.3936	0.8057	0.3936
1.5000	1.3597	0.5951	0.3768	2.5947	0.4172	0.7760	0.3676	0.7760	0.3676
1.6000	1.4503	0.6009	0.3692	2.5676	0.3946	0.7489	0.3451	0.7489	0.3451
1.7000	1.5410	0.6063	0.3622	2.5427	0.3749	0.7240	0.3253	0.7240	0.3253
1.8000	1.6316	0.6113	0.3559	2.5197	0.3574	0.7010	0.3079	0.7010	0.3079
1.9000	1.7223	0.6159	0.3501	2.4983	0.3418	0.6796	0.2923	0.6796	0.2923
2.0000	1.8129	0.6202	0.3449	2.4784	0.3278	0.6597	0.2783	0.6597	0.2783

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.188
F35%SPR	0.2494	0.2261

Weights in kilograms

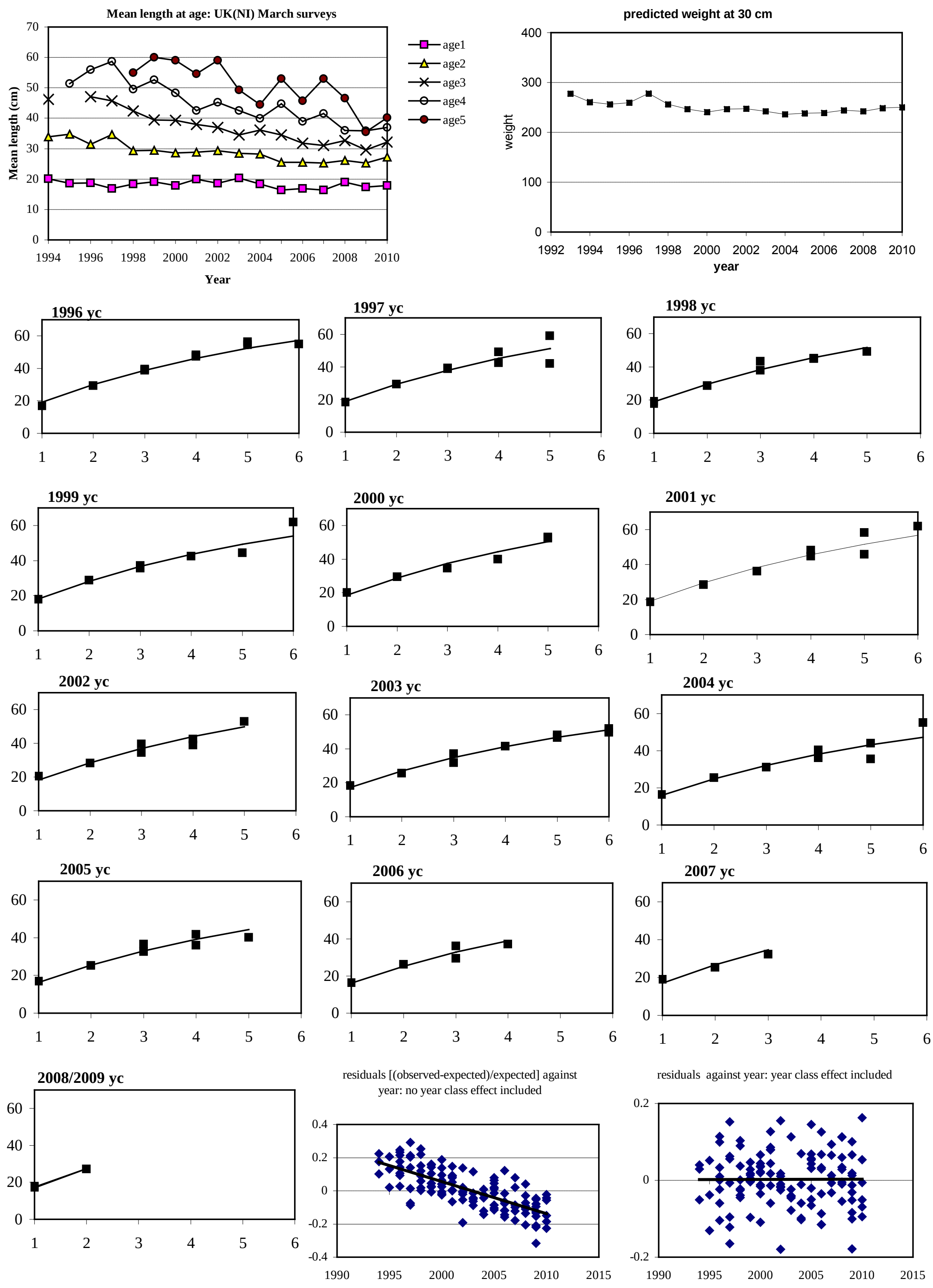


Figure 6.3.1. Haddock in VIIa: Growth of haddock in the Irish Sea. Top two panels: mean length-at-age in UK(NI) groundfish surveys in March, by year and age, and expected mean weight-at-length based on length–weight parameters from each survey. Lower panels: mean length-at-age from March surveys, and from Quarter 1 commercial landings at age 3 and over, by year class. Lines are Von Bertalanffy model fits with year-class effect included. Model residuals are shown for the fit without year-class effects, and for the fit with year-class effects.

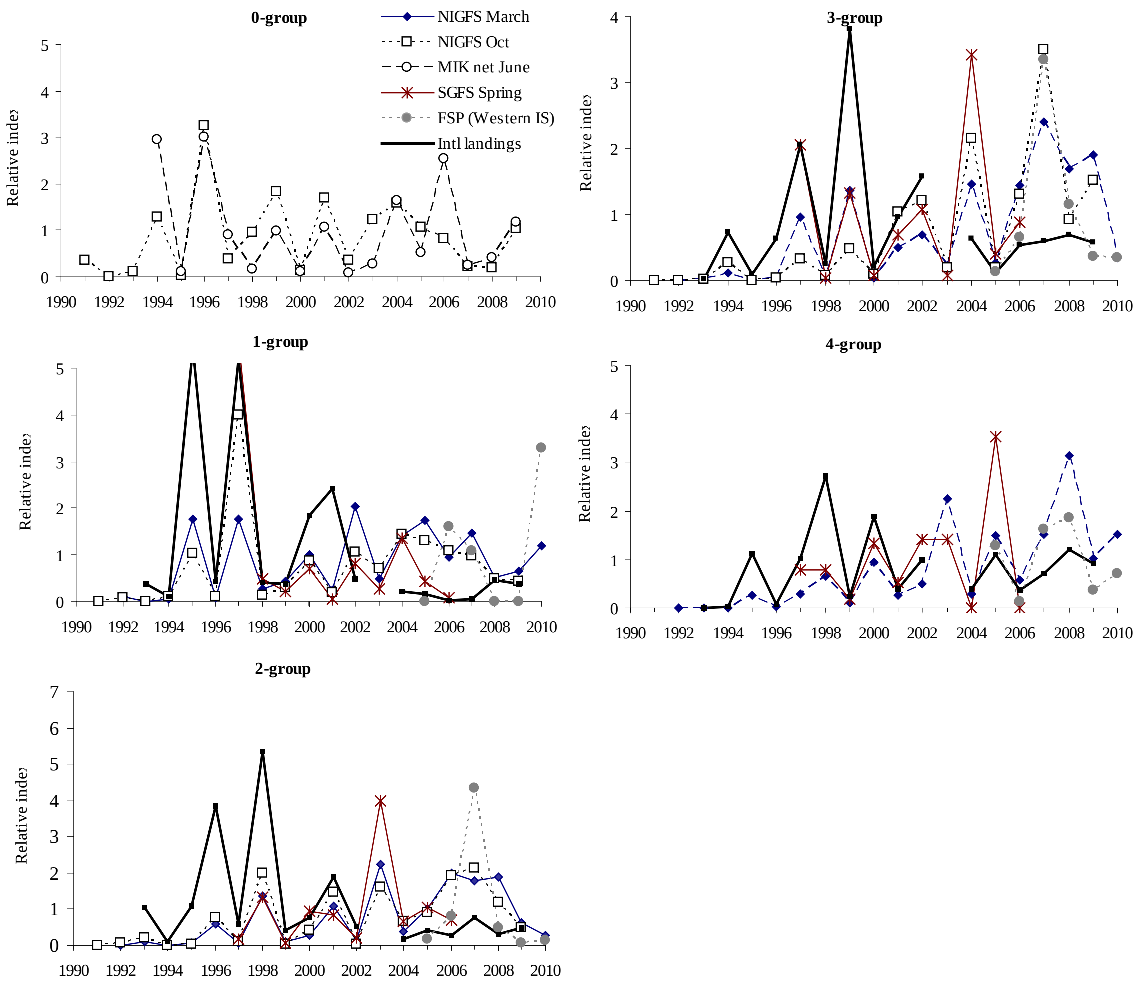


Figure 6.3.2. Haddock in VIIa: Trends in raw survey indices compared with international landings, by age class and year. All values are standardised to the mean for years common to all series in each plot (except for short FSP series).

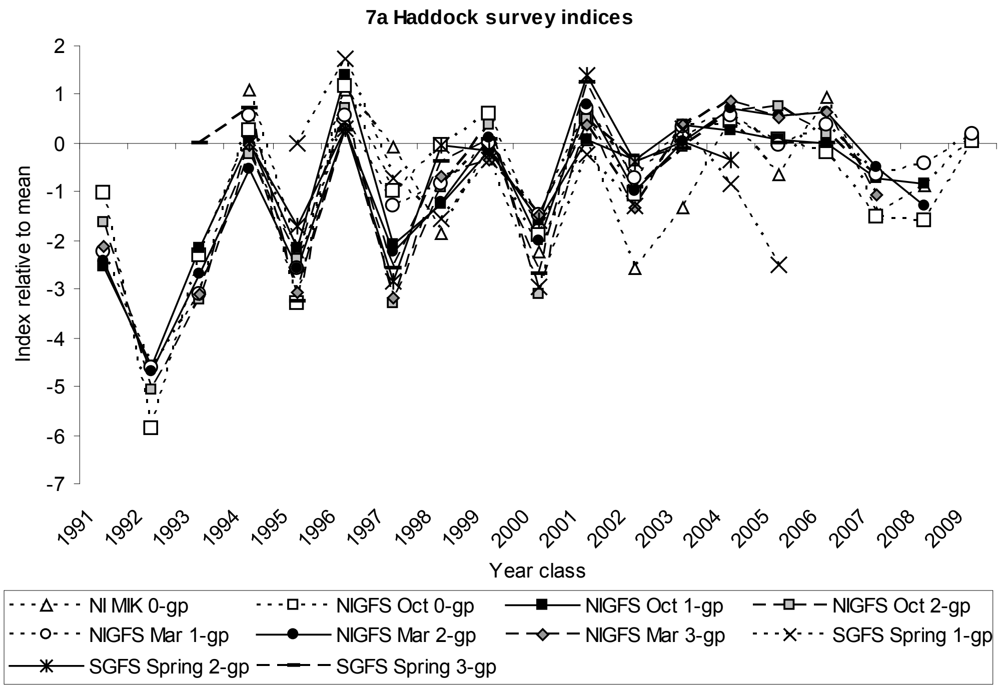


Figure 6.3.3. Haddock in VIIa: Time-series plots of the logarithms of survey indices at age by year class, after standardising by dividing by the series mean for years from 1991. Data have only been illustrated for the most abundant ages for comparison of year-class signals.

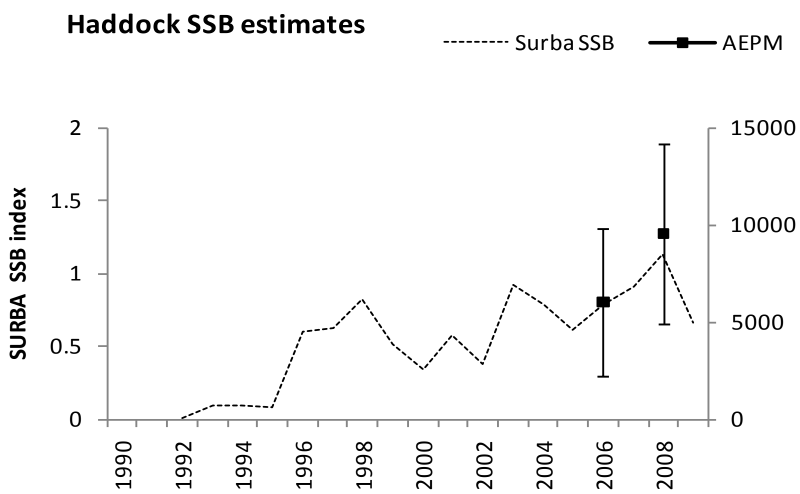


Figure 6.3.4. Haddock in VIIa: Comparison in the relative trends of SSB form 2009 SURBA run and the Irish Sea annual egg production method survey estimates of SSB (+ 2 SE) (Armstrong *et al.*, WD11).

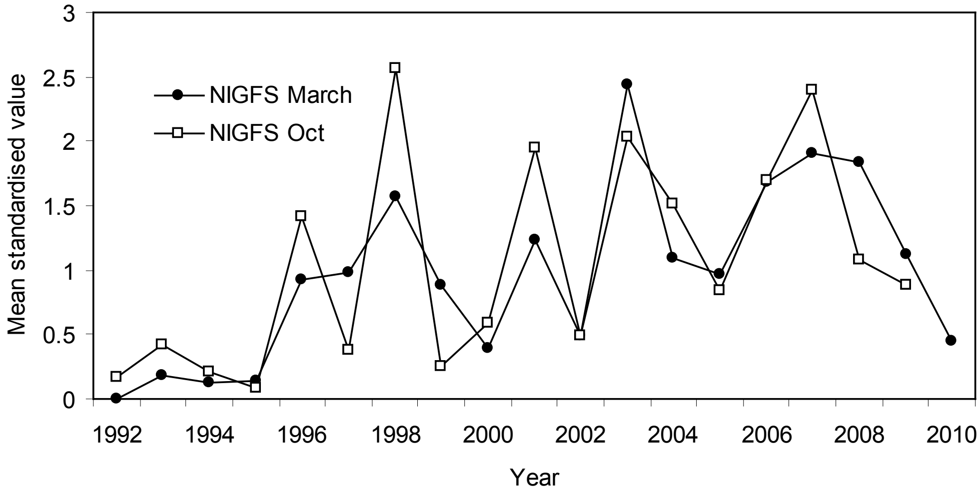


Figure 6.3.5. Haddock in VIIa: Mean Standardised empirical SSB indices from the NIGFS-Mar and NIGFS-Oct surveys, based on raw indices up to age 6.

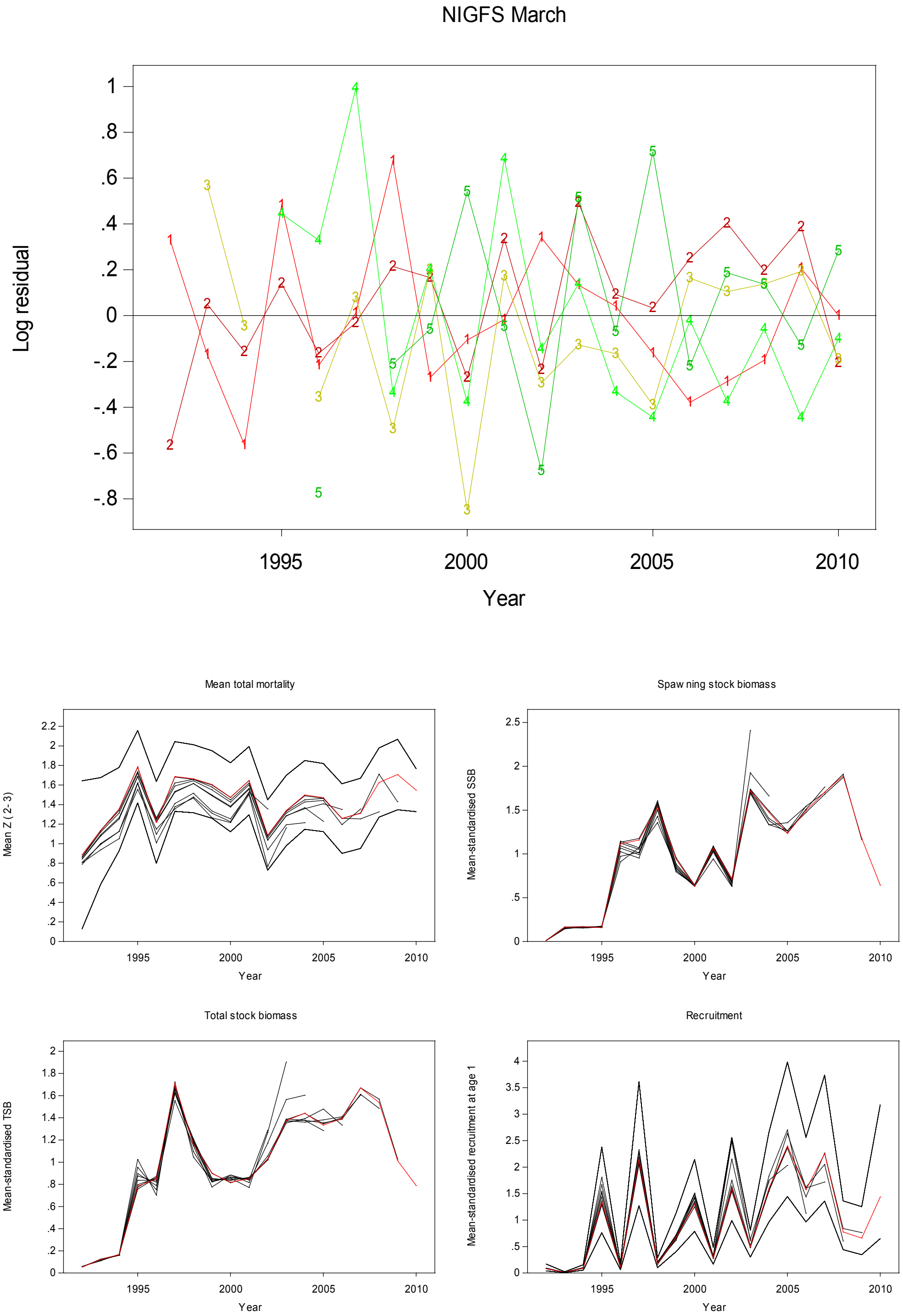


Figure 6.3.6. Haddock VIIa: SURBA 3.0 Residuals at age (top panel) and retrospective plots (bottom panel) for the NIGFS-Mar survey.

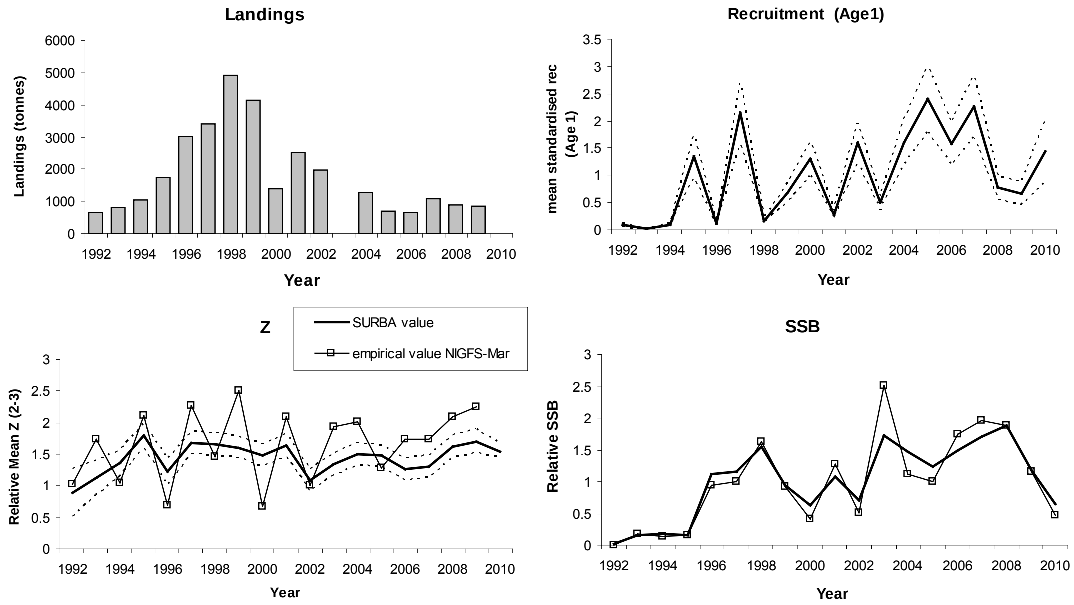


Figure 6.3.7. Haddock VIIa: Summary plots of landings and results of final SURBA 3.0 run using the NIGFS-Mar survey data. Dotted lines are +/- 1SE. Empirical estimates of SSB and Z given by SURBA from the raw survey data are also shown.

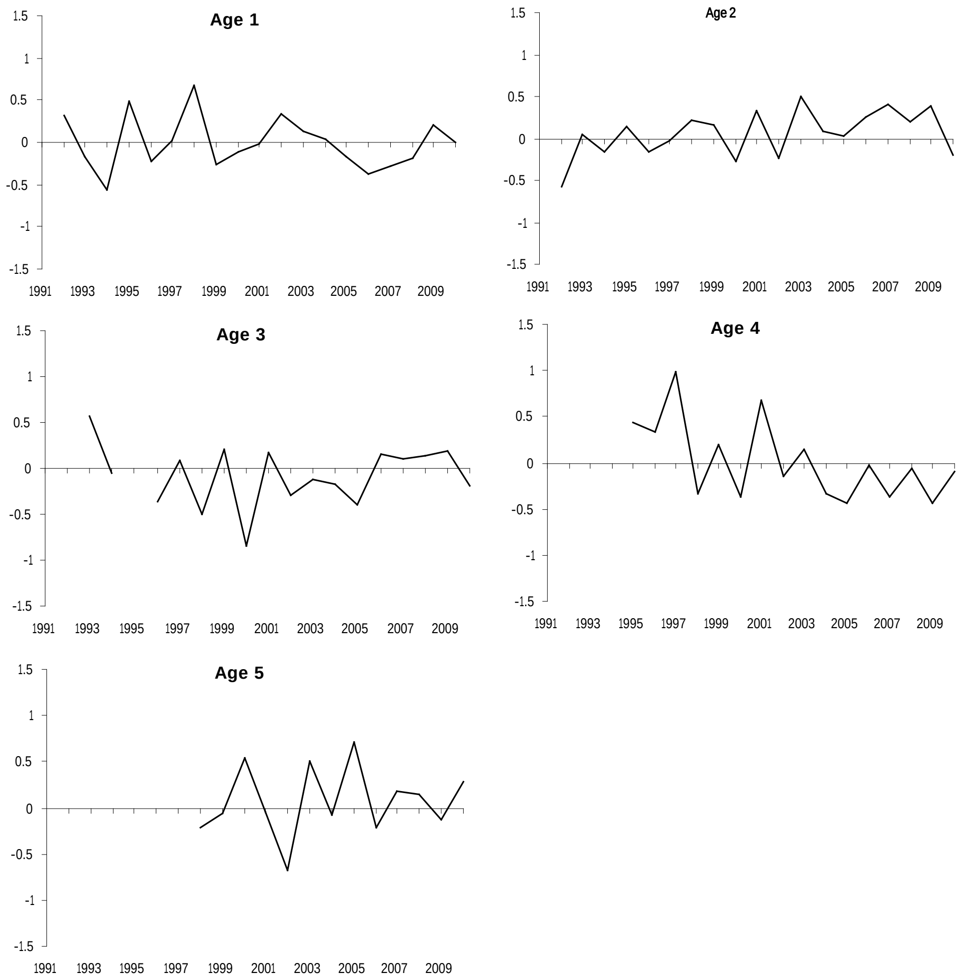


Figure 6.3.8. Haddock VIIa: SURBA 3.0 Residuals-at-age for final run using the NIGFS-Mar survey data.

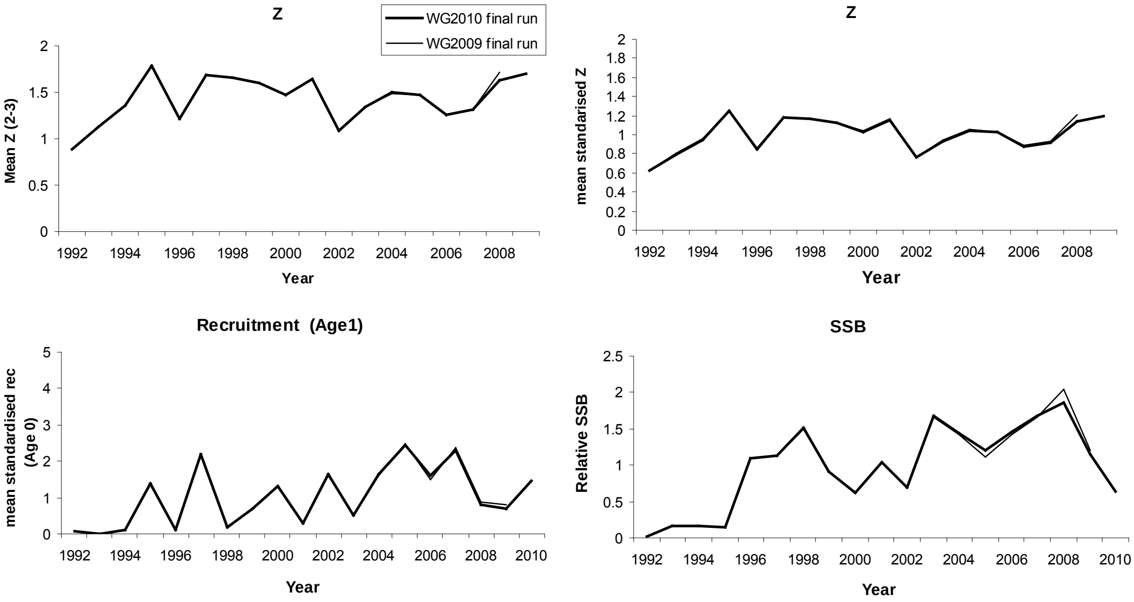


Figure 6.3.9. Haddock VIIa: Trends in SSB, recruitment and Z(2–3) from the 2009 and 2010 SURBA. SSB and recruitment are standardised to the mean for years common to all series (1992–2009) in each plot.

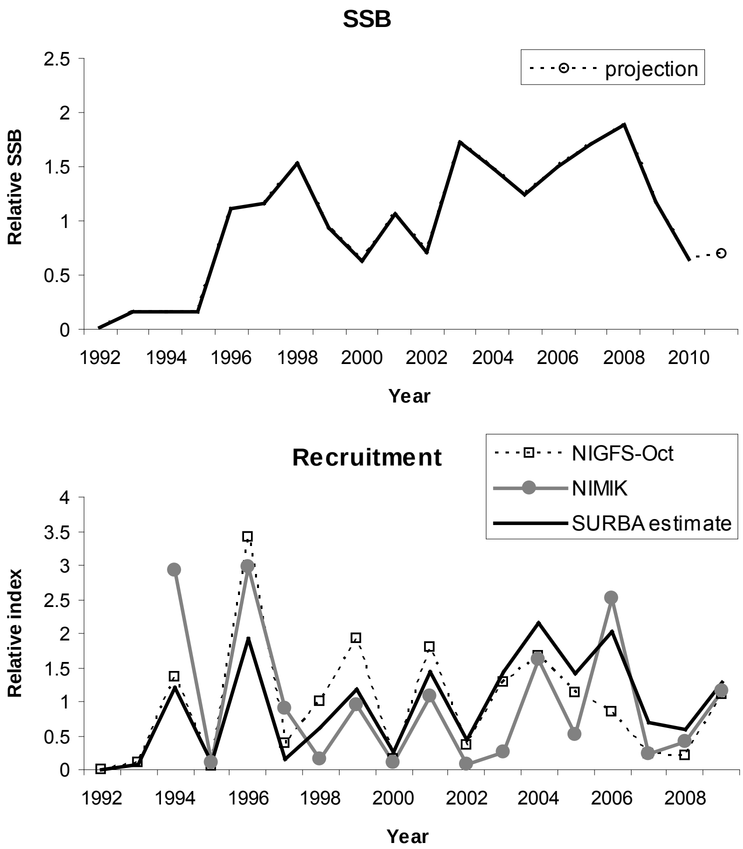


Figure 6.3.10. Haddock VIIa: Trend in SSB form 2010 SURBA projected to 2011 (top panel) and SURBA estimate of recruitment compared to available 0-gp indices. SSB and recruitment are standardised to the mean for years common to all series (1994–2009) in each plot.

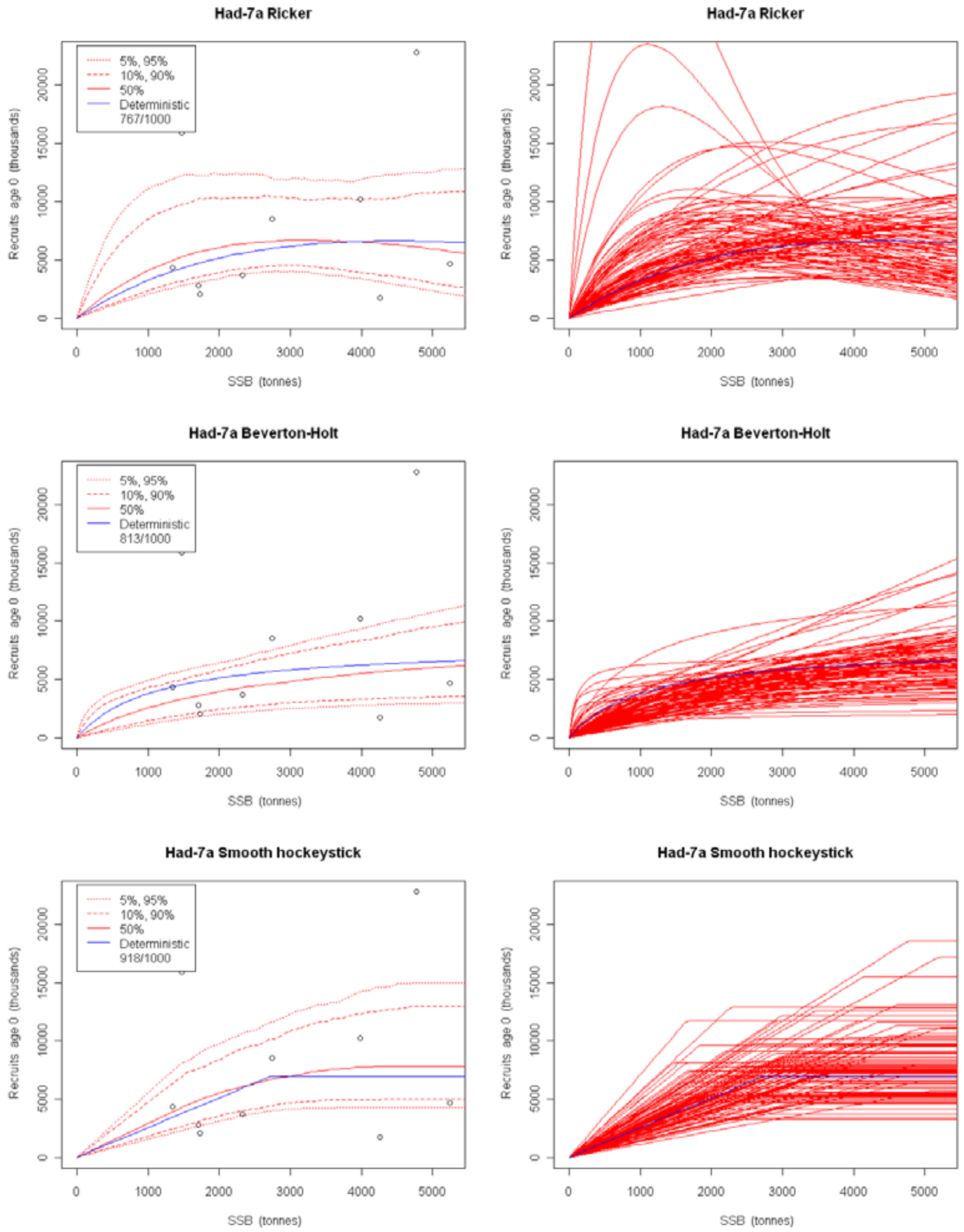


Figure 6.3.11. Haddock VIIa: MSY fitted stock and recruitment relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{msy}. Right hand panels: curves plotted from the first 100 MCMC re-samples with converged F_{msy} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

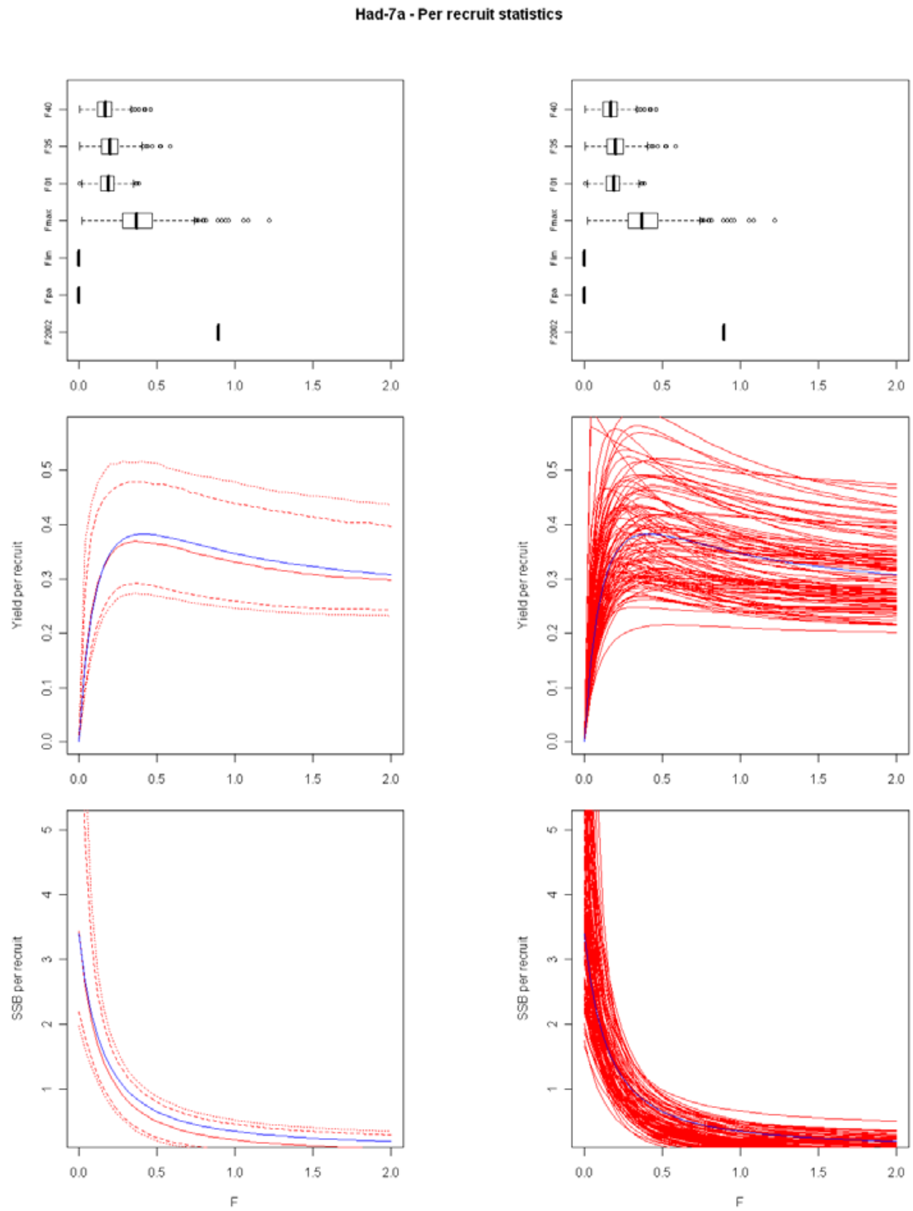
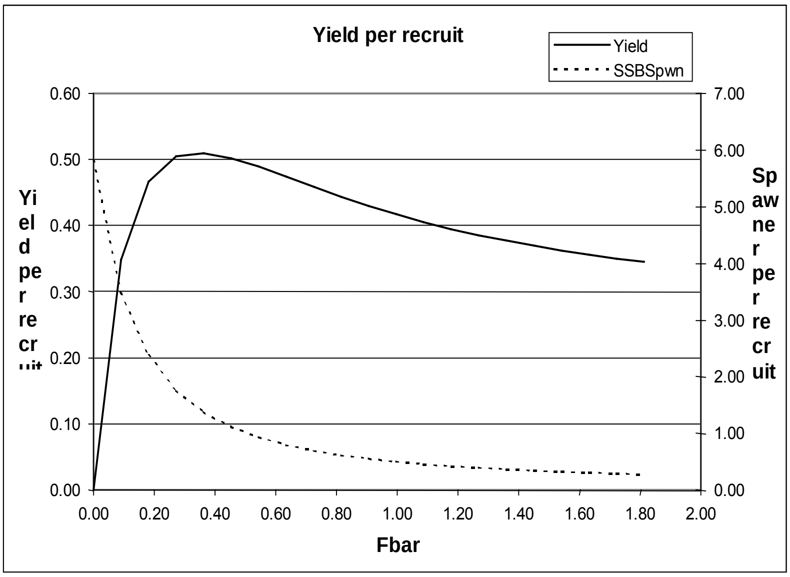


Figure 6.3.12. Haddock VIIa: Fitted yield-per-recruit F reference points, yield-per-recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.



MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.1880
F35%SPR	0.2494	0.2261

Weights in kilograms

Figure 6.3.13. Haddock VIIa: Yield-per-recruit based on analysis carried out in 2004.

6.4 *Nephrops* in Division VIIa (Irish Sea East, FU14)

Type of assessment in 2010

The assessment determines the health of the stock by looking at trends in total landings, lpue, size composition, and biological data from the commercial fisheries. For the first time for this stock the results from UWTV survey data are used to calculate absolute abundance estimates for 2009 and catch options following the process benchmarked at WK*NEPH* (2009).

ICES advice applicable to 2009

This stock was reassessed in 2008 based on trends in the fishery and biological parameters. The advice for this fishery for 2009 and 2010 was that landings and effort should not increase above that recorded for 2007.

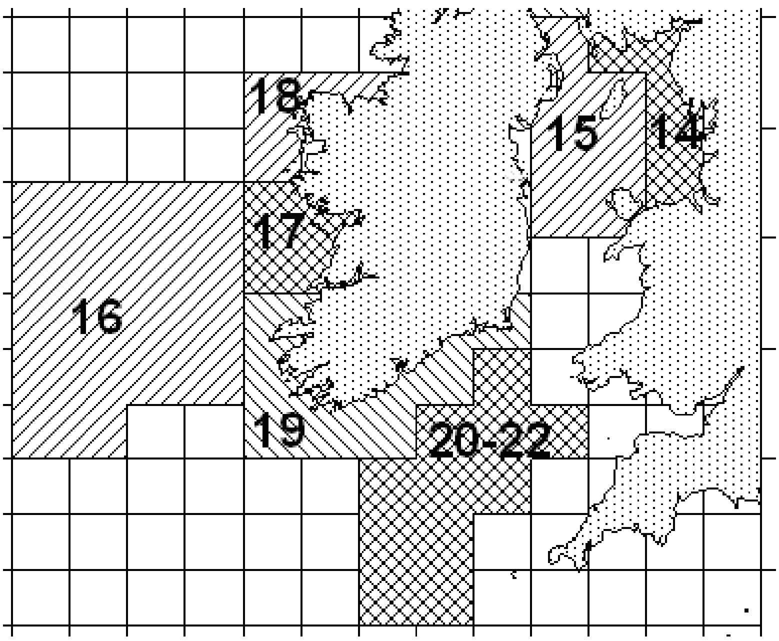
ICES advice applicable to 2010

The advice was biannual and still valid from the 2008 assessment which implied that effort should not increase compared to 2007 levels.

6.4.1 General

Stock description and management units

The Irish Sea East *Nephrops* stock (FU14) is in ICES Subarea VII which includes the Irish Sea West (FU15) stock; the Porcupine Bank (FU16); Aran Grounds (FU17); North-West Irish Coast (FU18), South-East and South-West Irish Coast (FU19); and the Celtic Sea stock (FU20–22). The TAC is set for the whole of Subarea VII which does not correspond to the areas occupied by these stocks.



Functional units in VIIa

Management applicable in 2009 and 2010

The TAC is currently set for the larger TAC Area VII. The TAC for 2010 is currently set at 22 432 t, a 9% reduction on the 2009 TAC of 24 650 t and 11% reduction on 2007/2008 TAC of 25 153. The TAC area includes a number of *Nephrops* stocks showing different levels of exploitation. A single TAC covering a number of distinct stocks allows the possibility of unrestricted catches being taken from a heavily exploited stock when advice suggests they should be limited.

In 2009 the main fleets targeting *Nephrops* include directed single-rig and twin-rig otter trawlers operating out of ports in UK (NI), UK (E&W) and Ireland. Details of all regulations including effort controls in place are provided in the Stock Annex.

The fishery in 2009

Between 1999 and 2003 the number of vessels fishing for *Nephrops* in FU14 declined by 40% to a fleet of around 50 vessels. This was largely due to the reduction in the number of visiting UK vessels and the decommissioning of part of the Northern Ireland and local English fleets. Since then, the number of vessels fishing the area has returned to and settled at around 80 vessels over the last three years, mainly from Northern Ireland. Currently, just under 30 of these vessels, between 9 and 21 m in length, have their 'home' ports in Whitehaven, Maryport and Fleetwood, England. The rest of the fleet is generally made up of larger vessels from Northern Ireland.

In 2009 about 70% of the landings from this fishery were made to Whitehaven and about 20% to Kilkeel. Over half of the Northern Ireland and a few of the English vessels use twin or triple trawls and account for around 30% of the *Nephrops* landings in weight from this FU. Between 1999 and 2009, the recorded number of vessels using these multiple trawls has fluctuated without trend between 15 and 29 vessels, with around 90% of these vessels coming from Northern Ireland. The earlier decline in the fleet was mainly in the number of single trawlers.

Of the Northern Ireland fleet the proportion returning at the end of a *Nephrops* trip in FU14, to land in to Northern Ireland, increased from only 6% in 1999 to around 30% from 2005 onward.

There has been little apparent change in the make-up of the English and Welsh fleet over the last three of years. However the current state of other stocks, technical conservation and cod recovery measures has had an effect on mesh sizes and fishing patterns. The number of recorded trips has increased yet effort has effectively declined. The average days per trip has declined to a value in 2009 where over 60% of the trips reported were one day trips. Traditionally a summer fishery, anecdotal data and records of monthly landings indicate the season is starting earlier and ending earlier.

In 2009 the most productive period in this fishery was June to July due in part to poor catches of prawns in the previous period but often due to the weather. The local enforcement agency at Whitehaven recorded that fishing over this period was better than had been experienced for some time with good landings of good sized prawns. The larger Northern Ireland vessels continued to make larger landings and fish predominately further offshore while the local fleet tended to fish closer inshore. Both weather and landings were poor for most of August and poor catches persisted. By September some of the UK fleet had already moved to other fisheries; including the North Sea. The number of UK vessels moving from this summer fishery to the Farn Deeps fishery in winter dropped from 30 in 2007 to only 9 in 2008 but increased again in 2009 to 17.

6.4.2 Data available

An overview of the data provided and used by the WG is provided in Table 2.1.

Landings

Official landings as reported to ICES from FU14 are presented in Table 6.4.1 and were updated for 2009. Between 1987 and 2006 landings from FU14 appeared relatively stable, fluctuating around a long-term average of about 550 t (Table 6.4.2 and Figure 6.4.1). Landings in 2007 were at their highest level since 1978 at 959 t, this is after landings dropped in 2003 to their lowest apparent level since 1974. The landings figure declined to 676 t in 2008 and rose slightly to 694 t in 2009. These landings are still higher than any others recorded since 1991; however this could be due to change in the process for recording landings. The introduction of the buyers and sellers legislation in 2006 by the UK precludes direct comparison with previous years as reported levels are considered to have significantly improved.

Over the last 10 years UK vessels have landed, on average, 87% of the reported annual international landings. Irish vessels increased their share of the landings to 35% in 2002 but it has since declined to 2% in 2009 (Table 6.4.2).

Length composition

Quarterly length compositions of landings, catch and discards were available from the UK England and Wales for most of the period 1992–2009. The numbers of samples taken are presented in Table 2.1. The raising and collation procedures are documented in the Stock Annex B1. Landings sampling deteriorated in 2005, it improved in 2007 and have remained at a consistently high level since. Figure 6.4.4 shows the annual catch and landings length distributions. Discard rates have been estimated from the same figures and have declined in the last six years from 24% to 4% of total catch by weight and 43% and 8% by number. Females generally have a higher discard rate because they are generally smaller. The sharp decline in the discard rate from 2008 to 2009 particularly for males might suggest a change in discard practice but the shift to the right for the catch distribution in 2009 and the minimum observed size might suggest a decline in recruitment. This could be partly a sampling artefact as only 10 observer trips were carried out in 2009, around a third of the number carried out in 2008. These observer trips have been the only source for catch and discard data in recent years. The landings were still well sampled so these concerns are only limited to defining the discarded component of the catch in 2009. A summary of mean size information is provided in Table 6.4.5. In 2009 the local enforcement agency remarked on improved catches of good sized prawns and better fishing than had been seen for some time, which would support the observed shift to larger prawns in the catch and a small increase in mean landing size of the males.

Commercial cpue

A 10% TAC increase in 2006 followed by a 17% increase in 2007 coupled with the implementation in the UK of buyers and sellers regulations effective from and throughout 2006, has improved the accuracy of reported landings information. This appears to have reduced the reasons to misreport, despite the decline in TAC 2009 for Area VII, and the legislation provides the quality control. Landings have not exceeded the advised TAC for this Functional Unit.

The introduction of the buyers and sellers legislation for 2006 complicates the interpretation of any prior trends. In 2009, most of the landings were made into England with a high proportion of these landings (60% of the directed landings) being made by visiting Northern Irish vessels. UK *Nephrops* directed effort fluctuated around a downward trend since 1978 reaching a minimum in 2004. Since then effort has remained relatively stable fluctuating without trend around a mean of 13 400 hrs. The effort for this fleet in 2009 was recorded at its lowest in the series at 12 000 hrs. Quarterly effort plots show a predominance of effort in the 2nd and 3rd quarters (Figure 6.4.2).

In light of the limited indices available for this stock, trends in recent lpue are still reviewed as some of the best available information despite reservations about the accuracy of the historical landings. The UK lpue series is based on a combination of directed *Nephrops* voyages by English and Welsh vessels landing to Fleetwood and Whitehaven, where the weight of *Nephrops* landed is more than 25% of the total landing and all trips by visiting Northern Irish vessels which target *Nephrops* (Table 6.4.4). Analysis of the lpue trends for this reference fleet shows that between 1989 and 2004 there is little correspondence between the E&W and NI figures. Uncertainties about the recorded landings during this period could account for some of the differences as they fall back into step after 2004. Further data and analysis is required to determine whether this series continues to be appropriate. Between 1990 and 2003 the combined lpue has fluctuated between 17 and 26 kg/hour trawling. Since then lpue has risen year on year to 40 kg/hour trawling in 2007, the highest level in the series (Figure 6.4.1). Since then the annual lpue has effectively stayed at this level. In 2009 the annual lpue was at 39 kg/hour. The fluctuations over the last three years reflect the influence of the NI fleet on the series as the lpue of the E&W fleet has continued to rise. The lpue of the Northern Irish fleet is driving this trend and since 2004 has been at a level comparable to the Republic of Ireland fleet. This could reflect a change in reporting and/or a change in targeted effort rather than any biological phenomena.

Male *Nephrops* predominate landings and the annual proportion of females appears highly dependent on the fishing effort in the third quarter (Figure 6.4.2). Lpues for males and females <35 mm CL (Figure 6.4.3) appear to exhibit the same general trends. Minima in 2003 were followed by upward trends to the highest values in both series in 2007. They have both since declined but still remain above any other values in the series. The lpue of the larger males (>35 mm) has been increasing since 2002. Whether this is an artefact of the recording practice is unclear but since the improvement in 2006 it has continued to rise. The quarterly pattern of availability to the fishery of females >35 mm, means that meaningful statistics for this portion of the population are highly dependent upon the level of fishing and the sampling effort deployed in the 3rd quarter.

The increasing lpue of the <35 mm CL categories up to 2007 and decline in mean size of the landings (Figure 6.4.3 and Figure 6.4.1) and the increase in the range of sizes in the catch (Figure 6.4.4) could be indicative of good recruitment. This was supported by the local enforcement agency who at the time noted an increase in the proportion of tails landed. The trends since have been reversed suggesting a decline in recruitment.

Surveys

In August 2007, 2008 and 2009 the UK and the Republic of Ireland carried out a joint underwater TV survey of the *Nephrops* grounds in the Eastern Irish Sea. The survey was of a fixed grid design and was carried out using the same protocols used in UWTV surveys in the Western Irish Sea. This survey and stock was not reviewed at WK*NEPH* 2009 but the protocols and standardised process has been adopted see Stock Annex.

In 2007 poor visibility hampered the survey and despite repeated attempts at over 15 stations, turbidity scores precluded the use of some of the counts. On first analysis only 20 stations were initially considered usable, a recent review of this data suggest that the original analysis was over optimistic. The 2008 and 2009 surveys were both far more successful. A new camera and sledge improved the resolution of the footage captured. Sea conditions were far better so the quality of the video data collected was much improved (35 and 32 stations respectively were considered usable).

6.4.3 Data analyses

Exploratory analyses of survey data

Table 6.4.6 provides the estimates for the burrow density and abundance for each survey. Figure 6.4.5 shows the range of densities experienced across the ground with the higher densities occurring in the centre of the survey area and diminishing towards the perimeter. In 2009 a significant numbers of burrow systems were still apparent at the southern edge of the survey grid which suggests that the survey area may need extending further south in 2010 to better delineate the ground. Figure 6.4.6 shows the frequency and range of different densities occurring over the ground on each survey and compares the overall estimate with those from other survey areas. The mean burrow density falls at the lower end of the range of densities seen on the other grounds assessed at this working group.

The limited number of stations available on the 2007 survey and the poor quality of the data processed preclude its use in this assessment. Despite there still being some uncertainties about the spatial limits of the stock and the characteristics of the ground in this fishery the estimates still provide a good measure of abundance. In light of SGSURV and WK*NEPH* (2009) the data will still require further analysis and a further survey to qualify the precision of these estimates. These results therefore are presented as provisional.

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WK*NEPH* (2009). A number of potential biases were highlighted including those due to edge effects; species burrow mis-identification and burrow occupancy. Using the same process adopted at WK*NEPH*, a cumulative bias correction factor for this FU was predicted to be 1.2 for FU14 (see Annex) which means the TV survey is likely to overestimate *Nephrops* abundance by 20%.

6.4.4 MSY considerations

As discussed in Section 2.2 no dynamic population model is fitted to the data so no estimates of spawning stock and recruitment were available to determine F_{MSY}. In response to the recommendations of WKFRAME (2010), the Bell/Dobby combined sex–length cohort analysis (LCA) model (WK*NEPH*, 2009) was adapted to determine Harvest Rates associated with fishing at $F_{35\%SPR}$ as well as $F_{0.1}$ and F_{max} (WGNSSK, 2010). These F estimates could be used as a proxy for F_{MSY}. Catch–length data were available for 2006, 2007, 2008 and 2009. The apparent change to the catch–length distribution for males in 2009 and the concerns about the estimate for the discarded component precluded using this data in the model. The scale and effect of any under-recording of landings pre 2006 was not known. The reference period 2006 to 2008 was selected as reflecting a recent period of relative stability for this stock despite the record landings in 2007. Figure 6.4.7 shows the estimated selection pattern and residuals and YPR curves, from the model. Figure 6.4.8 shows the spawner-per-recruit plot from the same model.

The results of the model in the text table below show the F multipliers required to achieve the potential F_{MSY} proxies; the harvest rates that correspond to those multiplers and the resulting level of spawner-per-recruit as a percentage of the virgin level.

		Fbar 20–40 mm		Harvest Rates	SPR	
		Female	Male		Female	Male
$F_{0.1}$	Combined	0.10	0.14	9.8%	44.6%	42.6%
	Female	0.11	0.15	10.2%	43.5%	41.4%
	Male	0.10	0.14	9.6%	45.3%	43.3%
$F_{35\%SPR}$	Combined	0.14	0.20	13.0%	35.9%	33.4%
	Female	0.15	0.21	13.5%	34.7%	32.2%
	Male	0.14	0.19	12.5%	37.1%	34.6%
F_{max}	Combined	0.20	0.28	16.4%	28.9%	26.2%
	Female	0.21	0.30	17.4%	27.3%	24.5%
	Male	0.19	0.26	15.8%	30.0%	27.2%

Following the check list presented in Section 2.2:

- Compared to other *Nephrops* fisheries in ICES Area VII the absolute population density of this stock is relatively low (Figure 6.4.6).
- Despite the area covered by this fishery being relatively small, the frequency distribution of the densities recorded on the two consecutive surveys 2008 and 2009 and the differences in their spatial distribution (Figure 6.4.5) suggest a degree of variation between years.
- The perception in the Irish Sea is that the growth rates in the east are similar to those in the west but the mean sizes (mm CL) in each fishery are markedly different, Eastern Irish Sea *Nephrops* being the larger.
- This fishery is highly seasonal, in effect a spring to early summer fishery, where the landings are predominantly male. Landings are around 60% male by weight and have ranged from 55 to 75% over the last 10 years.
- The annual variability of lpue for the smaller component of the catch would suggest that recruitment to this fishery, though apparently high in 2007, is quite variable. The change in discard rate and increase in the mean size of the under 35 mm component of the catch over the last two years could reflect a decline in recruitment as it does coincide with a slight decline in lpue for the same component. The rate of change in the discard rate and size could be exaggerated by poorer discard sampling in 2009, but the lpue series is more robust as the landings data are collected independently of the catch data and perceived to be well sampled.

If this decline in recruitment is real it is unclear if current levels are higher or lower than those experienced historically. Lpue overall is still high and kept high by the increasing lpue on larger males.

The two harvest ratios are 9.8% and 15.0% in 2008 and 2009 respectively

Stock density appears relatively low (Figure 6.4.6) in a highly seasonal male dominant fishery so sperm limitation could be a concern if this fishery is overexploited. To limit the potential of overfishing the males to meet a female MSY only the combined sex F_{MSY} and male proxies are considered appropriate. Guidelines suggest a combined sex F_{MSY} proxy as appropriate as long as the the virgin spawner recruit for males for that proxy does not fall below 20% (Section 2.2). At all levels of F the spawner-per-recruit is well above 20% for males.

The relatively stable trends in the mean size and the increasing lpue of the larger length group for males; the relative stability in the sex ratio and long-term decline in apparent effort suggests the current levels of effort have been sustainable. In this instance, therefore, the default proxy of $F_{35\%Spr}$ is considered appropriate as it will still deliver long-term yield with a low probability of recruitment overfishing.

The relatively low densities for the two years of the UWTV survey cannot be assumed to be indicative of the population potential. The time-series for the TV surveys is too short to base a $B_{trigger}$ on one of the estimated abundances.

No $B_{trigger}$ is available and a proxy for F_{MSY} as $F_{35\%SPR\ combined\ sex}$ is advised.

6.4.5 Short-term projections

A landings príiction for 2011 was made for FU14 using the approach agreed at the Benchmark Workshop (WK*NEPH*, 2009). The table below shows landings predicted at a range of harvest ratios including those equivalent to fishing at F_{MSY} proxies for the fishery as well as $F_{current}$, Only the Harvest Rates associated with the male and combined sex F_{MSY} proxies are identified in the table as they are considered more appropriate for this stock (see below). All F_{msy} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

			Implied fishery	
	Harvest Rate	Survey Index (Millions)	Retained number (Millions)	Landings (tonnes)
	0%	214.6	0	0.00
	2%	"	4	92.40
	4%	"	9	184.80
	6%	"	13	277.20
	8%	"	17	369.59
$F_{0.1Male}$	9.62%	"	21	444.58
$F_{0.1Comb}$	9.81%	"	21	453.38
	10%	"	21	461.99
	12%	"	26	554.39
$F_{35\%Male}$	12.50%	"	27	577.31
$F_{35\%Comb}$	13.00%	"	28	600.44
	14%	"	30	646.79
$F_{current}$	15.02%	"	32	694.00
$F_{maxMale}$	15.79%	"	34	729.62
	16%	"	34	739.19
$F_{maxComb}$	16.4%	"	35	756.35

		Basis
Landings Mean Weight (kg)	0.0289	Sampling 2006–2008
Survey Bias	1.2	As per WK*NEPH* 2009 (See Annex)
Survey Numbers (Millions)	257.5	UWTV Survey 2009
Proportion of removals retained by the fishery	0.79	Sampling 2006–2008

As *Nephrops* are advised on the basis of Harvest Rates and $F_{current}$ is above F_{MSY} a transition calculation will be required. Assuming linearity between Harvest Rate and F this will be:

$$HR_{2011} = \left((HR_{2009} \times 0.8) + (HR_{35\%\text{SPR combined sex}} \times 0.2)\right)$$

6.4.6 Biological reference points

Suggestions for proxies of biological reference points are shown in the catch option table.

6.4.7 Management plans

A number of cod recovery measures have been introduced since 2000 to conserve and promote recovery of Irish Sea cod stocks. These include a closure of the western Irish Sea cod spawning grounds from mid February to end of April since 2000, with a later extension to the eastern Irish Sea. Despite a partial derogation for *Nephrops* vessels during the closed period the distribution of effort on *Nephrops* has been affected by this management plan. There have also been various decommissioning schemes to reduce fishing effort. A 25% effort reduction on cod is in hand along with technical measures to reduce cod bycatch.

6.4.8 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the TV survey estimates (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to en-sure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007, WKNEPHBID 2008, SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WK*NEPH* 2009).

The cumulative bias estimates for FU14 are based on expert opinion. However these were based on experience on other *Nephrops* grounds and the limited survey experience on these grounds could make these less reliable in the long term. The precision of these estimates cannot yet be characterised. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

6.4.9 Quality of assessment

The length composition and sex ratio of catches have generally been well sampled over the last ten years by E &W. However the variability in the discard rate and selectivity within this fishery would suggest that sampling needs to be carried out at a higher level to improve on discard estimates. Discard sampling in 2009 was not as intense as in previous years which affected the confidence in the interpretation of the final inflection in the most recent trends in discard rates and catch information.

Confidence in the trends in lpue and landings has improved in the last four years.

Underwater TV surveys have been conducted annually for this stock since 2007. The quality of the data and the limited number of valid stations from the first survey limits the number of useable surveys to 2008 and 2009.

6.4.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could confer controls to ensure effort and catch were in line with the scale of the resource.

In view of uncertainties about historical catch statistics interpretation of trends in lpue prior to 2006 should be treated with caution. Recent catch, effort and historical trends in size still offer some reference to the status of the stock. The reliability of landings statistics has improved and effort appears to be relatively stable although evidence would suggest it has become more targeted. There are no explicit recruitment indices.

Good catch rates of all size ranges with no significant increases in effort and no marked changes in sex ratio suggests that this stock appears to be sustaining current levels of effort. . There appears to be a slight increase in average length for the males <35 mm category and a slight downturn in the lpue series from 2007 onwards which could indicate a slight decline in recruitment.

The new UWTV survey data allows for the provision of catch options and also to adopt the MSY approach. The UWTV surveys are conducted annually and a benchmarked process has been adopted. Over the last four years this stock has only been assessed biannually. These data provide the opportunity to reassess this stock more reliably on an annual basis.

Table 6.4.1. ICES Division Vlla, North of 53° N: Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 2000–2009.

Year	FU14	FU15	Other	Total
2000	567	8370	1	8938
2001	532	7441	3	7976
2002	577	6793	1	7371
2003	376	7052	3	7431
2004	472	7267	25	7764
2005	570	6554	103	7227
2006	628	7561	52	8241
2007	959	8491	83	9533
2008	676	10 508	122	11 306
2009*	694	9198	57	9949

*** provisional**

Table 6.4.2. Irish Sea East (FU14): Landings (tonnes) by country, 2000–2009.

Year	Rep. of Ireland	UK	Other countries **	Total
2000	114	451	2	567
2001	26	506	0	532
2002	203	373	1	577
2003	69	306	1	376
2004	62	409	1	472
2005	34	536	0	570
2006	34	594	0	628
2007	86	873	0	959
2008	29	646	0	676
2009*	16	678	0	694

*** provisional**

**** Other countries includes Belgium and Isle of Man**

Table 6.4.3. Irish Sea East (FU14): Effort ('000 hours trawling) and lpue (kg/hour trawling) of *Nephrops* directed voyages by UK trawlers, 2000–2009.

Year	Effort	LPUE
2000	17.9	21.2
2001	20.3	20.7
2002	14.7	20.1
2003	14.1	16.7
2004	12.1	27.5
2005	13.8	28.5
2006	13.1	29.6
2007	15.8	39.7
2008	13.8	35.3
2009*	12.0	38.8

*** provisional**

Table 6.4.4. Irish Sea East (FU14): Effort ('000 hours trawling) and lpue (kg/hour trawling) of *Nephrops* directed voyages by Republic of Ireland trawlers, 2000–2009.

Year	Effort	LPUE
2000	2.5	43.6
2001	0.5	43.9
2002	3.3	57.1
2003	1.1	37.6
2004	1.4	42.8
2005	0.8	40.6
2006	0.7	53.7
2007	1.7	49.3
2008	0.6	41.6
2009*	0.4	40.1

*** provisional**

Table 6.4.5. Irish Sea East (FU14): Mean sizes (mm CL) of male and female *Nephrops* from UK vessels landing in England and Wales, 2000–2009.

	Catch		Landings	
Year	Males	Females	Males	Females
2000	29.2	28.3	33.7	32.3
2001	31.6	29.2	34.2	32.5
2002	32.0	29.2	35.1	32.0
2003	36.4	30.7	38.4	34.5
2004	32.2	29.4	35.2	33.1
2005	32.8	29.9	34.6	32.3
2006	33.8	31.4	36.1	32.6
2007	31.7	30.0	33.5	32.1
2008	33.0	30.0	34.0	31.4
2009*	34.5	31.3	34.6	31.8

*** provisional**

Table 6.4.6. Irish Sea East (FU14): Results from NI/ROI/E&W collaborative UWTV surveys of *Nephrops* grounds in 2007–2009. Not corrected for bias.

Year	Area	No. stations	Non Zero stations	Mean density	Abundance	95% confidence interval
	km²			burrows/m²	millions	millions
2007	1043	20	18	0.38	393	202
2008	1043	35	31	0.36	377	87
2009	1043	32	29	0.25	258	77

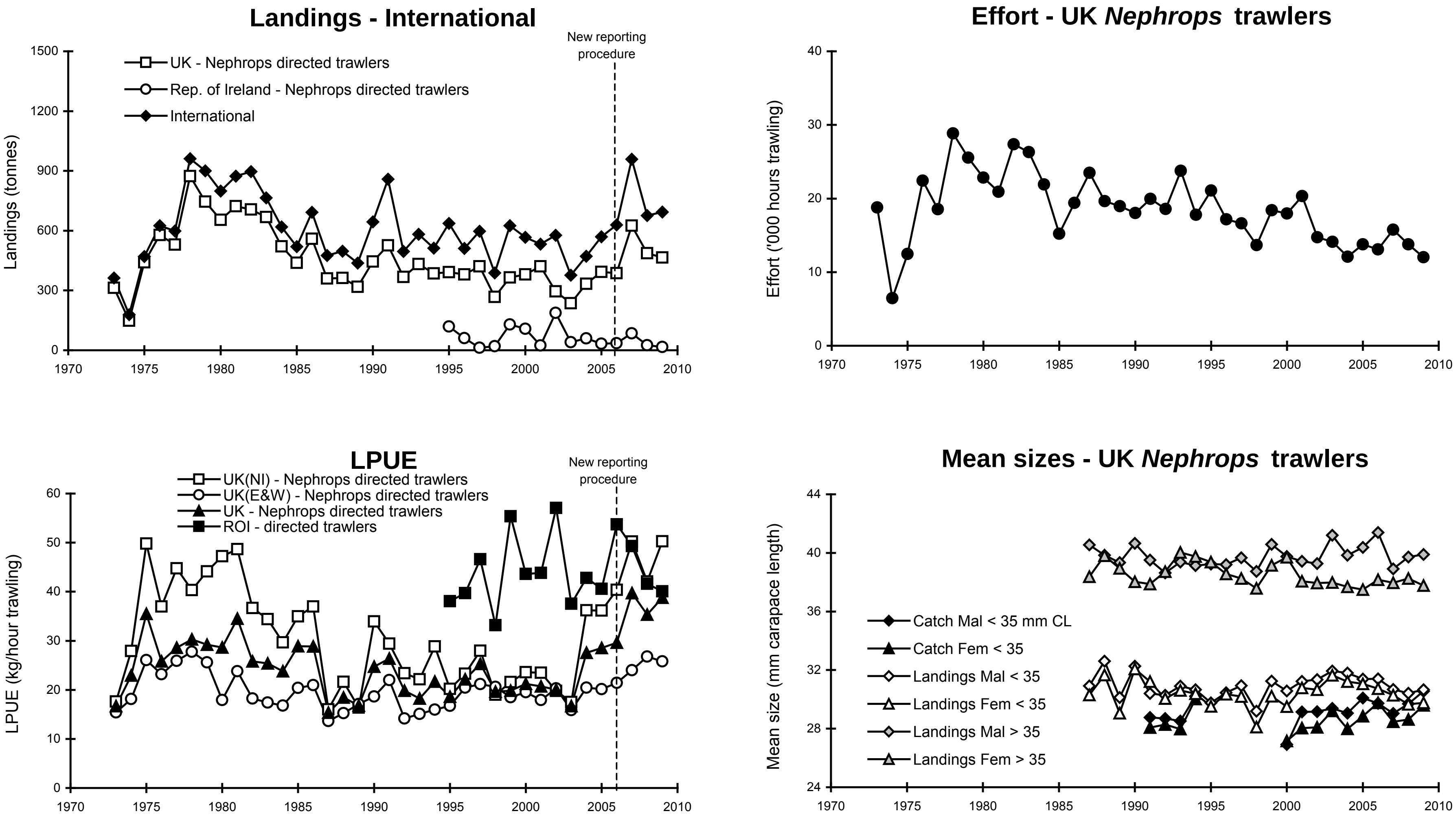


Figure 6.4.1. Irish Sea East (FU14). Long-term trends in landings, effort, lpues and mean sizes of *Nephrops*.

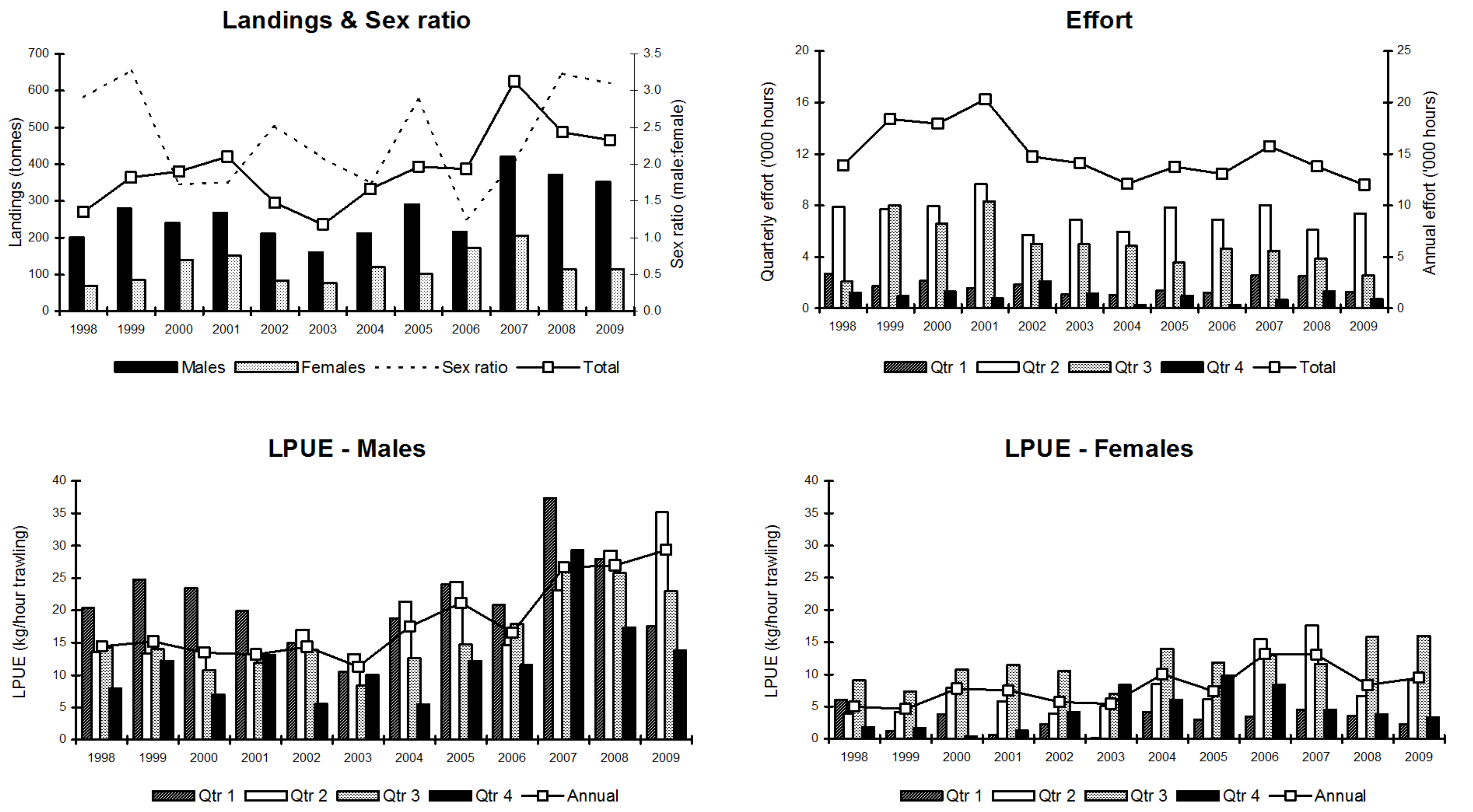


Figure 6.4.2. Irish Sea East (FU14). Landings, effort and lpues by quarter and sex from UK *Nephrops* directed trawlers.

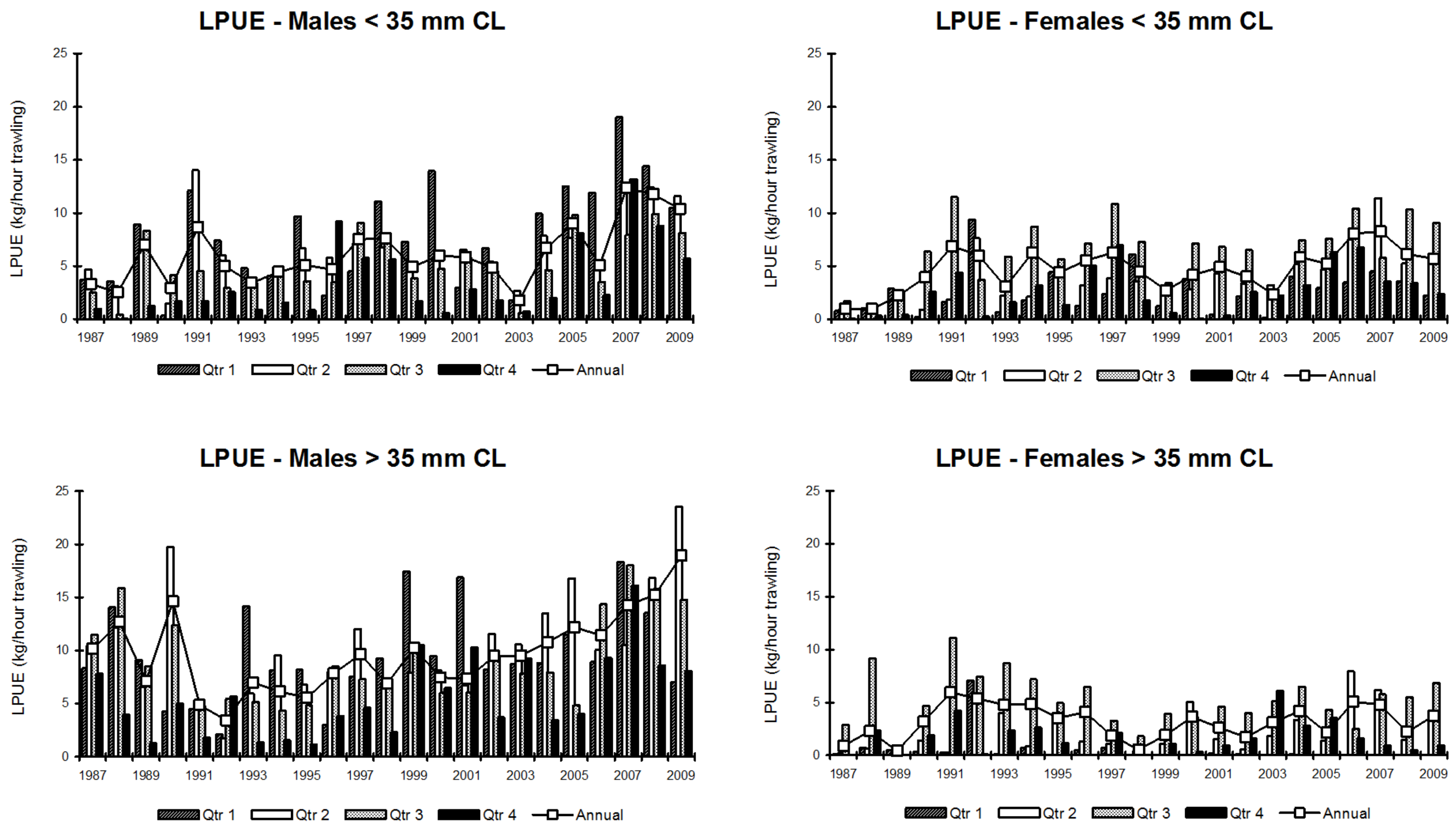


Figure 6.4.3. Irish Sea East (FU14). Lpues by sex and quarter for selected size groups, IK *Nephrops* directed trawlers.

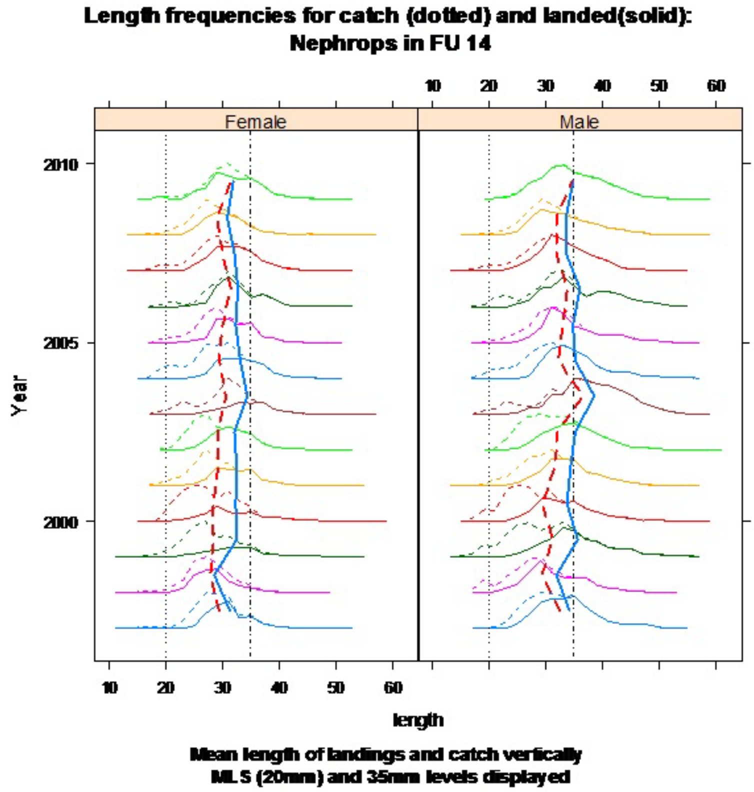


Figure 6.4.4. Irish Sea East (FU14): Length frequency distributions of male and female landings and catch, 1997–2009.

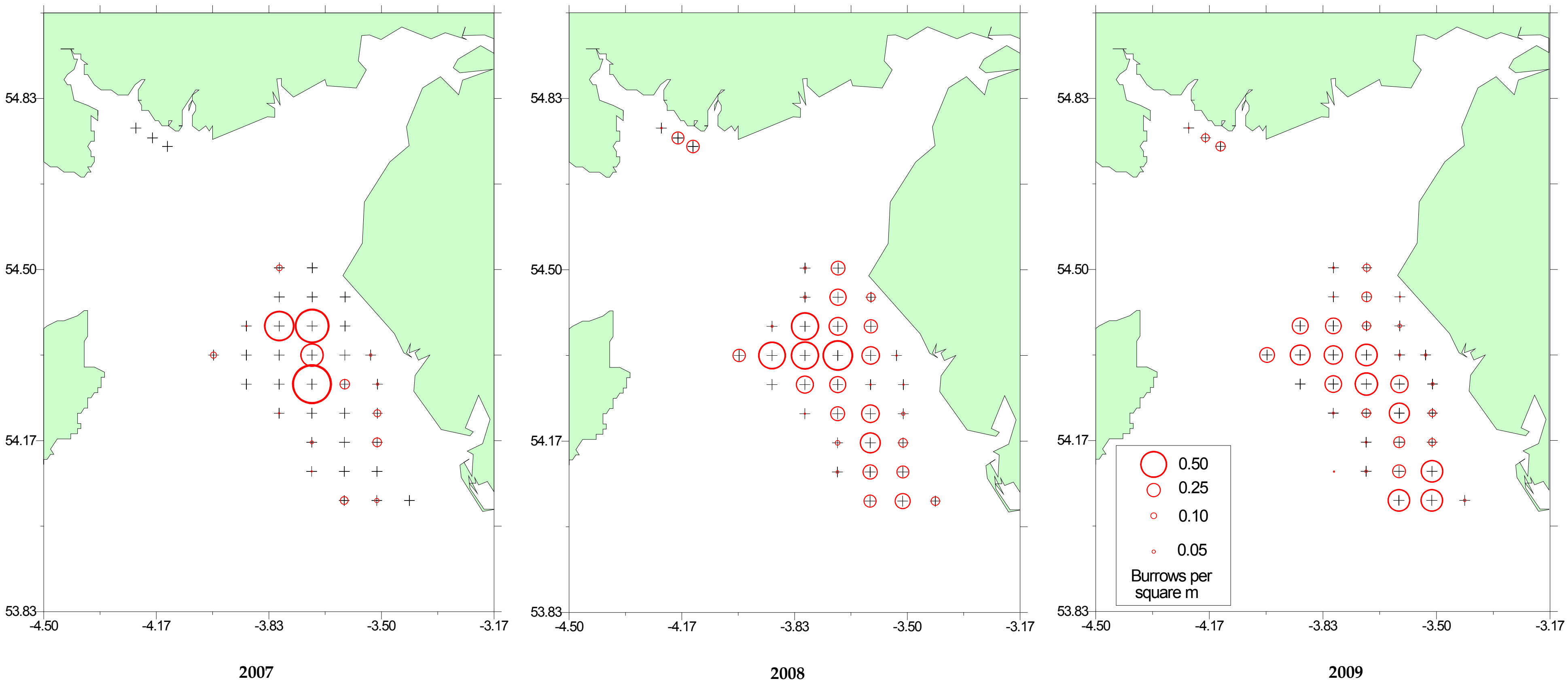
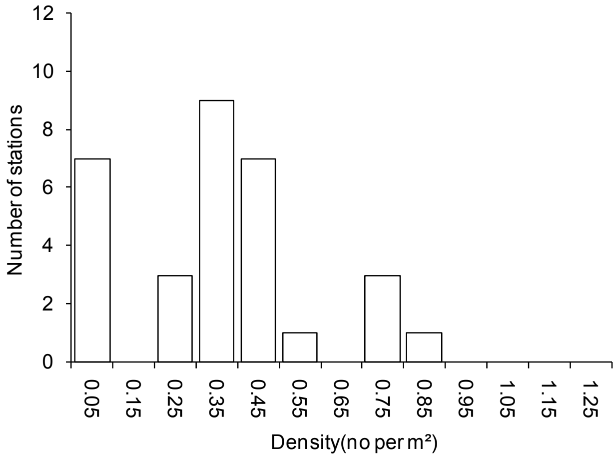
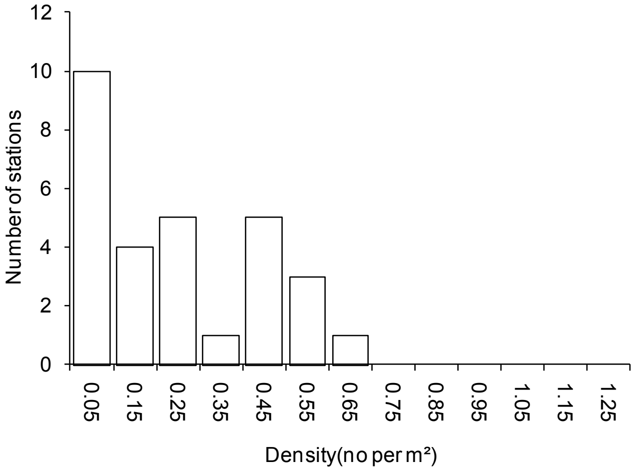


Figure 6.4.5. Irish Sea East (FU14): Station distribution and relative burrow density, from August TV surveys 2007–2009.

a)



2008



2009

b)

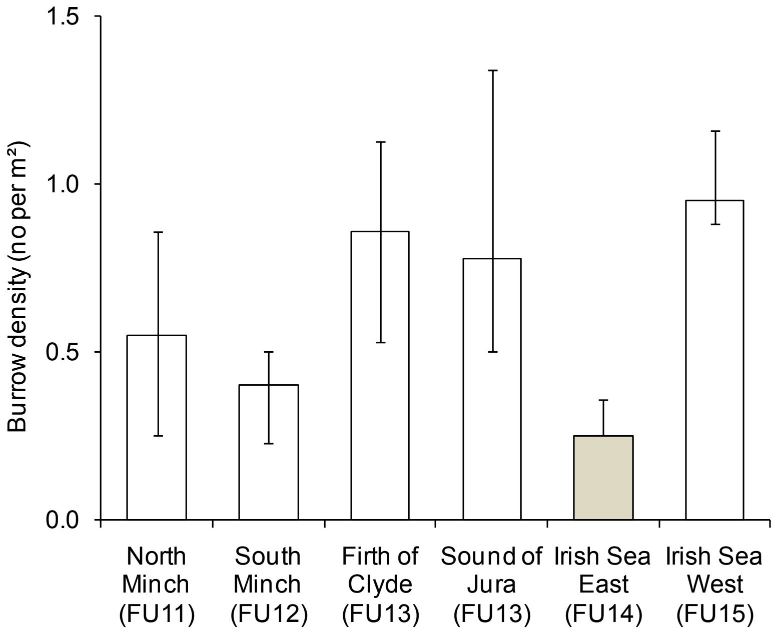


Figure 6.4.6. Irish Sea East (FU14): (a) Frequency distribution of densities on UWTV survey. (b) Estimated burrow density compared with most recent density estimates from surveys carried out on other *Nephrops* populations. The bars indicate the range of density estimates observed over the time-series.

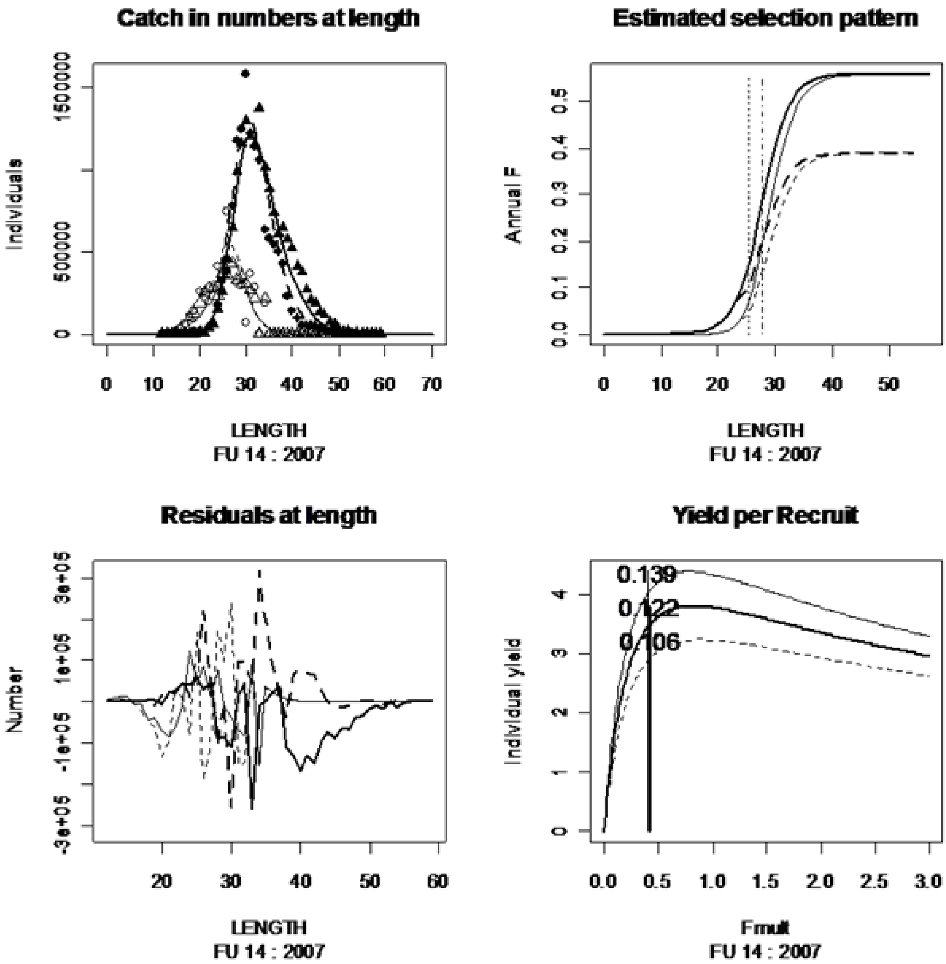


Figure 6.4.7. Irish Sea East (FU14): (a) Length compositions (b) Selection patterns (c) Residuals and (d) Yield-per-recruit curve and from combined sex–length cohort analysis (LCA) model (reference period:2006 to 2008). Male fine line; Female dotted line; Combined Sex bold line.

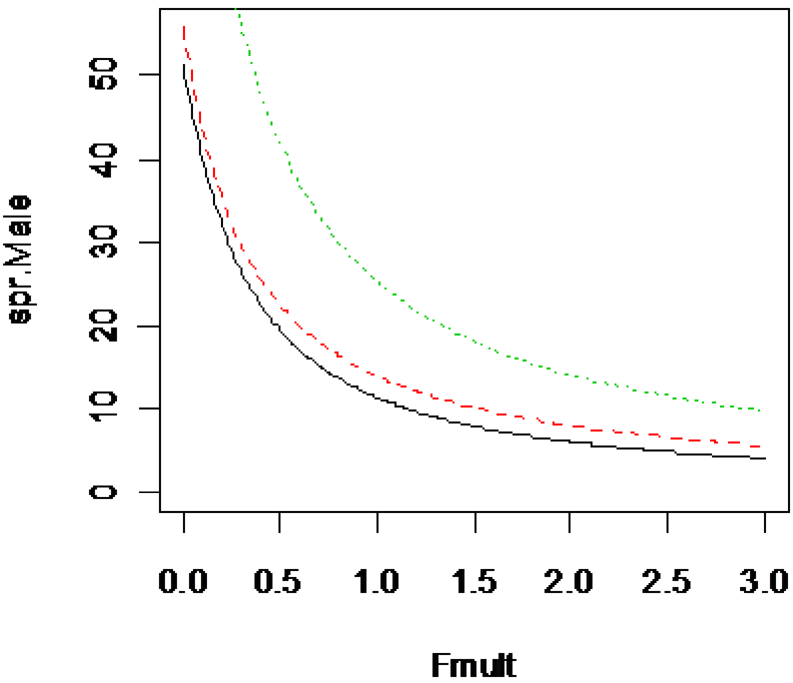


Figure 6.4.8. Irish Sea East (FU14): Spawner-per-recruit plot from combined sex–length cohort analysis (LCA) model (reference period: 2006 to 2008). Male red; Female black; Combined Sex green.

Introduction

Stock description and management units

A TAC is in place for ICES Areas VII which does not correspond to the assessment units. As *Nephrops* are limited to muddy habitats the distribution of suitable sediment defines the species distribution and the stocks are therefore assessed as six separate Functional Units (Figure 6.1.1). There are also some smaller catches from areas outside these Functional Units.

Section	FU no.	Name	ICES Divisions	Statistical rectangles
5.4.34.1	14	Irish Sea East	VIIa	35–38E6; 38E5
5.4.34.2	15	Irish Sea West	VIIa	36E3; 35–37 E4–E5; 38E4
5.4.34.3	16	Porcupine Bank	VIIb,c,j,k	31–36 D5–D6; 32–35 D7–D8
5.4.34.4	17	Aran Grounds	VIIb	34–35 D9–E0
5.4.34.5	19	Ireland SW and SE coast	VIIa,g,j	31–33 D9–E0; 31E1; 32E1–E2; 33E2–E3
5.4.34.6	20–22	Celtic Sea	VIIg,h	28–30 E1; 28–31 E2; 30–32 E3; 31 E4

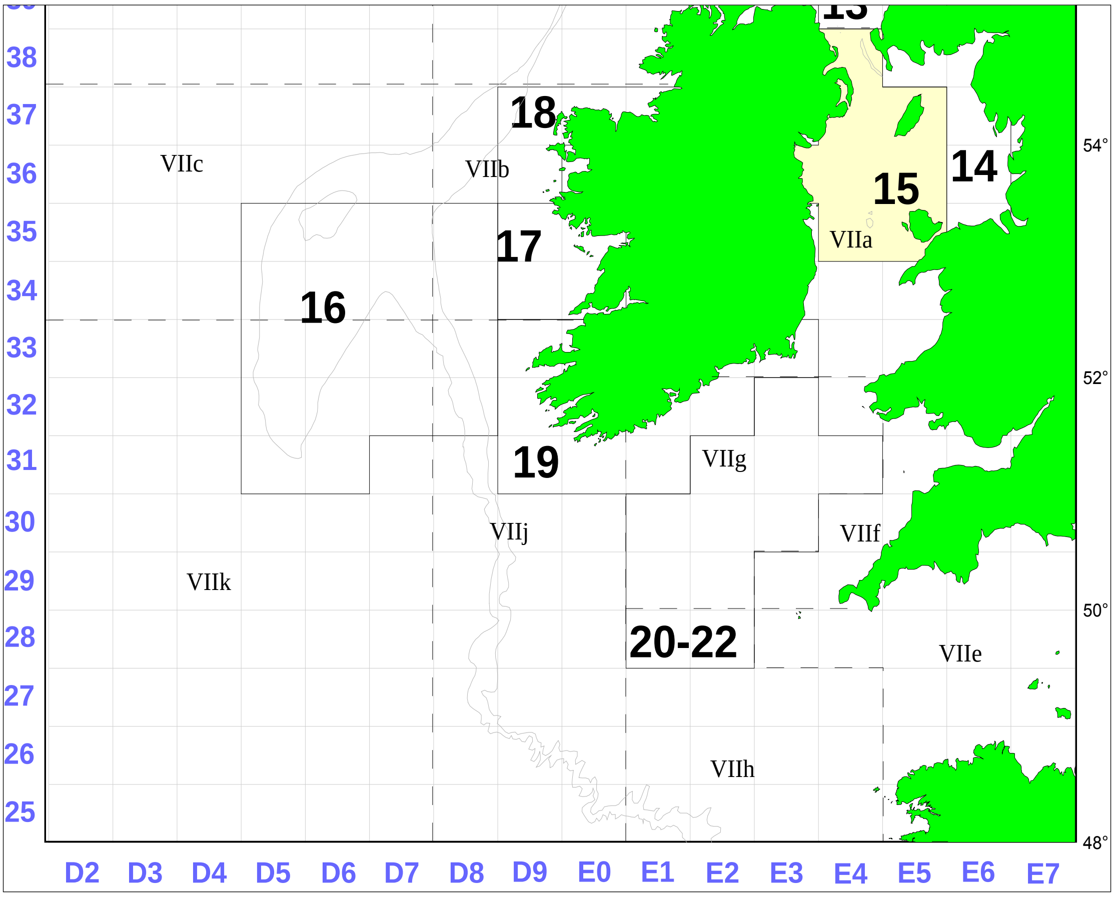


Figure 6.1. ***Nephrops*** **Functional Units in Subarea VII. The TAC covers all of Subarea VII. The stock area FU15 is shaded yellow.**

6.5 Irish Sea West, FU15

6.5.1 General

Type of assessment in 2010

Although the assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the general process defined by WK*NEPH* (2009) described in the Stock Annex new MSY target reference points were explored.

The fishery in 2009

The *Nephrops* fishery in the Irish Sea west is economically the most important in ICES Division VIIa and is mainly prosecuted by vessels from UK (Northern Ireland) and Ireland. Over 100 vessels from Northern Ireland and 56 Irish vessels reporting landings from this area in 2009. A decommissioning programme was in operation in Ireland during 2007 and 2008. 14 vessels active in the FU15 fishery were decommissioned. These vessels accounted for approximately 28% of the Irish landings in 2007–2008.

Working Group landings from FU 15 are presented in Table 6.5.1 and Figure 6.5.1. Total declared international *Nephrops* landings reported from FU15 in 2009 was 9198 t and was the second highest since 1999. Ireland's landings were 2343 t and were lower than in 2008. This was accompanied by a significant reduction in effort. UK vessels landed 6855 t which was the second highest and Northern Ireland landings contributed to over 95% of this figure.

Although there has been a steady reduction in effort by the UK fleet accompanied by a migration of some vessels to the North Sea there was a slight effort increase in 2008 followed by a drop in 2009 (Table 6.5.2). Ireland's effort showed a marked reduction in 2009 (Table 6.5.3) and a rise in lpue in 2009 to a record high whilst Northern Ireland lpue decreased slightly. The mean sizes of *Nephrops* in the catches of both the Northern Ireland and Ireland fisheries have fluctuated without obvious trend for many years (Table 6.5.4–6.5.5, Figure 6.5.1).

Discarding of undersized and unwanted *Nephrops* occurs in this fishery with Northern Ireland discarding 35.9% and Ireland 40.5% of the catch by number in 2009 (Table 6.5.6).

Further general information on the fishery can be found in the Stock Annex.

ICES advice applicable to 2009

"Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits
The current fishery appears sustainable. Therefore, ICES recommends that Nephrops fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 8500 tonnes for the Western Irish Sea stock."

ICES advice applicable to 2010

"Single-stock exploitation boundaries

June

ICES advises on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Rate for Nephrops fisheries should not exceed F0.1. This corresponds to landings of no more than 5465 t for the western Irish Sea stock.

November

ICES advises on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Rate for Nephrops fisheries should not exceed F0.1. This corresponds to landings of no more than 5892 t for the western Irish Sea stock."

6.5.2 Data

An overview of the data provided and used by the WG is shown in Table 2.1. Commercial size composition data for landings and discards were provided by Northern Ireland and Ireland. Other biological data used in the assessment were as listed in the Stock Annex compiled by the Benchmark meeting WK*NEPH* (2009).

Surveys

Since 2003 Ireland and Northern Ireland have jointly carried out underwater television surveys of the main *Nephrops* grounds in the western Irish Sea. These surveys were based on a randomised fixed grid design. The methods used during the surveys were similar to those employed for UWTV surveys of other *Nephrops* stocks and were as agreed by WKNEPHTV, WKNEPBID, SGNEPS and WK*NEPH*. An average of 145 valid stations was covered by the two surveys combined and the data were raised to a stock area of around 5340 x 10^{-6} km^2 as detailed in Table 6.5.7. Details of the survey methodology are available in WKNEPHTV.

From the time-series available, the mean density estimates calculated by the UWTV survey appeared to be very high in the initial years 2003 and 2004. The seabed in the Western Irish Sea has very high densities of *Nephrops* and other burrowing megafauna which makes counting a specialist task. SGNEPS 2009 reported that a random selection of 30% of the UWTV stations from 2003 and 2004 were subjected to verification in order to check for drift in burrow identification criteria over time. It concluded there was a drift at high density stations and recommended that all non-zero UWTV stations in initial years be verified by experienced counters. This was completed during 2009 and the results, which demonstrate a decrease from the initial abundance estimates in 2003 and 2004, are presented in Working Document 7. More recent abundance estimates have not been revised.

In addition to UWTV surveys Northern Ireland have completed spring (April) and summer (August) *Nephrops* trawl surveys since 1994 and provide data on catch rates, size composition and biological data from fixed stations in the western Irish Sea as detailed in the Stock Annex (Figure 6.5.2). The summer trawl survey catch rates correlate somewhat with UWTV survey abundance estimates (Figure 6.5.5). The longer time-series of the trawl survey shows that catch rates in the last few years (2005–2009) are close to the mean of the series when UWTV burrow abundances were in the range of 5–6 billion burrows. Mean carapace length-by-sex has remained stable over the time-series (Figure 6.5.2).

6.5.3 Historical stock development

The UWTV survey method assumes that the width of the viewed transects is the entire lower edge of the TV screen on which the burrows are counted. This can be calculated from the TV camera parameters and the position of the camera in relation to the seabed. The new camera and sledge employed in 2008 for the Northern Ireland leg of the survey was used again in 2009 and gave good resolution footage. Figure 6.5.3 shows the distribution of stations sampled in 2009 which was a slightly offset grid from those sampled in 2008. Although in early surveys the distance over the ground was estimated from the vessel position alone, recent surveys use USBL positioning technology located on the sledge to give a more accurate estimate of UWTV track. The field of view of the camera at the bottom of the screen was estimated at 75 cm assuming that the sledge was flat on the seabed (i.e. no sinking). This field of view was confirmed for the majority of UWTV tows using lasers.

A re-working of the UWTV survey abundances for 2003 and 2004 were presented to the meeting and burrow abundance time-series were krigged as described in WD 7. These data along with other meta-data are shown in Table 6.5.7 and Figure 6.5.4. Figure 6.5.6 is a contour plot of the krigged density estimates for FU15 over the period 2003–2009.

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WK*NEPH* (ICES, 2009) and potential biases were highlighted including those due to edge effects; species burrow mis-identification and burrow occupancy. A cumulative bias correction factor estimated for FU15 was 1.14 which means the TV survey is likely to overestimate *Nephrops* abundance by 14%.

6.5.4 MSY explorations

As discussed in Section 2.2 no dynamic population model is fitted to the data so no estimates of spawning–stock and recruitment were available to determine F_{MSY}. In response to the recommendations of WKFRAME (2010), the Bell/Dobby combined sex–length cohort analysis (LCA) model used to determine Harvest Rates associated with fishing at $F_{0.1}$ and F_{max} at WK*NEPH* (2009) was adapted to also output estimates of $F_{35\%Spr}$. These F estimates could be used as a proxy for F_{MSY}. The underwater TV survey is presented as the best available information on the FU15 *Nephrops* stock and provides a fishery independent estimate of *Nephrops* abundance. Catch–length data were available for Ireland and Northern Ireland for 2008 and 2009 and were used in an SLCA model along with the biological parameter described in the Stock Annex. For other stocks three years of length data were used in the analysis but in this case there was a gap in sampling in 2006 and 2007. YPR curves and other plots generated by the model are shown in Figure 6.5.8. The F multipliers required to achieve the various F_{MSY} proxies are shown in the text table below along with the harvest rates that correspond to those multipliers.

		Fbar 20-40 mm		Harvest Rate	% Virgin Spawner per Recruit	
		Female	Male		Female	Male
$F_{0.1}$	Comb	0.14	0.16	10.6%	40.6%	44.0%
$F_{0.1}$	Female	0.13	0.16	10.2%	41.7%	45.1%
$F_{0.1}$	Male	0.14	0.17	11.0%	39.5%	42.9%
$F_{35\%}$	Comb	0.18	0.22	13.4%	33.1%	36.2%
$F_{35\%}$	Female	0.17	0.20	12.7%	34.7%	37.9%
$F_{35\%}$	Male	0.19	0.23	14.1%	31.6%	34.6%
F_{max}	Comb	0.24	0.29	17.1%	25.5%	28.0%
F_{max}	Female	0.24	0.29	17.1%	25.5%	28.0%
F_{max}	Male	0.24	0.29	17.1%	25.5%	28.0%

WGCSE took into account the following considerations:

- Compared to other *Nephrops* fisheries in the ICES area the population density of FU15 is the highest of all stocks >~1/m2 (Figure 6.5.9). These high densities are observed throughout time and space. The high observed density implies intense competition for space and food on the seabed and that sperm limitation is not likely to be a problem.
- The seven year time-series of UWTV data for FU15 and the 2009 survey shows the stock is relatively stable. Trawl survey cpue since 1994 indicates that abundance has been at high levels over the last seven years (assuming constant survey catachability).
- The growth rate of *Nephrops* in this stock is known to be slow and they exhibit a relatively small size of maturity (McQuaid *et al.*). There appears to be little change is the size composition in catches despite over 40 years of intensive fishing (Lordan, 2010, WD2).
- This fishery occurs throughout the year and does not exhibit major inter annual changes seasonal pattern. Landings have fluctuated around 9000 t for over the 35 years.
- Larval production studies show that over 440 x 10^9 larvae were produced in 1995 (Briggs *et al.*, 2002). This >70 times more larvae produced annual than current stock size estimates. The high larval production is coupled with a strong retention mechanism and depositional environment due to the western Irish Sea gyre ensures continued good recruitment (Hill *et al.*, 1994).
- The harvest rate in recent years is thought to have been above F_{max} (note: harvest rates prior to 2007 are lower bounds as landings may have been under reported) with no apparent affect on the stock (Figure 6.5.10).

The WG concluded that a combined sex F_{max} was a suitable F_{msy} proxy for this stock. This corresponds to a harvest rate of 17.1%.

6.5.5 Short-term projections

A landings prediction for 2011 was made for FU15 using the approach agreed at the Benchmark Workshop (WK*NEPH* ICES, 2009). Catch option table inputs are given in (Table 6.5.7) and summarised below.

Basis: Bias corrected survey index (2009) = 4.6 billion, Mean weights (15.1g) in landings (2008–2009) and retention factors based (73%) on 2008–2009 sampling.

The landings corresponding to various fishing mortality reference points are shown in the table below.

Rationale	Harvest ratio	Landings 2011 (tonnes)
MSY framework	17.1%	8,724
MSY transition	17.8%	9,104
F_{2009}	18.0%	9,199
$F_{0.1}$ (combined)	11.0%	5,612
$F_{35\%}$ (combined)	13.4%	6,832
F_{max} (combined)	17.1%	8,724

MSY transition scheme

Assuming the WG recommendation that F_{msy}=F_{max}=HR of 17.1% is accepted the following transition scheme applies: The ICES MSY framework implies the harvest ratio should be reduced (0.8 x harvest ratio (F_{2009}) + 0.2 x harvest ratio(F_{msy}) to 17.8% resulting in landings of 9104 t in 2011.

6.5.6 Biological reference points

The cpue data from the trawl surveys was scaled to the UWTV index to provide a $B_{trigger}$ approximation based on the mean of the five lowest survey catch rates in the time-series (Figure 6.5.5). Harvest ratios equating to a range of fishing mortalities including $F_{0.1}$, $F_{35\%}$ and F_{max} are provided above. These calculations assumed that the TV survey has a knife-edge selectivity at 17 mm and that the supplied length frequencies represented the population in equilibrium. The WG concluded that a combined sex F_{max} was a suitable F_{msy} proxy for this stock. This corresponds to a harvest rate of 17.1%.

6.5.7 Management plans

A number of cod recovery measures have been introduced since 2000 to promote recovery of Irish Sea cod stocks. These include a closure of the western Irish Sea cod spawning grounds from mid February to end of April since 2000, with a later extension to the eastern Irish Sea closure. Despite a partial derogation for *Nephrops* vessels during the closed period the distribution of effort on *Nephrops* has been affected by this management plan. There have also been decommissioning schemes to reduce fishing effort.

6.5.8 Uncertainties in the assessment and forecast

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007, WKNEPHBID 2008, SGNEPS 2009). These have lead to a revision in the historical time-series of survey abundance estimates for FU15. These new estimates are thought to be of higher quality. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al*., 1996).

Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WK*NEPH* 2009). The survey estimates themselves are very precisely estimated (CVs 3–5%) given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU15 are largely based on expert opinion (see Stock Annex). The precision of these bias corrections cannot yet be characterised but is likely to be higher than that observed in the survey.

In the provision of catch options based on the absolute survey estimates additional uncertain-ties related to mean weight in the landings and the discard rates also arise. For FU15 deterministic estimates of the mean weight in the landings and discard rates for 2008 and 2009 are used although there is some variability in these over time.

There is a gap of 16 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated but remains a key uncertainty.

The quality of landings data has improved since 2007 with the implementation of sales notes and buyers and sellers legislation. Prior to that there were concerns that landings were underreported. The harvest ratio may be under estimated prior to 2007.

6.5.9 Management considerations

The FU15 *Nephrops* fishery first developed in the late 1950s. Since then it has sustained landings of around 9000 t for more than 35 years. Fishing effort in the past has been very high but has declined somewhat in recent years. The environment in the Western Irish Sea is very suitable for *Nephrops* with a large mud patch and gyre which retains the larvae over the mud patch thus ensuring good recruitment. The ground can be characterised as an area of very high densities of small *Nephrops*. All available information indicates that size structure of catches appears to have changed little since the fishery first began. Nevertheless the current analyses suggest that that stock is over-fished in relation to F_{max} which is considered and an appropriate F_{msy} proxy. Higher long-term yields could be achieved by reducing fishing mortality to $F_{msy.}$

The *Nephrops* trawl fisheries take bycatches of other species, especially juvenile whiting but also cod. Catches of these species should be reduced to as low as possible a level because of the poor status of these stocks.

The cod long-term plan was introduced in 2009 (EC 1342/2008). Annual effort in *Nephrops* trawl fisheries (Effort group TR2 OTB 70-99mm) in Division VIIa has been reduced by 25% in 2009 and a further 25% in 2010 and is expected to be very restrictive. The implementation of the plan is expected to cause large changes in fishing patterns. Vessels may also start using more selective gears to reduce cod catches to less than 1 or 1.5% of total catch. In 2009, three Irish vessels began using "Swedish grids" in the fishery and significantly reduced bycatches of cod, whiting and haddock (**STECF 01-2010**).

ICES has repeatedly advised that management should be at a smaller scale than the ICES Subarea VII. Management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort are at the same scale as the resource.

6.5.10 References

Briggs, R.P., Armstrong, M.J., Dickey-Collas, M., Allen, McQuaid, N. and Whitmore, J. 2002. Estimation of *Nephrops* Biomass in the Western Irish Sea from Annual Larval Production. ICES Journal of Marine Research, 59: 109–119.

Hill, A. E., Durazo, R. and Smeed, D. A. 1994. Observations of a cyclonic gyre in the western Irish Sea. Continental Shelf Research, 14: 479–490

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McQuaid, N., Briggs R. P. and Roberts D. 2009. Fecundity of *Nephrops norvegicus* from the Irish Sea. *Journal of the Marine Biological Association of the UK*, 89: 1181–1188.

Marrs, S.J., Atkinson, R.J.A., Smith, C.J. and Hills, J.M. 1996. Calibration of the towed underwater TV technique for use in stock assessment of *Nephrops norvegicus*. *Reference no. 94/069 (Study Project in support of the Common Fisheries Policy XIV/1810/C1/94, call for proposals 94/C 144/04).*

STECF 01-2010 33rd Plenary meeting report of the Scientific, Technical and Economic Committee for Fisheries (PLEN-10-01) plenary meeting, 26–30 April 2010, Norwich. Edited by John Casey and Hendrik Dörner.

Table 6.5.1. Irish Sea West (FU15): Landings (tonnes) by country, 2000–2009.

Year	Rep. of Ireland	Isle of Man	UK	Other countries	Total
2000	3,433	0	4937	0	8370
2001	2,689	3	4749	0	7441
2002	2,291	1	4501	0	6793
2003	2,709	4	4352	0	7065
2004	2,786	13	4470	1	7270
2005	2,133	0	4420	0	6554
2006	2,051	1	5508	1	7561
2007	2,767	0	5724	0	8491
2008	3,132	50	7323	2	10508
2009*	2,343	1	6855	0	9198

* provisional

Table 6.5.2. Irish Sea West (FU15):Landings (tonnes), effort ('000 hours trawling), and lpue (kg/hour trawling) of Northern Ireland *Nephrops* trawlers, 2000–2009.

Year	Landings	Effort	LPUE
2000	4758	168.7	28.2
2001	4587	163.7	28.0
2002	4495	130.8	34.4
2003	4146	136.1	29.0
2004	4273	144.3	29.6
2005	4235	138.4	30.6
2006	5356	144.1	37.2
2007	5512	126.9	43.4
2008	7056	141.4	49.9
2009*	6487	134.7	48.2

* provisional

Table 6.5.3. Irish Sea West (FU15): Catches and landings (tonnes), effort ('000 hours trawling), cpue and lpue (kg/hour trawling) Republic of Ireland *Nephrops* Directed Trawlers 2000–2009.

Year	Effort	Landings	LPUE
2000	61.1	3160	51.7
2001	52.4	2475	47.2
2002	49.0	2238	45.7
2003	45.4	2680	59.1
2004	51.5	2535	49.3
2005	48.6	2062	42.4
2006	50.6	1959	38.7
2007	48.0	2578	53.7
2008	47.1	3076	65.3
2009*	34.0	2290	67.3

* provisional

Table 6.5.4. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Northern Ireland catches, landings and discards, 2000–2009.

Year	Catches		Landings		Discards	
	Males	Females	Males	Females	Males	Females
2000	27.7	24.5	29.4	26.3	22.5	22.6
2001	25.7	23.6	26.1	24.4	21.7	21.2
2002	26.7	24.1	26.7	24.9	21.8	21.7
2003	na	na	na	na	na	na
2004	na	na	na	na	na	na
2005	na	na	na	na	na	na
2006	na	na	na	na	na	na
2007	na	na	na	na	na	na
2008	25.9	24.6	26.9	25.5	21.4	21.5
2009*	27.6	25.1	29.3	26.5	23.6	23.2

* provisional na = not available

Table 6.5.5. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Republic of Ireland catches, landings and discards, 2000–2009.

Year	Catches		Landings		Discards	
	Males	Females	Males	Females	Males	Females
2000	29.1	27.1	32.2	29.7	24.3	24.0
2001	26.7	24.8	28.6	27.0	23.0	22.2
2002	28.9	25.4	30.2	27.8	24.6	23.6
2003	27.7	24.9	29.7	26.9	24.0	23.1
2004	28.1	26.1	29.7	27.8	23.9	23.7
2005	28.5	26.8	30.1	29.1	23.9	23.2
2006	27.7	25.5	29.5	27.1	23.8	23.1
2007	27.7	25.4	29.8	27.9	24.0	23.3
2008	27.4	24.6	28.9	26.6	22.0	21.4
2009*	28.5	26.3	30.5	29.2	24.3	23.4

* provisional

Table 6.5.6. Irish Sea West (FU15): Proportion discarded by weight and number from FU15. (note a 10% survivorship of discards is assumed in HR and forecast calculations).

Year	Discards By Weight	Discards by number
1986	0.14	0.27
1987	0.14	0.24
1988	0.07	0.15
1989	0.08	0.16
1990	0.03	0.07
1991	0.03	0.08
1992	0.13	0.22
1993	0.17	0.29
1994	0.13	0.25
1995	0.18	0.32
1996	0.14	0.27
1997	0.12	0.23
1998	0.15	0.27
1999	0.21	0.35
2000	0.22	0.36
2001	0.22	0.36
2002	0.20	0.31
2003	0.27	0.42
2004	0.22	0.34
2005	0.18	0.31
2006	0.23	0.36
2007	0.28	0.42
2008	0.12	0.20
2009	0.24	0.37
Max	0.28	0.42
Min	0.03	0.07
Average	0.16	0.28

Table 6.5.7. Irish Sea West (FU15): Results from NI/ROI collaborative UWTV surveys of *Nephrops* grounds in 2003–2009 (before and after revalidation).

Survey estimates as used provided last year. Shade values have been revised (see WD 7).

Ground	Year	Number of stations	Mean Density (No./M²)	Domain Area (km²)	Unrevised estimate (billions)	CV on Burrow estimate
Western Irish Sea	2003	160	1.25	5292	7.0	1%
	2004	147	1.52	5302	8.5	2%
	2005	141	1.08	5288	6.0	3%
	2006	138	1.07	5429	5.9	4%
	2007	148	1.00	5452	5.6	3%
	2008	141	0.88	5287	4.9	3%
	2009	142	0.95	5267	5.3	3%

Revalidated survey data

Ground	Year	Number of stations	Mean Density (No./M²)	Domain Area (km²)	Revised Estimate (billions)	CV on Burrow estimate
Western Irish Sea	2003	160	1.12	5295	6.3	3%
	2004	147	1.13	5310	6.3	3%
	2005	141	1.16	5281	6.5	4%
	2006	138	1.10	5194	6.2	4%
	2007	148	1.06	5285	5.9	3%
	2008	141	0.88	5287	4.9	3%
	2009	142	0.95	5267	5.3	3%

Table 6.5.8. Irish Sea West (FU15): Catch option table inputs. Data used for 2011 catch prediction are shaded.

Year	Landings in Number (millions)	Discards in Number (millions)	Removals in Number (millions)	Prop Removals Retained	Adjusted Survey (billions)	Harvest Ratio	Landings (t)	Discards (t)	Mean Weight in landings (gr)
1986	740	268	981				9,978	1,680	
1987	774	242	992				9,753	1,608	
1988	576	104	669				8,586	639	
1989	644	121	753				8,147	673	
1990	678	53	726				8,308	276	
1991	792	65	850				9,566	345	
1992	525	151	661				7,547	1,079	
1993	679	275	926				8,102	1,622	
1994	619	203	801				7,606	1,185	
1995	554	260	787				7,796	1,724	
1996	469	170	622				7,247	1,202	
1997	731	214	924				9,971	1,330	
1998	616	229	822				9,128	1,560	
1999	710	388	1060				10,780	2,913	
2000	533	298	801				8,370	2,293	
2001	573	315	857				7,438	2,112	
2002	491	223	692				6,792	1,732	
2003	404	291	666	0.61	5.48	0.12	7,052	2,659	17.5
2004	416	218	612	0.68	5.55	0.11	7,267	1,993	17.5
2005	346	157	488	0.71	5.67	0.09	6,530	1,412	18.9
2006	467	261	701	0.67	5.40	0.13	7,534	2,285	16.1
2007	511	375	848	0.60	5.15	0.16	8,424	3,246	16.5
2008	755	191	927	0.81	4.29	0.22	10,478	1,421	13.9
2009	566	337	870	0.65	4.62	0.19	9,199	2,949	16.2
Max	792	388	1060	0.81	5.67	0.22	10,780	3,246	18.9
Min	346	53	488	0.60	4.29	0.09	6,530	276	13.9
Average	590	225	793	0.68	5.17	0.15	8,400	1,664	16.7
Avg. 08–09				0.73					15.06

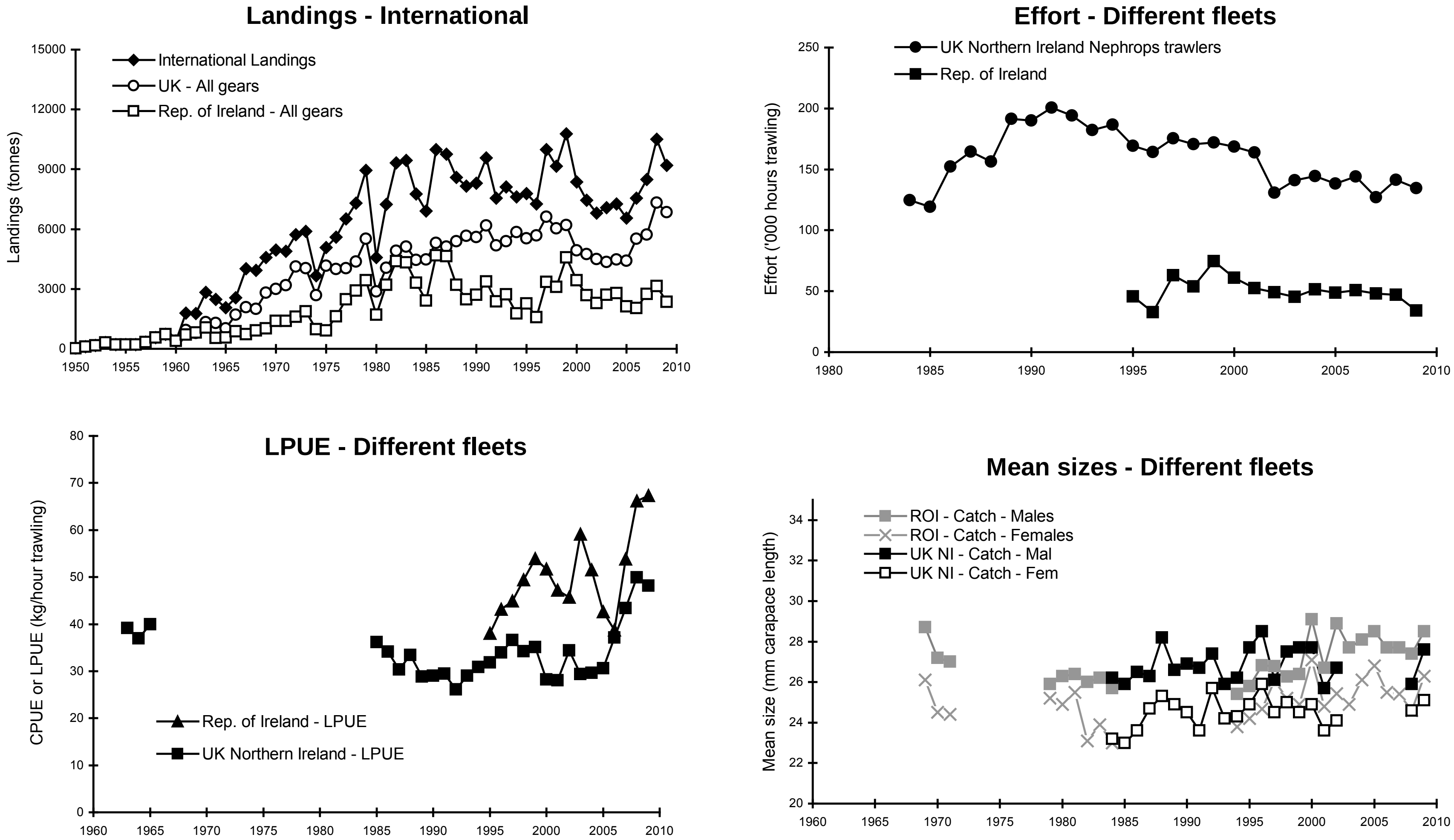
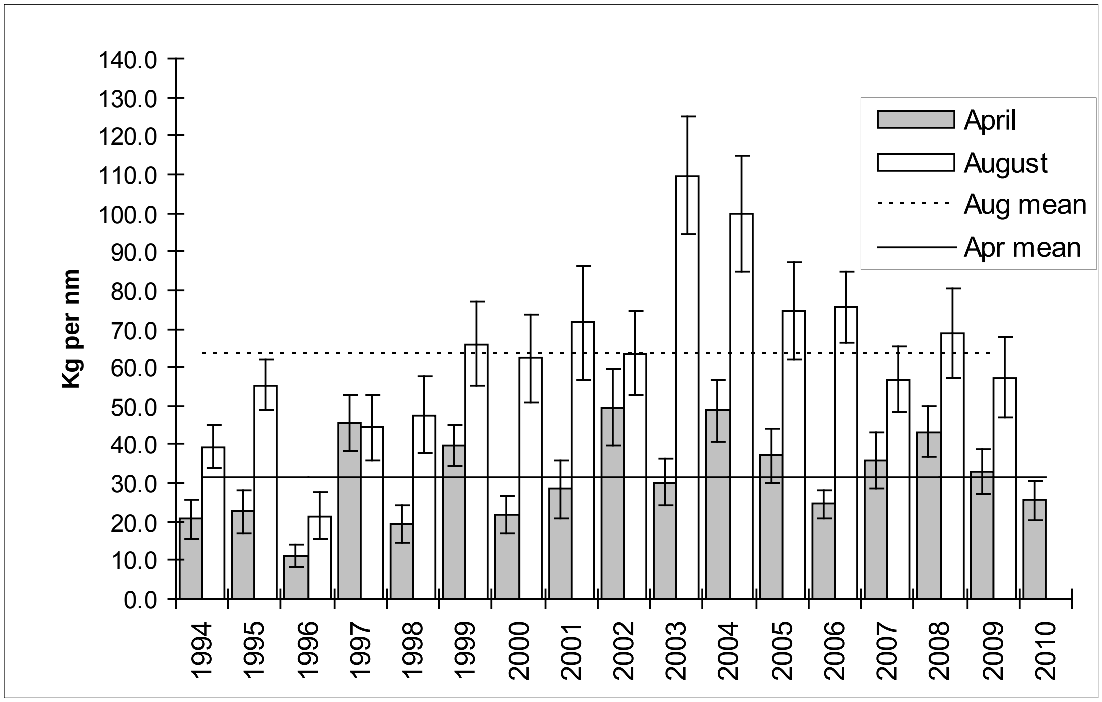


Figure 6.5.1. Irish Sea West (FU15): Long-term trends in landings, effort, cpues and/or lpues, and mean sizes of *Nephrops*.



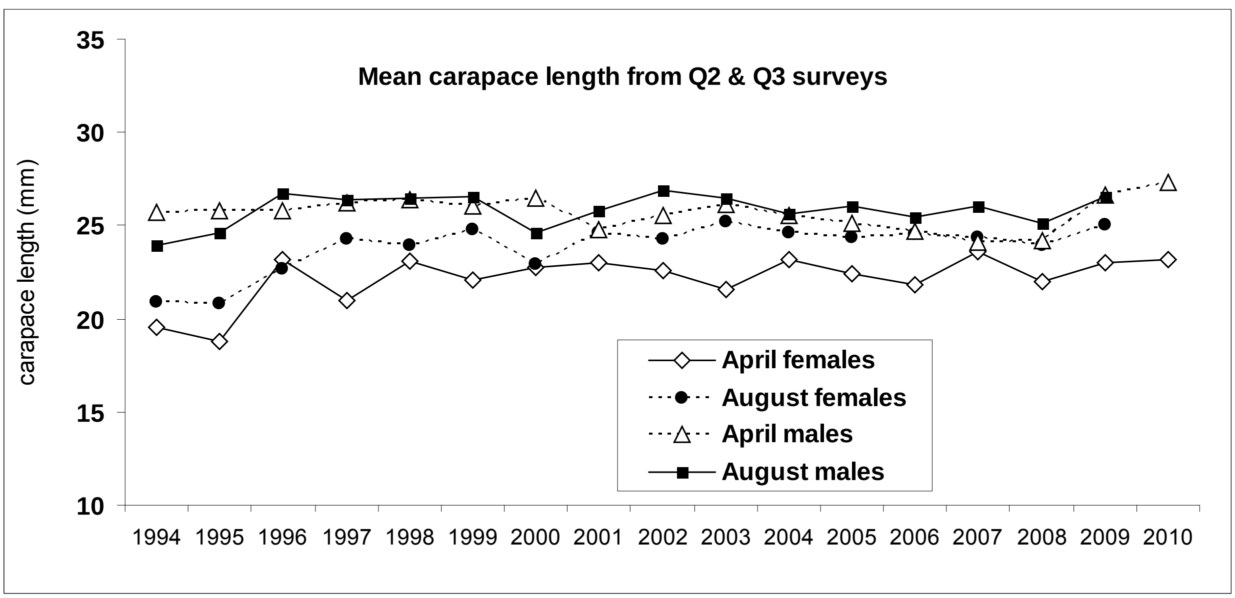


Figure 6.5.2. Irish Sea West (FU15): ***Nephrops*** **catches, sex ratio mean size from NI trawl surveys.**

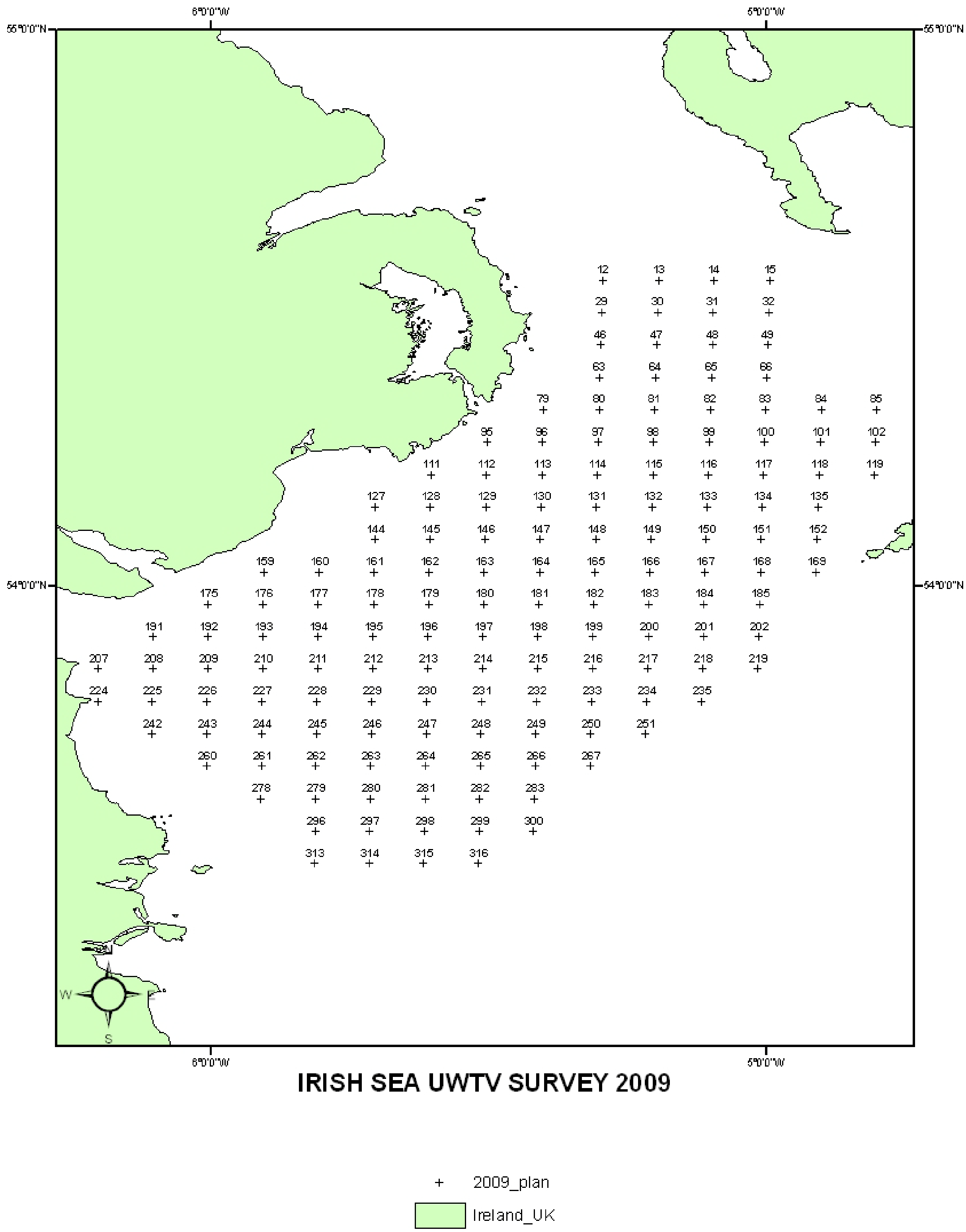


Figure 6.5.3. Irish Sea West (FU15): UWTV Stations for 2009 survey.

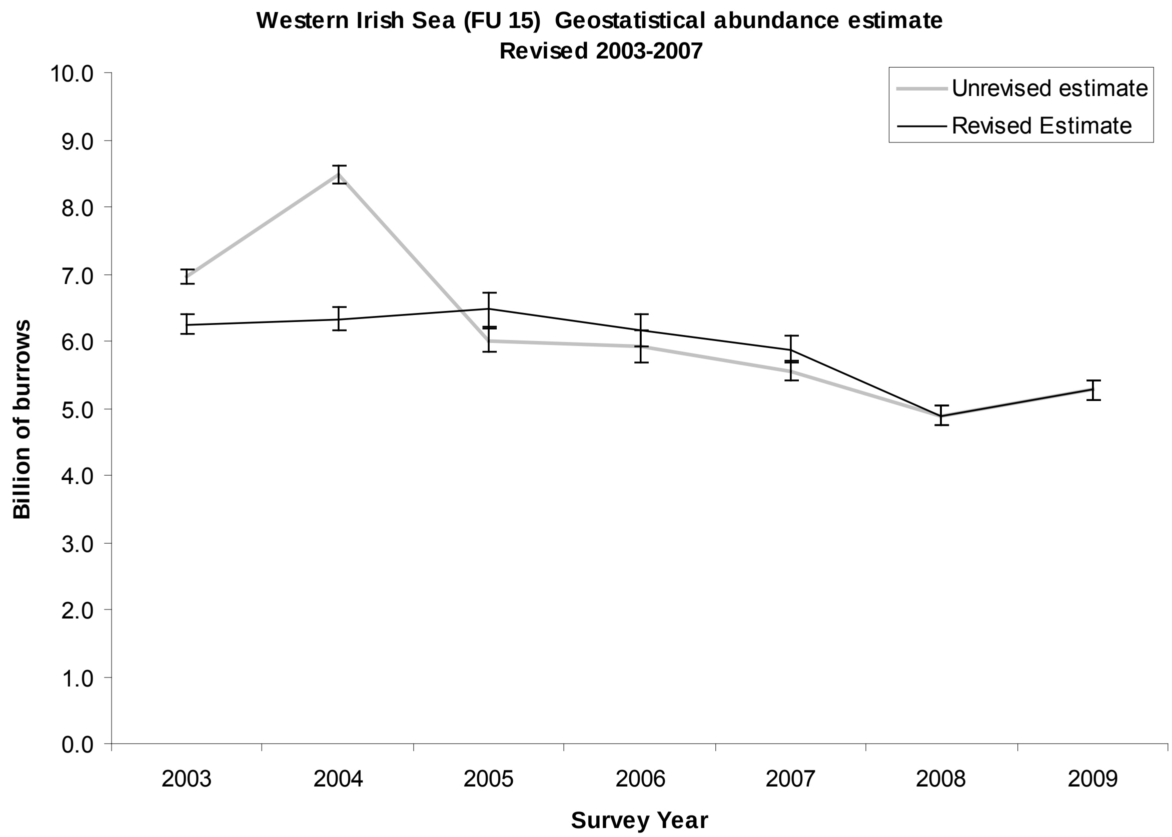


Figure 6.5.4. Irish Sea West (FU15): UWTV index revised and unrevised estimates.

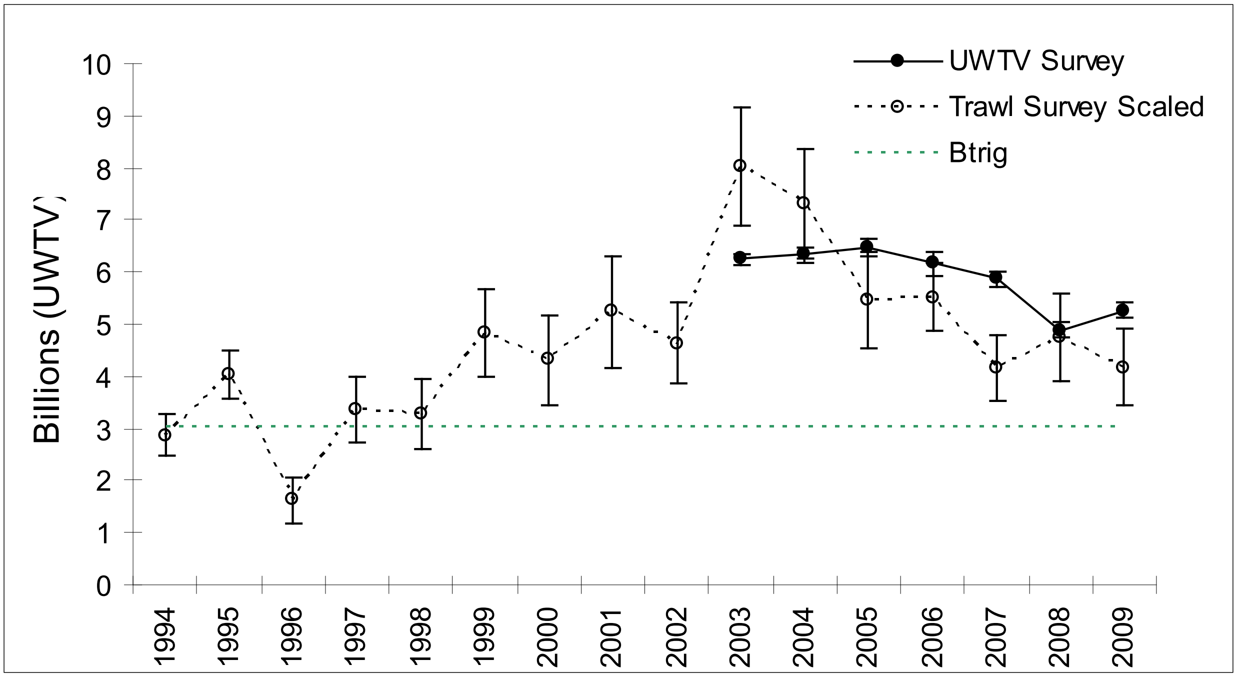


Figure 6.5.5. Irish Sea West (FU15): Revised UWTV index and scaled trawl survey. Cpue along with Btrigger based upon mean of 5 lowest trawl survey values

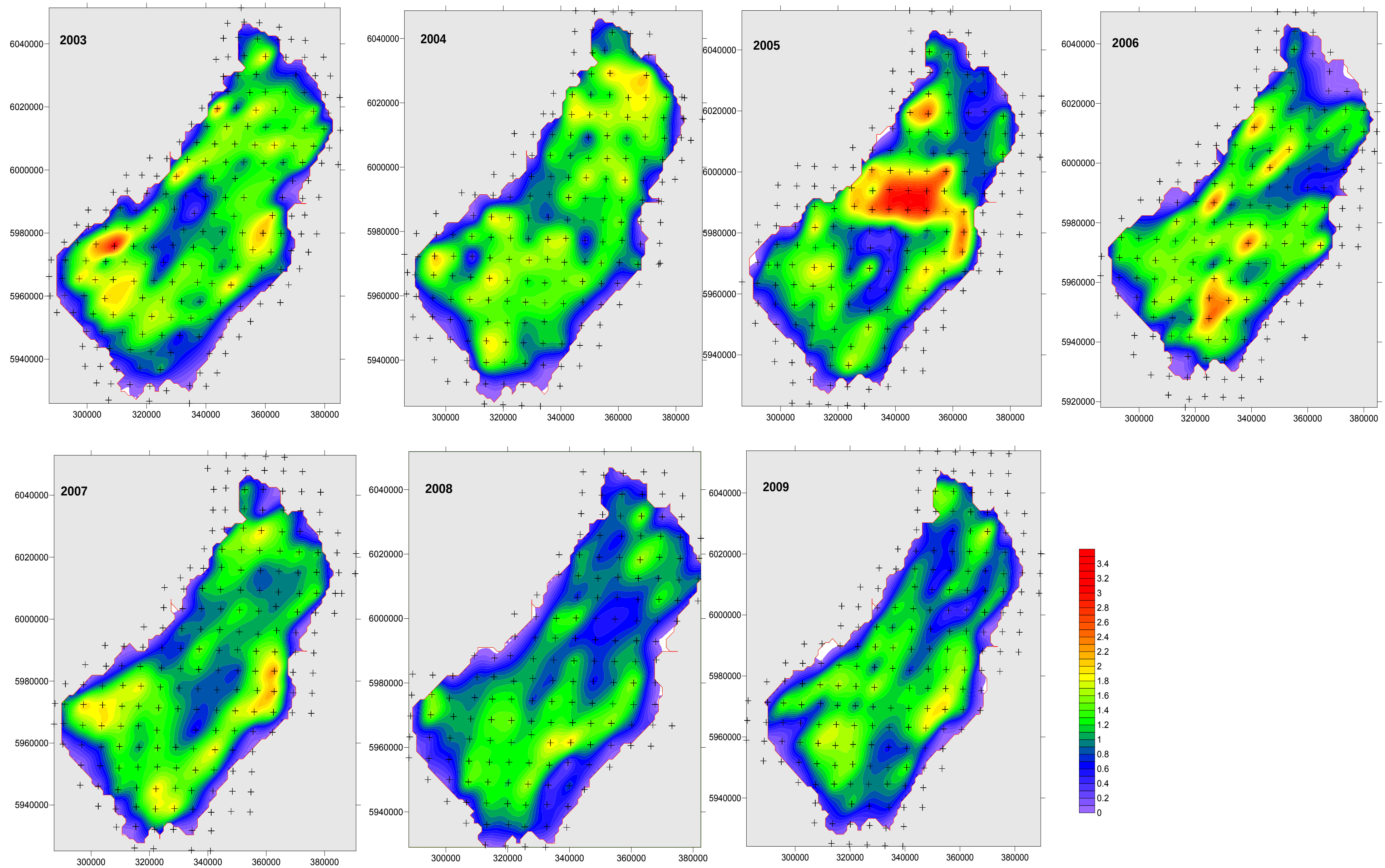


Figure 6.5.6. Irish Sea West (FU15): Contour plots of the krigged density estimates for the Irish Sea from 2003–2009.

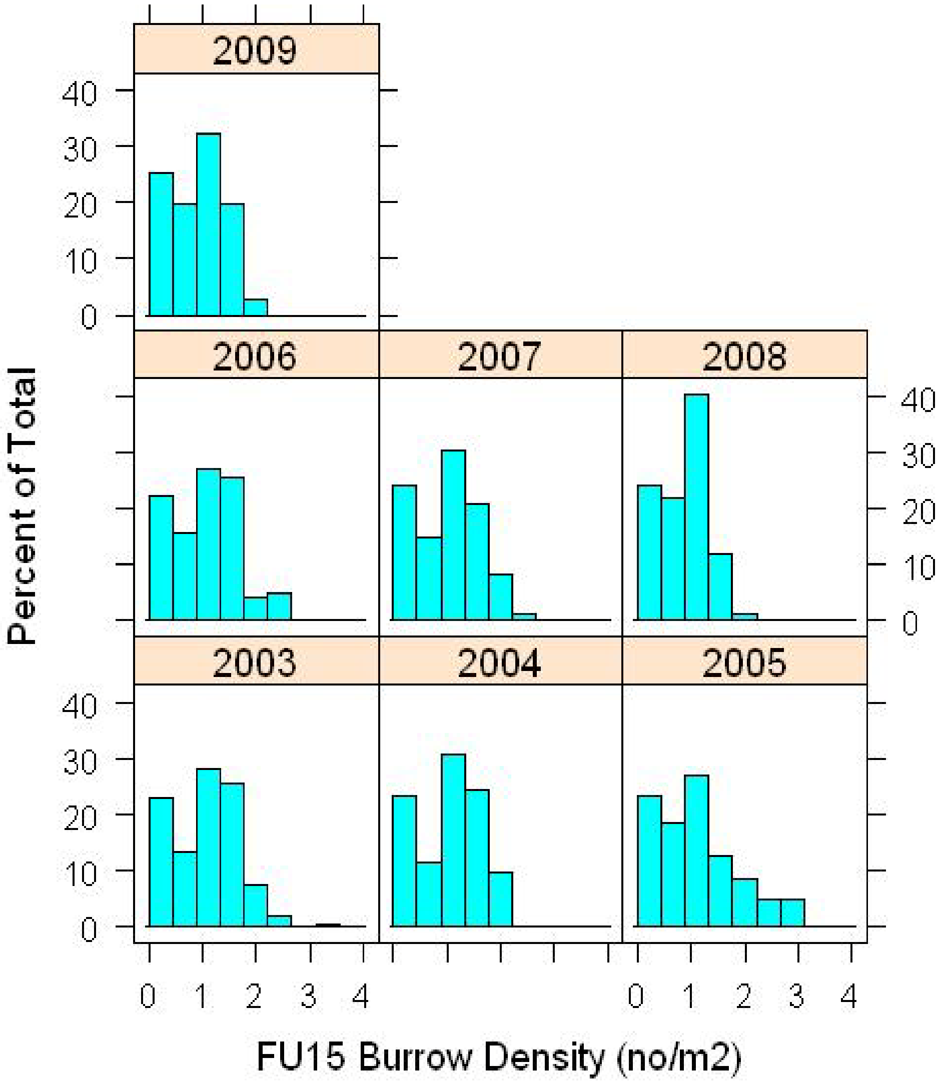


Figure 6.5.7. Irish Sea West (FU15): Burrow density distributions 2003–2009.

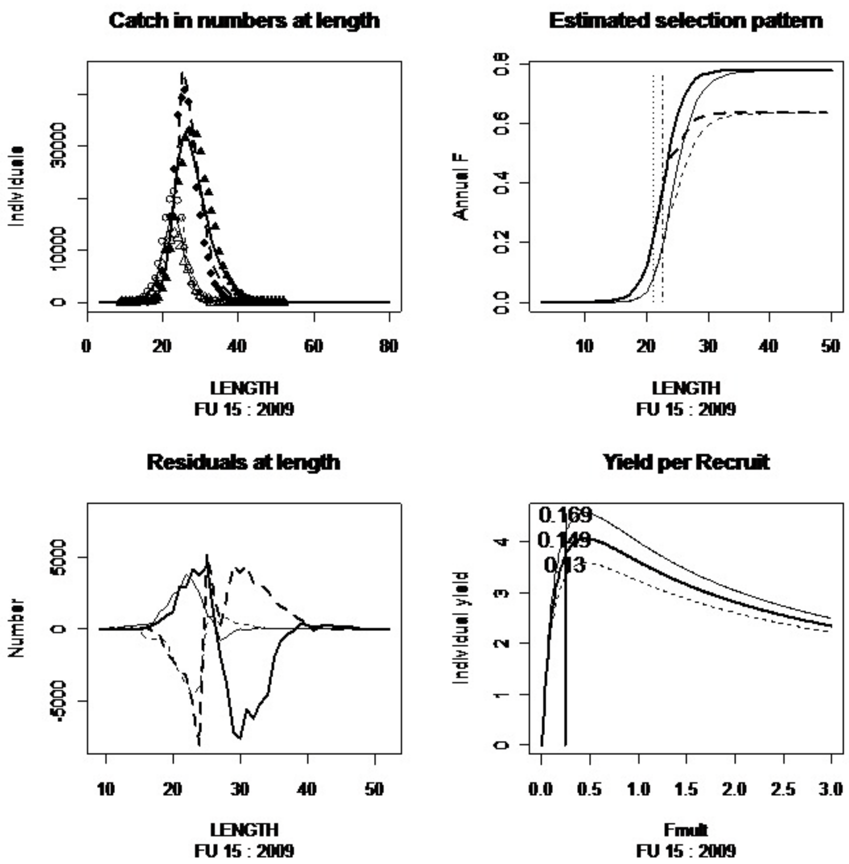


Figure 6.5.8. Irish Sea West (FU15): Outputs from LCA model.

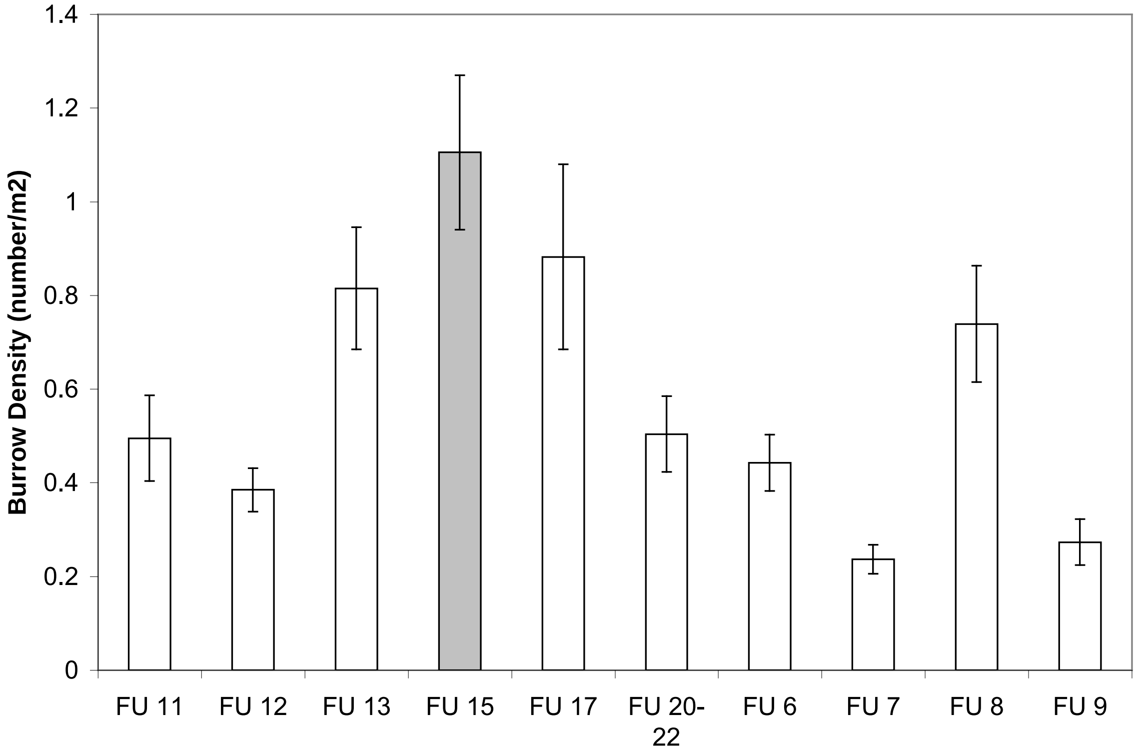
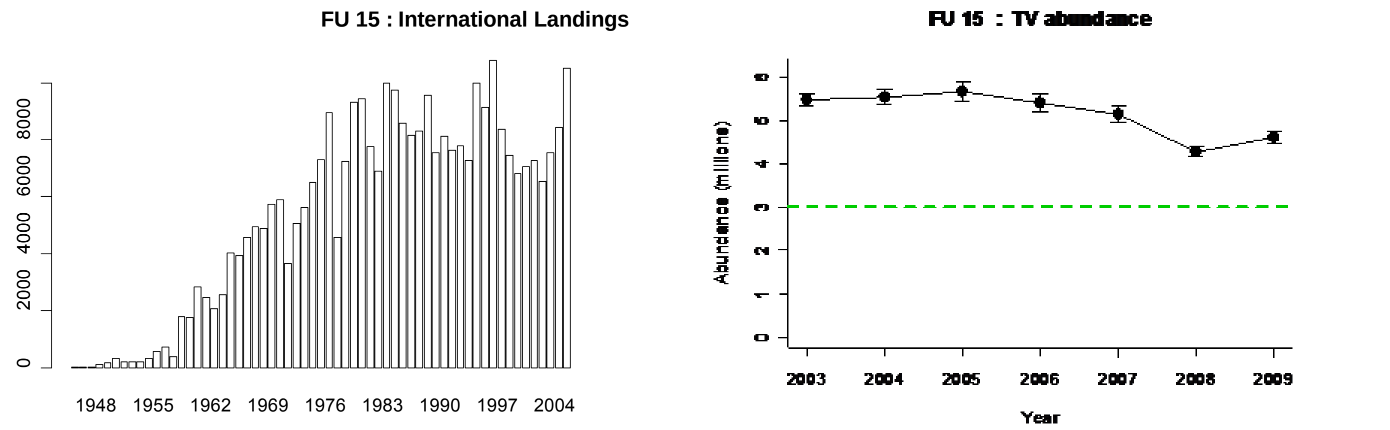


Figure 6.5.9. Irish Sea West (FU15): Estimated burrow density compared with most recent density estimates from surveys carried out on other *Nephrops* populations.



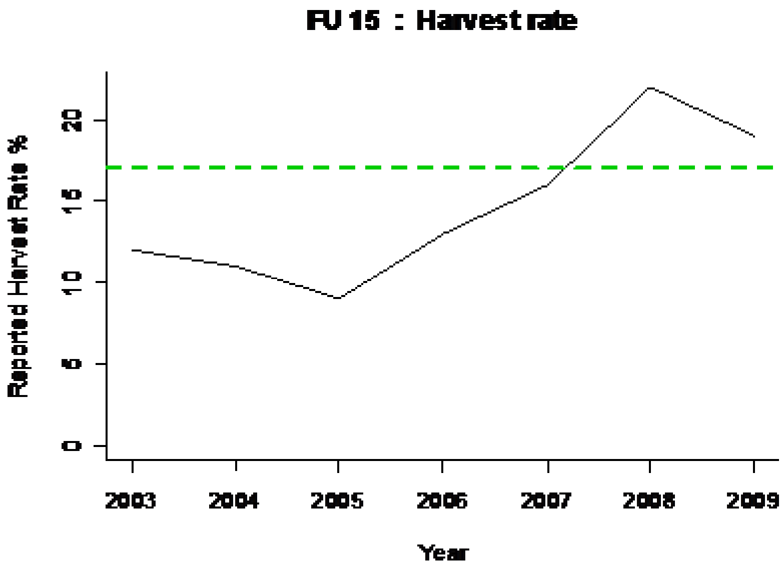


Figure 6.5.10. Irish Sea West (FU15): Stock summary plot of landings (tonnes), UWTV abundance and harvest rate (ratio).

6.6 Whiting in VIIa

Type of assessment

This year single fleet SURBA runs were carried out for two of the main surveys assessing this stock, the NIGFS March and NIGFS October to provide trends in the stock. Overall it is clear that the stock is in a state of decline. Landings have decreased, and have been at low levels in recent years (<100 t). The survey results indicate a decline in SSB to low levels in recent years. Total mortality has been variable over the time-series.

ICES advice applicable to 2009

The Single Stock Exploitation Boundary advised by ICES for 2009 was as follows:

- Exploitation boundaries in relation to precautionary limits.

On the basis of the stock status ICES advises that catches of whiting in 2009 should be the lowest possible.

ICES advice applicable to 2010

The Single Stock Exploitation Boundary advised by ICES for 2010 was as follows:

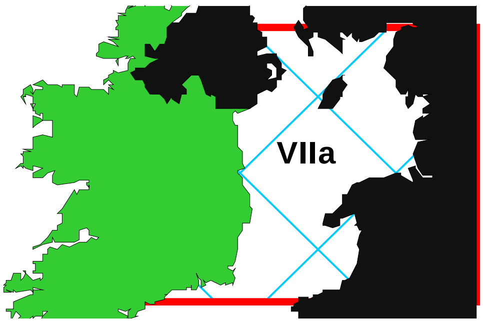
- Exploitation boundaries in relation to precautionary limits.

On the basis of the stock status ICES advises that catches of whiting in 2010 should be the lowest possible.

6.6.1 General

Stock description and management units

The stock and the management unit are both ICES Division VIIa (Irish Sea).



Red Box-TAC/Management Area
Blue Shading– Assessment Area

Management applicable to 2009 and 2010

The minimum landing size of whiting is 27 cm. The 2010 TAC for whiting VIIa has been reduced from 209 t to 157 t. This TAC has not been considered restrictive, with officially reported VIIa landings totalling t in 2009.

TAC 2009

Species: Whiting *Merlangius merlangus*		**Zone:** VIIa (WHG/07A.)
Belgium	1	
France	7	
Ireland	120	
The Netherlands	0	
United Kingdom	81	
EC	209	
TAC	209	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC 2010

Species: Whiting *Merlangius merlangus*		**Zone:** VIIa (WHG/07A.)
Belgium	0	
France	5	
Ireland	91	
The Netherlands	0	
United Kingdom	61	
EU	157	
TAC	157	Analytical TAC

Fishery in 2009

ICES officially reported landings for Division VIIa and landings as used by the Working Group are given in Table 6.6.1. In recent years the values provided to the WG are very similar to officially reported landings. In 2009 international landings provided to the Working Group have increased by 25% to those of 2008, although actual numbers remain extremely low, 100 t.

The Irish Sea whiting stock is primarily caught by otter trawlers and to a lesser extent, Scottish seines, beam trawls and gillnets. Otter trawlers utilize two main mesh size ranges, 70–89 mm and 100–119 mm. Effort of trawlers utilizing the larger mesh range, traditionally targeting whitefish (cod, haddock, whiting) has seen a large declined since 2003, partially as a result of effort management restrictions. The smaller range however has remained relatively stable. The primary target species of this smaller mesh range is *Nephrops* from which whiting is discarded at a high rate.

The closure of the western Irish Sea to whitefish fishing from mid-February to the end of April, designed to protect cod, was continued in 2009 but is unlikely to have affected whiting catches which are mainly bycatch in the derogated *Nephrops* fishery. *Nephrops* vessels can obtain a derogation to fish in certain sections of the closed area, providing they fit separator panels to their nets to allow escape of cod and other fish. The Irish and UK NI *Nephrops* fishery shows a peak in activity in summer months, after the reopening of the Irish Sea cod box.

In late 2009, a number of Irish vessels operating within the Irish Sea *Nephrops* fishery incorporated a Swedish grid into otter trawls, as part of the cod long-term management plan. It is expected that this will reduce the whiting catches of these vessels by ~60% in weight. Furthermore, a small number of vessels began utilizing an inclined separator panel expected to reduce whiting catch by ~75% in weight (STECF, 2010).

For a fourth successive year, Irish East Coast *Nephrops* vessels have moved away from their traditional Irish Sea grounds to the Smalls grounds (FU20; VIIg) which is not controlled by effort limitation and generally better prices are obtained for their catch.

During 2008 Ireland introduced a further decommissioning scheme with the aim of removing 11 140 GT from the fleet register. This was targeted at vessels over 10 years and >18 m. Of the decommissioned vessels 29 operated within the Irish Sea, primarily targeting *Nephrops* landing into east, and to a lesser extent south coast ports.

6.6.2 Data

An overview of the data provided and used by the WG is shown in Table 2.1 in the WGCSE Report.

Fishery landings

Table 6.6.1 gives the nominal landings of VIIa whiting as reported by each country to ICES. The officially reported landings have declined since 1996. Landings remained at a very low level in 2009, although show an increase of 25% to 2008, Working Group estimates of catch available since 1980 are illustrated in Figure 6.6.1 and indicate the declining trend since the start of the time-series. Minor revisions were made to last year's Working Group estimate of landings (~0.5 t).

There is evidence that officially reported landings of whiting in the past (especially around the mid 1990s) have been inaccurate due to misreporting. Landings data have previously been partially corrected for by using sample-based estimates of landings at a number of Irish Sea ports. Due to the low level of landings recently, this has not been carried out since 2003.

The introduction of UK and Irish legislation requiring registration of fish buyers and sellers may mean that the reported landings from 2006 onwards are more representative of actual landings.

Sampling and raising methods previously used are described in the Stock Annex for VIIa whiting. Methods for estimating quantities and composition of landings are described in the Stock Annex (Section B1.1).

Landings, discards and total catch numbers and weights-at-age for the period 1980 to 2002 as estimated by WGNSDS 2002 are given in Tables 6.6.3 to 6.6.8. The proportion of the total catch comprising of discards from the *Nephrops* fleets increased over time for ages 1 and above (Table 6.6.9), although this will also reflect trends in catch of vessels not sampled for discards. While the proportion of discarded fish has increased it is largely due to the decline in abundance of marketable sized whiting

(>27 cm) and the total volume over time has declined as shown in Table 6.6.10. Mean weights-at-age for landings and discards are presented in Figure 6.6.3.

Since 2003 it has not been possible to construct catch numbers-at-age for this stock. This is due to a number of factors including low levels of landings, leading to low sampling levels, in addition to restricted access to some ports in some years.

Discards data

Discarding of whiting is high within the Irish Sea. The onboard observer trips carried out in 2009 by UK (E&W), UK (NI) and Ireland, showed negligible fish were retained on board, while high numbers of small fish were discarded. Raised discards from the main national fleets landing whiting show over 40 million whiting, 1500 t in weight, were discarded in 2009. This focused on the two youngest ages, and to a lesser extent age 2. In some years up to age 4 fish are discarded. The following discard data were available for this stock:

- Discard numbers-at-age from 1980–2002 estimated from the NI *Nephrops* fishery and raised to the International Fleet (from the NI self sampling scheme).
- Discard numbers-at-age from the Irish Otter Trawl Fleet from 1996–2009, including length frequency data.
- Discard Length Frequencies for the UK (E and W) fleet, 2004–2009, raised to trip.
- Discard numbers-at-age for the NI fleet for 1997–2001, and 2006, 2007 and 2009, raised to trip, including length frequency data from the NI observer scheme.

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the Stock Annex Section B.1.2. Irish otter trawl fleet discard estimates (1996–2009), raised according to the methods described in Borges *et al.*, 2005 were available to the Working Group (Table 6.6.11).

Mean weights-at-age for the Irish otter trawl fleet are also presented (Figure 6.6.4(b)).

The length frequency of discards of national sampled fleets in 2009 is given in Figure 6.6.5.

Biological data

The derivation of these parameters and variables is described in the Stock Annex 6.6.

Survey data used in assessment

Table 6.6.2 describes the survey data made available to the Working Group. Slight revisions to the UK (E&W)-BTS-3Q survey time-series were made for the 2009 Working Group.

Figure 6.6.2 provides a comparison of mean catch weights of whiting from the eastern and western Irish Sea for UK NIGFS-Mar groundfish surveys from 1992 to March 2010 indicating low level catch rates since 2003. There is some indication within the 2009 NIGFS-Oct survey of a good recruitment, the signal for this far weaker in the following March survey.

Further information on whiting distribution is detailed in the results of Fisheries Science Partnership surveys of Irish Sea round fish stocks (www.cefas.co.uk/fsp,WD10).

WGNSDS 2006 also provides information on the distribution of whiting less than MLS in the Irish Sea up to 2006.

Survey-series for whiting provided to the Working Group are further described in the Stock Annex for VIIa whiting (SectionB.3).

Commercial cpue

Commercial catch and effort series data available to the Working Group are described in the Stock Annex for VIIa whiting (Section B.4). Although effort data were provided for the UK (E&W) and Ireland, it was decided not to include this data in the Report as it was considered not to be indicative of lpue trends due to the low levels of landings and changes in discard practices.

6.6.3 Historical stock development

No assessment was carried out for this stock in 2008 or 2009. The last assessment for this stock was a survey based assessment in 2007.

Catch-at-age data was not updated and commercial catch data was not explored in 2009.

Data screening

The general methodology is outlined in Section 2.

Final update assessment

Single fleet survey based runs were carried out on the NIGFS-Mar and NIGFS-Oct surveys using SURBA (version 2.2). Default values of 1 were used for both catchability and Lambda settings.

Log-mean standardised indices and scatter plots of log-index at age for the NIGFS-March are presented in Figures 6.6.6(a) and Figure 6.6.7(a), respectively. Both plots indicate poor internal consistency within the survey. The survey appears to track the 1991 year class but examination of the internal consistency via the scatter plots indicates poor correlation between age classes. Corresponding figures for the NIGFS-Oct are plotted in Figures 6.6.6(b) and 6.6.7(b) for the UK Northern Ireland October groundfish Survey. There is some indication of tracking for the 1991, 1994 and 1995 year class but scatterplots at age are noisy and do not show strong positive correlations.

Catch curves for the NIGFS-Mar and NIGFS-Oct survey are plotted in Figure 6.6.8(a) and (b). Both surveys show a steep decline in log-numbers at age over time.

Empirical SSB estimates are presented in Figure 6.6.9 for the NIGFS March and the NIGFS October surveys. Both NIGFS surveys show SSB to be leveling out at highly reduced levels since around 2005/2006.

Figure 6.6.10 shows the residual plots by age for the NIGFS March survey, the model fits well for age one but for older ages residuals are quite noisy, especially in the latter part of the time-series. Stock summary for the NIGFS March is shown in Figure 6.6.11. The temporal F trend is variable in later years with the current year being comparatively low, there are no extreme age or cohort effects. The plot of empirical SSB with model fit (bottom, centre) shows good fit for most years. Figure 6.6.12 shows the retrospective summary plot for the NIGFS March survey. SSB is declining since 2002, and has reached low levels in most recent years; there is no apparent retrospective pattern. F shows an increasing trend over the time-series, although it appears to have temporarily declined in 2008. Recruitment is also variable but estimated to be been good in 2006 and 2008. There is no strong retrospective pattern for recruitment but there are noisy periods 1995–2000 and 2004–2008.

Residual plots by age for the NIGFS October survey are shown in Figure 6.6.13. Residuals are quite noisy for all ages apart from age 0. Figure 6.6.14 shows the stock summary plot for the NIGFS October. The temporal F trend is variable throughout the time-series, particularly within the last 3 years. There appears to be an age effect for age 3 for this survey but no strong cohort effects. The plot of empirical SSB versus model estimates shows deteriorating fit for the latter part of the time-series. Retrospective patterns for the summary plots (Figure 6.6.15) show a variable F trend over the time-series. SSB has been declining since 2003 with a slight halt in 2008. Recruitment appears to have been good in 2006 and 2008. No retrospective bias is evident in F, SSB or recruitment.

The state of the stock

The decline in fishery landings to under 1000 t since 2000 has been interpreted in all assessment models as a collapse in biomass, despite the absence of an analytical assessment. Generally, trends in biomass have been declining in recent years. Recruitment appears to have been good in 2006 and 2008. However the long-term trends of recruitment for this stock are difficult to interpret given the uncertainty in discard estimates for younger ages.

6.6.4 Short-term predictions

6.6.5 Medium-term projection

There is no analytical assessment for this stock.

6.6.6 Maximum sustainable yield evaluation

High discarding, low landings and poor sampling has lead to uncertain catch data in recent years. This data does not support the evaluation or estimation of F_{msy}. However it is likely that current F is above F_{msy}.

6.6.7 Biological reference points

Precautionary approach reference points

No precautionary reference points have been defined for this stock.

6.6.8 Management plans

No management plan has been agreed or proposed.

6.6.9 Uncertainties and bias in assessment and forecast

There is no analytical assessment for this stock.

6.6.10 Recommendations for next benchmark assessment

Before a benchmark can be recommended, it is first necessary to construct international catch numbers/weights-at-length and age for the main fleets engaged in the fishery since 2003. Effort data for the main fleets engaged in whiting VIIa fisheries are required to provide a time-series of trends in commercial lpue. None of these issues will be resolved in the short term and a benchmark assessment of this stock in the near future is unlikely.

6.6.11 Management considerations

Technical measures applied to this stock include a minimum landing size (≥27 cm) and minimum mesh sizes applicable to the mixed demersal fisheries. These measures are set depending on areas and years by several regulations.

Whiting are caught within a number of different fisheries as a non-target species, primarily within demersal otter trawl fisheries. Significant decline of the mixed gadoid directed fishery has occurred within the Irish Sea to minimal levels. Bycatches also occur within flatfish and ray beam trawl fisheries.

Discarding of this stock is a major consideration and efforts should be made to reduce catches of undersized fish through technical considerations. In late 2009, a number of Irish vessels operating within the Irish Sea *Nephrops* fishery incorporated a Swedish grid into otter trawls, as part of the cod long-term management plan. It is expected that this will reduce the whiting catches of these vessels by ~60% in weight. Furthermore, a small number of vessels began utilizing an inclined separator panel expected to reduce whiting catch by ~75% in weight (STECF, 2010). Implementation of such measures should be actively encouraged.

Effort limitations are in force within the Irish Sea as a result of the cod long-term management plan. Although vessels catching whiting will be affected by this regulation at present it is not believed that the effort limitations will prove beneficial to the whiting stock.

Whiting has a low market value, which is likely to contribute to discarding rates.

6.6.12 References

STECF 01-2010. 33rd Plenary meeting report of the Scientific, Technical and Economic Committee for Fisheries (PLEN-10-01) plenary meeting, 26–30 April 2010, Norwich. Edited by John Casey and Hendrik Dörner.

Table 6.6.1. Nominal catch (t) of whiting in Division VIIa, 1988–2009, as officially reported to ICES and Working Group. Discard estimates available until 2001.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	90	92	142	53	78	50	80	92	80	47	52
France	1,063	533	528	611	509	255	163	169	78	86	81
Ireland	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119	1,260
Netherlands									17	14	7
UK(Engl. & Wales)[a]	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	3,557	3,152	1,900
Spain											
UK (Isle of Man)	15	26	75	74	44	55	44	41	28	24	33
UK (N.Ireland)	4,621										
UK (Scotland)	107	154	236	223	274	318	208	198	48	30	22
UK											
Total human consumption	11,492	11,328	8,183	7,411	7,094	5,977	5,637	5,465	5,581	4,472	3,355
Estimated Nephrops fishery discards used by the WG[b]	1,611	2,103	2,444	2,598	4,203	2,707	1,173	2,151	3,631	1,928	1,304
Working Group Estimates	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205	3,533

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	46	30	27	22	13	11	10	4.2	3	2	2.3
France	150	59	25	33	29	8	13	3.7	3	2	NA
Ireland	509	353	482	347	265	96	94	55.3	187	68	67.56
Netherlands	6	1									
UK(Engl. & Wales)[a]	1,229	670	506	284	130	82	47	21.7	3	11	19.9
Spain					85						
UK (Isle of Man)	5	2	1	1	1	1			1	1	
UK (N.Ireland)											
UK (Scotland)	44	15	25	27	31	6	<0.5	<0.5	<0.5		
UK											
Total human consumption	1,989	1,130	1,066	714	554	204	164	84.9	197	84	90
Estimated Nephrops fishery discards used by the WG[b]	1,092	2,118	1,012	740	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Working Group Estimates	2,762	2,880	1,745	1,487	676	184	158	86	196	81	101

[a] 1989-onwards Northern Ireland included with England and Wales.
[b] Based on UK(N.Ireland) and Ireland data.
[*] Preliminary.

Table 6.6.2. VIIa whiting survey data available to WGCSE 2010. Survey Titles highlighted in bold have been updated.

NIGFS West-October : Northern Ireland October Groundfish Survey - Irish Sea West - Nos. per 3 nm

1994	2009						
1	1 0.83	0.88					
0	5						
1	6077	1139	36	33.0	1.8	0.1	1994
1	4660	962	130	10.0	4.7	1.5	1995
1	5933	792	117	20.0	1.7	0.5	1996
1	8722	628	125	10.0	4.9	0.2	1997
1	8199	708	134	16.0	0.7	0.0	1998
1	7481	360	44	4.0	1.4	0.0	1999
1	4037	593	32	2.0	2.1	0.3	2000
1	15262	761	205	16.0	0.1	0.0	2001
1	7229	1712	114	11.7	0.9	0.5	2002
1	8487	1600	469	19.1	1.2	0.1	2003
1	11446	1119	124	12.0	0.0	0.0	2004
1	5433	299	54	7.2	0.5	0.0	2005
1	4625	173	22	4.7	0.5	0.0	2006
1	5932	1491	125	4.2	0.2	0.0	2007
1	13253	2814	294	10.0	0.0	0.0	2008
1	5927	555	117	14.5	1.9	0.1	2009

NIGFS West-March : Northern Ireland March Groundfish Survey - Irish Sea West - Nos. per 3 nm

1994	2010					
1	1 0.21	0.25				
0	4					
1	4307	73	121	6	0	1994
1	3604	988	53	30	1	1995
1	2323	587	188	11	15	1996
1	3250	447	52	14	1	1997
1	3857	535	71	9	3	1998
1	2373	228	39	7	2	1999
1	4037	231	23	3	0	2000
1	1998	631	30	2	1	2001
1	3580	163	36	3	0	2002
1	2952	812	25	6	1	2003
1	3568	174	36	1	0	2004
1	1219	97	6	1	0	2005
1	1266	150	12	0	0	2006
1	1825	190	10	1	0	2007
1	1254	290	17	1	0	2008
1	1941	227	10	1	0	2009
1	1485	297	20	1	0	2010

NIGFS East-October : Northern Ireland October Groundfish Survey - Irish Sea East - Nos. per 3 nm

1994	2009						
1	1 0.83	0.88					
0	5						
1	749	472	179	165.0	29.0	3.0	1994
1	2515	259	178	41.0	47.0	9.0	1995
1	1005	517	127	64.0	15.0	10.0	1996
1	640	668	682	88.0	26.0	6.0	1997
1	1446	277	178	95.0	11.0	4.0	1998
1	2287	1388	260	102.0	79.0	3.0	1999
1	1972	1288	216	26.0	22.0	9.0	2000
1	2998	691	300	35.0	7.0	5.0	2001
1	1296	1285	349	76.0	8.5	2.0	2002
1	3783	1939	1104	155.4	25.0	3.2	2003
1	1820	521	347	109.1	7.7	1.7	2004
1	1247	865	296	17.5	1.9	0.6	2005
1	2304	150	52	9.0	2.1	0.0	2006
1	1094	827	165	18.4	2.9	3.1	2007

```
1     2329     873    81     1.3    0.2    0.0    2008
1     641      675    48     4.4    1.1    0.0    2009
```

NIGFS East-March : Northern Ireland March Groundfish Survey - Irish Sea East - Nos. per 3 nm

```
1993  2010
1     1 0.21   0.25
1     5
1     611      290    390    47     12.0   1994
1     448      522    142    109    25.0   1995
1     1094     221    203    40     44.0   1996
1     561      1054   91     33     2.0    1997
1     409      903    522    32     11.0   1998
1     1023     407    135    52     6.0    1999
1     1481     524    229    35     4.0    2000
1     631      739    162    15     9.0    2001
1     869      1043   243    54     13.1   2002
1     1118     1328   178    24     5.7    2003
1     1026     302    69     4      1.6    2004
1     499      129    41     12     3.9    2005
1     964      323    39     10     0.7    2006
1     623      120    11     3      0      2007
1     669      417    51     3      0      2008
1     956      313    47     2      0      2009
1     671      357    24     2      2      2010
```

UKE&W-BTS : Corystes Irish Sea Beam Trawl Survey (Sept) - Prime stations only - Effort and numbers at age (per km towed)

```
1988  2009
1     1 0.75   0.79
0     1
1     326      134    1988
1     226      66     1989
1     316      242    1990
1     494      74     1991
1     451      596    1992
1     297      197    1993
1     196      133    1994
1     1952     74     1995
1     172      207    1996
1     406      277    1997
1     905      186    1998
1     581      153    1999
1     321      139    2000
1     596      197    2001
1     283      103    2002
1     520      184    2003
1     908      339    2004
1     845      293    2005
1     1019     222    2006
1     369      90     2007
1     826      85     2008
1     397      385    2009
```

NIGFS-Oct E&W : Northern Ireland October Groundfish Survey - Irish Sea East & West - Nos. per 3 nm

```
1992  2009
1     1 0.83   0.88
0     5
1     1454     995    96     26.0   4.0    0.0    1992
1     1554     425    300    27.0   2.0    0.1    1993
1     2450     686    133    123.0  20.0   2.0    1994
1     3199     483    163    30.9   33.6   6.9    1995
1     2628     605    124    50.0   10.8   6.8    1996
1     3219     655    504    63.0   19.0   4.0    1997
1     3601     414    164    70.0   7.9    3.0    1998
1     3945     1060   191    70.0   54.1   1.7    1999
```

1	2631	1066	158	18.0	15.8	6.1	2000
1	6911	713	270	29.0	4.7	3.1	2001
1	3189	1421	274	55.4	6.1	1.5	2002
1	5284	1831	901	111.9	17.4	2.2	2003
1	4892	712	276	78.1	5.3	1.2	2004
1	2583	684	219	14.2	1.5	0.4	2005
1	3045	157	43	7.6	1.6	0.0	2006
1	2638	1039	153	13.8	2.0	2.1	2007
1	5815	1492	149	4.1	0.1	0.0	2008
1	2328	637	70	7.6	1.3	0.0	2009

NIGFS-March E&W : Northern Ireland March Groundfish Survey- Irish Sea East & West - Nos. per 3 nm

1992 2010
1 1 0.21 0.25
1 5

1	1477	456	94	29	5.0	0.0	1992
1	667	655	67	9	2.0	0.5	1993
1	1790	221	304	34	8.0	5.0	1994
1	1696	698	116	85	17.0	3.0	1995
1	1478	280	160	28	32.0	5.6	1996
1	1419	860	79	27	1.7	4.3	1997
1	1730	767	196	12	3.3	0.1	1998
1	1453	350	104	38	5.0	1.0	1999
1	2297	431	163	25	2.7	0.0	2000
1	1067	704	120	11	7	1.6	2001
1	1734	762	177	38	9	0.3	2002
1	1703	1163	129	18	4	0.0	2003
1	1837	261	59	3	1	0.1	2004
1	729	119	30	9	3	0.3	2005
1	1054	274	31	7	1	0.1	2006
1	1007	142	11	2	0.1	0.0	2007
1	856	376	40	3	0.2	0.0	2008
1	1270	285	35	1	0.1	0.1	2009
1	931	338	23	2	1.5	0.0	2010

UKNI-MIK : Northern Ireland MIK Net Survey

1994 2009
1 1 0.46 0.50
0 0

1	778	1994
1	225	1995
1	397	1996
1	205	1997
1	59	1998
1	91	1999
1	40	2000
1	167	2001
1	19	2002
1	148	2003
1	101	2004
1	135	2005
1	118	2006
1	82	2007
1	99	2008
1	173	2009

ScoGFS Spring : Scottish groundfish survey in Spring

1996 2006
1 1 0.15 0.21
1 8

1	11610	4051	1898	362	229	59	3	4	1996
1	16322	16200	2953	964	250	105	39	1	1997
1	22145	8187	3817	137	110	0	5	0	1998
1	19815	6642	1706	282	11	0	27	0	1999
1	13019	1662	169	71	36	6	0	0	2000
1	9419	4541	407	40	2	0	0	0	2001
1	15605	3060	430	34	1	0	0	0	2002

```
1    14798   5404   375    45     0      4      0      0      2003
1    9199    2219   583    27     1      0      0      0      2004
1    3783    899     200   56     3      0      0      0      2005
1    7317    1040   319    32     2      0      0      0      2006

ScoGFS Autumn : Scottish groundfish survey
1995   2005
1       1      0.83  0.91
0       6
1
1    30094   8827   2530   435    215    4      0      1997
1    18457   7166   1291   37     35     26     0      1998
1    73309   7357   2166   263    219    0      6      1999
1    16862   8677   503    242    25     12     0      2000
1    0       140    133    13     0      0      0      2001
1    30324   16655  1435   224    2      28     0      2002
1    26671   7170   1138   69     0      0      0      2003
1    42435   19333  3321   319    3      0      0      2004
1    16510   3382   97     4      2      3      0      2005

IR-ISCSGFS : Irish Sea Celtic Sea GFS 4th Qtr - Effort min. towed -
No. at age
1997 2002
1    1 0.8    0.9
0    5
540  1566    3330   793    154    23     12     1997
1020 48396   6534   2249   170    15     0      1998
1170 208494  3302   624    24     28     2      1999
1128 97502   4402   25     1      0      0      2000
1221 28881   29577  3123   177    1      0      2001
1035 12112   10237  1497   225    33     5      2002

IR-Q4 IBTS: IRISH GFS RV Celtic Explorer: NUMBERS AT AGE
2003 2004
1    1 0.89   0.91
0    5
1    72340   19658  13391  1617   605    0      2003
1    75196   14563  1293   147    5      2      2004

IR-OTB : Irish Otter trawl - Effort in h - VIIa Whiting numbers at age
- Year
1995 2002
1    1 0      1
1    6
80314  6      437    206    261    21     1      1995
64824  64     682    1528   266    71     4      1996
92178  3      368    494    418    55     19     1997
93533  20     395    838    117    27     30     1998
110275 34     398    531    130    19     3      1999
82690  40     192    155    58     8      0      2000
77541  13     397    444    42     22     3      2001
77863  21     173    383    88     8      8      2002

UKNI-Pelagic trawl : Northern Ireland Midwater trawlers - Effort in h
- No per h fished
1993 2002
1    1 0      1
2    6
74014  3174   1060   172    29.5   4.8    1993
73778  1706   4340   574    72.8   16.2   1994
52773  1997   416    719    37.9   7.2    1995
53083  1432   2276   361    327.4  41.8   1996
55863  1241   660    549    12.3   17.5   1997
61153  438    423    98     45.8   2.7    1998
72859  162    185    57     13.5   11.6   1999
46412  67     53     11     7.9    1.1    2000
50302  7      4      2      0.5    0.2    2001
```

57754	189	316	90	11	15	2002

UKNI-Otter trawl : Northern Ireland single-rig otter trawlers - Effort in h - No per h fished - includes discards

1993 2002

1 1 0 1

0 6

195323	10308	9217	21444	2791	261	28	2	1993
191705	3172	11286	3957	9723	747	75	16	1994
161025	5228	10692	8874	987	1312	17	1	1995
154418	8663	20784	6748	4623	551	460	56	1996
165612	4344	12001	5864	1292	528	7	7	1997
149088	5869	11381	2368	1135	200	50	1	1998
146990	14625	3517	1202	344	59	12	8	1999
130117	4403	12613	3082	520	61	14	8	2000
131418	10658	6663	1833	228	64	13	10	2001
108616	4601	8586	1068	265	44	3	2	2002

UKE&W-Otter trawl : England/Wales Otter Trawl

1981 2000

1 1 0 1

2 6

107	906	766	162	103	4	1981	
127	1984	893	340	67	49	1982	
88	685	1065	227	67	21	1983	
103	1395	439	475	80	29	1984	
103	2077	889	148	125	25	1985	
90	2246	1006	158	20	17	1986	
131	2206	1505	316	58	5	1987	
132	1885	827	161	30	6	1988	
140	1344	1201	234	40	10	1989	
117	2076	671	222	35	14	1990	
107	2374	793	165	48	5	1991	
97	2072	1020	177	42	3	1992	
79	784	654	157	31	5	1993	
43	110	454	91	15	3	1994	
43	460	188	375	7	1	1995	Revised at NSWG 1997
42	260	604	102	90	10	1996	
40	331	211	155	7	1	1997	
37	311	355	81	28	1	1998	
23	194	175	46	11	8	1999	
27	186	134	47	36	4	2000	

Table 6.6.3. VIIa whiting International numbers-at-age ('000) for human consumption, 1980–2002 (partially corrected for misreporting). Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0	0	41	0	0	0	0	0	0	0
1	14520	11203	5427	4886	18254	15540	6306	10149	6983	11645
2	21811	29011	18098	9943	12683	35324	16839	21563	25768	14029
3	6468	16004	19340	9100	5257	8687	10809	6968	6989	13011
4	2548	2596	6108	4530	2571	996	1877	1943	1513	3645
5	350	821	813	1165	1045	675	285	242	396	490
6+	621	339	400	321	402	372	270	111	197	177

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0	102	0	38	0	0	129	0	0	1
1	9502	7426	8380	2742	3245	1124	1652	610	329	341
2	17604	18406	21907	21468	6983	10095	6162	4239	3287	2806
3	4734	5829	7959	7327	18509	3020	7432	2567	4727	2607
4	1477	993	1374	932	1801	4444	1263	1795	888	741
5	318	311	462	135	208	233	1082	87	261	160
6+	128	84	93	27	50	21	135	79	95	119

Age	2000	2001	2002
0	0	0	0
1	319	111	67
2	1364	1189	748
3	1002	1006	1480
4	299	171	376
5	115	53	48
6+	15	20	41

Table 6.6.4. VIIa whiting International discard numbers-at-age ('000), 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	12786	9865	4047	23847	26394	12380	28364	16594	6922	17247
1	32318	24935	8489	7328	33900	26461	21111	40598	17958	20701
2	6888	9162	560	2036	1568	1859	1464	1875	1940	2476
3	65	162	19	9	11	9	33	0	0	26
4	26	26	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	4216	20349	1497	12639	3731	7118	12732	8163	6096	20851
1	31810	29334	61451	13979	12063	17613	39647	25497	27131	7677
2	3353	3823	10404	17707	1812	7015	8168	5352	2293	2117
3	72	146	97	426	1702	492	1976	689	550	228
4	0	1	0	5	29	234	81	141	44	34
5	0	0	0	0	0	0	0	0	0	2
6+	0	0	0	0	0	0	0	0	0	2

Age	2000	2001	2002
0	7321	16940	8538
1	38922	12631	13412
2	4395	3150	1588
3	564	102	231
4	55	10	33
5	1	0	0
6+	10	0	1

Table 6.6.5. VIIa whiting International catch numbers-at-age ('000) combined landings and discards, 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	12786	9865	4088	23847	26394	12380	28364	16594	6922	17247
1	46838	36138	13916	12214	52154	42001	27417	50747	24941	32346
2	28699	38173	18658	11979	14251	37183	18303	23438	27708	16505
3	6533	16166	19359	9109	5268	8696	10842	6968	6989	13037
4	2574	2622	6108	4530	2571	996	1877	1943	1513	3645
5	350	821	813	1165	1045	675	285	242	396	490
6+	621	339	400	321	402	372	270	111	197	177

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	4216	20451	1497	12677	3731	7118	12861	8163	6096	20852
1	41312	36760	69831	16721	15308	18737	41299	26107	27460	8018
2	20957	22229	32311	39175	8795	17110	14330	9591	5580	4923
3	4806	5975	8056	7753	20211	3512	9408	3256	5277	2835
4	1477	994	1374	937	1830	4678	1344	1936	932	776
5	318	311	462	135	208	233	1082	87	261	161
6+	128	84	93	27	50	21	135	79	95	121

Age	2000	2001	2002
0	7321	16940	8538
1	39242	12742	13479
2	5758	4338	2336
3	1566	1108	1711
4	354	181	409
5	115	53	48
6+	25	20	42

Table 6.6.6. VIIa whiting International landings mean weight-at-age (kg), 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0.133	0.133	0.133	0	0.144	0	0.134	0	0	0
1	0.216	0.216	0.216	0.215	0.208	0.174	0.184	0.173	0.152	0.197
2	0.269	0.269	0.269	0.279	0.257	0.250	0.225	0.223	0.214	0.209
3	0.365	0.365	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269
4	0.533	0.533	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433
5	0.630	0.630	0.630	0.605	0.699	0.567	0.709	0.720	0.763	0.680
6+	0.772	0.888	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0	0.115	0	0.117	0	0	0	0	0	0.120
1	0.198	0.172	0.160	0.151	0.169	0.188	0.196	0.171	0.169	0.166
2	0.220	0.210	0.198	0.186	0.198	0.219	0.217	0.219	0.202	0.218
3	0.313	0.266	0.274	0.233	0.227	0.273	0.244	0.244	0.240	0.255
4	0.436	0.352	0.361	0.332	0.304	0.334	0.288	0.296	0.274	0.328
5	0.676	0.453	0.513	0.454	0.378	0.551	0.365	0.396	0.350	0.352
6+	0.800	0.692	1.007	0.892	0.496	1.320	0.415	0.537	0.421	0.328

Age	2000	2001	2002
0	0.064	0	0
1	0.179	0.182	0.145
2	0.216	0.250	0.214
3	0.269	0.319	0.273
4	0.317	0.346	0.356
5	0.347	0.538	0.449
6+	0.412	0.337	0.428

Table 6.6.7. VIIa whiting International discard mean weight-at-age (kg), 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0.034	0.034	0.029	0.033	0.024	0.022	0.023	0.024	0.021	0.026
1	0.062	0.062	0.072	0.101	0.075	0.080	0.058	0.078	0.069	0.063
2	0.125	0.125	0.125	0.147	0.130	0.137	0.126	0.157	0.114	0.105
3	0.230	0.230	0.141	0.245	0	0	0.155	0	0.449	0.091
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.034	0.030	0.014	0.029	0.029	0.031	0.026	0.026	0.017	0.028
1	0.060	0.051	0.050	0.050	0.048	0.055	0.051	0.041	0.034	0.038
2	0.113	0.115	0.110	0.089	0.123	0.120	0.111	0.101	0.090	0.086
3	0.115	0.130	0.137	0.143	0.154	0.153	0.161	0.141	0.130	0.147
4	0	0	0	0.175	0.149	0.179	0.186	0.170	0.145	0.237
5	0	0	0	0	0	0	0	0	0	0.218
6+	0	0	0	0	0	0	0	0	0	0.174

Age	2000	2001	2002
0	0.024	0.017	0.016
1	0.036	0.034	0.033
2	0.100	0.088	0.082
3	0.128	0.119	0.127
4	0.150	0.194	0.141
5	0.213	0	0
6+	0.152	0	0.213

Table 6.6.8. VIIa whiting International catch mean weight-at-age (kg) combined landings and discard, 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0.034	0.040	0.031	0.033	0.032	0.021	0.025	0.024	0.021	0.026
1	0.110	0.118	0.135	0.146	0.125	0.107	0.100	0.101	0.088	0.111
2	0.235	0.240	0.265	0.256	0.244	0.245	0.217	0.217	0.201	0.193
3	0.363	0.364	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269
4	0.529	0.529	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433
5	0.630	0.630	0.630	0.605	0.700	0.567	0.709	0.720	0.763	0.680
6+	0.772	0.888	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.036	0.031	0.014	0.029	0.030	0.031	0.027	0.026	0.017	0.028
1	0.094	0.077	0.063	0.067	0.074	0.063	0.057	0.044	0.035	0.044
2	0.204	0.194	0.170	0.142	0.183	0.179	0.159	0.153	0.156	0.161
3	0.310	0.263	0.272	0.228	0.221	0.257	0.230	0.222	0.228	0.246
4	0.436	0.352	0.361	0.331	0.301	0.326	0.284	0.287	0.268	0.324
5	0.676	0.453	0.513	0.454	0.378	0.551	0.364	0.396	0.350	0.351
6+	0.800	0.692	1.007	0.892	0.496	1.320	0.715	0.679	0.421	0.325

Age	2000	2001	2002
0	0.024	0.017	0.016
1	0.038	0.036	0.033
2	0.127	0.132	0.124
3	0.218	0.301	0.253
4	0.291	0.338	0.339
5	0.347	0.538	0.449
6+	0.310	0.337	0.425

Table 6.6.9. VIIa whiting estimates of discard numbers-at-age from the *Nephrops* fleet as a proportion of total International numbers-at-age.

Age	0	1	2	3	4	5
1981	1.000	0.690	0.240	0.010	0.010	0
1982	0.990	0.610	0.030	0.001	0	0
1983	1.000	0.600	0.170	0.001	0	0
1984	1.000	0.650	0.110	0.002	0	0
1985	1.000	0.630	0.050	0.001	0	0
1986	1.000	0.770	0.080	0.003	0	0
1987	1.000	0.800	0.080	0	0	0
1988	1.000	0.720	0.070	0	0	0
1989	1.000	0.640	0.150	0.002	0	0
1990	1.000	0.770	0.160	0.015	0	0
1991	0.995	0.798	0.172	0.024	0.001	0
1992	1.000	0.880	0.322	0.012	0	0
1993	0.997	0.836	0.452	0.055	0.005	0
1994	1.000	0.788	0.206	0.084	0.016	0
1995	1.000	0.940	0.410	0.140	0.050	0
1996	0.990	0.960	0.570	0.210	0.060	0
1997	1.000	0.977	0.558	0.212	0.073	0
1998	1.000	0.988	0.411	0.104	0.047	0
1999	1.000	0.957	0.430	0.081	0.044	0.009
2000	1.000	0.992	0.763	0.360	0.154	0.005
2001	1.000	0.991	0.726	0.092	0.055	0
2002	1.000	0.995	0.680	0.135	0.081	0.000
Mean 81-02	0.999	0.817	0.311	0.070	0.027	0.001

Table 6.6.10. VIIa whiting estimated landed and discarded catch (t). Data partially corrected for misreporting.

	Catch (t)	
Year	Landed	Discarded
1980	13461	3324
1981	17646	2960
1982	17304	808
1983	10525	1820
1984	11802	3433
1985	15582	2654
1986	10300	2115
1987	10519	3899
1988	10245	1611
1989	11305	2103
1990	8212	2444
1991	7348	2598
1992	8588	4203
1993	6523	2707
1994	6763	1173
1995	4893	2151
1996	4335	3631
1997	2277	1928
1998	2229	1304
1999	1670	1092
2000	762	2118
2001	733	1012
2002	747	740
2003	401	n/a
Mean:	7990	2253

Table 6.6.11. VIIa whiting discard numbers- and mean weights-at-age from the Irish otterboard trawl fleet 1996–2009.

	1996		1997		1998		1999		2000		2001		2002	
Age	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)
0	5631.20	0.015	4110.63	0.027	5073.57	0.027	187.26	0.036	7850.12	0.033	20981.54	0.016	29017.16	0.021
1	5925.33	0.035	8361.19	0.044	5939.53	0.064	276.50	0.102	3098.24	0.047	8883.11	0.054	12097.93	0.033
2	1802.90	0.111	3243.45	0.120	3826.20	0.107	150.99	0.174	137.80	0.153	1413.48	0.126	576.17	0.112
3	144.34	0.217	696.18	0.200	440.05	0.185	43.70	0.235	30.31	0.229	479.38	0.133	152.95	0.105
4	6.02	0.206	68.71	0.241	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	22.95	0.136	17.66	0.123
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
11	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
12	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
13	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
14+	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total weight (t)		520.8		1024.1		1010.3		71.6		434.3		1054.5		1100.9
Sampling Information	1996		1997		1998		1999		2000		2001		2002	
Number of Trips		8		8		7		4		10		2		1
Number of Hauls		48		44		58		40		111		34		7

	2003		2004		2005		2006		2007		2008		2009	
Age	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)	Numbers ('000)	Weight (kg)
0	1921.76	0.016	17091.56	0.018	442.07	0.010	1534.97	0.016	5138.89	0.043	4585.77	0.025	13319.29	0.028
1	2419.56	0.036	7347.29	0.034	2531.84	0.035	1483.43	0.060	23000.16	0.038	7879.78	0.040	12913.10	0.036
2	1287.21	0.178	731.35	0.101	783.68	0.091	621.58	0.133	3282.67	0.095	1485.70	0.093	712.51	0.081
3	603.20	0.246	142.50	0.165	129.28	0.159	99.02	0.218	916.09	0.145	161.03	0.119	2.60	0.175
4	108.64	0.268	96.30	0.218	40.12	0.154	16.82	0.312	10.96	0.276	13.46	0.130	0.89	0.257
5	0.00	0.000	0.00	0.000	24.48	0.371	0.00	0.000	1.92	0.304	0.00	0.000	0.00	0.000
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
11	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
12	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
13	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
14+	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total weight (t)		523.6		680.3		201.3		223.2		1544.7		585.3		892.3
Sampling Information	2003		2004		2005		2006		2007		2008		2008	
Number of Trips		9		11		8		5		15		18		12
Number of Hauls		60		122		96		56		90		91		55

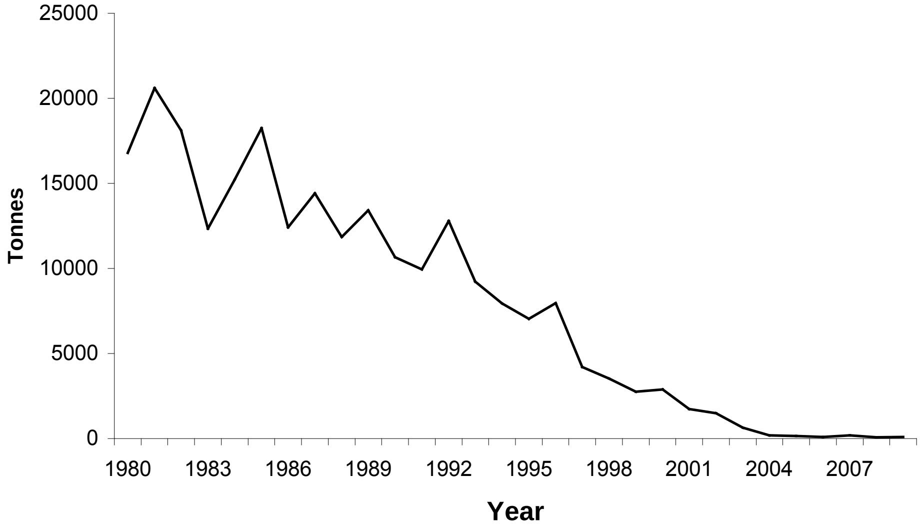


Figure 6.6.1. Whiting VIIa. Working Group estimates of landings 1980–2009. Note landings data prior to 2003 has been adjusted for misreporting and includes estimates of discards.

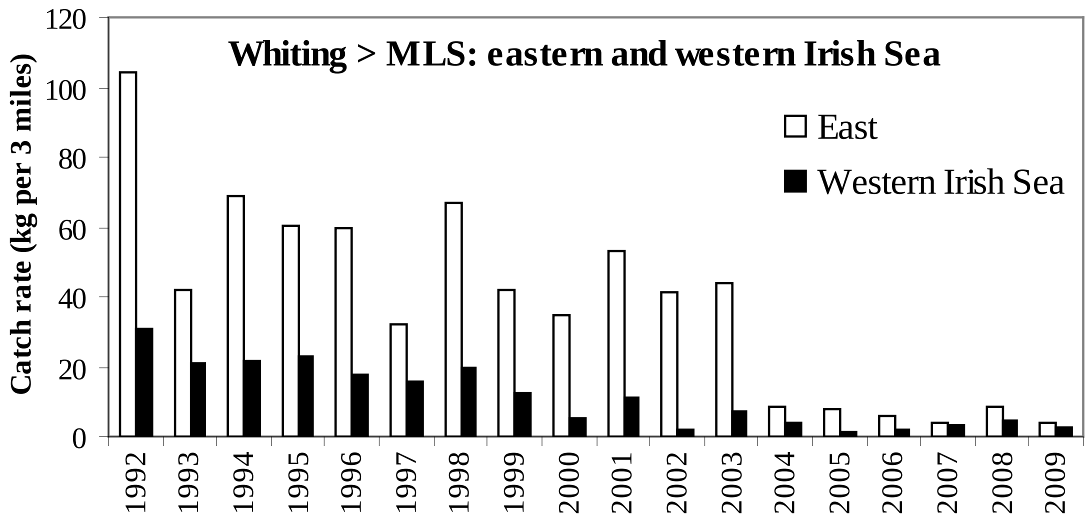


Figure 6.6.2. Eastern and western VIIa whiting mean catch rates in kg per 3-mile tow, for fish at and above the minimum landing size (27 cm) from the UK (NI) March groundfish survey, 1992–2009.

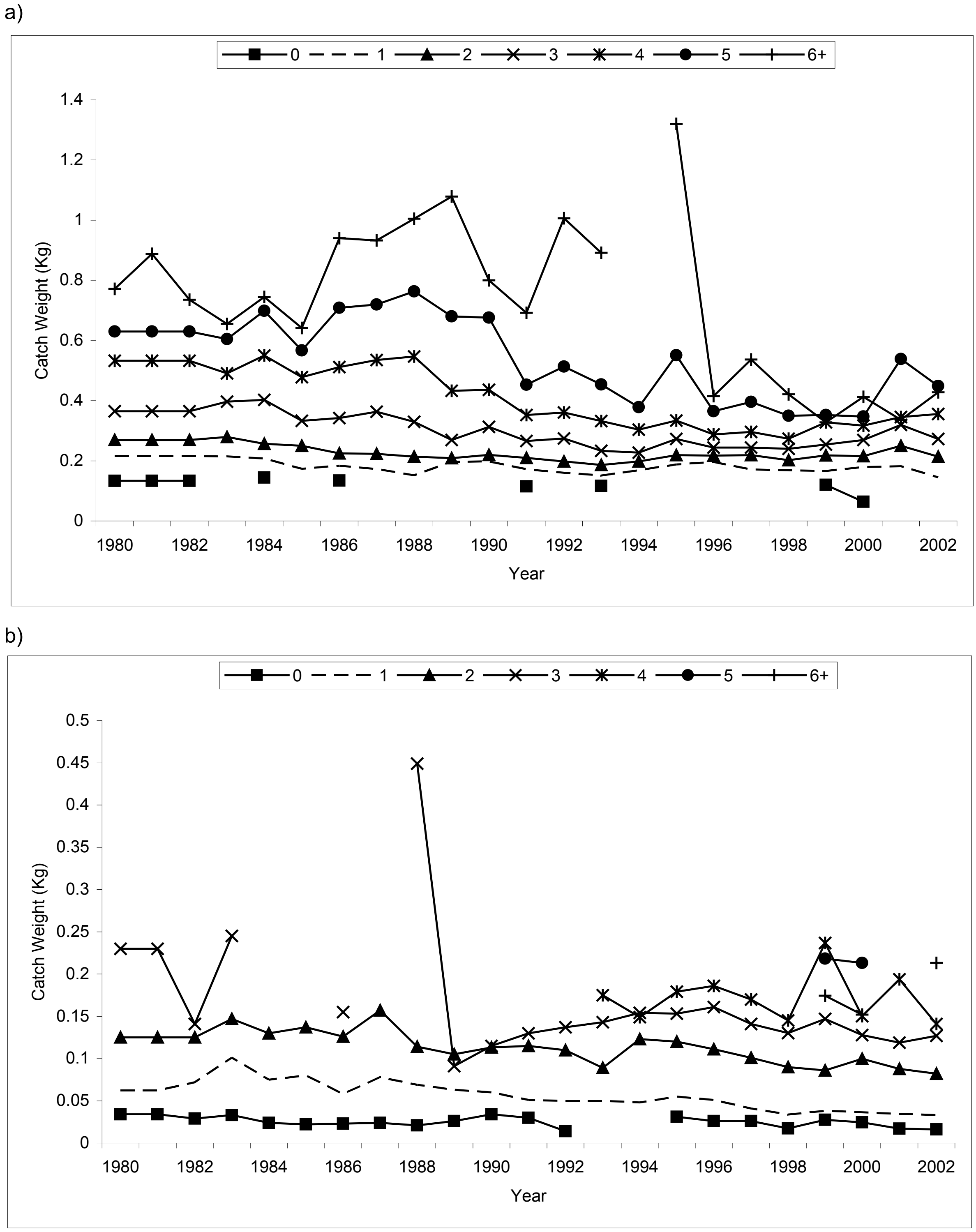


Figure 6.6.3. VIIa whiting International mean weights-at-age in (a) landings (Human Consumption Fishery) and (b) discards, 1980–2002.

a)

b)

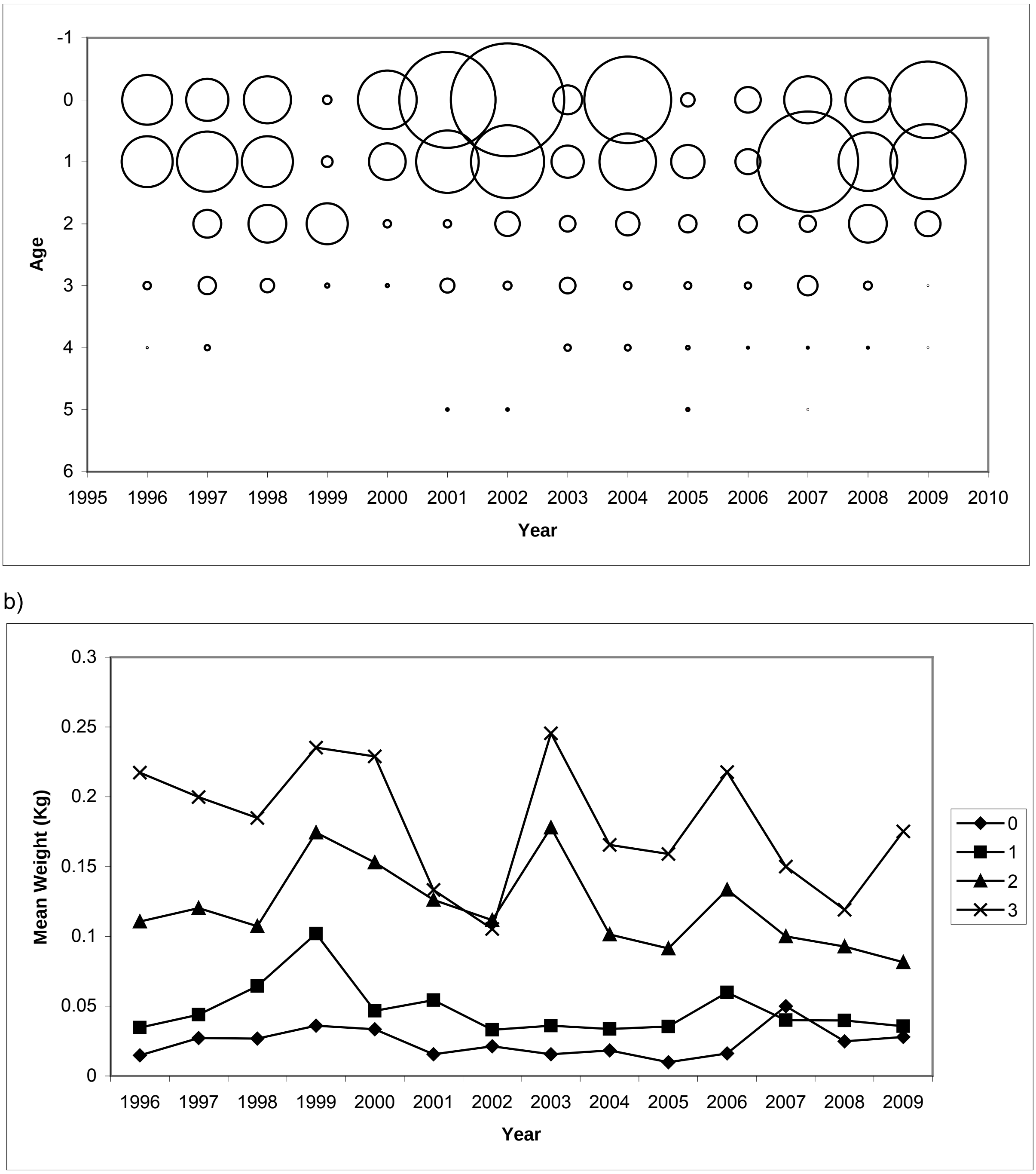


Figure 6.6.4. VIIa whiting discard information for the Irish commercial otterboard trawl fleet (a) numbers-at-age and (b) mean weights-at-age, 1996–2009.

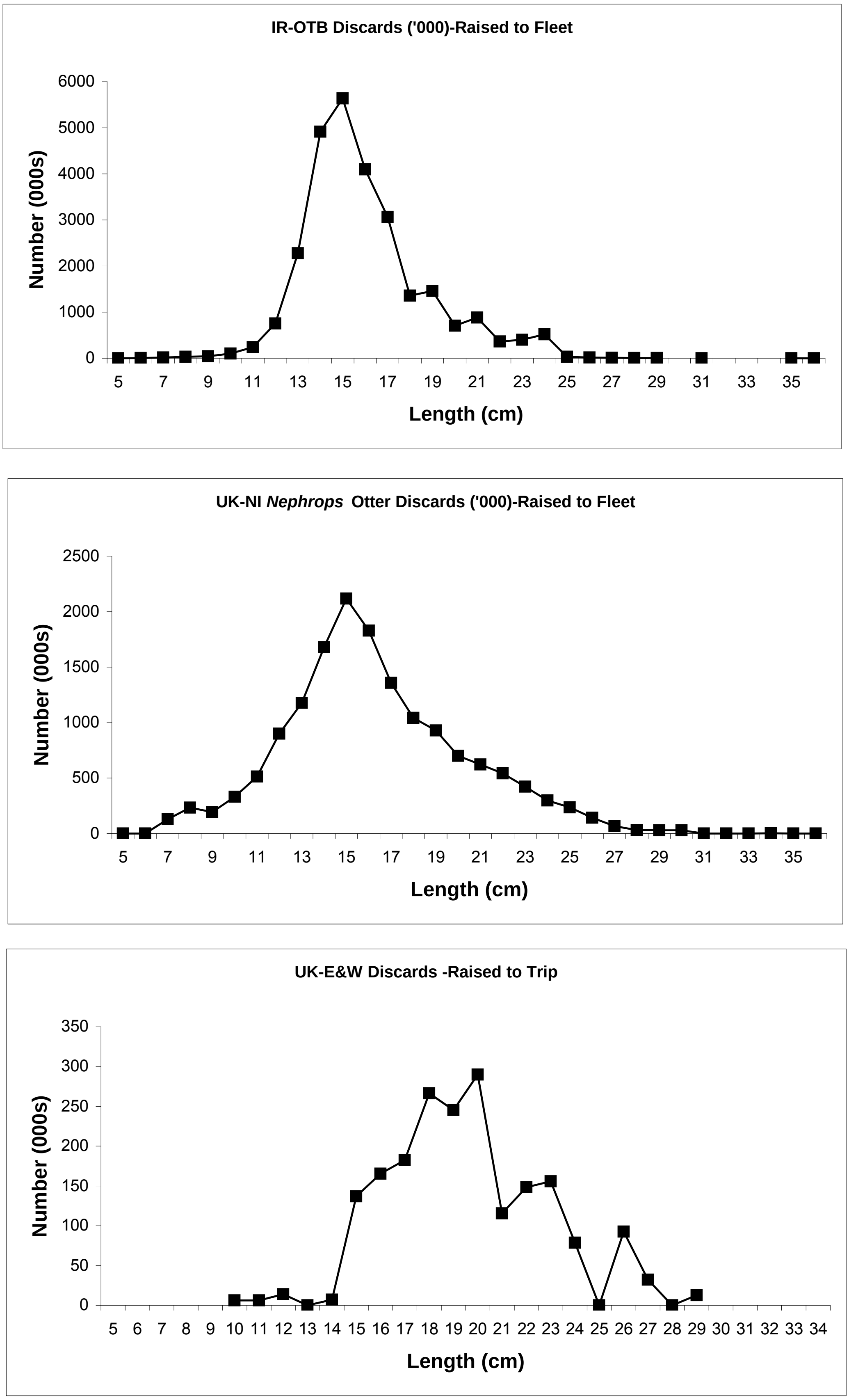
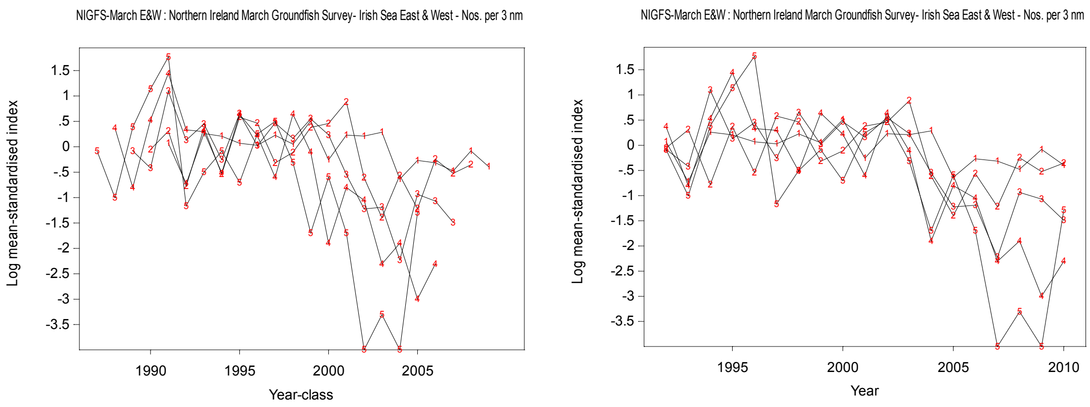


Figure 6.6.5. VIIa Whiting discard length frequency by national fleets in 2009. Note due to low levels of retained catch, and hence low sampling, this data is not presented.

a)



b)

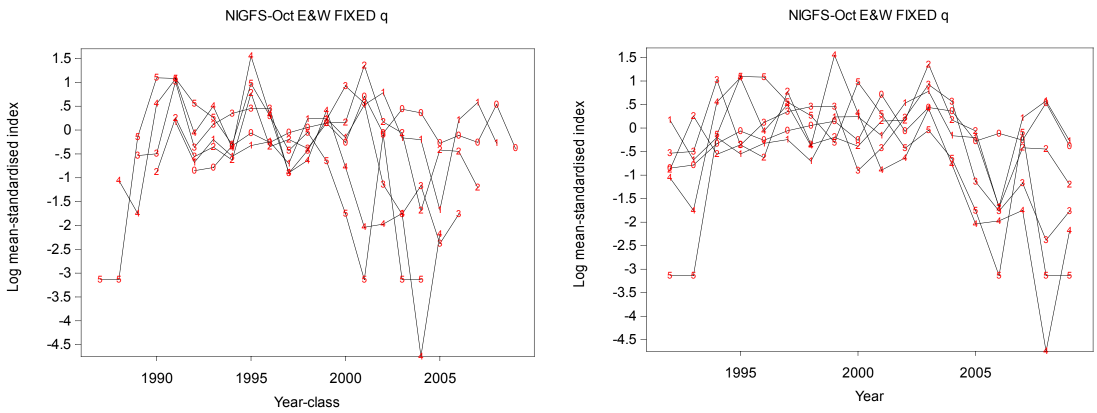
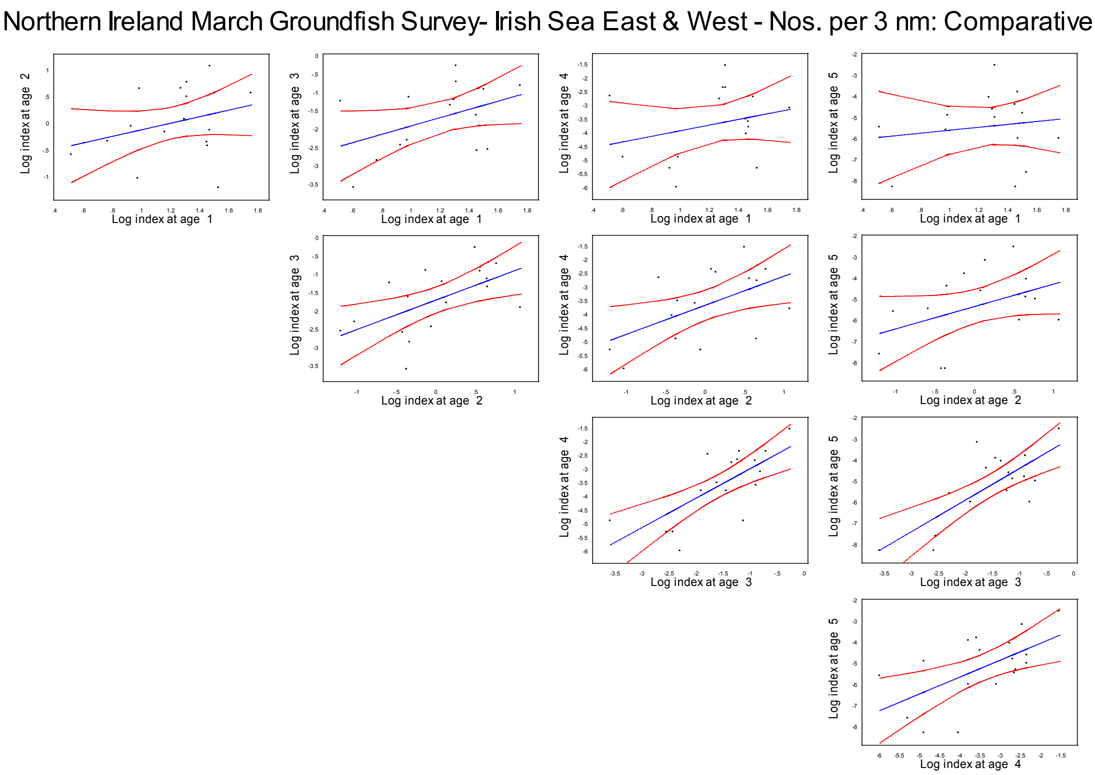


Figure 6.6.6. Log Mean Standardized Indices for (a) NIGFS March and (b) NIGFS October by year class and year.

a)



b)

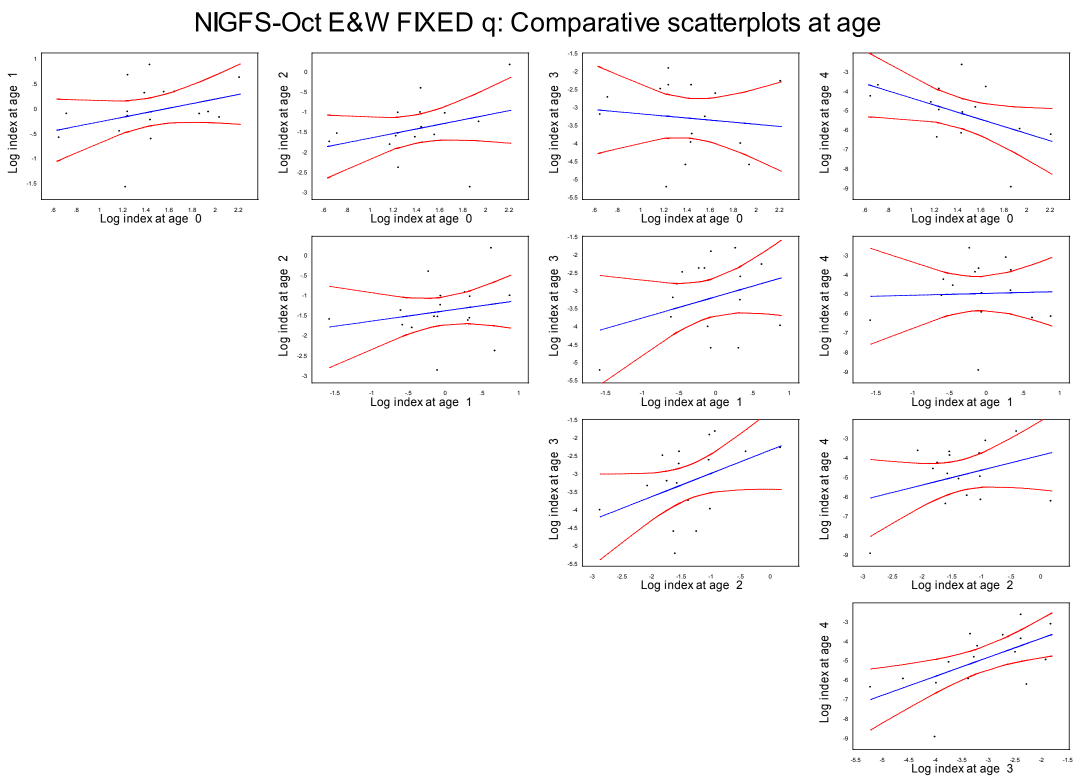
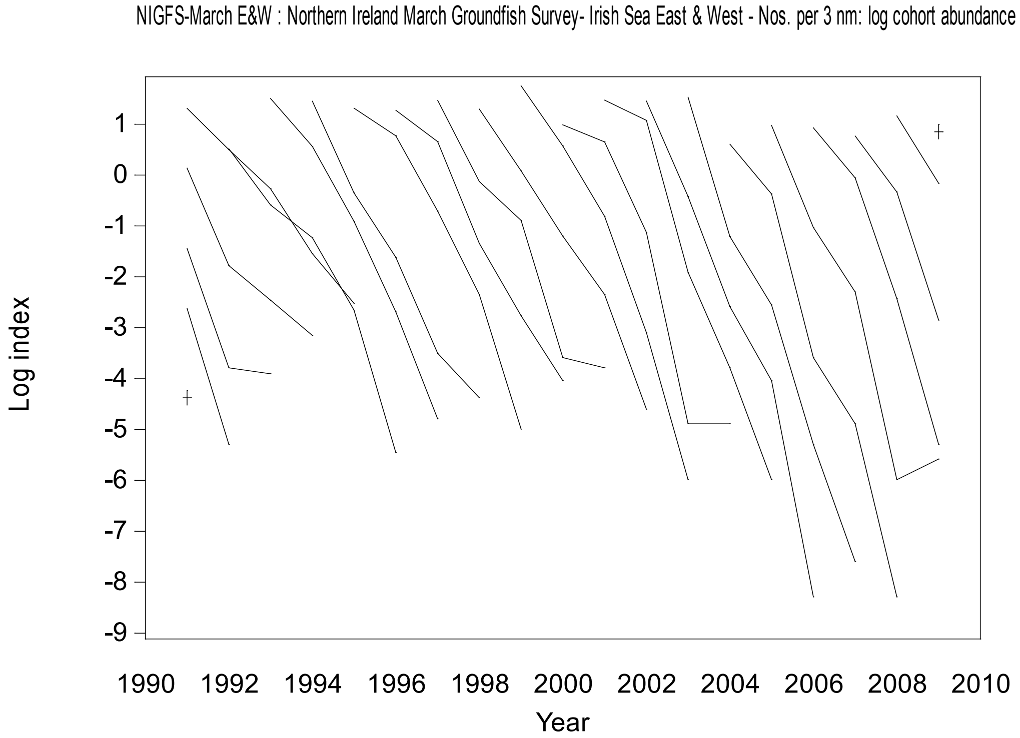


Figure 6.6.7. Scatter Plots of Log index-at-age for the NIGFS March (a) and NIGFS October (b) surveys.

a)



b)

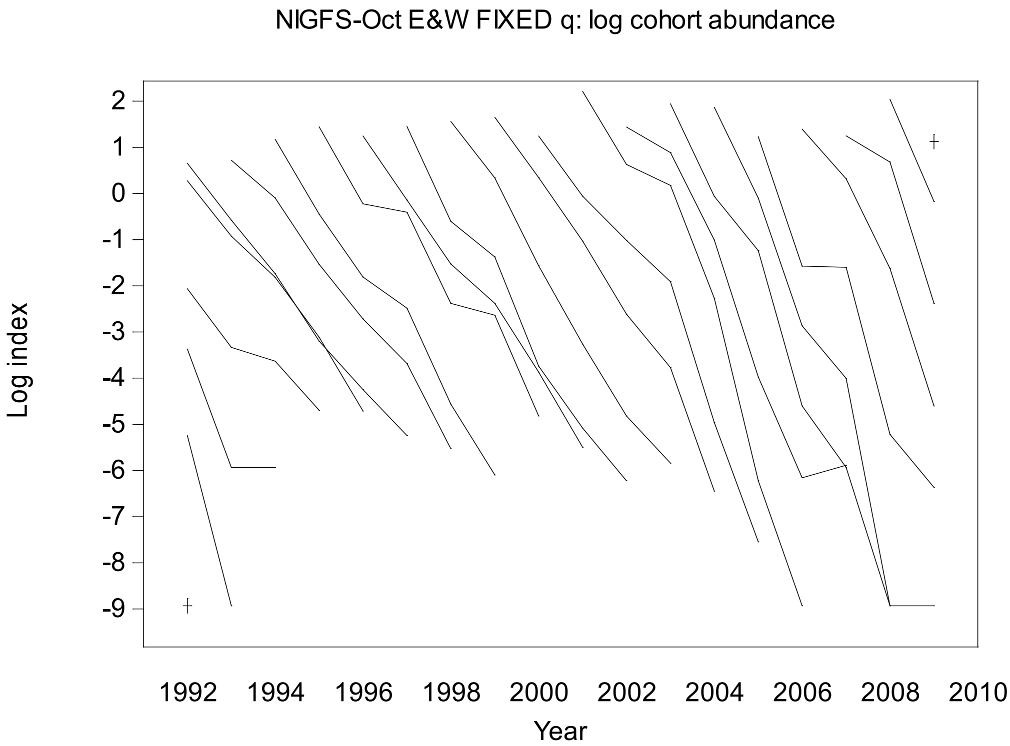
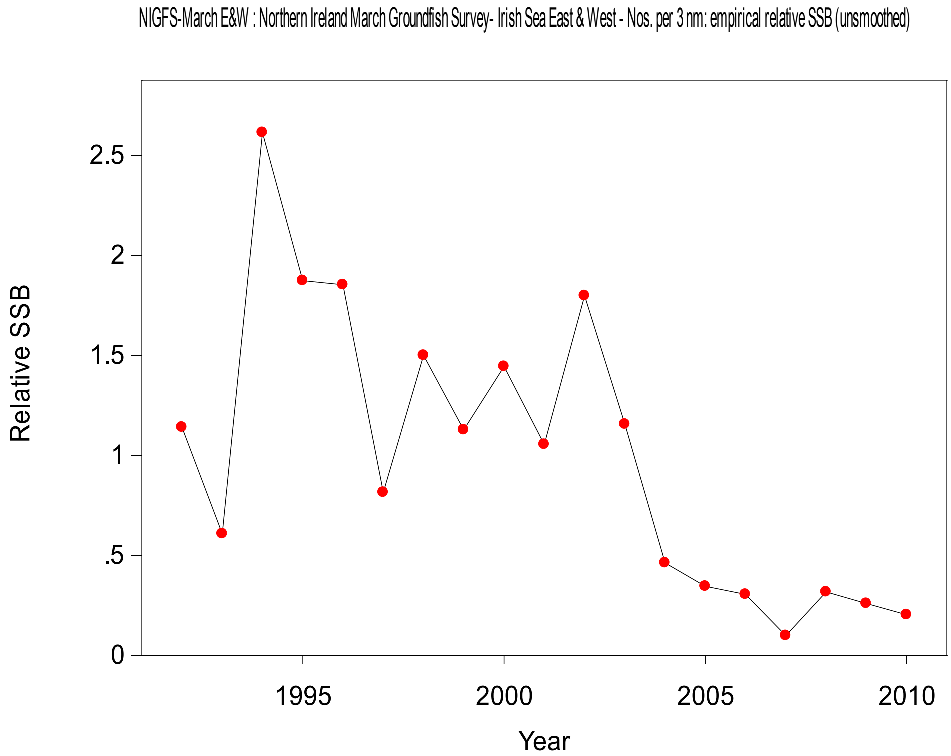


Figure 6.6.8. Catch Curves for NIGFS-March (a) and NIGFS-October (b) surveys.

a)



b)

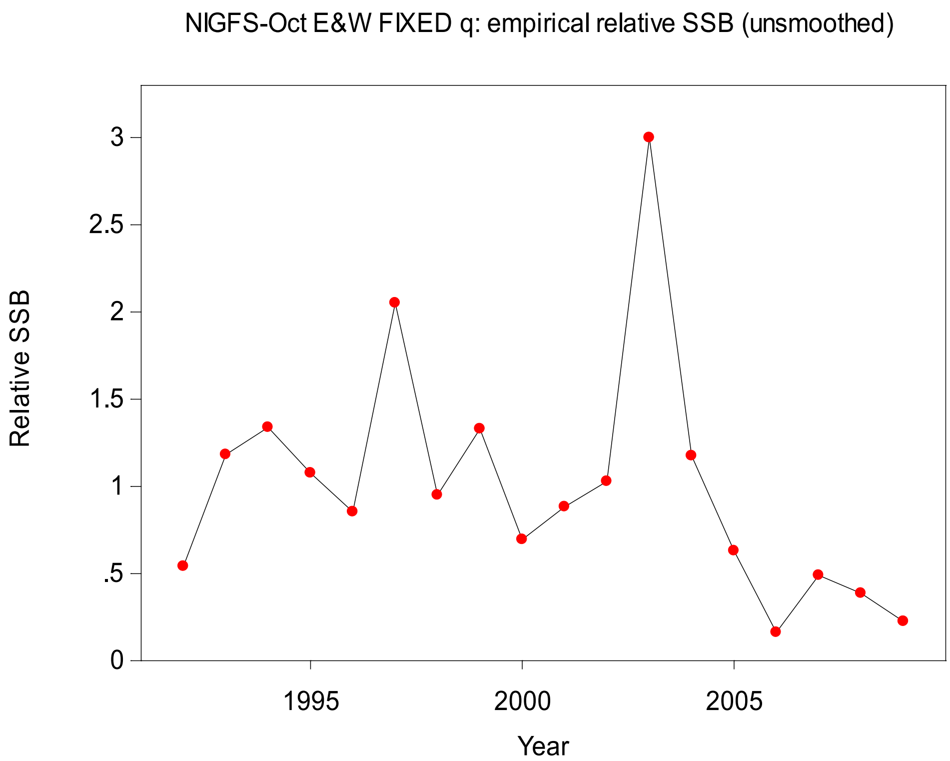


Figure 6.6.9. Empirical Estimates of SSB for NIGFS March (a) and NIGFS October (b) surveys.

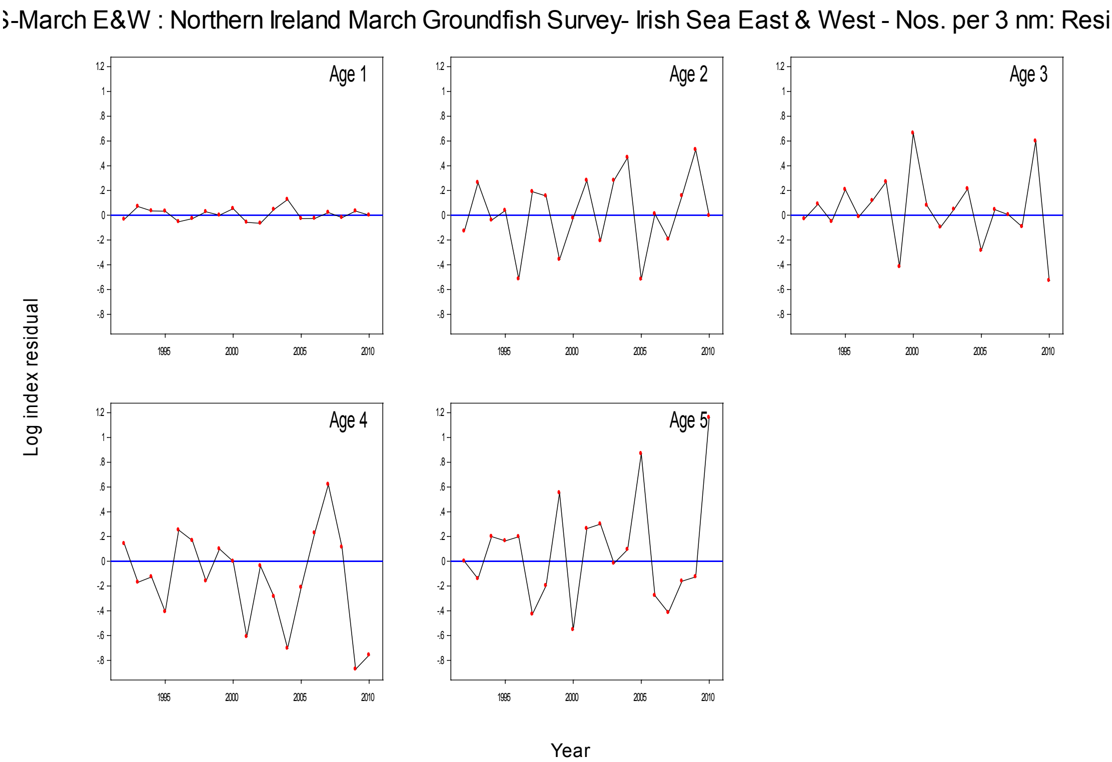


Figure 6.6.10. Residual Plots by Age of the NIGFS March survey.

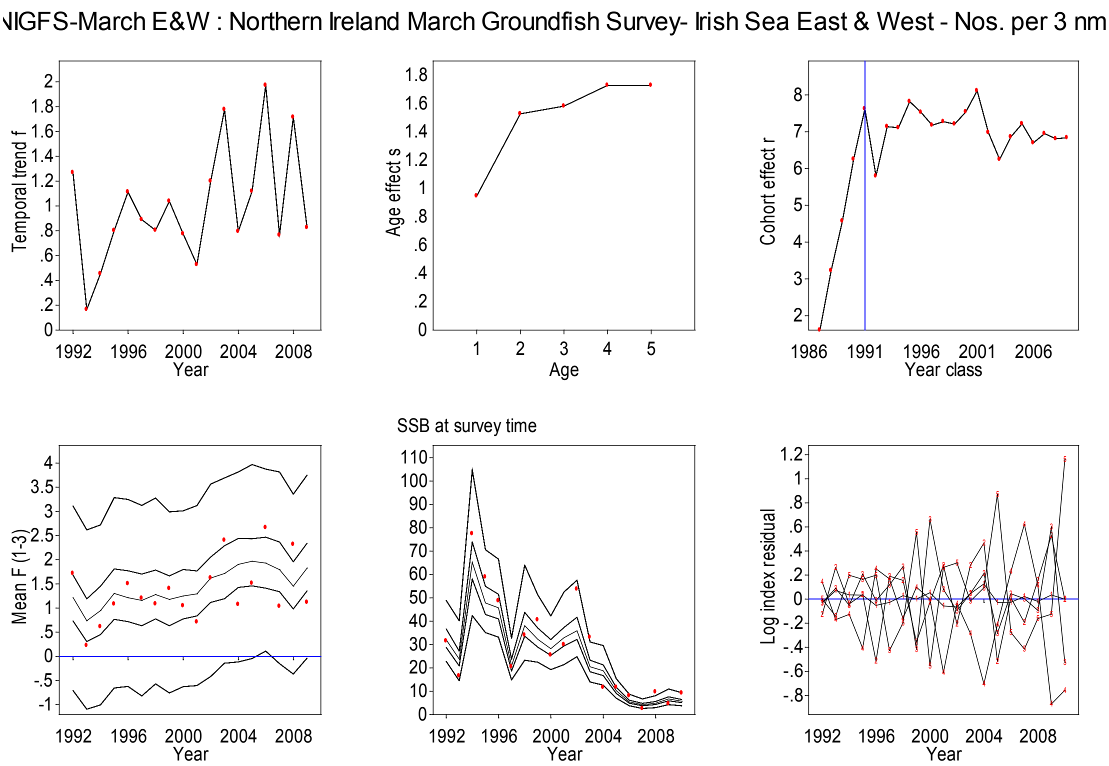


Figure 6.6.11. Stock Summary of the SURBA model fit for the NIGFS March survey. Empirical SSB (red dots) with model estimates of SSB (black line) are shown in bottom centre panel.

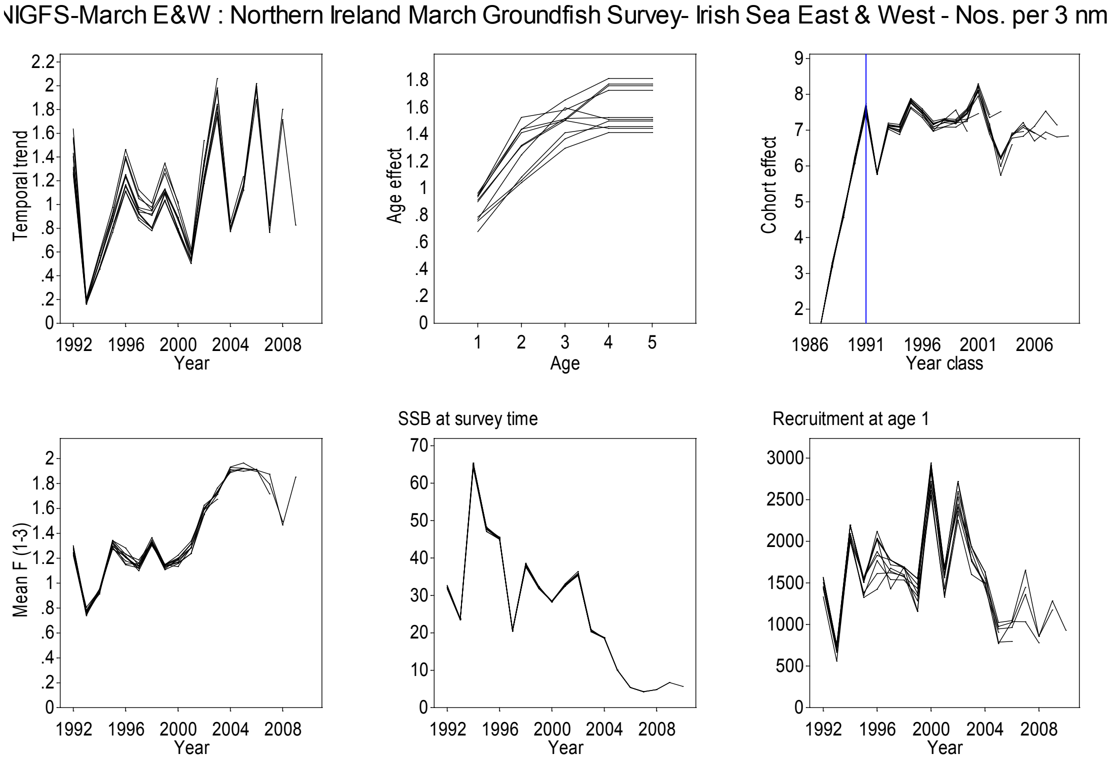


Figure 6.6.12. Retrospective pattern of Single fleet SURBA run for NIGFS March survey.

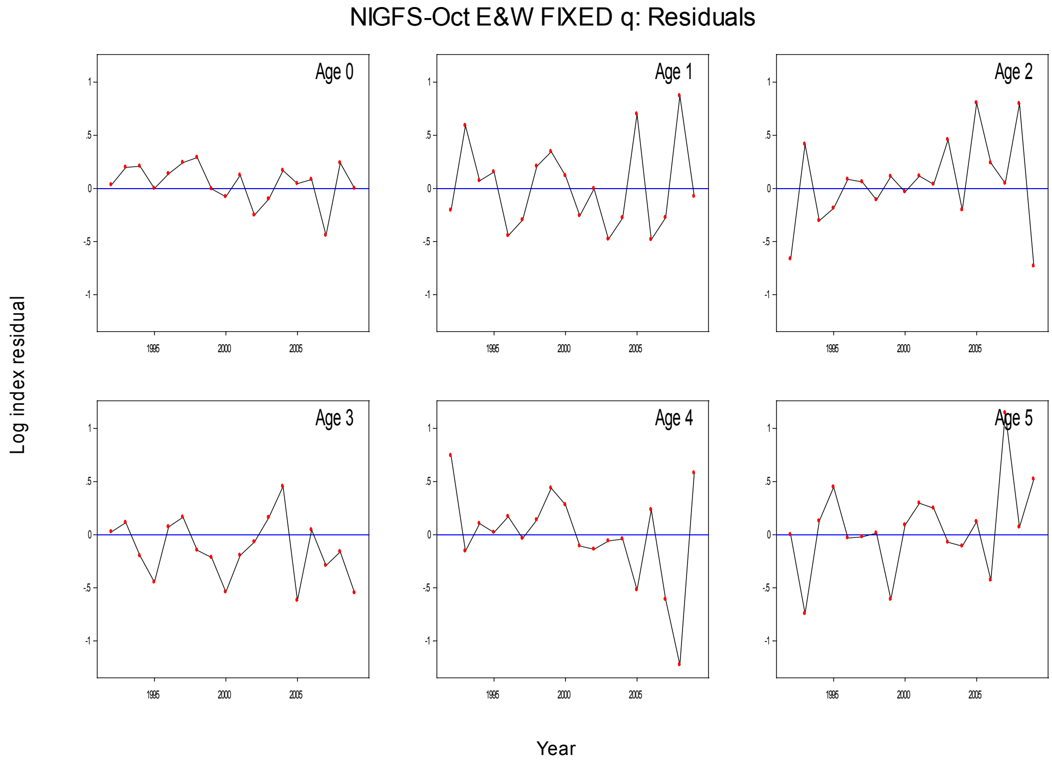


Figure 6.6.13. Residual Plots by Age of the NIGFS March survey.

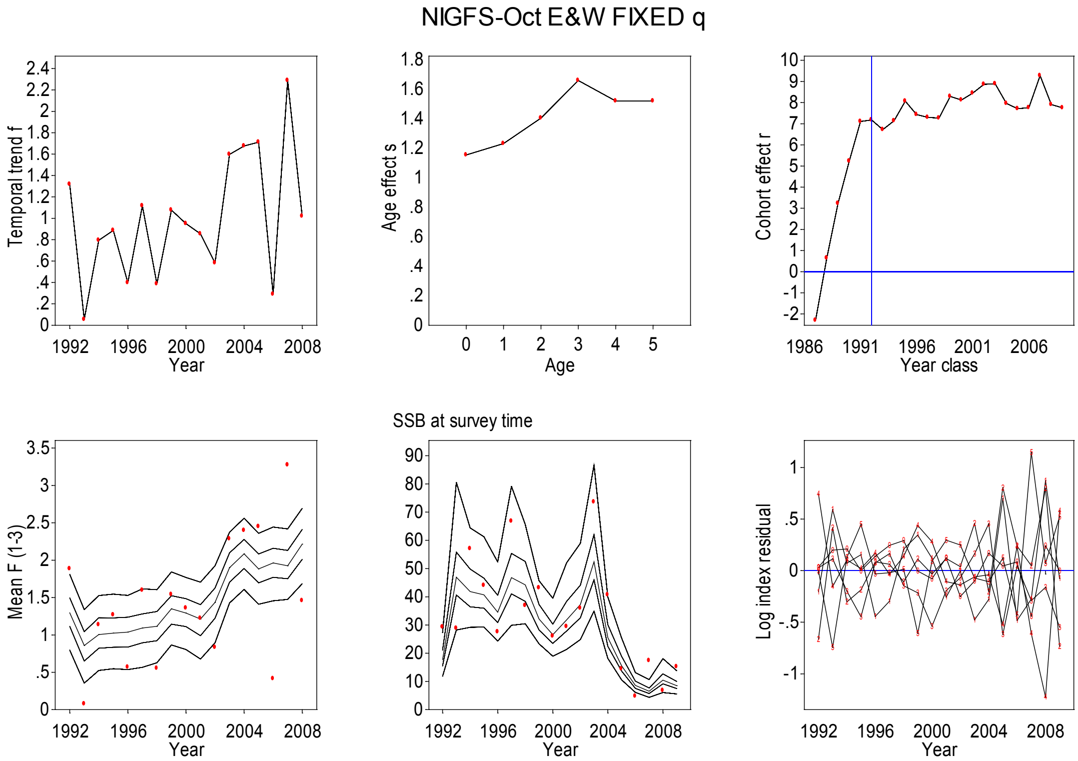


Figure 6.6.14. Stock Summary of the SURBA model fit for the NIGFS March survey. Empirical SSB (red dots) with model estimates of SSB (black line) are shown in bottom centre panel.

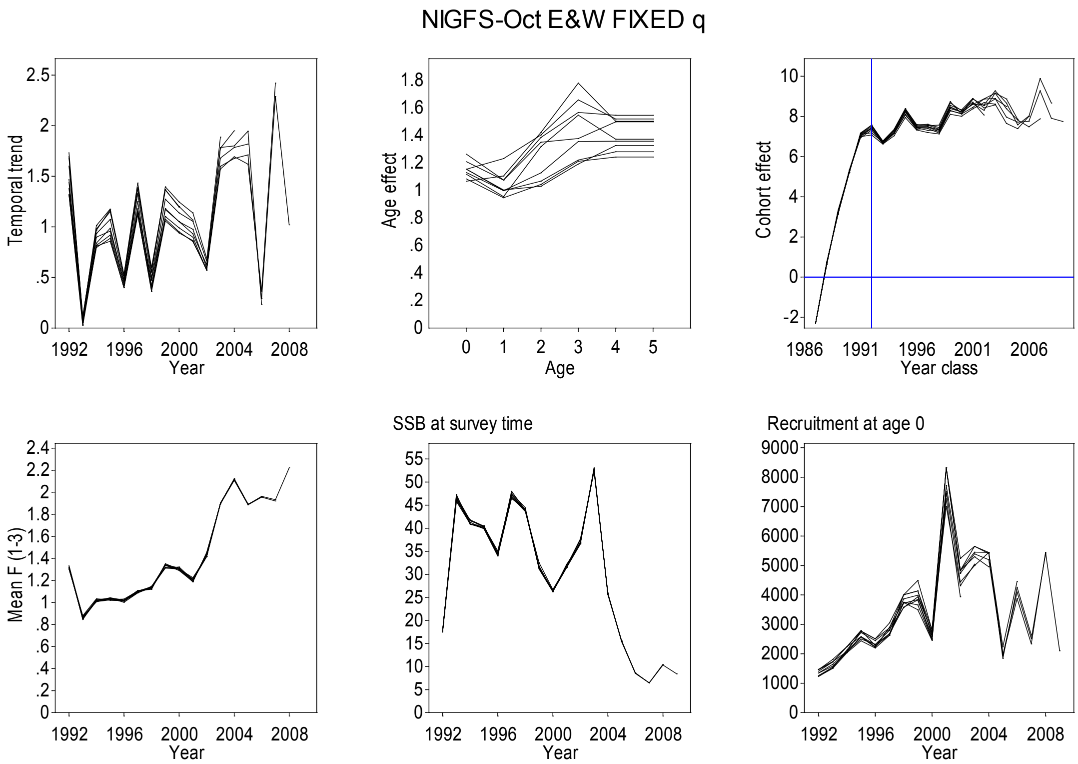


Figure 6.6.15. Retrospective pattern of Single fleet SURBA run for NIGFS March survey.

6.7 Plaice in Division VIIa (Irish Sea)

Type of assessment in 2010

Update assessment using the same settings as last year.

ICES advice applicable to 2009

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality (2007) is estimated to be 0.09, which is below the rate expected to lead to high long-term yields and low risk of stock depletion. There would be little gain to the long-term yield by increasing fishing mortalities above current levels. Fishing at $F_{0.1}$ *corresponds to landings in 2009 of 1430 t.*

Exploitation boundaries in relation to precautionary limits

Fishing mortality should be kept below F_{pa} *(0.45). This corresponds to catches of less than 3960 t in 2009 and will maintain SSB above* B_{pa} *in 2010.*

ICES advice applicable to 2010

ICES advises on the basis of high long-term yield that catches should not exceed 1627 t in 2010.

6.7.1 General

Stock description and management units

The stock assessment area and the management unit are both Division VIIa (Irish Sea).

Management applicable in 2009 and 2010

Management of plaice in Division VIIa is by TAC and there is a minimum landing size of 27 cm in force. The agreed TACs and associated implications for plaice in Division VIIa are detailed in the tables below.

2009:

Species: Plaice *Pleuronectes platessa*		**Zone**: VIIa (PLE/07A.)
Belgium	37	
France	16	
Ireland	934	
The Netherlands	11	
United Kingdom	432	
EC	1 430	
TAC	1 430	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

2010:

Species: Plaice *Pleuronectes platessa*		**Zone:** VIIa (PLE/07A.)
Belgium	42	
France	18	
Ireland	1 063	
The Netherlands	13	
United Kingdom	491	
EU	1 627	
TAC	1 627	Analytical TAC

The fishery in 2009

National landings data reported to ICES and Working Group estimates of total landings are given in Table 6.7.2.1.

The TAC in 2009 was 1430 tonnes and the Working Group estimate of landings in 2009 was 456 tonnes, which is a 19% decrease in landings comparable to 2008 and only 32% of the TAC in 2009. This shortfall in estimated landings relative to the TAC has occurred in previous years, increasing steadily from a 7% of TAC in 2003 to a 70% shortfall in 2008. It seems unlikely that the poor uptake of the quota is a consequence of an inability to catch sufficient quantities of plaice; rather the shortfall in the uptake of the TAC is likely due to limited consumer demand and poor value of the catch.

Landings by the Belgian, UK (E&W) and Irish fleets comprised approximately 41%, 38% and 21% respectively of total landings in 2009. The landings of plaice are split evenly between beam trawlers (primarily Belgian vessels then Irish vessels) targeting sole and otter trawlers (primarily UK vessels then Irish vessels) fishing for whitefish or, increasingly, *Nephrops*.

High levels of discarding are known to occur in this fishery (see Figures 6.7.2.3 to 6.7.2.5). Previous sampling studies for discards in the Irish Sea indicate that discarding of plaice is substantial (up to 80% by number) and that only a small proportion of the total catch may be retained onboard.

A general description of the fishery can be found in the Stock Annex (Stock Annex 6.6) and also in 'Other Relevant Data' section below. For general mixed fisheries advice applicable to this stock and other species taken in the same fisheries, see Section 6.1.

6.7.2 Data

Landings

National landings data reported to ICES and Working Group estimates of total landings are given in Table 6.7.2.1. Landed numbers-at-age for the younger ages (ages 2 to 4) have declined more rapidly over the last two decades than landings of older fish, despite the fact that high numbers of younger fish are caught by the beam trawl survey, suggesting that the selection pattern and/or discarding behaviour of the fleets has changed over time and that the landings-at-age matrix might not be representative of the true catch (Figure 6.7.2.2). The procedures used to determine the total international landings figures are documented in the Stock Annex.

Discards

Routine discard sampling has been conducted by the UK (E&W) since 2000 and by Ireland since 1993. Northern Ireland has collected data from 1996 but not between 2003 and 2005, and by Belgium since 2003. Length distributions of landed and discarded fish estimates are presented for UK (E&W) (Figure 6.7.2.3), Irish (Figure 6.7.2.4) and Belgian fleets (Figure 6.7.2.5), although Belgian data have been missing since 2007.

In 2009, observations by discard sampling trips suggest 90% discarding by number by the UK fleet and 99% by the Irish fleet.

Although these time-series of discard observations are available, they have so far not been raised to fleet level and are therefore not currently incorporated in the assessment. WKDRP has investigated the issue of raising discard samples to total catches but has not provided any clear advice on the best approach to adopt. In addition there is a considerable historical time period for which no discard sampling has taken place. Work is ongoing on the issue of raising samples and in the calculation of a historical time-series of discard data. However, raising the data remains problematic given the low sampling levels (see Working Document 8, WGNSDS 2005).

Biological

Landings numbers-at-age are given in Table 6.7.2.5 and plotted in Figure 6.7.2.2. Weights-at-age in the landings and stock are given in Tables 6.7.2.6–6.7.2.7. The history of the derivation of the landings weights and stock weights used in this assessment is described in the Stock Annex.

Landings weights-at-age for 2009 were obtained from the quadratic fit:

$$Wt = -0.002*age^2 + 0.0674*age + 0.0329$$

and used a SOP correction of 0.91882.

Landings weights-at-age calculations for this stock were problematic (large residuals about the quadratic fit) this year (2009 data) and last (2008 data) for ages greater than

12 due to the low number of sampled fish. Also UK (E&W) and Irish values of weight-at-age show differences in weight of these older fish, which should be addressed at the next benchmark assessment.

Surveys

All available tuning data are shown in Table 6.7.2.4. Due to inconsistencies in the available commercial tuning fleets, Irish Sea plaice assessments since 2004 have only included the UK (E&W) beam trawl survey (UK (E&W) BTS, September: 1989–2007) and the two UK (NI) spawning biomass indices based on groundfish surveys (UK (NI) GFS). For more information see WGNSDS 2004.

Inspection of UK (E&W) BTS log(cpue) plots (Figures 6.7.2.6 and 6.7.2.7) indicates that the survey has fair internal consistency and suggests increases in the abundance of plaice at all ages. The biomass index calculated from the UK (E&W) BTS during autumn (September) also indicates an upwards trend since 1991 (Figure 6.7.2.2). However, given that this survey covers only the northeastern part of the Irish Sea, it is not necessarily representative of the entire stock. In contrast, the UK (NI) groundfish surveys in March and October do cover both the northwestern and northeastern areas of the Irish Sea. Although the UK (E&W) BTS and the UK (NI) GFS surveys show similar increases in biomass between 1992 and 2003, low biomass values were recorded between 2004 and 2007 in the autumn index of the UK (NI) surveys and between 2004 and 2009 in the spring index. Nevertheless, both autumn and spring indices reach high biomass levels in 2009 and 2010 respectively; second only to the peak in biomass in 2003 in each index suggesting that the stock is currently at high levels.

The UK (NI) ground fish surveys' strata can be disaggregated into eastern (Strata 4–7) and western (Strata 1–3) subareas, where the subareas are divided by the deep trench that runs roughly north–south to the west of the Isle of Man. The notable difference in mean biomass between spring (17 kg per 3 miles) and autumn (5 kg per 3 miles) in the western area (Strata 1–3) suggests either that spawning fish migrate into the area during spring or that catchability of plaice increases during spawning. Both (March and October) time-series of the UK (NI) GFS appear dominated by change in the eastern subarea and notably this subarea includes the entire UK BTS survey area. This is particularly clear during the autumn when the correlation between the overall UK (NI) index and the eastern subarea is great, R = 0.99, which is due to the high weighting placed on stations in the larger strata i.e. in the eastern area relative to the west (Figure 6.7.2.8).

The observed increase in spawning–stock biomass by the UK (NI) GFS is pronounced in the autumn period (October samples), but not evident in the spring (March samples) when many mature fish have migrated to spawn. Indeed the autumn series for Strata 4–7 (the eastern Irish Sea) contains a statistically significant breakpoint in 1999 (supremum(F statistic) =18.6, p = 0.001; 95% confidence interval 1995–2001) after which the mean biomass (13.5 kg per 3 miles, 2000–2010) is double that in the early period (6.7 kg per 3 miles, 1992–1999).

In summary, the UK (E&W) BTS in September and the UK (NI) GFS index in October (but not March) indicate a sustained increase in biomass in the eastern Irish Sea, but this rise does not appear to extend across the deep channel to plaice in the western Irish Sea.

The SSB of plaice in the Irish Sea is also independently estimated using the Annual Egg Production Method (AEPM):

Year	SSB
1995	9081
2000	13 303
2006	11 487
2008	12 759

The results (revised in 2010 to ensure consistency across years, see WD 11) show substantial differences to ICES assessment values (from ICA), but they do confirm that SSB of plaice in the Irish Sea is lightly exploited. Splitting the SSB estimates from the AEPM into eastern and western Irish Sea areas also indicates that the perceived increase in plaice biomass is due to increased production in the eastern Irish Sea only in agreement with the trends noted above in BTS and GFS data (For more details see Stock Annex).

Work is currently being undertaken to supply cpue values for the Q4 western IBTS survey (UK, E&W) for the Irish Sea area. It is anticipated that this time-series will contribute to this assessment following benchmarking of the stock.

Commercial cpue

All available tuning data are shown in Table 6.7.2.4. Age based tuning data available for this assessment comprise 3 commercial fleets; the UK (E&W) otter trawl fleet (UK (E&W) OTB, 1987–2008), the UK (E&W) beam trawl fleet (UK (E&W) BT, 1989–2008) and the Irish otter trawl fleet (IR-OTB, 1995–2008). Due to inconsistencies in the available tuning fleets, Irish Sea plaice assessments since 2004 have omitted these indices. For more information see WGNSDS 2004.

Other relevant data

Table 6.7.2.2 and Figure 6.7.2.1 show that effort levels have decreased between 2008 and 2009 for all fleets. Both the UK otter and beam trawl fleets are at their lowest recorded effort levels in time-series extending back to 1972 and 1978 respectively. However, anecdotal information from the UK fishing industry has suggested an abundance of plaice in Area VIIa in recent years. Belgian vessels operating in Division VII typically move in and out of the Irish Sea, depending on the season, from specifically the Bristol Channel and Celtic Sea, the Bay of Biscay and the southern North Sea.

In 2009, landings by the Belgian fleet increased by 40 tonnes relative to 2008 landings. For the UK (E&W) , the otter trawl fleet reports the majority (approximately 99%) of plaice landings, which are typically low in the first quarter when the fish are generally found further offshore in deeper water. The Irish fishery landings in 2009 were split mostly between otter trawlers (57%), and beam trawlers (38%). The beam trawl component is mostly taken as part of a mixed fishery, and some of the landings also come as bycatch from the *Nephrops* fishery.

Landings by the Belgian fleet in 2009 were greatest in the four quarter (38%) and lowest in the first and third quarters (17% each). Landings by UK (E&W) were largely taken in the second and third quarters (38% and 34% respectively, with the highest landings occurring in July 30.5 tonnes), and lowest during quarter one (9%). Landings by the Irish fleet were greatest in the third quarter (39%) and lowest in the first and second quarters (16% each).

6.7.3 Historical Stock development

Model: ICA

Software: FLICA. (Software versions are given in Table 6.7.3.1.)

Model options chosen

Setting for this update stock assessment are given in the table below, as in standard for this stock the separable period has been increased by one year relative to last years assessment. The update ICA assessment follows the same procedure as in the 2009 assessment as described in Stock Annex.

Input data types and characteristics

New data added to the update ICA assessment are the fishery landings data for 2009 and survey data for 2009 for the following surveys: UK(E&W) BTS, UK(NI) GFS March and UK(NI) GFS October.

Data screening

Data was screened as described in the Stock Annex. A separable VPA model was used to examine the structure of the landings numbers-at-age data before its use in update assessment. The fitted model indicates that the age structure of the recorded landings may have changed over the last decade, with increasingly negative residuals at the younger ages (ages 2 and 3) and increasingly positive residuals at ages >4. This may be a result of discarding (noted earlier) and the same effect is visible clearly in plots of standardised proportions-at-age in the landings matrix (Figure 6.7.2.2).

Final update assessment

A summary plot for the final update ICA assessment is shown in Figure 6.7.3.3 and time-series estimates for F, SSB and recruitment are given in Table 6.7.3.4. The ICA assessment settings are shown in the following table, with changes to the previous years' settings highlighted in bold. Historical settings are given in the Stock Annex.

Assessment year		2009	2010
Assessment model		ICA	ICA
Tuning fleets	UK(E&W)OTB	Series omitted	Series omitted
	UK(E&W)BTS Sept	1989–2008	1989–2009
		ages 2–7	ages 2–7
	UK(E&W)BTS March	Survey omitted	Survey omitted
	UK(E&W)BT	Series omitted	Series omitted
	IR-OTB	Series omitted	Series omitted
	UK(NI) GFS Mar	1992–2008	1992–2009
		Biomass index	Biomass index
	UK(NI) GFS Oct	1992–2008	1992–2009
		Biomass index	Biomass index
Time-series weights		Full time-series - unweighted	Full time-series - unweighted
Num yrs for separable		8	9
Reference age		5	5
Terminal S		1	1
Catchability model fitted		linear	linear
SRR fitted		No	No
Landings number-at-age, range:		2–9+	2–9+

Diagnostic output from FLICA is printed in Table 6.7.3.1 with estimates of fishing mortality and population numbers-at-age in Table 6.7.3.2 and 6.7.3.3 respectively. Patterns in the ICA residuals for UK (E&W) beam trawl survey (linearly increasing ages 2 to 6) and UK (NI) GFS biomass survey (negative residuals between 2005 and 2008) have been noticed in recent years are present again in the assessment (Figure 6.7.3.1). Similarly, consistently positive residuals in the indices are apparent for age 5 throughout the separable period (2001–2009), while negative residuals are evident for ages 7 and 8. In the catch residuals, positive values are apparent in all years (except 2001) for age 5 data, while age 8 residuals are all negative. These patterns will need to be investigated at the benchmark meeting.

A retrospective analysis, with a constant separable period of nine years, was carried out and the results are shown in Figure 6.7.3.2. It can be seen that the assessment has a consistently biased retrospective pattern for SSB, recruitment and F_{bar}. Nevertheless, a general trend of increasing SSB and decreasing fishing mortality is evident.

Comparison with previous assessments

Comparisons between this years and last year's ICA assessment are shown in Figure 6.7.3.4. The two assessments perform similarly in terms of temporal trends in SSB, recruitment and F_{bar}. However, there is a slight difference in SSB and F_{bar} estimates between 2002 and 2006 in which the 2010WG estimates suggest a lower SSB (≈6% difference) and a higher F_{bar} (≈9%). Nevertheless, the difference in estimates of F_{bar} in 2008 (+0.003) between the 2009WG and 2010WG assessments is very small. The SSB estimate for 2008 has been revised up 9% by 733 kt.

State of the stock

Trends in F_{bar}, SSB, recruitment and landings, for the full time-series, are shown in Tables 6.7.3.4 and Figure 6.7.3.3. The update assessment estimates that fishing mortality rose to very high levels in the mid 1970s (F_{bar} >0.8) but has declined from these levels over the subsequent 40 years. Indeed, since the early 1990s fishing mortality has shown a marked and almost continuous decline and in 2009 is estimated to be at the lowest level in the time-series (0.046). Spawning biomass levels show an oscillatory pattern over the time-series. High SSB levels occurred at the beginning of the time-series, and although it is estimated to have been steadily rising since 2000 it is still short of the earlier highs. Estimated recruitment levels have been variable over the time-series, but the levels declined markedly in the early 1990s and displayed only minor variations until 2008, which has the highest value since 1988. However, this has been followed by a recruitment estimate for 2009 of 3223 thousand fish, which is the lowest in the time-series and approximately half the previous minimum of 6005 thousand in 1990.

SSB in 2009 was above B_{pa}, and fishing mortality has been declining since the early 1990s and has been below F_{pa} since 1998.

6.7.4 Short-term projections

A forecast is presented in this report as part of the usual update procedure. However, due to the consistent retrospective bias in the assessment, the Working Group considers any short-term forecast to be unreliable for this stock.

Population numbers for short-term forecasts were taken from the ICA output of survivors at ages 4 and above in 2010. Numbers-at-age 2 were taken as GM(90-07) (8.4 million). Because of the considerable uncertainty of the estimate of recruitment-at-age 2 in 2009, populations numbers-at-age 3 in 2010 have been overwritten with the GM(90-07) estimate depreciated for F_{sq} and M (7.1 million at age 3s in 2010).

The short-term forecast was run as *status quo* projection. Input data are shown in Table 6.7.4.1. The single option predicted forecast is given in Table 6.7.4.2, and the management option output is shown in Table 6.7.4.3 and summarised below.

Year	Landings (t)	Source	SSB (t) Jan 1st	Source
2009	456	WG Estimate	7872	ICA
2010	779	SQ Forecast	10 427	SQ Forecast
2011	839	SQ Forecast	11 523	SQ Forecast

Proportions that the 2005 to 2009 year-classes will contribute to landings and SSB in 2010 and 2011 are shown in Table 6.7.4.4. Approximately 14% of the predicted landings in 2010 and 33% of the predicted landings in 2011 rely on year classes for which geometric mean recruitment has been assumed.

The predicted landings for 2010 assuming status quo F is 779 t, and SSB is predicted to increase to 10 427 t. The TAC for 2010 is 1627 t.

Estimating recruiting year-class abundance

The update ICA estimates the strength of the 2007 year class at 3.2 million two year olds in 2009, which is below the geometric mean (1964–2007) of 11.7 million and the arithmetic mean (1964–2007) of 12.6 million. Considering the consistently low recruitment levels since the 1990s (Figure 6.7.3.3), GM90-07 (8.4 million) is used for the recruitment estimates in the short-term forecast.

Previous analyses have shown that recruitment estimates can be highly variable and dependant on model settings; therefore, recruitment is considered to be poorly estimated.

The recruitment estimates from various sources are shown below. Those used for the short-term forecasts are shown in bold.

update assessment	ICA estimate	GM 90-07
2009 recruitment (000's)-at-age 2	3223	8355
2010 recruitment (000's)-at-age 2		8355
2011 recruitment (000's)-at-age 2		8355
2012 recruitment (000's)-at-age 2		8355

6.7.5 Medium-term projections

There are no medium-term projections for this stock.

6.7.6 MSY explorations

Modelling approach

MSY reference points were explored using the Cefas ADMB module presented at WKFRAME 2010 and based on sen and sum files created from stock assessment outputs. The model applied assumes a single species harvest scenario with no density-dependent variation in growth or mortality rates at high stock abundance. The models used do not include uncertainty due to ecosystem effects and multi-species interactions affecting growth, maturity and natural mortality. Therefore the variability estimated at low fishing mortality rates is likely to be underestimated and the potential yields over estimated.

Stock and recruitment curves, assuming a smooth hockey stick or the traditional Ricker or Beverton–Holt models, were fitted to the data and the diagnostic output evaluated to determine the appropriate function for the estimation of F_{msy} or its proxies. Delta AICc values were also computed to guide model selection. Variability in the model, determined through MCMC re-sampling, reflects variance in the stock–recruit relationship and in the biological parameters of growth and maturity. Stocks of plaice do not generally show a strong stock–recruit relationship therefore, *a priori*, we favour a smooth hockey stick approach. For comparison, conventional YPR analyses were also conducted.

Results

From 1000 projections with each model, 525 runs were acceptable (in which the bounds of the fit were not violated.) based on the Ricker model, 225 on the Beverton–Holt (BH) model and 542 with the smooth hockey stick (HS) (Figure 6.7.3.6). Therefore, for this stock, the BH model appears particularly problematic and the deterministic fit is outside the confidence intervals. The fiftieth percentile estimate of F_{msy} is greatest when assuming a HS model (0.45, CV 59%) and lowest when based on the BH model (0.20, CV 43%), while the Ricker model estimate (0.35, CV 23%) is midway between and associated with a favourable coefficient of variability (Table 7.6.4.6, Figures 6.7.3.6–8). Notably, when assuming a HS model, F_{msy} is equal to the current F_{pa} estimate.

Conclusions

Given the noisy data, large rejection rate for all S-R models and relatively high CVs the stock–recruit relationship of plaice is not well captured by any of the models and the underlying data do not support the provision of absolute estimates of F_{msy}.

6.7.7 Biological reference points

Precautionary approach reference points

Biological reference points were proposed for this stock by the 1998 Working Group as below:

F_{lim}	No proposal	
F_{pa}	0.45	(on the basis of Fmed and long-term considerations)
B_{lim}	No proposal	
B_{pa}	3100 t	(on the basis of Bloss and evidence of highrecruitments at low SSBs)

Yield-per-recruit analysis

Yield-per-recruit analyses were performed and presented in Table 6.7.4.5 and Figure 6.7.3.5, but given the uncertainties associated with the short-term forecast of this stock, the results should be treated with caution. F_{max} was calculated as 0.625, and $F_{0.1}$ as 0.146. Notably, F_{max} is poorly defined and $F_{0.1}$ forgoes a great amount of yield. The yield-per-recruit analysis done as part of the MSY evaluations illustrates significant uncertainty (Figure 6.7.3.8) and both F_{max} and $F_{0.1}$ are poorly defined (CV of 58 and 92% respectively, Table 6.7.4.6), highlighting that the use of a deterministic YPR is inappropriate for this stock.

6.7.8 Management plans

There are no management plans for this stock.

6.7.9 Uncertainties and bias in assessment and forecast

It has been noted in previous years that aspects of this assessment appear to be deteriorating. Specific concerns in recent years have been the contradictory signals provided by the surveys, a retrospective bias in estimates of F_{bar} and SSB and the lack of discard data and contrast in the strength of incoming year classes.

Discard levels in this fishery are estimated to be very high and fish at the younger ages may be subject to substantially higher mortality levels than currently estimated. The landings of young fish represent only a small proportion of those caught and the lack of adequate information on mortality rates at these ages seriously impairs the ability to estimate recruitment levels in the population. There are no sufficiently reliable estimates of discard levels for the entire time-series of landings for this stock, to enable inclusion in the assessment.

The only age based tuning data in this assessment is restricted to the area where the increase in the plaice stock appears to be most dramatic. Further work needs to be carried out to determine to which degree the rise in SSB predicted by the UK (E&W) beam trawl survey is representative of the stock as a whole.

Landings weights-at-age calculations for this stock were problematic this year and last year for ages greater than 12 due to the low number of sampled fish. Also UK (E&W) and Irish values of weight-at-age show very different values in these older fish. There is evidence of a decline in weight-at-age from the raw commercial landings data and survey data.

6.7.10 Recommendations for next benchmark

2010 ICES Review: The 2010 ICES Review Group raised concerns regarding the stock definition, the paucity of ecosystem information and lack of discard information in the analysis. The RG noted that multiple fisheries catch plaice below the legal size and discards are greater than retained catch levels in all fisheries, which may be the root cause of the retrospective patterns seen in the assessment. The RG agreed with the WG that the forecasts are not reliable. Indeed, the RG concluded further that forecasts should not be included in the assessment or ICES advice. These RG suggested that these issues should be addressed as part of the benchmark process.

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2010	VIIa Plaice	Discards are available but incorporation into the assessment is problematic. Discards are considered significantly larger than landings. Recent SSB estimates from egg production methods suggest the SSB from the assessment might be biased in absolute magnitude and trend, further suggesting that lack of discard data might be major problem An alternative could be to develop an assessment method such as Year Class Curves (Cotter, 2000) that is not based on commercial catch data, given the lack of historical discard data. Landings weights show trends in recent years and it was noticed in 2009 that UK (E&W) and Irish landings-at-weight data show very different results. It is unlikely that the single age based survey used to tune the assessment is representative of the stock and all available survey data should be investigated to develop improved indices.	2011	Expert Group members.

6.7.11 Management considerations

The high level of discarding (typically up to 80% in number) in this fishery indicates a mismatch between the minimum landing size and the mesh size of the gear being used. Any measures that effect a reduction in discards will result in increased future yield. However, decreasing the mesh size may not have the desired result since the market demand for plaice is poor and small plaice are particularly undesirable.

Status quo F (average 2006–2009) is estimated to be 0.0701; below $\mathbf{F}_{0.1}$ and well below $\mathbf{F}_{pa}$. SSB in 2009 is estimated at 7872 t, and at 10 427 t in 2010, both of which are well above $\mathbf{B}_{pa}$ (3100 t). However, given the poor fit of the assessment model, estimates of fishing mortality and stock biomass should be interpreted with caution.

Whilst the precise levels of F_{bar} and SSB are considered poorly estimated, the overall state of the stock is consistently estimated to have low fishing mortality ($<F_{pa}$) and high spawning biomass ($>B_{pa}$). Therefore the stock is considered to be within safe biological limits.

A fishing mortality of F_{pa} (0.45) forecasts that landings in 2011 would be 4480 tonnes (Table 6.7.4.3). This however requires a substantial increase in F_{bar} (F multiplier = 6.42), and the landings would be far greater than the current TAC level, which is currently not met by the fishery. However, due to the consistent retrospective bias in the assessment the Working Group considers any short-term forecast to be unreliable and the results should therefore be treated with caution.

Table 6.7.2.1. Nominal landings of plaice in Division VIIa as officially reported to ICES.

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009 [1]
Belgium	321	128	332	327	344	459	327	275	325	482	636	628	431	566	343	194	157	197
France	42	19	13	10	11	8	8	5	14	9	8	7	2	9	2	2	2	-
Ireland	1,355	654	547	557	538	543	730	541	420	378	370	490	328	272	179	194	102	101
Netherlands	-	-	-	-	69	110	27	30	47	-	-	-	-	-	-	-	-	-
UK (Eng.&Wales)[2]	1,381	1,119	1,082	1,050	878	798	679	687	610	607	569	409	369	422	413	412	300	186
UK (Isle of Man)	24	13	14	20	16	11	14	5	6	1	1	1	0	0	0	0	1	…
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	70	72	63	60	18	25	18	23	21	11	7	9	4	1	0	0	1	0
UK (Total)																		
Total	3,193	2,005	2,051	2,024	1,874	1,954	1,803	1,566	1,443	1,488	1,591	1,544	1,134	1,270	937	802	562	484
Discards	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unallocated	74	-9	15	-150	-167	-83	-38	34	-72	-15	32	15	9	11	-5	3	1	-28
Total figures used by the Working Group for stock assessment	3,267	1,996	2,066	1,874	1,707	1,871	1,765	1,600	1,371	1,473	1,623	1,559	1,143	1,281	932	805	563	456

[1]Provisional.

[2]Northern Ireland included with England and Wales.

{UK (Total) excludes Isle of Man data}.

Table 6.7.2.2. Irish Sea plaice: English standardised lpue and effort, Belgian beam trawl lpue and effort and Irish otter trawl lpue and effort-series.

Year	CPUE		LPUE					Effort ('000hrs)				
	UK(E&W)[4] Beam trawl survey		English[1]		Belgian[3]	Irish[7]		English[2]		Belgian[5]	Irish	
	March	September	Otter Trawl	Beam Trawl	Beam Trawl	Otter Trawl	Beam Trawl	Otter Trawl	Beam Trawl	Beam Trawl	Otter Trawl	Beam Trawl
1972			6.96		9.8			128.4		6.8		
1973			6.33		9.0			147.6		16.5		
1974			7.45		10.4			115.2		14.2		
1975			7.71		10.7			130.7		16.2		
1976			5.03		5.8			122.3		15.1		
1977			4.82		5.3			101.9		13.4		
1978			6.77	4.88	6.9			89.1	0.9	12.0		
1979			7.18	15.23	8.0			89.9	1.7	13.7		
1980			8.24	8.98	8.6			107.0	4.3	20.8		
1981			6.87	4.91	7.1			107.1	6.4	26.7		
1982			4.92	1.77	4.4			127.2	5.5	21.3		
1983			5.32	3.08	7.8			88.1	2.8	18.5		
1984			7.77	6.98	6.8			103.1	4.1	13.6		
1985			9.97	25.70	8.8			102.9	7.4	21.9		
1986			9.27	4.21	8.7			90.3	17.0	38.3		
1987			7.20	3.57	8.2			130.6	22.0	43.2		
1988		392	5.02	3.05	6.3			132.0	18.6	32.7		
1989		253	5.51	13.59	6.2			139.5	25.3	36.7		
1990		239	5.93	12.02	7.2			117.1	31.0	38.3		
1991		157	4.79	10.56	7.5			107.3	25.8	15.4		
1992		188	4.20	9.99	11.9			96.8	23.4	23.0		
1993	91	235	3.97	9.50	5.0			78.9	21.5	24.4		
1994	128	225	4.90	7.79	9.2			43.0	20.1	31.6		
1995	134	169	5.08	7.69	9.5	3.2	17.0	43.1	20.9	27.1	80.3	8.6
1996	-[6]	210	5.37	12.96	11.8	4.1	18.9	42.2	13.3	22.2	64.8	6.3
1997	147	262	5.25	7.66	13.9	3.1	13.7	39.9	10.8	29.3	92.2	9.0
1998	113	249	5.00	5.66	12.3	3.7	22.2	36.9	10.4	23.8	93.5	11.6
1999	-[6]	264	5.38	7.76	12.0	2.3	23.2	22.9	11.0	22.1	110.3	14.7
2000	-[6]	357	5.02	13.04	11.6	2.0	13.8	27.0	6.3	18.2	82.7	11.4
2001		281	3.35	8.33	13.6	2.5	10.8	33.0	12.5	28.5	77.5	13.1
2002		340	5.66	5.46	10.7	2.8	7.9	24.8	8.0	36.2	77.9	17.7
2003		503	2.60	3.76	8.8	4.1	9.5	23.9	14.0	23.0	73.8	18.7
2004		540	3.17	4.20	14.9	2.1	8.6	23.5	7.4	27.6	72.5	14.2
2005		367	4.85	4.67	15.3	2.0	8.0	16.7	11.6	31.8	68.3	14.7
2006		356	6.50	2.19	11.6	1.4	6.3	5.2	4.6	28.1	64.9	11.9
2007		432	17.94	4.22	7.3	1.2	6.1	4.4	3.2	22.3	73.2	14.0
2008		416	9.03	4.47	10.6	0.9	5.2	2.7	1.3	11.1	58.8	9.5
2009		467	6.49	1.21	16.7	1.0	3.8	1.5	0.46	8.9	41.5	7.6

1 Whole weight (kg) per corrected hour fished, weighted by area
2 Corrected for fishing power (GRT)
3 Kg/hr
4 Kg/100km
5 Corrected for fishing power (HP) [uncorrected data for 2007-2008, replaced at 2010WG].
6 Carhelmar survey, Kg/100km not available
7 All years updated in 2007 due to slight historical differences

Fishing power corrections are detailed in Appendix 2 of the 2000 working group report

Table 6.7.2.3. Irish Sea plaice: UK (NI) index of relative SSB trends by region.

JK(NI) GFS Mar Spring	Estimated mean abundance			Estimated standard error		
	Combined	West	East	Combined	West	East
Year	Str1-7	Str1-3	Str4-7	Str1-7	Str1-3	Str4-7
1992	9.59	6.40	10.54	4.39	2.13	5.66
1993	13.27	21.40	10.85	2.22	5.56	2.36
1994	10.09	5.38	11.50	2.56	1.83	3.27
1995	7.59	6.56	7.89	1.39	1.66	1.74
1996	7.96	14.41	6.04	1.68	5.94	1.28
1997	13.73	15.80	13.11	3.99	6.78	4.76
1998	12.50	19.61	10.38	3.62	10.88	3.39
1999	9.37	19.10	6.46	2.34	7.42	2.09
2000	15.79	35.36	9.96	5.40	22.56	1.97
2001	13.52	23.78	10.46	2.11	6.21	2.02
2002	13.36	25.65	9.70	3.24	8.93	3.25
2003	26.79	55.52	18.23	8.36	32.38	4.95
2004	10.55	8.60	11.13	4.77	5.23	7.58
2005	15.86	27.20	12.48	3.54	8.59	3.82
2006	9.57	16.33	7.55	1.80	6.15	1.45
2007	8.73	21.76	4.84	1.81	7.00	1.06
2008	6.33	9.26	5.46	0.90	5.71	1.01
2009	11.00	17.85	8.96	1.89	4.61	2.03
2010	22.67	16.49	24.51	3.80	4.49	4.75

JK(NI) GFS Oct Autumn	Estimated mean abundance			Estimated standard error		
	Combined	West	East	Combined	West	East
Year	Str1-7	Str1-3	Str4-7	Str1-7	Str1-3	Str4-7
1991	0.81	3.38	0.04	0.39	1.71	0.03
1992	4.83	2.76	5.45	0.85	1.26	1.04
1993	4.64	2.91	5.16	0.95	1.18	1.18
1994	9.20	8.65	9.36	2.27	3.74	2.72
1995	4.77	8.31	3.72	1.28	3.52	1.29
1996	8.69	9.95	8.32	2.15	5.67	2.22
1997	8.22	7.67	8.38	2.18	2.80	2.71
1998	5.39	4.21	5.74	1.45	2.39	1.75
1999	6.90	4.91	7.50	2.29	3.12	2.82
2000	10.50	2.84	12.78	6.42	1.16	8.33
2001	13.93	4.03	16.88	6.45	1.96	8.35
2002	9.98	6.63	10.98	3.80	3.45	4.82
2003	18.65	10.09	21.20	5.41	4.87	6.87
2004	8.49	2.52	10.28	1.90	1.10	2.44
2005	11.58	3.88	13.88	4.39	2.39	5.66
2006	7.20	2.59	8.57	1.98	1.47	2.53
2007	8.48	6.09	9.19	1.69	2.55	2.05
2008	11.28	4.66	13.26	3.06	2.50	3.91
2009	14.83	5.36	17.66	3.25	3.71	4.07

Table 6.7.2.4. Irish Sea plaice: tuning fleet data available. Figures shown in bold are those used in the assessment.

Irish Sea plaice, 2010

101

UK BT SURVEY (Sept-Trad) - Prime stations only

1989 2009

1 1 0.75 0.85

1 8

129.710 309 441 530 77 13 44 3 0

128.969 1688 405 176 90 54 30 3 1

123.780 591 481 68 47 4 4 24 3

129.525 1043 470 267 23 19 14 14 3

131.192 1106 812 136 101 16 8 21 4

124.892 815 608 307 68 33 12 17 8

126.004 1283 387 179 84 16 18 0 1

126.004 1701 601 124 74 49 9 11 1

126.004 1363 668 322 65 50 23 8 7

126.004 1167 767 212 95 34 23 14 3

126.004 1189 965 344 113 38 17 7 7

126.004 2112 659 298 141 73 22 7 3

126.004 1468 663 218 130 89 28 10 7

126.004 1734 1615 647 243 79 51 16 17

126.004 1480 1842 827 296 122 62 39 10

126.004 1816 1187 1184 404 261 57 57 14

122.298 869 1295 666 499 297 111 17 17

126.004 1120 840 722 411 178 83 59 16

126.004 2667 1255 525 417 196 95 45 37

122.298 1293 1893 628 339 243 76 55 33

126.004 1460 1083 1225 310 189 251 65 31

UK(E+W)TRAWL FLEET (calculated using ABBT age compositions)

1987 2009

1 1 0 1

1 14

```
130.597 24.4 1475.8 1434.6 1593.3 409.0 291.2 31.4 46.8 16.9 24.2 11.2 1.4 3.2 3.6
131.950 22.0 1374.8 1421.0  455.0 295.5 142.5 78.9  8.1 28.9  6.7  9.6 3.5 4.1 1.1
139.521 10.6  771.5 2102.0  801.1 235.2  99.8 48.0 37.6 13.7 11.0  6.3 6.7 3.2 1.7
117.058  8.2  501.0 1094.3  983.9 217.0  82.8 60.0 17.5 15.9  4.5  3.2 6.7 3.0 2.2
107.288 94.3  949.9  451.3  419.5 245.0  99.7 35.2 38.7 12.1 11.1  0.6 3.6 1.8 1.5
 96.802 80.8  851.1  907.2  181.3 114.6  82.4 28.6  8.3 17.8  7.3  5.4 0.4 1.3 0.8
 78.945 12.9  387.7  519.1  367.7  63.5  55.7 69.5 21.8  5.2 10.7  2.6 1.1 0.0 0.2
 42.995 38.8  408.3  534.9  142.5  92.5  18.2 12.3 15.9  7.3  1.8  1.3 2.2 0.5 0.0
 43.146  7.3  350.1  512.5  255.7  88.9  46.1 10.9  4.8  8.3  2.4  1.7 0.7 0.2 0.2
 42.239 10.9  326.5  280.3  198.7  80.5  32.9 15.3  4.8  2.0 10.0  2.1 0.7 0.6 0.1
 39.886 11.2  250.6  214.7  125.2  74.2  37.5 12.8 12.4  1.8  0.8  1.4 0.4 0.2 0.7
 36.902  1.6  202.7  318.6  105.3  40.6  37.6 16.5  9.8  4.5  0.5  0.5 1.0 0.3 0.2
 22.903 17.6  139.2  200.5  120.0  35.0  14.0  9.0  5.4  1.6  0.8  0.2 0.1 0.1 0.0
 26.967  0.0  107.1  233.3  185.0  95.5  18.5 14.4  9.8  5.9  2.7  2.1 0.9 0.4 .01
 32.964  5.5   65.9  130.4  124.0 108.7  53.2 17.4 10.6  7.1  3.0  0.5 0.7 0.1 0.1
 24.762  0.5   78.6  175.8   95.3  58.6  33.0 23.8  3.3  2.5  1.4  0.4 0.4 0.0 0.1
 23.851  0.0   34.1   79.6   88.7  35.6  16.1 12.3  7.4  2.3  0.4  0.3 0.2 0.0 0.2
 23.456  1.5   34.8  149.1  103.1  60.6  27.0  8.7  5.8  4.3  1.2  0.7 0.2 0.1 0.0
 16.683  0.0   32.6   52.6  108.1  95.1  40.0 17.8  7.5  5.4  1.7  1.3 0.6 0.2 0.1
  5.218  0.8   15.1   46.9   34.8  55.1  23.4 13.9  4.9  2.6  1.9  0.7 0.6 0.1 0.0
  4.404  0.0    2.5   33.7   94.5  58.4  50.4 17.3 16.7  2.2  1.5  0.5 0.3 0.1 0.0
  2.710  0.1    5.8   27.8   37.9  40.9  23.9 15.4  7.3  2.9  1.1  0.5 0.2 0.1 0.0
  1.502  0.0    0.2    3.8    8.1   6.9   6.2  2.9  1.8  0.7  0.4  0.1 0.1 0.0 0.0
UK(E+W)BEAM TRAWL FLEET
1987 2009
1 1 0 1
1 14
21.997  0.0   1.1  27.1 113.1 36.0 31.3  2.9  6.7  1.9 3.1 0.6 0.1 0.2 0.1
18.564  0.0   2.0  48.0  23.7 24.4 13.2  8.5  1.4  2.6 1.6 1.5 0.6 0.8 0.3
25.291  3.1 132.8 297.5 163.4 52.6 42.4 25.1 16.1  4.3 5.3 3.3 5.7 2.6 1.1
31.003  2.2 136.2 391.9 361.1 78.2 30.2 17.2  8.4  3.6 1.5 1.9 3.8 1.4 0.5
25.838 17.3 282.5 182.9 174.5 91.8 35.9 11.2 11.8  3.5 4.7 0.2 1.0 0.6 0.3
23.399  3.9 141.5 335.6  79.6 64.6 45.5 18.6  8.0 12.2 7.1 4.0 0.2 0.7 1.0
```

21.503	0.6	73.4	112.8	95.2	23.3	24.2	32.0	11.8	4.5	7.1	2.2	1.2	0.0	0.4
20.145	13.4	151.8	186.1	39.9	26.0	6.8	6.6	7.8	3.5	1.2	0.9	1.2	0.2	0.0
20.932	5.2	183.4	229.1	100.6	33.1	16.1	3.9	1.7	3.3	1.0	0.9	0.5	0.1	0.2
13.320	13.4	144.0	111.4	75.3	30.8	11.0	5.9	2.1	1.2	2.7	0.5	0.2	0.4	0.3
10.760	0.9	98.6	69.5	39.0	30.2	13.5	3.7	3.2	0.5	0.4	0.3	0.2	0.1	0.1
10.386	0.3	63.5	103.7	32.6	12.0	9.7	6.3	2.7	1.8	0.3	0.2	0.5	0.2	0.0
11.016	4.8	51.3	124.4	80.4	24.4	12.5	10.5	5.6	0.9	0.8	0.2	0.2	0.2	0.1
6.275	0.0	25.2	61.4	46.6	27.9	7.3	6.5	4.5	1.9	0.7	0.7	0.7	0.1	0.1
12.495	1.5	20.6	47.5	56.6	42.7	20.8	7.0	4.5	2.5	1.2	0.4	0.1	0.1	0.0
8.017	0.0	11.5	33.1	21.0	18.8	14.9	8.0	2.3	1.3	1.4	0.4	0.4	0.0	0.0
13.996	0.0	11.4	45.5	47.7	20.9	10.0	8.7	5.4	1.7	0.3	0.0	0.3	0.0	0.1
7.396	0.2	18.0	29.4	11.7	11.9	5.1	1.7	1.4	1.0	0.3	0.2	0.1	0.0	0.0
11.406	0.1	6.5	11.0	24.0	20.7	9.2	3.4	1.6	1.3	0.4	0.4	0.1	0.1	0.0
4.649	0.2	2.7	8.1	4.9	8.2	3.8	2.6	0.9	0.6	0.5	0.2	0.2	0.1	0.0
3.197	0.0	0.2	3.2	7.2	4.5	5.3	1.8	1.3	0.3	0.3	0.1	0.1	0.0	0.0
1.300	0.0	0.0	1.4	3.5	3.9	2.1	1.7	0.8	0.3	0.1	0.1	0.0	0.0	0.0
0.462	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UK BT SURVEY (March) - Prime stations only

1993 1999

1 1 0.15 0.25

1 8

126.931	480	662	141	71	12	8	11	3
115.442	361	662	370	98	47	5	7	10
126.189	859	647	340	120	29	28	0	10
134.343	1559	908	295	98	49	16	8	1
121.742	967	905	351	63	39	31	10	13
130.081	648	957	217	82	24	23	12	1
130.822	570	770	389	98	26	11	9	6

IR-JPS : Irish Juvenile Plaice Survey 2nd Qtr - Effort min. towed - Plaice No. at age

1991 2004

1 1 0.37 0.43

1 7

555	185	206	60	21	9	1	1
570	1785	268	48	16	7	2	2
600	643	630	189	45	8	21	3
585	614	254	196	33	8	2	0
570	840	321	110	86	18	5	2
675	752	221	134	39	57	7	0
675	665	303	105	41	22	17	5
675	311	466	191	48	11	7	4
660	0	0	0	0	0	0	0
645	805	342	72	61	32	9	2
675	743	739	213	88	43	14	5
660	273	145	40	2	1	1	0
660	346	322	152	78	20	9	7
660	1046	501	171	86	50	10	6

IR-OTB : Irish Otter trawl - Effort in hours - VIIa Plaice numbers at age - Year

1995 2009

1 1 0 1

2 12

70682	5	84	263	202	51	29	24	10	5	1	1
58166	4	94	157	227	97	26	8	6	4	2	1
75029	27	136	197	147	74	74	21	12	16	3	2
81073	49	140	176	124	104	128	64	29	21	10	5
93221	51	129	152	126	71	46	32	19	4	2	1
64320	11	92	98	88	24	10	8	3	1	4	0
77541	55	90	97	104	100	38	16	11	3	1	0
77863	6	67	179	122	90	53	22	11	6	1	0
73854	18	177	278	174	102	48	19	5	3	1	13
72507	25	105	116	90	31	23	16	12	1	4	0
68336	1	45	89	129	80	43	17	10	8	1	2
64876	4	40	34	51	40	37	19	12	12	4	0
73157	14	47	77	58	40	17	11	5	2	1	0
58812	4	16	35	45	23	11	6	2	1	1	1

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41469   2   17   22   20   23   10   9   2   2   1   0
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UK(NI) GFS Spring and autumn spawning biomass indices

2 16 2

'Year''VPA' 'DARDS' 'DARDA'

1992 1 9.59 4.83

1993 1 13.27 4.64

1994 1 10.09 9.20

1995 1 7.59 4.77

1996 1 7.96 8.69

1997 1 13.73 8.22

1998 1 12.50 5.39

1999 1 9.37 6.90

2000 1 15.79 10.50

2001 1 13.52 13.93

2002 1 13.36 9.98

2003 1 26.79 18.65

2004 1 10.55 8.49

2005 1 15.86 11.58

2006 1 9.57 7.20

2007 1 8.73 8.48

2008 1 6.33 11.28

2009 1 11.00 14.83

2010 1 22.67

Table 6.7.2.5. Irish Sea plaice: Landings numbers-at-ages 1 to 15+ (thousands).

	Ages														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1964	0	997	1911	1680	446	851	480	140	26	155	30	2	1	1	10
1965	28	1416	3155	2841	1115	555	309	300	17	20	5	2	1	1	1
1966	0	120	4303	3605	2182	620	588	386	181	13	20	7	7	3	6
1967	0	164	1477	5593	4217	995	642	267	210	176	86	35	5	6	1
1968	0	171	1961	3410	4641	1611	319	113	135	24	17	3	4	1	1
1969	59	430	2317	2932	2080	2227	779	184	58	100	80	22	9	4	1
1970	9	803	2278	2179	1877	1028	899	239	64	29	52	51	20	3	2
1971	0	427	3392	3882	1683	1371	491	497	244	60	65	36	11	9	1
1972	0	142	3254	5136	1461	752	555	627	353	169	55	40	38	19	12
1973	0	925	4091	5233	2682	642	345	238	183	238	129	40	14	11	17
1974	7	1200	2530	2694	2125	1045	191	139	56	47	95	40	5	5	5
1975	18	1370	4313	1902	1158	933	152	119	81	94	47	72	18	16	4
1976	23	2553	4333	2425	902	563	391	198	59	79	47	22	58	11	5
1977	565	4124	2767	2470	839	236	150	112	63	21	15	8	8	10	3
1978	22	3063	5169	1535	542	202	98	54	52	43	10	9	4	4	2
1979	12	3380	5679	1835	363	187	109	61	68	68	17	5	6	4	6
1980	3	2783	6738	2560	646	312	125	64	24	54	16	13	7	5	5
1981	22	1742	5939	2984	837	222	105	53	52	41	28	35	13	3	11
1982	27	715	3288	3082	1358	330	137	69	44	36	11	15	11	14	13
1983	51	2924	2494	3211	1521	648	211	110	53	30	13	15	9	11	11
1984	41	3159	5179	1182	1054	459	299	113	60	13	22	15	10	6	13
1985	4	2357	6152	3301	614	429	262	181	78	36	21	8	7	3	6
1986	31	1652	5280	2942	1287	344	371	112	92	54	24	9	5	3	9
1987	62	3717	5317	5252	1341	1072	123	121	75	74	25	8	10	12	13
1988	46	2923	5040	2552	1400	750	316	84	112	44	41	28	38	21	37
1989	24	1735	5945	2671	854	436	214	153	56	47	26	38	18	7	19
1990	15	1019	2715	2935	1132	465	259	98	51	22	15	15	9	6	7
1991	180	2008	1506	1929	1205	465	182	122	49	34	5	6	3	3	4
1992	151	1958	3209	1435	1358	903	388	118	74	44	27	15	9	3	4
1993	28	910	1649	1357	474	556	377	179	42	50	16	8	2	3	2
1994	98	1146	2173	1309	644	318	245	134	86	18	6	9	6	1	3
1995	21	961	1703	1936	764	318	138	70	47	23	9	4	1	1	3
1996	37	856	1345	1196	943	370	128	44	25	37	14	7	5	1	2
1997	28	830	1590	1513	1003	482	285	139	42	53	12	7	1	2	1
1998	5	691	1739	1025	612	476	403	177	91	52	25	17	19	2	1
1999	68	803	1505	1294	696	280	196	117	69	43	6	4	1	0	1
2000	0	450	1174	1284	685	212	219	102	55	19	14	7	2	2	2
2001	14	374	1138	1083	767	409	178	90	45	18	6	2	4	0	0
2002	1	206	940	1482	842	539	318	96	48	17	4	3	0	0	0
2003	0	286	1031	1314	707	415	253	127	48	22	12	7	1	3	0
2004	7	198	967	1104	705	246	114	88	74	11	11	1	1	0	0
2005	6	228	708	1177	890	461	204	92	55	37	12	12	4	2	1
2006	5	180	620	550	684	346	220	87	53	46	20	6	2	1	1
2007	0	64	350	859	506	401	150	114	27	14	5	3	0	0	0
2008	1	99	386	389	409	215	141	61	36	9	7	3	1	1	0
2009	0	13	204	374	351	272	116	73	26	12	4	2	1	1	1

Table 6.7.2.6. Irish Sea plaice: Landings weights-at-ages 1 to 15+ (kg).

	Ages														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1964	0.000	0.190	0.292	0.413	0.463	0.597	0.831	1.042	1.155	0.552	1.358	1.015	1.544	1.605	1.654
1965	0.070	0.177	0.269	0.388	0.556	0.653	0.690	0.719	0.801	1.198	1.167	0.971	1.477	1.535	1.581
1966	0.000	0.152	0.223	0.316	0.418	0.532	0.697	0.691	0.939	0.983	1.074	1.071	1.233	1.281	1.320
1967	0.000	0.133	0.218	0.299	0.382	0.516	0.518	0.759	0.791	0.682	0.783	0.514	1.152	1.198	1.234
1968	0.000	0.149	0.213	0.313	0.413	0.509	0.584	0.777	0.893	0.957	1.017	0.887	1.174	1.220	1.257
1969	0.056	0.146	0.215	0.311	0.405	0.541	0.643	0.787	0.897	0.744	0.723	1.097	1.185	1.231	1.269
1970	0.058	0.149	0.219	0.324	0.417	0.523	0.648	0.685	0.908	0.925	0.877	0.603	1.231	1.279	1.318
1971	0.000	0.140	0.207	0.295	0.396	0.489	0.595	0.753	0.654	0.852	0.731	1.079	1.153	1.198	1.235
1972	0.000	0.143	0.235	0.332	0.432	0.560	0.737	0.712	0.959	1.071	1.144	1.208	1.288	1.339	1.379
1973	0.000	0.143	0.218	0.316	0.415	0.491	0.645	0.694	0.791	0.898	0.927	0.863	1.204	1.252	1.290
1974	0.063	0.158	0.246	0.334	0.445	0.514	0.686	0.847	0.964	1.052	1.108	1.048	1.326	1.378	1.420
1975	0.072	0.185	0.275	0.398	0.531	0.644	0.749	0.924	1.147	1.169	1.359	1.360	1.533	1.593	1.641
1976	0.060	0.150	0.228	0.323	0.419	0.525	0.590	0.719	0.797	0.842	0.834	1.003	1.267	1.317	1.357
1977	0.059	0.153	0.226	0.340	0.430	0.510	0.592	0.738	0.840	1.016	0.945	1.100	1.252	1.301	1.340
1978	0.071	0.185	0.268	0.391	0.525	0.672	0.720	0.910	1.035	1.049	1.264	1.329	1.497	1.556	1.603
1979	0.069	0.176	0.262	0.376	0.557	0.668	0.794	0.915	0.997	0.968	1.274	1.227	1.471	1.529	1.575
1980	0.066	0.177	0.255	0.365	0.483	0.517	0.671	0.884	1.047	1.072	1.259	1.273	1.403	1.458	1.503
1981	0.069	0.176	0.267	0.376	0.512	0.592	0.678	0.863	1.097	0.804	1.276	1.310	1.309	1.509	1.554
1982	0.201	0.274	0.284	0.348	0.421	0.545	0.650	0.651	0.780	0.777	1.185	1.164	1.147	1.164	1.744
1983	0.232	0.261	0.290	0.319	0.368	0.426	0.484	0.552	0.629	0.716	0.803	0.910	1.026	1.161	1.316
1984	0.260	0.290	0.330	0.380	0.470	0.560	0.660	0.760	0.870	0.980	1.100	1.240	1.420	1.630	1.940
1985	0.290	0.310	0.340	0.390	0.470	0.540	0.630	0.730	0.840	0.940	1.060	1.200	1.380	1.600	1.900
1986	0.270	0.280	0.340	0.420	0.500	0.540	0.630	0.830	0.920	1.020	1.210	1.480	1.420	1.720	1.610
1987	0.260	0.290	0.315	0.370	0.440	0.520	0.610	0.720	0.820	0.950	1.080	1.210	1.360	1.520	1.700
1988	0.230	0.260	0.300	0.370	0.460	0.550	0.680	0.820	0.960	1.120	1.300	1.480	1.690	1.900	2.130
1989	0.227	0.272	0.321	0.374	0.430	0.491	0.555	0.623	0.694	0.770	0.849	0.932	1.019	1.109	1.205
1990	0.200	0.257	0.316	0.376	0.439	0.504	0.570	0.639	0.709	0.781	0.856	0.932	1.010	1.091	1.173
1991	0.247	0.267	0.295	0.332	0.377	0.431	0.494	0.566	0.646	0.735	0.832	0.938	1.053	1.176	1.309
1992	0.169	0.218	0.274	0.337	0.407	0.484	0.568	0.658	0.756	0.860	0.971	1.089	1.213	1.345	1.483
1993	0.260	0.270	0.292	0.328	0.375	0.436	0.508	0.594	0.691	0.802	0.925	1.060	1.208	1.368	1.541
1994	0.156	0.207	0.268	0.338	0.416	0.504	0.600	0.706	0.821	0.945	1.077	1.219	1.370	1.530	1.698
1995	0.201	0.229	0.266	0.312	0.366	0.429	0.501	0.581	0.670	0.768	0.874	0.990	1.114	1.246	1.387
1996	0.144	0.203	0.268	0.338	0.414	0.496	0.584	0.677	0.776	0.881	0.992	1.108	1.230	1.358	1.492
1997	0.134	0.184	0.239	0.299	0.362	0.430	0.502	0.579	0.660	0.745	0.834	0.928	1.027	1.129	1.236
1998	0.202	0.222	0.252	0.294	0.346	0.410	0.484	0.569	0.665	0.773	0.891	1.020	1.160	1.310	1.472
1999	0.174	0.213	0.257	0.309	0.366	0.430	0.501	0.577	0.661	0.751	0.847	0.949	1.058	1.174	1.296
2000	0.000	0.222	0.257	0.302	0.357	0.422	0.497	0.581	0.676	0.780	0.894	1.018	1.152	1.296	1.450
2001	0.142	0.205	0.269	0.337	0.407	0.479	0.554	0.632	0.712	0.795	0.880	0.968	1.058	1.151	1.247
2002	0.185	0.225	0.271	0.324	0.383	0.449	0.521	0.600	0.685	0.776	0.874	0.978	1.089	1.206	1.329
2003	0.000	0.244	0.289	0.340	0.395	0.455	0.520	0.590	0.665	0.745	0.830	0.920	1.014	1.114	1.219
2004	0.207	0.230	0.261	0.300	0.348	0.404	0.468	0.542	0.623	0.713	0.811	0.918	1.033	1.157	1.289
2005	0.172	0.212	0.254	0.299	0.345	0.394	0.445	0.499	0.554	0.612	0.672	0.734	0.799	0.865	0.934
2006	0.227	0.232	0.249	0.278	0.320	0.374	0.440	0.518	0.609	0.712	0.827	0.954	1.094	1.246	1.410
2007	0.000	0.215	0.247	0.283	0.325	0.371	0.422	0.479	0.540	0.606	0.677	0.753	0.834	0.920	1.011
2008	0.000	0.224	0.233	0.252	0.280	0.318	0.365	0.421	0.486	0.560	0.644	0.737	0.840	0.951	1.072
2009	0.000	0.174	0.224	0.272	0.315	0.355	0.391	0.424	0.453	0.478	0.499	0.517	0.531	0.542	0.549

Table 6.7.2.7. Irish Sea plaice: Stock weights-at-ages 1 to 15+ (kg).

	Ages														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1964	0.02	0.11	0.23	0.35	0.41	0.55	0.77	0.98	1.09	0.54	1.31	0.99	1.51	1.54	1.63
1965	0.02	0.11	0.21	0.33	0.48	0.59	0.64	0.68	0.77	1.15	1.13	0.95	1.44	1.48	1.56
1966	0.02	0.09	0.18	0.27	0.37	0.48	0.64	0.65	0.88	0.95	1.04	1.04	1.20	1.23	1.30
1967	0.02	0.08	0.17	0.25	0.34	0.46	0.48	0.72	0.75	0.66	0.76	0.51	1.13	1.15	1.22
1968	0.02	0.08	0.17	0.26	0.36	0.46	0.54	0.73	0.84	0.92	0.98	0.86	1.15	1.17	1.24
1969	0.02	0.08	0.17	0.26	0.36	0.49	0.59	0.74	0.84	0.72	0.70	1.06	1.16	1.19	1.25
1970	0.02	0.09	0.18	0.27	0.37	0.47	0.60	0.65	0.85	0.89	0.85	0.59	1.20	1.23	1.30
1971	0.02	0.08	0.16	0.25	0.35	0.44	0.55	0.71	0.63	0.82	0.71	1.04	1.13	1.15	1.22
1972	0.02	0.09	0.19	0.28	0.38	0.50	0.68	0.67	0.90	1.03	1.10	1.17	1.26	1.29	1.36
1973	0.02	0.09	0.17	0.27	0.36	0.45	0.60	0.66	0.75	0.87	0.90	0.84	1.18	1.20	1.27
1974	0.02	0.09	0.19	0.28	0.39	0.47	0.63	0.80	0.91	1.01	1.07	1.02	1.30	1.33	1.40
1975	0.02	0.11	0.22	0.34	0.46	0.58	0.70	0.87	1.08	1.13	1.31	1.32	1.50	1.53	1.62
1976	0.02	0.09	0.18	0.27	0.37	0.48	0.55	0.68	0.76	0.81	0.81	0.97	1.24	1.27	1.34
1977	0.02	0.09	0.18	0.29	0.38	0.46	0.55	0.70	0.79	0.98	0.91	1.07	1.22	1.25	1.32
1978	0.02	0.11	0.21	0.33	0.46	0.60	0.67	0.86	0.98	1.01	1.22	1.29	1.46	1.50	1.58
1979	0.02	0.10	0.21	0.32	0.48	0.60	0.73	0.86	0.94	0.94	1.23	1.19	1.44	1.47	1.55
1980	0.02	0.10	0.20	0.31	0.42	0.47	0.62	0.83	0.98	1.03	1.22	1.23	1.37	1.40	1.48
1981	0.02	0.10	0.21	0.32	0.45	0.54	0.63	0.81	1.03	0.78	1.23	1.27	1.28	1.45	1.53
1982	0.02	0.09	0.21	0.31	0.41	0.48	0.57	0.66	0.75	0.85	0.95	1.05	1.15	1.26	1.37
1983	0.02	0.09	0.21	0.30	0.35	0.40	0.46	0.52	0.59	0.68	0.77	0.86	0.97	1.09	1.24
1984	0.02	0.10	0.23	0.35	0.43	0.52	0.61	0.71	0.82	0.93	1.04	1.17	1.33	1.53	1.79
1985	0.02	0.10	0.24	0.36	0.43	0.51	0.59	0.68	0.79	0.89	1.00	1.13	1.29	1.49	1.75
1986	0.02	0.12	0.26	0.38	0.44	0.52	0.61	0.72	0.83	0.96	1.12	1.26	1.41	1.56	1.72
1987	0.02	0.10	0.24	0.35	0.41	0.48	0.56	0.66	0.77	0.89	1.01	1.15	1.29	1.44	1.61
1988	0.25	0.26	0.29	0.34	0.40	0.48	0.59	0.70	0.84	1.00	1.17	1.36	1.57	1.79	2.03
1989	0.21	0.25	0.30	0.35	0.40	0.46	0.52	0.59	0.66	0.73	0.81	0.89	0.98	1.06	1.16
1990	0.17	0.23	0.29	0.35	0.41	0.47	0.54	0.60	0.67	0.75	0.82	0.89	0.97	1.05	1.13
1991	0.24	0.26	0.28	0.31	0.35	0.40	0.46	0.53	0.61	0.69	0.78	0.88	0.99	1.11	1.24
1992	0.15	0.19	0.25	0.31	0.37	0.45	0.53	0.61	0.71	0.81	0.91	1.03	1.15	1.28	1.41
1993	0.26	0.26	0.28	0.31	0.35	0.40	0.47	0.55	0.64	0.75	0.86	0.99	1.13	1.29	1.45
1994	0.13	0.18	0.24	0.30	0.38	0.46	0.55	0.65	0.76	0.88	1.01	1.15	1.29	1.45	1.61
1995	0.19	0.21	0.25	0.29	0.34	0.40	0.46	0.54	0.63	0.72	0.82	0.93	1.05	1.18	1.32
1996	0.12	0.17	0.23	0.30	0.38	0.45	0.54	0.63	0.73	0.83	0.94	1.05	1.17	1.29	1.42
1997	0.11	0.16	0.21	0.27	0.33	0.40	0.47	0.54	0.62	0.70	0.79	0.88	0.98	1.08	1.18
1998	0.20	0.21	0.24	0.27	0.32	0.38	0.45	0.53	0.62	0.72	0.83	0.95	1.09	1.23	1.39
1999	0.16	0.19	0.23	0.28	0.34	0.40	0.47	0.54	0.62	0.71	0.80	0.90	1.00	1.12	1.23
2000	0.00	0.21	0.24	0.28	0.33	0.39	0.46	0.54	0.63	0.73	0.84	0.96	1.08	1.22	1.37
2001	0.11	0.17	0.24	0.30	0.37	0.44	0.52	0.59	0.67	0.75	0.84	0.92	1.01	1.11	1.20
2002	0.17	0.20	0.25	0.30	0.35	0.42	0.48	0.56	0.64	0.73	0.82	0.93	1.03	1.15	1.27
2003	0.00	0.22	0.27	0.31	0.37	0.42	0.49	0.55	0.63	0.70	0.79	0.87	0.97	1.06	1.17
2004	0.20	0.22	0.24	0.28	0.32	0.38	0.44	0.50	0.58	0.67	0.76	0.86	0.98	1.09	1.22
2005	0.15	0.19	0.23	0.28	0.32	0.37	0.42	0.47	0.53	0.58	0.64	0.70	0.77	0.83	0.90
2006	0.23	0.23	0.24	0.26	0.30	0.35	0.41	0.48	0.56	0.66	0.77	0.89	1.02	1.17	1.33
2007	0.00	0.20	0.23	0.27	0.30	0.35	0.40	0.45	0.51	0.57	0.64	0.71	0.79	0.88	0.97
2008	0.22	0.23	0.24	0.27	0.30	0.34	0.39	0.45	0.52	0.60	0.69	0.79	0.89	1.01	1.14
2009	0.00	0.15	0.20	0.25	0.29	0.34	0.37	0.41	0.44	0.47	0.49	0.51	0.53	0.54	0.55

Table 6.7.3.1. Irish Sea plaice: Final ICA diagnostics and output.

```
FLICA CONFIGURATION SETTINGS

sep.2       : NA

sep.gradual : TRUE

sr          : FALSE

sr.age      : 2

lambda.age  : 1 1 1 1 1 1 1 0

lambda.yr   : 1 1 1 1 1 1 1 1 1

lambda.sr   : 0

index.model : linear linear linear

index.cor   : 1 -925596313493178307362200 -925596313493178307362200

sep.nyr     : 9

sep.age     : 5

sep.sel     : 1


FLR, R SOFTWARE VERSIONS

R version 2.8.1 (2008-12-22)


Package  : FLICA

Version  : 1.4-12

Packaged : 2009-10-08 15:16:26 UTC; mpa

Built    : R 2.9.1; ; 2009-10-08 15:16:27 UTC; windows


Package  : FLAssess

Version  : 1.99-102

Packaged : Mon Mar 23 08:18:19 2009; mpa

Built    : R 2.8.0; i386-pc-mingw32; 2009-03-23 08:18:21; windows


Package  : FLCore

Version  : 2.2

Packaged : Tue May 19 19:23:18 2009; Administrator

Built    : R 2.8.1; i386-pc-mingw32; 2009-05-19 19:23:22; windows
```

FITTED SELECTION PATTERN

Units : NA

Year									
age	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105
3	0.537	0.537	0.537	0.537	0.537	0.537	0.537	0.537	0.537
4	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078
5	1	1	1	1	1	1	1	1	1
6	1.116	1.116	1.116	1.116	1.116	1.116	1.116	1.116	1.116
7	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944
8	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1

Table 6.7.3.1. (cont).

FIT PARAMETERS

	Value	Std.dev	Lower.95.pct.CL	Upper.95.pct.CL
F2001	0.360523	0.1676	0.259598	0.500685
F2002	0.357308	0.1671	0.257501	0.495801
F2003	0.324909	0.1714	0.232218	0.454599
F2004	0.209357	0.1746	0.148687	0.294784
F2005	0.228515	0.1728	0.162852	0.320653
F2006	0.153648	0.1714	0.109809	0.214987
F2007	0.105777	0.169	0.07595	0.147317
F2008	0.070282	0.1684	0.050529	0.097758
F2009	0.049362	0.1751	0.035024	0.069569
Selectivity at age 2	0.104984	0.1653	0.075935	0.145145
Selectivity at age 3	0.536738	0.1506	0.399567	0.721001
Selectivity at age 4	1.07779	0.1381	0.82224	1.412764
Selectivity at age 6	1.115684	0.1245	0.874134	1.423981
Selectivity at age 7	0.944497	0.1233	0.74179	1.202597
Terminal year popage 2	3221.501647	0.3434	1643.480701	6314.691045
Terminal year popage 3	10269.86787	0.2415	6396.687947	16488.24938
Terminal year popage 4	6548.676293	0.1989	4434.18381	9671.489281
Terminal year popage 5	5311.593314	0.1716	3794.359981	7435.515784
Terminal year popage 6	4715.670137	0.1553	3478.249168	6393.31565
Terminal year popage 7	2602.214258	0.1527	1929.049085	3510.288616
Terminal year popage 8	2174.319325	0.1521	1613.686586	2929.729086
Last true age pop2001	324.443093	0.3326	169.059059	622.642297
Last true age pop2002	378.80891	0.2484	232.799521	616.393838
Last true age pop2003	596.277139	0.2181	388.83798	914.381941
Last true age pop2004	702.691156	0.2119	463.862361	1064.485723
Last true age pop2005	687.45457	0.1959	468.293967	1009.181879
Last true age pop2006	869.850702	0.184	606.491832	1247.568729
Last true age pop2007	1386.144405	0.167	999.197834	1922.938827
Last true age pop2008	1518.268688	0.1602	1109.202669	2078.195331
Index 2 biomass	0.002294	0.0794	0.001963	0.00268
Index 3 biomass	0.00175	0.0794	0.001498	0.002045
Index 1 age 2 numbers	0.000917	0.166	0.000662	0.00127
Index 1 age 3 numbers	0.000529	0.1646	0.000383	0.000731
Index 1 age 4 numbers	0.000347	0.1644	0.000251	0.000478
Index 1 age 5 numbers	0.000251	0.165	0.000182	0.000347
Index 1 age 6 numbers	0.000238	0.1666	0.000172	0.00033
Index 1 age 7 numbers	0.000232	0.1741	0.000165	0.000327

Table 6.7.3.1. (cont).

INDEX RESIDUALS

UK(E&W) BTS
Units: NA

age \ year	1989	1990	1991	1992	1993	1994	1995	1996
2	-0.8963	-0.41818	-0.6	-0.52202	-0.205	-0.21978	-0.539	-0.03933
3	-0.0183	-0.77834	-1.14	-0.00854	-0.788	-0.16396	-0.4784	-0.73395
4	-0.6597	-0.63775	-1.02	-1.07001	0.119	-0.47548	-0.4349	-0.44153
5	-1.056	-0.00762	-2.76	-0.81417	-0.456	0.00211	-1.0505	-0.04304
6	0.6982	0.62051	-1.96	-0.67469	-0.76	0.12918	0.0212	-1.07532
7	-0.9646	-1.27605	1.17	-0.01745	0.62	0.99827	-99	0.00381

age \ year	1997	1998	1999	2000	2001	2002	2003	2004
2	-0.176	-0.0732	0.3037	-0.1109	-0.363	0.688	0.664	0.392
3	0.353	-0.3698	0.0245	0.0126	-0.379	0.443	0.835	0.989
4	-0.299	0.1048	-0.0753	0.0048	0.0851	0.62	0.523	0.878
5	0.155	-0.0158	0.1517	0.2791	0.3432	0.392	0.709	1.076
6	-0.178	0.1159	-0.1513	0.1159	-0.116	0.351	0.685	0.373
7	-0.597	0.1433	-0.4746	-0.4291	-0.197	-0.179	0.554	0.977

age \ year	2005	2006	2007	2008	2009
2	0.24	-0.0861	0.3218	0.4713	1.1678
3	0.616	0.366	0.1621	0.3613	0.6985
4	0.918	0.8041	0.4685	0.3702	0.2193
5	1.269	0.4703	0.6226	0.4785	0.2519
6	0.67	0.3208	0.1411	-0.0374	0.7128
7	-0.442	0.3214	-0.0314	-0.1531	-0.025

NI SSB Spring
Units: NA

age \ year	1992	1993	1994	1995	1996	1997	1998	1999	2000
all	-0.532	-0.417	0.291	-0.329	0.215	0.238	-0.23	0.0397	0.417

age \ year	2001	2002	2003	2004	2005	2006	2007	2008	2009
all	0.557	0.149	0.648	-0.111	0.114	-0.472	-0.339	-0.314	0.0735

NI SSB Autumn
Units: NA

age \ year	1992	1993	1994	1995	1996	1997	1998	1999	2000
all	0.364	0.113	-0.135	-0.143	0.481	0.341	0.0753	0.555	0.257

age \ year	2001	2002	2003	2004	2005	2006	2007	2008	2009
all	0.171	0.74	-0.165	0.158	-0.457	-0.581	-1.16	-0.496	0

Table 6.7.3.1. (cont).

CATCH RESIDUALS

Units: Thousands NA

age	year 2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.132	-0.2947	-0.02554	0.2171	0.00096	0.3008	-0.352	0.203	-0.1885
3	0.1097	-0.3373	0.00245	0.1925	-0.03724	-0.061	-0.137	0.366	-0.2158
4	-0.1443	0.0884	-0.2186	0.1319	-0.09974	-0.3268	0.159	-0.133	0.1561
5	-0.089	0.1821	-0.00433	0.0776	0.25074	0.1518	0.295	0.113	0.375
6	-0.1979	-0.0443	-0.0601	-0.3277	-0.19337	-0.0851	0.138	-0.049	0.1323
7	0.0803	0.2185	-0.06266	-0.3405	-0.09071	-0.0467	-0.124	-0.118	0.0369
8	-0.0345	-0.117	-0.20977	-0.3551	-0.36731	-0.2968	-0.142	-0.466	-0.3024
9	0	0	0	0	0	0	0	0	0

Table 6.7.3.2. Irish Sea plaice: Final ICA population numbers-at-age (thousands).

age \ year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	21672	29108	15094	13596	10907	12508	18548	17283	11825	8746	11710	11514
3	11209	18283	24485	13274	11904	9513	10689	15695	14927	10354	6887	9258
4	5390	8147	13252	17674	10385	8716	6263	7342	10736	10184	5353	3739
5	2779	3206	4564	8372	10433	6014	4982	3513	2887	4721	4145	2231
6	2587	2046	1798	2008	3486	4912	3385	2661	1543	1196	1686	1692
7	1677	1496	1294	1014	851	1586	2274	2039	1080	666	461	521
8	516	1037	1037	597	302	456	678	1175	1347	439	268	230
9	829	163	637	1161	494	679	627	1007	1474	1167	488	642

age \ year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	9664	15014	16168	20089	18194	13554	7389	18737	18777	19800	14385	17600
3	8924	6176	9448	11464	14642	13522	10384	5881	13871	13686	15345	11205
4	4179	3866	2890	3556	4861	6686	6437	6128	2882	7452	6385	8663
5	1539	1445	1129	1130	1440	1921	3139	2829	2436	1450	3522	2912
6	897	524	499	495	662	673	921	1514	1089	1175	712	1918
7	630	272	244	253	264	296	389	508	737	536	640	310
8	320	194	101	125	123	117	164	216	253	373	231	222
9	454	222	232	356	238	404	342	279	311	328	404	398

age \ year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	18827	11496	6605	10234	9041	9897	8267	7147	6691	8302	8453	7474
3	12120	13952	8566	4901	7191	6181	7922	6255	5436	5130	6583	6847
4	4968	6033	6812	5052	2935	3377	3935	4988	3950	3559	3059	4207
5	2789	2023	2853	3296	2675	1262	1725	2263	2611	2382	1741	1753
6	1329	1166	995	1470	1794	1104	675	927	1291	1433	1174	971
7	701	479	626	448	868	748	460	302	524	798	819	596
8	160	326	225	312	227	407	311	179	139	345	441	350
9	610	450	287	266	338	280	300	225	287	292	516	371

age \ year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	7399	9360	7970	9281	7777	10195	8835	8743	11666	3223
3	5874	6139	7994	6808	7956	6748	8827	7711	7669	10271
4	4660	4107	4487	5852	5072	6306	5294	7209	6461	6550
5	2518	2929	2470	2708	3657	3590	4372	3979	5705	5313
6	903	1591	1811	1533	1735	2631	2533	3325	3175	4717
7	598	602	944	1078	946	1218	1808	1893	2621	2603
8	345	325	380	597	704	688	871	1387	1519	2175
9	341	262	253	355	549	637	960	517	891	1035

SURVIVORS AFTER TERMINAL YEAR

age \ year	2010
2	NA
3	2843
4	8871
5	5508
6	4485
7	3959
8	2204
9	2710

Table 6.7.3.3. Irish Sea plaice: Final ICA fishing mortality-at-age.

	year										
age	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.05	0.053	0.00847	0.0129	0.0168	0.0372	0.047	0.0266	0.0128	0.119	0.115
3	0.199	0.202	0.20594	0.1255	0.1917	0.298	0.256	0.2597	0.2623	0.54	0.491
4	0.4	0.459	0.33925	0.4072	0.4262	0.4392	0.458	0.8134	0.7015	0.779	0.755
5	0.186	0.458	0.70095	0.7561	0.6332	0.4547	0.507	0.7029	0.7615	0.91	0.776
6	0.427	0.338	0.45288	0.7382	0.6678	0.6501	0.387	0.7819	0.7206	0.833	1.053
7	0.36	0.247	0.65249	1.0927	0.5036	0.729	0.54	0.2941	0.7792	0.789	0.575
8	0.339	0.365	0.49923	0.6372	0.5035	0.5544	0.465	0.5908	0.6744	0.844	0.789
9	0.339	0.365	0.49923	0.6372	0.5035	0.5544	0.465	0.5908	0.6744	0.844	0.789

	year											
age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
2	0.135	0.328	0.343	0.224	0.196	0.177	0.146	0.108	0.181	0.196	0.135	0.13
3	0.675	0.717	0.639	0.857	0.738	0.664	0.622	0.407	0.593	0.501	0.642	0.452
4	0.767	0.942	1.111	0.819	0.784	0.808	0.636	0.702	0.802	0.567	0.63	0.665
5	0.791	0.957	0.943	0.705	0.415	0.641	0.615	0.609	0.835	0.609	0.592	0.488
6	0.868	1.075	0.644	0.557	0.509	0.687	0.429	0.476	0.601	0.588	0.487	0.712
7	0.368	1.056	0.87	0.551	0.604	0.693	0.47	0.466	0.577	0.559	0.723	0.94
8	0.786	1.05	0.933	0.829	0.723	0.795	0.649	0.588	0.767	0.638	0.715	0.716
9	0.786	1.05	0.933	0.829	0.723	0.795	0.649	0.588	0.767	0.638	0.715	0.716

	year											
age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.253	0.18	0.174	0.178	0.233	0.26	0.103	0.159	0.154	0.146	0.112	0.0907
3	0.693	0.578	0.597	0.408	0.393	0.636	0.332	0.343	0.34	0.304	0.397	0.3277
4	1.013	0.779	0.629	0.606	0.516	0.724	0.552	0.433	0.527	0.386	0.595	0.437
5	0.664	0.752	0.59	0.543	0.488	0.765	0.505	0.501	0.441	0.48	0.587	0.4642
6	0.887	0.9	0.502	0.679	0.407	0.755	0.756	0.686	0.45	0.361	0.439	0.5583
7	0.543	0.645	0.637	0.574	0.561	0.637	0.757	0.823	0.658	0.299	0.473	0.7306
8	0.853	0.808	0.682	0.616	0.531	0.795	0.623	0.606	0.533	0.409	0.555	0.5508
9	0.853	0.808	0.682	0.616	0.531	0.795	0.623	0.606	0.533	0.409	0.555	0.5508

	year										
age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.121	0.0667	0.0378	0.0375	0.0341	0.022	0.024	0.0161	0.0111	0.0074	0.0052
3	0.265	0.2377	0.1935	0.1918	0.1744	0.112	0.123	0.0825	0.0568	0.0377	0.0265
4	0.393	0.3444	0.3886	0.3851	0.3502	0.226	0.246	0.1656	0.114	0.0758	0.0532
5	0.543	0.3392	0.3605	0.3573	0.3249	0.209	0.229	0.1536	0.1058	0.0703	0.0494
6	0.364	0.2856	0.4022	0.3986	0.3625	0.234	0.255	0.1714	0.118	0.0784	0.0551
7	0.427	0.4888	0.3405	0.3375	0.3069	0.198	0.216	0.1451	0.0999	0.0664	0.0466
8	0.436	0.375	0.3605	0.3573	0.3249	0.209	0.229	0.1536	0.1058	0.0703	0.0494
9	0.436	0.375	0.3605	0.3573	0.3249	0.209	0.229	0.1536	0.1058	0.0703	0.0494

Table 6.7.3.4. Irish Sea plaice: Update ICA stock summary.

