REPORT OF THE

NORTH-WESTERN WORKING GROUP

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PARTS 1 AND 2

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1.2 Terms of Reference

The North Western Working Group (Chair: J. Boje, Denmark) met at ICES Headquarters from 26 April to 4 May 2000 to:

a) assess the status of and provide catch options for 2001 for the stocks of oceanic redfish in Sub-areas V, XII and XIV, Greenland halibut in Sub-areas V and XIV; cod in Sub-area XIV, NAFO Sub-area 1, and Divisions Va and Vb; saithe in Divisions Va; and Vb and haddock in Divisions Va and Vb;

b) for cod, haddock and saithe in Division Vb, where an effort control management system is in effect, estimate the probability profile of fishing mortalities which would be generated under the current effort control scheme and provide effort options which have a high probability (> 80%) that the realised fishing mortalities in 2001 which would correspond to the fishing mortality identified as being within safe biological limits;

c) update survey and fishery information on the stocks of redfish in Sub-areas V, VI, XII and XIV; In particular, update information on the development of the pelagic fishery for redfish with respect of seasonal and area distribution to allow NEAFC to further consider the appropriateness of area and seasonal closures;

d) consider further possibilities for the incorporation of biological interactions into the assessments of capelin, herring, and cod stocks in Division Va;

e) update information on the stock composition, distribution and migration of the redfish stocks in Sub-areas V and XIV, and comment on the possible relationship between pelagic “deep sea” Sebastes mentella and the Sebastes mentella fished in demersal fisheries on the continental shelf and slope;

f) provide information on the horizontal and vertical distribution of pelagic redfish stock components in the Irminger Sea as well as seasonal and interannual changes in distribution;

g) evaluate the stock development and associated risks for the different stock components if managing these under a common TAC;

h) identify major deficiencies in the assessment.

The above Terms of Reference are set up to provide ACFM with the information required to respond to request for advice/information from NEAFC.

NWWG will report to ACFM at its May 2000 Meeting.

1.3 General comments

Terms of reference for the NWWG in 2000 were changed only for the redfish stocks; item c), f) and g) contain detailed request from NEAFC putting emphasis on the pelagic components of redfish. Item c) is addressed in sections 7-10 under respective stocks and item f) and g) is mainly addressed in section 7 dealing with general redfish issues.

Even though TOR h) on identification of deficiencies in the assessment is new, the WG has dealt with this issue previously in the sections 'Comments on assessment' and 'Management considerations' for each stock, and will continue to do so.

We were unable to provide information on TOR b) on estimation of probability profiles of fishing mortalities generated under the present management system in Faroese fisheries and corresponding effort options. This was owing to unreliability of information on recent effort, and the group further elaborates on this in Section 2.1.4 and in Section 2.2.8 especially for cod.

In 1999 a TOR was included to review progress in determining precautionary reference points. This TOR was not repeated for NWWG 2000, but we have updated our review and it is summarised below in section 1.5; stock-specific arguments are found in the assessments.

The format of the report is similar to last year's, with Tables and Figures located after all text for each stock. In the 1999 report some information not used directly in the assessment was omitted in order to make it more digestible for clients. This year basic input information regarded as necessary to assess stock status has been included, but further attempts to reduce the amount of documentation have not been made, as clients of the report have requested that it should contain sufficient data.

The group acknowledges access to free coffee at ICES Headquarters as well as the concession of its historic right to the Castle Room.

1.4 Stocks and Assessment Methods

The stocks dealt with by NWWG can be divided into two classes: those for which data are sufficient to allow an analytical assessment, and those for which either data amount is limited or for which the quality of the data is questionable, impeding analytical assessments. All gadoid stocks are in the first class except for Faroe Bank cod, where a short time series inhibits analytical assessment, and cod in Greenland, where a ceased fishery prevents a VPA. The Greenland halibut stock in Greenland, Iceland and the Faroes is also in the first class. In the second class are all the stocks of redfishes, for which difficulties in age determination prevent calculations of catch at age and therefore age-based analytical assessment. For most of the stocks for which analytical assessments were carried out, terminal fishing mortalities have been estimated by tuning detailed catch data with selected fleet CPUE indices using the XSA module of the Lowestoft suite. Exceptionally, fishing mortalities for Iceland saithe have been modelled by a Time Series Analysis (TSA).

1.5 Progress in determining precautionary reference points

The methods used for determining precautionary reference points have generally remained stable since 1999, with a few minor changes (Table 1.5.1). They varied from stock to stock in response to the differences between stocks in the availability of data, the state of the stock, and the understanding of stock dynamic processes.

The principal change to be noticed is that reference points are derived in fewer different ways than last year. Biomass reference points are based either on an MBAL—more or less subjectively picked off the historic plot of recruitment against SSB—or on a lowest 'observed' (in fact, usually estimated) biomass B_{loss}. MBAL was referred to 3 times, once for B_{lim} and twice for B_{pa}. B_{loss} was referred to 3 times, always for B_{lim}. Reference points for fishing mortality appeal almost all the time to F_{med} either to set the value of F_{pa} or to justify a subjectively set value. The other standard Fs are not used in the precautionary context.

For either parameter and for most stocks, either a ‘pa’ or a ‘lim’ value was set, and the other value was derived by offsetting a multiple of an assumed standard error. For F, the ‘lim’ value was always derived from the ‘pa’ value, but vice versa for B. The multiple chosen was either 1.645 (3 times, for 2 stocks) or 2 (once: F for Faroe haddock); in a fifth case (B for Faroe haddock), the multiple 2 was initially used, but the result was then adjusted downwards and the final multiple was 1.2. It is not easy to know how the choice between a multiple of 2 and a multiple of 1.645 is made. Error CVs are usually assumed to be 30% for reasonable assessments, or 40% if there is less confidence. Exceptionally, for Faroe saithe, B_{lim} and B_{pa} were independently set (by ACFM 99), at B_{loss} and at MBAL.

We were still unable to specify reference points for most stocks of cod, as they were depleted, deficient in data, or unpredictable in dynamics.

The state of knowledge of redfish stocks and their dynamics has led to the adoption of a single reference parameter, a catch:effort ratio designated as ‘U’. Reference values are defined relatively to the historic maximum value observed for this parameter. The ‘lim’ value is taken as 20% of the maximum, and the ‘pa’ value at 50% or 60%.

1.6 Recommendations

There will be a joint effort on measurement of stock size of pelagic redfish in the year 2001. The group recommends that representatives from participating nations meet in advance to plan the survey and to investigate improvements in survey design.

Table 1.5.1a: Precautionary-approach reference points included in the assessments presented by the NWWG to the ACFM in 2000.

Stock	Limit reference points	Buffer (pa) reference points	Other values given in the assessment	Notes
2.2 Faroe Plateau Cod	$B=B_{loss}$ (ACFM); $F=F_{pa} + 1.645\sigma$	$B=B_{lim} + 1.645\sigma$ (ACFM); F= (ACFM);	$F_{0.1}$, F_{max}, F_{med}, F_{MSY}.	F_{pa} is 'close to F_{max}, F_{med}, F_{MSY}'
2.3. Faroe Bank Cod	None	None		'the current XSA is not suited to put forward precise reference values due to the scarce data and the short time span.' '. .in the beginning of the 1990s the SSB was probably among the lowest estimated.'
2.4. Faroe Haddock	B=MBAL; $F=F_{pa} + 2\sigma$ (ACFM)	$B= B_{lim}+ 2\sigma$, then reduced; $F=F_{med}$ (ACFM)	F_{max}, $F_{0.1}$, F_{med}, F_{high}.	ACFM98 set a lower B_{pa} directly from the SSB-R plot. F_{lim} & F_{pa} also set by ACFM98.
2.5 Faroe Saithe	$B=B_{loss}$ (ACFM99); F = (ACFM98)	B=MBAL (ACFM99); F = (ACFM98)	F_{max}, $F_{0.1}$, F_{med}, F_{high}.	the assessment cites the pa reference points suggested by ACFM in the last two years. F_{lim} is a little less than F_{max}, and F_{pa} than F_{med}.
3.2 Iceland Saithe	B=ACFM; no F.	B=ACFM; F=ACFM		the assessment cites the reference points suggested by ACFM.
3.3. Iceland Cod	None	None	F_{max}, $F_{0.1}$, F_{med}, F_{high}.	simulations appear to show that the current catch limitation rule will safeguard the stock. Present F is slightly above F_{med}.
3.4. Iceland Haddock	None	no B; $F_{pa}=F_{med}$	F_{max}, $F_{0.1}$, F_{high}.	
5.1. Greenland Cod—Offshore	none	B(tentative)=MBAL; no F	$F_{0.1}$, F_{max}, F_{med}, F_{high}.	stock is depleted, therefore no firm reference points.
5.2. Greenland Cod—Inshore	None	None		
6. Greenland halibut	$B=B_{loss}$(ACFM); no F	$B=Blim + 1.645\sigma$; $F=F_{med}$	F_{high}, F_{low}	reference points may need redefining.
8. *S. marinus*	$U_{lim}=0.2 \times U_{max}$	$U_{pa}=0.6 \times U_{max}$		U is the CPUE in the Icelandic groundfish survey. U_{max} is the series's maximum value.
9. Deep-sea *S. mentella* on the shelf	$U_{lim}=0.2 \times U_{max}$	$U_{pa}=0.5 \times U_{max}$		U is a CPUE index. Currrently close to or below U_{pa}. U_{max} is the series's maximum value.
10. Pelagic *S. mentella*	none	none		'Based on the status of knowledge. . .no new information on reference points.'

Table 1.5.1b: Technical bases for PA reference points in ACFM advisory summaries provided by NWWG in 2000.

Stock	F_{lim}	B_{lim}	F_{pa}	B_{pa}	Notes
3.2.2.a Greenland Cod					none; no fishing
3.2.2.b Iceland Cod			simulation-sustainable F		harvest control rule
3.2.3 Iceland Haddock					none; further work required
3.2.4 Iceland Saithe		B_{loss}	30-year-sustained F	SSBs in 1978–1993	
3.2.5 Greenland halibut		B_{loss}	F_{med}	1.6 B_{lim}	F_{pa} is not precautionary!
3.2.6 *Sebastes marinus*	U_{lim} is U_{max}/5		U_{pa} is 3 U_{lim}		Umax is the historical max. of a trawl survey CPUE index.
3.2.6.c Deep-sea *S. mentella* on the shelf	U_{lim} is U_{max}/5		U_{pa} is 2.5 U_{lim}		U is the historical max. of a commercial bottom trawl CPUE index.
3.2.6.d Pelagic *S. mentella*					none
3.3.2.a Faroe Plateau Cod	F_{pa} + 1.645σ; σ=0.4	B_{loss}	close to F_{med} and F_{max}	B_{lim} + 1.645σ; σ=0.4	
3.3.2.b Faroe Bank Cod					none
3.3.3 Faroe Haddock	F_{pa} + 2σ	former MBAL	F_{med}	B_{lim} + 2σ, reduced	
3.3.4 Faroe Saithe	consistent with B_{lim} = 60000	B_{loss}	consistent with F_{lim} and F_{med}	former MBAL	

2 DEMERSAL STOCKS IN THE FAROE AREA (DIVISION VB AND SUB-DIVISION IIA4)

2.1 Fisheries and management system

2.1.1 General Trends in Demersal Fisheries in the Faroe Area

The fishery at the Faroes is a multi-fleet and multi-species fishery. Tables 2.1.1 - 2.1.3 show the yields of cod, haddock and saithe for Faroese fleet categories in Vb, and Figure 2.1 gives a summary of the 2000 assessments of the stocks of Faroe Plateau cod, Faroe haddock and Faroe saithe.

In 1977 an EEZ was introduced in the Faroe area. The demersal fishery by foreign nations have since decreased. The fishing mortalities on cod remained high in the first years, increased considerably during the 1980s and decreased substantially in the first half of the 1990s. In 1995 and especially in 1996–97 the fishing mortalities increased again substantially, and although they since have declined they still are higher than the proposed F_{pa}. For saithe there has been a substantial increase in the fishing mortalities during most of the period but from 1990 it decreased generally steady to 1997–98 where they are estimated to be close to the proposed F_{pa}. A substantial increase in fishing mortality was noted for 1999, however. The fishing mortalities on haddock have been very low since the late 1970s. Catches decreased to a very low level due to poor recruitment but has in 1995 –1999 increased again because two very strong year classes have entered the fishery. The fishing mortalities in the late 1990s are estimated below or close to the proposed F_{pa}.

During the 1980s the Faroese authorities have attempted to regulate the fishery and the investment in fishing vessels. In 1987 a system of fishing licenses was introduced. The fishery also has been regulated by technical means such as legislation on the mesh size, permanent and temporarily area closures, import ban on fishing vessels and a programme of buying back fishing licenses. Mesh size regulations and closed areas are still enforced.

In March 1994 the Faroese Parliament passed a law on the regulation of fisheries within the EEZ. This law introduced quotas for 5 demersal stocks including the Faroe Plateau and the Faroe Bank Cod, Faroe Haddock, Faroe Saithe and redfish. The quotas were allocated to each fleet category by percentage of the total quota and then equally divided between all vessels in each category.

The fishing year starts 1 September and ends 31 August the following year.

2.1.2 The management system implemented in 1996

The catch quota management system introduced in the Faroese fisheries in 1994 was met with considerable criticism and it resulted in at least some fleets misreporting substantial portions of their catches. As a result of the dissatisfaction with the catch quota management system, the Faroese Parliament has adopted a law stipulating that the quota system would end as of May 31, 1996. In addition, the Faroese government has developed, in close cooperation with the fishing industry, a new system based on within fleet category individual transferable effort quotas in days. The new system entered into force on 1 June 1996.

The within fleet category individual transferable effort quotas apply to 1) the longliners less than 110 GRT, the jiggers and the single trawlers less than 400 HP, 2) the pair trawlers and 3) the longliners greater than 110 GRT. The single trawlers larger than 400 HP do not have effort limitations, but they are not allowed to fish within the 12 n. miles limit and the areas closed to them as well to the pairtrawlers have increased in area and time. Their harvest of cod and haddock is limited by maximum by-catch allocation of 4% and 1.75%. In addition, this fleet (13 trawlers) in the present fishing year have been permitted to perform directed cod and haddock fisheries and consequently allocated individual catch quotas of cod and haddock of 100 t each. These quotas have not been accounted for in the allocation of days to other fleets. The single trawlers < 400 HP are given special licenses to fish inside 12 n. miles with a by-catch allocation of 30% cod and 10% haddock. Holders of individual transferable effort quotas who fish outside an area where cod and haddock are normally found can fish 3 days for each day allocated within the area of normal cod and haddock distribution. One fishing days by longliners less than 110 GRT is considered equivalent to two fishing days for jiggers in the same gear category. Therefore longliners less than 110 GRT (and single trawlers < 400 HP) could double their allocation by converting to jigging. Figure 2.2 gives an overview of the different area regulations.

The effort quotas are transferable within gear categories. The allocations of number of fishing days by fleet categories was made such that together with other regulations of the fishery they should result in average fishing mortalities on each of the 3 stocks of 0.45 corresponding to average annual catches of 33% of the exploitable stocks in numbers. Built-in in the system is also an assumption that the day system is self-regulatory, because the fishery will move between stocks according to the relative availability of each of them and no stock will be overexploited. Pope (2000) examined changes in stock sizes and price and could not find relationships that would support the hypothesis that the economics of the fishery would prevent overfishing of the stocks by shifting the fishing effort to the most abundant species.

The number of days fished by gear category since 1985, the averages for 1985–1997 and 1990–1997 and the number of days by category as stated in the law, are presented in Table 2.1.5.

In addition to the number of days allocated in the law, it is also stated in the law what percentage of total catches of cod, haddock, saithe and redfish, each fleet category on average are allowed to fish. These percentages are as follows:

Fleet category	Cod	Haddock	Saithe	Redfish
Longliners < 110GRT, jiggers, single trawl. < 400HP	51%	58%	17.5%	1%
Longliners > 110GRT	23%	28%		
Pairtrawlers	21%	10.25%	69%	8.5%
Single trawlers > 400 HP	4%	1.75%	13%	90.5%
Others	1%	2%	0.5%	0.5%

Technical measures such as area closures during the spawning periods, to protect juveniles and young fish and mesh size regulations are also in effect.

2.1.3 Evaluation of the management system

In 1996, the Working Group estimated that the new management system proposed by the Faroese government could reduce the fishing mortality on cod in 1996 by a maximum of about 23% if all the factors relating nominal fishing effort to fishing mortality were the same in 1996 as in 1995 except for the number of days fished. The Working Group expected that it was highly unlikely, however, that all factors would remain the same, and it speculated that the decrease in fishing mortality on cod would probably be less than 23%, or that perhaps fishing mortality would not decrease at all. The current assessment suggests that the fishing mortality on cod doubled from F = 0.31 in 1995 to F = 0.66 in 1996, as did the catch.

There are many possible reasons to explain the discrepancy between the expected result of limiting the number of fishing days, and the estimated one. The fishing mortality is generally considered as being the product of the nominal fishing effort exerted multiplied by a factor, the catchability coefficient. Fishing day is an imprecise measure of the actual nominal fishing effort applied, and it leaves considerable scope for changes, for example in the number of hours fished, or the amount of gear utilized. The success of fishing is also related to atmospheric and hydrological conditions and to season. Therefore, by having the possibility to choose when to fish, one might predominantly fish during those days when the success is expected to be the greatest, and thus increase the efficiency of the fishing effort used. Thirdly, it is expected that the availability of fish varies from year to year, and therefore, a given amount of fishing effort will capture more fish when the availability is higher than normal. Evidence from the surveys suggests that cod may have been more available from 1995 to 1997, and this may have affected the commercial fishery as well, especially for longliners.

The current practise in allocating extra cod and haddock quotas to one of the fleets not included in the day regulations (see Section 2.1.2) is not compatible with the intentions in the management law, unless the number of fishing days allocated to other fleets are reduced correspondingly.

The Faroese government commissioned a review of the scientific basis for the initial allocation of fishing days and of the method to calculate probability profiles for expected fishing mortalities given the possible utilisation of the allocated fishing days (Pope 2000). The review states that no errors were found in calculations and lists minor concerns about the use of arithmetic means instead of geometric means in the calculations for the original allocation. “A potentially more serious effect is that the analysis assumes that catchabilities are in some sense typical over the adjustment period. It seems likely that changes in regulations, technical efficiency and fishing practices might change catchability systematically over the averaging period. Hence, average historic levels of catchability might prove relatively poor predictors of future fleet performance (page 4, paragraph 4)”. The concerns of the review have been investigated in Section 2.2.8 and appear well founded.

That catchability would increase as a result of the implementation of the effort management system should not come as a surprise. The NWWG has noted this possibility from its first evaluation of the system. It is well known on the Faroes that those involved in the days at sea system are trying to use as few days as possible, and to make the most use of the days that are used by fishing more hours per day. For longliners, the introduction of automatic baiting machines, in order to reduce costs, would also be expected to increase efficiency. This means that it is not possible to use the catchabilities for 1985 to 1995 as a base period to estimate the probability profiles of the number of days allocated to the various fleets. In addition, the fleet definitions have changed as mentioned above. As indicated above, the number of days recorded in 1996–97 is believed to overestimate the real number of days because the number of days fished in trips landed at multiple landing sites were recorded at each landing site. Although the problem with the recording of the number of days from multiple landings trips is believed to have been resolved from 1998 onwards, there is no basis to make a quantitative estimate of catchabilities by fleet categories, and of the fishing mortality that will be generated in 2000/2001 from the number of days allocated.

Given the recent history, however, fishing mortality is expected to be above the proposed Fpa, especially for cod and saithe, unless the number of days are reduced substantially.

Pope (2000) further states “Thus we cannot trust to catchability always being what it is now. We need to consider how it could change. The previous averaging over a number of years at least have the virtue that they include some variations that could repeat in the future. It would however be better to try to predict changes. Changes in vessel directivity to species might be more predictable than environment change, which might perhaps only be hindcast (page 6, last paragraph).” The NWWG could not implement this recommendation this year, given the problems with the 1996–97 data, and the change in the fleet categories.

In addition to the effort control, the fleets are supposed to be constrained to a pre-agreed species composition in the catch as indicated in the text table in Section 2.1.2. These restrictions do not take into account that several of these fleets are in fact involved in a multispecies fishery and that the actual species composition in the water is unlikely to be exactly the same as in catches under the regulation. The percentages are guidelines only and it is not expected they will result in discarding and misreporting. They are therefore unlikely to jeopardise one of the eventual potential benefits of an effort management system, an improvement in the quality of the information collected from the fisheries.

Management systems based on effort controls are expected to lead to overcapitalisation in the fishing fleets because vessel owners will want to maximise the catch they can harvest with the fishing effort allocation they have received. In the medium to long term, this process will lead to increased fishing efficiency of the fleets and it will be necessary to decrease the total number of fishing days available to be allocated in order not to exert excessive fishing mortality. In extreme cases, effort controls can lead to the fishery being open only for a few days per year as was the case for the Pacific halibut fishery a few years ago, and remains the case for some Pacific herring fisheries off the Coast of British Columbia.

In order to constrain fishing mortality within reasonable limits, it will therefore be necessary to adjust the number of days periodically. For this purpose, there is a need for a mechanism to monitor changes in efficiency, and detailed information on the activities of the fleets, on the physical characteristics of the boats and their equipment should therefore be collected.

2.1.4 Special request

b) *for cod, haddock and saithe in Division Vb, where an effort control management system is in effect, estimate the probability profile of fishing mortalities which would be generated under the current effort control scheme and provide effort options which have a high probability (> 80%) that the realised fishing mortalities in 2001 which would correspond to the fishing mortality identified as being within safe biological limits;*

In recent reports, the fishing mortality on cod, haddock and saithe that could be generated in the upcoming fishing year given the number of fishing days allocated to each fishing fleets, was estimated using partial fishing mortalities by age (3 to 7) and year for 1985 to 1995 to calculate catchability coefficients. Probability profiles for various combinations of effort allocations were then constructed from the effort allocated and the estimated catchabilities. Based on the 1999 assessment and the observed effort allocation, there was a high probability for all 3 stocks that fishing mortality was in excess of the proposed F_{pa}'s. The number of fishing days reported for 1996 to 1997 are not believed to be reliable because the number of days fished in trips landed at multiple landing sites were recorded at each landing site. This problem is believed to have been resolved from 1998 onwards. With the implementation of the fishing days system, it is expected that the mortality exerted by a single fishing day for the various fleet category will have changed and therefore the basis for the calculation of the expected fishing mortality is probably no longer valid. Another problem is that the fleet definitions have changed since the introduction of the day system and this make comparisons back in time difficult.

However, as stated elsewhere in the report, the recent history and the present assessment indicate, that fishing mortality on cod and saithe is expected to be above the proposed Fpa, unless the number of days are reduced substantially, while the fishing mortality on haddock with a high probability will stay close or below the proposed F_{pa} with the present allocation of days.

Table 2.1.1 Catches of COD in Vb by various faroese fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners < 100 GRT	Longliners > 100 GRT	Singletrawl < 400 HP	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl <1000 HP	Pairtrawl >1000HP	Gill net	Jiggers	Others	Total
1985	5650	9659	3133	2506	3051	4352	5393	2223	291	1522	256	38037
1986	2946	4707	1700	1643	2049	2840	10132	4793	443	919	532	32704
1987	2151	3231	2586	1393	1546	1791	6361	3273	283	638	142	23407
1988	591	3049	3201	1114	1660	1501	6065	3455	568	1647	172	23022
1989	964	5986	3840	1102	1314	1157	2278	1729	692	1913	160	21135
1990	511	4225	2440	507	517	568	863	1259	201	988	106	12184
1991	342	2474	1394	439	413	371	663	1038	160	624	53	7969
1992	142	1359	708	325	161	192	634	1119	1	376	279	5295
1993	113	809	701	699	323	178	717	1141	0	452	63	5194
1994	244	1090	1259	914	332	448	651	1950	58	1507	57	8508
1995	732	3108	3328	1135	713	865	1164	2203	55	4348	9	17662
1996	1345	6849	7340	1562	1317	666	3313	7253	95	7388	97	37225
1997	956	8569	9571	1326	1659	983	1966	4585	191	3287	43	33135
1998	483	6549	6894	1257	1397	1419	1004	2694	316	1517	39	23561
1999	478	4271	4384	932	921	2075	1101	2508	412	1111	84	18277

Table 2.1.2 Catches of HADDOCK in Vb by various faroese fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners < 100 GRT	Longliners > 100 GRT	Singletrawl < 400 HP	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl <1000 HP	Pairtrawl >1000HP	Gill net	Jiggers	Others	Total
1985	903	5294	1816	196	780	1055	2546	832	18	86	43	13570
1986	951	5038	1535	250	354	664	2654	1313	4	62	143	12967
1987	1520	5414	1796	313	639	274	2340	1251	3	47	233	13829
1988	201	5219	2076	167	436	253	1205	914	2	50	174	10697
1989	476	7399	2257	122	425	213	862	749	2	173	185	12866
1990	278	6109	1815	63	308	192	534	800	1	132	86	10316
1991	213	4206	1321	86	125	126	495	799	0	41	57	7469
1992	76	1893	917	57	38	44	439	576	0	13	49	4103
1993	27	783	821	217	145	37	424	713	0	6	102	3275
1994	34	631	952	247	136	121	363	1046	0	4	96	3629
1995	46	1010	1630	296	207	91	370	695	0	15	11	4371
1996	124	2351	3068	487	572	163	562	1141	0	60	8	8535
1997	231	4860	6059	447	966	405	973	1850	0	72	27	15890
1998	298	5997	7871	383	1115	585	1022	2333	0	53	8	19670
1999	250	3759	6497	282	802	1162	967	2301	0	25	12	16057

Table 2.1.3 Catches of SAITHE in Vb by various faroese fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners < 100 GRT	Longliners > 100 GRT	Singletrawl < 400 HP	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl <1000 HP	Pairtrawl >1000HP	Gill net	Jiggers	Others	Total
1985	89	38	28	23	2515	12923	10822	10805	13	982	139	38377
1986	107	67	21	31	1004	9872	9921	13173	54	1296	584	36132
1987	244	52	37	116	1468	7279	8134	15790	157	1985	409	35700
1988	173	101	31	40	2693	8224	7748	17266	113	2575	522	39586
1989	356	52	60	129	2148	7118	9440	16513	90	3717	509	40132
1990	309	131	101	84	2123	10742	13127	23442	122	4038	503	54721
1991	287	55	64	40	625	6791	12978	22584	281	4795	411	48910
1992	124	121	37	8	151	2248	7677	17486	0	3300	321	31472
1993	168	56	29	39	164	1879	6234	17639	0	2696	206	29111
1994	131	112	63	37	335	1995	5408	17243	2	3666	202	29194
1995	49	15	75	91	215	2406	4288	14776	5	2320	6	24248
1996	5	6	37	24	213	1178	4118	10173	5	1590	4	17353
1997	9	14	72	27	495	2098	3491	11529	3	1746	77	19561
1998	21	97	56	12	620	4531	3608	12610	0	1764	93	23421
1999	14	32	69	35	362	3715	5425	17752	2	1685	484	29575

Table 2.1.4 Number of fishing days used by various fleet groups in Vb1 1985-95 and 1998-99. For other fleets there are no effort limitations. Catches of cod, haddock saithe and redfish are regulated by the by-catch percentages given in section 2.1.1. In addition there are special fisheries regulated by licenses and gear restrictions. (This is the real number of days fishing not affected by doubling or tripling of days by changing areas/gears)

Year	Longliner 0-110 GRT, jiggers, trawlers < 400 HP	Longliners > 110 GRT	Pairtrawlers > 400 HP
1985	13449	2973	8582
1986	11399	2176	11006
1987	11554	2915	11860
1988	20736	3203	12060
1989	28750	3369	10302
1990	28373	3521	12935
1991	29420	3573	13703
1992	23762	2892	11228
1993	19170	2046	9186
1994	25291	2925	8347
1995	33760	3659	9346
Average(85-95)	22333	3023	10778
1998	23971	2519	6209
1999	21040	2428	7135
Average(98-99)	22506	2474	6672

Table 2.1.5 Number of allocated days for each fleet group since the new management scheme was adopted and number of licenses per fleet.

	Fleets	1996/1997	1997/1998	1998/1999	1999/2000	No. of licenses
Group 1	Single trawlers > 400 HP	Regulated by area and by-catch limitations				13
Group 2	Pair trawlers > 400 HP	8225	7199	6839	6839	31
Group 3	Longliners > 110 GRT	3040	2660	2527	2527	19
Group 4	Longliners and jiggers 15-110 GRT, single trawlers < 400 HP	9320	9328	8861	8861	106
Group 5	Longliners and jiggers < 15 GRT	22000	23625	22444	22444	696

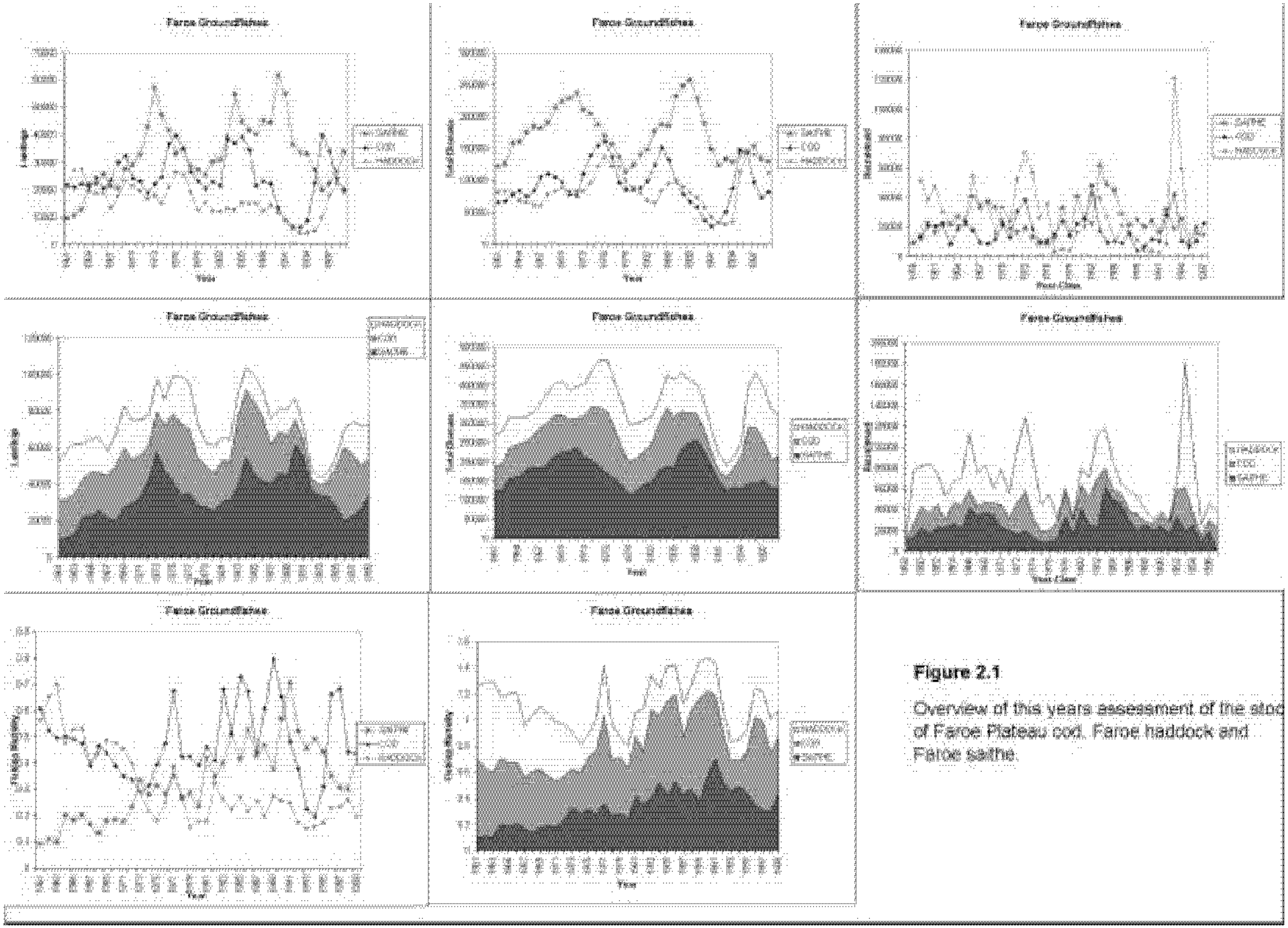


Figure 2.1

Overview of this years assessment of the stoc of Faroe Plateau cod, Faroe haddock and Faroe saithe.

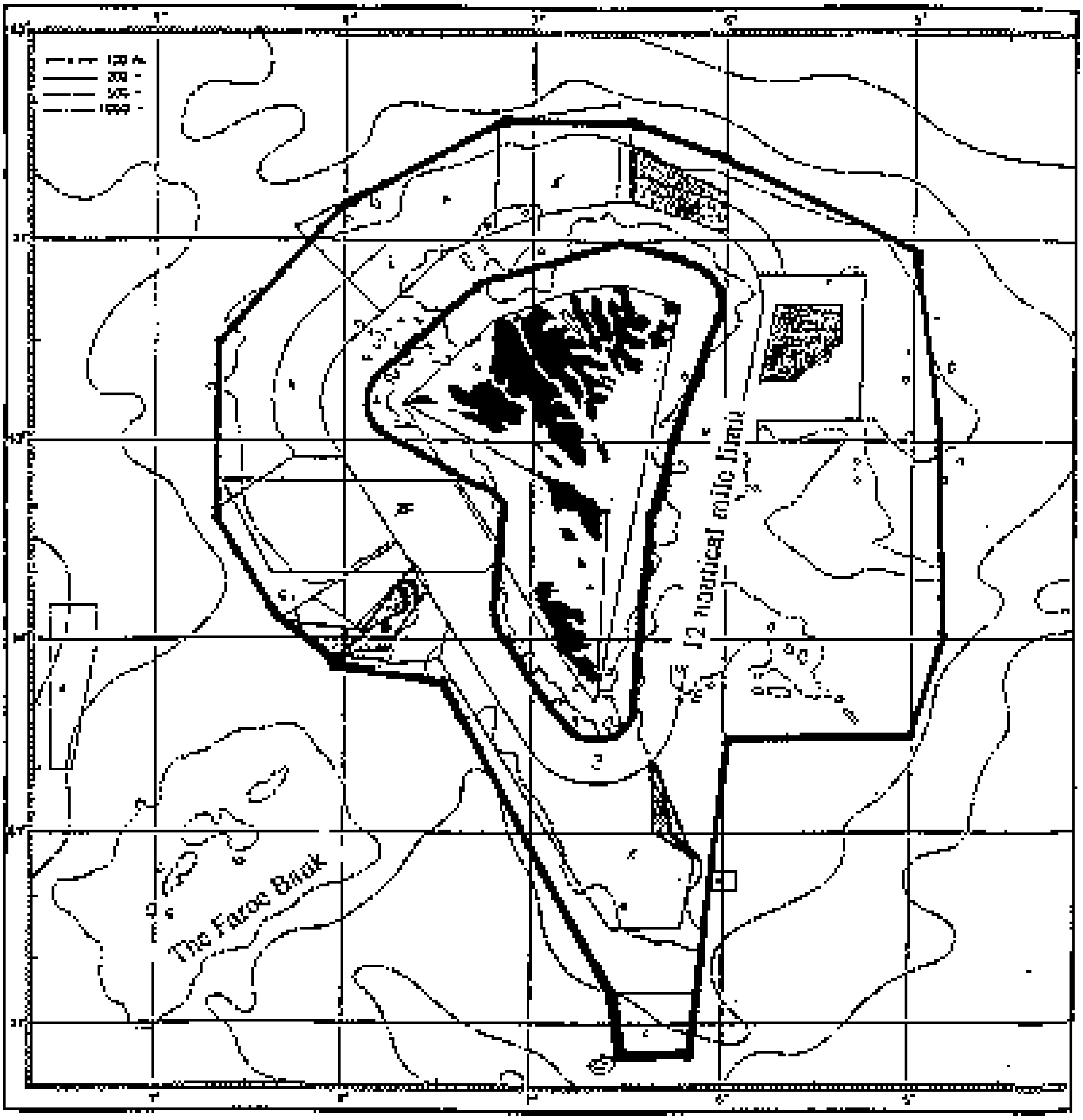


Figure 2.2 Fishing area regulations in Division Vb. Allocation of fishing days applies to the area inside the outer thick line. Holders of effort quotas who fish outside this line can triple their numbers of days. Trawlers are generally not allowed to fish inside the 12 nautical mile limit and only longliners < 100 GRT and jiggers < 100 GRT are allowed to fish inside the innermost thick line. Several areas are closed for parts of the year, to protect spawning areas, separate gears etc. The Faroe Bank (VB2) is managed separate from Vb1. The area on the bank shallower than 200 m is closed to trawling and the longline fishery is regulated by individual day quotas.

2.2 Faroe Plateau Cod

2.2.1 Trends in landings

The nominal landings of cod (1986-1999) from the Faroe Plateau by nations as officially reported to ICES, are given in Table 2.2.1.1. The relatively high recruitment in 1980-1983 allowed a good fishery for cod to be maintained from 1983 to 1986 when landings reached almost 40 000 t. Landings have steadily decreased afterwards to only 6 000 tonnes in 1993, the lowest on record. In 1995 the officially reported landings increased to slightly above 19 000 t. Information from the fishing industry indicated misreporting in the order of 3 330 t. (3 000 t. gutted weight) for 1995 which were added to the officially reported landings in Table 2.2.1.2. Misreporting is not suspected to have been a problem afterwards. Landings increased spectacularly in 1996, to above 40 000 t., the highest value during the 1961 to 1999 time period. This increase is believed to be due to a combination of increased stock size, increased availability, and increased effective fishing effort as a result of the new management system introduced June 1, 1996. The catches remained high in 1997 (34 000 t), but decreased to 24 000 t in 1998 and 20 000 t in 1999, which is close to the minimum during the whole century (except during the two world wars and at the beginning of the nineties).

In recent years, statistics for the Faroese fishery in that part of Sub-division IIa (Figure 2.2) which is within the Faroese EEZ, have become available. It is expected that these are taken from the Faroe Plateau area so they are included in the total used in the assessment in Table 2.2.1.2 under the row labelled "Total used in the assessment". No information on the Faroese landings from IIa were available for 1993-1996, however. The French landings of Faroe Plateau cod in 1989 and 1990 as reported to the Faroese authorities are also included.

During the last 15 years, the Faroe Plateau cod has almost entirely been exploited by the Faroese fishing fleets. Table 2.2.1.3 shows the landings for the most important fleet categories. In recent years, the longliners and the pair trawlers have taken most of the catches. The longliners, especially those less than 100 GRT, have a directed fishery for cod during the entire year.

2.2.2 Catch-at-age

Landings-at-age were updated to account for a change in the nominal landings for 1998. Landing-at-age for 1999 are provided for the Faroese fishery in Table 2.2.2.1. Faroese landings from most of the fleet categories were sampled (see text table below). Landings-at-age for the fleets covered by the sampling scheme were calculated from the age composition in each fleet category and raised by their respective landings. The age composition of the combined Faroese landings was used to raise the foreign landings prior to 1998 and 1999 when, the age composition of the corresponding Faroese fleets were used. Landings-at-age from 1961 to 1999 are shown in Table 2.2.2.3.

Samples from commercial fleets in 1999.

Fleet	Size	Samples	Length	Otoliths	Weights
Longliners	< 100 GRT	101	18,731	2,816	1,198
Longliners	> 100 GRT	52	9,438	1,920	1,020
Jiggers		12	1,551	539	538
Sing. trawlers	< 400 HP	22	3,897	780	600
Sing. trawlers	400-1000 HP	19	3,314	721	180
Sing. trawlers	> 1000 HP	2	286	120	120
Pair trawlers	< 1000 HP	20	3,655	540	479
Pair trawlers	> 1000 HP	47	8,962	1,319	1,018
Total		275	49,834	8,755	5,153

2.2.3 Mean weight-at-age

Mean weight-at-age data for 1961-1999 are provided for the Faroese fishery in Table 2.2.3.1. These were calculated using the length/weight relationship based on individual length/weight measurements of samples from the landings. The sum-of-products-check for 1999 showed a discrepancy of 1.4%.

Figure 2.2.3.1 shows the mean weight-at-age for 1961 to 1999. From 1991 to 1995 weights at age appeared to have increased, they remained stable in 1996 and decreased during 1997-1998. In 1999 and the first quarter of 2000, however, they have increased again (Figure 2.2.3.2) except for age 7 where the decline continued.

2.2.4 Maturity-at-age

The proportion of mature cod by age during the Faroese groundfish surveys carried out during the spawning period (March) are given in Table 2.2.4.1 and shown in Figure 2.2.4.1 for 1983 to 1999. The average maturity at age for 1983 to 1996 were used in years prior to 1983.

Full maturity is generally reached at age 5 or 6, but considerable changes have been observed in the proportion mature for younger ages between years. In 1994, maturity increased for age groups 2, 3 and 4. The observed values were used in the assessment as in previous years, since calculations during the 1995 assessment showed that smoothed values gave nearly the same spawning stock biomass.

2.2.5 Groundfish surveys

The groundfish surveys in Faroese waters with the research vessel *Magnus Heinason* were initiated in 1983. Up to 1991 three cruises per year were conducted between February and the end of March, with 50 stations per cruise selected each year based on random stratified sampling (by depth) and on general knowledge of the distribution of fish in the area. In 1992 the period was shortened by dropping the first cruise and one third of the 1991-stations were used as fixed stations. Since 1993 all stations are fixed stations. The standard abundance estimates is the stratified mean catch per hour in numbers at age calculated using smoothed age/length keys.

The overall mean catch (kg) of cod per unit effort (trawl hour) 1983-2000 is given in Figure 2.2.5.1. The CPUE have increased substantially in 1995 and have remained high up to 1998. The CPUE decreased in 1999 and 2000. Normally the stratified mean catch per trawl hour increases for the first 4-5 years of life of a year class, and decreases afterwards (Table 2.2.6.1.1). From 1994 to 1995, however, there was an increase for all year classes (age groups 3-8 in 1994 compared to age groups 4-9 in 1995), possibly because of increased availability. A more normal pattern is observed from 1996-2000.

2.2.6 Stock assessment

2.2.6.1 Tuning and estimates of fishing mortality

The two tuning series used in NWWG 1998, the single trawlers 400-1000 HP and longliners > 100 GRT both with fishing effort measured in days were replaced in NWWG 1999 by two newly developed tuning series based on logbook data for five longliners > 100 GRT and eight pair trawlers > 1000 HP. In the new series, effort is measured in 1000 hooks for the longliners and trawl hours for the pair trawlers. Both tuning series are shown in Table 2.2.6.1.1 (age disaggregated) and Figure 2.2.6.1.1 (kg/1000 hooks and kg/hour). The two series show very similar trends for most of the years, except for the first two and the last one.

In the longliner series, fishing sets with information on cod catch, effort and fishing location and with catches of tusk and ling together less than 20% of the total catch were selected. In this way only the fishery directed towards cod (and haddock) was used. The longliner series was further scrutinised in NWWG 1999 by looking at the individual CPUEs for each ship. All outliers were caused by either small catch or small effort data. Given that the index is based on the sum of all records, this meant that the outliers had little influence on the overall results and therefore all ships could be used.

In the Cuba trawler series, fishing sets with information on cod catch, effort, and fishing location east of 7 degrees W on the Faroe Plateau were used (in order to standardise). In addition only “saithe hauls” were used, i.e., the catch of saithe was more than 70%, and the sum of cod- and haddock-catch was less than 30%. Thus the Cuba series is a bycatch series. The Cuba series was in NWWG 1999 further scrutinised by looking at the individual CPUE for each ship. As for the longliners all ships could be used.

The residuals of log catchabilities are shown in Figure 2.2.6.1.2. For the longliners the first half of the series is divided almost equally in a negative run and then in a positive one. The latter part of the series is more random. In the Cuba series the residuals are mainly positive until 1990, but are fairly random afterwards.

The results from the retrospective analysis of the XSA (Figure 2.2.6.1.3) show that a shrinkage of 2.0 (as last year) performs better than the default shrinkage of 0.5. Both shrinkages give the same average fishing mortality estimate for 1999 (0.43).

The estimated fishing mortalities are shown in Table 2.2.6.1.3 and Figure 2.2.6.1.4. The average F for age groups 3 to 7 in 1999 is estimated at 0.43, somewhat higher than Fmax = 0.34.

2.2.6.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.2.6.1.5. A summary of the VPA, with recruitment, biomass and fishing mortality estimates is given in Table 2.2.6.1.6 and in Figure 2.2.6.1.4. The stock-recruitment relationship is presented in Figure 2.2.6.2.1.

The assessment is very consistent with last year's assessment. It confirms the poor recruitment for the 1984 to 1991 year classes, and the strong 1992 and 1993 year classes. Due to the continuous poor recruitment from 1984 to 1991 and the high fishing mortalities, the spawning stock biomass declined steadily from 1983 to 1992 when it was the lowest on record at 20,100 t. It has increased sharply since, with the increase in 1994 being partly due to a very high proportion of mature for ages 2 and 3 (Table 2.2.4.1) to almost 90,000 t. in 1996 and 1997 before declining to about 48 000 t in 1999. The 1997 year class seems to be above average strength.

2.2.6.3 Comment on the assessment

Same settings have been used in the current assessment as for last year.

Before the era of VPA calibrated with CPUE from the commercial fisheries or from surveys, cohort estimates were derived by an iterative process based on calculating the average fishing mortality in the most recent two or three years. The process was initiated by doing a first cohort run with an arbitrarily chosen terminal F, sometimes the one obtained from the previous assessment, taking the average for each age for the number of years chosen, then making another run with the average F at age as input values. The iterative process was repeated until the largest change between successive runs was smaller than a pre-agreed threshold. This iterative averaging method was applied to Faroe cod in the 1999 assessment and the 1998 fishing mortality thus obtained are compared with those from the 1999 calibrated assessment and with those for 1998 obtained from the current assessment in the text table below.

Cod	2	3	4	5	6	7	8	9
98 iterative in 99	0.049	0.186	0.432	0.616	0.784	0.909	0.832	0.785
98 calibrated in 99	0.041	0.142	0.330	0.517	0.443	0.312	0.541	0.568
98 calib. in 2000	0.048	0.173	0.372	0.657	0.555	0.459	1.087	0.660

The results of a similar exercise for the current assessment are presented in the text table below:

Cod	2	3	4	5	6	7	8	9
99 iterative in 2000	0.060	0.230	0.452	0.772	0.978	0.970	1.271	0.998
99 Calibrated in 2000	0.066	0.158	0.320	0.566	0.784	0.340	0.349	0.494

Similar to last year's results, the iterative averaging does not detect as large a decrease in fishing mortality as estimated in the calibrated VPA, particularly for older ages.

The results of the Magnus Heinason survey have not been used in recent assessments of Faroe Plateau cod because of suspected substantial changes in the catchability coefficient of the survey in the first part of the 1990s (Figure 2.2.6.3.1 in last years report).

2.2.7 Predictions of catch and biomass

2.2.7.1 Short-term prediction

The input data for the short time prediction are given in Table 2.2.7.1.1 and Table 2.2.7.1.3. The year classes 1997-99 were estimated by the RCT3 program (output in Table 2.2.7.1.2). The initial stock size in Table 2.2.7.1.3. is obtained in this way: number of 2 year old is taken directly from RCT3 and number of 3 year old (15405) is equal to 20094 (value from RCT3) multiplied by exp(-0.2-0.0657). 0.0657 is taken from fishing mortality at age in the XSA run. The rest of the column is taken directly from stock number at age in the XSA run. The exploitation pattern was the average fishing mortality for 1997-1999 rescaled to 1999 values. The rescaling was based on the ages 3-7. The weight at age for 2000-2002 was set to the average of the 1997-1999 values. The proportion mature in 2000 was set to the 2000 values from the groundfish survey, and for 2001-2002 to the average values for 1998-2000.

Table 2.2.7.1.4 shows that the landings in 2000 are expected to be 18 200 tonnes (9% lower than in 1999) at *status quo* fishing mortality. According to preliminary fishery statistics, the catch in the two first months of 2000 was 28% lower than for 1999, indicating a lower F than the 1999 fishing mortality. The spawning stock biomass is expected to remain relatively stable in 1999 and 2000 (about 49 000 t.) and to increase slightly afterwards (53 000 t. in 2001 and 56 000 t. at the beginning of 2002). The RCT3 run indicates that the 1997 year class is stronger than average, and that the 1998 and 1999 year classes are of average strength (Table 2.2.7.1.2). If only O-group survey indices are considered (Table 2.2.7.1.1), the 1998 and 1999 year classes might be stronger, and could in theory cause higher spawning stock biomass and future landings than stated here.

2.2.7.2 Biological reference points

In 1998, ACFM set B_{lim} equal to the lowest observed SSB, about 21 000 t and proposed that B_{pa} be set at 40 000 t based on $B_{pa} = B_{lim}e^{1.645\,\sigma}$, assuming a σ of about 0.40 to account for the relatively large uncertainties in the assessment. ACFM further proposed that F_{pa} be set at 0.35, more than twice $F_{0.1}$, about equal to F_{MAX} and F_{med} and at the low end of the range of previously estimated F_{MSY}, from 0.33 (Stefansson and Bell, WD prepared for the SGPAFM) to 0.56 (NWWG, 1997). In previous years, MBAL was considered to be 52 000 t. Over the period covered by the assessment, fishing mortality has been equal to or less than this proposed F_{pa} in 6 years.

Following the logic used to set Bpa, F_{lim} could be set at $F_{lim} = F_{pa}e^{1.645\sigma}$, that is, $F_{lim} = 0.68$, even though F has been estimated to exceed this value in 3 years since 1961.

The stock trajectory with respect to those reference points is illustrated in Figure 2.2.7.2.1.

1.1.1.3 Long-term prediction

The input data for the yield-per-recruit calculations (long-term predictions) are given in Table 2.2.7.3.1. The exploitation pattern (rescaled to 1999 values) and weight at age were set to the average values for 1961-1999. The proportion mature was set to the average for 1983-2000.

The output from the yield-per-recruit calculations is shown in Table 2.2.7.3.2. and in Figure 2.2.7.3.1. $F_{0.1}$ was calculated as 0.14 and F_{max} as 0.31. The average fishing mortality in 1999 on 0.43 is above F_{max} and F_{med} = 0.40 (Figure 2.2.7.2.1).

1.1.8 Management considerations

In 1996, the Working Group estimated that the new management system proposed by the Faroese government could reduce the fishing mortality on cod in 1996 by a maximum of about 23% if all the factors relating nominal fishing effort to fishing mortality were the same in 1996 as in 1995 except for the number of days fished. The Working Group expected that it was highly unlikely, however, that all factors would remain the same, and it speculated that the decrease in fishing mortality would probably be less than 23%, or that perhaps fishing mortality would not decrease at all. The current assessment suggests that the fishing mortality doubled from F = 0.31 in 1995 to F = 0.66 in 1996, as did the catch.

There are many possible reasons to explain the discrepancy between the expected result of limiting the number of fishing days, and the estimated one. The fishing mortality is generally considered as being the product of the nominal fishing effort exerted multiplied by a factor, the catchability coefficient. Fishing day is an imprecise measure of the actual nominal fishing effort applied, and it leaves considerable scope for changes, for example in the number of hours fished, or the amount of gear utilized. The success of fishing is also related to atmospheric and hydrological conditions and to season. Therefore, by having the possibility to choose when to fish, one might predominantly fish during those days when the success is expected to be the greatest, and thus increase the efficiency of the fishing effort used. Thirdly, it is expected that the availability of fish varies from year to year, and therefore, a given amount of fishing effort will capture more fish when the availability is higher than normal. Evidence from the surveys suggests that cod may have been more available from 1995 to 1997, and this may have affected the commercial fishery as well, especially for longliners.

In recent reports, the fishing mortality that could be generated in the upcoming fishing year given the number of fishing days allocated to each fishing fleets, was estimated using partial fishing mortalities by age (3 to 7) and year for 1985 to 1995 to calculate catchability coefficients. Probability profiles for various combinations of effort allocations were then constructed from the effort allocated and the estimated catchabilities.

The number of fishing days reported for 1996 to 1997 are not believed to be reliable because the number of days fished in trips landed at multiple landing sites were recorded at each landing site. This problem is believed to have been resolved from 1998 onwards. With the implementation of the fishing days system, it is expected that the mortality exerted by a single fishing day for the various fleet category will have changed and therefore the basis for the calculation of the expected fishing mortality is probably no longer valid. Nevertheless, the 1999 fishing mortality estimated from the current XSA, F = 0.43 is, as expected from last year's assessment, higher than the proposed F_{pa}.

The Faroese government commissioned a review of the scientific basis for the initial allocation of fishing days and of the method to calculate probability profiles for expected fishing mortalities given the possible utilisation of the allocated fishing days (Pope 2000). The review states that no errors were found in calculations and lists minor concerns about the use of arithmetic means instead of geometric means in the calculations for the original allocation. "A potentially more serious effect is that the analysis assumes that catchabilities are in some sense typical over the adjustment period. It seems likely, that changes in regulations, technical efficiency and fishing practices might change catchability systematically over the averaging period. Hence, average historic levels of catchability might prove relatively poor predictors of future fleet performance (page 4, paragraph 4)". Figure 2.2.8.1 shows relative catchability over the 1985 to 1997 time period. The trends are summarised in the following text table.

JIGGERS	Relatively steady decline from 1985-86 to 1994 then increases and decrease again
LL < 100	Steady decline from 1985 to 1994, then steep increase
LL > 100	High from 1987 to 1990, steady decrease to 1994 then steep increase
OPEN BOATS	Similar to jiggers, large decline from 1985 to 1993-94, then increase and decrease again
ST < 400	Highly variable, no trend
ST 400 – 1000	General increase from 1985 to 1992, markedly lower in 1993-1996, steep increase in 1997
ST > 1000	Relatively steady decrease from mid 1980s to 1997
PT 400 – 1000	Steady decrease from mid 1980s to 1995, stable since
PT > 1000	Steady decrease over the time period

The concerns of the review therefore appear well founded. That catchability would increase as a result of the implementation of the effort management system should not come as a surprise. The NWWG has noted this possibility from its first evaluation of the system. It is well known on the Faroes that those involved in the days at sea system are trying to use as few days as possible, and to make the most use of the days that are used by fishing more hours per day. For longliners, the introduction of automatic baiting machines, in order to reduce costs, would also be expected to increase efficiency. This means that it is not possible to use the catchabilities for 1985 to 1995 as a base period to estimate the probability profiles of the number of days allocated to the various fleets. In addition, the fleet definitions have changed. As indicated above, the number of days recorded in 1996-97 is believed to overestimate the real number of days because the number of days fished in trips landed at multiple landing sites were recorded at each landing site. Although the problem with the recording of the number of days from multiple landings trips is believed to have been resolved from 1998 onwards, there is no basis to make a quantitative estimate of catchabilities by fleet categories, and of the fishing mortality that will be generated in 2000/2001 from the number of days allocated.

Given the recent history, however, fishing mortality is expected to be above the proposed Fpa of F = 0.35 unless the number of days are reduced substantially.

Pope (2000) further states "Thus we cannot trust to catchability always being what it is now. We need to consider how it could change. The previous averaging over a number of years at least have the virtue that they include some variations that could repeat in the future. It would however be better to try to predict changes. Changes in vessel directivity to species might be more predictable than environment change, which might perhaps only be hindcast (page

6, last paragraph).” The NWWG could not implement this recommendation this year, given the problems with the 1996-97 data, and the change in the fleet categories.

The management approach based on the days at sea was suggested as being self-regulatory with the fishing effort changing from one species to the other as abundance fluctuates. However, Pope (2000) examined changes in stock sizes and price and could not find relationships that would support the hypothesis that the economics of the fishery would prevent overfishing of the stocks by adjusting shifting the fishing effort to the most abundant species.

For reference purpose, the day allocations are summarised in the text table below.

The number of days allocated to each fleet category are given in the table below:

Gear	Allocation	Optional change
LL< 100	8861	There are 8861 days to be shared/chosen to be fished either by longlining (< 100), jigging or trawling (< 400hp)
ST< 400	0	There are 8861 days to be shared/chosen to be fished either by longlining (< 100), jigging or trawling (< 400hp)
ST400–1000	0	No effort limitation, assumed to catch less than 4% cod.
ST> 1000	0	No effort limitation, assumed to catch less than 4% cod.
PT400–1000	1270	
PT> 1000	2149	
LL> 100	1264	
OPEN	11222	
JIGGERS		There are 8861 days to be shared/chosen to be fished either by longlining (< 100), jigging or trawling (< 400hp)

In addition to the effort control, the fleets are supposed to be constrained to a pre-agreed species composition in the catch as indicated in the table below:

Groups of fleets	Fleet	Cod %	Haddock %	Saithe %	Redfish %
Group 1	Single trawlers	4.0	1.75	13.0	90.5
Group 2	Pair trawlers	21.0	10.25	69.0	8.5
Group 3	Longliners > 100 GRT	23.0	28.0		
Group 4	Longliners and jiggers > 15 GRT	31.0	34.5	11.5	0.5
Group 5	Longliners and jiggers < 15 GRT	20.0	23.5	6.0	
Group 6	Others	1.0	2.0	0.5	0.5
		100	100	100	100

These restrictions do not take into account that several of these fleets are in fact involved in a multispecies fishery and that the actual species composition in the water is unlikely to be exactly the same as in catches under the regulation. The percentages are guidelines only and it is not expected they will result in discarding and misreporting. They are therefore unlikely to jeopardise one of the eventual potential benefits of an effort management system, an improvement in the quality of the information collected from the fisheries.

Management systems based on effort controls are expected to lead to overcapitalisation in the fishing fleets because vessel owners will want to maximise the catch they can harvest with the fishing effort allocation they have received. In the medium to long term, this process will lead to increased fishing efficiency of the fleets and it will be necessary to decrease the total number of fishing days available to be allocated in order not to exert excessive fishing mortality. In extreme cases, effort controls can lead to the fishery being open only for a few days per year as was the case for the Pacific halibut fishery a few years ago, and remains the case for some Pacific herring fisheries off the Coast of British Columbia.

In order to constrain fishing mortality within reasonable limits, it will therefore be necessary to adjust the number of days periodically. For this purpose, there is a need for a mechanism to monitor changes in efficiency, and detailed information on the activities of the fleets, on the physical characteristics of the boats and their equipment should therefore be collected.

Table 2.2.1.1. Faroe Plateau (Sub-division VB1) COD. Nominal landings (tonnes) by countries, 1986-1999, as officially reported to ICES.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999 [*]
Denmark	8	30	10	-	-	-	-	-	-	-	-	-	-	-
Faroe Islands	34,492	21,303	22,272	20,535	12,232	8,203	5,938	5,744	8,724	19,079	39,406	33,556	23,308	19,256
France [1)]	4	17	17	-	-	- [2]	3 [3]	1 [3]	-	2 [3]	1 [3]	-	- [*]	1
Germany	8	12	5	7	24	16	12	+	2 [3]	2	+	+	-	39
Norway	83	21	163	285	124	89	39	57	36	38	574 [*]	410 [*]	405 [*]	450
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	18 [A]
UK (Engl. and Wales)	-	8	-	-	-	1	74	186	56	43	126	61 [3]	27 [3]	-
UK (Scotland)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-	-	-	-	-	261 [3]
Total	34,595	21,391	22,467	20,827	12,380	8,309	6,066	5,988	8,818	19,164	40,107	34,027	23,740	20,025

[*] Preliminary

[1)] Included in Vb2.

[2] Quantity unknown 1991.

[3] Reported as Vb.

[A] Reported to the Faroese Coastal Guard.

Table 2.2.1.2. Faroe Plateau (Sub-division VB1) COD. Nominal catch (tonnes) 1986-1999, as used in the assessment.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999 [*]
Officially reported	34,595	21,391	22,467	20,827	12,380	8,309	6,066	5,988	8,818	19,164	40,107	34,027	23,740	20,025
Faroese catches in IIA within Faroe area jurisdiction			715	1,229	1,090	351	154							
Expected misreporting/discard										3330				
French catches as reported to Faroese authorities				12	17									
Total used in the assessmer	34,595	21,391	23,182	22,068	13,487	8,660	6,220	5,988	8,818	22,494	40,107	34,027	23,740	20,025

[*)] Preliminary

Table 2.2.1.3. Faroe Plateau COD. The landings of faroese fleets (in percents) of total catch.

Year	Open boats	Longliners <100 GRT	Singletrawl <400 HP	Gill net	Jiggers	Singletrawl 400-1000 HP	Singletrawl >1000 HP	Pairtrawl <1000 HP	Pairtrawl >1000 HP	Longliners >100 GRT	Industrial trawlers	Others	Total Round.weig
1986	9.5	15.1	5.1	1.3	2.9	6.2	8.5	29.6	14.9	5.1	0.4	1.3	34,492
1987	9.9	14.8	6.2	0.5	2.9	6.7	8.0	26.0	14.5	9.9	0.5	0.1	21,303
1988	2.6	13.8	4.9	2.6	7.5	7.4	6.8	25.3	15.6	12.7	0.6	0.2	22,272
1989	4.4	29.0	5.7	3.2	9.3	5.7	5.5	10.5	8.3	17.7	0.7	0.0	20,535
1990	3.9	35.5	4.8	1.4	8.2	3.7	4.3	7.1	10.5	19.6	0.6	0.2	12,232
1991	4.3	31.6	7.1	2.0	8.0	3.4	4.7	8.3	12.9	17.2	0.6	0.1	8,203
1992	2.6	26.0	6.9	0.0	7.0	2.2	3.6	12.0	20.8	13.4	5.0	0.4	5,938
1993	2.2	16.0	15.4	0.0	9.0	4.1	3.6	14.2	21.7	12.6	0.8	0.4	5,744
1994	3.1	13.4	9.6	0.5	19.2	2.7	5.3	8.3	23.7	13.7	0.5	0.1	8,724
1995	4.2	17.9	6.5	0.3	24.9	4.1	4.7	6.4	12.3	18.5	0.1	0.0	19,079
1996	4.0	19.0	4.0	0.0	20.0	3.0	2.0	8.0	19.0	21.0	0.0	0.0	39,406
1997	3.1	28.4	4.4	0.5	9.8	5.1	2.9	4.8	11.3	29.7	0.0	0.1	33,556
1998	2.4	31.2	6.0	1.3	6.5	6.3	5.5	3.1	8.6	29.1	0.1	0.0	23,308
1999	2.7	24.0	5.4	2.3	5.4	5.2	11.8	6.4	14.5	21.9	0.4	0.1	19,256

Table 2.2.2.1. Faroe Plateau COD. Catch in numbers at age for each fleet in 1998. Numbers are in thousands and the catch is in tonnes, round weight.

Age\Fleet	Open boats	LL < 100 G	Jiggers	Gill netters	ST 0-399H	ST 400-10(	ST > 1000	PT < 1000	PT > 1000	LL > 100 G	Others	Total Far.	Foreign fle	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	10	88	16	0	0	0	0	0	0	4	0	119	0	119
2	69	576	74	7	10	27	23	24	19	415	1	1249	47	1296
3	38	297	31	24	45	83	111	64	115	226	5	1043	43	1086
4	20	169	44	17	60	56	107	60	127	168	4	835	39	874
5	39	346	78	18	79	70	142	63	135	188	7	1169	42	1211
6	94	839	129	31	154	111	234	100	240	404	9	2352	82	2434
7	12	99	24	9	22	17	38	30	82	117	2	454	26	480
8	1	9	3	1	4	2	4	3	5	29	0	61	4	65
9	0	4	1	0	2	0	1	0	2	7	0	18	1	19
10	0	0	0	0	0	0	0	0	0	4	0	5	0	5
11	0	1	0	0	0	0	0	0	0	0	0	2	0	2
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	1	0	1	0	1
14	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
Total Numl	283	2428	400	107	376	366	660	344	725	1563	28	7308	284	7592
Catch, t	528.36	4614.27	1043.4	440.67	1035.63	1004.55	2273.28	1226.55	2783.88	4213.56	92.13	19256.28	711	20025

Others include industrial bottom trawlers and longlining for Atlantic salmon and halibut.

Table 2.2.2.2 Faroe Plateau COD. Samples of lengths, otoliths and individual weights in 1999.

Fleet	Size	Samples	Length	Otoliths	Weights
Longliners	< 100 GRT	101	18,731	2,816	1,198
Longliners	> 100 GRT	52	9,438	1,920	1,020
Jiggers		12	1,551	539	538
Sing. trawlers	< 400 HP	22	3,897	780	600
Sing. trawlers	400-1000 HP	19	3,314	721	180
Sing. trawlers	> 1000 HP	2	286	120	120
Pair trawlers	< 1000 HP	20	3,655	540	479
Pair trawlers	> 1000 HP	47	8,962	1,319	1,018
Total		275	49,834	8,755	5,153

Table 2.2.2.3 Faroe Plateau COD. Catch in numbers at age 1961-99.

Run title : FaroePlateau cod Vb1 (run: XSAPET01/X01)
At 27/04/2000 12:26

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE									
2,	3093,	4424,	4110,	2033,	852,	1337,	1609,	1529,	878,
3,	2686,	2500,	3958,	3021,	3230,	970,	2690,	3322,	3106,
4,	1331,	1255,	1280,	2300,	2564,	2080,	860,	2663,	3300,
5,	1066,	855,	662,	630,	1416,	1339,	1706,	945,	1538,
6,	232,	481,	284,	350,	363,	606,	847,	1226,	477,
7,	372,	93,	204,	158,	155,	197,	309,	452,	713,
8,	78,	94,	48,	79,	48,	104,	64,	105,	203,
9,	29,	22,	30,	41,	63,	33,	27,	11,	92,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALNUM,	8887,	9724,	10576,	8612,	8691,	6666,	8112,	10253,	10307,
TONSLAND,	21598,	20967,	22215,	21078,	24212,	20418,	23562,	29930,	32371,
SOPCOF %,	91,	94,	96,	98,	113,	109,	102,	106,	109,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	402,	328,	875,	723,	2161,	2584,	1497,	425,	555,	575,
3,	1163,	757,	1176,	3124,	1266,	5689,	4158,	3282,	1219,	1732,
4,	2172,	821,	810,	1590,	1811,	2157,	3799,	6844,	2643,	1673,
5,	1685,	1287,	596,	707,	934,	2211,	1380,	3718,	3216,	1601,
6,	752,	1451,	1021,	384,	563,	813,	1427,	788,	1041,	1906,
7,	244,	510,	596,	312,	452,	295,	617,	1160,	268,	493,
8,	300,	114,	154,	227,	149,	190,	273,	239,	201,	134,
9,	44,	179,	25,	120,	141,	118,	120,	134,	66,	87,
+gp,	0,	0,	0,	97,	91,	150,	186,	9,	56,	38,
0 TOTALNUM,	6762,	5447,	5253,	7284,	7568,	14207,	13457,	16599,	9265,	8239,
TONSLAND,	24183,	23010,	18727,	22228,	24581,	36775,	39799,	34927,	26585,	23112,
SOPCOF %,	99,	123,	125,	101,	101,	97,	97,	70,	100,	98,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	1129,	646,	1139,	2149,	4396,	998,	210,	257,	509,	2237,
3,	2263,	4137,	1965,	5771,	5234,	9484,	3586,	1362,	2122,	2151,
4,	1461,	1981,	3073,	2760,	3487,	3795,	8462,	2611,	1945,	2187,
5,	895,	947,	1286,	2746,	1461,	1669,	2373,	3083,	1484,	1121,
6,	807,	582,	471,	1204,	912,	770,	907,	812,	2178,	1026,
7,	832,	487,	314,	510,	314,	872,	236,	224,	492,	997,
8,	339,	527,	169,	157,	82,	309,	147,	68,	168,	220,
9,	42,	123,	254,	104,	34,	65,	47,	69,	33,	61,
+gp,	18,	55,	122,	102,	66,	80,	38,	26,	25,	9,
0 TOTALNUM,	7786,	9485,	8793,	15503,	15986,	18042,	16006,	8512,	8956,	10009,
TONSLAND,	20513,	22963,	21489,	38133,	36979,	39484,	34595,	21391,	23182,	22068,
SOPCOF %,	106,	104,	100,	97,	97,	95,	96,	96,	101,	98,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	243,	190,	199,	118,	559,	2552,	348,	198,	450,	1296,
3,	2849,	446,	442,	786,	768,	2651,	5124,	1268,	737,	1086,
4,	1481,	2130,	453,	591,	1035,	1960,	4572,	6656,	1541,	874,
5,	852,	616,	886,	218,	519,	988,	1530,	3701,	5083,	1211,
6,	404,	300,	285,	323,	122,	454,	1514,	652,	1512,	2434,
7,	294,	141,	128,	94,	172,	115,	591,	634,	157,	480,
8,	291,	92,	52,	32,	38,	171,	146,	169,	117,	65,
9,	50,	52,	29,	22,	22,	43,	344,	51,	28,	19,
+gp,	26,	24,	33,	25,	16,	48,	47,	119,	25,	8,
0 TOTALNUM,	6490,	3991,	2507,	2209,	3251,	8982,	14216,	13448,	9650,	7473,
TONSLAND,	13487,	8660,	6220,	5988,	8818,	22494,	40107,	34027,	23740,	20025,
SOPCOF %,	99,	106,	102,	102,	101,	101,	99,	101,	103,	101,

Table 2.2.3.1. Faroe Plateau (sub-divisionVb1) COD. Catch weight at age 1961-99.