Year	Recruitment	TSB	SSB	Fbar	Landings	Landings
	Age 2			(Ages 3-6)		SOP
	thousands	Tonnes	Tonnes	f	Tonnes	
1964	21672	11755	8302	0.3031	2879	1
1965	29108	14182	9385	0.3644	3664	1
1966	15094	13805	9910	0.4248	4268	1
1967	13596	13277	10116	0.5067	5059	1
1968	10907	12109	9586	0.4797	4695	0.999
1969	12508	11275	9041	0.4605	4394	0.999
1970	18548	10928	8328	0.402	3583	1
1971	17283	10897	8153	0.6395	4232	1
1972	11825	11846	8977	0.6115	5119	1
1973	8746	9190	7027	0.7653	5060	1
1974	11710	7348	5437	0.7689	3715	1
1975	11514	7902	5680	0.7755	4063	0.999
1976	9664	5600	3909	0.9228	3473	0.999
1977	15014	4818	3003	0.8343	2904	0.989
1978	16168	5992	3541	0.7346	3231	1
1979	20089	7097	4154	0.6115	3428	1
1980	18194	7690	4625	0.6999	3903	1
1981	13554	8314	5417	0.5756	3906	0.999
1982	7389	7199	5154	0.5487	3237	0.999
1983	18737	6869	4543	0.7076	3639	0.996
1984	18777	8575	5468	0.5665	4241	1.006
1985	19800	10025	6374	0.5877	5075	1.002
1986	14385	10881	7161	0.5791	4806	1.011
1987	17600	10201	6860	0.8145	6220	1.001
1988	18827	13058	7350	0.7523	5005	0.997
1989	11496	11273	6709	0.5795	4372	0.996
1990	6605	8660	5760	0.5588	3275	0.998
1991	10234	7875	4806	0.4509	2554	0.984
1992	9041	7088	4697	0.72	3267	0.99
1993	9897	7040	4021	0.5362	1996	0.998
1994	8267	6217	3929	0.4907	2066	0.993
1995	7147	6039	3786	0.4395	1874	0.998
1996	6691	5809	4003	0.3826	1707	0.997
1997	8302	5466	3700	0.5047	1871	0.998
1998	8453	6156	3875	0.4468	1765	0.998
1999	7474	5924	3789	0.3913	1600	0.992
2000	7399	6119	3953	0.3017	1371	1
2001	9360	6817	4558	0.3362	1473	0.997
2002	7970	7405	4911	0.3332	1623	0.999
2003	9281	8471	5571	0.303	1559	1
2004	7777	7994	5422	0.1952	1143	0.997
2005	10195	8598	5903	0.2131	1281	1
2006	8835	9487	6592	0.1433	934	0.997
2007	8743	9490	6802	0.0986	805	0.998
2008	11666	12611	8821	0.0655	563	0.89
2009	3223	9647	7872	0.046	456	0.998

Table 6.7.4.1. Irish Sea plaice: input to short-term forecast for update run.

MFDP version 1a
Run: wgcse10
Time and date: 13:53 10/05/2010
Fbar age range: 3-6

2010								
Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	8355	0.12	0.24	0	0	0.201	0.008	0.214
3	7077	0.12	0.57	0	0	0.234	0.040	0.245
4	8871	0.12	0.74	0	0	0.271	0.081	0.280
5	5508	0.12	0.93	0	0	0.311	0.075	0.319
6	4485	0.12	1	0	0	0.356	0.084	0.362
7	3959	0.12	1	0	0	0.404	0.071	0.408
8	2204	0.12	1	0	0	0.456	0.075	0.459
9	2710	0.12	1	0	0	0.557	0.075	0.557

2011								
Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	8355	0.12	0.24	0	0	0.201	0.008	0.214
3	.	0.12	0.57	0	0	0.234	0.040	0.245
4	.	0.12	0.74	0	0	0.271	0.081	0.280
5	.	0.12	0.93	0	0	0.311	0.075	0.319
6	.	0.12	1	0	0	0.356	0.084	0.362
7	.	0.12	1	0	0	0.404	0.071	0.408
8	.	0.12	1	0	0	0.456	0.075	0.459
9	.	0.12	1	0	0	0.557	0.075	0.557

2012								
Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	8355	0.12	0.24	0	0	0.201	0.008	0.214
3	.	0.12	0.57	0	0	0.234	0.040	0.245
4	.	0.12	0.74	0	0	0.271	0.081	0.280
5	.	0.12	0.93	0	0	0.311	0.075	0.319
6	.	0.12	1	0	0	0.356	0.084	0.362
7	.	0.12	1	0	0	0.404	0.071	0.408
8	.	0.12	1	0	0	0.456	0.075	0.459
9	.	0.12	1	0	0	0.557	0.075	0.557

Input units are thousands and kg - output in tonnes

Table 6.7.4.2. Irish Sea plaice: Single option prediction detailed forecast for update run.

MFDP version 1a
Run: wgcse10
Time and date: 13:53 10/05/2010
Fbar age range: 3-6

Year:	2010	F multiplier: 1		Fbar:	0.0701				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0079	62	13	8355	1679	2005	403	2005	403
3	0.0403	264	65	7077	1658	4034	945	4034	945
4	0.081	651	182	8871	2404	6565	1779	6565	1779
5	0.0751	376	120	5508	1713	5122	1593	5122	1593
6	0.0838	340	123	4485	1595	4485	1595	4485	1595
7	0.071	256	104	3959	1598	3959	1598	3959	1598
8	0.0751	150	69	2204	1005	2204	1005	2204	1005
9	0.0751	185	103	2710	1509	2710	1509	2710	1509
Total		2284	779	43169	13162	31084	10427	31084	10427

Year:	2011	F multiplier: 1		Fbar:	0.0701				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0079	62	13	8355	1679	2005	403	2005	403
3	0.0403	274	67	7352	1723	4191	982	4191	982
4	0.081	442	124	6028	1634	4461	1209	4461	1209
5	0.0751	495	158	7256	2257	6748	2099	6748	2099
6	0.0838	344	124	4532	1612	4532	1612	4532	1612
7	0.071	236	96	3658	1477	3658	1477	3658	1477
8	0.0751	223	103	3271	1491	3271	1491	3271	1491
9	0.0751	276	154	4043	2251	4043	2251	4043	2251
Total		2353	839	44494	14123	32908	11523	32908	11523

Year:	2012	F multiplier: 1		Fbar:	0.0701				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0079	62	13	8355	1679	2005	403	2005	403
3	0.0403	274	67	7352	1723	4191	982	4191	982
4	0.081	459	129	6263	1697	4635	1256	4635	1256
5	0.0751	337	107	4931	1533	4586	1426	4586	1426
6	0.0838	453	164	5969	2123	5969	2123	5969	2123
7	0.071	239	98	3696	1492	3696	1492	3696	1492
8	0.0751	206	95	3022	1378	3022	1378	3022	1378
9	0.0751	411	229	6017	3349	6017	3349	6017	3349
Total		2440	901	45605	14975	34120	12410	34120	12410

Input units are thousands and kg - output in tonnes

Table 6.7.4.3. Irish Sea plaice: Prediction with management options for update run.

MFDP version 1a
Run: wgcse10
IRISH SEA PLAICE,2010 WG, Forecast Inputs
Time and date: 13:53 10/05/2010
Fbar age range: 3-6

2010				
Biomass	SSB	FMult	FBar	Landings
13162	10427	1.0000	0.0701	779

2011					2012	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
14123	11523	0.0	0.0000	0	15847	13248
.	11523	0.1	0.0070	87	15757	13162
.	11523	0.2	0.0140	173	15668	13076
.	11523	0.3	0.0210	258	15579	12990
.	11523	0.4	0.0280	343	15491	12905
.	11523	0.5	0.0350	427	15403	12821
.	11523	0.6	0.0420	510	15317	12738
.	11523	0.7	0.0491	593	15230	12655
.	11523	0.8	0.0561	676	15145	12573
.	11523	0.9	0.0631	758	15060	12491
.	11523	1.0	0.0701	839	14975	12410
.	11523	1.1	0.0771	919	14892	12329
.	11523	1.2	0.0841	1000	14809	12249
.	11523	1.3	0.0911	1079	14726	12170
.	11523	1.4	0.0981	1158	14644	12091
.	11523	1.5	0.1051	1236	14563	12013
.	11523	1.6	0.1121	1314	14482	11936
.	11523	1.7	0.1191	1391	14402	11859
.	11523	1.8	0.1261	1468	14322	11782
.	11523	1.9	0.1331	1544	14243	11706
.	11523	2.0	0.1401	1620	14165	11631
.	11523	6.4	0.4485	4469	11221	8811
.	11523	6.42	0.4500	4480	11210	8800
.	11523	6.5	0.4555	4524	11164	8756

Input units are thousands and kg - output in tonnes

Table 6.7.4.4. Irish Sea plaice: Final run – Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class			2005	2006	2007	2008	2009
Stock No. (thousands) of 2 year-olds			8743	11666	8355	8355	8355
Source			ICA	ICA	GM90-07	GM90-07	GM90-07
Status Quo F:							
% in	2010	landings	16.5	28.5	11.6	2.7	-
% in	2011		14.6	21.0	18.8	11.6	2.6
% in	2010	SSB	15.3	17.1	9.1	3.9	-
% in	2011	SSB	14.0	18.2	10.5	8.5	3.5
% in	2012	SSB	12.0	17.1	11.5	10.1	7.9

GM : geometric mean recruitment

Plaice in VIIa - Final run. : Year-class % contribution to

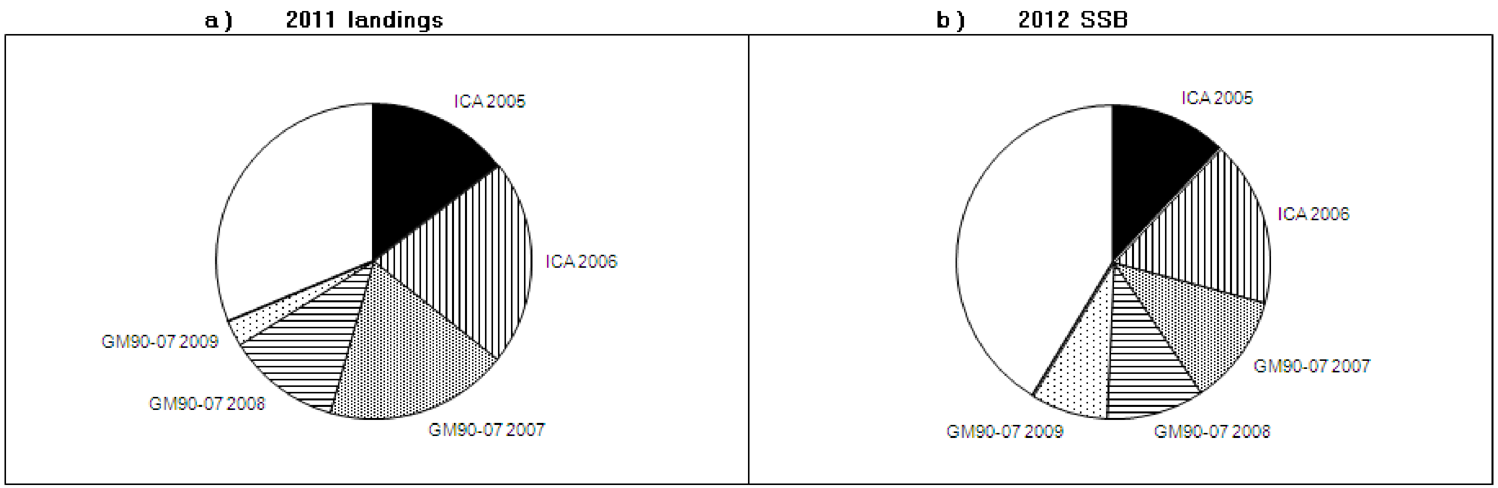


Table 6.7.4.5. Irish Sea plaice: Final run – Yield-per-recruit table under current selection pattern.

MFYPR version 2a
Run: wgcse2010
Time and date: 14:13 10/05/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	8.8433	3.6278	7.4486	3.3150	7.4486	3.3150
0.1000	0.0070	0.0509	0.0225	8.4196	3.4021	7.0268	3.0898	7.0268	3.0898
0.2000	0.0140	0.0962	0.0419	8.0431	3.2024	6.6522	2.8907	6.6522	2.8907
0.3000	0.0210	0.1366	0.0589	7.7063	3.0246	6.3173	2.7135	6.3173	2.7135
0.4000	0.0280	0.1731	0.0738	7.4033	2.8655	6.0162	2.5548	6.0162	2.5548
0.5000	0.0350	0.2060	0.0870	7.1292	2.7222	5.7439	2.4121	5.7439	2.4121
0.6000	0.0420	0.2360	0.0986	6.8801	2.5927	5.4967	2.2831	5.4967	2.2831
0.7000	0.0491	0.2633	0.1089	6.6527	2.4750	5.2711	2.1659	5.2711	2.1659
0.8000	0.0561	0.2884	0.1181	6.4443	2.3677	5.0645	2.0592	5.0645	2.0592
0.9000	0.0631	0.3115	0.1263	6.2526	2.2696	4.8746	1.9615	4.8746	1.9615
1.0000	0.0701	0.3328	0.1336	6.0757	2.1795	4.6995	1.8719	4.6995	1.8719
1.1000	0.0771	0.3525	0.1402	5.9119	2.0966	4.5375	1.7895	4.5375	1.7895
1.2000	0.0841	0.3708	0.1462	5.7598	2.0200	4.3872	1.7134	4.3872	1.7134
1.3000	0.0911	0.3878	0.1516	5.6183	1.9491	4.2474	1.6430	4.2474	1.6430
1.4000	0.0981	0.4037	0.1564	5.4861	1.8833	4.1170	1.5777	4.1170	1.5777
1.5000	0.1051	0.4186	0.1608	5.3626	1.8221	3.9952	1.5170	3.9952	1.5170
1.6000	0.1121	0.4326	0.1648	5.2467	1.7651	3.8811	1.4604	3.8811	1.4604
1.7000	0.1191	0.4457	0.1684	5.1379	1.7118	3.7740	1.4076	3.7740	1.4076
1.8000	0.1261	0.4581	0.1717	5.0355	1.6620	3.6733	1.3583	3.6733	1.3583
1.9000	0.1331	0.4697	0.1747	4.9390	1.6153	3.5785	1.3120	3.5785	1.3120
2.0000	0.1401	0.4807	0.1774	4.8478	1.5714	3.4890	1.2686	3.4890	1.2686

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.0701
FMax	8.9160	0.6248
F0.1	2.0861	0.1462
F35%SPR	2.2801	0.1598

Weights in kilograms

Table 6.7.4.6. Irish Sea plaice: Estimates of biomass and fishing mortality reference levels derived from the fit of three stock and recruit relationships (Ricker, Beverton–Holt, smooth hockeystick) and the yield-per-recruit F_{msy} proxies.

Ricker

525/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AICc
Deterministic	1.30379	0.360702	7361.88	2462.83	0.701422	1.06482	4.17742	0.000128261	48.1924
Mean	1.446129017	0.358935785	8385.039619	2693.954324	0.713836411	1.034744785	4.178940076	0.000124638	
5%ile	0.7114112	0.243361	5529.66	1986.168	0.6020188	0.6247296	2.97412	7.53E-05	
25%ile	0.938627	0.2983	6690.01	2343.96	0.66573	0.866909	3.60577	0.000104422	
50%ile	1.2196	0.351278	7832.42	2640.56	0.711289	1.0285	4.13509	0.000123886	
75%ile	1.76443	0.412307	9212.08	2910.28	0.757621	1.20384	4.66155	0.000145007	
95%ile	2.891902	0.5046566	11850.72	3428.244	0.822159	1.432274	5.50803	0.000172521	
CV	0.490664218	0.229907819	0.418691736	0.253501936	0.097567486	0.245231795	0.188086177	0.245231836	

Beverton-Holt

225/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AICc
Deterministic	5	0.283499	8765.86	2367.74	1.30646	1.46605	13048.8	1014.13	46.3924
Mean	2.339334169	0.181042194	33704.97138	3121.248978	0.995923169	1.369328844	18178.34533	3613.132253	
5%ile	0.8383842	0.0242317	7800.28	2030.506	0.6707234	1.216166	13191.84	1259.238	
25%ile	1.3744	0.130761	11131.7	2448.24	0.863055	1.30655	14878.9	1978.53	
50%ile	2.19428	0.195183	14891.6	2860.55	1.00291	1.36861	16998.3	2982.8	
75%ile	3.06495	0.237183	24274.9	3432.61	1.14576	1.43992	19752.7	4316.67	
95%ile	4.278444	0.290122	171687.4	4907.272	1.292314	1.532432	25416.86	7636.952	
CV	0.474484283	0.43278769	1.584233421	0.37087491	0.200848915	0.074055602	0.361308292	0.864867062	

Smooth hockeystick

542/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AICc
Deterministic	0.668061	0.62446	4486.07	2357.1	0.647442	0.707805	1.32949	4261.92	49.6155
Mean	0.850218749	0.456712244	16039.79068	2523.126328	0.739977157	0.638760079	1.519501764	3846.182638	
5%ile	0.50842485	0.028699305	3278.253	1965.195	0.55461095	0.50552535	1.13886	3043.9265	
25%ile	0.656644	0.291264	4490.9925	2246.47	0.64905875	0.5386975	1.3328025	3243.67	
50%ile	0.7842695	0.44772	6145.725	2437.365	0.7487845	0.5930465	1.537585	3570.925	
75%ile	0.958064	0.596283	9407.2525	2729.1625	0.83479925	0.7153345	1.714215	4307.265	
95%ile	1.4041595	0.9454021	87229.955	3367.233	0.91568425	0.87458945	1.880306	5266.184	
CV	0.363134893	0.588311531	1.939550863	0.171933832	0.154600765	0.216403775	0.154600775	0.216403777	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.159733	0.130935	0.146148	0.625148	0.395865	0.207998		0.45
Mean	0.144440731	0.118549045	0.129051199	0.670015642	1.408993089	0.222273389	49.95124926	
5%ile	0.001728576	0.001396494	0.002001092	0.03256357	0.2954358	0.17576805	47.430855	
25%ile	0.07597555	0.06195255	0.0710139	0.30744425	0.39264	0.20065825	48.41685	
50%ile	0.1528285	0.12593	0.1403895	0.467667	0.542314	0.217633	49.73625	
75%ile	0.214397	0.176807	0.18625625	0.77163125	0.8126365	0.2371355	50.849725	
95%ile	0.2841279	0.235097	0.23026565	2.120171	7.785563	0.2836772	53.761225	
CV	0.628068054	0.627919852	0.581019904	0.924230211	1.92542654	0.152337271	0.044153159	

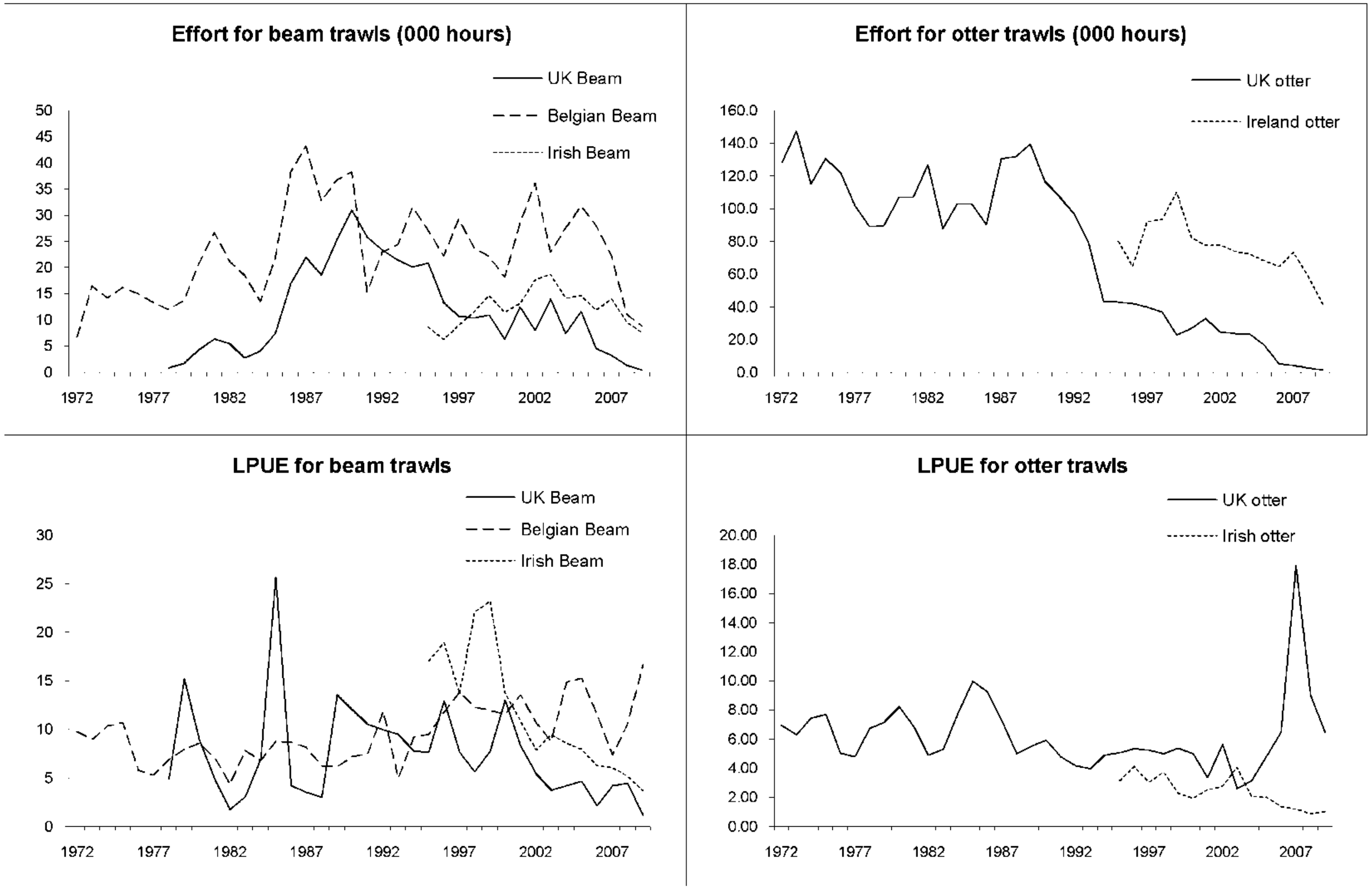


Figure 6.7.2.1. Irish Sea plaice: Effort and lpue for commercial fleets.

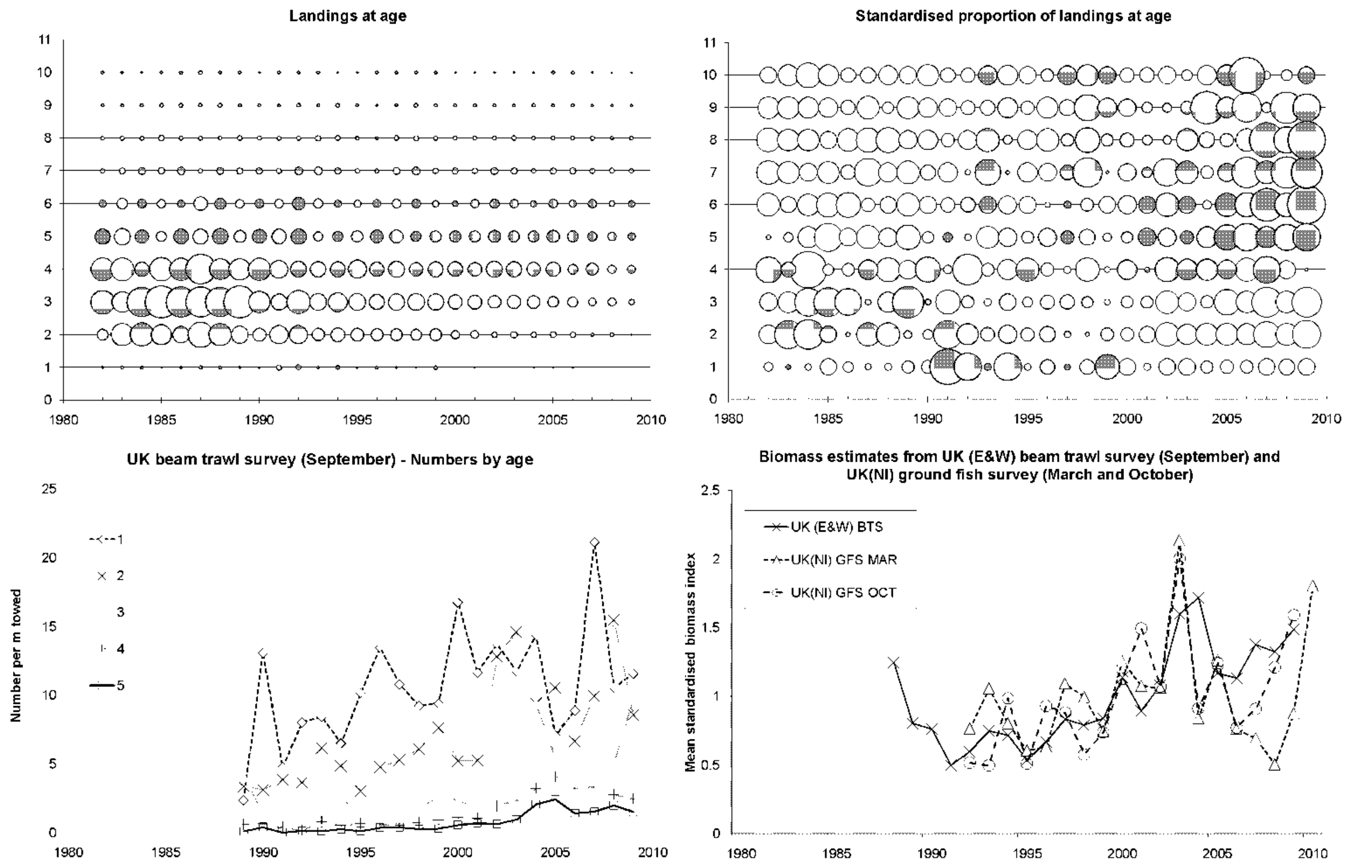


Figure 6.7.2.2. Landings and survey data. Raw landings-at-age data (top left), mean standardised proportion-at-age (topright, grey bubbles are positive values and white bubbles are negative), UK (E&W) beam trawl survey cpue for ages 1 to 5, and mean standardised indices of spawning biomass (bottom right) derived from UK (NI) groundfish surveys (UK(NI)GFS) in March and in October and, for comparison, the biomass index calculated from UK (E&W) beam trawl survey in September.

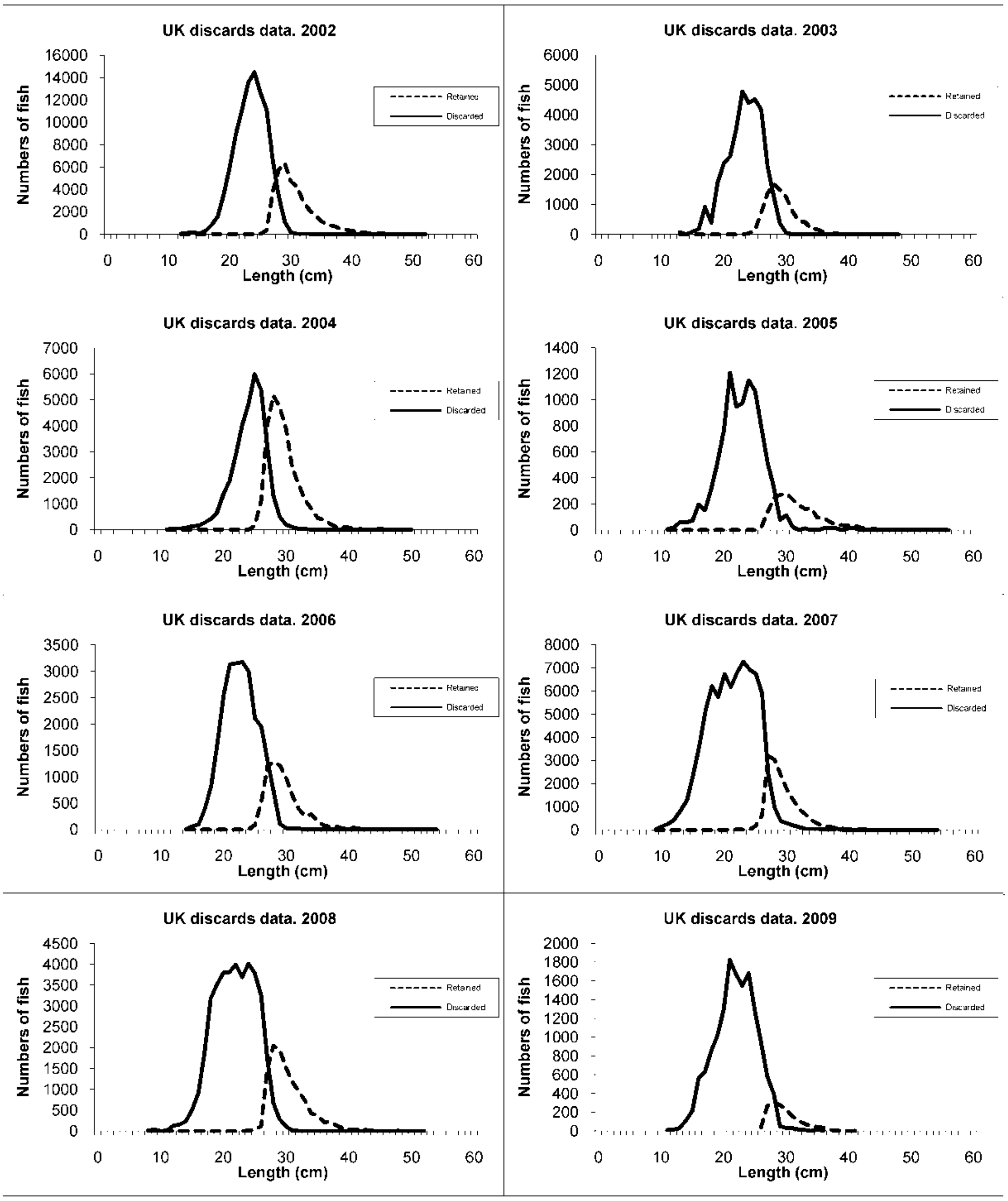


Figure 6.7.2.3. Length distributions of discarded and retained catches from UK (E&W).

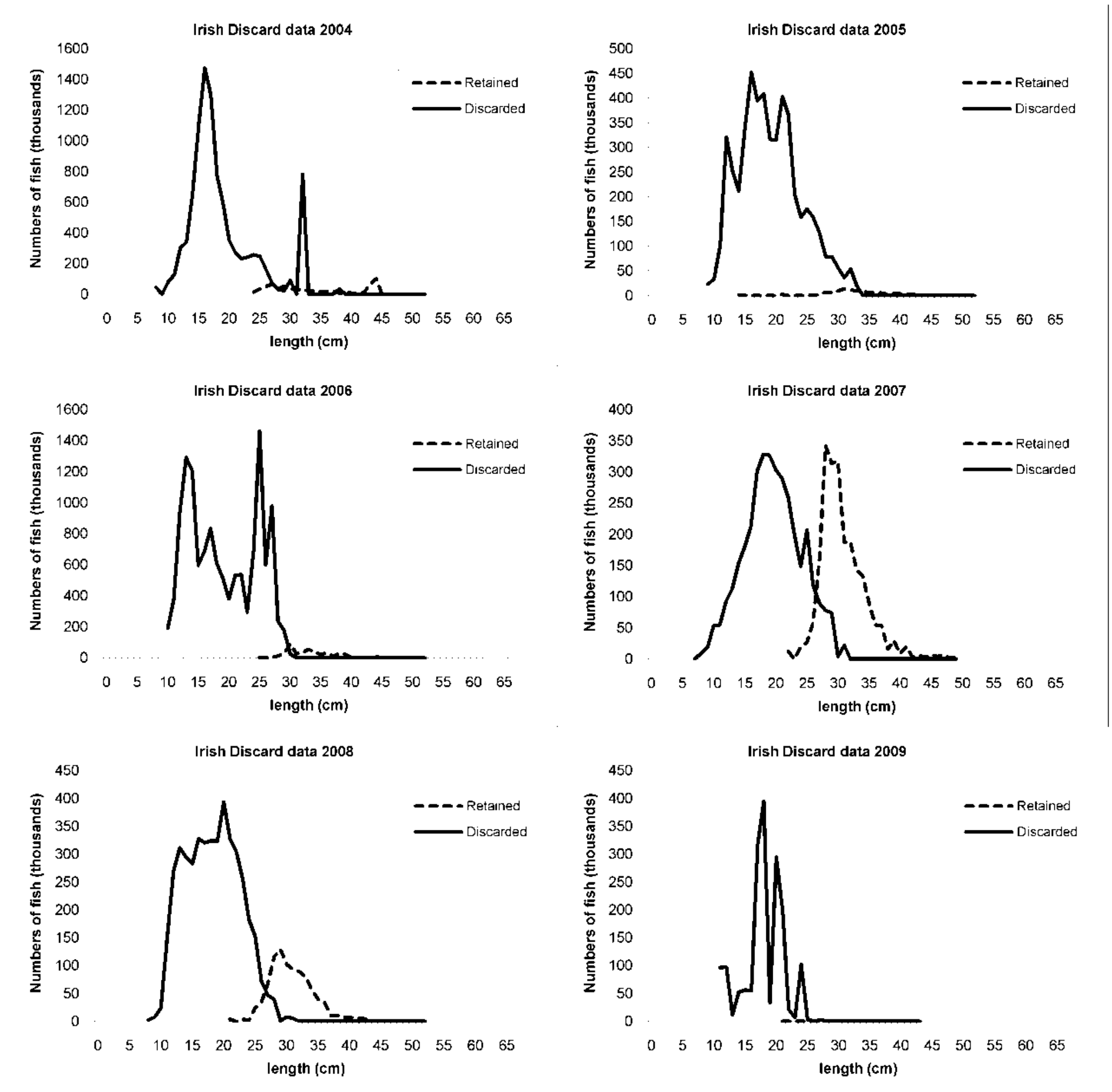


Figure 6.7.2.4. Length distributions of discarded and retained catches from Ireland.

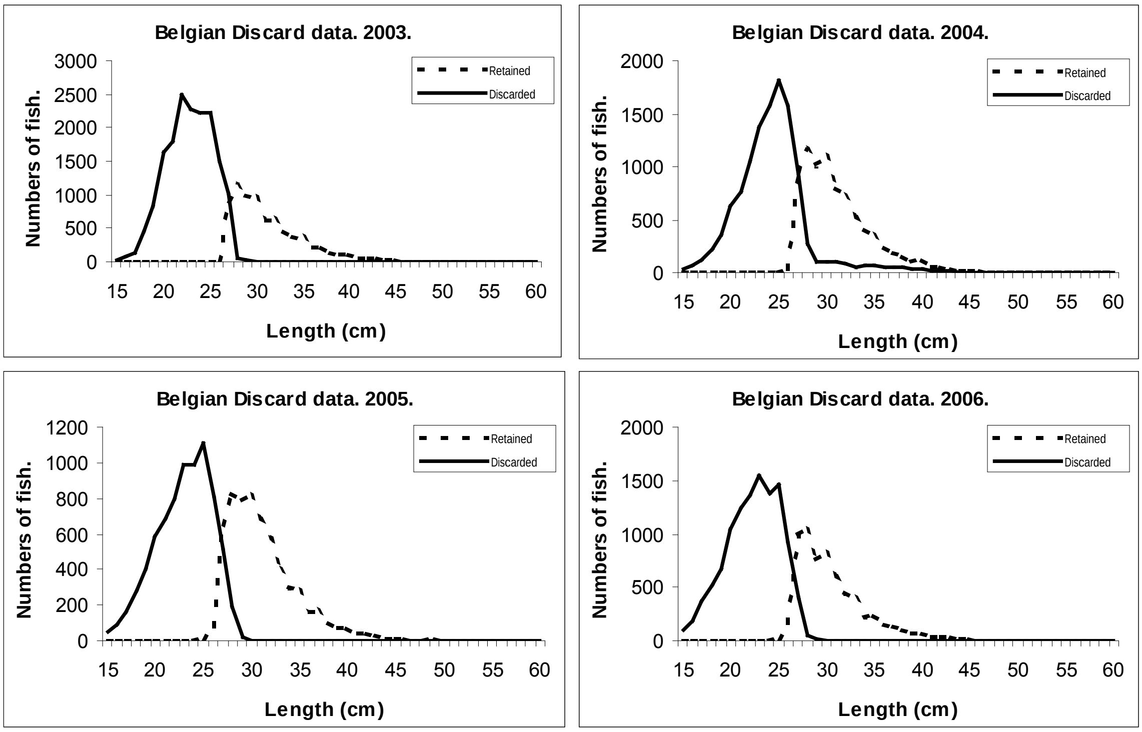


Figure 6.7.2.5. Length distributions of discarded and retained catches from Belgium.

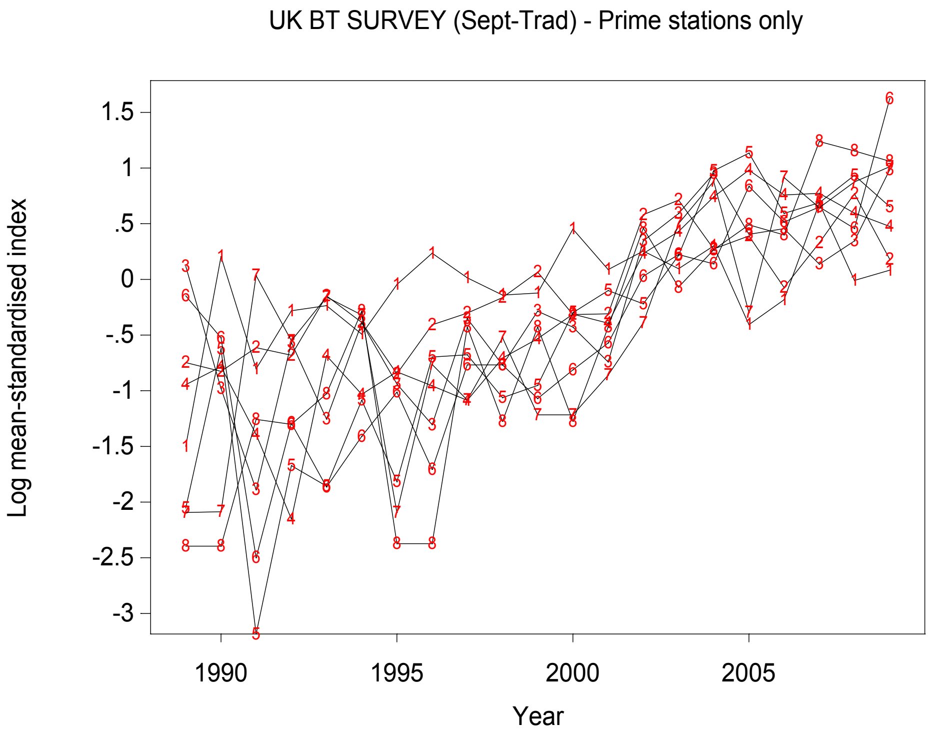


Figure 6.7.2.6. Log cpue plot of UK BT survey by year.

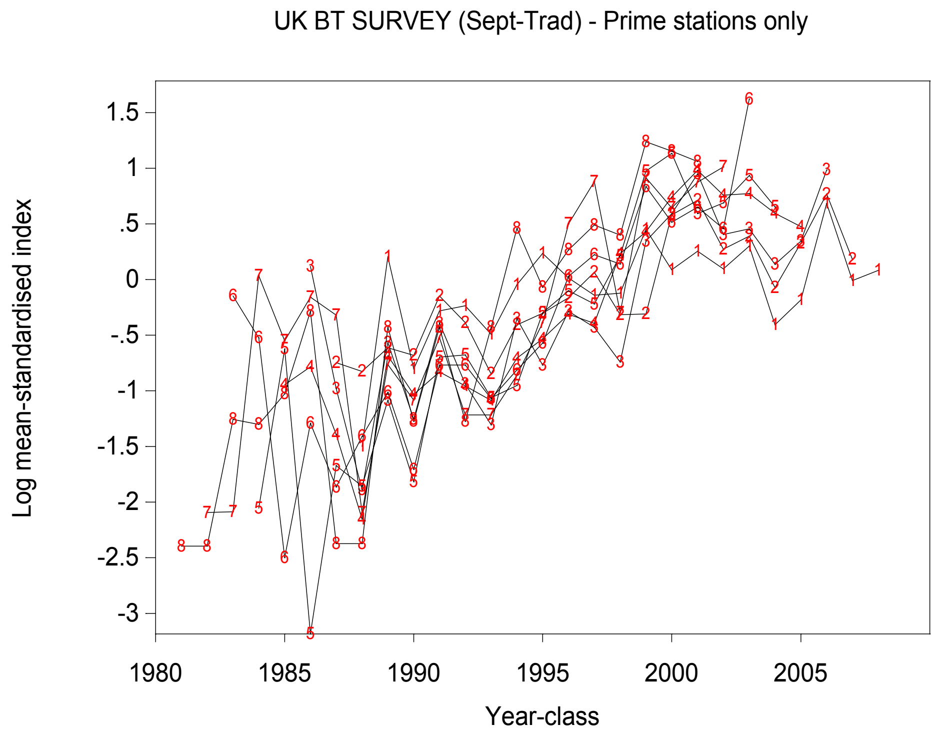


Figure 6.7.2.7. Log cpue plot of UK BT survey by year-class.

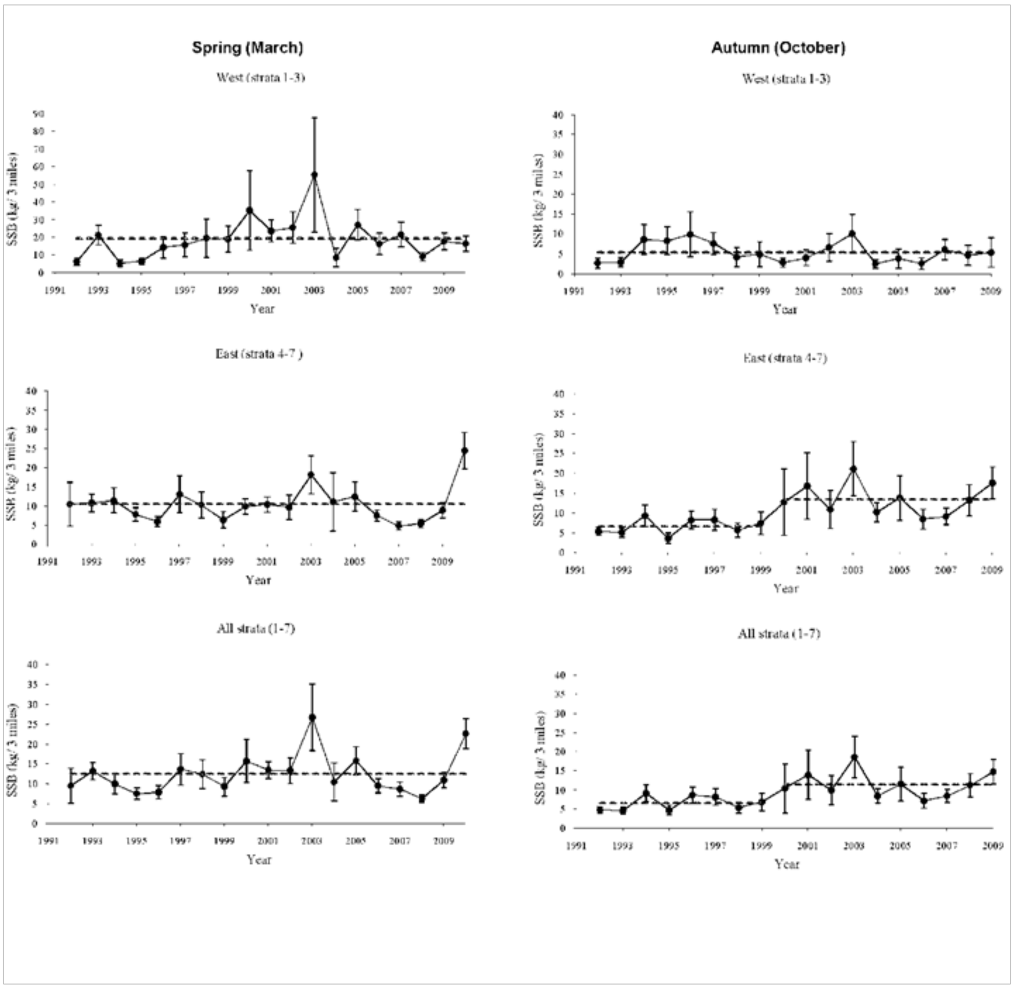


Figure 6.7.2.8. Northern Irish groundfish survey SSB indices split into spring (left hand panels) and autumn (right hand panels) sampling by western strata (1–3), eastern strata (4–7) and total survey area (strata 1–7) with confidence intervals (± 1 standard error, vertical lines) and mean biomass (kg/3 miles, dashed horizontal lines) for periods identified by statistical breakpoint analysis.

Note the different scale on the y-axis in the top-left panel.

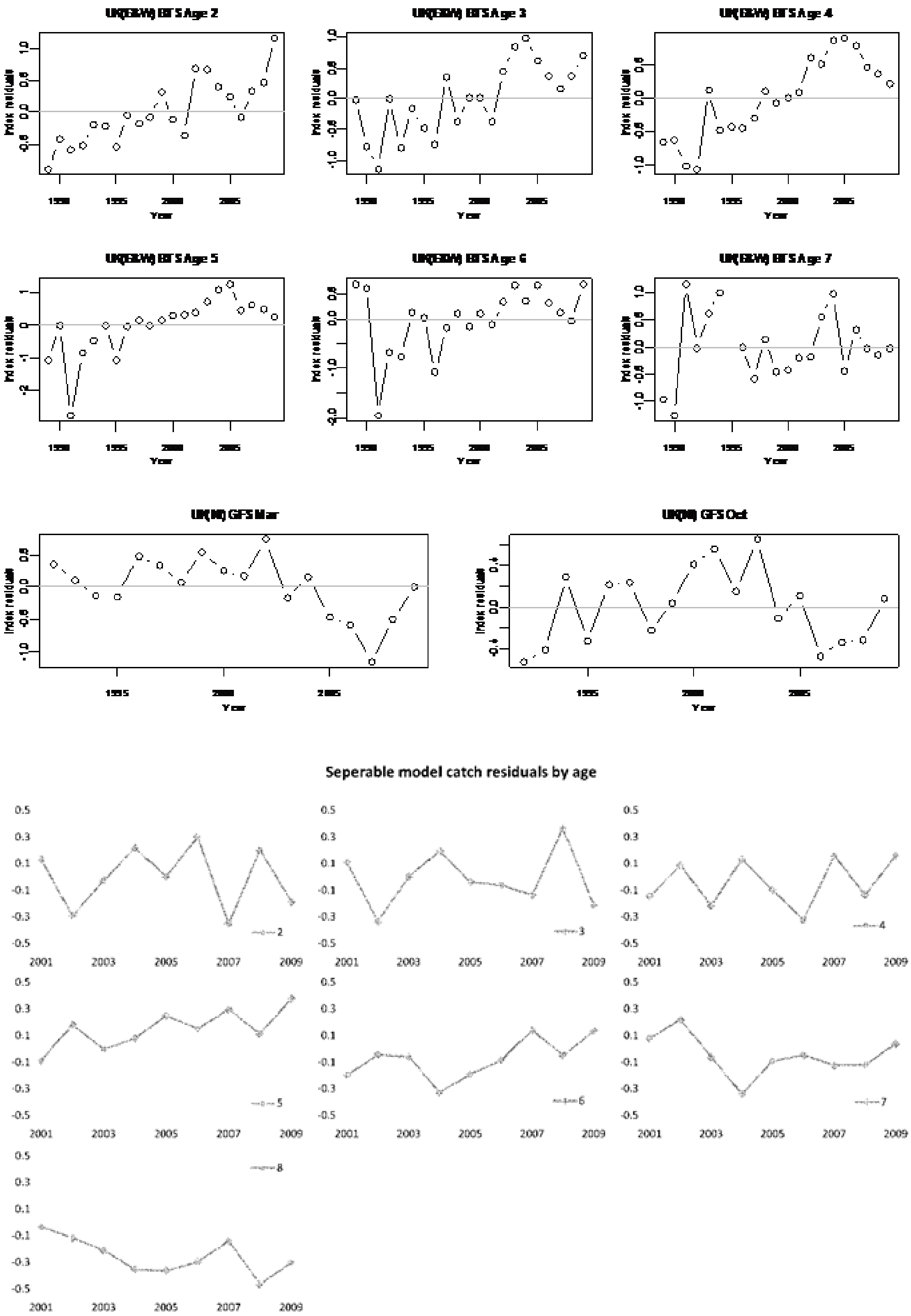


Figure 6.7.3.1. ICA residuals for UK (E&W) beam trawl survey (BTS) at age (top two rows), UK (NI)GFS SSB indices (middle 2 panes) and separable model residuals (below).

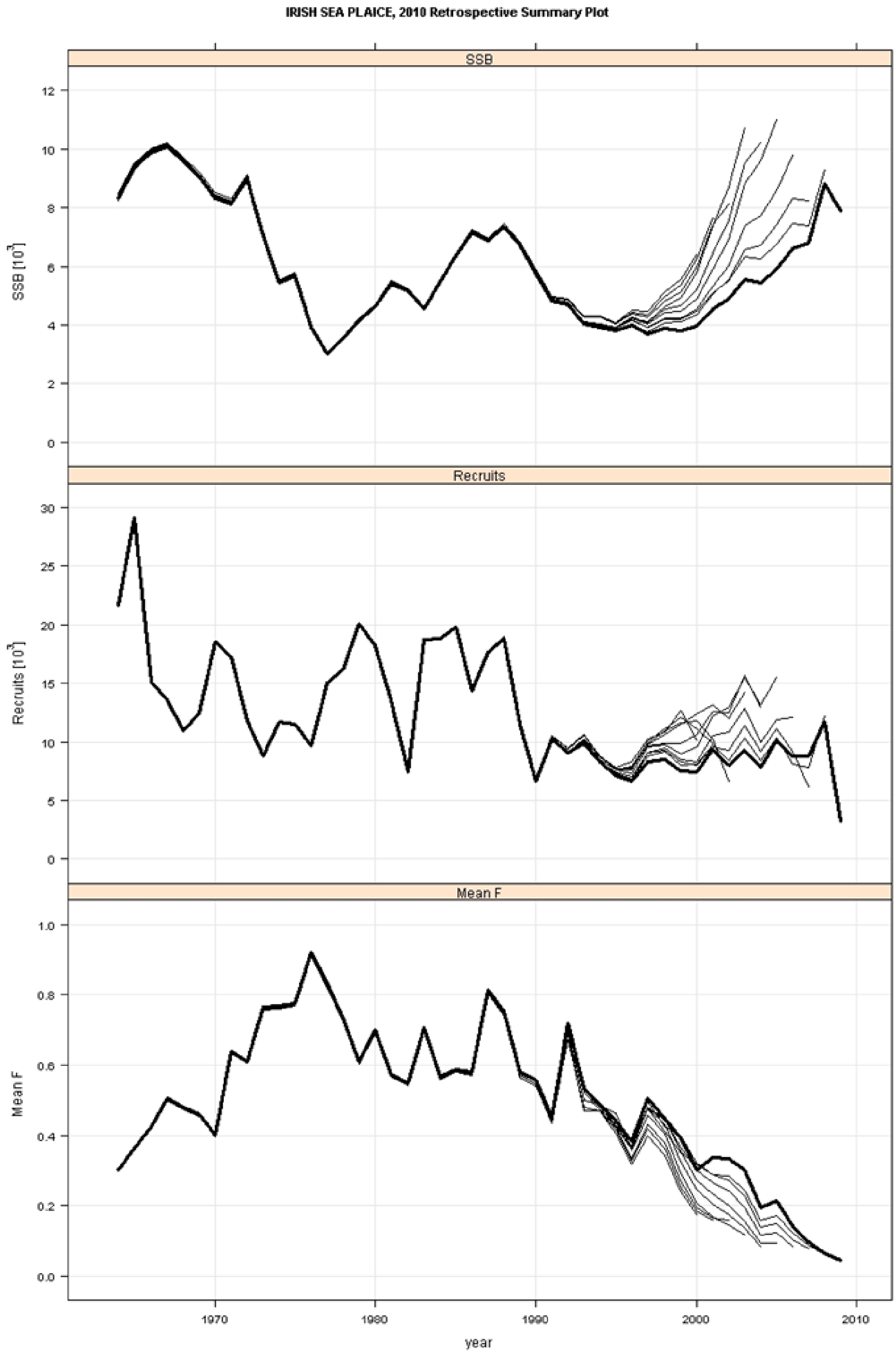


Figure 6.7.3.2. Retrospective pattern for update ICA.

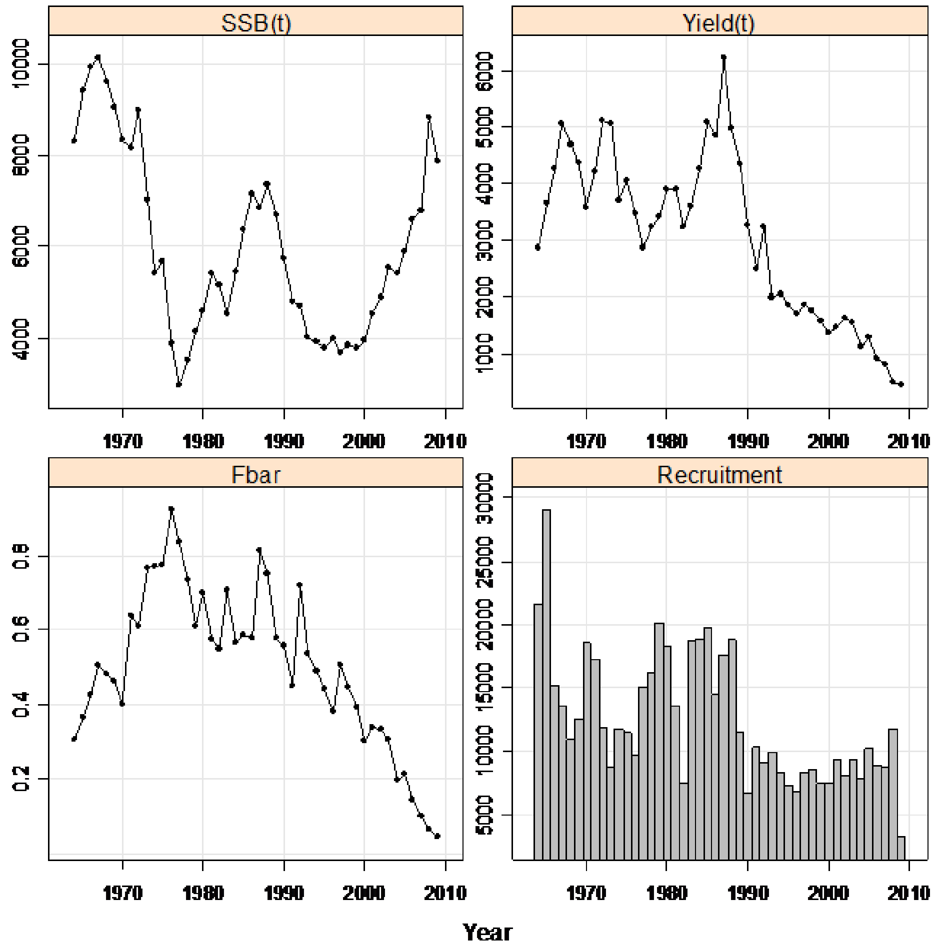


Figure 6.7.3.3. Irish Sea plaice: Summary plot for update ICA assessment.

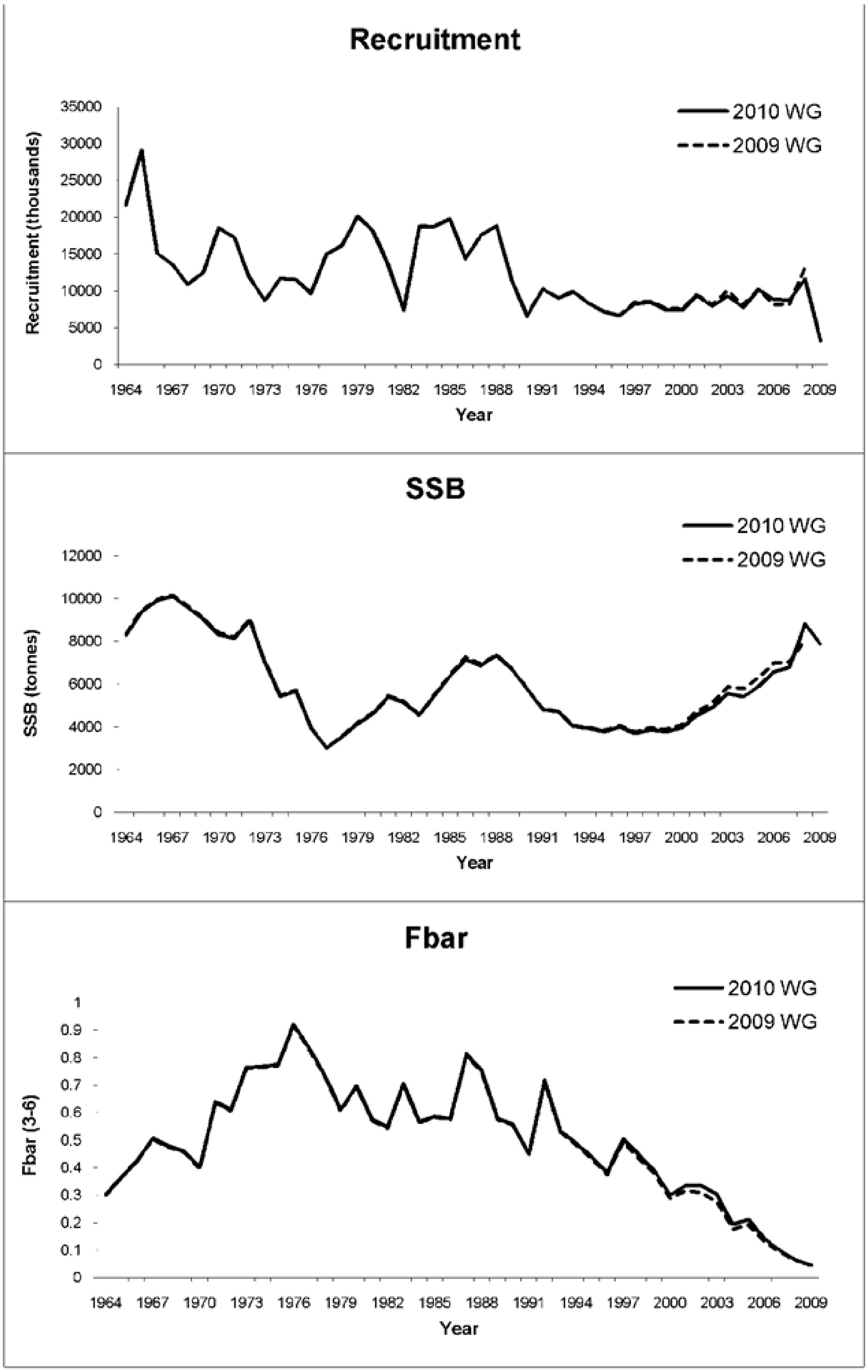
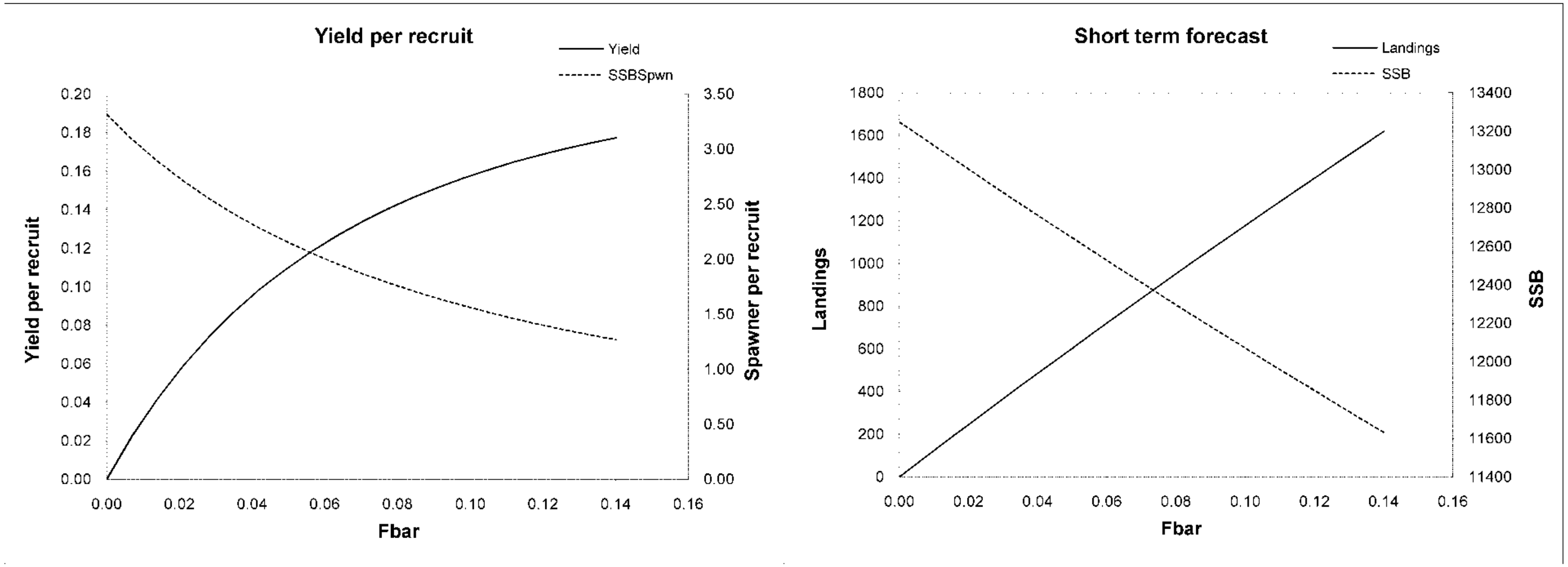


Figure 6.7.3.4. Comparison of recruitment (age 2), SSB and Fbar(ages 3–6) between 2009 and 2010 ICA assessments.



MFYPR version 2a
Run: wgcse2010
Time and date: 14:13 10/05/2010

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.0701
FMax	8.9160	0.6248
F0.1	2.0861	0.1462
F35%SPR	2.2801	0.1598

Weights in kilograms

MFDP version 1a
Run: wgcse10
IRISH SEA PLAICE,2010 WG, Forecast Inputs
Time and date: 13:53 10/05/2010
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 6.7.3.5. VIIa plaice, yield-per-recruit and short-term forecast from final ICA.

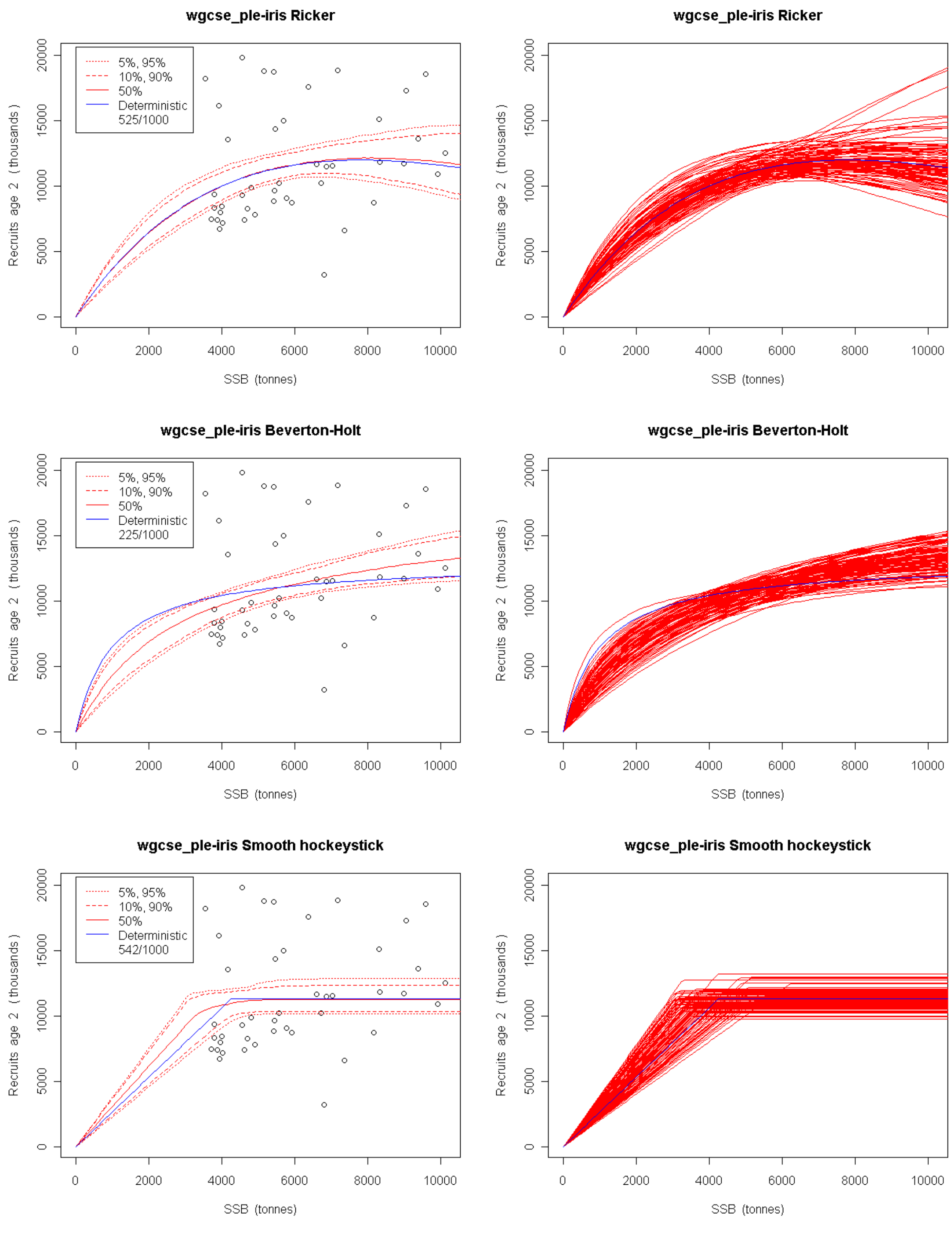


Figure 6.7.3.6. Plaice in Division VIIa : MSY fitted stock and recruit relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{msy}. Right hand panels: curves plotted from the first 100 MCMC re-samples with converged F_{msy} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

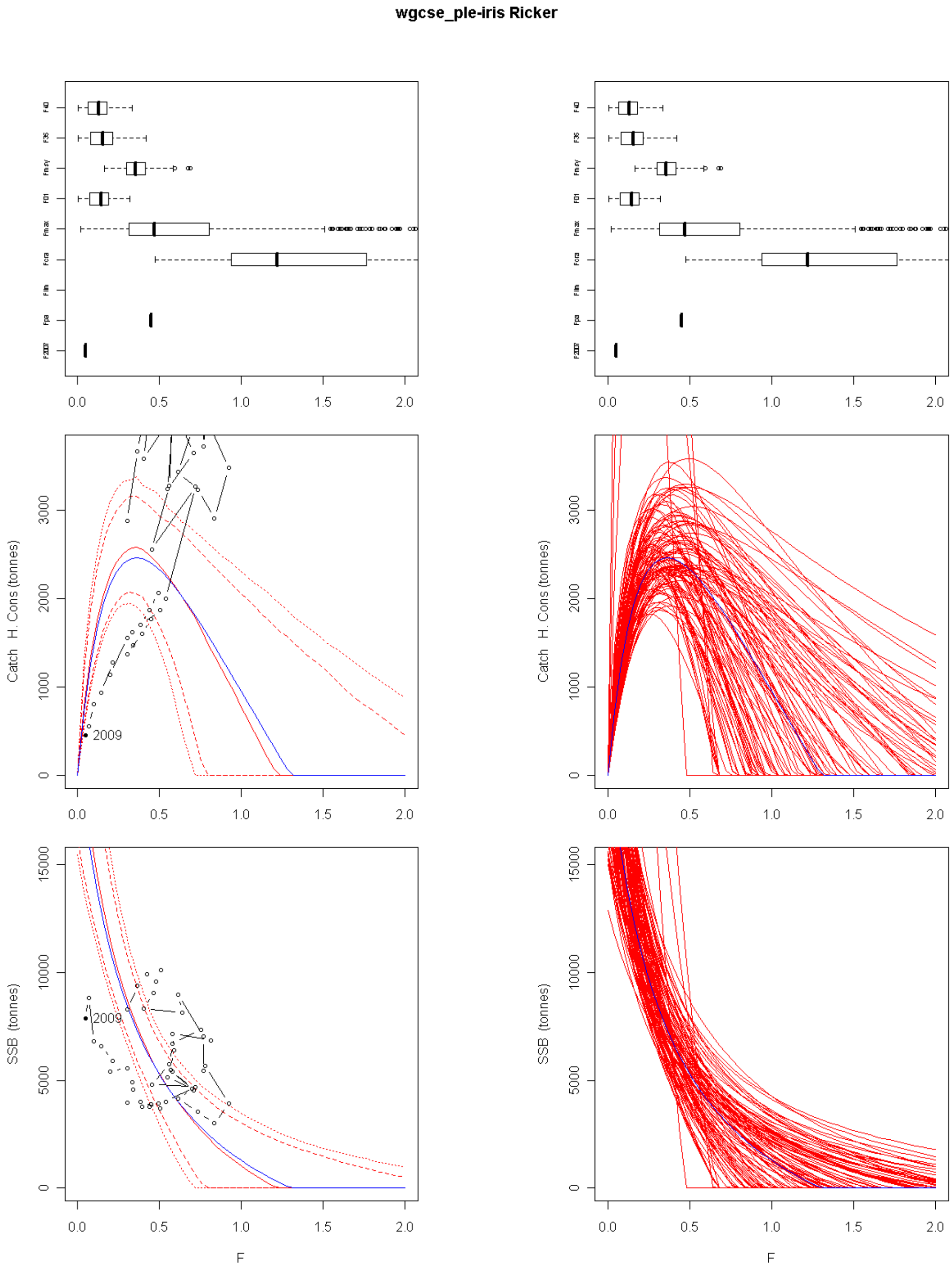


Figure 6.7.3.7a. Plaice in Division VIIa: Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Ricker stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles in left hand panels show assessment estimates with the most recent year labelled.

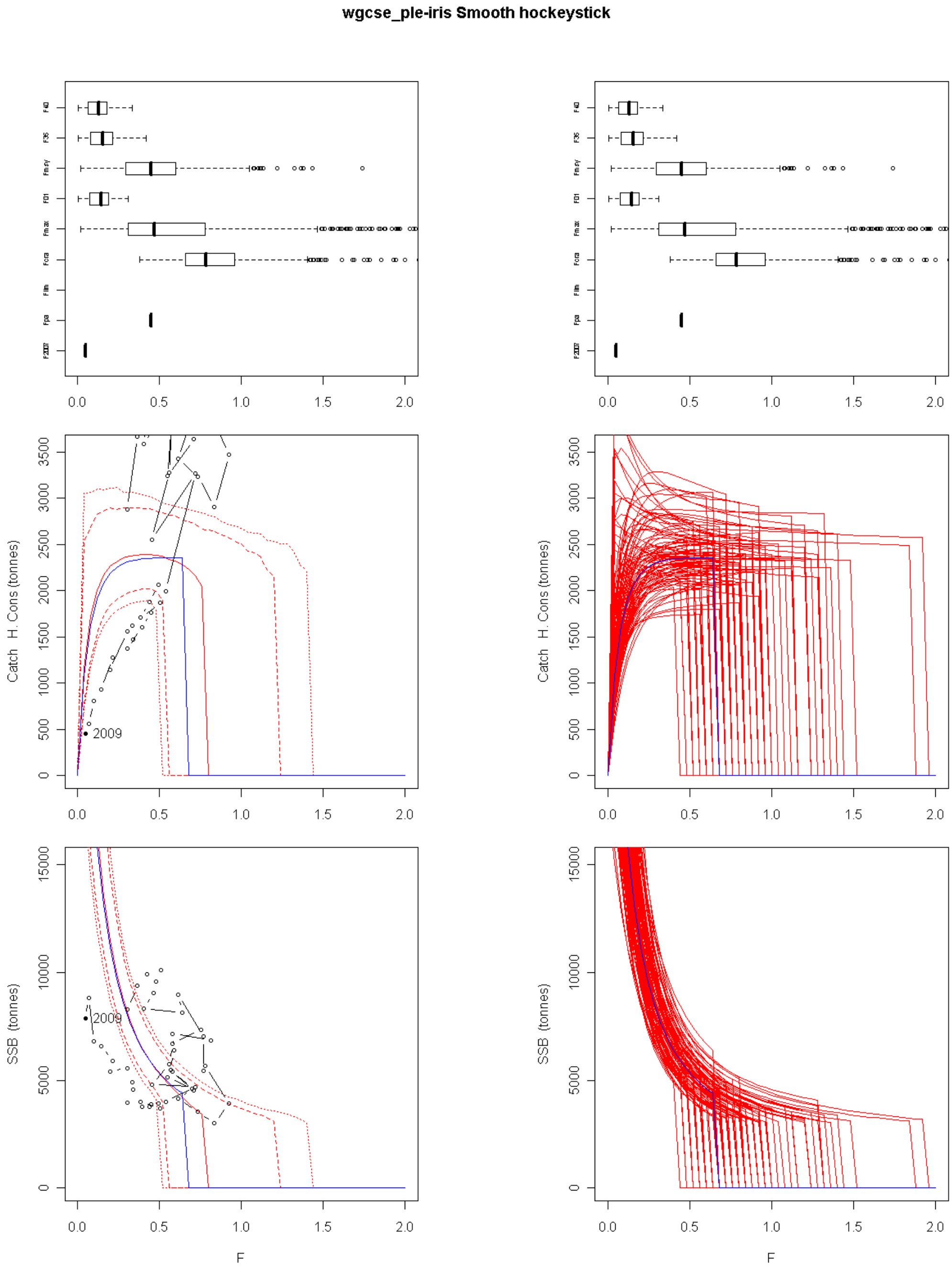


Figure 6.7.3.7b. Plaice in Division VIIa: Estimates of F reference points and equilibrium yield and SSB against fishing mortality using a Smooth hockeystick model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles in left hand panels show assessment estimates with the most recent year labelled.

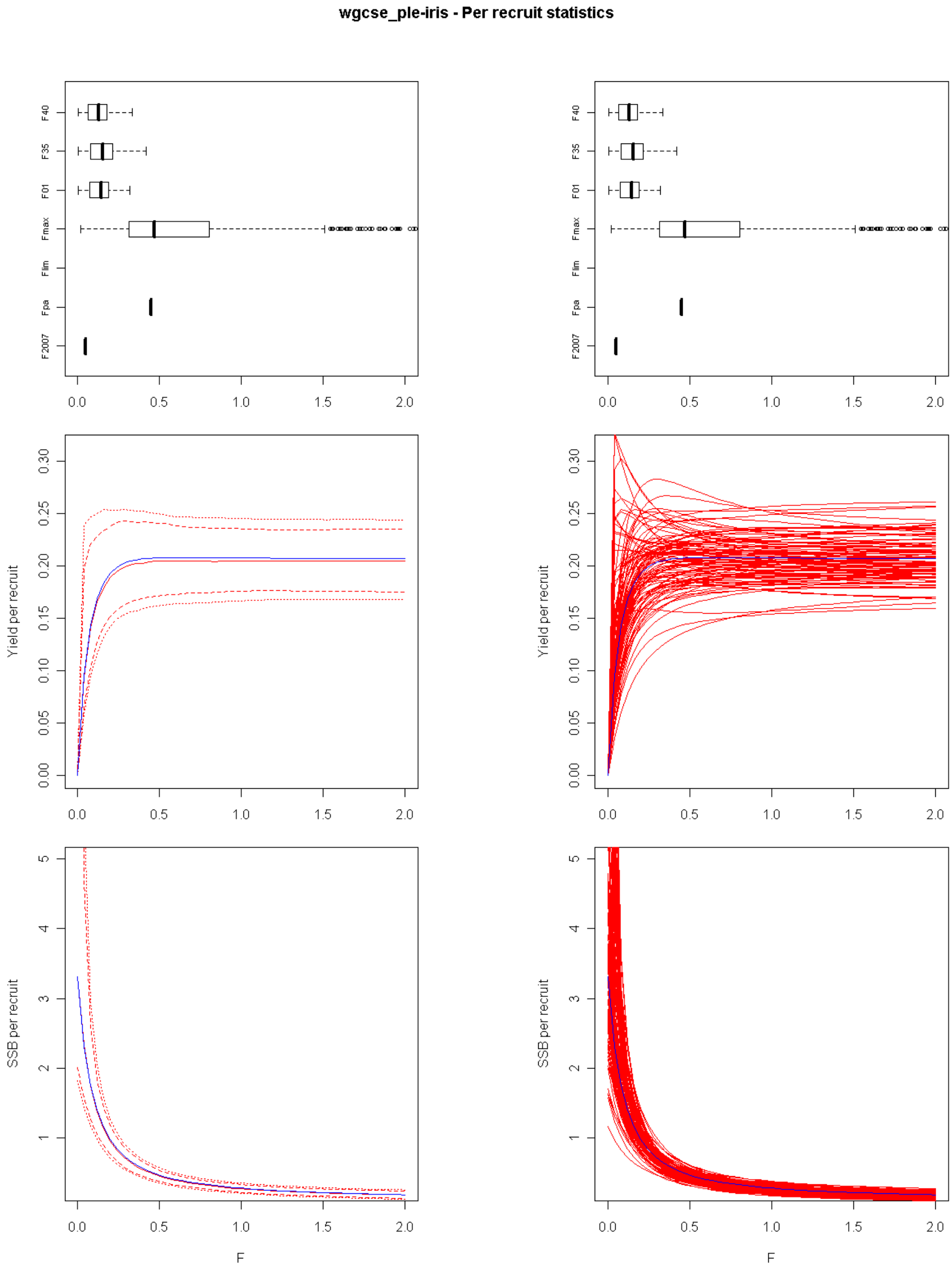


Figure 6.7.3.8. Plaice in Division VIIa: Fitted yield-per-recruit F reference points, yield-per-recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.

6.8 Sole in Division VIIa (Irish Sea)

Type of assessment in 2010

This assessment is an Update Assessment, and consequently no changes have been made to assessment or forecast procedures compared to last year.

ICES advice applicable to 2009

"Given the low SSB and low recruitment since 2000, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach. ICES recommends a closure of the fishery in 2009 and a recovery plan should be developed and implemented as a prerequisite to reopening the fishery"

ICES advice applicable to 2010

"Considering the options below, ICES advises on the basis of exploitation boundaries in relation to precautionary limits that no fishing of sole should take place in the Irish Sea in 2010."

6.8.1 General

Stock description and management units

The sole fisheries in the Irish Sea are managed by TAC (see text tables below) and technical measures, with the assessment area corresponding to the stock area. Technical measures in force are minimum mesh sizes and minimum landing size (24 cm). In addition beam trawlers, fishing with mesh sizes equal to or greater than 80 mm, are obliged to have 180 mm mesh sizes in the entire upper half of the anterior part of their net. More details can be found in Reg 254/2002 and the Stock Annex.

Since 2000, a spawning closure for cod has been in force. The first year of the regulation the closure covered the western and eastern Irish Sea. Since then, closure has been mainly in the western part whereas the sole fishery takes place mainly in the eastern part of the Irish Sea and no direct impact on the sole stock is expected from this closure.

Other regulations applicable to area VIIa are summarized in Section 6.1.

Management applicable to 2009 and 2010

TAC 2009

Species: Common sole *Solea solea*		**Zone:** VIIa (SOL/07A.)
Belgium	237	
France	3	
Ireland	80	
The Netherlands	75	
United Kingdom	107	
EC	502	
TAC	502	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC 2010

Species: Common sole *Solea solea*		**Zone:** VIIa (SOL/07A.)
Belgium	186	
France	2	
Ireland	73	
The Netherlands	58	
United Kingdom	83	
EU	402	
TAC	402	Analytical TAC

Year	Single stock exploitation bounderies	Basis	TAC	% change in F associated with TAC *	WG landings
2005	<1000 t	Keep F below F_{pa}	960 t	+ 3	855 t
2006	<930 t	Recent catch levels (2002–2004)	960 t	-	570 t
2007	0 t	Zero catch	816 t	+ 1	492 t
2008	0 t	Zero catch	669 t	0	333 t
2009	0 t	Zero catch	502 t	- 3	
2010	0 t	Zero catch	402 t		

F calculated, based on a *Status quo* forecast.

Fishery in 2009

The main countries fishing for Irish Sea sole are Belgium, Ireland and UK.

Effort declined in all the main fleets in 2009 with the exception of Belgium which increased.

6.8.2 Data

Landings

An overview of the landings data provided and used by the WG is provided in Table 6.8.1. The WG estimated the total international landings at 324 t in 2009, of which 79% (257 t) was landed by Belgium, 15% (47 t) by Ireland, 3% (10 t) by the UK (England and Wales) and the remainder by Northern Ireland and France (Table 6.8.1). These landing-figures correspond to an international uptake of only 65% of the agreed TAC in 2009 (502 t), and the lowest value in the time-series.

No revisions were made to the historical data.

Quarterly age compositions for 2009 were available from Belgium, UK (E&W) (except Q1) and Ireland (except Q1 and Q2) as well as quarterly landings from Northern Ireland. The sampled fleets are those taking the major part of the international landings. Annual length distributions are given in Table 6.8.2.

Catch numbers-at-age data are given in Table 6.8.3.

Catch weights-at-age for 2009 were calculated from Belgian, UK and Irish data. Stock weights-at-age were derived from the Q1 catch weights (Table 6.8.5).

Further details on raising methods are given in the Stock Annex.

Discards

Discard rates of sole are low in Irish Sea fisheries based on historical observation. No discard tables and figures are presented in this report.

There is no accurate information on the level of misreporting, but given the partial uptake of the agreed TAC in recent years, it is not considered a problem for this stock.

Biological

Natural mortality, maturity and proportions of natural mortality and fishing mortality before spawning were set as in previous years.

Natural mortality was set at 0.1 yr^{-1} (all ages and all years).

The maturity ogive used is as previously:

AGE	1	2	3	4	5	6 AND OLDER
	0.00	0.38	0.71	0.97	0.98	1.00

The proportions of natural mortality and fishing mortality before spawning were both set to 0 to reflect the SSB calculation date of 1 January.

Surveys

Cpue and effort-series were available from a UK (E&W) September beam trawl survey (1988–2009) and a UK March beam trawl survey (1993–1999) (Tables 6.8.6–7 and Figure 6.8.1). From 2006 onwards, only the two UK beam trawl surveys have been used as tuning indices in the Irish Sea sole assessments.

Commercial cpue

Commercial tuning data were available for Belgian beam trawlers, UK (E&W) beam and otter trawlers and Irish otter trawlers (Tables 6.8.6–7 and Figure 6.8.1).

Effort from both Belgian and UK commercial beam trawl fleets increased from the early seventies until the late eighties. Since then UK beam trawl effort has declined. The Belgian beam trawl effort declined in the early nineties, increased the early 2000s and decreased again recently. Effort of the Irish beam trawl fleet has been declining since 2000. In 2008 and 2009 effort declined substantially for most fleets (Tables 6.8.6–7 and Figure 6.8.1).

Lpue for both UK and Belgian beam trawlers was at a higher level in the late seventies and early eighties. More recently lpue for these beam trawlers is fluctuating at a lower level. Irish beam trawl lpue also shows a declining trendover the time-series.

6.8.3 Historical stock development

The method used to assess Irish Sea sole is XSA, using two survey tuning-series (Tables 6.8.6–7). It should be noted that the year range of the UK March beam trawl survey only covers 1993 up to 1999.

Data screening

No exploratory runs using different settings than last year's assessment, or taking revisions from earlier data into account, are presented in this report for Irish Sea sole.

Final update assessment

The model settings for the final assessment are summarized below. Since this is an update assessment, settings were kept the same as last year. Log catchability residuals for the final run are given in Figure 6.8.2. There are no apparent trends. The XSA diagnostics and the estimates of fishing mortality and the population numbers are given in Tables 8.6.8–10. The summary is given in Table 6.8.11 and Figure 6.8.3.

ASSMNT YEAR	2006	2007	2008	2009	2010
Assmnt Model	: XSA	: XSA	: XSA	:XSA	:XSA
Fleets	:	:	:	:	:
Bel Beam Trwl	: omitted	: omitted	: omitted	:omitted	:omitted
UK Trawl	: omitted	: omitted	: omitted	:omitted	:omitted
UK Sept BTS	:1988–2005 2–7	: 1988–2006 2–7	: 1988–2007 2–7	:1988–2008 2–7	:1988–2008 2–7
UK Mar BTS	1993–1999 2–7	: 1993–1999 2–7	: 1993–1999 2–7	:1993–1999 2–7	:1993–1999 2–7
Time-Ser. Wts	:linear 20 yrs	: linear 20 yrs	: linear 20 yrs	: linear 20 yrs	: linear 20 yrs
Power Model	:: none	: none	: none	: none	: none
Q plateau	:: 5	: 7	: 7	: 7	: 7
Shk se	: 1.5	: 1.5	: 1.5	:1.5	:1.5
Shk age-yr	:5 yrs 3 ages	: 5 yrs 3 ages	: 5 yrs 3 ages	: 5 yrs 3 ages	: 5 yrs 3 ages
Pop Shk se	: 0.3	: 0.3	: 0.3	: 0.3	: 0.3
Prior Wting	: none	: none	: none	: none	: none
Plusgroup	: 10	: 8	: 8	: 8	: 8
F_{bar}	: 4–7	: 4–7	: 4–7	: 4–7	: 4–7

Survivor and F estimates coming from the UK (E+W) September beam trawl survey and from F shrinkage are not always in line with each other. But given that the survey gets high weights (>96%) throughout, the survey has a bigger influence on the final estimates. The March survey was discontinued after 1999, and therefore does not contribute to the estimates in the final year.

The retrospective analysis is presented in Figure 6.8.4. A retrospective pattern is apparent in SSB, although for most recent estimates the yearly revisions are minor. Recruitment levels appear to be consistently estimated throughout the retrospective period.

Comparison with previous assessments

A comparison of the estimates of this year's assessment with last year's is given in Figure 6.8.5. Recruitment trends, historical SSB and fishing mortality estimates are very similar.

State of the stock

Estimated trends of Irish Sea sole landings, SSB, fishing mortality and recruitment are presented in Table 6.8.11 and Figure 6.8.3. Landings of Irish Sea sole have been declining since the late eighties and reached a record low of 324 t in 2009. SSB has been at a lower level since the early nineties compared to the period before. Since 2001 SSB has been decreasing dramatically and reached the lowest observed estimate in 2008 (for the first time only reaching values below 2000 t since 2006). High fishing mortalities were observed during the late eighties until the mid-nineties. Thereafter fishing mortality has declined somewhat, but remained fluctuating around F_{lim}. Since 2001 recruitment has been well below average.

6.8.4 Short-term projections

Estimating year-class abundance

The estimates up to the 2006 year class were taken from XSA.

The 2007 year class (age 2 in 2009) was estimated using RCT3 (input in Table 6.8.12, output in Table 6.8.13). Both RCT3 and XSA estimate a weak 2005 year class (higher for RCT3), but the RCT3 estimate was taken over the XSA estimate since it uses more recent survey data and is in line with last year's procedure.

The different estimates at age 2 are summarized below. The values in bold were selected for further predictions.

YEAR CLASS	: 2007	: 2008	:2009 AND OLDER
XSA	: 2397	: -	: -
RCT3	: 2877	: 2489	: -
GM	: 5326	: 5326	: 5326

The input to the short-term catch predictions is given in Table 6.8.14. Weights-at-age averaged over the last three years were used as input for the predictions. As for last year, fishing mortality-at-age was averaged over the last three years, not rescaled. XSA estimates up to year class 2007 were used for the starting population. For the year class 2008 the RCT3 estimate was used. GM over the full period was assumed for the recruiting ages from 2010 onwards.

The short-term catch option table is given in Table 6.8.15, a detailed management option table is presented in Table 6.8.16. A short-term forecast plot is shown in Figure 6.8.6. Assuming F_{sq}, landings in 2010 are estimated to be around 439 t, compared to a TAC of 402 t.

The relative contributions of the different year classes to the landings and SSB are presented in Table 6.8.17 and Figure 6.8.8. Given the low stock size, predictions become more dependent on the assumed incoming recruitment. 55% of the predicted landings in 2011 and 49% of the predicted SSB in 2012 are based on the assumed the RCT3 and GM recruitments.

6.8.5 MSY explorations

The VIIa sole times-series of assessment stock and recruit estimates, fishing mortality-at-age (average of the most recent three year), catch and stock weights (10 year averages), maturity and natural mortality-at-age were used to estimate proxies for the fishing mortality biomass and landings at maximum sustainable yield (F_{msy}, B_{msy} and MSY) within the srmsymc program. The sen and sum input data files are presented in Tables 6.8.19 and 6.8.20.

Three stock and recruit models are fitted by the program, Ricker, Beverton and Holt and the smooth hockey stock Figures 6.8.7–6.8.10. Based on the A.I.C. and number of successful fits all models have an equal fit to the available data. The estimates of F_{crash}, F_{msy}, B_{msy} and MSY are presented with their percentiles and coefficients of variation in Table 6.8.21. Figure 6.8.11 illustrates the uncertainty in yield-per-recruit curve, with estimates also presented in Table 6.8.21.

Each model assumes that there is a relationship between increasing levels of recruitment and increasing spawning–stock. In the past recruitment seems to have show some cyclical pattern at stock sizes >3000 t suggesting the dominant determinant of recruitment at higher stock sixes is likely to be environmental conditions rather than the level of SSB.

The link to environmental control of recruitment and independence from SSB would suggest the use of yield-per-recruit fishing mortality reference levels as appropriate. However, as shown by Figure 6.8.11 the form of the YPR curve is poorly determined and the estimates of $F_{0.1}$, $F_{35/40\%}$SPR have high cv, with F_{max} very poorly determined (Table 6.8.21).

For the Beverton and Holt model and the Ricker model F_{msy} overlaps with $F_{0.1}$ and $F_{35\%}$ and has a high probability of avoiding F_{crash}. For the smooth hockeystick the breakpoint is poorly determined and far to the right resulting in an F_{crash} estimate that is close to F_{msy}, $F_{0.1}$ and $F_{35\%}$. Given that the stock has been fished above F_{crash} for the time-series these resulting F reference estimates from the smooth hockey stick were considered unlikely.

Estimates of F_{msy} differ assumed B–H and Ricker stock and recruitment relationships are fitted to the S-R pairs for sole in VIIa, both models are equally plausible and there is no way of distinguishing between them. Consequently WGCSE consider that fishing mortalities in the range 0.07–0.16 are consistent with maximising long-term yield for sole in VIIa.

6.8.6 Biological reference points

Precautionary approach reference points

Biological reference points are:

B_{lim} = 2200 t	Basis: $B_{lim}=B_{loss}$	Changed in ACFM 2007 (from 2800 to 2200 t). The lowest observed spawning stock, followed by an increase in SSB.
B_{pa} = 3100 t	Basis: $B_{pa} \sim B_{lim} * 1.4$	Changed in ACFM 2007 (from 3800 to 3100 t).
F_{lim}=0.4	Basis: $F_{lim}=F_{loss}$	Although poorly defined, based that there is evidence that fishing mortality in excess of 0.4 has led to a general stock decline and is only sustainable during periods of above-average recruitment.
F_{pa}=0.3	Basis: F_{pa} be set at 0.30.	This F is considered to have a high probability of avoiding F_{lim}.

Yield-per-Recruit analysis

A yield-per-recruit analysis was carried out (Table 6.6.18 and Figure 6.8.6). Current fishing mortality (0.33) is well above $F_{0.1}$ (0.14). F_{max} was estimated at 0.68, but was considered to be not well defined given flat yield-per-recruit curve. Taking the results of the stochastic yield-per-recruit analysis into account, which shows high CVs on $F_{0.1}$ and very high CVs on F_{max} estimates, the WG concluded that these deterministic values should not be used as a basis of management advice.

6.8.7 Management plans

No management plan is currently in place for Irish Sea sole.

6.8.8 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for Irish Sea sole are sampled. Sampling is considered to be at a reasonable level. Under the DCF there is an initiative to co-ordinate sampling across the three countries involved in the fishery. One of the problems in this assessment may well be the quality of historical catch-at-age data.

Landings

There is no reliable information on the accuracy of the landing statistics. Nevertheless, the total TAC uptake over the last 3 years was only in the range of 50–60%. In this context, misreporting is not considered to be a major problem for these years.

Discards

The absence of discard data is unlikely to affect the quality of the assessment as information from 2003, 2004 and 2005 and 2007 indicates that discarding ranges by weight vary between 0 and 8%. In 2006 high discard rates were estimated for the UK beam trawl fleet, but this estimate was heavily influenced by one observation made in the fourth quarter.

Effort

There are no indications of Irish Sea sole fisheries misreporting effort. Effort in sole targeting beam trawl fisheries has declined substantially in the last few years.

Surveys

The UK (E&W) September beam trawl survey appears to track year-class strength well. As previously investigated, this tuning fleet is also quite consistent in estimating year-class strength of the same year class at different ages. Therefore the Working Group had confidence in using the UK (E&W) September survey. The bias problem in the assessment may be the result of the precise survey and less precise catch-at-age data.

Model formulation

At the moment XSA is used to assess Irish Sea sole. In the WG of 2007 the model settings were changed which did have a considerable impact on the estimates of SSB and fishing mortality. Due to the major revisions, ACFM changed the biomass reference points in its meeting of 2007. In the last two year's update assessment (2008–2009) no major changes were apparent.

6.8.9 Recommendations for next Benchmark

Last year WGCSE recommended this stock for benchmark in 2011. This year WGCSE reiterates this recommendation. Little progress has been made thus far but the WG considers that a benchmark in 2011 is still warranted and possible.

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2009	Sole VIIa	The priority should be to develop a long-term plan to rebuild the stock to sustainable levels. The WG recommends that various HCR might be developed and tested through simulations. The reintroduction of commercial tuning-series into the assessment should be examined The retrospective application of an international age–length-key and historical precision of catch-at-age data should be investigated The approach to smoothing catch weight and stock weights should be looked at. Weights in some years look unusual e.g. 2004. Given the current assessment diagnostics the choice of q plateau and F_{bar} range could also be reviewed.	2011	Expert Group members

6.8.10 Management considerations

SSB in 2009 is estimated at its lowest observed value, and well below B_{lim}. Recruitment-at-age 2 has been well below average since 2001, and is estimated to remain low in 2006–2009. The model indicates that fishing mortality has come down over the last couple of years (as did effort for most fleets fishing on Irish Sea sole), and is now close to F_{pa}.

It is not possible for the stock to reach $\mathbf{B}_{pa}$ in one year. A management plan for effort reduction that can be phased in over a number of years and implemented in conjunction with technical conservation measures should be considered.

Given the successive recent low recruitment, predictions become more dependent on the assumed incoming recruitment. 55% of the predicted SSB in 2012 is based on that assumption. A GM recruitment was used, which might be an optimistic assumption given the consecutive low recruitments in recent years.

Sole is caught in a mixed fishery with other flatfish as well as gadoids. Information from observer trips indicates that discarding of sole is relatively low.

Table 6.8.1. Sole in VIIa. Nominal landings (tonnes) as officially reported by ICES, and Working Group estimates of the landings.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Belgium	930	987	915	1010	786	371	531	495	706	675	533	570	525	469	493	674	817	687	527	662	419.3	305	216	257.2
France	17	5	11	5	2	3	11	8	7	5	5	3	3	0.5	3	4	4	4	1	3	1	1.0	1.0	n/a
Ireland	235	312	366	155	170	198	164	98	226	176	133	130	134	120	135	135	96	103	77	85	85	115	66.0	47.1
Netherlands	-	-	-	-	-	-	-	-	-	-	149	123	60	46	60	-	-	-	-	-	-	-	-	-
UK (Engl.& Wales)[1]	637	599	507	613	569	581	477	338	409	424	194	189	161	165	133	195	165	217	106	103	69	66	37	19.7
UK (Isle of Man)	1	3	1	2	10	44	14	4	5	12	4	5	3	1	1	+	+	+	+	+	+	<0.5	n/a	
UK (N. Ireland)[1]	50	72	47																					
UK (Scotland)	46	63	38	38	39	26	37	28	14	8	5	7	9	8	8	4	3	3	1	1	2	4	n/a	n/a
Total	1916	2041	1885	1823	1576	1223	1234	971	1367	1300	490	1027	895	810	833	1012	1085	1014	712	854	576	491	320	324
Used by WG	1995	2808	1999	1833	1583	1212	1259	1023	1374	1266	1002	1003	911	863	818	1053	1087	1014	699	855	569	492	333	324
Unallocated	79	767	114	10	7	-11	25	52	7	-34	512	-24	16	54	-15	41	2	0	-13	1	-7	1	13	0

* Preliminary

[1] 1989 onwards: N. Ireland included with England & Wales

Table 6.8.2. Sole in VIIa. Annual lenght distributions by fleet (2009).

	UK (England & Wales)	Belgium	Ireland
Length (cm)	All gears	All gears	All gears
20			
21	27		47
22	160	6837	513
23	489	97767	1680
24	1600	177268	2054
25	3293	172129	2567
26	4332	141190	5462
27	3743	125816	8496
28	3530	115845	9056
29	3607	59004	8963
30	1667	57273	11623
31	2543	47518	10830
32	1690	43129	9616
33	932	22237	9896
34	1277	18269	8963
35	751	14750	7515
36	547	12977	7609
37	214	7134	4855
38	378	4255	5415
39	298	2692	3641
40	74	2177	3081
41	27	1333	1727
42	145	658	1447
43	9	320	794
44		454	513
45		294	467
46		134	187
47		89	0
48			140
49			
50			
51			
52			
53			
54			
55			
56			
57			
58			
59			
60			
Total	31333	1131549	127156

Table 6.8.3. Sole in VIIa. Catch numbers-at-age (in thousands).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
2	29	113	31	368	25	262	29	221	65	108
3	895	434	673	363	891	733	375	416	958	1027
4	1009	2097	730	2195	576	2386	1332	1292	649	3433
5	467	1130	1537	557	1713	539	2330	774	1009	829
6	1457	232	537	815	383	842	247	1066	442	637
7	289	878	172	267	422	157	544	150	638	326
+gp	2537	1887	1500	1143	971	1006	739	648	587	620
TOTALNUM	6683	6771	5180	5708	4981	5925	5596	4567	4348	6980
TONSLAND	1785	1882	1450	1428	1307	1441	1463	1147	1106	1614
SOPCOF %	100	100	100	100	100	100	100	100	100	100
	1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
2	187	70	8	37	651	154	141	189	32	179
3	939	580	346	165	786	1601	3336	3348	444	771
4	1968	1668	1241	998	380	1086	3467	4105	4752	775
5	3055	1480	1298	758	610	343	961	3185	2102	3978
6	521	1640	711	757	343	334	235	844	1310	1178
7	512	114	641	416	424	164	277	307	203	552
+gp	1145	865	397	709	557	739	848	808	516	255
TOTALNUM	8327	6417	4642	3840	3751	4421	9265	12786	9359	7688
TONSLAND	1941	1667	1338	1169	1058	1146	1995	2808	1999	1833
SOPCOF %	100	100	100	100	100	100	100	100	100	100
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
2	564	1317	363	83	122	132	60	789	167	301
3	1185	1270	2433	543	1342	920	469	713	1728	1069
4	986	841	918	1966	1069	1444	1188	474	466	1258
5	598	300	556	559	1578	737	741	710	256	297
6	2319	226	190	251	394	1010	430	408	315	115
7	592	1173	156	199	133	179	509	258	191	136
+gp	466	459	929	686	524	350	347	531	423	232
TOTALNUM	6710	5586	5545	4287	5162	4772	3744	3883	3546	3408
TONSLAND	1583	1212	1259	1023	1374	1266	1002	1003	911	863
SOPCOF %	100	100	100	100	100	100	100	100	100	100
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
2	88	267	88	329	146	518	115	179	100	136
3	1013	1259	442	1082	946	1066	630	462	391	513
4	1180	909	1329	1042	352	617	554	399	255	335
5	556	604	1122	704	332	408	233	242	204	129
6	190	471	551	308	292	257	126	87	113	126
7	66	68	194	155	91	167	142	37	65	71
+gp	224	238	119	201	78	248	250	212	114	58
TOTALNUM	3317	3816	3845	3821	2237	3281	2050	1618	1242	1368
TONSLAND	818	1053	1090	1014	709	855	569	492	332	324
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 6.8.4. Sole in VIIa. Catch weights-at-age (kg).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
2	0.130	0.152	0.126	0.151	0.138	0.130	0.120	0.085	0.093	0.134
3	0.153	0.178	0.164	0.178	0.174	0.172	0.161	0.146	0.147	0.165
4	0.178	0.204	0.201	0.204	0.209	0.210	0.200	0.202	0.197	0.199
5	0.204	0.230	0.237	0.230	0.241	0.244	0.239	0.251	0.243	0.234
6	0.232	0.257	0.272	0.256	0.272	0.275	0.276	0.293	0.286	0.271
7	0.260	0.284	0.306	0.283	0.301	0.303	0.313	0.330	0.326	0.311
+gp	0.377	0.419	0.417	0.392	0.396	0.367	0.457	0.387	0.429	0.451
SOPCOFAC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	0.146	0.162	0.112	0.189	0.191	0.144	0.122	0.135	0.111	0.125
3	0.169	0.183	0.171	0.212	0.225	0.189	0.164	0.164	0.147	0.163
4	0.193	0.207	0.225	0.238	0.257	0.231	0.203	0.196	0.183	0.201
5	0.219	0.234	0.275	0.266	0.288	0.272	0.241	0.231	0.218	0.237
6	0.247	0.264	0.321	0.298	0.318	0.310	0.277	0.268	0.252	0.271
7	0.275	0.296	0.362	0.332	0.347	0.346	0.311	0.308	0.286	0.304
+gp	0.380	0.452	0.456	0.458	0.409	0.430	0.407	0.462	0.419	0.389
SOPCOFAC	1.001	1.000	1.000	1.000	1.000	0.999	0.999	1.000	0.999	1.000

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.135	0.133	0.149	0.102	0.175	0.129	0.156	0.154	0.187	0.179
3	0.162	0.172	0.177	0.156	0.198	0.182	0.193	0.197	0.209	0.217
4	0.192	0.208	0.207	0.205	0.227	0.232	0.228	0.237	0.234	0.252
5	0.227	0.241	0.239	0.248	0.261	0.277	0.263	0.275	0.263	0.285
6	0.265	0.272	0.274	0.285	0.301	0.318	0.296	0.311	0.295	0.314
7	0.307	0.300	0.310	0.318	0.346	0.356	0.327	0.345	0.331	0.341
+gp	0.414	0.345	0.379	0.370	0.509	0.451	0.410	0.407	0.440	0.399
SOPCOFAC	1.000	1.000	0.999	0.999	1.001	1.000	1.000	1.002	1.000	1.001

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.143	0.184	0.163	0.143	0.188	0.203	0.209	0.219	0.197	0.154
3	0.190	0.231	0.212	0.206	0.257	0.231	0.234	0.255	0.228	0.217
4	0.235	0.273	0.257	0.262	0.318	0.258	0.259	0.289	0.257	0.244
5	0.276	0.308	0.298	0.310	0.372	0.284	0.284	0.321	0.284	0.299
6	0.315	0.338	0.334	0.352	0.418	0.308	0.309	0.352	0.309	0.264
7	0.351	0.362	0.367	0.386	0.456	0.331	0.334	0.382	0.332	0.269
+gp	0.443	0.393	0.423	0.420	0.505	0.374	0.399	0.460	0.383	0.3319
SOPCOFAC	1.000	1.001	1.000	1.000	1.000	1.002	1.003	1.000	0.999	0.9994

Table 6.8.5. Sole in VIIa. Stock weights-at-age (kg).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
2	0.118	0.139	0.106	0.138	0.119	0.108	0.100	0.052	0.065	0.119
3	0.141	0.165	0.145	0.164	0.156	0.151	0.141	0.116	0.120	0.149
4	0.166	0.191	0.183	0.191	0.192	0.191	0.181	0.175	0.172	0.182
5	0.191	0.217	0.219	0.217	0.225	0.228	0.220	0.227	0.220	0.216
6	0.218	0.244	0.255	0.243	0.257	0.260	0.258	0.273	0.265	0.252
7	0.246	0.271	0.289	0.270	0.287	0.290	0.295	0.312	0.306	0.291
+gp	0.360	0.405	0.403	0.379	0.385	0.361	0.442	0.3815	0.417	0.428

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	0.135	0.152	0.081	0.179	0.174	0.121	0.101	0.121	0.093	0.105
3	0.157	0.172	0.142	0.200	0.208	0.167	0.143	0.149	0.129	0.144
4	0.181	0.195	0.198	0.224	0.241	0.210	0.183	0.180	0.165	0.182
5	0.206	0.220	0.251	0.252	0.273	0.252	0.222	0.213	0.200	0.219
6	0.233	0.249	0.299	0.282	0.303	0.291	0.259	0.249	0.235	0.254
7	0.261	0.280	0.342	0.315	0.332	0.328	0.294	0.287	0.269	0.288
+gp	0.363	0.430	0.443	0.436	0.396	0.415	0.393	0.437	0.403	0.374

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.123	0.113	0.135	0.073	0.165	0.101	0.136	0.132	0.177	0.159
3	0.148	0.153	0.162	0.130	0.186	0.156	0.174	0.176	0.198	0.199
4	0.176	0.190	0.192	0.181	0.212	0.207	0.211	0.217	0.221	0.235
5	0.209	0.225	0.223	0.227	0.243	0.255	0.246	0.257	0.248	0.269
6	0.245	0.257	0.256	0.267	0.280	0.298	0.279	0.294	0.279	0.300
7	0.286	0.286	0.292	0.302	0.323	0.338	0.312	0.328	0.312	0.328
+gp	0.388	0.334	0.359	0.362	0.478	0.440	0.397	0.393	0.418	0.391

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.119	0.158	0.137	0.109	0.151	0.189	0.196	0.201	0.181	0.159
3	0.167	0.208	0.188	0.175	0.224	0.218	0.221	0.237	0.213	0.199
4	0.213	0.253	0.235	0.235	0.289	0.245	0.246	0.272	0.243	0.235
5	0.256	0.291	0.278	0.287	0.346	0.271	0.271	0.305	0.271	0.269
6	0.296	0.324	0.317	0.332	0.396	0.296	0.296	0.337	0.297	0.300
7	0.334	0.351	0.351	0.370	0.438	0.320	0.321	0.367	0.321	0.328
+gp	0.430	0.386	0.413	0.415	0.497	0.365	0.386	0.447	0.375	0.391

Table 6.8.6. Sole in VIIa. Tuning-series (values in bold are used in the assessment).

BEL-BEAM		Belgium Beam trawl (Effort = Corrected formula)										
	1975	2005										
	1	1	0	1								
	4	14										
12.3		1045	275	393	69	105	94	61	72	11	15	64
11.8		568	1066	80	263	64	58	35	5	56	5	5
10.7		434	307	509	76	93	45	23	20	2	35	32
9.9		169	304	155	258	41	90	12	29	12	7	17
11.2		1455	510	323	193	162	37	36	9	41	0	0
16.7		958	1644	296	268	247	210	30	64	31	14	7
22.6		909	721	998	62	92	44	161	13	92	10	8
19.5		451	608	378	394	52	64	11	29	24	5	0
20.5		259	310	394	238	216	44	38	28	49	3	26
12		107	204	143	188	91	121	2	1	4	14	0
19.6		606	171	186	99	150	125	83	27	13	4	23
38		1531	468	138	135	90	104	69	69	20	8	21
43.2		1527	881	297	167	69	39	54	59	40	13	9
30.5		2027	1012	480	21	33	37	34	42	35	0	7
34		376	2423	751	250	59	15	9	2	14	0	1
36.1		307	223	1263	276	142	13	9	11	11	8	5
13.8		253	78	60	588	115	40	16	1	1	11	3
23.9		298	330	68	40	203	93	36	12	0	0	0
24.5		862	253	149	89	79	160	66	77	0	0	0
31		680	786	164	103	39	117	58	19	15	0	7
26.2		729	366	410	52	27	6	28	15	6	11	3
21.6		537	334	241	219	53	13	11	14	9	7	2
28.5		270	376	180	162	134	28	27	15	9	8	1
23.3		248	146	142	89	73	62	20	20	9	10	3
21.7		693	199	65	50	37	21	17	9	6	4	6
18.6		685	220	107	31	15	33	13	7	9	0.6	8
30.5		600	284	248	39	35	44	33	1	3	0.2	4
38.6		1138	814	349	109	30	9	2	1	1	1	0
24.45		724	436	196	84	20	7	2	1	0	2	1
25.58		313	197	159	47	12	11	6	3	0	0	0
32.15		505	342	156	71	87	9	7	1	13	2	1
E+W September beam trawl survey												
	1988	2009										
	1	1	0.75	0.85								
	1	9										
100.062		118	**196**	**180**	**410**	**76**	**40**	**4**	0	4		
129.71		218	**304**	**180**	**74**	**284**	**56**	**32**	8	6		
128.969		1712	**534**	**122**	**42**	**88**	**194**	**40**	20	6		
123.78		148	**1286**	**122**	**26**	**16**	**14**	**55**	19	7		
129.525		220	**309**	**657**	**142**	**34**	**22**	**7**	75	17		
131.192		83	**330**	**143**	**211**	**40**	**17**	**7**	16	36		
124.892		60	**408**	**203**	**73**	**132**	**49**	**11**	13	6		
126.004		246	**154**	**253**	**110**	**30**	**67**	**12**	5	5		
126.004		886	**126**	**32**	**76**	**46**	**23**	**31**	8	2		
126.004		1158	**577**	**72**	**24**	**55**	**27**	**16**	30	7		
126.004		539	**716**	**292**	**18**	**6**	**24**	**23**	5	18		
126.004		385	**293**	**255**	**203**	**29**	**8**	**26**	5	6		
126.004		354	**464**	**147**	**219**	**91**	**13**	**2**	13	6		
126.004		91	**284**	**192**	**65**	**96**	**64**	**6**	3	12		
126.004		205	**61**	**121**	**126**	**42**	**79**	**49**	2	1		
126.004		242	**210**	**51**	**97**	**81**	**40**	**43**	26	1		
126.004		406	**240**	**119**	**27**	**77**	**45**	**41**	17	19		
122.298		53	**165**	**69**	**25**	**13**	**35**	**25**	4	6		
126.004		107	**110**	**90**	**45**	**36**	**9**	**16**	15	10		
126.004		125	**93**	**49**	**57**	**41**	**11**	**4**	6	12		
122.298		126	**125**	**60**	**21**	**43**	**23**	**6**	2	9		
126.004		57	**150**	**68**	**39**	**23**	**30**	**12**	7	1		

Table 6.8.6. Sole in VIIa. Continued.

E+W March beam trawl survey

	1993	1999							
	1	1	0.15	0.25					
	1	9							
126.931	18	**337**	**147**	**332**	**73**	**15**	**17**	10	41
115.442	8	**354**	**208**	**69**	**151**	**51**	**14**	11	9
126.189	24	**96**	**186**	**140**	**30**	**104**	**27**	10	8
134.343	651	**114**	**49**	**110**	**78**	**32**	**54**	10	12
121.742	130	**417**	**33**	**17**	**69**	**23**	**11**	46	17
130.081	47	**421**	**330**	**39**	**19**	**48**	**27**	12	37
130.822	45	**227**	**284**	**177**	**14**	**4**	**34**	12	7

UK(E+W) Beam trawl

	1991	2008												
	1	1	0	1										
	2	14												
25.838	267	426	212	84	58	218	53	34	4	1	2	1	0	
23.399	36	460	176	68	37	32	121	34	38	3	1	0	0	
21.503	11	74	355	98	36	48	25	34	13	22	5	2	4	
20.145	24	228	150	234	87	17	25	19	42	10	17	1	0	
20.392	47	239	231	130	199	55	11	22	5	34	10	11	3	
13.32	0	13	109	98	49	100	37	9	8	6	14	8	3	
10.76	0	111	50	81	58	24	46	34	12	12	0	8	1	
10.386	43	219	40	28	49	31	12	22	11	9	2	1	0	
11.016	53	115	134	12	15	25	10	9	14	9	0	1	2	
6.275	16	90	84	82	9	6	10	5	5	7	2	1	1	
12.495	33	184	100	145	107	12	4	17	12	10	6	4	2	
8.017	4	63	152	50	79	47	5	4	6	3	1	1	1	
13.996	28	63	178	149	78	52	72	7	5	8	3	7	14	
7.396	54	61	29	43	25	12	10	5	1	1	4	0	1	
11.406	10	81	44	16	45	37	17	10	17	3	0	3	3	
4.649	7	28	33	11	5	10	12	7	9	5	2	0	1	
3.197	22	20	34	17	6	1	7	7	6	3	2	1	1	
1.302	1	11	5	7	12	1	2	4	3	4	0	3	1	

IR-OTB : Irish Otter trawl - Effort in hours - VIIa Sole numbers at age - Year

	1995	2005								
	1	1	0	1						
	2	10								
70682	6.8	17.7	25.5	9.2	25.8	3.6	0.8	1.5	1.9	1995
58166	0	5.7	12.9	12.7	4.7	4.7	2.2	0.2	0	1996
75029	27.8	10.2	4.1	9.2	6.4	3.5	3.9	1	0.2	1997
81073	5.5	40.7	14.7	6.6	12.3	5.4	2.7	4.1	1	1998
93221	26.6	36.8	30.9	5.1	3.8	5.3	2.4	0.5	1.2	1999
64320	1.6	13.2	13.4	11	3.4	1.1	1	0.4	0	2000
77541	0.2	6.1	18.6	18.6	10.8	2.1	4.1	1.3	0.3	2001
39996	20.3	20	30.2	16.4	8.2	2.9	2.4	1.4	0.5	2002
73854	0.9	35.9	21.7	9.8	3.3	0.5	0.8	0.2	0.2	2003
72507	9	15.1	4.1	3.2	1.9	1.6	0.3	0.2	0.1	2004
##										
31142	4	1.7	1.6	1.6	0.6	0.1	0	0	0	2005
##										

Please note the 2005 data is based only on Q3 and Q4 data and has not been raised to annual effort.
It should not be included as part of this time series.

Table 6.8.7. Sole in VIIa. Effort and cpue series.

	CPUE							Effort				
	Belgium [1]	UK(E+W) [3]		UK [5]		Ireland		Belgium [2]	UK(E+W) [4]		Ireland [6]	
	beam	beam	otter	beam survey		otter	beam	beam	beam	otter	otter	beam
Year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1972	-	-	1.06	-	-	-	-	-	-	128.4	-	-
1973	-	-	1.06	-	-	-	-	-	-	147.6	-	-
1974	-	-	1.09	-	-	-	-	-	-	115.2	-	-
1975	21.4	-	1.39	-	-	-	-	28.4	-	130.7	-	-
1976	23.1	-	0.94	-	-	-	-	24.9	-	122.3	-	-
1977	19.8	-	0.80	-	-	-	-	22.1	-	101.9	-	-
1978	18.1	34.32	1.04	-	-	-	-	17.5	0.9	89.1	-	-
1979	33.4	32.01	1.43	-	-	-	-	20.4	1.7	89.9	-	-
1980	28.2	31.70	1.01	-	-	-	-	32.0	4.3	107.0	-	-
1981	22.2	21.32	0.75	-	-	-	-	36.5	6.4	107.1	-	-
1982	22.0	29.94	0.53	-	-	-	-	26.5	5.5	127.2	-	-
1983	13.9	37.31	0.57	-	-	-	-	28.7	2.8	88.1	-	-
1984	22.5	16.24	0.71	-	-	-	-	17.5	4.1	103.1	-	-
1985	20.6	17.34	0.56	-	-	-	-	27.0	7.4	102.9	-	-
1986	19.1	19.23	0.84	-	-	-	-	44.5	17.0	90.3	-	-
1987	17.7	14.82	0.77	-	-	-	-	51.6	22.0	130.6	-	-
1988	21.3	11.81	0.46	158.7	-	-	-	38.2	18.6	132.0	-	-
1989	21.9	9.17	0.70	145.9	-	-	-	42.2	25.3	139.5	-	-
1990	17.5	9.52	0.61	190.1	-	-	-	42.4	31.0	117.1	-	-
1991	18.7	10.43	1.12	170.5	-	-	-	17.1	25.8	107.3	-	-
1992	19.2	9.50	1.02	158.3	-	-	-	25.1	23.4	96.8	-	-
1993	20.0	7.60	0.54	97.3	104.7	-	-	23.9	21.5	78.9	-	-
1994	19.1	11.76	0.74	107.7	91.9		-	32.5	20.1	43.0	-	-
1995	18.1	14.96	0.95	89.5	79.3	0.38	12.69	28.6	20.9	43.1	80.3	8.64
1996	17.7	9.44	0.53	86.8	-	0.25	14.94	23.2	13.3	42.2	64.8	6.26
1997	16.6	10.49	0.73	151.2	63.3	0.23	8.53	30.7	10.8	39.9	92.2	9.86
1998	19.0	8.42	0.48	140.8	89.3	0.38	7.77	24.7	10.4	36.9	93.5	11.58
1999	19.5	9.94	0.60	107.3	-	0.29	9.22	22.7	11.0	22.9	110.3	14.67
2000	15.5	12.90	0.44	122.6	-	0.29	8.49	26.0	6.3	27.0	82.7	11.42
2001	15.0	11.72	0.15	96.9	-	0.38	7.86	36.8	12.5	32.8	77.5	13.13
2002	15.0	16.73	1.48	76.0	-	0.32	4.67	47.0	8.0	24.8	77.9	17.67
2003	14.8	13.20	0.15	88.6	-	0.34	4.20	43.6	14.0	23.9	73.9	18.70
2004	15.4	13.86	0.17	98.9	-	0.14	4.31	32.0	7.4	23.5	72.5	14.19
2005	16.7	9.14	0.19	48.9	-	0.16	4.70	37.5	11.4	16.7	68.3	14.67
2006	15.7	7.83	0.52	52.6	-	0.16	6.00	24.6	4.6	5.2	66.2	12.20
2007	13.7	16.38	0.42	53.0	-	0.37	6.39	19.4	3.2	4.4	73.1	14.00
2008	19.5	15.25	0.30	50.7	-	0.20	6.13	9.6	1.3	2.7	58.8	9.46
2009*	23.2	18.88	0.22	45.8	-	0.28	4.53	11.1	0.5	1.5	41.5	7.59

All CPUE values in Kg/hr except UK beam survey (Kg/100 km)

[1] Kg/000'hr

[2] 000' hours fishing

[3] Kg/000'hr fished (GRT corrected > 40' vessels)

[4] 000'hours fished (GRT corrected > 40' vessels)

[5] Kg/100km fished

[6] 000'hours

* Provisional

Table 6.8.8. Sole in VIIa. Diagnostics.

Lowestoft VPA Version 3.1

28/05/2010 14:06

Extended Survivors Analysis

IRISH SEA SOLE 2010 WG COMBSEX PLUSGROUP.

CPUE data from file SOL7ATUN.DAT

Catch data for 40 years. 1970 to 2009. Ages 2 to 8.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
E+W September beam t	1988	2009	2	7	0.75	0.85
E+W March beam trawl	1993	2009	2	7	0.15	0.25

Time series weights :

Tapered time weighting applied
Power = 1 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00953

Final year F values

Age	2	3	4	5	6	7
Iteration 29	0.0616	0.3438	0.383	0.3057	0.2034	0.2379
Iteration 30	0.0615	0.3429	0.3814	0.3039	0.2016	0.2347

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Regression weights

0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	1

Fishing mortalities

Age	2000.000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.016	0.075	0.034	0.121	0.049	0.189	0.075	0.099	0.050	0.061
3	0.237	0.29	0.154	0.633	0.525	0.519	0.328	0.421	0.289	0.343
4	0.342	0.309	0.498	0.568	0.383	0.688	0.496	0.317	0.384	0.381
5	0.253	0.262	0.68	0.475	0.314	0.909	0.532	0.371	0.237	0.304

Table 6.8.8.cont. Sole in VIIa. Diagnostics.

6	**0.683**	0.315	0.36	0.35	0.326	0.379	0.704	0.343	0.263	0.202
7	1.033	0.49	0.184	0.145	0.147	0.28	0.33	0.403	0.412	0.235

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XSA population numbers (Thousands)

YEAR \ AGE	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00
2000	5.91E+03	5.04E+03	4.28E+03	2.61E+03	4.04E+02	1.08E+02
2001	3.88E+03	5.26E+03	3.60E+03	2.75E+03	1.83E+03	1.85E+02
2002	2.77E+03	3.26E+03	3.56E+03	2.39E+03	1.92E+03	1.21E+03
2003	3.04E+03	2.42E+03	2.53E+03	1.96E+03	1.10E+03	1.21E+03
2004	3.21E+03	2.44E+03	1.16E+03	1.30E+03	1.10E+03	6.98E+02
2005	3.16E+03	2.77E+03	1.30E+03	7.19E+02	8.57E+02	7.20E+02
2006	1.68E+03	2.37E+03	1.49E+03	5.93E+02	2.62E+02	5.31E+02
2007	2.00E+03	1.41E+03	1.54E+03	8.22E+02	3.15E+02	1.17E+02
2008	2.16E+03	1.64E+03	8.40E+02	1.02E+03	5.13E+02	2.02E+02
2009	2.40E+03	1.86E+03	1.11E+03	5.18E+02	7.26E+02	3.57E+02

Estimated population abundance at 1st Jan 2010

0.00E+00 2.04E+03 1.20E+03 6.90E+02 3.48E+02 5.42E+02

Taper weighted geometric mean of the VPA populations:

3.18E+03 2.81E+03 1.89E+03 1.16E+03 7.22E+02 4.23E+02

Standard error of the weighted Log(VPA populations) :

0.4856 0.5171 0.5959 0.6284 0.6964 0.8169

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Log catchability residuals.

Fleet : E+W September beam t

Age	1988	1989
2	99.99	99.99
3	99.99	99.99
4	99.99	99.99
5	99.99	99.99
6	99.99	99.99
7	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.48	0.59	0.04	-0.2	0.23	0.24	-0.22	0.21	0.54	-0.21
3	-0.07	-0.22	0.55	-0.19	0.02	0.35	-0.63	-0.03	0.24	0.11
4	-0.22	-0.88	0.52	-0.02	-0.2	0.12	-0.19	-0.13	-0.74	0.47
5	0.85	-0.79	-0.15	-0.42	-0.06	-0.65	-0.32	-0.1	-0.92	0.17
6	0.12	-0.32	-0.05	-0.22	0.43	-0.1	-0.21	-0.26	-0.43	0.15
7	0.07	-0.29	-0.19	-0.28	0.13	-0.32	-0.07	0.49	0.22	0.14

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.22	0.2	-1.04	0.18	0.2	-0.02	0.08	-0.24	-0.03	0.03
3	-0.28	-0.01	-0.1	-0.29	0.47	-0.18	0.06	0.04	0.02	0.04
4	0.5	-0.57	0.25	0.39	-0.26	-0.18	0.09	0.15	-0.15	0.15
5	-0.14	-0.13	-0.49	0.21	0.44	-0.24	0.64	0.31	0.07	0.14
6	0.1	-0.12	0.09	-0.04	0.05	0.12	0.18	-0.09	0.12	-0.04
7	-0.08	0.05	0.02	-0.14	0.36	-0.03	-0.16	0.02	-0.08	-0.12

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Table 6.8.8.cont. Sole in VIIa. Diagnostics.

Age	2	3	4	5	6	7
Mean Log q	**-7.5071**	-7.826	-7.9537	-7.7685	-7.7444	-7.8362
S.E(Log q)	0.3454	0.2442	0.3459	0.4042	0.1757	0.1931

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.81	1.015	7.61	0.77	20	0.28	-7.51
3	0.93	0.477	7.83	0.84	20	0.24	-7.83
4	0.84	0.982	7.89	0.82	20	0.29	-7.95
5	1.21	-0.823	7.92	0.64	20	0.5	-7.77
6	1.08	-0.851	7.83	0.94	20	0.19	-7.74
7	0.99	0.137	7.82	0.95	20	0.2	-7.84
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Fleet : E+W March beam trawl

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	99.99	99.99	99.99	0.07	0.38	-0.05	-0.17	0.08	0.19	-0.3
3	99.99	99.99	99.99	0.02	0.18	0.14	-0.23	-0.79	0.36	0.28
4	99.99	99.99	99.99	0.46	-0.23	0.25	0.04	-0.59	-0.06	0.28
5	99.99	99.99	99.99	0.37	0.27	-0.57	0.24	0.27	0.2	-0.5
6	99.99	99.99	99.99	-0.24	0.62	0.38	0.06	-0.3	0.39	-0.6
7	99.99	99.99	99.99	0.1	0.07	0.17	0.01	-0.46	0.04	0.16

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	99.9900	99.9900	99.9900	99.9900	99.9900	99.9900	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-7.7944	-8.1216	-8.227	-8.2405	-8.2046	-7.8454
S.E(Log q)	0.28	0.512	0.4198	0.4812	0.5528	0.2746

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.88	0.221	7.88	0.88	7	0.42	-7.79
3	0.6	1.099	8.19	0.94	7	0.29	-8.12
4	0.69	1.047	8.12	0.96	7	0.28	-8.23
5	0.86	0.205	8.09	0.82	7	0.71	-8.24
6	0.68	0.776	7.72	0.93	7	0.44	-8.2
7	0.92	0.103	7.72	0.78	7	0.45	-7.85
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Terminal year survivor and F summaries :

Table 6.8.8.cont. Sole in VIIa. Diagnostics.

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	2099	0.361	0	0	1	0.942	0.06
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	1337	1.5				0.058	0.092

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2044	0.35	0.11	2	0.31	0.061

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	1207	0.233	0.031	0.13	2	0.966	0.34
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	941	1.5				0.034	0.418

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1197	0.23	0.04	3	0.168	0.343

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Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	695	0.202	0.105	0.52	3	0.969	0.378
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	553	1.5				0.031	0.455

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
690	0.2	0.09	4	0.434	0.381

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	354	0.196	0.068	0.35	4	0.967	0.297
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	202	1.5				0.033	0.474

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
348	0.2	0.08	5	0.393	0.304

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Table 6.8.8.cont. Sole in VIIa. Diagnostics.

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	551	0.173	0.035	0.2	5	0.979	0.197
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	241	1.5				0.021	0.404

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
542	0.17	0.06	6	0.362	0.202

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2002

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
E+W September beam t	261	0.167	0.07	0.42	6	0.979	0.23
E+W March beam trawl	1	0	0	0	0	0	0
F shrinkage mean	196	1.5				0.021	0.296

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
259	0.17	0.07	7	0.393	0.235

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Table 6.8.9. Sole in VIIa. Fishing mortality.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
2	0.0083	0.0117	0.0103	0.0299	0.0045	0.042	0.0079	0.0148	0.0075	0.0128
3	0.1196	0.148	0.0809	0.1435	0.0846	0.1574	0.0703	0.1348	0.0741	0.1419
4	0.2956	0.3988	0.3518	0.362	0.3156	0.303	0.4189	0.325	0.2862	0.3632
5	0.4444	0.5544	0.5057	0.4393	0.472	0.4841	0.4812	0.4066	0.4027	0.6307
6	0.4292	0.3671	0.4929	0.4872	0.5433	0.397	0.3789	0.3747	0.3808	0.4246
7	0.3909	0.4415	0.4516	0.4309	0.4451	0.3959	0.4277	0.3699	0.3576	0.4744
+gp	0.3909	0.4415	0.4516	0.4309	0.4451	0.3959	0.4277	0.3699	0.3576	0.4744
FBAR 4-7	0.39	0.4405	0.4505	0.4298	0.444	0.395	0.4267	0.369	0.3568	0.4732

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	0.0391	0.0161	0.0033	0.0066	0.0441	0.01	0.0062	0.0595	0.0096	0.044
3	0.1318	0.1468	0.093	0.078	0.1694	0.1306	0.2743	0.1794	0.1734	0.2955
4	0.3898	0.3238	0.4683	0.3722	0.2313	0.3312	0.4064	0.5606	0.3686	0.4545
5	0.5632	0.5044	0.3988	0.5161	0.3632	0.3005	0.4845	0.7115	0.5542	0.5317
6	0.9427	0.5955	0.4282	0.3796	0.4122	0.3079	0.3085	0.929	0.6375	0.6137
7	0.6346	0.4763	0.4332	0.424	0.3366	0.3141	0.4012	0.7377	0.5229	0.5367
+gp	0.6346	0.4763	0.4332	0.424	0.3366	0.3141	0.4012	0.7377	0.5229	0.5367
FBAR 4-7	0.6326	0.475	0.4321	0.423	0.3358	0.3135	0.4002	0.7347	0.5208	0.5341

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	0.1139	0.1174	0.082	0.0143	0.0248	0.0714	0.0254	0.1098	0.0268	0.0553
3	0.3993	0.3569	0.2936	0.1524	0.2985	0.2351	0.3434	0.4126	0.3297	0.2131
4	0.6653	0.4861	0.4194	0.3635	0.4433	0.5338	0.4751	0.6119	0.4603	0.3772
5	0.6748	0.3824	0.6113	0.4318	0.4923	0.5535	0.5109	0.5136	0.7005	0.5305
6	0.6018	0.5149	0.3946	0.5456	0.5459	0.5977	0.6476	0.5204	0.3992	0.7008
7	0.6359	0.6188	0.7211	0.8209	0.5534	0.4535	0.6081	0.9265	0.4358	0.2667
+gp	0.6359	0.6188	0.7211	0.8209	0.5534	0.4535	0.6081	0.9265	0.4358	0.2667
FBAR 4-7	0.6444	0.5006	0.5366	0.5405	0.5087	0.5346	0.5604	0.6431	0.4989	0.4688

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR 06-08
2	0.0158	0.0751	0.0339	0.1209	0.049	0.1891	0.0745	0.0989	0.0499	0.0615	0.0701
3	0.2374	0.2899	0.1539	0.6335	0.5247	0.519	0.3282	0.4208	0.2889	0.3429	0.3508
4	0.342	0.3088	0.498	0.5681	0.3825	0.6877	0.4956	0.3173	0.3844	0.3814	0.361
5	0.2533	0.2623	0.6803	0.4746	0.3138	0.9087	0.5324	0.3706	0.237	0.3039	0.3038
6	0.6827	0.3146	0.36	0.3505	0.3263	0.3788	0.7043	0.3427	0.2633	0.2016	0.2692
7	1.033	0.4899	0.1843	0.1447	0.1474	0.2796	0.3302	0.4031	0.4117	0.2347	0.3498
+gp	1.033	0.4899	0.1843	0.1447	0.1474	0.2796	0.3302	0.4031	0.4117	0.2347	
FBAR 4-7	0.5778	0.3439	0.4307	0.3845	0.2925	0.5637	0.5156	0.3584	0.3241	0.2804	

Table 6.8.10. Sole in VIIa. Stock numbers-at-age (start of year, in thousands).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
2	3695	10180	3187	13142	5876	6690	3862	15821	9090	8947
3	8350	3316	9104	2854	11542	5293	5804	3467	14105	8163
4	4145	6704	2588	7597	2237	9596	4092	4895	2741	11851
5	1368	2791	4071	1647	4786	1477	6413	2435	3200	1863
6	4389	794	1451	2222	961	2701	823	3586	1467	1936
7	939	2586	498	802	1235	505	1643	510	2231	907
+gp	8213	5535	4321	3419	2830	3223	2224	2196	2046	1718
TOTAL	31100	31906	25219	31683	29466	29484	24861	32910	34881	35386

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	5132	4599	2563	5898	15874	16320	23828	3439	3535	4370
3	7993	4466	4095	2312	5302	13744	14620	21426	2932	3168
4	6409	6339	3489	3376	1935	4049	10913	10056	16203	2231
5	7458	3928	4149	1977	2106	1389	2631	6577	5194	10140
6	897	3842	2146	2520	1067	1325	931	1466	2921	2700
7	1146	316	1917	1265	1560	640	881	619	524	1397
+gp	2548	2390	1182	2148	2042	2873	2687	1617	1326	642
TOTAL	31583	25880	19541	19495	29885	40340	56492	45200	32635	24649

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	5509	12495	4846	6129	5231	2014	2514	7978	6648	5887
3	3784	4449	10054	4039	5467	4617	1696	2217	6468	5857
4	2133	2296	2817	6782	3138	3670	3303	1089	1328	4209
5	1281	992	1278	1676	4267	1823	1947	1858	534	758
6	5392	590	613	627	985	2360	948	1057	1006	240
7	1323	2673	319	374	329	516	1175	449	568	611
+gp	1035	1040	1889	1279	1290	1005	796	917	1254	1039
TOTAL	20457	24536	21815	20906	20706	16005	12379	15565	17807	18600

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 70-07	AMST 70-07
2	5905	3882	2771	3038	3212	3161	1684	1999	2158	2397	0	5326	6604
3	5040	5260	3258	2424	2436	2768	2367	1414	1638	1858	2044	4812	5939
4	4282	3597	3562	2528	1164	1304	1490	1543	840	1111	1197	3586	4518
5	2612	2752	2390	1959	1296	719	593	822	1016	518	690	2160	2767
6	404	1834	1916	1095	1102	857	262	315	513	726	348	1256	1625
7	108	185	1212	1209	698	720	531	117	202	357	542	722	927
+gp	362	643	742	1566	597	1066	932	669	354	291	467		
TOTAL	18714	18153	15851	13819	10506	10594	7859	6879	6723	7256	5288		

Table 6.8.11. Sole in VIIa. Summary.

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4-7
1970	3695	6709	6071	1785	0.294	0.39
1971	10180	6982	5895	1882	0.3192	0.4405
1972	3187	5277	4653	1450	0.3117	0.4505
1973	13142	6142	4831	1428	0.2956	0.4298
1974	5876	5697	4707	1307	0.2777	0.444
1975	6690	5704	4963	1441	0.2903	0.395
1976	3862	5036	4509	1463	0.3245	0.4267
1977	15821	4610	3947	1147	0.2906	0.369
1978	9090	5383	4498	1106	0.2459	0.3568
1979	8947	6327	5241	1614	0.3079	0.4732
1980	5132	6078	5219	1941	0.3719	0.6326
1981	4599	5641	4931	1667	0.3381	0.475
1982	2563	4342	4003	1338	0.3342	0.4321
1983	5898	4818	3996	1169	0.2925	0.423
1984	15874	6555	4497	1058	0.2353	0.3358
1985	16320	7257	5335	1146	0.2148	0.3135
1986	23828	8634	6464	1995	0.3086	0.4002
1987	3439	8069	6803	2808	0.4128	0.7347
1988	3535	5781	5366	1999	0.3725	0.5208
1989	4370	4871	4397	1833	0.4169	0.5341
1990	5509	3982	3383	1583	0.468	0.6444
1991	12495	4015	2925	1212	0.4144	0.5006
1992	4846	4036	3136	1259	0.4014	0.5366
1993	6129	3324	2850	1023	0.3589	0.5405
1994	5231	4581	3710	1374	0.3704	0.5087
1995	2014	3468	3101	1266	0.4083	0.5346
1996	2514	2760	2432	1002	0.412	0.5604
1997	7978	2975	2193	1003	0.4574	0.6431
1998	6648	3865	2753	911	0.331	0.4989
1999	5887	3973	3021	863	0.2857	0.4688
2000	5905	3437	2716	818	0.3012	0.5778
2001	3882	4325	3585	1053	0.2938	0.3439
2002	2771	3833	3382	1090	0.3223	0.4307
2003	3038	3372	3014	1014	0.3363	0.3845
2004	3212	2855	2377	709	0.2983	0.2925
2005	3161	2588	2029	855	0.4214	0.5637
2006	1684	1988	1618	569	0.3517	0.5156
2007	1999	1856	1492	492	0.3298	0.3584
2008	2158	1569	1214	332	0.2735	0.3241
2009	2397	1513	1183	324	0.2739	0.2804
Arith. Mean	6388	4606	3811	1258	0.3341	0.4621
0 Units	(Thousand	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.8.12. Sole in VIIa. Input to RCT3 (XSA = XSA estimates at age 2, M2 = abundance indices at age 2 from UK (E&W) March beam trawl survey, S2 = abundance indices at age 2 from UK(E&W) September beam trawl survey, M1 and S1 similar as previous but at age 1).

Irish Sea sole recruits - age 2

	4	41	2			
	1968	3695	-11	-11	-11	-11
	1969	10180	-11	-11	-11	-11
	1970	3187	-11	-11	-11	-11
	1971	13142	-11	-11	-11	-11
	1972	5876	-11	-11	-11	-11
	1973	6690	-11	-11	-11	-11
	1974	3862	-11	-11	-11	-11
	1975	15821	-11	-11	-11	-11
	1976	9090	-11	-11	-11	-11
	1977	8947	-11	-11	-11	-11
	1978	5132	-11	-11	-11	-11
	1979	4599	-11	-11	-11	-11
	1980	2563	-11	-11	-11	-11
	1981	5898	-11	-11	-11	-11
	1982	15874	-11	-11	-11	-11
	1983	16320	-11	-11	-11	-11
	1984	23828	-11	-11	-11	-11
	1985	3439	-11	-11	-11	-11
	1986	3535	-11	196	-11	-11
	1987	4370	-11	304	-11	118
	1988	5509	-11	534	-11	218
	1989	12495	-11	1286	-11	1712
	1990	4846	-11	309	-11	148
	1991	6129	265	330	-11	220
	1992	5231	307	408	14	83
	1993	2014	76	154	7	60
	1994	2514	85	126	19	246
	1995	7978	343	577	485	886
	1996	6648	324	716	107	1158
	1997	5887	174	293	36	539
	1998	5905	-11	464	34	385
	1999	3882	-11	284	-11	354
	2000	2771	-11	61	-11	91
	2001	3038	-11	210	-11	205
	2002	3212	-11	240	-11	242
	2003	3161	-11	165	-11	406
	2004	1684	-11	110	-11	53
	2005	1999	-11	93	-11	107
	2006	-11	-11	125	-11	125
	2007	-11	-11	150	-11	126
	2008	-11	-11	-11	-11	57
M2						
S2						
M1						
S1						

Table 6.8.13. Sole in VIIa.

Analysis by RCT3 ver3.1 of data from file :

SOL7aRCT.txt

Irish Sea sole recruits - age 2

Data for 4 surveys over 40 years : 1969 - 2008

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 2007

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I				I-----------Prediction---------I				
M2									
S2	.76	4.07	.24	.828	20	5.02	7.89	.262	.696
M1									
S1	.71	4.44	.46	.581	19	4.84	7.88	.502	.190
				VPA Mean =			8.59	.650	.114

Yearclass = 2008

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I				I-----------Prediction---------I				
M2									
S2									
M1									
S1	.71	4.44	.46	.581	19	4.06	7.32	.524	.606
				VPA Mean =			8.59	.650	.394

Predicted value = 7.32 = 1510 60.6% weight
39.4 % weight
Predicted value = 8.59 = 5378

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
2007	2877	7.96	.22	.16	.52		
2008	2489	7.82	.41	.62	2.32		

Table 6.8.14. VIIa sole : Catch forecast input data.

MFDP version 1a
Run: s71
Time and date: 16:01 31/05/2010
Fbar age range: 4-7

2010

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	2489	0.1	0.38	0	0	0.177333	0.0701	0.190067
3	2044	0.1	0.71	0	0	0.209667	0.3508	0.233367
4	1197	0.1	0.97	0	0	0.253	0.361	0.263333
5	690	0.1	0.98	0	0	0.29	0.3038	0.301300
6	348	0.1	1	0	0	0.304333	0.2692	0.308267
7	542	0.1	1	0	0	0.324333	0.3498	0.327567
8	467	0.1	1	0	0	0.381616	0.3498	0.391602

2011

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	5326	0.1	0.38	0	0	0.177333	0.0701	0.190067
3	.	0.1	0.71	0	0	0.209667	0.3508	0.233367
4	.	0.1	0.97	0	0	0.253	0.361	0.263333
5	.	0.1	0.98	0	0	0.29	0.3038	0.301300
6	.	0.1	1	0	0	0.304333	0.2692	0.308267
7	.	0.1	1	0	0	0.324333	0.3498	0.327567
8	.	0.1	1	0	0	0.381616	0.3498	0.391602

2012

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
2	5326	0.1	0.38	0	0	0.177333	0.0701	0.190067
3	.	0.1	0.71	0	0	0.209667	0.3508	0.233367
4	.	0.1	0.97	0	0	0.253	0.361	0.263333
5	.	0.1	0.98	0	0	0.29	0.3038	0.301300
6	.	0.1	1	0	0	0.304333	0.2692	0.308267
7	.	0.1	1	0	0	0.324333	0.3498	0.327567
8	.	0.1	1	0	0	0.381616	0.3498	0.391602

Input units are thousands and kg - output in tonnes

Table 6.8.15.a. VIIa sole: management option table; *status quo* forecast unscaled.

MFDP version 1a
Run: s7a
IRISH SEA SOLE
Time and date: 15:50 31/05/2010
Fbar age range: 4-7

2010				
Biomass	SSB	FMult	FBar	Landings
1902	1448	1.0000	0.3210	439

2011					2012	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
1962	1527	0.0000	0.0000	0	2962	2216
.	1527	0.1000	0.0321	54	2907	2163
.	1527	0.2000	0.0642	107	2854	2112
.	1527	0.3000	0.0963	158	2803	2062
.	1527	0.4000	0.1284	207	2753	2014
.	1527	0.5000	0.1605	254	2705	1967
.	1527	0.6000	0.1926	301	2658	1922
.	1527	0.7000	0.2247	345	2613	1879
.	1527	0.8000	0.2568	389	2569	1837
.	1527	0.9000	0.2889	431	2527	1796
.	1527	1.0000	0.3210	472	2486	1756
.	1527	1.1000	0.3530	511	2446	1718
.	1527	1.2000	0.3851	549	2408	1681
.	1527	1.3000	0.4172	586	2370	1645
.	1527	1.4000	0.4493	622	2334	1610
.	1527	1.5000	0.4814	657	2299	1577
.	1527	1.6000	0.5135	691	2265	1544
.	1527	1.7000	0.5456	724	2233	1513
.	1527	1.8000	0.5777	755	2201	1482
.	1527	1.9000	0.6098	786	2170	1453
.	1527	2.0000	0.6419	816	2140	1424

Input units are thousands and kg - output in tonnes

Table 6.8.15.b. VIIa sole: management option table; scaled (advice basis).

MFDP version 1a						
Run: s7a						
IRISH SEA 2010 WG COMBSEX PLUSGROUP.						
Time and date: 16:27 01/06/2010						
Fbar age range: 4-7						
2010						
Biomass	SSB	FMult	FBar	Landings		
1833	1422	1.0000	0.2802	386		
2011					2012	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
2446	1716	0.0000	0.0000	0	3474	2573
-	1716	0.1000	0.0280	50	3423	2525
-	1716	0.2000	0.0560	98	3374	2479
-	1716	0.3000	0.0841	145	3326	2433
-	1716	0.4000	0.1121	191	3280	2389
-	1716	0.5000	0.1401	236	3235	2346
-	1716	0.6000	0.1681	280	3190	2304
-	1716	0.7000	0.1961	322	3147	2264
-	1716	0.8000	0.2241	363	3106	2224
-	1716	0.9000	0.2522	404	3065	2186
-	1716	1.0000	0.2802	443	3025	2148
-	1716	1.1000	0.3082	481	2987	2112
-	1716	1.2000	0.3362	519	2949	2076
-	1716	1.3000	0.3642	555	2912	2042
-	1716	1.4000	0.3922	591	2876	2008
-	1716	1.5000	0.4203	625	2842	1975
-	1716	1.6000	0.4483	659	2808	1943
-	1716	1.7000	0.4763	692	2775	1912
-	1716	1.8000	0.5043	724	2742	1882
-	1716	1.9000	0.5323	755	2711	1852

Table 6.8.16. VIIa sole : forecast detailed results; *status quo* projection.

MFDP version 1a
Run: s71
Time and date: 16:01 31/05/2010
Fbar age range: 4-7

Year:	2010	F multiplier:	1	Fbar:	0.321				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0701	160	30	2489	441	946	168	946	168
3	0.3508	577	135	2044	429	1451	304	1451	304
4	0.361	346	91	1197	303	1161	294	1161	294
5	0.3038	172	52	690	200	676	196	676	196
6	0.2692	78	24	348	106	348	106	348	106
7	0.3498	153	50	542	176	542	176	542	176
8	0.3498	132	52	467	178	467	178	467	178
Total		1619	434	7777	1833	5591	1422	5591	1422

Year:	2011	F multiplier:	1	Fbar:	0.321				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0701	343	65	5326	944	2024	359	2024	359
3	0.3508	593	138	2100	440	1491	313	1491	313
4	0.361	377	99	1302	329	1263	320	1263	320
5	0.3038	189	57	755	219	740	215	740	215
6	0.2692	104	32	461	140	461	140	461	140
7	0.3498	68	22	241	78	241	78	241	78
8	0.3498	181	71	643	246	643	246	643	246
Total		1854	485	10828	2397	6862	1669	6862	1669

Year:	2012	F multiplier:	1	Fbar:	0.321				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0701	343	65	5326	944	2024	359	2024	359
3	0.3508	1269	296	4493	942	3190	669	3190	669
4	0.361	387	102	1338	338	1298	328	1298	328
5	0.3038	205	62	821	238	805	233	805	233
6	0.2692	113	35	504	153	504	153	504	153
7	0.3498	90	29	319	103	319	103	319	103
8	0.3498	159	62	564	215	564	215	564	215
Total		2566	652	13364	2935	8703	2061	8703	2061

Input units are thousands and kg - output in tonnes

Table 6.8.17. Sole VIIa. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class	2005	2006	2007	2008	2009
Stock No. (thousands) of 2 year-olds	1684	1999	2158	2489	5326
Source	XSA	XSA	XSA	RCT3	GM70-07
Status Quo F:					
% in 2010 landings	11.8	20.5	28.5	13.4	-
% in 2011 landings	5.4	9.5	15.7	45.5	10.0
% in 2010 SSB	13.8	20.7	21.4	11.8	-
% in 2011 SSB	8.4	12.9	19.2	18.7	21.5
% in 2012 SSB	5.0	7.4	11.3	15.9	32.5

GM : geometric mean recruitment

Sole VIIa : Year-class % contribution to

a) 2011 landings

b) 2012 SSB

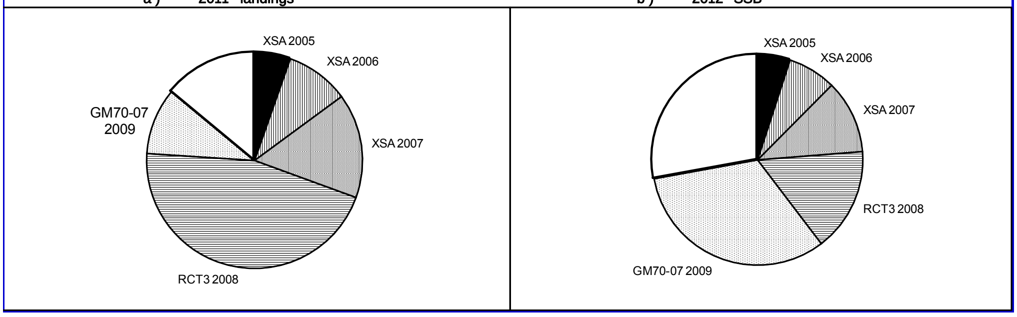


Table 6.8.18. Sole VIIa: Yield-per-recruit.

MFYPR version 2a
Run: s7a
Time and date: 16:09 31/05/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	pwnNosJa	SSBJan	wnNosSp	SSBSpwn
0.0000	0.0000	0.0000	0.0000	10.5083	3.3906	9.5866	3.2151	9.5866	3.2151
0.1000	0.0321	0.2346	0.0783	8.1649	2.5165	7.2470	2.3420	7.2470	2.3420
0.2000	0.0642	0.3736	0.1208	6.7773	2.0056	5.8633	1.8320	5.8633	1.8320
0.3000	0.0963	0.4659	0.1462	5.8574	1.6716	4.9471	1.4989	4.9471	1.4989
0.4000	0.1284	0.5317	0.1625	5.2015	1.4370	4.2947	1.2652	4.2947	1.2652
0.5000	0.1605	0.5812	0.1734	4.7094	1.2637	3.8061	1.0927	3.8061	1.0927
0.6000	0.1926	0.6197	0.1809	4.3261	1.1308	3.4261	0.9605	3.4261	0.9605
0.7000	0.2247	0.6507	0.1862	4.0188	1.0258	3.1221	0.8564	3.1221	0.8564
0.8000	0.2568	0.6761	0.1900	3.7669	0.9411	2.8734	0.7724	2.8734	0.7724
0.9000	0.2889	0.6974	0.1928	3.5566	0.8715	2.6661	0.7035	2.6661	0.7035
1.0000	0.3210	0.7155	0.1948	3.3783	0.8132	2.4907	0.6459	2.4907	0.6459
1.1000	0.3530	0.7310	0.1964	3.2252	0.7639	2.3405	0.5973	2.3405	0.5973
1.2000	0.3851	0.7445	0.1975	3.0923	0.7218	2.2105	0.5558	2.2105	0.5558
1.3000	0.4172	0.7564	0.1983	2.9760	0.6853	2.0969	0.5200	2.0969	0.5200
1.4000	0.4493	0.7669	0.1989	2.8732	0.6535	1.9968	0.4888	1.9968	0.4888
1.5000	0.4814	0.7763	0.1994	2.7818	0.6255	1.9080	0.4614	1.9080	0.4614
1.6000	0.5135	0.7847	0.1997	2.7001	0.6008	1.8287	0.4373	1.8287	0.4373
1.7000	0.5456	0.7923	0.2000	2.6265	0.5788	1.7576	0.4158	1.7576	0.4158
1.8000	0.5777	0.7991	0.2001	2.5599	0.5591	1.6934	0.3967	1.6934	0.3967
1.9000	0.6098	0.8054	0.2002	2.4994	0.5414	1.6353	0.3795	1.6353	0.3795
2.0000	0.6419	0.8111	0.2003	2.4441	0.5254	1.5824	0.3641	1.5824	0.3641

Reference poin	multiplie	Absolute F
Fbar(4-7)	1	0.321
FMax	2.13640	0.6857
F0.1	0.4471	0.1435
F35%SPR	0.4788	0.1537

Weights in kilograms

Table 6.8.19. Sole VIIa: SUM file input to MSY explorations in SRMSYMS.

Stock summary, Sole ,Irish Sea ,17: 1, 31/ 5/2010
12
1 0 0
Year
1970 2009
Recruits, age 2, (thousands)
2 1000
SSB, (tonnes)
1
TSB, (tonnes)
1
Catch, Total (tonnes)
1
Catch, H.cons (tonnes)
1
Not used
1
Not used
1
Mean F, Total
4 7
Mean F, H.cons.
4 7
Not used
0 0
Not used
0 0

1970	3695	6070.9	6708.5	1785	1785	0	0	0.39	0.39	0	0
1971	10180	5895.4	6981.9	1882	1882	0	0	0.44	0.44	0	0
1972	3187	4652.7	5277	1450	1450	0	0	0.45	0.45	0	0
1973	13142	4830.9	6141.7	1428	1428	0	0	0.43	0.43	0	0
1974	5876	4707.1	5697.2	1307	1307	0	0	0.444	0.444	0	0
1975	6690	4963.2	5704.7	1441	1441	0	0	0.395	0.395	0	0
1976	3862	4508.5	5035.7	1463	1463	0	0	0.427	0.427	0	0
1977	15821	3946.7	4610.1	1147	1147	0	0	0.369	0.369	0	0
1978	9090	4497.8	5383.2	1106	1106	0	0	0.357	0.357	0	0
1979	8947	5241.2	6326.8	1614	1614	0	0	0.473	0.473	0	0
1980	5132	5218.7	6077.7	1941	1941	0	0	0.633	0.633	0	0
1981	4599	4930.7	5641.3	1667	1667	0	0	0.475	0.475	0	0
1982	2563	4003.1	4342	1338	1338	0	0	0.432	0.432	0	0
1983	5898	3996.4	4817.7	1169	1169	0	0	0.423	0.423	0	0
1984	15874	4497.3	6555.1	1058	1058	0	0	0.336	0.336	0	0
1985	16320	5334.8	7257.3	1146	1146	0	0	0.313	0.313	0	0
1986	23828	6464.3	8634.3	1995	1995	0	0	0.4	0.4	0	0
1987	3439	6802.6	8068.8	2808	2808	0	0	0.735	0.735	0	0
1988	3535	5366.5	5781	1999	1999	0	0	0.521	0.521	0	0
1989	4370	4396.9	4870.3	1833	1833	0	0	0.534	0.534	0	0
1990	5509	3382.7	3981.9	1583	1583	0	0	0.644	0.644	0	0
1991	12495	2924.8	4015.1	1212	1212	0	0	0.501	0.501	0	0
1992	4846	3136.6	4036.4	1259	1259	0	0	0.537	0.537	0	0
1993	6129	2850.1	3324.2	1023	1023	0	0	0.54	0.54	0	0
1994	5231	3710.2	4580.9	1374	1374	0	0	0.509	0.509	0	0
1995	2014	3100.9	3468	1266	1266	0	0	0.535	0.535	0	0
1996	2514	2431.7	2759.8	1002	1002	0	0	0.56	0.56	0	0
1997	7978	2192.6	2975.4	1003	1003	0	0	0.643	0.643	0	0
1998	6648	2752.4	3864.8	911	911	0	0	0.499	0.499	0	0
1999	5887	3020.6	3972.7	863	863	0	0	0.469	0.469	0	0
2000	5905	2716.1	3436.6	818	818	0	0	0.578	0.578	0	0
2001	3882	3584.6	4325.5	1053	1053	0	0	0.344	0.344	0	0
2002	2771	3381.8	3833.2	1090	1090	0	0	0.431	0.431	0	0
2003	3038	3014.5	3371.9	1013.9	1013.9	0	0	0.384	0.384	0	0
2004	3212	2376.4	2854.4	709	709	0	0	0.293	0.293	0	0
2005	3161	2029.1	2588	855	855	0	0	0.564	0.564	0	0
2006	1684	1617.8	1988.4	569	569	0	0	0.516	0.516	0	0
2007	1999	1491.6	1855.5	492	492	0	0	0.358	0.358	0	0
2008	2158	1213.8	1568.8	332	332	0	0	0.324	0.324	0	0
2009	2397	1183.3	1513.8	324	324	0	0	0.28	0.28	0	0

Table 6.8.20. Sole VIIa: SEN file input to MSY explorations in SRMSYMS.

```
 Input to sensitivity analysis, SOL,7A
  2,  8, 2010,  3
  1, 0, 0
 'N2'  ,      5326, 0.64
 'N3'  ,      2044, 0.35
 'N4'  ,      1196, 0.23
 'N5'  ,       690, 0.20
 'N6'  ,       348, 0.20
 'N7'  ,       542, 0.17
 'N8'  ,       466, 0.17
 'sH2' ,     0.070, 0.28
 'sH3' ,     0.351, 0.16
 'sH4' ,     0.361, 0.21
 'sH5' ,     0.304, 0.20
 'sH6' ,     0.269, 0.14
 'sH7' ,     0.350, 0.20
 'sH8' ,     0.350, 0.20
 'WH2' ,     0.190, 0.17
 'WH3' ,     0.233, 0.08
 'WH4' ,     0.263, 0.09
 'WH5' ,     0.301, 0.06
 'WH6' ,     0.308, 0.14
 'WH7' ,     0.328, 0.17
 'WH8' ,     0.392, 0.16
 'WS2' ,     0.177, 0.14
 'WS3' ,     0.210, 0.14
 'WS4' ,     0.253, 0.07
 'WS5' ,     0.290, 0.06
 'WS6' ,     0.304, 0.10
 'WS7' ,     0.324, 0.13
 'WS8' ,     0.382, 0.16
 'M2'  ,      0.10, 0.10
 'M3'  ,      0.10, 0.10
 'M4'  ,      0.10, 0.10
 'M5'  ,      0.10, 0.10
 'M6'  ,      0.10, 0.10
 'M7'  ,      0.10, 0.10
 'M8'  ,      0.10, 0.10
 'MT2' ,      0.38, 0.10
 'MT3' ,      0.71, 0.10
 'MT4' ,      0.97, 0.10
 'MT5' ,      0.98, 0.10
 'MT6' ,      1.00, 0.10
 'MT7' ,      1.00, 0.00
 'MT8' ,      1.00, 0.00
 'R11' ,      5326, 0.64
 'R12' ,      5326, 0.64
 'HF10',         1, 0.12
 'HF11',         1, 0.12
 'HF12',         1, 0.12
 'K10' ,         1, 0.10
 'K11' ,         1, 0.10
 'K12' ,         1, 0.10
Sole
Irish Sea
                 1
  2  8  1
                 1
H.cons.
  4  7
 1970      2009
 Stock numbers in 2010 are VPA survivors.
                -1
```

Table 6.8.21. Sole VIIa: Estimates of biomass and fishing mortality reference levels derived from the fit of three stock and recruit relationships and the yield-per-recruit F_{msy} proxies.

Stock name
Sol-7a
Sen filename
sol7a.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
691/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.48	0.18	6,483	1,174	0.63	0.72	2.18	0.000118357	75.04
Mean	0.47	0.17	37,151	4,372	0.65	0.71	2.29	0.000117529	
5%ile	0.22	0.09	3,318	702	0.48	0.16	1.49	2.67E-05	
25%ile	0.30	0.12	4,732	1,000	0.57	0.42	1.78	6.87E-05	
50%ile	0.40	0.16	6,866	1,292	0.65	0.66	2.13	0.000108706	
75%ile	0.53	0.20	10,611	1,667	0.72	0.95	2.57	0.000156316	
95%ile	0.94	0.30	27,814	3,535	0.82	1.48	3.70	0.000244428	
CV	0.63	0.38	14.07	10.85	0.17	0.55	0.31	0.55	

Beverton-Holt
669/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.49	0.12	11,657	1,444	0.73	1.50	13865	6306	75.50
Mean	0.58	0.10	49,698	2,525	0.80	1.56	27870	17232	
5%ile	0.20	0.02	3,713	661	0.12	1.23	6646	1424	
25%ile	0.31	0.07	6,802	996	0.45	1.40	8961	2993	
50%ile	0.43	0.10	12,000	1,380	0.79	1.54	12894	5753	
75%ile	0.65	0.14	39,614	2,412	1.14	1.72	22390	12677	
95%ile	1.57	0.21	206,140	8,013	1.53	1.96	86895	60872	
CV	0.87	0.55	2.40	1.46	0.55	0.15	2.07	2.57	

Smooth hockeystick
691/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.31	0.31	4,093	1,201	0.45	1.07	0.76	4090.96	72.07
Mean	0.28	0.24	7,253	1,256	0.47	1.11	0.78	4232.701592	
5%ile	0.16	0.04	3,087	824	0.38	0.77	0.63	2942.24	
25%ile	0.22	0.19	3,926	1,041	0.42	1.00	0.71	3792.365	
50%ile	0.28	0.25	4,377	1,220	0.46	1.10	0.77	4181.98	
75%ile	0.32	0.30	5,142	1,429	0.50	1.21	0.84	4616.67	
95%ile	0.42	0.40	30,279	1,847	0.58	1.53	0.97	5829.76	
CV	0.30	0.39	1.47	0.25	0.16	0.20	0.16	0.20	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.15	0.12	0.14	0.68	0.66	0.19	0.3	0.4
Mean	0.14	0.12	0.14	0.76	1.11	0.19		
5%ile	0.00	0.00	0.00	0.04	0.54	0.14		
25%ile	0.06	0.05	0.06	0.37	0.61	0.17		
50%ile	0.14	0.12	0.14	0.59	0.68	0.19		
75%ile	0.22	0.18	0.21	0.96	0.76	0.22		
95%ile	0.29	0.23	0.27	2.10	4.91	0.26		
CV	0.69	0.69	0.65	0.79	1.42	0.19		

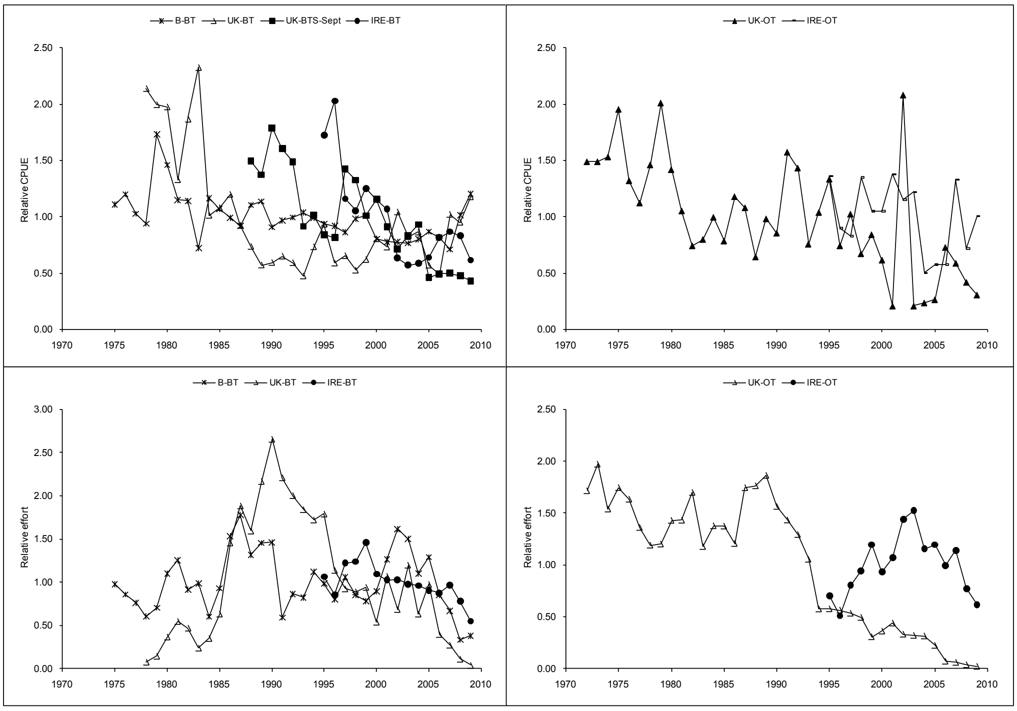


Figure 6.8.1. Sole in VIIa. Relative cpue and effort-series for beam trawlers from Belgium (B-BT), the UK (UK-BT) and Ireland (IRE-BT); for otter trawlers from the UK (UK-OT) and Ireland (IRE-OT); and cpue series for the UK (EandW) September beam trawl survey (UK-BTS-Sept).

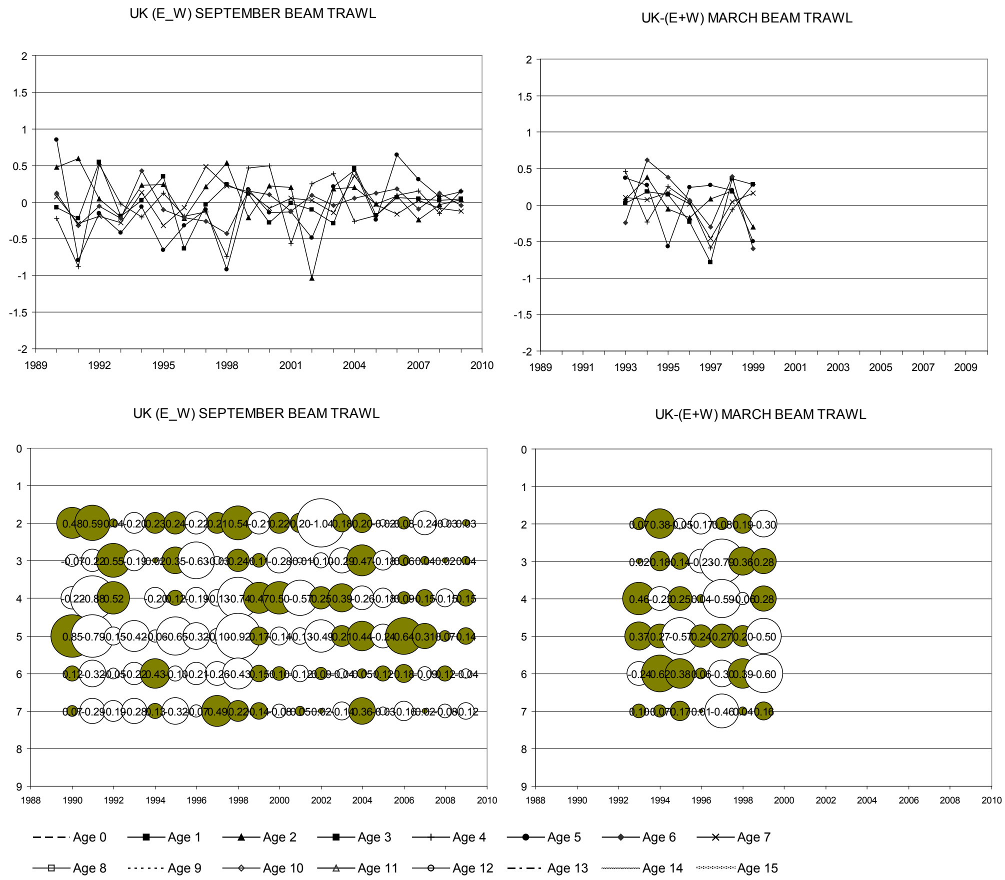


Figure 6.8.2. Sole in VIIa. Catchability residuals of final XSA run.

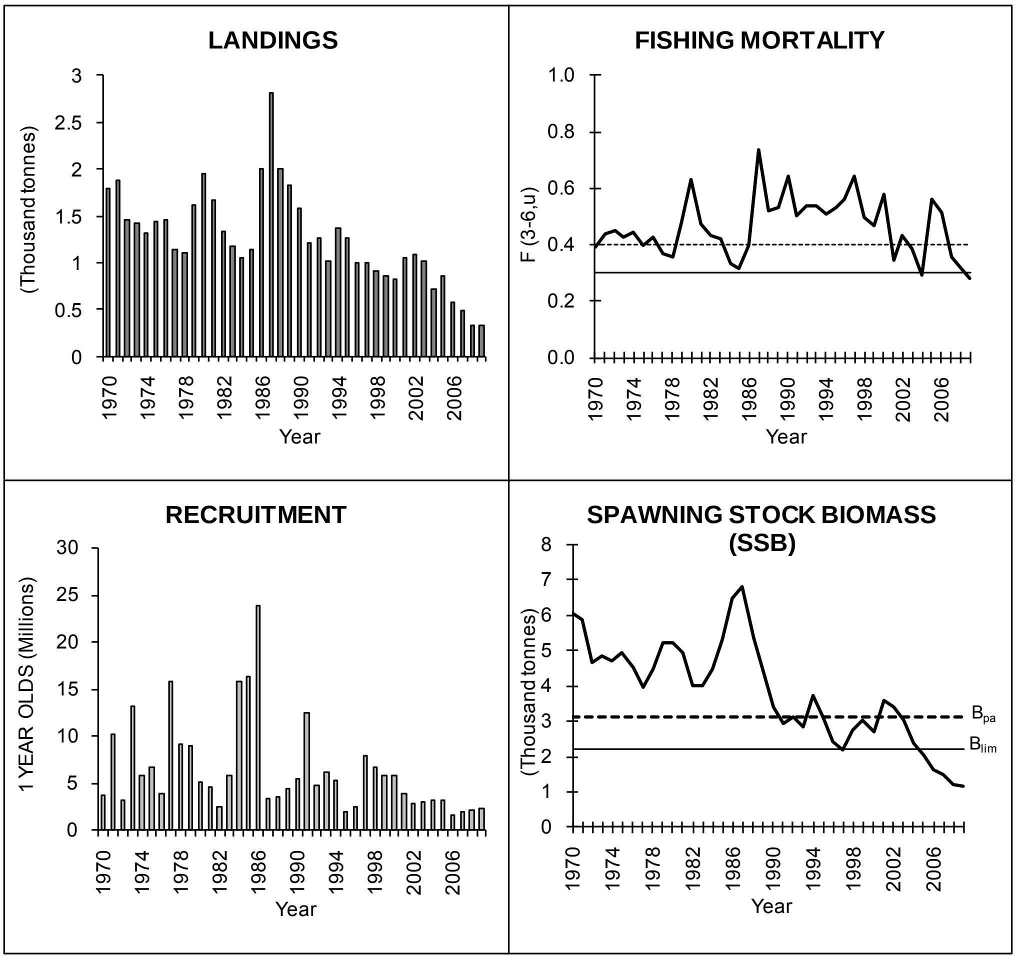


Figure 6.8.3. Sole in VIIa. Summary (B_{lim} = 2200 t, B_{pa} = 3100 t, F_{lim} = 0.4, F_{pa} = 0.3).

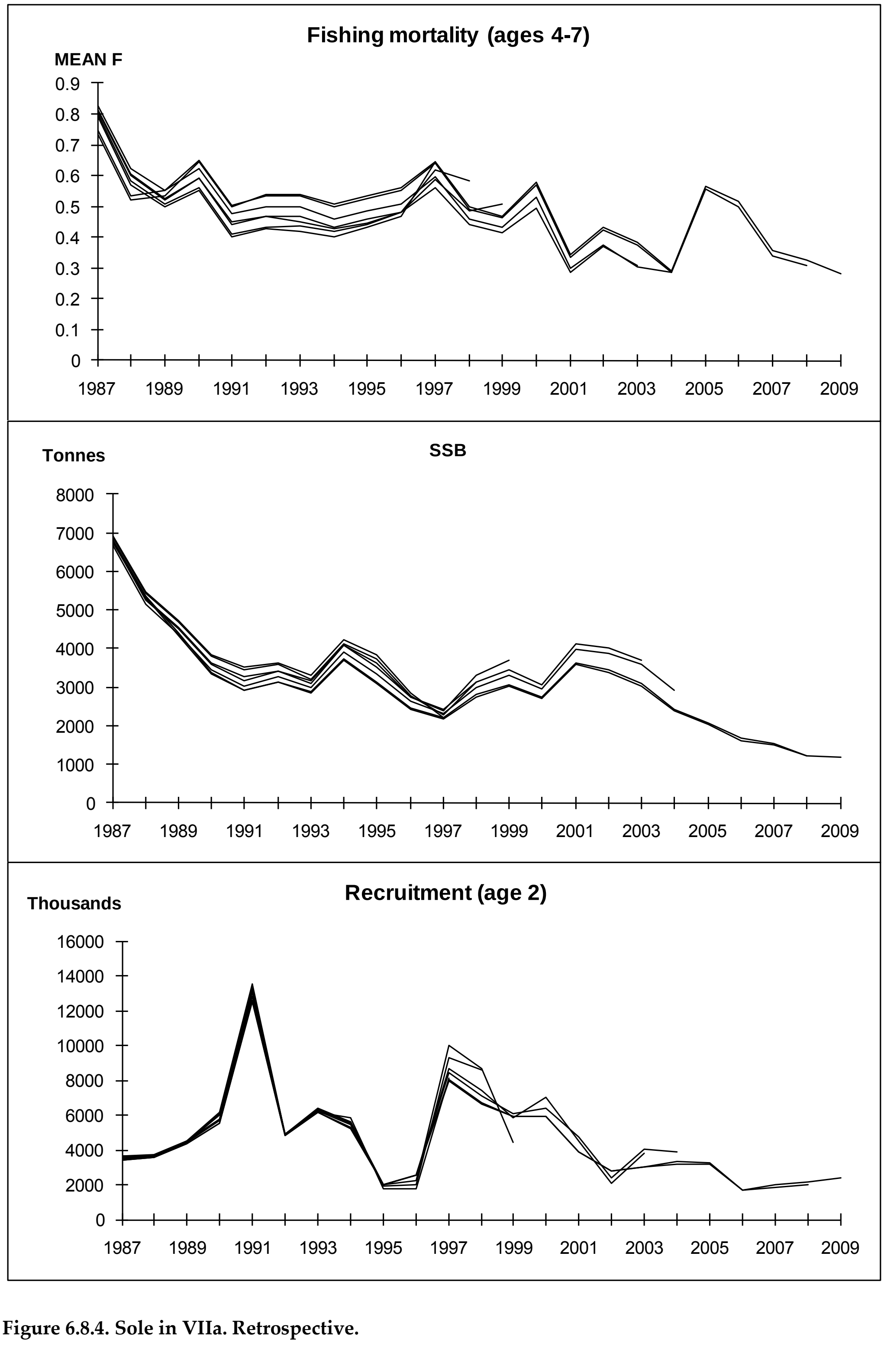


Figure 6.8.4. Sole in VIIa. Retrospective.

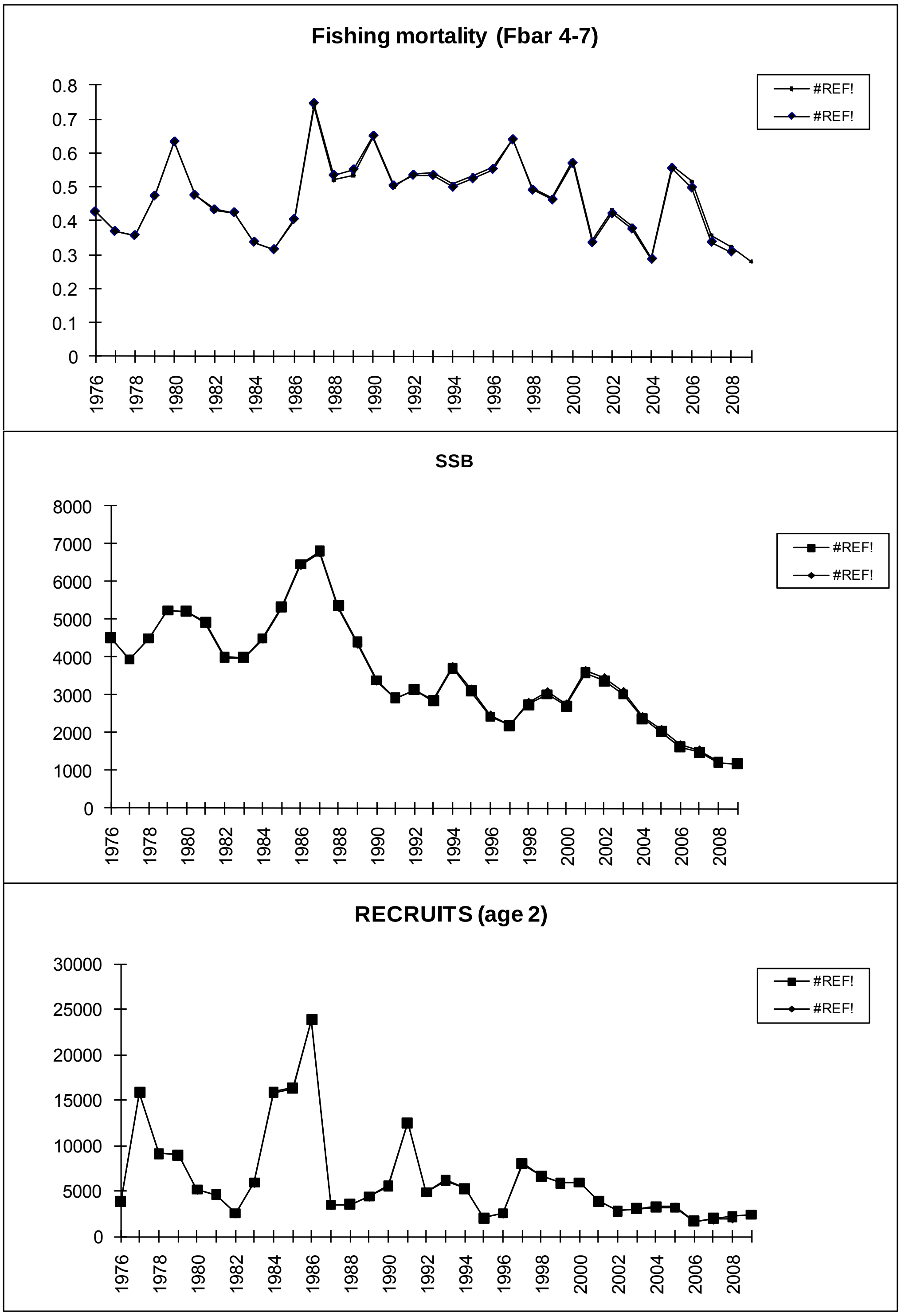


Figure 6.8.5. Sole in VIIa. Comparison of trends in Recruitment, SSB and Fishing Mortality from last year's (WG2009) and this year's final assessment (WG2010, same procedure as last year incl. an additional datayear).

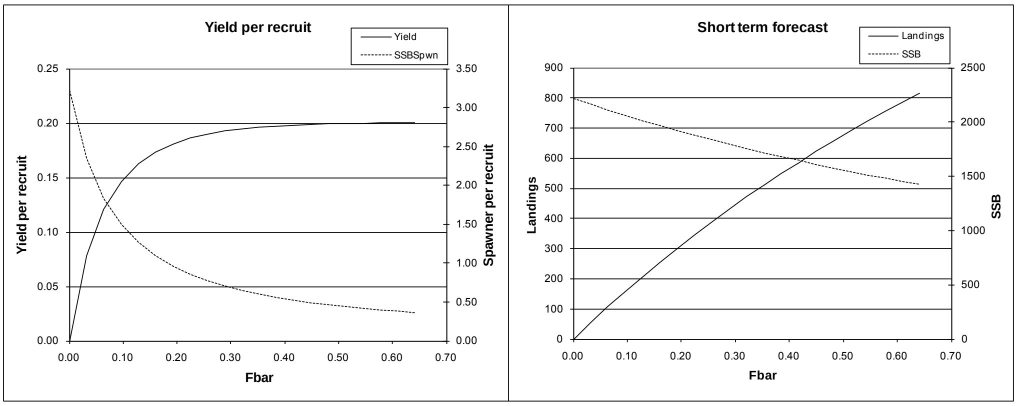


Figure 6.8.6. VIIa Sole : Yield-per-recruit and short-term forecast results.

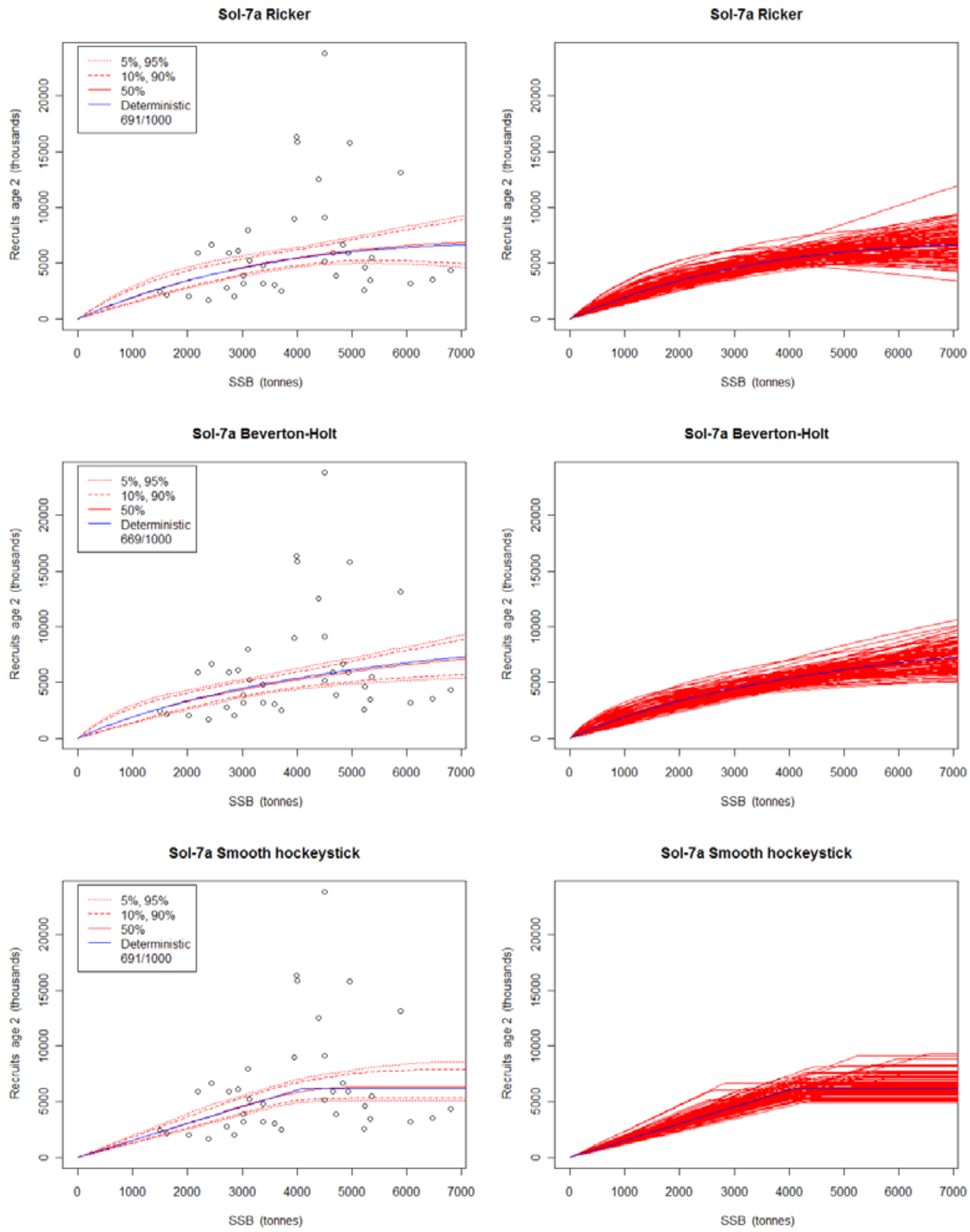


Table 6.8.7. VIIa Sole : MSY fitted stock and recruit relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{msy}. Right hand panels: curves plotted from the first 100 MCMC re-samples with converged F_{msy} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

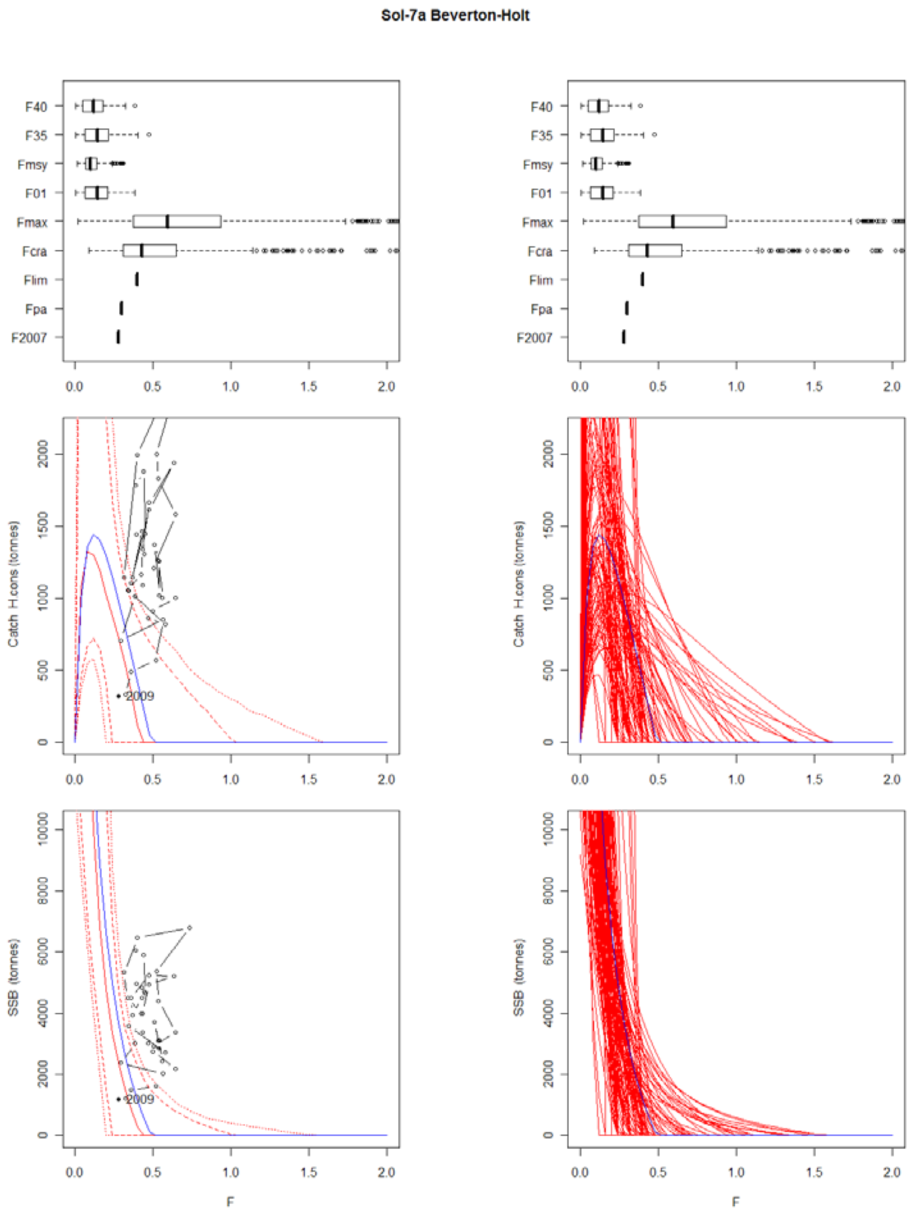


Table 6.8.8. VIIa Sole : Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Beverton and Holt stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

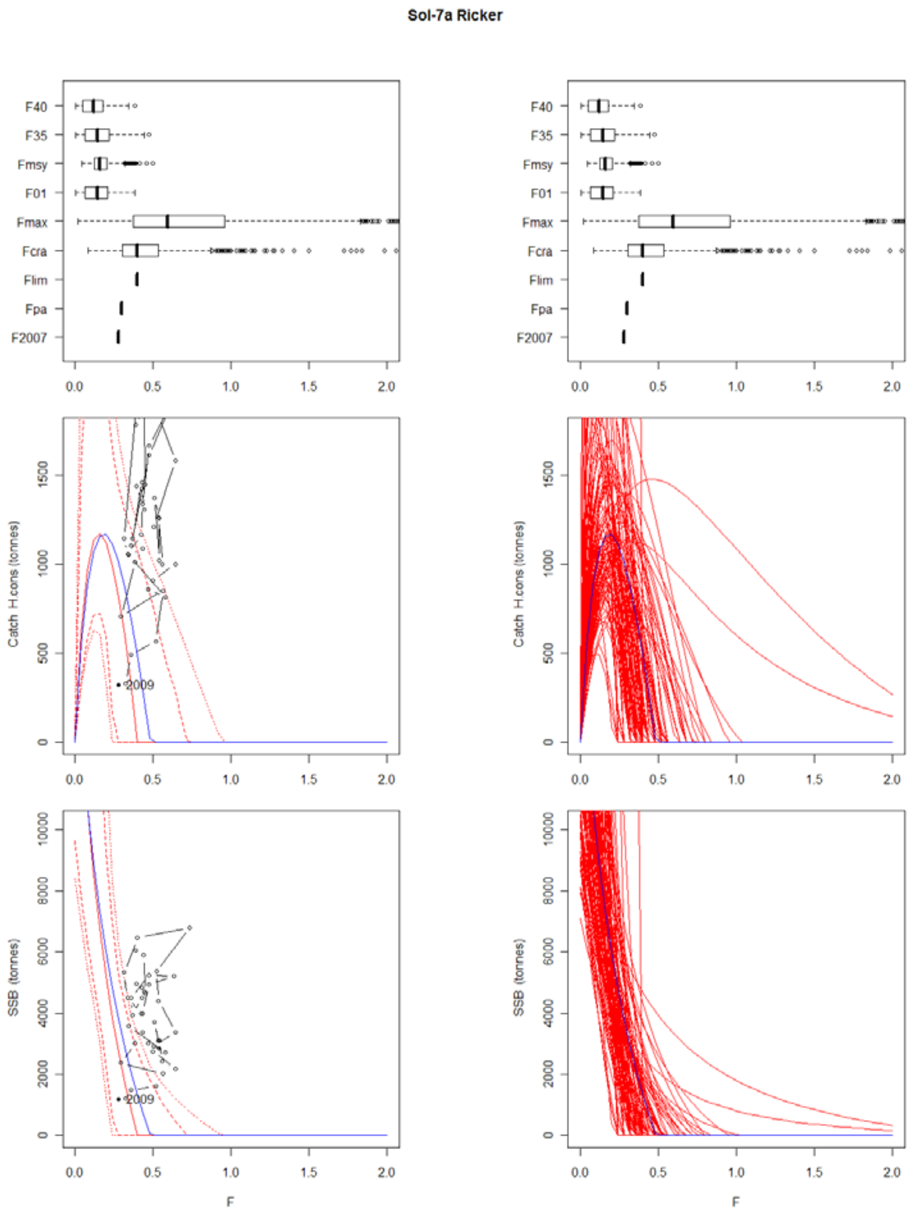


Table 6.8.9. VIIa Sole: Estimates of F reference points and equilibrium yield and SSB against fishing mortality using a Ricker stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

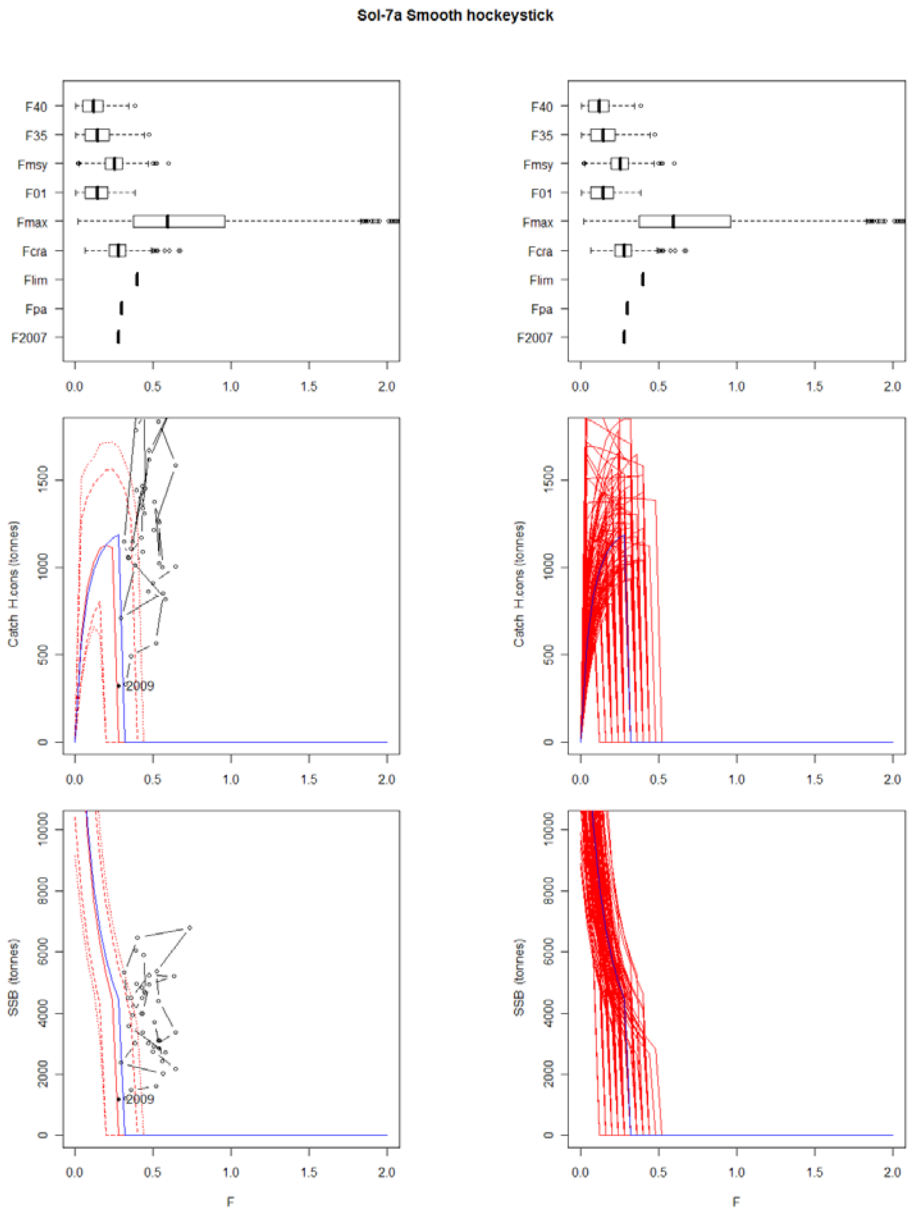


Table 6.8.10. VIIa Sole: Estimates of F reference points and equilibrium yield and SSB against fishing mortality using a Hockey Stick and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

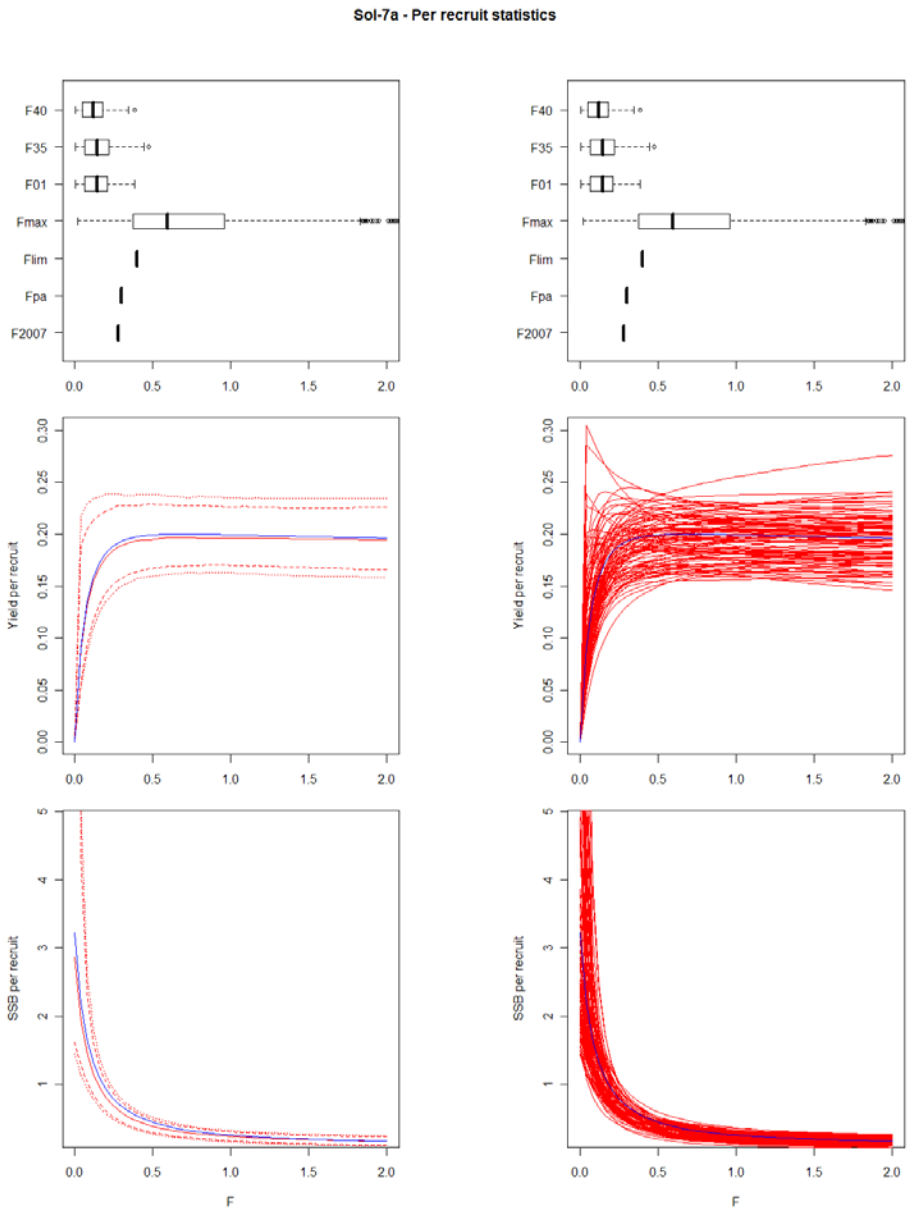


Table 6.8.11. VIIa Sole: Fitted yield-per-recruit F reference points, yield-per-recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.

7.1 Celtic Sea overview

There is no overview.

7.2 Cod in Division VIIe-k (celtic Sea)

Type of assessment in 2010

Trends analysis

For Celtic Sea cod, the Benchmark Workshop WKROUND 2009 concluded that more work was required before this stock could be benchmarked. The Review Group of WGCSE 2009 added that shortcomings of the data and reconstruction of datasets should be completed in order to continue using an aged based assessment in future.

The recommendations made by WKROUND 2009 were:

- Improvement of the quality of assessment input data, of documentation on data correction in the Stock Annex and data integration and fishery description at regional level through a regional database.
- Evaluation of sampling levels by fleet required to get precise discard estimates for stock assessment. The RG concurred with the conclusion drawn by the Benchmark that cooperative projects with industry on self sampling, and reference fleets, etc should be developed to obtain better estimates of discards. Datasets obtained through fishers science partnerships should be used to complement those discard data collected by fishery observers.
- Estimates of "true landings" as reported landings data and landings equivalents since 2003 are thought to be underestimated.
- International coordination on maturity sampling as there is evidence that maturity has changed for this stock. A directed survey might be needed.
- Improvement on knowledge on stock structure and migration behaviour.
- Reduction of noise in the data from the surveys.

Solutions to those recommendations have been suggested by WGCSE in last year's Report. No new development has been presented to the Working Group this year. Some effort to improve the knowledge on this stock is currently done through survey and industry–science partnerships. Those initiatives are summarized later in this section.

ICES advice applicable to 2009

"Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality is estimated at 0.67, which is well above the range that would lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits

The exploitation boundaries in relation to precautionary limits imply landings of less than 2600 t in 2009, which is expected to rebuild SSB to the Bpa (= 8800 t) in 2010.

Conclusion on exploitation boundaries

ICES recommends a 50% reduction in fishing mortality which is associated with landings in 2009 of 2600 t; the SSB is then expected to reach B_{pa} in 2010. This fishing mortality also corresponds to high long-term yield and low risk of stock depletion."

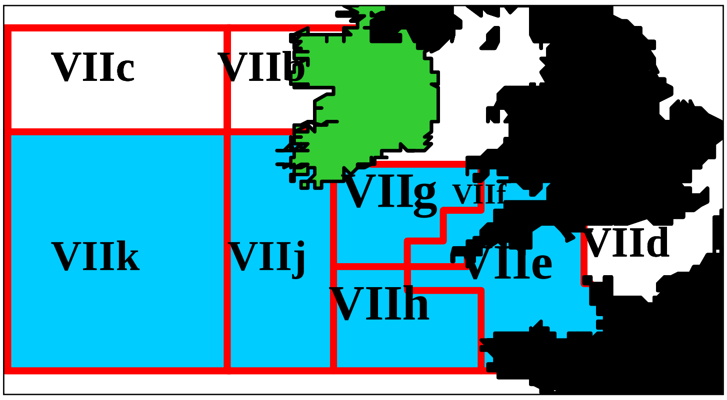
ICES advice applicable to 2010

"ICES advises on the basis of precautionary considerations that fishing effort and catches should be reduced although it is not possible to determine the appropriate scale of such reduction."

7.2.1 General

Stock description and management units

The 2010 TAC was set for ICES Areas VIIb–c, VIIe–k, VIII, IX, X, and CECAF 34.1.1(1), excluding VIId. This is more representative of the stock area than in the previous years as the cod population in VIId is more relevant to the North Sea population but landings from VIIbc are not included in the assessment area (see Section 7.3 for these).



Red Boxes-TAC/Management Areas **Blue Shading– Assessment Area.**

Management applicable to 2009 and 2010

TAC 2009

Species: Cod *Gadus morhua*		Zone: VIIb-c, VIIe-k, VIII, IX and X; EC waters of CECAF 34.1.1 (COD/7XAD34)
Belgium	167	
France	2 735	
Ireland	825	
The Netherlands	1	
United Kingdom	295	
EC	4 023	
TAC	4 023	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC 2010

Species: Cod *Gadus morhua*		Zone: VIIb, VIIc, VIIe-k, VIII, IX and X; EU waters of CECAF 34.1.1 (COD/7XAD34)
Belgium	167	
France	2 735	
Ireland	825	
The Netherlands	1	
United Kingdom	295	
EU	4 023	
TAC	4 023	Analytical TAC

Fishery in 2009

Landings data used by the WG are shown in Table 7.2.1. The Irish landings in 2008 were revised upward by 11 t to 1221 t. No revision was required for UK and Belgium.

French landings were very preliminary this year due to some major changes in the administrative processing of the data for all French fisheries. Data compilation showed strong evidence that official available landings were very partial (around 30% of French quota) and well below the landings reported by the French fishing organizations involved in the cod fishery (75% of the French quota). Quality checks of the industry data for 2009 based on the fishing activity per quarter during the period 2006–2008, suggests the industry data are the best estimates of the French landings for 2009. Subsequent estimates and raising, when possible, were based on the industry dataset. French landings in 2009 will be revised accordingly with official data whenever possible. However, French landings indicate that only 72% of the national quota has been taken. This is mainly related to 1) decommissioning of a substantial number of vessels in 2009 , 2) low fish market prices for cod landings which led the vessels to direct their fishing effort towards other demersal species (e.g. haddock).

International landings have decreased in 2008 (3600 t) and 2009 (3200 t) after the 2007 peak of 4200 t, which corresponded to approximately half of the average (8200 t) of the time-series. They are now close to their lowest historical values. Since 1988, French landings accounted for ~70% of the international landings and they have declined to around 58% of the total in the recent years. Irish landings accounted on average at 14% but more recently ~28%. UK and Belgium have contributed on average to 9% and 4%.

There is no information on the absolute level of misreporting for this stock but there is evidence that misreporting has increased from 2002 when quotas became restrictive. Irish landings data in some years have been corrected for area misreporting into the southern rectangles of VIIa. These misreporting estimates are summarized in table below.

Year	2004	2005	2006	2007	2008	2009
Mis alloc (t)	108	54	103	514	558	55

French landings have been corrected with high grading estimates from 2003 to 2005. The method used to estimate the high graded component is described in WD#1 of the WG SSDS 2006. For smaller length classes, a scaling of French numbers-at-length based on UK length frequencies or UK number-at-length has been used to estimate length compositions of the French component of high grading. The accuracy of this method is unknown but it probably underestimates the high-grading levels for those years. Unfortunately, the sampling level of total catch at sea in that period was too poor to get an estimate of the level of bias.

This method was not applied from 2006 onward because high grading was also observed in the UK landings. Instead, self sampling data obtained in 2008–2009 have been used to estimate the French high grading level, assuming that the discarding practices in 2006–2007 were the same as those observed in 2008 for the main self-sampled fleet. Applying this method back to 2003 was considered inappropriate. The representatives of Fishermen Organisations at WKROUND 2009 indicated that the discarding level was probably not the same in earlier years as high-grading practices are linked to the level of the TAC. The whole method has been described in the WD#17 of WKROUND 2009.

The estimates of high-grading by year are slightly revised when annual landings statistics are updated. In 2010, the time-series of estimates is:

Year	2003	2004	2005	2006	2007	2008	2009
HG (t)	210	148	74	432	592	322	25

In 2009, the low estimate of high-grading is likely to be related to the French vessels not being restricted by quota because of the decommissioning plan and the reports of effort directed towards more profitable species.

Both assumed Irish area misreporting and French high grading estimates since 2003 in percentages of the landings are summarized in the table below:

Year	2003	2004	2005	2006	2007	2008	2009
%	3	7	4	17	30	29	2

High-grading also occurred in the UK catches in 2007–2008 but given the low level of landings, it has not been estimated.

The MLS of the Belgian landings is currently set at 40 cm.

Fishery-science partnerships

French self-sampling programme

In 2009, the French self-sampling program has been extended to several "métiers". The programme is voluntary under the auspices of the main Fishermen Organization P.M.A (Pêcheurs de Manche et Atlantique). In 2009, six otter trawlers have participated, providing data for métiers targeting either gadoids (OTB or OTTPD), *Nephrops* (OTTLN) or benthic species such as monkfish, megrim, rays , john dory (OTB or OTTPB). 38 trips were sampled in 2008 and 86 in 2009, summarized in the text table below. Because the sampling program is on voluntary basis, the métier targeting benthic species has been strongly sampled (43 trips by one trawler) though its contribution to the cod catches or landings is generally small.

Gear Code	Q1	Q2	Q3	Q4	Total	Métier
OTBPB	7	15	14	7	43	BENTH= OTBPB+OTTPB
OTBPD	6	5			11	GADI= OTBPD+OTTPD
OTTLN	1	3	1		5	NEPH= OTTLN
OTTPB	1		3	2	6	
OTTPD	8	6	5	4	23	
Total	23	29	23	13	88	

Several metiers can be fished during a single trip by changing fishing grounds (from fish to *Nephrops* for instance). Métiers have been identified by targeted species indicated by the skippers for each haul carried out.

2883 hauls have been sampled from 6022 carried out in the trips involved in the self-sampling programme. The sampling level for the Gadoid métier has fluctuated between 34 and 49% of hauls carried out. There is no sampling in the first quarter from the *Nephrops* trawlers because the methodology was more difficult and more time consuming to use in hauls where fish and *Nephrops* were always mixed. Results were better during the *Nephrops* season (Q2&3) and poor in quarter 4 because of the heavy sea conditions. The number of hauls carried out and sampled is indicated in the text table below.

Métier	Q1	Q2	Q3	Q4	Total
BENTH Total	925	960	669	307	2861
BENTH sampled	231	559	501	266	1557
GADI Total	1147	1164	446	294	3051
GADI sampled	393	545	189	145	1272
NEPH Total	31	45	34	3*	110
NEPH sampled	0	29	24	1	54
three hauls targeting *Nephrops* in a GADI trip					

Retained and discarded part of the catch have been scrutinized in each haul sampled. Overall 17 215 cod have been measured, 15 310 belonging to the retained part and 1905 to the discarded part.

In 2010, the self-sampling programme is continuing and the sampling data are input by the Professional Organization (P.M.A) in a database currently located at Ifremer/Lorient. Motivation of the crew or the vessel owners could be a problem in future. The reasons are that 1) the effort of the industry to provide more biological data is not linked with incentives in setting TAC and quotas, 2) there has been in 2009 a pragmatic fit between the quota set and the fleet effort by change of métier or decommissioning which led to an under-consumption of the agreed quota, 3) the data collected by self-sampling have not been analyzed and used adequately because of the lack of official fisheries statistics data to raise properly the sampling data.

Ireland–UK tagging programme in the Irish and Celtic Seas

The tagging programme focuses on both nursery areas and spawning aggregations of cod in the Irish and Celtic Seas, and involves conventional (plastic) tags and sophisticated electronic data storage tags. The programme in the Celtic Sea commenced in 2007 and is ongoing. The main objectives are to examine the movements of cod in relation to closed areas and in respect to stock mixing; to determine fine-scale movements and behaviour of cod during spawning; to examine vertical distribution (in relation to catchability) and thermal experiences (in relation to gonad development). Results of tagging work to date was presented to the ICES ASC in 2009 (Bendall *et al.*, 2009). These results describe fundamental features of cod spatial ecology in the Irish and Celtic Sea, such as the location of feeding and spawning grounds (and the migratory pathways between them), the seasonality of migration and habitat occupation and the potential impact upon substock structure. Recaptures to date of juvenile cod tagged in the south of VIIa (Waterford estuary) shows that the majority of recaptures have occurred in VIIg mainly (O'Cuaig, Pers. comm.)

Irish industry–science partnership quarter 1 cod survey

ICES (2009) notes that "given the uncertainty in the landings, the surveys represent the main source of information for estimating the historical trends in the stock." However, the current IBTS survey is conducted in quarter 4 when the stock is widely dispersed resulting in poor ability to track abundance due to low catch rates. ICES notes that "changing the surveys' design or programming additional stations are not thought to be relevant solutions, given the implications on other survey objectives" and ICES (2009) conclude that "adding a survey in quarter 1 would be the best solution, in order to monitor both the concentration of fish and the maturity during the spawning period." In recognition of this advice, the Marine Institute and the Federation of Irish Fishermen, in 2010 initiated an annual Q1 fishery independent survey for Celtic Sea Cod. The survey uses a commercial vessel and a dedicated survey trawl specification, based on a commercial design and in accordance with the criteria laid down in the ICES Study Group on Survey Trawl Standardisation (SGSST, 2009). The survey stations (Figure 7.2.1) are based on both Irish and foreign fleet VMS and/or logbook data. Using the VMS and logbook data, the Celtic Sea has been divided into areas of low, medium and high commercial catches and the survey sites have been randomly selected within these three categories (survey strata) with around 50% of the effort in the high areas and 30 and 20% in the medium and low (Figure 7.2.1). The data from the first survey is currently being worked up and will be presented to the WGCSE in 2011.

7.2.2 Data

Landings

Tables 7.2.2 and 7.2.3 show the annual length structure of the landings per métier and country and the catch numbers-at-age respectively.

It is noticeable that this stock has always been composed of a few age classes. The catch number-at-age table (Table 7.2.3) shows the catch-was mainly composed of age 2 during the last 5 years. In 2009 the proportion of 2 year old fish is comparatively low and ages 3, 4, and 5 are higher than those observed since 2005.

Discards

Table 7.2.4 and Figure 7.2.2a–c show the length structure of landings and discards per country and quarter with a split by métier for France (No 2009 update for France was available at the time of the meeting). French information is split into self-sampling (Figure 7.2.2d) and on-board observer programmes, noting that the latter is incomplete, because validation of some trips is still ongoing. It is noticeable that the majority of the cod discarded result from the high-grading behaviour, for France and UK. Discarding of undersized individuals is at low level for all countries.

Biological

Catch in numbers-at-age (Figure 7.2.3) and stock weights are given respectively in Tables 7.2.5, 7.2.6. The final year estimates are consistent with the recent historical values.

Natural mortality, percentage of F before spawning and maturity ogive remained unchanged and are described in the Stock Annex. Celtic Sea cod are very fast growing and early maturing compared with more northern cod stocks.

Surveys

Tables 7.2.7 present the survey dataseries.

Internal consistency of the two ongoing surveys (FR-EVHOE & IR-GFS7gj combined) has been explored using SURBA software. The number of fish sampled during those surveys remains low as those species are not specifically targeted.

The raw abundance indices (number of individuals caught per 30 minutes tow) of FR-EVHOE have been provided to the WG. Indices have an average CV of around 25% and have changed since 2002 within the confidence intervals (bottom right of Figure 7.2.4a). CV were calculated taking account the surface of each stratum, total surface, sample mean catch per tow, variance of the catch and number of tow for each stratum according to the method in Cochran (1979).

Figure 7.2.4a summarises the single fleet analysis for FR-EVHOE. The tracking of recruitment is well defined for the relatively good YC 1996, 1999 and 2000, and poor YC 2001 and 2002, especially at age 1. The weakness seems to be in-between year consistency especially for the older ages. The log residuals show a low level of noise, resulting from the recurrent low catch rates.

Figure 7.2.4b represents the single fleet analysis for IR-GFS7gj. The short time-series prevents conclusions on the consistency, but the tracking of recent year classes is consistent with FR-EVHOE except for the 2007 YC.

The former UK-WCGFS was also included in the analysis to smooth the signal when looking at historical trends in the stock (Figure 7.2.4c).

Figure 7.2.4d represents SURBA model estimates of mean Z for the three single fleets. Each time-series of Z fluctuates within the magnitude of the uncertainty, resulting in non-robust general trends. Moreover, SURBA is known to provide poor estimates of parameters for the most recent years. As a result, no clear trend can be seen from the surveys.

Figure 7.2.4e shows the comparative analysis of the age 1 index from the FR-EVHOE survey and the estimates of recruitment from a Separable VPA summary. FR-EVHOE has demonstrated some ability to predict the level of expected recruitment but the recruitment indices have been diverging in recent years reflecting higher rates of discarding and high-grading in the catch data.

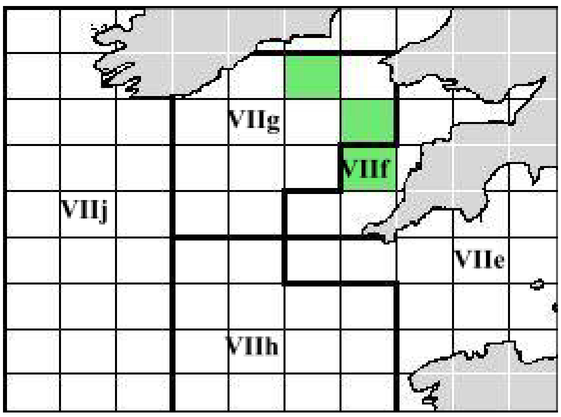
Overall, no clear trend of change in biomass or mortality can be derived from any of the survey indices.

Commercial cpue

Tables 7.2.8a, b and c show the series of landings, fishing effort and lpue dataseries for four French fleets, three UK fleets and eight Irish fleets. Figure 7.2.5a and b show their trends. French catch and effort data for 2009 were not available at the time of the meeting. A general decrease in the lpue trend is observed in almost all series between 1990 and 2004, where the TAC began to be constraining. From that point, the lpues seemed to stabilize, or even to increase if high grading is taken into account.

Different features are observed in the effort time-series. The métiers showing the highest levels of cod directed effort have decreased significantly in the last 5–10 years. Irish otter shows an increasing trend over the period, the majority of this effort is directed towards *Nephrops*.

A special effort has been made during the 2009 WG to combine international landings and effort datasets and produce historical distribution maps. These maps are respectively composed of France, UK, Ireland and Belgium landings (Figure 7.2.6), France and Ireland efforts (Figure 7.2.7) and lpue (Figure 7.2.8). The data are not corrected for misreporting or high-grading. The main outcome of these maps is the shrinking of the geographical area of the stock over the years. This is particularly visible in the distribution of the landings (Figure 7.2.6). The perceived decrease of landings over time is to be regarded with caution given the recent levels of misreporting and high-grading. The rectangles temporarily closed (30E4, 31E4 and 32E3) since 2005 were clearly among the most important in terms of lpue.



Green: Trevose closed areas.

7.2.3 Stock assessment

Model used: None.

No analytical assessment has been carried out on this stock, following the recommendations from WKROUND 2009 and the lack of revision of the available datasets.

Exploratory analysis on the MSY approach

Following the guidelines defined during WKFRAME, some exploratory work has been done on this stock in an attempt to define MSY indicators. The main issue for this stock is the lack of assessment due to the quality of recent data. Therefore, the range of methods is limited and this analysis can only be classified as exploratory.

As suggested by WKFRAME for stocks with age and length, YPR has been used to explore the expected yield under equilibrium conditions, of growth, maturity and natural mortality, for a given or assumed fishery pattern, across a range of exploitation levels.

YPR (http://nft.nefsc.noaa.gov/) requires age-structured data which were provided from the updated dataset that are used for the exploratory VPA (Table 7.2.9). Data were checked against the trends in the last ten years as well as over the full time-series. The age structure for cod has not experienced substantial changes through time except in abundance. Analyses from both 10 and 38 years long time-series (1991–2009) show a total mortality respectively between 1.05 and 1.02 (Figure 7.2.9).

With a natural mortality of M=0.2, assuming a fishing mortality between 0.82 and 0.85, the fishing mortality appears twice above the value of F_{max} and three times the value of $F_{0.1}$ and $F_{40\%.}$

	F	Y/R	SSB/R	Tot. Biom/R	Mean age	Mean gener. time	Expected spawning
F_0	0	0	72.15	76.81	5.17	7.11	6.40
F_{-01}	0.27	4.19	29.75	33.29	3.98	6.48	2.66
F_{Max}	0.38	4.35	21.63	24.90	3.58	6.22	1.95
F at 40% MSP	0.28	4.22	28.86	32.38	3.94	6.46	2.58

The F_{max} peak appears well defined (Figure 7.2.10) and running the same analysis for both 10 and 38 years time-series does not substantially change results. This YPR analysis also falls into the category of stocks where discards are substantial. A sensitivity analysis to the natural mortality has been performed with M varying between 0.1 and 0.3. Values of $F_{0.1}$ and F_{max} are not substantially affected by the change of M-value (Figure 7.2.11).

These F_{max} and $F_{0.1}$ estimates are very much in line with those obtained from historical XSA assessments for this stock (see previous WGSSDS reports). Fishing mortality from historical XSA assessments have been well above $F_{max.}$ and in line with those obtained here.

7.2.4 Short-term projections

No short-term projections were carried out.

7.2.5 Medium-term projection

No medium-term projections were carried out.

7.2.6 Biological reference points

WKROUND 2009 has suggested that, unless there is an investigation on the possible change in the maturity ogive, there was no solid reason to change the biological reference points. The biological reference points are then recalled below:

Ref. point	ACFM 1998	WG 1999*	ACFM 1999	WG 2004	ACFM 2004
F_{lim}	0.90 (Floss WG98)	0.90 (history WG99)	0.90 (history WG99)		0.90 (history WG99)
F_{pa}	0.68 (5th perc Floss WG98)	0.65 (Flim*0.72)	0.68 (5th perc Floss WG98)		0.68 (5th perc Floss WG98)
B_{lim}	4500 t (Bloss =B76 WG98)	5400 t(Bloss=B76 WG99)	5400 t (Bloss=B76 WG99)	6300 t (Bloss=B76 WG04)	6300 t (Bloss=B76 WG04)
B_{pa}	8000 t (Blim*1.65)	9000 t (Blim*1.65)	10 000 t (history)	Reject – no SR relation	8800 t (Bpa = Blim * 1.4)

7.2.7 Management plans

A long-term management plan has been under discussion for this stock and an effort based management system in the Celtic Sea (VIIfg) is being discussed by member states and the EC.

7.2.8 Uncertainties and bias in assessment and forecast

The assessment of this stock is impaired by a strong uncertainty in the level of catches, especially since the TAC became constraining from 2003 onward. For this reason, and until a more reliable information is available, WKROUND 2009 concluded that the current assessment procedure treating catch numbers as unbiased was no longer appropriate. Surveys lack robust trends mainly due to their low catch rates.

7.2.9 Recommendation for next Benchmark

This stock should be benchmarked with the other WGCSE cod stocks in late 2011 or 2012.

Cod VIIe–k	WKROUND 2009 concluded that more work is required before Celtic Sea cod can be benchmarked successfully. WGCSE 2010 reviewed the available infromation and several improvements have occurred since WKROUND. First there is now a time-series of self-sampling high-grading estimates. Discard and misreporting rates appear to have declined. has suggested a response to their recommendation in Section 7.2.	Late 2011	Expert Group members
	There is a growing body of new tagging information that may prove useful to assess stock structure and possible mortality rate.		Tagging experts
	There is a new dedicated survey for the stock that need to be considered and the two other IBTS survey-series should be examined to see if a comboned index might be possible.		Survey experts
	Ultimately the Benchmark should aim to develop an assessment and advice framework for the provision of MSY and precautionary advice form the information available.		

7.2.10 Management considerations

Fishing mortality from historical assessments have been well above potential F_{msy} proxies for this stock. It is not possible to determine current fishing mortality rates due uncertain catch-at-age data and surveys. This was also the case last year when ICES advised "that fishing effort and catches should be reduced although it is not possible to determine the appropriate scale of such reduction".

The geographical range of the stock appears to have contracted significantly according to the international landings and lpue distribution maps. This stock has had a very truncated age structure with age 2 fish being the most numerous in landings over many years. The historical dynamics of Celtic Sea cod have been "recruitment driven", i.e. the stock increased in the past in response to good recruitments and decreased rapidly during times of poor recruitment. Recruitment in recent years appears to be poor. Fishing mortality should be reduced in the longer term to maximize the contributions of recruitment to future SSB and yield and will result in reduced risk to the stock.

Cod in Divisions VIIe–k are caught in a range of fisheries including gadoid trawlers, *Nephrops* trawlers, otter trawlers, beam trawlers, and gillnetters. Other commercial species that are caught by these fisheries include haddock, whiting, *Nephrops*, plaice, sole, anglerfish, hake, megrim, and elasmobranchs.

In the recent past there have been indications of an underreporting of cod landings in some fleets. The introduction of the buyers and sellers legislation in the UK and Ireland may have reduced this, but may also have increased discards. Measures aimed at reducing discarding and improving the fishing pattern should be encouraged. These might include spatial and temporal changes in fishing practices or technical measures. These measures would need to be evaluated in the context of other species caught in mixed fisheries.

The exclusion of ICES Division VIId in the TAC area since 2009 makes the management area more in line with the boundaries of the stock as the stock is VIId is considered as an extension of the cod population in the North Sea.

Since 2005, ICES rectangles 30E4, 31E4, and 32E3 have been closed during the first quarter (Council Regulations 27/2005, 51/2006, and 41/2007, 40/2008 and 43/2009) with the objective of reducing fishing mortality on cod. At an annual resolution, maps of international effort distribution do not show evidence that this closure has redistributed effort of otter trawlers to other areas.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French otter trawlers has been declining since 1999 and a decommissioning plan has occurred in 2008 and a new plan is ongoing since 2009. A consequence of the Trevose closure is that a part of the effort displayed by the French otter trawlers in the three rectangles before or after the closure has been reported to the allowed area where the catch of mixed species (mainly gadoids) is still profitable, particularly in the rectangles neighbouring the closed area (rectangles 32E4, 32E2, 31E2, 31E3, 30E3, 29E3, 29E4) or in a more distant and still shallower rectangle 31E1. Another part of the effort is displayed in the rectangles 29E1, 28E1, meaning that this effort is then targeting *Nephrops*, monkfish, megrim, *Nephrops* and elasmobranch. Overall, a part of the French bottom trawlers has not changed their activity with the closed period and continue to target gadoid fish in the neighbouring rectangles of the closed area. Another part of them target benthic species (anglerfish, megrim and john dory) in more distant rectangles 28E1, 29E1.

Irish otter trawl effort in VIIg,j has been stable over the last four years. During this period there has been a fleet modernisation and several decommissioning schemes in Ireland both within the national whitefish fleet and beam trawl fleet.

7.2.11 References

Bendall, V., O Cuaig, M, Schön, P-J., Hetherington, S., Armstrong, M., Graham, N., and Righton, D. 2009. Spatiotemporal dynamics of Atlantic cod (Gadus morhua) in the Irish and Celtic Seas: results from a collaborative tagging programme ICES CM 2009/J:06

Cochran, W.G. 1977. Sampling Technics. J. Wiley & Sons. 428 p.

Table 7.2.1. Nominal landings of Cod in Divisions VII e–k used by the Working Group.

Year	Belgium	France	Ireland	UK	Others	Total						
1971						5782						
1972						4737						
1973						4015						
1974						2898						
1975						3993						
1976						4818						
1977						3058						
1978						3647						
1979						4650						
1980						7243						
1981						10596						
1982						8766						
1983						9641						
1984						6631						
1985						8317						
1986						10475						
1987						10228						
1988	554	13863	1480	1292	2	17191						
1989	910	15801	1860	1223	15	19809						
1990	621	9383	1241	1346	158	12749						
1991	303	6260	1659	1094	20	9336						
1992	195	7120	1212	1207	13	9747						
1993	391	8317	766	945	6	10425						
1994	398	7692	1616	906	8	10620						
1995	400	8321	1946	1034	8	11709						
1996	552	8981	1982	1166	0	12680						
1997	694	8662	1513	1166	0	12035						
1998	528	8096	1718	1089	0	11431			Benchmark 2009		WGCSE	
1999	326	5488	1883	897	0	8594			HG based	2008	HG based	2009
2000	208	4281	1302	744	0	6535			self sampling data		2009 FR self	
2001	347	6033	1091	838	0	8309	HG based on UK					
2002	555	7368	694	618	0	9235	Highgrading	Total	Highgrading	Total	Highgrading	Total
2003	136	5222	517	346	0	6221	210	6431				
2004	153	2425	663	282	0	3523	148	3671				
2005	186	1623	870	309	0	2988	74	3062				
2006	103	1896	959	368	0	3326			432	3758		
2007	108	2509	1210	412	0	4239			592	4831		
2008	65	2064	1221	289	0	3639			322	3961		
2009*	49	2027	870	264	0	3210					25	3235

*** provisional**

Updated for WKROUND and WGCSE 2009

Scaled landings 1971–1987 (SSDS WG 1999)

Table 7.2.2. Cod in Divisions VIIe–k. 2009 Landings in numbers-at-length (cm). Note: French data by metier were not available at the time of the meeting. é

	France	UK VII e–k	UK VII e–k	Ireland
	VII e–k	Beam trawl	All bar beam trawl	VIIg,j
Length (cm)				
24				
25				
26				
27				
28				
29				0
30				0
31	18			42
32	18			55
33	0			51
34	0		17	289
35	349	8	5	1154
36	1429	24	45	1801
37	2087	64	204	2589
38	4553	126	298	5046
39	4249	181	225	4710
40	5573	149	353	7053
41	5117	222	437	6644
42	5711	339	360	5904
43	4484	389	582	5302
44	4223	414	634	6591
45	5281	310	346	7133
46	5501	365	293	6373
47	5515	376	268	4133
48	5280	218	710	4608
49	4125	347	428	3623
50	5847	217	629	3832
51	5511	382	566	3388
52	6396	386	741	3115
53	8225	406	743	3585
54	8747	419	1193	2668
55	10836	383	938	3153
56	11693	488	1154	3569
57	10527	436	1283	3475
58	14229	418	974	3524
59	15250	583	1028	4023
60	17575	662	878	3614
61	16721	588	1229	4138
62	16312	523	1051	4279
63	14190	478	1077	4483
64	14602	539	873	6065

	France	UK VII e–k	UK VII e–k	Ireland
	VII e–k	Beam trawl	All bar beam trawl	VIIg,j
Length (cm)				
65	13657	551	1035	4471
66	13095	489	1290	5844
67	12916	481	949	5308
68	13111	417	874	5120
69	12811	562	1111	4576
70	13704	409	1292	5574
71	11205	397	1326	5418
72	12923	395	1419	5253
73	12264	315	1470	5069
74	11517	314	1653	6059
75	12242	236	1411	6281

Table 7.2.2. Continued.

	France	UK VII e–k	UK VII e–k	Ireland
	VII e–k	Beam trawl	All bar beam trawl	VIIg,j
Length (cm)				
76	12600	266	1272	4502
77	9595	301	1393	4000
78	11318	333	958	3760
79	8562	279	1319	2723
80	11945	438	1023	2916
81	6698	343	916	2957
82	7811	266	530	2699
83	7776	177	620	2582
84	7043	196	630	2431
85	6357	152	688	2418
86	6317	168	504	3070
87	5344	138	368	2804
88	6479	122	444	2589
89	5229	101	293	2619
90	5907	73	366	1503
91	3481	88	241	1453
92	3643	113	214	1857
93	3243	116	142	1395
94	3046	55	200	1558
95	2600	99	178	1208
96	1894	61	148	416
97	2206	53	181	632
98	1900	51	111	958
99	1869	66	68	298
100	2536	41	65	1040
101	939	48	44	394
102	1001	11	37	257

	France	UK VII e–k	UK VII e–k	Ireland
	VII e–k	Beam trawl	All bar beam trawl	VIIg,j
Length (cm)				
103	808	17	69	301
104	726	28	23	262
105	661	23	0	198
106	226	22	9	104
107	267	14	0	109
108	48	11	0	93
109	13	11	14	0
110	105	20		83
111	65			
112	92			
113	54			
114	0			
115	30			
116	0			
117	55			
118	50			
119	0			
120	9			
121	0			
122	22			
123	0			
124	0			
125	28			
Total	530215	19307	46460	245174
Tw	2027.1	67.3	178	653.8
Mean length	67.6	64.5	67.5	63.0
Mean Weight	3.823	3.486	3.831	2.667

Table 7.2.3. Cod in Divisions VIIe–k (Celtic Sea). Catch numbers-at-age. Area reallocation (IRL 2004 to 2009) and high-grading (FR 2003–2009) included.

Run title : Cod in Divisions VIIe-k,WGCSE10,index file

At 6/05/2010 12:02

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE									
1,	725,	4,	332,	1,	673,	51,	25,	197,	438,
2,	461,	774,	239,	224,	136,	1456,	416,	497,	357,
3,	557,	110,	346,	40,	185,	61,	236,	129,	263,
4,	96,	205,	60,	118,	61,	107,	15,	116,	68,
5,	35,	45,	74,	38,	105,	11,	60,	20,	104,
6,	17,	26,	17,	37,	20,	22,	2,	34,	19,
+gp,	11,	17,	11,	36,	33,	7,	17,	20,	32,
0 TOTALNUM,	1902,	1181,	1079,	494,	1213,	1715,	771,	1013,	1281,
TONSLAND,	5782,	4737,	4015,	2898,	3993,	4818,	3059,	3647,	4650,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	609,	315,	76,	1285,	737,	726,	651,	2741,	1830,	666,
2,	1213,	3086,	1157,	529,	1210,	1245,	1303,	946,	5443,	2639,
3,	285,	811,	888,	540,	134,	465,	673,	448,	320,	2483,
4,	175,	153,	169,	424,	97,	61,	254,	250,	133,	149,
5,	52,	41,	36,	77,	94,	40,	30,	62,	46,	77,
6,	55,	20,	19,	21,	22,	47,	31,	20,	21,	18,
+gp,	14,	12,	5,	11,	5,	15,	17,	15,	8,	11,
0 TOTALNUM,	2403,	4438,	2350,	2887,	2299,	2599,	2959,	4482,	7801,	6043,
TONSLAND,	7243,	10597,	8766,	9641,	6631,	8317,	10475,	10228,	17191,	19809,
SOPCOF %,	100,	100,	101,	100,	100,	101,	100,	98,	100,	100,

1

Run title : Cod in Divisions VIIe-k,WGCSE10,index file

At 6/05/2010 12:02

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	360,	1377,	1434,	274,	1340,	823,	617,	1184,	639,	496,

	2,	846,	1034,	2601,	2371,	692,	3320,	2248,	1870,	2545,	1141,
	3,	1006,	229,	329,	928,	1199,	310,	1199,	951,	641,	756,
	4,	663,	330,	64,	79,	258,	284,	134,	297,	254,	158,
	5,	79,	203,	70,	24,	27,	73,	95,	48,	99,	59,
	6,	21,	48,	53,	19,	10,	13,	43,	22,	36,	36,
	+gp,	16,	14,	17,	16,	17,	5,	4,	6,	8,	14,
0	TOTALNUM,	2991,	3235,	4568,	3711,	3543,	4828,	4340,	4378,	4222,	2660,
	TONSLAND,	12749,	9336,	9747,	10425,	10620,	11709,	12681,	12035,	11431,	8594,
	SOPCOF %,	99,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 1 Catch numbers at age Numbers*10**-3

	YEAR,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,	2009,
	AGE										
	1,	1693,	1091,	210,	103,	341,	295,	368,	491,	123,	166,
	2,	464,	2373,	2069,	556,	298,	664,	994,	1245,	769,	283,
	3,	419,	136,	883,	827,	175,	138,	249,	409,	312,	310,
	4,	169,	98,	64,	217,	168,	52,	25,	60,	101,	93,
	5,	44,	70,	33,	15,	59,	45,	14,	9,	24,	35,
	6,	17,	19,	12,	9,	8,	11,	13,	4,	4,	10,
	+gp,	14,	19,	11,	7,	7,	2,	5,	4,	4,	3,
0	TOTALNUM,	2820,	3806,	3282,	1734,	1056,	1207,	1668,	2222,	1337,	900,
	TONSLAND,	6536,	8308,	9236,	6420,	3672,	3062,	3776,	4830,	3961,	3235,
	SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

1

Table 7.2.4a. Cod in Divisions VIIe–k. Length structure of landings and discards from sampling by UK.

UK - Sampled data raised to trips sampled.

Length	Q1		Q2		Q3		Q4	
(cm)	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	2	0	0
12	0	0	0	0	0	4	0	0
13	0	0	0	0	0	3	0	1
14	0	0	0	0	0	6	0	0
15	0	0	0	0	0	2	0	0
16	0	0	0	0	0	3	0	0
17	0	0	0	0	0	1	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	1	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	2	0	0
23	0	1	0	2	0	1	0	0
24	0	1	0	0	0	0	0	0
25	0	4	0	0	0	0	0	0
26	0	4	0	3	0	0	0	0
27	0	2	2	2	0	0	0	0
28	0	2	2	2	0	0	0	0
29	0	7	0	1	0	1	0	0
30	0	2	0	1	0	1	0	0
31	0	0	0	0	0	8	0	0
32	0	1	0	0	0	7	0	0
33	0	0	0	2	0	7	0	0
34	0	0	0	4	1	0	0	0
35	0	0	0	0	4	1	0	4
36	0	0	0	0	0	1	0	0
37	1	0	0	0	6	3	1	0
38	1	0	0	0	0	6	0	0
39	0	0	0	0	0	1	1	0

Length	Q1		Q2		Q3		Q4	
(cm)	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded
40	0	0	0	0	2	1	0	0
41	0	1	1	0	5	0	4	0
42	0	1	0	0	0	1	0	0
43	0	0	0	0	0	1	1	0
44	1	6	0	0	1	0	1	0
45	0	0	1	0	2	1	0	0
46	3	1	0	0	0	1	0	0
47	2	1	0	0	0	0	4	0
48	0	5	0	0	0	1	0	0
49	0	11	1	0	0	3	0	0
50	3	12	0	0	1	2	0	0
51	2	20	1	0	1	5	0	0
52	1	24	2	0	0	5	0	0
53	5	16	2	0	0	28	0	0
54	4	12	4	0	0	9	1	0
55	1	17	7	1	3	7	0	0
56	4	9	2	1	4	7	0	0
57	5	7	6	0	3	7	0	0
58	3	4	9	0	2	8	0	0
59	2	1	5	0	1	11	0	0
60	5	1	3	0	4	5	0	0
61	5	0	1	0	2	6	0	0
62	6	0	5	0	1	7	0	0
63	5	0	1	0	2	2	0	0
64	5	0	1	0	4	8	0	0
65	4	0	3	0	0	1	0	0
66	9	0	1	0	1	0	4	0
67	6	0	2	0	5	0	0	0
68	13	0	0	0	2	0	0	0
69	9	1	1	0	2	1	0	0
70	12	0	0	1	2	0	0	0
71	9	0	0	0	1	0	0	0
72	11	0	0	1	1	0	0	0
73	7	0	1	0	0	0	0	0
74	6	0	1	1	0	0	1	0
75	13	0	5	1	1	0	0	0

Table 7.2.4a. Continued.

UK - Cod VIIe–k - Sampled data raised to trips sampled.

Length	Q1		Q2		Q3		Q4	
(cm)	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded
76	6	0	1	1	1	0	0	0
77	12	0	0	0	1	0	0	0
78	5	0	3	0	1	0	0	0
79	2	0	2	1	0	0	0	0
80	2	0	1	1	1	0	0	0
81	3	0	0	0	0	0	0	0
82	2	0	0	0	1	0	0	0
83	3	0	0	0	1	0	0	0
84	0	0	1	0	1	0	0	0
85	0	0	0	0	0	0	0	1
86	0	0	0	0	0	1	0	1
87	0	0	0	0	1	0	0	0
88	4	0	0	0	0	0	0	0
89	1	0	0	0	0	0	0	0
90	2	0	0	0	0	0	0	0
91	4	0	0	0	0	0	0	0
92	2	0	0	0	1	0	0	0
93	2	0	0	0	1	0	0	0
94	0	0	0	0	0	0	0	0
95	1	0	0	0	0	0	0	0
96	0	0	1	0	0	0	0	0
97	2	0	0	0	0	0	0	0
98	1	0	0	0	0	1	0	0
99	0	0	0	0	1	0	0	0
100	1	0	1	0	1	0	0	0
101	0	0	0	0	0	0	0	0
102	2	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0	0
105	0	0	1	0	0	0	0	0
106	0	0	0	0	0	0	0	0
107	0	0	0	0	0	0	0	0
108	0	0	0	0	0	0	0	0
109	1	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0
112	0	0	0	0	0	0	0	0
113	0	0	1	0	0	0	0	0
Total N	221	172	82	24	76	166	18	6
Trips	32		22		29		12	

Table 7.2.4b. Cod in Divisions VIIe–k. Length structure of landings and discards from sampling by Ireland.

Cod in ICES Division VIIg

Irish Otter Trawl Discard Numbers and Mean Weights-at-Age, and Raised length distribution

No of Trips= Sampled 16 Logbooks 2641

No. of hauls = 175

Fishing Year 2009

Total Otter Trawl Discards =82 tonnes [live]

Otter Trawl, Irish vessels landing into Irish and Foreign Ports

Raised (using Trip as Variable)

	Frequency ('000)			Frequency ('000)	
Length (cm)	Raised Discards	Retained Catch	Length (cm)	Raised Discards	Retained Catch
25	4.74	0.00	66	0.00	1.55
26	2.98	0.00	67	0.00	0.64
27	4.27	0.00	68	0.00	1.17
28	7.43	0.00	69	0.00	0.58
29	0.68	0.00	70	0.00	1.79
30	3.09	0.92	71	0.00	0.90
31	12.17	0.00	72	0.00	0.49
32	15.69	0.00	73	0.00	0.26
33	1.74	0.00	74	0.00	0.36
34	2.60	0.00	75	0.00	0.87
35	7.05	0.92	76	0.00	1.22
36	16.54	0.92	77	0.00	1.02
37	33.03	0.00	78	0.00	0.69
38	9.82	0.04	79	0.00	1.41
39	23.68	0.07	80	0.00	0.36
40	4.21	0.06	81	0.00	1.19
41	2.09	0.11	82	0.00	0.58
42	25.80	0.45	83	0.00	0.33
43	3.20	0.31	84	0.00	0.51
44	25.19	0.71	85	0.00	0.30
45	0.00	0.66	86	0.00	0.25
46	0.00	0.55	87	0.00	1.17
47	0.00	0.27	88	0.00	0.31
48	0.00	0.51	89	0.00	0.34
49	0.00	0.89	90	0.00	0.48
50	0.00	0.38	91	0.00	0.34
51	0.00	0.29	92	0.00	0.36
52	0.00	0.44	93	0.00	0.76
53	0.00	0.74	94	0.00	0.34
54	0.00	0.59	95	0.00	0.49
55	0.00	0.90	96	0.00	0.28
56	0.00	0.13	97	0.00	0.32
57	0.00	0.67	98	0.00	0.08

	Frequency ('000)			Frequency ('000)	
Length (cm)	Raised Discards	Retained Catch	Length (cm)	Raised Discards	Retained Catch
58	0.00	0.40	99	0.00	0.28
59	0.00	0.32	100	0.00	0.20
60	0.00	0.90	101	0.00	0.34
61	0.00	0.76	102	0.00	0.44
62	0.00	0.62	Total	205.99	38.86
63	0.00	0.28			
64	0.00	0.43			
65	0.00	0.62			

Table 7.2.4c. Cod in Divisions VIIe–k. Length structure of French landings and discards from the self-sampling Program. Sampling data raised by landing ratio to the total catch of the fleet in VIIfgh.

2008	Retained				Discarded				
	FR-GADOID				FR-GADOID				
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
20					20	0	0	0	0
21					21	0	0	0	0
22					22	0	0	0	0
23					23	0	0	0	0
24					24	0	40	0	0
25					25	0	20	0	0
26					26	0	0	0	0
27					27	46	20	14	0
28					28	0	60	41	15
29					29	69	40	0	107
30					30	161	40	96	168
31					31	323	241	329	259
32					32	576	181	233	229
33					33	1060	140	575	305
34					34	1129	281	726	442
35					35	1498	381	849	458
36					36	2235	481	534	549
37	24	31			37	2880	1244	835	580
38	280	31		19	38	3226	963	1013	656
39	154	16		29	39	3180	1625	671	610
40	398	16		89	40	4102	1946	342	610
41	567	78		224	41	3572	2187	205	366
42	617	126	18	78	42	3318	1805	205	427
43	646	47	62	239	43	3433	2066	137	320
44	1192	180	204	245	44	2973	2367	246	244
45	847	184	248	270	45	2419	2227	178	122
46	1642	159	254	310	46	1728	2628	233	153
47	1345	264	376	144	47	2327	2628	288	76
48	1100	254	752	300	48	1959	2086	411	183
49	1669	279	924	94	49	2143	1344	425	198
50	1548	763	1114	176	50	1360	1705	260	137
51	1770	995	1648	399	51	346	622	0	15
52	1701	1138	1967	327	52	138	782	0	76
53	1623	822	2466	379	53	69	582	0	76
54	1224	1111	2394	668	54	69	461	0	15
55	935	1072	2116	459	55	115	582	0	107
56	1355	1103	2288	390	56	46	140	0	92

2008	Retained				Discarded				
	FR-GADOID				FR-GADOID				
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
57	824	1054	2415	702	57	46	181	0	107
58	907	832	2151	509	58	46	140	0	107
59	1087	995	2003	882	59	0	60	0	137
60	615	864	1999	871	60	0	120	0	61
61	1344	822	1768	555	61	23	0	0	92
62	948	731	1409	599	62	0	0	0	15
63	1372	765	1292	920	63	0	20	0	61
64	1283	669	1236	815	64	23	0	0	0
65	1410	633	1042	1209	65				31
66	1506	750	1480	639	66				0
67	2435	890	703	744	67				0
68	2504	1014	880	774	68				15
69	2038	796	623	691	69				0
70	2142	1067	542	474	70				31
71	2055	1020	532	445	71				46
72	2024	978	625	304	72				61
73	1885	1065	638	271	73				15
74	1664	869	705	135	74				31
75	1398	963	609	128	75				15

Table 7.2.4c. Continued.

2008	Retained				Discarded				
	FR-GADOID				FR-GADOID				
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
76	944	654	746	137	76				31
77	995	724	861	142	77				15
78	944	694	727	135	78				0
79	611	490	906	268	79				15
80	600	466	705	139	80				0
81	445	344	780	171	81				31
82	764	479	598	200	82				0
83	638	401	455	207	83				46
84	691	316	514	215	84				0
85	553	473	374	173	85				15
86	700	421	460	193	86				0
87	645	393	549	120	87				31
88	521	325	287	166	88				15
89	419	260	290	128	89				15
90	282	243	418	162	90				
91	275	237	236	131	91				
92	269	221	385	86	92				
93	255	189	167	137	93				
94	161	55	179	104	94				
95	58	52	180	61	95				
96	126	96	115	54	96				
97	71	112	120	44	97				
98	108	140	119	25	98				
99	83	59	81	33	99				
100	58	64	68	6	100				
101	17	65	56	17	101				
102	48	36	42	6	102				
103	25	34	57	28	103				
104		82			104				
105		47	26		105				
106	23	10	29		106				
107			9	13	107				
108			12	5	108				
109		25	23		109				
110		25	25		110				
111			4		111				
112					112				
113	7	8			113				
114					114				

2008	Retained				Discarded				
	FR-GADOID				FR-GADOID				
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
115					115				
Tot N	61411	33681	50084	19810		46639	32438	8846	8632
N trips sampled	5	13	10	6					
N hauls sampled	91	288	154	67					

Table 7.2.4c. Cod in Divisions VIIe–k. Length structure of French landings and discards from the self-sampling Program Sampling data of FR-GADOID raised by landing ratio to the total catch of the fleet in VIIfgh assuming the same discarding practice as the French Gadoid trawlers.

2008	Retained				Discarded				
	FR-*NEPHROPS*				FR-*NEPHROPS*				
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
20					20	0	0	0	0
21					21	0	0	0	0
22					22	0	0	0	0
23					23	0	0	0	0
24					24	0	78	0	0
25					25	0	39	0	0
26					26	0	0	0	0
27					27	13	39	11	0
28					28	0	117	34	19
29					29	20	78	0	132
30					30	46	78	78	207
31					31	93	469	268	320
32					32	166	351	190	283
33					33	305	273	469	377
34					34	325	547	592	547
35					35	431	742	693	566
36					36	643	937	436	679
37				17	37	829	2421	682	716
38	71			70	38	928	1874	827	811
39	71		31	87	39	915	3163	548	754
40	106		31	35	40	1180	3788	279	754
41	106		92	121	41	1027	4256	168	452
42	71		92	157	42	955	3514	168	528
43	212		123	167	43	988	4022	112	396
44	141	0	92	143	44	855	4608	201	302
45	72	86	123	116	45	696	4334	145	151

2008	Retained					Discarded			
	FR-*NEPHROPS*					FR-*NEPHROPS*			
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
46	176	0	92	133	46	497	5115	190	189
47	106	86	154	218	47	670	5115	235	94
48	196	191	395	143	48	563	4061	335	226
49	288	211	167	79	49	616	2616	346	245
50	144	359	0	55	50	391	3319	212	170
51	255	485	228	86	51	99	1211	0	19
52	163	932	1052	103	52	40	1523	0	94
53	206	651	281	147	53	20	1132	0	94
54	382	1378	977	176	54	20	898	0	19
55	125	1591	754	113	55	33	1132	0	132
56	35	1381	1027	227	56	13	273	0	113
57	153	1756	999	171	57	13	351	0	132
58	230	864	797	384	58	13	273	0	132
59	145	2882	1229	183	59	0	117	0	170
60	91	2178	1169	251	60	0	234	0	75
61	132	1092	701	449	61	7	0	0	113
62	129	584	1606	585	62	0	0	0	19
63	76	292	1116	627	63	0	39	0	75
64	263	2570	633	565	64	7	0	0	0
65	163	106	745	318	65	0	0	0	38
66	323	1083	252	113	66	0	0	0	0
67	250	791	648	111	67	0	0	0	0
68	421	0	952	654	68	0	0	0	19
69	249	487	706	210	69	0	0	0	0
70	340	2931	764	205	70	0	0	0	38

Table 7.2.4c. Continued.

2008	Retained					Discarded			
	FR-NEPHROPS					FR-NEPHROPS			
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
71	833	404	505	455	71	0	0	0	57
72	626	1532	805	186	72	0	0	0	75
73	639	1017	809	276	73	0	0	0	19
74	281	1834	718	120	74	0	0	0	38
75	331	2965	1352	408	75	0	0	0	19
76	66	1341	857	174	76	0	0	0	38
77	275	1126	496	312	77	0	0	0	19
78	309	466	0	174	78	0	0	0	0
79	188	1731	1041	119	79	0	0	0	19
80	333	2021	533	252	80	0	0	0	0
81	108	1873	368	285	81	0	0	0	38
82	345	400	750	412	82	0	0	0	0
83	247	1447	825	321	83	0	0	0	57
84	172	1827	161	424	84	0	0	0	0
85	205	2108	972	17	85	0	0	0	19
86	209	231	419	188	86	0	0	0	0
87	203	352	663	322	87	0	0	0	38
88	142	1265	538	17	88	0	0	0	19
89	368	760	356	73	89	0	0	0	19
90	252	584	487	276	90				
91	61	0	203	204	91				
92	101	245	392	49	92				
93	138	273	341	267	93				
94		242	73	181	94				
95	58	231	149	162	95				
96	44	121	76	216	96				
97		381	203	48	97				
98	18	339	113	187	98				
99	76	0	26	43	99				
100	93	121	87	134	100				
101	193	623	197	69	101				
102	84	231	0	95	102				
103	32	339	0	0	103				
104		216	76		104				
105	32	0	0		105				
106	50	231	0		106				
107	84	0	0		107				
108			0		108				

2008	Retained					Discarded			
	FR-NEPHROPS					FR-NEPHROPS			
	2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4		2008 - Q1	2008 - Q2	2008 - Q3	2008 - Q4
Length (cm)					Length (cm)				
109			0		109				
110	32	0	0	43	110				
111	42	137	0		111				
112		0	0	17	112				
113			0	85	113				
114			0		114				
115	26		76		115				
Tot N	13187	53984	32695	13830		13417	63143	7219	10670

Table 7.2.4d. Cod in Divisions VIIe–k. Length structure of French landings and discards from on-board observer program. Otter Trawlers targeting demersal fish.

	Retained					Discarded			
	OT_DEF					OT_DEF			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
20	0	0	0	0	20	0	0	0	0
21	0	0	0	0	21	0	0	0	0
22	0	0	0	0	22	0	0	0	0
23	0	0	0	0	23	0	0	0	0
24	0	0	0	0	24	0	0	0	0
25	0	0	0	0	25	0	0	0	0
26	0	0	0	0	26	0	0	0	0
27	0	0	0	0	27	0	0	0	4
28	0	0	0	0	28	0	0	0	0
29	0	0	0	0	29	0	0	1	0
30	0	0	0	0	30	0	0	0	0
31	0	0	0	0	31	0	0	3	8
32	0	0	0	0	32	0	0	7	4
33	0	0	0	0	33	0	0	2	21
34	0	0	0	0	34	0	0	42	28
35	0	0	1	0	35	0	0	22	17
36	0	0	3	0	36	0	0	36	32
37	0	0	7	0	37	0	0	28	25
38	0	0	9	0	38	0	0	32	36
39	0	0	12	0	39	0	0	27	26
40	0	0	7	2	40	0	0	31	22
41	0	0	8	0	41	0	0	22	37
42	0	0	6	12	42	0	0	24	30
43	0	0	3	10	43	0	0	12	16
44	0	0	5	4	44	0	0	15	8
45	0	0	5	8	45	0	0	5	4
46	0	0	4	6	46	0	0	3	0
47	0	0	3	16	47	0	0	0	0
48	0	0	2	7	48	0	0	2	0
49	0	0	5	6	49	0	0	0	0
50	0	0	1	5	50	0	0	1	0
51	0	0	3	2	51	0	0	1	0
52	0	1	2	4	52	0	0	0	0
53	0	1	8	2	53	0	0	0	0
54	0	0	16	2	54	0	0	0	0
55	0	0	17	2	55	0	0	0	0
56	0	0	8	4	56	0	0	0	0
57	0	0	6	5	57	0	0	0	0
58	0	0	19	6	58	0	0	0	0

	Retained					Discarded			
	OT_DEF					OT_DEF			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
59	0	1	8	8	59	0	0	0	0
60	0	0	15	5	60	0	0	0	0
61	0	1	19	1	61	0	0	0	0
62	0	1	37	10	62	0	0	0	0
63	0	0	18	7	63	0	0	0	0
64	0	0	31	6	64	0	0	0	0
65	0	0	13	7	65	0	0	0	0
66	0	0	14	13	66	0	0	0	0
67	0	1	11	5	67	0	0	0	0
68	0	0	10	7	68	0	0	0	0
69	0	0	11	5	69	0	0	0	0
70	0	0	10	6	70	0	0	0	0

Table 7.2.4d. Continued.

	Retained					Discarded			
	OT_DEF					OT_DEF			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
71	0	1	11	5	71	0	0	0	0
72	0	2	4	2	72	0	0	0	0
73	0	0	4	1	73	0	0	0	0
74	0	2	7	1	74	0	0	0	0
75	0	2	5	3	75	0	0	0	0
76	0	0	8	0	76	0	0	0	0
77	0	1	7	2	77	0	0	0	0
78	0	0	4	2	78	0	0	0	0
79	0	1	9	2	79	0	0	0	0
80	0	3	13	0	80	0	0	0	0
81	0	0	8	1	81	0	0	0	0
82	0	2	8	1	82	0	0	0	0
83	0	1	14	1	83	0	0	0	0
84	0	0	5	1	84	0	0	0	0
85	0	1	9	0	85	0	0	0	0
86	0	0	7	2	86	0	0	0	0
87	0	2	3	0	87	0	0	0	0
88	0	2	2	0	88	0	0	0	0
89	0	1	6	0	89	0	0	0	0
90	0	0	4	0	90	0	0	0	0
91	0	1	1	0	91	0	0	0	0
92	0	0	2	0	92	0	0	0	0
93	0	1	2	0	93	0	0	0	0
94	0	0	0	0	94	0	0	0	0

	Retained					Discarded			
	OT_DEF					OT_DEF			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
95	0	0	3	0	95	0	0	0	0
96	0	1	2	0	96	0	0	0	0
97	0	0	1	0	97	0	0	0	0
98	0	1	0	0	98	0	0	0	0
99	0	0	1	0	99	0	0	0	0
100	0	1	0	1	100	0	0	0	0
101	0	0	0	0	101	0	0	0	0
102	0	0	1	0	102	0	0	0	0
103	0	0	0	0	103	0	0	0	0
104	0	0	1	0	104	0	0	0	0
105	0	0	1	0	105	0	0	0	0
106	0	1	1	0	106	0	0	0	0
107	0	0	0	0	107	0	0	0	0
108	0	0	0	0	108	0	0	0	0
109	0	0	1	0	109	0	0	0	0
110	0	1	0	0	110	0	0	0	0
111	0	0	0	0	111	0	0	0	0
112	0	0	0	0	112	0	0	0	0
113	0	0	0	0	113	0	0	0	0
114	0	0	0	0	114	0	0	0	0
115	0	0	0	0	115	0	0	0	0
116	0	0	0	0	116	0	0	0	0
117	0	0	0	0	117	0	0	0	0
118	0	0	0	0	118	0	0	0	0
119	0	0	0	0	119	0	0	0	0
120	0	0	0	0	120	0	0	0	0
121	0	0	0	0	121	0	0	0	0
Total N	0	34	509	206		0	0	316	316
Total weight (kg)	0	229	1660	537		0	0	206	220
Subsampling wt (kg)	0	229	1454	519		0	0	176	63
N hauls sampled	0	124	200	43					
N trips sampled	0	12	20	2					

Table 7.2.4d. Cod in Divisions VIIe–k. Length structure of French landings and discards from on-board observer programme. Otter Trawlers targeting *Nephrops*.

	Retained					Discarded			
	OT_CRU					OT_CRU			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
20	0	0	0	0	20	0	0	0	0
21	0	0	0	0	21	0	0	0	0
22	0	0	0	0	22	0	0	0	0
23	0	0	0	0	23	0	0	0	0
24	0	0	0	0	24	0	0	0	0
25	0	0	0	0	25	0	0	0	0
26	0	0	0	0	26	0	0	0	0
27	0	0	0	0	27	0	27	0	0
28	0	0	0	0	28	0	8	18	0
29	0	0	0	0	29	0	0	1	0
30	0	0	0	0	30	0	4	0	0
31	0	0	3	0	31	0	0	12	0
32	0	0	0	0	32	0	42	157	0
33	0	0	3	0	33	0	12	0	0
34	0	0	3	0	34	0	0	107	0
35	0	1	44	0	35	0	3	14	0
36	0	0	75	0	36	0	43	34	0
37	0	0	16	0	37	0	7	28	0
38	0	1	48	0	38	0	3	18	0
39	0	2	11	0	39	0	0	19	0
40	0	0	5	0	40	0	0	0	0
41	0	1	12	0	41	0	0	0	0
42	0	1	4	0	42	0	0	16	0
43	0	1	3	0	43	0	0	0	0
44	0	0	2	0	44	0	0	0	0
45	0	0	4	0	45	0	0	0	0
46	0	0	3	0	46	0	0	0	0
47	0	0	5	0	47	0	0	0	0
48	0	1	0	0	48	0	0	0	0
49	0	3	0	0	49	0	0	0	0
50	0	2	0	0	50	0	0	0	0
51	0	4	1	0	51	0	0	0	0
52	0	5	3	0	52	0	0	0	0
53	0	4	3	0	53	0	0	0	0
54	0	7	4	0	54	0	0	0	0
55	0	10	4	0	55	0	0	0	0
56	0	7	5	0	56	0	0	0	0
57	0	6	7	0	57	0	0	0	0
58	0	10	10	0	58	0	0	0	0

	Retained					Discarded			
	OT_CRU					OT_CRU			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
59	0	7	6	0	59	0	0	0	0
60	0	6	10	0	60	0	0	0	0
61	0	12	3	0	61	0	0	0	0
62	0	6	8	0	62	0	0	0	0
63	0	4	6	0	63	0	0	0	0
64	0	9	5	0	64	0	0	0	0
65	0	9	6	0	65	0	0	0	0
66	0	12	7	0	66	0	0	0	0
67	0	7	7	0	67	0	0	0	0
68	0	16	3	0	68	0	0	0	0
69	0	12	2	0	69	0	0	0	0
70	0	18	9	0	70	0	0	0	0

Table 7.2.4d. Continued.

	Retained					Discarded			
	OT_CRU					OT_CRU			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
71	0	18	9	0	71	0	0	0	0
72	0	30	3	0	72	0	0	0	0
73	0	17	6	0	73	0	0	0	0
74	0	19	3	0	74	0	0	0	0
75	0	27	4	0	75	0	0	0	0
76	0	19	8	0	76	0	0	0	0
77	0	35	6	0	77	0	0	0	0
78	0	20	7	0	78	0	0	0	0
79	0	16	6	0	79	0	0	0	0
80	0	21	6	0	80	0	0	0	0
81	0	11	3	0	81	0	0	0	0
82	0	18	5	0	82	0	0	0	0
83	0	18	8	0	83	0	0	0	0
84	0	13	4	0	84	0	0	0	0
85	0	16	3	0	85	0	0	0	0
86	0	11	3	0	86	0	0	0	0
87	0	14	1	0	87	0	0	0	0
88	0	9	1	0	88	0	0	0	0
89	0	8	2	0	89	0	0	0	0
90	0	19	3	0	90	0	0	0	0
91	0	15	4	0	91	0	0	0	0
92	0	3	2	0	92	0	0	0	0
93	0	10	2	0	93	0	0	0	0
94	0	8	5	0	94	0	0	0	0

	Retained					Discarded			
	OT_CRU					OT_CRU			
Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4	Length (cm)	2009 - Q1	2009 - Q2	2009 - Q3	2009 - Q4
95	0	12	2	0	95	0	0	0	0
96	0	5	1	0	96	0	0	0	0
97	0	3	2	0	97	0	0	0	0
98	0	4	1	0	98	0	0	0	0
99	0	5	2	0	99	0	0	0	0
100	0	0	1	0	100	0	0	0	0
101	0	2	0	0	101	0	0	0	0
102	0	2	1	0	102	0	0	0	0
103	0	1	0	0	103	0	0	0	0
104	0	3	0	0	104	0	0	0	0
105	0	1	0	0	105	0	0	0	0
106	0	2	0	0	106	0	0	0	0
107	0	1	0	0	107	0	0	0	0
108	0	1	0	0	108	0	0	0	0
109	0	0	1	0	109	0	0	0	0
110	0	0	1	0	110	0	0	0	0
111	0	2	0	0	111	0	0	0	0
112	0	0	0	0	112	0	0	0	0
113	0	0	0	0	113	0	0	0	0
114	0	0	0	0	114	0	0	0	0
115	0	1	0	0	115	0	0	0	0
116	0	0	0	0	116	0	0	0	0
117	0	0	0	0	117	0	0	0	0
118	0	1	0	0	118	0	0	0	0
119	0	0	0	0	119	0	0	0	0
120	0	0	0	0	120	0	0	0	0
121	0	0	0	0	121	0	0	0	0
Total N	0	620	470	0		0	149	424	0
Total weight (kg)	0	3171	1279	0		0	64	164	0
Subsampling wt (kg)	0	3114	1242	0		0	5	12	0
N hauls sampled	1	104	68						
N trips sampled	1	12	9	7					

Table 7.2.5. Cod in Divisions VIIe–k. Catch weight-at-age.

Run title : Cod in Divisions VIIe-k,WGCSE10,index file

At 6/05/2010 12:02

Table 2 Catch weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE									
1,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,	.9080,
2,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,	2.1930,
3,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,	4.8310,
4,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,	7.4640,
5,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,	9.6690,
6,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,	11.7840,
+gp,	14.8159,	14.4792,	14.6675,	14.9506,	14.5262,	15.1279,	15.7144,	15.2267,	14.3395,
0 SOPCOFAC,	1.0006,	.9972,	.9982,	.9966,	1.0011,	1.0029,	1.0004,	.9974,	1.0006,

Table 2 Catch weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.9080,	.9450,	.9450,	.9790,	.9810,	1.0010,	1.0540,	.9090,	.9060,	.8440,
2,	2.1930,	1.5490,	2.2420,	2.5250,	2.6450,	2.6370,	2.5540,	2.5040,	2.1870,	2.0130,
3,	4.8310,	4.3850,	4.4740,	4.9610,	5.2840,	5.5210,	5.3980,	5.2640,	5.3180,	4.7060,
4,	7.4640,	7.5650,	7.7970,	7.4570,	7.8280,	8.0820,	7.4400,	8.0890,	7.9970,	7.6380,
5,	9.6690,	9.0600,	10.2500,	9.9650,	9.7580,	10.4070,	10.7820,	10.4470,	10.6490,	9.4380,
6,	11.7840,	12.7500,	12.4650,	12.0100,	11.6720,	11.4690,	12.3960,	13.5740,	12.4860,	12.9170,
+gp,	13.8620,	14.7237,	15.4408,	16.4710,	15.3396,	14.3697,	13.5580,	15.3490,	14.6217,	13.3935,
0 SOPCOFAC,	1.0003,	1.0002,	1.0146,	1.0006,	.9984,	1.0092,	1.0000,	.9844,	.9997,	1.0003,

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Run title : Cod in Divisions VIIe-k,WGCSE10,index file

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Table 2 Catch weights at age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	.8800,	.9050,	.8150,	.8710,	.8740,	.8060,	.7870,	.7710,	.8530,	.9930,
2,	2.3000,	2.1350,	1.9160,	2.0430,	2.0000,	1.9730,	1.8770,	2.0390,	1.8960,	2.0980,
3,	4.6240,	4.9870,	4.9160,	4.5080,	4.4920,	4.5890,	4.6390,	4.5160,	4.4610,	4.4950,
4,	7.1880,	6.7380,	7.3590,	6.8660,	7.9260,	7.5600,	6.9970,	7.3890,	6.8810,	7.3260,
5,	9.0450,	8.8650,	9.7440,	8.4310,	10.0920,	9.7500,	9.8540,	9.7190,	9.3290,	8.9450,

	6,	11.7130,	10.8090,	11.4980,	10.9420,	12.2120,	11.1520,	11.4070,	11.8200,	11.2160,	11.2550,
	+gp,	14.8144,	14.1344,	12.6295,	12.3344,	14.0578,	14.0814,	12.3707,	14.3670,	14.0713,	14.6309,
0	SOPCOFAC,	.9900,	1.0000,	1.0000,	1.0009,	1.0000,	.9999,	1.0000,	1.0006,	1.0012,	1.0017,

Table 2 Catch weights at age (kg)

	YEAR,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,	2009,
	AGE										
	1,	.8630,	.7940,	.7570,	.8890,	.8840,	.7760,	.7890,	.7720,	.8470,	.9220,
	2,	2.5410,	2.0290,	1.8800,	1.8440,	2.1770,	2.1180,	1.7930,	1.6570,	1.8040,	2.3920,
	3,	4.6290,	5.1120,	4.7280,	4.2740,	4.5430,	3.9070,	4.7160,	4.2760,	4.5410,	4.2850,
	4,	7.0420,	7.8580,	6.7640,	6.6670,	7.0730,	6.1680,	7.4040,	7.4630,	7.1640,	6.7160,
	5,	9.5020,	9.8320,	9.3600,	9.5060,	9.4350,	9.1940,	9.1860,	9.6970,	9.2290,	8.8190,
	6,	10.6600,	11.4230,	10.7740,	11.0640,	10.8020,	11.5440,	11.6460,	11.8630,	11.0950,	10.3640,
	+gp,	12.1360,	13.8977,	13.1661,	12.1431,	12.8979,	10.0370,	12.3902,	12.8190,	13.3042,	11.3260,
0	SOPCOFAC,	.9995,	.9991,	.9996,	.9992,	1.0014,	1.0020,	1.0005,	1.0011,	1.0026,	1.0018,

Table 7.2.6. Cod in Divisions VIIe–k. Stock weight-at-ages = 1st quarter values.

Run title : Cod in Divisions VIIe-k,WGCSE10,index file

At 6/05/2010 12:02

Table 3 Stock weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE									
1,	.6620,	.6620,	.6620,	.6620,	.6620,	.6620,	.6620,	.6620,	.6620,
2,	1.7090,	1.7090,	1.7090,	1.7090,	1.7090,	1.7090,	1.7090,	1.7090,	1.7090,
3,	4.4440,	4.4440,	4.4440,	4.4440,	4.4440,	4.4440,	4.4440,	4.4440,	4.4440,
4,	7.3210,	7.3210,	7.3210,	7.3210,	7.3210,	7.3210,	7.3210,	7.3210,	7.3210,
5,	9.5290,	9.5290,	9.5290,	9.5290,	9.5290,	9.5290,	9.5290,	9.5290,	9.5290,
6,	11.6050,	11.6050,	11.6050,	11.6050,	11.6050,	11.6050,	11.6050,	11.6050,	11.6050,
+gp,	14.5404,	14.1778,	14.3755,	14.5822,	14.2402,	14.8683,	15.3589,	14.9079,	14.0056,

Table 3 Stock weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	.6620,	.4600,	.7040,	.4460,	.5120,	.5810,	.5280,	.5220,	.9060,	.8440,
2,	1.7090,	1.5490,	1.4880,	1.9450,	1.9510,	2.0700,	1.9020,	1.9470,	1.6210,	1.4630,
3,	4.4440,	2.2840,	3.8760,	4.4670,	4.9280,	5.3330,	5.2860,	4.8770,	4.8870,	4.5140,
4,	7.3210,	7.8060,	7.4070,	7.3530,	7.4330,	8.3760,	7.3820,	7.9460,	7.7770,	7.6150,
5,	9.5290,	10.5440,	9.6240,	9.7520,	9.5520,	10.8510,	10.6890,	10.3080,	10.3020,	9.4380,
6,	11.6050,	11.4390,	12.3160,	11.2230,	12.1800,	11.5850,	12.3930,	14.4190,	11.7860,	12.6920,
+gp,	13.5130,	14.6123,	15.7394,	17.4511,	15.2018,	14.9743,	14.4820,	15.4457,	13.4600,	14.1533,

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Table 3 Stock weights at age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
1,	.6130,	.5390,	.6630,	.7030,	.6050,	.6120,	.6730,	.4700,	.4210,	.7780,
2,	1.7740,	1.5380,	1.3180,	1.3850,	1.7540,	1.4440,	1.2830,	1.4100,	1.3140,	1.5420,
3,	4.3900,	4.7910,	4.6000,	4.2780,	4.1890,	4.3460,	4.4710,	4.0790,	4.3400,	4.2520,
4,	7.1860,	6.5240,	6.5580,	6.5740,	7.7200,	7.4520,	6.7470,	7.1120,	6.6760,	7.1260,
5,	8.4860,	8.6310,	9.3420,	8.0660,	9.7220,	9.1400,	9.8770,	9.0440,	9.3030,	8.7000,
6,	10.7030,	10.6720,	11.2850,	10.8150,	12.1010,	10.6460,	11.4240,	11.1560,	11.1720,	11.1420,

+gp,	14.6578,	13.8090,	12.4660,	12.1295,	13.9081,	14.0514,	12.8480,	13.7300,	12.8280,	15.2226,

Table 3 Stock weights at age (kg)

YEAR,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,	2009,
AGE										
1,	.5610,	.6300,	.3520,	.4820,	.5910,	.5880,	.7030,	.7220,	.8690,	.9380,
2,	1.6960,	1.4550,	1.2570,	1.3270,	1.2580,	1.6880,	1.2160,	1.3990,	1.4490,	1.5980,
3,	4.2230,	4.9040,	4.4520,	4.1110,	4.0530,	4.0750,	4.2330,	3.7940,	4.1880,	3.8690,
4,	6.6270,	7.8720,	7.0460,	6.6010,	6.7590,	5.9450,	6.8190,	6.9900,	6.8960,	6.5390,
5,	9.3260,	10.1920,	9.4000,	9.1830,	9.3720,	9.0180,	8.8950,	9.8090,	8.8810,	8.9100,
6,	10.5050,	11.6130,	10.6140,	10.6350,	10.1580,	11.3330,	11.4870,	12.2730,	11.5430,	10.5120,
+gp,	11.4651,	13.8257,	13.6879,	12.5877,	12.6100,	11.4870,	11.6694,	14.8977,	12.7292,	14.0950,

1

Table 7.2.7. Cod in Divisions VIIe–k. Series of surveys indices scrutinized at WGCSE.

```
UK-WCGFS West Coast March survey, effort in mn towed, numbers *10**2, final survey in 2004
1992    2004
1       1       0.15    0.25
1       5
3774    2800    7100    400     200     200
3602    500     7250    4850    1230    100
1915    7400    600     3180    1130    300
3439    11200   14520   880     1400    700
3695    1300    6800    8500    1000    800
3826    3700    3200    3400    700     100
3744    1800    2500    2000    700     500
3823    200     1500    300     400     100
4092    3000    0       410     200     200
3700    1450    1100    1000    100     100
3387    200     5450    2960    430     100
2326    0       579     3154    410     100
1689    1400    0       200     1000    200

FR-EVHOE Groundfish  Oct-Nov survey in VIIf,g,h,j, numbers per 30 mn
1997    2009
1       1       0.75    1
1       6
1       0.213   0.095   0.246   0.117   0.048   0       1997
1       0.212   0.52    0.207   0.045   0.045   0       1998
1       0.155   0.184   0.283   0.015   0.03    0.015   1999
1       1.046   0.041   0.118   0.064   0.013   0       2000
1       0.716   0.18    0.029   0.038   0.018   0.007   2001
1       0.033   0.313   0.148   0       0.015   0       2002
1       0.052   0.041   0.142   0.061   0.008   0       2003
1       0.066   0.144   0.072   0.122   0.046   0       2004
1       0.255   0.12    0.055   0       0.026   0       2005
1       0.125   0.139   0       0.048   0.045   0       2006
1       0.321   0.206   0.117   0.033   0       0       2007
1       0.217   0.141   0.117   0.096   0       0       2008
1       0.237   0.092   0.132   0.078   0       0.023   2009

IR-GFS-VIIgj combined: Irish Grounfish Survey (IBTS 4th Qrt)- Cod number per 30 mn towed
(Interim indices for the new Celtic Explorer series)
2003    2009
1       1       0.79    0.92
1       6
1       0.167   0.223   0.229   0.075   0       0       2003
1       0.3     0.106   0.035   0.018   0.018   0       2004
1       0.967   0.138   0.035   0       0       0       2005
1       0.632   0.2     0.031   0       0       0.015   2006
1       0.837   0.279   0.103   0.029   0       0       2007
1       0.164   0.432   0.104   0.015   0       0       2008
1       0.561   0.068   0.085   0.017   0       0       2009
```

Table 7.2.8a. Cod in Divisions VIIe–k. Time-series of landings, effort and lpue.

	France											
	Fr gadoid trawlers VIIfgh			Fr *Nephrops* trawlers VIIfgh			Fr Otter trawlers VIIe-k			Fr Otter trawlers VII e		
Year	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1978	Q2+Q3+Q4 for			Q2+Q3+Q4 for								
1979	consistency with			consistency with			includes Fr gadoid trawlers and					
1980	box closure			box closure			Fr Nephrops trawlers					
1981	during Q1 2005			during Q1 2005								
1982	and Feb–March 2006 to 2008			and Feb–March 2006 to 2008								
1983	1453	75.0	19.4	630	190.5	3.3	5443	904.3	6.0	472	210.6	2.2
1984	2002	60.6	33.1	671	170.5	3.9	4881	654.9	7.5	189	118.4	1.6
1985	1667	73.4	22.7	1023	150.7	6.8	6262	847.6	7.4	351	154.1	2.3
1986	2086	85.3	24.5	774	132.6	5.8	8046	932.0	8.6	431	220.4	2.0
1987	2804	107.8	26.0	778	145.7	5.3	8215	886.0	9.3	835	167.6	5.0
1988	6243	184.4	33.9	1726	144.1	12.0	13739	963.6	14.3	1320	199.4	6.6
1989	5171	166.3	31.1	1496	157.7	9.5	15715	1066.0	14.7	983	217.4	4.5
1990	3045	155.2	19.6	1138	206.3	5.5	9018	1073.3	8.4	383	198.6	1.9
1991	2096	127.1	16.5	690	186.2	3.7	5878	1013.2	5.8	335	177.7	1.9
1992	2304	133.0	17.3	1223	226.2	5.4	6709	1060.6	6.3	325	179.1	1.8
1993	2566	155.5	16.5	1236	205.3	6.0	8302	1095.6	7.6	295	238.4	1.2
1994	1725	121.8	14.2	1245	225.1	5.5	7353	959.7	7.7	306	185.1	1.7
1995	2598	128.2	20.3	1606	200.5	8.0	8248	1010.8	8.2	520	215.2	2.4
1996	2455	123.0	20.0	1450	181.6	8.0	8667	954.6	9.1	460	188.5	2.4
1997	2830	168.2	16.8	1246	152.6	8.2	8307	1057.5	7.9	584	258.3	2.3
1998	1707	139.3	12.3	805	111.1	7.2	5765	743.383*	7.76*	150*	28.2*	5.33*
1999	1271	138.8	9.2	546	114.6	4.8	5445	1047.3	5.2	647	298.4	2.2
2000	938	115.3	8.1	711	125.3	5.7	4254	1051.9	4.0	542	312.5	1.7
2001	1911	138.5	13.8	916	141.7	6.5	5957	1010.4	5.9	584	281.3	2.1
2002	2412	121.8	19.8	1083	147.6	7.3	7389	974.8	7.6	654	317.4	2.1
2003	1110	92.0	12.1	972	169.9	5.7	5157	1025.7	5.0	619	366.2	1.7
2004	469	83.1	5.6	462	128.2	3.6	2379	952.1	2.4	193	353.6	0.5
2005	483	79.1	6.1	343	113.3	3.0	1577	874.2	1.7	239	333.9	0.7
2006	430	55.6	7.7	376	108.3	3.5	1834	866.8	2.1	359	334.8	1.1
2007	678	63.4	10.7	509	85.1	6.0	2438	805.7	3.0	445	311.5	1.4
2008	496	54.0	9.2	445	78.1	5.7	1958	655.3	3.0	399	242.5	1.6
2009	data unavailable											

Units: landings in Tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished

*** unreliable**

	Fr gadoid trawlers VIIfgh			Fr *Nephrops* trawlers VIIfgh			Fr Otter trawlers VIIe-k		
	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
FR- High-grading input									
2003	1155	92.0	12.6	1011	169.9	6.0	5367	1025.7	5.2
2004	498	83.1	6.0	491	128.2	3.8	2527	952.1	2.7
2005	506	79.1	6.4	359	113.3	3.2	1651	874.2	1.9
2006	548	55.6	9.8	465	108.3	4.3	2229	866.8	2.6
2007	886	63.4	14.0	630	85.1	7.4	2995	805.7	3.7
2008	591	54.0	11.0	534	78.1	6.8	2284	655.3	3.5
2009	data unavailable								

Table 7.2.8b. Cod in Divisions VIIe–k. Time-series of landings, effort and lpue.

	UK (England and Wales)								
	Uk Otter trawlers VIIe–k			Uk Beam trawlers VIIe–k			Uk Otter trawlers VIIe		
Year	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1972	355	117.1	3.0				80	64.6	1.2
1973	223	118.5	1.9				58	69.5	0.8
1974	192	91.6	2.1				55	50.1	1.1
1975	136	100.3	1.4				38	54.7	0.7
1976	97	88.2	1.1				32	56.1	0.6
1977	119	88.5	1.3				78	55.4	1.4
1978	116	83.2	1.4	6	24.7	0.3	70	48.8	1.4
1979	130	73.5	1.8	14	44.0	0.3	74	49.9	1.5
1980	228	85.6	2.7	39	76.7	0.5	84	50.0	1.7
1981	324	104.3	3.1	63	87.6	0.7	76	46.9	1.6
1982	362	104.7	3.5	84	115.0	0.7	65	38.5	1.7
1983	163	82.1	2.0	84	135.3	0.6	73	52.6	1.4
1984	237	86.7	2.7	129	131.5	1.0	77	52.9	1.5
1985	249	90.3	2.8	145	152.5	1.0	64	57.7	1.1
1986	233	84.7	2.8	164	135.7	1.2	80	49.5	1.6
1987	221	84.3	2.6	246	177.1	1.4	96	45.1	2.1
1988	270	89.1	3.0	248	194.9	1.3	155	53.4	2.9
1989	186	84.1	2.2	230	198.2	1.2	105	54.7	1.9
1990	314	99.5	3.2	307	207.6	1.5	128	53.1	2.4
1991	243	76.7	3.2	258	203.2	1.3	84	40.8	2.0
1992	232	86.4	2.7	256	196.1	1.3	81	39.9	2.0
1993	181	61.9	2.9	220	208.4	1.1	43	39.2	1.1
1994	79	53.7	1.5	174	220.0	0.8	41	38.8	1.1
1995	115	52.3	2.2	239	243.1	1.0	55	35.5	1.5
1996	120	60.5	2.0	303	260.8	1.2	59	30.5	1.9
1997	149	66.7	2.2	299	264.8	1.1	79	33.3	2.4
1998	119	62.1	1.9	265	254.6	1.0	62	29.8	2.1
1999	90	98.4	0.9	257	251.4	1.0	47	27.5	1.7
2000	111	104.1	1.1	187	259.0	0.7	52	30.5	1.7
2001	110	85.3	1.3	256	272.7	0.9	59	31.9	1.8
2002	80	83.0	1.0	130	249.5	0.5	34	28.3	1.2
2003	58	72.3	0.8	103	282.1	0.4	24	25.1	1.0
2004	44	75.7	0.6	96	273.9	0.3	15	25.6	0.6
2005	41	76.4	0.5	102	270.3	0.4	17	21.1	0.8
2006	55	83.3	0.7	91	252.0	0.4	13	21.1	0.6
2007	49	87.6	0.6	111	239.9	0.5	22	22.4	1.0
2008	49	71.2	0.7	71	216.9	0.3	24	19.9	1.2
2009	27	73.8	0.4	67	190.9	0.4	13	21.4	0.6

Units: landings in tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished.

Table 7.2.8c. Cod in Divisions VIIe–k. Time-series of landings, effort and lpue.

	IRELAND											
	Ir Otter trawlers VIIg			Ir Beam trawlers VIIg			Ir Scottish seiners VIIg			Ir Gillnet VIIg		
Year	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1995	429.9	63.6	6.8	85.8	20.8	4.1	111.27	6.43	17.3	114.92		
1996	569.3	60.0	9.5	112.6	26.8	4.2	164.87	9.73	16.9	338.84		
1997	401.9	65.1	6.2	131.6	28.3	4.7	215.24	16.13	13.3	52.81		
1998	450.6	72.3	6.2	166.9	35.3	4.7	264.14	14.94	17.7	87.32		
1999	300.9	51.7	5.8	190.6	40.9	4.7	64.59	8.01	8.1	211.92		
2000	279.4	60.6	4.6	180.7	37.0	4.9	106.04	9.90	10.7	157.03		
2001	339.5	69.4	4.9	96.6	39.7	2.4	111.09	16.33	6.8	107.99		
2002	213.0	77.7	2.7	57.9	31.6	1.8	70.84	20.86	3.4	34.13		
2003	167.4	86.8	1.9	57.1	49.3	1.2	38.07	20.91	1.8	31.17		
2004	190.2	97.0	2.0	74.3	54.9	1.4	54.86	19.38	2.8	60.65		
2005	294.9	124.4	2.4	118.7	49.7	2.4	66.13	14.81	4.5	77.697		
2006	390.0	119.2	3.3	128.6	60.5	2.1	90.98	14.79	6.2	63.73		
2007	323.0	136.5	2.4	96.2	55.9	1.8	58.52	15.82	3.7	85.44		
2008	349.9	125.8	2.8	85.4	37.2	2.3	55.59	11.65	4.8	86.77		
2009	402.6	135.2	3.0	74.1	37.9	2.0	34.51	8.15	4.2	80.88		

Units: landings in Tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished

	IRELAND											
	Ir Otter trawlers VIIj			Ir Beam trawlers VIIj			Ir Scottish seiners VIIj			Ir Gillnet VIIj		
Year	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1995	338.5	93.7	3.6	0.1	0.2	0.2	75.52	5.26	14.4	179.57		
1996	326.4	70.2	4.6	8.7	1.5	5.9	124.55	8.15	15.3	64.96		
1997	352.8	83.2	4.2	3.4	1.8	1.9	115.81	10.73	10.8	45.47		
1998	262.3	89.6	2.9	19.2	5.2	3.7	103.37	6.61	15.6	59.13		
1999	76.7	40.6	1.9	27.6	7.4	3.7	9.57	1.41	6.8	24.01		
2000	95.5	64.6	1.5	21.2	6.9	3.1	23.71	3.49	6.8	13.98		
2001	140.4	67.7	2.1	10.4	3.0	3.5	27.95	4.42	6.3	12.69		
2002	150.1	90.4	1.7	5.4	3.1	1.7	24.65	8.87	2.8	12.23		
2003	78.5	111.3	0.7	8.8	9.0	1.0	14.72	9.15	1.6	6.17		
2004	36.1	92.0	0.4	2.5	2.2	1.2	11.57	9.18	1.3	4.21		
2005	40.6	73.9	0.5	4.7	2.4	1.9	17.76	6.09	2.9	3.30		
2006	42.7	65.9	0.6	2.0	1.5	1.3	15.64	5.33	2.9	7.18		
2007	39.0	80.5	0.5	7.8	2.4	3.3	9.83	3.51	2.8	6.50		
2008	33.5	66.5	0.5	2.6	1.1	2.3	9.46	2.84	3.3	6.50		
2009	26.2	72.5	0.4	4.7	2.8	1.7	8.90	3.33	2.7	7.78		

Units: landings in Tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished

Table 7.2.9. List of parameters and data used for the YPR analysis.

Age group	Selectivity on fishing mortality	Selectivity on natural mortality	Stock weights	Catch weights	Spawning-stock weights	Fraction mature
1	0.19	0.20	0.88	0.88	0.613	0.01
2	0.84	0.20	2.07	2.07	1.535	0.39
3	0.86	0.20	4.68	4.68	4.315	0.87
4	0.63	0.20	7.36	7.36	7.201	0.93
5	0.51	0.20	9.58	9.58	9.429	1.00
6	0.40	0.20	11.67	11.67	11.492	1.00
7	0.40	0.20	13.44	13.44	13.359	1.00
8	0.40	0.20	15.44	15.44	15.461	1.00
9	0.40	0.20	16.20	16.20	15.894	1.00
10	0.40	0.20	16.32	16.32	15.744	1.00
Natural mortality:			0.20			
Proportion of fishing mortality before spawning:			0.00			
Proportion of natural mortality before spawning:			0.00			

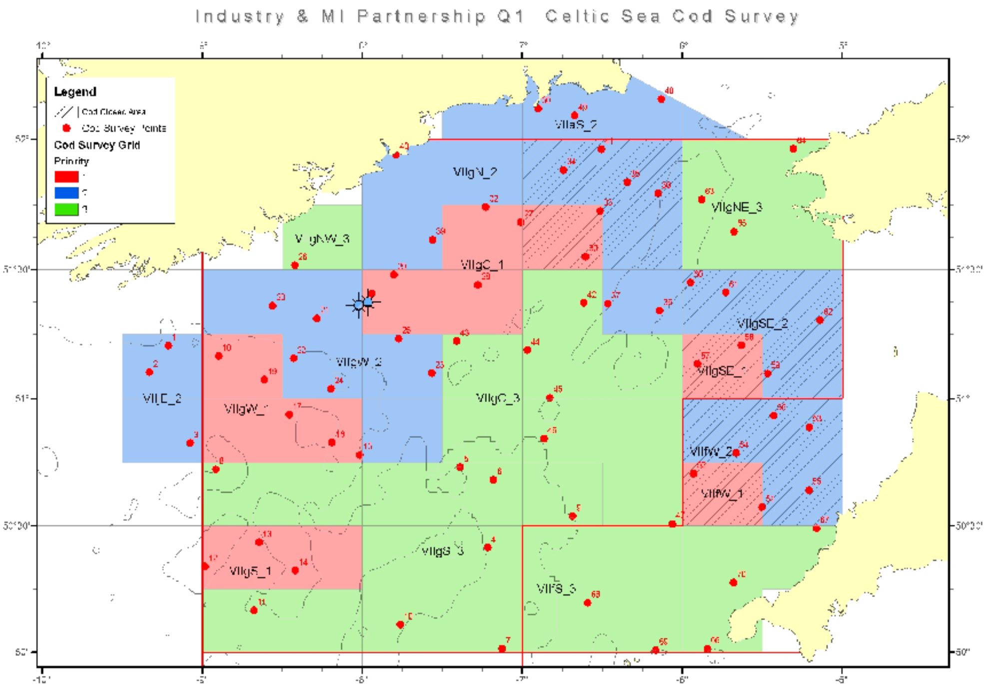


Figure 7.2.1. Irish industry and science survey. Maps of station and priority.

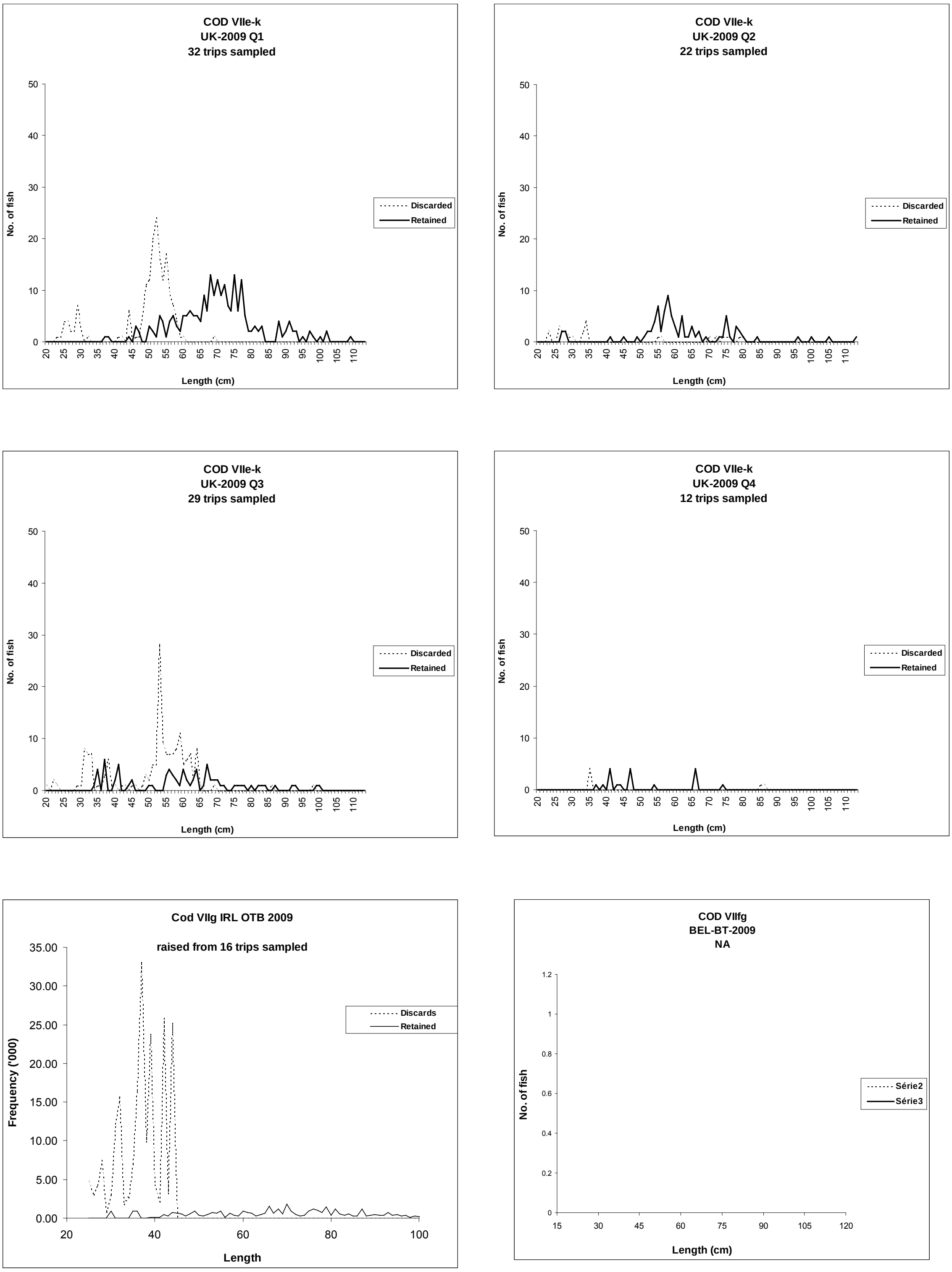


Figure 7.2.2a. Cod in Divisions VIIe–k. 2009 Quarterly or annual length compositions of UK, Irish discards raised using effort ratio for Irish data, from hauls sampled for UK.

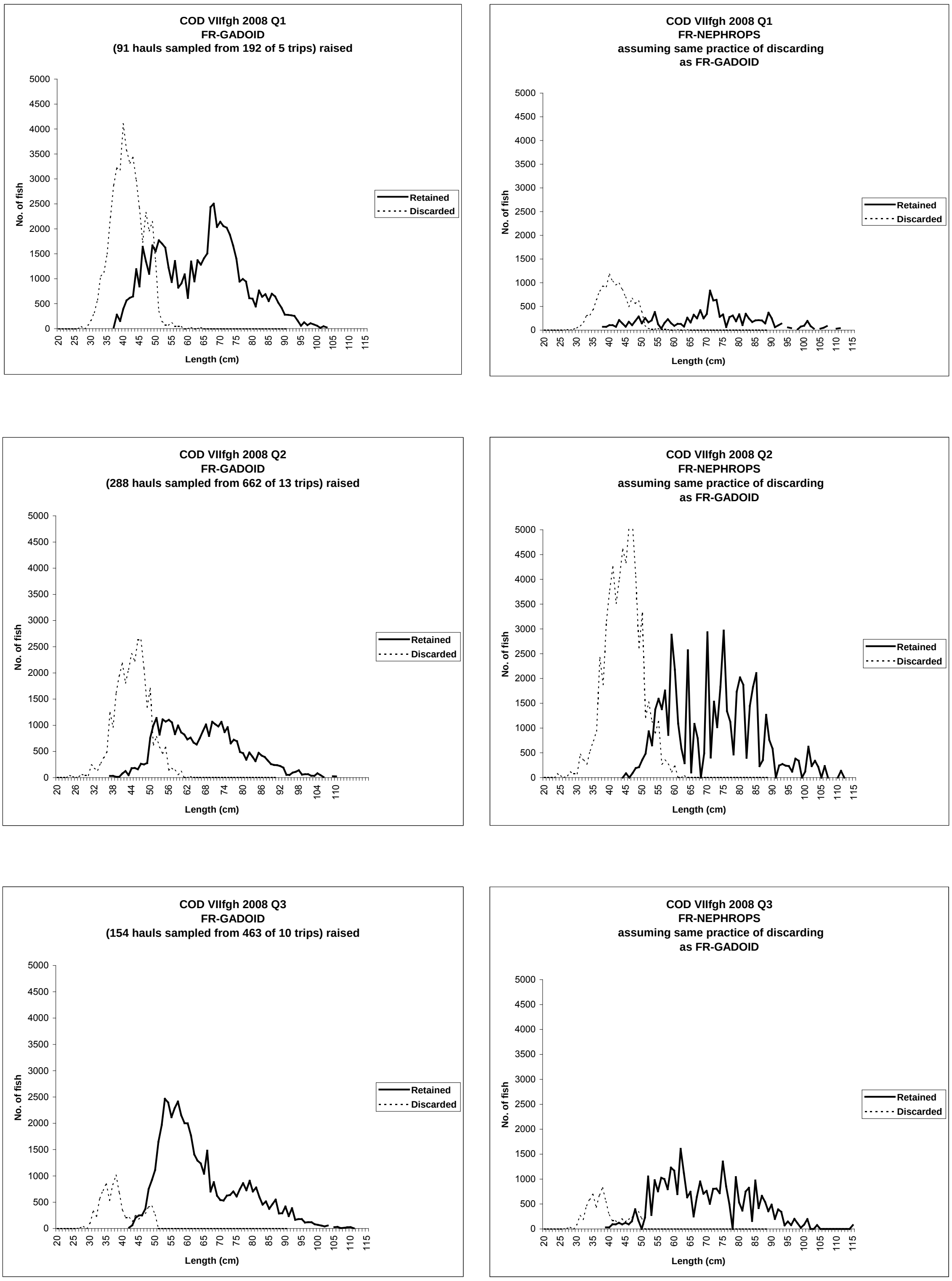
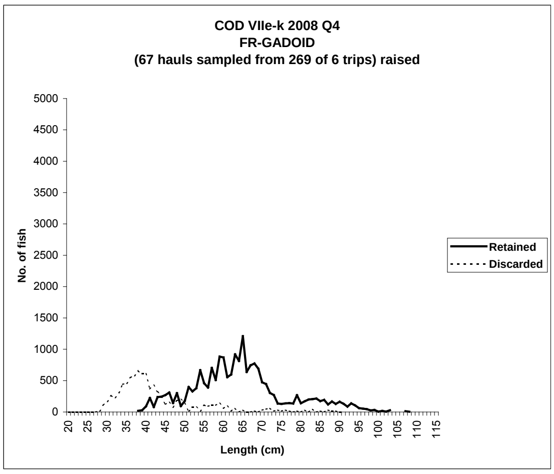


Figure 7.2.2b. Cod in Divisions VIIe–k. 2008 Quarterly length compositions of French catches in VIIfgh, self-sampling data from FR-GADOID raised by landings ratio



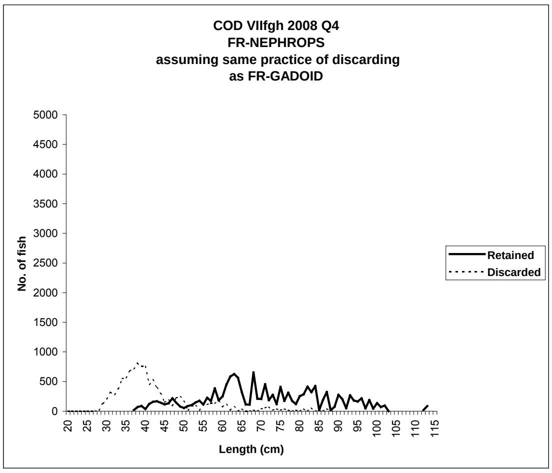
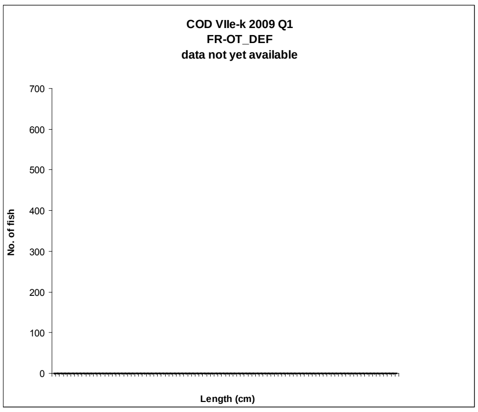
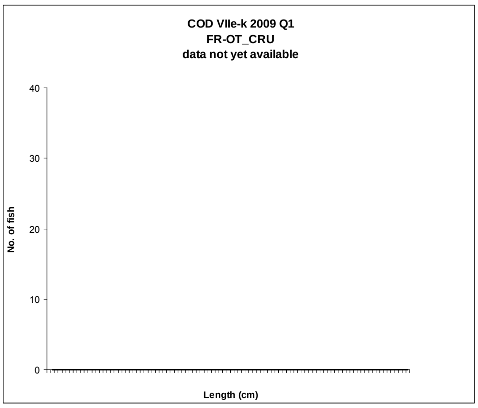
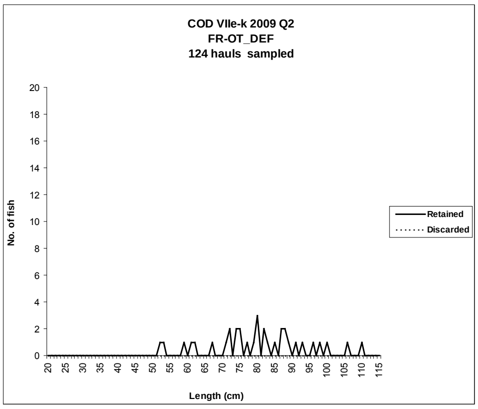
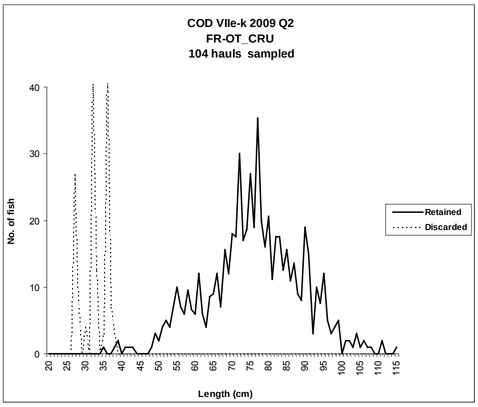


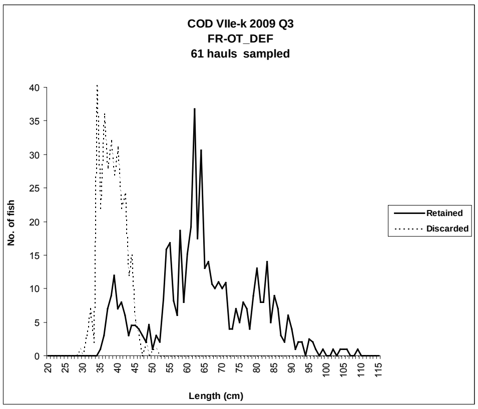
Figure 7.2.2b. Continued.

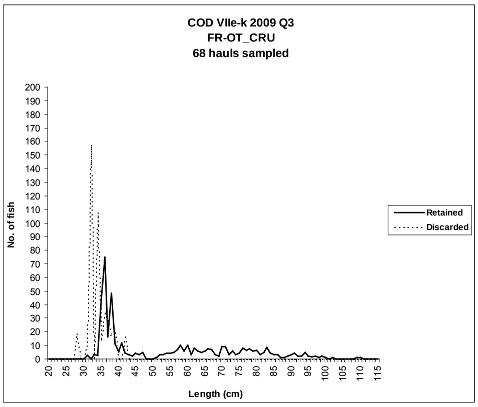

COD VIIe-k 2009 Q1
FR-OT_DEF
data not yet available
No. of fish
Length (cm)


COD VIIe-k 2009 Q1
FR-OT_CRU
data not yet available
No. of fish
Length (cm)


COD VIIe-k 2009 Q2
FR-OT_DEF
124 hauls sampled
No. of fish
Retained
Discarded
Length (cm)


COD VIIe-k 2009 Q2
FR-OT_CRU
104 hauls sampled
No. of fish
Retained
Discarded
Length (cm)


COD VIIe-k 2009 Q3
FR-OT_DEF
61 hauls sampled
No. of fish
Retained
Discarded
Length (cm)


COD VIIe-k 2009 Q3
FR-OT_CRU
68 hauls sampled
No. of fish
Retained
Discarded
Length (cm)

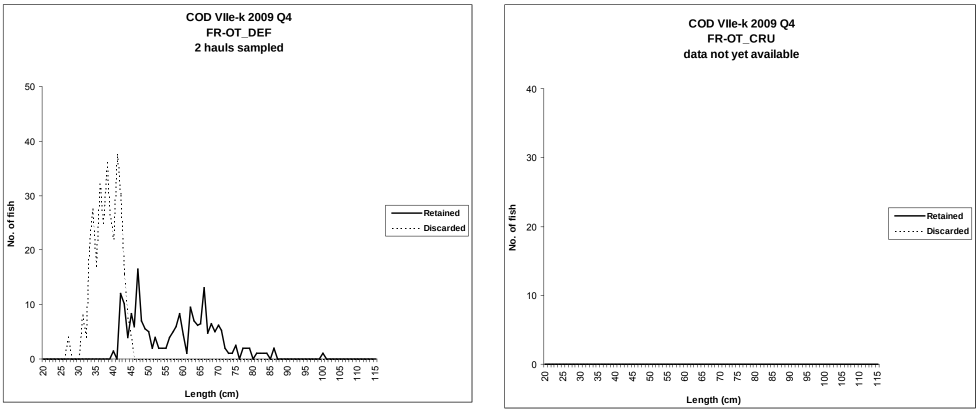


Figure 7.2.2c. Cod in Divisions VIIe–k. 2009 Quarterly length composition of French landings and discards available from hauls sampled by observers at sea.

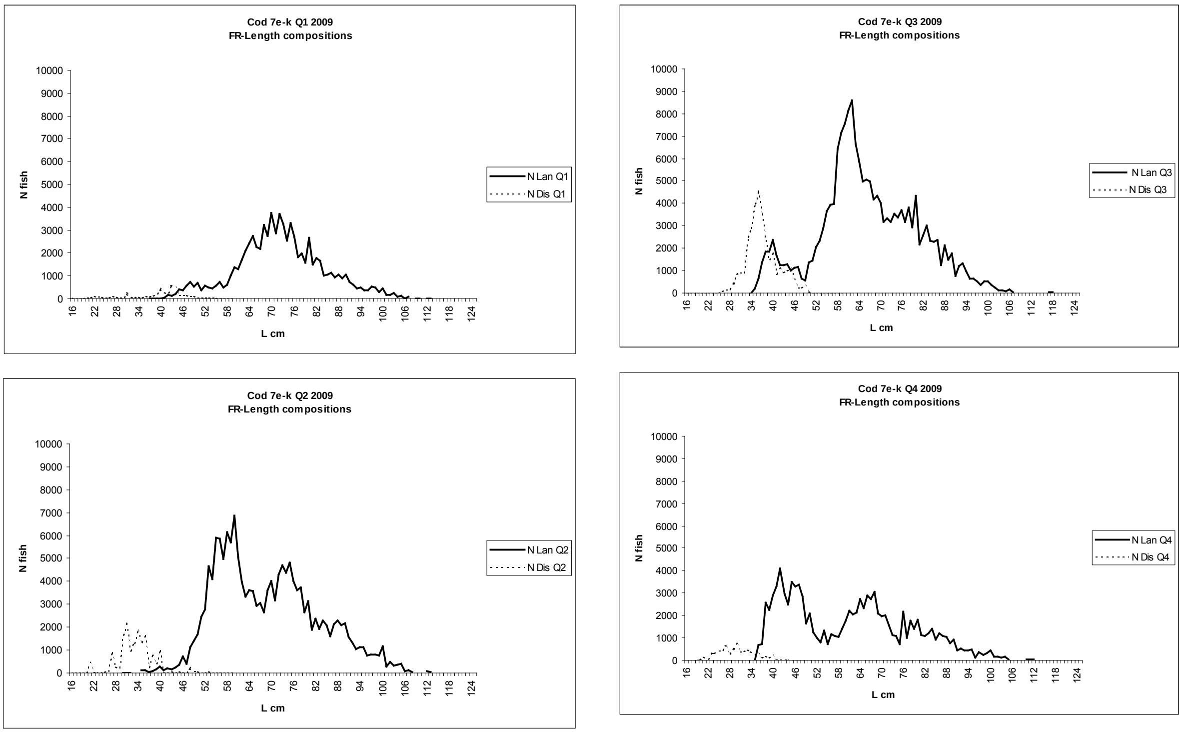


Figure 7.2.2d. Cod in Divisions VIIe–k. 2009 Quarterly length composition of French landings and discards. Self-sampling programme.

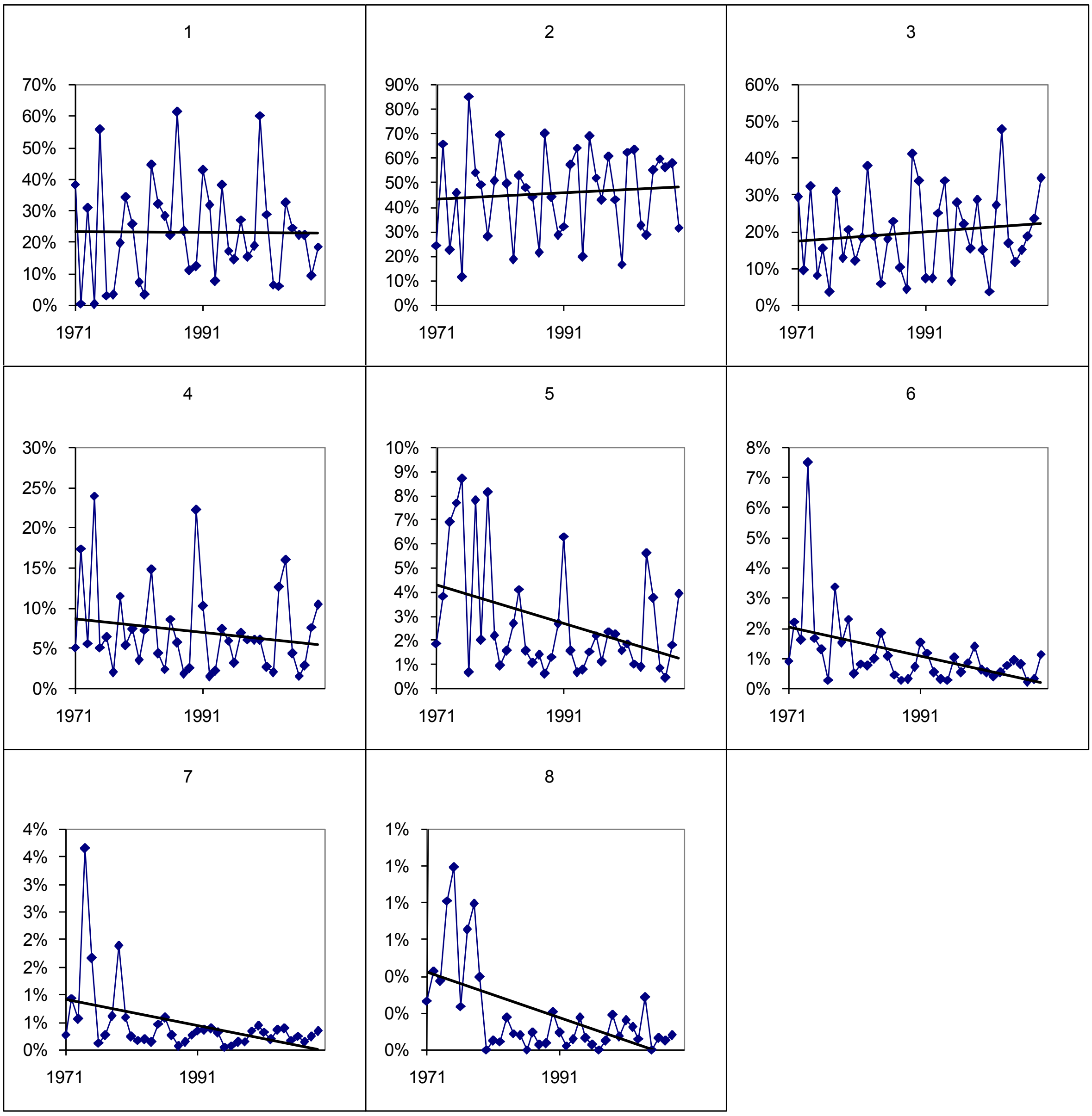
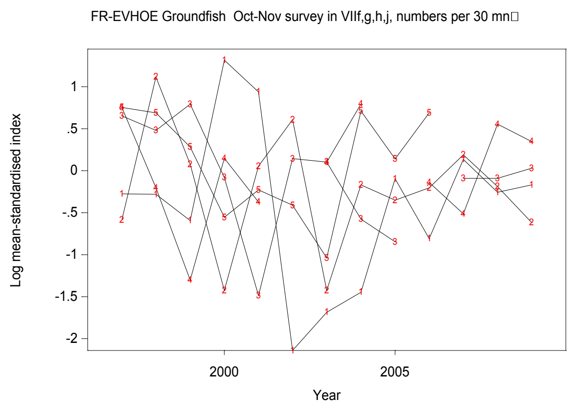
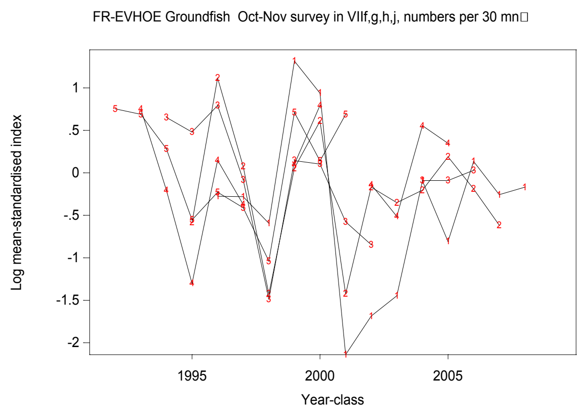
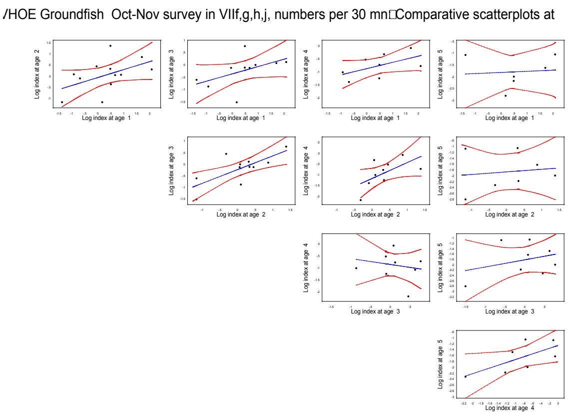
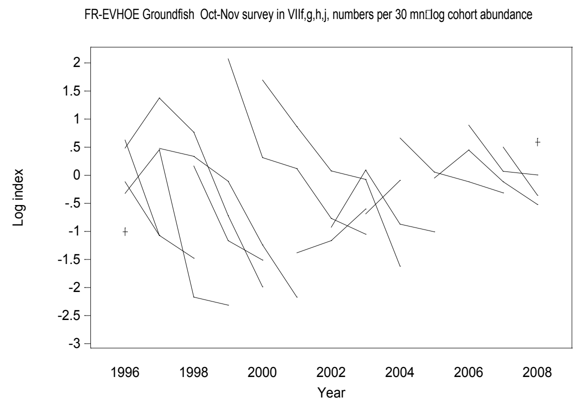


Figure 7.2.3. Cod in Divisions VIIe–k. Percentage of landings accounted for by each age class in Celtic Sea cod over the time-series (Data Source: WGCSE 2009).


FR-EVHOE Groundfish Oct-Nov survey in VIIf,g,h,j, numbers per 30 mn
Log mean-standardised index
Year


FR-EVHOE Groundfish Oct-Nov survey in VIIf,g,h,j, numbers per 30 mn
Log mean-standardised index
Year-class


/HOE Groundfish Oct-Nov survey in VIIf,g,h,j, numbers per 30 mnComparative scatterplots at


FR-EVHOE Groundfish Oct-Nov survey in VIIf,g,h,j, numbers per 30 mnlog cohort abundance
Log index
Year

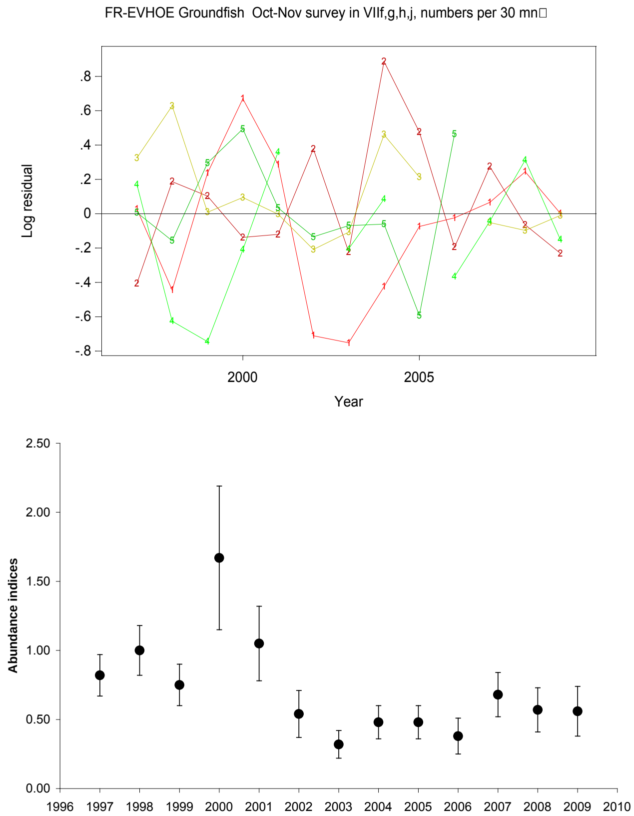


Figure 7.2.4a. Cod in VII e–k. Diagnostics SURBA v3.0 plots for FR-EVHOE survey, age groups 1–5. Log mean-standardised indices by year and age class, scatter plots, catch curves, and residuals (Single fleet). Bottom right: Raw abundance indices (number of cods caught per 30 min tow) from the FR-EVHOE survey.