Run title : FaroePlateau cod Vb1 (run: XSAPET01/X01)
At 27/04/2000 12:26

Table 2 Catch weights at age (kg)

YEAR, AGE	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
2,	1.0800,	1.0000,	1.0400,	.9700,	.9200,	.9800,	.9600,	.8800,	1.0900,
3,	2.2200,	2.2700,	1.9400,	1.8300,	1.4500,	1.7700,	1.9300,	1.7200,	1.8000,
4,	3.4500,	3.3500,	3.5100,	3.1500,	2.5700,	2.7500,	3.1300,	3.0700,	2.8500,
5,	4.6900,	4.5800,	4.6000,	4.3300,	3.7800,	3.5100,	4.0400,	4.1200,	3.6700,
6,	5.5200,	4.9300,	5.5000,	6.0800,	5.6900,	4.8000,	4.7800,	4.6500,	4.8900,
7,	7.0900,	9.0800,	6.7800,	7.0000,	7.3100,	6.3200,	6.2500,	5.5000,	5.0500,
8,	9.9100,	6.5900,	8.7100,	6.2500,	7.9300,	7.5100,	7.0000,	7.6700,	7.4100,
9,	8.0300,	6.6600,	11.7200,	6.1900,	8.0900,	10.3400,	11.0100,	10.9500,	8.6600,
+gp,	10.2700,	10.2700,	10.8200,	14.3900,	11.1100,	11.6500,	10.6900,	9.2800,	14.3900,
0 SOPCOFAC,	.9068,	.9444,	.9573,	.9824,	1.1262,	1.0905,	1.0224,	1.0598,	1.0851,

Table 2 Catch weights at age (kg)

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
2,	.9600,	.8100,	.6600,	1.1100,	1.0800,	.7900,	.9400,	.8700,	1.1120,	.8970,
3,	2.2300,	1.8000,	1.6100,	2.0000,	2.2200,	1.7900,	1.7200,	1.7900,	1.3850,	1.6820,
4,	2.6900,	2.9800,	2.5800,	3.4100,	3.4400,	2.9800,	2.8400,	2.5300,	2.1400,	2.2110,
5,	3.9400,	3.5800,	3.2600,	3.8900,	4.8000,	4.2600,	3.7000,	3.6800,	3.1250,	3.0520,
6,	5.1400,	3.9400,	4.2900,	5.1000,	5.1800,	5.4600,	5.2600,	4.6500,	4.3630,	3.6420,
7,	6.4600,	4.8700,	4.9500,	5.1000,	5.8800,	6.2500,	6.4300,	5.3400,	5.9270,	4.7190,
8,	10.3100,	6.4800,	6.4800,	6.1200,	6.1400,	7.5100,	6.3900,	6.2300,	6.3480,	7.2720,
9,	7.3900,	6.3700,	6.9000,	8.6600,	8.6300,	7.3900,	8.5500,	8.3800,	8.7150,	8.3680,
+gp,	9.3400,	10.2200,	11.5500,	7.5700,	7.6200,	8.1700,	13.6200,	10.7200,	12.3000,	13.0420,
0 SOPCOFAC,	.9943,	1.2264,	1.2481,	1.0134,	1.0134,	.9709,	.9653,	.7012,	.9964,	.9843,

Table 2 Catch weights at age (kg)

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
2,	.9270,	1.0800,	1.2300,	1.3380,	1.1950,	.9050,	1.0990,	1.0930,	1.0610,	1.0100,
3,	1.4320,	1.4700,	1.4130,	1.9500,	1.8880,	1.6580,	1.4590,	1.5170,	1.7490,	1.5970,
4,	2.2200,	2.1800,	2.1380,	2.4030,	2.9800,	2.6260,	2.0460,	2.1600,	2.3000,	2.2000,
5,	3.1050,	3.2100,	3.1070,	3.1070,	3.6790,	3.4000,	2.9360,	2.7660,	2.9140,	2.9340,
6,	3.5390,	3.7000,	4.0120,	4.1100,	4.4700,	3.7520,	3.7860,	3.9080,	3.1090,	3.4680,
7,	4.3920,	4.2400,	5.4420,	5.0200,	5.4880,	4.2200,	4.6990,	5.4610,	3.9760,	3.7500,
8,	6.1000,	4.4300,	5.5630,	5.6010,	6.4660,	4.7390,	5.8930,	6.3410,	4.8960,	4.6820,
9,	7.6030,	6.6900,	5.2160,	8.0130,	6.6280,	6.5110,	9.7000,	8.5090,	7.0870,	6.1400,
+gp,	9.6680,	10.0000,	6.7070,	8.0310,	10.9810,	10.9810,	8.8150,	9.8110,	8.2870,	9.1560,
0 SOPCOFAC,	1.0584,	1.0408,	1.0030,	.9695,	.9685,	.9491,	.9625,	.9642,	1.0061,	.9774,

Table 2 Catch weights at age (kg)

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
2,	.9450,	.7790,	.9890,	1.1550,	1.1940,	1.2180,	1.0160,	.9010,	1.0040,	1.0500,
3,	1.3000,	1.2710,	1.3640,	1.7040,	1.8430,	1.9860,	1.7370,	1.3410,	1.4170,	1.5860,
4,	1.9590,	1.5700,	1.7790,	2.4210,	2.6130,	2.6220,	2.7450,	1.9580,	1.8020,	2.3500,
5,	2.5310,	2.5240,	2.3120,	3.1320,	3.6540,	3.9250,	3.8000,	3.0120,	2.2800,	2.7740,
6,	3.2730,	3.1850,	3.4770,	3.7230,	4.5840,	5.1800,	4.4550,	4.1580,	3.4780,	3.2140,
7,	4.6520,	4.0860,	4.5450,	4.9710,	4.9760,	6.0790,	4.9780,	4.4910,	5.4330,	5.4960,
8,	4.7580,	5.6560,	6.2750,	6.1590,	7.1460,	6.2410,	5.2700,	5.3120,	5.8510,	8.2760,
9,	6.7040,	5.9730,	7.6190,	7.6140,	8.5640,	7.7820,	5.5930,	6.1720,	7.9700,	9.1290,
+gp,	8.6890,	8.1470,	9.7250,	9.5870,	8.7960,	8.6270,	7.4820,	7.0560,	7.3630,	10.6520,
0 SOPCOFAC,	.9897,	1.0597,	1.0205,	1.0213,	1.0136,	1.0106,	.9940,	1.0106,	1.0292,	1.0137,

Table 2.2.4.1. Faroe Plateau (sub-division Vb1) COD. Proportion mature at age 1983-2000. From 1961-1982 the average from 1983-1996 is used.

Run title : FaroePlateau cod Vb1 (run: XSAPET01/X01)

At 27/04/2000 12:26

Table 5 Proportion mature at age

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE									
2	.1700	.1700	.1700	.1700	.1700	.1700	.1700	.1700	.1700
3	.6400	.6400	.6400	.6400	.6400	.6400	.6400	.6400	.6400
4	.8700	.8700	.8700	.8700	.8700	.8700	.8700	.8700	.8700
5	.9500	.9500	.9500	.9500	.9500	.9500	.9500	.9500	.9500
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5 Proportion mature at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
2	.1700	.1700	.1700	.1700	.1700	.1700	.1700	.1700	.1700	.1700
3	.6400	.6400	.6400	.6400	.6400	.6400	.6400	.6400	.6400	.6400
4	.8700	.8700	.8700	.8700	.8700	.8700	.8700	.8700	.8700	.8700
5	.9500	.9500	.9500	.9500	.9500	.9500	.9500	.9500	.9500	.9500
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5 Proportion mature at age

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	.1700	.1700	.1700	.6300	.4000	.0000	.0000	.0000	.0600	.0500
3	.6400	.6400	.6400	.7100	.9600	.5000	.3800	.6700	.7200	.5400
4	.8700	.8700	.8700	.9300	.9800	.9600	.9300	.9100	.9000	.9800
5	.9500	.9500	.9500	.9400	.9700	.9600	1.0000	1.0000	.9700	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9600	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9400	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5 Proportion mature at age

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
2	.0000	.0000	.0600	.2500	.7200	.2100	.0400	.0700	.0000	.0200
3	.6800	.7200	.5000	.7300	.8900	.5300	.4400	.7500	.7400	.3900
4	.9000	.8600	.8200	.7800	.9800	.5500	.7500	.9500	.9300	.7000
5	.9900	1.0000	.9800	.9100	.9900	.7400	.8700	.9800	.9900	.9200
6	.9600	1.0000	1.0000	.9900	1.0000	.9700	.9400	1.0000	1.0000	.9900
7	.9800	1.0000	1.0000	1.0000	.9800	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.2.6.1.1. Faroe Plateau (sub-division Vb1) COD. The two tuning series used in the assessment. For Cuba trawlers the effort is in number of trawling hours and for longliners in 1000 hooks. The catch in number at age for both fleets is in thousands.

```
FAROE PLATEAU COD (ICES SUBDIVISION VB1)        C8L52.DAT
102
CUBA TRAWLERS
1985 1999
1 1 0.0 1.0
2 9
   2413     0.9    22.6    13.3     6.0     2.4     2.9     1.0     0.4
   2825     0.6     9.1    34.3    13.3     5.7     1.5     0.9     0.3
   5284     0.5     7.7    21.0    31.8    11.4     3.0     0.7     0.5
   6351     0.5    11.9    14.4    13.6    20.7     5.0     1.9     0.3
   5873     0.8     6.1    12.7    10.0     8.7     8.3     2.1     0.6
   7007     0.2    17.2    18.4    11.4     5.8     3.6     3.6     0.6
   7005     0.1     1.9    11.9     7.3     4.0     2.2     1.5     0.7
   5181     0.1     1.6     3.1     8.9     3.6     1.6     0.7     0.3
   4660     0.4     6.9     9.3     4.2     5.6     2.1     0.6     0.4
   4462     2.0     6.4     8.6    10.6     3.0     3.7     0.8     0.6
   4471     4.5    12.3    20.4    15.2     7.6     1.7     2.0     0.6
   2473     0.7    23.2    22.7     7.8     4.9     1.2     0.0     0.5
   2658     0.1     3.3    28.6    23.9     4.3     2.2     0.4     0.0
   3205     0.1     3.1     7.6    17.1    10.6     1.6     0.9     0.2
   6500     2.5    15.2    16.8    17.9    31.7    10.8     0.7     0.3
LONGLINERS
1986 1999
1 1 0.0 1.0
2 6
   2071       1      70     220      94      49
    827       1       5      28      50      25
   1537      10      68      65      61      81
   4277     236     230     218     122     144
   6060      34     357     186     138      91
   4561      13      45     278      94      50
   3957      23      57      57     109      40
   5517      10     263     256      88     158
   3024     161     205     102      64      20
   3069     105     268     154     106      63
   9816      41    1295    1265     506     696
  15602      48     551    3808    2429     544
  15655     288     455     766    2865     959
  14192     672     366     272     304     654
```

Table 2.2.6.1.2. Faroe Plateau (sub-division Vb1) COD. Final XSA run.

```
Lowestoft VPA Version 3.1


   27/04/2000  12:19


 Extended Survivors Analysis

 FaroePlateau cod Vb1 (run: XSAPET01/X01)

 CPUE data from file fleet

 Catch data for  39 years. 1961 to 1999. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,     year, year,  age ,  age
 FLT01: CUBA TRAWLERS,   1985, 1999,   2,     9,   .000,  1.000
 FLT02: LONGLINERS (C,   1986, 1999,   2,     6,   .000,  1.000


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years


 Catchability analysis :

      Catchability dependent on stock size for ages <    3

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  3


      Catchability independent of age for ages >=    6


 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 =   2.000

      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 =     .00016

 Final year F values
 Age          ,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 29,  .0657,  .1580,  .3198,  .5665,  .7837,  .3398,  .3496,  .4936
 Iteration 30,  .0657,  .1580,  .3198,  .5665,  .7837,  .3398,  .3494,  .4936


 Regression weights
       ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000
```

Table 2.2.6.1.2 (Continued)

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	.079	.032	.020	.013	.022	.070	.038	.034	.048	.066
3	.358	.204	.098	.101	.107	.141	.194	.190	.173	.158
4	.605	.500	.330	.184	.188	.433	.383	.416	.372	.320
5	.700	.549	.400	.262	.245	.275	.727	.617	.657	.566
6	.711	.573	.533	.247	.229	.351	.900	.812	.556	.784
7	.881	.583	.516	.333	.201	.350	1.104	1.371	.459	.340
8	1.162	.776	.441	.231	.217	.316	1.052	1.220	1.087	.349
9	.754	.653	.601	.338	.246	.409	2.436	1.586	.660	.494

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1990	3.53E+03	1.05E+04	3.61E+03	1.87E+03	8.77E+02	5.55E+02	4.68E+02	1.04E+02
1991	6.60E+03	2.67E+03	5.98E+03	1.61E+03	7.60E+02	3.53E+02	1.88E+02	1.20E+02
1992	1.13E+04	5.23E+03	1.78E+03	2.97E+03	7.63E+02	3.51E+02	1.61E+02	7.10E+01
1993	1.04E+04	9.03E+03	3.88E+03	1.05E+03	1.63E+03	3.66E+02	1.71E+02	8.48E+01
1994	2.79E+04	8.38E+03	6.68E+03	2.64E+03	6.60E+02	1.04E+03	2.15E+02	1.11E+02
1995	4.20E+04	2.23E+04	6.16E+03	4.54E+03	1.69E+03	4.30E+02	6.98E+02	1.42E+02
1996	1.03E+04	3.20E+04	1.59E+04	3.27E+03	2.82E+03	9.77E+02	2.48E+02	4.17E+02
1997	6.48E+03	8.10E+03	2.16E+04	8.88E+03	1.30E+03	9.39E+02	2.65E+02	7.09E+01
1998	1.05E+04	5.12E+03	5.48E+03	1.17E+04	3.92E+03	4.71E+02	1.95E+02	6.41E+01
1999	2.25E+04	8.21E+03	3.53E+03	3.09E+03	4.95E+03	1.84E+03	2.44E+02	5.39E+01

Estimated population abundance at 1st Jan 2000

0.00E+00	1.73E+04	5.74E+03	2.10E+03	1.44E+03	1.85E+03	1.07E+03	1.41E+02

Taper weighted geometric mean of the VPA populations:

1.25E+04	9.30E+03	6.25E+03	3.51E+03	1.72E+03	7.02E+02	2.66E+02	1.05E+02

Standard error of the weighted Log(VPA populations) :

.6767	.6748	.6928	.6900	.6772	.5798	.4505	.5674

1

Log catchability residuals.

Fleet : FLT01: CUBA TRAWLERS

Age	1985	1986	1987	1988	1989
2	.40	.65	.11	.15	-.04
3	.52	.42	.13	.37	.00
4	.11	.30	.10	.00	.08
5	-.17	.26	-.12	-.29	.08
6	-.09	.31	.10	-.13	.06
7	.24	.39	-.10	-.05	.13
8	.21	.13	.00	.08	.26
9	.09	.01	-.12	-.08	.01

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	.48	-.57	-.93	.03	.01	.09	.74	.02	-.57	.15
3	.39	-.52	-1.11	-.09	-.04	-.36	.54	-.11	.09	.49
4	.48	-.50	-.41	-.05	-.63	.43	.15	.02	-.14	.36
5	.22	-.14	-.32	.01	.05	-.12	.33	.34	-.44	.18
6	.09	-.19	-.02	-.36	-.04	.00	-.12	.42	-.09	.17
7	.15	-.02	-.06	.19	-.30	-.13	-.39	.29	.10	-.11
8	.43	.31	-.14	-.35	-.25	-.47	99.99	-.21	.67	-.82
9	-.03	-.06	-.10	.00	.13	-.03	.05	99.99	.10	-.10

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	-15.3885	-14.2417	-13.7578	-13.5460	-13.5460	-13.5460	-13.5460
S.E(Log q)	.4665	.3504	.2569	.2022	.2176	.4375	.0821

Table 2.2.6.1.2 (Continued)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2,	.59,	1.802,	14.72,	.66,	15,	.49,	-18.44,

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,	.75,	1.671,	13.85,	.83,	15,	.33,	-15.39,
4,	.93,	.446,	13.88,	.82,	15,	.34,	-14.24,
5,	1.07,	-.578,	14.16,	.87,	15,	.28,	-13.76,
6,	.99,	.071,	13.51,	.92,	15,	.21,	-13.55,
7,	1.09,	-.685,	14.16,	.87,	15,	.24,	-13.55,
8,	1.06,	-.169,	14.05,	.52,	14,	.48,	-13.60,
9,	.96,	.925,	13.18,	.98,	14,	.08,	-13.55,

1

Fleet : FLT02: LONGLINERS (C

Age	1985,	1986,	1987,	1988,	1989
2 ,	99.99,	-1.71,	-1.16,	.13,	1.06
3 ,	99.99,	-.44,	-1.66,	.32,	.73
4 ,	99.99,	-.33,	-.56,	.12,	.43
5 ,	99.99,	-.16,	-.50,	-.06,	.21
6 ,	99.99,	-.06,	-.08,	-.17,	.36
7 ,	No data for this fleet at this age				
8 ,	No data for this fleet at this age				
9 ,	No data for this fleet at this age				

Age	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
2 ,	.95,	-.15,	-.20,	-.91,	.38,	-.31,	-.33,	-.08,	.65,	.53
3 ,	.36,	-.14,	-.48,	.17,	.60,	-.11,	-.03,	.02,	.28,	-.32
4 ,	.14,	.28,	-.03,	.29,	-.57,	.02,	-.01,	.34,	.09,	-.44
5 ,	.17,	.15,	-.24,	.20,	-.45,	-.49,	.44,	.50,	.40,	-.45
6 ,	.17,	-.06,	-.17,	-.01,	-.58,	-.34,	.63,	.66,	.01,	-.41
7 ,	No data for this fleet at this age									
8 ,	No data for this fleet at this age									
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 ,	3,	4,	5,	6
Mean Log q,	-12.1755,	-11.4397,	-11.0683,	-10.7219,
S.E(Log q),	.5093,	.3262,	.3827,	.3913,

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2,	.67,	.951,	12.52,	.48,	14,	.73,	-14.04,

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,	1.00,	.009,	12.17,	.62,	14,	.53,	-12.18,
4,	.97,	.200,	11.36,	.83,	14,	.33,	-11.44,
5,	.95,	.326,	10.91,	.79,	14,	.38,	-11.07,
6,	.96,	.235,	10.59,	.77,	14,	.39,	-10.72,

1

Table 2.2.6.1.2 (Continued)

Terminal year survivor and F summaries :

Age 2 Catchability dependent on age and year class strength

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: CUBA TRAWLERS,	20029.,	.532,	.000,	.00,	1,	.462,	.057
FLT02: LONGLINERS (C,	29386.,	.814,	.000,	.00,	1,	.197,	.039
P shrinkage mean ,	9303.,	.67,,,,				.306,	.119
F shrinkage mean ,	26900.,	2.00,,,,				.035,	.043

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17257.,	.37,	.29,	4,	.805,	.066

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: CUBA TRAWLERS,	5831.,	.358,	.529,	1.48,	2,	.585,	.156
FLT02: LONGLINERS (C,	5615.,	.438,	.449,	1.02,	2,	.393,	.161
F shrinkage mean ,	5602.,	2.00,,,,				.022,	.162

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5740.,	.27,	.25,	5,	.898,	.158

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: CUBA TRAWLERS,	2615.,	.256,	.110,	.43,	3,	.513,	.264
FLT02: LONGLINERS (C,	1660.,	.270,	.212,	.78,	3,	.474,	.390
F shrinkage mean ,	1822.,	2.00,,,,				.013,	.361

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2099.,	.19,	.13,	7,	.718,	.320

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: CUBA TRAWLERS,	1625.,	.200,	.145,	.72,	4,	.570,	.515
FLT02: LONGLINERS (C,	1212.,	.229,	.148,	.64,	4,	.418,	.644
F shrinkage mean ,	1654.,	2.00,,,,				.012,	.508

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1438.,	.15,	.10,	9,	.680,	.566

Table 2.2.6.1.2 (Continued)

```
 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 1993

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: CUBA TRAWLERS,      1858.,   .184,       .144,    .78,   5,  .602,     .782
 FLT02: LONGLINERS (C,      1810.,   .222,       .188,    .85,   5,  .382,     .796

   F shrinkage mean  ,      2839.,   2.00,,,,                        .015,     .574

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1851.,       .14,      .10,   11,    .724,   .784


 Age  7   Catchability constant w.r.t. time and age (fixed at the value for age)  6

 Year class = 1992

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: CUBA TRAWLERS,      1043.,   .170,       .076,    .45,   6,  .739,     .348
 FLT02: LONGLINERS (C,      1217.,   .219,       .111,    .51,   5,  .250,     .305

   F shrinkage mean  ,       425.,   2.00,,,,                        .011,     .704

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1073.,       .14,      .07,   12,    .476,   .340


1
 Age  8   Catchability constant w.r.t. time and age (fixed at the value for age)  6

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: CUBA TRAWLERS,       132.,   .183,       .196,   1.07,   7,  .815,     .370
 FLT02: LONGLINERS (C,       216.,   .226,       .170,    .75,   5,  .168,     .241

   F shrinkage mean  ,        49.,   2.00,,,,                        .016,     .786

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       141.,       .16,      .15,   13,    .935,   .349


 Age  9   Catchability constant w.r.t. time and age (fixed at the value for age)  6

 Year class = 1990

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: CUBA TRAWLERS,        27.,   .234,       .100,    .43,   8,  .933,     .493
 FLT02: LONGLINERS (C,        25.,   .204,       .264,   1.29,   5,  .041,     .522

   F shrinkage mean  ,        28.,   2.00,,,,                        .026,     .475

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        27.,       .22,      .08,   14,    .343,   .494
```

Table 2.2.6.1.3. Faroe Plateau (sub-division Vb1) COD. Fishing mortality at age.

Run title : FaroePlateau cod Vb1 (run: XSAPET01/X01)
At 27/04/2000 12:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR, AGE	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
2,	.3346,	.2701,	.2534,	.1086,	.1209,	.0829,	.0789,	.1010,	.1099,
3,	.5141,	.4982,	.4138,	.2997,	.2518,	.1969,	.2389,	.2318,	.3063,
4,	.4986,	.4838,	.5172,	.4523,	.4498,	.2552,	.2687,	.3949,	.3806,
5,	.5737,	.7076,	.5124,	.5229,	.5622,	.4499,	.3442,	.5339,	.4179,
6,	.4863,	.5569,	.5405,	.5659,	.6604,	.5016,	.5779,	.4472,	.5709,
7,	.9566,	.3662,	.4879,	.6677,	.5304,	.9680,	.5203,	.7132,	.5118,
8,	.8116,	.6826,	.3269,	.3531,	.4345,	.8519,	1.0438,	.3331,	.8457,
9,	.6715,	.5641,	.4806,	.5164,	.5318,	.6106,	.5555,	.4882,	.5499,
+gp,	.6715,	.5641,	.4806,	.5164,	.5318,	.6106,	.5555,	.4882,	.5499,
0 FBAR 3- 7,	.6059,	.5226,	.4944,	.5017,	.4909,	.4743,	.3900,	.4642,	.4375,

Table 8 Fishing mortality (F) at age

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
2,	.0530,	.0309,	.0464,	.0656,	.0816,	.0774,	.0932,	.0481,	.0578,	.0431,
3,	.2081,	.1337,	.1476,	.2321,	.1568,	.3191,	.1721,	.3032,	.1894,	.2570,
4,	.3654,	.2225,	.2070,	.3047,	.2046,	.4357,	.3662,	.4741,	.4282,	.4301,
5,	.3408,	.3845,	.2497,	.2812,	.2952,	.4132,	.5564,	.7521,	.4279,	.5033,
6,	.3708,	.5572,	.6057,	.2526,	.3796,	.4543,	.5165,	.7323,	.4837,	.4887,
7,	.6559,	.4650,	.4686,	.3722,	.5328,	.3502,	.7615,	1.1127,	.5952,	.4460,
8,	.4208,	.7527,	.2464,	.3258,	.3051,	.4484,	.6425,	.7766,	.5661,	.6867,
9,	.4338,	.4800,	.3577,	.3091,	.3456,	.4233,	.5734,	.7772,	.5041,	.5150,
+gp,	.4338,	.4800,	.3577,	.3091,	.3456,	.4233,	.5734,	.7772,	.5041,	.5150,
0 FBAR 3- 7,	.3882,	.3526,	.3357,	.2886,	.3138,	.3945,	.4745,	.6749,	.4249,	.4250,

Table 8 Fishing mortality (F) at age

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
2,	.0549,	.0525,	.0584,	.0991,	.1074,	.0660,	.0248,	.0284,	.0657,	.1770,
3,	.2381,	.2910,	.2233,	.4659,	.3708,	.3547,	.3559,	.2215,	.3425,	.4316,
4,	.3594,	.3388,	.3659,	.5608,	.5762,	.5066,	.6237,	.4782,	.5663,	.7219,
5,	.4326,	.4192,	.3854,	.6583,	.6660,	.6080,	.7009,	.4866,	.5545,	.7685,
6,	.5154,	.5619,	.3803,	.7713,	.4746,	.9396,	.8107,	.5524,	.7782,	.9831,
7,	.4094,	.6872,	.6869,	.9467,	.4626,	1.2354,	.8762,	.4730,	.7889,	1.0741,
8,	.6388,	.4966,	.5426,	.9241,	.3706,	1.2276,	.6978,	.6798,	.8075,	1.0671,
9,	.4747,	.5047,	.4758,	.7800,	.5141,	.5699,	.5947,	.8644,	.8606,	.8007,
+gp,	.4747,	.5047,	.4758,	.7800,	.5141,	.5699,	.5947,	.8644,	.8606,	.8007,
0 FBAR 3- 7,	.3910,	.4596,	.4084,	.6806,	.5100,	.7289,	.6734,	.4423,	.6061,	.7958,

Table 8 Fishing mortality (F) at age

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
2,	.0792,	.0323,	.0197,	.0127,	.0224,	.0696,	.0381,	.0344,	.0484,	.0657,	.0495,
3,	.3583,	.2044,	.0980,	.1011,	.1068,	.1405,	.1944,	.1900,	.1731,	.1580,	.1737,
4,	.6050,	.5001,	.3304,	.1842,	.1877,	.4329,	.3825,	.4163,	.3720,	.3198,	.3693,
5,	.7003,	.5487,	.4000,	.2615,	.2446,	.2754,	.7267,	.6175,	.6570,	.5665,	.6136,
6,	.7115,	.5732,	.5328,	.2471,	.2286,	.3510,	.8997,	.8120,	.5556,	.7837,	.7171,
7,	.8806,	.5835,	.5164,	.3334,	.2013,	.3505,	1.1045,	1.3711,	.4594,	.3398,	.7235,
8,	1.1619,	.7761,	.4414,	.2312,	.2174,	.3158,	1.0522,	1.2198,	1.0866,	.3494,	.8853,
9,	.7536,	.6526,	.6007,	.3379,	.2464,	.4088,	2.4360,	1.5861,	.6596,	.4936,	.9131,
+gp,	.7536,	.6526,	.6007,	.3379,	.2464,	.4088,	2.4360,	1.5861,	.6596,	.4936,	
0 FBAR 3- 7,	.6511,	.4820,	.3755,	.2255,	.1938,	.3101,	.6616,	.6814,	.4434,	.4336,	

Table 2.2.6.1.4. Faroe Plateau (sub-division Vb1) COD. Stock number at age.

Run title : FaroePlateau cod Vb1 (run: XSAPET01/X01)

At 27/04/2000 12:26

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE									
2,	12019,	20654,	20290,	21834,	8269,	18566,	23451,	17583,	9326,
3,	7385,	7042,	12907,	12893,	16037,	5999,	13991,	17744,	13012,
4,	3747,	3616,	3503,	6986,	7823,	10207,	4034,	9021,	11522,
5,	2699,	1863,	1825,	1710,	3639,	4085,	6475,	2525,	4976,
6,	666,	1245,	752,	895,	830,	1698,	2133,	3758,	1212,
7,	668,	335,	584,	358,	416,	351,	842,	980,	1967,
8,	155,	210,	190,	294,	151,	200,	109,	410,	393,
9,	66,	56,	87,	112,	169,	80,	70,	31,	240,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTAL,	27403,	35021,	40138,	45083,	37333,	41186,	51104,	52051,	42648,

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	8609,	11929,	21323,	12576,	30495,	38356,	18595,	10006,	10929,	15054,
3,	6841,	6685,	9470,	16666,	9642,	23012,	29065,	13870,	7807,	8446,
4,	7843,	4549,	4788,	6689,	10818,	6749,	13693,	20034,	8386,	5289,
5,	6447,	4456,	2981,	3187,	4038,	7219,	3574,	7773,	10210,	4474,
6,	2682,	3754,	2484,	1902,	1970,	2461,	3910,	1677,	3000,	5449,
7,	561,	1516,	1761,	1110,	1209,	1103,	1279,	1910,	660,	1514,
8,	965,	238,	779,	902,	626,	581,	636,	489,	514,	298,
9,	138,	519,	92,	499,	533,	378,	304,	274,	184,	239,
+gp,	0,	0,	0,	400,	342,	476,	466,	18,	155,	103,
0 TOTAL,	34087,	33646,	43678,	43932,	59674,	80335,	71522,	56051,	41846,	40868,

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	23365,	13968,	22175,	25182,	47726,	17269,	9487,	10161,	8845,	15242,
3,	11805,	18108,	10851,	17125,	18672,	35097,	13236,	7577,	8087,	6781,
4,	5348,	7618,	11082,	7106,	8799,	10552,	20154,	7592,	4971,	4701,
5,	2817,	3056,	4444,	6293,	3321,	4049,	5205,	8844,	3853,	2310,
6,	2215,	1496,	1645,	2475,	2667,	1397,	1805,	2114,	4451,	1812,
7,	2737,	1083,	698,	921,	937,	1359,	447,	657,	996,	1674,
8,	794,	1488,	446,	288,	293,	483,	323,	152,	335,	371,
9,	123,	343,	741,	212,	93,	165,	116,	132,	63,	122,
+gp,	52,	152,	353,	205,	180,	201,	93,	49,	47,	18,
0 TOTAL,	49255,	47312,	52437,	59807,	82689,	70572,	50865,	37278,	31649,	33031,

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 61-97	AMST 61-97
AGE													
2,	3525,	6598,	11253,	10364,	27911,	41966,	10276,	6478,	10527,	22510,	0,	14913,	17342,
3,	10455,	2666,	5230,	9033,	8378,	22346,	32050,	8098,	5125,	8211,	17257,	11340,	13084,
4,	3606,	5982,	1779,	3882,	6685,	6165,	15897,	21604,	5483,	3529,	5740,	7059,	8184,
5,	1870,	1612,	2970,	1047,	2644,	4536,	3274,	8878,	11665,	3095,	2099,	3676,	4194,
6,	877,	760,	763,	1630,	660,	1695,	2820,	1296,	3920,	4951,	1438,	1750,	2028,
7,	555,	353,	351,	366,	1042,	430,	977,	939,	471,	1841,	1851,	823,	963,
8,	468,	188,	161,	171,	215,	698,	248,	265,	195,	244,	1073,	346,	420,
9,	104,	120,	71,	85,	111,	142,	417,	71,	64,	54,	141,	149,	197,
+gp,	54,	55,	80,	96,	81,	157,	55,	161,	56,	22,	38,		
0 TOTAL,	21514,	18334,	22658,	26675,	47727,	78134,	66012,	47790,	37506,	44457,	29637,		

Table 2.2.6.1.5. Faroe Plateau (sub-division Vb1) COD. Summary table.

Run title : FaroePlateau cod Vb1 (run: XSAPET01/X01) ,
At 27/04/2000 12:26

Table 16 Summary (without SOP correction)
Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1961,	12019,	65428,	46439,	21598,	.4651,	.6059,
1962,	20654,	68225,	43326,	20967,	.4839,	.5226,
1963,	20290,	77602,	49054,	22215,	.4529,	.4944,
1964,	21834,	84666,	55362,	21078,	.3807,	.5017,
1965,	8269,	75043,	57057,	24212,	.4243,	.4909,
1966,	18566,	83919,	60629,	20418,	.3368,	.4743,
1967,	23451,	105291,	73935,	23562,	.3187,	.3900,
1968,	17583,	110435,	82485,	29930,	.3629,	.4642,
1969,	9326,	105540,	83489,	32371,	.3877,	.4375,
1970,	8609,	98403,	82038,	24183,	.2948,	.3882,
1971,	11929,	78224,	63312,	23010,	.3634,	.3526,
1972,	21323,	76447,	57186,	18727,	.3275,	.3357,
1973,	12576,	110731,	83560,	22228,	.2660,	.2886,
1974,	30495,	139304,	98455,	24581,	.2497,	.3138,
1975,	38356,	153736,	109605,	36775,	.3355,	.3945,
1976,	18595,	161382,	123160,	39799,	.3231,	.4745,
1977,	10006,	136360,	112177,	34927,	.3114,	.6749,
1978,	10929,	96592,	78684,	26585,	.3379,	.4249,
1979,	15054,	85565,	67040,	23112,	.3447,	.4250,
1980,	23365,	85319,	59275,	20513,	.3461,	.3910,
1981,	13968,	88654,	63902,	22963,	.3593,	.4596,
1982,	22175,	99227,	67298,	21489,	.3193,	.4084,
1983,	25182,	123470,	98951,	38133,	.3854,	.6806,
1984,	47726,	152274,	115754,	36979,	.3195,	.5100,
1985,	17269,	131846,	85462,	39484,	.4620,	.7289,
1986,	9487,	99033,	73549,	34595,	.4704,	.6734,
1987,	10161,	77878,	61503,	21391,	.3478,	.4423,
1988,	8845,	66470,	52207,	23182,	.4440,	.6061,
1989,	15242,	58553,	38739,	22068,	.5697,	.7958,
1990,	3525,	37564,	28963,	13487,	.4657,	.6511,
1991,	6598,	28077,	20674,	8660,	.4189,	.4820,
1992,	11253,	34870,	20134,	6220,	.3089,	.3755,
1993,	10364,	50550,	34993,	5988,	.1711,	.2255,
1994,	27911,	87305,	75725,	8818,	.1164,	.1938,
1995,	41966,	147666,	74261,	22494,	.3029,	.3101,
1996,	10276,	143660,	89182,	40107,	.4497,	.6616,
1997,	6478,	98325,	87531,	34027,	.3887,	.6814,
1998,	10527,	72569,	59154,	23740,	.4013,	.4434,
1999,	22510,	82317,	47876,	20025,	.4183,	.4336,
Arith. Mean ,	17300,	94321,	68773,	24478,	.3649,	.4771,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.2.7.1.1. Faroe Plateau (sub-division Vb1) COD. Input data to RCT3.

```
FAROE PLATEAU COD: GROUNDFISH SURVEY AND 0-GROUP SURVEY DATA
3 11 2
'Yrclass'   'VPA'  'Ogrpsurv'     'Suage2'     'Suage3'
1989         6598         78         2.54         2.10
1990        11253        523         1.48         4.48
1991        10364         17         0.41         3.74
1992        27911        120         4.72         9.77
1993        41966       1193         7.67        52.93
1994        10276        664         2.91        13.98
1995         6478         59         1.03         9.99
1996        10527        380         0.45        13.94
1997          -11       1196         4.96          -11
1998          -11       8676          -11          -11
1999          -11       6202          -11          -11
```

Table 2.2.7.1.2. Faroe Plateau (sub-division Vb1) COD. Output from RCT3.

```
Analysis by RCT3 ver3.1 of data from file :

 codrct3.dat

 FAROE PLATEAU COD: GROUNDFISH SURVEY AND 0-GROUP SURVEY DATA

 Data for    3 surveys over   11 years :  1989 - 1999

 Regression type = C
 Tapered time weighting applied
 power =    3 over  20 years
 Survey weighting not applied

 Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as    .20
 Minimum of   3 points used for regression

 Forecast/Hindcast variance correction used.

 Yearclass =   1997
          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept   Error           Pts  Value   Value    Error   Weights

 Ogrpsu     .98   4.32   1.34   .226      8   7.09   11.23    1.817     .078
 Suage2    1.38   7.92    .66   .549      8   1.79   10.38     .864     .344
 Suage3
                                        VPA Mean =    9.45     .666     .578

 Yearclass =   1998
          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept   Error           Pts  Value   Value    Error   Weights

 Ogrpsu     .98   4.31   1.34   .227      8   9.07   13.16    2.322     .077
 Suage2
 Suage3
                                        VPA Mean =    9.45     .668     .923

 Yearclass =   1999
          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept   Error           Pts  Value   Value    Error   Weights

 Ogrpsu     .98   4.30   1.35   .228      8   8.73   12.83    2.269     .080
 Suage2
 Suage3
                                        VPA Mean =    9.45     .671     .920


 Year      Weighted      Log      Int      Ext      Var      VPA       Log
 Class      Average      WAP      Std      Std     Ratio               VPA
          Prediction             Error    Error

 1997       20094       9.91      .51      .41      .65
 1998       16916       9.74      .64      .99     2.36
 1999       16749       9.73      .64      .92     2.04
```

Table 2.2.7.1.3. Faroe Plateau (sub-division Vb1) COD. Input to management option table.

```
The SAS System                           19:14 Friday, April 28, 2000
   Faroe Plateau cod (Sub-division Vb1)

                  Prediction with management option table: Input data
```

Year: 2000								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	16916.000	0.2000	0.0200	0.0000	0.0000	0.985	0.0413	0.985
3	15405.000	0.2000	0.4300	0.0000	0.0000	1.448	0.1450	1.448
4	5740.000	0.2000	0.8800	0.0000	0.0000	2.037	0.3082	2.037
5	2099.000	0.2000	0.9800	0.0000	0.0000	2.689	0.5121	2.689
6	1438.000	0.2000	1.0000	0.0000	0.0000	3.618	0.5985	3.618
7	1851.000	0.2000	1.0000	0.0000	0.0000	5.141	0.6039	5.141
8	1073.000	0.2000	1.0000	0.0000	0.0000	6.481	0.7389	6.481
9	141.000	0.2000	1.0000	0.0000	0.0000	7.757	0.7621	7.757
10+	38.000	0.2000	1.0000	0.0000	0.0000	8.837	.	8.837
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	16749.000	0.2000	0.0100	0.0000	0.0000	0.985	0.0413	0.985
3	.	0.2000	0.5200	0.0000	0.0000	1.448	0.1450	1.448
4	.	0.2000	0.8400	0.0000	0.0000	2.037	0.3082	2.037
5	.	0.2000	0.9600	0.0000	0.0000	2.689	0.5121	2.689
6	.	0.2000	1.0000	0.0000	0.0000	3.618	0.5985	3.618
7	.	0.2000	1.0000	0.0000	0.0000	5.141	0.6039	5.141
8	.	0.2000	1.0000	0.0000	0.0000	6.481	0.7389	6.481
9	.	0.2000	1.0000	0.0000	0.0000	7.757	0.7621	7.757
10+	.	0.2000	1.0000	0.0000	0.0000	8.837	.	8.837
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	14937.000	0.2000	0.0100	0.0000	0.0000	0.985	0.0413	0.985
3	.	0.2000	0.5200	0.0000	0.0000	1.448	0.1450	1.448
4	.	0.2000	0.8400	0.0000	0.0000	2.037	0.3082	2.037
5	.	0.2000	0.9600	0.0000	0.0000	2.689	0.5121	2.689
6	.	0.2000	1.0000	0.0000	0.0000	3.618	0.5985	3.618
7	.	0.2000	1.0000	0.0000	0.0000	5.141	0.6039	5.141
8	.	0.2000	1.0000	0.0000	0.0000	6.481	0.7389	6.481
9	.	0.2000	1.0000	0.0000	0.0000	7.757	0.7621	7.757
10+	.	0.2000	1.0000	0.0000	0.0000	8.837	.	8.837
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

```
 Notes: Run name     : MANPET05
        Date and time: 28APR00:19:15
```

Table 2.2.7.1.4. Faroe Plateau (sub-division Vb1) COD. Management option table.

The SAS System 19:14 Friday, April 28, 2000
Faroe Plateau cod (Sub-division Vb1)

Prediction with management option table

(cont.)

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4335	79408	48512	18201	0.0000	0.0000	82927	53430	0	104010	75406
.	.	.	.	.	0.1000	0.0434	.	53430	2282	101542	73058
.	.	.	.	.	0.2000	0.0867	.	53430	4462	99179	70813
.	.	.	.	.	0.3000	0.1301	.	53430	6544	96917	68666
.	.	.	.	.	0.4000	0.1734	.	53430	8536	94750	66613
.	.	.	.	.	0.5000	0.2168	.	53430	10441	92672	64649
.	.	.	.	.	0.6000	0.2601	.	53430	12264	90681	62768
.	.	.	.	.	0.7000	0.3035	.	53430	14009	88771	60967
.	.	.	.	.	0.8000	0.3468	.	53430	15681	86938	59242
.	.	.	.	.	0.9000	0.3902	.	53430	17283	85178	57589
.	.	.	.	.	1.0000	0.4335	.	53430	18819	83488	56004
.	.	.	.	.	1.1000	0.4769	.	53430	20293	81865	54483
.	.	.	.	.	1.2000	0.5202	.	53430	21707	80304	53025
.	.	.	.	.	1.3000	0.5636	.	53430	23065	78804	51625
.	.	.	.	.	1.4000	0.6070	.	53430	24370	77360	50280
.	.	.	.	.	1.5000	0.6503	.	53430	25623	75971	48989
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

(cont.)

Notes: Run name : MANPET05
Date and time : 28APR00:19:15
Computation of ref. F: Simple mean, age 3 - 7
Basis for 2000 : F factors

Table 2.2.7.3.1. Faroe Plateau (sub-division Vb1) COD. Input data to yield per recruit calculations.

16:36 Tuesday, May 2, 2000

Faroe Plateau cod (Sub-division Vb1)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	1	0.2	0.14	0	0	1.01	0.0749	1.01
3	.	0.2	0.63	0	0	1.714	0.2351	1.714
4	.	0.2	0.87	0	0	2.582	0.372	2.582
5	.	0.2	0.96	0	0	3.48	0.4545	3.48
6	.	0.2	0.99	0	0	4.371	0.5175	4.371
7	.	0.2	1	0	0	5.459	0.5887	5.459
8	.	0.2	1	0	0	6.511	0.5862	6.511
9	.	0.2	1	0	0	7.851	0.5662	7.851
10+	.	0.2	1	0	0	9.922	0.5662	9.922
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDPET03
Date and time: 02MAY00:16:38

Table 2.2.7.3.2. Faroe Plateau (sub-division Vb1) COD. Output data to yield per recruit calculations.

16:36 Tuesday, May 2, 2000
Faroe Plateau cod (Sub-division Vb1)

Yield per recruit: Summary table

						01-Jan		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.00	0.00	0.00	0.00	5.52	24.97	4.24	23.27	4.24	23.27
0.05	0.02	0.09	473.98	5.09	21.38	3.81	19.68	3.81	19.68
0.10	0.04	0.15	800.68	4.75	18.65	3.48	16.96	3.48	16.96
0.15	0.07	0.21	1030.21	4.48	16.52	3.21	14.84	3.21	14.84
0.20	0.09	0.25	1193.62	4.25	14.82	2.99	13.15	2.99	13.15
0.25	0.11	0.29	1310.96	4.06	13.44	2.80	11.78	2.80	11.78
0.30	0.13	0.33	1395.58	3.90	12.30	2.64	10.65	2.64	10.65
0.35	0.15	0.35	1456.59	3.76	11.35	2.50	9.70	2.50	9.70
0.40	0.17	0.38	1500.37	3.63	10.55	2.38	8.90	2.38	8.90
0.45	0.20	0.40	1531.43	3.52	9.86	2.27	8.22	2.27	8.22
0.50	0.22	0.42	1553.04	3.42	9.26	2.18	7.63	2.18	7.63
0.55	0.24	0.44	1567.58	3.33	8.74	2.09	7.12	2.09	7.12
0.60	0.26	0.46	1576.81	3.25	8.29	2.02	6.67	2.02	6.67
0.65	0.28	0.47	1582.02	3.18	7.88	1.95	6.28	1.95	6.28
0.70	0.30	0.48	1584.19	3.11	7.53	1.88	5.93	1.88	5.93
0.75	0.33	0.50	1584.08	3.05	7.21	1.82	5.62	1.82	5.62
0.80	0.35	0.51	1582.22	3.00	6.92	1.77	5.33	1.77	5.33
0.85	0.37	0.52	1579.06	2.94	6.66	1.72	5.08	1.72	5.08
0.90	0.39	0.53	1574.92	2.89	6.42	1.67	4.85	1.67	4.85
0.95	0.41	0.54	1570.06	2.85	6.21	1.63	4.64	1.63	4.64
1.00	0.43	0.55	1564.66	2.80	6.01	1.59	4.45	1.59	4.45
1.05	0.46	0.56	1558.88	2.76	5.83	1.55	4.27	1.55	4.27
1.10	0.48	0.56	1552.83	2.72	5.66	1.51	4.11	1.51	4.11
1.15	0.50	0.57	1546.60	2.69	5.51	1.48	3.96	1.48	3.96
1.20	0.52	0.58	1540.26	2.65	5.36	1.45	3.83	1.45	3.83
1.25	0.54	0.59	1533.87	2.62	5.23	1.41	3.70	1.41	3.70
1.30	0.56	0.59	1527.47	2.59	5.10	1.39	3.58	1.39	3.58
1.35	0.59	0.60	1521.08	2.56	4.99	1.36	3.47	1.36	3.47
1.40	0.61	0.60	1514.74	2.53	4.88	1.33	3.36	1.33	3.36
1.45	0.63	0.61	1508.45	2.50	4.78	1.31	3.27	1.31	3.27
1.50	0.65	0.61	1502.25	2.48	4.68	1.28	3.17	1.28	3.17
1.55	0.67	0.62	1496.12	2.45	4.59	1.26	3.09	1.26	3.09
1.60	0.69	0.62	1490.09	2.43	4.50	1.24	3.00	1.24	3.00
1.65	0.72	0.63	1484.16	2.41	4.42	1.22	2.93	1.22	2.93
1.70	0.74	0.63	1478.33	2.39	4.34	1.20	2.85	1.20	2.85
1.75	0.76	0.64	1472.60	2.36	4.27	1.18	2.79	1.18	2.79
1.80	0.78	0.64	1466.98	2.34	4.20	1.16	2.72	1.16	2.72
1.85	0.80	0.65	1461.46	2.33	4.13	1.15	2.66	1.15	2.66
1.90	0.82	0.65	1456.04	2.31	4.07	1.13	2.60	1.13	2.60
1.95	0.85	0.65	1450.73	2.29	4.00	1.11	2.54	1.11	2.54
2.00	0.87	0.66	1445.52	2.27	3.95	1.10	2.49	1.10	2.49
2.05	0.89	0.66	1440.41	2.25	3.89	1.08	2.44	1.08	2.44
2.10	0.91	0.67	1435.40	2.24	3.84	1.07	2.39	1.07	2.39
2.15	0.93	0.67	1430.48	2.22	3.78	1.05	2.34	1.05	2.34

Table 2.2.7.3.2 (Continued)

2.20	0.95	0.67	1425.66	2.21	3.74	1.04	2.29	1.04	2.29
2.25	0.98	0.67	1420.93	2.19	3.69	1.03	2.25	1.03	2.25
2.30	1.00	0.68	1416.29	2.18	3.64	1.01	2.21	1.01	2.21
2.35	1.02	0.68	1411.73	2.16	3.60	1.00	2.17	1.00	2.17
2.40	1.04	0.68	1407.27	2.15	3.56	0.99	2.13	0.99	2.13
2.45	1.06	0.69	1402.88	2.13	3.51	0.98	2.09	0.98	2.09
2.50	1.08	0.69	1398.58	2.12	3.47	0.97	2.06	0.97	2.06
2.55	1.11	0.69	1394.35	2.11	3.44	0.95	2.02	0.95	2.02
2.60	1.13	0.69	1390.21	2.10	3.40	0.94	1.99	0.94	1.99
2.65	1.15	0.70	1386.14	2.08	3.36	0.93	1.96	0.93	1.96
2.70	1.17	0.70	1382.14	2.07	3.33	0.92	1.93	0.92	1.93
2.75	1.19	0.70	1378.21	2.06	3.30	0.91	1.90	0.91	1.90
2.80	1.21	0.70	1374.35	2.05	3.26	0.90	1.87	0.90	1.87
2.85	1.24	0.71	1370.56	2.04	3.23	0.89	1.84	0.89	1.84
2.90	1.26	0.71	1366.83	2.03	3.20	0.89	1.81	0.89	1.81
2.95	1.28	0.71	1363.17	2.02	3.17	0.88	1.79	0.88	1.79
3.00	1.30	0.71	1359.57	2.01	3.14	0.87	1.76	0.87	1.76
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDPET03
Date and time : 02MAY00:16:38
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.3342
F-max factor : 0.7215
F-0.1 reference F : 0.1449
F-max reference F : 0.3128
Recruitment : Single recruit

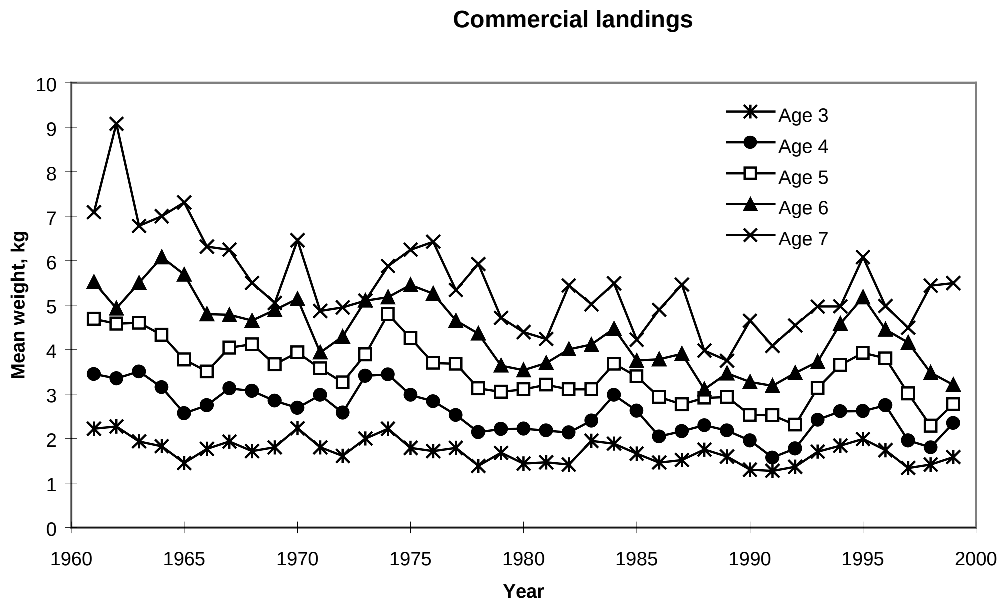


Figure 2.2.3.1. Faroe Plateau (sub-division VB1) COD. Mean weight at age 1961-1999.

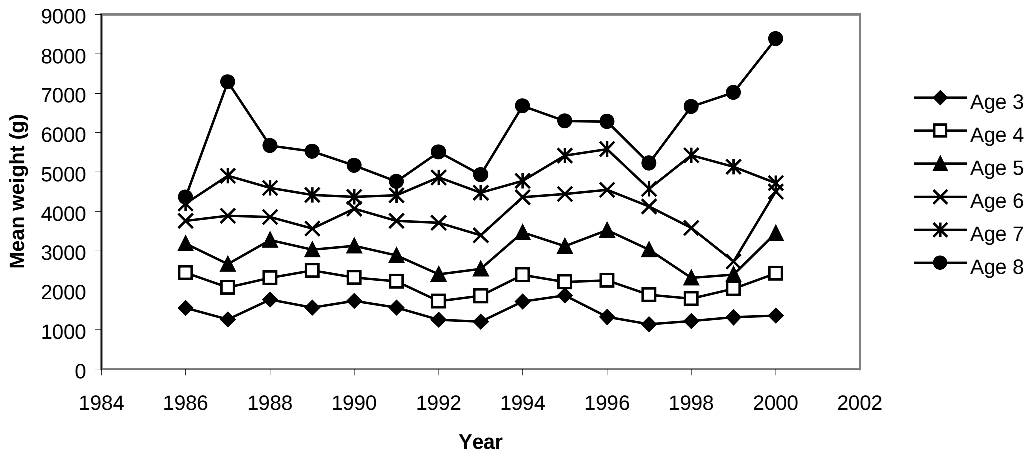


Figure 2.2.3.2. Faroe Plateau (sub-division VB1) COD. Mean weight at age the first quarter of the years 1986-2000.

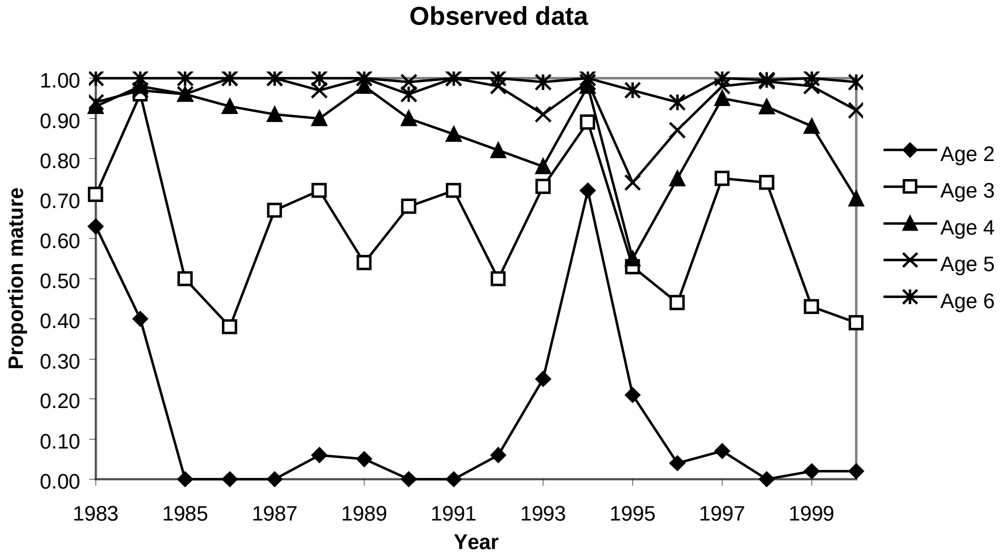


Figure 2.2.4.1. Faroe Plateau (sub-division VB1) COD. Proportion mature at age as observed in the spring groundfish survey.

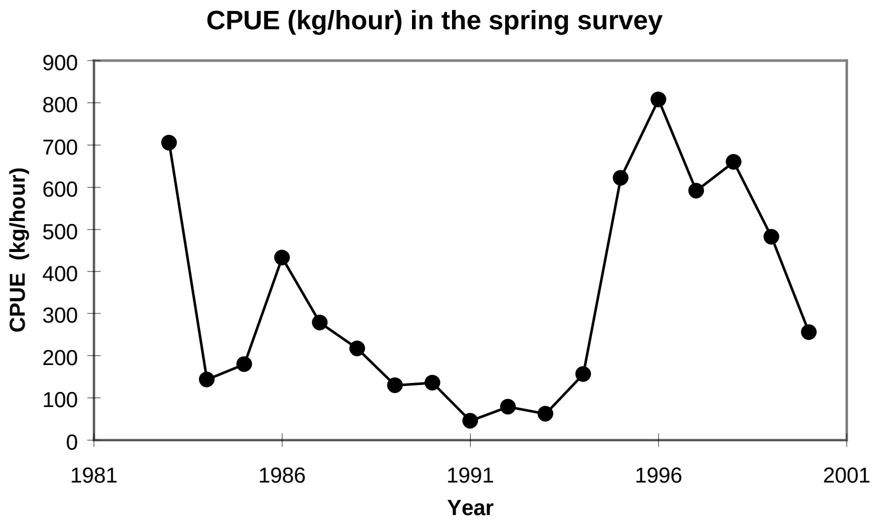


Figure 2.2.5.1. Faroe Plateau (sub-division VB1) COD. Catch per unit effort in the spring groundfish survey.

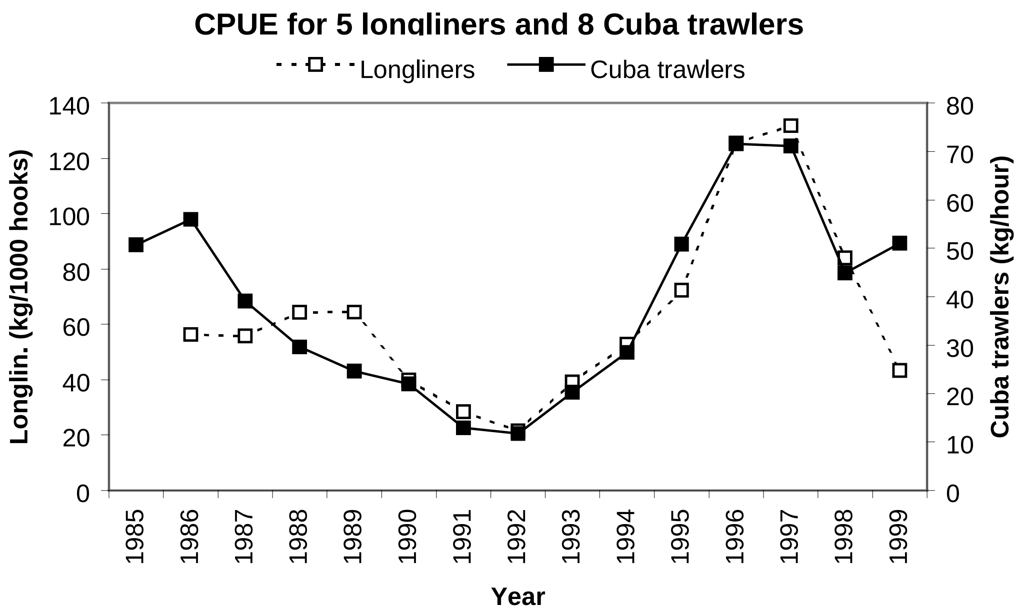
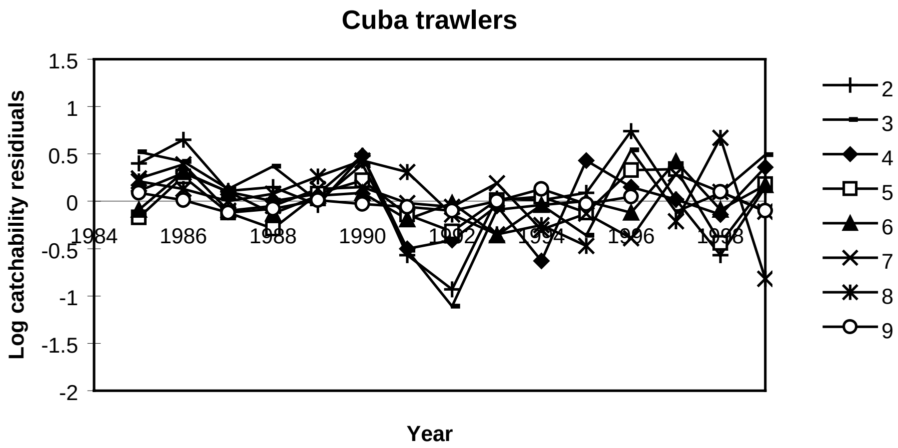


Figure 2.2.6.1.1. Faroe Plateau (sub-division VB1) COD. CPUEs for Cuba trawlers and longliners.



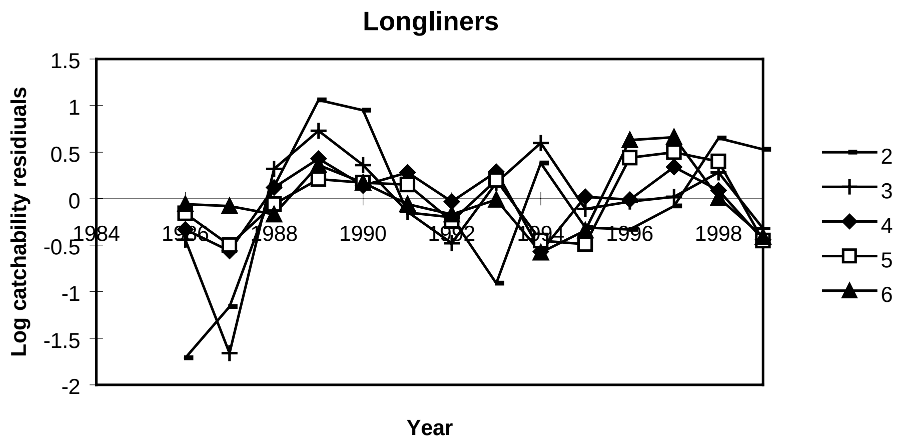
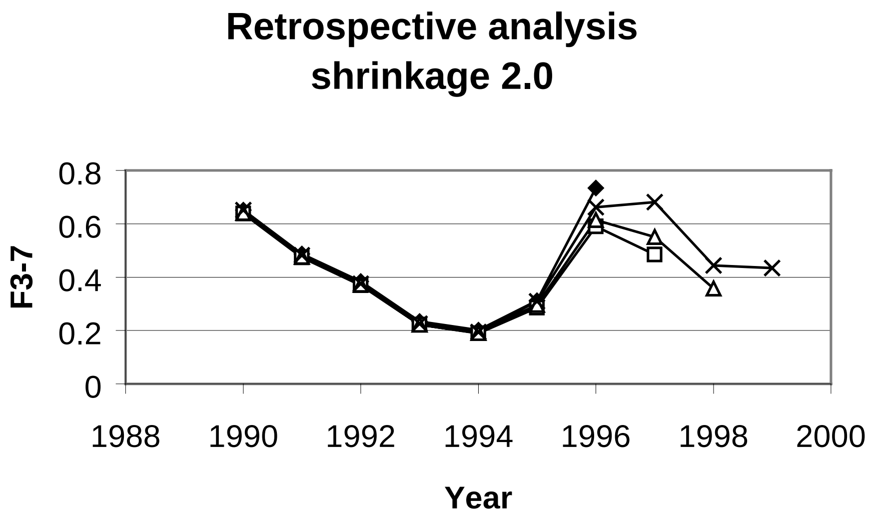


Figure 2.2.6.1.2. Faroe Plateau (sub-division VB1) COD. Log catchability residuals for Cuba trawlers and 5 longliners.



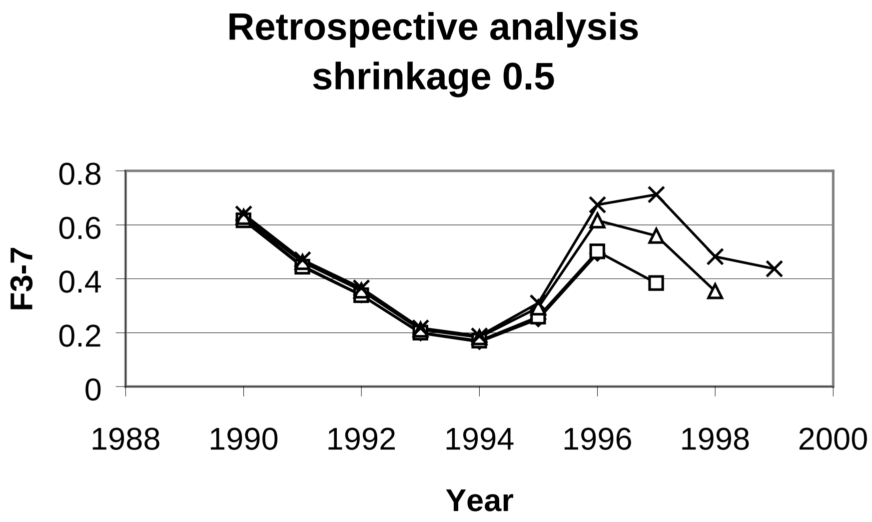
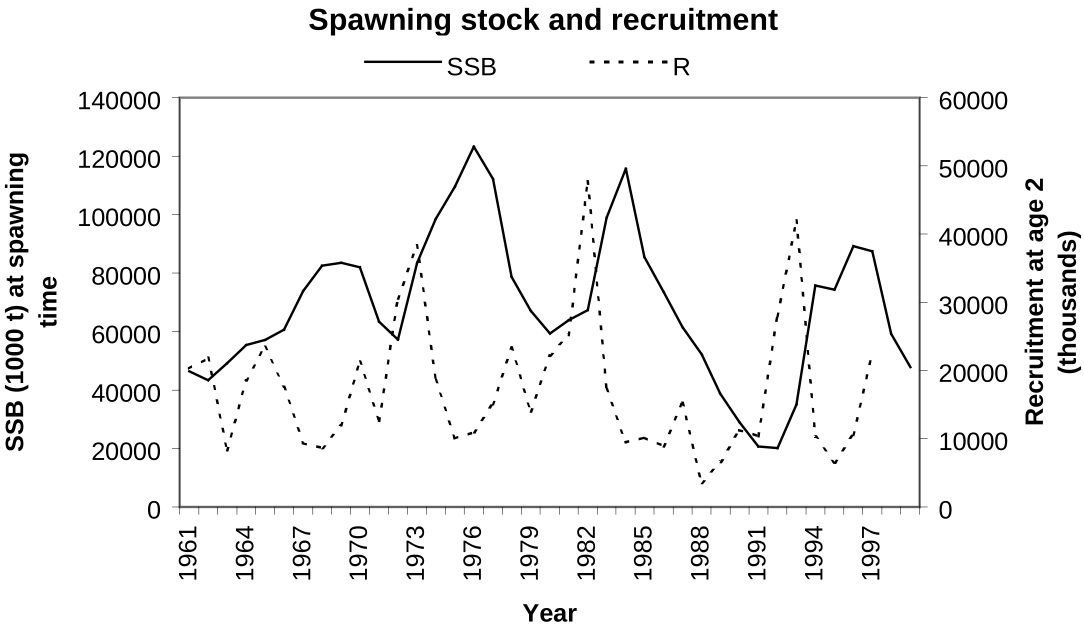


Figure 2.2.6.1.3. Faroe Plateau (sub-division VB1) COD. Retrospective analysis comparing shrinkages of 2.0 and 0.5.



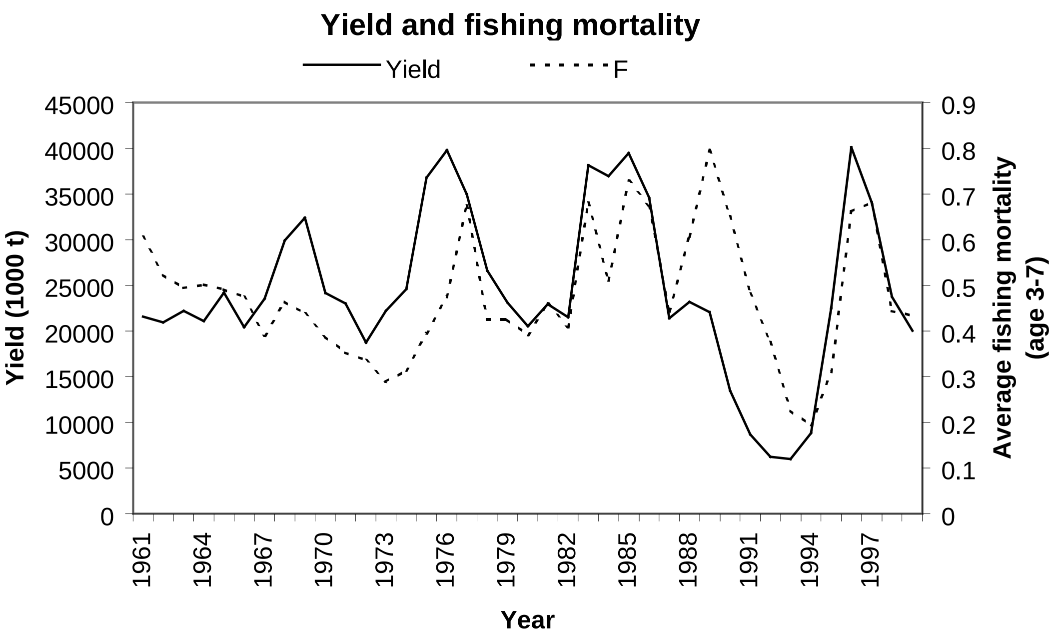


Figure 2.2.6.1.4. Faroe Plateau (sub-division VB1) COD. Yield and fishing mortality versus year. Spawning stock biomass (SSB) and recruitment versus year.

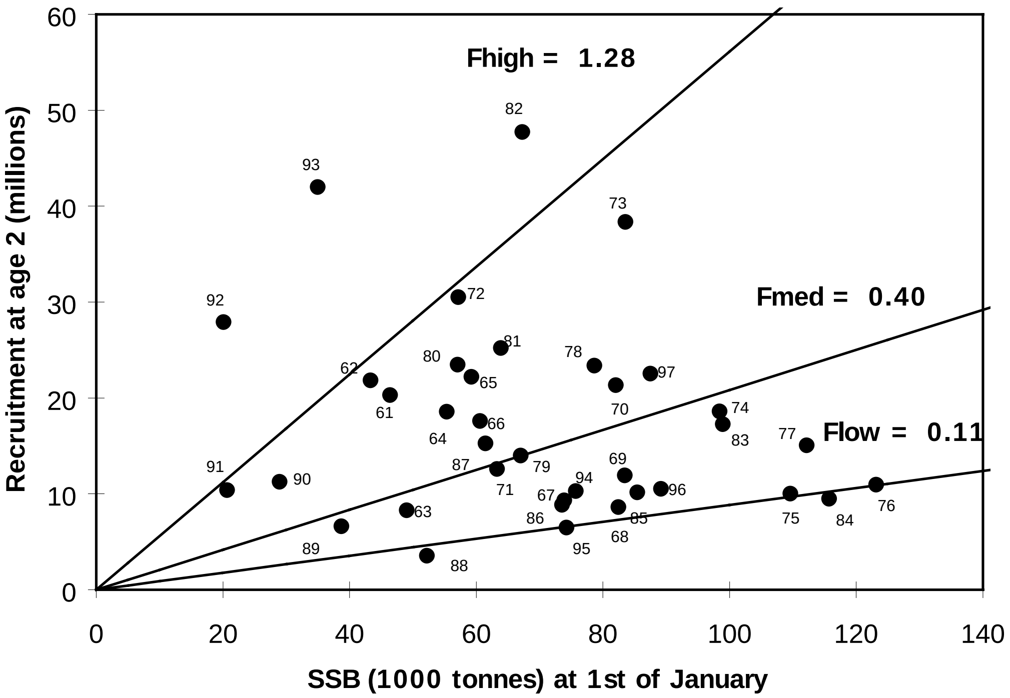
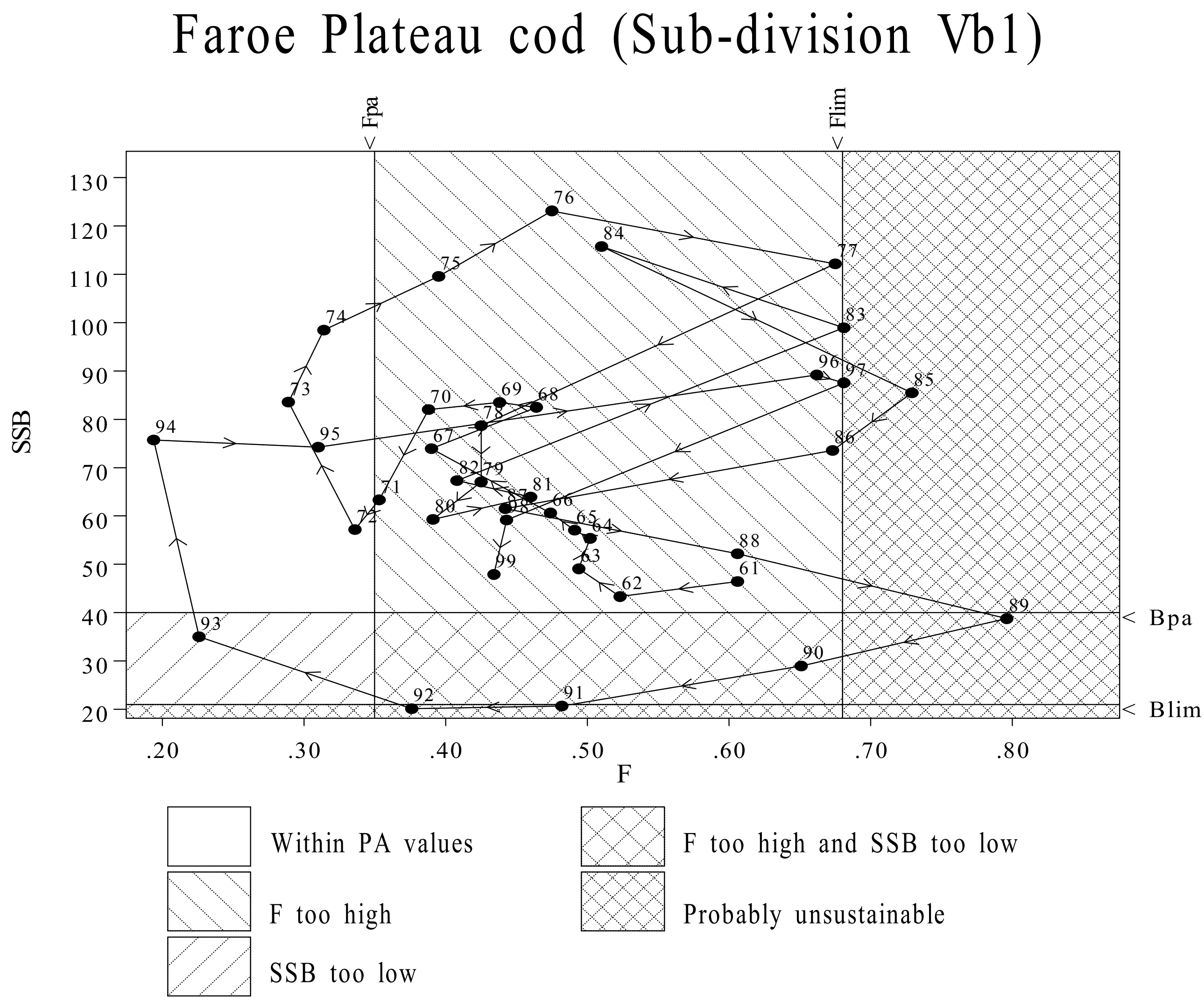


Figure 2.2.6.2.1. Faroe Plateau (sub-division Vb1) COD. Spawning stock – recruitment relationship 1961-97. Years are shown at each data point.



Data file(s):W:\ifapdata\work\nwwg\cod_farp\xsapet01\pap_data.pa;*.sum
Plotted on 28/04/2000 at 14:34:38

Figure 2.2.7.2.1. Faroe Plateau (sub-division Vb1) COD. Spawning stock biomass versus fishing mortality 1961-99. Output from the PA-software.

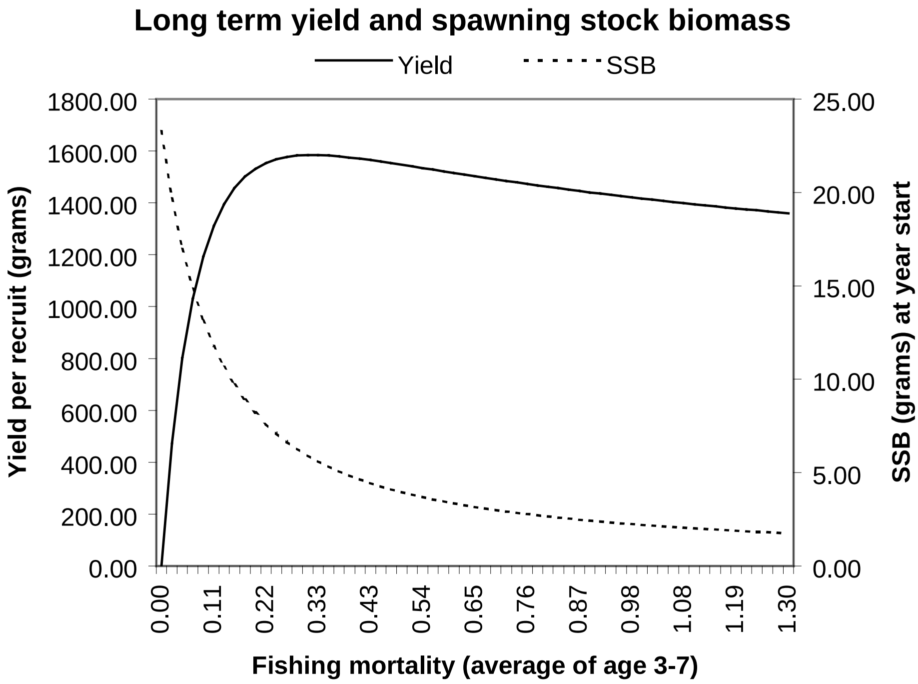


Figure 2.2.7.3.1. Faroe Plateau (sub-division Vb1) COD. Yield per recruit and spawning stock biomass per recruit versus fishing mortality.

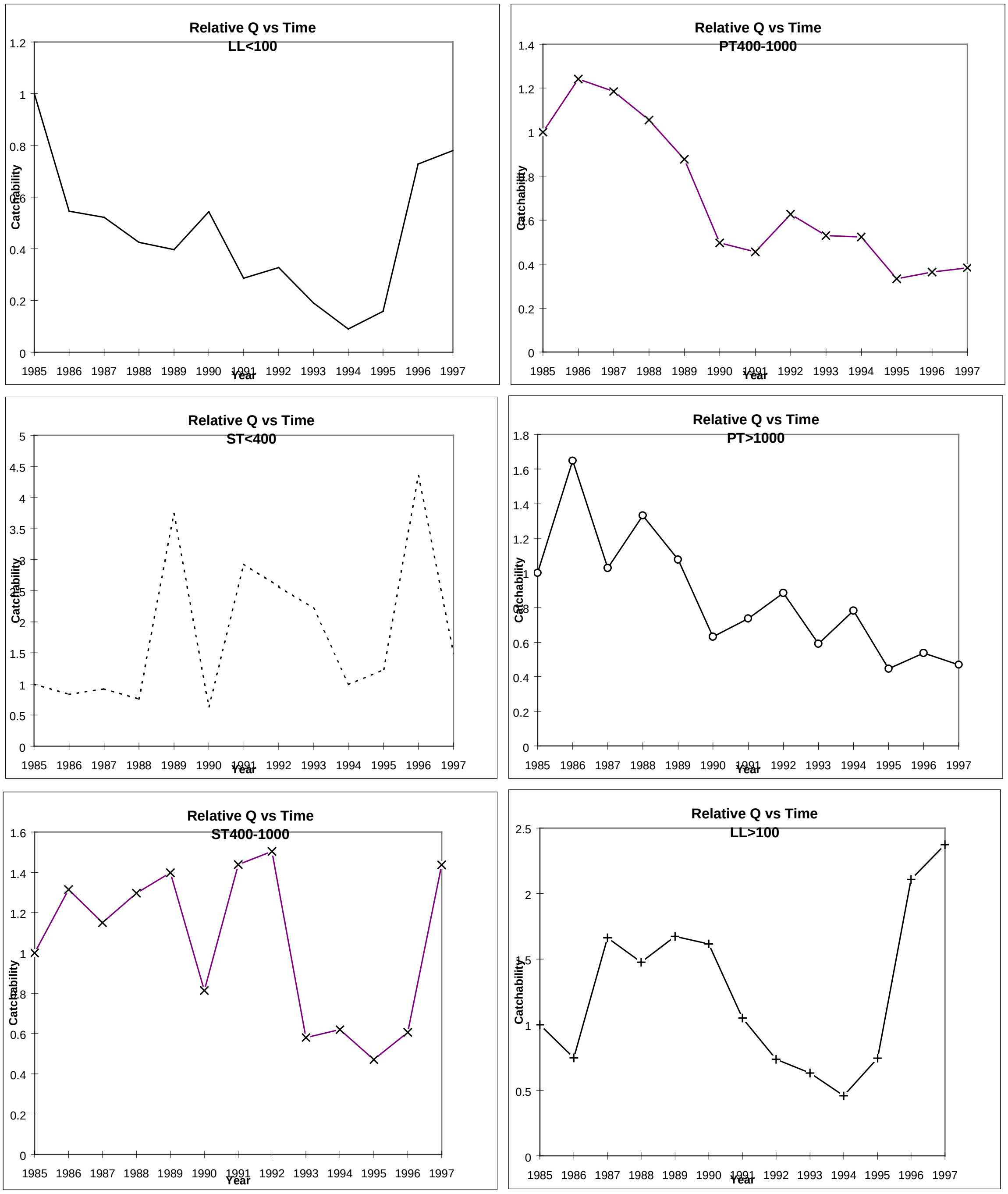


Figure 2.2.8.1. Faroe Plateau (sub-division Vb1) COD. Catchability of different faroese fleets versus time (1985 to 1997).

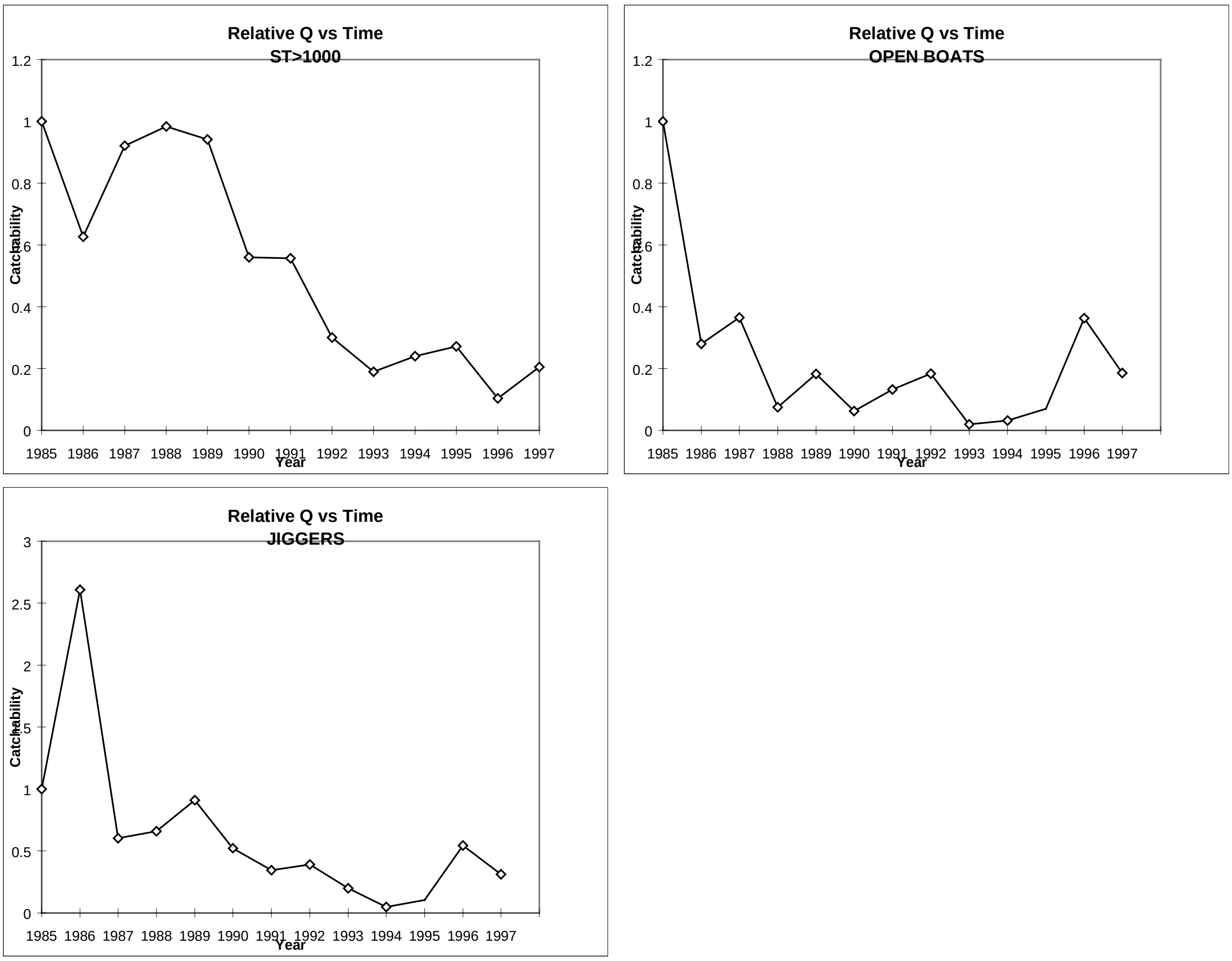


Figure 2.2.8.1. (Continued) Faroe Plateau (sub-division Vb1) COD. Catchability of different faroese fleets versus time (1985 to 1997).

1.3 Faroe Bank Cod

1.3.1 Trends in landings and effort

Total nominal landings of the Faroe Bank cod from 1986 to 1999 as officially reported to ICES are given in Table 2.3.1.1 and since 1965 in Figure 2.3.1.1. Landings have been highly irregular from 1965 to the mid 1980s, reflecting the opportunistic nature of the fishery on the Bank, with a peak value exceeding slightly 5 000 t in 1973. The evolution of landings has been smoother since 1987, declining from about 3 500 t in 1987 to only 330 t in 1992 before increasing to 3 900 t in 1997. In 1999, 1 060 t were reported from the Faroe Bank.

The decreasing trend in the cod landings from Faroe Bank lead ACFM in 1990 to advise the Faroese authorities to close the Bank to all fishing. This advice was followed for depths shallower than 200 meters. In 1992 and 1993 longliners and jiggers were allowed to participate in an experimental fishery inside the 200 meter depth contour. For the quota year 1 September 1995 to 31 August 1996 a fixed quota of 1 050 t was set. The new management regime with fishing days was introduced on 1 June 1996 allowing longliners and jiggers to fish inside the 200 m contour. The trawlers are allowed to fish outside the 200 contour.

1.3.2 Stock assessment

Biological samples have been taken from commercial landings since 1974 (the 1999 sampling is shown in the text table below) and from the groundfish survey from 1983. An attempt was made this year to run an XSA based on catch at age for 1992-1999, using the spring groundfish survey as a tuning series (1995-1999). The results of the 2000 survey were not available and it was therefore not possible to update the production model used in recent years. However, the results from last year's non-equilibrium general production model are included.

Sampling from commercial fleets in 1999.

Fleet	Size	Samples	Length	Otoliths	Weights
Longliners	<100 GRT	0	0	0	0
Longliners	>100 GRT	8	1,479	239	181
Jiggers		5	937	121	119
Sing. trawlers	<400 HP	0	0	0	0
Sing. trawlers	400-1000 HP	0	0	0	0
Sing. trawlers	>1000 HP	0	0	0	0
Pair trawlers	<1000 HP	0	0	0	0
Pair trawlers	>1000 HP	0	0	0	0
Total		13	2,416	360	300

The Faroese groundfish surveys cover the Faroe Bank and cod is mainly taken within the 200 m depth contour. The catches of cod per trawl hour in depths shallower than 200 meter are shown in Figure 2.3.2.1. The CPUE declined from 266 kg/hour in 1986 to only 23 kg/hour in 1990. The index of stock size increased to 637 kg/hour in 1998, but decreased to 369 kg/hour in 1999.

The length distributions in the 1983-1999 surveys illustrated in Figure 2.3.2.2 show substantially higher numbers in 1996-1999 compared to previous years. They also show, that the 1996 year class is extremely weak, since no fish in the size range 40-65 cm in 1998 (2 years old) are observed.

The catch-at-age was calculated in the same manner as described for Faroe Plateau cod, the main differences being that the data usually restricted the analyses to be based on half year intervals or whole year intervals (not 4 months as for Faroe Plateau cod). Also otoliths from the survey had to be used in the calculations of commercial catch at age for some years (autumn 1996 and 1999). The weights-at-age were calculated as for Faroe Plateau cod. Maturity-at-age was obtained from the survey. Since the data were scarce from 1992-1994, averages from 1995-1999 were used for those years.

In order to compare the results from the XSA and the production model, the results from the last years report are presented. Last year the Schaefer non-equilibrium general production model was fit to the Faroe Bank cod landings data using the research vessel survey CPUE for 1983 to 1999 in kg/hour as an index of stock biomass. The results are shown in Table 2.3.2.2. Parameter estimates were not stable with different set of initial values and/or constraints leading to different results.

According to the survey CPUE, the stock reached a recent peak in 1998, with the 1999 point being about 60% of the 1998. The landings are highly correlated with the ln survey CPUE in the previous year (Landings y = -3269.9 + 1148.04 x ln CPUE y-1, $r^2 = 0.84$).

1.3.2.1 Comment on the assessment

New or changed things compared to last years report: An XSA is presented and the results from the production model in last years report are used in this report.

The XSA run can only be taken as indicative due to scarce catch-at-age data. Since the production model and the XSA fit fairly well except for 1997 and 1998 (Figure 2.3.2.4), there seems to be reason to believe that the SSB fluctuates between 5 000 and 20 000 t. The XSA also suggest that the current fishing mortalities are within safe limits.

1.3.3 Reference points

The current XSA is not suited to put forward precise reference values due to the scarce data and the short time span. Since the catch in the beginning of the 1990s was the lowest on record (Figure 2.3.1.1), the SSB probably also was amongst the lowest recorded.

1.3.4 Management considerations

The landing estimates are uncertain because since 1996 the vessels are allowed to fish both on the Plateau and on Faroe Bank during the same trip, rendering landings from both areas uncertain. Given the relative size of the two fisheries, this is a bigger problem for Faroe Bank cod than for Faroe Plateau cod, but the magnitude remains unquantified for both. The ability to provide advice depends on the reliability of input data. If the cod landings from Faroe Bank are not known, it is difficult to provide advice on landings. If the fishery management agency intends to manage the two fisheries to protect the productive capacity of each individual unit, then it is necessary to regulate the catch removed from each stock.

Table 2.3.1.1. Faroe Bank (Sub-division Vb2) COD. Nominal catches (tonnes) by countries 1986-99 as officially reported to ICES. The catches by Faroe Islands and Norway are used in the assessment.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999 *
Faroe Islands	1,836	3,409	2,960	1,270	289	297	122	264	717	561	2,051	3,459	3,092	1,060
Norway	6	23	94	128	72	38	32	2	8	40	57 *	135 *	148 *	88
UK (E/W/NI)	-	-	-	-	-	-	+	1	1	-	- 2	- 2	- 2	-
UK (Scotland) 1	63	47	37	14	205	90	176	118	227	551	382	277	265	-
United Kingdom														- 2
Total	1,905	3,479	3,091	1,412	566	425	330	385	953	1,152	2,490	3,871	3,505	1,148
Used in assessment							154	266	725	601	2,108	3,594	3,240	1,148

*) Preliminary.

1) Includes Vb1

2) Included in Vb1

Table 2.3.2.2. Faroe Bank (Sub-division Vb2) COD. Results of production modelling (non-equilibrium Schaefer form). The run at the bottom was chosen for Figure 2.3.2.4.

No constraints				
r	1.27	MSY	3859.565	Catch is greater than the biomass in some years
K	12201	FMSY	11.59582	
BI	2361	FMSY	0.632649	
q	0.0546	SSQ	4.135218	
r	0.99	MSY	6627.811	r constrained to be less than or equal to .99. First stopped at r=.96, then when re-started hit the constraint, r=.99
K	26779	FMSY	11.17375	
BI	2700	FMSY	0.495	
q	0.0443	SSQ	4.20135	
r	0.96	MSY	6455.456	Additional constraint that observed catches have to be less than or equal to biomass
K	26781	FMSY	34.0192	
BI	2835	FMSY	0.482098	
q	0.0142	SSQ	23.43681	
r	0.65	MSY	3864.293	Additional constraint that BI greater than first catch
K	23644	FMSY	12.43644	Initial values r=.3, K=25000, BI=9450 (10000 lead to negative BI even with the constraint)
BI	4437	FMSY	0.326873	
q	0.0263	SSQ	7.16443	
r	0.71	MSY	2585.834	Initial r=.5, K=13000, BI=11000
K	14533	FMSY	13.03784	
BI	4843	FMSY	0.355859	
q	0.0273	SSQ	8.977429	
r	0.66	MSY	3533.049	Initial r=.3, K=18950, BI=12320
K	21309	FMSY	12.53817	
BI	4490	FMSY	0.331603	
q	0.0264	SSQ	7.411156	

Table 2.3.2.3. Faroe Bank (subdivision Vb2) COD. Input and results from tentative XSA run.

Run title : Cod Faroe Bank Vb2 (run: XSAPET01/X01)

At 2/05/2000 19:18

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE								
2,	5,	3,	183,	14,	238,	45,	0,	36,
3,	9,	28,	36,	50,	135,	124,	50,	0,
4,	1,	10,	12,	6,	27,	163,	51,	22,
5,	2,	2,	6,	2,	7,	79,	110,	37,
6,	7,	4,	3,	3,	6,	23,	68,	42,
7,	6,	4,	8,	2,	4,	22,	40,	20,
8,	2,	5,	7,	4,	3,	10,	19,	5,
9,	1,	2,	5,	5,	4,	4,	12,	3,
+gp,	0,	1,	2,	1,	1,	33,	31,	1,
0 TOTALNUM,	33,	59,	262,	87,	425,	503,	381,	166,
TONSLAND,	154,	266,	725,	601,	2108,	3594,	3240,	1148,
SOPCOF %,	98,	100,	100,	103,	111,	99,	96,	102,

1

Run title : Cod Faroe Bank Vb2 (run: XSAPET01/X01)

At 2/05/2000 19:18

Table 2 Catch weights at age (kg)

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE								
2,	1.1090,	1.4190,	1.6970,	1.6470,	2.7370,	2.1650,	.0000,	2.1020,
3,	1.7900,	2.5390,	2.6320,	6.2210,	5.2990,	4.2060,	4.4660,	.0000,
4,	5.1230,	3.4680,	4.5980,	7.3120,	8.6360,	6.8700,	6.0250,	5.7870,
5,	6.1070,	6.2380,	5.2690,	10.2680,	10.3240,	9.3890,	7.7940,	6.7980,
6,	5.8280,	6.7500,	7.8130,	10.6130,	11.8730,	10.8100,	10.0840,	8.1540,
7,	7.6380,	8.2810,	7.1460,	12.3620,	13.7510,	11.9680,	11.8320,	10.5460,
8,	10.0400,	9.3470,	9.7140,	13.0950,	13.4870,	13.0960,	13.0880,	12.0400,
9,	11.3170,	11.2030,	11.8880,	12.0380,	13.6230,	13.0630,	12.7360,	13.4790,
+gp,	11.7330,	13.0000,	12.7000,	16.3820,	13.2820,	13.7740,	13.6040,	14.8700,
0 SOPCOFAC,	.9808,	1.0046,	.9993,	1.0291,	1.1056,	.9900,	.9614,	1.0219,

1

Run title : Cod Faroe Bank Vb2 (run: XSAPET01/X01)

At 2/05/2000 19:18

Table 5 Proportion mature at age

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE								
2,	.1900,	.1900,	.1900,	.0000,	.0000,	.7500,	.1900,	.0000,
3,	.7400,	.7400,	.7400,	.5700,	.6400,	.9900,	.4900,	1.0000,
4,	.9000,	.9000,	.9000,	.7900,	.7400,	1.0000,	.9800,	1.0000,
5,	.9300,	.9300,	.9300,	.9700,	.6800,	1.0000,	.9900,	1.0000,
6,	.9600,	.9600,	.9600,	1.0000,	.8100,	1.0000,	1.0000,	1.0000,
7,	.9600,	.9600,	.9600,	1.0000,	.7900,	1.0000,	1.0000,	1.0000,
8,	.9500,	.9500,	.9500,	1.0000,	.7500,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

1

Table 2.3.2.3 (Continued)

```
FAROE BANK COD (ICES SUBDIVISION VB2)        SSURVEY2.DAT
101
SPRING GROUNDFISH SURVEY
1995 1999
1 1 0.25 0.33
3 7
 19.80    95    49    43    14    13
 20.58   222   348   133   141   126
 22.02   450  1084   642   130   239
 20.00   178   468   768   324    88
 23.00     2   255   427   437   152
```

```
Lowestoft VPA Version 3.1

    2/05/2000  19:16

 Extended Survivors Analysis

 Cod Faroe Bank Vb2 (run: XSAPET01/X01)

 CPUE data from file fleet

 Catch data for   8 years. 1992 to 1999. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 FLT01: SPRING GROUND,   1995, 1999,   3,     7,   .250,   .330


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years


 Catchability analysis :

      Catchability dependent on stock size for ages <    3

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  3


      Catchability independent of age for ages >=    5


 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 =    .500

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting not applied


 Tuning converged after   38 iterations

1


 Regression weights
       ,  .976,  .990,  .997, 1.000, 1.000
```

Table 2.3.2.3 (Continued)

Fishing mortalities

Age	1995	1996	1997	1998	1999
2	.011	.221	.088	.000	.115
3	.100	.138	.171	.133	.000
4	.035	.072	.246	.099	.079
5	.017	.052	.310	.261	.096
6	.039	.063	.241	.481	.150
7	.074	.066	.347	.864	.251
8	.062	.153	.234	.576	.235
9	.045	.081	.312	.489	.163

1

XSA population numbers (Thousands)

	AGE							
YEAR	2	3	4	5	6	7	8	9
1995	1.43E+03	5.81E+02	1.93E+02	1.34E+02	8.77E+01	3.08E+01	7.35E+01	1.24E+02
1996	1.33E+03	1.16E+03	4.30E+02	1.53E+02	1.08E+02	6.91E+01	2.34E+01	5.65E+01
1997	5.93E+02	8.70E+02	8.26E+02	3.28E+02	1.19E+02	8.29E+01	5.29E+01	1.65E+01
1998	7.38E+00	4.45E+02	6.00E+02	5.29E+02	1.97E+02	7.64E+01	4.79E+01	3.43E+01
1999	3.67E+02	6.04E+00	3.19E+02	4.45E+02	3.33E+02	9.96E+01	2.64E+01	2.21E+01

Estimated population abundance at 1st Jan 2000

0.00E+00	2.68E+02	4.94E+00	2.41E+02	3.31E+02	2.35E+02	6.35E+01	1.71E+01

Taper weighted geometric mean of the VPA populations:

3.58E+02	2.60E+02	2.71E+02	1.90E+02	1.32E+02	8.65E+01	5.64E+01	4.30E+01

Standard error of the weighted Log(VPA populations) :

1.7148	1.6742	.8191	.7773	.6577	.5362	.6446	.6643

1

Log catchability residuals.

Fleet : FLT01: SPRING GROUND

Age	1995	1996	1997	1998	1999
3	-.53	-.40	.54	.37	.00
4	-.98	.15	.62	.15	.03
5	-1.06	-.09	.72	.51	-.10
6	-1.76	.32	.12	.70	.23
7	-.77	.65	1.12	.45	.41

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
Mean Log q	-4.1827	-3.3108	-2.9953	-2.9953	-2.9953
S.E(Log q)	.4631	.5873	.6926	.9612	.8144

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	1.01	-.065	4.17	.96	5	.54	-4.18
4	.51	4.222	4.66	.96	5	.13	-3.31
5	.56	1.736	4.15	.84	5	.32	-3.00
6	.50	1.185	4.04	.65	5	.45	-3.07
7	.43	2.789	3.52	.89	5	.18	-2.62

Table 2.3.2.3 (Continued)

```
Terminal year survivor and F summaries :

Age  2   Catchability dependent on age and year class strength

Year class = 1997

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SPRING GROUND,         1.,   .000,       .000,    .00,   0,  .000,     .000

  P shrinkage mean  ,       260.,   1.67,,,,                        .082,     .118

  F shrinkage mean  ,       269.,    .50,,,,                        .918,     .114

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      268.,       .48,     5.59,    2,  11.668,   .115


Age  3   Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SPRING GROUND,         5.,   .508,       .000,    .00,   1, 1.000,     .000

  F shrinkage mean  ,         0.,    .50,,,,                        .000,     .000

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
        5.,       .51,      .00,    1,    .000,   .000


1
Age  4   Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SPRING GROUND,       303.,   .400,       .165,    .41,   2,  .573,     .064

  F shrinkage mean  ,       178.,    .50,,,,                        .427,     .106

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      241.,       .31,      .26,    3,    .838,   .079


Age  5   Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: SPRING GROUND,       428.,   .355,       .186,    .52,   3,  .609,     .075

  F shrinkage mean  ,       222.,    .50,,,,                        .391,     .140

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      331.,       .29,      .26,    4,    .907,   .096
```

Table 2.3.2.3 (Continued)

```
1


 Age  6   Catchability constant w.r.t. time and age (fixed at the value for age)  5

 Year class = 1993

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: SPRING GROUND,       279.,   .345,       .253,    .73,   4,  .551,     .128

   F shrinkage mean  ,       190.,    .50,,,,                         .449,     .182

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       235.,       .29,      .21,    5,    .706,   .150


 Age  7   Catchability constant w.r.t. time and age (fixed at the value for age)  5

 Year class = 1992

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: SPRING GROUND,        75.,   .339,       .241,    .71,   5,  .496,     .215

   F shrinkage mean  ,        54.,    .50,,,,                         .504,     .291

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        63.,       .30,      .19,    6,    .614,   .251


1
 Age  8   Catchability constant w.r.t. time and age (fixed at the value for age)  5

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: SPRING GROUND,        14.,   .404,       .333,    .82,   4,  .292,     .288

   F shrinkage mean  ,        19.,    .50,,,,                         .708,     .216

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        17.,       .37,      .21,    5,    .554,   .235


 Age  9   Catchability constant w.r.t. time and age (fixed at the value for age)  5

 Year class = 1990

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT01: SPRING GROUND,        15.,   .511,       .685,   1.34,   3,  .235,     .163

   F shrinkage mean  ,        15.,    .50,,,,                         .765,     .163

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
        15.,       .40,      .27,    4,    .677,   .163


1
1
```

Table 2.3.2.3 (Continued)

Run title : Cod Faroe Bank Vb2 (run: XSAPET01/X01)

At 2/05/2000 19:18

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE									
2,	.0182,	.0098,	.2509,	.0109,	.2212,	.0876,	.0000,	.1148,	.0675,
3,	.0529,	.1339,	.1558,	.1000,	.1379,	.1714,	.1326,	.0000,	.1013,
4,	.0172,	.0765,	.0780,	.0349,	.0719,	.2461,	.0986,	.0793,	.1413,
5,	.0144,	.0432,	.0601,	.0166,	.0520,	.3098,	.2613,	.0964,	.2225,
6,	.0312,	.0361,	.0844,	.0385,	.0635,	.2408,	.4809,	.1500,	.2906,
7,	.0524,	.0224,	.0940,	.0744,	.0661,	.3473,	.8637,	.2508,	.4873,
8,	.0369,	.0563,	.0496,	.0621,	.1525,	.2341,	.5764,	.2350,	.3485,
9,	.0305,	.0470,	.0734,	.0454,	.0814,	.3124,	.4888,	.1629,	.3214,
+gp,	.0305,	.0470,	.0734,	.0454,	.0814,	.3124,	.4888,	.1629,	
0 FBAR 3- 7,	.0336,	.0624,	.0944,	.0529,	.0783,	.2631,	.3674,	.1153,	

1

Run title : Cod Faroe Bank Vb2 (run: XSAPET01/X01)

At 2/05/2000 19:18

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 92-97	AMST 92-97
AGE											
2,	307,	340,	911,	1430,	1326,	593,	7,	367,	0,	689,	818,
3,	193,	247,	276,	581,	1158,	870,	445,	6,	268,	444,	554,
4,	65,	150,	177,	193,	430,	826,	600,	319,	5,	222,	307,
5,	155,	52,	114,	134,	153,	328,	529,	445,	241,	135,	156,
6,	251,	125,	41,	88,	108,	119,	197,	333,	331,	106,	122,
7,	130,	200,	99,	31,	69,	83,	76,	100,	235,	88,	102,
8,	61,	101,	160,	73,	23,	53,	48,	26,	63,	67,	79,
9,	37,	48,	78,	124,	57,	16,	34,	22,	17,	50,	60,
+gp,	0,	24,	31,	25,	14,	135,	88,	7,	20,		
0 TOTAL,	1199,	1287,	1886,	2679,	3337,	3023,	2024,	1626,	1181,		

1

Run title : Cod Faroe Bank Vb2 (run: XSAPET01/X01) ,

At 2/05/2000 19:18

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1992,	307,	5450,	4855,	154,	.0317,	.0336,
1993,	340,	6245,	5469,	266,	.0486,	.0624,
1994,	911,	7585,	5902,	725,	.1228,	.0944,
1995,	1430,	12934,	8688,	601,	.0692,	.0529,
1996,	1326,	18560,	10730,	2108,	.1965,	.0783,
1997,	593,	18737,	18380,	3594,	.1955,	.2631,
1998,	7,	14870,	13743,	3240,	.2358,	.3674,
1999,	367,	10135,	9364,	1148,	.1226,	.1153,
Arith. Mean ,	660,	11814,	9641,	1480,	.1278,	.1334,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

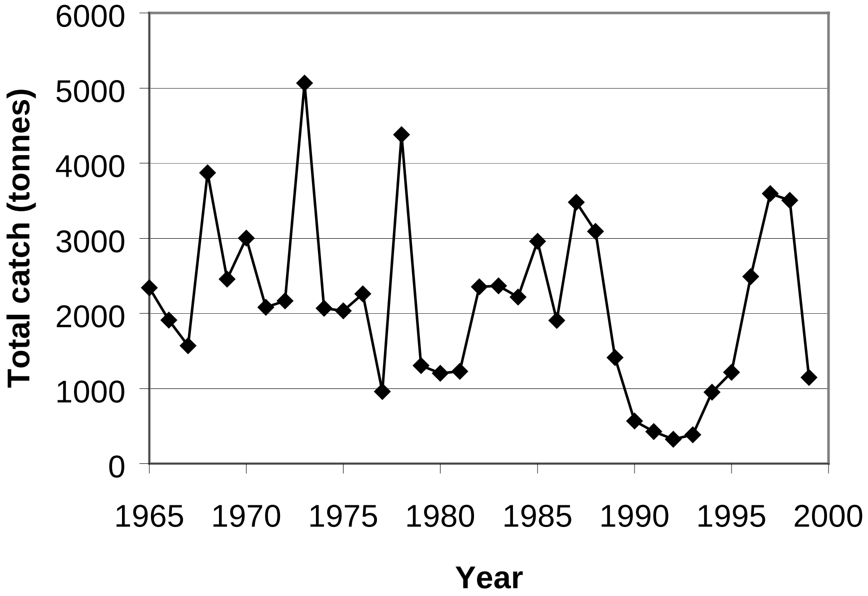


Figure 2.3.1.1. Faroe Bank (Sub-division Vb2) COD. Reported landings 1965 to 1999.

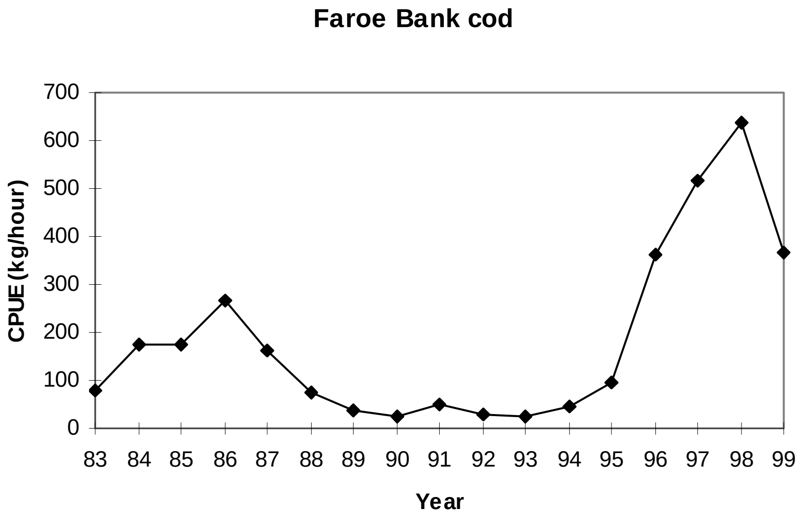


Figure 2.3.2.1. Faroe Bank (Sub-division Vb2) COD. Catch per unit effort in the spring groundfish survey.

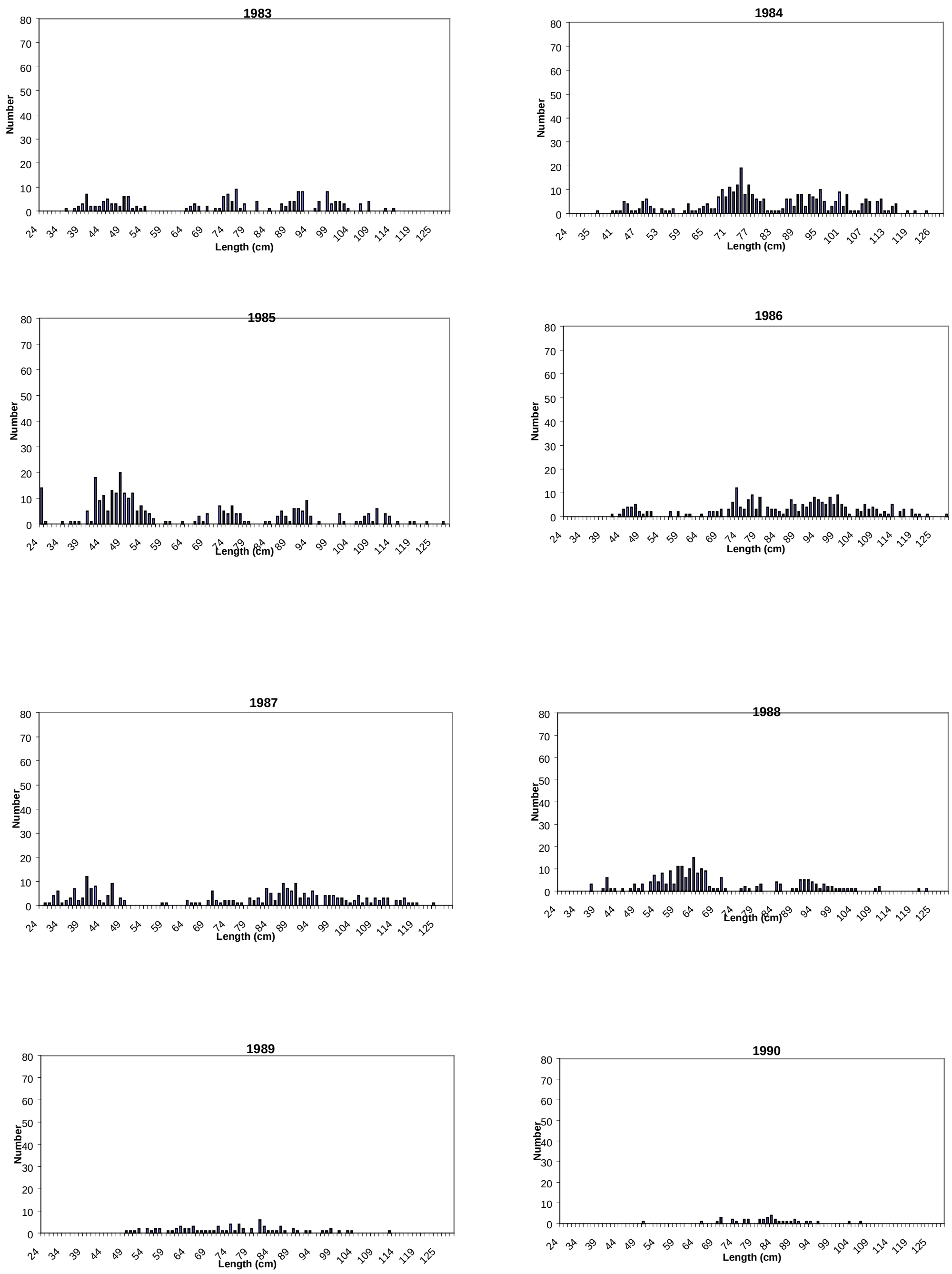


Figure 2.3.2.2. Faroe Bank (Sub-division Vb2) COD. Length distributions in the spring survey 1983-99.

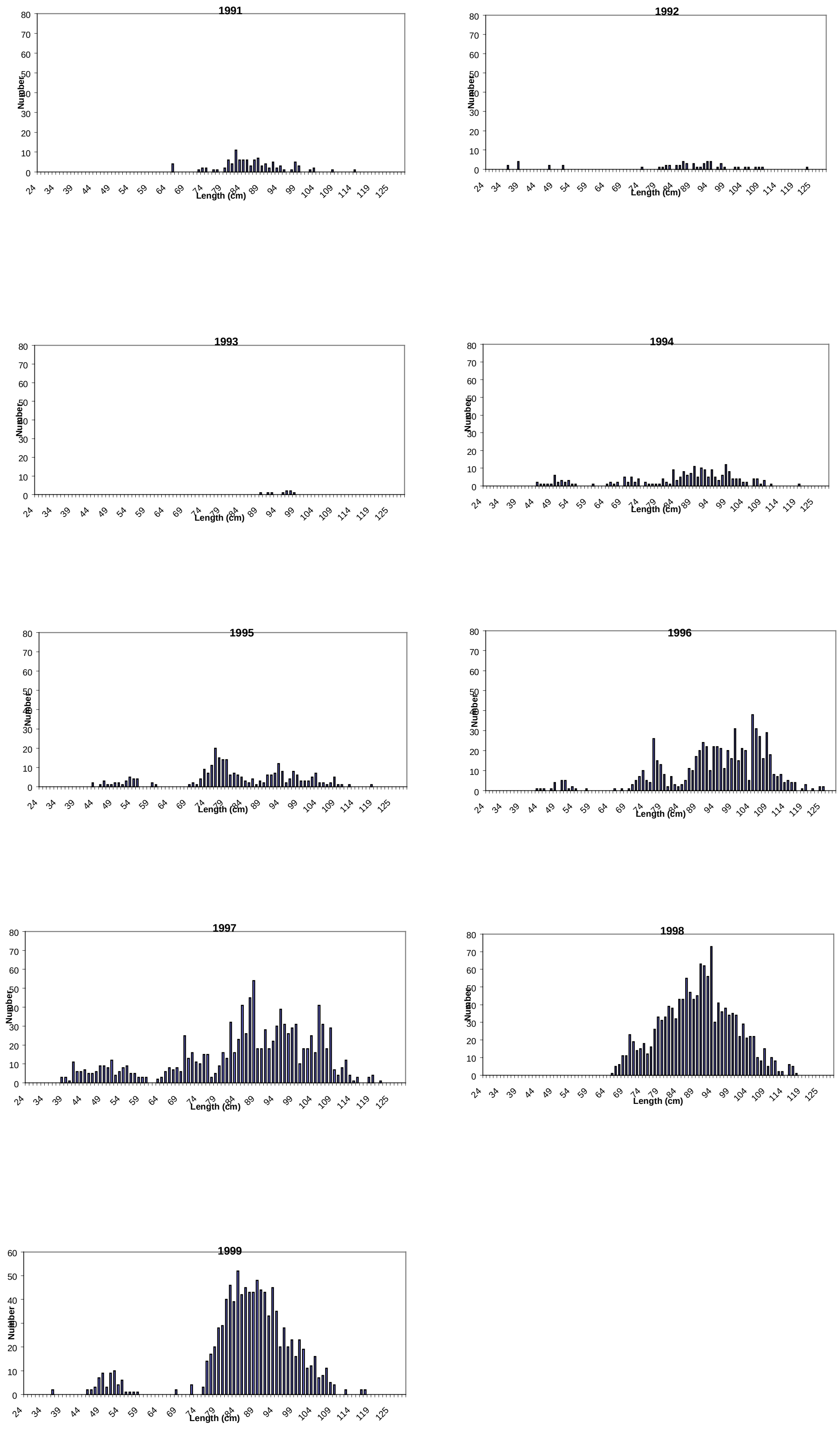


Figure 2.3.2.2 (Continued)

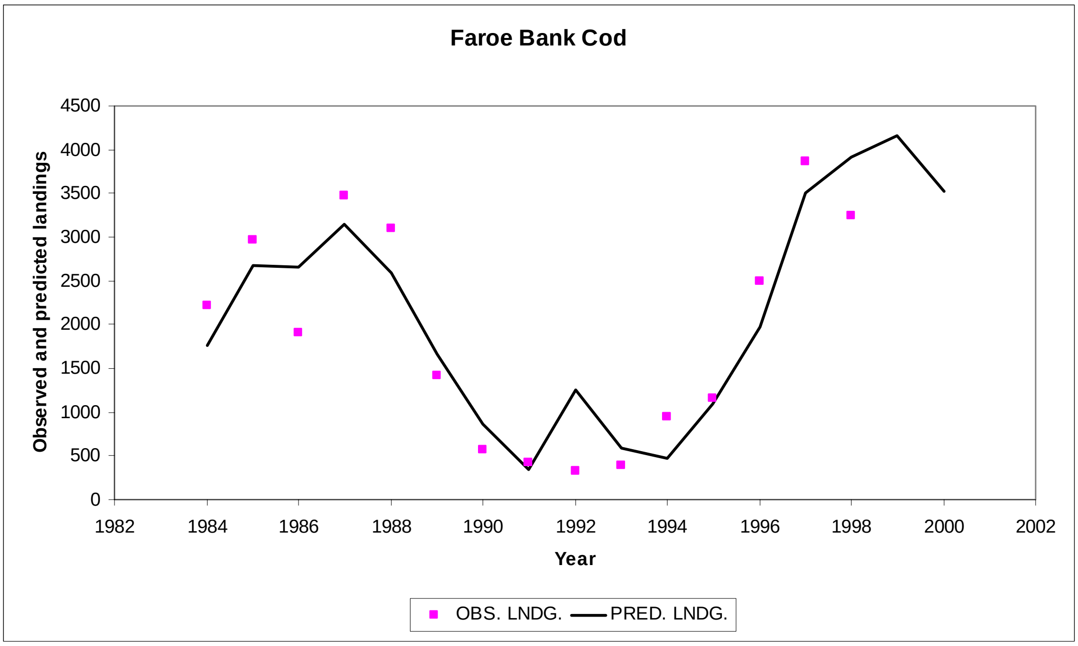


Figure 2.3.2.3. Faroe Bank (Sub-division Vb2) COD. Observed and predicted landings using the ln survey CPUE in the previous year (Landings y+1 = -3269.9 + 1148.04 x ln CPUE y, r^2 = 0.84).

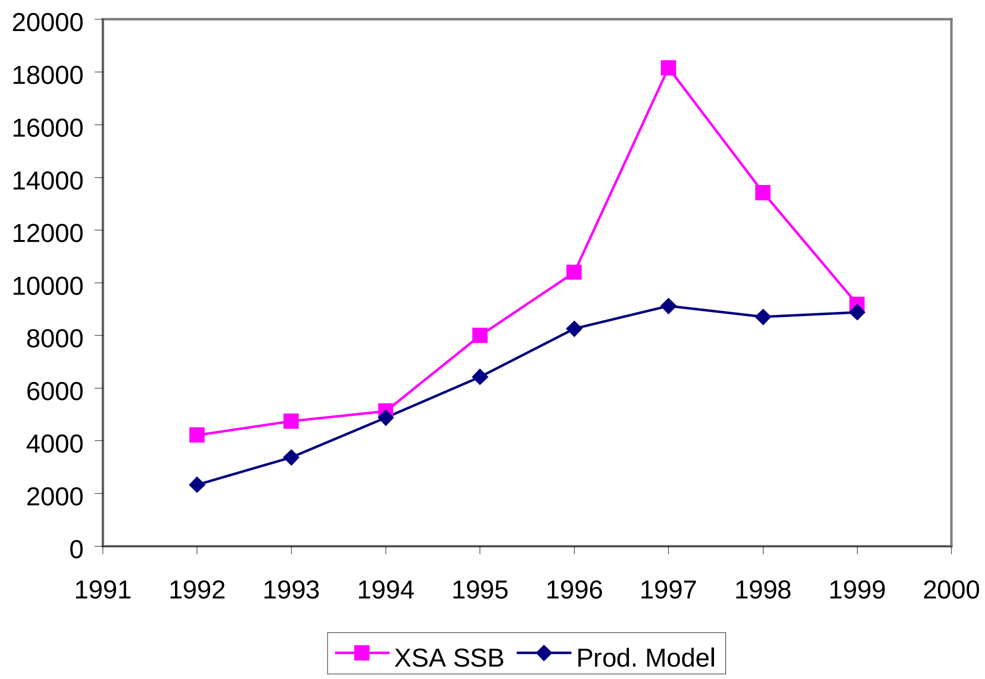


Figure 2.3.2.4. Faroe Bank (Sub-division Vb2) COD. Spawning stock biomass (SSB) based on the XSA vesus the production model (last version presented in Table 2.3.2.2).

1.4 Faroe Haddock

1.4.1 Landings and trends in the fishery

Nominal landings of haddock from the Faroe Plateau increased from a low of 10 000 t in 1982 to 14 000 t in 1987, but later decreased drastically to the lowest recorded at about 4 000 t; a slight increase to about 4 600 t was noted for 1995 but in 1996 and 1997 catches almost doubled each year to about 9 300 t and 16 800 t, respectively. In 1998 landings increased further to more than 19 000 t but decreased again in 1999 to 17 700 t (Table 2.4.1). Nominal landings for 1982−1992 from the Faroe Bank have varied between 500 and 1 600 t (on average 1 000 t), but dropped in 1993−1996 to 300-500 t. The closure of the fishery on the shallower parts of the Bank in 1990 and the introduction of a controlled fishery there since 1993, as described in Section 2.1, reduced the Faroese landings (Table 2.4.2) whereas Scottish landings remained relatively high in 1990-92. However, in the assessment only the fraction of the Scottish catches which have been reported to the Faroese authorities are included. In 1997 and 1998, landings on the bank increased abruptly to 1 300 and 3 000 t, but declined again in 1999 to about 1 100 t. In some years, minor Faroese catches of haddock are taken in ICES Division IIa close to the boundary with Sub-Division Vb1 (labelled IIa4 in Figure 2.1.15 in ICES C.M.1997). These catches are believed to be from the Faroe haddock stock and are consequently used in the assessment (Table 2.4.1).

Faroese vessels have taken almost the entire catch in recent years. Table 2.4.3 shows the Faroese landings since 1985 and the proportion taken by each fleet category. Pair trawlers and longliners took most of the catches in these years and within these two groups the relative importance of the larger vessels has increased. Due to poor catches and poor economic conditions, the effort of most fleets decreased in the early 1990s but from 1995 it has increased again (Tables 2.1.4 and 2.4.8). In addition, the fishing ban on the cod spawning grounds before and during the spawning period of cod since 1992 (Section 2.1) has had a restrictive impact on the haddock fishery as well. The catch rates for most fleets has declined drastically since the late 1980s. However, from 1995 the CPUE for most fleets has increased considerably (ICES C.M., 1998).

The 1998 monthly Faroese landings of haddock by fleet category from Sub-Divisions Vb1 and Vb2, are shown on Figure 2.4.1. The landings from the Plateau are high from late summer to the end of the spawning time in late April and stay low during the summer time. On the Faroe Bank the monthly landings show a similar pattern although the landings in mid winter are small. In 1999, longliners larger than 100 GRT took almost all catch of haddock on the Faroe Bank. On the Faroe Plateau the longliner landings are substantial except during the summer months when most of the longliners fish in deeper waters and/or outside the Faroese EEZ. The longline fishery mostly targets both cod and haddock, although haddock since the late 1980s must be characterized as a by-catch only except for the most recent years. The trawler catches of haddock must be regarded as a by-catch since the late 1980s.

1.4.2 Catch at age

For the Faroese landings, catch-at-age data were provided for fish taken from the Faroe Plateau and the Faroe Bank. Data from the two areas are combined as the fish are believed to belong to the same stock. The sampling intensity in 1999 is shown in the text table below; compared to 1998, number of length measurements was higher whereas the number of age readings and individual weightings was somewhat lower.

No. of samples:	288
No. of length measurements:	64005
No. of individual weight measurements:	4139
No. of aged fish:	8338

Samples from each fleet category were disaggregated by season and then raised by the catch proportions to give the 1999 catch at age in numbers for each fleet (Table 2.4.4). Catches of some minor fleets have been included under the others heading. No catch-at-age data were available from other nations fishing in Faroese waters. Therefore, catches by UK and France trawlers were assumed to have the same age composition as Faroese otter board trawlers greater than 1000 HP. The Norwegian longliners were assumed to have the same age distribution as the Faroese longliners greater than 100 GRT. The most recent data were revised according to the final catch figures. The resulting total catch at age in numbers are given in Table 2.4.4 and Table 2.4.5.

1.4.3 Weight at age

Mean weight-at-age data are provided for the Faroese fishery (Table 2.4.6). The sum-of-products check for 1999 was 1.04. Figure 2.4.2 shows the mean weights-at-age in the landings for most age groups since 1976. After an increase for all age groups in the most recent years, the weights have decreased again or levelled out for most ages.

1.4.4 Maturity at age

Maturity-at-age data were available from the Faroese Groundfish Surveys 1982–2000. The surveys are carried out in February-March, so the maturity at age is determined just prior to the spawning of haddock in Faroese waters and the determinations of the different maturity stages should be relatively easy. In order to reduce eventual year to year effects due to possible inadequate sampling and at the same time allow for trends in the series, a 3 year running average was used in the assessment. For the years prior to 1982, average maturity at age from the surveys 1982–1995 was adopted (Table 2.4.7).

1.4.5 Assessment

1.4.5.1 Tuning and estimates of fishing mortality

Several catch per unit effort series are available for tuning. They consist of catch at age in numbers and corresponding effort. Following numerous analyses of all available series of catch and effort data, the NWWG in successive recent years has decided to reduce the number of fleets and omit some years and ages from the tuning series. Last year only 3 reduced commercial series were used for tuning, i.e., the longliners less than 100 GRT (effort measured as number of fishing days), the pairtrawlers larger than 1 000 HP (effort measured as number of fishing days), and a new longliner series consisting of the logbook data from 5 selected longliners larger than 100 GRT (directed effort measured as number of hooks). The number of fishing days for the longliners less than 100 GRT and the pairtrawlers larger than 1 000 HP had to be estimated based on several data sources because of problems in the reportings. Although the exact numbers might be questioned, the level of days was believed to reflect the truth. However, examinations of the data have shown that the numbers of days from 1995 onwards are not precisively known, and although the reporting of days for 1998 and 1999 are considered reliable, they can not be used in updating of the old series. The main reason for this is that when the number of fishing days is limited by regulation, fishermen use them more efficiently, so one "fishing day" no longer represent the same fishing effort that it did before regulations came in force.

The group therefore decided to use the two remaining commercial cpue series for tuning of this year's VPA. One of them is the longliner series consisting of the logbook data from 5 selected longliners larger than 100 GRT (directed effort measured as number of hooks) as was also used in last years assessment. The series has been revised as more logbooks now are available and only sets which represent a directed cod and haddock fishery are included. The other series was introduced in last years report but it was felt premature to use it for tuning. It consists of logbook data (catch at age in numbers and corresponding effort in number of trawlhours) from a homogenous group of pairtawlers larger than 1,000 HP which have been engaged in a mixed saithe, cod and haddock fishery since the middle of the 1980s.

Data from the two tuning series are presented in Table 2.4.8 and log q residuals from Laurec-Shephard tuning are shown in Figure 2.4.5; information on the spring survey is also included. The latter is not used directly in the tuning, but the indices at age are used together with the total commercial catch at age in numbers in a catch curve analysis; in general the catch curve graphs indicate low fishing mortalities since the late 1970s (Figure 2.4.4). The survey indices for ages 1-3 are also used in the Rct3 prediction of year class strength.

Based on the diagnostics from the L-S tunings (Figure 2.4.5) some ages were removed from the tuning series before tuning due to noise and apparent trends in the residuals. In last years assessment the XSA was made with a shrinkage of 0.7. As there were no clear differences in the retrospective patterns of the fishing mortalities in this years assessment with shrinkages of 0.3, 0.5 and 0.7 (WD 15), and because the VPA of reasons discussed in section 2.4.8 is very unstable from year to year, it was felt sensible to use a heavy shrinkage in the XSA. Therefore the XSA this year was made with a shrinkage of 0.3. The diagnostics from the XSA are shown in Table 2.4.9. The retrospective plot of reference fishing mortalities is shown in Figure 2.4.7.

The fishing mortalities from the final XSA run are given in Table 2.4.10 and in Figure 2.4.8A. According to this the fishing mortality has shown an overall decline since the early 1960s and it has been estimated to be below the natural mortality of 0.2 in several years of the 1990s. Since 1994 it has been increasing again and in 1998 it was estimated at 0.26, but decreased again in 1999 to 0.2. It is very difficult to explain these very low fishing mortalities given the size of the fleet and the number of fishing days used. However, one possible reason is that due to the very small recruitment in many years the stock declined to historical lows and the haddock therefore has been only a by-catch in other fisheries. The introduction of large areas banned to trawling and of large mesh sizes in the codend in most trawler fisheries (145 mm) are likely reasons for the small trawler catches of haddock.

As seen in the retrospective plot on Figure 2.4.7, there has been a tendency to overestimate terminal fishing mortalities in recent years. This is normal when stock sizes increase abruptly. According to the overall cpue values from the survey (Figure 2.4.3), the stock seem to be declining again from the recent historical highs. This is confirmed by preliminary landings figures for the two first months of the year showing a 17% decline 1998/1999 and further 38% decline 1999/2000. This could imply that this years assessment of the fishing mortalities are underestimates. A comparison between fishing mortality estimates from last years assessment and from this years assessment only up to 1998 included (not included in the report but is available in ICES files) also might as well indicate a high probability that this years assessments of fishing mortalities are underestimates.

1.4.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.4.11 and a summary of the "VPA" with the biomass estimates is given in Table 2.4.12 and Figure 2.4.8B. According to this assessment, the spawning stock biomass decreased from 68 000 t in 1987 to 28 000 t in 1994, increased to 37 000 t in 1995 but have since increased considerably to about 114 000 t in 1997 and 1998. The decline in the spawning stock began in the late 1970s due to very poor recruitment in those years. The stabilization at relatively high SSB's in the mid−1980s was due to the relatively good 1982 and 1983 year classes, but the decline since then was partly due to poor year classes since the mid−1980s, as well as the pronounced decline in the mean weights at age in the stock. The main reason for the very abrupt increase in the spawning stock biomass is the growth of the historical outstanding big 1993 year class and the well above the long term average 1994 year class. It should be underlined, however, that as discussed in Section 2.4.5.1, this assessment might overestimate the stock size.

1.4.6 Prediction of catch and biomass

1.4.6.1 Input data

1.4.6.1.1 Short-term prediction

The input data for the short-term predictions are given in Table 2.4.15. The year classes up to 1997 inclusive are from the final VPA while the 1998 year class at age 2 was predicted using the RCT3 program. As input for RCT3, stratified mean-catch-per-hour of age groups 1-3 in the Faroese groundfish survey 1985-99 were used (Table 2.4.13). The output from the RCT3 is given in Table 2.4.14. The 1999-2000 year classes at age 2 were estimated as the geometric mean of the 2 year olds in 1986-2000, i.e., 1984-97 year classes from the final VPA, the 1998 year class from the RCT3.

The exploitation pattern used in the prediction was derived from averaging the 1997−1999 fishing mortality matrices from the final VPA and then rescaling the averages to 1999. The same pattern was used for all three years.

The mean weight at age for ages 2-10 in 2000 was calculated as the average weight at age in 1997-99. The 2000 mean weights at age were also applied for 2001 and 2002.

The maturity ogives for 2000-2002 are based on samples from the Faroese Groundfish Surveys and estimated as the average of the 1998-2000 values. As in the assessment, 3 years running average has been estimated in the order to reduce eventual year to year effects due to possible inadequate sampling and at the same time allow for trends in the series.

1.4.6.1.2 Long-term Prediction

The input data for the long-term yield and spawning stock biomass (yield per recruit calculations) are listed in Table 2.4.16. Mean weights-at-age are averages for the 1977−1999 period. The maturity ogives are averages for the years 1983-1999. The exploitation pattern was derived from the fishing mortality matrix from the final VPA as average F-values for the long time period. Before averaging the annual fishing mortalities were scaled to let the Fbar(age3-7) equal 1.0. In the input table the values are rescaled again to the 1999 Fbar(age3-7).

1.4.6.2 Biological reference points

The yield- and spawning stock biomass per recruit (age 2) based on the long-term data are shown in Table 2.4.18 and Figure 2.4.8C. F_{max} and $F_{0.1}$ are indicated here as 0.52 and 0.19, respectively. From Figure 2.4.9, showing the recruit/spawning stock relationship, and from Table 2.4.18, F_{med} and F_{high} were calculated to be 0.24 and 0.9, respectively.

In previous assessments of this stock the Minimum Biological Acceptable Limit (MBAL) was set at 40 000 t because the occurrence of good recruitment is considerably higher when the spawning stock biomass is above this value (Figure 2.4.9). Therefore, this is an appropriate value for a limit reference point and thus, B_{lim} is set by ACFM at 40 000 t. In the 1998 assessment, the B_{pa} was calculated as the value lying 2 standard deviations above B_{lim} , that is 65 000 t. By examining among other things the SSB-R plot, ACFM instead proposed B_{pa} = 55 000 t. The reference point F_{pa} was proposed by ACFM as the F_{med} value 0.25. The F_{lim} is defined to be two standard deviations above F_{pa} and was set by ACFM at 0.40. By inspecting the VPA results for the whole series, the NWWG felt this proposal to make sense as the recruitment in the last two decades has been very low with occasional big year classes. However, if recruitment returns to the levels seen in the 1960s and 1970s, when the stock apparently could withstand high fishing mortalities, this proposal might be too conservative.

The history of the haddock fishery in relation to the four reference points can be seen in Figure 2.4.10. In the period 1961-71 the fishing mortality was above F_{lim} and the spawning stock biomass was below B_{pa} until 1969. Except for 1977–1978 the stock/fishery was in a precautionary zone in the period 1974–1981. In 1989 the biomass went below Bpa and continued to decrease and went below B_{lim} in 1991. This decrease in SSB continued until the the lowest observed SSB was reached in 1994. The biomass has since increased, mainly due to the outstanding high 1993 year class and the well above long term average 1994 year class. According to this assessment, the stock has been within or close to safe biological limits (PA values) since 1996.

1.4.6.3 Projections of catch and biomass

1.4.6.3.1 Short-term prediction

In the light of the performance of the new management system (Section 2.4.8), it is not unrealistic to assume the same fishing mortalities in 2000 as in 1999. The prediction was therefore run with a *status quo* reference F in 2000. The catch in 2000 is then predicted to be about 22 000 t and continuing with this fishing mortality will result in a 2001 catch of 18 000 t. The SSB will in this case decrease from 123 000 t in 2000 to 90 000 t in 2001, and 73 000 t in 2002. The results of the short-term prediction are shown in Table 2.4.17 and in Figure 2.4.8D. As discussed in section 2.4.5.1, the 1999 fishing mortality might be underestimated and this prediction should therefore be interpreted cautiously.

The overall cpue from the survey supports the development of the SSB in the short term (Figure 2.4.3). This series also seems to be correlated to the total catches (Figure 2.4.6). Since the series can be updated with the results from the 2000 survey, it should be possible to predict the catch for year 2000. In doing so, the predicted 2000 catch is 14 000 t only. Although this value probably is too small as the curves for the observed and predicted landings are deviating in the most recent years, this exercise might indicate the catch in 2000 to be not too far from the one in 1999.

1.4.7 Managements considerations

In the management of demersal fish stocks in Vb several technical measurements have been introduced. Based on among others a certain number of fishing days allocated to the fleets in the system and an arrangement with temporarily and static area closures the goal is on average to keep the fishing mortality on each of the stocks of cod, haddock and saithe at F=0.45 corresponding to yearly average catches of 33% of the exploitable stock in numbers.

The estimated fishing mortalities from the present and the most recent assessments have been very low during at least the last two decades. This has not changed under the new management system.

In recent reports of the working group, the fishing mortality that could be generated in the upcoming fishing year given the number of fishing days allocated to each fishing fleets, was estimated using partial fishing mortalities by age (3 to 7) and year for 1985 to 1995 to calculate catchability coefficients. Probability profiles for various combinations of effort allocations were then constructed from the effort allocated and the estimated catchabilities. Based on the 1999 assessment and the observed effort allocation, there is a high probability that fishing mortality (ages 3 to 7) will be somewhat higher than the proposed F_{pa} of 0.25. However, it still is far from the intended F=0.45 which is believed not to be sustainable for this stock, as the proposed F_{pa} = 0.25 is set at F_{med} .

1.4.8 Comments on the assessment

Although the assessment basically is an updated version of the 1999 assessment there are some important changes. Of reasons explained in 2.4.5.1 and in WD 15, it was not possible to update one of the 3 tuning series from last years assessment and the other 2 were revised. They are now based on catch at age in numbers and corresponding effort in number of hooks and number of trawl hours, from logbooks. In addition, only sets/hauls in the directed mixed fishery for saithe, cod and haddock (trawlers) and for cod and haddock (longliners) are used. These series seem to behave better than the former but still they are rather noisy for especially the younger ages.

One of the major "haddock fleet", i.e. the longliners below 100 GRT, are not obliged to keep logbooks and consequently the only information on effort is in number of fishing days. It is not possible to update this series for the last two years because the value of a fishing day has changed. The series has in the past resulted in higher estimates of F compared with other fleets, and it was the main index for estimating F on ages 2 (shrinkage received the highest weight for age 2), 3 and 4.

In order to evaluate the effect of not having the series as a tuning series, the retrospective patterns in the average fishing mortality (ages 3-7) from last years assessment and from this years assessment up to 1998 incl. have been compared. The 2000 assessment result in very low 1998 F's whereas the F from last years assessment is almost twice as high. Inclusion of the longliner <100GRT series would most likely have had a similar (or more strong) effect. In a situation like this, i.e the VPA results are changing from year to year, using heavy shrinkage or average F's for the most recent years in the assessment of the stock size would appear advisable.

The assessment of Faroe haddock has been problematic in recent years as indicated by the large differences from year to year seen in retrospective analyses. The reasons for the unstable assessment results are among others:

- Recruitment has been low since the middle of the 1980s except for the exceptionally large 1993 and the large 1994 yc's.
- Due to the low recruitment, the stock has been very low and most of the haddock was taken as by-catch.
- The fishing mortalities have been less than 0.25 for the 1980s and 1990s. Therefore, it takes many years for the VPA to converge and large changes can be observed from one assessment to the next.
- When large yc's enter the fishery, the VPA tends to overestimate the F's and underestimates their size, while when weak yc's enter the fishery, the F's tend to be underestimated. This is possibly linked to shrinkage
- The fishing mortality in the assessment might be underestimated and the stock size correspondingly overestimated. However, the overall patterns in the assessment with very small but increasing fishing mortalities and very high stock levels are believed to reflect the status of the stock as being inside biological safe limits both regarding biomass and fishing mortality.