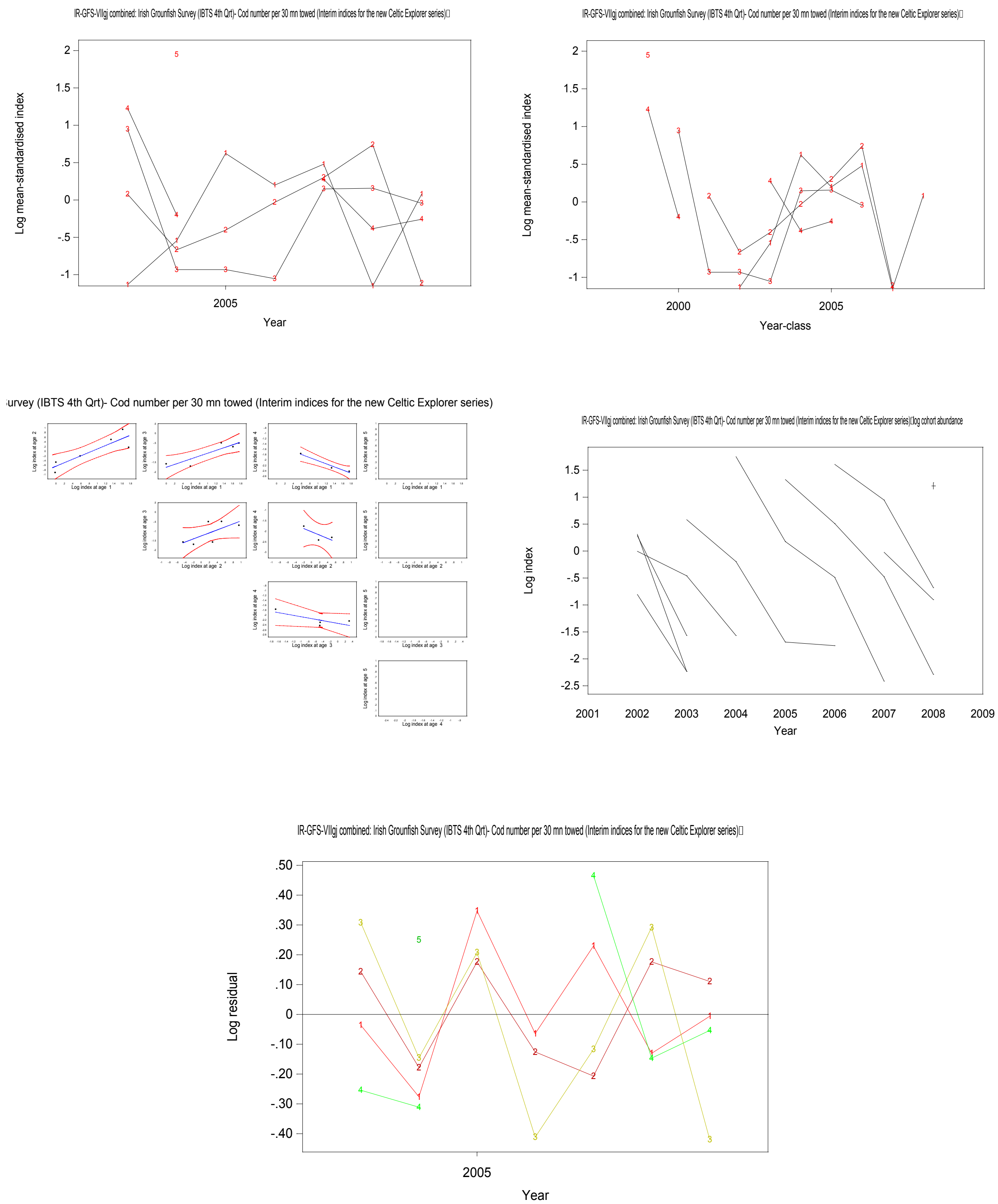


Figure 7.2.4b. Cod in VII e–k. Diagnostics SURBA v3.0 plots for IR-GFS7gj survey, age groups 1–5. Log mean standardised indices by year and age class, scatter plots, catch curves, and residuals. (Single fleet).

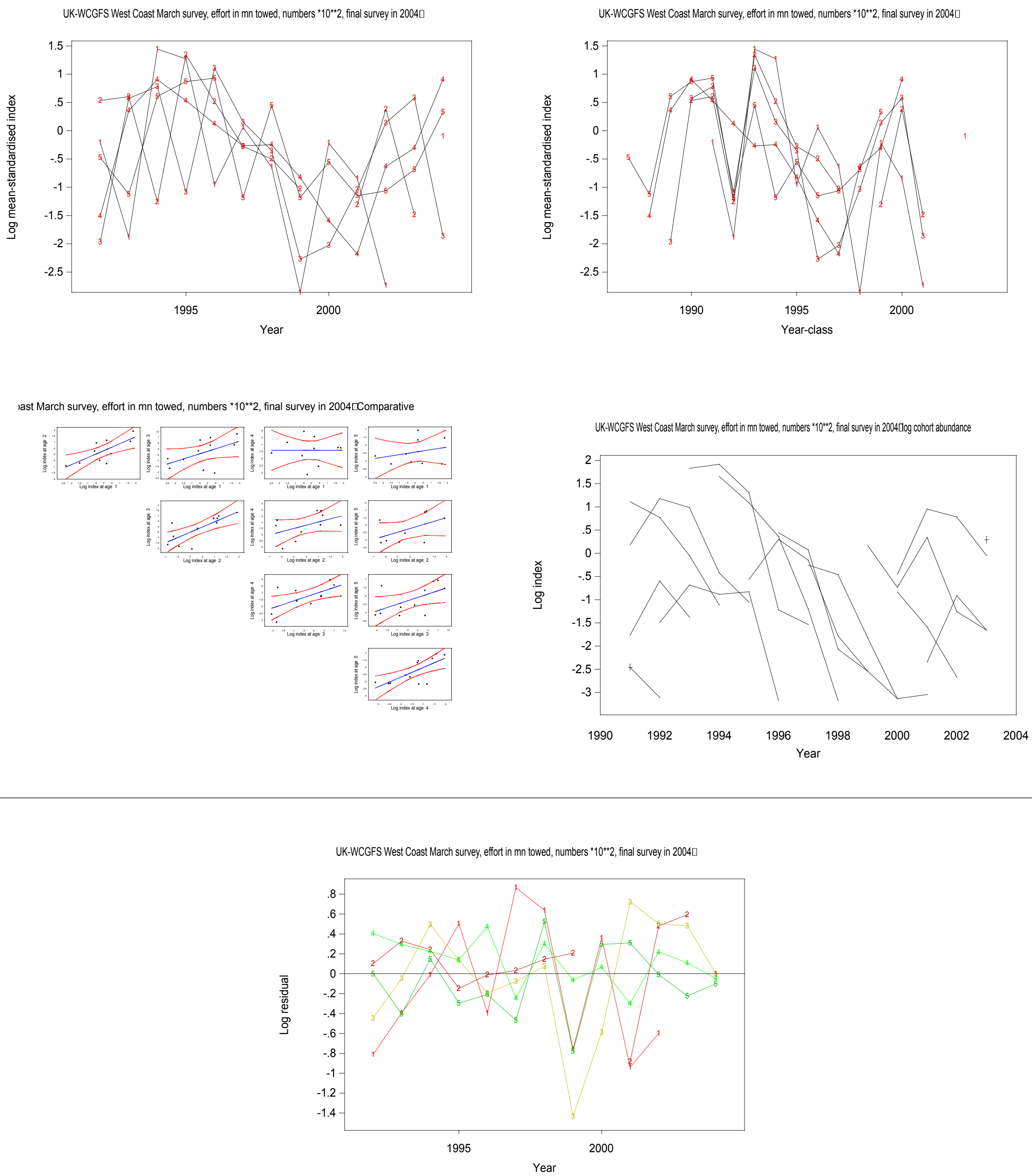
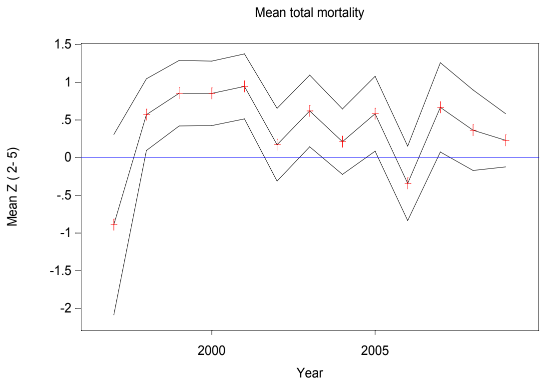
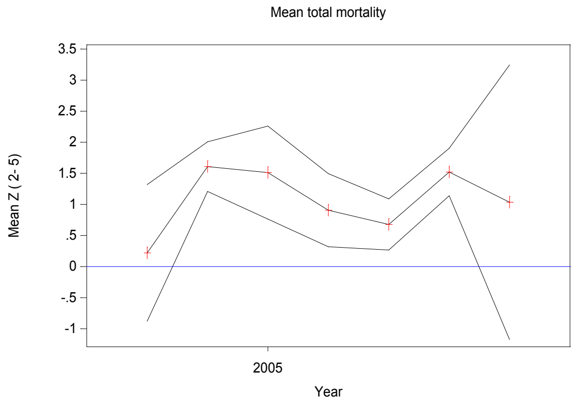


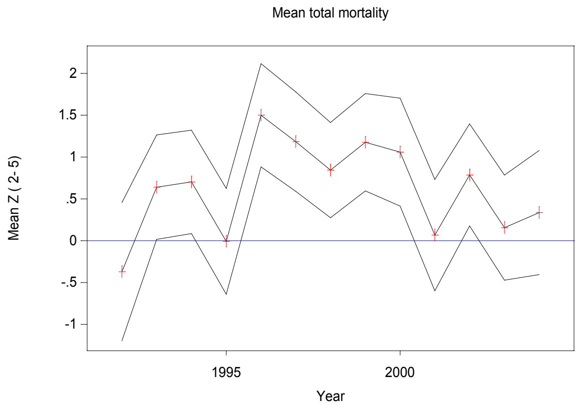
Figure 7.2.4c. Cod in VII e–k. Diagnostics of WGCSE 2009 SURBA v3.0 plots for UKWCGFS survey, age groups 1–5. Log mean standardised indices by year and age class, scatter plots, catch curves, and residuals. (Single fleet).



FR-EVHOE



IR-GFS7g,j



UK-WCGFS WGCSE 2009

Figure 7.2.4d. Cod in VII e–k. Trends of relative mean Z. SURBA v3.0 plots for the 3 surveys used separately.

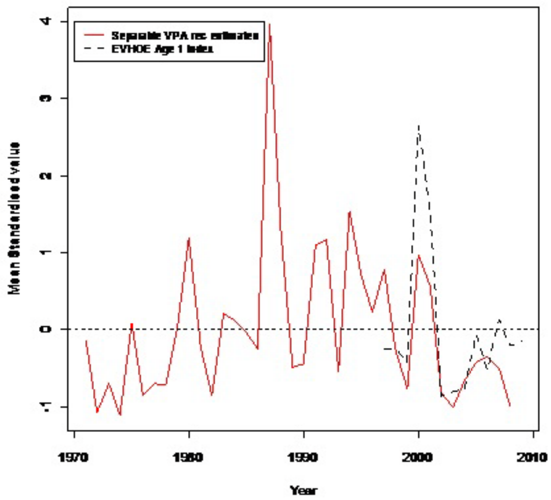


Figure 7.2.4e. Comparative trends of age 1 index of FR-EVHOE survey and recruitment estimates from a Separable VPA run.

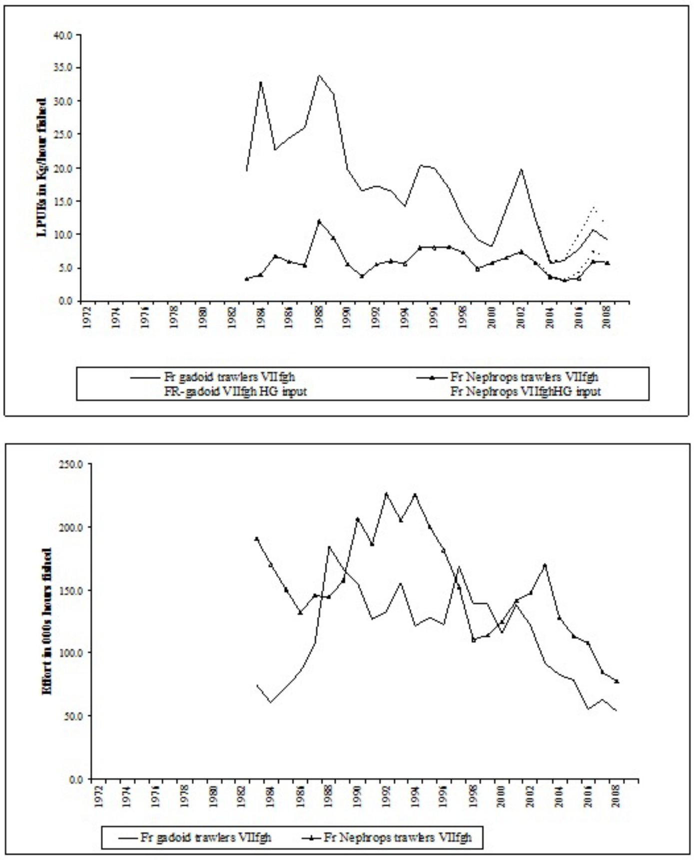


Figure 7.2.5a. Cod in Divisions VIIe–k. Trends of lpues and effort. French Gadoid trawlers and French *Nephrops* trawlers in VIIfgh.

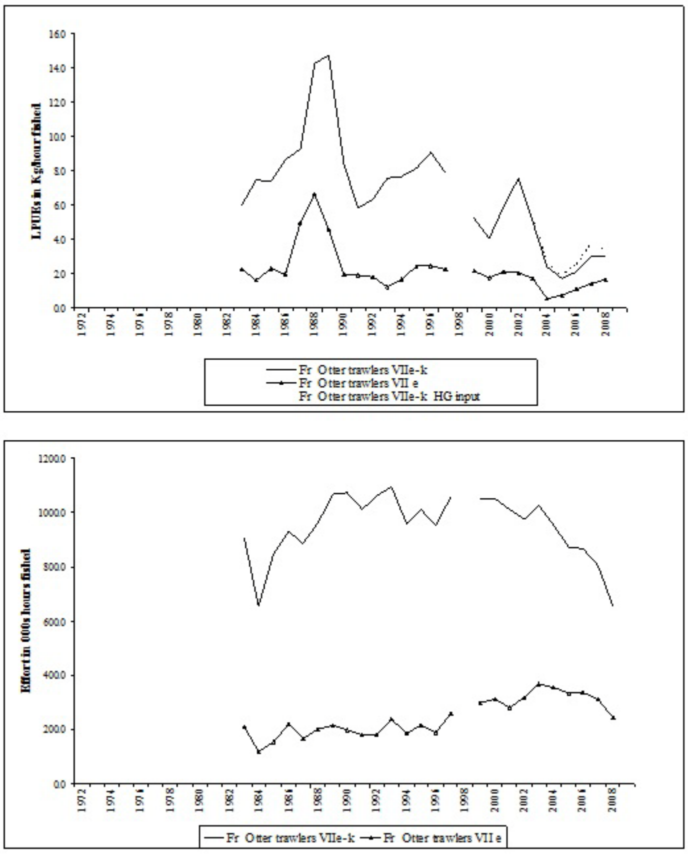
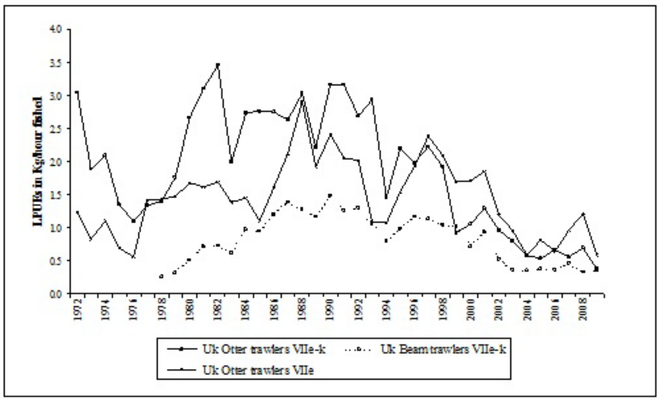


Figure 7.2.5a. Continued. Cod in Divisions VIIe–k. Trends of lpues and effort. French otter trawlers in VIIe–k (including Gadoid trawlers and *Nephrops* trawlers in VIIfgh) and French otter trawlers in VIIe.



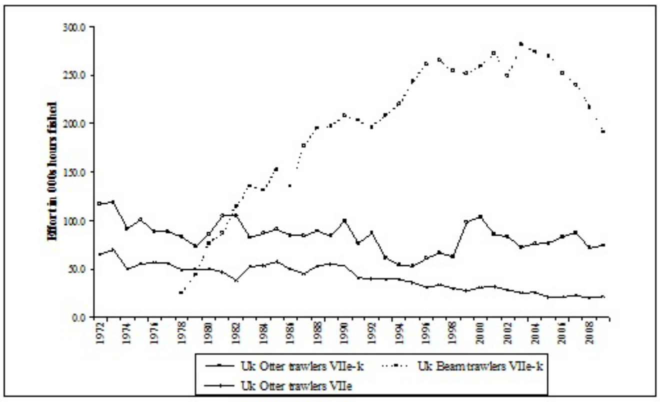


Figure 7.2.5a. Continued. Cod in Divisions VIIe–k. Trends of lpues and effort. UK otter trawlers in VIIe–k and VIIe, UK beam trawlers in VIIe–k.

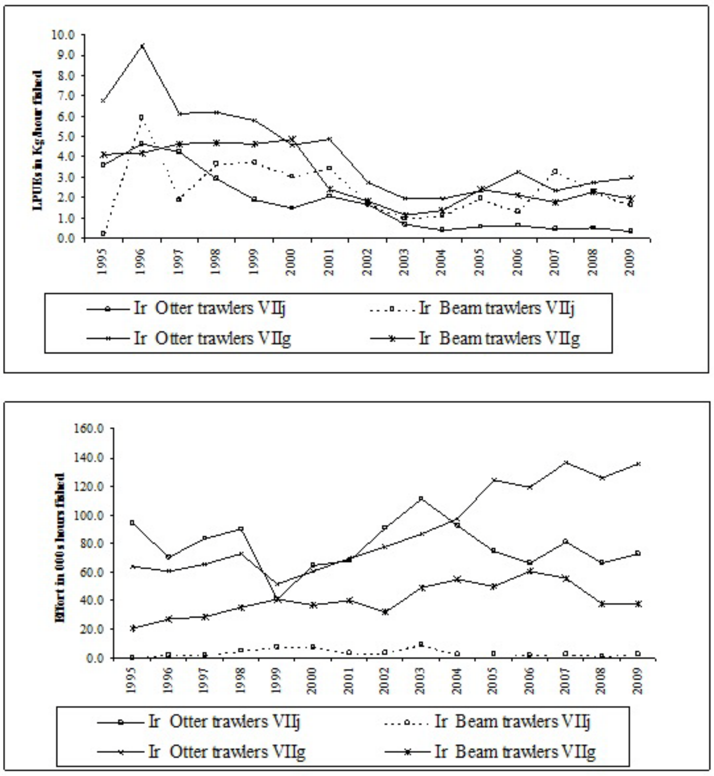


Figure 7.2.5b. Cod in Divisions VIIe–k. Trends of lpues and effort. Irish otter trawlers in VIIg and VIIj, Irish beam trawlers in VIIg and VIIj.

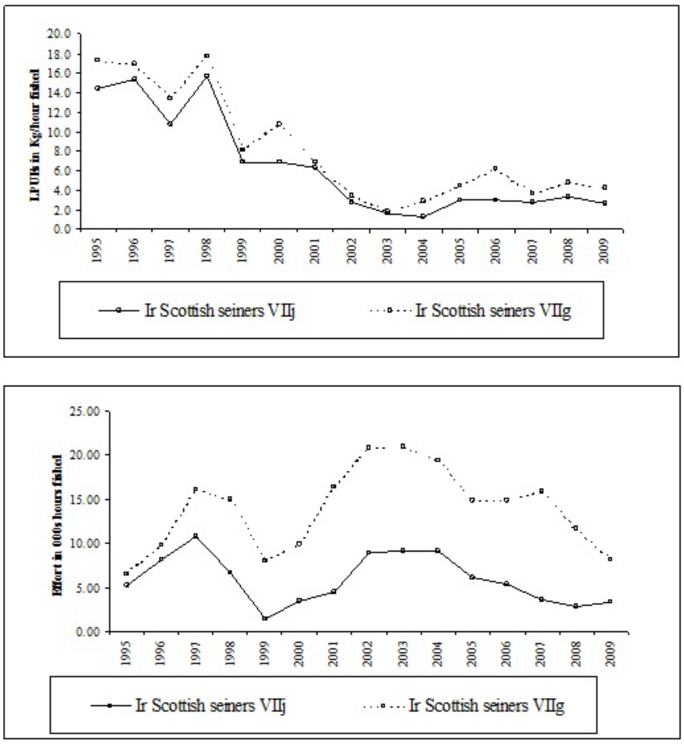


Figure 7.2.5b. Cod in Divisions VIIe–k. Trends of lpues and effort. Irish Scottish seiners in VIIg and VIIj.

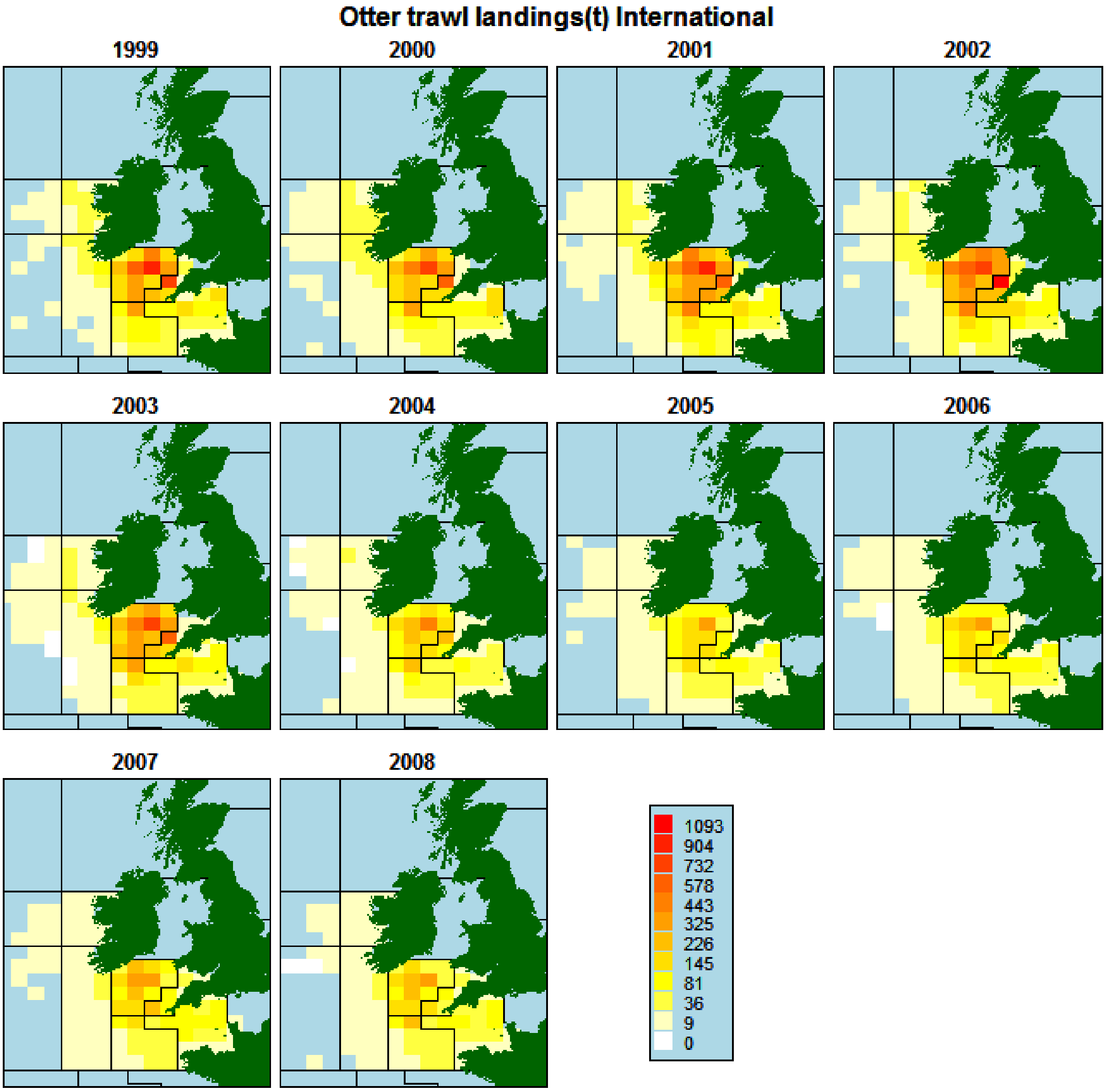


Figure 7.2.6. Cod in VII e–k. Distribution of landings by otter trawlers in the TAC area.

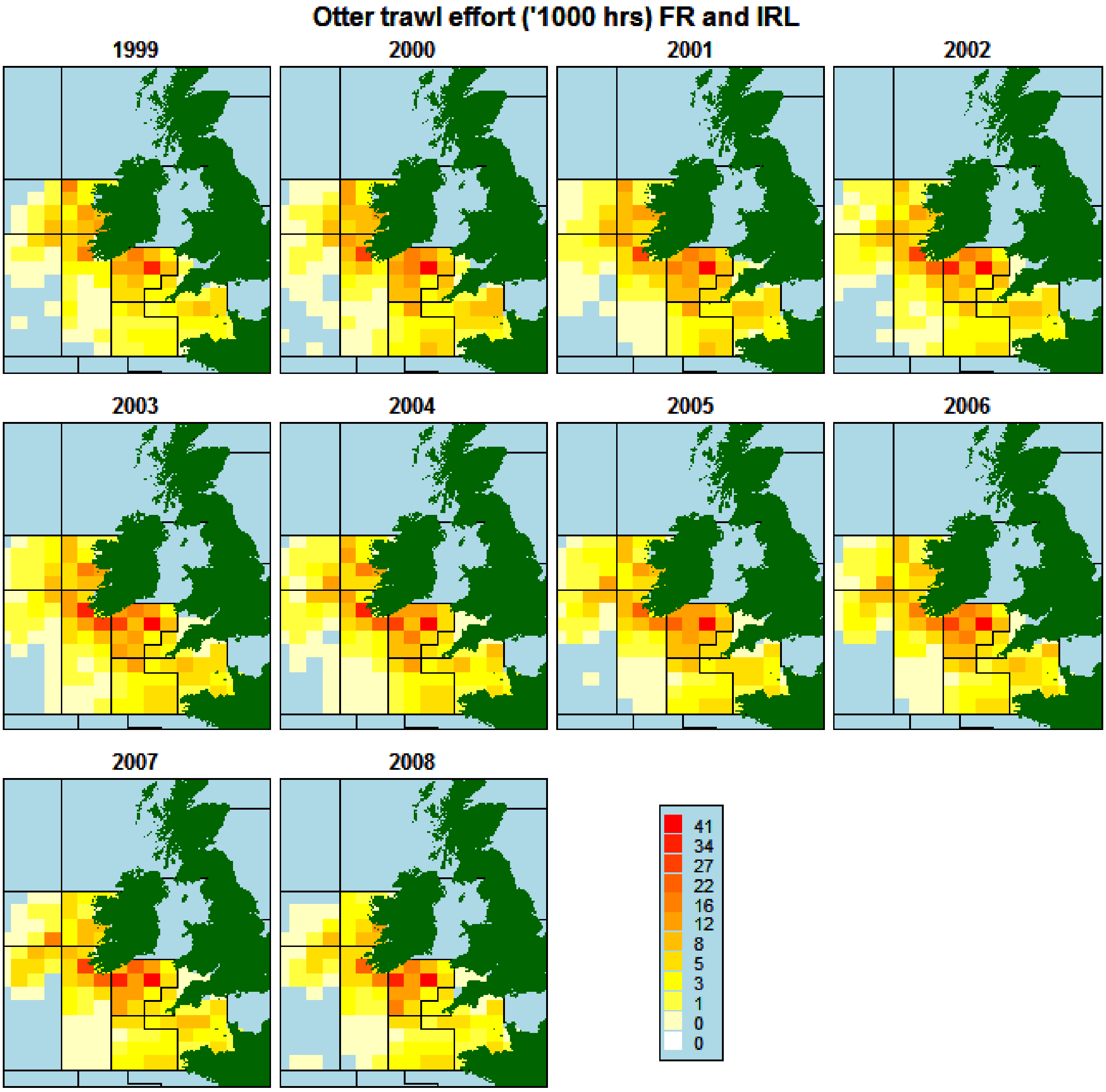


Figure 7.2.7. Cod in VII e–k. Distribution of effort by French and Irish otter trawlers in the TAC area.

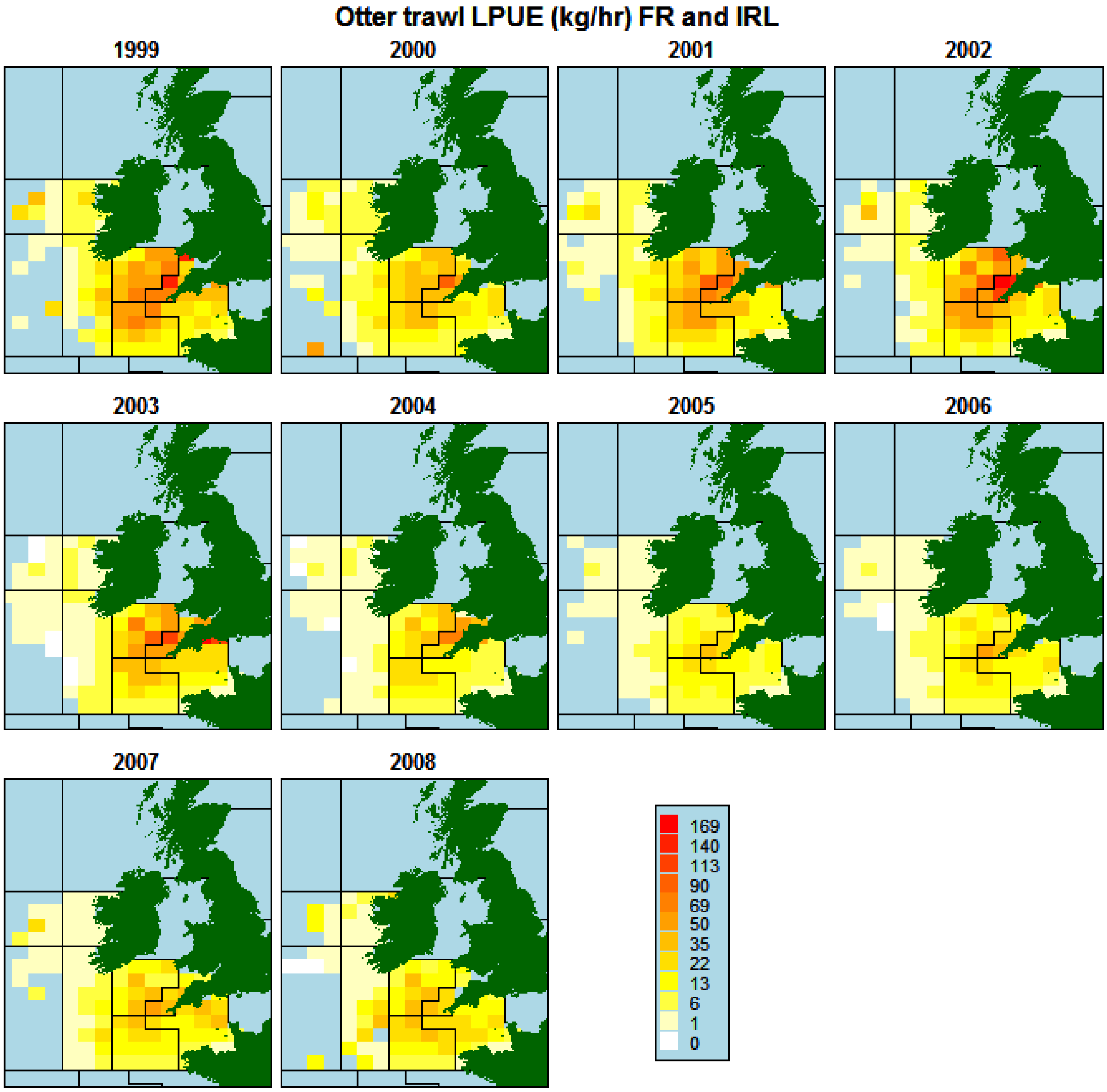


Figure 7.2.8. Cod in VII e–k. Distribution of lpues by French and Irish otter trawlers in the TAC area.

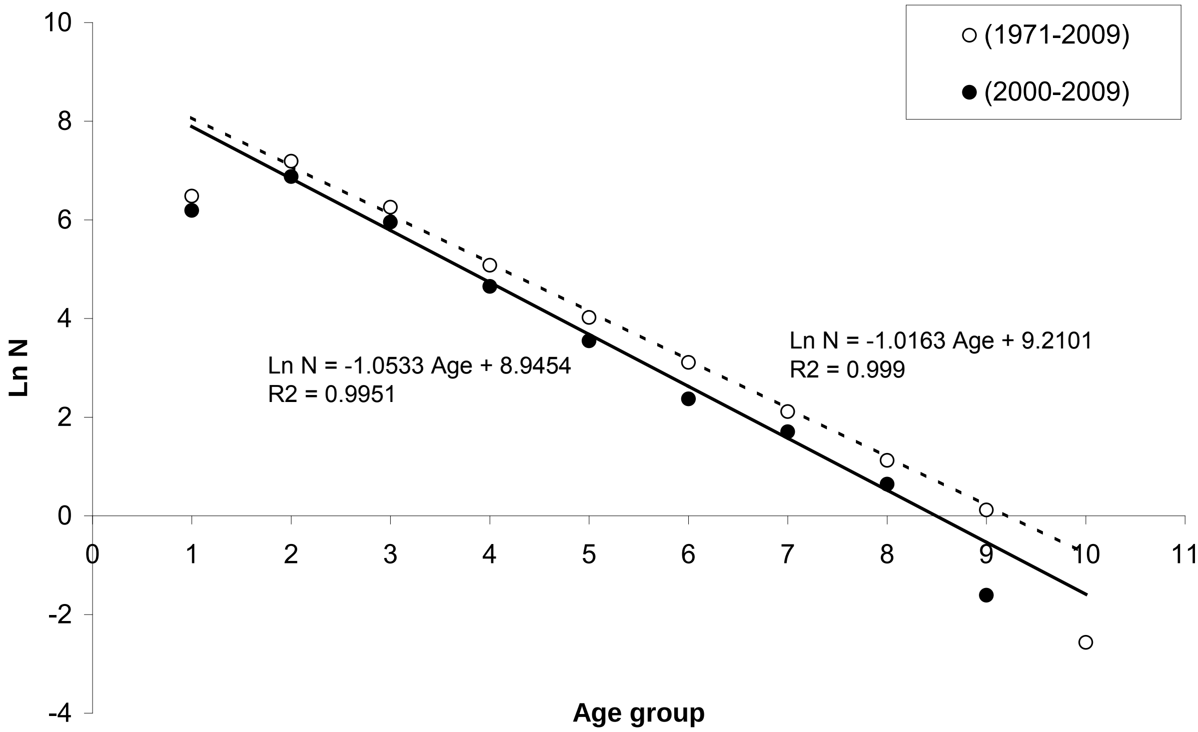
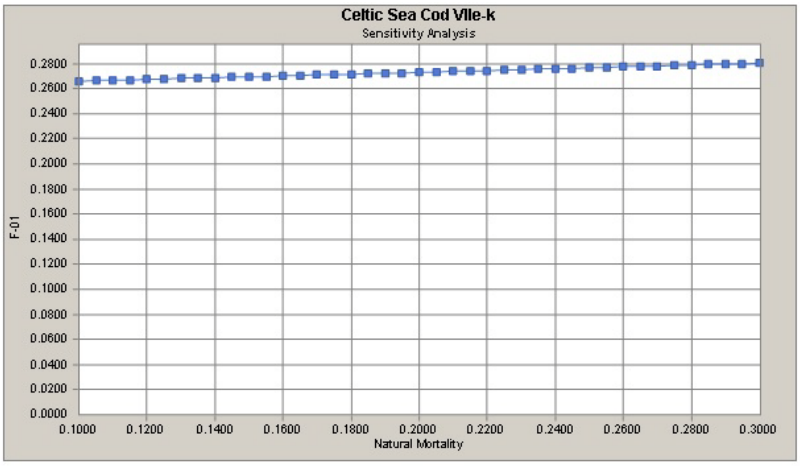


Figure 7.2.9. Exploratory catch curve analysis on 1971–2009 and 2000-2009 Celtic Sea cod catch-at-age data.

Figure 7.2.10. Cod in VIIe–k. Exploratory yield and SSB per recruit.



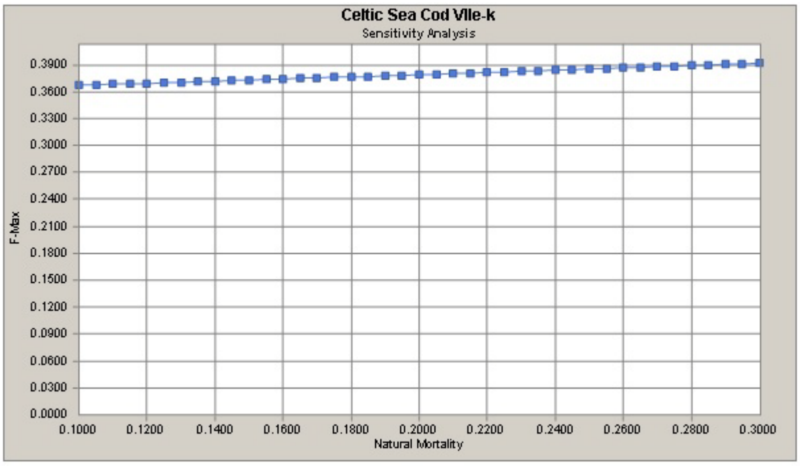


Figure 7.2.11. Cod in VIIe–k. Sensibility analysis on F_{max} and $F_{0.1}$ to a change in natural mortality.

7.3 Cod in Divisions VIIb, c

Type of assessment: No assessment

The nominal landings are given in Table 7.3.1.

Table 7.3.1. Landings (t) of cod in Division VIIb,c for 1995–2009 as officially reported to ICES.

Country	1995	1996	1997	1998	1999	2000	2001	2002
France	91	115	71	44	…[1]	46	38	54
Germany	-	-	3	-	-	-	-	-
Ireland	282	353	177	234	154	141	107	59
Netherlands	-	-	-	-	-	-	+	-
Norway	3	1	6		11	+*	1	5
Spain	6	3		6	2	3	1	1
UK(E/W/NI)	25	35	37	25	4	4	2	1
UK(Scotland)	66	12	7	9	1	-		1
UK								
Total	473	519	301	318	172	194	150	122

Country	2003	2004	2005	2006	2007	2008	2009
France	33	13	13	10	18	14	
Germany							
Ireland	59	60	32	16	11	18	17
Netherlands	1						
Norway				1	1		
Spain							
UK(E/W/NI)	8		0	1	2	1	
UK(Scotland)	1	10		0			
UK							0
Total	102	83	45	28	32	33	17

[1]See VIIg-k.

7.4 Haddock in Divisions VIIb–k

Type of assessment in 2010

Update.

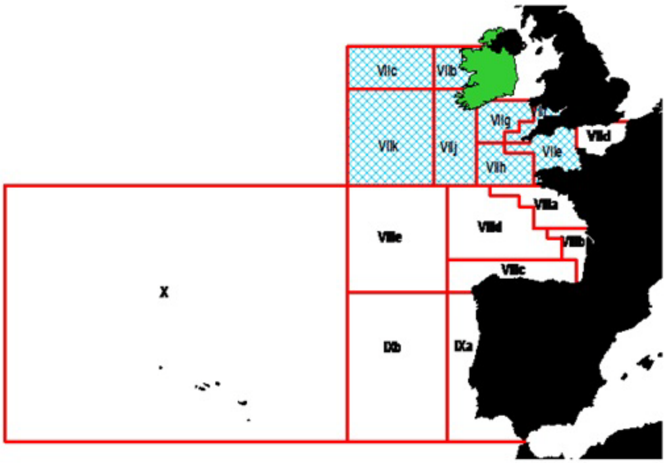
ICES advice applicable to 2009 and 2010

"Last year's advice remains unchanged: Future catches and SSB will be highly dependent on the strength of incoming year classes and their discard mortality. No strong recruitment has been observed since 2002 and estimated recruitment for 2006 is the lowest since 1997. In this context the stock should be managed by ensuring that fishing effort is not allowed to increase."

7.4.1 General

Stock description and management units

The basis for the stock assessment Area VIIb-k is described in detail in the Stock Annex. The TAC for haddock is set for all of Subarea VIIb–k, VIII, IX and X, which does not correspond to the stock assessment area (VIIb–k). However, official international landings from VIII, IX and X have been less than 2% of all landings in the TAC area in most years since 1973.



Red Boxes-TAC/Management Areas   Blue Shading– Assessment Area.

Management applicable to 2009 and 2010

TAC table 2009

Species: Haddock *Melanogrammus aeglefinus*		Zone: VIIb-k, VIII, IX and X; EC waters of CECAF 34.1.1 (HAD/7X7A34)
Belgium	129	
France	7 719	
Ireland	2 573	
United Kingdom	1 158	
EC	11 579	
TAC	11 579	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC table 2010

Species: Haddock *Melanogrammus aeglefinus*		Zone: VIIb-k, VIII, IX and X; EU waters of CECAF 34.1.1 (HAD/7X7A34)
Belgium	129	
France	7 719	
Ireland	2 573	
United Kingdom	1 158	
EU	11 579	
TAC	11 579	Analytical TAC

Since 2009, a separate TAC is set for VIIa haddock, previously a separate allocation for VIIa existed within the TAC for VII, VIII, IX and X.

Fishery in 2009

The official landings reported to ICES and Working Group estimates of the landings and discards are given in Table 7.4.1. France did not submit official landings and the Irish official landings (1794 t) appear to be incorrect and were considerably lower than those used by the Working Group (2966 t). France, the UK and Ireland provided minor revisions to the landings figures for 2008. The 2008 landings figure of 7013 t was revised to 7049 t. The 2009 landings were estimated by the WG to be 10 028 t.

Before 2002, the TAC was well in excess of the landings in the TAC area. During 2002, 2003 and 2004 the TAC was reduced to less than 10 000 t and it appeared to be restrictive. (WGSSDS05 provided some qualitative evidence that misreporting was now a problem). During 2005–2008 the TAC was between 11 520 t and 11 579 t and the landings in the TAC area were less than 70% of the TAC. In 2009 the total landings (WG estimates) are still lower than the TAC but the quota appeared to be restrictive for Ireland and Belgium (WG landings of 2966 t and 131 t respectively) but not for France and the UK (WG landings of 6230 t and 703 t respectively).

7.4.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Numbers-at-length

Length compositions of landings were available for haddock landed into Ireland, France and the UK in 2009 (Table 7.4.2; Figure 7.4.1). Length distributions of the various fleets are quite similar.

Discard length distributions for 2008 are shown in Figure 7.4.2. The figure shows that there are considerable numbers of small (<20 cm) haddock in the Irish discards in VIIb and VIIg and in the UK discards. These fish first appeared in the third quarter of 2009 and are likely to be 0-group haddock. The figure also shows that there appears to be considerable discarding of haddock over the minimum landing size by the French gadoid and benthic fleet and the UK fleets.

Discard numbers-at-age

Irish otter trawl discard data were raised to the national level using the number of trips as auxiliary variable as described in the Stock Annex. The numbers of OTB discard trips by year and métier are given in Table 7.4.3a and the total number of OTB trips is given in Table 7.4.3b. Irish discard data from VIIgj were used to estimate international discards by using the ratio of the international effort in VIIe–k to the Irish effort in VIIgj (Table 7.4.3c). French effort data were not available and the average 2006–2008 effort was assumed for 2009.

Figure 7.4.3a shows the Irish discard numbers-at-age and the discard numbers-at-age raised to international levels. Figure 7.4.3b shows the proportions-at-age that are discarded; over the last 10 years 88% of 1-year-olds have been discarded, 49% of 2-year-olds and 16% of 3-year-olds have been discarded. By number, 66% of the total catch was discarded, by weight 41% was discarded (average last 10 years).

Landings numbers-at-age

Landings numbers-at-age were raised using the procedure described in the Stock Annex with the exception of the French data. Due to problems with the French logbooks database, the landings data were not available by quarter and métier. To address this, the annual catch was allocated to quarters using the mean proportion by quarter over the period 2006–2008, which appeared to be reasonably stable. Secondly the sample length distributions within each quarter were assumed to be representative of the landings of each métier.

Landings numbers-at-age are given in Table 7.4.4a, discard numbers-at-age are given in Table 7.4.4b and catch numbers-at-age in Table 7.4.4c. Despite uncertainty about the quality of the discard data, it is possible to track strong year classes in both the discards and the landings-at-age matrices. Figure 7.4.4 shows the age compositions of the catches, the figure shows that discards account for a large proportion of the catch numbers up to age 3.

Mean landings weights-at-age are given in Table 7.4.5a, catch weights-at-age are given in Table 7.4.5b and stock weights are given in Table 7.4.5c.

Biological

The assumptions of natural mortality and maturity are described in the Stock Annex. The maturity ogive used in the assessment is knife-edged at age 2. Irish Q1 survey data from 2004–2009 in VIIbgj (WD 3) suggested a similar maturity ogive for females but also indicated that a significant number of males mature before the age of two.

Surveys and commercial tuning fleets

The surveys are described in the Stock Annex. Available survey indices and tuning fleet data are given in Table 7.4.6. Survey data tuning-series were made available by Ireland, the UK, and France. Commercial tuning fleets were made available by Ireland; the French tuning fleet was not available for 2009 due to problems with the French logbooks database.

The standardised indices are given by year in Figure 7.4.5a and by cohort in Figure 7.4.5b. In addition to the indices that were used in the assessment, the Irish Groundfish Survey (IGFS–IBTS-EA-4Q) indices in VIIb and VIIj are shown. The EVHOE–IBTS-EA-4Q survey is noisy and has a strong year-effect in 2000 but on further analysis did show patterns that were consistent with other surveys, particularly for ages 0, 2, 3 and 4.

Figure 7.4.6 shows the standardised recruitment (age 0) indices for the EVHOE, SAGFS and IGFS VIIj surveys (the latter is not used in the assessment). All surveys indicate that the 2009 recruitment is the highest in the time-series. The EVHOE survey estimates the 2009 cohort to be 4½ times as high as average recruitment over the rest of the survey time-series, the SAGFS estimates it to be nearly seven times higher than average and the IR-GFS VIIj index is nearly eight times higher than average.

Commercial lpue

Effort and lpue data are given in Table 7.4.7 and Figure 7.4.7.

Other relevant data

No specific issues were raised by the industry on VIIb–k haddock.

7.4.3 Historical stock development

Model used: eXtended Survival Analysis (XSA)

Software used: FLR, VPA95

Exploratory data analysis and the assessment were carried out using FLR under R version 2.8.1 with packages FLCore 2.2, FLAssess 1.99–102, FLXSA 1.99–100 and FLEDA 2.0. The final assessment was also run using the Lowestoft VPA95 software.

Data screening

The general approach to data screening and analysis was followed in addition to the data exploration tools available in the FLR package FLEDA. The results of the data screening are available in the folder 'Data\Stock\had-7b–k\Exploratory runs' on SharePoint.

One particular exploratory assessment will be highlighted here: The sensitivity of the assessment to discard data was investigated by setting the catch numbers-at-ages 0, 1 and 2 to zero. For these ages the total mortality is then assumed to be equal to the natural mortality. This exploratory assessment showed virtually identical estimates for F_{bar} 3–5 while SSB and recruitment showed very similar trends. This suggests that the trends-only assessment is not excessively sensitive to inclusion of discard numbers-at-age.

Final update assessment

The final assessment was run with the same settings as last year. The only difference is that no data were available for the French commercial tuning fleet (FR7fgGAD) in 2009.

Input data types and characteristics:

Type	Name	Year range	Age range
Caton	Catch in tonnes	1993–2009	0–8+
Canum	Catch-at-age in numbers	1993–2009	0–8+
Weca	Weight-at-age in the catch	1993–2009	0–8+
West	Weight-at-age at spawning time.	1993–2009	0–8+
Mprop	Proportion of M before spawning	1993–2009	0–8+
Fprop	Proportion of F before spawning	1993–2009	0–8+
Matprop	Proportion mature-at-age	1993–2009	0–8+
Natmor	Natural mortality	1993–2009	0–8+

A plusgroup of 8+ was used. Age group 0 was included in the assessment data to allow inclusion of 0-group indices in the XSA runs. However, catch numbers-at-age 0 were set to zero to avoid spurious F-shrinkage effects at this age.

Model Options:

Option	Setting
Ages catch dep stock size	None
Q plateau	4
Taper	No
F shrinkage SE	1.5
F shrinkage year range	5
F shrinkage age range	3
Fleet SE threshold	0.3
Prior weights	No

Tuning data:

Type	Name	Year range	Age range
Survey	UK7efghjWCS	1996–2004	Not used
Survey	FR7fghjEVHOE	1997–present	0–5
Survey	IR7bjWCGFS	1999–2002	Not used
Survey	IR7gSAGFS	1999–present	0–5
Survey	IR7bIGFS	2003–present	Not used
Survey	IR7jIGFS	2003–present	Not used
Commercial	IR7bjOTB	1995–present	2–7
Commercial	FR7fghGAD	2002–2008	2–6

The XSA diagnostics are given in Table 7.4.8. The estimated fishing mortality is quite variable. The catchability regressions and residuals are given in Figure 7.4.8, the residuals are relatively large and some year effects are apparent. The catchability regression for age 7 is very tight, suggesting that the model adjusts the population numbers at that age to the tuning data. Increasing the fleet SE threshold can prevent this; however the assessment results do not change noticeably when the SE is increased therefore last year's settings were not changed.

The weighting applied to the terminal survivor estimates is shown in Figure 7.4.9. The 2009 cohort takes equal weight from the two surveys. The French Gadoid fleet gets relatively little weight because no 2009 data were available. F-shrinkage does not account for much of the weighting in any of the cohorts.

The retrospective analysis was run back to 2002. The results are shown in Figure 7.4.10. Recruitment in 2002 was initially estimated to be very high (similar to 2009) but was subsequently reduced as more data became available. The survey tuning fleets consist of short time-series which might account for a larger retrospective changes in the estimated recruitment early in the time-series than in more recent years. F_{bar} was consistently revised upwards up to 2005 but has not shown a retrospective pattern since.

Comparison with previous assessments

The XSA settings have not changed since 2007 and revisions to previous years' data were minor. This year's assessment did not have any 2009 data for the French gadoid tuning fleet. The last year's estimates of F_{bar}, SSB, and recruitment have not changed significantly.

State of the stock

The state of the stock is not precisely known. However SSB has shown an increasing trend over the time-series.

The stock summary is given in Table 7.4.9 and Figure 7.4.11. Following good recruitment in 1999, 2001 and 2002 the SSB and catch increased, however, due to high discarding, the landings (and TAC) did not increase in line with the increased stock levels. Recruitment also has been relatively high in 2007–2008 and the catches in 2009 have increased, but most of these catches were discarded. Recruitment of the 2009 year class appears to be exceptionally good, however under the current discarding pattern it is likely that many of these fish will be discarded before they are of marketable size.

7.4.4 Short-term projections

Short-term projections are presented here for reference only; they are not considered reliable for the following reasons:

- It appears that the 2009 cohort is exceptionally strong; however the accuracy of the recruitment estimate is unknown and will have a very large influence on the short-term forecast. The last time that similar recruitment was retrospectively estimated was in 2001 when the survey tuning fleets series were still very short.
- Recruitment of haddock is characterised by sporadic events, therefore the use of geometric mean recruitment (1993–2007) for 2010–2012 is questionable.

Short-term projections were performed using MFDP1a software.

Recruitment for 2010–2012 was estimated at 36 586 (GM 93-07; thousands). Three year averages were used for F and weights-at-age. Input data for the short-term forecast are given in Table 7.4.10. Landings and discard numbers and weights were supplied separately. Table 7.4.11 gives the management options. The short-term forecasts are highly influenced by the strong 2009 year class. Estimates of the relative contribution of recent year classes to the 2011 landings and 2012 SSB are shown in Table 7.4.12. The high recruitment in 2009 accounts for 85% of the projected landings in 2011 and for 67% of the SSB in 2012.

Conclusion: the short-term projections and management options are highly dependent on the accuracy of the estimated size of the 2009 cohort and are not considered to be reliable.

7.4.5 MSY evaluation

There are a number of major points that should be considered when interpreting the MSY analysis:

- Haddock stocks are characterised by extreme recruitment events; recruitment modelled from a stock–recruitment (SR) relationship is therefore only a useful concept in the long term. Additionally, the time-series is quite short and there is little information to inform the SR model.
- The yield in this analysis refers to landings only and is based on the current selectivity pattern. If the selectivity is improved, the MSY reference points will change.
- The assessment is accepted for trends only and that F reference points should therefore only be interpreted in a broad sense, i.e. current F appears to be well above any candidate F target reference point.

MSY estimates were evaluated using the srmsymc ADMB package.

Yield and F_{bar} refer to landings only. The potential yield of the discards is not taken into account nor is the mortality due to discarding. F_{msy} in this context is therefore the F at which the landings are maximised while accepting a continuation of current discard mortality. Figure 7.4.12 illustrates the estimates of the catch, landings and discard components of F and the selectivity patterns estimated from them.

The R-package FLBRP was used to investigate the sensitivity to the averaging options to YPR estimates. Figure 7.4.13 shows that the F target reference points did not appear to be very sensitive to the number of years used to estimate average F and average weights-at-age so the default three-year averaging period was maintained.

Figure 7.4.14 shows three stock–recruitment relationships fitted by srmsymc. There is little information in the data to inform the shape stock–recruit relationship and no single model provided the best mathematical fit (Table 7.4.13 provides AIC values for all three models). Sporadic exceptional recruitment is a feature of many haddock stocks; therefore the 2009 recruitment was retained although it had a large influence on the fit of the SR models.

Figures 7.4.15 to 7.4.17 show box plots of F_{msy} and F_{crash} as well as F_{pa} and F_{lim}. Table 7.4.13 summarises the MSY evaluation. The BH and hockey stick models estimate current F to be above any of the candidate F reference points but the Ricker model suggests that F_{msy} is above current F. The Ricker model assumes impaired recruitment at high stock levels and therefore arrives at higher F_{msy} than the other models. This level of F_{msy} overlaps with the confidence limits of F_{crash} and is therefore not an appropriate F target. Therefore the Ricker model was rejected. The BH and hockey stick models both result in F_{msy} estimates that are below current F.

Conclusion: The stock–recruit relationship of haddock is not well captured by any of the models and the underlying data do not support the provision of absolute estimates of F_{msy}. However it is likely that current F is above F_{msy}.

7.4.6 Biological reference points

Precautionary approach reference points

It is not possible to derive precautionary reference points for this stock from the short time-series of information available.

7.4.7 Management plans

No management plan for VIIbk haddock has been agreed or proposed.

7.4.8 Uncertainties and bias in assessment and forecast

Landings

The sampling levels of landings for countries supplying data for 2009 are given in Table 2.1. Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches, although the assessment is contingent on the accuracy of the landings statistics. The French landings data were not fully available and the catch numbers-at-age data were raised using an *ad hoc* approach as described in 7.4.2. The aggregated landings data were fully available; however, the lack of quarterly and métier data means that the weighting of the sampling data might be inaccurate. It is difficult to estimate how this will have affected the assessment.

Discards

Sampling levels for discarding are low, resulting in a high level of variability. Discards account for more than half of the catch weight in some years and it is therefore very important that they are taken into account. France and the UK have collected discard data in recent years and WD3 (WGCSE09) provides a comparison of the French and Irish discarding data. The method of raising discards data used here has a few undesirable features. Firstly, the data is only from the Irish OTB fleet and this fleet is not the largest component of the overall fishery, although otter trawlers in general do account for most of the haddock VIIb–k fishery. Secondly, a small number of discard trips was raised to account for a very large component of the catch data. The level of variability is unknown but likely to be high. Finally, raising data to international levels using effort, assumes that discard rates per hour trawled of the Irish OTB fleet are similar to all other fleets. It is known that the lpue of the French gadoid fleet is much higher than that of the other fleets so it is likely that the cpue is different as well. The French fleets mainly use >=100 mm mesh size while the Irish fleets use both 80 mm and 100 mm mesh. Nevertheless, the discard-at-age matrix did allow tracking of cohorts and there does seem to be merit in including them in the assessment, despite the reservations outlined above. The sensitivity of the assessment to discard data was investigated during the data exploration by running an assessment with the same settings as the final assessment but excluding the age classes for which significant discarding takes place. The results suggest that the current trends-only assessment is not particularly sensitive to inclusion of discard numbers-at-age.

Surveys

None of the available surveys cover the full assessment area. The EVHOE survey covers the southern end of the area (VIIh+f and the southern part of VIIg+j) while the SAGFS only covers VIIj. The IGFS in VIIb and VIIj is not presently included but should be considered at the next Benchmark.

Forecast

The short-term forecast is heavily dependent on the accuracy of the estimated size of the 2009 year class. There is insufficient information to predict whether this estimate is likely to be revised downwards in future.

7.4.9 Recommendation for next Benchmark

Review Group comments

Comments from the Review Group were addressed as far as possible without performing a benchmark assessment. The Stock Annex was amended to take some of the Review Group comments into account.

Recommendations for future work

It is unlikely that the precision and accuracy of the historical discard data can be improved significantly by further analysis and until the time-series of international discards is long enough and of sufficient quality, no benchmark assessment will be proposed. However the following issues can be explored in preparation for any future benchmark.

- Methods of including the French discard data into the assessment need to be investigated and bias in the historical discard (before French data became available) data needs to be investigated and addressed. A first step towards this goal is presented in WGCSE WD3, which concludes that the Irish fleets catch and discard more 1-year-old haddock than the French fleets. The current procedure of raising the Irish discard numbers-at-age is therefore likely to overestimate the number of 1-year-olds.
- The two survey tuning fleets (EVHOE and SAGFS) show very good agreement on the trends in the 0-group (Figure 7.4.6). The new Irish Groundfish Survey in VIIb and VIIj (IRGFS; not used in the analysis) generally agrees with the other surveys. It is believed that a significant amount of recruitment takes place in VIIb and the north of VIIj, these divisions are not covered by the EVHOE or SAGFS indices; therefore it would be worth considering including the IRGFS index at the next Benchmark Assessment.
- EVHOE tuning fleet data from 1997 to 2000 are based on Irish survey Age–Length Keys. The time-series is now sufficiently long to omit these years.
- Commercial tuning fleets might be improved by selecting a subset of vessels that have a consistent spatial and temporal effort and catch composition over a significant period of the time-series. This would require a detailed analysis of vessel behaviour.
- The Review Group suggested that *"a model that allows for catch by multiple fleets should be developed to account for differences between countries and gear types. The RG suggests that in order to account for numerous fleets a forward projection, statistical catch-at-age model should be considered in the next benchmark assessment, because it may be a more appropriate method than the XSA model due*

to its increased flexibility. In addition, such a model will allow for error in catch-at-age, which is important for a fishery with such high and uncertain levels of discards. It might also be possible under such a framework to more readily and easily include all the surveys, even those for which sampling has been discontinued."

7.4.10 Management considerations

Management by TAC is inappropriate for this stock because landings, but not catches, are controlled.

Discarding is a serious problem for this stock; over the last 10 years 66% of the catch has been discarded (41% by weight). The discard rate of one-year-olds was 88%; two-year-olds 49% and three-year-olds 16% by number.

An increase in mesh size to reduce discarding will be beneficial to this stock and could increase the yield considerably. Reduced selectivity on younger ages would reduce discarding and would promote stock increase when strong year classes occur. In Celtic Sea fisheries, some fleets are using 80 mm mesh to target *Nephrops*, 90 mm mesh in mixed fisheries and 100 mm to target gadoids and other species. Recent gear trials have shown that square mesh panels can significantly reduce discards of undersized haddock when using *Nephrops* gear (BIM, 2009). WGSSDS 08 has pointed out that the selection L50 for 90 mm mesh for haddock in VIIg is 19 cm, which is well below the MLS of 30 mm. In order to minimise discards, a square mesh panel of at least 120 mm should be introduced for the *Nephrops* fleet and a minimum mesh size of at least 100 mm with a square mesh panel of at least 110 mm for all other fleets.

The TAC has not been restrictive in recent years but in 2009 the national quota of Ireland and Belgium appeared to have become restrictive. The catches are likely to increase as the 2009 cohort enters the fishery; a restrictive TAC is likely to result in high-grading in addition to discarding of fish below MLS.

7.4.11 References

BIM. 2009. Summary report of Gear Trials to Support Ireland's Submission under Articles 11 & 13 of Reg. 1342/2008. *Nephrops* Fisheries VIIa & VIIb–k. Project 09.SM.T1.01. Bord Iascaigh Mhara (BIM) May 2009.

Table 7.4.1. Landings (t) of haddock in VIIb–k, officially reported to ICES and the landings used by the Working Group.

	Official landings						Un-	Used by WG		
Year	**Belgium**	**France**	**Ireland**	**UK**	**Others**	**Total**	**allocated**	**Landings**	**Discards**	**Catch**
1984	0	3328	646	403	549	4926				
1985	4	2438	794	175	565	3976				
1986	6	2279	317	245	86	2933				
1987	12	2380	314	273	0	2979				
1988	64	3275	275	409	0	4023				
1989	117	3412	323	295	27	4174				
1990	22	2110	461	318	31	2942				
1991	18	1508	1020	250	97	2893				
1992	21	1461	1073	306	26	2887				
1993	51	1839	1262	256	0	3408	-60	3348	1193**	4541
1994	123	2788	908	240	17	4076	55	4131	1193**	5324
1995	189	2964	966	266	83	4468	2	4470	472	4942
1996	133	4527	1468	439	86	6653	103	6756	1403	8159
1997	246	6581	2789	569	85	10270	557	10827	2120	12947
1998	142	3674	2788	444	312	7360	308	7668	356	8025
1999	51	2725	2034	278	159	5247	-365	4882	625	5507
2000	90	3088	3066	289	123	6656	755	7411	7057	14468
2001	165	4842	3608	422	665	9702	-1070	8632	1952	10584
2002	132	4348	2188	315	106	7089	-686	6403	7468	13871
2003	118	5781	1867	393	82	8241	-95	8146	8221	16367
2004	136	6130	1715	313	159	8453	128	8581	5371	13952
2005	167	4174	2037	292	197	6867	-219	6648	2563	9212
2006	99	3190	1875	274	209	5647	-264	5383	2092	7474
2007	119	4142	1930	386	52	6629	-119	6510	3252	9762
2008	108	3639	1800	566	121	6234	815	7049	9302	16350
2009*	131	-	1794	715	1	2641	7387	10028	7095	17123

	Landings used by WG					
Year	Belgium	France	Ireland	UK	Others	Total
2002	134	3878	2070	301	21	6403
2003	116	5960	1667	362	41	8146
2004	137	6336	1732	303	73	8581
2005	165	4096	1991	282	20	6555
2006	98	3151	1857	262	14	5383
2007	118	4073	1925	383	10	6510
2008	109	4587	1794	545	14	7049
2009	128	6230	2966	703	2	10028

Table 7.4.2. Length frequency distributions ('000) of the landings of haddock in VIIb–k in 2009. FR GAD is the French gadoid fleet, IRL OTB is the Irish otter trawl fleet, UK trawl includes all trawl gears except beam trawl.

	FR GAD VIIfgh	IRL OTB VIIb	IRL OTB VIIg	IRL OTB VIIj	UK Trawl VIIe-k	UK Beam VIIe-k
	Landings	Landings	Landings	Landings	Landings	Landings
Length (cm)	4490	252	1329	575	579	109
24	0.0	0.1	0.0	0.3	0.0	0.0
25	0.0	0.3	0.0	0.9	0.0	0.0
26	0.0	0.2	0.0	6.4	0.0	0.0
27	1.3	1.2	0.2	21.8	0.0	0.0
28	47.0	3.8	3.0	30.7	0.0	0.0
29	150.7	6.6	6.4	47.4	0.6	0.4
30	240.4	12.8	15.3	48.6	0.6	1.0
31	266.3	15.0	30.2	41.0	3.6	3.0
32	353.7	17.1	67.3	49.0	18.1	3.8
33	455.6	16.8	90.5	44.0	39.8	6.5
34	582.6	18.7	119.0	56.8	71.2	7.1
35	597.8	21.4	150.1	62.7	55.4	9.0
36	548.7	26.9	156.5	73.9	60.2	10.4
37	497.5	26.4	160.1	68.5	68.9	7.9
38	410.5	27.0	133.1	60.9	60.1	10.3
39	417.4	24.0	119.2	64.5	57.3	7.8
40	414.9	21.7	115.5	45.4	71.9	6.8
41	278.0	19.4	91.1	35.2	66.8	7.1
42	227.2	19.7	86.0	28.3	47.4	4.8
43	164.3	14.5	70.1	26.2	43.4	4.3
44	148.7	12.1	68.5	21.5	40.1	4.2
45	202.2	8.9	51.2	18.2	30.0	4.0
46	144.7	6.9	47.3	16.7	19.7	3.4
47	130.1	7.0	34.8	14.3	17.8	3.7
48	70.6	6.9	36.3	13.7	7.0	3.5
49	72.4	3.7	23.7	10.1	6.4	2.6
50	63.0	3.6	27.8	8.1	10.7	2.2
51	61.4	3.3	21.1	6.8	13.1	2.0
52	61.2	2.7	11.0	8.6	7.3	1.8
53	37.6	3.5	12.6	4.7	4.2	1.4
54	39.1	2.7	14.6	2.9	0.8	1.6
55	32.5	2.8	12.1	4.2	0.0	1.6
56	16.1	1.9	8.9	2.0	0.0	1.3
57	15.9	2.1	6.4	3.3	3.1	0.9
58	13.3	2.2	5.4	2.6	0.8	0.9
59	22.0	1.8	5.9	1.1	1.0	0.6
60	10.3	1.1	5.6	1.4	0.0	0.6
61	8.3	0.9	4.5	0.5	0.0	0.4
62	7.0	1.0	3.3	0.9	0.0	0.3
63	11.6	1.2	3.2	0.7	0.0	0.3
64	5.3	0.7	2.0	0.7	0.6	0.4
65	7.4	0.4	1.6	0.4	0.0	0.4
66	3.3	0.6	1.7	0.3	0.0	0.1
67	2.0	0.2	1.4	0.6	1.0	0.3
68	2.4	0.4	1.0	0.3	0.0	0.3
69	4.7	0.1	0.2	0.8	0.0	0.0
70	2.3	0.1	0.3	0.5	0.0	0.0
71	1.2	0.2	0.5	0.3	0.0	0.0
72	1.6	0.2	1.2	0.0	0.0	0.1
73	3.1	0.2	1.2	0.2	0.0	0.2
74	1.2	0.0	0.7	0.0	0.0	0.1
75	0.2	0.0	0.6	0.0	0.0	0.1
76	0.1	0.0	0.5	0.0	0.0	0.0
77	0.6	0.0	0.0	0.3	0.0	0.0
78	0.0	0.0	0.0	0.2	0.0	0.0
79	0.0	0.0	0.3	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0	0.0

Table 7.4.3. Overview of the number of OTB (otter trawl) discard trips, the total number of OTB trips and the raising factor used to raise the Irish discard data to international discards.

a). Number of Irish OTB discard trips by year and metier

Metier	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
OTB VIIb Neph	1	1	0	5	2	2	1	1	2	1	5	6	4	1	0	5	NA	37
OTB VIIbc Dem	0	3	0	0	1	0	0	0	0	0	1	0	0	0	2	1	NA	8
OTB VIIck Neph	1	1	0	0	1	1	2	0	0	0	0	0	0	0	1	1	NA	8
OTB VIIg Dem	3	3	0	0	5	2	1	0	0	0	2	10	7	1	4	1	NA	39
OTB VIIgfh Neph	4	6	0	2	1	1	1	1	2	2	2	2	3	0	10	4	NA	41
OTB VIIj Dem	1	1	2	4	0	2	2	0	2	0	7	3	6	1	2	2	NA	35
OTB VIIj Neph	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	NA	6
Other gears VIIbk	1	0	0	1	3	4	0	0	0	0	3	5	3	0	0	2	NA	22
Total discard trips	11	15	2	12	13	12	7	2	6	3	22	28	25	3	19	16	NA	196

b). Total number of Irish OTB trips by year and Division

Metier	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
OTB VIIb	1352	860	949	1267	1156	1192	1115	941	1468	1333	973	788	990	942	903	16229
OTB VIIg	1834	1763	1913	1979	1342	1408	1474	1732	1773	1891	2337	2308	2825	2843	2641	30063
OTB VIIj	2181	1808	1916	1976	838	1136	1699	1756	2405	2049	1675	1411	2248	2157	2139	27394
Total OTB VIIbgj	5367	4431	4778	5222	3336	3736	4288	4429	5646	5273	4985	4507	6063	5942	5683	73686

c). Effort (per 1000h) and the raising factor used to raise the Irish VIIgj discard data to international discards

Fleet	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
IRL OTB VIIb	56*	56*	65	41	50	64	62	63	61	47	64	60	47	40	41	37	38	817
IRL OTB VIIgj	138*	132*	157	130	148	162	92	125	137	168	198	189	198	185	217	192	208	2376
International VIIe-k**	413	366	394	361	441	413	397	400	413	428	415	384	376	348	389	334	359***	5933
Raising Factor (INT 7ek/IRL 7	3.00	2.78	2.50	2.77	2.97	2.55	4.31	3.19	3.01	2.54	2.09	2.03	1.90	1.88	1.79	1.74	1.73	2.50

* Average of 1995-99

** Includes IRL OTB VIIgj, FR GAD VIIfgh and UK Trawl VIIe-k

*** assuming average effort 2006-8 for France

Table 7.4.4. (a) Catch numbers-at-age of haddock in VIIb–k. (b) Landings numbers-at-age. (c) Discard numbers-at-age. Strong year classes are highlighted.

a) Haddock VIIbk - Landings numbers at age

0	1	2	3	4	5	6	7	8	9	10	
9	494	3311	954	815	257	130	130	42	3	0	#1993
0	1491	2934	870	461	297	66	25	63	0	0	#1994
25	2237	1185	1090	462	581	338	161	44	0	0	#1995
0	2399	10373	1206	648	260	275	126	71	10	10	#1996
0	1581	12102	3119	694	580	239	130	33	42	22	#1997
3	640	3264	6199	846	302	252	179	73	56	6	#1998
0	622	2585	1560	1646	245	80	44	14	3	0	#1999
28	4676	2344	587	535	589	134	23	14	2	0	#2000
11	3998	8036	1053	282	295	298	51	29	7	0	#2001
1	872	4216	3354	760	39	88	73	19	5	2	#2002
16	665	8293	1998	1149	112	42	48	41	10	0	#2003
4	117	5870	4540	881	573	50	12	16	3	0	#2004
0	783	833	4166	1884	436	114	4	13	3	0	#2005
0	831	3313	1431	2106	376	64	7	0	0	0	#2006
0	653	6198	2566	503	827	149	29	3	2	0	#2007
0	1528	3854	4212	914	216	358	65	11	1	0	#2008
0	951	8532	2934	1575	437	188	170	24	3	0	#2009

b) Haddock VIIbk - Discard numbers at age

0	1	2	3	4	5	6	7	8	9	10	
577	3092	1488	95	7	2	0	0	0	0	0	#1993
577	3092	1488	95	7	2	0	0	0	0	0	#1994
12740	1620	81	0	0	0	0	0	0	0	0	#1995
192	4144	1497	42	19	6	0	0	0	0	0	#1996
992	5457	3167	252	8	1	0	0	0	0	0	#1997
423	602	534	33	0	0	0	0	0	0	0	#1998
607	2597	460	7	0	0	0	0	0	0	0	#1999
4737	35484	6935	291	14	0	0	0	0	0	0	#2000
1247	6913	2050	199	14	1	0	0	0	0	0	#2001
11949	22165	6810	978	60	4	0	0	0	0	0	#2002
11303	25087	10001	395	150	0	0	0	0	0	0	#2003
1470	4365	10011	1203	65	79	0	0	0	0	0	#2004
1226	3302	3136	1897	78	0	0	0	0	0	0	#2005
6091	5108	656	0	0	0	0	0	0	0	0	#2006
2171	6532	4052	306	5	5	0	0	0	0	0	#2007
2658	29246	8653	1016	40	0	0	0	0	0	0	#2008
6980	16502	7447	329	41	0	0	0	0	0	0	#2009

c) Haddock VIIbk - Catch numbers at age

0	1	2	3	4	5	6	7	8	9	10	
585	3586	4799	1049	822	259	130	130	42	3	0	#1993
577	4583	4422	965	468	299	66	25	63	0	0	#1994
12766	3857	1265	1090	462	581	338	161	44	0	0	#1995
192	6543	11870	1248	667	266	275	126	71	10	10	#1996
992	7038	15269	3372	702	581	239	130	33	42	22	#1997
425	1242	3798	6232	846	302	252	179	73	56	6	#1998
607	3218	3045	1568	1646	245	80	44	14	3	0	#1999
4765	40160	9279	879	549	589	134	23	14	2	0	#2000
1257	10911	10086	1252	296	296	298	51	29	7	0	#2001
11950	23037	11026	4331	820	43	88	73	19	5	2	#2002
11319	25752	18294	2392	1299	112	42	48	41	10	0	#2003
1474	4482	15881	5742	947	652	50	12	16	3	0	#2004
1226	4085	3969	6062	1962	436	114	4	13	3	0	#2005
6091	5939	3969	1431	2106	376	64	7	0	0	0	#2006
2171	7186	10250	2871	508	832	149	29	3	2	0	#2007
2658	30774	12507	5229	954	216	358	65	11	1	0	#2008
6980	17453	15979	3263	1616	437	188	170	24	3	0	#2009

Table 7.4.5. (a) Mean landings weights-at-age. (b) Mean discard weights-at-age. (c) Mean stock weights-at-age (including discards). A 3-year running average was applied to the stock weights.

a) Haddock VIIbk - Landings weights at age

0	1	2	3	4	5	6	7	8	9	10	
0.141	0.187	0.320	0.556	0.851	1.402	1.693	2.130	2.593	2.325	2.325	#1993
0.000	0.321	0.537	0.869	1.167	1.428	1.990	2.399	2.673	2.593	2.325	#1994
0.156	0.285	0.735	0.932	0.964	1.052	1.284	2.040	2.495	2.673	2.593	#1995
0.000	0.207	0.339	0.689	1.137	1.389	1.450	1.850	2.105	1.835	1.415	#1996
0.000	0.321	0.442	0.863	1.237	1.417	1.453	0.965	1.451	0.706	1.570	#1997
0.101	0.291	0.341	0.664	1.024	1.325	1.558	1.915	2.106	1.544	2.044	#1998
0.000	0.360	0.444	0.661	1.094	1.406	2.267	2.594	2.559	1.575	1.544	#1999
0.160	0.437	0.918	1.392	1.709	1.826	2.308	2.486	2.213	2.449	1.575	#2000
0.442	0.345	0.541	1.104	1.865	1.783	1.705	2.297	1.669	1.386	2.449	#2001
0.114	0.373	0.513	0.825	1.032	1.732	1.671	1.504	1.532	1.589	1.840	#2002
0.282	0.347	0.520	0.883	1.242	1.429	1.800	1.705	1.589	2.143	3.045	#2003
0.197	0.432	0.523	0.758	1.192	1.380	1.855	1.806	1.876	3.092	1.950	#2004
0.104	0.429	0.546	0.719	1.027	1.256	1.946	2.667	1.881	2.185	2.708	#2005
0.000	0.349	0.482	0.545	0.938	1.486	2.118	2.619	4.022	4.019	2.185	#2006
0.000	0.330	0.467	0.640	0.886	1.199	1.630	1.487	3.427	1.448	5.779	#2007
0.000	0.377	0.519	0.673	0.875	1.139	1.267	1.654	1.745	2.553	2.878	#2008
0.000	0.360	0.541	0.796	1.037	1.185	1.402	1.479	2.040	1.307	0.000	#2009

b) Haddock VIIbk - Discard weights at age

0	1	2	3	4	5	6	7	8	9	10	
0.074	0.184	0.384	0.538	0.305	0.329	0.000	0.000	0.000	0.000	0.000	#1993
0.074	0.184	0.384	0.538	0.305	0.329	0.000	0.000	0.000	0.000	0.000	#1994
0.095	0.283	0.166	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	#1995
0.056	0.166	0.454	0.471	0.551	0.830	0.000	0.000	0.000	0.000	0.000	#1996
0.082	0.144	0.369	0.639	0.255	0.490	0.000	0.000	0.000	0.000	0.000	#1997
0.069	0.244	0.360	0.505	0.255	0.000	0.000	0.000	0.000	0.000	0.000	#1998
0.059	0.176	0.357	0.551	0.163	0.000	0.000	0.000	0.000	0.000	0.000	#1999
0.091	0.134	0.325	0.200	0.198	0.000	0.000	0.000	0.000	0.000	0.000	#2000
0.096	0.166	0.347	0.435	0.553	0.322	0.000	0.000	0.000	0.000	0.000	#2001
0.084	0.211	0.341	0.407	1.333	1.174	0.000	0.000	0.000	0.000	0.000	#2002
0.012	0.192	0.318	0.246	0.750	0.000	0.000	0.000	0.000	0.000	0.000	#2003
0.085	0.207	0.366	0.586	0.907	0.523	0.000	0.000	0.000	0.000	0.000	#2004
0.068	0.187	0.317	0.473	0.694	0.000	0.000	0.000	0.000	0.000	0.000	#2005
0.066	0.376	0.259	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	#2006
0.088	0.201	0.433	0.593	0.335	0.206	0.000	0.000	0.000	0.000	0.000	#2007
0.077	0.174	0.416	0.583	0.224	0.000	0.000	0.000	0.000	0.000	0.000	#2008
0.089	0.233	0.410	0.550	0.311	0.000	0.000	0.000	0.000	0.000	0.000	#2009

c) Haddock VIIbk - Stock weights at age (3-year running average)

0	1	2	3	4	5	6	7	8	9	10	
0.073	0.190	0.362	0.659	0.866	1.581	2.010	2.114	3.779	2.384	2.384	#1993
0.080	0.252	0.441	0.766	0.956	1.536	1.864	2.142	3.403	2.473	2.473	#1994
0.075	0.244	0.438	0.821	1.147	1.385	1.720	1.998	2.833	2.166	2.170	#1995
0.078	0.238	0.454	0.936	1.266	1.484	1.712	1.961	2.484	1.575	2.033	#1996
0.069	0.173	0.342	0.805	1.234	1.421	1.676	2.044	2.542	1.037	1.368	#1997
0.070	0.180	0.366	0.671	1.071	1.311	1.782	2.198	2.231	1.040	1.365	#1998
0.073	0.182	0.363	0.645	1.088	1.456	2.050	2.363	2.324	1.376	1.358	#1999
0.082	0.185	0.430	0.785	1.335	1.691	2.224	2.373	1.934	1.560	1.560	#2000
0.090	0.195	0.410	0.864	1.380	1.710	1.893	1.817	1.562	1.753	1.670	#2001
0.064	0.199	0.399	0.827	1.372	1.671	1.895	1.724	1.601	2.647	2.409	#2002
0.060	0.204	0.367	0.727	1.200	1.556	1.944	1.386	1.610	3.145	2.409	#2003
0.055	0.207	0.352	0.682	1.225	1.626	2.315	1.968	1.927	3.147	2.732	#2004
0.073	0.260	0.358	0.604	1.100	1.555	2.172	2.421	2.676	3.151	2.891	#2005
0.074	0.261	0.369	0.580	0.982	1.448	2.110	2.564	3.343	2.752	4.182	#2006
0.077	0.247	0.391	0.590	0.885	1.361	1.820	2.203	3.315	3.079	4.179	#2007
0.085	0.211	0.406	0.632	0.897	1.196	1.641	1.847	3.304	2.287	3.387	#2008
0.083	0.212	0.406	0.630	0.891	1.147	1.488	1.825	3.116	2.319	2.182	#2009

Table 7.4.6. Tuning data available for haddock in VIIB–k. The tuning data used in the final assessment is highlighted in grey.

HADDOCK VIIb-k, WGSSDS 2009, TUNING DATA, updated HG 280410

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IR-7b-OT : Irish Otter Trawl in 7B - effort, nos at age per 1000h

1995	2009									
1	1	0	1							
0	10									
65.3	0	0	20.5	104.3	76.1	105.3	62	29.6	8.1	0
	0	#1995	423.4 t							
41.5	0	19.4	93.2	30.2	30	17.9	21.5	9.4	5.1	0.8
	0.8	#1996	187.0 t							
49.5	0	8.3	195.2	116.9	29.6	31.9	19.1	13.5	4.1	5.3
	8.4	#1997	273.3 t							
63.5	0	9.8	147.4	290.7	68.1	37.7	34.6	25	9.5	8.4
	0.9	#1998	445.2 t							
62	0	0.4	193.6	225.9	190.9	49.6	12.4	6	2.3	0.7
	0	#1999	404.2 t							
57.7	0	41.3	57.2	22.2	56.8	98.5	31.2	7.5	6.9	0.7
	0	#2000	299.8 t							
60.7	0.0	20.2	289.1	72.8	13.9	42.5	60.4	7.4	8.2	2.0
	0.0	#2001	298.9 t							
46.8	0.26	3.9	38.9	95.2	28.6	4.3	17.3	17.6	4.8	1.3
	0.6	#2002	160.0 t							
64.0	0.0	2.2	21.7	42.2	66.8	15.1	9.0	10.6	10.4	2.5
	0.1	#2003	163.6 t							
60.4	0.0	0.6	43.7	68.3	59.8	79.6	11.0	3.2	4.8	0.3
	0.2	#2004	189.0 t							
47.4	0.0	9.7	60.8	64.4	57.4	32.7	2.0	1.6	1.0	0.3
	0.0	#2005	157.5 t							
39.7	0.0	20.9	120.5	108.9	50.7	7.2	9.3	0.0	0.0	0.0
	0.0	#2006	141.9 t							
40.7	0.0	0.0	63.5	64.9	45.3	69.5	14.9	7.9	0.0	0.0
	0.0	#2007	192.6 t							
37.3	0.0	0.0	37.6	96.6	63.3	33.3	62.4	12.2	3.1	0.2
	0.0	#2008	202.9 t							
37.8	0.0	0.1	75.1	54.3	81.3	80.5	34.4	44.3	4.7	1.3
	0.0	#2009	253.7 t							

IR-7j-OT : Irish Otter Trawl in 7J - effort, nos at age per 1000h

1995	2009									
1	1	0	1							
0	10									
93.6	3.56	323.2	92.2	37.7	1.4	0.5	0	0	0	0
	0	#1995	220.7 t							

70.2	0	146.9	464.1	24	9.9	3.2	1.6	0	0	0
	0	#1996	236.0 t							
83.2	0	136.4	929	190.9	38.6	26.4	6.7	1.5	0	0
	0	#1997	758.5 t							
89.6	0.34	69	287.7	515.6	48	7.3	4.3	3	1.6	0
	0	#1998	581.9 t							
40.6	0	8.5	119.2	52.1	61.2	3.2	1.6	1.8	0.6	0
	0	#1999	183.9 t							
64.1	0	100.1	80.4	30.6	26.2	37	4.9	0	0	0
	0	#2000	305.3 t							
67.7	0.4	347.9	523.0	62.7	21.1	10.4	6.3	1.4	0.1	0.0
	0.0	#2001	564.0 t							
90.4	0.2	38.9	495.4	322.3	36.0	3.9	7.3	3.2	0.6	0.0
	0.0	#2002	587.3 t							
111.3	0.7	26.6	318.3	125.7	150.1	23.0	3.6	4.1	2.6	0.0
	0.0	#2003	483.4 t							
92.0	0.0	7.8	204.5	207.1	84.4	34.4	2.4	0.8	0.6	0.3
	0.0	#2004	362.5 t							
73.9	0.1	2.3	32.2	207.1	152.6	61.2	9.6	0.0	0.0	0.0
	0.0	#2005	339.5 t							
65.9	0.0	32.4	117.6	111.7	222.8	44.3	5.4	0.9	0.0	0.0
	0.0	#2006	333.9 t							
80.5	0.0	28.1	148.6	152.6	41.9	157.8	16.6	2.1	0.6	0.0
	0.2	#2007	386.7 t							
66.5	0.0	177.7	232.8	120.6	74.4	22.6	38.5	8.3	0.5	0.0
	0.1	#2008	379.3 t							
72.5	0.0	102.0	577.5	105.6	52.5	38.6	34.8	20.4	3.1	0.0
	0.0	#2009	572.0 t							

IR-7bj-OT : Irish Otter Trawl in 7B&J - effort, nos at age per 1000h

1995	2009									
1	1	0	1							
0	10									
158.9	3.56	323.2	112.7	142	77.6	105.8	62	29.6	8.1	0
	0	#1995	644.1 t							
111.7	0	166.3	557.4	54.1	39.9	21.1	23.1	9.4	5.1	0.8
	0.8	#1996	423.0 t							
132.7	0	144.7	1124.2	307.8	68.1	58.2	25.8	15	4.1	5.3
	8.4	#1997	1031.8 t							
153.1	0.34	78.8	435.1	806.3	116.1	45.1	39	28	11.2	8.4
	0.9	#1998	1027.1 t							
102.7	0	8.9	312.8	277.9	252.1	52.8	13.9	7.8	3	0.7
	0	#1999	588.1 t							
121.7	0	141.3	137.6	52.8	83	135.5	36.1	7.5	6.9	0.7
	0	#2000	605.1 t							
128.4	0.4	368.1	812.0	135.6	35.0	52.9	66.7	8.8	8.3	2.0
	0.0	#2001	862.9 t							
137.2	0.5	42.9	534.2	417.5	64.6	8.3	24.6	20.8	5.4	1.3
	0.6	#2002	747.3 t							
175.2	0.7	28.8	340.0	167.9	216.9	38.1	12.6	14.7	13.0	2.5
	0.1	#2003	647.0 t							

152.4	0.0	8.4	248.2	275.3	144.2	114.0	13.4	4.0	5.4	0.6
	0.2	#2004	551.5 t							
121.3	0.1	12.1	92.9	271.6	210.1	93.9	11.7	1.6	1.0	0.3
	0.0	#2005	497.0 t							
105.6	0.0	53.3	238.1	220.6	273.6	51.5	14.7	0.9	0.0	0.0
	0.0	#2006	475.8 t							
121.2	0.0	28.1	212.0	217.5	87.2	227.3	31.5	10.0	0.6	0.0
	0.2	#2007	579.3 t							
103.8	0.0	177.7	270.4	217.2	137.7	56.0	100.9	20.5	3.6	0.2
	0.1	#2008	582.2 t							
110.3	0.0	102.1	652.6	160.0	133.7	119.1	69.2	64.7	7.8	1.3
	0.0	#2009	825.7 t							

IR-7g-ISCSGFS : Irish Sea Celtic Sea GFS (VIIg; Prime stations only) - effort, nos at age per 30min

1997	2002					
1	1	0.8	0.9			
0	4					
1	18.9	11.7	15.2	2.4	2.4	#1997
1	241.6	23.6	5.6	0.8	0.2	#1998
1	2465.2	6.6	0.4	0.4	0.1	#1999
1	1191.4	710.6	0.9	0	0	#2000
1	1200.9	34.5	13.7	0	0	#2001
1	560.9	119.9	8.5	2.8	0.2	#2002

IR-7bj-WCGFS : Irish Autumn WCGFS - effort, nos at age per min

1993	2002							
1	1	0.75	0.79					
0	6							
1901	6647	1307	86	52	7	6	0	#1993
2386	47261	727	111	68	5	7	0	#1994
2210	239176	6136	17	6	2	3	0	#1995
2248	37211	9305	333	141	28	22	0	#1996
2396	661	8679	526	249	88	120	0	#1997
2486	12340	601	685	451	50	31	0	#1998
2304	53123	808	22	66	7	18	0	#1999
2400	57484	14036	28	22	6	22	0	#2000
1107	45261	10419	6230	209	173	364	302	#2001
1301	141437	17366	2026	849	7	5	27	#2002

UK-7efghj-WCGFS-1gp : Standardised no <= 26 cm as proxy for 1-gp

1992	2001		
1	1	0.15	0.25
1	1		
1	1.7	#1992	
1	19.8	#1993	
1	33.4	#1994	
1	20.8	#1995	
1	145.9	#1996	
1	26.7	#1997	
1	7.1	#1998	
1	9.3	#1999	
1	19.6	#2000	

1 15.6 #2001

UK-7efghj-WCGFS : Aged component - effort, nos at age per min

1998 2004

1 1 0.15 0.25

1 6

3744	380.3	245.8	170.3	51	9.5	10.9	#1998	Cirolana
3823	580.2	18.5	8	37.9	14.5	1	#1999	Cirolana
4092	1639	33	1.5	1.5	11.2	1	#2000	Cirolana
3700	949.9	335.5	33.1	0	1.5	4.5	#2001	Cirolana
3387	3995.1	317.5	100.8	13.8	2.1	0	#2002	Cirolana
2326	13655.1	947.1	75.3	45.7	4.6	0	#2003	Cirolana
1689	3334.1	7174.4	410.7	56.4	18.7	4	#2004	Cefas Endeavour

FR-7fghj-EVHOE: THALASSA - effort, nos at age per 30min

1997 2009

1 1 0.75 1

0 5

1	6.38	10.49	1.53	0.1	0.07	0	#1997
1	10.72	8.85	1.38	1.82	0.44	0.13	#1998
1	102.68	57.65	1.7	0.58	0.32	0.16	#1999
1	26.03	15.5	0.17	0.03	0.04	0.02	#2000
1	188.39	16.98	3.12	0.29	0.01	0	#2001
1	281.02	12.38	7.49	5.53	0.31	0	#2002
1	46.57	228.87	11.61	0.77	0.1	0.01	#2003
1	83.49	3.25	9.52	1.24	0.11	0.03	#2004
1	111.84	26.13	1.26	2.36	0.49	0.1	#2005
1	14.74	8.67	1.04	0.2	0.34	0.17	#2006
1	101.33	8.63	2.17	0.67	0.1	0.35	#2007
1	83.6	27.94	1.83	0.62	0.15	0.05	#2008
1	396.22	15.14	4.52	0.26	0.11	0.03	#2009

FR-7fgh-GAD : French Gadoid Trawlers in VIIfgh FU05 - effort, nos at age per 1000h

2002 2008

1 1 0 1

1 9

178.7	267.5	1518.8	1435.8	17.3	5.1	3.9	1.2	0	0	#2002
144.2	124.8	3434.6	787.5	313	9.3	2.3	0.8	0.1	0.3	#2003
119.4	0	2901.3	1909.1	219.5	102	4.5	0.1	0.1	1	#2004
101	284.2	256.4	1353.4	457.6	109	24.8	1	4.8	0	#2005
79.2	212.5	808.2	212.2	534.1	79.3	4.9	0.1	0	0	#2006
83.9	69.9	2260.4	772.9	93	124.4	24.9	1.8	0.9	1.1	#2007
70	415.7	1137.3	1601.4	235.5	22.1	46.2	3.7	0.6	0	#2008

IR-7g-SAGFS : VIIg, Irish Sea Celtic Sea GFS +Irish Groundfish Survey (IBTS 4th Qtr) - effort, nos at age per 10km2

1999 2009

1 1 0.8 0.9

0 8

10 4894 129 17 17 5 1 0 0 0 #1999
ISCSGFS
10 1549 3038 25 0 0 0 0 0 0 #2000
ISCSGFS
10 26150 1676 122 12 0 0 0 0 0 #2001
ISCSGFS
10 14484 2402 272 37 3 0 0 3 3 #2002
ISCSGFS
10 2819 6393 453 11 6 0 0 0 0 #2003
IBTS Q4
10 11248 1853 1302 78 6 3 0 0 0 #2004
IBTS Q4
10 12470 2204 140 106 16 1 0 0 0 #2005
IBTS Q4
10 3387 2102 240 21 6 2 1 0 0 #2006
IBTS Q4
10 9395 795 325 62 2 3 0 0 0 #2007
IBTS Q4
10 8871 3148 109 29 7 0 3 0 0 #2008
IBTS Q4
10 65717 1050 521 35 6 1 0 0 0 #2009
IBTS Q4
IR-7g-GFS : Irish Groundfish Survey in VIIg (IBTS 4th Qtr) - Haddock no. @ age
2003 2009

1 1 0.79 0.92

0 7

832 3042 6975 489 11 6 0 0 0 #2003

980 14567 2400 1687 101 7 4 0 0 #2004

845 15997 2594 173 125 20 1 0 0 #2005

1046 5098 3163 361 32 9 3 1 0 #2006

1168 15557 1316 539 102 3 4 0 0 #2007
1139 12644 4487 156 41 9 0 4 0 #2008
1018 88424 1412 701 47 7 1 0 0 #2009
IR-7j-GFS : Irish Groundfish Survey in VIIj (IBTS 4th Qtr) - Haddock no. @ age
2003 2009
1 1 0.79 0.92
0 7
780 4592 16281 640 74 20 1 0 0 #2003
720 5175 1620 1395 44 7 4 1 0 #2004
881 1474 1273 240 286 36 6 2 0 #2005
901 2636 262 124 53 50 7 0 0 #2006
874 22831 2116 192 71 20 36 1 0 #2007
873 14056 4934 222 20 15 6 6 3 #2008
747 56856 1476 205 2 1 2 2 1 #2009

IR-7gj-GFS : Irish Groundfish Survey in VIIg & j (IBTS 4th Qtr) - Haddock no. @ age

2003 2009

1 1 0.79 0.92

0 7

1612	7708	23095	1212	88	27	1	1	0	#2003
1740	19162	4533	3109	183	15	10	1	0	#2004
1726	16119	5196	433	413	56	6	2	0	#2005
1947	7776	3433	416	87	75	10	1	0	#2006
2042	38414	3527	611	171	26	38	1	0	#2007
2012	26721	9403	376	62	25	5	11	3	#2008
1765	145133	3014	931	47	8	3	2	1	#2009

IR-7b-GFS : Irish Groundfish Survey in VIIb (IBTS 4th Qtr) - Haddock no. @ age

2003 2009

1 1 0.79 0.92

0 8

757	11834	34773	2793	874	313	6	1	2	7	#2003
728	31311	2960	6688	925	372	196	46	2	1	#2004
724	3737	7082	964	2299	188	37	5	0	0	#2005
700	8823	2303	2471	614	421	39	16	7	0	#2006
734	56350	2383	770	747	434	392	26	9	0	#2007
653	10948	11622	398	148	172	98	273	54	4	#2008
770	46145	6349	8264	258	272	122	165	110	4	#2009

Table 7.4.7. Lpue of haddock and effort for Irish Otter trawls in VIIb, VIIg and VIIj, the French gadoid fleet in VIIfgh and effort only for UK beam and trawl fleets in VIIe–k. Lpue in kg/hour and effort in hours fishing.

	IRL OTB VIIb		IRL OTB VIIg		IRL OTB VIIj		FR GAD VIIfgh		UK Beam VIIe-k	UK Trawl VIIe-k
	LPUE	Effort	LPUE	Effort	LPUE	Effort	LPUE	Effort	Effort	Effort
1983							2.18	115379	135344	82054
1984							2.02	85790	131465	86722
1985							2.83	92012	152487	90298
1986							1.64	119664	135738	84748
1987							3.20	144186	177118	84267
1988							7.27	221164	194882	89148
1989							5.28	247929	198156	84140
1990							2.23	201349	207576	99492
1991							1.94	179381	203196	76712
1992							3.74	190784	196065	86397
1993							4.23	213508	208421	61903
1994							7.95	181031	220023	53743
1995	6.47	65423	1.48	63560	2.36	93688	9.12	184067	243136	52270
1996	4.51	41496	5.36	60041	3.36	70237	15.36	170141	260817	60509
1997	5.51	49560	5.82	65105	9.12	83187	19.58	226015	264814	66707
1998	7.00	63560	4.09	72298	6.49	89610	11.62	189457	254590	62114
1999	6.51	62047	2.34	51657	4.53	40609	5.05	206601	251431	98350
2000	5.05	62758	10.43	60604	4.68	64626	8.86	170292	258962	104088
2001	4.92	60725	8.34	69427	8.34	67659	16.39	190482	272662	85338
2002	3.42	46793	3.28	77689	6.49	90446	13.61	176678	249480	83023
2003	2.56	63959	3.28	86791	4.34	111267	22.01	144180	282097	72303
2004	3.13	60446	3.45	96991	3.94	91957	31.41	119444	273871	75681
2005	3.32	47399	4.42	124395	4.59	73920	21.48	101027	270347	76361
2006	3.58	39698	4.16	119227	5.07	65856	17.74	79214	252001	83308
2007	4.73	40718	4.10	136525	4.80	80485	22.62	83904	239921	87683
2008	5.44	37338	4.57	125815	5.70	66503	31.22	70044	216529	71154
2009	6.71	37805	9.51	135178	7.89	72453			190914	73847

LPUE in kg/hour fishing
Effort in hours fishing

Table 7.4.8. XSA diagnostics for haddock in VIIb–k.

```
Lowestoft VPA Version 3.1
   30/04/2010  14:56
 Extended Survivors Analysis
 HADDOCK VIIb-k, WGCSE 2010, COMBSEX, PLUSGROUP
 CPUE data from file had7bktu.txt
 Catch data for  17 years. 1993 to 2009. Ages  0 to   8.
      Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
 "IR-7bj-OT : Irish O,   1995, 2009,   2,     7,   .000,  1.000
 "FR-7fghj-EVHOE: THA,   1997, 2009,   0,     5,   .750,  1.000
 "FR-7fgh-GAD : Frenc,   2002, 2009,   2,     6,   .000,  1.000
 "IR-7g-SAGFS : VIIg,,   1999, 2009,   0,     5,   .800,   .900

 Time series weights :
      Tapered time weighting not applied

 Catchability analysis :
      Catchability independent of stock size for all ages
      Catchability independent of age for ages >=    4

 Terminal population estimation :
      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   3 oldest ages.
      S.E. of the mean to which the estimates  are shrunk =   1.500
      Minimum standard error for population
      estimates derived from each fleet =    .300
      Prior weighting not applied

 Tuning converged after   30 iterations
1

 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

 Fishing mortalities
    Age,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
      0,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000
      1, 1.011,  .428,  .485,  .515,  .380,  .258,  .208,  .270,  .590,  .560
      2, 1.377,  .769, 1.078,  .929,  .707,  .693,  .431,  .667, 1.074,  .714
      3,  .903,  .670,  .933,  .721,  .884,  .653,  .580,  .646,  .894,  .953
      4,  .531,  .924, 1.440,  .832,  .715,  .900,  .496,  .417,  .459,  .788
      5,  .545,  .618,  .314,  .770, 1.589,  .884,  .418,  .371,  .313,  .394
      6,  .532,  .595,  .372,  .581, 1.002, 1.788,  .294,  .289,  .269,  .496
      7,  .231,  .395,  .278,  .357,  .321,  .184,  .467,  .210,  .197,  .198

1
 XSA population numbers (Thousands)
               AGE
 YEAR ,          0,        1,        2,        3,        4,        5,        6,        7,

 2000 ,    4.23E+04, 6.98E+04, 1.37E+04, 1.63E+03, 1.47E+03, 1.55E+03, 3.59E+02, 1.23E+02,
```

2001 ,	8.10E+04,	3.46E+04,	2.08E+04,	2.83E+03,	5.42E+02,	7.10E+02,	7.35E+02,	1.73E+02,
2002 ,	8.64E+04,	6.63E+04,	1.85E+04,	7.89E+03,	1.19E+03,	1.76E+02,	3.13E+02,	3.32E+02,
2003 ,	1.91E+04,	7.07E+04,	3.34E+04,	5.15E+03,	2.54E+03,	2.30E+02,	1.05E+02,	1.77E+02,
2004 ,	2.42E+04,	1.57E+04,	3.46E+04,	1.08E+04,	2.05E+03,	9.05E+02,	8.73E+01,	4.83E+01,
2005 ,	4.27E+04,	1.98E+04,	8.77E+03,	1.40E+04,	3.65E+03,	8.21E+02,	1.51E+02,	2.62E+01,
2006 ,	4.10E+04,	3.50E+04,	1.25E+04,	3.59E+03,	5.95E+03,	1.22E+03,	2.78E+02,	2.07E+01,
2007 ,	9.32E+04,	3.36E+04,	2.33E+04,	6.67E+03,	1.65E+03,	2.97E+03,	6.56E+02,	1.69E+02,
2008 ,	5.50E+04,	7.63E+04,	2.10E+04,	9.78E+03,	2.86E+03,	8.88E+02,	1.68E+03,	4.02E+02,
2009 ,	3.78E+05,	4.50E+04,	3.46E+04,	5.87E+03,	3.28E+03,	1.48E+03,	5.31E+02,	1.05E+03,

Estimated population abundance at 1st Jan 2010

,	0.00E+00,	3.10E+05,	2.10E+04,	1.39E+04,	1.85E+03,	1.22E+03,	8.18E+02,	2.65E+02,

Taper weighted geometric mean of the VPA populations:

,	4.30E+04,	2.95E+04,	1.54E+04,	5.22E+03,	2.13E+03,	8.99E+02,	3.90E+02,	1.78E+02,

Standard error of the weighted Log(VPA populations) :

,	.8666,	.6805,	.6255,	.5783,	.5323,	.6739,	.7638,	1.0171,

1

Log catchability residuals.

Fleet : "IR-7bj-OT : Irish O

Age ,	1995,	1996,	1997,	1998,	1999
0 ,	No data for this fleet at this age				
1 ,	No data for this fleet at this age				
2 ,	-.37,	.56,	.58,	.72,	1.38
3 ,	-.40,	-.75,	.41,	.55,	.95
4 ,	-.62,	-1.04,	-.18,	.06,	.49
5 ,	.11,	-1.06,	-.08,	.19,	.50
6 ,	.41,	-.25,	-.46,	.40,	.24
7 ,	.01,	-.12,	.02,	.30,	.07

Age ,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008,	2009
0 ,	No data for this fleet at this age									
1 ,	No data for this fleet at this age									
2 ,	-.40,	.67,	.43,	-.92,	-1.22,	-.61,	.00,	-.77,	-.10,	.07
3 ,	-.02,	.23,	.37,	-.45,	-.49,	-.63,	.63,	-.11,	-.24,	-.07
4 ,	.07,	.32,	.28,	.25,	.15,	.25,	.00,	-.04,	.04,	-.04
5 ,	.52,	.34,	-.32,	.89,	1.07,	.93,	-.12,	.31,	.25,	.47
6 ,	.65,	.52,	.21,	.48,	1.05,	.88,	.05,	-.19,	.18,	.99
7 ,	.01,	-.14,	-.06,	.02,	.14,	.00,	-.08,	-.02,	-.02,	.11

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7
Mean Log q,	-8.3204,	-7.7169,	-7.4066,	-7.4066,	-7.4066,	-7.4066,
S.E(Log q),	.7244,	.5045,	.3859,	.6048,	.5712,	.1117,

Regression statistics :

```
 Ages with q independent of year class strength and constant w.r.t. time.
 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q
  2,    1.65,   -1.346,      7.41,     .25,     15,    1.17,   -8.32,
  3,    1.18,    -.670,      7.56,     .51,     15,     .61,   -7.72,
  4,    1.02,    -.129,      7.40,     .67,     15,     .41,   -7.41,
  5,    1.04,    -.205,      7.16,     .62,     15,     .58,   -7.14,
  6,    1.38,   -2.082,      7.49,     .69,     15,     .55,   -7.06,
  7,     .98,     .684,      7.35,     .99,     15,     .11,   -7.39,
1

 Fleet : "FR-7fghj-EVHOE: THA

  Age  ,  1995,  1996,  1997,  1998,  1999
     0 , 99.99, 99.99,  -.65, -1.08,  -.05
     1 , 99.99, 99.99,   .19,   .53,  1.47
     2 , 99.99, 99.99,  -.98,   .10,  1.04
     3 , 99.99, 99.99, -1.51,   .67,   .49
     4 , 99.99, 99.99,  -.35,  1.36,   .27
     5 , 99.99, 99.99, 99.99,  1.22,  1.06
     6 , No data for this fleet at this age
     7 , No data for this fleet at this age

  Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
     0 ,  -.72,   .61,   .94,   .65,  1.00,   .72, -1.26,  -.15,   .18,  -.19
     1 ,  -.37,  -.08, -1.00,  1.88,  -.98,   .76,  -.96,  -.87,  -.23,  -.34
     2 , -1.86,   .10,  1.37,  1.08,   .66,  -.01,  -.78,  -.46,  -.17,  -.08
     3 , -1.50,   .01,  2.16,   .43,   .31,   .50,  -.68,  -.03,  -.27,  -.58
     4 , -1.01, -1.06,  2.04,  -.38,  -.17,   .90,  -.30,  -.31,  -.42,  -.58
     5 , -1.74, 99.99, 99.99,  -.34,   .11,   .80,   .53,   .32,  -.47, -1.43
     6 , No data for this fleet at this age
     7 , No data for this fleet at this age

 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time
    Age ,         0,         1,         2,         3,         4,         5
 Mean Log q,   -6.4955,   -6.9893,   -8.0627,   -8.4385,   -8.8631,   -8.8631,
 S.E(Log q),     .7638,     .9370,     .9070,     .9717,     .9143,    1.0028,

 Regression statistics :
 Ages with q independent of year class strength and constant w.r.t. time.
 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q
  0,     .91,     .418,      6.90,     .64,     13,     .72,   -6.50,
  1,    1.25,    -.494,      6.16,     .27,     13,    1.21,   -6.99,
  2,    1.03,    -.063,      8.01,     .30,     13,     .97,   -8.06,
  3,     .57,    1.833,      8.54,     .62,     13,     .51,   -8.44,
  4,     .90,     .242,      8.74,     .36,     13,     .86,   -8.86,
  5,    1.54,    -.684,      9.94,     .17,     10,    1.59,   -8.86,
1

 Fleet : "FR-7fgh-GAD : Frenc

  Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
     0 , No data for this fleet at this age
```

```
    1 , No data for this fleet at this age
    2 , 99.99, 99.99,  -.23,   .15,   .04,  -.85,   .07,   .53,   .29, 99.99
    3 , 99.99, 99.99,  -.10,  -.14,   .26,  -.27,  -.56,   .09,   .72, 99.99
    4 , 99.99, 99.99, -1.85,   .26,   .26,   .66,   .40,  -.16,   .42, 99.99
    5 , 99.99, 99.99, -1.63,  -.88,   .65,   .71,   .04,  -.47,  -.84, 99.99
    6 , 99.99, 99.99, -2.44, -1.58,  -.35,  1.27, -1.32,  -.61,  -.76, 99.99
    7 , No data for this fleet at this age

 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time
    Age ,         2,         3,         4,         5,         6
 Mean Log q,   -6.8843,   -6.2804,   -6.8550,   -6.8550,   -6.8550,
 S.E(Log q),     .4404,     .4092,     .8520,     .9392,    1.4644,

 Regression statistics :
 Ages with q independent of year class strength and constant w.r.t. time.
 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

  2,     .63,    2.005,      8.00,     .85,      7,     .23,   -6.88,
  3,     .70,    1.273,      7.09,     .78,      7,     .27,   -6.28,
  4,     .45,    2.589,      7.39,     .82,      7,     .28,   -6.85,
  5,     .68,    1.421,      7.00,     .80,      7,     .54,   -7.20,
  6,    1.17,    -.303,      8.04,     .38,      7,    1.48,   -7.68,
1

 Fleet : "IR-7g-SAGFS : VIIg,

  Age  ,  1995,  1996,  1997,  1998,  1999
    0 , 99.99, 99.99, 99.99, 99.99,  -.92
    1 , 99.99, 99.99, 99.99, 99.99, -2.11
    2 , 99.99, 99.99, 99.99, 99.99, -1.02
    3 , 99.99, 99.99, 99.99, 99.99,  -.12
    4 , 99.99, 99.99, 99.99, 99.99,  -.47
    5 , 99.99, 99.99, 99.99, 99.99,  -.59
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age

  Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
    0 , -1.37,   .81,   .16,   .03,  1.17,   .71,  -.55,  -.35,   .12,   .19
    1 ,   .51,   .12,  -.12,   .82,   .97,   .81,   .15,  -.73,   .10,  -.50
    2 , -1.25,  -.59,   .59,   .38,  1.21,   .34,   .30,   .19,  -.46,   .30
    3 , 99.99,  -.25,   .07,  -.89,   .46,   .32,  -.01,   .51,  -.42,   .33
    4 , 99.99, 99.99,   .81,   .23,   .34,   .90,  -.91,  -.79,  -.05,  -.06
    5 , 99.99, 99.99, 99.99, 99.99,  1.21,  -.39,  -.49, -1.01, 99.99, -1.40
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age

 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time
    Age ,         0,         1,         2,         3,         4,         5
 Mean Log q,   -4.0741,   -4.9157,   -6.0247,   -6.7751,   -7.7020,   -7.7020,
 S.E(Log q),     .7583,     .8845,     .7386,     .4400,     .6437,    1.0167,
```

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0,	1.08,	-.239,	3.51,	.49,	11,	.86,	-4.07,
1,	.81,	.446,	5.97,	.39,	11,	.75,	-4.92,
2,	.60,	1.904,	7.53,	.72,	11,	.39,	-6.02,
3,	.76,	1.165,	7.25,	.74,	10,	.33,	-6.78,
4,	2.15,	-1.155,	7.47,	.13,	9,	1.36,	-7.70,
5,	5.76,	-1.104,	13.22,	.01,	6,	5.04,	-8.15,

1

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"IR-7bj-OT : Irish O,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-7fghj-EVHOE: THA,	255865.,	.793,	.000,	.00,	1,	.500,	.000
"FR-7fgh-GAD : Frenc,	1.,	.000,	.000,	.00,	0,	.000,	.000
"IR-7g-SAGFS : VIIg,,	374972.,	.792,	.000,	.00,	1,	.500,	.000
F shrinkage mean ,	0.,	1.50,,,,				.000,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
309793.,	.56,	.19,	2,	.341,	.000

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"IR-7bj-OT : Irish O,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-7fghj-EVHOE: THA,	20464.,	.614,	.258,	.42,	2,	.428,	.572
"FR-7fgh-GAD : Frenc,	1.,	.000,	.000,	.00,	0,	.000,	.000
"IR-7g-SAGFS : VIIg,,	18232.,	.601,	.305,	.51,	2,	.447,	.624
F shrinkage mean ,	38548.,	1.50,,,,				.126,	.343

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
21044.,	.42,	.18,	5,	.434,	.560

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"IR-7bj-OT : Irish O,	14866.,	.748,	.000,	.00,	1,	.210,	.679
"FR-7fghj-EVHOE: THA,	12057.,	.537,	.041,	.08,	3,	.305,	.788
"FR-7fgh-GAD : Frenc,	1.,	.000,	.000,	.00,	0,	.000,	.000
"IR-7g-SAGFS : VIIg,,	15047.,	.495,	.197,	.40,	3,	.378,	.673
F shrinkage mean ,	13676.,	1.50,,,,				.107,	.721

```
 Weighted prediction :
 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     13885.,       .33,      .08,    8,    .225,   .714

 Age  3   Catchability constant w.r.t. time and dependent on age
 Year class = 2006
 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 "IR-7bj-OT : Irish O,      1724.,   .459,       .013,    .03,   2,  .286,     .998
 "FR-7fghj-EVHOE: THA,       939.,   .552,       .204,    .37,   4,  .137,    1.422
 "FR-7fgh-GAD : Frenc,      2479.,   .471,       .000,    .00,   1,  .102,     .784
 "IR-7g-SAGFS : VIIg,,      2130.,   .376,       .211,    .56,   4,  .398,     .870
   F shrinkage mean  ,      2701.,   1.50,,,,                        .077,     .739

 Weighted prediction :
 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1854.,       .25,      .12,   12,    .494,   .953

1
 Age  4   Catchability constant w.r.t. time and dependent on age
 Year class = 2005
 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 "IR-7bj-OT : Irish O,      1092.,   .323,       .115,    .36,   3,  .422,     .850
 "FR-7fghj-EVHOE: THA,       835.,   .538,       .224,    .42,   5,  .114,    1.012
 "FR-7fgh-GAD : Frenc,      2361.,   .336,       .090,    .27,   2,  .159,     .482
 "IR-7g-SAGFS : VIIg,,      1068.,   .359,       .145,    .40,   5,  .254,     .863
   F shrinkage mean  ,      1769.,   1.50,,,,                        .050,     .603

 Weighted prediction :
 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1220.,       .20,      .10,   16,    .520,   .788

 Age  5   Catchability constant w.r.t. time and age (fixed at the value for age)  4
 Year class = 2004
 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 "IR-7bj-OT : Irish O,       949.,   .290,       .127,    .44,   4,  .418,     .348
 "FR-7fghj-EVHOE: THA,       482.,   .481,       .365,    .76,   6,  .134,     .599
 "FR-7fgh-GAD : Frenc,       956.,   .325,       .099,    .31,   3,  .178,     .346
 "IR-7g-SAGFS : VIIg,,       843.,   .336,       .334,    .99,   6,  .235,     .384
   F shrinkage mean  ,       374.,   1.50,,,,                        .034,     .722

 Weighted prediction :
 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       818.,       .18,      .13,   20,    .734,   .394

1
```

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 2003

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"IR-7bj-OT : Irish O,	399.,	.272,	.231,	.85,	5,	.509,	.355
"FR-7fghj-EVHOE: THA,	186.,	.498,	.162,	.33,	6,	.105,	.649
"FR-7fgh-GAD : Frenc,	145.,	.339,	.141,	.42,	4,	.188,	.776
"IR-7g-SAGFS : VIIg,,	210.,	.339,	.237,	.70,	5,	.158,	.593
F shrinkage mean ,	157.,	1.50,,,,				.041,	.735

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
265.,	.18,	.13,	21,	.739,	.496

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 2002

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"IR-7bj-OT : Irish O,	766.,	.217,	.088,	.41,	6,	.731,	.183
"FR-7fghj-EVHOE: THA,	945.,	.523,	.225,	.43,	6,	.051,	.151
"FR-7fgh-GAD : Frenc,	563.,	.366,	.175,	.48,	5,	.103,	.241
"IR-7g-SAGFS : VIIg,,	536.,	.354,	.328,	.93,	6,	.092,	.252
F shrinkage mean ,	203.,	1.50,,,,				.023,	.564

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
704.,	.17,	.08,	24,	.488,	.198

1
1

Table 7.4.9. Stock Summary for haddock in VIIb–k.

Year	Recruits age 0	TotBio	SSB	Landings	Discards	Yield/ SSB	Fbar 2-5 Lan+Dis
1993	14212	15506	11473	3348	1193	0.292	0.500
1994	35576	19070	13292	4131	1193	0.311	0.419
1995	54814	23313	12094	4470	472	0.370	0.394
1996	22199	31219	18807	6756	1403	0.359	0.571
1997	9674	24820	21008	10827	2120	0.515	0.810
1998	24807	18744	15582	7668	356	0.492	0.775
1999	85217	20190	10273	4882	625	0.475	0.704
2000	42285	29393	13018	7411	7057	0.569	0.839
2001	80956	28867	14830	8632	1952	0.582	0.745
2002	86396	35924	17205	6403	7468	0.372	0.941
2003	19138	35800	20222	8146	8221	0.403	0.813
2004	24213	28572	23996	8581	5371	0.358	0.974
2005	42737	25830	17556	6555	2563	0.373	0.783
2006	41018	27121	14954	5383	2092	0.360	0.481
2007	93185	35661	20191	6510	3252	0.322	0.525
2008	54954	42836	22067	7049	9302	0.319	0.685
2009	378381	66521	25577	10028	7095	0.392	0.712

Table 7.4.10. Input values for short-term forecast (.prd).

MFDP version 1a
Run: dp_
Time and date: 10:05 16/05/2010
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2010

Age	N	M	Mat	PF	PM	SWt
0	36586	0.2	0	0	0	8.17E-02
1	309793	0.2	0	0	0	0.223333
2	21044	0.2	1	0	0	0.401
3	13885	0.2	1	0	0	0.617333
4	1854	0.2	1	0	0	0.891
5	1220	0.2	1	0	0	1.234667
6	818	0.2	1	0	0	1.649667
7	265	0.2	1	0	0	1.958333
8	816	0.2	1	0	0	3.172

CATCH

Age	Sel	CWt	DSel	DCWt
0	0	0	0	8.47E-02
1	2.81E-02	0.355667	0.445206	0.202667
2	0.371838	0.509	0.446495	0.419667
3	0.718136	0.703	0.112882	0.575333
4	0.540219	0.932667	0.014447	0.29
5	0.358923	1.174333	7.43E-04	6.87E-02
6	0.351333	1.433	0	0
7	0.201667	1.54	0	0
8	0.201667	2.206	0	0

2011

Age	N	M	Mat	PF	PM	SWt
0	36586	0.2	0	0	0	8.17E-02
1	.	0.2	0	0	0	0.223333
2	.	0.2	1	0	0	0.401
3	.	0.2	1	0	0	0.617333
4	.	0.2	1	0	0	0.891
5	.	0.2	1	0	0	1.234667
6	.	0.2	1	0	0	1.649667
7	.	0.2	1	0	0	1.958333
8	.	0.2	1	0	0	3.172

CATCH

Age	Sel	CWt	DSel	DCWt
0	0	0	0	8.47E-02
1	2.81E-02	0.355667	0.445206	0.202667
2	0.371838	0.509	0.446495	0.419667
3	0.718136	0.703	0.112882	0.575333
4	0.540219	0.932667	0.014447	0.29
5	0.358923	1.174333	7.43E-04	6.87E-02
6	0.351333	1.433	0	0
7	0.201667	1.54	0	0
8	0.201667	2.206	0	0

2012

Age	N	M	Mat	PF	PM	SWt
0	36586	0.2	0	0	0	8.17E-02
1	.	0.2	0	0	0	0.223333
2	.	0.2	1	0	0	0.401
3	.	0.2	1	0	0	0.617333
4	.	0.2	1	0	0	0.891
5	.	0.2	1	0	0	1.234667
6	.	0.2	1	0	0	1.649667
7	.	0.2	1	0	0	1.958333
8	.	0.2	1	0	0	3.172

CATCH

Age	Sel	CWt	DSel	DCWt
0	0	0	0	8.47E-02
1	2.81E-02	0.355667	0.445206	0.202667
2	0.371838	0.509	0.446495	0.419667
3	0.718136	0.703	0.112882	0.575333

Table 7.4.11. Management options table (.prm).

MFDP version 1a
Run: dp_
Time and date: 10:05 16/05/2010
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

2010						
		"CATCH"	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
96800	24625	1	0.4973	10860	0.1436	23383

2011							2012	
		"CATCH"	Landings		Discards			
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
87583	77906	0	0	0	0	0	115317	105640
.	77906	0.1	0.0497	3293	0.0144	2864	107734	98056
.	77906	0.2	0.0995	6346	0.0287	5518	100718	91040
.	77906	0.3	0.1492	9179	0.0431	7978	94226	84549
.	77906	0.4	0.1989	11806	0.0575	10259	88219	78542
.	77906	0.5	0.2486	14245	0.0718	12373	82660	72982
.	77906	0.6	0.2984	16508	0.0862	14334	77514	67836
.	77906	0.7	0.3481	18610	0.1005	16153	72750	63072
.	77906	0.8	0.3978	20561	0.1149	17841	68338	58660
.	77906	0.9	0.4476	22375	0.1293	19407	64253	54575
.	77906	1	0.4973	24060	0.1436	20861	60468	50791
.	77906	1.1	0.547	25626	0.158	22211	56962	47285
.	77906	1.2	0.5967	27082	0.1724	23465	53714	44036
.	77906	1.3	0.6465	28437	0.1867	24630	50703	41025
.	77906	1.4	0.6962	29698	0.2011	25712	47912	38234
.	77906	1.5	0.7459	30872	0.2155	26718	45324	35647
.	77906	1.6	0.7956	31964	0.2298	27654	42925	33247
.	77906	1.7	0.8454	32982	0.2442	28524	40699	31021
.	77906	1.8	0.8951	33931	0.2586	29334	38634	28956
.	77906	1.9	0.9448	34815	0.2729	30087	36718	27040
.	77906	2	0.9946	35640	0.2873	30789	34939	25261

Input units are thousands and kg - output in tonnes

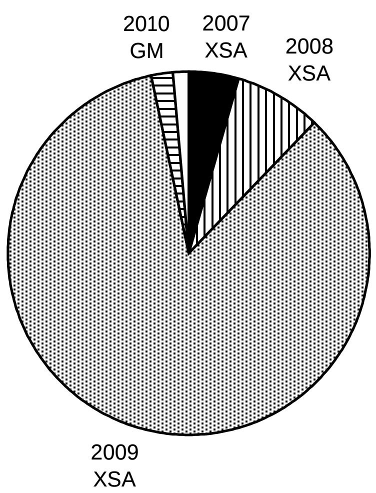
Table 7.4.12. Haddock VIIbk. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class			2007	2008	2009	2010	2011
Stock No. (thousands) of 0 year-olds			93185	54954	378381	36586	36586
Source			XSA	XSA	XSA	GM	GM
Status Quo F:							
% in	2010	landings	32.9	26.0	33.5	0.0	-
% in	2011		4.3	7.8	84.7	1.8	0.0
% in	2010	SSB	34.8	34.3	0.0	0.0	-
% in	2011	SSB	5.7	6.0	81.3	0.0	0.0
% in	2012	SSB	5.5	4.6	67.3	14.6	0.0

MR : mean recruitment

Haddock in VIIb-k : Year-class % contribution to

a) 2011 landings



b) 2012 SSB

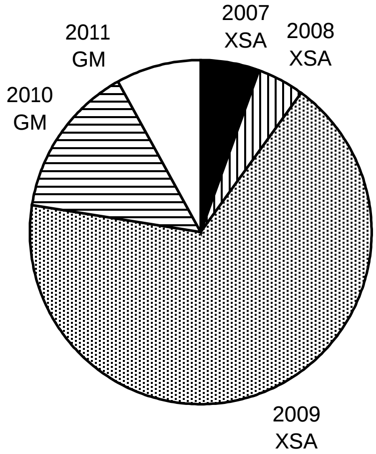


Table 7.4.13. Haddock VIIbk. Output from srmsymc ADMB package.

Stock name
had7bk
Sen filename
had7bk.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
910/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alph	ADMB Beta	Unscaled A	Unscaled B	AIC
Determinis	0.94	0.43	42.25	8.95	0.81	0.35	4.34	0.03	50.2
Mean	1.50	0.56	70.33	14.78	1.08	0.70	11.02	0.06	
5%ile	0.59	0.28	13.26	4.09	0.62	0.09	2.83	0.01	
25%ile	0.86	0.39	18.28	5.70	0.80	0.34	4.48	0.03	
50%ile	1.20	0.49	24.95	7.41	0.98	0.64	6.98	0.06	
75%ile	1.86	0.65	42.15	9.98	1.24	0.94	11.62	0.08	
95%ile	3.48	1.04	155.53	28.68	1.83	1.56	30.00	0.14	
CV	0.59	0.50	5.21	4.65	0.39	0.67	1.31	0.67	

Beverton-Holt
920/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alph	ADMB Beta	Unscaled A	Unscaled B	AIC
Determinis	1.48	0.25	94.53	10.59	0.71	1.14	61.17	6.86	50.0
Mean	1.32	0.21	843.31	40.21	0.58	1.41	289.59	101.27	
5%ile	0.49	0.13	41.91	4.97	0.07	0.92	36.92	1.22	
25%ile	0.71	0.17	76.83	8.11	0.29	1.16	53.40	6.00	
50%ile	0.99	0.21	134.64	12.03	0.56	1.35	77.88	16.22	
75%ile	1.62	0.24	280.26	22.37	0.82	1.61	149.00	42.55	
95%ile	3.46	0.32	1667.87	87.26	1.18	2.06	592.54	247.14	
CV	0.68	0.30	5.99	4.82	0.62	0.26	8.04	9.01	

Smooth hockeystick
978/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alph	ADMB Beta	Unscaled A	Unscaled B	AIC
Determinis	0.80	0.28	64.71	8.29	0.44	0.78	1.66	13.42	50.3
Mean	0.82	0.28	138.99	10.21	0.44	0.99	1.67	17.04	
5%ile	0.46	0.16	32.77	4.95	0.27	0.63	1.04	10.82	
25%ile	0.60	0.21	52.04	7.07	0.35	0.76	1.33	13.04	
50%ile	0.73	0.26	69.92	9.24	0.42	0.95	1.61	16.26	
75%ile	0.92	0.32	103.52	12.14	0.52	1.21	1.96	20.85	
95%ile	1.48	0.47	252.67	18.90	0.65	1.44	2.47	24.82	
CV	0.47	0.42	3.00	0.45	0.28	0.27	0.28	0.27	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Determinis	0.20	0.18	0.20	0.28	1.46	0.19	-	-
Mean	0.17	0.15	0.18	0.28	2.58	0.19		
5%ile	0.09	0.07	0.10	0.16	0.72	0.11		
25%ile	0.15	0.13	0.15	0.21	1.04	0.14		
50%ile	0.18	0.15	0.18	0.26	1.33	0.18		
75%ile	0.21	0.18	0.21	0.32	1.82	0.21		
95%ile	0.26	0.22	0.28	0.47	4.41	0.30		
CV	0.31	0.31	0.32	0.43	3.04	0.34		

Per recruit (human consumption + discards - for comparison only)

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Determinis	0.20	0.18	0.25	0.40	0.91	0.27	-	-
Mean	0.19	0.17	0.25	0.42	1.56	0.27		
5%ile	0.10	0.09	0.13	0.24	0.37	0.20		
25%ile	0.17	0.15	0.21	0.35	0.59	0.24		
50%ile	0.20	0.17	0.25	0.41	0.80	0.27		
75%ile	0.22	0.19	0.29	0.48	1.15	0.30		
95%ile	0.26	0.22	0.35	0.61	2.77	0.37		
CV	0.25	0.25	0.28	0.29	3.04	0.19		

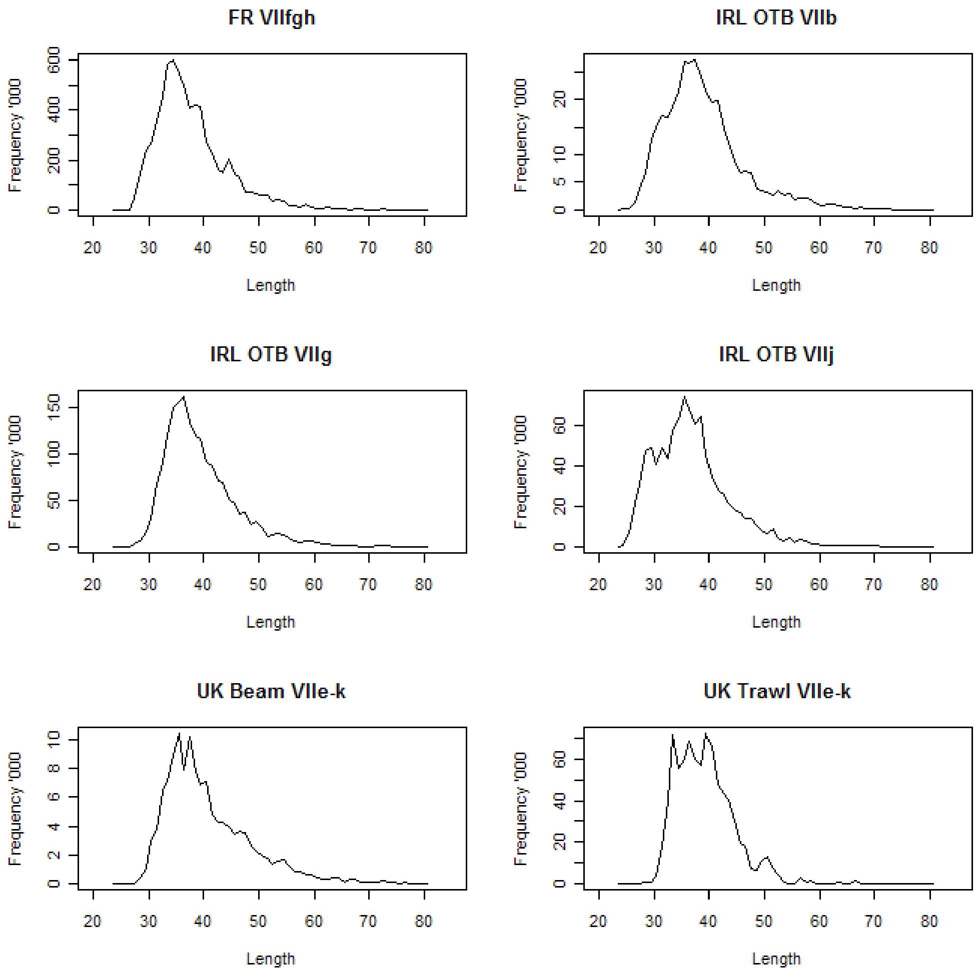


Figure 7.4.1. Length distributions of the landings of haddock in VIIb–k in 2009. All French fleets were combined; IRL OTB is the Irish otter trawl fleet; UK beam is the UK beam trawl fleet and UK trawl is all trawls except beam.

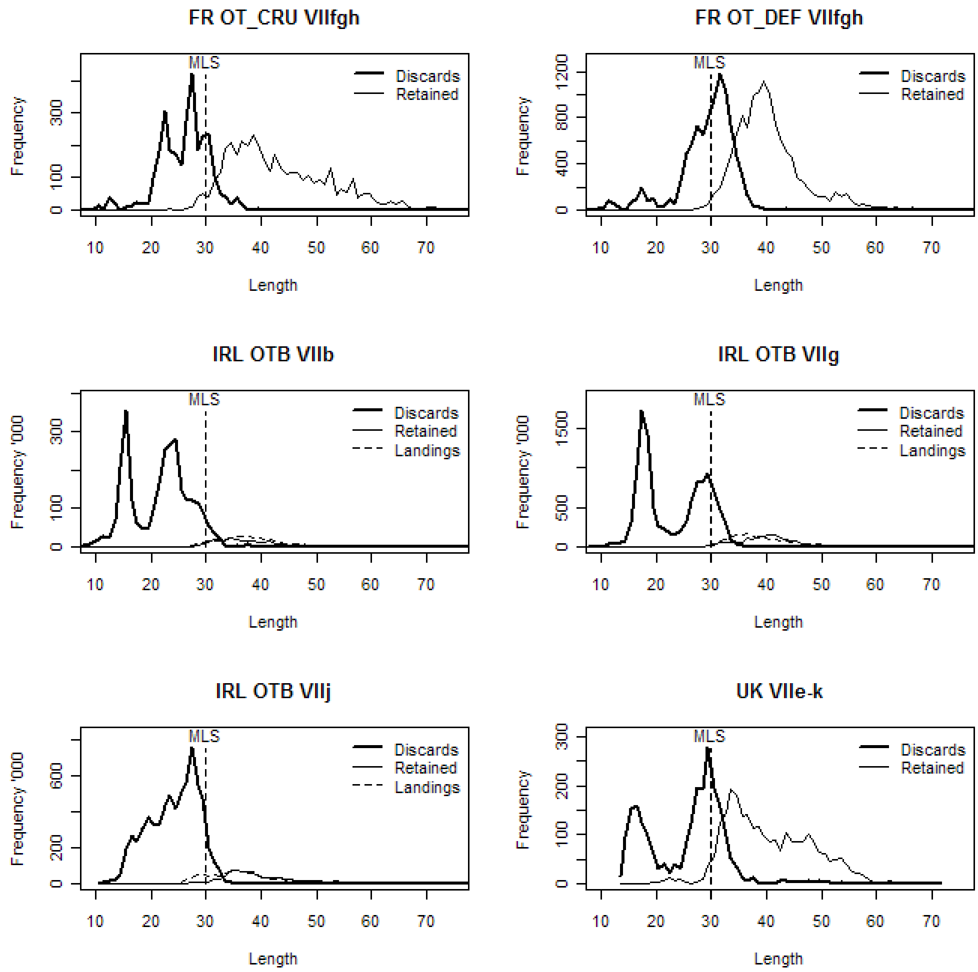


Figure 7.4.2. Length distributions of discards and the retained catch of haddock in VIIb–k in 2009. FR OT_CRU is the French otter trawl *Nephrops* fleet; FR OT_DEF is the French otter trawl gadoid+benthic fleet; IRL OTB is the Irish otter trawl fleet; all UK fleets were combined. Irish data were raised to total numbers, the length distributions of the landings (from port sampling) is given for comparison.

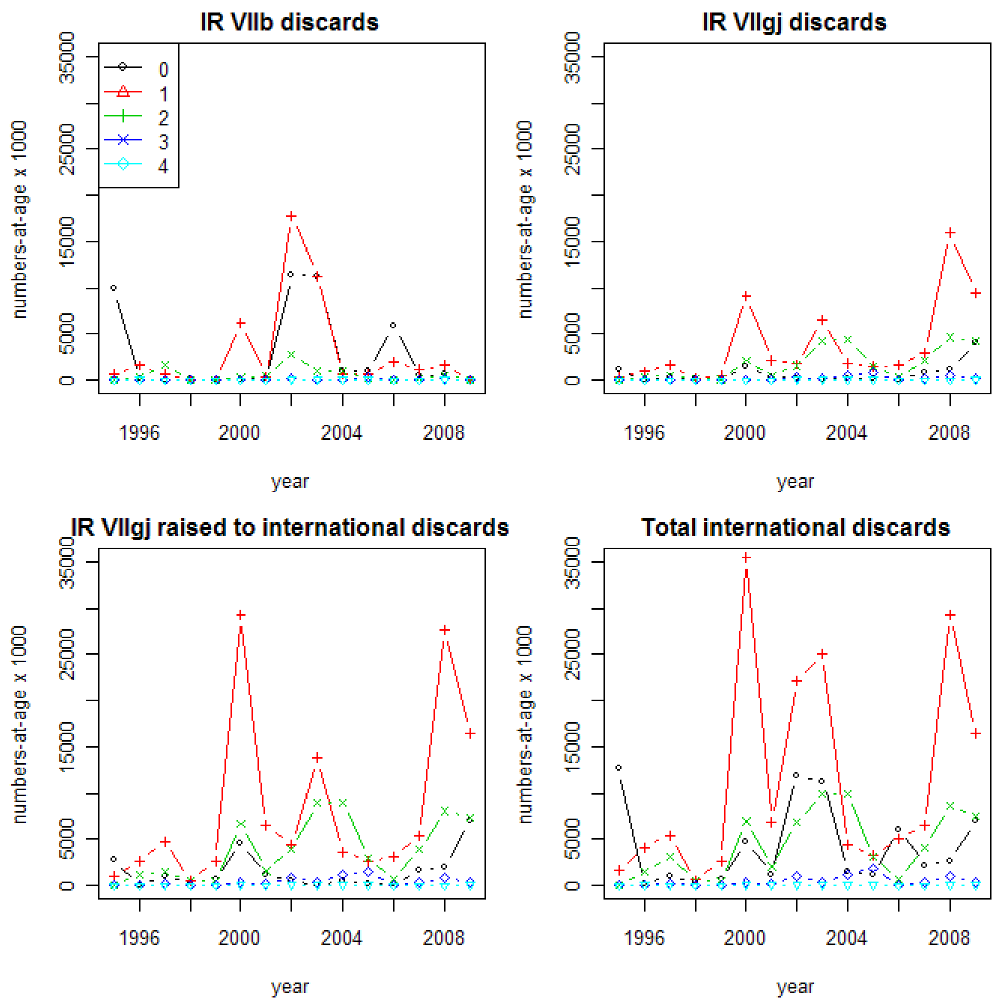


Figure7.4.3a. Numbers-at-age of Irish Discards of haddock in VIIb and VIIgj. The Irish discards in VIIgj were raised to international levels using effort as auxiliary variable.

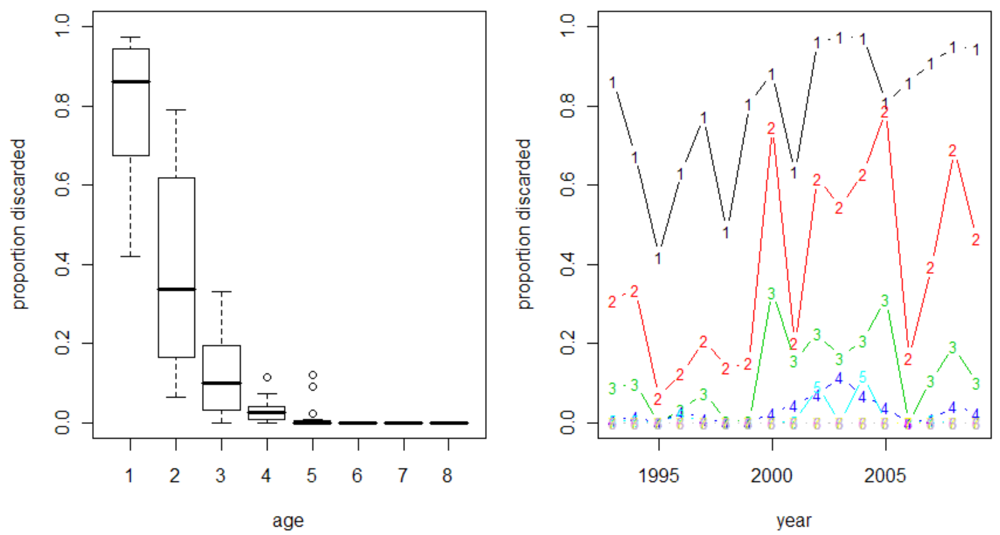


Figure7.4.3b. Proportion of discards by age and year.

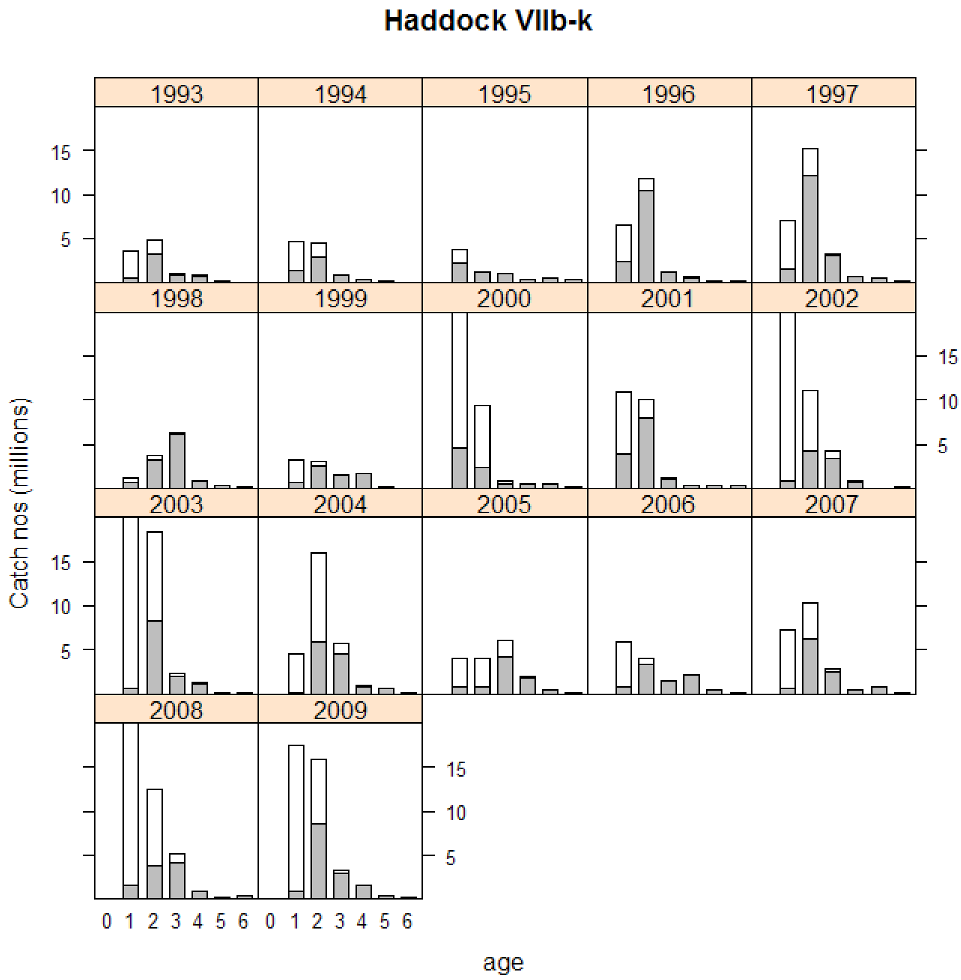


Figure7.4.4. Age composition of the landings (grey) and discards (white).

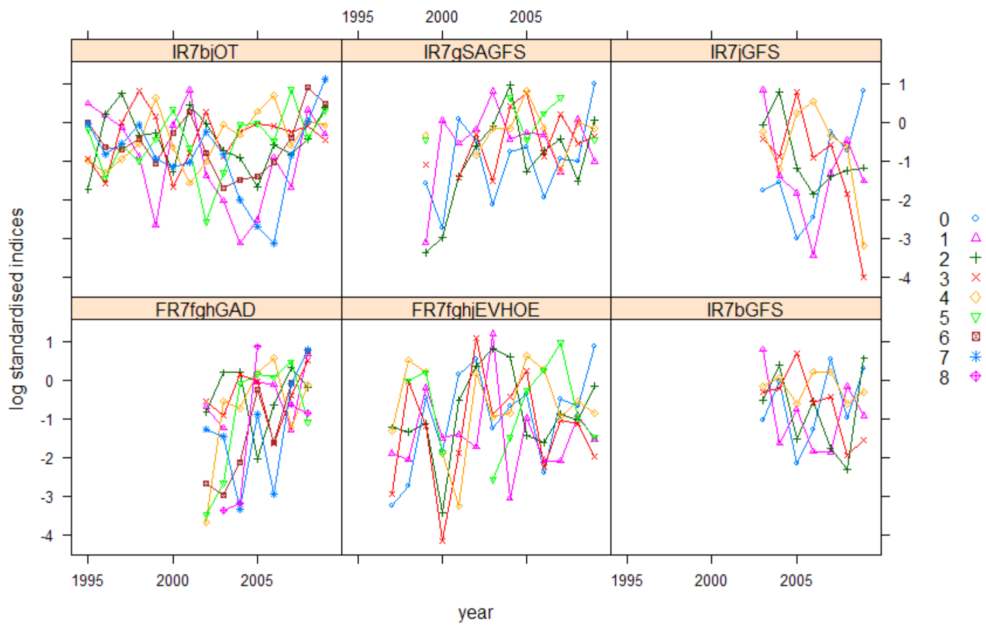


Figure 7.4.5a. Log standardised indices of tuning fleets by year. The IR7bGFS and IR7jGFS were not used in the assessment. See Stock Annex for a description of the fleets.

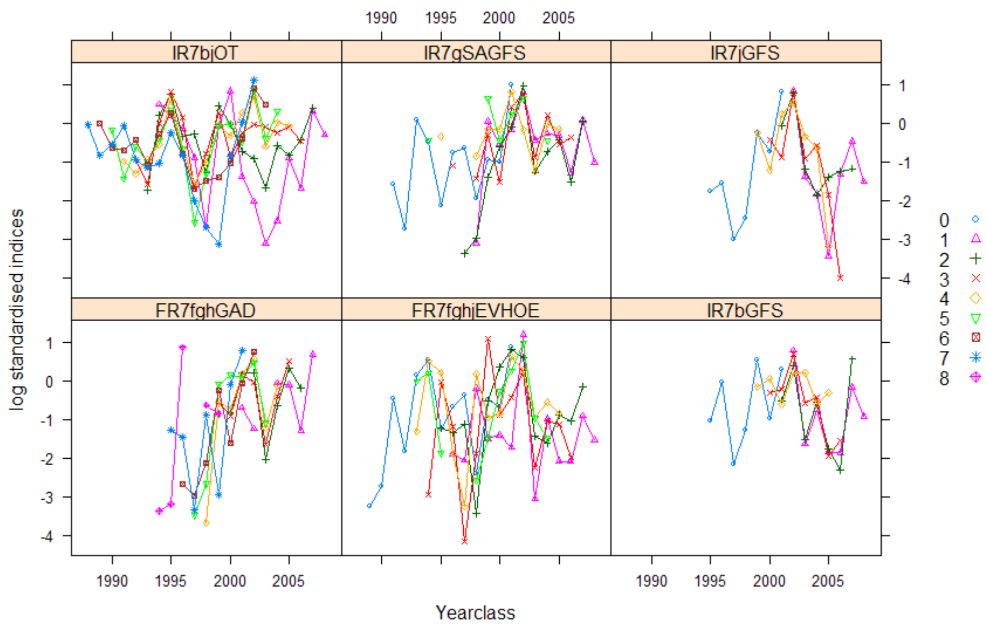


Figure 7.4.5b. Log standardised indices of tuning fleets by year class. The IR7bGFS and IR7jGFS were not used in the assessment. See Stock Annex for a description of the fleets.

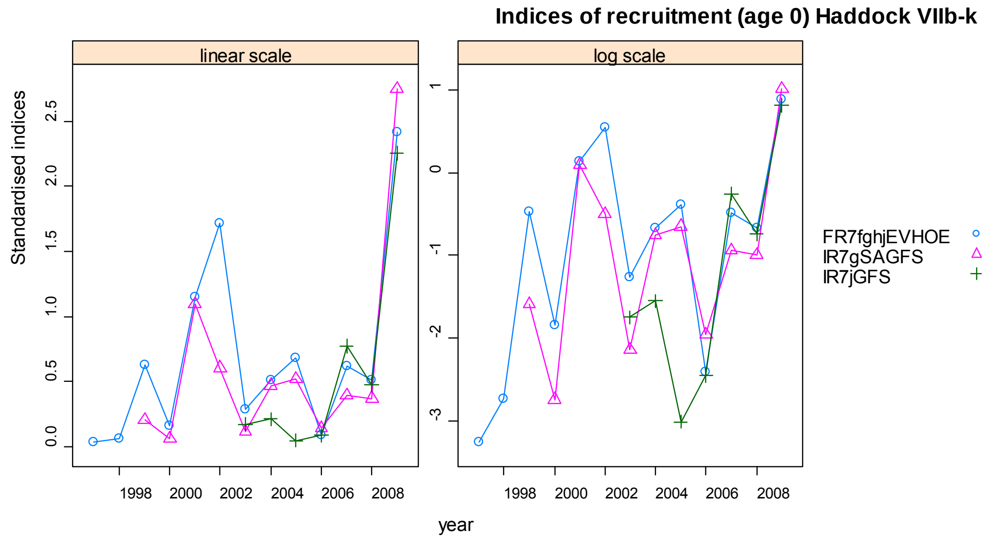


Figure 7.4.6. Survey indices of recruitment-at-age 0, presented on a linear and logscale. The EVHOE and SAGFS were used as tuning fleets. The IR GFS fleets are presently not used.

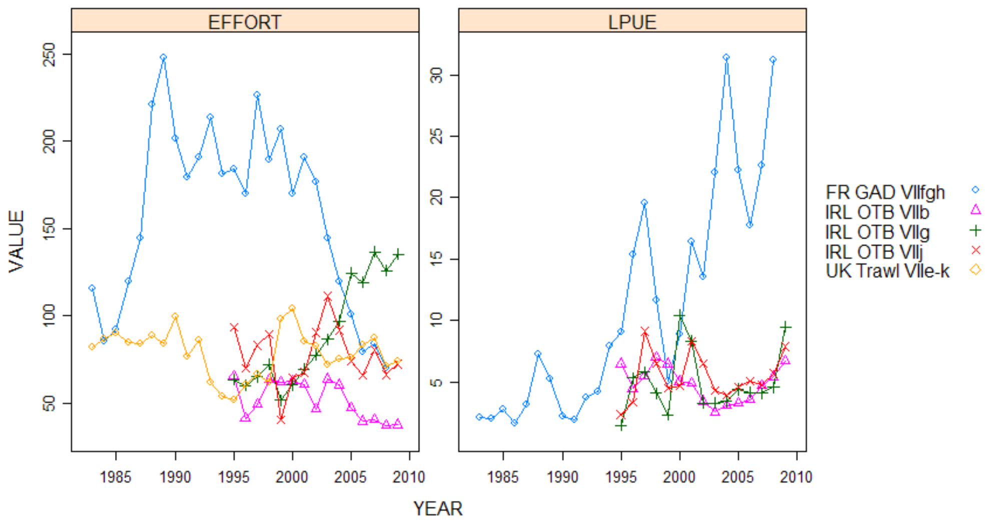


Figure 7.4.7. Lpue of haddock and effort for Irish Otter trawl fleets, the French gadoid fleet and effort only for UK trawl (all trawl gears except beam trawl) fleet.

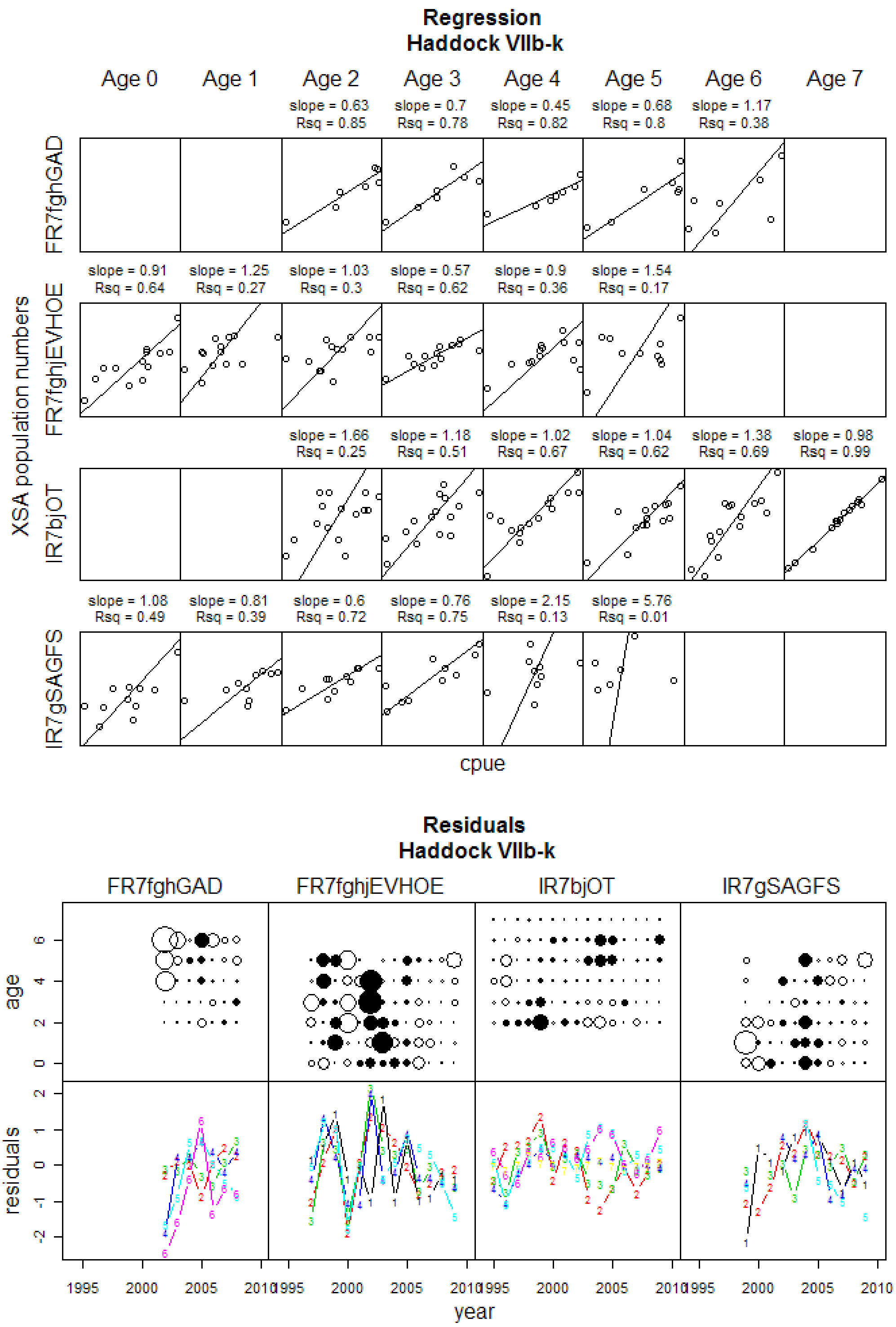


Figure 7.4.8. Log catchability regressions and residual plots of the tuning fleets used in the assessment.

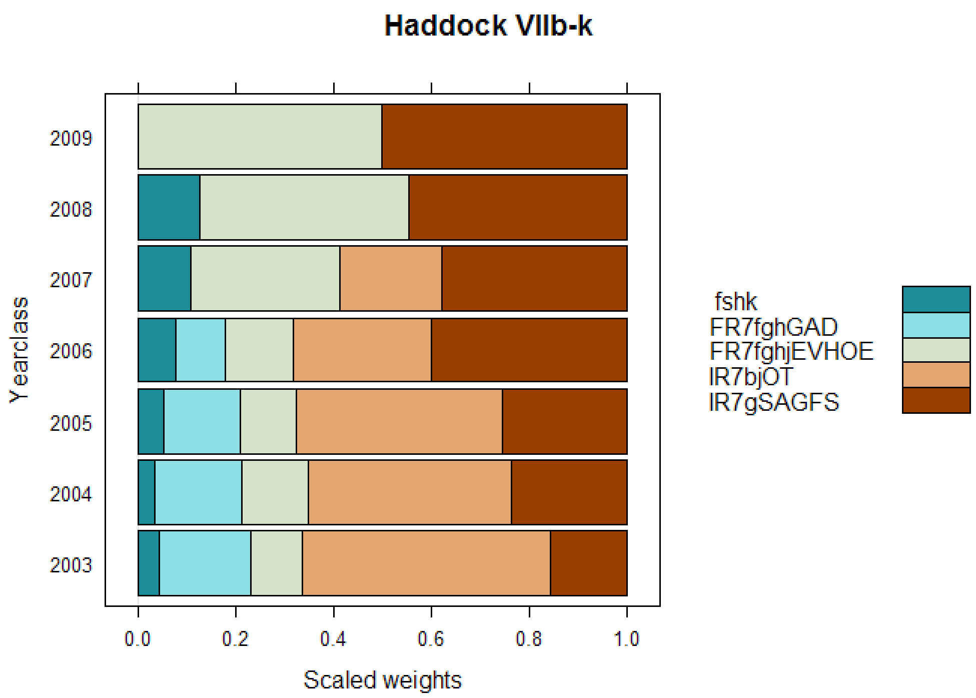


Figure7.4.9. Scaled weights of the tuning fleets used in the assessment.

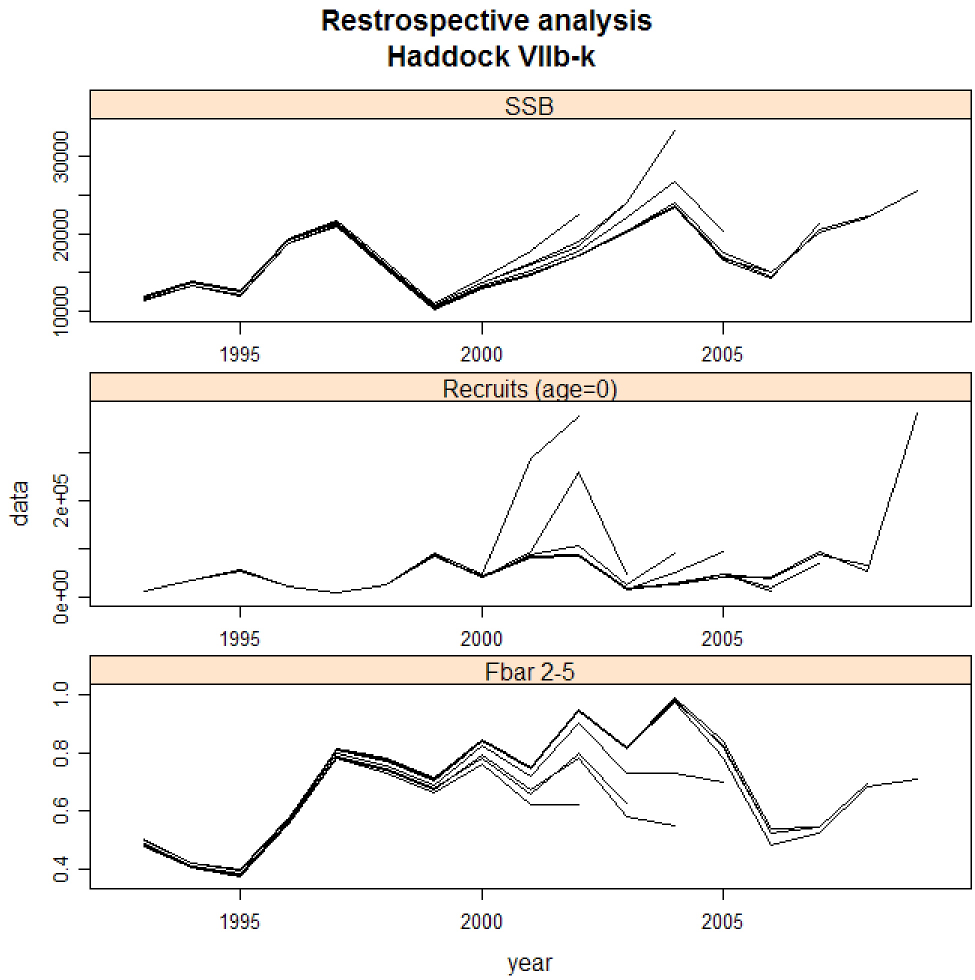


Figure7.4.10. Retrospective XSA analysis.

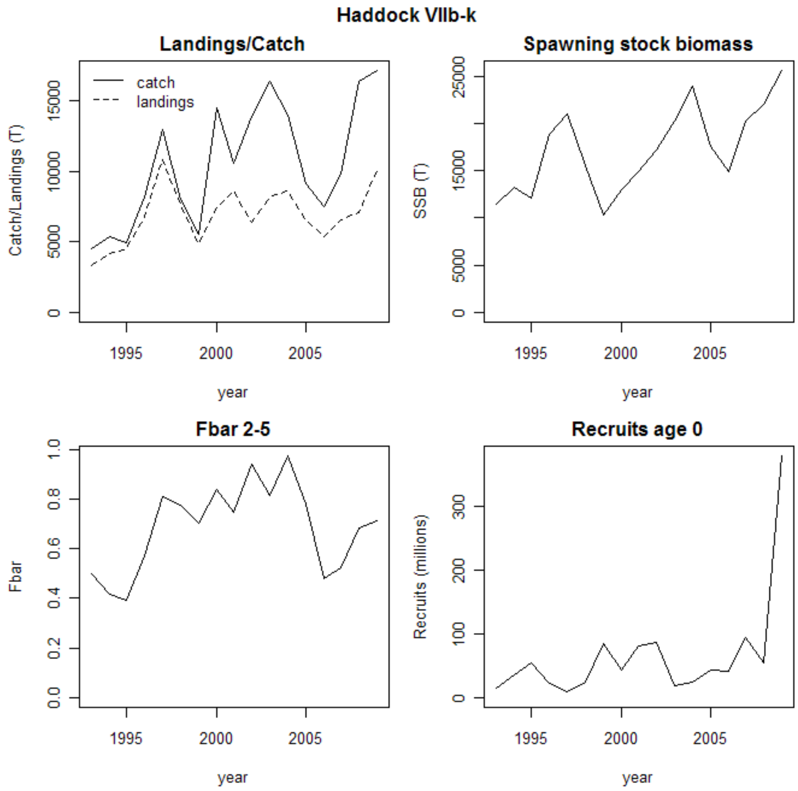


Figure7.4.11. Stock summary plot.

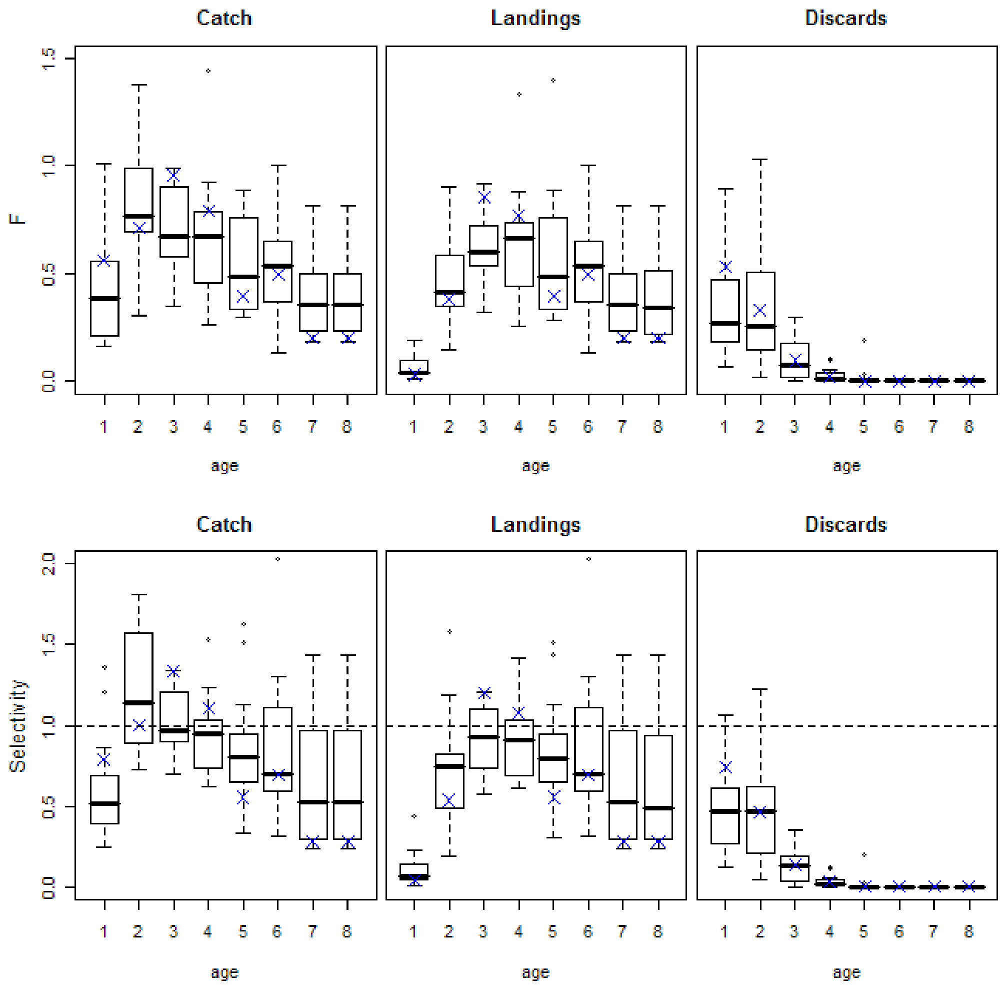


Figure7.4.12. Fishing mortality and selectivity-at-age, the blue crosses represent the most recent year. F was separated into a landings and discards component using the proportion of the catch numbers that were discarded for each age and year. Selectivity was estimated by dividing the F matrix by the catch F_{bar} 2–5 for each year.

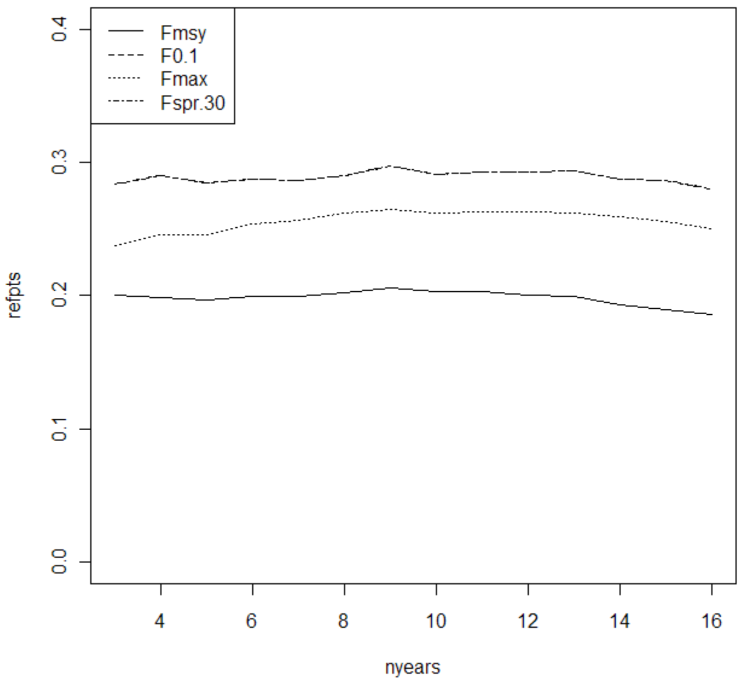


Figure7.4.13. Sensitivity of the F reference points to the number of years over which average F and weights-at-age are calculated (F_{msy} based on hockey stick model)

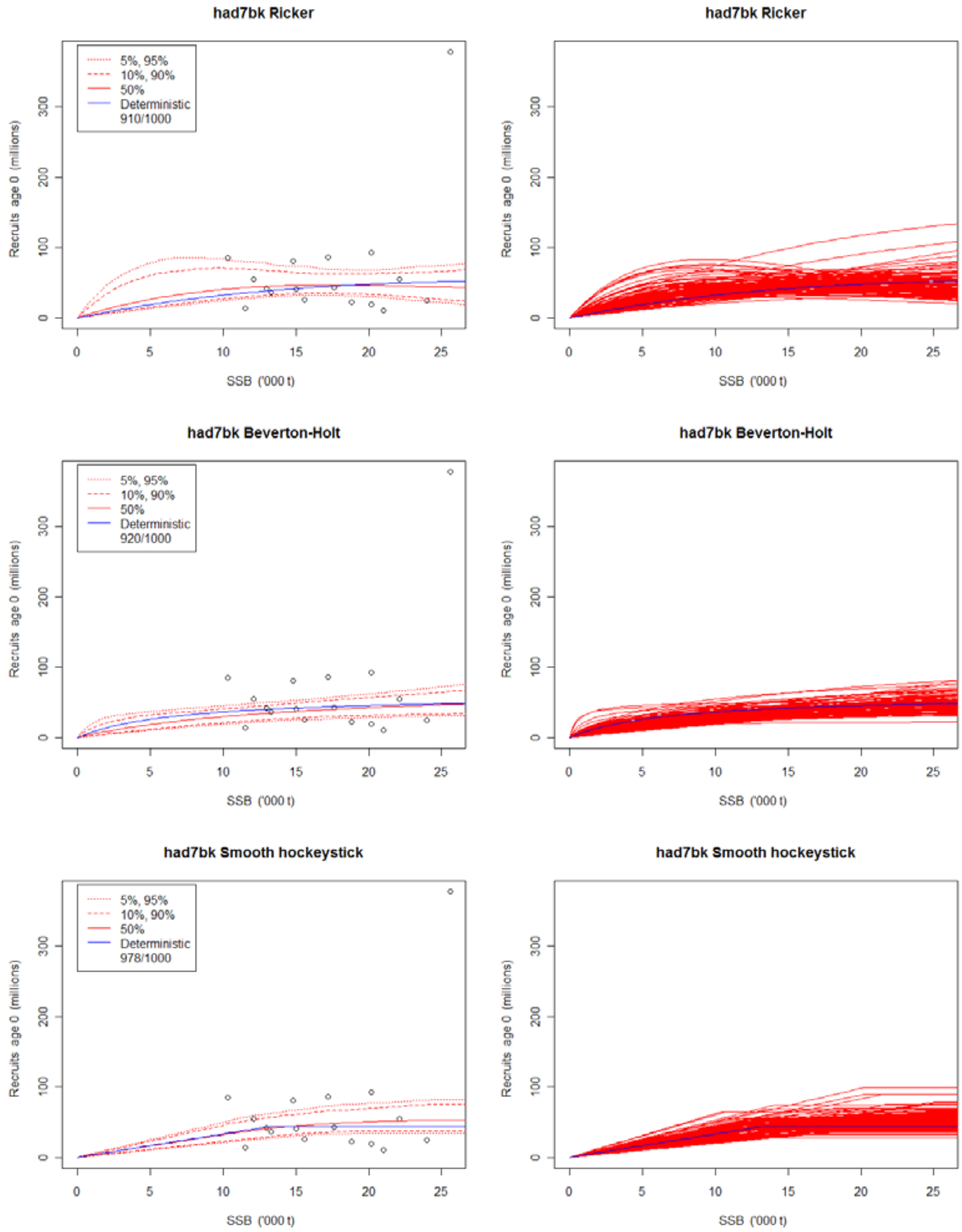


Figure7.4.14. Fitted stock–recruit relationships with 1000 MCMC re-samples. The left-hand plots show the deterministic fit (blue) as well as the confidence intervals from converged estimates of F_{msy} (red). Right-hand panels show the fits from the first 100 converged MCMC re-samples for illustration. The legends show the number of converged values for F_{msy} from 1000 re-samples.

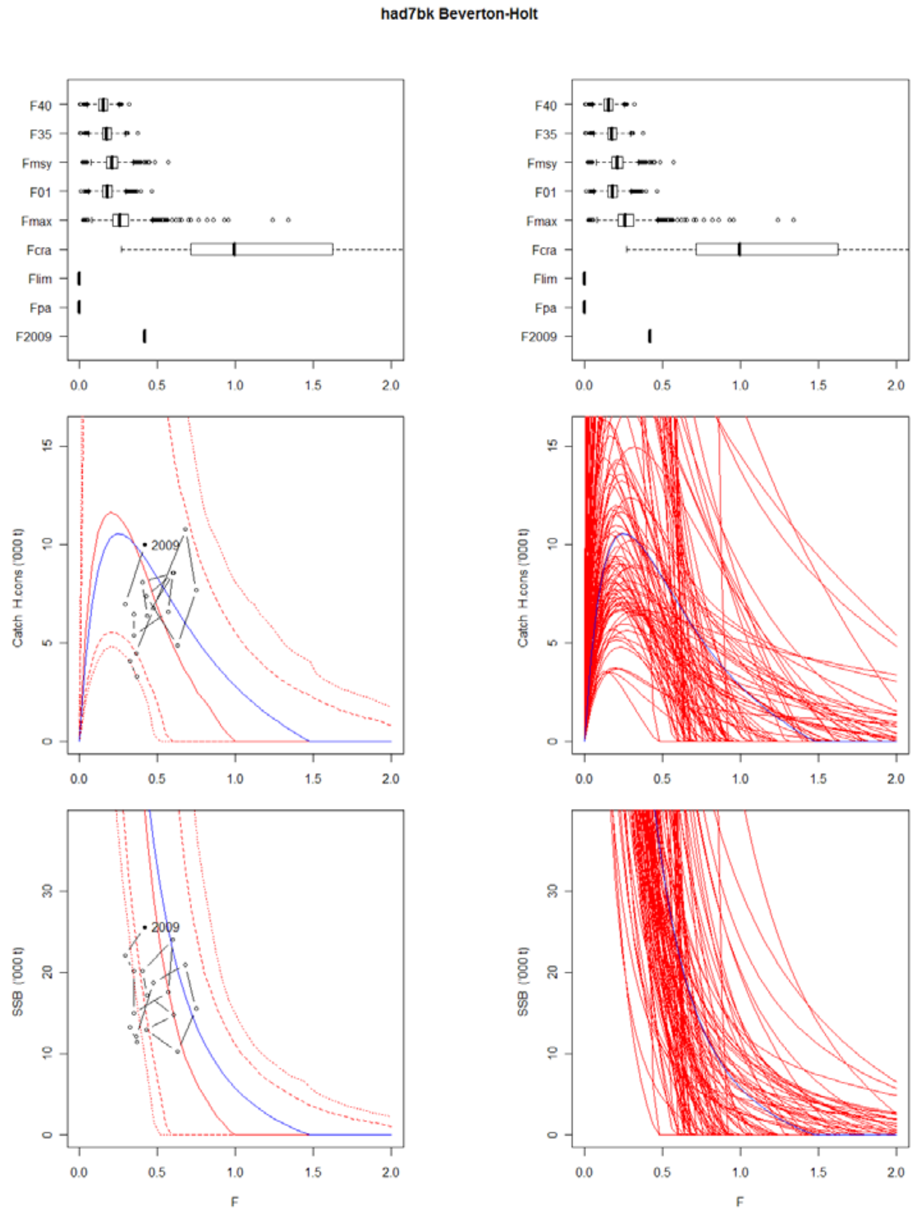


Figure 7.4.15. Estimates of F reference points and equilibrium yield and SSB against mortality using a Beverton and Holt recruitment model. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals of the converged estimates (red) and the right hand plots show the fit for the first 100 re-samples for illustration. The top two plots are identical. Note that F2009 represents the landings component of F_{bar}.

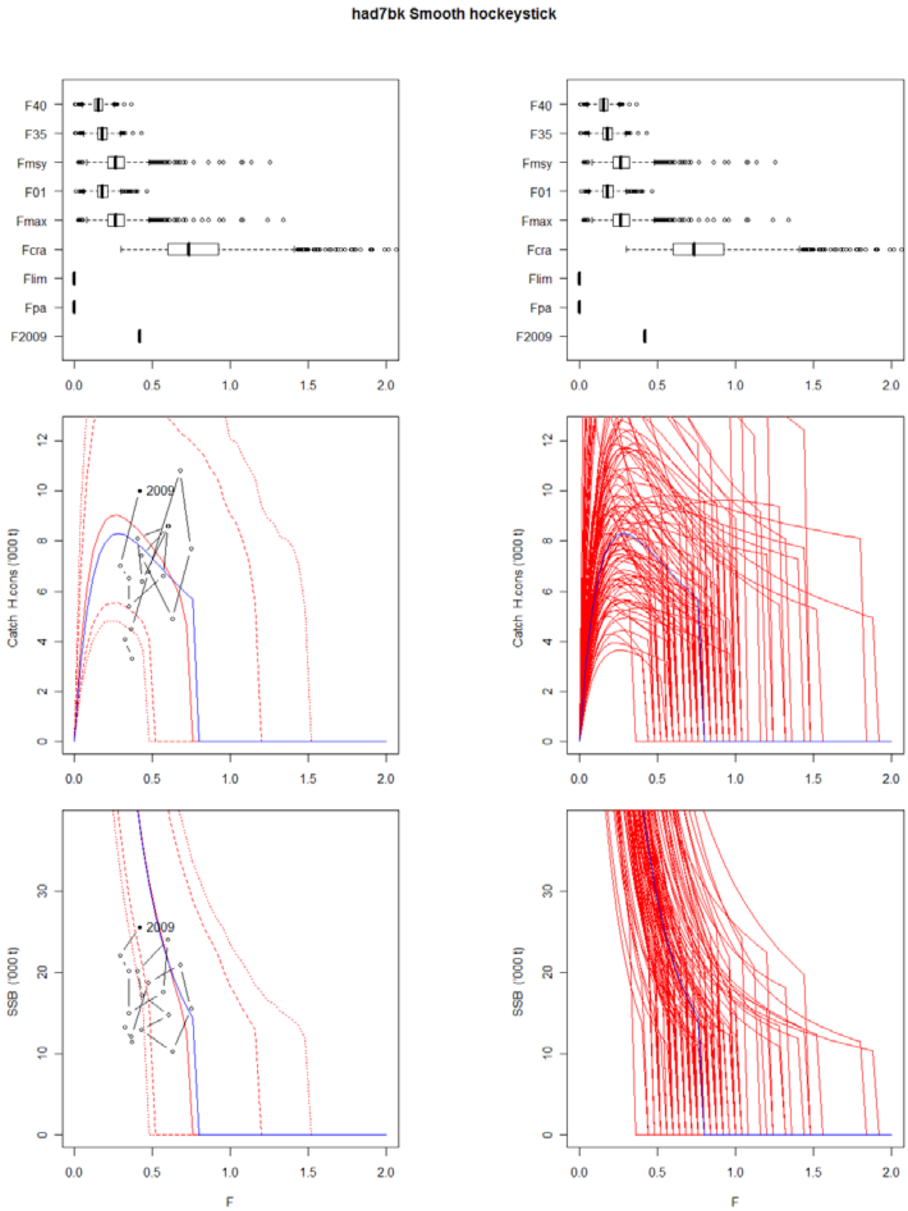


Figure 7.4.16. Estimates of F reference points and equilibrium yield and SSB against mortality using a hockey stick recruitment model. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals of the converged estimates (red) and the right hand plots show the fit for the first 100 re-samples for illustration. The top two plots are identical. Note that F2009 represents the landings component of F_{bar}.

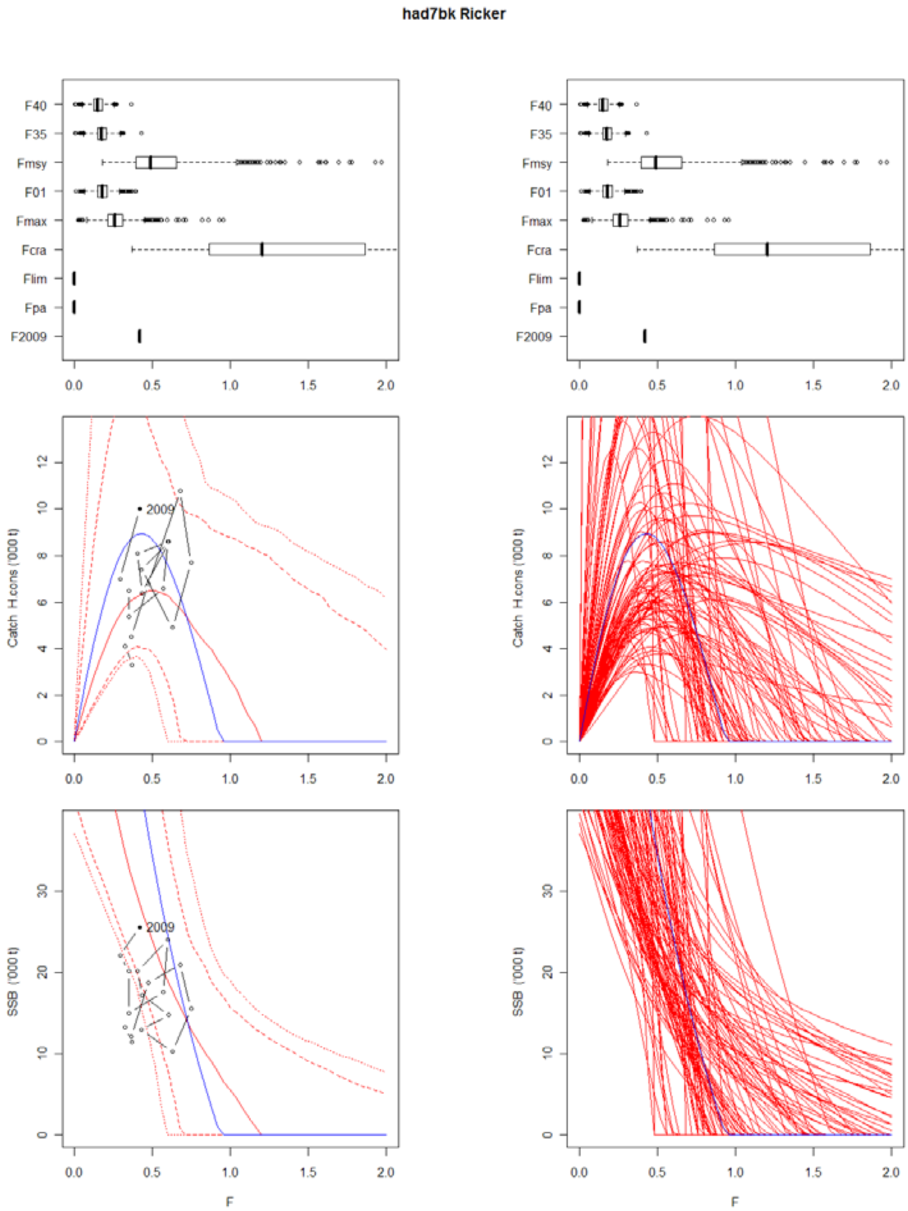


Figure 7.4.17. Estimates of F reference points and equilibrium yield and SSB against mortality using a Ricker recruitment model. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals of the converged estimates (red) and the right hand plots show the fit for the first 100 re-samples for illustration. The top two plots are identical. Note that F2009 represents the landings component of F_{bar}.

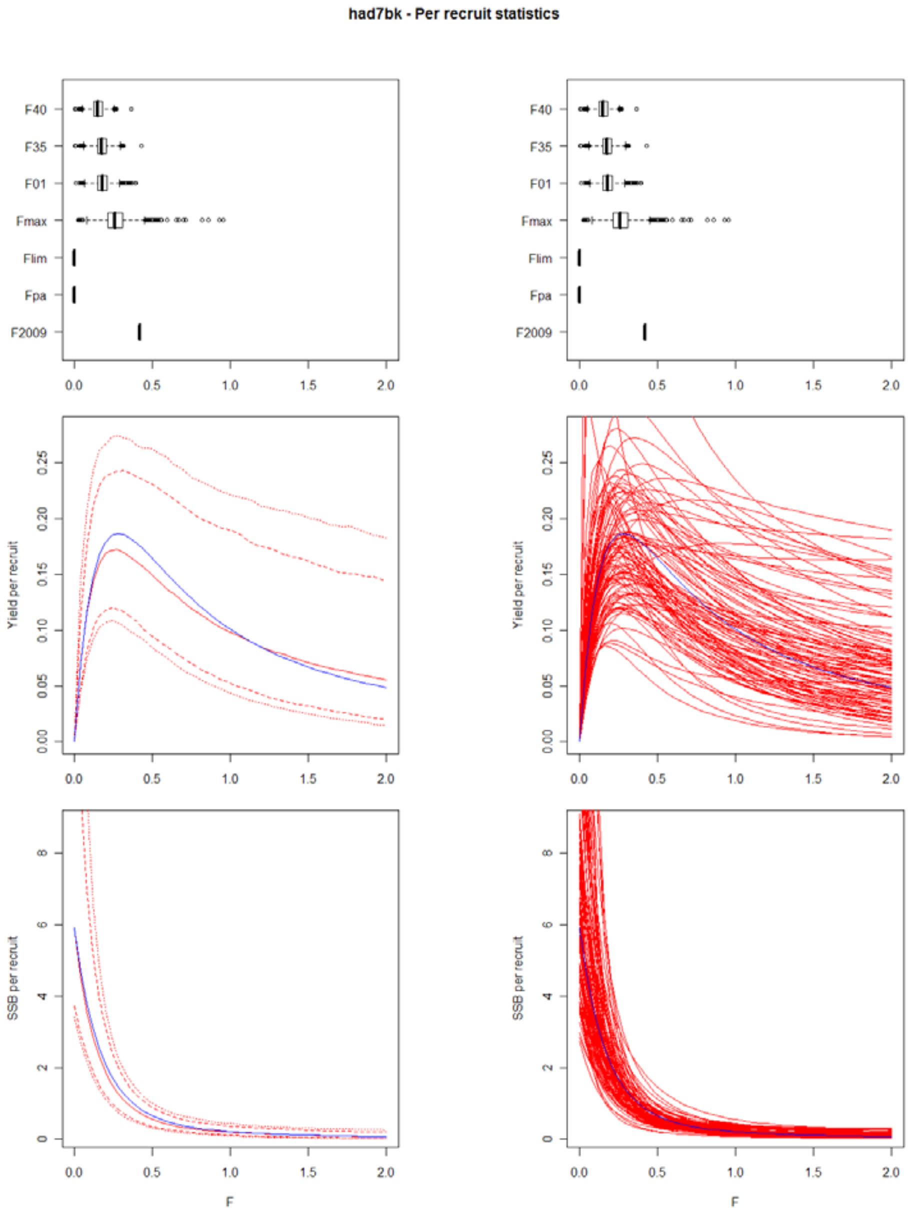


Figure 7.4.18. Fitted of F reference points and equilibrium yield and SSB from the ADMB srmsymc package. The left-hand plot illustrate the deterministic fit (blue) and confidence intervals (red) and the right hand plots show the fit for the first 100 iterations. The top two plots are identical. Note that F2009 represents the landings component of F_{bar}.

7.5 *Nephrops* in Division VIIb (Aran Grounds, FU17)

Type of assessment in 2010

UWTV based assessment using WK*NEPH* 2009 protocol as described in the Stock Annex. This year long-term reference points have been examined for this stock. Further description on the background is presented in Section 7.5.2.

ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary limits/considerations

"The current fishery appears sustainable. Therefore, ICES recommends that Nephrops fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 900 tonnes for the Aran Grounds (FU 17)."

ICES advice applicable to 2010

June 2010:

"Advises on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Ratio for Nephrops fisheries should be less than the lower bound of $F_{0.1}$ ranges for similar stocks (8%).This corresponds to landings of no more than 505 t for the Aran Grounds stock."

Advice was re-opened in November after the 2009 UWTV survey results were available.

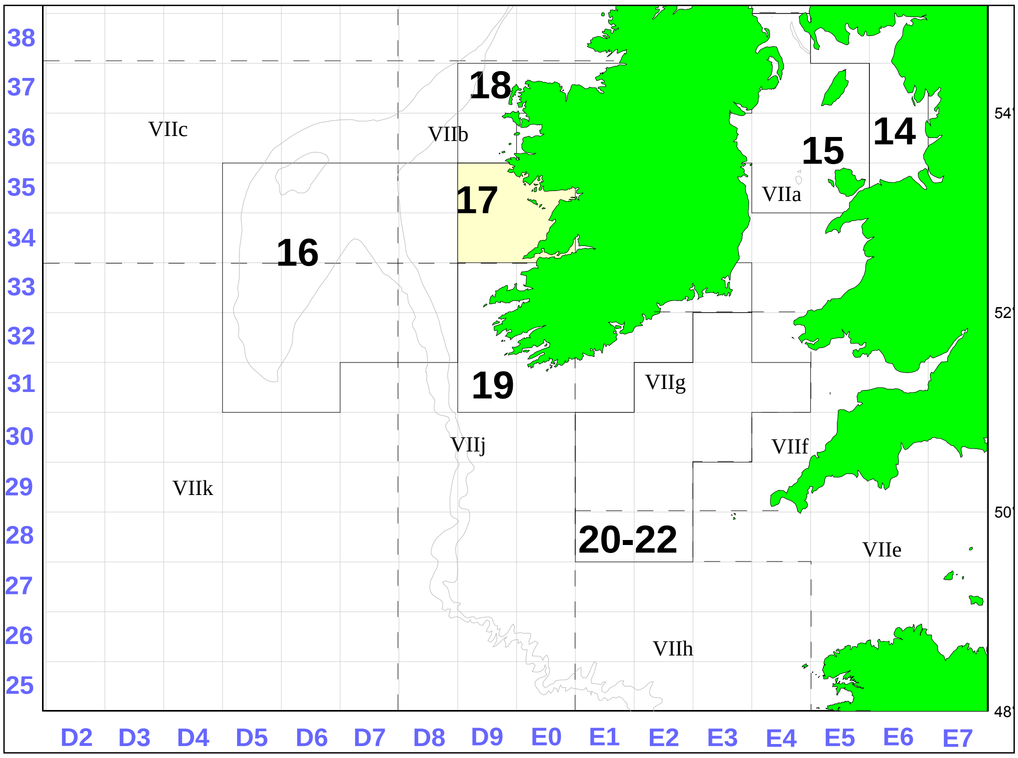
November 2010:

"ICES recommends that on the basis of exploitation boundaries in relation to high long-term yield and low risk of depletion of production potential that the Harvest Ratio for Nephrops fisheries should be less than the lower bound of $F_{0.1}$ ranges for similar stocks (8%). This corresponds to landings of no more than 704 t for the Aran Grounds stock."

7.5.1 General

Stock description and management units

The Aran Grounds *Nephrops* stock (FU17) covers ICES rectangles 34–35 D9–E0 within VIIb. This stock is included as part of the TAC Area VII *Nephrops* which includes the following stocks: Irish Sea East and West (FU14, FU15), Porcupine Bank (FU16), northwestern Irish Coast (FU18), southeastern and southwestern Irish Coast (FU19) and the Celtic Sea (FU20–22).



The TAC is set for Subarea VII which does not correspond to the stock area (FU 17 is shaded light yellow). There is no evidence that the individual functional units belong to the same stock. The 2010 TAC is 22 432 t, 9% less than the 2009 TAC. No FU17 specific restrictions in TAC apply thus, up to 100% of the Area VII TAC could, in theory be taken within FU17.

Management applicable to 2009 and 2010

TAC in 2009

Species: Norway lobster *Nephrops norvegicus*		**Zone**: VII (NEP/07.)
Spain	1 479	
France	5 994	
Ireland	9 091	
United Kingdom	8 086	
EC	24 650	
TAC	24 650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC in 2010

Species: Norway lobster *Nephrops norvegicus*		**Zone:** VII (NEP/07.)
Spain	1 346	
France	5 455	
Ireland	8 273	
United Kingdom	7 358	
EU	22 432	
TAC	22 432	Analytical TAC

The MLS implemented by EC is set at 25 mm CL i.e. 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL i.e. 11.5 cm total length) is applied by the French trawlers.

Ecosystem aspects

This section is detailed in Stock Annex.

Fishery description

Since 1996 the Republic of Ireland fleet had over 99% of the landings from this FU. A description of the fleet is given in the Stock Annex. 37 Irish trawlers reported landings from this FU in 2009. This is about 32% decrease compared with the number of vessels reporting in 2008. However, only 16 of these vessels reported landings in excess of 10 t. The majority of these vessels are based in the port of Ros-a-Mhíl. Typical vessel length is 13–38 m and engine power ranges from 120–870 kW. The majority of the landings are made with 80 mm mesh. Fishing trips usually last 3-7 days.

The majority of the landings come from the grounds to the west and southwest of the Aran Islands known as the 'back of the Arans ground' (See Stock Annex). The fishery on the Aran Grounds operates throughout the year, weather permitting with a seasonal trend (Figure 7.5).

Fishery in 2009

The 2009 landings decreased by 32% from 2008 to 625 t. The decline in landings is mainly attributable to a decline in fishing effort. A decommissioning programme was in operation in Ireland during 2007 and 2008. Eight vessels active in the FU17 fishery were decommissioned. These vessels accounted for approximately 25% of the landings from the 2007–2008 period. In addition increasing fuel prices and poor market value for *Nephrops* impacted in the activity of the remaining fleet during 2009. Landings in Q4 accounted for ~50% of the 2009 landings which is somewhat unusual and this explains the relatively low proportion of females in the landings (males normally dominate the landings in Q4 see Annex).

7.5.2 Data

Sampling of landings and discards resumed in 2008 after a break of two years (2006–2007) in the sampling programme. This break was due to non-cooperation with sampling by the fishing industry. Sampling levels in 2009 were good and are detailed in Section 2 (Table 2.1). Historical data availability and quality is reported in the Stock Annex (Section B).

Landings

The reported landings time-series is shown in Figure 7.5.1and Table 7.5.1. The reported Irish landings from FU17 have fluctuated around 800 t in the recent years. There is concern about the accuracy of reported landings statistics for *Nephrops* by Irish vessels due to restrictive quotas and various misreporting practices. The introduction of sales notes and increased control and enforcement since 2007 should improve the accuracy of reported landings data. The TAC was increased in 2007 and 2008 this has led to an increase in reported landings and lpue.

Commercial cpue

Effort data for this FU is available from 1995 for the Irish otter trawl *Nephrops* directed fleet. In 2009 this fleet accounted for ~90% of the landings compared with an average of 70% over the time period. These data have not been standardised to take into account vessel or efficiency changes during the time period. Effort has declined between 2003–2006 then increased in 2007 to 2008 and declined again in 2009 (Table 7.5.2.). Landings per unit of effort (lpues) have been fluctuating around an average of 39 kg/hr. Lpue in 2009 was above average at 52 kg/hr (Figure 7.5.2).

Discarding

Before 2001 there was no discard sampling and it was thought that *Nephrops* discarding in this fishery was relatively low. Since 2001 discard rates have been estimated using unsorted catch and discards sampling (as described in the Stock Annex). Discard rates range between 14–24% of total catch by weight and 25–40% of total catch by number (Table 7.5.3). Discard rate of females tends to be higher due to the smaller average size and market reasons. There is no information on discard survival rate in this fishery (10% is assumed). No estimates of discards were available from 2006 and 2007 due to the non co-operation of the fishing industry with sampling programmes.

Biological sampling

Sampling programme resumed in 2008 and since then coverage and intensity has been very good. The mean size of whole *Nephrops* (>35 mm) in Irish landings has remained stable between 1995 and 2000 for both sexes (Figure 7.5.3 and Table 7.5.4). The mean size of *Nephrops* in the catch has remained relatively stable since 2001.

The sex ratio in the landings is slightly male biased (Figure 7.5.4). The proportion of males is high in 2009 due an increased proportion of the landings taken in autumn (see Fishery in 2009).

There is no change to other biological parameter as described in the Annex.

Abundance indices from UWTV surveys

Prior to the 2010 WG burrow counts for 2004 and 2005 surveys were verified and there were also minor revisions to 2002 to 2007 where the survey data was quality controlled. This verification and QC process resulted in some changes to historical abundance estimates although it did not change the overall perception in the trend in the time-series (See Lordan and Doyle, WD8). WK*NEPH* 2009 concluded that this survey could be used as an absolute index of abundance for this stock provided the bias (see text table below) was taken into account. This direct use of the survey is in lieu of alternative assessment approaches. These bias sources are not easily estimated and are largely based on expert opinion. In the Aran Grounds the largest source of perceived bias is the "edge effect".

FU	Area	Edge effect	detection rate	species identification	Occupancy	Cumulative bias
17	Aran	1.35	0.9	1.05	1	1.3

The blanked krigged contour plot and posted point density data are shown in Figure 7.5.5. The krigged contours correspond very well to the observed data. In general the densities are higher towards the western side of the ground rather and there is a notable trend towards lower densities towards the east. Densities and abundance have fluctuated considerably of the time-series (e.g. 0.6–1.4 burrows/m^2). The mean density in 2009 is approx 30% increase on 2008 it remains below the average of the time-series.

The summary statistics from this geostatistical analysis are given in Table 7.5.5 and plotted in Figure 7.5.6. The 2009 estimate of 718 million burrows is the third lowest to date but the estimates have fluctuated fairly widely to date since the survey commenced. The estimation variance of the survey as calculated by EVA is relatively low (CVs in the order <5%). Random stratified estimates are given for the smaller Slyne Head and Galway Bay grounds. Currently the spatial extent of these other grounds not well estimated. The size and contribution to landings of these grounds is small relative to the Aran grounds and these have not been taken into account in the overall abundance estimate or catch options.

As in previous years the relationship between commercial lpue in the autumn and spring commercial fishery and survey abundance was explored in Figure 7.5.7. The results also suggest that there is a negative relationship between survey abundance in June and lpue in the autumn and a weakly positive relationship with the fishery in the subsequent spring.

7.5.3 Assessment

Review Group comments on the 2009 assessment

The RG agrees with the WG on the assessment used and considers the data the best available. With that said, the RG disagrees with ICES (advice for 2009) *and the WG advice* (for 2009) *that the fishery is sustainable at current levels of effort. The 2008 survey estimates of burrows is the lowest in the time-series at ~60% of the time-series average with a high current F and has the highest harvest rate in the short time-series. Effort has increased and is at the highest level in the time-series, but lpue (kg/hr) decreased slightly from 2007 to 2008. The slight decrease in lpue coupled with the lowest abundance estimate in the time-series could be an indicator that the TAC could be set lower to decrease F and effort. This may be difficult given the changes in the fishery (i.e. increases in effort being displaced from other areas and misreporting of landing statistical area). Unless there is an observed increased in burrows in the next survey, a precautionary approach should be taken.* (the UWTV abundance in 2009 increased by ~30%). Advice was reopened in November 2009 following the UWTV survey which showed that abundance in 2009 had increased by ~30%.

Approach in 2010

The assessment approach used by WGCSE 2010 is consistent with that set out in the Stock Annex and WK*NEPH* (2009). Exploratory SCAs (Separable cohort analysis) were carried out to derive suitable reference points for this stock. These SCAs used 2008 and 2009 sampling data and combined 2008–2009 sampling. Different selection patterns between sexes were included in the model to take into account differences in selection observed in the fishery.

Comparison with previous assessments

The assessment is based on similar methods and data as used in 2009. The stock size is estimated to have increased and harvest ratio has decreased based on the UWTV survey.

State of the stock

UWTV abundance estimates suggest that the stock size has fluctuated widely. A diffusion model (Dennis *et al*., 1991) that takes into account stochastic variability in the estimates results in a slope or μ close to 0 indicating no overall trend in abundance. The fluctuations in survey abundance appear to be largely independent of harvest rate estimates from the fishery. This may suggest that natural or other unaccounted mortality and recruitment are largely responsible for the observed variability (assuming landings and UWTV abundance estimates are accurate).

Table 7.5.6 summarises recent harvest ratios for the stock along with other stock parameter. Figure 7.5.8 is the stock summary plot for FU17. Recent harvest rates have fluctuated around 8%, abundance has fluctuated around 600 million and landing have fluctuated around 800 t.

7.5.4 Short-term projections

Forecast inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 7.5.6. Since 2002 mean weight in the landings has varied between 18–27 grs. The estimate harvest ratio has also varied a lot, 3–13% with 2008 being the highest observed.

A prediction of landings for 2011 was made for the Aran Grounds Functional Unit using the approach agreed procedure proposed at WK*NEPH* 2009 and outlined in the Stock Annex. The notable difference is that for FU17 a two year average landing weight and proportion retained by the fishery has been used due to lack of sampling in 2007–2008. Table 7.5.7 shows landings predictions at various harvest ratios, including those equivalent to fishing within the range of $F_{0.1}$ to F_{max}. The 2009 harvest ratio for the Aran grounds is estimated to be below F_{max}.

7.5.5 MSY explorations

As discussed in Section 2.2 no dynamic population model is fitted to the data so no estimates of spawning stock and recruitment were available to determine F_{msy}. In response to the recommendations of WKFRAME (2010), the Bell/Dobby combined sex–length cohort analysis (SCA) model used to determine Harvest Rates associated with fishing at $F_{0.1}$ and F_{max} at WK*NEPH* (2009) was adapted to also output estimates of $F_{35\%Spr}$ and to take into account separate sex selection. The SCA model fits are presented in Figure 7.5.9. These F estimates could be used as a proxy for F_{msy}. Catch–length data were available for the most recent two years in the fishery 2008 and 2009. For other stocks three years of length data were used in the analysis but in this case there was a gap in sampling in 2006 and 2007.

The results of the model in the text table below show the F multipliers required to achieve the potential F_{msy} proxies, the harvest rates that correspond to those multipliers and the resulting level of spawner per recruit as a percentage of the virgin level.

		Fbar 20-40mm		Harvest Rate	% Virgin Spawner per Recruit	
		Female	Male		Female	Male
$F_{0.1}$	Comb		0.06	0.17	7.2%	64.3%
$F_{0.1}$	Female		0.11	0.31	9.1%	49.7%
$F_{0.1}$	Male		0.05	0.14	6.4%	68.8%
F_{35}	Comb		0.12	0.34	10.5%	47.0%
$F_{35\%}$	Female		0.55	0.19	12.8%	34.9%
$F_{35\%}$	Male		0.07	0.21	8.4%	60.0%
F_{max}	Comb		0.12	0.34	11.1%	47.0%
F_{max}	Female		0.56	0.19	13.0%	34.5%
F_{max}	Male		0.09	0.26	9.8%	54.1%

This fishery is highly seasonal (see Annex), but the timing of the fishery has varied somewhat in recent years. In 2009 a larger proportion of the landings were taken in autumn leading to a change in sex ratio and size compared with 2008. This coupled with limited time-series of survey data and biological knowledge of the stock suggest a risk adverse harvest rate would be appropriate.

Compared to other *Nephrops* fisheries in ICES area the absolute population density of this stock is relatively high Figure 6.5.9. This implies that sperm limitation if males are over fished is not likely to be a significant problem. The combined sex $F_{35\%}$ SPR would result in >20% males SPR and 47% female SPR. This combined sex $F_{35\%}$ also corresponds to F_{max}. **The WG concluded that a combined sex $F_{35\%}$ was a suitable F_{msy} proxy for this stock. This corresponds to a harvest rate of 9.7%.**

7.5.6 Biological reference points

Precautionary reference points have not been defined for *Nephrops* stocks. Given the short time-series of UWTV survey data it is not possible to define an appropriate $B_{trigger}$. $F_{35\%}$ SPR is proposed by the WG as proxy for F_{msy}.

7.5.7 Management strategies

As yet there are no explicit management strategies for this stock but there have been some discussions amongst the fishing industry and scientists about developing a long-term plan for the management of the Aran fishery. Sustainable utilisation of the *Nephrops* stock will form the cornerstone of any management strategy for this fishery.

7.5.8 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). These recommendations have been retrospectively applied to historical survey estimates this year (Section 5.1) and these are now considered final. Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WK*NEPH* 2009). The survey estimates themselves are likely to be fairly precisely estimated given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU17 are largely based on expert opinion. The precision of these cannot yet be characterised. Ultimately there still remains a degree of subjectivity in the production of UWTV indices.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU17 deterministic estimates of the mean weight in the landings and discard rates for 2008 and 2009 have been used since sampling data was not available for the previous two years. Historical data suggest parameters have been variable in the past (Table 7.5.6). In future years the uncertainty in these key parameters should be estimated.

Landings data are assumed to be accurate. Since 2007 the introduction of "buyers and sellers legislation" in Ireland is thought to have improved the accuracy of the reported landings.

Finally, the catch options developed do not have any additional catches for the smaller Slyne or Galway Bay Grounds. This is likely to cause a small (<3%) underestimate in the catch options for FU17 as a whole.

7.5.9 Recommendation for next Benchmark

This stock was benchmarked in 2009. WK*NEPH* 2009 suggested several areas to be addressed before the next Benchmark. Currently there is no recommended time frame for another benchmark.

7.5.10 Management considerations

The trends from the fishery (landings, effort lpue, mean size, etc.) appear to be relatively stable. Lpues have been relatively high in the last three years. Conversely, the UWTV abundance and mean density estimates show large fluctuations in burrow abundance and harvest rates. This suggests that the *Nephrops* population at current exploitation and recruitment rates is rather dynamic. The generally low apparent harvest rate (9% average) appears to have little impact on observed stock fluctuations. A new survey point should be available after June 2010 which will provide a more up to date prognosis of stock status. The use of the most up to date survey information should be considered for this stock.

In recent years several newer vessels specialising in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimise catch rates. Since the introduction of effort management associated with the cod long-term plan (EC 1342/2008) there have been concerns that effort will be displaced towards the Aran and other *Nephrops* grounds where effort control has not been put in place. This has not occurred in 2009 and effort is down substantially (-37%). This can be explained by the decommissioning of several vessels that actively participated in the fishery heretofore, and generally poor economic conditions for this fishery. Nevertheless management measures should be established to prevent unsustainable increases in effort and catch for this stock.

7.5.11 References

Dennis, B., P.L. Munholland and J.M. Scott. 1991. Estimation of growth and extinction parameters for endangered species. Ecological Monographs 64:205–224.

Table 7.5.1 *Nephrops* in FU17 (Aran Grounds). Landings in tonnes by country.

	FU 17			
Year	France	Rep. of Ireland	UK	Total
1974	477			477
1975	822			822
1976	131			131
1977	272			272
1978	481			481
1979	452			452
1980	442			442
1981	414			414
1982	210			210
1983	131			131
1984	324			324
1985	207			207
1986	147			147
1987	62			62
1988	14	814		828
1989	27	317		344
1990	30	489		519
1991	11	399		410
1992	11	361		372
1993	11	361	0	372
1994	18	707	4	729
1995	91	774	1	866
1996	2	519	4	525
1997	2	839	0	841
1998	9	1401	0	1410
1999	0	1140	0	1140
2000	1	879	0	880
2001	1	912	0	913
2002	2	1152	0	1154
2003	0	933	0	933
2004	0	525	0	525
2005	0	778	0	778
2006	0	637	0	637
2007	0	913	0	913
2008	0	1050	7	1057
2009	0	625	0	625

Table 7.5.2. ***Nephrops*** **in FU 17 (Aran Grounds). Irish effort and lpue for** ***Nephrops*** **directed fleet.**

Year	Irish Nephrops Directed Fleet		
	Effort (Hrs)	Landings (tonnes)	LPUE (kg/hr)
1995	15306	530	34.6
1996	9109	311	34.1
1997	15763	478	30.3
1998	21909	926	42.3
1999	19546	743	38.0
2000	17131	547	31.9
2001	18700	600	32.1
2002	18565	861	46.4
2003	19922	732	36.8
2004	12899	381	29.5
2005	14900	729	45.8
2006	10798	559	51.8
2007	13608	815	59.9
2008	16676	963	57.8
2009	10620	561	52.8

Table 7.5.3. ***Nephrops*** **in FU17 (Aran Grounds). Landings and discard weight and numbers by year and sex.**

	Female		Male		Both sexes
Year	Landings (t)	Discards (t)	Landings (t)	Discards (t)	% Discard
2001	312	109	601	138	21%
2002	423	96	729	99	14%
2003	237	89	688	98	17%
2004	267	71	259	45	18%
2005	323	106	441	86	20%
2006					
2007	No Sampling				
2008	324	160	726	98	20%
2009	90	130	726	134	24%

	Female Numbers '000s		Male Numbers '000s		Both sexes
Year	Landings	Discards	Landings	Discards	% Discard
2001	18,665	12,161	29,949	13,250	34%
2002	23,105	9,374	31,256	8,326	25%
2003	14,530	9,577	29,538	8,744	29%
2004	16,109	7,068	12,930	4,282	28%
2005	20,280	11,383	21,828	8,967	33%
2006					
2007	No Sampling				
2008	15,697	13,223	31,184	8,350	32%
2009	3,084	7,485	20,421	8,218	40%

Table 7.5.4. ***Nephrops*** **in FU17 (Aran Grounds). Mean size trends for catches and whole landings by sex.**

Year	Catches		Catches		Whole Landings			
	<35mm CL		>35mm CL		<35mm CL		>35mm CL	
	Males	Females	Males	Females	Males	Females	Males	Females
1995	na	na	na	na	32.0	31.8	38.3	37.0
1996	na	na	na	na	31.1	32.1	37.8	37.4
1997	na	na	na	na	31.9	32.0	37.8	37.4
1998	na	na	na	na	31.3	31.7	38.0	37.2
1999	na	na	na	na	31.3	32.3	38.0	37.1
2000	na	na	na	na	32.0	31.4	38.4	36.3
2001	28.9	27.5	38.0	37.3	na	na	na	na
2002	30.7	29.1	38.2	37.2	na	na	na	na
2003	30.5	27.4	38.2	38.0	na	na	na	na
2004	29.3	28.3	37.3	37.5	na	na	na	na
2005	28.9	27.7	37.8	37.2	na	na	na	na
2006	No Sampling							
2007								
2008	27.4	29.7	36.8	37.8	na	na	na	na
2009	30.3	28.4	38.0	37.1	na	na	na	na

na = not available

Table 7.5.5. ***Nephrops*** **in FU17 (Aran Grounds). Results summary table for geostatistical analysis of UWTV survey.**

Ground	Year	Number of stations	Mean Density (No./M2)	Domain Area (m2)	Geostatistical abundance estimate (million burrows)	CV on Burrow Estimate
Aran	2002	49	0.84	943	818	4%
	2003	41	1.01	943	989	5%
	2004	64	1.43	943	1397	3%
	2005	70	1.09	936	1063	3%
	2006	67	0.64	932	621	3%
	2007	71	0.93	942	906	3%
	2008	62	0.57	842	515	3%
	2009	82	0.73	940	718	2%

Results summary table for empirical statistical analysis of UWTV survey

Ground	Year	Number of stations	Mean Density (No./M^2)	Area Surveyed (m2)	Burrow count	Standard Deviation	95%CI	CV
Galway Bay	2002	7	1.58	1,299	2,017	0.37	0.34	9%
	2003	3	1.60	591	941	0.29	0.73	11%
	2004	9	0.73	2,312		0.42	0.32	19%
	2005	4	1.67	661	1,625	0.20	0.32	6%
	2006	3	0.98	540	1,107	0.27	0.67	16%
	2007	5	1.14	890	992	0.24	0.29	9%
	2008	10	0.42	1,907	859	0.31	0.22	23%
	2009	8	0.93	1,207	1,116	0.16	0.14	6%
Slyne Grounds	2002	5	0.85	1,216	1,027	0.19	0.23	10%
	2003	0	-	-	-	-	-	-
	2004	3	0.68	827	531	0.27	0.66	23%
	2005	3	0.55	531	294	0.05	0.13	6%
	2006	3	0.41	526	210	0.20	0.49	28%
	2007	4	0.63	838	547	0.31	0.49	24%
	2008	0	-	-	-	-	-	-
	2009	6	0.40	531	144	0.22	0.23	22%

*random stratified estimates are given for the Slyne Head and Galway Bay grounds

Table 7.5.6. *Nephrops* in FU17 (Aran Grounds). Forecast inputs (highlighted) and historical estimates of mean weight in landings and harvest ratio.

Year	Landings in Number (millions)	Discards in Number (millions)	Removals in Number (millions)	Prop Removals Retained	Adjusted Survey (millions)	Harvest Ratio	Landings (t)	Discards (t)	Mean Weight in landings (gr)
2001	48.7	25.4	71.6	0.68			913		
2002	54.5	17.7	70.4	0.77	629	11.2%	1,154	192	21.2
2003	44.1	18.3	60.6	0.73	761	8.0%	933	183	21.2
2004	29.0	11.4	39.3	0.74	1075	3.7%	525	112	18.1
2005	42.4	19.7	60.1	0.70	818	7.4%	778	182	18.4
2006	na	na	49.5	na	478	10.4%	637	na	na
2007	na	na	57.3	na	697	8.2%	913	na	na
2008	46.9	21.6	66.3	0.71	396	16.7%	1,057	245	22.5
2009	23.5	15.7	37.6	0.62	552	6.8%	625	256	26.6
Avg 08 &09				0.67					24.6

na= not available due to non-cooperation with sampling programmes.

Shading indicates removal estimated based on combined 2005 and 2008 numbers-at-length scaled appropriately to landings in 2006 and 2007. The commensurate harvest ratio estimate is also shaded.

Table 7.5.7. *Nephrops* in FU 17 (Aran Grounds). Short-term forecast management option table giving catch options for 2011.

			Implied fishery	
	Harvest rate	Survey Index (millions)	Retained number (millions)	Landings (tonnes)
MSY framework	10.5%	552	39	948
F 2010 (avg. 2007-2009)	10.6%	552	39	957
F0.1 Combined	7.2%	552	26	650
Fmax Combined	11.1%	552	41	1,002
F0.1 Comb	7.2%	552	26	650
F0.1 Female	9.1%	552	33	822
F0.1 Male	6.4%	552	24	578
F35% Comb	10.5%	552	39	948
F35% Female	12.8%	552	47	1,156
F35% Male	8.4%	552	31	759
Fmax Comb	11.1%	552	41	1,002
Fmax Female	13.0%	552	48	1,174
Fmax Male	9.8%	552	36	885
	2.0%	552	7	181
	4.0%	552	15	361
	6.0%	552	22	542
	8.0%	552	29	722
	10.0%	552	37	903
	12.0%	552	44	1,084
	14.0%	552	51	1,264
				Basis
Landings Mean Weight (Kg)		0.0		Sampling 2008 and 2009
Survey Overestimate Bias		1.30		WK*NEPH* 2009
Survey Numbers (Millions)		718		UWTV Survey 2009
Prop. Retained by the Fishery		0.67		Sampling 2008 and 2009

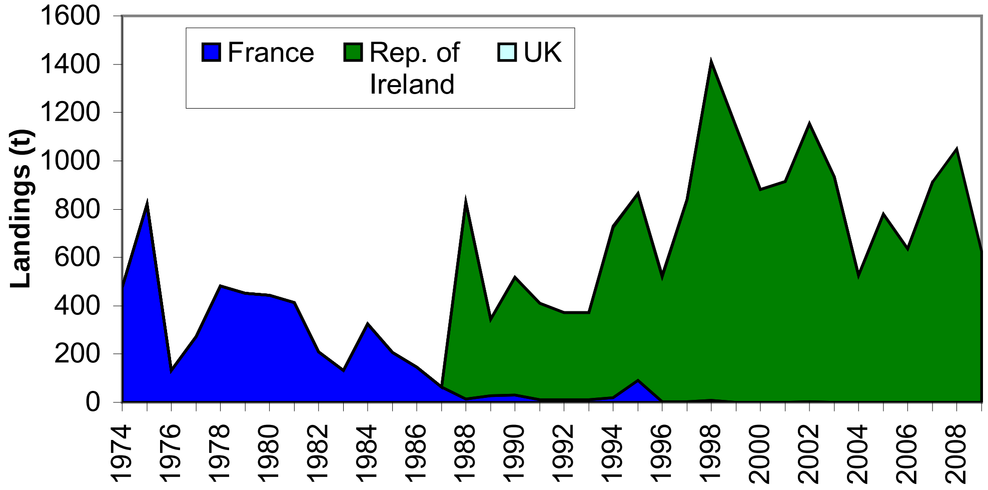


Figure 7.5.1. ***Nephrops*** **in FU17 (Aran Grounds). Landings in tonnes by country.**

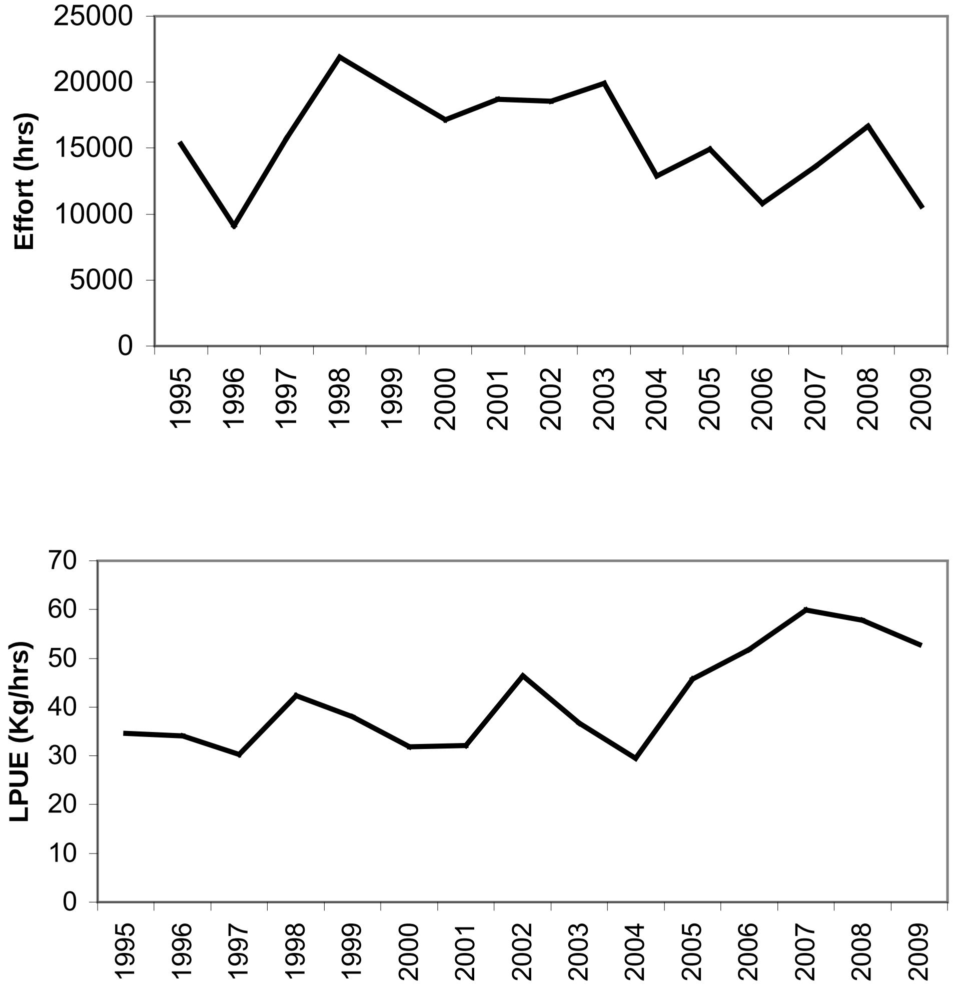


Figure 7.5.2. ***Nephrops*** **FU17 Aran Grounds. Irish effort and lpue for** ***Nephrops*** **directed fleet.**

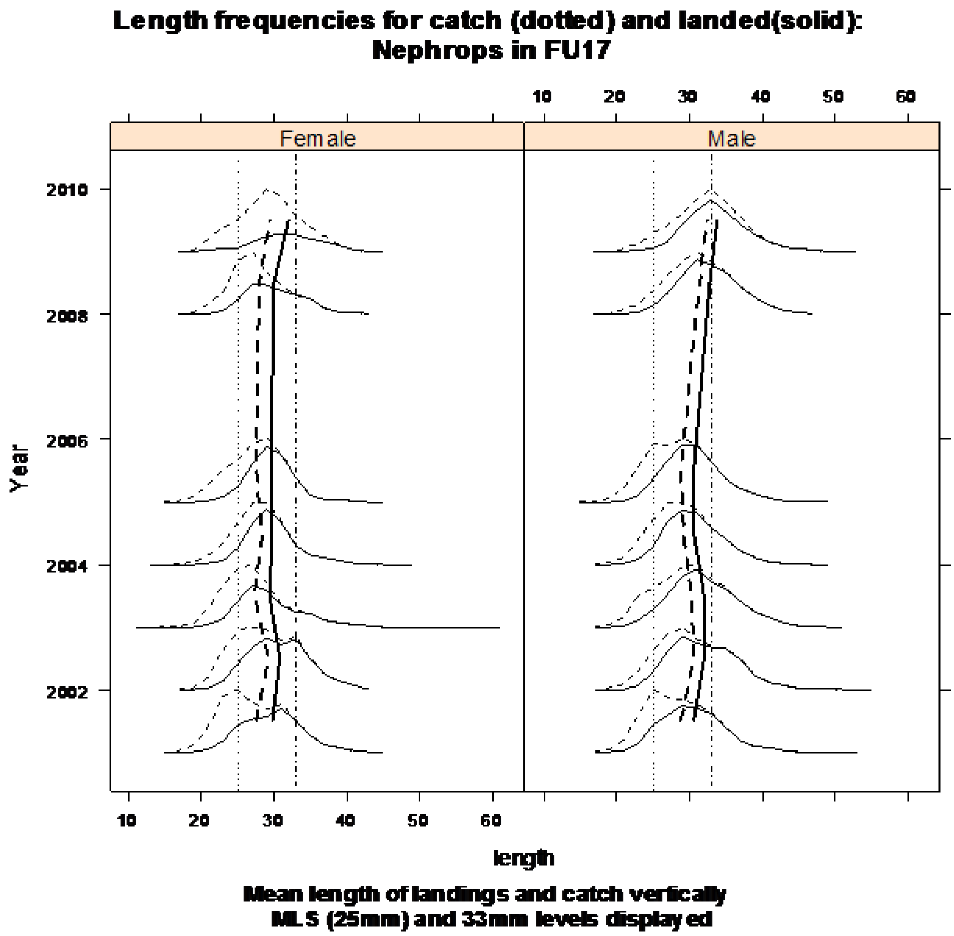


Figure 7.5.3. ***Nephrops*** **FU17 Aran Grounds. Length distributions in the catches 2001–2005, 2008–2009 and in the landings 1995–2001.**

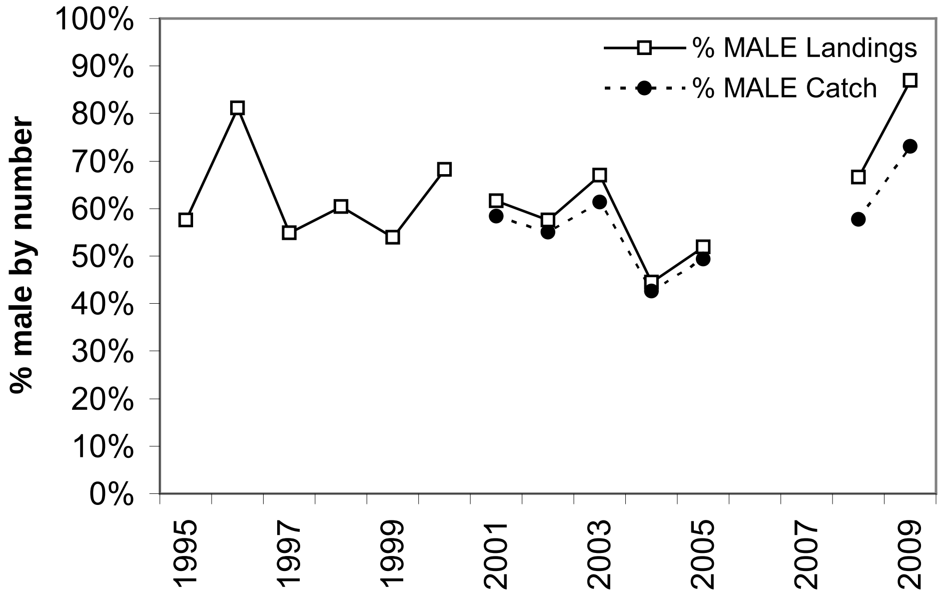


Figure 7.5.4. ***Nephrops*** **in FU17 (Aran Grounds). Sex ratio of whole landings (1995–2000), landings (2001–2009) and catch (2001–2009).**

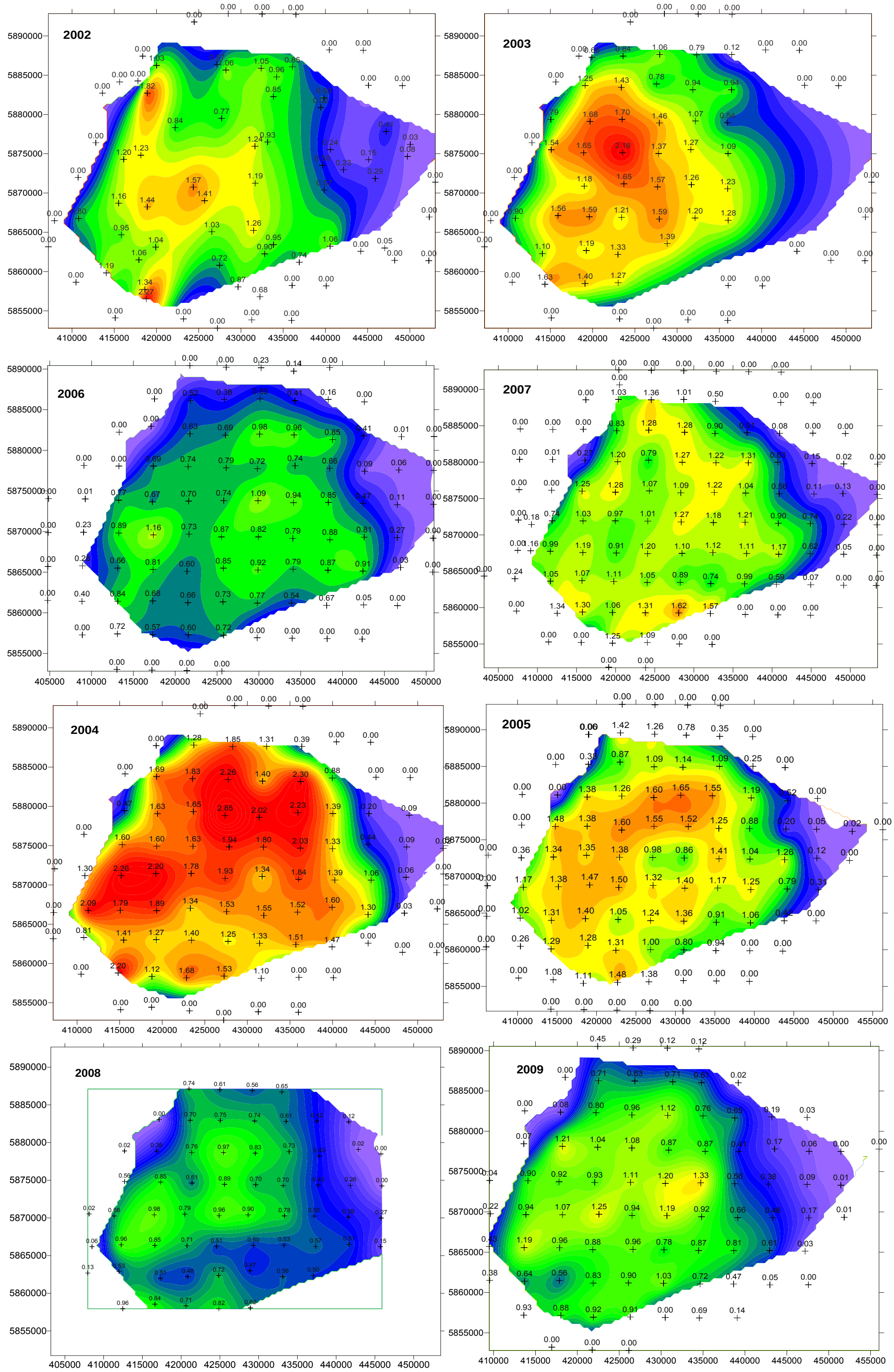


Figure 7.5.5. ***Nephrops*** **in FU17 (Aran Grounds). Contour plots of the krigged density estimates for the Aran Ground UWTV surveys from 2002–2009.**

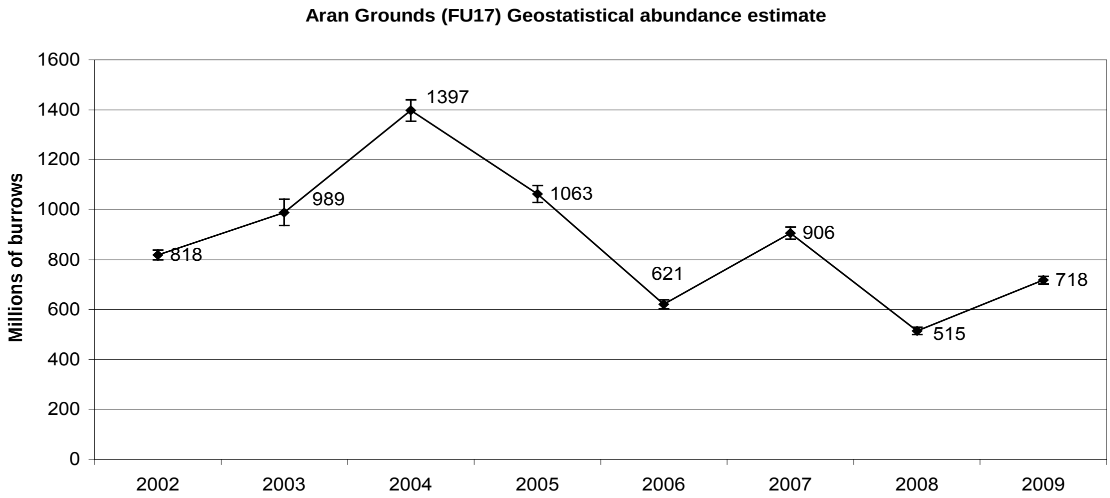


Figure 7.5.6. ***Nephrops*** **FU17 Aran Grounds.**

a)

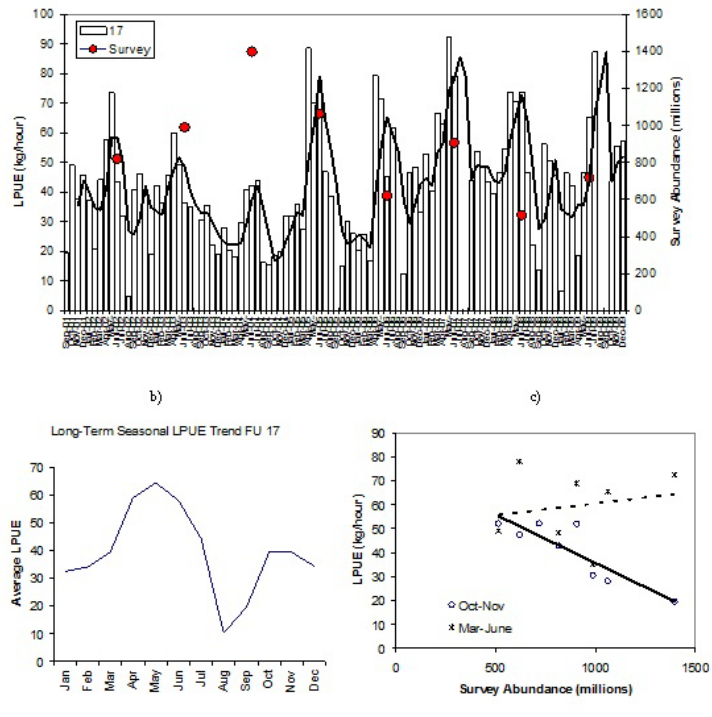
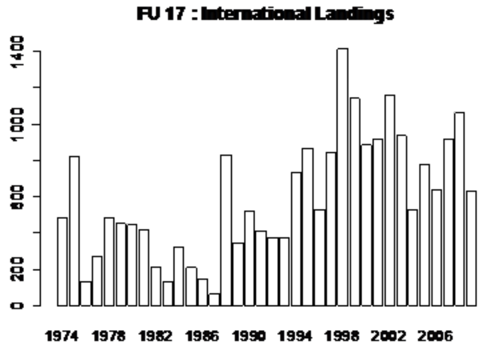


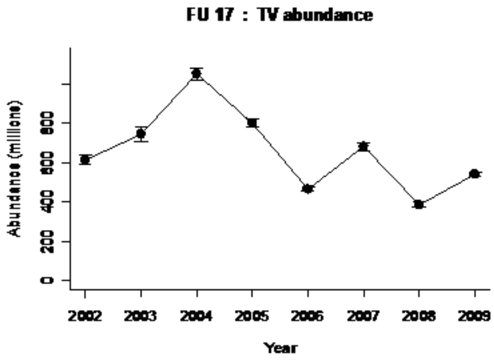
Figure 7.5.7. ***Nephrops*** **FU 17 Aran Grounds.**

a) The monthly lpue from FU17 (bars) and survey abundance index (red dots).

b) mean standardised long-term (1995–2009) seasonal trend in lpue for FU17.

c) the relationship between lpues for two time periods and survey abundance estimates.





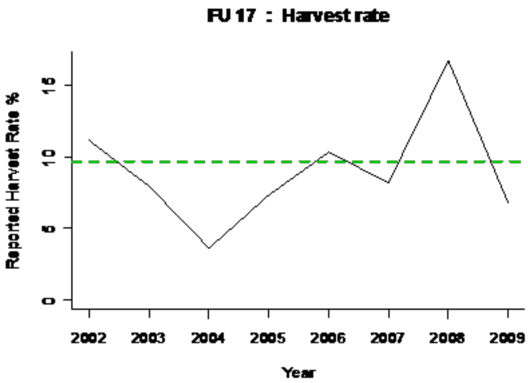


Figure 7.5.8. ***Nephrops*** **FU17 Aran Grounds. Stock Summary plots: Landings (tonnes), UWTV abundance (millions) and Harvest Ratio (% dead removed/UWTV abundance).**

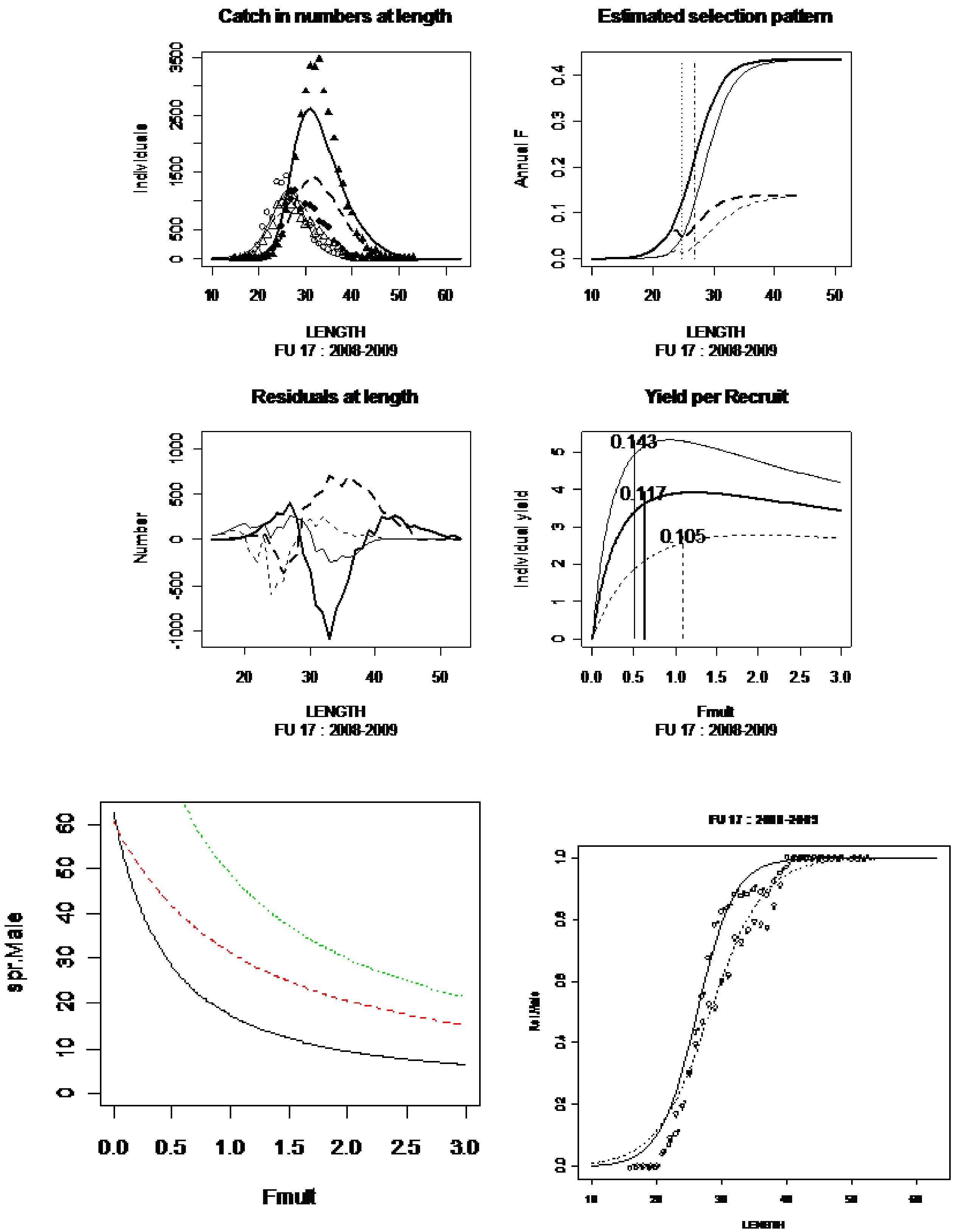


Figure 7.5.9. *Nephrops* FU17 Aran Grounds.SCA outputs based on 2008 and 2009 length distributions.

7.6 *Nephrops* in Division VIIb,c,j,k (Porcupine Bank, FU16)

Type of assessment in 2010

This year the Working Group updated the fishery information, survey data and other indicators for *Nephrops* in Division VIIbcjk. There are recruits appearing in the survey and commercial catches for the first time in several years. The landings in recent years have been dominated by increasing larger individuals and higher proportions of females. All indicators suggested that the stock was over exploited and on the point of collapse. The new recruitment offers an opportunity to begin the rebuild of the stock if exploitation rates can be kept low.

ICES advice applicable to 2009

"Because of the apparent low recruitment and the recent expansion of the fishery there is an associated increased exploitation. ICES recommends reduction in the exploitation rate and restricting catches in 2009 to no more than 1000 t, which corresponds to the catch level before the expansion of the fishery (2000–2003). The fishery should not be allowed to expand again unless it can be shown that it is sustainable".

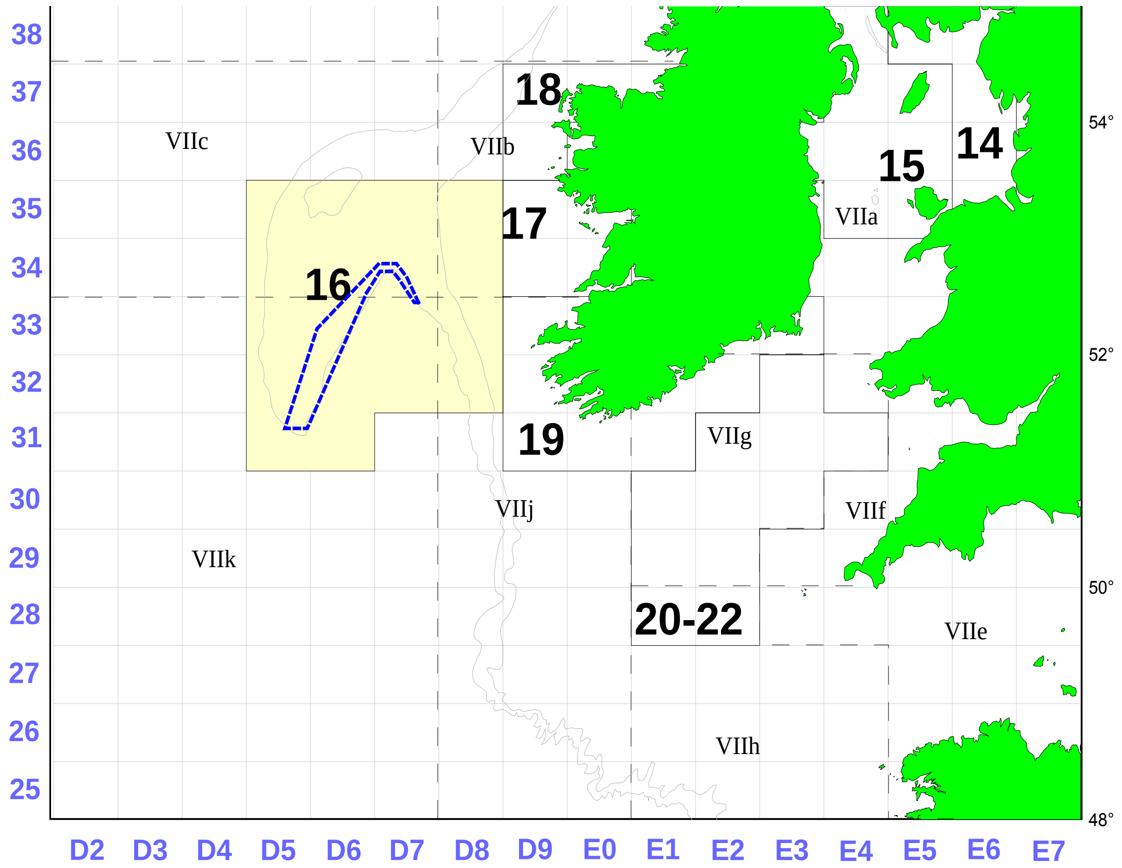
ICES advice applicable to 2010

"ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that catches in 2010 should be reduced to the lowest possible level."

7.6.1 General

Stock description and management units

The TAC area is Subarea VII. The Functional Unit for assessment includes some parts of the following ICES Divisions VIIb, c, j, and k. The exact stock area is shown on the map below and includes the following ICES Statistical rectangles: 31–35 D5–D6; 32–35 D7–D8.



The TAC is set for all of Subarea VII. The FU16 is shaded light yellow and the closed area from 01/05/10–31/07/10 is within the blue dotted line.

Management applicable to 2009 and 2010

TAC in 2009

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 479	
France	5 994	
Ireland	9 091	
United Kingdom	8 086	
EC	24 650	
TAC	24 650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC in 2010

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 346	
France	5 455	
Ireland	8 273	
United Kingdom	7 358	
EU	22 432	
TAC	22 432	Analytical TAC

Closed area restrictions

A closed area is in operation in 2010 (Council Regulation 23/2010 as of 14 January 2010 fixing for 2010 the fishing opportunities for certain fish stocks and groups of fish stocks). The closed area is shown in the map above.

Article 11

Restrictions on the use of certain fishing opportunities

During the period from 1 May to 31 July 2010 it shall be prohibited to fish for or retain on board any marine organisms other than herring, mackerel, pilchard/sardines, horse mackerel, sprat, blue whiting and argentines within the area bounded by rhumb lines sequentially joining the following positions:

Point	Latitude	Longitude
1	52° 27' N	12° 19' W
2	52° 40' N	12° 30' W
3	52° 47' N	12° 39,600' W
4	52° 47' N	12° 56' W
5	52° 13,5' N	13° 53,830' W
6	51° 22' N	14° 24' W
7	51° 22' N	14° 03' W
8	52° 10' N	13° 25' W
9	52° 32' N	13° 07,500' W
10	52° 43' N	12° 55' W
11	52° 43' N	12° 43' W
12	52° 38,800' N	12° 37' W
13	52° 27' N	12° 23' W
14	52° 27' N	12° 19' W

The following TCMs are in place for *Nephrops* in VII (excluding VIIa) after EC 850/9 in operation since 2000:

Minimum Landing Sizes (MLS); total length >85 mm, carapace length >25 mm, tail length >46 mm. Although it is legal to land smaller prawns from this fishery, marketing restrictions imposed by producer organisations in France mean smaller *Nephrops* (< 35 mm CL or 115 mm whole length) are not retained in this fishery.

The mesh size restrictions apply to towed gears in VIIb–k targeting *Nephrops and* are given in Section 7.1. Vessels mainly used 80–99 mm mesh to target *Nephrops* on the Porcupine Bank.

Fishery in 2009

The *Nephrops* fisheries in this area are very seasonal and rather sporadic, mainly targeting *Nephrops* when available and when weather conditions are good. At other times the vessels switch to other fisheries. Effort by French and Irish vessels in 2009 reduced substantially (>40%) compared with 2008. Total international landings (Figure 7.6.1 and Table 7.6.1) in 2009 were the second lowest observed and of similar magnitude to landings in 2000 and 2003.

Effect of regulations

Landings for the TAC area (Subarea VII) are undershot (Table 7.8.4). UK and Irish national quotas are restrictive but uptake by France and Spain is well below their quotas due to changes in relative landings from different FUs within this TAC area (Section 7.1). In the past TACs and quotas applied to the whole of VII do little to restrict the FU16 fishery. The closed area to be implemented in 2010 is coincident with a time period where the majority of annual international landings have been taken (see text table below). It is also spatial coincident with the main fishery (Figure 7.6.10). It is therefore expected to be quite effective at reducing fishing mortality provided that effort is not increase outside the time/area to compensate for the closure.

	2003	2004	2005	2006	2007	2008	2003–2008
% of annual Int. landings taken May–July	60%	53%	64%	54%	67%	68%	61%

There has been discarding of small and maturing female *Nephrops* in this fishery in the past due to lower market price but there are no reliable estimates of this during the time-series. Discarding patterns are known to vary between countries.

7.6.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Length compositions of annual landings are available from Spain (1986–2009), France (1995–2007) and Ireland (1995–2005 and 2008–2009). No sampling was possible in 2006 and 2007 for Ireland due to the withdrawal of co-operation with scientific sampling programmes by the fishing industry. Sampling in Ireland resumed in 2008. There was no sampling in France in 2008 and 2009 due to low landings. Sampling intensity in Spain was extremely low in 2008 and 2009 (two and five samples).

Sampling of *Nephrops* in this area is hampered by several factors:

- The remote nature of the fishery.
- Trips are long duration sometimes fishing in multiple areas.
- An increasing proportion of the landings are landed frozen or graded at sea.
- There is reluctance from fishermen and processors to allow sampling of landings due to high value of the larger *Nephrops* and the risk of damage to individuals during sampling.

These issues need to be resolved as current sampling intensity is insufficient to get precise and accurate length structure data of the catches.

Despite the low sampling intensity in recent years, the trends in indicators such as length and sex ratio are consistent across all countries and in the survey.

Landings

Data on the mean size (carapace length, CL) of male and female *Nephrops* in the landings are available from Spain, France and Ireland (Table 7.6.2, Figure 7.6.2). The longest time-series are from Spain and, prior to 2002, these have been quite stable at between 39 and 43 mm CL for the males, and between 34 and 38 mm CL for the females. Since 2002 there has been an increasing trend in the mean size in the landings peaking in 2008. Mean *Nephrops* sizes in French landings also show an increasing trend in both sexes. Mean sizes in the landings of Irish trawlers are more variable but clearly show increasing trend over the last number of years.

Raised frequency distributions of the sampled landings by sex are given in Figure 7.6.3. This also shows significant shift towards larger individuals in the landings since 2002 and few individuals at smaller sizes. The 2009 data for males shows a recruiting year class entering the landings at ~35 mm CL. This is the first time in the time series a very obvious year-class signal has appeared in the landings–length distributions (though there are possibly other YC appearing at a slightly large size in other years).

It is difficult to extract other useful signals in the length frequency distributions plot, so for males a number of indicators were calculated (Figure 7.6.4). These included a recruitment proxy (% of males <32 mm CL), and percentage of larger individuals (>50 mm CL) in the sampled landings. An exploitation proxy was calculated using the slope of ln(CL) versus ln(Numbers) between 41–56 mm CL i.e. the slope of downward limb on the Right-Hand-Side of the length frequency distribution.

These indicators suggest the following: recruitment has fluctuated in the past and recruitment in the last five years (2004 to 2008) has probably been very weak. Recruitment in 2009 has more average levels (note: this conclusion is relatively insensitive to length threshold). The fishery in recent years exploits a higher proportion of larger individuals than ever before in the time-series. The exploitation proxy shows an increasing trend (i.e. steepness) since the early 2000s. The exploitation proxy in 2009 remains among the highest in the series.

Discards

There are no estimates of discards for this stock but the intra-country differences in size structure of the landings suggest different on-board selection patterns (mesh sizes used are broadly similar across fleets).

Biological

In the most recent years there has been a large change in sex ratio in the landings and survey catches (Figure 7.6.5). See section below for survey details. The change in sex ratio in the landings is strongly influenced by the re-availability of data from Irish fishery which lands a greater proportion of female *Nephrops* than either the French or Spanish fleet. The survey also shows higher proportions of females in the catches in the last few years.

There are no changes to other biological parameters for this stock and they are not relevant to the current trends based assessment.

Surveys

The only fishery-independent source of data is from the Spanish Porcupine trawl survey. Further information on this survey is provided in the IBTS report (ICES, 2009) and in previous IBTS reports. Catchability of *Nephrops* in trawl surveys is typically an issue due to variable emergence patterns of *Nephrops* from their burrows (ICES, 2007). However, this stock (FU16) is found in deep water where animals are known to emerge mainly during the day. Survey hauls are only conducted during the day and the survey is scheduled for the same time each year, thus minimising variability due to emergence patterns. In addition, the *Nephrops* stock in this area is widely distributed and at relatively low densities over a large area, such that catchability is less variable than for those stocks in shallower water.

Problems with the trawl encountered in 2008 were rectified for 2009 and gear parameters and catch rates returned to more normal levels (WD 1). Distribution of *Nephrops* catches and biomass in Porcupine surveys between 2001 and 2009 are shown in Figure 7.6.6. There is evidence of an increase in abundance indices in 2009 particularly in one area of the ground (Figure 7.6.6). The stratified abundance estimate increased significantly in 2009 but it remains below levels observed in 2001 and 2002 (Figure 7.6.7). The biomass in 2009 shows a slight increase compared with 2008 but is also well below that observed at the start of the series.

The size structure of the catches in the survey shows two things: a much lower mean size than in the commercial fleets and an increasing trend in mean size for both sexes up to 2008 (Table 7.6.2, Figure 7.6.7). In 2009 there is large reduction of mean size in both sexes due to a recruiting year class with a modal length at around 27 mm. The proportion of larger sizes remains very low, >3 times lower than at the start of the series.

Commercial cpue

The *Nephrops* fishery on the Porcupine Bank is both seasonal and opportunistic with increased targeting during periods of high *Nephrops* emergence and good weather.

Effort and lpue data are not standardised, and hence do not take into account vessel capacity, efficiency, seasonality or other factors that may bias perception of lpue and abundance trends over the longer term. These data are presented by country in Table 7.6.3 and Figure 7.6.9. Note: Irish and French effort is in hours Spanish effort is power adjusted and is reported in thousands of day*BHP/100.

The effort index for the Spanish fleet (all gears) operating in Porcupine shows a steady decline from the 1970s until the early 1990s. Since then Spanish effort has declined more gradually. *Nephrops* lpue data for the Spanish fleet (all gears) shows a general declining trend until 2003. In 2004 and 2005 lpue increased rapidly, probably due to increased targeting of *Nephrops*, before declining again in the more recent years.

Fishing effort for French *Nephrops* vessels[1] has fluctuated widely with peaks in the mid 1980s and through the late 1990s. Effort in 2009 was the lowest in the series. Lpue data for the French fleet in FU16 were high in the 1980s but declined with fluctuations to a series low in 2008.

Fishing effort data for the Irish otter trawl *Nephrops* directed fleet[2]. Increased rapidly over the period 2003–2007 before declining again in 2008 and 2009. Irish lpue has fluctuated but with a general declining trend.

7.6.3 Stock assessment

The assessment is based on multiple lines of evidence from several indicators. The available data includes commercial landings compositions for males and females from the main fleets. Catch rates and length distributions from the Spanish Porcupine Bank survey (2001–2009,) along with lpue and effort data for the main fleets.

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[1] where *Nephrops* constituted 10% of the landed value.

[2] A threshold of 30% of *Nephrops* in reported landings by trip is used to identify the landing and effort of this fleet.

Comparison with previous assessments

The assessment is based on similar indicators to those used in 2009. The additional data show a continued deterioration in stock status although there is new recruitment to the fishery and survey in 2009.

This year further information was provided from the Spanish Porcupine survey including spatial and size distributions of catches and gear parameters (WD 1). This fishery-independent information has proven increasingly important for this stock.

State of the stock

The absolute stock size is uncertain but the stock is likely to be close or at the lowest levels observed based on stock indicators. Effort and landings trends indicate that fishing mortality has been high since the early 2000s. Fishery-independent survey information indicated that recruitment has been very weak or absent since 2004. However there is new recruitment to survey catches in 2009. This has been also been in the commercial catch data for males.

Landings per unit of effort (lpue) show a generally declining trend in most fleets over the time-series available and reached their lowest levels in the early 2000s. This probably reflects a decline in stock abundance. There was a substantial increase in landings and lpue in 2004 and 2005 indicating some signs of a stock increase, but since 2006 these indicators show a large decrease causing renewed concern about stock status. All the size distribution information shows a large increase in the size of *Nephrops* in this area. This is considered to be due to the combined effects of weak recruitment in recent years and the growth of a good year class that entered the commercial fishery in 2002. The combined effect of increased targeting and weak recruitment in recent years has resulted in a sudden deterioration in stock status.

Another important signal is the large change in sex ratio in the survey catches and fishery landings with female *Nephrops* accounting for a higher proportion since 2007. Such changes in sex ratio appear to be consistent with sperm limitation occurring at the population level. This occurs when the male component of the stock is reduced due to fishing leading to higher proportions of unfertilized females. Catchability of the unfertilized females increases as a consequence because they focus on feeding and growth rather than reproduction. Landings have declined by 17% between 2008 and 2009.

7.6.4 Short-term projections

There is no possibility to forecast catches in the short term using the available stock indicators.

7.6.5 MSY explorations

It has not been possible to carry out explorations of MSY targets for this stock but given the recent stock indicators the stock is probably exploited well above MSY levels.

7.6.6 Biological reference points

There are no reference points defined or agree for this stock.

7.6.7 Management plans

There is no management plan for this stock.

7.6.8 Uncertainties and bias in assessment and forecast

Discarding/high-grading practices for *Nephrops* fleets in this area are unknown and unquantified but all fleets show similar recent increases in mean size. All information points to poor recruitment and an increasing reliance of the fishery on larger individuals with a high female component.

7.6.9 Recommendation for next Benchmark

There needs to be improved sampling of catches for this stock. Sampling levels are currently low and several factors complicate sampling (see Section 7.6.2).

In the short term the survey may be the most appropriate method of monitoring stock status. The development of full analytical assessment would require better growth information and an improvement in sampling of catches. Spatially explicit landings and effort data, either by rectangle or at finer resolution by gear from all countries would also be useful.

Currently there are no plans to benchmark this stock before 2012.

7.6.10 Management considerations

Nephrops on the Porcupine Bank are fished in relatively deep waters over a widespread area where they occur at low abundance. Given the sedentary nature of *Nephrops* populations the closed area as introduced in 2010 may be an appropriate management tool to substantially reduce catches and allow the stock to recover the stock. The measure is expected to be quite effective at reducing fishing mortality provided that effort is not increase outside the time/area to compensate for the closure (Figure 7.6.10).

Productivity of deep-water *Nephrops* stocks is generally lower than that in shelf waters, though individual *Nephrops* grow to relatively large sizes and attain high market prices. Other deep-water *Nephrops* stocks off the Spanish and Portuguese coast have collapsed and have been subject to recovery measures for several years e.g. FU25, 26, 27 and 31. Recruitment in *Nephrops* populations in deep water may be more sporadic than for shelf stocks with strong larval retention mechanisms. This makes these stocks more vulnerable to over exploitation and potential recruitment failure as has been observed on the Porcupine Bank over the last decade.

7.6.11 References

ICES. 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (WKNEPHTV). ICES CM: 2007/ACFM: 14 Ref: LRC, PGCCDBS.

Table 7.6.1. - Porcupine Bank (FU 16): Landings (tonnes) by country, 1965-2009.

Year	France	Rep. of Ireland	Spain	UK E& W	UK Scotland	Total
1965	514					514
1966	0					0
1967	441					441
1968	441					441
1969	609					609
1970	256					256
1971	500		1444			1944
1972	0		1738			1738
1973	811		2135			2946
1974	900		1894			2794
1975	0		2150			2150
1976	6		1321			1327
1977	0		1545			1545
1978	2		1742			1744
1979	14		2255			2269
1980	21		2904			2925
1981	66		3315			3381
1982	358		3931			4289
1983	615		2811			3426
1984	1067		2504			3571
1985	1181		2738			3919
1986	1060		1462	69		2591
1987	609		1677	213		2499
1988	600		1555	220		2375
1989	324	350	1417	24		2115
1990	336	169	1349	41		1895
1991	348	170	1021	101		1640
1992	665	311	822	217		2015
1993	799	206	752	100		1857
1994	1088	512	809	103		2512
1995	1234	971	579	152		2936
1996	1069	508	471	182		2230
1997	1028	653	473	255		2409
1998	879	598	405	273		2155
1999	1047	609	448	185		2290
2000	351	227	213	120		910
2001	425	369	270	158		1222
2002	369	543	276	139		1327
2003	131	307	333	108	29	908
2004	289	494	588	126	28	1526
2005	397	754	799	208	156	2315
2006	462	731	571	201	155	2120
2007	302	1060	496	146	183	2186
2008	26	562	234	41	138	1000
2009	4	356	294	12	159	825

Table 7.6.2 - Porcupine Bank (FU 16): Mean sizes (mm CL) of male and female *Nephrops* in Spanish, French and Irish landings and the Spanish Porcupine Groundfish survey 1981-2009

Year	Spain Landings		Rep. Of Ireland Landings		France Landings		Porcupine Survey Catch	
	Males	Females	Males	Females	Males	Females	Males	Females
1981	39.9	34.5	-	-	-	-	-	-
1982	40.9	34.8	-	-	-	-	-	-
1983	40.8	34.0	-	-	-	-	-	-
1984	39.7	33.1	-	-	-	-	-	-
1985	38.7	33.5	-	-	-	-	-	-
1986	40.7	36.4	-	-	-	-	-	-
1987	39.3	35.0	-	-	-	-	-	-
1988	40.7	38.3	-	-	-	-	-	-
1989	40.5	36.8	-	-	-	-	-	-
1990	41.0	36.1	-	-	-	-	-	-
1991	39.4	34.5	-	-	-	-	-	-
1992	39.2	34.1	-	-	-	-	-	-
1993	41.6	36.1	-	-	-	-	-	-
1994	40.8	36.5	-	-	-	-	-	-
1995	41.3	36.6	40.7	36.5	43.2	38.3	-	-
1996	41.6	35.1	34.6	35.3	41.7	38.9	-	-
1997	39.7	34.8	35.9	34.5	41.9	38.4	-	-
1998	41.1	34.6	37.2	35.6	41.9	38.4	-	-
1999	41.5	35.7	36.6	33.7	43.1	39.1	-	-
2000	41.1	34.8	na	na	45.3	40.5	-	-
2001	41.1	36.3	37.8	35.4	45.4	39.4	35.5	28.4
2002	39.7	35.3	36.1	38.5	45.3	40.3	37.0	31.2
2003	41.4	37.8	44.5	36.2	46.2	38.9	39.2	31.4
2004	43.5	38.5	43.5	35.7	46.4	41.5	39.4	30.0
2005	43.4	38.1	46.9	40.6	45.9	41.0	44.6	33.3
2006	43.9	38.0	na	na	48.9	41.4	43.6	34.5
2007	43.7	41.0	na	na	48.3	43.8	45.4	37.4
2008	51.0	40.6	43.3	37.5	na	na	48.0	38.2
2009	43.0	42.7	44.1	40.1	na	na	32.2	28.3

Table 7.6.3. - Nephrops Porcupine Bank (FU 16)

Landings and effort for the various different fleets exploiting the stock 1971-2009

Year	Spanish fleet			French Nep fleet[1]			Irish Nep Fleet[2]		
	Landings	Effort		Landings	Effort	LPUE (>10%)	Landings	Effort	LPUE
	Tonnes	day*BHP/100 (x1000)	T/day * BHP/100	Tonnes	('000's Hrs)	(kg/hr)	Tonnes	('000's Hrs)	(kg/hr)
1971	1444	159	9						
1972	1738	188	9						
1973	2135	181	12						
1974	1894	192	10						
1975	2150	229	9						
1976	1321	187	7						
1977	1545	196	8						
1978	1742	166	11						
1979	2255	157	14						
1980	2904	163	18						
1981	3315	143	23						
1982	3931	138	29						
1983	2811	108	26	615	18	35			
1984	2504	114	22	1067	30	35			
1985	2738	115	24	1181	33	36			
1986	1462	95	15	1060	28	38			
1987	1677	105	16	609	24	26			
1988	1555	109	14	600	22	27			
1989	1417	105	14	324	14	23			
1990	1349	96	14	336	15	23			
1991	1021	85	12	348	19	18			
1992	822	59	14	665	32	21			
1993	752	49	15	799	36	22	206		
1994	809	50	16	1088	38	28	512		
1995	579	48	12	1234	42	30	971	15	41
1996	471	43	11	1069	41	26	508	8	42
1997	473	42	11	1028	41	25	653	11	35
1998	405	43	10	879	40	22	598	10	42
1999	448	37	12	889	43	21	609	9	35
2000	213	30	7	313	23	16	227	2	31
2001	270	29	9	366	24	17	369	8	30
2002	276	31	9	324	18	22	543	10	38
2003	333	38	9	130	7	19	296	7	26
2004	588	32	18	232	9	25	494	16	21
2005	799	30	27	380	15	26	628	24	30
2006	571	39	15	446	22	21	683	28	25
2007	496	35	14	297	17	20	977	36	27
2008	234	24	10	25	4	7	534	20	26
2009	294	26	11	na	na	na	327	12	27

[1] = Vessels where <10% of landed value was Nephrops; [2] = Vessels where 30% of the landed weight was Nephrops

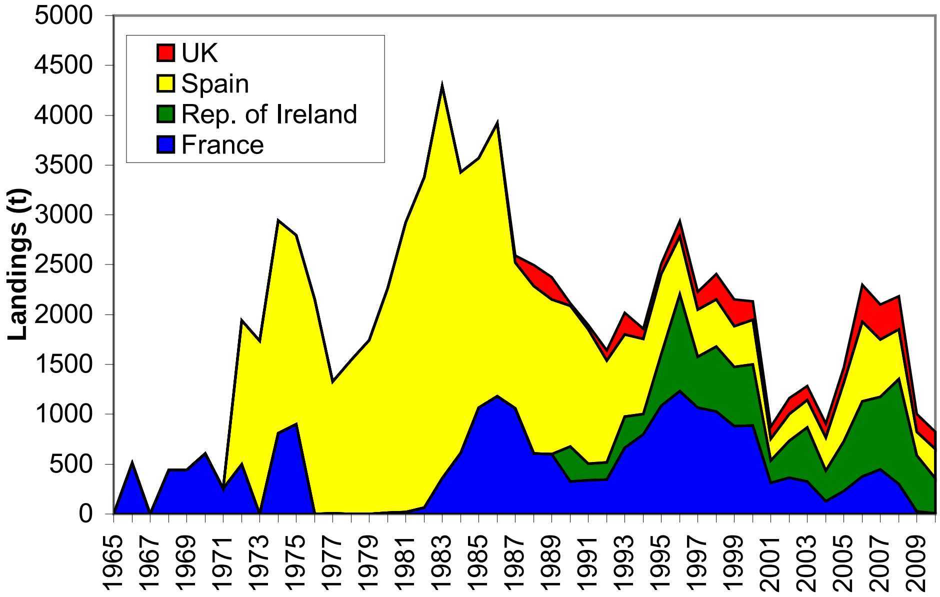


Figure 7.6.1. *Nephrops* in FU16 (Porcupine Bank). Landings in tonnes by country.

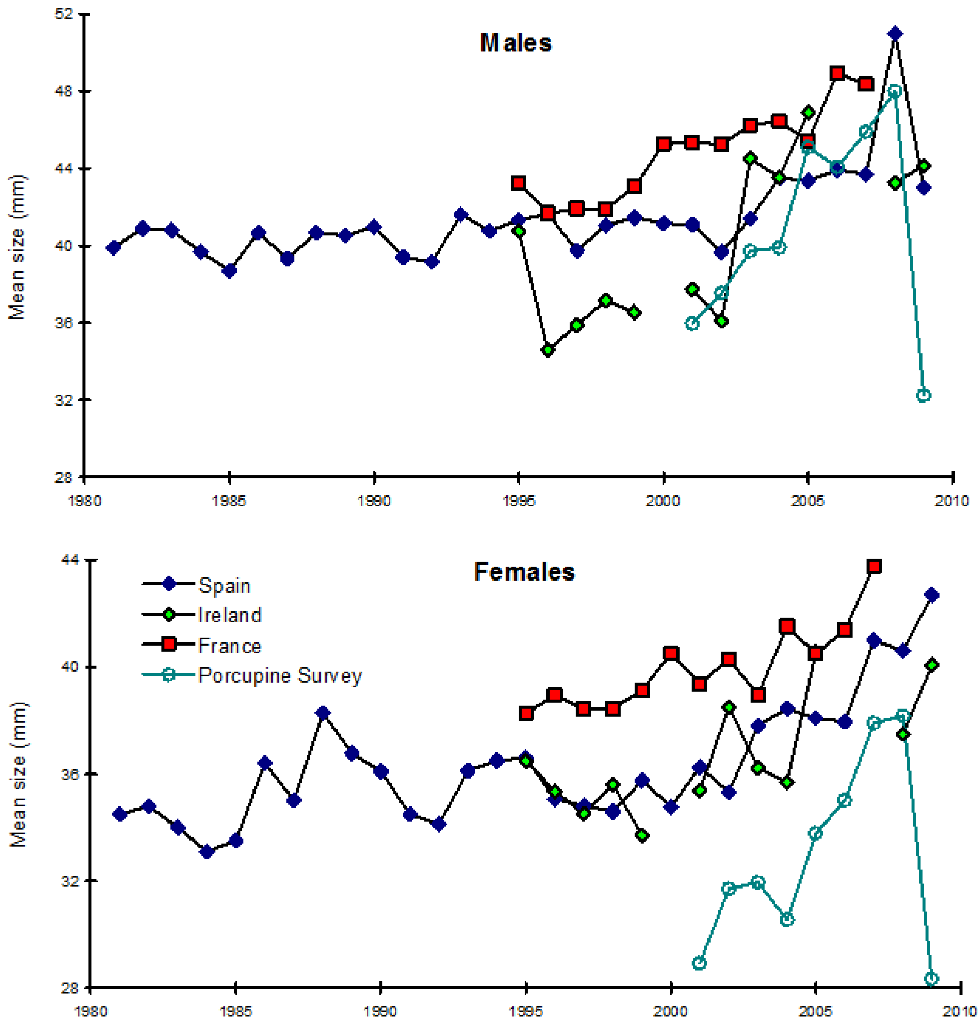


Figure 7.6.2. ***Nephrops*** **in FU16 (Porcupine Bank). Landings mean sizes by sex and country and mean size in the catch for the Porcupine survey.**

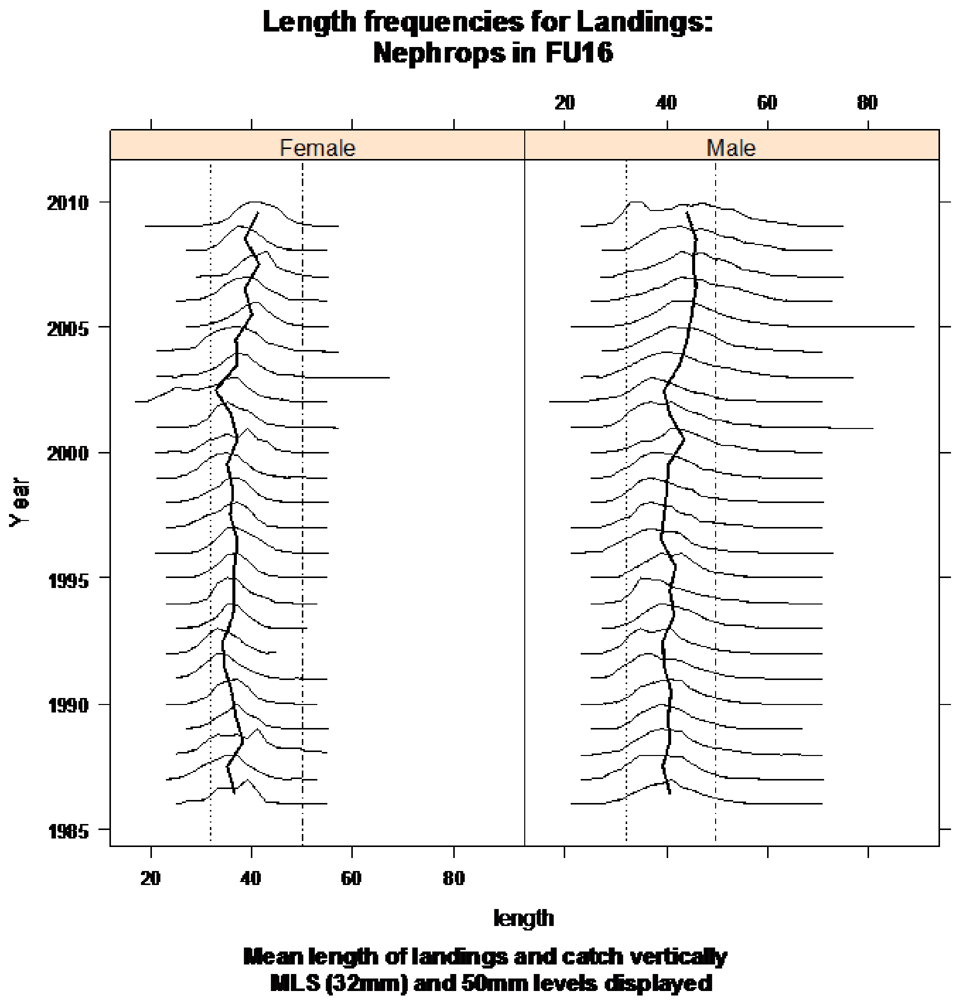
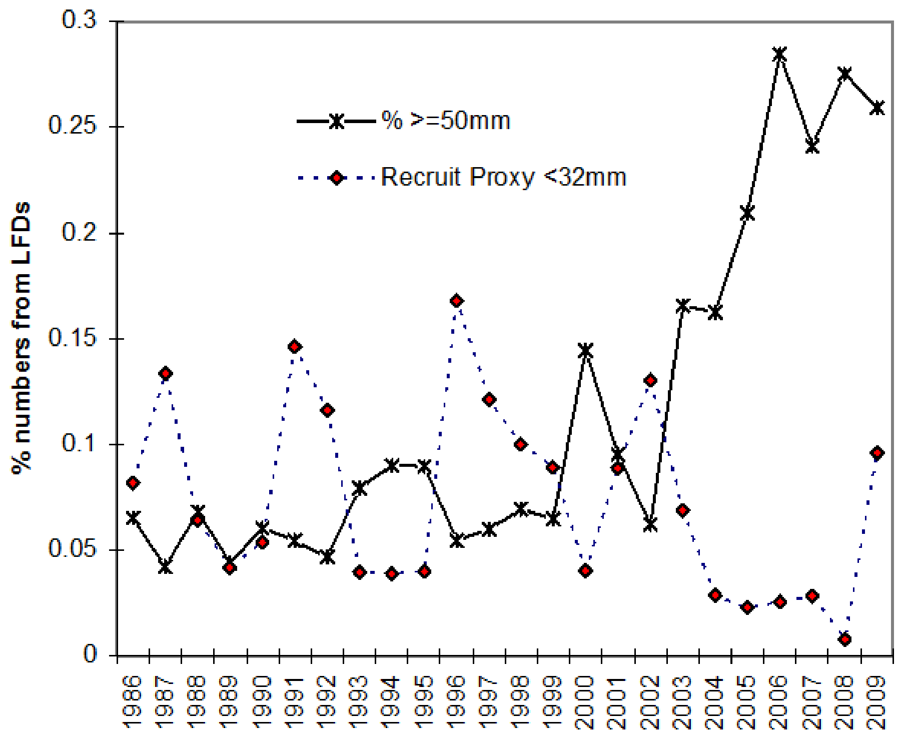


Figure 7.6.3. ***Nephrops*** **in FU16 (Porcupine Bank). Female and male landings length distributions.**



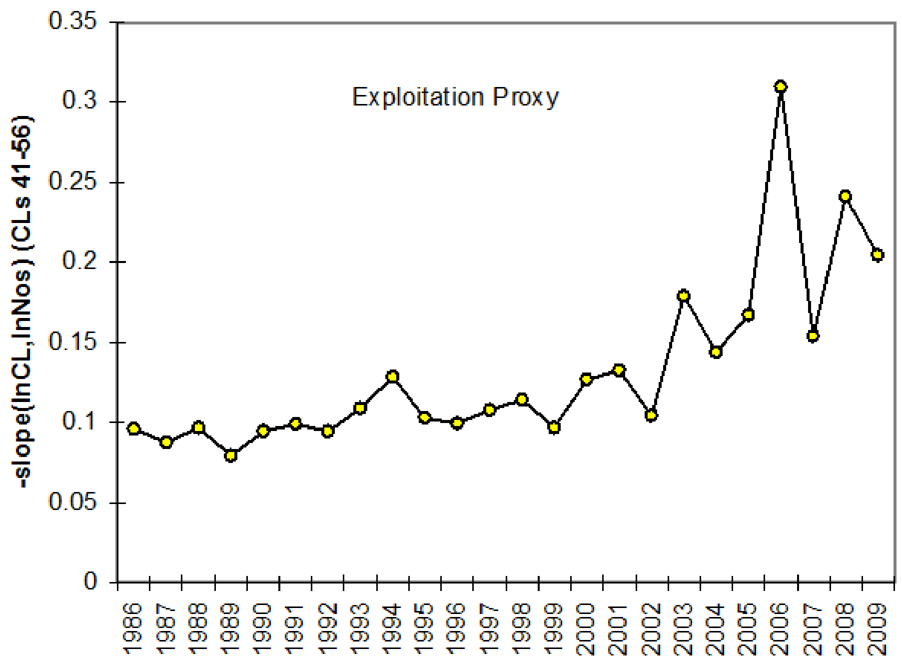


Figure 7.6.4. *Nephrops* in FU16 (Porcupine Bank). Trends in various indicators from male length frequency data.

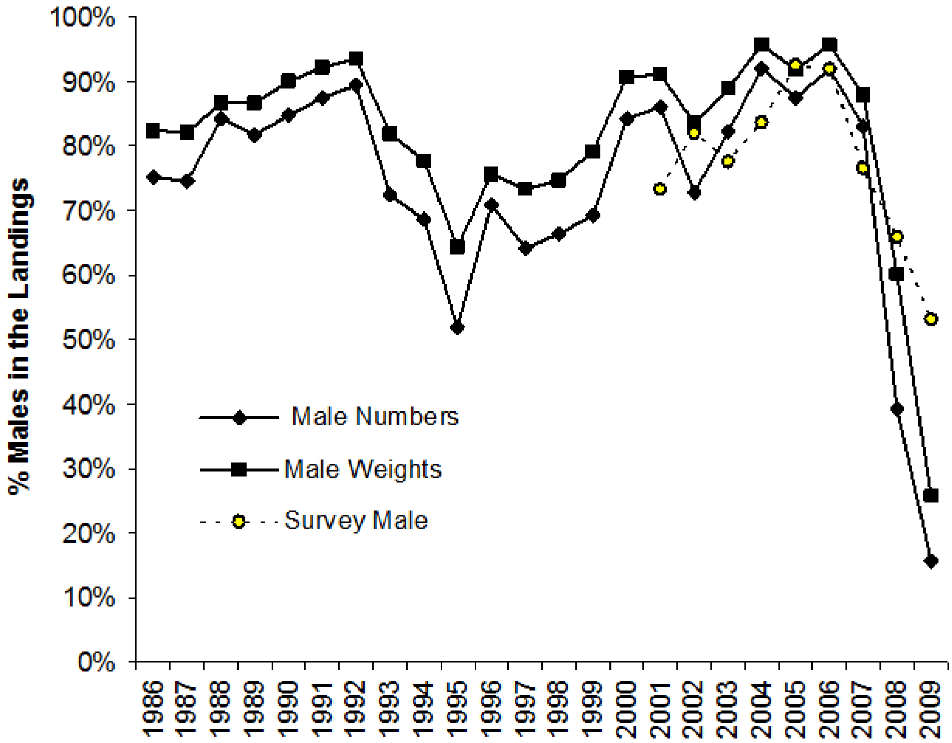


Figure 7.6.5. *Nephrops* in FU16 (Porcupine Bank). Sex ratio of landings and survey catches.

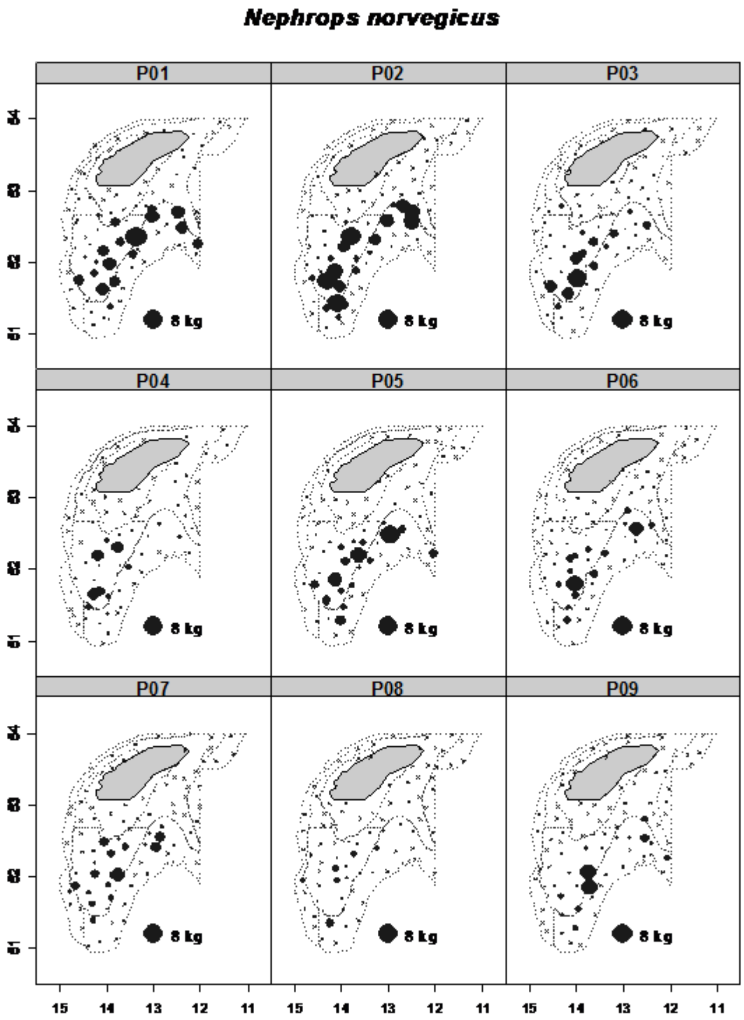


Figure 7.6.6. ***Nephrops*** **in FU16 (Porcupine Bank). Distribution of** ***Nephrops norvegicus*** **catches in Porcupine surveys between 2001 and 2009.**

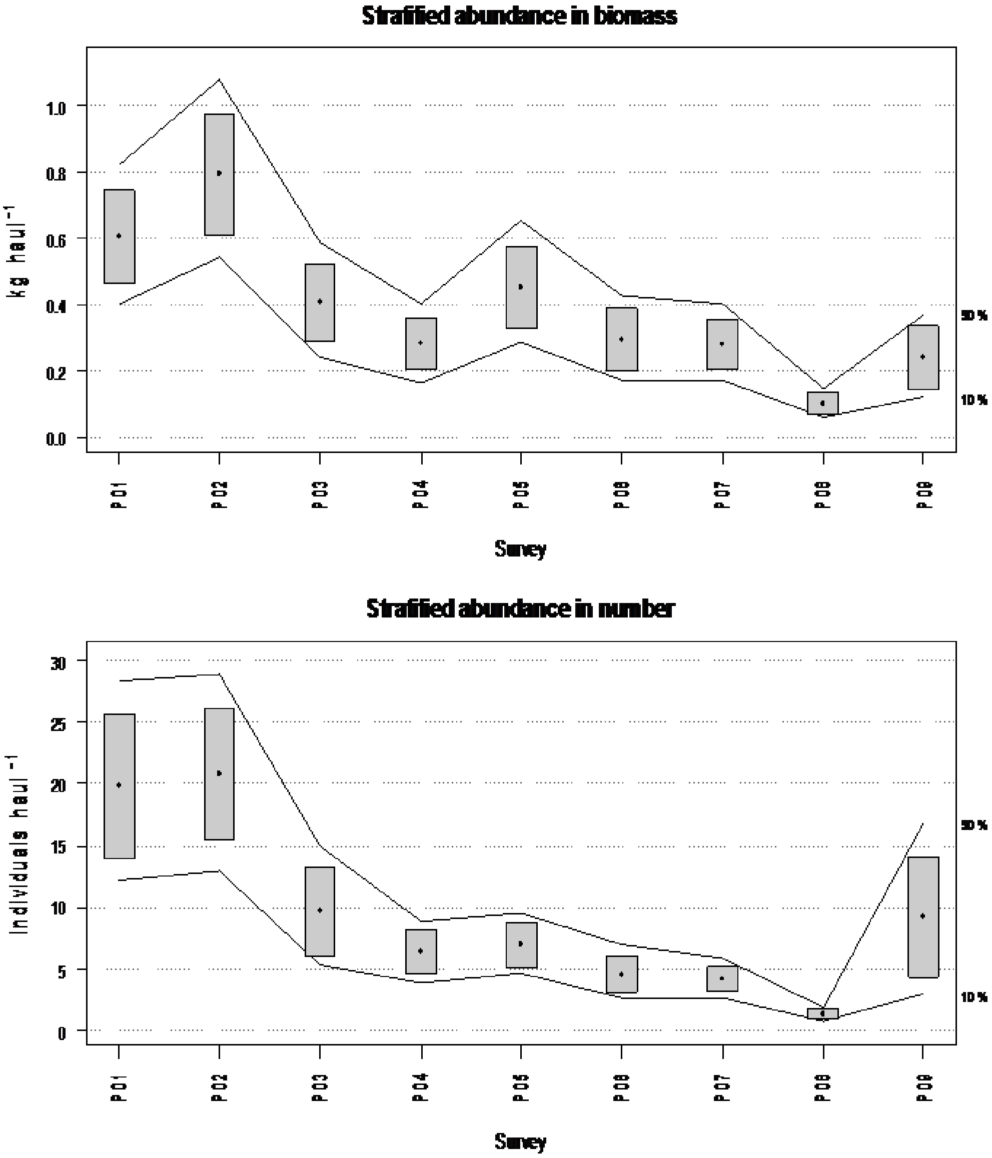


Figure 7.6.7. ***Nephrops*** **in FU16 (Porcupine Bank). Changes in** ***Nephrops norvegicus*** **biomass and number stratified indices during Porcupine Survey time-series (2001–2009). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α=0.80, bootstrap iterations=1000).**

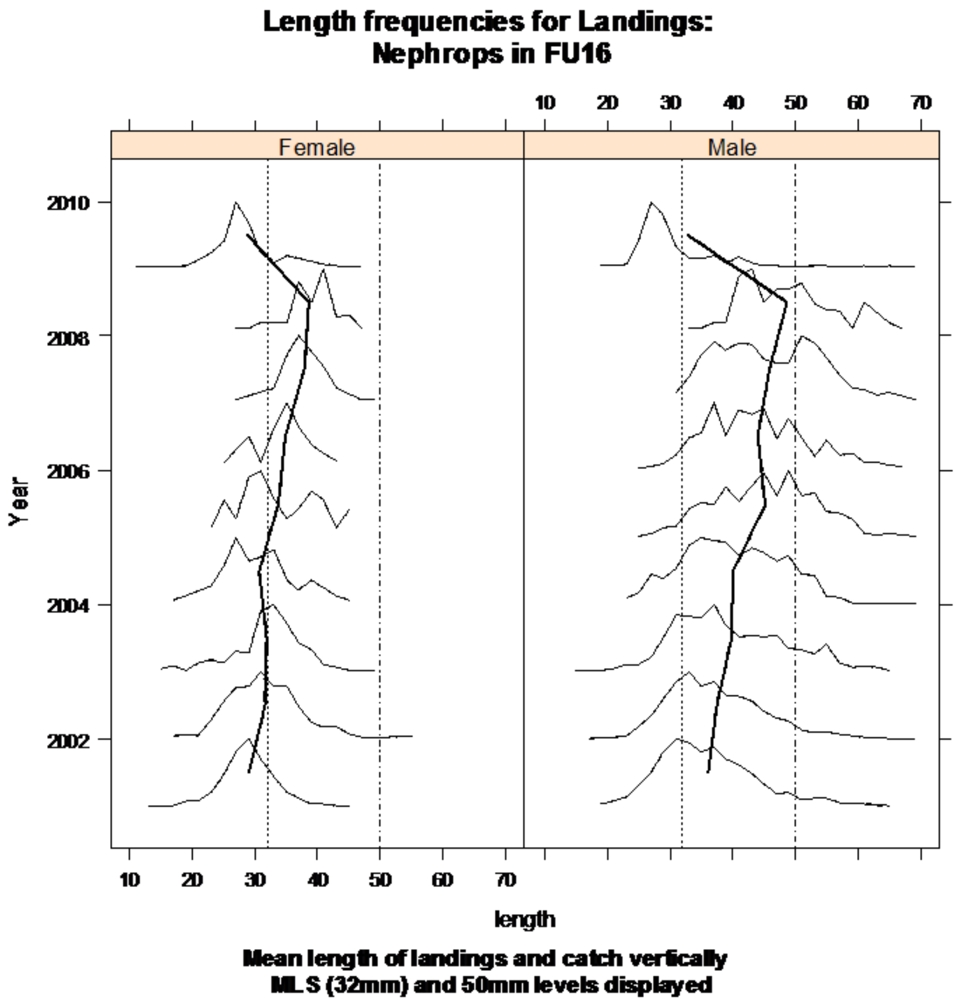
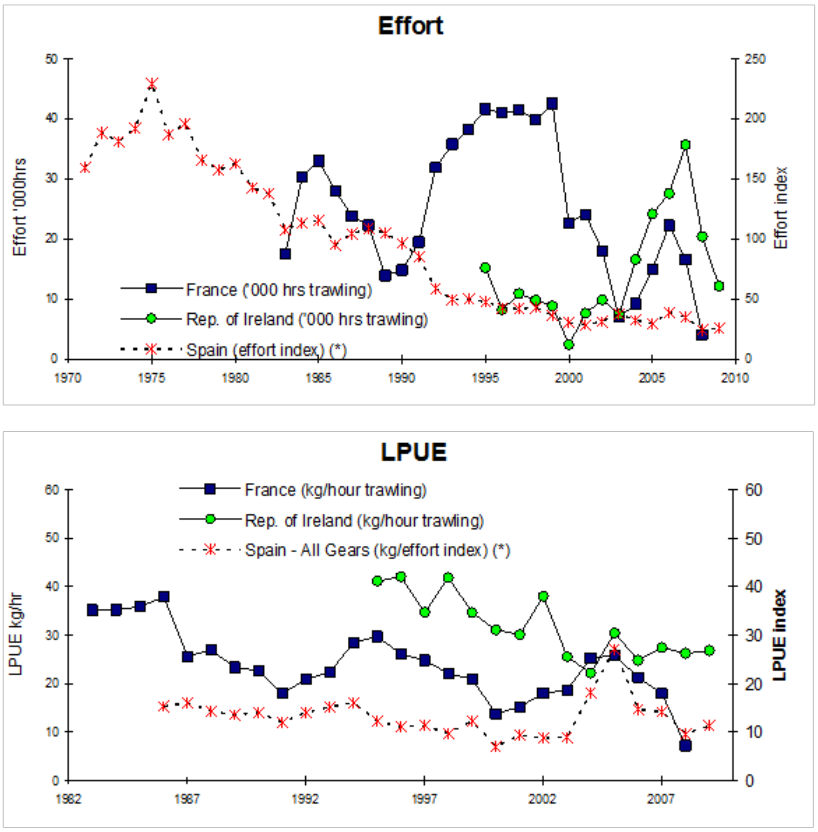


Figure 7.6.8. ***Nephrops*** **in FU16 (Porcupine Bank). Female and male Porcupine Survey length distributions.**

Figure 7.6.9 Nephrops in FU 16 (Porcupine Bank)
Effort and LPUE trends for fleets
(*) The Spanish effort index is based on a combination of hours at sea and average engine power. Irish and French effort and LPUE is unstandardised.



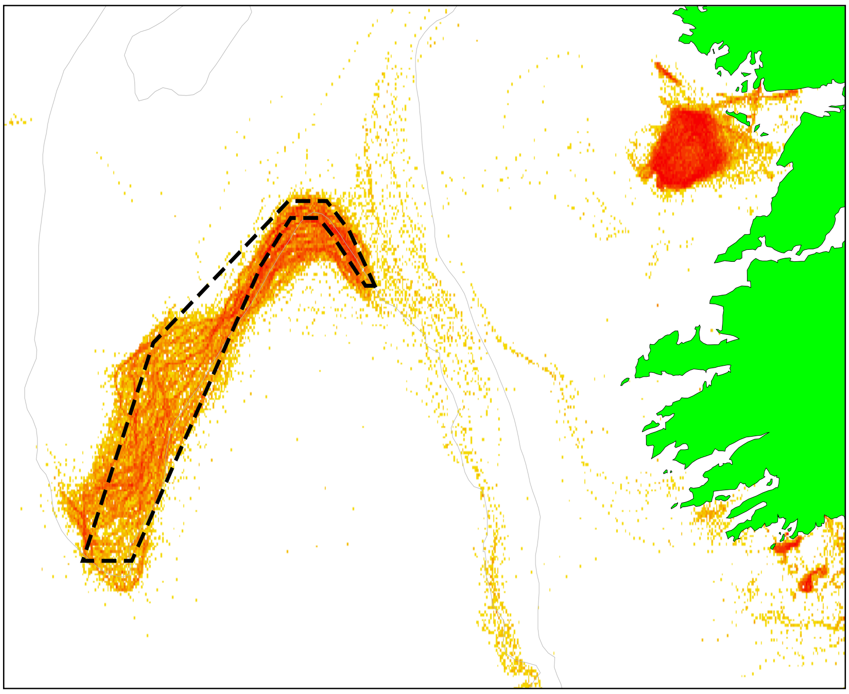


Figure 7.6.10. *Nephrops* in FU16 (Porcupine Bank). The area on the Porcupine Bank to be closed seasonally to *Nephrops* fishing in 2010 shown as a dotted black line overlaid on the distribution of recent (2006–2006) Irish fishing effort directed towards *Nephrops*.

7.7 *Nephrops* in the Celtic Sea, FU20–22

ICES description	VIIfgh
Functional Units	Celtic Sea, VIIfgh (FU20–22)

Type of assessment in 2010

Update assessment.

The assessment in 2010 is based on an examination of trends in fishery indicators. Main changes in the assessment methodology compared to last year: discard derivation investigated for French trawlers (WGSSDS 2006–2008; WGCSE 2009; Stock Annex) is temporarily delayed because of the revision for DLFs from French landings including tailed individuals. Unknown lpue status in 2009 due to the lack of reliable information from official French statistics of Fisheries Direction. UWTV survey data is also available for the “Smalls” component of FU20–22 but this is not representative of the whole stock area.

ICES advice applicable to 2009 and 2010

Exploitation boundaries in relation to precautionary considerations

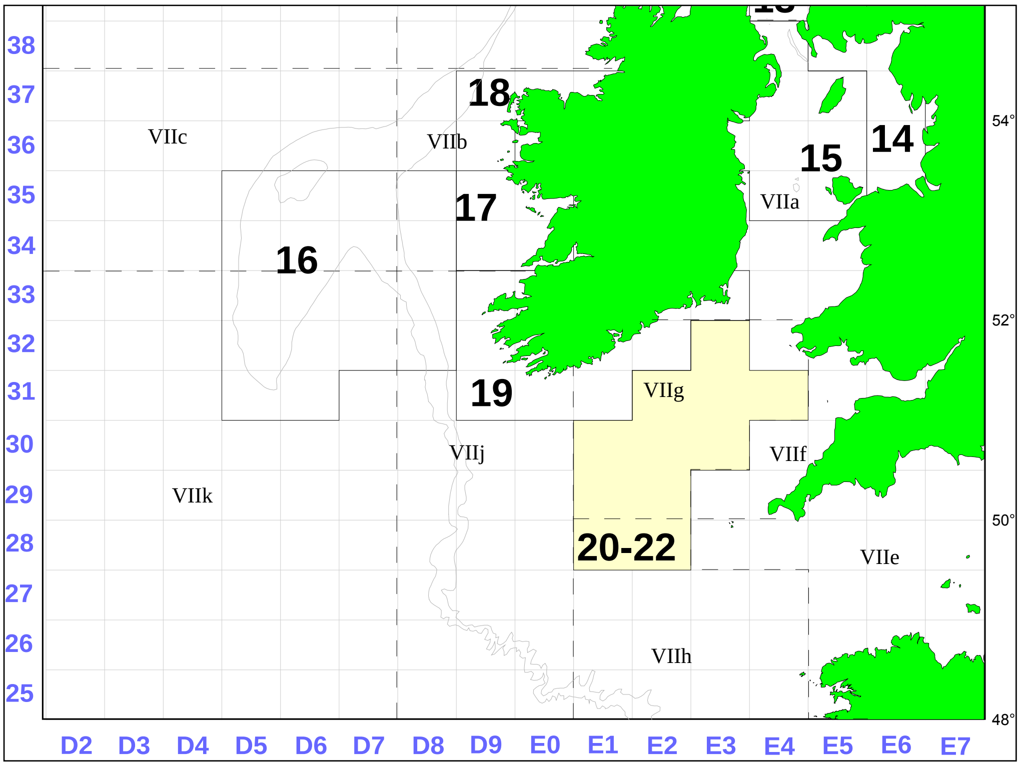
"*The current fishery appears sustainable. Therefore, ICES recommends that Nephrops fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 5300 tonnes for the Celtic Sea stock (FU20–22).*"

7.7.1 General

Stock description and management units

The Celtic Sea *Nephrops* stock (FU20–22) is included in the whole ICES Area VII as Irish Sea East [FU14], Irish Sea West FU15], Porcupine Bank [FU16], Aran Islands [FU17], northwest Irish Coast [FU18], southeast and southwest Irish Coast [FU19]. The TAC is set for Subarea VII which does not correspond to the stock area.

There is no evidence that the whole exploited area belongs to the same stock or that there are several patches linked in meta-population sense.



The TAC for Subarea VII is bounded by the red line. The FUs with the TAC area are shaded.

Management applicable in 2008 and 2009

Currently the TAC is set for Subarea VII .The 2010 TAC is 22 432 t, 9% less than the 2009 TAC. This TAC includes many *Nephrops* stocks and this may allow unrestricted catches for stocks under excessive fishing pressure where catches should be limited.

The MLS implemented by EC is set at 25 mm CL i.e. 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL i.e. 11.5 cm total length) is applied by the French trawlers.

In application of the Council Regulation (EC) N° 1459/1999, June 24th, 1999, modifying the regulation (EC) N° 850/98 of the Council for the conservation of fishery resources through technical measures for the protection of juveniles, the French minimum mesh size of codend was set at 100 mm in January 2000 whereas the Irish mesh size was maintained at 80 mm.

TAC in 2009

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 479	
France	5 994	
Ireland	9 091	
United Kingdom	8 086	
EC	24 650	
TAC	24 650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC in 2010

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 346	
France	5 455	
Ireland	8 273	
United Kingdom	7 358	
EU	22 432	
TAC	22 432	Analytical TAC

Ecosystem aspects

This section is detailed in Stock Annex.

Fishery description

This section is detailed in Stock Annex.

Fishery in 2009

France and Ireland are the main countries involved in the FU20–22 *Nephrops* fishery.

In 2009 74 French trawlers landed *Nephrops* from FU20–22 (88 in 2008). Of these, 43 exceeded landings of 10 t representing more than 98% of French landings. Five vessels accounted for more than 20% of the total quantity harvested by France where these vessels landings were between 78 t and 103 t. In 2009, 79 Irish vessels reported landings from FU20–22 (99 in 2008). Of these, 54 vessels (67 in 2008) reported landings in excess of 10 t accounting for 95% of the total landings.

A decommissioning programme was in operation in Ireland during 2007 and 2008. Twelve vessels active in the FU 20 fishery were decommissioned. These vessels accounted for approximately 18% of the landings in the 2007–2008 period.

In 2009 increasing fuel prices and poor market value for *Nephrops* impacted in the activity of the fleets.

Uptake of quotas

There is no specific TAC or quota for the FU20–22 *Nephrops*, thus the question should be examined for the whole Subarea VII. For the two main fleets operating in the Celtic Sea, the total harvested quantities in Area VII remained below the allowed quotas. In 2008, 5994 t were allocated to France whereas actual French landings 2008 were 2420 t almost exclusively i.e. 97% coming from the Celtic Sea. In 2008, 9091 t were allocated to the Republic of Ireland and 9053 t were landed (38% from the Celtic Sea). For 2009, the ICES recommended for the FU20–22 *Nephrops* to not exceed 5300 t of landings coming: however, the total harvested quantity was 5359 t. This value may be revised when current information from the official French statistics on landings is modified.

7.7.2 Data

An overview of the data provided and used by the WG is shown in Table 2.1.

Landings

At WGSSDS 2008, the French landings were revised sharply downwards for 1999 (2036 t against 2745 t previously used). This revision was performed by including information of the new database "Harmonie" of statistics. The change involves notably reported fishing effort of trawlers from the FU20–22 stock (Celtic Sea) to the FU16 (Porcupine Bank) during the 2nd quarter of this year. In 2009, new revisions of French and of Irish statistics were carried out by the WGCSE (see Table below).

Country	Year	Previous landings (t)	Revised landings (WGCSE 2009) (t)
France	1999	2036	2078
	2000	2782	2848
	2001	2532	2626
	2002	3134	3154
	2003	3510	3595
	2004	2511	2605
	2005	2490	2502
	2006	2397	2368
	2007	2082	2033
Ireland	2006	1877	1864
	2007	3226	3213

The new official French statistics were generally changed upwards apart from years 2006 and 2007 whilst a proportion of the fishing effort for French trawlers was reallocated to the FU19 (SE and SW Irish coast).In 2010, Irish landings for 2008 were slightly modified (3411 t against 3422 t).

Landings are reported mainly by France and the Republic of Ireland (Figure 7.7.1; Table 7.7.1). The contribution of French landings has gradually decreased from 80–90% at the end of 1980s to 50–60% at the beginning of 2000s. Then, since 2007, French landings declined to less than 40% of the total reported quantities (Table 7.7.1). The overall fishing profile remains typically seasonal (Table 7.7.2) with the majority of landings coming from the 2nd and 3rd quarters.

French landings increased notably by 16% from 2033 t in 2007 to 2348 t in 2008. In 2009 landings decreased by 8% to 2156 t which is the third lowest value in the French time-series.

Irish landings in 2008 (3411 t) were the highest reported for this nation's time-series. In 2009, landings declined by around 17% to 2844 t (third highest in the series).

Table 7.7.2 shows the landings by quarter for France and Ireland and there is a seasonal trend exhibited by both countries mainly in quarters 2 and 3.

Commercial lpue

Effort data is available from 1983 to 2008 for the French *Nephrops* fleet (Table 7.7.17; Figure 7.7.9). No 2009 data is available because the new registration system of official French statistics is not yet validated.

French effort has fluctuated over the series with a decreasing trend since 2004 to the lowest observed in 2008 the available time-series. The decrease of the French fishing effort was caused by the reduction of the number of trips by vessel whereas the total number of vessels remained almost stable. Lpue for French trawlers increased between 2007 and 2008 (+22%: 22.6 kg/h in 2008 against 18.5 kg/h for 2007). In 2009, because of lack of reliable official French statistics as explained above, lpue indices are unavailable.

Effort data for this FU is available from 1995 for the Irish otter trawl *Nephrops* directed fleet. These data have not been standardised to take into account vessel or efficiency changes during the time period. Irish effort has fluctuated over the series with an increasing trend since 2004 to 2008 and declined somewhat in 2009 (Table 7.7.17; Figure 7.7.9). The increase of the Irish fishing effort involves either in the number of fishing vessels (95 and 99 Irish trawlers were respectively listed in 2007 and 2008 compared to 80 for 2006) or in the number of trips by vessel. Lpue has been fluctuating around an average of 45 kg/h with an increase to the highest (54 kg/h) in the time-series in 2008. A decrease occurred in 2009 to 48 kg/h.

Biological

Length–frequency distribution information by country (France and Ireland) is given in the Stock Annex. All data are presented in and Tables 7.7.3 to 7.7.10, 7.7.11, 7.7.12 and 7.7.13a. The Table 7.7.14 provides information on mean size of landings by year and country.

The LFD data reveal significant differences between the two countries. The two ogives of selectivity through meshes are different. The evolution of the French landings had shown a substantial increase of mean sizes since the beginning of 2000s (this coincides with mesh regulations cited in the Stock Annex), but a significant decrease of the mean size occurred in 2006 (41.0 mm CL for both sexes combined against 42.8 mm CL in 2005). The same trend was observed for Irish landings (29.2 mm CL against 31.1 mm CL in 2005). In 2007, a new decrease occurs for both countries (40.4 mm CL for France, 28.4 mm for Ireland).

The WGCSE 2009 and 2010 pointed out a significantly increasing proportion of tailed individuals present in French landings (Figure 7.7.3) whereas this proportion was already high for Irish trawlers. For years 2005–2008, tailed *Nephrops* were comprised between 11 to 20% of the French landings whereas this component of the landings was less than 5% until the beginning of 2000s. In 2009, the tailed *Nephrops* component accounted for 17% of French landings. Industry explained this recent change due to the economic difficulties of increasing fuel prices. Tailed individuals are intended to compensate this loss for the crew participation at the total investment by trip. As the European MLS for FU20–22 *Nephrops* is fixed at 8.5 cm of total length (25 mm CL) and the MLS retained by the French Producers' Organizations is equal to 11.5 cm (35 mm CL), it was expected that tailed individuals should be comprised between these two sizes.

By the end of 2007, tailed *Nephrops* could not be sampled at auction and, as the sampling onboard remains difficult to apply routinely due to long trip duration by the French trawlers, the problem was partially tackled by apportioning tailed individuals to the smallest category of landings at auction. Since the end of 2007, new biometric relationships established during the EVHOE survey have been used (Stock Annex): this allows fitting CL vs. 2nd abdominal segment of tail by sex.

The DLF of French landings for 2008 and 2009 were estimated by two ways: one using the extrapolations from tails to CL, the other apportioning tails to the small category as for previous years. The resulting difference appears relevant (Table 7.7.12; Figures 7.7.4 and 7.7.5): in 2008, 46 million *Nephrops* were provided by the previous method whereas 58 million were estimated by including tails (+28%). Almost 30% of landed individuals were below the French Producers' Organization MLS, but no *Nephrops* was undersized compared with European MLS. Moreover, the sex ratio seems to be affected by the tailing practice: 13% of *Nephrops* (7.4 million) were females although this percentage would be 7% (3.2 million) under the previous method. In 2009, the method including tails and the previous one give respectively 48 and 39 million *Nephrops* (+21%); moreover, 19% of individuals are smaller than the French Producers' Organization MLS and the sex ratios are respectively 10% and 3%. As indicated in Table 7.7.14 the mean size of French landings for 2008 and 2009 decreases at around 2.5–5.5 mm CL by sex when tails are involved by sampling. However, the mean CL for 2008 remains larger than the Irish one.

The size composition is overestimated when raised to the composition of entire individuals and, therefore, the total number of landed *Nephrops* is underestimated.

Discards

The increasing practice of tailing *Nephrops* for the French trawlers may affect the total discard rate of this fleet. Hence, method for discard derivation applied since 2006 on DLF French dataset for years with no sampling onboard is not currently used for the assessment.

Sampling

The available dataset is detailed in the Stock Annex. Additional French dataset was also acquired in 2005, but it involves in only two quarters (Q3 and Q4; Stock Annex). Data sampled in 2009 (14 trips, 199 hauls in three quarters) cannot yet be routinely integrated in the assessment. As for landings, the Irish discard sampling began in 2002. Thus, there is no common dataset on discards between French and Irish fleets (lack of information of the Irish sampling program for 2005-Q3, 2005-Q4, 2006-Q4, 2007-Q2). Available information on complete yearly sets (1997-FR, 2003-IRL, 2008-IRL, 2009-IRL) is given by Figures 7.7.6, 7.7.7 and Table 7.7.15. Tables 7.7.13b,c,d provide discard estimates, total catches and removals for Irish trawlers (using mortality rate of discards equal to 75%: Charuau *et al*, 1982).

The notable contrast between the retained proportions onboard and the spatial heterogeneity of the exploited area prevents direct comparisons of the main fleets. It is not yet possible to estimate if the inter-fleet variability of the discard rate is larger than the inter-annual one.

Changes in discard rate is a consequence of the strength of recruitments, increase in the MLS (which tends to increase the discards) and the gear selectivity. Other practices as stated above (tailing individuals) may affect discard rate. The relative contribution of each of these four factors remains unknown.

Back-calculation

As for the main *Nephrops* stocks, the lack of estimation of discards hampers quantitative analysis of recruitment indices, therefore, possibilities of back-calculation for discards were investigated. For a long period, a "proportional derivation" of discards was processed on the FU20–22 *Nephrops* by WGNEPH, but was considered as unreliable because it induces lack of contrast in inter-annual variations of recruitment (see reports of WGSSDS 2005–2008; WGCSE 2009). An alternative probabilistic approach developed since 2006 on other *Nephrops* stocks (VIIIab; Bay of Biscay; FU23–24) was also applied to the FU20–22. The main concepts of the back-calculation are detailed in Stock Annex.

The increasing proportion of tails probably modifies discard practices and the WGCSE 2010 decided not to develop the back-calculation approach as this stock is not benchmarked.

Surveys

UWTV Survey

The UWTV survey was developed in 2006 by Ireland and has become the main source of fishery independent and new information on this stock. The methods employed during the Celtic Sea UWTV surveys have recently been discussed and well documented by WKNEPHTV, WKNEPHBID, WKNEPH and SGNEPS (ICES, 2007, 2008, 2009a and 2009b).This survey indicates that burrow density in 2009 for the “Smalls” ground decreased slightly ~2% from that observed in 2008, but has remained stable (Working Document 9).

Figure 7.7.8 points to a possible relationship between the 2006 geostatistical abundance estimate which is the highest level observed in the series and the strong lpue values obtained by commercial vessels in the same area in 2007. However, a more detailed investigation is required to examine the relationship between burrow abundance and lpue. The survey area is not representative of the whole stock area and there are many discrete *Nephrops* grounds with FU20–22. Table 7.7.16 gives the landings by statistical rectangle and shows that the Irish and French fisheries exploit different grounds. By the end of 1990s, more than 40% of French landings were reported from the "Smalls" area compared to less than 10% at the end of 2000s, whereas ²/₃ of the total Irish landings are reported from the "Smalls" (ICES statistical rectangle 31E3) WGCSE propose that the various stock parameters and reference points required to develop catch options for FU20–22 “Smalls” component will be explored during the summer and made available to apply to the new survey data when a new data point will be available after July 2010.

In FU20–22, the French groundfish survey EVHOE while not focusing on *Nephrops per se*, it does provide some indication of the length distributions and the strength of recruitment (Stock Annex). The Irish groundfish survey has been carried out since 2003 giving some information on the length compositions of *Nephrops* catches. The UK bottom trawl survey occurred on the same area between 1984 and 2004 (see WGSSDS 2006), however, only two sampling stations were surveyed within FU20–22 area. Further information on these surveys is provided in the IBTS report (ICES, 2009) and in previous IBTS reports.

In 2008, an experiment intending to update the maturity ogive for females was carried out during the EVHOE survey. The sampling plan of this survey is not designed for *Nephrops* (late period in the year i.e. November/December affecting female abundance because of burrowing) and also the sensitive period for *Nephrops* maturity occurs during the 2nd and 3rd quarters. These data should be collected during a more adequate season; however, data sampled owing to commercial trips may be biased (selectivity of mesh size 100 mm), furthermore the long duration of French trips is an obstacle for this experiment.

Other relevant data

French partnership of the fishing industry underlined that the increase of lpue series since the end of 1990s may be caused by the change of the global fishing efficiency of the fleet because some old vessels were replaced by more recent ones. Fishing power analysis including spatial distribution will be undertaken on a set of French *Nephrops* trawlers remaining in the fishery for a long period (e.g. 1999–2008; 40 vessels) combining information involving in other substantial species targeted in the Celtic Sea (cod). Furthermore, the problem of the actual size composition of tailed individuals in landings was also debated with Producers' Organisations. The possibility of European regulation such as a numerous clauses licence system was also debated. Moreover, taking into account the current difficulty to collect information during French commercial trips, the perspective of self-sampling applied on discarded fraction of catches was also discussed.

7.7.3 Historical stock development

For a long period, the FU20–22 *Nephrops* stock was analytically investigated by XSA. However, the *Nephrops* ageing cannot be performed routinely. The L2AGE slicing program is usually applied on *Nephrops* stocks and allocates length classes into age groups by assuming von Bertalanffy model of individual growth. This slicing can be applied to length distributions by sex. All parameters, L_∞ and K by sex, calculated mean sizes by age for each sex, natural mortality and maturity by sex (assumed to be knife-edged for males and s-shaped for females) and combined are given in Stock Annex.

The slicing process converting size-frequencies to age-compositions at the aim of performing XSA is often disapproved because it may induce lack of contrast between years (input set of common parameters for individual growth). Moreover, the von Bertalanffy's equation is often invalidated for crustaceans. As it would not be reasonable to expect that methods of direct age determination for *Nephrops* will be routinely available in the foreseeable future, alternative methods as CSA have to be investigated. The main current disadvantage of CSA is linked to the recruitment indices required: as the independent UWTV survey cannot yet provide consistent dataset on young year classes, the recruitment indices can be given only by annual discard indicators. Thus, no CSA investigation can be envisaged before providing discards estimators by reliable indices for both main fleets and for the complete time-series.

Comparison with previous assessments

Only comparisons based on global indicators for the stock can be carried out. Even if there is no possibility for catch-at-age analysis regarding absolute levels of abundance of *Nephrops* in FU20–22, there is usually significant information on the relative stock state.

The current abundance indices applied for both main fleets for FU20–22 involve in commercial data (thresholds of 10% and 30% i.e. percentage of total landings composed from *Nephrops* respectively applied on French and Irish trawlers as tuning fleets).

For the WGCSE 2010, the information is severely hampered due to the lack of 2009 official French data on fishing effort and lpue whereas information on landings based on the sales at auction seems to be more satisfactory.

In 2007, the lpue has increased substantially for the Irish fleet and slightly for the French fleet. In 2008, both lpue changed upwards mainly the French one. The EVHOE also shows a strong increase in catches for 2007 and 2008. In 2009, Irish indices declined and there is no possibility for calculation of French indices as explained above.

The French trawlers' lpue and cpue series both have indicated a rise in stock abundance since the early 2000s. However, it should be important to investigate whether the sharp Irish lpue variations correspond to actual signals for the stock or to other factors linked to fleet capacity. It is noticeable that the French groundfish survey EVHOE while no focusing on *Nephrops* had provided in 2007 the highest indices for this species since the beginning of the survey 10 years ago. Trenkel and Rochet (2003) examining indicators in the French EVHOE Celtic Sea survey suggest that *Nephrops* population is increasing during 2000s.

Until 2005, the mean size of landings had also increased except for 2001 when the smaller size composition suggests a stronger recruitment entry in the fishery. Nevertheless, in 2006 and 2007, mean sizes in landings for both fleets decreased. This point combined to the former UK survey on this area (suggesting a slight trend of decrease of mean sizes for some sampling reference stations: see WGSSDS 2006) could be induced either by stronger recruitment abundance than previously or by over-fishing.

From the end of 2007 onwards, the revised DLFs taking into account tailed individuals in French sampling changed estimates of mean sizes: WGCSE 2010 performed recalculation of the mean sizes and sex ratios over the period since 1999. On 28 314 t of official French landings over the period 1999–2009, the actual number of landed *Nephrops* is estimated equal to 591 million whereas the previous sampling process provided 515 million (+15%). It is not currently possible to estimate whether the additional removals up to +15% contradict the current advice on this stock mostly if the additional landings are compensated by less discards.

As no analytical XSA run was performed, abundance of recent recruiting year classes can be examined only by comparison of independent indicators such as discarded individuals estimated by the logistic derivation method and some surveys indices. As detailed in the Stock Annex, independent sources of information (EVHOE survey's indices, logistically derived discards for no sampled years) agree that some recent recruiting classes (mainly 2001 and probably 2002 and 2003) should be of a good level whereas it is still impossible to indicate the actual state of the more recent year classes.

State of the stock

The state of the stock is unknown.

7.7.4 Short-term projections

No short-term projection was performed for this stock. For other *Nephrops* stocks in VII with UWTV surveys these have been used as the basis for catch options in 2011.

This should be also possible for the Smalls component of FU20–22 (32E3, 31E3 and 31E4) which represents around 50% of the total landings (average on years 2003–2008). A new survey estimate will be available in late summer 2010. WGCSE propose that the various stock parameters and reference points required to develop catch options for FU20–22 will be explored during the summer and made available to apply to the new survey data.

7.7.5 MSY explorations

No MSY explorations were carried out at WGCSE but these explorations will be carried out for the Smalls component of the catches during the summer of 2010 in time for the 2011 advice.

7.7.6 Biological reference points

There are no biological reference points for FU20–22 *Nephrops* stock.

7.7.7 Management plans

No specific management plan exists for this stock.

7.7.8 Uncertainties and bias in assessment and forecast

The revision of French landings, fishing effort and lpue over the recent years, underlines the heterogeneous composition of the standard pool of vessels (e.g. it could be divided into two separate fleets i.e. the one able to switch between different stocks of the Subarea VII and the other composed of less efficient trawlers limited to the Celtic Sea). Currently, misreporting does not seem to be a problem for the stock.

Exploitation pattern and spatial variability

The French and Irish time-series remain different and were provided by applying different exploitation pattern on different areas. As pointed out by the Table 7.7.16, French and Irish trawlers cover different areas and have presented contrasting features over the last decade. French fleet moved gradually from the "Smalls" Ground (32E3, 31E3 and 31E4) to the "Labadie" (30E2): at the end of 1990s, more than 40% of French landings were reported from the "Smalls" area whereas the contribution of this rectangle became minor less than 10% at the end of 2000s. Irish vessels fishing occupied the "Smalls" ground (current production of 31E3 is around $^2/_3$ of the total Irish landings and around 50% of the total landings from FU20–22).

Heterogeneity of DLFs for landings and discards

The problem of high variability of landing samples between trips still remains (higher coefficients of variation at auction because of higher heterogeneity of the fished area and of long duration of trips i.e. 12–15 days and, therefore, less availability of samples at auction). Hence, high CV of numbers at sizes (20–30%) are usual. In any case, commercial samples can be extended by including the commercial part sampled onboard during the DCF plan.

The sampling of tailed individuals in French landings provides valuable information, but underlines the necessity to re-calculate the actual size-composition of discarded individuals under the revised DLFs for landings.

While the selectivity parameters are not significantly improved for *Nephrops* trawlers, it appears appropriate to continue the Irish discard plan and to conduct a French one on a yearly basis. For French trawlers, it should be suitable to investigate possibilities of reliable self-sampling onboard. It should be interesting to examine the part of decrease of the French discard rate since the early 2000s due to the selectivity improvement from that related to some weak recruiting classes (however, size-composition of landings for 2006 and 2007 may suggest a positive signal for recruitment). Moreover, if the individual growth of this species is faster during the latter period of the compiled time-series, there would be decline of the discarded amounts with no possibility to investigate the actual recruitment level.

7.7.9 Recommendation for next Benchmark

Many quantitative explorations attempted in recent years for the FU20–22 *Nephrops* stock (e.g. sampling onboard, maturity ogive, discard derivation) were handicapped by the overall spatial heterogeneity, by the divergence of exploitation pattern for the two main fleets .As the stock state seems to be stable, fishery indicators only provide provisionally adequate information. The following issues need to be addressed at the benchmarking of this stock.

Biological sampling

Auction

As the French sampling of tailed *Nephrops* on landings at auction has recently been standardized, updated information for DLF and sex ratio was provided in 2010 and should be benchmarked.

Onboard

The Irish plan of sampling onboard under DCF will continue to provide information on discarded amounts and DLF. For the French trawlers, self-sampling onboard may be more realistic than in the past (concentration of a huge proportion of total landings from a small number of vessels; see above §7.7.1). Difficulties of sampling onboard when long trip duration should be addressed.

Maturity

Re-estimation of maturity parameters requires a specifically designed experiment which should be commonly organized by France and Ireland under DCF.

Back-calculation for missing biological data

Tails

The modification of DLF for tailed individuals was extended on the overall period since the tailed fraction became significant by applying probabilistic concepts combined with s-shaped quarterly curves of tailing *Nephrops* vs. size.

Discards

After re-calculating DLF for French landings on recent years, by an analogous way as already performed by WGSSDS 2006–2008, DLF of discards for French trawlers should be carried out for the whole time-series integrating the change of relative selectivity for trawls in 2000 (100 mm replacing 80 mm).