Table 2.4.1 Faroe Plateau (Sub-division Vb1) HADDOCK. Nominal catches (tonnes) by countries 1982-1999, as officially reported to ICES, and the total Working Group estimate in Vb.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990
Denmark	-	-	-	-	1	8	4	-	-
Faroe Islands	10,319	11,898	11,418	13,597	13,359	13,954	10,867	13,506	11,106
France[1]	2	2	20	23	8	22	14	-	-
Germany	1	+	+	+	1	1	-	+	+
Norway	12	12	10	21	22	13	54	111	94
UK (Engl. and Wales)	-	-	-	-	-	2	-	-	7
UK (Scotland)[3]	1	-	-	-	-	-	-	-	-
United Kingdom									
Total	10,335	11,912	11,448	13,641	13,391	14,000	10,939	13,617	11,207
Working Group estimate[4,5]	11,937	12,894	12,378	15,143	14,477	14,882	12,178	14,325	11,726

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999 [2]
Faroe Islands	8,074	4,655	3,622	3,675	4,549	9,152	16,585	19,135	16,969
France[1]	-	164	-					2 [2]	0 [6]
Germany	+	-	-		5	-	-		33 [6]
Greenland									30 [6]
Norway	125	71	28	22	28	164 [2]	45 [2]	71 [2]	415 [6]
UK (Engl. and Wales)	-	54	81	31	23	5	22 [1]	30 [1]	
UK (Scotland)[3]	-	-	-	-	-	…	…	…	
United Kingdom									252 [6]
Total	8,199	4,944	3,731	3,728	4,605	9,321	16,652	19,238	17,699
Working Group estimate[4,5]	8,429	5,476	4,026	4,252	4,967	9,761	17,923	22,108	18,847

1) Including catches from Sub-division Vb2. Quantity unknown 1989-1991, 1993 and 1995-99.

2) Provisional data

3)From 1983 to 1996 catches included in Sub-division Vb2.

4) Includes catches from Sub-division Vb2 and Division IIa in Faroese waters.

5)Includes French and Greenlandic catches from Division Vb, as reported to the Faroese coastal guard service

6) Reported as Division Vb, to the Faroese coastal guard service.

Table 2.4.2 Faroe Bank (Sub-division Vb2) HADDOCK. Nominal catches (tonnes) by countries, 1982-1999, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990
Faroe Islands	1,533	967	925	1,474	1,050	832	1,160	659	325
France[1]	-	-	-	-	-	-	-	-	-
Norway	1	2	5	3	10	5	43	16	97
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)[3]	48	13	+	25	26	45	15	30	725
Total	1,582	982	930	1,502	1,086	882	1,218	705	1,147

Country	1991	1992	1993	1994	1995	1996	1997 [2]	1998	1999 [2]
Faroe Islands	217	338	185	353	303	338	1,133	2,810	1,145
France[1]	-	-	-	-	-	-	-		
Norway	4	23	8	1	1 [2]	40 [2]	4 [2]	60 [2]	3
UK (Engl. and Wales)	-	+	+	+	... [1]	… [1]	… [1]	… [1]	[1]
UK (Scotland)[3]	287	869	102	170	39	62	135 [1]	102	[1]
Total	508	1,230	295	524	343	440	1,272	2,972	1,148

1) Catches included in Sub-division Vb1.

2) Provisional data

3)From 1983 to 1996 includes also catches taken in Sub-division Vb1 (see Table 2.4.1)

Table 2.4.3 Total Faroese landings of haddock from Division Vb and the contribution (%) by each fleet category (metier). In the column to the right are the average haddock percentages of the total landings of all species by each fleet category. Total catch in this table may deviate from official landings.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Haddock %
Open boats	7	7	11	2	3	2	3	2	1	1	1	2	2	2	2	18
Longliners < 100GRT	39	39	39	49	58	60	56	46	24	18	23	28	31	30	23	38
Longliners > 100GRT	13	12	13	19	18	18	18	22	25	25	38	36	38	40	40	21
Otterboard trawlers < 400HP	1	2	2	2	1	1	2	2	8	8	7	6	3	2	2	11
Otter board trawlers 400-999HP	6	3	5	4	3	3	1	1	3	2	5	7	6	6	5	12
Otterboard trawlers > 1000HP	8	5	2	2	2	2	2	1	1	3	2	2	3	3	7	1
Pairtrawlers < 1000HP	19	20	17	11	7	5	7	11	13	10	8	7	6	5	6	7
Pairtrawlers > 1000HP	6	10	9	9	6	8	11	14	22	29	16	13	12	12	14	4
Nets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jigging	1	0	0	0	1	1	1	0	0	0	0	1	1	0	0	1
Other gears	0	1	1	2	1	1	1	1	3	3	0	0	0	0	0	6
Total catch, tonnes gutted	13570	12967	13829	10697	12866	10319	7469	4103	3275	3629	4371	8535	15890	19669	16062	

Table 2.4.4

Haddock in ICES Division Vb 1999
Catch at age in numbers by fleet category

Age	Vb1 Open Boats	Vb1 LLiners < 100GRT	Vb1 LLiners > 100GRT	Vb1 OB. trawl. < 400HP	Vb1 OB. trawl. 400-999HP	Vb1 OB. trawl. > 1000HP	Vb1 Pair trawl. < 1000HP	Vb1 Pair trawl. > 1000HP	Vb1 Others	Vb1 All Faroese Fleets	Vb2 All Fleets	Vb Foreign Trawlers	Vb Foreign LLiners	Vb Total
1	1	8	0	0	0	0	0	0	0	9	0	0	0	9
2	4	55	68	2	5	5	8	5	4	155	10	1	5	171
3	39	554	254	11	35	21	26	26	31	984	113	5	19	1120
4	15	222	236	12	37	31	55	121	15	743	157	7	17	924
5	55	830	1460	62	176	388	345	777	72	4172	224	86	107	4588
6	100	1511	2082	130	371	473	376	917	107	6074	162	105	152	6493
7	3	43	77	5	13	12	11	32	4	202	12	3	6	222
8	0	6	10	0	1	0	1	4	0	24	1	0	1	25
9	1	8	4	1	3	0	1	0	1	19	0	0	0	20
10	1	18	24	1	2	0	1	1	1	50	0	0	2	51
11	1	18	20	1	4	1	1	3	1	49	0	0	1	51
12	1	12	40	1	1	2	2	6	1	67	0	0	3	70
13	0	1	3	0	1	0	0	1	0	6	0	0	0	7
14	0	6	0	0	0	0	0	1	0	8	0	0	0	8
15	0	1	0	0	0	0	0	0	0	2	0	0	0	2
Total no.	220	3294	4278	226	652	934	829	1895	238	12564	678	207	312	13761
Catch, t.	248	3709	5537	283	799	1158	966	2299	287	15286	1032	257	404	16979

Notes: Numbers in 1000'
Catch, gutted weight in tonnes
Others includes netters, jiggers, other small categories and catches not otherwise accounted for
LLiners = Longliners OB.trawl. = Otterboard trawlers Pair Trawl. = Pair trawlers

Table 2.4.5

Run title : Haddock Faroes Vb (run: XSAJAK03/X03)

At 27/04/2000 17:13

Catch numbers at age Numbers*10**-3

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE									
2,	7932,	9631,	13552,	2284,	1368,	1081,	1425,	5881,	2384,
3,	7330,	13977,	8907,	7457,	4286,	3304,	2405,	4097,	7539,
4,	5134,	5233,	7403,	3899,	5133,	4804,	2599,	2812,	4567,
5,	1937,	2361,	2242,	2360,	1443,	2710,	1785,	1524,	1565,
6,	1305,	1407,	1539,	1120,	1209,	1112,	1426,	1526,	1485,
7,	838,	868,	860,	728,	673,	740,	631,	923,	1224,
8,	236,	270,	257,	198,	1345,	180,	197,	230,	378,
9,	59,	72,	75,	49,	43,	54,	52,	68,	114,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,
TOTALNUM,	24771,	33819,	34835,	18095,	15500,	13985,	10520,	17061,	19256,
TONSLAND,	20831,	27151,	27571,	19490,	18479,	18766,	13381,	17852,	23272,
SOPCOF %,	89,	90,	90,	101,	94,	109,	102,	103,	108,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	1728,	717,	750,	3300,	5633,	7337,	4396,	255,	32,	1,
3,	4855,	4393,	3744,	8388,	2899,	7952,	7858,	4039,	1022,	1161,
4,	6581,	4727,	4179,	1236,	3970,	2097,	6798,	5168,	4248,	1754,
5,	1624,	3267,	2706,	2786,	451,	1371,	1251,	4918,	4054,	3341,
6,	1383,	1292,	1171,	916,	976,	247,	1189,	2128,	1841,	1850,
7,	1099,	864,	696,	1051,	466,	352,	298,	946,	717,	772,
8,	326,	222,	180,	150,	535,	237,	720,	443,	635,	212,
9,	68,	147,	113,	68,	68,	419,	258,	731,	243,	155,
+gp,	0,	0,	0,	11,	147,	187,	318,	855,	312,	74,
TOTALNUM,	17664,	15629,	13539,	17906,	15145,	20199,	23086,	19483,	13104,	9320,
TONSLAND,	21361,	19393,	16485,	17976,	14773,	20715,	26211,	25555,	19200,	12418,
SOPCOF %,	103,	99,	98,	98,	97,	117,	107,	98,	99,	104,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	143,	74,	539,	441,	1195,	985,	230,	283,	655,	63,
3,	58,	455,	934,	1969,	1561,	4553,	2549,	1718,	444,	1518,
4,	3724,	202,	784,	383,	2462,	2196,	4452,	3565,	2463,	658,
5,	2583,	2586,	298,	422,	147,	1242,	1522,	2972,	3036,	2787,
6,	2496,	1354,	2182,	93,	234,	169,	738,	1114,	2140,	2554,
7,	1568,	1559,	973,	1444,	42,	91,	39,	529,	475,	1976,
8,	660,	608,	1166,	740,	861,	61,	130,	83,	151,	541,
9,	99,	177,	1283,	947,	388,	503,	71,	48,	18,	133,
+gp,	86,	36,	214,	795,	968,	973,	712,	334,	128,	81,
TOTALNUM,	11417,	7051,	8373,	7234,	7858,	10773,	10443,	10646,	9510,	10311,
TONSLAND,	15016,	12233,	11937,	12894,	12378,	15143,	14477,	14882,	12178,	14325,
SOPCOF %,	100,	109,	92,	106,	106,	106,	101,	102,	97,	100,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	105,	77,	40,	113,	277,	807,	330,	77,	106,	171,
3,	1275,	1044,	154,	298,	191,	454,	5298,	2913,	1049,	1120,
4,	1921,	1774,	776,	274,	307,	236,	1032,	10517,	5245,	924,
5,	768,	1248,	1120,	554,	153,	226,	181,	710,	9810,	4588,
6,	1737,	651,	959,	538,	423,	132,	165,	116,	443,	6493,
7,	1909,	1101,	335,	474,	427,	297,	163,	123,	98,	222,
8,	885,	698,	373,	131,	383,	292,	273,	93,	87,	25,
9,	270,	317,	401,	201,	125,	263,	237,	220,	94,	20,
+gp,	108,	32,	162,	185,	301,	297,	399,	517,	501,	189,
TOTALNUM,	8978,	6942,	4320,	2768,	2587,	3004,	8078,	15286,	17433,	13752,
TONSLAND,	11726,	8429,	5476,	4026,	4252,	4967,	9761,	17923,	22108,	18847,
SOPCOF %,	102,	106,	106,	104,	100,	103,	100,	103,	101,	104,

Table 2.4.6

Run title : Haddock Faroes Vb (run: XSAJAK03/X03)

At 27/04/2000 17:13

Catch weights at age (kg)

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE									
2,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,
3,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,
4,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,
7,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,
8,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,
9,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,
+gp,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,
SOPCOFAC,	.8938,	.9011,	.8964,	1.0131,	.9401,	1.0920,	1.0166,	1.0278,	1.0835,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.3110,	.3570,	.3570,
3,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.6330,	.7900,	.6720,
4,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.0440,	1.0350,	.8940,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.4260,	1.3980,	1.1560,
6,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.8250,	1.8700,	1.5900,
7,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.2410,	2.3500,	2.0700,
8,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.2050,	2.5970,	2.5250,
9,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	2.5700,	3.0140,	2.6960,
+gp,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	2.5910,	2.9200,	3.5190,
SOPCOFAC,	1.0274,	.9874,	.9795,	.9776,	.9718,	1.1712,	1.0746,	.9784,	.9947,	1.0380,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	.6430,	.4520,	.7000,	.4700,	.6810,	.5280,	.6080,	.6050,	.5010,	.5800,
3,	.7130,	.7250,	.8960,	.7400,	1.0110,	.8590,	.8870,	.8310,	.7810,	.7790,
4,	.9410,	.9570,	1.1500,	1.0100,	1.2550,	1.3910,	1.1750,	1.1260,	.9740,	.9230,
5,	1.1570,	1.2370,	1.4440,	1.3200,	1.8120,	1.7770,	1.6310,	1.4620,	1.3630,	1.2070,
6,	1.4930,	1.6510,	1.4980,	1.6600,	2.0610,	2.3260,	1.9840,	1.9410,	1.6800,	1.5640,
7,	1.7390,	2.0530,	1.8290,	2.0500,	2.0590,	2.4400,	2.5190,	2.1730,	1.9750,	1.7460,
8,	2.0950,	2.4060,	1.8870,	2.2600,	2.1370,	2.4010,	2.5830,	2.3470,	2.3440,	2.0860,
9,	2.4650,	2.7250,	1.9610,	2.5400,	2.3680,	2.5320,	2.5700,	3.1180,	2.2480,	2.4240,
+gp,	3.3100,	3.2500,	2.8560,	3.0400,	2.6860,	2.6860,	2.9220,	2.9330,	3.2950,	2.5140,
SOPCOFAC,	1.0017,	1.0870,	.9238,	1.0554,	1.0602,	1.0559,	1.0141,	1.0197,	.9695,	1.0025,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	.4380,	.5470,	.5250,	.7550,	.7540,	.6660,	.5340,	.5190,	.6220,	.5040,
3,	.6990,	.6930,	.7240,	.9820,	1.1030,	1.0540,	.8580,	.7710,	.8460,	.6240,
4,	.9390,	.8840,	.8170,	1.0270,	1.2540,	1.4890,	1.4590,	1.0660,	1.0160,	.9740,
5,	1.2040,	1.0860,	1.0380,	1.1920,	1.4650,	1.7790,	1.9930,	1.7990,	1.2830,	1.2200,
6,	1.3840,	1.2760,	1.2490,	1.3780,	1.5930,	1.9400,	2.3300,	2.2700,	2.0800,	1.4900,
7,	1.5640,	1.4770,	1.4300,	1.6430,	1.8040,	2.1820,	2.3510,	2.3400,	2.5560,	2.4560,
8,	1.8180,	1.5740,	1.5640,	1.7960,	2.0490,	2.3570,	2.4690,	2.4750,	2.5720,	2.6580,
9,	2.1680,	1.9300,	1.6330,	1.9710,	2.2250,	2.4900,	2.7770,	2.5010,	2.4520,	2.5980,
+gp,	2.3350,	2.1530,	2.1260,	2.2400,	2.4230,	2.6780,	2.5820,	2.6690,	2.8010,	2.9530,
SOPCOFAC,	1.0195,	1.0635,	1.0554,	1.0361,	.9969,	1.0322,	1.0044,	1.0250,	1.0096,	1.0368,

Table 2.4.7

Run title : Haddock Faroes Vb (run: XSAJAK03/X03)

At 27/04/2000 17:13

Proportion mature at age

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE									
2,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,
3,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,
4,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,
3,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,
4,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	.0600,	.0600,	.0700,	.0800,	.0800,	.0300,	.0300,	.0500,	.0500,	.0200,
3,	.4800,	.4800,	.5200,	.6200,	.7600,	.6200,	.4300,	.3200,	.2400,	.2200,
4,	.9100,	.9100,	.8800,	.8900,	.9800,	.9600,	.9500,	.9100,	.8900,	.8700,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	.9800,	.9800,	.9900,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	.0800,	.1600,	.1800,	.1500,	.1200,	.1000,	.0600,	.0200,	.0100,	.0100,
3,	.3700,	.5800,	.6500,	.5300,	.5000,	.5500,	.5700,	.5500,	.4500,	.4100,
4,	.9000,	.9300,	.9100,	.9000,	.9200,	.9700,	.9500,	.9300,	.8900,	.8600,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	.9900,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.4.8. Faroe haddock (Division Vb) (run name: XSAJAK03)

a) The 2 tuning fleets

102
FLT01: 5 longliners > 100 GRT revised 2000 (Catch: Thousands) (Effort: Unknown)
1986 1999
1 1 0.00 1.00
4 8

2809	64.665	22.537	13.703	0.566	2.831
2468	13.666	26.226	17.886	11.857	2.110
3120	13.948	32.838	35.149	7.333	2.949
6734	9.804	51.973	60.703	54.256	12.221
9996	65.494	30.296	64.825	78.860	38.762
7748	63.010	54.083	30.717	54.083	32.293
6986	20.199	47.206	41.079	20.653	15.433
8862	16.567	37.350	40.362	37.651	6.024
6452	18.654	8.744	19.820	20.597	17.683
6519	8.166	10.145	6.805	12.744	13.362
13303	57.859	10.737	9.842	6.710	16.552
18364	815.202	69.770	12.852	14.918	9.410
18614	415.397	967.785	53.390	10.417	13.282
15474	63.692	393.482	561.249	20.761	2.647

FLT02: Cuba pair trawlers > 1000 HP revised 2000 (Catch: Thousands) (Effort: Unknown)
1985 1999
1 1 0.00 1.00
5 8

4341	17.865	1.996	1.248	0.749
4623	13.938	5.575	0.338	0.845
7165	34.734	12.892	5.008	0.639
7454	29.868	23.107	6.514	2.212
7213	11.285	16.875	16.242	4.113
8219	5.464	15.027	17.661	8.879
8119	18.346	10.528	13.238	7.609
8197	14.351	20.091	6.949	5.438
8589	9.647	13.058	14.352	4.470
9549	6.448	26.801	25.794	24.383
11307	10.378	5.661	15.725	14.467
11644	5.118	4.386	4.386	8.042
15228	26.350	1.568	3.451	3.451
12815	362.434	13.100	2.779	0.397
14119	145.072	171.192	6.058	0.470

b) The spring groundfish survey:

MH1_00: Magnus Heinason (Catch: Numbers) (Effort: No. of stations)
1983 1999
1 1 0.2 0.3
1 10

100	45.500	25.500	16.100	2.300	1.700	0.001	6.000	2.100	2.400	0.800
100	110.000	111.900	22.200	9.700	0.400	0.600	0.200	1.800	0.700	1.500
100	186.400	54.700	34.700	6.500	2.100	0.001	0.300	0.200	1.000	0.200
100	23.600	87.100	46.500	21.700	4.200	0.800	0.001	0.100	0.300	0.600
100	40.600	11.800	26.400	16.700	8.700	1.500	0.001	0.001	0.100	0.001
100	40.500	88.100	11.800	21.200	10.700	3.800	1.100	0.200	0.100	0.001
100	43.800	146.600	113.000	8.500	23.200	31.200	18.900	2.400	0.001	0.001
100	6.100	43.100	64.000	23.900	2.500	7.700	7.900	3.800	0.900	0.100
100	4.000	16.500	13.400	9.800	3.900	1.500	1.100	0.300	0.100	0.001
100	6.200	26.900	8.500	15.500	6.800	5.100	1.600	1.200	0.600	0.200
100	28.100	9.200	9.900	6.200	6.300	7.700	2.600	0.700	0.500	0.700
100	186.300	21.300	3.100	4.000	2.000	3.600	4.800	3.400	0.500	0.600
100	486.900	252.600	10.100	2.900	2.500	0.800	2.400	3.900	3.000	0.500
100	65.600	244.200	137.100	6.100	0.900	0.700	0.500	0.800	1.000	0.900
100	3.200	84.700	161.700	244.700	5.300	1.300	0.400	1.300	0.500	1.500
100	32.500	3.100	43.600	96.300	111.100	3.000	0.100	0.001	0.600	0.400
100	43.350	67.350	1.245	17.880	45.010	28.940	0.426	0.135	0.162	0.203

Table 2.4.9

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Lowestoft VPA Version 3.1   27/04/2000  17:12

 Extended Survivors Analysis

 Haddock Faroes Vb (run: XSAJAK03/X03)

 CPUE data from file fleet

 Catch data for  39 years. 1961 to 1999. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,     year, year,  age ,  age
 FLT01: 5 longliners ,    1986, 1999,   4,     8,   .000,  1.000
 FLT02: Cuba pair tra,    1985, 1999,   5,     8,   .000,  1.000


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years


 Catchability analysis :

      Catchability dependent on stock size for ages <    3

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  3


      Catchability independent of age for ages >=    6


 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 =    .300

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting not applied


 Tuning converged after   44 iterations



 Regression weights
       ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000



 Fishing mortalities
    Age,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999

      2,  .011,  .024,  .015,  .058,  .036,  .007,  .006,  .009,  .007,  .013
      3,  .113,  .138,  .062,  .143,  .132,  .077,  .062,  .069,  .159,  .100
      4,  .193,  .227,  .145,  .149,  .215,  .239,  .252,  .167,  .171,  .204
      5,  .217,  .185,  .218,  .146,  .116,  .242,  .292,  .275,  .233,  .222
      6,  .345,  .290,  .212,  .154,  .158,  .138,  .281,  .309,  .276,  .238
      7,  .427,  .384,  .237,  .154,  .177,  .159,  .253,  .350,  .467,  .217
      8,  .423,  .272,  .215,  .137,  .180,  .176,  .215,  .224,  .449,  .205
      9,  .334,  .262,  .247,  .172,  .187,  .180,  .212,  .269,  .372,  .173
```

Table 2.4.9. Continued

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1990	1.10E+04	1.32E+04	1.21E+04	4.34E+03	6.58E+03	6.07E+03	2.84E+03	1.05E+03
1991	3.57E+03	8.94E+03	9.67E+03	8.15E+03	2.86E+03	3.82E+03	3.24E+03	1.52E+03
1992	3.07E+03	2.85E+03	6.37E+03	6.31E+03	5.54E+03	1.75E+03	2.13E+03	2.02E+03
1993	2.21E+03	2.47E+03	2.19E+03	4.51E+03	4.16E+03	3.67E+03	1.13E+03	1.41E+03
1994	8.56E+03	1.71E+03	1.76E+03	1.55E+03	3.20E+03	2.92E+03	2.57E+03	8.08E+02
1995	1.21E+05	6.76E+03	1.23E+03	1.16E+03	1.13E+03	2.23E+03	2.00E+03	1.76E+03
1996	5.93E+04	9.79E+04	5.12E+03	7.90E+02	7.45E+02	8.05E+02	1.56E+03	1.37E+03
1997	9.75E+03	4.82E+04	7.54E+04	3.26E+03	4.83E+02	4.61E+02	5.12E+02	1.03E+03
1998	1.60E+04	7.91E+03	3.69E+04	5.22E+04	2.03E+03	2.90E+02	2.66E+02	3.35E+02
1999	1.43E+04	1.30E+04	5.53E+03	2.54E+04	3.39E+04	1.26E+03	1.49E+02	1.39E+02

Estimated population abundance at 1st Jan 2000

	0.00E+00	1.15E+04	9.64E+03	3.69E+03	1.67E+04	2.19E+04	8.30E+02	9.95E+01

Taper weighted geometric mean of the VPA populations:

	1.34E+04	1.08E+04	7.82E+03	5.39E+03	3.06E+03	1.59E+03	1.02E+03	7.56E+02

Standard error of the weighted Log(VPA populations) :

	1.1478	1.1874	1.2335	1.2747	1.2134	1.0055	1.0649	1.0013

Log catchability residuals.

Fleet : FLT01: 5 longliners

Age	1985	1986	1987	1988	1989
4	99.99	.46	-1.02	-.88	-1.03
5	99.99	.16	-.25	-.35	-.26
6	99.99	.46	.33	.08	-.23
7	99.99	-.60	1.03	-.34	.33
8	99.99	.96	1.38	-.06	-.11

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
4	-.19	.27	-.39	.24	.93	.47	.29	-.12	-.09	.13
5	-.30	-.11	.12	-.05	-.13	.36	.11	.23	.06	.06
6	-.10	.21	-.09	-.09	-.22	-.26	-.13	.27	.23	-.07
7	.21	.53	.38	-.03	-.08	-.31	-.60	.48	.62	-.08
8	.26	.13	-.11	-.70	-.10	-.14	-.38	-.14	.94	-.02

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	7	8
Mean Log q	-14.0485	-13.6691	-13.4661	-13.4661	-13.4661
S.E(Log q)	.5518	.2113	.2155	.4656	.5263

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
4	1.27	-1.715	15.43	.81	14	.64	-14.05
5	1.06	-1.043	13.95	.97	14	.22	-13.67
6	1.04	-.636	13.67	.97	14	.23	-13.47
7	1.02	-.152	13.49	.82	14	.49	-13.36
8	1.31	-1.648	15.40	.75	14	.63	-13.41

Table 2.4.9. Continued

Fleet : FLT02: Cuba pair tra

Age	1985	1986	1987	1988	1989
4	No data for this fleet at this age				
5	.89	.11	-.09	-.37	-.92
6	.77	.09	-.03	-.17	-.54
7	.21	-.58	.13	-.29	.09
8	-.07	.29	.15	-.19	-.23

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
4	No data for this fleet at this age									
5	-.89	-.31	-.29	-.43	.11	.77	.44	.38	.39	.09
6	-.34	.13	.07	-.15	.73	.04	.23	-.62	.23	-.13
7	-.06	.11	.17	.07	.79	.39	.14	.24	.71	-.19
8	.01	-.33	-.28	.07	.86	.42	.07	.08	-1.16	-.62

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	5	6	7	8
Mean Log q	-14.6057	-14.5006	-14.5006	-14.5006
S.E(Log q)	.5191	.3772	.3873	.5190

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
5	1.13	-.916	15.39	.83	15	.59	-14.61
6	1.05	-.476	14.82	.91	15	.41	-14.50
7	1.06	-.500	14.72	.89	15	.37	-14.32
8	.80	1.867	13.04	.90	15	.37	-14.58

Terminal year survivor and F summaries :

Age 2 Catchability dependent on age and year class strength

Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: 5 longliners	1.	.000	.000	.00	0	.000	.000
FLT02: Cuba pair tra	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	10755.	1.19				.060	.014
F shrinkage mean	11601.	.30				.940	.013

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11548.	.29	9.35	2	32.161	.013

Table 2.4.9. Continued

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: 5 longliners ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT02: Cuba pair tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	9639.,	.30,,,,				1.000,	.100

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
9639.,	.30,	.00,	1,	.000,	.100

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: 5 longliners ,	4216.,	.575,	.000,	.00,	1,	.181,	.181
FLT02: Cuba pair tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	3581.,	.30,,,,				.819,	.210

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3689.,	.27,	.15,	2,	.554,	.204

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: 5 longliners ,	17178.,	.267,	.057,	.21,	2,	.441,	.216
FLT02: Cuba pair tra,	18198.,	.541,	.000,	.00,	1,	.110,	.205
F shrinkage mean ,	15838.,	.30,,,,				.448,	.233

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
16670.,	.19,	.04,	4,	.229,	.222

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: 5 longliners ,	21356.,	.201,	.048,	.24,	3,	.485,	.243
FLT02: Cuba pair tra,	22324.,	.320,	.236,	.74,	2,	.203,	.234
F shrinkage mean ,	22331.,	.30,,,,				.312,	.234

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
21851.,	.15,	.05,	6,	.354,	.238

Table 2.4.9. Continued

```
Age  7   Catchability constant w.r.t. time and age (fixed at the value for age)  6

Year class = 1992

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: 5 longliners ,       982.,   .189,       .075,    .40,   4,  .432,     .186
FLT02: Cuba pair tra,       877.,   .255,       .168,    .66,   3,  .276,     .206

  F shrinkage mean  ,       615.,    .30,,,,                         .292,     .283

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      830.,       .14,      .11,    8,    .757,   .217


 Age  8   Catchability constant w.r.t. time and age (fixed at the value for age)  6

Year class = 1991

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: 5 longliners ,       126.,   .190,       .107,    .56,   5,  .385,     .165
FLT02: Cuba pair tra,        93.,   .242,       .365,   1.51,   4,  .280,     .217

  F shrinkage mean  ,        80.,    .30,,,,                         .335,     .250

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       99.,       .14,      .14,   10,   1.003,   .205


Age  9   Catchability constant w.r.t. time and age (fixed at the value for age)  6

Year class = 1990

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT01: 5 longliners ,       137.,   .186,       .202,   1.09,   5,  .347,     .124
FLT02: Cuba pair tra,        88.,   .237,       .391,   1.65,   4,  .246,     .187

  F shrinkage mean  ,        74.,    .30,,,,                         .407,     .218

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       96.,       .15,      .17,   10,   1.164,   .173
```

Table 2.4.10

Run title : Haddock Faroes Vb (run: XSAJAK03/X03)

At 27/04/2000 17:13

Terminal Fs derived using XSA (With F shrinkage)

Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE									
2,	.1875,	.3232,	.3801,	.0876,	.0691,	.0609,	.0641,	.1261,	.0860,
3,	.4162,	.5866,	.5639,	.3722,	.2354,	.2370,	.1872,	.2647,	.2362,
4,	.4209,	.5980,	.7261,	.5193,	.4767,	.4515,	.2971,	.3482,	.5319,
5,	.4387,	.3480,	.5591,	.5369,	.3678,	.5006,	.2997,	.2847,	.3329,
6,	.5879,	.6706,	.4026,	.6107,	.5882,	.5421,	.5406,	.4540,	.4974,
7,	.9483,	1.0499,	1.2493,	.3375,	.9618,	.9128,	.6906,	.8366,	.8275,
8,	.8742,	.9736,	1.1139,	1.2027,	2.3618,	.7509,	.6634,	.5850,	1.0629,
9,	.6600,	.7351,	.8185,	.6472,	.9619,	.6372,	.5022,	.5056,	.6565,
+gp,	.6600,	.7351,	.8185,	.6472,	.9619,	.6372,	.5022,	.5056,	.6565,
FBAR 3- 7,	.5624,	.6506,	.7002,	.4753,	.5260,	.5288,	.4030,	.4376,	.4852,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	.0551,	.0526,	.0253,	.1670,	.1265,	.1224,	.0903,	.0107,	.0010,	.0004,
3,	.2528,	.1936,	.4222,	.4304,	.2170,	.2646,	.1867,	.1121,	.0543,	.0454,
4,	.3343,	.4185,	.2852,	.2380,	.3724,	.2409,	.3803,	.1802,	.1653,	.1245,
5,	.3638,	.2753,	.4516,	.3130,	.1276,	.2111,	.2213,	.5256,	.2097,	.1896,
6,	.5557,	.5558,	.1494,	.2692,	.1711,	.0954,	.2864,	.7228,	.3801,	.1393,
7,	.8737,	.8373,	.6715,	.1943,	.2131,	.0858,	.1596,	.3890,	.5733,	.2703,
8,	.5427,	.4221,	.4055,	.2903,	.1431,	.1596,	.2532,	.3773,	.4940,	.3279,
9,	.5384,	.5057,	.3953,	.2623,	.2064,	.1592,	.2615,	.4422,	.3668,	.2113,
+gp,	.5384,	.5057,	.3953,	.2623,	.2064,	.1592,	.2615,	.4422,	.3668,	.2113,
FBAR 3- 7,	.4760,	.4561,	.3960,	.2890,	.2202,	.1796,	.2469,	.3859,	.2765,	.1538,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	.0321,	.0235,	.0377,	.0251,	.0324,	.0281,	.0095,	.0321,	.0355,	.0043,
3,	.0281,	.1354,	.4568,	.1881,	.1162,	.1664,	.0944,	.0911,	.0645,	.1077,
4,	.2009,	.1293,	.3639,	.3425,	.3800,	.2380,	.2437,	.1852,	.1827,	.1285,
5,	.2723,	.2091,	.2859,	.3405,	.2125,	.3352,	.2580,	.2549,	.2378,	.3243,
6,	.2113,	.2237,	.2740,	.1348,	.3212,	.4043,	.3411,	.3054,	.2948,	.3227,
7,	.1681,	.1978,	.2485,	.2941,	.0830,	.1983,	.1513,	.4399,	.2058,	.4887,
8,	.3916,	.0907,	.2230,	.3038,	.2863,	.1666,	.4825,	.5528,	.2140,	.3826,
9,	.2501,	.1708,	.2806,	.2847,	.2579,	.2699,	.2980,	.3280,	.2175,	.2966,
+gp,	.2501,	.1708,	.2806,	.2847,	.2579,	.2699,	.2980,	.3280,	.2175,	.2966,
FBAR 3- 7,	.1761,	.1790,	.3258,	.2600,	.2226,	.2684,	.2177,	.2553,	.1971,	.2744,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	.0106,	.0242,	.0145,	.0581,	.0364,	.0074,	.0062,	.0088,	.0073,	.0133,
3,	.1127,	.1382,	.0616,	.1428,	.1319,	.0771,	.0617,	.0691,	.1585,	.1000,
4,	.1934,	.2265,	.1446,	.1486,	.2147,	.2393,	.2518,	.1675,	.1711,	.2043,
5,	.2175,	.1855,	.2182,	.1457,	.1157,	.2425,	.2920,	.2753,	.2328,	.2224,
6,	.3448,	.2897,	.2123,	.1544,	.1582,	.1384,	.2806,	.3085,	.2764,	.2381,
7,	.4272,	.3837,	.2372,	.1541,	.1766,	.1590,	.2533,	.3495,	.4667,	.2167,
8,	.4228,	.2718,	.2151,	.1368,	.1796,	.1759,	.2150,	.2243,	.4485,	.2049,
9,	.3342,	.2616,	.2474,	.1719,	.1874,	.1803,	.2115,	.2693,	.3717,	.1731,
+gp,	.3342,	.2616,	.2474,	.1719,	.1874,	.1803,	.2115,	.2693,	.3717,	.1731,
FBAR 3- 7,	.2591,	.2447,	.1748,	.1491,	.1594,	.1712,	.2279,	.2340,	.2611,	.1963,

Table 2.4.11

Run title : Haddock Faroes Vb (run: XSAJAK03/X03)

At 27/04/2000 17:13

Terminal Fs derived using XSA (With F shrinkage)

Stock number at age (start of year) Numbers*10**-3

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE									
2	51279	38537	47363	30111	22645	20207	25358	54864	31978
3	23796	34806	22837	26515	22586	17303	15566	19472	39598
4	16517	12850	15850	10638	14961	14614	11177	10568	12236
5	6028	8877	5786	6278	5182	7605	7618	6799	6108
6	3245	3182	5132	2708	3005	2937	3774	4622	4188
7	1512	1476	1332	2809	1204	1366	1398	1800	2403
8	448	480	423	313	1641	377	449	574	638
9	135	153	148	114	77	127	146	189	262
+gp	0	0	0	0	0	0	0	0	0
TOTAL	102958	100362	98871	79486	71302	64535	65486	98889	97410

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
2	35608	15467	33202	23708	52392	70395	56273	26372	35344	2826
3	24024	27590	12015	26505	16424	37798	50996	42095	21361	28908
4	25598	15276	18613	6449	14110	10824	23751	34642	30809	16564
5	5885	15003	8230	11458	4162	7960	6964	13295	23686	21381
6	3585	3349	9328	4290	6860	2999	5277	4570	6435	15724
7	2085	1684	1573	6577	2683	4734	2232	3244	1816	3603
8	860	713	597	658	4434	1775	3557	1558	1800	838
9	181	409	382	326	403	3146	1239	2261	875	899
+gp	0	0	0	52	867	1398	1518	2621	1114	427
TOTAL	97826	79491	83940	80023	102336	141030	151807	130656	123240	91170

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	5010	3520	16094	19692	41410	39299	26897	9910	20784	16220
3	2313	3972	2815	12689	15723	32822	31284	21814	7857	16424
4	22617	1841	2841	1460	8607	11460	22753	23307	16305	6031
5	11974	15148	1325	1616	848	4820	7396	14600	15856	11121
6	14482	7466	10062	815	941	562	2822	4678	9264	10235
7	11200	9599	4888	6264	583	559	307	1643	2822	5649
8	2251	7751	6448	3121	3822	439	375	216	866	1881
9	494	1246	5796	4224	1886	2350	304	190	102	573
+gp	427	252	961	3524	4677	4518	3033	1311	720	346
TOTAL	70769	50795	51229	53404	78498	96829	95173	77668	74577	68480

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE											
2	11031	3565	3066	2211	8562	120503	59281	9745	16008	14294	0
3	13223	8937	2849	2474	1708	6760	97929	48237	7909	13010	11548
4	12073	9672	6372	2194	1756	1226	5124	75384	36857	5526	9639
5	4343	8146	6314	4515	1548	1160	790	3261	52203	25430	3689
6	6583	2861	5541	4156	3195	1129	745	483	2027	33864	16670
7	6069	3818	1753	3668	2916	2233	805	461	290	1259	21851
8	2837	3241	2130	1132	2575	2001	1560	512	266	149	830
9	1050	1522	2022	1406	808	1761	1374	1030	335	139	99
+gp	417	153	812	1288	1937	1980	2301	2405	1770	1308	997
TOTAL	57626	41915	30859	23045	25006	138753	169909	141518	117666	94980	65323

Table 2.4.12

Run title : Haddock Faroes Vb (run: XSAJAK03/X03) ,

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Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1961,	51279,	81164,	47797,	20831,	.4358,	.5624,
1962,	38537,	83420,	51875,	27151,	.5234,	.6506,
1963,	47363,	80753,	49547,	27571,	.5565,	.7002,
1964,	30111,	68578,	44128,	19490,	.4417,	.4753,
1965,	22645,	65656,	45556,	18479,	.4056,	.5260,
1966,	20207,	60936,	43954,	18766,	.4269,	.5288,
1967,	25358,	60210,	41961,	13381,	.3189,	.4030,
1968,	54864,	78089,	45384,	17852,	.3934,	.4376,
1969,	31978,	83837,	53433,	23272,	.4355,	.4852,
1970,	35608,	87336,	59882,	21361,	.3567,	.4760,
1971,	15467,	81806,	62946,	19393,	.3081,	.4561,
1972,	33202,	83152,	62030,	16485,	.2658,	.3960,
1973,	23708,	82842,	61651,	17976,	.2916,	.2890,
1974,	52392,	95542,	64726,	14773,	.2282,	.2202,
1975,	70395,	122086,	75536,	20715,	.2742,	.1796,
1976,	56273,	136094,	89459,	26211,	.2930,	.2469,
1977,	26372,	121741,	96921,	25555,	.2637,	.3859,
1978,	35344,	121360,	97854,	19200,	.1962,	.2765,
1979,	2826,	98463,	86080,	12418,	.1443,	.1538,
1980,	5010,	88454,	82653,	15016,	.1817,	.1761,
1981,	3520,	79867,	76715,	12233,	.1595,	.1790,
1982,	16094,	69257,	57177,	11937,	.2088,	.3258,
1983,	19692,	64941,	52696,	12894,	.2447,	.2600,
1984,	41410,	84773,	54798,	12378,	.2259,	.2226,
1985,	39299,	95260,	63781,	15143,	.2374,	.2684,
1986,	26897,	99888,	66750,	14477,	.2169,	.2177,
1987,	9910,	89304,	68493,	14882,	.2173,	.2553,
1988,	20784,	79812,	63077,	12178,	.1931,	.1971,
1989,	16220,	73244,	53187,	14325,	.2693,	.2744,
1990,	11031,	57651,	46249,	11726,	.2535,	.2591,
1991,	3565,	43198,	38360,	8429,	.2197,	.2447,
1992,	3066,	33220,	30709,	5476,	.1783,	.1748,
1993,	2211,	31179,	28392,	4026,	.1418,	.1491,
1994,	8562,	34928,	28128,	4252,	.1512,	.1594,
1995,	120503,	112735,	37245,	4967,	.1334,	.1712,
1996,	59281,	141966,	75705,	9761,	.1289,	.2279,
1997,	9745,	140911,	113593,	17923,	.1578,	.2340,
1998,	16008,	132493,	114166,	22108,	.1936,	.2611,
1999,	14294,	109900,	96915,	18847,	.1945,	.1963,
Arith. Mean ,	28744,	86052,	62295,	15996,	.2684,	.3155,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.4.13

Faroe Haddock: VPA and groundfish survey data
3 14 2

'Yearclass'	'VPAage2'	'Survage1'	'Survage2'	'Survage3'
1985	9910	23.6	11.8	11.8
1986	20784	40.6	88.1	113.0
1987	16220	40.5	146.6	64.0
1988	11031	43.8	43.1	13.4
1989	3565	6.1	16.5	8.5
1990	3066	4.0	26.9	9.9
1991	2211	6.2	9.2	3.1
1992	8562	28.1	21.3	10.1
1993	120503	186.3	252.6	137.1
1994	59281	486.9	244.2	161.7
1995	9745	65.6	84.7	43.6
1996	16008	3.2	3.1	1.245
1997	14294	32.5	67.35	-11
1998	-11	43.35	-11	-11

Table 2.4.14

```
Analysis by RCT3 ver3.1 of data from file : rct3a99.dat
Faroe Haddock: VPA and groundfish survey data
Data for    3 surveys over   14 years :  1985 - 1998
Regression type = C
Tapered time weighting applied
power =    3 over  20 years
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as    .20
Minimum of   3 points used for regression
Forecast/Hindcast variance correction used.
Yearclass =   1998

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error           Pts  Value   Value    Error   Weights
Survage    .99   6.05    .95   .627     13   3.79    9.82    1.102     .530
Survage
Survage
                                       VPA Mean =    9.43    1.170     .470
Year     Weighted      Log     Int     Ext     Var     VPA      Log
Class     Average      WAP     Std     Std    Ratio             VPA
         Prediction           Error   Error

1998       15260      9.63     .80     .19      .06
```

Table 2.4.15

The SAS System 11:35 Wednesday, May 10, 2000
Faroe haddock (Division Vb)

Prediction with management option table: Input data

Year: 2000								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	15260.000	0.2000	0.0200	0.0000	0.0000	0.548	0.0083	0.548
3	11548.000	0.2000	0.3200	0.0000	0.0000	0.747	0.0930	0.747
4	9639.000	0.2000	0.8400	0.0000	0.0000	1.019	0.1541	1.019
5	3689.000	0.2000	0.9900	0.0000	0.0000	1.434	0.2074	1.434
6	16670.000	0.2000	1.0000	0.0000	0.0000	1.947	0.2337	1.947
7	21851.000	0.2000	1.0000	0.0000	0.0000	2.451	0.2933	2.451
8	830.000	0.2000	1.0000	0.0000	0.0000	2.568	0.2492	2.568
9	99.000	0.2000	1.0000	0.0000	0.0000	2.517	0.2311	2.517
10+	997.000	0.2000	1.0000	0.0000	0.0000	2.808	0.2311	2.808
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	13006.000	0.2000	0.0100	0.0000	0.0000	0.548	0.0083	0.548
3	.	0.2000	0.3900	0.0000	0.0000	0.747	0.0930	0.747
4	.	0.2000	0.8600	0.0000	0.0000	1.019	0.1541	1.019
5	.	0.2000	0.9900	0.0000	0.0000	1.434	0.2074	1.434
6	.	0.2000	1.0000	0.0000	0.0000	1.947	0.2337	1.947
7	.	0.2000	1.0000	0.0000	0.0000	2.451	0.2933	2.451
8	.	0.2000	1.0000	0.0000	0.0000	2.568	0.2492	2.568
9	.	0.2000	1.0000	0.0000	0.0000	2.517	0.2311	2.517
10+	.	0.2000	1.0000	0.0000	0.0000	2.808	0.2311	2.808
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	13006.000	0.2000	0.0100	0.0000	0.0000	0.548	0.0083	0.548
3	.	0.2000	0.3900	0.0000	0.0000	0.747	0.0930	0.747
4	.	0.2000	0.8600	0.0000	0.0000	1.019	0.1541	1.019
5	.	0.2000	0.9900	0.0000	0.0000	1.434	0.2074	1.434
6	.	0.2000	1.0000	0.0000	0.0000	1.947	0.2337	1.947
7	.	0.2000	1.0000	0.0000	0.0000	2.451	0.2933	2.451
8	.	0.2000	1.0000	0.0000	0.0000	2.568	0.2492	2.568
9	.	0.2000	1.0000	0.0000	0.0000	2.517	0.2311	2.517
10+	.	0.2000	1.0000	0.0000	0.0000	2.808	0.2311	2.808
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANJAK05
Date and time: 04MAY00:14:25

Table 2.4.16

The SAS System 11:35 Wednesday, May 10, 2000

Faroe haddock (Division Vb)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	1.000	0.2000	0.0724	0.0000	0.0000	0.550	0.0359	0.550
3	.	0.2000	0.4924	0.0000	0.0000	0.812	0.1216	0.812
4	.	0.2000	0.9182	0.0000	0.0000	1.078	0.1897	1.078
5	.	0.2000	0.9953	0.0000	0.0000	1.411	0.1947	1.411
6	.	0.2000	1.0000	0.0000	0.0000	1.746	0.2183	1.745
7	.	0.2000	1.0000	0.0000	0.0000	2.046	0.2572	2.046
8	.	0.2000	1.0000	0.0000	0.0000	2.226	0.2762	2.226
9	.	0.2000	1.0000	0.0000	0.0000	2.434	0.2284	2.434
10+	.	0.2000	1.0000	0.0000	0.0000	2.760	0.2284	2.760
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDJAK02
Date and time: 29APR00:17:46

Table 2.4.17

The SAS System 11:35 Wednesday, May 10, 2000

Faroe haddock (Division Vb)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.1963	123294	107609	22488	0.0000	0.0000	103718	89690	0	104308	90852
.	.	.	.	.	0.1000	0.0196	.	89690	2013	102317	88880
.	.	.	.	.	0.2000	0.0393	.	89690	3979	100374	86956
.	.	.	.	.	0.3000	0.0589	.	89690	5898	98478	85078
.	.	.	.	.	0.4000	0.0785	.	89690	7772	96626	83245
.	.	.	.	.	0.5000	0.0982	.	89690	9603	94819	81456
.	.	.	.	.	0.6000	0.1178	.	89690	11390	93054	79710
.	.	.	.	.	0.7000	0.1374	.	89690	13136	91332	78005
.	.	.	.	.	0.8000	0.1570	.	89690	14841	89650	76341
.	.	.	.	.	0.9000	0.1767	.	89690	16506	88008	74717
.	.	.	.	.	1.0000	0.1963	.	89690	18132	86405	73132
.	.	.	.	.	1.1000	0.2159	.	89690	19721	84840	71584
.	.	.	.	.	1.2000	0.2356	.	89690	21272	83312	70073
.	.	.	.	.	1.3000	0.2552	.	89690	22788	81820	68598
.	.	.	.	.	1.4000	0.2748	.	89690	24269	80363	67159
.	.	.	.	.	1.5000	0.2945	.	89690	25715	78940	65753
.	.	.	.	.	1.6000	0.3141	.	89690	27128	77550	64380
.	.	.	.	.	1.7000	0.3337	.	89690	28508	76194	63040
.	.	.	.	.	1.8000	0.3533	.	89690	29857	74868	61731
.	.	.	.	.	1.9000	0.3730	.	89690	31175	73574	60454
.	.	.	.	.	2.0000	0.3926	.	89690	32462	72310	59206
.	.	.	.	.	2.1000	0.4122	.	89690	33720	71076	57988
.	.	.	.	.	2.2000	0.4319	.	89690	34950	69870	56798
.	.	.	.	.	2.3000	0.4515	.	89690	36151	68693	55637
.	.	.	.	.	2.4000	0.4711	.	89690	37325	67542	54502
.	.	.	.	.	2.5000	0.4908	.	89690	38472	66418	53394
.	.	.	.	.	2.6000	0.5104	.	89690	39593	65321	52312
.	.	.	.	.	2.7000	0.5300	.	89690	40689	64249	51255
.	.	.	.	.	2.8000	0.5496	.	89690	41760	63201	50223
.	.	.	.	.	2.9000	0.5693	.	89690	42807	62178	49215
.	.	.	.	.	3.0000	0.5889	.	89690	43830	61178	48230
.	.	.	.	.	3.1000	0.6085	.	89690	44831	60201	47268
.	.	.	.	.	3.2000	0.6282	.	89690	45808	59246	46329
.	.	.	.	.	3.3000	0.6478	.	89690	46764	58314	45411
.	.	.	.	.	3.4000	0.6674	.	89690	47699	57402	44514
.	.	.	.	.	3.5000	0.6871	.	89690	48612	56512	43639
.	.	.	.	.	3.6000	0.7067	.	89690	49506	55642	42783
.	.	.	.	.	3.7000	0.7263	.	89690	50379	54791	41947
.	.	.	.	.	3.8000	0.7459	.	89690	51233	53960	41130
.	.	.	.	.	3.9000	0.7656	.	89690	52068	53148	40332
.	.	.	.	.	4.0000	0.7852	.	89690	52885	52354	39552
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Table 2.4.18

The SAS System 11:35 Wednesday, May 10, 2000

Faroe haddock (Division Vb)

Yield per recruit: Summary table

¦ 1 January ¦ Spawning time ¦

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	8593.936	4.116	7683.308	4.116	7683.308
0.0500	0.0098	0.041	74.869	5.312	8089.616	3.913	7180.120	3.913	7180.120
0.1000	0.0196	0.078	139.646	5.129	7641.307	3.731	6732.936	3.731	6732.936
0.1500	0.0294	0.111	195.961	4.964	7240.563	3.567	6333.312	3.567	6333.312
0.2000	0.0393	0.141	245.128	4.813	6880.527	3.417	5974.390	3.417	5974.390
0.2500	0.0491	0.169	288.220	4.676	6555.572	3.282	5650.544	3.282	5650.544
0.3000	0.0589	0.194	326.120	4.551	6261.041	3.158	5357.115	3.158	5357.115
0.3500	0.0687	0.217	359.556	4.436	5993.047	3.043	5090.218	3.043	5090.218
0.4000	0.0785	0.239	389.140	4.329	5748.323	2.938	4846.586	2.938	4846.586
0.4500	0.0883	0.258	415.382	4.231	5524.104	2.841	4623.453	2.841	4623.453
0.5000	0.0982	0.277	438.715	4.139	5318.033	2.751	4418.464	2.751	4418.464
0.5500	0.1080	0.294	459.506	4.054	5128.094	2.667	4229.600	2.667	4229.600
0.6000	0.1178	0.310	478.068	3.975	4952.548	2.588	4055.124	2.588	4055.124
0.6500	0.1276	0.325	494.670	3.900	4789.891	2.515	3893.532	2.515	3893.532
0.7000	0.1374	0.339	509.542	3.830	4638.816	2.446	3743.517	2.446	3743.517
0.7500	0.1472	0.352	522.884	3.765	4498.180	2.382	3603.935	2.382	3603.935
0.8000	0.1570	0.365	534.869	3.703	4366.982	2.321	3473.786	2.321	3473.786
0.8500	0.1669	0.377	545.649	3.644	4244.341	2.264	3352.189	2.264	3352.189
0.9000	0.1767	0.388	555.353	3.589	4129.478	2.209	3238.366	2.209	3238.366
0.9500	0.1865	0.399	564.098	3.536	4021.704	2.158	3131.626	2.158	3131.626
1.0000	0.1963	0.409	571.984	3.487	3920.405	2.109	3031.356	2.109	3031.356
1.0500	0.2061	0.418	579.101	3.439	3825.036	2.063	2937.011	2.063	2937.011
1.1000	0.2159	0.427	585.528	3.394	3735.106	2.019	2848.100	2.019	2848.100
1.1500	0.2257	0.436	591.332	3.351	3650.179	1.977	2764.187	1.977	2764.187
1.2000	0.2356	0.444	596.577	3.310	3569.860	1.937	2684.877	1.937	2684.877
1.2500	0.2454	0.452	601.317	3.271	3493.793	1.899	2609.816	1.899	2609.816
1.3000	0.2552	0.460	605.601	3.234	3421.660	1.863	2538.682	1.863	2538.682
1.3500	0.2650	0.467	609.472	3.198	3353.170	1.828	2471.187	1.828	2471.187
1.4000	0.2748	0.474	612.969	3.163	3288.059	1.795	2407.066	1.795	2407.066
1.4500	0.2846	0.481	616.127	3.130	3226.089	1.763	2346.082	1.763	2346.082
1.5000	0.2945	0.487	618.977	3.098	3167.041	1.732	2288.016	1.732	2288.016
1.5500	0.3043	0.494	621.548	3.067	3110.719	1.702	2232.670	1.702	2232.670
1.6000	0.3141	0.500	623.863	3.038	3056.939	1.674	2179.862	1.674	2179.862
1.6500	0.3239	0.505	625.947	3.009	3005.536	1.646	2129.427	1.646	2129.427
1.7000	0.3337	0.511	627.819	2.982	2956.358	1.620	2081.212	1.620	2081.212
1.7500	0.3435	0.516	629.498	2.956	2909.264	1.595	2035.077	1.595	2035.077
1.8000	0.3533	0.522	631.000	2.930	2864.126	1.570	1990.893	1.570	1990.893
1.8500	0.3632	0.527	632.342	2.905	2820.825	1.546	1948.543	1.546	1948.543
1.9000	0.3730	0.532	633.536	2.881	2779.253	1.523	1907.916	1.523	1907.916
1.9500	0.3828	0.536	634.596	2.858	2739.308	1.501	1868.912	1.501	1868.912
2.0000	0.3926	0.541	635.532	2.836	2700.896	1.480	1831.437	1.480	1831.437
2.0500	0.4024	0.545	636.354	2.814	2663.931	1.459	1795.404	1.459	1795.404
2.1000	0.4122	0.550	637.073	2.793	2628.332	1.439	1760.735	1.439	1760.735
2.1500	0.4220	0.554	637.697	2.772	2594.026	1.419	1727.353	1.419	1727.353
2.2000	0.4319	0.558	638.233	2.752	2560.942	1.401	1695.190	1.401	1695.190
2.2500	0.4417	0.562	638.689	2.733	2529.017	1.382	1664.181	1.382	1664.181
2.3000	0.4515	0.566	639.071	2.714	2498.190	1.364	1634.266	1.364	1634.266
2.3500	0.4613	0.570	639.385	2.696	2468.405	1.347	1605.389	1.347	1605.389
2.4000	0.4711	0.573	639.637	2.678	2439.610	1.330	1577.497	1.330	1577.497
2.4500	0.4809	0.577	639.832	2.661	2411.756	1.314	1550.543	1.314	1550.543
2.5000	0.4907	0.580	639.974	2.644	2384.796	1.298	1524.480	1.298	1524.480
2.5500	0.5006	0.584	640.068	2.627	2358.689	1.283	1499.264	1.283	1499.264
2.6000	0.5104	0.587	640.117	2.611	2333.393	1.267	1474.857	1.267	1474.857
2.6500	0.5202	0.590	640.125	2.595	2308.871	1.253	1451.220	1.253	1451.220
2.7000	0.5300	0.593	640.095	2.580	2285.088	1.238	1428.317	1.238	1428.317
2.7500	0.5398	0.596	640.031	2.565	2262.010	1.225	1406.116	1.225	1406.116
2.8000	0.5496	0.599	639.935	2.551	2239.606	1.211	1384.585	1.211	1384.585
2.8500	0.5595	0.602	639.809	2.536	2217.847	1.198	1363.694	1.198	1363.694
2.9000	0.5693	0.605	639.657	2.523	2196.703	1.185	1343.417	1.185	1343.417
2.9500	0.5791	0.608	639.479	2.509	2176.150	1.172	1323.726	1.172	1323.726
3.0000	0.5889	0.611	639.279	2.496	2156.163	1.160	1304.596	1.160	1304.596
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDJAK02

Date and time : 29APR00:17:46

Computation of ref. F: Simple mean, age 3 - 7

F-0.1 factor : 0.9645

F-max factor : 2.6352

F-0.1 reference F : 0.1893

F-max reference F : 0.5173

Recruitment : Single recruit

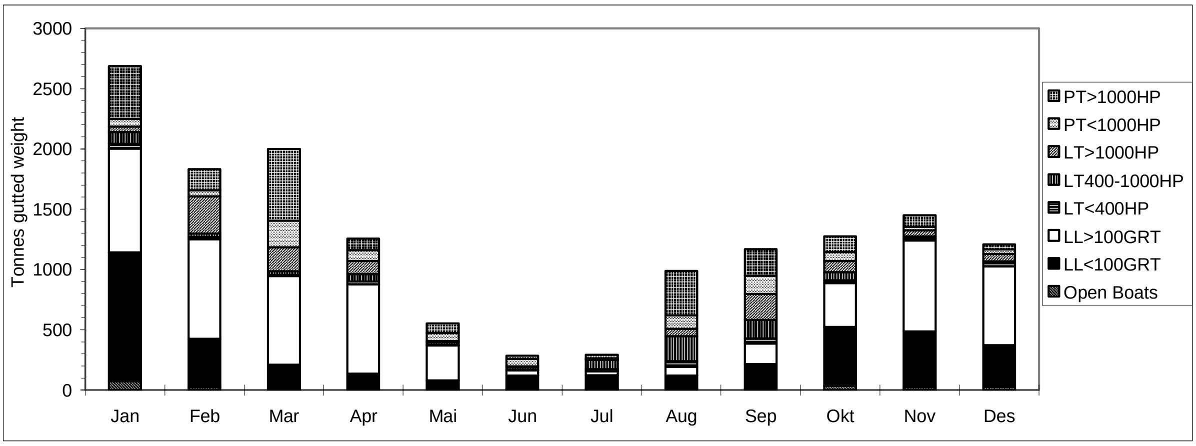


Figure 2.4.1.A. Faroese landings of haddock from Vb1 in 1999 per fleet category. Tonnes gutted weight.

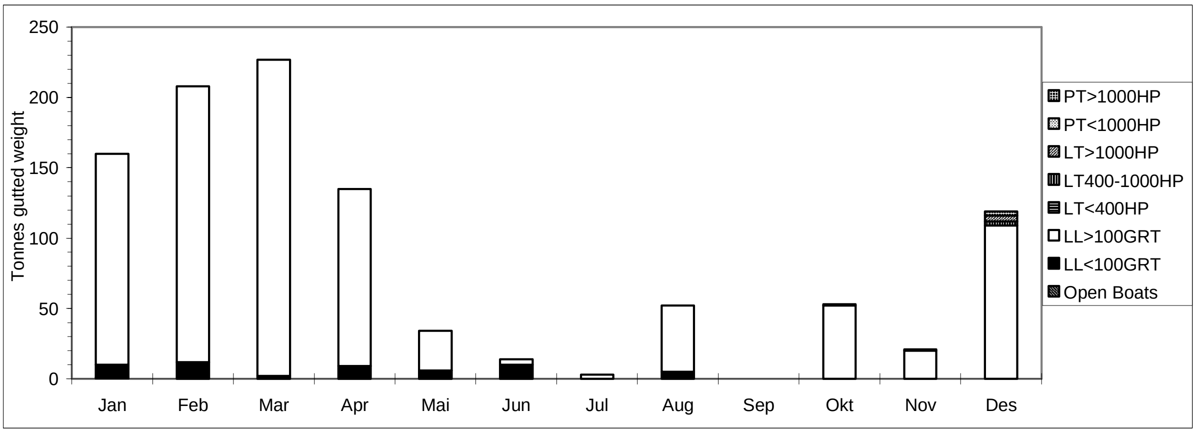


Figure 2.4.1.B. Faroese landings of haddock from Vb2 in 1999 per fleet category. Tonnes gutted weight.

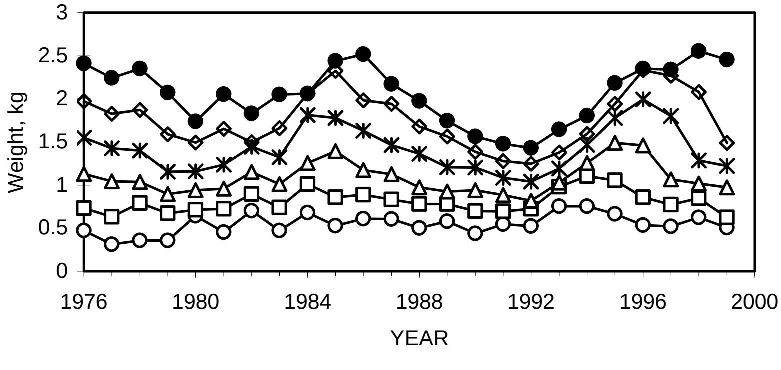


Figure 2.4.2. Mean weight at age for ages 2-7 of Faroe haddock 1976-1999.

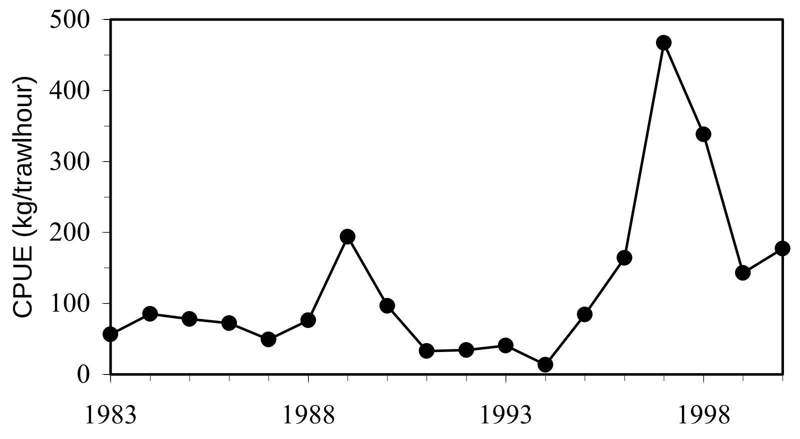
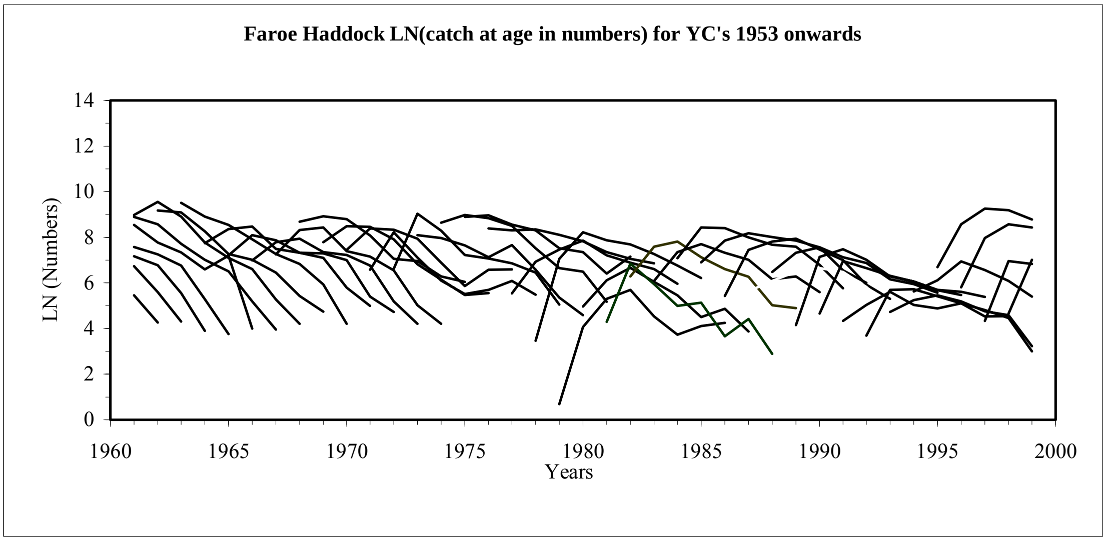


Figure 2.4.3. Faroe haddock. CPUE (kg/trawlhour) in the Faroese groundfish surveys in February-March 1983-2000.



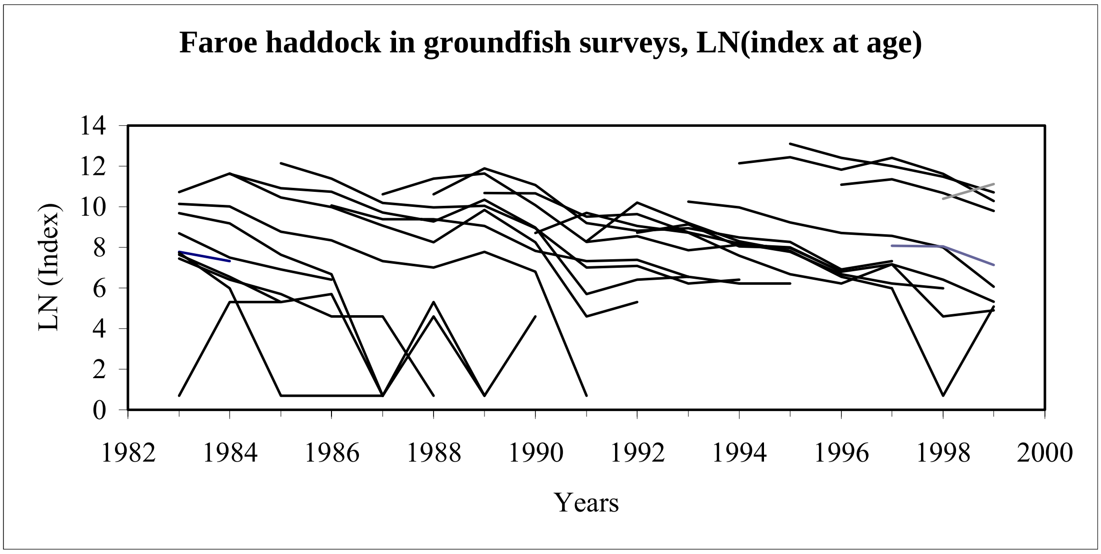


Figure 2.4.4. LN (catch at age in numbers) in commercial landings and survey.

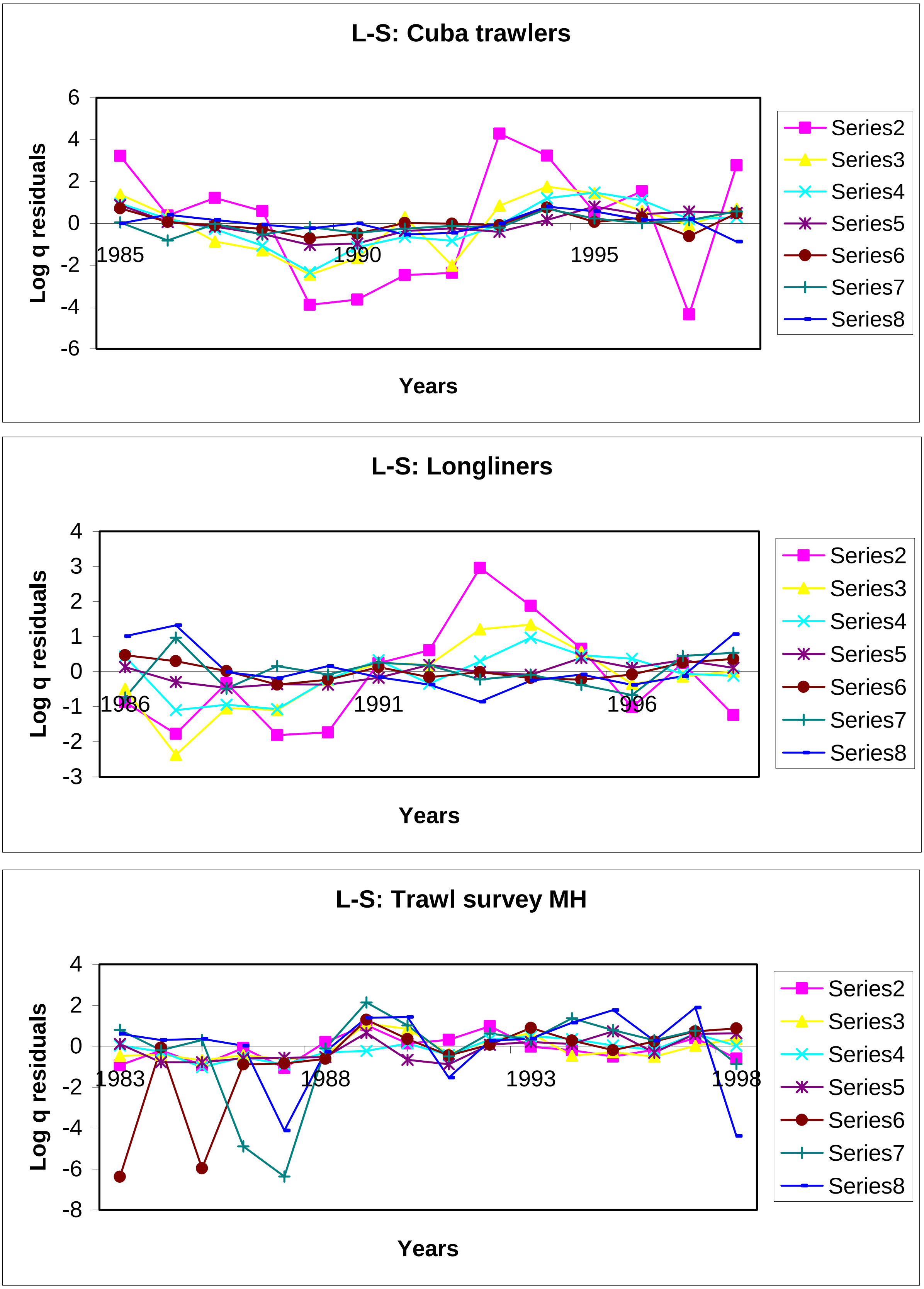
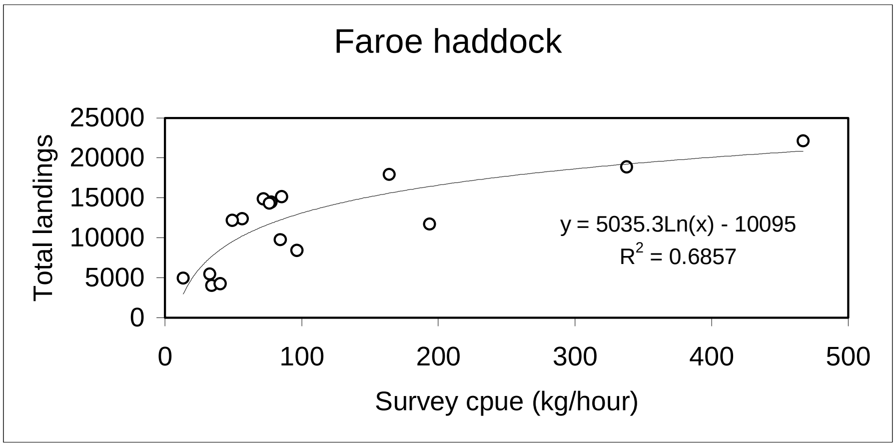


Figure 2.4.5. Log q residual plots from individual L-S tunings with two commercial fleets and the spring survey. All ages and years are included.

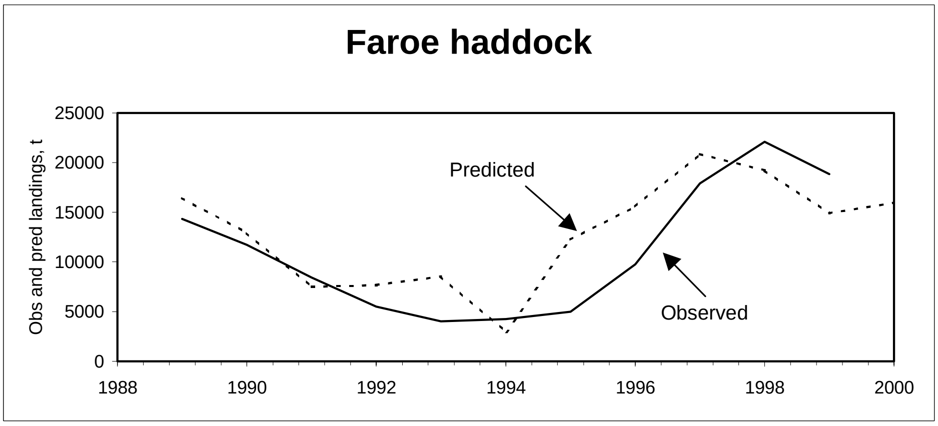
Figure 2.4.6 Faroe haddock total landings and survey cpue

Year	Survey cpue	Landings
1983		12894
1984	57	12378
1985	85	15143
1986	78	14477
1987	72	14882
1988	49	12178
1989	76	14325
1990	194	11726
1991	97	8429
1992	33	5476
1993	34	4026
1994	40	4252
1995	13	4967
1996	84	9761
1997	164	17923
1998	467	22108
1999	338	18847
2000	143	
2001	177	



a: 5035.3
b: 10095

Year	Obs	Pred
1989	14325	16421
1990	11726	12916
1991	8429	7476
1992	5476	7675
1993	4026	8528
1994	4252	2944
1995	4967	12238
1996	9761	15584
1997	17923	20854
1998	22108	19226
1999	18847	14894
2000		15968



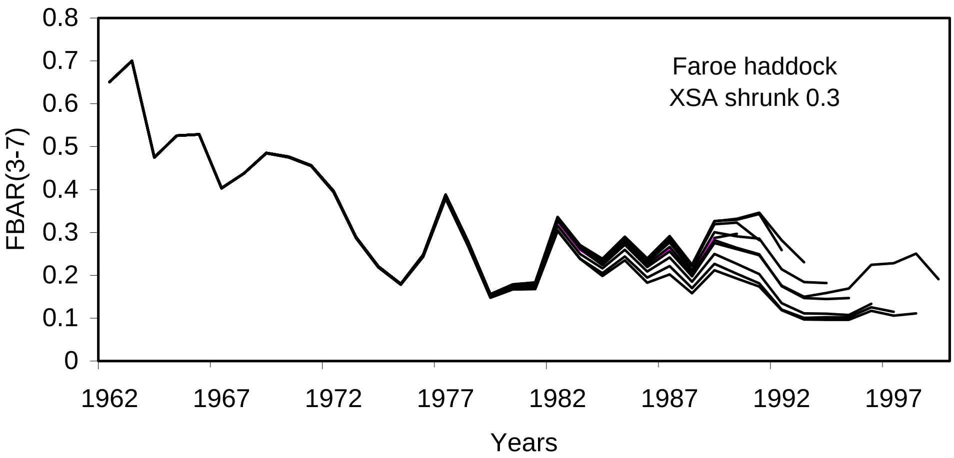
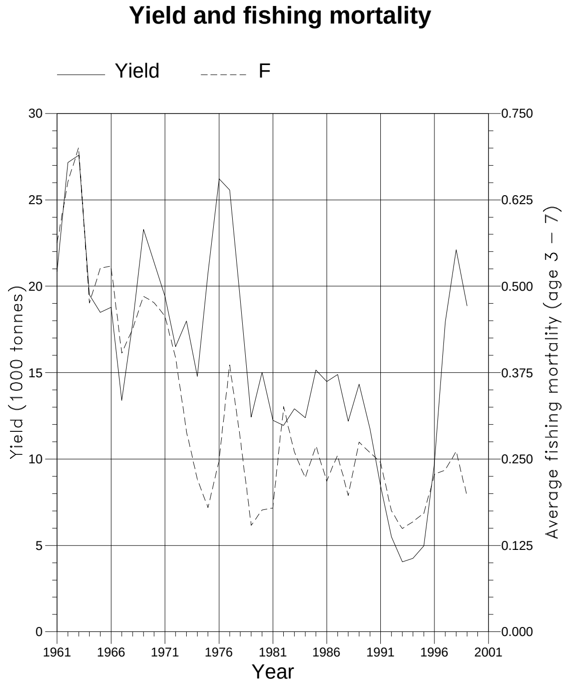
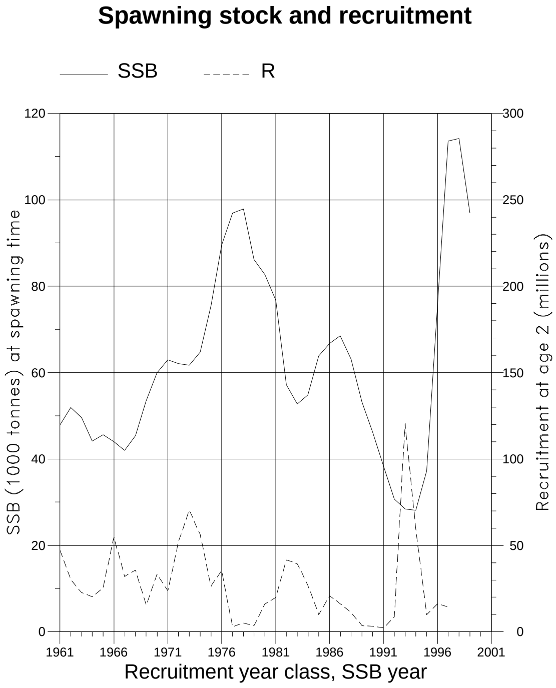


Figure 2.4.7. Faroe haddock. Retrospective analysis of the 2000 XSA shrunk 0.3.

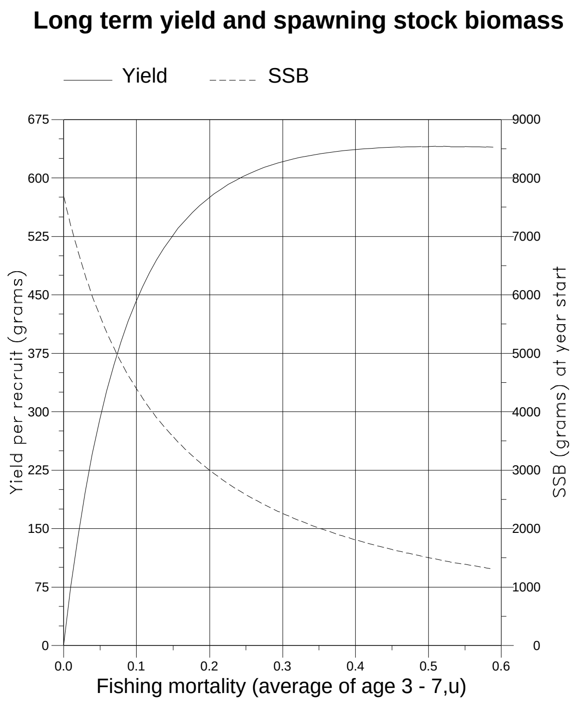
Figure 2.4.8 Faroe Haddock (Division Vb)



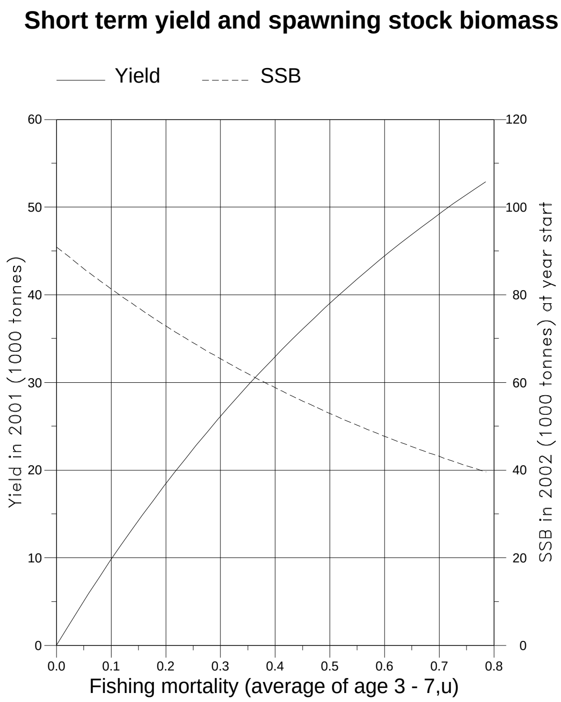
(run: XSAJAK03) **A**



(run: XSAJAK03) **B**

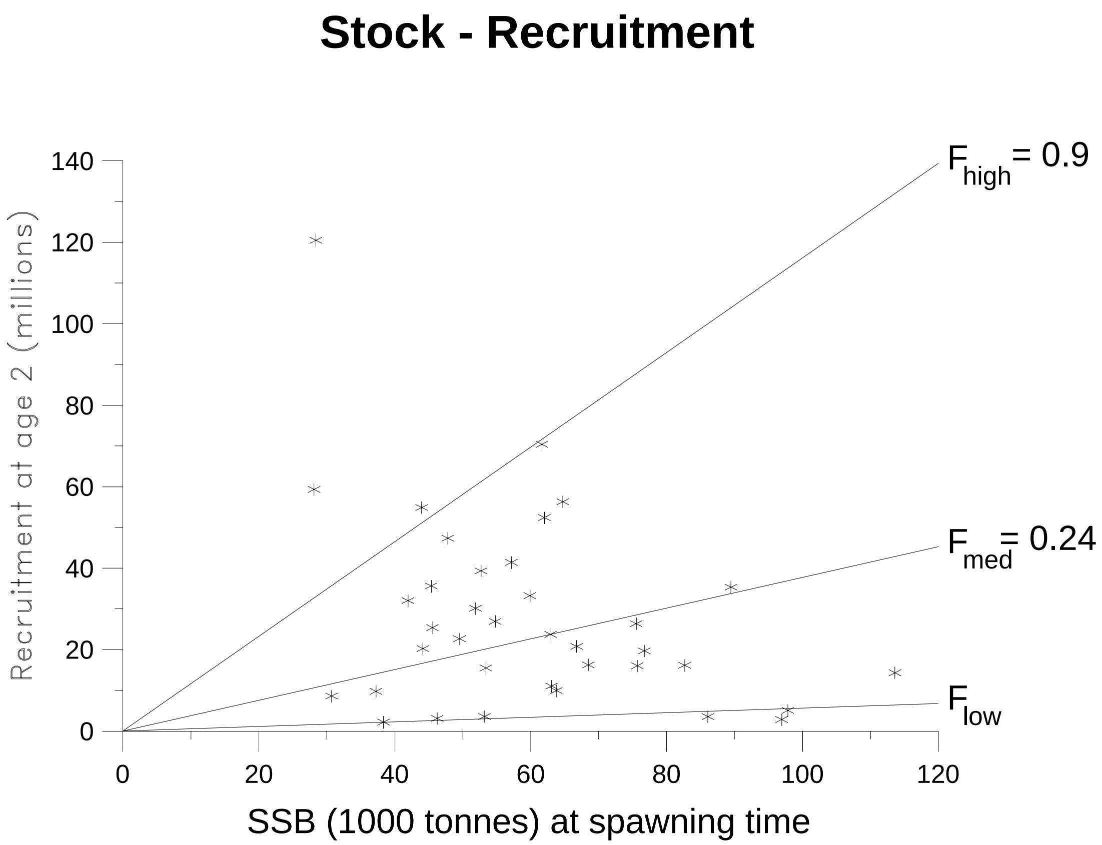


(run: YLDJAK02) **C**



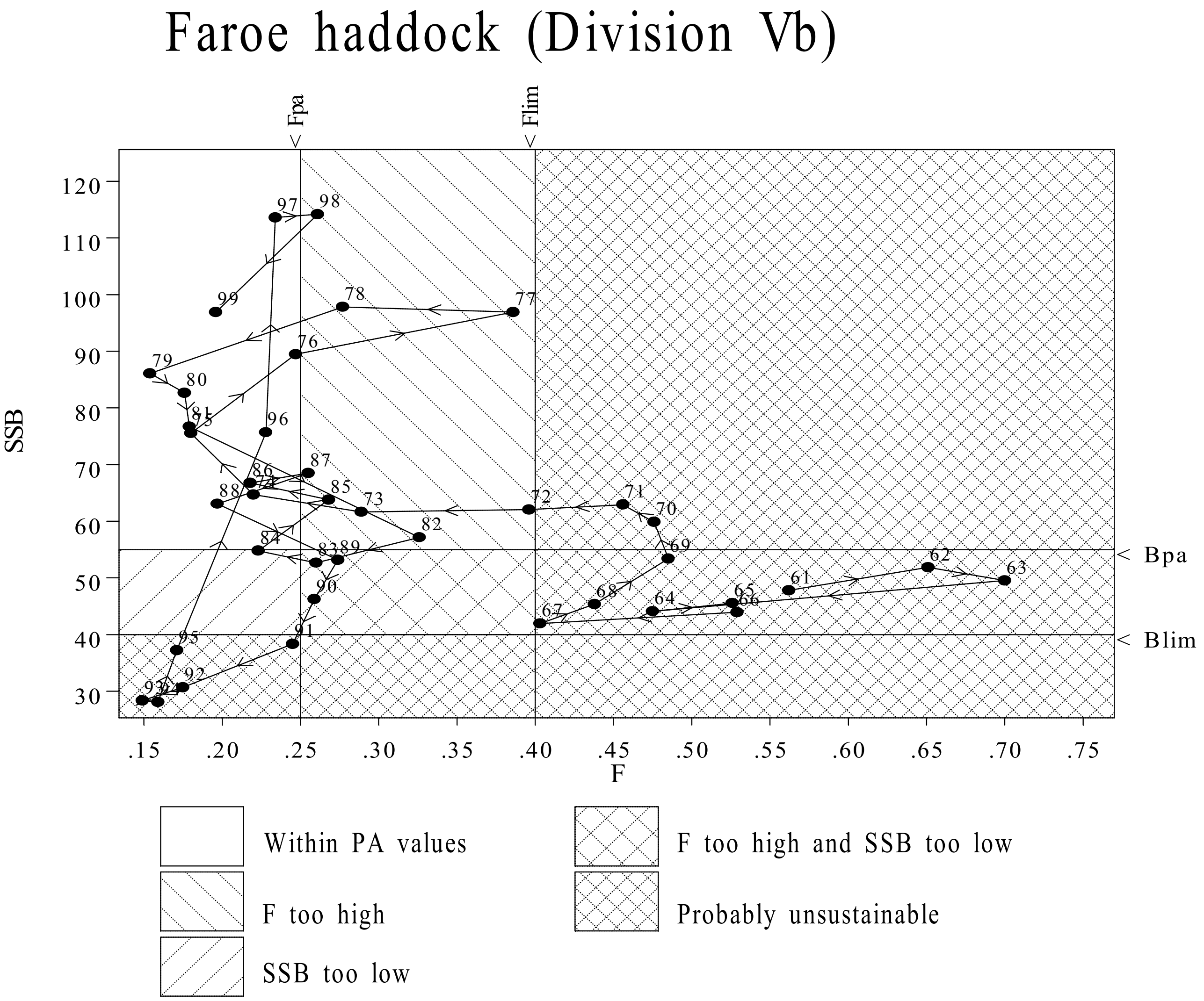
(run: MANJAK05) **D**

Figure 2.4.9 Faroe Haddock (Division Vb)



(run: XSAJAK03)

Figure 2.4.10



Data file(s):W:\ifapdata\work\nwwg\had_faro\xsajak03\pap_data.pa;*.sum
Plotted on 27/04/2000 at 17:40:11

1.5 Faroe Saithe

1.5.1 Landings and trends in the fishery

Nominal landings of saithe from the Faroese grounds (Division Vb) have been highly variable since 1960 ranging from 10 000 t to 60 000 t over that period. In 1990 record high landings of about 60 000 t were reached. Thereafter landings declined steadily to 20 000 t in 1996, before increasing again to 22 000 t in 1997, to 26 000 t in 1998 and 34 000 t in 1999 (Table 2.5.1.1).

With the introduction of the 200 miles EEZ in 1977, saithe has mainly been fished by Faroese vessels. The principal fleet consists of large pair trawlers (> 1000 HP), which have a directed fishery for saithe, accounting for about 60% of the reported landings in 1993–99 (Table 2.5.1.2). The smaller pair trawlers (< 1000 HP) have a more mixed fishery for saithe, and they account for about 20% of the total landings in 1993–99. During the last decade the proportion of saithe in the catches has generally increased for larger pair trawlers but decreased for the smaller pair trawlers, larger single trawlers (> 1000 HP) and jiggers. Other vessels only have small catches of saithe as by-catch.

Prior to 1996, when a fishery management system based on days fished was introduced; practically all the fish from a given trip were landed at the same place. This practice changed in 1997-1998 for saithe, with a single trip being possibly landed in several sites. The landing slips are the main source of information on landings and number of fishing days, and for those trips that have been landed at several sites, a landing slip was completed at each landing site, each one recording the actual landings, but the total number of fishing days. The number of trips/landings in 1997 affected by this problem is being examined in order to try to rectify the problem. An adjustment was made for 1998, but the WG believes that the data have been 'over-corrected' resulting in an underestimate of the number of days for that year. The statistical office, whose responsibility it is to produce landings and effort statistics, could not guarantee that the changes in the number of days fished would be minor. It was therefore considered unwise to proceed with using data that are expected to change, possibly significantly, in the near future.

The CPUE derived from the Cuba trawlers, with effort either in days or in hours fished is not affected by the problem mentioned above because the effort comes from logbooks rather than from the landing slips and also because of a more direct contact with the captain of the boats involved. The effort for Cuba Beta pair trawlers, which is used as tuning fleet, increased by 20% in 1999.

Catches used in the assessment are presented in Table 2.5.1.1. These include foreign catches that have been reported to the Faroese Authorities but not officially reported to ICES. Also catches in that part of Sub-division IIa which lies immediately north of the Faroes have been included.

1.5.2 Catch at age

Catch at age is based on length and otolith samples from Faroese landings of jiggers, small and large single and pair trawlers, and landing statistic by fleet provided by the Faroese Authorities. Catch at age was calculated for each fleet by four month periods. Catch at age was raised by the foreign catches. The catch-at-age data for previous years were revised according to the final catch statistics (Tables 2.5.2.1, 2.5.2.2). The sampling intensity in 1999 was slightly higher than in 1998:

Fleet	*Samples*	*Lengths*	*Otoliths*	*Weights*
Jiggers	24	4266	1086	540
Single trawlers 400 – 699 HP	5	844	240	0
Single trawlers 1000 - 1499 HP	3	597	0	0
Single trawlers 1500 - 1999 HP	4	815	180	179
Pair trawlers 100 – 699 HP	6	1198	120	120
Pair trawlers 700 – 999 HP	30	5847	1251	1131
Pair trawlers 1000 – 1499 HP	104	21325	3418	2815
Total	176	34892	6295	4785

1.5.3 Weight at age

Mean weights at age have varied by a factor of about 2 during 1961–1999. For example, the mean weights at age 5 varied between about 1.6 kg and 3.3 kg while for age 7 it varied between 2.6 kg and 5.3 kg (Table 2.5.3.1 and Figure 2.5.3.1). Mean weights at age were generally high during 1980–86 and dropped in the period 1987–1991. The mean weights increased again in the period 1992–96 but have shown a general decreased since. The SOP for 1999 was 104%.

1.5.4 Maturity at age

Maturity at age data is available from 1983 onward. Due to poor sampling in 1988 the proportion mature for this year was calculated as the average of the two adjacent years. A model was used, described in the 1993 Working Group report (ICES C.M.1993/Assess:18), for predicting maturity at age in order to alleviate some of the problems involved with the sampling data. The basic model used was a GLM with a Logit link function describing maturity at age as a function of age, year class strength, mean weight at age and a year effect. Of those factors, age and mean weight at age were significant, and no other independent variables were needed. This model was applied to predict the entire maturity at age for 1983–1999 (Table 2.5.4.1 and Figure 2.5.4.1).

1.5.5 Stock assessment

1.5.5.1 Tuning and estimation of fishing mortality

Two tuning series derived from the same vessels have been tried in the XSA runs since 1998. The first one was the commercial Cuba series consisting of total saithe catch at age and total effort in days, used in previous assessments, hereafter referred to as the Cuba Beta series. The series extends back to 1982 and consists of data from 8 pair trawlers greater than 1000 HP (Cuba trawlers) which specialise in fishing on saithe and account for 5 000–8 000 t of saithe each year. The 1993 Working Group report (ICES C.M. 1993/Assess:18) provides a description of how and why this particular series was chosen.

The second series was introduced in 1998 (ICES C.M. 1998/ACFM:19), and consists of saithe catch at age and effort in hours, hereafter referred to as the Cuba Logbook series. In the Cuba Logbook series, information for each haul was supplied and only those hauls where saithe consisted of more than 50% of the total catches of cod, haddock and saithe were used (Table 2.5.5.1).

Measuring fishing effort in hours, as in the Logbook series, rather than in days is more precise and is generally recommended by the working group. With the new effort management system adopted by the Faroes since 1996, the fishing mortality exerted by one day's fishing is expected to have increased and therefore the CPUE in catch per day under the recent management system is not expected to be comparable with CPUE in catch per day before 1996 because of increased effency.

Since introducing the Cuba Logbook series in 1998, the working group has stated that there are only negligible differences in the XSA using the two tuning series. The two series are compared age by age in Figure 2.5.5.1, and show good agreement. In the following only the XSA run using the Cuba Logbook will be discussed.

The XSA run was made with the same parameters as last year. The output from the XSA is presented in Tables 2.5.5.3–5 and the diagnostics are in Table 2.5.5.2. The values of the S.E. log q are reasonably low for the principal year classes. The log catchability residuals from the XSA tuning for age groups 4–8 (Figure 2.5.5.2) show considerably more negative values (37) in the first seven years than in the last seven years (21) of the 15 years time series.

Retrospective analysis of the average fishing mortality for age groups 4–8 years (Figure 2.5.5.3) shows a tendency to overestimate F in the two previous assessments with Fbar (4–8) for 1998 estimated at 0.42 in 1998 but at 0.30 in 1999 while the estimated biomass for 1998 increased from 61 000 t in the 1999 assessment to 79 000 t in the current one. This could be due to an underestimation of the 1992 year class in previous assessments. The 1992 year-class is the only one amongst the 1953 to 1996 year classes where catch numbers increased from age 6 to 7 (Figure 2.5.5.4). This could be due to an immigration of seven-year-old saithe into Faroese fishing grounds in 1999 or to the late recruitment of the 1992 year-class. Neither maturity ogive nor catch weights at age show any abnormality for this age group in 1999.

The fishing mortalities for 1961–1999 are presented in Table 2.5.5.3. The average fishing mortality for age groups 4–8 was 0.44 in 1999.

1.5.5.2 Stock estimates and recruitment

Recruitment in the 1980s was above or close to average (24 millions). The strongest year class since 1961 was produced in the 1980s and the average for that decade is about 33 million. Even though recruitment had been above average, the spawning stock biomass declined from nearly 100 000 t in 1989 to about 65 000 t in 1992 as a result of high fishing mortality yielding the highest (1990) and third highest (1991) landings of the whole 1961–99 period. The historically low SSB persisted in 1992–1996 (Table 2.5.5.5 and Figure 2.5.5.5B). The SSB increased in 1997 with the maturation of the 1992 year class, witch is estimated to be well above average. The 1993 and 1995 year classes are estimated to be around average, while the 1994 year class is estimated to be at the lowest recorded.

1.5.6 Prediction of catch and biomass

1.5.6.1 Input data

Input data for prediction with management options are presented in Table 2.5.6.1 and input data for the yield per recruit calculations are given in Table 2.5.6.2.

Population numbers for the short term prediction up to the 1996 year class are from the final VPA run whereas values for the 1997–1999 year classes are the geometric mean of the 1994 to 1996 year classes. The mean weights for the stock and for the catches are the same for 2000–2002, the arithmetic mean for 1997–99. In the long term prediction (yield per recruit) mean weights for 1961–1999 were used.

In the short term prediction the fitted proportion mature values for 2000 were used for that year and for 2001 and 2002 the average of fitted values for 1998–2000 was used. In the long term prediction the average of fittet values for 1983–2000 was used.

For all three years in the short term prediction the average exploitation pattern in the final VPA for 1997–99, rescaled to Fbar (ages 4–8) in 1999, was used. In the long term prediction the exploitation pattern was set equal to the average of exploitation patterns for 1961–1999.

1.5.6.2 Biological reference points

The yield per recruit and spawning stock biomass per recruit curves are presented in Figure 2.5.6.1C. Compared to the 1999 average fishing mortality of 0.44 in age groups 4–8, F_{max} is 0.43, $F_{0.1}$ is 0.17, F_{med} is 0.32 and F_{high} is 0.58 (Table 2.5.6.3, Figure 2.5.6.1C and Figure 2.5.6.2).

In May 1998, ACFM set B_{lim} at 85 000 t, the previously defined MBAL, and correspondingly F_{lim} at 0.40. ACFM proposed that F_{pa} be set at 0.28 which is consistent with both estimates derived from F_{lim} and F_{med} and that B_{pa} be set at 110 000 t. Stock-recruitment scatter plot from the current assessment supports the conclusion that lower recruitment have been observed at SSBs below 80 000–90 000 t. However, the highest recruitments have actually been observed at SSBs smaller than the proposed B_{pa}. In May 1999, ACFM set B_{lim} at 60 000 t, the lowest observed SSB, and B_{pa} at the former MBAL = 85 000 t.

SSB was estimated to be 69 000 t in 1999, which is a decrease of 10 000 t compared to SSB in 1998, and slightly higher than the estimated record low SSB level of 65 000 t in the 1992–96 period.

The history of the stock/fishery in relation to the four reference points can be seen in Figure 2.5.6.3.

1.5.6.3 Projection of catch and biomass

Results from predictions with management option are presented in Table 2.5.6.4 and Figure 2.5.6.1D. Catches at status quo F would result in catches of 30 000 t in 2000 and 26 000 t in 2001. The spawning stock biomass would decrease from 65 000 t in 2000 to 57 000t, less than B_{lim}, in 2002.

Results from the yield per recruit estimates are shown in Table 2.5.6.3 and Figure 2.5.6.1.

1.5.7 Management considerations

The spawning stock biomass is continuing to be less than B_{pa} and is expected to decline below B_{lim} at *status quo* fishing mortality. A 20% reduction in fishing mortality in 2001 would prevent the SSB falling below B_{lim} in 2002. Zero fishing mortality in 2001 would bring the SSB close to B_{pa} in 2002.

The cumulative probability distribution of F in 1998 showed that there was an approximately 50% probability that the fishing mortality in 1999/2000 will be about 0.40 with the present number fishing days allocated in 1998. The fishing mortality was higher (0.44) in 1999. It has been estimated that a decrease to 60% of the allocated number of days would be required to have an 80% probability that F would be at the proposed F_{pa} = .28 or less. Although no probability distribution is available for 2000/2001 (see Section 2.1.4), there is no doubt that fishing mortality will exceed the proposed F_{pa} at current fishing effort.

1.5.8 Comments on the assessment

The XSA settings are the same as last year, but the Cuba Logbook tuning series has been used instead of the old Cuba Beta series. The main argument for using the Logbook series is that effort is measured in hours, a more appropriate measure than days fishing.

There still is no independent recruitment index to predict recruits in the first year in the short term prediction. An attempt should be tried to analyse the correlation between survey index and stock in number from VPA. A programme for echo sounding and biological sampling of age group 0–3 is in progress and might provide a recruitment index in near future.

The question of migration has been brought up previously. Although tagging data indicates that saithe migrate between management areas, no attempts have been made to quantify the rate of migration of saithe. This should be undertaken.

Table 2.5.1.1. Saithe in the Faroes (Division Vb). Nominal catches (tonnes) by countries, 1986-99, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Denmark	21	255	94	-	2	-	-
Faroe Islands	40,139	39,301	44,402	43,624	59,821	53,321	35,979
France [3]	87	153	313	-	-	-	120
German Dem.Rep.	-	-	-	9	-	-	5
German Fed. Rep.	105	49	74	20	15	32	
Netherlands	-	-	-	22	67	65	-
Norway	24	14	52	51	46	103	85
UK (Eng. & W.)	-	108	-	-	-	5	74
UK (Scotland)	1,340	140	92	9	33	79	98
USSR/Russia [2]	-	-	-	-	30	-	12
Total	41,716	40,020	45,027	43,735	60,014	53,605	36,373
Working Group estimate [4,5]	41,716	40,020	45,285	44,477	61,628	54,858	36,487

Country	1993	1994	1995	1996	1997	1998	1999 [1]
Estonia	-	-	-	-	16	-	-
Faroe Islands	32,719	32,406	26,918	19,267	21,721	25,995	33,057
France	75	19	10	12	9	17	
Germany	2	1	41	3	5	-	100
Norway	32	156	10	96	67	54	189
UK (Eng. & W.)	279	151	21	53	-	19	...
UK (Scotland)	425	438	200	580	460	337	...
United Kingdom							509
Russia	-	-	-	18	28	-	-
Total	33,532	33,171	27,200	20,029	22,306	26,422	33,855
Working Group estimate [4,5]	33,554	33,193	27,222	20,029	22,320	26,409	33,855

[1] Preliminary.

[2] As from 1991.

[3] Quantity unknown 1989-91.

[4] Includes catches from Sub-division Vb2 and Division IIa in Faroese waters.

[5] Includes French catches from Division Vb, as reported to the Faroese coastal guard service.

Table 2.5.1.2. Saithe in the Faroes (Division Vb). Total faroese landings (rightmost column) and the contribution (%) by each fleet category. Averages for 1985-99 are given at the bottom.

Year	*Open boats*	*Long-liners <100 GRT*	*Single trawl <400 HP*	*Gill-nets*	*Jiggers*	*Single trawl 400-1000 HP*	*Single trawl >1000 HP*	*Pair trawl <1000 HP*	*Pair trawl >1000HP*	*Long-liners >100 GRT*	*Indust-rial trawlers*	*Others*	*Total catch tonnes gutted*
1985	0.2	0.1	0.1	0.0	2.6	6.6	33.7	28.2	28.2	0.1	0.2	0.2	38377
1986	0.3	0.2	0.1	0.1	3.6	2.8	27.3	27.5	36.5	0.1	0.7	0.9	36132
1987	0.7	0.1	0.3	0.4	5.6	4.1	20.4	22.8	44.2	0.1	1.1	0.0	35700
1988	0.4	0.3	0.1	0.3	6.5	6.8	20.8	19.6	43.6	0.1	1.3	0.1	39586
1989	0.9	0.1	0.3	0.2	9.3	5.4	17.7	23.5	41.1	0.1	1.3	0.0	40132
1990	0.6	0.2	0.2	0.2	7.4	3.9	19.6	24.0	42.8	0.2	0.9	0.0	54721
1991	0.6	0.1	0.1	0.6	9.8	1.3	13.9	26.5	46.2	0.1	0.8	0.0	48910
1992	0.4	0.4	0.0	0.0	10.5	0.5	7.1	24.4	55.6	0.1	1.0	0.0	31472
1993	0.6	0.2	0.1	0.0	9.3	0.6	6.5	21.4	60.6	0.1	0.7	0.0	29111
1994	0.4	0.4	0.1	0.0	12.6	1.1	6.8	18.5	59.1	0.2	0.7	0.0	29194
1995	0.2	0.1	0.4	0.0	9.6	0.9	9.9	17.7	60.9	0.3	0.0	0.0	24248
1996	0.0	0.0	0.1	0.0	9.2	1.2	6.8	23.7	58.6	0.2	0.0	0.0	17353
1997	0.0	0.1	0.1	0.0	8.9	2.5	10.7	17.8	58.9	0.4	0.4	0.0	19561
1998	0.1	0.4	0.1	0.0	8.1	2.8	13.8	16.5	57.6	0.3	0.4	0.0	23417
1999	0.0	0.1	0.1	0.0	5.7	1.2	12.6	18.5	60.0	0.2	1.6	0.0	29781
Average	0.4	0.2	0.1	0.1	7.9	2.8	15.2	22.0	50.3	0.2	0.7	0.1	33180

Table 2.5.2.1. Saithe in the Faroes (Division Vb). Catch in number at age by fleet categories.

Age	*Jiggers*	*ST>1000 HP*	*PT<100 HP*	*PT>1000HP*	*Others*	*Tot. Faroe*	*Foreign*	*Total*
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	1	1	0	1
3	51	33	81	139	16	321	8	328
4	79	75	136	339	22	652	16	668
5	232	361	743	1644	103	3082	74	3157
6	129	323	501	1495	92	2540	61	2601
7	199	509	805	2432	150	4094	99	4193
8	37	124	125	592	32	911	22	933
9	16	54	36	259	13	379	9	388
10	7	19	29	87	5	146	4	150
11	1	3	4	14	1	23	1	24
12	2	4	0	20	1	27	1	28
13	0	1	0	3	0	5	0	5
14	1	4	0	17	1	23	1	23
15	0	2	0	11	0	14	0	14
Total No.	755	1513	2462	7052	436	12217	295	12512
Catch, t.	1698	3735	5487	17833	1028	29781	719	30500

Table 2.5.2.2. Saithe in the Faroes (Division Vb). Catch in numbers at age (thousands).

Run title : Saithe Faroes Vb (run: XSABJM07/X07)
At 29/04/2000 16:29

Table 1 Catch numbers at age (Thousands)

YEAR / AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	183	562	614	684	996	488	595	614	1191
4	379	542	340	1908	850	1540	796	1689	2086
5	483	617	340	1506	1708	1201	1364	1116	2294
6	403	495	415	617	965	1686	792	1095	1414
7	216	286	406	572	510	806	1192	548	1118
8	129	131	202	424	407	377	473	655	589
9	116	129	174	179	306	294	217	254	580
10	82	113	158	150	201	205	190	128	239
11	45	71	94	100	156	156	97	89	115
+gp	82	105	274	174	285	225	140	187	190
TOTALNUM	2118	3051	3017	6314	6384	6978	5856	6375	9816
TONSLAND	9592	10454	12693	21893	22181	25563	21319	20387	27437
SOPCOF %	108	93	96	99	92	98	104	102	97

YEAR / AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
3	1445	2857	2714	2515	3504	2062	3178	1609	611	287
4	6577	3316	1774	6253	4126	3361	3217	2937	1743	933
5	1558	5585	2588	7075	4011	3801	1720	2034	1736	1341
6	1478	1005	2742	3478	2784	1939	1250	1288	548	1033
7	899	828	1529	1634	1401	1045	877	767	373	584
8	730	469	1305	693	640	714	641	708	479	414
9	316	326	1017	550	368	302	468	498	466	247
10	241	164	743	403	340	192	223	338	473	473
11	86	100	330	215	197	193	141	272	407	368
+gp	132	100	210	186	265	298	287	330	535	691
TOTALNUM	13462	14750	14952	23002	17636	13907	12002	10781	7371	6371
TONSLAND	29110	32706	42663	57431	47188	41576	33065	34835	28138	27246
SOPCOF %	96	109	100	120	113	116	107	104	100	102

YEAR / AGE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	996	411	387	2483	368	1224	1167	1581	866	451
4	877	1804	4076	1103	11067	3990	1997	5793	2950	5981
5	720	769	994	5052	2359	5583	4473	3827	9555	5300
6	673	932	1114	1343	4093	1182	3730	2785	2784	7136
7	726	908	380	575	875	1898	953	990	1300	793
8	284	734	417	339	273	273	1077	532	621	546
9	212	343	296	273	161	103	245	333	363	185
10	171	192	105	98	52	38	104	81	159	83
11	196	92	88	98	65	26	67	43	27	55
+gp	786	1021	902	540	253	275	158	97	60	39
TOTALNUM	5641	7206	8759	11904	19566	14592	13971	16062	18685	20569
TONSLAND	25230	30103	30964	39176	54665	44605	41716	40020	45285	44477
SOPCOF %	99	96	96	100	100	94	94	96	99	97

YEAR / AGE	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	294	1030	521	1316	690	398	297	343	138	321
4	3833	5125	4067	2611	3961	1019	1087	829	1588	652
5	10120	7452	3667	4689	2663	3469	1146	2432	1854	3082
6	9219	5544	2679	1665	2368	1836	1449	1761	3326	2540
7	5070	3487	1373	858	746	1177	1156	1330	1306	4094
8	477	1630	894	492	500	345	521	622	663	911
9	123	405	613	448	307	241	132	164	363	379
10	61	238	123	245	303	192	77	71	75	146
11	60	128	63	54	150	104	64	29	32	23
+gp	79	118	108	52	49	117	82	100	68	69
TOTALNUM	29336	25157	14108	12430	11737	8898	6011	7681	9413	12217
TONSLAND	61628	54858	36487	33532	33171	27220	20029	22306	26422	33855
SOPCOF %	98	99	105	102	102	102	103	100	106	104

Table 2.5.3.1. Saithe in the Faroes (Division Vb). Catch weights at age (kg).

Run title : Saithe Faroes Vb (run: XSABJM07/X07)
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Table 2 Catch weights at age (kg)

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE									
3	1.4300	1.2730	1.2800	1.1750	1.1810	1.3610	1.2730	1.3020	1.1880
4	2.3020	2.0450	2.1970	2.0550	2.1250	2.0260	1.7800	1.7370	1.6670
5	3.3480	3.2930	3.2120	3.2660	2.9410	3.0550	2.5340	2.0360	2.3020
6	4.2870	4.1910	4.5680	4.2550	4.0960	3.6580	3.5720	3.1200	2.8530
7	5.1280	5.1460	5.0560	5.0380	4.8780	4.5850	4.3680	4.0490	3.6730
8	6.1550	5.6550	5.9320	5.6940	5.9320	5.5200	5.3130	5.1830	5.0020
9	7.0600	6.4690	6.2590	6.6620	6.3210	6.8370	5.8120	6.2380	5.7140
10	7.2650	6.7060	8.0000	6.8370	7.2880	7.2650	6.5540	7.5200	6.4050
11	7.4970	7.1500	7.2650	7.6860	8.0740	7.6620	7.8060	8.0490	6.5540
+gp	9.3400	9.0240	8.8590	8.5590	8.9040	9.2230	8.1490	9.0920	8.0870
SOPCOFAC	1.0779	.9342	.9590	.9933	.9220	.9769	1.0357	1.0194	.9663

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
3	1.2440	1.1010	1.0430	1.0880	1.4300	1.1140	1.0880	1.2230	1.4930	1.2200
4	1.4450	1.3160	1.4850	1.4610	1.5250	1.6580	1.6760	1.6410	2.3240	1.8800
5	2.2490	1.8180	2.0550	1.5820	2.2070	2.2600	2.8780	2.6600	3.0680	2.6200
6	2.8530	2.9780	2.8290	2.2490	2.5000	3.1200	3.0810	3.7900	3.7460	3.4000
7	3.5150	3.7020	3.7910	3.6870	3.1200	3.5570	4.2870	4.2390	4.9130	4.1800
8	4.4180	4.2710	4.1750	4.3850	4.6010	4.0960	4.3520	5.5970	4.3680	4.9500
9	5.4440	5.3880	4.8080	5.1280	5.5590	5.1280	4.7900	5.3500	5.2760	5.6900
10	5.7330	5.9720	5.2940	5.2760	5.7140	6.0940	5.9120	5.9120	5.8320	6.3800
11	6.6620	6.4900	6.9480	6.7270	6.2590	7.1960	6.6190	6.8370	6.0530	7.0200
+gp	8.5840	8.0050	7.5150	8.0310	8.0100	8.5980	7.8940	7.7080	7.5760	8.6260
SOPCOFAC	.9634	1.0935	1.0043	1.2006	1.1296	1.1607	1.0680	1.0442	1.0049	1.0248

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	1.2300	1.3100	1.3370	1.2080	1.4310	1.4010	1.7180	1.6090	1.5000	1.3090
4	2.1200	2.1300	1.8510	2.0290	1.9530	2.0320	1.9860	1.8350	1.9750	1.7350
5	3.3200	3.0000	2.9510	2.9650	2.4700	2.9650	2.6180	2.3950	1.9780	1.9070
6	4.2800	3.8100	3.5770	4.1430	3.8500	3.5960	3.2770	3.1820	2.9370	2.3730
7	5.1600	4.7500	4.9270	4.7240	5.1770	5.3360	4.1860	4.0670	3.7980	3.8100
8	6.4200	5.2500	6.2430	5.9010	6.3470	7.2020	5.5890	5.1490	4.4190	4.6670
9	6.8700	5.9500	7.2320	6.8110	7.8250	6.9660	6.0500	5.5010	5.1150	5.5090
10	7.0900	6.4300	7.2390	7.0510	6.7460	9.8620	6.1500	6.6260	6.7120	5.9720
11	7.9300	7.0000	8.3460	7.2480	8.6360	10.6700	9.5360	6.3430	9.0400	6.9390
+gp	9.2150	8.9620	10.0410	10.0550	10.0980	11.9500	10.2180	10.2440	9.3370	9.9360
SOPCOFAC	.9937	.9564	.9632	.9997	.9991	.9415	.9419	.9620	.9928	.9698

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
3	1.2230	1.2400	1.2640	1.4080	1.5030	1.4560	1.4320	1.4760	1.4220	1.3740
4	1.6330	1.5680	1.6020	1.8600	1.9510	2.1770	1.8750	1.7830	1.7430	1.7120
5	1.8300	1.8640	2.0690	2.3230	2.2670	2.4200	2.4960	2.0320	1.9760	1.9050
6	2.0520	2.2110	2.5540	3.1310	2.9360	2.8950	3.2290	2.7780	2.4270	2.3960
7	2.8660	2.6480	3.0570	3.7300	4.2140	3.6510	3.7440	3.5980	3.3020	2.8450
8	4.4740	3.3800	4.0780	4.3940	4.9710	5.0640	4.9640	4.7660	4.2030	4.1240
9	5.4240	4.8160	5.0120	5.2090	5.6570	5.4400	6.3750	5.9820	5.0120	5.2560
10	6.4690	5.5160	6.7680	6.5400	5.9500	6.1670	6.7450	7.6580	6.3500	5.5260
11	6.3430	6.4070	7.7540	8.4030	6.8910	7.0800	7.4660	7.8820	6.6950	6.9560
+gp	8.2870	7.7290	8.2300	8.0500	9.1090	7.5390	7.9810	9.2450	8.4300	8.5240
SOPCOFAC	.9811	.9938	1.0506	1.0166	1.0237	1.0208	1.0319	1.0027	1.0619	1.0428

Table 2.5.4.1. Saithe in the Faroes (Division Vb). Proportion mature at age.

Run title : Saithe Faroes Vb (run: XSABJM07/X07)
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Table 5 Proportion mature at age

YEAR AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400
4	.2600	.2600	.2600	.2600	.2600	.2600	.2600	.2600	.2600
5	.5700	.5700	.5700	.5700	.5700	.5700	.5700	.5700	.5700
6	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200
7	.9100	.9100	.9100	.9100	.9100	.9100	.9100	.9100	.9100
8	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

YEAR AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
3	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400
4	.2600	.2600	.2600	.2600	.2600	.2600	.2600	.2600	.2600	.2600
5	.5700	.5700	.5700	.5700	.5700	.5700	.5700	.5700	.5700	.5700
6	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200
7	.9100	.9100	.9100	.9100	.9100	.9100	.9100	.9100	.9100	.9100
8	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

YEAR AGE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	.0400	.0400	.0800	.1000	.1000	.1200	.1100	.1000	.0900	.0800
4	.2600	.2600	.2900	.2800	.2900	.2800	.2600	.2800	.2400	.2300
5	.5700	.5700	.6700	.5700	.6700	.6000	.5600	.4700	.4600	.4400
6	.8200	.8200	.9000	.8800	.8600	.8200	.8100	.7700	.6800	.6200
7	.9100	.9100	.9500	.9700	.9700	.9300	.9200	.9000	.9000	.8100
8	.9800	.9800	.9900	.9900	1.0000	.9900	.9800	.9600	.9700	.9700
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9900	1.0000	.9900
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

YEAR AGE	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	.0900	.0900	.1000	.1000	.1000	.1000	.1000	.1000	.1000	.0900
4	.2200	.2200	.2600	.2800	.3200	.2700	.2500	.2700	.2800	.2400
5	.4500	.4900	.5400	.5300	.5600	.5800	.4800	.5700	.5700	.4600
6	.6500	.7100	.8000	.7700	.7700	.8100	.7500	.7700	.8000	.6900
7	.7800	.8300	.9000	.9300	.8900	.9000	.8900	.9000	.9100	.8100
8	.9200	.9500	.9600	.9800	.9800	.9800	.9700	.9700	.9800	.9500
9	.9900	.9900	.9900	1.0000	.9900	1.0000	1.0000	1.0000	1.0000	.9900
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.5.5.1. Saithe in the Faroes (Division Vb). Effort (hours) and catch in numbers at age for commersial Cuba Logbook pair trawlers.

```
Faroe Saithe (ICES Div. Vb)
101
Cuba Logbook series
1985 1999
1 1 0 1
3 14
3433    30  169  389   81  102   13    5   1   2   4  1   0
3714    64  122  335  240   67   71   17   6   3   2  6   0
6700   119  468  396  314  118   62   32   7   5   0  1   2
7092    66  274  869  306  124   52   34   8   1   1  2   2
6852    52  589  500  633   72   42   14   8   5   1  0   1
8042    23  244  739  715  394   36   10   4   4   2  1   1
7919    34  283  495  399  252  123   15  14  10   5  0   0
8418    11  262  275  232  116   68   59  11   6   2  3   1
8226    82  321  520  187  100   59   44  26   6   4  0   0
8236    81  602  371  348  111   78   51  47  22   3  3   0
8937    69  262  839  344  212   71   36  27  20  11  2   2
7163    37   55  194  201  246  188   90  23  13  12  8   2
10212   91  177  464  340  261  118   28  13   5  11  6   3
10212   21  278  333  579  245  123   69  13   5   5  4   2
12522   57  139  671  611  992  241  105  35   6   7  1  12
```

Table 2.5.5.2. Saithe in the Faroes (Division Vb). Diagnostics from XSA with Cuba Logbook tuning series.

```
Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Saithe Faroes Vb (run: XSABJM07/X07)

CPUE data from file fleet

Catch data for  39 years. 1961 to 1999. Ages  3 to  12.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
FLT02: Cuba Logbook ,   1985, 1999,   3,    11,   .000,  1.000


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability dependent on stock size for ages <    4

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  4


     Catchability independent of age for ages >=    9


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 =    .500

     Minimum standard error for population
     estimates derived from each fleet =    .300

     Prior weighting not applied


Tuning converged after   23 iterations


Regression weights
      ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000
```

Table 2.5.5.2 (Continued)

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	.016	.047	.030	.063	.047	.014	.018	.015	.018	.019
4	.204	.414	.263	.203	.272	.091	.048	.062	.090	.112
5	.631	.768	.595	.552	.329	.406	.141	.144	.193	.253
6	.783	.887	.708	.599	.605	.398	.295	.333	.300	.439
7	.804	.795	.565	.516	.596	.703	.471	.487	.443	.745
8	.425	.663	.478	.404	.656	.618	.801	.503	.481	.644
9	.228	.797	.565	.471	.477	.788	.510	.639	.628	.564
10	.212	.929	.602	.463	.687	.630	.631	.574	.692	.561
11	.571	.931	.684	.585	.581	.534	.442	.519	.557	.468

XSA population numbers (Thousands)

YEAR	AGE 3	4	5	6	7	8	9	10	11
1990	2.07E+04	2.30E+04	2.39E+04	1.88E+04	1.01E+04	1.52E+03	6.67E+02	3.53E+02	1.52E+02
1991	2.49E+04	1.67E+04	1.54E+04	1.04E+04	7.03E+03	3.72E+03	8.15E+02	4.35E+02	2.33E+02
1992	1.98E+04	1.94E+04	9.04E+03	5.83E+03	3.52E+03	2.60E+03	1.57E+03	3.00E+02	1.41E+02
1993	2.39E+04	1.57E+04	1.22E+04	4.08E+03	2.35E+03	1.64E+03	1.32E+03	7.30E+02	1.35E+02
1994	1.66E+04	1.84E+04	1.05E+04	5.76E+03	1.84E+03	1.15E+03	8.94E+02	6.74E+02	3.76E+02
1995	3.18E+04	1.29E+04	1.15E+04	6.18E+03	2.58E+03	8.27E+02	4.88E+02	4.54E+02	2.78E+02
1996	1.89E+04	2.57E+04	9.66E+03	6.26E+03	3.40E+03	1.04E+03	3.65E+02	1.82E+02	1.98E+02
1997	2.52E+04	1.52E+04	2.00E+04	6.87E+03	3.81E+03	1.74E+03	3.84E+02	1.80E+02	7.92E+01
1998	8.49E+03	2.03E+04	1.17E+04	1.42E+04	4.03E+03	1.92E+03	8.60E+02	1.66E+02	8.29E+01
1999	1.92E+04	6.83E+03	1.52E+04	7.90E+03	8.61E+03	2.12E+03	9.72E+02	3.76E+02	6.81E+01

Estimated population abundance at 1st Jan 2000

0.00E+00, 1.54E+04, 5.00E+03, 9.67E+03, 4.17E+03, 3.35E+03, 9.12E+02, 4.53E+02, 1.76E+02,

Taper weighted geometric mean of the VPA populations:

2.29E+04, 1.89E+04, 1.43E+04, 7.82E+03, 3.69E+03, 1.58E+03, 7.08E+02, 3.13E+02, 1.39E+02,

Standard error of the weighted Log(VPA populations) :

.4558, .4765, .4042, .4764, .5178, .4165, .4560, .5141, .5741,

Log catchability residuals.

Fleet : FLT02: Cuba Logbook

Age	1985	1986	1987	1988	1989
3	.46	.06	.33	-.21	.04
4	.45	.21	-.11	-.47	.45
5	.70	.59	.26	-.12	-.49
6	-.19	.56	.25	.28	-.18
7	.01	-.05	-.06	-.11	-.57
8	-.43	.42	-.07	-.22	-.40
9	-.66	.63	-.01	.13	-.74
10	-1.62	.12	.26	-.60	-.47
11	-.13	.09	.18	-.63	-.20

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	-.57	-.35	-1.26	.50	.85	-.05	.09	.32	.01	-.05
4	-.15	.43	.07	.49	.99	.34	-1.70	-.36	-.19	.02
5	.11	.22	.03	.37	.09	.76	-.43	-.64	-.41	-.15
6	-.02	.05	-.05	.07	.34	.09	-.29	-.19	-.40	.10
7	-.16	-.23	-.47	-.21	.17	.44	.43	.03	-.11	.46
8	-.85	-.39	-.77	-.46	.29	.42	1.46	.00	-.06	.38
9	-1.36	-.89	-.33	-.47	.07	.38	1.68	.17	.26	.33
10	-1.64	-.27	-.34	-.41	.36	.09	1.07	.13	.26	.17
11	-.65	.01	-.15	-.13	.14	.24	.33	-.03	-.06	.08

Table 2.5.5.2 (Continued)

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,	7,	8,	9,	10,	11
Mean Log q,	-13.1963,	-12.1909,	-11.7914,	-11.6210,	-11.5939,	-11.6275,	-11.6275,	-11.6275,
S.E(Log q),	.6719,	.4333,	.2454,	.3290,	.6226,	.7576,	.6756,	.2778,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
3,	.96,	.122,	14.86,	.43,	15,	.55,	-15.09,

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,	1.51,	-.768,	14.91,	.19,	15,	1.04,	-13.20,
5,	1.41,	-.854,	13.26,	.31,	15,	.62,	-12.19,
6,	1.23,	-1.180,	12.43,	.74,	15,	.30,	-11.79,
7,	.97,	.142,	11.52,	.72,	15,	.34,	-11.62,
8,	3.59,	-1.672,	22.51,	.04,	15,	2.07,	-11.59,
9,	3.89,	-1.563,	26.22,	.03,	15,	2.76,	-11.63,
10,	1.47,	-.798,	14.54,	.23,	15,	1.00,	-11.72,
11,	.83,	1.441,	10.54,	.89,	15,	.22,	-11.67,

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Cuba Logbook ,	14727.,	.574,	.000,	.00,	1,	.261,	.020
P shrinkage mean ,	18863.,	.48,,,,				.387,	.015
F shrinkage mean ,	12810.,	.50,,,,				.351,	.022

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15433.,	.30,	.12,	3,	.418,	.019

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Cuba Logbook ,	5069.,	.464,	.004,	.01,	2,	.507,	.110
F shrinkage mean ,	4931.,	.50,,,,				.493,	.113

Table 2.5.5.2 (Continued)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5001.,	.34,	.01,	3,	.041,	.112

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Cuba Logbook ,	9449.,	.318,	.153,	.48,	3,	.647,	.259
F shrinkage mean ,	10103.,	.50,,,,				.353,	.244

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9675.,	.27,	.10,	4,	.379,	.253

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Cuba Logbook ,	3974.,	.219,	.130,	.59,	4,	.754,	.456
F shrinkage mean ,	4837.,	.50,,,,				.246,	.389

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4171.,	.21,	.11,	5,	.530,	.439

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Cuba Logbook ,	2865.,	.188,	.285,	1.52,	5,	.731,	.830
F shrinkage mean ,	5120.,	.50,,,,				.269,	.544

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3349.,	.19,	.26,	6,	1.333,	.745

Table 2.5.5.2 (Continued)

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Cuba Logbook ,	889.,	.187,	.144,	.77,	6,	.685,	.656
F shrinkage mean ,	966.,	.50,,,,				.315,	.617

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
912.,	.20,	.11,	7,	.544,	.644

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Cuba Logbook ,	486.,	.202,	.139,	.69,	7,	.609,	.534
F shrinkage mean ,	405.,	.50,,,,				.391,	.614

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
453.,	.23,	.11,	8,	.473,	.564

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age)

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Cuba Logbook ,	210.,	.241,	.096,	.40,	8,	.519,	.487
F shrinkage mean ,	145.,	.50,,,,				.481,	.649

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
176.,	.27,	.11,	9,	.414,	.561

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age)

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Cuba Logbook ,	40.,	.249,	.075,	.30,	9,	.684,	.416
F shrinkage mean ,	26.,	.50,,,,				.316,	.595

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
35.,	.23,	.10,	10,	.443,	.468

Table 2.5.5.3. Saithe in the Faroes (Division Vb). Fishing mortality (F) at age.

Run title : Saithe Faroes Vb (run: XSABJM07/X07)
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Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	.0226	.0465	.0307	.0478	.0495	.0250	.0248	.0321	.0328
4	.0556	.0864	.0358	.1260	.0773	.1007	.0518	.0910	.1453
5	.0994	.1208	.0716	.2198	.1588	.1492	.1218	.0955	.1720
6	.1219	.1402	.1115	.1798	.2137	.2326	.1388	.1358	.1685
7	.0933	.1192	.1634	.2213	.2217	.2785	.2564	.1345	.2001
8	.0852	.0752	.1157	.2567	.2424	.2537	.2616	.2184	.2095
9	.0972	.1150	.1355	.1424	.2983	.2771	.2269	.2183	.3065
10	.0915	.1295	.2012	.1658	.2356	.3347	.2904	.2028	.3290
11	.0916	.1069	.1514	.1891	.2601	.2901	.2610	.2142	.2832
+gp	.0916	.1069	.1514	.1891	.2601	.2901	.2610	.2142	.2832
FBAR 4- 8	.0911	.1083	.0996	.2007	.1828	.2030	.1661	.1350	.1791

YEAR AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
3	.0479	.0885	.0936	.1272	.2296	.1508	.2059	.1484	.0841	.0376
4	.2549	.1481	.0728	.3229	.3172	.3600	.3714	.2984	.2378	.1788
5	.1539	.3582	.1651	.4587	.3547	.5446	.3159	.4266	.2891	.2907
6	.1599	.1405	.2988	.3490	.3281	.2895	.3436	.4152	.1925	.2792
7	.1537	.1263	.3289	.2923	.2300	.1960	.2052	.3672	.2010	.3234
8	.1944	.1119	.2998	.2428	.1773	.1755	.1770	.2544	.4131	.3592
9	.1657	.1245	.3763	.1984	.1963	.1185	.1668	.2031	.2651	.3888
10	.2009	.1213	.4604	.2499	.1812	.1488	.1205	.1745	.3028	.4721
11	.1878	.1197	.3814	.2315	.1857	.1482	.1554	.2116	.3290	.4095
+gp	.1878	.1197	.3814	.2315	.1857	.1482	.1554	.2116	.3290	.4095
FBAR 4- 8	.1833	.1770	.2331	.3331	.2814	.3132	.2826	.3524	.2667	.2862

YEAR AGE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	.0933	.0138	.0298	.0696	.0159	.0633	.0211	.0366	.0216	.0176
4	.1543	.2437	.1847	.1111	.4983	.2381	.1395	.1383	.0887	.2040
5	.2039	.1968	.2055	.3670	.3666	.5076	.4590	.4315	.3551	.2275
6	.2317	.4426	.4860	.4724	.5775	.3161	.7756	.5852	.6528	.4925
7	.3236	.5614	.3247	.5017	.6549	.5846	.4560	.4779	.6041	.3862
8	.2572	.6384	.5489	.5414	.4745	.4346	.7996	.5007	.6338	.5544
9	.3151	.5667	.5799	.8791	.5390	.3282	.9079	.6208	.7800	.3885
10	.5139	.5271	.3356	.3824	.3971	.2306	.6522	.9096	.6967	.4004
11	.3644	.5823	.4919	.6062	.4738	.3534	.8176	.6246	.9260	.5543
+gp	.3644	.5823	.4919	.6062	.4738	.3534	.8176	.6246	.9260	.5543
FBAR 4- 8	.2341	.4166	.3500	.3987	.5144	.4162	.5259	.4267	.4669	.3729

YEAR AGE	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99
3	.0158	.0469	.0296	.0627	.0472	.0139	.0175	.0151	.0181	.0186	.0173
4	.2036	.4142	.2632	.2030	.2717	.0911	.0479	.0621	.0902	.1115	.0880
5	.6306	.7682	.5949	.5516	.3291	.4064	.1405	.1441	.1925	.2533	.1966
6	.7826	.8867	.7084	.5994	.6051	.3978	.2955	.3329	.2996	.4390	.3571
7	.8037	.7950	.5651	.5162	.5965	.7027	.4711	.4867	.4428	.7449	.5581
8	.4252	.6625	.4785	.4041	.6556	.6176	.8009	.5033	.4809	.6437	.5426
9	.2279	.7974	.5650	.4709	.4773	.7883	.5097	.6386	.6278	.5641	.6102
10	.2122	.9291	.6023	.4632	.6869	.6298	.6314	.5740	.6917	.5606	.6088
11	.5706	.9314	.6839	.5853	.5807	.5344	.4418	.5190	.5566	.4676	.5144
+gp	.5706	.9314	.6839	.5853	.5807	.5344	.4418	.5190	.5566	.4676	
FBAR 4- 8	.5691	.7053	.5220	.4549	.4916	.4431	.3512	.3058	.3012	.4385	

Table 2.5.5.4. Saithe in the Faroes (Division Vb). Stock number at age (start of year) (thousands).

Run title : Saithe Faroes Vb (run: XSABJM07/X07)
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Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) (Thousands)

YEAR	1961	1962	1963	1964	1965	19666	1967	1968	1969
AGE									
3	9046	13662	22427	16187	22797	21821	26866	21504	40780
4	7738	7241	10677	17806	12634	17763	17424	21457	17050
5	5643	5993	5438	8434	12852	9575	13150	13545	16040
6	3880	4183	4348	4144	5542	8977	6752	9532	10080
7	2680	2812	2977	3184	2835	3665	5824	4812	6813
8	1746	1998	2044	2070	2090	1859	2271	3690	3444
9	1384	1313	1518	1491	1311	1343	1181	1431	2428
10	1036	1028	958	1085	1058	797	833	771	942
11	568	774	740	641	753	685	467	510	515
+gp	1032	1141	2147	1111	1367	981	669	1066	846
TOTAL	34753	40144	53273	56154	63239	67465	75438	78319	98938

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
3	34114	37261	33585	23272	18878	16277	18878	12896	8369	8597
4	32310	26623	27922	25041	16778	12286	11461	12581	9103	6299
5	12072	20502	18797	21255	14844	10003	7017	6473	7643	5875
6	11056	8474	11732	13048	11001	8524	4751	4189	3459	4686
7	6973	7715	6029	7124	7535	6487	5224	2758	2264	2336
8	4567	4896	5567	3552	4354,	4902,	4366,	3484,	1564,	1516,
9,	2287,	3078,	3584,	3377,	2281,	2986,	3367,	2995,	2212,	847,
10,	1463,	1586,	2225,	2014,	2267,	1535,	2171,	2333,	2001,	1389,
11,	555,	980	1150	1150	1284	1549	1083	1576	1605	1210
+gp	848	976	726	989	1720	2381	2195	1902	2094	2254
TOTAL	106246	112092	111317	100823	80944	66930	60514	51187	40314	35011

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	12358	33074	14588	40808	25828	22052	61811	48672	44703	28587
4	6779	9217	26707	11593	31164	20813	16947	49551	38418	35816
5	4313	4757	5914	18177	8494	15501	13430	12068	35327	28785
6	3597	2880	3199	3942	10311	4820	7640	6948	6418	20278
7	2902	2336	1515	1611	2013	4739	2876	2880	3169	2735
8	1384	1719	1091	896	799	856	2162	1493	1462	1418
9	867	876	743	516	427	407	454	796	741	635
10	470	518	407	341	175	204	240	150	350	278
11	709	230	250	238	190	97	133	102	49	143
+gp	2823	2528	2541	1298	734	1013	308	228	108	100
TOTAL	36203	58135	56954	79421	80134	70501	106001	122887	130745	118776

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 61-97	AMST 61-97
AGE													
3	20726	24863	19757	23927	16552	31788	18901	25233	8493	19204	0	22404	24904
4	22997	16703	19424	15704	18399	12927	25665	15206	20348	6828	15433	16858	19033
5	23912	15360	9038	12223	10495	11480	9662	20029	11699	15223	5001	11233	12814
6	18772	10420	5833	4082	5765	6183	6260	6874	14198	7901	9675	6516	7367
7	10145	7027	3515	2352	1835	2577	3401	3814	4034	8615	4171	3626	4094
8	1522	3719	2598	1636	1149	827	1045	1738	1919	2121	3349	2032	2365
9	667	815	1570	1318	894	488	365	384	860	972	912	1153	1443
10	353	435	300	730	674	454	182	180	166	376	453	672	917
11	152	233	141	135	376	278	198	79	83	68	176	395	582
+gp	199	212	238	128	122	309	251	270	174	202	139		
TOTAL	99444	79787	62414	62235	56261	67311	65930	73807	61976	61511	39307		

Table 2.5.5.5. Saithe in the Faroes (Division Vb). Summery table.

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Run title : Saithe Faroes Vb (run: XSABJM07/X07)
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    Table 16    Summary     (without SOP correction)

               Terminal Fs derived using XSA (With F shrinkage)
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	RECRUITS Age 3	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
1961	9046	121962	83791	9592	.1145	.0911
1962	13662	126450	85628	10454	.1221	.1083
1963	22427	158220	100621	12693	.1261	.0996
1964	16187	160406	98370	21893	.2226	.2007
1965	22797	174743	107198	22181	.2069	.1828
1966	21821	184102	108754	25563	.2351	.2030
1967	26866	181587	104603	21319	.2038	.1661
1968	21504	189724	115917	20387	.1759	.1350
1969	40780	214929	123737	27437	.2217	.1791
1970	34114	224320	129069	29110	.2255	.1833
1971	37261	228275	139407	32706	.2346	.1770
1972	33585	236870	147453	42663	.2893	.2331
1973	23272	210343	136546	57431	.4206	.3331
1974	18878	203841	137437	47188	.3433	.2814
1975	16277	187144	137677	41576	.3020	.3132
1976	18878	169439	121792	33065	.2715	.2826
1977	12896	155956	113835	34835	.3060	.3524
1978	8369	136930	95727	28138	.2939	.2667
1979	8597	112550	83201	27246	.3275	.2862
1980	12358	124076	88394	25230	.2854	.2341
1981	33074	141132	75721	30103	.3976	.4166
1982	14588	148026	87641	30964	.3533	.3500
1983	40808	176638	89918	39176	.4357	.3987
1984	25828	187568	98298	54665	.5561	.5144
1985	22052	185911	104937	44605	.4251	.4162
1986	61811	232801	91952	41716	.4537	.5259
1987	48672	248004	90130	40020	.4440	.4267
1988	44703	257746	93898	45285	.4823	.4669
1989	28587	226759	93245	44477	.4770	.3729
1990	20726	189577	92691	61628	.6649	.5691
1991	24863	149320	75722	54858	.7245	.7053
1992	19757	123976	65316	36487	.5586	.5220
1993	23927	133840	65446	33532	.5124	.4549
1994	16552	127704	65528	33171	.5062	.4916
1995	31788	143458	65166	27220	.4177	.4431
1996	18901	144478	64877	20029	.3087	.3512
1997	25233	152953	76129	22306	.2930	.3058
1998	8493	133898	79300	26422	.3332	.3012
1999	19204	128647	69077	33855	.4901	.4385
Arith. Mean	24337	172674	97542	33108	.3529	.3277
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 2.5.6.1. Saithe in the Faroes (Division Vb). Predictioon with management table: input data.

The SAS System 19:45 Wednesday, May 3, 2000
Faroe saithe (Division Vb)

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	16025.000	0.2000	0.0900	0.0000	0.0000	1.424	0.0210	1.424
4	15433.000	0.2000	0.2400	0.0000	0.0000	1.746	0.1340	1.746
5	5001.000	0.2000	0.4600	0.0000	0.0000	1.971	0.3460	1.971
6	9675.000	0.2000	0.6900	0.0000	0.0000	2.534	0.5240	2.534
7	4171.000	0.2000	0.8100	0.0000	0.0000	3.248	0.6130	3.248
8	3349.000	0.2000	0.9500	0.0000	0.0000	4.364	0.5760	4.364
9	912.000	0.2000	0.9900	0.0000	0.0000	5.417	0.5130	5.417
10	453.000	0.2000	1.0000	0.0000	0.0000	6.511	0.5270	6.511
11	176.000	0.2000	1.0000	0.0000	0.0000	7.178	0.4320	7.178
12+	139.000	0.2000	1.0000	0.0000	0.0000	9.005	0.4320	9.005
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	16025.000	0.2000	0.0900	0.0000	0.0000	1.424	0.0210	1.424
4	.	0.2000	0.2500	0.0000	0.0000	1.746	0.1340	1.746
5	.	0.2000	0.4900	0.0000	0.0000	1.971	0.3460	1.971
6	.	0.2000	0.7100	0.0000	0.0000	2.534	0.5240	2.534
7	.	0.2000	0.8500	0.0000	0.0000	3.248	0.6130	3.248
8	.	0.2000	0.9600	0.0000	0.0000	4.364	0.5760	4.364
9	.	0.2000	0.9900	0.0000	0.0000	5.417	0.5130	5.417
10	.	0.2000	1.0000	0.0000	0.0000	6.511	0.5270	6.511
11	.	0.2000	1.0000	0.0000	0.0000	7.178	0.4320	7.178
12+	.	0.2000	1.0000	0.0000	0.0000	9.005	0.4320	9.005
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	16025.000	0.2000	0.0900	0.0000	0.0000	1.424	0.0210	1.424
4	.	0.2000	0.2500	0.0000	0.0000	1.746	0.1340	1.746
5	.	0.2000	0.4900	0.0000	0.0000	1.971	0.3460	1.971
6	.	0.2000	0.7100	0.0000	0.0000	2.534	0.5240	2.534
7	.	0.2000	0.8500	0.0000	0.0000	3.248	0.6130	3.248
8	.	0.2000	0.9600	0.0000	0.0000	4.364	0.5760	4.364
9	.	0.2000	0.9900	0.0000	0.0000	5.417	0.5130	5.417
10	.	0.2000	1.0000	0.0000	0.0000	6.511	0.5270	6.511
11	.	0.2000	1.0000	0.0000	0.0000	7.178	0.4320	7.178
12+	.	0.2000	1.0000	0.0000	0.0000	9.005	0.4320	9.005
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANBJM05
Date and time: 03MAY00:19:53

Table 2.5.6.2. Saithe in the Faroes (Division Vb). Yield per recruit: input data.

The SAS System 11:16 Thursday, May 4, 2000
Faroe saithe (Division Vb)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.1100	0.0000	0.0000	1.317	0.0770	1.317
4	.	0.2000	0.2700	0.0000	0.0000	1.843	0.2490	1.843
5	.	0.2000	0.5200	0.0000	0.0000	2.491	0.4200	2.491
6	.	0.2000	0.7800	0.0000	0.0000	3.251	0.5100	3.251
7	.	0.2000	0.9200	0.0000	0.0000	4.115	0.5100	4.115
8	.	0.2000	0.9800	0.0000	0.0000	5.057	0.5030	5.057
9	.	0.2000	0.9900	0.0000	0.0000	5.845	0.5050	5.845
10	.	0.2000	1.0000	0.0000	0.0000	6.552	0.5000	6.552
11	.	0.2000	1.0000	0.0000	0.0000	7.388	0.5030	7.388
12+	.	0.2000	1.0000	0.0000	0.0000	8.794	0.5030	8.794
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDBJM05
Date and time: 04MAY00:11:16

Table 2.5.6.3. Saithe in the Faroes (Division Vb). Yiels per recruit: summery table.