Dataset on DLF of Irish landings before 2002

For the years 1995–2002, available series on Irish landings on quarterly basis was not associated to samples on DLF. In spite of spatial variability affecting size composition by fleet, the possibility to extrapolate French DLF for this period has to be investigated: before 2000, the same selectivity parameters for trawls should be used (the difference involved in MLS; §7.7.1).

Surveys

UWTV Irish survey

The UWTV Irish survey initiated in 2006 this could form the basis for catch options and management advice for the the Smalls component of the stock using methodologies outlined in WKNEPH 2009. This will be carried out later in 2010 outside the scope of a full benchmark.

Commercial fleets

Stratification of the French fleet

The existence of official French statistics by vessel and trip (at least for the recent ten years), allows to stratify the whole fleet in order to propose homogeneous pools for commercial tuning fleets. Spatio-temporal variability of fishing power should also be performed aiming to evaluate the effect of different decommissioning plans throughout the time-series.

Development of lpue or cpue indicators based on VMS

Ireland has linked VMS and log book information for all vessels (See Gerritsen, 2009, WD 1). Using this data it is possible to develop lpue indicators at an appropriate spatial scale for mud patches with FU20–22. As the time-series develops these will become useful assessment input. This analysis should be extended to French and UK fleets fishing in FU20–22.

7.7.10 Management considerations

The average landings during 2000s have been stable with a slight increasing trend, but in 2009 total landings from the area declined and French global indicators on the stock remain unknown. However, various additional information such as mean sizes in landings, discard rate, abundances provided by UWTV survey suggest that there is little evidence for significant changes in the status of this stock.

ICES has repeatedly advised that management should be at a smaller scale than the ICES Subarea VII. Management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort are at the same scale as the resource.

The *Nephrops* fisheries target different areas, and *Nephrops* catches and landings show very different size structures. These fisheries also have differences in non-*Nephrops* bycatch composition. Cod, whiting, and to a lesser extent haddock are the main bycatch species.

Discarding of small *Nephrops* is substantial. The discard rate seems to have notably fluctuated between fleets or years. This shows that trawls currently used to target *Nephrops* are not technically adapted to select marketable *Nephrops*. The calculation of the discard rate may be impacted by the upwards trend of tailed individuals in landings. Discarding of other fish species is also a problem in *Nephrops* fishery.

The French trawlers showed an overall decline during the last decade. It should be substantial to examine the evolution of the French fishing effort (decommissioning schemes associated to constraints linked to fuel prices). Irish fleet has also been impacted by European decommissioning plans.

In 2008, the lpue has increased for both fleets, but in 2009 Irish lpue changed downwards whereas the current lack of reliability for French official statistics does not allow for the estimation of French lpue indices for 2009. All lpue values over the whole time-series have not been corrected to take into account changing fishing power of fishing practices.

In 2006 and 2007, mean sizes in landings for both fleets decreased and that could be induced by stronger recruitment abundance than previously. However, since 2008, the French sampling plan at auction has included tailed individuals and modified interpretation of the signal. Back-calculations on mean sizes including tails since their proportion became significant (end of 1990s) were performed, but are not currently benchmarked.

Effort of Irish vessels is directed mainly in the Smalls ground which has high densities of small *Nephrops*. Currently, French effort is directed towards other grounds such as the Labbadie where the substrate is more heterogeneous and the mean size of *Nephrops* is significantly larger. There have been some changes in these patterns the over time. In 2009, Irish effort on the Labadie has increased and effort in the Smalls has declined (Gerritsen, 2010, WD 4).

7.7.11 References

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Table 7.7.1. *Nephrops* FU 20–22 (Celtic Sea). Total and by country nominal landings (t) in Division VIIfgh as used by WG.

Year	France	Rep. of Ireland	UK	Other Countries[1]	Total reported	Unallocated	Total
1983	3667						
1984	3653						
1985	3599						
1986	2638						
1987	3080	329					
1988	2926	239					
1989	3221	784					
1990	3762	528					
1991	2651	644					
1992	3415	750					
1993	3815	770	63	0	4648	-274	4374
1994	3658	1415	68	2	5143	-274	4869
1995	3803	1575	125	2	5505	-282	5223
1996	3363	1377	86	2	4828	-217	4611
1997	2589	1552	95	4	4240	-213	4027
1998	2241	1619	64	1	3925	-90	3835
1999	2078	824	41	0	2943	-78	2865
2000	2848	1793	47	1	4689	-44	4545
2001	2626	2123	21	1	4771	-33	4738
2002	3154	1496	15	8	4673	-50	4623
2003	3595	1388	19	N/A	5002	0	5002
2004	2605	1627	36	N/A	4268	0	4268
2005	2502	2391	53	N/A	4946	0	4946
2006	2368	1864	32	N/A	4264	0	4264
2007	2033	3213	47	6	5299	0	5299
2008	2348	3411	242	N/A	6001	0	6001
2009	2156	2844	359	N/A	5359	0	5359

[1] Other countries include Belgium.

Table 7.7.2. ***Nephrops*** **FU 20–22 (Celtic Sea). Nominal landings (t) by quarter in Division VIIfgh as used by WG.**

	French trawlers					Irish trawlers				
year	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
1987	759	941	972	409	3080					329
1988	547	1065	683	631	2926					239
1989	411	1493	838	480	3221					784
1990	482	1765	1229	287	3762					528
1991	500	1245	518	388	2652					644
1992	681	992	1064	678	3415					750
1993	972	1598	742	504	3815					770
1994	541	1303	1052	762	3658					1415
1995	693	1631	876	604	3803	193	1137	109	136	1575
1996	674	1437	728	523	3363	268	714	330	66	1377
1997	460	1028	683	417	2589	249	971	196	136	1552
1998	642	881	456	262	2241	351	952	264	52	1619
1999	479	447	606	546	2078	214	184	105	321	824
2000	598	1261	743	246	2848	420	1154	149	71	1793
2001	422	879	667	658	2626	456	843	317	508	2123
2002	479	1211	823	641	3154	167	557	408	363	1496
2003	533	1401	1187	474	3595	202	519	478	190	1388
2004	496	981	677	452	2605	234	685	341	367	1627
2005	628	909	537	428	2502	491	1390	233	277	2391
2006	486	1024	563	295	2368	354	978	233	299	1864
2007	294	966	423	350	2033	416	1331	415	1051	3213
2008	450	794	681	424	2348	493	1589	600	728	3411
2009	534	890	489	244	2156	932	1186	529	197	2844

Table 7.7.3. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2002. Quarterly and total values (10[3]). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

- The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire ***Nephrops*** **at auction). (2) Tails are included (simulation of hand-sorting s-shaped curve vs. CL: see Stock Annex).**

- The Irish data reported from the whole MA M (See Stock Annex).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17											1			1	
18											1			1	
19			4			5					1	24		2	33
20			13			6					2	126		3	145
21		1	37			4					4	172		5	213
22		1	72			17					7	564		8	653
23		2	124			85			6		11	1124		14	1340
24		4	236		1	136			67	81	77	1804	81	83	2243
25		8	421		2	216			75		29	1533		39	2245
26		15	538		3	245		1	182		47	1495		66	2459
27		29	778		6	326		2	202		77	1110		113	2417
28		54	760	83	69	577		4	607		126	1516	83	254	3459
29	21	118	639		19	776		10	470		347	1220	21	494	3104
30	41	223	510		35	741		22	1125	242	685	1107	283	966	3483
31	47	395	589		65	1075		49	1685	242	733	1284	289	1242	4632
32	132	439	565		119	1199		108	1558	242	674	1002	375	1340	4325
33	140	459	453	83	278	1624	37	266	1551	404	725	995	664	1729	4624
34	236	523	419	122	879	1654	165	830	1455	404	739	753	927	2971	4281
35	366	609	326	540	1521	1654	401	1471	1152	678	866	782	1985	4466	3913
36	503	678	256	995	2072	1376	1125	1763	599	601	776	512	3223	5288	2742
37	648	744	221	1541	2279	1361	706	1360	711	823	905	412	3718	5288	2705
38	797	806	198	1603	2133	1156	1603	1752	580	1146	1083	526	5150	5774	2460
39	847	801	198	2230	2385	820	1463	1490	341	824	830	270	5364	5505	1628
40	1078	941	116	2901	2660	907	1466	1309	313	1618	1368	270	7063	6278	1606
41	817	712	47	2757	2350	380	1028	888	249	1377	1139	171	5978	5088	847
42	1114	915	140	2365	1905	322	1186	953	207	669	566	156	5334	4338	825
43	509	427	12	2070	1582	249	781	626	129	836	662	85	4196	3297	474
44	604	489	47	1003	784	234	1076	835	129	771	618	28	3454	2726	438
45	352	286	23	1157	877	132	605	475	74	612	523	71	2727	2161	300
46	144	121		467	368	132	893	691	37	306	278	14	1811	1459	183
47	179	149		345	301	15	470	371	97	247	236	14	1241	1057	126
48	78	67	23	472	389	102	422	331	55	175	160	14	1147	947	195
49	87	74	12	133	123	59	202	164	37	55	58	14	477	419	121
50	73	62		242	207	15	158	129		87	91	14	560	489	29

CL	Q1			Q2			Q3			Q4			Year		
51	48	41		166	142		126	106	18	95	83		435	371	18
52	32	29		72	73		120	100	18	94	74		318	276	18
53	30	28		76	77		45	43		24	25		175	172	
54	31	29		57	57		65	54	18	23	24		176	164	18
55	24	24		53	53		99	80	18	17	17		192	174	18
56	18	18		40	41		19	18		8	9		85	85	
57	11	11		42	42		9	9	18	15	15		77	78	18
58	11	11		23	23		8	8	18				42	42	18
59	10	10		12	12		2	2		1	1		25	26	
60	12	13		14	14		7	6	18	1	1		34	34	18
61	3	3		18	18		7	7		1	1		28	28	
62	4	4		20	21		1	1		1	1		26	26	
63	2	2					1	1		8	8		11	11	
64	2	2								1	1		2	2	
65	2	2					1	1					3	3	
66															
67															
68	1	1					1	1					2	2	
69															
70															
71															
72															
73															
74															
75															
Total	9056	10 381	7774	21 703	23 985	17 600	14 293	16 334	13 821	12 732	14 706	19 184	57 783	65 406	58 378

Table 7.7.4. *Nephrops* in VIIfgh. Length distribution of landings by country in 2003. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (simulation of hand-sorting s-shaped curve vs. CL: see Stock Annex).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17															
18						2									2
19						10									10
20			123			26			71			49			269
21			554			72			270			172		1	1068
22			565			169			398		1	198		1	1330
23			1444			319			596		1	211		2	2570
24			444		1	848		1	607		2	239		3	2139
25			149		1	1110		1	736		3	477		5	2473
26			2322		2	1836		3	1071		4	586		9	5815
27			319		4	1894		5	1643		7	514		16	4370
28			1666		7	1967		11	2063		11	948		30	6644
29		1	448		14	1895		23	2330		18	901		56	5574
30		1	370		27	1744		49	2543		28	445		105	5102
31	25	22	827		50	1682		101	1905	25	62	828	50	236	5241
32		6	997	47	129	1796	211	363	1809	99	289	1307	357	786	5908
33		11	545	47	212	2035		1222	1359	99	301	437	146	1746	4376
34		21	426	328	1340	1565	739	2369	1373	124	464	477	1191	4195	3841
35	77	218	236	516	1502	1293	1689	3142	868	496	789	240	2778	5650	2637
36	75	355	189	563	1601	856	1901	2693	509	545	834	254	3083	5483	1808
37	298	527	189	1220	1925	639	1478	1993	378	595	785	233	3591	5229	1440
38	323	554	284	1313	1800	492	2649	2525	390	694	774	206	4979	5653	1372
39	497	674	95	1360	1678	359	2745	2335	434	694	696	137	5297	5383	1025
40	828	910		2224	2176	158	1496	1281	179	620	606	158	5168	4972	495
41	1024	1009	47	2499	2238	257	2217	1682	219	942	779	69	6683	5708	592
42	1044	962	95	2385	2026	197	1409	1072	223	697	581	34	5535	4642	549
43	1096	945	47	2478	2004	228	1224	922	112	737	573	27	5535	4443	414
44	761	649		1734	1395	80	1472	1098	96	501	394	27	4467	3536	203
45	751	621		1532	1232	70	1229	972	20	459	360	21	3971	3184	110
46	462	385	47	1692	1358	50	1193	930	20	312	267	14	3659	2939	131
47	298	265		1008	854	20	391	335	120	243	216	27	1941	1670	167
48	308	273		674	586	10	313	286	60	204	180		1498	1325	70
49	243	223		392	378	30	180	183	40	142	132	7	958	916	77
50	99	104		313	294	20	108	110	20	156	153		676	662	40
51	79	83		212	219	20	81	82	40	78	81		450	465	60

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
52	42	44		119	123	10	90	91		57	59	14	308	317	24
53	25	26		93	96		54	55		27	28		199	204	
54	12	13		86	89		18	18		9	9		126	129	
55	25	26		40	41		9	9		21	21		94	97	
56	10	10		33	34		36	36		3	3		82	84	
57	10	10		27	27	10	36	36		3	3		75	77	10
58	5	5		20	20								25	26	
59	2	3		13	14		9	9					25	25	
60															
61				7	7								7	7	
62	5	5											5	5	
63															
64															
65															
66															
67															
68															
69															
70															
71															
72															
73															
74															
75															
Total	8424	8963	12 429	22 977	25 502	23 767	22 978	26 043	22 500	8581	9514	9258	62 959	70 021	67 953

Table 7.7.5. *Nephrops* in VIIfgh. Length distribution of landings by country in 2004. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

- The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (simulation of hand-sorting s-shaped curve vs. CL: see Stock Annex).

- The missing Irish data of the 1st and 4th quarters were calculated by likelihood function as explained (Stock Annex).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17												1			1
18			3									2			6
19			16									4			20
20			30			1			1			8		1	40
21			46			11		1	1			19		1	77
22			69			8		1				57		3	134
23		1	108		1	25		3	4		1	107		5	245
24		1	160		1	100		5	13		1	207		9	480
25		3	213		1	189		11	37		2	368		17	806
26		5	298		3	445		21	107		4	565		32	1414
27		9	390		4	576		40	286		6	799		59	2052
28		16	443		8	703		78	699		10	1091		112	2935
29		29	537		13	1010		151	1126		17	1360		211	4034
30		53	680		23	1398		293	1652		30	1521		399	5251
31		97	737		39	1960	73	939	1798		50	1563	73	1125	6058
32	80	466	783	64	110	2487	254	1281	1606		84	1542	398	1942	6417
33	321	727	800	64	159	2862	363	1141	1403		143	1386	748	2170	6451
34	351	842	745		388	3030	327	992	1337	161	337	1144	838	2560	6256
35	728	993	633	191	631	2293	689	1188	988	183	633	908	1792	3445	4823
36	618	819	553	318	1231	1901	1161	1323	708	688	1120	738	2785	4492	3900
37	763	811	443	1080	1753	1698	871	961	449	1009	1245	544	3723	4770	3134
38	827	770	373	1080	1749	1299	1161	986	353	596	821	397	3664	4326	2422
39	537	499	298	1652	1728	797	798	664	225	688	695	297	3675	3586	1616
40	695	574	216	826	1006	498	980	740	134	573	550	223	3074	2869	1071
41	486	403	150	1525	1326	447	1161	836	135	573	498	162	3745	3063	893
42	612	481	105	1789	1401	249	762	544	82	688	532	118	3852	2958	554
43	516	405	68	837	683	161	726	508	57	575	428	79	2653	2023	365
44	461	366	41	1218	885	74	635	447	59	392	289	59	2706	1988	233
45	470	364	31	1092	823	50	527	370	30	482	339	46	2571	1896	156
46	129	118	21	827	598		142	111	22	432	294	29	1530	1121	72
47	309	248	16	457	367	50	408	309	24	90	73	17	1264	998	106
48	178	166	11	661	569	25	278	225	11	182	135	14	1299	1095	61
49	178	166	9	352	319	25	282	229	11	123	101	6	935	814	51

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
50	125	120	5	395	360		149	155	5	69	63	4	739	697	14
51	149	143	4	193	197		145	151	3	54	56	3	541	547	10
52	117	118	2	215	219		126	131	3	58	59	3	516	527	7
53	81	81	2	204	208		114	106	8	81	83	2	479	478	12
54	60	60	2	129	131		37	39	3	61	63	2	287	293	6
55	60	60		64	66		37	39	3	48	49	3	209	214	6
56	36	37		54	55		37	39		36	37	3	164	167	3
57	26	26		54	55		37	39	16	17	18	3	134	137	19
58	18	18		11	11		26	27		12	12	3	66	68	3
59	3	3		32	33		4	4	5	10	10	3	48	49	8
60	3	3					15	15		6	6	1	23	24	1
61							15	15		2	2	1	17	17	1
62							11	12					11	12	
63							4	4					4	4	
64															
65										2	2		2	2	
66									3						3
67												1			1
68										2	2	1	2	2	1
69									3						3
70												1			1
71												1			1
72									3						3
73															
74															
75															
Total	8938	10 099	9042	15 381	17 152	24 371	12 354	15 173	13 411	7892	8903	15 412	44 565	51 327	62 236

Table 7.7.6. *Nephrops* in VIIfgh. Length distribution of landings by country in 2005. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (simulation of hand-sorting s-shaped curve vs. CL: see Stock Annex).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17															
18						3									3
19			10			7									17
20			22			31			41		1	107		1	200
21			22			74			187		1	379		1	662
22			60			79			226		1	422		1	787
23		1	150			209			343	1	2	811	1	3	1513
24		1	543			446			759		3	1506		4	3253
25		2	705		1	1035			1074		4	1874		7	4688
26		3	1303		1	1302		1	1143	8	12	3006	8	17	6754
27	9	12	1942		3	2227		1	1712	1	13	2404	10	29	8285
28		10	1878		5	2983		3	1897	2	21	1753	2	39	8510
29		18	2122		9	4281		6	1610	1	32	1296	1	64	9310
30	9	38	2281		16	5134		11	1404	4	59	1059	13	125	9878
31		57	2427		30	6639		23	1150	21	104	1048	21	214	11264
32	70	153	2056		56	7014	8	52	575	70	264	631	148	525	10276
33	44	426	1312	10	109	6247	18	105	709	162	506	491	233	1146	8759
34	131	573	1436		190	4688	58	628	439	471	867	624	660	2257	7187
35	289	792	1101	69	768	4429	196	833	169	769	1163	247	1323	3556	5945
36	464	876	688	223	1296	3546	297	948	140	1076	1322	322	2060	4443	4696
37	525	805	553	429	1455	1916	515	944	151	1188	1271	123	2656	4475	2743
38	578	752	557	483	1334	1985	558	852	62	1109	1064	192	2728	4003	2796
39	814	822	459	598	1134	1343	761	822	31	934	817	178	3106	3594	2011
40	658	637	379	615	924	659	696	652	31	731	599	69	2700	2813	1137
41	735	636	180	617	770	493	545	468	16	589	451	41	2487	2325	730
42	780	632	99	744	707	370	493	388	75	415	316	27	2432	2043	573
43	570	454	159	588	529	110	412	310	23	450	319	14	2021	1613	305
44	613	473	99	598	479	27	276	212	60	288	212		1775	1376	186
45	547	418		746	544	27	247	192		271	198	14	1812	1352	41
46	520	402	80	701	493	82	161	134		182	139		1563	1169	163
47	400	312		752	513	27	199	164		135	110		1486	1099	27
48	258	218		757	511		158	135	68	75	66		1248	931	68
49	271	238		677	461		177	134		49	48		1174	881	
50	241	220		698	489	41	302	226		34	35		1275	969	41
51	263	239		476	350		271	203		40	42		1051	833	

CL	**Q1**			**Q2**			**Q3**			**Q4**			**Year**		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
52	179	171		349	277		215	165		21	22		764	635	
53	153	139		332	262		198	144		23	24		707	569	
54	101	101		241	193		181	133		20	20		543	448	
55	89	88		193	167		205	149		16	16		502	420	
56	50	51		132	114		85	64		9	9		276	238	
57	58	56		140	106		73	56		9	9		280	228	
58	33	33		64	53		68	50		4	5		169	141	
59	31	32		48	41		48	35		5	5		133	113	
60	15	15		8	8		13	14		4	4		39	41	
61	15	15		9	9		18	13		1	1		43	39	
62	3	3		5	5		4	7					11	15	
63	3	3		3	3		10	8		1	1		17	15	
64							1	2					1	2	
65				2	2		1	2					2	3	
66				2	2		1	2					3	4	
67							1	2					1	2	
68							1	2					1	2	
69															
70							1	2					1	2	
71															
72							1	1					1	1	
73								1						1	
74								1						1	
75							1	3					1	3	
Total	9519	10 928	22 620	11 307	14 417	57 455	7474	9304	14 093	9190	10 181	18 639	37 491	44 830	11 2807

Table 7.7.7. *Nephrops* in VIIfgh. Length distribution of landings by country in 2006. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (simulation of hand-sorting s-shaped curve vs. CL: see Stock Annex).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17															
18									4						4
19						7			8						15
20			79			20			11			123			233
21			92			57			13			341		1	504
22			267			198			71			587		1	1123
23			563			494		1	124		1	1153		2	2334
24			1542			863		2	431		1	1719		4	4554
25			1999		1	1520		4	696		2	2226		7	6442
26		1	2944		1	3106		7	1339		4	2729		13	10118
27		2	3260		3	4662		14	1730		7	2892		25	12544
28		3	3247		5	5777	10	34	2059	6	15	2374	15	57	13457
29		6	2827		10	6544		57	1697		20	1453		92	12521
30		11	1950	13	27	6529	10	119	1444	11	41	1128	34	197	11051
31		21	1738		36	4693	20	239	1017		57	735	20	352	8183
32	18	52	989	26	84	4636	68	771	709	34	121	581	146	1028	6916
33	53	380	673	13	138	3346	78	958	651	85	317	431	229	1792	5102
34	152	591	398	208	915	2472	205	941	576	312	567	345	877	3013	3791
35	286	728	412	312	1498	1703	254	1001	270	431	754	331	1283	3982	2717
36	397	813	178	845	2114	1205	488	1057	274	738	927	264	2468	4912	1922
37	642	885	124	1430	2561	837	714	1149	145	772	881	250	3558	5476	1356
38	648	796	96	1963	2518	525	1143	1216	111	755	745	174	4509	5276	906
39	788	780	82	1769	2027	359	1133	1006	92	590	550	141	4281	4363	675
40	735	660	13	2015	1807	280	918	731	20	568	474	97	4237	3672	410
41	636	536	13	1755	1419	265	1026	699	52	540	412	68	3957	3066	398
42	722	563		1496	1099	129	791	519	11	319	245	53	3329	2426	193
43	674	508	13	1257	864	99	815	504	7	315	223	32	3061	2099	152
44	486	363		965	642	86	519	320	11	211	149	38	2181	1474	135
45	429	317		897	579	58	335	206	7	119	87	17	1781	1189	82
46	346	259		696	458	13	468	284	4	119	84	14	1629	1085	32
47	297	229	27	529	362	28	287	183		86	64	14	1198	839	69
48	262	208		465	331	7	138	107		48	38	11	913	684	18
49	168	145		248	202	13	138	98		66	51	2	619	496	16
50	87	84		216	184		117	89		23	22	5	443	380	5
51	71	71		100	98		115	92		27	25		313	285	

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
52	68	68		156	127	13	70	63		19	18		313	276	13
53	62	64		114	101		46	52		10	11		231	227	
54	42	44		72	69		42	39		9	10		166	161	
55	34	35		63	59		27	28		10	10		134	133	
56	33	35		39	41		23	24		8	9		105	108	
57	29	30		38	39		13	14		5	5		85	87	
58	17	18		38	39		12	12		5	5		71	74	
59	11	11	13	26	27		8	9		3	4		49	50	13
60	7	7		15	15		12	12		2	2		36	37	
61	4	4		10	11		6	6		1	1		21	22	
62	3	3		3	3		4	4		1	1		10	11	
63	1	1					1	1		1	1		3	3	
64	2	2		2	2		2	2					7	7	
65				1	1		1	1					2	2	
66															
67															
68															
69		1												1	
70															
71															
72															
73															
74															
75															
Total	8209	9336	23 543	17 796	20 517	50 546	10 060	12 675	13 589	6249	6959	20 328	42 315	49 487	108 006

Table 7.7.8. ***Nephrops*** **in VIIfgh. Length distribution of landings by country in 2007. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (simulation of hand-sorting s-shaped curve vs. CL: see Stock Annex).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17															
18															
19						29									29
20			105			147			10			204			467
21			211			354			36						601
22			494			1048			167			650		1	2360
23			916			2896			539			3669		1	8020
24		1	2756		1	3974			1308			5096		2	13134
25		1	4216		2	5682			2577		1	5667		4	18142
26		2	5318		3	8819			2948		1	5620		7	22705
27		4	6274	21	17	9504		1	3387		2	3055	21	24	22221
28		8	5456	21	22	11328		2	4069		4	3630	22	36	24482
29		15	4524		22	11790		4	4176	5	9	3528	5	50	24017
30	5	33	1767	42	64	10036		9	3041		11	4662	47	117	19506
31	5	61	916		79	6475		20	2014	5	22	3376	10	183	12781
32	15	122	356	64	185	4082	22	57	1192	25	47	3386	125	411	9017
33	81	424	105	127	951	2756	54	535	1007	45	282	2526	307	2191	6395
34	161	531		255	1660	1429	194	953	383	121	449	2196	731	3593	4008
35	218	561	105	806	2241	1118	517	1312	288	226	583	1797	1768	4696	3308
36	328	567		1125	2601	707	862	1550	168	301	671	1697	2616	5389	2572
37	385	570		1804	2654	441	1412	1552	69	453	755	1248	4053	5532	1757
38	603	629		1973	2289	352	1121	1096	49	592	815	1073	4290	4829	1474
39	522	499		1783	1820	293	1013	800	32	744	794	823	4063	3914	1148
40	461	391		2295	1730	321	884	615	39	597	617	548	4238	3353	909
41	410	319		1490	1102	232	766	486	27	646	542	678	3312	2450	938
42	363	268		1429	924	72	540	328		515	401	374	2848	1922	447
43	334	239		1399	839	116	423	248	16	353	263	349	2510	1589	481
44	317	222		866	529	87	267	158	6	335	226	50	1784	1134	142
45	233	164		973	569	73	278	167		293	193	75	1777	1093	148
46	264	183		569	366	57	196	122	6	253	164	75	1282	835	138
47	116	87		328	240	14	98	72		205	133	50	747	531	64
48	136	99		391	280		72	60		176	113	50	774	552	50
49	91	70		158	146	14	46	44		126	88	75	421	348	89
50	68	56		160	124		38	35		86	59		352	274	
51	44	39		73	77		35	32		44	32		196	180	

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
52	34	31		70	62		19	20		20	18		142	132	
53	22	21		39	41		11	12		25	19	24	98	93	24
54	18	17		21	22		9	9		27	19		76	67	
55	19	18		17	18		8	8		6	6		50	50	
56	9	9		18	19		5	5		19	12		51	46	
57	7	7		7	7		2	2		8	6		24	22	
58	11	10		6	6	14	2	2		2	2		21	20	14
59	4	4		5	5					1	1		10	10	
60	5	5		6	6		1	1		2	2		13	13	
61	2	2		5	5		1	1		1	1		8	9	
62	2	2		3	4		1	1					7	7	
63	1	1		2	2								3	4	
64				1	1								2	2	
65													1	1	
66															
67															
68															
69															
70															
71															
72															
73															
74															
75															
Total	5296	6293	33 520	18 354	21 736	84 262	8897	10 322	27 553	6256	7366	56 253	38 803	45 716	201 588

Table 7.7.9. *Nephrops* in VIIfgh. Length distribution of landings by country in 2008. Quarterly and total values (10[3]). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (as performed since WGCSE 2009).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17															
18															
19															
20															
21						28									28
22						296									296
23						651			69			539			1258
24						1475			410			1736			3621
25			18			2557			913			3494			6981
26			958		27	4475		22	1136			5829		49	12397
27			1011		82	5408		22	1782			1578		104	9779
28		26	3759		218	6541		89	1582		10	2856		343	14738
29	6	4	3033		463	6436	10	72	2256	6	43	1777	22	582	13502
30	6	162	3336	12	742	7257		245	2116		108	1878	18	1256	14588
31	19	275	980	13	1042	7312		467	2969	18	167	1419	50	1951	12680
32	38	497	1087	61	1774	6648	20	989	3241	55	307	1460	174	3567	12436
33	89	752	1319	280	1527	4916	30	1372	3063	146	488	1520	544	4140	10817
34	247	1058	1123	536	1789	4829	181	1629	2363	273	721	1698	1236	5198	10013
35	438	977	1462	925	1818	4573	441	1720	1221	450	817	1939	2253	5332	9194
36	554	1167	1123	1448	1993	3000	941	2116	1383	753	979	1219	3697	6254	6725
37	668	920	677	1692	1596	2042	1422	1589	718	863	897	900	4645	5001	4337
38	647	751	659	1814	1383	1224	1682	1525	666	1087	1032	999	5231	4690	3548
39	669	567	356	1583	1242	915	2063	1434	244	844	828	780	5159	4071	2294
40	597	444	339	1558	1148	562	1462	965	213	911	750	600	4528	3306	1713
41	654	465	267	1418	946	378	1382	856	282	772	619	679	4226	2886	1606
42	560	383	178	1027	671	393	1052	595	182	744	566	439	3383	2215	1192
43	576	367	89	1044	607	267	703	368	91	521	378	280	2845	1720	726
44	511	316	89	812	471	321	782	414		374	291	60	2480	1493	470
45	598	371	53	568	342	84	455	245		255	233	160	1876	1190	297
46	345	225		405	259	84	277	180		198	171	40	1225	835	123
47	290	206		219	151		184	112		118	123	40	812	593	40
48	209	144		201	173	41	105	76		84	62	40	600	456	81
49	102	74		128	97	167	100	76		65	50	40	395	298	207
50	117	84		93	81	125	55	45		44	36	40	308	247	165
51	49	39		56	56	41	74	60		50	37	20	229	192	61

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
52	28	25		47	40	41	30	30		17	14		120	109	41
53	36	29		28	28		23	23		14	12		102	92	
54	11	11		21	21		16	16		6	16		55	65	
55	13	11		17	17		12	12		3	3		46	43	
56	8	8		12	12		7	7		1	1		28	28	
57	12	10		7	7		5	5		2	2		27	24	
58	14	12		4	4		1	1		1	1		20	17	
59	4	4		3	3		1	1					8	8	
60	1	1		3	3		1	1					4	4	
61				1	1								2	2	
62				1	1								1	1	
63				1	1								1	1	
64															
65															
66															
67															
68															
69															
70															
71															
72															
73															
74															
75															
Total	8117	10 387	21 914	16 039	20 836	73 086	13 516	17 380	26 900	8676	9763	34 056	46 348	58 365	155 956

Table 7.7.10. *Nephrops* in VIIfgh. Length distribution of landings by country in 2009. Quarterly and total values (10^3). The reported size is the carapace length (CL). Conversion of CL to TS (total size) is done by multiplication by 3.3.

The French data are presented by two ways: (1) Previous method (tails not sampled and systematically apportioned in the smallest category of entire *Nephrops* at auction). (2) Tails are included (as performed since WGCSE 2009).

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
17															
18															
19															
20			116						11						127
21			167												167
22			399			35			31			102			566
23			1017			217			103			306			1643
24			2582			505			364			756			4207
25			3963			1284			879			1279			7405
26			6524			1969			1536			1495			11525
27			5825			3351			2396		4	759		4	12331
28			4684			3619		14	2953		22	489		35	11744
29			5095		106	3889		14	2804		30	831		150	12619
30		15	3619		252	3852		151	2735		69	658		487	10865
31		166	2509		583	3759		329	1813	5	163	549	5	1241	8630
32	11	234	2044		769	3074	10	637	2361	9	152	754	31	1792	8234
33	34	309	1671	32	894	2872	41	736	1716	23	295	472	131	2233	6731
34	125	595	1799	205	1365	2222	10	705	1273	92	370	400	432	3035	5694
35	194	685	1285	488	1449	2003	249	985	1117	129	482	242	1059	3601	4647
36	479	991	1003	678	1759	1839	425	1011	774	267	434	417	1849	4196	4032
37	673	997	1119	1165	1828	1433	632	1027	603	345	454	242	2814	4306	3397
38	844	1048	1054	1714	1827	1369	902	967	502	419	442	181	3878	4283	3106
39	1072	1076	694	1885	1741	1339	912	780	380	524	444	157	4394	4040	2569
40	1028	911	411	1839	1542	808	1129	898	209	465	395	199	4461	3746	1627
41	935	790	823	1972	1383	724	987	644	236	410	329	48	4304	3145	1831
42	913	685	308	1575	1085	420	832	478	113	489	337	24	3808	2585	864
43	732	523	334	1438	968	288	837	524	175	345	244		3352	2259	797
44	703	555	154	1206	756	231	651	424	84	314	216	48	2875	1951	517
45	495	336	102	690	451	89	302	201	25	174	140	24	1660	1128	240
46	486	373	77	411	305	160	332	221	44	193	135	12	1422	1035	293
47	275	203	77	447	335	29	193	163	8	118	95	24	1033	796	137
48	233	196	102	147	127	43	136	107		63	52	24	579	482	169
49	142	118		175	156	29	139	110		67	52	12	523	435	40
50	77	73		101	88	43	113	79	8	31	29		321	268	51
51	37	52		97	90	29	38	34		20	20		192	196	29

CL	Q1			Q2			Q3			Q4			Year		
(mm)	F		IRL	F		IRL	F		IRL	F		IRL	F		IRL
	no tails	tails		no tails	tails		no tails	tails		no tails	tails		no tails	tails	
52	32	32		51	51	57	23	23	11	11	11		116	116	68
53	18	18		37	37	43	16	16		9	9		81	81	43
54	10	10		24	24	171	13	13		5	9		51	55	171
55	10	10		35	28	86	6	6		2	2		52	45	86
56	6	6		10	10	171	3	3		1	1		20	20	171
57	1	1		8	8	57	1	1		1	1		11	11	57
58	1	1		1	1	86	1	1		1	1		4	4	86
59	1	1		1	1	57				1	1		3	3	57
60	3	3		1	1	86							4	4	86
61				1	1	71				1	1		2	2	71
62						43									43
63						29									29
64						57									57
65						14									14
66															
67															
68						14									14
69						14									14
70						14									14
71															
72															
73															
74															
75															
Total	9569	11 013	49 557	16 433	20 020	42 590	8933	11 299	25 263	4531	5441	10 505	39 467	47 773	127 915

Table 7.7.11. *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh) landings length distributions in 1987–1998. French trawlers.

Landings CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21		57		7								
22							38					
23		53		36					43			
24		106		57		30			43			
25	24	289			14		85		86			
26	88	309		29	53	60	19	12	109	15		
27	149	490		143	34	111	84	23	644	20	15	
28	684	1177	110	465	448	669	111	78	601	60	28	59
29	1104	3180	710	728	922	966	213	309	610	62	45	93
30	2030	4373	958	1241	1719	2139	393	631	1113	246	236	294
31	2317	7579	1804	2146	3047	3212	935	1113	1074	696	542	475
32	3640	8076	3103	2521	4057	4393	2253	2650	2486	1803	1220	1043
33	4449	8059	4294	4456	6036	6608	2468	3177	3203	2699	2144	1396
34	4312	8452	5210	5034	5804	6509	3757	4532	3129	4239	2186	2308
35	6179	6948	6479	6677	5721	7896	5213	6666	4870	6136	3608	3354
36	5691	5137	5914	5800	4591	8225	5941	5440	4339	5583	3827	3587
37	5479	5084	5281	5077	3959	8066	6026	6653	7127	6995	4262	4465
38	4940	3623	5931	6143	3797	7579	6784	6950	7141	7410	4804	4525
39	3870	2383	4832	5402	3091	5528	5667	4853	5497	5691	3619	3127
40	4622	2590	4843	4796	2772	3386	7263	5497	6493	5277	4918	4453
41	2482	2302	3636	3702	2216	2745	5349	4396	4044	4225	3062	2875
42	2695	2462	3675	4147	2218	2919	5485	4473	4433	4096	3414	2996
43	1994	1645	2371	3271	2110	2429	3652	3222	3257	3205	2725	2267
44	1275	1274	2165	3235	1793	1680	2415	2580	3403	2115	1849	2109
45	1590	1231	1999	2366	1550	1636	2732	2183	2142	2086	2288	1474
46	1265	988	1415	2066	1229	1222	1653	1348	1747	1183	1428	1014
47	1184	806	1151	1446	865	939	1604	1323	1635	1247	1021	1012
48	1182	778	858	1787	1057	966	1134	1204	1338	877	970	789
49	767	525	708	1277	766	738	950	898	816	747	603	433
50	834	437	565	809	527	576	981	969	972	702	733	420
51	571	307	511	692	437	406	489	639	743	504	353	274
52	668	353	447	786	403	278	612	571	770	510	372	253
53	526	260	315	477	303	303	365	395	635	389	286	157
54	268	205	253	387	236	191	344	462	448	294	198	110
55	391	111	148	204	128	171	276	364	262	197	110	109
56	150	107	156	95	121	96	162	191	152	141	54	76
57	129	85	118	90	48	74	93	110	176	116	81	41
58	55	49	96	91	73	68	83	154	124	56	36	28
59	92	33	74	31	12	48	93	68	49	22	8	7
60	52	4	26	26	17	24	47	71	69	17	23	13
61	7	4	22	8		11	19	22	22	5	8	
62	11	10	7	21	7	9	25	9	29	20	3	
63	6		12		1		5	12	13	2		2
64			5									
65	16	4	5				6	2	3			
66						2		2				
67	6											
68			5									
69												
70												
71												
72								2				
73												
74												
75												
Total	**67794**	**81948**	**70215**	**77770**	**62182**	**82908**	**75824**	**74255**	**75892**	**69686**	**51080**	**45637**
Weights	**3080**	**2926**	**3221**	**3762**	**2652**	**3415**	**3815**	**3658**	**3803**	**3363**	**2589**	**2241**

Table 7.7.12. ***Nephrops*** **in FUs 20–22 Celtic Sea (VIIfgh) landings length distributions in 1999–2009. French trawlers.**

Years 2008 and 2009: DLFs including tails are provided by sampling at auction. For previous years sampling involves only in entire ***Nephrops;*** **DLF including tails are estimated by simulation (see Stock Annex).**

Landings CL mm/Year	1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails	no tails	tails
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	1	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	1	0	3	0	1	0	3	0	0	0	1	0	1	0	0	0	0	0	0	0	0
21	0	2	0	5	0	1	0	5	0	1	0	1	0	1	0	1	0	0	0	0	0	0
22	0	4	0	8	0	2	0	8	0	1	0	3	0	1	0	1	0	1	0	0	0	0
23	0	7	0	14	0	4	0	14	0	2	0	5	1	3	0	2	0	1	0	0	0	0
24	0	11	0	25	0	8	81	83	0	3	0	9	0	4	0	4	0	2	0	0	0	0
25	0	20	0	44	0	15	0	39	0	5	0	17	0	7	0	7	0	4	0	0	0	0
26	0	34	45	115	0	27	0	66	0	9	0	32	8	17	0	13	0	7	0	49	0	0
27	34	88	23	156	26	69	0	113	0	16	0	59	10	29	0	25	21	24	0	104	0	4
28	18	120	45	413	0	91	83	254	0	30	0	112	2	39	15	57	22	36	0	343	0	35
29	15	199	90	501	0	169	21	494	0	56	0	211	1	64	0	92	5	50	22	582	0	150
30	255	643	150	530	258	710	283	966	0	105	0	399	13	125	34	197	47	117	18	1256	0	487
31	469	1386	155	602	606	1623	289	1242	50	236	73	1125	21	214	20	352	10	183	50	1951	5	1241
32	1171	2099	324	830	1990	3765	375	1340	357	786	398	1942	148	525	146	1028	125	411	174	3567	31	1792
33	1801	2671	739	1592	3095	5119	664	1729	146	1746	748	2170	233	1146	229	1792	307	2191	544	4140	131	2233
34	2441	3102	1113	2546	3766	6087	927	2971	1191	4195	838	2560	660	2257	877	3013	731	3593	1236	5198	432	3035
35	3034	3413	2115	3425	6159	7364	1985	4466	2778	5650	1792	3445	1323	3556	1283	3982	1768	4696	2253	5332	1059	3601
36	3102	3243	2554	3751	5506	6554	3223	5288	3083	5483	2785	4492	2060	4443	2468	4912	2616	5389	3697	6254	1849	4196
37	3457	3340	3381	4081	5602	5580	3718	5288	3591	5229	3723	4770	2656	4475	3558	5476	4053	5532	4645	5001	2814	4306
38	3483	3158	3354	3830	3324	3473	5150	5774	4979	5653	3664	4326	2728	4003	4509	5276	4290	4829	5231	4690	3878	4283
39	2646	2384	4471	4360	3500	3173	5364	5505	5297	5383	3675	3586	3106	3594	4281	4363	4063	3914	5159	4071	4394	4040
40	3819	3228	4316	4019	4325	3587	7063	6278	5168	4972	3074	2869	2700	2813	4237	3672	4238	3353	4528	3306	4461	3746
41	2365	2024	4108	3584	3404	2727	5978	5088	6683	5708	3745	3063	2487	2325	3957	3066	3312	2450	4226	2886	4304	3145
42	2898	2421	3889	3314	2180	1740	5334	4338	5535	4642	3852	2958	2432	2043	3329	2426	2848	1922	3383	2215	3808	2585
43	1828	1543	3223	2671	2723	2049	4196	3297	5535	4443	2653	2023	2021	1613	3061	2099	2510	1589	2845	1720	3352	2259
44	1938	1632	3006	2502	2231	1690	3454	2726	4467	3536	2706	1988	1775	1376	2181	1474	1784	1134	2480	1493	2875	1951
45	1459	1257	2688	2252	1346	1037	2727	2161	3971	3184	2571	1896	1812	1352	1781	1189	1777	1093	1876	1190	1660	1128
46	1045	920	2280	1937	1073	845	1811	1459	3659	2939	1530	1121	1563	1169	1629	1085	1282	835	1225	835	1422	1035
47	921	843	1358	1208	934	765	1241	1057	1941	1670	1264	998	1486	1099	1198	839	747	531	812	593	1033	796
48	825	765	1115	1012	652	576	1147	947	1498	1325	1299	1095	1248	931	913	684	774	552	600	456	579	482
49	530	504	846	792	466	450	477	419	958	916	935	814	1174	881	619	496	421	348	395	298	523	435
50	461	450	801	807	438	417	560	489	676	662	739	697	1275	969	443	380	352	274	308	247	321	268
51	330	321	650	657	335	330	435	371	450	465	541	547	1051	833	313	285	196	180	229	192	192	196
52	270	263	458	466	347	327	318	276	308	317	516	527	764	635	313	276	142	132	120	109	116	116
53	220	219	439	451	251	241	175	172	199	204	479	478	707	569	231	227	98	93	102	92	81	81
54	197	196	277	284	194	190	176	164	126	129	287	293	543	448	166	161	76	67	55	65	51	55
55	144	142	243	249	137	135	192	174	94	97	209	214	502	420	134	133	50	50	46	43	52	45
56	80	80	155	159	182	178	85	85	82	84	164	167	276	238	105	108	51	46	28	28	20	20
57	53	52	82	84	103	101	77	78	75	77	134	137	280	228	85	87	24	22	27	24	11	11
58	24	24	104	107	111	109	42	42	25	26	66	68	169	141	71	74	21	20	20	17	4	4
59	15	14	64	66	94	93	25	26	25	25	48	49	133	113	49	50	10	10	8	8	3	3
60	14	14	55	57	71	69	34	34	0	0	23	24	39	41	36	37	13	13	4	4	4	4
61	11	11	57	58	39	38	28	28	7	7	17	17	43	39	21	22	8	9	2	2	2	2
62	5	5	11	11	27	27	26	26	5	5	11	12	11	15	10	11	7	7	1	1	0	0
63	0	0	15	16	0	0	11	11	0	0	4	4	17	15	3	3	3	4	1	1	0	0
64	0	0	0	0	3	3	2	2	0	0	0	0	1	2	7	7	2	2	0	0	0	0
65	0	0	10	10	0	0	3	3	0	0	2	2	2	3	2	2	1	1	0	0	0	0
66	0	0	5	5	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	2	2	0	0	2	2	1	2	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0
Numbers	41375	42854	48813	53611	55498	61560	57783	65406	62959	70022	44565	51327	37491	44830	42315	49487	38803	45716	46348	58365	39467	47773
Weights	2078		2848		2626		3154		3595		2605		2502		2368		2033		2348		2156	

Table 7.7.13a. *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh). Landings–length distributions in 2002–2009. Irish trawlers.

Landings CL mm/Year	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	1	0	0	0	0	0
18	0	2	6	3	4	0	0	0
19	33	10	20	17	15	29	0	0
20	145	269	40	200	233	467	0	127
21	213	1068	77	662	504	601	28	167
22	653	1330	134	787	1123	2360	296	566
23	1340	2570	245	1513	2334	8020	1258	1643
24	2243	2139	480	3253	4554	13134	3621	4207
25	2245	2473	806	4688	6442	18142	6981	7405
26	2459	5815	1414	6754	10118	22705	12397	11525
27	2417	4370	2052	8285	12544	22221	9779	12331
28	3459	6644	2935	8510	13457	24482	14738	11744
29	3104	5574	4034	9310	12521	24017	13502	12619
30	3483	5102	5251	9878	11051	19506	14588	10865
31	4632	5241	6058	11264	8183	12781	12680	8630
32	4325	5908	6417	10276	6916	9017	12436	8234
33	4624	4376	6451	8759	5102	6395	10817	6731
34	4281	3841	6256	7187	3791	4008	10013	5694
35	3913	2637	4823	5945	2717	3308	9194	4647
36	2742	1808	3900	4696	1922	2572	6725	4032
37	2705	1440	3134	2743	1356	1757	4337	3397
38	2460	1372	2422	2796	906	1474	3548	3106
39	1628	1025	1616	2011	675	1148	2294	2569
40	1606	495	1071	1137	410	909	1713	1627
41	847	592	893	730	398	938	1606	1831
42	825	549	554	573	193	447	1192	864
43	474	414	365	305	152	481	726	797
44	438	203	233	186	135	142	470	517
45	300	110	156	41	82	148	297	240
46	183	131	72	163	32	138	123	293
47	126	167	106	27	69	64	40	137
48	195	70	61	68	18	50	81	169
49	121	77	51	0	16	89	207	40
50	29	40	14	41	5	0	165	51
51	18	60	10	0	0	0	61	29
52	18	24	7	0	13	0	41	68
53	0	0	12	0	0	24	0	43
54	18	0	6	0	0	0	0	171
55	18	0	6	0	0	0	0	86
56	0	0	3	0	0	0	0	171
57	18	10	19	0	0	0	0	57
58	18	0	3	0	0	14	0	86
59	0	0	8	0	13	0	0	57
60	18	0	1	0	0	0	0	86
61	0	0	1	0	0	0	0	71
62	0	0	0	0	0	0	0	43
63	0	0	0	0	0	0	0	29
64	0	0	0	0	0	0	0	57
65	0	0	0	0	0	0	0	14
66	0	0	3	0	0	0	0	0
67	0	0	1	0	0	0	0	0
68	0	0	1	0	0	0	0	14
69	0	0	3	0	0	0	0	14
70	0	0	1	0	0	0	0	14
71	0	0	1	0	0	0	0	0
72	0	0	3	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
Total	**58378**	**67953**	**62236**	**112807**	**108006**	**201588**	**155956**	**127915**
Weights	**1496**	**1388**	**1627**	**2391**	**1864**	**3213**	**3411**	**2844**

Table 7.7.13b. *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh). Discards–length distributions in 2002–2009. Irish trawlers.

Total Discards CL mm/Year	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0
11	0	0	1	0	0	0	0	0
12	0	0	1	0	0	0	0	0
13	0	0	1	0	19	0	0	0
14	0	19	2	0	38	40	0	0
15	0	84	3	0	206	0	35	25
16	0	68	5	35	138	153	70	0
17	0	171	15	35	243	200	181	178
18	0	261	16	164	364	772	320	300
19	0	614	77	265	564	1784	744	644
20	0	1489	49	786	883	3919	1372	1266
21	1	3118	94	1120	1687	7572	1854	1273
22	3	4657	125	1512	2993	11791	2848	3018
23	12	5158	215	2213	3393	15300	4324	3688
24	48	4482	358	3103	4829	17669	6275	5080
25	194	4164	498	3957	5468	17333	9561	5596
26	1161	4026	748	5023	5758	13454	9047	4877
27	618	2926	787	4766	6746	10606	8600	4447
28	476	2227	751	3433	5199	10847	6591	2991
29	238	1556	762	2667	2630	5029	4500	2335
30	163	890	708	2001	1071	1752	3580	1650
31	174	511	635	1051	607	541	2652	1150
32	162	275	421	622	347	151	1626	749
33	103	67	304	65	166	17	905	461
34	61	0	107	1	64	5	617	236
35	34	0	92	0	0	1	55	68
36	19	0	9	0	0	0	27	0
37	10	0	5	0	0	0	0	0
38	5	0	3	0	0	0	0	0
39	3	0	2	0	0	0	0	0
40	1	0	1	0	0	0	0	0
41	1	0	1	0	0	0	0	0
42	0	0	1	0	0	0	0	0
43	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
Total	**3488**	**36762**	**6799**	**32820**	**43413**	**118937**	**65784**	**40032**
Weights	**49**	**333**	**99**	**371**	**451**	**1097**	**765**	**426**

Table 7.7.13c. *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh). Catches–length distributions in 2002–2009. Irish trawlers.

Total catches CL mm/Year	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0
11	0	0	1	0	0	0	0	0
12	0	0	1	0	0	0	0	0
13	0	0	1	0	19	0	0	0
14	0	19	2	0	38	40	0	0
15	0	84	3	0	206	0	35	25
16	0	68	5	35	138	153	70	0
17	0	171	15	35	243	200	181	178
18	0	263	21	167	368	772	320	300
19	33	624	97	282	579	1813	744	644
20	146	1758	89	987	1116	4387	1372	1393
21	214	4186	171	1782	2191	8173	1882	1440
22	656	5986	259	2300	4116	14151	3144	3584
23	1352	7728	460	3726	5727	23320	5582	5331
24	2291	6621	838	6356	9383	30802	9896	9287
25	2439	6637	1304	8645	11910	35475	16542	13001
26	3620	9841	2162	11777	15876	36158	21444	16402
27	3035	7296	2839	13051	19291	32827	18379	16778
28	3935	8871	3687	11944	18656	35329	21329	14735
29	3343	7130	4796	11977	15151	29046	18002	14954
30	3646	5992	5959	11879	12123	21258	18168	12515
31	4806	5752	6693	12315	8790	13322	15332	9780
32	4487	6183	6838	10898	7263	9168	14062	8983
33	4728	4443	6756	8824	5268	6412	11722	7192
34	4343	3841	6362	7188	3855	4013	10630	5930
35	3948	2637	4915	5946	2717	3310	9249	4715
36	2760	1808	3909	4696	1922	2573	6752	4032
37	2715	1440	3139	2743	1356	1757	4337	3397
38	2465	1372	2425	2796	906	1474	3548	3106
39	1631	1025	1618	2011	675	1148	2294	2569
40	1608	495	1072	1137	410	909	1713	1627
41	848	592	894	730	398	938	1606	1831
42	826	549	554	573	193	447	1192	864
43	475	414	366	305	152	481	726	797
44	438	203	234	186	135	142	470	517
45	300	110	156	41	82	148	297	240
46	183	131	72	163	32	138	123	293
47	126	167	107	27	69	64	40	137
48	195	70	61	68	18	50	81	169
49	121	77	51	0	16	89	207	40
50	29	40	14	41	5	0	165	51
51	18	60	10	0	0	0	61	29
52	18	24	7	0	13	0	41	68
53	0	0	12	0	0	24	0	43
54	18	0	6	0	0	0	0	171
55	18	0	6	0	0	0	0	86
56	0	0	3	0	0	0	0	171
57	18	10	19	0	0	0	0	57
58	18	0	3	0	0	14	0	86
59	0	0	8	0	13	0	0	57
60	18	0	1	0	0	0	0	86
61	0	0	1	0	0	0	0	71
62	0	0	0	0	0	0	0	43
63	0	0	0	0	0	0	0	29
64	0	0	0	0	0	0	0	57
65	0	0	0	0	0	0	0	14
66	0	0	3	0	0	0	0	0
67	0	0	1	0	0	0	0	0
68	0	0	1	0	0	0	0	14
69	0	0	3	0	0	0	0	14
70	0	0	1	0	0	0	0	14
71	0	0	1	0	0	0	0	0
72	0	0	3	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
Total	**61866**	**104715**	**69034**	**145627**	**151419**	**320525**	**221740**	**167947**
Weights	**1545**	**1721**	**1727**	**2762**	**2315**	**4311**	**4176**	**3271**

Table 7.7.13d. *Nephrops* in FUs 20–22 Celtic Sea (VIIfgh). Removals–length distributions in 2002–2009. Irish trawlers.

Removals=Landings+dead catches (discard survival rate : 25%)								
CL mm/Year	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	1	0	0	0	0	0
13	0	0	1	0	14	0	0	0
14	0	14	2	0	29	30	0	0
15	0	63	2	0	155	0	26	19
16	0	51	4	26	104	115	53	0
17	0	128	12	26	182	150	136	134
18	0	197	18	126	277	579	240	225
19	33	471	77	216	438	1367	558	483
20	145	1386	77	790	896	3407	1029	1076
21	214	3407	148	1502	1769	6280	1419	1122
22	655	4822	228	1921	3368	11203	2432	2830
23	1349	6438	406	3172	4879	19495	4501	4409
24	2279	5500	748	5580	8176	26385	8327	8017
25	2390	5596	1179	7656	10543	31142	14152	11602
26	3330	8834	1975	10521	14436	32795	19183	15183
27	2881	6564	2642	11859	17604	30176	16229	15666
28	3816	8314	3499	11085	17357	32618	19681	13988
29	3283	6741	4606	11310	14493	27789	16877	14370
30	3605	5769	5782	11379	11855	20820	17273	12102
31	4763	5625	6534	12052	8638	13187	14669	9492
32	4446	6114	6733	10743	7176	9131	13656	8796
33	4702	4426	6680	8808	5226	6408	11496	7077
34	4327	3841	6336	7187	3839	4012	10476	5871
35	3939	2637	4892	5946	2717	3309	9236	4698
36	2756	1808	3906	4696	1922	2573	6745	4032
37	2712	1440	3138	2743	1356	1757	4337	3397
38	2464	1372	2424	2796	906	1474	3548	3106
39	1630	1025	1617	2011	675	1148	2294	2569
40	1607	495	1072	1137	410	909	1713	1627
41	847	592	894	730	398	938	1606	1831
42	825	549	554	573	193	447	1192	864
43	475	414	366	305	152	481	726	797
44	438	203	233	186	135	142	470	517
45	300	110	156	41	82	148	297	240
46	183	131	72	163	32	138	123	293
47	126	167	107	27	69	64	40	137
48	195	70	61	68	18	50	81	169
49	121	77	51	0	16	89	207	40
50	29	40	14	41	5	0	165	51
51	18	60	10	0	0	0	61	29
52	18	24	7	0	13	0	41	68
53	0	0	12	0	0	24	0	43
54	18	0	6	0	0	0	0	171
55	18	0	6	0	0	0	0	86
56	0	0	3	0	0	0	0	171
57	18	10	19	0	0	0	0	57
58	18	0	3	0	0	14	0	86
59	0	0	8	0	13	0	0	57
60	18	0	1	0	0	0	0	86
61	0	0	1	0	0	0	0	71
62	0	0	0	0	0	0	0	43
63	0	0	0	0	0	0	0	29
64	0	0	0	0	0	0	0	57
65	0	0	0	0	0	0	0	14
66	0	0	3	0	0	0	0	0
67	0	0	1	0	0	0	0	0
68	0	0	1	0	0	0	0	14
69	0	0	3	0	0	0	0	14
70	0	0	1	0	0	0	0	14
71	0	0	1	0	0	0	0	0
72	0	0	3	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
Total	60994	95525	67335	137422	140565	290791	205294	157939
Weights	1533	1638	1702	2669	2202	4036	3984	3164

Table 7.7.14. *Nephrops* in VIIfgh. Mean sizes (carapace length, CL in mm) of French and Irish landings. For 2008 and 2009, French values are calculated (1) including the samples involving in tailed individuals and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire *Nephrops* at auction).

	French sampling			Irish sampling		
Year	Males	Females	Total	Males	Females	Total
1987	38.8	35.1	38.1			
1988	35.7	34.7	35.6			
1989	38.9	36.0	38.5			
1990	39.7	35.4	39.0			
1991	38.2	34.1	37.5			
1992	37.6	34.9	37.3			
1993	40.0	36.6	39.6			
1994	39.7	37.1	39.3			
1995	39.9	36.1	39.4			
1996	39.5	36.8	39.2			
1997	39.9	37.4	39.8			
1998	39.9	36.4	39.5			
1999	40.1	36.9	39.6			
2000	42.0	39.2	41.4			
2001	38.8	39.1	38.9			
2002	40.9	39.7	40.8	33.0	31.1	32.2
2003	41.5	39.8	41.4	31.1	29.1	30.2
2004	41.6	39.8	41.5	33.5	32.3	32.9
2005	43.1	40.3	42.8	30.9	30.8	30.9
2006	41.6	39.5	41.1	29.7	28.6	29.2
2007	40.7	38.7	40.4	29.3	27.3	28.5
2008	37.6	34.7	37.2	32.0	29.7	31.1
	40.1	39.6	40.1			
2009	39.0	34.5	38.6	31.8	28.8	30.8
	41.0	40.1	41.0			

Note: French values for the period 1999–2007 are provisional (they will be revised after validation of the revision for DLF including tailed *Nephrops*).

Table 7.7.15. ***Nephrops*** **in VIIfgh. French (year 1997) and Irish (years 2003, 2008 and 2009) programs of discard sampling onboard. Length distribution of landings (L) and discards (D) by sex (10[3]). The reported size is the carapace length (CL, in mm). Conversion of CL to TS (total size) is done by multiplication by 3.3.**

	French sampling (year 1997)						Irish sampling (year 2003)						Irish sampling (year 2008)						Irish sampling (year 2009)					
	males		females		Total		males		females		Total		males		females		Total		males		females		Total	
CL	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D
14										19		19												
15								10		74		84				35		35		25				25
16				1		1		10		58		68		35		35		70						
17								30		141		171				181		181		42		136		178
18				1		1	1	134	1	127	2	261		83		237		320		77		223		300
19		1				1	3	242	7	372	10	614		166		578		744		239		405		644
20		1		12		13	53	452	215	1038	269	1489		370		1002		1372		247	127	1019	127	1266
21				10		10	164	902	904	2216	1068	3118		988	28	866	28	1854	111	679	56	594	167	1273
22		187		294		481	472	1963	858	2693	1330	4657	98	1127	198	1721	296	2848	220	1182	346	1836	566	3018
23		630		1150		1780	1469	2503	1101	2655	2570	5158	195	1431	1063	2893	1258	4324	756	1610	887	2078	1643	3688
24		874		1172		2046	1251	2392	888	2091	2139	4482	1491	2022	2130	4253	3621	6275	2015	2235	2192	2845	4207	5080
25		1428		2490		3918	1209	2056	1264	2109	2473	4164	3058	2931	3923	6630	6981	9561	4121	2814	3284	2782	7405	5596
26		1439		1889		3328	3132	1631	2683	2396	5815	4026	5878	2971	6519	6076	12397	9047	5814	2316	5711	2561	11525	4877
27	15	4695		7332	15	12027	1978	1304	2392	1622	4370	2926	4798	3416	4981	5184	9779	8600	6595	2292	5735	2155	12331	4447
28	28	4399		6888	28	11287	3591	1030	3053	1196	6644	2227	8319	3258	6419	3333	14738	6591	6508	1644	5236	1347	11744	2991
29	45	3521		5089	45	8610	2568	723	3006	833	5574	1556	8292	2362	5209	2138	13502	4500	7532	1311	5087	1024	12619	2335
30	218	6863	19	9305	236	16167	2327	433	2775	457	5102	890	9274	1926	5314	1654	14588	3580	6985	1076	3879	574	10865	1650
31	521	3140	21	4821	542	7960	2977	300	2265	211	5241	511	7186	1431	5495	1221	12680	2652	5539	751	3091	399	8630	1150
32	1155	4842	65	6535	1220	11377	3570	166	2338	109	5908	275	7137	914	5299	712	12436	1626	5748	580	2486	169	8234	749

	French sampling (year 1997)						Irish sampling (year 2003)						Irish sampling (year 2008)						Irish sampling (year 2009)					
	males		females		Total		males		females		Total		males		females		Total		males		females		Total	
CL	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D
33	1984	3885	160	5140	2144	9025	2313	57	2063	9	4376	67	7181	585	3636	320	10817	905	4680	388	2051	73	6731	461
34	2035	1360	152	1384	2186	2744	2371		1470		3841		7008	332	3005	285	10013	617	4353	220	1341	16	5694	236
35	3251	1385	357	1254	3608	2639	1468		1168		2637		6570	55	2624		9194	55	3721	68	926		4647	68
36	3409	570	418	950	3827	1520	1108		700		1808		5201	27	1524		6725	27	3236		797		4032	
37	3799	410	464	333	4262	743	1056		384		1440		3430		906		4337		2864		533		3397	
38	4138	205	666	189	4804	394	1140		232		1372		2993		556		3548		2785		321		3106	
39	3395	72	224	85	3619	157	891		134		1025		1928		366		2294		2334		235		2569	
40	4713	120	205	64	4918	184	404		91		495		1526		187		1713		1411		216		1627	
41	2861	33	202	41	3062	74	572		20		592		1459		148		1606		1667		163		1831	
42	3367	43	47	34	3414	77	492		57		549		1114		78		1192		827		37		864	
43	2678	25	47		2725	25	386		29		414		650		76		726		766		32		797	
44	1787	8	63		1849	8	155		48		203		431		40		470		503		14		517	
45	2236	7	52	2	2288	9	110				110		297				297		226		15		240	
46	1428	1			1428	1	131				131		123				123		270		23		293	
47	1021				1021		167				167		40				40		137				137	
48	954	2	16		970	2	70				70		81				81		169				169	
49	603				603		77				77		207				207		40				40	
50	733	1			733	1	40				40		165				165		51				51	
51	353				353		60				60		61				61		29				29	
52	372				372		24				24		41				41		57		11		68	
53	286	3			286	3													43				43	
54	198				198														171				171	

	French sampling (year 1997)						Irish sampling (year 2003)						Irish sampling (year 2008)						Irish sampling (year 2009)					
	males		females		Total		males		females		Total		males		females		Total		males		females		Total	
CL	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D
55	110				110														86				86	
56	54				54														171				171	
57	81				81		10				10								57				57	
58	36				36														86				86	
59	8				8														57				57	
60	23				23														86				86	
61	8				8														71				71	
62	3				3														43				43	
63																			29				29	
64																			57				57	
65																			14				14	
66																								
67																								
68																			14				14	
68																			14				14	
70																			14				14	
	47 904	40 149	31 76	56 463	51 080	96 612	37 807	16 335	30 146	20 427	67 953	36 762	96 232	26 430	59 724	39 354	155 956	65 784	83 082	19 796	44 833	20 236	127 915	40 032
%D		46		95		65		30		40		35		22		40		30		19		31		24

Table 7.7.16. *Nephrops* in the Celtic Sea (FU20–22). Production by rectangle for French and Irish trawlers. The total by rectangle and the % involve in years 1999–2008 for French fleet and in years 2003–2009 for Irish fleet. Rectangles associated with the "Smalls" ground are highlighted in grey.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	%
						French trawlers							
28E1	78	75	127	207	246	164	191	212	375	362	Not yet available	2038	8%
28E2	146	350	331	287	363	259	296	214	189	252		2687	10%
29E1	105	182	302	535	653	353	277	258	398	354		3417	13%
29E2	129	287	205	204	249	261	371	423	240	223		2593	10%
30E1	121	170	205	437	374	205	179	104	106	146		2048	8%
30E2	293	424	434	741	806	781	577	773	437	661		5928	23%
31E3	847	1016	763	489	679	396	423	249	193	230		5285	20%
						Irish trawlers							
28E1				0	6	4	10	2	10	18	64	114	1%
28E2	0	3	1	1	2	23	15	6	2	6	72	131	1%
29E1	13	18	0	9	34	38	105	91	194	374	476	1,352	6%
29E2	1	2			1	11	19	24	31	23	67	179	1%
30E1	5	11	28	39	62	104	133	141	154	292	297	1,265	6%
30E2	3	4	3	2	5	36	52	99	69	147	151	570	3%
30E3	13	9	0	5	2	27	55	39	40	15	16	221	1%
31E2	39	45	53	49	37	56	68	49	101	61	59	615	3%
31E3	544	1165	1628	1103	941	1101	1571	1168	2392	2257	1549	15,419	69%
31E4	24	21	142	130	115	17	129	85	96	61	40	859	4%
32E3	86	195	222	130	185	211	231	145	126	156	53	1,740	8%

Table 7.7.17. Division VIIfgh. *Nephrops* effort and lpue data by country. The French data are calculated for otter trawlers getting at least 10% of their landings by targeting this species. The Irish data are linked to otter trawl vessels where >30% of monthly landings in live weight were *Nephrops*.

	Effort (Effective hours fishing)		lpue (kg/h)			
	France	Rep. of Ireland	France			Rep. of Ireland
Year	Otter	Otter	Total otter	Single Otter [1 3]	Twin otter [1 3]	Otter
1983	231440		14.2	14.2		
1984	204600		15.8	15.8		
1985	202830		16.0	16.0		
1986	162510		14.9	14.9		
1987	189580		15.2	15.2		
1988	170840		16.4	16.4		
1989	179060		16.8	16.8		
1990	229470		15.6	15.6		
1991	224710		11.3	11.3		
1992	276450		11.7	11.7		
1993	268410		13.2	13.2		
1994	258490		13.5	13.5		
1995	239240	26681	14.6	14.6		46.9
1996	220120	20579	14.2	14.2	14.2	50.0
1997	187180	23255	12.6	12.5	14.4	49.2
1998	155340	25380	13.0	12.9	14.9	53.1
1999	150770	15491	10.9	10.2	10.0	41.5
2000	194150	28267	13.8	11.5	11.4	47.8
2001	170320	36205	14.6	11.4	13.3	54.6
2002	165670	29990	18.7	15.4	16.7	44.3
2003	191600	28532	18.2	16.3	15.0	33.9
2004	152700	31309	15.8	13.5	12.9	32.8[4]
2005	146880	51031	16.0	13.0	13.2	41.3[4]
2006	136650	45383	16.3	14.4	12.8	34.9[4]
2007	101980	59899	18.5	15.9	14.3	48.1[4]
2008	99789	59875	22.6	18.4	16.4	53.8[4]
2009	na	55454[4]	na[5]	na[5]	na[5]	48.2

[1]The single and twin otter French lpue can be compared with the total otter indices until 1999 when the definition of the fishing effort of trawlers was changed (see note 2).

[2]For the period 1999–2008, the French statistics differentiate fishing effort calculated on the basis of the "number of fishing hours" from that deduced from the "number of use of a fishing gear".

[3]Information for single and twin trawl lpue involve in the total fishing fleet whereas aggregated indices are calculated for the otter trawlers getting at least 10% of their landings by targeting this species.

[4] Revised data (WGCSE2010).

[5] Not available.

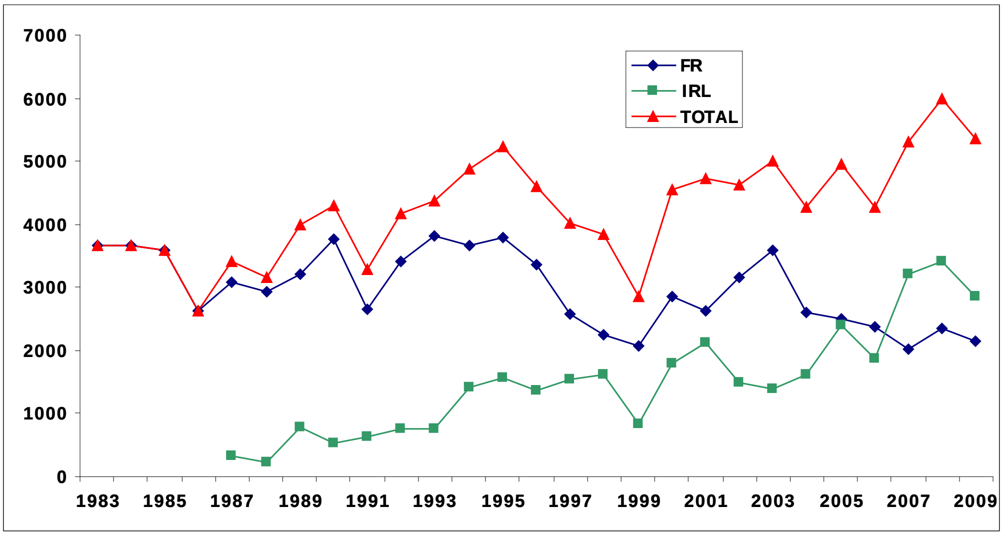


Figure 7.7.1. *Nephrops* in VIIfgh. Evolution of nominal landings (t).

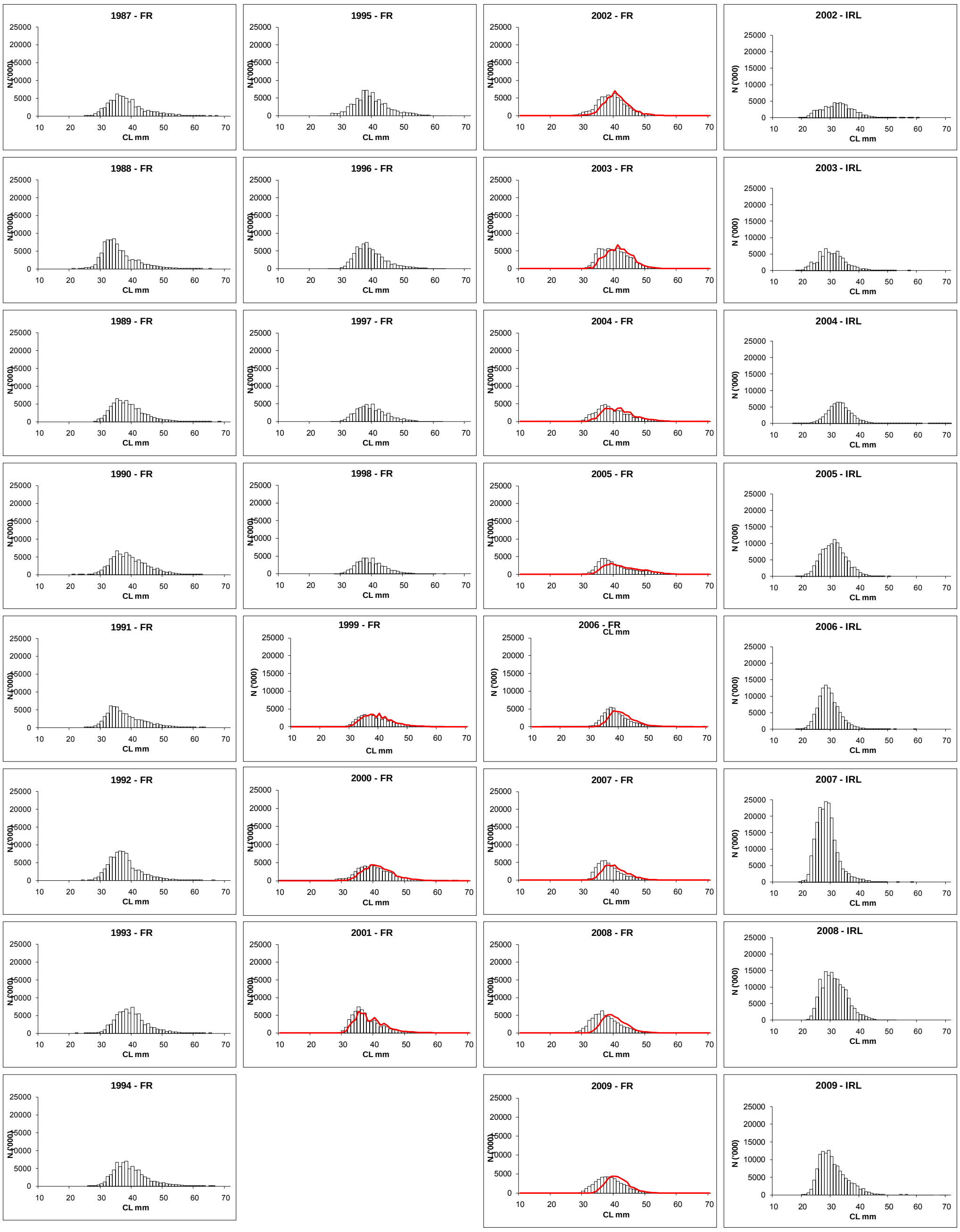


Figure 7.7.2. ***Nephrops*** **in FU 20–22 Celtic Sea (VIIfgh) landings of French trawlers (1987–2009) and of Irish trawlers (2002–2009). French landings since 1999 are presented by two ways: (1) Lines: previous method (tails not sampled and systematically apportioned in the smallest category of entire** ***Nephrops*** **at auction).(2) Bars: tails are included (years 1999–2007: simulation; since 2008: sampled data).**

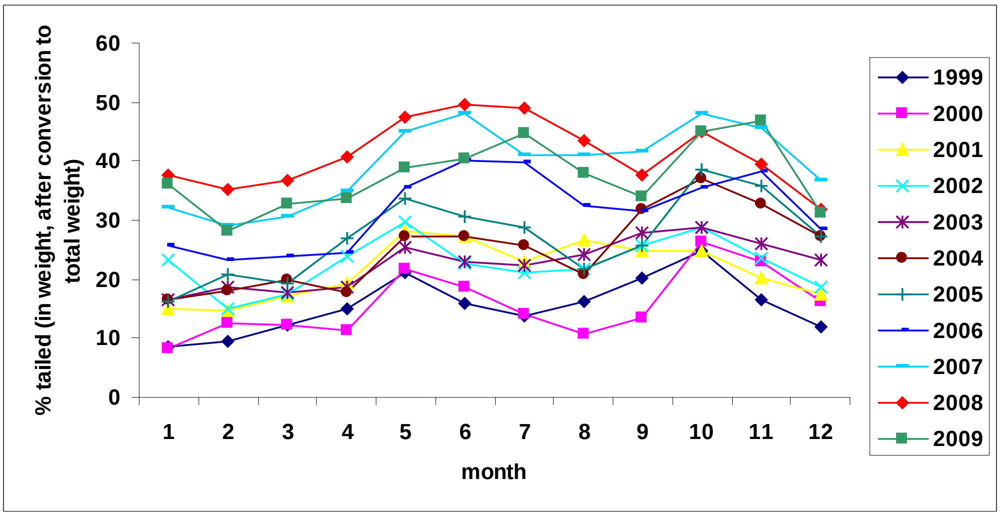


Figure 7.7.3. ***Nephrops*** **of the Celtic Sea (VIIfgh, FU20–22). Years 1999–2009. Monthly percentages of tailed individuals in the French landings (after conversion to total weight).**

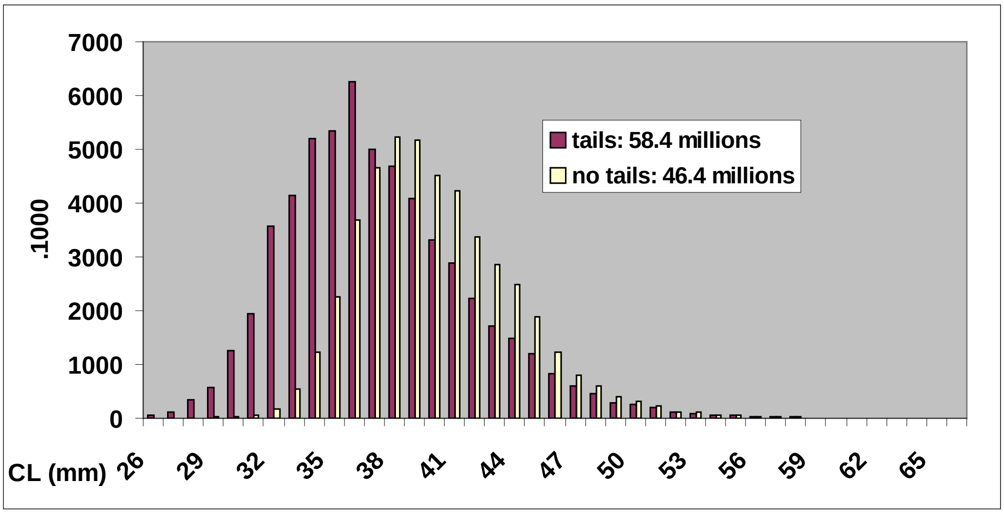


Figure 7.7.4. ***Nephrops*** **of the Celtic Sea (VIIfgh, FU20–22). French landings for 2008. Length distributions (1) including the data on tails and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire** ***Nephrops*** **at auction).**

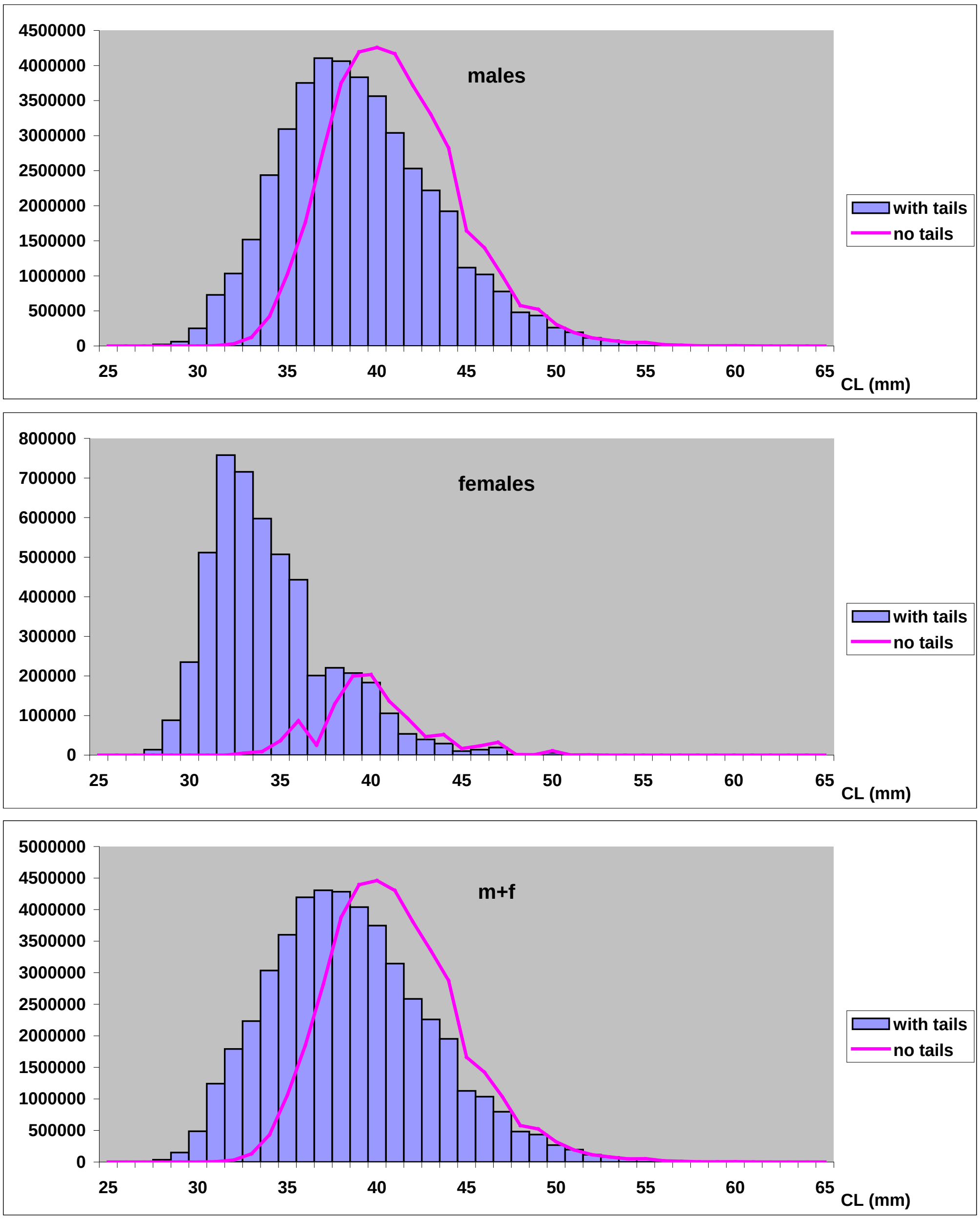


Figure 7.7.5. ***Nephrops*** **of the Celtic Sea (VIIfgh, FU20–22). French landings for 2009 by sex. Length distributions (1) including the data on tails and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire** ***Nephrops*** **at auction).**

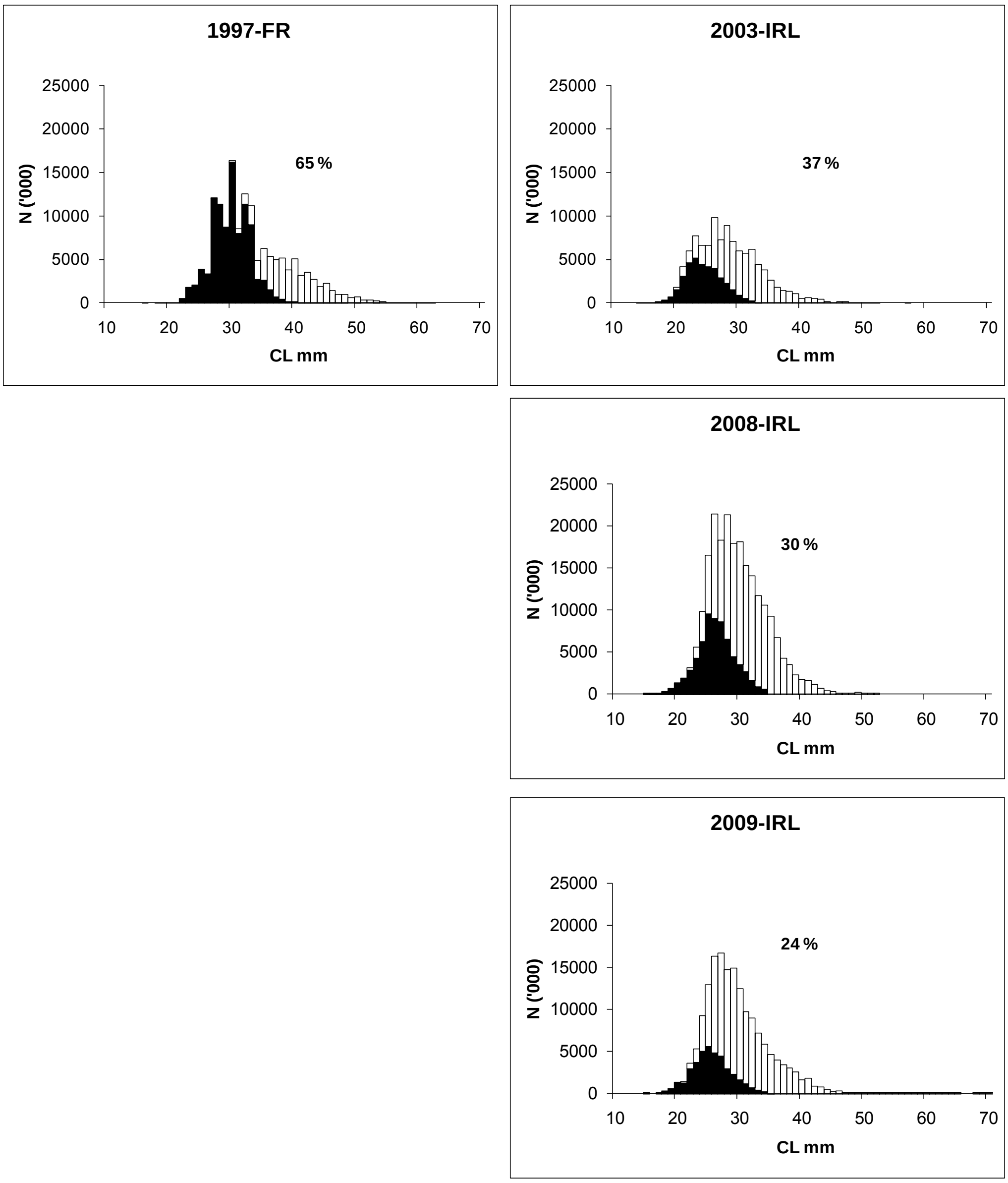


Figure 7.7.6. ***Nephrops*** **in FU 20–22 Celtic Sea (VIIfgh). Years with complete set of discard samples: French data (1997), Irish data (2003, 2008 and 2009). Landings in white, discards in black.**

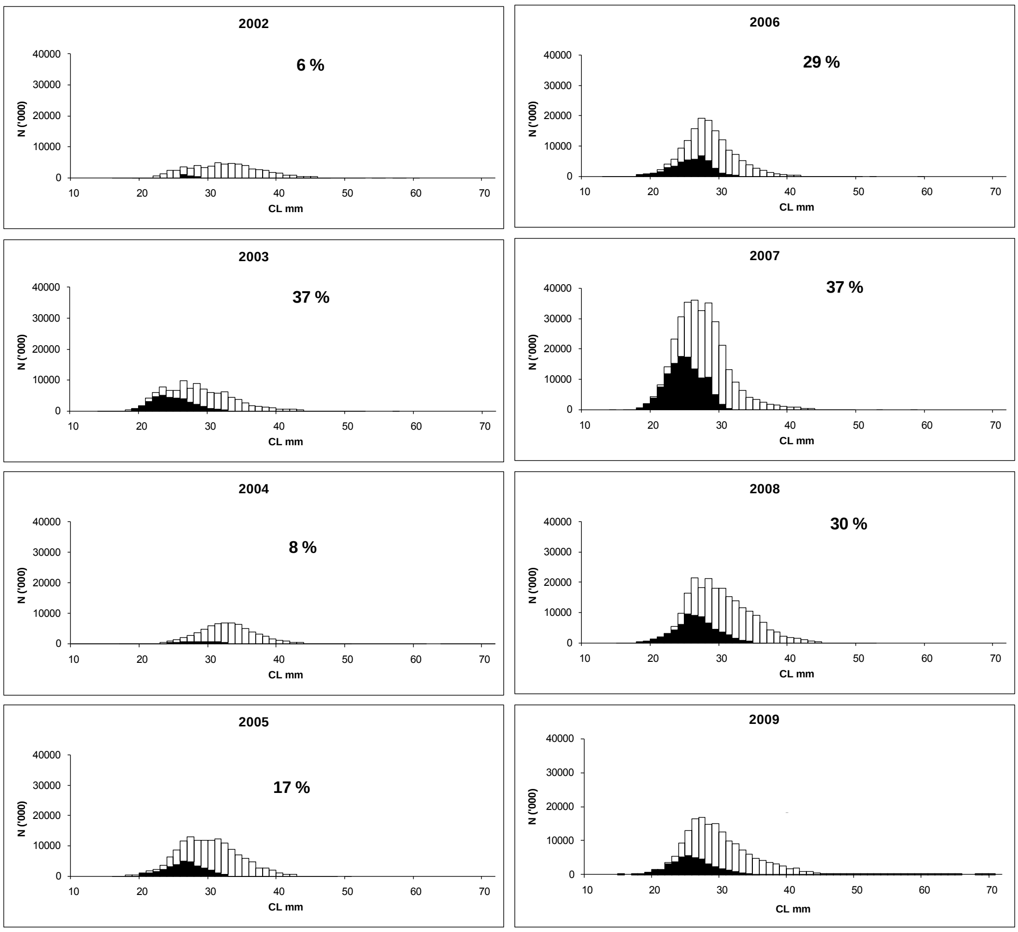


Figure 7.7.7. ***Nephrops*** **in FU 20–22 Celtic Sea (VIIfgh). Catches (landings in white and discards in black) of the Irish fleet. Length distributions in 2002–2009.**

Ground	Year	Number of stations	Mean Density (No./M2)	Domain Area (m2)	Geostatistical abundance estimate (million burrows)	CV on Burrow estimate
	2006	100	0.62	2847	1914	3%
	2007	107	0.46	2915	1402	6%
	2008	76	0.47	2698	1448	6%
Smalls	2009	67	0.47	2824	1421	5%

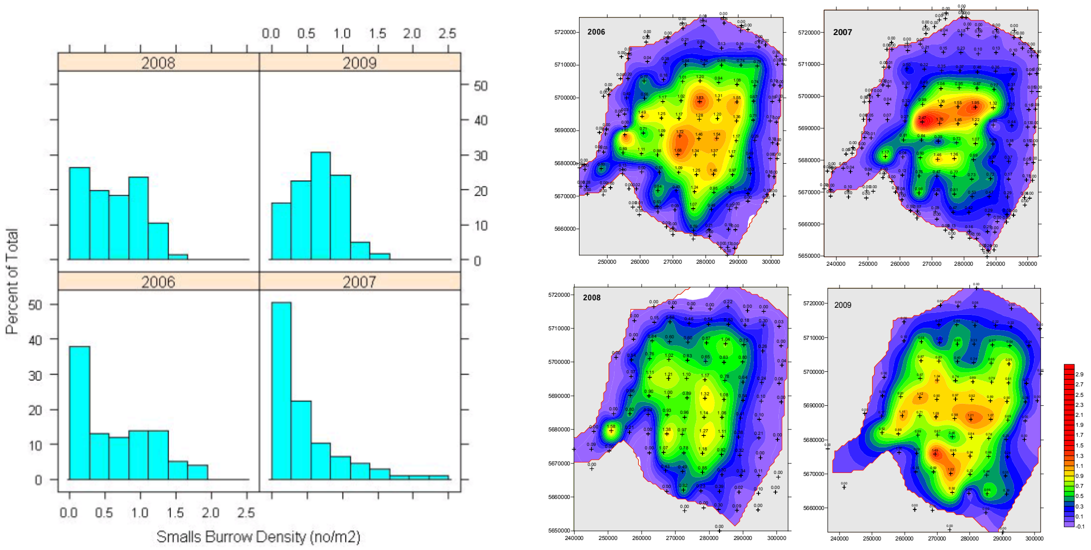


Figure 7.7.8. ***Nephrops*** **in the Celtic Sea (FU 20–22).Summary of geostatistics results 2006–2009 of the Irish UWTV survey carried out on the Smalls ground (ICES statistical rectangle 31E3) and contour plots of burrow densities.**

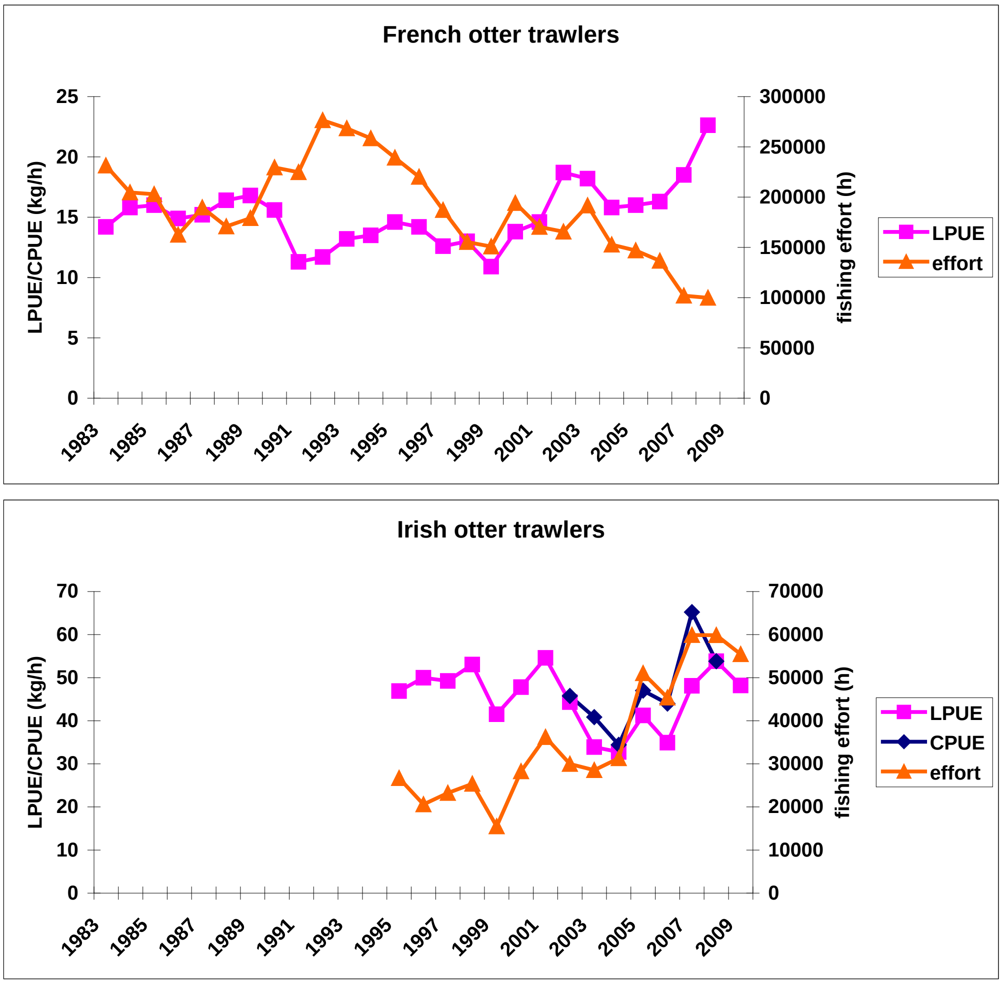


Figure 7.7.9. ***Nephrops*** **in VIIfgh. Lpue and fishing effort series for French and Irish fleet. The cpue indices are calculated by including discard sampling onboard. For French data, calculations of discards based on the derivation method (performed by WGSSDS 2006–2008; see Stock Annex) were not re-validated after revision of landings by including tailed individuals, thus, they are not presented.**

7.8 *Nephrops* in Divisions VIIjg (South and SW Ireland, FU19)

Type of assessment in 2010

ICES is providing new advice for this stock this year so the Report consists of an update to available data.

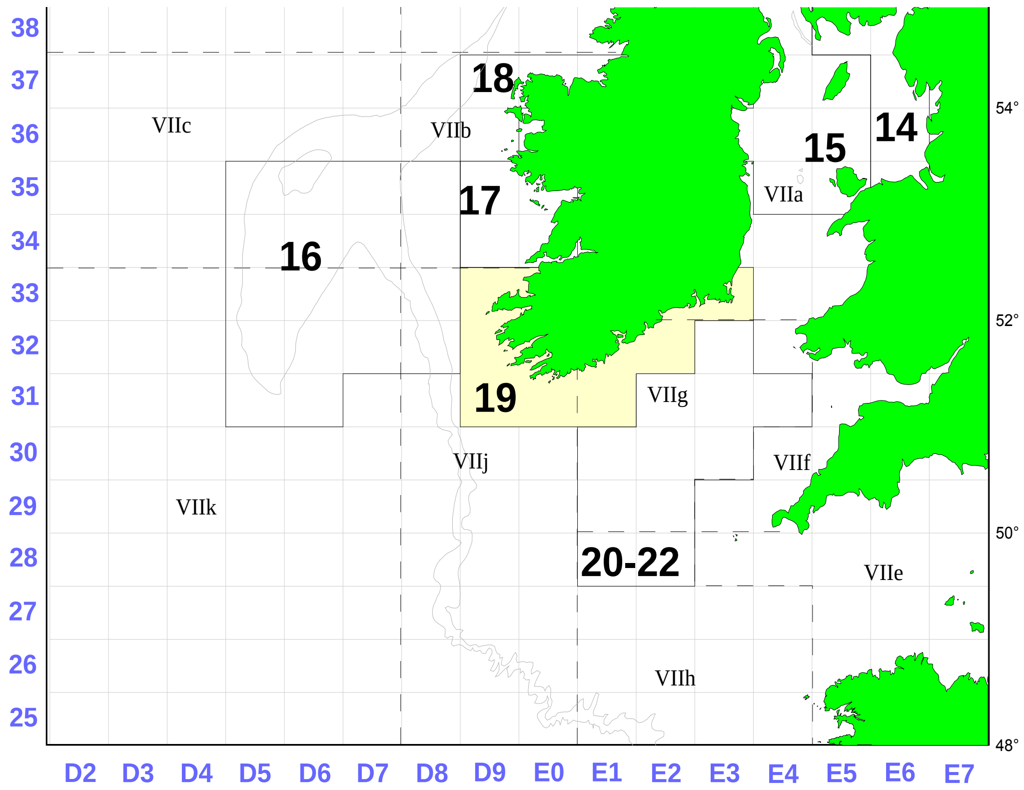
ICES advice applicable to 2009 and 2010

The current fishery appears sustainable. Therefore, ICES recommends that *Nephrops* fisheries should not be allowed to increase relative to 2007. This corresponds to landings of no more than 800 tonnes for the Ireland SW and SE Coast (FU19).

7.8.1 General

Stock description and management units

In FU19 *Nephrops* are caught on a large number of spatially discrete small inshore grounds and on some larger grounds further offshore Figure 7.8.1. Of these the 'Galley ground', around the Kinsale Gas Rigs and south of Cork appear to be the most important.



A map of the spatial distribution of FU19 is given in the FU includes *Nephrops* within the following ICES statistical rectangles; 31–33 D9–E0; 31E1; 32E1–E2; 33E2–E3.

7.8.2 Fishery description

The number of Irish vessels reporting landings in this area has increased from 28 in 2000 to 82 in 2009. Of these, only 14 reported landings in excess of 10 t and these 14 vessels accounted for 64% of the total landings. Fleet segmentation data shows that the *Nephrops* métiers in this area also have important catches of megrim and monkfish. There are also some catches of hake and the offshore parts of FU19 which is an important nursery area for juvenile hake. The Irish fleet fishing *Nephrops* in FU19 was described in detail in the 2001 WG Report (ICES, 2001a). The minimum mesh size in use is 70 mm, with the average being 80 mm. French trawlers harvesting *Nephrops* on this area fish also in the Celtic Sea (FU20) and switch to the FU19 according to meteorological conditions. They have used mesh size 100 mm for codend since January 2000 (in order to not be constrained by bycatch composition) and they apply MLS of 11.5 cm (i.e. 35 mm CL) adopted by French Producers' Organizations larger than the European one (8.5 cm i.e. 25 mm CL). However, the increasing proportion of tailed individuals in French landings (as for FU20) may shift DLF for *Nephrops* to smaller sizes compared with previous years. In 2009, 20 French trawlers reported landings from FU19, but only three exceeded 5 tonnes. 24 French vessels were recorded in 2008, 31 in 2007, 30 in 2006 and 35 in 2005.

7.8.3 Data

The sampling level for the species is given in Table 2.1.

7.8.4 Commercial catches and discards

Landings data for FU19 are summarised in Table 7.8.1. The Republic of Ireland, France and the UK report landings for FU19. The Republic of Ireland landings have fluctuated considerably throughout the time-series, with a marked dip in 1994 (Figure 7.8.2). The highest landings in the time-series were observed in 2002–2004 (>1000 t). Landings in 2005 and 2006 have been below average for the series. In 2009 landings decreased by approx. 1% for the Irish fleet but were above the series average. Landings by the French fleet have fluctuated with a declining trend throughout the time-series from the highest value in 1989 of 245 t to 55 t in 2009. Landings from the UK are minor.

Effort and lpue data are available for the Irish *Nephrops* directed fleet in FU19 from 1995–2009 (Table 7.8.2, Figure 7.8.4.2). The effort increases substantially in 2002 this is in part due to the inclusion of smaller vessels (10–18 m) in the dataset. These vessels did not record logbook operations prior 2002. The lpue and effort-series is based on the same criteria for FU16 and 17 and will be contingent on the accuracy of landings data reported in logbooks. The lpues have fluctuated between 15–30 kg/hr with a slightly declining trend. The lpues are lower than that of other FUs reflecting the smaller size of the vessels and generally more mixed nature of this fishery.

For FU18 landings information from 1993 was available to the WG only. The Republic of Ireland has taken 100% of the landings for the last seven years. The highest reported landings were in 1994 with 124 t landings in recent years have been minor (10 t in 2009).

7.8.5 Biological sampling

Length frequency data of the landings were collected on an irregular basis in the years 1996 to 1997, 1999 and 2002 to 2006. Spatial and temporal coverage is also problematic with landings from FU19 coming from several discrete grounds. In 2005 length frequency data are only available for quarters 2 and 3. The length frequencies for the remaining quarters have been derived by raising those length frequencies observed to the quarter 1 and 4 landings figures.

The dataseries of the mean sizes of *Nephrops* in the landings of Irish trawlers is too short and inconsistent to draw definite conclusions (Table 7.8.3 Figure 7.8.4). The mean size of males varied between 29 and 41 mm CL, and for females between 26 and 40 mm CL. There is a decrease in mean size for males and females in 2009. However, the dataseries is too short to provide useful information on the state of the stock.

It should be noted that due to the change in sampling methodology from 2001 onwards the profile of the length frequencies has changed as a result of inclusion of smaller individuals from the discard component.

7.8.6 Information from surveys

The UK March groundfish survey has been carried between 1984 and 2004. This survey was examined in 2006 and there is a slight indication of a decline in mean sizes of *Nephrops* compared with those observed in the late 1980s. In 2006 some UWTV stations were carried out within FU19 as part of the Celtic Sea UWTV survey (which mainly targets FU20–22). The heterogeneous distribution of *Nephrops* and sediment in FU19 will make accurate UWTV survey abundance estimate difficult to obtain on a regular basis.

7.8.7 Assessment

A much improved and longer historical time-series of data is needed to carry out analytical assessment of this stock. Although sampling of this stock is required under the EU data collection regulation it is difficult to obtain precise length frequency data at the spatial resolution required to assess *Nephrops* in such a heterogeneous area where several small discrete fisheries occur. Future assessments would benefit from a higher spatial resolution of landings and effort data (possibly from VMS as in Figure 7.8.1). Fishery independent methods such as UWTV surveys may also be useful for this FU in the future.

7.8.8 Management considerations

The time-series of lpue data based on logbook data for FU19 is short and variable but is without an obvious trend. Reported landings in 2009 have been around 4% above series average.

Nephrops fisheries in this area are fairly mixed also catching megrim, anglerfish and other demersal species. There are also some catches of hake, and the offshore parts of the area. The *Nephrops* grounds in FU19 coincide with an important nursery area for juvenile hake and anglerfish among other species (ICES, 2009).

ICES has repeatedly advised that management should be at a smaller scale than the ICES Subarea VII. Management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort are at the same scale as the resource. A time-series of landings by all FUs in ICES Subarea VII together with the overall TAC is shown in Table 7.8.4. (Note that national quotas for Ireland and the UK are restrictive in most of the recent years).

7.8.9 References

ICES. 2009. Review of the Biologically Sensitive Area/Irish Box. http://www.ices.dk/committe/acom/comwork/report/2009/Special%20Requests/EC%20Irish%20box.pdf.

Table 7.8.1. *Nephrops* in FU18 and FU19 (NW, SW and SE Ireland). Landings in tonnes by country and Functional Unit.

Year	FU 18		
	Rep. of Ireland	UK	Total
1989			
1990			
1991			
1992			
1993	9	1	10
1994	124	2	126
1995	24	2	26
1996	46	1	46
1997	13	2	15
1998	77	1	78
1999	15	0	16
2000	9	0	9
2001	2	0	2
2002	14	0	14
2003	16	0	16
2004	22	0	22
2005	15	0	15
2006	14	0	14
2007	3	0	3
2008	1	0	1
2009	10	0	10

FU 19			
France	Rep. of Ireland	UK	Total
245	652	2	899
181	569	4	754
212	860	5	1077
233	640	15	888
229	672	4	905
216	153	21	390
175	507	12	695
145	736	7	888
93	656	7	756
92	733	2	827
77	499	3	579
144	541	11	696
111	702	2	815
188	1130	0	1318
165	1075	0	1239
76	997	1	1074
62	648	2	711
65	675	1	741
63	894	0	957
46	805	15	866
55	764	15	833

Table 7.8.2. *Nephrops* in FU19 (SW and SE Ireland). Irish *Nephrops* directed effort hrs and lpue, 1993–2009.

Year	Irish Fleet		
	Nephrops trawlers (>30% landings weight)		
	Effort hrs	Landings Tonnes	LPUE Kg/hr
1995	9126	206	22.5
1996	9295	220	23.7
1997	9604	248	25.8
1998	15775	386	24.5
1999	13345	206	15.4
2000	9329	178	19.1
2001	9701	309	31.8
2002	25565	764	29.9
2003	28887	621	21.5
2004	26554	529	19.9
2005	23848	455	19.1
2006	24272	460	19.0
2007	30361	665	21.9
2008	25101	573	22.8
2009	22797	527	23.1

Table 7.8.3. *Nephrops* in FU19 (SW and SE Ireland). Mean time-series for catches and landings.

Year	Catches		Landings <35mm CL		Landings >35mm CL	
	Males	Females	Males	Females	Males	Females
1995	na	na	na	na	na	na
1996	34.5	31.3	31.1	29.7	38.7	38.8
1997	34.6	32.9	31.2	30.9	39.8	38.4
1998	na	na	na	na	na	na
1999	38.5	35.4	31.8	31.2	41.3	39.1
2000	na	na	na	na	na	na
2001	na	na	na	na	na	na
2002	30.4	28.8	29.7	28.8	39.9	40.5
2003	33.1	29.4	31.1	30.0	38.4	38.0
2004	32.8	28.8	32.0	30.2	39.8	37.7
2005	31.3	27.5	29.1	26.9	38.4	37.0
2006	34.4	31.7	31.4	30.4	38.9	37.7
2007	35.6	33.2	32.4	31.7	39.1	38.2
2008	36.2	33.1	32.5	31.6	38.9	38.1
2009	33.9	29.2	31.2	29.8	39.3	37.4
na = not available						

Table 7.8.4 *Nephrops* in VII summary table of landings by Function Unit and outside FU for TAC Area VII.

Year	FU 14 – Irish Sea East	FU 15 – Irish Sea West	FU 16 – Porcupine Bank	FU 17 – Aran Grounds	FU 18 – Ireland North West Coast	FU 19 – Ireland South West and South East coast	Fus 20+21+22 – All Celtic Sea FUs combined	Other statistical rectangles Outside FUs	Total Landings ICES Sub-area VII	TAC for VII
1978	961	7,296	1,744	481				249	10,730	
1979	900	8,948	2,269	452				237	12,807	
1980	730	4,578	2,925	442				205	8,880	
1981	829	7,249	3,381	414				382	12,255	
1982	869	9,315	4,289	210				234	14,917	
1983	763	9,448	3,426	131			3,667	174	17,609	
1984	602	7,760	3,571	324			3,653	187	16,097	
1985	498	6,901	3,919	207			3,599	194	15,317	
1986	671	9,978	2,591	147			2,638	113	16,138	
1987	449	9,753	2,499	62			3,409	107	16,279	24,700
1988	462	8,586	2,375	828			3,165	140	15,557	24,700
1989	401	8,128	2,115	344		899	4,005	134	16,026	26,000
1990	563	8,300	1,895	519		754	4,290	102	16,423	26,000
1991	747	9,554	1,640	410		1,077	3,295	169	16,892	26,000
1992	427	7,541	2,015	372		888	4,165	409	15,816	20,000
1993	515	8,102	1,857	372	10	905	4,648	455	16,863	20,000
1994	447	7,606	2,512	729	126	390	5,143	570	17,523	20,000
1995	584	7,796	2,936	866	26	695	5,505	397	18,805	23,000
1996	475	7,247	2,230	525	46	888	4,828	623	16,862	23,000
1997	566	9,971	2,409	841	15	756	4,240	340	19,138	23,000
1998	388	9,128	2,155	1,410	78	827	3,925	514	18,426	23,000
1999	624	10,786	2,289	1,140	16	579	2,943	322	18,699	23,000
2000	567	8,370	911	880	9	696	4,689	243	16,365	21,000
2001	532	7,441	1,222	913	2	815	4,771	368	16,064	18,900
2002	577	6,793	1,327	1,154	14	1,318	4,673	243	16,099	17,790
2003	376	7,052	907	933	16	1,239	5,002	186	15,712	17,790
2004	472	7,266	1,525	525	22	1,074	4,268	161	15,314	17,450
2005	570	6,529	2,312	778	15	711	4,946	180	16,042	19,544
2006	628	7,535	2,120	637	14	741	4,264	270	16,210	21,498
2007	959	8,424	2,186	1,096	3	957	5,300	206	19,130	25,153
2008	726	10,482	1,000	1,057	1	841	6,001	322	20,430	25,153
2009	693	9,166	825	625	10	833	5,359	107	17,619	24,650
2010										22,432
Average	612	8,220	2,231	619	25	852	4,311	268	16,158	

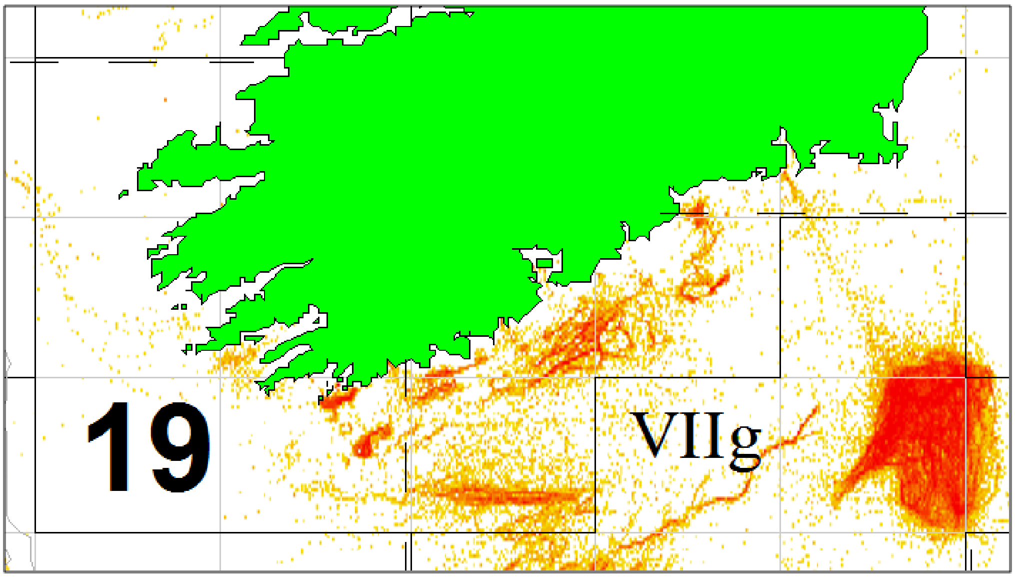


Figure 7.8.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). The spatial distribution of the fishery of the Irish Fishery from VMS data.**

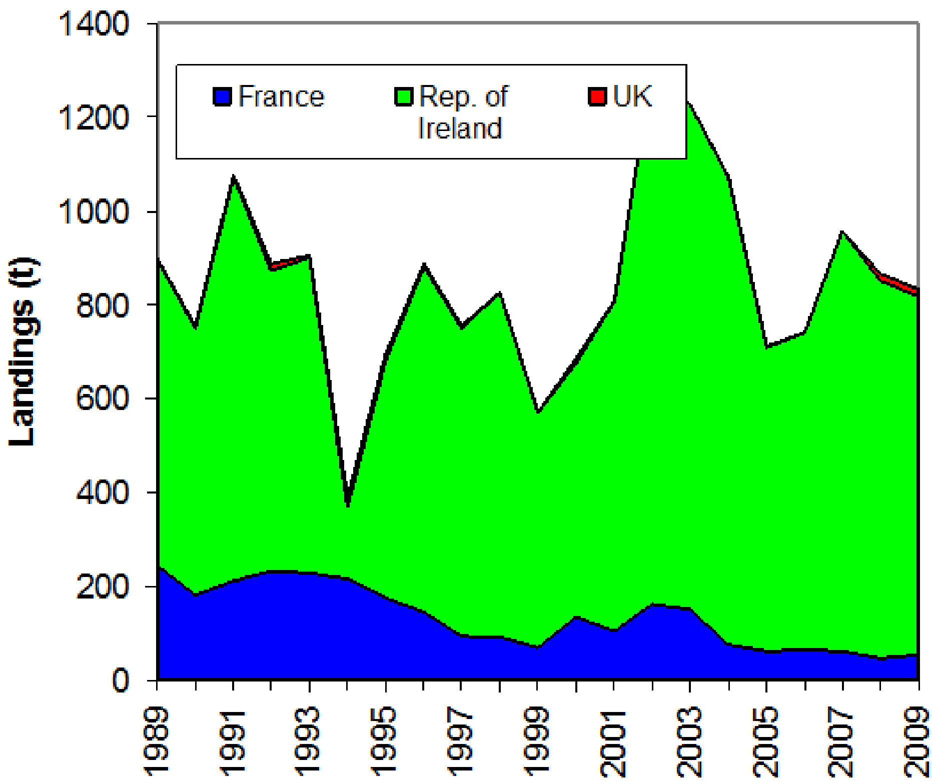
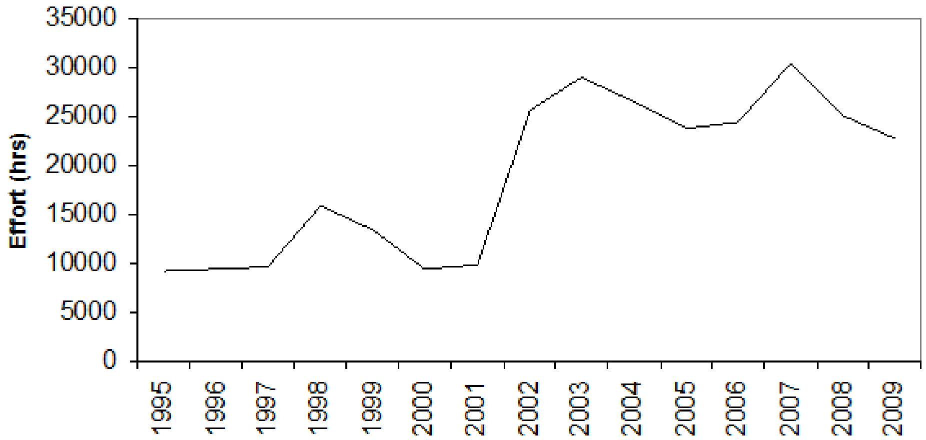


Figure 7.8.2. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Landings in tonnes by country.**



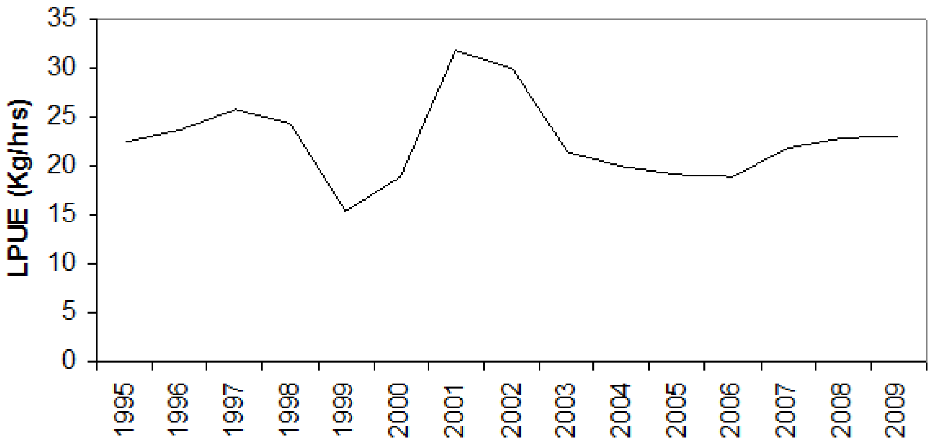


Figure 7.8.3. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Trawl effort for Irish OTB vessels where >30% of landed weight was** ***Nephrops*****. Trawl lpue for Irish OTB vessels where >30% of landed weight was** ***Nephrops*****.**

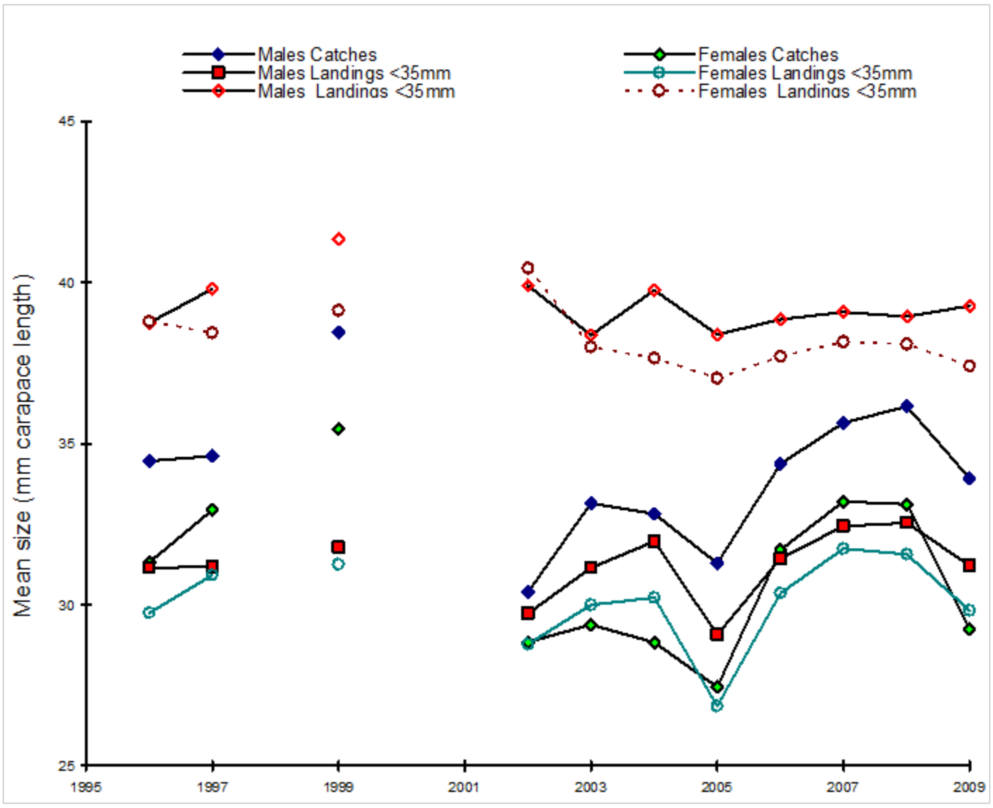


Figure 7.8.4. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean size trends for catches and whole landings by sex.**

7.9 Plaice in West of Ireland Division VII b, c

Type of assessment in 2010

No assessment was performed.

7.9.1 General

Stock Identity

Plaice in VIIb are mainly caught by Irish vessels on sandy grounds in coastal areas. Plaice catches in VIIc are negligible. There are two distinct areas in which plaice are caught by Irish vessels in VIIb: an area to the west of the Aran Islands and an area in the north of VIIb which extends into VIa (the Stags Ground). During 1995–2000 a large proportion of the VIIbc plaice landings were taken from the Stags Grounds (Rectangles 37D8, 37D9, 37E0 and 37E1). The landings and lpue in this area have dropped sharply since 2000, in line with a general decrease of lpue in Division VIa. The landings and lpue on the Aran grounds appear to have been more or less stable since the start of the logbooks time-series in 1995 (WD 1, WGCSE 2009). It is not known how much exchange there is between plaice on the Aran grounds and those on the Stags ground.

7.9.2 Data

The nominal landings are given in Table 7.9.1.

Table 7.9.1. Landings of plaice in VIIbc as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Denmark	-	-	-	-	-	-	2	-	-	-	-	-	-
France	60	45	10	9	4	16	6	12	9	8.00	37	2	10
Ireland	124	106	153	133	135	122	117	142	135	122	108	110	150
Spain	-	-	-	-	-	-	-	65	58	22	7	-	-
UK - Eng+Wales+N.Irl.	.	.	.	.	.	.	.	.	.	.	.	.	.
UK - England & Wales	1	1	-	-	-	-	-	-	4	4	-	3	7
UK - Scotland	-	-	-	-	-	-	-	-	-	-	-	3	-
Total	185	152	163	142	139	138	125	219	206	156	152	118	167

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-
France	11	13	9	1	11	9	3	2	1	5	1	3	-
Ireland	114	153	157	159	130	179	180	191	200	239	248	206	160
Spain	-	-	-	-	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N.Irl.	.	.	.	1	2	-	6	1	2	1	2	-	1
UK - England & Wales	5	1	2	.	.	.	.	.	.	.	.	.	.
UK - Scotland	-	-	-	13	90	3	3	2	3	1	-	-	-
Total	130	167	168	174	233	191	192	196	206	246	251	209	161
Unallocated											-11	4	22
WG estimate											240	213	183

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Denmark	-	-	-	-			.				
France	.	31	8	17	7	14	12	11	12	9	
Ireland	157	99	70	51	56	39	25	20	23	21	20
Spain	-	-	-	2				1		1	
UK - Eng+Wales+N.Irl.	-	-	-	2		0	0	0			
UK - England & Wales	.	.	.	.							
UK - Scotland	2	-	-	-	0						
UK											
Total	159	130	78	72	63	53	37	31.6	35.3	31	20
Unallocated	13	-22	9	-1	9	2	1	-1	-1	4	
WG estimate	172	108	87	71	72	55	38	30	34	35	

7.10 Plaice in Divisions VIIf,g (Celtic Sea)

Type of assessment in 2010

Update, no changes to the assessment.

ICES advice applicable to 2010

ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that a 50% reduction in F is needed to increase SSB to around B_{pa} *in 2011. This corresponds to landings of less than 330 t in 2010.*

ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary considerations: a 75% reduction in F is needed to increase SSB to around B_{pa} *in 2010. This corresponds to landings of less than 170 t in 2009.*

7.10.1 General

Stock description and management units

A TAC is in place for ICES Areas VIIf&g which corresponds to the stock area.

Management applicable to 2009 and 2010

TACs and quotas set for 2009

Species: Plaice *Pleuronectes platessa*		Zone: VIIf and VIIg (PLE/7FG.)
Belgium	59	
France	107	
Ireland	200	
United Kingdom	56	
EC	422	
TAC	422	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TACs and quotas set for 2010

Species: Plaice *Pleuronectes platessa*		Zone: VIIf and VIIg (PLE/7FG.)
Belgium	67	
France	120	
Ireland	201	
United Kingdom	63	
EU	451	
TAC	451	Analytical TAC

Fishery in 2009

The main fishery is concentrated on the Trevose Head ground off the north Cornwall coast and around Land's End. Although plaice are taken throughout the year, heaviest landings are in March, after the peak of spawning, with a second peak in September. The fisheries taking plaice in the Celtic Sea mainly involve vessels from Belgium, France, England and Wales. In 2008 Belgium reported 50% of officially reported landings, the UK 17%, France 17%, and Ireland the remaining 17%. In 2009, officially reported French data were not available; of the landings reported Belgium reported 58%, the UK 15% and Ireland 17%. The WG estimated total international landings for 2009 were 463 t, 10% above the TAC (420 t) and 21% below the *status quo* prediction given by last year's assessment (580 t).

Although the current assessment indicates a decline in F in recent years, it is unclear as to whether this is linked to the Trevose Head spring fishery closure. Discards are considered to be significant but are presently not quantified.

7.10.2 Data

Landings

National landings data and estimates of total landings used by the WG are given in Table 7.10.1. Minor revisions were reported to landings data for 2008.

Discards

Indications are that discard rates, although variable, may be substantial in some fleets/periods. Total raised discard information is available for some fleets, and data raised to sampled vessels for others, but the WG has not yet been able to analyse these data. For this update assessment, discard data were excluded pending a more thorough examination at the next Benchmark Workshop. All references to 'catch' (e.g. 'catch weights-at-age, etc.) therefore relate to landings only.

Data from 2009 discard sampling programmes are summarized in Figures 7.10.3a and b.

Biological

Annual length compositions for 2009 are given in Table 7.10.4, and length compositions for UK (E+W) landings for the last ten years are presented in Figure 7.10.4.

Following minor revisions to landings data for previous years (see above), the international age compositions and weights-at-age have been amended.

Quarterly age compositions for 2009 were available for Belgium, Ireland and UK (E+W), representing approximately 72% of the total landings. Methods for the derivation of international catch numbers-at-age and for the calculation of catch and stock weights-at-age are fully described in the Stock Annex, Section B.1 and B.2.

Parameter estimates for the in-year smoothing of catch and stock weights in 2009 are as follows:

$$Wt = 0.012Age^2 - 0.092Age + 0.447 \qquad (R^2 = 0.91)$$

Catch weights-at-age are plotted as mid-year, and stock weights-at-age are interpolated from the fitted curve at 1 January. The catch and stock weights-at-ages 1 and 2 for 2008 and 2009 exhibited bias due to the application of the quadratic smoother, they were modelled as being heavier than ages 3 and 4. In order to correct the bias average weights-at-age over the years 2002–2007 were used for ages 1 and 2 in 2008 and 2009.

The age compositions of landings for the last 10 years are shown in Figure 7.10.5. Catch numbers and weights-at-age in the catch and stock as used for the assessment are given in Tables 7.10.5–7.10.7. As in previous assessments, numbers-at-age 1 have been replaced by zero values; see Section B.1 in the Stock Annex.

A natural mortality estimate of 0.12 was applied to all ages and to all years, as previously. The maturity ogive used in this update assessment was derived in 1997 and was applied to all years. Further details of the derivation of these can be found in Section B.2 of the Stock Annex.

Surveys

Indices of abundance from the UK (BTS-Q3) beam trawl survey in VIIf and the Irish Celtic Explorer IBTS survey (IBTS-EA-4Q) are presented in Table 7.10.8. The UK (E&W) data indicate relatively strong 1994 and 1999 year classes. The Celtic Explorer IBTS survey-series started in 2003 and is not yet included in the assessment.

Figure 7.10.6 presents the log UK (BTS-Q3) cpueUE indices by year and year class, the log catch curves for each cohort and the gradient of the catch curves used as an indication of total mortality trends. The plots illustrate the historical consistency of year class estimates from the survey, with less agreement in recent years.

Commercial cpue

Commercial tuning indices of abundance from the UK (E&W) beam trawl and otter trawl data are presented in Table 7.10.9. Figures 7.10.7a and b presents the log commercial cpue indices by year and year class, the log catch curves for each cohort and the gradient of the catch curves used as an indication of total mortality trends. The plots illustrates the historical consistency of year class estimates from the commercial data throughout the time-series for the beam trawls with more noise resulting from two major year effects in the otter trawl data.

Effort and lpue data were available for the UK (E+W) beam trawl, UK (E&W) otter trawl, Irish otter trawl, beam trawl and seine fleets, Belgian beam trawl and the UK September beam trawl survey (Tables 7.10.2, 7.10.3 and Figures 7.10.1, 7.10.2).

Commercial lpue data appear to show a general pattern of steep decline since the high levels in the early 1990s, with a further decline in recent years. There was an increase in 2007 and 2008 for beam trawlers in VIIf and a smaller increase in 2007 and 2008 for otter trawlers in VIIg east but the levels returned to the recent low levels in 2009.

UK (E&W) beam trawl effort levels have declined in both VIIf and VIIg from the high levels observed in 1999–2001; effort in VIIf in 2009 was at the lowest level since 1983. UK (E&W) otter trawl effort levels for VIIf and VIIg have shown a general decline since 1990, increased in VIIf after 2000 and have been relatively stable since 2003.

Irish otter trawl effort has steadily increased since 1999, while beam trawl show a less pronounced increase over the time-series prior to 2008, with a decrease in 2008 and 2009; the Irish seine fleet shows only a weak downward since 2003.

Other relevant data

Other than the rectangle closures, there were no early closures of the fishery for plaice in 2009. There is relatively little information on the level of landings misreporting on this stock, although it is not considered to be a problem. Reports from industry suggest that the main issues affecting the fishery in VIIf&g are displacement of effort due to the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W.

7.10.3 Stock assessment

Section 1.4.1 outlines the general approach adopted at this year's Working Group meeting, and the specific approach for this stock is given in the Stock Annex.

Data screening

A separable analysis was carried out to screen the catch-at-age data; no anomalies were apparent (results are available in the 'Exploratory runs' folder).

Final update assessment

The commercial tuning data available, and the subset used in the assessment, are given in Table 7.10.9. No exploratory XSA runs were carried out for this update assessment.

Final settings, used since 2005, are detailed below:

		2009 XSA		
Fleets	UK-CSBT	90–09		4–8
UK-CSOT		89–-09		4–8
UK-BCCSBTS-S		90–09		1–5
Taper			No	
Taper range				-
Ages catch dep. Stock size				1–5
Q plateau				7
F shrinkage se				2.5
year range				5
age range				4
Fleet threshold se				0.5
Age range				1–9+
Age 1 catch numbers			Set to zero	
F_{bar} age range				3–6

XSA diagnostics from the final run are given in Table 7.10.10 and log catchability residuals plotted in Figure 7.10.8. Survivor estimates for ages 4 and above are reasonably consistent between fleets. The standard error threshold operates on the commercial fleet data, maintaining relatively even weighting up to age 5, after which the survey contribution sharply declines reflecting the lack of data for older ages. The survey contributes around 40% of the weight to estimates of survivors at age 1, with the remainder coming from P-shrinkage. At ages 2 and 3 the survey provides around 65% of the weighting. F-shrinkage is negligible throughout.

The residuals for the UK beam trawl survey (Figure 7.10.8) show apparent cohort and age effects, in contrast to the commercial data sets for older ages. The Working Group considers this to be due to the heavy discarding of the youngest age classes, resulting in these fish being absent from commercial data. The survey estimates of these age classes are probably a true reflection of their strength within the fishery. There are some year effects apparent in the otter trawl fleet data, but these are relatively small.

The retrospective analysis (Figure 7.10.9) shows a historical tendency to underestimate terminal F values, and to overestimate SSB, recent estimates are based in the same direction but more consistent. There is a pattern of overestimating recruitment, which is likely to result from discarding causing overestimation of the future landings numbers at the youngest ages and partly due to the use of population shrinkage, which will tend to bias recruit estimates towards the mean during periods of low recruitment. Recent estimates of recruitment have been more stable from year to year.

Fishing mortalities and population numbers from the final XSA run are given in Tables 7.10.11 and 7.10.12 and the summary in Table 7.10.13. Fishing mortality in 2009 is estimated to have been at 0.41, which is the lowest in the time-series. SSB in 2009 is estimated at 1128 t above B_{lim} (1100 t) for the first time since 2001. However, the retrospective analysis suggests that this estimate of SSB is likely to be an overestimation.

Comparison with previous assessments

The current assessment suffers from a retrospective pattern, when compared with results from previous assessments, which is evident in SSB, fishing mortality and recruitment (Figure 7.10.13).

State of the stock

A summary of the time-series of XSA results is given in Table 7.10.13 and Figure 7.10.10. Fishing mortality has fluctuated without trend since 1977 but has declined since 2004. The most recent value should be viewed with caution as the retrospective pattern implies that these may be revised upwards in next year's assessment.

SSB rose to a high level throughout the 1980s, as a result of a series of above-average recruitments, but has declined since 1990. SSB is estimated to have been below B_{pa} (1800 t) since 1996, and SSB was below B_{lim} (1100 t) between 2002 and 2008. In 2009, SSB is estimated to be 1128 t, at B_{lim}, but this initial estimate is typically revised downward by ~10% in the following year's assessment due to the retrospective pattern present in the stock (Figure 7.10.9).

With the exception of the 1994 year-class, all recruitments-at-age 1 since 1992 have been below the long-term arithmetic average (4.4 million).

7.10.4 Short-term projections

Estimating year-class abundance

The XSA estimate of the 2007 year class (2.2 million 1 year olds in 2008) has been revised downwards from last year's estimate (2.9 million). The 2008 year class is estimated at 3.0 million 1 year olds in 2009; the sources of this estimate are detailed in the table below. Recruitment estimates for subsequent years were derived from a short-term geometric mean ($GM_{1989-08}$, 2.8 million).

Working Group estimates of year-class strength used for prediction can be summarised as follows:

Recruitment-at-age 1:

Year class	Thousands	Basis	Surveys	Commercial	P Shrinkage
2007	2191	XSA	65%	-	35%
2008	3021	XSA	44%		56%
2009	2815	GM (89–08)			
2010	2815	GM (89–08)			

The input values for the catch forecast (using the MFDP software) are given in Table 7.10.14. The F at age values used were calculated as the mean of the XSA values from 2007–2009, unscaled. Catch and stock weights-at-age were also the mean of the period 2007–2009. Stock numbers-at-age in 2009 for ages 2 and older were obtained from the XSA. SSB values are calculated for 1 January.

Table 7.10.15 gives the management option table from the *status quo* catch prediction, and short-term results are shown in Figure 7.10.12. Assuming *status quo* F (F_{sq} = 0.44) implies landings of 539 t in 2010 and 556 t in 2011. (The TAC for 2010 is 451 t.). SSB is predicted to remain stable at 1300 t in 2010 and 1350 t in 2011, increasing to 1400 t in 2012. These results are discussed further in Section 7.10.10.

The detailed output for the *status quo* F forecast by age group is given in Table 7.10.16, and the estimated contributions of recent year classes to the predicted catches and SSBs are given in Table 7.10.17. The assumptions of $GM_{1989-08}$ recruitment are predicted to contribute 7% to the landings in 2011 and 28% to SSB in 2012.

The stock and recruitment scatterplot is given in Figure 7.10.11; it should be recalled that the unknown mortality from discarding would have an impact on the stock–recruitment relationship. It is noteworthy that recruitment is strongly auto-correlated for this stock such that there is a dominant recruitment - SSB relationship rather than stock and recruitment; recruitment has exhibited strong and weak series at high stock biomass.

The recruitment of Celtic Sea plaice and neighbouring stocks appear to respond to negatively to sea temperature anomalies (Fox *et al*., 2000). However, compared with fisheries on some other species (e.g. cod), those on plaice are less dependent on the incoming year class. Therefore, the incorporation of temperature data into plaice stock dynamic models will probably not have a large impact on short-term projections, but may allow medium to long-term forecasts to be made under varying environmental scenarios.

7.10.5 Maximum sustainable yield evaluation

The VIIf&g plaice times-series of assessment stock and recruit estimates, fishing mortality-at-age (average of the most recent three year), catch and stock weights (10 year averages), maturity and natural mortality-at-age were used to estimate proxies for the fishing mortality biomass and landings at maximum sustainable yield (F_{msy}, B_{msy} and MSY) within the srmsymc program. The sen and sum input data files are presented in Tables 7.10.19 and 7.10 .20.

Three stock and recruit models are fitted by the program, Ricker, Beverton and Holt and the smooth hockey stick Figures 7.10.13–7.10.16. Based on the A.I.C. all models have an equal fit to the available data. The estimates of F_{crash}, F_{msy}, B_{msy} and MSY are presented with their percentiles and coefficients of variation in Table 7.10.21. Figure 7.10.17 illustrates the uncertainty in yield-per-recruit curve, with estimates also presented in Table 7.10.21.

Each model assumes that there is a relationship between increasing levels of recruitment and increasing spawning–stock. However, as shown in Figure 7.10.11 and, as discussed in the previous section, for VIIfg plaice recruitment has exhibited strong autocorrelation and the dominant determinant of recruitment is likely to be environmental conditions rather than the level of SSB.

The link to environmental control of recruitment and independence from SSB would suggest the use of yield-per-recruit fishing mortality reference levels as appropriate. However, as shown by Figure 7.10.17 the form of the YPR curve is poorly determined and the estimates of $F_{0.1}$, $F_{35/40\%}$SPR have high cv, with F_{max} poorly determined (Table 7.10.21).

For all stock and recruit relationships, yield is forgone at levels of fishing mortality below the estimates of $F_{0.1}$ and $F_{35\%}$ and as F increases yield is maximised at 0.19 for the Beverton and Holt model, 0.36 for the Ricker model and 0.34 for the smooth hockey stick. All of the estimates of F_{msy} are below the 5th percentiles of F_{crash} (0.53, 0.57, 0.43 respectively).

Estimates of F_{msy} differ between the assumptions for the stock and recruitment dynamics of plaice in VIIfg, each are equally plausible and there is no way of distinguishing between them. Consequently WGCSE consider that fishing mortalities in the range 0.19–0.36 are consistent with maximising long-term yield for plaice in VIIfg.

Yield-per-recruit analysis

Results for deterministic yield and SSB per recruit (using program MFYPR), conditional on the recent exploitation pattern, are given in Table 7.10.18 and Figure 7.10.12. F_{max} is given by a reference F of 0.35, around 80% of F_{sq}. Long-term yield and SSB (at F_{sq} and assuming GM_{89-08} recruitment = 2.8 million) are given as 610 t and 1538 t respectively.

7.10.6 Precautionary approach reference points

The Working Group's current approach to reference points is outlined in Section 1.4.4. Current reference points are detailed below.

F_{lim}	No proposal		
F_{pa}	No proposal		
B_{lim}	1100 t	Basis	B_{loss} (B78, WG98)
B_{pa}	1800 t	basis	B_{lim} . exp(1.645*0.3)

SSB is currently below B_{pa} and at F_{sq} will remain below B_{pa} in the short term.

B_{loss} (1010 t, 1978) is considered stable. The estimate of SSB in 1978 has not been revised in the last nine assessments of this stock. Further details can be found in Section G of the Stock Annex. A general discussion on target reference points is given in Section 1.

7.10.7 Management plans

There is no management plan for Celtic Sea plaice.

This WG has in the past provided a number of scenarios for potential management plans for Celtic Sea plaice (ICES, 2006). The analyses indicated that an F in the range 0.25 to 0.56 would be sustainable in terms of maintaining the stock above B_{pa}. The range was also considered consistent with sustainable fishing for VIIfg sole. The range of fishing mortalities estimated within the MSY framework overlap with the lower portion of the previous management plan range due to the requirement to maximise yield

7.10.8 Uncertainties in assessment and forecast

Sampling

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches, and associated CVs of some national catch-at-age datasets are available in the Stock Annex**.** The sampling levels for those countries supplying information are given in Table 2.1.

Discards

Estimates of discarding are not included in this assessment. However, data from discard sampling indicates that rates are high for this stock in some seasons/fleets (Figures 7.10.3a, b) and their non-inclusion may represent a major deficiency in the assessment. The composition of the fleets and therefore the gear types employed in the fishery show fluctuations over time, so it is likely that the discard rates observed in the fishery now are not applicable to periods earlier in the time-series. From 2003 onwards, discard sampling for Ireland, Belgium, France and UK (E&W) has been improved under the Data Collection Regulation.

Consistency

The trends and estimates of fishing mortality, SSB and recruitment in this assessment are consistent with last year's assessment (Figure 7.10.13). Last year's assessment estimated F in 2008 at 0.365; this year it has been revised upwards to 0.41. Last year's assessment estimated SSB in 2008 to be 1243 t; this estimate has been revised downwards to around 1063 t this year.

Misreporting

Misreporting has been considered a potential problem for this stock in earlier years. However, misreporting of catches across ICES Divisions is thought to be minor. The *status quo* forecast indicates landings around 20% in excess of the TAC for 2010. It should be noted that even though total reported landings for this stock in recent years have been below the TAC, fleets may be restricted by their individual quota allocation.

7.10.9 Recommendation for next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2009	VIIf,g Plaice	Biological interactions with adjacent stocks; in particular Irish Sea plaice (Dunn and Pawson, 2002) The lack of discard data in the assessment The need to review the tuning data included in the assessment as additional survey data are becoming available and the age ranges of all tuning datasets should be re-inspected Need to reconsider the assessment model setting being used as the power model is only indicated by one of the fleets There is also a retrospective bias in SSB, F and recruitment, which should be examined Review the new maturity data, which has become available from sampling carried out under the EU DCR	2011	Expert Group members

7.10.10 Management considerations

The SSB of this stock is estimated to have been below B_{lim} (1100 t) since 2002, but the SSB is now estimated to have been 1128 t in 2009. However, the retrospective plot indicates that this is expected to be revised downwards next year by ~10%. The *status quo* catch forecast implies that SSB will continue rise above B_{lim} to 1300 t in 2010, 1350 t in 2011 and 1400 t in 2012, assuming GM_{89-08} recruitment levels. Despite the use of a recent GM recruitment level, catch forecasts in recent years have been overly-optimistic, e.g. last year's forecast indicated landings of 580 t in 2009, whereas the landings value used by the WG this year was 463 t. The level of fishing mortality in the last three years appears to have been at the lowest level for the time-series, which is consistent with the reductions in effort in the beam trawl fleets. Landings in 2010 are this year predicted to be 540 t, well above the TAC of 450 t.

The high level of discarding indicated for some fleets in this fishery would suggest a mismatch between the mesh size employed in the fishery and the size of the fish being landed on the market. Increases in the mesh size of the gear should result in fewer discards and ultimately, in increased yield from the fishery. The results of studies presented to the 2004 WG (ICES, 2004) indicate that this would also benefit the sole VIIf,g stock without decreasing sole landings in the long term.

Regulations and their effects

Technical measures in force for this stock are minimum mesh sizes, minimum landing size, and restricted areas for certain classes of vessels. Technical regulations regarding allowable mesh sizes for specific target species, and associated minimum landing sizes, came into force on 1 January 2000 (Section 2.1). The minimum landing size for plaice in Divisions VIIf,g is currently 27 cm.

Since 2005, ICES rectangles 30E4, 31E4, and 32E3 have been closed during the first quarter (Council Regulations 27/2005, 51/2006, 41/2007, 40/2008, 43/2009 and 2010) with the intention of reducing fishing mortality on cod. There is evidence that this closure has redistributed effort to other areas. Many vessels (particularly beam trawlers from the UK and Belgium) fished close to the borders of the closed rectangles during the closure, and fished intensively inside the rectangles when they were reopened. Information from the UK shows that plaice can be caught in areas outside of the closed area with the same catch rates. Fishing mortality has decreased since 2005, and the closure may have been one of the contributing factors.

References

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ICES, 2004. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 29 June–8 July 2004, Oostende, Belgium. ICES CM 2005/ACFM:03. 543 pp.

Table 7.10.1. Plaice in Divisions VIIf&g. Nominal landings (t) as reported to ICES, and total landings as used by the Working Group.

National landings as estimated by the working group 1977 - 1985; as reported to ICES and total landings as used by the working group 1986 onwards

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	214	196	171	372	365	341	314	283	357	665	581	617	843	794	836	371
UK (Engl. & Wales)	150	152	176	227	251	196	279	366	466	529	496	629	471	497	392	302
France	365	527	467	706	697	568	532	558	493	878	708	721	1089	767	444	504
Ireland	28	0	49	61	64	198	48	72	91	302	127	226	180	160	155	180
N. Ireland												1				
Netherlands										9						
Scotland	0	0	0	7	0	0	0	0	0	1				1		5
Total	757	875	863	1373	1377	1303	1173	1279	1407	2384	1912	2194	2583	2219	1827	1362
Unallocated	0	0	0	0	0	0	-27	-69	345	-693	-11	-78	-432	-137	-326	-174
Total as used by WG	757	875	863	1373	1377	1303	1146	1210	1752	1691	1901	2116	2151	2082	1501	1188

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	542	350	346	410	594	540	371	224	241	248	221	212	168	172	194	187	216
UK (Engl. & Wales)	290	251	284	239	258	176	170	134	136	105	127	87	55	88	61	63	55
France	373	298	254	246	329	298		287	262	186	165	145	132	106	104	62	N/A
Ireland	89	82	70	83	78	135	115	76	45	79	51	45	44	48	58	63	63
N. Ireland																	
Netherlands																	
Scotland	9	1	2														
Total reported	1303	982	956	978	1259	1149	656	721	684	618	564	489	399	414	417	375	N/A
Unallocated	-189	88	72	-26	-42	-82	312	-3	30	24	30	21	-13	-10	-7	62	N/A
Total as used by WG	1114	1070	1028	952	1217	1067	968	718	714	642	594	510	386	404	410	437	463

N/A Not available

Table 7.10.2. Plaice in Divisions VIIf&g. Lpue for UK (E&W) fleets.

	LANDINGS PER UNIT EFFORT (LPUE)						LANDINGS/EFFORT DATA				ADDITIONAL EFFORT DATA			
	RECT. GROUP VIIf (grp 1)		RECT. GROUP VIIg EAST (grp 2)		RECT. GROUP VIIg WEST (grp 3)		RECT GROUP VIIf (grp1)				VIIg (East)		VIIg (West)	
							otter trawl catch		Beam trawl catch		Otter	Beam	Otter	Beam
YEAR	TRAWL	BEAM TRAWL	TRAWL	BEAM TRAWL	TRAWL	BEAM TRAWL	tonnes	000s hr fished	tonnes	000s hr fished	000s hr fished	000s hr fished	000s hr fished	000s hr fished
1972	7.70		4.97		1.15		361.82	45.72			6.01		0.74	
1973	7.54		2.75		34.92		353.95	45.28			3.59		0.05	
1974	4.99		1.22		0.00		198.12	38.94			2.03		0.00	
1975	4.88		4.07		0.75		173.01	33.53			10.35		0.04	
1976	4.54		2.70		2.13		112.09	25.61			5.21		0.04	
1977	4.06		1.76		0.00		102.81	27.16			5.36		0.04	
1978	4.19	3.06	2.24	0.00	0.00	0.00	117.74	27.08	7.58	2.50	6.73	0.00	0.00	0.00
1979	5.31	3.62	3.34	2.19	0.00	0.00	125.81	23.84	6.30	1.96	4.54	0.13	0.00	0.00
1980	5.91	4.27	4.03	7.15	2.46	0.00	162.29	26.43	17.65	4.31	2.67	0.10	0.60	0.00
1981	5.36	3.50	3.20	3.13	1.05	5.23	126.27	24.10	23.72	6.24	7.78	0.78	4.78	0.10
1982	4.82	5.10	1.14	6.73	0.06	5.57	92.65	19.20	55.42	9.95	7.50	1.86	2.56	0.58
1983	6.05	3.92	2.66	5.24	0.00	4.88	108.76	17.61	47.72	12.35	5.33	6.82	0.00	0.80
1984	6.15	6.41	4.90	7.49	0.00	4.14	160.64	23.16	99.01	13.55	4.35	4.31	0.00	2.06
1985	6.98	6.38	5.09	8.05	2.61	7.10	188.06	25.24	146.73	18.69	5.72	5.14	0.57	1.41
1986	6.62	5.22	4.28	10.62	1.44	11.31	142.84	21.18	90.44	20.72	7.72	4.31	0.82	0.68
1987	6.60	4.32	6.46	10.79	0.86	10.66	199.03	24.43	145.37	38.76	9.87	4.83	0.83	0.92
1988	10.04	8.53	7.32	9.95	1.97	14.42	205.56	20.09	204.58	25.62	9.96	2.18	0.43	0.88
1989	7.40	5.63	6.36	9.67	4.35	16.42	130.67	17.61	96.05	20.26	8.13	3.72	0.25	0.26
1990	4.16	3.93	2.43	6.80	2.70	5.34	97.82	22.56	157.15	30.77	10.55	4.89	0.45	4.32
1991	2.87	3.58	2.22	2.83	1.17	2.94	56.52	18.57	193.27	40.81	6.25	12.39	0.91	2.52
1992	2.78	2.26	2.32	2.54	1.68	2.08	44.82	16.00	91.34	35.78	5.22	16.61	8.42	2.59
1993	2.72	2.84	1.43	2.28	1.77	1.41	38.14	13.79	107.43	39.64	4.43	18.44	0.94	2.73
1994	2.71	2.47	2.18	3.07	0.83	4.14	23.36	9.48	84.97	37.03	3.03	9.48	0.24	1.94
1995	2.93	2.66	2.23	3.34	3.35	2.22	26.38	8.46	96.28	37.59	2.61	11.60	0.46	2.16
1996	2.63	2.05	1.91	1.84	0.38	0.77	23.60	8.67	81.18	39.78	4.60	8.70	1.68	3.91
1997	2.41	1.90	1.89	2.33	1.30	0.48	20.47	8.14	83.68	43.00	5.18	12.67	1.90	2.56
1998	1.59	1.54	1.24	0.93	0.33	0.69	10.94	7.13	85.06	47.84	5.09	10.45	1.55	2.81
1999	2.59	1.63	1.99	0.67	0.35	0.68	11.99	5.69	85.44	50.87	1.97	26.00	3.86	5.47
2000	2.29	1.00	3.10	0.68	0.19	0.60	10.98	4.05	53.46	51.19	2.56	17.53	2.34	3.36
2001	2.25	1.07	2.53	0.87	0.32	0.68	9.78	4.42	53.31	49.32	2.71	19.95	2.68	1.55
2002	1.31	1.14	3.70	1.49	0.54	0.27	6.81	6.10	37.93	37.53	1.54	6.19	2.49	0.93
2003	1.67	1.17	0.82	1.25	0.29	0.09	15.83	9.94	47.73	40.71	0.55	11.87	1.73	2.40
2004	1.28	1.16	0.93	0.51	0.18	0.22	12.44	9.42	40.06	32.37	3.03	14.25	2.03	2.42
2005	0.81	0.75	0.13	0.51	0.01	0.07	9.5	12.09	22.25	27.73	0.30	9.57	2.35	1.67
2006	1.53	0.88	0.47	0.91	0.05	0.03	19.78	12.97	13.99	18.57	0.31	10.48	3.47	1.16
2007	1.07	1.95	1.45	0.85	0.1	0.56	11.85	10.66	18.10	15.37	0.41	6.79	3.49	0.19
2008	1.27	2.95	1.69	0.8	0.01	0.1	13.21	10.13	18.80	13.83	1.58	3.84	3.65	0.08
2009*	1.02	1.39	0.81	1.07	0.09	0.09	8.23	8.97	8.97	12.23	3.43	3.48	4.38	0.71

* Provisional

Table 7.10.3. Plaice in Divisions VIIf&g. Lpue and effort for Irish and Belgian fleets in VIIf,g.

	IR-OTB-7G			IR-SCC-7G		
Year	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**
1995	94.23	63.56	1.48	9.55	6.43	1.49
1996	133.66	60.04	2.23	14.20	9.73	1.46
1997	119.84	65.10	1.84	38.79	16.13	2.40
1998	96.72	72.30	1.34	21.38	14.94	1.43
1999	60.05	51.66	1.16	10.40	8.01	1.30
2000	28.78	60.60	0.47	11.40	9.90	1.15
2001	23.82	69.43	0.34	10.93	16.33	0.67
2002	42.30	77.69	0.54	16.42	20.86	0.79
2003	26.35	86.79	0.30	13.80	20.91	0.66
2004	26.62	96.99	0.27	5.04	19.38	0.26
2005	22.78	124.40	0.18	6.46	14.81	0.44
2006	24.58	118.36	0.21	5.10	14.79	0.34
2007	30.38	135.41	0.22	4.76	15.81	0.30
2008	39.17	125.81	0.31	8.38	11.65	0.72
2009	43.09	135.18	0.32	7.87	8.15	0.97

	IR-TBB-7G			IR-GN-7G		
Year	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h)**
1995	37.92	20.78	1.83	0.90	4.33	0.21
1996	53.02	26.76	1.98	1.35	5.51	0.24
1997	94.59	28.25	3.35	1.17	1.51	0.78
1998	122.13	35.25	3.46		0.00	
1999	25.80	40.87	0.63	0.48	5.47	0.09
2000	12.62	37.03	0.34	2.54	7.03	0.36
2001	4.80	39.71	0.12	0.30	4.46	0.07
2002	7.08	31.62	0.22	0.36	5.86	0.06
2003	9.37	49.26	0.19	0.20	10.97	0.02
2004	6.17	54.86	0.11	0.33	12.05	0.03
2005	9.49	49.65	0.19	0.12	10.89	0.01
2006	14.40	60.35	0.24	0.09	7.76	0.01
2007	20.35	54.85	0.37	0.32	8.83	0.04
2008	14.18	37.22	0.38	0.01	13.13	0.00
2009	6.96	37.92	0.18	0.07	12.61	0.01

	BELGIAN Beam Trawl VIIfg		
Year	**Landings (t)**	**Effort (000 hr)**	**LPUE (kg/h**
1996	356.89	53.27	6.70
1997	474.71	57.36	8.28
1998	443.38	57.79	7.67
1999	410.22	55.11	7.44
2000	230.63	51.34	4.49
2001	274.84	54.90	5.01
2002	259.80	49.60	5.24
2003	215.95	62.73	3.44
2004	207.27	78.73	2.63
2005	153.73	64.50	2.38
2006	134.44	50.28	2.67
2007	139.39	45.72	3.05
2008	106.29	28.71	3.70
2009	215.99	30.84	7.00

Table 7.10.4. Plaice in Divisions VIIf&g. Annual length distribution by fleet in 2009.

	UK (England & Wales)		Ireland	Belgium
Length (cm)	Beam trawl	All gears (exc beam)	All gears	All gears
19				
20				
21				
22				
23		20	47	
24	13		264	130
25	193	20	499	2549
26	2096	373	1828	23333
27	7832	3972	3540	124965
28	11494	7384	8080	142810
29	11577	9951	14591	115634
30	11583	10067	18427	108691
31	9310	9438	17377	48863
32	7462	7670	16360	51705
33	5028	5886	14327	33036
34	4190	5155	10555	26521
35	2767	4093	7725	20264
36	2749	2399	6645	15995
37	1733	1813	4312	9735
38	1317	1021	2987	5920
39	821	935	2598	2965
40	827	552	1654	3561
41	492	854	1322	2536
42	366	267	1192	1404
43	327	280	722	467
44	245	209	1013	201
45	151	176	643	643
46	198	67	222	242
47	88	74	539	412
48	60	51	248	242
49	46	83	139	271
50	53		193	271
51	35		71	71
52	23		85	201
53	18		43	
54	9		78	201
55	4		24	71
56	29			
57	7			
58	13			
59	7			130
60	7		24	
61				
62	6			
63				
64			24	
Total	83176	72810	138398	744040

Table 7.10.5. Plaice in Divisions VIIf&g. Catch numbers-at-age.

Run title : CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP

At 12/05/2010 18:34

Table 1 Catch numbers at age Numbers*10**-3

AGE\YEAR	1977	1978	1979
1	0	0	0
2	989	851	877
3	426	903	673
4	411	291	638
5	105	136	72
6	72	76	70
7	37	47	34
8	59	23	8
+gp	75	98	46
TOTALNUM	2174	2425	2418
TONSLAND	757	875	863
SOPCOF %	101	103	102

AGE\YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0	0	0	0	0	0	0	0	0	0
2	1921	822	300	750	704	1461	703	434	967	797
3	1207	2111	1180	560	918	2503	2595	1883	2099	3550
4	658	681	955	827	343	393	1332	1812	1568	1807
5	146	109	443	372	373	102	156	772	612	741
6	21	54	86	92	209	177	59	156	413	160
7	16	53	51	44	70	62	48	22	65	98
8	16	11	14	27	41	25	32	125	16	24
+gp	32	44	60	23	42	38	24	76	73	23
TOTALNUM	4017	3885	3089	2695	2700	4761	4949	5280	5813	7200
TONSLAND	1373	1377	1303	1146	1210	1752	1691	1901	2116	2151
SOPCOF %	101	100	101	100	100	100	100	100	100	100

AGE\YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0	0	0	0	0	0	0	0	0	0
2	164	279	800	1019	428	488	812	420	426	243
3	2078	1072	526	1179	936	572	734	1318	921	982
4	2427	1193	357	284	730	743	514	929	849	802
5	655	578	471	139	164	334	219	272	287	372
6	242	179	275	185	117	117	137	121	96	116
7	86	94	80	115	86	57	59	60	82	45
8	70	78	21	61	92	48	37	20	39	27
+gp	46	79	96	59	64	131	96	82	56	69
TOTALNUM	5768	3552	2626	3041	2617	2490	2608	3222	2756	2656
TONSLAND	2082	1501	1188	1114	1070	1028	952	1217	1067	968
SOPCOF %	100	101	100	100	101	101	100	100	100	100

AGE\YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0	0	0	0	0	0	0	0	0	0
2	320	651	170	239	126	201	331	130	270	123
3	606	371	661	571	578	327	458	513	341	594
4	482	323	543	465	428	265	140	340	443	333
5	203	199	183	150	261	134	134	104	145	262
6	145	108	113	85	46	73	76	76	47	67
7	53	62	65	34	27	24	50	46	29	21
8	22	23	24	26	15	14	12	26	11	10
+gp	32	28	28	24	17	16	15	13	15	12
TOTALNUM	1862	1763	1786	1593	1498	1054	1217	1249	1300	1421
TONSLAND	718	714	642	594	510	386	404	410	437	463
SOPCOF %	100	103	100	100	100	101	101	100	101	100

Table 7.10.6. Plaice in Divisions VIIf&g. Catch weights-at-age.

Run title : CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP

At 12/05/2010 18:34

Table 2 Catch weights at age (kg)

AGE\YEAR	1977	1978	1979
1	0.078	0.194	0.076
2	0.205	0.258	0.203
3	0.323	0.323	0.325
4	0.43	0.389	0.44
5	0.528	0.457	0.55
6	0.615	0.525	0.652
7	0.693	0.595	0.749
8	0.76	0.666	0.839
+gp	0.8762	0.8435	1.0653
SOPCOFAC	1.0053	1.0265	1.0226

AGE\YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.118	0.185	0.151	0.178	0.276	0.135	0	0.129	0.26	0.102
2	0.238	0.255	0.245	0.274	0.324	0.251	0.16	0.208	0.288	0.176
3	0.354	0.33	0.339	0.369	0.384	0.363	0.301	0.288	0.325	0.255
4	0.467	0.412	0.433	0.464	0.455	0.47	0.434	0.368	0.37	0.337
5	0.576	0.5	0.526	0.559	0.538	0.572	0.559	0.449	0.423	0.423
6	0.682	0.595	0.62	0.654	0.633	0.67	0.677	0.53	0.484	0.514
7	0.784	0.695	0.714	0.749	0.739	0.763	0.787	0.612	0.554	0.608
8	0.882	0.802	0.808	0.844	0.857	0.851	0.889	0.694	0.633	0.706
+gp	1.1812	1.1824	1.0948	1.1579	1.2661	1.0036	1.1033	0.8632	0.8887	0.9932
SOPCOFAC	1.0136	1.0043	1.0126	0.9997	1.0003	1.0048	0.9997	1.0034	1.0026	1.0007

AGE\YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.24	0.2	0.148	0.172	0.145	0.22	0.222	0.181	0.188	0.096
2	0.27	0.26	0.257	0.247	0.24	0.264	0.26	0.248	0.248	0.188
3	0.309	0.327	0.362	0.326	0.331	0.319	0.309	0.318	0.316	0.279
4	0.358	0.4	0.464	0.407	0.42	0.382	0.368	0.392	0.39	0.369
5	0.416	0.481	0.563	0.492	0.506	0.456	0.438	0.469	0.471	0.457
6	0.483	0.567	0.658	0.58	0.589	0.539	0.519	0.55	0.559	0.545
7	0.56	0.661	0.75	0.671	0.67	0.632	0.609	0.634	0.655	0.631
8	0.646	0.761	0.839	0.765	0.747	0.735	0.711	0.723	0.757	0.716
+gp	0.9097	1.0465	1.0399	1.0061	0.9077	1.0351	0.9946	0.9972	1.1417	1.0022
SOPCOFAC	1.001	1.0115	1.0023	1.0031	1.0138	1.0104	1.0002	1.001	1.003	1.0021

AGE\YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.145	0.248	0.132	0.183	0.14	0.176	0.257	0.163	0.262	0.272
2	0.226	0.299	0.202	0.24	0.204	0.229	0.261	0.212	0.272	0.297
3	0.309	0.354	0.278	0.305	0.273	0.293	0.284	0.267	0.294	0.297
4	0.394	0.414	0.358	0.38	0.347	0.366	0.326	0.33	0.321	0.308
5	0.481	0.478	0.444	0.463	0.426	0.449	0.386	0.399	0.371	0.345
6	0.57	0.547	0.535	0.556	0.511	0.542	0.465	0.476	0.446	0.41
7	0.661	0.62	0.631	0.657	0.602	0.645	0.563	0.56	0.544	0.502
8	0.753	0.697	0.733	0.767	0.697	0.757	0.68	0.651	0.666	0.621
+gp	1.0422	0.9739	1.0376	1.0235	0.9414	1.0386	0.9749	0.8497	0.9128	0.8924
SOPCOFAC	1.005	1.0277	1.001	1.0037	1.0015	1.0118	1.0086	1.0038	1.0236	1.0063

Table 7.10.7. Plaice in Divisions VIIf&g. Stock weights-at-age.

Run title : CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP

At 12/05/2010 18:34

Table 3 Stock weights at age (kg)

YEAR	1977	1978	1979
1	0.112	0.086	0.107
2	0.216	0.17	0.212
3	0.315	0.252	0.313
4	0.406	0.334	0.412
5	0.492	0.414	0.507
6	0.57	0.493	0.599
7	0.642	0.57	0.689
8	0.707	0.646	0.775
+gp	0.8389	0.8218	1.0148

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.109	0.082	0.096	0.103	0.256	0.075	0	0.089	0.249	0.066
2	0.217	0.167	0.192	0.206	0.298	0.193	0.087	0.168	0.273	0.139
3	0.322	0.257	0.288	0.307	0.352	0.307	0.232	0.248	0.305	0.215
4	0.426	0.35	0.383	0.408	0.418	0.417	0.369	0.328	0.346	0.295
5	0.528	0.447	0.479	0.507	0.495	0.521	0.498	0.408	0.395	0.38
6	0.628	0.548	0.574	0.606	0.584	0.621	0.619	0.489	0.453	0.468
7	0.727	0.653	0.668	0.704	0.685	0.717	0.733	0.571	0.518	0.56
8	0.823	0.762	0.763	0.801	0.797	0.808	0.839	0.653	0.593	0.657
+gp	1.1318	1.129	1.0492	1.1136	1.1897	0.9646	1.0635	0.8219	0.8373	0.938

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.228	0.173	0.092	0.135	0.097	0.201	0.207	0.149	0.161	0.049
2	0.254	0.229	0.203	0.209	0.193	0.241	0.24	0.214	0.217	0.142
3	0.288	0.293	0.31	0.286	0.286	0.29	0.284	0.282	0.281	0.234
4	0.332	0.363	0.414	0.366	0.376	0.349	0.338	0.354	0.352	0.324
5	0.386	0.44	0.514	0.45	0.463	0.418	0.402	0.43	0.43	0.413
6	0.448	0.523	0.611	0.536	0.548	0.496	0.477	0.509	0.514	0.501
7	0.52	0.613	0.705	0.625	0.63	0.585	0.563	0.592	0.606	0.588
8	0.602	0.71	0.795	0.718	0.709	0.682	0.659	0.678	0.705	0.673
+gp	0.8537	0.987	1.0002	0.9544	0.8723	0.9712	0.9302	0.9476	1.0787	0.9622

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.105	0.224	0.099	0.158	0.11	0.153	0.262	0.142	0.154	0.154
2	0.185	0.273	0.167	0.21	0.171	0.201	0.257	0.187	0.199	0.199
3	0.268	0.326	0.239	0.271	0.238	0.26	0.27	0.239	0.252	0.253
4	0.352	0.384	0.317	0.341	0.309	0.328	0.303	0.298	0.305	0.299
5	0.438	0.446	0.401	0.42	0.386	0.406	0.353	0.364	0.343	0.323
6	0.525	0.512	0.489	0.508	0.468	0.494	0.423	0.437	0.405	0.374
7	0.615	0.583	0.583	0.605	0.556	0.592	0.512	0.517	0.492	0.453
8	0.707	0.658	0.682	0.711	0.649	0.7	0.619	0.604	0.602	0.558
+gp	0.9934	0.9283	0.9794	0.9582	0.8869	0.9709	0.8956	0.7964	0.8296	0.8068

Table 7.10.8. Plaice in Divisions VIIf&g. Survey abundance indices (figures used in the assessment shown in bold).

IRGFS : Irish Groundfish Survey (IBTS 4th qtr VIIg)

2003 2008

1 1 0.79 0.92

2 7

832	45	84	37	8	3	1
980	6	31	51	20	13	1
845	63	83	19	9	3	3
1046	105	80	22	18	11	12
1168	51	166	68	22	9	8
1139	113	106	72	19	8	5
1018	199	548	247	100	21	16

E+W B/T Survey

1990 2009 (Effort in Km towed, Numbers caught; all stations)

1 1 0.75 0.85 (Revised 2008 – Indices automated 1995 on)

1 5

69.86 161 215 64 15 6

123.41 841 33 65 21 12

125.08 487 307 13 5 15

127.67 120 107 44 2 5

120.82 127 40 20 11 1

114.9 275 103 19 3 8

118.6 265 342 37 1 3

114.9 259 117 40 5 2

114.9 272 144 54 10 2

118.6 181 94 34 23 8

118.6 403 75 37 8 7

118.6 251 185 19 10 5

118.6 162 208 95 7 7

118.6 117 95 72 26 3

114.9 297 38 31 15 3

118.6 228 89 25 10 13

118.6 102 121 41 11 2

118.6 178 109 56 18 2

118.6 167 257 57 19 6

118.6 192 66 93 25 13

Table 7.10.9. Plaice in Divisions VIIf&g. Commercial tuning data available to the Working Group. (figures used in the assessment shown in bold).

UK (E+W) BEAM TRAWL VIIF.

1990 2009 Thousands of hours, numbers in thousands.

1 1 0 1

1 8

30.8	0.0	1.6	68.2	159.5	46.3	26.6	11.0	9.2
40.8	9.4	22.6	74.4	141.5	87.1	29.0	15.1	14.1
35.8	1.6	39.9	27.3	32.0	46.7	27.4	7.5	2.3
39.6	1.0	40.9	139.5	25.0	15.5	24.6	15.1	7.3
37	12.6	31.7	52.4	49.1	9.2	9.1	7.6	9.8
37.6	1.0	28.3	30.0	39.5	29.7	9.9	5.8	6.4
39.8	0.0	74.6	53.8	13.6	13.6	12.8	3.8	4.4
43	0.6	40.7	112.3	23.7	8.4	6.7	4.5	0.7
47.8	2.7	54.1	73.9	63.1	17.5	3.6	4.3	2.7
50.8	0.8	22.1	64.2	52.5	25.8	7.7	2.4	1.9
51.2	0.6	11.9	26.0	26.9	17.8	12.7	4.9	1.8
49.3	2.8	42.5	27.7	27.5	17.7	10.1	5.9	2.4
37.5	0.5	19.4	40.3	16.5	7.6	7.2	3.7	2.0
40.7	1.6	27.7	43.2	33.8	9.9	4.9	3.4	2.4
32.4	0.9	12.2	34.5	25.8	17.5	3.4	2.5	2.0
27.7	1.5	12.0	9.1	12.7	7.5	5.0	1.9	1.1
18.6	0.6	10.2	17.7	4.5	4.4	3.0	1.6	0.4
15.4	0.5	9.3	24.6	12.0	3.2	2.0	1.4	0.6
13.8	0.2	10.8	16.1	18.1	5.2	1.9	1.4	0.9
12.2	0.3	10.4	30.1	15.2	10.6	3.0	1.0	0.6

UK(E+W) OTTER TRAWL VIIF

1989 2009 Thousands of hours, numbers in thousands.

1 1 0 1

1 8

17.6	0.8	91.2	256.0	62.0	23.1	7.4	5.1	0.4
22.6	0.1	6.4	97.0	129.1	34.2	13.3	4.1	4.4
18.6	5.2	13.6	46.9	78.8	36.9	16.5	4.4	5.0
16.0	3.6	68.2	14.6	12.5	18.5	8.5	1.4	0.4
13.8	1.3	25.3	42.1	8.8	3.9	6.3	4.1	2.7
9.5	4.2	11.7	20.5	15.1	2.7	3.1	1.4	1.7
8.5	5.1	37.8	18.2	14.5	5.5	1.6	0.8	0.7
8.7	0.0	35.8	20.6	4.3	3.4	2.5	1.0	1.1
8.1	0.4	16.5	33.7	5.5	1.2	0.7	0.4	0.1
7.1	0.4	7.8	11.0	8.6	2.0	0.5	0.7	0.2
5.7	1.0	8.3	12.2	7.9	3.8	0.9	0.2	0.1
4.1	0.5	9.3	11.4	6.5	2.5	1.3	0.4	0.1
4.4	1.4	11.1	4.9	4.0	2.4	1.3	0.6	0.2
6.1	0.0	4.4	8.3	2.9	1.5	1.1	0.5	0.2
9.9	0.6	11.9	16.2	9.3	2.1	1.3	0.9	0.6
9.4	0.3	4.3	14.3	10.4	5.8	0.9	0.5	0.3
12.1	1.5	10.0	5.4	5.5	2.8	1.5	0.5	0.3
13.0	0.7	12.8	23.3	6.8	6.4	4.5	2.3	0.6
10.6	0.2	5.2	14.8	7.4	2.2	1.4	1.0	0.5
10.1	0.3	5.8	16.5	8.2	2.4	1.6	1.1	0.6
9.0	0.2	5.6	7.8	7.3	2.3	0.9	0.5	0.3

Table 7.10.10. Plaice in Divisions VIIf&g. XSA Diagnostics.

Lowestoft VPA Version 3.1
15/05/2010 10:55

Extended Survivors Analysis

CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP

CPUE data from file P7FTUN3.DAT

Catch data for 33 years. 1977 to 2009. Ages 1 to 9.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
UK(E+W) BEAM TRAWL V	1990	2009	4	8	0	1
UK(EW)OTTER TRAWL VI	1989	2009	4	8	0	1
EW BT Survey	1990	2009	1	5	0.75	0.85

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 6
Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 6

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 4 oldest ages.

S.E. of the mean to which the estimates are shrunk = 2.500

Minimum standard error for population
estimates derived from each fleet = .500

Prior weighting not applied

Tuning converged after 71 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g. XSA Diagnostics.

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0	0	0	0	0	0	0	0	0	0
2	0.191	0.276	0.093	0.151	0.128	0.126	0.152	0.075	0.096	0.069
3	0.546	0.322	0.453	0.463	0.589	0.508	0.423	0.338	0.262	0.287
4	0.669	0.572	0.99	0.605	0.69	0.536	0.384	0.582	0.496	0.399
5	0.519	0.584	0.681	0.745	0.748	0.43	0.517	0.499	0.476	0.559
6	0.697	0.524	0.711	0.717	0.48	0.43	0.422	0.569	0.4	0.385
7	0.641	0.656	0.63	0.437	0.463	0.461	0.542	0.444	0.394	0.28
8	1.131	0.566	0.53	0.506	0.321	0.417	0.407	0.55	0.164	0.206

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8
2000	3.23E+03	1.95E+03	1.53E+03	1.05E+03	5.33E+02	3.07E+02	1.19E+02	3.40E+01
2001	2.28E+03	2.86E+03	1.43E+03	7.86E+02	4.76E+02	2.81E+02	1.36E+02	5.56E+01
2002	2.04E+03	2.02E+03	1.93E+03	9.18E+02	3.93E+02	2.36E+02	1.48E+02	6.24E+01
2003	1.26E+03	1.81E+03	1.63E+03	1.09E+03	3.02E+02	1.77E+02	1.03E+02	6.97E+01
2004	2.03E+03	1.12E+03	1.38E+03	9.12E+02	5.27E+02	1.27E+02	7.65E+01	5.88E+01
2005	2.81E+03	1.80E+03	8.73E+02	6.78E+02	4.06E+02	2.21E+02	6.98E+01	4.27E+01
2006	2.16E+03	2.50E+03	1.41E+03	4.66E+02	3.52E+02	2.34E+02	1.28E+02	3.90E+01
2007	3.54E+03	1.91E+03	1.90E+03	8.19E+02	2.81E+02	1.86E+02	1.36E+02	6.58E+01
2008	2.19E+03	3.14E+03	1.57E+03	1.20E+03	4.06E+02	1.52E+02	9.35E+01	7.74E+01
2009	3.02E+03	1.94E+03	2.53E+03	1.07E+03	6.50E+02	2.24E+02	9.01E+01	5.59E+01

Estimated population abundance at 1st Jan 2010

0.00E+00	2.68E+03	1.61E+03	1.68E+03	6.39E+02	3.29E+02	1.35E+02	6.04E+01

Taper weighted geometric mean of the VPA populations:

3.75E+03	3.36E+03	2.47E+03	1.30E+03	5.64E+02	2.70E+02	1.34E+02	6.94E+01

Standard error of the weighted Log(VPA populations) :

0.5609	0.5596	0.5708	0.5682	0.5561	0.5304	0.5704	0.7299

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g :XSA Diagnostics.

Log catchability residuals.

Fleet : UK(E+W) BEAM TRAWL V

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	0.09	0.29	0.15	0.1	0.04	0.01	-0.63	-0.6	-0.06	-0.01
5	0.02	0.06	0.1	-0.12	-0.17	0.21	-0.17	-0.4	-0.16	-0.15
6	0.86	0.39	0.11	0.36	-0.21	0.37	0.28	-0.4	-0.74	-0.33
7	-0.07	0.91	-0.3	-0.03	-0.14	-0.11	0.37	-0.05	-0.01	-0.31
8	0.16	0.33	-0.17	0.05	0.11	0.21	0.07	-0.19	0.26	0.33

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	-0.25	0.05	-0.13	0.03	0.2	0.05	-0.09	0.26	0.22	0.27
5	-0.14	0.01	-0.13	0.25	0.23	-0.06	0.01	0.15	0.17	0.29
6	0.01	-0.17	0.05	-0.15	-0.07	-0.1	-0.27	-0.19	0	0.18
7	0	0.1	-0.24	-0.08	0.15	0.12	-0.22	-0.27	0.19	-0.04
8	0.46	0.06	-0.09	-0.01	0.13	0.05	-0.48	-0.34	-0.17	-0.11

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	6	7	8
Mean Log q	-6.7505	-6.772	-6.772
S.E(Log q)	0.3493	0.2779	0.2369

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
4	0.73	2.233	6.91	0.79	20	0.26	-6.85
5	0.67	3.384	6.64	0.86	20	0.19	-6.81

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	0.72	2.372	6.43	0.8	20	0.23	-6.75
7	1.07	-0.547	6.9	0.76	20	0.3	-6.77
8	0.92	1.188	6.55	0.92	20	0.21	-6.74

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g. XSA Diagnostics.

Fleet : UK(EW)OTTER TRAWL VI

Age	1989
1	No data for this fleet at this age
2	No data for this fleet at this age
3	No data for this fleet at this age
4	-0.02
5	0.05
6	-0.25
7	-0.07
8	-0.06

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	0.17	0.41	-0.1	-0.06	0.08	0.28	-0.54	-0.59	-0.24	0.1
5	0.13	0.12	0.1	-0.35	-0.09	0.12	-0.07	-0.63	-0.34	0.09
6	0.56	0.7	-0.17	0.14	0.16	0.12	0.26	-0.9	-0.72	-0.2
7	-0.52	0.69	-0.95	-0.06	-0.24	-0.38	0.78	-0.57	0.31	-0.38
8	-0.05	0.3	-0.89	0.33	-0.06	-0.29	0.43	-0.24	-0.22	-0.2

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	0.46	0.27	-0.23	-0.02	0.32	-0.15	0.29	0.02	-0.27	-0.19
5	0.28	0.33	-0.03	0.14	0.37	-0.19	0.53	0.12	-0.16	-0.55
6	0.34	0.28	0.05	0.02	-0.07	-0.39	0.58	-0.09	0.22	-0.64
7	0.25	0.46	-0.37	0.23	0	-0.16	0.73	-0.01	0.49	-0.2
8	0.32	0.21	-0.25	0.24	-0.31	-0.2	0.51	0.07	-0.04	-0.27

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	6	7	8
Mean Log q	-6.8357	-6.9957	-6.9957
S.E(Log q)	0.4209	0.4654	0.3288

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
4	0.8	1.605	6.75	0.77	21	0.3	-6.66
5	0.73	1.877	6.7	0.72	21	0.3	-6.82

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	0.84	0.961	6.64	0.65	21	0.35	-6.84
7	1.4	-1.588	7.78	0.46	21	0.63	-7
8	0.95	0.51	6.89	0.84	21	0.32	-7.03

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g. XSA Diagnostics.

Fleet : UK (BT-Q3) Survey

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	1	0.52	1.2	0.5	-0.98	-1.14	-0.31	-0.09	0.06	0.53	-0.05
	2	0.75	-0.74	0.23	-0.49	-0.84	-0.4	0.25	-0.28	0.03	0.06
	3	0.57	0.74	-1.33	-0.33	-1.26	-1.04	-0.55	-0.43	0.16	-0.18
	4	0.62	0.53	-1.17	-2.48	-0.06	-1.79	-3.58	-1.03	-0.19	1.47
	5	-0.06	-0.25	0.36	-0.21	-1.33	0.35	-0.48	-0.56	-0.79	0.28
	6	No data for this fleet at this age									
	7	No data for this fleet at this age									
	8	No data for this fleet at this age									

Age		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	1	0.65	0.36	-0.13	-0.09	0.74	0.02	-0.81	-0.55	-0.16	-0.29
	2	-0.06	0.3	0.63	0.17	-0.05	0.11	0.03	0.17	0.35	-0.23
	3	0.21	-0.89	1.19	0.98	0.16	0.19	0.3	0.34	0.47	0.7
	4	-0.17	0.35	0.16	1.6	1.06	0.45	0.79	1.27	0.86	1.29
	5	0.31	0.15	0.73	0.25	-0.27	1.09	-0.44	-0.23	0.4	0.71
	6	No data for this fleet at this age									
	7	No data for this fleet at this age									
	8	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.36	-0.899	6.94	0.26	20	0.61	-7.2
2	0.77	0.854	7.67	0.44	20	0.42	-7.63
3	1.39	-0.88	8.42	0.22	20	0.75	-8.19
4	1.6	-0.896	10.1	0.11	20	1.42	-8.95
5	0.93	0.237	8.73	0.37	20	0.59	-8.92

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g. XSA Diagnostics.

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2008

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	1	0	0	0	0	0	0
UK(EW)OTTER TRAWL VI	1	0	0	0	0	0	0
UK (BT-Q3) Survey	2010	0.632	0	0	1	0.44	0
P shrinkage mean	3357	0.56				0.56	0
F shrinkage mean	0	2.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2679	0.42	0.38	2	0.917	0

Age 2 Catchability dependent on age and year class strength
Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	1	0	0	0	0	0	0
UK(EW)OTTER TRAWL VI	1	0	0	0	0	0	0
UK (BT-Q3) Survey	1312	0.393	0.038	0.1	2	0.652	0.084
P shrinkage mean	2469	0.57				0.331	0.046
F shrinkage mean	943	2.5				0.017	0.116

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1608	0.32	0.21	4	0.661	0.1

Age 3 Catchability dependent on age and year class strength
Year class = 2006

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	1	0	0	0	0	0	0
UK(EW)OTTER TRAWL VI	1	0	0	0	0	0	0
UK (BT-Q3) Survey	1963	0.352	0.34	0.97	3	0.633	0.251
P shrinkage mean	1303	0.57				0.349	0.357
F shrinkage mean	1054	2.5				0.018	0.426

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1682	0.3	0.23	5	0.764	0.3

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g. XSA Diagnostics.

Age 4 Catchability dependent on age and year class strength
Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	836	0.5	0	0	1	0.208	0.318
UK(EW)OTTER TRAWL VI	527	0.5	0	0	1	0.208	0.467
UK (BT-Q3) Survey	681	0.347	0.34	0.98	4	0.323	0.379
P shrinkage mean	564	0.56				0.25	0.442
F shrinkage mean	438	2.5				0.012	0.54

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
639	0.23	0.14	8	0.615	0.4

Age 5 Catchability dependent on age and year class strength
Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	429	0.364	0.031	0.08	2	0.254	0.454
UK(EW)OTTER TRAWL VI	212	0.364	0.133	0.37	2	0.254	0.772
UK (BT-Q3) Survey	489	0.331	0.164	0.5	5	0.236	0.408
P shrinkage mean	270	0.53				0.245	0.649
F shrinkage mean	347	2.5				0.011	0.537

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
329	0.2	0.12	11	0.603	0.6

Age 6 Catchability constant w.r.t. time and dependent on age
Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	163	0.312	0.022	0.07	3	0.403	0.328
UK(EW)OTTER TRAWL VI	93	0.312	0.197	0.63	3	0.403	0.518
UK (BT-Q3) Survey	204	0.341	0.133	0.39	5	0.181	0.271
F shrinkage mean	108	2.5				0.012	0.462

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
135	0.19	0.11	12	0.602	0.4

Table 7.10.10. (cont.) Plaice in Divisions VIIf&g. XSA Diagnostics.

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	60	0.276	0.042	0.15	4	0.44	0.28
UK(EW)OTTER TRAWL VI	62	0.276	0.119	0.43	4	0.44	0.272
UK (BT-Q3) Survey	57	0.338	0.123	0.36	5	0.111	0.295
F shrinkage mean	33	2.5				0.01	0.463

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
60	0.18	0.05	14	0.28	0.3

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK(E+W) BEAM TRAWL V	40	0.267	0.072	0.27	5	0.467	0.209
UK(EW)OTTER TRAWL VI	42	0.267	0.175	0.66	5	0.467	0.197
UK (BT-Q3) Survey	34	0.356	0.154	0.43	5	0.057	0.237
F shrinkage mean	18	2.5				0.009	0.407

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
40	0.18	0.07	16	0.41	0.2

Table 7.10.11. Plaice in Divisions VIIf&g. Fishing Mortalities.

Run title : CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP
At 15/05/2010 10:56

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

AGE\YEAR	1977	1978	1979
1	0	0	0
2	0.3501	0.3347	0.2376
3	0.5445	0.5649	0.4377
4	0.8499	0.8152	0.9283
5	0.4485	0.6925	0.4329
6	0.6853	0.6196	0.8666
7	0.6003	1.2891	0.5671
8	0.6493	0.8593	0.7025
+gp	0.6493	0.8593	0.7025
FBAR 3- 6	0.632	0.673	0.6664

AGE\YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0	0	0	0	0	0	0	0	0	0
2	0.3388	0.1954	0.1927	0.2921	0.0958	0.1883	0.1126	0.0654	0.1011	0.1403
3	0.5382	0.6923	0.4297	0.5929	0.6314	0.5161	0.536	0.4461	0.46	0.5801
4	0.9296	0.6043	0.7117	0.5519	0.8183	0.5532	0.5197	0.8173	0.7503	0.8369
5	0.5023	0.3374	0.9385	0.6081	0.4693	0.5529	0.4014	0.5894	0.6567	0.9053
6	0.1962	0.3176	0.4417	0.4531	0.7554	0.3863	0.6568	0.8141	0.6621	0.3198
7	0.439	0.9595	0.5076	0.3862	0.6768	0.4739	0.1557	0.4949	0.8929	0.2893
8	0.5191	0.5573	0.6532	0.502	0.6836	0.4937	0.4351	0.6825	0.7447	0.9174
+gp	0.5191	0.5573	0.6532	0.502	0.6836	0.4937	0.4351	0.6825	0.7447	0.9174
FBAR 3- 6	0.5416	0.4879	0.6304	0.5515	0.6686	0.5021	0.5285	0.6667	0.6323	0.6605

AGE\YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0	0	0	0	0	0	0	0	0	0
2	0.0667	0.166	0.2237	0.3162	0.1947	0.16	0.2051	0.1408	0.1658	0.1394
3	0.585	0.7096	0.4842	0.5388	0.4864	0.3914	0.3486	0.5391	0.4683	0.6321
4	0.9314	0.7229	0.491	0.4768	0.69	0.8227	0.6642	0.9042	0.7316	0.8827
5	0.7659	0.5327	0.6387	0.3261	0.507	0.7187	0.5521	0.8269	0.7175	0.7615
6	0.7814	0.4379	0.4738	0.504	0.4556	0.7575	0.6664	0.6144	0.717	0.6529
7	0.2592	0.7314	0.3242	0.3366	0.4208	0.3813	1.0333	0.6306	1.0451	0.8104
8	0.3149	0.3604	0.3168	0.3993	0.4477	0.3993	0.4151	1.1773	1.0327	1.1861
+gp	0.3149	0.3604	0.3168	0.3993	0.4477	0.3993	0.4151	1.1773	1.0327	1.1861
FBAR 3- 6	0.7659	0.6008	0.5219	0.4614	0.5348	0.6726	0.5578	0.7211	0.6586	0.7323

AGE\YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR 07-09
1	0	0	0	0	0	0	0	0	0	0	0
2	0.1915	0.2763	0.0932	0.1512	0.1278	0.1262	0.152	0.075	0.0957	0.0693	0.08
3	0.5458	0.3224	0.4525	0.4634	0.5894	0.508	0.423	0.3379	0.2615	0.287	0.2955
4	0.6688	0.5722	0.9904	0.6046	0.6899	0.536	0.3835	0.5815	0.4961	0.3991	0.4922
5	0.5192	0.5844	0.6807	0.7453	0.7482	0.4303	0.5168	0.4994	0.4763	0.5589	0.5115
6	0.6967	0.524	0.7111	0.7167	0.4802	0.4296	0.4216	0.569	0.3996	0.3853	0.4513
7	0.6411	0.6564	0.6301	0.4368	0.463	0.4613	0.5423	0.4444	0.3944	0.2796	0.3728
8	1.1314	0.5656	0.5304	0.5065	0.3209	0.4165	0.4072	0.5496	0.1635	0.206	0.3064
+gp	1.1314	0.5656	0.5304	0.5065	0.3209	0.4165	0.4072	0.5496	0.1635	0.206	
FBAR 3- 6	0.6076	0.5008	0.7087	0.6325	0.6269	0.476	0.4362	0.4969	0.4084	0.4076	

Table 7.10.12. Plaice in Divisions VIIf&g. Population numbers.

Run title : CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP

At 15/05/2010 10:56

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

AGE\YEAR	1977	1978	1979
1	3582	4964	8004
2	3555	3177	4403
3	1077	2222	2016
4	762	554	1120
5	309	289	218
6	154	175	128
7	87	69	83
8	131	42	17
+gp	166	179	96
TOTAL	9823	11671	16085

AGE\YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	5544	2049	3545	9224	10191	7905	8204	12045	7287	3044
2	7099	4917	1818	3144	8181	9039	7011	7276	10683	6463
3	3079	4487	3587	1329	2082	6593	6641	5556	6045	8564
4	1154	1594	1992	2070	652	982	3490	3446	3155	3384
5	393	404	773	867	1057	255	501	1841	1350	1321
6	125	211	256	268	419	587	130	297	906	621
7	48	91	136	146	151	174	354	60	117	414
8	42	27	31	73	88	68	96	268	32	42
+gp	83	109	132	62	89	103	72	162	146	40
TOTAL	17568	13890	12269	17183	22910	25706	26498	30952	29721	23895

AGE\YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	2184	4778	4500	2896	3951	5242	3827	3338	2235	2199
2	2700	1937	4238	3991	2569	3504	4649	3395	2961	1982
3	4982	2240	1455	3005	2580	1875	2648	3358	2615	2225
4	4253	2461	977	795	1555	1407	1125	1657	1737	1452
5	1300	1486	1060	530	438	692	548	513	595	741
6	474	536	774	496	340	234	299	280	199	258
7	400	192	307	427	266	191	97	136	134	86
8	275	274	82	197	271	155	116	31	64	42
+gp	180	276	374	189	187	421	299	124	91	104
TOTAL	16747	14181	13767	12528	12156	13720	13608	12833	10633	9089

AGE\YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 77-08	AMST 77-08
1	3229	2280	2039	1261	2034	2814	2156	3535	2191	3021	0	3846	4519
2	1950	2864	2022	1809	1118	1804	2495	1912	3136	1943	2679	3425	4021
3	1529	1428	1927	1634	1379	873	1410	1901	1573	2527	1608	2503	2979
4	1049	786	918	1087	912	678	466	819	1203	1074	1682	1314	1564
5	533	476	393	302	527	406	352	281	406	650	639	568	669
6	307	281	236	177	127	221	234	186	152	224	329	276	320
7	119	136	148	103	76	70	128	136	93	90	135	138	164
8	34	56	62	70	59	43	39	66	77	56	60	70	93
+gp	50	69	71	64	64	51	48	32	104	66	88		
TOTAL	8800	8377	7817	6506	6297	6959	7328	8870	8935	9651	7222		

Table 7.10.13. Plaice in Divisions VIIf&g. Summary.

Run title : CELTIC SEA PLAICE 2010 WG COMBSEX PLUSGROUP

At 15/05/2010 10:56

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1977	3582	2345	1169	757	0.6473	0.632
1978	4964	2131	1010	875	0.8662	0.673
1979	8004	3238	1323	863	0.6524	0.6664
1980	5544	4078	1789	1373	0.7676	0.5416
1981	2049	3200	1792	1377	0.7683	0.4879
1982	3545	3255	2054	1303	0.6344	0.6304
1983	9224	3682	1938	1146	0.5912	0.5515
1984	10191	7100	2297	1210	0.5268	0.6686
1985	7905	5547	2635	1752	0.665	0.5021
1986	8204	4185	2814	1691	0.601	0.5285
1987	12045	6042	3245	1901	0.5858	0.6667
1988	7287	8812	3801	2116	0.5566	0.6323
1989	3044	5029	3140	2151	0.6851	0.6605
1990	2184	5272	3380	2082	0.616	0.7659
1991	4778	4339	2744	1501	0.547	0.6008
1992	4500	3803	2479	1188	0.4792	0.5219
1993	2896	3470	2008	1114	0.5548	0.4614
1994	3951	3113	1927	1070	0.5552	0.5348
1995	5242	3964	1956	1028	0.5257	0.6726
1996	3827	3812	1780	952	0.5349	0.5578
1997	3338	3340	1768	1217	0.6882	0.7211
1998	2235	2932	1659	1067	0.6433	0.6586
1999	2199	1994	1363	968	0.7104	0.7323
2000	3229	2020	1165	718	0.6161	0.6076
2001	2280	2596	1241	714	0.5753	0.5008
2002	2039	1762	1048	642	0.6123	0.7087
2003	1261	1783	1038	594	0.5724	0.6325
2004	2034	1426	863	510	0.5907	0.6269
2005	2814	1637	798	386	0.4836	0.476
2006	2156	2084	842	404	0.4798	0.4362
2007	3535	1878	859	410	0.4775	0.4969
2008	2191	2104	1063	437	0.4111	0.4084
2009	3021	2231	1128	463	0.4104	0.4076
Arith. Mean	4403	3461	1822	1090	0.5949	0.587
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 7.10.14. Plaice in Divisions VIIf&g. Short-term forecast input data.

MFDP version 1a
Run: Plaice_VIIfg_sq
Time and date: 17:19 15/05/2010
Fbar age range: 3-6

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	2815	0.12	0	0	0	0.15	0	0.171
2	2679	0.12	0.26	0	0	0.195	0.08	0.220667
3	1608	0.12	0.52	0	0	0.248	0.295467	0.277667
4	1682	0.12	0.86	0	0	0.300667	0.492233	0.319667
5	639	0.12	1	0	0	0.343333	0.511533	0.371667
6	329	0.12	1	0	0	0.405333	0.4513	0.444
7	135	0.12	1	0	0	0.487333	0.3728	0.535333
8	60	0.12	1	0	0	0.588	0.306367	0.646
9	88	0.12	1	0	0	0.810946	0.306367	0.88495

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	2815	0.12	0	0	0	0.15	0	0.171
2	.	0.12	0.26	0	0	0.195	0.08	0.220667
3	.	0.12	0.52	0	0	0.248	0.295467	0.277667
4	.	0.12	0.86	0	0	0.300667	0.492233	0.319667
5	.	0.12	1	0	0	0.343333	0.511533	0.371667
6	.	0.12	1	0	0	0.405333	0.4513	0.444
7	.	0.12	1	0	0	0.487333	0.3728	0.535333
8	.	0.12	1	0	0	0.588	0.306367	0.646
9	.	0.12	1	0	0	0.810946	0.306367	0.88495

2012

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	2815	0.12	0	0	0	0.15	0	0.171
2	.	0.12	0.26	0	0	0.195	0.08	0.220667
3	.	0.12	0.52	0	0	0.248	0.295467	0.277667
4	.	0.12	0.86	0	0	0.300667	0.492233	0.319667
5	.	0.12	1	0	0	0.343333	0.511533	0.371667
6	.	0.12	1	0	0	0.405333	0.4513	0.444
7	.	0.12	1	0	0	0.487333	0.3728	0.535333
8	.	0.12	1	0	0	0.588	0.306367	0.646
9	.	0.12	1	0	0	0.810946	0.306367	0.88495

Input units are thousands and kg - output in tonnes

Table 7.10.15. Plaice in Divisions VIIf&g. Management option table *status quo* forecast.

MFDP version 1a
Run: Plaice_VIIfg_sq
CELTIC SEA PLAICE
Time and date: 17:19 15/05/2010
Fbar age range: 3-6

2010 Biomass	SSB	FMult	FBar	Landings
2374	1303	1.0000	0.4376	539

2011 Biomass	SSB	FMult	FBar	Landings	2012 Biomass	SSB
2440	1352	0.0000	0.0000	0	3067	1939
.	1352	0.1000	0.0438	66	3000	1876
.	1352	0.2000	0.0875	129	2935	1816
.	1352	0.3000	0.1313	190	2873	1758
.	1352	0.4000	0.1751	249	2813	1703
.	1352	0.5000	0.2188	305	2756	1650
.	1352	0.6000	0.2626	359	2701	1598
.	1352	0.7000	0.3063	411	2648	1549
.	1352	0.8000	0.3501	461	2597	1502
.	1352	0.9000	0.3939	510	2548	1457
.	1352	1.0000	0.4376	556	2501	1414
.	1352	1.1000	0.4814	601	2455	1372
.	1352	1.2000	0.5252	644	2411	1332
.	1352	1.3000	0.5689	686	2369	1293
.	1352	1.4000	0.6127	726	2329	1256
.	1352	1.5000	0.6565	765	2290	1221
.	1352	1.6000	0.7002	802	2252	1187
.	1352	1.7000	0.7440	838	2216	1154
.	1352	1.8000	0.7877	873	2181	1122
.	1352	1.9000	0.8315	906	2147	1092
.	1352	2.0000	0.8753	938	2115	1062

Input units are thousands and kg - output in tonnes

Table 7.10.16. Plaice in Divisions VIIf&g. Forecast detailed results; *status quo* forecast.

MFDP version 1a
Run: Plaice_VIIfg_sq
Time and date: 17:19 15/05/2010
Fbar age range: 3-6

Year:	2010	F multiplier	1	Fbar:	0.4376				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
1	0	0	0	2815	422	0	0	0	0
2	0.08	194	43	2679	522	697	136	697	136
3	0.2955	389	108	1608	399	836	207	836	207
4	0.4922	619	198	1682	506	1447	435	1447	435
5	0.5115	242	90	639	219	639	219	639	219
6	0.4513	113	50	329	133	329	133	329	133
7	0.3728	40	21	135	66	135	66	135	66
8	0.3064	15	10	60	35	60	35	60	35
9	0.3064	22	19	88	71	88	71	88	71
Total		1634	539	10035	2374	4230	1303	4230	1303

Year:	2011	F multiplier	1	Fbar:	0.4376				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
1	0	0	0	2815	422	0	0	0	0
2	0.08	181	40	2497	487	649	127	649	127
3	0.2955	530	147	2193	544	1141	283	1141	283
4	0.4922	391	125	1061	319	913	274	913	274
5	0.5115	346	129	912	313	912	313	912	313
6	0.4513	117	52	340	138	340	138	340	138
7	0.3728	55	29	186	91	186	91	186	91
8	0.3064	21	13	82	48	82	48	82	48
9	0.3064	24	21	97	78	97	78	97	78
Total		1664	556	10183	2440	4319	1352	4319	1352

Year:	2012	F multiplier	1	Fbar:	0.4376				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
1	0	0	0	2815	422	0	0	0	0
2	0.08	181	40	2497	487	649	127	649	127
3	0.2955	494	137	2044	507	1063	264	1063	264
4	0.4922	533	170	1448	435	1245	374	1245	374
5	0.5115	218	81	575	198	575	198	575	198
6	0.4513	167	74	485	197	485	197	485	197
7	0.3728	56	30	192	94	192	94	192	94
8	0.3064	28	18	114	67	114	67	114	67
9	0.3064	29	26	117	95	117	95	117	95
Total		1707	577	10286	2501	4440	1414	4440	1414

Input units are thousands and kg - output in tonnes

Table 7.1.17. Plaice in Divisions VIIf&g. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to ladings and SSB (by weight) of these year classes.

Year-class			2006	2007	2008	2009	2010
Stock No. (thousands)			3535	2191	3021	2815	2815
of	1	year-olds					
Source			XSA	XSA	XSA	GM89-08	GM89-08
Status Quo F:							
% in	2010	landings	36.7	20.0	8.0	0.0	-
% in	2011	landings	23.2	22.5	26.4	7.2	0.0
% in	2010	SSB	33.4	15.9	10.4	0.0	-
% in	2011	SSB	23.2	20.3	20.9	9.4	0.0
% in	2012	SSB	13.9	14.0	26.4	18.6	9.0

GM : geometric mean recruitment

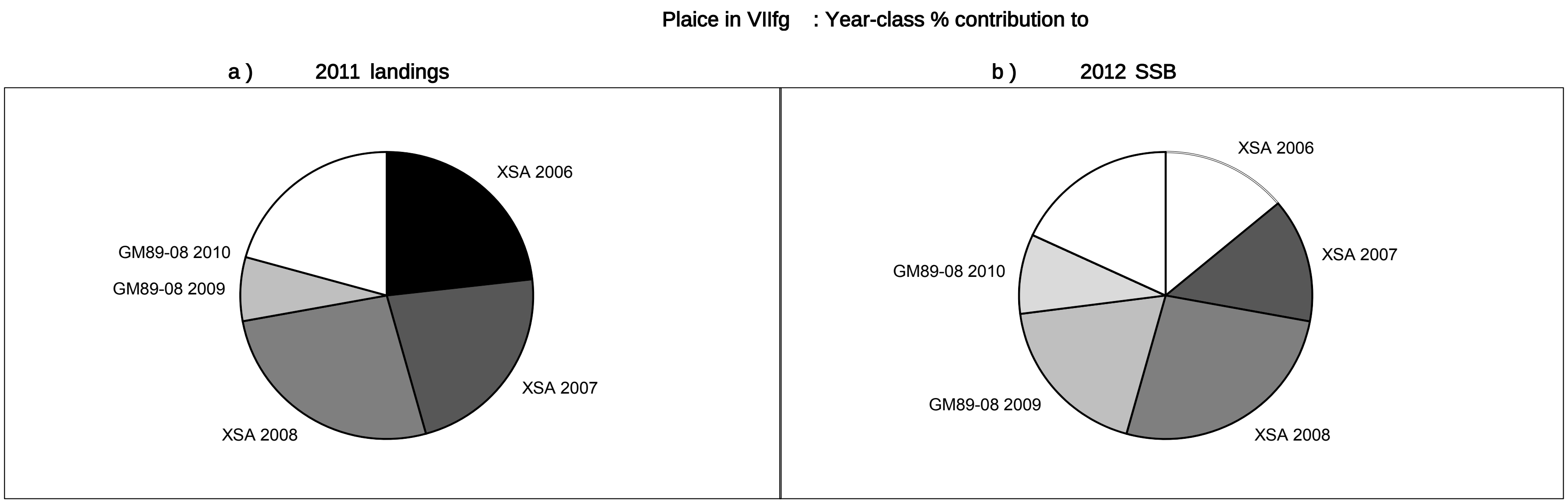


Table 7.10.18. Plaice in Divisions VIIf&g. Yield-per-recruit summary table.

MFYPR version 2a
Run: Plaice_VIIfg_yield
Time and date: 17:33 15/05/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	8.8433	4.3997	6.7118	3.9987	6.7118	3.9987
0.1000	0.0438	0.1895	0.1034	7.2667	3.2359	5.1418	2.8367	5.1418	2.8367
0.2000	0.0875	0.3108	0.1573	6.2584	2.5186	4.1399	2.1212	4.1399	2.1212
0.3000	0.1313	0.3942	0.1865	5.5664	2.0455	3.4542	1.6499	3.4542	1.6499
0.4000	0.1751	0.4544	0.2024	5.0670	1.7182	2.9609	1.3243	2.9609	1.3243
0.5000	0.2188	0.4997	0.2110	4.6924	1.4832	2.5923	1.0909	2.5923	1.0909
0.6000	0.2626	0.5347	0.2153	4.4028	1.3095	2.3086	0.9188	2.3086	0.9188
0.7000	0.3063	0.5626	0.2172	4.1732	1.1778	2.0847	0.7887	2.0847	0.7887
0.8000	0.3501	0.5852	0.2178	3.9873	1.0759	1.9045	0.6884	1.9045	0.6884
0.9000	0.3939	0.6039	0.2175	3.8341	0.9956	1.7567	0.6095	1.7567	0.6095
1.0000	0.4376	0.6196	0.2168	3.7057	0.9311	1.6338	0.5465	1.6338	0.5465
1.1000	0.4814	0.6329	0.2159	3.5968	0.8787	1.5301	0.4955	1.5301	0.4955
1.2000	0.5252	0.6444	0.2150	3.5031	0.8354	1.4415	0.4536	1.4415	0.4536
1.3000	0.5689	0.6545	0.2140	3.4216	0.7991	1.3651	0.4187	1.3651	0.4187
1.4000	0.6127	0.6633	0.2131	3.3501	0.7685	1.2985	0.3894	1.2985	0.3894
1.5000	0.6565	0.6712	0.2122	3.2868	0.7422	1.2400	0.3645	1.2400	0.3645
1.6000	0.7002	0.6782	0.2114	3.2303	0.7195	1.1882	0.3431	1.1882	0.3431
1.7000	0.7440	0.6845	0.2107	3.1794	0.6997	1.1419	0.3245	1.1419	0.3245
1.8000	0.7877	0.6903	0.2101	3.1334	0.6823	1.1004	0.3083	1.1004	0.3083
1.9000	0.8315	0.6955	0.2094	3.0914	0.6668	1.0629	0.2940	1.0629	0.2940
2.0000	0.8753	0.7003	0.2089	3.0530	0.6529	1.0289	0.2813	1.0289	0.2813

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4376
FMax	0.8074	0.3534
F0.1	0.3654	0.1599
F35%SPR	0.3736	0.1635

Table 7.10.19. Plaice in Divisions VIIf&g. MSY analysis sen file.

```
Input to sensitivity analysis,
PLE,VIIF
  1,  9, 2009,  3
  1, 0, 0
 'N1'  ,      2815, 0.56
 'N2'  ,      2679, 0.42
 'N3'  ,      1608, 0.32
 'N4'  ,      1682, 0.30
 'N5'  ,       639, 0.23
 'N6'  ,       329, 0.20
 'N7'  ,       135, 0.19
 'N8'  ,        60, 0.18
 'N9'  ,        88, 0.18
 'sH1' ,     0.000, 0.00
 'sH2' ,     0.080, 0.34
 'sH3' ,     0.296, 0.28
 'sH4' ,     0.492, 0.18
 'sH5' ,     0.511, 0.10
 'sH6' ,     0.451, 0.17
 'sH7' ,     0.372, 0.23
 'sH8' ,     0.306, 0.3
 'sH9' ,     0.306, 0.3
 'WH1' ,     0.208, 0.26
 'WH2' ,     0.245, 0.14
 'WH3' ,     0.288, 0.05
 'WH4' ,     0.340, 0.08
 'WH5' ,     0.406, 0.11
 'WH6' ,     0.487, 0.11
 'WH7' ,     0.582, 0.10
 'WH8' ,     0.691, 0.08
 'WH9' ,     0.948, 0.07
 'WS1' ,     0.162, 0.29
 'WS2' ,     0.203, 0.13
 'WS3' ,     0.255, 0.05
 'WS4' ,     0.312, 0.05
 'WS5' ,     0.371, 0.09
 'WS6' ,     0.444, 0.11
 'WS7' ,     0.532, 0.10
 'WS8' ,     0.635, 0.09
 'WS9' ,     0.878, 0.08
 'M1'  ,      0.12, 0.10
 'M2'  ,      0.12, 0.10
 'M3'  ,      0.12, 0.10
 'M4'  ,      0.12, 0.10
 'M5'  ,      0.12, 0.10
 'M6'  ,      0.12, 0.10
 'M7'  ,      0.12, 0.10
 'M8'  ,      0.12, 0.10
 'M9'  ,      0.12, 0.10
 'MT1' ,      0.00, 0.00
 'MT2' ,      0.26, 0.10
 'MT3' ,      0.52, 0.10
 'MT4' ,      0.86, 0.10
 'MT5' ,      1.00, 0.00
 'MT6' ,      1.00, 0.00
 'MT7' ,      1.00, 0.00
 'MT8' ,      1.00, 0.00
 'MT9' ,      1.00, 0.00
 'R11' ,      2815, 0.35
 'R12' ,      2815, 0.35
 'HF10',         1, 0.10
 'HF11',         1, 0.10
 'HF12',         1, 0.10
 'K10' ,         1, 0.10
 'K11' ,         1, 0.10
 'K12' ,         1, 0.10
Plaice
Celtic Sea
 1
  1  9  1
 1
H.cons.
  3  6
 1977      2009
 Stock numbers in 2010 are
survivors.
-1
```

Table 7.10.20. Plaice in Divisions VIIf&g. MSY analysis sum file.

Stock summary Plaice Celtic Sea 2010WG
12
1 0 0
Year
1977 2009
Recruits, age 1, (thousands)
1 1000
SSB, (tonnes)
1
TSB, (tonnes)
1
Catch, Total (tonnes)
1
Catch, H.cons (tonnes)
1
Not used
1
Not used
1
Mean F, Total
3 6
Mean F, H.cons.
3 6
Not used
0 0
Not used
0 0

1977	3582	1169	2345	757	757	0	0	0.632	0.632	0	0
1978	4964	1010	2131	875	875	0	0	0.673	0.673	0	0
1979	8004	1323	3238	863	863	0	0	0.6664	0.6664	0	0
1980	5544	1789	4078	1373	1373	0	0	0.5416	0.5416	0	0
1981	2049	1792	3200	1377	1377	0	0	0.4879	0.4879	0	0
1982	3545	2054	3255	1303	1303	0	0	0.6304	0.6304	0	0
1983	9224	1938	3682	1146	1146	0	0	0.5515	0.5515	0	0
1984	10191	2297	7100	1210	1210	0	0	0.6686	0.6686	0	0
1985	7905	2635	5547	1752	1752	0	0	0.5021	0.5021	0	0
1986	8204	2814	4185	1691	1691	0	0	0.5285	0.5285	0	0
1987	12045	3245	6042	1901	1901	0	0	0.6667	0.6667	0	0
1988	7287	3801	8812	2116	2116	0	0	0.6323	0.6323	0	0
1989	3044	3140	5029	2151	2151	0	0	0.6605	0.6605	0	0
1990	2184	3380	5272	2082	2082	0	0	0.7659	0.7659	0	0
1991	4778	2744	4339	1501	1501	0	0	0.6008	0.6008	0	0
1992	4500	2479	3803	1188	1188	0	0	0.5219	0.5219	0	0
1993	2896	2008	3470	1114	1114	0	0	0.4614	0.4614	0	0
1994	3951	1927	3113	1070	1070	0	0	0.5348	0.5348	0	0
1995	5242	1956	3964	1028	1028	0	0	0.6726	0.6726	0	0
1996	3827	1780	3812	952	952	0	0	0.5578	0.5578	0	0
1997	3338	1768	3340	1217	1217	0	0	0.7211	0.7211	0	0
1998	2235	1659	2932	1067	1067	0	0	0.6586	0.6586	0	0
1999	2199	1363	1994	968	968	0	0	0.7323	0.7323	0	0
2000	3229	1165	2020	718	718	0	0	0.6076	0.6076	0	0
2001	2280	1241	2596	714	714	0	0	0.5008	0.5008	0	0
2002	2039	1048	1762	642	642	0	0	0.7087	0.7087	0	0
2003	1261	1038	1783	594	594	0	0	0.6325	0.6325	0	0
2004	2034	863	1426	510	510	0	0	0.6269	0.6269	0	0
2005	2814	798	1637	386	386	0	0	0.476	0.476	0	0
2006	2156	842	2084	404	404	0	0	0.4362	0.4362	0	0
2007	3535	859	1878	410	410	0	0	0.4969	0.4969	0	0
2008	2191	1063	2104	437	437	0	0	0.4084	0.4084	0	0
2009	3021	1128	2231	463	463	0	0	0.4075	0.4075	0	0

Table 7.10.21. Plaice in Divisions VIIfg. Estimates of biomass and fishing mortality reference levels derived from the fit of three stock and recruit relationships and the yield-per-recruit F_{msy} proxies.

Stock name
Plaice VIIfg
Sen filename
wgcse_ple-celt.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
700/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Determinis	0.98	0.35	3631	1164	1.12	0.32	3.75	0.00028	54.04
Mean	1.23	0.38	4515	1387	1.15	0.34	3.96	0.00029	
5%ile	0.57	0.25	2186	818	0.95	0.13	2.66	0.00011	
25%ile	0.78	0.31	2801	1017	1.05	0.26	3.34	0.00022	
50%ile	1.01	0.36	3599	1180	1.13	0.33	3.84	0.00029	
75%ile	1.45	0.43	4692	1462	1.23	0.43	4.51	0.00037	
95%ile	2.73	0.56	8981	2337	1.38	0.55	5.50	0.00047	
CV	0.59	0.25	1.00	0.73	0.12	0.38	0.22	0.38	

Beverton-Holt
616/1000 Iterations resulted in feasible parameter estimates

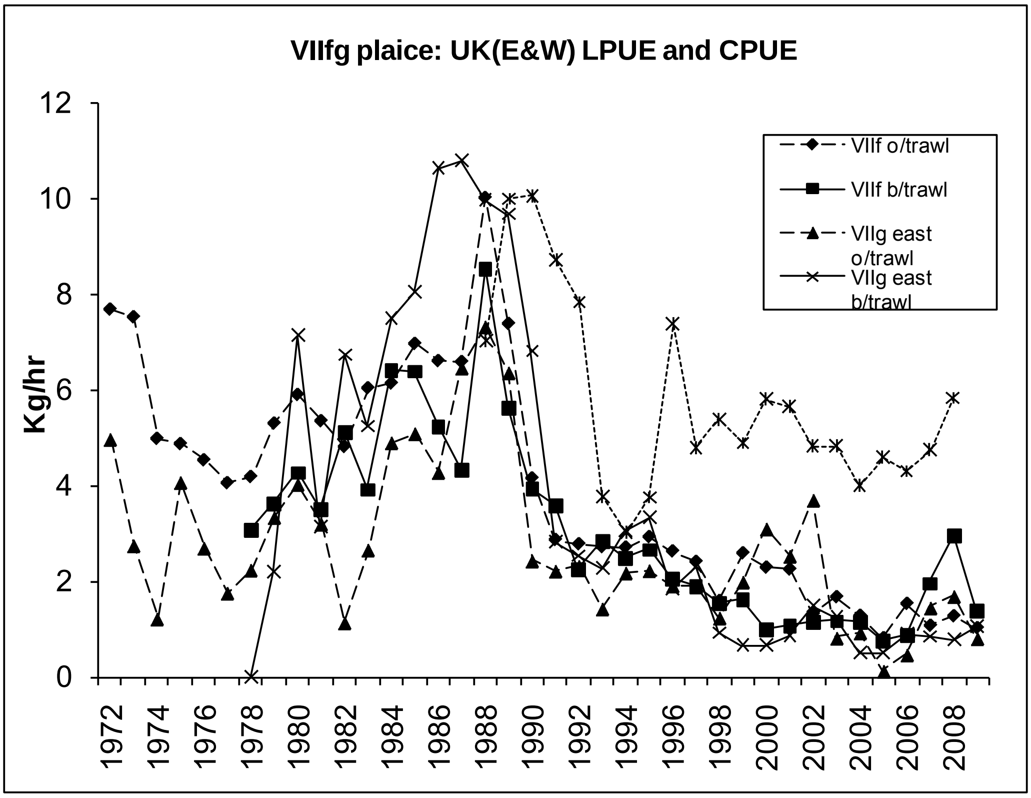
	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Determinis	1.20	0.19	8666	1484	0.35	0.90	8097	1841	54.38
Mean	1.36	0.18	37227	2313	0.33	0.94	11735	3550	
5%ile	0.53	0.03	4001	876	0.10	0.78	4955	594	
25%ile	0.79	0.14	7034	1234	0.23	0.86	6672	1304	
50%ile	1.11	0.19	10303	1653	0.33	0.93	8585	2083	
75%ile	1.64	0.22	23139	2430	0.42	1.00	12108	3768	
95%ile	3.12	0.28	171972	5586	0.57	1.13	27540	10160	
CV	0.60	0.43	2.15	1.02	0.42	0.11	0.98	1.51	

Smooth hockeystick
719/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Determinis	0.62	0.35	3790	1193	0.51	1.13	1.24	2059	54.55
Mean	0.72	0.34	14968	1352	0.55	1.14	1.32	2069	
5%ile	0.43	0.03	1889	834	0.44	0.67	1.05	1221	
25%ile	0.56	0.23	2722	1090	0.49	0.90	1.18	1640	
50%ile	0.66	0.34	4189	1270	0.53	1.13	1.28	2062	
75%ile	0.80	0.46	7107	1537	0.59	1.31	1.42	2395	
95%ile	1.19	0.66	85576	2200	0.72	1.67	1.74	3047	
CV	0.38	0.57	2.08	0.29	0.17	0.27	0.17	0.27	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Determinis	0.16	0.14	0.16	0.35	0.74	0.23	0	0
Mean	0.15	0.13	0.15	0.44	2.87	0.26		
5%ile	0.00	0.00	0.00	0.03	0.38	0.19		
25%ile	0.10	0.09	0.10	0.23	0.51	0.22		
50%ile	0.16	0.14	0.16	0.35	0.79	0.24		
75%ile	0.21	0.18	0.21	0.49	1.33	0.28		
95%ile	0.26	0.22	0.29	1.35	16.81	0.37		
CV	0.54	0.54	0.57	1.05	2.04	0.22		



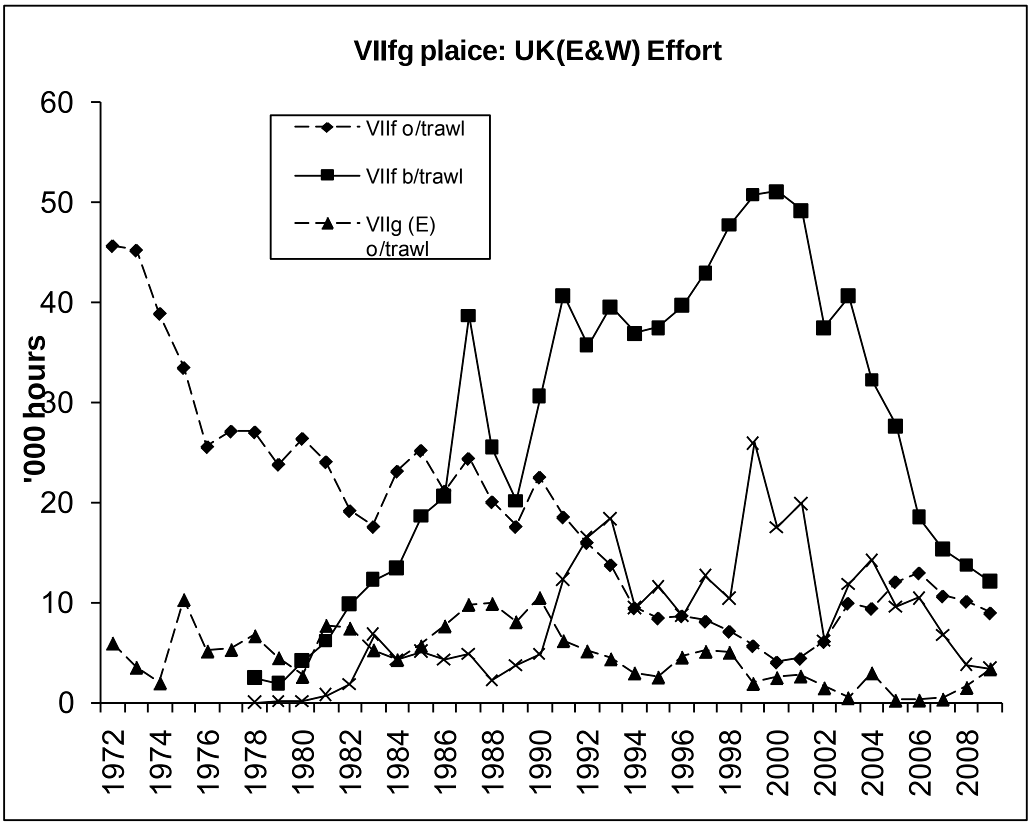


Figure 7.10.1. Plaice in Division VIIf&g. UK (E&W) lpue and effort by fleet.

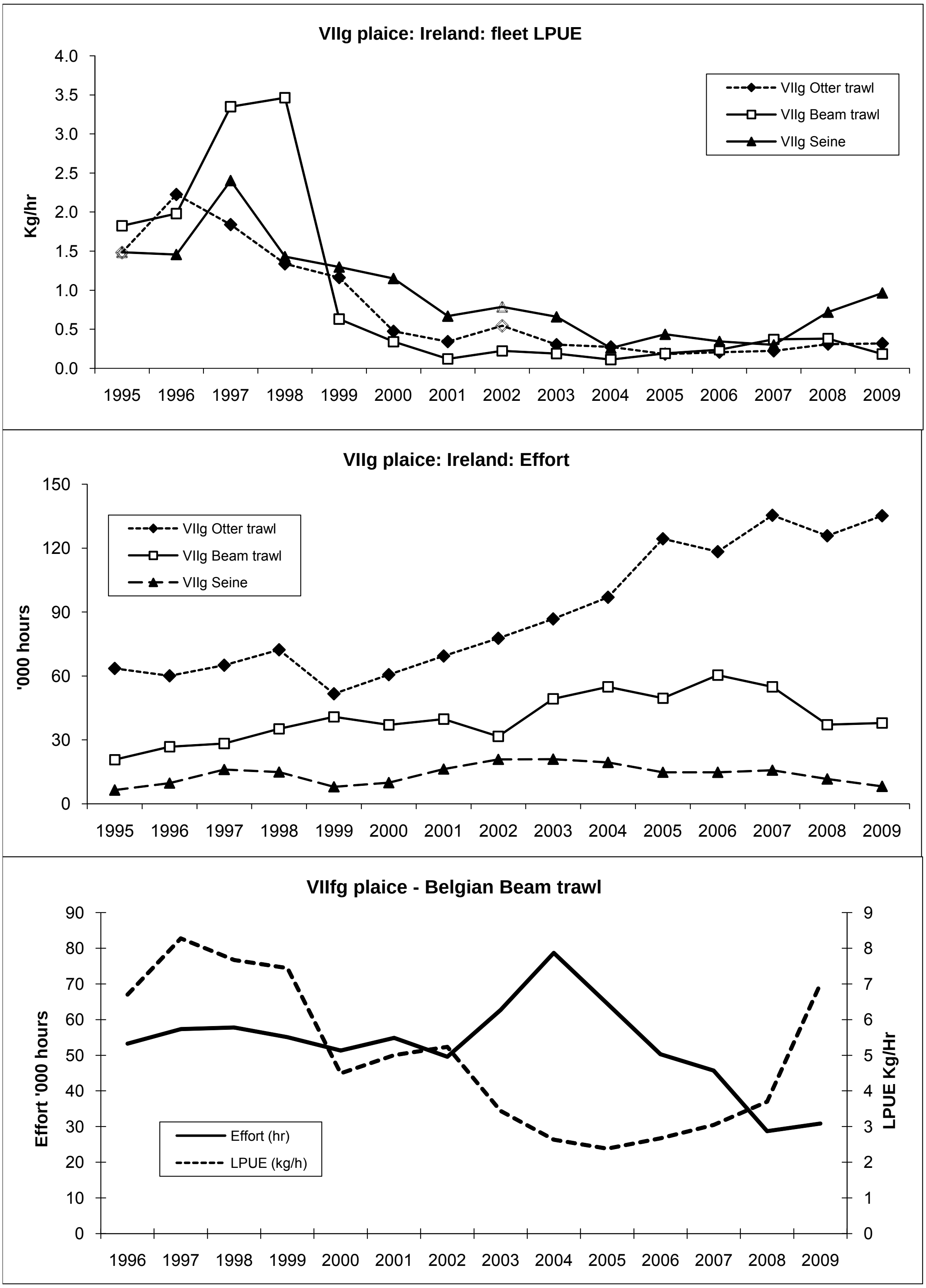


Figure 7.10.2. Plaice in Division VIIf&g. Ireland and Belgium: lpue and effort by fleet.

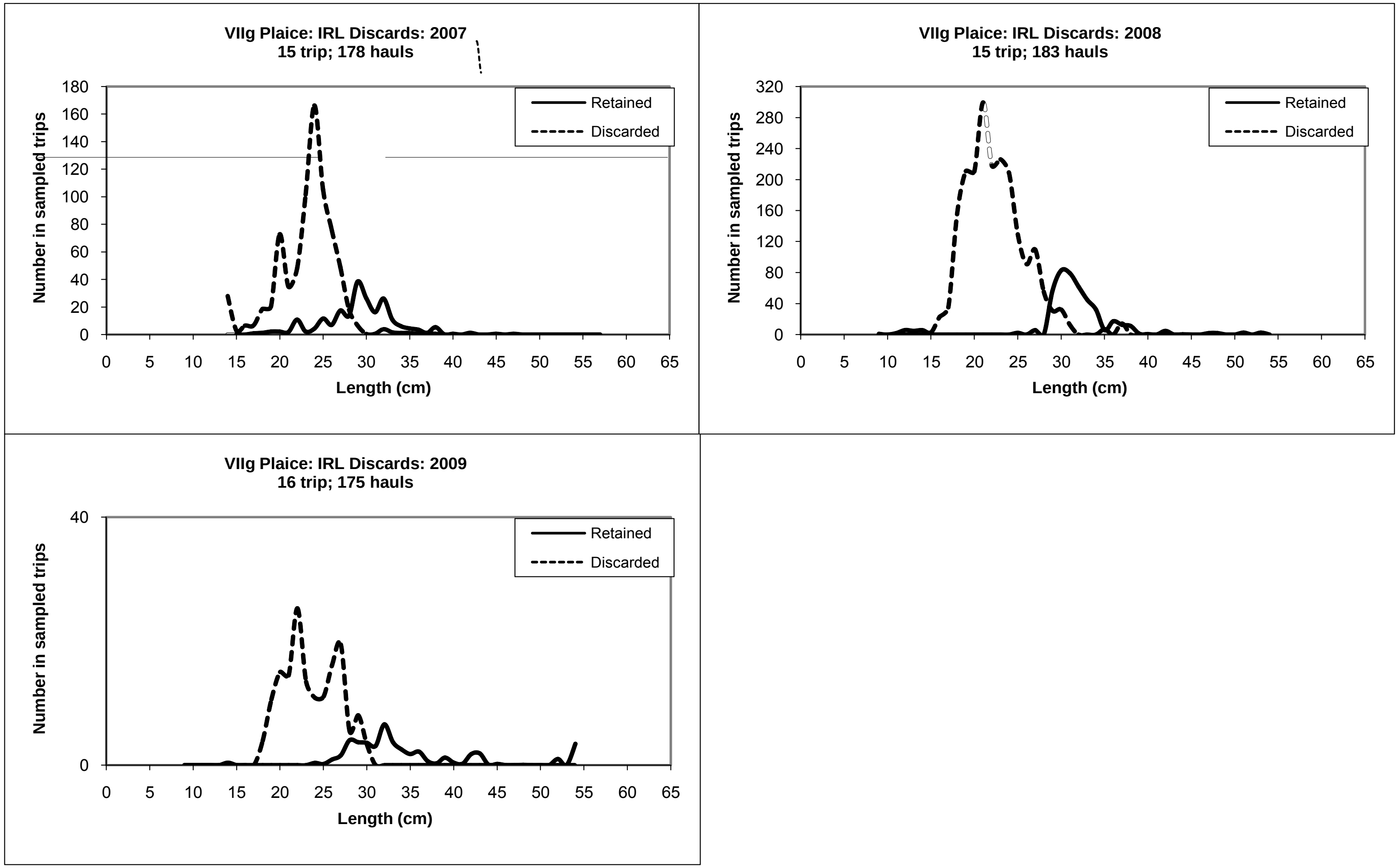


Figure 7.10.3a. Plaice in Division VIIf&g. Ireland otter trawl discard sampling results in 2007–2009: raised to sampled trips.

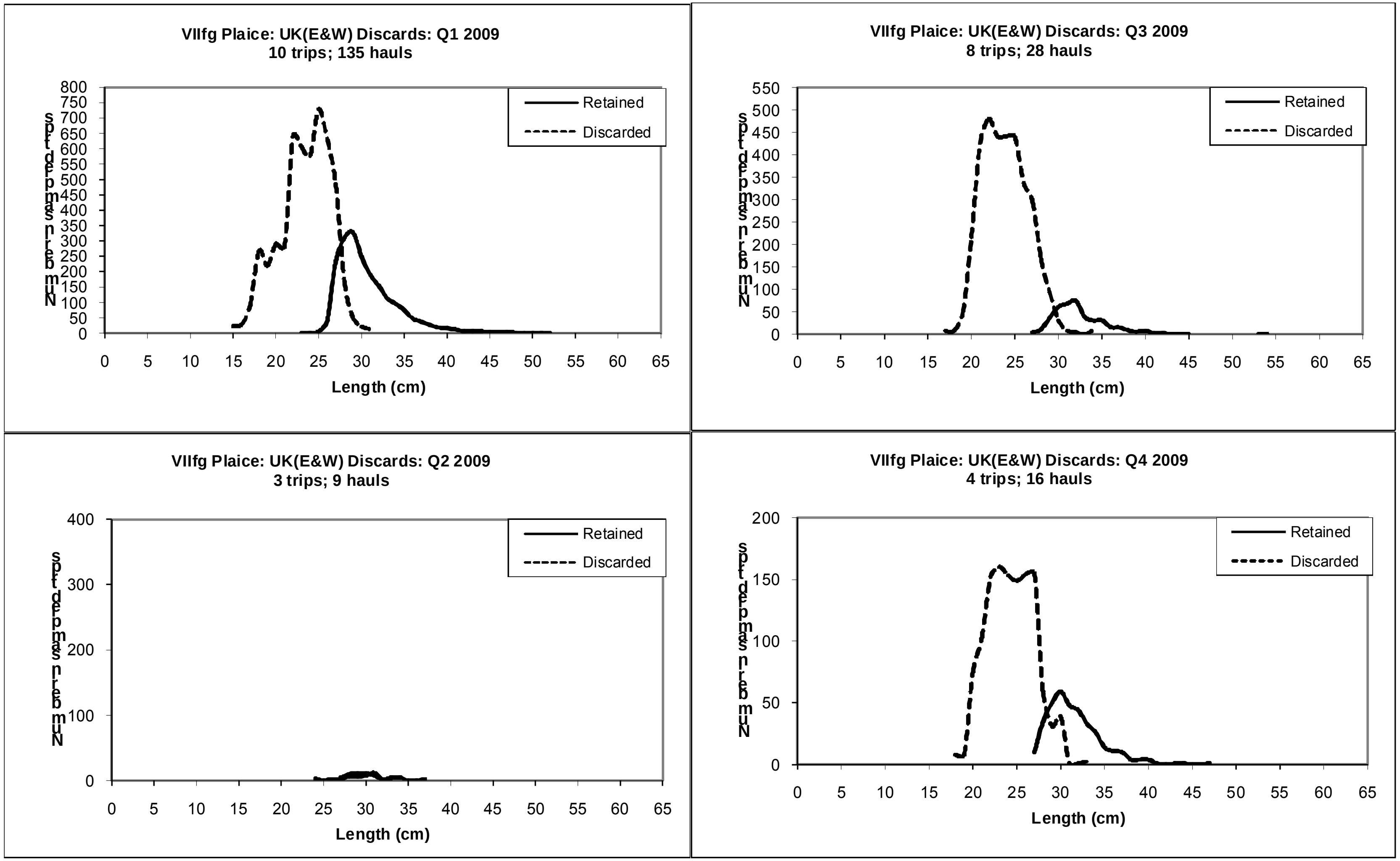


Figure 7.10.3b. Plaice in Division VIIf&g. UK (E&W) Discard sampling results in 2009: raised to sampled trips. All gears

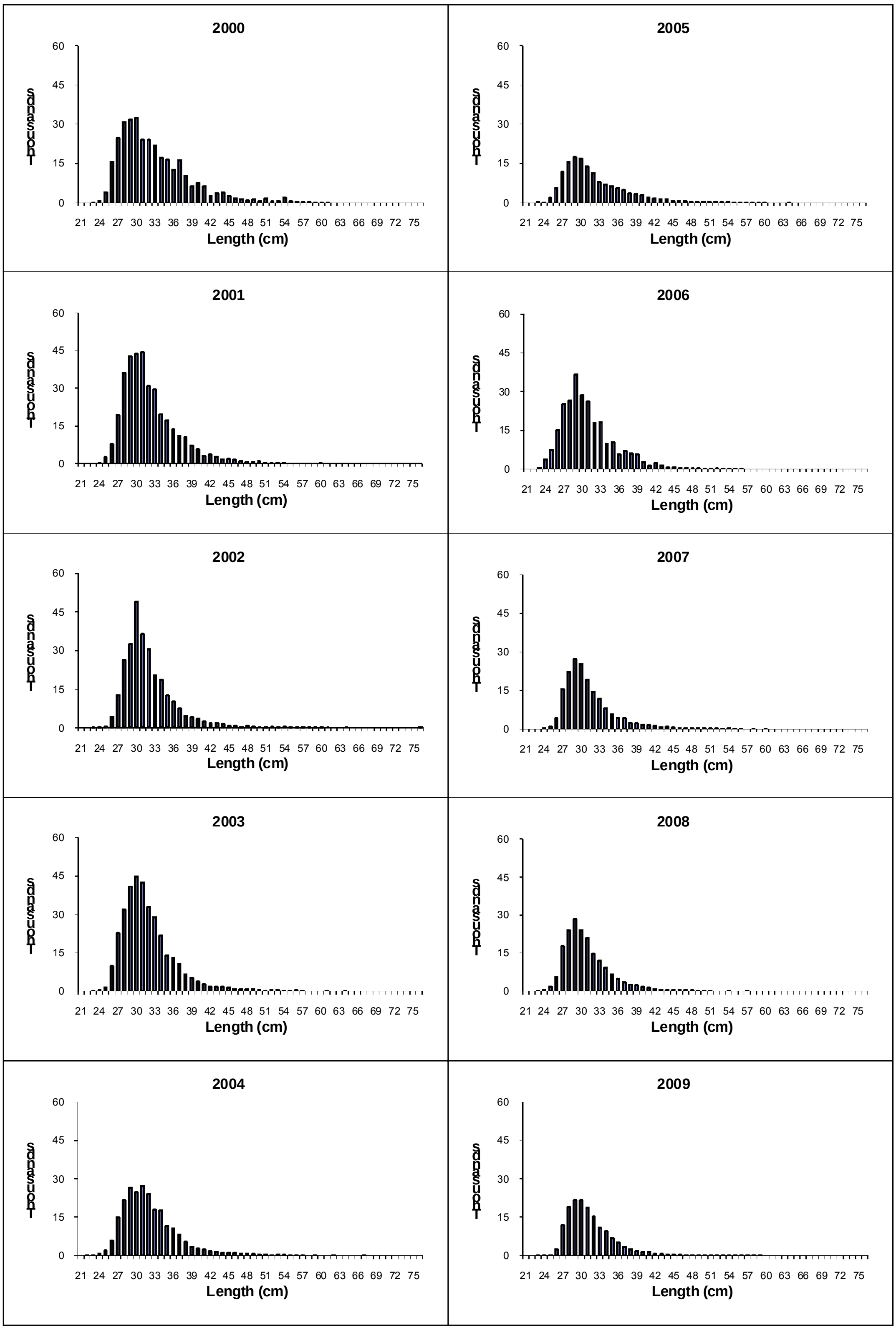


Figure 7.10.4. Plaice in Division VIIf&g. Length distributions of UK (England & Wales) landings from 2000 to 2009.

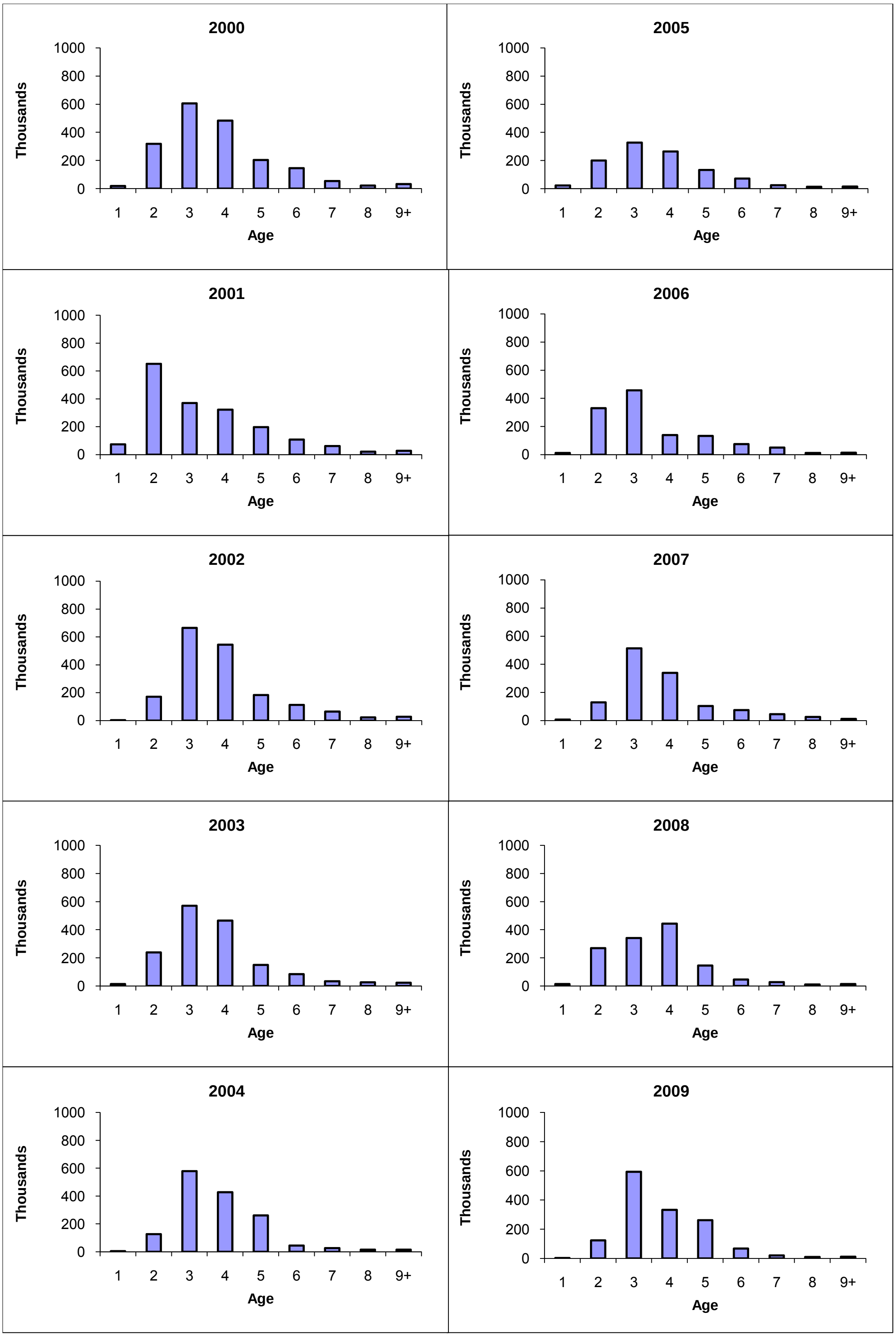


Figure 7.10.4. Plaice in Division VIIf&g. Age composition of International landings from 2000 to 2009.

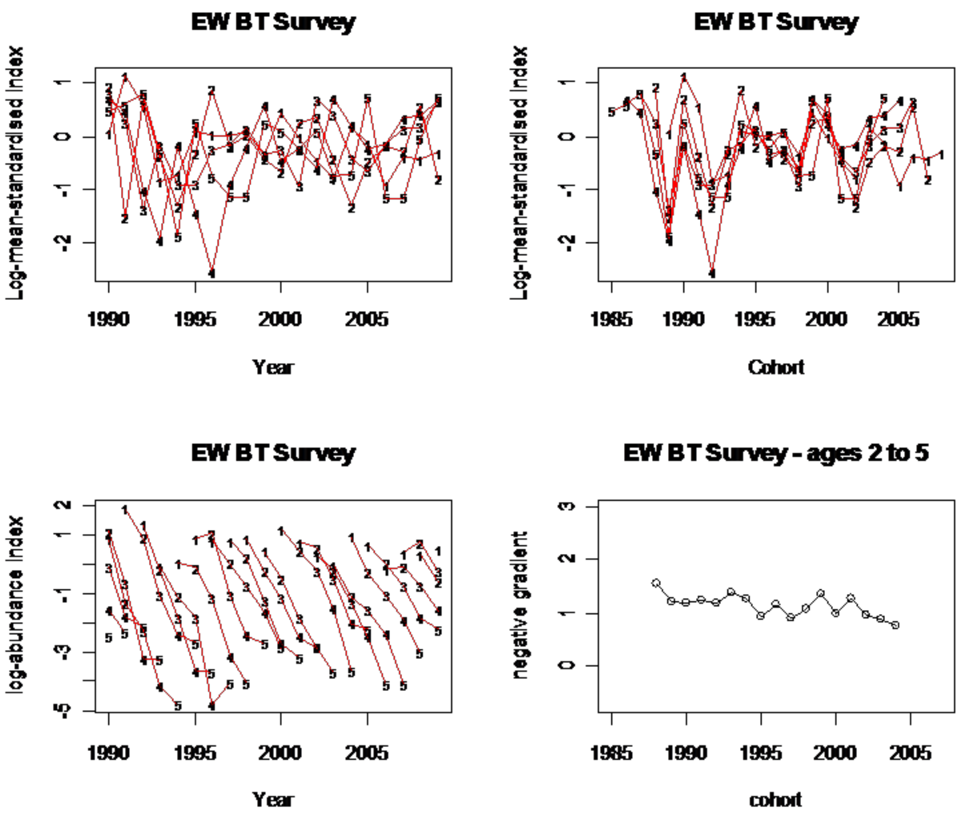


Figure 7.10.6. UK (BTS-Q3) Beam trawl survey log cpue by year, year class, log catch curves and the negative slope of the catch curves (~Z).

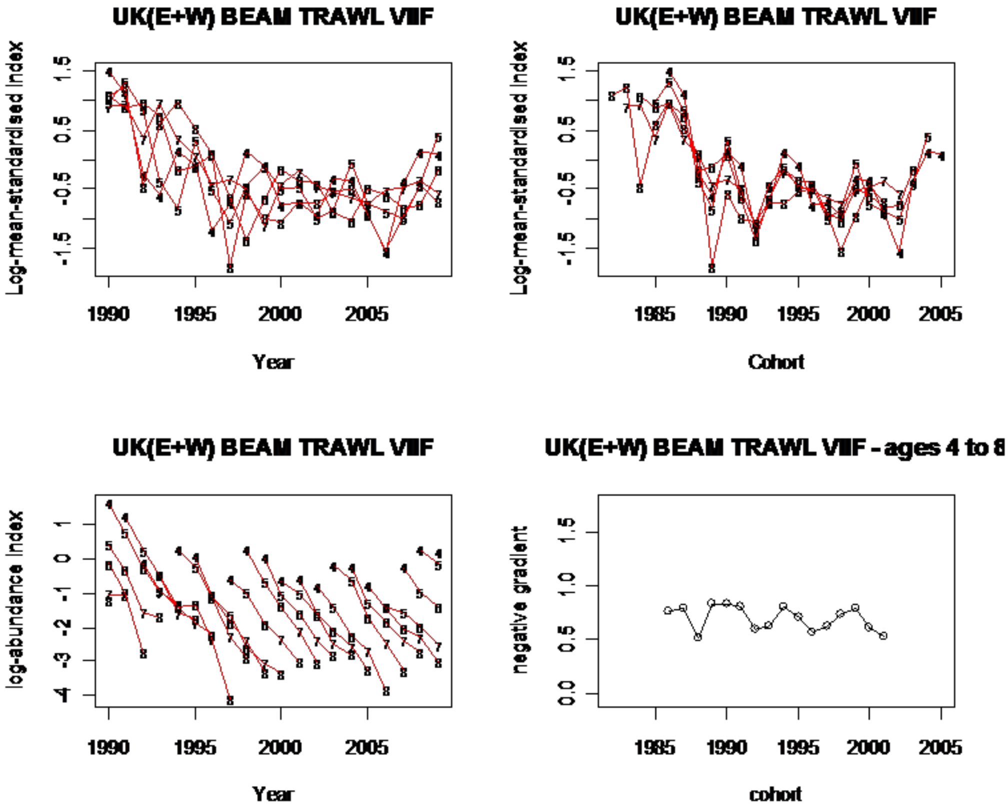


Figure 7.10.7a. UK EW Beam trawl fleet log cpue by year, year class, log catch curves and the negative slope of the catch curves (~Z).

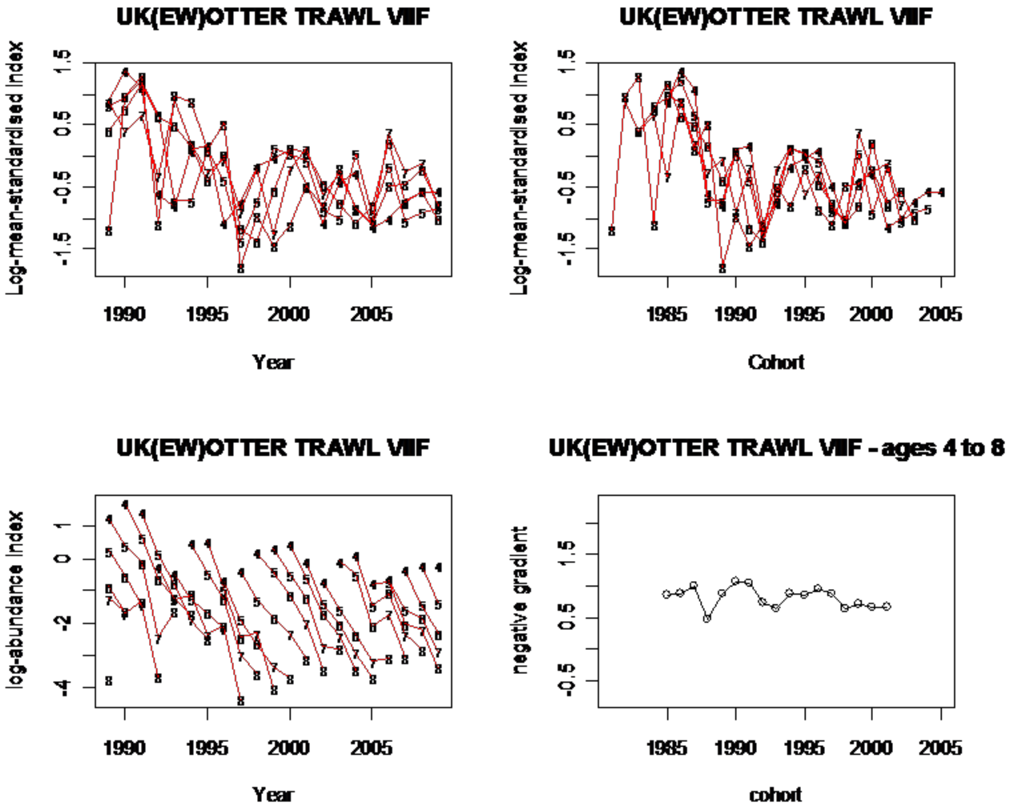


Figure 7.10.7b. UK EW Otter trawl fleet log cpue by year, year class, log catch curves and the negative slope of the catch curves (~Z).

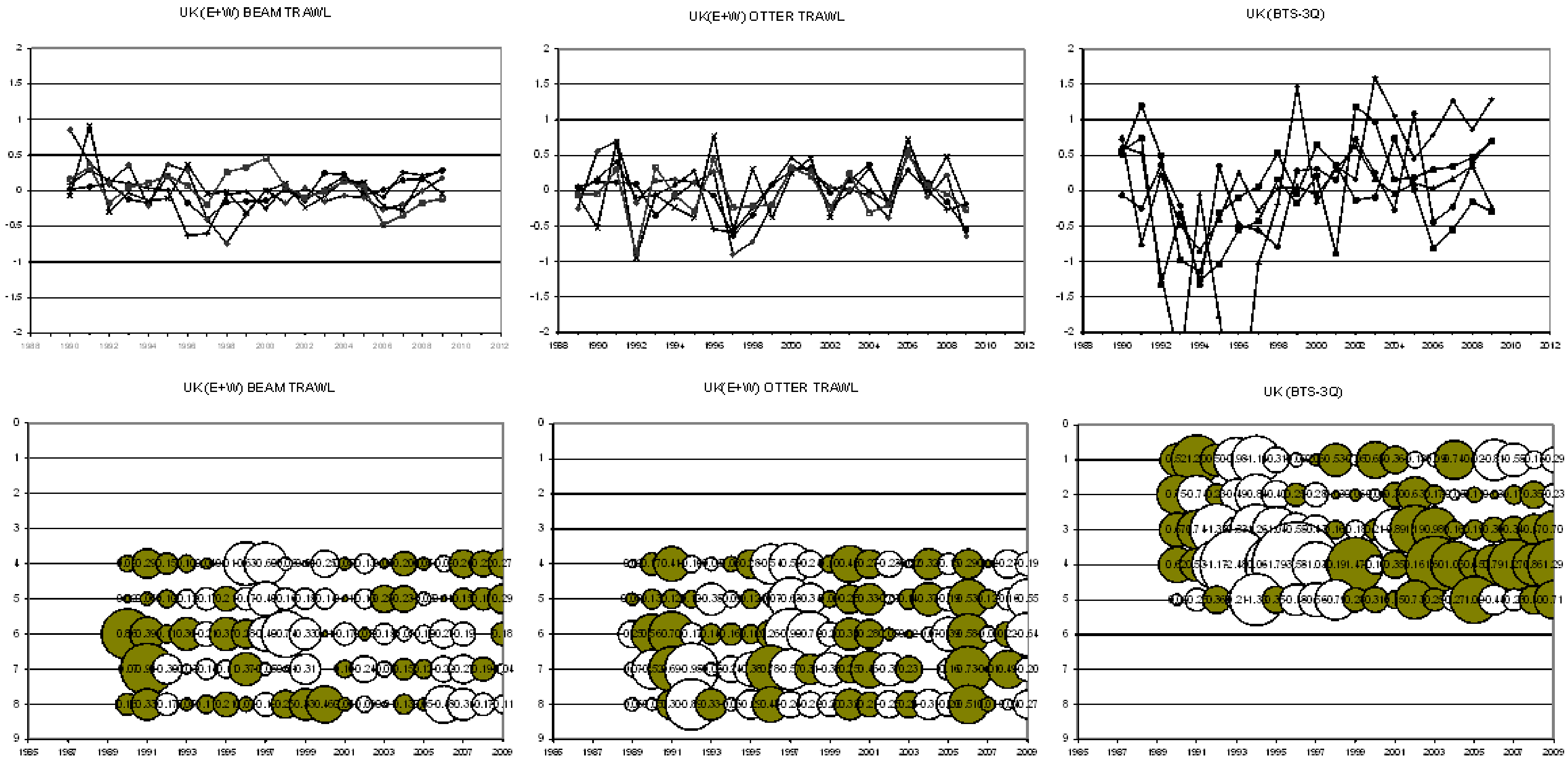


Figure 7.10.8. Plaice in Division VIIf&g. Commercial fleet and survey log catchability residuals from the final run.

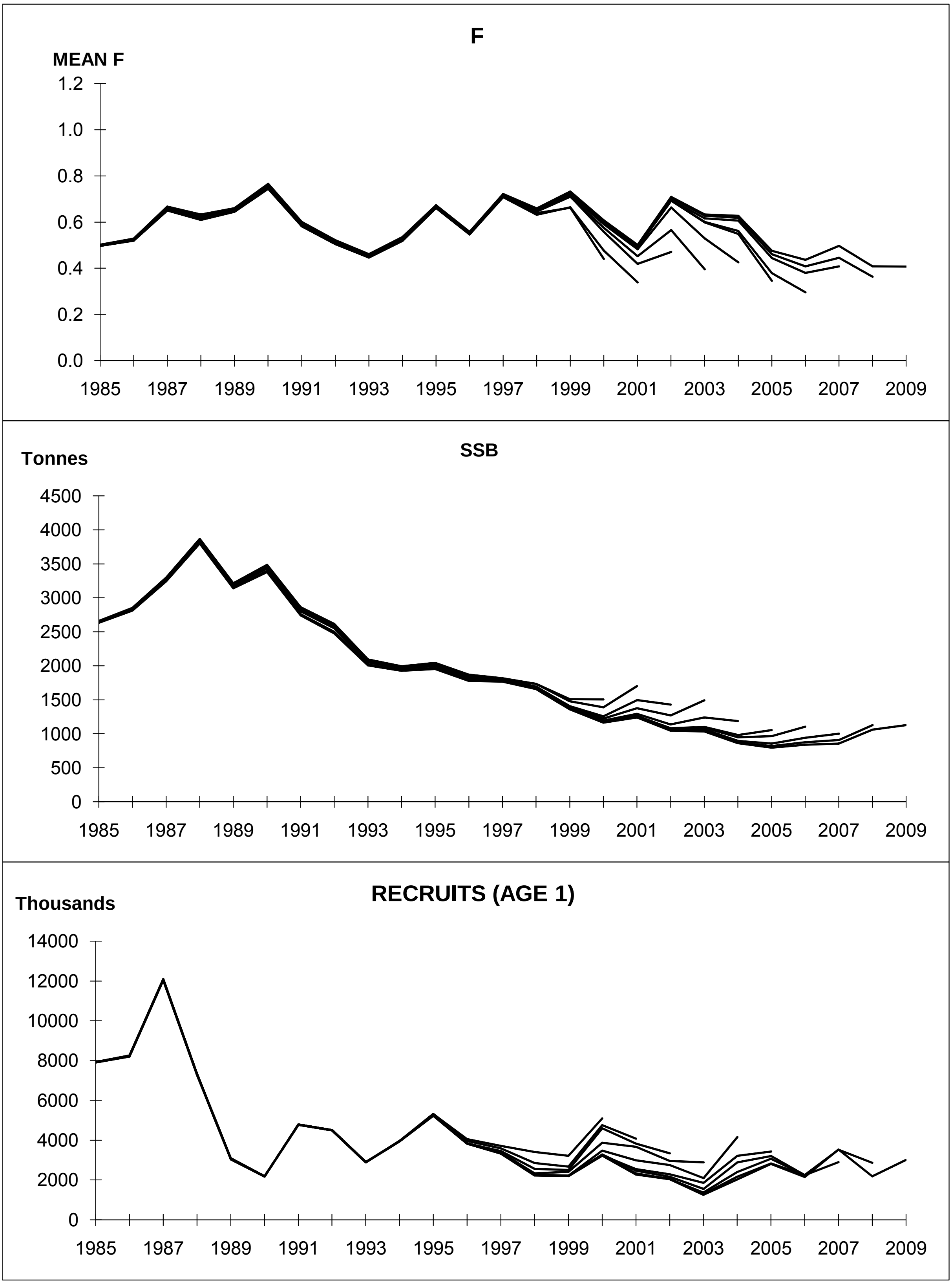


Figure 7.10.9. Plaice in Division VIIf&g. Assessment model estimate retrospective bias.

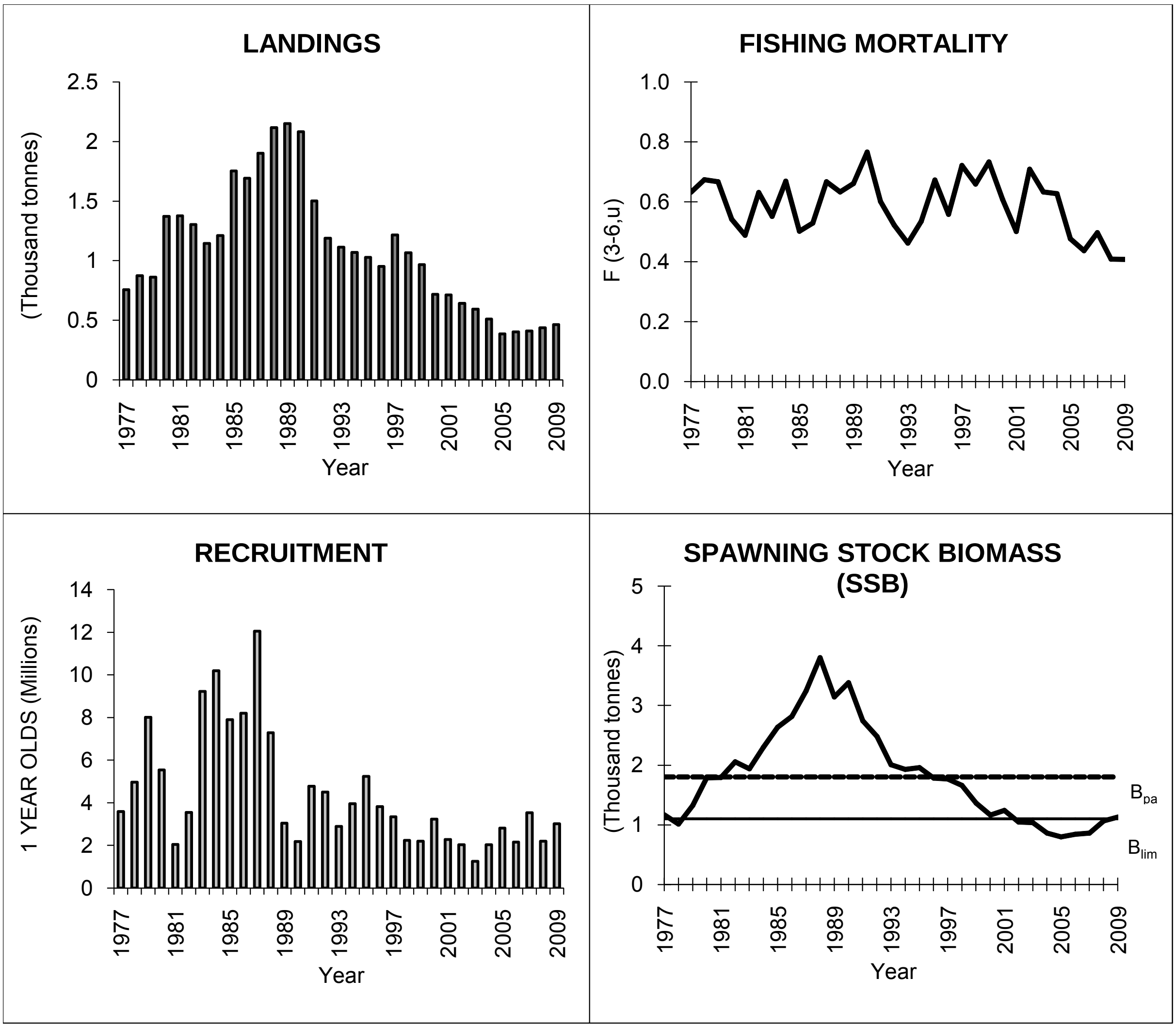


Figure 7.10.10. Plaice in Division VIIf&g. The time-series of stock and fishery trends.

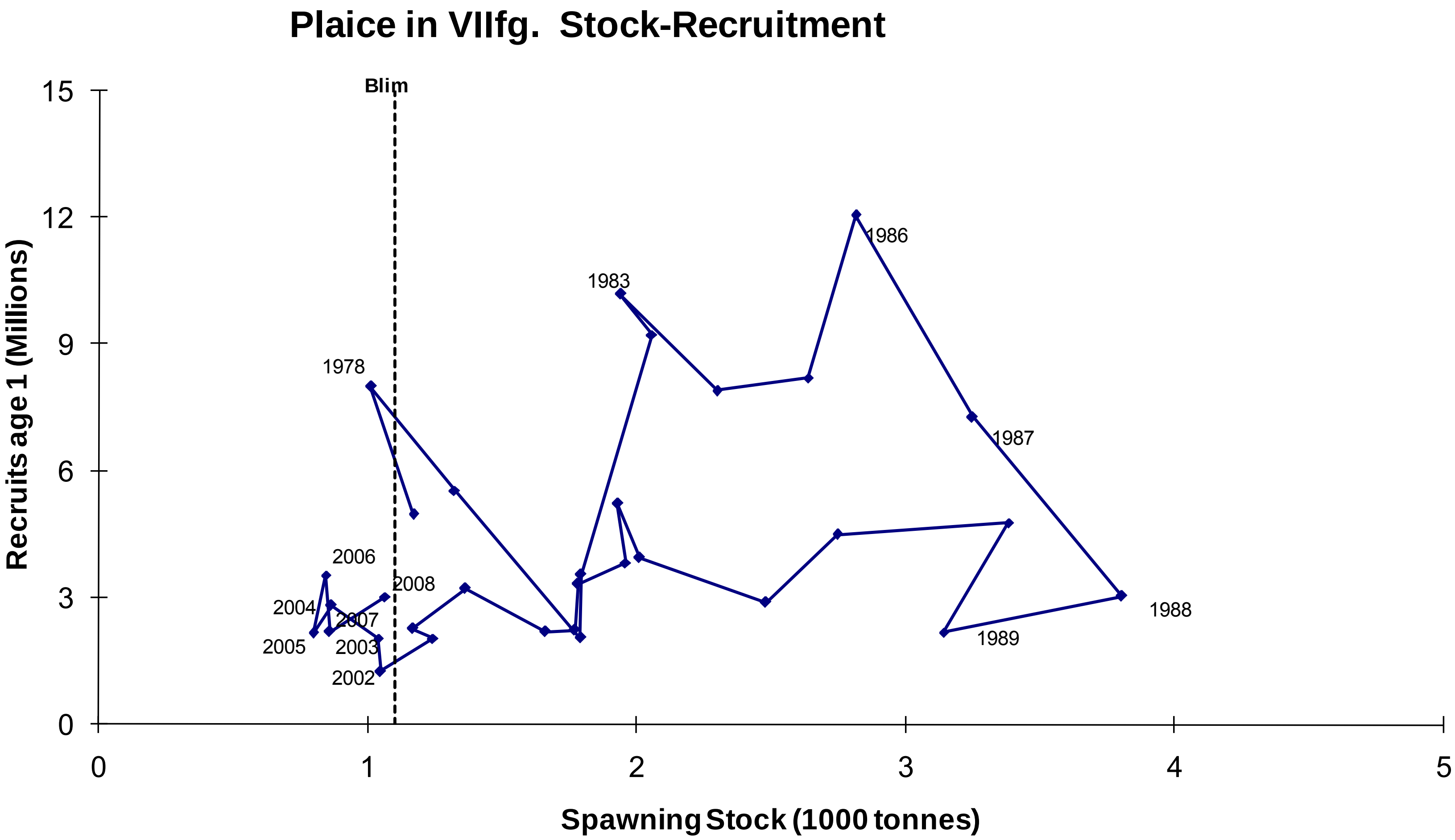
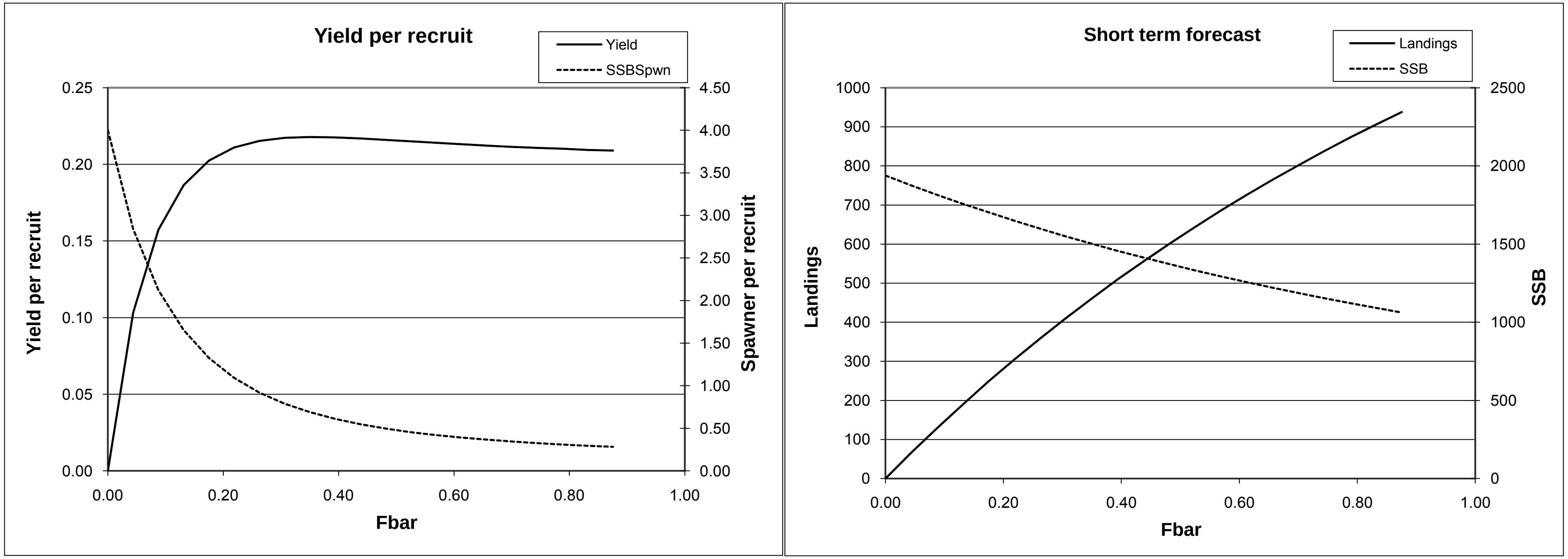


Figure 7.10.11. Plaice in Division VIIf&g. Stock and recruitment.



MFYPR version 2a
Run: Plaice_VIIfg_yield
Time and date: 17:33 15/05/2010

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4376
FMax	0.8074	0.3534
F0.1	0.3654	0.1599
F35%SPR	0.3736	0.1635

MFDP version 1a
Run: Plaice_VIIfg_sq
CELTIC SEA PLAICE
Time and date: 17:19 15/05/2010
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 7.10.12. Plaice in Division VIIf&g. Yield-per-recruit and short-term forecast.

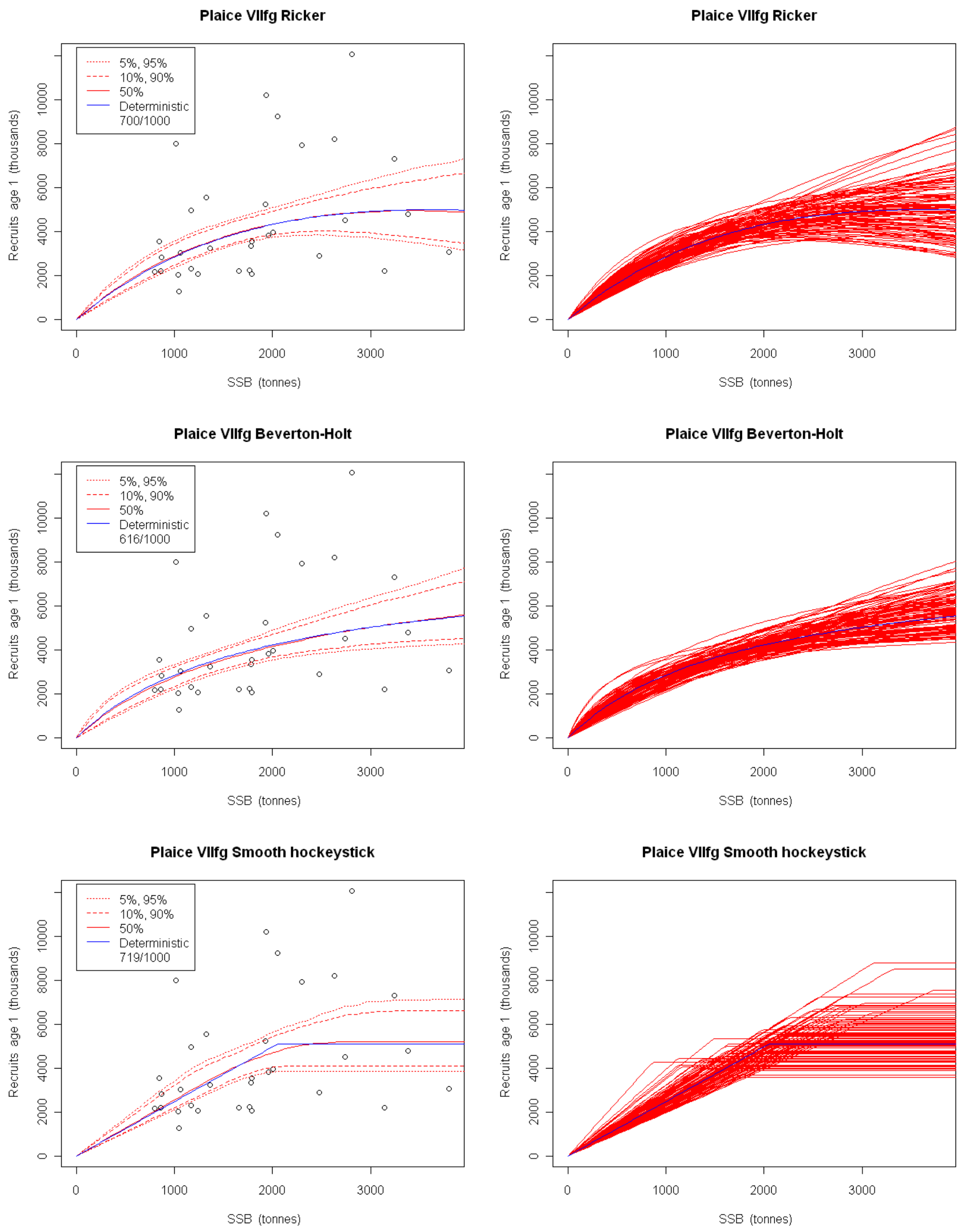


Figure 7.10.13. Plaice in Divisions VIIfg. MSY fitted stock and recruit relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{msy}. Right hand panels: curves plotted from the first 100 MCMC re-samples with converged F_{msy} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

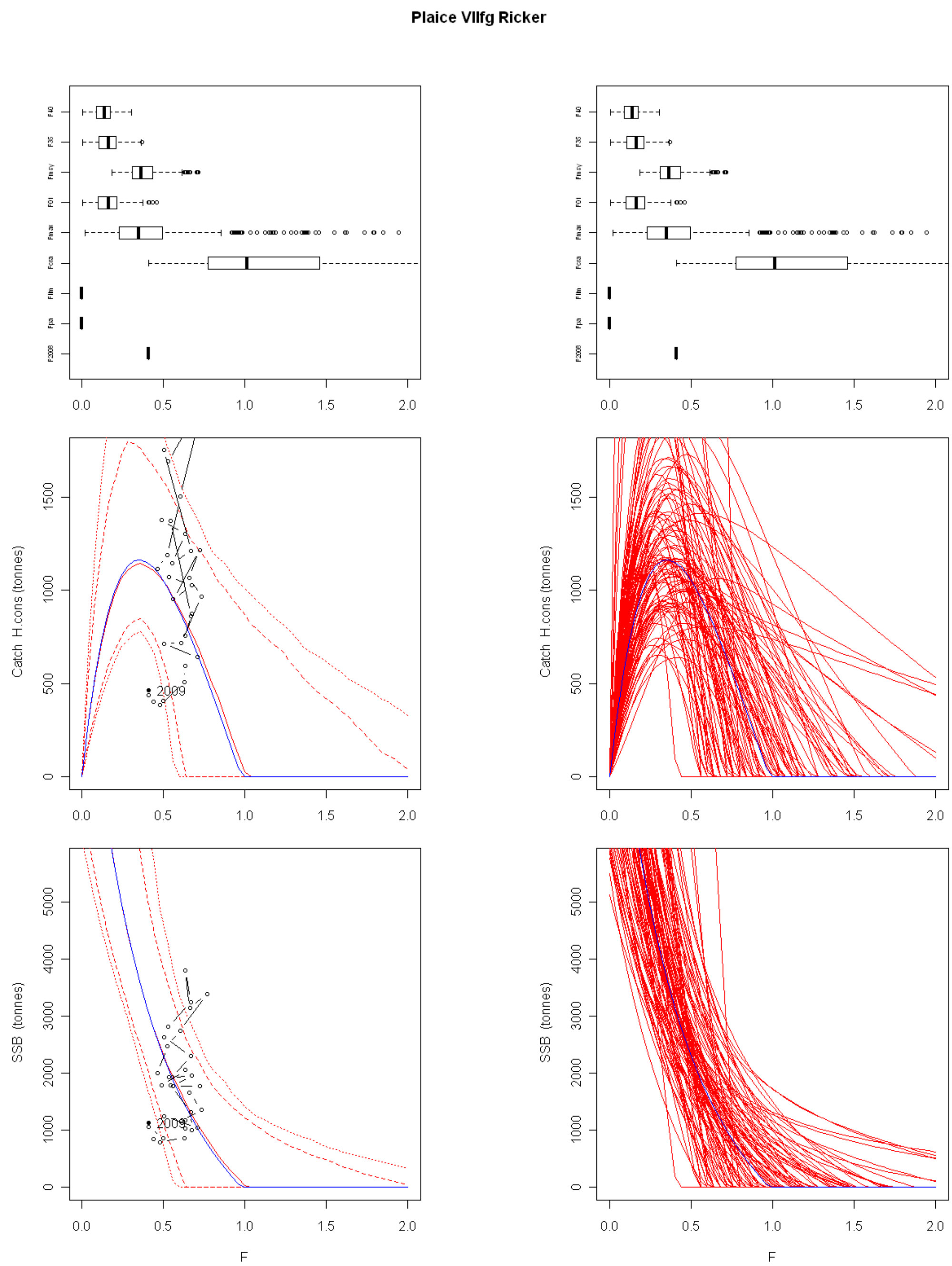


Figure 7.10.14. Plaice in Divisions VIIfg. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Ricker stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

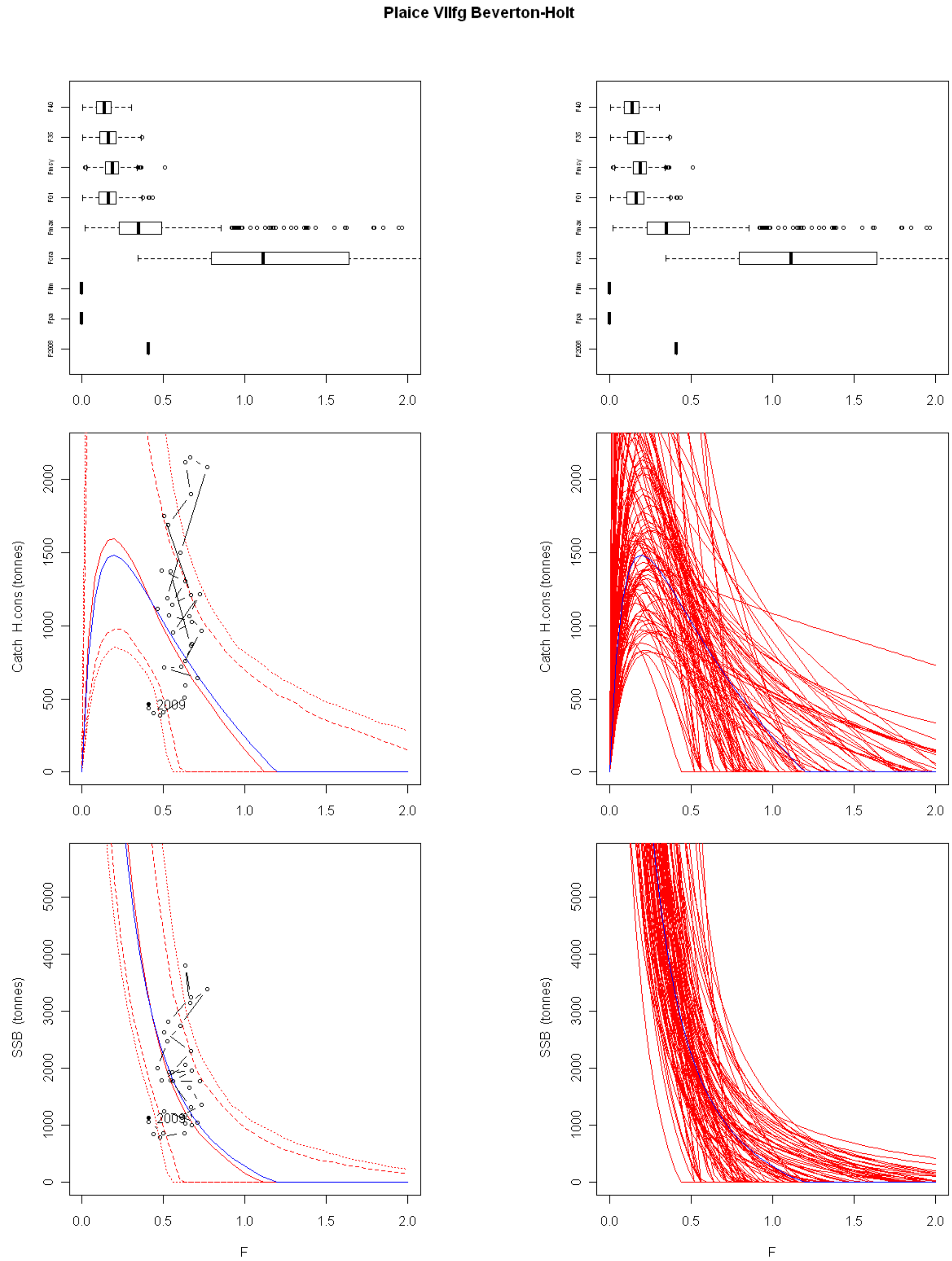


Figure 7.10.15. Plaice in Divisions VIIfg. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Beverton and Holt stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

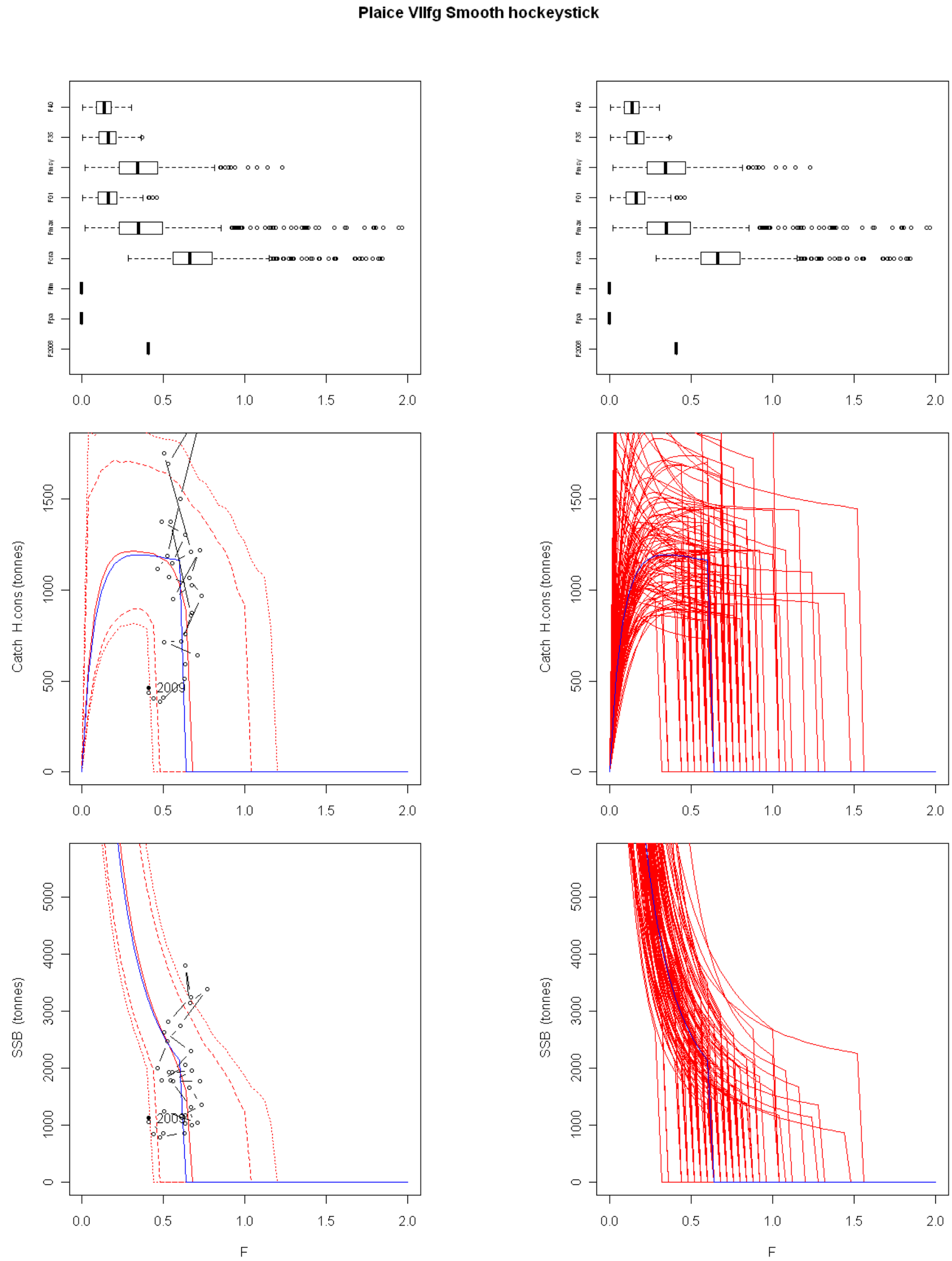


Figure 7.10.16. Plaice in Divisions VIIfg. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using smooth hockey stick stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

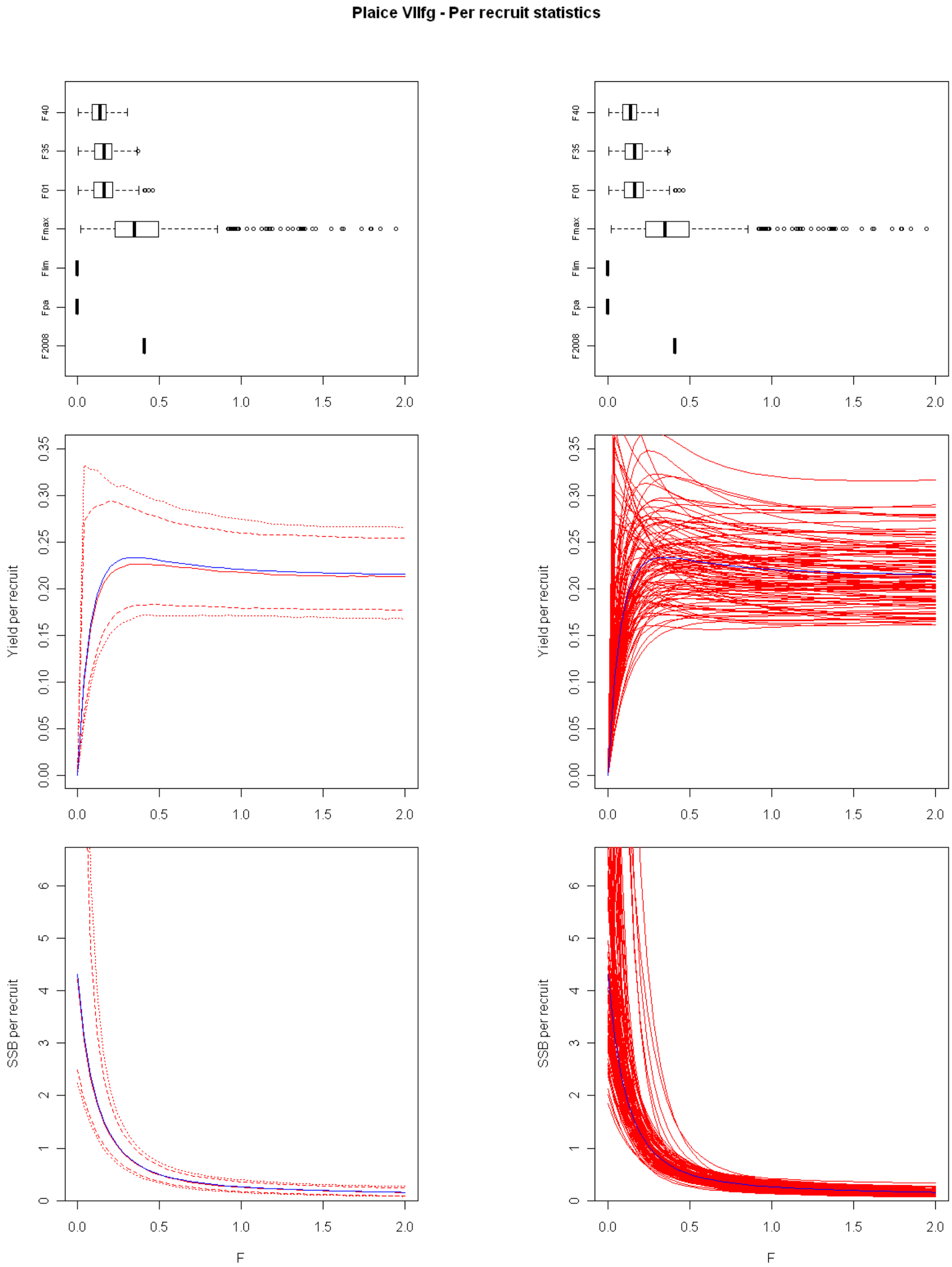


Figure 7.10.17. Plaice in Divisions VIIfg. Fitted yield-per-recruit F reference points, yield-per-recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.

7.11 Plaice in the Southwest of Ireland (ICES Divisions VIIh–k)

Type of assessment in 2010

No assessment was performed, however catch numbers and weights were aggregated for the Irish landings for the years 1993–2009 and these were used to perform a yield-per-recruit analysis for the VIIjk part of the stock.

7.11.1 General

Stock Identity

Plaice in VIIj are mainly caught by Irish vessels on sandy grounds off counties Kerry and west Cork. Plaice catches in VIIk are negligible. VIIh is also considered part of the stock for assessment purposes but there is no evidence to suggest that this is actually the same stock.

7.11.2 Data

The nominal landings are given in Table 7.11.1.

Most non-Irish landings were from VIIh which is likely to be a different stock. Because age data were only available for Irish landings (which were mainly from VIIjk) the remainder of Section 7.11 concerns Irish data only in VIIjk

Sampling

Figure 7.11.1 shows that plaice landings in VIIjk in 2009 were mostly taken in VIIj by otter trawlers. This was reflected in the sampling.

Data quality

Figure 7.11.2 shows the length distribution of the Irish landings in VIIjk between 1993 and 2009. Sample numbers appear to be adequate. There are no distinct modes of strong year classes discernible. One sample was removed (420-DEM196); it contained 192 plaice at 27 cm and no other length classes. In 1994 and 1995 a considerable number of small plaice (<20 cm) appeared in the samples. The most likely explanation for this is that discard fish were mistakenly entered as landings; these were therefore excluded from the analysis. The age data for 1995 were considered insufficient and for this year the combined age data for 1993–1996 were used.

Annual Age–Length-Keys (ALKs) were constructed (all quarters and gear types combined) and applied to the sampled length frequency distributions. Figure 7.11.3 shows the age distribution of plaice in VIIjk between 1993 and 2009.

7.11.3 Historical stock development

Because plaice in VIIh were not sampled, it would not be appropriate to raise the data to all landings in VIIhjk. Instead, the official International landings figures for VIIjk were used to raise the age distributions (Table 7.11.2).

The estimated catch numbers-at-age are given in Table 7.11.3, catch weights-at-age are given in Table 7.11.4. There appears to be relatively little contrast (particularly weak or strong year classes) in the catch numbers. This is also illustrated by Figure 7.11.4, which shows the standardised catch proportions-at-age. Figure 7.11.5 shows the log catch numbers-at-age. The rate of decline in catch numbers through the cohorts appears to be reasonably stable. This can be further investigated by calculating the slope of the log catch numbers (Z). Figure 7.11.6 shows the catch curve; plaice under the age of 4 are not fully selected and from age 7 onwards the data get quite noisy, therefore the slope of the log catch numbers was estimated over ages 4 to 7 (Figure 7.11.7). It appears that Z varied between 0.6 and 1.2. The estimate for Z appears to be quite variable. These levels of Z are quite high compared to other plaice stocks. There is a possibility that this can be the consequence of migration. If young fish are highly concentrated in inshore areas and have a higher catchability than older fish, which might be distributed more widely further offshore, this could result in apparent high levels of Z. This possibility will be investigated further intersessionally.

Yield-per-recruit

The yield-per-recruit was estimated using a method by Thompson and Bell (1934). This method requires the selectivity to be estimated. This was done by estimating the slope of the log catch numbers for ages that are fully selected and using this slope (Z) to predict the population numbers for ages that are not fully selected. The Z was estimated on pseudo-cohorts which were standardised to take account of annual variations in the catch numbers. Figure 7.11.8 shows that plaice in VIIjk appear to be fully selected by the age of 4 and that after the age of 9 the data get very sparse. Figure 7.11.9 shows the slope of the mean log standardised catch numbers. The predicted catch numbers from this slope were used to estimate the 'observed' selectivity. This was then modelled by applying a linear model after a logit transformation. The estimated selection curve is also shown in Figure 7.11.9. A natural mortality of 0.12 was assumed (based on the value used by the WG for plaice in VIIfg) and the WG maturity ogive for plaice in VIIfg was used to estimate SSB. The yield was estimated for a range of F values based on the average catch weights. Figure 7.11.10 shows the YPR curve, F_{max} is estimated to be 0.24. $F_{0.1}$ is estimated at 0.14. Recent values of Z ranged from 0.5 to 1.2, with M=0.12 this would result in an F of between 0.48 and 1.08. This is well above F_{max} and $F_{0.1}$.

7.11.4 References

Thompson and Bell. 1934. W.F. Thompson and F.H. Bell, Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear, Rep. Int. Fish. (Pacific Halibut) Comm. 8 (1934), p. 49.

Table 7.11.1. Plaice in Divisions VII h–k (Southwest Ireland). Nominal landings (t), 1987–2009, as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium*	250	245	403	301	252	246	344	197	235
Denmark	1	1	1	-	-	-	-	-	-
France	85	135	229	77	173	90	64	48	60
Ireland	300	369	454	338	478	477	383	271	321
Netherlands	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N	.	.	73	88	287	264	218	258	282
UK - England & Wa	246	433	.	.	.	.	.	.	.
UK - Scotland	-	1	-	1	1	6	7	1	4
Total	882	1184	1160	805	1191	1083	1016	775	902
Unallocated							-361	-198	-360
WG estimate							655	577	542

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium*	304	442	335	45	4	27	69	20	67
Denmark	-	-	-	-	-	-	-	-	-
France	48	69	49	.	54	50	45	32	32
Ireland	305	344	286	299	200	160	155	127	91
Netherlands	52	-	13	1	2	-	-	-	-
Spain	-	-	-	1	5	3	2	6	6
UK - Eng+Wales+N	154	138	106	82	75	73	59	56	36
UK - England & Wa	.	.	.	.	.	.	.	.	.
UK - Scotland	1	1	1	1	1	-	-	-	-
Total	864	994	790	428	341	313	330	241	232
Unallocated	-411	-349	-346	-22	-42	-52	-17	-24	-11
WG estimate	453	645	444	406	299	261	313	217	221

Country	2005	2006	2007	2008	2009
Belgium	32	22	7	25	1
Denmark					
France	20	37	30	12	
Ireland	90	65	72	72	72
Netherlands	.				
Spain	.	1	13	1	
UK - Eng+Wales+N	28	18	20	12	32
UK - England & Wa	.				
UK - Scotland	.				
Total	170	143	142	122	105
Unallocated	-6	4	-22	13	
WG estimate	164	147	120	135	

* Belgian Landings up to 1998 include VIIg

Table 7.11.2. Official landings (t) of plaice in VIIjk.

Year	Bel	Fra	Irl	Esp	UK	Total
1993	.	8	383	-	46	437
1994	.	6	251	-	60	317
1995	.	12	317	-	90	419
1996	.	3	295	-	38	336
1997	.	6	337	-	32	375
1998	.	8	282	-	16	306
1999	42	0	296	<0.5	15	353
2000	4	16	195	5	9	229
2001	-	16	157	3	6	182
2002	14	21	155	2	5	197
2003	4	7	125	6	9	151
2004	<0.5	5	87	6	6	104
2005	-	4	88	-	2	94
2006	-	6	63	1	1	71
2007	-	9	72	11	2	94
2008	-	5	72	1	1	79
2009*	-		72		2	74

*** Preliminary data**

Table 7.11.3. Catch numbers-at-age for plaice in VIIjk.

	1	2	3	4	5	6	7	8	9	10	11	12+
1993	0	92	624	479	115	45	23	10	6	2	0	1
1994	68	104	340	260	82	46	18	8	5	1	1	0
1995	10	208	634	348	107	36	16	7	4	1	2	0
1996	1	77	316	229	127	37	23	5	1	0	0	0
1997	0	164	277	269	120	42	20	5	0	0	0	9
1998	0	46	355	164	103	38	26	10	4	3	0	0
1999	11	143	312	201	65	37	18	11	9	2	2	8
2000	2	74	161	190	64	36	7	5	3	2	0	2
2001	1	55	165	146	47	6	21	2	7	0	0	0
2002	0	54	155	172	54	42	44	12	4	2	0	1
2003	0	74	165	65	29	6	15	11	2	2	1	0
2004	7	31	121	91	27	12	2	2	4	1	1	0
2005	1	25	71	77	48	22	13	4	0	1	0	1
2006	0	17	41	53	38	12	7	1	1	0	2	0
2007	0	47	136	61	22	17	4	2	0	0	0	0
2008	1	55	106	70	21	5	2	1	0	0	0	0
2009	0	13	105	73	28	10	4	0	1	0	0	0

Table 7.11.4. Catch weight-at-age for plaice in VIIjk.

	1	2	3	4	5	6	7	8	9	10	11	12+
1993		0.197	0.256	0.306	0.417	0.582	0.750	0.933	1.159	1.534		1.969
1994	0.046	0.222	0.302	0.368	0.460	0.563	0.708	0.871	1.031	1.307	1.373	
1995	0.100	0.228	0.272	0.325	0.390	0.519	0.645	0.818	1.197	1.475	1.558	
1996	0.029	0.298	0.379	0.431	0.463	0.512	0.528	0.494	0.595	2.322		
1997	1.111	0.285	0.338	0.431	0.485	0.653	0.807	0.928				1.314
1998		0.249	0.308	0.419	0.529	0.690	0.779	0.757	0.941	1.192	2.201	
1999	0.218	0.289	0.354	0.417	0.596	0.627	0.840	0.881	1.170	1.731	2.121	1.135
2000	0.119	0.274	0.348	0.420	0.486	0.610	0.805	1.113	1.437	1.088		1.737
2001	0.214	0.243	0.325	0.405	0.536	0.648	0.798	0.561	1.119			
2002		0.211	0.296	0.328	0.415	0.498	0.567	0.701	1.014	1.098		1.532
2003		0.274	0.356	0.402	0.482	0.575	0.737	0.881	1.048	1.872	1.257	
2004	0.128	0.258	0.309	0.341	0.448	0.550	0.633	0.635	0.900	1.137	1.328	1.803
2005	0.174	0.238	0.276	0.324	0.381	0.459	0.731	0.949		1.222	1.534	2.020
2006		0.272	0.319	0.370	0.438	0.520	0.794	0.895	0.792		1.880	
2007		0.239	0.281	0.354	0.433	0.482	0.573	0.727	1.394	0.837	1.266	
2008	0.293	0.239	0.282	0.336	0.358	0.530	0.756	0.399	1.106	1.576		
2009		0.224	0.255	0.335	0.403	0.462	0.520		1.080		1.393	1.138

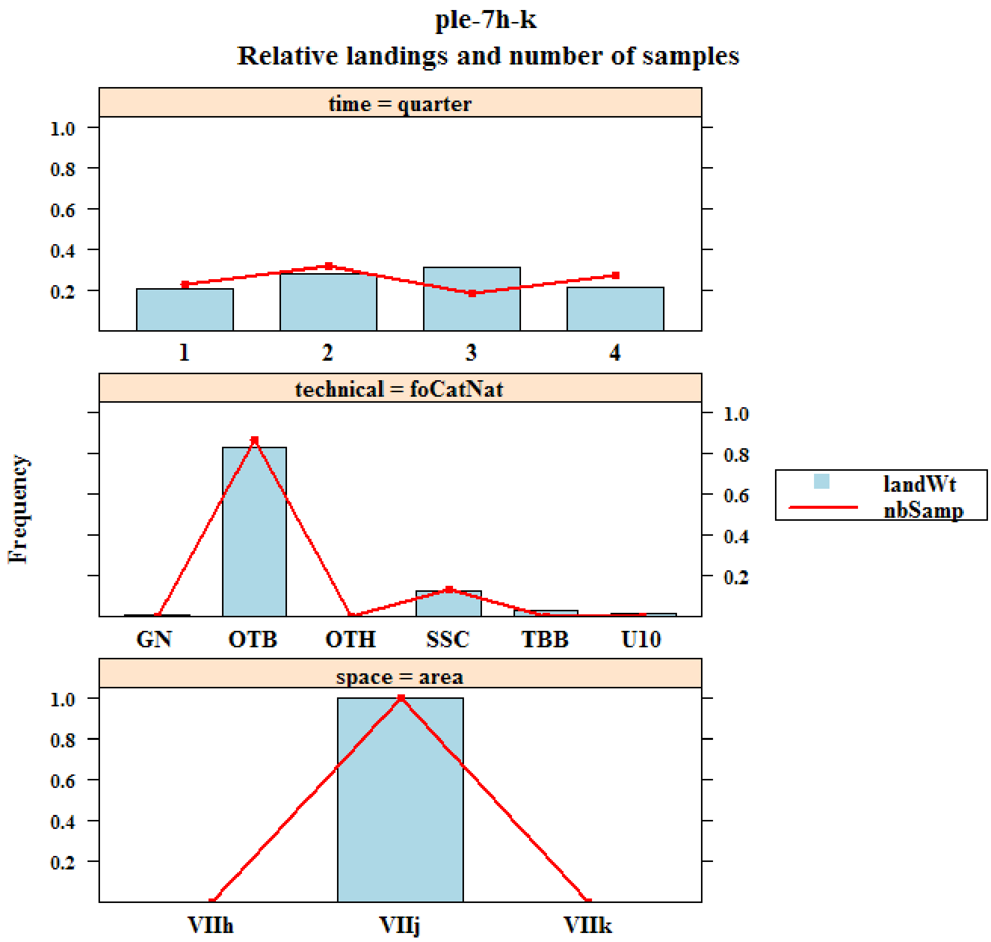


Figure 7.11.1. Irish Operational landings and sampling levels (number of samples) for plaice in VIIjk by quarter (top), geartype (middle) and ICES Division (bottom). The sampling appears to be representative of the landings.

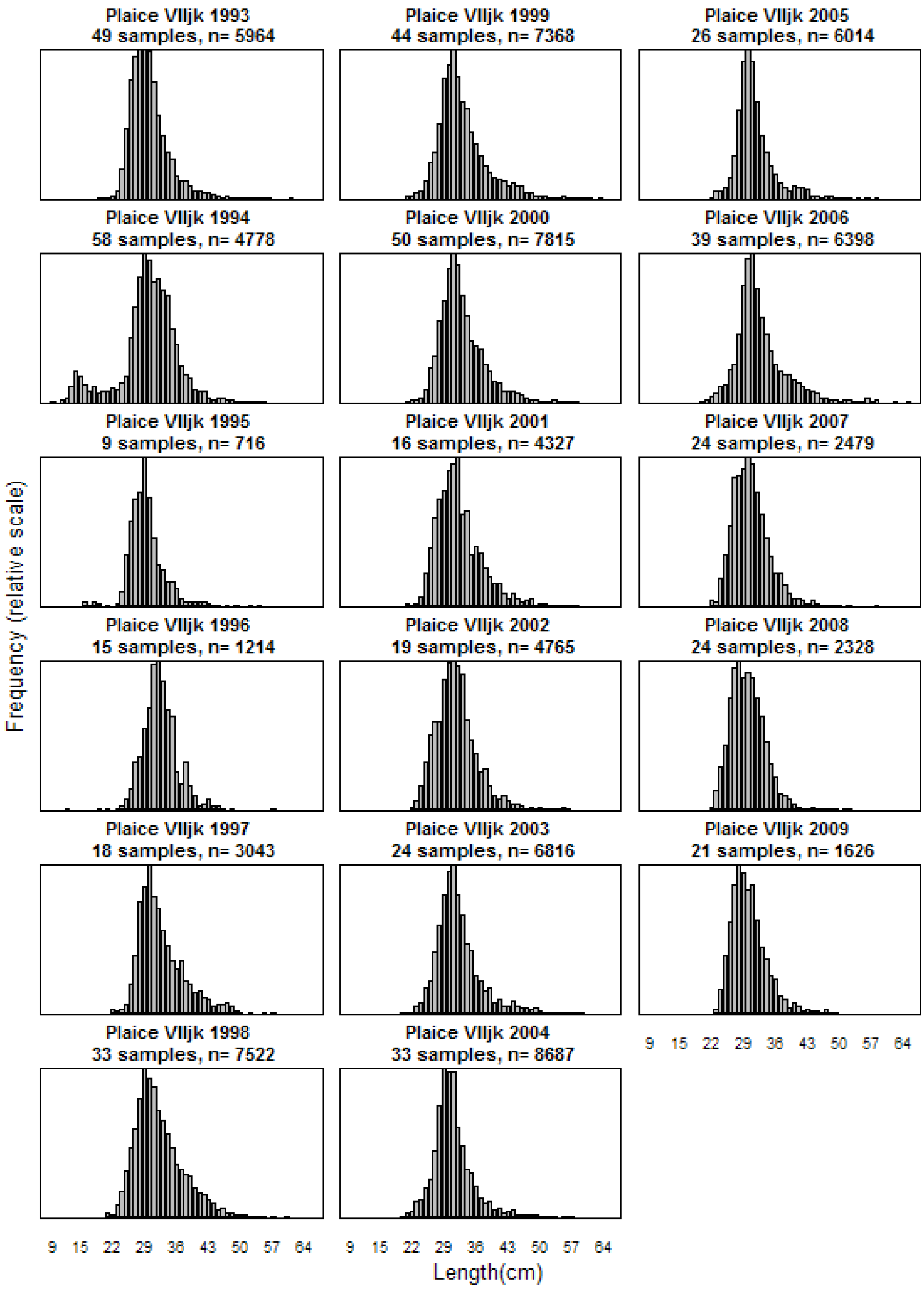


Figure 7.11.2. Length frequency distribution of the Irish landings of plaice in VIIjk between 1993 and 2000. All gears and quarters combined. Sampling was poor during 2006 and 2007.

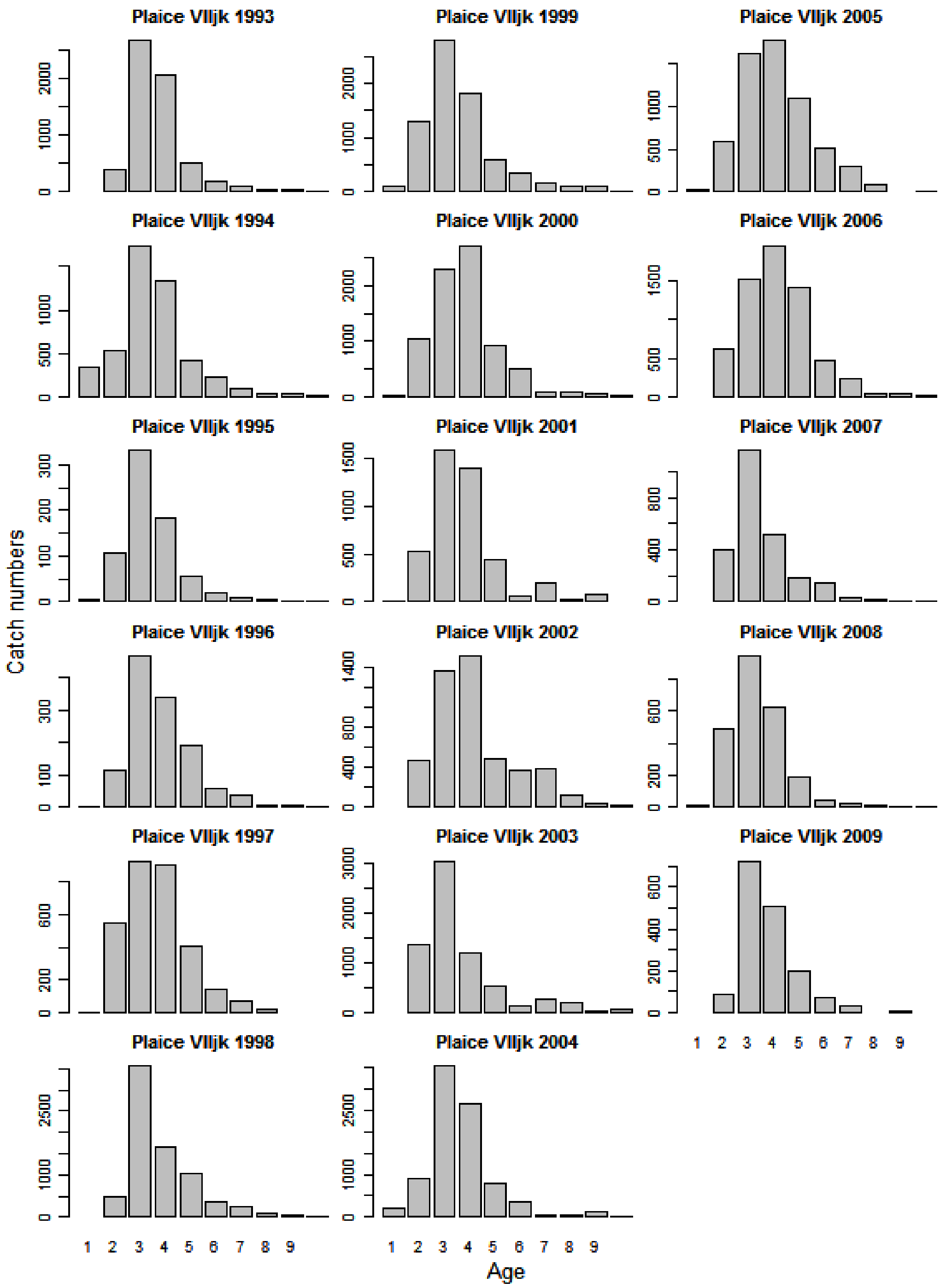


Figure 7.11.3. Age distribution of plaice in VIIjk between 1993 and 2009. All gears and quarters combined. The age data for 1995 were considered insufficient and for this year the combined age data for 1993–1996 were used.

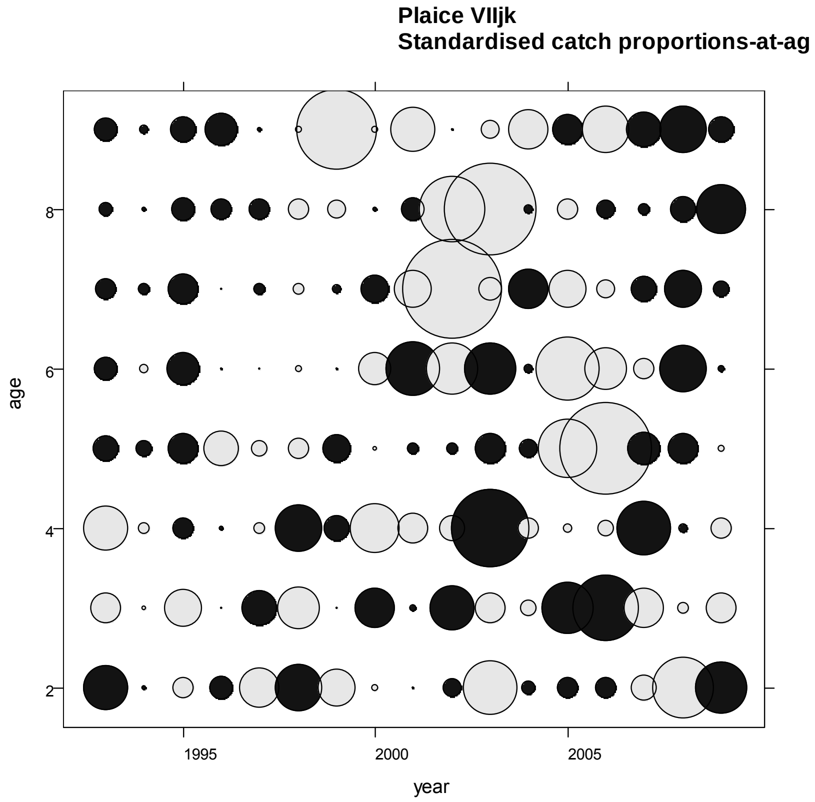


Figure 7.11.4. Standardised catch proportions-at-age for plaice in VIIjk. Grey bubbles represent higher than average catch-at-age and black bubbles represent lower than average catch-at-age.

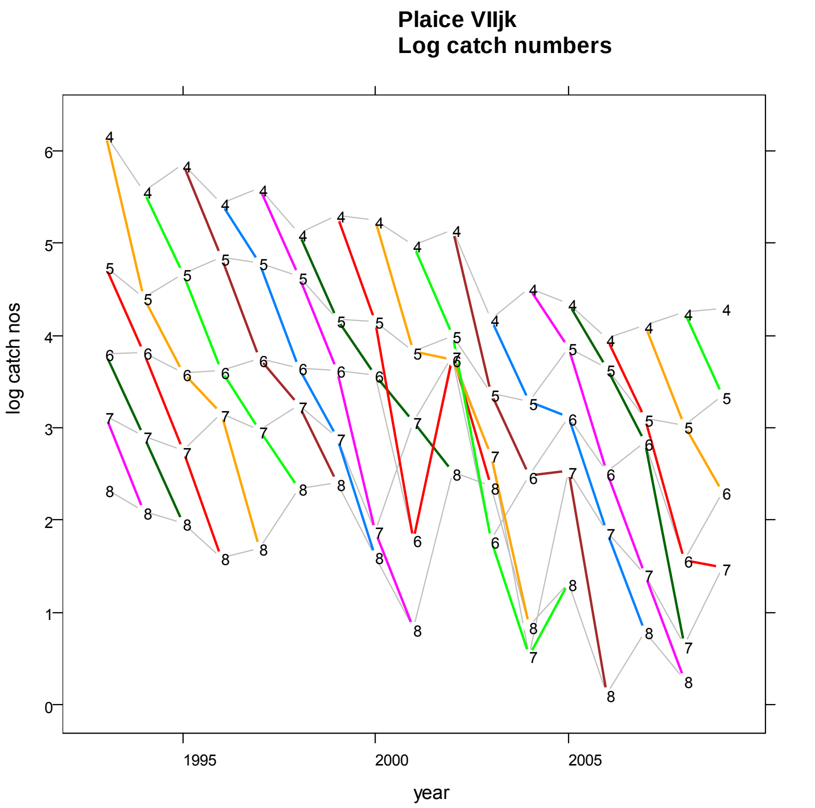


Figure 7.11.5. Log catch numbers-at-age (ages 4–8).

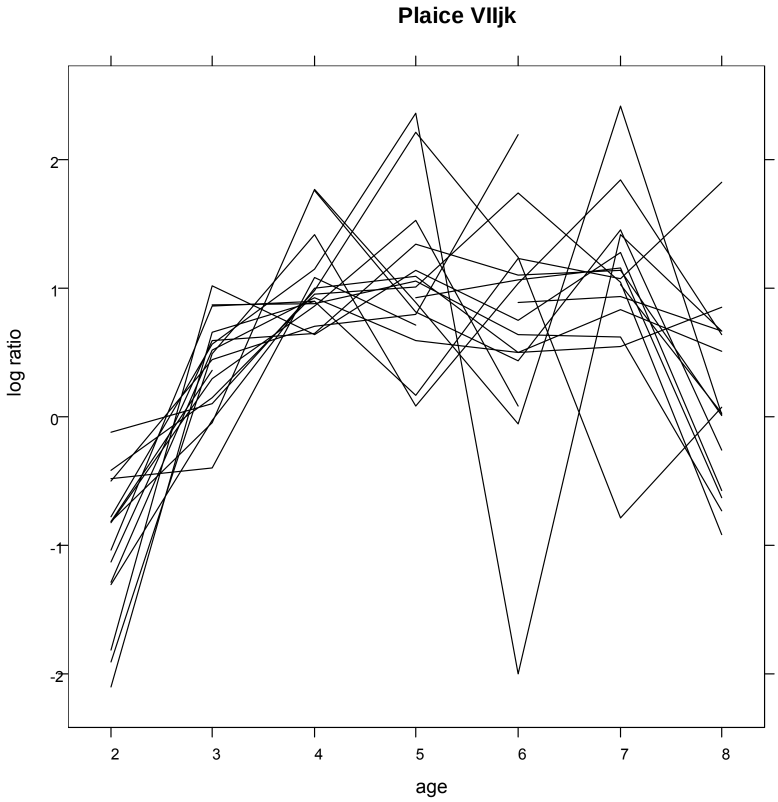


Figure 7.11.6. Catch curve of plaice in VIIbc. Plaice from the age of 4 appear to be fully selected; the data get quite noisy from the age of 7 onwards.

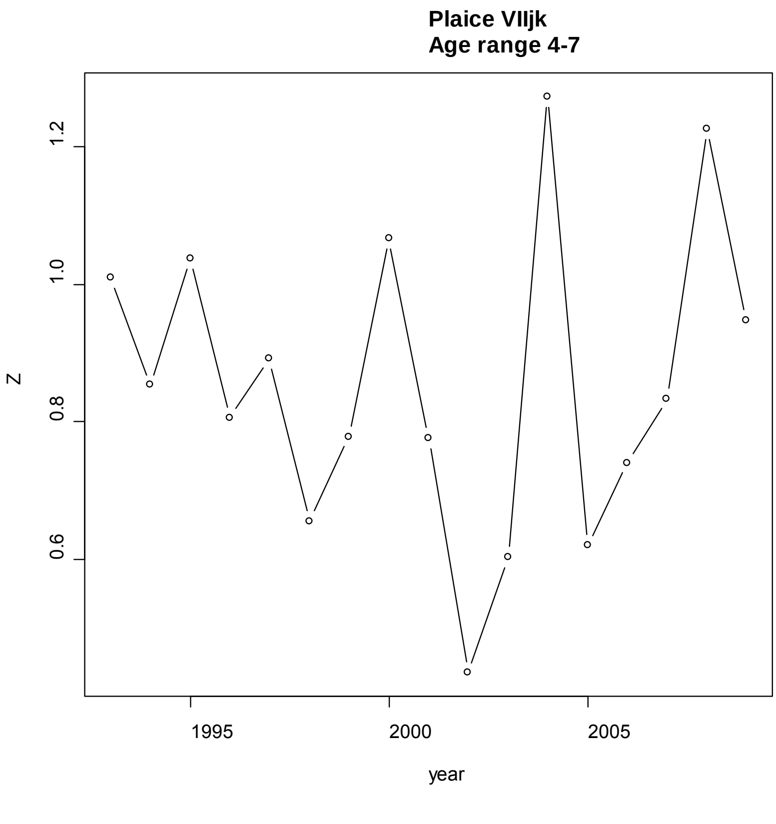


Figure 7.11.7. Z estimated over pseudo-cohorts as the slope of the log catch numbers.

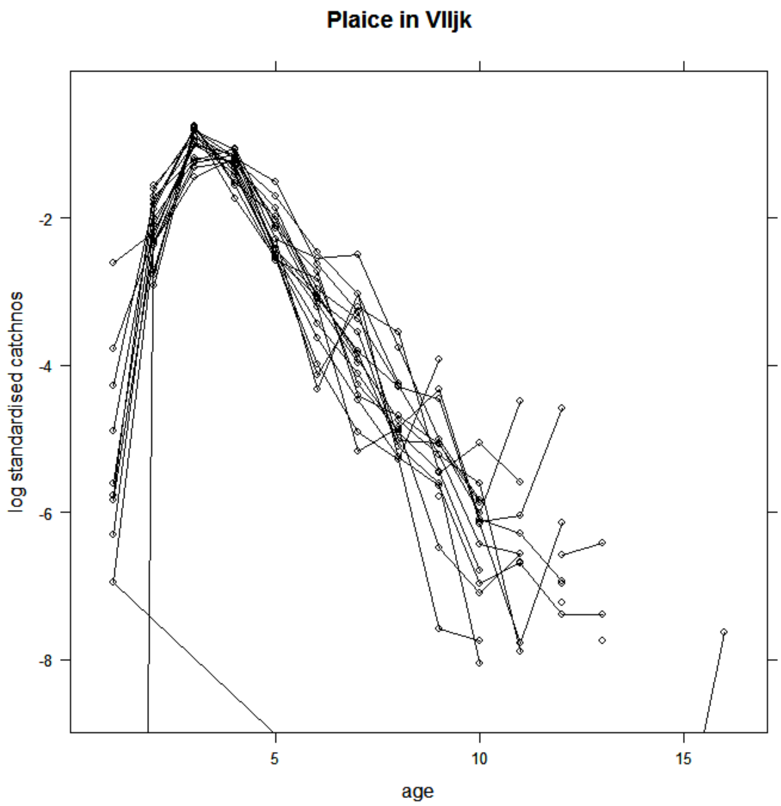


Figure 7.11.8 Log catch numbers (standardised by year). Fish appear to be fully selected from the age of 4.

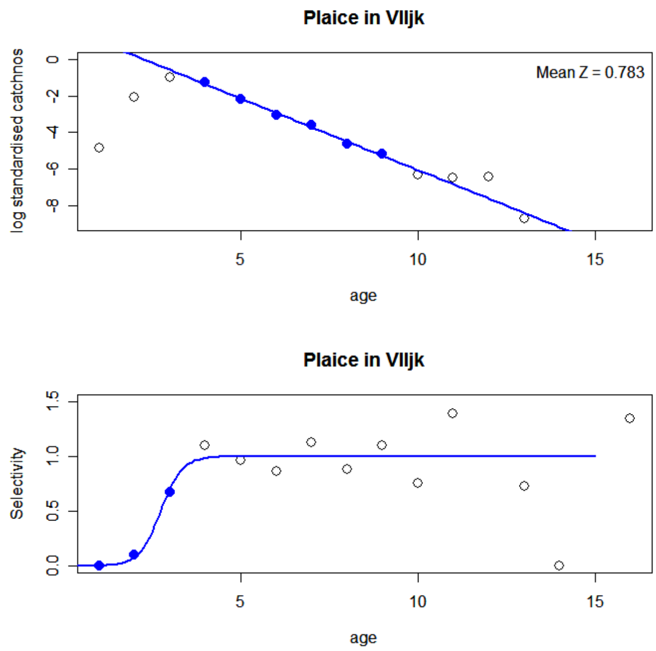


Figure 7.11.9. Selectivity was modelled by fitting a line through the mean log standardised catch numbers of ages 4 to 9 to predict the expected catch numbers for ages 1 to 3 if these were fully selected. The proportions of observed divided by expected catch number were taken as the 'observed' selectivity. This was then modelled using a logit transformation.

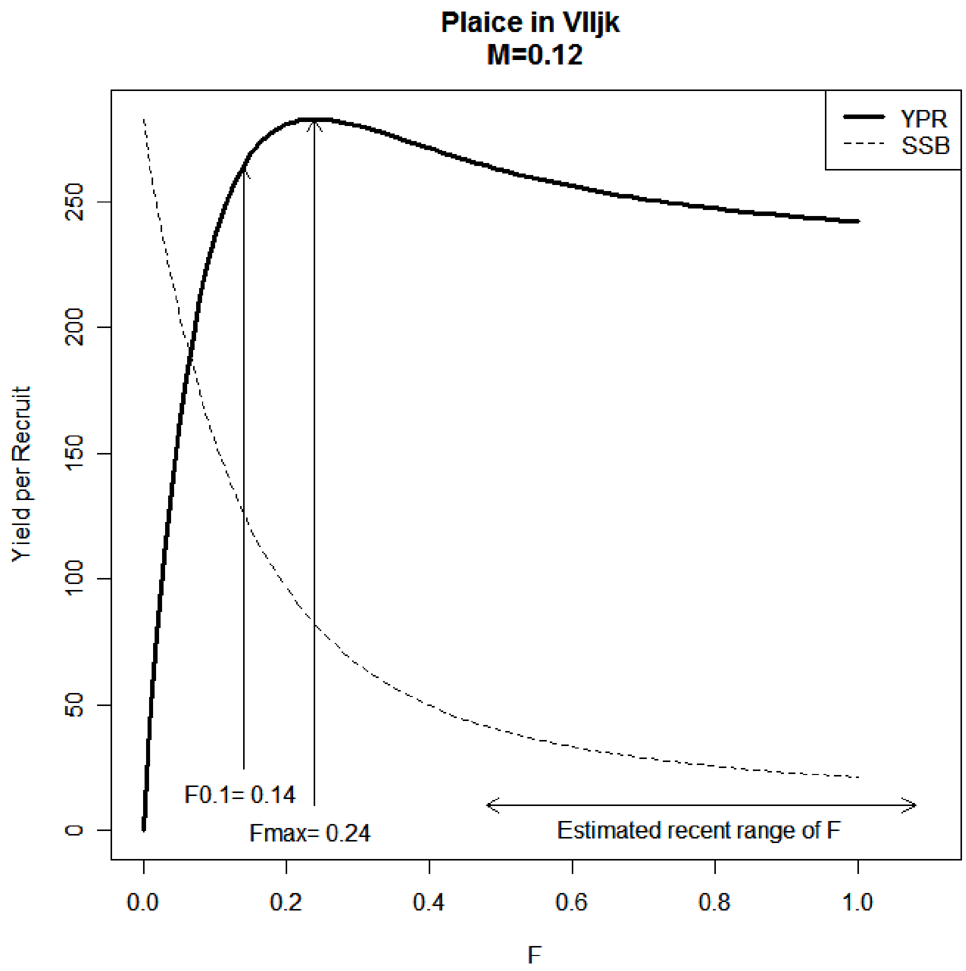


Figure 7.11.10. YPR analysis using the Thompson–Bell approach. Recent estimates of Z were between 0.5 to 1.2 which translates to an F of 0.48 to 1.08.

7.12 Sole in West of Ireland Division VIIb, c

Type of assessment in 2010

No assessment was performed.

7.12.1 General

Stock Identity

Sole in VIIb are mainly caught by Irish vessels on sandy grounds in coastal areas. Sole catches in VIIc are negligible. In VIIb there are two distinct areas where sole are caught: an area to the west of the Aran Islands and an area in the north of VIIb which extends into VIa (the Stags Ground). The landings and lpue of Sole in VIIbc appear to have been more or less stable since the start of the logbooks time-series in 1995 (WD1, WGCSE 2009). It is not known how much exchange there is between sole on the Aran grounds and those on the Stags ground.

7.12.2 Data

The nominal landings are given in Table 7.12.1.

Table 7.12.1. Landings of Sole in VIIbc as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
France	-	25	7	6	3	3	6	9	6	5	9	3	6
Ireland	12	12	19	44	14	16	13	24	47	55	40	17	44
Spain	19	16	30	25	1	-	11	1	-	-	-	-	-
UK - Eng+\	.	.	.	.	.	.	.	.	.	.	.	.	.
UK - Engla	-	-	-	-	-	-	-	-	-	1	-	-	-
Total	31	53	56	75	18	19	30	34	53	61	49	20	50

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
France	8	2	2	-	-	5	2	1	1	2	2	3	-
Ireland	29	39	34	38	41	46	43	59	60	59	52	51	49
Spain	-	-	-	-	-	-	-	-	-	-	-	-	-
UK - Eng+\	.	.	.	-	-	-	-	-	-	-	-	1	-
UK - Engla	-	-	1	.	.	.	.	.	.	.	.	.	.
Total	37	41	37	38	41	51	45	60	61	61	54	55	49
Unallocated								0	9	-2	3	0	17
Total as estimated by the Working Group								60	70	59	57	55	66

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
France	.	12	7	14	19	18	7	12	7	6	
Ireland	68	65	53	50	50	49	38	31	34	31	31
Spain	-	-	-	-	-	-	.	.			
UK - Eng+\	-	-	-	-	0	-	.	.			
UK - Engla	.	.	.	.	.	.	.	.			
Total	68	77	60	64	69	67	45	43	41	37	31
Unallocate	4	-9	0	-3	-5	2	-1	0	1	3	
Total as es	72	68	60	61	64	69	44	43	42	40	

7.13 Sole in Divisions VIIfg

Type of assessment in 2010

Update.

ICES advice applicable to 2009

In the advice for 2009 ICES considered the stock as having full reproductive capacity and being harvested sustainably.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality (2007) is estimated to be 0.33, which is above the rate expected to lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits

F should be kept below Fpa, corresponding to landings of less than 1090 tonnes in 2009. This is expected to keep the stock above Bpa.

Conclusion on exploitation boundaries

In the present situation with a stock that is above Bpa and a fishing mortality below Fpa, there is no long-term gain in yield to increase fishing mortality. ICES therefore recommends to limit landings in 2009 to no more than 940 t.

ICES advice applicable to 2010

In the advice for 2010 ICES considered the stock as having full reproductive capacity and being harvested sustainably.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality (2008) is estimated to be 0.27, which is slightly above the rate expected to lead to high long-term yields and low risk of stock depletion.

Exploitation boundaries in relation to precautionary limits

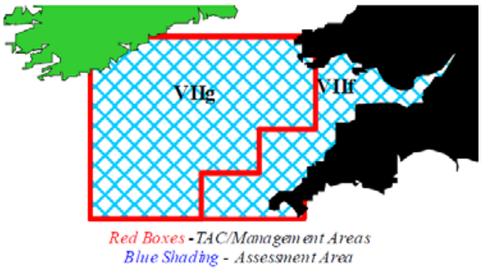
F should be kept below Fpa, corresponding to landings of less than 1185 tonnes in 2010. This is expected to keep the stock above Bpa.

Conclusion on exploitation boundaries

ICES advises that there is no long-term gain in yield to increase fishing mortality. ICES therefore recommends limiting landings in 2010 to no more than 920 t.

7.13.1 General

Stock description and management units



A TAC is in place for ICES Divisions VIIfg. These Divisions correspond to the stock area. The basis for the stock assessment Area VIIfg is described in detail in the Stock Annex.

Management applicable to 2009 and 2010

Management of sole in VIIfg is by TAC and technical measures. The agreed TACs in 2009 and 2010 are presented in the text tables below. Technical measures in force for this stock are minimum mesh sizes and minimum landing size (24 cm). National regulations also restricted areas for certain types of vessels.

2009 TAC

Species: Common sole *Solea solea*		Zone: VIIf and VIIg (SOL/7FG.)
Belgium	621	
France	62	
Ireland	31	
United Kingdom	279	
EC	993	
TAC	993	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

2010 TAC

Species: Common sole *Solea solea*		Zone: VIIf and VIIg (SOL/7FG.)
Belgium	621	
France	62	
Ireland	31	
United Kingdom	279	
EU	993	
TAC	993	Analytical TAC

Three rectangles in the Celtic Sea (30E4, 31E4 and 32E3) were closed during the first quarter of 2005, and in February-March 2006, 2007, 2008 and 2009. A derogation permitted beam trawlers to fish in March 2005. This derogation was not continued in the years thereafter. The effects of this closure were discussed in WGSSDS and ACFM 2007. No new information was available at the time of the update Working Group.

Fishery in 2009

The Working Group estimated the total international landings at 790 t in 2009 (Table 7.13.1), which is about 20% below the 2009 TAC (993 t) and also 9% below last year's forecast of 869 t.

Early in the time-series officially reported landings included Divisions VIIg-k for some countries and their total was higher than the WG estimate. Since 1999 official landings correspond to Divisions VIIfg, and the total is lower than the Working Group estimate. During the period 2002–2004 the difference between the two estimates was substantial. This was mainly due to area misreporting, which was taken into account in the Working Group estimates. Although no official landings were available from France, estimates of French landings were provided to the Working Group.

7.13.2 Data

Landings

Irish landings submitted to the Working Group for 2008 were revised upward by 1% to 28 t. The 2008 values for the numbers-at-age were therefore also updated. Total landings now amount to 800 t (Table 7.13.1).

Annual length compositions for 2008 are given by fleet in Table 7.13.2. Length distributions of the total Belgian and UK (England and Wales) landings for the last eleven years are plotted in Figure 7.13.1. Belgium lands a greater proportion of small fish compared to the UK (England and Wales).

Quarterly numbers and weight-at-age data are available for the Belgian and UK landings (approx. 90% of the total landings). Catch weights-at-age were calculated, weighted by national catch numbers-at-age, and then quadratically smoothed in year (using age = 1.5, 2.5, etc.) and SOP-corrected. For 2009, the quadratic fit used was:

$$W(t) = +0.0617 + (0.0469*(AGE)) - (0.00009*(AGE)^2) \qquad R2 = 0.98$$

Further details on raising procedures are given in the Stock Annex.

Stock weights-at-age were the first quarter catch weights of the Belgium and the UK beam trawl fleets and smoothed by fitting a quadratic fit:

$$W(t) = -0.0216 + (0.0704*(AGE)) - (0.0012*(AGE)^2) \qquad R2 = 0.99$$

Catch numbers-at-age are given in Table 7.13.3, and weights-at-age in the catch and the stock are given in Tables 7.13.4–5. Age compositions over the last eleven years are plotted in Figure 7.13.2. The standardised catch proportion-at-age is presented in Figure 7.13.3.

UK has provided data this year under the ICES InterCatch format. Belgium, France and Ireland are working to provide data using this format for the next Working Group.

Sampling levels for those countries providing age compositions are given in Table 1.3.1.

Discards

The available discard data indicate that discarding of sole is usually minor. In 2007, 2008 and 2009, discarding of sole in the UK fleet was estimated at about 3%, 1% and 6% respectively in numbers. Discard rates of sole in the Belgian beam trawl fleet were available to the Working Group in 2004–2005, and were about 5% of the total sole catches. Length distributions of retained and discarded catches of sole for 2007, 2008 and 2009 from samples taken onboard UK vessels are given in Figure 7.13.4.

Biological

Natural mortality was assumed to be 0.1 for all ages and years. The maturity ogive is based on samples taken during the UK (E&W) beam-trawl survey of March 1993 and 1994 and is applied to all years of the assessment (See also Stock Annex).

The proportion of M and F before spawning was set to zero.

Surveys

Standardised abundance indices for the UK beam trawl survey (UK (BTS-3Q)) are shown in Table 7.13.6 and Figure 7.13.5. Abundance-at-age 0 is highly variable and not used in the assessment. The UK survey appears to track the stronger year classes reasonably well for most ages. The internal consistency plot also indicates a reasonable fit for most of the age range (Figure 7.13.6).

Commercial lpue

Available estimates of effort and lpue are presented in Tables 7.13.7–8 and Figure 7.13.7.

Belgian beam trawl (BEL-BEAM) effort was at highest levels in 2004–2005. During these years effort shifted from the Eastern English Channel (VIId) to the Celtic Sea because of days at sea limitations in the former area. In 2006, these restrictions had been lifted and effort decreased back to similar levels compared to the early 2000s. The sharp effort reduction in 2008 may be a combined result of the unrestricted effort regime in VIId and the high fuel prices. Effort stayed at the same level in 2009. Lpue peaked in 2002. After a sharp decline to its record low in 2004, lpue has been increasing gradually to average levels of the time-series.

The effort from the UK (E&W) beam trawl fleet (UK-CBT) has declined sharply since the early 2000s to a record low in 2009. Lpue in the 1990s and 2000s was stable, but at lower levels compared to the period before. In 2007, lpue increased considerably and gave a similar value for 2008. In 2009 there was a decrease to a level just above the mean of the time-series.

Irish effort and lpue data are also presented. The main target species in the Irish fisheries are megrim, anglerfish, etc. The vessels usually operate on fishing grounds in the Western Celtic Sea with lower sole densities.

The internal consistency plots for the main two commercial lpue series, used in the assessment (UK-CBT and BEL-CBT), show high consistencies for the entire age range (Figures 7.13.8–9).

Other relevant data

Reports from UK industry suggest that the main issues affecting the fishery in VIIfg were displacement of effort due to the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W (Trebilcock and Rozarieux, 2009)

No additional information was received from the Belgian, French or Irish industries.

7.13.3 Stock assessment

The method used to assess Celtic Sea sole is XSA, using one survey and two commercial tuning-series (Table 7.13.9). It should be noted that the year range of the Belgian commercial beam trawl tuning fleet only covers 1971 up to 2003 (see also Section 7.13.9 recommendation for next Benchmark). Table 7.13.9 also includes tuning indices of the Irish ground fish survey (IR-GFS) and the commercial UK otter trawl fleet (UK-COT) which are not used in this assessment.

Data screening

Adding the 2n009 data to the different time-series, together with the Irish landings revisions for 2008 did not cause any additional anomalies compared to previous years. The "single fleet runs", "separable VPA", etc. that are used to screen the data of this stock are therefore not presented in this report, but are available in the 'Exploratory runs folder'. This folder also contains a comparison plot of SSB, R and F of last year's final assessment and of the same assessment but with the Irish landings revisions. The output was very similar for both assessments.

The catchability residuals for the final XSA are shown in Figure 7.13.10 and the XSA tuning diagnostics are given in Table 7.13.10. There is a marked change in the catchability residuals year effect in 2007, 2008 and 2009 for the UK beam trawl fleet (UK-CBT, positive residuals) and for the UK beam trawl survey (UK (BTS-3Q), negative residuals), indicating a conflicting signal between these two fleets.

In this year's assessment the estimates for the recruiting year class 2008 were estimated solely by the UK beam trawl survey UK (BTS-3Q) (Figure 7.13.11). The survivor estimates of the two prominent fleets (the UK (BTS-3Q) survey and the UK-CBT commercial fleet) which have at least 90% of the weighting for all the ages, differ from each other for most of the ages. The Working Group was not able to clarify that particular issue. The different estimates from the two fleets do not generate a retrospective bias and therefore probably balance off each other in the assessment. The Working Group also assumed that the Trevose closure, a change in special distribution of the UK beam trawl fleet and the ending of the Belgian tuning-series in 2003, may have an influence on the divergence in survivor estimates from both dominant tuning-series.

F shrinkage has a low weighting for all ages (<4%). The weighting of the survey decreases for the older ages as the commercial UK-CBT fleet is given more weight (Figure 7.13.11).

Final update assessment

The final settings used in this year's assessment (and since 2006) are as detailed below:

	2010 assessment		
Fleets	Years	Ages	α-β
BEL-CBT commercial	71–03	2–9	0–1
UK-CBT commercial	91–09	2–9	0–1
UK(BTS-3Q) survey	88–09	1–9	0.75–0.85
-First data year	1971		
-Last data year	2009		
-First age -Last age	1 10+		
Time-series weights	None		
-Model	Mean q model all ages		
-Q plateau set at age	7		
-Survivors estimates shrunk towards mean F	5 years/5 ages		
-s.e. of the means	1.5		
-Min s.e. for pop. Estimates	0.3		
-Prior weighting	None		

Retrospective patterns for the final run are shown in Figure 7.13.12. SSB is generally underestimated and fishing mortality overestimated.

The final XSA output is given in Table 7.13.11 (fishing mortalities) and Table 7.13.12 (stock numbers). A summary of the XSA results is given in Table 7.13.13 and trends in yield, fishing mortality, recruitment and spawning–stock biomass are shown in Figure 7.13.13.

Comparison with previous assessment

Figure 7.13.14 gives the historical performance of this stock. The trends in SSB, F and recruitment are consistent from year to year. However, some major revisions in the estimates were made in the period just after 1998. The underlying causes were the exceptionally strong 1998 year class, and the use of a power model in the assessment at that time, which substantially revised the year class.

With the addition of the 2009 data, estimates of fishing mortality and SSB for the most recent years were revised slightly. For example, last year fishing mortality and SSB in 2008 were estimated to be 0.27 and 3128 t. In this year's assessment, the 2008 estimates have been revised downwards by 10% (fishing mortality) and upwards by 10% (SSB). The estimated recruitment by XSA in 2008 was revised downward by 32%, however the value used in the forecast (7700 thousand fish) was revised upward by 30% in this year's assessment.

State of the stock

Trends in landings, SSB, F (4–8) and recruitment are presented Table 7.13.13 and Figure 7.13.13.

During the eighties fishing mortality increased for this stock. In the following decades fishing mortality fluctuated around this higher level. However fishing mortality has decreased since the late 1990s and was estimated to be 0.19 in 2009, which is very close to the record low value of the time-series.

Recruitment has fluctuated around 5 million recruits with occasional strong year classes. The 1998 year class is estimated to be the strongest in the time-series. The 2007 year class is confirmed by this year's assessment to be the second highest for this stock and the incoming recruitment (year class 2008) is estimated to be above average.

SSB has declined almost continuously from the highest value of 8000 t in 1971 to the lowest observed in the time-series in 1998. The exceptional year class of 1998 has increased SSB to above the long-term average. The two good recruitments in 2007 and 2008 are predicted to keep SSB well above B_{pa}.

7.13.4 Short-term projections

The 2007 year class was estimated to be around 10.0 million fish at age 1, which is the second highest value in the time-series and about 30% lower than estimated last year. The XSA survivor estimate for this year class was used for further prediction.

The 2008 year class in 2009 was estimated by XSA to be 7.3 million one year olds which is above average. The estimates solely coming from the UK (BTS-3Q) survey. The XSA survivor estimates for this year class were used for further prediction.

The long-term $GM_{71\text{-}07}$ recruitment (5.0 million) was assumed for the 2009 and subsequent year classes.

The Working Group estimates of year-class strength used for prediction can be summarised as follows:

Year class	At age in 2010	XSA		Source
2007	3	7615		XSA
2008	2	6624		XSA
2009	1	-	4998	GM 1971-07
2010 & 2011	recruits	-	4998	GM 1971-07

Population numbers at the start of 2010, estimated for ages 4 and older, were taken from the XSA output.

Fishing mortality was set as the mean over the last three years rescaled to 2009. Weights-at-age in the catch and in the stock are averages for the years 2007–2009. Input data are shown in Table 7.13.14. Results are presented in Table 7.13.15 (management options) and Table 7.13.16 (detailed output).

Assuming *status quo* F, implies a catch in 2010 of around 870 t (the agreed TAC is 993 t) and a catch of 947 t in 2011. Assuming *status quo* F will result in a SSB of 5050 t in 2011 and 5390 t in 2012.

Assuming *status quo* F, the proportional contributions of recent year classes to the predicted landings and SSB are given in Table 7.13.17. The assumed GM recruitment accounts for about 4% of the landings in 2011 and about 8 % of the 2012 SSB.

There are no known specific environmental drivers known for this stock.

7.13.5 MSY explorations

Yield-per-recruit results, long-term yield and SSB, conditional on the present exploitation pattern and assuming *status quo* F in 2009, are given in Table 7.13.18 and Figure 7.13.15. F_{max} is estimated to be 0.30. Long-term yield and SSB (using GM recruitment and F_{sq}) are estimated to be 910 t and 5100 t respectively.

Investigations for possible F_{msy} candidates for this stock were done with the PLOT-MSY program. The inputs are the standard SEN and SUM files, used to produce the standard graphs (Table 7.13.14). The results are shown in Table 7.13.19 and Figures 7.13.16–19. The Working Group decided that the use of a “Ricker” and a “smooth hockey stick” were possible candidates as a stock–recruitment relationship for this stock in estimating F_{msy} (Figures 7.13.17 and 7.13.18). The “Ricker” was finally chosen as it modelled the stock and recruit estimates somewhat better than the “smooth hockey stick”. The analysis also show that F_{max} is poorly defined (Figure 7.13.19) and that F_{msy} candidates at or below 0.31 may be appropriate for sole in VIIfg.

7.13.6 Biological reference points

The Working Group’s current approach to reference points is outlined in Section 1.4.4. Current biological reference points are given in the text table below:

Reference points	ACFM 98 onwards
Flim	0.52 (based on Floss, WG98)
Fpa	0.37 (Flim x 0.72)
Blim	Not defined
Bpa	2200 t (based on Bloss (1991), WG98)

7.13.7 Management plans

There are no explicit management plans for Celtic Sea sole.

In 2006, the Working Group presented results from a series of medium-term scenarios, carried out in conjunction with VIIfg plaice, to simulate some possible management plans for the two stocks Results indicated that an F in the range 0.27 to 0.49 in the long-term would maintain yield at or above 95% of that given by F_{max}, whilst posing a low probability (<5%) of SSB falling below B_{pa}. Three year average exploitation patterns were calculated and are given in Figure 7.13.20. The results suggest that the results of the analysis carried out in 2006 can still be used. The results of the F_{msy} analysis, carried out during this year's Working Group also confirm that a fishing mortality of 0.31 could be a candidate for a long-term management objective for sole in VIIfg.

7.13.8 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for VIIfg sole are sampled. Sampling is considered to be at a reasonable level (Table 1.3.1).

Discards

Discard estimates, which are low (Figure 7.13.4) are not included in the assessment.

Surveys

The UK (BTS-3Q) survey, which is solely responsible for the recruiting estimates, has been able to track year-class strength rather well in the past. However, strong year classes have been revised downward in previous assessments and therefore estimates of the very strong year classes may cause possible bias, especially in the forecast.

Consistency

Figure 7.13.14 gives the historical performance of this stock. The trends in SSB, F and R are consistent from year to year. However, some major revisions in the estimates were made in the period just after 1998. The underlying causes were the exceptionally strong 1998 year class, and the use of a power model in the assessment at that time, which substantially revised the year class

With the addition of the 2009 data, estimates of fishing mortality and SSB for the most recent years were revised slightly. Last year fishing mortality and SSB in 2008 were estimated to be 0.27 and 3128 t. In this year's assessment, the 2008 estimates have been revised downwards by 10% (fishing mortality) and upwards by 10% (SSB). The estimated recruitment by XSA in 2008 was revised downward by 32%, however the value used in the forecast (7700 thousand fish) was revised upward by 30% in this year's assessment.

Misreporting

Area misreporting is known to have been considerable over the period 2002–2004. This was due to a combination of the good 1998 year class still being an important part of the catch composition and restrictive TACs. The area misreporting has been corrected for the years 2002–2006 (method explained in the Report of WGSSDS 2007). Since 2007 the area misreporting that could be estimated was negligible (see Stock Annex).

7.13.9 Recommendation for next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting
2010	VIIf,g sole	A need to update the Belgian commercial tuning-series. The Belgian beam trawl tuning-series is only used up to 2003, mainly because the estimation of the corresponding lpue series could not be calculated correctly. At the 2009 WKFLAT a possible way of calculating Belgian beam trawl lpue for Division VIId was proposed, using a more realistic horsepower correction method. The proposed method should be investigated, not only for the Belgian beam trawl lpue but also for the UK beam trawl lpue in Division VIIfg, which are the two commercial fleets used in this assessment. A need to investigate the spatial distribution of the major Celtic sea fleets and possible impacts of the Trevose closure.	2012	Expert Group members

7.13.10 Management considerations

There is no apparent stock–recruitment relationship for this stock and no evidence of reduced recruitment at low levels of SSB.

SSB has declined almost continuously from the highest value of 8000 t in 1971 to the lowest observed in the time-series in 1998, increased subsequently due to the strong 1998 year class, to above the long-term average. The two good recruitments in 2007 and 2008 are predicted to keep SSB well above B_{pa}.

The Celtic Sea is an area without days at sea limitations for demersal fisheries. In this context and given that many demersal vessels are very mobile, changes in effort measures in areas other than the Celtic Sea, can influence the effort regime in the Celtic Sea (cfr. increased effort in Celtic Sea for Belgian beamers during 2004–2005 when days at sea limitations were in place for the Eastern English Channel).

References

Trebilcock P. and N. de Rozarieux. 2009. National Federation Fishermen's Organisation Annual Fisheries Reports. Cornish Fish Producers Organisation / Seafood Cornwall Training Ltd, March 2009.

ICES. 2009. Report of the Benchmark and Data Compilation Workshop for Flatfish (WKFLAT 2009), 6–13 February 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:31. 192 pp.

Table 7.13.1 - Celtic Sea Sole (ICES Divisions VIIfg). Official Nominal landings and data used by the Working Group (t)

Year	Belgium	Denmark	France	Ireland	UK(E.&W,NI.)	UK(Scotland)	Netherlands	Total-Official	Unallocated	Used by WG
1986	1039 *	2	146	188	611	-	3	1989	-389	1600
1987	701 *	-	117	9	437	-	-	1264	-42	1222
1988	705 *	-	110	72	317	-	-	1204	-58	1146
1989	684 *	-	87	18	203	-	-	992	0	992
1990	716 *	-	130	40	353	0	-	1239	-50	1189
1991	982 *	-	80	32	402	0	-	1496	-389	1107
1992	543 *	-	141	45	325	6	-	1060	-79	981
1993	575 *	-	108	51	285	11	-	1030	-102	928
1994	619 *	-	90	37	264	8	-	1018	-9	1009
1995	763 *	-	88	20	294	-	-	1165	-8	1157
1996	695 *	-	102	19	265	0	-	1081	-86	995
1997	660 *	-	99	28	251	0	-	1038	-111	927
1998	675 *	-	98	42	198	-	-	1013	-138	875
1999	604	-	61	51	231	0	-	947	65	1012
2000	694	-	74	29	243	-	-	1040	51	1091
2001	720	-	77	35	288	-	-	1120	48	1168
2002	703	-	65	32	318	+	-	1118	227	1345
2003	715	-	124	26	342	+	-	1207	185	1392
2004	735	-	79	33	283	-	-	1130	119	1249
2005	645	-	101	34	217	-	-	997	47	1044
2006	576	-	75	38	232	-	-	921	25	946
2007	582	-	85	32	244	-	-	943	2	945
2008	466	-	68	28	218	-	-	780	20	800
2009 [1]	511	-	n/a	27.82	194	-	-	733	57	790

1 Preliminar

* including VIIg-k

Table 7.13.2 - Sole in VIIfg. Annual length distributions by fleet

Length (cm)	UK (England & Wales) Beam trawl	Belgium All gears	Ireland* All gears
17			
18			
19			
20			
21			2
22	25	204	9
23	2334	110022	42
24	8225	235141	66
25	18692	237347	95
26	30860	217947	125
27	37298	215261	172
28	41288	186040	175
29	32026	116905	193
30	36929	119425	201
31	29516	92349	175
32	26603	90993	205
33	23999	60246	218
34	23095	58462	188
35	27744	57544	160
36	19256	45686	170
37	15726	38334	124
38	14922	33386	108
39	14960	23506	90
40	16514	20261	54
41	9799	15977	45
42	6557	8256	28
43	6447	6916	14
44	5959	1904	18
45	3576	1361	11
46	3196	1212	5
47	1921	272	5
48	571	445	1
49	176	74	
50	24		
51	253		
52	0		
53	665		
54			
55			
56			
57			
58			
59			
60			
Total	459157	1995476	2699

* Distributions from sample only

Table 7.13.3 - Sole in VIIfg. Catch numbers at age (in thousands)

Run title : CELTIC SEA SOLE,2010WG,COMBSEX,PLUSGROUP
At 21/04/2010 17:41

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE									
1	0	0	0	0	0	0	0	0	0
2	386	541	364	155	119	312	314	318	328
3	270	902	1882	438	287	834	438	741	560
4	1341	314	748	863	336	560	349	339	747
5	625	670	305	411	638	611	271	154	208
6	433	329	352	209	304	559	244	159	154
7	537	213	119	239	110	261	404	99	197
8	763	232	110	97	102	131	120	198	124
9	376	314	116	109	67	197	28	71	153
+gp	1220	730	644	541	372	463	365	174	169
0 TOTALNUM	5951	4245	4640	3062	2335	3928	2533	2253	2640
TONSLAND	1861	1278	1391	1105	919	1350	961	780	954
SOPCOF %	100	100	100	100	100	100	100	100	100

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	657	602	342	647	672	196	494	318	526	479
3	972	675	831	1078	846	1473	1296	957	464	1164
4	876	792	309	729	606	766	1173	797	879	601
5	584	399	467	284	542	565	526	577	441	621
6	180	377	280	349	184	296	358	273	387	237
7	62	150	207	225	277	100	193	205	127	188
8	96	120	92	192	106	140	87	100	78	82
9	100	94	111	52	47	73	103	61	67	24
+gp	352	380	326	320	274	240	328	179	268	102
0 TOTALNUM	3879	3589	2965	3876	3554	3849	4558	3467	3237	3498
TONSLAND	1314	1212	1128	1373	1266	1328	1600	1222	1146	992
SOPCOF %	100	100	100	100	100	100	100	100	100	100

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	277	1458	433	354	295	129	177	245	197	608
3	994	690	1700	863	790	1156	1035	890	932	1718
4	1176	658	644	1104	739	1098	904	599	724	834
5	399	496	409	332	864	420	424	400	297	282
6	452	151	253	186	283	483	229	252	171	143
7	138	156	61	161	149	133	192	127	108	80
8	115	55	59	63	65	112	57	126	51	31
9	50	46	28	83	42	65	43	45	52	23
+gp	129	162	89	99	146	109	106	106	87	44
0 TOTALNUM	3730	3872	3676	3245	3373	3705	3167	2790	2619	3763
TONSLAND	1189	1107	981	928	1009	1157	995	927	875	1012
SOPCOF %	100	100	100	100	100	100	100	100	100	100

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	1721	704	29	119	425	271	685	335	211	599
3	1480	1918	1465	697	1721	855	1330	865	447	458
4	683	860	2202	1134	792	837	715	743	552	421
5	241	436	660	1860	794	473	576	474	558	343
6	60	242	249	402	721	398	163	325	274	289
7	56	65	95	223	114	348	148	157	196	172
8	43	39	54	80	60	48	178	145	75	102
9	19	26	36	26	34	41	44	184	108	43
+gp	51	81	51	75	49	43	51	70	171	190
0 TOTALNUM	4354	4371	4841	4616	4710	3314	3890	3298	2592	2617
TONSLAND	1091	1168	1345	1392	1249	1044	946	945	800	790
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 7.13.4 - Sole in VIIfg. Catch weights at age (kg)

Run title : CELTIC SEA SOLE,2010WG,COMBSEX,PLUSGROUP
At 21/04/2010 17:41

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE									
1	0.039	0.106	0.081	0.063	0.046	0.114	0.098	0.068	0.023
2	0.106	0.147	0.143	0.137	0.132	0.167	0.169	0.154	0.132
3	0.167	0.186	0.202	0.205	0.212	0.218	0.235	0.234	0.232
4	0.222	0.226	0.258	0.270	0.286	0.268	0.297	0.309	0.321
5	0.272	0.264	0.311	0.329	0.355	0.316	0.355	0.378	0.401
6	0.315	0.302	0.361	0.385	0.417	0.363	0.409	0.441	0.471
7	0.352	0.340	0.408	0.436	0.473	0.409	0.460	0.499	0.531
8	0.383	0.376	0.452	0.483	0.523	0.453	0.506	0.551	0.581
9	0.408	0.413	0.493	0.525	0.567	0.496	0.548	0.598	0.622
+gp	0.4397	0.5384	0.6021	0.6239	0.6715	0.6649	0.6681	0.7196	0.6636

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.048	0.078	0.061	0.085	0.019	0.089	0.046	0.048	0.074	0.013
2	0.144	0.154	0.156	0.173	0.131	0.170	0.144	0.146	0.157	0.109
3	0.234	0.225	0.243	0.255	0.235	0.246	0.236	0.236	0.235	0.198
4	0.316	0.292	0.324	0.330	0.330	0.317	0.321	0.320	0.309	0.280
5	0.392	0.355	0.397	0.398	0.416	0.383	0.400	0.396	0.378	0.355
6	0.461	0.414	0.462	0.459	0.494	0.444	0.471	0.466	0.442	0.424
7	0.523	0.469	0.521	0.514	0.562	0.500	0.536	0.528	0.502	0.487
8	0.579	0.519	0.572	0.561	0.622	0.552	0.594	0.584	0.557	0.543
9	0.627	0.565	0.617	0.602	0.673	0.598	0.645	0.632	0.608	0.592
+gp	0.720	0.665	0.704	0.679	0.772	0.703	0.748	0.740	0.739	0.691
0 SOPCOFA	0.999	1.000	0.999	1.000	0.999	1.002	1.000	1.001	0.999	0.999

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.049	0.054	0.073	0.057	0.081	0.068	0.027	0.074	0.079	0.015
2	0.134	0.150	0.147	0.134	0.151	0.147	0.124	0.156	0.163	0.122
3	0.214	0.239	0.216	0.207	0.216	0.220	0.214	0.234	0.244	0.222
4	0.291	0.320	0.281	0.275	0.276	0.288	0.296	0.307	0.320	0.315
5	0.363	0.393	0.342	0.338	0.331	0.351	0.372	0.376	0.393	0.400
6	0.43	0.459	0.398	0.396	0.38	0.409	0.439	0.44	0.462	0.478
7	0.494	0.516	0.451	0.45	0.425	0.462	0.5	0.5	0.528	0.549
8	0.553	0.566	0.499	0.500	0.465	0.510	0.552	0.555	0.589	0.613
9	0.609	0.608	0.543	0.545	0.500	0.553	0.598	0.605	0.647	0.670
+gp	0.747	0.674	0.640	0.645	0.563	0.643	0.677	0.707	0.781	0.766
0 SOPCOFA	0.999	1.000	1.000	0.999	1.000	0.998	1.001	1.000	0.999	1.001

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE										
1	0.078	0.066	0.054	0.123	0.066	0.068	0.085	0.075	0.098	0.132
2	0.166	0.148	0.130	0.171	0.130	0.145	0.139	0.139	0.155	0.178
3	0.248	0.225	0.202	0.218	0.194	0.219	0.192	0.200	0.209	0.225
4	0.322	0.296	0.271	0.266	0.256	0.288	0.245	0.258	0.26	0.271
5	0.39	0.363	0.336	0.313	0.317	0.354	0.297	0.313	0.31	0.317
6	0.451	0.425	0.399	0.361	0.377	0.415	0.349	0.365	0.356	0.363
7	0.506	0.482	0.457	0.408	0.435	0.473	0.4	0.414	0.401	0.408
8	0.553	0.533	0.513	0.454	0.493	0.528	0.451	0.46	0.443	0.454
9	0.594	0.579	0.564	0.501	0.549	0.578	0.501	0.503	0.482	0.499
+gp	0.6649	0.6773	0.7045	0.6379	0.7217	0.6918	0.6177	0.6087	0.5448	0.6037
0 SOPCOFA	1	0.9954	1.0001	1.0019	1.0003	1.0004	0.9992	0.9999	1.0035	1

Table 7.13.5 - Sole in VIIfg. Stock weights at age (kg)

Run title : CELTIC SEA SOLE,2010WG,COMBSEX,PLUSGROUP
At 21/04/2010 17:41

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE									
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.09	0.09
2	0.076	0.113	0.113	0.113	0.113	0.113	0.145	0.113	0.113
3	0.136	0.157	0.142	0.159	0.141	0.160	0.174	0.167	0.163
4	0.190	0.222	0.203	0.221	0.215	0.210	0.236	0.257	0.255
5	0.239	0.298	0.263	0.305	0.295	0.269	0.366	0.36	0.392
6	0.406	0.351	0.334	0.450	0.353	0.354	0.392	0.413	0.437
7	0.472	0.352	0.322	0.448	0.593	0.432	0.454	0.521	0.485
8	0.389	0.593	0.400	0.464	0.423	0.462	0.505	0.508	0.595
9	0.346	0.417	0.539	0.624	0.465	0.425	0.907	0.56	0.657
+gp	0.5826	0.6005	0.5822	0.6707	0.7112	0.728	0.7006	0.7826	0.6963

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.113	0.113	0.113	0.113	0.118	0.113	0.113	0.113	0.113	0.113
3	0.157	0.159	0.164	0.175	0.173	0.175	0.180	0.153	0.158	0.152
4	0.238	0.232	0.255	0.262	0.274	0.268	0.273	0.242	0.233	0.227
5	0.354	0.306	0.356	0.370	0.429	0.472	0.398	0.361	0.363	0.308
6	0.394	0.385	0.487	0.488	0.517	0.433	0.462	0.473	0.466	0.465
7	0.622	0.462	0.543	0.633	0.641	0.462	0.546	0.468	0.687	0.546
8	0.556	0.551	0.61	0.606	0.613	0.48	0.636	0.587	0.687	0.526
9	0.704	0.737	0.766	0.464	0.836	0.944	0.890	0.820	0.676	0.542
+gp	0.771	0.663	0.856	0.823	0.978	0.798	0.844	0.838	0.818	0.752

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.113	0.113	0.113	0.148	0.113	0.113	0.104	0.113	0.113	0.110
3	0.164	0.179	0.184	0.196	0.135	0.143	0.186	0.178	0.195	0.204
4	0.247	0.230	0.265	0.267	0.227	0.233	0.284	0.276	0.282	0.317
5	0.369	0.356	0.388	0.392	0.329	0.335	0.387	0.386	0.371	0.433
6	0.476	0.536	0.498	0.47	0.43	0.441	0.486	0.495	0.454	0.541
7	0.523	0.376	0.751	0.492	0.521	0.540	0.573	0.598	0.529	0.635
8	0.753	0.859	0.754	0.576	0.599	0.629	0.647	0.689	0.593	0.712
9	0.847	0.735	0.475	0.636	0.661	0.705	0.708	0.766	0.644	0.772
+gp	0.973	0.679	0.896	0.727	0.757	0.845	0.808	0.892	0.732	0.853

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE										
1	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.062	0.113	0.113	0.158	0.116	0.149	0.143	0.117	0.151	0.147
3	0.169	0.187	0.189	0.205	0.176	0.213	0.188	0.177	0.2	0.21
4	0.306	0.312	0.289	0.258	0.248	0.275	0.235	0.236	0.249	0.271
5	0.434	0.434	0.403	0.317	0.329	0.337	0.284	0.294	0.298	0.329
6	0.534	0.538	0.512	0.381	0.415	0.399	0.334	0.35	0.349	0.385
7	0.603	0.619	0.609	0.449	0.502	0.459	0.386	0.406	0.4	0.439
8	0.648	0.68	0.691	0.521	0.587	0.52	0.441	0.46	0.453	0.49
9	0.677	0.725	0.757	0.594	0.667	0.579	0.496	0.513	0.506	0.539
+gp	0.707	0.7835	0.873	0.8113	0.869	0.7401	0.6414	0.6622	0.6027	0.6406

Table 7.13.6 - Sole in VIIfg. Indices of abundance (No/100km) for UK(BTS-3Q) survey

	0	1	2	3	4	5	6	7	8	9
1988	30	81	326	49	19	5	0	0	0	0
1989	144	222	331	176	20	15	7	4	2	2
1990	30	385	313	50	16	4	7	3	0	0
1991	32	241	517	67	17	15	4	0	2	2
1992	4	394	260	139	30	18	10	1	2	1
1993	3	169	320	43	19	1	2	2	1	1
1994	1	333	387	99	14	7	7	0	0	2
1995	27	124	222	52	11	6	12	1	1	1
1996	3	150	211	54	23	6	2	3	1	2
1997	32	433	180	18	11	12	4	3	5	0
1998	90	770	411	50	9	7	4	2	1	5
1999	24	2464	250	32	14	5	4	4	1	0
2000	13	916	1356	31	22	5	0	2	1	1
2001	22	379	599	259	20	7	5	2	0	2
2002	8	663	238	127	102	12	6	2	3	0
2003	12	392	530	47	26	47	8	3	3	0
2004	55	750	377	87	13	19	37	4	2	0
2005	37	343	225	32	14	6	4	14	1	2
2006	11	273	201	39	13	7	0	2	10	0
2007	88	357	108	43	14	11	6	3	3	12
2008	5	1039	104	13	15	6	8	3	3	4
2009	1	509	318	24	6	8	3	2	2	2
Geomean	15	383	300	53	17	8	6	3	2	2
Mean	30	518	354	70	20	11	6	3	2	2

Table 7.13.7 - Sole in VIIfg. Indices of effort.

	England & Wales		Belgium		Ireland		
Year	Otter trawl	Beam trawl[1]	Beam trawl[2]	Beam trawl[4]	Otter trawl[3]	Scottish seine[4]	Beam trawl[4]
1971			11.06				
1972	45.72		8.44				
1973	45.28		17.39				
1974	38.94		18.83				
1975	33.53		16.38				
1976	25.61		28.07				
1977	27.16		24.11				
1978	27.08		18.09				
1979	23.84		18.90				
1980	26.43		29.02				
1981	24.10		35.39				
1982	19.20		28.77				
1983	17.61		34.95				
1984	23.16		33.48				
1985	25.24	18.70	40.49				
1986	21.18	20.72	52.46				
1987	24.43	38.76	37.26				
1988	20.09	25.62	42.92				
1989	17.61	20.26	53.58				
1990	22.56	30.77	40.27				
1991	18.57	40.81	18.05				
1992	16.00	35.78	25.47				
1993	13.79	39.64	31.27				
1994	9.48	37.03	38.35				
1995	8.46	37.59	47.81		63.56	6.43	20.78
1996	8.67	39.78	47.63	53.27	60.04	9.73	26.76
1997	8.14	43.00	51.98	57.36	65.10	16.13	28.25
1998	7.13	47.84	52.11	57.79	72.30	14.94	35.25
1999	5.69	50.87	55.03	55.11	51.66	8.01	40.87
2000	4.05	51.19	56.05	51.34	60.60	9.90	37.03
2001	4.42	49.32	52.06	54.90	69.43	16.33	39.71
2002	6.10	37.53	43.24	49.60	77.69	20.86	31.62
2003	9.94	40.71	42.81	62.73	86.79	20.91	49.26
2004	9.42	32.37		78.73	96.99	19.38	54.86
2005	12.09	27.73		64.50	124.40	14.81	49.65
2006	12.97	18.57		50.28	119.23	14.79	60.48
2007	10.66	15.37		45.72	136.53	15.82	55.86
2008	10.13	13.83		28.71	125.81	11.65	37.22
2009	8.97	12.23		30.85	135.18	8.15	37.92

[1]Division VIIf only - Fishing hours (x10^3) corrected for fishing power
[2]Fishing hours (x 10^3) corrected for fishing power using P = 0.000204 BHP^1.23
[3]Division VIIg only - Fishing hours (x10^3)
[4]Fishing hours (x10^3)

Table 7.13.8 - Sole in VIIfg. LPUE

	UK	England & Wales			Belgium		Ireland		
	BT Survey[4]	Otter trawl[1]	Otter trawl[1]	Beam trawl[1]	Beam trawl[2]	Beam trawl[5]	Otter trawl[5]	Scottish sein[5]	Beam trawl[5]
Year	Division VIIfg	Division VIIf	Division VIIg[3]	Division VIIf	Division VIIfg	Division VIIfg	Division VIIg	Division VIIg	Division VIIg
1971	-			-	47.92				
1972	-	2.42	2.11	-	37.06				
1973	-	2.45	0.98	-	39.47				
1974	-	2.10	1.83	-	37.81				
1975	-	1.82	1.79	-	31.41				
1976	-	2.02	1.30	-	30.50				
1977	-	1.84	1.21	-	27.90				
1978	-	1.82	1.17		23.35				
1979	-	1.80	1.15		33.19				
1980	-	1.86	1.55		29.73				
1981	-	1.45	0.60		24.03				
1982	-	1.73	0.56		25.93				
1983	-	2.22	1.14		22.18				
1984	-	1.53	1.70		20.78				
1985	-	1.55	1.55	12.52	17.94				
1986	-	1.38	0.99	10.94	17.83				
1987	-	0.94	1.15	7.31	17.32				
1988	71.14	0.62	0.27	4.39	15.29				
1989	135.18	0.99	0.87	5.38	11.33				
1990	90.67	0.76	0.67	5.98	15.64				
1991	122.88	0.69	0.85	4.80	24.24				
1992	115.79	1.00	1.25	4.14	18.57				
1993	75.42	0.55	0.25	4.80	15.21				
1994	107.77	0.90	0.27	4.26	13.94				
1995	72.50	0.96	0.87	4.52	13.62		0.40	0.62	0.81
1996	70.15	0.66	0.52	3.94	11.27	11.45	0.73	0.05	0.88
1997	81.66	0.86	0.52	3.28	9.96	9.68	0.42	0.23	1.16
1998	135.41	0.60	0.40	2.67	10.12	9.64	0.48	0.11	1.11
1999	168.46	0.91	0.74	3.21	11.26	12.14	0.17	0.09	0.50
2000	236.43	0.49	1.85	3.36	11.90	13.77	0.19	0.05	0.26
2001	154.79	1.14	2.13	4.02	13.25	13.60	0.27	0.55	0.15
2002	118.11	0.78	3.60	5.64	18.71	17.80	0.43	0.29	0.14
2003	123.93	0.57	0.00	5.23	19.48	11.40	0.12	0.03	0.20
2004	149.65	0.60	0.19	5.75		9.17	0.18	0.02	0.20
2005	76.26	0.76	0.26	4.94		9.78	0.14		0.28
2006	68.96	1.16	0.60	5.97		10.70	0.11	0.05	0.26
2007	80.95	0.78	1.00	9.87		11.74	0.13	0.02	0.20
2008	115.96	0.82	0.86	9.46		14.51	0.12	0.02	0.29
2009	89.80	0.94	0.46	6.61		12.90	0.10	0.00	0.28

[1]Kg/hr corrected for GRT.

[2]Kg/hr corrected for fishing power using P = 0.000204 BHP^1.23

[3]Division VIIg (East).

[4]Kg/100km

[5]Kg/hour

Table 7.13.9 - Sole in VIIfg. Tuning series

Indices in bold are used in the assessment

BEL-CBT **Belgium Beam trawl (Effort = Corrected formula)**

	1971	2003												
	1	1	0	1										
	2	14												
11.06		111	77	384	179	124	154	218	108	32	107	76	21	40
8.44		132	220	76	163	80	52	57	76	39	23	14	38	14
17.39		179	926	368	150	173	58	54	57	108	32	23	21	45
18.83		102	287	565	270	136	156	64	79	90	75	38	39	37
16.38		69	167	195	370	176	64	59	39	33	29	37	18	23
28.07		199	533	357	391	357	167	84	125	40	17	21	51	35
24.11		220	307	244	190	170	283	84	20	35	39	36	18	52
18.09		173	403	185	84	86	54	108	38	11	21	61	8	9
18.9		222	379	506	141	104	133	84	103	35	12	16	4	6
29.02		438	647	583	389	119	45	63	66	92	22	25	16	10
35.39		429	481	565	286	268	107	86	67	86	74	33	13	13
28.77		245	594	221	334	200	148	66	80	54	19	41	16	25
34.95		363	605	409	159	196	127	108	29	44	32	15	12	12
33.48		372	467	334	300	102	153	59	26	26	16	24	19	18
40.49		52	909	471	372	208	75	104	46	68	15	29	16	10
52.46		377	900	823	359	230	140	49	58	65	29	50	6	9
37.23		247	664	438	344	191	119	47	29	20	4	14	2	16
42.92		362	293	603	250	197	77	51	36	26	19	19	13	16
53.58		244	680	428	471	179	145	62	13	24	10	19	3	17
40.27		231	742	663	181	240	70	59	17	26	12	2	4	12
18.05		1028	380	225	131	29	26	9	7	13	8	4	1	2
25.47		327	1062	376	210	98	14	14	7	9	5	0	0.3	2
31.27		296	615	629	161	81	75	38	36	19	4	2	1	1
38.35		205	524	523	530	176	71	20	15	16	11	6	5	7
47.81		77	827	838	277	250	78	48	21	17	8	1	5	2
47.63		104	737	579	258	130	88	29	17	9	12	3	3	0
51.98		193	661	377	241	143	74	55	23	16	18	7	3	2
52.11		166	771	608	188	100	84	33	25	21	8	6	10	7
55.03		493	1286	622	189	66	36	11	14	5	3	1	3	0
56.05		1509	1174	435	124	20	16	14	6	2	9	3	1	1
52.06		621	1445	710	307	174	38	16	11	11	6	17	1	1
43.24		0	1292	1704	570	163	56	27	15	1	1	1	4	0.6
42.81		16	538	929	1273	315	160	50	19	12	2	7	1	3

UK-CBT **UK(E+W) VIIf Beam trawl**

	1991	2009													
	1	1	0	1											
	1	14													
40.81		0	52	98	189	171	60	67	23	20	16	13	5	4	4
35.78		0	18	220	103	83	69	22	21	10	13	5	3	1	1
39.64		1.9	6	83	198	77	50	41	11	24	9	5	4	3	4
37.03		0	23	80	59	116	36	31	19	11	15	8	5	5	4
37.59		0	16	87	73	56	105	24	30	23	8	8	4	5	3
39.78		0.2	22	96	128	70	45	53	15	13	12	4	9	5	2
43		0	10	60	86	69	53	27	39	11	11	5	5	3	2
47.84		0	13	101	73	77	50	17	13	20	7	6	4	2	1
50.87		0.4	31	204	107	52	50	28	13	6	10	4	2	1	0
51.19		0.1	72	152	150	75	27	28	20	9	4	8	3	2	2
49.32		0	37	272	99	89	48	19	17	11	9	3	7	1	2
37.53		0	11	149	375	90	63	28	18	14	9	6	4	4	1
40.71		0.1	18	101	176	369	77	45	18	6	7	3	4	1	2
32.37		0	19	91	65	114	180	34	27	15	7	3	5	1	1
27.73		0	27	78	126	55	60	115	15	14	4	5	2	2	1
18.57		0	16	86	94	103	32	39	69	13	8	4	2	2	1
15.37		0.9	18	77	89	77	82	32	41	76	8	8	4	2	3
13.83		0	12	76	100	67	52	54	19	32	42	10	5	2	3
12.23		0	22	54	73	73	63	28	29	12	12	29	4	3	1

Table 7.13.9 - Sole in VIIfg. Tuning series - continued

Indices in bold are used in the assessment

UK-(BTS-3Q)		**UK(E+W) VIIf Corystes (automated indices since 1995)**									
	1988	**2009**									
	1	**1**	**0.75**	**0.85**							
	0	**9**									
74.120		22	**60**	**242**	**36**	**14**	**4**	**0**	**0**	**0**	**0**
91.909		132	**204**	**304**	**162**	**18**	**14**	**6**	**4**	**2**	**2**
69.858		21	**269**	**219**	**35**	**11**	**3**	**5**	**2**	**0**	**0**
123.410		40	**297**	**638**	**83**	**21**	**18**	**5**	**0**	**3**	**2**
125.078		5	**493**	**325**	**174**	**37**	**23**	**12**	**1**	**2**	**1**
127.672		6	**207**	**436**	**52**	**28**	**3**	**2**	**2**	**1**	**1**
120.816		1	**424**	**430**	**133**	**23**	**11**	**9**	**0**	**0**	**3**
114.886		31	**142**	**255**	**60**	**13**	**7**	**14**	**1**	**1**	**1**
118.592		3	**178**	**251**	**64**	**27**	**7**	**3**	**4**	**1**	**3**
114.886		37	**498**	**207**	**21**	**13**	**14**	**5**	**3**	**6**	**0**
114.886		104	**885**	**472**	**57**	**11**	**9**	**5**	**2**	**1**	**5**
118.592		29	**2922**	**297**	**38**	**16**	**7**	**4**	**5**	**1**	**0**
118.592		16	**1086**	**1608**	**37**	**26**	**6**	**0**	**2**	**1**	**1**
118.592		26	**449**	**711**	**307**	**23**	**9**	**6**	**2**	**0**	**2**
118.592		9	**786**	**283**	**151**	**121**	**14**	**7**	**2**	**3**	**0**
118.592		14	**465**	**628**	**55**	**30**	**56**	**9**	**3**	**3**	**0**
114.886		63	**862**	**434**	**99**	**15**	**22**	**42**	**4**	**3**	**0**
118.592		44	**407**	**267**	**38**	**16**	**7**	**5**	**17**	**1**	**2**
118.592		13	**324**	**238**	**47**	**16**	**8**	**0**	**2**	**12**	**0**
118.592		104	**424**	**128**	**51**	**16**	**13**	**7**	**3**	**4**	**14**
118.592		6	**1232**	**124**	**15**	**18**	**7**	**9**	**4**	**3**	**5**
118.592		1	**604**	**377**	**29**	**8**	**10**	**4**	**3**	**3**	**2**

IR - GFS : Irish Groundfish Survey (IBTS 4th Qtr) - VIIb Sole number at age (Interim indices for new Celtic Explorer series)

	2003	2009									
	1	1	0.79	0.92							
	1	10									
832		1.0	5.2	1.1	3.2	3.0	4.1	4.0	0.0	1.0	0.0
980		1.0	8.0	6.0	5.0	1.0	2.0	1.0	0.0	0.0	1.0
845		0.0	0.0	6.0	2.0	4.0	2.0	2.0	0.0	0.0	0.0
1046		0.0	0.0	4.0	4.0	6.0	4.0	1.0	0.0	0.0	0.0
1168		0.0	2.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0
1139		2.0	9.0	7.0	3.0	2.0	0.0	2.0	0.0	1.0	0.0
1018		0.0	15.0	3.0	4.0	1.0	1.0	2.0	1.0	0.0	2.0

UK (E+W) TRAWL 107F. (Processed as unsexed - from 2001WG)

1991	2009									
1	1	0	1							
1	10									
18.57	0	1.7	6.4	13	11.2	3.5	3.3	1.1	0.8	0.8
16	0	8.4	29.4	10.4	6.9	5.9	1.5	1.8	0.8	0.9
13.79	0.1	0.8	3.7	10.2	3.8	2	1.4	0.3	0.6	0.2
9.48	0	1.7	4.3	2.5	4.9	1.7	1.5	1.1	0.6	0.7
8.46	0	2.3	12	5.3	2.5	4.5	0.9	1.2	0.7	0.2
8.67	0.1	2.8	4.3	4.9	2.4	1.4	1.4	0.3	0.5	0.2
8.14	0	2	8	6.8	4.1	2.1	0.7	1.2	0.4	0.3
7.13	0	2	4	2.7	2.1	1.3	0.4	0.3	0.5	0.1
5.69	0.1	8.5	12.4	3.5	1.5	1.2	0.8	0.4	0.1	0.3
4.05	0	0.9	1.8	1.6	0.7	0.2	0.2	0.2	0.1	0
4.42	0	1.5	10.1	2.3	1.7	0.6	0.3	0.2	0.2	0.1
6.1	0	0.5	4.8	8.2	1.8	1	0.3	0.2	0.2	0.1
9.94	0.1	1.6	2.8	3.3	6.7	1	0.7	0.3	0.1	0.1
9.42	0	1	4.8	2.9	3.3	4.9	0.9	0.6	0.4	0.2
12.09	0	2.6	4.9	6.1	2.3	2.6	4.9	0.7	0.7	0.2
12.97	0	0.4	7.1	7.7	9.5	3	3.9	6.9	1.3	0.9
10.66	0	0.5	2.6	3.5	3.2	3.2	1.2	1.5	2.6	0.3
10.13	0	0.4	3.5	**5**	3.8	2.9	2.7	0.9	1.6	2.2
8.97	0	0	0	0	0	0	0	0	0	0

Table 7.13.10 - Sole VIIfg - XSA diagnostics

Lowestoft VPA Version 3.1

21/04/2010 17:39

Extended Survivors Analysis

CELTIC SEA SOLE 2010WG COMBSEX PLUSGROUP

CPUE data from file SOL7FTUN.txt

Catch data for 39 years. 1971 to 2009. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
BEL-CBT	1971	2009	2	9	0	1
UK-CBT	1991	2009	2	9	0	1
UK(BTS-3Q)	1988	2009	1	9	0.75	0.85

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 48 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0	0	0	0	0	0	0	0	0	0
2	0.142	0.11	0.008	0.02	0.096	0.051	0.136	0.09	0.057	0.072
3	0.416	0.208	0.311	0.243	0.396	0.253	0.334	0.227	0.15	0.153
4	0.383	0.402	0.346	0.374	0.425	0.303	0.309	0.281	0.198	0.185
5	0.318	0.4	0.544	0.488	0.432	0.43	0.313	0.308	0.314	0.163
6	0.233	0.538	0.372	0.667	0.314	0.355	0.229	0.26	0.262	0.237
7	0.345	0.376	0.37	0.59	0.353	0.219	0.193	0.319	0.221	0.232
8	0.478	0.381	0.543	0.538	0.273	0.219	0.149	0.262	0.222	0.153
9	0.618	0.527	0.641	0.484	0.408	0.271	0.286	0.203	0.283	0.171

1

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9
2000	7860	13700	4570	2250	929	304	202	119	43
2001	4180	7110	10800	2730	1390	612	218	129	67
2002	6900	3780	5770	7910	1650	843	323	135	80
2003	5410	6240	3390	3820	5060	868	526	202	71
2004	6320	4900	5530	2410	2380	2810	403	264	107
2005	6270	5720	4030	3370	1420	1400	1860	256	182
2006	4500	5680	4920	2830	2250	838	887	1350	186
2007	4390	4070	4480	3190	1880	1490	604	662	1050
2008	10000	3970	3370	3230	2180	1250	1040	397	461
2009	7320	9050	3390	2620	2400	1440	872	754	288

Estimated population abundance at 1st Jan 2010

0	6620	7620	2630	1970	1850	1030	625	585

Taper weighted geometric mean of the VPA populations:

5140	4620	3670	2470	1500	898	548	348	221

Standard error of the weighted Log(VPA populations) :

0.351	0.3465	0.337	0.3613	0.4293	0.4961	0.605	0.7877	0.9591

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Log catchability residuals.

Fleet : BEL-CBT

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	No data for this fleet at this age								
2	0.23	0.14	0.54	0.11	-0.15	0.55	0.21	0.38	0.41
3	-0.48	0.18	0.38	-0.1	-0.34	0.4	0.15	0.08	0.08
4	0.26	-0.16	0.13	-0.05	-0.31	-0.01	-0.02	0.07	0.41
5	0.32	0.14	0.2	0.14	0	0.26	-0.08	-0.46	0.13
6	0.13	0.3	-0.09	0.51	0.27	-0.18	0.08	-0.21	0.05
7	0.5	-0.01	-0.3	0.12	0.38	0.15	0.19	-0.38	0.63
8	0.32	0.21	-0.42	-0.01	-0.45	0.57	-0.01	-0.17	0.3
9	0.02	-0.1	-0.18	0.15	-0.1	0.07	-0.27	-0.23	0.02

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	No data for this fleet at this age									
2	1.18	0.55	0.22	0.45	0.17	-1.66	-0.09	0.42	0.05	-0.31
3	0.05	0.22	0.12	-0.02	-0.19	-0.05	0.01	-0.16	-0.54	-0.48
4	0.27	-0.09	-0.15	-0.25	-0.34	-0.12	-0.09	0	-0.19	-0.15
5	0.21	-0.13	0.05	-0.24	0.02	0.12	-0.04	0	-0.05	-0.1
6	-0.04	0.21	0.21	-0.18	-0.1	0.07	0.11	0.38	-0.02	0.09
7	-0.87	0.17	0.41	0.14	0.22	-0.06	0.05	0.69	0.02	0.19
8	-0.16	-0.14	0.36	0.5	-0.08	0.19	-0.27	-0.13	0.57	0.17
9	-0.01	0.08	0.42	-0.22	-0.29	-0.06	-0.08	0.16	0.03	-0.3

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	0.09	1.61	0.79	0.42	-0.16	-1.11	-0.77	-0.44	-0.91	0.03
3	0.18	0.42	0.42	0.29	-0.2	0.1	0.25	0.07	0	0.2
4	0.13	0.08	0.31	-0.03	0.23	0.42	0.19	-0.08	0.45	0.1
5	-0.04	0	0.24	-0.18	0.19	0.05	0.04	0.02	-0.07	0.04
6	0.22	-0.35	0.02	-0.34	0.36	-0.03	0.03	0.21	-0.09	-0.47
7	0.2	-0.45	-0.85	0.23	-0.08	0.1	-0.32	0.21	0.66	-0.45
8	0.25	-0.41	-0.97	0.44	-0.74	-0.02	-0.27	-0.25	0.16	-0.64
9	-0.16	-0.4	-0.47	0.29	-0.01	-0.29	-0.32	0.07	-0.42	-0.09

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	0.26	0.09	99.99	-3.29	99.99	99.99	99.99	99.99	99.99	99.99
3	-0.03	-0.7	0.04	-0.33	99.99	99.99	99.99	99.99	99.99	99.99
4	-0.55	-0.17	-0.2	-0.06	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.92	-0.31	0.39	0.06	99.99	99.99	99.99	99.99	99.99	99.99
6	-1.6	0.07	-0.2	0.57	99.99	99.99	99.99	99.99	99.99	99.99
7	-1.28	-0.4	-0.22	0.45	99.99	99.99	99.99	99.99	99.99	99.99
8	-0.82	-0.74	-0.01	0.22	99.99	99.99	99.99	99.99	99.99	99.99
9	-0.6	-0.39	-0.02	0.27	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-6.3729	-5.1053	-4.8863	-4.9165	-4.9817	-5.0695	-5.0695	-5.0695
S.E(Log q)	0.866	0.2855	0.2321	0.2419	0.3734	0.4505	0.4193	0.2561

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.98	0.035	6.4	0.15	32	0.87	-6.37
3	1.06	-0.415	4.91	0.58	33	0.31	-5.11
4	1.07	-0.599	4.69	0.71	33	0.25	-4.89
5	0.85	1.94	5.28	0.84	33	0.2	-4.92
6	0.76	2.371	5.39	0.76	33	0.27	-4.98
7	0.81	1.746	5.28	0.74	33	0.36	-5.07
8	0.89	1.302	5.21	0.83	33	0.37	-5.14
9	0.92	2.089	5.19	0.96	33	0.2	-5.17
1							

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Fleet : UK-CBT

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	99.99	0.38	0.13	-1.15	0.26	0.13	0.42	-0.64	-0.79	-0.09
3	99.99	0.07	0.33	-0.13	-0.22	-0.08	0.22	-0.32	-0.12	0.25
4	99.99	0.56	0.15	0.05	-0.44	-0.31	0.33	0.11	-0.11	-0.11
5	99.99	0.57	0.09	-0.04	-0.18	-0.2	0.03	0.07	0.24	-0.05
6	99.99	0.4	0.17	-0.22	-0.36	0.19	-0.01	0.25	0.15	0.17
7	99.99	0.37	-0.04	0.08	-0.18	-0.14	0.03	0.09	-0.15	0.07
8	99.99	0.41	-0.21	-0.34	-0.06	0.44	-0.05	0.28	0.01	0.3
9	99.99	0.53	0.24	0.34	0.4	0.74	0.28	0.22	0.14	-0.17

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	: at this age									
2	-0.12	-0.11	-0.47	-0.55	0.01	0.34	0.27	0.88	0.59	0.51
3	-0.16	-0.5	-0.15	-0.12	-0.42	-0.17	0.17	0.29	0.63	0.41
4	-0.05	-0.62	-0.1	-0.2	-0.48	-0.06	0.23	0.23	0.4	0.41
5	-0.22	-0.38	-0.2	-0.01	-0.24	-0.29	0.22	0.3	0.12	0.16
6	-0.37	-0.32	-0.17	0.05	-0.21	-0.43	-0.21	0.36	0.19	0.35
7	0.07	-0.35	-0.08	-0.08	0.03	-0.19	-0.14	0.3	0.33	-0.02
8	0.27	0.07	0.42	-0.06	0.19	-0.24	-0.01	0.42	0.25	0.12
9	0.59	0.36	0.74	-0.14	0.57	0.06	0.37	0.55	0.65	0.21

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-8.9437	-6.9296	-6.359	-6.031	-5.8216	-5.7627	-5.7627	-5.7627
S.E(Log q)	0.5221	0.2989	0.3229	0.2386	0.274	0.1865	0.2703	0.4482

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.95	0.167	8.92	0.38	19	0.51	-8.94
3	1.3	-1.151	6.52	0.47	19	0.38	-6.93
4	1.04	-0.194	6.3	0.58	19	0.35	-6.36
5	0.99	0.059	6.04	0.82	19	0.24	-6.03
6	1	0.01	5.82	0.81	19	0.28	-5.82
7	0.96	0.643	5.78	0.93	19	0.18	-5.76
8	1.01	-0.109	5.65	0.89	19	0.25	-5.65
9	0.92	0.99	5.37	0.91	19	0.25	-5.41
1							

Fleet : UK(BTS-3Q)

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-1.35	-0.15
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.05	0.33
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.35	1.12
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.09	0.6
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.19	0.36
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.48
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.54
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.68
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	1.74

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.44	-0.19	0.24	-0.64	0.39	-0.63	-0.63	0.13	0.57	0.85
2	0.43	0.19	0.15	0.34	0.37	0.13	0.13	-0.23	0.27	-0.3
3	0.16	0.53	0.61	-0.01	0.84	0.21	0.53	-0.56	0.19	-0.45
4	-0.03	0.22	0.84	-0.13	0.42	-0.09	0.73	0.24	0.18	0.16
5	-0.11	0.63	0.96	-1.08	-0.27	0.04	0.09	0.96	0.65	0.56
6	0.16	0.26	0.62	-1.19	0.58	0.57	-0.3	0.47	0.45	0.27
7	0.6	99.99	-0.68	-0.32	99.99	-0.64	0.14	0.76	0.72	1.28
8	99.99	1.03	-0.11	-0.13	99.99	-0.23	-0.09	1.24	0.37	0.68
9	99.99	0.89	0.43	-0.19	1.76	0.33	1.52	99.99	1.63	99.99

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.52	0.26	0.32	0.04	0.53	-0.24	-0.14	0.16	0.4	0
2	0.53	0.34	-0.03	0.28	0.24	-0.47	-0.51	-0.83	-0.86	-0.56
3	-0.64	0.45	0.45	-0.09	0.17	-0.62	-0.54	-0.45	-1.45	-0.8
4	0.29	-0.01	0.55	-0.1	-0.26	-0.66	-0.48	-0.62	-0.58	-1.19
5	-0.23	-0.16	0.22	0.44	0.25	-0.41	-0.83	-0.17	-0.93	-0.79
6	99.99	0.2	-0.1	0.36	0.48	-0.95	99.99	-0.75	-0.33	-1.3
7	0.31	0.26	-0.14	-0.05	0.35	0.13	-1.29	-0.4	-0.73	-0.84
8	0.25	99.99	1.27	0.87	0.42	-0.72	0.05	-0.25	-0.06	-0.75
9	1.37	1.56	99.99	99.99	99.99	0.36	99.99	0.49	0.35	-0.18

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8	9
Mean Log q	-7.1906	-7.2537	-8.5374	-9.1455	-9.2541	-9.0942	-9.3451	-9.3451	-9.3451
S.E(Log q)	0.5135	0.4145	0.6218	0.4997	0.585	0.6257	0.6566	0.6647	1.1462

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.6	2.506	7.76	0.66	22	0.28	-7.19
2	0.94	0.25	7.33	0.48	22	0.4	-7.25
3	0.86	0.401	8.5	0.3	22	0.55	-8.54
4	1.68	-1.449	10.04	0.19	22	0.82	-9.15
5	1.51	-1.32	10.28	0.25	22	0.87	-9.25
6	1.66	-1.463	10.67	0.23	19	1.01	-9.09
7	2.2	-2.501	13.29	0.2	19	1.27	-9.35
8	1.65	-2.058	11.42	0.39	18	0.92	-9.09
9	2.04	-2.554	12.1	0.34	14	1.22	-8.48
1							

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	1	0	0	0	0	0	0
UK(BTS-3Q)	6624	0.525	0	0	1	1	0
F shrinkage mean	0	1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6624	0.53	0	1	0	0

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	12627	0.536	0	0	1	0.265	0.044
UK(BTS-3Q)	6348	0.33	0.471	1.43	2	0.699	0.086
F shrinkage mean	6333	1.5				0.036	0.086

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7615	0.28	0.29	4	1.04	0.072

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	4142	0.266	0.078	0.29	2	0.544	0.1
UK(BTS-3Q)	1543	0.293	0.327	1.12	3	0.436	0.249
F shrinkage mean	1390	1.5				0.02	0.273

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2634	0.2	0.26	6	1.336	0.153

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	3489	0.208	0.112	0.54	3	0.605	0.109
UK(BTS-3Q)	813	0.255	0.259	1.02	4	0.38	0.401
F shrinkage mean	1128	1.5				0.015	0.304

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1972	0.16	0.29	8	1.81	0.185

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	2413	0.174	0.056	0.32	4	0.674	0.127
UK(BTS-3Q)	1079	0.24	0.087	0.36	5	0.313	0.264
F shrinkage mean	752	1.5				0.013	0.36

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1847	0.14	0.14	10	0.964	0.163

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	1311	0.157	0.049	0.31	5	0.72	0.19
UK(BTS-3Q)	537	0.236	0.24	1.02	6	0.266	0.413
F shrinkage mean	835	1.5				0.014	0.285

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1027	0.13	0.15	12	1.122	0.237

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	1	0	0	0	0	0	0
UK-CBT	695	0.144	0.068	0.47	6	0.752	0.211
UK(BTS-3Q)	450	0.233	0.147	0.63	7	0.236	0.31
F shrinkage mean	547	1.5				0.012	0.262

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
625	0.12	0.08	14	0.648	0.232

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	22	0.879	0	0	1	0.006	1.696
UK-CBT	692	0.135	0.092	0.68	7	0.771	0.131
UK(BTS-3Q)	356	0.234	0.166	0.71	8	0.213	0.241
F shrinkage mean	384	1.5				0.01	0.225

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
585	0.12	0.12	17	1.003	0.153

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BEL-CBT	158	0.3	0	0	1	0.041	0.23
UK-CBT	232	0.136	0.101	0.74	8	0.777	0.162
UK(BTS-3Q)	185	0.264	0.074	0.28	8	0.169	0.199
F shrinkage mean	191	1.5				0.013	0.194

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
219	0.12	0.07	18	0.561	0.171

Table 7.13.11 - Sole in VIIfg. Fishing mortality

Run title : CELTIC SEA SOLE,2010WG,COMBSEX,PLUSGROUP
At 21/04/2010 17:41

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0826	0.0677	0.1042	0.0546	0.0415	0.1301	0.0729	0.0831	0.0719
3	0.1456	0.2514	0.3136	0.1579	0.1221	0.3975	0.2427	0.2195	0.1846
4	0.3795	0.2249	0.3037	0.2066	0.1566	0.3286	0.2559	0.2678	0.3195
5	0.3891	0.2942	0.3158	0.2427	0.2076	0.4167	0.2332	0.1534	0.2335
6	0.3040	0.3240	0.2214	0.3302	0.2543	0.2529	0.2589	0.1867	0.2024
7	0.4005	0.2146	0.1660	0.2058	0.2582	0.3212	0.2612	0.1422	0.3301
8	0.3347	0.2681	0.1469	0.1775	0.1140	0.4906	0.2138	0.1763	0.2376
9	0.2482	0.1994	0.1862	0.1903	0.1605	0.2981	0.1620	0.1694	0.1799
+gp	0.2482	0.1994	0.1862	0.1903	0.1605	0.2981	0.1620	0.1694	0.1799
FBAR 4-8	0.3616	0.2652	0.2308	0.2325	0.1981	0.3620	0.2446	0.1853	0.2646

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.2434	0.1466	0.0853	0.1670	0.1222	0.0496	0.1070	0.1245	0.1126	0.1323
3	0.2800	0.3752	0.2755	0.3715	0.3047	0.3780	0.4649	0.2768	0.2404	0.3446
4	0.4316	0.3438	0.2618	0.3674	0.3279	0.4407	0.5181	0.5145	0.3911	0.4928
5	0.3934	0.3170	0.3111	0.3624	0.4539	0.5105	0.5452	0.4605	0.5301	0.4679
6	0.2898	0.4214	0.3415	0.3587	0.3750	0.4257	0.6283	0.5375	0.5682	0.5365
7	0.1051	0.3705	0.3828	0.4486	0.4756	0.3192	0.4820	0.8060	0.4556	0.5290
8	0.2365	0.2707	0.3624	0.6503	0.3492	0.4157	0.4488	0.4379	0.7360	0.5308
9	0.2732	0.3407	0.3825	0.3185	0.2848	0.3829	0.5432	0.5779	0.5223	0.4618
+gp	0.2732	0.3407	0.3825	0.3185	0.2848	0.3829	0.5432	0.5779	0.5223	0.4618
FBAR 4-8	0.2913	0.3447	0.3319	0.4375	0.3963	0.4224	0.5245	0.5513	0.5362	0.5114

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0905	0.2192	0.1276	0.0969	0.0806	0.0449	0.0640	0.0729	0.0427	0.1191
3	0.3922	0.3022	0.3794	0.3564	0.2889	0.4517	0.5236	0.4573	0.3823	0.5451
4	0.6151	0.4328	0.4524	0.4023	0.5195	0.7224	0.6803	0.5799	0.7366	0.6172
5	0.6298	0.5043	0.4653	0.3944	0.5592	0.5584	0.6017	0.6472	0.5633	0.6325
6	0.6538	0.4572	0.4616	0.3535	0.6079	0.6215	0.5990	0.7810	0.5621	0.5150
7	0.6104	0.4339	0.2995	0.5320	0.4707	0.5700	0.4758	0.6986	0.8225	0.4944
8	0.6374	0.4628	0.2576	0.5083	0.3760	0.6919	0.4524	0.5831	0.5954	0.5189
9	0.6384	0.5011	0.4022	0.6102	0.6696	0.7021	0.5504	0.6914	0.4480	0.5202
+gp	0.6384	0.5011	0.4022	0.6102	0.6696	0.7021	0.5504	0.6914	0.4480	0.5202
FBAR 4-8	0.6293	0.4582	0.3873	0.4381	0.5067	0.6329	0.5618	0.6580	0.6560	0.5556

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR 07-09
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1417	0.1099	0.0081	0.0203	0.0957	0.0511	0.1357	0.0904	0.0575	0.0722	0.0734
3	0.4158	0.2076	0.3108	0.2434	0.3960	0.2526	0.3343	0.2267	0.1503	0.1531	0.1767
4	0.3834	0.4021	0.3463	0.3737	0.4247	0.3027	0.3086	0.2812	0.1977	0.1849	0.2213
5	0.3183	0.4000	0.5443	0.4883	0.4317	0.4296	0.3131	0.3077	0.3140	0.1627	0.2615
6	0.2325	0.5378	0.3716	0.6674	0.3143	0.3553	0.2286	0.2604	0.2616	0.2372	0.2531
7	0.3447	0.3760	0.3696	0.5897	0.3531	0.2194	0.1928	0.3195	0.2210	0.2325	0.2576
8	0.4779	0.3810	0.5432	0.5381	0.2730	0.2195	0.1493	0.2616	0.2215	0.1534	0.2122
9	0.6175	0.5266	0.6406	0.4843	0.4076	0.2706	0.2858	0.2032	0.2826	0.1709	0.2189
+gp	0.6175	0.5266	0.6406	0.4843	0.4076	0.2706	0.2858	0.2032	0.2826	0.1709	
FBAR 4-8	0.3514	0.4194	0.4350	0.5314	0.3593	0.3053	0.2385	0.2861	0.2432	0.1941	

Table 7.13.12 - Sole in VIIfg. Stock numbers at age (start of year, in thousand)

Run title : CELTIC SEA SOLE,2010WG,COMBSEX,PLUSGROUP
At 21/04/2010 17:41

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	9606	4274	3386	3403	2972	5192	4635	5492	3534
2	5121	8692	3868	3064	3079	2689	4698	4194	4970
3	2095	4267	7350	3153	2625	2673	2137	3952	3492
4	4464	1639	3002	4861	2437	2102	1625	1517	2871
5	2038	2763	1184	2005	3577	1885	1369	1138	1050
6	1736	1250	1863	781	1423	2630	1124	981	884
7	1711	1159	818	1351	508	999	1848	785	737
8	2820	1037	846	627	995	355	656	1288	616
9	1799	1826	718	661	475	803	197	479	977
+gp	5822	4236	3976	3275	2633	1883	2561	1172	1077
TOTAL	37211	31143	27012	23181	20724	21212	20850	20999	20208

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	5131	4858	4888	6789	4704	5656	3157	5738	4491	3719
2	3197	4642	4395	4423	6143	4256	5118	2857	5192	4063
3	4185	2268	3628	3652	3386	4919	3665	4161	2282	4198
4	2627	2862	1410	2492	2279	2259	3050	2083	2855	1624
5	1888	1544	1836	982	1562	1486	1316	1644	1127	1747
6	752	1152	1018	1217	619	898	807	690	939	600
7	653	509	684	654	769	385	531	389	365	481
8	479	532	318	422	378	433	253	296	157	209
9	440	342	367	200	199	241	258	146	173	68
+gp	1544	1379	1074	1229	1159	790	819	426	689	289
TOTAL	20896	20089	19619	22062	21198	21323	18973	18432	18270	16999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	8607	4199	4455	4426	3410	3319	4051	5478	6293	15138
2	3365	7788	3800	4031	4005	3086	3003	3666	4957	5694
3	3221	2782	5660	3026	3310	3343	2669	2549	3084	4298
4	2691	1969	1861	3504	1917	2244	1926	1431	1460	1904
5	898	1316	1156	1071	2121	1032	986	883	725	632
6	990	433	719	657	653	1097	534	489	418	373
7	318	466	248	410	417	322	533	266	203	216
8	256	156	273	166	218	236	165	300	119	81
9	111	123	89	191	90	135	107	95	151	60
+gp	286	430	281	227	313	226	262	222	252	114
TOTAL	20743	19662	18541	17709	16455	15040	14237	15377	17663	28509

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 71-07	AMST 71-07
1	7860	4177	6896	5413	6325	6273	4502	4389	9997	7321	0*	4998	5320
2	13697	7112	3779	6240	4898	5723	5676	4073	3971	9046	6624	4554	4845
3	4574	10757	5766	3392	5533	4027	4920	4484	3367	3393	7615	3690	3932
4	2255	2731	7909	3824	2406	3369	2831	3187	3234	2621	2634	2447	2635
5	929	1390	1653	5061	2381	1424	2253	1881	2177	2402	1972	1469	1620
6	304	612	843	868	2810	1399	838	1490	1251	1439	1847	879	997
7	202	218	323	526	403	1857	887	604	1039	872	1027	532	642
8	119	129	135	202	264	256	1349	662	397	754	625	340	481
9	43	67	80	71	107	182	186	1052	461	288	585	215	360
+gp	116	207	113	204	153	190	215	399	728	1269	1187		
TOTAL	30100	27400	27498	25802	25280	24700	23657	22221	26624	29403	24117		

* Replaced with GM = 4998

Table 7.13.13 - Sole in VIIfg. Summary

Run title : CELTIC SEA SOLE,2010WG,COMBSEX,PLUSGROUP
At 21/04/2010 17:41

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
1971	9606	9497	8030	1861	0.232	0.362
1972	4274	7990	6333	1278	0.202	0.265
1973	3386	6632	5298	1391	0.263	0.231
1974	3403	6696	5676	1105	0.195	0.233
1975	2972	5883	5028	919	0.183	0.198
1976	5192	5386	4359	1350	0.310	0.362
1977	4635	5938	4675	961	0.206	0.245
1978	5492	5082	3762	780	0.207	0.185
1979	3534	5094	3884	954	0.246	0.265
1980	5131	5243	4021	1314	0.327	0.291
1981	4858	4597	3421	1212	0.354	0.345
1982	4888	4807	3557	1128	0.317	0.332
1983	6789	5135	3657	1373	0.375	0.438
1984	4704	5374	3916	1266	0.323	0.396
1985	5656	4790	3307	1328	0.402	0.422
1986	3157	4622	3367	1600	0.475	0.525
1987	5738	3733	2517	1222	0.486	0.551
1988	4491	3903	2708	1146	0.423	0.536
1989	3719	3245	2109	992	0.470	0.511
1990	8607	3882	2403	1189	0.495	0.629
1991	4199	3601	2128	1107	0.520	0.458
1992	4455	3858	2447	981	0.401	0.387
1993	4426	3836	2478	928	0.375	0.438
1994	3410	3265	2257	1009	0.447	0.507
1995	3319	3086	2155	1157	0.537	0.633
1996	4051	3061	2081	995	0.478	0.562
1997	5478	2975	1821	927	0.509	0.658
1998	6293	3058	1625	875	0.539	0.656
1999	15138	4282	1821	1012	0.556	0.556
2000	7860	3895	1942	1091	0.562	0.351
2001	4177	5409	3121	1168	0.374	0.419
2002	6896	5970	4095	1345	0.328	0.435
2003	5413	5640	3772	1392	0.369	0.531
2004	6325	5219	3539	1249	0.353	0.359
2005	6273	5471	3581	1044	0.292	0.305
2006	4502	4895	3190	946	0.297	0.239
2007	4389	4846	3503	945	0.270	0.286
2008	9997	5331	3436	800	0.2328	0.2432
2009	7321	6475	4180	790	0.189	0.1941
2010	4998[1]	6569[2]	4420[2]			0.1941[3]
Arith. Mean	5491	4915	3467	1132	0.362	0.3984
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

[1] Geometric mean 1971-2007

[3] From forecast

[4] $F_{(07\text{-}09)}$ rescaled to F_{2009}

Table 7.13.14 - Sole in VIIfg
Input for catch forecast and Fmsy analysis

Input: F mean 07-09 rescaled to F2009
Catch and stock weights are mean 07-09
Recruits age 1 in 2010,11 and 12 GM (71-07)

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	4997	0.34	WS1	0.090	0.00
N2	6624	0.53	WS2	0.138	0.13
N3	7614	0.29	WS3	0.196	0.09
N4	2633	0.26	WS4	0.252	0.07
N5	1972	0.29	WS5	0.307	0.06
N6	1847	0.14	WS6	0.361	0.06
N7	1027	0.15	WS7	0.415	0.05
N8	624	0.12	WS8	0.468	0.04
N9	585	0.12	WS9	0.519	0.03
N10	1186	0.12	WS10	0.635	0.05
H.cons selectivity			Weight in the HC catch		
sH1	0.0000	0	WH1	0.102	0.28
sH2	0.0590	0.22	WH2	0.157	0.12
sH3	0.1420	0.14	WH3	0.211	0.06
sH4	0.1780	0.10	WH4	0.263	0.03
sH5	0.2110	0.21	WH5	0.313	0.01
sH6	0.2040	0.15	WH6	0.361	0.01
sH7	0.2070	0.14	WH7	0.408	0.02
sH8	0.1710	0.08	WH8	0.452	0.02
sH9	0.1760	0.25	WH9	0.495	0.02
sH10	0.1760	0.25	WH10	0.586	0.06
Natural mortality			Proportion mature		
M1	0.1	0.1	MT1	0	0
M2	0.1	0.1	MT2	0.14	0.1
M3	0.1	0.1	MT3	0.45	0.1
M4	0.1	0.1	MT4	0.88	0.1
M5	0.1	0.1	MT5	0.98	0.1
M6	0.1	0.1	MT6	1	0
M7	0.1	0.1	MT7	1	0
M8	0.1	0.1	MT8	1	0
M9	0.1	0.1	MT9	1	0
M10	0.1	0.1	MT10	1	0
Relative effort in HC fihery			Year effect for natural mortality		
HF10	1	0.19	K10	1	0.1
HF11	1	0.19	K11	1	0.1
HF12	1	0.19	K12	1	0.1
Recruitment in 2011 and 2012					
R11	4998	0.34			
R12	4998	0.34			

Table 7.13.15 - Sole in VIIfg. Management option table

MFDP version 1a
Run: Sole VIIfg_Fin
CELTIC SEA SOLE 2010WG COMBSEX PLUSGROUP
Time and date: 18:22 13/05/2010
Fbar age range: 4-8

2010 Biomass	SSB	FMult	FBar	Landings
6569	4420	1.0000	0.1941	866

2011 Biomass	SSB	FMult	FBar	Landings	2012 Biomass	SSB
6842	5053	0.0000	0.0000	0	7998	6382
.	5053	0.1000	0.0194	102	7885	6274
.	5053	0.2000	0.0388	203	7774	6169
.	5053	0.3000	0.0582	302	7665	6065
.	5053	0.4000	0.0777	399	7558	5963
.	5053	0.5000	0.0971	494	7453	5863
.	5053	0.6000	0.1165	588	7349	5765
.	5053	0.7000	0.1359	680	7248	5668
.	5053	0.8000	0.1553	770	7148	5573
.	5053	0.9000	0.1747	859	7050	5480
.	5053	1.0000	0.1941	947	6953	5388
.	5053	1.1000	0.2136	1033	6859	5299
.	5053	1.2000	0.2330	1118	6765	5210
.	5053	1.3000	0.2524	1201	6674	5124
.	5053	1.4000	0.2718	1282	6584	5038
.	5053	1.5000	0.2912	1363	6496	4955
.	5053	1.6000	0.3106	1441	6409	4872
.	5053	1.7000	0.3300	1519	6324	4792
.	5053	1.8000	0.3495	1595	6240	4712
.	5053	1.9000	0.3689	1670	6158	4634
.	5053	2.0000	0.3883	1744	6077	4558

Input units are thousands and kg - output in tonnes

Fmult corresponding to Fpa = 1.91

.	5053	1.91	0.37	1675	6153	4630

Fmult corresponding to Fmsy = 1.6

.	5053	1.6	0.3106	1441	6409	4872

Bpa = 2 200 t

Table 7.13.16 - Sole in VIIfg. Detailed results

MFDP version 1a
Run: Sole VIIfg_Fin
Time and date: 18:22 13/05/2010
Fbar age range: 4-8

Year:	2010	F multiplier:	1	Fbar:	0.194				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4998	450	0	0	0	0
2	0.059	362	57	6624	916	927	128	927	128
3	0.142	962	203	7615	1490	3427	671	3427	671
4	0.178	410	108	2634	664	2318	584	2318	584
5	0.211	357	112	1972	605	1933	593	1933	593
6	0.204	325	117	1847	667	1847	667	1847	667
7	0.208	183	75	1027	426	1027	426	1027	426
8	0.171	94	42	625	292	625	292	625	292
9	0.176	90	45	585	304	585	304	585	304
10	0.176	183	107	1187	754	1187	754	1187	754
Total		2965	866	29114	6569	13876	4420	13876	4420

Year:	2011	F multiplier:	1	Fbar:	0.194				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4998	450	0	0	0	0
2	0.059	247	39	4522	626	633	88	633	88
3	0.142	714	151	5650	1105	2542	497	2542	497
4	0.178	929	244	5977	1506	5259	1325	5259	1325
5	0.211	361	113	1994	612	1955	600	1955	600
6	0.204	254	92	1446	522	1446	522	1446	522
7	0.208	243	99	1363	566	1363	566	1363	566
8	0.171	113	51	755	353	755	353	755	353
9	0.176	73	36	477	248	477	248	477	248
10	0.176	207	121	1344	854	1344	854	1344	854
Total		3142	947	28526	6842	15774	5053	15774	5053

Year:	2012	F multiplier:	1	Fbar:	0.194				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4998	450	0	0	0	0
2	0.059	247	39	4522	626	633	88	633	88
3	0.142	487	103	3857	755	1736	340	1736	340
4	0.178	690	181	4434	1117	3902	983	3902	983
5	0.211	819	257	4525	1389	4435	1362	4435	1362
6	0.204	257	93	1462	528	1462	528	1462	528
7	0.208	191	78	1067	443	1067	443	1067	443
8	0.171	150	68	1002	469	1002	469	1002	469
9	0.176	89	44	576	299	576	299	576	299
10	0.176	213	125	1381	877	1381	877	1381	877
Total		3142	987	27826	6953	16195	5388	16195	5388

Input units are thousands and kg - output in tonnes

Table 7.13.17 Sole VIIf,g
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 1 year-olds	4389	9997	7321	4998	4998
Source	XSA	XSA	XSA	GM71-07	GM71-07
Status Quo F:					
% in 2010 landings	12.5	23.4	6.6	0.0	-
% in 2011 landings	11.9	25.8	16.0	4.1	0.0
% in 2010 SSB	13.2	15.2	2.9	0.0	-
% in 2011 SSB	11.9	26.2	9.8	1.7	0.0
% in 2012 SSB	9.8	25.3	18.2	6.3	1.6

GM : geometric mean recruitment

Sole VIIf,g : Year-class % contribution to

a) 2011 landings **b) 2012 SSB**

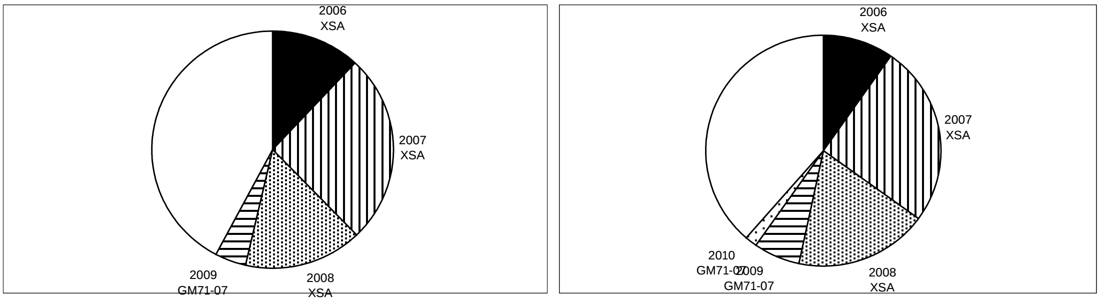


Table 7.13.18 - Sole in VIIfg. Yield per recruit summary table

MFYPR version 2a
Run: Sole VIifg_FinalYield
Time and date: 14:35 14/05/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.000	0.000	0.000	10.508	4.394	8.178	4.082	8.178	4.082
0.1000	0.019	0.129	0.056	9.219	3.624	6.894	3.312	6.894	3.312
0.2000	0.039	0.224	0.094	8.270	3.066	5.949	2.756	5.949	2.756
0.3000	0.058	0.297	0.120	7.543	2.647	5.227	2.338	5.227	2.338
0.4000	0.078	0.355	0.139	6.969	2.322	4.657	2.014	4.657	2.014
0.5000	0.097	0.401	0.152	6.504	2.064	4.197	1.757	4.197	1.757
0.6000	0.117	0.440	0.162	6.120	1.856	3.818	1.550	3.818	1.550
0.7000	0.136	0.472	0.169	5.799	1.684	3.501	1.380	3.501	1.380
0.8000	0.155	0.499	0.175	5.525	1.542	3.232	1.238	3.232	1.238
0.9000	0.175	0.523	0.178	5.289	1.422	3.000	1.119	3.000	1.119
1.0000	0.194	0.544	0.181	5.084	1.320	2.800	1.018	2.800	1.018
1.1000	0.214	0.562	0.183	4.905	1.232	2.624	0.931	2.624	0.931
1.2000	0.233	0.578	0.184	4.746	1.156	2.470	0.856	2.470	0.856
1.3000	0.252	0.592	0.185	4.604	1.089	2.332	0.790	2.332	0.790
1.4000	0.272	0.605	0.186	4.477	1.031	2.210	0.733	2.210	0.733
1.5000	0.291	0.616	0.186	4.363	0.980	2.099	0.683	2.099	0.683
1.6000	0.311	0.627	0.186	4.259	0.934	1.999	0.638	1.999	0.638
1.7000	0.330	0.636	0.185	4.164	0.893	1.909	0.598	1.909	0.598
1.8000	0.350	0.645	0.185	4.078	0.857	1.826	0.562	1.826	0.562
1.9000	0.369	0.653	0.185	3.999	0.824	1.751	0.530	1.751	0.530
2.0000	0.388	0.661	0.184	3.926	0.794	1.682	0.501	1.682	0.501

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.000	0.194
FMax	1.535	0.298
F0.1	0.662	0.128
F35%SPR	0.669	0.130

Weights in kilograms

Table 7.13.19 - Sole VIIfg - FMSY summary

Estimates of biomass and fishing mortality reference levels derived from the fit of three stock

and recruit relationships and the yield per recruit Fmsy proxies.

Stock name
SOLVIIFG.SUM
Sen filename
solviifg.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
936/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alph	ADMB Beta	Unscaled Alpl	Unscaled Beta	AIC
Determinist	0.906	0.357	3019	1015	0.205	2.762	5.138	0.0003	32.557
Mean	0.846	0.322	3047	1004	0.220	2.686	5.071	0.0003	
5%ile	0.512	0.222	2419	731	0.152	2.096	3.781	0.0003	
25%ile	0.664	0.275	2730	878	0.187	2.444	4.456	0.0003	
50%ile	0.796	0.314	2984	998	0.216	2.681	5.005	0.0003	
75%ile	0.955	0.359	3284	1125	0.248	2.935	5.595	0.0004	
95%ile	1.339	0.454	3911	1305	0.307	3.281	6.602	0.0004	
CV	0.342	0.216	0.151	0.174	0.216	0.135	0.171	0.1351	

Beverton-Holt
342/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alph	ADMB Beta	Unscaled Alpl	Unscaled Beta	AIC
Determinist	1.018	0.176	7250	1160	1.656	1.927	7682	1313	42.969
Mean	2.588	0.198	10804	951	2.260	2.368	5689	404	
5%ile	1.048	0.027	2062	648	1.869	2.067	4859	140	
25%ile	1.731	0.159	3030	787	2.139	2.269	5328	219	
50%ile	2.459	0.215	4235	916	2.272	2.368	5598	308	
75%ile	3.368	0.257	6565	1080	2.387	2.477	5948	520	
95%ile	4.478	0.323	55013	1346	2.618	2.692	6804	903	
CV	0.423	0.437	1.615	0.250	0.099	0.079	0.110	0.680	

Smooth hockeystick
929/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alph	ADMB Beta	Unscaled Alpl	Unscaled Beta	AIC
Determinist	0.579	0.298	3374	938	0.982	0.469	1.556	1624	31.567
Mean	0.491	0.290	8656	965	0.922	0.506	1.460	1754	
5%ile	0.342	0.029	1683	694	0.795	0.471	1.259	1633	
25%ile	0.416	0.208	1997	828	0.873	0.481	1.383	1666	
50%ile	0.478	0.315	2809	935	0.924	0.497	1.463	1724	
75%ile	0.555	0.385	4870	1069	0.973	0.522	1.542	1811	
95%ile	0.687	0.481	45548	1348	1.042	0.574	1.650	1989	
CV	0.218	0.477	1.803	0.205	0.083	0.066	0.083	0.066	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Determinist	0.130	0.108	0.128	0.298	0.668	0.186	0.37	0.52
Mean	0.114	0.095	0.118	0.333	1.692	0.189		
5%ile	0.002	0.001	0.002	0.029	0.326	0.136		
25%ile	0.055	0.045	0.060	0.207	0.390	0.164		
50%ile	0.123	0.103	0.132	0.319	0.553	0.185		
75%ile	0.169	0.142	0.171	0.411	0.949	0.208		
95%ile	0.218	0.183	0.221	0.684	8.979	0.256		
CV	0.625	0.628	0.611	0.714	1.788	0.195		

Figure 7.13.1 - Sole in VIIfg. Dotted lines give the length distributions of UK (England and Wales) landings; solid lines of Belgian landings

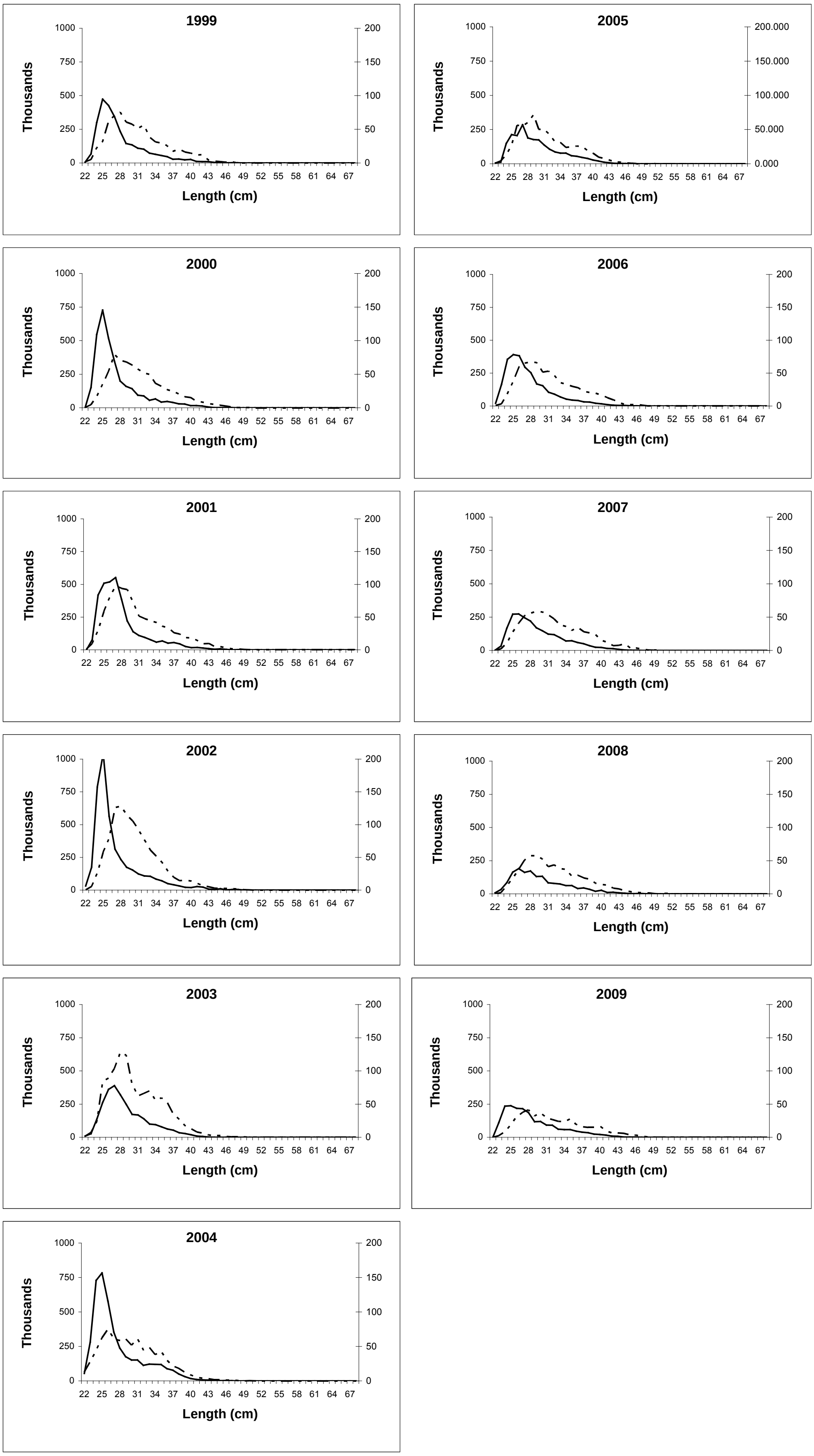


Figure 7.13.2 - Sole in VIIfg. Age composition of landings

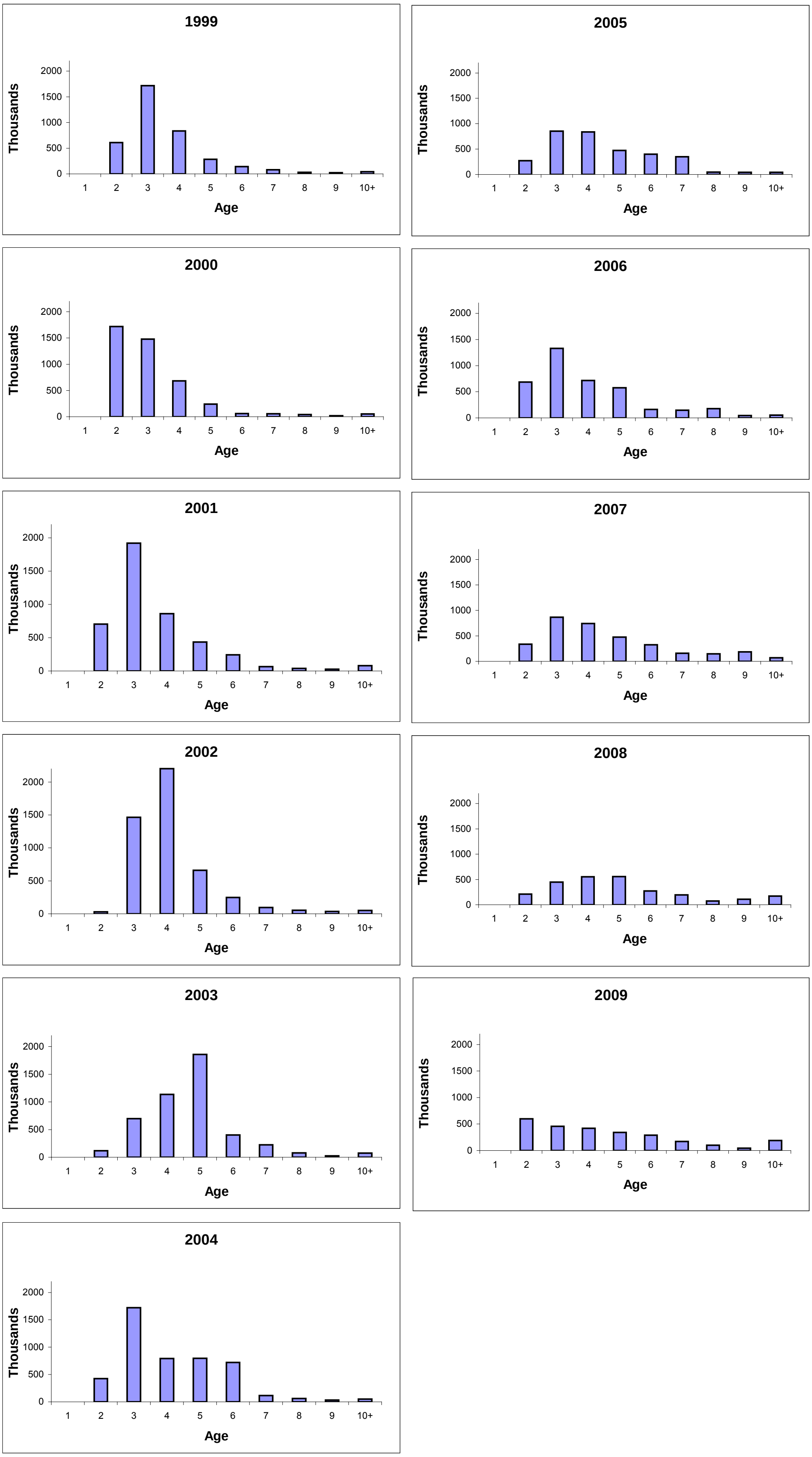


Figure 7.13.3 - Sole in VIIfg - standardised catch proportion

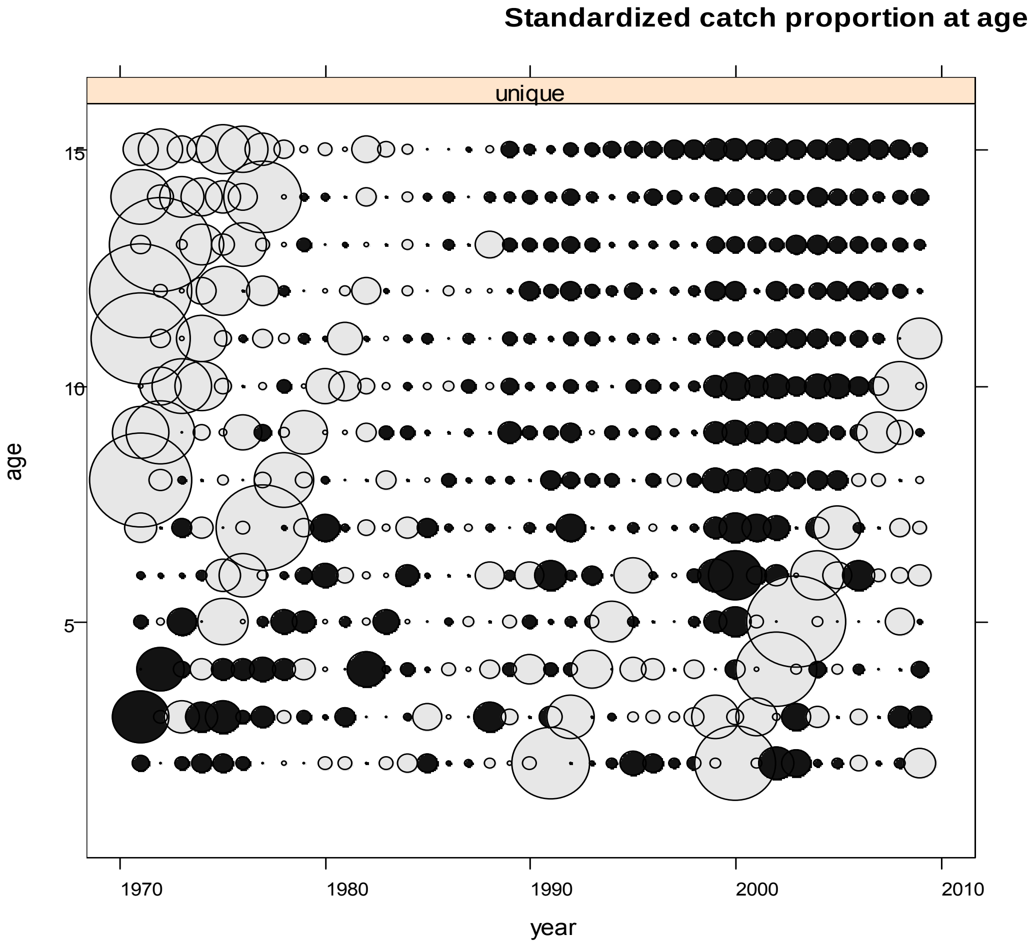
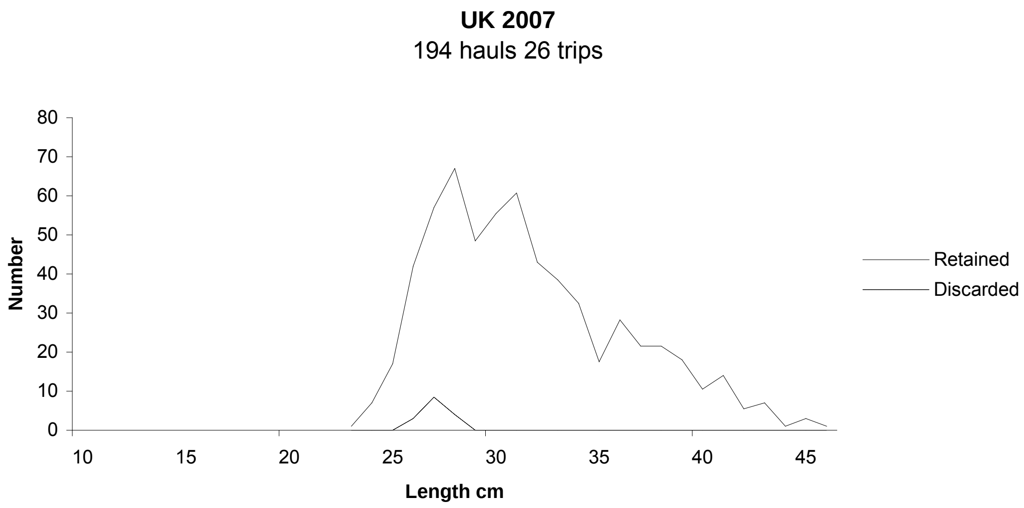
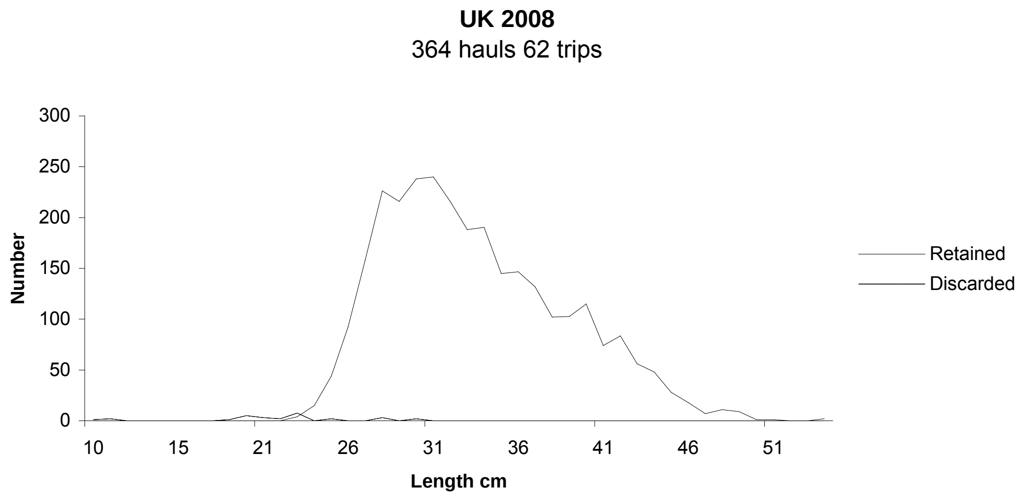


Figure 7.13.4 - Sole VIIfg - Length distributions of discarded and retained fish





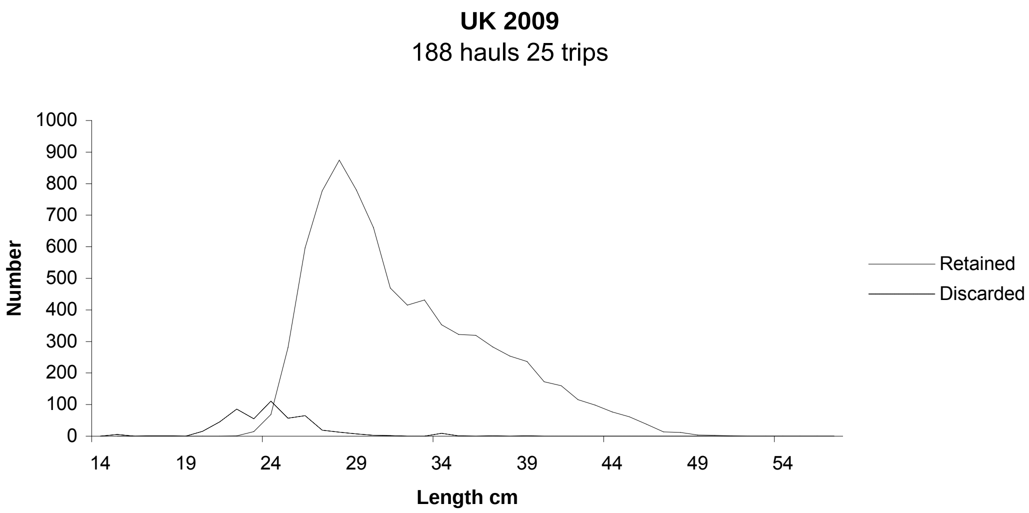
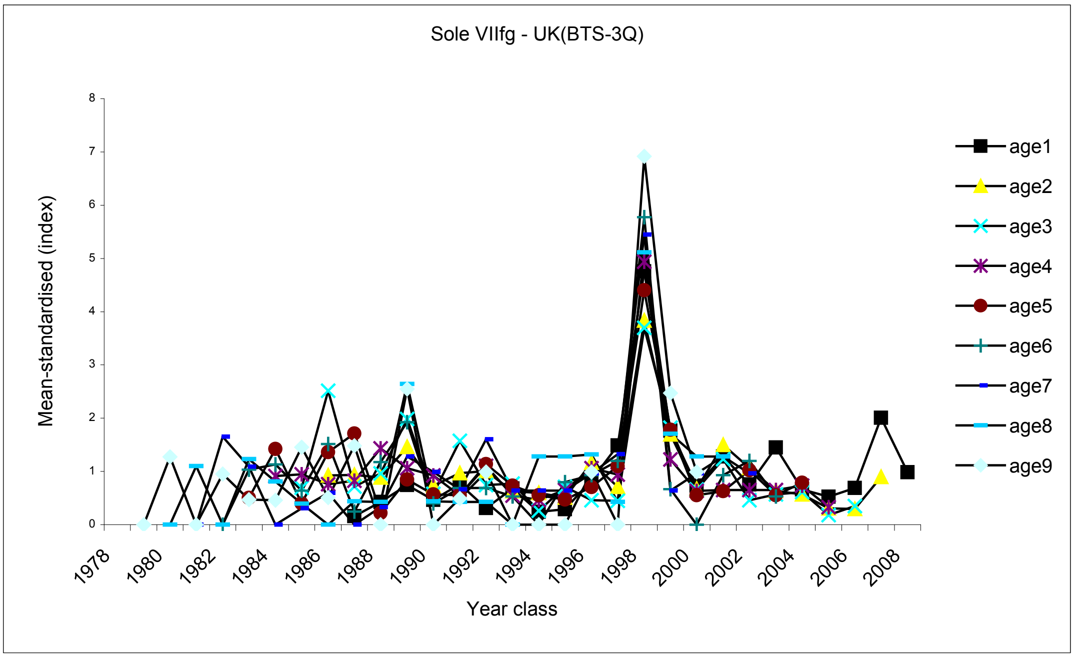


Figure 7.13.5 - Sole VIIfg - Mean-standardised index of UK(E&W) VIIfg Corystes survey



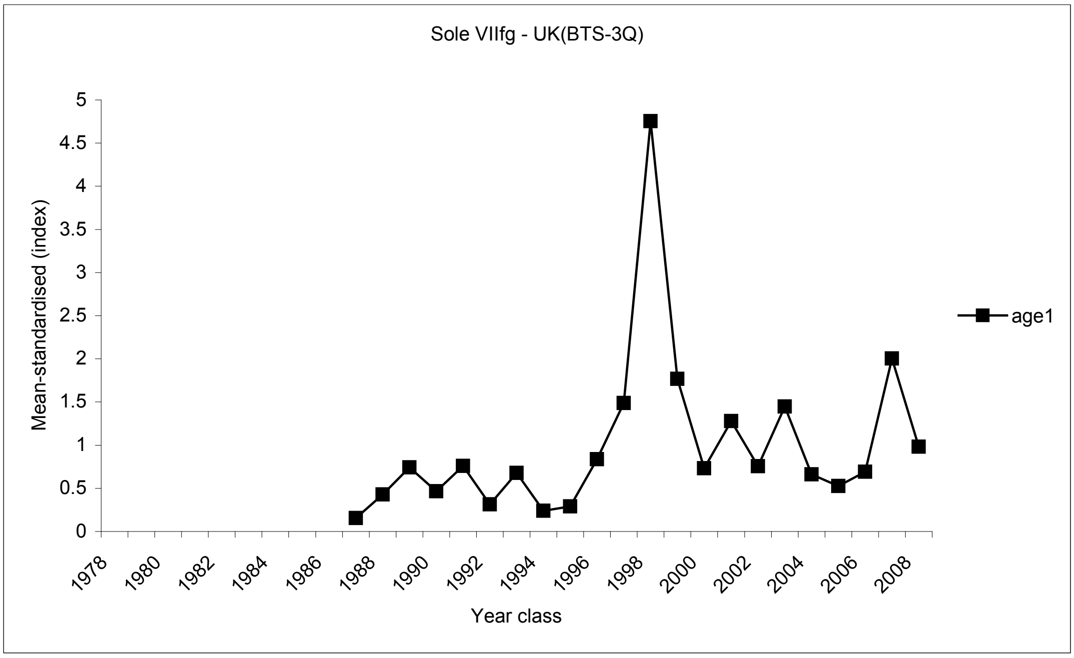


Figure 7.13.6 - Sole in VIIfg - Consistency plot UK-(BTS-3Q) survey

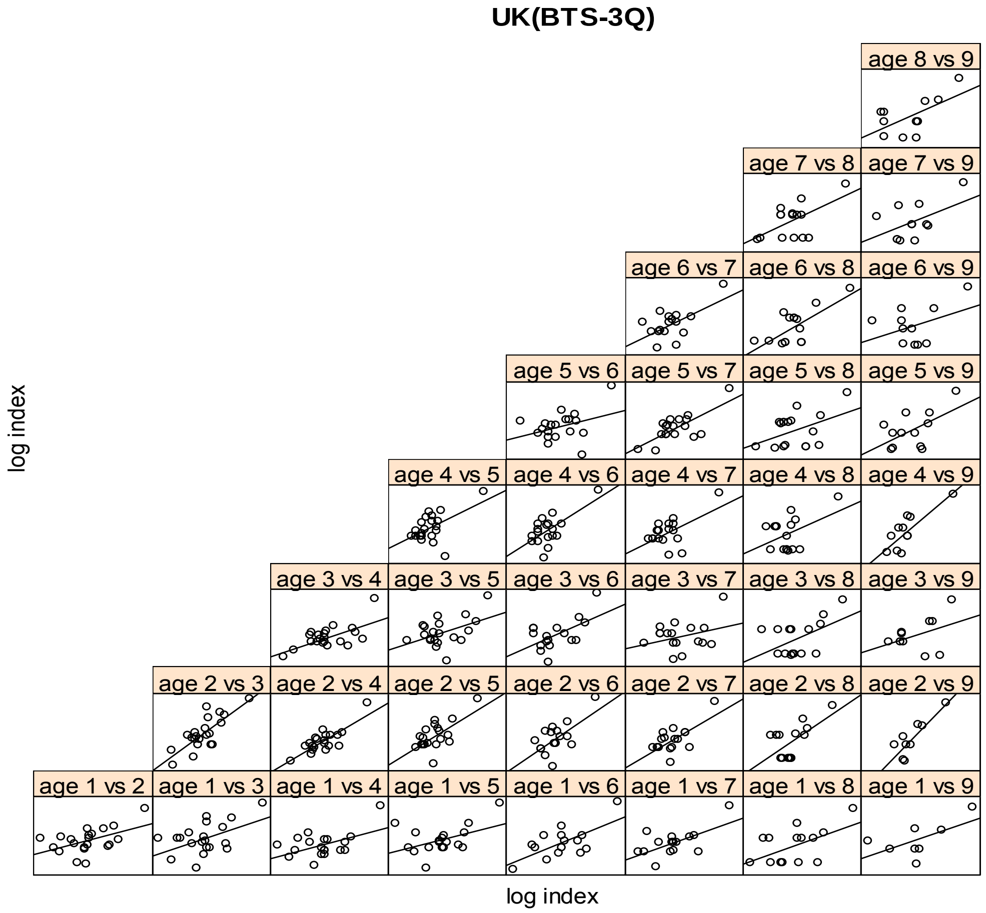


Figure 7.13.7 - Sole in VIIfg. Effort (in thousand hours, GRT corrected in case of E&W beam trawl fleet) and LPUE (in kg/hour; or in kg/100km in case of UK(BTS-3Q) survey) for three beam trawl fleets and one survey.

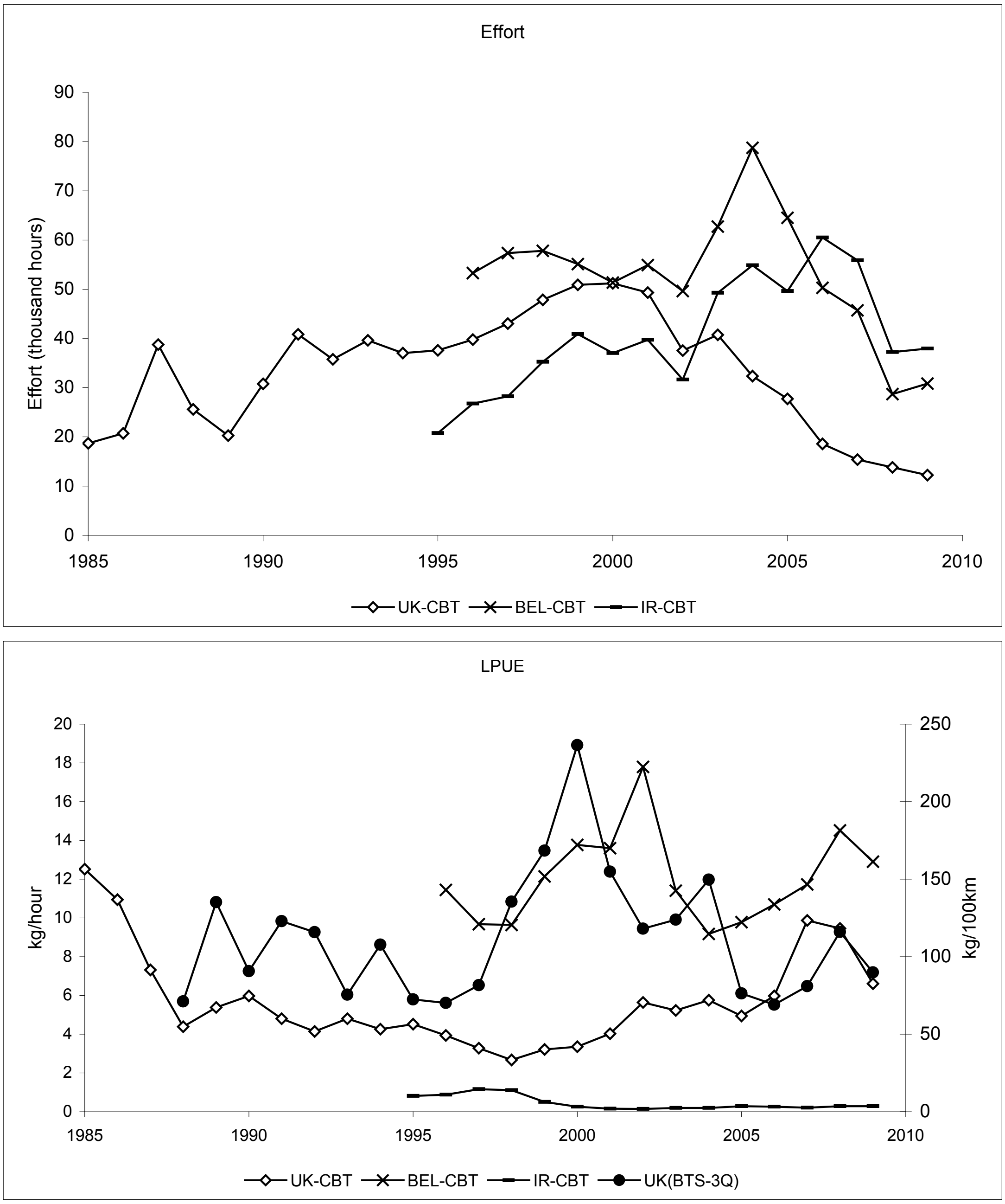


Figure 7.13.8 - Sole in VIIfg - Consistency plot Uk beam trawl

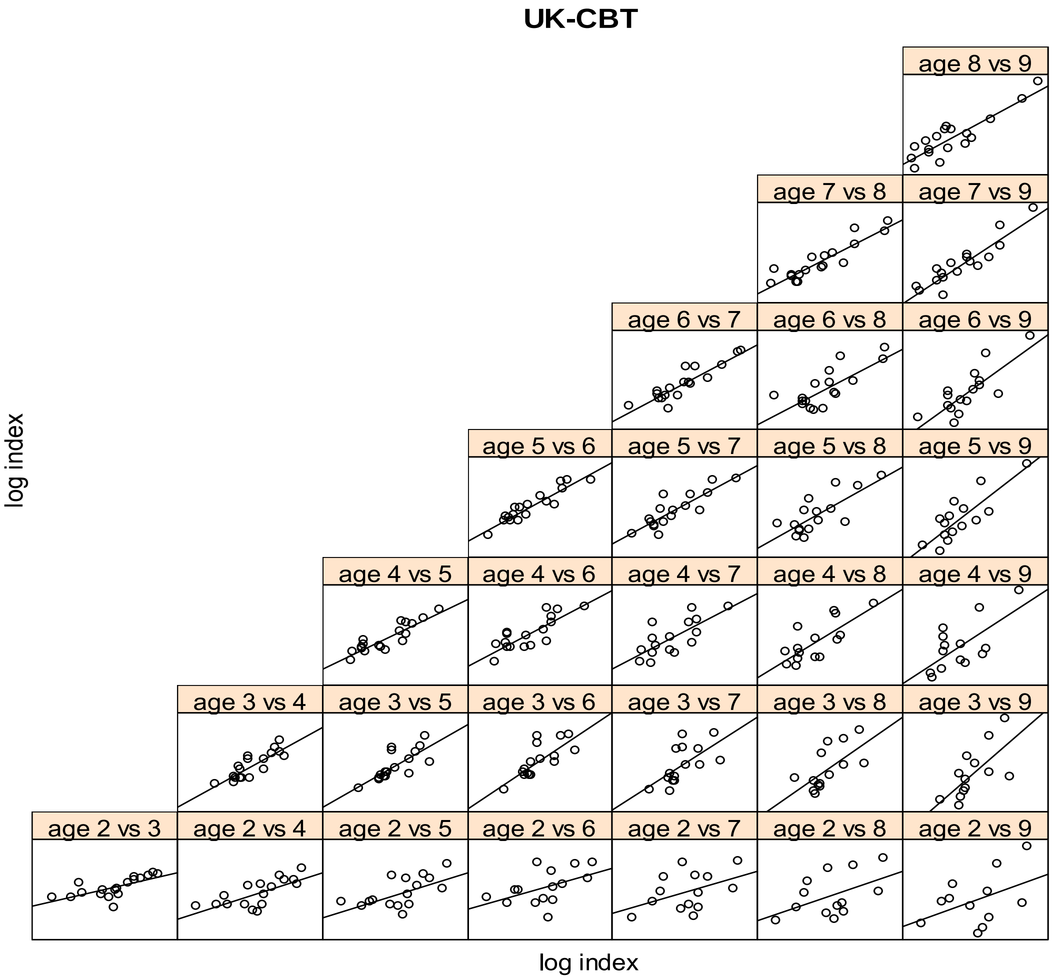


Figure 7.13.9 - Sole in VIIfg - Consistency plot Belgian beam trawl

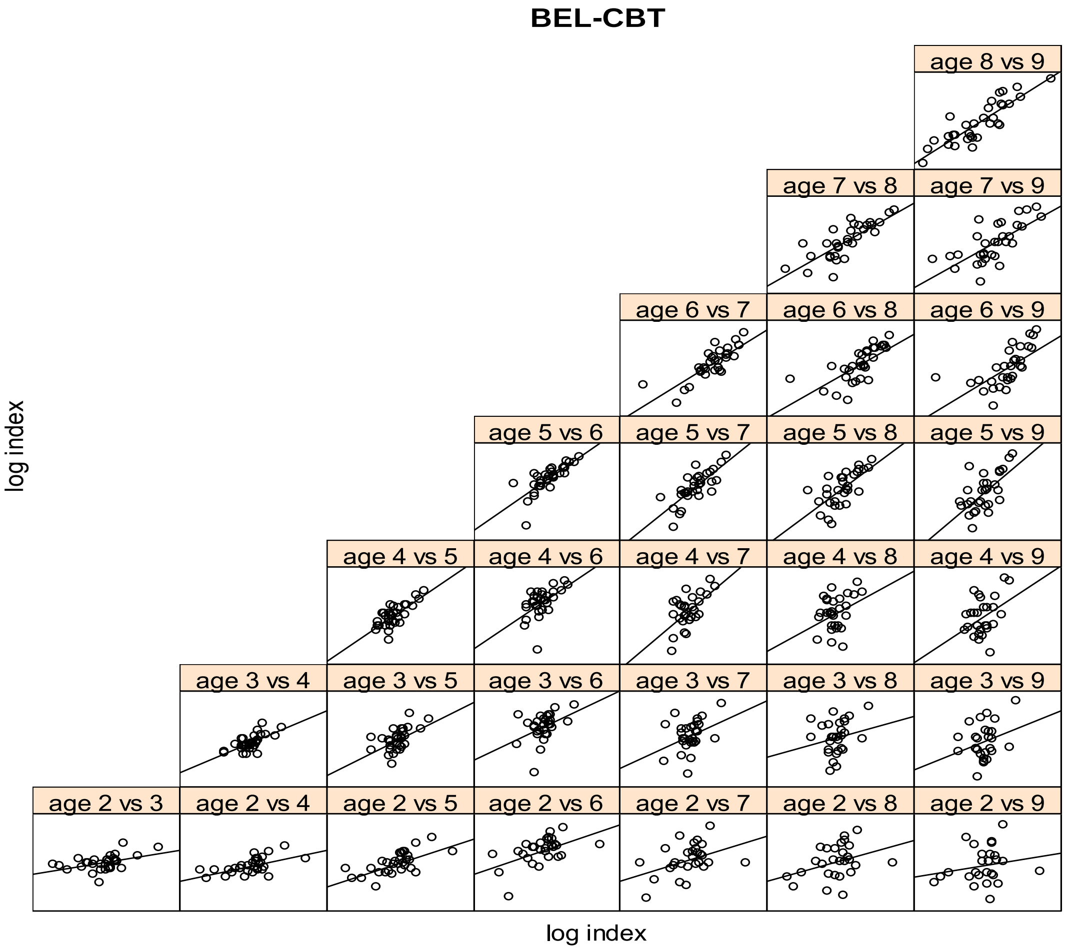
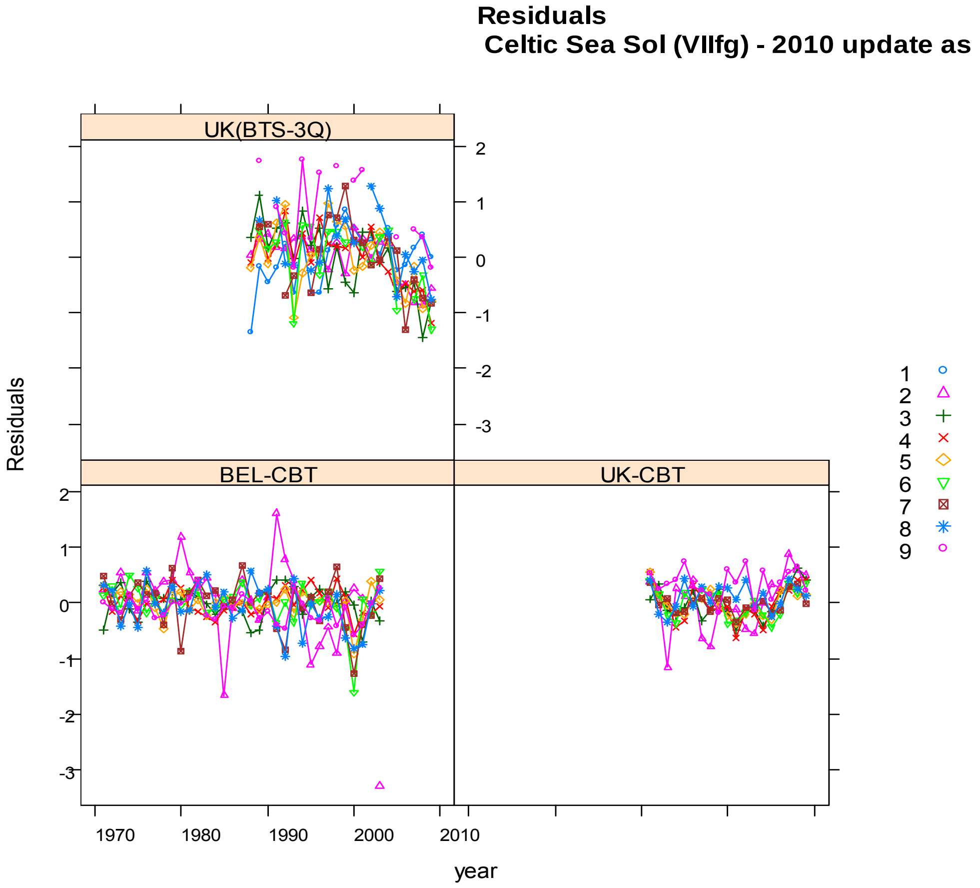


Figure 7.13.10 - Sole in VIIfg. Catchability residuals for final XSA run



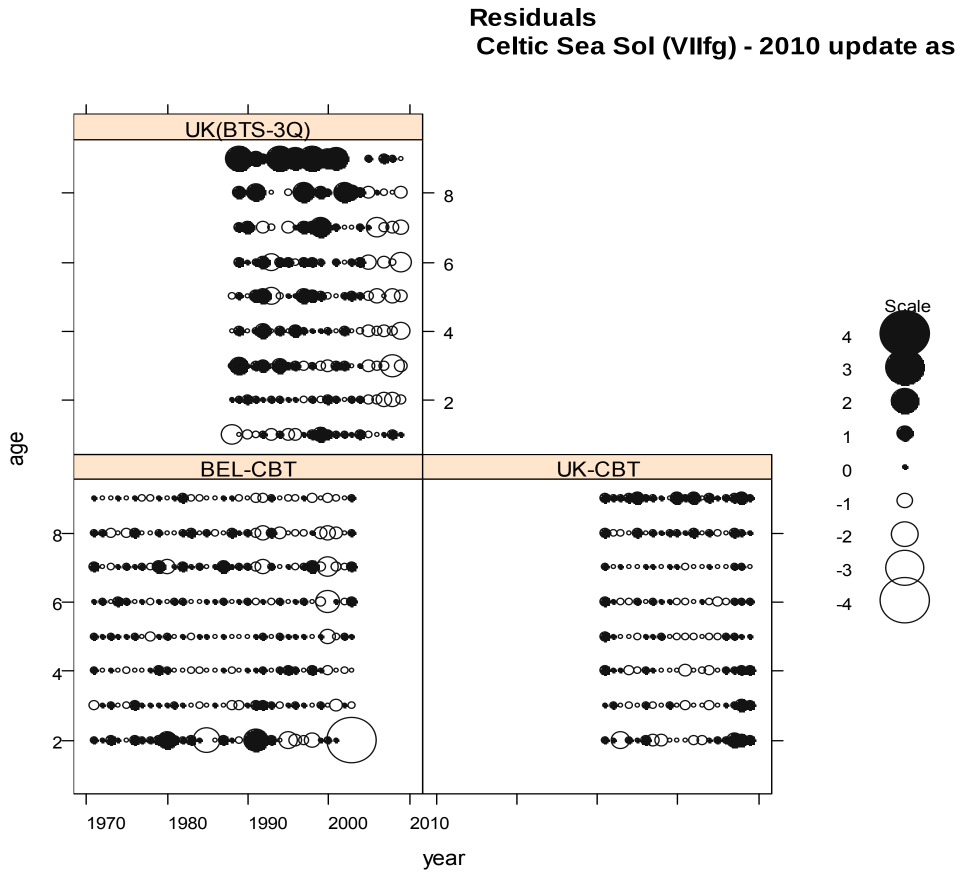


Figure 7.13.11 - Sole in VIIfg. Estimates of survivors from different fleets and shrinkage, as well as their different weighting in the final XSA-run

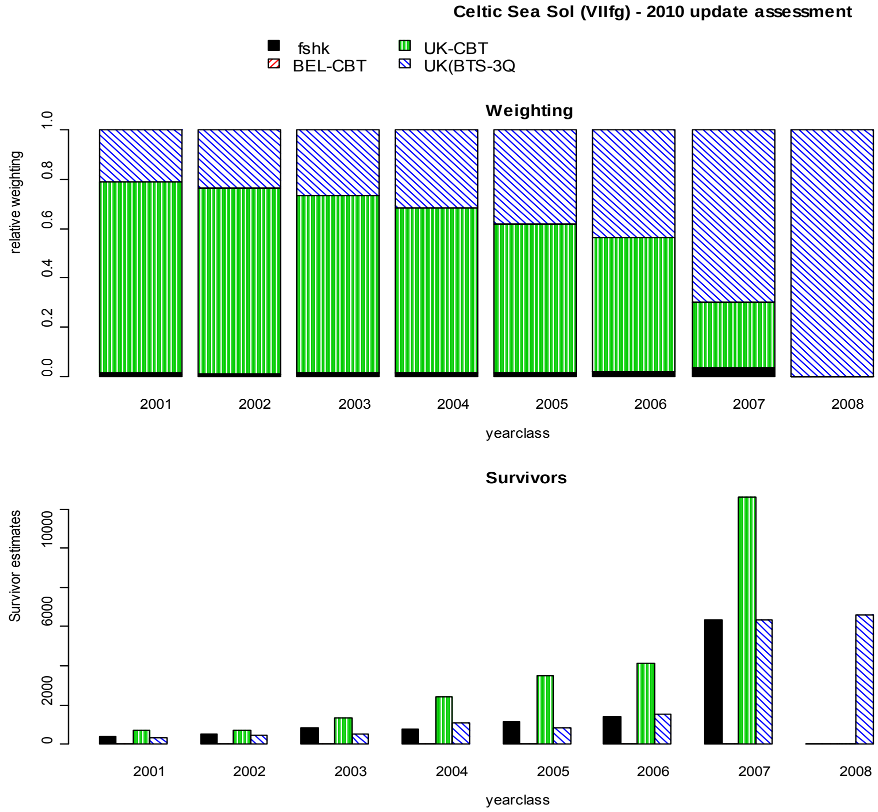


Figure 7.13.12 - Sole VIIf,g retrospective XSA analysys (shinkage SE=1.5)

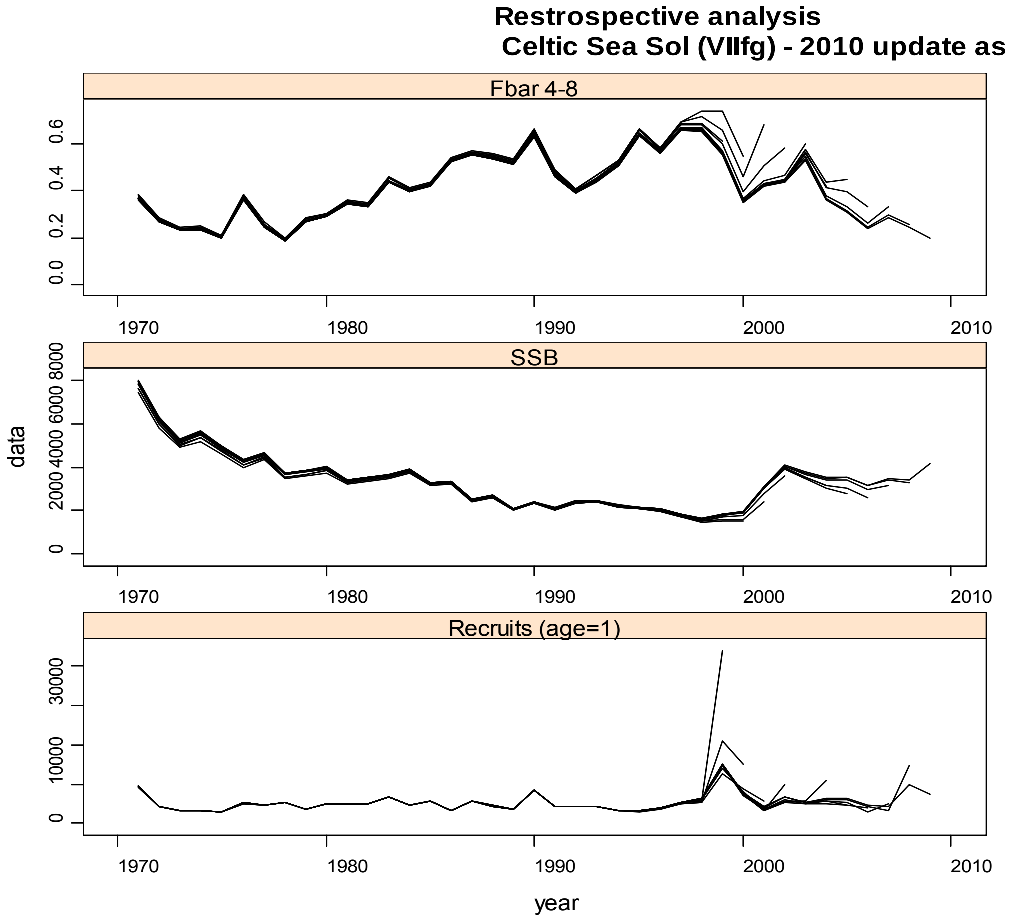
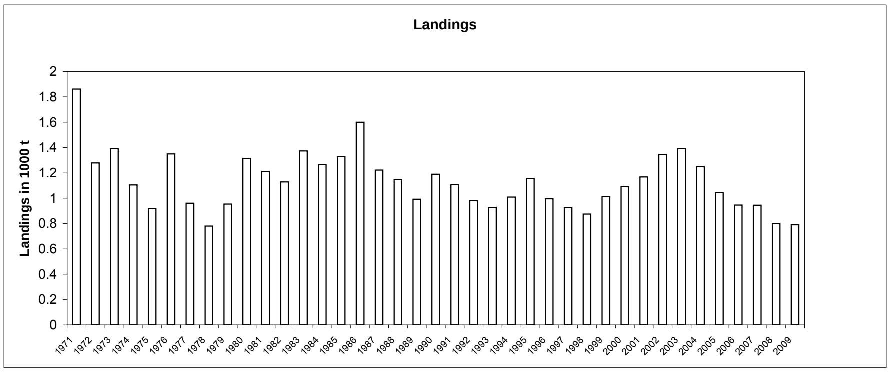
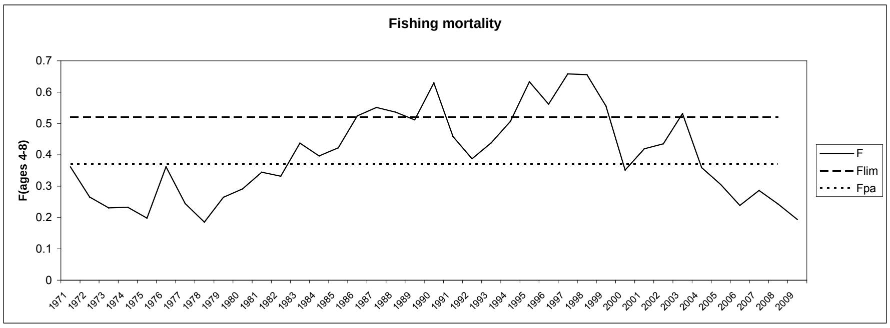
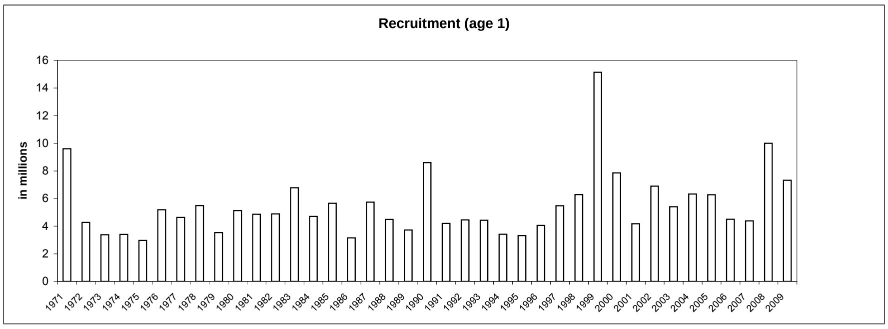
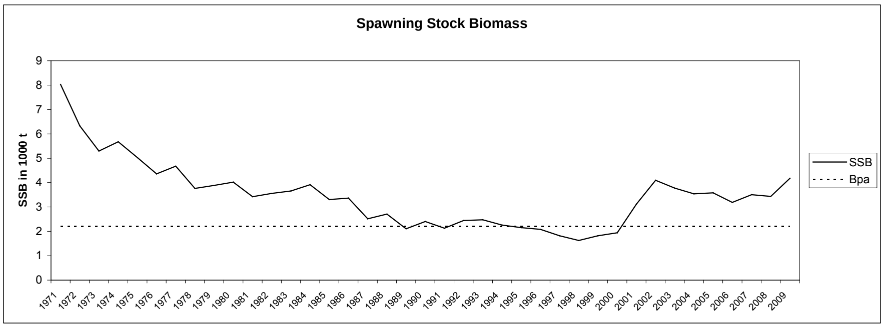


Figure 7.13.13 Sole in VIIfg. Summary plots









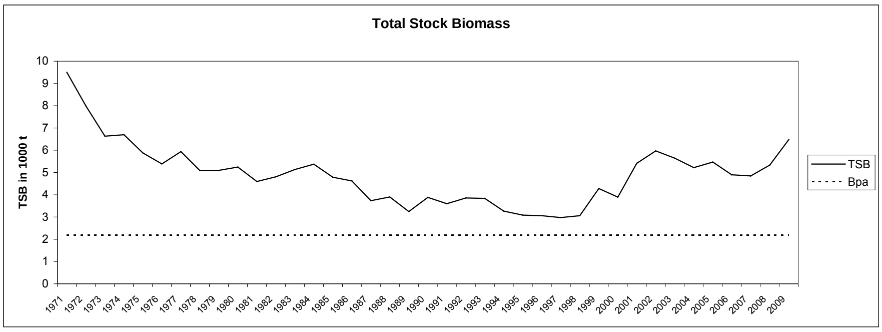


Figure 7.13.14 - Sole in VIIfg. Quality control plots - Historical performance

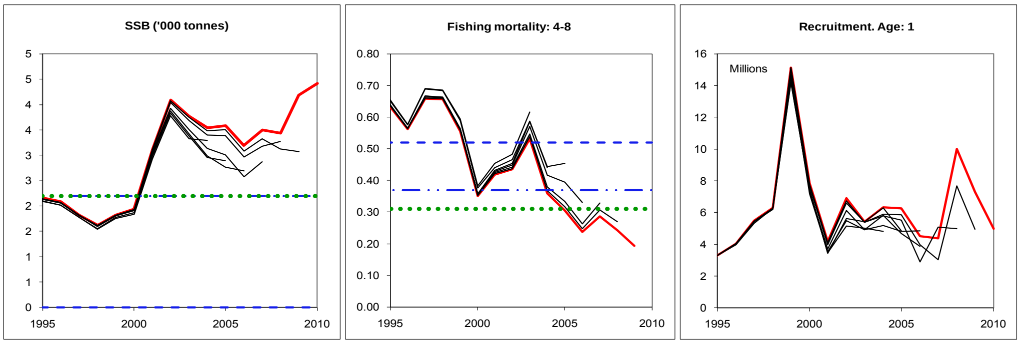
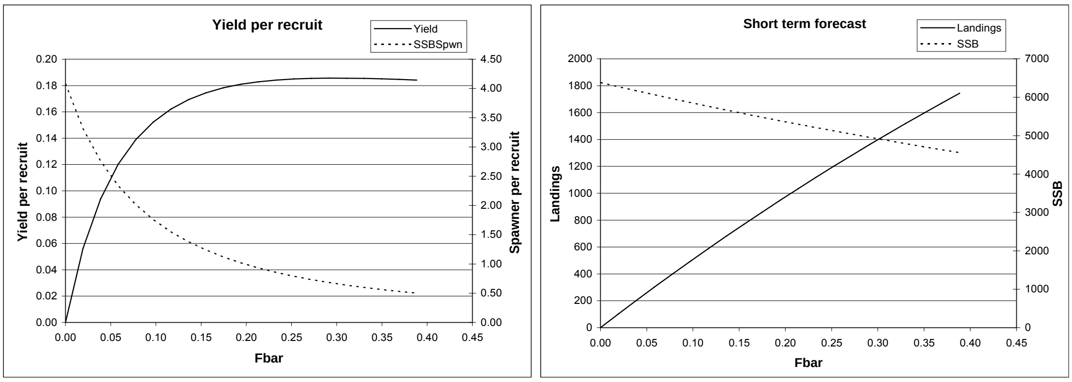


Figure 7.13.15 - Sole in VIIfg Yield per recruit and short term forecast plots



MFYPR version 2a
Run: Sole VIifg_FinalYield
Time and date: 14:35 14/05/2010

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.0000	0.1941
FMax	1.5349	0.2980
F0.1	0.6615	0.1284
F35%SPR	0.6693	0.1299

MFDP version 1a
Run: Sole VIIfg_Fin
CELTIC SEA SOLE 2010WG COMBSEX PLUSGROUP
Time and date: 18:22 13/05/2010
Fbar age range: 4-8

Input units are thousands and kg - output in tonnes

Figure 7.13.16 Sole in VIIfg

MSY fitted stock and recruit relationships. Left hand panels: blue line indicates the deterministic estimate; from the 1000 re-samples. red line median and percentiles of curves with converged estimates of Fmsy. Right hand panels : curves plotted from the first 100 MCMC re-samples with converged Fmsy estimates.
The legends for each recruitment model show the number of converged values of FMSY

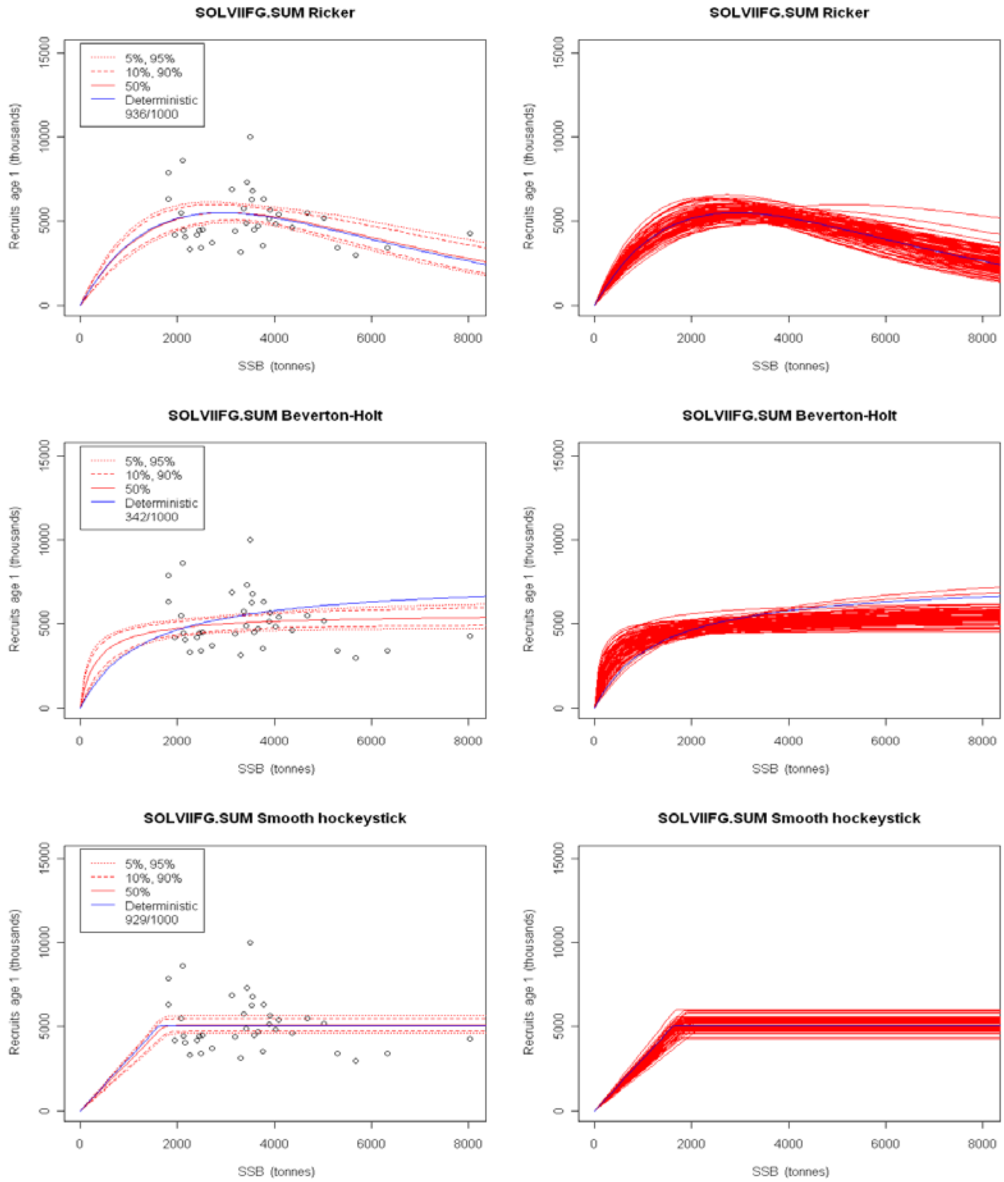


Figure 7.13.17 Sole in VIIfg
Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Ricker stock and recruitment model. Left hand panels : blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of Fmsy. Right hand panels : the first 100 MCMC re-samples converged Fmsy estimates. Circles show assessment estimates with the most recent year labelled.

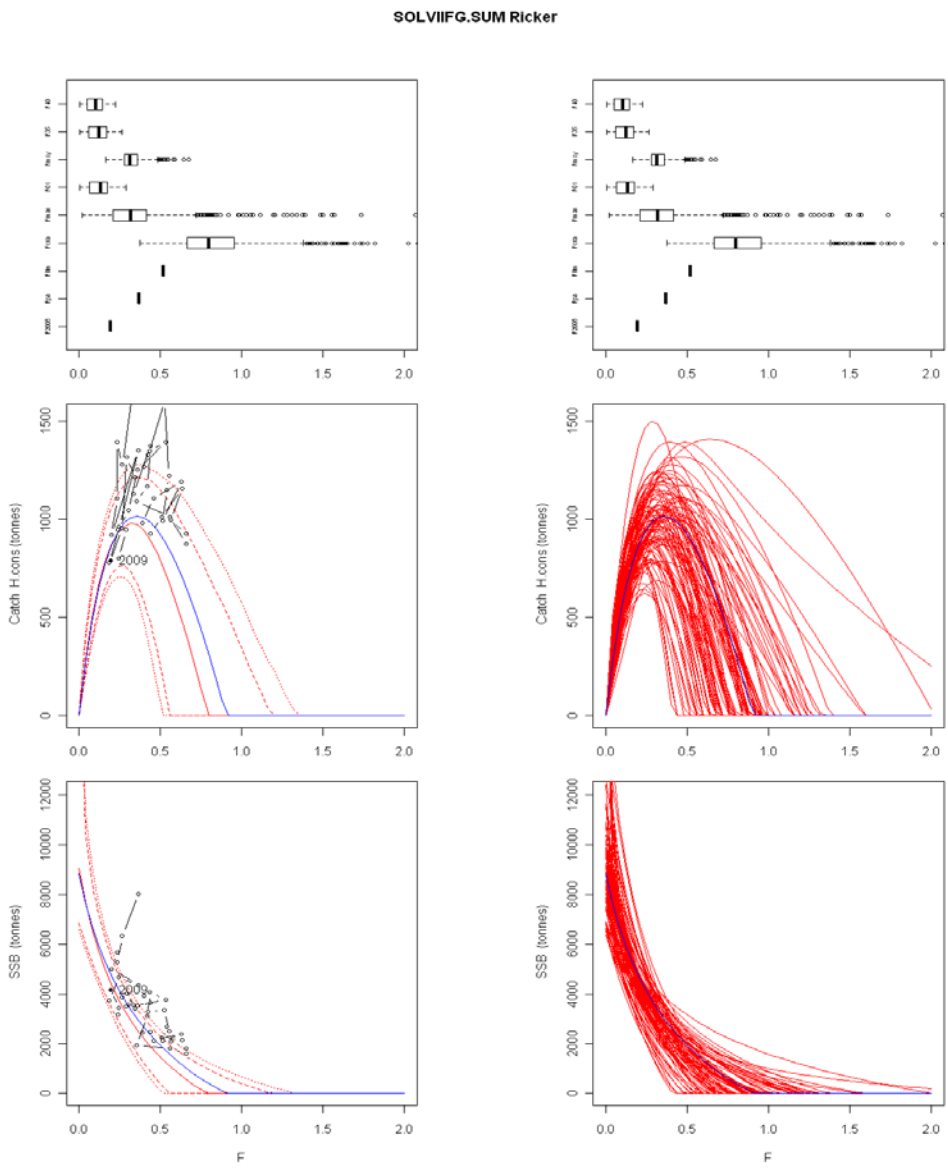


Figure 7.13.18 Sole in VIIfg

Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Smooth hockeystick stock and recruitment model. Left hand panels : blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of Fmsy. Right hand panels : the first 100 MCMC re-samples converged Fmsy estimates. Circles show assessment estimates with the most recent year labelled.

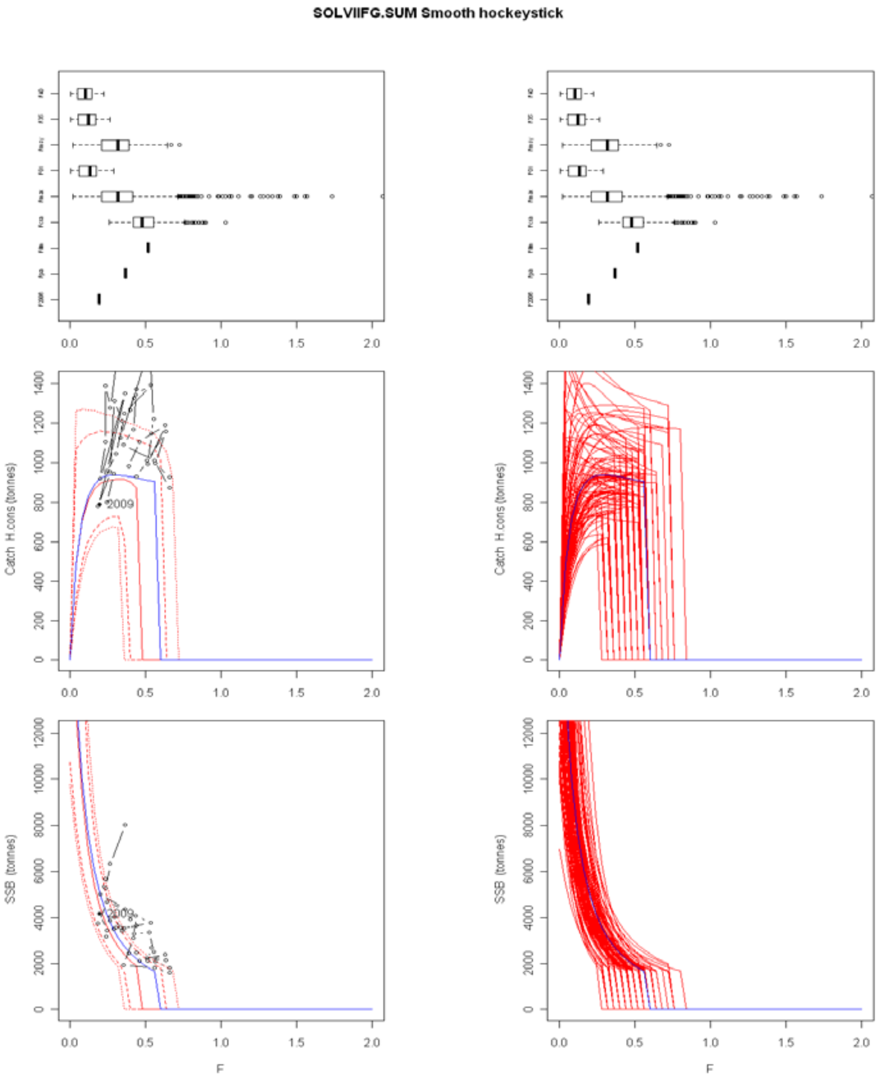


Figure 7.13.19 Sole in VIIfg

Fitted yield per recruit F reference points, yield per recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight at age, natural mortality and maturity estimates and their c.v. Left hand panels : blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels : the first 100 re-samples.

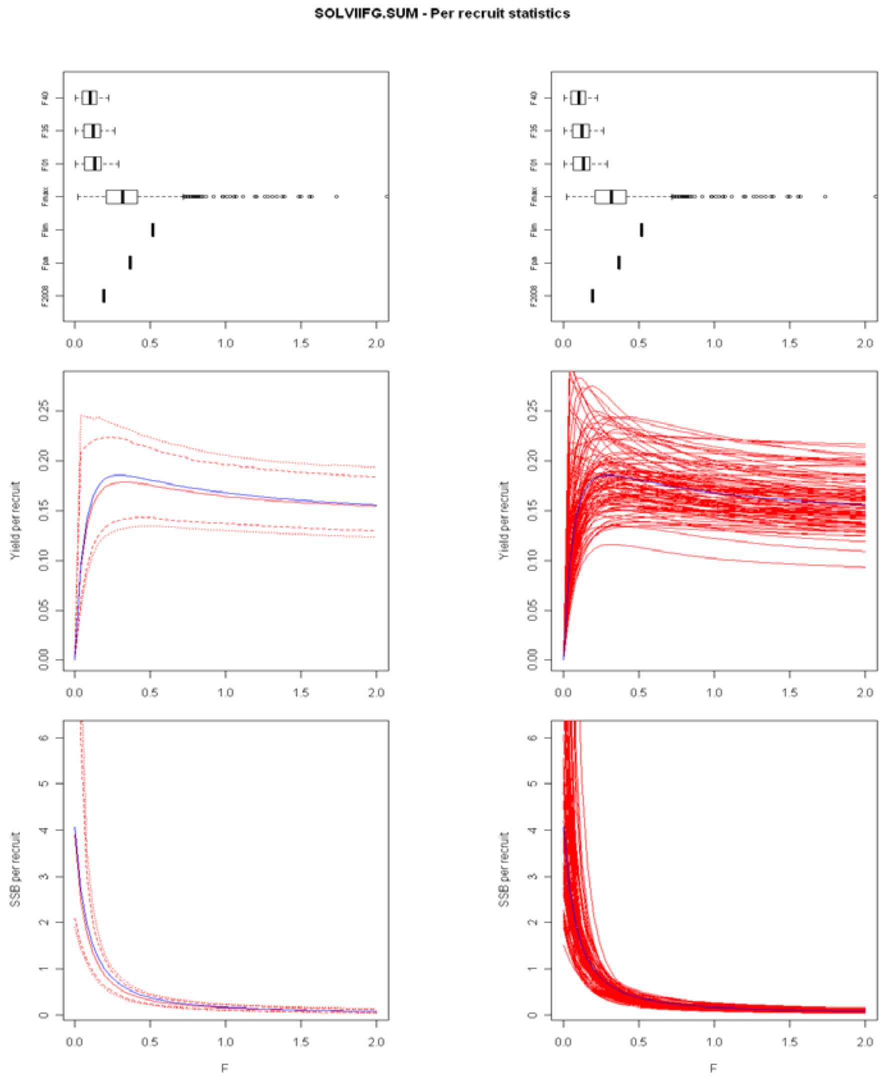
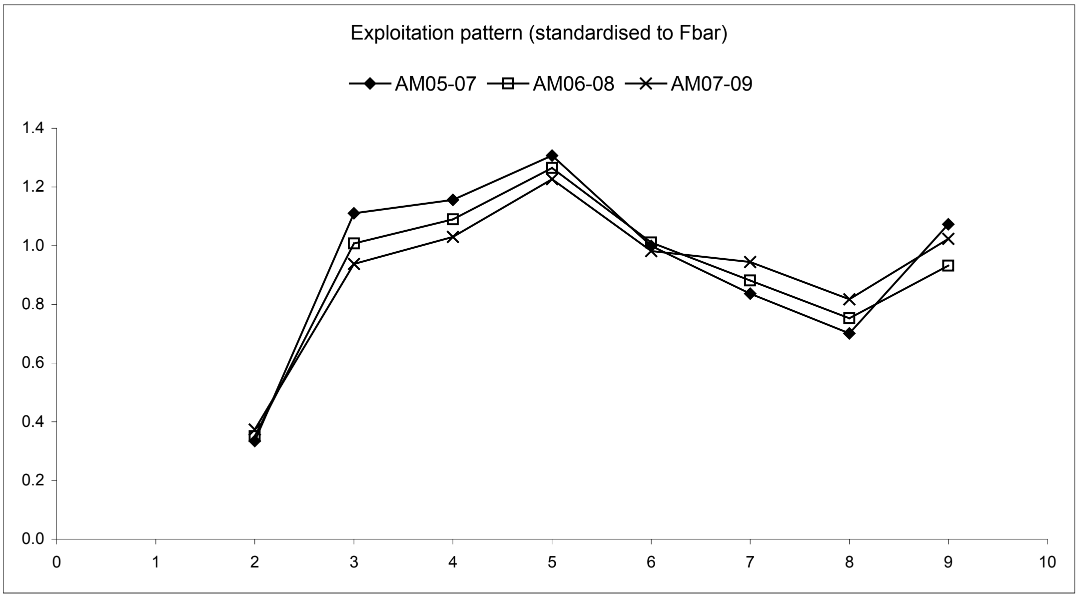


Figure 7.13.20 - Sole in VIIfg. Three year average exploitation pattern, standardised to Fbar (4-8)



7.14 Sole in the Southwest of Ireland (ICES Divisions VIIh–k)

Type of assessment in 2010

No assessment was performed, however catch numbers and weighs were aggregated for the Irish landings for the years 1993–2009 and these were used to perform a yield-per-recruit analysis.

7.14.1 General

Stock identity

Sole in VIIj are mainly caught by Irish vessels on sandy grounds off counties Kerry and west Cork. Sole catches in VIIk are negligible. VIIh is also considered part of the stock for assessment purposes but there is no evidence to suggest that this is actually the same stock

7.14.2 Data

The nominal landings are given in Table 7.14.1.

Most non-Irish landings were from VIIh which is likely to be a different stock. Because age data were only available for Irish landings (which were mainly from VIIjk) therefore the remainder of Section 7.14 concerns Irish data only in VIIgjk.

Sampling

Figure 7.14.1 shows that sole landings in VIIjk were mostly taken by otter trawlers in VIIj. This is reflected in the sampling.

Data quality

Figure 7.14.2 shows the length distribution of the Irish landings in VIIjk between 1993 and 2008. Sample numbers appear to be adequate. In some years distinct modes of strong year classes are discernible but cohorts cannot easily be tracked.

Annual Age–Length-Keys (ALKs) were constructed (all quarters and gear types combined) and applied to the sampled length frequency distributions. Figure 7.14.3 shows the age distribution of sole in VIIjk between 1993 and 2009. The precision of the age distributions varies somewhat between years.

7.14.3 Historical stock development

Because sole in VIIh were not sampled, it would not be appropriate to raise the data to all landings in VIIhjk. Instead, the official International landings figures for VIIjk were used to raise the age distributions (Table 7.14.2).

The estimated catch numbers-at-age are given in Table 7.14.3, catch weights-at-age are given in Table 7.14.4. It is possible to track some strong and weak year classes in the catch numbers-at-age matrix. This is also illustrated by Figure 7.14.4, which shows the standardised catch proportions-at-age. Figure 7.14.5 shows the log catch numbers-at-age. The rate of decline in catch numbers through the cohorts appears to be reasonably stable. This can be further investigated by calculating the slope of the log catch numbers (Z). Figure 7.14.6 shows the catch curve, sole under the age of 4 are not fully selected and from age 10 onwards the data get quite noisy, therefore the slope of the log catch numbers was estimated over ages 4 to 9 (Figure 7.14.7). Z estimates varied mostly between 0.2 and 0.6.

Yield-per-recruit

The yield-per-recruit was estimated using a method by Thompson and Bell (1934). This method requires the selectivity to be estimated. This was done by estimating the slope of the log catch numbers for ages that are fully selected and using this slope (Z) to predict the population numbers for ages that are not fully selected. The Z was estimated on pseudo-cohorts which were standardised to take account of annual variations in the catch numbers. Figure 7.14.8 shows that sole in VIIjk appears to be fully selected by the age of 5 and that after the age of 10 the data get very sparse. Figure 7.14.9 shows the slope of the mean standardised log catch numbers. The predicted catch numbers from this slope were used to estimate the 'observed' selectivity. This was then modelled by applying a linear model after a logit transformation. The estimated selection curve is also shown in Figure 7.14.9. A natural mortality of 0.1 was assumed (based on the value used by the WG for sole in VIIfg) and the WG maturity ogive for sole in VIIfg was used to estimate SSB. The yield was estimated for a range of F values based on the average catch weights. Figure 7.14.10 shows the YPR curve, F_{max} is estimated to be 0.31. $F_{0.1}$ is estimated at 0.13. Recent (2005–2009) values of Z ranged between 0.20 and 0.35, with M=1.0 this would result in an F of 0.10 to 0.25. This suggests that this stock may be within safe biological limits.

7.14.4 References

Thompson and Bell. 1934. W.F. Thompson and F.H. Bell, Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear, Rep. Int. Fish. (Pacific Halibut) Comm. 8 (1934), p. 49.

Table 7.14.1. Sole in Divisions VII h–k (Southwest Ireland). Nominal landings (t), 1973–2009, as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Belgium	406	369	210	638	519	290	384	522	576	471
Denmark	-	-	-	-	-	-		-	-	-
France	390	143	207	19	103	23	29	27	107	104
Ireland	108	116	97	152	126	73	109	162	195	172
Netherlands	4	15	2	33	140	60	-	-		
Spain	190	153	152	131	26	1	8	2		
UK - Eng+Wales+N.I	.	.	.	.	.	.	.	.	.	.
UK - England & Wale	6	5	24	11	12	11	18	42	83	108
UK - Scotland	-	-	-	-	-	-	-	-	-	-
Total	1104	801	692	984	926	458	548	755	961	855

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	411	474	318	442	271	254	252	353	358	312
Denmark	-	-	-	-	-	-	-	-	-	-
France	176	120	25	38	44	53	84	66	55	43
Ireland	176	156	201	188	168	182	206	266	306	255
Netherlands	51	194	280	3		-	-	-	-	-
Spain	38					-	-	-	-	-
UK - Eng+Wales+N.I	.	.	.	.	.	.	177	144	234	215
UK - England & Wale	129	151	200	261	193	166	.	.	.	.
UK - Scotland	-	-	-	-	-	-	-	-	-	2
Total	981	1095	1024	932	676	655	719	829	953	827

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Belgium	317	338	433	375	368	346	101	8	13	154
Denmark	-	-	-	-	-	-	-	-	-	-
France	44	42	47	50	58	74	.	79	103	108
Ireland	237	184	243	183	203	221	207	111	125	130
Netherlands	-	-	-	70	-	7	1	10	-	-
Spain	-	-	-	-	-	-	-	-	-	1
UK - Eng+Wales+N.I	209	172	192	148	113	111	97	95	111	124
UK - England & Wale	.	.	.	.	.	.	.	.	.	.
UK - Scotland	5	2	-	-	-	-	-	-	-	-
Total	812	738	915	826	742	759	406	303	352	517
Unallocated				-383	-178	-336	-25	26	-27	-87
WG estimate				443	564	423	381	329	325	430

Country	2003	2004	2005	2006	2007	2008	2009
Belgium	170	157	90	36	31	10	11
Denmark	-	-	.				
France	133	103	93	92	78	57	
Ireland	105	111	98	63	78	72	71
Netherlands	-	-	.	1			
Spain	-	-	2				
UK - Eng+Wales+N.I	78	79	112	87	91	80	58
UK - England & Wale	.	.	.				
UK - Scotland	-	-	.				
Total	486	450	395	279	278	219	140
Unallocated	-241	-160	-69	-7	-1	6	
WG estimate	245	290	326	272	277	225	

Table 7.14.2. Official landings of sole in VIIjk.

Year	Bel	Fra	Ire	Esp	UK	Total
1993	-	1	237	.	8	246
1994	-	0	176	.	2	178
1995	-	3	232	.	6	241
1996	-	2	163	.	1	166
1997	-	2	187	.	2	191
1998	-	9	208	.	2	219
1999	96	0	199	.	1	296
2000	8	6	103	.	0	117
2001	7	13	114	.	0	134
2002	69	23	121	.	0	213
2003	48	20	82	.	0	150
2004	2	7	78	.	0	87
2005	-	7	70	<0.5	0	77
2006	-	11	49	-	1	61
2007	-	9	74	.	0	83
2008	-	8	69	-	0	77
2009*	0	**	68	-	0	68

*** Preliminary data**

**** Not available at the time of the Working Group.**

Table 7.14.3. Catch numbers-at-age for sole in VIIjk.

	2	3	4	5	6	7	8	9	10	11	12	13	14+
1993	33	218	224	77	56	57	32	21	12	11	5	5	14
1994	23	117	130	69	41	22	19	11	12	13	11	4	27
1995	0	279	81	174	117	51	15	15	4	22	8	8	6
1996	12	46	116	80	53	54	31	8	5	6	10	3	33
1997	39	161	84	110	43	41	38	16	1	0	4	3	17
1998	23	137	113	59	93	40	43	34	9	5	3	5	32
1999	51	179	218	187	67	77	30	28	19	2	11	1	19
2000	39	96	83	42	29	16	21	11	17	8	3	0	5
2001	65	115	53	49	38	22	22	14	9	4	2	5	8
2002	13	139	183	66	38	39	15	8	24	8	21	5	31
2003	2	54	93	128	76	45	18	4	5	9	14	0	9
2004	7	18	92	48	36	19	14	6	8	1	7	1	20
2005	10	34	47	65	17	38	21	9	4	4	0	4	14
2006	13	29	30	28	38	18	16	11	6	4	1	1	11
2007	1	44	36	30	44	42	21	16	10	4	4	1	8
2008	1	25	90	42	21	20	25	11	8	5	3	3	7
2009	0	15	38	75	31	17	16	16	6	6	5	1	4

Table 7.14.4. Catch weight-at-age for sole in VIIjk.

	2	3	4	5	6	7	8	9	10	11	12	13	14+
1993	0.154	0.221	0.275	0.342	0.412	0.455	0.511	0.496	0.628	0.567	0.761	0.499	0.706
1994	0.143	0.233	0.278	0.346	0.421	0.453	0.514	0.552	0.610	0.632	0.632	0.583	0.737
1995		0.194	0.322	0.362	0.338	0.370	0.493	0.452	0.722	0.579	0.401	0.297	0.592
1996	0.138	0.169	0.230	0.307	0.435	0.421	0.505	0.587	0.613	0.711	0.755	0.643	0.698
1997	0.133	0.200	0.281	0.334	0.409	0.526	0.618	0.592	0.679		0.692	0.846	0.922
1998	0.137	0.223	0.281	0.357	0.379	0.448	0.515	0.554	0.455	0.646	0.497	0.641	0.805
1999	0.152	0.192	0.308	0.345	0.400	0.426	0.461	0.575	0.578	0.657	0.449	0.896	
2000	0.180	0.210	0.255	0.396	0.416	0.472	0.502	0.489	0.505	0.452	0.554		0.641
2001	0.164	0.228	0.295	0.337	0.394	0.481	0.548	0.530	0.587	0.795	0.542	0.740	0.727
2002	0.203	0.198	0.255	0.305	0.470	0.490	0.473	0.655	0.732	0.724	0.627	0.616	0.895
2003	0.168	0.191	0.296	0.323	0.329	0.378	0.371	0.575	0.503	0.548	0.477		0.600
2004	0.095	0.200	0.198	0.294	0.313	0.353	0.287	0.581	0.632	0.498	0.595	0.498	0.724
2005	0.128	0.168	0.198	0.249	0.383	0.318	0.340	0.445	0.525	0.468		0.489	0.614
2006	0.160	0.180	0.205	0.257	0.298	0.354	0.354	0.377	0.456	0.377	0.612	0.438	0.718
2007	0.154	0.208	0.268	0.282	0.329	0.341	0.378	0.395	0.449	0.376	0.418	0.554	0.522
2008	0.143	0.205	0.236	0.275	0.305	0.339	0.339	0.395	0.389	0.448	0.559	0.450	0.631
2009	0.123	0.196	0.234	0.265	0.268	0.318	0.386	0.420	0.393	0.417	0.368	0.476	0.587

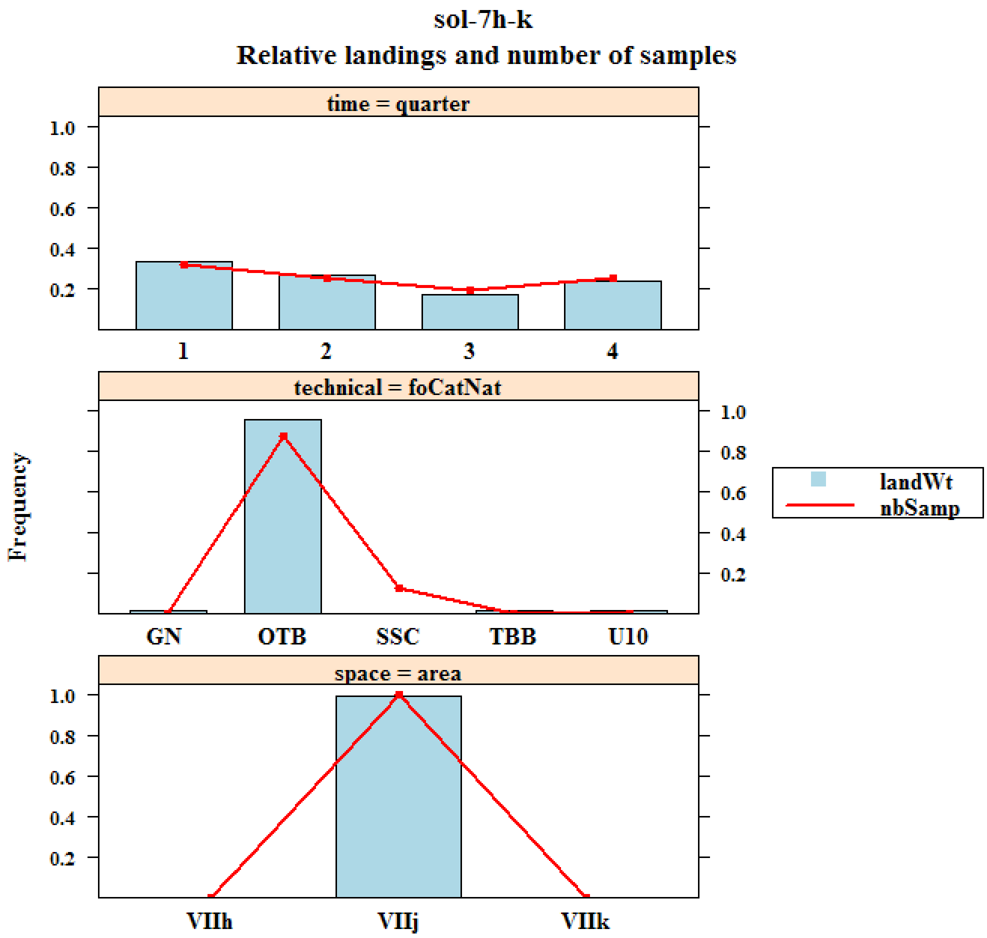


Figure 7.14.1. Irish Operational landings and sampling levels (number of samples) for sole in VIIjk by quarter (top), geartype (middle) and ICES Division (bottom). The sampling appears to be representative of the landings.

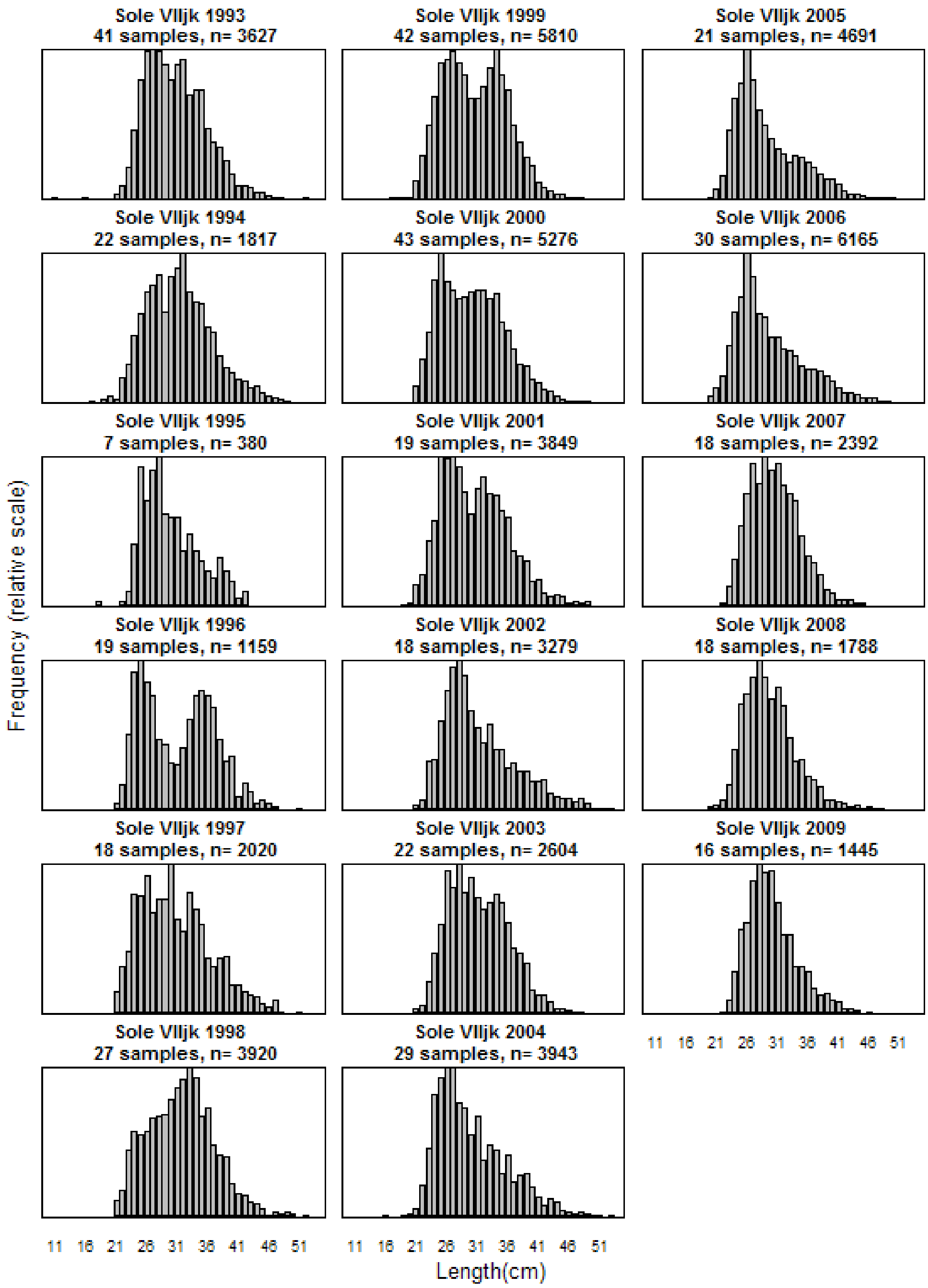


Figure 7.14.2. Length frequency distribution of the Irish landings of sole in VIIjk between 1993 and 2009. All gears and quarters combined. Sampling was poor during 2006 and 2007.

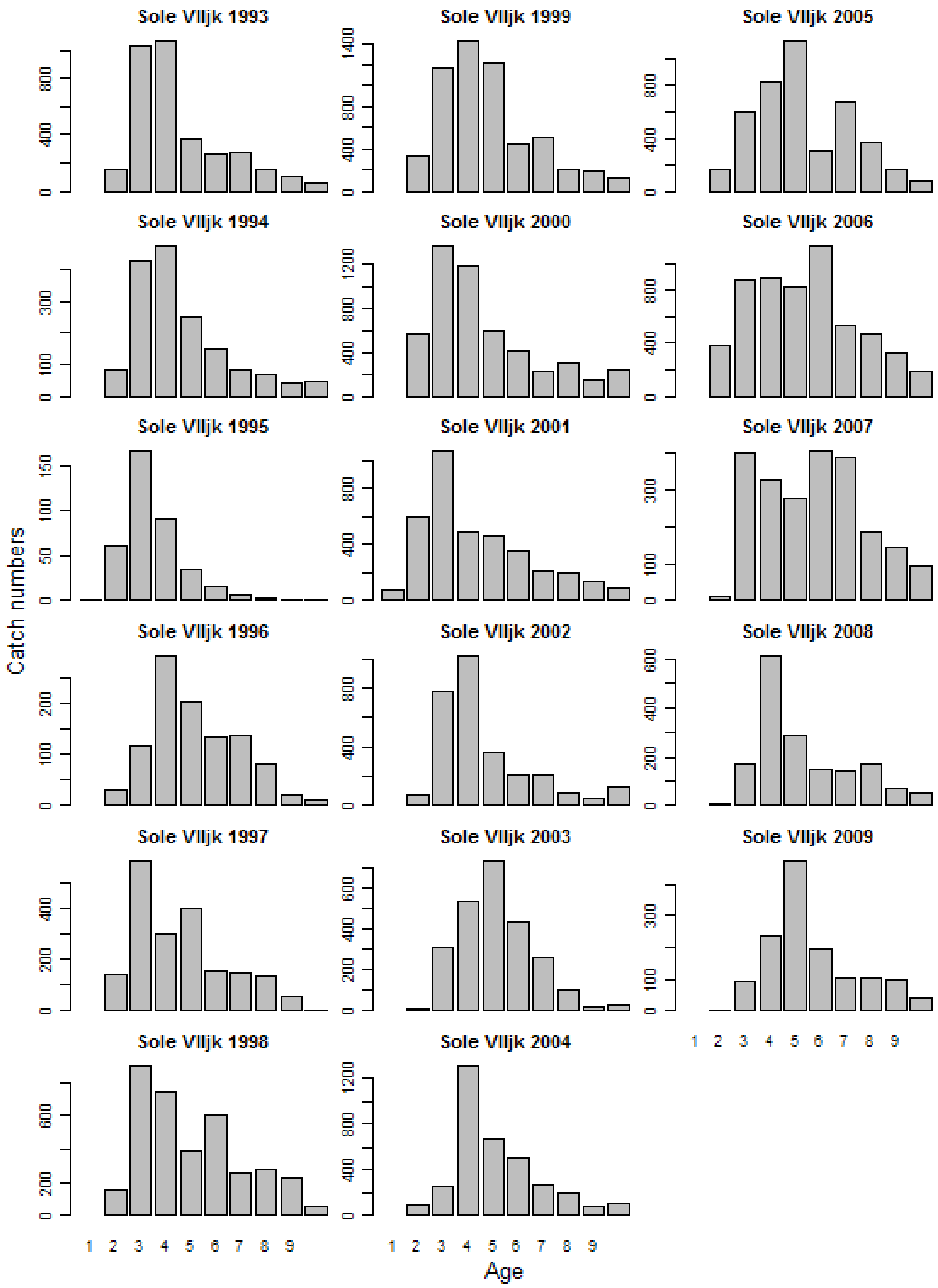


Figure 7.14.3. Age distribution of sole in VIIjk between 1993 and 2009. All gears and quarters combined.

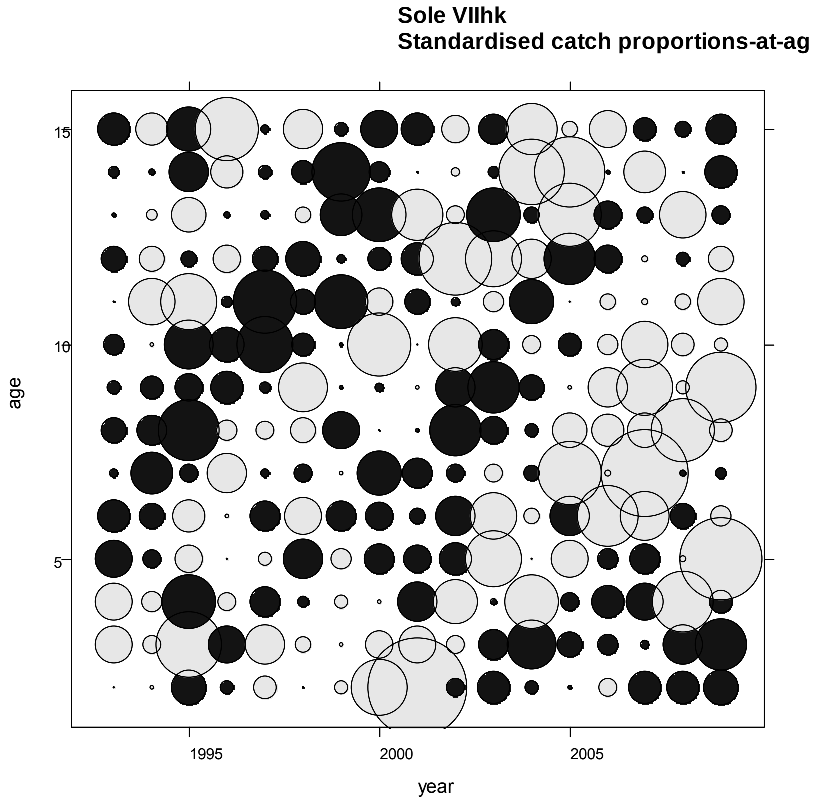


Figure 7.14.4. Standardised catch proportions-at-age for sole in VIIjk. Grey bubbles represent higher than average catch-at-age and black bubbles represent lower than average catch-at-age.

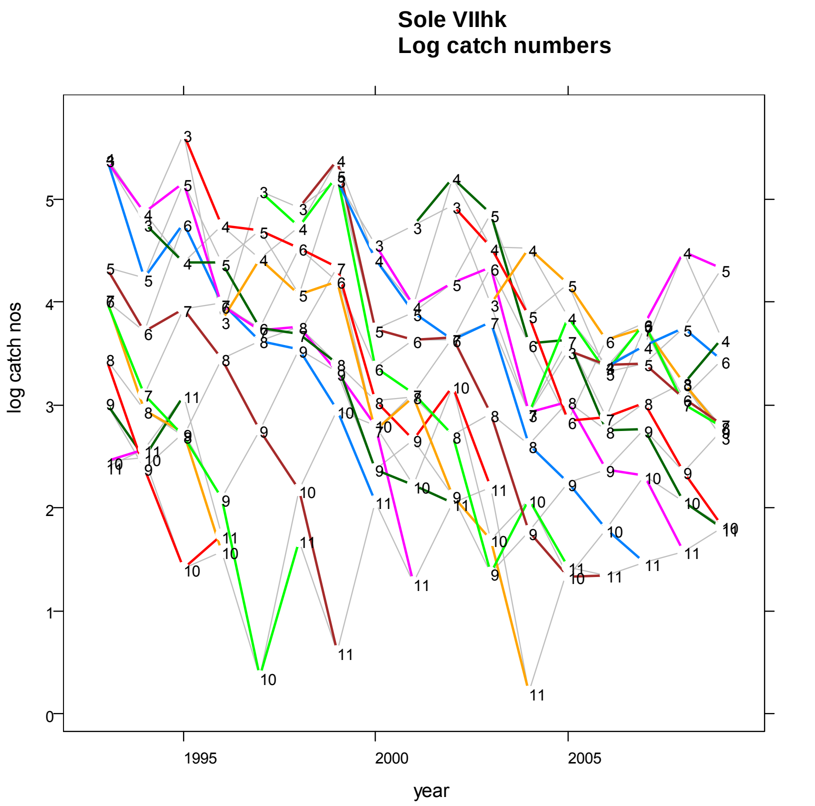


Figure 7.14.5. Log catch numbers-at-age (ages 4–8).

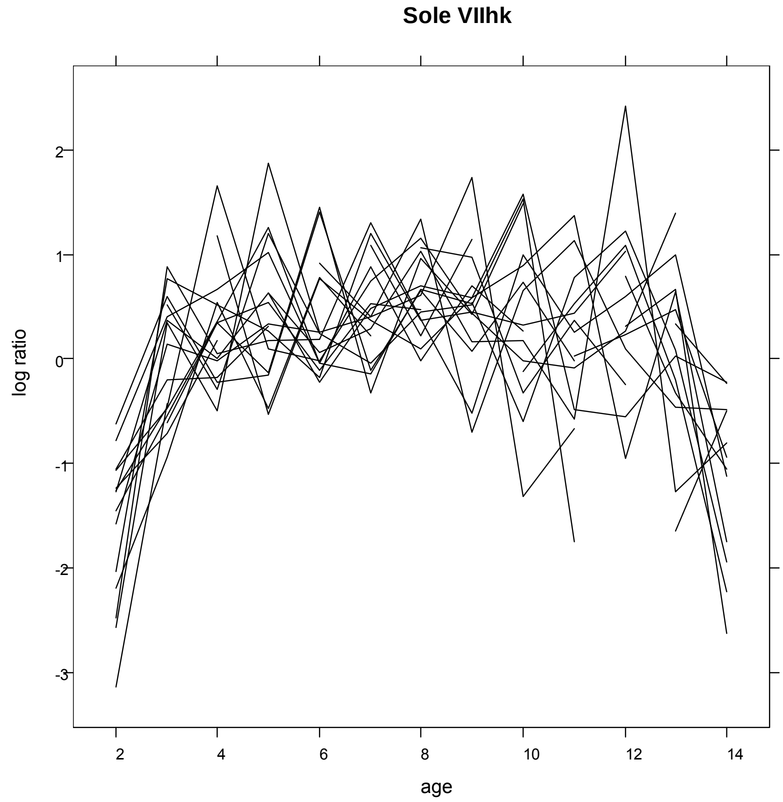


Figure 7.14.6. Catch curve of plaice in VIIbc. Plaice from the age of 4 appear to be fully selected; the data get quite noisy from the age of 7 onwards.

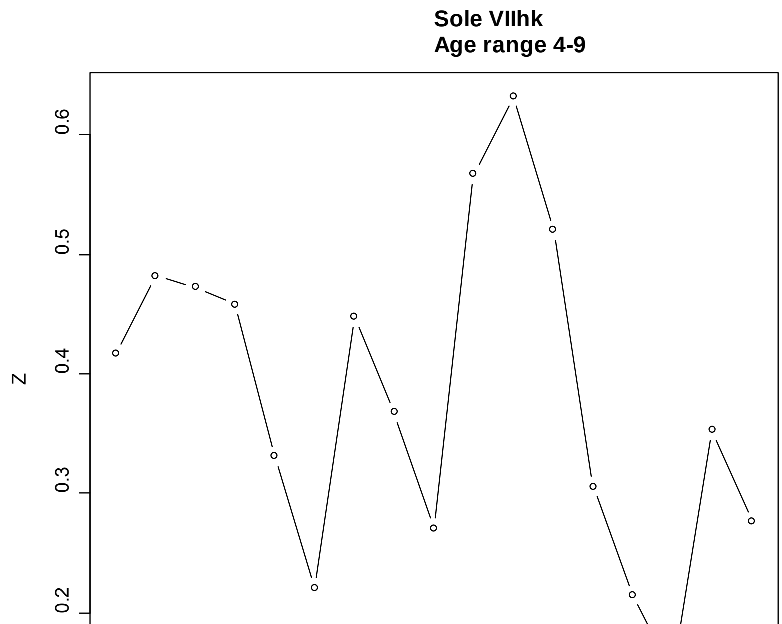


Figure 7.14.7. Z estimated over pseudo-cohorts as the slope of the log catch numbers.

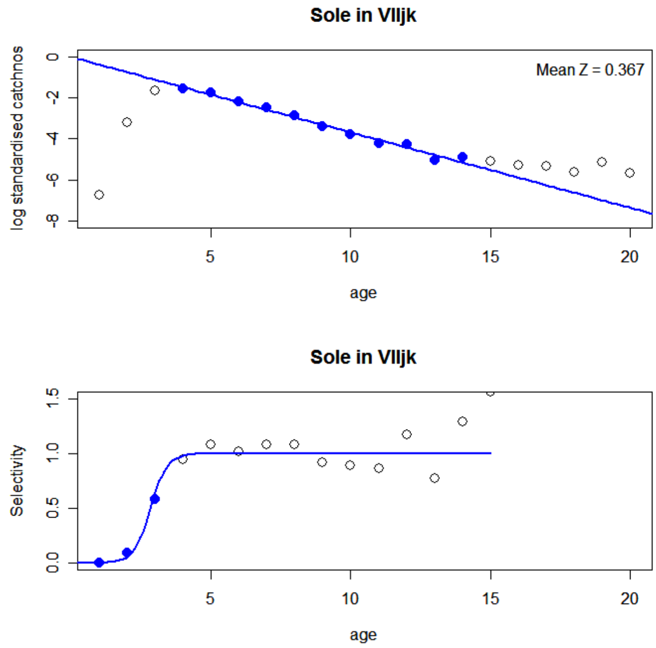


Figure 7.14.8. Selectivity was modelled by fitting a line through the mean log standardised catch numbers of ages 4 to 14 to predict the expected catch numbers for ages 1 to 3 if these were fully selected. The proportions of observed divided by expected catch number were taken as the 'observed' selectivity. This was then modelled using a logit transformation.

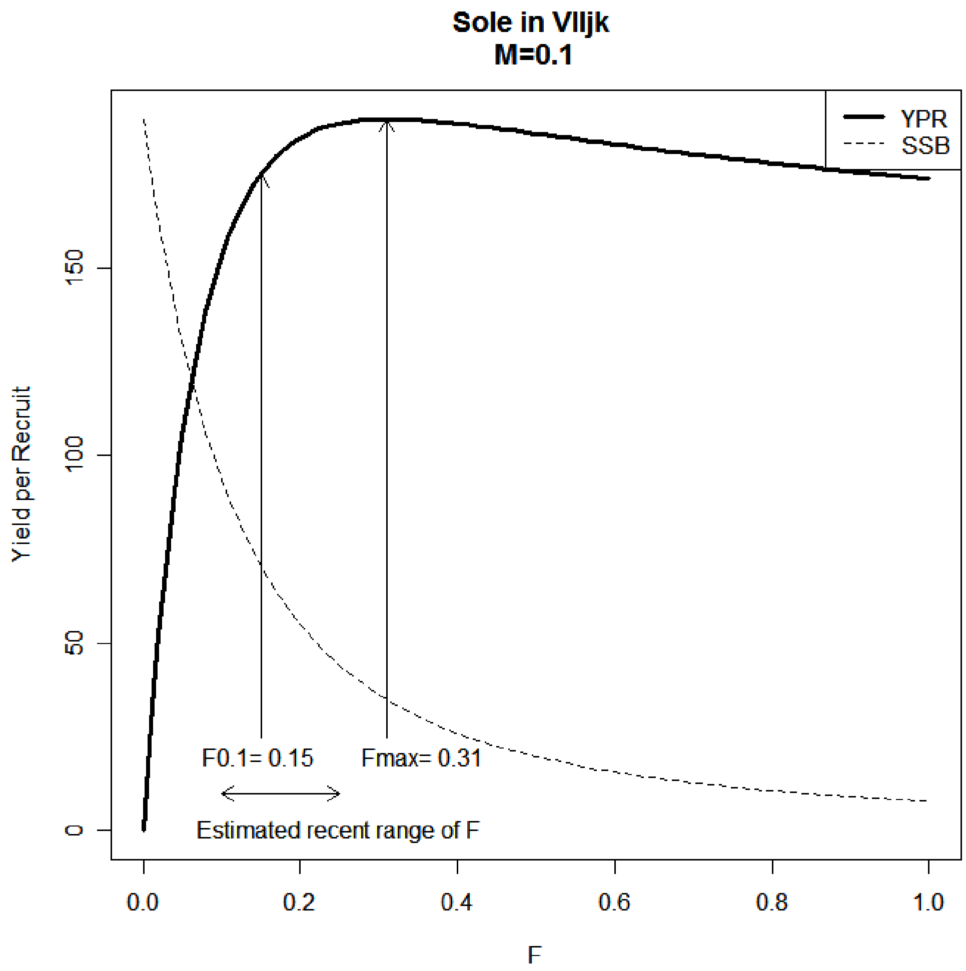


Figure 7.14.9. YPR analysis using the Thompson–Bell approach. Recent estimates of Z were between 0.2 to 0.5 which translates to an F of 0.1 to 0.4.

7.15 Whiting in Division VIIe–k

Type of assessment in 2010

Update assessment. Same Advice as Last Year.

ICES advice applicable to 2009 and 2010

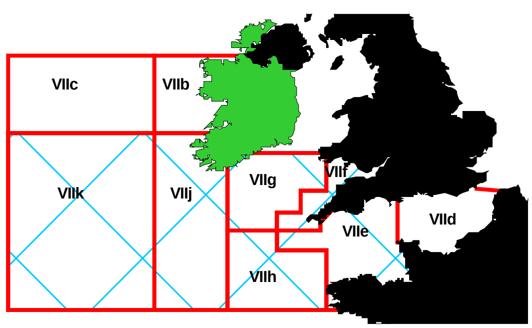
Exploitation boundaries in relation to precautionary limits: *The current estimates of fishing mortality and SSB are uncertain, but SSB shows a decreasing trend while recruitment has been low in recent years although the 2007 year class is above average, and the 2008 year class may be very strong. In order to reverse the trend in SSB, ICES considers that fishing mortality should be reduced. However, ICES cannot quantify the required reduction in fishing mortality.*

In addition, ICES offers the following consideration: surveys indicate that the 2007 year class is above average, and the 2008 year class may be very strong. Management measures should be introduced in the Celtic Sea to reduce discarding of these year classes in order to maximize their contribution to future yield and SSB.

7.15.1 General

Stock description and management units

The TAC for whiting is set for Divisions VIIb–h and VIIk. However VIIj has been omitted from the area for the last three years. This assessment area does not correspond to the TAC area. Whiting in VIIb,c are not assessed and whiting in VIId are included in the WDNSSK assessment of the North Sea stock. Any management measures implemented for this stock should be consistent with the assessment area.



Red Boxes-TAC/Management Areas   Blue Shading– Assessment Area

The 2010 TAC for whiting VIIb–h and k has been reduced from 16 949 t to 14 407 t. This TAC has not been considered restrictive, with officially reported VIIe–k landings totalling 3270 t in 2009, although this does not include French landings, around 3000 t in 2008. The assessment is based on landings only, as reported in logbooks, and does not include discards. The introduction of buyers and sellers legislation in 2007 should improve landings statistics.

TAC in 2009

Species: Whiting *Merlangius merlangus*		Zone: VIIb, VIIc, VIId, VIIe, VIIf, VIIg, VIIh and VIIk (WHG/7X7A.)
Belgium	163	
France	9 999	
Ireland	4 918	
The Netherlands	81	
United Kingdom	1 788	
EC	16 949	
TAC	16 949	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

TAC in 2010

Species: Whiting *Merlangius merlangus*		Zone: VIIb, VIIc, VIId, VIIe, VIIf, VIIg, VIIh and VIIk (WHG/7X7A.)
Belgium	133	
France	8 180	
Ireland	4 565	
The Netherlands	66	
United Kingdom	1 463	
EU	14 407	
TAC	14 407	Analytical TAC

Fishery in 2009

ICES officially reported landings for Divisions VIIe–k and landings as used by the Working Group are given in Table 7.15.1. It was not possible to compare the ICES officially reported landings and those reported to the WG for 2009 due to the lack of official French landings. In 2008 higher WG landings were reported by France. Official landings were wrongly allocated to VIIbc, which has now been corrected reducing the discrepancy for 2008. In 2009 international landings provided to the Working Group are very similar to those of 2008.

Minimal revisions (<1 t) to 2008 landings were submitted to the WG. ICES Official landings increased by ~1200 t, primarily resulting from French revisions. Landings from Spain, UK Scotland and the Channel Islands have also now been reported (combined <50 t).

The VIIe–k whiting stock is primarily targeted by otter trawlers and to a lesser extent Scottish seines and beam trawls. Otter trawlers utilize two mesh size ranges to 70–89 mm and 100–119 mm. Effort of trawlers utilizing these two mesh size ranges has remained relatively stable within the Celtic Sea as a whole, however effort of the larger mesh range has declined within VIIf and VIIg over recent years. The vessels utilising these mesh ranges have different species selectivity patterns. Several main species groups are targeted by otter trawlers catching whiting, as part of a targeted mixed gadoid fishery and as bycatch within the *Nephrops* and hake, anglerfish, and megrim fisheries. Beam trawlers operate to the eastern side of the assessment area, VIIe–h where small quantities of whiting are taken as a bycatch species in flatfish, anglerfish, and ray target fisheries. The spatial distributions of landings by country in 2009 are given in Figure 7.15.1. Irish catches are primarily from within VIIg particularly within 31E2 and 31E3. Landings also originate, to a lesser extent from VIIj. In previous years French landings have exhibited similar spatial and temporal focus around 31E3. No French spatial data was available for 2009. The majority of UK landings are from otter trawlers in VIIe, and focused within 29E5 and 29E6.

7.15.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Landings

National landings and numbers-at-age data were aggregated for the area VIIe–k following methodology described in the Stock Annex, with the exception of the French data. Due to problems with the French logbook database, the landings data were considered incomplete and not available by quarter and métier. Although considered incomplete the available data, around 2100 t, was included in the assessment. The landings data was allocated to quarters using the mean proportion by quarter over the period 2006–2008, which appeared to be reasonably stable. Secondly, the sample length distributions within each quarter were assumed to be representative of the landings of each métier. National sampling levels for the landings are presented in Table 2.1.

The length compositions from various fleets for 2009 are displayed in Table 7.15.2 and Figure 7.15.2. The landings length distributions of the Irish otter trawl, UK and French fleets, which account for the majority of the landings, are similar, peaking around 32–34cm. Scottish seine fleets land a wider distribution reaching sizes over 50 cm. The peak length ranges from 37 cm to 44 cm, with a slight tendency for seiners in VIIg to land smaller fish than in VIIj.

The international catch numbers-at-age are given in Table 7.15.3 and Figure 7.15.3. It is possible to track strong year classes in the landings-at-age matrices. The age distribution has remained similar over time, with the exception of periods where strong year classes pass through older ages. Age group 0 was included in the assessment data to allow inclusion of 0-group indices in the XSA, although landings at this age were not recorded in most years. Very small landings of 0-group whiting were not included in the catch-at-age data-file to avoid spurious F-shrinkage effects at this age. Mean weights-at-age in the catch and stock (Tables 7.15.4 and 7.15.5) were derived as per the methodology described in the Stock Annex. The stock weights are shown in Figure 7.15.4. There is some variability in stock weights particularly at older ages. There is some indication of a decreasing trend in weights for ages 6 and 7 over the whole time period.

Discards

Discard data are available from the Irish fishery since 1994 (ICES: SGDBI, 2002), from French sampling in 1991, 1997, and 2005–2009, and for the UK (E&W) fisheries from 2001–2009. These data are not used in the assessment as the data available does not cover the full time-series of landings-at-age-data, and historically sampled fleets may not be representative of the main fleets involved in the fishery. Furthermore, there is a need to examine and agree the best raising practice for the various fleets. Discard rates are substantial (>50% by fleet/quarter) and variable. It is not clear if current sampling intensity will obtain precise enough annual estimates to support an assessment method where catch numbers are assumed to be exact as in XSA.

A summary of the 2009 discard sampling and discard rates is presented in Table 7.15.6. Discard rates between years, quarters and fleets can be very variable, although the UK data are similar to the range observed in 2008. Discarding is much higher for Irish otter trawls in VIIg than last year.

Discarded whiting length distributions from 2009 Irish and French otter trawlers, and all UK gears were made available to the WG (Figure 7.15.5). The available data indicate that discarding occurs above the 27 cm MLS with some fish being discarded up to 50 cm in some fleets. The discard L_{50}'s for most countries/fleets is around 25–27 cm.

Age compositions for Irish discard data were provided for otter trawlers in VIIg and VIIj for 2003–2009 indicating discarding from age 0 up to age 8 in some years. Substantial discarding of ages 1 and 2 occurs for most years (Figure 7.15.6). Discard numbers-at-age have not yet been calculated for other fleets.

Biological

Mean stock weights- and numbers-at-age data were calculated, following methodology described in the Stock Annex.

Natural mortality was assumed to be 0.2 over all age groups and years.

Available data on maturity-at-age are described in the Stock Annex. Since 2006 the knife-edge maturity ogive has been replaced with indices calculated based on data from the UK WCGFS but a fixed vector is still used. Recent maturity sampling by Ireland and the UK on dedicated surveys confirms the use of this ogive but is in-sufficient to provide annual data.

Age	0	1	2	3	4	5+
Maturity	0	0.39	0.90	0.99	0.99	1.00

The proportions of F and M before spawning were both set to zero to reflect the SSB calculation date of January 1st.

Surveys

A time-series of available standardized survey abundance indices for ages 0–3 are displayed in Table 7.15.8. Further details of these surveys are given in WGSSDS 2008 Table 1.3.3 and described in the Stock Annex. Figure 7.15.9 shows standardised and log standardised abundance indices by age (0–3) for the three surveys used in the assessment by year class. In total four fishery-independent survey indices including 2009 data were available to the WG. The strong 1999 year class is evident in all surveys. The complete time-series and ages available from these surveys are given in the tuning fleet information available to the Working Group (Table 7.15.8).

The internal consistency of the surveys was examined, pairwise scatterplots of log numbers-at-age were examined, bearing in mind that the correlations may be impacted by changed in fishing mortality. Plots for the three surveys included in the assessment are provided in Figure 7.15.7b. Year effects were examined with mean log standardized plots of indices by age and year (Figure 7.15.8a). Cohort tracking was examined with mean log standardized plots of indices by age and cohort (Figure 7.15.8b).

The FR-EVHOE survey log indices scatterplots display reasonable positive correlation between adjacent ages. The mean log standardized indices by year display a year effect in 2006 and by cohort demonstrates good tracking of stronger year classes. The UK-WCGFS also demonstrated inconsistencies between years in the log-index scatterplots but reasonably consistent catch-curves. Log-indices for the Irish VIIg swept-area survey reveal some positive correlation for younger ages. The mean log standardized index by year demonstrated some slight year effect in 2003 which was the first year of the new series.

Commercial lpue

Estimates of commercial lpue, from 1995 to 2009, were available for the Irish otter trawl, Scottish seine, and beam trawl fleets operating in Divisions VIIg and VIIj (Table 7.15.9 and Figure 7.15.10). The effort-series is raw effort in hours uncorrected for changes in vessel power or changes in species targeting (i.e. métier compositions). Increased Irish VIIg otter trawl landings and lpue occurred 2005–2007, then returned to prior levels. This increase coincides with the 1999 year class passing through the fishery. Landings and effort for this fleet increased in 2009, although little change in lpue is observed. The recent elevated effort has been associated with the displacement, and subsequent relocation of effort in response to restrictive management in other areas particularly VIa and VIIa. The VIIj otter trawl fleet landings, effort, and lpue show similar levels since 2005, although slight increases to those of 2008 are observed. In the earlier part of the time-series lpue for the IR-7G-SSC and IR-7J-SSC showed declining tends. Since 2006/2007 lpue has increased. Landings by these two fleets however are low. Effort and lpue data for the Irish beam trawls (TBB) operating in VIIg and VIIj are also included in Table 7.15.9 but is not plotted as landings, effort and lpue are minimal.

Estimates of commercial lpue, up to 2008 were available for French gadoid trawlers and French *Nephrops* trawlers operating in Divisions VIIf,g (Table 7.15.9 and Figure 7.15.10). Fishing effort in the FR-GADOID fleet has been declining since 1989, while the effort in the FR-*NEPHROPS* has declined since 1992. The FR-GADOID fleet's lpue increased to high levels in 1994 and 1995 but declined since. Sharp increases in lpue for the French gadoid fleet occurred in both 1998 and 2005, since which lpue has declined. Lpue for the FR-*NEPHROPS* fleet peaked in the mid-to-late 1990s, having declined since to levels similar to the early 1980s. Landings, effort and lpue for both these fleets currently demonstrate the lowest levels within the time-series. Limited lpue data from France are available for Divisions VIIj–k, but they are not considered representative. The commercial tuning fleets available to the assessment are given in Table 7.15.8.

Abundance indices-at-age were available for three commercial fleets, the French gadoid, and *Nephrops* fleets, and the Irish otter trawl fleet. As with the surveys, the internal consistency of these fleets (Figure 7.15.7a), any year effects (Figure 7.15.8a) and cohort tracking (Figure 7.15.8b) were examined. The French commercial *Nephrops* index demonstrates very good internal consistency. The French gadoid fleet shows good consistency, although consistency at age 3 is slightly poorer. The IROTB-7g&j previously used in the assessment was not considered as a consequence of poor cohort tracking and *a priori* concerns about changes in targeting practice and fishing power because of recent fleet changes since 2002.

Other relevant data

Meetings held with representatives of the fishing industry raised no specific concerns or comments.

7.15.3 Historical stock development

An XSA assessment was carried out for this stock applying the same settings as last year's update assessment, with the addition of 2009 data. The settings previously used and applied this year are detailed within the Stock Annex.

Data screening

The general methodology is outlined in Section 2. Preliminary investigations were carried out using FLR under R version 2.4.1. The packages FLCore 1.4–3, FLAssess 1.4.1, FLXSA 1.4–2 and FLEDA 1.4–2 were used.

Final update assessment

The assessment was carried out with FLXSA 1.4–2 under R version 2.4.1. The assessment uses the same settings as last year (detailed below), with the exception of the French commercial tuning fleets which were not updated in 2009 due to data non-availability. The tuning data available, and the subset used in the assessment, are given in Table 7.15.8. No exploratory runs were carried out for this assessment.

		2009	2010
Catch date range:	Years	82–08	82–09
	Ages	0–7+	0–7+
Fbar Age Range:		2–5	2–5
Assessment Method:		XSA	XSA
Commercial Tuning Fleets:			
FR-Gadoid Late	Yrs	93–08	93–08
	Ages	3–6	3–6
FR-*Nephrops*	Yrs	93–08	93–08
	Ages	3–6	3–6
Survey Tuning-series:			
FR-EVHOE	Yrs	97–08	97–09
	Ages	0–4	0–4
UK-WCGFS	Yrs	87–01	87–01
	Ages	1–6	1–6
IR-IGFS Swept area	Yrs	99–08	99–09
	Ages	0–6	0–6
Time taper:		No	No

		2009	2010
Q plateau age:		5	5
F shrinkage S.E:		1	1
	Num yrs	5	5
	Num ages	3	3
Fleet S.E:		0.5	0.5

The full XSA diagnostics are given in Table 7.15.10. Substantially higher survivor estimates are given by the IR-IGFS Swept area survey than the FR-EVHOE survey for the 2009 year class (age 0), although weighting between the two is almost equal. The FR-EVHOE survey estimated substantially higher survivors for both the 2008 year class (age 1) and the 2007 year class (age 2). The two estimates of survivors converge from the 2005 year class (age 4). The French gadoid fleet generally gave higher estimates than the *Nephrops* tuning-series. Figure 7.15.11 shows the scaled weights received by each fleet in the assessment.

The log-catchability residuals from the XSA fit are plotted for each tuning-series in Figure 7.15.12. There are some year effects and noise in the short time-series of data. Year effects can be seen within the French commercial fleets in recent years. The Gadoid fleet displays increased catchability while the *Nephrops* fleet reveals reduced catchability suggesting a shift in the fishing patterns of this two fleets and noise in the short time-series of data.

The retrospective pattern is shown in Figure 7.15.13. The retrospective bias around the 1999 year-class remains, since which it has been relatively consistent. Recruitment bias is a result of the non-inclusion of discards in the assessment while discarding rates are high. The large 2008 recruitment given by the assessment has been revised downwards. The bias in F of recent years is not seen in the last two assessments. SSB shows little bias in recent years.

Estimates of fishing mortality and stock numbers from the final XSA are given in Tables 7.15.11 and 7.15.12. These are summarized in Table 7.15.13 and Figure 7.15.14. The assessment this year reveals a continued decline in fishing mortality. Although the last two years of recruitment have been revised downward they remain above average of recent years. Recruitment of 2009 is below the time-series average.

Comparison with previous assessments

This assessment is an update of the assessment settings carried out since 2007, with the exception of the French commercial tuning fleet for which 2009 data was not available. Minor revisions to landings and landings numbers-at-age have been included. The current assessment estimates of F agree with those estimated last year, as do SSB with a slight reduction in 2008. This is coupled with a decreased estimate of recruitment. This implies revisions are due to the assessments ability to predict recruitment, opposed to changes in landings inputs.

State of the stock

Trends in landings, F(2–5), SSB, and recruitment are presented in Table 7.15.13 and Figure 7.15.14. SSB displays peak biomass in the mid-1990s following a series of good recruitment in preceding years. Subsequently SSB has shown a declining trend, which was temporarily halted by the strong 1999 year class. SSB for the last two years shows an increase, particularly in 2009, estimated to be 33 680 t, well above B_{pa} (21 000 t). Fishing mortality (F_{bar}) is estimated to have declined in the last two years following a period of increase which peaked in 2007. The 2009 estimate of fishing mortality is estimated to be 0.48.

Recruitment estimates of 2007 and 2008 year classes are above those of the six preceding year classes. The very large estimate of the 2008 year class has been revised downward by the current assessment. The WG believe this to be an above average year class, although the size is still considered to be uncertain. The relationship between SSB and recruitment is poorly defined (Figure 7.15.16) and there is no evidence of reduced recruitment at lower levels of SSB.

7.15.4 Short-term projections

Estimating year-class abundance

The XSA estimate of the 2007 and 2009 year classes (71.9 m and 56 m respectively) were kept for the prediction. The 2007 estimate has demonstrated only a minor downward revision from last year. The 2009 year class has been retained within the forecast as it is similar to the recruitment of the early 2000s. The 2008 year-class XSA estimate has been reduced by 25% at age 0 and age 1 adjusted accordingly. This should account for the likely hood of further downward revisions of initial year-class size as seen in the retrospective analysis of the 1999 year class. Subsequent year classes have been set at GM recruitment over the full time-series (using the adjusted 2008 recruitment) of 69 136.

The Working Group estimates of year-class strength can be summarized as follows (recruitment-at-age 0):

Year class	Thousands	Basis	FR-EVHOE	IR-GFS7gSwept	Shrinkage
2007	71 912	XSA	36.3%	56.9%	6.8%
2008	89 231	XSA–25%	35.8%	55.5%	8.8%
2009	56 010	XSA	45.1%	54.9%	
Onwards	69 136	GM 1982–2009			

Short-term predictions

Input data for the predictions are given in Table 7.15.14. The exploitation pattern is based on the fishing mortalities averaged over 2007–2009, unscaled ($F_{2\text{-}5}$=0.782). Weights-at-age were the mean of 2007–2009. Table 7.15.15 is the management option table and Table 7.15.16 gives the detailed results. Figure 7.15.20 gives the short-term yield and SSB forecasts.

Assuming *status quo* F, landings are predicted to be around 14 472 t in 2010 and 15 281 t in 2011 (Table 7.15.16). SSB is predicted to be at 42 731 t in 2010, above B_{pa}, declining in 2011 to 41 408 t, and in 2012 to 39 415 t. This is in contrast to last year’s forecast which indicated SSB would increase. Estimates of the relative contribution of recent year classes to the 2011 landings and 2012 SSB are displayed in Table 7.15.17. The assumed GM recruitment accounts for 1.4% of the landings in 2011 and 42.3% of the SSB in 2012.

7.15.5 Medium-term projection

No medium-term projections were carried out.

7.15.6 Maximum Sustainable Yield Evaluation

The whiting VIIe–k time-series of assessment stock and recruit estimates, fishing mortality-at-age (average of the most recent three years, with CVs from eight year average of standardised F to allow greater variation), catch and stock weights (eight year averages), maturity and natural mortality-at-age were used to estimate proxies for the fishing mortality biomass and landings at maximum sustainable yield (F_{msy}, B_{msy} and MSY) within the srmsymc ADMB programme. The input data files (sen and sum) are presented in Tables 7.15.18 and 7.15 .19.

Three stock and recruit models are fitted by the programme, Ricker, Beverton and Holt and the smooth hockey stock, a summary of which is given in Figure 7.15.17. No iterations could be fitted to the Beverton–Holt recruitment model, and therefore discounted from further consideration for this stock. Figures 7.15.18a and 7.15.18b show output plots for the remaining two models. Based on the A.I.C. all models have an equal fit to the available data (Table 7.15.20). Table 7.15.20 also details the estimates of F_{crash}, F_{msy}, B_{msy} and MSY, presented with their percentiles and coefficients of variation.

The stock–recruitment relationship for this stock is poorly defined with little information in the data to inform the shape of the stock–recruitment relationship. There is a high rejection rate of iterations for both the Ricker and hockey stick models. The F parameters are poorly defined by the models having both wide distributions and high levels of uncertainty. Furthermore, the form of the YPR curve is poorly determined. Figure 7.15.19 illustrates the uncertainty in yield-per-recruit curve. The estimates from the YPR are presented in Table 7.15.20 where high CV's are observed particularly for F_{max}.

There are two important considerations to be noted in addition to the evaluation of the MSY analysis.

- This assessment is accepted as trends only due to high levels of uncertainty within the underlying data, the outputs of which are required to determine MSY parameters.
- A large amount of potential yield is lost through discarding. The yield in this analysis refers to landings only, whilst discarding for this stock is high.

The Working Group is unable to provide values of F_{msy} as a result of the above considerations. However, the Working Group considers it likely that fishing mortality is above F_{msy} and a reduction of discarding is needed to improve the catch selectivity pattern.

Yield-per-recruit analysis

Results of a yield-per-recruit analysis, using MFYPR, (Table 7.15.21 and Figure 7.15.20) indicate that F_{max} is 0.73, 86% of *status quo* F (0.78). Assuming $F_{0.1}$ (F 0.17), the current exploitation pattern, and the GM recruitment applied within the short-term forecast, long-term yield is estimated to be 11 490 t below the current TAC and an SSB of 82 846 t. Maintaining *status quo* F would yield 13 668 t with an SSB of 39 221 t.

7.15.7 Biological reference points

Precautionary approach to reference points.

The Working Groups current approach to reference points is outlined in Section 2. A summary of reference point proposals to date and their technical basis is given in the Stock Annex. The reference points were not re-examined in this update assessment, those currently adopted and their basis are as follows:

F_{LIM}	No Proposal
F_{PA}	No Proposal
B_{LIM}	15 000 t (BLIM = BLOSS 1983, ACFM1998)
B_{PA}	21 000 t (BPA = BLOSS 1983 x 1.4)

7.15.8 Management plans

No management plan has been agreed or proposed.

7.15.9 Uncertainties and bias in assessment and forecast

Sampling

The sampling levels for those countries supplying data for 2009 are given in Table 2.1. Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches. Sampling levels were not available by fishery/métier and the WG was therefore unable to evaluate whether or not current sampling levels are sufficient to support fishery/métier disaggregated assessment approaches.

Ageing

The strong recent cohorts passing through the fishery indicates that age estimation is consistent throughout the age range used in the assessment, although some underestimation does occur at older ages.

Discards

Discarding is a major feature of most fisheries catching whiting in the Celtic Sea. The non-inclusion of discard data in the assessment could explain some of the retrospective bias problems and changing catchabilities in commercial fleets observed throughout the assessment period. The availability of discard data has improved in the most recent years since the implementation of the DCF sampling programmes.

Surveys

Currently, there are two IBTS surveys (French and Irish) covering the Celtic Sea. Although these surveys normally catch large quantities of whiting they seem prone to year effects as has been observed for this species in other areas (e.g. Irish Sea, North Sea). These surveys give very different estimates of the 2009, 2008, 2007, and 2006 year classes. The estimation of younger year classes is one of the most important factors in the short-term development of the stock.

Misreporting

The level of misreporting of this stock is not known and underreporting has previously been considered unlikely to have been a significant source of unaccounted mortality of whiting in the assessment because the TAC has been in excess of recent landings.

Consistency

Inter-annual comparison between the results of this year's and last year's assessments shows consistent estimates up until 2005. Estimated recruitment for the 2007 and 2008 year class have been revised downward, by 18% and 55% respectively. Estimates of F are highly consistent between assessments, only a slight downward revision is observed in 2007 (<2%). SSB estimates exhibit a small downward revision (11%).

SSB has been rescaled upwards slightly in the past when the full time-series of commercial tuning data was included in the assessment. Consistency between more recent assessments showed some problems with recruitment and SSB estimates as strong year classes during the 1990s passed through the fishery and were heavily discarded. Assessments for the last few years have been reasonably consistent for SSB with some downward revisions, while F is revised upwards. Estimates of recruitment in the most recent assessment, remains problematic.

7.15.10 Recommendation for next Benchmark

The 2009 assessment was accepted for trends only by the Celtic Sea Review Group which had no specific comments on the assessment of whiting VIIe–k. The RG comment that the WG should provide potential management actions that can be taken to protect the 2008 year class.

A benchmark assessment of whiting is necessary.

Problem: The assessment of this stock has not been accepted for a number of years and considered to be indicative of trends only. The primary uncertainty of this assessment is underestimation of mortality. Currently the assessment is based on landings only. Discarding is a major feature of most fisheries catching whiting in this stock area. Mortality may therefore be grossly underestimated in younger ages. This could explain some of the retrospective bias problems and changing catchabilities in commercial fleets observed throughout the assessment period.

Solution: The available discard data has improved in the most recent years since the implementation of the DCR sampling programmes. Data are now available for the main fleets, operating within VIIe–k. Work is now required to compile a complete time-series of discard data, and evaluate raising options and uncertainty levels. Assessment model and settings then need to be reviewed to ensure optimum performance.

Year of last benchmark: No benchmark assessment of this species has been carried out. Exploratory analyses were carried out in the WGSSDS up until 2007.

WGCSE 2011 should review the time-series of discard data and options for inclusion of into this assessment. Until this happens WGCSE will not propose a time frame for the next Benchmark.

Expertise required: Expertise in discard raising and uncertainty methods, in addition to expertise in assessment methods permitting inclusion of discard data.

A further matter for consideration is the improvement of commercial tuning fleets by selection of vessel subsets with consistent spatial and temporal effort and catch composition over the majority of the time-series, moving towards the métier based approach. This would require a detailed analysis of vessel behaviour.

7.15.11 Management considerations

Catches and SSB in VIIe–k whiting fluctuate considerably depending on year-class strength. Indications are that the 2008 year class is strong and the 2007 and 2009 are stronger than recent years. Management measures should be considered to reduce discarding of this year class such that yield and SSB contributions can be maximized. This could be achieved through gear modifications to increase the likelihood of small whiting passing through the gear, such as introduction of larger minimum mesh sizes, separator panels, or grids.

Technical measures applied to this stock include a minimum landing size (≥27 cm) and minimum mesh sizes applicable to the mixed demersal fisheries. These measures are set depending on areas and years by several regulations. Whiting are caught in directed gadoid trips and as part of mixed fisheries throughout the Celtic Sea, as well as bycatch within *Nephrops* fisheries. Discard rates are high as a consequence of the low market value of the species, particularly at smaller sizes. High-grading above the MLS to some extent is also prevalent in most fisheries. The current assessment doesn't include discard estimates. Recent selection data from FTFB should be investigated at the next Benchmark Workshop.

From the 1 February to the 31 March fishing activity has been prohibited within ICES rectangles: 30E4, 31E4, 32E3 (excluding within six nautical miles from the baseline) annually since 2005 to protect the cod stock. The impact of this on whiting remains unclear but spatial distribution of landings in 2009 suggest that landings from the closed rectangles are lower than those of adjacent rectangles. Irish quarterly landings by rectangle indicate little or no landings from within these closed rectangles during the first quarter.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French gadoid fleet has been declining since 1999. Irish otter trawl effort in VIIg,j has been stable over the last four years. During this period there has been a fleet modernisation and several decommissioning schemes in Ireland both within the national whitefish fleet and beam trawl fleet. The most recent round of decommissioning occurred in 2008 and 2009 removed 40 vessels which had operated within the Celtic Sea in 2007–2008. The decommissioned vessels accounted for 15–16% of whiting landings from the stock area in 2007 and 2008. The majority of these vessels primarily landed *Nephrops* or a combination of Hake, monkfish and megrim. Only eight vessels primarily landed whitefish (cod, haddock and whiting). A French decommissioning scheme was implemented in 2008 and 2009. A reduction in the French fleet operating in VIIe–k is expected as a result.

Table 7.15.1. Whiting in Divisions VIIe–k. Nominal Landings (t) as reported to ICES, and total landings as used by the Working Group.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	130	158	160	107	112	159	295	317	304	111	145	228	205	268
Denmark														
France	7,572	4,024	7,819	7,763	9,773	10,947	19,771	19,348	10,006	9,620	11,285	13,535	13,400	9,936
Germany										14				
Ireland	1,511	1,227	2,241	1,309	1,518	2,036	1,651	1,764	1,403	1,875	3,630	5,053	6,077	6,115
Netherlands		398		124										8
Spain													4	31
UK (E/W/NI)	1,192	986	751	910	1,098	1,632	1,326	1,829	2,023	1,393	1,776	1,624	1,803	1,724
UK(Scotland)						1	33	32	20	41	16	23	23	34
United Kingdom Channel Islands			2	2	2								1	1
Total	10,405	6,793	10,973	10,215	12,503	14,775	23,076	23,290	13,756	13,054	16,852	20,463	21,513	18,116
Unallocated	1,376	3,192	-135	-263	149	353	-6,535	-9,184	-248	-690	-532	-429	1,165	144
Total as used by Working Group	11,781	9,985	10,838	9,952	12,652	15,128	16,541	14,106	13,508	12,364	16,320	20,034	22,678	18,260

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009a
Belgium	449	479	448	194	171	149	129	180	218	128	127	122	87
Denmark													
France	11,370	11,711	16,418[b]	9,077	7,203	7,435	5,897	4,811	5,784	4,649	3,543	3,046	
Germany													
Ireland	6,893	5,226	5,807	4,795	5,008	5,332	4,093	4,215	5,709	4,521	4,764	2,330	2,328
Netherlands		1			5	4	9	18	60	40	64	23	29
Spain	24	53	21	11	9	12	-	76	56	70	21	8	
UK (E/W/NI)	1,742	1,706	1,344	1,249	943	843	758	586	471	402	569	610	826
UK(Scotland)	42	68	3	2	11	12	5	7	-	6	4	7	
United Kingdom Channel Islands		3	2	3	3	1	4	0	0	0	1	1	
Total	20,520	19,247	24,043	15,331	13,353	13,788	10,895	9,893	12,298	9,816	9,093	6,147	3,270
Unallocated	12	-2	-4,128	-466	-583	-642	-312	61	-269	-283	-146	-410	2,439
Total as used by Working Group	20,532	19,245	19,915	14,865	12,770	13,146	10,583	9,954	12,030	9,533	8,948	5,737	5,708

[a]: Preliminary

[b]: Preliminary, Reported as VIIb-k

Table 7.15.2. Whiting in Divisions VIIe–k. Raised length distributions for 2009 by country and fleet (Numbers in '000s).

Length (cm)	France	UK (E+W)		Ireland					
		Beam trawl	All gears (exc beam)	Scottish Seine	Otter trawl	Beam trawl	Gillnet	Otter trawl	Scottish seine
	VII fgh	VIIe-k	VIIe-k	VIIg	VIIg	VIIg	VIIg	VIIj	VIIj
20									
21					0.2				
22					0.6				
23					2.1				
24	0.2				4.5				
25	0.5				5.1			3.2	
26	1.8		6.4		6.2			14.7	
27	7.2		7.8	1.1	16.5			26.9	
28	39.1		14.1	2.1	38.9			48.9	0.6
29	117.8		60.9	9.1	91.9			46.2	2.6
30	133.8	4.0	82.8	28.3	200.1	0.0		59.3	3.9
31	195.9	4.0	190.5	69.5	313.5	0.0		61.9	12.9
32	232.2	2.0	257.0	77.3	410.6	0.1		73.5	13.6
33	276.8	8.0	255.6	92.4	476.4	0.2		61.7	18.1
34	276.0	8.0	283.5	94.5	427.7	0.5		68.5	23.2
35	227.2	4.0	203.9	92.5	367.9	0.3		61.4	19.4
36	182.6	14.0	181.3	97.8	273.6	0.7	0.0	52.3	17.4
37	138.9	8.0	125.2	110.7	200.9	0.5	0.0	40.4	21.3
38	115.9	8.0	125.1	88.9	147.6	0.3	0.0	33.1	31.6
39	101.4	6.0	93.3	88.6	107.8	0.4	0.0	26.6	22.6
40	85.5	10.0	54.9	100.0	75.1	0.3	0.2	24.0	33.6
41	55.3	6.0	46.1	97.8	58.5	0.4	0.1	14.5	36.2
42	51.9	4.0	24.1	59.5	52.3	0.2	0.5	16.4	36.8
43	34.0	6.0	19.9	62.4	30.8	0.3	0.4	10.1	34.2
44	31.1	0.0	15.3	42.1	27.1	0.3	0.1	8.7	36.8
45	24.5	0.0	4.3	44.2	24.0	0.2	0.3	4.4	31.6
46	26.2	0.0	6.8	39.4	17.9	0.1	0.2	3.5	23.9
47	14.6	2.0	2.6	25.8	19.2	0.1	0.2	2.7	14.8
48	17.4	2.0	0.3	22.4	17.8	0.1	0.1	1.7	10.3
49	12.7	0.0	1.7	18.1	9.4	0.0	0.2	1.7	9.7
50	15.8	0.0	2.0	8.2	7.4	0.0	0.6	0.5	8.4
51	10.7	0.0	1.1	8.2	4.8	0.0	0.4	1.2	7.7
52	7.2	2.0	0.5	2.1	3.6	0.1	0.3	0.2	7.1
53	8.4	0.0	1.4	9.3	6.0	0.0	0.3	1.9	5.2
54	3.5	2.0		5.1	1.4	0.0	0.4	1.4	10.3
55	2.6			2.1	3.3	0.0	0.4	1.3	3.2
56	4.5			2.1	1.1	0.0	0.5	0.0	3.9
57	1.3			3.0	1.6		0.2	0.0	1.3
58	1.7			0.0	1.3		0.2	0.0	1.9
59	1.0			1.1	1.6		0.1	0.0	1.9
60	0.8			3.1	1.4		0.2	0.2	0.0
61	0.2			0.0	1.0		0.0		0.0
62	0.9			1.1	0.0		0.0		0.6
63	0.4				0.0		0.0		0.0
64	0.0				0.2		0.0		0.0
65	0.0				0.0		0.0		0.6
66					0.0				0.0
67					0.0				0.6
68					0.2				
69									
Total N.	**2459.5**	**100.1**	**2068.6**	**1409.6**	**3459.1**	**5.2**	**6.1**	**773.1**	**508.1**
Total (t)	**1090.1**	**47.1**	**751.9**	**733.2**	**1296.0**	**2.7**	**6.6**	**283.2**	**351.6**

Table 7.15.3. Whiting in Divisions VIIe–k. Landings numbers-at-age ('000), examples of strong year classes are highlighted.

Age	0	1	2	3	4	5	6	7
1982	0	2624	12523	9862	4564	880	41	23
1983	0	5867	9981	9059	3393	1319	195	10
1984	0	2854	18645	4697	1815	618	128	28
1985	0	3698	15538	8005	1380	289	96	33
1986	0	3769	15157	6465	2091	553	60	45
1987	0	5977	19376	8825	2467	587	112	60
1988	0	2315	26780	11400	1962	409	70	21
1989	0	602	17057	24243	3459	339	63	25
1990	0	3270	9249	19509	8654	749	62	21
1991	0	8339	11997	5578	11742	2700	143	3
1992	0	4964	20513	9198	1420	1275	435	39
1993	0	2304	22277	17939	2829	526	382	172
1994	0	1272	14110	25384	6165	1019	135	177
1995	0	540	15062	21854	14142	2242	310	92
1996	0	1345	7473	17783	12850	5486	775	114
1997	0	609	4451	11734	21209	7322	2787	720
1998	0	1182	6680	10938	12758	13240	2865	882
1999	0	4163	10223	12444	8406	8733	6479	1188
2000	0	3575	9357	10328	5468	2351	1993	1845
2001	0	336	11648	11076	5135	2061	745	275
2002	0	1067	5962	19658	5732	1064	274	63
2003	0	462	3599	8264	11530	1675	264	20
2004	0	1209	4141	5963	6755	5978	496	69
2005	0	768	6169	8141	5008	4551	3456	147
2006	0	1366	6342	7631	3672	1767	1148	581
2007	0	988	5598	8479	4984	1535	412	226
2008	0	1269	3710	5948	2923	700	173	31
2009	0	341	4194	5693	2768	695	165	36

Table 7.15.4. Whiting in Divisions VIIe–k. Landings weights-at-age (kg).

Age	0	1	2	3	4	5	6	7
1982	0.000	0.245	0.279	0.395	0.557	0.646	1.193	1.593
1983	0.000	0.273	0.328	0.441	0.545	0.678	0.731	1.652
1984	0.000	0.227	0.286	0.457	0.656	0.807	1.060	1.514
1985	0.000	0.233	0.335	0.433	0.631	1.008	1.157	0.980
1986	0.000	0.198	0.277	0.493	0.585	0.781	1.469	1.680
1987	0.000	0.222	0.284	0.398	0.658	0.877	0.897	0.990
1988	0.000	0.224	0.303	0.416	0.628	0.977	1.322	1.374
1989	0.000	0.201	0.281	0.376	0.593	0.980	1.444	1.877
1990	0.000	0.226	0.260	0.328	0.452	0.722	1.083	1.721
1991	0.000	0.220	0.291	0.355	0.395	0.534	0.834	1.695
1992	0.000	0.208	0.289	0.388	0.472	0.623	0.739	1.084
1993	0.086	0.205	0.286	0.379	0.589	0.831	0.963	1.360
1994	0.000	0.249	0.300	0.404	0.637	0.915	0.982	1.222
1995	0.090	0.202	0.275	0.382	0.527	0.844	1.124	1.197
1996	0.000	0.229	0.266	0.346	0.460	0.598	0.616	1.058
1997	0.000	0.196	0.277	0.329	0.406	0.536	0.714	1.005
1998	0.000	0.188	0.270	0.333	0.396	0.452	0.567	0.896
1999	0.000	0.222	0.298	0.352	0.426	0.441	0.497	0.633
2000	0.101	0.250	0.326	0.419	0.510	0.573	0.585	0.597
2001	0.000	0.265	0.286	0.393	0.521	0.624	0.761	0.820
2002	0.082	0.217	0.293	0.363	0.519	0.682	0.810	1.022
2003	0.000	0.211	0.281	0.369	0.447	0.603	0.831	1.149
2004	0.086	0.218	0.303	0.376	0.433	0.492	0.523	0.754
2005	0.101	0.246	0.318	0.396	0.506	0.509	0.487	0.595
2006	0.112	0.232	0.299	0.414	0.545	0.585	0.586	0.707
2007	0.000	0.206	0.290	0.389	0.492	0.603	0.564	0.673
2008	0.116	0.235	0.291	0.378	0.512	0.617	0.754	1.124
2009	0.000	0.245	0.322	0.405	0.504	0.592	0.669	0.902

Table 7.15.5. Whiting in Divisions VIIe–k. Stock weights-at-age (kg).

AGE	0	1	2	3	4	5	6	7	8	9	10
1982	0	0.157	0.270	0.345	0.474	0.607	0.843	1.403	1.255	0.688	0.688
1983	0	0.167	0.276	0.363	0.498	0.632	0.826	1.313	1.256	0.732	0.732
1984	0	0.192	0.282	0.371	0.521	0.709	0.847	1.188	1.270	0.723	0.723
1985	0	0.179	0.272	0.389	0.534	0.738	1.030	1.187	1.382	1.046	0.957
1986	0	0.183	0.259	0.370	0.543	0.756	1.020	1.223	1.513	1.145	0.98
1987	0	0.171	0.253	0.367	0.533	0.752	1.059	1.261	1.474	1.585	0.864
1988	0	0.186	0.252	0.342	0.531	0.784	1.050	1.322	1.685	1.465	0.768
1989	0	0.173	0.249	0.331	0.477	0.760	1.114	1.439	1.643	1.853	0.599
1990	0	0.166	0.247	0.317	0.427	0.651	1.007	1.524	1.461	1.465	0.842
1991	0	0.151	0.248	0.317	0.396	0.553	0.815	1.310	1.154	1.032	0.929
1992	0	0.174	0.253	0.327	0.421	0.551	0.736	1.133	1.105	0.866	1.216
1993	0	0.166	0.251	0.340	0.470	0.637	0.779	1.034	1.337	0.954	1.126
1994	0	0.175	0.254	0.340	0.487	0.715	0.906	1.077	1.258	1.405	1.158
1995	0	0.108	0.259	0.346	0.476	0.711	0.861	0.994	1.047	1.341	1.044
1996	0	0.135	0.256	0.328	0.430	0.626	0.820	0.942	0.990	1.107	1.035
1997	0	0.110	0.245	0.307	0.396	0.525	0.645	0.830	1.123	0.912	0.912
1998	0	0.148	0.238	0.293	0.378	0.453	0.585	0.747	1.043	0.968	0.968
1999	0	0.112	0.245	0.324	0.419	0.491	0.518	0.677	0.779	0.725	0.725
2000	0	0.144	0.253	0.357	0.465	0.556	0.611	0.711	0.685	0.895	0.895
2001	0	0.182	0.259	0.370	0.490	0.612	0.676	0.802	0.649	0.995	0.995
2002	0	0.193	0.248	0.361	0.480	0.627	0.795	1.009	0.850	1.062	1.062
2003	0	0.187	0.244	0.332	0.439	0.560	0.693	0.886	1.202	0.875	1.127
2004	0	0.167	0.253	0.333	0.449	0.541	0.652	0.892	1.380	1.38	1.38
2005	0	0.163	0.256	0.346	0.484	0.535	0.582	0.765	1.431	1.431	1.431
2006	0	0.177	0.280	0.390	0.553	0.624	0.647	0.832	0.990	0.799	0.799
2007	0	0.204	0.285	0.403	0.566	0.666	0.727	0.951	0.811	0.633	0.633
2008	0	0.227	0.298	0.397	0.549	0.659	0.714	0.920	0.527	0.467	0.467
2009	0	0.220	0.286	0.380	0.525	0.631	0.723	0.981	0.540	0.54	0.54

Table 7.15.6. Whiting in Divisions VIIe–k. Summary of discard data in 2009 provided the Working Group.

				Sampling							Discard Rates	
Country	Year	Quarter	Gear/Fleet	Trips	Hauls	Numbers Retained	Weight Retained	Number Discarded	Weight Discarded	Units	Number	Weight
France	2009	Q1-3	OT VIIe-k Crustacean	22	173	2555	880	4569	640	No. & KG Sampled	64%	42%
France	2009	Q2-4	OT VIIe-k Demersal fish	42	357	1396	666	1842	286	No. & KG Sampled	57%	30%
UK	2009	1	All Gears	33	453	3175	1409	5612	1026	Raised No. & KG Sampled	64%	42%
UK	2009	2	All Gears	22	164	2387	841	2497	560	Raised No. & KG Sampled	51%	40%
UK	2009	3	All Gears	29	398	2377	796	2994	644	Raised No. & KG Sampled	56%	45%
UK	2009	4	All Gears	12	73	3294	1629	2088	315	Raised No. & KG Sampled	39%	16%
UK	2009	All	All Gears	96	1088	11233	4674	13191	2546	Raised No. & KG Sampled	54%	35%
Ireland	2009	All	Otter Trawls VIIg	16	175	5703	1969	18909	3051	No. '000s & tonnes raised to Fleet	77%	61%
Ireland	2009	All	Otter Trawls VIIj	15	200	106	43	367	58	No. '000s & tonnes raised to Fleet	78%	57%

Table 7.15.7. Whiting in Divisions VIIe–k. Standardised survey abundance indices of age groups 0–3.

Survey	UK-WCGFS			UK-BCCSBTS-S		FR-EVHOE				IR-GFS-7g&j				IR-GFS-7g-Swept Area			
Units	No. per min			No. per km towed		No. per 30 min haul				No. per 30 min haul				No. per 10 kmsq			
Year	1-gp	2-gp	3-gp	0-gp	1-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp
1987	0.36	1.61	0.16														
1988	0.24	0.23	0.06	0.1	0.9												
1989	0.25	0.73	0.49	0.9	1.1												
1990	0.02	0.06	0.25	5.2	0.5												
1991	0.21	0.01	0.01	4.4	1.4												
1992	1.31	0.53	0.11	6.7	1.3												
1993	4.88	0.92	0.27	10.0	1.7												
1994	8.99	1.33	0.92	2.7	1.5												
1995	0.59	5.52	1.43	2.3	1.5												
1996	0.52	1.51	1.39	4.6	1.5												
1997	0.73	0.56	0.18	10.7	0.5	31	24	9	8.5								
1998	1.19	0.77	0.53	5.3	0.5	48	15	7.9	1.2								
1999	0.84	0.50	0.15	15.1	1.0	261	62	18	5.1					24175	7307	1881	633
2000	14.91	0.93	0.29	1.2	3.1	31	77	23	2.9					6077	15835	3116	190
2001	2.49	1.35	0.24	1.7	0.5	23	35	49	8					4650	2836	13871	1849
2002	3.35	1.80	3.04	5.3	0.3	39	15	11	10					2468	3664	1719	1252
2003	3.20	2.51	2.48	3.9	0.1	47	58	27	20	127	88	38	11	6061	2219	1027	413
2004	2.00	1.80	0.99	10.3	0.1	28	108	31	14	295	95	48	10	9778	3444	655	321
2005	Survey discontinued			6.4	0.0	44	16	5	2	83	106	29	10	1146	3177	1573	422
2006				4.3	0.3	15	10	3	1	373	161	50	10	15260	5883	2175	707
2007				7.7	0.7	178	46	4	1	332	218	47	7	9951	8081	2718	455
2008				25.1	0.7	365	45	10	3	402	140	44	11	16344	5554	2238	475
2009				6.7	0.6	30	68	31	6	346	289	65	17	11053	10819	2154	589

Table 7.15.8. Whiting in Divisions VIIe–k. Available commercial and survey tuning-series, ages and years used in the assessment are highlighted in bold.

Whiting in the Celtic Sea VIIe-k Tuning data WGCSE 2009 (Sarah Davie 27/04/09)
114
FR-GADOID-Early: French Gadoid trawlers (FU5) - Effort, No. of whiting/age/1000 hours fished, Year, Live weight (t)

1983 1992
1 1 0 1
1 11

1000	18325	41531	38575	15377	6184	886	51	0	0	0	0	#1983 5742t
1000	13779	97659	25223	9993	3362	688	82	46	22	0	0	#1984 4598t
1000	14948	75447	37539	6687	1506	540	189	9	0	0	0	#1985 4514t
1000	13417	66679	29328	9073	2310	266	183	20	3	2	0	#1986 5049t
1000	25446	79928	33683	10141	2358	518	161	30	36	0	0	#1987 6859t
1000	6738	71192	30313	5029	1040	184	45	4	2	0	0	#1988 7921t
1000	1539	41365	58078	7808	843	161	30	12	0	0	0	#1989 8974t
1000	10547	29023	60936	24967	2297	148	49	18	2	0	0	#1990 7897t
1000	31392	41485	18143	40085	8616	352	15	0	0	0	0	#1991 7525t
1000	15843	65677	28694	4589	4435	1226	132	0	0	0	0	#1992 6460t

FR-GADOID-late: French Gadoid trawlers (FU5) - Effort, No. of whiting/age/1000 hours fished, Year, Live weight (t)

1993 2008
1 1 0 1
1 11

1000	4736	57675	**35630**	**5286**	**825**	**883**	469	40	20	6	0	#1993 7815t
1000	448	26922	**65786**	**18395**	**2948**	**289**	454	125	80	0	0	#1994 9236t
1000	86	10737	**43840**	**34895**	**7662**	**1360**	248	0	28	32	0	#1995 9186t
1000	8	2509	**34872**	**31293**	**13650**	**1708**	328	32	31	29	0	#1996 6028t
1000	0	3641	**17743**	**45915**	**14168**	**4338**	721	63	12	0	0	#1997 7218t
1000	3827	17367	**32394**	**25399**	**30762**	**21832**	3285	631	186	0	0	#1998 7674t
1000	3457	15689	**29265**	**22945**	**27790**	**19723**	2967	570	168	0	0	#1999 9102t
1000	4987	23934	**29232**	**15124**	**6851**	**7110**	5976	1306	132	10	0	#2000 6053t
1000	213	23745	**25724**	**9253**	**3440**	**1465**	593	539	114	57	0	#2001 4624t
1000	405	9574	**48049**	**13052**	**2399**	**816**	136	59	27	25	0	#2002 4799t
1000	13	2004	**15027**	**33581**	**3776**	**542**	94	48	67	13	3	#2003 2975t
1000	238	4747	**10190**	**18892**	**20570**	**1688**	269	17	0	0	0	#2004 2589t
1000	278	11772	**23815**	**15806**	**17601**	**15832**	418	54	0	0	0	#2005 3659t
1000	295	16943	**35200**	**15517**	**7869**	**5396**	2180	142	6	0	0	#2006 2795t
1000	369	13147	**23994**	**12964**	**2496**	**461**	400	460	53	0	0	#2007 1898t
1000	257	8841	**14651**	**10665**	**2942**	**586**	50	65	0	0	0	#2008 1133t

FR-NEPHROPS-Early: French Nephrops trawlers (FU8) - Effort, No. whiting/age/1000 hours fished, Year, Live weight (t)
1987 1992
1 1 0 1
1 11

1000	917	3681	2247	761	176	23	18	2	6	0	0	#1987 588t
1000	632	7960	3610	918	165	39	11	0	0	0	0	#1988 844t
1000	131	4874	6866	1294	128	31	5	1	0	0	0	#1989 891t
1000	321	1139	3596	2297	279	27	8	5	0	0	0	#1990 671t
1000	1048	2312	982	1745	498	33	6	0	0	0	0	#1991 527t
1000	1542	6078	3348	478	571	171	14	0	0	0	0	#1992 1153t

FR-NEPHROPS-Late: French Nephrops trawlers (FU8) - Effort, No. whiting/age/1000 hours fished, Year, Live weight (t)

1993 2008
1 1 0 1
1 11

1000	766	6928	**5695**	**1001**	**163**	**86**	74	1	2	0	0	#1993 1356t
1000	184	6145	**8313**	**1840**	**214**	**17**	16	5	2	0	0	#1994 1565t
1000	29	2217	**7580**	**4802**	**697**	**91**	20	0	3	3	0	#1995 1446t
1000	2	979	**5599**	**4992**	**2359**	**305**	55	4	1	7	0	#1996 1230t
1000	0	737	**3511**	**10406**	**4124**	**1231**	275	23	1	0	0	#1997 1393t
1000	58	1042	**2567**	**4299**	**5925**	**1236**	239	46	2	0	0	#1998 881t
1000	1253	4408	**4764**	**3762**	**3867**	**3563**	575	136	8	0	0	#1999 1190t
1000	277	2381	**3085**	**2213**	**923**	**836**	959	232	23	0	0	#2000 869t
1000	104	2948	**3131**	**1531**	**557**	**213**	106	95	36	8	0	#2001 548t
1000	27	747	**4007**	**1455**	**462**	**170**	69	13	14	7	0	#2002 550t

```
1000    5      311     1708   3944    574     95     27     7     1     0     2     #2003  543t
1000    47     748     1090   2045    2726    233    49     6     0     0     0     #2004  435t
1000    104    1285    1926   1133    1266    1283   54     2     0     0     0     #2005  378t
1000    46     802     1299   591     299     187    101    12    0     0     0     #2006  174t
1000    138    981     1159   604     137     26     19     16    5     0     0     #2007  96t
1000    41     506     565    408     96      19     7      2     0     0     0     #2008  54t

FR-EVHOE: Thalassa Survey - No. whiting at age/30 min, Year
1997    2009
1       1       0.75    1
0       8
1       30.82   23.85   8.93    8.47    10.38   1.93    0.24    0.00    0.00    #1997
1       48.10   15.15   7.88    1.23    1.67    0.55    0.18    0.02    0.00    #1998
1       260.66  62.15   17.64   5.09    1.92    1.67    1.18    0.15    0.13    #1999
1       30.62   76.50   23.18   2.85    1.17    0.33    0.18    0.50    0.06    #2000
1       22.77   35.46   48.80   8.12    0.79    0.14    0.11    0.02    0.04    #2001
1       38.50   15.33   11.00   9.58    0.82    0.00    0.00    0.00    0.00    #2002
1       46.62   58.30   27.11   19.94   14.74   0.05    0.01    0.00    0.00    #2003
1       28.23   108.11  31.11   14.36   6.98    3.98    0.00    0.00    0.00    #2004
1       44.14   15.85   5.19    1.89    1.15    0.63    0.16    0.00    0.00    #2005
1       14.60   9.53    3.45    1.18    0.30    0.03    0.00    0.01    0.00    #2006
1       178.39  46.30   4.34    0.68    0.36    0.07    0.00    0.00    0.01    #2007
1       364.99  44.55   10.17   3.27    1.43    0.14    0.00    0.00    0.03    #2008
1       29.93   68.10   30.54   6.47    1.34    0.02    0.01    0.00    0.00    #2009

UK-WCGFS : UK (E+W) PHHT Groundfish Survey in VIIf&g - Effort mins towed, no.s at age,
Year, Vessel (final survey in 2004)

1987    2004
1       1       0.15    0.25
1       7
360     129     580     57      8       6       4       1       #1987   Cirolana
540     129     125     31      3       3       0       0       #1988   Cirolana
540     137     393     267     21      4       2       0       #1989   Cirolana
540     11      31      137     55      9       1       0       #1990   Cirolana
482     99      6       3       11      9       1       0       #1991   Cirolana
840     1097    441     94      28      22      6       1       #1992   Cirolana
840     4101    772     229     29      4       8       3       #1993   Cirolana
535     4809    713     490     70      17      1       3       #1994   Cirolana
1320    777.4   7282.9  1891.2  595     82.2    18.6    11.3    #1995   Cirolana
1475    773     2225    2050    391     148     11      2       #1996   Corystes
1519    1113    852     280     646     226     60      5       #1997   Cirolana
900     1071.5  691.5   477     343.3   104.8   13.3    12.5    #1998   Cirolana
900     760.2   453.9   139.4   52.1    47.8    90.2    30.5    #1999   Cirolana
1038    15471.8 962.8   296.4   118.9   47.2    51      50.6    #2000   Cirolana
880     2195.3  1186.5  206.8   35.4    2       7.6     1       #2001   Cirolana
762     2551.5  1368.9  2313.6  155.9   75.7    1.2     4.4     #2002   Cirolana
863     2765.7  2169.9  2138.8  1665.8  157.9   0       0       #2003   Cirolana
860     1716.8  1548.2  852.1   203.6   184.3   2       0       #2004   Cefas Endeavour

UK BT SURVEY : (Sept) - Prime stations only (VIIf) Effort (km towed), numbers at age per
Km towed
1988    2009
1       1       0.75    0.85
0       1
74.12   6       66      #1988   Tows 15 minute duration - raised here to 30 minutes
91.91   80      104     #1989   Tows 15 minute duration - raised here to 30 minutes
69.86   363     37      #1990
123.41  540     175     #1991
125.08  839     164     #1992
127.67  1279    213     #1993
120.82  330     182     #1994
104.14  240     154     #1995
122.11  557     188     #1996
115.63  1238    56      #1997
104.7   553     49      #1998
117.11  1770    116     #1999
105.99  128     333     #2000
118.22  204     56      #2001
113.03  602     36      #2002
111.92  442     6       #2003
101.92  1053    6       #2004
119.11  760     5       #2005
120.56  520     31      #2006
118.59  910     81      #2007
```

```
119.33  2994    81      #2008
123.22  826     72      #2009

IR-GFS-7G Swept Area : Swept Area Method - Effort in kmsq
1999    2009
1       1       0.75    0.92
0       8
10.0    24175   7307    1881    633     292     110     85      40      0 #1999
10.0    6077    15835   3116    190     35      27      8       0       0 #2000
10.0    4650    2836    13871   1849    222     18      22      6       0 #2001
10.0    2468    3664    1719    1252    127     3       9       0       0 #2002
10.0    6061    2219    1027    413     0       10      0       0       0 #2003 *age   4
replaced with zero, was 22
10.0    9778    3444    655     321     147     123     1       0       0 #2004
10.0    1146    3177    1573    422     169     104     163     0       0 #2005 *rev2009
10.0    15260   5883    2175    707     68      0       28      0       0 #2006 *rev2009
10.0    9951    8081    2718    455     83      23      4       0       3 #2007 *rev2009
10.0    16344   5554    2238    475     65      2       0       0       0 #2008
10.0    11053   10819   2154    589     110     25      0       3       0 #2009

IR-7G&J-OT : Irish Otter Trawl Fleet (Areas VIIg&j) - Effort in hours, no.s @ age, Year,
Live weight (t), LPUE (kg/h)

1995    2009
1       1       0       1
1       4
157085  679     2281    1889    1333    #                       #1995
130257  164     1549    1889    905     #                       #1996
148276  170     756     1488    1247    #                       #1997
161909  180     933     980     736     #                       #1998
92195   388     960     962     449     #                       #1999
125229  619     1042    808     500     #228    103     65      #2000   1506.6t 12.03
137086  91      2224    1538    1046    #412    125     48      #2001   2227.9t 16.25
168134  291     1140    2615    613     #86     13      6       #2002   1761.4t 10.48
198059  147     878     1640    1195    #155    8       0       #2003   1544.6t 7.80
188948  132     628     1763    1002    #428    42      2       #2004   2243.9t 11.88
198315  96      1743    2848    1226    #1162   745     31      #2005   3730.4t 18.81
185083  188     1900    2070    950     #427    283     127     #2006   3008.2t 16.25
217009  78      1063    3112    2305    #614    141     70      #2007   3597.2t 16.58
192317  131     860     1038    677     #173    55      7       #2008   1269.3t 6.60
207631  216     894     1471    675     #283    69      17      #2009   1573.3t 7.58

IR-GFS-7G&J : Irish Groundfish Survey in VIIg&j (IBTS 4th Qtr) - Whiting no. @ age (In-
terim indices: New Celtic Explorer series)

2003    2009
1       1       0.79    0.92
0       6
1612    6836    4714    2064    582     96      12      0       #2003
1700    16710   5405    2733    570     170     115     10      #2004
1726    4761    6085    1655    573     142     75      101     #2005
1947    24194   10418   3250    637     100     3       25      #2006
2042    22609   14869   3182    508     82      39      10      #2007
2012    26990   9362    2957    734     135     6       8       #2008
1765    20379   17026   3845    989     196     41      0       #2009
```

Table 7.15.9. Whiting in Divisions VIIe–k. Landings (t), lpue of French and Irish fleets, and Effort ('000 h) of French, Irish and UK fleets.

	FR-Gadoid VII fg French gadoid trawlers			FR-*Nephrops* VII fg French *Nephrops* trawlers			IR-OTB-7G Irish otter trawlers VIIg			IR-OTB-7J Irish otter trawlers VIIj			UK (E&W) in VIIe-k	
													Beam	Otter
Year	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Effort[4]	Effort[4]
1983	5,742	109	53	470	207	2							135	82
1984	4,598	84	55	340	173	2							131	87
1985	4,514	89	51	651	185	4							152	90
1986	5,049	116	44	374	146	3							136	85
1987	6,859	137	50	588	177	3							177	84
1988	7,921	200	40	844	156	5							195	89
1989	8,974	231	39	891	159	6							198	84
1990	7,897	188	42	671	196	3							208	99
1991	7,525	167	45	527	187	3							203	77
1992	6,460	173	37	1,153	234	5							196	86
1993	7,815	201	39	1,356	223	6							208	62
1994	9,236	171	54	1,565	223	7							220	54
1995	9,186	171	54	1,446	202	7	829	64	13	1,305	94	14	243	52
1996	6,028	152	40	1,230	179	7	906	60	15	803	70	11	261	61
1997	7,218	195	37	1,393	149	9	1,066	65	16	783	83	9	265	67
1998	9,102	172	53	881	125	7	813	72	11	545	90	6	255	62
1999	9,102	191	48	1,190	130	9	946	52	18	247	41	6	251	98
2000	6,053	157	38	869	161	5	990	61	16	517	65	8	259	104
2001	4,624	174	27	548	137	4	1,286	69	19	942	68	14	273	85
2002	4,841	165	29	550	142	4	1,004	78	13	758	90	8	249	83
2003	2,975	125	24	543	161	3	1,051	87	12	494	111	4	282	72
2004	2,589	107	24	435	127	3	1,932	97	20	312	92	3	274	76
2005	3,787	93	41	378	114	3	3,445	124	28	285	74	4	270	76
2006	2,795	75	37	175	107	2	2,757	119	23	251	66	4	252	83
2007	1,898	80	24	96	75	1	3,324	137	24	273	80	3	240	88
2008	1,133	62	18	54	70	1	1,037	126	8	233	67	4	217	71
2009*	Not available			Not available			1,280	135	9	293	72	4	191	74

	IR-SSC-7J Irish Scottish Seiners			IR-SSC-7G Irish Scottish Seiners			IR-TBB-7J Irish Beam Trawls			IR-TBB-7G Irish Beam Trawls		
Year	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]	Landings	Effort[4]	LPUE[3]
1995	1,008	5	192	1,123	6	175	0	0	1	63	21	3
1996	1,100	8	135	1,534	10	158	5	1	3	33	27	1
1997	806	11	75	2,654	16	165	3	2	2	44	28	2
1998	467	7	71	2,502	15	167	5	5	1	46	35	1
1999	77	1	55	1,378	8	172	8	7	1	47	41	1
2000	187	3	54	1,187	10	120	8	7	1	64	37	2
2001	236	4	53	1,005	16	62	6	3	2	79	40	2
2002	409	9	46	1,971	21	94	6	3	2	60	32	2
2003	371	9	41	1,560	21	75	13	9	1	55	49	1
2004	314	9	34	1,038	19	54	1	2	1	33	55	1
2005	253	6	41	1,004	15	68	1	2	1	24	50	0
2006	192	5	36	912	15	62	1	2	0	19	60	0
2007	205	4	58	825	16	52	0	2	0	25	56	0
2008	225	3	79	741	12	64	0	1	0	4	37	0
2009*	347	3	104	731	8	90	0	3	0	2	38	0

1 = LPUE calculated as landings in kg/h fishing, power corrected.
2 = Effort in hours fishing, power corrected
3 = LPUE calculated as landings in kg/h fishing.
4 = Effort in 000 hours fishing.
* Provisional

Table 7.15.10. Whiting in Divisions VIIe–k. XSA Diagnostics.

```
Lowestoft VPA Version 3.1
    6/05/2010  10:28

 Extended Survivors Analysis
"Whiting in the Celtic Sea (VIIe-k), WGCSE 2010, COMBSEX (Updated by SD 04/05/20

 CPUE data from file whg7ektutrimed.txt
 Catch data for  28 years. 1982 to 2009. Ages  0 to   7.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                 ,       year, year,  age ,  age
 "FR-GADOID-late: Fre,   1993, 2009,   3,     6,   .000,  1.000
 "FR-NEPHROPS-Late: F,   1993, 2009,   3,     6,   .000,  1.000
 "FR-EVHOE: Thalassa ,   1997, 2009,   0,     4,   .750,  1.000
 "UK-WCGFS: UK (E+W) ,   1987, 2009,   1,     6,   .150,   .250
 IR-GFS-7G-SweptArea:,   1999, 2009,   0,     6,   .750,   .920


 Time series weights :

      Tapered time weighting not applied


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    5


 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   3 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =   1.000

      Minimum standard error for population
      estimates derived from each fleet =    .500

      Prior weighting not applied


 Tuning converged after   28 iterations

 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities
    Age,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009

      0,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000,  .000
      1,  .037,  .007,  .038,  .016,  .039,  .026,  .053,  .026,  .024,  .004
      2,  .295,  .160,  .168,  .173,  .199,  .285,  .314,  .321,  .131,  .104
      3,  .782,  .686,  .444,  .372,  .481,  .755,  .688,  .922,  .676,  .303
      4,  .967, 1.272,  .974,  .511,  .597, 1.006,  .969, 1.560, 1.016,  .797
      5,  .972, 1.387, 1.050,  .889,  .549, 1.113, 1.377, 1.805, 1.034,  .717
      6,  .823, 1.012,  .669,  .828,  .729,  .726,  .993, 1.858, 1.201,  .738

XSA population numbers (Thousands)

                                  AGE
 YEAR ,       0,         1,         2,         3,         4,         5,         6,
 2000 ,    6.39E+04, 1.10E+05, 4.05E+04, 2.10E+04, 9.75E+03, 4.18E+03, 3.93E+03,
 2001 ,    3.88E+04, 5.23E+04, 8.69E+04, 2.47E+04, 7.88E+03, 3.04E+03, 1.29E+03,
 2002 ,    3.84E+04, 3.18E+04, 4.25E+04, 6.06E+04, 1.02E+04, 1.81E+03, 6.21E+02,
 2003 ,    4.27E+04, 3.14E+04, 2.50E+04, 2.94E+04, 3.19E+04, 3.14E+03, 5.18E+02,
 2004 ,    3.98E+04, 3.50E+04, 2.53E+04, 1.72E+04, 1.66E+04, 1.56E+04, 1.06E+03,
```

```
2005 ,    3.54E+04, 3.26E+04, 2.75E+04, 1.70E+04, 8.72E+03, 7.49E+03, 7.40E+03,
2006 ,    5.13E+04, 2.90E+04, 2.60E+04, 1.70E+04, 6.54E+03, 2.61E+03, 2.02E+03,
2007 ,    7.19E+04, 4.20E+04, 2.25E+04, 1.56E+04, 6.97E+03, 2.03E+03, 5.39E+02,
2008 ,    1.19E+05, 5.89E+04, 3.35E+04, 1.34E+04, 5.06E+03, 1.20E+03, 2.74E+02,
2009 ,    5.60E+04, 9.74E+04, 4.71E+04, 2.40E+04, 5.57E+03, 1.50E+03, 3.50E+02,

Estimated population abundance at 1st Jan 2010

   ,     0.00E+00, 4.59E+04, 7.94E+04, 3.47E+04, 1.45E+04, 2.05E+03, 5.99E+02,

Taper weighted geometric mean of the VPA populations:

   ,     6.98E+04, 5.63E+04, 4.24E+04, 2.35E+04, 8.69E+03, 2.46E+03, 5.85E+02,

Standard error of the weighted Log(VPA populations) :

   ,        .4998,    .5147,    .5141,    .6386,    .8797,   1.1387,   1.4433,

Log catchability residuals.


Fleet : "FR-GADOID-late: Fre

 Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
    0 , No data for this fleet at this age
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 , 99.99, 99.99, 99.99,   .24,   .09,  -.36, -1.02, -1.10,   .16,   .31
    4 , 99.99, 99.99, 99.99,  -.32,   .13,  -.21,  -.48,  -.67,  -.61,   .27
    5 , 99.99, 99.99, 99.99,  -.33,  -.03,   .10,  -.43,  -.63,  -.44,   .32
    6 , 99.99, 99.99, 99.99,  -.07,   .01,   .18,  -.40,  -.63,   .68,   .11


 Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
    0 , No data for this fleet at this age
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 ,   .51,   .19,  -.19,  -.66,  -.47,   .51,   .88,   .68,   .23, 99.99
    4 ,   .22,   .06,   .03,  -.36,  -.25,   .39,   .64,   .62,   .54, 99.99
    5 ,   .11,  -.10,  -.08,  -.24,  -.29,   .52,   .87,   .13,   .53, 99.99
    6 ,   .14,  -.25,  -.24,  -.40,  -.02,   .27,   .60,  -.22,   .46, 99.99


Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time


   Age ,         3,         4,         5,         6
Mean Log q,   -6.6427,   -6.1577,   -5.9894,   -5.9894,
S.E(Log q),     .5836,     .4297,     .4085,     .3712,


Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 3,    2.69,   -3.229,       .41,     .21,     16,    1.23,   -6.64,
 4,    1.82,   -4.883,      3.40,     .72,     16,     .49,   -6.16,
 5,    1.16,   -1.446,      5.59,     .85,     16,     .46,   -5.99,
 6,     .95,     .661,      6.04,     .93,     16,     .36,   -5.97,


Fleet : "FR-NEPHROPS-Late: F

 Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
    0 , No data for this fleet at this age
    1 , No data for this fleet at this age
```

```
    2 , No data for this fleet at this age
    3 , 99.99, 99.99, 99.99,   .70,   .32,   .19,  -.55,  -.42,  -.07,   .80
    4 , 99.99, 99.99, 99.99,   .23,   .03,   .02,  -.11,   .06,  -.17,   .67
    5 , 99.99, 99.99, 99.99,   .23,  -.47,  -.12,  -.01,   .31,   .09,   .52
    6 , 99.99, 99.99, 99.99,  -.22,  -.64,  -.34,   .06,   .29,  -.01,   .58


 Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
    0 , No data for this fleet at this age
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 ,   .57,   .38,  -.38,  -.54,  -.40,   .30,  -.12,  -.05,  -.72, 99.99
    4 ,   .50,   .47,   .05,  -.29,  -.26,  -.04,  -.41,  -.23,  -.51, 99.99
    5 ,   .28,   .25,   .46,   .05,  -.14,   .07,  -.22,  -.60,  -.71, 99.99
    6 ,   .18,   .00,   .37,   .03,   .18,  -.06,  -.58,  -.91,  -.79, 99.99

Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


   Age ,         3,         4,         5,         6
 Mean Log q,   -8.9431,   -8.3682,   -8.1678,   -8.1678,
 S.E(Log q),     .4791,     .3338,     .3614,     .4467,


 Regression statistics :


 Ages with q independent of year class strength and constant w.r.t. time.

 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

  3,    1.05,    -.214,      8.88,     .59,     16,     .52,   -8.94,
  4,    1.01,    -.068,      8.36,     .84,     16,     .35,   -8.37,
  5,     .89,    1.414,      8.20,     .92,     16,     .31,   -8.17,
  6,     .82,    2.923,      8.10,     .95,     16,     .29,   -8.29,


 Fleet : "FR-EVHOE: Thalassa

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
    0 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.50,  -.21,   .77
    1 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.42,  -.83,   .48
    2 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.61,  -.60,   .39
    3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.32, -1.48,   .29
    4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.08, -1.22,   .10
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age


  Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
    0 ,  -.63,  -.42,   .11,   .20,  -.23,   .33, -1.15,  1.02,  1.23,  -.52
    1 ,  -.07,  -.12,  -.43,   .90,  1.43,  -.43,  -.80,   .39,   .01,  -.09
    2 ,   .51,   .37,  -.40,  1.04,  1.19,  -.61,  -.94,  -.56,  -.27,   .47
    3 ,  -.08,   .73,  -.22,  1.18,  1.48,  -.30,  -.82, -1.08,   .42,   .19
    4 ,  -.07,   .02,  -.46,   .89,   .86,   .06, -1.03,  -.40,   .83,   .48
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age

Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


   Age ,         0,         1,         2,         3,         4
 Mean Log q,   -6.8422,   -6.9973,   -7.5428,   -7.9747,   -7.9445,
 S.E(Log q),     .6957,     .6544,     .6938,     .8516,     .6705,
```

```
Regression statistics :

 Ages with q independent of year class strength and constant w.r.t. time.

 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

  0,     .54,    2.018,      8.74,     .63,     13,     .33,   -6.84,
  1,    1.09,    -.181,      6.65,     .26,     13,     .75,   -7.00,
  2,     .85,     .316,      7.99,     .28,     13,     .61,   -7.54,
  3,    1.17,    -.249,      7.63,     .17,     13,    1.03,   -7.97,
  4,    1.05,    -.187,      7.87,     .54,     13,     .74,   -7.94,

 Fleet : "UK-WCGFS: UK (E+W)

  Age  ,  1987,  1988,  1989
     0 , No data for this fleet at this age
     1 , -1.22, -1.40,  -.18
     2 ,  1.34, -1.28,   .05
     3 ,   .56,  -.86,   .40
     4 ,   .06, -1.11,   .20
     5 ,  1.13,   .16,   .62
     6 ,  1.74, 99.99,  1.12



  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     0 , No data for this fleet at this age
     1 , -3.20, -1.56,  -.14,  1.29,  1.62,  -.52,  -.10,   .31,   .83,   .34
     2 , -1.28, -3.28,  -.21,  -.16,   .29,  1.41,   .69,   .26,   .65,   .31
     3 ,  -.21, -2.38,  -.12,   .04,   .55,   .98,   .58,  -.86,   .80,  -.24
     4 ,   .08, -1.37,   .64,  -.09,   .44,   .73,   .07,  -.02,   .51,  -.49
     5 ,   .73,  -.44,   .39,  -.31,   .67,   .53,  -.07,   .08,  -.75,  -.76
     6 ,   .62,   .24,   .12,   .60,   .14,   .88,  -.58,  -.09, -1.34,   .04



  Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
     0 , No data for this fleet at this age
     1 ,  2.49,  1.44, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
     2 ,   .81,   .39, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
     3 ,   .57,   .20, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
     4 ,   .56,  -.21, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
     5 ,   .30, -2.29, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
     6 ,   .41,  -.18, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99

 Mean log catchability and standard error of ages with catchability
 independent of year class strength and constant w.r.t. time


    Age ,         1,          2,          3,          4,          5,          6
 Mean Log q,  -11.3524,  -11.3959,  -11.5834,  -11.6821,  -11.4950,  -11.4950,
 S.E(Log q),    1.4620,    1.1905,     .8605,     .6083,     .8417,     .7964,


 Regression statistics :


 Ages with q independent of year class strength and constant w.r.t. time.

 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

  1,     .60,     .856,     11.29,     .26,     15,     .88,  -11.35,
  2,     .55,    1.313,     11.20,     .40,     15,     .64,  -11.40,
  3,     .59,    2.204,     11.07,     .69,     15,     .45,  -11.58,
  4,     .91,     .551,     11.48,     .75,     15,     .57,  -11.68,
  5,    1.38,   -1.657,     12.80,     .60,     15,    1.09,  -11.50,
```

```
 6,    1.44,   -2.745,     13.18,     .76,     14,     .88,  -11.23,

Fleet : IR-GFS-7G-SweptArea:

 Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
    0 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .33
    1 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .24
    2 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.08
    3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .11
    4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .46
    5 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .29
    6 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .09


 Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
    0 ,  -.31,  -.07,  -.70,   .10,   .64, -1.38,   .84,   .07,   .06,   .42
    1 ,   .26,  -.74,   .04,  -.47,  -.12,  -.14,   .61,   .54,  -.18,  -.03
    2 ,   .28,   .90,  -.47,  -.45,  -.89,  -.03,   .38,   .75,   .00,  -.40
    3 ,  -.89,  1.15,  -.34,  -.79,  -.41,   .10,   .56,   .41,   .39,  -.29
    4 , -1.33,   .98,  -.08, 99.99,  -.74,   .39,  -.26,   .36,  -.01,   .23
    5 ,   .01,   .27, -1.28,  -.77,  -.14,   .89, 99.99,  1.27, -1.29,   .75
    6 , -1.27,  1.01,   .57, 99.99, -2.11,  1.03,   .80,   .89, 99.99, 99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time


   Age ,         0,        1,        2,        3,        4,        5,        6
Mean Log q,  -4.1830,  -4.3005,  -4.7342,  -5.3037,  -5.6291,  -6.3805,  -6.3805,
S.E(Log q),    .6261,    .4043,    .5453,    .6132,    .6586,    .8842,   1.1898,


Regression statistics :


Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 0,     .70,    1.015,      6.24,     .55,     11,     .43,   -4.18,
 1,     .99,     .026,      4.35,     .57,     11,     .42,   -4.30,
 2,     .70,     .948,      6.42,     .53,     11,     .39,   -4.73,
 3,    1.92,   -1.027,       .99,     .12,     11,    1.17,   -5.30,
 4,    1.83,    -.777,      2.80,     .10,     10,    1.23,   -5.63,
 5,     .80,     .734,      6.74,     .64,     10,     .73,   -6.38,
 6,    1.03,    -.076,      6.21,     .46,      8,    1.32,   -6.25,


Terminal year survivor and F summaries :

Age  0   Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
"FR-GADOID-late: Fre,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-NEPHROPS-Late: F,         1.,   .000,       .000,    .00,   0,  .000,     .000
"FR-EVHOE: Thalassa ,     27337.,   .722,       .000,    .00,   1,  .451,     .000
"UK-WCGFS: UK (E+W) ,         1.,   .000,       .000,    .00,   0,  .000,     .000
IR-GFS-7G-SweptArea:,     70109.,   .654,       .000,    .00,   1,  .549,     .000

  F shrinkage mean  ,         0.,   1.00,,,,                        .000,     .000

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    45857.,       .48,      .47,    2,    .967,   .000
```

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"FR-GADOID-late: Fre,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-NEPHROPS-Late: F,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-EVHOE: Thalassa ,	134933.,	.495,	.659,	1.33,	2,	.358,	.002
"UK-WCGFS: UK (E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
IR-GFS-7G-SweptArea:,	79789.,	.397,	.044,	.11,	2,	.555,	.004
F shrinkage mean ,	8942.,	1.00,,,,				.088,	.034

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
79443.,	.30,	.42,	5,	1.434,	.004

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"FR-GADOID-late: Fre,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-NEPHROPS-Late: F,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-EVHOE: Thalassa ,	55965.,	.408,	.293,	.72,	3,	.363,	.066
"UK-WCGFS: UK (E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
IR-GFS-7G-SweptArea:,	28732.,	.326,	.125,	.38,	3,	.569,	.124
F shrinkage mean ,	13285.,	1.00,,,,				.068,	.251

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
34731.,	.25,	.20,	7,	.829,	.104

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"FR-GADOID-late: Fre,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-NEPHROPS-Late: F,	1.,	.000,	.000,	.00,	0,	.000,	.000
"FR-EVHOE: Thalassa ,	11760.,	.371,	.345,	.93,	4,	.352,	.363
"UK-WCGFS: UK (E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
IR-GFS-7G-SweptArea:,	18980.,	.291,	.241,	.83,	4,	.575,	.240
F shrinkage mean ,	4969.,	1.00,,,,				.074,	.711

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
14530.,	.22,	.22,	9,	.964,	.303

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"FR-GADOID-late: Fre,	2592.,	.602,	.000,	.00,	1,	.082,	.676
"FR-NEPHROPS-Late: F,	997.,	.500,	.000,	.00,	1,	.118,	1.256
"FR-EVHOE: Thalassa ,	2271.,	.366,	.262,	.71,	5,	.282,	.743
"UK-WCGFS: UK (E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
IR-GFS-7G-SweptArea:,	2593.,	.296,	.316,	1.07,	5,	.389,	.676
F shrinkage mean ,	1366.,	1.00,,,,				.129,	1.041

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2054.,	.22,	.17,	13,	.790,	.797

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"FR-GADOID-late: Fre,	1061.,	.413,	.056,	.13,	2,	.172,	.465
"FR-NEPHROPS-Late: F,	410.,	.385,	.207,	.54,	2,	.189,	.930
"FR-EVHOE: Thalassa ,	635.,	.387,	.393,	1.02,	5,	.145,	.688
"UK-WCGFS: UK (E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
IR-GFS-7G-SweptArea:,	873.,	.388,	.158,	.41,	6,	.303,	.543
F shrinkage mean ,	275.,	1.00,,,,				.191,	1.190

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
599.,	.25,	.17,	16,	.656,	.717

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2003

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
"FR-GADOID-late: Fre,	241.,	.400,	.059,	.15,	3,	.258,	.482
"FR-NEPHROPS-Late: F,	76.,	.390,	.157,	.40,	3,	.264,	1.086
"FR-EVHOE: Thalassa ,	123.,	.364,	.364,	1.00,	5,	.052,	.795
"UK-WCGFS: UK (E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
IR-GFS-7G-SweptArea:,	85.,	.447,	.341,	.76,	6,	.130,	1.011
F shrinkage mean ,	177.,	1.00,,,,				.295,	.611

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
137.,	.34,	.14,	18,	.430,	.738

Table 7.15.11. Whiting in Divisions VIIe–k. Fishing mortality (F)-at-age. F_{bar} range is 2–5.

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0	0	0	0	0	0	0	0	0	0
1	0.106	0.137	0.080	0.097	0.074	0.063	0.030	0.025	0.084	0.110
2	0.623	0.731	0.839	0.803	0.713	0.656	0.436	0.322	0.640	0.496
3	1.048	1.441	0.965	1.169	0.984	1.347	1.099	0.927	0.754	1.080
4	1.237	1.506	1.557	0.874	1.230	1.520	1.482	1.353	1.095	1.759
5	1.386	1.985	1.519	1.302	1.151	1.775	1.284	1.266	1.420	1.417
6	1.239	1.667	1.364	1.128	1.135	0.766	1.252	0.676	0.842	1.315
+gp	1.239	1.667	1.364	1.128	1.135	0.766	1.252	0.676	0.842	1.315
FBAR	1.073	1.416	1.220	1.037	1.020	1.325	1.075	0.967	0.977	1.188

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0	0	0	0	0	0	0	0	0	0
1	0.042	0.022	0.009	0.007	0.029	0.014	0.029	0.089	0.037	0.007
2	0.428	0.267	0.178	0.139	0.123	0.127	0.212	0.364	0.295	0.160
3	0.919	0.846	0.556	0.460	0.241	0.289	0.523	0.768	0.782	0.686
4	0.927	0.835	0.816	0.704	0.543	0.507	0.587	1.037	0.967	1.272
5	1.015	1.175	0.853	0.823	0.663	0.697	0.701	1.103	0.972	1.387
6	0.954	1.032	1.211	0.694	0.774	0.875	0.658	0.933	0.823	1.012
+gp	0.954	1.032	1.211	0.694	0.774	0.875	0.658	0.933	0.823	1.012
FBAR	0.822	0.781	0.601	0.531	0.393	0.405	0.506	0.818	0.754	0.876

AGE	2002	2003	2004	2005	2006	2007	2008	2009
0	0	0	0	0	0	0	0	0
1	0.038	0.016	0.039	0.026	0.053	0.026	0.024	0.004
2	0.168	0.173	0.199	0.285	0.314	0.321	0.131	0.104
3	0.444	0.372	0.482	0.755	0.688	0.922	0.676	0.303
4	0.974	0.511	0.597	1.006	0.969	1.560	1.016	0.797
5	1.050	0.889	0.549	1.113	1.377	1.805	1.034	0.718
6	0.669	0.828	0.729	0.726	0.993	1.858	1.201	0.738
+gp	0.669	0.828	0.729	0.726	0.993	1.858	1.201	0.738
FBAR	0.659	0.486	0.457	0.790	0.837	1.152	0.714	0.481

Table 7.15.12. Whiting in Divisions VIIe–k. Stock number-at-age (‘000).

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	62046	50256	53997	71465	133033	105422	33073	55008	108378	163345
1	28885	50799	41147	44209	58511	108918	86313	27078	45037	88732
2	29860	21275	36282	31106	32849	44494	83766	68572	21625	33914
3	16784	13116	8387	12835	11408	13180	18897	44351	40708	9336
4	7108	4818	2542	2617	3265	3490	2806	5156	14375	15677
5	1297	1690	875	439	894	781	625	522	1092	3939
6	64	266	190	157	98	231	108	142	120	216
+gp	35	13	41	53	72	122	32	56	40	4
TOTAL	146080	142234	143460	162880	240129	276639	225619	200883	231374	315163

AGE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	145794	193497	107334	63214	58597	56795	65996	134508	63904	38799
1	133735	119366	158422	87877	51755	47975	46500	54033	110126	52320
2	65102	105002	95644	128554	71459	41156	38728	37001	40472	86928
3	16911	34740	65811	65539	91622	51744	29669	25663	21044	24669
4	2596	5523	12211	30913	33885	58923	31747	14394	9752	7884
5	2210	841	1962	4419	12513	16115	29052	14448	4178	3036
6	782	656	213	684	1590	5281	6569	11805	3927	1294
+gp	69	290	273	200	230	1343	1997	2128	3581	469
TOTAL	367200	459915	441869	381402	321652	279333	250257	293981	256984	215400

AGE	2002	2003	2004	2005	2006	2007	2008	2009	2010
0	38396	42692	39835	35443	51252	71912	118975	56010	0
1	31766	31436	34953	32614	29018	41962	58877	97409	45857
2	42532	25042	25320	27523	26007	22522	33461	47056	79443
3	60631	29428	17247	16983	16952	15554	13374	24039	34731
4	10175	31854	16616	8725	6538	6974	5063	5568	14530
5	1809	3144	15647	7492	2612	2031	1201	1500	2054
6	621	518	1059	7401	2016	539	274	350	599
+gp	141	39	145	311	1002	287	48	75	166
TOTAL	186071	164152	150820	136492	135397	161781	231272	232006	177380

Table 7.15.13. Whiting in Divisions VIIe–k. Summary table.

	Recruits age 0	TotBIO	TotSSB	Landings	Yield/ssb	Fbar 2-5
1982	62,046	22,640	18,977	11,225	0.592	1.073
1983	50,256	22,836	16,999	11,781	0.693	1.416
1984	53,997	23,375	17,494	9,985	0.571	1.220
1985	71,465	23,311	17,574	10,838	0.617	1.037
1986	133,033	26,075	18,632	9,952	0.534	1.020
1987	105,422	37,602	25,036	12,652	0.505	1.325
1988	33,073	45,760	33,777	15,128	0.448	1.075
1989	55,008	39,510	34,776	16,541	0.476	0.967
1990	108,378	32,771	27,483	14,106	0.513	0.977
1991	163,345	33,332	24,227	13,508	0.558	1.188
1992	145,794	48,259	32,343	12,364	0.382	0.822
1993	193,497	61,820	46,978	16,320	0.347	0.781
1994	107,334	82,314	62,670	20,034	0.320	0.601
1995	63,214	85,140	75,531	22,678	0.300	0.531
1996	58,597	79,351	72,806	18,260	0.251	0.393
1997	56,795	67,793	63,157	20,532	0.325	0.405
1998	65,996	55,650	50,289	19,245	0.383	0.506
1999	134,508	44,470	39,690	19,915	0.502	0.818
2000	63,904	46,002	35,044	14,865	0.424	0.754
2001	38,799	49,070	40,721	12,770	0.314	0.876
2002	38,396	45,376	40,296	13,146	0.326	0.659
2003	42,692	37,963	33,521	10,583	0.316	0.486
2004	39,835	34,784	30,444	9,953	0.327	0.457
2005	35,443	31,103	27,043	12,030	0.445	0.790
2006	51,252	26,530	22,549	9,533	0.423	0.837
2007	71,912	27,395	21,389	8,947	0.418	1.152
2008	118,975	32,553	23,295	5,737	0.246	0.714
2009	56,010	48,379	33,792	5,708	0.169	0.481
GeoMean (82-09)	69850					
2008 Recruit -25%	89231	2009 age 1	45857			
Reduced GeoMean	69136					

Table 7.15.14. Whiting in Divisions VIIe–k. Prediction input data.

MFDP version 1a	In puts: F Mean 07-09
Run: SFwhg7ekRed2008	Catch and stock weights are mean 07-09
Time and date: 14:51 07/05/2010	Recruits age 0 in 10, 11 and 12 GM mean 82-09 (2008 reduced by 25%)
Fbar age range: 2-5	

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	69136	0.2	0.00	0	0	0.000	0.000	0.039
1	45857	0.2	0.39	0	0	0.217	0.018	0.229
2	59582	0.2	0.90	0	0	0.290	0.185	0.301
3	34731	0.2	0.99	0	0	0.393	0.634	0.391
4	14530	0.2	0.99	0	0	0.547	1.124	0.503
5	2054	0.2	1.00	0	0	0.652	1.185	0.604
6	599	0.2	1.00	0	0	0.721	1.265	0.662
7	166	0.2	1.00	0	0	0.951	1.265	0.900

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	69136	0.2	0.00	0	0	0.000	0.000	0.039
1	.	0.2	0.39	0	0	0.217	0.018	0.229
2	.	0.2	0.90	0	0	0.290	0.185	0.301
3	.	0.2	0.99	0	0	0.393	0.634	0.391
4	.	0.2	0.99	0	0	0.547	1.124	0.503
5	.	0.2	1.00	0	0	0.652	1.185	0.604
6	.	0.2	1.00	0	0	0.721	1.265	0.662
7	.	0.2	1.00	0	0	0.951	1.265	0.900

2012

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	69136	0.2	0.00	0	0	0.000	0.000	0.039
1	.	0.2	0.39	0	0	0.217	0.018	0.229
2	.	0.2	0.90	0	0	0.290	0.185	0.301
3	.	0.2	0.99	0	0	0.393	0.634	0.391
4	.	0.2	0.99	0	0	0.547	1.124	0.503
5	.	0.2	1.00	0	0	0.652	1.185	0.604
6	.	0.2	1.00	0	0	0.721	1.265	0.662
7	.	0.2	1.00	0	0	0.951	1.265	0.900

Input units are thousands and kg - output in tonnes

Table 7.15.15. Whiting in Divisions VIIe–k. Management options table.

MFDP version 1a
Run: SFwhg7ekRed2008 (2008 yearclass strenght reduced by 25%)
Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 04/05/2010)
Time and date: 14:51 07/05/2010
Fbar age range: 2-5

2010				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
50743	42731	1.0000	0.7822	14472

2011					2012	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
50211	41408	0.0000	0.0000	0	66594	57459
.	41408	0.1000	0.0782	2112	64062	54943
.	41408	0.2000	0.1564	4060	61730	52626
.	41408	0.3000	0.2347	5861	59579	50489
.	41408	0.4000	0.3129	7527	57594	48517
.	41408	0.5000	0.3911	9069	55759	46696
.	41408	0.6000	0.4693	10500	54062	45011
.	41408	0.7000	0.5476	11827	52489	43451
.	41408	0.8000	0.6258	13062	51031	42004
.	41408	0.9000	0.7040	14210	49678	40662
.	41408	1.0000	0.7822	15281	48420	39415
.	41408	1.1000	0.8605	16279	47250	38254
.	41408	1.2000	0.9387	17212	46160	37174
.	41408	1.3000	1.0169	18084	45143	36166
.	41408	1.4000	1.0951	18901	44194	35226
.	41408	1.5000	1.1734	19666	43306	34347
.	41408	1.6000	1.2516	20385	42476	33525
.	41408	1.7000	1.3298	21060	41698	32755
.	41408	1.8000	1.4080	21696	40968	32033
.	41408	1.9000	1.4863	22295	40282	31355
.	41408	2.0000	1.5645	22860	39638	30717

Input units are thousands and kg - output in tonnes

Table 7.15.16. Whiting in Divisions VIIe–k. Detailed results.

MFDP version 1a
Run: SFwhg7ekRed2008 (2008 yearclass strenght reduced by 25%)
Time and date: 14:51 07/05/2010
Fbar age range: 2-5

Year:	2010	F multiplier	1	Fbar:	0.7822				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
0	0	0	0	69136	0	0	0	0	0
1	0.0181	747	171	45857	9951	17884	3881	17884	3881
2	0.1852	9158	2757	59582	17259	53624	15533	53624	15533
3	0.634	14936	5835	34731	13661	34384	13524	34384	13524
4	1.1243	9055	4551	14530	7943	14385	7864	14385	7864
5	1.1854	1318	796	2054	1339	2054	1339	2054	1339
6	1.2655	398	263	599	432	599	432	599	432
7	1.2655	110	99	166	158	166	158	166	158
Total		35721	14472	226655	50743	123095	42731	123095	42731

Year:	2011	F multiplier	1	Fbar:	0.7822				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
0	0	0	0	69136	0	0	0	0	0
1	0.0181	922	211	56604	12283	22075	4790	22075	4790
2	0.1852	5667	1706	36870	10680	33183	9612	33183	9612
3	0.634	17432	6810	40535	15944	40129	15784	40129	15784
4	1.1243	9400	4725	15083	8246	14933	8163	14933	8163
5	1.1854	2479	1498	3865	2520	3865	2520	3865	2520
6	1.2655	341	226	514	371	514	371	514	371
7	1.2655	117	106	177	168	177	168	177	168
Total		36359	15281	222783	50211	114875	41408	114875	41408

Year:	2012	F multiplier	1	Fbar:	0.7822				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
0	0	0	0	69136	0	0	0	0	0
1	0.0181	922	211	56604	12283	22075	4790	22075	4790
2	0.1852	6995	2106	45510	13183	40959	11865	40959	11865
3	0.634	10787	4214	25083	9866	24832	9767	24832	9767
4	1.1243	10970	5514	17604	9623	17428	9527	17428	9527
5	1.1854	2574	1555	4012	2616	4012	2616	4012	2616
6	1.2655	642	425	967	698	967	698	967	698
7	1.2655	106	95	160	152	160	152	160	152
Total		32996	14120	219076	48420	110433	39415	110433	39415

Input units are thousands and kg - output in tonnes

Table 7.15.17. Whiting in Divisions VIIe–k. Stock numbers of recruits and the source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Year-class			2007	2008	2009	2010	2011
Stock No. (thousands) of	0	year-olds	71912	89231	56010	69136	69136
Source			XSA	XSA-25%	XSA	GM82-09	GM82-09
Status Quo F:							
% in	2010	landings	40.3	19.1	1.2	0.0	-
% in	2011		30.9	44.6	11.2	1.4	0.0
% in	2010	SSB	31.6	36.4	9.1	0.0	-
% in	2011	SSB	19.7	38.1	23.2	11.6	0.0
% in	2012	SSB	6.6	24.2	24.8	30.1	12.2

GM : geometric mean recruitment

Whiting VIIe-k : Year-class % contribution to

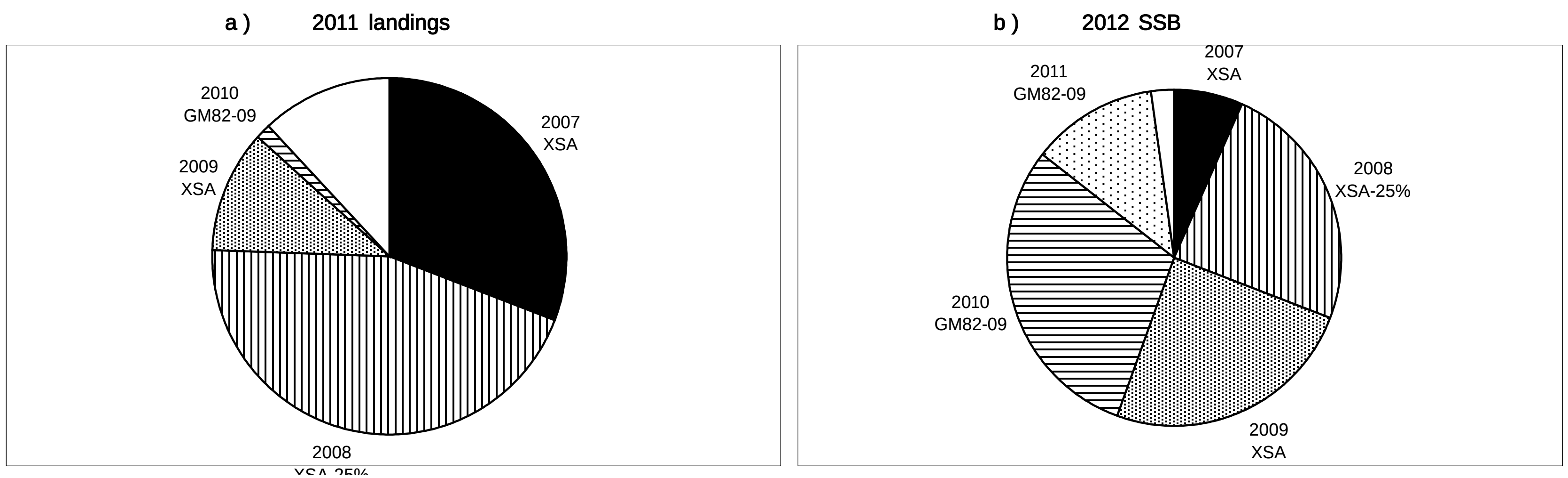


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Table 7.15.18. Whiting VIIe--k (Celtic Sea) input ".sen" data file for maximum sustainable yield analysis.

```
  0,  7, 2010,  3
  1, 0, 0
 'N0'  ,     69136, 0.50
 'N1'  ,     45857, 0.48
 'N2'  ,     59582, 0.42
 'N3'  ,     34731, 0.25
 'N4'  ,     14529, 0.22
 'N5'  ,      2054, 0.22
 'N6'  ,       599, 0.25
 'N7'  ,       166, 0.34
 'sH0' ,     0.000, 0.00
 'sH1' ,     0.018, 0.59
 'sH2' ,     0.185, 0.28
 'sH3' ,     0.634, 0.18
 'sH4' ,     1.124, 0.14
 'sH5' ,     1.185, 0.12
 'sH6' ,     1.265, 0.22
 'sH7' ,     1.265, 0.22
 'WH0' ,     0.062, 0.07
 'WH1' ,     0.226, 0.07
 'WH2' ,     0.300, 0.05
 'WH3' ,     0.386, 0.05
 'WH4' ,     0.495, 0.08
 'WH5' ,     0.585, 0.10
 'WH6' ,     0.653, 0.20
 'WH7' ,     0.866, 0.25
 'WS0' ,     0.000, 0.00
 'WS1' ,     0.192, 0.12
 'WS2' ,     0.269, 0.08
 'WS3' ,     0.368, 0.08
 'WS4' ,     0.506, 0.10
 'WS5' ,     0.605, 0.09
 'WS6' ,     0.692, 0.09
 'WS7' ,     0.905, 0.09
 'M0'  ,      0.20, 0.10
 'M1'  ,      0.20, 0.10
 'M2'  ,      0.20, 0.10
 'M3'  ,      0.20, 0.10
 'M4'  ,      0.20, 0.10
 'M5'  ,      0.20, 0.10
 'M6'  ,      0.20, 0.10
 'M7'  ,      0.20, 0.10
 'MT0' ,      0.00, 0.0
 'MT1' ,      0.39, 0.10
 'MT2' ,      0.90, 0.10
 'MT3' ,      0.99, 0.0
 'MT4' ,      0.99, 0.0
 'MT5' ,      1.00, 0.0
 'MT6' ,      1.00, 0.0
 'MT7' ,      1.00, 0.0
 'R11' ,     69136, 0.50
 'R12' ,     69136, 0.50
 'HF10',         1, 0.44
 'HF11',         1, 0.44
 'HF12',         1, 0.44
 'K10' ,         1, 0.10
 'K11' ,         1, 0.10
 'K12' ,         1, 0.10
Whiting
VIIe-k
 1
  0  7  1
 1
H.cons.
  2  5
 1982      2009
 Stock numbers in 2010 are VPA survivors.
 These are overwritten at   Age  0  Age  2
-1
```

Table 7.15.19. Whiting VIIe–k (Celtic Sea) input ".sum" data file for maximum sustainable yield analysis.

```
Stock summary, Whiting ,VIIe-k           , 9:45, 17/ 5/2010
          12
   1   0   0
 Year
    1982    2009
 Recruits, age 0, (millions)
       0 1000000
 SSB, ('000 t)
    1000
 TSB, ('000 t)
    1000
 Catch, Total  ('000 t)
    1000
 Catch, H.cons ('000 t)
    1000
 Not used
    1000
 Not used
    1000
 Mean F, Total
       2       5
 Mean F, H.cons.
       2       5
 Not used
       0       0
 Not used
       0       0
```

1982	62	19.0	22.6	11.2	11.2	0.0	0.0	1.073	1.073	0.000	0.000
1983	50	17.0	22.8	11.8	11.8	0.0	0.0	1.416	1.416	0.000	0.000
1984	54	17.5	23.4	10.0	10.0	0.0	0.0	1.220	1.220	0.000	0.000
1985	71	17.6	23.3	10.8	10.8	0.0	0.0	1.037	1.037	0.000	0.000
1986	133	18.6	26.1	10.0	10.0	0.0	0.0	1.020	1.020	0.000	0.000
1987	105	25.0	37.6	12.7	12.7	0.0	0.0	1.325	1.325	0.000	0.000
1988	33	33.8	45.8	15.1	15.1	0.0	0.0	1.075	1.075	0.000	0.000
1989	55	34.8	39.5	16.5	16.5	0.0	0.0	0.967	0.967	0.000	0.000
1990	108	27.5	32.8	14.1	14.1	0.0	0.0	0.977	0.977	0.000	0.000
1991	163	24.2	33.3	13.5	13.5	0.0	0.0	1.188	1.188	0.000	0.000
1992	146	32.3	48.2	12.4	12.4	0.0	0.0	0.822	0.822	0.000	0.000
1993	193	47.1	61.9	16.3	16.3	0.0	0.0	0.781	0.781	0.000	0.000
1994	107	62.6	82.2	20.0	20.0	0.0	0.0	0.601	0.601	0.000	0.000
1995	63	74.6	84.1	22.7	22.7	0.0	0.0	0.531	0.531	0.000	0.000
1996	59	72.7	79.3	18.3	18.3	0.0	0.0	0.393	0.393	0.000	0.000
1997	57	62.9	67.6	20.5	20.5	0.0	0.0	0.405	0.405	0.000	0.000
1998	66	50.0	55.3	19.2	19.2	0.0	0.0	0.506	0.506	0.000	0.000
1999	135	39.4	44.1	19.9	19.9	0.0	0.0	0.818	0.818	0.000	0.000
2000	64	34.6	45.4	14.9	14.9	0.0	0.0	0.754	0.754	0.000	0.000
2001	39	39.9	48.1	12.8	12.8	0.0	0.0	0.876	0.876	0.000	0.000
2002	38	40.2	45.2	13.1	13.1	0.0	0.0	0.659	0.659	0.000	0.000
2003	43	33.5	37.9	10.6	10.6	0.0	0.0	0.486	0.486	0.000	0.000
2004	40	30.4	34.7	10.0	10.0	0.0	0.0	0.457	0.457	0.000	0.000
2005	35	27.0	31.0	12.0	12.0	0.0	0.0	0.789	0.789	0.000	0.000
2006	51	22.4	26.4	9.5	9.5	0.0	0.0	0.837	0.837	0.000	0.000
2007	72	21.2	27.2	8.9	8.9	0.0	0.0	1.152	1.152	0.000	0.000
2008	119	23.2	32.5	5.7	5.7	0.0	0.0	0.714	0.714	0.000	0.000
2009	56	33.7	48.2	5.7	5.7	0.0	0.0	0.480	0.480	0.000	0.000

Table 7.15.20. Whiting VIIe–k (Celtic Sea) output table from maximum sustainable yield analysis.

Ricker

329/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	5.00	0.90	38.10	14.99	1.49	0.50	5.55	0.03	48.02
Mean	2.37	0.55	41.54	15.53	1.49	0.50	5.63	0.03	
5%ile	0.89	0.29	27.95	10.92	1.16	0.27	3.50	0.01	
25%ile	1.52	0.41	33.03	13.24	1.34	0.41	4.62	0.02	
50%ile	2.13	0.52	38.66	15.23	1.47	0.51	5.44	0.03	
75%ile	3.18	0.66	45.02	17.07	1.61	0.58	6.42	0.03	
95%ile	4.46	0.94	66.33	21.79	1.85	0.70	8.36	0.04	
CV	0.47	0.37	0.34	0.22	0.15	0.26	0.26	0.26	

Beverton-Holt

0/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	5.00	0.81	36.53	13.79	0.61	0.61	70.71	0.00	46.65
Mean									
5%ile									
25%ile									
50%ile									
75%ile									
95%ile									
CV									

Smooth hockeystick

559/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	4.84	0.81	36.31	13.71	0.84	0.53	1.89	18.60	46.32
Mean	1.93	0.65	46.38	14.68	0.77	0.61	1.74	21.29	
5%ile	0.66	0.20	21.48	10.29	0.60	0.50	1.36	17.54	
25%ile	1.04	0.36	29.25	12.80	0.69	0.54	1.56	18.83	
50%ile	1.61	0.53	38.82	14.31	0.77	0.59	1.73	20.75	
75%ile	2.56	0.80	51.69	16.53	0.84	0.65	1.90	22.95	
95%ile	4.25	1.58	84.06	19.70	0.97	0.77	2.19	27.18	
CV	0.58	0.67	0.95	0.20	0.14	0.16	0.14	0.16	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.31	0.24	0.17	0.81	0.52	0.19	0.00	0.00
Mean	0.26	0.20	0.16	0.70	0.64	0.20		
5%ile	0.07	0.05	0.06	0.20	0.30	0.15		
25%ile	0.17	0.14	0.12	0.37	0.42	0.18		
50%ile	0.24	0.19	0.16	0.54	0.54	0.20		
75%ile	0.34	0.26	0.20	0.83	0.69	0.22		
95%ile	0.51	0.39	0.26	1.88	1.17	0.26		
CV	0.54	0.51	0.39	0.74	0.98	0.16		

Table 7.15.21. Whiting in Divisions VIIe–k. Yield-per-recruit summary table.

MFYPR version 2a
Run: YPRwhg7ekRed2008 (2008 yearclass strenght reduced by 25%)
Time and date: 14:52 07/05/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	2.5837	3.9402	2.4513	3.9402	2.4513
0.1000	0.0782	0.1983	0.1250	4.5304	1.7059	2.9546	1.5738	2.9546	1.5738
0.2000	0.1564	0.2887	0.1662	4.0826	1.3302	2.5074	1.1983	2.5074	1.1983
0.3000	0.2347	0.3417	0.1831	3.8218	1.1244	2.2471	0.9928	2.2471	0.9928
0.4000	0.3129	0.3772	0.1907	3.6483	0.9955	2.0741	0.8641	2.0741	0.8641
0.5000	0.3911	0.4029	0.1944	3.5228	0.9073	1.9490	0.7762	1.9490	0.7762
0.6000	0.4693	0.4228	0.1963	3.4267	0.8432	1.8534	0.7122	1.8534	0.7122
0.7000	0.5476	0.4387	0.1972	3.3500	0.7942	1.7772	0.6634	1.7772	0.6634
0.8000	0.6258	0.4519	0.1976	3.2869	0.7554	1.7145	0.6248	1.7145	0.6248
0.9000	0.7040	0.4630	0.1977	3.2337	0.7239	1.6616	0.5935	1.6616	0.5935
1.0000	0.7822	0.4727	0.1977	3.1879	0.6976	1.6162	0.5673	1.6162	0.5673
1.1000	0.8605	0.4811	0.1976	3.1479	0.6752	1.5766	0.5451	1.5766	0.5451
1.2000	0.9387	0.4886	0.1974	3.1125	0.6559	1.5415	0.5259	1.5415	0.5259
1.3000	1.0169	0.4954	0.1972	3.0808	0.6390	1.5101	0.5092	1.5101	0.5092
1.4000	1.0951	0.5015	0.1970	3.0521	0.6240	1.4818	0.4943	1.4818	0.4943
1.5000	1.1734	0.5070	0.1967	3.0260	0.6106	1.4560	0.4811	1.4560	0.4811
1.6000	1.2516	0.5121	0.1965	3.0021	0.5986	1.4324	0.4691	1.4324	0.4691
1.7000	1.3298	0.5169	0.1962	2.9800	0.5876	1.4106	0.4583	1.4106	0.4583
1.8000	1.4080	0.5213	0.1960	2.9596	0.5776	1.3905	0.4484	1.3905	0.4484
1.9000	1.4863	0.5254	0.1957	2.9405	0.5684	1.3717	0.4393	1.3717	0.4393
2.0000	1.5645	0.5292	0.1955	2.9227	0.5599	1.3541	0.4309	1.3541	0.4309

Reference point	F multiplier	Absolute F
Fbar(2-5)	1.0000	0.7822
FMax	0.9342	0.7308
F0.1	0.2111	0.1651
F35%SPR	0.406	0.3176

Weights in kilograms

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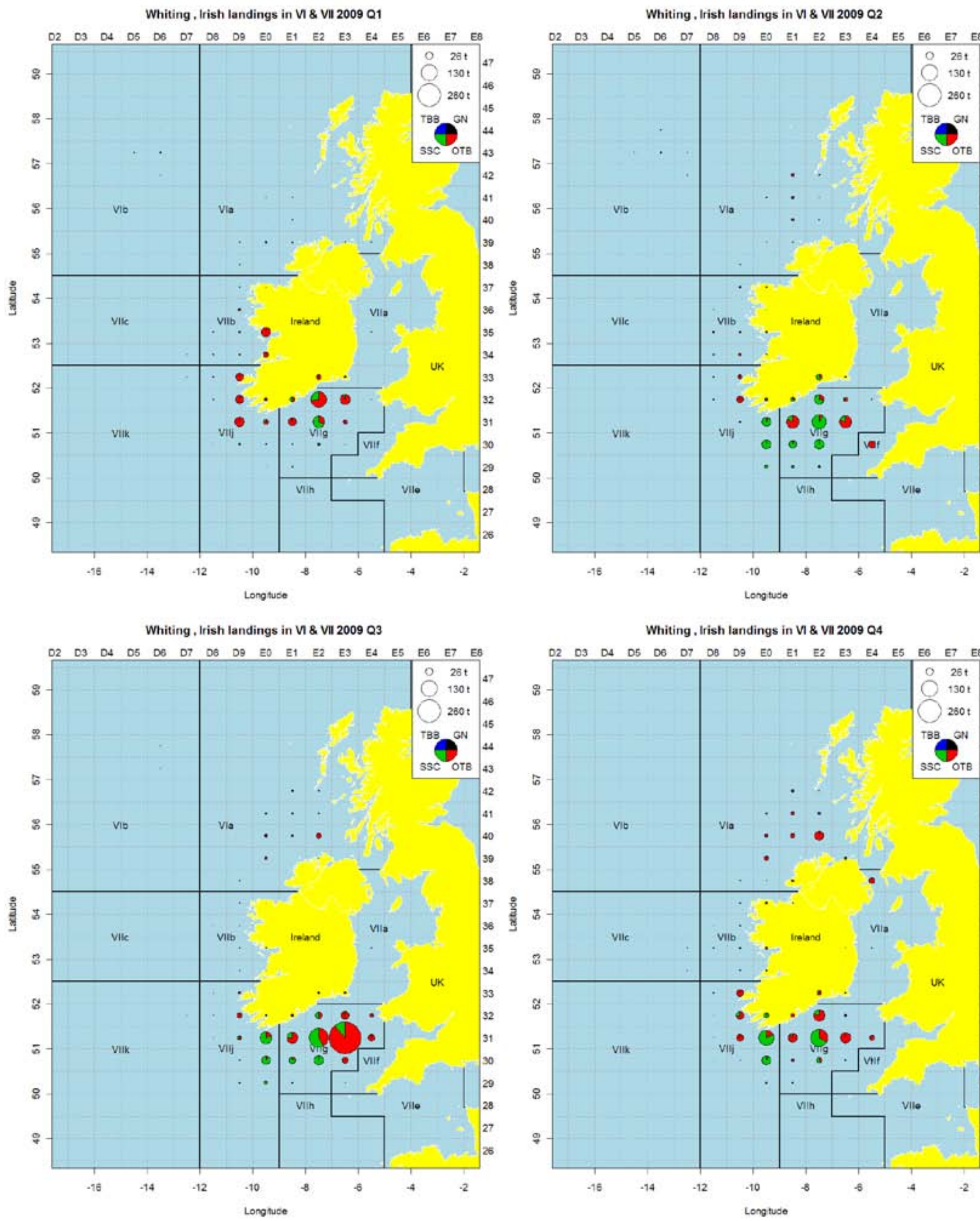
Irish landings for the main gear types by quarter in 2009:



UK (E&W) whiting landings for all gears 2009:

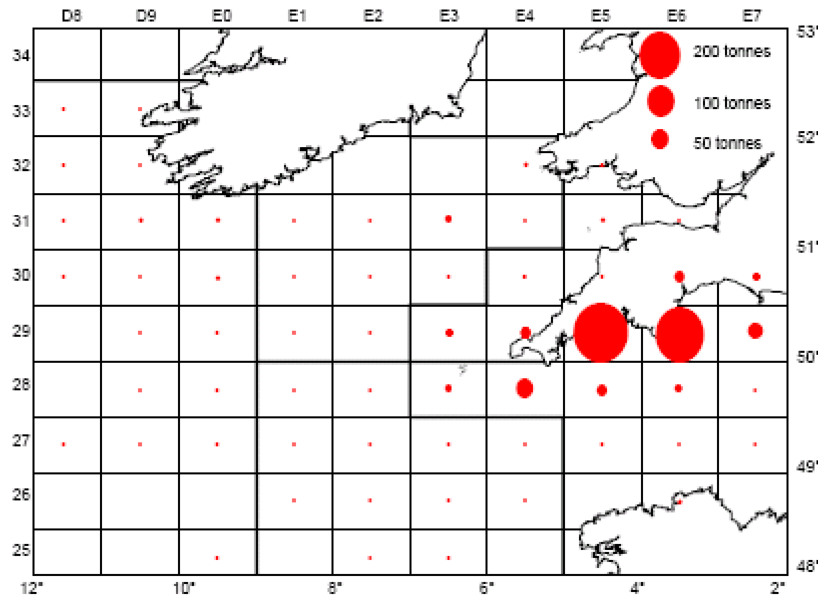


Figure 7.15.1. Whiting in VIIe–k (Celtic Sea). The spatial and temporal distribution of landings data in 2009 available to the WG. French landings distributions for otter trawlers and twin rigged otter trawlers was not available to the WG in 2010.