```
The SAS System                            11:16 Thursday, May 4, 2000
Faroe saithe (Division Vb)

                                              Yield per recruit: Summary table
```

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	22876.247	3.540	19205.864	3.540	19205.864
0.0500	0.0219	0.084	399.606	5.096	19835.382	3.135	16210.598	3.135	16210.598
0.1000	0.0438	0.152	685.374	4.759	17478.665	2.813	13897.711	2.813	13897.711
0.1500	0.0658	0.208	893.470	4.483	15610.184	2.550	12071.393	2.550	12071.393
0.2000	0.0877	0.254	1047.165	4.252	14100.655	2.333	10602.452	2.333	10602.452
0.2500	0.1096	0.294	1161.946	4.056	12861.559	2.150	9402.455	2.150	9402.455
0.3000	0.1315	0.328	1248.400	3.887	11830.424	1.994	8409.013	1.994	8409.013
0.3500	0.1534	0.357	1313.934	3.740	10962.029	1.859	7576.979	1.859	7576.979
0.4000	0.1754	0.384	1363.823	3.611	10222.922	1.742	6872.971	1.742	6872.971
0.4500	0.1973	0.407	1401.889	3.496	9587.897	1.640	6271.849	1.640	6271.849
0.5000	0.2192	0.427	1430.937	3.394	9037.647	1.549	5754.368	1.549	5754.368
0.5500	0.2411	0.446	1453.052	3.302	8557.174	1.468	5305.586	1.468	5305.586
0.6000	0.2630	0.463	1469.798	3.218	8134.677	1.396	4913.758	1.396	4913.758
0.6500	0.2850	0.478	1482.364	3.143	7760.766	1.331	4569.542	1.331	4569.542
0.7000	0.3069	0.493	1491.657	3.073	7427.891	1.272	4265.435	1.272	4265.435
0.7500	0.3288	0.505	1498.377	3.010	7129.925	1.218	3995.356	1.218	3995.356
0.8000	0.3507	0.517	1503.065	2.951	6861.854	1.169	3754.332	1.169	3754.332
0.8500	0.3726	0.529	1506.146	2.896	6619.543	1.124	3538.266	1.124	3538.266
0.9000	0.3946	0.539	1507.951	2.846	6399.554	1.083	3343.758	1.083	3343.758
0.9500	0.4165	0.549	1508.744	2.799	6199.015	1.045	3167.969	1.045	3167.969
1.0000	0.4384	0.558	1508.733	2.755	6015.506	1.010	3008.512	1.010	3008.512
1.0500	0.4603	0.566	1508.082	2.713	5846.979	0.977	2863.370	0.977	2863.370
1.1000	0.4822	0.574	1506.926	2.675	5691.692	0.947	2730.830	0.947	2730.830
1.1500	0.5042	0.582	1505.370	2.638	5548.152	0.919	2609.427	0.919	2609.427
1.2000	0.5261	0.589	1503.499	2.604	5415.079	0.893	2497.904	0.893	2497.904
1.2500	0.5480	0.595	1501.384	2.571	5291.365	0.868	2395.179	0.868	2395.179
1.3000	0.5699	0.602	1499.080	2.540	5176.048	0.845	2300.314	0.845	2300.314
1.3500	0.5918	0.608	1496.632	2.510	5068.293	0.823	2212.494	0.823	2212.494
1.4000	0.6138	0.614	1494.078	2.482	4967.368	0.803	2131.008	0.803	2131.008
1.4500	0.6357	0.619	1491.446	2.456	4872.630	0.783	2055.233	0.783	2055.233
1.5000	0.6576	0.624	1488.762	2.430	4783.514	0.765	1984.622	0.765	1984.622
1.5500	0.6795	0.629	1486.046	2.406	4699.520	0.748	1918.693	0.748	1918.693
1.6000	0.7014	0.634	1483.313	2.383	4620.205	0.731	1857.019	0.731	1857.019
1.6500	0.7234	0.639	1480.576	2.360	4545.174	0.716	1799.222	0.716	1799.222
1.7000	0.7453	0.643	1477.847	2.339	4474.077	0.701	1744.965	0.701	1744.965
1.7500	0.7672	0.648	1475.133	2.318	4406.598	0.687	1693.948	0.687	1693.948
1.8000	0.7891	0.652	1472.442	2.299	4342.455	0.674	1645.903	0.674	1645.903
1.8500	0.8110	0.656	1469.778	2.280	4281.395	0.661	1600.588	0.661	1600.588
1.9000	0.8330	0.660	1467.147	2.261	4223.189	0.649	1557.787	0.649	1557.787
1.9500	0.8549	0.663	1464.551	2.243	4167.630	0.637	1517.306	0.637	1517.306
2.0000	0.8768	0.667	1461.994	2.226	4114.531	0.626	1478.968	0.626	1478.968
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

```
Notes: Run name                YLDBJM05
       Date and time           04MAY00:11:16
       Computation of ref. F   Simple mean, age 4 - 8
       F-0.1 factor            0.3841
       F-max factor            0.9737
       F-0.1 reference F       0.1684
       F-max reference F       0.4269
       Recruitment             Single recruit
```

Table 2.5.6.4. Saithe in the Faroes (Division Vb). Prediction with management table.

```
The SAS System                       19:45 Wednesday, May 3, 2000
Faroe saithe (Division Vb)

                                      Prediction with management option table
```

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4386	122706	65184	30531	0.0000	0.0000	112021	58502	0	135746	78669
.	.	.	.	.	0.1000	0.0439	.	58502	3190	132127	75557
.	.	.	.	.	0.2000	0.0877	.	58502	6238	128676	72597
.	.	.	.	.	0.3000	0.1316	.	58502	9152	125385	69781
.	.	.	.	.	0.4000	0.1754	.	58502	11937	122244	67103
.	.	.	.	.	0.5000	0.2193	.	58502	14601	119247	64555
.	.	.	.	.	0.6000	0.2632	.	58502	17150	116387	62130
.	.	.	.	.	0.7000	0.3070	.	58502	19588	113656	59823
.	.	.	.	.	0.8000	0.3509	.	58502	21922	111048	57626
.	.	.	.	.	0.9000	0.3947	.	58502	24156	108557	55534
.	.	.	.	.	1.0000	0.4386	.	58502	26295	106177	53542
.	.	.	.	.	1.1000	0.4825	.	58502	28345	103902	51645
.	.	.	.	.	1.2000	0.5263	.	58502	30309	101728	49837
.	.	.	.	.	1.3000	0.5702	.	58502	32192	99648	48115
.	.	.	.	.	1.4000	0.6140	.	58502	33997	97660	46474
.	.	.	.	.	1.5000	0.6579	.	58502	35728	95757	44910
.	.	.	.	.	1.6000	0.7018	.	58502	37388	93936	43418
.	.	.	.	.	1.7000	0.7456	.	58502	38982	92193	41996
.	.	.	.	.	1.8000	0.7895	.	58502	40512	90524	40639
.	.	.	.	.	1.9000	0.8333	.	58502	41981	88925	39345
.	.	.	.	.	2.0000	0.8772	.	58502	43392	87394	38110
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
Notes: Run name              : MANBJM05
       Date and time         : 03MAY00:19:53
       Computation of ref. F: Simple mean, age 4 - 8
       Basis for 2000        : F factors
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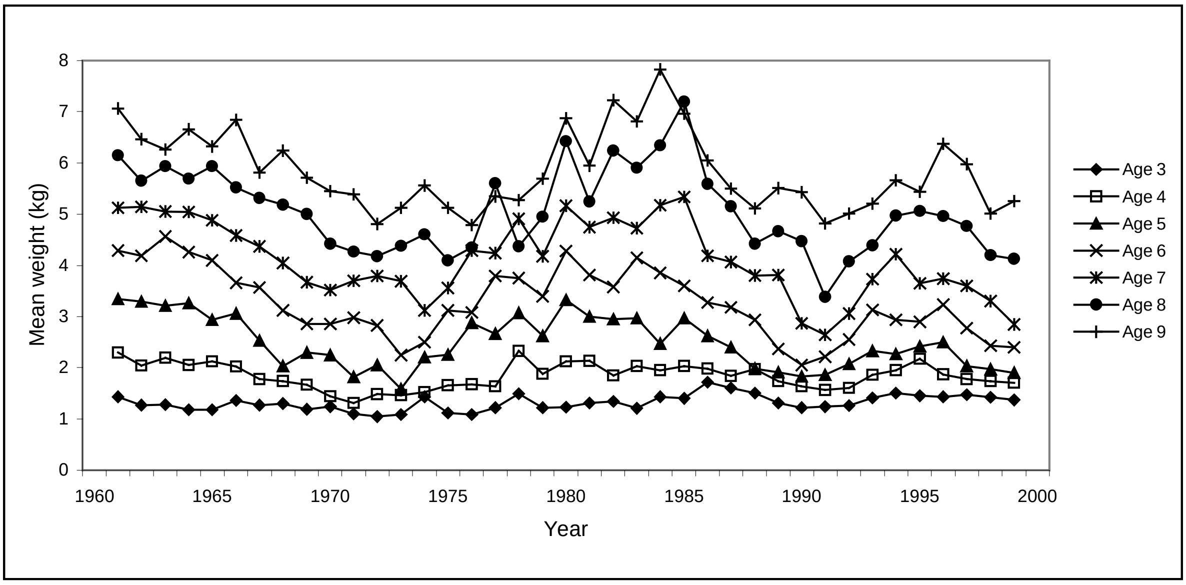


Figure 2.5.3.1. Saithe in the Faroes (Division Vb). Mean weight (kg) at age in the catches in the period 1961-99.

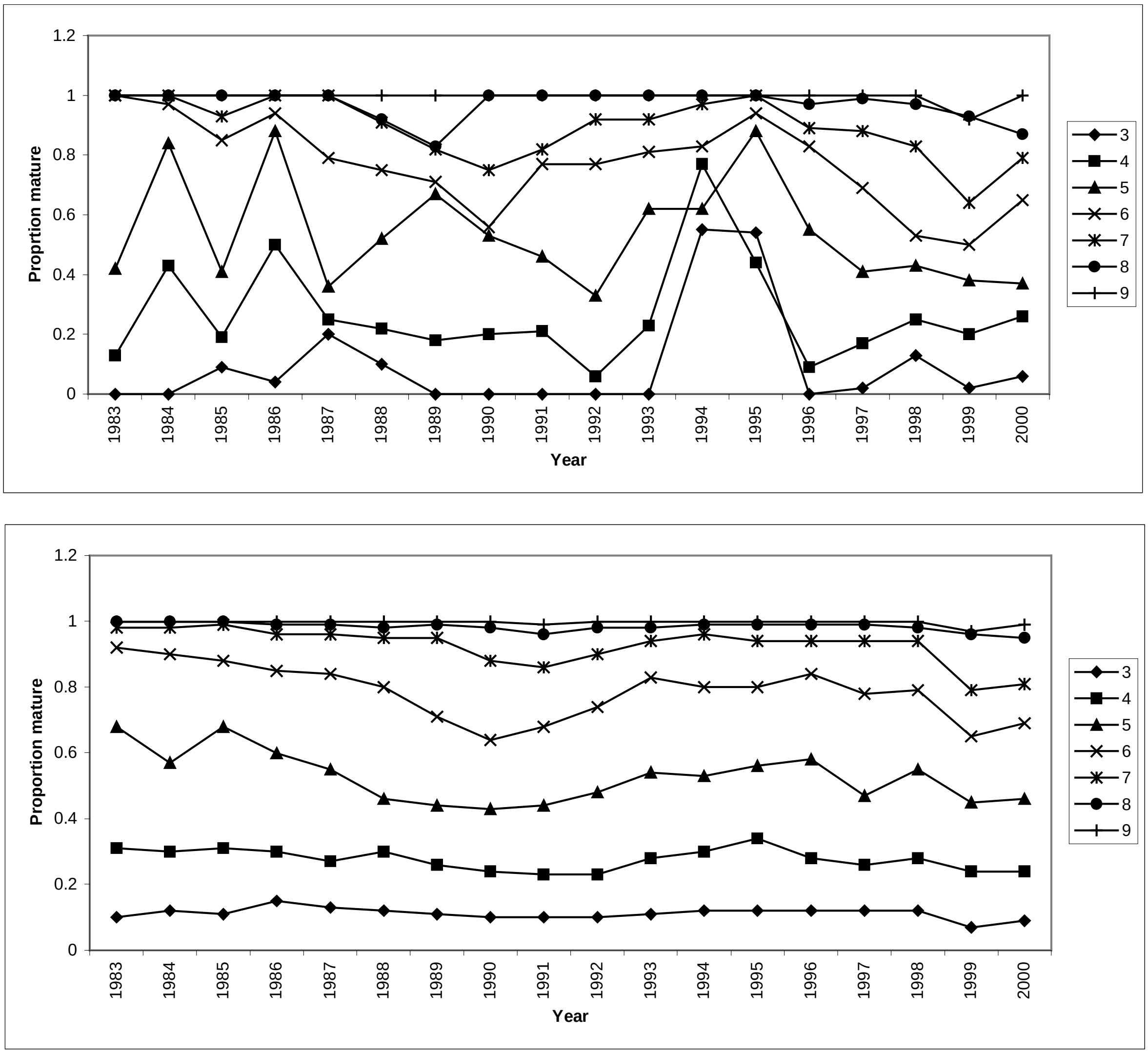


Figure 2.5.4.1. Saithe in the Faroes (Division Vb). Observed (upper panel) and fitted values (lower panel) proportion mature for the period 1983-99**.**

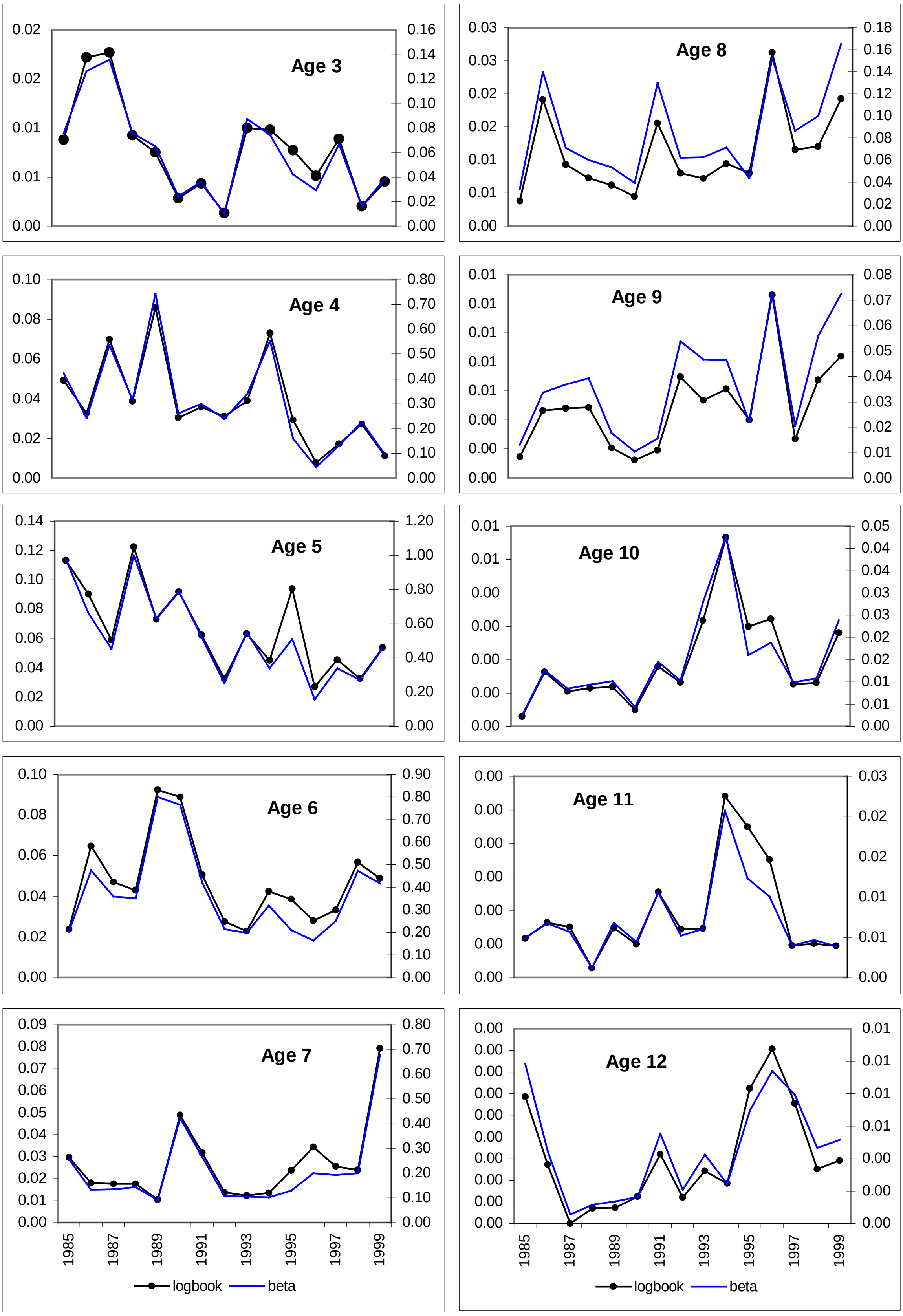


Figure 2.5.5.1. Saithe in the Faroes (Division Vb). Comparison of the Cuba Beta and Cuba Logbook tuning series CPUE indicies by age.

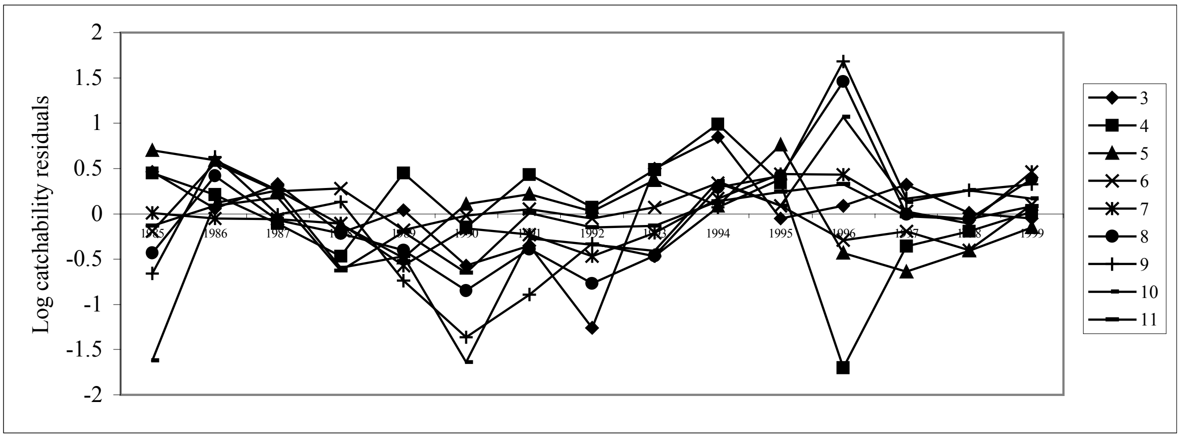


Figure 2.5.5.2. Saithe in the Faroes (Division Vb). Log catchability residuals for age groups 4-11 from XSA.

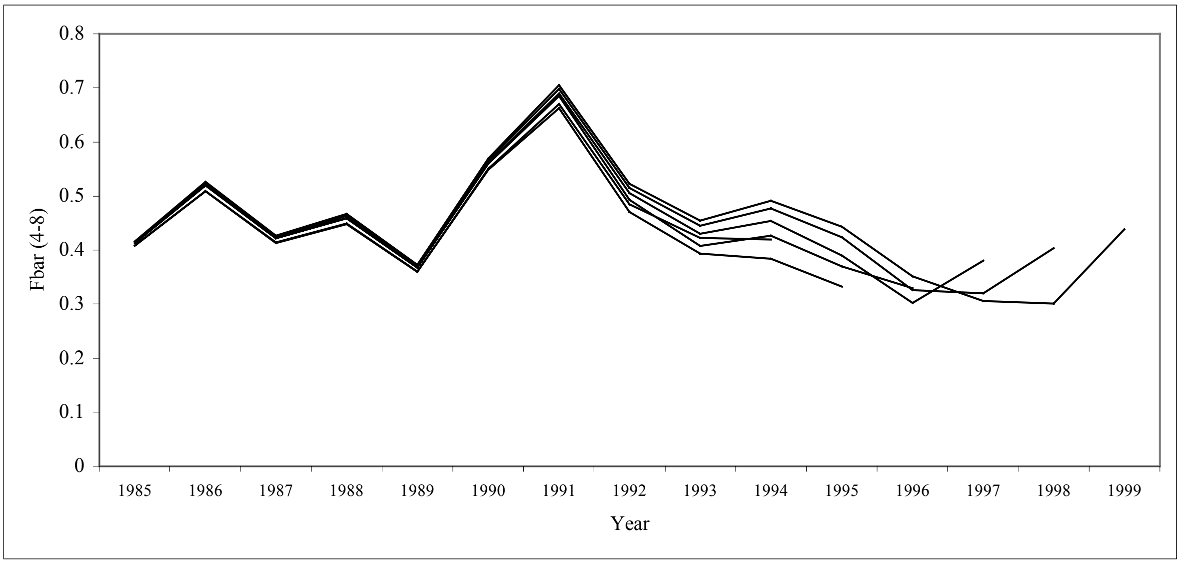


Figure 2.5.5.3. Saithe in the Faroes (Division Vb). Retrospective analysis of average fishing mortality of age groups 4-8 from XSA for the years 1994-99.

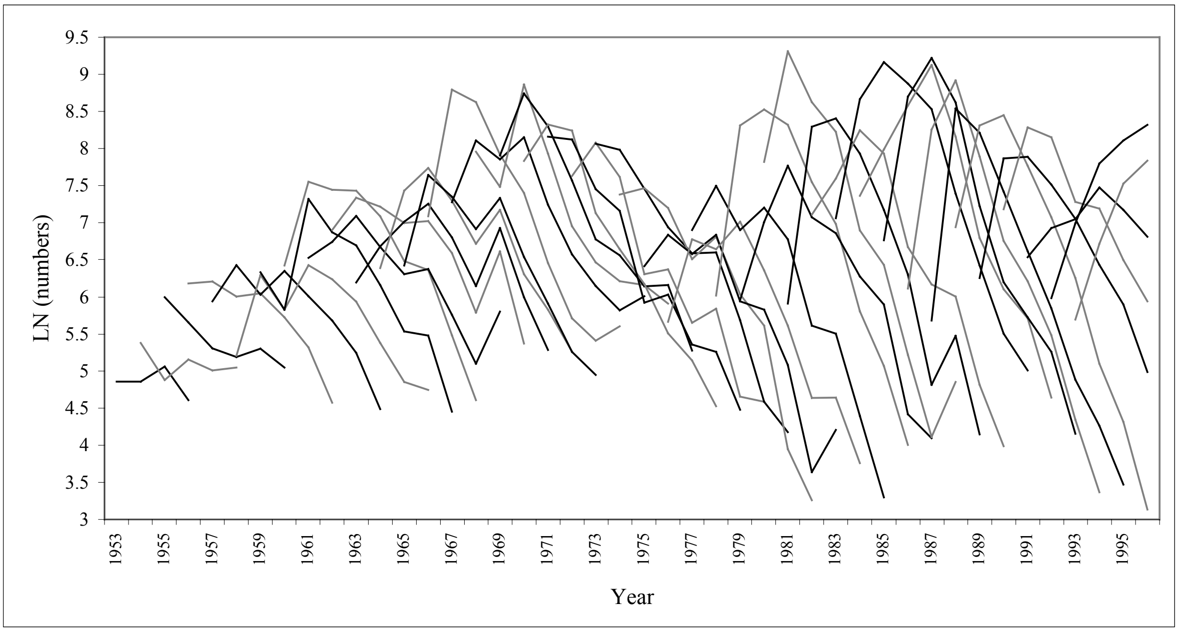


Figure 2.5.5.4. Saithe in the Faroes (Division Vb). Catch curve (LN numbers) for year-classes 1953-93.

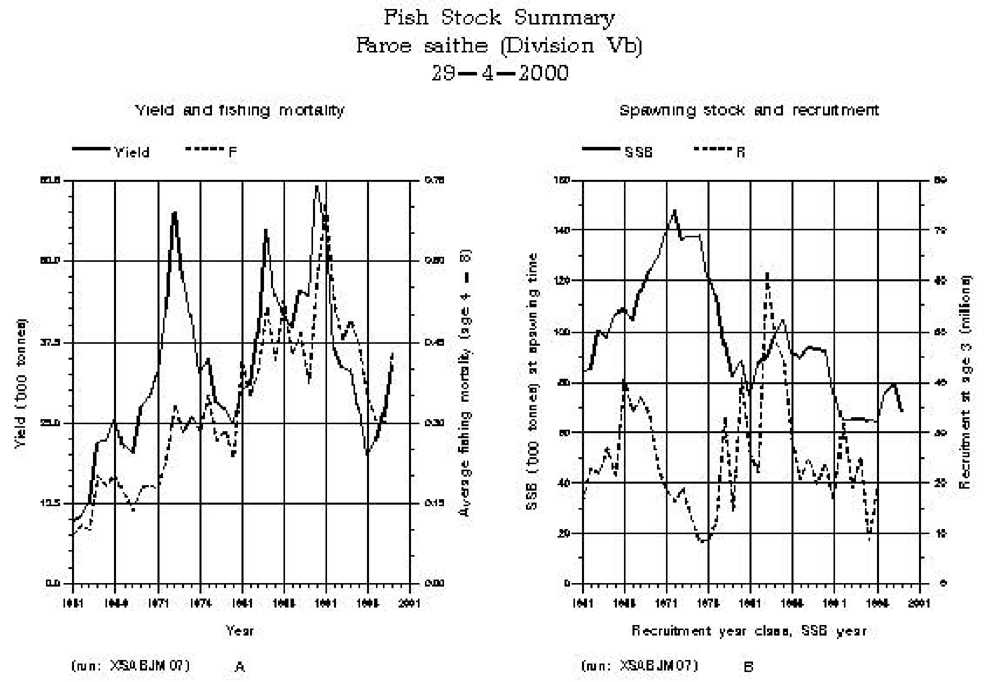


Figure 2.5.5.5

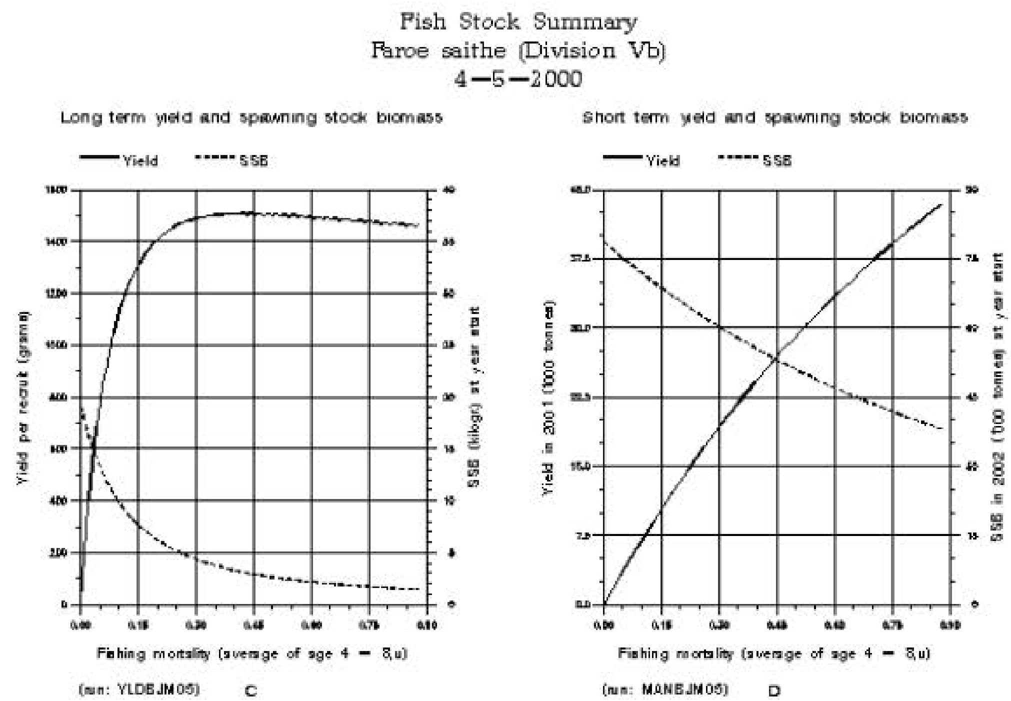
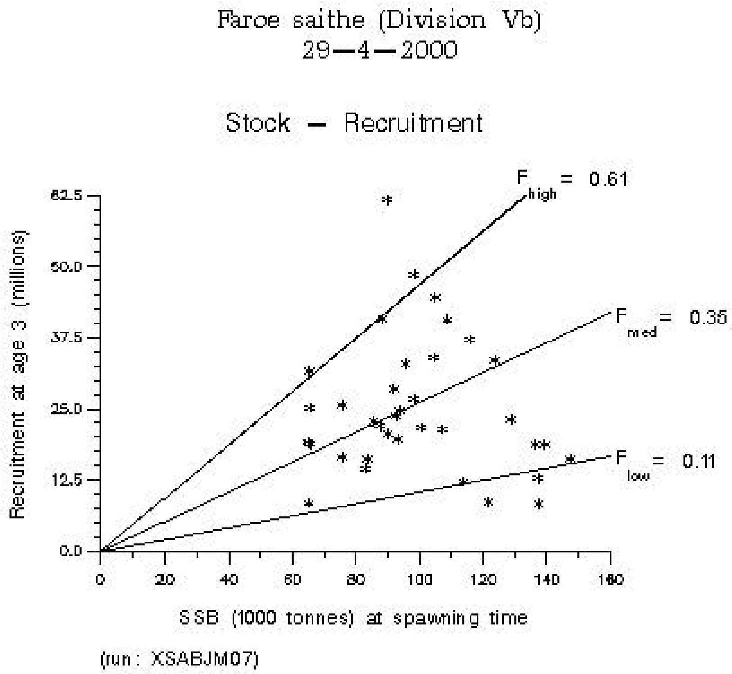


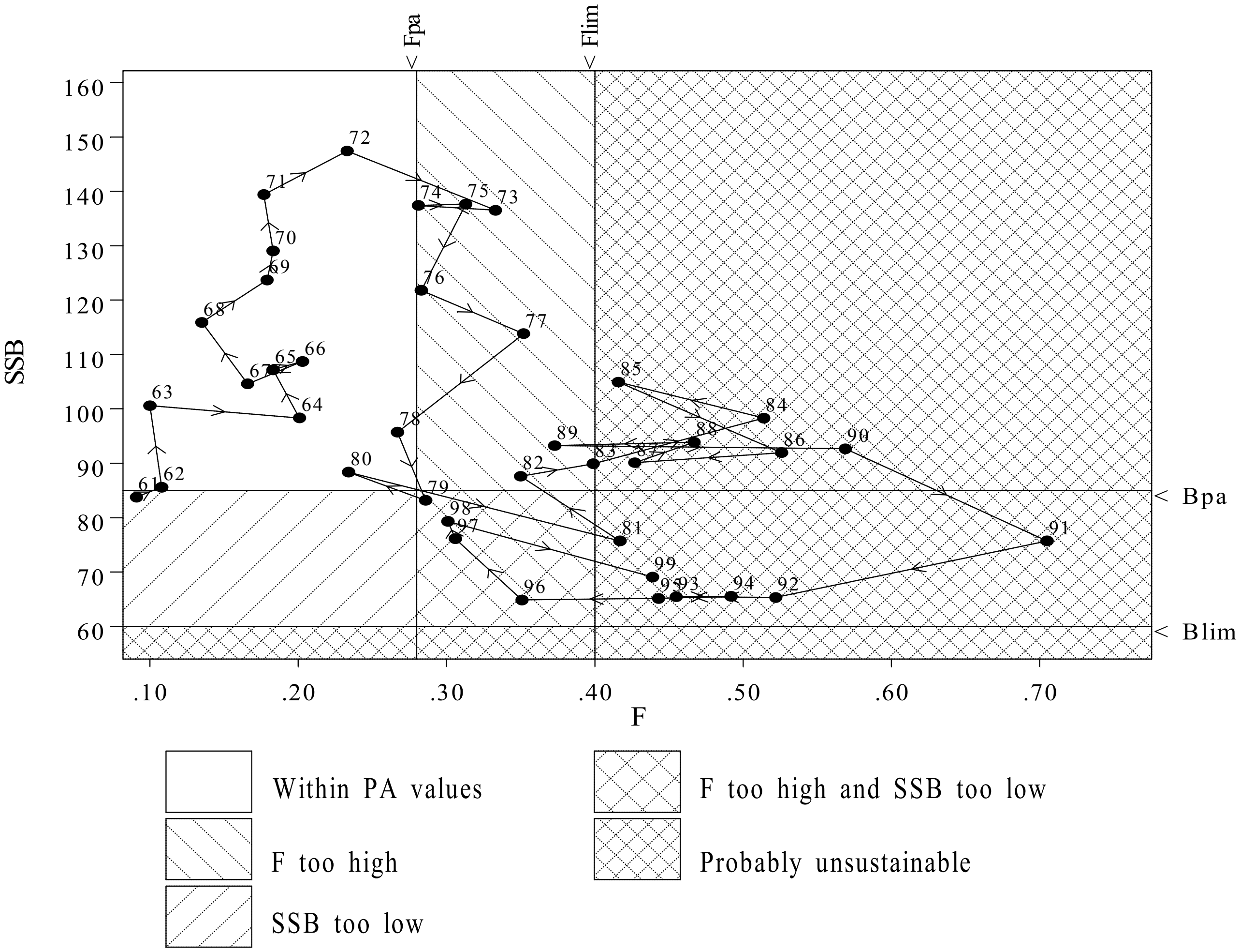
Figure 2.5.6.1



Faroe saithe (Division Vb)
29—4—2000
Stock — Recruitment
F_{high} = 0.61
F_{med} = 0.35
F_{low} = 0.11
Recruitment at age 3 (millions)
SSB (1000 tonnes) at spawning time
(run: XSABJM07)

Figure 2.5.6.2

Faroe saithe (Division Vb)



Data file(s):W:\ifapdata\work\nwwg\sai_faro\xsabjm07\pap_data.pa;*.sum
Plotted on 04/05/2000 at 11:59:54

Figure 2.5.6.3

2 DEMERSAL STOCKS AT ICELAND (DIVISION VA)

2.1 Regulation of Demersal Fisheries

With the extension of the fisheries jurisdiction to 200 miles in 1975, Iceland introduced new measures to protect young juvenile fish. The mesh size in trawls was increased from 120 mm to 155 mm in 1977. Only in the fisheries for redfish was 135 mm mesh size allowed in certain areas. In addition a system was implemented whereby fishing can be forbidden immediately in areas where the number of small fish in the catches exceeds a certain percentage (25% < 55 cm for cod and saithe and 25% < 48 cm for haddock). These areas are usually been closed for two weeks and can be extended in time and space if necessary.

A quota system however, was not introduced, until 1984.The quotas are transferable boat quotas. The agreed quotas are based on the Marine Research Institute's TAC recommendations, also taking socio-economic effects into account. Until 1990, the quota year corresponded to the calendar year but at present the quota-, or so-called fishing year, starts on 1 September and ends on 31 August of the following year. This was done to meet the need of the fishing industry.

Since the beginning of 1995/1996 fishing year i.e., 1st of September 1995 a harvesting control law has been enforced in order to manage the cod fisheries. According to this management scheme, catch will be limited to 25% of the fishable (4+) stock biomass calculated from the average stock at 1st of January of the previous fishing year and the coming fishing year. However, with a minimum catch level of 155 000 t.

2.2 Saithe in Icelandic waters

2.2.1 Trends in landings

Saithe landings from Icelandic grounds (Division Va) have declined from a peak of 103 000 t in 1991 to around 30 000 t in the last 2-3 years (Table 3.2.1). The Icelandic landings in the quota year September 1998/August 1999 amounted to 30 800 t or slightly in excess of the national TAC of 30 000 t for the same period.

2.2.2 Fleets and fishing grounds

Almost three quarters of the catches were taken by bottom trawl, 15%in gillnets and 5% each on hooks and in Danish seine in 1999. The proportion of the catch taken in gillnets has declined from almost a third of the total in 1994 and 1995, while the bottom trawl share has increased. Landings from hooks and Danish seine have been fairly stable in the period 1993-1999 (Figure 3.2.1)

The main fishing grounds of the bottom trawl fishery are southwest of Reykjanes and off the south east coast, but the gillnet fishery is concentrated on the spawning grounds south and southwest of Iceland (Figure 3.2.3}.

2.2.3 Catch at age

Data from samples from all gear types were used to calculate the catch in numbers at age for the total landings in 1999, with the sampling level indicated in the text table below, and used as input for the assessment (Table 3.2.2).

Gear/nation	Landings (t)	No. of otolith samples	No. of otoliths read	No. of length samples	No of length measurements
Gillnets	4 332	25	1300	25	3 544
Jiggers	1 639	5	250	5	711
Danish seine	1 510	4	200	5	730
Bottom trawl	22 372	88	4 407	143	22 873
Other gear	707	-	-	-	-
Faroese jiggers	704	-	-	-	-
Total	31 264	122	6 157	178	27 858

Gillnet catches were split according to a gear-specific age-length key, the rest of the catches were split according to a key based on all samples from commercial gear except those from gill nets. The length weight relationship used was $W = 0.02498 \cdot L^{2.75674}$ for all fleets. Splitting the year in two was tried and had minor effects on catch in numbers. No area division was studied No adjustments were made to the catch in numbers at age in 1998 to account for slightly revised total landings, since the age readings for that year will be supplemented before next assessment by agereadings from a backlag of samples.

Compared to last years prognosis considerably lower proportions of age groups 4 and 5 and higher proportion of age groups 6 and 7 were observed in the 1999 landings. The difference between last years prognosis and the present estimate was as large as 15% for age group. 5 (Figure 3.2.2)

2.2.4 Mean weight at age

Mean weights at age in the landings are computed on the basis of samples of otoliths and lengths along with length distributions and length-weight relationships. The mean weights at age are computed for the same categories as the catch numbers at age and are then weighted together across the fleets. In recent years a slight increasing trend in mean weight at age is apparent, with the exception of the 1992 year class which has had lower than average mean weight as age groups 4-7 (Figure 3.2.4 and Table 3.2.3). Age group 6 in 1999 had mean weight similar to that of the year class 1992 the year before. These weights at age where also used as weight at age in the stock.

2.2.5 Maturity at age

As has been pointed out in earlier reports of this working group, the maturity at age data for saithe can be misleading due to the nature of the fishery and of the species, and inadequate sampling. A GLM model, described in the 1993 Working Group report (ICES. C.M.1993/Assess:18), was used to explain maturity at age as a function of age and year class strength. This model was used to predict maturity at age for 1980-1999 (Table 3.2.4). The maturity at age prior to 1980 is derived from ICES C.M. 1979/G:6.

2.2.6 Migration of saithe

According to available data approximately 115 thousand saithe have been tagged in the NE-Atlantic this century, most of them in the Barents Sea with total returns just under 20 thousand (S.T. Jonsson 1996). At Iceland 6000 saithe were tagged in 1964-65, the recapture rate being 50% (Jones and Jonsson, 1971). Based on recaptures by area approximately 1 in 500 of tagged saithe released outside Icelandic waters were recaptured in Icelandic waters and 1 in 300 released in Icelandic waters were recaptured in distant waters (S.T. Jonsson 1996). For comparison, cod long term average rate of emigration from Icelandic waters is 1 in 2000 (J. Jonsson 1996), a rate almost an order of maginitude lower. Taken at face value, this leads to the conclusion that there is no significant difference in the rates of semi-trans-Atlantic migration east and west. Since there are more saithe in distant waters than on Icelandic grounds the latter might on average be on the receiving end of a NE-Atlantic saithe migratory budget.

Other evidence of saithe migrations exist, albeit of a more circumstantial nature. Sudden changes in the average length or weight at age and reciprocal fluctuation in catch numbers at age in different areas of the NE-Atlantic have been interpreted as signs of migrations between saithe stocks (Reinsch 1976, Jakobsen and Olsen 1987, S.T. Jonsson 1996). Since mean weight at age decrease along an approximately NW-SE-NE gradient, migration of e.g. northeast arctic saithe to Icelandic waters will, theoretically, be detectable as a reduction in size at age (Figure 3.2.4). Catch curves from some year classes, from different areas show some reciprocal variations. Inspection of the data based on the above indicate that the most likely years and ages for immigration are as follows: Age 10 in 1986, age 7 in 1991, age 9 in 1993 and age 7 in 1999.

2.2.7 Stock Assessment

2.2.7.1 Tuning input

CPUE data based on Icelandic trawler log books is available from 1970 to 1999 and from the gillnet fleet from 1988. To begin with the logbooks were kept on a voluntary basis by skippers of a few vessels, but since 1991 it has been mandatory to keep logbooks, both for the trawling fleet and the gillnets.

With reduced stock size in the nineties a continuous shift, from effort directed at saithe towards mixed fisheries has been observed. Traditional analyses using CPUE data from commercial fleets have been based on the criteria using tows where more than certain percent (50-70) of the catch was saithe. For saithe big schools of fish are occasionally encountered but the number of schools might decrease with reduced stocksize.

To bypass this problem CPUE from all tows and gillnet settings from the most important fishing areas for saithe was calculated. The areas selected are shown in Figure 3.2.3. In the tuning CPUE from the trawler fleet in the period January – May was used. The CPUE was disaggregated on ages 4 to 11.

The age disaggregated indices are shown in Table 3.2.5 and the CPUE in Figure 3.2.5.

2.2.7.2 Estimates of fishing mortality

As in previous years time series analysis (Gudmundsson 1994) was used. The final run selected was the one using the tuning indices described in section 3.2.7.1. Other options were tested among them survey indices and catch at age data only. Survey indices are an interesting alternative but are very noisy.

No useful indices of recruitment are available for saithe. Therefore first estimates of a year class have to be based on mean recruitment or stock-recruitment relationships. In the last decade recruitment has been showing a more or less continuous decrease, so using mean recruitment or a stock-recruitment relationship as the first estimate of a year class will be an overestimate. Currently this problem of declining recruitment is solved in TSA by allowing the mean recruitment to follow a linear trend. This solution seems to work at the moment but will be unacceptable if recruitment starts to improve. Currently no signs of improved recruitment are visible so this is not a problem in the current asssessment.

The main change from last years assessment was introduction of saithe migration in 4 years. The years and ages were selected by anomalies in length at age data as well as comparison with Norwegian catch at age data (see also section 3.2.6). These years and age groups where the largest discrepancies in catch at age data had been detected in TSA runs. The strength of the migrations was estimated in TSA.

It has been observed that Icelandic saithe shows density dependent growth which causes larger year classes to grow slower. Distunguising between slower growth and migration can at times be tricky as slower growth delays recruitment to the fishery. Even though slower growth is the cause of anomalies in catch at age data, modelling it as migrations is probably better than ignoring them.

Tables 3.2.7 and 3.2.8 shows the estimated stock size and fishing mortalities from the selected run along with estimated standard errors. The estimated standard errors are underestimates of the real standard errors. This applies in particular to results using commercial fleet data as these data are strongly correlated with the catch-at-age data.

The terminal F values obtained from the TSA were used as input into the vpa program that has been used for backcalculation of stock size of Icelandic cod (see section 3.3.5.2) with the inclusions of estmated size of of the immigration in units of millions as follows: $N_{10,86} = 2.6$, $N_{7,91}=4.9$, $N_{9,93}=3.9$, $N_{7,91}=1.9$.

2.2.7.3 Spawning stock and recruitment

The spawning stock biomass is shown in Figure 3.2.6 and given in Table 3.2.9. After a decline from 1970-1977, the spawning stock biomass averaged between 160-180 000 t in 1978-1989 and increased to about 190 000 t in 1990. Since 1992 the spawning stock biomass has declined to a minimum in 1999 of 90 000 t , which is the lowest SSB recorded. Spawning stock biomass at the beginning of 2000 is estimated at only 94 000 t.

Estimates of recruitment at age 3 are plotted in Figure 3.2.7. The 1983-1985 year classes are all well above the 1967-1987 long-term average of about 40 million 3 year old recruits. The 1984 year class is among highest on record at 86 million recruits. All year classes after 1985 are well below the long term average. The average size of the 1986-1994 year classes is estimated at only 22 million recruits, which is below the lower quartile of the historic series of recruitment. Since no information is available for the more recent year classes, the 1995-1997 year classes were set at the rounded average for the 1987-1994 year classes, *i.e.* at 20 million recruits.

2.2.8 Prediction of catch and biomass

2.2.8.1 Input data

The input data for the catch projections is shown in Table 3.2.10.

For catch predictions and stock biomass calculations, the mean weight at ages 4-9 were predicted using a multiple regression analysis where the mean weight at age was predicted by the mean weight of the year class in the previous year and the year class strength. Since the regression analysis showed significant relationships only for the above age groups, the mean weights at age for other age groups were averaged over the 1995-1997 period, excluding the strong 1984 year class as it had weight at age much lower than average.

For the short-term predictions, maturity at age was predicted as described in Section 3.2.5. For long term predictions of maturity at age, averages over the period 1980-1999 were used.

For short term prediction, selection pattern was based on average fishing mortality for 1997-1999, with F8+ set at the average for age groups 8-14. This average was scaled to the reference F of 1999.

For a short term prediction the rounded average of the 1987-1994 year classes was used as recruitment.

For long-term yield and spawning stock biomass per recruit, the exploitation pattern was taken as the average of the fishing mortalities during 1980-1998 from the standard VPA run. Averages over 1980-1998 for maturity and mean weight at age for all age groups were used, along with a natural mortality of 0.2 (Table 3.2.12).

2.2.8.2 Biological reference points

The yield and spawning stock biomass-per-recruit (age 3) curves are shown in Figure 3.2.8.

The ACFM has set B_{pa} at 150 000 t and B_{lim} was tentatively set at 90 000 t and F_{pa} at 0.3. F_{lim} has not been set for this stock. The stock is well below B_{pa} and close to B_{lim} to according to this assessment.

2.2.8.3 Projections of catch and biomass

Based on the input data given in Table 3.2.10, options for 2000 were calculated and are given in Table 3.2.11 and Figure 3.2.8.

As can be seen from the prediction (Table 3.2.11), total catch in 2000 is assumed 31 000 t which is a likely result of the TAC of 30 000 t for the 1999/2000 quota year. The resulting stock size in the beginning of 2001 is estimated about 175 000 t and SSB at 99 000 t . The same reference F in 2001, as in 1999, would result in a yield of approx. 34 000 t , and both total and spawning stock biomass in 2002 would remain close to the 2000 level. Total and spawning stock biomass are at historical low and will continue to be so in the coming years, even at very low fishing mortalities, unless an increase in recruitment occurs.

2.2.9 Management considerations

The stock was overestimated until in the 1997 assessment but is more stable in the more recent assessments. It is at the lowest observed level at present. The reference F values have been at or above F_{med} for the whole time series in the assessment, and were higher than F_{max} in 1993-1995. Recruitment in recent years (the 1986 and more recent year classes) has been well below the long term average.

2.2.10 Comments on the assessment

Same setting for the analytical assessment was used as last year except that migrations were estimated.

Time series analysis has been used to assess this stock in recent years. An exploratory assessment using XSA (WD 28) gave same terminal F-values (0.33) and SSB. Excluding the migration gave a terminal F of 0.33 in the TSA. TSA runs using catch at age only gave somewhat higher terminal F or 0.35. However the reasonable close aggreement between different options and methods is not considered an indicator of precision of the stock assessment.

Tag returns and stock assessment data indicate migration between saithe stock units in NE-Atlantic, and indications from catch at age have been described (Reinch 1977, Jakobsen & Olsen 1987). Little is known about their magnitude and frequency. Better understanding of saithe biology, e.g. behaviour, recruitment and migrations, is needed.

Table 3.2.1. Nominal catch (tonnes) of SAITHE in Division Va by countries, 1982-1999, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989
Belgium	201	224	269	158	218	217	268	369
Faroe Islands	3,582	2,138	2,044	1,778	783	2,139	2,596	2,246
France	23	-	-	-	-	-	-	-
Iceland	65,124	55,904	60,406	55,135	63,867	78,175	74,383	79,810
Norway	1	+	-	1	-	-	-	-
UK (Engl. and Wales)	-	-	-	29	-	-	-	-
Total	70,913	60,249	64,703	59,086	66,854	82,518	79,235	82,425
WG estimate	-	-	-	-	66,376[2)]	-	-	

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998[C]
Belgium	190	236	195	104	30	-	-	-	-
Faroe Islands	2,905	2,690	1,570	1,562	975	1,161	801	716	801
France	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	1	-	3
Iceland	95,032	99,390	77,832	69,982	63,333	47,466	39,297	36,360	30,469
Norway	-	-	-	-	-	1	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
Total	98,127	102,316	79,597	71,648	64,338	48,628	40,099	37,264	31,393
WG estimate		102,737[3)]	-	-	-	-	-		

Country	1999[1)]
Belgium	-
Faroe Islands	706
France	-
Germany	2
Iceland	30560
Norway	6
UK (Engl. and Wales)	-
Total	
WG estimate	31274

1) Provisional

2) Additional catch of 1,508 t by Faroe Islands included

3) Additional catch of 451 t by Iceland included

Table 3.2.2. Saithe in division Va. Catch in numbers 1980-1999.

Marine Research Institute Wed May 3 10:28:34 2000
Virtual Population Analysis : Catch in numbers, millions
Ufsi FinalRun 2000 - TSAjanmaymigr

Age	1980	1981	1982	1983	1984	1985	1986
3	0.275	0.203	0.508	0.107	0.053	0.376	3.108
4	2.540	1.325	1.092	1.750	0.657	4.014	1.400
5	5.214	3.503	2.804	1.065	0.800	3.366	4.170
6	2.596	5.404	4.845	2.455	1.825	1.958	2.665
7	2.169	1.457	4.293	4.454	2.184	1.536	1.550
8	1.341	1.415	1.215	2.311	3.610	1.172	1.116
9	0.387	0.578	0.975	0.501	0.844	0.747	0.628
10	0.262	0.242	0.306	0.251	0.376	0.479	1.549
11	0.155	0.061	0.059	0.038	0.291	0.074	0.216
12	0.112	0.154	0.035	0.012	0.135	0.023	0.051
13	0.064	0.135	0.048	0.002	0.185	0.072	0.030
14	0.033	0.128	0.046	0.004	0.226	0.071	0.014
Juvenile	7.297	6.498	6.329	4.312	2.516	6.732	8.329
Adult	7.851	8.107	9.897	8.638	8.670	7.156	8.168
Sum 3- 3	0.275	0.203	0.508	0.107	0.053	0.376	3.108
Sum 4-14	14.873	14.402	15.718	12.843	11.133	13.512	13.389
Total	15.148	14.605	16.226	12.950	11.186	13.888	16.497

Age	1987	1988	1989	1990	1991	1992	1993
3	0.956	1.318	0.315	0.143	0.198	0.242	0.657
4	5.135	5.067	4.313	1.692	0.874	2.928	1.083
5	4.428	6.619	8.471	5.471	3.613	3.844	2.841
6	5.409	3.678	7.309	10.112	6.844	4.355	2.252
7	2.915	2.859	1.794	6.174	10.772	3.884	2.247
8	1.348	1.775	1.928	1.816	3.223	4.046	2.314
9	0.661	0.845	0.848	1.087	0.858	1.290	3.671
10	0.496	0.226	0.270	0.380	0.838	0.350	0.830
11	0.498	0.270	0.191	0.151	0.228	0.196	0.223
12	0.058	0.107	0.135	0.055	0.040	0.056	0.188
13	0.027	0.024	0.076	0.076	0.006	0.054	0.081
14	0.048	0.001	0.010	0.037	0.005	0.015	0.012
Juvenile	11.532	13.599	16.344	15.037	12.413	8.527	4.957
Adult	10.447	9.190	9.316	12.157	15.086	12.733	11.442
Sum 3- 3	0.956	1.318	0.315	0.143	0.198	0.242	0.657
Sum 4-14	21.023	21.471	25.345	27.051	27.301	21.018	15.742
Total	21.979	22.789	25.660	27.194	27.499	21.260	16.399

Age	1994	1995	1996	1997	1998	1999
3	0.702	1.573	2.118	0.603	0.202	0.947
4	2.955	1.853	3.465	2.960	1.246	0.698
5	1.770	2.661	2.327	2.766	1.944	1.581
6	2.603	1.807	1.838	1.651	1.490	2.269
7	1.377	2.370	0.814	1.178	1.073	1.977
8	1.243	0.905	1.129	0.599	0.566	0.702
9	1.263	0.574	0.321	0.454	0.352	0.340
10	2.009	0.482	0.209	0.125	0.258	0.139
11	0.454	0.521	0.144	0.095	0.138	0.066
12	0.158	0.106	0.168	0.114	0.084	0.021
13	0.188	0.035	0.085	0.077	0.070	0.020
14	0.082	0.013	0.033	0.043	0.083	0.020
Juvenile	4.962	5.164	6.442	4.963	2.837	3.289
Adult	9.842	7.736	6.209	5.702	4.669	5.491
Sum 3- 3	0.702	1.573	2.118	0.603	0.202	0.947
Sum 4-14	14.102	11.327	10.533	10.062	7.304	7.833
Total	14.804	12.900	12.651	10.665	7.506	8.780

Table 3.2.3. Saithe in Division Va. Mean weight (kg) at age in the catches 1980-1999.

Marine Research Institute Wed May 3 10:28:34 2000
Virtual Population Analysis : Weight at age in the catches, in grams
Ufsi FinalRun 2000 - TSAjanmaymigr

Age	1980	1981	1982	1983	1984	1985	1986
3	1428	1585	1547	1530	1653	1609	1450
4	1983	2037	2194	2221	2432	2172	2190
5	2667	2696	3015	3171	3330	3169	2959
6	3689	3525	3183	4270	4681	3922	4402
7	5409	4541	5114	4107	5466	4697	5488
8	6321	6247	6202	5984	4973	6411	6406
9	7213	6991	7256	7565	7407	6492	7570
10	8565	8202	7922	8673	8179	8346	6487
11	9147	9537	8924	8801	8770	9401	9616
12	9617	9089	10134	9039	8831	10335	10462
13	10066	9351	9447	11138	11010	11027	11747
14	11041	10225	10535	9818	11127	10644	11902

Age	1987	1988	1989	1990	1991	1992	1993
3	1516	1261	1403	1647	1224	1269	1381
4	1715	2017	2021	1983	1939	1909	2143
5	2670	2513	2194	2566	2432	2578	2742
6	3839	3476	3047	3021	3160	3288	3636
7	5081	4719	4505	4077	3634	4150	4398
8	6185	5932	5889	5744	4967	4865	5421
9	7330	7523	7172	7038	6629	6168	5319
10	8025	8439	8852	7564	7704	7926	7006
11	7974	8748	10170	8854	9061	8349	8070
12	9615	9559	10392	10645	9117	9029	10048
13	12246	10824	12522	11674	10922	11574	9106
14	11656	14099	11923	11431	11342	9466	11591

Age	1994	1995	1996	1997	1998	1999	2000
3	1444	1370	1210	1325	1375	1232	1311
4	1836	1977	1745	1936	2030	2004	1954
5	2649	2769	2684	2409	2927	2671	2801
6	3512	3722	3741	3906	3430	3461	3699
7	4906	4621	4850	5032	5039	3785	4328
8	5539	5854	5620	6171	6089	5776	5219
9	6818	6416	6966	7202	6991	7028	7215
10	6374	7356	7430	7883	7884	8189	7985
11	8341	6815	8884	8856	8876	8755	8829
12	9770	8312	8025	9649	10183	10658	10163
13	10528	9119	10246	9621	10171	10909	10442
14	11257	11910	12177	10877	10120	11260	11438

Table 3.2.4. Saithe in Division Va. Maturity at age in the catch.

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      Marine Research Institute Wed May  3 10:28:34 2000
 Virtual Population Analysis : Sexual maturity at age in the catches
Ufsi FinalRun 2000 - TSAjanmaymigr
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Age	1980	1981	1982	1983	1984	1985	1986
3	0.120	0.150	0.140	0.110	0.080	0.100	0.040
4	0.180	0.240	0.290	0.270	0.220	0.170	0.220
5	0.320	0.340	0.430	0.480	0.470	0.400	0.320
6	0.670	0.520	0.550	0.640	0.690	0.670	0.610
7	0.800	0.830	0.720	0.740	0.800	0.840	0.830
8	0.910	0.900	0.920	0.860	0.870	0.910	0.920
9	0.960	0.960	0.960	0.960	0.930	0.940	0.960
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1987	1988	1989	1990	1991	1992	1993
3	0.030	0.070	0.110	0.140	0.120	0.160	0.140
4	0.100	0.080	0.140	0.230	0.280	0.250	0.310
5	0.390	0.210	0.160	0.280	0.420	0.470	0.440
6	0.530	0.600	0.380	0.320	0.480	0.630	0.680
7	0.790	0.720	0.780	0.590	0.520	0.690	0.800
8	0.920	0.900	0.860	0.890	0.770	0.720	0.840
9	0.970	0.960	0.950	0.940	0.950	0.890	0.860
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1994	1995	1996	1997	1998	1999	2000
3	0.150	0.130	0.130	0.160	0.140	0.140	0.140
4	0.280	0.290	0.260	0.260	0.310	0.280	0.280
5	0.510	0.470	0.480	0.460	0.450	0.510	0.480
6	0.650	0.710	0.680	0.690	0.660	0.660	0.680
7	0.830	0.810	0.850	0.830	0.840	0.820	0.840
8	0.900	0.920	0.910	0.930	0.920	0.920	0.920
9	0.920	0.960	0.960	0.960	0.970	0.960	0.970
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 3.2.5. Saithe in Division Va. Tuning data series.

TRW CPUE, JAN-MAY, MAIN TRW GROUNDS
1991 1999
1 1 0 0.42
4 11

1	1.6472	10.8243	21.8838	36.1199	11.5300	3.7650	3.5295	1.1766
1	7.4690	15.4417	22.9111	23.6665	23.5826	5.9587	1.1750	0.5036
1	1.0431	5.2151	11.7944	15.3246	11.2328	10.3504	2.4069	0.5616
1	7.4092	6.7035	14.3773	6.8359	5.9979	4.5425	7.4972	1.0584
1	7.5771	11.3984	10.8712	14.2316	4.4144	2.0424	1.8448	2.3060
1	14.3773	9.9167	10.8014	6.0827	8.9213	1.6958	1.1429	0.4792
1	18.8663	8.4982	7.1387	10.1415	4.8723	3.1727	0.9066	0.4532
1	6.7754	14.1228	8.6725	6.8356	4.7276	3.2221	2.0478	0.8732
1	3.5418	10.0983	14.1249	10.2879	4.2795	1.9184	0.9065	0.3794

Table 3.2.6. Saithe in Division Va. Results from TSA-runs

Catch-at-age 4-11 years
CPUE trawl Jan.-May 6-11 years
Linear trend in recruitment
STOCK

	4	5	6	7	8	9	10	11	BIOM
1987	57496.	21252.	18492.	8895.	4031.	1886.	1453.	1463.	333.6
1988	58848.	42396.	13535.	10300.	4695.	2091.	954.	744.	377.3
1989	44708.	43589.	28249.	7869.	5593.	2366.	1027.	499.	368.7
1990	25969.	32709.	28429.	16645.	4487.	2946.	1220.	541.	353.4
1991	18035.	19405.	21448.	25842.	8050.	2125.	1438.	606.	314.4
1992	24242.	13667.	12539.	11571.	11900.	3642.	960.	636.	264.2
1993	13005.	16728.	7878.	6430.	5892.	8803.	1823.	478.	226.0
1994	17623.	9677.	10876.	4269.	3124.	2755.	4004.	830.	185.7
1995	15231.	11212.	6367.	6505.	2176.	1387.	1163.	1677.	156.6
1996	19288.	10759.	6902.	3567.	3224.	1001.	646.	549.	140.5
1997	18688.	11530.	6746.	4080.	2040.	1655.	519.	338.	142.5
1998	10409.	12421.	7142.	3998.	2266.	1138.	923.	293.	133.8
1999	6830.	7243.	8174.	7120.	2338.	1283.	623.	500.	120.3

STANDARD DEVIATION OF STOCK ESTIMATES

1998	1341.	1345.	985.	440.	307.	155.	154.	58.	11.9
1999	3355.	1021.	1008.	737.	346.	246.	127.	121.	13.6

FISHING MORTALITY RATES

	4	5	6	7	8	9	10	11	FGBAR	FBAR(4-9)
1987	0.105	0.251	0.385	0.439	0.456	0.481	0.469	0.464	0.315	0.353
1988	0.094	0.205	0.342	0.410	0.485	0.511	0.447	0.463	0.296	0.341
1989	0.112	0.223	0.326	0.360	0.441	0.462	0.441	0.451	0.290	0.321
1990	0.090	0.221	0.410	0.525	0.543	0.513	0.497	0.503	0.326	0.384
1991	0.073	0.234	0.417	0.575	0.593	0.595	0.616	0.590	0.337	0.415
1992	0.159	0.324	0.462	0.473	0.484	0.489	0.494	0.494	0.373	0.399
1993	0.092	0.222	0.384	0.507	0.559	0.587	0.586	0.580	0.330	0.392
1994	0.225	0.218	0.313	0.461	0.586	0.639	0.649	0.623	0.372	0.407
1995	0.146	0.255	0.368	0.497	0.570	0.560	0.547	0.532	0.360	0.399
1996	0.302	0.266	0.323	0.359	0.462	0.454	0.447	0.442	0.353	0.361
1997	0.208	0.276	0.323	0.379	0.382	0.377	0.369	0.378	0.317	0.324
1998	0.148	0.209	0.276	0.337	0.356	0.388	0.390	0.389	0.271	0.285
1999	0.164	0.277	0.350	0.364	0.359	0.334	0.312	0.308	0.297	0.308

STANDARD DEVIATIONS OF LOG(F)

1998	0.15	0.13	0.13	0.13	0.13	0.14	0.15	0.16	0.097
1999	0.36	0.20	0.17	0.14	0.16	0.16	0.17	0.17	0.129

Migrations:	year	age	stockno	stdev
	1991	7	10400	2300
	1993	9	2800	900
	1999	7	2700	1000

Table 3.2.7. Saithe in Division Va. Fishing mortality.

Marine Research Institute Wed May 3 10:28:35 2000
Virtual Population Analysis : Fishing mortality
Ufsi FinalRun 2000 - TSAjanmaymigr

Age	1980	1981	1982	1983	1984	1985	1986
3	0.011	0.012	0.026	0.004	0.001	0.012	0.047
4	0.081	0.067	0.080	0.116	0.028	0.120	0.056
5	0.217	0.153	0.195	0.104	0.071	0.192	0.177
6	0.369	0.366	0.327	0.262	0.259	0.249	0.229
7	0.378	0.366	0.558	0.566	0.392	0.362	0.318
8	0.553	0.455	0.594	0.674	1.363	0.378	0.488
9	0.276	0.493	0.659	0.526	0.563	1.328	0.358
10	0.229	0.278	0.531	0.349	0.994	0.738	0.900
11	0.394	0.076	0.101	0.113	0.884	0.531	0.916
12	0.252	0.871	0.057	0.027	0.724	0.150	0.884
13	0.137	0.546	0.755	0.004	0.700	1.165	0.296
14	0.253	0.443	0.361	0.123	0.826	0.646	0.749
W.Av 4- 9	0.206	0.217	0.296	0.287	0.241	0.201	0.172
Ave 4- 9	0.312	0.317	0.402	0.375	0.446	0.438	0.271

Age	1987	1988	1989	1990	1991	1992	1993
3	0.012	0.026	0.011	0.008	0.008	0.018	0.035
4	0.103	0.084	0.113	0.077	0.058	0.159	0.103
5	0.252	0.187	0.197	0.205	0.234	0.384	0.228
6	0.365	0.343	0.325	0.381	0.426	0.490	0.408
7	0.420	0.335	0.280	0.502	0.655	0.458	0.508
8	0.506	0.490	0.396	0.507	0.537	0.553	0.548
9	0.607	0.698	0.461	0.407	0.481	0.428	0.638
10	0.534	0.430	0.503	0.387	0.637	0.368	0.542
11	0.852	0.633	0.800	0.591	0.425	0.296	0.425
12	0.680	0.439	0.772	0.567	0.303	0.174	0.514
13	2.307	0.678	0.647	1.561	0.108	0.866	0.406
14	1.093	0.545	0.680	0.776	0.368	0.426	0.472
W.Av 4- 9	0.223	0.181	0.215	0.292	0.391	0.373	0.353
Ave 4- 9	0.375	0.356	0.295	0.347	0.398	0.412	0.405

Age	1994	1995	1996	1997	1998	1999	1997-1999
3	0.041	0.076	0.099	0.046	0.022	0.025	0.031
4	0.217	0.144	0.239	0.195	0.126	0.100	0.140
5	0.243	0.310	0.270	0.306	0.190	0.232	0.242
6	0.337	0.419	0.365	0.313	0.268	0.353	0.311
7	0.471	0.586	0.338	0.423	0.344	0.425	0.397
8	0.592	0.657	0.623	0.447	0.370	0.398	0.405
9	0.665	0.607	0.517	0.553	0.518	0.398	0.490
10	0.901	0.582	0.466	0.390	0.716	0.398	0.501
11	0.654	0.626	0.342	0.400	1.011	0.398	0.603
12	0.610	0.308	0.422	0.499	0.753	0.398	0.550
13	1.642	0.259	0.434	0.348	0.661	0.398	0.469
14	0.952	0.444	0.416	0.409	0.785	0.398	0.531
W.Av 4- 9	0.324	0.330	0.304	0.283	0.219	0.248	0.251
Ave 4- 9	0.421	0.454	0.392	0.373	0.303	0.318	0.331

Table 3.2.8. Saithe in Division Va. Stock in numbers

Marine Research Institute Wed May 3 10:28:34 2000
Virtual Population Analysis : Stock in numbers, millions
Ufsi FinalRun 2000 - TSAjanmaymigr

Age	1980	1981	1982	1983	1984	1985	1986
3	28.024	19.438	22.035	32.599	47.662	34.868	73.912
4	35.966	22.696	15.731	17.582	26.593	38.975	28.208
5	29.338	27.155	17.386	11.894	12.817	21.180	28.291
6	9.219	19.327	19.076	11.710	8.778	9.772	14.309
7	7.560	5.217	10.972	11.265	7.379	5.545	6.239
8	3.450	4.242	2.963	5.141	5.237	4.081	3.161
9	1.763	1.624	2.205	1.339	2.144	1.097	2.290
10	1.406	1.095	0.812	0.934	0.648	1.000	2.838
11	0.522	0.915	0.679	0.391	0.539	0.196	0.391
12	0.552	0.288	0.694	0.503	0.286	0.182	0.094
13	0.549	0.351	0.099	0.537	0.401	0.113	0.129
14	0.162	0.392	0.166	0.038	0.438	0.163	0.029
Juvenile	79.038	62.346	52.010	55.951	76.413	80.983	119.181
Adult	39.471	40.394	40.807	37.981	36.509	36.190	40.710
Sum 3- 3	28.024	19.438	22.035	32.599	47.662	34.868	73.912
Sum 4-14	90.485	83.302	70.783	61.333	65.260	82.305	85.979
Total	118.509	102.740	92.818	93.932	112.922	117.173	159.891

Age	1987	1988	1989	1990	1991	1992	1993
3	85.525	55.651	30.969	21.046	27.011	15.164	21.050
4	57.708	69.158	44.373	25.070	17.102	21.936	12.197
5	21.831	42.617	52.051	32.441	18.999	13.213	15.322
6	19.407	13.891	28.931	34.989	21.635	12.304	7.367
7	9.317	11.032	8.069	17.120	24.470	11.574	6.172
8	3.715	5.013	6.464	4.993	8.486	10.408	5.994
9	1.588	1.834	2.514	3.562	2.461	4.062	8.500
10	1.311	0.709	0.747	1.298	1.941	1.246	2.168
11	0.945	0.629	0.378	0.370	0.722	0.840	0.706
12	0.128	0.330	0.274	0.139	0.168	0.386	0.512
13	0.032	0.053	0.174	0.104	0.064	0.101	0.266
14	0.078	0.003	0.022	0.075	0.018	0.047	0.035
Juvenile	159.636	158.268	130.189	92.336	72.173	47.694	40.840
Adult	41.949	42.652	44.777	48.871	50.904	43.589	39.449
Sum 3- 3	85.525	55.651	30.969	21.046	27.011	15.164	21.050
Sum 4-14	116.061	145.270	143.998	120.161	96.066	76.119	59.239
Total	201.585	200.920	174.966	141.207	123.077	91.283	80.289

Age	1994	1995	1996	1997	1998	1999	2000
3	19.370	23.590	24.746	14.860	20.000	20.000	20.000
4	16.642	15.225	17.895	18.350	11.622	16.013	15.970
5	9.009	10.965	10.795	11.534	12.359	8.392	11.863
6	9.988	5.784	6.586	6.746	6.957	8.368	5.448
7	4.011	5.839	3.114	3.742	4.039	6.256	4.813
8	3.040	2.050	2.660	1.819	2.007	2.343	3.349
9	2.836	1.377	0.870	1.169	0.952	1.135	1.289
10	3.677	1.194	0.614	0.425	0.550	0.464	0.624
11	1.032	1.223	0.546	0.316	0.235	0.220	0.255
12	0.378	0.439	0.535	0.318	0.173	0.070	0.121
13	0.251	0.168	0.264	0.287	0.158	0.067	0.039
14	0.145	0.040	0.106	0.140	0.166	0.067	0.037
Juvenile	37.570	40.151	43.234	35.191	35.217	37.046	37.687
Adult	32.810	27.743	25.499	24.513	24.002	26.350	26.120
Sum 3- 3	19.370	23.590	24.746	14.860	20.000	20.000	20.000
Sum 4-14	51.010	44.304	43.987	44.845	39.219	43.396	43.808
Total	70.380	67.894	68.733	59.705	59.219	63.396	63.808

Table 3.2.9. Saithe in Division Va. Stock summary table.

Marine Research Institute Tue May 2 19:30:40 2000
Virtual Population Analysis : Catch weight in 1000tons
Ufsi LongRun 2000 - TSAjanmaymigr - Fresh weight and maturity

	RECRUT	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4-9
Age	Age 3					
1962	31	266	131	50	0.38	0.287
1963	84	324	133	48	0.36	0.304
1964	55	373	134	60	0.45	0.250
1965	94	461	161	60	0.37	0.231
1966	70	544	208	52	0.25	0.178
1967	68	641	273	76	0.28	0.237
1968	60	692	341	79	0.23	0.210
1969	89	760	393	116	0.30	0.295
1970	66	753	396	117	0.29	0.323
1971	51	714	378	137	0.36	0.443
1972	26	602	333	111	0.33	0.361
1973	26	516	313	111	0.35	0.345
1974	25	433	287	98	0.34	0.287
1975	26	386	262	88	0.34	0.278
1976	31	346	227	82	0.36	0.326
1977	22	298	184	62	0.34	0.282
1978	49	305	163	50	0.30	0.237
1979	44	330	160	64	0.40	0.245
1980	28	328	160	58	0.37	0.312
1981	19	308	158	59	0.37	0.317
1982	22	294	166	69	0.42	0.402
1983	33	286	159	58	0.37	0.375
1984	48	331	160	63	0.39	0.446
1985	35	321	140	57	0.41	0.438
1986	74	412	172	66	0.39	0.271
1987	86	464	166	81	0.48	0.375
1988	56	476	160	77	0.48	0.356
1989	31	444	163	82	0.51	0.295
1990	21	414	180	98	0.54	0.347
1991	27	352	184	103	0.56	0.398
1992	15	281	169	80	0.47	0.412
1993	21	258	166	72	0.43	0.405
1994	19	213	137	64	0.47	0.421
1995	24	185	107	49	0.46	0.454
1996	25	169	93	40	0.43	0.392
1997	15	161	91	37	0.41	0.373
1998	20	162	89	32	0.35	0.303
1999	20	161	90	31	0.35	0.318
ArthMean	42	389	194	72	0.39	0.330

Table 3.2.10. Saithe in Division Va. Prediction with management option - Input data.

The SAS System 22:26 Wednesday, May 3, 2000
Icelandic saithe (Division Va)

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	20.000	0.2000	0.1400	0.0000	0.0000	1.311	0.0280	1.311
4	15.970	0.2000	0.2800	0.0000	0.0000	1.954	0.1270	1.954
5	11.863	0.2000	0.4800	0.0000	0.0000	2.801	0.2200	2.801
6	5.448	0.2000	0.7100	0.0000	0.0000	3.699	0.2820	3.699
7	4.813	0.2000	0.8200	0.0000	0.0000	4.328	0.3600	4.328
8	3.349	0.2000	0.9200	0.0000	0.0000	5.219	0.4590	5.219
9	1.289	0.2000	0.9700	0.0000	0.0000	7.215	0.4590	7.215
10	0.624	0.2000	1.0000	0.0000	0.0000	7.985	0.4590	7.985
11	0.255	0.2000	1.0000	0.0000	0.0000	8.829	0.4590	8.829
12	0.121	0.2000	1.0000	0.0000	0.0000	10.163	0.4590	10.163
13	0.039	0.2000	1.0000	0.0000	0.0000	10.442	0.4590	10.442
14	0.037	0.2000	1.0000	0.0000	0.0000	11.438	0.4590	11.438
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	20.000	0.2000	0.1400	0.0000	0.0000	1.311	0.0280	1.311
4	.	0.2000	0.2800	0.0000	0.0000	2.008	0.1270	2.008
5	.	0.2000	0.4800	0.0000	0.0000	2.767	0.2200	2.767
6	.	0.2000	0.6800	0.0000	0.0000	3.762	0.2820	3.762
7	.	0.2000	0.8500	0.0000	0.0000	4.841	0.3600	4.841
8	.	0.2000	0.9100	0.0000	0.0000	5.788	0.4590	5.788
9	.	0.2000	0.9600	0.0000	0.0000	6.810	0.4590	6.810
10	.	0.2000	1.0000	0.0000	0.0000	7.985	0.4590	7.985
11	.	0.2000	1.0000	0.0000	0.0000	8.829	0.4590	8.829
12	.	0.2000	1.0000	0.0000	0.0000	10.163	0.4590	10.163
13	.	0.2000	1.0000	0.0000	0.0000	10.442	0.4590	10.442
14	.	0.2000	1.0000	0.0000	0.0000	11.438	0.4590	11.438
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	20.000	0.2000	0.1400	0.0000	0.0000	1.311	0.0280	1.311
4	.	0.2000	0.2800	0.0000	0.0000	2.008	0.1270	2.008
5	.	0.2000	0.4800	0.0000	0.0000	2.803	0.2200	2.803
6	.	0.2000	0.6800	0.0000	0.0000	3.739	0.2820	3.739
7	.	0.2000	0.8400	0.0000	0.0000	4.859	0.3600	4.859
8	.	0.2000	0.9300	0.0000	0.0000	5.984	0.4590	5.984
9	.	0.2000	0.9600	0.0000	0.0000	6.578	0.4590	6.578
10	.	0.2000	1.0000	0.0000	0.0000	7.985	0.4590	7.985
11	.	0.2000	1.0000	0.0000	0.0000	8.829	0.4590	8.829
12	.	0.2000	1.0000	0.0000	0.0000	10.163	0.4590	10.163
13	.	0.2000	1.0000	0.0000	0.0000	10.442	0.4590	10.442
14	.	0.2000	1.0000	0.0000	0.0000	11.438	0.4590	11.438
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANEHJ03
Date and time: 03MAY00:22:26

Table 3.2.11 Short-term prediction

The SAS System 22:26 Wednesday, May 3, 2000
Icelandic saithe (Division Va)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.9502	0.3020	167709	94143	31000	0.0000	0.0000	175381	99200	0	215332	131940
.	.	.	.	.	0.0500	0.0159	.	99200	1979	213110	130101
.	.	.	.	.	0.1000	0.0318	.	99200	3926	210924	128293
.	.	.	.	.	0.1500	0.0477	.	99200	5842	208773	126517
.	.	.	.	.	0.2000	0.0636	.	99200	7727	206657	124772
.	.	.	.	.	0.2500	0.0795	.	99200	9582	204574	123057
.	.	.	.	.	0.3000	0.0954	.	99200	11408	202525	121372
.	.	.	.	.	0.3500	0.1112	.	99200	13205	200509	119715
.	.	.	.	.	0.4000	0.1271	.	99200	14973	198524	118088
.	.	.	.	.	0.4500	0.1430	.	99200	16714	196571	116488
.	.	.	.	.	0.5000	0.1589	.	99200	18426	194649	114915
.	.	.	.	.	0.5500	0.1748	.	99200	20112	192757	113370
.	.	.	.	.	0.6000	0.1907	.	99200	21772	190895	111851
.	.	.	.	.	0.6500	0.2066	.	99200	23406	189063	110358
.	.	.	.	.	0.7000	0.2225	.	99200	25014	187259	108890
.	.	.	.	.	0.7500	0.2384	.	99200	26597	185483	107447
.	.	.	.	.	0.8000	0.2543	.	99200	28156	183735	106029
.	.	.	.	.	0.8500	0.2702	.	99200	29690	182014	104634
.	.	.	.	.	0.9000	0.2861	.	99200	31201	180320	103264
.	.	.	.	.	0.9500	0.3019	.	99200	32688	178652	101916
.	.	.	.	.	1.0000	0.3178	.	99200	34153	177010	100591
.	.	.	.	.	1.0500	0.3337	.	99200	35595	175393	99288
.	.	.	.	.	1.1000	0.3496	.	99200	37016	173801	98007
.	.	.	.	.	1.1500	0.3655	.	99200	38414	172233	96748
.	.	.	.	.	1.2000	0.3814	.	99200	39791	170690	95509
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANEHJ03
Date and time : 03MAY00:22:26
Computation of ref. F: Simple mean, age 4 - 9
Basis for 2000 : TAC constraints

Table 3.2.12 Saithe in Division Va. Yield per recruit - Input data.

The SAS System 22:26 Wednesday, May 3, 2000
Icelandic saithe (Division Va)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.1200	0.0000	0.0000	1.433	0.0230	1.436
4	.	0.2000	0.2300	0.0000	0.0000	2.025	0.0970	2.025
5	.	0.2000	0.3900	0.0000	0.0000	2.744	0.1860	2.734
6	.	0.2000	0.6000	0.0000	0.0000	3.655	0.2950	3.668
7	.	0.2000	0.7700	0.0000	0.0000	4.728	0.3710	4.711
8	.	0.2000	0.8800	0.0000	0.0000	5.833	0.4760	5.818
9	.	0.2000	0.9500	0.0000	0.0000	6.951	0.4760	6.949
10	.	0.2000	1.0000	0.0000	0.0000	7.832	0.4760	7.830
11	.	0.2000	1.0000	0.0000	0.0000	8.800	0.4760	8.795
12	.	0.2000	1.0000	0.0000	0.0000	9.571	0.4760	9.537
13	.	0.2000	1.0000	0.0000	0.0000	10.649	0.4760	10.676
14	.	0.2000	1.0000	0.0000	0.0000	11.218	0.4760	12.219
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDEHJ01
Date and time: 03MAY00:09:26

Table 3.2.13. Saithe in Division Va. Yield per recruit - Summary table.

The SAS System 22:26 Wednesday, May 3, 2000
Icelandic saithe (Division Va)

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.016	21274.351	2.715	15961.535	2.715	15961.535
0.0500	0.0158	0.054	319.574	4.843	19891.222	2.555	14632.759	2.555	14632.759
0.1000	0.0317	0.101	581.677	4.688	18664.908	2.411	13459.052	2.411	13459.052
0.1500	0.0475	0.142	796.795	4.547	17574.678	2.282	12419.763	2.282	12419.763
0.2000	0.0634	0.178	973.468	4.419	16602.761	2.166	11497.196	2.166	11497.196
0.2500	0.0792	0.210	1118.653	4.303	15733.903	2.062	10676.167	2.062	10676.167
0.3000	0.0951	0.238	1238.024	4.197	14954.994	1.967	9943.634	1.967	9943.634
0.3500	0.1109	0.263	1336.212	4.100	14254.749	1.881	9288.374	1.881	9288.374
0.4000	0.1267	0.285	1416.995	4.010	13623.441	1.802	8700.720	1.802	8700.720
0.4500	0.1426	0.305	1483.465	3.928	13052.671	1.731	8172.330	1.731	8172.330
0.5000	0.1584	0.323	1538.148	3.853	12535.177	1.665	7695.999	1.665	7695.999
0.5500	0.1743	0.340	1583.114	3.782	12064.673	1.605	7265.488	1.605	7265.488
0.6000	0.1901	0.355	1620.057	3.717	11635.702	1.549	6875.392	1.549	6875.392
0.6500	0.2059	0.368	1650.370	3.657	11243.525	1.498	6521.017	1.498	6521.017
0.7000	0.2218	0.381	1675.194	3.600	10884.018	1.451	6198.283	1.451	6198.283
0.7500	0.2376	0.393	1695.470	3.547	10553.584	1.407	5903.633	1.407	5903.633
0.8000	0.2535	0.404	1711.970	3.497	10249.081	1.366	5633.968	1.366	5633.968
0.8500	0.2693	0.414	1725.332	3.451	9967.762	1.328	5386.576	1.328	5386.576
0.9000	0.2852	0.423	1736.082	3.407	9707.216	1.293	5159.083	1.293	5159.083
0.9500	0.3010	0.432	1744.655	3.365	9465.327	1.260	4949.407	1.260	4949.407
1.0000	0.3168	0.440	1751.411	3.326	9240.234	1.229	4755.719	1.229	4755.719
1.0500	0.3327	0.448	1756.649	3.289	9030.294	1.199	4576.407	1.199	4576.407
1.1000	0.3485	0.456	1760.617	3.253	8834.059	1.172	4410.053	1.172	4410.053
1.1500	0.3644	0.463	1763.522	3.220	8650.244	1.146	4255.399	1.146	4255.399
1.2000	0.3802	0.469	1765.534	3.188	8477.712	1.122	4111.335	1.122	4111.335
1.2500	0.3960	0.476	1766.798	3.157	8315.452	1.099	3976.876	1.099	3976.876
1.3000	0.4119	0.482	1767.433	3.128	8162.563	1.077	3851.145	1.077	3851.145
1.3500	0.4277	0.487	1767.540	3.100	8018.242	1.056	3733.363	1.056	3733.363
1.4000	0.4436	0.493	1767.203	3.073	7881.772	1.036	3622.833	1.036	3622.833
1.4500	0.4594	0.498	1766.494	3.047	7752.510	1.017	3518.935	1.017	3518.935
1.5000	0.4753	0.503	1765.473	3.023	7629.880	0.999	3421.112	0.999	3421.112
1.5500	0.4911	0.508	1764.189	2.999	7513.362	0.982	3328.863	0.982	3328.863
1.6000	0.5069	0.513	1762.685	2.976	7402.489	0.966	3241.741	0.966	3241.741
1.6500	0.5228	0.518	1760.998	2.954	7296.840	0.951	3159.342	0.951	3159.342
1.7000	0.5386	0.522	1759.158	2.933	7196.033	0.936	3081.300	0.936	3081.300
1.7500	0.5545	0.526	1757.192	2.912	7099.723	0.921	3007.287	0.921	3007.287
1.8000	0.5703	0.530	1755.121	2.892	7007.596	0.908	2937.003	0.908	2937.003
1.8500	0.5861	0.534	1752.965	2.873	6919.367	0.894	2870.180	0.894	2870.180
1.9000	0.6020	0.538	1750.740	2.854	6834.776	0.882	2806.570	0.882	2806.570
1.9500	0.6178	0.542	1748.460	2.836	6753.586	0.870	2745.950	0.870	2745.950
2.0000	0.6337	0.545	1746.136	2.819	6675.579	0.858	2688.116	0.858	2688.116
2.0500	0.6495	0.549	1743.779	2.802	6600.558	0.847	2632.883	0.847	2632.883
2.1000	0.6654	0.552	1741.397	2.785	6528.340	0.836	2580.079	0.836	2580.079
2.1500	0.6812	0.556	1738.999	2.769	6458.758	0.825	2529.549	0.825	2529.549
2.2000	0.6970	0.559	1736.590	2.754	6391.656	0.815	2481.149	0.815	2481.149
2.2500	0.7129	0.562	1734.175	2.738	6326.895	0.805	2434.748	0.805	2434.748
2.3000	0.7287	0.565	1731.761	2.724	6264.341	0.796	2390.225	0.796	2390.225
2.3500	0.7446	0.568	1729.350	2.709	6203.874	0.786	2347.468	0.786	2347.468
2.4000	0.7604	0.571	1726.947	2.695	6145.382	0.778	2306.374	0.778	2306.374
2.4500	0.7762	0.574	1724.554	2.681	6088.759	0.769	2266.848	0.769	2266.848
2.5000	0.7921	0.576	1722.174	2.668	6033.910	0.761	2228.802	0.761	2228.802
2.5500	0.8079	0.579	1719.809	2.655	5980.745	0.752	2192.153	0.752	2192.153
2.6000	0.8238	0.582	1717.460	2.642	5929.179	0.745	2156.827	0.745	2156.827
2.6500	0.8396	0.584	1715.131	2.630	5879.135	0.737	2122.753	0.737	2122.753
2.7000	0.8554	0.587	1712.821	2.618	5830.539	0.729	2089.865	0.729	2089.865
2.7500	0.8713	0.589	1710.531	2.606	5783.324	0.722	2058.102	0.722	2058.102
2.8000	0.8871	0.592	1708.264	2.594	5737.425	0.715	2027.407	0.715	2027.407
2.8500	0.9030	0.594	1706.019	2.583	5692.782	0.708	1997.727	0.708	1997.727
2.9000	0.9188	0.596	1703.798	2.571	5649.341	0.702	1969.013	0.702	1969.013
2.9500	0.9347	0.599	1701.599	2.561	5607.047	0.695	1941.217	0.695	1941.217
3.0000	0.9505	0.601	1699.425	2.550	5565.852	0.689	1914.297	0.689	1914.297
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDEHJ01
Date and time : 03MAY00:09:26
Computation of ref. F: Simple mean, age 4 - 9
F-0.1 factor : 0.5866
F-max factor : 1.3359
F-0.1 reference F : 0.1859
F-max reference F : 0.4233
Recruitment : Single recruit

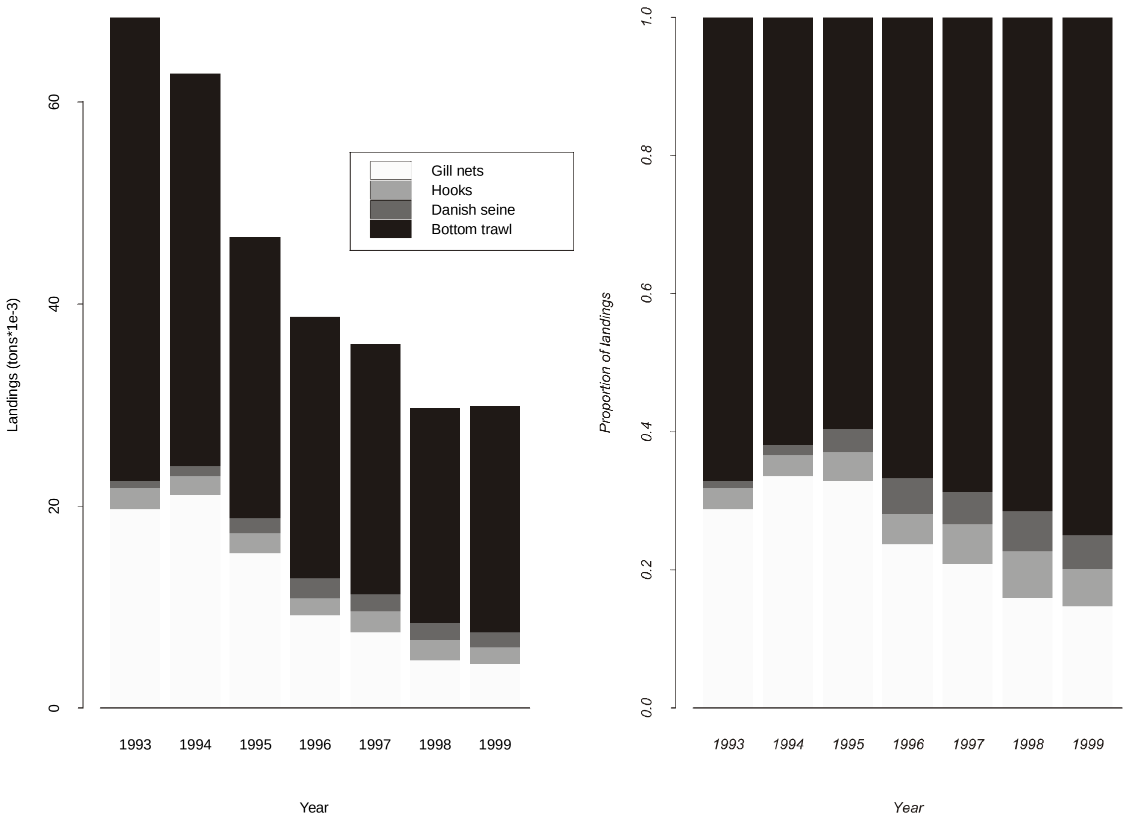


Figure 3.2.1. Saithe in division Va. Proportional catches in different gears 1980-1998.

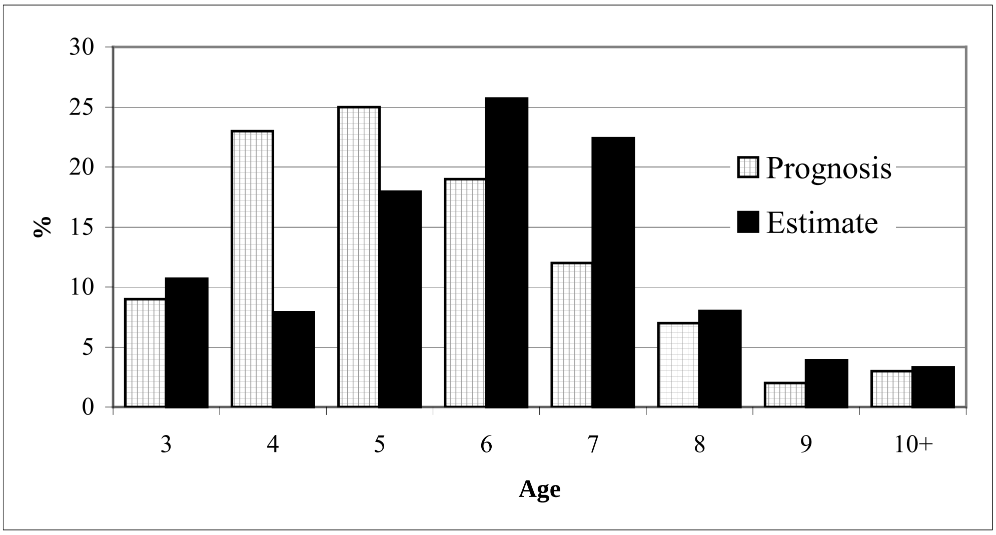
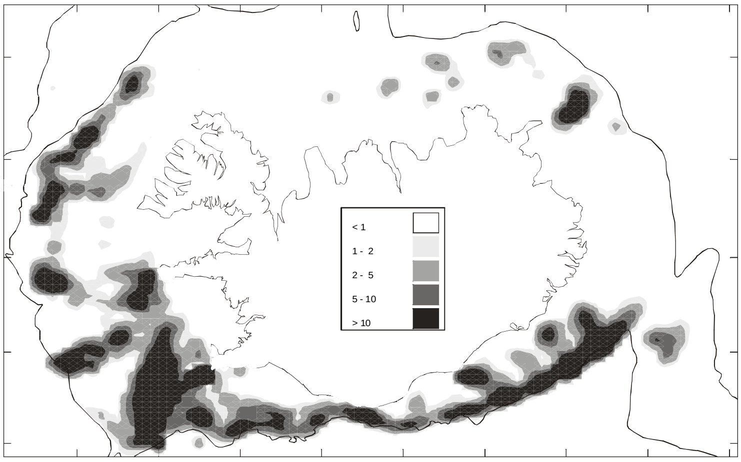


Figure 3.2.2. Saithe in division Va. Prognosis in May 1999 and estimate in April 2000 for percent (by number) age distribution in 1999 landings.

A



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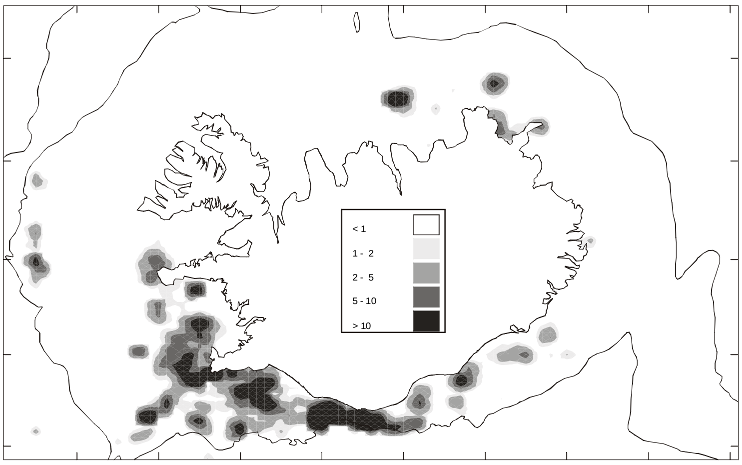


C

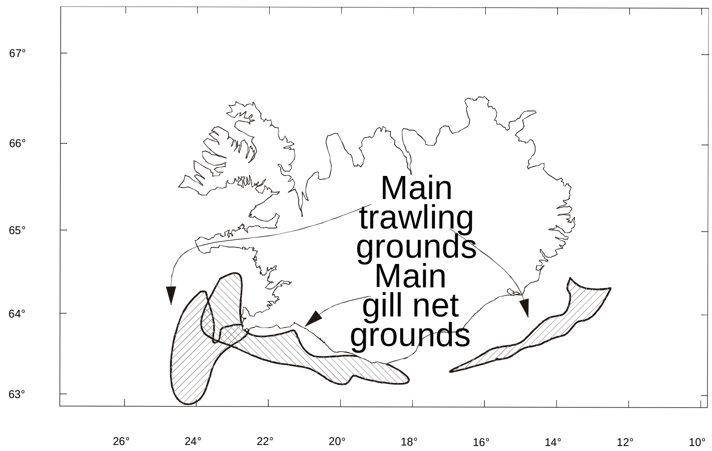
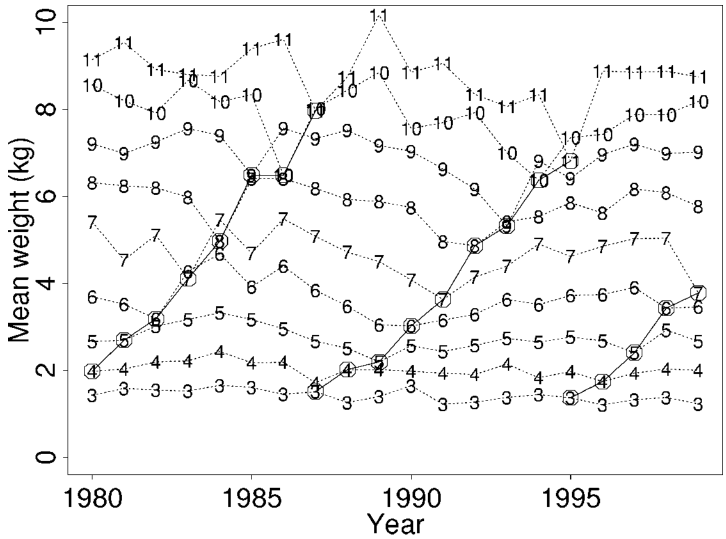


Figure 3.2.3. Saithe in div. Va. A) Bottom trawl and B) gill catches in the period 1991-1998 (tonnes/square nm). C) Selected areas for the computation of CPUE of the tuning fleets.

a)



b)

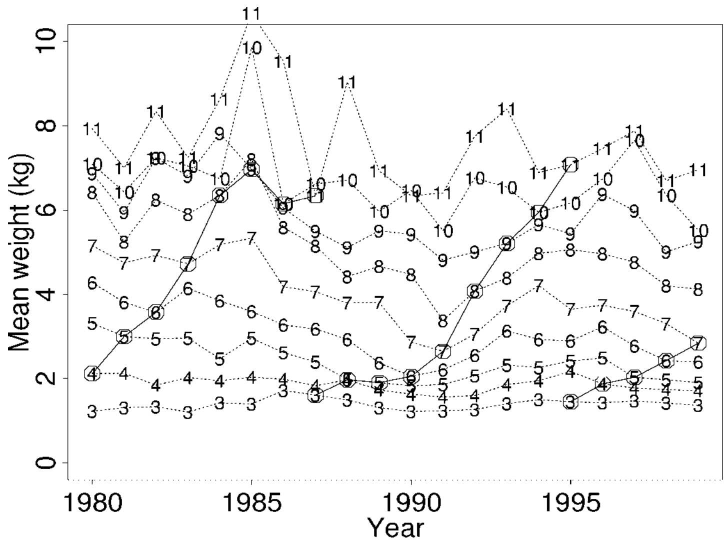


Figure 3.2.4..Saithe in div. Va (a) and Vb (b). Mean weight at age in the catches 1980-1999 for age groups 3-11.

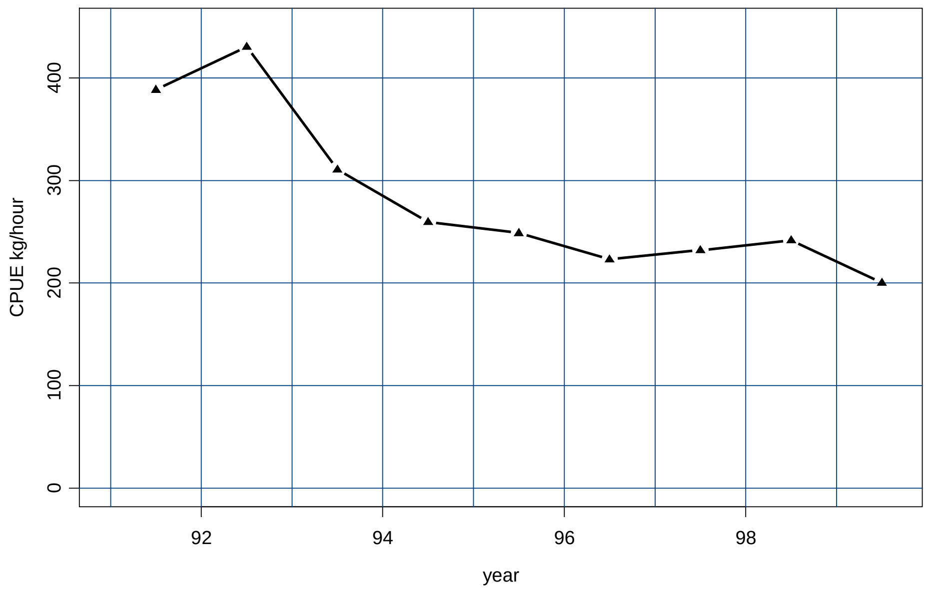
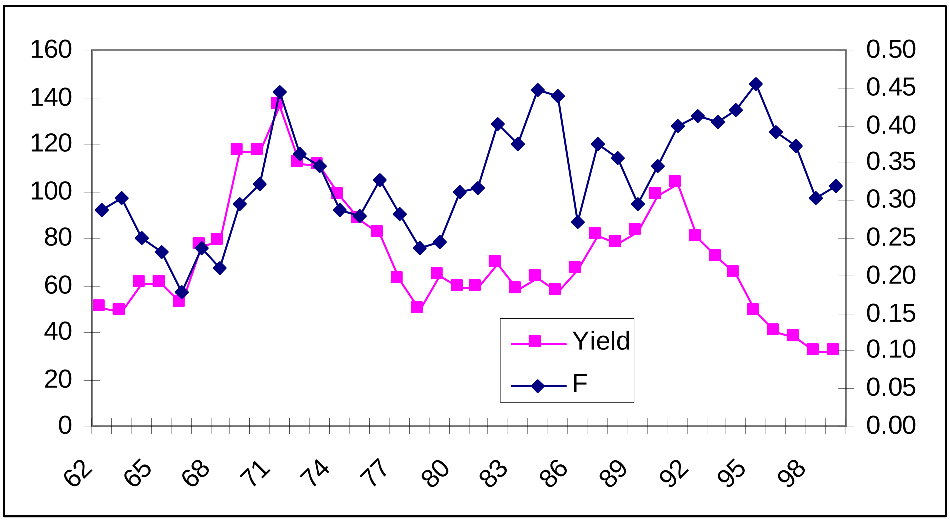


Figure 3.2.5 CPUE from trawlers in January-May based on all tows in the areas shown in Figure 3.2.6.1.1



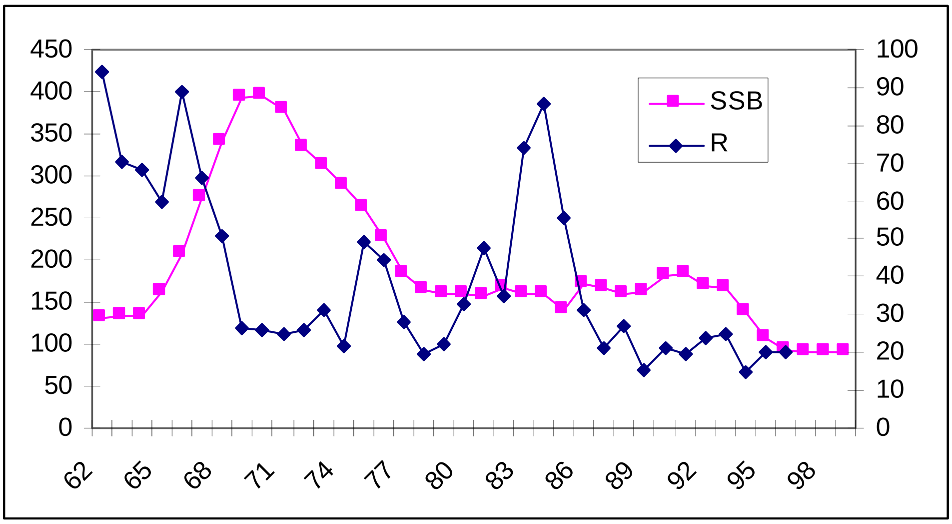


Figure 3.2.6. Saithe in division Va. Fish stock summary

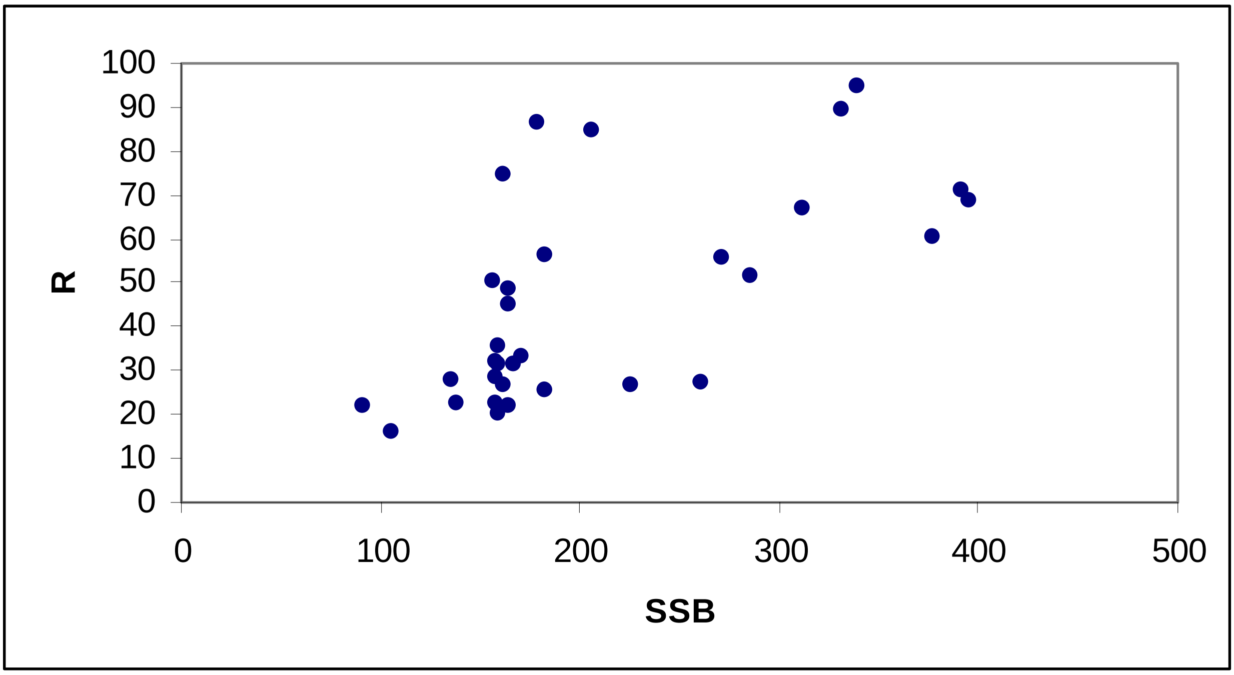
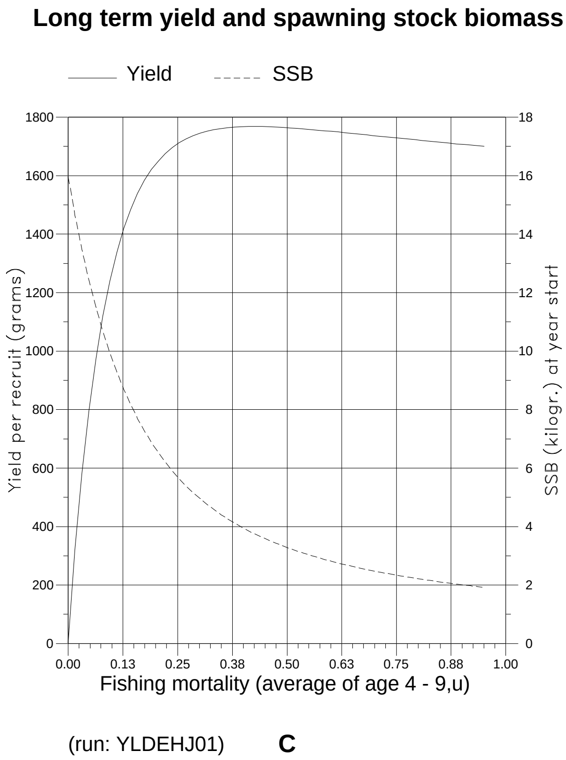
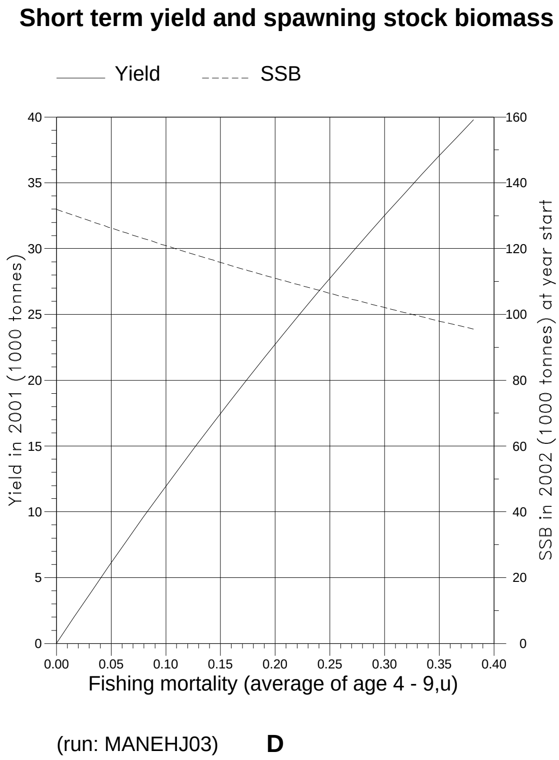


Figure 3.2.7. Saithe in division Va. Stock and recruitment.

Figure 3.2.8 Icelandic Saithe (Division Va)





2.3 Icelandic cod (Division Va)

2.3.1 Trends in landings and fisheries

In the period 1978–1981 landings of cod increased from 320 000 t to 469 000 t due to immigration of the strong 1973 year class from Greenland waters combined with an increase in fishing effort. Catches then declined rapidly to only 280 000 t in 1983. Although cod catches have been regulated by quotas since 1984, catches increased to 392 000 t in 1987 due to the recruitment of the 1983 and 1984 year classes to the fishable stock in those years (Table 3.3.1).

During the period 1988–1996 all year classes entering the fishable stock have been well below average, or even poor, resulting in a continuous decline in the landings. The 1995 catch of only 170 000 t is the lowest catch level since 1942. Since 1993 a marked reduction in effort against cod has taken place (Table 3.3.2 and Figure 3.3.1) due to further reduction in quota and a diversion of the effort towards other stocks and areas. As a result of these cod catch rates for all fleet categories increased considerably up to 1998 but decreased in 1999. (Table 3.3.2 and Figure 3.3.2).

Due to an increase of the fishable stock biomass landings in 1996 to 182 000 t, 203 000 t in 1997 and 243 000 t in 1998. For 1998/1999 fishing year and for the 1999/2000 fishing year the quota was set to 250 000 t. Landings in 1999 amounted 260 000 t.

2.3.2 Catch in numbers at age and sampling intensity

The fleet fishing for cod at Iceland operates throughout the year. The fishing vessels are of different sizes but can however be grouped into three main categories:

1. Trawlers; > 300 GRT.
2. Multi-gear boats; < 300 GRT
3. Small boats; < 20 GRT

The trawlers operate throughout the year outside the 12 mile limits. They follow the spawning and feeding migration patterns of cod and fish on spawning grounds off the south west and south-coasts during the spawning season but move to feeding areas off the northwest coast during the summer time. During the autumn, this fleet is more spread out. The multi-gear boats operate mainly using gillnet during the spawning season in winter and spring along the south-west coasts but in recent years this fleet has also used gillnet in late autumn. Part of this fleet uses longlines during autumn and early winter. During summer some of these boats trawl along the coast out to the 3 mile limit. Others fish with Danish seines close to the shore. Most of the smaller boats operate with handlines mainly in shallow waters during the summer and autumn period. In recent year the mesh sizes used by the gillnet fleet have been increasing.

The data samples comprising the age-length keys for 1999 are given in the following table:

Gear	Period	Area	Landings	Nos. samples aged	Nos fish measured	Nos. fish aged
Longline	Jan-May	S	19648	14	3534	861
Gillnet	Jan-May	S	35138	25	18723	3902
Handlines	Jan-May	S	859	1	504	100
Danish seine	Jan-May	S	7215	2	471	146
Bottom trawl	Jan-May	S	23517	21	20888	987
Longline	Jan-May	N	7541	2	2246	196
Gillnet	Jan-May	N	2108	3	5824	150
Handlines	Jan-May	N	2635	0	0	0
Bottom trawl	Jan-May	N	30300	17	16084	1019
Longline	Jun-Dec	S	11338	8	1277	246
Handlines	Jun-Dec	S	4285	3	1001	248
Gillnet	Jun-Dec	S	9012	7	1128	386
Bottom trawl	Jun-Dec	S	11916	11	3534	530
Longline	Jun-Dec	N	14221	22	8810	1030
Gillnet	Jun-Dec	N	1242	0	0	0
Handlines	Jun-Dec	N	9810	3	672	147
Danish seine	Jun-Dec	N	3135	1	158	50
Bottom trawl	Jun-Dec	N	65416	22	83902	1030
Total			260404	152	168756	9998

The fleets (or "metiers") are defined by the gear, season and area combinations. The gears are long lines, bottom trawl, gillnets, hand lines and Danish seine. In the historical data sets each of these classes may contain related gears (based on sparseness of data and low catches). Notably hand lines are included with long lines and pelagic trawl is included with the bottom trawl. The basic areas splits are the "northern" and "southern" areas. In the historical data set, seasons are split into the "spawning" season (January-May) and "non-spawning" season (June-December). Historically, there have been some changes in fleet definitions and thus there does not currently exist a fully consistent set of catch-at-age data on a per-fleet basis.

Total catch at age (aggregated across fleets) was used as VPA input, and seasonal data (aggregated across gears and regions) were used to estimate the proportion of fishing mortality in January-May.

The total catch-at-age data is given in Table 3.3.3. It should be noted that much higher proportions of the older age groups are taken during the first part of the year and this will considerably affect the estimation of the spawning stock at spawning time. Since the catch-at-age data have historically only been available for January to May, and not by shorter seasons, it is assumed that 60% of those catches were taken during January to March, i.e., before spawning time (Table 3.3.4).

In recent years emphasis has been put on improving the sampling scheme in order to obtain the most realistic information on catch at age The data for these calculations is based on samples taken from all gears on the main fishing grounds throughout the year. In recent years, annually 10 000 –15 000 cod otoliths have been read. The age-length keys have then been used to convert about 100 000–150 000 length measurements also collected throughout the year. However for the years 1998 and 1999 not all otoliths collected from the commercial fisheries have been aged so far. As the otoliths which already been worked up are distributed by gear, fishing areas over the year in accordance with the catches, the catch in numbers figures presented in this report are thought to be fairly reliable.

Because of the quota system the question about discarding has been revived. There is, however, no information available for the time being and discarding is not thought to be a major problem at present.

2.3.3 Mean weight at age

2.3.3.1 Mean weight at age in the landings

Mean weight at age in the landings are computed using samples of otoliths and lengths along with length distributions and length-weight relationships.

The mean weights at age are computed for the same categories as the catch numbers at age and are then weighted together across the fleet categories. The data are given in Table 3.3.5. Mean weights at age are not available on an annual basis for catches taken before 1973, and hence the average across the years 1973 - 1991 is used as the constant (in time) mean weight at age for earlier years.

2.3.3.2 Mean weight at age in the stock

The weights at age in the landings have been used without modification to compute general stock biomasses, with the exception of the spawning stock biomass (see below).

The Icelandic groundfish survey does provide better estimates of mean weights at age in the stock, but it is not at all clear how these should be combined across areas which have different catchabilities, and in any case these weights are only available back to 1985.

2.3.3.3 Mean weight at age in the spawning stock

For years up to 1999, weight at age data from the period January-May have been used for the estimation of the mean weights at age in the spawning stock. It is assumed that the catches in the different gears and areas appropriately reflect the stock composition with regard to mean weight at age. These weight-at-age data are presented in Table 3.3.6.

2.3.4 Maturity at age

Maturity at age is based on samples from the commercial fleets in the months January-May (ICES C.M. 1992/Assess:14) (Table 3.3.7.). It has been pointed out that using data collected throughout the year may bias the proportion mature in various ways (Stefánsson, 1992). The approach taken is, therefore, to compute the proportion mature at the time of spawning, by considering only the first part of the year (January-May), but aggregating across gears and regions.

The maturity-at-age data are not available on an annual basis for the catches taken prior to 1973 and, hence, the average for the years 1973–1991 is used as a constant (in time) maturity at age for the years prior to 1973.

2.3.5 Stock Assessment

2.3.5.1 Tuning data

Commercial trawler CPUE data were analysed as described in Stefansson (1988) to yield GLM indices of abundance (numbers) at age. The analysis takes into account catchability changes in the fleet due to vessel renewal and vessels shifting between regions, but not changes in the spatial distribution of the resource or changes within vessels in the fleet. For this reason the analysis of the logbook data was restricted to the years 1994–1999.

These indices are based on logbooks from demersal trawl fisheries for two parts of the year (January-May and June-December) and two areas i.e., south-western areas, and northern areas (Table 3.3.8).

The same method was applied for the gillnet fleet. Logbooks for this fleet have been analysed for the years 1994–1999 but are available since 1988. However information based on these logbooks for the years 1988–1990 is scarce as the logbooks were not mandatory until 1991. The gillnet fleet operates mainly during the spawning season and at the spawning grounds off the south and west coasts of the island. This fishery has often been referred to as "the spawning fishery" in earlier reports of this Working Group. The GLM indices presented here (Table 3.3.9).are based on the gillnet fishery in the south and west areas during January-May.

The Icelandic groundfish survey data (Palsson *et al.*, 1989) are used as part of the assessment. A description of the Icelandic groundfish survey design is given the 1998 WG report (ICES C.M. 1998/ACFM:19). The basic data are age-disaggregated (Palsson and Stefansson, 1991) and abundance indices computed by using the a modified Gamma-Bernoulli (G-B) method to accommodate spatial information in an appropriate manner. The method is described in Working Paper by H. Björnsson, Annex I in ICES C.M. 1994/Assess:19. Indices are calculated for three areas i.e southwestern, southeastern and the northern areas separately, age groups 3 to 14 and for the years 1985–1999.

To use the latest information available in the XSA, the 2000 survey abundance indices were moved back in time of approximately three months i.e., to December 1999 for the age groups 4–9. The same applies to abundance indices for the other survey years. For the age group 3 and age group 2 no shifting in time has taken place. The resulting indices are given in Table 3.3.10 by fleet, area and age group.

2.3.5.2 Assessment methods

Migrations from Greenland into the Icelandic cod stock can have major effects and hence these need to be taken into account in the assessments. Time series analysis (TSA) of Gudmundsson (1984) and an ADAPT-type of method (Stefansson, 1992) which were applied to this stock earlier (ICES C.M. 1992/Assess:14) can estimate migration for a given year and age. As the ADAPT-method uses an average selection pattern in determining the terminal fishing mortality recent changes in fishing pattern can not be accounted for. In recent years the Group has used the XSA-method even though the XSA has not been developed to account for migration – but there is a way to handle this:

XSA uses a cohort-analysis to project the stock (or back calculating):

$$N_{a,y} = e^{-M} N_{a-1,y-1} - e^{-M/2} C_{a-1,y-1} \text{ or}$$
$$N_{a-1,y-1} = e^{M} N_{a,y} + e^{M/2} C_{a-1,y-1}$$

were N is stock size and C is catch in numbers and M natural mortality. If fish of age a and in the year y is migrating, in amount of G, to the stock in the beginning of the year, then the cohort equation will be:

$$N_{a,y} = e^{-M} N_{a-1,y-1} - e^{-M/2} C_{a-1,y-1} + G_{a,y}$$

and in back calculation the equations will be:

$$N_{a-1,y-1} = e^{M}\left(N_{a,y} - G_{a,y}\right) + e^{M/2}C_{a-1,y-1}$$
$$= e^{M}N_{a,y} + e^{M/2}\left(C_{a-1,y-1} - e^{M/2}G_{a,y}\right)$$

That is, if the size of the migration, *G*, is approximately known it can be implemented into the cohort equations by changing the catch-in-numbers the year before, for the cohort in question. The results are stock in numbers taking into account the migration but the fishing mortality given for age *a–1* and year *y–1* will be incorrect and the correct value can be calculated by:

$$F_{a,-1,y-1} = \ln\left(\frac{N_{a-1,y-1}}{N_{a,y} - G_{a,y}}\right) - M$$

For the Icelandic cod the estimated immigration of 6 years old cod in the year 1990 is about 30 millions at beginning of the year. The total catch of 5 years old cod 1989 is estimated about 50 millions. The "corrected" catch of 5 years old cod of Icelandic origin in 1989 will then be:

$$50 - e^{0.2/2}30 = 16.8 \text{ millions}$$

which is the number used in the assessment.

2.3.5.3 Estimates of fishing mortality

Tuning fleets used and the relevant tuning indices are given in Tables 3.3.8.-3.3.10. As there has been a major decline in fishing effort for this stock during the most recent period the XSA was shrunk to the mean of the three latest years instead of using a default setting of five years. The retrospective analysis for this XSA with shrinkage of s.e. = 0.5 is given in Figure 3.3.3. The total output of the XSA is given in Table 3.3.11.

The resulting fishing mortalities from the final XSA are given in Table 3.3.12 and in Figure 3.3.4.A. The fishing mortality reached a peak in 1988 decreased in 1989 but then rose to another peak in 1993. Due to further restriction of the cod quota effort has dropped markedly in 1994 and again in 1995. Fishing mortality has decreased correspondingly but has shown again an increasing trend. (see Table 3.3.16). Present fishing mortality is sligthy above the F_{med} level.

2.3.5.4 Stock and recruitment estimates

The resulting stock size in numbers and stock in weight from the final VPA are given in Tables 3.3.13–14. In the stock in numbers table, the recruitment in the most recent years (year classes 1996–1999 as 3-year-olds in 1999–2002) was estimated using RCT3 as described in Section 3.3.7.1.

The current spawning stock at spawning time and recruitment levels must be considered in relation to historical sizes. The migration estimates of 39 and 7 million immigrants of the 1973 year class in 1980 and 1981, respectively are taken from the last 1993 ADAPT-assessment (ICES C.M. 1993/Assess:18). With given migration estimates, the recruitment from the SSB can be recomputed by adding back-calculated migration. The approach taken here is to do these back-calculations with natural mortality only, since it would be incorrect to use the sometimes high fishing mortalities at Iceland. This back calculation revises the 1973 and 1984 year class estimates to 433 and 334 millions, respectively. The resulting SSB and recruitment estimates are given in Table 3.3.15 along with average fishing mortalities. A better estimate might be obtained by back calculating using the fishing mortality at Greenland also, but this is unlikely to have major effects on the issue at hand which is the stock-recruitment diagram.

2.3.6 Biological and technical interactions

Several important biological interactions in the ecosystem around Iceland are connected to the cod stock. The single most important interaction is the cod-capelin connection (Pálsson, 1981) and this has been studied in some detail (Magnússon and Pálsson, 1989 and 1991a and Steinarsson and Stefánsson, 1991). Another important interaction is between cod and shrimp. This has been studied by Magnússon and Pálsson (1991b) and Stefánsson *et al.* (1994). The cod-capelin interaction is used in the short-term prediction in Section 3.3.7.1 based on the results in Steinarsson and Stefánsson (1996).

Various factors affect the natural mortality of cod and several of these factors will change in magnitude in the future. The cod is a cannibal and the mortality through cannibalism has been estimated in Björnsson (WD 26,1998).Table 3.3.16 shows that the cannibalism occur mainly on prerecruits and immature fish. Further, the minke whale, the harbour seal and the grey seal are apex predators, all of which consume cod to varying degrees. Most of these M values will affect cod at an early age, before recruitment to the fishery.

It has been illustrated that not only may cetaceans have a considerable impact on future yields from cod in Division Va (Stefánsson *et al.*, 1995), but seals may have an even greater impact (Stefánsson *et al.*, 1997). These results imply that predictions which do not take into account the possible effects of marine mammals may be too optimistic in terms of long-term yields. It is therefore desirable to include marine mammals as a part of future natural mortality for the cod stock.

A number of fleets operate in Division Va. The primary gears are described in Section 3.3.2. Earlier work by this group included the separation of catches into finer seasonal and areal splits, but this has not been taken further at this meeting.

A numerical description of interactions between fisheries and species requires data on landings as well as catches in numbers at age of each species by gear type, region and season.

2.3.7 Prediction of catch and biomass

2.3.7.1 Input data to the short-term prediction

For short-term predictions, it is essential to take into account potential changes in mean weights at age due to environmental conditions.

It has been shown that cod growth is to some extent correlated to size the of the capelin stock. Table 3.3.17 gives the size of the capelin stock biomass since 1979. The present data set has been updated.

Regressions are used to predict the mean weights at age for age groups 4–8 in the catches and ages 5–8 in the spawning stock for the years 2000-2002. For the year 2001 onwards, the average capelin biomass is used. For ages 3 and 9−14 respectively in both data sets and age 4 in the SSB, the average over the years 1996−1999 is used (Table 3.3.20).

In the most recent period maturity at age has been at high levels compared to the years prior to 1993. For the short-term predictions the average for the years 1997−1999 has been used for the years 2000–2002.

The exploitation pattern used for the short-term predictions was taken as the average of the years 1997−1999 from the VPA rescaled to the 1999 fishing level.

The modified Delta-Gamma (D-E) method (ICES C.M. 1994/Assess:19) used for the analysis of the Icelandic Groundfish Survey and as tuning data for this stock was also used for recruitment prediction. The resulting indices used for recruitment prediction are given in Table 3.3.18. As an input to the RCT3 program age groups 1–4 from the survey were chosen.

The size of the year classes 1996−1999 has been estimated using RCT3, with the output as given in Table 3.3.19. Taking natural and fishing mortalities into account the revised recruitment estimates are then used in the predictions.

2.3.7.2 Short-term prediction results

Results from projections up to the year 2002 with different fishing mortalities are given in Table 3.3.21.

Based on the harvest control rule the expected catch in 2000 will be 235 000 t. Continuing fishing in 2001 at the 1999 level of fishing mortality (F = 0.57) a slight increase in the SSB in the short term.

The average size of the year classes at present which mainly contribute to the fishable stock (1990−1997) is 141 million individuals. The yield-per-recruit computations indicate that the maximum obtainable yield per recruit is 1.77 kg. These two numbers indicate that the average yield from these year classes cannot be expected to exceed 250 000 t. From the RCT3 output the 1998 year class is at about average size and although the size of the 1999 year class is not well estimated at present the 1999 0-group index for cod is the highest observed (Table 3.3.19).

2.3.7.3 Input data to the long-term prediction

For long-term predictions, fluctuating environmental conditions can be ignored, but it is essential to take into account potential changes due to density-dependent growth. These have been investigated for this stock (Steinarsson and Stefánsson, 1991, and ICES C.M. 1991/Assess:7) where no significant density-dependent relationships were found concerning growth. However, the results in Schopka (1994) contain indications of some density dependence of growth and this will affect the long-term results at low fishing mortalities. This is not taken into account in typical yield-per-recruit calculations.

Naturally, any stock-recruitment relationship will affect yield-potential calculations and this is not taken into account in the yield-per-recruit calculations.

Average exploitation pattern, mean weight at age and maturity at age over the years 1979–1998 has been used as input (Table 3.3.21).

2.3.7.4 Long-term prediction results and biological reference points

The biological reference values for F_{max} and $F_{0.1}$ are 0.36 and 0.20 respectively. Yield per recruit at the F_{max}- level is 1.77 kg. (Figure 3.3.5 Table 3.3.22).

A plot of the spawning stock biomass and recruitment is given in Figure 3.3.5. When using the period 1955–1996, the reference points F_{med} and F_{high} are about 0.52 and 1.05, respectively.

The inclusion of the stock recruitment relationship has a major effect on long-term predictions. From Figure 3.3.5 it is seen that below-median recruitment occurs more frequently when the SSB is below-median than when the SSB is above the median. The increased probability of poor recruitment at low SSB levels is of major concern. Simulations have shown that the harvest control rule currently applied to this stock appears to be in accordance with the precautionary approach as there is a vey low probability of that the stock will be driven to very low levels.

2.3.8 Management considerations

In recent period, there has been a substantial reduction in fishing effort directed on cod (Table 3.3.2) and hence in fishing mortality (Figure 3.3.4). Fishing mortality was at the level of F = 0.80–0.90 in 1992–1993 but dropped considerably to F = 0.47 in 1995. In 1997 it increased to F = 0.58 and F = 0.66 in 1998 but decreased to the 1997-level in 1999.

Medium-term predictions have been carried out during previous meetings (Anon. 1995/Assess:19 Anon. 1997/Assess:13). The model used incorporated the cod, capelin and shrimp stocks to account for interactions between these stocks. Based on similar calculations, Iceland introduced a catch rule in 1995 which has been enforced since then. According to this harvest control rule catches are limited to 25% of the fishable (4+) stock biomass calculated from the average stock at 1st of January of the previous year and the coming fishing year. In the long term this corresponds to a fishing mortality of about 0.4.

Since there is an adopted strategy for harvesting the cod stock off Iceland, and this strategy appears sustainable, medium-term predictions where not carried out at this meeting.

Applying this management strategy for the 2000/2001 fishing year the catch will be 203 000 t which corresponds to F = 0.47.

2.3.9 Comments on the assessment

Current assessment has used the same settings as for last year.

Stock assessements in recent years showed that fishing mortality decreased considerably since 1993 which is in accordance with the measures taken by Iceland to reduce fishing effort against cod. However the current assessment show higher fishing mortality than previous assessments do. In last years assessment the estimated fishing mortality in 1998 was F = 0.49, but in the current assessment the 1998 fishing mortality is estimated to have been F = 0.66. This is about a 30% increase in F between this two assessments.

Differences between the current and recent assessments are unclear at present, as TAC´s based on the harvest control rule have not been overshot. There are therefore some reservations about these most recent assessments:

Other factors affecting the stock assessment is the availability and/or catchability of cod. In 1997 and 1998 CPUE of trawlers was among the highest on record in the northern area as cod migrated there. This may have led to increased catchability both in the fishery as well as in the Icelandic groundfish survey. In addition the 1999 capelin spawning migrations which are the major prey of cod in spring, were restricted to the more south-easterly spawning grounds and never reached the south-western area. Less availability of capelin may have therefore contributed to the decrease of CPUE for cod in 1999 in that area. In winter 2000 the distribution of the capelin was back to normal but CPUE of the fleet has however not increased.

In order to improve the cod assessment further Iceland launched an autumn groundfish survey in 1995. The disaggregated CPUE-indices at age from this survey were not available and therefore this series could not be used in present assessment.

It is clear that the stock was heavily overexploited for a long time but is now recovering which is expected to continue under the current management scheme.

Table 3.3.1 Nominal catch (tonnes) of Cod in Division Va, by countries, 1986- 1999 as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Belgium	226	597	365	309	260	548	222
Faroe Islands	2,554	1,848	1,966	2,012	1,782	1,323	883
Germany	-	-	-	-	-	-	-
Iceland	365,852	389,808	375,741	353,985	333,348	306,697	266,662
Norway	1	4	4	3	-	-	-
Total	368,633	392,257	378,076	356,309	335,390	308,568	267,767
WG estimate	-	-	-	-	-	-	-

Country	1993	1994	1995	1996	1997	1998	1999 [1]
Belgium	145	136	-	-	-	-	-
Faroe Islands	664	754	739	599	408	1,078	-
Germany	-	-	-	-	-	9	21
Iceland	251,170	177,919	168,685	181,052	202,745	241,545	258,226
Norway	-	-	-	7	-	-	85
Total	251,979	178,809	169,424	181,658	203,153	242,632	
WG estimate	-	-	-	-	-	-	260,029 [2]

1) Provisional.
2) Additional landings by Iceland of 539 t, and Faroes of 1158 t are included.

Table 3.3.2. Cod at Iceland. Division Va. Landings (tonnes), effort, cpue and percentage changes in effort and cpue in the period 1991-1999 (with 1991 as 100%). Data are based on logbooks which have been mandatory in the fisheries since 1991.

Bottom trawl

Year	Catch	effort	effort % changes	cpue	cpue % changes
1991	175142	234946	100	745	100
1992	131504	228196	97	576	77
1993	114587	182882	78	627	84
1994	66186	83975	36	788	106
1995	60580	71202	30	851	114
1996	66867	67057	29	997	134
1997	81202	74159	32	1095	147
1998	109947	85314	36	1289	167
1999	123384	116265	49	1061	143

Gillnet

Year	Catch	effort	effort % changes	cpue	cpue % changes
1991	58948	1060	100	56	100
1992	59712	984	93	61	109
1993	56701	1008	95	56	101
1994	39192	718	68	55	98
1995	32309	437	41	74	133
1996	41764	492	46	85	153
1997	46742	483	46	97	174
1998	51554	721	68	71	127
1999	47500	771	73	62	107

Long line

Year	Catch	effort	effort % changes	cpue	cpue % changes
1991	44711	2006	100	22	100
1992	42301	2016	100	21	94
1993	47263	2224	111	21	95
1994	36426	1652	82	22	99
1995	44588	1724	86	26	116
1996	39770	1478	74	27	121
1997	31276	824	41	38	170
1998	37243	972	48	38	173
1999	52658	1539	77	34	155

Table 3.3.3. Cod at Iceland. Division Va. Catch in numbers (millions).

Age	1980	1981	1982	1983	1984	1985	1986
3	4.348	2.118	3.285	3.554	6.750	6.457	20.642
4	28.530	13.297	20.812	10.910	31.553	24.552	20.330
5	32.500	39.195	24.462	24.305	19.420	35.392	26.644
6	15.119	23.247	28.351	18.944	15.326	18.267	30.839
7	27.090	12.710	14.012	17.382	8.082	8.711	11.413
8	7.847	26.455	7.666	8.381	7.336	4.201	4.441
9	2.228	4.804	11.517	2.054	2.680	2.264	1.771
10	0.646	1.677	1.912	2.733	0.512	1.063	0.805
11	0.246	0.582	0.327	0.514	0.538	0.217	0.392
12	0.099	0.228	0.094	0.215	0.195	0.233	0.103
13	0.025	0.053	0.043	0.064	0.090	0.102	0.076
14	0.004	0.068	0.011	0.037	0.036	0.038	0.040

Age	1987	1988	1989	1990	1991	1992	1993
3	11.002	6.713	2.605	5.785	8.554	12.217	20.500
4	62.130	39.323	27.983	12.313	25.131	21.708	33.078
5	27.192	55.895	50.059	27.179	15.491	26.524	15.195
6	15.127	18.663	31.455	44.534	21.514	11.413	13.281
7	15.695	6.399	6.010	17.037	25.038	10.073	3.583
8	4.159	5.877	1.915	2.573	6.364	8.304	2.785
9	1.463	1.345	0.881	0.609	0.903	2.006	2.707
10	0.592	0.455	0.225	0.322	0.243	0.257	1.181
11	0.253	0.305	0.107	0.118	0.125	0.046	0.180
12	0.142	0.157	0.086	0.050	0.063	0.032	0.034
13	0.046	0.114	0.038	0.015	0.011	0.012	0.011
14	0.058	0.025	0.005	0.020	0.012	0.008	0.013

Age	1994	1995	1996	1997	1998	1999
3	6.160	10.770	5.356	1.722	3.458	2.684
4	24.142	9.103	14.886	16.442	7.707	20.824
5	19.666	16.829	7.372	17.298	25.394	14.764
6	6.968	13.066	12.307	6.711	20.167	25.193
7	4.393	4.115	9.430	7.379	5.893	12.004
8	1.257	1.596	2.157	5.958	3.856	2.472
9	0.599	0.313	0.837	1.147	2.951	1.370
10	0.508	0.184	0.208	0.493	0.500	0.849
11	0.283	0.156	0.076	0.126	0.196	0.138
12	0.049	0.141	0.065	0.028	0.055	0.049
13	0.018	0.029	0.055	0.037	0.033	0.010
14	0.006	0.008	0.005	0.021	0.013	0.005

Table 3.3.4. Cod at Iceland. Division Va. Proportion of fishing and natural mortality before spawning.

Age	PropF	PropM
3	0.085	0.250
4	0.180	0.250
5	0.248	0.250
6	0.296	0.250
7	0.382	0.250
8	0.437	0.250
9	0.477	0.250
10	0.477	0.250
11	0.477	0.250
12	0.477	0.250
13	0.477	0.250
14	0.477	0.250

Table 3.3.5. Cod at Iceland. Division Va. Mean weight at age in the landings (g).

Age	1980	1981	1982	1983	1984	1985	1986
3	1392	1180	1006	1095	1288	1407	1459
4	1862	1651	1550	1599	1725	1971	1961
5	2733	2260	2246	2275	2596	2576	2844
6	3768	3293	3104	3021	3581	3650	3593
7	5259	4483	4258	4096	4371	4976	4635
8	6981	5821	5386	5481	5798	6372	6155
9	8037	7739	6682	7049	7456	8207	7503
10	10731	9422	9141	8128	9851	10320	9084
11	12301	11374	11963	11009	11052	12197	10356
12	17281	12784	14226	13972	14338	14683	15283
13	14893	12514	17287	15882	15273	16175	14540
14	19069	19069	16590	18498	16660	19050	15017

Age	1987	1988	1989	1990	1991	1992	1993
3	1316	1438	1186	1290	1309	1289	1392
4	1956	1805	1813	1704	1899	1768	1887
5	2686	2576	2590	2383	2475	2469	2772
6	3894	3519	3915	3034	3159	3292	3762
7	4716	4930	5210	4624	3792	4394	4930
8	6257	6001	6892	6521	5680	5582	6054
9	7368	7144	8035	8888	7242	6830	7450
10	9243	8822	9831	10592	9804	8127	8641
11	10697	9977	11986	10993	9754	12679	10901
12	10622	11732	10003	14570	14344	13410	12517
13	15894	14156	12611	15732	14172	15715	14742
14	12592	13042	16045	17290	20200	11267	16874

Age	1994	1995	1996	1997	1998	1999
3	1443	1348	1457	1484	1230	1349
4	2063	1959	1930	1877	1788	1757
5	2562	2920	3132	2878	2477	2497
6	3659	3625	4141	4028	3588	3482
7	5117	5176	4922	5402	5013	4804
8	6262	6416	6009	6386	7293	6451
9	7719	7916	7406	7344	7843	8319
10	8896	10273	9772	8537	9283	9225
11	10847	11022	10539	10797	10976	10670
12	12874	11407	13503	11533	15352	11861
13	14742	13098	13689	10428	17718	15006
14	17470	15182	16194	12788	16068	15045

Table 3.3.6. Cod at Iceland. Division Va. Mean weight at age in the spawning stock (g)

Age	1980	1981	1982	1983	1984	1985	1986
3	1333	967	996	891	1002	1131	1182
4	1680	1513	1626	1472	1479	1597	1762
5	2708	2101	2095	2139	2257	2285	2681
6	3875	3225	3006	2918	3476	3524	3562
7	5446	4520	4339	4130	4480	5010	4824
8	7106	5851	5571	5553	5887	6195	6457
9	8120	7661	6801	7007	7660	7800	7843
10	10737	9084	9259	7770	9920	9225	9419
11	12628	10833	11550	10817	11035	11336	10674
12	17528	12401	13445	13176	14531	13277	13660
13	15939	11724	17138	14175	15378	15325	13812
14	25212	14326	16554	18543	16394	18932	18479

Age	1987	1988	1989	1990	1991	1992	1993
3	1289	1218	1012	813	1122	876	1037
4	1811	1604	1542	1330	1776	1389	1570
5	2735	2499	2423	2132	2233	2174	2518
6	4202	3566	3743	3187	3044	3185	3611
7	5110	5161	5298	4691	3891	4481	4872
8	6497	6238	6910	6627	5897	5587	6150
9	7802	7302	7725	8915	7657	6775	7538
10	10220	8647	9397	10362	10573	8225	8840
11	11197	10184	11953	12093	11230	11702	11088
12	10620	11504	9529	15453	14340	13474	12002
13	15893	14159	12195	15337	14172	15436	14402
14	16514	10952	14270	17257	20200	11267	18383

Age	1994	1995	1996	1997	1998	1999
3	1193	1066	1264	1221	1260	1169
4	1748	1826	1627	1613	2018	1463
5	2382	2735	2600	2595	2335	2231
6	3684	3497	3829	3807	3529	3184
7	5175	4741	4605	5434	5321	4855
8	6210	6126	5792	6440	7731	6847
9	7676	7582	7550	7629	8173	8576
10	8814	9887	9433	8606	9397	9552
11	10842	10829	11293	10486	10995	10961
12	12595	11307	12984	11774	15274	11943
13	14402	13098	13821	10943	17387	15006
14	17470	15182	16194	15225	15069	15045

Table 3.3.7. Cod at Iceland. Division Va. Maturity at age in the SSB.

Age	1980	1981	1982	1983	1984	1985	1986
3	0.056	0.000	0.023	0.000	0.000	0.027	0.005
4	0.023	0.029	0.051	0.087	0.043	0.058	0.054
5	0.165	0.085	0.129	0.167	0.189	0.202	0.244
6	0.478	0.289	0.226	0.338	0.416	0.548	0.543
7	0.807	0.659	0.544	0.515	0.656	0.774	0.762
8	0.915	0.890	0.849	0.717	0.782	0.903	0.891
9	0.979	0.952	0.956	0.857	0.858	0.938	0.981
10	0.977	0.962	0.967	0.979	0.949	1.000	0.962
11	1.000	0.988	1.000	0.985	0.969	1.000	0.988
12	0.964	1.000	1.000	1.000	0.948	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1987	1988	1989	1990	1991	1992	1993
3	0.020	0.039	0.000	0.000	0.000	0.072	0.078
4	0.046	0.020	0.048	0.075	0.063	0.225	0.246
5	0.238	0.206	0.226	0.303	0.214	0.562	0.470
6	0.585	0.477	0.550	0.633	0.543	0.706	0.714
7	0.808	0.690	0.820	0.819	0.781	0.906	0.939
8	0.942	0.831	0.858	0.912	0.887	0.961	0.984
9	0.952	0.929	0.887	0.953	0.945	0.977	0.973
10	1.000	0.946	0.991	0.986	0.842	1.000	0.968
11	0.979	0.974	1.000	1.000	1.000	1.000	1.000
12	1.000	0.821	0.903	1.000	1.000	1.000	1.000
13	1.000	1.000	0.859	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1994	1995	1996	1997	1998	1999
3	0.096	0.043	0.078	0.073	0.026	0.083
4	0.281	0.394	0.097	0.305	0.258	0.368
5	0.570	0.729	0.512	0.502	0.480	0.660
6	0.796	0.849	0.742	0.740	0.646	0.778
7	0.895	0.853	0.862	0.880	0.830	0.867
8	0.919	0.954	0.911	0.922	0.942	0.977
9	1.000	1.000	0.841	0.971	0.985	0.987
10	0.852	1.000	1.000	0.932	0.925	0.995
11	0.985	1.000	1.000	1.000	0.998	1.000
12	1.000	1.000	0.986	0.913	1.000	1.000
13	1.000	1.000	0.971	1.000	1.000	0.839
14	1.000	1.000	1.000	1.000	1.000	1.000

Table 3.3.8. Cod at Iceland. Division Va. Bottom trawl CPUE (GLM) indices 1994-1999 used in XSA tuning.

TRAWL-JUN-DEC-N

Year/age	4	5	6	7
1994	1850	1137	221	106
1995	604	1413	1067	183
1996	1136	706	841	463
1997	1774	1114	376	285
1998	506	1667	1302	319
1999	1353	803	1088	444

TRAWL-JAN-MAY-N

Year/age	4	5	6	7	8	9
1994	1222	1439	499	328	52	21
1995	283	1695	1380	326	65	11
1996	1358	731	1339	627	114	28
1997	1183	1504	557	546	466	29
1998	401	2583	1882	595	234	145
1999	837	994	2633	717	79	47

TRAWL-JAN-MAY-S

Year/age	5	6	7	8
1994	483	240	143	53
1995	410	449	279	143
1996	202	575	485	133
1997	513	364	411	239
1998	728	933	501	279
1999	456	1461	626	110

TRAWL-JUN-DEC-S

Year/age	5	6	7	8
1994	275	106	115	34
1995	581	358	104	63
1996	359	450	228	52
1997	735	361	239	141
1998	1004	645	204	77
1999	354	827	24	24

Table 3.3.9. Cod at Iceland. Division Va. Gillnet CPUE (GLM) indices 1994-1999 used in XSA tuning.

GILLNET-JAN-MAY-S

Year/age	8	9
1994	188	89
1995	301	90
1996	319	159
1997	543	109
1998	734	308
1999	226	265

Table 3.3.10. Cod at Iceland. Division Va. Icelandic Groundfish Survey indices used in XSA tuning.

IceGFS. N.

Year/age	3	4	5	6	7
1984	55261	48059	13027	6211	1990
1985	22540	18404	17203	4864	1388
1986	77227	15257	7551	7364	1453
1987	92490	49378	5573	2906	2306
1988	60113	46566	18693	1665	545
1989	8272	15722	18464	6501	456
1990	22262	8102	8772	9355	1242
1991	13601	9542	2499	2303	1347
1992	31684	9441	5124	1100	672
1993	18211	13369	2675	1550	263
1994	4301	11353	7088	1330	417
1995	19228	6083	6923	6599	1160
1996	48173	23365	5898	5422	3004
1997	13959	48786	20710	5656	2806
1998	35495	7683	12466	5233	811
1999	4451	20382	4670	3675	1447

IceGFS. a3 on a3. N

Year/age	3
1985	31297
1986	84656
1987	99294
1988	68604
1989	17511
1990	19408
1991	15633
1992	30540
1993	26030
1994	5556
1995	17477
1996	37466
1997	11969
1998	28949
1999	5985

IceGFS. a2 on a3. N.

Year/age	3
1986	39301
1987	52943
1988	25874
1989	5820
1990	14921
1991	11786
1992	14473
1993	16407
1994	2237
1995	10539
1996	28480
1997	3869
1998	18566
1999	3570

Table 3.3.10. (Cont´d.) Cod at Iceland. Division Va. Icelandic Groundfish Survey indices used in XSA tuning.

IceGFS. SE

Year/age	4	5	6	7
1984	561	470	524	373
1985	686	1171	608	294
1986	404	391	842	286
1987	3153	519	333	385
1988	4474	3858	619	274
1989	419	1673	1762	265
1990	114	324	1104	396
1991	511	309	763	1087
1992	391	361	146	163
1993	1189	356	321	79
1994	1943	2084	619	300
1995	460	1056	1654	502
1996	860	358	582	561
1997	3397	1605	624	615
1998	637	1591	915	214
1999	2437	632	889	525

IceGFS. SW.

Year/age	3	4	5	6	7	8
1984	1723	4444	2588	1911	813	417
1985	1413	2203	2968	1310	535	232
1986	4003	1266	1190	1656	410	104
1987	3929	5935	1144	860	873	102
1988	5857	9371	5845	812	296	224
1989	1702	6149	8867	4150	409	113
1990	3044	2560	4625	7491	1556	193
1991	1088	2019	1016	1702	2172	387
1992	4112	1935	1664	420	359	255
1993	4366	3533	851	573	114	66
1994	1298	4397	3538	866	355	22
1995	3829	1958	3133	3764	804	181
1996	3785	3024	1181	1655	1554	126
1997	911	5132	3131	1182	895	537
1998	3820	1874	5897	3780	851	317
1999	619	4485	1550	2267	1375	121

Table 3.3.11. Cod at Iceland. Div. Va. XSA diagnostic output

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

"ICELANDIC COD (Div. Va); data from 1971-99(4/2000)"

CPUE data from file codvarnt.dat

Catch data for 16 years. 1984 to 1999. Ages 3 to 14.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
IceGFS. N.	1984	1999	3	7	0.99	1
IceGFS. a3 on a3. N	1985	1999	3	3	0.17	0.25
IceGFS. a2 on a3. N.	1986	1999	3	3	0.17	0.25
IceGFS. SE	1984	1999	4	7	0.99	1
IceGFS. SW.	1984	1999	3	8	0.99	1
TRAWL-JUN-DEC-N	1994	1999	4	7	0.42	1
TRAWL-JAN-MAY-N	1994	1999	4	9	0	0.42
TRAWL-JAN-MAY-S	1994	1999	5	8	0	0.42
GILLNET-JAN-MAY-S	1994	1999	8	9	0	0.42
TRAWL-JUN-DEC-S	1994	1999	5	8	0.42	1

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 5

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 5

Catchability independent of age for ages >= 11

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 3 years or the 4 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 210 iterations

Total absolute residual between iterations
209 and 210 = .00081

Final year F values

Age	3	4	5	6	7	8	9	10	11	12
Iteration **	0.0412	0.1845	0.3823	0.4772	0.6395	0.7154	0.4271	0.7641	0.8769	0.8175
Iteration **	0.0412	0.1845	0.3822	0.4772	0.6395	0.7148	0.427	0.7642	0.8768	0.8175

Age	13	14
Iteration **	1.077	0.8903
Iteration **	1.077	0.8903

Table 3.3.11 (Cont'd)

Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	0.049	0.097	0.08	0.161	0.097	0.076	0.029	0.022	0.023	0.041
4	0.23	0.311	0.38	0.321	0.29	0.203	0.142	0.119	0.127	0.184
5	0.443	0.505	0.635	0.502	0.322	0.338	0.251	0.244	0.272	0.382
6	0.638	0.773	0.896	0.782	0.455	0.369	0.445	0.382	0.501	0.477
7	0.786	0.949	1.101	0.812	0.653	0.537	0.499	0.529	0.692	0.639
8	0.817	0.787	1.024	1.132	0.769	0.525	0.608	0.692	0.588	0.715
9	0.789	0.78	0.617	1.239	0.804	0.434	0.584	0.784	0.924	0.427
10	0.835	0.882	0.528	0.952	0.826	0.621	0.582	0.846	1.005	0.764
11	0.629	0.965	0.396	0.905	0.627	0.657	0.57	0.877	1.04	0.877
12	0.75	0.845	0.709	0.578	0.673	0.757	0.639	0.424	1.379	0.817
13	0.438	0.357	0.264	0.569	0.705	1.183	0.774	0.974	1.432	1.077
14	0.669	0.77	0.479	0.76	0.714	0.812	0.648	0.788	1.228	0.89

1

XSA population numbers (Thousands)

YEAR \ AGE	3	4	5	6	7	8	9	10	11	12
1990	1.33E+05	6.63E+04	8.40E+04	1.04E+05	3.46E+04	5.09E+03	1.23E+03	6.28E+02	2.79E+02	1.05E+02
1991	1.02E+05	1.04E+05	4.32E+04	4.41E+04	4.52E+04	1.29E+04	1.84E+03	4.58E+02	2.23E+02	1.22E+02
1992	1.76E+05	7.59E+04	6.23E+04	2.13E+04	1.67E+04	1.43E+04	4.81E+03	6.92E+02	1.55E+02	6.96E+01
1993	1.52E+05	1.33E+05	4.25E+04	2.70E+04	7.12E+03	4.54E+03	4.21E+03	2.13E+03	3.34E+02	8.56E+01
1994	7.38E+04	1.06E+05	7.89E+04	2.11E+04	1.01E+04	2.59E+03	1.20E+03	9.99E+02	6.71E+02	1.11E+02
1995	1.64E+05	5.48E+04	6.48E+04	4.68E+04	1.09E+04	4.32E+03	9.82E+02	4.39E+02	3.58E+02	2.94E+02
1996	2.04E+05	1.24E+05	3.67E+04	3.79E+04	2.65E+04	5.23E+03	2.09E+03	5.21E+02	1.93E+02	1.52E+02
1997	8.89E+04	1.62E+05	8.82E+04	2.34E+04	1.99E+04	1.32E+04	2.33E+03	9.54E+02	2.38E+02	8.95E+01
1998	1.71E+05	7.13E+04	1.18E+05	5.66E+04	1.30E+04	9.58E+03	5.41E+03	8.72E+02	3.35E+02	8.13E+01
1999	7.36E+04	1.37E+05	5.14E+04	7.34E+04	2.81E+04	5.35E+03	4.36E+03	1.76E+03	2.61E+02	9.70E+01

Estimated population abundance at 1st Jan 2000

0.00E+00	5.78E+04	9.30E+04	2.87E+04	3.73E+04	1.21E+04	2.14E+03	2.33E+03	6.70E+02	8.90E+01

Taper weighted geometric mean of the VPA populations:

1.34E+05	1.10E+05	7.10E+04	4.10E+04	1.76E+04	6.66E+03	2.48E+03	8.75E+02	3.22E+02	1.35E+02

Standard error of the weighted Log(VPA populations) :

0.4351	0.422	0.443	0.509	0.5359	0.545	0.5877	0.5284	0.4979	0.5719

YEAR \ AGE	13	14
1990	4.68E+01	4.53E+01
1991	4.05E+01	2.47E+01
1992	4.29E+01	2.32E+01
1993	2.80E+01	2.70E+01
1994	3.93E+01	1.30E+01
1995	4.62E+01	1.59E+01
1996	1.13E+02	1.16E+01
1997	6.57E+01	4.26E+01
1998	4.79E+01	2.03E+01
1999	1.68E+01	9.37E+00

Estimated population abundance at 1st Jan 2000

3.51E+01	4.67E+00

Taper weighted geometric mean of the VPA populations:

5.64E+01	2.41E+01

Table 3.3.11 (Cont'd)

Standard error of the weighted Log(VPA populations) :

	0.6997	0.747
1		

Log catchability residuals.

Fleet : IceGFS. N.

Age		1984	1985	1986	1987	1988	1989
	3	0.47	-0.02	-0.23	0.03	0.32	0.02
	4	0.22	0.17	-0.04	-0.03	0.02	-0.15
	5	0.4	0.29	0.26	-0.21	0.25	-0.06
	6	0.52	0.18	0.33	0.29	-0.38	-0.01
	7	0.4	0.14	0.29	0.59	0.01	-0.51
	8	No data for this fleet at this age					
	9	No data for this fleet at this age					

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	3	0.06	0.1	-0.02	-0.11	-0.15	-0.2	0.02	0.22	0.04	-0.16
	4	0.09	-0.2	0.15	-0.22	-0.12	0.07	0.1	0.3	-0.09	-0.06
	5	0.05	-0.48	0	-0.4	-0.22	-0.03	0.29	0.66	-0.1	-0.15
	6	0.09	-0.32	-0.2	-0.21	-0.44	0.27	0.37	0.83	-0.01	-0.65
	7	-0.44	-0.46	-0.01	-0.38	-0.43	0.4	0.43	0.68	0.02	-0.22
	8	No data for this fleet at this age									
	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	5	6	7
Mean Log q	-1.6702	-1.6691	-1.9108
S.E(Log q)	0.3146	0.4179	0.4158

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
3	0.51	4.187	6.68	0.88	16	0.17	-1.67
4	0.66	2.865	4.97	0.88	16	0.17	-1.54

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
5	0.83	0.957	3.3	0.76	16	0.26	-1.67
6	1.1	-0.363	0.74	0.55	16	0.48	-1.67
7	0.94	0.261	2.38	0.65	16	0.41	-1.91
1							

Fleet : IceGFS. a3 on a3. N

Age		1984	1985	1986	1987	1988	1989
	3	99.99	0.16	-0.1	0.17	0.46	0.36
	4	No data for this fleet at this age					
	5	No data for this fleet at this age					
	6	No data for this fleet at this age					
	7	No data for this fleet at this age					

Table 3.3.11 (Cont'd)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	-0.04	0.11	-0.04	0.02	-0.18	-0.3	-0.07	0.08	-0.05	-0.14
4	No data for this fleet at this age									
5	No data for this fleet at this age									
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									
9	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
3	0.59	2.883	5.9	0.84	15	0.2	-1.81
1							

Fleet : IceGFS. a2 on a3

Age	1984	1985	1986	1987	1988	1989
3	99.99	99.99	-0.27	0.07	0.2	0.13
4	No data for this fleet at this age					
5	No data for this fleet at this age					
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					
9	No data for this fleet at this age					

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	0.16	0.31	-0.13	0.09	-0.23	-0.22	0.07	-0.14	0.02	0.01
4	No data for this fleet at this age									
5	No data for this fleet at this age									
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									
9	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
3	0.52	3.797	6.93	0.87	14	0.18	-2.44
1							

Fleet : IceGFS. SE

Age	1984	1985	1986	1987	1988	1989
3	No data for this fleet at this age					
4	-0.79	-0.11	-0.49	-0.11	0.2	-0.61
5	-0.66	-0.13	-0.43	-0.31	0.94	-0.19
6	-0.29	-0.24	-0.17	-0.21	0.29	0.35
7	-0.17	-0.31	-0.23	-0.11	0.42	0.05
8	No data for this fleet at this age					
9	No data for this fleet at this age					

Table 3.3.11 (Cont'd)

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	3	No data for this fleet at this age									
	4	-0.66	-0.22	-0.02	0.02	0.51	0.3	-0.2	0.3	0.18	0.32
	5	-0.98	-0.3	-0.38	-0.14	0.83	0.36	-0.24	0.38	0.11	0.12
	6	-0.38	0.24	-0.56	-0.12	0.46	0.56	-0.2	0.29	-0.09	-0.41
	7	-0.48	0.43	-0.32	-0.49	0.34	0.66	-0.15	0.26	-0.21	-0.13
	8	No data for this fleet at this age									
	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	5	6	7
Mean Log q	-3.9404	-3.3338	-3.0093
S.E(Log q)	0.4964	0.3643	0.3695

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	0.56	1.584	7.53	0.57	16	0.38	-4.37

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
5	0.75	0.992	5.76	0.61	16	0.37	-3.94
6	1.17	-0.638	2.12	0.6	16	0.44	-3.33
7	1.06	-0.262	2.6	0.65	16	0.41	-3.01
1							

Fleet : IceGFS. SW.

Age		1984	1985	1986	1987	1988	1989
	3	-0.26	-0.44	-0.53	-0.38	0.41	0.23
	4	-0.21	-0.33	-1	-0.15	0.39	0.51
	5	-0.09	-0.33	-0.45	-0.66	0.22	0.34
	6	0.11	-0.36	-0.39	-0.16	-0.33	0.31
	7	-0.08	-0.4	-0.56	0.03	-0.19	-0.2
	8	0.33	0	-0.5	-0.35	0.67	0.33
	9	No data for this fleet at this age					

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	3	0.19	-0.24	0.15	0.4	0.21	0.17	-0.09	-0.28	0.09	-0.35
	4	0.27	-0.34	0	0	0.42	0.15	-0.28	-0.02	-0.23	0.08
	5	0.54	-0.24	0.01	-0.41	0.22	0.31	-0.18	-0.09	0.28	-0.12
	6	0.64	0.15	-0.4	-0.44	-0.1	0.48	-0.05	0.04	0.43	-0.36
	7	0.2	0.43	-0.22	-0.81	-0.18	0.45	0.18	-0.05	0.48	0.14
	8	0.47	0.2	-0.08	-0.18	-1.08	0.28	-0.2	0.41	0.1	-0.15
	9	No data for this fleet at this age									

Table 3.3.11 (Cont'd)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	5	6	7	8
Mean Log q	-2.8042	-2.4396	-2.3222	-2.7268
S.E(Log q)	0.3212	0.3636	0.3773	0.4459

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
3	0.71	1.369	6.11	0.69	16	0.3	-3.8
4	1.03	-0.124	2.84	0.62	16	0.34	-3.1

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
5	0.72	2.028	5.16	0.84	16	0.2	-2.8
6	0.74	1.751	4.55	0.82	16	0.25	-2.44
7	0.75	1.672	4.17	0.82	16	0.26	-2.32
8	0.72	1.658	4.41	0.78	16	0.3	-2.73
1							

Fleet : TRAWL-JUN-DEC-N

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	No data for this fleet at this age									
4	99.99	99.99	99.99	99.99	0.53	0.12	-0.16	-0.04	-0.35	-0.07
5	99.99	99.99	99.99	99.99	-0.09	0.33	0.15	-0.28	-0.14	0.03
6	99.99	99.99	99.99	99.99	-0.5	0.21	0.24	-0.13	0.31	-0.14
7	99.99	99.99	99.99	99.99	-0.39	0	0.02	-0.16	0.49	0.02
8	No data for this fleet at this age									
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	5	6	7
Mean Log q	-3.7821	-3.5929	-3.5773
S.E(Log q)	0.2195	0.3113	0.2874

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	0.91	0.258	4.98	0.66	6	0.33	-4.29

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
5	1.49	-1.575	0.18	0.72	6	0.29	-3.78
6	0.74	1.314	5.4	0.87	6	0.22	-3.59
7	0.95	0.166	3.89	0.73	6	0.3	-3.58

Table 3.3.11 (Cont'd)

Fleet : TRAWL-JAN-MAY-N

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	3	No data for this fleet at this age									
	4	99.99	99.99	99.99	99.99	0.32	-0.07	0.22	-0.15	-0.1	-0.21
	5	99.99	99.99	99.99	99.99	-0.1	0.26	-0.03	-0.18	0.08	-0.03
	6	99.99	99.99	99.99	99.99	-0.23	-0.03	0.17	-0.24	0.12	0.19
	7	99.99	99.99	99.99	99.99	0.09	-0.02	-0.26	-0.1	0.44	-0.15
	8	99.99	99.99	99.99	99.99	-0.02	-0.35	0.03	0.53	0.14	-0.34
	9	99.99	99.99	99.99	99.99	0.22	-0.31	-0.1	-0.13	0.66	-0.34

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	5	6	7	8	9
Mean Log q	-3.7967	-3.3799	-3.3448	-3.6925	-4.0562
S.E(Log q)	0.1549	0.1944	0.2464	0.331	0.3831

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	0.71	1.096	6.77	0.79	6	0.24	-4.83

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
5	1.01	-0.059	3.71	0.88	6	0.18	-3.8
6	0.74	3.509	5.22	0.98	6	0.08	-3.38
7	1.57	-1.731	-0.28	0.7	6	0.33	-3.34
8	0.72	1.869	5.1	0.92	6	0.19	-3.69
9	0.83	0.794	4.7	0.84	6	0.33	-4.06
1							

Fleet : TRAWL-JAN-MAY-S

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	3	No data for this fleet at this age									
	4	No data for this fleet at this age									
	5	99.99	99.99	99.99	99.99	-0.04	0	-0.16	-0.11	-0.04	0.34
	6	99.99	99.99	99.99	99.99	-0.23	-0.42	0.06	0.07	0.15	0.34
	7	99.99	99.99	99.99	99.99	-0.44	0.13	-0.21	-0.08	0.57	0.01
	8	99.99	99.99	99.99	99.99	-0.13	0.3	0.05	-0.27	0.18	-0.14
	9	No data for this fleet at this age									

Table 3.3.11 (Cont'd)

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	5	6	7	8
Mean Log q	-4.949	-4.1144	-3.6472	-3.5604
S.E(Log q)	0.1793	0.2718	0.342	0.2178

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
5	1.07	-0.294	4.53	0.83	6	0.21	-4.95
6	0.81	0.966	5.37	0.86	6	0.22	-4.11
7	1.1	-0.231	3.06	0.59	6	0.42	-3.65
8	1.07	-0.347	3.2	0.86	6	0.26	-3.56
1							

Fleet : GILLNET-JAN-MAY-S

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	99.99	99.99	99.99	99.99	0.24	0.15	0.03	-0.34	0.26	-0.31
9	99.99	99.99	99.99	99.99	0.15	0.28	0.13	-0.32	-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	8	9
Mean Log q	-2.6637	-2.5433
S.E(Log q)	0.2703	0.222

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
8	1.28	-1.04	0.99	0.78	6	0.34	-2.66
9	1.29	-1.85	1.05	0.91	6	0.23	-2.54

Table 3.3.11 (Cont'd)

Fleet : TRAWL-JUN-DEC-S

Age		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	3	No data for this fleet at this age									
	4	No data for this fleet at this age									
	5	99.99	99.99	99.99	99.99	-0.73	0.23	0.26	0.09	0.13	0
	6	99.99	99.99	99.99	99.99	-0.66	-0.31	0.19	0.41	0.18	0.16
	7	99.99	99.99	99.99	99.99	0.49	0.23	0.11	0.46	0.84	-2.1
	8	99.99	99.99	99.99	99.99	0.41	0.35	0.02	0.15	-0.2	-0.7
	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	5	6	7	8
Mean Log q	-4.5649	-4.1681	-4.3743	-4.0684
S.E(Log q)	0.3628	0.3963	1.0711	0.4122

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
5	1.26	-0.476	2.88	0.47	6	0.5	-4.56
6	0.8	0.626	5.42	0.72	6	0.34	-4.17
7	-1.91	-1.636	19.95	0.07	6	1.77	-4.37
8	1.26	-0.599	2.87	0.58	6	0.56	-4.07
1							

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	49299	0.3	0	0	1	0.217	0.048
IceGFS. a3 on a3. N	50368	0.3	0	0	1	0.217	0.047
IceGFS. a2 on a3. N.	58349	0.3	0	0	1	0.217	0.041
IceGFS. SE	1	0	0	0	0	0	0
IceGFS. SW.	40659	0.357	0	0	1	0.153	0.058
TRAWL-JUN-DEC-N	1	0	0	0	0	0	0
TRAWL-JAN-MAY-N	1	0	0	0	0	0	0
TRAWL-JAN-MAY-S	1	0	0	0	0	0	0
GILLNET-JAN-MAY-S	1	0	0	0	0	0	0
TRAWL-JUN-DEC-S	1	0	0	0	0	0	0
P shrinkage mean	110492	0.42				0.114	0.022
F shrinkage mean	97349	0.5				0.081	0.025

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
57816	0.14	0.15	6	1.102	0.041

Table 3.3.11 (Cont'd)

Age 4 Catchability dependent on age and year class strength

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	92055	0.212	0.049	0.23	2	0.229	0.186
IceGFS. a3 on a3. N	88406	0.3	0	0	1	0.113	0.193
IceGFS. a2 on a3. N.	95228	0.3	0	0	1	0.113	0.181
IceGFS. SE	127996	0.414	0	0	1	0.061	0.137
IceGFS. SW.	101024	0.24	0.005	0.02	2	0.178	0.171
TRAWL-JUN-DEC-N	86414	0.368	0	0	1	0.077	0.197
TRAWL-JAN-MAY-N	75043	0.3	0	0	1	0.116	0.224
TRAWL-JAN-MAY-S	1	0	0	0	0	0	0
GILLNET-JAN-MAY-S	1	0	0	0	0	0	0
TRAWL-JUN-DEC-S	1	0	0	0	0	0	0
P shrinkage mean	71002	0.44				0.064	0.235
F shrinkage mean	135792	0.5				0.05	0.13

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
92999	0.1	0.05	11	0.496	0.184

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	28535	0.179	0.114	0.64	3	0.205	0.384
IceGFS. a3 on a3. N	31069	0.3	0	0	1	0.068	0.358
IceGFS. a2 on a3. N.	24932	0.3	0	0	1	0.068	0.429
IceGFS. SE	33585	0.318	0.029	0.09	2	0.066	0.335
IceGFS. SW.	23445	0.202	0.051	0.25	3	0.161	0.451
TRAWL-JUN-DEC-N	26318	0.244	0.177	0.72	2	0.115	0.411
TRAWL-JAN-MAY-N	27032	0.213	0.033	0.16	2	0.149	0.402
TRAWL-JAN-MAY-S	40498	0.3	0	0	1	0.079	0.285
GILLNET-JAN-MAY-S	1	0	0	0	0	0	0
TRAWL-JUN-DEC-S	28583	0.392	0	0	1	0.046	0.383
F shrinkage mean	45524	0.5				0.042	0.257

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
28699	0.08	0.05	17	0.606	0.382

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	34934	0.167	0.189	1.13	4	0.164	0.502
IceGFS. a3 on a3. N	34606	0.302	0	0	1	0.044	0.506
IceGFS. a2 on a3. N.	39988	0.302	0	0	1	0.044	0.451
IceGFS. SE	33649	0.252	0.225	0.89	3	0.082	0.517
IceGFS. SW.	35386	0.177	0.138	0.78	4	0.152	0.497
TRAWL-JUN-DEC-N	33012	0.196	0.03	0.15	3	0.132	0.525
TRAWL-JAN-MAY-N	39625	0.176	0.098	0.56	3	0.163	0.454
TRAWL-JAN-MAY-S	44379	0.214	0.186	0.87	2	0.118	0.415
GILLNET-JAN-MAY-S	1	0	0	0	0	0	0
TRAWL-JUN-DEC-S	43120	0.292	0.012	0.04	2	0.063	0.424
F shrinkage mean	40570	0.5				0.039	0.446

Table 3.3.11 (Cont'd)

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
37273	0.07	0.05	24	0.668	0.477

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	12891	0.166	0.164	0.99	5	0.142	0.611
IceGFS. a3 on a3. N	8986	0.304	0	0	1	0.027	0.792
IceGFS. a2 on a3. N.	9705	0.304	0	0	1	0.027	0.751
IceGFS. SE	11256	0.219	0.096	0.44	4	0.1	0.675
IceGFS. SW.	13345	0.171	0.112	0.66	5	0.142	0.595
TRAWL-JUN-DEC-N	12064	0.173	0.118	0.68	4	0.158	0.642
TRAWL-JAN-MAY-N	11760	0.16	0.093	0.58	4	0.181	0.654
TRAWL-JAN-MAY-S	12497	0.193	0.072	0.37	3	0.127	0.625
GILLNET-JAN-MAY-S	1	0	0	0	0	0	0
TRAWL-JUN-DEC-S	11018	0.288	0.487	1.69	3	0.047	0.686
F shrinkage mean	13883	0.5				0.05	0.578

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
12130	0.07	0.05	31	0.691	0.639

1

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	2579	0.165	0.157	0.95	5	0.092	0.624
IceGFS. a3 on a3. N	1794	0.307	0	0	1	0.017	0.81
IceGFS. a2 on a3. N.	1701	0.307	0	0	1	0.017	0.839
IceGFS. SE	2174	0.218	0.148	0.68	4	0.065	0.708
IceGFS. SW.	2299	0.182	0.11	0.61	6	0.128	0.68
TRAWL-JUN-DEC-N	2670	0.173	0.143	0.82	4	0.101	0.608
TRAWL-JAN-MAY-N	2020	0.163	0.153	0.94	5	0.18	0.745
TRAWL-JAN-MAY-S	2179	0.18	0.152	0.84	4	0.173	0.706
GILLNET-JAN-MAY-S	1565	0.3	0	0	1	0.09	0.888
TRAWL-JUN-DEC-S	1711	0.28	0.317	1.13	4	0.072	0.836
F shrinkage mean	2522	0.5				0.066	0.635

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2145	0.07	0.05	36	0.74	0.715

Table 3.3.11 (Cont'd)

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
IceGFS. N.		2851	0.174	0.168	0.96	5	0.071	0.361
IceGFS. a3 on a3. N	2374	0.313	0	0	1	0.011	0.42	
IceGFS. a2 on a3. N.	2548	0.313	0	0	1	0.011	0.396	
IceGFS. SE	2747	0.225	0.145	0.65	4	0.054	0.372	
IceGFS. SW.	2640	0.184	0.079	0.43	6	0.101	0.385	
TRAWL-JUN-DEC-N	2591	0.179	0.145	0.81	4	0.084	0.391	
TRAWL-JAN-MAY-N	2260	0.17	0.108	0.64	6	0.211	0.437	
TRAWL-JAN-MAY-S	2537	0.178	0.062	0.35	4	0.139	0.398	
GILLNET-JAN-MAY-S	2348	0.221	0.184	0.83	2	0.193	0.424	
TRAWL-JUN-DEC-S	2313	0.277	0.13	0.47	4	0.057	0.429	
F shrinkage mean	1065	0.5				0.068	0.772	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2327	0.08	0.05	38	0.658	0.427

1

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	717	0.174	0.138	0.79	5	0.062	0.729
IceGFS. a3 on a3. N	642	0.32	0	0	1	0.01	0.787
IceGFS. a2 on a3. N.	588	0.32	0	0	1	0.01	0.836
IceGFS. SE	821	0.223	0.219	0.98	4	0.047	0.66
IceGFS. SW.	885	0.18	0.068	0.38	6	0.087	0.625
TRAWL-JUN-DEC-N	700	0.192	0.079	0.41	3	0.066	0.741
TRAWL-JAN-MAY-N	892	0.182	0.193	1.06	5	0.17	0.621
TRAWL-JAN-MAY-S	519	0.175	0.063	0.36	4	0.117	0.908
GILLNET-JAN-MAY-S	560	0.224	0.118	0.53	2	0.167	0.863
TRAWL-JUN-DEC-S	588	0.272	0.202	0.74	4	0.048	0.836
F shrinkage mean	605	0.5				0.217	0.819

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
670	0.12	0.05	36	0.407	0.764

Age 11 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	89	0.189	0.177	0.93	5	0.041	0.878
IceGFS. a3 on a3. N	99	0.331	0	0	1	0.005	0.815
IceGFS. a2 on a3. N.	121	0.331	0	0	1	0.005	0.708
IceGFS. SE	140	0.236	0.162	0.69	4	0.033	0.639
IceGFS. SW.	86	0.197	0.132	0.67	6	0.062	0.897
TRAWL-JUN-DEC-N	75	0.238	0.241	1.02	2	0.038	0.981
TRAWL-JAN-MAY-N	82	0.199	0.052	0.26	4	0.122	0.922
TRAWL-JAN-MAY-S	90	0.202	0.088	0.44	3	0.081	0.87
GILLNET-JAN-MAY-S	73	0.222	0.168	0.76	2	0.133	0.997
TRAWL-JUN-DEC-S	77	0.332	0.221	0.67	3	0.031	0.965
F shrinkage mean	95	0.5				0.448	0.838

Table 3.3.11 (Cont'd)

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
89	0.23	0.04	32	0.166	0.877

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 11
Year class = 1987

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	28	0.216	0.094	0.43	5	0.023	0.956
IceGFS. a3 on a3. N	34	0.346	0	0	1	0.003	0.838
IceGFS. a2 on a3. N.	41	0.346	0	0	1	0.003	0.731
IceGFS. SE	40	0.258	0.153	0.59	4	0.02	0.752
IceGFS. SW.	35	0.227	0.12	0.53	6	0.04	0.82
TRAWL-JUN-DEC-N	24	0.318	0	0	1	0.018	1.052
TRAWL-JAN-MAY-N	31	0.227	0.12	0.53	3	0.081	0.897
TRAWL-JAN-MAY-S	39	0.246	0.321	1.3	2	0.051	0.755
GILLNET-JAN-MAY-S	40	0.221	0.01	0.05	2	0.104	0.744
TRAWL-JUN-DEC-S	50	0.428	0.036	0.09	2	0.019	0.633
F shrinkage mean	35	0.5				0.639	0.822

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
35	0.32	0.03	28	0.093	0.817

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 11
Year class = 1986

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	4	0.221	0.1	0.45	5	0.007	1.252
IceGFS. a3 on a3. N	7	0.367	0	0	1	0.001	0.852
IceGFS. a2 on a3. N.	5	0.367	0	0	1	0.001	0.992
IceGFS. SE	3	0.271	0.044	0.16	4	0.006	1.434
IceGFS. SW.	2	0.244	0.193	0.79	6	0.013	1.608
TRAWL-JUN-DEC-N	1	0	0	0	0	0	0
TRAWL-JAN-MAY-N	4	0.295	0.139	0.47	2	0.026	1.211
TRAWL-JAN-MAY-S	4	0.307	0	0	1	0.014	1.166
GILLNET-JAN-MAY-S	6	0.23	0.021	0.09	2	0.045	0.908
TRAWL-JUN-DEC-S	7	0.456	0	0	1	0.006	0.826
F shrinkage mean	5	0.5				0.881	1.072

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5	0.44	0.03	24	0.068	1.077

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 11
Year class = 1985

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	3	0.222	0.089	0.4	5	0.003	0.909
IceGFS. a3 on a3. N	5	0.394	0	0	1	0	0.644
IceGFS. a2 on a3. N.	4	0.394	0	0	1	0	0.777
IceGFS. SE	2	0.268	0.2	0.75	4	0.002	1.05
IceGFS. SW.	3	0.27	0.118	0.44	6	0.006	0.916
TRAWL-JUN-DEC-N	1	0	0	0	0	0	0
TRAWL-JAN-MAY-N	4	0.424	0	0	1	0.012	0.769
TRAWL-JAN-MAY-S	1	0	0	0	0	0	0
GILLNET-JAN-MAY-S	4	0.307	0	0	1	0.022	0.807
TRAWL-JUN-DEC-S	1	0	0	0	0	0	0
F shrinkage mean	3	0.5				0.955	0.893

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3	0.48	0.03	20	0.058	0.89

3.3.12. Cod at Iceland. Division Va. Fishing mortality.

Marine Research Institute Fri Apr 28 08:17:54 2000
Virtual Population Analysis : Fishing mortality
FINAL-VPA

Age	1980	1981	1982	1983	1984	1985	1986
3	0.034	0.016	0.027	0.017	0.055	0.051	0.070
4	0.176	0.137	0.221	0.120	0.211	0.288	0.222
5	0.358	0.388	0.400	0.433	0.323	0.388	0.580
6	0.378	0.470	0.541	0.622	0.539	0.572	0.697
7	0.442	0.635	0.581	0.767	0.598	0.683	0.883
8	0.554	0.839	1.046	0.852	0.900	0.731	0.936
9	0.514	0.802	1.187	0.930	0.746	0.802	0.806
10	0.453	0.950	0.910	1.082	0.634	0.770	0.764
11	0.425	0.982	0.479	0.671	0.639	0.613	0.740
12	0.700	0.904	0.404	0.678	0.587	0.641	0.672
13	0.171	1.076	0.417	0.533	0.685	0.711	0.445
14	0.453	0.943	0.679	0.779	0.658	0.707	0.685
W.Av 5-10	0.404	0.529	0.582	0.609	0.479	0.486	0.689
Ave 5-10	0.450	0.681	0.777	0.781	0.623	0.658	0.778

Age	1987	1988	1989	1990	1991	1992	1993
3	0.045	0.045	0.035	0.050	0.098	0.080	0.162
4	0.309	0.222	0.265	0.231	0.313	0.381	0.322
5	0.519	0.506	0.485	0.445	0.508	0.636	0.503
6	0.785	0.838	0.602	0.640	0.776	0.895	0.781
7	0.976	0.953	0.727	0.785	0.949	1.100	0.811
8	0.994	1.393	0.875	0.816	0.786	1.024	1.127
9	0.975	1.112	0.819	0.786	0.779	0.619	1.233
10	0.707	0.986	0.546	0.836	0.870	0.530	0.949
11	0.582	1.032	0.665	0.624	0.963	0.391	0.903
12	0.665	0.905	0.975	0.772	0.829	0.710	0.563
13	0.739	2.334	0.575	0.438	0.378	0.361	0.572
14	0.734	1.274	0.716	0.691	0.764	0.522	0.844
W.Av 5-10	0.697	0.629	0.544	0.596	0.751	0.791	0.692
Ave 5-10	0.826	0.965	0.676	0.718	0.778	0.801	0.901

Age	1994	1995	1996	1997	1998	1999	1996-1999
3	0.097	0.076	0.030	0.022	0.023	0.041	0.029
4	0.291	0.204	0.143	0.120	0.128	0.184	0.144
5	0.323	0.339	0.253	0.245	0.273	0.382	0.288
6	0.456	0.370	0.446	0.384	0.501	0.477	0.452
7	0.653	0.539	0.501	0.529	0.692	0.639	0.590
8	0.768	0.527	0.610	0.693	0.587	0.715	0.651
9	0.801	0.436	0.587	0.786	0.923	0.427	0.681
10	0.823	0.619	0.585	0.847	1.004	0.764	0.800
11	0.627	0.654	0.568	0.881	1.037	0.877	0.841
12	0.672	0.755	0.635	0.422	1.375	0.817	0.812
13	0.668	1.162	0.770	0.952	1.369	1.077	1.042
14	0.718	0.725	0.629	0.778	1.142	0.890	0.835
W.Av 5-10	0.396	0.375	0.405	0.357	0.399	0.484	0.415
Ave 5-10	0.637	0.472	0.497	0.581	0.663	0.567	0.577

3.3.13. Cod at Iceland. Division Va. Stock in numbers (millions).

Marine Research Institute Fri Apr 28 08:17:53 2000
Virtual Population Analysis : Stock in numbers, millions
FINAL-VPA

Age	1980	1981	1982	1983	1984	1985	1986
3	144.033	143.274	133.575	226.324	139.006	144.030	335.795
4	194.528	113.999	115.390	106.396	182.089	107.717	112.094
5	118.551	133.569	81.350	75.742	77.274	120.679	66.118
6	52.650	67.877	74.178	44.652	40.214	45.817	67.038
7	83.048	29.534	34.736	35.350	19.620	19.203	21.166
8	20.159	50.702	12.818	15.903	13.437	8.835	7.941
9	6.065	9.481	17.940	3.687	5.554	4.471	3.484
10	1.942	2.970	3.480	4.482	1.191	2.156	1.642
11	0.778	1.011	0.940	1.147	1.244	0.517	0.817
12	0.214	0.417	0.310	0.476	0.480	0.537	0.230
13	0.175	0.087	0.138	0.170	0.198	0.219	0.232
14	0.012	0.121	0.024	0.075	0.081	0.082	0.088
Juvenile	477.619	450.104	383.310	444.544	405.967	361.270	531.436
Adult	144.537	102.936	91.570	69.860	74.422	92.993	85.209
Sum 3- 3	144.033	143.274	133.575	226.324	139.006	144.030	335.795
Sum 4-14	478.123	409.766	341.305	288.080	341.383	310.234	280.850
Total	622.156	553.041	474.880	514.404	480.390	454.264	616.645

Age	1987	1988	1989	1990	1991	1992	1993
3	277.516	168.485	82.921	131.891	101.240	174.405	150.793
4	256.301	217.280	131.884	65.538	102.762	75.173	131.769
5	73.478	154.005	142.503	82.811	42.578	61.550	42.061
6	30.294	35.805	76.018	102.813	43.429	20.984	26.683
7	27.346	11.313	12.686	34.105	44.370	16.368	7.020
8	7.168	8.435	3.571	5.022	12.730	14.058	4.463
9	2.551	2.172	1.715	1.219	1.818	4.747	4.132
10	1.274	0.788	0.585	0.619	0.455	0.683	2.093
11	0.627	0.514	0.240	0.277	0.220	0.156	0.329
12	0.319	0.287	0.150	0.101	0.122	0.069	0.086
13	0.096	0.134	0.095	0.046	0.038	0.043	0.028
14	0.122	0.038	0.011	0.044	0.024	0.022	0.025
Juvenile	607.914	516.051	345.131	311.570	246.749	260.140	216.688
Adult	69.176	83.205	107.248	112.916	103.036	108.117	152.794
Sum 3- 3	277.516	168.485	82.921	131.891	101.240	174.405	150.793
Sum 4-14	399.574	430.771	369.458	292.595	248.546	193.853	218.689
Total	677.091	599.256	452.379	424.486	349.785	368.258	369.482

Age	1994	1995	1996	1997	1998	1999	2000
3	73.152	162.217	202.089	88.318	170.379	72.000	212.000
4	104.990	54.336	123.095	160.620	70.754	136.291	56.581
5	78.163	64.256	36.291	87.367	116.682	50.981	92.832
6	20.824	46.324	37.491	23.081	55.968	72.696	28.487
7	10.002	10.802	26.196	19.660	12.874	27.755	36.939
8	2.554	4.263	5.160	13.000	9.488	5.277	11.994
9	1.184	0.970	2.061	2.296	5.322	4.319	2.114
10	0.986	0.435	0.513	0.939	0.857	1.732	2.307
11	0.663	0.355	0.192	0.234	0.329	0.257	0.660
12	0.109	0.290	0.151	0.089	0.079	0.096	0.088
13	0.040	0.046	0.112	0.065	0.048	0.016	0.035
14	0.013	0.017	0.012	0.042	0.021	0.010	0.005
Juvenile	141.781	197.936	348.197	214.085	336.286	262.779	340.967
Adult	150.898	146.374	85.166	181.626	106.514	108.650	104.074
Sum 3- 3	73.152	162.217	202.088	88.318	170.379	72.000	213.000
Sum 4-14	219.528	182.093	231.274	307.393	272.421	299.429	232.041
Total	292.680	344.310	433.363	395.711	442.800	371.429	445.041

3.3.14. Cod at Iceland. Division Va. Stock in weight (tonnes).

Marine Research Institute Fri Apr 28 08:17:54 2000
Virtual Population Analysis : Stock weight 1. Jan. in 1000 x tons
FINAL-VPA

Age	1980	1981	1982	1983	1984	1985	1986
3	200.494	169.064	134.376	247.825	179.040	202.650	489.925
4	362.211	188.212	178.855	170.127	314.104	212.310	219.816
5	324.001	301.866	182.712	172.314	200.603	310.870	188.041
6	198.384	223.519	230.249	134.895	144.007	167.234	240.868
7	436.751	132.400	147.906	144.792	85.761	95.554	98.106
8	140.732	295.134	69.040	87.164	77.907	56.296	48.878
9	48.742	73.375	119.873	25.988	41.413	36.696	26.139
10	20.838	27.981	31.809	36.430	11.733	22.251	14.919
11	9.574	11.495	11.244	12.631	13.747	6.311	8.462
12	3.706	5.325	4.411	6.657	6.884	7.892	3.509
13	2.611	1.091	2.388	2.692	3.024	3.537	3.370
14	0.229	2.308	0.404	1.378	1.358	1.557	1.321
Juvenile	1053.176	914.623	715.807	746.863	768.930	756.209	1002.733
Adult	695.097	517.146	397.460	296.031	310.652	366.948	340.620
Sum 3- 3	200.494	169.063	134.376	247.825	179.040	202.650	489.925
Sum 4-14	1547.779	1262.706	978.890	795.069	900.541	920.507	853.428
Total	1748.272	1431.770	1113.266	1042.894	1079.581	1123.157	1343.353

Age	1987	1988	1989	1990	1991	1992	1993
3	365.211	242.281	98.345	170.140	132.523	224.808	209.904
4	501.325	392.190	239.106	111.678	195.145	132.907	248.648
5	197.361	396.717	369.082	197.339	105.381	151.967	116.592
6	117.966	125.997	297.610	311.936	137.191	69.078	100.381
7	128.964	55.775	66.092	157.700	168.251	71.922	34.610
8	44.848	50.620	24.614	32.746	72.305	78.469	27.019
9	18.795	15.516	13.777	10.832	13.166	32.424	30.785
10	11.771	6.949	5.750	6.553	4.459	5.552	18.086
11	6.702	5.129	2.883	3.050	2.142	1.977	3.588
12	3.390	3.363	1.500	1.476	1.745	0.920	1.081
13	1.525	1.903	1.197	0.729	0.543	0.683	0.407
14	1.532	0.489	0.171	0.756	0.494	0.242	0.419
Juvenile	1123.660	1028.407	754.906	621.649	498.325	432.842	388.159
Adult	275.730	268.523	365.223	383.284	335.021	338.108	403.362
Sum 3- 3	365.211	242.281	98.345	170.140	132.523	224.807	209.904
Sum 4-14	1034.179	1054.649	1021.784	834.794	700.823	546.142	581.617
Total	1399.391	1296.930	1120.129	1004.934	833.346	770.950	791.521

Age	1994	1995	1996	1997	1998	1999	2000
3	105.558	218.668	294.443	131.064	209.566	97.128	293.940
4	216.595	106.444	237.574	301.484	126.507	239.463	107.447
5	200.252	187.627	113.664	251.442	289.021	127.300	248.511
6	76.195	167.925	155.251	92.972	200.812	253.126	102.753
7	51.180	55.912	128.938	106.201	64.535	133.337	176.423
8	15.992	27.352	31.006	83.015	69.198	34.042	75.144
9	9.138	7.676	15.265	16.859	41.742	35.927	16.333
10	8.772	4.471	5.015	8.014	7.952	15.974	21.234
11	7.194	3.908	2.021	2.527	3.615	2.742	7.096
12	1.407	3.308	2.038	1.027	1.220	1.133	1.146
13	0.594	0.598	1.528	0.683	0.846	0.247	0.491
14	0.223	0.257	0.189	0.541	0.332	0.150	0.069
Juvenile	285.085	337.644	675.764	447.106	616.060	525.450	627.400
Adult	408.016	446.502	311.168	548.722	399.286	415.119	423.187
Sum 3- 3	105.558	218.668	294.443	131.064	209.566	97.128	293.940
Sum 4-14	587.543	565.478	692.489	864.764	805.781	843.441	756.647
Total	693.101	784.146	986.932	995.828	1015.347	940.569	1050.587

Table 3.3.15. Cod at Iceland. Division Va. Landings (´000 tonnes), average fishing mortality of age groups 5-10, recruitment (at age 3, in millions), spawning stock at spawning time (´000 tonnes).

Year	Landings	F5-10	Recruitment	SSB
1955	538	0.31	260	1261
1956	481	0.26	307	1199
1957	452	0.32	153	1145
1958	509	0.32	191	1034
1959	453	0.33	143	928
1960	465	0.38	163	825
1961	374	0.33	292	760
1962	387	0.40	255	729
1963	410	0.45	273	683
1964	434	0.54	328	569
1965	394	0.61	174	454
1966	357	0.54	255	412
1967	345	0.49	186	476
1968	381	0.67	178	594
1969	406	0.53	136	693
1970	471	0.56	303	684
1971	453	0.62	170	615
1972	399	0.71	265	477
1973	383	0.71	432	436
1974	375	0.76	143	329
1975	371	0.81	222	339
1976	348	0.76	246	283
1977	340	0.63	144	319
1978	330	0.48	143	375
1979	368	0.43	134	447
1980	434	0.45	226	602
1981	469	0.68	139	389
1982	388	0.78	144	266
1983	300	0.78	336	213
1984	283	0.62	278	219
1985	325	0.66	168	268
1986	369	0.78	83	268
1987	392	0.83	132	253
1988	378	0.96	101	193
1989	356	0.68	174	268
1990	335	0.72	151	343
1991	309	0.78	73	230
1992	268	0.80	162	243
1993	252	0.90	202	219
1994	179	0.64	88	260
1995	169	0.47	170	339
1996	182	0.50	72	287
1997	203	0.58	212	384
1998	243	0.66	195	387
1999	260	0.57	204	441

Table 3.3.16. Cod at Iceland . Division Va. Estimated mortality due to cannibalism on cod in period 1982-1997[1].

Year/Age	0	1	2	3	4	5
1982	0.10	0.60	0.49	0.16	0.06	0.04
1983	0.06	0.47	0.39	0.19	0.09	0.02
1984	0.11	0.42	0.38	0.18	0.11	0.02
1985	0.15	0.52	0.39	0.2	0.08	0.02
1986	0.14	0.68	0.40	0.19	0.08	0.02
1987	0.10	0.74	0.49	0.19	0.09	0.02
1988	0.07	0.53	0.53	0.22	0.10	0.02
1989	0.06	0.47	0.42	0.26	0.11	0.02
1990	0.08	0.38	0.43	0.24	0.14	0.03
1991	0.06	0.41	0.29	0.20	0.11	0.03
1992	0.06	0.33	0.28	0.13	0.07	0.02
1993	0.06	0.33	0.27	0.12	0.07	0.02
1994	0.06	0.33	0.26	0.14	0.07	0.02
1995	0.06	0.35	0.30	0.16	0.08	0.02
1996	0.08	0.39	0.32	0.18	0.08	0.02
1997	0.07	0.47	0.4	0.22	0.09	0.02

1) No data for 1998-99 were available at the WG meeting.

Table 3.3.17. Cod at Iceland. Division Va. Capelin biomass (´000 tonnes) at 1. August used for prediction of cod mean weights.

Year	Total Biomass
1979	3177
1980	2110
1981	1500
1982	1209
1983	2385
1984	3373
1985	3724
1986	4195
1987	3994
1988	3094
1989	2780
1990	2197
1991	2519
1992	3164
1993	3405
1994	3350
1995	3921
1996	4705
1997	4229
1998	3344
1999	3565
2000	3798
Average	3170

Table 3.3.18. Cod at Iceland. Division Va. Input file for the RCT3 program.