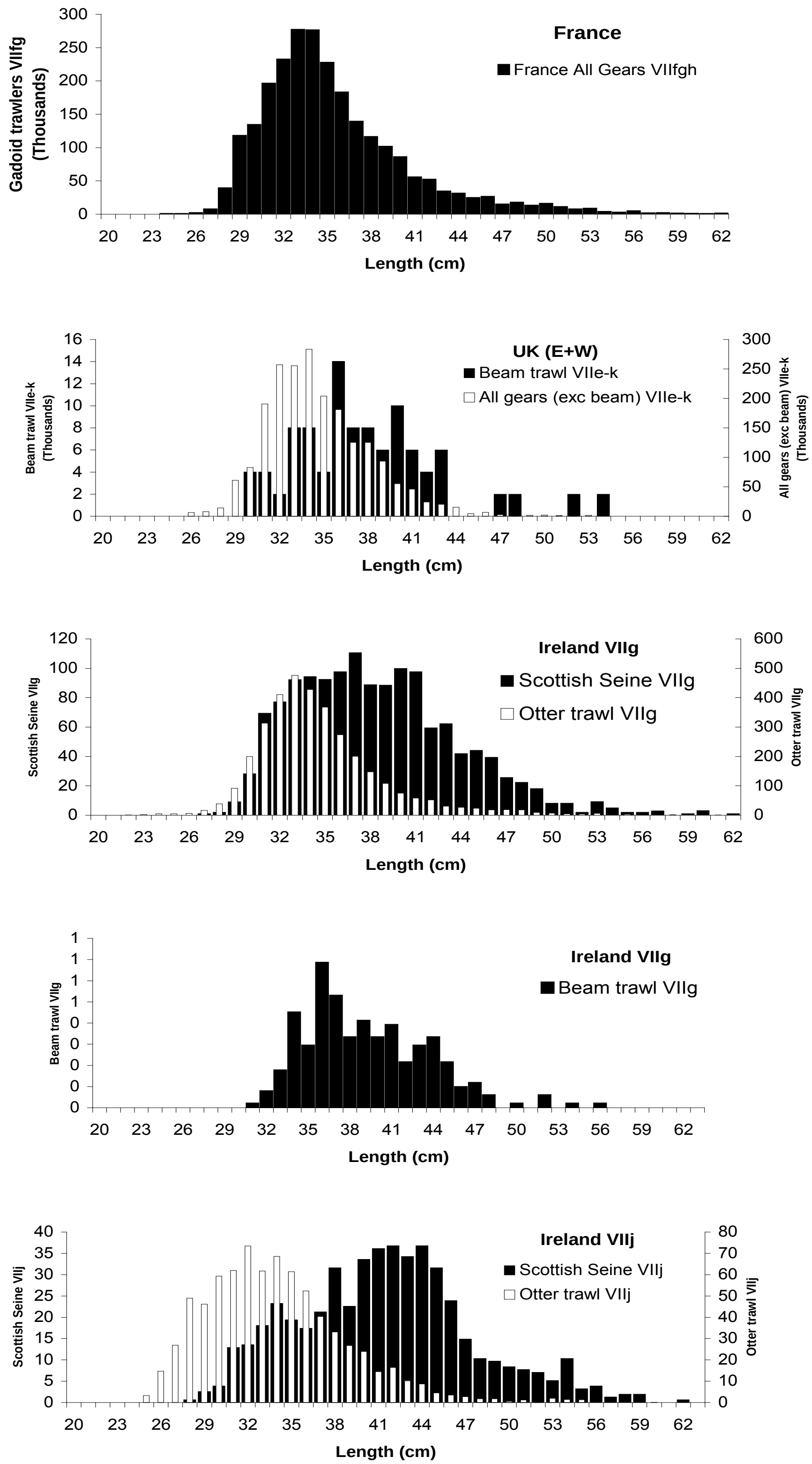
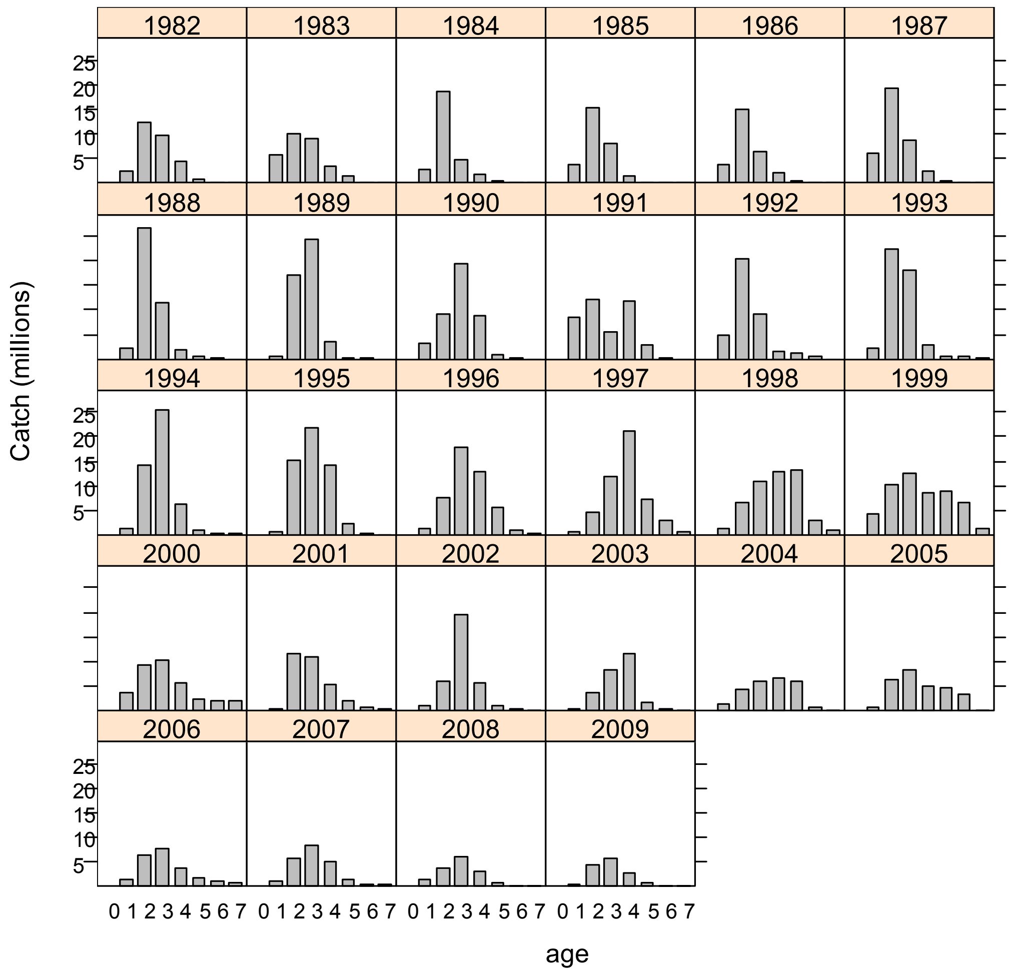


Figure 7.15.2. Whiting in VIIe–k (Celtic Sea). 2009 length compositions (raised numbers) of French, UK and Irish fleets.

(a)



1982
1983
1984
1985
1986
1987
1988
1989
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1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
5
10
15
20
25
Catch (millions)
0 1 2 3 4 5 6 7
age

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(b)

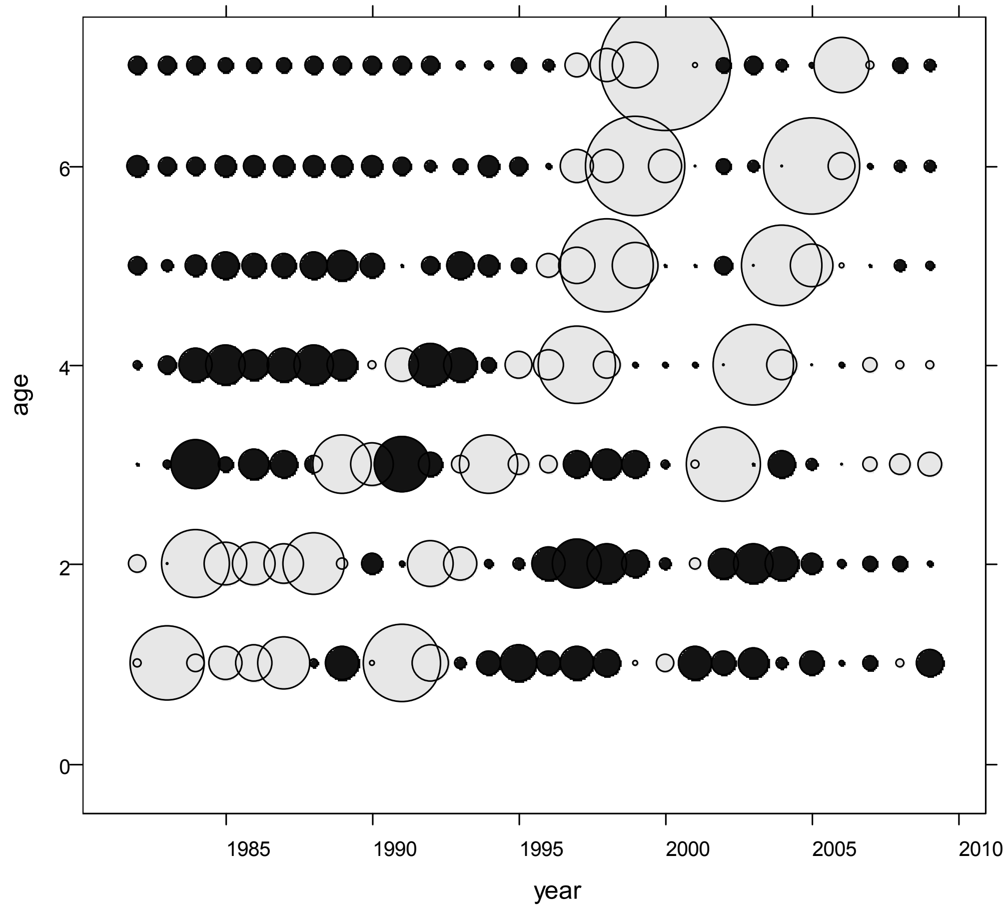


Figure 7.15.3. Whiting in VIIe–k (Celtic Sea). Annual landings age composition (a) and standardized catch proportions-at-age (b).

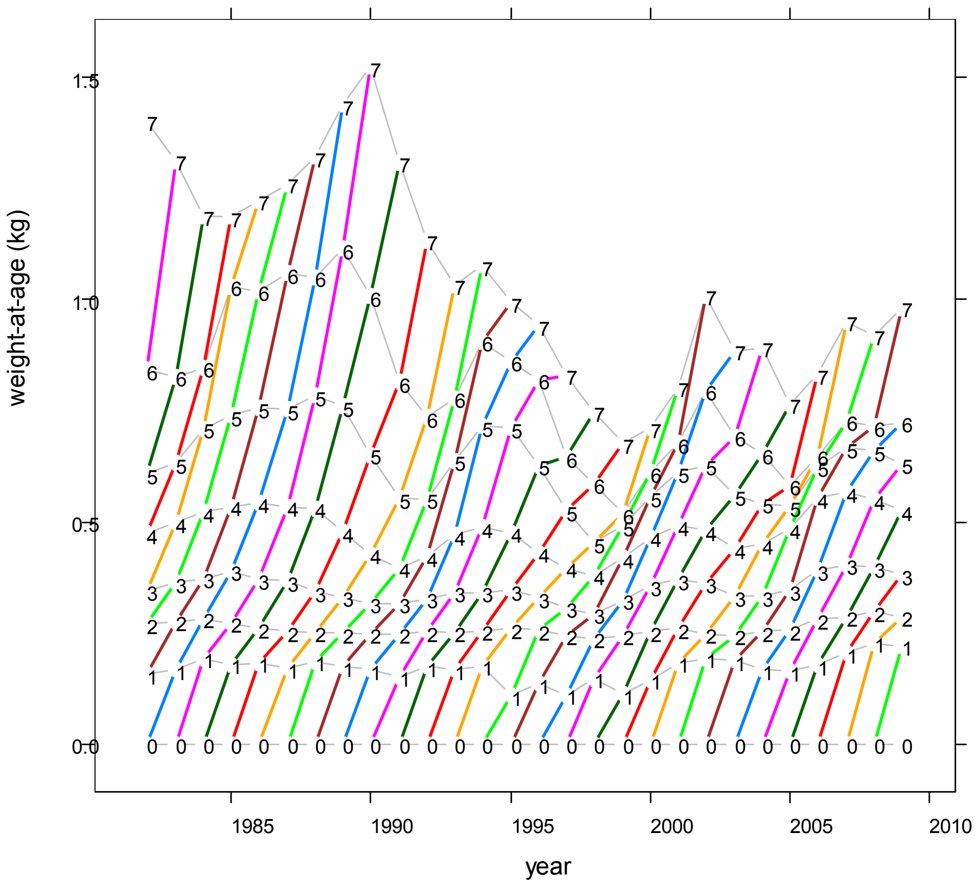


Figure 7.15.4. Whiting in VIIe–k (Celtic Sea). Stock weights-at-age.

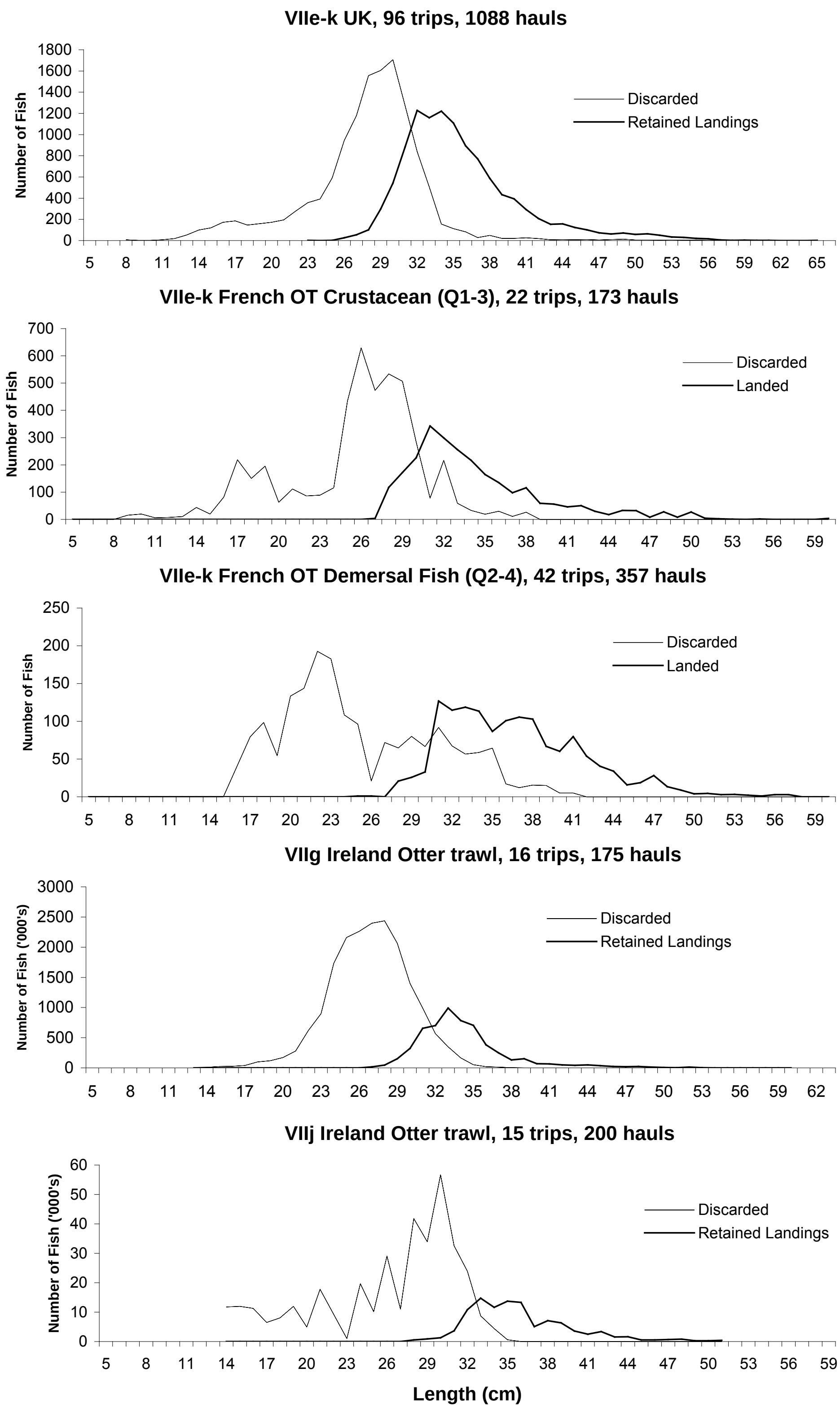


Figure 7.15.5. Whiting in VIIe–k (Celtic Sea). 2009 Annual length compositions of Irish, UK and French discards. Numbers are raised to the sampled catch for the UK and are raised by trip to the fleet for Ireland and are unraised sampled lengths for France.

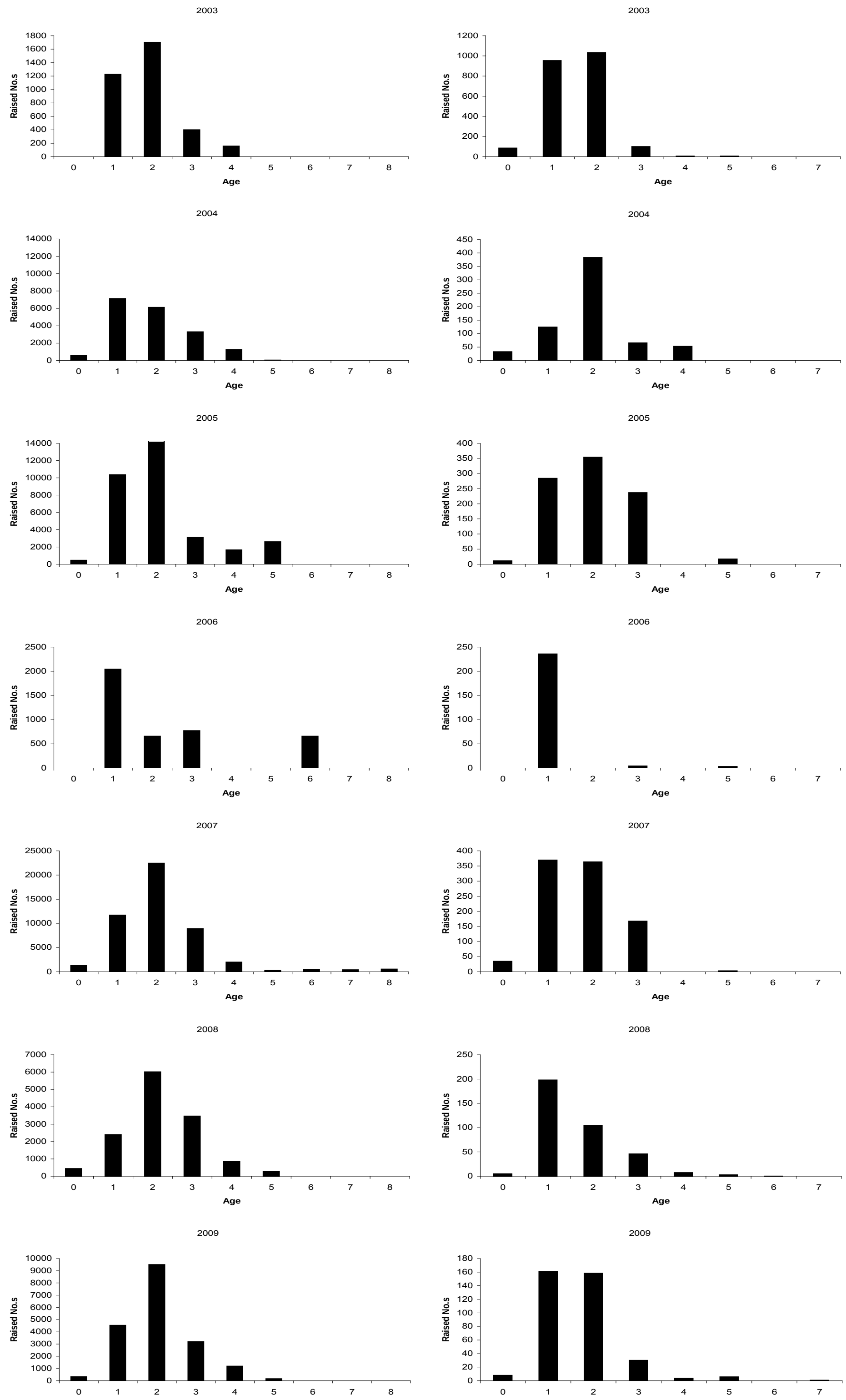
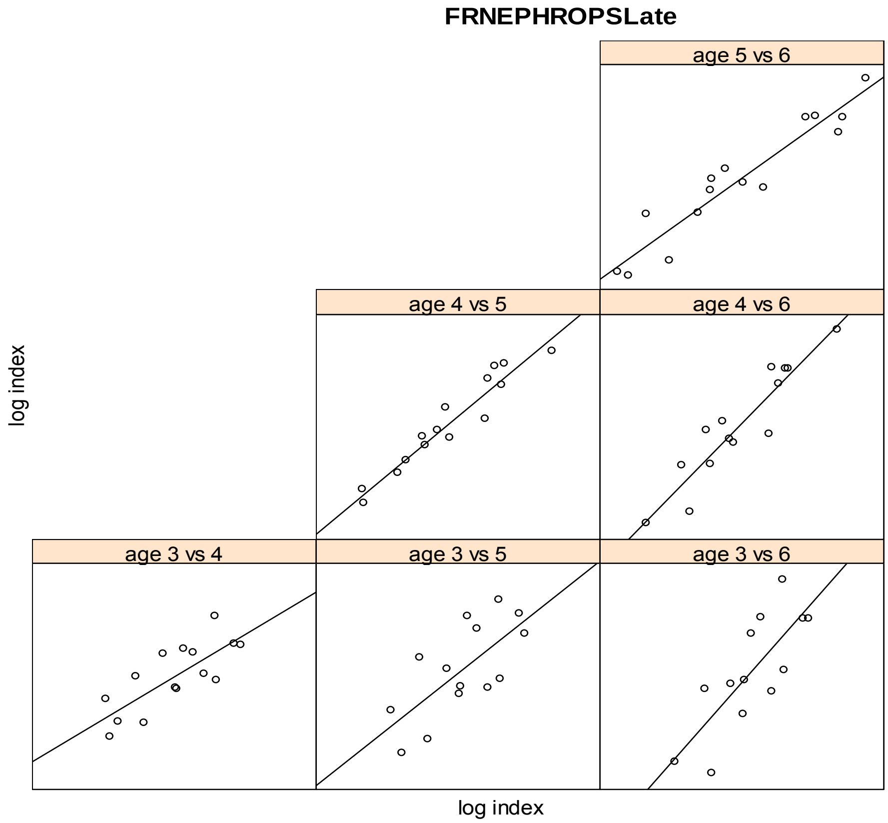
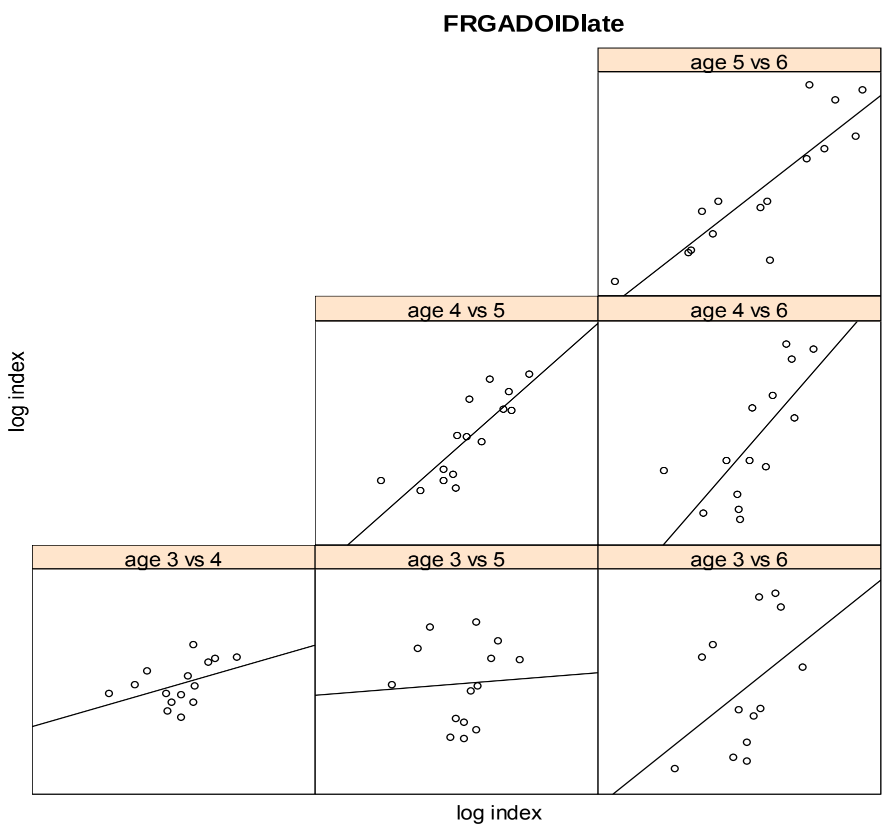


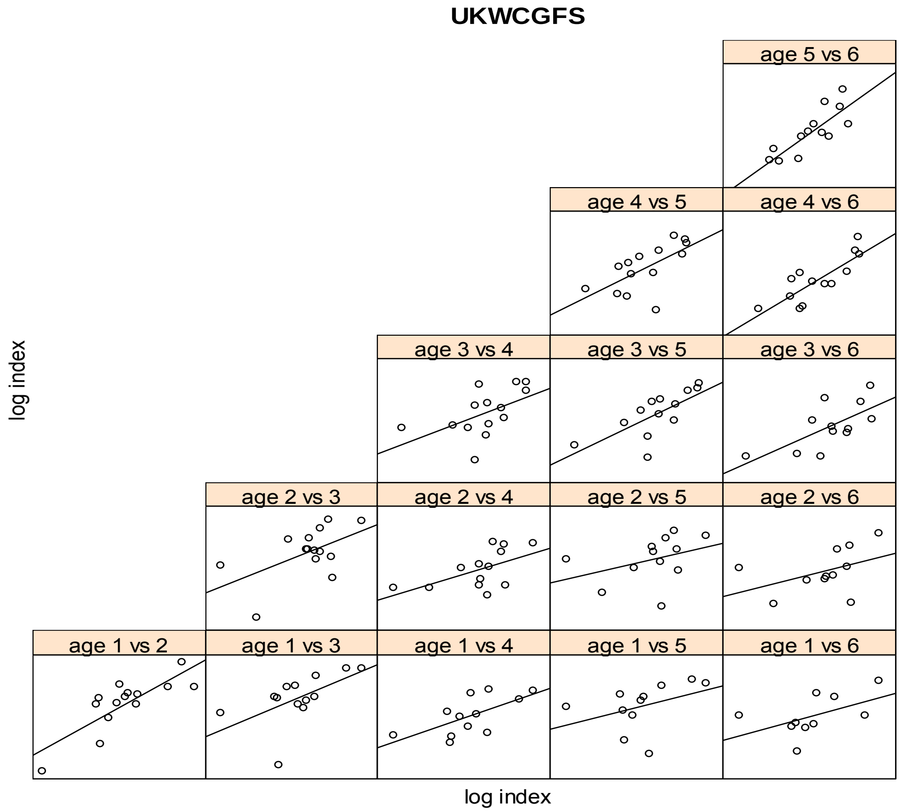
Figure 7.15.6. Whiting in VIIe–k (Celtic Sea). Age Composition of Discards from Irish Otter board trawlers 2003–2009 in VIIg (left) and VIIj (right).

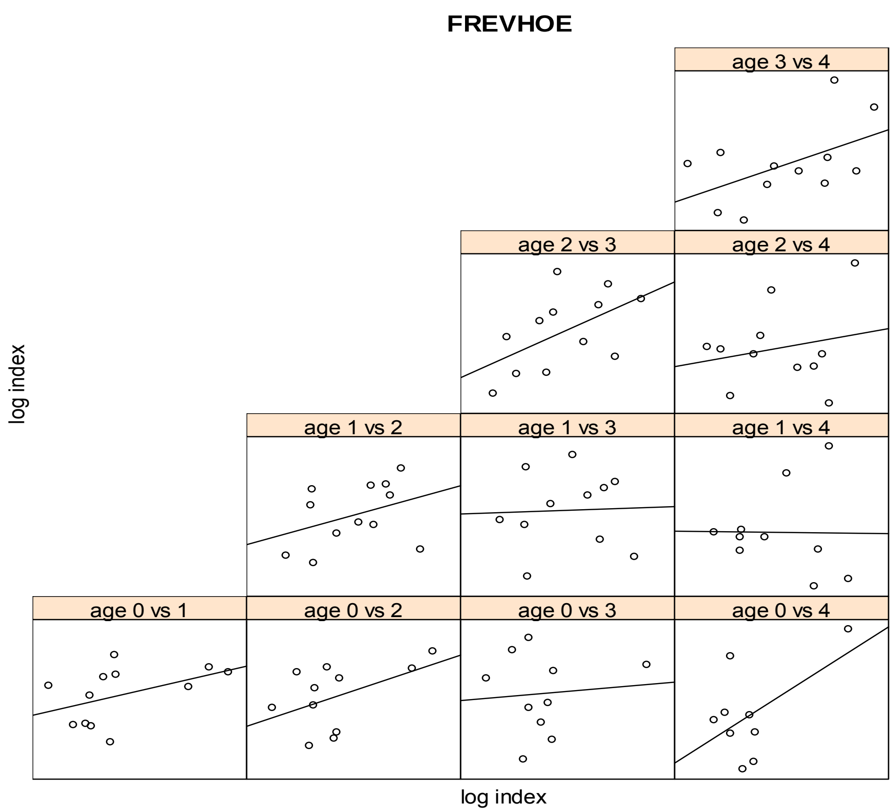
(a)


FRNEPHROPSLate
age 5 vs 6
age 4 vs 5
age 4 vs 6
age 3 vs 4
age 3 vs 5
age 3 vs 6
log index
log index


FRGADOIDlate
age 5 vs 6
age 4 vs 5
age 4 vs 6
age 3 vs 4
age 3 vs 5
age 3 vs 6
log index
log index

(b)


UKWCGFS
age 5 vs 6
age 4 vs 5
age 4 vs 6
age 3 vs 4
age 3 vs 5
age 3 vs 6
age 2 vs 3
age 2 vs 4
age 2 vs 5
age 2 vs 6
age 1 vs 2
age 1 vs 3
age 1 vs 4
age 1 vs 5
age 1 vs 6
log index
log index


FREVHOE
age 3 vs 4
age 2 vs 3
age 2 vs 4
age 1 vs 2
age 1 vs 3
age 1 vs 4
age 0 vs 1
age 0 vs 2
age 0 vs 3
age 0 vs 4
log index
log index

(b) Cont.

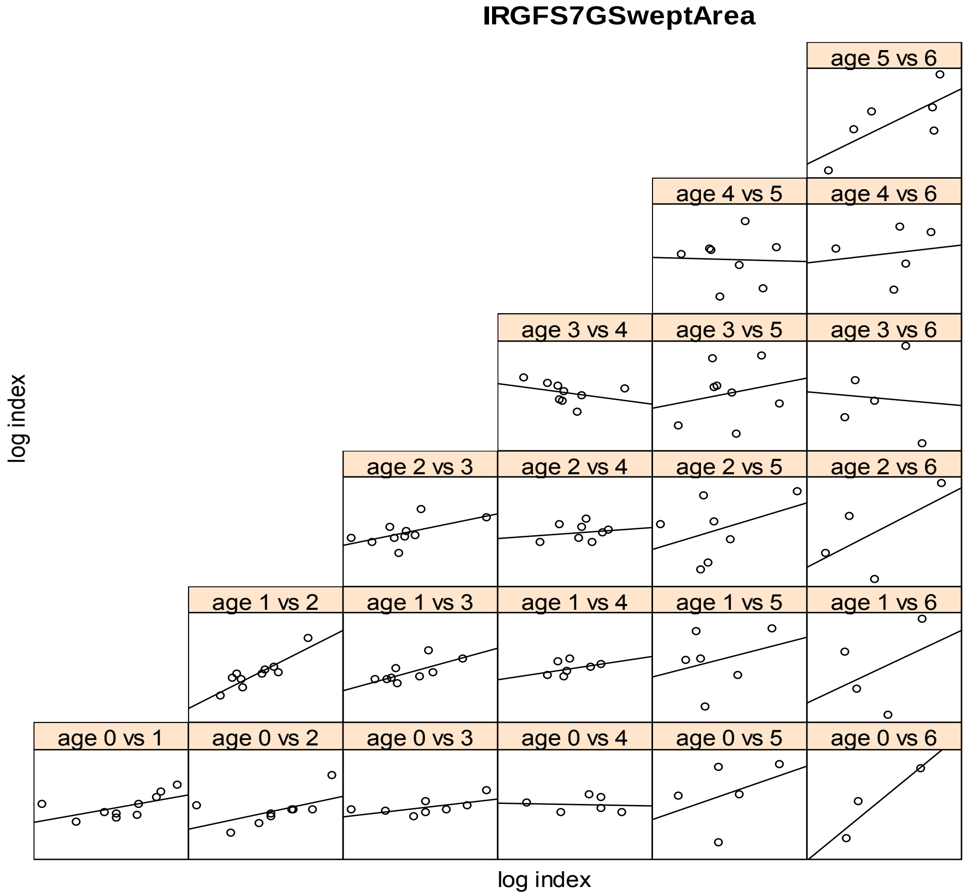


Figure 7.15.7. Whiting in VIIe–k (Celtic Sea). Pair wise scatterplots for the log numbers-at-age for the main tuning fleets to examine internal constancy of the indices (a) commercial fleets and (b) surveys.

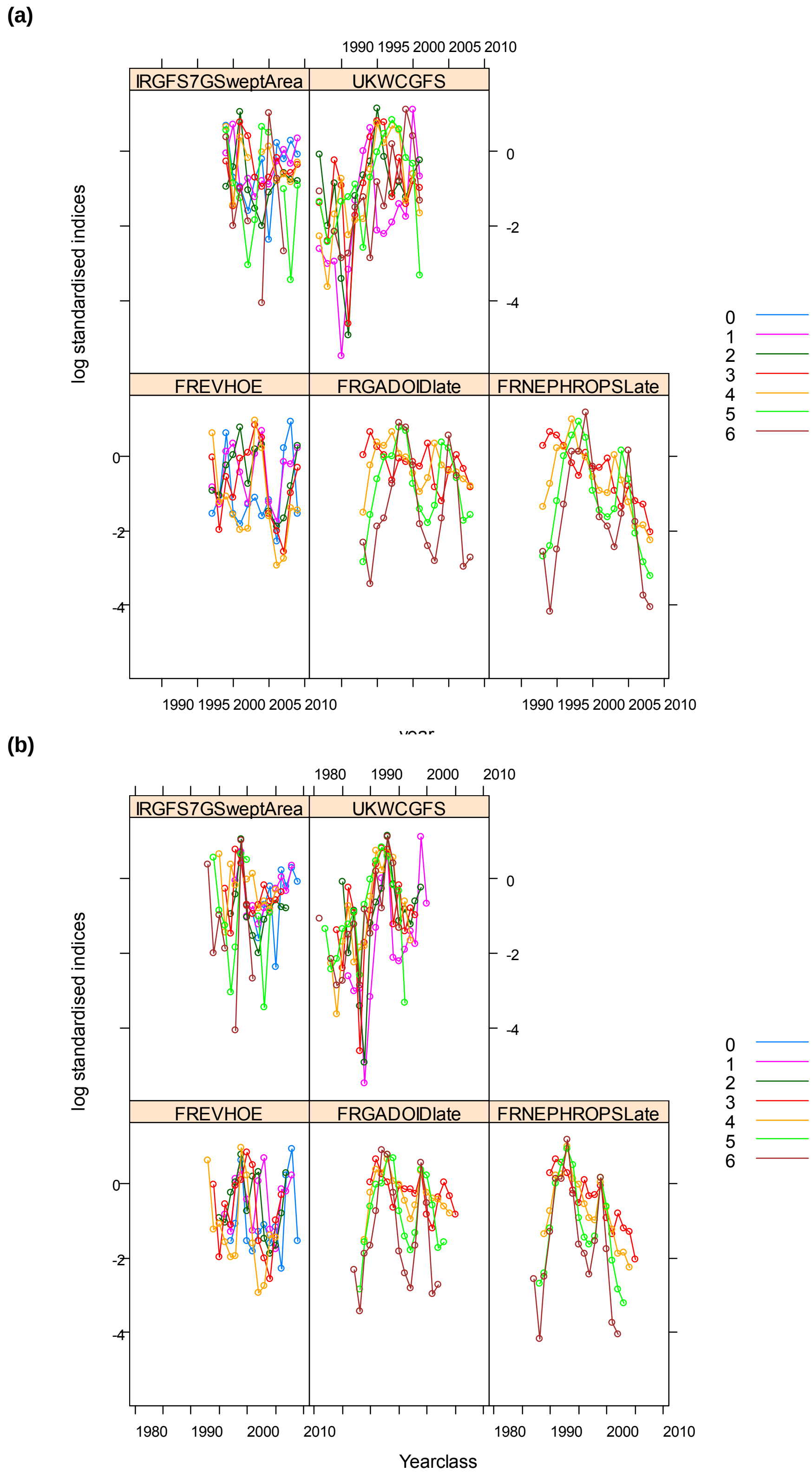


Figure 7.15.8. Whiting in VIIe–k (Celtic Sea). Mean log standardized plots of indices by (a) age and year, and (b) age and cohort.

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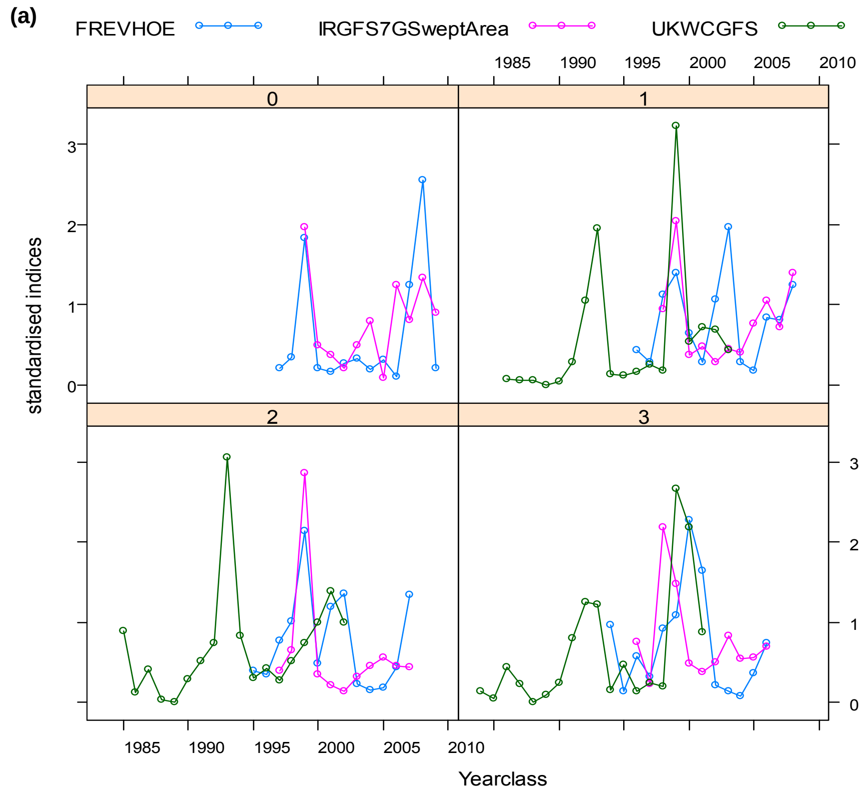


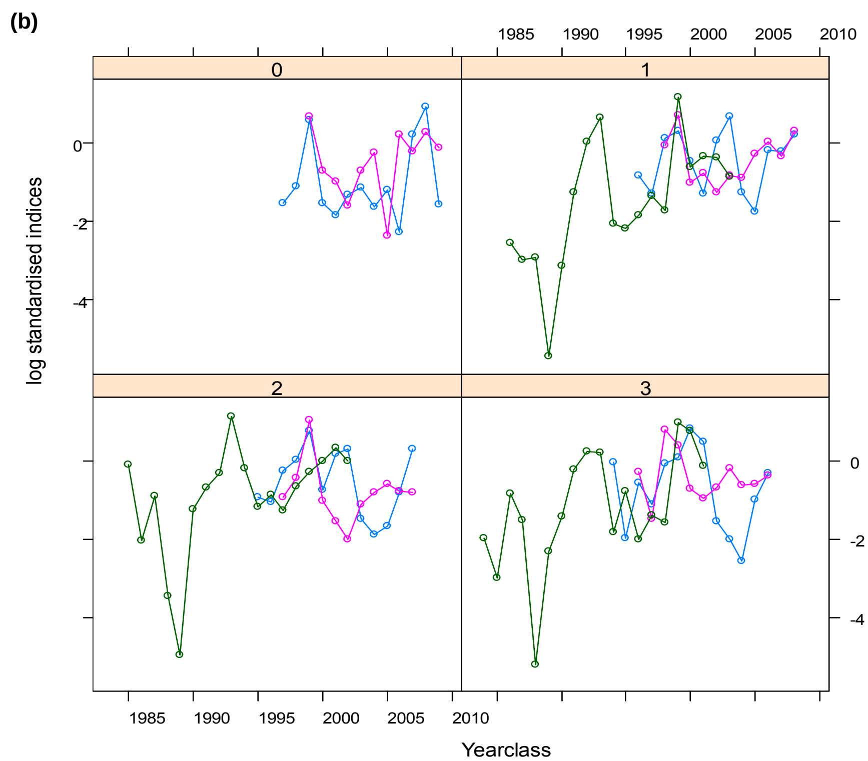


Figure 7.15.9. Whiting in VIIe–k (Celtic Sea). (a) standardized and (b) log standardized plots of survey indices used within the assessment for younger ages (0-3) by cohort.

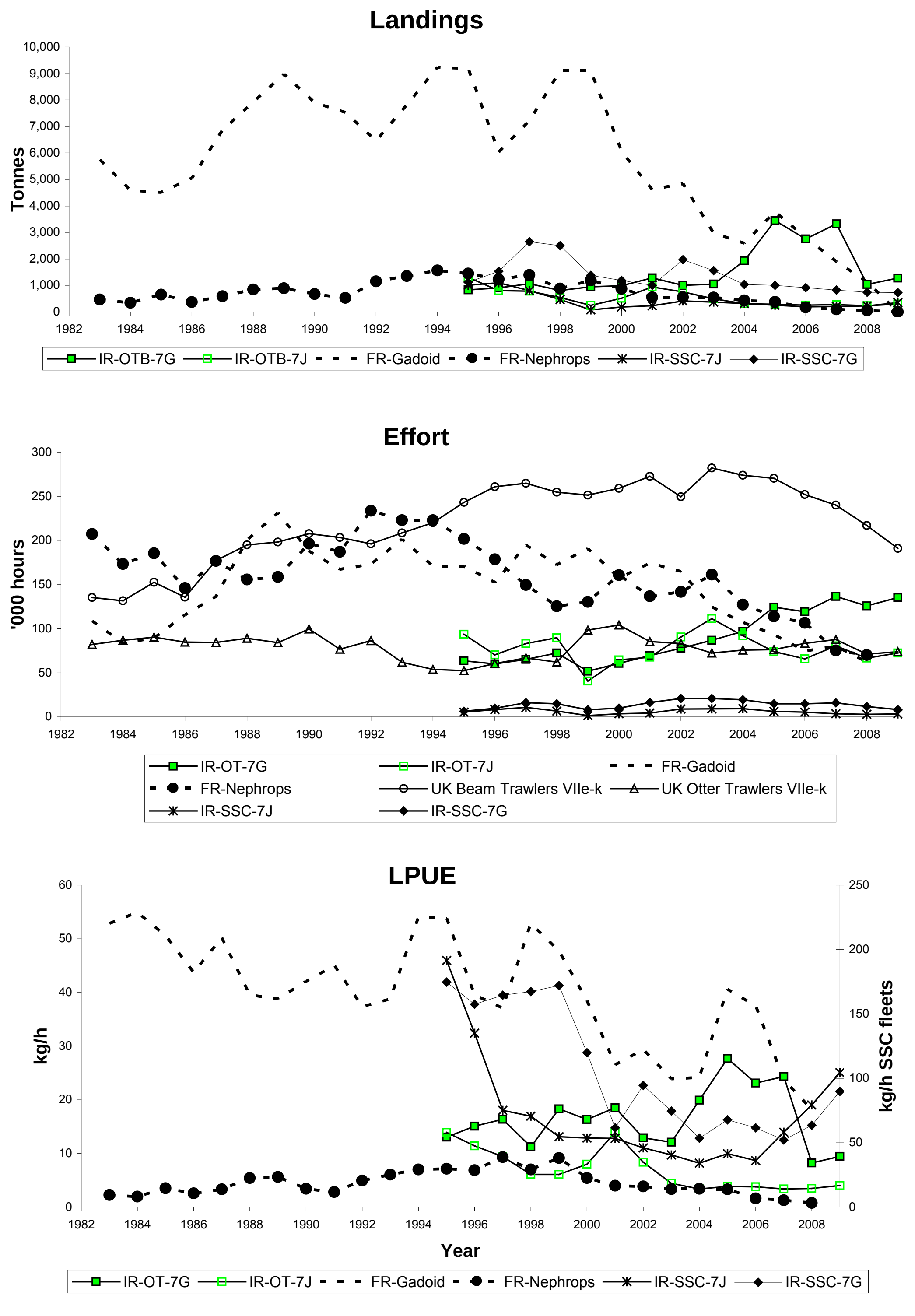


Figure 7.15.10. Whiting in VIIe–k (Celtic Sea). Landings, Effort and Landings per Unit of Effort (lpue) for some fleets landing whiting. For the UK fleets Effort is GRT corrected.

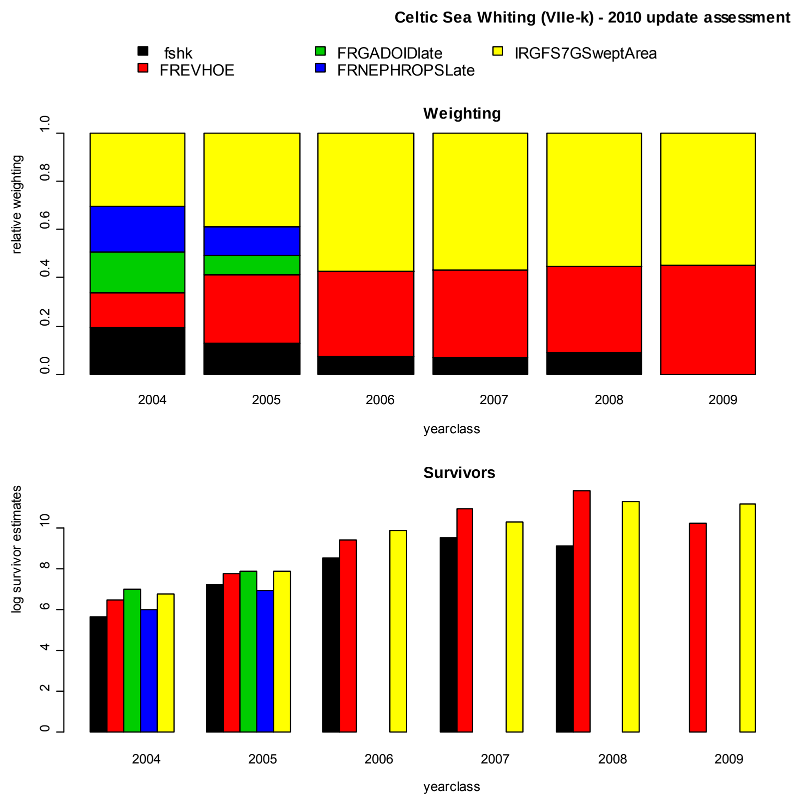
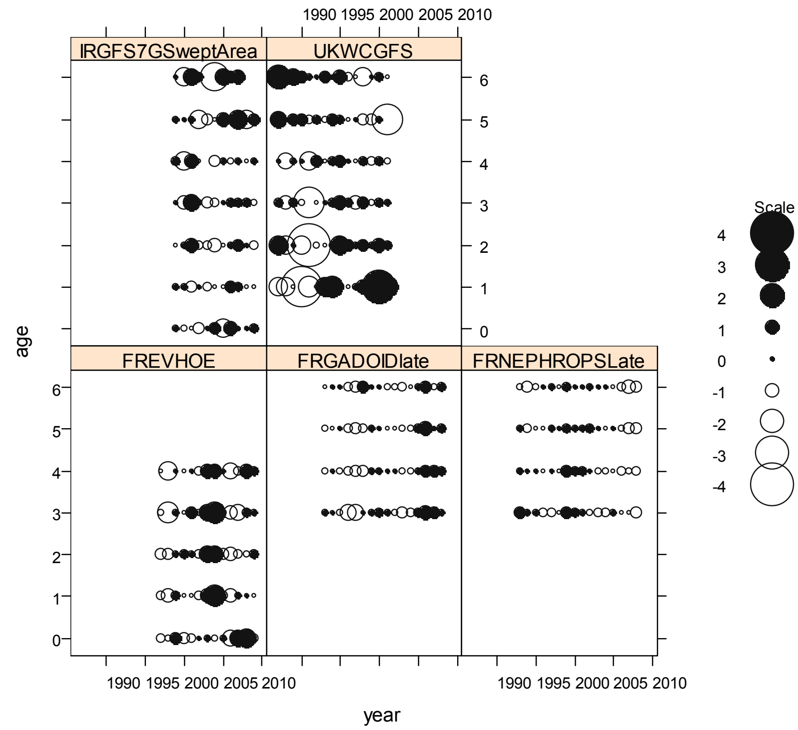


Figure 7.15.11. Whiting in VIIe–k (Celtic Sea). The survivor estimate weightings given by all fleets.

(a)



(b)

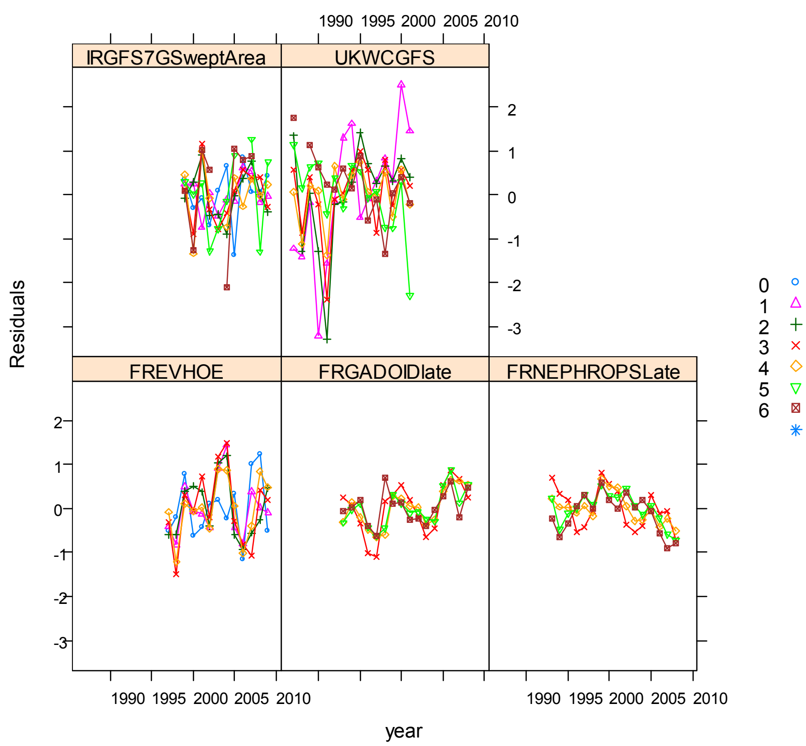


Figure 7.15.12. Whiting in VIIe–k (Celtic Sea). Log fleet catchability residuals bubble (a) and line (b) plots.

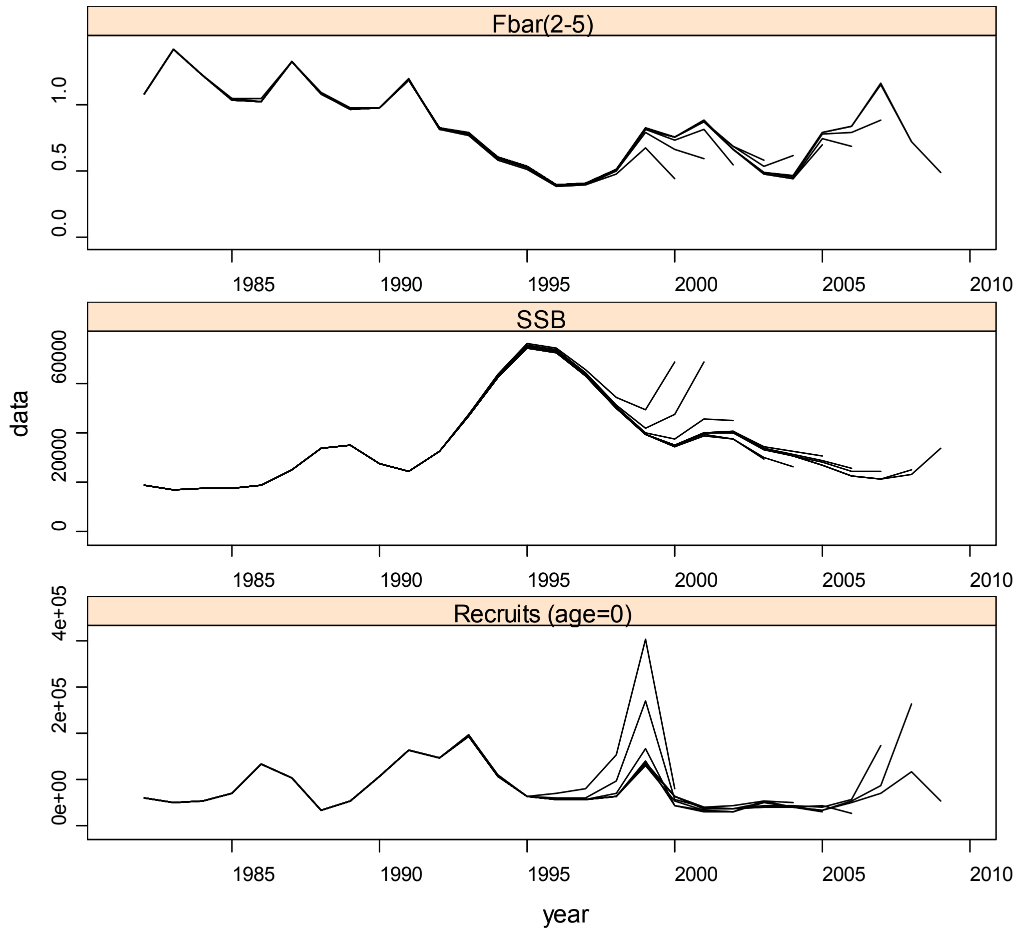


Figure 7.15.13. Whiting in VIIe–k (Celtic Sea). Retrospective analysis.

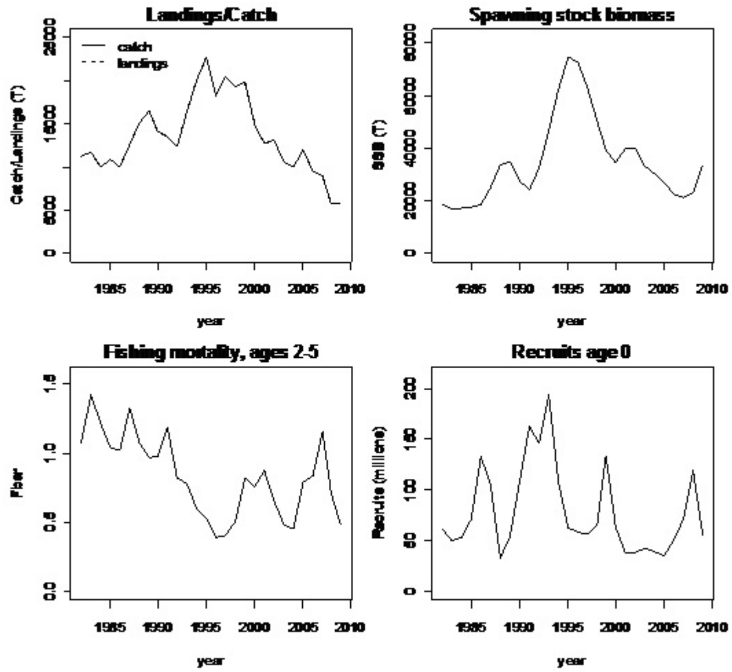


Figure 7.15.14. Whiting in VIIe–k (Celtic Sea). Stock summary.

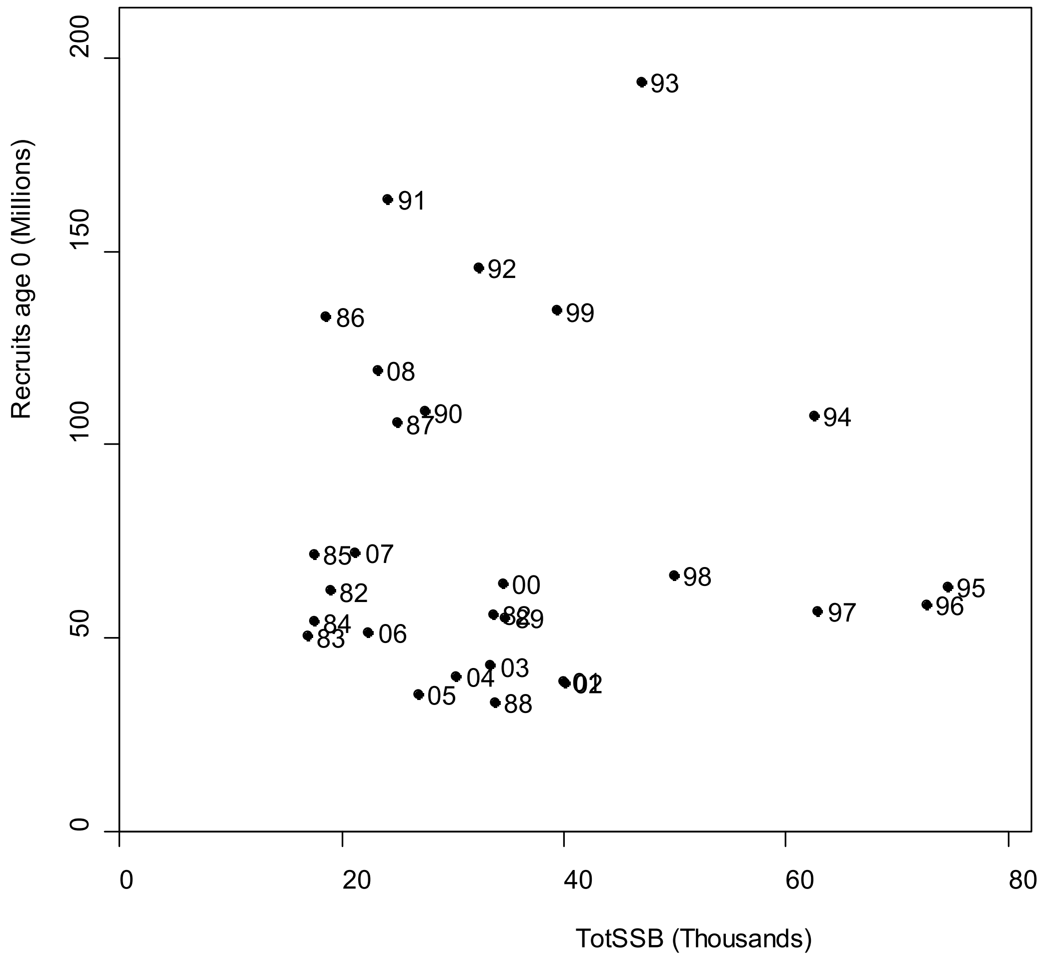


Figure 7.15.16. Whiting in VIIe–k (Celtic Sea). Stock–recruitment relationship.

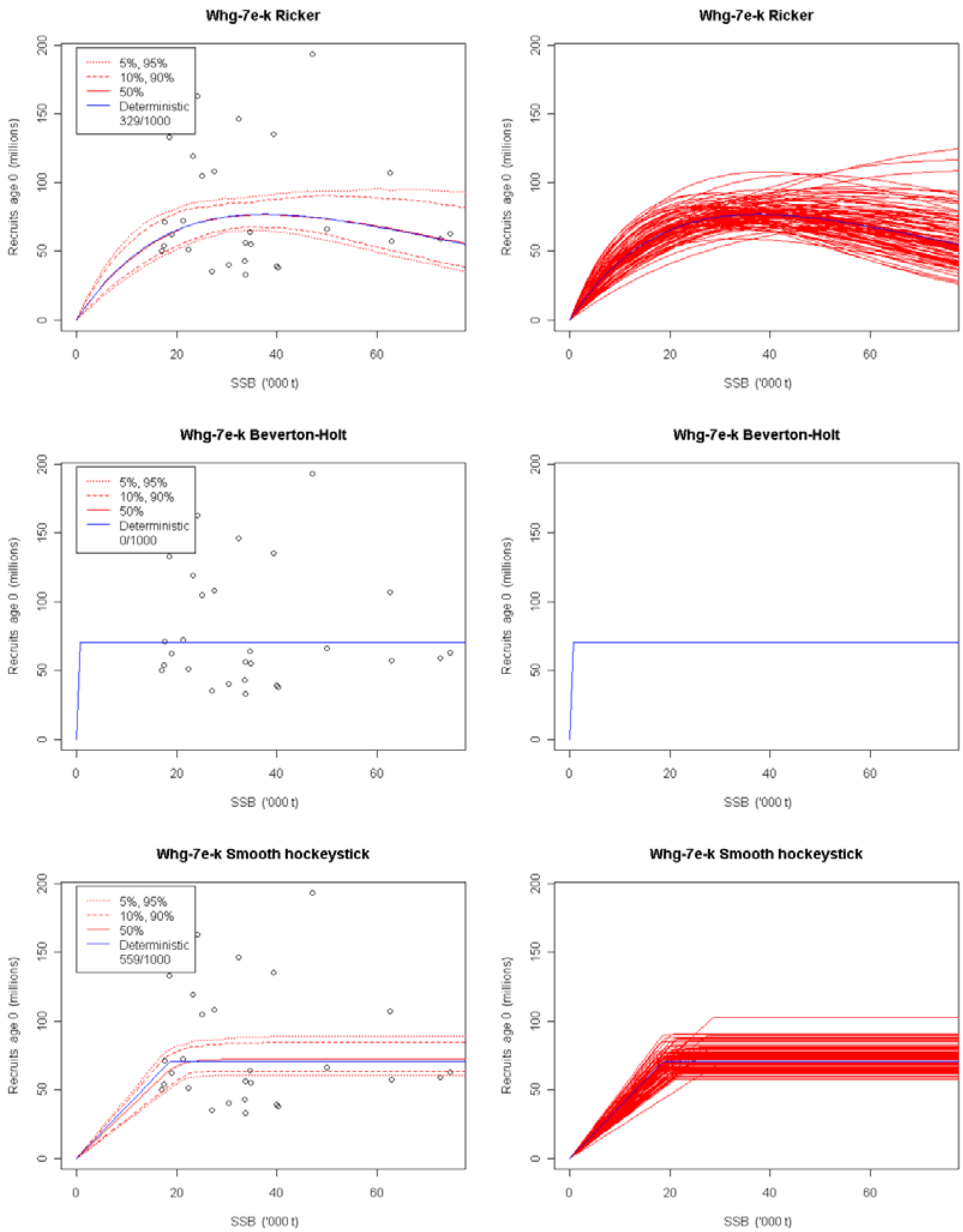
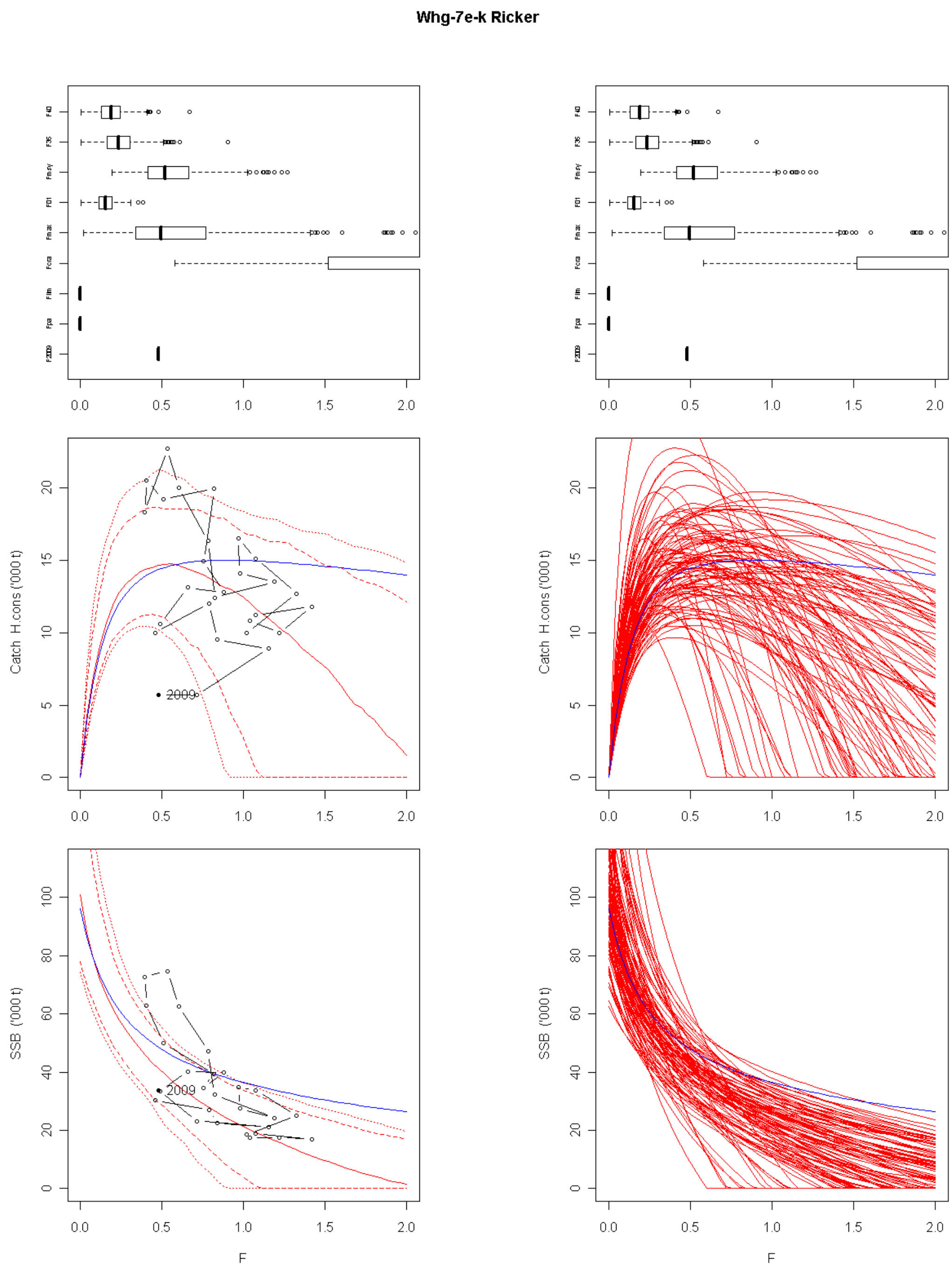


Figure 7.15.17. Whiting in VIIe–k (Celtic Sea). Fitted stock recruit–relationships with 1000 MCMC re-samples. Left hand panels illustrate confidence intervals for converged estimates of F_{msy}. Right hand panels present curves plotted from the first 100 converged MCMC re-samples for illustration. The blue line indicates the deterministic estimate. The legends for each recruitment model show the number of converged values of F_{msy} from the 1000 re-samples.

(a)



(b)

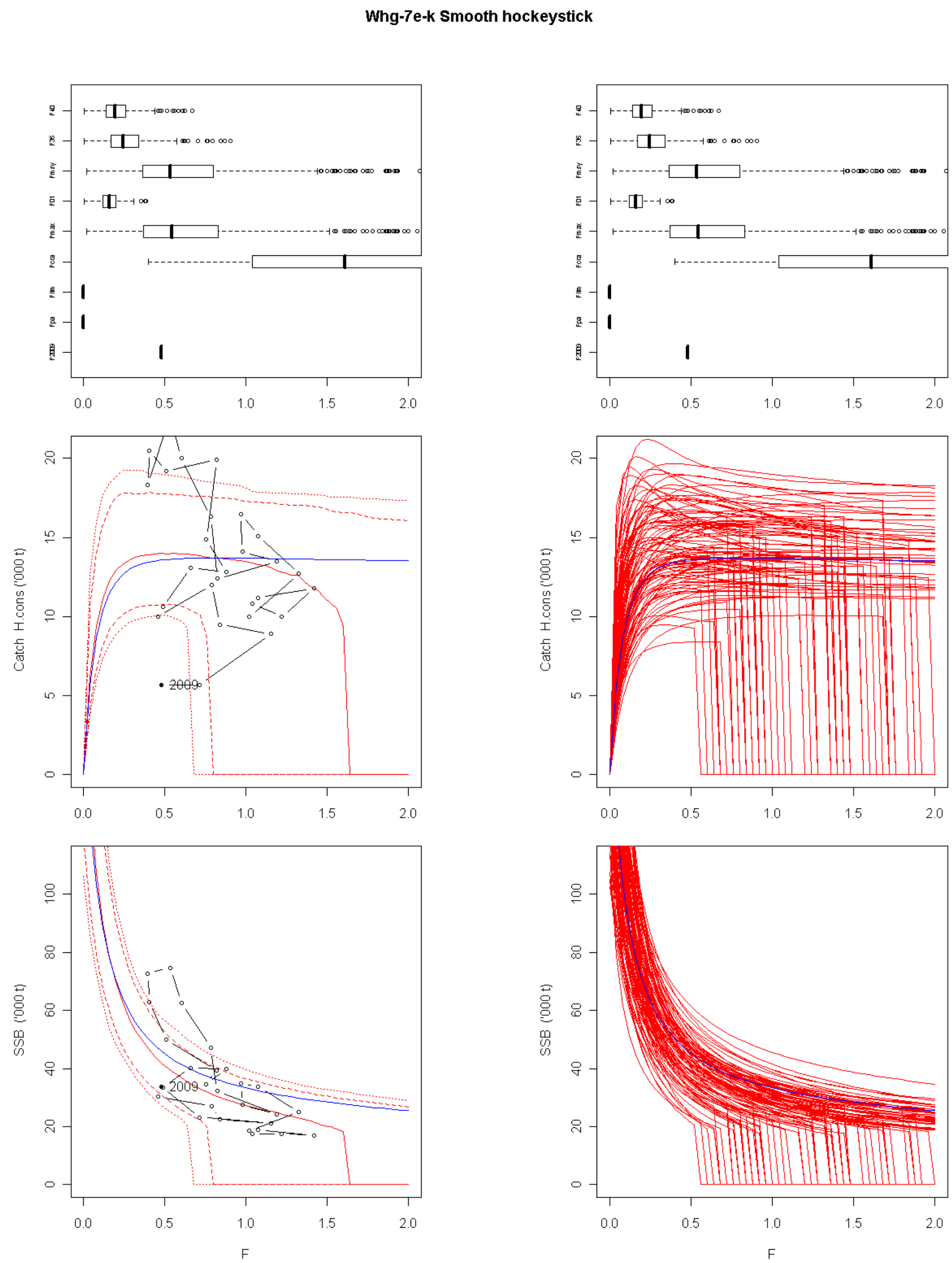


Figure 7.15.18. Whiting in VIIe–k (Celtic Sea). Estimates of F reference points and equilibrium yield and SSB plots. Left hand panels illustrate confidence intervals for converged estimates. Right hand panels present curves plotted from the first 100 converged MCMC re-samples for illustration. The blue line indicates the deterministic estimate. Circles show assessment estimates with the most recent year labelled. (a) Ricker and (b) Hockey stick stock–recruitment models.

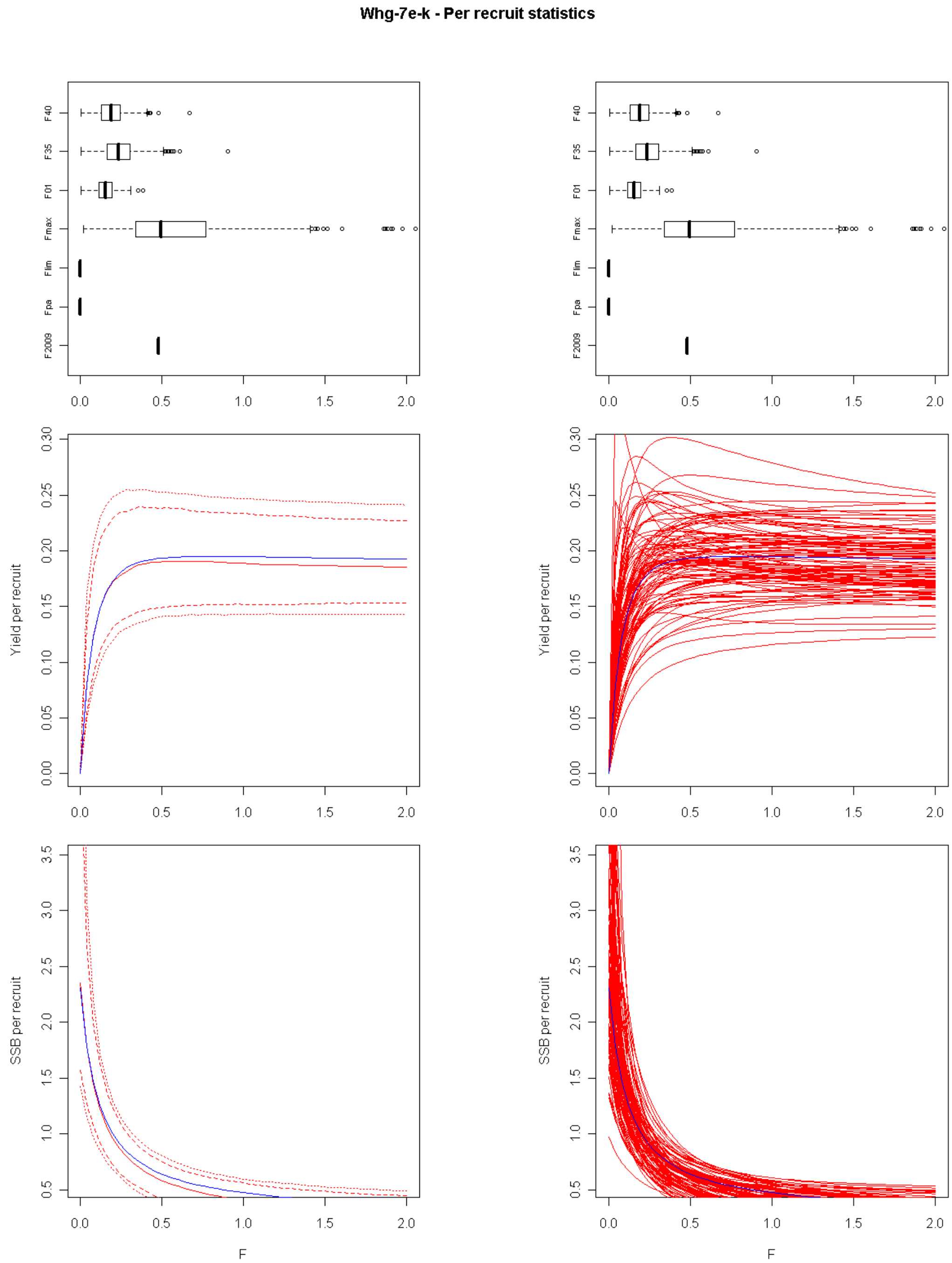
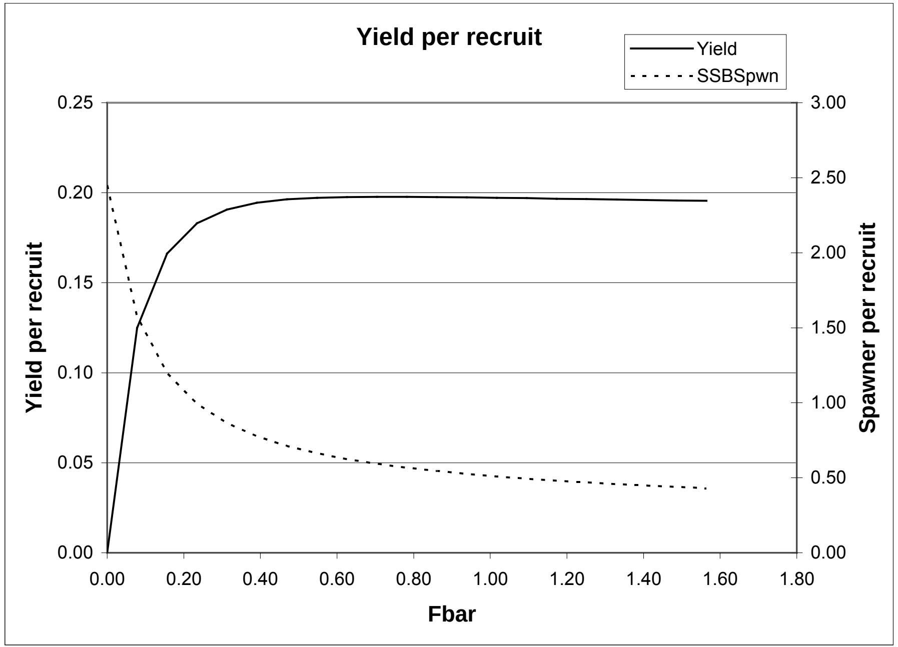
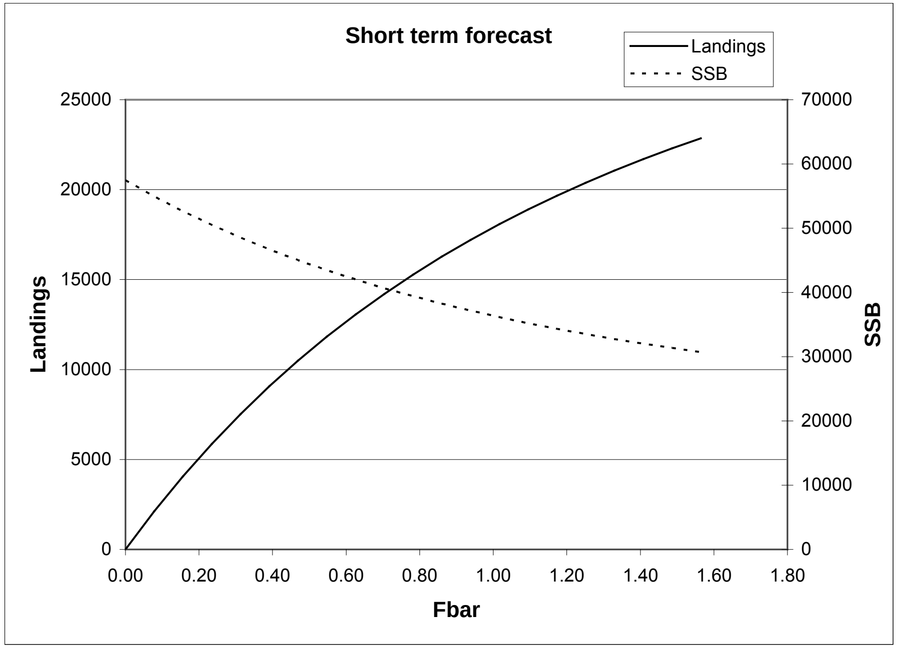


Figure 7.15.19. Whiting in VIIe–k (Celtic Sea). Fitted F reference points, yield-per-recruit and SSB per recruit against mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v.





MFYPR version 2a
Run: YPRwhg7ekRed2008
Time and date: 14:52 07/05/2010

Reference point	F multiplier	Absolute F
Fbar(2-5)	1.0000	0.7822
FMax	0.9342	0.7308
F0.1	0.2111	0.1651
F35%SPR	0.4060	0.3176

Weights in kilograms

MFDP version 1a
Run: SFwhg7ekRed2008
Whiting in the Celtic Sea (VIIe-k), WGCSE 2009, COMBSEX (Updated by SD 04/05/2010)
Time and date: 14:51 07/05/2010
Fbar age range: 2-5

Input units are thousands and kg - output in tonnes

Figure 7.15.20. Whiting in VIIe–k (Celtic Sea). Yield-per-recruit and short-term forecast plots.

7.16 Whiting in Divisions VIIb, c

Type of assessment

No assessment.

The nominal landings are given in Table 7.16.1.

Table 7.16.1. Nominal Landings (t) of Whiting in Division VIIb,c for 1995–2009.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009[a]
France	57	76	65	37*	…1*	107	114	111	92	59	102	62	32	26	
Ireland	1,894	1,233	403	323	206	563	357	386	423	135	65	49	100	76.0	76.3
Netherlands	-	-	-	-	-	-	2	-	3	-	2	-	-	-	
Spain	+	+	-	27	1	4	-	6	-	31	18	19	1	4	
UK(E/W/NI)	24	96	75	49	10	6	5	4	5	1	11	5	1	1	1.6
UK(Scotland)	71	17	4	27	-	19	1	+	-	-	-	-	-	-	
Total	2,046	1,422	547	463	217	699	479	507	523	226	198	135	134	107	78

*See VIIg-k.

[a] provisional

8.1 Western Channel overview

There is no overview.

8.2 Plaice in the Western Channel (ICES Divisions VIIe)

Type of assessment in 2010

Update assessment with no changes to the assessment settings agreed at the Benchmark Assessment meeting (WKFLAT 2010) in February 2010.

WKFLAT had considerable debate over the most appropriate assessment model. WKFLAT felt that the biologically based approach, which incorporates the migration issue by including 15% of VIId quarter 1 catches in the assessment for VIIe is a sound basis for advice. However it recognised that it is dependent on the assumption that historical patterns of migration have persisted and that the relative size of the sub-populations has been roughly stable. WKFLAT recognised that there were possible implementation issues which could not be reviewed by the meeting with regards to keeping other assessments, such as North Sea plaice, consistent with the information used. In addition, WKFLAT was unable to anticipate all of the management problems that may arise from such a change. Therefore a 'back-up' alternative assessment methodology based on VIIe catches only was developed (the 'truncated model').

Given the improved performance of the assessment with regards to the retrospective pattern, WKFLAT recommended that the historical short-term forecast methodology be reinstated; this was previously removed because of retrospective bias in F and SSB in the assessment.

This recommended model differed from that previously used at the Working Group:

- 15% of quarter 1 catches (and associated age compositions) from UK (E&W), Belgium and France added into VIIe data;
- First year of catch and weight-at-age data changed from 1976 to 1980;
- UK (E&W) FSP survey data truncated to exclude age 9;
- $F_{(Bar)}$ age-range reduced from F(3–7) to F(3–6).

ICES advice applicable to 2009

Exploitation boundaries in relation to precautionary limits: Given the low stock size, recent poor recruitment, high fishing mortality, the uncertainty in the assessment, and the inability to reliably forecast catch, ICES recommends a substantial reduction in catch until the estimate of SSB is above B_{pa} or other strong evidence of rebuilding is observed.

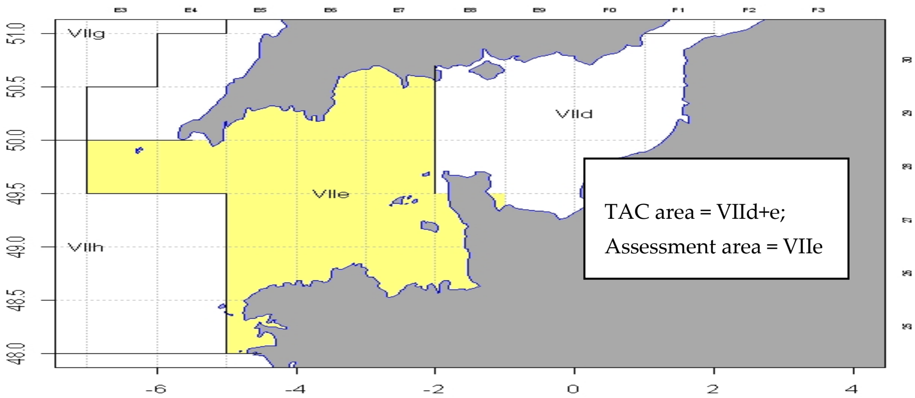
ICES advice applicable to 2010

Exploitation boundaries in relation to precautionary limits: Given the low stock size, recent poor recruitment, high fishing mortality, the uncertainty in the assessment, and the inability to reliably forecast catch, ICES recommends a substantial reduction in catch until the estimate of SSB is above B_{pa} or other strong evidence of rebuilding is observed.

8.2.1 General

Stock description and management units

The management area for this stock is strictly that for ICES Area VIIe called the Western English Channel. The TAC area does not correspond to the stock area as it includes the larger component of VIId (Eastern English Channel). However as determined by WKFLAT 2010, a significant proportion of the catches of the VIIe stock are taken in the adjacent area during the time of spawning. Plaice is not the target species in VIIe, and it is generally caught as a bycatch by the sole and anglerfish directed fleets.



Management applicable to 2009 and 2010

There are technical measures in operation including a minimum 80 mm mesh size and a MLS (27 cm) for this species.

The TAC and the national quotas by country for 2009

Species: Plaice *Pleuronectes platessa*		**Zone:** VIId and VIIe (PLE/7DE.)
Belgium	760	
France	2 534	
United Kingdom	1 352	
EC	4 646	
TAC	4 646	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

In addition, Annex IIc, restricts the number of days-at-sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet due to a reduction in capacity of the fleet.

The TAC and the national quotas by country for 2010

Species: Plaice *Pleuronectes platessa*		**Zone:** VIId and VIIe (PLE/7DE.)
Belgium	699	
France	2 332	
United Kingdom	1 243	
EU	4 274	
TAC	4 274	Analytical TAC

In addition, Annex IIc, restricts the number of days-at-sea to 164 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet due to a reduction in capacity of the fleet.

The fishery in 2009

A full description of the fishery is provided in the Stock Annex, Section A2.

In the western English Channel plaice are taken mainly as a bycatch in beam trawls directed at sole and anglerfish. In 2009, the UK beam trawl fleet took around 57% of the total landing of this stock with the UK otter trawl fleet taking around 21%. The remainder of the landings is taken by the French and Belgian fleets.

UK Otter trawl effort in 2009 continues the downward trend whereas the UK beam trawl effort has now fallen sharply from the high level observed over the period 2003–2008, and is now at the same level observed in 2000.

This stock is the smaller of the two stocks that make up the larger TAC area of VIId,e. The landings from this stock in 2009 and 2008 amounted to around 20% of the TAC.

Landings

National landings data reported to ICES, and estimates of total landings used by the Working Group, are given in Table 8.2.1. Estimated total international landings in 2009 were 916 t. The Working Group estimate of the 2008 landings was revised upwards due to minor revisions to the landings by UK (E&W) and UK (Guernsey) but these had minimal impact.

Landings increased to levels of 2600 t during the latter half of the 1980s due to a series of good recruitments in 1986–1988, but subsequently dropped to levels fluctuating around 1200 t. The last three years have seen landings fall to under 1000 t. Unallocated landings in recent years, are generally the additional French landings derived from sales note information. In addition to the reported landings for VIIe, an extra 127 tonnes was added from the VIId plaice stock representing an adjustment for migration of 15% of quarter 1 between the two stocks. This process was agreed at the Benchmark Assessment meeting in February 2010 and the method is documented in the Stock Annex. A reciprocal correction was made to the VIId stock.

Data

Sampling levels are detailed Section 2 (Table 2.1).

Discards

Discards estimates, from the UK (E&W) and French discard sampling programme, are available for the period 2002–2009 (Annual Data Files on ICES network) and indicate that discarding appears to be higher in quarters 1 and 2 in this fishery, but is still low compared to other plaice stocks. Quarterly profiles of numbers landed and discarded-at-length, in 2009, are given in Figure 8.2.2.

Biological

Annual length compositions of the UK (E&W) landings in 2009 are provided for two UK fleets (Table 8.2.3). No length data for the French landings were available. Length distributions of UK (E&W) landings from 2000 to 2009 as used by the WG are illustrated in Figure 8.2.3.

Quarterly age compositions for landings in 2009 were available from UK (E&W) only, which accounted for almost 80% of the total reported international landings. Additional age compositions representing the migration adjustment (15% of quarter 1 landings for VIId) were available from UK (E&W), Belgium and France. The method for the derivation of the international catch numbers and the calculation of the catch and stock weights-at-age are fully described in the Stock Annex, Section B1. Catch numbers-at-age landed annually (including migration element) are given in Table 8.2.4 and plotted for 2000 to 2009 in Figure 8.2.4. Catch and stock weights-at-age are given in Tables 8.2.5 and 8.2.6.

Catch weights are plotted as mid-year values; stock weights are interpolated back to January 1st, as standard for this stock. The standard settings used for natural mortality and the proportions of F and M before spawning were used. (See Stock Annex).

Surveys

There are currently two surveys that provide abundance estimates to the Working Group. The UK (E&W) commercial beam trawl survey has used the FV Carhelmar for most survey years with the exception being 2002 and 2004, when the RV CORYSTES was used instead. Detailed information on the survey protocols and area coverage can be found in the Stock Annex. Table 8.2.7 gives abundance indices as numbers caught per 100 km for age groups 1 to 9 as obtained by UK-WECBTS. Strong and weak year classes have been well tracked by this survey in the past. (Figure 8.2.6).

Since 2003 the UK Fisheries Science Partnership (FSP: Cefas-UK industry cooperative project) has been conducting a survey using commercial vessels with scientific observers and following a standard grid of stations extending from the Scilly Isles to Lyme Bay. The survey covers a substantially larger area than the current survey (UK-WECBTS) and is thought to be more representative of the stock in UK waters. This dataset was first included in the 2007 assessment, and the exploratory analysis can be seen in that report (ICES, 2007; Section 3.2.5). There have been a number of vessel changes, gear changes and temporal variations in this survey series, but the survey has performed well in tracking year classes in the past. However, a strong year effect was noticed in 2008 having a significant impact on the survivor estimates. The 2009 WG excluded the 2008 data.

Commercial fleet effort and cpue

The UK (E&W) cpue data shows the individual fleets that make up the composite of all otter trawl and all beam trawl fleets that are used in the commercial tuning data sets. Trends in lpue and effort are given in Table 8.2.2 and Figure 8.2.1; more detailed information on the distribution of effort by area and trends in the fishery can be found in the Stock Annex. Lpue in the North of VIIe for both commercial beam and otter trawlers reached a peak in 1988–1990, fell sharply to 1995 and is now at stable but low levels. Survey cpue (Beam trawl survey in the North of VIIe) has shown a similar but slightly earlier trend in the early years but indicates a more pronounced temporary increase in catches during 2000 and 2001 compared to the commercial series. Commercial beam trawl lpue in the South and West of VIIe shows a general decline from 1990 to 2008, with otter trawler lpue declining slowly since 1997 in the west, but showing much more variation throughout the time-series in the south. All lpue time-series show an increase in 2009.

Effort (fishing power corrected, using GRT) by UK (E&W) beam trawlers shows an increasing trend between 1992 and 2003, then remaining stable at this high level until 2008. In 2009 effort fell dramatically back to the level observed in 2000. In contrast, effort by otter trawlers continues to decline slowly from the highest values shown at the beginning of the time-series.

8.2.2 Stock assessment

Catch-at-age analysis

Section 1.3 outlines the general approach adopted at this year's Working Group meeting, and the specific approach for this stock is given in the Stock Annex. All relevant tuning and XSA outputs not included in this report are available in the 'Exploratory runs' folder. The details of the previous assessment approaches for this stock can be found in the Stock Annex.

Data screening

The age range for the analysis was 1–10+, as standard.

As this was an update assessment, full data screening, tuning data and exploratory XSA trials were not carried out. For catch data screening, a separable VPA was carried out using the standard setting as detailed in the Stock Annex. The results (Figure 8.2.5.cont.) show no anomalies in recent years, and high residuals on the youngest age as previously observed. The changes made to the assessment data as recommended at WKFLAT made no improvement.

Tuning information available consisted of same five fleets as last year: three UK commercial series, UK otter historic, UK otter trawl, UK beam trawl; and two UK survey-series: UK-WEC-BTS, and UK (E+W) FSP. These are presented in Table 8.2.8. The figures in bold indicate the data used for the final run.

Details of the derivation of the tuning fleets are presented in the Stock Annex.

Tuning indices were examined for inconsistencies using SURBA version 3.0. Log(cpue) plots plotted by year class and by year (Figure 8.2.6). Four of the tuning indices indicate highly consistent year-class estimates, and plots of index by year do not indicate substantial year effects in the tuning data. The UK (E&W) FSP indices show a large year effect in the 2008 data. Inclusion of these data at the WGCSE 2009 led to the final estimates of each year-class for this fleet being reduced significantly from the previous year's estimate at all ages and given that this fleet's estimates received heavy weighting in the final estimates or survivors, this data was excluded from the final assessment. There were a number of changes to the survey in 2008, but these mostly affected the eastern part of the survey, whereas the greatest change in abundance was noted in the western survey and these changes continued in 2009.

The addition of the 2009 data for this survey did not eradicate this problem, but greatly reduced its impact. Nevertheless the 2008 data have been excluded once again. The cause of this year effect remains unclear.

In addition, this dataset requires further analysis and standardisation across years. Also consideration should be given to using the standard 12 m beams on future surveys in order to ensure consistency in the gear selectivity.

Final update assessment

The settings used for the final run are shown in the table. The full assessment history is given in the Stock Annex.

		2009 XSA	2010 WKFLAT	2010 XSA
Catch-at-age data		1976–2008, 1–10+	1980–2008, 1–10+ add catch from 7d	1980–2009, 1–10+ add catch from 7d
Fleets	UK-WECBTS – Survey	1986–08, 1–8	1986–08, 1–8	1986–09, 1–8
	UK WECOT – Commercial	1988--08, 3–9	1988–08, 3–9	1988–09, 3–9
	UK WECOT–Commercial historic	1976–87, 2–9	1980–87, 2–9	1980–87, 2–9
	UK WECBT – Commercial	1989–08, 3–9	1989–08, 3–9	1989–09, 3–9
	UK E+W FSP - Survey	2003–07, 2–9	2003–07, 2–8	2003–09, 2–8 (exc 08)
Taper		No	No	No
Taper range		-	-	-
Ages catch dep. Stock size		None	None	None
q plateau		7	7	7
F shrinkage se		2.5	2.5	2.5
year range		5	5	5
age range		4	4	4
Fleet SE threshold		0.5	0.5	0.5
Prior weighting		-	-	-
Plus group		10	10	10
F Bar Range		F(3–7)	F(3–6)	F(3–6)

The diagnostics for the final XSA run are shown in Table 8.2.9 and the catchability residuals are plotted in Figure 8.2.5. Some weak trends/patterns can be seen in the commercial beam trawl and otter trawl fleets (UK-WECBT; UK-WECOT) and a year effect can be seen in the survey results (UK-WEC-BTS) for 2004 probably associated with a change in vessel effect.

Estimates for the youngest ages are almost entirely determined by the UK beam trawl survey and get more weight than the other fleets up to age 5. The commercial fleets provide around 50% of the weight of ages 4 and older. The contribution of F-shrinkage is minor for all ages. Fishing mortalities and population numbers estimated from the final run are given in Tables 8.2.10 and 8.2.11, and summarized in Table 8.2.12. The 2006 and 2007 above average year classes have led to an increase in SSB in 2009. The 2008 year class appears to be weak. However in last year's assessment, the 2007 year class was estimated to be weak but is now being estimated to be above average.

Retrospective analysis (Figure 8.2.7) was run without the short UK (E&W) FSP tuning-series, and indicates a strong downward revision of the 2001 year class strength, going from the second strongest year class in history to a value much closer to long-term GM. The changes to the assessment made at WKFLAT 2010 have arguably resolved the retrospective bias seen in last previous assessments where there was a sequential downwards revision of F and a commensurate revision in SSB. This assessment shows that retrospective pattern in F is substantially reduced and the F level remains relatively stable throughout the time-series.

Comparison with previous assessments

Fishing mortality has decreased in 2009 (0.44) and SSB is estimated to have increased to 1833 t. Last year, fishing mortality and SSB in 2008 were estimated to be 0.64 and 1500 t; this year's estimates for 2008 are 0.71 and 1653 t, an upward revision of 11% and 10% respectively. It should be noted that the $F_{(bar)}$ age range was revised at WKFLAT in 2010 and is now for ages 3 to 6.

There is now no bias in the retrospective analysis. Historical stock trends are strongly converged. The most recent estimates of F show a slight underestimation with a slight overestimation in SSB.

State of the stock

A summary of the final assessment is given in Table 8.2.12 and Figure 8.2.8. Spawning–stock biomass (SSB) was stable during the period 1981–1987, peaked above 5000 t during 1988–1990 following good recruitments in the mid-1980s, and then decreased to around 2400 t in 1995–1996. Since then SSB increased following the good 1996 year class but has subsequently declined steadily to the lowest level in the time-series of around 1650 t in 2008. The SSB estimate for 2009 shows a slight increase from this level.

Fishing mortality showed a gradually increasing trend up until the mid 1990s, then a slight decline followed by a sharp increase up to 2007. This assessment shows a reduction in F in 2008 followed by a larger reduction again in 2009. The decline in F in 2009 is evidenced by a large reduction in effort observed for the UK beam trawl survey and a corresponding reduction in Belgian beam trawl effort although the decline in F may be overestimated.

Two periods of below average recruitments in the period 1989–1994 and from 1998–2006 have contributed to the decrease in yield and SSB. This assessment estimates that only two year classes have been above the long-term GM_{80-07} (5981) since 2000.

8.2.3 Short-term projections

In recent years, no catch forecast has been provided by the Working Group due to the persistent strong bias in the estimation of F in the most recent years, the degree of which was unpredictable.

Given the changes made to the assessment at the Benchmark meeting in February 2010, this bias was removed making it now suitable to provide more detailed management advice. This year's forecast was run with F scaled to the last year due to the large fall in F observed in the final year of the assessment.

Estimating year-class abundance

The 2007 year class is now estimated at 5.7 million at age 1, which is over four times the estimate from last year's assessment (1.4 million) which was the lowest value in the time-series. This year's estimate shows that UK-WEC-BTS survey takes 57% of the weight, the UK (E&W) FSP taking 42% of the weight and the remainder coming from F shrinkage.

The 2008 year class is estimated to be around 2.0 million with 92% of the weight coming from the UK-WEC-BTS. This is the lowest value in the time-series but given the revised estimate of the 2007 year class, this should be considered to be highly uncertain.

Working Group estimates of year-class strength used for prediction can be summarised as follows:

Recruitment-at-age 1.

Year class	Thousands	Basis	Surveys	Commercial	Shrinkage
2007	5686	XSA	98%	-	2%
2008	1962	XSA	92%	-	8%
2009	4969	GM (89–07)	-	-	-
2010	4969	GM (89–07)	-	-	-

The input values for the catch forecast (using the MFDP software) are given in Table 8.2.13. The F at age values used were calculated as the mean of the XSA values from 2007–2009, scaled to the final year. Catch and stock weights-at-age were also the mean of the period 2007–2009. Stock numbers-at-age in 2010 for ages 2 and older were obtained from the XSA. SSB values are calculated for 1 January.

Table 8.2.14 gives the management option table from the *status quo* catch prediction, and short-term results are shown in Figure 8.2.10. Assuming *status quo* F (Fsq = 0.44) implies landings of 1079 t in 2010 and 1040 t in 2011. (The TAC for 2010 is 4274 t. for VIId,e). SSB is predicted to rise from 2165 t in 2010 to 2337 t in 2011 and 2439 t in 2011. These results are discussed further in Section 8.2.10.

The detailed output for the *status quo* F forecast by age group is given in Table 8.2.15, and the estimated contributions of recent year classes to the predicted catches and SSBs are given in Table 8.2.16. The assumptions of $GM_{1989\text{-}07}$ recruitment are predicted to contribute 13% to the landings in 2011 and 33% to SSB in 2012.

The stock and recruitment scatter plot is given in Figure 8.2.11.

8.2.4 FMSY evaluation

To derive an F_{MSY} estimate the SRMSYMC package was employed and F_{msy} was calculated based on the three common stock–recruit relationships; Ricker, Beverton–Holt and smooth Hockey stick. Figure 8.2.12 illustrates the curves and the percentiles of estimates with converged F_{MSY} values for the three models estimated by the package. Models were fitted using 1000 MCMC re-samples. For all three stock–recruit relationships (SRR), all re-samples allowed F_{MSY} and F_{crash} values to be determined. All three models show that there is little evidence of a stock–recruitment relationship with only limited information as to the trends at extreme levels of SSB.

The smooth hockey stick model showed a 'break-off' point in the SRR that was inconsistent with the data and as such was rejected. The yield-per-recruit estimates were highly uncertain with high CV's. Therefore these estimates were also rejected. The yield-per-recruit output from the model is shown in Figure 8.2.15.

Figures 8.2.13–8.2.14 show box plots of F_{MSY} and F_{crash} together with values of F_{pa} and F2009 (F_{lim} is not defined) for the Ricker and the Beverton–Holt SRR models. The two SRR models have very different levels of estimated F_{MSY}.

The full diagnostics for all model fits are shown at Table 8.2.18 and Figure 8.2.16.

Therefore, the suggested level of F_{MSY} for this stock is F's within the range of 0.14 and 0.31.

STOCK–RECRUIT RELATIONSHIP MODEL	FMSY	FCRASH
Ricker	0.312	0.750
Beverton–Holt	0.143	0.781

8.2.5 Biological reference points

ICES previously defined the following precautionary reference points.

F_{lim}	Not defined	F_{pa}	0.45	(low probability that SSBMT<B_{pa})
B_{lim}	1300 t (equal to B_{loss})	B_{pa}	2500 t	(equal to M_{BAL})

However the Working Groups since 2004 had considered the biological reference points for this stock as unreliable for the following reasons:

- The stock–recruitment relation shows no evidence of reduced recruitment at low stock levels;
- The basis for B_{pa} is weak, and heavily dependent on two consecutive points (1985 and 1986);
- F_{pa} is based on B_{pa}, and then this reference point is also rejected;
- WKFLAT 2010 examined the stock dynamics provided by the migration model to determine appropriate biological reference points for this stock on the basis of the new assessment. It concluded that the historical reference points for this stock were no longer appropriate as the new assessment indicated significant changes to the historical perspective of the stock caused by the inclusion of catches from VIId in the VIIe plaice stock. WKFLAT 2010 provided a number of options for the preferred assessment methodology none of which are entirely satisfactory, but suggested that a $B_{trigger}$ could reasonably be set at 2200 t provided that the move towards a suitable proxy of F_{msy} is effective to avoid further deterioration of SSB. F_{msy} for plaice needs to consider the management target set for sole 7e as plaice are taken largely as a bycatch in the same fisheries, and because there is a currently accepted management target of F=0.27 for sole VIIe.

The current assessment with the VIId migration correction shows a 'scaled-up' time-series of SSB compared to last year's assessment. This shows that SSB has been below 2500 t (B_{pa}) since 2003. Increases to SSB have been observed since then and recruitment does not appear to have been limited. F has been between 0.55 and 0.75 for almost the entire time-series, well above F_{pa}, without apparent stock collapse.

Yield-per-recruit analysis

Results for the deterministic yield and SSB per recruit (using program MFYPR), conditional on the recent exploitation pattern, are given in Table 8.2.17 and Figure 8.2.10. F_{max} is given by a reference F of 0.27, around 62% of $F_{sq.}$ Long-term yield and SSB (at F_{sq} and assuming GM_{89-07} recruitment = 4.969 million) are given as 1450 t and 3220 t respectively.

8.2.6 Management plans

There is no management plan in place for this stock.

8.2.7 Uncertainties and bias in assessment and forecast

The WKFLAT (2010) Benchmark Assessment reviewed the stock identity, data and assessment model suggesting modifications to resolve long-term problems with the assessment, particularly the retrospective bias. As a result, the retrospective bias has been reduced and provision of a short-term forecast is now possible. The revision introduced new uncertainties into a portion of the data (~10%). A spawning migration correction assumes that a constant 15% of quarter 1 catches in VIId to originate from VIIe, based on historical tagging information. This proportion makes no provision for changes in the relative sizes of the two populations. In addition, this correction utilises the age structure of the VIId catches, representing a mix of age structure from VIIe, VIId and portions of the Area IV populations migrating into VIId for spawning.

There is a heavy reliance on the age composition data derived from UK (E&W) sample data. Around 20% of the landings for this stock come from countries that do not provide age based data and this situation is improved only slightly once the migration correction data from VIId is added in. Survivor estimates for ages 1 and 2 almost entirely come from the UK survey data and some consideration should be given to using age 2 information from the commercial tuning fleets.

UK Discard data indicate low discard levels in the second half of the year, and overall that discarding for this stock is variable but relatively low compared to other plaice stocks. As the time-series of data expands, the WG will be able to better determine how to include this data in the assessment appropriately.

Both the UK-WEC_BTS and the UK (E&W) FSP surveys are spatially restricted to the same area as the commercial tuning fleets and little information exists on stock dynamics on the French coast.

8.2.8 Recommendation for next Benchmark

A benchmark assessment was carried out for this stock in February 2010.

8.2.9 Management considerations

The assessment model developed at WKFLAT 2010 includes an element of catch and associated age based data from the adjacent ICES plaice stock in VIId. Therefore a reciprocal removal of this data must occur with that stock. This adjustment is made to account for the spawning migration that occurs between the two areas. However, WKFLAT recognised that this is based on historical tagging information that assumes the historical patterns of migration has persisted and that the relative size of the sub-populations is roughly stable. WKFLAT suggested that tagging experiments should be reinitiated to provide a more up-to-date and precise estimate of the level of migration.

The stock unit (Division VIIe) does not correspond with the management unit (Divisions VIId and VIIe). This hampers effective management of plaice in the Western English Channel, but because components of the VIIe stock are also taken during spawning time in Area VIId, some provision must be made in management to accommodate effective management of both plaice stocks.

Plaice are taken as a bycatch in the beam trawl fishery mainly targeting sole, and as part of a mixed demersal fishery by otter trawlers. Therefore the restrictions under the management plan for sole should also benefit the plaice stocks. In addition to the days-at-sea regulations there has been a recent UK decommissioning scheme that has reduced the number of beam trawlers in the southwest fleet. Fishing mortality in 2009 is estimated to have declined heavily which is consistent with the decline observed in beam trawl effort in 2009.

The assessment is now able to accurately estimate recent trends in F and historical trends are estimated with some certainty. Fishing mortality is estimated to be well above long-term targets with some certainty.

Table 8.2.1 Plaice in VIIe. Nominal landings (t) in Division VIIe, as used by Working Group.

Year	Belgium	Denmark	France	UK (Engl. & Wales)	Others	Total reported	Unallocated[1]	Total	VIIe stock caught in VIId[4]	As used by WG
1976	5	- [3]	323	312	-	640	-	640	-	640
1977	3	- [3]	336	363	-	702	-	702	-	702
1978	3	- [3]	314	467	-	784	-	784	-	784
1979	2	- [3]	458	515	-	975	2	977	-	977
1980	23	- [3]	325	609	9	966	113	1079	136	1215
1981	27	-	537	953	-	1517	-16	1501	245	1746
1982	81	-	363	1109	-	1553	135	1688	250	1938
1983	20	-	371	1195	-	1586	-91	1495	259	1754
1984	24	-	278	1144	-	1446	101	1547	266	1813
1985	39	-	197	1122	-	1358	83	1441	310	1751
1986	26	-	276	1389	- [1]	1691	119	1810	351	2161
1987	68	-	435	1419	-	1922	36	1958	430	2388
1988	90	-	584	1654	-	2328	130	2458	536	2994
1989	89	-	448 [1]	1708	2	2247	111	2358	450	2808
1990	82	2	N/A [2]	1885	18	1987	606	2593	465	3058
1991	57	-	251 [1]	1323	16	1647	201	1848	402	2250
1992	25	-	419	1102	14	1560	64	1624	326	1950
1993	56	-	284	1080	24	1444	-27	1417	274	1691
1994	10	-	277	998	3	1288	-132	1156	315	1471
1995	13	-	288	857	-	1158	-127	1031	264	1295
1996	4	-	279	855	-	1138	-94	1044	277	1321
1997	6	-	329	1038	1	1374	-51	1323	331	1654
1998	22	-	327	892	1	1242	-111	1131	299	1430
1999	12	-	194 [1]	947	-	1153	118	1271	345	1616
2000	4	-	360	926	+	1290	-9	1281	397	1678
2001	12	-	303	797	-	1112	-6	1106	273	1379
2002	27	-	242	978	+	1253	4	1257	351	1608
2003	39	-	216	985	-	1217	1	1218	260	1478
2004	46	-	184	912	-	1142	12	1154	248	1402
2005	48	-	198	887	-	1133	66	1199	171	1370
2006	52	-	223	966	-	1241	72	1313	153	1466
2007	84	-	201	677	-	962	41	1003	181	1184
2008	66	-	105	669	-	840	134	974	170	1144
2009	60	-	-	724	3	787	129	916	127	1043

[1]Estimated by the Working Group.

[2]Divisions VIId,e = 4,739 t.

[3]Included in Division VIId

[4]Migration correction (15% of VIId Qtr 1) added to stock.

Table 8.2.2 Division VIIe PLAICE effort and CPUE data.
The UK (E&W) data are for vessels > 12m and are corrected for fishing power (based on GRT). All effort data are in fishing hours, CPUE data are in kg/hr for the commercial fleets and in kg/10 km towed for the autumn beam trawl survey .

Year	(CPUE) (kg/hr).						Effort (000 hours)		Landings (tonnes)		(CPUE) (kg/10 km)
	West Sector		North Sector		South Sector						
	Otter	Beam	Otter	Beam	Otter	Beam	Otter	Beam	Otter	Beam	Survey
1972	2.31	-	4.50	-	0.00	-	64.60	-	194.36	-	-
1973	2.25	-	3.85	-	0.00	-	69.54	-	200.45	-	-
1974	1.65	-	3.47	-	2.94	-	50.09	-	121.03	-	-
1975	1.78	-	3.53	-	2.54	-	54.69	-	132.95	-	-
1976	1.89	-	3.62	-	4.14	-	56.13	-	144.56	-	-
1977	1.37	-	3.10	-	4.96	-	55.40	-	117.72	-	-
1978	1.61	5.41	3.63	10.35	4.24	11.84	48.80	22.09	114.02	204.69	-
1979	1.84	4.16	4.58	7.37	1.64	6.58	49.92	39.38	142.52	233.81	-
1980	2.02	3.15	5.82	6.06	0.67	6.45	49.95	62.16	150.69	335.16	-
1981	2.61	4.44	10.98	8.35	7.30	8.33	46.88	65.29	257.28	471.20	-
1982	3.28	4.43	10.77	9.23	0.00	7.69	38.51	81.59	249.60	611.52	-
1983	2.57	2.76	11.03	9.64	8.10	5.71	52.59	103.07	303.04	612.16	-
1984	2.95	4.08	10.92	10.38	2.43	7.80	52.89	87.63	281.94	575.22	-
1985	2.60	3.79	8.81	9.00	0.09	6.38	57.69	92.19	255.86	540.61	15.21
1986	3.25	6.30	10.94	12.21	10.17	6.85	49.52	76.33	315.08	602.07	16.46
1987	3.56	5.37	11.02	9.69	3.63	7.45	45.11	87.05	329.97	672.81	20.59
1988	3.90	3.50	15.38	6.51	5.04	4.85	53.40	103.36	433.20	564.72	25.34
1989	2.69	6.50	10.87	14.25	1.42	6.88	54.71	109.95	315.73	900.19	14.80
1990	2.95	6.52	7.77	15.64	3.55	10.17	53.05	100.95	268.81	990.05	11.60
1991	2.80	6.16	5.08	13.24	0.41	7.47	40.79	83.57	152.93	721.46	8.72
1992	1.92	6.30	3.51	10.61	3.06	9.69	39.91	80.87	105.41	695.70	7.45
1993	1.39	6.14	3.03	11.04	5.46	7.17	39.17	83.92	81.77	655.48	6.16
1994	1.46	4.62	2.48	9.17	2.11	6.47	38.77	100.42	63.67	650.99	5.70
1995	1.61	4.60	1.99	6.29	2.36	5.40	35.45	100.80	60.20	531.06	5.13
1996	2.00	3.09	2.49	6.66	11.62	4.39	30.54	116.45	64.83	482.18	5.97
1997	2.69	3.50	3.08	7.16	1.56	5.58	33.28	108.39	99.05	561.74	9.82
1998	1.65	2.97	4.13	6.10	1.85	3.03	29.80	111.17	73.30	459.22	8.74
1999	1.39	3.49	3.60	8.55	1.11	4.59	27.52	103.56	59.67	576.76	8.42
2000	0.81	2.98	4.00	6.63	1.25	3.72	30.49	118.83	61.82	541.33	11.31
2001	0.89	2.30	3.03	5.45	3.14	3.61	31.90	143.27	48.82	527.38	10.56
2002	0.90	2.90	4.18	6.52	0.56	3.45	28.35	139.83	57.44	651.04	8.05
2003	0.96	3.26	2.10	8.18	0.50	2.89	25.06	159.95	36.88	743.07	7.96
2004	0.88	3.38	2.01	6.16	0.19	2.80	25.58	158.68	37.98	701.17	4.53
2005	0.88	2.62	2.13	8.20	3.48	2.75	21.13	157.81	29.44	691.27	7.02
2006	0.96	2.68	3.41	6.97	1.71	2.50	21.06	161.44	28.57	665.16	7.47
2007	0.68	1.71	1.95	4.55	1.31	2.13	22.35	158.01	27.27	472.27	7.94
2008	0.94	1.83	2.07	4.88	0.71	2.06	19.86	158.50	25.72	465.09	8.18
2009	1.26	2.62	2.23	7.59	1.78	3.48	21.40	122.53	32.45	521.17	12.85

Table 8.2.3. Plaice in VIIe. Annual length distribution by fleet (2009)

Length (cm)	UK (England & Wales) Beam trawl	All gears (excl. beam)
23	43	112
24	0	544
25	3142	2694
26	22054	12196
27	47104	25147
28	77147	47446
29	101185	61758
30	105559	61043
31	125512	61622
32	147176	51168
33	124418	44881
34	107038	38625
35	87257	27375
36	65046	21741
37	45314	16069
38	38344	12542
39	25152	8871
40	22212	5664
41	16959	5955
42	14118	3022
43	9052	2531
44	7910	2210
45	7402	2112
46	5177	1199
47	4149	1039
48	3442	1042
49	2318	775
50	1851	572
51	2133	684
52	1788	134
53	1175	278
54	1125	424
55	1399	223
56	901	119
57	344	150
58	703	205
59	557	93
60	149	78
61	42	55
62	0	5
63	155	0
64	0	236
65	11	
66	0	
67	21	
68	8	
Total	1226591	522639

Table 8.2.4 Plaice in VIIe. Catch numbers-at-age.

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	19	41	72	3	77	3	10	74	12	10
2	814	723	310	790	970	727	1025	1258	1932	352
3	800	2268	2131	893	1864	1605	2532	2303	5179	2960
4	252	591	1420	1702	702	1399	963	1407	1160	3014
5	230	120	263	593	531	157	488	657	464	843
6	62	103	89	104	197	255	116	233	155	274
7	63	21	83	41	92	142	129	90	116	121
8	23	47	17	50	30	28	68	52	40	97
9	13	19	28	2	33	16	29	45	25	32
+gp	138	95	122	100	51	52	62	52	53	101
TOTALNUM	2415	4027	4534	4276	4546	4383	5421	6170	9136	7805
TONSLAND	1215	1746	1938	1754	1813	1751	2161	2388	2994	2808
SOPCOF%	100	100	100	100	100	100	100	100	100	100

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	57	41	90	36	84	6	15	7	7	19
2	391	691	841	844	409	421	1160	963	636	678
3	3408	1352	1430	1488	1707	818	774	2443	1732	2480
4	2757	1943	760	650	878	986	403	486	1158	1219
5	1222	973	654	266	256	269	392	185	159	414
6	272	528	452	272	111	120	127	155	66	94
7	135	106	264	219	119	58	60	80	61	38
8	80	46	72	171	83	84	41	34	23	40
9	57	33	33	40	86	69	48	18	21	17
+gp	73	51	50	86	65	90	107	101	63	46
TOTALNUM	8451	5764	4646	4071	3797	2920	3127	4472	3926	5046
TONSLAND	3058	2250	1950	1691	1471	1295	1321	1654	1430	1616
SOPCOF%	100	100	100	100	100	100	100	100	100	100

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE										
1	46	6	188	23	21	22	18	3	5	5
2	399	585	1400	1004	600	831	1089	428	1015	735
3	1331	946	1251	1208	1644	1034	1448	1168	781	1328
4	2069	795	597	622	600	858	543	723	563	288
5	496	950	428	207	349	282	388	287	252	143
6	181	145	511	172	102	146	121	196	107	74
7	38	79	116	224	75	52	60	70	83	29
8	14	19	49	54	96	50	29	30	32	20
9	22	12	13	41	44	53	22	10	15	7
+gp	52	37	42	39	38	44	45	49	28	16
TOTALNUM	4648	3574	4595	3594	3569	3372	3764	2962	2882	2646
TONSLAND	1678	1379	1608	1478	1402	1370	1466	1184	1144	1043
SOPCOF%	100	100	100	100	100	100	100	100	100	100

Table 8.2.5 Plaice in VIIe. Catch weights-at-age.

Table 2 Catch weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.248	0.144	0.186	0.106	0.136	0.098	0.171	0.252	0.134	0.156
2	0.337	0.268	0.273	0.221	0.238	0.214	0.257	0.288	0.215	0.217
3	0.428	0.389	0.36	0.33	0.343	0.328	0.346	0.337	0.303	0.285
4	0.519	0.507	0.447	0.432	0.447	0.437	0.438	0.403	0.399	0.36
5	0.612	0.622	0.532	0.529	0.55	0.543	0.533	0.48	0.504	0.44
6	0.706	0.733	0.619	0.617	0.654	0.644	0.632	0.572	0.618	0.528
7	0.801	0.841	0.702	0.699	0.757	0.743	0.734	0.679	0.74	0.622
8	0.898	0.946	0.786	0.775	0.861	0.837	0.84	0.799	0.87	0.723
9	0.996	1.047	0.869	0.844	0.965	0.928	0.95	0.933	1.009	0.83
+gp	1.404	1.387	1.217	1.027	1.39	1.253	1.427	1.388	1.357	1.122
SOPCOFAC	0.9999	1.0007	0.9999	1.0003	1.0000	0.9996	0.9993	0.9997	0.9991	1.0001

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.236	0.194	0.242	0.212	0.201	0.213	0.173	0.188	0.179	0.107
2	0.267	0.245	0.282	0.269	0.258	0.281	0.266	0.259	0.239	0.196
3	0.308	0.306	0.335	0.332	0.322	0.353	0.36	0.334	0.294	0.282
4	0.359	0.377	0.401	0.405	0.391	0.429	0.455	0.412	0.411	0.364
5	0.421	0.456	0.481	0.484	0.464	0.507	0.551	0.494	0.526	0.444
6	0.493	0.545	0.574	0.571	0.543	0.588	0.647	0.58	0.638	0.521
7	0.577	0.643	0.68	0.667	0.628	0.674	0.743	0.669	0.747	0.596
8	0.67	0.75	0.799	0.769	0.717	0.763	0.84	0.762	0.853	0.667
9	0.775	0.866	0.933	0.88	0.812	0.855	0.938	0.86	0.958	0.735
+gp	1.078	1.221	1.317	1.202	1.117	1.055	1.17	1.11	1.274	0.95
SOPCOFAC	0.9996	1.0004	0.9996	1.0000	1.0002	0.9998	1.0006	0.9992	1.0004	1.0000

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE										
1	0.117	0.167	0.193	0.147	0.254	0.226	0.206	0.186	0.208	0.096
2	0.204	0.231	0.246	0.25	0.293	0.287	0.276	0.259	0.279	0.238
3	0.29	0.305	0.306	0.352	0.342	0.354	0.352	0.334	0.356	0.376
4	0.375	0.384	0.372	0.45	0.4	0.426	0.434	0.412	0.438	0.509
5	0.459	0.468	0.446	0.548	0.468	0.504	0.521	0.493	0.526	0.637
6	0.542	0.558	0.525	0.641	0.545	0.586	0.614	0.577	0.619	0.761
7	0.624	0.654	0.612	0.734	0.632	0.674	0.712	0.663	0.718	0.88
8	0.705	0.754	0.706	0.822	0.728	0.766	0.814	0.752	0.822	0.995
9	0.784	0.861	0.806	0.91	0.833	0.864	0.923	0.844	0.932	1.105
+gp	1.029	1.272	1.137	1.231	1.189	1.106	1.165	1.095	1.27	1.347
SOPCOFAC	0.9997	1.0001	0.9998	1.0003	1.0005	1.0002	1.0003	1.0001	1.0002	0.9994

Table 8.2.6 Plaice in VIIe. Stock weights-at-age.

Table 3 Stock weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.1140	0.1260	0.1080	0.1160	0.1110	0.1120	0.0960	0.0680	0.1030	0.1380
2	0.2270	0.2500	0.2140	0.2280	0.2220	0.2220	0.1950	0.1450	0.1840	0.2000
3	0.3380	0.3730	0.3180	0.3350	0.3340	0.3310	0.2970	0.2320	0.2750	0.2700
4	0.4470	0.4920	0.4190	0.4360	0.4460	0.4380	0.4010	0.3260	0.3730	0.3470
5	0.5540	0.6090	0.5170	0.5320	0.5600	0.5430	0.5070	0.4290	0.4810	0.4310
6	0.6600	0.7250	0.6150	0.6230	0.6730	0.6470	0.6150	0.5390	0.5980	0.5220
7	0.7640	0.8380	0.7100	0.7100	0.7880	0.7490	0.7270	0.6590	0.7230	0.6200
8	0.8670	0.9490	0.8020	0.7910	0.9030	0.8490	0.8400	0.7880	0.8580	0.7250
9	0.9670	1.0570	0.8930	0.8670	1.0180	0.9480	0.9550	0.9240	1.0020	0.8370
+gp	1.3510	1.4350	1.2550	1.0940	1.4980	1.3290	1.4420	1.3470	1.3630	1.1430

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.2360	0.1820	0.2350	0.1880	0.1880	0.1910	0.1340	0.1710	0.1690	0.0690
2	0.2620	0.2320	0.2690	0.2410	0.2480	0.2620	0.2330	0.2480	0.2250	0.1710
3	0.3000	0.2920	0.3170	0.3020	0.3140	0.3360	0.3330	0.3290	0.2540	0.2700
4	0.3490	0.3620	0.3780	0.3710	0.3850	0.4130	0.4340	0.4140	0.3820	0.3650
5	0.4080	0.4420	0.4540	0.4470	0.4620	0.4950	0.5350	0.5030	0.5070	0.4570
6	0.4790	0.5310	0.5430	0.5310	0.5450	0.5800	0.6370	0.5960	0.6290	0.5450
7	0.5610	0.6310	0.6460	0.6230	0.6330	0.6680	0.7390	0.6940	0.7490	0.6310
8	0.6540	0.7400	0.7630	0.7230	0.7280	0.7600	0.8420	0.7950	0.8660	0.7120
9	0.7580	0.8580	0.8930	0.8300	0.8280	0.8560	0.9450	0.9010	0.9800	0.7910
+gp	1.0640	1.2230	1.2740	1.1450	1.1500	1.0640	1.1910	1.1760	1.3260	1.0400

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE										
1	0.0820	0.1390	0.1800	0.1000	0.2460	0.2050	0.1770	0.1560	0.1750	0.0230
2	0.1810	0.2040	0.2330	0.2110	0.2820	0.2660	0.2480	0.2290	0.2430	0.1670
3	0.2790	0.2770	0.2930	0.3190	0.3270	0.3340	0.3230	0.3050	0.3170	0.3080
4	0.3760	0.3560	0.3600	0.4250	0.3830	0.4060	0.4050	0.3850	0.3960	0.4430
5	0.4720	0.4410	0.4350	0.5290	0.4480	0.4840	0.4920	0.4670	0.4810	0.5740
6	0.5670	0.5310	0.5160	0.6300	0.5230	0.5670	0.5840	0.5510	0.5720	0.7000
7	0.6600	0.6270	0.6050	0.7280	0.6080	0.6560	0.6820	0.6390	0.6680	0.8210
8	0.7520	0.7290	0.7010	0.8240	0.7020	0.7490	0.7860	0.7300	0.7690	0.9380
9	0.8420	0.8360	0.8050	0.9180	0.8070	0.8490	0.8950	0.8230	0.8760	1.0500
+gp	1.1220	1.2530	1.1480	1.2630	1.1600	1.0950	1.1390	1.0780	1.2070	1.2980

Table 8.2.7 UK-WECBTS effort standardised plaice abundance indices

age year	0	1	2	3	4	5	6	7	8	9	10+
1985	0.00	82.16	75.37	72.36	113.06	20.35	15.83	8.29	0.75	0.00	2.26
1986	0.00	61.62	86.67	168.60	64.33	23.70	2.71	12.19	1.35	0.00	1.35
1987	0.74	398.98	110.17	104.21	54.34	27.54	21.59	10.42	5.95	5.95	2.98
1988	0.00	108.40	289.33	265.15	75.65	17.16	8.58	7.80	3.12	4.68	3.12
1989	0.00	18.71	42.26	169.63	113.49	13.88	6.64	8.45	4.83	3.62	10.87
1990	0.00	14.23	21.63	125.24	49.53	42.70	1.14	3.42	0.57	3.42	3.98
1991	1.16	12.81	15.73	36.70	46.02	36.11	23.88	5.24	0.00	0.58	1.75
1992	0.00	77.31	22.38	36.62	12.21	20.35	10.17	8.65	1.53	2.54	2.03
1993	0.00	11.10	37.00	31.71	12.69	6.87	13.21	6.87	5.81	1.06	1.06
1994	0.00	16.52	15.54	47.60	14.57	4.86	0.97	4.37	6.31	3.89	0.97
1995	0.00	26.72	24.58	24.04	25.65	6.41	2.14	2.67	3.21	0.53	2.14
1996	0.54	17.90	57.49	16.27	9.22	13.56	2.71	0.54	1.63	3.80	4.34
1997	0.00	28.69	66.04	106.63	12.99	3.25	6.50	3.79	0.54	0.54	3.79
1998	0.00	43.67	67.39	67.39	45.83	4.85	3.23	3.77	2.16	0.00	1.62
1999	0.53	20.22	23.42	96.86	28.21	15.97	1.60	1.06	3.19	2.13	1.06
2000	0.00	26.57	34.79	69.51	99.00	21.13	12.30	0.60	1.11	0.00	2.77
2001	11.52	17.91	35.78	28.65	62.57	54.75	13.79	7.08	0.00	1.69	2.81
2002	0.00	76.78	56.50	48.17	12.91	13.06	22.18	2.97	1.11	0.00	1.11
2003	0.00	15.82	75.35	32.84	27.52	2.47	9.91	14.86	3.96	0.00	1.10
2004	0.00	6.71	19.82	35.67	14.03	6.10	1.83	0.61	6.10	0.00	2.44
2005	0.80	16.31	40.42	48.71	37.42	6.90	1.71	1.43	2.81	1.18	1.47
2006	0.00	29.77	55.43	55.78	16.45	16.89	1.44	2.06	0.00	2.44	1.08
2007	0.00	20.44	50.35	66.58	18.67	14.93	3.31	3.04	0.28	1.38	2.21
2008	0.00	8.54	83.46	38.71	17.67	6.87	4.48	5.44	2.00	0.57	1.72
2009	1.74	9.40	90.88	124.18	16.93	8.50	6.36	4.65	2.68	0.58	1.45

Table 8.2.8 Plaice in VIIe. Tuning fleet data available (data in bold have been used for tuning)

W.CHANNEL PLAICE 2010 WGCSE									
105	idh	06/05/2010							
UK-WEC-BTS									
1986	2009								
1	1	0.75	0.8						
1	8								
147.68	91	128	249	95	35	4	18	2	0
134.34	536	148	140	73	37	29	14	8	8
128.23	139	371	340	97	22	11	10	4	6
165.66	31	70	281	188	23	11	14	8	6
175.66	25	38	220	87	75	2	6	1	6
171.68	22	27	63	79	62	41	9	0	1
196.6	152	44	72	24	40	20	17	3	5
189.19	21	70	60	24	13	25	13	11	2
205.87	34	32	98	30	10	2	9	13	8
187.15	50	46	45	48	12	4	5	6	1
184.37	33	106	30	17	25	5	1	3	7
184.74	53	122	197	24	6	12	7	1	1
185.49	81	125	125	85	9	6	7	4	0
187.89	38	44	182	53	30	3	2	6	4
180.37	48	63	125	179	38	22	1	2	0
177.98	32	64	51	111	97	25	13	0	3
179.74	138	102	87	23	23	40	5	2	0
182.24	29	137	60	50	5	18	27	7	0
163.99	11	33	59	23	10	3	1	10	0
186.6	30	75	91	70	13	3	3	5	2
184.74	55	102	103	30	31	3	4	0	5
181.02	37	91	121	34	27	6	6	1	3
174.66	15	146	68	31	12	8	10	4	1
172.05	16	156	214	29	15	11	8	5	1
UK-WECOT									
1988	2009								
1	1	0	1						
3	9								
53.402	754.5	116.9	51.5	15.1	10	3.4	1.9		
54.707	494	359.7	77	26.5	7	5.9	0.8		
53.05	347.1	265.9	85.3	18.4	11.3	6	2.8		
40.789	89.5	134.9	64.8	30.3	6.3	2.7	1.9		
39.909	71.7	46.3	40.1	25.5	12.9	3.9	1.3		
39.24	76.1	33.1	12	12.2	9.8	7.7	1.7		
38.768	86.1	37.1	9.8	3.5	4.4	2.4	2.7		
35.453	47.8	48.8	10.8	5.7	1.3	2.7	2.2		
30.541	39.8	16.3	14.5	4	2	1	1.2		
33.281	180.1	14.6	5.5	4.3	1.6	0.6	0.3		
29.802	96.2	61.3	6.4	2.4	1.6	0.4	0.5		
27.516	90.1	34.6	14.3	2.8	1.1	0.9	0.3		
30.493	49.6	64.4	13.3	6.5	1.3	0.5	0.8		
31.9	31.3	29.3	31.5	4.4	2.6	0.5	0.3		
28.346	57.1	17.9	12.6	15.6	3.3	1.4	0.5		
25.06	33.2	15.8	5.1	3.5	4.3	1.2	0.6		
25.584	50.7	18.2	10.5	2.8	1.4	2.1	1.1		
21.129	24.1	17.6	5.7	2.6	0.8	0.8	0.8		
21.058	32.4	9.9	6.5	1.9	1	0.4	0.3		
22.347	36.6	18.6	5.3	2.8	1	0.3	0.1		
19.855	19.2	12.2	5.4	1.9	1.2	0.6	0.3		
21.398	43.8	8.6	3.5	1.8	0.7	0.5	0.1		

Table 8.2.8 (Cont.) Plaice in VIIe. Tuning fleet data available (data in bold have been used for tuning)

UK-WECBT								
1989	2009							
1	1	0	1					
3	9							
109.947	922.6	784.7	210.1	96.9	48.9	35.2	7.5	
100.947	1053.9	826.9	326.5	77.2	54.4	23.5	13.1	
83.574	365.7	641.3	355.6	159.9	35.7	11.3	8.1	
80.865	465.5	308	293.7	172	89.2	25.9	9.7	
83.918	543.6	248.2	102.7	114.7	89.6	66.6	14.3	
100.415	659	312.7	104.4	43.1	53.3	34.7	38	
100.797	285.7	343.6	101.6	51.4	18.9	34.3	33.5	
116.446	221.8	115	126.4	41.1	21.5	12.6	19.2	
108.388	683.6	76.7	43.9	46.9	20.7	9.6	5.4	
111.171	413.3	297.9	48.6	26.1	26.7	8.8	8.8	
103.555	747.8	274.5	135.3	40	14.4	16	8	
118.833	388.4	529.8	111.8	54.7	11	5.4	6.8	
143.272	248.7	283.6	393.2	61	35	7.4	4	
139.832	497.3	164.6	148.5	197.6	46.8	19.2	4.5	
159.894	495.5	260.2	95	81.9	116.1	26.8	22.9	
158.681	690	299.6	168.3	49.9	40.1	51.6	24.9	
157.812	464.1	355.3	136.4	71.6	24.9	23	27.3	
161.44	599	202.1	159.3	52.5	27.5	11.2	8.3	
158.005	416.7	246.1	100.2	67.6	27.3	13.2	4.3	
158.501	261.7	187.1	94.7	41.4	25.5	14.1	6.3	
122.528	617.7	135.5	63.3	34.8	11.4	10.4	4	
UK-WECOT (historic)								
1976	1987							
1	1	0	1					
2	9							
22.771	13.7	80.4	20.2	14.2	7.5	7.7	4.8	1.8
21.194	60.1	29.4	25.8	8.1	4.8	3	4.5	1.4
16.823	18.8	71.1	8	10.6	3.8	2.3	2	1.6
16.981	42.5	57.1	44.5	5.7	6.1	2.9	1.9	1.2
13.647	53.1	50.8	14.7	13.4	4	4.2	1.4	1
15.172	76.6	216.2	44.4	11	10.3	1.8	5	1.6
14.422	27	169.1	111.9	19.5	7.1	7.3	1.1	2.6
19.117	103.7	102.2	173.4	75.3	12.4	4.8	5.5	0.3
15.8	100.5	155	49.7	40.6	16.3	7.7	2.2	3.2
17.545	60.5	129.6	102.4	12.9	21.2	13.4	2.1	0.4
20.758	108.3	254.8	77.8	44.1	8.2	12.9	7.4	3.3
17.995	116.3	208.7	124.7	62.2	22	5.6	4.2	4.1
UK(E+W) FSP								
2003	2009							
1	1	0.75	0.8					
2	8							
1	0.295	0.32	0.159	0.061	0.047	0.09	0.038	0.025
1	0.288	0.567	0.22	0.13	0.022	0.038	0.047	0.019
1	0.296	0.362	0.235	0.086	0.044	0.01	0.016	0.032
1	0.492	0.375	0.175	0.097	0.036	0.027	0.006	0.008
1	0.132	0.294	0.139	0.068	0.034	0.01	0.006	0.005
-9	-9	-9	-9	-9	-9	-9	-9	-9
1	0.362	0.373	0.153	0.049	0.028	0.019	0.006	0.003

Table 8.2.9 Plaice in VIIe. Diagnostics

Lowestoft VPA Version 3.1

10/05/2010 9:25

Extended Survivors Analysis

W.CHANNEL PLAICE 2010 WGCSE

CPUE data from file c:\vpa\PLE7ETU5.dat

Catch data for 30 years. 1980 to 2009. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
UK-WEC-BTS	1986	2009	1	8	0.75	0.8
UK WECOT	1988	2009	3	9	0	1
UK WECBT	1989	2009	3	9	0	1
UK WECOT historic	1980	2009	2	9	0	1
UK (E+W) FSP	2003	2009	2	8	0.75	0.8

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 4 oldest ages.

S.E. of the mean to which the estimates are shrunk = 2.500

Minimum standard error for population
estimates derived from each fleet = .500

Prior weighting not applied

Tuning converged after 27 iterations

Regression weights

1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.011	0.001	0.032	0.006	0.005	0.005	0.007	0	0.001	0.003
2	0.149	0.169	0.387	0.219	0.206	0.227	0.351	0.201	0.209	0.168
3	0.512	0.562	0.587	0.615	0.604	0.589	0.696	0.71	0.612	0.421
4	0.615	0.599	0.769	0.593	0.647	0.669	0.645	0.835	0.826	0.433
5	0.652	0.58	0.689	0.601	0.718	0.656	0.665	0.776	0.721	0.457
6	0.527	0.362	0.647	0.596	0.615	0.686	0.594	0.769	0.682	0.432
7	0.522	0.416	0.499	0.595	0.509	0.663	0.612	0.75	0.805	0.357
8	0.417	0.481	0.452	0.419	0.499	0.7	0.905	0.651	0.868	0.409
9	0.496	0.635	0.625	0.782	0.644	0.512	0.699	0.783	0.71	0.421

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9
2000	4.55E+03	3.06E+03	3.53E+03	4.78E+03	1.10E+03	4.69E+02	9.90E+01	4.44E+01	5.86E+01
2001	5.23E+03	3.99E+03	2.34E+03	1.87E+03	2.29E+03	5.08E+02	2.46E+02	5.21E+01	2.60E+01
2002	6.30E+03	4.63E+03	2.99E+03	1.18E+03	9.13E+02	1.14E+03	3.14E+02	1.44E+02	2.86E+01
2003	3.88E+03	5.41E+03	2.79E+03	1.48E+03	4.86E+02	4.07E+02	5.29E+02	1.69E+02	8.11E+01
2004	4.92E+03	3.42E+03	3.85E+03	1.34E+03	7.23E+02	2.36E+02	1.99E+02	2.59E+02	9.86E+01
2005	4.43E+03	4.34E+03	2.47E+03	1.87E+03	6.21E+02	3.13E+02	1.13E+02	1.06E+02	1.39E+02
2006	2.83E+03	3.91E+03	3.07E+03	1.21E+03	8.48E+02	2.86E+02	1.40E+02	5.18E+01	4.67E+01
2007	6.43E+03	2.50E+03	2.44E+03	1.36E+03	5.65E+02	3.87E+02	1.40E+02	6.72E+01	1.86E+01
2008	5.69E+03	5.70E+03	1.81E+03	1.06E+03	5.22E+02	2.31E+02	1.59E+02	5.87E+01	3.11E+01
2009	1.96E+03	5.04E+03	4.10E+03	8.70E+02	4.13E+02	2.25E+02	1.04E+02	6.31E+01	2.19E+01

Table 8.2.3 Plaice in VIIe. Diagnostics (Cont.)

Estimated population abundance at 1st Jan 2010

0.00E+00	1.74E+03	3.78E+03	2.39E+03	5.01E+02	2.32E+02	1.30E+02	6.42E+01	3.71E+01

Taper weighted geometric mean of the VPA populations:

5.75E+03	5.32E+03	3.91E+03	1.90E+03	8.60E+02	4.11E+02	2.17E+02	1.15E+02	6.00E+01

Standard error of the weighted Log(VPA populations):

0.4954	0.4593	0.5007	0.5706	0.5578	0.5821	0.6168	0.6582	0.763

Log catchability residuals.

Fleet : UK-WEC-BTS

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	99.99	99.99	99.99	99.99	-0.3	1.79	0.8	-0.1
2	99.99	99.99	99.99	99.99	99.99	99.99	0.13	-0.32	0.94	-0.78
3	99.99	99.99	99.99	99.99	99.99	99.99	0.61	0.07	0.26	0.01
4	99.99	99.99	99.99	99.99	99.99	99.99	0.42	0.28	0.36	0.13
5	99.99	99.99	99.99	99.99	99.99	99.99	0.17	0.51	-0.07	-0.37
6	99.99	99.99	99.99	99.99	99.99	99.99	-0.57	0.86	0.14	-0.09
7	99.99	99.99	99.99	99.99	99.99	99.99	0.85	1.12	0.02	0.37
8	99.99	99.99	99.99	99.99	99.99	99.99	-0.87	0.68	0.53	0.13
9	No data for this fleet at this age									

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.44	-0.67	0.99	-0.13	0.13	-0.33	-0.62	-0.58	0.57	0.23
2	-0.54	-0.86	-0.63	-0.28	-0.36	0.06	-0.09	0.15	-0.34	-0.59
3	0.04	-0.26	-0.2	-0.51	-0.28	-0.14	-0.63	0.35	-0.15	-0.4
4	-0.45	-0.1	-0.52	-0.47	-0.41	-0.09	-0.33	-0.05	0.34	-0.26
5	0.02	0.11	-0.02	-0.2	-0.58	-0.34	0.22	-0.44	-0.2	0.17
6	-1.92	0.29	-0.24	0.43	-1.27	-0.5	-0.29	0.43	0.47	-0.35
7	-0.37	-0.15	-0.48	-0.31	-0.44	0.06	-1.54	0.56	0.16	-0.25
8	-1.67	99.99	-0.82	-0.28	0.1	-0.16	0.37	-0.86	0.63	0.59
9	No data for this fleet at this age									

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.24	-0.3	0.99	-0.12	-1.22	-0.24	0.82	-0.38	-1.13	0.02
2	0.22	0	0.47	0.47	-0.4	0.07	0.59	0.83	0.52	0.69
3	0.17	-0.26	0.04	-0.26	-0.5	0.24	0.24	0.66	0.34	0.54
4	0.29	0.75	-0.24	0.16	-0.37	0.3	-0.13	0.05	0.23	0.08
5	0.36	0.52	0.08	-0.3	-0.41	-0.17	0.4	0.78	0.04	0.31
6	0.8	0.74	0.61	0.79	-0.34	-0.69	-0.67	-0.12	0.65	0.82
7	-1.05	0.54	-0.61	0.62	-1.66	-0.01	0.04	0.57	1.03	0.91
8	0.37	99.99	-0.78	0.27	0.37	0.6	99.99	-0.56	1.16	0.97
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8
Mean Log q	-9.8816	-9.0893	-8.2197	-8.1985	-8.3241	-8.557	-8.2463	-8.2463
S.E(Log q)	0.7111	0.5196	0.3603	0.3378	0.3917	0.72	0.7421	0.729

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Q

1	0.87	0.536	9.71	0.42	24	0.63	-9.88
2	1.04	-0.163	9.11	0.45	24	0.55	-9.09
3	0.91	0.663	8.22	0.72	24	0.33	-8.22
4	0.89	1.043	8.13	0.79	24	0.3	-8.2
5	0.82	1.602	8.05	0.78	24	0.31	-8.32
6	0.88	0.498	8.27	0.45	24	0.65	-8.56
7	1.03	-0.107	8.33	0.38	24	0.78	-8.25
8	1.75	-1.747	10.68	0.22	21	1.21	-8.21

Table 8.2.9 Plaice in VIIe. Diagnostics (Cont.)

Fleet : UK WECOT

Age		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	1	No data for this fleet at this age									
	2	No data for this fleet at this age									
	3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.57	0.37
	4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.09	0.52
	5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.38	0.58
	6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.08	0.56
	7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.13	-0.02
	8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.44	0.12
	9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.14	-0.29

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	1	No data for this fleet at this age									
	2	No data for this fleet at this age									
	3	0.32	0.15	-0.01	-0.07	-0.11	0.2	0.09	0.57	0.08	-0.49
	4	0.45	0.44	0.3	0.03	0.03	0.18	0.03	-0.25	0.43	-0.17
	5	0.05	0.29	0.27	-0.02	-0.23	-0.08	0.14	-0.15	0	0.05
	6	0.18	0.13	0.27	-0.01	-0.35	0.2	-0.03	-0.21	0.08	0.16
	7	0.63	0.15	0.05	0.17	-0.26	-0.44	0.13	-0.1	-0.28	0.23
	8	0.49	0.06	0.24	0.13	-0.68	-0.11	0.17	-0.49	-0.64	-0.19
	9	0.05	0.23	-0.14	0	-0.32	-0.16	-0.15	-0.23	0.22	-0.19

Age		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	1	No data for this fleet at this age									
	2	No data for this fleet at this age									
	3	-0.31	-0.39	0.1	-0.24	-0.16	-0.28	-0.15	0.15	-0.12	-0.28
	4	-0.33	-0.23	-0.07	-0.37	-0.13	-0.29	-0.45	0.1	0.03	-0.36
	5	-0.23	-0.18	-0.01	-0.2	0.16	-0.14	-0.31	-0.12	0.07	-0.32
	6	0.05	-0.54	0.16	-0.2	0.11	-0.02	-0.28	-0.18	0.03	-0.19
	7	0.17	-0.13	0.02	-0.08	-0.28	-0.02	-0.02	-0.02	0.17	-0.21
	8	-0.03	-0.2	-0.08	-0.29	-0.14	0.07	0.18	-0.54	0.5	-0.03
	9	0.2	0.05	0.58	-0.09	0.24	-0.29	-0.09	-0.29	0.38	-0.57

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-7.0677	-7.0535	-7.2397	-7.4413	-7.6209	-7.6209	-7.6209
S.E(Log q)	0.292	0.2942	0.2324	0.2395	0.2278	0.3406	0.2731

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	0.82	1.905	7.27	0.85	22	0.23	-7.07
4	0.79	2.704	7.15	0.9	22	0.2	-7.05
5	0.84	2.461	7.16	0.92	22	0.18	-7.24
6	0.89	1.501	7.28	0.9	22	0.21	-7.44
7	0.95	0.597	7.52	0.89	22	0.22	-7.62
8	0.98	0.185	7.61	0.8	22	0.34	-7.67
9	1.04	-0.506	7.81	0.88	22	0.29	-7.67

Fleet : UK WECBT

Age		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	1	No data for this fleet at this age									
	2	No data for this fleet at this age									
	3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.34
	4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.17
	5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.08
	6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.04
	7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.01
	8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.03
	9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.01

Table 8.2.9 Plaice in VIIe. Diagnostics (Cont.)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.15	0.2	0.52	0.5	0.34	0.31	-0.17	0.09	-0.42	-0.34
4	0.17	0.5	0.72	0.51	0.44	0.31	-0.13	-0.54	-0.08	-0.2
5	-0.21	0.32	0.59	0.41	0.22	0.15	0	-0.21	-0.25	0.01
6	-0.15	-0.04	0.36	0.35	0.09	0.24	-0.16	-0.12	0.03	0.37
7	0.31	-0.07	0.04	0.38	0.04	-0.05	-0.07	0.04	-0.02	0.24
8	-0.03	-0.47	0.18	0.28	-0.2	0.15	0.13	-0.14	-0.11	0.12
9	-0.29	-0.28	-0.07	0.13	0.13	0.28	0.05	0.24	0.53	0.52

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.25	-0.45	0.03	-0.03	-0.02	0.03	0.09	-0.01	-0.23	-0.01
4	-0.36	-0.24	-0.22	-0.2	0.07	-0.07	-0.24	-0.05	-0.09	-0.13
5	-0.42	-0.12	-0.1	-0.09	0.14	0.06	-0.11	-0.1	-0.1	-0.13
6	-0.3	-0.53	-0.01	-0.02	0.05	0.16	-0.12	-0.07	-0.09	-0.09
7	-0.29	-0.28	-0.17	0.13	0.01	0.17	0.01	0.09	-0.09	-0.4
8	-0.25	-0.25	-0.3	-0.28	-0.01	0.17	0.23	0.05	0.34	0.02
9	-0.26	-0.1	-0.06	0.46	0.29	-0.01	-0.05	0.27	0.1	0.13

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-6.4303	-6.278	-6.279	-6.3228	-6.3802	-6.3802	-6.3802
S.E(Log q)	0.2793	0.3234	0.2381	0.2186	0.1911	0.2184	0.2619

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.1	-0.692	6.25	0.7	21	0.31	-6.43
4	0.94	0.467	6.35	0.79	21	0.31	-6.28
5	0.95	0.607	6.3	0.88	21	0.23	-6.28
6	0.99	0.079	6.32	0.88	21	0.22	-6.32
7	0.91	1.495	6.29	0.93	21	0.17	-6.38
8	0.99	0.106	6.39	0.91	21	0.22	-6.4
9	1.05	-0.699	6.4	0.9	21	0.26	-6.28

Fleet : UK WECOT historic

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	No data for this fleet at this age									
2	-0.16	0.08	-0.06	0.25	0.54	-0.3	0.09	-0.43	99.99	99.99
3	-0.25	0.26	0.02	0.08	-0.06	-0.18	0.12	0.03	99.99	99.99
4	-0.37	-0.02	0.22	0.35	0.11	-0.06	-0.4	0.17	99.99	99.99
5	-0.34	-0.02	0.06	0.5	0.08	-0.5	-0.18	0.42	99.99	99.99
6	0.38	-0.11	0.29	0	-0.09	0.11	-0.53	-0.05	99.99	99.99
7	-0.41	0.15	-0.02	0.19	0.23	0.11	0.02	-0.26	99.99	99.99
8	-0.39	0.16	0.54	-0.05	0.34	-0.57	-0.04	-0.37	99.99	99.99
9	0	0.23	0.11	-0.24	0.17	-0.41	0.3	0.16	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Table 8.2.9 Plaice in VIIe. Diagnostics (Cont.)

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-7.2676	-5.9594	-5.8043	-5.9658	-6.0674	-5.9803	-5.9803	-5.9803
S.E(Log q)	0.3113	0.1647	0.2703	0.3443	0.2807	0.226	0.3873	0.2496

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.43	-1.13	6.58	0.54	8	0.44	-7.27
3	0.83	1.321	6.37	0.91	8	0.13	-5.96
4	0.79	1.59	6.18	0.91	8	0.19	-5.8
5	0.73	1.511	6.18	0.84	8	0.23	-5.97
6	1.33	-1.471	6.11	0.77	8	0.34	-6.07
7	1.12	-0.769	6.07	0.87	8	0.26	-5.98
8	1.48	-1.603	6.71	0.65	8	0.51	-6.03
9	0.81	2.871	5.54	0.97	8	0.14	-5.94

Fleet : UK (E+W) FSP

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	99.99	99.99	99.99	-0.3	0.13	-0.07	0.64	-0.34	99.99	-0.06
3	99.99	99.99	99.99	-0.06	0.19	0.17	0.07	0.07	99.99	-0.44
4	99.99	99.99	99.99	-0.25	0.21	-0.04	0.08	-0.11	99.99	0.11
5	99.99	99.99	99.99	-0.08	0.37	0.06	-0.12	0.01	99.99	-0.25
6	99.99	99.99	99.99	0.01	-0.19	0.27	0.09	-0.13	99.99	-0.05
7	99.99	99.99	99.99	0.21	0.26	-0.39	0.35	-0.54	99.99	0.1
8	99.99	99.99	99.99	0.35	0.2	0.17	0.07	-0.39	99.99	-0.51
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8
Mean Log q	-9.2562	-8.448	-8.3312	-8.3455	-8.5181	-8.3363	-8.3363
S.E(Log q)	0.3582	0.2317	0.1687	0.2114	0.1678	0.3716	0.3511

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.96	0.068	9.22	0.4	6	0.38	-9.26
3	2.18	-1.21	8.95	0.21	6	0.48	-8.45
4	1.43	-1.008	8.83	0.57	6	0.24	-8.33
5	0.71	1.138	7.79	0.8	6	0.15	-8.35
6	0.89	0.348	8.22	0.73	6	0.17	-8.52
7	0.81	0.821	7.73	0.82	6	0.31	-8.34
8	0.73	1.787	7.34	0.92	6	0.21	-8.35

Table 8.2.9 Plaice in VIIe. Diagnostics (Cont.)

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	1770	0.726	0	0	1	0.922	0.003
UK WECOT	1	0	0	0	0	0	0
UK WECBT	1	0	0	0	0	0	0
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	1	0	0	0	0	0	0
F shrinkage mean	1375	2.5				0.078	0.004

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1736	0.7	0.07	2	0.101	0.003

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	4004	0.428	0.865	2.02	2	0.565	0.16
UK WECOT	1	0	0	0	0	0	0
UK WECBT	1	0	0	0	0	0	0
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	3552	0.5	0	0	1	0.415	0.178
F shrinkage mean	2558	2.5				0.02	0.24

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3776	0.32	0.38	4	1.173	0.168

Age 3 Catchability constant w.r.t. time and dependent on age

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	3432	0.327	0.249	0.76	3	0.408	0.311
UK WECOT	1810	0.5	0	0	1	0.194	0.525
UK WECBT	2357	0.5	0	0	1	0.194	0.426
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	1541	0.5	0	0	1	0.194	0.594
F shrinkage mean	1379	2.5				0.012	0.646

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2389	0.22	0.16	7	0.755	0.421

Table 8.2.9 Plaice in VIIe. Diagnostics (Cont.)

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	714	0.291	0.181	0.62	4	0.319	0.322
UK WECOT	379	0.369	0.115	0.31	2	0.229	0.54
UK WECBT	426	0.369	0.047	0.13	2	0.229	0.492
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	488	0.379	0.21	0.55	2	0.214	0.442
F shrinkage mean	253	2.5				0.009	0.728

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
501	0.17	0.11	11	0.613	0.433

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	323	0.303	0.09	0.3	5	0.282	0.348
UK WECOT	197	0.337	0.137	0.41	3	0.251	0.521
UK WECBT	209	0.337	0.028	0.08	3	0.251	0.496
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	210	0.378	0.201	0.53	3	0.207	0.494
F shrinkage mean	130	2.5				0.01	0.711

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
232	0.17	0.08	15	0.454	0.457

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	172	0.317	0.196	0.62	6	0.214	0.341
UK WECOT	119	0.315	0.074	0.24	4	0.28	0.461
UK WECBT	120	0.315	0.026	0.08	4	0.28	0.46
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	123	0.368	0.024	0.07	4	0.217	0.449
F shrinkage mean	73	2.5				0.01	0.673

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
130	0.16	0.06	19	0.382	0.432

Table 8.2.9 Plaice in VIIe. Diagnostics (Cont.)

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	118	0.34	0.163	0.48	7	0.178	0.21
UK WECOT	55	0.299	0.064	0.21	5	0.294	0.406
UK WECBT	50	0.299	0.079	0.26	5	0.294	0.442
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	70	0.351	0.019	0.05	5	0.225	0.331
F shrinkage mean	29	2.5				0.009	0.671

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
64	0.16	0.08	23	0.497	0.357

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	76	0.393	0.164	0.42	8	0.157	0.22
UK WECOT	36	0.304	0.062	0.21	6	0.301	0.417
UK WECBT	36	0.304	0.024	0.08	6	0.301	0.418
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	25	0.362	0.087	0.24	6	0.232	0.559
F shrinkage mean	18	2.5				0.01	0.728

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
37	0.17	0.08	27	0.479	0.409

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK-WEC-BTS	21	0.368	0.262	0.71	8	0.097	0.28
UK WECOT	10	0.303	0.179	0.59	7	0.4	0.504
UK WECBT	15	0.303	0.048	0.16	7	0.4	0.37
UK WECOT historic	1	0	0	0	0	0	0
UK (E+W) FSP	10	0.287	0.158	0.55	5	0.09	0.499
F shrinkage mean	13	2.5				0.013	0.415

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
13	0.18	0.08	28	0.471	0.421

Table 8.2.10 Plaice in VIIe. Fishing mortality-at-age.

Run title : W.CHANNEL PLAICE 2010 WGCSE

At 10/05/2010 9:27

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.0024	0.0120	0.0098	0.0005	0.0097	0.0004	0.0006	0.0055	0.0012	0.0024
2	0.1241	0.1086	0.1091	0.1303	0.1832	0.1091	0.1505	0.0880	0.1772	0.0413
3	0.4328	0.5360	0.4799	0.4684	0.4627	0.4702	0.6026	0.5297	0.5572	0.4079
4	0.4918	0.5995	0.6947	0.8086	0.7539	0.6887	0.5208	0.7299	0.5053	0.6721
5	0.4276	0.4155	0.5302	0.6390	0.5758	0.3338	0.4936	0.7451	0.5098	0.7740
6	0.7298	0.3145	0.5650	0.3734	0.4073	0.5465	0.4017	0.4206	0.3496	0.5865
7	0.3457	0.5119	0.4076	0.5057	0.6062	0.5258	0.5376	0.5668	0.3477	0.4598
8	0.3902	0.4270	0.9835	0.4169	0.7718	0.3413	0.4648	0.3891	0.4824	0.4999
9	0.4623	0.5728	0.4353	0.2918	0.4870	1.1677	0.6151	0.5871	0.2992	0.8048
+gp	0.4623	0.5728	0.4353	0.2918	0.4870	1.1677	0.6151	0.5871	0.2992	0.8048
FBAR 3- 6	0.5205	0.4664	0.5675	0.5724	0.5499	0.5098	0.5047	0.6063	0.4805	0.6101

Table 8 Fishing mortality (F) at age

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.0127	0.0080	0.0154	0.0134	0.0298	0.0008	0.0022	0.0007	0.0014	0.0059
2	0.1114	0.1916	0.2067	0.1787	0.1894	0.1876	0.1903	0.1765	0.0720	0.1664
3	0.6162	0.6150	0.6791	0.6130	0.5912	0.6354	0.5585	0.6885	0.4968	0.3977
4	0.7526	0.7935	0.7734	0.6898	0.8265	0.7448	0.6790	0.7540	0.7540	0.7151
5	0.5767	0.5914	0.6149	0.6170	0.5812	0.5879	0.6835	0.6979	0.5355	0.6050
6	0.5534	0.4780	0.5498	0.5084	0.5112	0.5390	0.5531	0.5753	0.5216	0.6363
7	0.5844	0.3924	0.4247	0.5119	0.3973	0.5041	0.5195	0.7458	0.4269	0.5933
8	0.5648	0.3595	0.4620	0.4859	0.3348	0.4876	0.7380	0.5770	0.4475	0.4977
9	0.5597	0.4465	0.4318	0.4514	0.4411	0.4696	0.5203	0.7942	0.7747	0.6370
+gp	0.5597	0.4465	0.4318	0.4514	0.4411	0.4696	0.5203	0.7942	0.7747	0.6370
FBAR 3- 6	0.6247	0.6195	0.6543	0.6071	0.6276	0.6268	0.6185	0.6789	0.5770	0.5885

Table 8 Fishing mortality (F) at age

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR 07-09
AGE											
1	0.0109	0.0012	0.0322	0.0063	0.0046	0.0054	0.0069	0.0004	0.0009	0.0029	0.0014
2	0.1491	0.1689	0.3869	0.2194	0.2062	0.2273	0.3509	0.2009	0.2094	0.1684	0.1929
3	0.5122	0.5619	0.5868	0.6153	0.6037	0.5889	0.6960	0.7103	0.6123	0.4210	0.5812
4	0.6148	0.5990	0.7690	0.5932	0.6470	0.6693	0.6447	0.8351	0.8263	0.4326	0.6980
5	0.6519	0.5797	0.6887	0.6012	0.7183	0.6561	0.6650	0.7760	0.7210	0.4570	0.6513
6	0.5270	0.3618	0.6472	0.5965	0.6149	0.6865	0.5937	0.7693	0.6818	0.4317	0.6276
7	0.5223	0.4165	0.4989	0.5954	0.5091	0.6627	0.6121	0.7501	0.8049	0.3572	0.6374
8	0.4165	0.4814	0.4517	0.4187	0.4991	0.6997	0.9052	0.6507	0.8676	0.4092	0.6425
9	0.4956	0.6351	0.6252	0.7817	0.6440	0.5117	0.6989	0.7829	0.7096	0.4208	0.6378
+gp	0.4956	0.6351	0.6252	0.7817	0.6440	0.5117	0.6989	0.7829	0.7096	0.4208	
FBAR 3- 6	0.5765	0.5256	0.6729	0.6015	0.6460	0.6502	0.6498	0.7727	0.7104	0.4356	

Table 8.2.11 Plaice in VIIe. Stock numbers-at-age.

Run title : W.CHANNEL PLAICE 2010 WGCSE

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Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	8432	3637	7814	6942	8504	8791	17880	14321	10433	4450
2	7407	7461	3187	6863	6154	7470	7794	15849	12632	9242
3	2419	5803	5936	2534	5343	4544	5941	5947	12872	9384
4	690	1392	3011	3258	1407	2983	2519	2884	3106	6540
5	700	374	678	1333	1287	587	1329	1327	1233	1662
6	128	405	219	354	624	642	373	719	559	657
7	229	55	262	110	216	368	330	221	419	349
8	76	144	29	155	59	104	193	171	111	262
9	38	46	83	10	90	24	66	108	103	61
+gp	394	231	364	417	138	79	141	123	217	192
TOTAL	20513	19546	21584	21975	23823	25594	36565	41671	41685	32800

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	4803	5434	6269	2874	3033	8022	7139	10973	5302	3470
2	3938	4206	4781	5475	2515	2611	7110	6317	9725	4696
3	7866	3124	3080	3448	4062	1846	1920	5213	4696	8027
4	5535	3767	1498	1385	1657	1994	867	974	2323	2534
5	2962	2313	1511	613	616	643	840	390	406	969
6	680	1476	1136	725	293	306	317	376	172	211
7	324	347	811	581	387	156	158	162	188	91
8	196	160	208	471	309	230	84	83	68	109
9	141	99	99	116	257	196	126	35	42	39
+gp	179	151	151	249	192	252	279	194	122	102
TOTAL	26623	21077	19544	15938	13321	16257	18838	24717	23044	20248

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 80-07	AMST 80-07
AGE													
1	4553	5230	6297	3879	4916	4428	2833	6434	5686	1962	0	5981	6682
2	3060	3995	4633	5408	3419	4340	3906	2495	5704	5039	1736	5316	5953
3	3526	2338	2992	2791	3851	2467	3067	2439	1810	4104	3776	4013	4553
4	4783	1874	1182	1476	1338	1868	1214	1356	1063	870	2389	2000	2336
5	1099	2294	913	486	723	621	848	565	522	413	501	899	1047
6	469	508	1140	407	236	313	286	387	231	225	232	427	504
7	99	246	314	529	199	113	140	140	159	104	130	225	269
8	44	52	144	169	259	106	52	67	59	63	64	120	147
9	59	26	29	81	99	139	47	19	31	22	37	64	81
+gp	141	83	95	76	85	115	94	94	59	49	41		
TOTAL	17834	16646	17738	15302	15125	14511	12488	13998	15325	12850	8906		

Table 8.2.12 Plaice in VIIe. Summary

Run title : W.CHANNEL PLAICE 2010 WGCSE

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Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1980	8432	5051	2410	1215	0.5043	0.5205
1981	3637	6256	3282	1746	0.532	0.4664
1982	7814	5901	3470	1938	0.5586	0.5675
1983	6942	6234	3665	1754	0.4787	0.5724
1984	8504	6386	3487	1813	0.5198	0.5499
1985	8791	6680	3564	1751	0.4912	0.5098
1986	17880	7582	3753	2161	0.5759	0.5047
1987	14321	7095	3626	2388	0.6586	0.6063
1988	10433	9821	5166	2994	0.5796	0.4805
1989	4450	9002	5487	2808	0.5119	0.6101
1990	4803	8598	5297	3058	0.5773	0.6247
1991	5434	6653	4313	2250	0.5216	0.6195
1992	6269	6568	3595	1950	0.5424	0.6543
1993	2874	5158	3069	1691	0.5511	0.6071
1994	3033	4455	2721	1471	0.5405	0.6276
1995	8022	4872	2420	1295	0.535	0.6268
1996	7139	4918	2376	1321	0.5561	0.6185
1997	10973	6420	2505	1654	0.6604	0.6789
1998	5302	5881	2669	1430	0.5358	0.577
1999	3470	4964	2960	1616	0.546	0.5885
2000	4553	4800	3293	1678	0.5096	0.5765
2001	5230	4456	2722	1379	0.5066	0.5256
2002	6297	4923	2510	1608	0.6406	0.6729
2003	3879	4255	2507	1478	0.5895	0.6015
2004	4916	4873	2274	1402	0.6166	0.646
2005	4428	4521	2257	1370	0.6071	0.6502
2006	2833	3822	2059	1466	0.7118	0.6498
2007	6434	3574	1717	1184	0.6896	0.7727
2008	5686	4009	1653	1144	0.6919	0.7104
2009	1962	3161	1833	1043	0.5691	0.4356
Arith. Mean	6491	5696	3089	1735	0.5703	0.5951
Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)		

Table 8.2.13 VIIe plaice : Catch forecast input data

MFDP version 1a
Run: ple7e2010
Time and date: 14:07 16/05/2010
Fbar age range: 3-6

2010

Age	***N***	***M***	***Mat***	***PF***	***PM***	***SWt***	***Sel***	***CWt***
1	4969	0.12	0	0	0	0.118	0.001	0.163
2	1736	0.12	0.26	0	0	0.213	0.131	0.259
3	3776	0.12	0.52	0	0	0.310	0.396	0.355
4	2389	0.12	0.86	0	0	0.408	0.475	0.453
5	501	0.12	1	0	0	0.507	0.444	0.552
6	232	0.12	1	0	0	0.608	0.427	0.652
7	130	0.12	1	0	0	0.709	0.434	0.754
8	64	0.12	1	0	0	0.812	0.438	0.856
9	37	0.12	1	0	0	0.916	0.434	0.960
10	41	0.12	1	0	0	1.194	0.434	1.237

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4969	0.12	0	0	0	0.118	0.001	0.163
2	.	0.12	0.26	0	0	0.213	0.131	0.259
3	.	0.12	0.52	0	0	0.310	0.396	0.355
4	.	0.12	0.86	0	0	0.408	0.475	0.453
5	.	0.12	1	0	0	0.507	0.444	0.552
6	.	0.12	1	0	0	0.608	0.427	0.652
7	.	0.12	1	0	0	0.709	0.434	0.754
8	.	0.12	1	0	0	0.812	0.438	0.856
9	.	0.12	1	0	0	0.916	0.434	0.960
10	*.*	*0.12*	*1*	*0*	*0*	*1.194*	*0.434*	*1.237*

2012

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4969	0.12	0	0	0	0.118	0.001	0.163
2	.	0.12	0.26	0	0	0.213	0.131	0.259
3	.	0.12	0.52	0	0	0.310	0.396	0.355
4	.	0.12	0.86	0	0	0.408	0.475	0.453
5	.	0.12	1	0	0	0.507	0.444	0.552
6	.	0.12	1	0	0	0.608	0.427	0.652
7	.	0.12	1	0	0	0.709	0.434	0.754
8	.	0.12	1	0	0	0.812	0.438	0.856
9	.	0.12	1	0	0	0.916	0.434	0.960
10	.	0.12	1	0	0	1.194	0.434	1.237

Input units are thousands and kg - output in tonnes

Table 8.2.14 VIIe plaice : management option table - status quo forecast

MFDP version 1a
Run: ple7e2010
WESTERN CHANNEL PLAICE,2010 WG, Forecast Inputs
Time and date: 14:07 16/05/2010
Fbar age range: 3-6

2010				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
3724	2165	1.0000	0.4356	1079

2011					2012	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
3947	2337	0.0000	0.0000	0	5371	3441
.	2337	0.1000	0.0436	124	5241	3321
.	2337	0.2000	0.0871	242	5115	3205
.	2337	0.3000	0.1307	357	4995	3095
.	2337	0.4000	0.1742	466	4879	2989
.	2337	0.5000	0.2178	572	4768	2887
.	2337	0.6000	0.2613	673	4662	2790
.	2337	0.7000	0.3049	770	4559	2697
.	2337	0.8000	0.3485	864	4461	2607
.	2337	0.9000	0.3920	954	4366	2522
.	2337	1.0000	0.4356	1040	4275	2439
.	2337	1.1000	0.4791	1124	4188	2361
.	2337	1.2000	0.5227	1204	4104	2285
.	2337	1.3000	0.5662	1281	4023	2212
.	2337	1.4000	0.6098	1355	3946	2143
.	2337	1.5000	0.6534	1426	3871	2076
.	2337	1.6000	0.6969	1495	3799	2012
.	2337	1.7000	0.7405	1561	3730	1951
.	2337	1.8000	0.7840	1624	3664	1892
.	2337	1.9000	0.8276	1686	3600	1835
.	2337	2.0000	0.8712	1745	3538	1781

Input units are thousands and kg - output in tonnes

Table 8.2.15 VIIe plaice : forecast detailed results - status quo projection

MFDP version 1a
Run: ple7e2010
Time and date: 14:07 16/05/2010
Fbar age range: 3-6

Year:	2010	F multiplier:	1	Fbar:	0.4356				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0954	4	1	4969	586	0	0	0	0
2	0.1314	202	52	1736	370	451	96	451	96
3	0.3958	1168	415	3776	1171	1964	609	1964	609
4	0.4754	856	388	2389	975	2055	838	2055	838
5	0.4436	170	94	501	254	501	254	501	254
6	0.4274	76	50	232	141	232	141	232	141
7	0.4341	43	33	130	92	130	92	130	92
8	0.4376	21	18	64	52	64	52	64	52
9	0.4344	12	12	37	34	37	34	37	34
10	0.4344	14	17	41	49	41	49	41	49
Total		2567	1079	13875	3724	5474	2165	5474	2165

Year:	2011	F multiplier:	1	Fbar:	0.4356				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0954	4	1	4969	586	0	0	0	0
2	0.1314	511	132	4403	938	1145	244	1145	244
3	0.3958	418	148	1350	419	702	218	702	218
4	0.4754	808	366	2254	920	1939	791	1939	791
5	0.4436	447	247	1317	668	1317	668	1317	668
6	0.4274	94	61	285	173	285	173	285	173
7	0.4341	45	34	134	95	134	95	134	95
8	0.4376	25	21	75	61	75	61	75	61
9	0.4344	12	12	37	34	37	34	37	34
10	0.4344	15	18	45	54	45	54	45	54
Total		2378	1040	14869	3947	5678	2337	5678	2337

Year:	2012	F multiplier:	1	Fbar:	0.4356				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0954	4	1	4969	586	0	0	0	0
2	0.1314	511	132	4403	938	1145	244	1145	244
3	0.3958	1059	376	3424	1062	1781	552	1781	552
4	0.4754	289	131	806	329	693	283	693	283
5	0.4436	421	233	1243	631	1243	631	1243	631
6	0.4274	247	161	750	456	750	456	750	456
7	0.4341	55	41	165	117	165	117	165	117
8	0.4376	26	22	77	63	77	63	77	63
9	0.4344	14	14	43	39	43	39	43	39
10	0.4344	16	19	47	56	47	56	47	56
Total		2643	1130	15926	4275	5943	2439	5943	2439

Input units are thousands and kg - output in tonnes

Table 8.2.16 Plaice in VIIe
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 1 year-olds	6434	5686	1962	4969	4969
Source	XSA	XSA	XSA	GM89-07	GM89-07
Status Quo F:					
% in 2010 landings	35.9	38.4	4.8	0.1	-
% in 2011	23.8	35.2	14.2	12.7	0.1
% in 2010 SSB	38.7	28.1	4.4	0.0	-
% in 2011 SSB	28.6	33.8	9.3	10.4	0.0
% in 2012 SSB	18.7	25.9	11.6	22.6	10.0

GM : geometric mean recruitment

Plaice in VIIe : Year-class % contribution to

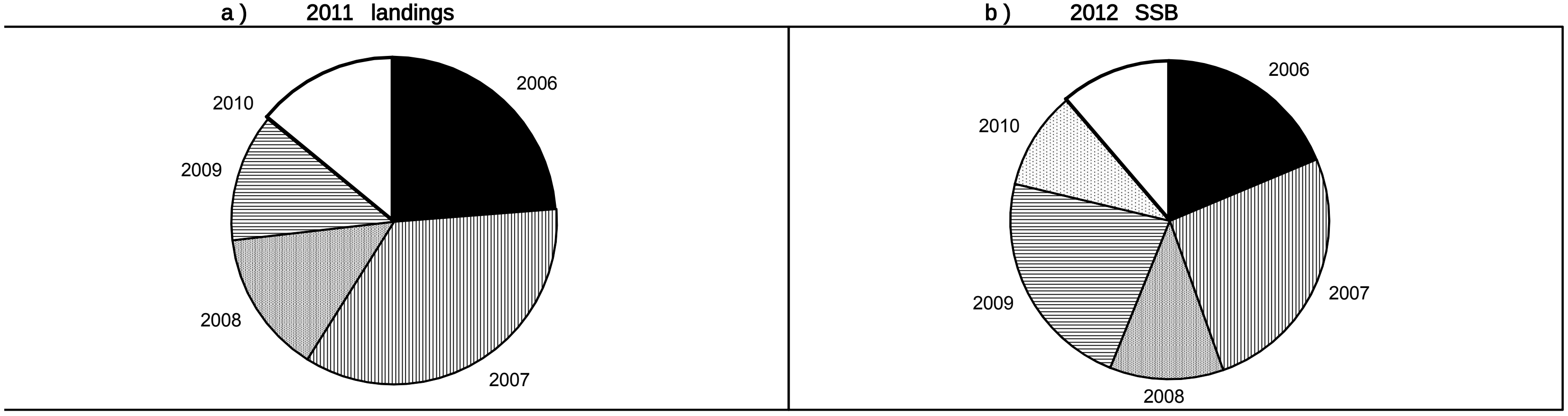


Table 8.2.17 VIIe plaice : Yield per recruit

MFYPR version 2a
Run: ple7e2010wg
Time and date: 16:18 16/05/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	8.8433	6.1164	6.7118	5.7017	6.7118	5.7017
0.1000	0.0436	0.2173	0.1674	7.0353	4.1784	4.9138	3.7673	4.9138	3.7673
0.2000	0.0871	0.3434	0.2408	5.9873	3.1167	3.8755	2.7091	3.8755	2.7091
0.3000	0.1307	0.4258	0.2751	5.3035	2.4640	3.2011	2.0597	3.2011	2.0597
0.4000	0.1742	0.4839	0.2909	4.8221	2.0314	2.7289	1.6304	2.7289	1.6304
0.5000	0.2178	0.5271	0.2975	4.4649	1.7290	2.3805	1.3311	2.3805	1.3311
0.6000	0.2613	0.5605	0.2994	4.1893	1.5087	2.1134	1.1138	2.1134	1.1138
0.7000	0.3049	0.5871	0.2989	3.9700	1.3429	1.9025	0.9510	1.9025	0.9510
0.8000	0.3485	0.6088	0.2971	3.7914	1.2147	1.7320	0.8256	1.7320	0.8256
0.9000	0.3920	0.6269	0.2947	3.6431	1.1134	1.5914	0.7270	1.5914	0.7270
1.0000	0.4356	0.6423	0.2921	3.5178	1.0317	1.4738	0.6480	1.4738	0.6480
1.1000	0.4791	0.6554	0.2894	3.4106	0.9647	1.3739	0.5835	1.3739	0.5835
1.2000	0.5227	0.6668	0.2868	3.3178	0.9089	1.2882	0.5302	1.2882	0.5302
1.3000	0.5662	0.6769	0.2843	3.2365	0.8618	1.2139	0.4856	1.2139	0.4856
1.4000	0.6098	0.6857	0.2819	3.1647	0.8217	1.1489	0.4478	1.1489	0.4478
1.5000	0.6534	0.6937	0.2797	3.1009	0.7870	1.0917	0.4154	1.0917	0.4154
1.6000	0.6969	0.7008	0.2776	3.0436	0.7569	1.0408	0.3875	1.0408	0.3875
1.7000	0.7405	0.7072	0.2757	2.9920	0.7304	0.9954	0.3632	0.9954	0.3632
1.8000	0.7840	0.7131	0.2739	2.9451	0.7070	0.9546	0.3418	0.9546	0.3418
1.9000	0.8276	0.7184	0.2722	2.9024	0.6862	0.9178	0.3230	0.9178	0.3230
2.0000	0.8712	0.7234	0.2706	2.8633	0.6675	0.8845	0.3062	0.8845	0.3062

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4356
FMax	0.6185	0.2694
F0.1	0.2865	0.1248
F35%SPR	0.3127	0.1362

Weights in kilograms

Table 8.2.18 VIIe plaice : Summary of FMSY estimation models

Stock name
Ple VIIe
Sen filename
pleviie.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
937/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.920	0.346	5528	1972	1.037	0.460	3.452	0.00019	44.128
Mean	0.858	0.327	8024	2429	1.064	0.501	3.829	0.00021	
5%ile	0.401	0.195	3093	1239	0.877	0.144	2.290	0.00006	
25%ile	0.555	0.250	4033	1564	0.981	0.359	2.991	0.00015	
50%ile	0.750	0.312	5207	1878	1.061	0.493	3.655	0.00020	
75%ile	1.013	0.382	7125	2295	1.139	0.642	4.490	0.00027	
95%ile	1.788	0.526	16488	4205	1.265	0.874	5.884	0.00036	
CV	0.534	0.323	2.063	1.565	0.112	0.431	0.303	0.43124	

Beverton-Holt
879/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	1.059	0.169	15786	2732	0.456	0.985	11105.500	2795.670	44.852
Mean	0.996	0.137	72709	5035	0.452	1.012	22508.660	9063.629	
5%ile	0.391	0.019	6456	1383	0.112	0.855	6522.405	535.177	
25%ile	0.563	0.111	10909	1937	0.296	0.936	8346.805	1454.855	
50%ile	0.781	0.143	18120	2735	0.458	1.002	11050.900	2864.230	
75%ile	1.149	0.176	43899	4261	0.607	1.079	17109.800	6048.485	
95%ile	2.483	0.226	320659	10192	0.776	1.205	45310.970	20989.390	
CV	0.693	0.441	3.054	4.497	0.454	0.108	5.735	7.829	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.136	0.114	0.125	0.270	1.080	0.299	0.45	0
Mean	0.115	0.096	0.106	0.266	2.955	0.299		
5%ile	0.002	0.001	0.002	0.023	0.514	0.208		
25%ile	0.076	0.063	0.074	0.160	0.761	0.249		
50%ile	0.125	0.105	0.116	0.232	1.101	0.285		
75%ile	0.161	0.135	0.147	0.313	1.755	0.333		
95%ile	0.205	0.171	0.182	0.519	16.753	0.443		
CV	0.546	0.548	0.528	0.968	1.820	0.241		

Figure 8.2.1 VIIe plaice: UK(E&W) commercial fleet LPUE and effort; and survey CPUE

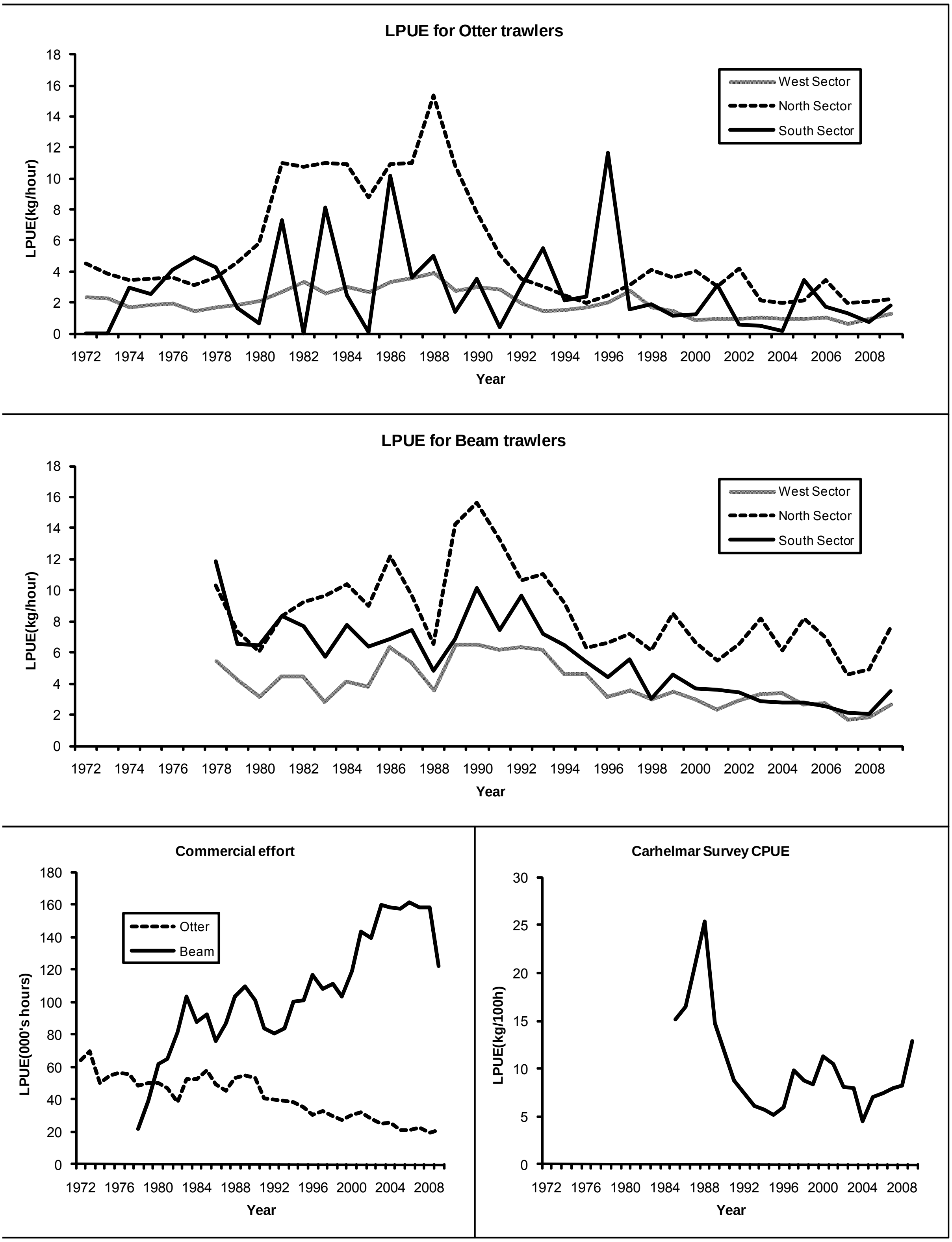
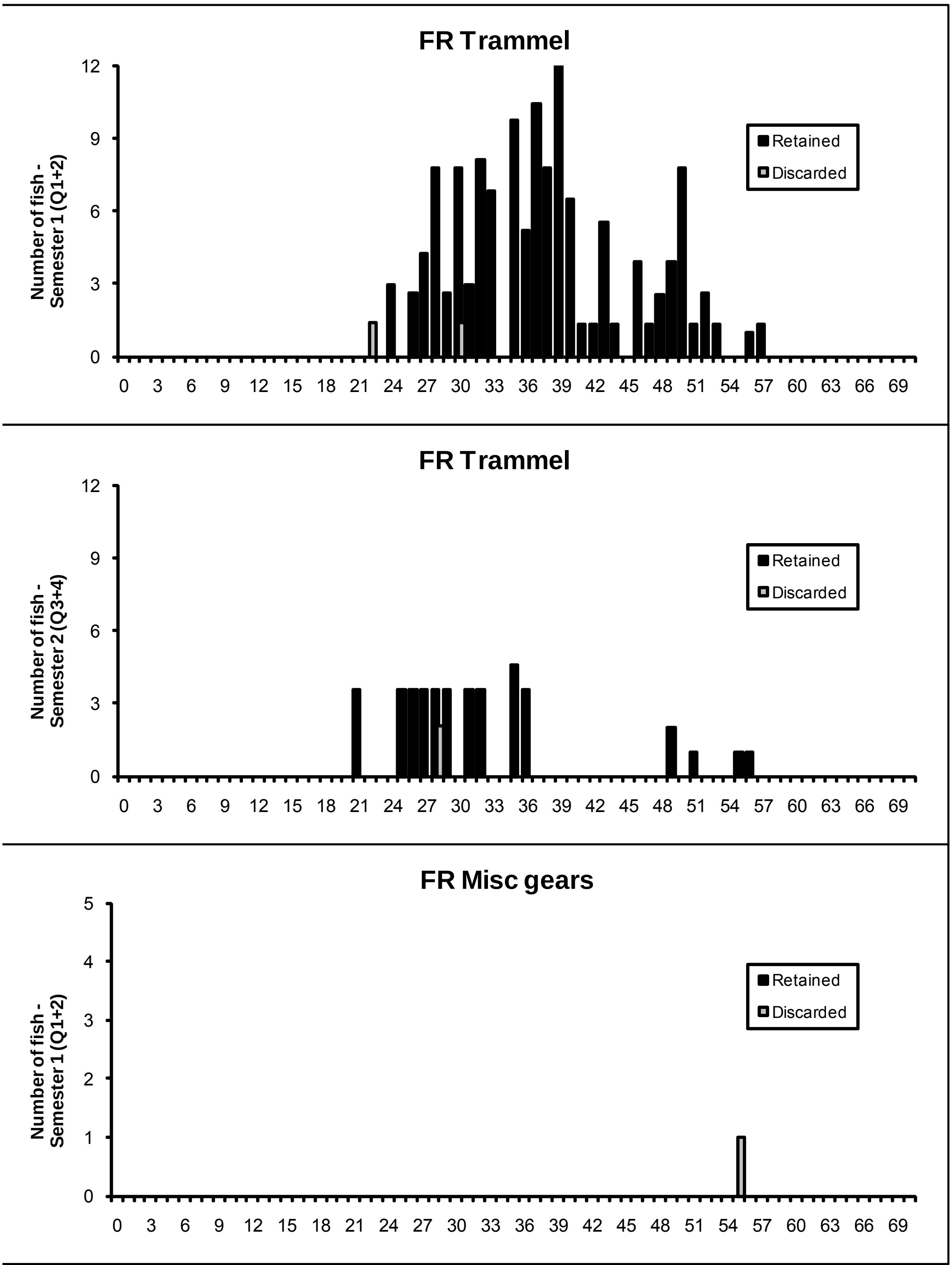
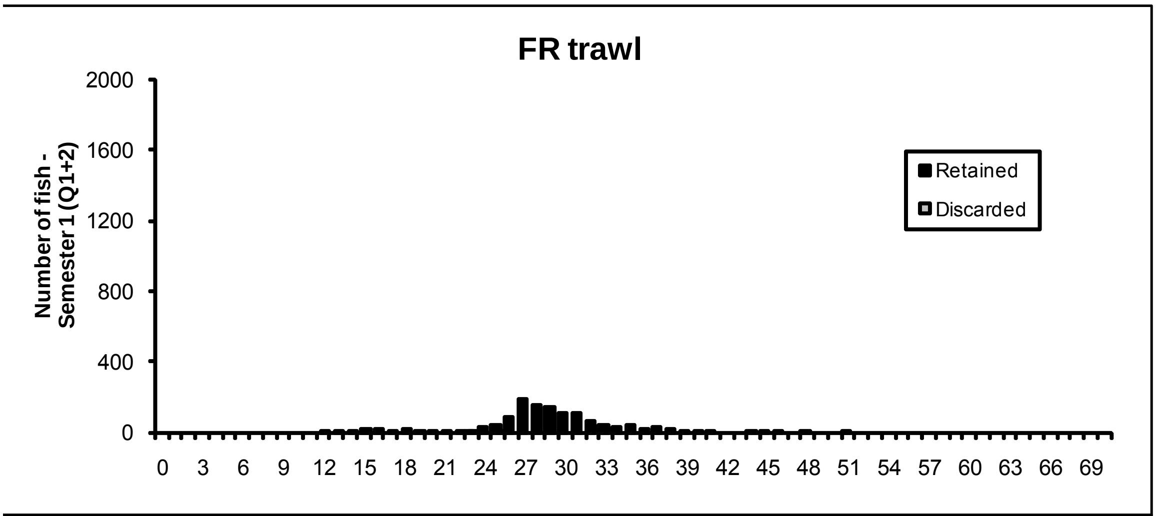


Figure 8.2.2 Plaice VIIe Discards by Semester and fleet (2009)



There was no discard sampling for Misc gears in Semester 2.

Figure 8.2.2 (cont.) Plaice VIIe Discards by Quarter and fleet (2009)



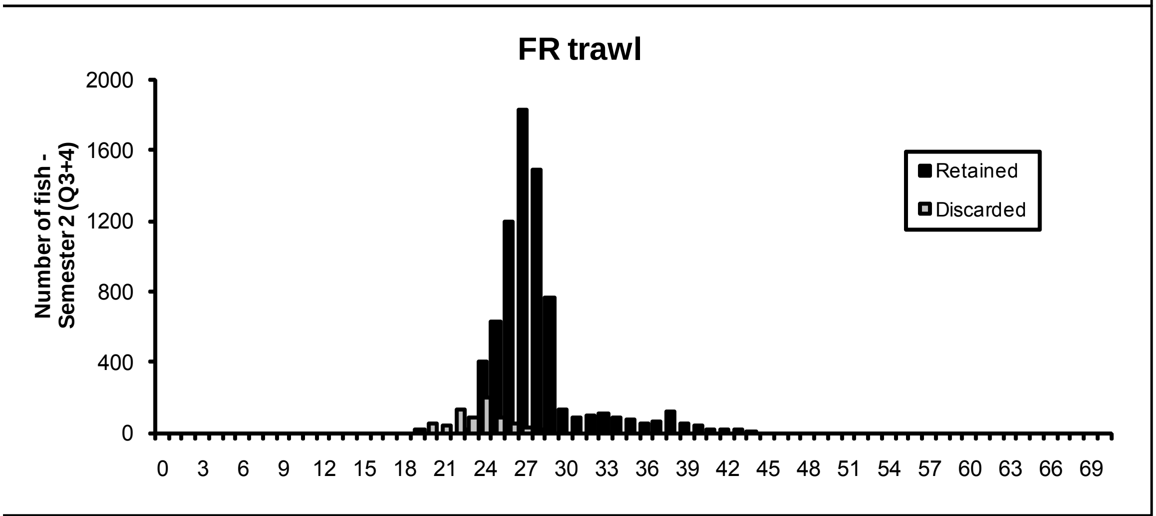


Figure 8.2.2 (cont.) Plaice VIIe Discards by Quarter and fleet (2009)

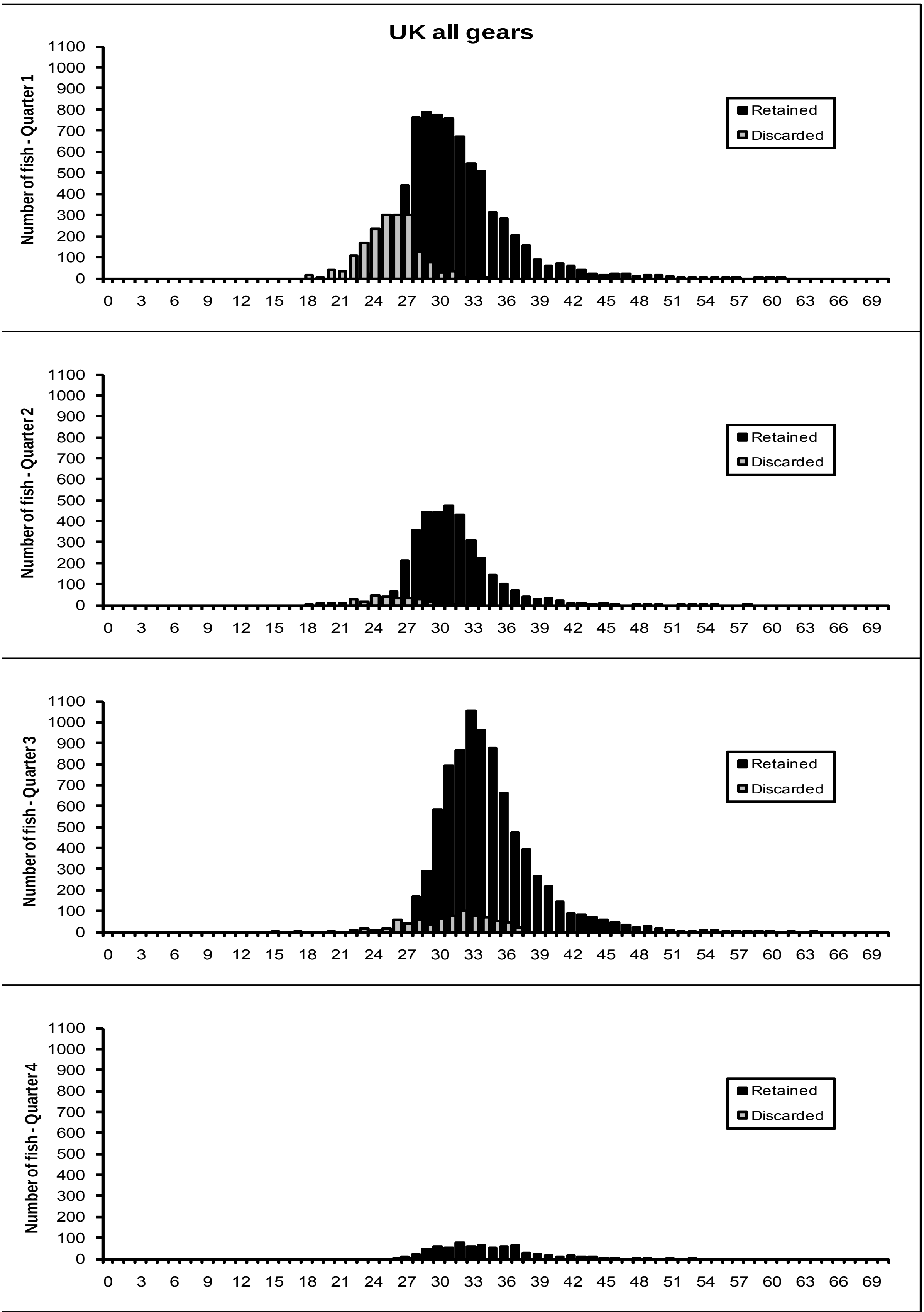


Figure 8.2.3 : Plaice in Division VIIe Length distributions of UK (England & Wales) landings from 2000 to 2009

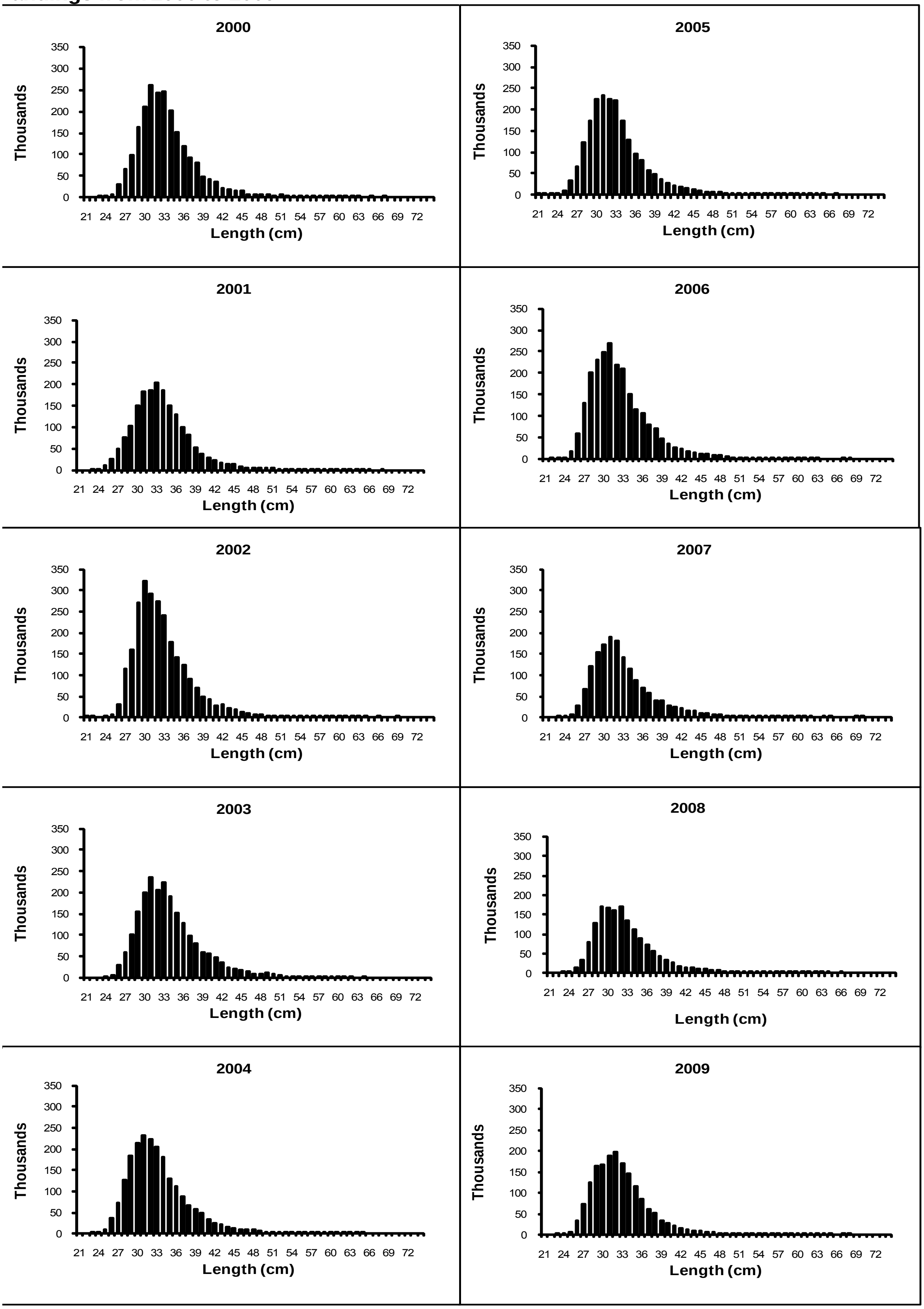


Figure 8.2.4 : Plaice in Division VIIe Age composition of international landings 2000-2009

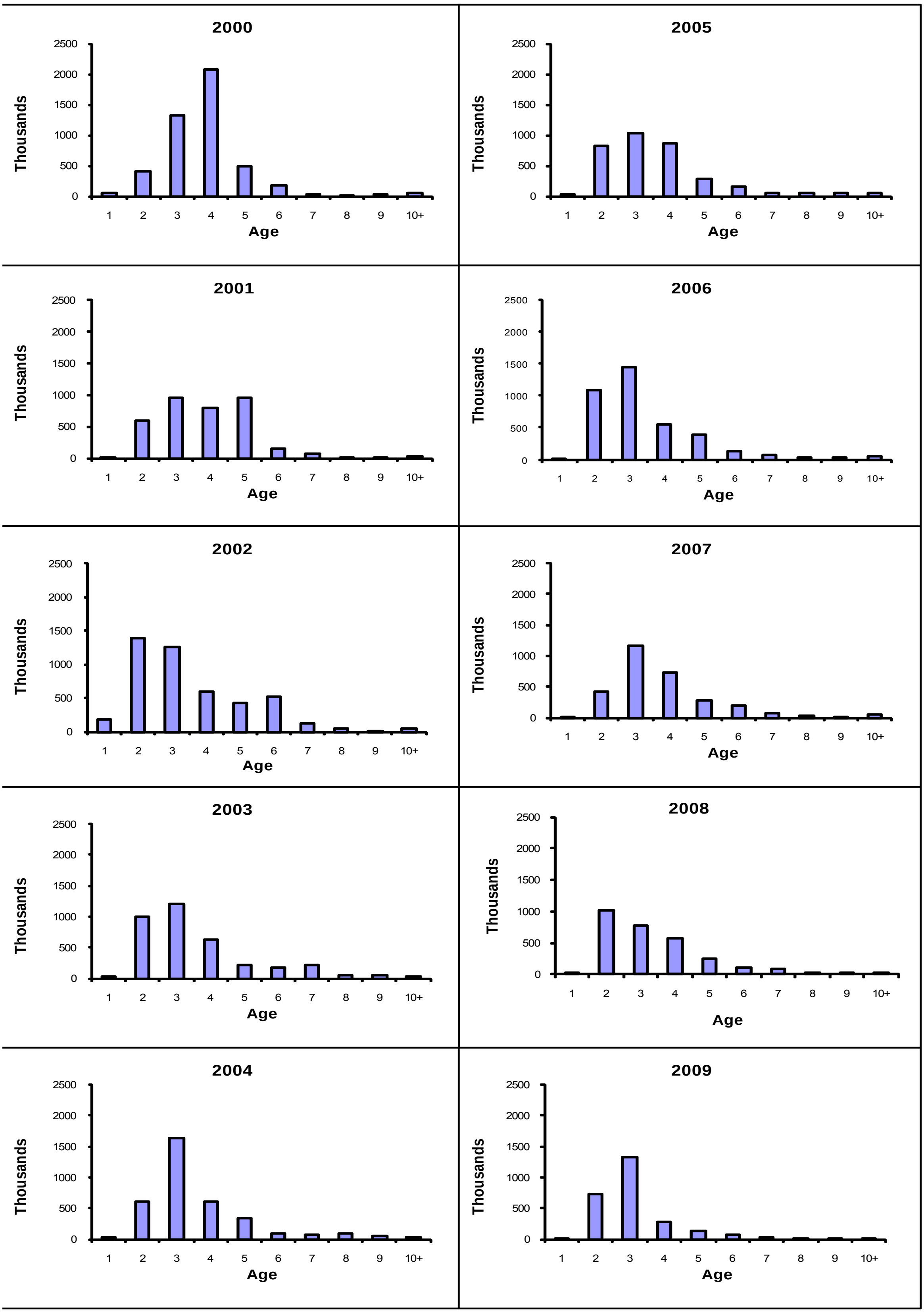


Figure 8.2.5 VIIe Plaice fleet log catchability residuals from the final run

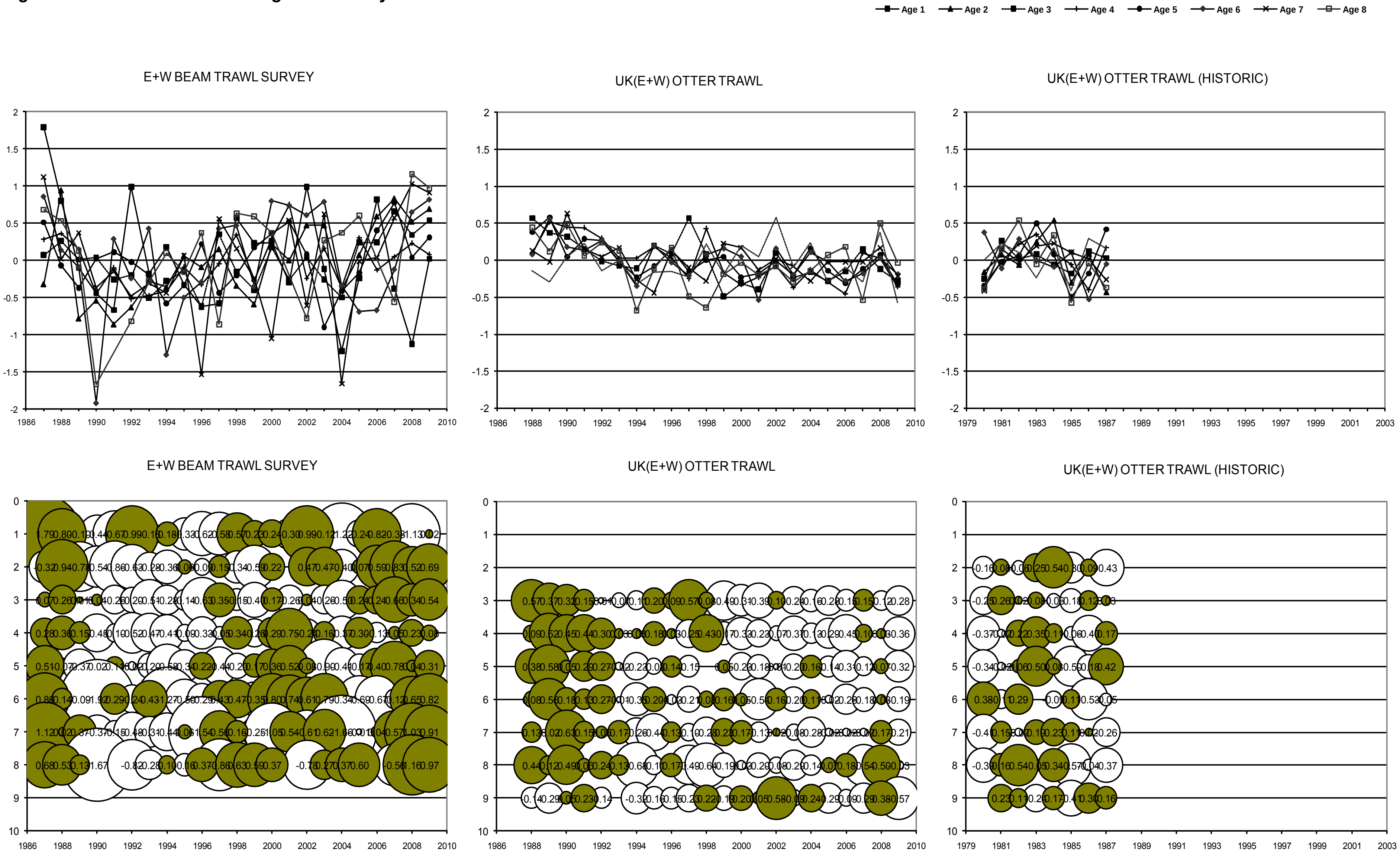


Figure 8.2.5 (cont.) VIIe Plaice fleet log catchability residuals from the final run

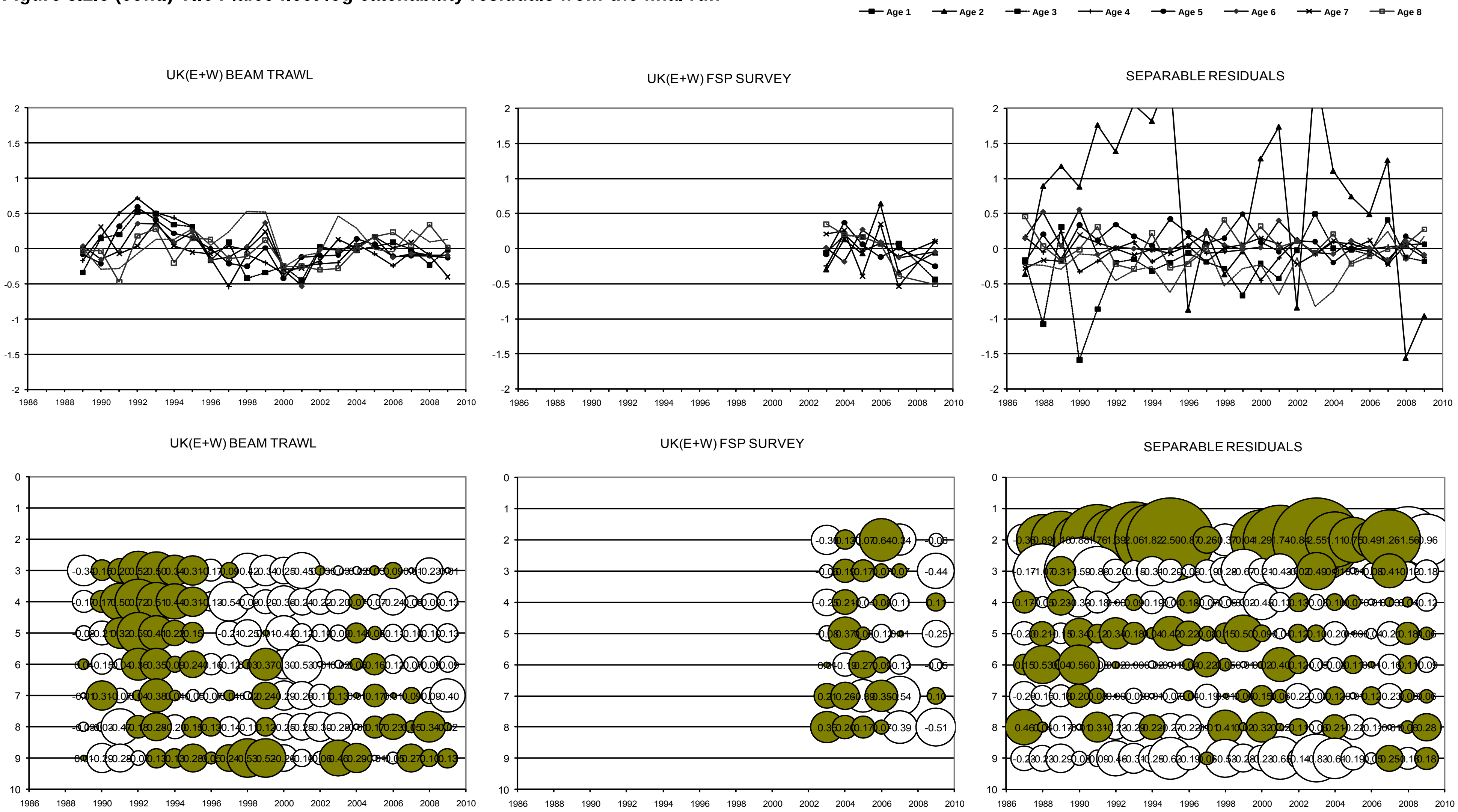
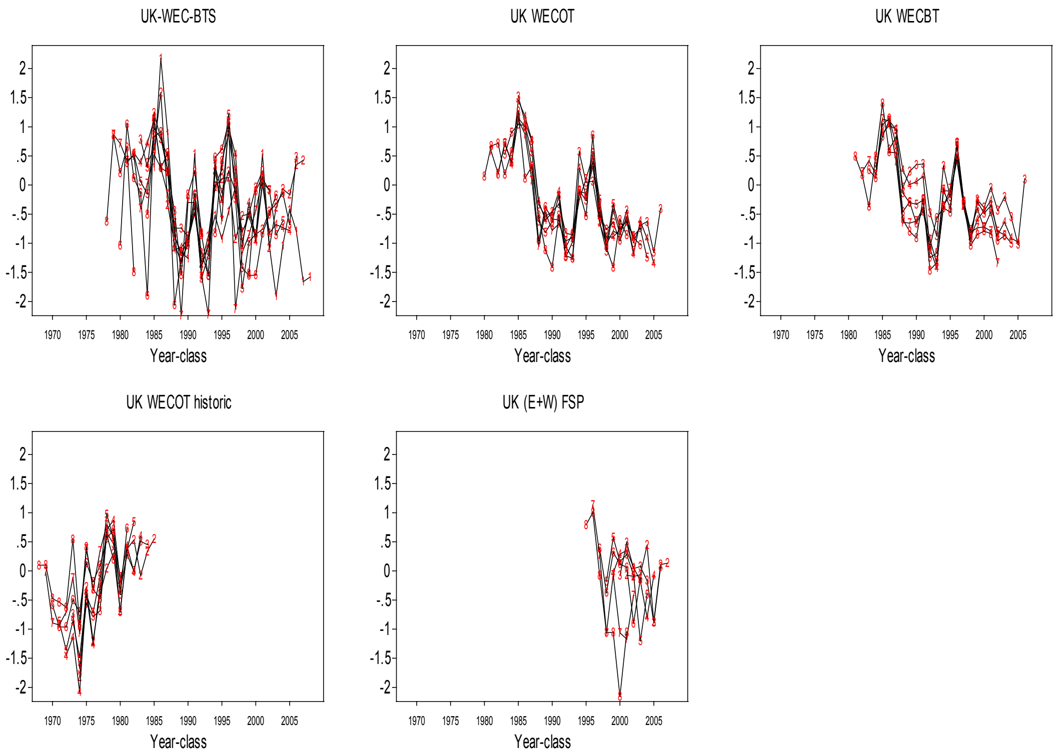


Figure 8.2.6 VIIe Plaice – Surba results

Tuning fleets by year-class



Tuning fleets by year

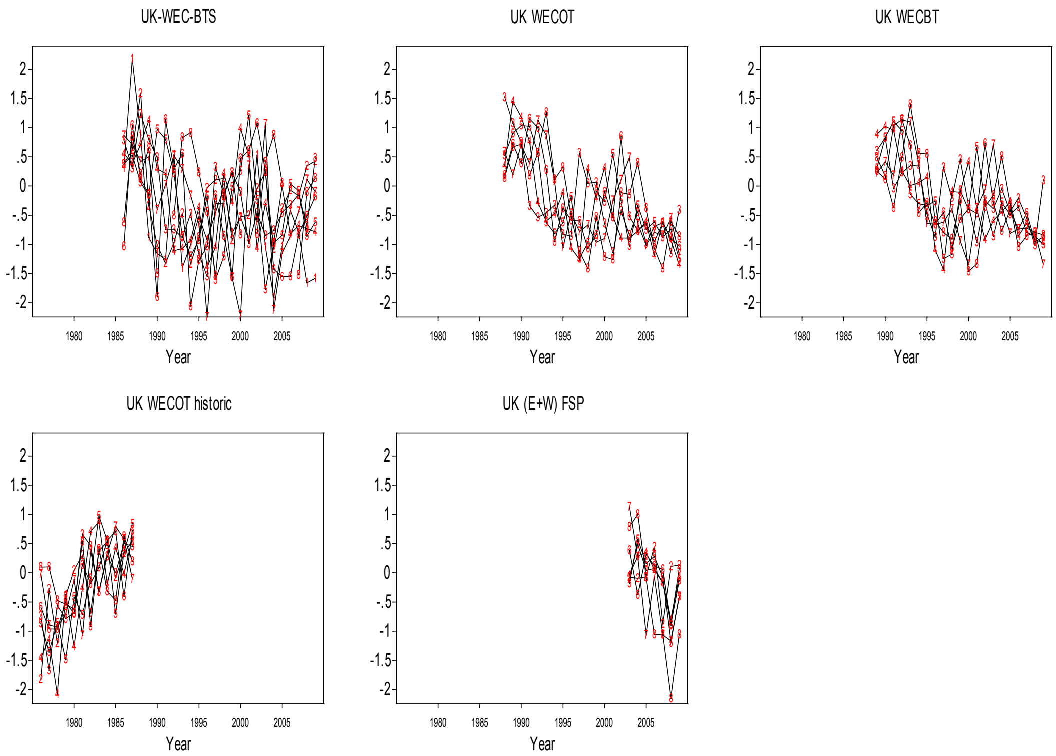
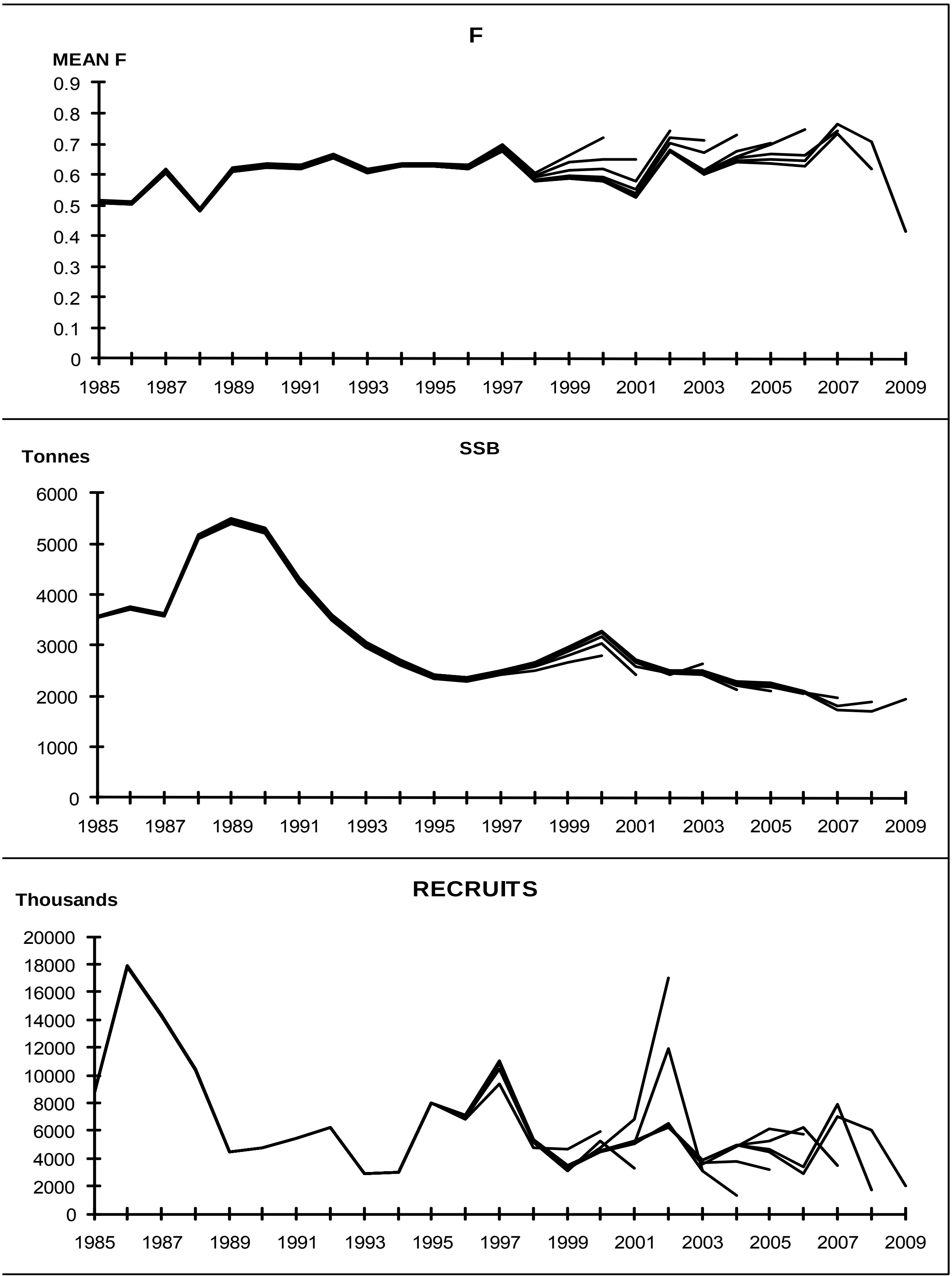


Figure 8.2.7 **VIIe Plaice: Retrospective XSA results**
(Shrinkage SE=2.5)



Note: the retrospective analysis was run without the short FSP survey

Figure 8.2.8 Plaice in Division VIIe (Western Channel)

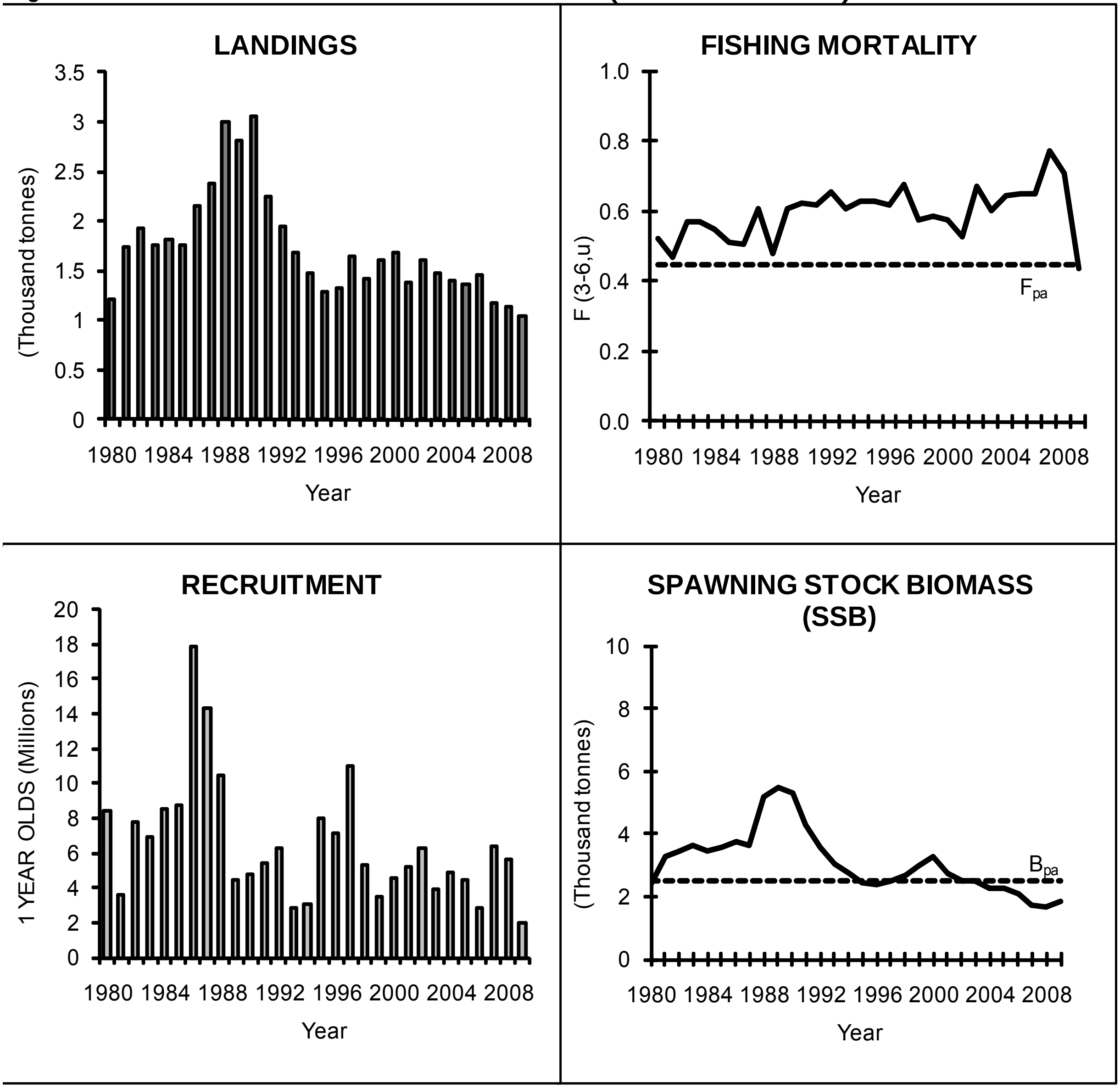
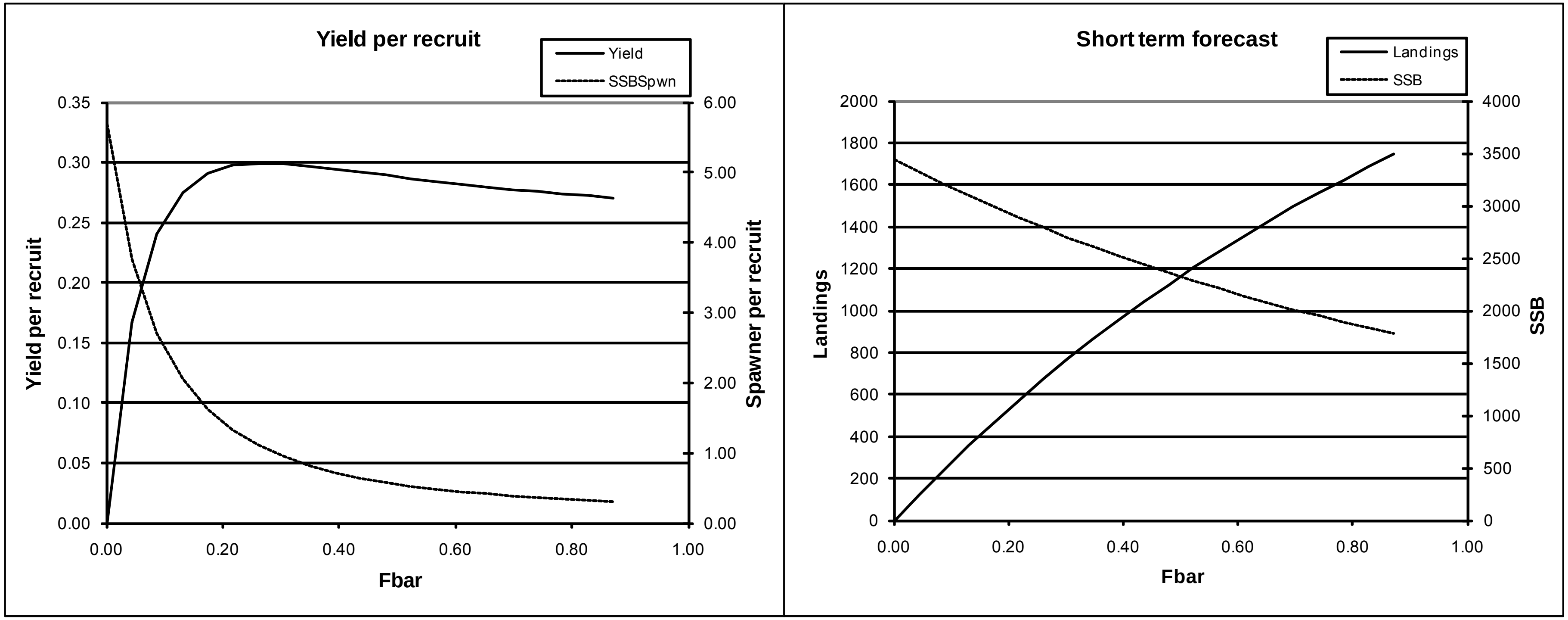


Figure 8.2.10 VIIe Plaice : Yield per recruit and short term forecast results



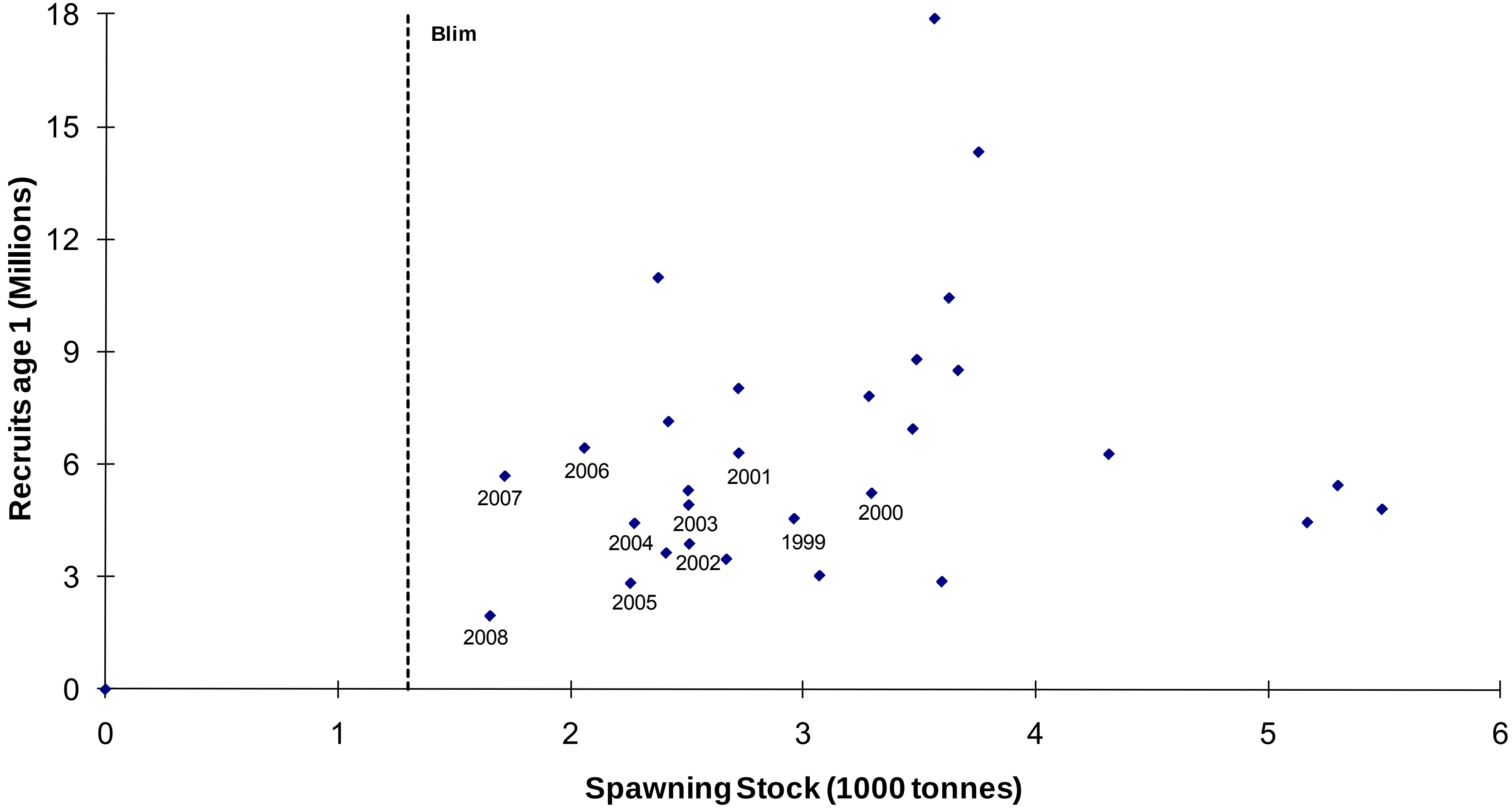
MFYPR version 2a
Run: ple7e2010wg
Time and date: 16:18 16/05/2010

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.4356
FMax	0.6185	0.2694
F0.1	0.2865	0.1248
F35%SPR	0.3127	0.1362

MFDP version 1a
Run: ple7e2010
WESTERN CHANNEL PLAICE,2010 WG, Forecast Inputs
Time and date: 14:07 16/05/2010
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 8.2.11 Plaice in VIIe. Stock-Recruitment



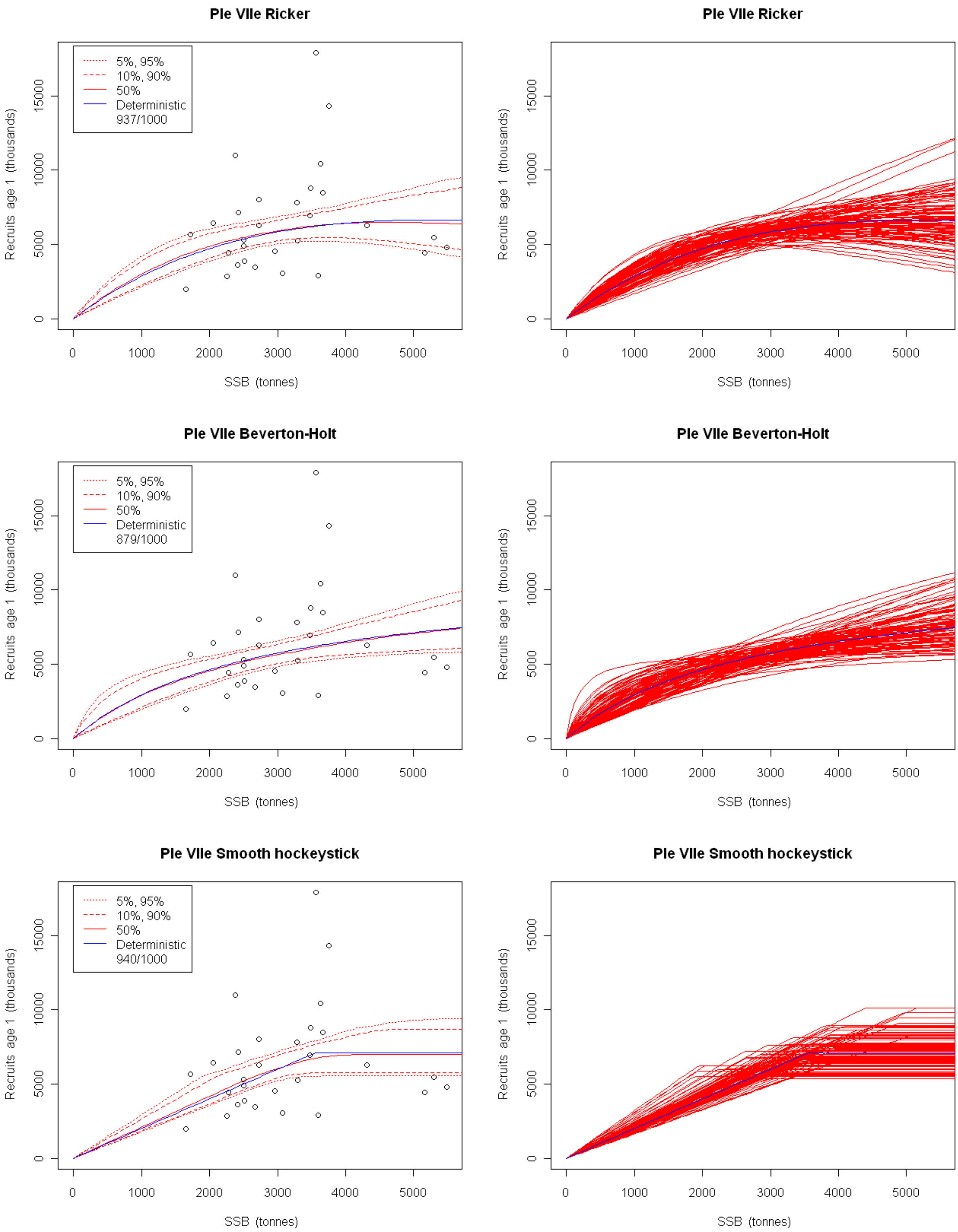


Figure 8.2.12. Plaice in Divisions VIIe. MSY fitted stock and recruit relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{msy}. Right hand panels: curves plotted from the first 100 MCMC re-samples with converged F_{msy} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

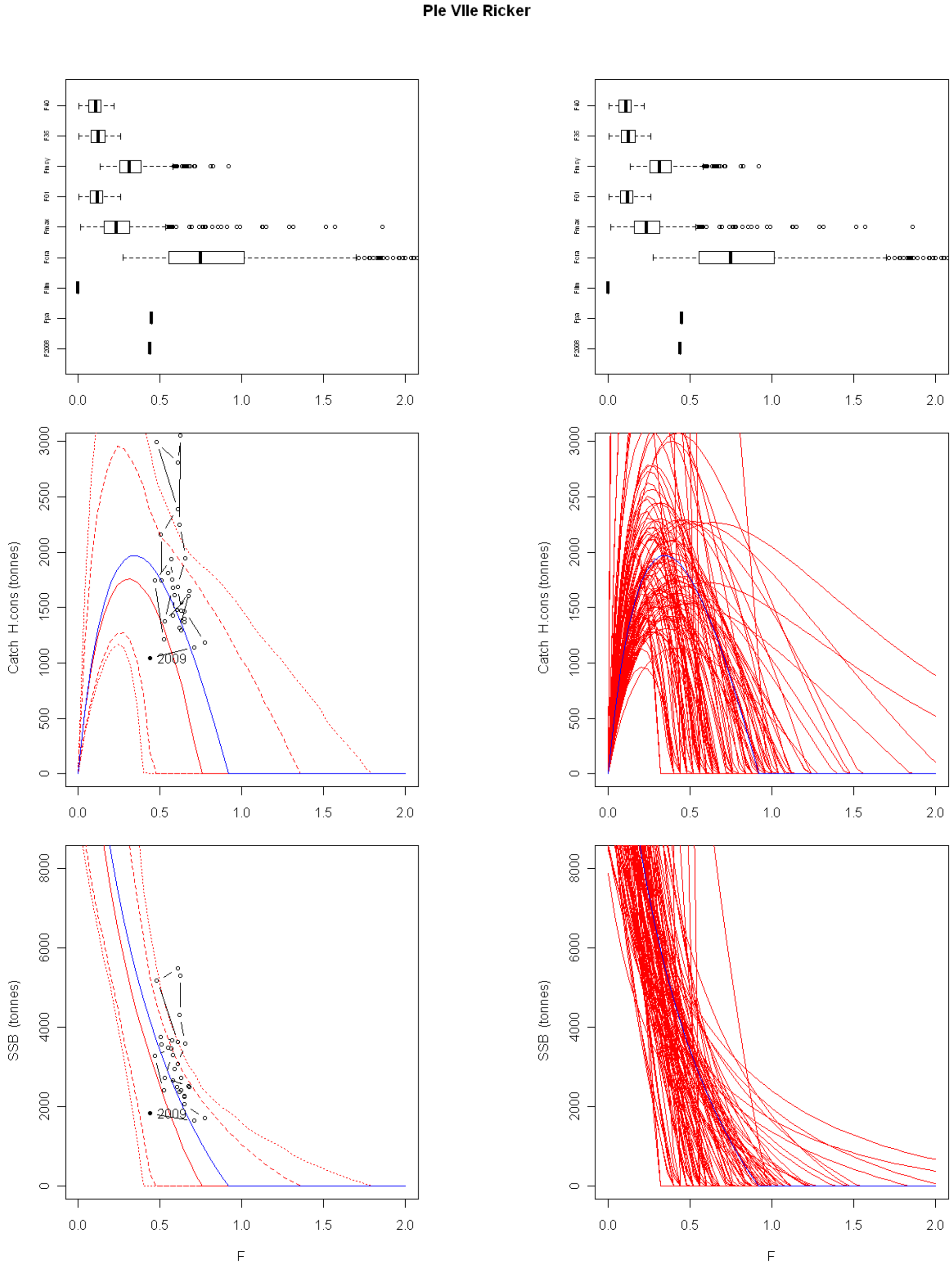


Figure 8.2.13. Plaice in Divisions VIIe. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Ricker stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

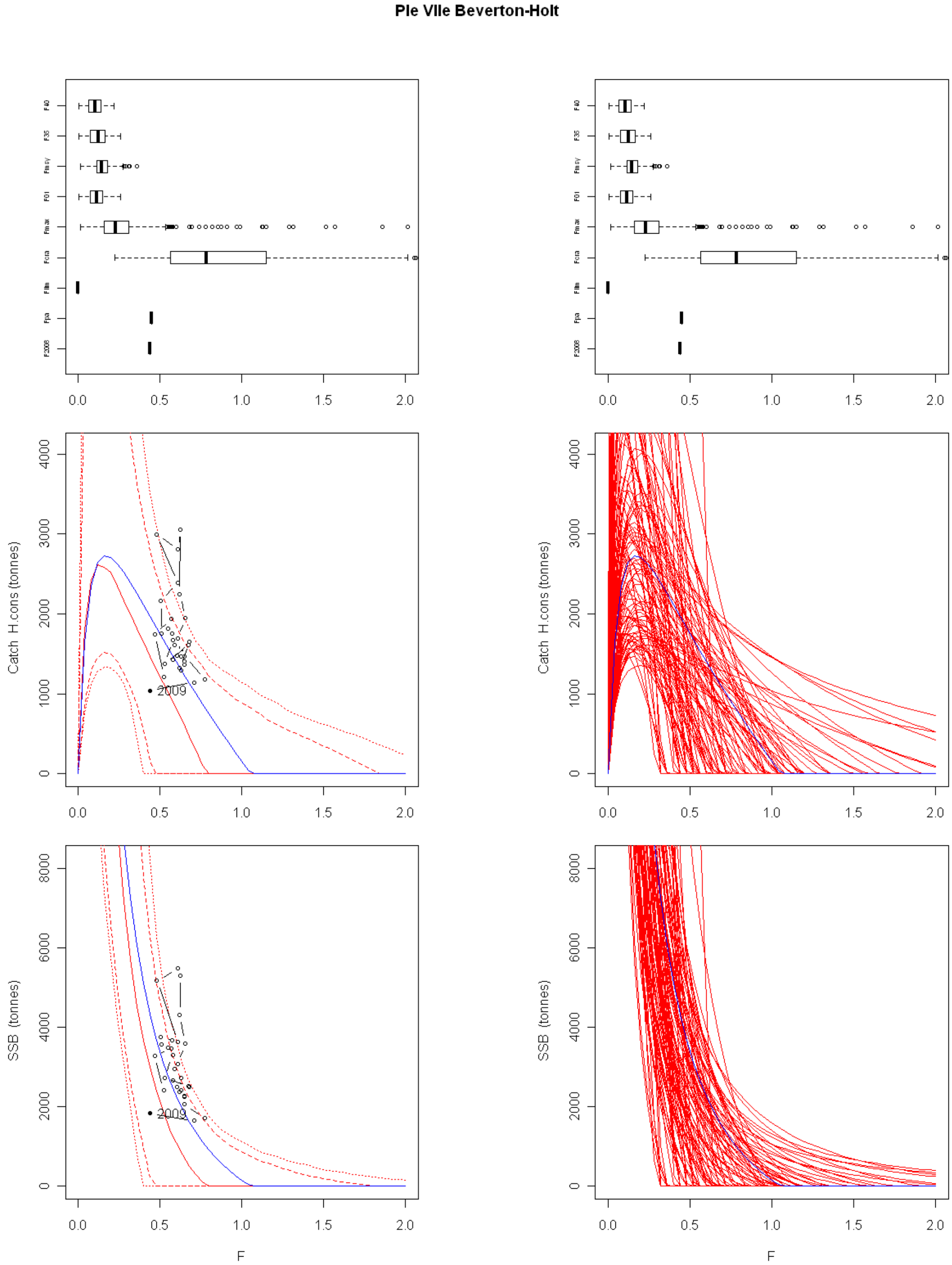


Figure 8.2.14. Plaice in Divisions VIIe. Estimates of F reference points and equilibrium yield and SSB against fishing mortality using Beverton and Holt stock and recruitment model. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles for converged estimates of F_{msy}. Right hand panels: the first 100 MCMC re-samples converged F_{msy} estimates. Circles show assessment estimates with the most recent year labelled.

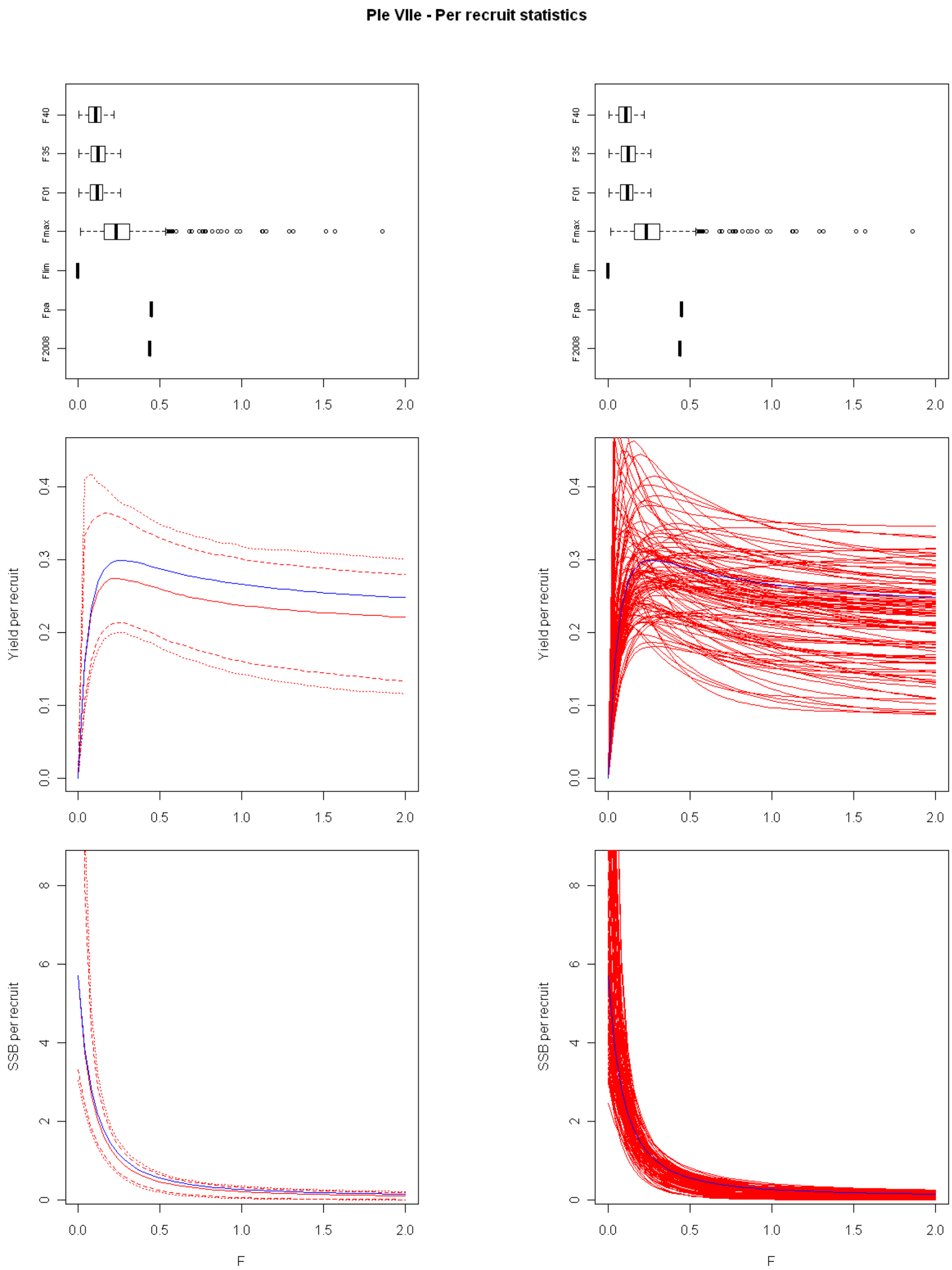


Figure 8.2.15. Plaice in Divisions VIIe. Fitted yield-per-recruit F reference points, yield-per-recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.

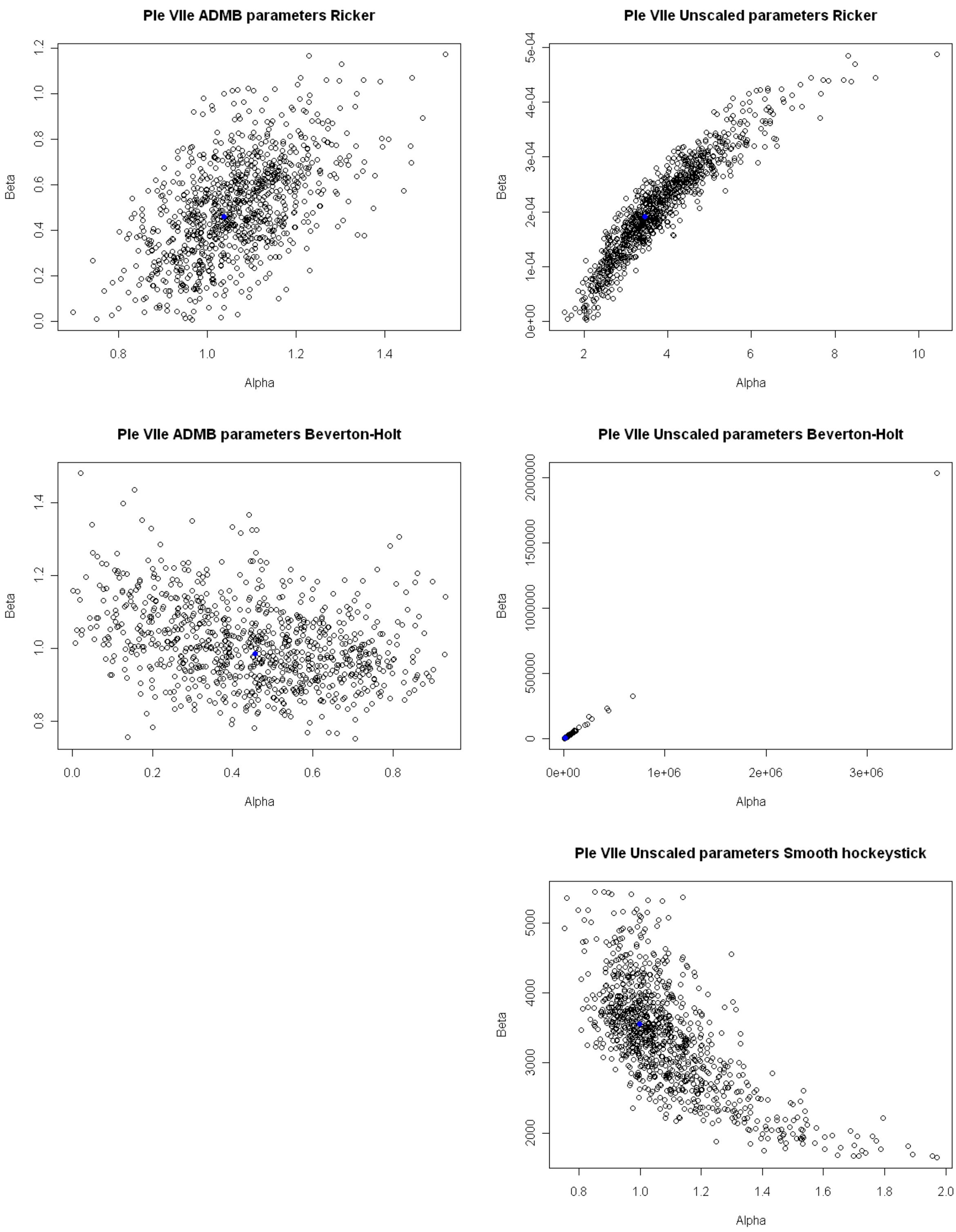


Figure 8.2.16. Plaice in Divisions VIIe. MSY diagnostics.

8.3 Sole in Division VIIe

Type of assessment in 2010

This stock was placed on the observational list in 2004 and has been subject to a full assessment in subsequent years. A management plan for this stock was agreed in May 2007 (Council Regulation (EC) No 509/2007).

In 2009 WKFLAT benchmarked this assessment, but failed to develop an update procedure, because it was not possible to address or even elucidate the cause of the substantial and persistent retrospective bias in F and SSB. Consequently the WG only updated data tables, performed an assessment according to previous update settings and commented on useful indicators of stock trends.

The management plan is inoperable in the absence of an analytical TAC estimate. Following a series of analyses an interim constrained model fit to the historical information was developed and is presented as a final assessment.

ICES advice applicable to 2009

Exploitation boundaries in relation to existing management plans

The multi-annual plan implies a 20% reduction in F compared to average F(03 05), corresponding to landings of 650 t.

This is a 15% reduction in the TAC compared to 2008.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects.

Fishing mortality around F = 0.27 can be considered as a candidate target reference point consistent with taking high long-term yields and achieving a low risk (< 5%) of depleting the productive potential. The present fishing mortality (0.42) is above the candidate reference point.

Exploitation boundaries in relation to precautionary limits

Rebuilding the stock above Bpa in just one year would require that fishing mortality is reduced by 70%. This would correspond to landings of around 320 tonnes in 2009.

Conclusion on exploitation boundaries

Considering that the management plan has not been evaluated by ICES, ICES advises on the basis of precautionary limits. This corresponds to a TAC of less than 320 t in 2009.

ICES advice applicable to 2010

Precautionary reference points established in 2001 for this stock are no longer valid and there is no accepted assessment.

Survey, lpue, and the exploratory assessment suggest low stock size and high fishing mortality relative to historic estimates.

Single stock exploitation boundaries

ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that fishing effort and catches should be reduced although it is not possible to determine the appropriate scale of such reductions.

Technical consideration

Review Group comments on the 2009 assessment:

Technical comments

- It would be useful to include some data regarding mixed species impacts in the next Report. This may be especially relevant if a precautionary TAC is used in 2009, as discarding of sole in fisheries targeting other species may increase.
- Based on the available figures (8.3.3 a–c) it appears that sampling is adequate for the combined UK fleet (486 sampled hauls), but sparse in the French trawl fleet (37 sampled hauls). Based on the available data, it appears that discarding may be more prevalent in the French trawl fleet, especially in the first and second quarter. The assessment may become better informed if sampling intensity is increased in the French fleet.

Conclusions

As a formal assessment was not possible, the precautionary TAC proposed by the WG seems appropriate. Lpue indices for the beam trawl fleets have declined consistently over the available time-series. In addition, the trends in F and SSB estimated in the XSA suggest that the production of the stock is declining. Therefore, a precautionary approach seems most appropriate until a suitable assessment can be conducted.

The WG has developed an interim model specification to address the requirements of the management plan.

Mixed fisheries impacts are addressed in the assessment results summary and management advice.

8.3.1 General

Stock description and management units

The TAC is specified for ICES Area VIIe consistent with the assessment area.

Official national landings data as reported to ICES and the landings estimates as used by the Working Group are given in Table 8.3.1.

Official landings in 2009 were 374 t, well below the 2009 TAC (650 t), but no official landings were reported by France, generally responsible for about one third of landings. WG landings included information based on French sales slips and indicated total international landings were 626 t in 2009 roughly in line with the TAC. A UK single area licence scheme introduced at the end of 2008 stopped the previous practice of misreporting; previous UK landings estimates have been corrected for area misreporting to ICES Division VIId. In previous five years landings had been stable at around 1000, with the UK taking about 65% of the TAC and France reporting the majority of the remainder.

Management applicable to 2009 and 2010

2009

Species: Common sole *Solea solea*		Zone: VIIe (SOL/07E.)
Belgium	23	
France	245	
United Kingdom	382	
EC	650	
TAC	650	Analytical TAC Article 3 of Regulation (EC) No 847/96 applies. Article 4 of Regulation (EC) No 847/96 applies. Article 5(2) of Regulation (EC) No 847/96 applies.

In addition, Annex IIc, restricts the number of days-at-sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet due to a reduction in capacity of the fleet. In November 2008 the UK introduced a single area licence scheme to eliminate the opportunity for UK vessels to misreport catches to Area VIId.

2010

Species: Common sole *Solea solea*		Zone: VIIe (SOL/07E.)
Belgium	22	
France	233	
United Kingdom	363	
EU	618	
TAC	618	Analytical TAC

In addition, Annex IIc, restricts the number of days-at-sea to 192 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional 12 days for the UK beam trawl fleet due to a reduction in capacity of the fleet. In November 2008 the UK introduced a single area licence scheme to eliminate the opportunity for UK vessels to misreport catches to Area VIId.

8.3.2 Data

Landings

Total international catch numbers-at-age (Table 8.3.2, Figure 8.3.1), catch weights and stock weights-at-age (Table 8.3.3, 8.3.4, Figure 8.3.2) as used in the assessment were derived mostly by the procedure described in the Annex, except in 2009 some UK age information was used to supplement sparse French age information at larger lengths. The differences in the length distributions between the different fleets are shown in Table 8.3.5.

The UK reported landings revisions this year for 2008 (+2.0 UK; +2.0 t Guernsey).

Weights-at-age were calculated as in previous years for ages 1–14, but the 15+ group was not included in the within year smoothing, instead the observed weights were used, in accordance with changes with requested by WKFLAT 2009.

Discards

Discard data suggests that discarding in 2009 is again minor in this stock (Figure 8.3.3 a–c, of both the UK and French fleets. Discarding is largely restricted to fish under the minimum landing size, although some individual discard trips may have sporadically higher rates. Discarding due to quota restrictions is rare. For a summary of historical UK discard information see the Stock Annex. In 2009 the UK provided some discard information originating from some gear experiments which indicated that discarding from the traditional gear was high at all ages. These were not included in the assessment as this discard practice was uncharacteristic of all other discard trips and the experimental conditions were deemed to have affected fishermen's behaviour.

Biological

Natural mortality and maturity were used as in previous assessments and described in the Stock Annex.

Survey indices

Aggregated cpue varies considerably, but indicates substantially increased catch rates from the low point of the time-series observed in 2005 to the second highest values in the time-series. (Figure 8.3.4, Table 8.3.6).

The abundance for the UK-WEC- BTS survey carried out on the chartered beam trawler *FV Carhelmar* is given in Table 8.3.7 and shown in Figures 8.3.4 and 8.3.5, plotted by cohort and by years. The figures show few clear year effects and good year-class tracking for the survey at all ages until about the mid 1990s. Since then, the estimate of year-class strength at age 1 and at ages greater than 7 has deteriorated slightly. This may partly be associated with the change of vessel that occurred in 2002 and 2004 (*RV Corystes* used), but it seems likely this is not the only cause and weather may play a part in the catchability. One notable difference between the commercial and survey tuning-series that has been noted is the estimate of the strength of the 1998 year class. This is well represented in the commercial data, but much less clearly so in the survey data. This YC was also seen to be very strong in the VIIf&g stock and may represent some overspill of recruitment from that stock in the adjacent western part of VIIe, not covered by the survey.

Commercial fleets effort and lpue

Effort in hours fished for both over and under 24 m beam trawlers increased until 2001 thereafter remaining stable until 2006 (Figure 8.3.4, Table 8.3.6). Since then, >24 m boats have declined in favour of smaller boats due to a combination of the UK decommissioning scheme and the substantial increases in fuel costs, making the larger boats commercially unviable. The decline of the larger boats has resulted in a resurgence of the use of vessels under 24 m. Given the licence transfer rules currently in force in the UK restructuring of the fleets will lead to a 10% decrease in the kW day capacity of replaced vessels not withstanding any latent capacity. Otter trawl effort (UK-COT) has been in continual decline since the early 1970s and is currently near the time-series low, at values roughly a third of those seen in the 1970s (Table 8.3.7). Gross registered tonnage corrected effort used in the assessment also shown in Figure 8.3.4 shows a strong decline in effort in the main fleet exploiting the stock in 2009 as vessels moved out of the area as a result of the UK single area licensing scheme (Figure 8.3.4, Table 8.3.7).

Otter trawl effort, as used in the tuning information has been declining steadily since the late 1990s and is now at historically low levels, but takes only a small proportion of the landings.

Lpue for both over and under 24 m beam trawlers has declined steadily since 1988. Cpue from the survey is variable, but stable across this period, it is representative only of the younger ages in the fishery (1 to ~6) and only a proportion of the area exploited by the fishery.

Age disaggregated commercial abundance indices used in the assessment are the commercial beam trawl fleet (UK-CBT) and the otter trawl fleet (UK-COT) are given in Table 8.3.7, and plotted log converted by cohort and year in Figure 8.3.5 and 8.3.6 (historical fleets are retained for assessment stability). The UK-CBT shows very good year-class tracking indicated by the consistent estimation of strong and weak year classes at different ages, and demonstrates a decline in the abundance-at-age from 1975 to 1990, after which levels stabilise. There is little indication of year effects in this time-series. The UK-COT fleet also shows good year-class tracking over the middle of the time period and also gives some indication of a decline in lpue in the early 1980s although this is much less clear than in the beam trawl fleet. This is likely in part caused by the strong year effect seen for this fleet in 1991-2 and to a lesser degree in 2004. The causes of this are not clear from anecdotal evidence, but sampling for the fleet is now at relatively low levels, due to the small size of the fleet and landings.

See also the Stock Annex for historical fleet data used in the assessment.

Information from the fishing industry

The UK fishing industry reported high abundance of sole for the area in 2009, and that improved compliance with the TAC through increased enforcement had resulted in a redistribution of effort to other divisions as well as concentrating on fishing opportunities on other species within the area.

The UK fisheries science partnership (FSP) in 2009 again conducted a survey, now in its 7th year, of sole and plaice abundance in the western channel. The results indicate that sole continue to be widespread in the area and that a large number of cohorts contribute to the stock.

8.3.3 Stock assessment

Model used: Reformulated XSA assessment

Software used: FLR-FLXSA (FLCore 1.4-3–"Golden Jackal"; R 2.4.1)

Model Options chosen: data as in previous years (See Stock Annex) but with additional shrinkage to stabilise F trends.

Input data types and characteristics: catch numbers-at-age without discards, five tuning fleets, one survey, two current commercial cpue series, two historical cpue series.

Data screening

Data screening of the catch-at-age, weights, tuning information and ancillary qualitative information was carried out by the procedures set out in the Annex.

Single fleet XSA's for the current tuning fleets (see Annex for procedures) were run. Residuals for all single fleet runs were generally small (Figure 8.3.7). Residuals of the single fleet runs indicated a small but persistent decreasing trend for the CBT fleet, two large negative residuals in the COT fleet in 1992 and 2003-4 and more variable, but largely unbiased residuals for the UK-WEC-BTS. The characteristics of the individual tuning fleets are consistent with those shown previously in the screening of the tuning fleet data and hence suggest that all tuning fleets are largely consistent with the available landings data.

Summary plots of the single fleet runs are shown in Figure 8.3.8 indicate F, SSB and recruitment estimates are consistent between the fleets, although the final estimates vary slightly, with UK-CBT giving the highest F values, followed by the UK-WEC-BTS and the UK-COT fleets with the reverse being true of the SSB estimates.

Final assessment

WKFLAT 2009 described the assessment methodology used prior to 2009 as unsuitable for management advice, but failed to develop a more suitable methodology. The management plan is inoperable in the absence of an analytical TAC estimate.

The WG fitted the XSA model using the previous setting, which indicated a much reduced retrospective pattern in the last two years, and considered re-introducing the old assessment methodology. However, the retrospective bias observed in previous years remained apparent and no explanations for the historical pattern can be given. Previous studies by the ICES Working Group on Assessment Methods (ICES 1991, ICES CM1991/ Assess:25) established that where retrospective bias patterns are severe, such that estimates are considered unreliable, shrinkage to the mean fishing mortality of the previous years at each age could be used to provide coherent population and fishing mortality estimates that can be taken forward into stock forecasts. An XSA with heavy shrinkage was therefore considered to be the most likely methodology to provide quantitative information suitable for management advice. The results from exploratory runs established that an increased level of shrinkage (0.5 from 1.0) and an increased time period over which this is applied (10 years from 5 years) was optimal for consistent series of estimates. All other settings were maintained as previously and the complete set of settings is shown in the text table below.

Figure 8.3.9 shows the residual plots from the final fitted model. Figure 8.3.10 shows a comparison with the 2009 assessment. XSA diagnostic tables, fishing mortality-at-age, and stock numbers-at-age are shown in Tables 8.3.8–8.3.10. Comparisons of the XSA estimate weighting between the previous, SPALY and current assessment highlights the increased weighting given to F-shrinkage in this year's assessment in order to decrease the retrospective bias (Figure 8.3.11).

A seven year retrospective analysis was run for the interim assessment (Figure 8.3.12), which still shows some retrospective bias prior to 2006, but confirms that the more recent period is more stable with respect to F and SSB trends.

		2009
Catch-at-age data		1969–2009, 1–12+
Fleets	UK-BTS – Survey	1988–09, 1–9
	UK-Inshore – Commercial	1973–1987, 2–11
	UK-Offshore – Commercial	1973–1987, 3–11
	UK Combined Beam Trawl–Commercial (UK-CBT)	1988–09, 3–11
	UK Otter trawl–Commercial (UK-COT)	1988–09,3–11
Taper		No
Ages catch dep. Stock size		None
q plateau		8
F shrinkage se		0.5
year range		10
age range		5
Fleet SE threshold		0.5
Catch data		Age 1 catches = 0
Plus group		12
F_{Bar} Range		F(3–7)

State of the stock

Stock trends are shown in Table 8.3.11 and plotted in Figure 8.3.10.

SSB is estimated to have increased from 1970 to 1980 following successive strong recruitments. Subsequently it has declined until 1993 after which it remained stable for 12 years before declining slightly to historically low levels in 2006/2007. There has been a slight increase in the last two years.

The base level of recruitment has remained stable during the whole time-series in the range 4–5 million recruits. The main development has been a reduction in recruitment variability since 1991 with very few if any of the very abundant year classes that maintained a higher level of biomass during the early period.

Fishing mortality was stable at a low level until 1977 after which it increased sharply until 1982, remained relatively constant until 2004 and then increased until 2007. F decreased slightly in 2008 and then sharply in 2009, commensurate with the improved compliance associated with the single area licensing scheme introduced in the UK.

Information that is consistent with the decrease in fishing mortality in the most recent year is provided by the decline in effort (Figure 8.3.4) and landings (Table 8.3.1) which have decreased to levels close to the TAC.

The age structure of the VIIe sole stock continues to be more extended than other sole stocks in European waters, implying low mortality rates, with the plus group (at age 12) containing a high proportion of the catches and including some individual of ages 33–38 in recent years.

8.3.4 Short-term projections

A short-term forecast based on Fsq has been used previously for this stock, because area misreporting had meant that in the past the TAC had not been constraining. However, recent evidence suggests that the TAC is likely to be observed so a TAC constraint forecast was implemented this year using the average stock and catch weights 07–09 and the selectivity pattern 07–09 scaled to achieve a 2010 TAC of 618 t for the interim year.

Estimating year class abundance

As implemented previously, the geometric mean recruitment over the entire time-series (69–07) was used as there is no evidence of a significant relationship between SSB and subsequent recruitment over the range of SSB values observed in the assessment.

Year class	Thousands	Basis	Surveys	Commercial	Shrinkage
2007	3037	XSA	62%	-	38%
2008	4332	GM (69–07)			
2009	4332	GM (69–07)			
2010	4332	GM (69–07)			

Complete input data for the short-term forecast is shown in Table 8.3.12, and resulting F_{sq} forecast constrained in 2010 to the 618 t TAC is shown in Table 8.3.13.

SSB estimated at 2470 t in 2009 will remain stable at 2400 t in 2010, despite a decrease in F in 2009 (0.25) as a result of weaker recruitment (07, 08) but will increase at F_{sq} (0.355) in 2011 to 2540 t as cohorts for which $GM_{(69\text{-}07)}$ has been assumed enter the fishery.

The proportions that the 2007–2011 year classes will contribute to the landings in 2011, and to the SSB in 2012, are given in Table 8.3.14. 29% of the landings for 2011 and 40% of the SSB for 2012 rely on year classes for which GM recruitment has been assumed. The 2008 year class that has been replaced with GM (69–07) contributes 21% to the landings in 2010 and 23% of the SSB in 2012.

A full management options table is provided in Table 8.3.15. The management plan for this stock requires a reduction in F of 85% of the average $F_{07\text{-}09}$ = 0.36 (F_{2011}=0.3) resulting in a yield of 809 t in 2011 and representing a 31% increase in the yield over 2010. The TAC-stability clause in the management plan allowing for a maximum 15% change in TAC from year to year will limit the TAC to 710 t equivalent to an F=0.25 just below the long-term management target of F_{manag}=0.27.

8.3.5 Biological reference points

Biological reference points were rejected by WKFLAT 2009 due to a lack of an appropriate assessment to evaluate their suitability. Reference points should be revised once an appropriate assessment methodology has been fully developed.

ICES is moving towards management advice based on MSY reference points. Management of this stock in the short term is likely to be on the basis of the management plan so that a lack of PA reference points is unlikely to significantly impact management decisions in either the short or medium term.

8.3.6 MSY evaluation

Although there is no benchmark procedure for providing a yield-per-recruit or MSY analysis for this stock, ICES ACOM requires the provision of such information to inform the commission on suitable long-term management targets. The interim assessment provided by the WG is reasonably stable with regards to estimates of selectivity, especially when using the average selectivity pattern over the last seven years. Input data used by the SRMSYMC program is shown in the .sen file (Table 8.3.16). A thousand MCMC iterations were provided, roughly 90% of which provided converged F_{msy} estimates for the various stock–recruit relationships investigated.

Stock–recruitment plots for the three stock–recruitment models are shown in Figure 8.3.12 and indicate a cloud of stock–recruit points through which it is possible to draw plausible fits of any of the stock–recruitment relationships, with little information to distinguish the suitability of any of them.

As noted previously, the base level of recruitment has remained stable during the whole time-series in the range 4–5 million recruits. The main development has been a reduction in recruitment variability since 1991 with none of the very large year classes that maintained a higher level of biomass during the early period. The model fits pass through the cloud of estimates and there is no information as to the structure of the relationship (Table 8.3.16).

All models imply that the population in recent years has been exploited at levels close to or above F_{crash}. The stock has been exploited at these levels since the 1980s, and SSB and recruitment have been stable for the last 20 years. Based on the unrealistic estimates of F_{crash} all stock–recruit models were rejected.

The yield-per-recruit analysis indicates that all reference points are poorly defined when low levels of uncertainty are associated with natural mortality, maturity and selection and weights-at-age.

Higher yields and lower risk to the stock can be obtained at levels of F lower than those observed in the last 10 years. However, little or no information is available on the stock dynamics at such levels so that it is not possible to provide estimates of F_{msy} for use as management targets based on the analysis performed during this WG.

Stochastic analyses performed by WGSSDS in 2006, assuming no variability in M, suggested that yields of 865 t could be safely extracted from the stock at levels of F=0.27 while the probability of SSB dropping below lowest observed SSB values would remain at less than 5% . This value remains consistent with the results of the current assessment and is accepted as the best estimate of F_{msy} available for this stock.

8.3.7 Management plan

The commission implemented a management plan for the recovery of the stock early in 2007 (Council Regulation (EC) No 509/2007). ICES evaluated the management plan and concluded that:

> The long-term management target (F=0.27) is precautionary in the sense that it ensures that there is a less than 5% chance of SSB declining below previously observed levels, as well as maintaining yield within 10% of MSY (*WGCSE note: long term yield at F_{max}*) (WG 2005, WG 2006).
>
> The methodology of reaching the long-term target in 3-year stepped reductions in F is also acceptable. However, the size of further steps is based on observed fishing mortalities within the period of the management plan. This

can only have the desired effect if management measures (TAC) are effective and if estimates of recent levels of F from the assessment are accurate. In 2009 newly introduced enforcement measures appear to have resulted in increased compliance with the TAC; continued development of the SSB will be dependent on effective controls of fishing effort.

The WG has provided an interim assessment as a means of providing management advice for 2011, which implies a TAC of 700 t in 2011. Catches at this level are likely to maintain F around the long-term management target.

8.3.8 Uncertainties in assessment and forecast

The WG provided a constrained interim assessment due to the need for management advice in relation to the management plan, as the current plan makes no provisions as to how to manage the stock in the absence of a full analytical assessment. The methodology provided is as robust as possible under the currently available understanding of the stock dynamics and at present does not appear to suffer from the retrospective pattern, which led to the rejection of the assessment as suitable for management advice by WKFLAT 2009. However, the retrospective analysis suggest that even the new methodology still retains some retrospective bias in the earlier period so that the uncertainty in the current estimates of F and SSB is likely to be greater than indicated by the assessment output diagnostics. The absolute values are used in the short-term forecast and the uncertainty is used in the MSY analysis.

Sampling

Age and length sampling for this stock is mostly adequate. Age data from the largest two sectors prosecuting this fishery (UK and France, together about 95% of landings) are included in the assessment. French age data in 2009 was insufficient at older ages to raise the length compositions, so that UK data was used to cover the larger fish. The use of commercial tuning data is unavoidable, as there is little information available for older ages from the survey.

Discarding

There is currently little discarding of undersized fish in this stock. There is some anecdotal evidence of a change in high-grading practice in the UK fleet due to the introduction of a single area licensing scheme. Despite this, high-grading was not found to be a significant contributor to mortality in 2009 in the UK discard data. However, gear trials conducted by the UK suggested that incentives to high-grade remain under the current fleet capacity. If this is found to be significant in future it should be possible to include this in the assessment in subsequent years, as it would not require a time-series of discards unlike most other stocks currently assessed without discards.

Surveys

Currently only one survey index is used in the assessment (UK-WEC-BTS) which provides stability to the assessment in general. Year-class tracking is internally consistent and agrees reasonably with information from commercial tuning fleets. However, in the recent past there is some question regarding the consistency of the tuning-series due to a vessel effect in 2002 and 2004. In addition in recent years it has become apparent that there are some differences in the year-class consistency between the commercial and survey tuning information. Specifically, the 1998 year class known to have been very strong in VIIf&g is not represented in the survey that operates solely in the eastern part of the area. This suggests that there may be both an open population as well as an incomplete mixing problem in the data contributing to the inconsistency of the assessment.

Consistency

The interim assessment provided by the WG is mostly consistent with the previous methodology as it uses the same information, but weights the value of the different sources differently. The estimates of stock status in 2009 are consistent with those produced by the previous assessment methodology.

Misreporting

Area misreporting, mainly to Area VIId had declined to low levels in recent years, through a combination of enforcement and a substantial increase in the TAC in 2005. There have also been some attempts to prosecute UK fishermen for misreporting to Area VIIh, although to date none of those prosecutions have been successful for lack of legally acceptable evidence.

Levels of underreporting are thought to have been serious in the early 1980s prior to the shift to area misreporting. Although it is clear that levels of underreporting are also much lower now, no quantitative information is available on the size of the problem.

Landings in 2009 were in line with the TAC for the first time, suggesting improved compliance. The decrease in landings is also consistent with a reduction in effort by the main fleet and a reduction in F observed in the plaice VIIe stock, a major bycatch of the sole fishery.

8.3.9 Recommendation for the next Benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2009	VIIe Sole	WKFLAT 2009 could not recommend an appropriate assessment procedure for this stock for the following reasons: Closed population and complete mixing assumptions of the assessment are violated. Tuning data indicate differences in trends in F and recruitment resulting in a serious retrospective pattern in the assessment. Survey information only partially covers the stock area. Effort correction parameters/methodologies require updating as the main beamtrawl fleet has restructured substantially recently. This effort would be greatly enhanced by an internationally coordinated survey that more appropriately covers the management area and is able to assess recruitment dynamics irrespective of the sources of recruitment and environmental drivers.	2012	Experts with expertise in spatial modelling of stock dynamics, expertise in the analysis of tagging information.

8.3.10 Management considerations

This stock is subject to a management plan based on reductions in fishing mortality in relation to historical levels of F. Previously both the most recent and the target fishing mortality and population estimates were continually revised by subsequent assessments, which is why the assessment was rejected by WKFLAT 2009.

A constrained interim assessment model has been fitted in order to provide management advice in relation to the management plan, as the current plan makes no provisions as to how to manage the stock in the absence of a full analytical assessment. The model is considered to provide population and mortality estimates that are coherent and suitable for the provision of stock forecasts.

The management of the stock by TAC in the past has been ineffective, as the restrictiveness of the TAC was inversely related to the degree of area misreporting. In November 2008 the UK introduced a single area licensing scheme for beam trawlers in VIIe, which appears to have restricted the possibility of area misreporting in 2009 but had little or no effect in 2008.

Effort restrictions have not been sufficient to ensure an observable decrease in F in recent years. Decommissioning in the UK fleet in 2007–2008 did not reduce fleet capacity sufficiently, but TAC restrictions appear to have been effective in 2009 and resulted in the fleet utilising fishing opportunities in other ICES divisions so that effective effort in Division VIIe dropped markedly.

Plaice are taken as a bycatch in this fishery, so that management advice for sole must also take into account the advice for plaice. The effort reductions in 2009 have also positively impacted the plaice stock with a sizeable reduction in F indicated for that stock also. Angler fish, cuttle fish, and lemon sole are also important bycatches in this fishery. The UK beam trawl fleet has recently started to land sizeable quantities of gurnards for human consumption.

Estimates of F_{msy} and its proxies were all considered highly uncertain for this stock and therefore not considered appropriate. The current management plan is considered appropriate to achieving high long-term yields consistent with MSY.

8.3.11 Ecosystem considerations

Beam trawling, especially using chain-mat gear, is known to have a significant impact on the benthic communities, although less so on soft substrates and in areas which have been historically exploited by this fishing method. Discard rates of non-commercial species and commercial species of unmarketable size are substantial, but total discards are lower compared to some other gears due to the relatively small area swept by the gear.

8.3.12 Regulations and their effects

In November of 2008 the UK introduced a single area licensing scheme for beam trawlers, which is thought to be highly effective in eliminating the current practice of area misreporting by this fleet, but will have had little effect on the fishery in 2008. Landings and effort data for 2009 indicate that the measure has been effective.

Management of this stock is mainly by TAC. In 2005 effort restrictions were implemented for beam trawlers and entangling gears targeting sole this fishery to enforce the TAC and improve data quality. To date these restrictions have not been limiting in this fishery, in part due to the large numbers of days available, but also because in the UK fleet there appears to remain some latent effort/overcapacity in the beam trawl fleet despite decommissioning.

Mesh restrictions for towed gears are set to 80 mm codends, which correspond well with the minimum landing size of sole at 24 cm. Consequently there is little discarding of sole in this fishery.

8.3.13 Changes in fishing technology and fishing patterns

The UK industry has applied for MSC certification in 2009 commensurate with which it has started to adopt larger codend meshes and square mesh panels to limit the impact on benthic ecosystems. However these changes have not been adopted fully in 2008 so the effects are likely to be minimal for this year's assessment, but significant changes may be observed in the 2009 data and the WG will endeavour to monitor the situation.

8.3.14 Changes in the environment

WGRED 2008 overall indicated that there were no consistent environmental drivers altering the ecosystem in Celtic Sea Area, although it did provide some more detailed description of the environmental changes occurring in the system, including climate change, NAO and changes in plankton productivity and species composition.

The winter NAO experienced a strong negative phase in the 1960s, becoming more positive in the 1980s and early 1990s. It remained mainly negative from 1996 to 2004, but became positive in 2005 (6.7 mbar).

Although the assessment only goes back to 1969, relative year class for sole VIIe from catches indicates some very strong recruitment for example in 1963, following which recruitment appears to have declined coinciding with the strong negative phase of the NAO. Positive NAOs in the 1980s and 1990s coincide with some of the highest recruitments seen in the assessment, which have declined since then along with NAO values. Since 2005 the NAO again shows more favourable conditions although this has not immediately resulted in returns of the occasional exceptional year classes.

This should be investigated further by the next Benchmark.

Table 8.3.1 Sole VIIE Nominal landings (t) as used by the WG

Year	Belgium	Denmark	France	Netherlands	Ireland	Jersey	Guernsey	UK E W Ni	UK other	Unallocated	Total
1974			323							104	427
1975	3		271				2	215	2		491
1976	4		352				1	259	1		616
1977	3		331					272			606
1978	4		384					453		20	861
1979	1		515				2	663	2		1181
1980	45		447		13		1	763	1		1269
1981	16		415	1			4	784	4	-5	1215
1982	98		321				15	1013	15	-1	1446
1983	47		405	3		2	16	1025	18		1498
1984	48		421			9	14	878	23		1370
1985	58		130			9	8	894	17	310	1409
1986	62		467			3	6	831	9	50	1419
1987	48		432			1	5	626	6	168	1280
1988	67		98			0	4	780	4	495	1444
1989	69		112	6			3	610	3	590	1390
1990	41	0	81			1	3	632	4	556	1315
1991	35		325					477		15	852
1992	41		267				2	457	11	119	895
1993	59		236			1		479	19	111	904
1994	33		257					546	2	-38	800
1995	21		294			1	2	562	3	-24	856
1996	8		297					428	9	91	833
1997	13		348		1	13	13	470	26	91	949
1998	40		343			17	3	369	20	108	880
1999	13					18	3	375	21	548	957
2000	4		241			22	5	386	27	256	914
2001	19		224			20	5	382	25	419	1069
2002	33		198			15	5	289	20	566	1106
2003	1		363		1	15	5	235	20	458	1078
2004	7		302			7	6	172	13	581	1075
2005	26		406			17	5	505	22	80	1039
2006	32		357			4	4	568	8	57	1022
2007	34		383		2	2		525	2	69	1015
2008	28		183		0	2	6	463	8	230	908
2009	18				1	1		354	1	252	626

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's

Age	1969	1970	1971
1	0	0	0
2	89	53	51
3	322	232	200
4	80	322	246
5	148	90	198
6	210	83	65
7	21	112	80
8	50	13	156
9	26	35	10
10	20	52	35
11	9	22	54
+gp	63	113	113
Total	1037	1127	1207
Landings	353	391	432

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0	0	0	0	0	0	0	0	0	0
2	146	71	45	82	167	426	250	227	175	245
3	412	396	349	567	419	318	1123	803	559	806
4	167	433	220	170	472	384	347	811	497	651
5	115	89	178	199	161	206	214	250	630	467
6	112	99	71	115	135	102	189	229	126	389
7	14	120	80	28	92	70	103	174	183	179
8	25	17	43	53	46	74	72	103	140	126
9	134	52	32	26	58	10	77	90	65	76
10	38	30	24	22	51	24	38	104	56	58
11	54	4	55	24	14	32	27	28	130	55
+gp	106	136	106	171	213	159	203	290	342	211
Total	1323	1446	1202	1456	1830	1804	2644	3108	2902	3262
Landings	437	459	427	491	616	606	861	1181	1269	1215

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0	0	0	0	0	0	0	0	0	0
2	128	91	333	287	246	487	443	390	341	450
3	1451	753	663	1700	1618	808	1438	871	902	415
4	916	1573	826	756	971	1090	596	1233	581	482
5	553	583	758	469	421	427	728	497	553	289
6	352	351	325	585	321	204	374	509	244	220
7	240	267	204	179	336	224	153	225	264	93
8	136	294	129	97	84	229	162	110	143	111
9	113	119	152	103	75	47	109	107	103	68
10	81	73	54	85	90	50	39	113	75	37
11	61	37	28	29	74	41	50	48	85	31
+gp	294	262	255	125	127	162	171	214	235	145
Total	4324	4401	3727	4414	4363	3770	4262	4316	3525	2341
Landings	1446	1498	1370	1409	1419	1280	1444	1390	1315	852

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0	0	0	0	0	0	0	0	0	0
2	316	209	97	95	365	216	265	280	307	145
3	1434	704	657	308	445	831	606	915	599	1401
4	417	1107	558	629	364	724	536	500	751	531
5	297	350	558	427	298	325	336	398	367	497
6	115	219	112	411	235	180	209	255	229	268
7	112	151	106	131	257	194	151	114	107	178
8	61	78	49	101	68	173	80	103	53	100
9	74	60	57	61	61	44	127	54	68	55
10	26	56	44	33	49	20	35	107	51	43
11	23	31	50	18	37	40	34	25	88	42
+gp	90	79	99	142	143	88	162	123	91	159
Total	2964	3045	2388	2356	2321	2835	2543	2874	2710	3419
Landings	895	904	800	856	833	949	880	957	914	1069

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	2002	2003	2004	2005	2006	2007	2008	2009	geom mean 07-09	arith mean 07-09
1	0	0	0	0	0	0	0	0	0.00	0.00
2	332	598	398	258	500	201	281	122	190.38	201.36
3	1251	835	1080	468	786	852	752	393	631.50	665.69
4	843	953	448	834	472	755	678	339	557.79	590.66
5	387	645	445	449	606	293	376	302	321.56	323.58
6	322	130	526	366	250	362	163	188	222.94	237.61
7	129	74	164	293	224	179	184	62	126.75	141.56
8	105	50	116	113	185	130	105	67	96.92	100.52
9	94	58	61	80	85	110	71	35	64.74	71.94
10	33	63	54	45	56	55	67	46	55.61	56.29
11	18	14	35	24	31	27	39	32	32.16	32.57
+gp	85	61	85	96	87	99	89	59	80.29	82.25
Total	3599	3482	3412	3027	3282	3062	2805	1645	2417.49	2504.04
Landings	1106	1078	1075	1039	1023	1015	908	626	832.48	849.67

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs

Age	1969	1970
1	0.000	0.000
2	0.188	0.187
3	0.245	0.223
4	0.332	0.294
5	0.329	0.314
6	0.367	0.354
7	0.522	0.434
8	0.455	0.498
9	0.463	0.442
10	0.606	0.512
11	0.647	0.528
+gp	0.660	0.593

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.113	0.000	0.000	0.144	0.142	0.139	0.118	0.000	0.000	0.000
2	0.151	0.194	0.203	0.183	0.181	0.170	0.197	0.180	0.187	0.189
3	0.222	0.227	0.224	0.224	0.214	0.217	0.248	0.241	0.237	0.254
4	0.296	0.272	0.262	0.281	0.299	0.286	0.302	0.303	0.327	0.343
5	0.367	0.369	0.310	0.379	0.358	0.323	0.356	0.390	0.423	0.389
6	0.350	0.408	0.381	0.434	0.403	0.390	0.399	0.439	0.460	0.525
7	0.359	0.458	0.414	0.372	0.435	0.454	0.502	0.377	0.468	0.560
8	0.431	0.495	0.459	0.464	0.497	0.413	0.463	0.486	0.477	0.609
9	0.455	0.402	0.466	0.475	0.591	0.475	0.517	0.489	0.565	0.646
10	0.476	0.454	0.537	0.487	0.651	0.478	0.484	0.488	0.522	0.655
11	0.388	0.508	0.654	0.474	0.535	0.583	0.552	0.540	0.569	0.600
+gp	0.653	0.600	0.561	0.731	0.676	0.628	0.681	0.670	0.725	0.783

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.000	0.120	0.000	0.088	0.000	0.106	0.098	0.091	0.110	0.158
2	0.174	0.213	0.188	0.209	0.162	0.174	0.174	0.170	0.167	0.216
3	0.226	0.208	0.251	0.242	0.225	0.237	0.245	0.244	0.222	0.270
4	0.322	0.276	0.272	0.304	0.296	0.297	0.310	0.312	0.275	0.322
5	0.382	0.345	0.307	0.379	0.358	0.354	0.370	0.375	0.326	0.370
6	0.478	0.424	0.390	0.389	0.389	0.407	0.425	0.432	0.375	0.416
7	0.515	0.495	0.419	0.478	0.469	0.456	0.474	0.484	0.422	0.458
8	0.534	0.507	0.475	0.539	0.520	0.502	0.518	0.531	0.467	0.498
9	0.599	0.520	0.532	0.559	0.531	0.544	0.557	0.572	0.510	0.534
10	0.620	0.523	0.610	0.601	0.519	0.583	0.590	0.608	0.551	0.567
11	0.710	0.561	0.553	0.722	0.584	0.618	0.618	0.639	0.590	0.597
+gp	0.661	0.659	0.667	0.639	0.817	0.703	0.665	0.694	0.692	0.664

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0.105	0.088	0.000	0.122	0.133	0.164	0.000	0.000	0.158	0.141
2	0.182	0.166	0.146	0.183	0.192	0.214	0.186	0.191	0.208	0.201
3	0.255	0.238	0.209	0.241	0.248	0.262	0.244	0.247	0.257	0.257
4	0.323	0.305	0.268	0.295	0.301	0.308	0.300	0.300	0.303	0.309
5	0.386	0.366	0.324	0.347	0.351	0.354	0.354	0.350	0.347	0.357
6	0.445	0.423	0.376	0.396	0.397	0.399	0.406	0.397	0.389	0.400
7	0.499	0.474	0.425	0.442	0.441	0.442	0.455	0.441	0.429	0.440
8	0.549	0.520	0.470	0.484	0.481	0.484	0.503	0.482	0.467	0.475
9	0.594	0.561	0.513	0.524	0.518	0.524	0.548	0.520	0.502	0.507
10	0.634	0.597	0.551	0.561	0.552	0.564	0.592	0.555	0.535	0.534
11	0.669	0.627	0.587	0.595	0.583	0.602	0.633	0.586	0.566	0.557
+gp	0.742	0.684	0.672	0.671	0.652	0.695	0.734	0.661	0.636	0.645

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	mean 07-09
1	0.000	0.123	0.101	0.122	0.123	0.106	0.117	0.147	0.109	0.124
2	0.203	0.181	0.173	0.176	0.180	0.168	0.183	0.197	0.190	0.190
3	0.245	0.236	0.241	0.230	0.235	0.226	0.244	0.245	0.264	0.251
4	0.287	0.290	0.306	0.282	0.289	0.280	0.299	0.292	0.333	0.308
5	0.326	0.342	0.367	0.334	0.342	0.331	0.350	0.337	0.396	0.361
6	0.365	0.391	0.425	0.385	0.393	0.378	0.395	0.382	0.454	0.410
7	0.402	0.439	0.479	0.435	0.443	0.421	0.436	0.425	0.505	0.455
8	0.438	0.485	0.530	0.485	0.492	0.461	0.471	0.468	0.551	0.497
9	0.472	0.529	0.577	0.533	0.539	0.497	0.501	0.509	0.591	0.534
10	0.505	0.570	0.620	0.581	0.585	0.529	0.526	0.549	0.625	0.567
11	0.537	0.610	0.660	0.628	0.629	0.558	0.546	0.588	0.653	0.596
+gp	0.615	0.705	0.746	0.756	0.746	0.667	0.616	0.652	0.717	0.662

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs

Age	1969	1970
1	0.040	0.045
2	0.125	0.120
3	0.200	0.195
4	0.270	0.255
5	0.330	0.305
6	0.380	0.355
7	0.425	0.395
8	0.460	0.430
9	0.490	0.465
10	0.520	0.490
11	0.550	0.510
+gp	0.609	0.541

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.030	0.055	0.035	0.040	0.071	0.095	0.086	0.090	0.064	0.052
2	0.090	0.130	0.105	0.125	0.144	0.146	0.156	0.156	0.141	0.125
3	0.170	0.200	0.170	0.200	0.221	0.198	0.221	0.217	0.216	0.206
4	0.240	0.265	0.235	0.265	0.267	0.247	0.278	0.276	0.287	0.288
5	0.295	0.325	0.290	0.320	0.327	0.294	0.332	0.330	0.352	0.360
6	0.345	0.380	0.340	0.370	0.385	0.338	0.382	0.380	0.414	0.436
7	0.390	0.420	0.390	0.410	0.435	0.380	0.425	0.425	0.463	0.513
8	0.420	0.460	0.435	0.455	0.479	0.417	0.462	0.463	0.502	0.575
9	0.445	0.490	0.475	0.490	0.516	0.456	0.497	0.498	0.539	0.620
10	0.470	0.520	0.510	0.515	0.545	0.491	0.527	0.526	0.574	0.650
11	0.490	0.540	0.540	0.530	0.569	0.523	0.553	0.555	0.608	0.674
+gp	0.544	0.558	0.585	0.571	0.628	0.595	0.629	0.630	0.719	0.714

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.038	0.038	0.040	0.032	0.095	0.071	0.058	0.050	0.081	0.128
2	0.119	0.117	0.120	0.108	0.150	0.140	0.137	0.131	0.139	0.187
3	0.197	0.195	0.195	0.192	0.204	0.206	0.210	0.208	0.195	0.243
4	0.276	0.265	0.250	0.268	0.258	0.268	0.278	0.278	0.249	0.296
5	0.358	0.335	0.307	0.339	0.311	0.326	0.341	0.344	0.300	0.346
6	0.427	0.398	0.365	0.400	0.364	0.381	0.398	0.404	0.350	0.393
7	0.490	0.455	0.420	0.453	0.416	0.432	0.450	0.459	0.398	0.437
8	0.543	0.506	0.475	0.501	0.468	0.480	0.497	0.508	0.444	0.478
9	0.582	0.536	0.520	0.545	0.520	0.524	0.538	0.552	0.488	0.516
10	0.616	0.562	0.570	0.577	0.571	0.564	0.574	0.591	0.531	0.551
11	0.645	0.585	0.615	0.607	0.621	0.601	0.605	0.624	0.571	0.583
+gp	0.699	0.632	0.709	0.696	0.790	0.691	0.659	0.687	0.675	0.654

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0.065	0.048	0.000	0.091	0.103	0.139	0.000	0.000	0.132	0.110
2	0.144	0.128	0.114	0.153	0.163	0.189	0.156	0.162	0.183	0.172
3	0.219	0.202	0.178	0.212	0.221	0.238	0.215	0.220	0.233	0.230
4	0.290	0.272	0.239	0.268	0.275	0.285	0.272	0.274	0.280	0.284
5	0.355	0.336	0.296	0.322	0.326	0.331	0.327	0.325	0.326	0.333
6	0.416	0.395	0.350	0.372	0.374	0.376	0.380	0.374	0.369	0.379
7	0.473	0.449	0.401	0.419	0.419	0.420	0.431	0.419	0.410	0.421
8	0.524	0.498	0.448	0.463	0.461	0.463	0.480	0.462	0.448	0.458
9	0.572	0.542	0.492	0.505	0.500	0.504	0.526	0.501	0.485	0.492
10	0.614	0.580	0.532	0.543	0.536	0.544	0.570	0.537	0.519	0.521
11	0.652	0.613	0.570	0.578	0.568	0.583	0.612	0.571	0.551	0.546
+gp	0.731	0.677	0.659	0.659	0.641	0.677	0.717	0.650	0.624	0.643

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	mean 07-09
1	0.000	0.094	0.063	0.095	0.094	0.074	0.083	0.122	0.067	0.091
2	0.181	0.152	0.137	0.149	0.152	0.138	0.151	0.172	0.150	0.158
3	0.224	0.209	0.207	0.203	0.208	0.197	0.214	0.221	0.228	0.221
4	0.266	0.263	0.274	0.256	0.263	0.254	0.272	0.268	0.300	0.280
5	0.307	0.316	0.337	0.308	0.316	0.306	0.325	0.315	0.366	0.335
6	0.346	0.367	0.396	0.360	0.368	0.355	0.373	0.360	0.426	0.386
7	0.384	0.415	0.452	0.410	0.419	0.400	0.416	0.404	0.480	0.433
8	0.420	0.462	0.505	0.460	0.468	0.442	0.454	0.447	0.529	0.477
9	0.455	0.507	0.554	0.509	0.516	0.479	0.486	0.489	0.571	0.515
10	0.489	0.550	0.599	0.557	0.562	0.514	0.514	0.529	0.608	0.550
11	0.521	0.591	0.641	0.605	0.607	0.544	0.536	0.569	0.640	0.582
+gp	0.602	0.688	0.732	0.734	0.726	0.661	0.614	0.640	0.712	0.655

Table 8.3.5 Sole VIIE Landings Length Frequency Distributions

Length	UK BeamTrawl	UK other	French Nets	French Trawl	French other
19	0	0	0	109	0
20	0	0	0	420	0
21	0	0	971	713	0
22	174	0	870	109	0
23	281	919	7822	1411	0
24	992	3643	1856	25202	0
25	4693	14044	4004	19273	251
26	12648	13384	10517	16712	721
27	24246	14165	5329	14134	1135
28	49020	12475	4490	12582	1056
29	55932	14134	10885	8645	2267
30	70066	11687	16375	7957	2294
31	76810	12969	13854	7612	2116
32	73826	12395	11618	7086	1347
33	83125	10779	25942	11874	897
34	73051	12643	25572	12059	836
35	61801	8075	10185	14733	1054
36	57455	7105	14557	10530	785
37	44483	7968	10357	14898	675
38	30936	4819	14834	12812	1314
39	19953	3402	1528	7210	612
40	15871	2371	9068	7912	1005
41	9261	2235	7440	5405	142
42	7107	1566	1056	2467	284
43	4525	1336	346	994	331
44	3670	1759	1229	1029	142
45	1268	999	173	430	0
46	1110	441	983	256	84
47	814	184	907	87	0
48	236	235	0	87	0
49	217	141	0	87	0
50	148	132	0	0	0
51	25	138	173	174	0
52	62	103	133	0	0
53	55	0	173	691	0
54	149	7	0	0	0
55	20	0	0	0	0
56	0	0	0	0	0
57	0	0	0	0	0
58	0	0	0	0	0
59	0	0	0	0	0
Total	784030	176253	213247	225700	19348

Table 8.3.6 Sole VIIE effort & CPUE data

Year	Effort BT u24	Effort BT o24	Landings BT u24	Landings BT o24	Survey CPUE	BTu24 LPUE	BTo24 LPUE	Survey CPUE MS	BTu24 LPUE MS	BTo24 LPUE MS
1988	46.33	60.90	332.79	441.99	74.24	7.18	7.26	1.28	1.49	1.96
1989	35.29	86.80	200.99	520.43	69.36	5.70	6.00	1.20	1.18	1.62
1990	36.35	78.51	238.56	474.06	43.72	6.56	6.04	0.75	1.36	1.63
1991	27.93	64.94	165.12	296.01	72.58	5.91	4.56	1.25	1.22	1.23
1992	29.47	61.95	169.31	291.50	78.13	5.74	4.70	1.35	1.19	1.27
1993	31.08	65.31	199.90	281.75	49.63	6.43	4.31	0.86	1.33	1.16
1994	34.77	73.47	189.29	317.87	40.66	5.44	4.33	0.70	1.13	1.17
1995	31.30	76.80	158.01	328.93	37.78	5.05	4.28	0.65	1.04	1.16
1996	33.16	94.91	164.71	300.93	48.72	4.97	3.17	0.84	1.03	0.86
1997	34.15	88.68	192.26	332.09	63.11	5.63	3.74	1.09	1.17	1.01
1998	43.41	83.09	186.94	306.70	65.83	4.31	3.69	1.14	0.89	1.00
1999	42.82	73.17	185.15	271.41	54.50	4.32	3.71	0.94	0.89	1.00
2000	49.07	79.58	202.29	250.02	51.94	4.12	3.14	0.90	0.85	0.85
2001	65.65	92.42	302.55	300.74	74.67	4.61	3.25	1.29	0.95	0.88
2002	61.55	92.19	293.79	298.56	43.18	4.77	3.24	0.75	0.99	0.87
2003	67.25	107.01	277.64	329.50	50.28	4.13	3.08	0.87	0.85	0.83
2004	56.25	108.64	206.17	239.23	57.99	3.67	2.20	1.00	0.76	0.59
2005	51.49	107.66	198.42	255.15	35.67	3.85	2.37	0.62	0.80	0.64
2006	50.87	110.87	225.31	238.63	49.10	4.43	2.15	0.85	0.92	0.58
2007	65.32	94.07	237.46	213.78	62.91	3.64	2.27	1.09	0.75	0.61
2008	76.21	83.37	222.79	170.25	73.55	2.92	2.04	1.27	0.61	0.55
2009	63.66	58.99	184.35	115.31	77.38	2.90	1.95	1.34	0.60	0.53

Table 8.3.7: Available tuning information for the assessment process

W CHANNEL SOLE 2010 WG, 1-14, SEXES COMBINED,

105												
UK-CBT												
1988	2009											
1	1	0	1									
3	14											
107.23	747.49	382.4	497.05	225.59	71.83	70.57	66.73	14.92	24.57	15.09	31.15	7.87
122.09	480.71	603.07	295.68	344.28	124.29	52.66	52.11	48.82	30.47	18.98	21.01	12.79
114.86	478.16	361.27	271.68	174.7	170.9	65.4	49.23	31.81	27.42	14.67	24.04	12.6
92.87	229.74	240.99	186.87	121.76	52.87	67.89	37.54	17.79	12.29	22.67	5.38	9.83
91.43	773.74	216.51	152.49	57.61	60.04	28.95	41.72	10.8	7.61	7.45	7.99	7.08
96.39	382.12	602.61	186.88	114.16	81.18	41.21	31.94	31.52	15.68	4.58	11.85	8.02
108.24	443.52	361.7	347.1	69.39	62.83	30.89	34.86	26.44	29.61	14.09	10.91	5.74
108.1	173.64	357.84	240.49	233.61	71.61	56.73	33.47	18.33	10.07	22.33	9.28	6.44
128.07	239.43	194.61	165.43	133.04	143.67	38.1	34.8	27.59	20.8	22.58	20.66	8.37
122.83	474.85	387.28	181.39	95.01	104.45	92.27	23	10.67	21.69	8.71	10.14	7.52
126.5	352.44	311.69	194.66	115.68	83.44	44.32	66.82	18.37	18.3	15.18	16.05	7.08
115.99	471.41	244.17	181.4	114.13	48.08	45.38	23.67	47.22	10.45	17.65	5.01	5.3
128.65	308.67	374.19	177.98	110.37	53.08	26.86	31.31	23.64	41.62	4.51	6.91	2.95
158.07	832.95	295.63	281.48	143.95	95.75	53.72	28.03	23.25	22.22	25.86	9.65	7.28
153.74	775.07	469.78	172.07	172.99	77.14	54.4	23.91	10.98	12.98	7.28	13.62	6.31
174.26	425.77	550.11	423.34	69.8	59.67	33.48	43.96	21.73	7.15	6.69	10.92	9.19
164.89	494.01	207.46	180.26	253.67	38.28	50.45	25.25	20.16	14.39	7.15	3.98	6.39
159.15	223.71	346.97	141.36	165.05	140.46	29.15	34.66	23.97	15.14	8.83	6.32	5.14
161.74	380.29	188.15	245.65	86.37	109.33	107.95	37.56	20.86	13.81	13.74	6.74	3.01
159.39	488.97	280.33	113.45	110.97	58.13	66.53	55.17	16.44	11.91	11.16	9.05	8.76
159.57	314.87	306.44	135.02	72.71	70.1	45.39	42.38	38.92	15.58	12.62	4.6	6.4
122.65	189.59	182.36	152.53	89.41	25.94	27.83	13.17	16.07	12.85	4.84	3.73	1.9
UK-COT												
1988	2009											
1	1	0	1									
3	14											
53402	33.38	16.95	20.78	9.3	2.75	2.75	1.98	0.38	0.82	0.43	0.93	0.27
54707	16.22	19.72	9.91	12.63	5.08	2.6	2.54	2.16	1.51	1.2	1.07	0.7
53050	19.09	13.1	9.6	6.35	5.76	2.17	1.91	1.16	0.94	0.65	1	0.53
40789	10.04	7.04	4.12	2.46	0.96	1.44	0.42	0.41	0.24	0.27	0.08	0.18
39909	26.15	5.98	3.59	1.19	1.14	0.48	0.65	0.17	0.09	0.07	0.17	0.1
39240	12.22	17.24	5.29	3.38	2.44	1.24	0.98	0.9	0.55	0.13	0.32	0.29
38768	12.67	11.69	12.6	2.55	2.65	1.25	1.38	1.05	1.2	0.63	0.46	0.27
35453	5.26	9.75	6.34	6.18	1.89	1.49	0.91	0.52	0.25	0.59	0.32	0.18
30541	9.46	6.52	4.36	3.14	3.53	0.95	0.75	0.67	0.45	0.44	0.42	0.18
33281	15.05	8.74	4.75	2.81	2.88	2.52	0.62	0.28	0.43	0.31	0.26	0.27
29802	8.5	7.38	4.14	2.42	1.49	0.9	1.43	0.31	0.43	0.37	0.34	0.12
27516	11.35	5.73	4.83	2.84	1.42	1.44	0.72	1.47	0.38	0.56	0.19	0.19
30493	6.4	8.07	3.87	2.53	1.19	0.57	0.77	0.59	0.95	0.09	0.2	0.05
31900	17.9	5.23	4.93	2.67	1.99	1.11	0.7	0.51	0.5	0.65	0.24	0.22
28346	9.77	6.05	2.36	2.64	1.26	0.81	0.33	0.2	0.24	0.17	0.27	0.1
25060	4.49	5.72	4.67	1.01	0.83	0.47	0.52	0.26	0.12	0.15	0.22	0.17
25584	5.98	2.55	2.2	3.21	0.45	0.57	0.29	0.24	0.18	0.13	0.07	0.09
21129	6.34	9.41	3.47	4.07	3.39	0.73	0.89	0.57	0.45	0.25	0.19	0.14
21058	6.85	3.24	4.08	1.34	1.61	1.73	0.59	0.3	0.2	0.19	0.12	0.05
22347	9.16	5.35	2.26	2.28	1.17	1.39	1.11	0.35	0.21	0.23	0.2	0.2
19855	5.58	4.81	2.06	1.14	1.17	0.74	0.74	0.7	0.31	0.23	0.11	0.1
21398	7.93	5.46	3.91	2.17	0.64	0.83	0.39	0.52	0.45	0.18	0.12	0.08
UK-WEC-BTS												
1988	2009											
1	1	0.75	0.8									
1	9											
128.2	2	39	129	52	75	22	0	12	3			
165.7	5	56	120	107	34	40	17	5	7			
175.7	23	52	76	31	24	7	15	3	6			
171.7	11	231	79	51	23	21	5	17	4			
196.6	5	140	316	44	36	12	7	5	11			
189.2	5	54	115	105	14	10	9	3	3			
205.9	6	47	106	62	44	5	5	2	3			
187.2	14	37	44	42	26	31	4	5	5			
184.4	28	112	67	25	32	20	17	3	2			
184.7	11	130	126	43	14	16	13	14	5			
185.5	11	141	114	76	22	10	14	6	8			
187.9	11	97	128	47	23	8	4	4	4			
180.4	12	136	70	52	23	16	5	3	5			
178	9	197	162	52	31	12	12	4	1			
180	6	37	113	48	27	6	3	2	0			
170.7	23	158	57	50	19	4	4	6	1			
164.9	16	110	120	24	15	10	16	9	4			
186.6	8	110	39	53	12	12	6	2	4			
184.7	5	120	95	26	37	10	7	9	0			
181	7	188	135	50	11	23	3	3	1			

174.7	10	85	158	77	40	2	14	3	6				
172	11	104	126	96	49	13	13	12	1				
UK-Inshore													
1973	1987												
1	1	0	1										
2	14												
15.76	28.3	142.9	145.8	28.7	28.7	33.8	4.9	15.2	8.4	1	8.4	12.7	1.2
12.58	17.2	117.7	67.5	51.6	18	19.3	11	8.2	5.8	12	3.1	4.8	2.9
12.84	30	163.3	41.9	45.1	21.2	4.8	10	4.9	3.7	3.7	7	3.8	5.2
12.58	63.6	137.5	139.9	44.9	32.6	21.4	11.4	14.4	11.7	2.9	3.7	16	4.6
14.01	169.7	106.7	114.5	57.4	24.3	15.8	18.1	2.5	5.3	6.4	3.5	4.5	8.2
22.31	117.8	449.7	124.4	72.1	54.5	28.5	21.1	22.5	10.4	6.7	5.8	5.9	3.5
31.15	114.2	342.9	310.5	89.6	70.2	51.1	32.4	28.1	30.2	7.3	6.8	17.3	3.6
42.4	131.4	322.7	221.1	257.7	36.9	46.3	37.1	18.1	13.7	32.5	9.2	7.6	8.9
46.36	161.9	478.9	320.6	190.5	123.1	52.6	37.8	22.1	15.7	12.1	11.3	3.4	3.7
51.68	86	857.6	442	215.7	113.5	70.6	43	33.6	22.2	16.7	10.3	8.2	7.6
51.09	76.8	353.4	623.5	210.6	80.1	78.3	94.1	33.8	26.4	5.3	6.5	34.8	5.1
48.21	177.7	280.2	309	257	88.6	43.9	39.6	38.1	8.5	5.9	13.9	17.5	4
54.87	57.7	598.4	320.7	168.7	198.1	37.2	29.9	45.9	32.4	17.7	7.6	4.2	5.6
53.46	103.2	823.1	361.7	111.3	82.9	87.1	23.2	9.3	7.6	17.8	4.2	5.1	9.4
35.61	116.6	183.2	269.3	93.4	17.1	16.7	32	5.9	9	3.6	7.8	4.5	5.2
UK-Offshore													
1973	1987												
1	1	0	1										
3	14												
5.64	24.6	37.3	8.9	13	16.8	2.1	6.6	4.3	0.7	4.3	4.3	0.7	
6.72	30.3	25.7	23.8	12.2	14.4	7.1	5.4	4.5	11.3	2.3	2.4	2.4	
13.94	85.2	32.5	42.1	29.2	7.3	13.1	6.4	5.8	6.9	10.8	3.8	8.7	
7.36	38.6	58.4	22.7	24.2	17.3	8.1	10.2	9.8	2.9	3	8.8	4.2	
9.88	36.1	57.7	34.9	21.7	15.5	15.3	2.1	5.3	7.9	3.5	3	8.8	
14.5	140.5	57.7	40.4	44.9	25.8	16.6	17.9	9.7	7.7	5.3	3.6	3.5	
20.38	107.9	145.1	50.6	58.2	46.4	25.5	22.4	28.3	8.3	6.3	10.6	3.7	
28.18	103.1	104.9	147.7	31.1	42.7	29.7	14.7	13	37.9	8.8	4.7	9	
28.75	142.8	142.1	101.9	96.6	45.3	28.2	16.7	13.9	13.1	10	2	3.5	
39.85	317.9	243.4	143.3	110.7	75.7	39.9	31.6	24.5	22.5	11.3	5.9	9	
66.45	104.1	433.6	167.6	116.5	100.9	104.4	47.8	27.7	19.8	9.2	18.7	10.2	
49.07	152.8	234.7	214.8	133.2	69.9	22.9	54.3	28.5	7.8	29.7	8.2	6.7	
47.15	245.2	130.3	110.8	211.1	75.6	26.7	31.6	15.5	7.1	0	7.9	6.8	
34.66	425.5	215.7	100.2	79.1	70	15.2	7.9	30.1	28.6	5.3	13.7	7.6	
47.41	158.4	344.2	138.8	53.3	50.7	95.7	22.7	19	26.1	13.8	14.2	14.6	

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics
FLR XSA Diagnostics 2010-05-20 17:50:34

CPUE data from index.final
Catch data for 41 years. 1969 to 2009. Ages 1 to 12.

fleet	first age	last age	first year	last year	alpha	beta
UK-CBT	3	11	1988	2009	0	1
UK-COT	3	11	1988	2009	0	1
UK-WEC-BTS	1	9	1988	2009	0.75	0.8
UK-Inshore	2	11	1973	1987	0	1
UK-Offshore	3	11	1973	1987	0	1

Time series weights :
Tapered time weighting not applied

Catchability analysis :
Catchability independent of size for all ages
Catchability independent of age for ages >7

Terminal population estimation :
Survivor estimates shrunk towards the mean F
of the final 10 years or
the 5 oldest ages.
S.E. of the mean to which the estimates are shrunk = 0.5
min. S.E. for population estimates derived from each fleet = 0.5

Regression weights
Year

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	1	1	1	1	1	1	1	1	1

Estimated population abundance at 1st Jan 2010
Age

1	2	3	4	5	6	7	8	9	10	11	12
0	4753	2371	1765	1428	1018	510	190	263	86	128	110

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-CBT

Fleet q-residuals

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
3	0.451	0.339	0.411	0.100	0.376	0.215	0.372	-0.250	-0.473	0.228	0.023	0.133	-0.163	0.007	0.152	-0.151	-0.308	-0.349	-0.269	-0.070	-0.343	-0.431
4	0.389	0.490	0.408	0.210	0.236	0.302	0.239	0.408	-0.160	0.253	0.007	-0.053	0.055	-0.212	-0.322	-0.026	-0.584	-0.369	-0.272	-0.268	-0.286	-0.444
5	0.462	0.501	0.377	0.404	0.173	0.490	0.024	0.246	-0.086	0.242	-0.006	-0.028	-0.044	0.056	-0.290	-0.160	-0.630	-0.486	-0.232	-0.222	-0.479	-0.312
6	0.538	0.492	0.635	0.349	-0.359	0.302	-0.144	0.045	-0.040	-0.160	0.327	0.034	-0.141	0.084	0.189	-0.883	-0.097	-0.181	-0.411	-0.403	-0.054	-0.122
7	0.105	0.410	0.408	0.171	0.132	0.363	0.073	0.350	-0.165	0.279	0.170	0.133	-0.346	0.043	0.064	-0.484	-0.988	-0.063	-0.023	-0.138	-0.235	-0.259
8	0.275	0.168	0.425	0.145	-0.006	0.121	-0.303	0.437	0.036	-0.153	-0.124	0.167	-0.040	-0.097	0.049	-0.450	-0.156	-0.714	0.221	0.057	0.336	-0.395
9	0.192	0.304	0.677	0.557	-0.046	0.387	0.165	0.061	0.190	-0.079	-0.189	-0.352	0.135	0.239	-0.421	0.125	-0.336	-0.025	-0.016	0.033	0.040	-0.082
10	-0.346	0.140	0.369	0.394	-0.322	-0.112	0.487	-0.172	0.042	-0.629	0.017	-0.113	-0.124	0.078	-0.136	-0.071	-0.154	0.076	-0.025	-0.318	0.137	-0.267
11	0.529	0.638	0.116	0.088	-0.037	0.325	-0.008	-0.117	0.108	0.226	0.203	-0.089	0.039	0.006	-0.091	-0.219	0.198	0.056	-0.023	-0.052	0.207	-0.311

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-6.7596	-6.5793	-6.5753	-6.6351	-6.7335	-6.8219	-6.8219	-6.8219	-6.8219
S.ELogq	0.2968	0.3177	0.3342	0.3564	0.3298	0.288	0.2728	0.2618	0.2223

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-COT

Fleet q-residuals

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
3	0.299	0.012	0.222	0.052	0.077	-0.069	0.103	-0.373	-0.011	0.341	0.004	0.105	-0.340	0.027	-0.271	-0.505	-0.599	0.367	0.013	0.176	-0.032	0.401
4	0.322	0.225	0.215	-0.148	-0.172	-0.001	0.186	0.272	0.230	0.120	0.062	-0.014	0.011	-0.294	-0.631	-0.301	-0.767	0.395	0.058	0.090	-0.004	0.146
5	0.367	0.290	0.189	-0.205	-0.364	0.206	0.118	0.107	0.094	0.288	-0.028	0.168	-0.050	-0.006	-0.506	-0.345	-0.790	0.209	0.091	0.209	-0.195	0.153
6	0.413	0.357	0.460	-0.363	-1.043	0.049	-0.054	-0.106	0.015	-0.008	0.272	0.147	-0.110	0.064	0.065	-0.812	-0.237	0.503	-0.171	0.044	0.241	0.272
7	-0.091	0.386	0.161	-0.644	-0.633	0.127	0.304	0.200	-0.067	0.365	-0.040	0.420	-0.334	0.140	0.010	-0.449	-1.197	0.603	0.168	0.291	0.126	0.155
8	0.074	0.310	0.139	-0.539	-0.929	-0.137	-0.136	0.259	0.125	-0.101	-0.228	0.502	-0.106	-0.029	-0.121	-0.430	-0.429	-0.035	0.473	0.501	0.651	0.185
9	-0.281	0.433	0.547	-0.766	-1.032	0.148	0.309	-0.082	0.133	-0.039	-0.240	-0.059	0.217	0.497	-0.666	-0.026	-0.592	0.679	0.216	0.439	0.423	0.491
10	-0.972	0.171	0.177	-0.207	-1.298	-0.422	0.634	-0.273	0.104	-0.617	-0.272	0.204	-0.028	0.206	-0.104	-0.211	-0.374	0.703	0.118	0.144	0.549	0.395
11	0.173	0.783	-0.138	-0.678	-1.299	0.220	0.160	-0.351	0.055	-0.042	0.245	0.382	0.045	0.159	-0.044	-0.020	0.027	0.906	0.128	0.222	0.721	0.431

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-15.927	-15.8395	-15.8656	-15.9101	-16.0115	-16.0766	-16.0766	-16.0766	-16.0766
S.ELogq	0.2726	0.2915	0.2909	0.3775	0.4223	0.3804	0.4684	0.4897	0.4701

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-WEC-BTS

Fleet q-residuals

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	-1.167	-0.238	0.308	0.186	-0.599	-0.179	-0.441	0.337	1.225	0.008	0.236	-0.387	-0.059	0.015	-0.772	1.313	0.635	-0.308	-0.539	-0.012	0.437	0.000
2	-0.522	-0.406	-0.257	0.285	0.257	-0.536	-0.395	-0.910	0.104	0.408	0.200	0.063	-0.197	0.369	-0.911	0.243	0.638	0.090	0.105	0.751	0.197	0.425
3	0.235	0.361	-0.133	0.088	0.407	0.022	-0.016	-0.515	-0.455	0.193	0.195	0.043	-0.306	-0.050	-0.224	-0.433	-0.024	-0.567	-0.094	0.211	0.577	0.486
4	0.379	0.691	-0.296	0.199	0.030	0.041	-0.019	-0.102	-0.431	-0.167	0.365	-0.028	-0.081	0.088	-0.617	-0.219	-0.598	-0.236	-0.192	0.081	0.414	0.697
5	0.812	0.491	-0.014	0.099	0.367	-0.336	-0.295	-0.110	0.310	-0.294	-0.163	-0.156	-0.006	0.171	0.124	-0.833	-0.711	-0.665	0.191	-0.228	0.645	0.603
6	0.770	0.770	-0.269	0.689	-0.026	-0.090	-0.740	0.172	0.404	0.347	0.240	-0.382	0.299	0.226	-0.573	-1.051	-0.589	-0.226	0.042	0.654	-0.985	0.319
7	NA	0.741	0.151	-0.227	-0.208	0.087	-0.526	-0.478	-0.089	0.402	0.605	-0.217	-0.475	0.464	-0.737	-0.613	0.740	-0.757	-0.282	-0.567	0.689	1.298
8	0.960	0.136	-0.426	0.731	0.063	-0.578	-1.113	0.084	-0.264	0.146	0.087	-0.114	0.038	-0.197	-0.781	0.433	0.755	-0.924	0.246	-0.532	0.232	1.018
9	-0.491	0.632	0.833	0.328	0.433	-0.038	-0.334	0.208	-0.414	0.586	-0.101	-0.024	0.596	-0.553	NA	-1.024	0.443	0.304	NA	-1.468	0.614	-0.373

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9
MeanLogq	-11.2386	-8.7326	-8.3386	-8.6131	-8.8631	-9.2261	-9.2122	-9.3235	-9.3235
S.ELogq	0.5878	0.4586	0.3239	0.3563	0.4389	0.5468	0.5833	0.5793	0.606

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-Inshore

Fleet q-residuals

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.186	-0.408	0.200	1.055	1.102	0.617	0.325	0.057	-0.377	-0.569	-0.459	-0.002	-1.439	-0.203	-0.085
3	0.361	0.483	0.477	0.380	0.105	0.300	0.034	-0.295	-0.070	-0.149	-0.490	-0.444	-0.145	-0.043	-0.506
4	0.271	0.098	-0.324	0.680	0.376	0.060	-0.074	-0.401	-0.077	0.139	-0.056	-0.206	-0.038	-0.108	-0.338
5	0.145	-0.029	0.193	0.258	0.261	0.003	-0.030	0.049	-0.040	0.100	0.182	-0.172	-0.262	-0.322	-0.335
6	0.231	0.482	-0.410	0.486	0.104	0.360	0.280	-0.613	-0.086	0.057	-0.072	0.223	0.200	-0.213	-1.029
7	0.561	0.414	-0.521	-0.067	0.013	0.163	0.419	0.045	0.087	-0.293	0.258	-0.021	-0.164	-0.026	-0.868
8	-0.423	-0.156	-0.083	0.538	-0.196	0.016	0.198	0.133	0.099	0.132	0.359	0.015	-0.166	-0.238	-0.228
9	0.369	0.511	-0.826	0.523	-0.895	-0.257	0.233	-0.410	-0.106	0.300	0.361	-0.048	0.415	-0.947	-0.878
10	-0.571	-0.169	-0.081	0.245	-0.378	0.270	-0.068	-0.505	-0.363	0.187	0.565	-0.493	0.033	-0.899	-0.205
11	-0.180	0.193	-0.459	-0.103	-0.264	-0.426	-0.146	0.017	-0.422	-0.072	-0.816	-0.446	0.484	-0.167	-0.771

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-7.3059	-5.7416	-5.7272	-5.9856	-6.3199	-6.4512	-6.4189	-6.4189	-6.4189	-6.4189
S.ELogq	0.6466	0.3452	0.2878	0.1993	0.4221	0.3692	0.2518	0.5564	0.3857	0.3397

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-Offshore

Fleet q-residuals

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
3	0.352	0.475	0.467	0.368	0.093	0.290	0.025	-0.305	-0.080	-0.160	-1.253	-0.346	-0.163	0.453	-0.215
4	0.279	0.104	-0.317	0.686	0.384	0.066	-0.067	-0.394	-0.069	0.147	-0.338	-0.155	-0.443	0.152	-0.035
5	0.135	-0.043	0.175	0.245	0.246	-0.012	-0.044	0.034	-0.055	0.084	-0.176	-0.237	-0.397	0.139	-0.092
6	0.178	0.432	-0.460	0.436	0.052	0.309	0.228	-0.664	-0.138	0.004	-0.248	0.325	0.127	-0.115	-0.467
7	0.514	0.372	-0.559	-0.119	-0.033	0.119	0.371	-0.003	0.039	-0.339	-0.127	0.051	0.321	-0.187	-0.420
8	-0.376	-0.100	-0.028	0.599	-0.148	0.074	0.250	0.186	0.150	0.183	0.066	-0.683	-0.261	-0.361	0.448
9	0.429	0.587	-0.775	0.581	-0.853	-0.188	0.297	-0.343	-0.041	0.366	0.311	0.155	0.060	-0.810	0.050
10	-0.347	0.071	0.153	0.471	-0.162	0.498	0.158	-0.282	-0.140	0.413	0.217	0.565	-0.686	0.777	0.123
11	0.357	0.626	-0.051	0.300	0.162	0.011	0.273	0.446	0.002	0.352	0.106	-0.318	-0.411	0.607	0.790

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-6.4638	-6.0712	-6.1186	-6.0318	-6.0755	-6.2856	-6.2856	-6.2856	-6.2856
S.ELogq	0.4543	0.3112	0.1808	0.3427	0.3084	0.334	0.4894	0.3939	0.3386

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2008 at terminal Age 1

Source	Age 1
fshk	1
	0.0000
UK-CBT	1
	0.0000
UK-COT	1
	0.0000
UK-WEC-BTS	4753
	2.7684

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	NaN	NA	NA	NA	0	NA	0.000
UK-CBT	NaN	NA	NA	NA	0	NA	0.000
UK-COT	NaN	NA	NA	NA	0	NA	0.000
UK-WEC-BTS	4753	0.601	NaN	NaN	1	1.000	0.000

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
4753	0.601	NaN	1	Var Ratio	0.000

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2007 at terminal Age 2

Source	Age 1	Age 2
fshk	1	1185
	0.0000	4.0000
UK-CBT	1	1
	0.0000	0.0000
UK-COT	1	1
	0.0000	0.0000
UK-WEC-BTS	3669	3627
	2.6389	3.8129

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	1185	0.488	NaN	NaN	1	0.383	0.094
UK-CBT	NaN	NA	NA	NA	0	NA	0.000
UK-COT	NaN	NA	NA	NA	0	NA	0.000
UK-WEC-BTS	3644	0.384	0.006	0.015	2	0.617	0.031

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
2371	0.302	0.591	3	Var Ratio	0.048

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2006 at terminal Age 3

Source	Age 1	Age 2	Age 3
fshk	1	1	1054
	0.0000	0.0000	4.0000
UK-CBT	1	1	1148
	0.0000	0.0000	3.3009
UK-COT	1	1	2636
	0.0000	0.0000	3.3009
UK-WEC-BTS	1745	2150	2869
	2.0525	2.9656	3.3009

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	1054	0.454	NaN	NaN	1	0.211	0.303
UK-CBT	1148	0.500	NaN	NaN	1	0.174	0.281
UK-COT	2636	0.500	NaN	NaN	1	0.174	0.132
UK-WEC-BTS	2290	0.305	0.141	0.462	3	0.440	0.151

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
1765	0.206	0.22	6	Var Ratio	0.192

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2005 at terminal Age 4

Source	Age 1	Age 2	Age 3	Age 4
fshk	1	1	1	740
	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	1014	916
	0.0000	0.0000	2.3823	3.2631
UK-COT	1	1	1383	1653
	0.0000	0.0000	2.3823	3.2631
UK-WEC-BTS	833	3028	2543	2869
	1.5479	2.2365	2.3823	3.2631

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	740	0.452	NaN	NaN	1	0.162	0.361
UK-CBT	956	0.358	0.050	0.139	2	0.228	0.290
UK-COT	1533	0.358	0.088	0.246	2	0.228	0.191
UK-WEC-BTS	2301	0.264	0.262	0.994	4	0.381	0.131

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
1428	0.17	0.216	9	Var Ratio	0.203

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2004 at terminal Age 5

Source	Age 1	Age 2	Age 3	Age 4	Age 5
fshk	1	1	1	1	616
	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	949	764	745
	0.0000	0.0000	1.5952	2.1555	3.1184
UK-COT	1	1	1214	1014	1186
	0.0000	0.0000	1.5952	2.1555	3.1184
UK-WEC-BTS	748	1130	1257	1540	1861
	0.9701	1.4016	1.5952	2.1555	3.1184

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	616	0.441	NaN	NaN	1	0.148	0.382
UK-CBT	795	0.299	0.069	0.232	3	0.255	0.308
UK-COT	1135	0.299	0.055	0.182	3	0.255	0.225
UK-WEC-BTS	1402	0.243	0.141	0.579	5	0.343	0.186

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
1018	0.151	0.131	12	Var Ratio	0.248

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2003 at terminal Age 6

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
fshk	1	1	1	1	1	382
	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	390	390	316	451
	0.0000	0.0000	0.9469	1.2747	2.0154	2.9613
UK-COT	1	1	517	558	420	670
	0.0000	0.0000	0.9469	1.2747	2.0154	2.9613
UK-WEC-BTS	962	558	464	553	972	702
	0.6089	0.8797	0.9469	1.2747	2.0154	2.3682

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	382	0.430	NaN	NaN	1	0.151	0.383
UK-CBT	390	0.272	0.084	0.309	4	0.272	0.376
UK-COT	550	0.272	0.111	0.408	4	0.272	0.281
UK-WEC-BTS	698	0.239	0.117	0.490	6	0.306	0.228

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
510	0.143	0.084	15	Var Ratio	0.300

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2002 at terminal Age 7

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
fshk	1	1	1	1	1	1	144
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	134	145	152	180	147
	0.0000	0.0000	0.6096	0.8014	1.2332	1.9552	3.0548
UK-COT	1	1	275	202	234	242	222
	0.0000	0.0000	0.6096	0.8014	1.2332	1.9552	3.0548
UK-WEC-BTS	708	360	108	157	151	71	697
	0.3564	0.5150	0.6096	0.8014	1.2332	1.5636	2.1426

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	144	0.437	NaN	NaN	1	0.151	0.343
UK-CBT	154	0.259	0.048	0.184	5	0.289	0.322
UK-COT	231	0.259	0.037	0.144	5	0.289	0.227
UK-WEC-BTS	226	0.246	0.373	1.518	7	0.272	0.231

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
190	0.141	0.107	18	Var Ratio	0.269

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2001 at terminal Age 8

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
fshk	1	1	1	1	1	1	1	156
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	193	182	208	176	208	177
	0.0000	0.0000	0.4475	0.6090	0.8805	1.3710	2.1684	3.2203
UK-COT	1	1	144	390	288	275	298	316
	0.0000	0.0000	0.4475	0.6090	0.8805	1.3710	2.1684	3.2203
UK-WEC-BTS	121	335	256	208	318	505	523	728
	0.2734	0.3950	0.4475	0.6090	0.8805	1.0964	1.5209	2.2944

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	156	0.449	NaN	NaN	1	0.138	0.341
UK-CBT	188	0.246	0.034	0.138	6	0.301	0.290
UK-COT	294	0.246	0.083	0.337	6	0.301	0.195
UK-WEC-BTS	447	0.247	0.179	0.726	8	0.260	0.133

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
263	0.138	0.113	21	Var Ratio	0.216

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2000 at terminal Age 9

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9
fshk	1	1	1	1	1	1	1	1	79
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	74	48	53	57	75	120	79
	0.0000	0.0000	0.2282	0.3212	0.4235	0.6547	0.9865	1.6439	2.8914
UK-COT	1	1	52	40	106	72	115	165	140
	0.0000	0.0000	0.2282	0.3212	0.4235	0.6547	0.9865	1.6439	2.8914
UK-WEC-BTS	87	35	56	47	44	90	49	108	59
	0.1430	0.2066	0.2282	0.3212	0.4235	0.5236	0.6919	1.1713	1.8742

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	79	0.425	NaN	NaN	1	0.167	0.346
UK-CBT	80	0.250	0.109	0.437	7	0.299	0.344
UK-COT	120	0.250	0.150	0.598	7	0.299	0.242
UK-WEC-BTS	65	0.265	0.119	0.447	9	0.234	0.409

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
86	0.142	0.054	24	Var Ratio	0.324

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 1999 at terminal Age 10

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
fshk	1	1	1	1	1	1	1	1	1	93
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	149	125	68	107	125	136	133	98
	0.0000	0.0000	0.2475	0.3464	0.5220	0.7067	1.0417	1.5325	2.1973	2.9823
UK-COT	1	1	98	95	58	212	151	211	196	190
	0.0000	0.0000	0.2475	0.3464	0.5220	0.7067	1.0417	1.5325	2.1973	2.9249
UK-WEC-BTS	121	185	102	103	63	102	97	75	237	1
	0.1663	0.2403	0.2475	0.3464	0.5220	0.5651	0.7306	1.0919	1.4243	0.0000

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	93	0.432	NaN	NaN	1	0.141	0.383
UK-CBT	115	0.222	0.071	0.319	8	0.337	0.322
UK-COT	172	0.222	0.122	0.549	8	0.335	0.226
UK-WEC-BTS	117	0.239	0.169	0.707	9	0.188	0.316

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
128	0.13	0.07	26	Var Ratio	0.293

Table 3.2.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 1998 at terminal Age 11

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
fshk	1	1	1	1	1	1	1	1	1	1	93
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
UK-CBT	1	1	111	80	94	100	103	137	114	126	81
	0.0000	0.0000	0.1966	0.2685	0.3546	0.4866	0.7323	1.0627	1.5503	2.2198	3.1389
UK-COT	1	1	113	59	78	87	201	177	171	191	169
	0.0000	0.0000	0.1966	0.2685	0.3546	0.4866	0.7323	1.0627	1.5503	2.1770	3.1389
UK-WEC-BTS	75	90	105	59	48	61	52	141	25	1	1
	0.1292	0.1867	0.1966	0.2685	0.3546	0.3892	0.5137	0.7571	1.0049	0.0000	0.0000

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	93	0.443	NaN	NaN	1	0.144	0.281
UK-CBT	103	0.220	0.071	0.323	9	0.360	0.256
UK-COT	161	0.220	0.100	0.453	9	0.359	0.172
UK-WEC-BTS	58	0.236	0.216	0.914	9	0.137	0.420

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
110	0.133	0.063	28	Var Ratio	0.242

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's

Age	1969	1970	1971	1972
1	1609	3974	2954	2618
2	2179	1456	3596	2673
3	2437	1887	1267	3206
4	761	1899	1487	955
5	1072	613	1412	1112
6	1671	829	469	1089
7	181	1312	671	363
8	583	143	1081	531
9	667	480	117	830
10	298	579	402	97
11	102	250	475	331
+gp	720	1291	981	653
Total	12279	14714	14912	14457

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	3580	3357	3142	7205	5071	4713	5163	8942	5157	4164
2	2369	3239	3037	2843	6519	4589	4265	4672	8091	4666
3	2280	2076	2888	2670	2413	5494	3914	3643	4060	7089
4	2509	1686	1546	2074	2017	1881	3902	2778	2764	2907
5	705	1858	1317	1237	1428	1460	1372	2759	2041	1882
6	896	554	1512	1002	966	1096	1118	1004	1898	1402
7	878	717	433	1259	778	777	812	794	789	1347
8	315	681	573	366	1052	638	605	570	544	544
9	457	269	575	468	287	881	509	449	382	372
10	624	364	213	496	368	250	724	375	345	274
11	51	536	307	172	400	311	190	556	286	257
+gp	1695	1034	2169	2629	1993	2309	1972	1456	1100	1241
Total	16360	16371	17713	22422	23293	24398	24545	27998	27457	26145

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	6580	7836	4233	6446	4203	4114	3146	7902	4367	3803
2	3768	5954	7090	3831	5832	3803	3722	2846	7150	3952
3	4101	3323	5070	6142	3232	4814	3020	2997	2251	6042
4	5034	2994	2376	2970	4019	2155	2988	1904	1854	1642
5	1759	3058	1924	1431	1764	2599	1384	1531	1169	1218
6	1176	1037	2047	1294	895	1190	1659	779	860	783
7	934	730	630	1296	866	616	721	1017	473	568
8	991	591	467	400	853	571	411	438	669	340
9	363	617	412	330	282	554	362	268	260	500
10	230	216	414	275	227	210	397	226	145	171
11	171	138	144	294	163	158	153	252	134	96
+gp	1210	1239	623	503	644	539	687	695	630	373
Total	26316	27735	25429	25212	22980	21322	18651	20856	19962	19488

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	2596	3721	4384	3663	4851	3846	7079	5796	4090	5922
2	3441	2349	3367	3967	3314	4389	3480	6405	5245	3700
3	3276	2915	2033	2956	3243	2793	3719	2883	5503	4608
4	4103	2295	2013	1547	2252	2143	1951	2496	2039	3647
5	1089	2659	1545	1223	1053	1349	1429	1290	1544	1339
6	820	652	1875	992	823	644	901	915	818	924
7	599	533	484	1306	674	574	383	572	610	486
8	407	399	382	313	937	425	375	238	416	383
9	249	294	314	250	219	683	309	242	165	281
10	382	169	212	226	168	156	497	228	155	97
11	130	293	111	160	158	133	108	348	158	99
+gp	330	574	850	625	345	623	536	361	592	459
Total	17424	16852	17569	17228	18036	17760	20769	21774	21334	21945

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	2003	2004	2005	2006	2007	2008	2009	2010 survivors	geom mean 03-09	arith mean 03-09
1	2976	4225	4789	3811	3214	3038	4332[a]	0	3815	3901
2	5359	2693	3823	4333	3448	2908	2749	3920	3512	3616
3	3032	4280	2058	3214	3445	2929	2364	2371	2972	3046
4	2979	1949	2845	1417	2160	2307	1935	1765	2169	2227
5	2499	1789	1338	1781	833	1236	1443	1428	1484	1560
6	844	1647	1196	783	1035	475	761	1018	902	963
7	530	640	990	734	470	592	275	510	567	604
8	317	409	422	618	451	255	361	190	391	405
9	246	240	259	275	383	285	131	263	249	260
10	165	168	159	159	167	242	190	86	177	178
11	57	89	100	101	91	99	155	128	95	99
+gp	252	214	395	283	335	223	286	313	278	284
Total	19254	18341	18375	17508	16033	14590	15903			

[a] XSA estimate (5252) replaced with GM recruitment69-07

Table 8.3.10 Sole VIIE Fishing Mortality at Age

Age	1969	1970
1	0.000	0.000
2	0.044	0.039
3	0.149	0.138
4	0.117	0.196
5	0.157	0.167
6	0.141	0.111
7	0.132	0.094
8	0.094	0.099
9	0.041	0.079
10	0.074	0.099
11	0.096	0.097
+gp	0.096	0.097
Fbar$_{3-9}$	0.119	0.126

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.015	0.059	0.032	0.015	0.029	0.064	0.071	0.059	0.058	0.040
3	0.182	0.145	0.202	0.195	0.231	0.180	0.149	0.242	0.243	0.176
4	0.191	0.203	0.200	0.148	0.123	0.274	0.223	0.215	0.247	0.208
5	0.160	0.116	0.142	0.106	0.173	0.147	0.164	0.167	0.212	0.274
6	0.158	0.115	0.123	0.145	0.083	0.153	0.118	0.200	0.242	0.141
7	0.134	0.042	0.155	0.124	0.069	0.080	0.099	0.151	0.254	0.277
8	0.164	0.050	0.057	0.068	0.102	0.143	0.077	0.126	0.197	0.299
9	0.092	0.185	0.126	0.134	0.048	0.141	0.038	0.096	0.206	0.164
10	0.095	0.540	0.052	0.073	0.114	0.115	0.070	0.175	0.164	0.171
11	0.129	0.187	0.088	0.114	0.086	0.089	0.087	0.097	0.167	0.282
+gp	0.129	0.187	0.088	0.114	0.086	0.089	0.087	0.097	0.167	0.282
Fbar$_{3-9}$	0.154	0.122	0.144	0.131	0.119	0.160	0.124	0.171	0.229	0.220

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.032	0.029	0.026	0.061	0.043	0.070	0.092	0.131	0.117	0.135
3	0.234	0.242	0.214	0.235	0.435	0.324	0.305	0.377	0.361	0.380
4	0.285	0.403	0.398	0.343	0.407	0.421	0.336	0.343	0.569	0.387
5	0.275	0.370	0.428	0.302	0.296	0.370	0.294	0.349	0.474	0.477
6	0.243	0.306	0.376	0.399	0.357	0.302	0.274	0.401	0.389	0.399
7	0.272	0.207	0.358	0.347	0.354	0.318	0.317	0.303	0.398	0.319
8	0.280	0.305	0.374	0.261	0.248	0.249	0.332	0.354	0.330	0.419
9	0.233	0.384	0.421	0.300	0.304	0.275	0.193	0.232	0.371	0.516
10	0.195	0.370	0.406	0.306	0.242	0.422	0.263	0.216	0.355	0.427
11	0.225	0.285	0.257	0.243	0.237	0.307	0.307	0.403	0.395	0.436
+gp	0.225	0.285	0.257	0.243	0.237	0.307	0.307	0.403	0.395	0.436
Fbar3-9	0.260	0.317	0.367	0.312	0.343	0.323	0.293	0.337	0.413	0.414

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.068	0.088	0.066	0.045	0.030	0.102	0.071	0.066	0.088	0.052
3	0.215	0.287	0.256	0.270	0.174	0.172	0.314	0.259	0.299	0.246
4	0.320	0.310	0.334	0.295	0.399	0.284	0.412	0.305	0.314	0.380
5	0.301	0.296	0.413	0.249	0.343	0.296	0.392	0.304	0.346	0.355
6	0.313	0.167	0.330	0.199	0.262	0.286	0.261	0.418	0.354	0.306
7	0.232	0.233	0.308	0.234	0.334	0.232	0.361	0.324	0.377	0.220
8	0.191	0.209	0.226	0.140	0.324	0.259	0.216	0.220	0.339	0.265
9	0.321	0.169	0.290	0.230	0.229	0.297	0.235	0.218	0.203	0.348
10	0.312	0.173	0.167	0.322	0.177	0.259	0.137	0.267	0.258	0.268
11	0.277	0.291	0.287	0.199	0.192	0.275	0.311	0.318	0.275	0.307
+gp	0.277	0.291	0.287	0.199	0.192	0.275	0.311	0.318	0.275	0.307
Fbar3-9	0.270	0.239	0.308	0.231	0.295	0.261	0.313	0.293	0.319	0.303

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	2001	2002	2003	2004	2005	2006	2007	2008	2009	mean F_{07-09}
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.030	0.099	0.125	0.169	0.074	0.129	0.063	0.107	0.048	0.073
3	0.311	0.336	0.342	0.308	0.274	0.297	0.301	0.315	0.192	0.269
4	0.320	0.278	0.410	0.277	0.369	0.431	0.458	0.369	0.204	0.344
5	0.413	0.362	0.317	0.303	0.436	0.443	0.461	0.385	0.249	0.365
6	0.421	0.456	0.177	0.409	0.388	0.410	0.458	0.446	0.301	0.402
7	0.366	0.327	0.160	0.315	0.372	0.386	0.511	0.395	0.270	0.392
8	0.293	0.341	0.180	0.355	0.331	0.378	0.360	0.565	0.217	0.381
9	0.432	0.433	0.284	0.310	0.391	0.394	0.359	0.305	0.325	0.330
10	0.345	0.436	0.517	0.417	0.350	0.461	0.428	0.346	0.294	0.356
11	0.331	0.217	0.296	0.539	0.294	0.389	0.370	0.543	0.242	0.385
+gp	0.331	0.217	0.296	0.539	0.294	0.389	0.370	0.543	0.242	0.385
$Fbar_{3-9}$	0.365	0.362	0.267	0.325	0.366	0.391	0.415	0.397	0.251	0.355

Table 8.3.11 Sole VIIE Summary Table

Year	Recruits[000']	TSB[t]	SSB[t]	Landings[t]	Yield//SSB	FBar3-9
1969	1608	3338	2740	352.72	0.13	0.119
1970	3974	3599	3006	389.61	0.13	0.126
1971	2954	3285	2749	431.92	0.16	0.154
1972	2617	3557	2724	436.55	0.16	0.122
1973	3579	3894	3267	458.25	0.14	0.144
1974	3356	3999	3222	426.52	0.13	0.131
1975	3142	5136	4127	500.63	0.12	0.119
1976	7205	5584	4183	614.25	0.15	0.160
1977	5071	6018	4337	604.58	0.14	0.124
1978	4713	6571	4804	868.31	0.18	0.171
1979	5162	6746	5289	1170.17	0.22	0.229
1980	8942	6702	5206	1268.10	0.24	0.220
1981	5156	6332	4762	1217.81	0.26	0.260
1982	4164	6221	4728	1437.95	0.30	0.317
1983	6580	5888	4634	1503.84	0.32	0.367
1984	7835	5820	4548	1362.66	0.30	0.312
1985	4233	5968	3997	1400.09	0.35	0.343
1986	6445	5619	3899	1418.02	0.36	0.323
1987	4202	5415	3964	1279.28	0.32	0.293
1988	4113	5150	3875	1443.13	0.37	0.337
1989	3145	4509	3388	1389.36	0.41	0.413
1990	7902	5190	3242	1306.25	0.40	0.414
1991	4367	4476	2963	852.20	0.29	0.270
1992	3803	4179	2829	895.68	0.32	0.239
1993	2596	3606	2823	903.83	0.32	0.308
1994	3720	4225	3146	800.26	0.25	0.231
1995	4384	4464	3217	855.85	0.27	0.295
1996	3662	4640	3038	833.38	0.27	0.261
1997	4850	3778	2870	949.66	0.33	0.313
1998	3846	3936	2907	880.05	0.30	0.293
1999	7078	4910	2876	955.93	0.33	0.319
2000	5796	4897	2853	911.73	0.32	0.303
2001	4089	4479	2910	1068.62	0.37	0.365
2002	5922	4752	3058	1105.32	0.36	0.362
2003	2975	4396	3117	1078.12	0.35	0.267
2004	4225	4190	2895	1073.92	0.37	0.325
2005	4789	4253	2970	1036.77	0.35	0.366
2006	3811	3717	2519	1015.53	0.40	0.391
2007	3214	3695	2499	1014.65	0.41	0.415
2008	3037	3516	2277	908.12	0.40	0.397
2009	4332[a]	3552	2469	625.17	0.25	0.251

[a] replaced XSA estimate (5252) with GM recruitment69-07

Table 8.3.12 Sole VIIE Short-term Forcast Input Table

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4332	0.10	0.00	0.00	0.00	0.091	0.000	0.124
2	3920	0.10	0.14	0.00	0.00	0.158	0.050	0.190
3	2371	0.10	0.45	0.00	0.00	0.221	0.185	0.251
4	1765	0.10	0.88	0.00	0.00	0.280	0.236	0.308
5	1428	0.10	0.98	0.00	0.00	0.335	0.251	0.361
6	1018	0.10	1.00	0.00	0.00	0.386	0.276	0.410
7	510	0.10	1.00	0.00	0.00	0.433	0.269	0.455
8	190	0.10	1.00	0.00	0.00	0.477	0.262	0.497
9	263	0.10	1.00	0.00	0.00	0.515	0.227	0.534
10	86	0.10	1.00	0.00	0.00	0.550	0.245	0.567
11	128	0.10	1.00	0.00	0.00	0.582	0.265	0.596
12	313	0.10	1.00	0.00	0.00	0.655	0.265	0.662

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4332	0.10	0.00	0.00	0.00	0.091	0.000	0.124
2		0.10	0.14	0.00	0.00	0.158	0.073	0.190
3		0.10	0.45	0.00	0.00	0.221	0.269	0.251
4		0.10	0.88	0.00	0.00	0.280	0.344	0.308
5		0.10	0.98	0.00	0.00	0.335	0.365	0.361
6		0.10	1.00	0.00	0.00	0.386	0.402	0.410
7		0.10	1.00	0.00	0.00	0.433	0.392	0.455
8		0.10	1.00	0.00	0.00	0.477	0.381	0.497
9		0.10	1.00	0.00	0.00	0.515	0.330	0.534
10		0.10	1.00	0.00	0.00	0.550	0.356	0.567
11		0.10	1.00	0.00	0.00	0.582	0.385	0.596
12		0.10	1.00	0.00	0.00	0.655	0.385	0.662

2012

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4332	0.10	0.00	0.00	0.00	0.091	0.000	0.124
2		0.10	0.14	0.00	0.00	0.158	0.073	0.190
3		0.10	0.45	0.00	0.00	0.221	0.269	0.251
4		0.10	0.88	0.00	0.00	0.280	0.344	0.308
5		0.10	0.98	0.00	0.00	0.335	0.365	0.361
6		0.10	1.00	0.00	0.00	0.386	0.402	0.410
7		0.10	1.00	0.00	0.00	0.433	0.392	0.455
8		0.10	1.00	0.00	0.00	0.477	0.381	0.497
9		0.10	1.00	0.00	0.00	0.515	0.330	0.534
10		0.10	1.00	0.00	0.00	0.550	0.356	0.567
11		0.10	1.00	0.00	0.00	0.582	0.385	0.596
12		0.10	1.00	0.00	0.00	0.655	0.385	0.662

Table 8.3.13 Sole VIIE Single Option Output

Year=2010 F-multiplier= 0.688 Fbar= 0.244

Age	F	Catch No	Yield	Stock No	Biomass	SS No	SSB
1	0.000	0	0	4332	393	0	0
2	0.050	182	35	3920	618	549	87
3	0.185	382	96	2371	524	1067	236
4	0.236	354	109	1765	494	1554	435
5	0.251	302	109	1428	479	1400	469
6	0.276	234	96	1018	393	1018	393
7	0.269	115	52	510	221	510	221
8	0.262	42	21	190	91	190	91
9	0.227	51	27	263	135	263	135
10	0.245	18	10	86	47	86	47
11	0.265	28	17	128	75	128	75
12	0.265	69	46	313	205	313	205
Total		1778	618	16325	3675	7077	2394

Year=2011 F-multiplier= 1.000 Fbar= 0.355

Age	F	Catch No	Yield	Stock No	Biomass	SS No	SSB
1	0.000	0	0	4332	393	0	0
2	0.073	262	50	3920	618	549	87
3	0.269	760	191	3374	746	1518	336
4	0.344	495	152	1783	499	1569	439
5	0.365	368	133	1261	423	1236	414
6	0.402	318	130	1006	389	1006	389
7	0.392	216	98	699	303	699	303
8	0.381	107	53	352	168	352	168
9	0.330	36	19	133	68	133	68
10	0.356	54	31	190	104	190	104
11	0.385	19	11	61	35	61	35
12	0.385	93	62	306	201	306	201
Total		2726	930	17416	3947	7618	2544

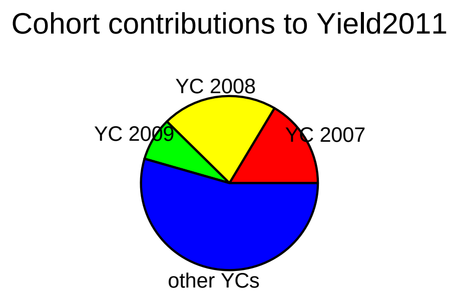
Year=2012 F-multiplier= 1.000 Fbar= 0.355

Age	F	Catch No	Yield	Stock No	Biomass	SS No	SSB
1	0.000	0	0	4332	393	0	0
2	0.073	262	50	3920	618	549	87
3	0.269	743	186	3298	729	1484	328
4	0.344	647	199	2332	653	2052	575
5	0.365	334	120	1144	384	1121	376
6	0.402	250	103	792	306	792	306
7	0.392	188	86	609	264	609	264
8	0.381	129	64	427	204	427	204
9	0.330	58	31	218	112	218	112
10	0.356	25	14	86	47	86	47
11	0.385	37	22	120	70	120	70
12	0.385	69	46	226	148	226	148
Total		2742	921	17505	3928	7685	2516

input units are in 000's and kg, output in t

Table 8.3.14 Sole VIIE Contributions and Source of Cohort for Short-term Forecast

YC	Source	Yield2010	Yield2011	SSB2010	SSB2011	SSB2012
2007	XSA	10.3	16.5	9.3	17.5	16.5
2008	GM 69-07	3.8	21	3.4	14.7	23.3
2009	GM 69-07		8		3.5	13.7
2010	GM 69-07					3.4
2011	GM 69-07					



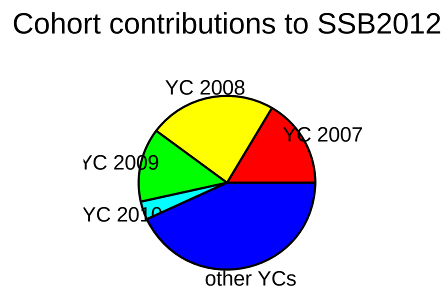


Table 8.3.15 Sole VIIE Management Options Output

SSB 2011	TSB 2011	F-mult	F	basis	Yield 2011	SSB 2012	TSB 2012	%SSB-Change	%TAC-Change
2544	3947	0.0	0.000	Fsq	0	3406	4875	34	-100
2544	3947	0.1	0.035	Fsq	107	3303	4765	30	-83
2544	3947	0.2	0.071	Fsq	211	3203	4659	26	-66
2544	3947	0.3	0.106	Fsq	312	3106	4557	22	-50
2544	3947	0.4	0.142	Fsq	409	3013	4458	18	-34
2544	3947	0.5	0.177	Fsq	503	2923	4362	15	-19
2544	3947	0.529	0.188	Fsq	530	2898	4335	14	-14
2544	3947	0.6	0.213	Fsq	594	2836	4269	11	-4
2544	3947	0.627	0.222	Fsq	618	2813	4245	11	0
2544	3947	0.6761	0.240	Fsq	662	2772	4201	9	7
2544	3947	0.7	0.248	Fsq	682	2752	4180	8	10
2544	3947	0.7321	0.260	Fsq	710	2726	4151	7	15
2544	3947	0.8	0.284	Fsq	768	2671	4093	5	24
2544	3947	0.9	0.319	Fsq	850	2592	4009	2	38
2544	3947	1.0	0.355	Fsq	930	2516	3928	-1	50
2544	3947	1.1	0.390	Fsq	1007	2443	3849	-4	63
2544	3947	1.2	0.425	Fsq	1082	2372	3773	-7	75
2544	3947	1.3	0.461	Fsq	1155	2304	3700	-9	87
2544	3947	1.4	0.496	Fsq	1225	2238	3628	-12	98
2544	3947	1.5	0.532	Fsq	1293	2174	3560	-15	109
2544	3947	1.6	0.567	Fsq	1358	2112	3493	-17	120
2544	3947	1.7	0.603	Fsq	1422	2052	3428	-19	130
2544	3947	1.8	0.638	Fsq	1484	1994	3366	-22	140
2544	3947	1.9	0.674	Fsq	1543	1938	3305	-24	150
2544	3947	2.0	0.709	Fsq	1601	1884	3247	-26	159
2544	3947	0.762	0.270	Fmsy	736	2701	4125	6	19
2544	3947	0.85	0.301	Fmp F	809	2631	4051	3	31
2544	3947	0.7321	0.260	Fmp TAC	710	2726	4151	7	15

Table 8.3.16: Sole VIIe senfile used as input data in MSY analysis

	1	9	2009	3
	1	0	0	
'N1'		2815	0.38	
'N2'		4753	0.6	
'N3'		2371	0.49	
'N4'		1765	0.21	
'N5'		1428	0.19	
'N6'		1018	0.16	
'N7'		510	0.15	
'N8'		190	0.15	
'N9'		263	0.14	
'N10'		86	0.15	
'N11'		128	0.13	
'N12'		313	0.13	
'sH1'		0	0	
'sH2'		0.073	0.587	
'sH3'		0.269	0.107	
'sH4'		0.344	0.125	
'sH5'		0.365	0.096	
'sH6'		0.402	0.074	
'sH7'		0.392	0.092	
'sH8'		0.381	0.214	
'sH9'		0.33	0.181	
'sH10'		0.356	0.148	
'sH11'		0.385	0.327	
'sH12'		0.385	0.327	
'WH1'		0.121	0.126	
'WH2'		0.185	0.065	
'WH3'		0.242	0.048	
'WH4'		0.297	0.054	
'WH5'		0.348	0.06	
'WH6'		0.397	0.064	
'WH7'		0.443	0.066	
'WH8'		0.486	0.068	
'WH9'		0.526	0.07	
'WH10'		0.562	0.072	
'WH11'		0.597	0.076	
'WH12'		0.687	0.079	
'WS1'		0.08	0.419	
'WS2'		0.155	0.095	
'WS3'		0.214	0.052	
'WS4'		0.27	0.051	
'WS5'		0.323	0.057	
'WS6'		0.373	0.062	
'WS7'		0.42	0.065	
'WS8'		0.465	0.067	
'WS9'		0.506	0.069	
'WS10'		0.544	0.07	
'WS11'		0.58	0.074	
'WS12'		0.675	0.074	

continued

'M1'		0.1	0.1
'M2'		0.1	0.1
'M3'		0.1	0.1
'M4'		0.1	0.1
'M5'		0.1	0.1
'M6'		0.1	0.1
'M7'		0.1	0.1
'M8'		0.1	0.1
'M9'		0.1	0.1
'M10'		0.1	0.1
'M11'		0.1	0.1
'M12'		0.1	0.1
'MT1'		0	0
'MT2'		0.14	0.1
'MT3'		0.45	0.1
'MT4'		0.88	0.1
'MT5'		0.98	0
'MT6'		1	0
'MT7'		1	0
'MT8'		1	0
'MT9'		1	0
'MT10'		1	0
'MT11'		1	0
'MT12'		1	0
'R11'		4332	0.35
'R12'		4332	0.35
'HF10'		1	0.1
'HF11'		1	0.1
'HF12'		1	0.1
'K10'		1	0.1
'K11'		1	0.1
'K12'		1	0.1
Sole			
VIIe			
	1		
	1	12	1
	1		
H.cons.			
	3	9	
	1969	2009	
Stock numbers in 2010 are VPA survivors.			
	-1		

Table 8.3.17: Sole in Division VIIe : Estimates of biomass and fishing mortality reference levels derived from the fit of three stock and recruit relationships and the yield per recruit Fmsy proxies.

Stock name
Sole VIIe
Sen filename
wgcse_sol7e.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker

905/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Determinis	0.335	0.144	9994	1475.9	1.038	0.200	1.678	0.000073	13.926
Mean	0.341	0.145	15146	2001.7	1.050	0.236	1.784	0.000086	
5%ile	0.210	0.093	4442	702.19	0.967	0.049	1.373	0.000018	
25%ile	0.275	0.119	6337	1034.3	1.008	0.138	1.557	0.000050	
50%ile	0.328	0.140	9088	1343.7	1.046	0.228	1.730	0.000083	
75%ile	0.397	0.165	14964	2022.3	1.088	0.320	1.962	0.000117	
95%ile	0.521	0.213	41855	5119.2	1.152	0.467	2.352	0.000170	
CV	0.284	0.248	1.538	1.313	0.055	0.543	0.175	0.543	

Beverton-Holt

905/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Determinis	0.355	0.107	16176	1763	0.214	0.961	16964.300	9575.410	13.867
Mean	0.394	0.095	243226	15720	0.247	0.959	260561.129	199863.124	
5%ile	0.205	0.018	5299	748	0.037	0.869	7200.992	2233.994	
25%ile	0.283	0.073	9334	1142	0.135	0.922	10654.900	4785.210	
50%ile	0.354	0.099	17234	1713	0.235	0.957	15412.100	8399.560	
75%ile	0.449	0.123	50286	2979	0.341	0.995	26822.500	17293.300	
95%ile	0.677	0.158	327204	9625	0.504	1.048	98835.740	74117.580	
CV	0.578	0.463	18.120	21.668	0.573	0.058	25.499	26.015	

Smooth hockeystick

905/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Determinis	0.263	0.263	4220	1143	0.505	1.227	0.668	4217.600	15.668
Mean	0.253	0.216	8393	1173	0.507	1.279	0.672	4395.680	
5%ile	0.164	0.039	3613	783	0.464	1.034	0.614	3554.802	
25%ile	0.210	0.182	4158	982	0.488	1.168	0.646	4015.100	
50%ile	0.250	0.225	4628	1141	0.505	1.277	0.669	4391.610	
75%ile	0.290	0.264	5188	1338	0.523	1.414	0.693	4860.090	
95%ile	0.354	0.326	35746	1643	0.551	1.514	0.729	5206.500	
CV	0.227	0.368	1.462	0.230	0.059	0.122	0.059	0.122	

Yield per Recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Determinis	0.142	0.118	0.142	0.376	0.749	0.203	0.2	0.28
Mean	0.131	0.109	0.129	0.422	1.424	0.200		
5%ile	0.002	0.002	0.002	0.039	0.692	0.141		
25%ile	0.066	0.054	0.073	0.261	0.732	0.171		
50%ile	0.141	0.117	0.144	0.375	0.765	0.195		
75%ile	0.191	0.159	0.185	0.501	0.817	0.225		
95%ile	0.253	0.209	0.235	0.932	6.052	0.274		
CV	0.624	0.626	0.594	0.765	1.436	0.205		

Figure 8.3.1 Sole VIIE International Landings Age Compositions

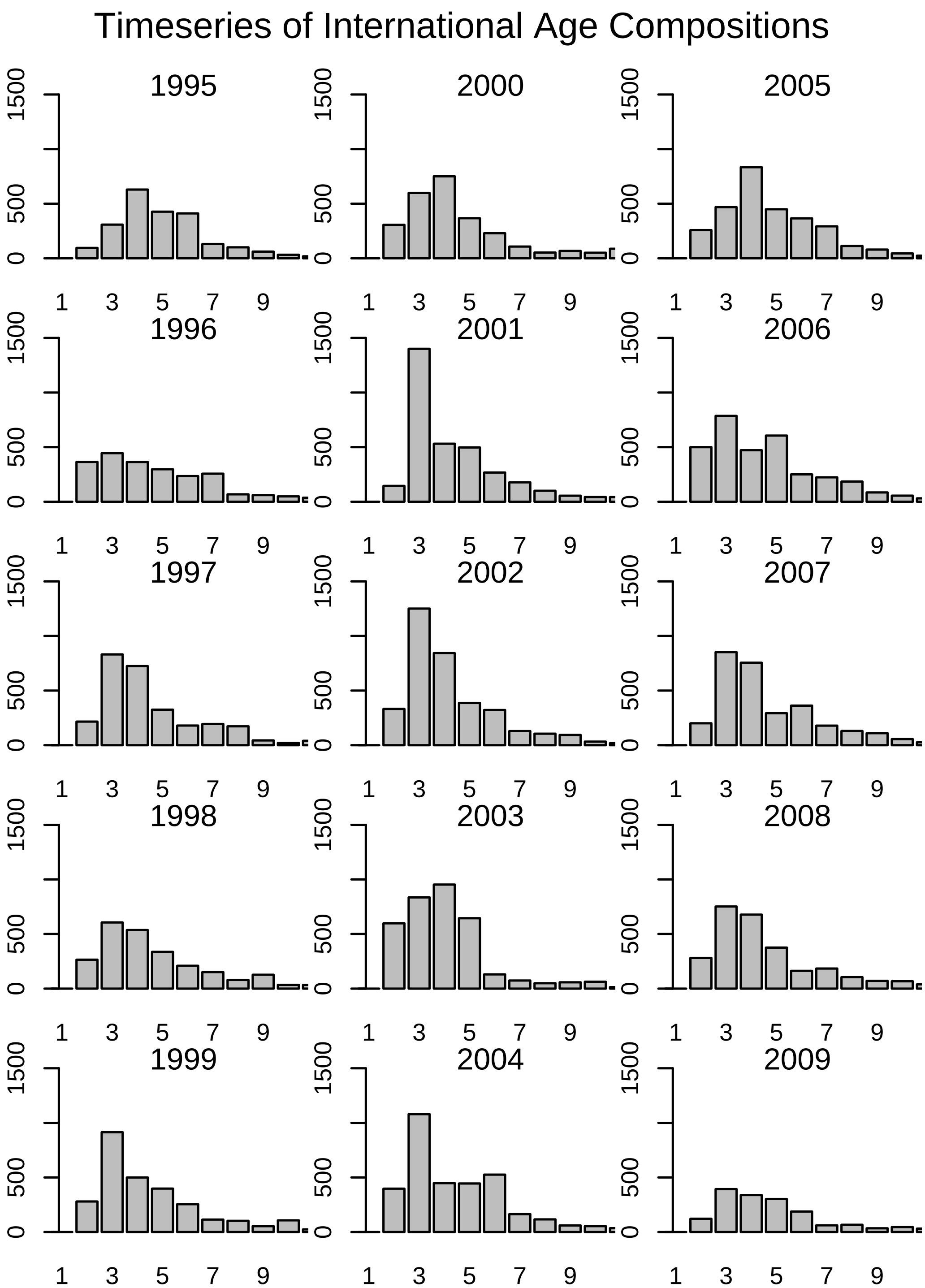
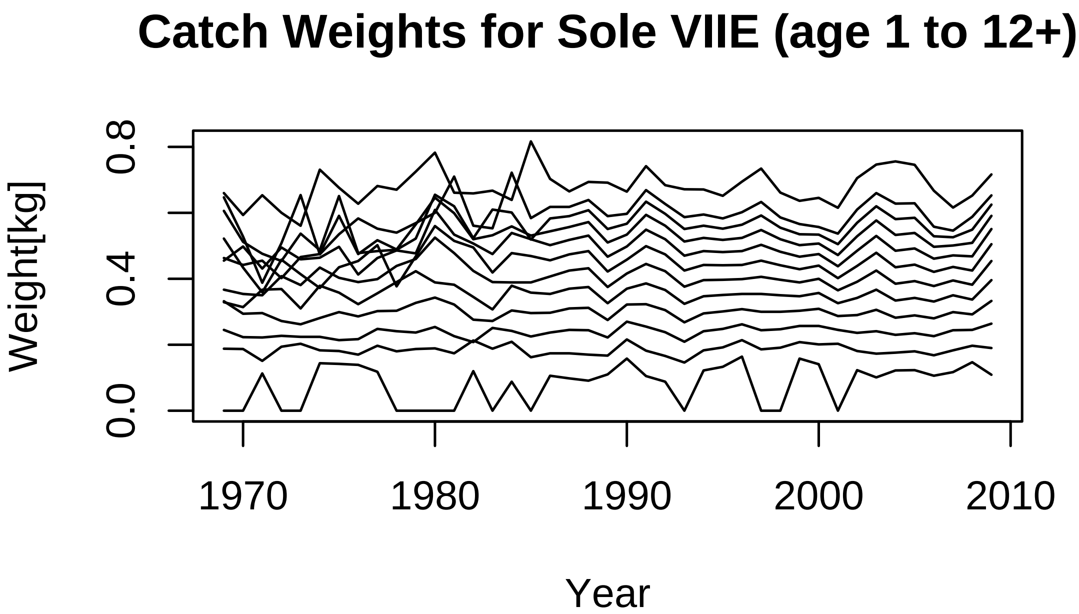


Figure 8.3.2 Sole VIIE Catch and Stock Weights at Age



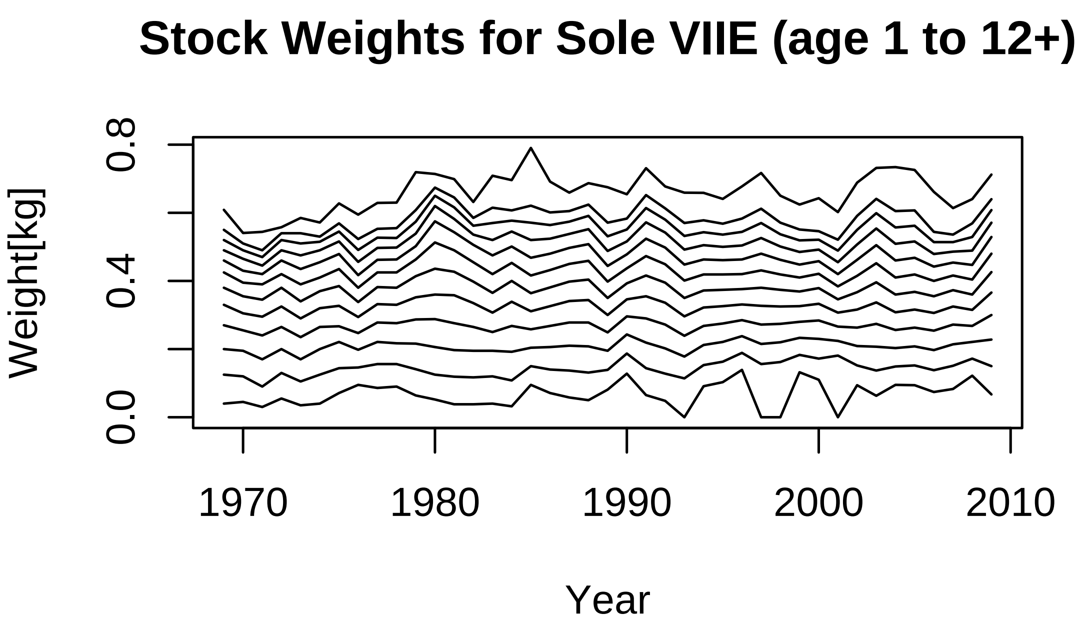


Figure 8.3.3a Sole VIIE Discards by Quarter, Fleet

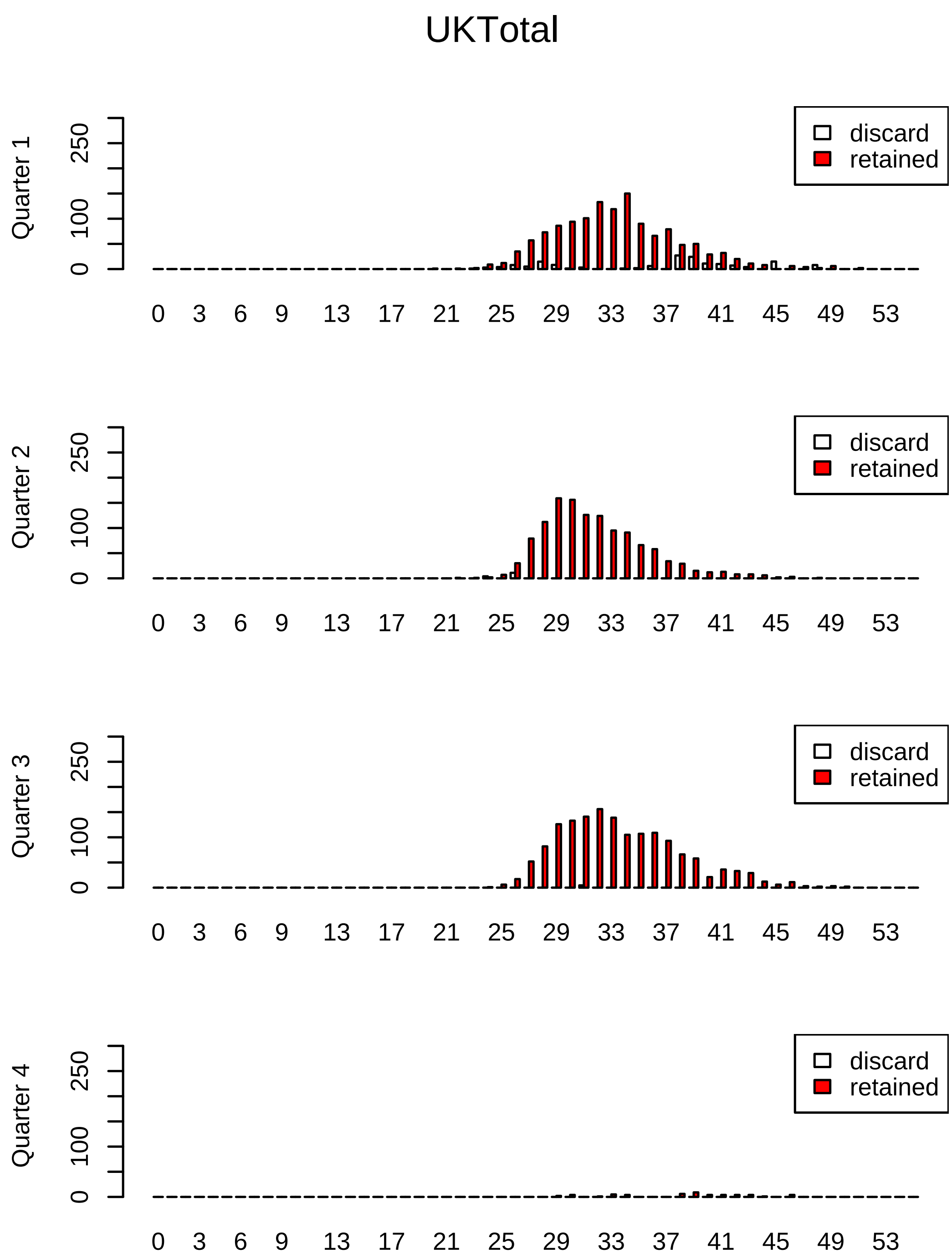


Figure 8.3.3b Sole VIIE Discards by Quarter, Fleet continued

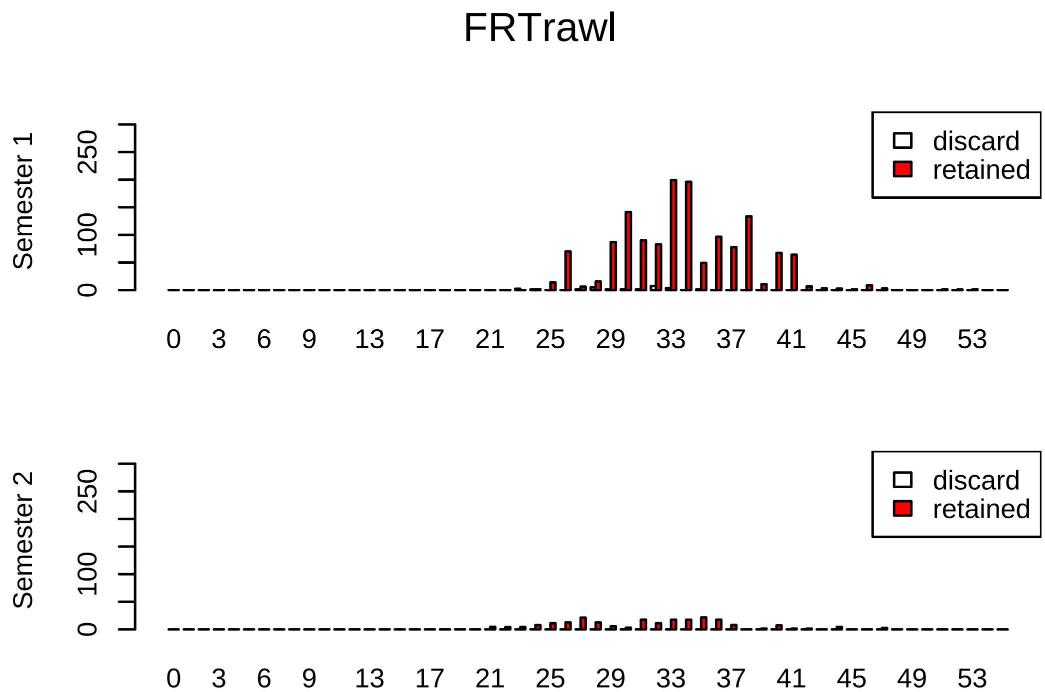


Figure 8.3.3c Sole VIIE Discards by Quarter, Fleet continued

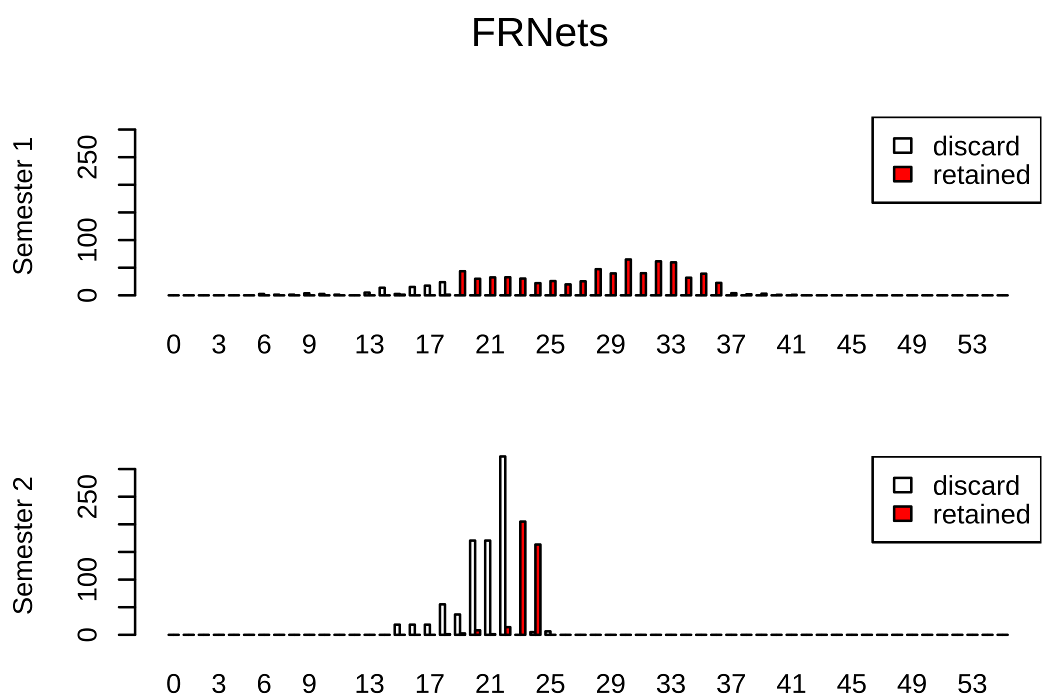
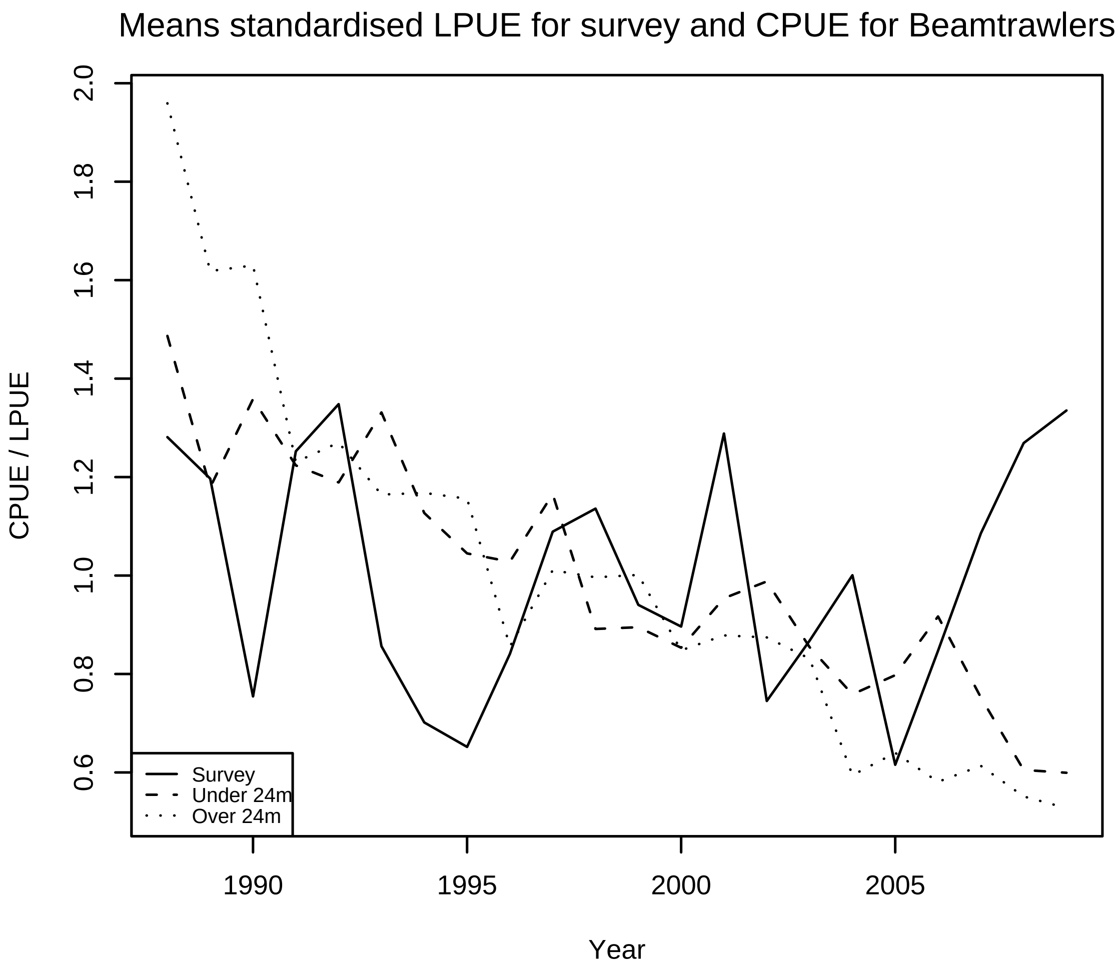


Figure 8.3.4 Sole VIIE LPUE and effort



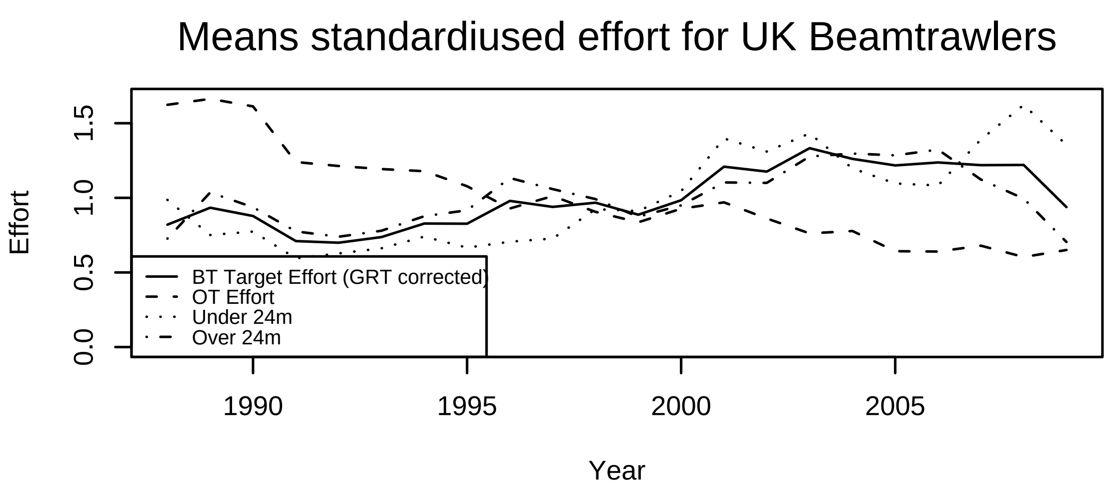


Figure 8.3.5 Sole VIIE Log CPUE by Yearclass

note the cohorts differ on the x-axes due to the differences in the length and age range of the tuning series

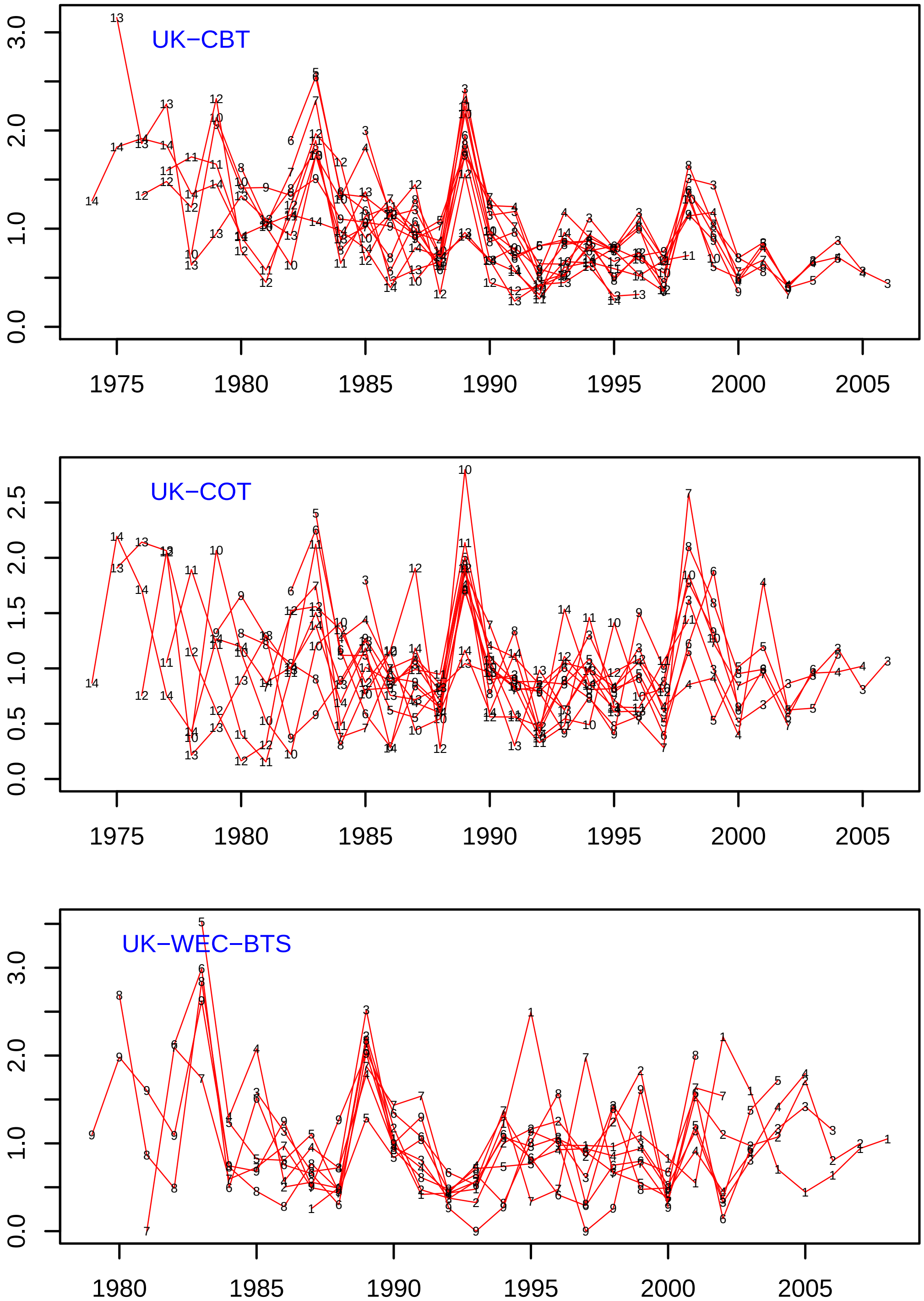


Figure 8.3.6 Sole VIIE Log CPUE by Year

note the cohorts differ on the x-axes due to the differences in the length and age range of the tuning series

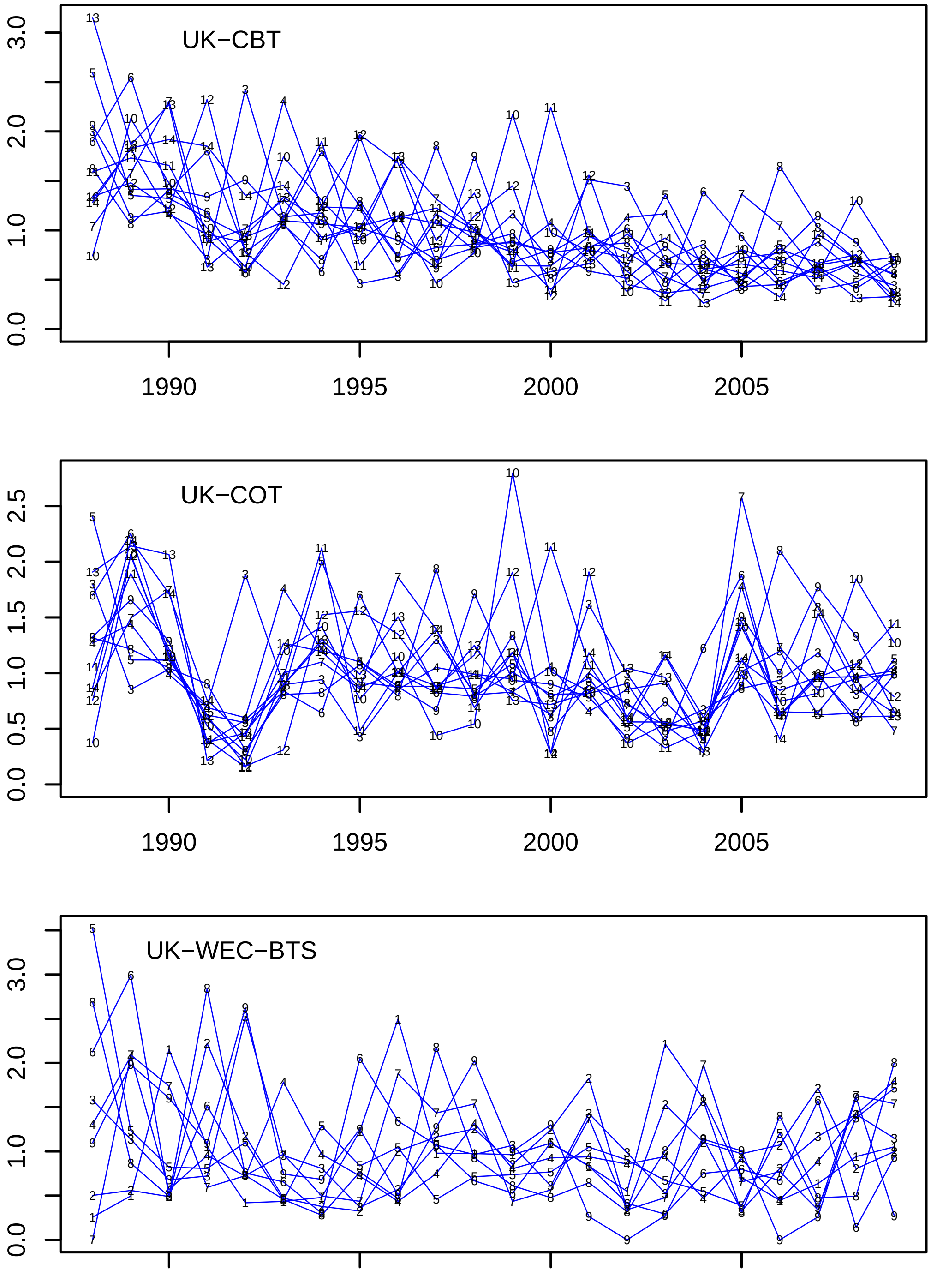


Figure 8.3.7 Sole VIIE Single Fleet log catchability Residuals

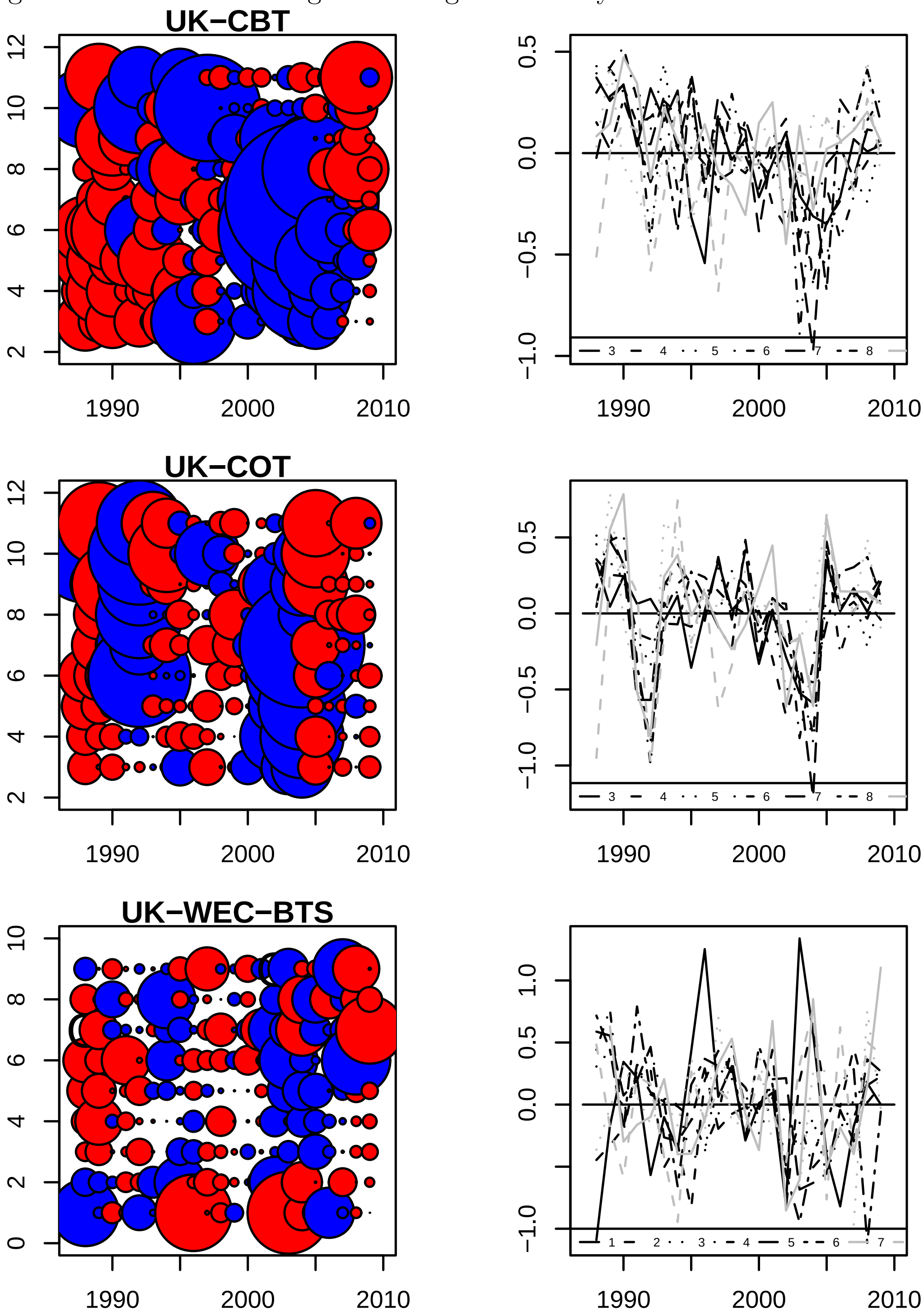


Figure 8.3.8 Sole VIIE Single Fleet Summary

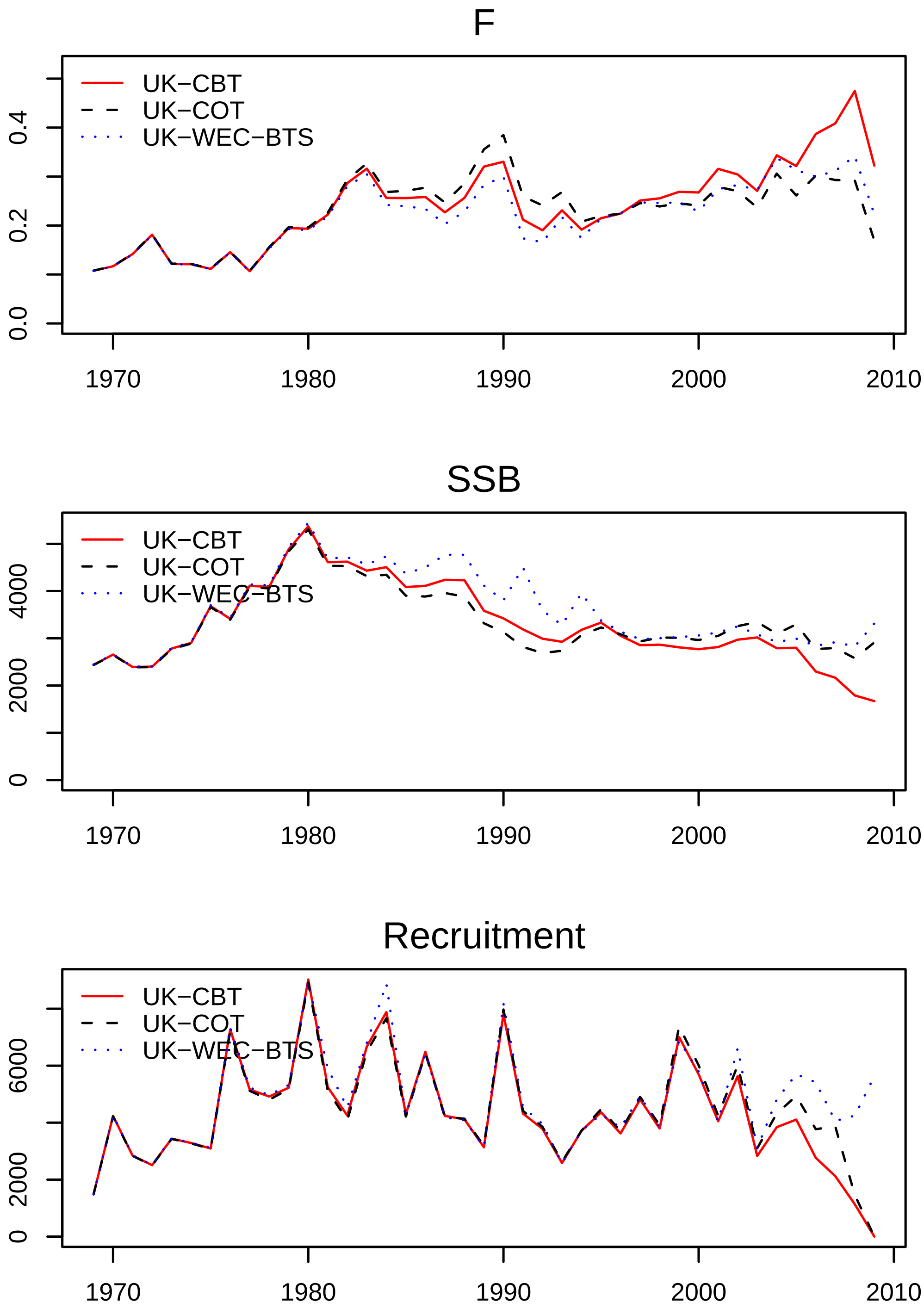


Figure 8.3.9 Sole VIIE Final XSA Fleet log catchability Residuals

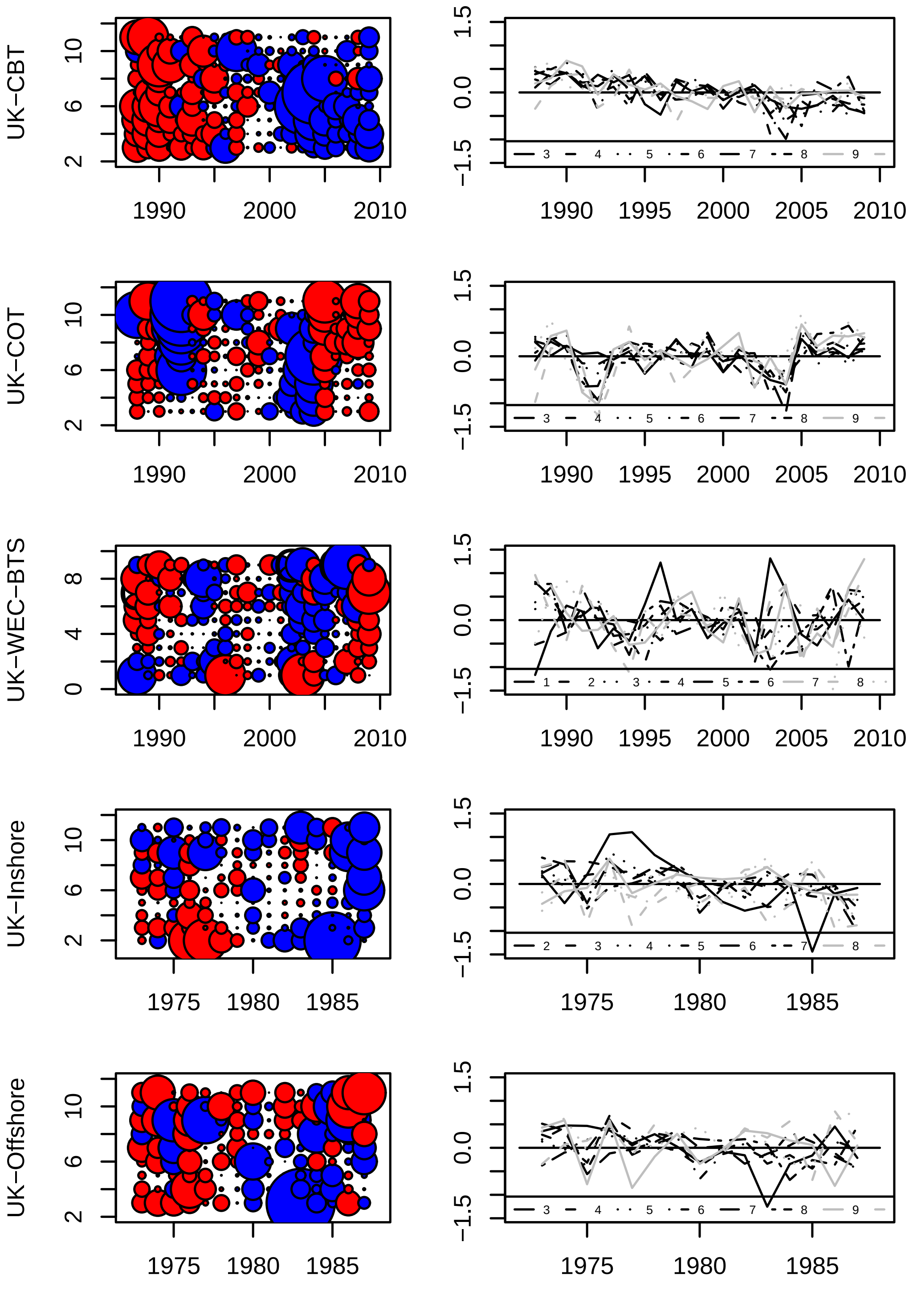


Figure 8.3.10 Sole VIIE Final XSA and previous XSAs

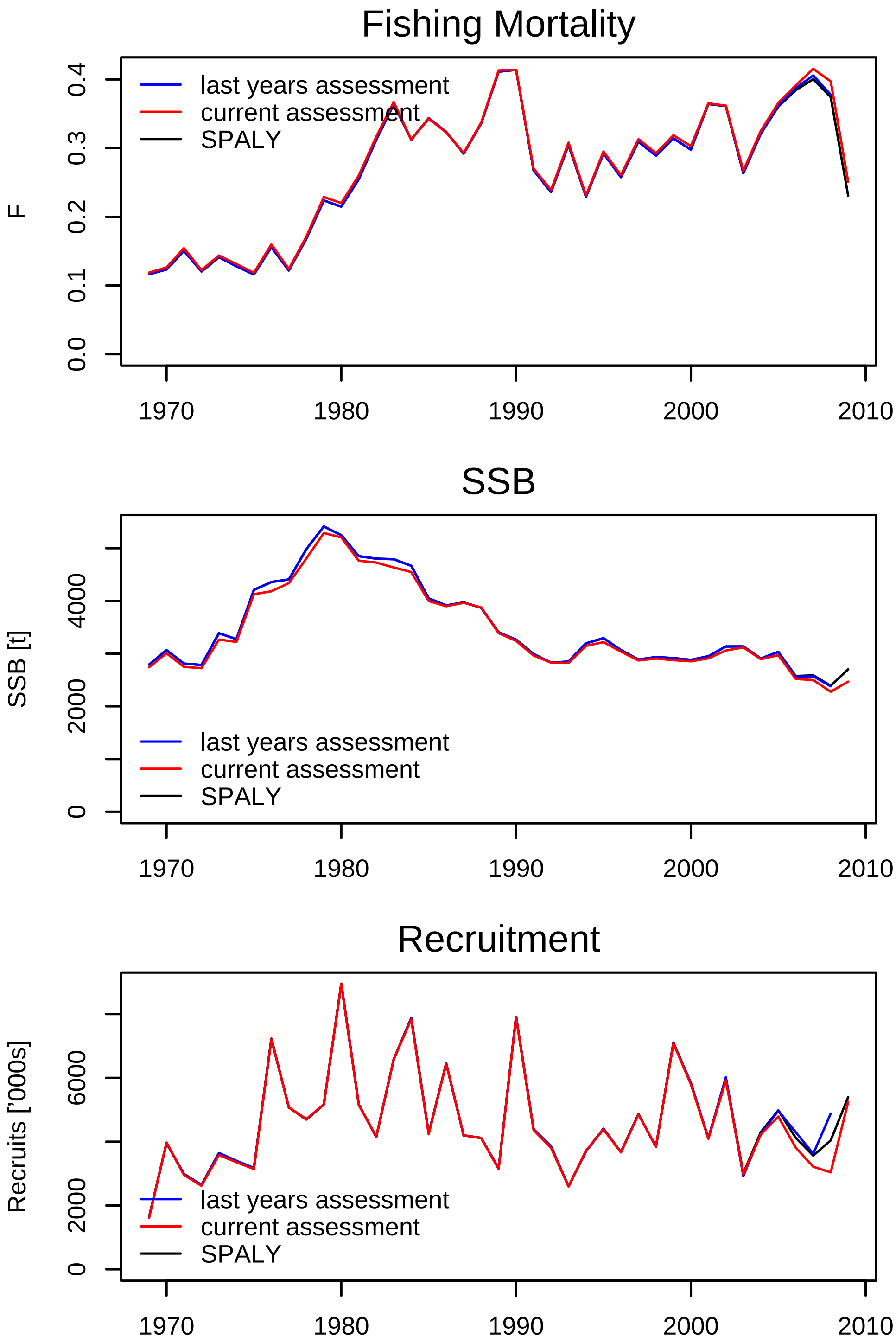


Figure 8.3.11 Sole VIIE Final and previous Assessment weights

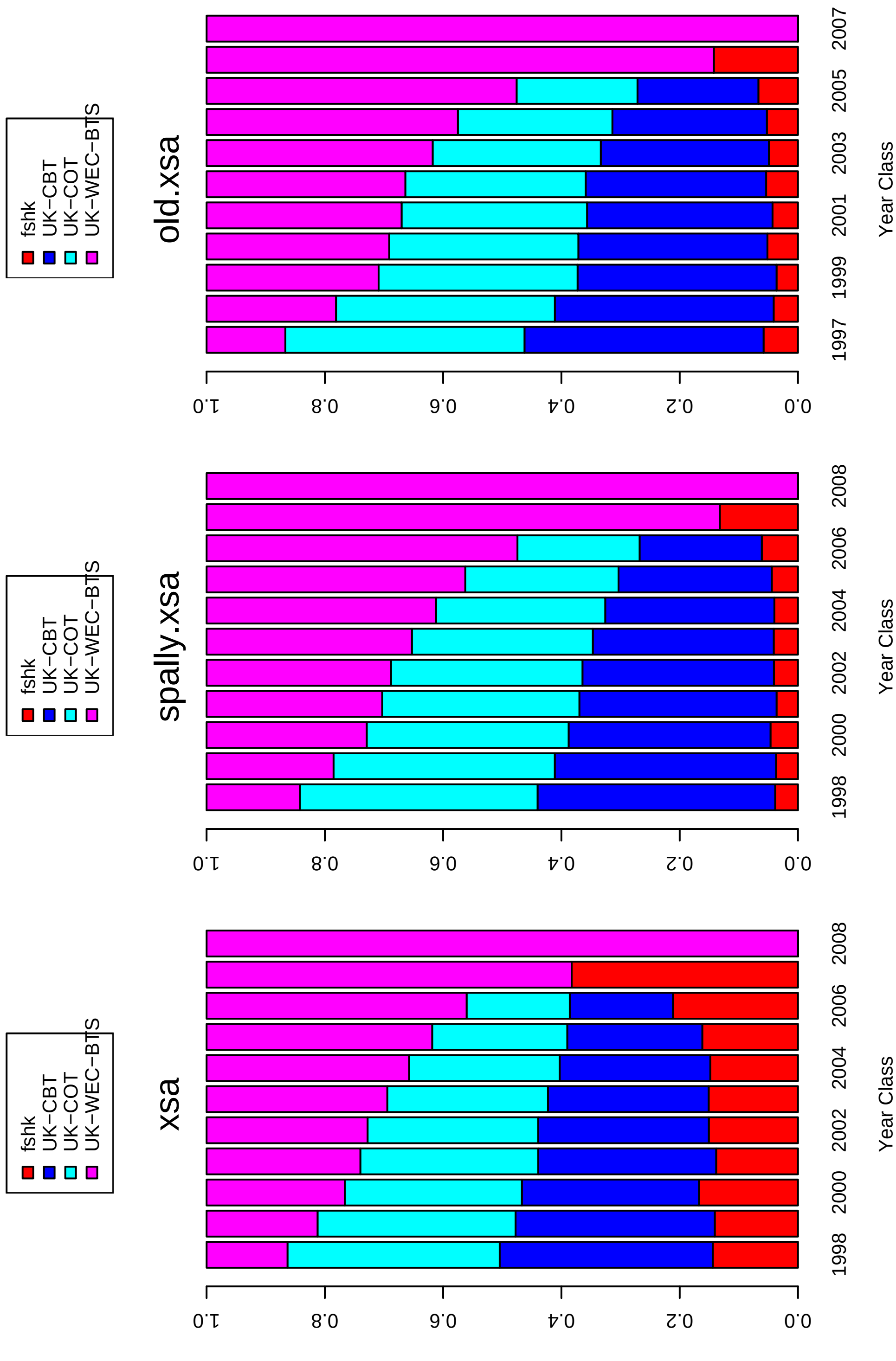


Figure 8.3.12 Sole VIIE XSA Retrospective Plots

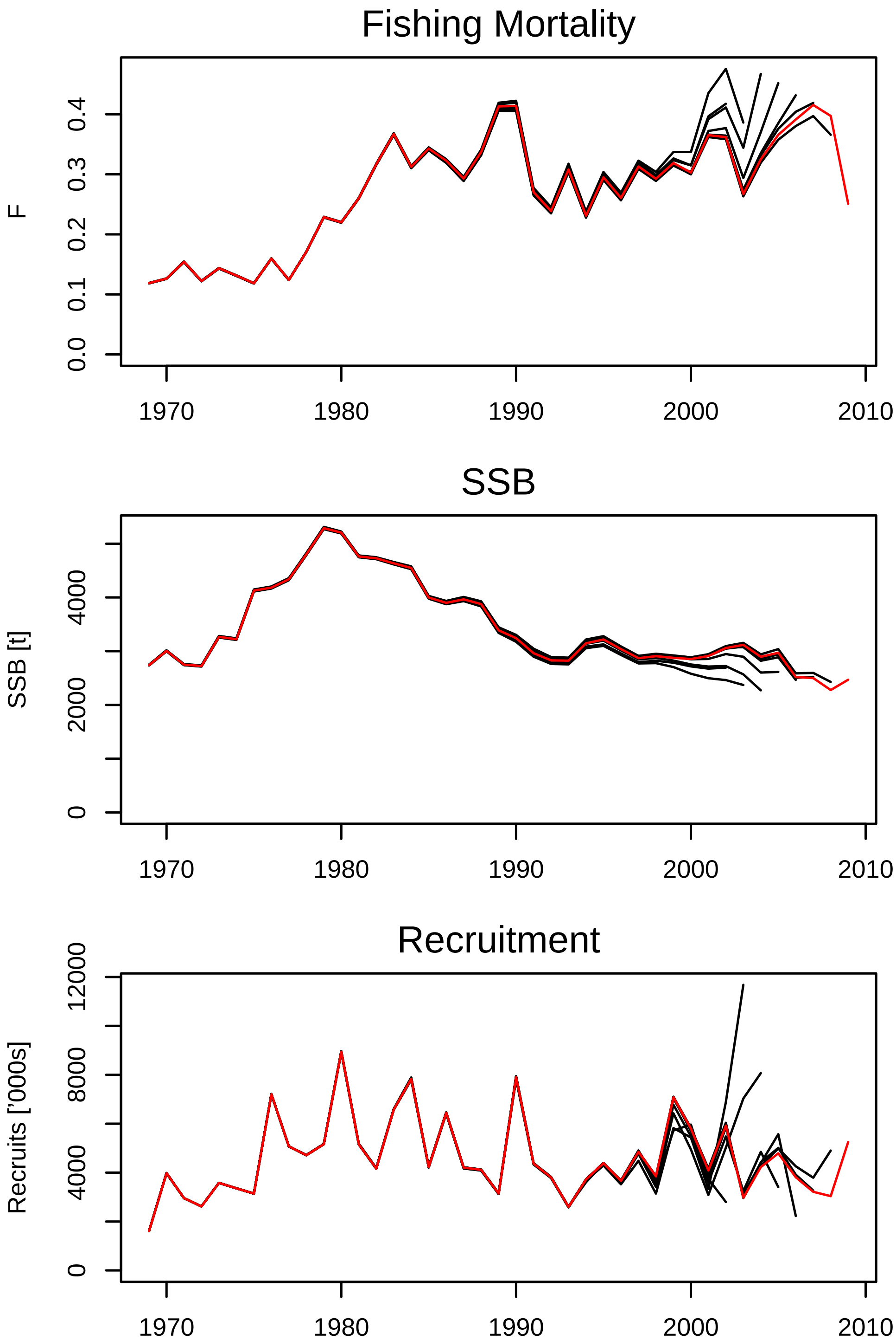
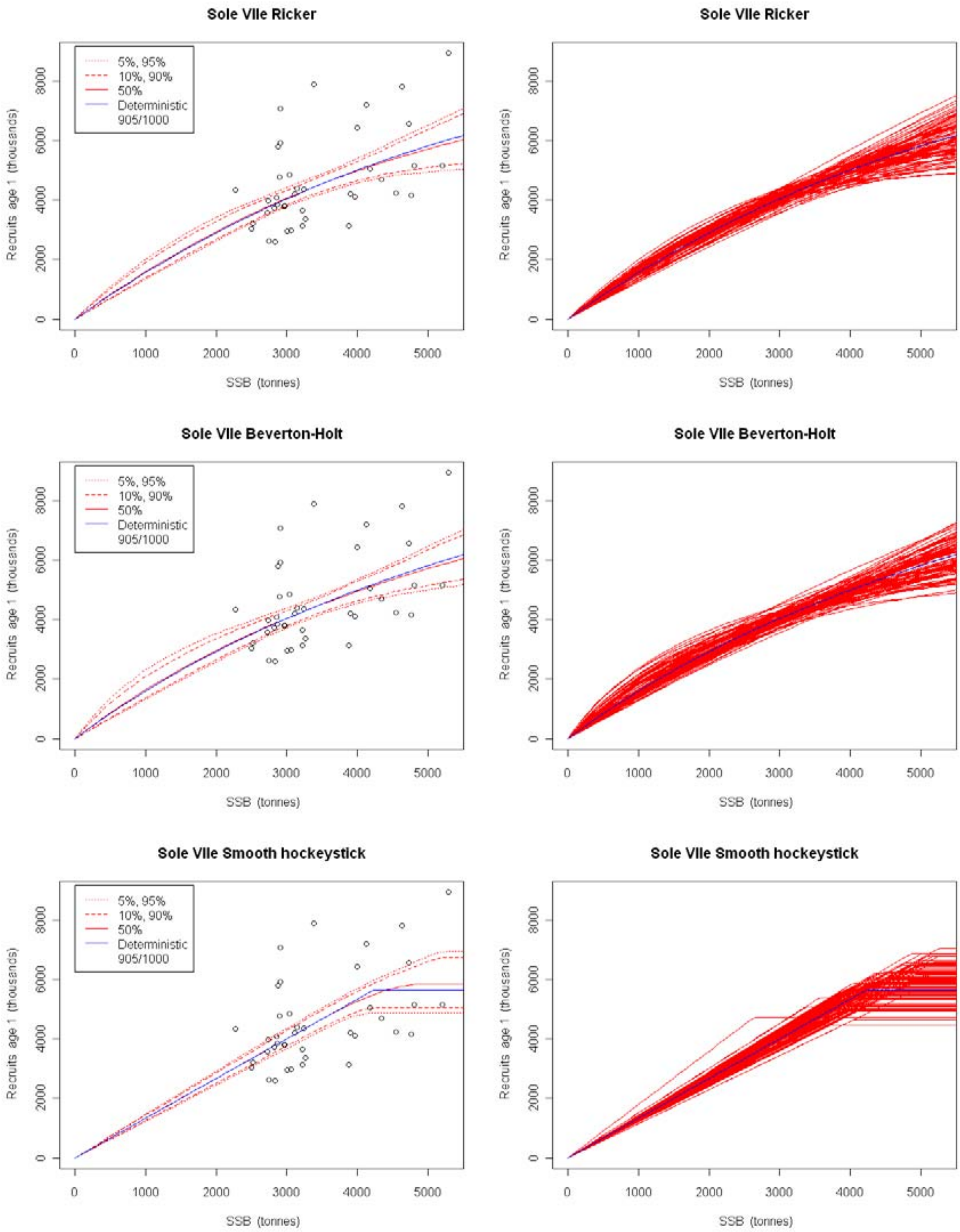


Figure 8.3.13: Sole in Divisions VIIe : Fitted yield per recruit F reference points, yield per recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight at age, natural mortality and maturity estimates and their c.v. Left hand panels : blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels : the first 100 re-samples.



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Annex 2: Technical minutes from the Celtic Seas Review Group

- RGCS
- By correspondence and through WebEx conference 26–28 May 2010
- Participants: Mike Armstrong (Chair), Marie Storr-Paulson, Jens Floeter, Yvonne Walther. WG Chairs: Pieter-Jan Schön and Colm Lordan, Ireland. Secretariat: Cristina Morgado, Barbara Schoute, Mette Bertelsen and Helle Gjeding Jørgensen.
- Working Group: WGCSE

General

Stocks to be reviewed

The Review Group considered the following stocks:

Fish stocks	Perform assessment	Advice
Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIa, IIIa, Subarea IV and VI	Y	Update
Cod in Division VIIe–k (Celtic Sea)	Y	Update
Cod in Division VIIa (Irish Sea)	Y	Update
Cod in Division VIb (Rockall)	N	Catch statistics only
Cod in Division VIa (West of Scotland)	Y	Update
Haddock in Divisions VIIb–k	Y	Update
Haddock in Division VIIa (Irish Sea)	Y	Update
Haddock in Division VIb (Rockall)	Y	Update
Haddock in Division VIa (West of Scotland)	Y	Update
Megrim (*Lepidorhombus spp*) in Subarea VI (West of Scotland and Rockall) and Subarea IV (North Sea)	Y	Update
Nephrops in Division VIa (North Minch)	Y	Update
Nephrops in Division VIa (South Minch)	Y	Update
Nephrops in Division VIa (Firth of Clyde)	Y	Update
Nephrops in Division VIIa (Irish Sea East)	Y	Update
Nephrops in Division VIIa (Irish Sea West)	Y	Update
Nephrops in Division VIIb,c,j,k (Porcupine Bank)	Y	Update
Nephrops in Division VIIb (Aran Grounds, FU 17)	Y	Update
Nephrops in Division VIIa,g,j (South East and West of IRL, FU 19)	Y	Update
Nephrops in Divisions VIIfgh (Celtic Sea, FU 20–22	Y	Update
Plaice in Division VIIb,c (West of Ireland)	Y	Update
Plaice in Divisions VIIh,k (Southwest of Ireland)	Y	Same advice as last year
Plaice in Divisions VIIf,g (Celtic Sea)	Y	Update
Plaice in Division VIIe (Western Channel)	Y	Update
Plaice in Division VIIa (Irish Sea)	Y	Update
Sole in Division VIIb, c (West of Ireland)	N	Catch statistics only
Sole in Divisions VIIh–k (Southwest of Ireland)	Y	Same advice as last year

Fish stocks	Perform assessment	Advice
Sole in Divisions VIIf,g (Celtic Sea)	Y	Update
Sole in Division VIIe (Western Channel)	Y	Update
Sole in Division VIIa (Irish Sea)	Y	Update
Whiting in Divisions VIIe–k	Y	Update
Whiting in Division VIIa (Irish Sea)	Y	Update
Whiting in Division VIb (Rockall)	N	Catch statistics only
Whiting in Division VIa (West of Scotland)	Y	Update

The following special requests were addressed:

Additional Requests to ICES concerning West Scotland haddock

On behalf of the European Commission, ICES is requested and required to incorporate the following elements in its advice to be provided in June 2010.

a) ICES should report on the catch of haddock in Divisions Vb and VIa in 2010 that would be consistent with the application of the harvest rule in Annex, paragraph 1.

Such reports could adequately be presented as additional lines in the "catch option table".

Special request on VIIe sole

Request from UK authorities to consider potential alternative methods for estimating the current exploitation rate on VIIe sole and to identify an appropriate method for the calculation of a TAC for 2011, in accordance with the management plan.

Review process

The Review Group conducted its work by correspondence and through Webex conference facilities organised by ICES. The reviews have been carried out according the Guidelines provided by ICES, particularly focusing on the need to Quality Assure the assessment results supporting the provision of fishery management advice by ICES in the annual ACOM advice sheets. All stocks were reviewed by at least two reviewers. This involved:

- Checking that update assessments have been correctly implemented using the methods described in the Stock Annexes;
- Checking that the assessments have been implemented correctly, which could involve re-running the assessments to ensure the results in the WG Report can be replicated exactly;
- Ensuring the assessment results and forecast results are carried over correctly to the advice sheets and advising ICES of any errors detected;
- Evaluating the ability of the stock assessments for providing credible management advice, and suggesting alternative advice where assessments do not appear appropriate;
- Providing recommendations to the Working Group to help with future development of the assessments through benchmarking.

The RG did not have access to all of the WG report sections and advice sheets prior to the scheduled start date of the review process on 26 May. This meant that a very heavy workload was experienced during the week commencing 31 May. Unfortunately one of the three reviewers became unavailable during that week, increasing the workload on the remaining reviewers. The RG advises that insufficient time was provided to review the large number of stocks, which included four herring stocks from HAWG and anglerfish and megrim stocks from WGHMM. ICES must review the logistics of the review process for future years.

General comments regarding the WGCSE stock assessments

Several issues were common to many of the assessments carried out by the WGCSE:

1) Discard estimates

Many of the stocks are heavily discarded at the younger age classes and also in some cases throughout the age classes due to high-grading. Apart from west-of-Scotland gadoids, there is an absence of appropriately fleet-raised estimates of discards for all the significant fleets included in the assessments (Scotland is currently reviewing its raising procedures). In some cases (e.g. plaice in VIIa and VIIfg; whiting in VIIa) where very high rates of discarding occur across many age classes but fleet-raised estimates are not provided to the WG by all countries, there is no valid basis for a catch-at-age assessment and any estimates of fishing mortality from a landings-only assessment will be severely biased. EU member States are required through the Data Collection Framework to collect data on discards for fleets where discarding exceeds a specified percentage, and are expected to meet precision targets. This has been a requirement since the inception of the DCR/DCF. However, discards estimates are often not being transmitted to the WG in a usable form for inclusion in an assessment, or in some cases are based on extremely low sample sizes. In some cases it is not even possible to quantify the general level of discarding.

2) Biological sampling on surveys

Considerable archives of biological data collected on surveys exist for many stocks. However, very little of this is used by the WG to provide time-series of biological parameters such as maturity, length/weight-at-age, etc. For example, the practice of using mean weights-at-age in annual commercial catches (or even worse, in landings) as values for weight-at-age in the stock, is prevalent despite the existence of good data from surveys at different times of year, which can be modelled to obtain year and age or year-class effects (see VIIa haddock for example). The benchmark assessment process provides a focus for such analyses, but the WGCSE stocks have been poorly serviced by benchmarks so far.

3) Commercial lpue tuning data

There are a number of stocks (typically flatfish) where commercial fleet tuning data are still used in the assessments. In some cases these comprise a large fraction of the total fishery catch and this leads to correlated errors between the tuning fleets and the catch-at-age matrix. The Stock Annexes do not always provide adequate evidence to support the contention of constant catchability over time, for example contemporary evaluation of "power factors", and evaluation of how catchability is affected by changes in fleet behaviour caused by management regimes or other drivers such as fuel costs. It is not uncommon for surveys and commercial tuning fleets to give conflicting signals. The benchmark process should involve full evaluation of commercial tuning fleets if these are to be used. VMS data linked to EU logbook data, and observer data, provide an opportunity to examine spatio-temporal patterns in cpue, at least for the larger vessels.

4) F_{MSY} estimates

The RG appreciates the efforts of the WG to explore candidate F_{MSY} values for the different stocks. However there is a clear problem with characterising the true nature of the stock–recruit relationship, which is critical for robust estimation of F_{MSY}. Problems exist due to the characteristics of the variability in recruitment, the lack of any apparent decline in recruitment at reduced SSB, and time-series effects suggesting a Ricker-type domed S/R even when the time-series covers a range of stock sizes that are already well depleted from the "virgin" stock. Bootstrapping from often noisy assessment data also leads to difficulties in finding solutions, making it difficult even to make robust estimates of yield-per-recruit parameters in some cases. A basic problem is that individual stocks cannot yield sufficient statistical power to define the parameters due to natural variability and sampling error. As a result, the WG has been unable to specify F_{MSY} targets for many stocks, which is a problem given the commitments to an MSY approach to management. It seems more likely that a meta-analysis approach would lead to more robust outcomes; there are likely to be similarities in appropriate F_{MSY} reference points between stocks with similar biology and dynamics, and the variability between the "true" values for these stocks is probably much less than the estimation errors and biases for individual assessments.

5) Benchmarking

So far, few of the stocks covered by WGCSE have been the subject of benchmark assessments. Without the target of a data compilation and benchmark assessment, national scientists may not have the leverage to find the resources to carry out the necessary intersessional preparatory work. This can lead to an argument that the stocks are not ready for benchmarking because the data have not been adequately compiled, resulting in perpetuation of inadequate assessments and advice. All efforts should be made to benchmark stocks that have important linkages, e.g. gadoid stocks in the North Sea and west of Scotland, or western waters cod stocks.

6) Quality of official landings data

The non-provision of official landings data by France in 2009 has affected the quality of landings dataseries for many stocks in this and other WGs. In many cases French data have been obtained from a different source, e.g. sales slips, but it is not clear how accurate these estimates are.

7) Stock Annexes

A number of Stock Annexes are comprehensively updated each year but others contain old information or data evaluations (e.g. catch-curves) which haven't been updated and are of limited current value. The Annexes should be brought fully up to date and any out-of-date analyses revised if they are still thought to be useful, or removed if no longer of use and aren't necessary for interpreting historical data or assessments.

8) *Nephrops* assessments

The assessments and advice for most of the *Nephrops* stocks in Subareas VI and VII have fallen into a common approach based on UWTV surveys, yield-per-recruit F_{MSY} estimates, and supporting trends indicators. The RG appreciates the efforts by WGCSE to standardise the methods and streamline the reports. However there remain some inconsistencies in the way in which key variables are presented. The sections for the Aran and Irish Sea west stocks include useful tables detailing all the inputs for calculating historical harvest ratios and inputs to forecasts, but other stocks lack this detail making it difficult for the RG to evaluate the assessments. This was not helped by errors in some key tables for west-of-Scotland stocks. Efforts to standardise the tables further would be appreciated.

Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIa, IIIa, Subarea IV and VI (Report Section 5.2)

1) **Assessment type**: Update
2) **Assessment**: trends
3) **Forecast**: none
4) **Assessment model**: No assessment model presented
5) **Consistency**: Survey-series 2005–2008 revised
6) **Stock status**: Unknown
7) **Management Plan**: There is no management plan for the stock

General comments

The WG has addressed the ToR in providing an update of survey data and other indicators.

The WG Report and the Stock Annex do not contain any information on ecosystem aspects or environmental drivers.

There is no EU management plan for this stock.

A detailed description of the anglerfish fisheries is given in the Stock Annex. However the WG has not considered mixed fishery issues in relation to management of anglerfish in its advice.

A new revised survey estimate from the joint science/industry anglerfish survey was introduced. The 2010 survey data has not been finalised yet. The 2010 survey result could be used for evaluating TAC options for 2011 using the Commission rules in its Consultation on Fishing Opportunities for 2010, and a final recommendation should be given as along with other ICES' survey updates later on in the year. The survey time-series goes back to 2005.

There are age reading problems for the species a workshop is planned in 2011. There is concern of area and species misreporting.

A section with management consideration for the IIIa, IV and VI stock is missing and it is unclear what management advice the WG is providing.

Technical comments

1) The collaborative survey-series has been revised this year. The WG should provide a comparison with the results from last year's WG and explain any differences.
2) In the MSY section the WG provides an approximate estimate of Z = 0.6 from the survey catch-at-age data but does not provide the diagnostics of the method including how selectivity is accounted for.
3) The increasing trend in the anglerfish survey catch rates is also reflected in the lpue in the Irish fishery in VIb (Rockall). However the survey and the Irish lpue have opposite trends in VIa. The WG has not provided updates of Scottish lpue (using days fished as effort) due to historical inaccuracies in landings data. However it is stated that the reported landings data from 2006 onwards are more accurate due to Buyers and Sellers legislation. Spatial lpue trends from 2006 on would be useful additional evidence given the downward trend in the survey index in 2009.

Conclusions

The RG agrenes with the conclusions of the WG and the material in the draft advice sheets that no reliable assessment can be provided at this stage.

The stock suffers from data deficiencies regarding age reading, area misreporting and limited knowledge about population dynamics. The new joint science/industry anglerfish survey is an important initiative for providing biomass estimates and stock trends. Catchability with respect to the efficiency of the trawl in retaining anglerfish in the path of the net has been studied in detail although there are still catchability issues related to distribution (for example underrepresentation of young anglerfish). Survey data indicate a sharp decrease in numbers from 2007–2009 and a sharp drop in biomass from 2008–2009. However the time-series is very short and the propensity for year effects in survey results is not apparent yet.

Cod in Division VIIe–k (Celtic Sea) (Report Section 7.2)

1) **Assessment type**: Update
2) **Assessment**: survey and fishery trends
3) **Forecast**: none provided
4) **Assessment model**: none
5) **Consistency**: failed benchmarked in 2009, no new assessment proposed
6) **Stock status**: Unknown. Yield-per-recruit analysis suggests $F_{0.1}$ (0.27) and F_{max} (0.38) values that are consistent with previous analyses, and well below historical F reported in previous XSA.
7) **Management Plan**: No agreed management plan has been developed yet. However, a long-term management plan is under discussion for this stock and an effort based management system in the Celtic Sea (VIIfg) is being discussed by member states and the EC.

General comments

The specific ToR for VIIe–k cod was to perform an update assessment (as opposed to SALY). The WG continues to follow the WKROUND advice not to perform an analytical assessment due to catch uncertainties. This unfortunately precludes any presentation of long-term trends in SSB, F and recruitment other than the separable VPA recruitment-series presented, and it is not possible to see if the addition of new data has affected the WKROUND conclusions. This leaves a critical cod stock with very little quantitative advice on stock status.

The WG Report and Stock Annex do not include any ecosystem information relevant to this stock and its fisheries, or any information on climate changes that could affect the stock. Given the location of the stock at the southern limits of the species range, this is a major omission that the WG should address. The Stock Annex comment that "no environmental drivers are known for this stock" is not correct given the history of studies on cod and climate.

There is no agreed Management Plan for this stock.

The WG has not used mixed fishery data in the stock section or annex other than a statement of which fisheries cod is caught in. Cod in the Celtic Sea are often taken as a minor bycatch in a range of trawl and netting fisheries targeting a diverse range of species. Management measures to conserve cod could impact a wide range of fisheries that do not target cod and the impact of this, needs to be evaluated.

As with other stocks, official landings data were not received from France for 2009 and catches had to be derived from landings reported by fishing organizations. Only 72% of the French quota was taken, resulting in an apparent sharp reduction in discarding/high-grading in 2009. Discarding (mainly high-grading with some undersized cod) and landings misreporting had been exacerbated since 2003, when quotas became increasingly restrictive. Discard data were presented in previous WGSSDS but not used in the assessments as they did not cover all the main fleets and quarters yet.

The two main problems in assessing the stock are: 1) perceived problems with accuracy of catch-at-age data in the 2000s due to high-grading (although attempts have been made to adjust for this), and (2) available surveys lack robust trends mainly due to their low catch rates, with all current survey-series taking place in autumn when cod are dispersed and often present in non-trawlable grounds. A new Irish industry led survey during spring is commencing, which should provide important new data on distribution and abundance but will require several years to indicate stock trends.

Technical comments

1) SURBA results are given in terms of Z, but only the raw indices of recruitment for the EVHOE survey are given for comparison with separable VPA. Given the noise in the survey data, the use of SURBA recruitment estimates (using several data points for some year classes) may be more robust and should be investigated.

2) The WG makes a strong statement that the range of the stock has contracted, based on the plots in Figs 7.2.6–7.2.8. It is not clear if this is the case (the yellow areas cover the same area each year) or if what is being seen is a general reduction in the overall catch level across the stock range.

3) The Report contains many tables of catch-at-age and length frequencies. It would be useful to highlight the ages and years where high-grading is expected to be sufficient to have introduced an unacceptable bias in the XSA. The main question for the WG to address is how the bias/imprecision in these catch-at-age values can be accounted-for in a suitable analytical model formulation.

4) The WG should provide a better explanation of the YPR inputs, including why the stock weights and spawning–stock weights are different over all the ages.

5) An "exploratory VPA" is mentioned as the source of YPR selectivity data, and the recruit trends from a separable VPA are given elsewhere. However no details of this VPA are given.

6) In the Stock Annex two commercial French tuning fleets are described: the French trawlers targeting Gadoids in Divisions VIIf, g, h (FR-GADOIDS) and the French *Nephrops* trawlers in VIIf,g,h (FR-*NEPHROPS*). The Q2–Q4 data for these were used in previous assessments, but the series have not been updated in the WG Report, presumably due to the lack of French data for 2009?

Conclusions

The RG agrees that this stock requires a further benchmark assessment to review and take into account more recent information. However, the proposed date in late 2011 will mean no new advice on this stock until 2012, relating to TACs for 2013.

The RG supports the continued efforts to improve the input data, including the instigation of the new Q1 survey by the Marine Institute and the Federation of Irish Fishermen in 2010.

Cod in Division VIIa (Irish Sea) (Report Section 6.2)

1) **Assessment type**: Update
2) **Assessment**: analytical
3) **Forecast**: a B-adapt short-term predictions
4) **Assessment model**: B-Adapt-F.exe (13/5/06) with 5 survey indices
5) **Consistency**: very consistent with last year
6) **Stock status**: The spawning–stock biomass has declined ten-fold since the late 1980s and is suffering reduced reproductive capacity ($SSB_{2009=1192t}$) <B_{lim} of 6000 t). The fishing mortality estimates since 1988 have remained above the F_{lim} value of F=1.0 and the stock has therefore been harvested unsustainably over this period.
7) Management Plan: In 2008 the EU adopted a long-term plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008) that repeals Regulation (EC) No 423/2004, and has the objective of ensuring the sustainable exploitation of the cod stocks on the basis of maximum sustainable yield while maintaining a target fishing mortality of 0.4 on specified age groups.

General comments

The Report is well written and has a good structure. The WG addressed the ToRs by providing an update with associated management advice.

The assessment was carried out according to the Stock Annex description. The RG found no errors in the implementation of the assessment, and the results were carried over correctly to the advice sheets.

The WG Report and Stock Annex do not include any ecosystem information. Previous WGs (2006) documented a relationship between temperature in spring and cod recruitment anomalies and this is mentioned in the Annex. However the assessment and advice do not take climate effects into account. The WG Report includes information on stock structure and migrations based on tagging studies, indicating mixing of cod stocks between the Irish Sea, west of Scotland and the Celtic Sea.

The stock is subject to an EU multi-annual management plan. ICES (2009 Advice) evaluated the management plan, and considers the implementation to Irish Sea cod is not in accordance with the precautionary approach if a constraint on interannual TAC adjustments is applied, given the poor state of the stock.

The WG has not used mixed fishery data in providing management advice.

Discards data are not included in the assessment. Data presented up to 2009 show discarding on the observer trips to have been predominantly undersized cod at ages 0 and 1, rather than the high-grading observed in some other cod stocks. The RG noted that discards data for UK (E&W) are presented by gear up to 2006 but for combined gears thereafter.

The major issue with this assessment is the apparently large "catch bias" estimated by B-Adapt over the 2000–2009 period. Although slowly reducing, the bias multiplier remains between 2 and 3. This represents the multiplier that has to be applied to the landings-at-age to remove any catchability trends in the surveys. The WG still has no knowledge of the cause of such removals, or the extent to which the bias may reflect true catchability trends in the surveys. The TAC has not been fully utilized for a number of years, and landings reporting is considered more accurate since introduction of Buyers and Sellers legislation in 2006.

The WG Irish Sea Overview Section was not available to the RG to evaluate effort trends. Last year's WG showed large declines in the whitefish trawl effort (100 mm+ mesh) during the 2000s, and more stable *Nephrops* trawl effort. It is difficult to reconcile this with the lack of any recovery in age composition as shown by the continued very high Z. All available trawl data indicate a truncated age distribution in the Irish Sea. The declining SSB is supported by the Fishery Science Partnership surveys not included in the assessment.

Technical comments

1) The three 0-gp indices in the assessment indicated above-average 2004 and 2005 year classes that were not evident in the March GFS or the B-Adapt. The indices for the 2009 year class are divergent, but the large 1-gp index in the March 2010 survey gives more confidence in the possibility of an above average year class. The decision to conduct medium-term forecasts with and without the 2009 estimate is sensible. However the results do not change the management advice.

2) In the Stock Annex the survey ages for ScoGFS-Q1 Survey is 1–5, but in the input data it is age 1–4 (however, the time-series stopped in 2006 and the difference is probably very small).

3) Table 6.2.8 diagnostics. For the survey NIGFS_oct (0–2 gr) the t-value is very high 3.79 indicating a density-dependent catchability for this age. Future benchmarks should consider how 0-gp trawl indices are handled in the assessment, as the preferred habitat for 0-gp cod would be inshore rough ground poorly covered by the surveys.

4) MSY evaluation: The WG used only data up to 2005 for F due to the uncertainty in the F estimation for the most recent years in this stock. The retrospectives show some large adjustments to F (e.g. in 2005 and 2007), and the large 2006 F estimate is probably effectively converged. It would be more useful to examine the effect on the F_{MSY} estimates of different year ranges of assessment results. The catch bias is also highest in 2003 and has been declining.

Advice sheets

1) The reference points table in the advice sheet has the wrong F_{MSY} range (0.24–0.49). The correct values are 0.25–0.54. This error was transmitted to ICES.

Conclusions

The RG accepts the updated assessment as a basis for providing advice on the state of the stock relative to biological reference points.

The RG recommends that the assessment of this stock should be benchmarked in the context of a benchmarking of all three western waters cod stocks, given the availability of new data not included in the assessments (FSP surveys; egg production survey estimates; discards data collected in the 2000s through the DCF) and improving knowledge of metapopulation structure and movements of cod in the overall ecoregion. Other issues for Irish Sea cod that could be addressed include:

- Modelling framework that is not constrained to estimate equal catch-biases for all ages and fleets and can avoid the need to truncate the oldest true age to 4 for the entire time-series;
- Modelling of survey data to generate stock weights and maturity ogives (weights-at-age in the catches are becoming very variable at the older ages due to small sample sizes).

Cod in Division VIb (Rockall) (Report Section 4.2)

1) **Assessment type**: No advice; catch statistics only
2) **Assessment**: not presented
3) **Forecast**: not presented
4) **Assessment model**: none
5) **Consistency**:
6) **Stock status**: unknown
7) **Management Plan**: none

General comments

Official landing are below 100 t decreasing from close to 2000 t in the mid-1980s.

Technical comments

The unit of the landings are not stated in tables and figures.

Conclusions

There are no data allowing an assessment of stock trends.

Cod in Division VIa (West of Scotland) (Report Section 3.2)

1) **Assessment type**: update
2) **Assessment**: analytical
3) **Forecast**: TSA-short term
4) **Assessment model**: TSA
5) **Consistency**: This year's assessment is very similar to the results from last year
6) **Stock status**: SSB 5166 t in 2009 is below B_{lim} (14 000 t) and Z-0.2 (0.89) is estimated to be above F_{lim} (0.8) however the Z-0.2 estimate has very large confidence intervals.
7) **Management Plan**: Cod in Division VIa is included in the EU long-term management plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008). The plan and its evaluation by ICES were addressed by WGCSE 2009.

General comments

The WG addressed the ToRs by providing an update with associated management advice.

Some of the Reviewers found the text hard to follow and considered the Report could be better structured.

The assessment was carried out according to the Stock Annex description. The RG could not run the TSA model and could only check the documented inputs which are in accordance with the annex. The results were carried over correctly to the advice sheets.

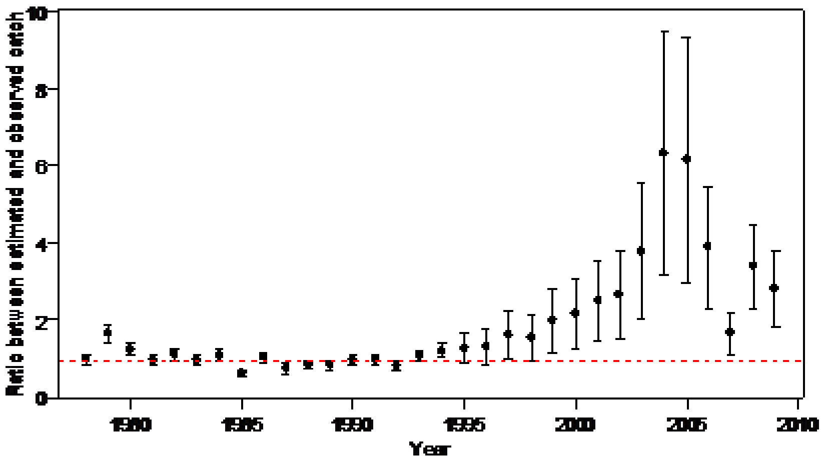
The WG Report and Stock Annex only include ecosystem information in respect to the possible role of seal predation as a source of the unaccounted mortality. Climate effects on cod production are not considered.

The stock is subject to an EU multi-annual management plan. ICES WGCSE (2009) reviewed the plan in relation to west of Scotland cod and could not conclude that it was precautionary.

The WG has not used mixed fishery data in providing management advice.

Discarding/high-grading appears to be a major problem with discard rates in 2009 as high as 82% at age 4. The 2005 year class has been very heavily discarded.

The main issue with this assessment is the exclusion of all fishery (landings and discards) data other than weights-at-age, from 1995 onwards. Effectively the assessment is a survey-based model calibrated against fishery catch-based population estimates pre-1995. The model gives a clear picture of a major decline in abundance at all ages, with a slight upturn in recent years due to improved recruitment of the 2005 and 2008 year classes. The removals predicted from the survey based Z (minus 0.2 for M) drift progressively away from the WG figures for fishery catches until 2004–2005, then the difference starts to reduce (see WG Figure 3.2.16 below).



As the WG has indicated more accurate catch reporting since 2006 under the Buyers and Sellers legislation, an additional TSA run was conducted by WGCSE re-introducing the landings and discards-at-age data for 2006 onwards. This approach is adopted as the final run for VIa haddock this year. This gives qualitatively the same picture of stock trends as given by the baseline model (WG Report Figure 3.2.23), and gives "true" F estimates for recent years close to F_{lim} (0.8); i.e. very similar to the Z-0.2 estimates for the most recent years from the baseline model. The arguments put forward by the WG for not adopting this as the final model (which would be consistent with VIa haddock approach adopted by the WG this year) are firstly that the model estimates of removals are scaled downwards to an extent that they are the same as the WG catch data in the mid-1990s, whereas the WG states there is evidence for inaccurate catch reporting at that time. Secondly, the TSA model as presently configured can only handle discards up to age 2 whereas high-grading across a wider age range is presently occurring. The first of these arguments may be spurious, as the confidence intervals around the model predicted removals in the 1990s are wide and could encompass the likelihood of misreporting. The second problem (discard age range) is more of an issue and would require reconfiguring of the TSA. Nonetheless, the exercise is useful in indicating that recent F could be of the same magnitude as the Z-0.2 from the baseline model.

Technical comments

1) The WG should explain the differences between the official landings figures and the WG estimates. For example in 2009, do the WG figures include non-official estimates from France and corrections for area misreporting (e.g. to Faroes or North Sea as mentioned in WG Report)?

2) Neither the Stock Annex nor the WG Report gives any indication of the sampling effort for estimating discards by fleet/country (other than for 2009 in WG Report). The methods used to raise discards data are only briefly described in the "uncertainties and bias" section of the WG Report.

3) Stock weight and catch weight are the same data. More robust and realistic (for younger ages) stock weights could be obtained from Q1 survey data, for example by modelling age and year effects. Q1 fishery data could be included for fully selected ages.

4) The table provided in the Stock Annex gives the available input data but not the used input data. The WG should revise the annex to clearly state the "update" assessment inputs (e.g. age ranges in surveys).

5) All input data files have a headline saying "with discard" although this is only true for some of the input files.

Advice sheet

In the advice sheets it is stated that"Catch (landings + discards) is seven times the reported landings". This statement is conditional on the assumption that the reported landings (and the international raised discard estimates) are now accurate. More careful wording would be appropriate.

Conclusions

The RG considers the updated TSA assessment to be appropriate for providing management advice for the stock, confirming that SSB is well below B_{lim} and fishing mortality is likely to be well above any F_{MSY} candidates.

The WG has inserted a long and well covered list of future work before the next Benchmark. The RG supports these proposals, but would include the need to view the VIa stock in the context of the western waters metapopulations, and consider the implications of mixing of populations between neighbouring stock areas in VII and in the North Sea (see VIIa cod benchmark proposals).

Haddock in Divisions VIIb–k (Report Section 7.4)

1) **Assessment type**: Update
2) **Assessment**: Indicator of trends only.
3) **Forecast**: Short-term forecast presented, not used in advice sheets due to uncertainties in the data and the estimate of the large 2009 year class
4) **Assessment model**: XSA, tuned with two surveys and two commercial fleets
5) **Consistency**: XSA has been performed with the same settings as before. Updated results up to 2008 are similar to last year's run
6) **Stock status**: The state of the stock is not precisely known due to uncertainties in the discards data and there are no accepted biological reference points. SSB is perceived to be increasing. The stock is highly dependent on the incoming recruits. Between 2002–2008 no strong year classes have been observed, whilst the 2009 year class seems to be the highest on record.
7) **Management Plan**: None

General comments

The WG addressed the ToRs relevant to providing advice through an update assessment.

The assessment was carried out according to the Stock Annex description. The RG found no errors in the implementation of the assessment and forecast, and the assessment results were carried over correctly to the advice sheets. No forecast is given in the advice sheets.

The WG Report and the Stock Annex do not contain any information on ecosystem aspects or environmental drivers.

There is no EU management plan for this stock.

The WG has not used mixed fishery data in providing management advice. The proposed increase in square mesh panels to 120 mm will impact other species such as whiting and all such measures should be viewed in the context of mixed species catches.

The WG has done a good job with the available data. The time-series available for the assessment is short although a longer series of landings data are available. The haddock stock in the neighbouring Irish Sea expanded rapidly in the mid-1990s. It would be of interest if the WG plotted reported haddock landings from VIIb–k over a longer period of years to provide a longer-term picture.

Landings show a marked increase from 2008 to 2009. Recent ICES advice has been for no increase in effort. In general, reported effort statistics show declining effort in the French gadoid fleet (which takes most of the haddock catch) and stable effort in the Irish fleets, so the landings increase represents improved availability of haddock in 2009.

As with other stocks, official French data were not received for 2009 and the WG obtained alternative figures for the assessment (not described). There is also a large discrepancy between Irish official landings data for 2009 and the WG estimates.

The major source of uncertainty in the assessment is the estimates of discards which are based on very small numbers of Irish observer trips, extrapolated to all fleets.

There are also some uncertainties concerning landings data. Discarding appears to be an important feature in the fishery, comprising a large fraction of the catches up to age 3 and including fish above MLS. With this stock and many others in WGCSE, it is disconcerting that after eight years of EU Data Collection Framework requirements to estimate discards (to a given precision level) and transmit the data to ICES WGs, that estimates provided by ICES remain incomplete and of such poor quality, even for heavily discarded species such as haddock that are caught widely in trawl fisheries. The WG should highlight this issue.

Survey data for VIIb–k haddock have variable area coverage but appear to be consistent in tracking year classes, and provide a consistent index showing a potentially very large 2009 year class. The potential of the new Irish Q1 joint science–industry survey to provide additional data on haddock is not mentioned.

Technical comments

1) The data for this stock are patchy and subject to large variability. The RG agrees with the advice from last year's RG that the data for VIIb–k haddock are more suitable for inclusion in a statistical modelling framework in which the nature and magnitude of the errors in the different datasets are accounted for, and the bias and variance in the population estimates can be properly evaluated. This should be explored before any future benchmark.

2) The WG has not included F and N at-age tables from the assessment, and does not provide a graphical comparison with last year's assessment.

3) The WG has declined to put forward any candidate F_{MSY} values due to concerns that the stock–recruit relationship is not well captured. It is clear that the Ricker model would not be a robust choice. However, the range of B&H and hockey stick F_{MSY} and yield-per-recruit $F_{0.1}$, $F_{35\%}$ and F_{MAX} values for landings are within the range 0.18–0.26.

4) The Stock Annex refers to the use of ALKs derived from all years combined, to estimate age compositions for young haddock where no age data have been collected. Unless it is for the very youngest age classes with effectively no significant overlap in length-at-age, this will smooth out year-class signals.

5) In Summary Table 7.4.9, it would be useful to give the F(2–5) separated by landings and discards.

Conclusions

The WG has taken note of earlier recommendations from RG and made a good compilation of the needed steps to perform before making a benchmark assessment. Particular progress is needed on obtaining and making best use of available discards data, and evaluating the quality of such data using the ICES Quality Assurance Framework.

The RG agrees that the WG assessment is suitable for indicating general trends but not for providing forecasts. However, the forecast has a useful exploratory role, given the possibility of a very large 2009 year class entering the fishery. Given a scenario that this is true, the weight discarded would increase from around 7–9 thousand tonnes (± some unknown but very large standard error) to over 20 thousand tonnes in 2010 and 2011. A key question is where in the Celtic Seas this abundance of small haddock will be located, and hence where would measures to avoid discarding be best targeted. The WG should monitor the distribution of these fish through surveys and observer data and provide managers with this information.

Haddock in Division VIIa (Irish Sea) (Report Section 6.3)

1) **Assessment type**: update
2) **Assessment**: survey trends
3) **Forecast**: none
4) **Assessment model**: Single fleet SURBA analysis, using only the NIGFS-Mar survey
5) **Consistency**: Updated survey trends are very consistent with last year's assessment.
6) **Stock status**: uncertain. SSB has decrease since 2008. Recruitment in the last year appears to be above average. Total mortality appears relatively stable.
7) **Management Plan**: There is no specific management plan for haddock in the Irish Sea. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod management plan (Council Regulation (EC) 1342/2008).

General comment

The assessment was carried out according to the Stock Annex description and the WG addressed the ToRs. The RG found no errors in the assessment.

Mixed fishery data are not used when formulating management advice by the WG. The Advice Sheet notes that discarding of small haddock is substantial in the *Nephrops* fisheries and recommends the use of 120 mm square mesh panels.

The WGCSE was unable to provide absolute values for F_{msy} or F_{msy} proxies, as there are insufficient data to derive absolute estimates of F_{msy} with any degree of precision.

The method used by the WG to estimate stock weights based on survey data could be further developed and applied to other stocks with good survey data but noisy stock weights from fishery sampling at older ages.

The survey data show very coherent year-class signals and appear to give a very clear picture of the development of the stock.

Technical comments

1) The WG states that sample-based evidence suggests that WG estimates are close to reported landings since 2006. This could be made more explicit in the landings tables (e.g. a statement such as "since 2006, officially reported landings are used by the WG as sample-based evidence confirms more accurate catch reporting since 2006").
2) The WG should make it clear in the Table 6.33 and 6.34 headings that it is landings-at-age, not catch-at-age.
3) In Table 6.3.4 weights in 2003 are not present; however they are found in the input data for that year. The derivation of the figures in the input file should be explained.
4) The WG shows the results of Annual Egg Production Survey estimates of haddock SSB as relative trends confirming the trends in the March GFS between 2006 and 2008 but does not cite the absolute estimates (6 kt [CV 32%] in 2006 and 9.5kt [CV 24%] in 2008). These are very large compared to the WG landings of 650–870 t for these years, even if the discarding-at-

age 2 was taken into account. This would imply a much lower mortality than given by the age profile in the groundfish surveys (which indicate Z of around 1.5). However there is no evidence from any fishery data for an age composition that would reflect low mortality.

5) The main problem with the historical yield-per-recruit analysis is the absence of discard fishing mortality.

Advice sheet

The advice sheet was only partially completed the time of review. The correct plots were carried over from the WG Report.

Conclusions

The RG considers the updated survey-based analysis to provide an appropriate basis for formulating management advice based on relative abundance trends. The different surveys provide a consistent picture of the stock development. The SSB indices appear to respond dynamically to the very variable recruitment, as would be expected given the steep age profile in the surveys. Stock trends indicate an increase in SSB over the time-series followed by a decrease since 2008 due to some below-average year classes. Recruitment in the last year appears to be above average which is expected to halt the decline in SSB. The index of total mortality appears relatively stable.

The state of the stock with regard to reference points is uncertain as there are no biological reference points calculated, and the fishing mortality cannot be estimated directly from the surveys without independent knowledge of the survey selectivity characteristics across the age classes.

Discarding of haddock can be substantial, and the WG should have a priority to derive appropriately raised and quality-assured discards-at-age estimates, following the guidelines in the ICES Workshop on Discard Raising Procedures (which can be implemented through COST tools) and evaluating precision and bias. The present tabulation of historical discards data (Table 6.3.5) is unwieldy and does not give a clear picture of the trends in discarding.

Given the availability of data other than those used in the survey assessment (other survey data; egg production estimates; discards data) there is an urgent need for a data compilation workshop and benchmark assessment for this stock to establish a more comprehensive evidence base and a robust quantitative procedure for developing management advice. Benchmarking alongside the VIIe–k stock would be beneficial.

Haddock in Division VIb (Rockall) (Report Section 4.3)

1) **Assessment type**: Update
2) **Assessment**: analytical
3) **Forecast**: Short-term forecast provided
4) **Assessment model**: XSA
5) **Consistency**: Updated assessment results in 60% upward revision of 2008 F and a small downward revision of SSB. Assessment does not exhibit retrospective bias but appears to be unstable due to weak shrinkage used with noisy data. The survey-series has been revised since last year.
6) **Stock status**: SSB is currently well above B_{pa} and F is below F_{pa} and close to F giving long-term equilibrium yield.
7) **Management Plan**: None

General comments

The WGCSE addressed the ToRs in providing an updated assessment with associated management advice.

The assessment was carried out according to the Stock Annex description. However the method for deriving the abundance indices for the Rockall survey was altered in 2009 to exclude sporadically sampled strata, resulting in a new tuning file. This appears to have been done by the stock assessor rather than the lab that conducts the survey, and may not be adequately quality-assured. This results in some substantial revision (e.g. halving of the indices in 1992 and 2006) but there is almost no discernible difference to SSB, F and recruitment trends using the two series for an assessment using data up to 2008. The addition of 2009 data however causes the assessment with the "old" survey data file to fail (no convergence) and the new survey data to give a large residual and implausibly low F at age 5 in 2009. During the Advice Drafting Group it also came to light that the Scottish survey data for 2008 had been reworked by the assessor using Russian ALKs, which may further have degraded the consistency of the series. See Technical Comment 2 below.

The RG found no obvious errors in the implementation of the assessment and forecast (although the RG has concerns about the model settings and re-worked survey-series). No RCT3 input and output tables were provided so these could not be checked. The results were carried over correctly to the advice sheets apart from two errors in the forecast table headers that ICES has been advised of.

Ecosystem aspects: The Stock Annex describes closures on Rockall to protect vulnerable habitats. In order to protect cold-water corals, three areas (North West Rockall, Logachev Mounds and West Rockall Mounds) are closed since January 2007. A new area to protect cold-water corals (Empress of British Banks) was established by the NEAFC in 2007. These are in addition to the Rockall Haddock Box to protect pre-recruits that has been in place since 2002.

There is no EU management plan in place for this stock.

The WG has not used mixed fishery data in providing management advice. The Stock Annex and WG Report do not provide information to evaluate bycatches in the directed haddock fishery.

A major signal in the fishery data is the very sharp reduction in Russian landings of haddock from around 5000 t in 2004–2005 to only 55 t in 2009. UK landings declined in the mid-2000s but have subsequently increased again.

Substantial discarding occurs in the EU fisheries but has only been directly estimated in a few years. For other years, the WG conducts a convoluted process to infer discards from the Scottish survey length frequencies together with theoretical selection parameters and a discarding ogive, tuned using data from the few historical years with observer data. It remains unclear if these estimates are robust over the full time-series since there appears to have been no observer data since 2001 other than a few trips sampled by Ireland in 2007–2009. The WG has not used the latter data to check their consistency with the imputed values. Improved sampling of discards is needed. The WG recommends the need for technical measures to reduce discarding.

Technical comments

1) Table 4.3.14 highlights 1995, 1997, 1999 and 2001 as years with discards estimates calculated directly from observer trips. The Stock Annex also mentions 1998 and 2000 as years with Irish discards estimates (both are years with no survey). Why were these data not used for estimating discards?

2) The large negative catchability residual at age 5 using the new survey data series updated to 2009 may originate from the unusually low survey indices for age 5 in 2009. An unusually low 6-gp index is also apparent in 2009 and may be related to generation of a large positive Q residual for age 5 in 2008. A possible problem could be the dominance of 4-year olds in the survey (2005 year class) which could lead to a tendency to allocate 5-year old haddock as 4-year olds where the ageing is not clear, simply because of the large number of 4-year-olds in the samples. Anomalously low F is generated at age 5 in 2009 and age 4 in 2008 in the final XSA. This age group has a slope of 2.33 (but low R-square). A large F is induced at age 6 in 2009, age 5 in 2008 and age 4 in 2007 (an apparently weak year class). These impact the F_{bar} 2–5 estimates for 2008 and 2009, which are relatively low. The WG should firstly check the accuracy of the survey index values at ages 5 and 6 in 2009 in the input files, and if these are correct, consider how to deal with the tuning problem to smooth the F's in the terminal year. The assessment is clearly unstable (no convergence was possible with the "old" survey series updated to 2009). Given the noise in the data, stronger shrinkage would be beneficial although this may generate retrospective bias in periods of rapid change in F and stock size. The use of the power model for several age classes also increases the number of parameters to be estimated. During the ADG, the XSA was re-run with the original Scottish survey-series (excluding the changes made to the 2008 and 2009 data), and with stronger shrinkage. This also did not converge rapidly, but provided more coherent catchability residuals. The revised assessment will be included in the WGCSE Report.

3) The RCT3 input and output tables are missing and should be provided.

4) The F_{MSY} output table for the different stock–recruit options is not given in the WG Report.

5) The RG could not evaluate the significance of the results of the StatCam model, or interpret the differences with the XSA, as the method is not explained anywhere.

Advice sheets

Short-term forecast table: header says 2010 landings are 3.3 kt. Value should be 3.9 kt (forecast needs updating following ADG re-run of assessment). *Status quo* F is stated as F(06–08) when it should be F(07–09). ICES was advised of the errors.

Conclusions

The RG is prepared to accept the Advice Drafting Group re-run of the WG final assessment as a basis for providing management advice but is concerned about the instability in the assessment due to noisy data, and the potential errors in the discards data due to the method of calculation from survey data. The forecasted landings at *status quo* F are in line with recent reported landings levels.

The very low 0-gp survey indices for 2008 and 2009 indicate extremely weak year classes, given the generally good correlation between 0-gp indices and the XSA 1-gp estimates for these year classes. These are reflected in the short-term and medium-term forecasts which indicate a sharp decline in SSB over the next few years, possibly heading for another trough in the SSB series as observed in the late 1990s and early 2000s.

Haddock in Division VIa (West of Scotland) (Report Section 3.3)

1) **Assessment type**: Update
2) **Assessment**: Analytical
3) **Forecast**: Short term
4) **Assessment model**: TSA, tuned with two surveys
5) **Consistency**: The current assessment method has been in use since 2006 and is considered consistent. However a major change is introduced this year in incorporating recent landings and discards-at-age into the TSA. The assessment is therefore no longer a simple update. The retrospective bias for SSB, R or F has decreased in the last years, but is considerable e.g. in the period 1995–2005 particularly in estimating F and SSB.
6) **Stock status**: ICES classifies the stock as being at risk of reduced reproductive capacity. The stock is below B_{pa} since 2005 F has decreased in the same time period without any positive response on SSB and is now estimated to be below F_{pa}. No strong year classes have been recorded since 2000. There is poor relationship between SSB and R.
7) **Management Plan**: There is a proposed management plan and it is evaluated by ICES as precautionary

General comments

The WG addressed the ToRs in providing an update assessment with associated management advice although has altered the basis of the assessment this year from the procedure used last year.

The TSA modeling approach was carried out according to the Stock Annex description, although the input data were altered this year to include fishery data for 2006–2009. The RG could not run the TSA and was only able to check the model settings. The data files were not available on the SharePoint.

Ecosystem consideration is not discussed in the Report or Stock Annex (which only includes some basic haddock biology under the heading "Ecosystem aspects").

The proposed management plan has been evaluated by ICES and *"ICES advises that a harvest rule with a target fishing mortality of 0.3 and a TAC constraint of ±15% is consistent with the precautionary approach."*

The WG provides some indication that haddock is taken in mixed fisheries but does not use mixed fishery data in providing advice in support of management.

Two versions of the Report were available on the SharePoint site, one including the assessment results with the 2006–2009 fishery data incorporated, and the other with the data excluded. As the results from the former appear in the draft advice sheets, this version of the Report has been reviewed.

Catch data is only considered reliable in the periods 1978–1994 and 2006–2009. This is a change compared to last year where catch data after 1994 were not used. In the VIa cod assessment the 2006–2009 catch data is not incorporated even though the same arguments are put forward that the accuracy of fishery data have improved since 2006 due to Buyers and Sellers legislation. Discard estimates probably have derived from the same trips. The main argument put forward by the WG for not adopting the same procedure for both cod and haddock is that the cod assessment only handles discards up to age 2 (high-grading is occurring recently) and that predation by seals is likely to be a source of significant unaccounted mortality.

Given the major change in the assessment procedure, the WG has not provided a detailed comparison of the trends (and error ranges) for the assessments with and without the 2006–2009 data to give a clearer picture of how the advice has changed due to the new approach. The only comparison in the report is the point estimates for 2008–2009. It is important that the benefits of having more accurate catch data are clearly demonstrated. Some "unallocated" removals remain for the 2006–2009 period, and have to be removed from the catch forecast.

The SSB estimates from years assessment were SSB (2008)=30 436 t just above B_{pa}, and SSB (2009)=20 271 t less than B_{lim}. This year's assessment shifts the estimate down for SSB (2008) to 22 114 t, that is around B_{lim} and SSB (2009)=16 818 t (the lowest value on record). The estimate for 2010 SSB=13 336 indicates a steady decline of the stock. The changes between this and last year's assessment is not visible in the retrospective analysis due to the change in data inputs this year.

Technical comments

1) Discard-at-ages 9–15+ is absent for the whole time period and need not be separately presented in the Table 3.3.4

2) The WG has replaced the mean weight-at-age 1 in the Irish landings in 2009 by an average value. It is quite possible that only a few fish were recorded at this age in the landing samples and they were at the upper end of the length-at-age distribution. Unless an error is suspected (in which case the data should be reviewed) there is no justification for over-writing mean weights-at-age in national raised data as this will result in an inconsistency between numbers and weights.

3) The WG should clarify if down-weighting of individual data points described in the WG Report were the same as in previous assessments; e.g. ScoGFS Q4 2007 (age 2): was this also down-weighted similarly last year, or has the down-weighting been adjusted according to residuals apparent in the updated assessment?

4) If there is no apparent stock–recruit relationship, why is recruitment modeled using a Ricker function in TSA, or is the assessment relatively insensitive to this? The MSY section states that there is no ability to distinguish between Ricker, B–H and hockey stick.

5) There is no MSY output Table 3.3.18 in the WG Report, therefore the estimates can only be evaluated from the plots. The F_{MSY} estimates have poor precision yet the WG provides estimates the estimates in the text as if they are endorsed. The upper limit of these is put in the advice sheets. This is inconsistent with other stocks with poorly fitting stock–recruit curves where the WG is not prepared to accept the F_{MSY} estimates.

6) The WG states that the short-term forecast is done using MFDP whereas it appears to be the Marine Lab software.

Advice sheet

1) The advice sheet was only partially completed at the time of review and had no forecast outputs other than the table header, no YPR figures and no plots for the updated assessment.

2) The draft forecast table had incorrect headers: total removals in 2010 given as 8340 t; correct value is 5350 t. ICES was advised.

3) The advice sheet shows only the upper limit of the F_{MSY} values given in the Report. This is from the smoothed hockey stick model.

Conclusions

The RG considers the updated assessment with 2006–2009 catch data included provides a better basis for providing management advice than the previous approach excluding all recent fishery data, although some unallocated removals estimates remain. It addresses possible concerns by industry that more accurate catch reporting in recent years is not reflected in the assessment. However, as noted by the WG, the assessment requires benchmarking to validate the approach and explore other assessment approaches and other not included at present.

The RG aggrees with the WG that on the basis of the revised assessment, the stock currently has reduced reproductive capacity (SSB < B_{lim}). However according to the F_{pa}=0.5 the stock is harvested sustainably. The short-term forecast indicates that the SSB will not rebuild to B_{pa} in 2012 even in the absence of fishing.

The suggested F_{MSY} range of 0.19–0.35 seems appropriate for a haddock stock (e.g. with reference to North Sea haddock), but the arguments for accepting these and rejecting F_{msy} estimates from equally badly fitting stock–recruit curves for other stocks is inconsistent.

The RG acknowledges the WG statement of a need for a long-term management plan that takes into account the recruitment characteristics of the stock.

Benchmark suggestions

1) Weight-at-age in stock is derived from weight-at-age in catch "in the absence of a sufficiently long time-series of survey-based weight measurements;" however, 25 years seems to be a sufficient long time-series, and stock weights that include data from Q-1 surveys could be incorporated in the next Benchmark.

2) There appear to be linkages with the North Sea stock. Any benchmark assessment of North Sea haddock and VIa haddock should be done in the same meeting to allow these connections and their effect on the assessments to be explored.

Megrim (*Lepidorhombus* spp) in Subarea VI (West of Scotland and Rockall) and Subarea IV (North Sea) (Report Section 5.3)

1) **Assessment type**: trends
2) **Assessment**: There is no accepted analytical assessment for this stock
3) **Forecast**: not presented
4) **Assessment model**: cpue trends
5) **Consistency**:
6) **Stock status**: unknown
7) **Management Plan**: Category 6-stock no management plan

General comments

ICES has not conducted an analytical assessment of this stock since 1999. The assessment area has this year increased and includes now also Area IV and IIa. The commercial effort has in recent years decreased in Area VIa, however for 2009 only Irish effort data is available.

Only 53% of the overall TAC was used. No landings data were made available to the WG by Spain or France therefore the uptake during 2009 will be higher than indicated by the official figures. Historically, France only utilizes ~10% of its available quota, Spanish uptake has been ~80%.

The survey and fishery catch rates presented in the Report suggest an increase in abundance of megrim around Scotland since the mid-2000s. The Irish lpue data from VIb does not show an increase. There is therefore consistent evidence that megrim populations in VIa and IV are at least stable, and probably increasing, but the picture for VIb is less clear.

Technical comments

1) Section 5.3.2 Discards data are stated as only available from Ireland, and only three trips were sampled. The year of sampling is not mentioned but is presumed to be 2009 as last year's WG Report indicated nine Irish trips were sampled. Additional information is given from Laurenson and McDonald (2008) but the fleet sampled is not referred to. Sampling and provision of data to the WG will need to be adequate to demonstrate if discard rates decline as expected from the selection curves given in the WG Report, following the increase to 120 mm mesh.
2) Section 5.3.2 surveys: The WG Report states that the ratio of 2007–2009 biomass indices to 2003–2006 is 28 and 53% for ICES Area VI and IV (partial coverage) respectively. According to Table 5.3.4 the biomass increase for VIa is 28% and the increase for IV is 23%, not 53%.

Conclusions

The RG considers that the survey and fishery lpue data for VIa and the northern North Sea are consistent with the stock being at least stable and probably increasing since the mid-2000s. This may reflect the large decline in fishing effort. However the population dynamics underlying the trends (recruitment and F) are not known.

The aim is to benchmark VI and IV megrim in 2010/2011. Area misreporting was not taken into account this year, however as data from 1996 and 1997 indicate misreporting in the area of 50% of estimated landings for Division VIa this should be taken account for in the Benchmark. Exploring other models e.g. SURBA, Catch-Survey Analysis (CSA), etc would be interesting in a benchmarking.

The RG agrees that the Benchmark for megrim should include all the megrim stocks covered by WGCSE and WGHMM.

Nephrops in Division VIa (FU 11 North Minch) (Report Section 3.5)

1) **Assessment type**: Update

2) **Assessment**: Fishery trends and absolute abundance estimates from UWTV survey .

3) **Forecast**: short-term prediction of landings for 2010 at various harvest ratios using catch option table developed during the Benchmark.

4) **Assessment model**: Assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG (WK*NEPH*, 2009).

5) **Consistency**: Methods are the same as last year plus attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES.

6) **Stock status**: The UWTV series indicates that abundance has declined from the high estimates in 2003–2006 to around the same values in 2000–2002. The current harvest ratio is above the F_{msy} proxy. The length–frequency distribution, mean size and mean weight of *Nephrops* have all been stable for the time-series. Since current harvest rate is above the F_{msy} proxy, the transition scheme towards the ICES MSY framework applies.

7) **Management Plan**: There is no management plan for this stock.

General comments

The assessment was carried out according to the Stock Annex description and the WG addressed the ToRs. Errors were found in two key tables of historical weights and harvest ratios (see technical comment 2) but the catch forecasts appear to have used the correct values.

The RG was not able to run the mentioned "Bell/Dobby combined sex–length cohort analysis (LCA) model". So, the calculation of the F_{msy} proxy candidates could not be reviewed.

This year's assessment is performed using combined length compositions from trawl and (new) creels. The WG considers the incorporation of creel length compositions has improved the estimates of harvest ratios. However the effect on F_{msy} estimates and catch forecasts of including these data is not explored.

Length compositions and mean weights have been relatively stable over time.

Discards are included in the assessment and forecast. The WG states that discards are sampled adequately for the fishery, although no statistics are provided to indicate bias and precision.

Technical comments

1) In the WG Report Section 3.5 it reads "*The stock is being exploited unsustainably*" the same section also quotes ICES advice for the same year "*The current fishery appears sustainable*".

2) Table 3.5.9 (mean weights in landings, FU11–13) and Table 3.5.10 appear to be wrong. The mean weights (07–09) do not conform to the values used in the catch forecasts. The harvest ratios in Table 3.5.10 appear to be landings numbers (not total catch numbers) divided by adjusted survey numbers and are different from the values plotted in the advice sheets. This was

checked at the ADG and both the harvest ratios and the discard rates appear to be incorrect for FU11. Corrected Tables 3.5.9 and 3.5.10 need to be inserted. Table 3.5.10 should in any case be replaced with a table similar to Table 6.5.7 in the FU15 report, laying out all the key variables.

3) In Section 3.5.7 the text reads; "Table 3.5.10 also shows the estimated harvest ratios over this period. These range from 7–32%." But they range from 13% to 34%. The 7% is a discard rate. This text is incorrect anyway as the Table has the wrong harvest ratios.

4) Sampling levels for discards are given, but no discards estimates are provided other than discard rates.

5) Legend for Table 3.5.8 should indicate the burrow counts are not bias-adjusted.

6) The "Conclusions of the Review of the 2009 assessment" cited in the 2010 Report are not the ones for FU11 but the ones for FU13 (Clyde).

7) The WG presented some ecosystem aspects in Section 3.5.1 and referred to further information in the Annex, although this section is empty in the Annex.

8) The WG states that the UWTV bias factors include expert judgment, but there is no knowledge of the precision of this, or of the constancy of the bias factors (e.g. edge effects) when burrow density is changing. This needs further investigation.

9) As with other *Nephrops* stocks, more accurate catch reporting since the introduction of Buyers and Sellers legislation has resulted in an apparent increase in landings and lpue which causes misleading trends plots (Figure 3.5.4). This should be clearly indicated on the figure legends.

Conclusions

The RG considers the Underwater Television Survey (UWTV) and associated catch options to be an appropriate basis for management advice.

The RG agrees with the WG that management of this stock should be applied at a local FU level rather than at the ICES Division level.

The RG agrees with the WG that $F_{35\%spr}$ (combined between sexes) is consistent with the approach adopted by the WGCSE for choosing F_{msy} proxies for *Nephrops*.

If ICES is to use UWTV abundance estimates as absolute, then biases due to incomplete coverage of *Nephrops* habitat need to be evaluated. The RG agrees that the relationship between fishing area (VMS) and survey area need further exploration.

Nephrops in Division VIa (FU 12 South Minch) (Report Section 3.6)

1) **Assessment type**: Update
2) **Assessment**: Fishery trends, and UWTV survey estimates
3) **Forecast**: Short-term prediction of landings for 2010 at various harvest ratios using catch option table developed during the Benchmark
4) **Assessment model**: Assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG (WK*NEPH*, 2009).
5) **Consistency**: Methods are the same as last year plus attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES.
6) **Stock status**: The UWTV series indicates that abundance has declined from the high estimates in the early 2000s to around the same values in the late 1990s. The harvest ratio in 2009 was close to the $F_{35\%spr}$ F_{msy} proxy. The length–frequency distribution and mean size of *Nephrops* have all been stable for the time-series.
7) **Management Plan**: None

General comments

The assessment and provision of advice in 2010 followed the process defined by the Benchmark WG and the WG fulfilled the ToRs.

At the time of initial reviewing the advice sheet was not completed.

Ecosystem consideration is briefly described in the WG Report and refers to more information in Stock Annex, where this section is empty.

The RG was not able to run the mentioned "Bell/Dobby combined sex–length cohort analysis (LCA) model", so the calculation of the F_{MSY} proxy candidates could not be reviewed.

This year's assessment is performed using combined length compositions from trawl and (new) creels. The WG considers the incorporation of creel length compositions has improved the estimates of harvest ratios. However the effect on F_{msy} estimates and catch forecasts of including these data is not explored.

Length compositions and mean weights have been relatively stable over time.

Estimates of discard rates are included in the assessment.

The WG gives a good overview of the MSY work done and clear view of the preferred F_{msy}.

The technical aspects and general fishery information is well described in the Stock Annex.

Technical comments

1) The catch forecast table in Section 3.6.8 gives the wrong mean weight in the landings. This is given as 21.3 g whereas the value used in the forecast is 23.8 g. Figure 21.3 links to the incorrect Table 3.5.9 in the FU11 Report.
2) The RG recommends replacing Table 3.6.5 with a table similar to Table 6.5.7 in the FU15 Report, laying out all the key variables.

3) The discard rates in Table 3.6.5 (if correct) indicate that the 16.7% rate used in the forecast could be slightly below recent averages.

4) No discards estimates are provided; just discard rates.

5) Legend for Table 3.6.4 should indicate the burrow counts are not bias-adjusted.

6) The WG states that the UWTV bias factors include expert judgment, but there is no knowledge of the precision of this, or of the constancy of the bias factors (e.g. edge effects) when burrow density is changing. This needs further investigation.

7) As with other *Nephrops* stocks, more accurate catch reporting since the introduction of Buyers and Sellers legislation has resulted in an apparent increase in landings and lpue which causes misleading trends plots (Figures 3.6.1 and 3.6.2). This should be clearly indicated on the figure legends.

Conclusions

The RG considers the Underwater Television Survey (UWTV) and associated catch options to be an appropriate basis for management advice.

The RG agrees with the WG that management of this stock should be applied at a local FU level rather than at the ICES Division level.

The RG agrees that $F_{35\%spr}$ (combined between sexes) is consistent with the approach adopted by WGCSE for choosing F_{msy} proxies for *Nephrops*.

If ICES is to use UWTV abundance estimates as absolute, then biases due to incomplete coverage of *Nephrops* habitat need to be evaluated. The RG agrees that the relationship between fishing area (VMS) and survey area need further exploration.

An improvement suggested by WG and endorsed by RG is improving the coverage and timing of the UWTV survey and correlating it with VMS data for best adjustment to the harvest area.

Nephrops in Division VIa (FU 13 Firth of Clyde) (Report Section 3.7)

1) **Assessment type**: update
2) **Assessment**: Fishery lpue trends and UWTV survey estimates
3) **Forecast**: Short-term prediction of landings for 2010 at various harvest ratios using catch option table developed during the Benchmark.
4) **Assessment model**: Assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG (WK*NEPH*, 2009).
5) *Consistency*: Methods are the same as last year plus attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES.
6) **Stock status**: As with the other VIa FUs. The UWTV series indicate that abundance has declined over the last three years, in this case following a progressive increase from low values in the mid 1990s. Recent harvest ratios are above the $F_{35\%spr}$ F_{msy} proxy. The length–frequency distribution and mean size of *Nephrops* have all been stable for the time-series. The Sound of Jura Subarea appears to have very low harvest ratios.
7) **Management Plan**: none.

General comments

The assessment and provision of advice in 2010 followed the process defined by the Benchmark WG and the WG fulfilled the ToRs.

For the first time an attempt is also made to use the UWTV data available for the Sound of Jura Subarea. Although the dataseries is incomplete it indicates a lower burrow density and lower harvest ratios than in the Clyde.

As with other *Nephrops* stocks, more accurate catch reporting since the introduction of Buyers and Sellers legislation has resulted in an apparent increase in landings and lpue which causes misleading trends plots (Figure 3.7.1 and 3.7.2). This should be clearly indicated on the figure legends.

The length composition indicators (>35 mm) are relatively stable over time. A good upcoming recruitment may be indicated as the means size of females (<35 mm) in the catches are at the lowest observed boundaries since two years.

Estimates of discard rates are included in the assessment.

Technical comments

1) The combination of a sharp dip in burrow count and increased landings in 2007 gives a very large harvest ratio (~0.5) yet the burrow count the following year increases to a value more in keeping with the general trend. This would be unexpected if such a large fraction of the stock had been caught, unless the burrow density is heavily driven by new recruits.
2) The RG recommends replacing Table 3.7.8 with a table similar to Table 6.5.7 in the FU15 Report, laying out all the key variables.
3) The discard rate adjusted to account for some survival was estimated at the Benchmark Workshop to be 18.6% (taking a three year average 2005–2007) and according to the agreed benchmark protocol this value is used in the provision of landings options for 2011. However the discard rate in 2009 was 39% and the time-series average is 31%. The landings forecast is

therefore likely to be overoptimistic. The WK*NEPH* 2009 Report suggests keeping the discard rate in forecasts at the value estimated by WK*NEPH*. However, the mean value of 18.6% for 2005–2007 is very different from the mean for those years in Table 3.7.8 (~33%). This was raised at the ADG but not adequately resolved.

4) In Section 3.7.7, first paragraph, the F_{msy} harvest ratio for the Clyde is given as 13% whereas the stated forecast landings of 3558 t is for the proposed F_{max} ratio of 16.5%.

5) The WG states that the effort and lpue are not reported due to the problem with a discontinuity around 1995, however the data are presented in Figure 3.7.2. It would be useful to have a consistent effort series. The WG should indicate clearly on the plot legends that the landings and lpue data from ~2006 onwards are likely to have increased due to more accurate catch reporting.

Conclusions

The RG considers the Underwater Television Survey (UWTV) and associated catch options to be an appropriate basis for management advice, but is concerned about the possible overestimate of landings in the forecast due to the use of a discard rate well below the recent average.

The RG agrees with the WG that management of this stock should be applied at a local FU level rather than at the ICES Division level.

The RG agrees that F_{max} (harvest ratio 16.5% combined between sexes) is consistent with the approach adopted by WGCSE for choosing F_{msy} proxies for *Nephrops*. This is predicted to deliver an $F_{35\%spr}$ of about 20% for males. The use of the low UWTV estimates from the mid-1990s to give a $B_{trigger}$ of 579 million individuals is appropriate as a first estimate but has no basis other than being a low point in a relatively short-time series.

The WG was not able to conduct a yield-per-recruit for the Sound of Jura population and has adopted the Clyde F_{MSY} calculations as an interim approach (combined sex $F_{35\%SpR}$ HR of 13%, based on low burrow density). The RG notes that the discard rates appear to be negligible which means that the F_{MSY} estimates for the Clyde (where an 18.6% discard rate was adopted) may have an additional bias. The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance) has not been defined but is expected to be below 200 million individuals. RG agrees on this provisional figure as the approach is consistent with the other VIa FUs.

Nephrops in Division VIIa (FU 14 Irish Sea East) (Report Section 6.4)

1) **Assessment type**: Update
2) **Assessment**: Fishery lpue trends and UWTV survey estimates
3) **Assessment**: Forecast: presented
4) **Assessment model**: Assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WG (WK*NEPH*, 2009).
5) **Consistency**: New approach and advice based on UWTV survey
6) **Stock status**: provisional estimate
7) **Management Plan**: None.

General comments

The assessment and provision of advice in 2010 followed the process defined by the Benchmark WG and the WG fulfilled the ToRs.

The assessment determines the health of the stock by looking at trends in total landings, lpue, size composition, and biological data from the commercial fisheries. For the first time for this stock the results from UWTV survey data were used to calculate provisionally absolute abundance estimates for 2009.

Presentation was clear with respect to updated data tables and figures.

The RG was not able to run the mentioned "Bell/Dobby combined sex–length cohort analysis (LCA) model". So, the calculation of the F_{MSY} proxy candidates could not be reviewed.

Technical comments

1) As with other *Nephrops* stocks, more accurate catch reporting since the introduction of Buyers and Sellers legislation has resulted in an apparent increase in landings and lpue which causes misleading trends plots (Figure 6.4.1–6.4.3) This should be clearly indicated on the figure legends.
2) The RG recommends including a table similar to Table 6.5.7 in the FU15 Report, laying out all the key variables.
3) The WG does not provide any discard estimates other than what can be inferred from Figure 6.44, and should provide a table. It is not possible to evaluate the quality of the data from what has been presented, and it is noted that the discard sample rates in 2009 indicate a substantial decline in sampling in 2009. With no knowledge of the variance of the discards estimates, the significance of the apparent very sharp drop in discarding in 2009 cannot be evaluated.
4) The forecast table in Section 6.4.5 gives total numbers caught under the header "retained number."

Conclusions

The RG agrees that the UWTV survey and associated F_{MSY} values represent an appropriate means of providing quantitative management advice, but notes the short time-series and the absence of stock-specific growth rates which are inferred from FU15.

The indications of a recent decline in recruitment should be revisited in 2011 and if the 2010 UWTV is successful there opens the opportunity to assess this stock more reliably on an annual basis.

RG also again agrees with WG that TAC allocations should be made at an FU level instead of a single TAC for the entire Area VII in order to prevent localized overfishing.

Nephrops in Division VIIa (Irish Sea West) (Report Section 6.5)

1) **Assessment type**: Update
2) **Assessment**: Fishery lpue trends and UWTV survey estimates
3) **Forecast**: Landing predictions for 2011 presented
4) **Assessment model**: Assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WK (WK*NEPH*, 2009).
5) **Consistency**: Methods are the same as last year plus attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES.
6) **Stock status**: The UWTV survey together with trawl survey data gives the impression of a constant high abundance over the time-series. Reported landings have been stable around 9000 tonnes without a negative impact on the stock.
7) **Management Plan**: None.

General comments

The assessment was carried out according to the Stock Annex description and the WG addressed the ToRs. The RG found no errors in the assessment.

The RG was not able to run the mentioned "Bell/Dobby combined sex–length cohort analysis (LCA) model". So, the calculation of the F_{MSY} proxy candidates could not be reviewed.

The fishery is well described in WG and Stock Annex. Mixed fisheries data are not used in providing management advice. Discards estimates are included in the assessment but not tabulated in the Report as weights or numbers, only as proportions.

The WG Report is succinct but could be structured more clearly. The WG should establish what types of information should go into different sections. For example the Section "Historical stock development" is more about the UWTV survey design and biases than about historical stock development. Ecosystem considerations are not described in the appropriate section in the WG Report, but information occurs in other sections including in the MSY explorations.

There is no management plan for this stock but the fishery is affected by measures implemented for cod. The cod closure affects the distribution of fishing to some extent, and the types of gears used (e.g. Swedish grids being used by some vessels). The effort control regime has also influenced the switching of effort into the *Nephrops* fishery.

Technical comments

1) Table 6.5.6: the header does not make it clear if the 10% survival of discards is included in the figures in the table or applied afterwards. The figure of 20% for 2008 appears low compared to surrounding values; the WG should provide information on discard sampling rates for the different fleets, and ideally precision and bias evaluations, considering the sensitivity of the landings forecasts to assumed discard rates.
2) As with other *Nephrops* stocks, more accurate catch reporting since the introduction of Buyers and Sellers legislation has resulted in an apparent in-

crease in landings and lpue which causes misleading trends plots (Figure 6.5.1) This should be clearly indicated on the figure legends.

3) The scaling of the UWTV estimates vs. the Trawl survey (Figure 6.5.5) is heavily influenced by the 2003 and 2004 trawl estimates which look like possible year effects in the survey. If the two series were rescaled so that the UWTV and trawl survey data for 2005 onwards lie on top of each other, the 2003 and 2004 UWTV figures would probably be more in accordance with the trawl data up to 2002. This would bring the UWTV estimates closer to a re-calculated $B_{trigger}$ level. The WG should evaluate the 2003 and 2004 trawl survey data to see if there is an explanation for the high values. The high values in 2003 and 2004 are not apparent in the April survey (Figure 6.5.2).

4) The WG should provide the time-series of fishery landings–discards length compositions given for other FUs in VIa and VII, to allow a more direct comparison.

Conclusions

The RG agrees that the UWTV survey and associated F_{MSY} values represent an appropriate means of providing quantitative management advice. However there are concerns about the inclusion of a very low discard rate estimate for 2008 in a 2-year-mean value used in the forecast.

The RG agrees with the WG that management on a FU level would be beneficial.

The FU15 stock is the most abundant and most densely packed of the assessed *Nephrops* stocks. Official landings fluctuated around ~9000 tonnes over a period in the 1990s during which the stock increased according to the trawl surveys. The more recent abundance indices from UWTV surveys and trawl survey data in the 2000s (excluding 2003 and 2004 August surveys) have remained stable whilst the stock has yielded landings of around 9000 t.

The RG agrees that F_{max} (harvest ratio 17.1% combined between sexes) is consistent with the approach adopted by WGCSE for choosing F_{msy} proxies for *Nephrops*. This is predicted to deliver an SPR for males of 28% virgin SPR. The RG considers that the method adopted for estimating a $B_{trigger}$ is strongly influenced by possible year effects in the trawl survey in 2003–2004, and that the rescaling of the trawl survey estimates would be better done using 2005–2009 data.

The bias correction factor needs further investigation including, as suggested by the WG a precision estimate.

Nephrops in Division VIIb,c,j,k (FU 16 Porcupine Bank) (Report Section 7.6)

1) **Assessment type**: update
2) **Assessment**: trends
3) **Forecast**: not presented
4) **Assessment model**: No Analytical Assessment
5) **Consistency**: Consistent with last assessment
6) **Stock status**: Status of the stock cannot be evaluated because reference points have not been determined for this stock, although the stock is perceived to be over exploited and on the point of collapse.
7) **Management Plan**: There is currently no management plan for this stock, but there are area closures, MLS and mesh size regulations.

General comments

The assessment was carried out according to the Stock Annex description and the WG addressed the ToRs in providing updated series of indicators.

General ecosystem information has not been provided, and mixed fishery data are not used in support of management advice.

The main indicators are poor recruitment in 2004–2008 based on % of LFD <32 mm CL, with indications of a return to more “normal” level in 2009. A proxy for Z based on the LFDs shows increasing Z in the 2000s, and a very large reduction in % males in the landings and survey has been apparent in the last 2–3 years. Discards data are not used in this assessment, and discard levels are unknown.

Technical comments

1) It is difficult to compare the effort and lpue series for the Irish, French and Spanish fleets (Figure 7.6.9) as the Spanish data include an engine power correction and the others are in “hours trawling”. It is also difficult to see why the lpue (kg per h trawling) should be so different in the French and Irish fleets unless there are differences in the accuracy/completeness of landings or effort reporting. The lpue series from all countries would benefit from being standardized in the same way.
2) It would be useful to mark the area of the closure on the survey maps in Figure 7.6.7, particularly as Figure 7.6.10 has no latitudes or longitudes.

Conclusions

The RG considers that the indicators of the state of the stock continue to suggest a depleted population with an unnatural sex ratio that could impair productivity. Nonetheless, despite the low proportion male, the stock appears to have produced a better recruitment in 2009, which will need to be protected to promote rebuilding of the biomass. Unfortunately the discard practices are poorly known and sampled and unless this is rectified it will not be known if the 2009 recruitment is being heavily fished and discarded.

The area closure in 2010 may not be fully effective as there appears to be high trawling effort south of the northern “hook”, and (in previous years) the time period of the closure covered ca. 60% of landings (leaving enough time to increase targeting). From the maps presented it is not clear whether the zones of high recruitment in 2009 are protected in 2010.

Nephrops in Division VIIb (Aran Grounds, FU 17) (Report Section 7.5)

1) **Assessment type**: Update
2) **Assessment**: Trends
3) **Forecast**: Short term
4) **Assessment model**: Assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the Benchmark WK (WK*NEPH*, 2009).
5) **Consistency**: Methods are the same as last year plus attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES.
6) **Stock status**: Unclear. The UWTV survey gives a fluctuating abuandance that does not follow the landings. This may be caused by unallocated landings and/or unaccounted natural mortality.
7) **Management Plan**: none.

General comments

The assessment was carried out in accordance with the description in the Stock Annex and the RG found no errors in the assessment.

At the time of review the advice sheet was not entirely finished. Some figures as basis for the outlook table were missing and the Section "Additional consideration" looked like last year's text.

The assessment approach used by WGCSE 2010 was said to be consistent with that set out in the Stock Annex and WK*NEPH* (2009). Exploratory SCAs (Separable cohort analysis) were carried out to derive suitable reference points for this stock. The RG could not evaluate the SCA as the input files were not available.

The Stock Annex was very clear and contained good information on ecosystem consideration.

Discard estimates are included in the assessment since 2001 with the exception of 2006–2007 when there was no sampling of landings and discards.

Technical comments

1) During the ADG, feedback from the RG led to an investigation of the inputs to the F_{MSY} calculations (see point (2) below). This led to a discovery of a mistake in the calculations and a revision of the F_{MSY} harvest ratios. The amendments are given below:

Ref point	Sex	WG harvest ratio	Revised ratio
F0.1	Combined	6.0%	7.2%
F0.1	Female	9.1%	9.1%
F0.1	Male	5.2%	6.4%
F35%	Combined	9.7%	10.5%
F35%	Female	13.1%	12.8%
F35%	Male	6.9%	8.4%
Fmax	Combined	9.7%	11.1%
Fmax	Female	13.2%	13.0%
Fmax	Male	8.1%	9.8%

The revised forecast table is given below:

			Implied fishery	
	Harvest rate	Survey Index (millions)	Retained number (millions)	Landings (tonnes)
MSY framework	10.5%	552	39	948
F2010(avg.2007–2009)2009)	10.6%	552	39	957
F0.1 Combined	7.2%	552	26	650
Fmax Combined	11.1%	552	41	1002
F0.1 Comb	7.2%	552	26	650
F0.1 Female	9.1%	552	33	822
F0.1 Male	6.4%	552	24	578
F35% Comb	10.5%	552	39	948
F35% Female	12.8%	552	47	1156
F35% Male	8.4%	552	31	759
Fmax Comb	11.1%	552	41	1002
Fmax Female	13.0%	552	48	1174
Fmax Male	9.8%	552	36	885
	2.0%	552	7	181
	4.0%	552	15	361
	6.0%	552	22	542
	8.0%	552	29	722
	10.0%	552	37	903
	12.0%	552	44	1084
	14.0%	552	51	1264
				Basis
Landings Mean Weight (Kg)		0.0		Sampling 2008 and 2009
Survey Overestimate Bias		1.30		WK*NEPH* 2009
Survey Numbers (Millions)		718		UWTV Survey 2009
Prop. Retained by the Fishery		0.67		Sampling 2008 and 2009

2) The combined-sex F_{MSY} proxy harvest-ratios for the *Nephrops* stocks in VIa and VII other than FU17, all tend to be very similar despite the variations in growth rates and discard rates (see table below). The much lower value for FU17 appears to be due to a low value for females (similar to FU15) and a very low value for males (50% lower than FU15). The same growth data are used for FU15 and FU17. The RG asked for the FU17 model inputs to be checked as the $L_{infinity}$ for mature females in the Stock Annex table is given as 50 mm but is claimed to be derived from FU15 and FU16 values which are 56–60 mm. The RG was advised that the LCA was run using the same parameters as for the Irish Sea. A source of the large difference between FU17 and other FUs could therefore be a very different length composition and selectivity pattern for males in the 2008–2009 FU17 data than is obtained for the other stocks. The WG should further explore the reasons for the different F_{MSY} values in FU17, including the quality of the LFDs for landings and discards and the effect of the shift in timing of the fishery in recent years.

Harvest ratios for different (combined sex) FMSY proxies				Harvest ratios for F35%spr for males and females		Males and imm. females		Mature females		Burrow densities (per m²)
FU	F0.1	Fmax	F35%spr	Male	Female	Linf	K	Linf	K	
11	9.8	16.9	13.3	10.5	19.2	70	0.16	60	0.06	0.55
12	9.7	16.9	13.1	9.8	21.1	66	0.16	59	0.06	0.43
13	9.3	16.9	13.1	9.7	22.2	73	0.16	60	0.06	0.8–1.0
14	9.8	16.4	13.0	14.1	12.7	Same as FU15				0.25–0.38
15	10.6	17.1	13.4	12.5	13.5	60	0.16	56	0.10	~1.0
16						75	0.14	60	0.16	
17	7.2	11.1	10.5	8.4	12.8	60	0.15	56*	0.1	0.6–1.4
20–22						68	0.17	49	0.10	0.23–0.4

3) The Stock Annex and WK*NEPH* 2009 should be amended to show the correct Linf of mature females in FU17 (56 mm if derived from FU15). The RG/ADG was advised that the F_{MSY} calculations were done for FU17 using "the same growth inputs as for the Irish Sea"

4) The UWTV estimates and the annual fishery lpue appear to be negatively correlated, although Figure 7.5.7c indicates this may depend in which season lpue is calculated in. If the large UWTV estimate for 2004 was due to strong recruitment, this could generate a subsequent increase in fishery lpue as observed. The fishery LFDs for females show no evidence for a strong recruitment pulse in 2004, although the ones for males shift slightly towards the smaller length classes in 2004 then increase again in subsequent years.

5) The Figure captions for Figure 7.59 need more detail to explain what the lines actually are.

6) Table 7.5.6 provided clear information on all relevant variables allowing the derivation of historical harvest ratios and forecast inputs to be checked. This should be done for other stocks (a similar table is provided for FU15).

Conclusions

The RG agrees that the UWTV survey and associated F_{MSY} values represent an appropriate means of providing quantitative management advice. The UWTV is a method susceptible to bias but the WG concludes that the survey estimates are considered fairly precise. The RG agrees that $F_{35\%spr}/F_{max}$ (both giving harvest ratio of 9.7% combined between sexes) is consistent with the approach adopted by WGCSE for choosing F_{msy} proxies for *Nephrops*. This is predicted to deliver an SPR for males of 23% virgin SPR. However the RG still has concerns about the different harvest ratios for males compared to other stocks which should be investigated further. The mean weight in landings and discard rates should also be examined further as they are also key sources of uncertainty.

The bias correction factor needs further investigation including, as suggested by the WG, a precision estimate.

The RG agrees with the WG that management on a FU level would be beneficial.

Nephrops in Division VIIa,g,j (South East and West of IRL, FU 19) (Report Section 7.8)

1) **Assessment type**: None
2) **Assessment**: None
3) **Forecast**: None
4) **Assessment model**: -
5) **Consistency**: Cannot be evaluated
6) **Stock status**: The status of the stock cannot be evaluated. Sampling indicates a decline in mean size of indviduals.
7) **Management Plan**: None

General comments

The FU was not assessed and no data analysis was carried out in 2009 or 2010. It's stated in the ToRs for 2010 that an assessment is to be performed but this is probably an error, there is no history of assessment of this FU.

Advice is given biannually and should be updated in 2010. The advice sheets were not completed at the time of review by one of the Reviewers (2 June) and could not be checked.

The only available information for the FU19 is from the UK March groundfish survey that indicated some decline in mean size. In 2006 there was some UWTV stations covered in the FU19 but there does not seem to be an annual coverage of the area. The WG states that the area and FU is heterogeneous and a UWTV survey abundance is hard to obtain on an accurate and regular level.

No ecosystem considerations are presented in Report.

Discard is not discussed in the text but should be included under the Section named "Commercial Catches and Discards".

The biological sampling could be better described. The sampling is obviously irregular and inconsistent and the time-series is too short to give any information. In 2001 there was a change in sampling methodology and it seems that discard data are included from this point but it is not described.

The fishery description contains information about mixed fisheries and indicates that it is of importance, but there are no indications how it can be used in future advice.

Technical comments

1) Table 7.8.1 presents landings from FU18 but it is not referred to in text how FU18 and 19 are connected.

Conclusions

RG agrees that analytical assessment is not possible to perform on this FU

It is recommended that the WG gives some suggestion how the sampling and survey data can be improved.

Nephrops in Divisions VIIfgh (Celtic Sea, FU 20–22 (Report Section 7.7)

1) **Assessment type**: update
2) **Assessment**: trends
3) **Forecast**: no
4) **Assessment model**: no
5) **Consistency**: consistent with last year's methods and stock annex
6) **Stock status**: unknown
7) **Management Plan**: no

General comments

The WG has addressed the ToR by providing an update of fishery and survey trends.

No French lpue and effort indices for 2009 were available.

The WG Report and the Stock Annex for this FU are comprehensive but difficult to follow due to the amount of detail.

Technical comments

1) Data from the EVHOE survey were cited but time-series plots of number caught by year, etc, were not found.
2) For consistency with other FUs, it would be useful to plot the landings–discards length compositions in a column with a line through the mean lengths. Otherwise some of the LFD plots are just duplicating tables with the same data and are hard to interpret.
3) Table 7.7.16, showing landings by rectangle and year might be better presented as a series of maps?
4) Some values of sex ratio are given in the text, but no data on trends in sex ratio are provided, as for other stocks.
5) Figure 7.7.8 gives a "domain area" as in m^2. Should this not be km^2 to give abundances in millions?

Conclusions

The RG considers that the indicators provide relatively little information for evaluating stock trends. Irish and French fleets show different lpue trends but it is not clear if this reflects shifts in activities between different grounds.

The UWTV results for the Smalls grounds indicate a stable abundance over the last 3–4 years. The RG recommends that VMS and other data be used to map out the *Nephrops* grounds more accurately (see VIa stocks) to allow the possibility of extending the UWTV coverage to include other significant mud patches (Labadie/Nymphe/Seven heads ground) on an annual basis if funding is available for this. The Annex indicates that UWTV was tried on very small areas of these three grounds in 2006 but that poor weather precluded surveys in 2007 and 2008. The different allocation of French and Irish Effort between the four main grounds would argue for UWTV coverage of all areas given the different trends in effort of these fleets. The WG proposal to develop fishery data (length compositions, discard rates, etc.) specifically for the Smalls is a necessity for developing the UWTV survey for providing quantitative management advice for this ground. However the other mud patches should not be ignored.

The back calculation of discard rates when fishing procedures (tailing) are changing is rather difficult and should be replaced by observer data whenever possible. However, the method should be further evaluated for the next Benchmark.

Plaice in Division VIIb,c (West of Ireland) (Report Section 7.9)

1) **Assessment type**: No assessment
2) **Assessment**: None
3) **Forecast**: None
4) **Assessment model**: None
5) **Consistency**: -
6) **Stock status**: -
7) **Management Plan**: None.

General comments

Only landings are presented for this stock. It shows a decrease in landings the last ten years. The WG does not suggest any explanation for this.

Technical comments

The unit of the landings in Table 7.9.1 is not defined.

Plaice in Divisions VIIh,k (Southwest of Ireland) (Report Section 7.11)

1) **Assessment type**: SALY
2) **Assessment**: trends
3) **Forecast**: none
4) **Assessment model**: catch-curve analysis and yield-per-recruit analysis
5) **Consistency**: Same approach as last year
6) **Stock status**: Unknown
7) **Management Plan**: None

General comments

The WG addressed the ToRs by updating the tables and catch-curve analysis.

This is a very small fishery: 135 t in 2009, with a large decline in landings over time. No information is provided on discard patterns, given that discarding in some other plaice stocks is extensive.

Catch-curve estimates of Z varied between 0.6 and 1.2. The estimate for Z appears to be quite variable. These levels of Z are quite high compared to other plaice stocks. There is a possibility that this can be the consequence of declining catchability-at-age due to age-related shifts in distribution and/or seasonal migrations, but is also influenced by an overall decline in catch at all ages over time (see Technical comment 2). The absence of discards numbers-at-age could lead to an underestimation of Z.

In the YPR curve, F_{max} is estimated to be 0.24. Recent values of Z ranged from 0.5 to 1.2, with M=0.12 this would result in an F of between 0.48 and 1.08. This is well above F_{max}, however the catch-curve Z's may be biased.

It appears that no survey covers this stock, as no information on this is provided in the Report.

Technical comments

1) Figure 7.11.6 is described as a catch-curve whereas it is log catch ratios. Figure 7.11.8 shows catch-curves.
2) A problem with the catch-curve analysis is that the overall catches are declining throughout the period. Hence the numbers-at-age i+1, year y+1 will decline from the number at year i and age y not only due to mortality but also due to a decline in the overall amount of fishing and catch. This will bias the Zs upwards to some extent. Landings appear more stable from about 2004 onwards, so Z estimates for those years could be shown separately (will probably remain quite high, though).
3) Some smoothing of age composition estimates is expected from using an annual ALK built up from all available fleet sampling data. Lumping data to avoid inadequate ALKs at the season, fleet stratum level doesn't necessarily provide better estimates it just covers up the underlying deficiencies and leads to non-quantifiable bias and precision.
4) Given a time-series of landings-at-age data, why does the WG resort to catch-curve analysis rather than a simple separable VPA approach with a range of terminal Fs and S values?

5) Are there any data on fishing effort of fleets taking the bulk of the plaice catch? Does this suggest any trend in F?

Conclusions

The RG considers that the analysis could indicate exploitation rates in excess of yield-per-recruit F_{msy} proxies; however the magnitude of any difference is unknown without additional information on catchability-at-age and removing any effect of overall reductions in catch.

Improved sampling is needed to allow seasonal ALKs. Estimates of discards-at-age are also needed.

Plaice in Divisions VIIf,g (Celtic Sea) (Report Section 7.10)

1) **Assessment type**: Update, no change in assessment
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: XSA-tuning two commercial + one survey
5) **Consistency**: The trends and estimates of fishing mortality, SSB and recruitment in this assessment are consistent with last year's assessment
6) **Stock status**: SSB estimate for 2010 (1300 t) is currently below B_{pa} (1800 t) and just above B_{lim} (1100 t). Recent F estimates are around 0.41, above the range of F_{MSY} (0.19–0.36) proposed by the WG (No F_{pa} of F_{lim} defined).With exception of 1994 year class, all recruitments at age 1 since 1992 have been below the long-term arithmetic mean.
7) **Management Plan**: There is no management plan for Celtic Sea plaice.

General comments

The WG addressed the ToRs requiring an update assessment and associated management advice, and the assessment was carried out according to the Stock Annex description. The RG found no errors in the implementation of the assessment and forecast, and the results were carried over correctly to the advice sheets.

The WG Report and Stock Annex exclude ecosystem information. The WG Report cites a study on plaice recruitment indicating effects of sea temperature anomalies but does not directly use this information in the assessment or advice (the forecast is considered relatively insensitive to incoming recruitment and hence any environmental effects, although it is acknowledged these could affect longer-term forecasts if they were done).

There is no management plan for this stock.

An important mixed fishery issue is the management of sole and plaice taken in the same fisheries. The sole stock appears healthy whilst the plaice stock is depressed. The WG Reports that increases in mesh size to reduce plaice discarding could (as shown by WGSSDS 2004) also benefit the sole stock. There at present is no attempt to link the advice for sole and plaice taken together in the same fisheries.

As with VIIa plaice, the absence of discards data in the assessment is a serious problem, given the very high discard rates in the 80 mm beam trawl and otter trawl fisheries, and the sexual dimorphism in plaice that may lead to a very high discard rate across a relatively broad age range of males. Information on discard survival is sparse and not referred to by the WG.

The WG estimated total international landings for 2009 were 463 t, 10% above the TAC (420 t) and 25% below the *status quo* prediction given by last year's assessment (580 t). Discards are considered to be significant but are presently not quantified. In 2009 French data were not available. The retrospective bias in F and abundance could lead to overoptimistic forecasts.

The *status quo* catch forecast implies that SSB will continue to rise above B_{lim} in 2010, 2011 and in 2012, assuming $GM_{89\text{-}08}$ recruitment levels, but will remain below B_{pa}.

Technical comments

1) The WG does not explain the derivation of the 2009 landings figures in the absence of official French data.

2) The use of the quadratic smoother to estimate weights-at-age should be reviewed in any future benchmark. This year the WG has had to over-write some recent estimates for younger ages due to anomalous results.

3) The WG screens survey tuning data for internal consistency and provides Z indices, but does not go as far as deriving recruitment and SSB trends and retrospective analysis as can be provided by SURBA. Given the strong survey catchability trends in XSA (minus discards), the performance of the survey in a stand-alone survey based assessment would be informative.

4) The XSA converged after 71 iterations. This indicates some difficulty in finding a solution. Evidence for a power model at ages 1–5 is weak in the beam trawl survey and the decision for this model in the past is probably a patch-up to deal with the lack of discards data.

5) As with VIIa plaice, the use of an XSA catch-at-age assessment is an issue when such a large fraction of the catch is missing (discarded), particularly as discarding of males may extend over a relatively wide age range. The full magnitude of the problem has been obscured by the WG not presenting raised discards estimates by age and fleet (ideally including a breakdown by sex) for the series of recent years when such data have been required by the EU Data Collection Framework. The WG must address this as a matter of urgency in preparation for benchmarking of the stock.

6) The WG should include in the Stock Annex a description on how the commercial tuning fleet data have been estimated. Is it standardised (vessel power, length, etc)? Does it include all vessels in the fleet or a subset (to be more independent of the catch-matrix)?

Conclusions

The RG considers that this assessment is not appropriate for providing quantitative management advice, and is useful only for indicating long-tem trends. The assessment has a retrospective bias that probably originates from the absence of the large discard quantities from the assessment. Without any knowledge of how discard rates have changed over time, the ability to implement a combined catch and survey analysis is seriously compromised, and the strong catchability trends induced in the survey-series is indicative of this. The type of retrospective behaviour of the assessment has also been seen in the VIIa plaice assessment; although to a more extreme extent due to the very high discard rates in VIIa. It is important that the ICES review process identifies when update assessments are no longer performing adequately in order that a suitable benchmarking process can be initiated to try and improve the assessment and advice.

The RG proposes that:

1) The E&W BT survey (either raw or modelled) is used for developing an interim fishery-independent assessment of stock trends. It is acknowledged that survey data for the older age classes is relatively sparse, which would need to be allowed for.

2) The WG focuses on reconstruction of landings and discards-at-age (by fleet and ideally also sex disaggregated) and that a data compilation and

benchmark process is scheduled at a suitable date to develop a more robust assessment approach. The Benchmark should include VIIa plaice as there are similar problems with the two stocks and there may be mixing between the stocks.

Plaice in Divisions VIIe (Western Channel) (Report Section 8.2)

1) **Assessment type**: Update, Benchmarked in 2010
2) **Assessment**: Analytical
3) **Forecast**: Short-term forecast provided
4) **Assessment model**: XSA tuned by three commercial fisheries and two surveys. Separable VPA was used for data screening and SURBA for examining tuning series.
5) **Consistency**: The assessment was made according to the settings decided in WKFLAT 2010. Changes to previous assessment were: addition of 15% of Q1 catches-at-age from VIId; change in first year with catch-at-age data to 1980; reduction in F_{bar} from F(3–7) to F(3–6); and truncation of FSP survey to exclude age 9.
6) **Stock status**: Outside safe biological limits. SSB has been below B_{pa} since 2004. Estimated fishing mortality declined sharply from around 0.7 in 2006–2008 to 0.44 in 2009, just under F_{pa} (0.45) but above the proposed F_{MSY} of 0.14–0.31.
7) **Management Plan**: None

General comments

The WG addressed the ToRs relevant to providing advice, and the assessment was carried out according to the WKFLAT Benchmark Assessment. The RG found no errors in the implementation of the assessment and forecast, and the results were carried over correctly to the advice sheets.

The WG Report does not include ecosystem information. The Stock Annex includes reference to impacts of beam trawling. WKFLAT attempted to include sea temperature as an index in the tuning file but this only explained extremes of recruitment and has not been included in the WGCSE assessment.

There is no EU management plan for this stock.

An important mixed fishery issue is the bycatch of plaice in the sole fishery in VIIe, which is subject to the sole management plan. A key finding is that F on both sole and plaice declined sharply by about the same amount between 2008 and 2009 (just under 40% reduction), although this is greater than the 23% reduction in beam trawl effort in VIIe between 2008 and 2009. Subsequent assessments may revise the 2009 F upwards.

Discarding occurs at a lower rate than in adjacent plaice stocks. Last year's RG and WG agreed that it would be useful to include discards in the Benchmark. However WKFLAT advised against including noisy discards data as these could degrade the management advice whilst simply rescaling F and SSB series. Discards data are available for 2002–2009 but not included this year. The RG suggests that raised discards estimates should be tabulated and a quantitative evaluation made of the likely fishing mortality rate due to discarding.

Overall, the WG has done a good job with the available data. The migratory effect between the adjacent Area VIId has been partly covered by adding 15% of the catches from VIId into VIIe. The calculation is based on old tagging data. The RG agrees with the WG that new effort on tagging would be useful for confirming mixing rates. Furthermore, suitably designed tagging experiments could yield valuable data on fishery selectivity.

The changes to the assessment have improved the bias in the retrospective pattern of F but uncertainties still exists in recruitment estimates.

Figure 8.2.9 is missing from the Report.

Technical comments

1) The upward adjustment of SSB throughout the series caused by the addition of VIId data means that the basis for the previous B_{lim} and B_{pa} is no longer valid. A revision to the precautionary reference points is needed if these are to be retained for the stock. The B_{lim} value now lies below all historical SSB values in the assessment (see Figure 8.2.11). Alternative reference points are considered in the Stock Annex, but the old values continue to be added to the biomass and stock–recruit plots which is misleading.

Conclusions

The RG accepts the assessment as a basis for providing quantitative management advice, on the basis of the improved retrospective performance although there still remains uncertainty in recruitment estimates.

The advice based on the MSY framework or MSY transition is acceptable. The main issue is to reduce F to rebuild the SSB.

Plaice in Division VIIa (Irish Sea) (Report Section 6.7)

1) **Assessment type**: Update
2) **Assessment**: Analytical
3) **Forecast**: Short term (not used for advice)
4) **Assessment model**: FLICA tuned with one survey and two biomass indexes
5) **Consistency**: The assessment is biased for SSB, F and recruitment. The updated assessment provides similar estimates to last year's assessment showing a growing SSB and decreasing F since the 1990s.
6) **Stock status**: SSB estimates for 2009 and 2010 are above B_{pa} (3100 t) and F is below F_{pa} (0.45)
7) **Management Plan**: No.

General comments

The WG addressed the ToRs in providing an update assessment with associated management advice. The assessment was carried out according to the Stock Annex description with the exception that in the Stock Annex the survey used in tuning UK BT survey has age 1–7, in WG Report Table 6.7.2.4 marked with bold it is age 1–8. The RG found no errors in the implementation of the assessment and forecast, and the results of the assessment were carried over correctly to the draft advice sheets. No forecast is provided in the advice sheets.

The WG Report and the Stock Annex exclude any ecosystem information.

There is no management plan for the stock.

The WG has not used mixed fishery data in providing advice in support of management.

The Report was very well structured and the necessary information was easy to find. The sections on MSY calculations, uncertainties and bias and recommendations for benchmark showed that the WG has a good idea of what work can be useful for improving the assessment.

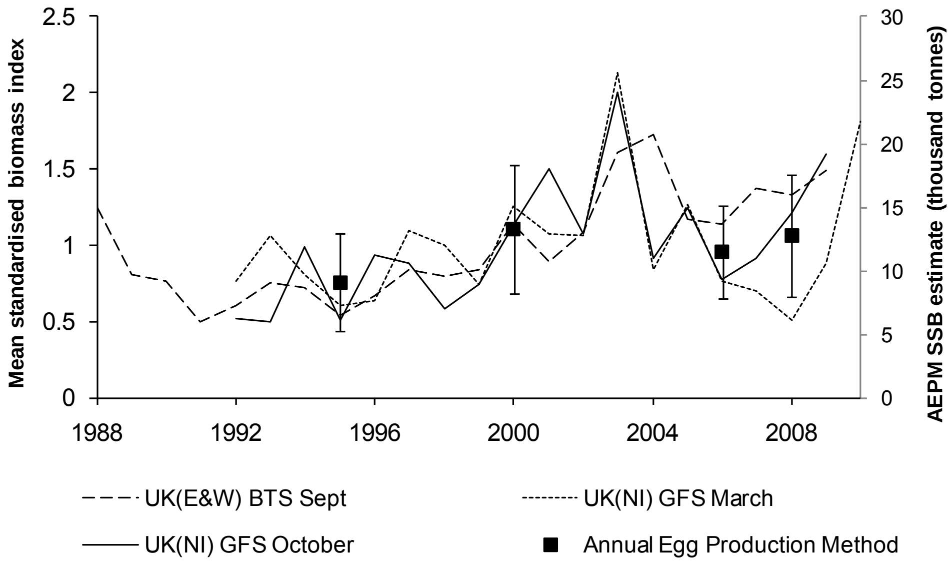
Effort has been decreasing in later years and only 1/3 of the TAC is utilised. The fleets targeting plaice or having plaice as an important bycatch have experienced large reductions in effort since the 2000s. Belgian beam effort has declined four-fold since the mid-2000s, and Irish beam trawl effort has halved in the same period. The UK beam trawl fleet has virtually ceased operating in the Irish Sea, and the UK (E&W) otter trawl fleet which fishes predominantly in parts of the Irish Sea where plaice are most abundant, has also declined to very low effort. As with VIIa sole, international landings of plaice in 2009 were the lowest level in the series (although discard rates are high). A reduction in F on plaice would be expected, and the assessment indicates a progressive reduction over at least the last decade.

Discarding is a very large component of the fishery catches. In 2009, observer data indicated 90% discarding by number in the UK fleet and 99% by the Irish fleet. Sexual dimorphism in plaice growth means that a very large proportion of male plaice are probably discarded. Discard survival is poorly known. Given the magnitude of the discard problem, there is clearly no basis for assessing the stock using a catch-at-age model including landings only. There are indications that the selection pattern or/and discard behaviour has changed in the fishery over time.

The outcome of the deficient catch-at-age matrix is that the assessment model cannot reconstruct population numbers that match the trends in survey indices, leading to pronounced retrospective bias and catchability trends in the surveys that have been evident in many of the recent assessments. The catchability trends are most pronounced at ages 2–5 in the beam trawl survey, covering age classes likely to be most heavily discarded. There are contradictory signals provided by the surveys, which have different spatial coverage.

The ability to implement a catch-at-age model when recent F estimates are around half the M value of 0.12 is debatable, particularly when discard F (if estimated) would be much higher than this. Results of annual egg production method (AEPM) survey estimates for the whole Irish Sea in 1995, 2000, 2006 and 2008 provide SSB estimates 1.5–3.3 times larger than the ICA estimates, and do not suggest a continued steep increase in SSB through the 2000s as indicated by ICA. Discrepancies between recent AEPM and catch-at-age assessment estimates of SSB for North Sea plaice have been resolved by including discards estimates in the assessment.

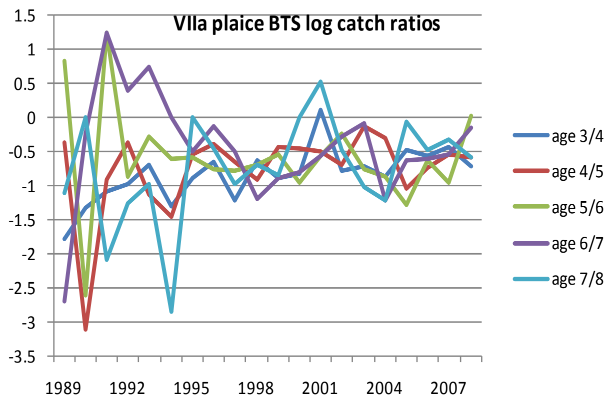
The egg production survey trend matches the groundfish trawl survey indices of SSB (which cover the whole Irish Sea) more closely as shown in the Figure below. Splitting the egg survey estimates into eastern and western components shows that the increase between 1995 and 2000 is effectively due to the eastern Irish Sea component. The UK (BTS) survey covers only the eastern Irish Sea.

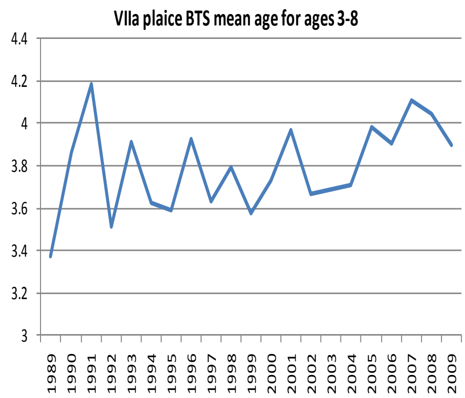


Relative trends in Irish Sea plaice SSB from groundfish surveys and beam trawl survey, with absolute estimates from applications of the annual egg production method (±2 SE) plotted on secondary axis. <Figure included in Advice sheets>

The main indicator of stock status emerging from the catch-at-age assessment is the expansion of the age composition over time, indicating a reduction in F to low values as would be expected given the ratio of fishery landings to egg production estimates of SSB (4–10% since 2000). However the key issue is the absence of discards estimates, which will also include mature fish. Log catch ratios-at-age for the UK beam trawl survey in the eastern Irish Sea are noisy at the start of the series but show some reduction in Z for most ages (see plots below), but the reduction in Z over time is not as pronounced as may be inferred from the ICA. The mean age in the survey has increased slowly, also indicating a reducing mortality (but could also be influenced by recruitment).

VIIa plaice UK beam trawl survey data:





It is noted that the TAC is substantially underutilized despite the abundance of the stock. This appears to be due to marketing issues.

Technical comments

1) The landings-at-age data do not provide a suitable basis for an analytical assessment, and therefore the WG assessment update is rejected.
2) Given the major uncertainties in the ICA model approach, the WG should provide the results of a survey-only model, to indicate trends in abundance and mortality.
3) The RG noted a small discrepancy between stock weight in Table 6.7.2.7 and the stock weight used in the input file (for 2008) although this is largely irrelevant given the rejection of the assessment.

Conclusions

The RG considers the WG update assessment to be unsuitable as a basis for providing management advice other than as an indicator of the general reduction in F on ages less subject to discarding. The problems with the assessment are analogous to those of the VIIf and g plaice assessment, but are more extreme due to the higher discard rates. The RG recommends that the Advice Sheet should be reworked to provide only trends from surveys and general indicators of stock status such as the broad age range indicating low F (also indicated by the large egg production SSB estimates relative to catches).

On the basis of the overall evidence presented, the RG agrees that a confident statement can be made that the SSB is currently well above the B_{pa} value (which is however based on an assessment excluding discards) and that the stock is lightly exploited. Without knowledge of the true level of F at-age due to landings and discards, it is not possible to calculate a meaningful F_{MSY} value.

The RG recommends that a data compilation and benchmark assessment is scheduled for this stock at a suitable date. The WG has proposed some approaches for a benchmark in the WG Report. It is recommended that the VIIa and VIIf and g plaice stocks are benchmarked at the same meeting as there are issues common to both stocks. There are also possible stock mixing dynamics to consider. Important tasks for the Benchmark are:

1) Compilation of fleet-raised discards estimates for as many years as possible, and an evaluation of the quality of the data based on the ICES QA framework;
2) Evaluation of all available survey data including data not presently provided to the WG (e.g. fourth Q western IBTS survey; UK FSP survey data; egg production survey results).
3) Better use of survey data to estimate key biological parameters (weight-at-age; maturity)
4) Disaggregation of the fishery and survey data by sex would be advantageous as the selectivity and discard rates will be different by sex due to slower growth in males. Maturity and natural mortality in males and females may be different.
5) Model building using more flexible statistical models to more appropriately account for the different types and magnitude of errors in the data.

Sole in Division VIIb, c (West of Ireland) (Report Section 7.12)

1) **Assessment type**: no advice
2) **Assessment**: not presented
3) **Forecast**: not presented
4) **Assessment model**:
5) **Consistency**:
6) **Stock status**: unkown
7) **Management Plan**: none.

General comments

The landings and lpue of Sole in VIIbc appear to have been more or less stable since the start of the logbooks time-series in 1995.

Sole in VIIb are mainly caught by Irish vessels.

Technical comments

None.

Conclusions

There are no suitable data on which to base meaningful advice.

Sole in Divisions VIIh-k (Southwest of Ireland) (Report Section 7.14)

1) **Assessment type**: No assessment , Landings and catch-at-weight sampled for 1993–2009, same advice as last year
2) **Assessment**: None
3) **Forecast**: None
4) **Assessment model**: catch-curve analysis; Yield-per-Recruit analysis
5) **Consistency**: Same approach as last year
6) **Stock status**: The stock is assumed to be within safe biological limits, but the assumption is based on very basic analysis from only parts of the stock unit.
7) **Management Plan**: None.

General comments

The WG addressed the ToR by updating the catch data and Z estimates.

Area VIIh is considered part of the stock for assessment purposes (management unit) yet it is not believed to be part of the biological stock. There is no possibility to review the background of the stock components since there is no available Stock Annex.

Area VIIh is not sampled although a considerable part of the landings in the assessed stock is from this area. The WG states correctly the inappropriateness of raising landings to all landings in VIIhjk. The conclusion of why VIIh is part of the stock is not defined.

The estimated Z is variable. The Z was peaking in 2003 and on its lowest in 2007. The WG estimate of landings does not show a similar trend but is rather stable in this period.

Technical comments

1) Figure 7.14.6 is described as a catch-curve whereas it is log catch ratios.
2) As with VIIhk plaice, problem with the catch-curve analysis is that the overall catches are declining throughout the period. Hence the numbers-at-age 1+1, year y+1 will decline from the number at year I and age y not only due to mortality but also due to a decline in the overall amount of fishing and catch. This will bias the Zs upwards to some extent. Landings appear more stable from about 2004 onwards, so Z estimates for those years could be shown separately (will probably remain quite high, though).
3) As with VIIh–k plaice, some smoothing of age composition estimates is expected from using an annual ALK built up from all available fleet sampling data.
4) In the yield-per-recruit Section it says M=1.0, should be 0.1
5) Given a time-series of landings-at-age data, why does the WG resort to catch-curve analysis rather than a simple separable VPA approach with a range of terminal Fs and S values?
6) Are there any data on fishing effort of fleets taking the bulk of the sole catch? Does this suggest any trend in F?

Conclusions

The RG considers that the analysis could indicate exploitation rates close to yield-per-recruit F_{msy} proxies (F_{max}). However the magnitude of any difference is unknown without additional information on catchability-at-age and removing any effect of overall reductions in catch.

Choice of F_{MSY} proxies should be consistent with other sole stocks.

Improved sampling including seasonal ALKs is needed to make any progress with the quality of the analysis.

Sole in Division VIIf,g (Celtic Sea) (Report Section 6.7)

1) **Assessment type**: update
2) **Assessment**: analytic
3) **Forecast**: presented
4) **Assessment model**: XSA three tuning fleets two commercial and one survey
5) **Consistency**: Have been some large retrospective adjustments of F and SSB (underestimation of SSB and overestimation of F) but retrospective analysis shows fairly stable results for last few years.
6) **Stock status**: SSB>$B_{trigger}$ and F<F_{msy}, the 2007 and 2008 year classes are above the long-time average.
7) **Management Plan**: None.

General comments

The WG Report is well structured and easy to follow. The WG addressed the ToRs relevant to providing an update assessment and associated advice. The assessment was carried out according to the Stock Annex description. The RG found no errors in the implementation of the assessment and forecast, and the results were carried over correctly to the advice sheets.

The WG Report and Stock Annex do not include ecosystem information.

Discarding is estimated to be a minor issue for this stock. However other species including plaice can be discarded in the sole fishery.

An important mixed fishery issue is the management of sole and plaice taken in the same fisheries. The sole stock appears healthy whilst the plaice stock is depressed. The WG Report on Celtic Sea plaice states that increases in mesh size to reduce plaice discarding could (as shown by WGSSDS 2004) also benefit the sole stock. At present there is no attempt to link the advice for sole and plaice taken together in the same fisheries.

The Working Group estimated the total international landings at 790 t in 2009 which is about 20% below the 2009 TAC (993 t). The TAC is not fully utilized and many age groups are caught in the fishery.

Not all settings are updated in the Stock Annex for last year's assessment.

Technical comments

1) The divergent signals from the commercial and research beam trawl tuning-series are of concern. It is not enough to assume that somehow they cancel each other out (two wrongs don't make a right). Presumably on its own, the survey would produce higher F and lower survivors in recent years. Neither the WG Report nor the Stock Annex describes how the commercial beam trawl tuning data are derived (e.g. is it just annual catch divided by annual effort). It is not possible from the provided data to consider how the Trevose closure, or any changes to fleet structure and activities associated with the large effort reduction in the UK beam trawl fleet, might have affected the lpue of sole in recent years. The WG needs to establish the cause of the difference between the fleets; if it is related to changes in the commercial fishery activity causing more targeting of sole

in coastal waters in recent years the problem may be with the commercial fleet. It is recommended that VMS data is used to evaluate spatio-temporal effects in sole lpue.

2) The choice of a Ricker model for the F_{MSY} evaluation is largely driven by the four largest SSB and associated recruitment, which also happen to be the first four in the time-series. The perception of S-R patterns is therefore affected by time-series effects that are well known to cause bias in fitted stock–recruit curves (see Hilborn and Walters book). The SSB at the start of the series may already be substantially depleted and there is no biological reason to suspect strong density-dependence of recruitment at these SSB values.

3) Given the absence of any evidence for reducing recruitment as SSB is reduced, the F_{max} and F_{msy} values are not surprisingly very close. However, note that the F_{msy}/F_{max} F of ~0.3 leads to a substantial % depletion of SSB/recruit. An F of ~0.3 in the 1970s was associated with a declining trend in SSB despite fairly static recruitment. Comparisons of F_{MSY} ref points with other sole stocks should be carried out.

4) In the advice sheet table "Outlook 2011" the SSB referred to for 2011 is the SSB for 2010 (according to the forecast table in the WG Report). The correct figure is 5050t.

Conclusions

The RG agrees that the update assessment is suitable for providing quantitative management advice based on a forecast, as recent assessments appear relatively stable from year to year. However concerns regarding the divergent signals from the two UK beam trawl tuning-series should be investigated further, before any future benchmark.

The stock appears to be in a healthy state and should be exploited in accordance with F_{msy}. Further work may however be needed before agreeing an F_{MSY} reference point, including comparison with other sole stocks.

Sole in Division VIIe (Western Channel) (Report Section 8.3)

1) **Assessment type**: update
2) **Assessment**: analytical
3) **Forecast**: short-term forecast provided
4) **Assessment model**: XSA two commercial tuning fleets, two historic commercial tuning fleets and one survey
5) **Consistency**: Benchmark procedure in 2009 failed to develop an update procedure due to retrospective bias problem.
6) **Stock status**: Biological reference points were rejected by WKFLAT 2009
7) **Management Plan**: A management plan for this stock was agreed in May 2007 (Council Regulation (EC) No 509/2007).

General comments

The WG addressed the ToRs relevant to providing advice. The WGCSE addressed a special request from the UK to develop an assessment allowing the VIIe sole Management Plan to operate. The RG found no errors in the assessment and forecast, and the results were carried over correctly to the advice sheets apart from some errors in the header of the forecast table which were transmitted to the WG Chairs.

In 2009 WKFLAT benchmarked this assessment, but failed to develop an update procedure, as it was not possible to address the cause of the substantial retrospective bias in F and SSB. The 2010 WGCSE assessment was based on previous accepted XSA formulations described in the Stock Annex, with an decrease in the F-shrinkage SE from 1.0 to 0.5 (stronger shrinkage) and an increase in the time period for shrinkage from 5 to 10 years. A change in F_{bar} from 3–7 to 3–9 also seems to have been made. The new settings still showed retrospective bias in the past but improved the pattern for recent years.

The WG Report includes brief ecosystem information related to discard rates and the impacts of beam trawling on benthic communities. The WG suggests that sole recruitment patterns may be related to changes in the NAO but does not include any environmental data in the assessment and advice process.

There is an EU management plan for this stock aimed at achieving a long-term F target of 0.27 in three year stepped reductions. WGSSDS (2005, 2006) showed that a long-term target F of 0.27 had a low risk of stock depletion below lowest observed values whilst maintaining yield within 10% of the yield associated with F_{MAX} and average recruitment.

An important mixed fishery issue is the bycatch of plaice in the sole fishery in VIIe. A key finding is that F on both sole and plaice declined sharply by about the same amount between 2008 and 2009 (just under 40% reduction), although this is greater than the 23% reduction in beam trawl effort in VIIe between 2008 and 2009. Otter trawl effort has been declining over a longer period. Subsequent assessments may revise the 2009 F upwards on sole and plaice.

Discarding of sole occurs at a very low rate in the fisheries and is not included in the assessment. The stock has a broad age composition, and year classes can be followed in the commercial fishery until at least age 12, indicating the stock has not been too heavily exploited in the past.

A general problem in this year's Working Groups has been the non-availability of official landings data from France, which is generally responsible for about one third of VIIe sole landings. Official international landings in 2009 were 374 t, well below the 2009 TAC (650 t). A derivation of French landings from sales slips resulted in the WG estimate of 626 t.

Estimates of F_{msy} and its proxies were all considered highly uncertain for this stock and therefore not considered appropriate. The WG has decided to use the results of the stochastic simulations carried out by WGSSDS in 2006 to propose an F_{MSY} of 0.27.

The Report Section needs reviewing to ensure all table and figure numbers are correct and to ensure a consistent naming of tuning fleets in the text and tables.

Technical comments

1) The two commercial tuning fleets show pronounced negative residuals around 2003–2005, associated mainly with the 1998 year class. The WG notes that the commercial fleets indicated a bigger 1998 year class than was indicated by the survey, and suspects this may be a result of mixing between VIIe and VIIfg occurring beyond the western limit of the survey. The WG should consider spatial mapping of cpue data from the different fleets in the English Channel and VIIfg, linking VMS with logbook data and shore-based and at-sea sampling data.

2) The WG states that "recruitment estimates are consistent between the single-fleet XSA runs, although the final estimates vary slightly". However the recruitment estimates from the survey and commercial fleets diverge substantially in the final years. The XSA diagnostics show that at ages 3–5, the UK beam trawl survey generates much larger survivor estimates and lower F estimates than the commercial fleets, with the differences becoming less pronounced at the older ages. Differences are also apparent in the combined-age cpue where the UK beam trawl survey seems stable but noisy whereas lpue in the beam trawl fishery has been declining continuously since the 1990s. The WG should review the appropriateness of the commercial fleets for providing indices for the younger age classes.

3) F_{bar} in the Report model settings table and Stock Annex table is age 3–7; however the WG has used an F_{bar} of 3–9 in the assessment and advice sheets.

4) The short-term predictions previously used F_{sq} for the interim year (as area misreporting meant the TAC was not limiting). This year a TAC constraint was used for 2010 on the basis that "recent evidence suggests that the TAC is likely to be observed" although the evidence is not described. In practice, the TAC constraint leads to an F in 2010 of 0.24 which is close to the low F estimate of 0.25 for 2009.

5) The SEN file Table 8.3.16 includes a figure for N(1) of 2815 that does not represent either the XSA estimate or the GM of 4332. This may have no impact on the F_{MSY} bootstrap computations.

Advice sheet

In the Advice sheets Outlook table the SSB for 2011 is given as 2400 t. This is the 2010 SSB. The correct value is 2544 t. The 210 landings should be 618 t not 608 t. ICES was advised of the error.

Conclusions

The RG agrees that the revised assessment is a pragmatic solution to allow implementation of the Management Plan. However there remain a number of issues with the assessment. The retrospective pattern is now less apparent in the most recent years but is still apparent in the past, and could reappear in future assessments. The RG agrees that a future benchmark should evaluate spatio-temporal dynamics to try and resolve conflicts between data sources. Considerable work would be required prior this to develop the necessary datasets.

The WG has proposed tagging programmes as a means to provide quantitative estimates of stock mixing in plaice in the English Channel. Extending such a programme to include sole in the Channel and VIIfg could also provide valuable data on spatial dynamics of sole as well as information on selectivity patterns in different gears.

Sole in Division VIIa (Irish Sea) (Report Section 6.8)

1) **Assessment type**: Update
2) **Assessment**: Analytical
3) **Forecast**: Short-term forecast provided
4) **Assessment model**: XSA
5) **Consistency**: 2010 WG assessment is very consistent with the 2009 WG results, continuing to show a reduction in SSB (to lowest in series) and a reduction in F to close to the lowest in the series.
6) **Stock status**: SSB (2009) has fallen to around half of the B_{lim} of 2200 t. F (2009) is just below F_{pa} of 0.3.
7) **Management Plan**: There is no management plan in place for Irish Sea sole.

General comments

The WG addressed the ToRs in providing an update assessment and associated management advice. The assessment was carried out using the procedure detailed in the Stock Annex, with the addition of 2009 catch and survey data. The implementation of the assessment appears to be correct. The advice sheet was not completed at the time of the review.

The WG Report does not include any ecosystem information relevant to VIIa sole and its fisheries.

There is no management plan. ICES recommends that a management plan is put into place given the declining biomass.

Mixed fisheries data are not taken into account by the WG in providing advice in support of management of VIIa sole (Irish Sea Overview Section was not available for review).

Discarding is very low in this stock.

The fleets targeting sole or having sole as an important bycatch have experienced large reductions in effort since the 2000s. Belgian beam effort has declined four-fold since the mid-2000s, and Irish beam trawl effort has halved in the same period. The UK beam trawl fleet has virtually ceased operating in the Irish Sea, and the UK (E&W) otter trawl fleet which fishes predominantly in parts of the Irish Sea where sole are most abundant, has also declined to very low effort. International landings of sole are at their lowest level in the series. A reduction in F on sole would be expected, and the assessment provides some indication of a reduction in the last few years.

Technical comments

1) RCT3 input file has wrong data from March BTS compared with Table 6.8.6. This series should be removed from RCT as it has no input to recent year-class forecasts.
2) The short-term forecast uses an F_{sq} that predicts landings of 439 t in 2010, larger than the TAC of 402 t, and likely to be overoptimistic given the 65% TAC uptake in 2009 and the dramatic effort reduction in fleets taking sole in recent years.

Conclusions

The RG considers the updated assessment is suitable for providing management advice in the form of stock trends and short-term forecast. The SSB has been declining due to a run of below average recruitment coupled with F above F_{pa} and F_{lim} for a number of years in the last decade, although the F estimates have dropped below F_{pa} in 2009.

Whiting in Divisions VIIe-k (Report Section 7.15)

1) **Assessment type**: Update
2) **Assessment**: Indicator of trends only.
3) **Forecast**: Short-term forecast provided but not used in advice sheets.
4) **Assessment model**: FLXSA tuned with two commercial and three survey indices.
5) **Consistency**: The assessment is consistent with last year's update but shows periods of retrospective bias. The bias in SSB has decreased lately.
6) **Stock status**: The SSB estimate for 2010 (43 kt) is well above B_{pa} (21 kt). There is no F_{lim} or F_{pa} defined.
7) **Management Plan**: None

General comments

The WG addressed the ToR requiring an update assessment and associated management advice. The assessment was carried out according to the Stock Annex description, with the exception of missing French commercial lpue for 2009 in the tuning file which was not updated. The RG found no errors in the implementation of the assessment and forecast. However, both the F_{msy} and the short-term predictions are considered very unreliable and are not carried forward to the advice sheets.

The WG Report and the Stock Annex do not contain any information on ecosystem aspects or environmental drivers.

There is no EU management plan for this stock.

The WG has not used mixed fishery data in developing advice for this stock. A brief description is given in the WG Report of fisheries taking whiting. The WG proposal that square mesh panels of 120 mm should be used to reduce haddock discards will impact whiting and all such measures should be viewed in the context of mixed species catches.

The absence of official French landings data is an issue for data quality in 2009, and has also resulted in non-availability of French commercial tuning lpue for 2009. The origin of the WG estimates of French landings in 2009 (associated with large unallocated figure for 2009) is not explained.

As with VIIb–k haddock, the discard issue for the whiting stock is considerable and is discussed at length by the WG, which excluded discards data from the assessment. Discards data of variable coverage are provided to the WG but are not used for the following reasons given by the WG: 1) don't have discards data for the full period of landings-at-age data; 2) sampled fleets are not representative of the main fleets in the fishery and 3) need to examine and agree the best raising procedures for the various fleets. In the "recommendation for the next Benchmark" section, the WG at least makes a clear proposal for work that needs to be done to make use of the discards data. The same proposal should apply to Area VII haddock and other stocks with significant discarding not included in the assessment. The WG should ensure that these proposals are followed up and a commitment is made to resolving the discards data issues.

The TAC has not been utilized in many years and in 2009 only $^{1}/_{3}$ of the TAC was landed. However the stock area does not fully correspond to the assessment area.

Technical comments

1) The internal consistency of the surveys is generally quite poor. Some of the year-class time-series in the SURBA data screening plots in Figure 7.15.9 look out of synch by a year, e.g. age 3 in the bottom plot. Is this indicative of age errors?

2) The tuning fleets IRGFS7 used in the assessment shows a strong increasing trend in time; it has very large residuals and not very good internal consistency for age 3 and older ages. The concern is that it has a very high weighting in the assessment for most ages.

3) For the short-term forecast, the WG has accepted the 2009 year-class estimate from XSA (despite poor precision) but has reduced the 2008 estimate by a rather arbitrary 25% based on historic adjustments to the 1999 year class. However note that the current estimate for the 1999 year class is close to the current XSA estimate for the 2008 year class. If this forecast was actually being used to set a TAC, the 25% adjustment would feed directly into the 2011 TAC and would be hard to defend to the industry.

4) The estimation errors in the catch data make XSA a questionable model for this assessment. As with VIIb–k haddock, the RG suggests exploring a more statistical model that can deal with a variety of different datasets of differing quality and more accurately deal with the types and magnitude of errors.

5) As with VIIb–k haddock, the WG has declined to put forward any candidate F_{MSY} values. The reasons given in this case are the uncertainty in the data and the absence of discards mortality estimates. F_{MAX} is clearly unsuitable as the YPR is asymptotic. The YPR reference points $F_{0.1}$ and $F_{35\%-40\%}$ appear well estimated and are in the range 0.16–0.24 but the analysis excludes discard mortality. The WG is in the best position to propose appropriate long-term F targets for this stock and should continue to explore possibilities through simulation.

Conclusions

The RG supports the use of the updated XSA assessment as providing an indication of longer-term trends but not for providing a forecast. The assessment shows difficulties in estimating recruitment. The estimate of the strong year class 2008 is shifted down by 55% in this year’s assessment. The downshift for the 2007 year class in last year’s assessment was 49%. The indication is nevertheless that the last three year classes are strong, but not of the magnitude as previously estimated.

The stock is currently well above the B_{pa} of 21 000 t

The major problems to be addressed are the treatment of discards and the difficulties in estimating recent year-class strength based on the surveys.

Whiting in Division VIIa (Irish Sea) (Report Section 6.6)

1) **Assessment type**: Update
2) **Assessment**: survey trends
3) **Forecast**: not presented
4) **Assessment model**: SURBA
5) **Consistency**: Retrospective SURBA runs show consistent trends compared to previous assessments.
6) **Stock status**: The state of the stock is unknown; however the stock is perceived to be subject to high fishing mortality and is at an extremely low level. Existing biological reference points are from XSA assessments no longer considered valid.
7) **Management Plan**: No management plan has been agreed or proposed.

General comments

The WG has addressed the ToR in providing an updated assessment using a survey based model, able to provide information on relative trends. The SURBA model has been implemented using the approach outlined in previous assessments. The Stock Annex does not tabulate SURBA model settings.

The whiting fishery for human consumption in VIIa has effectively disappeared and most of the catch is now discarded in the small mesh fisheries. A range of discards data is presented by the WG but the data are patchy and there is no unified set of discards-at-age for the full period up to 2009. Some fleets do not appear to have discards data after 2002 despite the DCF requirement to collect discards data for stocks with significant discard rates. It is therefore not possible to evaluate the full extent of discarding-at-age. It is important that steps are taken to obtain robust and reliable estimates of discards; otherwise the effectiveness of technical measures to reduce discarding will be difficult to quantify.

The TAC in 2010 was set at a very small value of 157 t, but even this was not fully utilised.

The Irish Sea whiting stock is primarily caught by otter trawlers which utilize two main mesh size ranges, 70–89 mm and 100–119 mm. Effort of trawlers utilizing the larger mesh range, traditionally targeting whitefish (cod, haddock, whiting) has seen a large declined since 2003. The smaller range however has remained relatively stable. There primary target species is *Nephrops* from which whiting is discarded at a high rate.

In late 2009, a number of Irish vessels operating within the Irish Sea *Nephrops* fishery incorporated a Swedish grid into otter trawls, as part of the cod long-term management plan. It is expected that this will reduce the whiting catches of these vessels by 60% in weight. Furthermore, a small number of vessels began utilizing an inclined separator panel expected to reduce whiting catch by 76% in weight.

Technical comments

1) Section 6.6.2: Survey data. March groundfish surveys are available from 1992 to March 2010; however in Figure 6.6.2 data are only plotted to 2009.
2) The Stock Annex is several years out of date and should be updated before next year's WG.

3) The decline in catch rates >MLS appears particularly sharp between 2003 and 2004 in the eastern Irish Sea. The tuning file for the March-East survey suggests this occurs over the age range, indicating a shift in whiting distribution or a change in catchability. The WG should evaluate causes for this.

4) The NIGFS East-March tuning data has 1993–2010 in the year range, but the column of years starts at 1994.

Conclusions

The RG considers that the SURBA model indices of abundance provide credible information showing a severe decline in biomass of whiting in the Irish Sea since the mid-1990s. Available discards data show that most of the whiting catch is discarded but there is no single coherent set of fleet-raised discards data for tracking changes in discarding over time.

Whiting in Division VIb (Rockall)

Report Section not available.

Whiting in Division VIa (West of Scotland) (Report Section 3.4)

1) **Assessment type**: Update
2) **Assessment**: Assessment of trends only.
3) **Forecast**: None
4) **Assessment model**: SURBA, with comparative assessment using XSA
5) **Consistency**: The stock has not been assessed since 2007.
6) **Stock status**: It is not possible to evaluate stock status relative to reference points. SSB and recruitment appear to have declined to a very low level. Survey and fishery data indicate declining mortality since the mid-2000s.
7) **Management Plan**: None.

General comments

The WG met the ToRs by providing an update survey based assessment. The assessments were conducted following the procedures outlined in the Stock Annex, and appear to have been implemented correctly. The correct figures have been carried into the Advice sheets.

There are no ecosystems considerations described although reference is made to possible shifts in predation or regime shifts that could explain discrepancies between SURBA and XSA trends during the 1980s and 1990s.

Mixed fisheries is described as a problem as whiting is mainly linked with fisheries for cod and haddock in VIa that are affected by the cod management plan. Shifts in effort to small mesh *Nephrops* fisheries would worsen the exploitation pattern for whiting.

There is no management plan for VIa whiting.

Experimental runs using both in SURBA and XSA were performed to evaluated different possibilities for the assessment. The surveys available all have some quality issues, in many cases noisy, or changed and discontinued. Only the ScoGFSQ1 is used for the final SURBA run. However, the trends given by the Q1 and Q4 survey are qualitatively similar and lead to a similar conclusion regarding recent stock trends. The VIa whiting assessment suffers a similar problem to the North Sea whiting assessment in that survey data and XSA results agree for a recent period but diverge considerably in earlier years. The North Sea WG considers this could be due to bias in catch estimates, changes in survey catchability, or changes in natural mortality due to predation or regime shift. It is therefore not possible to consider biological reference points based on long-term XSA results.

Substantial discarding occurs in this stock. This may reduce substantially due to the mesh increase to 120 mm for whitefish vessels. The WG states that Scottish discards are being reworked. It is noted by the RG that the cited methodology for this nonetheless dates back to 2004. It is important that discards data are fully worked up by country and fleet prior to any benchmark assessment.

Technical comments

1) The WG states that weights-at-age from the commercial catch data were used to provide stock weights-at-age for this year’s assessment. It is not clarified why the surveys don’t deliver any reliable stock weights.

Conclusions

The RG considers that the updated survey analysis are suitable for providing advice on recent stock trends since the 1990s, but there are some difficulties in interpreting stock trends for earlier years. Even given the uncertainties in the performance of the assessment the stock is likely to be on its lowest level.

The WG outlines several feasible ways to improve the data and assessment before benchmarking and making a formal analytical assessment. The RG recommends that benchmarking of North Sea and west of Scotland whiting should take place at the same time as there appear to be similar problems with the long-term data for both stocks, and linkages between whiting in the two areas could be evaluated.

Whiting in Division VIIb, c (West of Ireland) (Southwest of Ireland)) (Report Section 7.16)

1) **Assessment type**: No advice
2) **Assessment**: not presented
3) **Forecast**: not presented
4) **Assessment model**:
5) **Consistency**:
6) **Stock status**: unknown
7) **Manageement Plan**: none.

General comments

Landings are very small 78 t and only a landing table is provided. It appears that France normally has landings for this stock, but no official data are available for 2009. This has however, not been mentioned.

Landings have been decreasing in time, from more than 2000 t in the mid-1990s to below 100 t at present. There are no indications from the WG whether this could be stock or market related. Some of the decline is due to the decreasing landings from France, but a large stock decline would be consistent with the picture for some other whiting stocks in the NE Atlantic.

Technical comments

None.

Conclusions

There is no scientific basis for providing advice for this stock.

Stock Annex 3.2: Cod in VIa

- Stock Annex 3.2 Cod VIa: for latest update see WGCSE 2009, Annex 03.2 Cod VIa

Stock Annex 3.3: Haddock in VIa

- Stock Annex 3.3 Haddock in VIa: for latest update see WGCSE 2009 Annex 03.3 Haddock VIa

Stock Annex 3.4: Whiting in Area VI

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Whiting (Area VI)
Working Group	Assessment of Northern Shelf Demersal Stocks
Date	17 May 2007
Last updated	25 May 2010 (a.jaworski@marlab.ac.uk)

A. General

A.1. Stock definition

Whiting occur throughout northeast Atlantic waters, in a wide range of depths, from shallow inshore waters down to 200 m. Adult whiting are widespread throughout Area VIa, while high numbers of juvenile fish occur in inshore areas. Whiting are less common in Division VIb, and it is likely these fish are migrants from VIa, rather than a separate stock.

While an exploration of stock identity in the North Sea has been carried out, stock definition in Area VI and surrounding waters remains poorly defined (ICES-SGISIMUW, 2005). Tagging experiments on recruiting fish have shown that whiting stocks west of Ireland are distinct from those in the Minches, Clyde and the Irish Sea. On the basis of preliminary results from FRS project MF0464, there appears to be three putative populations of whiting are found in VIa, between which interchange is limited. These are along the northwest of Scotland, the Stanton Bank region and the Firth of Clyde. Maximum likelihood analysis indicates a high degree of mixing for adult whiting between IVa whiting and the VIa component off the northwest of Scotland. Within VIa, there was little indication of interaction between population components in the south and that off the northwest coast.

A.2. The fishery

The demersal fisheries in Division VIa are predominantly conducted by otter trawlers fishing for cod, haddock, anglerfish and *Nephrops*, with bycatches of whiting, saithe, megrim, lemon sole, ling and a number of skate species. Since 1976, effort by Scottish heavy trawlers and seiners has decreased. Light trawler effort has declined rapidly since 1997 after a long-term increasing trend. More recently, days-at-sea limitations associated with the cod recovery plan and the seasonal closure of some areas has lead to some switching of effort away from VIa.

The demersal whitefish fishery in Area VI occurs largely in Division VIa with the UK, Ireland, Spain and France being the most important exploiters. Landings from Rockall (Division VIb) are generally less than 10 t. The whiting fishery in VIa is dominated by the UK (Scotland) and Irish fleets. French whiting landings have declined considerably since the late 1980s.

Landings of whiting in Division VIa are affected by emergency measures introduced in 2001 as part of the cod recovery programme. Council Regulation 423\2004 introduced a cod recovery plan affecting division VIa. The measures only take effect, however east of a line defined in Council Regulation No 51\2006. Measures brought in in 2002, such as a switch from 100 to 120 mm mesh codends at the start of 2002 (Commission Regulation EC2056/2001), are likely to have had some impact on whiting.The UK implemented a regulation requiring the fitting of a square mesh panel in certain towed gears.

Most catch of whiting comes in non-whiting directed fisheries, particularly the *Nephrops* trawl fishery. The *Nephrops* trawl fishery in VIa discards significant amounts of small whiting, making whiting landings figures a poor indicator of removals due to fishing. The proportion of whiting discarded has been very high and appears to have increased in recent years. Whiting also has a low market demand, which contributes to increased discarding and high-grading.

The minimum landing size of whiting in the human consumption fishery in this area is 27 cm.

There has been some problems regarding area misreporting of Scottish landings during the early 1990s, which are linked to area misreporting of other species such as haddock and anglerfish into Division VIb. More recently there has been area misreporting of anglerfish from VIa to IVa, which may have affected the reliability of whitings landings distribution.

A.3. Ecosystem aspects

No information.

B. Data

B.1. Commercial catch

Monthly length frequency distribution data were available from Scotland for Area VIa. A total international catch-at-age distribution for Division VIa was obtained using the raising procedure described in Section 2.3 to raise this distribution to the WG estimates of total international catch from this area. Landings officially reported to ICES were used for countries not supplying estimates directly to the WG. The Scottish market sampling length–weight relationships (given below) have been used to raise the sampled catch-at-length distribution data Working Group estimates of total landings for Division Via.

Month	b	a
1	2.9456	0.01
2	2.9456	0.0094
3	2.9456	0.009
4	2.9456	0.0088
5	2.9456	0.0088
6	2.9456	0.0089
7	2.9456	0.009
8	2.9456	0.0092
9	2.9456	0.0095
10	2.9456	0.0096
11	2.9456	0.0097
12	2.9456	0.0097

Discard age-compositions are generally available from both Scotland and Ireland, but in recent years (2006 and 2007) lack of access to fishing vessels by Irish observers has meant that no Irish data have been collected. Work is underway to revise the Scottish discard estimates with an aim to reduce bias and increase precision. Such revisions are particularly important for the estimation of total catch for this stock which has very high discards across a wide age range. A working document set out the methodology of this work at the 2004 meeting of WGNSDS (Fryer and Millar, 2004).

B.2. Biological

Natural mortality is assumed to be constant (M=0.2, applied annually) for the whole range of ages and years.

A combined sex maturity is assumed, knife-edged at age 2. The use of a knife-edged maturity ogive has been a source of criticism in previous assessments. However, recent research on gadoid maturity conducted by the UK (NI) gives no evidence for substantial change in whiting maturity since the 1950s, although there has been an increase in the incidence of precocious maturity-at-age 1, particularly in males, since 1998, in the Irish Sea.

As in previous years, SSB is computed at the start of each year, and the proportions of M and F before spawning were set to zero. Stock weights are calculated using a procedure first described in the 1998 Working Group report. To derive representative stock weights for the start of the year for year i and age j the following formula is adopted:

(CW i,j + CW i+1,j+1)/2 = SW at start of year.

B.3. Surveys

Four research vessel survey-series for whiting in VIa were available to the Working Group in 2007. In all surveys listed the highest age represents a true age not a plus group.

- Scottish first-quarter west coast groundfish survey (ScoGFSQ1): ages 1–7, years 1985–2010.

The survey gear is a GOV trawl, and the design is a minimum of one station per rectangle, but with more depending on logistic limitations. Ages are reported from 0 to the maximum obtained. Sex/Maturity-Sex and Maturity (ICES 4-stage scale) are reported. The Scottish groundfish survey has been conducted with a new vessel and gear since 1999. The catch rates for the series as presented are corrected for the change on the basis of comparative trawl haul data (Zuur *et al.*, 2001).

- Irish fourth-quarter west coast groundfish survey (IreGFS): ages 0–5, years 1993–2002.

The Irish quarter four survey was a comparatively short series, was discontinued in 2003 and has been replaced by the IRGFS.

- Scottish fourth quarter west coast groundfish survey (ScoGFSQ4): ages 0–8, years 1996–2009.

The Scottish quarter four survey was presented to the WG for the first time in 2007.

- Irish fourth quarter west coast groundfish survey (IRGFS); ages 0–6, years 2003–2009.

This survey used the RV Celtic Explorer and is part of the IBTS coordinated western waters surveys. The vessel uses a GOV trawl, and the design is a depth stratified survey with randomised stations. Effort is recorded in terms of minutes towed. There were 41 stations sampled in 2003, 44 in 2004 and 34 in 2005, corresponding to 1229, 1321 and 1010 minutes towed.

Further descriptions of these surveys and distribution plots of whiting catch rates obtained on these surveys can be found in the IBTS WG Report of 2008.

The indices are provided in Table B.1.

The distribution of catches per unit of effort from the surveys in 2008 are given in Figure B.1 for the Scottish fourth quarter west coast groundfish survey (ScoGFSQ4); and Figure B.2 for the first quarter west coast groundfish survey (ScoGFSQ1).

B.4. Commercial cpue

Due to a number of concerns regarding the non-mandatory recording of effort in terms of hours fished, the present assessment of the stocks does not make use of commercial catch per unit of effort data. The data are included here for completeness (Table B.2) and include:

- Scottish light trawlers (ScoLTR): ages 1–7 years 1965–2005
- Scottish seiners (ScoSEI): ages 1–6 years 1965–2005
- Scottish Neprhops trawlers (ScoNTR): ages 1–6 years 1965–2005
- Irish Otter Trawlers (IreOTB): ages 1–7 years 1995–2005

Data to update these time-series were not available for 2006 or 2007.

B.5. Fecundity

Fecundity data for a number of areas are available from Hislop and Hall (1974), and was estimated at 4.933 $L^{3.25}$ for whiting in Area VI.

C. Historical stock development

Whiting has never been a particularly valuable species and has tended not to be targeted by commercial fishermen. It tends to be taken more as a bycatch, with other species fished more intensively in Division VIa, such as haddock, cod and angler fish. As with other gadoids in VIa, whiting stocks have declined steadily since the late 1970s.

D. Short-term projection

Not done.

E. Medium-term projections

No medium-term projections are carried out for this stock.

F. Yield and biomass-per-recruit/long-term projections

Not done.

G. Biological reference points

Precautionary approach reference points:

> VIa-"Long-term information on the historical yield and catch composition all indicate that the present stock size is low. A survey-based assessment covering the more recent period indicates that the stock is at its lowest level over this time period. Total mortality is at the highest level over the time period.

ICES considers that B_{lim} is 16 000 t and B_{pa} be set at 22 000 t. ICES proposes that F_{lim} is 1.0 and F_{pa} be set at 0.6."

VIb-"Landings of whiting from Division VIb are negligible. No assessment has been carried out on this stock."

H. Other issues

None.

I. References

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ICES. 2000. ICES CM 2000/ACFM:1.

ICES-SGSIMUW. 2005. Report of the Study Group on Stock Identity and Management Units of Whiting. ICES CM 2005/G:03.

Table B.1. Available survey tuning-series. For IreGFS, effort is given as minutes towed, numbers are in units.

SCOGFSQ1: Scottish Groundfish Sruvey - Effort in hours - Numbers at age								
	Effort	Age						
Year	(hours)	1	2	3	4	5	6	7
1985	10	3140	1792	380	85	23	156	18
1986	10	1456	1526	403	68	10	9	10
1987	10	6938	1054	584	143	36	2	1
1988	10	567	3469	653	189	42	5	1
1989	10	910	505	586	237	48	3	0
1990	10	1818	572	122	216	61	4	1
1991	10	3203	277	298	22	39	9	1
1992	10	4777	1597	410	517	56	18	0
1993	10	5532	6829	644	91	30	11	2
1994	10	6614	2443	1487	174	56	15	6
1995	10	5598	2831	1160	370	70	17	32
1996	10	9384	2238	635	341	135	30	5
1997	10	5663	2444	1531	355	102	17	4
1998	10	9851	1352	294	195	50	14	1
1999	10	6125	4952	489	103	16	1	0.4
2000	10	12862	471	152	34	10	11	0
2001	10	4653	1954	242	41	8	1	1
2002	10	5542	1028	964	86	15	1	1
2003	10	6934	746	436	300	32	2	4
2004	10	5888	1566	189	131	44	9	1
2005	10	1308	723	183	35	8	11	2
2006	10	1441	466	282	77	0.3	3	0.6
2007	10	614	522	127	75	16	3	2
2008	10	593	127	77	26	8	3	0
2009	10	906	387	103	105	20	9	7
2010	10	3523	340	108	52	40	4	3

IR-WCGFS : Irish West Coast GFS (VIa) - Effort (min. towed) - Whiting number at age							
	Effort	Age					
Year	(min)	0	1	2	3	4	5
1993	2130	14403	32643	11419	1464	231	13
1994	1865	264	11969	4817	2812	78	57
1995	2026	34584	5609	6406	734	186	80
1996	2008	376	7457	3551	374	232	5
1997	1879	1550	13865	8207	1022	524	50
1998	1936	1829	4077	3361	663	121	5
1999	1914	3337	3059	1965	322	11	12
2000	1878	682	10102	2126	109	109	4
2001	965	1118	5201	2903	149	70	3
2002	796	594	8247	9348	820	280	0

(cont). Whiting in VIa. Available survey tuning-series. For ScoGFSQ4, numbers are standardised to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardising.

	IRGFS: Irish groundfish survey – effort in minutes – numbers at age							
	Effort	Age						
Year	(min)	0	1	2	3	4	5	6
2003	1127	1101	12886	2894	512	290	102	1
2004	1200	6924	3114	1312	104	35	16	1
2005	960	910	2228	1126	91	5	4	0
2006	1510	99	1055	921	214	27	3	0
2007	1173	138	1989	2380	722	169	251	122
2008	1135	24	4342	1328	573	243	123	36
2009	1378	16906	1430	989	325	68	21	41

	ScoGFSQ4 : Quarter four Scottish groundfish survey – Effort in hours – numbers at age									
	Effort	Age								
Year	(hours)	0	1	2	3	4	5	6	7	8
1996	10	5154	1908	1116	570	188	51	6	1	0
1997	10	8001	2869	951	323	160	46	12	1	0
1998	10	1852	2713	1124	149	100	20	1	0	+
1999	10	8203	2338	582	141	33	24	1	1	0
2000	10	4434	4055	789	160	9	7	1	0	0
2001	10	9615	1957	1420	155	40	12	2	0	0
2002	10	14658	1591	621	479	30	9	5	0	0
2003	10	9932	3446	567	338	83	27	4	0	0
2004	10	5923	1758	940	83	57	62	1	0	0
2005	10	2297	308	318	76	9	4	0.9	0.7	0
2006	10	415	296	140	101	35	8	3	0.5	0
2007	10	1894	434	326	99	83	48	0.6	0	0
2008	10	2297	208	78	110	28	24	4	0	+
2009	10	4833	236	178	50	58	12	6	6	0

Table B.2. Commercial cpue tuning-series available to whiting in VIa.

2009 WHITING AREA 6A							
108							
SCOLTR: Scottish Light Trawl: Effort in hours: Numbers-at-age (thousands)							
1965	2005						
1	1	0	1				
1	7						
37387	2011.623	469.253	3512.923	393.473	14.925	5.445	0.909
40538	1036.117	926.485	162.985	5508.27	333.46	32.68	6.196
80916	2539.797	4967.604	1637.023	101.256	2456.915	133.979	12.466
65348	1931.014	3404.448	1868.458	677.298	51.295	844.125	58.939
106856	46.897	8823.442	2211.584	578.006	278.879	28.188	516.892
129741	94.958	5275.823	8514.611	712.848	143.241	35.554	3.428
137728	1566.57	4472.064	1026.561	9818.08	337.772	63.477	25.237
154288	13450.885	4637.042	1716.159	334.786	5435.152	309.86	29.756
93992	4613.649	12778.492	680.372	148.997	42.975	478.522	39.083
88651	7452.711	15917.02	1773.837	159.241	17.112	6.477	78.812
132353	10597.964	6684.991	10431.537	837.283	79.71	12.155	2.811
139225	10858.324	15481.895	3550.826	5483.438	412.525	13.045	4.668
143574	18222.115	4276.619	5983.177	773.244	1126.782	74.579	1.916
127387	9805.191	5887.935	1561.61	1814.903	127.832	244.126	3.76
99803	1846.163	9530.148	2446.896	368.018	290.896	31.887	57.01
121211	1856.938	4385.272	4359.469	1052.873	170.989	172.29	10.997
165002	983.137	13544.1	4617.56	1330.75	504.711	152.752	62.619
135280	8248.806	2593.129	10934.792	1899.759	316.934	74.891	62.409
112332	4809.036	4322.894	2548.597	8292.216	1696.241	253.9	54.475
132217	29865.064	4084.418	2582.188	1149.781	5206.862	592.972	221.473
142815	9243.535	11577.551	2515.313	663.96	360.662	917.939	82.73
126533	3187.288	6006.487	2693.592	621.738	98.497	50.635	93.945
131720	12328.429	6004.925	2767.12	1229.144	147.776	43.178	32.132
158191	5358.52	15325.219	2988.119	1334.433	316.668	46.956	2.997
217443	3161.234	1640.767	5226.339	1473.139	434.728	129.89	14.252
169667	4110.42	4152.38	972.043	1380.502	386.872	51.478	6.092
209901	7018.52	2968.053	3981.784	336.752	423.153	73.429	5.829
189288	9761.596	6548.587	1727.049	2100.437	113.974	102.439	10.66
189925	2623.886	10105.623	4392.988	1169.932	1701.769	51.678	46.841
174879	3251.43	6503.608	5363.793	1739.967	333.927	291.821	13.881
175631	1775.509	5661.947	5310.813	1995.375	569.453	114.177	107.935
214159	2738.034	8043.865	4647.63	2543.265	833.461	213.15	24.196
179605	3107.284	3973.701	5098.515	1858.52	532.696	95.153	39.379
142457	3997.939	3171.019	2547.76	2327.54	654.589	149.808	79.812
98993	559.916	3273.961	1709.217	814.593	793.265	122.037	34.883
76157	4363.101	2324.771	2202.561	627.094	169.833	201.883	8.678
35698	575.281	2603.626	1358.595	783.414	117.804	37.996	5.442
15174	389.652	848.153	1566.132	374.617	166.509	16.845	5.038
9357	565.293	207.507	273.115	578.307	100.052	41.916	0.206
7116	1769.901	1215.938	242.922	199.9	221.001	27.997	3.138
3063	217.522	400.094	268.966	23.085	27.158	14.318	2.462

Table B.2. continued.

SCOSEI: Scottish Seine: Effort in hours: Numbers-at-age (thousands)						
1965	2005					
1	1	0	1			
1	6					
153103	8570.938	4534.63	19453.707	1412.984	62.399	15.334
156511	2872.249	12671.39	1491.149	13027.566	736.15	68.22
158208	7058.77	23604.969	5804.573	363.182	5528.921	304.951
150094	11817.932	14128.65	4897.227	1409.535	134.705	1651.222
140718	1314.237	19167.426	4024.433	1038.908	420.643	45.006
95629	979.255	2065.056	9177.95	815.703	176.987	51.144
98748	3280.938	6459.36	2466.983	14808.06	484.003	73.488
70741	20563.777	7286.501	1143.727	588.902	3139.349	112.588
59596	16428.303	16410.354	1995.231	373.15	97.243	886.47
56448	8764.309	28089.33	3578.12	289.184	22.105	9.317
56420	15931.473	9161.576	13093.543	585.337	37.682	9.127
57090	7559.305	30718.529	6226.15	4887.683	283.504	18.081
41920	14522.98	4873.693	6783.85	584.118	1035.664	43.296
33599	9880.994	4708.252	812.33	1086.089	65.835	152.233
38465	3779.036	13497.126	3739.924	473.079	392.189	16.481
38700	2222.899	3686.353	4277.55	1081.223	273.049	118.803
37208	789.787	9229.84	3128.155	1025.456	426.614	90.387
36689	1146.222	1977.49	9664.041	1183.655	229.857	68.248
38080	3803.96	3110.436	1942.945	5805.497	1181.95	138.395
29561	3965.733	2170.117	1220.296	382.107	2024.552	218.843
26365	18813.885	6473.455	1248.851	327.561	171.234	557.447
19960	1423.965	4902.12	1815.778	359.211	53.845	24.911
26332	8664.831	3706.126	2068.674	916.903	142.281	19.137
21383	7392.194	8210.657	1658.022	1078.674	218.449	22.005
39350	2182.008	1845.431	4488.746	1282.547	272.354	186.923
27664	2699.332	2964.297	687.892	940.682	279.68	34.508
25787	4160.412	2318.718	3285.513	305.785	290.789	53.282
20273	7513.958	5370.645	1341.721	1622.613	102.037	101.204
24315	1509.725	6046.03	2291.531	675.422	789.292	22.916
21305	1725.208	3310.909	2498.717	701.186	108.245	140.133
21950	721.806	2616.333	2260.832	970.329	298.966	83.208
15205	1270.19	2353.781	1371.875	819.771	297.3	67.732
11449	1096.1	1273.361	1933.262	696.409	187.498	33.748
11166	4251.142	1659.104	1010.394	614.297	265.65	62.355
8638	823.21	2152.386	706.708	294.599	179.097	43.194
6431	2601.077	887.944	755.637	152.896	66.565	19.536
5893	728.924	1007.442	454.373	240.788	40.285	22.082
3817	335.558	583.357	482.121	132.428	40.991	2.935
2370	3130.339	260.924	133.135	290.007	34.543	8.6
1173	7323.289	758.611	165.379	83.46	77.222	2.096
476	676.408	225.196	143.246	10.154	15.355	3.048

Table B.2. continued.

SCONTR: Scottish Nephrops Trawl: Effort in hours: Numbers-at-age (thousands)					
1965	2005				
1	1	0	1		
1	6				
101975	1659.715	453.604	1101.02	102.448	4.875
116972	613.623	951.561	154.546	785.807	44.575
135811	1788.967	2002.916	444.377	15.668	322.969
166713	1761.346	1850.07	637.399	159.199	12.641
155131	736.536	2706.572	437.098	155.072	44.263
144704	439.172	645.419	1379.363	127.922	31.719
127638	1072.488	444.198	235.897	1405.7	60.499
185397	3744.591	1908.742	232.266	70.731	730.108
186342	3462.89	5445.012	486.932	168.428	24.824
186342	1933.55	5427.964	650.405	87.286	11.605
203053	5916.971	2730.363	2846.712	319.449	35.425
224347	4061.224	4343.339	893.637	1142.92	125.278
196403	3573.612	1393.724	1431.401	168.241	289.689
219562	6053.242	2596.492	417.688	570.766	110.339
273713	659.614	3413.303	934.795	207.461	216.936
254147	1439.22	1529.161	1377.826	281.539	44.696
286461	1090.91	5250.686	1199.303	430.934	105.108
288902	2882.413	422	2552.725	439.981	95.697
293396	2702.936	1289.896	464.524	1258.148	205.504
312947	15763.118	731.211	414.638	132.72	870.58
384215	14885.186	3109.454	505.209	225.601	91.132
368971	2231.072	1259.03	707.734	246.405	8.838
395355	12048.819	1562.25	799.307	375.73	43.994
397682	19926.506	12751.985	539.705	138.471	31.741
379169	9854.602	485.161	443.582	152.424	71.883
390391	7434.593	1407.942	58.831	63.502	8.758
414817	13745.576	1280.079	294.651	27.112	43.958
391325	15245.132	3122.017	453.21	211.635	19.575
406753	6063.665	2833.312	611.27	159.111	112.856
380688	22785.318	4821.332	2174.707	613.104	18.004
333756	14759.284	5645.468	494.013	362.773	33.499
345007	14700.369	1316.965	633.638	192.741	44.427
354884	7854.017	1893.631	387.294	176.713	17.444
350882	13268.769	1926.434	620.474	116.935	63.417
337585	7208.116	1905.577	475.713	92.945	80.71
332659	31208.406	934.503	360.23	101.447	28.855
305743	1743.097	1271.809	189.3	80.436	14.844
258169	7281.766	1291.392	483.271	29.948	8.517
255729	4468.485	586.213	191.646	197.557	41.643
232356	3881.27	1310.954	239.992	157.625	102.126
220936	1738.881	829.542	258.178	41.47	16.707

Table B.2. continued.

IreOTB : Irish otter trawl – Effort in hours – numbers at age (thousands)							
1995	2005						
1	1	0	1				
1	7						
56335	222	298	530	461	92	28	98
60709	165	531	670	281	175	33	12
62698	99	358	515	282	339	133	89
57403	51	1092	552	312	186	218	232
53192	98	315	437	266	198	109	123
46913	50	131	188	303	158	76	65
48358	14	304	144	101	126	100	44
37231	31	162	388	27	65	97	47
39803	90	294	604	492	131	30	0
35140	33	387	266	245	200	28	21
30941	23	159	188	78	41	19	2

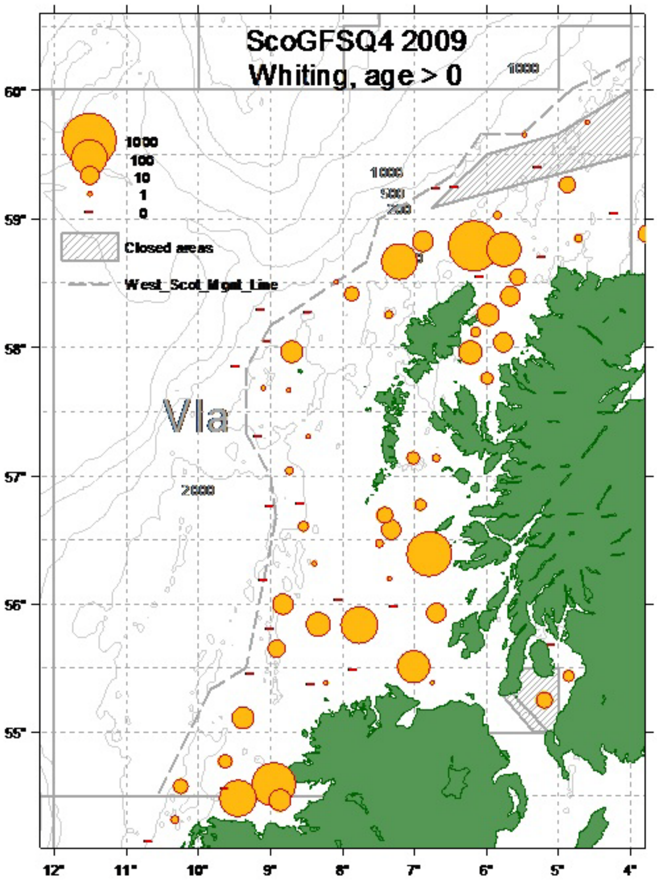

Figure B.1. Map of the west coast of Scotland showing the catch per unit of effort of whiting during the 2009 Scottish fourth quarter west coast groundfish survey. Each circle is centred on the sample location and the size of the circle is proportional to the number density (n/30 min fished) of whiting at age 1+, according to the legend (top left).

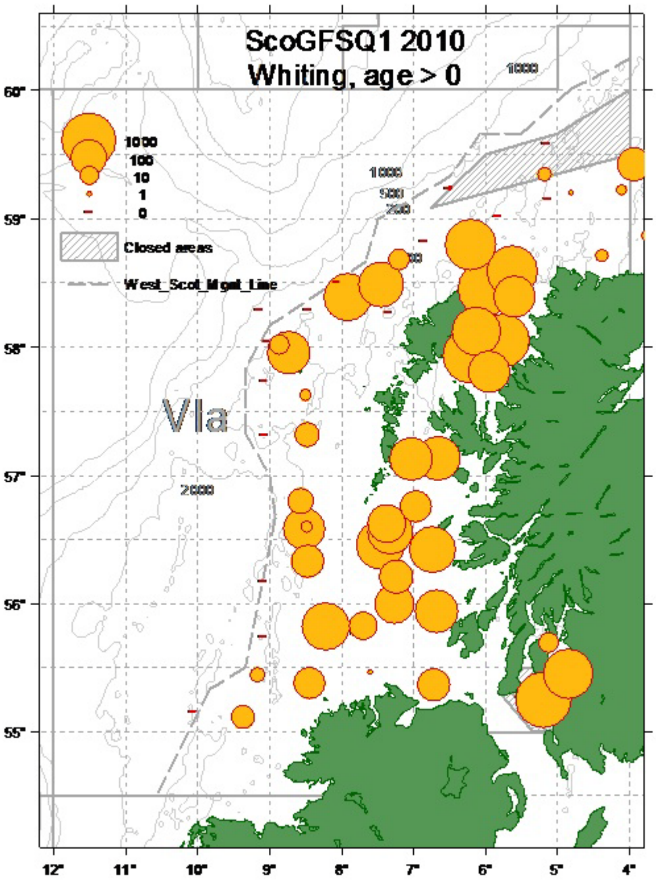

Figure B.2. Map of the west coast of Scotland showing the catch per unit of effort of whiting during the 2010 Scottish first quarter west coast groundfish survey (ScoGFSQ1). Each circle is centred on the sample location and the size of the circle is proportional to the number density (n/30 min fished) of whiting at age 1+, according to the legend (top left).

Stock Annex 3.5: *Nephrops* in VIa FU11

- Stock Annex 3.5 *Nephrops* VIa FU11: for latest update see WGCSE 2009, Annex 03.5 *Nephrops* VIa FU11.

Stock Annex 3.6: *Nephrops* in VIa FU12

- Stock Annex 3.6 *Nephrops* VIa FU12: for latest update see WGCSE 2009, Annex 03.6 *Nephrops* VIa FU12.

Stock Annex 3.7: *Nephrops* in VIa FU13

- Stock Annex 3.7 *Nephrops* VIa FU13: for latest update see WGCSE 2009, Annex 03.7 *Nephrops* VIa FU13.

Stock Annex 4.3: Haddock in Division VIb

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Haddock in Division VIb
Working Group:	WGCSE
Date	20 May 2010
Revised by	Vladimir Khlivnoy, Andrzej Jaworski

A. General

A.1. Stock definition

The haddock stock at Rockall is an entirely separate stock from that on the continental shelf of the British Isles (Chuksin and Gerber, 1976; Shestov, 1977; Blacker, 1982; Newton *et al*., 2008). The TAC for haddock VIb was previously (before 2004) set for Subarea Vb, VI, XII and XIV combined, with a limitation on the amount to be taken in Vb and VIa. In 2004, the TAC for Division VI was split and the VIb TAC for haddock was included with Divisions XII and XIV. This combined TAC has been in place since then.

A.2. Fishery

The development of the Rockall haddock fishery is documented in the 2001 Working Group Rneport (ICES-WGNSDS, 2001) and in the Report of the ICES Group meeting on Rockall haddock convened in January 2001 (ICES, WGNSDS, 2002). That meeting was set up to respond to a NEAFC request for information on the Rockall haddock fishery. NEAFC agreed to consider regulation of the international fishery in 2001.

The Rockall haddock fishery changed markedly in 1999 when a revision of the EU EEZ placed the southwestern part of the Rockall plateau in international waters. This has opened opportunities for other nations, notably Russia, to exploit the fishery in this area. The table of official statistics includes Russian catches from the Rockall area.

The Russian fleet started fishing operations in international waters at Rockall in May–October 1999. The Russian haddock fishery uses bottom trawls with cod-end mesh size of 40–100 mm (mainly 40–70 mm) and retains haddock of all length classes in the catch. This fishery targets concentrations of haddock mainly during the spring and the beginning of summer. Russian catches increased from 458 t in 1999 to 2154 t in 2000. In 2001, they were markedly reduced to 630 t due to the introduction of a closed area and low density of fish concentrations. Russian catches increased again in 2002–2004 from 1630 to 5844 t. In 2005–2007, they decreased from 4708 t to 1282 t, and are estimated to be 1669 t in 2008.

Prior to 1999, the UK and Ireland fisheries had been principally summer fisheries but in more recent years the Scottish and Irish fishery was conducted throughout the year with the peak in April–May. This shift in the fishery appears to have followed the discovery of concentrations of haddock in deeper water to the west of Rockall, at depths between 200 and 400 m. High catch rates attracted effort into the area. However, catch rates in 2000 were reported to be poor in deeper water. Anecdotal evidence suggests that increased discarding has been associated with the deeper-water fishery compared to the traditional fishery at northern Rockall. In 2004–2007, a considerable proportion of EU landings were taken in the international waters. Historical fishing patterns of the Scottish fleet at Rockall are presented by Newton *et al*. (2004).

There are some indications that, due to a general decline in catches by the Scottish and Irish fleets in Division VIa, there is an increasing focus in the Rockall fishery in Division VIb (ICES, WGFTFB, 2007). Paired gear (both seine and trawl) are to be tested by some Scottish fishermen, which, if it proves successful, can lead to a considerable increase in effective effort in VIb. The fishery at Rockall seems particularly attractive given the lack of effort restrictions in this area.

Information on the Russian fishery and biological investigations from commercial vessels fishing in Rockall during 2008 are presented in WD11 to WGCSE 2009.

An analysis of the spatial and depth distributions of Rockall haddock in association with oceanographic variables is presented by Vinnichenko and Sentyabov (2004), a WD to WGNSDS 2004. Changes in distribution have occurred over a period coincidental with changes in oceanographic variables. Information on oceanographic conditions on Rockall bank in spring 2005 was presented by Sentyabov at WGNSDS 2005.

A.3. Ecosystem aspects

In May 2001, the International Waters component of statistical rectangle 42D5, which is mainly at depths less than 200 m, was closed by NEAFC to all fishing activities, except with longlines. That area had the following coordinates:

Latitude	Longitude
57.000°N	15.000°W
57.000°N	14.700°W
56.575°N	14.327°W
56.500°N	14.450°W
56.500°N	15.000°W

In spring 2002, the EU component of this rectangle, again mostly shallow water, was also closed to trawling activities (EC No 2287/2003). The whole Rockall Haddock Box is bounded by the following coordinates:

Latitude	Longitude
57°00′N	15°00′W
57°00′N	14°00′W
56°30′N	14°00′W
56°30′N	15°00′W

At the 25th Annual Meeting of NEAFC (in November 2006), a closure of three areas on the Rockall Bank to bottom fishery was proposed to protect cold-water corals: North West Rockall, Logachev Mounds and West Rockall Mounds (NEAFC AM, 2006). This measure will be in force for the period January 2007–December 2009.

In 2007, the ICES prepared advice for NEAFC and arrived at the conclusion about the expediency of establishing a new closed area on the so-called Empress of British Banks and adjusting the boundaries of the currently closed area of Northwest Rockall. At the 26th Annual Meeting of NEAFC (in November 2007), a new closed area (Empress of British Banks) was established, and the boundaries of the Northwest Rockall closure were slightly modified (NEAFC AM, 2007). Due to the complex shape of the boundaries of the Northwest Rockall closure proposed by ICES, which potentially could cause problems with enforcement, the introduced changes differed from the ICES recommendation. NEAFC also requested ICES to continue providing all available new information on distribution of vulnerable habitats in the NEAFC Convention Area and fisheries activities in and in the vicinity of such habitats.

WGDEC supported the ICES conclusion on the necessity of revising the boundaries of the Northwest Rockall area established to protect cold+water corals and recommended to consider proposals at the WGNSDS meeting. These recent proposals greatly simplify the boundaries, which would create better conditions for enforcement (see WD8 to WGNSDS, 2008).

B. Data

B.1. Commercial catch

Landings

Nominal landings as reported to ICES are given in Table 4.3.1 of the main Report, along with Working Group estimates of total estimated landings. Reported international landings of Rockall haddock in 1991–2005 were about 4000–6000 t, except for 2001–2002, when they decreased down to about 2300–3000 t. In 2006, they were also low at 2760 t, but increased slightly to 3348 in 2007, and 4221 t in 2008. Revisions to official catch statistics for previous years are also shown in Table 4.3.1.

Anecdotal evidence suggests that misreporting of haddock from Rockall have occurred historically (which may have led to discrepancies in assessment), but an estimation of overall magnitude is not possible.

Age composition and mean weight-by-age of Scottish and Irish landings were obtained from port sampling. Data on the volume, length-age and weight composition of landings for the period from 1988 to 1998 correspond to values used at this WG.

In 2002, there was no sampling of the Russian catch and therefore the length composition has to be estimated for this year.

In 2002 and 2003, the structure of the Russian fishery on the Rockall Bank was the same: the same vessels were operating with the same gear in the same fishing areas. The relationship between the haddock length composition obtained from the trawl survey and that in the Russian catches is assumed to be the same for 2002 and 2003; i.e. it is assumed that the length dependent selectivity pattern in 2002 is the same as that in 2003 as there no changes to the fishery in these years. The relationship is described as:

$$P_L = S_L p_L \qquad (1)$$

where P_L is the proportion of fish with length L in catches, p_L is proportion of fish with length L in the stock (survey), and S_L is the proportion of fish of length L taken aboard. S_L is determined using a theoretical selectivity curve (Stock Annex, Figure 4.3.1) which may be described by the following formula:

$$S_L = \frac{1}{1+\exp(S_1 - S_2 L)}. \qquad (2)$$

where SL is the proportion of fish of size L taken aboard, L is the size group, S1 and S2 are coefficients.

The selectivity curve (Stock Annex, Figure 4.3.1), fitted to the data on catch measurements in different periods of the Russian fishery in 2003 is described well by Equation 2 with coefficients S1 = 12.539 and S2 = 0.4951. The estimated length frequency distributions for 2003 are compared with the measured length frequency distributions for this year in Stock Annex, Figure 4.3.2. The size distribution in the Russian catch in 2002 is then estimated by applying the theoretical selectivity curve to the survey length frequency in 2002.

To determine the age composition in Russian catches in 2002, the combined age–length key for all years of Russian catches was used.

Discards

The haddock catch estimated by landings is underestimated as a result of unaccounted discarding of small individuals in the Scottish and Irish fisheries in most years. On Russian vessels, the whole catch of haddock is retained onboard and therefore, total catch is equivalent to landings.

Haddock discards onboard Scottish vessels in 1999 and 2001 and Irish vessels in 1995, 1997, 1998, 2000 and 2001 were determined directly. In other years, indirect estimates of discarding were calculated.

The direct estimates from the Scottish trawlers in 1985, 1999 and 2001 showed a higher proportion of discards of small haddock: from 12 to 75% by weight (Table 4.3.6 in the main report) and up to 80–90% of catch numbers. Discard trips in 1995, 1997, 1998, 2000 and 2001 showed that discarding by Irish fishing vessels also reaches considerable values (Table 4.3.7 in the main Report).

Total numbers and weight landed and discarded by age on the Scottish observer trips in 1999 and 2001 are presented in Stock Annex, Tables 4.3.1 and 4.3.2.

The analysis of the discard data collected by Scottish scientists in 1999 and 2001 indicated that only a relatively small proportion of fish taken aboard is landed (Figure 4.2.5). The probability of being retained increases with increasing fish length (Stratoudakis *et al.*, 1999; Palsson *et al.*, 2002; Palsson, 2003; Sokolov, 2003). The relationship between the number of individuals caught and number discarded may be described by the following relationship:

$$ND_L = PD_L \times NP_L \quad (3)$$

where ND_L is the number of discarded fish with length L, NP_L is the number of fish caught at length L, PD_L is the portion of discarded fish at length L.

The length composition of fish taken onboard by Scottish and Irish trawlers was calculated by applying the logistic selectivity curve (Stock Annex, Figure 4.3.3) to the haddock stock length composition obtained from the survey. The selectivity parameters were calculated from Scottish and Irish catches taken by trawls with mesh size that are typical for the fleets of those countries operating at Rockall. The parameters were calculated as S_1 = 12.608 and S_2 = 0.4360 for the Scottish fleet. S_1 = 26.248 and S_2 = 0.8524 were used for Irish catches.

The catch-at-length compositions obtained by the theoretical curve of selectivity agree well with available results of catch measurements in 1999 and 2001and the distributions are compared in Stock Annex, Figure 4.3.4.

The proportion of fish discarded from catches at different sizes may be determined and modelled using a logistic curve (Stock Annex, Figure 4.3.5) described by the following equation:

$$PD_L = \frac{1}{1 + \exp(-b(L - DL_{50}))} \qquad (4)$$

where L is size group, DL_{50} is the fish length at which 50% of this size fish caught are discarded and b is a constant reflecting the angle of curve slope. The parameters were determined from research on discards by Scottish vessels (Stock Annex, Table 4.3.3). The following values were used in subsequent calculations: $DL_{50} = 34.66$ cm, $b = -0.8764$. The logistic curve of discards may be found using Equation 2 and the coefficient values: $S_1 = -15.494$ and $S_2 = -0.4565$.

To determine abundance of discards the following procedure was used:

a) A theoretical catch-at-length distribution (%) was calculated by applying the theoretical selectivity curve to the survey length composition.

b) An estimate of total catch-at-length was made by summing the reported landings-by-length to the number of discards-at-length calculated from the assumed discard ogive and the landings-at-length data.

c) An intermediate theoretical catch size distribution in numbers is calculated by dividing the estimate of the total numbers retained (numbers greater than 34 cm) in B by the fraction retained from the theoretical catch length distribution calculated in a).

d) Theoretical discard size frequency is then calculated by applying the theoretical discard ogive to the intermediate theoretical catch size distribution.

The spreadsheet containing these calculations can be found in the stock file.

Calculations where the discard curve was applied agree well with the results of size composition measurements by Scottish vessels in 1999 and 2001 (Stock Annex, Figure 4.3.6).

Aboard Irish vessels, larger fish are retained (Stock Annex, Figure 4.3.7). The portion of discards was calculated using Equation 2 with coefficients $S_1 = -10.093$ and $S_2 = -0.2459$, from the combined 1995–2002 Irish discard trips.

The Russian fleet fish in the areas covered only partially by the bottom+trawl surveys. However, Russian vessels retain all haddock and therefore there is no need to calculate discards. There is no information on large-scale fisheries of other countries outside the surveyed area. In addition, available data on the real length composition of catches indicate a correspondence between length composition obtained by the results from surveys and commercial catches, including the catches obtained in the parts of Russian fishery (Stock Annex, Figures 4.3.2 and 4.3.6).

The amount of discarded haddock by age was determined using a length–age key derived by the data collected during the trawl survey allowing for selectivity of the fishery (Stock Annex, Figure 4.3.3).

In 1998 and 2000, the trawl survey for haddock in the Rockall Bank area was not carried out. To determine the haddock length composition in these years, the length distribution was calculated from the survey data in the previous and following years.

For this purpose, the length–age matrices characterizing the stock status in the years before and after the missing data year were obtained. The length–age distribution from the year before the missing year was projected forward on the basis of mean growth increment at age and estimated total mortality. Similarly the distribution from the year after was projected backwards. The length composition in the missing year was then calculated from these two estimates.

The total loss (Z) used in the calculation described above was determined by minimization of values of deviation square sum between survey age group abundance values in previous and following years by the data from surveys and calculated data. At that, the factor of age effect (S_a) was taken into account. The mean growth increment at age was also estimated from the survey data. The method of calculation is explained further in WD8 to WGNSD 2004 and a spreadsheet showing the calculations is in the stock file.

B.2. Biological

Age composition and mean weight-at-age of Scottish and Irish landings were obtained from port sampling.

Age composition and mean weight-at-age of Russian landings were obtained by observers onboard commercial fishing vessels. In 2002, there was no sampling of the Russian catch and therefore the length composition for that year had to be estimated (for estimation details, see Stock Annex). Observer data from commercial vessels are also available for Norwegian landings for 2006–2008.

In the absence of any direct estimates of natural mortality, M has been set at 0.2 for all ages and years.

Natural mortality coefficient and portion of mature individuals by age used for estimation correspond to those adopted by Working Group before.

Previous Working Groups have adopted a maturity ogive with knife-edge maturity-at-age 3 in assessments of this stock (see the Table below).

Age	1	2	3	4	5	6	7+
Proportion mature	0	0	1	1	1	1	1

The data from new Russian histological examination of haddock gonad samples mass sexual maturation occurs at age of two years with length of 25 cm (WGNSDS WD6 2006). These data agree well with the results of recent Scottish research in compliance with which the majority of fish become mature at the age of 2 years (ICES 2003; Newton *et al.*, 2004). Visual estimation of maturity stage of post-spawning haddock on the Rockall Bank in expeditions leads to considerable errors. For more precise estimation of length and age-at-maturity for haddock it is necessary to conduct investigations in pre-spawning and spawning periods as well as to collect gonads for further histological analysis (see WGNSDS WD6 2006 for further details).

Research on determining more precise values for natural mortality and maturity ogive parameters should be continued and new estimates could be used in future stock assessments.

In the absence of any direct estimates of natural mortality, M has been set at 0.2 for all ages and years. MSVPA estimates for the North Sea haddock stock give estimates of M of 2.05 at age 0, 1.65 at age 1, 0.40 at age 2, 0.25 at ages 2 and 4, and 0.20 at ages 5+ (ICES CM 2003/ACFM:02). Similarly, large values of M at the younger ages at Rockall would have implications for interpretation of fishing mortality patterns from survey-based methods such as SURBA which essentially estimate total mortality conditional upon assumptions regarding survey catchability-at-age.

ACFM in 2001 encouraged the WG to investigate a more realistic maturity ogive for this stock. At the 2002 Working Group combined sex maturity ogives were presented to the WG for Russian sampling in 2000–2001 and Scottish sampling in 2002. In 2003 new sex disaggregated maturity data were supplied to the Working Group for Russian sampling. The results of all these recent studies indicate that a high proportion of both females and males at age 2 were mature.

B.3. Surveys

There is only one research survey index available for VPA assessment of this stock from the Scottish survey conducted annually in September (Figure 4.2.4, Table 4.2.8). However, from 1997 onwards the Scottish survey was only conducted in alternate years. Due to concerns about the haddock stock at Rockall some extra time was allocated to carry out a partial survey in September 2002. Full surveys have been conducted since 2005 to improve the quality of assessment. The Scottish survey is currently conducted on about 40 (the target number for a survey) standard trawl stations. However, the survey area and number of stations varied in different years. The majority of stations are within the 200 m depth contour. In 2002 the survey was carried out in the central and northern parts of the bank. In 1999 the survey switched from using an Aberdeen 48′ bottom trawl to a GOV trawl and from 60 min tows to 30 min tows. The indices have been adjusted for tow duration, but no calibration has been made for gear changes. A 20 mm mesh size is used on the survey.

In spring 2005, the Russian trawl-acoustic survey (TAS) for haddock on the Rockall Bank was conducted for the first time (Oganin *et al*., 2005). However, no such survey has been carried out in subsequent years. In the 2005 survey, the trawl survey method estimated the total stock number at 190.63 million individuals and its biomass at 43 400 t (see the Table below). The acoustic survey yielded a haddock biomass estimate of 60 000 t with the abundance of 225.9 million (see the WGNSDS 2006 Report for more details of the trawl-acoustic survey). The estimates of haddock abundance and biomass from the two methods are quite similar. The results of the Russian trawl-acoustic survey are summarised in the Table below:

Survey type	Area component	Area (sq. miles)	Total stock		Spawning stock	
			Abundance (106)	Biomass (103 t)	Abundance (106)	Biomass (103 t)
Trawl survey	Whole	5554	190.6	43.4		
Acoustic survey	International waters	3374	144.2	41.1	133.0	38.5
	EU zone	2180	81.7	18.9	52.4	16.3
	Whole	5554	225.9*	60.0*	185.4	54.8

*** Pelagic component estimated to make up 13.7%.**

The Irish Fisheries Board (BIM) and the Marine Institute recently conducted a collaborative series of surveys to assess the length structure of haddock at various locations on the Rockall Bank and tested the selectivity of a number of codend configurations, which are typically used by both the Irish and Russian fleets.

B.4. Commercial cpue

Commercial cpue series are available for Scottish trawlers, light trawlers, seiners, Irish otter trawlers and Russian trawlers fishing in VIb. The effort data for these five fleets are shown in Figure 4.2.1 and Table 4.2.7. Commercial cpue series for the different fleets are shown in Figure 4.2.2.

In 2005–2007, the Russian effort in bottom fishery (in hours and number of vessels/days) decreased due to economic reasons. The effort in 2008 increased slightly compared to 2007. Haddock catches varied accordingly with the changes in fishing effort. In 2006–2007, fishing efficiency in the Russian haddock fishery (mainly with trawlers of tonnage class 10) increased compared to previous years. In 2008, with trawlers of class 8 and 9 only, it was still high (on average, 12.2 t per fishing day for trawlers of class 9), but lower than the efficiency in 2007 (on average, 16.9 t per fishing day for a trawler of class 10). In the period of the targeted fishery (April–May), the mean catch of haddock per hour trawling by a trawler of tonnage class 9 was 0.86 t (in 2007, it was 0.88 t for a trawler of class 10) (Figure 4.2.2). The dynamics of catch per unit of effort for this type of vessels agrees well with year-to-year variations in total biomass of haddock (Figure 4.2.3).

The effort data from the Scottish fleets are known to be unreliable due to changes in the practices of effort recording and non-mandatory effort reporting (see the Report of WGNSSK 2000, CM 2001/ACFM:07, for further details). It is unknown what proportion of Scottish and Irish effort was applied directly to the haddock fishery. The apparent effort increase may just be the result of more exact reporting of effort due to VMS, but another suggestion is that it arises from a 'days at sea' measure. Working at Rockall keeps 'days at sea' elsewhere intact (the years in question do correspond to the introduction of the days at sea legislation) and it is possible that vessels are either working extra days in VIb or they are simply reporting extra days from VIb. It is difficult to conclude which of these scenarios is more likely.

The Irish otter trawl effort-series indicated low values between 2002 and 2005 with the lowest value in 2004. In 2006–2008, the effort increased considerably.

The WG decided that the commercial cpue data, which do not include discards and have not been corrected for changes in fishing power despite known changes in vessel size, engine power, fish-finding technology and net design, were unsuitable for catch-at-age tuning.

B.5. Other relevant data

C. Historical stock development

Model used:

The assessment is based on catch-at-age data and one survey index (Scottish Groundfish Survey) and conducted using the XSA method.

Software used:

XSA from Lowestoft suite of VPA programs

Model Options chosen:

Settings for the final XSA assessment in the recent years are shown in the Table below.

Assessment year	2005	2006	2007	2008	2009
Assessment model	XSA	XSA	XSA	XSA	XSA
Time series weights	none	none	none	none	none
Model	power	power	power	power	power
Catchability dependent for ages <	4	4	4	4	4
Regression type	C	C	C	C	C
Q plateau	5	5	5	5	5
Shk se	1.0	1.0	1.0	1.0	1.0
Shk age-yr	4 yrs 3 ages	4 yrs 3 ages	4 yrs 3 ages	4 yrs 3 ages	4 yrs 3 ages
Min se	0.3	0.3	0.3	0.3	0.3
Plus group	7	7	7	7	7
Fbar	2–5	2–5	2–5	2–5	2–5

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1991–2008	1–7+	Yes
Canum	Catch-at-age in numbers	1991–2008	1–7+	Yes
Weca	Weight-at-age in the commercial catch	1991–2008	1–7+	Yes
West	Weight-at-age of the spawning stock at spawning time.	1991–2008	1–7+	Yes
Mprop	Proportion of natural mortality before spawning	1991–2008	1–7+	No, set to 0 for all ages in all years
Fprop	Proportion of fishing mortality before spawning	1991–2008	1–7+	No, set to 0 for all ages in all years
Matprop	Proportion mature-at-age	1991–2008	1–7+	No, the same ogive for all years
Natmor	Natural mortality	1991–2008	1–7+	No, set to 0.2 for all ages in all years

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	SCOGFS	1991–2008	1–6

D. Short-term projection

Model used: Age-structured

Software used: MFDP prediction with management option table and yield-per-recruit routines. MLA used for probability profiles and sensitivity analysis.

Initial stock size: Taken from XSA for age 1 and older. The recruitment-at-age 1 in 2009 is estimated using RCT3. For forecasting recruitment in 2010 and thereafter, a geometric mean was used for 1991–2006.

Natural mortality: Set to 0.2 for all ages in all years.

Maturity: The same ogive as in the assessment is used for all years.

F and M before spawning: Set to 0 for all ages in all years.

Weight-at-age in the stock: Three-year means (mean weights in the stock are assumed to be the same as catch weights, see below).

Weight-at-age in the catch: Three-year means.

Exploitation pattern: Average of the three last years. Landings F are varied in the management option table.

Intermediate year assumptions: *Status quo* F.

Stock–recruitment model used: XSA estimate of recruits at age 1 for intermediate year. RCT3 model. used for intermediate year +1 in 2009 and the long-term geometric mean recruitment-at-age 1 is used for forecasting recruitment in 2010 and thereafter.

Procedures used for splitting projected catches: F vectors in each of the last three years of the assessment are multiplied by the proportion landed at age to give partial F for landings. The vectors of partial F are then averaged over the last three years to give the forecast values.

E. Medium-term projections

Model used: Age structured

Software used: MLA used for Medium-term projections.

Initial stock size: Taken from the XSA for age 1 and older. The recruitment-at-age 1 in 2009 is estimated using RCT3. For forecasting recruitment in 2010 and thereafter, a geometric mean was used for 1991–2006.

Natural mortality: Set to 0.2 for all ages in all years.

Maturity: The same ogive as in the assessment is used for all years.

F and M before spawning: Set to 0 for all ages in all years.

Weight-at-age in the stock: Three-year means (mean weights in the stock are assumed to be the same as catch weights, see below).

Weight-at-age in the catch: Three-year means.

Exploitation pattern: Average of the three last years.

Intermediate year assumptions:

Stock–recruitment model used: RCT3 model used for intermediate year +1 in 2009.

Uncertainty models used:

1) Initial stock size:

2) Natural mortality:

3) Maturity:

4) F and M before spawning:

5) Weight-at-age in the stock:

6) Weight-at-age in the catch:

7) Exploitation pattern:

8) Intermediate year assumptions:

9) Stock–recruitment model used:

F. Yield and biomass–per–recruit/long–term projections

Model used: Yield and biomass-per-recruit over a range of F values.

Software used: MLA and "st graf".

Maturity: Fixed maturity ogive as used in the assessment.

F and M before spawning: Set to 0 for all ages in all years.

Weight-at-age in the stock: Three-year means (mean weights in the stock are assumed to be the same as catch weights, see below).

Weight-at-age in the catch: Three-year means.

G. Biological reference points

Biological reference points for this stock are given below:

B_{lim}: 6000 t (lowest observed SSB)

B_{pa}: 9000 t (B_{loss} × 1.4)

F_{pa}: 0.4 (by analogy with other haddock stocks).

H. Other issues

None.

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Table 4.3.1. Scottish landings and raised discards of haddock in 1999 estimates at Rockall from discard observer trips conducted on Scottish vessels.

	Age													
	0	1	2	3	4	5	6	7	8	9	10	11	12	Total
Landing, N (*1000)	0	0	436.9	1211.9	1069.5	849.4	1220.6	1432.3	411.9	87.7	0.4	0	1.4	6722
Landing, tonnes	0	0	135.8	432.5	420.7	383.9	646	760.7	245.5	49.6	0.5	0	4.3	3079.5
Discards, N (*1000)[1]	22.4	14420.8	15276.9	6844.7	2534.8	1516	734.3	219.4	39.6	0	0	0	0	41609.1
Discards, tonnes[1]	1.5	2284.1	3658.2	1936.2	799.1	515.4	248.8	86.2	17.6	0	0	0	0	9547.2
Discards, N (*1000)[2]	12.5	13306.1	15895.9	7168.1	2588.9	1555.7	772.5	247.9	48.6	12.2	0.7	0	0	41609.2
Discards, tonnes[2]	0.3	2241.2	3791.3	2035.1	821.7	538.7	268	103.8	22.7	6.3	0.5	0	0	9829.6

[1] raised estimates from discard observer trips at Rockall.

[2] estimates obtained from a logistic discard curve for 1999.

Table 4.3.2. Scottish landings and raised discards of haddock in 2001 estimates at Rockall from discard observer trips conducted aboard Scottish commercial vessels.

	Age													
	0	1	2	3	4	5	6	7	8	9	10	11	12	Total
Landing, N (*1000)	0	0	326.5	489.1	132.9	774.3	326	223.9	113.5	22.4	3.8	0	0	2412.3
Landing, tonnes	0	0	128.6	157	82.4	262.4	125.2	90.2	59.3	19.9	3	0	0	928
Discards, N (*1000)[1]	3.1	6309.9	549.7	228.4	66.3	8.1	1	0.1	0.1	0.1	0	0	0	7166.8
Discards, tonnes[1]	0.2	967.4	126.8	58.7	17.8	2.4	0.3	0.1	0	0	0	0	0	1173.8
Discards, N (*1000)[2]	531	5987.3	436.2	162.6	46.9	2.9	0.5	0.1	0	0	0	0	0	7167.6
Discards, tonnes[2]	14.3	936.2	93	38.6	11.6	0.9	0.2	0.1	0	0	0	0	0	1094.9

[1] raised estimates from discard observer trips at Rockall.

[2] estimates from a logistic discard curve for 2001.

Table 4.3.3. Values of DL_{50} by Scottish discard trips in the Rockall area.

Year	DL50	b
1999	36.62	–0.5923
2001	31.20	–0.8238
Theoretical:	34.66	–1.2328

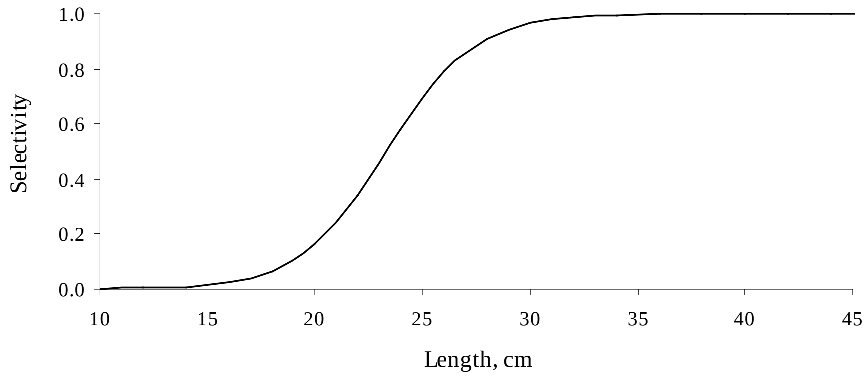

Figure 4.3.1. Theoretical haddock selectivity curve used to estimate the proportion of haddock lifted onboard Russian trawlers.

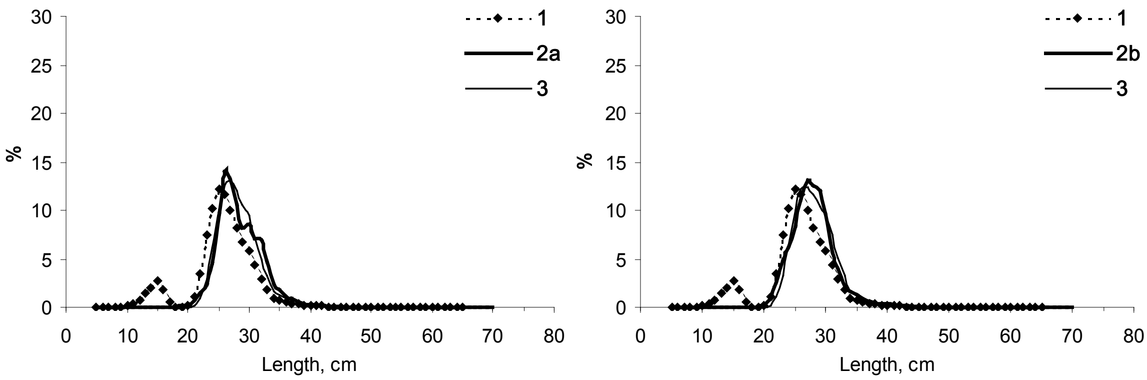

Figure 4.3.2. Length distribution of haddock in 2003: 1 – by Scottish groundfish survey, 2a – by commercial Russian trawlers in June, 2b – by commercial Russian trawlers in July, 3 – theoretically-derived.

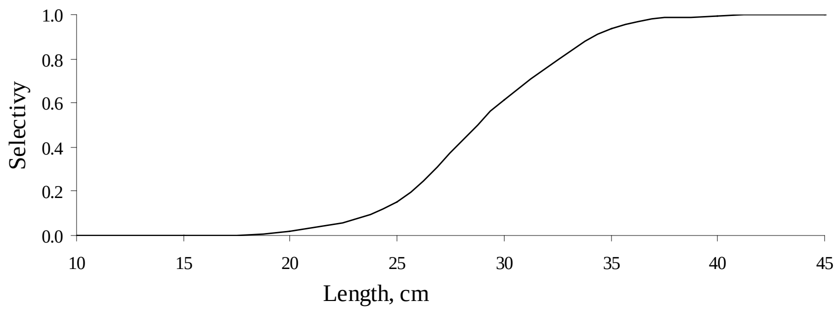

Figure 4.3.3. Theoretical haddock selectivity curve used to estimate the proportion of haddock lifted onboard Scottish trawlers.

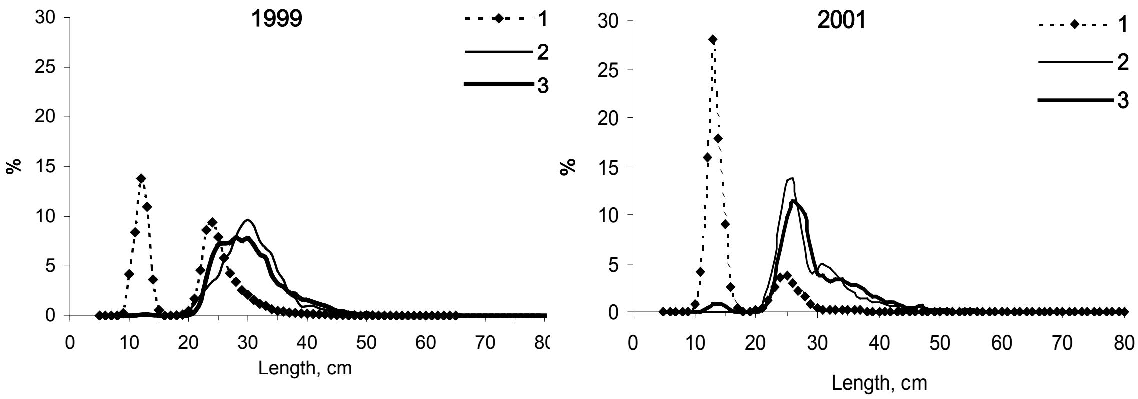

Figure 4.3.4. Length distribution of haddock in 1999 and 2001: 1 – by Scottish groundfish survey, 2 – by commercial Scottish trawlers, 3 – theoretically-derived.

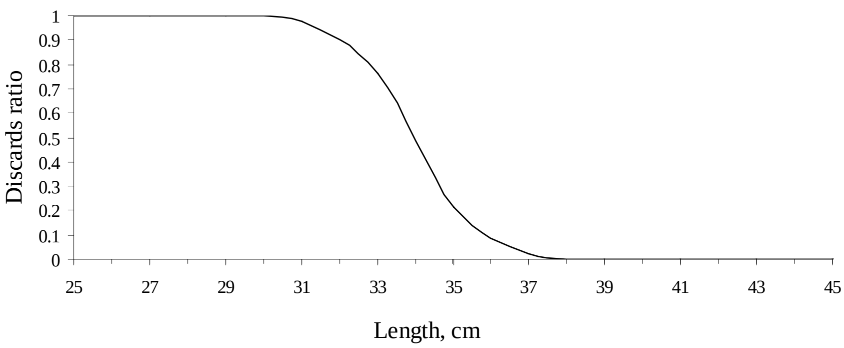

Figure 4.3.5. Selectivity curve used to estimate the proportion of discarded haddock in catches Scottish trawlers.

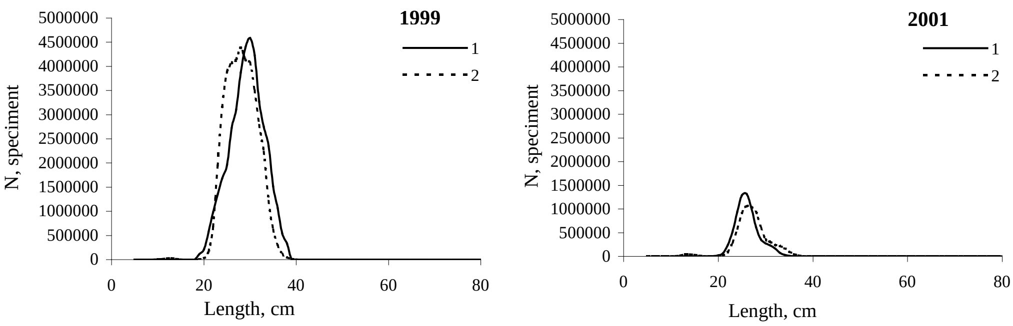

Figure 4.3.6. Length distribution of discarded haddock in catches Scottish trawlers in 1999 and 2001: 1 – research data; 2 – theoretically-derived.

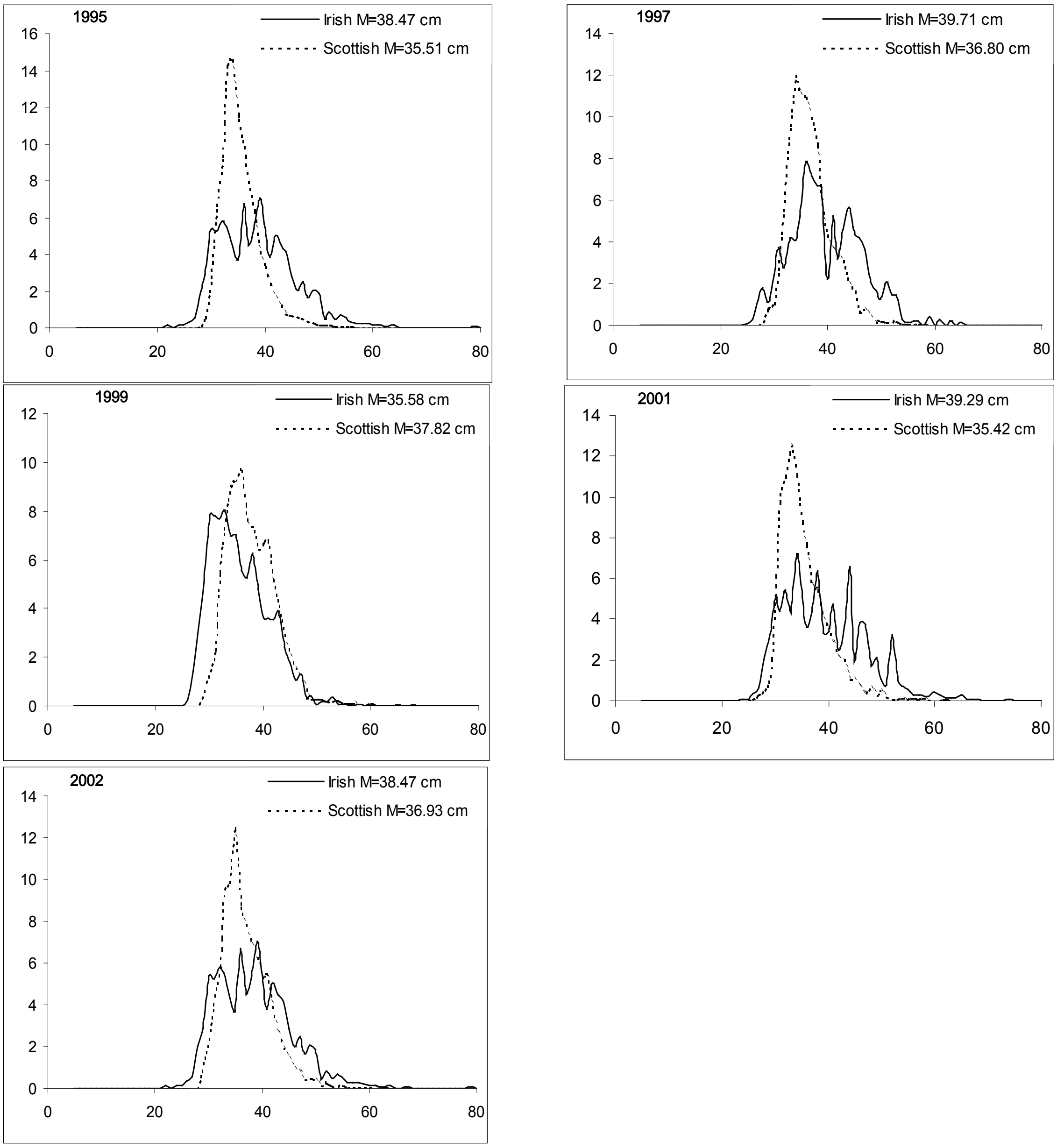

Figure 4.3.7. Length distribution of haddock landings in VI b (Scottish and Irish data).

Stock Annex 5.2: Northern Shelf Anglerfish

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Anglerfish (Northern Shelf, Division IIIa, Subarea IV and Subarea VI, and Norwegian Sea, Division IIa)
Working Group	Assessment of Northern Shelf Demersal Stocks
Date	17 May 2005
Last updated	19 May 2008

A. General

A.1. Stock definition

Anglerfish occur in a wide range of depths, from quite shallow inshore waters down to at least 1000 m. Small anglerfish occur over most of the northern North Sea and Division VIa, but large fish, the potential spawners, are more rarely caught. Little is known about when and where anglerfishes spawn in northern European waters and consequently stock structure is unclear. This lack of knowledge is due to the unusual spawning habits of anglerfish. The eggs and larvae are pelagic, but whereas most marine fish produce individual free-floating eggs, anglerfish eggs are spawned in a large, buoyant, gelatinous ribbon which may contain more than a million eggs. Due to this strange behaviour, anglerfish eggs and larvae are rarely caught in conventional surveys.

An EU-funded research project entitled 'Distribution and biology of anglerfish and megrim in the waters to the West of Scotland' (Anon, 2001) did however, improve our understanding. A particle tracking model was use to predict the origins of young fish and indicates that post-larval anglerfish may be transported over considerable distances before settling to the seabed (Hislop *et al.*, 2001). Anglerfish in deeper waters to the west of Scotland and at Rockall could therefore be supplying recruits to the western shelf and the North Sea. Furthermore, results of microsatellite DNA analysis carried out as part of this project show no structuring of the anglerfish stock into multiple genetic populations within or among samples from Divisions IVa, Division VIa and Rockall. In fact this project also suggested that anglerfish from further south (Subarea VII) may also be part of the same stock. Fish tagged and released around the Shetland Islands (Division IVa) by Laurenson *et al.*, 2005 have occasionally been recaptured in Subarea V and also Division IIa.

The WGNSDS considered the stock structure on a wider European scale in 2004, and found insufficient evidence to indicate an extension of the stock area northwards to include Division IIa. Anglerfish in IIa is at present treated separately by the Working Group.

A.2. Fishery

A.2.1. Northern Shelf anglerfish fisheries

UK vessels account for more than 50% of the total reported anglerfish landings from the Northern Shelf area. The Danish and Norwegian fleets are the next most important exploiters of this stock in the North Sea while Irish and French vessels take a significant proportion of the landings to the West of Scotland. The fishery for anglerfish in Subarea VI occurs largely in Division VIa with the UK and France being the most important exploiters, followed by Ireland. Landings from Rockall (Division VIb) are generally less than 1000 t with the UK taking on average around 50% of the total. In the North Sea, the majority of landings are reported in Division IVa which reflects the northerly distribution of the species within the North Sea (Knijn *et al.*, 1993).

A general description of the anglerfish fisheries of the most important nations taking part in this fishery is given below:

Scottish (UK) fishery

The Scottish fishery for anglerfish in Division VIa comprises two main fleets targeting mixed roundfish. The Scottish Light Trawl Fleet (SCOLTR) takes around 60% of landings and the Scottish Heavy Trawl Fleet (SCOTRL) over 20%. Around 10% of landings are bycatch from the *Nephrops* trawlers. The development of a directed fishery for anglerfish has led to considerable changes in the way the Scottish fleet operates. Part of this is a change in the distribution of fishing effort; the development of a directed fishery having led to effort shifting away from traditional roundfish fisheries in inshore areas to more offshore areas and deeper waters. The expansion in area and depth range fished has been accompanied by the development of specific trawls and vessels to exploit the stock. There has been an almost linear increase in landings from Division VIa since the start of the directed fishery until 1996 which has been followed more recently by a very severe decline, indicating the previous increase was almost certainly due only to the expansion and increase in efficiency of the fishery. More recent declines in landings (2002–2004) may have been due to restrictive TACs and the decline is not necessarily representative of the actual landings.

The Scottish fleet operating in VIb consists mainly of large otter trawlers (SCOTRL) targeting haddock and anglerfish at Rockall. Their activity is dependent on weather and the availability of haddock quota in VIb.

The Scottish fishery for anglerfish in the North Sea is located in two main areas: on the Shelf Edge to the north and west of Shetland and at the Fladen Ground. It expanded in a similar manner since the 1980s to that operating in Division VIa. The fishery to the north and west of Shetland operates as an extension to that in Division VIa and consists mainly of light trawlers targeting mixed round-fish. The highest reported landings in recent years (to 2007) come from the statistical rectangles around Shetland. The light-trawler fleet accounted for approximately 55% of Scottish reported landings in this area in 2007. The landings from the fishery at Fladen are lower but still significant (around 15% of the total) with anglerfish caught as a bycatch in the *Nephrops* fishery which consists of approximately 200 vessels in 2007. A small component of the landings (~10% in recent years) comes from the gillnet fishery which operates on the shelf edge in the far northwest of Division IVa. A large proportion of the landings in the gillnet fishery are taken by Spanish owned, UK registered vessels.

Ahead of the anglerfish STECF Review Group meeting in 2006 (SGRST-06–03), attempts were made to develop descriptions of the main Scottish anglerfish fisheries which were spatially more relevant to the stock distribution and activity of fishing vessels, rather than by ICES area. The descriptions used data on catch rates from various sources, including research vessel surveys, observer trips on board commercial boats, consultation with skippers and analysis of individual trip records. An 'anglerfish fishery' area was defined as the combined area of high abundance (catch-rates) from FRS/industry survey and observer data analysis. A '*Nephrops* fishery' area was assumed to cover the *Nephrops* grounds which are well defined by soft substrate and are described in the appropriate ICES WGs. The areas are mostly separate but where overlaps occur, these are taken to be part of the anglerfish area. A third area is defined to include all other statistical rectangles.

In the Scottish 'anglerfish' area, large meshed otter trawlers have the largest contribution to the total landings associated with anglerfish. This métier has a mixed species catch composition with haddock being the most important species and anglerfish and cod the next most important. In the *Nephrops* area the largest overall landings associated with anglerfish come from the <100 mm gear category with the dominant species being *Nephrops*, followed by haddock and anglerfish.

Previous studied have found it difficult to identify a specific anglerfish fishery as catch composition can vary a great deal over a small spatial scale (i.e. less than a statistical rectangle). Further analysis of the main, large mesh trawl operating in the 'anglerfish area' is required to provide a more comprehensive picture of catch composition. This has so far been beyond the scope of the WG.

Irish fishery

The Irish fleet which takes around 15–20% of the total Division VIa landings is a light trawl fleet targeting anglerfish, hake, megrim and other gadoids on the Stanton Bank and on the slope northwest of Ireland. This fleet uses a mesh size of 80 mm or greater. Irish Division VIa landings come mainly from the Stanton bank with some landings from Donegal Bay and the slope northwest of Ireland. Since 1996 there has been an increase in the number of vessels using twin rigs in this fleet. There have also been changes to the fleet composition since 2000, with around ten vessels decommissioned and four new vessels joining the fleet. The activity of this fleet is not thought to have been significantly affected by the recent hake and cod recovery plans.

The Irish fleet otter trawl in Division VIb take anglerfish as a bycatch in the haddock fishery on the Rockall Bank. The fleet targeting haddock uses 100 mm mesh and twin rig trawls. Occasionally Irish-Spanish flag vessels target anglerfish, witch and megrim with 80 mm mesh on the slope in VIb. Discarding practices of these vessels are not known although discarding of anglerfish from the fleet targeting haddock in Division VIb is not thought to be significant (Anon, 2001). The fleet composition changed in 2001. Four vessels have recently been decommissioned and two new vessels have joined the fleet that targets haddock. In 2006 and 2007, the effort of the Irish fleet operating at Rockall has increased with the increase in Rockall haddock TAC.

Danish fishery

According to logbook records, the majority of Danish anglerfish landings are taken in the northeastern North Sea, in the part constituting the Norwegian Deeps, situated in the Norwegian EEZ of the North Sea. Other important fishing areas for anglerfish are the Fladen Ground (also in IVa) and in the Skagerrak (IIIa). More than 80% of the Danish landings come from ICES Divisions IVa and IIIa. The remaining part is from the most northern part of Division IVb.

The majority of the Danish vessels are taking anglerfish with demersal trawls with over 90% of these vessels in the size range 20–40m.

Fishery definitions by gear type and mesh size as currently used by Danish Fisheries Directorate for the North Sea are given in the following text table:

Fishery/gear	Mesh size, mm
Dem. Trawl	>= 100 mm
Nephrops trawl	70–99 mm
Shrimp trawl	33–69 mm
Industrial trawl	< = 32 mm
Beam trawl	>= 80 mm

Note that in the North Sea demersal trawls account for more than 90% of total Danish landings. However, it is necessary to further specify that at present the majority of the Danish catches of anglerfish are taken by fisheries in the Norwegian zone of IVa applying demersal trawls with mesh size >= 120 mm. In 2006, the fishery with demersal trawl in the Norwegian Deeps (in the Norwegian zone) accounted for around 75% of total Danish landings by all gears from the entire North Sea. In the Skagerrak (IIIa) the two main fisheries taking anglerfish are the (mixed) *Nephrops* fishery and the demersal trawl fishery. In both areas minor landings are taken in gillnets and as bycatch in fisheries for shrimp (*Pandalus*).

Information on the species composition of the landings from Danish fisheries taking anglerfish is available from the Danish logbook records and also from the Danish at-sea samples from observers on discard trips. Further details can be found in Section 6.2.1 of ICES WGNSDS 2007. Typically anglerfish constitutes less than 15% by weight of the landings from demersal trawlers fishing in the Norwegian Deeps.

Norwegian fisheries

A Norwegian directed gillnet fishery (360 mm mesh size), targeting large anglerfish, carried out by small vessels in coastal waters in the eastern part of the Northern North Sea started in the early 1990s. These vessels are responsible for around 60–70% of the total Norwegian landings from this area and they comprise around 6% of the total landings from Division IVa since 1999. The remaining Norwegian landings in IVa are mostly bycatch in various trawl fisheries. A similar pattern of fishing is found in the Skagerrak (IIIa). The third quarter has in recent years been the most important season for the directed fishery, while the second quarter is apparently most important for other gears.

Other fisheries

French demersal trawlers also take a considerable proportion of the total landings from this area. The vessels catching anglerfish may be targeting saithe and other demersal species or fishing in deep water for roundnose grenadier, blue ling or orange roughy.

Since the mid-1990s, a deepwater gillnet fishery targeting anglerfish has been conducting a fishery on the continental slopes to the West of the British Isles, North of Shetland, at Rockall and the Hatton Bank. These vessels, though mostly based in Spain are registered in the UK, Germany and other countries outside the EU such as Panama. Gear loss and discarding of damaged catch are thought to be substantial in this fishery. Until now these fisheries have not been well documented or understood and they seem to be largely unregulated, with little or no information on catch composition, discards and a high degree of suspected misreporting. There are currently (2005) around 16 vessels participating in the fishery, 12 UK registered and four German registered.

In response to the concerns with these gillnet fisheries for deep-water sharks and anglerfish in Subarea VI, the EC banned the setting of gillnets in waters greater than

200 m in 2006 (Council Regulation 51/2006). However, this regulation was reviewed in July 2006 and a new regulation put in place which is a permanent ban, but allows a derogation for entangling nets in waters less than 600 m, not exceeding 100 km in total length with a maximum soak time of 72 hours. (EC Regulation No 40/2008 Annex III, article 8). NEAFC have also introduced an indefinite ban. There is also legislation proposed which will extend the ban to other areas including Division IVa.

In addition, the EU has recently funded a ghost net retrieval programme, DEEP-CLEAN, (coordinated by the Marine Institute, Ireland) which is due to commence in autumn 2007. The intention of this programme is to a) maximize the recovery of lost or abandoned gillnets and b) to quantify the scale and biological consequences.

A.2.2. Division IIa anglerfish fisheries

In Division IIa most of the anglerfish is caught by small vessels in a directed gillnet fishery close to the coast. The legal mesh size has, since 1995, been 360 mm and maximum 2 days soaking time. Offshore gillnetting, trawls and Danish seines are responsible for the other catches. For the directed gillnet fishery, the area between N 62° and N 64° has been the most important with maximum catches almost reaching 3000 tonnes in 1993. During recent years the catches have varied between 1000–2000 tonnes. A fishery north of N 64° has developed rapidly, with catches reaching 2400 tonnes in 2007, exceeding the level of catches in the southern part of IIa for the first time. For the other gears, catches have increased from around 100 tonnes in the early 1990s to approximately 300–500 tonnes during the last four years. Very low catch figures are reported from other nations north of N 62°.

A.3. Ecosystem aspects

No information.

B. Data

B.1. Commercial catch

B.1.1. Data compilation

Quarterly length–frequency distribution data were available from Scotland and Ireland for Division VIa and Spain for Subarea VI in the past. A total international catch-at-length distribution for Division VIa was obtained by summing national raised catch-at-length distributions and then raising this distribution to the WG estimates of total international catch from this area. Landings officially reported to ICES were used for countries not supplying estimates directly to the WG. Since 2001, the Scottish market sampling length–weight relationships (given below) have been used to raise the sampled catch-at-length distribution data Working Group estimates of total landings for Division VIa. Length–frequency data availability for VIb has been limited to Scottish and Irish samples.

Year Range	Formula (L – length in cm, W – weight in g)	Source
1992–2000	W=0.01626L2.988	Coull *et. al.*, 1989
2001 onwards	W=0.0232L2.828	Scottish Market Sampling

For anglerfish in the North Sea, catch-at-age composition data are available from Scotland for the years 1992 to 2007. In the past the Scottish quarterly age–length keys were applied to the available length–frequency data and non-sampled catches were attributed to age assuming their length–frequency distributions to be equivalent to the combined sampled distribution.

As a first step in assembling assessment data for the North Sea component of the stock, length compositions from Scottish market sampling have been raised to Working Group estimates of total landings in the past. The Working Group estimate of total landings was assumed equal to the landings obtained by national scientists plus official landings as reported to ICES for those countries not providing landings data to the Working Group. The Scottish market sampling data are only available from 1993 onwards, and even for these years the level of sampling has been relatively low. More recently, additional length samples are available from the Danish and Norwegian fisheries since 2002 including samples from Division IIIa.

Total international catch-at-length distribution data for the whole Northern shelf (Division IIIa, Subarea IV and Subarea VI) have previously been obtained by summing the length distributions from the individual areas and assuming that this distribution is representative of the whole Northern Shelf. This was then raised to Working Group estimates of total landings for the Northern Shelf.

In addition, catch-at-length distribution data are available from the Norwegian directed coastal gillnetting in Division IIa from 1993 to 2007, although there are no data from 1997–2001. There are also catch-at-length distribution data from anglerfish caught as bycatch in the offshore gillnetting and longlining fleets for 2004–2007. No attempts have been made to present raised catch-at-length distribution for anglerfish from Division IIa.

B.1.2. Commercial catch data quality

For a number of years, anglerfish in Subarea VI, XII, XIV and Division Vb (EU zone) were subjected to a precautionary TAC (8600 t), based on average landings in earlier years. In 2002 the TAC was set at 4770 t and was further reduced to 3180 t in 2003 and 2004. The TAC was increased in 2005 to 4686 t and to 5155 t for 2007. At the WG in 2003, it was highlighted that the reduction off the TAC in 2003 to just two-thirds of that in 2002 would likely imply an increased incentive to misreport landings and increase discarding unless fishing effort was reduced accordingly (Section 6.4.6, ICES WGNSDS 2003). Anecdotal information from the fishery in 2003 to 2005 appeared to suggest that the TAC was particularly restrictive in these years. The official statistics for these years are, therefore, likely to be particularly unrepresentative of actual landings.

The absence of a TAC for Subarea IV prior to 1999 means that before then, landings in excess of the TAC in other areas, were likely to be misreported into the North Sea. In 1999, a precautionary TAC was introduced for North Sea anglerfish, but unfortunately for current and future reporting purposes, the TAC was set in accord with recent catch levels from the North Sea which includes a substantial amount misreported from Subarea VI. The area misreporting practices have thus become institutionalised and the statistical rectangles immediately east of the 4°W boundary (E6 squares) have accounted for a disproportionate part of the combined VIa/North Sea catches of anglerfish.

The Working Group historically (prior to 2005) provided estimates of the actual Division VIa landings by adjusting the reported data for Division VIa to include a proportion of the landings declared from Division IVa in the E6 ICES statistical rectangles. The correction has been applied by first estimating a value for the true catch in each E6 square and then allocating the remainder of the catch into VIa squares in proportion to the reported catches in those squares. The ‘true’ catches in the E6 squares are estimated by replacing the reported values by the mean of the catches in the adjacent squares to the east and west. This mean is calculated iteratively to account for increases in catches in the VIa squares resulting from reallocation from the E6 squares. Such a re-allocation of catches may still inadvertently include some landings taken legally in Division IVa on the shelf-edge to the west of Shetland, but these are likely to comprise fish within the distribution of the Division VIa stock component. Due to technical problems associated with changes to the Scottish Executive database and lack of landings data provided to the Working Group by some of the major nations exploiting the fishery, WG estimates of the actual Division VIa landings have not been calculated for recent years (2005–2007).

At the 2010 WGCSE, for data in 2009, this procedure was adjusted to reallocate data to the whole of Area VI: i.e. not just VIa but including Rockall (VIb). This was based on information received from Marine Scotland Compliance indicating that some vessels fishing for anglerfish at Rockall are reporting large catches in the E6 squares from the same voyage. The distribution of landings this new scheme produced was more in keeping with the distribution of the stock as indicated from the anglerfish surveys.

B.2. Biological

Previous assessments of this stock used the natural mortality rate applied to anglerfish in Division VI adopted by an earlier Hake Assessment Working Group of 0.15 yr^{-1}. This value is once more adopted for all ages and lengths in the absence of any direct estimates for this stock.

Historically, the catch-at-age analysis of anglerfish in Division VIa used the same maturity ogive as that applied to anglerfish in Subareas VII and VIII by the Working Group on the Assessment of Southern Shelf Demersal Stocks. However, a number of more recent maturity studies based on the VIa stock indicate that maturity does not occur until much later than previously estimated. Afonso-Dias and Hislop, 1996 give a length–maturity ogive for this stock, 50% maturity at approximately 74 cm in females, and 50 cm in males. However, this study was based on few samples. New information has become available from the EU-funded project (Anon, 2001) which indicates female 50% maturity at approximately 94 cm and males at 57 cm. The corresponding age-based ogives indicate 50% maturity at approximately age 9 in females and age 5 in males. This has also been supported by more recent studies by Laurenson *et al.*, 2005.

B.3. Surveys

In previous length-based assessments of this stock, a recruitment index was used which had been obtained from the Scottish March West Coast survey. The index consists of numbers of anglerfish less than 30 cm caught per hour. However, at more recent meetings of this WG it has been concluded that the traditional groundfish surveys are ineffective at catching anglerfish and do not provide a reliable indication of stock size. As a result of this conclusion, and the urgent requirement for fishery independent data, Marine Scotland Science began a new joint science/industry survey in 2005. This is a targeted anglerfish survey with a scientific design using commercial gear. In 2006, 2007 and 2009 Ireland extended the anglerfish survey to cover the remaining part of VIa (from 54°30′ to 56°39′). Further details of the survey including information on design, sampling protocol and gear and vessel are given in Fernandes *et al.*, 2007 and in annual working documents which describe the survey results.

B.4. Commercial cpue

B.4.1. Official logbook data

Previous length-based assessments attempted to use effort data to constrain the temporal trend in fishing mortality. Scottish Light Trawl data, disaggregated into an inshore and offshore component, the latter of which is associated with the anglerfish fishery, for both West of Scotland and Shetland (N Sea) were provided to the Working Group. However, these data are no longer considered to be reliable due to non-mandatory recording of hours fished in the logbook data. Further details of the Scottish fleet effort recording problem can be found in the report of the 2000 WGNSSK (ICES, 2001). Since these data are considered unreliable, they are not presented here.

Irish lpue data in terms of hours fished has been presented to the WG for Division VIa and Division VIb for all fleets up to 2006 (shown in Table B.4.1). The measure of kWdays is believed to be a more reliable proxy for effort than hours fished due to reporting issues and these data are presented in the WG report.

Danish landings and effort data (hours fished) from logbook data are also available to the WG for Division IIIa and Division IVa. Although these data are considered to be reliable (in terms of accuracy of reporting), it is not know to what extent they are useful in providing an indicator of stock size due to management regulations in the Norwegian zone (TAC constraints) and technological creep.

No effort data have been made available to the WG for fisheries operating in Division IIa.

B.4.2. Tallybook data

Analysis of skippers' personal diary information collected in 2004 and 2005 in an attempt to improve knowledge of the state of the stock and of the Scottish anglerfish fishery provided valuable information to ICES (Bailey, *et al*., 2004) on temporal and spatial trends in catch rate. Following the success of this data collation exercise, ICES advised the process to continue and a more formal scheme was proposed by FRS.

Extensive discussions with the fishing industry during 2005 resulted in FRS implementing the monkfish tallybook project at the start off 2006. The project is part of a long-term approach to providing better information on the monkfish fishery and the state of the stock, and is being operated in conjunction with fishers' organisations (Scottish Fishermen's Federation, Fishermen's Association Limited and Pecheurs de Manche et Atlantique) and the North Atlantic Fisheries College (NAFC) Marine Centre, Shetland. These organisations have been responsible for distributing the tallybooks, co-ordinating the returns and allocating a vessel code before the anonymised tallybook sheets are forwarded to FRS. The tallybooks are filled in on a haul-by-haul basis to give weight caught by size category and information on haul location, duration and depth in a standardized format as well as gear and mesh being used. Additionally information on mature females has been requested. Data are stored in a database at FRS.

So far, the time-series is relatively short, with the first returns from fishing trips at the end of December 2005 and the most recent from March 2008. Initial participation in the scheme was high with returns received from up to 37 vessels with a wide spatial coverage (across Subarea VI, Division IVa, IIa and Vb) and different target species. Of the 37 vessels which have so far supplied information, two are French and these are operating towards the southern end of the shelf edge in Division VIa northwest of Ireland. The haul depth information collated so far indicates that most of the hauls are taken in depths between 100 and 400 m although there are a significant number of hauls from depths between 600 and 800 m. The records from the deeper water are largely from the French vessels although it does appear that a number of the Scottish vessels make occasional trips into deeper water. Average catch rates are similar to those previously seen in the diary data and observer data (presented in previous WG reports) and range from around 10 kg/hr for boats targeting *Nephrops* to over 100 kg/hr for some whitefish boats.

Analysis of the catch rate data is presented in the WG report and in Dobby *et al.*, 2007.

B.5. Other relevant data

None.

C. Historical stock development

Since 2003 the WG has been unable to provide an assessment of anglerfish. This is due to a combination of unreliable commercial data: landings misreporting in some of the main fleets involved in the fishery and uncertain effort data, and poor catchability of anglerfish in traditional research vessel surveys.

Although, the stock status has been classified as uncertain in recent years, TAC increases of 10% occurred in both the West of Scotland and North Sea areas on the basis of advice from the STECF Review Group meeting (SGRST-06–03) which examined trends in commercial catch rate data and fishery information.

In previous years the stock assessment has been conducted using a length-based model for which the settings are outlined below.

Model used: Catch-at-length analysis (modified CASA-Sullivan *et. al.*, 1990; Dobby, 2002).

Software used: Fortran coded executable-LBAV4_1.

Model Options chosen:

Sex differentiated von Bertalanffy growth, variability distributed according to a beta function. Parameters taken from Scottish anglerfish survey in 2000: L_4(F)=140.5, K(F)=0.117, L_4(M)=110.5, K(M)=0.154.

Fishing mortality in 1993=1.0

Historical equilibrium fishing mortality fitted using mean of historical WG estimates of landings which is approximately 18 000 t over 1987–1991.

Logistic exploitation pattern with fitted parameters.

Trend in temporal fishing mortality equal to trend in recent SCOLTR effort data

Total recruitment normally distributed over length classes

Input data types and characteristics:

Name	Year range	Variable from year to year Yes/No
Catch in tonnes	1993–last data year	Yes
Catch-at-length in numbers	1993–last data year	Yes
Weight-at-length in the commercial catch	1993–last data year	Yes/No–2 weight-length relationships: covering 1993–2000, and 2001 onwards
Weight-at-length of the spawning stock at spawning time.	1993–last data year	Yes/No-assumed to be the same as weight-at-length in the catch
Proportion mature-at-length	1993–last data year	No–the same ogive for all years
Natural mortality	1993–last data year	No–set to 0.15 for all lengths in all years

Auxiliary data:

Type	Name	Year range	Size range
Recruitment index	Scottish March West Coast survey	1993–last data year	< 30 cm

D. Short-term projection

In previous years the short-term forecast has used a length-structured method with settings outlined below.

Model used: Length-structured

Software used: Fortran coded executable LBForecast.exe

Initial stock size: taken from catch-at-length analysis. The long-term geometric mean recruitment is used in all projection years. Natural mortality: Set to 0.15 for all lengths in all years

Maturity: The same ogive as in the assessment is used for all years

Weight–length relationship: as used in the assessment (Scottish Market sampling)

Exploitation pattern: Fixed exploitation-at-length pattern is estimated in the catch-at-length analysis. This is assumed to apply in all further years.

E. Medium-term projections

No medium-term projections are carried out for this stock.

F. Yield and biomass-per-recruit/long-term projections

Previous yield and biomass-per-recruit calculations were carried out on the basis of the results of length-based assessments which are no longer carried out.

G. Biological reference points

Precautionary approach reference points: "ICES considers that there is currently no biological basis for defining B_{lim} or F_{lim}. ICES proposes that $F_{35\%SPR}$ =0.30 be chosen as F_{pa}. It is considered to be an approximation of F_{MSY}."

The statement included above first appeared in 1998, but the WG has been unable to find the basis of the derivation of this reference point and considers it no longer appropriate to include it.

H. Other issues

In previous ('catch-at-length') assessments of this stock, the SSB was always estimated to be at a very low level. The length data have been based on the U.K. landings only (in Subdivisions. IVa and VIa), where very few individuals over 80 cm appear in the catch and therefore the model predicts very few in the population. Since females do not mature until they are over 90 cm in length the SSB is estimated to be very low. The length data from the eastern part of the North Sea (Danish and Norwegian fisheries) for the recent years indicate a higher amount of larger individuals in the catches. Although the Danish and Norwegian landings are small in comparison to the UK landings, the inclusion of the Danish and Norwegian length frequencies in the data used for any future assessment may change the concept of the magnitude of the SSB.

The fact that mature female anglerfish are rarely observed either on scientific surveys or by observers on board commercial vessels supports a very low estimate of spawning–stock biomass, yet there is little evidence of reduction in spatial distribution as fish are still recruiting to relatively inshore areas. It has been hypothesized that females may become pelagic when spawning as they produce a buoyant, gelatinous ribbon of eggs, and would therefore not appear in the catch of trawlers. (Anglerfish have been caught near the surface, Hislop *et al*., 2000). This would imply different exploitation patterns for males and females: a dome-shaped pattern (decreased exploitation at larger sizes) for females and a logistic pattern for males. It is also not known whether anglerfish are an iteroparous or semelparous species. The latter would also account for the almost complete absence of spawning females in commercial catches or research vessel surveys.

The key features of the species' life history in relation to its exploitation are the location of the main spawning areas, and whether or not there is any systematic migration of younger fish back into the deeper waters to spawn. At present, despite the large increase in catches during the mid 1990s, there is no apparent contraction in distribution; fish are still recruiting to relatively inshore areas such as the Moray Firth in the northern North Sea. The fact that spawning may occur largely in deep water off the edge of the continental shelf may offer the stock some degree of refuge. However, this assumes that the spawning component of the stock is resident in the deep water, and is thus not subject to exploitation. It is not known to what extent this is true, but if such a reservoir exists then the currently used assessment methods which make dynamic pool assumptions about the population are likely to be inappropriate. Nevertheless, it is clear that further expansion of the fishery into deeper water is likely to have a negative effect on the SSB and given the spatial development of the fishery, it cannot be ruled out that the serial depletion of fishing grounds has been occurring. In addition, some life-history characteristics of anglerfish suggest that it may be particularly vulnerable to high exploitation. A detailed discussion of the fishery development and biology can be found in Sections 7.5.4 and 7.5.5 of the 2000 Report of this Working Group (ICES, 2001).

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Table B.4.1. Anglerfish in Subarea VI. Landings, effort and lpue from the Irish OTB fleet.

		IR-OTB-4-6			IR-TBB-4-6			IR-SCC-4-6			IR-GN-4-6	
		IV–VI			IV–VI			IV–VI			IV–VI	
Year	Landings (t)	Effort (hr)	lpue (kg/h)	Landings (t)	Effort (hr)	lpue (kg/h)	Landings (t)	Effort (hr)	lpue (kg/h)	Landings (t)	Effort (hr)	lpue (kg/h)
1995	769.21	66.54	11.56		0.00		5.70	2.65	2.15	0.87	1.57	0.55
1996	698.93	68.90	10.14	16.54	1.23	13.45	4.91	2.94	1.67	1.91	2.25	0.85
1997	680.78	72.71	9.36	2.055	1.07	1.93	7.79	3.00	2.60	3.40	1.83	1.86
1998	656.23	66.40	9.88	10.381	2.36	4.41	12.72	2.95	4.32	0.95	1.22	0.77
1999	512.92	63.23	8.11	1.939	1.12	1.73	12.14	4.22	2.87	6.19	0.49	12.65
2000	471.95	63.33	7.45	0.045	0.13	0.35	4.64	3.86	1.20	0.87	0.11	7.60
2001	408.46	55.99	7.30	0.12	0.12	0.98	2.95	1.31	2.26	22.23	0.43	51.69
2002	317.13	40.00	7.93		0.00		5.06	1.58	3.20	4.94	0.23	21.48
2003	299.17	44.44	6.73		0.00		3.84	2.22	1.73	1.86	0.54	3.45
2004	197.89	37.50	5.28	0.176	0.35	0.50	2.15	0.98	2.20	2.46	0.54	4.57
2005	350.33	34.79	10.07		0.04	0.00	1.07	0.69	1.56	0.00	0.04	0.00
2006	423.39	34.62	12.23	0.12	0.07	1.71	1.18	0.49	2.40	0.02	0.24	0.07

Stock Annex 6.2: Cod in VIIa

- Stock Annex 6.2 Cod VIIa: for latest update see WGCSE 2009, Annex 06.2 Cod VIIa

Stock Annex 6.3: Haddock in VIIa

- Stock Annex 6.3 Haddock in VIIa: for latest update see WGCSE 2009 Annex 06.3 Haddock VIIa

Stock Annex 6.4: Irish Sea East *Nephrops* (FU14)

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Irish Sea East *Nephrops* (FU14)
Working Group	Assessment of Northern Shelf Demersal Stocks
Date	May 2010

A. General

A.1. Stock definition

Throughout its distribution, *Nephrops* is limited to muddy habitat, and requires sediment with a silt & clay content of between 30–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small scale movements (a few 100 m) but larval transfer may occur between separate mud patches in some areas. In the eastern Irish Sea the *Nephrops* stock inhabits an area of muddy sediment extending along the Cumbria coast and its fishery contributes to less than 10% of overall Irish Sea landings. There is little evidence of mixing between the east and west Irish Sea stocks due to the nature of water current movements in the Irish Sea. The two are treated as separate populations since they have differing population characteristics.

A.2. The fishery

Between 1999 and 2003 the number of vessels fishing for *Nephrops* in FU14 declined by 40% to a fleet of around 50 vessels. This was largely due to the reduction in the number of visiting UK vessels and the decommissioning of part of the Northern Irish and local English fleets. Since then the number of vessels fishing the area has returned to around 80 vessels mainly from Northern Ireland. Currently, around 30 of these vessels, between six and 23 m in length, have their 'home' ports in Whitehaven, Maryport and Fleetwood, England. The rest of the fleet is generally made up of larger vessels from Kilkeel or Portavogie, Northern Ireland.

Between 1987 and 2006, landings from FU14 appeared relatively stable, fluctuating around a long-term average of about 550 t. Landings in 2007, however bucked this trend, and are at their highest level since 1978 at 959 t, this is after landings dropped in 2003 to their lowest apparent level since 1974. The 2008 and 2009 figures of 676 and 694 t respectively are lower than 2007 still remains high, above any other figure recorded since 1990. The introduction of the buyers and sellers legislation in 2006 really precludes direct comparison with previous years as reporting levels are considered to have significantly improved since.

Over the last ten years UK vessels have landed, on average, 87% of the reported annual international landings. ROI vessels increased their share of the landings to 35% in 2002 but it has since declined to 2% in 2009. In 2009, most of the landings were made into England with a high proportion of these landings (67% of the directed landings and 62% of the total landings) being made by visiting Northern Irish vessels. UK *Nephrops* directed effort has fluctuated around a downward trend since 1993 but has remained relatively stable since 2003 fluctuating around a mean of 13 800 hrs. Changes to recording practices will affect interpretation of the scale of this decline but a decline is real.

The changes to the structure and landing practices of the Northern Irish fleet (see above) will have had some impact on this dataseries. From 2002–2004, fewer of the Northern Irish fleet were landing in England. The differences between lpue figures for individual vessels suggest that earlier years may have included less truly directed effort. Reductions in quota between 2002 and 2006 for VIIa cod and plaice may have restricted total effort in FU14 thereby reducing the more casual effort on *Nephrops*. Further research is needed to better define the directed fishery. From 2003 the main fleets targeting *Nephrops* include *Nephrops* directed single-rig and twin-rig otter trawlers operating out of ports in UK (NI), UK (E&W) and Ireland.

Regulations

Regulations introduced as part of a revised package of EC Fisheries Technical Conservation measures in 2000 remain in place. This legislation incorporates a system of 'mesh size ranges' for each of which has been identified a list of target species. In effect, nets in the 70–79 mm mesh size range must have at least 35% of the list of target species (which includes *Nephrops*) and the 80–99 mm mesh size range requires at least 30% of the list of target species. A square mesh panel (SMP) of 80 mm is required for 70–79 mm nets in the Irish Sea. Vessels using twin-rig gear in the Irish Sea must comply with a minimum mesh size of 80 mm (no SMP is required for nets with 80 mm meshes and above).

Other regulations restricting trawling in other fisheries within the Irish Sea will affect effort on these and other stocks. This could either attract local effort or even relocate effort to fisheries in other areas. Although unrestrictive the result of better catch information through the buyers and sellers legislation introduced to the UK from 2006 will have the same effect as quota uptake of stocks which used to be misreported will be quicker.

As well as an Area VII TAC other *Nephrops* conservation measures in the Irish Sea are a minimum landing size of 20 mm CL length (equivalent to 37 mm tail length or 70 mm total length).

In addition to *Nephrops* measures the cod spawning areas of the Irish Sea are closed to whitefish directed vessels between 14th February to 30th April part of the Irish Sea cod recovery plan. There is derogation for *Nephrops* vessels during this closure.

A.3. Ecosystem aspects

The Working Group has collated no information on the ecosystem aspects of this stock.

B. Data

B.1. Commercial catch

Length and sex compositions of *Nephrops* landed from the Irish Sea East are estimated from port sampling by England and Wales. Length data from this sampling are applied to catch samples collected at sea and raised to total international landings. Catch–length samples are collected independently of landings–length samples but both are considered representative. The independent raising process means that the final annual catch–length frequency distribution still requires scaling to the reported landings. Using a discard ogive derived from samples collected in the early 1990s an initial estimate of discards is taken from the catch distribution. These are then added to the landings distribution to create a dummy catch distribution. The difference between the numbers-at-length for both the raised sampled and dummy catch distribution was then used to tune a raising factor by minimizing the sums of squares. Once the raising factor is derived, the final discard–length distribution is the difference between the raised catch distribution and the landings distribution and a final catch distribution is a sum of the landings and discard distributions. In 2008 a new discard ogive was calculated from the discard samples collected from 2003 until March 2008 and applied to the 2003 data to date. The lack of discard and catch data between 1995 and 1999 is likely to adversely affect the quality of any analytical assessments. Apparent differences between catch LFDs and discard practices in 1992 to 1994 and 1999 to 2000 are discussed in the Section 5.12 of the 2001 WGNEPH report (ICES, 2001a). 2001 and 2002 catch and landings sampling provided catch compositions to help estimate the LFDs for the missing years. Quarterly discard distributions for the years 1995 to 1999 were estimated by using the discard LFDs for the two preceding and the two following years.

Trial XSAs using these data were attempted at the 2003 WGNEPH. In the absence of routine methods of direct age determination in *Nephrops*, age compositions of removals were inferred from length compositions by means of 'slicing'. This procedure, introduced at the 1991 WG, uses von Bertalanffy growth parameters to determine length boundaries between age classes. All animals in length classes between boundaries are assigned deterministically to the same age class. The method was implemented in the L2AGE programme which automatically generated the VPA input files. The programme was modified in 1992 to accommodate the two-stage growth pattern of female *Nephrops* (ICES, 1992) and again in 2001 to separate 'true' as opposed to 'nominal' age classes (ICES, 2001a). The age classes are 'true' to the extent that the first slicing boundary, i.e. lower length boundary for 'age' 0, is the *length-at-age* zero rather than the lowest length in the data. This was to ensure comparability of 'age' classes across stocks.

B.2. Biological

Mean weights-at-age for this stock are estimated from studies by Bailey and Chapman, 1983.

A natural mortality rate of 0.3 was assumed for all age classes and years for males and immature females, with a value of 0.2 for mature females. The lower value for mature females reflects the reduced burrow emergence while ovigerous and hence an assumed reduction in predation.

The time-invariant values used for proportion mature-at-age are: males age 1+: 100%; females age 1: 0%; age 2+: 100%. The source of these values is not known.

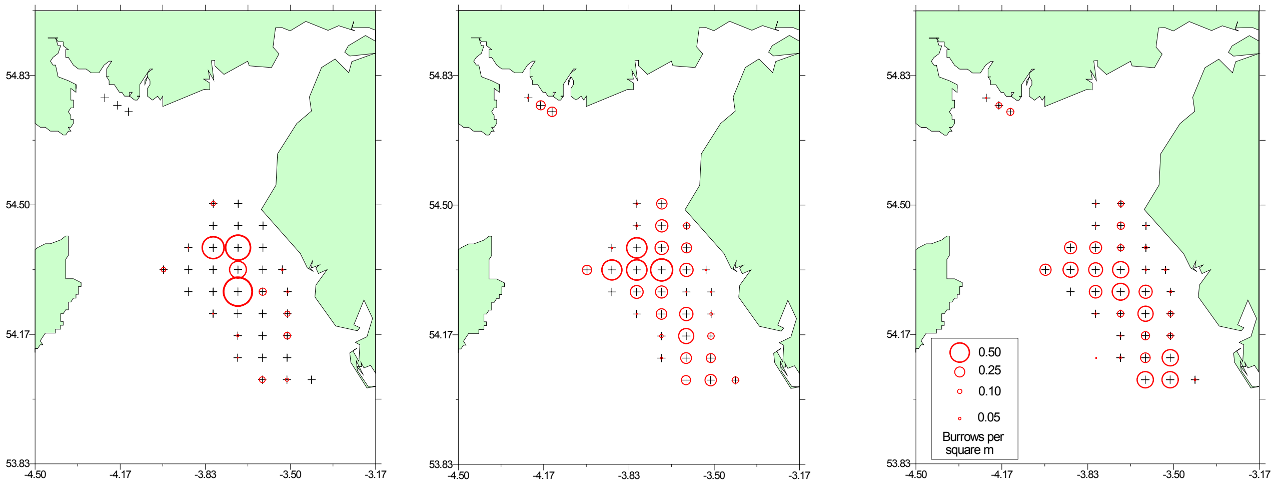
Proportion of F and M prior to spawning was specified as zero to give estimates of spawning–stock biomass at January 1. In the absence of independent estimates, the mean weights-at-age in the total catch were assumed to represent the mean weights in the stock.

B.3. Surveys

ACFM recommended that UWTV surveys could provide useful fishery-independent data on the status of *Nephrops* stocks. The UWTV surveys conducted in August 2007 and 2008 are presented here as a preliminary to future assessments. Two previous UWTV surveys were conducted for this fishery in 1997 and 1998 with limited success, because of weather. These surveys and their design were documented at WKNEPHTV (ICES, 2007). The surveys in 2007 and 2008 are consistent but follow a different design to the earlier surveys. For ease of comparison, and consistency, the survey has been based on the current ROI and NI survey in the Western Irish Sea. A randomised fixed grid (3.4 x 3.4 nm) of 34 stations plus a transect of 3 stations in Wigtown bay were sampled. Figure B.3.1 shows the distribution of stations in the TV surveys with the size of the symbol reflecting the *Nephrops* burrow density.

The survey protocols used were the same, and followed the standards set by WKNEPHTV (ICES, 2007). In 2007 poor visibility hampered the survey and despite repeated attempts at over 15 stations, turbidity scores precluded the use of some of the counts. On first analysis only 20 were considered usable. The 2008 and 2009 survey was far more successful, sea conditions were far better and the quality of the video data collected was much improved. 35 and 32 stations respectively were considered useable. Table B.3.1 provides the estimates for the burrow density and abundance.

These are the first two of a planned series of surveys. Because of uncertainties about the limits of the stock and characteristics of this fishery and in light of SGSURV and WK*NEPH* (2009) the data will require further analysis and a further survey to qualify the precision of these estimates. These results therefore are only presented as provisional.



2007 **2008** **2009**

Figure B.3.1. Station distribution and relative burrow density, from August TV surveys 2007 to 2009.

Table B.3.1. Irish Sea East (FU14): Results from NI UWTV survey of *Nephrops* ground.

Year	Area	No. stations	Non Zero stations	Mean burrow density	Abundance
	km²			no./m²	millions
2007*	1043	20	18	0.38	393
2008*	1043	35	31	0.36	334
2009*	1043	32	28	0.25	257

*** provisional**

A number of factors are suspected to contribute bias to the surveys. In order to use the survey abundance estimate as an absolute it is necessary to correct for these potential biases. The history of bias estimates are given in the following table and are based on expert opinion on those used in adjacent survey areas which used simulation models, and preliminary experimentation. The biases associated with the estimates of *Nephrops* abundance in the E. Irish Sea are:

	Time period	Edge effect	Detection rate	Species identification	Occupancy	Cumulative bias
FU14: Irish Sea East	<=2009	1.3	0.75	1.15	1	1.2

Edge effect: Same sledge and set up as Western Irish Sea. Larger burrows systems increase the edge effect.

Detection rate: Same sledge and set up as Western Irish Sea and same staff so detection rate maintained.

Species identification: Factor kept the same as Eastern Irish Sea; *Calocaris* spp not a perceived problem on Eastern Irish Sea grounds but *Goneplax* spp. are prevalent across the ground.

B.5. Other relevant data

When carrying out the XSA in 2003 the landings per unit of effort time-series for the following fleet was used:

England and Wales *Nephrops* trawl gears. Landings-at-age and effort data from this fishery are used to generate a cpue index. There is also a cpue series from 1995 for Republic of Ireland vessels. Catch-at-age are estimated by raising length sampling of discards and landings to officially recorded landings and slicing into ages (knife-edge slicing using growth parameters). Cpue is estimated using officially recorded effort (hours fished) although the recording of effort is not mandatory. Combined effort for *Nephrops* trawlers is raised to landings. Discard sampling commenced in 1992 for this fishery, though some years have been missed as discussed above. There is no account taken of any technological creep in the fleet.

C. Historical stock development

D. Short-term projection

E. Medium-term projections

F. Yield and biomass-per-recruit/long-term projections

G. Biological reference points

H. Other issues

I. References

Biological Input Parameters

Parameter	Value	Source
Discard Survival	0.00	
MALES		
Growth - K	0.160	Irish Sea West data ; Bailey and Chapman (1983)
Growth - L(inf)	60	"
Natural mortality - M	0.3	Brander and Bennett (1986, 1989)
Length/weight - a	0.00022	Hossein *et al*. (1987)
Length/weight - b	3.348	"
FEMALES		
Immature Growth		
Growth - K	0.160	Irish Sea West data ; Bailey and Chapman (1983)
Growth - L(inf)	60	"
Natural mortality - M	0.3	Brander and Bennett (1986, 1989)
Size at maturity	24	Briggs (1988)
Mature Growth		
Growth - K	0.100	Irish Sea West data ; Bailey and Chapman (1983)
Growth - L(inf)	56	"
Natural mortality - M	0.2	Brander and Bennett (1986, 1989)
Length/weight - a	0.00114	Hossein *et al*. (1987)
Length/weight - b	2.820	"

Stock Annex 6.5: Irish Sea West *Nephrops* (FU15)

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Irish Sea West *Nephrops* (FU15)
Working Group	WK*NEPH* 2009 (WK*NEPH*2009)
Date	6 March 2009

A. General

A.1. Stock definition

Throughout its distribution, *Nephrops* is limited to muddy habitat, and requires sediment with a silt & clay content of between 10–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small scale movements (a few 100 m) but larval transfer may occur between separate mud patches in some areas. In the western Irish Sea the *Nephrops* stock inhabits an extensive area of muddy sediment between the Isle of Man and Northern Ireland and its fishery contributes to more than 90% of overall Irish Sea landings. There is little evidence of mixing between the east and west Irish Sea stocks due to the nature of water current movements, which is characterised in the west by a gyre, which has a retention affect on both sediment and larvae. The eastern and western *Nephrops* stocks are treated as separate populations as they have different population characteristics.

A.3. Ecosystem aspects

A number of studies have examined *Nephrops* larvae distribution in order to examine how recruitment may impinge upon the distribution of a "catchable" (adult) *Nephrops* population and the maintenance of the population. Hillis (1968) found that although generally the larvae occupied the same areas as the adults, there was some evidence of advective losses to the southeastern part of their range, most probably due to tidal currents (White *et al*., 1988). More recent studies in the western Irish Sea have uncovered the existence of a seasonal cyclonic gyre which appears to facilitate retention of larvae over the mud patch (Dickey-Collas *et al*., 1996; Hill *et al*., 1996; Horsburgh *et al*., 2000).

B. Data

B.1. Commercial catch

Length and sex compositions of *Nephrops* landed from the Irish Sea West are estimated from port sampling by Ireland and Northern Ireland and Ireland. A lack of co-operation by the Northern Ireland industry prevented sampling commercial catches over the period 2003–2007. The Irish LFDs are therefore raised to the international catch for these years. Northern Ireland sampling resumed in 2008 and these data are combined with those from Ireland for that year. Sample data is used to compute international removals (Landings + dead discards).

Landings per unit of effort time-series are available from the following fleets:

Northern Ireland *Nephrops* trawl gears. Landings-at-age and effort data from this fishery since 1986 are used to generate a cpue index. There is also a cpue series since

1995 for a subset of Republic of Ireland *Nephrops* vessels. Catch-at-age are estimated by raising length sampling of discards and landings to officially recorded landings and slicing into ages (knife-edge slicing using growth parameters). Cpue is estimated using officially recorded effort (hours fished). Discard sampling commenced in the mid-1980s by Northern Ireland and the Republic of Ireland. There is no account taken of any technological creep in the fleet.

B.2. Biological

Mean weights-at-length for this stock are estimated from studies by Pope and Thomas (1955).

A natural mortality rate of 0.3 was assumed for males and immature females, with a value of 0.2 for mature females. The lower value for mature females reflects the reduced burrow emergence while ovigerous and hence an assumed reduction in predation.

Maturity for females is taken as 22.1 mm carapace length (McQuaid *et al*., 2006).

Proportion of F and M prior to spawning was specified as zero to give estimates of spawning–stock biomass at January 1. In the absence of independent estimates, the mean weights-at-age in the total catch were assumed to represent the mean weights in the stock.

B.3. Surveys

Ireland and Northern Ireland jointly carry out underwater television (UWTV) surveys on the main *Nephrops* grounds in the western Irish Sea (Figure 1) since 2003. These surveys are based on a randomised fixed grid design. The methods used during the survey are similar to those employed for UWTV surveys of *Nephrops* stocks elsewhere and are detailed in WKNEPHTV, 2007 and WKNEPHBID, 2008.

Northern Ireland have carried out a spring (April) and summer (August) *Nephrops* trawl surveys since 1994. These surveys provide data on catch rates and length frequency distributions from of stations throughout in the western Irish Sea. These surveys generate data on *Nephrops* size composition, mean size, maturity and sex ratio.

A number of factors are suspected to contribute bias to the UWTV surveys. In order to use the survey abundance estimate as an absolute it is necessary to correct for these potential biases. The history of bias estimates are given in the following table and are based on simulation models, preliminary experimentation and expert opinion, the biases associated with the estimates of *Nephrops* abundance in the Irish Sea West are:

	Time period	Edge effect	detection rate	species identification	occupancy	Cumulative bias
FU15: Irish Sea West	<=2009	1.24	0.75	1.15	1	1.14

B.4. Commercial cpue

B.5. Other relevant data

Table 1 is a summary of available data along with an assessment of its reliability.

Table 2 is a summary of assessment parameters.

C. Historical stock development

1) Survey indices are worked up annually resulting in the TV index.

2) Adjust index for bias (see Section B3). The combined effect of these biases is to be applied to the new survey index.

3) Generate mean weight in landings. Check the time-series of mean landing weights for evidence of a trend in the most recent period. If there is no firm evidence of a recent trend in mean weight use the average of the three most recent years. If, however, there is strong evidence of a recent trend then apply most recent value (don't attempt to extrapolate the trend further in the future).

D. Short-term projection

1) The catch option table will include the harvest ratios associated with fishing at $F_{0.1}$ and F_{max}. These values have been estimated by the Benchmark Workshop (see Section 9.2) and are to be revisited by subsequent benchmark groups. The values are FU specific and have been put in the Stock Annexes.

2) Create catch option table on the basis of a range of harvest ratios ranging from 0 to the maximum observed ratio or the ratio equating to F_{max}, whichever is the larger. Insert the harvest ratios from step 4 and also the current harvest ratio.

3) Multiply the survey index by the harvest ratios to give the number of total removals.

4) Create a landings number by applying a discard factor. This conversion factor has been estimated by the Benchmark Workshop and is to be revisited at subsequent benchmark groups. The value is FU specific and has been put in the Stock Annex.

5) Produce landings biomass by applying mean weight.

The suggested catch option table format is as follows.

			Implied fishery	
	Harvest rate	Survey Index	Retained number	Landings (tonnes)
	0%	12 345	0	0.00
	2%	"	247	123.45
	4%	"	494	246.90
	6%	"	741	370.35
	8%	"	988	493.80
$F_{0.1}$	8.60%	"	1062	530.84
	10%	"	1235	617.25
	12%	"	1481	740.70
F_{max}	13.50%	"	1667	833.29
	14%	"	1728	864.15
	16%	"	1975	987.60
	18%	"	2222	1111.05
	20%	"	2469	1234.50
	22%	"	2716	1357.95
$F_{current}$	21.5%	"	2654	1327.09

E. Medium-term projections

None presented.

F. Long-term projections

None presented.

G. Biological reference points

Harvest ratios equating to fishing at $F_{0.1}$ and F_{max} were calculated in WK*Neph* (2009). These calculations assume that the TV survey has a knife-edge selectivity at 17 mm and that the supplied length frequencies represented the population in equilibrium.

$F_{0.1}$ = 10.9%

F_{max}= 20.2%

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Table 1. Summary table of available data.

FU15 Irish Sea West: Data Available															
Data															
Commercial Data	pre-1995	1994	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Landings															
Effort															
cpue/lpue															
Mean size															
Sex ratio															
LFDs															
Catch															
Landings															
Discards															
Survey Data															
***Trawl survey*s**															
Catch rate															
mean size															
LFDs															
Sex ratio															
Camera Surveys															
Density estimate															
Data Quality															
Poor															
Acceptable															
Reliable															

Table 2: Biological Input Parameters.

Parameter	Value	Source
Discard Survival	0.10	ICES (1991a)
Discard rate	40.2%	2007 discard sampling.
MALES		
Growth - K	0.160	Hillis (1979) ; ICES (1991a)
Growth - L(inf)	60	"
Natural mortality - M	0.3	Brander and Bennett (1986, 1989)
Length/weight - a	0.00032	After Pope and Thomas (1955) (data for Scottish stocks)
Length/weight - b	3.210	"
FEMALES		
Immature Growth		
Growth - K	0.160	Hillis (1979) ; ICES (1991a)
Growth - L(inf)	60	"
Natural mortality - M	0.3	Brander and Bennett (1986, 1989)
Size at maturity	22.1	McQuaid *et al*., 2006
Mature Growth		
Growth - K	0.100	Hillis (1979) ; ICES (1991a)
Growth - L(inf)	56	"
Natural mortality - M	0.2	Brander and Bennett (1986, 1989)
Length/weight - a	0.00068	After Pope and Thomas (1955) (data for Scottish stocks)
Length/weight - b	2.960	"

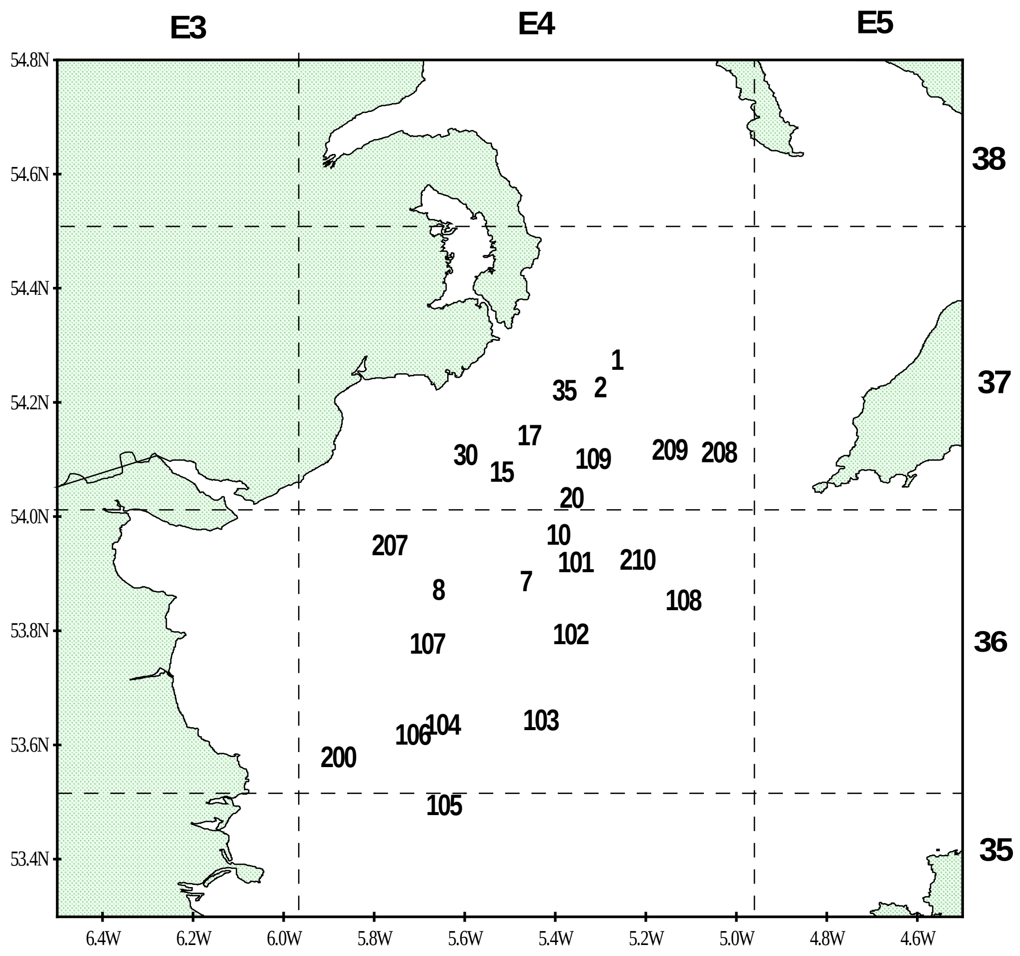

Figure 1: Western Irish Sea Nephrops stations

Stock Annex 6.6: WhitingVIIa

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Irish Sea Whiting (Division VIIa)
Working Group	Assessment of Northern Shelf Demersal Stocks
Last updated	WGNSDS 2008
Updates	Inclusion of Fishery Data from Ireland

A. General

A.1. Stock definition

Whiting in Division VIIa are considered a single stock for management purposes. In 2004 an informal meeting was established to review current knowledge of the distribution, movements and stock structure of whiting in the Irish Sea, and linkages between whiting in the Irish Sea and surrounding management areas. Information on egg and larval, tagging, survey studies was presented as a working document (WD10) in WGNSDS, 2005. The results of this are synopsized below:

UK egg and larva surveys have shown that whiting spawn in spring throughout the eastern Irish Sea and in the coastal waters of the western Irish Sea. This is supported by the distribution of actively spawning fish caught during trawl surveys in March.

Transport of whiting eggs, larvae or pelagic pre-recruits from Celtic Sea spawning grounds into the Irish Sea is likely to be impeded by the Celtic Sea thermal front that becomes increasingly established from spring onwards.

Whiting recruitment grounds are in the same general area as the spawning grounds, and young whiting are widespread in the coastal bights of the Irish Sea. The gyre system that becomes established from late spring onwards in the western Irish Sea appears important in retaining larvae and pelagic pre-recruits of whiting, as shown by the results of frame-trawl surveys of pelagic pre-recruits in the western Irish Sea.

As the whiting become demersal from late summer onwards, they are found throughout the western Irish Sea although densities appear highest around the periphery of the mud patch in coastal waters and along the southern boundary between Ireland and the Isle of Man. This pattern is also noted by fishermen operating in this area. Densities of young whiting in the eastern Irish Sea appear highest off Cumbria and the Solway Firth in autumn, but are more widespread in spring.

Tagging studies in the late 1950s show some seasonal dispersal of whiting from the Irish Coast to as far as the Clyde, Liverpool Bay and the Celtic Sea, with evidence of return migrations. Whiting tagged in these studies ranged from about 20–40 cm, averaging around 30 cm. Whiting recaptured well away from the tagging sites off County Down in the western Irish Sea tended to be several cm larger, on average, than the tagged whiting.

Both the western Irish Sea and the Clyde have historically been characterised bycatches of immature and first-maturing whiting, whilst the eastern Irish Sea has a broader age-range of whiting. This pattern persists to the present day.

The evidence for interchange of whiting between the western Irish Sea and other areas within the Irish Sea precludes treating different areas within the Irish Sea as containing functionally separate stocks. Spatial modelling of the populations would require information on rates of dispersal between areas.

Trawl surveys continue to show that juvenile whiting are very abundant in the coastal waters of the Irish Sea, and that whiting are one of the most abundant fish species taken in the surveys. Hence, there have been no indications of depressed recruitment associated with the apparent steep decline in abundance of large whiting. Length at 50% maturity in female whiting is only 20–21 cm in the Irish Sea and neighbouring management areas, and spawning appears predominantly by young whiting of 1–3 years old.

A.2. The fishery

Most landings by the Irish and UK (NI) fleet, which take the bulk of the Division VIIa whiting catch, are from the western Irish Sea (ICES CM 2003/ACFM:04) and are made predominately by single- and twin-rig trawlers. A small number of UK pair trawlers also fish for whiting. The UK (E&W) fleet has declined substantially over time, and the bulk of its landings are from inshore otter trawlers targeting mixed flatfish and roundfish in the eastern Irish Sea. Discarding in this stock is thought to be high in all fleets, particularly in the *Nephrops* fishery. The *Nephrops* directed fishery operates on the main whiting nursery areas in the western Irish Sea, and is particularly intensive in the summer months. The mesh size mainly in use in the fishery is 70 mm in single trawls and 80 mm in twin trawls targeting *Nephrops*. The western Irish Sea fishery for whiting has declined substantially in recent years, and the increase in abundance of haddock has resulted in few vessels targeting whiting.

Vessels operating with 70 mm and 80 mm mesh are required to use square mesh panels. Square mesh panels were introduced as a technical measure to reduce fishing mortality on whiting. Square mesh panels have been mandatory for all UK trawlers (excluding beam trawlers) in the Irish Sea since 1993 and for Irish trawlers since 1994. While the effects of this technical measure have not been formally evaluated, the *Nephrops* fishery still generates substantial quantities of whiting discards. Effort by Irish *Nephrops* trawlers in the main areas of whiting bycatch has shown some reduction during the period of the Irish Sea cod recovery plan closures. However, the summer peak in activity of the *Nephrops* fishery was not affected by the recovery plans. As the activities of the *Nephrops* fleet were not restricted by the cod recovery plan, it is unlikely that the recovery plan was effective in reducing levels of discarding in this stock.

There has been some recent decommissioning of vessels in the Irish Sea. Most recently, Ireland introduced a further decommissioning scheme in 2008, which aims to remove 11 140 GT from the fleet register. This is targeted at vessels over 10 years of age and >18 m in length. To date the majority of applications emanate from east and west coast ports from vessels, which traditionally target *Nephrops* with uptake from the Southeast also. It is expected that much of the actual effort removed from the decommissioning scheme may be partially negated through the introduction of ~21 modern second-hand vessels (mostly ex-French) into the fleet over the last few years.

The reported landings of whiting in 1999–2001 by UK vessels decommissioned in 2002 amounted to about 7% of the total international landings of whiting in those years. Whilst few new Irish vessels have joined the fishery, some vessels from County Donegal have reported catches of whiting in VIIa. These vessels have been attracted into the Celtic Sea fishery in recent years in response to poor catches in other areas. Irish landings of whiting in the southwestern part of VIIa now contribute the bulk of the total Irish landings in the Division (ICES CM 2003/ACFM:04). The difference in grounds in the southern part of VIIa means that whiting in the area are more likely to function as part of the Celtic Sea stock rather than the Irish Sea stock.

Irish otter board trawlers fishing ICES Area VIIa generally use twin-rig gear to fish for *Nephrops*. However there are also localized mixed fisheries both in the north and south ends of VIIa. The Irish Sea *Nephrops* fleet is highly opportunistic and of this fleet, there are only a handful of boats that fish the Irish Sea Prawn Grounds 100% of the time. The rest of the fleet divides its time between the Irish Sea, Smalls, Aran and Porcupine Grounds dependant on tides, weather and market forces. Because of the need to fish further away from their home port and in rougher sea conditions, many of the older and smaller wooden vessels are being replaced with new and second hand steel vessels. Most of these newer vessels are French-style twin-riggers. To maximize the return on their investment, many of the owners of newer vessels are opting for relief skippers and crews so that the vessels are fishing as much as possible.

In 2006, for the Irish fleet for the first time, *Nephrops* landings from the Smalls grounds (VIIg) have surpassed those from the Irish Sea grounds. This reflects the increasing amount of effort by East Coast vessels in 7g where in general, better prices are obtained for their catch. Two significant fleet movements occurred in 2006 for the Irish fleets. Firstly, there was a brief shift in effort by the *Nephrops* fleet towards the Aran Grounds around October due to reports of good fishing in the area. Also, some of the larger twin-riggers in the fleet switched to tuna fishing in the Bay of Biscay during the summer months.

The main species targeted by the otter trawl fleet are *Nephrops*, cod, ray, haddock, anglerfish and whiting. The Irish beam trawl fleet predominantly targets black sole and other high-quality flatfish and divides its effort between VIIa and VIIg depending on weather, tides and market forces.

For the UK NI fleet decommissioning at the end of 2003 removed 19 out of 237 UK vessels that operated in the Irish Sea, representing a loss of 8% of the fleet by number and 9.3% by tonnage. Of these vessels, 13 were vessels that used demersal trawls with mesh size >=100 mm. The previous round of decommissioning in 2001 removed 29 UK (NI) *Nephrops* and whitefish vessels and four UK (E&W) vessels registered in Irish Sea ports at the end of 2001. Of these, 13 were vessels that used demersal trawls with mesh size >=100 mm.

A.3. Ecosystem aspects

Recruitment in Irish Sea whiting appears less variable than in cod and haddock, although there is some similarity in the timing of strong and weak year classes that may indicate a similar response to changes in environmental conditions affecting spawning or early-stage survival. The diet of Irish Sea whiting has been examined in some detail since the 1970s using samples collected from research vessels. Cannibalism occurs in adult whiting; however the effect of this on the assessment of the stock has not yet been investigated. Young whiting are common in the diets of larger predators such as cod and anglerfish.

B. Data

B.1. Commercial catch

B.1.1. Landings

The following table gives the source of landings data for Irish Sea whiting:

	Kind of data				
Country	Caton (catch-in-weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)	Mat_{prop} (proportion mature-by-age)	Length composition-in-catch
UK(NI)	X	X	X	X	X
UK(E&W)	X	X	X		X
UK(Scotland)	X		X		
UK (IOM)	X				
Ireland	X	X	X		X
France	X				
Belgium	X				
Netherlands	X				

Quarterly landings and length/age composition data are supplied from databases maintained by national Government Departments and research agencies. These figures may be adjusted by national scientists to correct for known or estimated misreporting by area or species. Data are supplied on paper or Excel files to a stock coordinator nominated by the ICES Northern Shelf Demersal Working Group, who compiles the international landings and catch-at-age data, and maintains a time-series of such data with any amendments. To avoid double counting of landings data, each UK region supplies data for UK landings into its regional ports, and landings by its fleet into non-UK ports.

The UK (E&W) currently supplies raised quarterly length frequencies of landings but only sporadic age data. The catch and mean weight-at-age are estimated using combined UK (NI) and Irish quarterly length–weight relationships and age–length keys. Quarterly landings are provided by the UK (Scotland), Belgium and France and annual landings are provided by UK (IOM). The quarterly estimates of landings-at-age into UK (E&W), UK (NI) and Ireland are raised to include landings by France, Belgium, UK (Scotland), UK (IOM) (distributed proportionately over quarters), and then summed over quarters to produce the annual landings-at-age.

The Excel spreadsheet files used for age distribution, adjustments and aggregations can be found with the stock co-ordinator and for the current and previous year in the ICES computer system under **w:\acfm\wgnsds\year\personal\name** (of stock co-ordinator).

The result files (FAD data) can be found at ICES and with the stock co-ordinator, as ASCII files on the Lowestoft format, under **w:\acfm\wgnsds\year\data\whg_7a**.

B.1.2. Discards

The Irish Sea *Nephrops* fishery takes place on the whiting nursery grounds of the north western Irish Sea and has traditionally produced high whiting discarding. The quantity of whiting discarded from the UK (NI) *Nephrops* fishery in 2002 was estimated on a quarterly basis from samples of discards and total catch provided by skippers. The discards samples contain the heads of *Nephrops* tailed at sea. Using a length–weight relationship, the live weight of *Nephrops* that would have been landed as tails only is calculated from the carapace lengths of the discarded heads. The number of whiting in the discard samples is summed over all samples in a quarter and expressed as a ratio of the summed live weight of *Nephrops* in the discard samples (i.e. those represented as heads only in the samples). The reported live weight of *Nephrops* landed as tails only is then used to estimate the quantity of whiting discarded using the whiting:*Nephrops* ratio in the discard samples. The length frequency of whiting in the discard samples is then raised to the fleet estimate, and numbers and mean weight-at-age of discarded whiting is computed from the age–length key and length–weight parameters for whiting. The UK (NI) estimates are available since 1980 but the reliability of these estimates has not been determined. Roughly 40 discard samples are collected annually.

There are several limitations to these data: only a small subset of single-rig trawlers is sampled; the method of raising to the fleet discards will be affected by any inaccuracies in the reported landings of *Nephrops*; and there are no estimates of landings of whiting from these vessels with which to calculate proportions discarded-at-age. However, the WG has used these data in past assessments because removal of discards data would remove a large fraction of catch from the assessment.

A re-analysis of the Irish discard data raised to the *Nephrops* landings produced estimates of discards from the Irish *Nephrops* fleet that were more consistent with those of the UK (NI) *Nephrops* fleet. However, this method of raising could not be used to recalculate an entire time-series of discard estimates from the Irish *Nephrops* fleet. The quarterly UK (NI) discard ratios were therefore used by the Working Group to estimate the tonnage discarded from the Irish *Nephrops* fishery. Length frequencies and age–length keys from the whiting discarded by the Irish *Nephrops* fleet are used to estimate the numbers discarded-at-age from the Irish *Nephrops* fleet.

At the WGNSDS 2006 revised Irish discard estimates (1996–2005) raised according to the methods described in Borges *et al.*, 2005 were available to the Working Group See Table 1.0. These are available in the ICES files. Discard rates in this series were variable compared with previous estimates based on the UK NI self sampling scheme. Given the differences in raising procedure applied to the NI Discard estimates and the Irish discard estimates further examination of the discard data is needed before international estimates of discard numbers-at-age can be made. The Working Group did therefore not estimate international discard volumes and numbers-at-age for 2004.

B.2. Biological

Natural mortality was assumed to be constant (M=0.2, applied annually) for the whole range of ages and years.

A combined sex maturity is assumed, knife-edged at age 2. The use of a knife-edged maturity ogive has been a source of criticism in previous assessments. However, recent research on gadoid maturity conducted by the UK (NI) gives no evidence for substantial change in whiting maturity since the 1950s, although there has been an increase in the incidence of precocious maturity at age 1, particularly in males, since 1998.

As in previous years, SSB is computed at the start of each year, and the proportions of M and F before spawning were set to zero.

Stock weights are calculated using a procedure first described in the 1998 Working Group Report. To derive representative stock weights for the start of the year for year *i* and age *j* the following formula is adopted:

$(CW_{i,j} + CW_{i+1,j+1})/2$ = SW at start of year.

These values are then smoothed using a 3-year moving average.

Recent investigations into the biological parameters (maturity, sex and growth parameters) of whiting in VIIa (funded under the Data Directive Regulation (1639/2001)) took place during a Biological Sampling survey (BBS) in March 2004. Parameter estimates of maturity at length indicate the L_{50} for whiting in VIIa for males and females is 13.65 cm and 19.76 cm, respectively. Maturity-at-age for both sexes are similar for most stock area (VIIa, b, j and g) with the notable exception of age 1 males in the Celtic Sea where the estimates are outside the 95% CI bounds for VIIa and considerably lower than VIa. In most areas whiting were mature by age three and most were mature at age 2. The sex ratio for whiting tended to increase with length for nearly all the age classes in all areas indicating that females tend to have larger length-at-age than males (Gerritsen, 2005).

Gerritsen *et al.*, 2002 describes the relationships between maturity, length and age of whiting sampled on a length-stratified basis from NI groundfish surveys of the Irish Sea during spawning in spring 1992–2001. Findings show that most one year old females were immature whilst most two year old females were mature; almost all 3 year olds of both sexes were mature. Length at 50 maturity average around 19 cm in males and 22 cm in females.

B.3. Surveys

Seven research vessel survey-series for whiting in VIIa were available to the Working Group in 2005. In all surveys listed the highest age represents a true age not a plus group.

- UK (England and Wales) Beam Trawl Survey (UK E&W-BTS): ages 0 and 1, years 1988–2002: The survey covers the entire Irish Sea and is conducted in September on the R.V. *Corystes*. The survey uses a 4 m beam trawl targeted at flatfish. The survey is stratified by area and depth band, although the survey indices are calculated from the total survey catch without accounting for stratification. Numbers of whiting at age per km towed are provided for prime stations only (i.e. those fished in most surveys).
- UK (Northern Ireland) October Groundfish Survey (NIGFS-October): ages 0–5, years 1992–2005: The survey series commenced in its present form in 1992. It comprises 45 three mile tows at fixed station positions in the northern Irish Sea, with an additional 12 one mile tows at fixed station positions in the St George's channel from October 2001 (the latter are not included in the tuning data). The surveys are carried out using a rockhopper otter trawl deployed from the R.V. *Lough Foyle*. The survey designs are stratified by depth and sea bed type. The mean numbers at length per three mile tow are calculated separately by stratum, and weighted by surface area of the strata to give a weighted mean for the survey or group of strata. The strata are grouped into

western Irish Sea and eastern Irish Sea, and a separate age–length key is derived for each area to calculate abundance indices by age class. The survey design and time-series of results including distribution patterns of whiting are described in detail in Armstrong *et al.*, 2003.

- UK (Northern Ireland) March Groundfish Survey (NIGFS-March): ages 1–5, years 1992–2006: Description as for UKNI-GFS-October above.
- UK (Northern Ireland) Methot Isaacs–Kidd Survey (UKNI-MIK): age 0, years 1993–2005: The survey uses a Methot Isaacs–Kidd frame trawl to target pelagic juvenile gadoids in the western Irish Sea at 40–45 stations. The survey is stratified and takes place in June during the period prior to settlement of gadoid juveniles. Indices are calculated as the arithmetic mean of the numbers-per-unit sea area.
- Ireland's Irish Sea Celtic Sea Groundfish Survey (IR-ISCSGFS): ages 0–5, years 1997–2002: This survey commenced in 1997 and is conducted in October-November on the R.V. *Celtic Voyager*. The α and β of the series are set to account for the variable timing of this survey within the fourth quarter. The survey uses a GOV otter trawl with standard ground gear and a 20 mm codend liner. The survey operates mainly in the western Irish Sea but has included some stations in the eastern Irish Sea. The survey design has evolved over time and has different spatial coverage in different years. Indices are calculated as arithmetic means of all stations, without stratification by area.
- UK (Scotland) groundfish survey in spring (ScoGFS-spring): ages 1–8, years 1996–2006: This survey represents an extension of the Scottish West Coast groundfish survey (Area VI), using the research vessel *Scotia*. The survey gear is a GOV trawl, and the design is two fixed-position stations per ICES rectangle from 1997 onwards (17 stations) and one station per rectangle in 1996 (nine stations). The survey extends from the Northern limit of the Irish Sea to around 53^{o} 30'.
- UK (Scotland) groundfish survey in Autumn (ScoGFS-autumn): ages 0–5, years 1997–2005: The survey covers a similar area to the ScoGFS in spring, but has only 11–12 stations.
- IRGFS (Ireland): This survey commenced in 2003 aboard the R.V. Celtic Explorer. It is a depth stratified survey using a GOV trawl with a 20 mm mesh liner on the codend. The survey currently covers VIIb, j, g and VIa. Prototcols for the survey are governed by the International Bottom Trawl Survey Working Group (IBTS).

To allow the inclusion of the NIGFS-March and ScoGFS-spring surveys for the year after the last year with commercial catch data in an XSA, the surveys may be treated as if they took place at the end of the previous year, and the age range and year range of the surveys may be shifted back accordingly in the data files.

The following research surveys were available to the 2007 Working Group:

- UK (NI) groundfish survey: March 1992–2007.
- UK (NI) groundfish survey: October 1992–2006.
- UK (Scotland) groundfish survey: March 1996–2006.

- UK (Scotland) groundfish survey: autumn 1997–2005.
- Irish groundfish survey: autumn 2003 and 2004.
- UK (NI) MIK net surveys of pelagic-stage 0-group cod, western Irish Sea 1994–2006.
- UK (E&W) beam trawl survey: 0–1 gp cod, 1988–2006.

FSP surveys of Irish Sea round fish: 2004–2007.

Further details of the tuning data are given in Appendix 1 and 2 of the 1999 WG Report.

B.4. Commercial cpue

No cpue data have been provided for the French (Lorient) trawl fleet since 1992. Four commercial catch-effort dataseries were available to the WG:

- Irish otter trawl (IR-OTB): ages 1–6, years 1995–2002: Effort and cpue data provided for the Irish fleet comprise total annual effort (hours fished, not corrected for fishing power) and total numbers-at-age in landings from otter trawlers. The data were revised to take account of updated logbook information. This fleet operates mainly in the western Irish Sea, targeting *Nephrops* and/or whitefish. The distribution of fishing is concentrated in the western part of the range of the whiting stock in the Irish Sea. Hence the catch rates will represent changes in abundance of whiting in the western part of VIIa. The use of this fleet as a tuning index therefore relies on the assumption that trends in abundance in the west of VIIa reflect those of the entire stock. The catch-at-age data comprise a large proportion of the total international catch. Hence, some correlation of errors can be expected between the tuning dataset and the catch-at-age data. The effect of such correlations has not been evaluated. The otter trawl catch-at-age data contained data for landings only. Hence the reliability of the tuning fleet will be limited for age groups which are heavily discarded.
- UK (Northern Ireland) pelagic trawl: ages 2–6, years 1993–2002: The pelagic trawl catch-at-age data contained data for landings only. Hence the reliability of the tuning fleet will be limited for age groups which are heavily discarded. This fleet currently targets haddock and cod in the deeper waters of the western Irish Sea and the North Channel. Bycatches of whiting are currently very small and are heavily discarded due to their low value. The fleet is considered unsuitable for indexing whiting abundance.
- UK (Northern Ireland) single rig otter trawl: ages 0–6, years 1993–2002: This fleet operates mainly in the western Irish Sea. The distribution of fishing does not encompass the entire range of the whiting stock (which surveys suggest is distributed across the Irish Sea). Whiting discards from single-rig trawlers (estimated from fisher self-sampling scheme) are included.
- UK (England and Wales) otter trawl: ages 2–6, years 1981–2000: Estimates up to and including 2000 of commercial lpue from UK (E&W) otter trawlers contain data for landings only. Hence the reliability of the tuning fleet will be limited for age groups which are heavily discarded. This fleet operates mainly in the eastern Irish Sea. The distribution of fishing does not encompass the entire

range of the whiting stock (which surveys suggest is distributed across the Irish Sea) or the main whiting nursery grounds (in the western Irish Sea). Age compositions in most years have been estimated from length frequencies using ALKs that were obtained from sampling of fleets operating mainly in the western Irish Sea. This has introduced additional uncertainties into the data.

B.5. Other relevant data

None.

C. Historical stock development

Model used:

XSA (up to 2002)

SURBA 2.0–2003

SURBA 3.0–2004

SURBA 2.2–2005

Software used:

Lowestoft VPA suite

XSA Model Options chosen:

Tapered time weighting not applied

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 4

Survivor estimates shrunk towards the mean F of the final 5 years or the 2 oldest ages

S.E. of the mean to which the estimate are shrunk = 0.500

Minimum standard error for population estimates derived from each fleet = 0.300

Prior weighting not applied

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1980–last data year	0–6+	Yes
Canum	Catch-at-age in numbers	1980–last data year	0–6+	Yes
Weca	Weight-at-age in the commercial catch	1980–last data year	0–6+	Yes
West	Weight-at-age of the stock at spawning time.	1980–last data year	0–6+	Yes: uses smoothed catch weights adjusted to start of year
Mprop	Proportion of natural mortality before spawning	1980–last data year	0–6+	No – set to 0 for all ages in all years
Fprop	Proportion of fishing mortality before spawning	1980–last data year	0–6+	No – set to 0 for all ages in all years
Matprop	Proportion mature-at-age	1980–last data year	0–6+	No – the same ogive for all years
Natmor	Natural mortality	1980–last data year	0–6+	No – set to 0.2 for all ages in all years

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	NIGFS-Oct	1992–last data year	0–5
Tuning fleet 2	NIGFS-Mar (adjusted)	1991–(last data year-1)	0–4
Tuning fleet 3	ScoGFS-Spring	1996–last data year	1–5
Tuning fleet 4	UK(E&W) BTS	1988–last data year	0–1

For analysis of alternative procedures see WG reports from WGNSDS 1997–2005.

D. Short-term projection

Model used:

Age structured

Software used:

MFDP prediction with management option table and yield-per-recruit routines. MLA suite (WGFRANSW) used for sensitivity analysis and probability profiles.

Initial stock size.

Taken from the XSA for age 1 and older. The recruitment at age 0 in the last data year is estimated as a short-term GM (1992 onwards) because of a reduction in mean recruitment since then.

Natural mortality:

Set to 0.2 for all ages in all years.

Maturity:

The same ogive as in the assessment is used for all years.

F and M before spawning:

Set to 0 for all ages in all years.

Weight-at-age in the stock:

average stock weights for last three years.

Weight-at-age in the catch:

Average weight of the three last years.

Exploitation pattern:

Average of the three last years. Discard F's, which are generated by the *Nephrops* fleet as there are no discard estimates for other fleets, are held constant while landings F's are varied in the management option table.

Intermediate year assumptions:

status quo F

Stock–recruitment model used:

None, the short-term geometric mean recruitment at age 0 is used.

Procedures used for splitting projected catches:

F vectors in each of the last three years of the assessment are multiplied by the proportion landed or discarded-at-age to give partial Fs for landings and discards. The vectors of partial Fs are then averaged over the last three years to give the forecast values.

E. Medium-term projections

No medium-term projections are done for this stock due to problems with estimating current F.

F. Yield and biomass-per-recruit/long-term projections

Model used:

yield and biomass-per-recruit over a range of F values that may reflect fixed or variable discard F's.

Software used:

MFY or MLA

Selectivity pattern:

mean F array from last 3 years of assessment (to reflect recent selection patterns).

Stock and catch weights-at-age:

mean of last three years (weights-at-age have declined as the stock has declined since the 1980s; it is not known if this is an environmental effect on growth that is independent of stock size).

Proportion discarded:

Partial F vectors are the recent average.

Maturity:

Fixed maturity ogive as used in assessment.

G. Biological reference points

Precautionary approach reference points have remained unchanged since 1999. B_{pa} is set at 7000 t and is defined as B_{lim}*1.4. B_{lim} is defined as the lowest observed SSB (ACFM, 1999), considered to be 5000 t. There is not considered to be clear evidence of reduced recruitment at the lowest observed SSBs. F_{pa} is set at 0.65 on the technical basis of high probabilities of avoiding F_{lim} and of SSB remaining above B_{pa} in the long term. F_{lim} is defined as 0.95, the fishing mortality estimated to lead to a potential stock collapse.

H. Other issues

None.

I. References

Armstrong, M.J., Peel, J., McAliskey, M., McCurdy, W., McCorriston, P. and Briggs, R. 2003. Survey indices of abundance for cod, haddock and whiting in the Irish Sea (Area VIIaN): 1992–2003. Working Document No. 3 submitted to 2003 meeting of the ICES Working Group on Assessement of Northern Shelf Demersal Stocks. 33pp.

Borges, L.; Rogan, E. and Officer, R. 2005. "Discarding by the demersal fishery in the waters around Ireland", Fish. Res. (in press).

Gerritsen, H. 2005. Biological parameters for Irish Demersal Stocks in 2004. WD5 (WGNSDS, 2005)

Table 1.0 Revised Discard estimates raisesd according to the method oulined in Borges *et al.,* 2005.

Age	1996 Numbers ('000)	1996 Weight (kg)	1997 Numbers ('000)	1997 Weight (kg)	1998 Numbers ('000)	1998 Weight (kg)	1999 Numbers ('000)	1999 Weight (kg)	2000 Numbers ('000)	2000 Weight (kg)	2001 Numbers ('000)	2001 Weight (kg)	2002 Numbers ('000)	2002 Weight (kg)	2003 Numbers ('000)	2003 Weight (kg)	2004 Numbers ('000)	2004 Weight (kg)	2005 Numbers ('000)	2005 Weight (kg)
0	5631.20	0.015	4110.63	0.027	5073.57	0.027	187.26	0.036	7850.12	0.033	20981.54	0.016	29017.16	0.021	1921.76	0.016	17091.56	0.018	442.07	0.010
1	5925.33	0.035	8361.19	0.044	5939.53	0.064	276.50	0.102	3098.24	0.047	8883.11	0.054	12097.93	0.033	2419.56	0.036	7347.29	0.034	2531.84	0.035
2	1802.90	0.111	3243.45	0.120	3826.20	0.107	150.99	0.174	137.80	0.153	1413.48	0.126	576.17	0.112	1287.21	0.178	731.35	0.101	783.68	0.091
3	144.34	0.217	696.18	0.200	440.05	0.185	43.70	0.235	30.31	0.229	479.38	0.133	152.95	0.105	603.20	0.246	142.50	0.165	129.28	0.159
4	6.02	0.206	68.71	0.241	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	108.64	0.268	96.30	0.218	40.12	0.154
5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	22.95	0.136	17.66	0.123	0.00	0.000	0.00	0.000	24.48	0.371
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
OTB Discards (tonnes, whole weight)		520.8		#####		1010.3		71.6		434.3		1054.5		1100.9		523.6		680.3		201.3

Sampling Information	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Number of Trips	8	8	7	4	10	2	1	9	11	8
Number of Hauls	48	44	58	40	111	34	7	60	122	96

Stock Annex 6.7: Irish Sea Plaice

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Plaice (Division VIIa)
Working Group	Celtic Seas Ecoregion
Date	18th May 2010
By	Christopher Lynam

A. General

A.1. Stock definition

There are considered to be three principle spawning areas of plaice in the Irish Sea: one off the Irish coast, another northeast of the Isle of Man towards the Cumbrian coast, and the third off the north Wales coast (Nichols *et al.*, 1993; Fox *et al.*, 1997; Figure A1). Cardigan Bay has also been identified as a spawning ground for plaice in the Irish Sea (Simpson, 1959).

The level of mixing between the east and west components of the Irish Sea stock appears small. (Dunn and Pawson, 2002). Length-at-age measurements from research surveys as well as anecdotal information from the fishing industry suggests that plaice in the western Irish Sea grow at a much slower rate than those in the eastern Irish Sea. Earlier studies have suggested that the east and west components of the stock are distinct (Brander 1975; Sideek 1989) and should therefore be considered independently of one another. Morphometric differences have been observed between the east and west components of the stock; a comment in the 1982 WG report states that plaice to the west of the 5°W line are approximately 3 cm larger at-age (for the most abundant age groups) than those to the east of this line. In contrast, the 2004 WG indicated that the UK (E&W) beam trawl survey in September (from 1989) catches plaice off the Irish coast that are smaller-at-age than those caught in the eastern Irish Sea. In 2009, the raw catch weight data (prior to polynomial smoothing) from UK (E&W) and Irish fleets (all gears) indicates that plaice caught by the Irish fleets are approximately 50 g heavier than those caught by the UK (E&W) fleet (Figure A2).

The degree of separation between the stocks of plaice in the Irish Sea and the Celtic Sea is unclear. Numerous tagging studies indicate a southerly movement of mature fish (or fish maturing for the first time) from the southeast Irish Sea, off North Wales, into the Bristol Channel and Celtic Sea during the spawning season, such that 43% of the new recruits are likely to recruit outside of the Irish Sea (Figure A1). While some of these migrant spawning fish will remain in the Bristol Channel and Celtic Sea, the majority (≥70%) are expected to return to summer feeding grounds in the Irish Sea (Dunn and Pawson, 2002).

Very little mixing is considered to occur between the Irish Sea and Channel stocks or between the Irish Sea and North Sea (Pawson 1995). Nevertheless, time-series of recruitment estimates for all stocks in waters around the UK (Irish Sea, Celtic Sea, western and eastern Channel, North Sea) show a significant level of synchrony (Fox *et al.*, 2000). This could indicate that the stocks are subject to similar large-scale environmental forces and respond similarly to them, or alternatively that there are subpopulations that share a common spawning.

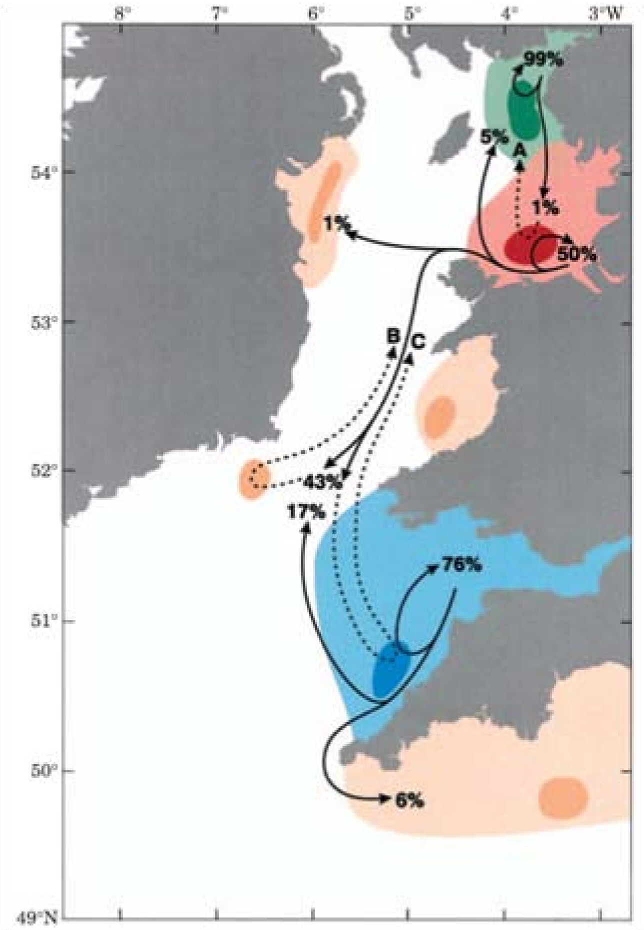

Figure A1. (right) Principal substock areas and movements of plaice on the west coast of England and Wales. Percentages are the recaptures rates of tagged plaice <25 cm total length when released, and >26 cm when recaptured in English and Welsh commercial fisheries. Tagging exercises in 1979–1980 and 1993–1996 were combined based on the assumption that the dispersal patterns of plaice were consistent over time. For each substock, the main feeding area (derived from tag recaptures during April–December; light shading), and the main spawning area (derived from tag recaptures during January–March, and ichthyoplankton surveys; dark shading) are indicated. The substocks tagged have been coloured green, red and blue. The substocks coloured orange are less well determined, with the feeding area around south-east Ireland unknown. Letters represent return migrations, where A ≈ 6%, and B+C ≈ 46%. Reproduced from Dunn and Pawson (2002).

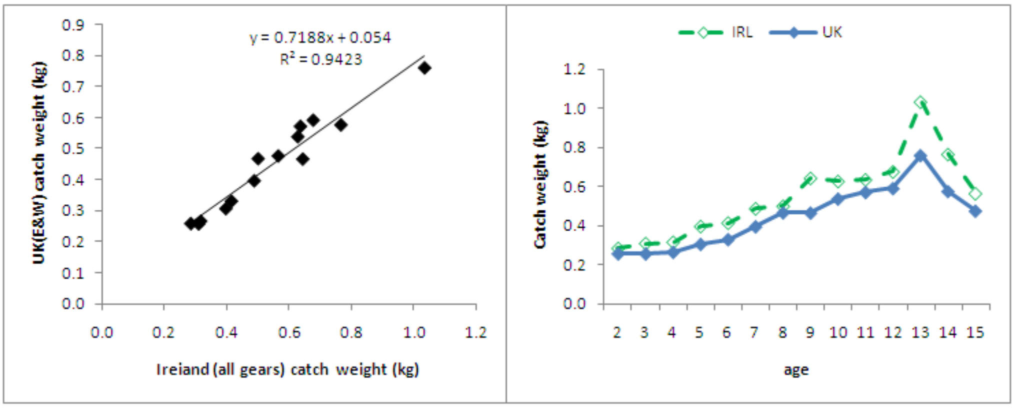

Figure A2. Observed weight-at-age of plaice from landed catches by the UK (E&W) and Irish fleets (all gears) in 2009.

A.2. Fishery

The status and activities of the fishing fleets operating in ICES Subdivision VIIa are described by Pawson *et al.*, 2002 and also by Anon, 2002. The majority of vessels operating in the Irish Sea are otter trawlers fishing for cod, haddock, whiting and plaice with bycatch of anglerfish, hake and sole. Since 2001 these trawlers have adopted mesh sizes of 100–120 mm and other gear modifications depending on the requirements of recent EU technical conservation regulations and national legislation. Square mesh panels have been mandatory for UK otter trawlers since 1993 and for Irish trawlers since 1994. The number of Irish vessels operating in this area has declined in recent years. Fishing effort (hours fished) in the UK (England and Wales) fleet declined rapidly after 1989 and in 2009 effort by the Irish and UK (E&W) otter fleets reached historic lows.

Although some of the otter trawlers also take part in the fishery for sole, there have been a growing number of beam trawlers, particularly from southern England and Belgium exploiting sole. This fishery has important bycatch of plaice, rays, brill, turbot and anglerfish. The fishing effort of the Belgium beam trawl fleet varies according to the catch rates of sole in the Irish Sea compared with other areas in which the fleet operates. In 2009, effort (hours fished) by the UK (E&W) beam trawl fleet fell to the lowest observed level.

A fleet of vessels primarily from Ireland and Northern Ireland take part in a targeted *Nephrops* fishery using 70 mm mesh nets with 75 mm square mesh panels. This fishery takes a substantial bycatch of whiting, most of which is discarded. Some inshore shrimp beam trawlers occasionally switch to flatfish when shrimp become temporarily unavailable. Other gear types employed in the Irish Sea to catch demersal species are gillnets and tanglenets, notably by inshore boats targeting cod, bass, grey mullet, sole and plaice.

The minimum landing size for plaice in the Irish Sea was set in 1980 to 25 cm (Council Regulation (EEC) No 2527/80). This was increased in 1998 to 27 cm (Annex XII of Council Regulation 850/98).

Since 2000 a recovery programme has been implemented to reduce exploitation of the cod spawning stock in the Irish Sea. In 2002 the European Commission regulations included a prohibition on the use of demersal trawl, enmeshing nets or lines within the main cod spawning area in the northwest Irish Sea between the 14th February and 30th April. Some derogations were permitted for *Nephrops* trawls and beam trawlers targeting flatfish.

A.3. Ecosystem aspects

Plaice are preyed upon and consume a variety of species through their life history. However, plaice have not as yet been included in an interactive role in multispecies assessment methods (e.g. ICES WGSAM 2008). Among other prey items, plaice typically consume high proportions of polychaetes and molluscs.

Other than statistical correlations between recruitment and temperature (Fox *et al*., 2000) little is known about the effects of the environment on the stock dynamics of plaice in the Irish Sea. Negative correlations between year-class strength of plaice (in either the Irish Sea, Celtic Sea, Channel and North Sea) and sea surface temperature are generally strongest for the period February–June. However, western (North Sea and Channel) and eastern (Irish Sea and Celtic Sea) stocks have been found to respond to different time-scales of temperature variability, which might imply that different mechanisms are operating in these stocks and/or that the Irish Sea and Celtic Sea share common spawning (Fox *et al*., 2000).

B. Data

B.1. Commercial catch

Landings

International landings-at-age data based on quarterly market sampling and annual landings figures are available from 1964. Throughout the period 1978 to 2003 quarterly age compositions have typically represented around 80–90% of the total international landings. Table B1 details the derivation of international landings for the period 1978 to 2003.

Prior to 1983 the stock was assessed on a separate sex basis: the catch numbers of males and females were worked up separately and the numbers of males and females in the stock as estimated from each assessment combined to give a total biomass estimate. Since 1983 a combined sex assessment of the stock has been conducted and the numbers of males and females in the catch have been combined at the international data aggregation level prior to running a single assessment.

Data exploration

Data exploration for commercial landings data for Irish Sea plaice currently involves:

- expressing the total landings-at-age matrix as proportions-at-age, normalised over time, so that year classes making above-average contributions to the landings are shown as large positive residuals (and vice-versa for below-average contributions);
- applying a separable VPA model in order to examine the structure of the landed numbers-at-age before they are used in catch-at-age analyses, in particular whether there are large and irregular residuals patterns that would lead to concerns about the way the recorded catch has been processed.

Discards

In 1986, the UK fleet was restricted to a 10% bycatch of plaice for almost the entire year. Estimates were made of the increased quantity of plaice that would have been discarded based on comparisons of lpue values for 1985–1986 with those for 1984–1985. The estimated quantity of 250 tonnes was added to the catch. A similar situation arose the following year and 250 tonnes was added to the catch for 1987.

The 10% plaice bycatch restriction was enforced again in 1988 to all UK (E&W) vessels in the 1st quarter and to beam trawlers in the 2nd and 3rd quarters. However, this time the landings were not corrected for discard estimates.

Discard information is not routinely incorporated into the assessment.

B.2. Biological

Weights-at-age

A number of different methodologies have been employed to determine weights-at-age for this stock. Stock weights and catch weights-at-age were determined on a separate sex basis and remained unchanged from 1978 until 1983. Catch weights were derived from a von Bertalanffy length-at-age fit to Belgian (70–74), UK (E&W) (64–74) and Irish (62–66) catch samples. The estimated lengths-at-age were converted to weights-at-age using a Belgian length–weight dataset (ages 2–15 females; 3–9 males). Stock weights were calculated as the mean of adjacent ages from the catch weights, where catch weights represented 1st July values and stock weights 1st January.

From 1983 weights-at-age have been calculated on a combined sex basis. Catch weights were taken from market sampling measurements combined on a sex weighted basis and smoothed. For the period 1983 to 1987 catch weights were smoothed by eye, from 1988 onwards a smooth curve was fitted using a numerical minimization routine. Stock weights were derived from the smoothed international catch weights-at-age curve with values representing 1st January. In 1985 the stock weights-at-age were adjusted for ages 1 to 4. The difference between the smoothed catch weights and survey (F.V. *Silver Star*) observations were adjusted using the maturity ogive to give "best estimate" stock weights "for ages where growth and maturity differences can bias sampling procedures". The same procedure was adopted in 1986 (when stock weights in 1982 and 1983 were also revised so as to be consistent with this methodology) and 1987. In 1988 however, the *Silver Star* survey was discontinued and stock weights-at-ages 1 to 3 were calculated as means of the three previous years. Correction of the estimated stock weights of the younger age groups did not occur in 1989 or in subsequent years which explains the sudden increase in weight of the younger age groups for this stock from 1988 onwards.

Catch weights at the younger ages also show a similar increase coincident with the start of the smoothing process. This apparent increase in the estimated catch weights is not believed to have affected the derivation of catch numbers since smoothing of the catch weights occurs after having determined the catch numbers-at-age. SOP checks are generally very close to 100%.

The 1982 WG Report notes a study by R. Cross, unpublished stating that there was no evidence for a change in growth rates for the stock nor was there any evidence of density-dependent effects on growth.

Natural mortality and maturity ogives

As for the weights-at-age, natural mortality and maturity was initially determined on a separate sex basis. Natural mortality was taken as 0.15 for males and 0.1 for females. In 1983 when a combined sex assessment was undertaken a sex weighted average value of 0.12 was used as an estimate of natural mortality. This estimate of natural mortality has remained unchanged since 1983.

The maturity estimates used prior to 1982 are not specified. A new separate sex maturity ogive (Sideek, 1981) was implemented in 1982. This ogive was recalculated as sex weighted mean values in 1983 when the assessment was conducted on a combined sex basis. The maturity ogive was revised again in 1992 based on the results of an EU project. Maturity ogives are applied as vectors to all years in the assessment.

Table A1. Maturity ogives for Irish Sea plaice used in ICES WGs.

Age	WG 1978–1982		WG 1983–1992	WG 1992–2009
	M	F		
1	0	0	0	0
2	0.3	0.04	0.15	0.24
3	0.8	0.4	0.53	0.57
4	1.0	0.94	0.96	0.74
5	1.0	1.0	1.0	0.93
6	1.0	1.0	1.0	1.0

The proportion of fishing mortality and natural mortality before spawning was originally set to 0. It was changed in 1983 to a value of 0.2 on the grounds that approximately 20% of the catch was taken prior to March (considered to be the time of peak spawning activity). As for Celtic Sea plaice the proportion of F and M before spawning was reset to 0, as it was considered that these settings were more robust to changes in the fishing pattern, especially with respect to the medium-term projections.

B.3. Surveys

In 1993, the UK (E&W) beam trawl survey-series that began in 1988 was considered to be of sufficient length for inclusion in the assessment. Since 1991, tow duration has been 30 minutes but prior to this it was 15 minutes. In 1997, values for 1988 to 1990 were raised to 30 minute tows. However, data for 1988 and 1989 were of poor quality and gave spurious results: thus, the series was truncated to 1990. A similar March beam trawl survey began in 1993 and was made available to the WG in 1998. The March beam trawl survey ended in 1999 but continued to be used as a tuning index in the assessment until 2003.

An Irish juvenile plaice survey index was presented to the WG in 2002 (1976–2001, ages 2–8). Between 1976 and 1990 this survey had used an average ALK for that period. Serious concerns were expressed regarding the quality of the data for this period and the series was truncated to 1991. The stations for this survey are located along the coast of southeast Ireland between Dundalk Bay and Carnsore Point and there was some concern that this localised survey-series would not be representative of the plaice population over the whole of the Irish Sea. Numerous tests were conducted at the 2002 WG to determine the validity of this and other tuning indices and it was concluded that this survey could be used as an index of the plaice population over the whole of the Irish Sea.

The SSB of plaice can be estimated using the Annual Egg Production Method (AEPM) (Armstrong *et al.*, 2002 and WD 11, WGCSE 2010). This method uses a series of ichthyoplankton surveys to quantify the spatial extent and seasonal pattern of egg production, from which the total annual egg production can be derived. The average fecundity (number of eggs spawned per unit body weight) of mature fish is estimated by sampling adult females immediately prior to the spawning season. Dividing the annual egg production by average fecundity gives an estimate of the biomass of mature females. Total SSB can be estimated if the sex ratio is known. Although substantial discrepancies between absolute estimates of SSB from the Annual Egg Production method (AEPM) and the ICES catch-based assessments were observed, they do confirm that SSB of plaice in the Irish Sea is currently at high levels.

AEPM estimates of SSB for plaice (RSE = relative standard error, as %), based on production of Stage 1 eggs) are shown below (note 1995–2006 estimates were revised in 2010, see WD11 WGCSE 2010):

Table A3. AEPM estimates of SSB for Irish Sea plaice.

	total		west		east	
Year	SSB(t)	RSE	SSB(t)	RSE	SSB(t)	RSE
1995	9081	21	3411	42	5670	22
2000	13 303	19	5654	36	7649	19
2006	11 487	16	3655	29	7833	19
2008	12 729	19	4309	43	8420	18

Splitting the SSB estimate by substrata (Figure below) suggests that the perceived increase in plaice SSB is limited to the eastern Irish Sea. This finding agrees with an analysis of UK (NI) GFS data by substrata, which also indicates an increase in biomass limited to the eastern Irish Sea.

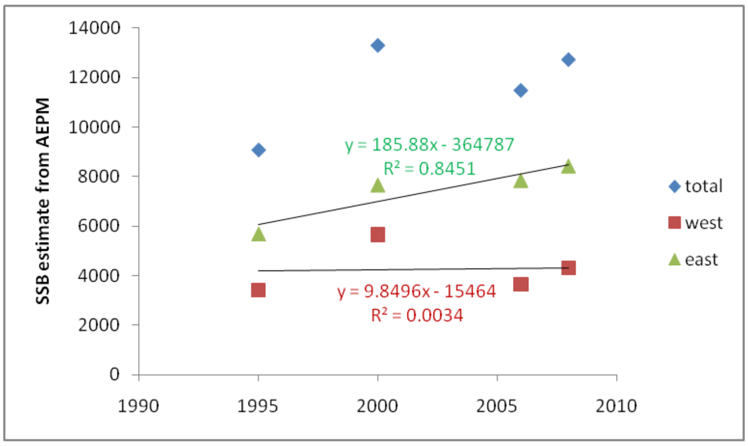

Figure A3. AEPM estimates by year and substrata.

B.4. Commercial cpue

Prior to 1981 tuning data were not used in the assessment of this stock. A separable assessment method was used and estimates of terminal S and F were derived iteratively based on an understanding of the recent dynamics of the fishery.

In 1981 the choice of terminal F was determined from a regression of exploited stock biomass on cpue. Catch and effort series were available for the UK (E&W) trawl fleet and the Belgian beam trawl fleet for the period 1964 to 1980. In 1994 the Belgian and UK cpue series were combined to provide one mean standardised international index. The UK (E&W) trawl series was revised in 1986 (not known how) and in 1987 was recalculated as an age based cpue index enabling the use of the hybrid method of tuning an *ad hoc* VPA.

The UK (E&W) trawl tuning-series was revised in 1999 and separate otter trawl and beam trawl tuning-series were produced using length samples from each gear type and an all gears ALK. Since the data could only be separated for 1988 onwards the two new tuning-series were slightly reduced in length. In 1996 UK (E&W) commercial effort data were re-scaled to thousands of hours so as to avoid numerical problems associated with low cpue values and in 2000 the UK (E&W) otter trawl series was re-calculated using otter trawl age compositions only rather than combined fleet age compositions as previously.

Two newly revised survey indices for the *Lough Beltra* were presented to the WG in 1996 though they were considered too noisy for inclusion in the assessment. They were revised again for the following year and found to be much improved but were again not included because they ended in 1996 and the WG felt that they would add little to the assessment. An Irish otter trawl tuning index was made available in 2001 (1995–2000, age 0 to 15). Whilst this fleet mainly targets *Nephrops*, vessels do on occasion move into areas where plaice are abundant. Landings of plaice by this fleet were approximately 15% of total international landings in 2000 and the WG considered that this fleet could provide a useful index of abundance for plaice.

The effects of vessel characteristics on lpue for UK (E&W) commercial tuning-series was investigated in 2001 to investigate the requirement for fishing power corrections due to MAGP IV re-measurement requirements. It was found that vessel characteristics had less effect on lpue than geographic factors and unexplained noise and concluded that corrections were not necessary. However, vessels of certain size tended to fish in certain rectangles. This confounding may have resulted in the under-estimation of vessel effects.

Currently, age-based tuning data available for this assessment comprise three commercial fleets; the UK (E&W) otter trawl fleet (UK (E&W) OTB, from 1987), the UK (E&W) beam trawl fleet (UK (E&W) BT, from 1989) and the Irish otter trawl fleet (IR-OTB, from 1995). However, as a consequence of inconsistencies in these commercial tuning fleets and surveys in the Irish Sea no commercial tuning information is used in the assessment.

B.5. Other relevant data

C. Historical stock development

The stock of plaice in the Irish Sea has been assessed by ICES since 1977.

Assessment methods and settings

In 1987 the stock was assessed using a Laurec–Shepherd (hybrid) tuned VPA. Concerns about deteriorating data quality prompted the use in 1994 of XSA. A subsequent divergence in commercial cpue and survey data, and the wish to include biomass indices, prompted the use of ICA. The settings for each of the assessments between 1991 and 2009 are detailed in Table B.2. Since 2006, the assessment has been an update ICA assessment with the separable period increased by one year at each assessment working group. Since 2009, FLICA has been used to run the assessment: the R and FLR packages have been documented within the WG Report.

Over the years, trial runs have explored many of the options with regards XSA settings, including:

- The applicability of the power model on the younger ages was explored in: 1994; 1996; 1998; 1999; 2000 and 2001.
- Different levels of F shrinkage were explored in 1994; 1995; 1997.
- The effect of different time tapers was investigated in 1996.
- The S.E. threshold on fleets was examined in 1996.
- The level of the catchability plateau was investigated in 1994.

ICA settings explored since 2005 have included:

- The length of the separable period;
- The reference age;
- The age range of the landings data.

D. Short-term projection

Short-term projections are considered unreliable and although presented in the Report they should not be used for advice.

Software: Multi Fleet Deterministic Projection (MFDP)

Age-based short-term projections are conducted for a three year period using initial stock numbers derived from ICA analyses. Numbers-at-age 2 are considered poorly estimated and are generally overwritten using a geometric mean (GM) of past recruitment values. Population numbers-at-age 3 in the intermediate year (terminal year +1) are also overwritten with the GM estimate depreciated for F_{sq} and natural mortality. Recent recruitments have been estimated to be at a lower level and to be less variable than those earlier in the time-series. Consequently a short-term geometric mean (from 1990 to 2 years before the terminal year) is used.

Currently, the exploitation pattern is an un-scaled three year arithmetic mean. However, alternative options may be used depending on recent F trajectories and the Working Group's perception of the fishery. Catch and stock weights-at-age are generally taken as the mean of the last three years and the maturity ogive and natural mortality estimates are those used in the assessment method.

E. Medium-term projections

Medium-term projections are not carried out for this stock.

Previous Software: *MLA miscellany*

Input values to the medium-term forecast were the same as those used in the short-term forecast. Although a Beverton–Holt stock–recruit relationship has been assumed previously, a simple geometric mean may now be more appropriate. It remains unclear whether the full time-series or a reduced time-series from 1989 should be used.

F. Yield and biomass-per-recruit/long-term projections

Software: *Multi Fleet Yield-per-Recruit (MFYPR)*

Yield-per-recruit calculations are conducted using the same input values as those used for the short-term forecasts. Currently the YPR calculations are used as a basis for determining the catch option for advice.

G. Biological reference points

Biological reference points were proposed for this stock by the 1998 Working Group as below:

	Type	Value	Technical basis
Precautionary approach	B_{lim}	Not defined.	There is no biological basis for defining B_{lim} as the stock–recruitment data are uninformative.
	B_{pa}	3100 t	$B_{pa} = B_{loss}$.
	F_{lim}	Not defined.	There is no biological basis for defining F_{lim} as F_{loss} is poorly defined.
	F_{pa}	0.45	$F_{pa} = F_{med}$ in a previous assessment, and in long-term considerations. This is considered to provide a high probability of maintaining SSB above B_{loss} in the long term.
Targets	F_y	Not defined.	

Yield and spawning biomass-per-Recruit

F-reference points:

	Fish Mort	Yield/R	SSB/R
	Ages 3-6		
Average last 3 years	0.10	0.17	1.64
$F_{0.1}$	0.14	0.19	1.31
F_{med}	0.43	0.21	0.53

Estimated by the WG in 2010

MSY reference points were explored by WGCSE 2010 using the Cefas ADMB code presented to WKFRAME (ICES, 2010). However, due to the high level of discards in the stock and unreliable estimates of recruitment, MSY reference points were rejected by the Working Group.

H. Other issues

None.

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Table B.1. Data sources and derivation of international landings, where % sampled indicates the percentage of the total landings represented by sampling.

Year		Source					
of WG	Data	UK	Belgium	Ireland	Netherlands	Derivation of international landings	% sampled
1978	Len. comp.	quarterly1	quarterly1	quarterly1		Irish raised to Irish and N.Irish; UK raised to UK (E&W) and Scotland	85
	ALK	quarterly1	quarterly1	quarterly1		Belgian raised to Belgian, Dutch and French	
	Age comp.	quarterly1	quarterly1	quarterly1		UK + Bel + IR combined to total int. separate sex	
1979							
1980	Len. comp.	quarterly1	quarterly1	quarterly1		Irish raised to Irish and N.Irish; UK raised to UK (E&W), Sco and IOM.	86
	ALK	quarterly1	quarterly1	quarterly1		Belgian raised to Belgian, Dutch and French	
	Age comp.	quarterly1	quarterly1	quarterly1		UK + Bel + IR combined to total int. separate sex	
1981							
1982		As for 1980	As for 1980	As for 1980		As for 1980, separate sex	92
1983		As for 1980	As for 1980	As for 1980		As for 1980; sexes combined	90
1984	Len. comp.	quarterly	2nd qtr	quarterly		Irish raised to Irish and N.Irish	90
	ALK	quarterly	2nd qtr	quarterly		UK raised to UK (E&W), Scotland, I.O.M., French, Dutch and Belgian	
	Age comp.	quarterly	2nd qtr	quarterly		UK + IR combined to total int. sexes combined	
1985	Len. comp.	quarterly	quarterly	quarterly		Irish raised to Irish and N.Irish; UK raised to UK (E&W), Sco and IOM	92
	ALK	quarterly	quarterly	quarterly		Belgian raised to Belgian, Dutch and French	
	Age comp.	quarterly	quarterly	quarterly		UK + Bel + IR combined to total int. sexes combined	
1986	Len. comp.	quarterly	quarterly	quarterly		Irish raised to Irish.,N.Irish and French	91
	ALK	quarterly	quarterly	quarterly		UK raised to UK (E&W), Scotland and I.O.M.; Belgian used alone	
	Age comp.	quarterly	quarterly	quarterly		UK + Bel + IR combined to total int.	
1987		As for 1986	As for 1986	As for 1986		As for 1986	84
1988		As for 1986	As for 1986	As for 1986		As for 1986 except Irish beam trawl raised using UK age comps	75

Year of WG	Data	Source UK	Belgium	Ireland	Netherlands	Derivation of international landings	% sampled
1989		As for 1986	As for 1986	As for 1986		As for 1986 (Irish beam trawl now sampled)	86
1990							
1991		As for 1986	As for 1986	As for 1986		As for 1986	83
1992		As for 1986	As for 1986	As for 1986		As for 1986	83
1993		As for 1986	As for 1986	As for 1986		As for 1986	91
1994		As for 1986	As for 1986	As for 1986		As for 1986 (Belgian samples supplemented with UK data)	90
1995							
1996		As for 1986	As for 1986	As for 1986		As for 1986	89
1997		As for 1998	As for 1998	As for 1998	As for 1998	As for 1998	83
1998	Len. comp.	quarterly	quarterly	quarterly	quarterly	Irish raised to Irish., N.Irish and French; Belgian and Dutch used alone	87
	ALK	quarterly	quarterly	quarterly	quarterly	UK raised to UK (E&W), Scotland and I.O.M.	
	Age comp.	quarterly	quarterly	quarterly	quarterly	UK + Bel + IR + NL combined to total int.	
1999		As for 1986	As for 1986	As for 1986		As for 1986 (except UK raised to include NL landings)	89
2000		As for 1999	As for 1999	As for 1999		As for 1999	88
2001		As for 1998	As for 1998	As for 1998	As for 1998	As for 1998	87
2002		As for 1986	As for 1986	As for 1986		As for 1986	88
2003	Len. comp.	quarterly	1st qtr	quarterly		Belgium raised using 1st qtr values	70
	ALK	quarterly	1st qtr	quarterly		UK raised to Sco and France; Irish raised to Irish and N.Irish	
	Age comp.	quarterly	1st qtr	quarterly		UK + Bel + IR combined to total int.	
2004	Len. comp.	quarterly	quarterly	quarterly			52
	ALK	quarterly	-	quarterly		UK raised to Sco and France; Irish raised to Irish, N.Irish and Bel	
	Age comp.	quarterly	-	quarterly		UK + IR combined to total int.	
2005	Len. comp.	quarterly	quarterly	quarterly			81
	ALK	quarterly	qrts 1,2	quarterly		UK raised to Sco and France; Irish raised to Irish, N.Irish and Bel	

Year of WG	Data	Source UK	Belgium	Ireland	Netherlands	Derivation of international landings	% sampled
	Age comp.	quarterly	qrts 1,2	quarterly		UK + IR combined to total int.	
2006	Len. comp.	quarterly	quarterly	quarterly			923
	ALK	quarterly	quarterly	quarterly		UK raised to Sco and France; Irish raised to Irish, N.Irish and Bel	
	Age comp.	quarterly	quarterly	quarterly		UK + IR combined to total int.	
2007	Len. comp.	quarterly	quarterly	quarterly			903
	ALK	quarterly	quarterly	quarterly		UK raised to Sco and France; Irish raised to Irish and N.Irish	
	Age comp.	quarterly	quarterly	quarterly		UK + Bel + IR combined to total int.	
2008	Len. comp.	quarterly	annual	quarterly			94
	ALK	quarterly	annual	quarterly		UK raised to Sco and France; Irish raised to Irish and N.Irish	
	Age comp.	quarterly	annual	quarterly		UK + Bel + IR combined to total int.	
2009	Len. comp.	quarterly	quarterly	quarterly			89
	ALK	quarterly	quarterly	quarterly		UK raised to Sco and France; Irish raised to Irish and N.Irish	
	Age comp.	quarterly	quarterly	quarterly		UK + Bel + IR combined to total int.	
2010	Len. comp.	quarterly	quarterly	quarterly			94
	ALK	quarterly	quarterly	quarterly		UK raised to Sco and France; Irish raised to Irish and N.Irish	
	Age comp.	quarterly	quarterly	quarterly		UK + Bel + IR combined to total int.	

1 Assumed – (not explicitly stated in report)

2 Revised 2007

3 Revised 2008

Table B.2. Assessment model settings since 1991.

Assessment Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Assessment Age Range	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+	1–9+
Fbar Age Range	3–8	3–6	3–6	3–6	3–6	3–6	3–6	3–6	3–6	3–6	3–6	3–6	3–6	3–6
Assessment Method	L.S.	L.S.	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA
Tuning Fleets														
UK trawl, years: ages:	81–90 1–8	82–91 1–8	76–92 1–8	76–93 1–8	76–94 1–8	-	-	-	-	-	-	-	-	-
UK otter, years: ages:	-	-	-	-	-	86–95 2–8	87–96 2–8	88–97 2–8	89–98 2–8	90–99 2–8	91–00 2–8	87–01 2–8	87–02 2–8	87–03 2–8
UK beam, years: ages:			-	-	-	-	-	-	89–98 2–8	90–99 2–8	91–00 2–8	89–01 2–8	89–02 2–8	89–03 2–8
Bel Beam, years: ages:	-	-	-	-	85–94 2–8	86–95 3–8	87–96 3–8	88–97 3–8	-	-	-	-	-	-
IR otter, years: ages:					-	-	-	-	-	-	-	95–01 2–8	95–02 2–8	95–03 2–8
UKBTS Sept, years: ages:			88–92 1–4	88–93 1–4	88–94 1–4	88–95 1–4	89–96 1–4	89–97 1–4	89–98 1–4	90–99 1–4	91–00 1–4	89–01 1–4	89–02 1–4	89–03 1–7
UKBTS Mar, years: ages:								93–97 1–4	93–98 1–4	93–99 1–4	93–99 1–4	93–99 1–4	93–99 1–4	-
IR-JPS, years: ages:						-	-	-	-	-	-	91–01 1–6	91–02 1–6	-

Assessment Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Time taper			20yr tri	20yr tri	20yr tri	No	No	No	No	No	No	No	No	No
Power model ages			1	0	1	1	1	1	1	0	0	0	0	0
P shrinkage			True	False	True	True	True	True	True	False	False	False	False	False
Q plateau age			5	5	5	5	5	5	5	5	5	5	5	5
F shrinkage S.E			0.3	0.3	0.5	0.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Number of years			5	5	5	5	5	5	5	5	5	5	5	5
Number of ages			5	5	4	4	4	4	4	4	4	4	4	4
Fleet S.E.			0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table B.2. continued.

Assessment year		2005	2006	2007	2008	2009	2010
Assessment model		ICA	ICA	ICA	ICA	ICA	ICA
Tuning fleets	UK(E&W)OTB	-	-	-	-	-	-
	UK(E&W)BTS Sept	1989–2004	1989–2005	1989–2006	1989–2007	1989–2008	1989–2009
	ages:	1–7	2–7	2–7	2–7	2–7	2–7
	UK(E&W)BTS March	-	-	-	-	-	-
	UK(E&W)BT	-	-	-	-	-	-
	IR-OTB	-	-	-	-	-	-
	UK(NI) GFS Mar	1992–2004	1992–2005	1992–2006	1992–2007	1992–2008	1992–2009
	Biomass index						
	UK(NI) GFS Oct	1992–2004	1992–2005	1992–2006	1992–2007	1992–2008	1992–2009
	Biomass index						
Time series weights		Full time-series - unweighted	Full time-series - unweighted	Full time-series - unweighted	Full time-series - unweighted	Full time-series - unweighted	Full time-series - unweighted
Num years for separable		5	5	6	7	8	9
Reference age		4	5	5	5	5	5
Terminal S		1	1	1	1	1	1
Catchability model fitted		Linear	Linear	Linear	Linear	Linear	Linear
SRR fitted		No	No	No	No	No	No
Landings number-at-age, range:		1–9+	2–9+	2–9+	2–9+	2–9+	2–9+

Stock Annex 6.8: Sole in VIIa

- Stock Annex 6.8 Sole VIIa: for latest update see WGCSE 2009, Annex 06.8 Sole VIIa

Stock Annex 7.2: Cod in VIIe-k

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Cod in VIIe-k (Celtic Sea cod)
Expert Group	Celtic Sea Working Group
Date	WKROUND 2009, WGCSE 2009-2010
Revised by	Robert Bellail, Lionel Pawlowski

A. General

A.1. Stock definition

Since 1997, this assessment has related to the cod in Divisions VIIe–k, covering the Western Channel and the Celtic Sea. The assessed area has gradually increased from VIIfg before 1994 to VIIfgh, to VIIefgh in 1996 and finally to VIIe–k.

Up to 2008, the management area was set in Divisions VIIb–k,VIII, IX, X, and CECAF 34.1.1 which does not correspond to the area assessed.

In 1994, at the request of ACFM, the ICES Working Group on Southern Shelf Demersal Stocks (WGSSDS) studied the possible extension of the area assessed from VIIfg to VIIfgh. Examination of data from surveys and logbooks indicated a continuity of the distribution of VIIg cod into VIIh. Depending on the year, catches in Division VIIh represented 9–15% of the catches in VIIfg, with a coincidence of years of peak or low catches in both areas. Therefore, catches from VIIh were included in the assessment. In 1996, at the request of ACFM, WGSSDS studied the possible extension of the area assessed from VIIfgh to VIIefgh. The population dynamics parameters for VIIfgh and VIIe cod were examined and compared for the period 1988–1994, when independent tuning fleets, international catch-at-age, mean weights-at-age in the landings and in the stocks were available for both areas. Patterns of F were consistent between VIIe and VII fgh in earlier years (1988–1990), and SSBs trends were similar in the period 1988–1992. The patterns of recruitment (age 1) were found to be fairly consistent through this period 1988–1994, though it cannot be assumed that this consistency was also valid in earlier years when catch-at-age were only available in Divisions VIIf, g, h. It was therefore decided to combine Western Channel Cod with the Celtic Sea Cod assessment for the years 1988–1995, but an independent assessment of Celtic sea Cod in VIIfgh was maintained for the longer period available 1971–1995. This was to allow scaling of the historical (1971–1987) SSBs and recruitments values from VIIfgh to VIIe–h.

At WGSSDS 1997, due to the lack of a long independent series of catch-at-age in Divisions VIIj,k, the estimate of landings from Divisions VIIjk was discussed and it was decided to combine the data of Divisions VIIe,f,g,h and Divisions VIIjk for the period 1993–1996 and to raise the data in Divisions VIIe–h to landings in Divisions VIIe–k for the period 1988–1992. The results of an XSA assessment of this series in Divisions VIIe–k for 1988–1996 had been compared with the results of the assessment in Divisions VIIe–h in terms of trends of F, SSB and recruitment. Patterns of these parameters were found very similar and the merging of Divisions VIIjk with Divisions VIIe–h mainly resulted in a scaling upwards of SSB and recruitment. The new assessment areas comprised cod in Divisions VIIe–k.

At the 1999 WGSSDS meeting, an alternative procedure to the tedious re-scaling of SSB and recruitment of the earlier series 1971–1987 in VIIfgh to VIIe–k every year was proposed (Bellail, 1999, WD3). A long series of landings data from 1971–1987 was reconstructed. An average raising factor (1.24) from VIIfgh to VIIe–k in the period 1988–1997 was applied to VIIfgh landings of the series 1971–1987. Results of assessment in terms of SSB and R were very close to those obtained when these parameters were scaled. ACFM accepted this procedure.

In the past, few biological criteria have been used to justify the widening the stock area. However, recent tagging work by Ireland and the UK supports the idea that there is a resident stock in the Celtic Sea and Western Channel (VIIe–k) and mixing with other areas appears to be minimal. The Irish Sea front, running from SE Ireland (Carnsore point) to the Welsh Coast, appears to act as boundary between the Irish Sea and Celtic Sea stock. Juveniles found close to the SE Irish Coast (south of VIIa) are considered part of the Celtic Sea stock.

Migrations are known to occur in this cod stock. Cod can be caught throughout the English Channel (ICES Areas VIId and VIIe) in autumn (quarter 4) and winter (quarter 1), being more aggregated during the spawning season in January/February. Electronic tagging experiments in the English Channel (VIId and VIIe) have shown that cod tagged on or close to English Channel spawning grounds in quarters 4 and 1 either remain close to the point of release (residency), or move to feeding grounds to the south and/or west. Smaller fish (<50 cm) are more likely to be resident. Migrants tend to move offshore to deeper areas, whereas the habitat selection of residents is less clearcut.

From the migratory phenotypes identified by electronic tagging, historical mark-recapture experiments can be re-evaluated. Although sample size is limited, results from data on the movements of adult cod (>50 cm) show that, after tagging in VIIe (the western Channel) in quarters 1 and 4, 47% of cod (27 of 58) are recaptured in ICES Areas VIIf through VIIj, while 48% are recaptured in VIIe (i.e. are probably resident). In contrast, no adult cod tagged in VIId were recaptured in ICES Areas VIIf through VIIj, 5% moved into VIIe and 51% remain in VIId. Juvenile cod are more likly to be recaptured in the same area that they were tagged in. These figures vary slightly when recaptures are separated into autumn/winter and spring/summer seasons, but are broadly comparable. The data therefore provide evidence that cod in the eastern English Channel and western English Channel might be classed as separate substocks, and that movement of cod between eastern English Channel and the Celtic Sea is limited, whereas movement between the western Channel and the Celtic Sea is frequent.

A.2. Fishery

Cod in Divisions VIIe–k are mainly taken as components of catches in mixed demersal trawl fisheries with a minor part by gillnets. Landings are made throughout the year but are generally more abundant during the first semester. Constraining TACs set since 2003 and the impact of the Trevose Head Closure applied since 2005 have led the landings to spread across the first three quarters of the year.

WGSSDS has been collating a database of landings and effort for the Celtic Sea. Available data on cod landings are analyzed and presented. Effort data is not yet fully available for similar investigations. Recent temporal and spatial patterns in landings distributions for the main fleets catching Celtic Sea Cod are shown in Figure A.2.1 and Figure A.2.2. Highest landings are in quarter 1 when the cod aggregate to spawn. There is an indication that Q1 landings have declined in 2006 and 2007 as a result of the closure of a known spawning area at Trevose Head, although this was not the case in 2005 the first year of introduction of the closure. In most years there is a distinct peak in landings in February or March. The scale of this peak may be related to the relative strength of age 2 fish entering the fishery. The majority of the landings come from VIIg, ~55%, and the relative contributions of different ICES Divisions to the landings has been fairly stable over recent years. In 2002 there were larger than normal landings from rectangle 30E4 in VIIf.

The majority of the landings are made by demersal trawls targeting roundfish (i.e. cod, haddock and whiting), although, in recent years an increasing component have been from gillnets and otter trawls targeting *Nephrops* and benthic species.

A.3. Ecosystem aspects

No environmental drivers are known for this stock.

B. Data

B.1. Commercial catch

Landings

On a quarterly basis, France and UK (E+W) have provided catch numbers-at-age and catch weights-at-age for their landings. Ireland has provided with the same data in Divisions VIIg and j separately and estimates of misreporting in VIIg. Landings only are available for Belgium.

Irish data are first aggregated to the landings in VIIe–k and then both datasets for France, UK and Ireland are added and raised to international landings taking into account Belgian data. Then the quarterly datasets are summed up to the annual values.

As a consequence of an update to the French database of landings statistics, some minor revisions (downward) have been applied since 2002 and the updated datasets for international landings.

Nothing is hidden in the aggregating procedure but the level of available data has changed and consequently the aggregation procedures. Compiling the previous reports of the WGSSDS and before the reports of the WGIRCS shows the following datasets available and the history of the aggregation procedures to produce the landings numbers-at-age series:

Year range	Landings VIIe-k	Length structure (Ls) VIIe-k	Age structure (As) VIIe-k
1971–1976	Annual VIIfgh expanded to Annual VIIe-k using the mean landings VIIe-k 1988-1997 over the mean landings VIIfgh 1988–1997 as a ratio	UK VII fg raised to international landings in VIIfg	UK alks VIIa to UK Ls VIIfg then UK VIIfg As raised to international landings
1977–1980		UK VIIfg + FRVIIfg raised to international landings in VIIfg	UK alks VIIa to UK Ls VIIfg and FR Ls VIIfg then As summed and raised to international landings
1981–1987		UK VIIfg FR VIIfg raised to VIIfgh	FR alks VIIfg to UK&FR Ls VIIfg then As summed and raised to international landings

Year range	Landings VIIe-k	Length structure (Ls) VIIe-k	Age structure (As) VIIe-k
1988–1989		UK VIIfg UK VIIe FR VIIfg raised to VIIfgh	FR alks VIIfg to FR Ls UK alks VIIfg to UK Ls UK alks VIIe to UK Ls then As summed and raised to international landings
1990		UK VIIfg UK VIIe FR VIIfg raised to VIIfgh IR VIIg	FR alks VIIfg to FR Ls UK alks VIIfg to UK Ls UK alks VIIe to UK Ls IR alks VIIg to IR Ls then As summed and raised to international landings
1991–1998		UK VIIfg UK VIIe FR VIIfg raised to VIIfgh IR VIIg IR VIIj annual	FR alks VIIfg to FR Ls UK alks VIIfg to UK Ls UK alks VIIe to UK Ls IR alk VIIg to IR VIIg Ls IR alk VIIj to IR VIIj Ls then sum of As VIIg or VIIfg raised to VIIfgh international, As UK VIIe raised to VIIe international, As IR VIIj raised to VIIjk international landings, (VIIfgh internat+ VIIe internat + VIIjk internat) = VIIek
1999–2001		UK VIIfg UK VIIe FR VIIfg raised to VIIfgh IR VIIg IR VIIj quarterly	FR alks VIIfgh to FR Ls UK alks VIIfg to UK Ls UK alks VIIe to UK Ls IR alk VIIg to IR VIIg Ls IR alk VIIj to IR VIIj Ls then sum of As VIIg or VIIfg raised to VIIfgh international, As UK VIIe raised to VIIe international, As IR VIIj raised to VIIjk international landings, (VIIfgh internat+ VIIe internat + VIIjk internat) = VIIek

Year range	Landings VIIe–k	Length structure (Ls) VIIe–k	Age structure (As) VIIe–k
2002–…		FR-VIIe–k	FR alks VIIfgh to FR Ls
		UK VIIe–k	UK alks VIIfg to UK Ls
		IR VIIg	UK alks VIIe to UK Ls
		IR VIIj	IR alk VIIg to IR VIIg Ls
			IR alk VIIj to IR VIIj Ls
			Then sum As UK raised to UK landings in VIIe-k,
			Sum As IR raised to IR landings in VIIe-k,
			Then AsUK+As IR+ As FR raised to international landings

At each step of the aggregations, mean weight-at-age is the weighted mean by numbers-at-age.

Discards

Discards data sampled under EU/DCR since 2003 have been generally presented in previous WGSSDS but not used in the assessments as they do not cover all the main fleets and quarters yet.

Due to the annual management system adopted by the French POs since 2003 in response to the quota restrictions, high grading has occurred in the French fishery, mainly in VIIfgh. On an annual basis, a procedure using both the UK and French landings length data enabled estimation of the French high grading for the years 2003–2005 (WD 1, WGSSDS 2006). The adjustments were reapplied to improve estimates of French landings from 2003 at the ICES WKROUND 2009. This procedure could not be used in later years as high-grading has also occurred in that years.

In 2008 the French self-sampling programme on Celtic Sea cod has produced datasets enabling estimation of discarding and high-grading rates on a quarterly basis. Assuming the same pattern of discarding in recent years, estimates of French discarding and high-grading back to 2006 were also computed. Estimates of high-grading were also calculated for the French tuning fleets used in the analysis (ICES WKROUND, 2009, WD 17*)*. Since the WKROUND, the database of the 2008 self sampling has increased and led to a slight update of the estimates of the level of French high-grading.

Lpue

The table below summarizes the available data.

Name	Area	series
FR gadoid fleet [1]	VIIfgh	1983–…
FR Nephrops fleet [1]	VIIfgh	1983–…
FR otter trawlers [2]	VIIe	1983–…
FR otter trawlers [2]	VIIfgh	1983–…
FR otter trawlers [2]	VIIe–k	1983–…
UK otter trawlers	VIIe	1972–…
UK otter trawlers	VIIe–k	1972–…
UK beam trawlers	VIIe–k	1978–…
IR otter trawlers	VIIg	1995–…
IR beam trawlers	VIIg	1995–…
IR Scottish seiners	VIIg	1995–…
IR otter trawlers	VIIj	1995–…
IR beam trawlers	VIIj	1995–…
IR Scottish seiners	VIIj	1995–…

[1] For Q2+3+4 for consistency with the Trevose Head Closure since 2005 during the first quarter.

[2] Annual values, including the Fr gadoid and *Nephrops* fleets.

B.2. Biological

Weights-at-age

At the 1999 WGSSDS, data for the years 1971–1980 were set to the average 1981–1997. A revision was carried out at 2001 WGSSDS where the values for the period 1971–1980 were set to the average values for 1981–2000. Depending on the annual datasets available by country for the period 1988–2001, catch weights-at-age data were calculated as the weighted means from French, Irish and UK datasets. Since 2002, VIIe–k catch weights-at-age have been calculated as the annual weighted means of French, Irish and UK datasets in VIIe–k.

Maturity

The maturity ogive applied since 1999, was estimated from the datasets of the UK-WCGFS survey (first quarter) has been used for the overall series. It replaced an assumed ogive used for the year prior to 1999, derived from Irish Sea cod data, when both stocks (VIIa and VIIfg) were assessed in the Irish Sea and Bristol Channel WG up to 1992. Table below summarizes the maturity ogives used.

Age	1	2	3	4	5+
Before 1999	0.00	0.05	1.00	1.00	1.00
Current	0.00	0.39	0.87	0.93	1.00

Natural mortality

In the assessments, natural mortality is assumed to be constant (M=0.2) for the whole range of years and ages.

B.3. Surveys

Three survey-series are available. The common range of ages used is 1–5:

> The discontinued UK-WCGFS (1986–2004), conducted during the first quarter, is generally truncated into a shorter series (1992–2004) as it showed a strong trend (dome-shaped) when using the full series. This pattern is related to the progressive extension of the studied area of this survey from VIIe to VIIefgh over the years. This time-series only contributes to the estimates at older ages (4 and older). Due to the lack of new data the series is no longer used for calibration.
>
> The FR-EVHOE survey (1997–…), during the fourth quarter, covers the Divisions VIIfghj. The full series is used.
>
> The IrGFS survey (2003–…), during the fourth quarter, in VIIg and VIIj is also used in the assessment. It is the main contributor to the terminal year estimates, partly because this series is short.

The absolute numbers of cods caught in all of these surveys are extremely low.

B.4. Commercial cpue

Two French commercial fleets are used for tuning: the French trawlers targeting Gadoids in Divisions VIIf, g, h (FR-GADOIDS) and the French *Nephrops* trawlers in VIIf,g,h (FR-*NEPHROPS*), for which cod is generally a bycatch. Both fleets account on average for ~30% of the international landings from 1988; the series starts in 1983. Other commercial fleets used are the English West Coast otter trawlers (UK-WECOT) in VIIe from 1988 and the Irish 7J otter trawlers (IR-7J-OT) in VIIj from 1995. Both fleets fish throughout the majority of the assessed area.

B.5. Other relevant data

Input from industry

No new datasets.

C. Historical stock development

Model used:

The Separable VPA was used at the former Irish Sea and Bristol Channel WG and the Laurec–Shepherd model in the period 1987–1992. The XSA was the model used subsequently. SURBA was also used for survey catch-at-age analysis in 2005–2007.

Corrections for some misreporting estimates have been integrated into the datasets used in the assessment but the change of discarding practices to manage the restricting national quotas may impact the assessment. This also affects the reliability of the commercial tuning fleets used.

In previous assessments (2006, 2007 and 2008), adding a new year of data has generally raised the stock numbers at younger ages (age 1 and 2) resulting in increased estimates of recruitment strength. These upwards revisions are considered a result of the recent high-grading practices. Given this uncertainty and the recent reports from the industry of underreporting the XSA assessment, which assumes unbiased catch data cannot be applied. Improved datasets on landings, recorded and high-grading are required before XSA could be used.

WKROUND (2009) evaluated XSA with adjusted recent catch levels against B-Adapt and the SAM state-space model, which estimate additional unallocated mortality. All models exhibited different patterns in the recent years with a high degree of uncertainty. The Group concluded that no model could be recommended as a basis for providing advice on recent stock trends until further investigations or additional datasets were available to resolve the situation.

D. Short-term projection

No decision has been taken on the forecast methodology.

E. Sensitivity analysis and medium-term projections

Medium-term forecasts are not provided for this stock.

F. Long-term projections

Long-term forecasts are not provided for this stock.

G. Biological reference points

Reference points

	Type	Value	Technical basis
Precautionary approach	B_{lim}	6 300 t	$B_{lim} = B_{loss}$.(B76), the lowest observed spawning-stock biomass.
	B_{pa}	8 800 t	$B_{pa} = B_{lim}$ * 1.4. Biomass above this value affords a high probability of maintaining SSB above B_{lim}, taking into account the variability in the stock dynamics and the uncertainty in assessments.
	F_{lim}	0.90	The fishing mortality estimated to lead to potential collapse.
	F_{pa}	0.68	F_{pa} = 5th percentile of F_{loss}. This F is considered to have a high probability of avoiding F_{lim} and maintaining SSB above B_{pa} in the medium term (assuming normal recruitment), taking into account the uncertainty assessments.
Targets	F_y	Not defined.	

(unchanged since: 2004)

Due to the current uncertainties on the state of this stock, the Benchmark WK is unable to make new proposals for the Reference Points and the 2004 values remain.

H. Other issues

None.

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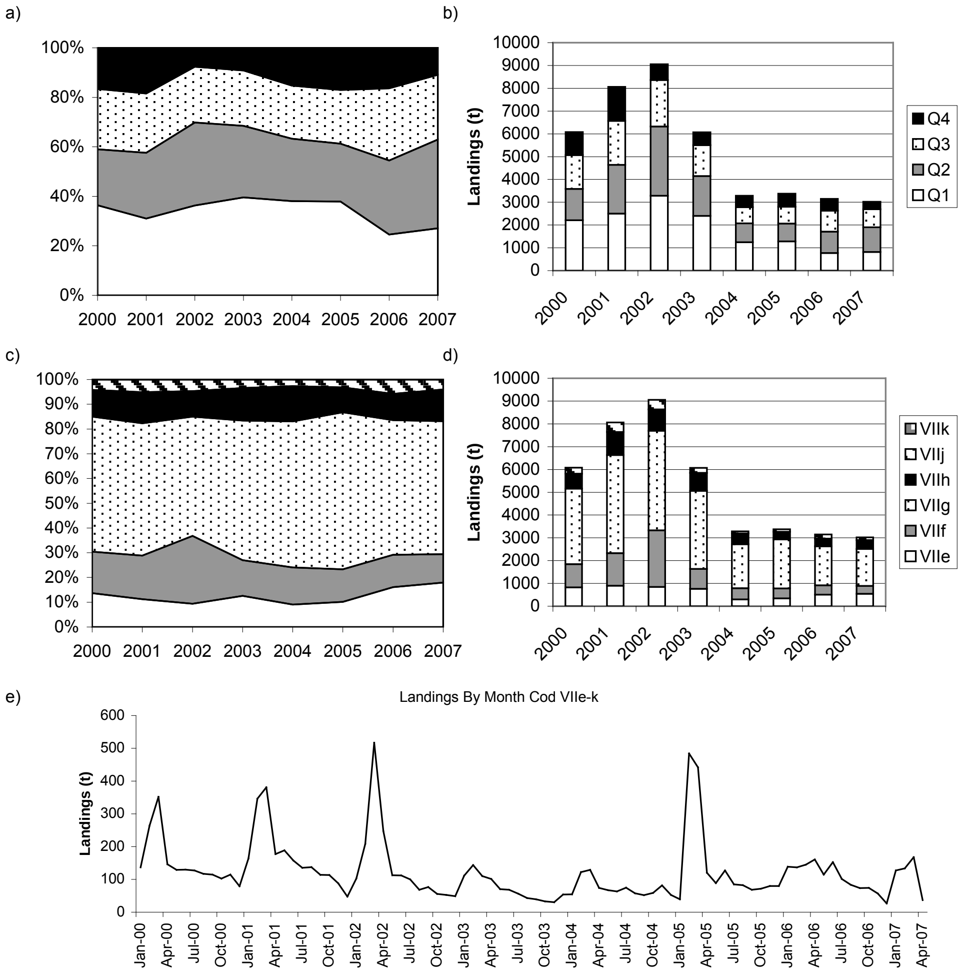
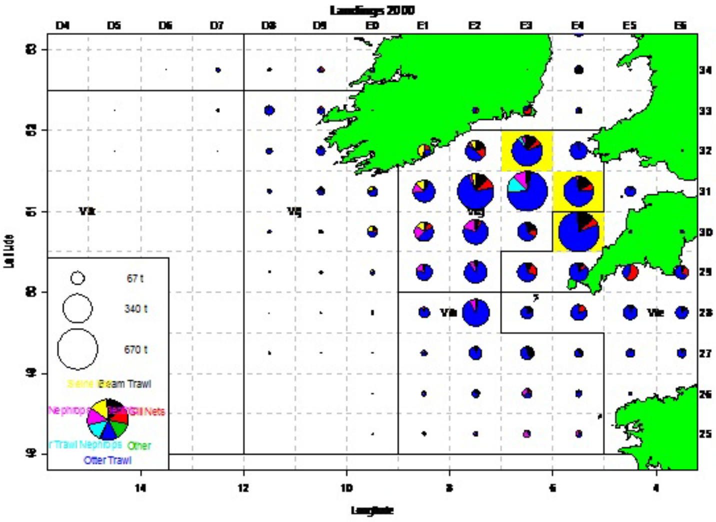


Figure A.2.1. Temporal and spatial patterns in landings patterns for Celtic Sea cod (VIIe–k).



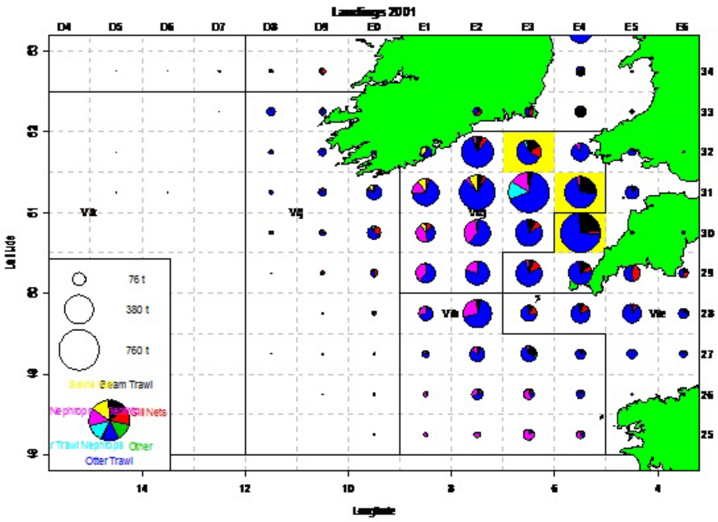
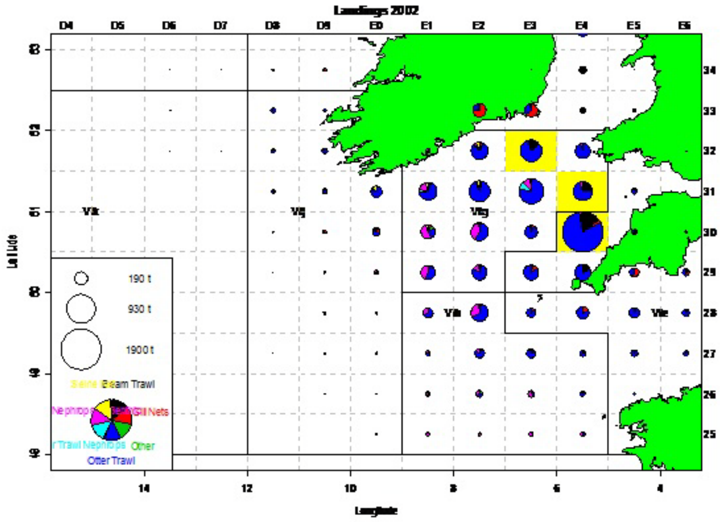


Figure A.2.2. The spatial and temporal distribution of cod landings from the Celtic Sea, from 2000–2007 by gear type. The closed rectangles are highlighted in yellow. Each year is scaled to, the maximum.



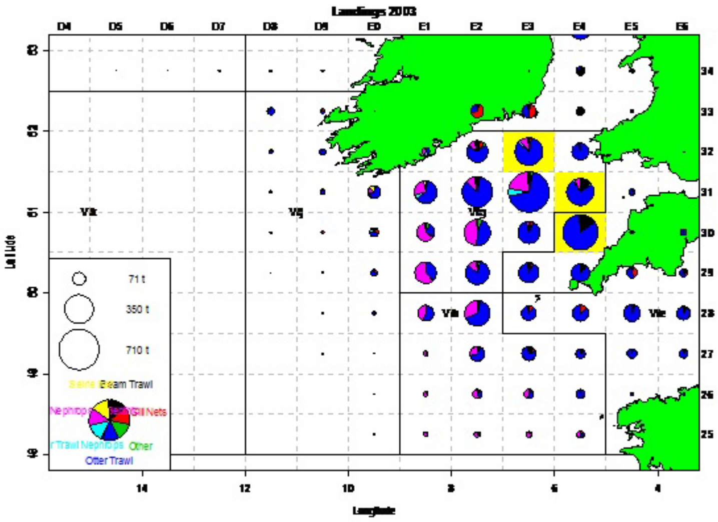
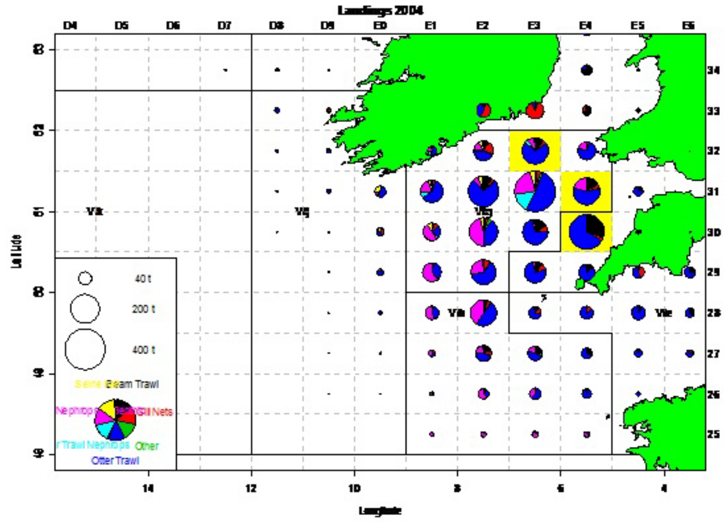
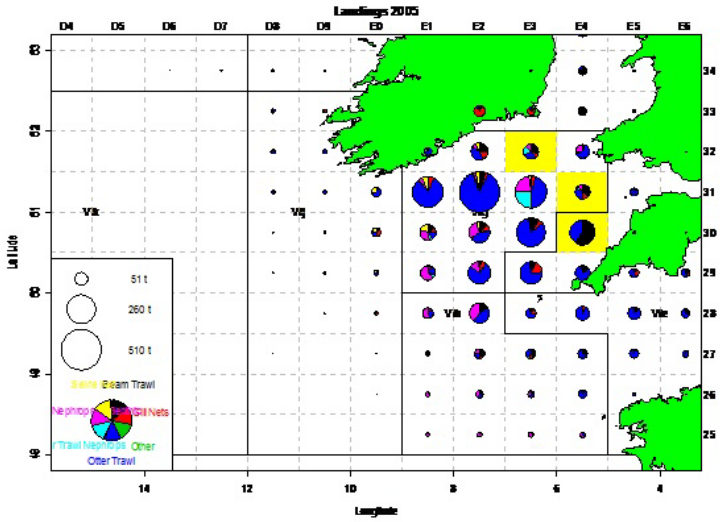


Figure A.2.2. continued.





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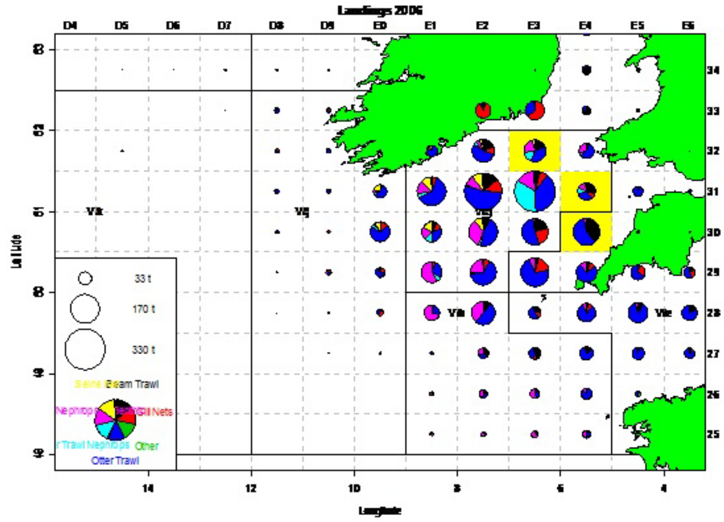


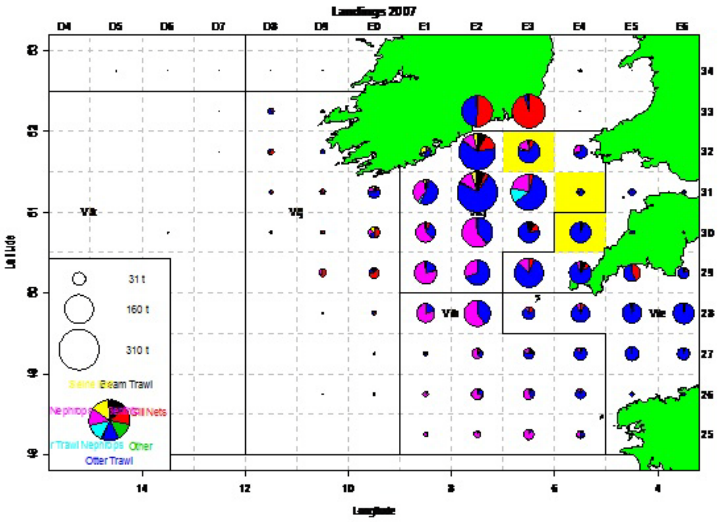


Figure A.2.2. continued.

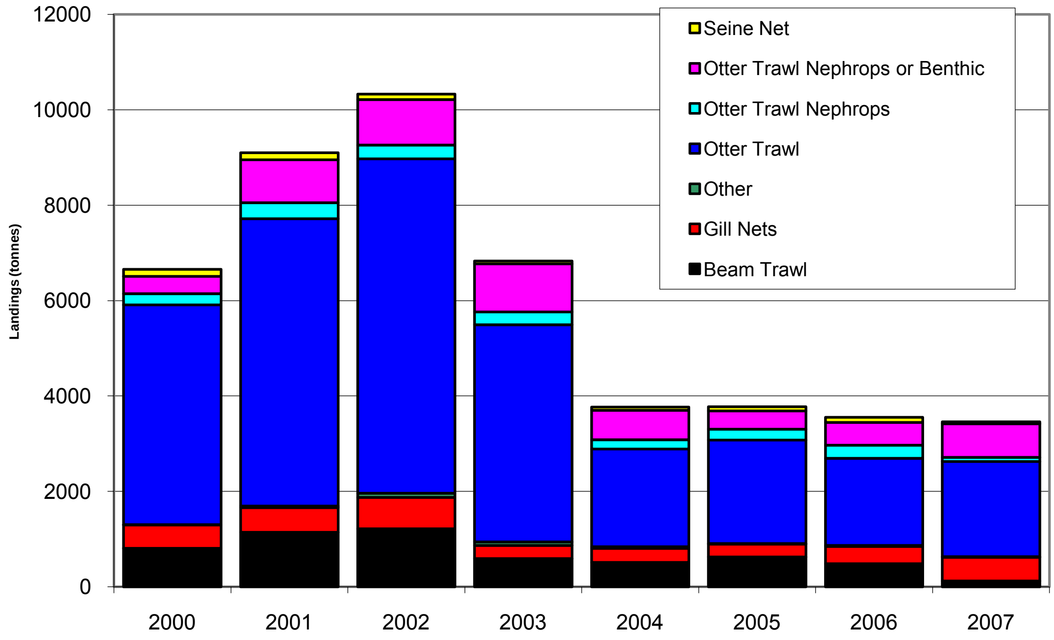


Figure A.2.2. continued.

Stock Annex 7.4: Haddock in VIIb-k

- Stock Annex 7.4 HaddockVIIb–k for latest update see WGCSE 2009, Annex 07.4 Haddock VIIb–k

Stock Annex 7.5: FU17, Aran Grounds

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Aran Grounds *Nephrops* (FU17)
Date	06 March 2009 (WK*NEPH* 2009)
Revised by	Colm Lordan and Jennifer Doyle (WK*NEPH*, 2009)

A. General

A.1. Stock definition

Nephrops is limited to muddy habitat, and requires sediment with a silt and clay content of between 10–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* probably only undertake very small scale movements (a few 100 m) but larval transfer may occur between separate mud patches in some areas. In FU17, the main *Nephrops* stock inhabits an extensive area of muddy sediment known as the Aran Grounds which lie to the west and southwest of the Aran Islands, there are also smaller discrete mud patches in Galway Bay and Slyne Head.

A.2. Fishery

In recent years the *Nephrops* stock in FU17 are almost exclusively exploited by Irish vessels. Figure A.2.1 shows the spatial distribution of landings and lpue for Irish otter trawl vessels in 2005 using logbook and VMS data linked together to give finer spatial resolution. The Aran ground fishery is clearly highlighted.

The *Nephrops* fishery 'at the back of the Aran Islands' can be considered the mainstay of the Ros a Mhíl fleet. Without this *Nephrops* fishery the majority of vessels in the fleet would cease being economically viable (Meredith, 1999). The Irish fishery consists of entirely of otter trawl vessels. The majority of vessels use twin-rigs and 80 mm. Smaller vessels do use 70 mm with a SMP. Some vessels have using 90 mm. Vessels from Ros a Mhíl, Dingle, Union Hall, Dunmore East, Clogherhead and Kinsale mainly exploit the fishery.

The number of Irish vessels reporting *Nephrops* landings from FU17 has fluctuated around 50/yr (Figure A.2.2). Around 18 vessels report landings in excess of 10 t. These are the main vessels in the fishery accounting for around 85% of the total landings. The majority of these vessels are between 20–22 m overall length (Figure A.2.3). There has been a slight shift to lager vessels over time. The majority of vessels are in the power range of 200–400 KW (Figure A.2.4). There has also been a shift to more powerful vessels over time with the introduction of twin-rigs to the fishery in the early 2000s. Most of the larger boats move freely between the *Nephrops* fisheries in FUs 15, 16, 20-22 and other areas depending on the tides and weather.

The fishery shows a distinctive seasonal pattern with highest landings, catches, lpue and cpue in April–June and October–November. The monthly landings time-series with the average pattern is shown in Figure A.2.5. The first period of elevated landings is associated with the emergence of females from their burrows post hatching of their eggs. The sex ratio during this period is biased towards females (Figure A.2.6). Females mature quickly during the early summer and spawning occurs in July and August. This is coincident with a decline in landings and cpue in the fishery. The

Ros a Mhíl fleet traditionally tie up in August each year for maintenance and refurbishment.

The following TCMs are in place for *Nephrops* in VII (excluding VIIa) after EC 850/98: Minimum Landing Sizes (MLS); total length >85 mm, carapace length >25 mm, tail length >46 mm. Mesh Size Restrictions; Vessels targeting *Nephrops* using towed gears having at least 35% by weight of this species on board will require 70 mm diamond mesh plus an 80 mm square mesh panel as a minimum or having at least 30% by weight of *Nephrops* on board will require 80–99 mm diamond mesh.

A.3. Ecosystem aspects

Physical oceanography

The Aran Ground is coincident with a pool of oceanic water, which is rich in nutrients and low in dissolved oxygen. The currents throughout the water column over the ground are generally weak although there is a well-documented bottom density front on the eastern flank of the ground (Nolan and Lyons, 2006). This is a seasonal feature, which establishes in May and persists until autumn. The front causes a persistent jet like flow from south to north close to the seabed through the *Nephrops* ground. The mean position of jet varies from year to year by up to 30 km. Timing and position of the jet may influence recruitment and settlement success of post-larval *Nephrops* since it could potentially advect larval from the area. Salinity differences, due to over winter fresh water input, are thought to heavily influence the density structure and location of this front. Until a time-series of recruitment and jet dynamics is established it is not possible to draw any firm conclusions about the impact of this ecosystem feature on the stock and fishery. Potential sinks for advected larvae include Slyne head and possibly Galway Bay.

Temperature and salinity time-series

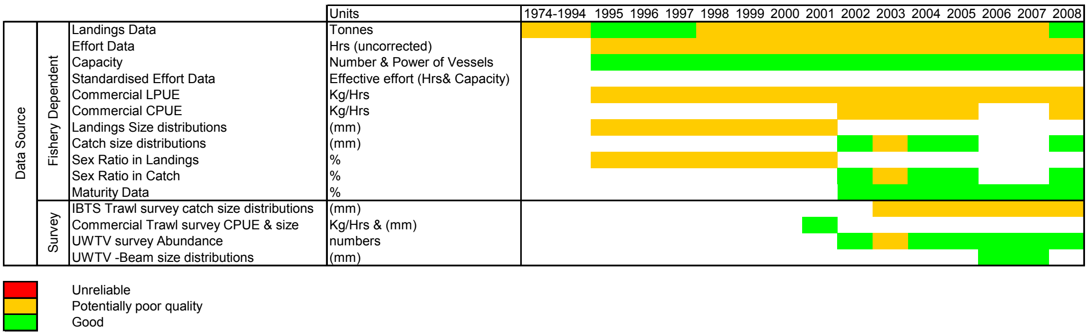
An emerging time-series of temperature and salinity data are available for a transect through the Aran Grounds (Nolan and Lyons, 2006). In all years since 1999 (except 2001) the 53°N section has exhibited positive anomalies in temperature of between 0.2°C and 2°C (Figure A.3.1). In 2001, the temperature anomaly from the long-term climatology was zero. Years with lower temperature anomalies seem to coincide with years of strongly negative salinity anomalies (e.g. 2001 and 2005, 2006) perhaps reflecting the limited influence of ENAW on the section in those years as the section is dominated by coastal discharges from the Loire and Shannon. Salinity anomalies along 53°N range from -0.3 to +0.1 psu over the period. The freshest years were 2001, 2005 and 2006. In 2000, 2003 and 2004 ENAW has a stronger influence on the salinity structure and positive anomalies in salinity from the long-term climatology are the result. The higher UWTV abundance in 2003 and 2004 is coincident with the warmest anomaly but the time-series remains too short to draw definitive conclusions.

Sediment distribution

There is a growing body of information on the spatial extent of the sediment suitable for *Nephrops* from UWTV surveys, seabed mapping programmes and the fishing industry. Figure A.3.1 depicts contour and post plots of the a) mean size (phi) and classification based on the Friedman and Sanders (1978) scales and b) sorting (σ_g) of the sediments on the Aran Grounds based on PSA results from samples collected from 2002–2006 UWTV surveys. The majority of the ground has similar mean particle size at around 4–5 µm. There are some patches of softer silt towards the middle of the ground. Figure A.3.2 is bathymetry of the Aran grounds obtained from seabed mapping programmes. The eastern flank of the ground shallows up quickly but the majority of the ground is gradually deepening from around 100 m to 110 m with the deepest parts to the southwest.

B. Data

The table below summarises the available data for this stock and attempts to quantify the quality subjectively.



B.1. Commercial catch

Prior to 1988 landings data for this fishery are only available to the WG for France. Since 1988 reported landings data for the Irish fleet were obtained from EU logbooks. The quality of landings data is not well known. In earlier, years there are no landings from Ireland although there was probably some catch. The Irish landings have been close to quota for this TAC area since around 1997 (Figure B.1.1). In more recent years (2003–2005 and 2008) there are a few observations of both under and over reporting but it is not possible to correct landings using these as it is not known how representative they might be.

Landings length and sex compositions were estimated from port sampling by Ireland (between 1995–2001). There was a perception during this period that that discarding was not significant. In 2002 a new catch self-sampling programme was put in place. This involves unsorted catch and discard samples being provided by vessels or collected by observers at sea on discard trips. The catch sample is partitioned into landings and discards using an onboard discard selection ogive derived for the discard samples (Table B.1.1). Sampling effort is stratified monthly but quarterly aggregations are used to derive length distributions and selection ogives. The length–weight regression parameters given in Table B.2.1 are used to calculate sampled weights and appropriate quarterly raising factors. The sampling intensity and coverage has varied over the time-series (Table B.1.1). The quality of the sampling has not yet been qualitatively assessed in terms of precision and accuracy.

Nephrops landings and discards from the Aran Grounds have not been sampled for the majority of 2006 and all 2007 due to a lack of co-operation by the industry. However, sampling resumed in 2008 and the intensity and coverage is considered the best to date.

Fish and other bycatches in the fishery have been collected by on board observers since 1994. The number of trips is variable over time with a gap in the series in 2006 and 2007.

B.2. Biological

Biological parameters for this stock are outlined in Table B.2.1.

Length–weight

Mean weights-at-age for this stock are estimated from studies on Scottish stocks by Pope and Thomas (1955). This relationship was examined in 2003 and it seemed appropriate. Given the variability in length–weight parameters found in Allan *et al.*, 2009 it would be worth monitoring these more closely in the future.

Natural mortality

A natural mortality rate of 0.3 was assumed for all age classes and years for males and immature females, with a value of 0.2 for mature females. The lower value for mature females reflects the reduced burrow emergence while ovigerous and hence an assumed reduction in predation. The accuracy of these assumptions is unknown. Cod are not common on the Aran Grounds but other potential predators include dogfish, monkfish megrim and gurnards. Stomach contents data on the Irish GFS could be used to examine this in the future.

Maturity

The L_{50} of females using a macroscopic visual maturity scale is known to vary depending sampling month (Lordan and Gerritsen, 2006). The L_{50} in July was chosen as the most appropriate estimate given the maturity schedules observed (Figure B.2.1). It is worth mentioning that commercial vessel surveys in November 2001 and in June 2002 demonstrated considerable differences between the maturity schedules of female *Nephrops* sampled in shallower waters of Galway Bay compared with the Aran Grounds.

Proportion of F and M prior to spawning was specified as zero to give estimates of spawning stock biomass at January 1. In the absence of independent estimates, the mean weights-at-age in the total catch were assumed to represent the mean weights in the stock.

Discard survival

Given the trip durations (~5 days average) and behaviour of the fleet the majority of discards on the Aran Grounds are returned to the sea over suitable sediment. The proportion scavenged by birds is probably quite low. Tow durations, volume of catches, prolonged sorting on deck and relatively high density of *Nephrops* on the seabed probably results in relatively low discard survival. This is estimated to be around 10%.

B.3. Surveys

Since 2002 Ireland has conducted underwater television survey (UWTV) annually on the main *Nephrops* grounds - Aran grounds. Indicator camera stations are also carried out on the adjacent grounds of Galway Bay and Slyne Head weather and time permitting. The surveys were based on a randomised fixed grid design. The methods used during the survey were similar to those employed for UWTV surveys of *Nephrops* stocks around Scotland and elsewhere and are documented by WKNEPHTV (ICES, 2007).

A number of factors are suspected to contribute bias to the surveys. In order to use the survey abundance estimate as an absolute it is necessary to correct for these potential biases. The history of bias estimates are given in the following table and are based on simulation models, preliminary experimentation and expert opinion, the biases associated with the estimates of *Nephrops* abundance in the Aran Grounds are:

	Time period	Edge effect	detection rate	species identification	occupancy	Cumulative bias
FU17: Aran	<=2009	1.35	0.9	1.05	1	1.3

B.4. Commercial cpue

Prior to 1988 landings data for this fishery are only available to the WG for France. Since 1988 reported landings data for the Irish fleet were obtained from EU logbooks (Table B.4.1).

Effort data for FU17 is available from 1995 for the Irish otter trawl *Nephrops* directed fleet (Table B.4.2). A threshold of 30% of *Nephrops* in reported landings by trip is used to identify the catches and effort of this fleet. This threshold was based on an analysis of the trip-by-trip catch compositions. In 2007 this fleet accounted for ~90% of the landings and compared with an average of 70% over the time period. These data have not been standardised to take into account vessel or efficiency changes during the time period. Landings per unit of effort (lpues) have been fluctuating around an average of 39 kg/hr with an increasing trend since 2004, to the highest observed (59 kg/hr) in the time-series in 2007 (Figure B.4.1).

B.5. Other relevant data

C. Historical stock development

Age structured XSA assessment for this stock was carried *Nephrops* WG in 2003 (ICES, 2003). The results were considered unreliable for several reasons most importantly; inadequate historical sampling of catch, growth and natural mortality assumptions and concern about accuracy of tuning data. Since then the focus has been on developing a time-series of UWTV survey data as the basis of assessment and advice for this stock.

The 2009 Benchmark decided on the following procedure:

1) Survey indices are worked up annually resulting in the TV index.

2) Adjust index for bias (see Section B.3). The combined effect of these biases is to be applied to the new survey index.

3) Generate mean weight in landings. Check the time-series of mean landing weights for evidence of a trend in the most recent period. If there is no firm evidence of a recent trend in mean weight use the average of the three most recent years. If, however, there is strong evidence of a recent trend then apply most recent value (don't attempt to extrapolate the trend further in the future).

D. Short-term projection

1) The catch option table will include the harvest ratios associated with fishing at $F_{0.1}$ and F_{max}. These values have been estimated by the Benchmark Workshop (see Section 9.2) and are to be revisited by subsequent bench-

mark groups. The values are FU specific and have been put in the Stock Annexes.

2) Create catch option table on the basis of a range of harvest ratios ranging from 0 to the maximum observed ratio or the ratio equating to F_{max}, whichever is the larger. Insert the harvest ratios from step 4 and also the current harvest ratio.

3) Multiply the survey index by the harvest ratios to give the number of total removals.

4) Create a landings number by applying a discard factor. This conversion factor has been estimated by the Benchmark Workshop and is to be revisited at subsequent benchmark groups. The value is FU specific and has been put in the Stock Annex.

5) Produce landings biomass by applying mean weight.

The suggested catch option table format is as follows.

			Implied fishery	
	Harvest rate	Survey Index	Retained number	Landings (tonnes)
	0%	12345	0	0.00
	2%	"	247	123.45
	4%	"	494	246.90
	6%	"	741	370.35
	8%	"	988	493.80
$F_{0.1}$	8.60%	"	1062	530.84
	10%	"	1235	617.25
	12%	"	1481	740.70
F_{max}	13.50%	"	1667	833.29
	14%	"	1728	864.15
	16%	"	1975	987.60
	18%	"	2222	1111.05
	20%	"	2469	1234.50
	22%	"	2716	1357.95
$F_{current}$	21.5%	"	2654	1327.09

E. Medium-term projections

None presented.

F. Long-term projections

None presented.

G. Biological reference points

The time-series of available length frequencies were insufficient to generate reliable estimates of $F_{0.1}$ and F_{max}.

H. Other issues

I. References

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Table B.1.1. *Nephrops* in FU17 (Aran Grounds) Landings and discard numbers by year and sex.

	Female Numbers '000s		Male Numbers '000s		Both sexes
Year	Landings	Discards	Landings	Discards	% Discard
2001	18,665	12,161	29,949	13,250	34%
2002	23,105	9,374	31,256	8,326	25%
2003	14,530	9,577	29,538	8,744	29%
2004	16,109	7,068	12,930	4,282	28%
2005	20,280	11,383	21,828	8,967	33%
2006					
2007	No Sampling				

Table B.2.2. Numbers of samples and numbers measured for the FU17 *Nephrops* Stock by year.

Number of Samples				Total numbers of *Nephrops* measured			
Year	Graded Landings	Catch	Discards	Year	Graded Landings	Catch	Discards
1990	24			1990	10451		
1991	20			1991	8260		
1992	0			1992	0		
1993	0			1993	0		
1994	0			1994	0		
1995	13			1995	6370		
1996	3			1996	1440		
1997	11			1997	5203		
1998	12			1998	5388		
1999	16			1999	6944		
2000	5			2000	2255		
2001	32	5	5	2001	13 231	3194	3891
2002		13		2002		9399	
2003	1	9	9	2003		6284	4829
2004		14	14	2004	578	12934	13 167
2005		13	9	2005		8729	7559
2006		2	0	2006		767	436
2007		0	0	2007			
2008		19	18	2008		4944	8701

Table B.2.1. Biological Input Parameters for FU17 *Nephrops* Stock.

Parameter	Value	Source
Discard Survival	10%	WK*NEPH* 2009
MALES		
Growth - K	0.150	based on FU15 and FU16
Growth - L(inf)	60	based on FU15
Natural mortality - M	0.3	assumed, in line with other stocks
Length/weight - a	0.000322	based on Scottish data (Pope and Thomas, 1955)
Length/weight - b	3.207	"
FEMALES		
Immature Growth		
Growth - K	0.150	based on FU15 and FU16
Growth - L(inf)	60	based on FU15
Natural mortality - M	0.3	assumed, in line with other stocks
Size at maturity (L50)	22	ICES 2006 (Lordan and Gerritsen)
Mature Growth		
Growth - K	0.100	based on FU15 and FU16
Growth - L(inf)	50	based on FU15
Natural mortality - M	0.2	assumed, in line with other stocks
Length/weight - a	0.000684	based on Scottish data (Pope and Thomas, 1955)
Length/weight - b	2.963	"

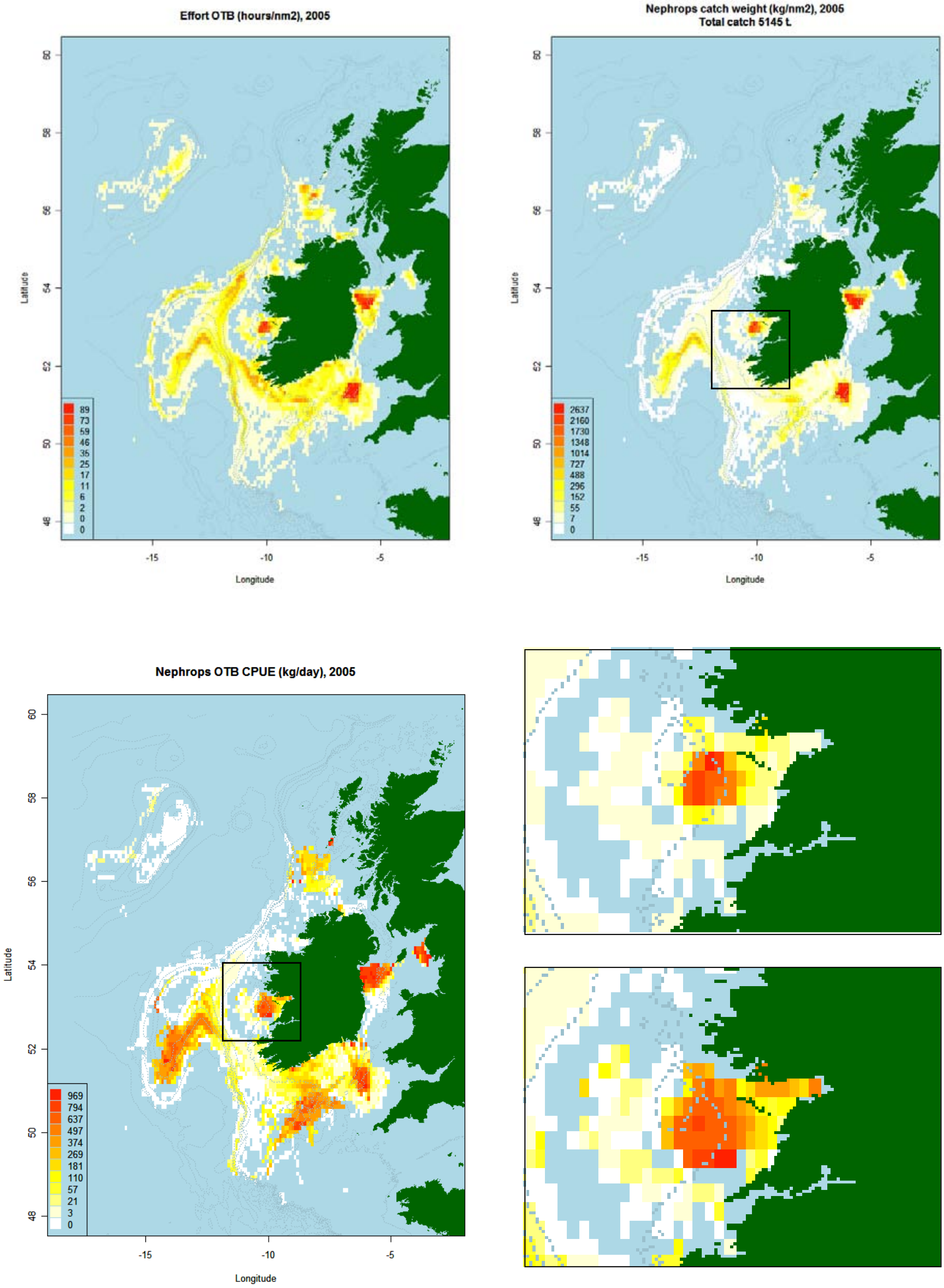


Figure A.2.1. Effort, catch and catch per unit of effort for *Nephrops*, Irish otter trawlers in 2005. The boxed and zoomed in plots show a zoomed in view of landings and lpue from the fishery on the Aran Ground.

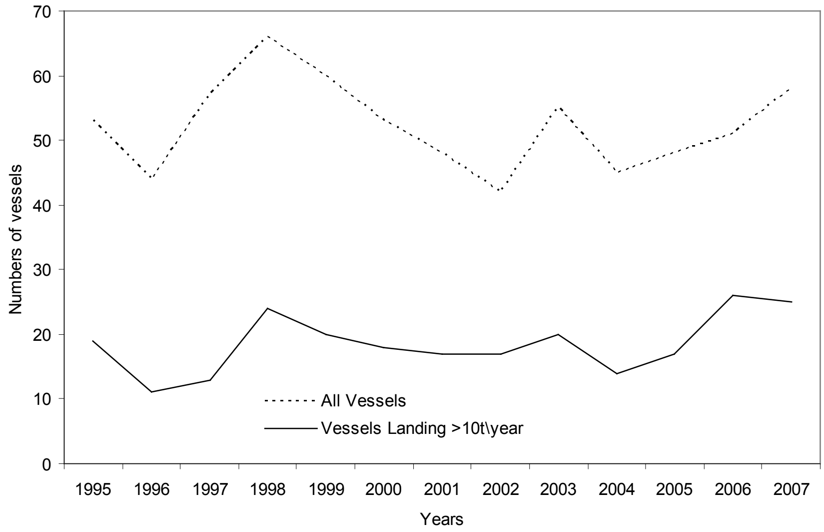


Figure A.2.2. Time-series of the number of Irish vessels reporting landings of *Neprhrops* from FU17. The vessels with annual landings >10 t/yr can be considered the main participants in the fishery these general account for ~85% of the total landings.

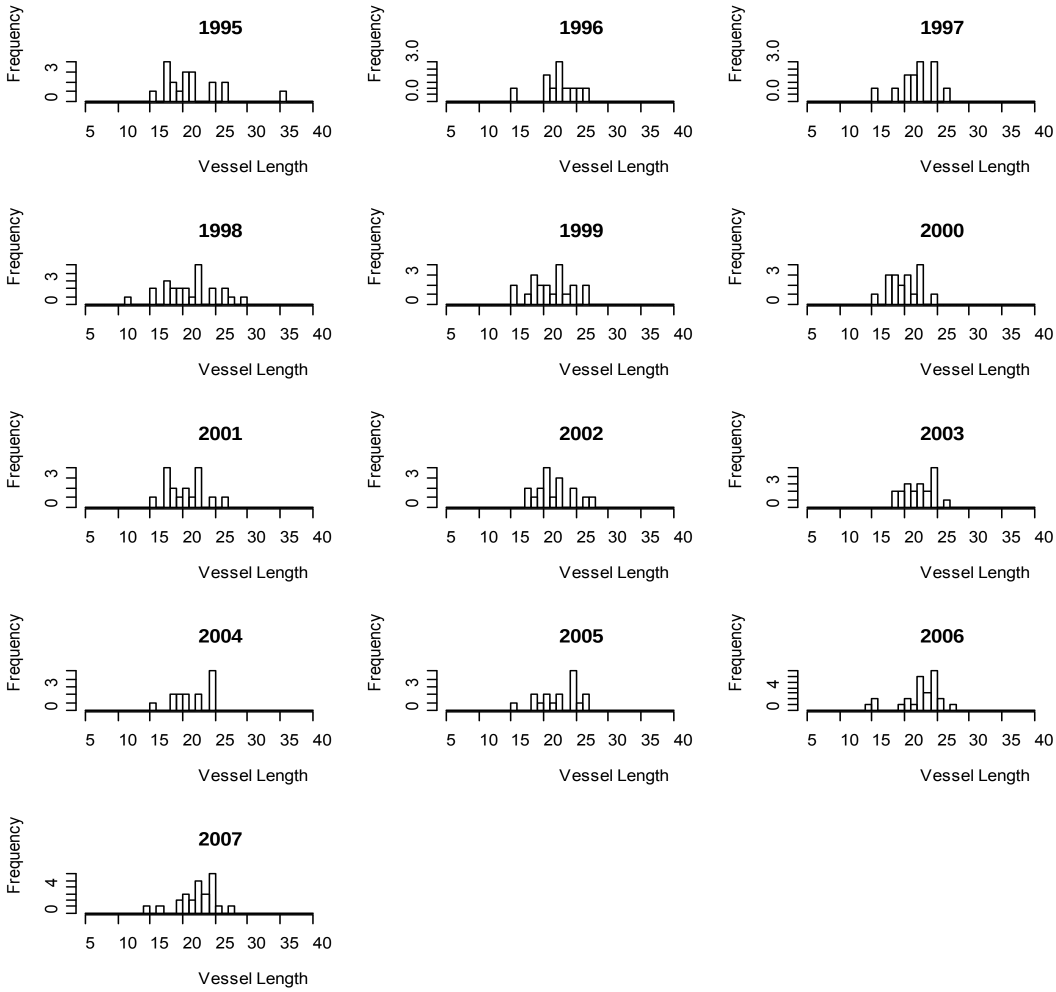


Figure A.2.3. The time-series of length distributions of Irish vessels landing >10 t of *Nephrops* from FU17.

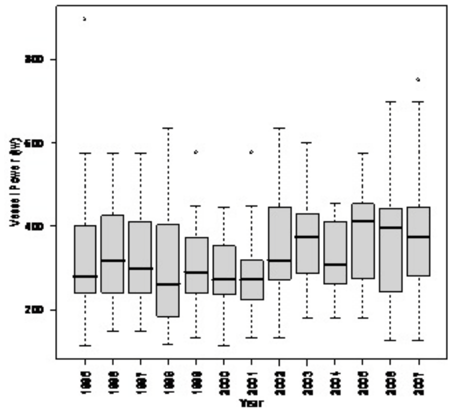


Figure A.2.4. Box plot of the time-series of vessel power in KW of Irish vessels landing >10 t of *Nephrops* from FU17.

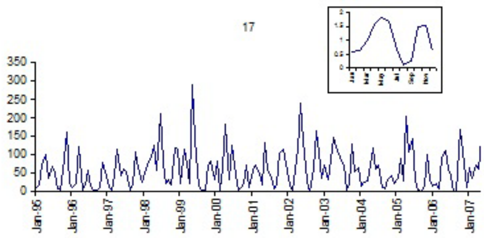


Figure A.2.5. Monthly landings of *Nephrops* from FU17 from 1995–2007. The inset shows the average pattern for all years.

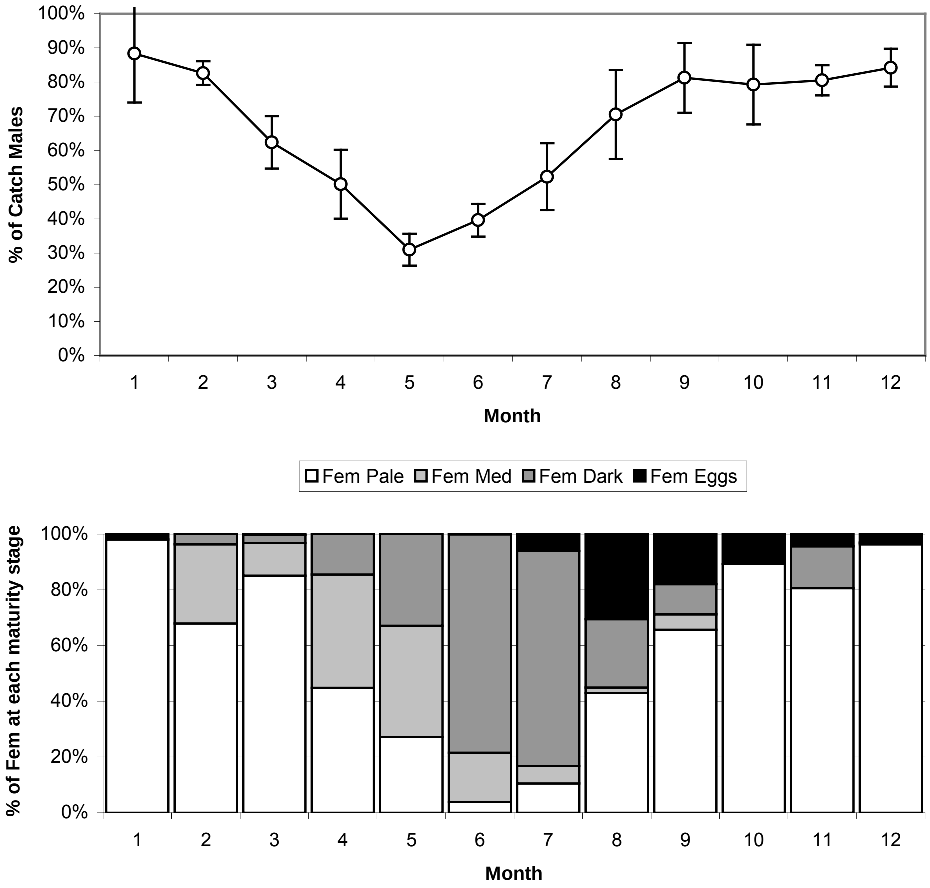


Figure A.2.6. The upper panel shows the sex ratio in sampled catches 2003–2008 (error bars = 95% confidence intervals). The low panel shows the female maturity schedule i.e. percentage at each maturity stage by month.

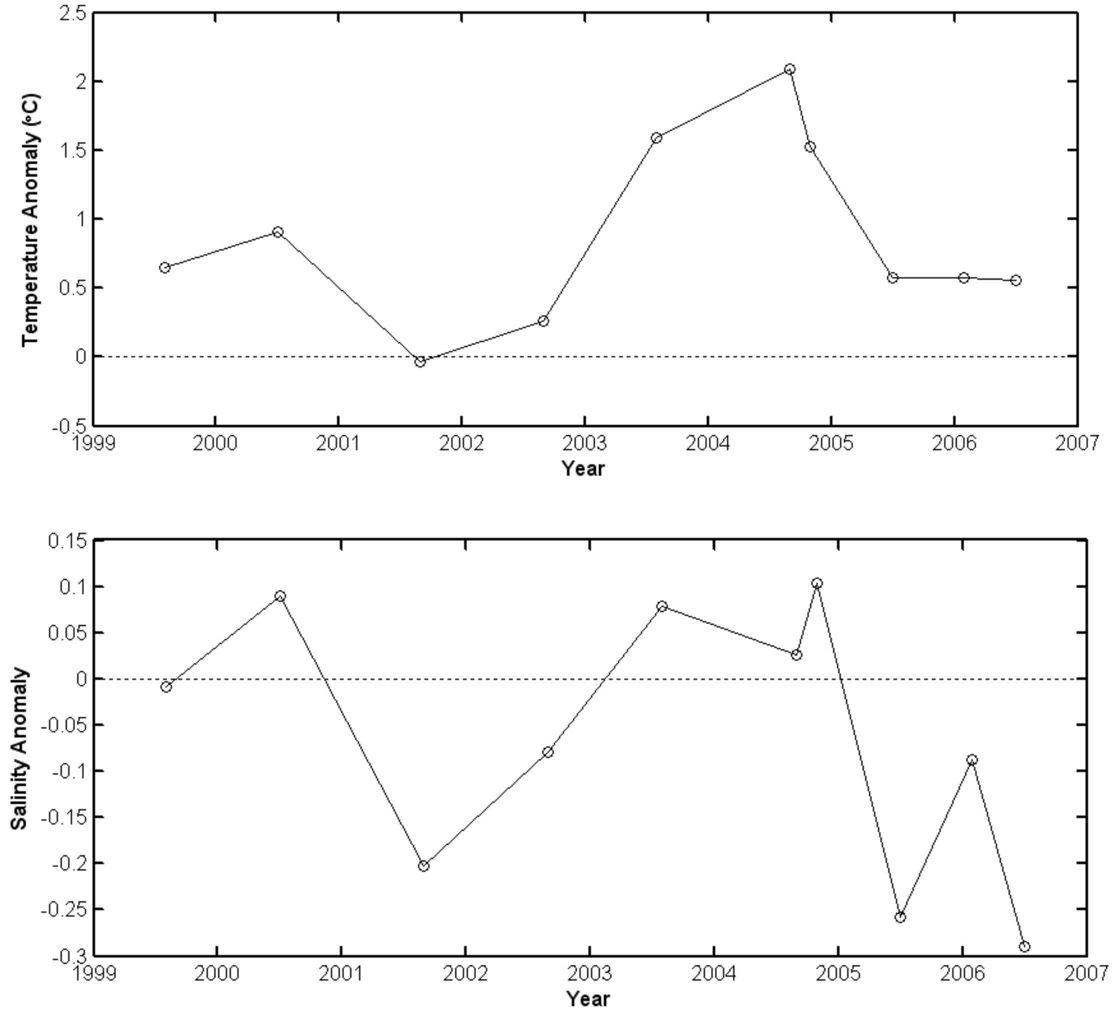
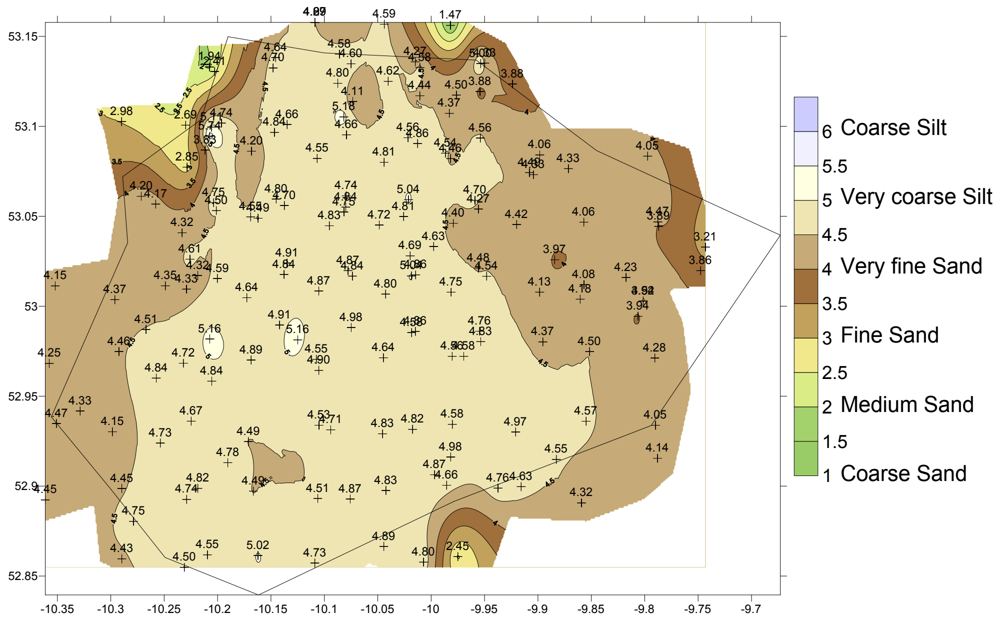


Figure A.3.1. Anomalies in temperature (upper panel) and salinity (lower panel) for the 53°N section running through the Aran Grounds (1999–2006).

a)



b)

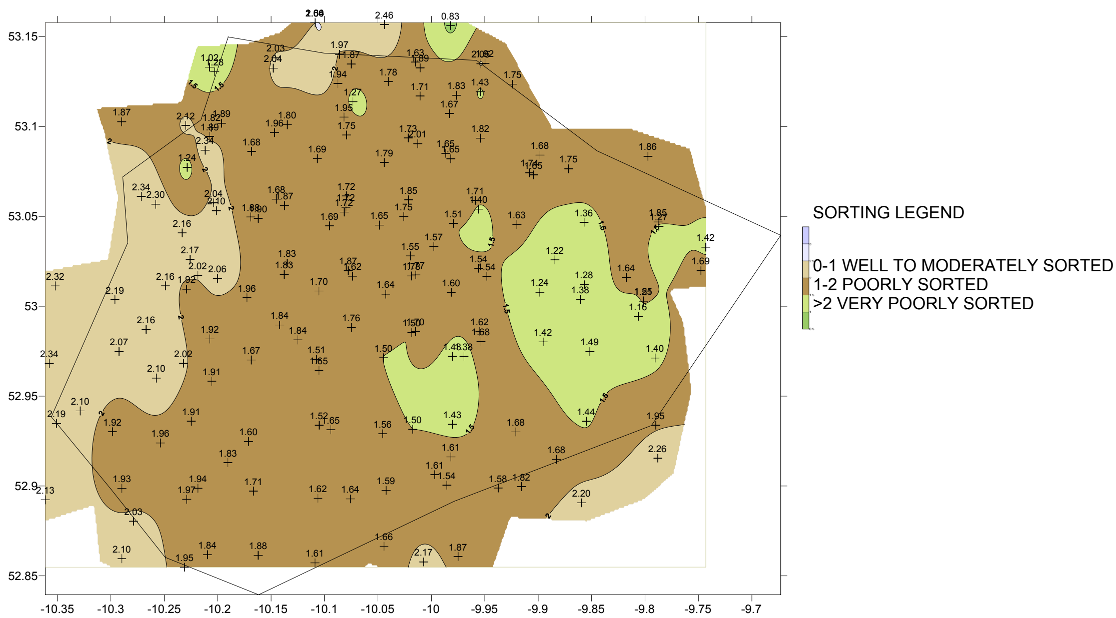


Figure A.3.1. Contour and post plots of the a) mean size (phi) and classification based on the Friedman and Sanders (1978) scales and b) sorting (σ_g) of the sediments on the Aran Grounds based on PSA results from samples collected from 2002–2006.

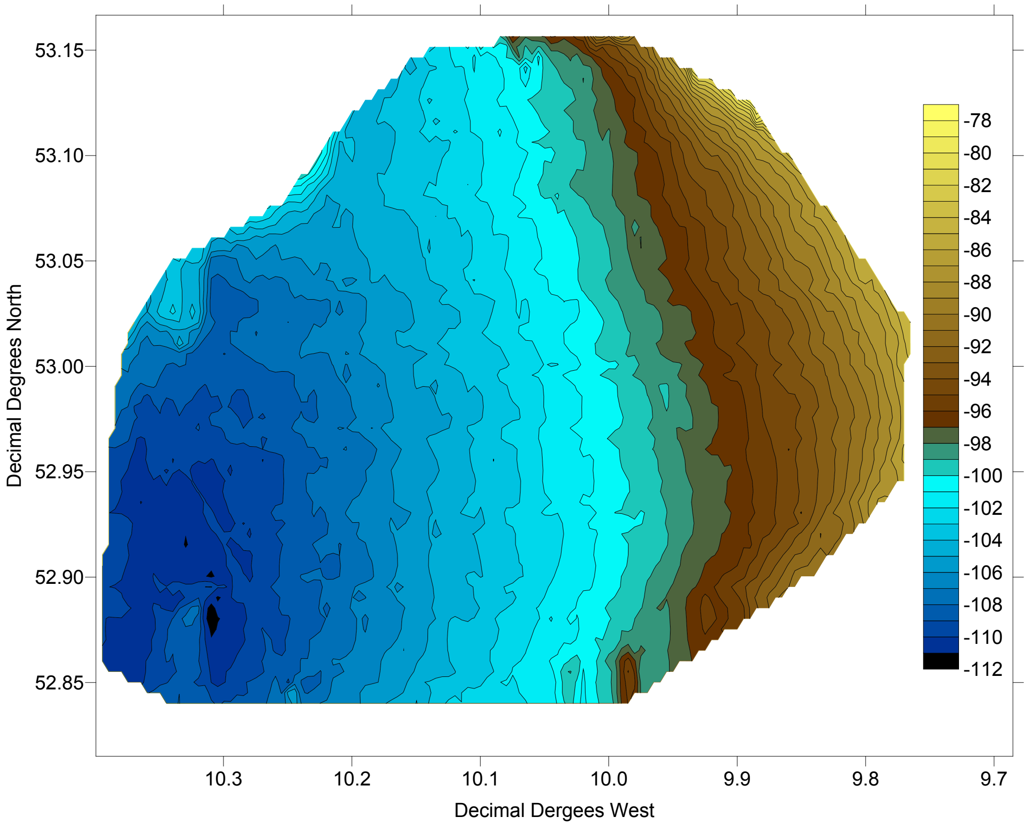


Figure A.3.2. The bathymetry of the Aran grounds.

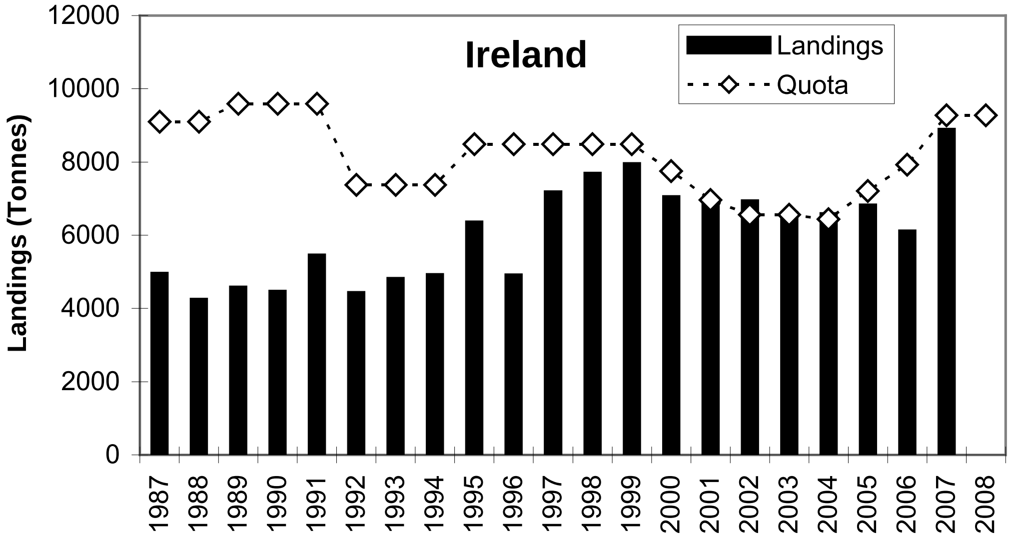


Figure B.1.1. *Nephrops* landings and quota for Ireland since the introduction of TACs in 1987.

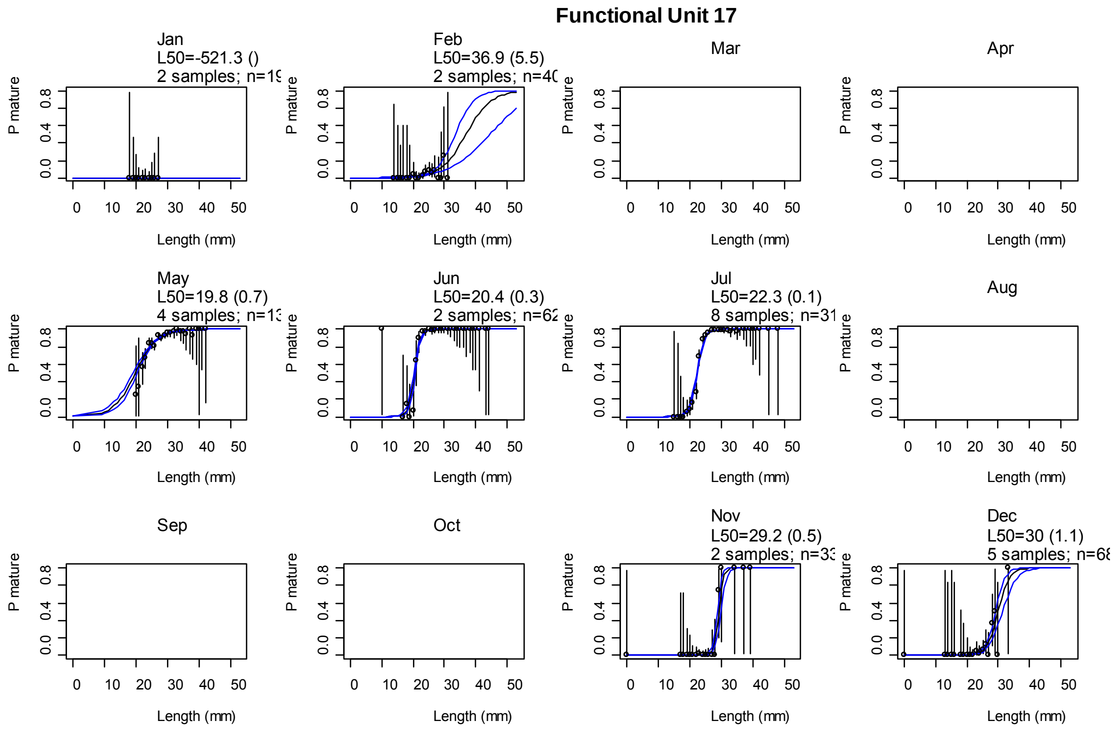


Figure B.2.1. Female proportions mature-at-length for FU17. The 95% confidence limits of the proportions mature-at-length are indicated by the vertical bars. The black curve indicates the model and its standard errors are given by the blue lines. The L_{50} is the estimated length at 50% maturity and its standard error is given between brackets. Blank plots indicate no sampling took place.

Stock Annex 7.6: FU16, Porcupine Bank

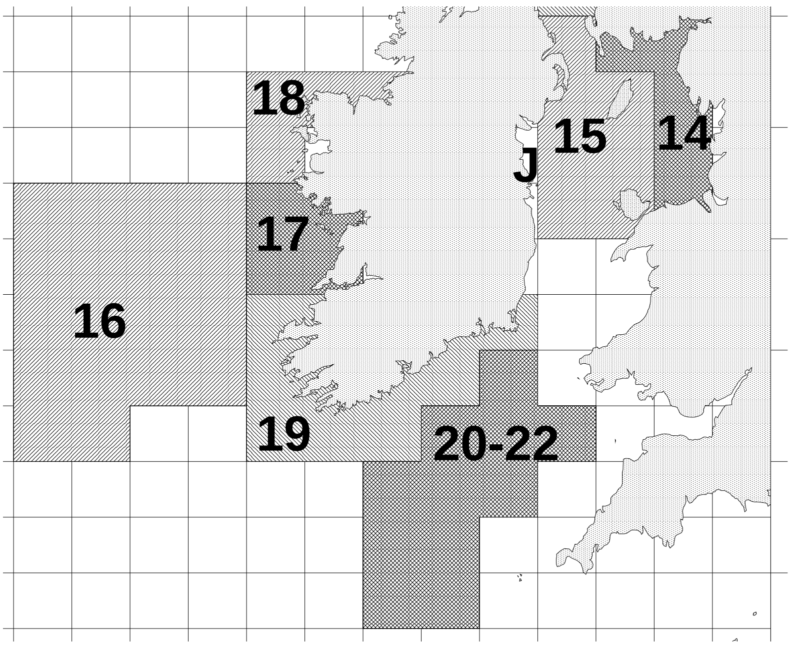
Stock specific documentation of standard assessment procedures used by ICES.

Stock	FU16, Porcupine Bank
Working Group	WGCSE 2010
Date	Version 1, 04/05/2010
Revised by	Jennifer Doyle

A. General

A.1. Stock definition

The Functional Unit for assessment includes some parts of the following ICES Divisions VIIb,c,j,k. The exact stock area is shown on the map below includes the following ICES Statistical rectangles: 31–36 D5–D6; 32–35 D7–D8.



A.2. Fishery

France

The French fleet fishing *Nephrops* in FU16 also fishes in Division VIIg–h and was described in detail in the 1999 WGNEPH Report (ICES, 1999a). The French fleet only lands large *Nephrops* from this FU. Investigation of the landings data by statistical rectangle carried out by WGNEPH in 2002. These indicated that the majority of the French landings between 1999–2000 were from the south of the Porcupine Bank.

Ireland

The fishery is mainly seasonal taking place mainly between April and July, landings for the remainder of the year are minimal. Most of the Irish vessels are multi-purpose trawlers and are relatively large (between 20 and 35 m in total length). Irish vessels land both whole prawns and tails depending on markets from this FU and the sizes of the Irish landings are significantly smaller than those for the French and Spanish fleets. The Irish vessels are mainly using twin-rig trawls. Fishing is often weather dependent (particularly for the smaller vessels), with trip duration varying between seven and ten days. Investigation of the landings data by statistical rectangle provided to the WGNEPH in 2002 indicates that the majority of the Irish landings between 1995 and 2001 were from the south central area of the Porcupine Bank.

The recent spatial distribution of the fishery is shown in Figure 1.

Spain

The Spanish fishery in the Porcupine area is a typical multi-species fishery, targeting different demersal species, amongst which *Nephrops*. The fleet, which consists of about 35 vessels, is composed of side-trawlers and is part of the so-called '300 fleet' in the Adhesion Treaty of Spain to the EEC in 1986. Within the Porcupine fleet, two components can be distinguished: one consisting of vessels fishing with finfish trawls (average engine power 980 hp), and the other fishing with *Nephrops* trawls (average engine power 680 hp). The average duration of their trips is 15 days, of which 10–12 are actual fishing days. The major landing port is La Coruña.

The target species for the finfish directed fleet are hake, megrim and anglerfish, with *Nephrops* as a valued bycatch. Vessels fishing with *Nephrops* trawls are much more directed towards *Nephrops* (especially in spring and summer), and fish is a bycatch. These two fleets not are currently disaggregated in the time-series.

A.3. Ecosystem aspects

Productivity of deep-water *Nephrops* stocks is generally lower that those on the shelf although individual *Nephrops* grow to relatively large sizes.

A persistent Taylor column circulation around Porcupine Bank provides an important mechanism for the retention of pelagic eggs and larvae of the various marine species spawning in the area. (Mohn, *et al.*, 2002). The *Nephrops* stock on the Porcupine Bank is distributed on mud patches in relatively deep waters 200–600 m. It is not know how larvae are retained over these grounds but the Taylor column may help with larval retention.

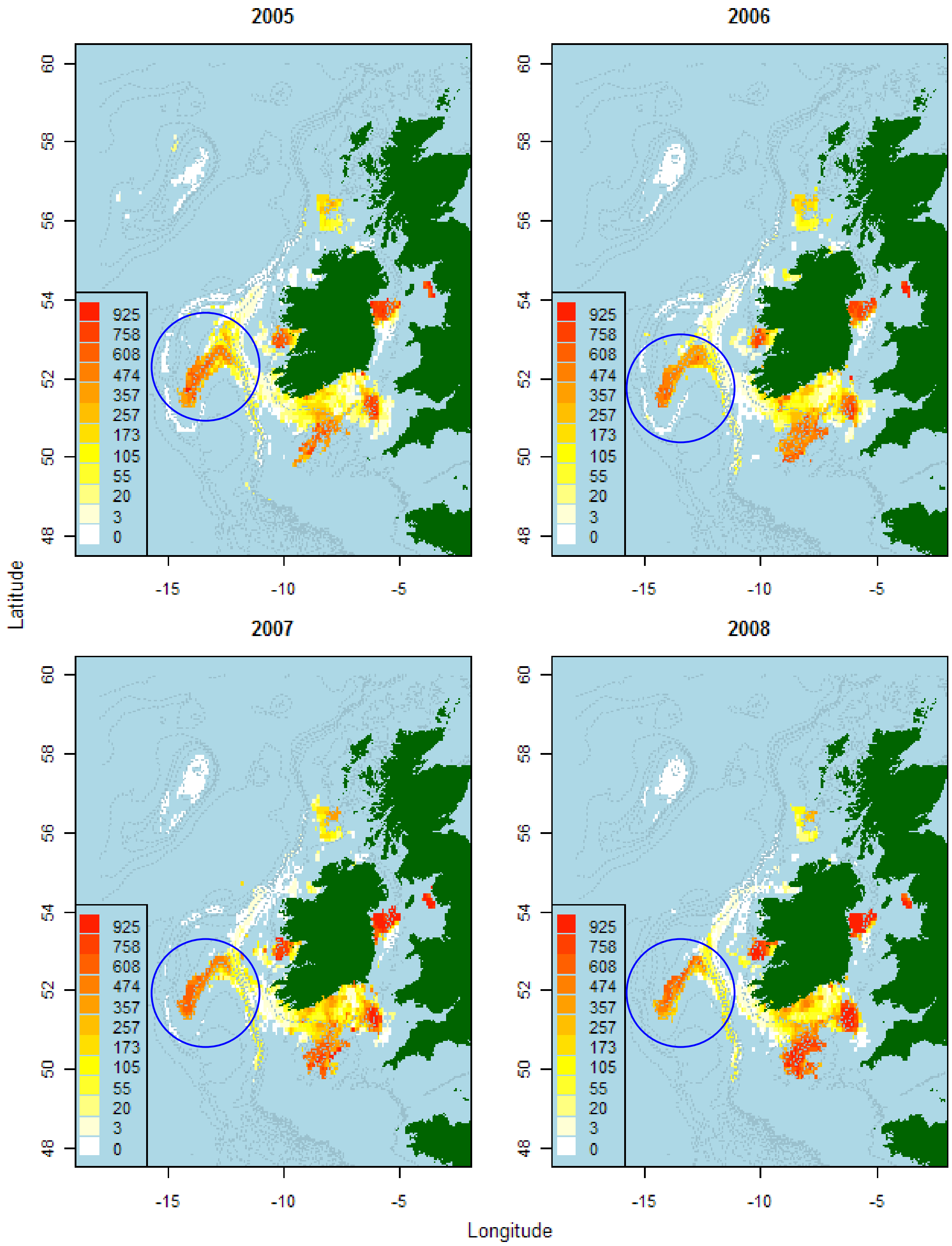


Figure 1. The spatial distribution of lpue of *Nephrops* caught by Irish otter trawlers between 2005–2008 derived using integrated VMS and logbook records.

B. Data

B.1. Commercial catch

Commercial catch and effort data is supplied by Ireland, France, Spain and the UK. These are the countries exploiting the stock.

B.2. Biological

BIOLOGICAL PARAMETERS		
Parameter	Value	Source
Discard Survival		Discards considered negligible
MALES		
Growth - K	0.140	based on values in other areas (Anon., 1991)
Growth - L(inf)	75	based on maximum sizes observed in samples
Natural mortality - M	0.2	Anon, 1990 (estimated)
Length/weight - a	0.00009	based on Celtic Sea (FU20–22)
Length/weight - b	3.550	"
FEMALES		
Immature Growth		
Growth - K	0.140	Not applicable
Growth - L(inf)	75	
Natural mortality - M	0.2	
Size at maturity	26.2	Fariña and González Herraiz (2001)
Mature Growth		
Growth - K	0.160	Anon, 1991
Growth - L(inf)	60	based on maximum sizes observed in samples
Natural mortality - M	0.2	As for males
Length/weight - a	0.00009	"
Length/weight - b	3.550	"

B.3. Surveys

The only fishery-independent source of data is the Spanish Porcupine trawl survey which commenced in 2001. Further information on this survey is provided in the IBTS Report (ICES, 2010) and in previous IBTS reports. Figure 2 and 3 give gear parameters and spatial distributions of *Nephrops* catches on the Spanish Porcupine survey.

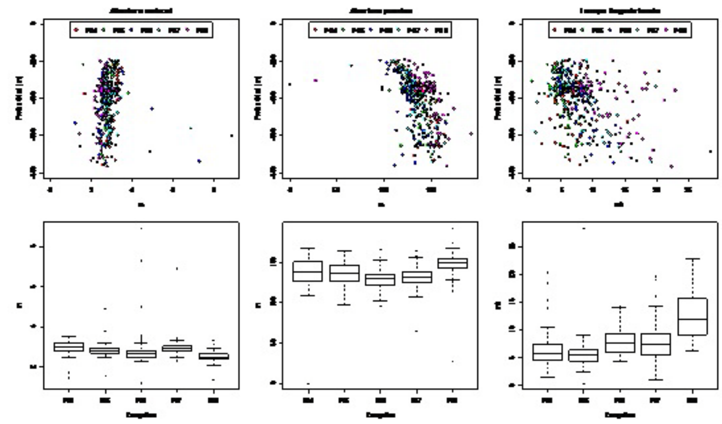


Figure 2. Door spread, vertical opening and time to settle on the ground between 2004 and 2008.

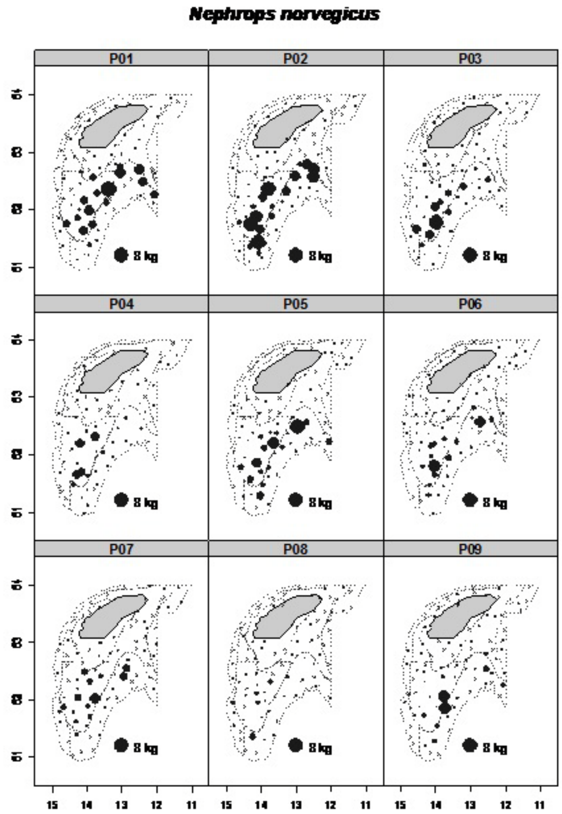


Figure 3. Distribution of *Nephrops norvegicus* catches in biomass in Porcupine surveys between 2001 and 2009.

B.4. Commercial lpue

The *Nephrops* fishery on the Porcupine Bank is both seasonal and opportunistic with increased targeting during periods of high *Nephrops* emergence and good weather.

Effort and lpue data are not standardised, and hence do not take into account vessel capabilities, efficiency, seasonality or other factors that may bias perception of lpue abundance trend over the longer term. The available effort time-series are summarized below:

Country	First year of effort data	Units	Comment
France	1983	Hours	For trips where *Nephrops* constituted 10% of the landed value
Ireland	2005	Hours	For trips where *Nephrops* constituted 30% of the landings in weight
Spain	1971	ay*BHP/100 (x1000)	

Only commercial landings data is available for all countries involved in the fishery.

B.5. Other relevant data

C. Historical stock development

An experimental age structured assessment for this stock was carried out by the *Nephrops* WG in 1993 (ICES, 1993), in 2003 (ICES, 2003) and by the WGHMM (ICES, 2005) in all cases the assessments being considered inadequate. This conclusion was based on poor quality, and unexplainable inconsistencies in the input data. Unknown growth rates and concern about the utility of age based assessment models impeded progress to an accepted assessment. In additional the lack of a time-series of reliable standardised cpue data was also perceived as a problem. This problem has been solved with the developing Porcupine trawl survey-series.

Model used: XSA, LCA

Software used: n/r

Model Options chosen: No Final model was accepted

G. Biological reference points

No reference points have been proposed or used for this stock.

H. Other issues

None.

I. References

Gerritsen, H. 2009. Working Document 1 ICES Working Group for the Celtic Seas Ecoregion 13–19 May 2009.

Stock Annex 7.7: *Nephrops* FU 20–22 (Celtic Sea; VIIfgh)

Stock specific documentation of standard assessment procedures used by ICES.

Stock	*Nephrops* (*Nephrops norvegicus*) : Division VIIfgh
Working Group	WGCSE (Working Group for Celtic Seas Ecoregion)
Date created	June 2007
Last updated	May 2009

A. General

A.1. Stock definition

The management area for this stock is delimited in Area VIIfgh (FU 20–22; Figure 1). The management unit is pertinent because of the sedentary feature of *Nephrops*. However, the sources of recruits are much more poorly defined. There is no evidence that the whole exploited area belongs to the same stock or that there are several patches linked in meta-population sense.

A.2. Fishery

Nephrops present particular ground features and in the FU 20–22 are known to occur in several areas of muddy sediment and the stock structure is uncertain. The *Nephrops* fisheries target different areas and have very different size structures in *Nephrops* catches and landings. These fisheries also have differences in non-*Nephrops* bycatch composition.

As for all crustaceans, *Nephrops* grow by successive moults which are to a large extent tied to reproduction. For this species moult occurs twice a year, in spring and autumn until sexual maturity. Once males are sexually mature, they continue to moult twice a year while females moult only once a year in the latter spring/summer right after the hatching of their eggs. In previous references (1970–1980s), it is pointed out that maturation of females happens at a median size of 31 mm CL (10 cm of total length) which corresponds to 3.5 years old individuals. There is no specific reference for the sexual maturation of males in the FU 20–22, but biological references on close areas with similar hydrological conditions (FU 15; Western Irish Sea) indicate a first size of functional maturity of 29–31 mm CL.

As reported by the WGNEPH 2004 and the WGSSDS 2005 and 2006, *Nephrops* in FU 20–22 is mainly exploited by trawlers from France, Republic of Ireland and UK although the contribution of other countries is lower. The spatial distribution of landings by statistical rectangles are provided below (Figure 2–5). It indicates heterogeneous spatial behaviour of the main fleets.

France

No major changes have taken place in the fishery for more than fifteen years apart from the implementation of a new mesh regulation in 2000 which increased the minimum codend mesh size from 80 to 100 mm (in fact, the regulation involves to 90 mm mesh size, but 100 mm meshes are adopted aiming to avoid problems with bycatch composition). The 100 mm mesh size also allows them to switch to finfish (cod, whiting, haddock) when *Nephrops* catch rates are low (e.g. because of diurnal and seasonal variations of catchability for this species or during periods of bad weather). The MLS applied by the French Producers' Organisations is fixed at 11.5 cm total length (*i.e.* 35 mm CL). The total number of vessels from the harbours of the South Brittany remains stable (more than 90 declared *Nephrops* catches from the Celtic Sea in recent years, but around 70 are actually targeting this species). A part of these units (15–20) switch to other *Nephrops* stocks (FU 16; Porcupine bank; Figure 1) mainly in 2nd and 3rd quarters when the meteorological conditions are favourable. At the opposite, many trawlers (20–30) move towards the FU19 *Nephrops* (SE and SW Irish coast) mainly in autumn and winter according to difficulties due to weather.

Analytical investigations were carried out on the data collected in 2006 and 2007 involving in the French trawlers. Global indices for fishing effort and lpue provided by this fleet (97 trawlers composed by 73 exclusive in Celtic Sea, 15 switching to Porcupine Bank i.e. FU16 and eight also targeting *Nephrops* in the Bay of Biscay i.e. FU23–24) seem to be pertinent: 99% of vessels*months registered for sales at auction can also be found in logbooks (94% of French landings in 2007). In 2006, almost 50% of French landings occurred in two ICES rectangles (29E2, 30E2; the rectangle 30E2 during the 2nd quarter concentrated 21% of yearly landings). In 2007, the contribution of the two rectangles 29E1 and 30E2 was 41% of yearly landings. In 2008, the rectangles 28E1 and 30E2 were represented by 44% of yearly landings. The peak of production is observed during the 2nd quarter of the year (Figure 4): in 2006, the maximum landings are obtained in June whereas a shift occurred in 2007 (maximum value in May which may be caused by bad meteorological conditions in June). In 2008, the shape of French landings vs. month was bi-modal (May and July were the mostly represented months).

The historical review of French landings shows that the contribution of the rectangle 31E3 (concentrating the major part of Irish landings) declined over the last 10 years: from 41% of total French landings registered in 1999 this contribution is currently less than 10% (Figure 3). During the last 10 years, the most productive rectangle for French trawlers was 30E2 mainly during the late 2000s: the average annual contribution of this rectangle was around 15% in the early 2000s, but this proportion reached more than 30% during the recent years. It seems that the French fleet moved gradually from 31E3 to 30E2 under the steeply increasing concentration of Irish trawlers on the "traditional" *Nephrops* grounds (Smalls, Labadie).

Republic of Ireland

More than 60 Irish vessels target *Nephrops* in the Celtic Sea. In 2007, 95 Irish trawlers were registered as landing *Nephrops*, but 63 of them exceeded threshold of 10 t (Figure 6). In 2008, 99 Irish vessels reported landings from this area whereas 67 of them landed more than 10 t. The fishery presents a more typical seasonal profile than the French vessels and most of the landings are made between March and July. These vessels are mid-size multi-purpose trawlers, with a length of 18–23 m and engine power between 250 and 350 kW. Many of the vessels switch between FU15 and FU20–22, depending on the tides in the Irish Sea. Other vessels switch from targeting finfish in the winter to *Nephrops* in the spring and early summer. The mesh size used by Irish vessels is 80 mm, and increasingly these vessels are using twin trawls. The MLS applied by Irish trawlers is the European one fixed at 8.5 cm total length (i.e. 25 mm CL).

The Irish landings seem to be more concentrated spatially than the French. During the period 2003–2006, 63–67% of the Irish nominal landings were provided by one ICES rectangle (31E3). The Irish fishing effort is located more northerly than the French one.

UK

The UK fishery in the Celtic Sea has generally remained unchanged. Since the early 2000s, the number of UK *Nephrops* directed vessels has increased from around 10 to 15, but their contributions in total landings remains minor (usually less than 50 t of landings). The maximum historical value of UK landings is reported in 2008 (242 t).

A.3. Ecosystem aspects

Nephrops occur in discrete patches where the sediment is suitable for them to construct their burrows. There is a larval phase of long duration where there may be some mixing with *Nephrops* from other areas depending on the oceanographic conditions, but the mechanisms for this in the Celtic Sea are not currently known.

Cod has been identified as a predator of *Nephrops* in some areas, and the generally low level of the cod stock is likely to have resulted in reduced predation on *Nephrops*.

B. Data

B.1. Commercial catch

Landings are reported mainly by France and the Republic of Ireland. French landings fluctuated between 2000 and 3800 t. Irish landings rose from around 500 to more than 2000 t in the last 15 years. The highest value of Irish landings is observed in 2007 (more than 3200 t). A part of this trend is due to greater accuracy of reporting mainly after the end of the late 1990s. The contribution of French landings has gradually decreased from 80–90% at the end of 1980s to 50–60% at the beginning of 2000s. Between 2004 and 2005, French landings remained stable whilst Irish landings steeply increased and the total harvested quantity was the highest during the last decade. For the first time, in 2007, the Irish ladings exceeded the French ones (3230 t against 2080 t). This may be caused by constraints linked to the international context affecting fuel prices for fishing vessels. The overall fishing profile remains typically seasonal with a dominance of the 2nd and 3rd quarters (60–70%; the other quarters are less productive because of meteorological conditions and of less accessibility of females due to burrowing).

During the recent years, the evolution of the French fishing effort and lpue was sometimes considerably different from the evolution of the same indicators for the Irish fleet (e.g. between 2004 and 2005: -5% of fishing effort and +2% of lpue for French trawlers against +50% of fishing effort and +25% of lpue for Irish trawlers). In 2007, an increase occurred for lpue values of both main fleets: a slight upwards trend of French trawlers (+13% associated to a strong reduction of the fishing effort: -25% whereas the total number of vessels remained almost stable) and a steep one for the Irish fleet (+36% coinciding with +31% of the fishing effort which was displayed by an increasing number of trawlers operating in the Celtic Sea: +19% between 2006 and 2007). This underlines the divergence of features of the targeting vessels for each country and indicates the great heterogeneity of the area. A direct comparison between both countries cannot be undertaken because the fishing effort is not available in the same unit (France: otter trawlers getting at least 10% of their total landings by targeting this species; Ireland: otter trawl vessels where >30% of monthly landings in live weight were *Nephrops*). Furthermore, the actual fishing areas are different and the Irish fleet is more restricted spatially as already reported by WGSSDS 2005–2008.

B.2. Biological

Natural mortality and maturity-at-age

A natural mortality of 0.3 is applied to all *Nephrops* males whereas the mortality of females changes at the size of first maturity (occurring at 31 mm CL as explained previously): a value of 0.2 is usually applied on mature individuals.

The L2AGE slicing program usually applied on *Nephrops* stocks allocates length classes into age groups by assuming von Bertalanffy model of individual growth. This slicing is applied to length distributions by sex. All parameters, L∞ and K by sex, calculated mean sizes by age for each sex, natural mortality and maturity by sex (assumed to be knife-edged for males and s-shaped for females) and combined are given below.

Table 1. *Nephrops* FU20–22 (Celtic Sea). Individual growth, natural mortality, maturity parameters by sex.

Males and immature females: L∞=68, K=0.17; mature females: L∞=49, K=0.10									
age		1	2	3	4	5	6	7	8+
Size (CL mm) mm	males	11	20	27	34	39	44	47	51
	females	11	20	27	32	33	35	36	37
M	males	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	females	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
	combined	0.3	0.3	0.3	0.25	0.25	0.25	0.25	0.25
Maturity	males	0	0	1	1	1	1	1	1
	females	0	0	0	0.5	1	1	1	1
	combined	0	0	0.5	0.75	1	1	1	1

Biological sampling

Landings: The total French landings have been available since 1983 (on quarterly basis since 1987) whereas the Irish series began in 1987 (on quarterly basis since 1995).

Lpue and fishing effort: Lpue series are provided since 1987 in France whilst Irish data are available over 1996. It has to be noted that the French and Irish method of calculation of the fishing effort are not carried out by the same way (threshold of 10% in weight for *Nephrops* on total landings applied for French trawlers whereas 30% is the threshold used for Irish fleet), thus a direct comparison of those indices is not appropriate.

DLF of landings: French sampling plan at auction started in 1983, but only after 1986 the data can be used on quarterly basis. The Irish plan as written previously began in 2002 (in fact, solely 2003 has been entirely sampled in the FU20–22 area; 2002 data involving the whole Management Area M: see processing by WGSSDS 2006; two quarters were not sampled in 2004 and 2005: see processing by WGSSDS 2006). For French landings, the increasing proportion of tailed individuals (see below) and the inappropriate method of sampling before the end of 2007 provided

DLF of discards: French estimation of discards occurred only in three separate years (1985, 1991 and 1997), but only the data collected in 1997 can be included in analytical investigations. The available dataset is given for only one year of discard sampling (1997) because of unavailable quarterly data for landings for the first year of discard sampling (1985) whereas data collected in 1991 were considered as unreliable (samples sorted by fishermen). Irish sampling has been undertaken since 2002 (lack of information for two quarters in 2004; see processing by WGSSDS 2006).

Length compositions of the landings by sex are provided for the two main fleets, but the time-series are different. Sampling of French landings since 1984 has provided length frequencies by sex on a monthly basis. Due to uncertainty of the older datasets, the data for 1984–1986 were omitted from further analysis. The Irish sampling program was launched in 2002 under the EU DCR and gave length frequencies for the period 2002–2006 (after simulation undertaken for some missing information in 2004 as explained during WGSSDS 2006).

French estimation of discards occurred only in several separate years (1985, 1991 and 1997; in 2005, samples for two quarters, 3rd and 4th, were also provided), but only the data collected in 1997 can be included in analytical investigations because of unavailable quarterly data on landings for the first year of discard sampling (1985) whereas data collected in 1991 were considered as unreliable (samples sorted by fishermen not representative of the discarding behaviour of the whole fleet). The 1997 French plan onboard showed high spatial and temporal variability of discard size-composition vs. that of landings (CV>30%). The Irish sampling launched under DCR gave results as presented by Table 2.

The heterogeneity of the dataset in addition to that of the harvested area by each country affects the discard rate by fleet: it was higher for French vessels: 65% in 1997 against 37% for Irish in 2003 (the only one year with sampling , but only 11% during the quarters 2 and 3 in 2004) and by sex (stronger in the case of females growing less quickly).

Table 2. FU 20–22 Irish Sampling Summary.

Year	Quarter	Number of samples			Numbers Measured		
		Catch	Discards	Landings	Catch	Discards	Landings
2003	1	1	1		186	417	
	2	5	5		4057	3016	
	3	3	3		2535	3638	
	4	2	1		996	528	
2004	1	0	0		0	0	
	2	3	2		1634	2781	
	3	7	6		4284	7171	
	4	0	0		0	0	
2005	1	1	1		1330	2271	
	2	2	2		2208	3238	
	3	2	0		1634	0	
	4	2	0		1627	0	
2006	1	2	1	2	1891	1152	2252
	2	10	2	2	7241	1049	363
	3	5	1	0	3178	1101	0
	4	9	0	0	8266	0	0
2007	1	1	3	0	767	770	0
	2	12	0	0	9648	0	0
	3	15	4	2	7784	1862	411
	4	6	5	0	1959	1417	0
2008	1	2	5		680	1758	
	2	10	13		3409	5333	
	3	3	2		878	546	
	4	4	4		1356	1573	

Extrapolations

Landings: DLF of tailed Nephrops

The WGCSE 2009 pointed out a significantly increasing proportion of tailed individuals in French landings whereas this proportion was already high for Irish trawlers. In 2008, 20% of total French landings involved in tailed *Nephrops* (19% in 2007, 15% in 2006 and 11% in 2005; less than 5% until the beginning of 2000s). The overall upwards trend is illustrated by the Figure 7 presenting also monthly tailed fractions (after conversion of weight of tails to total one).

The seasonal variability of tailed *Nephrops* may be explained by biological features of the species (two peaks appear by year corresponding to the two moulting periods, spring and winter) and by the particular conditions of trips (12–15 days) compromising the conservation of *Nephrops*. As regards to the annual increasing proportion of tails (96% explained by using an exponential function), industry explained it by the economic difficulties of the vessels because of the rapidly increasing fuel prices. Tailed individuals are intended to compensate this loss for the crew participation at the total investment by trip. As the European MLS for FU20–22 *Nephrops* is fixed at 8.5 cm of total length (25 mm CL) and the MLS retained by the French Producers' Organizations is equal to 11.5 cm (35 mm CL), it was expected that tailed individuals should be comprised between these two sizes.

Before the end of 2007, the tailed *Nephrops* could not be sampled at auction and, as the sampling onboard remains difficult to apply routinely (long trip duration for French trawlers), the problem was partially tackled by apportioning tailed individuals to the smallest category of landings at auction. Since the end of 2007, new biometric relationships established during the EVHOE survey have been used: they allow fitting CL vs. 2nd abdominal segment of tail by sex (Figure 8). The DLF of French landings for 2008 were estimated by two ways: one using the extrapolations from tails to CL, the other apportioning tails to the small category as for previous years. The resulting difference appears relevant (Figure 9): in 2008, 46 million *Nephrops* were provided by the previous method whereas 58 million were estimated by including tails (+28%). Almost 30% of landed individuals were below the French Producers' Organization MLS, but no *Nephrops* was undersized compared with European MLS. Moreover, the sex ratio seems to be affected by the tailing practice: 13% of *Nephrops* (7.4 million) were females although this percentage would be 7% (3.2 million) under the previous method. The mean size of French landings for 2008 decreases at around 2.5–5 mm CL by sex when tails are involved by sampling. However, the mean CL for 2008 remains larger than the Irish one.

Table 3. *Nephrops* in VIIfgh. Mean sizes (CL in mm) of French and Irish landings for 2008. French values are calculated (1) including the samples involving in tailed individuals and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire *Nephrops* at auction).

French sampling			Irish sampling		
Males	Females	Total	Males	Females	Total
37.6	34.7	37.2	32.0	29.7	31.1
40.1	39.6	40.1			

This result emphasizes the WGSSDS 2008 conclusion that the size composition may be overestimated when raised to the composition of entire individuals.

Discards: years with no sampling onboard

Generalities

As the sampling plan for both countries was not routinely undertaken, the whole time-series of landings by quarter either for the French fleet (years 1987–2007) or for the Irish one (years 1995–2007, years 1987–1994 are only represented by annual landings) misses information. Therefore, a methodology of extrapolation from sampled data to years or quarters with no information was developed (see WD 1; WGSSDS 2007).

The main concepts of the derivation (back-calculation) are summarized as:

1) The first step involves applying hand-sorting selection of retained catches which is explained by s-shaped (logistic) function vs. size. As statistically tested by fleet, the hand-sorting function is stable within-quarter for given parameters of the exploitation pattern (if mesh size and MLS remain constant within period).

2) The second step consists in removing undersized individuals unusual in landings which can generate unreliably extreme values of discards due to

sampling problems (very high CV of landings for the extreme size classes). Hence, size classes less than a tested threshold (e.g. 1 or 5% of cumulative landings) were eliminated.

3) The third step allows the generation of missing size classes by applying a probability density function which can be symmetrical or not. The whole calculation is based on multiple maximum likelihood function according to the number of missing years. Relationship as between mean sizes of landings and of discards tested on the FU23–24 *Nephrops* (Bay of Biscay; WGHMM) can also be included in the final fitting.

Particularities for FU20-22 *Nephrops* stock

The approach summarized above was already developed on the FU23–24 *Nephrops* stock (Bay of Biscay) and its validation was investigated during the WGHMM 2007 (Figure 10–14). The WGSSDS 2007 examined statistical formulation and validation of this method on French (years 1987–2006) and Irish (years 2002–2006, investigation by quarter) discards for FU20–22. There are some differences from the calculation applied on the Bay of Biscay as:

1) The available French dataset is given for only one year of discard sampling (1997). It means that the hand-sorting s-shaped curves by quarter are calculated on only one year[1] instead of six in the case of the Bay of Biscay stock.

2) The cumulative percentage level for removing of undersized generated discards (see above: 2nd stage) is fixed at 5% for French data and 1% for Irish data (also 1% for the Bay of Biscay *Nephrops* stock). In the case of the French fishery in Celtic Sea, this can be justified by the high variability of landing samples between trips (higher coefficients of variation at auction because of higher heterogeneity of the fished area and of long duration of trips i.e. 12–15 days and, hence, less availability of samples at auction).

3) For the French discards, with only one year of discard sampling, the initial value of the parameter Lm cannot be assumed to be equal to any expected mean size of discards *vs.* mean size of landings (see above 3rd stage). Furthermore, the interval in which Lm should be contained is not statistically calculable. Hence, Lm is initially introduced as the size corresponding to the maximum number of discarded individuals as provided by the 2nd stage of calculation (i.e. after removing extremely high values of discards obtained after the 1st stage: hand-sorting logistic function). Its interval is built by using an *a priori* coefficient of variation around the initial Lm (CV of 0.10 and 0.20 were tested). For the Irish data, no constraint on relationship between mean sizes of discards and landings was set because of lack of any information on that due to the short time-series.

4) (4) The large mesh size of the French vessels in the FU20–22 area indicates that the distribution of length frequencies of discards is probably no symmetrical because of selectivity effects which should be more significant than for the FU23–24 stock or for the Irish trawlers in the FU20–22.

5) For French discards, the absence of reference about any relationship between mean sizes of landings and discards at the opposite of the Bay of

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[1] The six trips sampled in 2005 provided new s-shaped curves of hand-sorting for Q3 and Q4 which were used for simulations of the recent period since 2000 i.e. since the mesh size change.

Biscay, implies that the final fitting aims to provide the more linear as possible relationship (after log-log transformation) with only one reference point (year 1997). Hence, the optimisation is more based on geometric concept than on statistical one.

1st stage: the s-shaped hand-sorting curve

Let j be a year with no dataset on discards. By quarter k, the number of discarded individuals by sex (m or f) and by size L, ND_{jklm} (or ND_{jklf}), is not calculated on data provided from other years, but from the number of landed individuals NL_{iklm} (or NL_{iklf}) during the same year, quarter k, sex (m or f) and size L:

$$ND_{jklm} = NL_{jklm}.\exp(-\alpha_k.(L - L50_k)) \text{ or}$$
$$ND_{jklf} = NL_{jklf}.\exp(-\alpha_k.(L - L50_k)) \quad [1]$$

α_k and $L50_k$ are the parameters of the s-shaped curve (logistic model) fitted by quarter k describing the commercial *Nephrops* hand-sorting onboard. For this fitting, both sexes are combined and the dependent variable is expressed by the number of landed individuals for size L and the independent one is the total number of catches by size L for the years with discard sampling onboard.

The estimates α_k and $L50_k$ were calculated by assuming the stability of hand-sorting process onboard if mesh size and MLS remain unchanged. The short Irish time-series 2002–2006 was considered as a common dataset, but, for the French trawlers, the overall time-series was divided into three periods:

1) *Years 1987–1990*: The results of sampling carried out in 1985 are not available on computing support. Thus, there is no formal information if the hand-sorting onboard could be approximated by the more recent parameters of 1990s. α and L50 were not got fixed, but their values were estimated by the multiple likelihood function as for the parameters of the probability density by year (see below).

2) *Years 1991–1999*: The hand-sorting was fitted on data from 1997 (1991 data were not representative of the whole fleet). The missing data of years 1991–1996 and 1998–1999 were therefore estimated.

3) *Years 2000–2006*: Because of the mesh size change, the hand-sorting should be different from 1997 sampling data. However, there is no new information for the 1st and 2nd quarters (the 2005 sampling plan provided relevant results only for the 3rd and 4th quarters). Hence, α and L50 for the first two quarters were fixed equal to 1997 parameters, but the simulation for the other two quarters is based on 2005 data.

2nd stage: removing of unreliable size classes of discards

This derivation approach reduces interdependence between yearly datasets which may induce lack of contrast in recruitment time-series. In spite of that, some inconveniencies of the new approach have to be taken into account: (1) the hand-sorting onboard s-shaped curve implies that, for a given size class, no calculation of discards is possible while there is no landed individuals and (2) the exponential expression gives extremely unreliable high values of discards when undersized individuals are sampled in landings (mainly because of hand-sorting deviation due to sampling rate not representative for extreme size classes).

1) *Undersized individuals unusual in landings*. As written previously, undersized *Nephrops* sampled in landings should produce unreliable high discarded amounts by size because of the exponential calculation. All size classes representing less than a minimum cumulative percentage level in landings by year were removed (5% for French landings, 1% for Irish landings).

2) *Discarded individuals by size exceeding observed mean ratios discards/landings*. Generated discarded numbers were removed when the calculated ratio discards/landings by size (decreasing function vs. size) exceeded observed mean ratios by size[2]. Almost all size classes involved by (2) were already removed by (1). This operation was added at the aim of elimination of not normally high ratios discards/landings for large sizes (which has a little impact on total discarded number due to the s-shaped function of hand-sorting).

This calculation process retains only a part of the initial hand-sorting generated distributions of discards mainly the decreasing part of discarded individuals.

3rd stage: simulation of densities of probability of discarded individuals (yearly distribution for French and quarterly for Irish discards)

Finally, the assumed distribution of discards for the whole range of sizes was calculated from the descending part. This process needs to input the probability density of discards given by:

$$\varphi(L) = \frac{\alpha}{1 + \exp(\beta.(L - Lm)} \quad [2]$$

where α, β, Lm are coefficients of the distribution ($\phi(L)=\alpha/2$ when L=Lm).

Because of the assumed skewness for the French discard distribution, as explained above, the whole function of the probability density is approximated by:

$$\varphi(L) = \frac{\alpha}{1 + \exp(-\gamma\beta.(L - Lm)} \text{ for } L \leq Lm$$
$$\varphi(L) = \frac{\alpha}{1 + \exp(\beta.(L - Lm)} \text{ for } L > Lm \quad [3]$$

with a complementary coefficient γ: if γ=1 the whole probability density is symmetrical, if γ<1 the skewness of the distribution is positive if γ>1 the skewness is negative (γ=1 for Irish discards, $\gamma \neq 1$ for French discards).

The fitting of $\phi(L)$ is processed on two stages:

- *Lm and α are fixed*: α is initially fixed at 2*ϕmax which is the maximum frequency retained after the 2nd stage of calculation (see above), Lm is fixed at the size corresponding to the maximum number of discarded individuals as provided by the 2nd stage of calculation (see previously) and, hence, β is given by:

$$\beta = \frac{1}{n} \sum_{L=L\min}^{L\min+n-1} \ln\left[2.\frac{\varphi\max}{\varphi(L)} - 1\right]^{\frac{1}{L-Lm}} \quad [4]$$

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[2] This procedure is performed only on Irish dataset whereas it is not pertinent for French data (only one year dataset).

(Lmin= first size represented by not null individuals and n= number of total size classes with discards different from zero).

All parameters are estimated: α, β, Lm got obtained by the 1st stage are input for the final calculation using Newton cancellation of gradient and assuming stochastic approach for Lm. Lm is assumed to be included in the interval defined accordingly to an a priori CV of Lm (see above) [3].

Otherwise, the final run includes constraints as:

- The sum of frequencies for descending part of distribution is equal to that calculated by the model i.e. the retained values of the 2nd stage of calculation described previously are assumed to be reliable.
- Lm ≥ Lmin [Lmin=(1-$Z_{1-\alpha/2}$.CV)*Lm] (usually: α=0.05=>$Z_{1-\alpha/2}$=1.96)
- Lm ≤ Lmax [Lmax=(1+ $Z_{1-\alpha/2}$.CV)*Lm]
- For French discards, the coefficient of determination of the relationship between the mean sizes of landings and the mean sizes of discards for missing years has to be as close as possible to 1 (with no possibility of statistical test because of only one year dataset).

Statistical formulation and validation

Calculation of variances

Matrix of variances–covariances of model parameters

The Generalized Reduced Gradient and the Complex method do not give an estimate of the matrix of variances-covariances of the four (three for Irish) parameters. In this case, it is usually recommended to apply non-parametric techniques such as the Bootstrap method. The calculation can also be carried out according to parametric procedure (Lin, 1987; Fifas and Berthou, 1999; Fifas *et al.*, 2004) using Jacobian matrix (i.e. matrix of partial derivatives of the objective).

The matrix of variances-covariances is obtained by the following relationship:

$$[M] = s^2.[I]^{-1} \quad [5]$$

with:

[M]= matrix of variances-covariances; $[I]^{-1}$= inverse of matrix of information; s^2= sum of mean residual squares of the fitted function (s^2=SCE/DDL [4]):

$$SCE = \sum_{i=1}^{Lj<Lm}\left[\varphi(L_i) - \frac{\alpha}{1+\exp(-\gamma\beta.(L_i - Lm))}\right]^2 + \sum_{i=j+1}^{Lj>=Lm}\left[\varphi(L_i) - \frac{\alpha}{1+\exp(\beta.(L_i - Lm))}\right]^2 \quad [6]$$

The matrix of information is obtained by:

$$[I] = [J]'.[J] \quad [7]$$

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[3] For French discards, are also included in the optimisation algorithm, the parameters α and L50 of the first period (1987–1990) which remained unknown.

[4] DDL is equal to nc-4 for French discards, but equal to nc-3 for Irish data (parameter γ is omitted).

[J] is the Jacobian matrix (nc rows and 4 columns for French data, 3 for Irish):

$$[J]=\begin{bmatrix} \frac{\partial\varphi(L_1)}{\partial\alpha} & \frac{\partial\varphi(L_1)}{\partial\beta} & \frac{\partial\varphi(L_1)}{\partial\gamma} & \frac{\partial\varphi(L_1)}{\partial Lm} \\ \frac{\partial\varphi(L_2)}{\partial\alpha} & \frac{\partial\varphi(L_2)}{\partial\beta} & \frac{\partial\varphi(L_2)}{\partial\gamma} & \frac{\partial\varphi(L_2)}{\partial Lm} \\ . & . & . & . \\ \frac{\partial\varphi(L_{nc})}{\partial\alpha} & \frac{\partial\varphi(L_{nc})}{\partial\beta} & \frac{\partial\varphi(L_{nc})}{\partial\gamma} & \frac{\partial\varphi(L_{nc})}{\partial Lm} \end{bmatrix} \quad [8]$$

[J]' is the transpose of [J], the partial derivatives of the equation [8], also defined as *absolute coefficients of sensitivity of order 1* written as a(α), a(β), a(γ), a(Lm) are given below:

$$\frac{\partial\varphi(L)}{\partial\alpha}=\frac{\varphi(L)}{\alpha} \quad [9]$$

$$\frac{\partial\varphi(L)}{\partial\beta}=\gamma.(L-Lm).\varphi(L).(1-\frac{\varphi(L)}{\alpha}) \text{ if } L \le Lm \quad [10a]$$

$$\frac{\partial\varphi(L)}{\partial\beta}=-(L-Lm).\varphi(L).(1-\frac{\varphi(L)}{\alpha}) \text{ if } L > Lm \quad [10b]$$

$$\frac{\partial\varphi(L)}{\partial\gamma}=\beta.(L-Lm).\varphi(L).(1-\frac{\varphi(L)}{\alpha}) \text{ if } L \le Lm \quad [11a]$$

$$\frac{\partial\varphi(L)}{\partial\gamma}=0 \text{ if } L > Lm \quad [11b]$$

$$\frac{\partial\varphi(L)}{\partial Lm}=-\beta.\gamma.\varphi(L).(1-\frac{\varphi(L)}{\alpha}) \text{ if } L \le Lm \quad [12a]$$

$$\frac{\partial\varphi(L)}{\partial\gamma}=\beta.\varphi(L).(1-\frac{\varphi(L)}{\alpha}) \text{ if } L > Lm \quad [12b]$$

Uncertainty of simulated discards

The matrix of variances-covariances of the four (three for Irish) parameters of the model and the use of partial derivatives of order 1 provide an approximate calculation of the variance of the variable Ψ(L) corresponding to simulated discards vs. size L. This procedure is based on limited developments of order 1 in Taylor's series (called Delta methods: Laurec, 1986; Laurec and Mesnil, 1987; Chevaillier, 1990; Chevaillier and Laurec, 1990; Fifas and Berthou, 1999; Fifas *et al.*, 2004).

By using Taylor's polynomial on a function Φ against parameters θ_1, θ_2, …, θ_k it is possible to present the variance of Φ by:

$$V[\Phi] \approx \sum_{i=1}^{k}\left(\frac{\partial\Phi}{\partial\theta i}\right)^2.V[\theta_i] + 2.\sum_{i=1}^{k-1}\sum_{j=i+1}^{k}\frac{\partial\Phi}{\partial\theta i}.\frac{\partial\Phi}{\partial\theta j}Cov[\theta_i,\theta_j] \quad [13]$$

Then, the variance of simulated discards vs. size, V[Ψ(L)], is written as:

$$V[\Psi(L)] \approx a(\alpha)^2.V[\alpha] + a(\beta)^2.V[\beta] + a(\gamma)^2.V[\gamma] + a(Lm)^2.V[Lm] + 2.a(\alpha).a(\beta).Cov[\alpha,\beta] +$$

$$2.a(\alpha).a(\gamma).Cov[\alpha,\gamma] + 2.a(\alpha).a(Lm).Cov[\alpha,Lm] + 2.a(\beta).a(\gamma).Cov[\beta,\gamma] + 2.a(\beta).a(Lm).Cov[\beta,Lm] +$$

$$2.a(\gamma).a(Lm).Cov[\gamma,Lm] \quad [14]$$

where the absolute coefficients of sensitivity of order 1 (partial derivatives) are defined above (equations [9] to [12]).

Validation

The generated by simulation values are tested against discards estimated by sampling. This procedure is undertaken on French data of 1997 and also on available Irish set (all quarters of 2003, 2004-Q2, 2004-Q3, 2005-Q1, 2005-Q2, 2006 apart from Q4 i.e. 11 quarters). As performed for the Bay of Biscay *Nephrops* stock, this validation involves in three main stages (Figure 10–14): (1) Examination of the total amount of discards calculated by simulation that should not be significantly different from that obtained by sampling. (2) Test by linear regression performed on simulated numbers vs. size as dependent variable against sampled numbers as independent one. The slope of this relationship should not be significantly different from 1 (bisecting line) and the intercept should not be significantly different from 0. (3) Test of cumulative frequencies of the sets, sampled and simulated, using non parametric approaches such as Kolmogorov–Smirnov.

Results

Hand-sorting s-shaped curves

The French and Irish hand-sorting logistic curves estimated by sampling are provided by Figure 15. In the Table 4, are also presented the French parameters involving in years 1987–1990 (simulated by the multiple likelihood function applied for probability density of discards; see above).

Table 4. Summary of parameters of s-shaped hand-sorting curves.

	FR (years 1987–1990)		FR (year 1997)		IRL (years 2003–2005)	
quarter	α	L50	α	L50	α	L50
Q1	0.797	32.685	1.006	32.776	0.480	25.876
Q2	0.494	35.573	0.718	36.019	0.426	26.016
Q3	0.331	32.227	0.851	33.654	0.559	25.785
Q4	0.697	31.138	0.815	32.381	0.412	24.886

These values indicate the high heterogeneity between the two fleets which accentuates the *a priori* high spatial heterogeneity of the targeted resource. Some weak differences are observed between the simulated values α and L50 of the first French period (1987–1990) and the sampling of 1997. Nevertheless, these parameters are given by deterministic way; therefore, there is no possibility of further statistical comparison.

Estimates of French discards

Estimates of French discards (1987–2006), total number of discarded individuals, parameters α, β, γ and Lm and corresponding coefficients of variation (CV, in %), are given below (Table 5). The Table 6 and Figure 16 present discard rates by sex and combined for the overall time-series.

Table 5. French *Nephrops* trawlers, Celtic Sea (FU20–22). Estimates of discards, coefficients of model and coefficients of variation of parameters.

year	disc	CV(disc)	Lm	CV(Lm)	α	CV(α)	β	CV(β)	γ	CV(γ)
1987	125752	4.62	30.278	3.25	25773	13.79	0.293	32.11	0.768	44.61
1988	425396	4.88	28.917	5.28	59518	16.97	0.260	39.24	0.534	56.57
1989	99536	4.02	31.061	4.36	14417	13.86	0.221	33.01	0.740	45.69
1990	81530	8.74	30.579	8.28	12219	28.86	0.221	61.77	0.866	92.51
1991	389726	5.69	29.479	5.70	57932	18.85	0.218	40.78	0.868	60.75
1992	377075	18.48	30.752	14.57	61039	58.97	0.314	142.51	0.534	193.98
1993	118210	199.42	31.299	147.10	20679	612.24	0.258	1356.53	0.879	1956.90
1994	93687	7.62	31.438	6.77	14384	24.84	0.232	54.91	0.830	79.80
1995	131541	136.57	31.808	95.39	25096	418.52	0.273	880.20	0.808	1323.18
1996	82811	6.05	32.357	5.61	12121	20.20	0.255	49.20	0.637	66.91
1997	96612	6.21	32.403	2.11	18050	15.36	0.673	46.01	0.397	55.62
1998	30494	7.62	31.393	10.98	3453	28.85	0.161	61.94	0.893	94.65
1999	36900	12.14	31.827	10.67	5618	40.01	0.236	84.90	0.791	127.28
2000	22234	46.41	33.790	56.24	2655	171.90	0.175	359.92	0.863	552.62
2001	98962	5.59	31.766	7.43	11594	20.94	0.191	46.64	0.682	69.25
2002	34283	18.42	33.466	21.52	4223	66.86	0.193	150.64	0.762	217.87
2003	59692	4.73	34.452	3.48	9659	15.04	0.285	36.31	0.638	49.26
2004	29493	9.36	33.546	9.20	4050	32.24	0.202	69.23	0.874	103.22
2005	15097	18.92	34.739	17.57	2098	65.03	0.205	136.51	0.873	206.98
2006	17286	6.86	36.327	7.29	2350	24.93	0.238	64.77	0.530	85.17

Note: the sampled year 1997 is given in bold and italic fonts whereas in coloured fonts are presented the years for which the model based on the probability density seems to be inappropriate (years 1993, 1995, 2000; extremely high CV of parameters and discarded numbers). The total discarded number cited for 1997 is the value obtained by sampling.

Table 6. French *Nephrops* trawlers, Celtic Sea (FU20–22). Discard rate (%) by year.

year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
total	65.0	83.8	58.6	51.2	86.2	82.0	60.9	55.8	63.4	54.3	65.4	40.1	40.3	31.7	64.9	37.4	49.3	40.7	28.8	28.7
males	46.5	67.0	38.5	32.8	73.7	65.3	40.7	37.0	44.2	33.6	45.6	23.0	23.8	19.8	46.4	21.0	30.0	24.0	16.6	18.2
females	86.7	96.5	86.1	79.6	96.0	96.3	90.2	82.3	88.3	88.1	94.7	75.0	72.9	55.6	85.5	80.8	90.6	81.4	68.8	48.9

As presented above, the model based on probability density with skewness gives generally adequate results (see parameters' CV) except for three years on twenty of the overall time-series. Nevertheless, the provided CV are estimated by the model and do not necessarily reflect the actual uncertainty because of complex organisation of samples (sub-sampling stratified plan applied onboard). This is illustrated by the sampled year 1997 which showed high spatial and temporal variability of discard size-composition vs. that of landings (CV of samples>30%) although the estimated by the model CV seems unlikely (weak value of 6.21%). Moreover, the generated by the model total number of discarded *Nephrops* for 1997 was under-estimated (66 millions i.e. 68% of the total number estimated by sampling: 97 millions). The use of the coefficient γ in the model was justified by the expected skewness of discard distributions due to the selectivity effect: in fact, all values of γ do not exceed 1. However, using the simulated model for the year 1997 with assumed symmetrical distribution of discards and with no constraint on relationship between mean sizes in discards and in landings provided more satisfactory results (Figure 17). The symmetrical simulation gave un estimate of 83 millions of discards i.e. 86% of the 97 millions calculated by sampling closer than the value generated with skewness. Moreover, the CV of parameters α, Lm and mainly β are less strong.

There is no current statistical evidence for choosing symmetrical or not distribution for simulations and there is no possibility to validate any relationship between mean sizes in discards and landings while the actual sampling is limited to only one complete year.

However, as underlined in the Stock Annex, the generated by model cpue (including discards calculated by the probabilistic simulation with skewness) show a good agreement with EVHOE groundfish survey indices for the period 1997–2005 (R^2=0.65) whilst the relationship between lpue and EVHOE indices seems more sparse (R^2=0.36). As also reported by WGSSDS 2007, throughout the overall time-series, some high (years 1988, 2001) or low (year 1990) values of simulated discard rates coincide with increase or decrease of lpue for 1–2 years later (increase in 1989–1990 and 2002–2003, decrease in 1991–1992). It is noticeable that no constraint was set for back-calculations on the relationship between discard rate (year i) and lpue (years i+1/i+2).

Estimates of Irish discards

Estimates of Irish discards by quarter (since 2002), total numbers of discarded individuals, parameters α, β and Lm and corresponding coefficients of variation (CV, in %), are provided below (Table 7).

A first examination of results shows an overall better statistical adequacy than for French discards. Except for one sampled quarter (coloured fonts; 2005-Q2), the coefficients of determination are strong and the CV of model parameters remain relatively low. Despite this initial overview, the adequacy of the probabilistic approach will be tested as regards the procedure developed for the Bay of Biscay stock.

The Table 8 and Figure 18 present quarterly discard rates by sex and combined for the overall time-series. Discard rates by sampling and by simulation can be directly compared for 11 quarters (Table 8): it seems that the average simulated discard percentage is slightly lower than the sampled one (26.0% against 27.3%), but for 8 quarters on 11, the simulated values are under-estimated.

The Table 9 and Figure 19 give comparisons between sampled and simulated discarded numbers. Two sampled years (2003 and 2005) for the 1st quarter give low correlations between sampled and simulated discards. Despite more good correlation levels (9 on 11), the overall conclusion is that the null hypothesis (slope=1) is refused apart from one example (2004-Q2) which although provides biased results of simulated discards (very high ratio Nexp/Nobs). It is worth noting that the descending part of simulated DLF of discards seems to be more coherent with the sampled DLF than the ascending one (except for one case on 11, 2005-Q2 which is denoted by the less good statistical consistency of simulation in regards with the low value of ϱ^2: Table 7). Introduction of some constraint between mean sizes in discards and in landings as for the French example may give different results for the ascending DLF.

Table 7. Irish *Nephrops* trawlers, Celtic Sea (FU20–22). Estimates of discards, coefficients of model and coefficients of variation of parameters (bold characters=sampled quarters).

year	Q	disc	Lm	CV(Lm)	α	CV(α)	β	CV(β)	ρ²
2002	Q1	2664	26.039	0.95	1282	13.89	0.674	18.09	0.990
2003	Q1	6318	20.994	1.97	1476	11.52	0.319	15.53	0.855
2004	Q1	2208	24.743	1.34	998	18.48	0.625	24.42	0.960
2005	Q1	7613	25.929	0.88	3764	13.27	0.691	17.29	0.994
2006	Q1	11279	25.218	0.68	4594	8.56	0.564	11.32	0.929
2002	Q2	1670	27.891	1.10	666	14.69	0.555	19.37	0.950
2003	Q2	10236	25.119	0.72	4204	8.98	0.571	11.84	0.980
2004	Q2	4953	24.685	1.05	1003	6.39	0.278	8.59	0.951
2005	Q2	23437	25.139	1.42	3701	6.79	0.214	9.27	0.608
2006	Q2	15977	26.854	0.35	7902	5.61	0.688	7.35	0.987
2002	Q3	729	27.444	0.77	363	13.40	0.686	17.73	0.982
2003	Q3	15985	22.042	0.43	5780	4.04	0.504	5.33	0.940
2004	Q3	1291	28.143	0.26	571	3.90	0.615	5.13	0.969
2005	Q3	4795	24.751	0.64	2562	10.55	0.739	13.85	0.960
2006	Q3	2518	25.484	0.44	1144	6.48	0.626	8.60	0.927
2002	Q4	11343	24.442	0.56	5197	7.89	0.631	10.46	0.990
2003	Q4	2166	24.284	0.83	630	7.23	0.402	9.64	0.967
2004	Q4	1561	27.543	0.93	713	14.91	0.630	19.77	0.992
2005	Q4	9249	24.318	0.67	4603	10.22	0.687	13.49	0.992
2006	Q4	10394	25.289	0.67	5666	11.50	0.753	15.11	0.990

Table 8. Irish *Nephrops* trawlers, Celtic Sea (FU20–22). Discard rate (%) by quarter and year (for the sampled quarters: the cited percentages in bold correspond to the sampling results; those in brackets are obtained by the simulation).

year	2002	2003	2004	2005	2006	2002	2003	2004	2005	2006	2002	2003	2004	2005	2006	2002	2003	2004	2005	2006
quarter	Q1	Q1	Q1	Q1	Q1	Q2	Q2	Q2	Q2	Q2	Q3	Q3	Q3	Q3	Q3	Q4	Q4	Q4	Q4	Q4
total	7.3	26.9	15.4	35.3	41.1	2.6	37.6	11.5	21.4	29.5	1.2	41.2	10.1	11.1	19.5	9.9	26.4	2.3	54.3	7.2
		(41.6)		(24.5)	(32.4)		(29.9)	(16.5)	(28.8)	(24.1)		(40.6)	(9.0)		(15.6)		(22.9)			
males	6.6	22.1	13.7	37.9	34.5	2.5	34.0	11.1	19.3	22.9	1.3	42.2	9.3	5.2	17.0	10.9	20.7	4.3	47.0	8.0
females	8.9	75.1	18.7	34.0	56.8	2.7	40.5	11.7	22.7	32.7	1.2	40.6	11.4	40.0	20.9	6.5	59.1	0.2	71.2	3.8

It would also be interesting to re-examine the comparisons after assuming skewness of discards distributions (use of coefficient $\gamma \neq 1$ as for the French fleet). It is noticeable that for 5 quarters on 11 (Figure 19) the DLF of samples deviates from the assumed symmetry of simulations, then small sized individuals are under-estimated (however, the overestimation of the small *Nephrops* by the simulation occurs less often, but provides extremely divergent results). Although, there is no current basis for further analysis of this point because there is no evidence of any particular effect of some biological feature affecting the symmetry of distributions i.e. moulting which occurs in spring and autumn (example examined in the French fishery of the Bay of Biscay). The short time-series and the low sampling rate do not allow generalising this first overview.

Table 9. Irish *Nephrops* trawlers, Celtic Sea (FU20–22). Relationships between discarded numbers by sampling (Nobs) and by simulation (Nexp).

year/quarter		Nexp=Ψ(Nobs)	ρ^2	p(slope)	Nexp/Nobs
2003	Q1	Nexp=0.87*Nobs+84.99	0.44	0.41	194%
2005	Q1	Nexp=0.60*Nobs-2.72	0.72	0.00*	60%
2006	Q1	Nexp=0.72*Nobs-12.49	0.89	0.00*	69%
2003	Q2	Nexp=0.72*Nobs-3.87	0.84	0.00*	71%
2004	Q2	Nexp=0.94*Nobs+45.90	0.85	0.38	152%
2005	Q2	Nexp=0.78*Nobs+267.45	0.85	0.00*	148%
2006	Q2	Nexp=0.83*Nobs-39.77	0.94	0.00*	76%
2003	Q3	Nexp=0.89*Nobs+32.24	0.94	0.00*	97%
2004	Q3	Nexp=0.86*Nobs+0.92	0.97	0.00*	88%
2006	Q3	Nexp=0.80*Nobs-2.90	0.91	0.00*	77%
2003	Q4	Nexp=0.74*Nobs+5.79	0.88	0.00*	83%

Note: *=significant result (1-α=0.95).

Conclusion

The biolognical sampling onboard for *Nephrops* FU20–22 stock remains poor for both main fleets. The duration of trips for French trawlers (12–15 days) restricts possibilities of regular participation of observers. Moreover, in agreement with results of sampling design applied in 1997, the long duration of trips implies a high spatial variability of harvested areas by trip and a low total number of trips sampled by quarter. Thus, the CV of discarded numbers estimated by sampling remains high. By the way, the simulations developed on French discards are hampered by the sampling of only one year throughout a long time-series. The discard practices during the whole period may change, but there is no current possibility to test the effect of such a modification on the hand-sorting onboard. In spite of that, some discard rates by year agree overall with independent indices as EVHOE groundfish survey indices (as pointed by last year's WG) and with the most notable changes in terms of lpue during the whole time-series.

The Irish dataset takes more promising because of a shorter duration of trips. Hence, conceptual problems of sampling design inherent to the French fleet should not affect the Irish data. As the Irish fleet seems to be more recruitment directed, the indices provided by the sampling onboard should improve the diagnostic accuracy. In the meantime, the simulation based on the probabilistic approach indicated an overall consistent reconstitution of discards for more sampled quarters. Many further investigations have to be carried out in the order to validate extrapolations from French catches to Irish for the period before 2002.

B.3. Surveys

Direct *Nephrops* assessment by trawling is inappropriate because of notable diurnal variations of availability which is higher during dawn and dusk. The most adapted way is based on transect with video and TV runs of burrows (combined with hauls on area and geo-statistical analysis of catches with the aim of separating burrows of *Nephrops* from those of squat lobster), but it needs heavy preliminary arrangements because the spatial heterogeneity of resource requires to well define the survey area and the sampling plan in order to avoid biased results. The current situation will be improved in the future once a data time-series has been collected by the Irish specifically designed survey program launched in 2006. However, the Irish and French exploited areas are different. On FU20–22 the French groundfish survey EVHOE while not focusing on *Nephrops* does provide an indication of the length distributions and the strength of recruitment (Figure 20). An Irish groundfish survey giving size composition of *Nephrops* catches has also been carried out since 2003. Moreover, a UK bottom trawl survey had occurred on the same area between 1984 and 2004, but only two sampling stations were within FU20–22 area.

A comparative analysis conducted between lpue and cpue of French and Irish vessels with EVHOE indices shows a good agreement between commercial French cpue and EVHOE series for the period 1997–2005 (R^2=0.65) whilst the relationship is more sparse (R^2=0.36) when the commercial French lpue are used (Figure 21). The Irish data are not significantly linked to the French dataset probably due to the difference of harvested area and the short time-series.

The results of the UWTV survey initiated by Republic of Ireland in 2006 involving in the three first years, 2006–2008, are shown by Figures 20–25 and Tables 10–11. It is noticeable that the strongest values of this short time-series (2006) coincide with the highest level on "Smalls" as reported by Irish industry in 2007. In a timeframe of around 2–4 years, this survey should provide valuable information to tune data for the FU20–22 *Nephrops* stock especially on the "Smalls" ground where are located more than the $^2/_3$ of the total Irish yearly production. Nevertheless, the historical longer series of French landings in the Celtic Sea is less involved by the area covered by UWTV (the contribution of the rectangle 31E3 in the total French production fell from 41% in 1999 at less than 10% in 2008). This implies the necessity to tune data for the whole area.

B.4. Commercial cpue

Between 2006 and 2007, the French fishing effort declined notably by -25% and the lpue increased (+13%) although the evolution of the same indicators for the Irish fleet was different (+31% of fishing effort and +36% of lpue). It is noticeable that the decrease of the French fishing effort was caused by the reduction of the number of trips by vessel whereas the total number of vessels remained almost stable. The evolution of the Irish fishing effort involves either in increase of the fishing vessels (95 Irish trawlers were listed in 2007 against 80 for 2006) or in increase of the number of trips by vessel.

Between 2007 and 2008, the effort of the French trawlers decreased slightly i.e. 99 789 h against 101 980 h for 2007 whereas the Irish fishing effort remained stable (59 727 h against 59 899 h in 2007). Lpue of both fleets increased mainly for French trawlers (+22%: 22.6 kg/h against 18.5 kg/h for 2007) and, to a lesser degree, for Irish (+11%: 55.2 kg/h against 49.4 in 2007).

C. Historical stock development

There is no currently specific development for analytical assessment of the stock. By the WGNEPH 2003, the FU20–22 *Nephrops* stock was analytically assessed by XSA (software VPA; Darby and Flatman, 1994). Because of the lack of long and consistent Irish series (before DCR), the analysis was limited on the male component involved by French trawlers (see input parameters: Table 1).

D. Short-term projection

No short-term projection is performed for this stock.

E. Medium-term projections

No medium-term projection is performed for this stock.

F. Long-term projections

No long-term projection is performed for this stock.

G. Biological reference points

There is no biological reference point for this stock.

H. Other issues

None.

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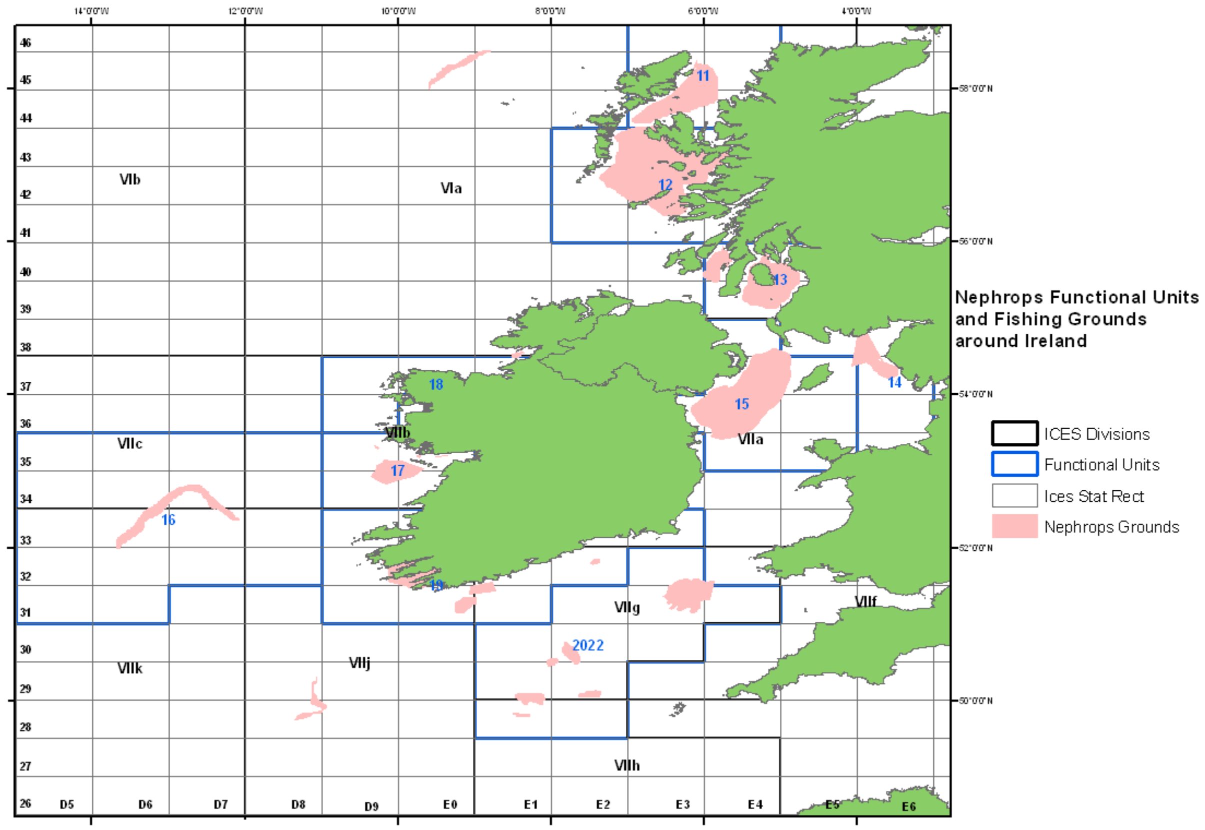


Figure 1. Functional units 20–22 (*Nephrops* grounds in Celtic Sea).

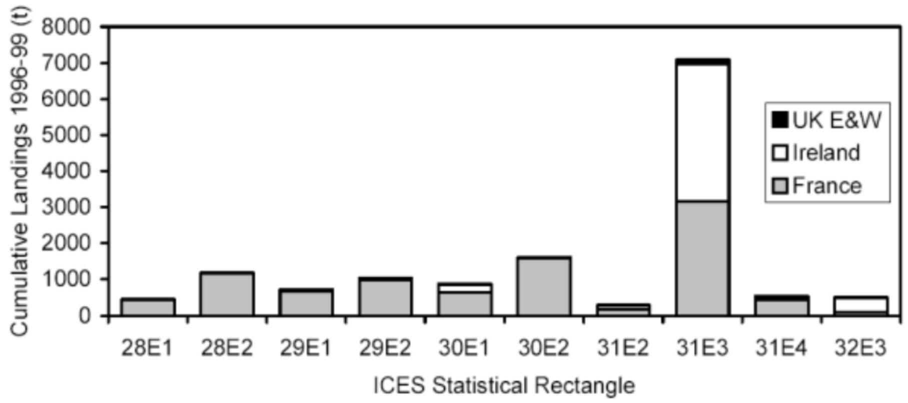
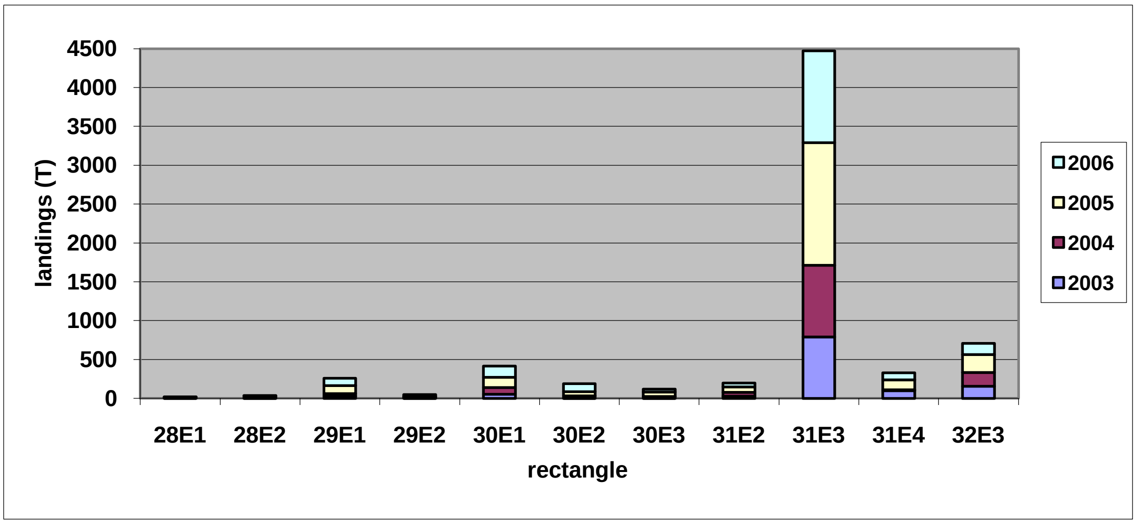


Figure 2. *Nephrops* FU20–22 (Celtic Sea). Spatial distribution of landings of the main fleets (average value of the period 1996–1999).



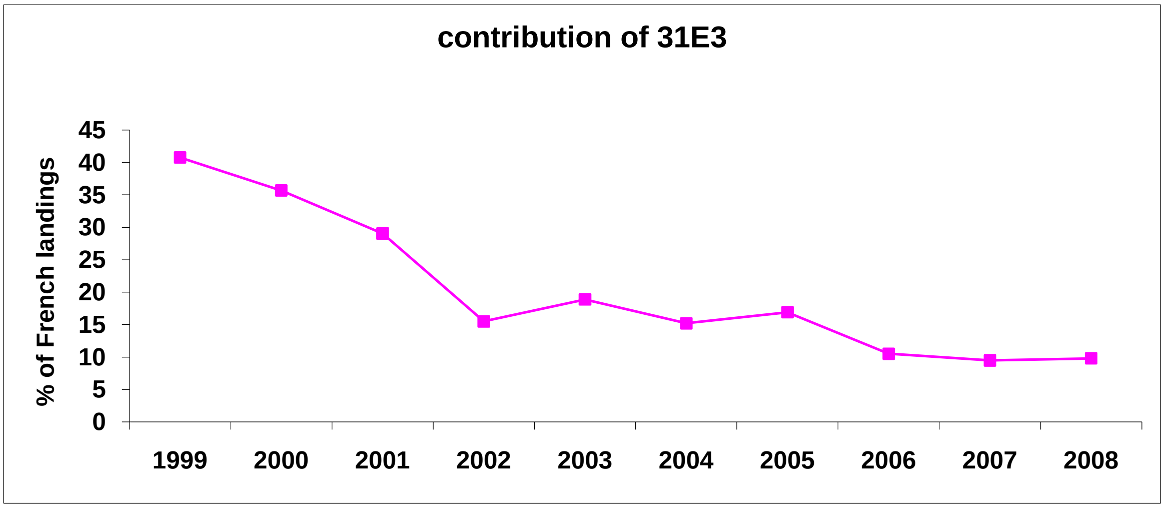


Figure 3. *Nephrops* **FU20–22 (Celtic Sea). Above: Spatial and by year distribution of Irish landings. Below: Contribution of the rectangle 31E3 (concentrating more than ²/₃ of the total Irish production) in the total French landings. Years 1999–2008.**

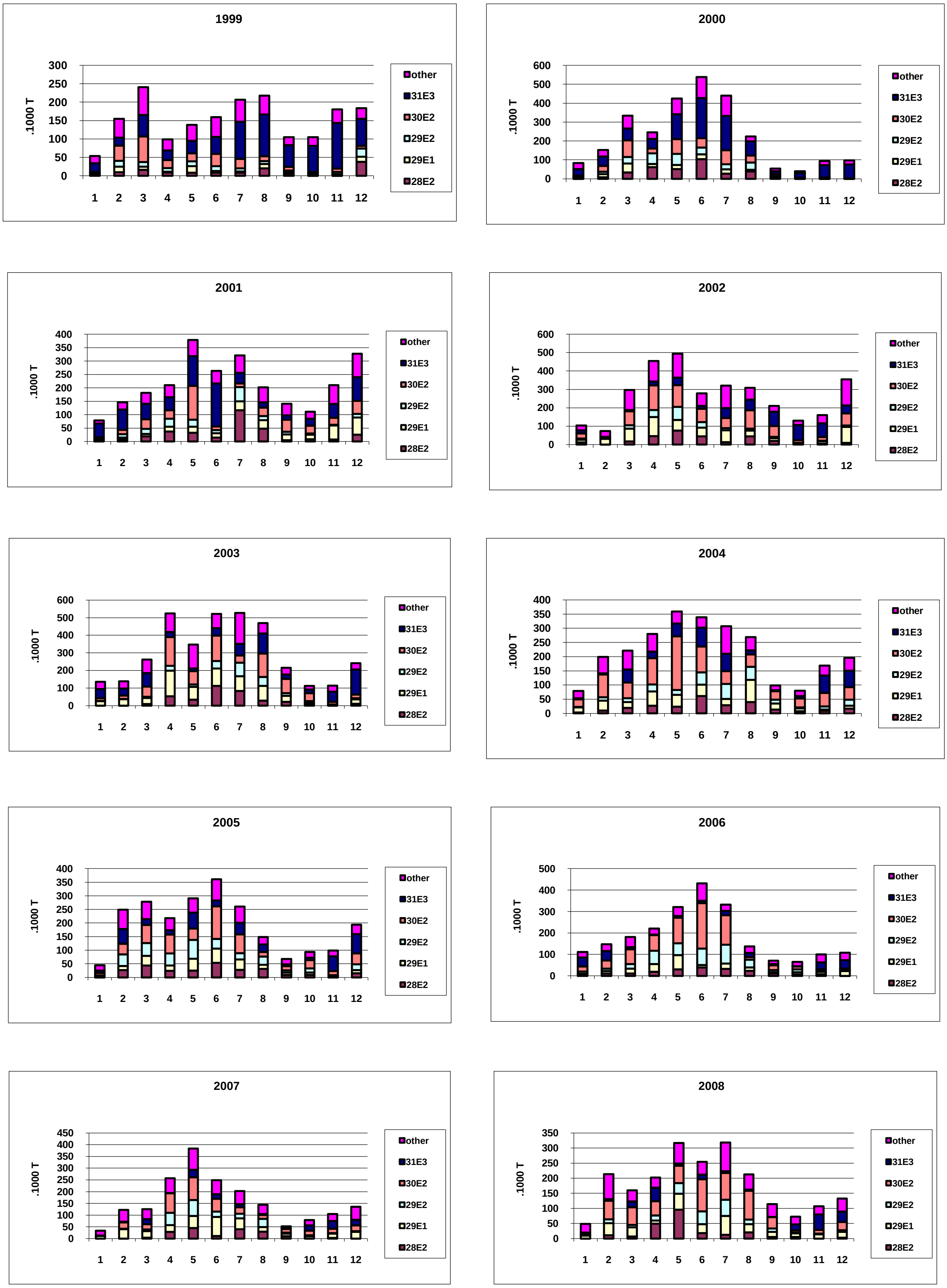


Figure 4. ***Nephrops*** **FU20–22 (Celtic Sea). Spatial and monthly distribution of French landings.**

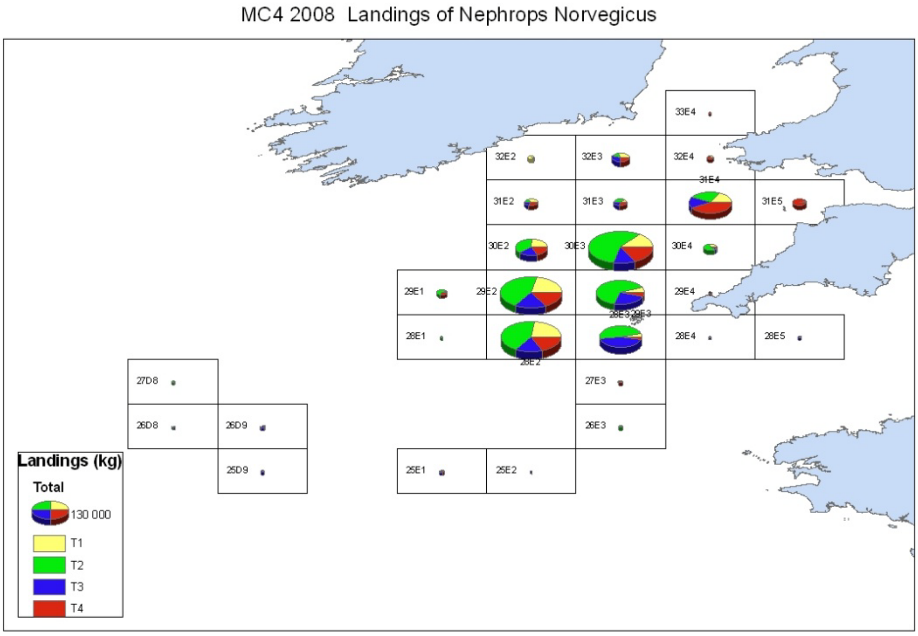


Figure 5. ***Nephrops*** **FU20–22 (Celtic Sea). Spatial distribution of French landings in 2007.**

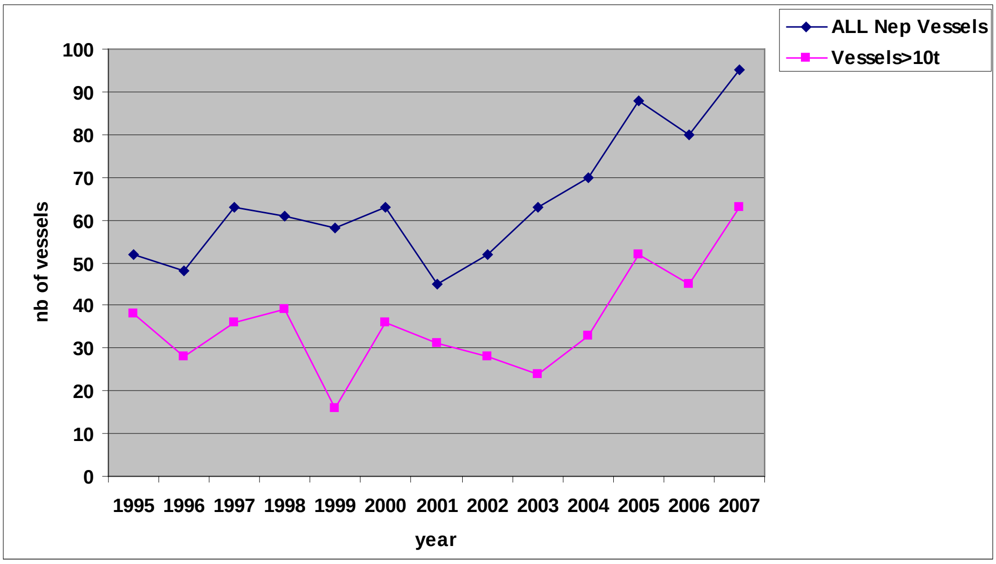


Figure 6. ***Nephrops*** **FU20–22 (Celtic Sea). Number of Irish trawlers involving** ***Nephrops*** **landings.**

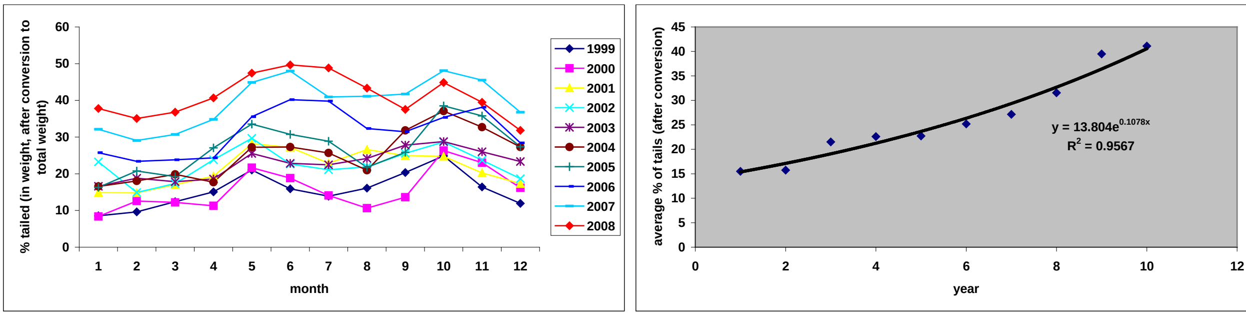


Figure 7. *Nephrops* FU20–22 (Celtic Sea). Tailed proportion (in converted weight) in landings by month (left) and by year (right).

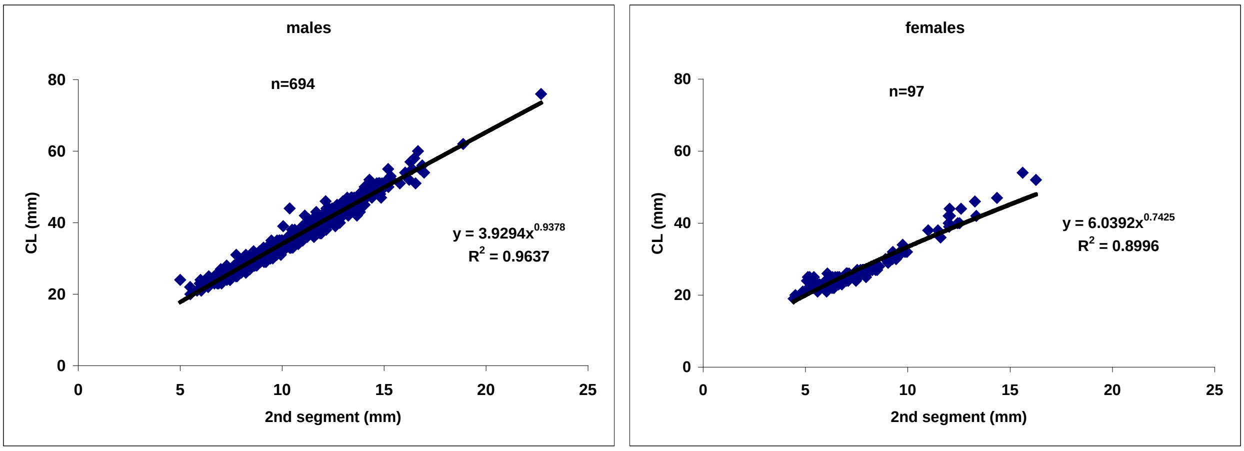


Figure 8. *Nephrops* of the Celtic Sea (VIIfgh, FU20–22). Biometric relationships (CL vs. 2nd abdominal segment by sex). Data harvested during the survey EVHOE 2007.

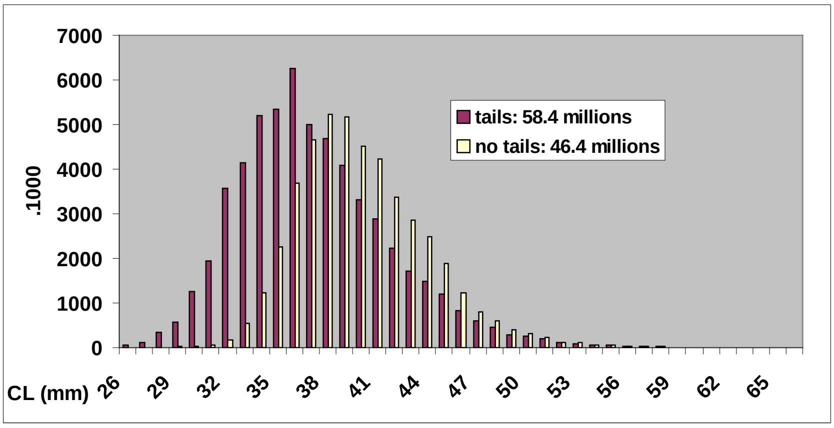


Figure 9. *Nephrops* of the Celtic Sea (VIIfgh, FU20–22). French landings for 2008. Length distributions (1) including the data on tails and (2) using the previous method (no sampling of tails; the total tailed proportion was apportioned in the smallest category of entire *Nephrops* at auction).

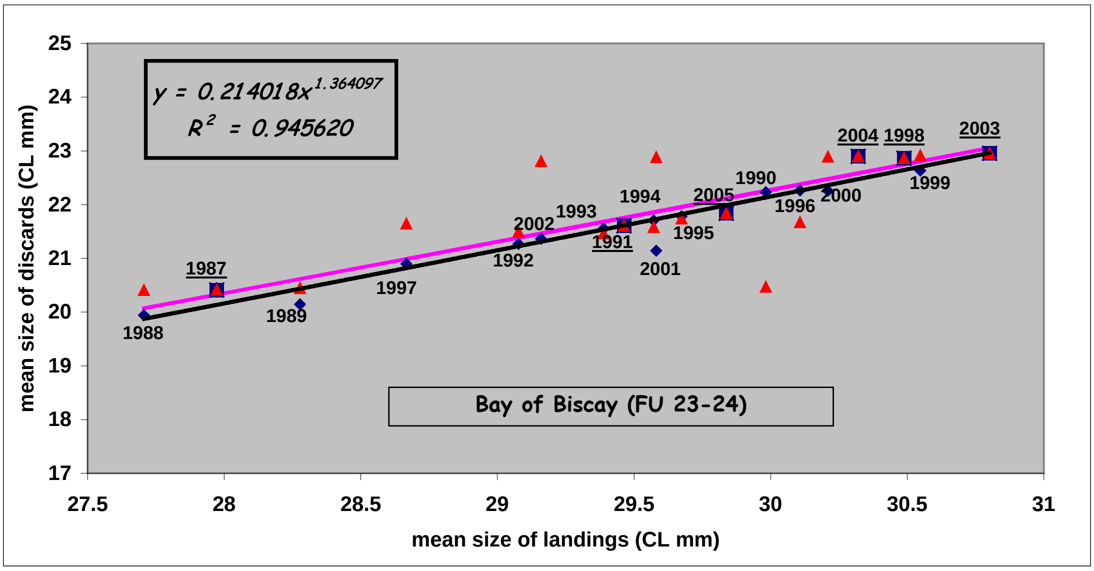


Figure 10. ***Nephrops*** **of FU23–24 (Bay of Biscay). Final results of logistic derivation of discards. Relationship between mean sizes of landings and discards. The triangular fonts represent the results of the** ***status quo*** **(proportional derivation) method. The underlined years correspond to the available datasets of sampling onboard. The rhombus fonts correspond to the logistic derivation. The dark curve is provided by the final fitting on the whole time-series. The bright curve is the result of the fitting on the years with available data.**

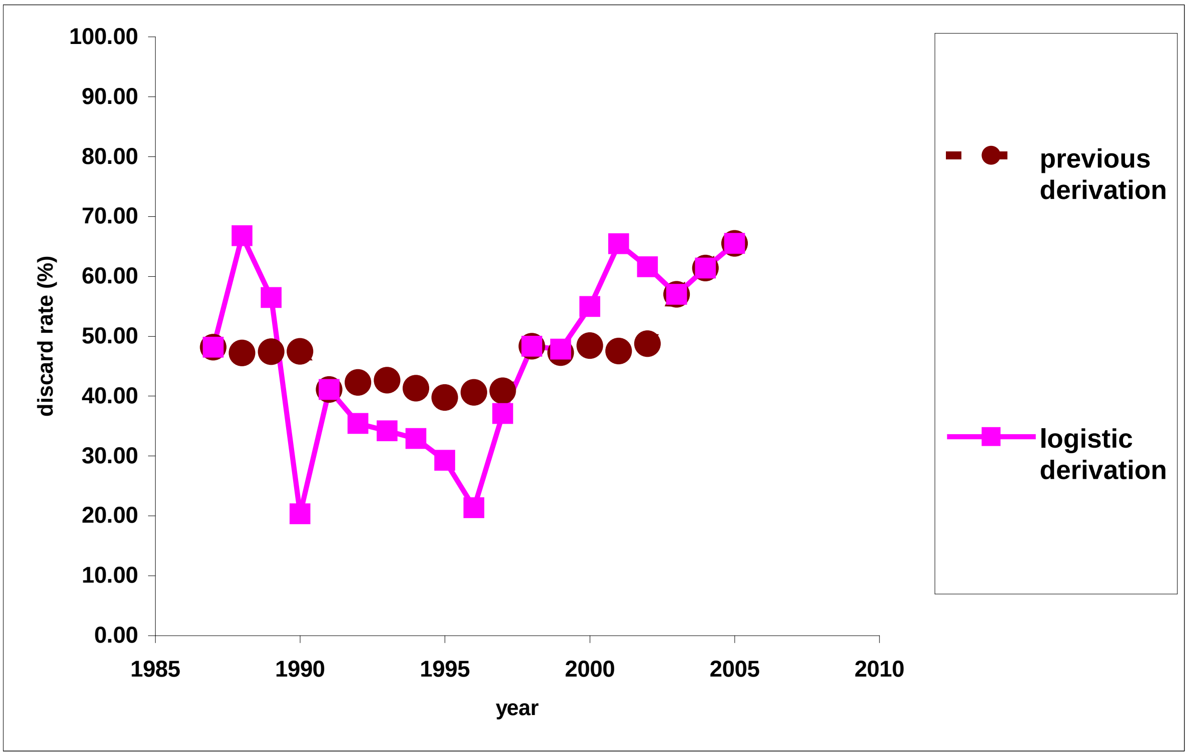


Figure 11. ***Nephrops*** **of FU23–24 (Bay of Biscay). Comparison between discard rates obtained by previous (proportional) derivation and by logistic derivation. Combined sexes and whole year datasets.**

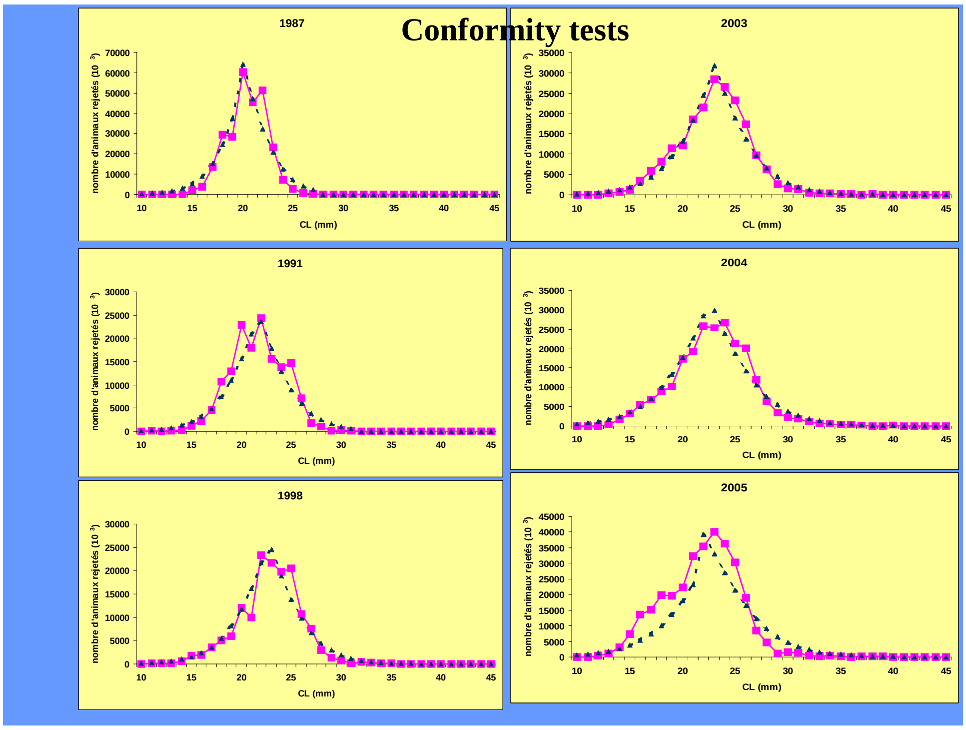


Figure 12. *Nephrops* **of FU23–24 (Bay of Biscay). Comparison between distributions of length frequencies (carapace length, CL in mm) of discards obtained by sampling and by simulation (broken lines).**

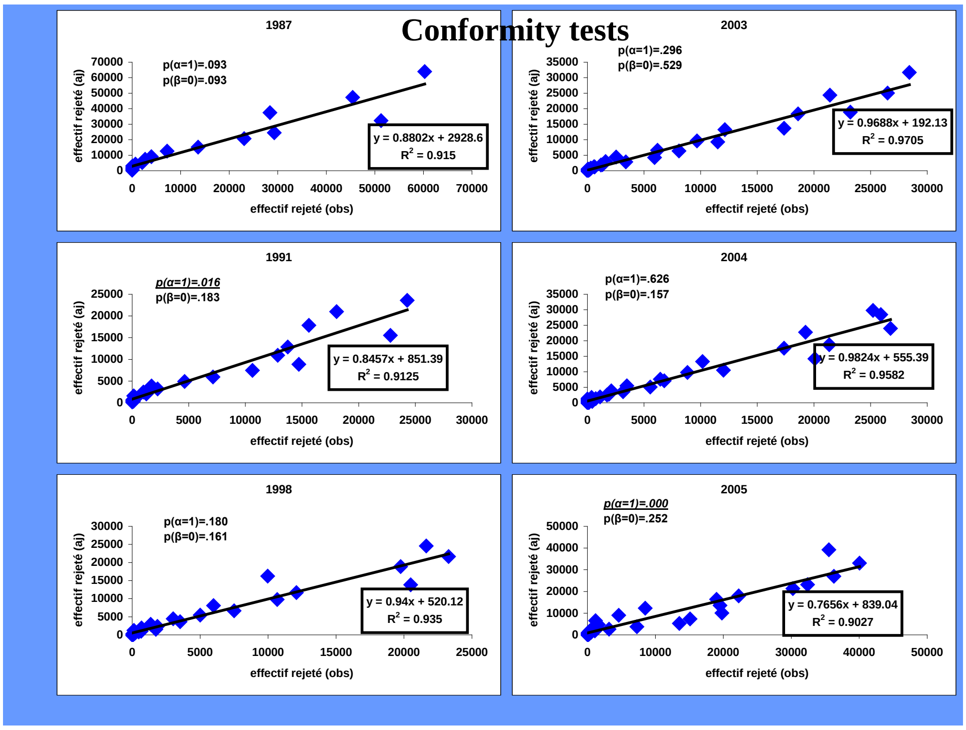
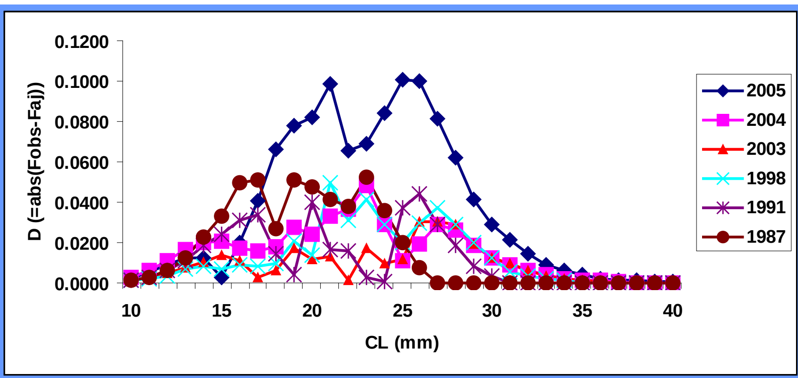


Figure 13. *Nephrops* **of FU23–24 (Bay of Biscay). Comparison between discarded numbers of individuals obtained by simulation (Y axis) and by sampling (X axis). Statistical tests on linear regressions of Y vs. X by year.**



year	Da	Dobs	%
2005	0.113	0.101	85
2004	0.127	0.048	107
2003	0.135	0.031	100
1998	0.154	0.049	106
1991	0.157	0.044	97
1987	0.115	0.052	108

Figure 14. ***Nephrops*** **of FU23–24 (Bay of Biscay). Statistical test (Kolmogorov-Smirnov) between cumulated frequencies of sampled and simulated discards by year.**

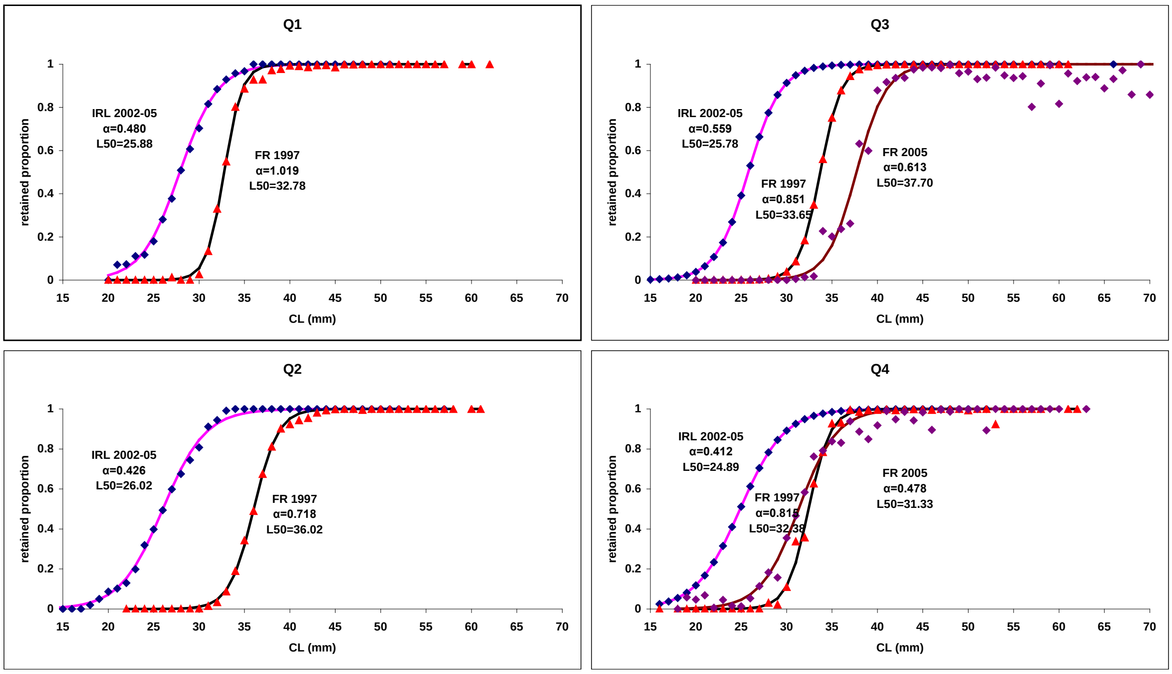


Figure 15. ***Nephrops*** **FU20–22 (Celtic Sea). Different hand-sorting logistic curves by quarter, country and dataset. In 2005 no sample was collected in France during the 1st quarter and 2nd quarter providing inconsistent results.**

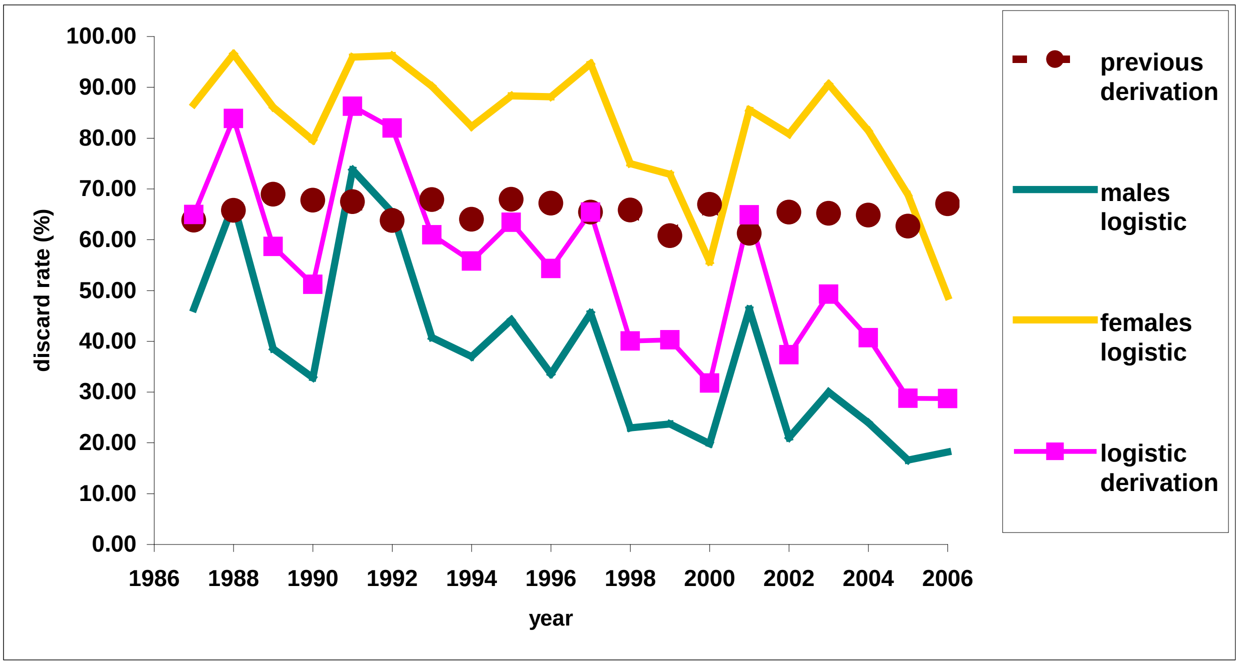
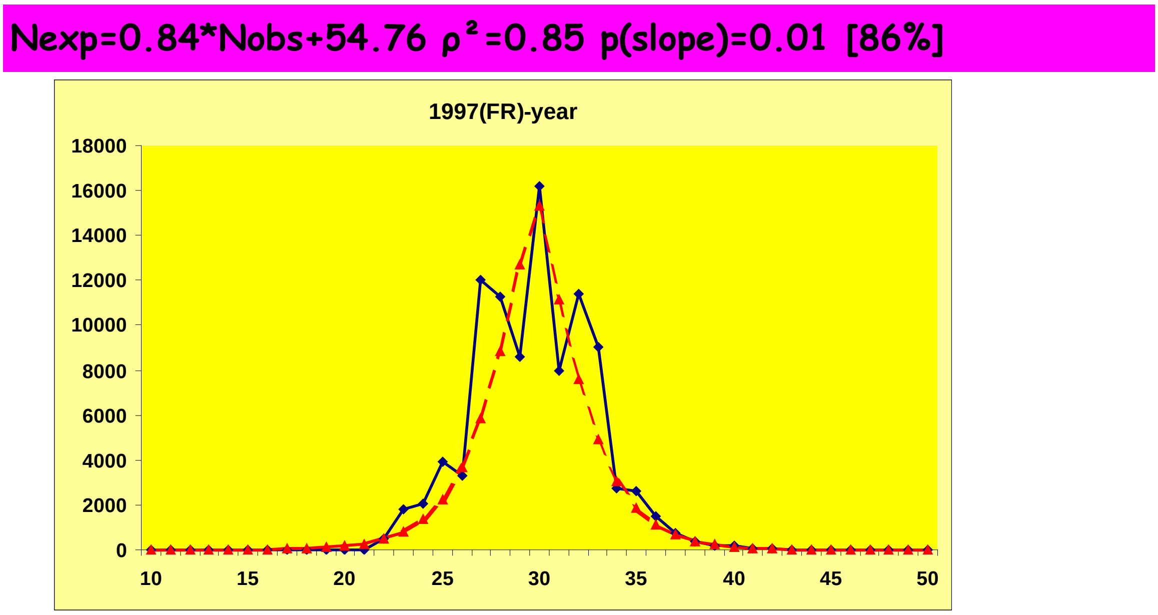


Figure 16. ***Nephrops*** **of FU20–22 (Celtic Sea). Comparison between discard rates obtained by previous (proportional) derivation (used by WGNEPH until 2004) and by logistic derivation. Combined sexes and whole year datasets.**



year	disc	Lm	CV(Lm)	α	CV(α)	β	CV(β)	ρ²
1997	83 306	29.807	1.29	32 335	9.42	0.538	6.43	0.913

Figure 17. ***Nephrops*** **of FU20–22 (Celtic Sea). French fleet. Results of the discard simulation on the year 1997. The distribution is assumed symmetrical and no constraint was set on relationship between mean sizes in discards and landings. Simulated number (Nexp) illustrated by broken line are compared to sampled one (Nobs).**

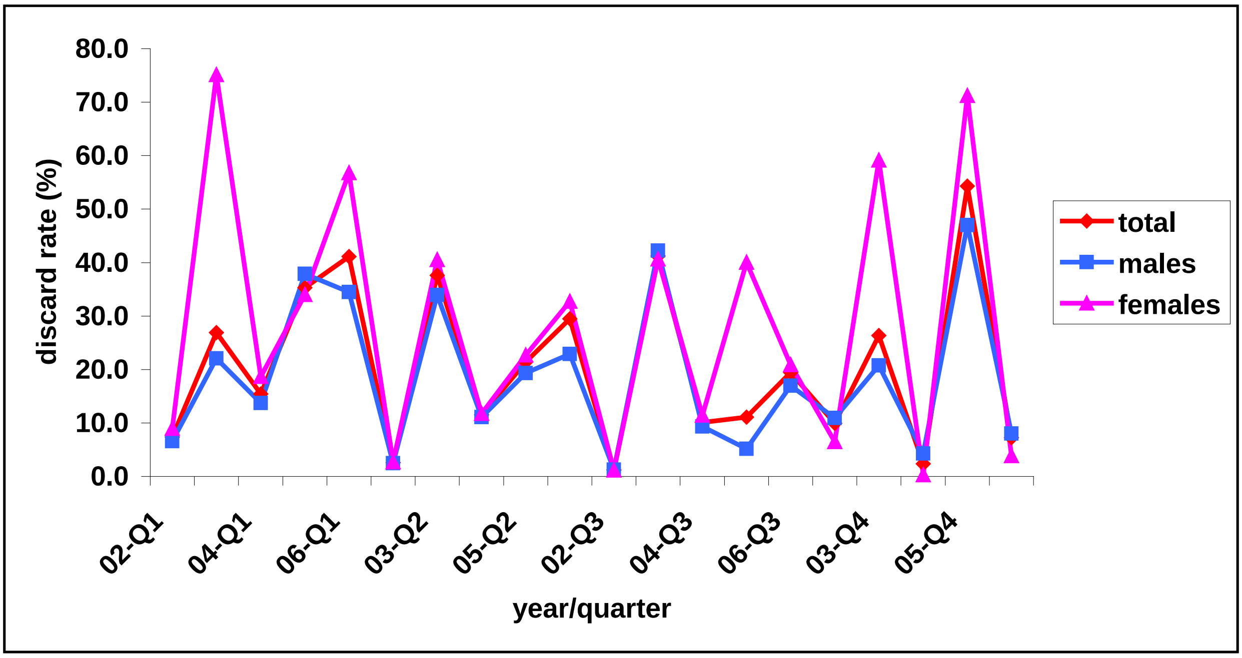


Figure 18. *Nephrops* **of FU20–22 (Celtic Sea). Discard rate (%) of Irish trawlers by year and quarter.**

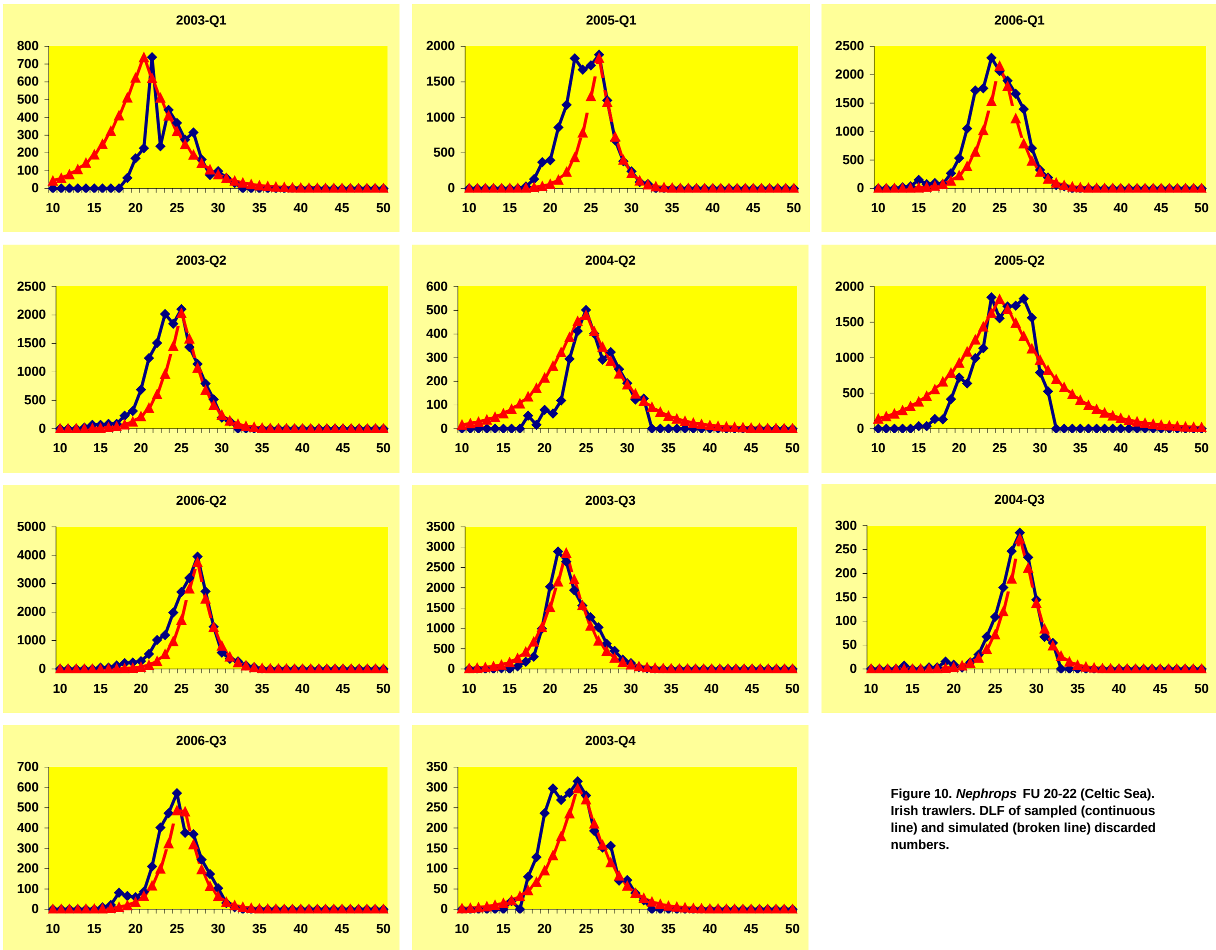


Figure 19. *Nephrops* **FU20–22 (Celtic Sea). Irish trawlers . DLF of sampled (continuous line) and simulated (broken line) discarded numbers.**

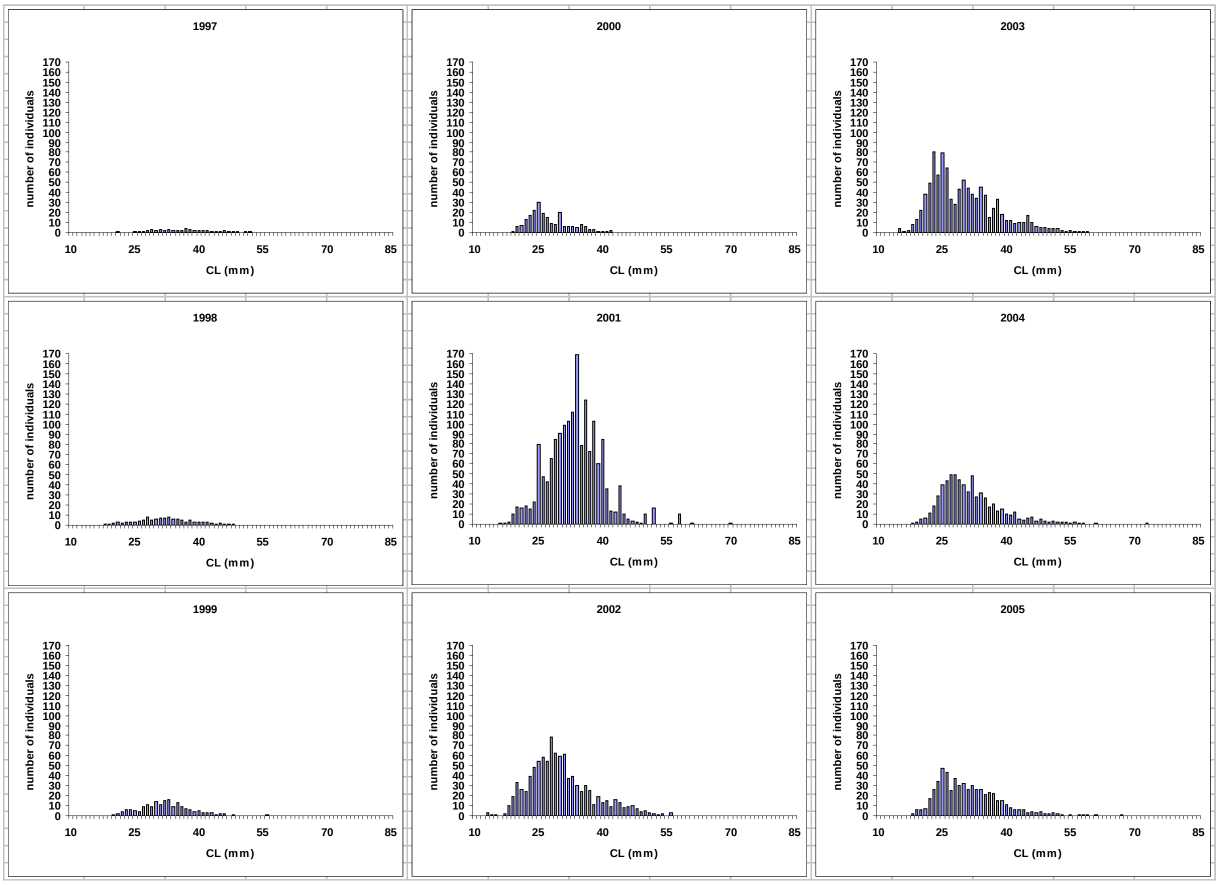


Figure 20. ***Nephrops*** **FU20–22. Indices of the French groundfish survey EVHOE.**

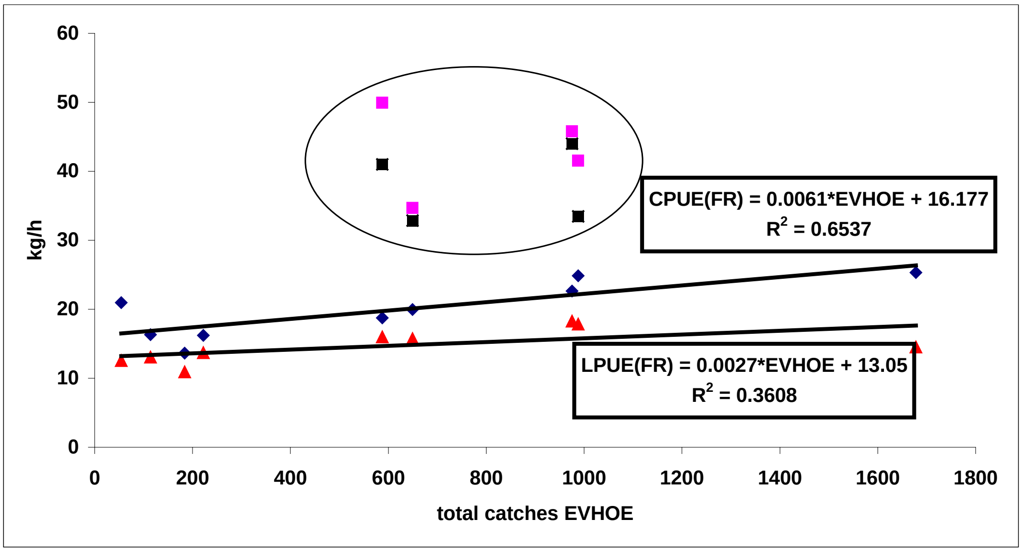


Figure 21. ***Nephrops*** **FU20–22. Comparison of indices EVHOE and of commercial lpue and cpue for French and Irish trawlers.**

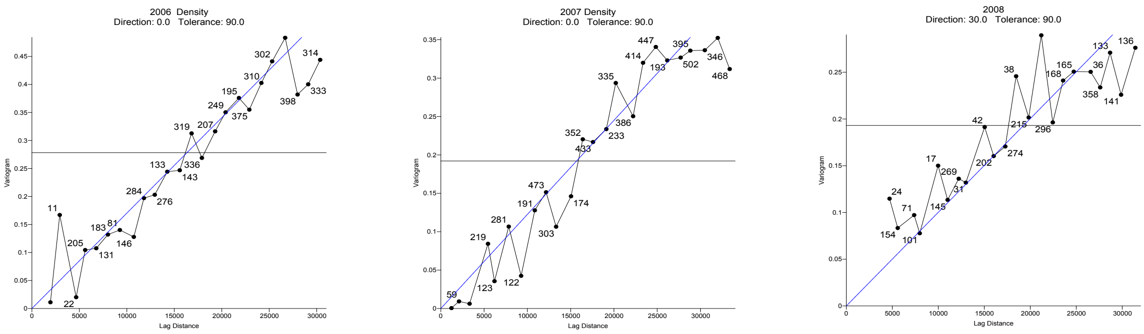


Figure 22. Omnidriectional mean variograms for the Celtic Sea FU20–22 by year from 2006–2008.

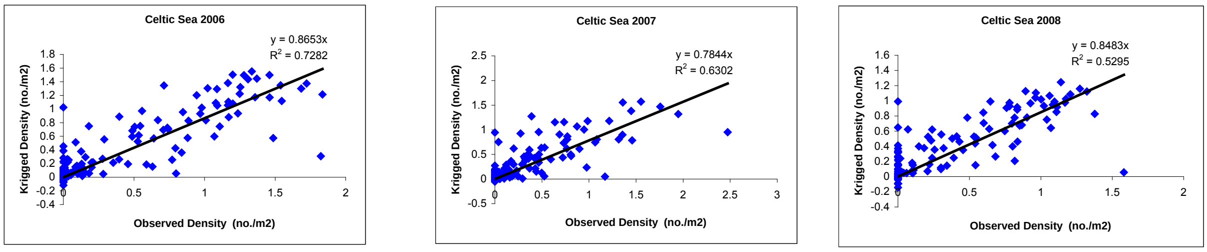


Figure 23. Cross validation plots for the Celtic Sea FU20–22 by year from 2006–2008.

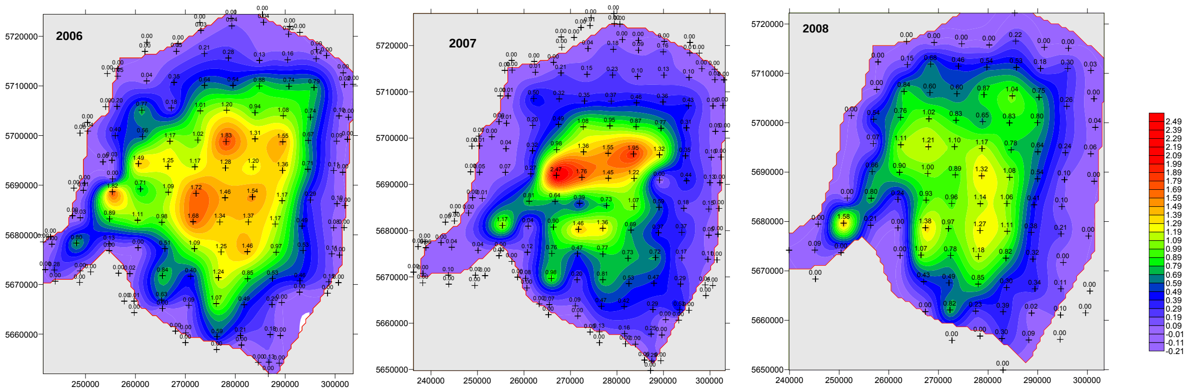


Figure 24. Contour plots of the krigged density estimates for the Celtic Sea FU20–22 by year from 2006–2008.

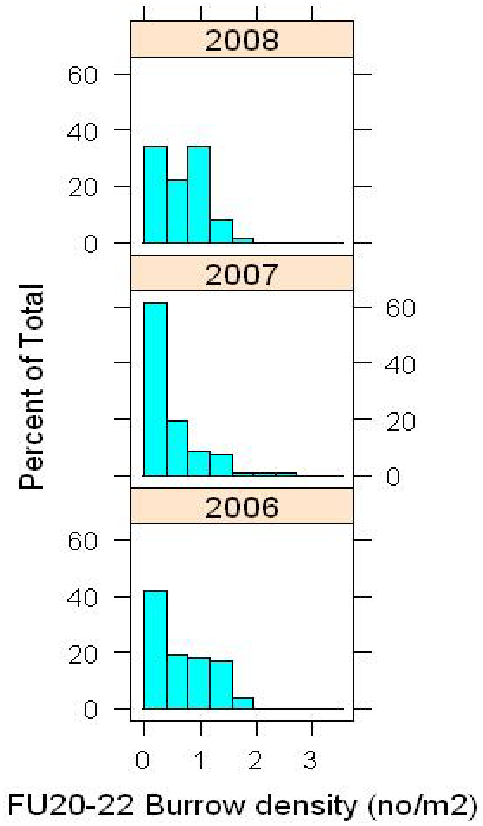


Figure 25. Burrow density distributions for the Celtic Sea FU20–22 by year from 2006–2008.

Table 10. Summary geostatistics for the *Nephrops* UWTV surveys of the Celtic Sea from 2006–2008.

Ground	Year	Number of stations	Number of boundary points	Mean Density (No./M2)	Standard Deviation	CVgeo (%)	Var	Domain Area (m2)	Raised abundance estimate (million burrows)
Smalls	2006	100	50	0.62	0.50	80%	0.25	2847	1914
Smalls	2007	107	63	0.46	0.44	96%	0.19	2915	1402
Smalls	2008	76	31	0.47	0.40	85%	0.16	2698	1448

Table 11. Summary statistics for the *Nephrops* UWTV survey indicator stations of the Labadie and Nymphe Bank and Seven Heads Grounds from 2006–2008.

Ground	Year	Number of stations	Mean Density (No./M2)*	Area Surveyed (M2)	Burrow count	Standard Deviation	95%CI	CV
	2006	9	0.42	1,322	760	0.37	0.28	29%
	2007	-	-	-	-	-	-	-
Labadie Bank	2008	-	-	-	-	-	-	-
	2006	2	0.27	195	89	0.39	3.47	100%
	2007	-	-	-	-	-	-	-
Nymphe Bank	2008	-	-	-	-	-	-	-
	2006	7	0.23	995	293	0.25	0.23	41%
	2007	-	-	-	-	-	-	-
Seven Heads	2008	-	-	-	-	-	-	-

*random stratified estimates are given for the Labadie Bank, Nymphe Bank and Seven Heads grou

- Area not surveyed in 2007 to 2008 due to weather

Stock Annex 7.10: Plaice in VIIfg

- Stock Annex 7.10 Plaice VIIfg for latest update see WGCSE 2009, Annex 07.10 Plaice VIIfg

Stock Annex 7.13: Sole in VIIfg

- Stock Annex 7.13 Sole VIIfg for latest update see WGCSE 2009, Annex 07.13 Sole VIIfg

Stock Annex 7.15: Whiting VIIe–k

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Whiting VIIe–k
Working Group	Celtic Sea Eco-region
Date	17 May 2010
Revised by	Sarah Davie

A. General

A.1. Stock definition

The degree of separation of whiting stocks between the Irish Sea, and ICES Divisions VIIb–c from the Celtic Sea, is currently unclear. SAMFISH (EU Study Contract 99-009, Improving sampling of western and southern European Atlantic Fisheries) described the stock unit as follows:

The main spawning areas of whiting in the Western Channel and Celtic Sea are off Start Point, off Trevose Head and southeast of Ireland. The spawning season is from February to May, and the larvae are found in mid-water before moving to live near the seabed by September. For the next two years, juvenile whiting are found in shallow coastal and estuarine areas, being particularly abundant around Start Point. Nearly 4000 adult whiting were tagged and released off Start Point during August 1958 and 1960. Most returns were within three months of release and demonstrated little indication of movement. Subsequent recaptures indicated more movement of whiting into the Celtic Sea than between the western and eastern Channel. Whiting released in summer between 1957 and 1961 near Carmarthen Bay moved south and west towards the two spawning grounds off Trevose and southeast of Ireland. There was no evidence of emigration out of the Celtic Sea area. Returns of whiting tagged and released in the County Down spawning area in the Irish Sea demonstrate more movement south into the Celtic Sea than north to the west of Scotland.

A.2. Fishery

Whiting in Divisions VIIe–k are taken as a component of catches in mixed trawl fisheries. Whiting landings through the mid 1980s totalled between 10 000 t and 15 000 t, through the mid to late 1990s landings were elevated to around 20 000 t. Since the turn of the century, landings have been in decline and are now below 10 000 t. Through the 1980s and early 1990s France accounted for around 60–85% of landings. While Ireland accounted for between 10% and 20% of landings, the UK 10%, and Belgium had minimal contribution (1–2%). Landings from both the UK and Belgium have remained at similar levels over time. Since the early 1990s Ireland has accounted for a greater proportion of landings. Proportions since 2004 have been similar to France whose landings have been falling since the turn of the century.

French landings are made mainly by gadoid trawlers, which prior to 1980 were mainly fishing for hake in the Celtic Sea. Irish demersal trawlers from Dunmore East and Castletownbere and other ports in southwest Ireland have traditionally targeted Celtic Sea whiting in a mixed trawl fishery. In response to poor catches in other areas vessels have been attracted into this fishery in recent years from County Donegal.

A detailed description of the Irish fishery is given in the annual WD to WGSSDS: 'A summary of the Irish Fishery and Sampling of Whiting in VIIe–k'.

A.3. Ecosystem aspects

No relevant information has been made available to the Working Group.

B. Data

B.1. Commercial catch

Data on international landings-at-age and mean weight-at-age are available for Irish, French and UK fleets from 1999 to present. The following procedures have been applied to aggregate the data for the areas VIIe, VIIfgh and VIIj,k and build the database for VIIe–k. UK VIIe–k data were used to scale catch numbers according to the landings for each area. French VIIf,g,h data were used with Irish VIIg data to scale VIIf,g,h catch numbers. Irish VIIj data were used to scale VIIj,k catch numbers. The Table below demonstrates the data available and the procedures used to derive quarterly length compositions, age compositions and mean weights-at-age.

		Data source:				
Division	Data	UK	France	Ireland	Belgium /Other	Derivation of international landings:
VII e	Length composition	VIIe–k				
	ALK	VIIe–k				
	Age Composition	VIIe–k				UK raised
	Mean weight-at-age	VIIe–k				UK VIIe–k
	Landings	VIIe	VIIe	VIIe	VIIe	
VII f,g,h	Length composition	VIIe–k	VIIf,g,h	VIIg		
	ALK	VIIe–k	VIIf,g,h	VIIg		
	Age Composition	VIIe–k	VIIf,g,h	VIIg		(UK + FR+ IRL) raised to international landings
	Mean weight-at-age	VIIe–k	VIIf,g,h	VIIg		Weighted mean by numbers caught
	Landings	VIIf,g,h	VIIf,g,h	VIIf,g,h	VIIf,g,h	
VII j,k	Length composition			VIIj		
	ALK			VIIj		
	Age Composition			VIIj		IRL raised
	Mean weight-at-age			VIIj		IRL VIIj
	Landings	VIIj,k	VIIj,k	VIIj,k	VIIj,k	
VII e,f,g,h,j,k	Length composition					
	ALK					
	Age Composition					VIIe + VII fgh + VIIjk
	Mean weight-at-age					Weighted mean by numbers caught
	Landings					VIIe + VII fgh + VIIjk

B.2. Biological

Age group 0 is included in the assessment data to allow inclusion of 0-group indices in the XSA, although in most years, no landings are recorded. Very small landings of 0-group whiting were not included in the catch-at-age datafile to avoid spurious F-shrinkage effects at this age. Mean weights-at-age in the catch were derived by combining French, Irish and English data, weighted by the numbers landed at-age.

Mean weight-at-age in the stock are taken as mean weights-at-age in the quarter 1 catch. Where age 1 was poorly represented in quarter 1 landings, quarter 2 values were used as estimates of mean weight-at-age 1 in the stock. Stock weights-at-age are smoothed using a three year rolling average across ages to dampen the noise exhibited by the stock weight dataset. This approach is also used in Irish Sea whiting and Celtic Sea haddock.

Natural mortality is assumed to be 0.2 over all age groups and years.

Maturity data collected in the Celtic Sea in November 2002 during the French EVHOE survey were presented to the WG (Working Document 1: WGSSDS 2003). Results indicated 13% of age 1 fish are mature, 97% at-age 2, and 100% at-age 3 and older. These results are similar to previous assumptions of knife-edged maturity at-age 2. Exploratory analyses indicated that use of the French maturity ogive made little impact on the assessment. The WG therefore retained the assumptions of knife-edged maturity at-age 2. Since 2006 the knife edge maturity ogive has been replaced with indices calculated based on data from the UK WCGFS (Working Document 3: WGSSDS 2006) but a fixed vector is still used. Maturity sampling by Ireland and the UK on dedicated surveys confirms the use of this ogive but is insufficient to provide annual data.

The proportions of F and M before spawning were both set to zero to reflect the SSB calculation date of 1 January.

The knife edge maturity ogive was replaced with new indices calculated based on data from the UK WCGFS as detailed in WD 3, WGSSDS, 2006.

Age	0	1	2	3	4	5+
Maturity	0	0.39	0.90	0.99	0.99	1.00

B.3. Surveys

The following surveys are available as survey tuning data input for the assessment of whiting VIIe–k:

- UK-WCGFS, 1987–2004

  The March UK groundfish survey was extended in 1992 to provide better coverage for gadoids in VIIf,g. The whiting tuning data calculated from this survey is for VIIf,g. The survey was carried out on the RV Cirolana until 2003. In 2004 it was carried out on the RV Endeavour and discontinued thereafter. The survey fished fixed station positions allocated by area and depth strata. The survey used a modified Portuguese High-Headline trawl (PHHT) with 350 mm rubber bobbins, a bunt tickler chain and a 20 mm codend liner. The mean log standardized index by year demonstrated some evidence of positive catchability in the last three years of the survey (2002–2004) and cohort tracking in the mean standardized index up to then was very noisy in the last three years. These years were not included in the final assessment.

- UK-BCCSBTS-S, 1988–2001

  The Autumn UK Bristol Channel beam trawl survey (VIIf) is commercially rigged (1989 style) with 4 m beam trawl fitted with a chain mat, flip-up ropes, and a 40 mm codend liner. The gear is towed at 4 knots (ground speed) for 30 minutes. This survey provides information for age 0 and age 1 whiting.

- FR-EVHOE, 1997–present

This fourth-quarter annual groundfish is carried out on the RV Thalassa. Age data are available from 2001 onwards. The sampling design is a stratified random allocation. The number of hauls per stratum is optimized by a Neyman allocation taking into account the most important commercial species in the area (hake, monkfish and megrim). The fishing gear used is a GOV with an average vertical opening of 4 m and a horizontal opening of 20 m.

- IR-WCGFS, 1993–2002

The fourth-quarter Irish west-coast groundfish survey (WCGFS) was carried out in VIaS and VIIbj on chartered commercial vessels. The sampling design attempted to allocate at least two stations per rectangle. Stations were selected randomly within each rectangle from known clear tow positions. A Rockhopper GOV with 12 inch discs was used. The nets were fitted with a 20 mm codend liner. This survey was discontinued after the 2002 survey, giving way to a new Irish groundfish survey on board the RV *Celtic Explorer*.

- IR-ISCSGFS, 1997–2002

Ireland commenced a Celtic Sea research vessel survey on board the RV *Celtic Voyager* in 1997 carried out in VIIa and VIIg. The survey used a GOV Trawl with a mean vertical opening is 6 m and door spread 48 m. Data from this survey (IR-ISCSGFS) were presented for the first time to the 2003 WG. The data made available were from prime stations only in a limited area of Division VIIg. The survey was discontinued after the 2002 survey, giving way to a new Irish groundfish survey on board the RV *Celtic Explorer*.

- IR-GFS 7g and j, 2003–present

Ireland commenced a new fourth quarter survey in 2003 on board the RV *Celtic Explorer* which covers VIaS, VIIbgj as part of the internationally coordinated, Quarter 4 IBTS survey program. The IGFS has a random stratified design and uses a GOV (with rock-hopper in VIa) with a 20 mm codend liner. This is a substantially different design to the Irish Sea/Celtic Sea groundfish survey (IR-ISCSGFS) it replaces. Data from this survey (IR-GFS) were presented for the first time to the 2004 WG.

- IR-IGFS Swept Area, 1999–present

This survey index constitutes a combination of the IR-ISCSGFS and IR-GFS surveys in the area of overlap between them (VIIg). The two surveys were standardized using a swept-area estimate of catches, described in WD 5 (WGSSDS 2006). This survey was presented for the first time to the 2006 WG. The mean standardized index by year demonstrated good tracking of the strong 1999 year class to age 7 with the exception of age 4 in 2003. Although the source data were checked, this is probably an anomaly of the year effect in 2003. This point has been removed from recent assessments to ensure the survey gets higher scaled weight in further runs. This compromise is not ideal but given the short time-series of the survey and apparently good performance otherwise the WG considered that the survey should be a good index for this stock.

B.4. Commercial cpue

Information on effort, and whiting landings and lpue are available from a number of commercial fleets. This includes two French (gadoid and *Nephrops* directed) since 1983, four Irish (VIIj, and VIIg otter trawlers, and Scottish seines) since 1995, in addition to effort only from UK England and Wales VIIe–k beam trawlers and VIIe–k otter trawlers since 1983.

Across the majority of commercial fleets lpue has fallen over time, as is the case with landings. In the mid 1990s at the start of the Irish Scottish seine dataseries lpue was high, falling steeply over several years. Lpue continues to remain at these lower levels with some annual fluctuation. In relation to otter trawlers, the French gadoid directed fleet consistently revealed the highest lpue. This too has declined over the period of data available to levels half those of the early 1980s. The Irish VIIg otter trawl fleet is the only one to demonstrate an overall increasing lpue trend although the increase has been relatively small.

B.5. Other relevant data

No other relevant data to report.

C. Historical stock development

Data screening: Exploratory data analysis carried out using FLR. A separable VPA was performed using the Lowestoft VPA95 software to screen for outliers in the catch numbers.

Model used: XSA

Software used: FLR under R version 2.4.1 in conjunction with FLCore 1.4–3, FLAssess 1.4.1, FLXSA 1.4–2 and FLEDA 1.4–2

Lowestoft VPA95 software also for XSA and separable VPA

Model Options:

Option	Setting
Ages catch dep stock size	None
Q plateau	5
Taper	No
F shrinkage SE	1.00
F shrinkage year range	5
F shrinkage age range	3
Fleet SE threshold	0.50
Prior weights	No

Input data types and characteristics:

Type	Name	Year range	Age range	Variable year to year
Caton	Catch in tonnes	1982–current	0–7+	Yes
Canum	Catch-at-age in numbers	1982–current	0–7+	Yes
Weca	Weight-at-age in the commercial catch	1982–current	0–7+	Yes
West	Weight-at-age of the stock at spawning time	1982–current	0–7+	Yes:
Mprop	Proportion of natural mortality before spawning	1982–current	0–7+	No
Fprop	Proportion of fishing mortality before spawning	1982–current	0–7+	No
Matprop	Proportion mature-at-age	1982–current	0–7+	No
Natmor	Natural mortality	1982–current	0–7+	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	FR-Gadoid Late	1993–current	3–6
Tuning fleet 2	FR-*Nephrops*	1993–current	3–6
Tuning fleet 3	FR-EVHOE	1997–current	0–4
Tuning fleet 4	UK-WCGFS	1987–current	1–6
Tuning fleet 5	IR-IGFS Swept area	1999–current	0–6

Settings for each assessment since 1999 are detailed in Table 1. Trial runs have, over the years, explored most of the options with regards XSA settings. This stock has not had a benchmark assessment, however exploratory assessments have been carried out within the WGSSDS up until 2007.

D. Short-term projection

Model used: Multi Fleet Deterministic Projection

Software used: MFDP1a

Initial stock size: initial stock numbers derived from XSA analyses. Numbers-at-age 0 are not considered to be well estimated and are replaced with a geometric mean of the full time-series (1982–2007). Recruitment has been at a low level since 1995 with the exception of the 1999 year class. The two most recent years have displayed good recruitment, with last year's being revised downward. Recruitment is solely estimated from the FR-EVHOE and IR-GFS7gSweptArea surveys, in recent years the French survey estimates have been far higher than those of the Irish survey. Because of these reasons the geometric mean is used.

Natural mortality: That used in the assessment

Maturity: Maturity ogive used in the assessment

F and M before spawning: Those used in the assessment method

Weight-at-age in the stock: Unscaled 3 year arithmetic mean

Weight-at-age in the catch: Unscaled 3 year arithmetic mean

Exploitation pattern: Unscaled 3 year arithmetic mean (though alternative options may be used depending on recent F trajectories and the Working Group's perception of the fishery).

Intermediate year assumptions: *Status quo* F

Stock–recruitment model used: Geometric mean of full time-series (1982 to present-1) for age 0 recruitment

F_{bar}: That used in the assessment

E. Medium-term projections

None.

F. Long-term projections

Model used: Multi Fleet Yield-per-recruit

Software used: MFYPR2a

Yield-per-recruit calculations are conducted using the same input values as those used for the short-term forecasts.

G. Biological reference points

A summary of reference point proposals to date, their technical basis and currently adopted reference points is given in the text Table below:

	WG 1998	ACFM 1998	WG 2000	ACFM 2000
$\mathbf{F_{lim}}$	No Proposal	No Proposal	1.18 (Flim=Floss)	No Proposal
$\mathbf{F_{pa}}$	No Proposal	No Proposal	0.72 ($\mathbf{F_{pa}}$=$\mathbf{F_{lim}}$ x $e^{-1.645 \times 0.3}$)	No Proposal
$\mathbf{B_{lim}}$	15,000 t	15,000 t	15 000 t (Blim=Bloss)	15,000 t (Blim=Bloss)
$\mathbf{B_{pa}}$	18,000 t	21,000 t	21 000 t (Bpa=Bloss x 1.4)	21,000 t (Bpa=Bloss x 1.4)

The technical basis of ACFM's 1998 B_{pa} proposal is given below (1999 WG text):

B_{pa} = B_{lim} x 1.4 = 21 000 t. In the past the WG have selected MBAL as 18 000 t based on evidence of reduced recruitment at SSB's <18 000 t. However this MBAL is driven by a period of low recruitments at low SSB in the earlier years of the time-series (1982–1985) when the data are probably not reliable. Examination of the stock–recruit plot provides no compelling evidence of reduced recruitment below SSB of 18 000 t.

The technical basis of the WG's 2000 F_{lim} and F_{pa} proposals are given below:

On the basis of results obtained from a LOWESS fitted non-parametric stock and recruitment relationship and the derived equilibrium SSB and yield curves with the original data trajectories the 2000 Working Group considered that F_{pa} and F_{lim} could be defined because F_{loss} appeared reasonably estimated. However, taking into account the uncertainties in the data the 2000 Working Group decided to use 0.3 as the SE in calculation of F_{pa} from F_{loss}. The technical basis for the proposed reference points are defined below:

$F_{lim} = F_{loss}$ (1.18 in this year's assessment)
$F_{pa} = F_{lim}$ x e-1.645*0.3 = 0.72

The currently adopted reference points are as follows:

	Current Reference Points
F_{lim}	No Proposal
F_{pa}	No Proposal
B_{lim}	15,000 t ($B_{LIM} = B_{LOSS\ 1983}$, $ACFM_{1998}$)
B_{pa}	21,000 t ($B_{PA} = B_{LOSS\ 1983}$ x 1.4)

H. Other issues

No other issues.

I. References

Table 1. Model settings/Input data/Tuning data.

		1999	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***
Catch date range:	***Years***	82-98	82-99	82-00	82-01	82-02	82-03	82-04	82-05	82-06	82-07	82-08
	Ages	1-7+	0-7+	0-7+	0-7+	0-7+	0-7+	0-7+	0-7+	0-7+	0-7+	0-7+
Assmnt Method:		XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA	XSA
Fbar Age Range:		2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5
Time taper:		No	No	No	No	No	No	No	No	No	No	No
Q plateau age:		4	4	4	4	4	4	4	4	5	5	5
F shrinkage S.E:		0.8	2.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1	1
	Num yrs	5	5	5	5	5	5	5	5	5	5	5
	Num ages	3	3	3	3	3	3	3	3	3	3	3
Fleet S.E:		0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5
Commercial Tuning Fleets:												
FR-Gadoid	*Yrs*	89-98	90-99	93-00	82-92	82-92	82-92	83-92	83-05			
	Ages	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6			
FR-Gadoid Late	*Yrs*				93-01	93-02	93-03	93-04		93-06	93-07	93-08
	Ages				3-6	3-6	3-6	3-6		3-6	3-6	3-6
FR-Nephrops	*Yrs*	89-98	90-98	93-00	93-01	87-02	87-03	87-04	87-05	93-06	93-07	93-08
	Ages	2-6	4-6	2-6	2-6	2-6	2-6	2-6	3-6	3-6	3-6	3-6
IR-7g&j-OT	*Yrs*			95-00	95-01	95-02	95-03	95-04	95-05			
	Ages			1-6	1-4	1-4	1-4	1-4	3-4			
Survey Tuning series:												
FR-EVHOE	*Yrs*			97-00	97-01	97-02	97-03	97-04	97-05	97-06	97-07	97-08
	Ages			0-4	0-4	0-4	0-4	0-4	0-4	0-4	0-4	0-4
UK-WCGFS	*Yrs*	92-98	92-99	93-00	92-01	92-02	92-03	92-04	92-04	87-01	87-01	87-01
	Ages	1-6	1-6	2-6	2-4	2-4	2-4	2-4	1-6	1-6	1-6	1-6
UK-BCCSBTS	*Yrs*	89-98	90-99	89-00	89-01	89-02	89-03	89-04	89-05			
	Ages	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1			
IR WCGFS	*Yrs*			93-00								
	Ages			1-1								
IR-IGFS Swept area	*Yrs*								99-05	99-06	99-07	99-08
	Ages								0-6	0-6	0-6	0-6

Stock Annex 8.2: Plaice in VIIe

- Stock Annex 8.2 Plaice VIIe: for latest update see WGCSE 2009, Annex 08.2 Plaice VIIe

Stock Annex 8.3: Sole in VIIe

- Stock Annex 8.3 Sole VIIe: for latest update see WGCSE 2009, Annex 08.3 Sole VIIe