```
Year class  VPA age3      Surv4       Surv3       Surv2      Surv1
1981          139        55261         -11         -11         -11
1982          144        22540       31297         -11         -11
1983          336        77227       84656       39301         -11
1984          278        92490       99294       52943       16492
1985          168        60113       68604       25874       13903
1986           83         8272       17511        5820        2605
1987          132        22262       19408       14921        1711
1988          101        13601       15633       11786        2048
1989          174        31684       30540       14473        3509
1990          151        18211       26030       16407        1712
1991           73         4301        5556        2237         223
1992          162        19228       17477       10539        1312
1993          202        48173       37466       28480        8920
1994           88        13959       11969        3869         487
1995          170        35495       28949       18566        2454
1996          -11         4451        5985        3570         530
1997          -11        -11         54472       31265        5299
1998          -11        -11         -11         27498        5587
1999          -11        -11         -11           -11       16664
```

Table 3.3.19. Cod at Iceland. Division. Va. Output from RCT3.

```
Analysis by RCT3 ver3.1 of data from file :

Recnwwg.dat

Iceland Cod: VPA and groundfish survey data

Data for    4 surveys over   25 years :  1975 - 1999

Regression type = C
Tapered time weighting applied
power =    3 over  20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as    .20
Minimum of   3 points used for regression

Forecast/Hindcast variance correction used.

Year class =   1996

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Surv4      .54   -.42    .19   .831    15   8.40    4.08     .257     .267
Surv3      .62  -1.28    .22   .795    14   8.70    4.10     .291     .208
Surv2      .52    .04    .19   .844    13   8.18    4.30     .242     .300
Surv1      .39   1.90    .31   .635    12   6.27    4.37     .383     .120

                                       VPA Mean =    4.97     .409     .105


Year class =   1997

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Surv4
Surv3      .62  -1.28    .22   .794    14  10.91    5.48     .272     .299
Surv2      .51    .11    .19   .844    13  10.35    5.43     .233     .407
Surv1      .39   1.92    .31   .640    12   8.58    5.28     .370     .161

                                       VPA Mean =    4.95     .407     .133

Year class =   1998

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Surv4
Surv3
Surv2      .51    .19    .19   .846    13  10.22    5.36     .230     .585
Surv1      .39   1.95    .30   .648    12   8.63    5.31     .371     .225

                                       VPA Mean =    4.94     .404     .190
```

Table 3.3.19 (Continued)

Year class = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	-----------Prediction---------			I
Surv4									
Surv3									
Surv2									
Surv1	.39	1.99	.29	.659	12	9.72	5.74	.415	.481
					VPA Mean =		4.93	.399	.519

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	72	4.28	.13	.13	.96		
1997	212	5.36	.15	.10	.44		
1998	194	5.27	.18	.11	.42		
1999	204	5.32	.29	.41	1.99		

Table 3.3.20

11:35 Wednesday, May 10, 2000
Icelandic cod (Division Va)

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	212000.00	0.2000	0.0600	0.0850	0.2500	1232.000	0.0270	1380.000
4	56581.000	0.2000	0.3100	0.1800	0.2500	1694.000	0.1350	1899.000
5	92832.000	0.2000	0.5470	0.2480	0.2500	2436.000	0.2820	2677.000
6	28487.000	0.2000	0.7210	0.2960	0.2500	3504.000	0.4260	3614.000
7	36939.000	0.2000	0.8590	0.3820	0.2500	4638.000	0.5820	4782.000
8	11994.000	0.2000	0.9470	0.4370	0.2500	6233.000	0.6240	6280.000
9	2114.000	0.2000	0.9810	0.4770	0.2500	7996.000	0.6680	7728.000
10	2307.000	0.2000	0.9510	0.4770	0.2500	9270.000	0.8180	9204.000
11	660.000	0.2000	0.9990	0.4770	0.2500	11077.000	0.9010	10746.000
12	88.000	0.2000	0.9710	0.4770	0.2500	12832.000	0.9010	13092.000
13	35.000	0.2000	0.9460	0.4770	0.2500	14289.000	0.9010	14210.000
14	5.000	0.2000	1.0000	0.4770	0.2500	15383.000	0.9010	15024.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	194000.00	0.2000	0.0600	0.0850	0.2500	1232.000	0.0270	1380.000
4	.	0.2000	0.3100	0.1800	0.2500	1694.000	0.1350	1860.000
5	.	0.2000	0.5470	0.2480	0.2500	2464.000	0.2820	2638.000
6	.	0.2000	0.7210	0.2960	0.2500	3552.000	0.4260	3617.000
7	.	0.2000	0.8590	0.3820	0.2500	4831.000	0.5820	4812.000
8	.	0.2000	0.9470	0.4370	0.2500	6098.000	0.6240	6180.000
9	.	0.2000	0.9810	0.4770	0.2500	7996.000	0.6680	7728.000
10	.	0.2000	0.9510	0.4770	0.2500	9270.000	0.8180	9204.000
11	.	0.2000	0.9990	0.4770	0.2500	11077.000	0.9010	10746.000
12	.	0.2000	0.9710	0.4770	0.2500	12832.000	0.9010	13092.000
13	.	0.2000	0.9460	0.4770	0.2500	14289.000	0.9010	14210.000
14	.	0.2000	1.0000	0.4770	0.2500	15383.000	0.9010	15024.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	204000.00	0.2000	0.0600	0.0850	0.2500	1232.000	0.0270	1380.000
4	.	0.2000	0.3100	0.1800	0.2500	1694.000	0.1350	1860.000
5	.	0.2000	0.5470	0.2480	0.2500	2464.000	0.2820	2617.000
6	.	0.2000	0.7210	0.2960	0.2500	3574.000	0.4260	3598.000
7	.	0.2000	0.8590	0.3820	0.2500	4874.000	0.5820	4815.000
8	.	0.2000	0.9470	0.4370	0.2500	6254.000	0.6240	6202.000
9	.	0.2000	0.9810	0.4770	0.2500	7996.000	0.6680	7728.000
10	.	0.2000	0.9510	0.4770	0.2500	9270.000	0.8180	9204.000
11	.	0.2000	0.9990	0.4770	0.2500	11077.000	0.9010	10746.000
12	.	0.2000	0.9710	0.4770	0.2500	12832.000	0.9010	13092.000
13	.	0.2000	0.9460	0.4770	0.2500	14289.000	0.9010	14210.000
14	.	0.2000	1.0000	0.4770	0.2500	15383.000	0.9010	15024.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Notes: Run name : MANSAS02
Date and time: 03MAY00:23:00

Table 3.3.21

11:35 Wednesday, May 10, 2000
Icelandic cod (Division Va)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.0319	0.0850	0.2500	1101.350	0.0460	1323.450
4	.	0.2000	0.1120	0.1800	0.2500	1634.300	0.1960	1837.600
5	.	0.2000	0.3070	0.2480	0.2500	2410.400	0.3380	2603.450
6	.	0.2000	0.5613	0.2960	0.2500	3525.000	0.5040	3568.550
7	.	0.2000	0.7817	0.3820	0.2500	4851.550	0.6140	4792.550
8	.	0.2000	0.9025	0.4370	0.2500	6284.150	0.6360	6209.450
9	.	0.2000	0.9512	0.4770	0.2500	7675.300	0.6360	7618.650
10	.	0.2000	0.9669	0.4770	0.2500	9370.800	0.6360	9400.750
11	.	0.2000	0.9951	0.4770	0.2500	11313.050	0.6360	11255.050
12	.	0.2000	0.9956	0.4770	0.2500	13062.700	0.6360	13356.300
13	.	0.2000	0.9987	0.4770	0.2500	14402.200	0.6360	14619.000
14	.	0.2000	1.0000	0.4770	0.2500	15455.547	0.6360	15278.369
Unit	Numbers	-	-	-	-	Grams	-	Grams

Notes: Run name : YLDSAS03
Date and time: 03MAY00:23:03

The SAS System 11:48 Wednesday, May 24, 2000 Icelandic cod (Division Va)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0057	0.5699	976378	405606	235000	0.0000	0.0000	1066938	500210	0	1455427	766086
.	.	.	.	.	0.1000	0.0567	.	492076	28381	1422043	726280
.	.	.	.	.	0.2000	0.1133	.	484133	55510	1390165	689351
.	.	.	.	.	0.3000	0.1700	.	476376	81455	1359713	655064
.	.	.	.	.	0.4000	0.2267	.	468801	106277	1330610	623203
.	.	.	.	.	0.5000	0.2833	.	461401	130036	1302787	593572
.	.	.	.	.	0.6000	0.3400	.	454172	152788	1276174	565992
.	.	.	.	.	0.7000	0.3967	.	447110	174584	1250710	540299
.	.	.	.	.	0.8000	0.4533	.	440210	195474	1226333	516345
.	.	.	.	.	0.9000	0.5100	.	433467	215505	1202989	493991
.	.	.	.	.	1.0000	0.5667	.	426878	234721	1180623	473114
.	.	.	.	.	1.1000	0.6233	.	420438	253162	1159185	453598
.	.	.	.	.	1.2000	0.6800	.	414144	270869	1138629	435339
.	.	.	.	.	1.3000	0.7367	.	407990	287877	1118909	418241
.	.	.	.	.	1.4000	0.7933	.	401975	304222	1099984	402215
.	.	.	.	.	1.5000	0.8500	.	396094	319937	1081813	387181
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSAS02
Date and time : 03MAY00:23:00
Computation of ref. F: Simple mean, age 5 - 10
Basis for 2000 : TAC constraints

Table 3.3.22

11:35 Wednesday, May 10, 2000
Icelandic cod (Division Va)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.016	23208.985	2.457	18072.404	2.337	17191.003
0.0500	0.0280	0.080	500.325	4.749	20630.476	2.215	15604.999	2.083	14643.075
0.1000	0.0561	0.146	867.438	4.518	18478.999	2.009	13557.352	1.868	12554.016
0.1500	0.0841	0.201	1135.808	4.318	16674.727	1.832	11850.342	1.686	10832.959
0.2000	0.1121	0.246	1331.000	4.144	15153.754	1.680	10420.685	1.530	9408.089
0.2500	0.1402	0.285	1471.982	3.991	13864.786	1.548	9217.637	1.396	8222.494
0.3000	0.1682	0.318	1572.830	3.856	12766.541	1.433	8200.400	1.281	7230.941
0.3500	0.1962	0.347	1643.993	3.736	11825.699	1.332	7336.084	1.181	6397.371
0.4000	0.2243	0.371	1693.227	3.628	11015.287	1.243	6598.100	1.094	5692.955
0.4500	0.2523	0.393	1726.293	3.532	10313.406	1.165	5964.888	1.017	5094.563
0.5000	0.2803	0.413	1747.465	3.445	9702.215	1.096	5418.912	0.950	4583.583
0.5500	0.3084	0.430	1759.920	3.366	9167.136	1.034	4945.868	0.890	4144.982
0.6000	0.3364	0.445	1766.013	3.294	8696.216	0.978	4534.046	0.837	3766.578
0.6500	0.3644	0.459	1767.493	3.228	8279.618	0.928	4173.831	0.789	3438.462
0.7000	0.3925	0.472	1765.657	3.168	7909.221	0.882	3857.298	0.746	3152.545
0.7500	0.4205	0.484	1761.465	3.112	7578.292	0.841	3577.896	0.708	2902.199
0.8000	0.4485	0.495	1755.627	3.060	7281.234	0.804	3330.188	0.673	2681.970
0.8500	0.4766	0.505	1748.668	3.012	7013.371	0.770	3109.648	0.641	2487.355
0.9000	0.5046	0.514	1740.973	2.967	6770.784	0.738	2912.490	0.612	2314.622
0.9500	0.5326	0.523	1732.826	2.925	6550.178	0.709	2735.541	0.586	2160.662
1.0000	0.5607	0.531	1724.434	2.886	6348.768	0.682	2576.127	0.561	2022.881
1.0500	0.5887	0.539	1715.946	2.849	6164.192	0.658	2431.990	0.539	1899.098
1.1000	0.6167	0.546	1707.470	2.814	5994.441	0.635	2301.213	0.518	1787.478
1.1500	0.6448	0.553	1699.084	2.781	5837.799	0.613	2182.166	0.499	1686.471
1.2000	0.6728	0.559	1690.839	2.750	5692.791	0.594	2073.455	0.481	1594.757
1.2500	0.7008	0.565	1682.772	2.720	5558.149	0.575	1973.883	0.464	1511.215
1.3000	0.7289	0.571	1674.907	2.692	5432.778	0.557	1882.423	0.449	1434.883
1.3500	0.7569	0.577	1667.258	2.665	5315.726	0.541	1798.185	0.434	1364.937
1.4000	0.7849	0.582	1659.832	2.639	5206.166	0.526	1720.399	0.421	1300.664
1.4500	0.8130	0.587	1652.632	2.614	5103.373	0.511	1648.395	0.408	1241.451
1.5000	0.8410	0.592	1645.658	2.591	5006.713	0.498	1581.588	0.396	1186.761
1.5500	0.8690	0.597	1638.906	2.568	4915.629	0.485	1519.466	0.385	1136.131
1.6000	0.8971	0.601	1632.372	2.547	4829.626	0.472	1461.580	0.374	1089.153
1.6500	0.9251	0.605	1626.048	2.526	4748.270	0.461	1407.533	0.364	1045.470
1.7000	0.9531	0.610	1619.928	2.506	4671.171	0.450	1356.975	0.354	1004.770
1.7500	0.9812	0.614	1614.006	2.486	4597.986	0.439	1309.595	0.345	966.774
1.8000	1.0092	0.617	1608.273	2.468	4528.404	0.429	1265.119	0.337	931.238
1.8500	1.0372	0.621	1602.722	2.450	4462.149	0.420	1223.299	0.329	897.944
1.9000	1.0653	0.625	1597.346	2.432	4398.972	0.411	1183.916	0.321	866.699
1.9500	1.0933	0.628	1592.138	2.416	4338.649	0.402	1146.773	0.313	837.329
2.0000	1.1213	0.632	1587.090	2.399	4280.978	0.394	1111.694	0.306	809.681
2.0500	1.1494	0.635	1582.196	2.384	4225.775	0.386	1078.518	0.300	783.615
2.1000	1.1774	0.638	1577.449	2.368	4172.874	0.378	1047.102	0.293	759.007
2.1500	1.2054	0.641	1572.842	2.354	4122.123	0.371	1017.317	0.287	735.745
2.2000	1.2335	0.644	1568.371	2.339	4073.384	0.364	989.044	0.281	713.726
2.2500	1.2615	0.647	1564.029	2.325	4026.530	0.357	962.176	0.275	692.860
2.3000	1.2895	0.650	1559.811	2.312	3981.447	0.351	936.616	0.270	673.062
2.3500	1.3176	0.653	1555.712	2.298	3938.027	0.345	912.274	0.265	654.257
2.4000	1.3456	0.655	1551.726	2.286	3896.174	0.339	889.071	0.260	636.376
2.4500	1.3736	0.658	1547.849	2.273	3855.798	0.333	866.931	0.255	619.357
2.5000	1.4017	0.661	1544.078	2.261	3816.815	0.327	845.786	0.250	603.141
2.5500	1.4297	0.663	1540.406	2.249	3779.149	0.322	825.573	0.246	587.676
2.6000	1.4577	0.666	1536.831	2.237	3742.730	0.317	806.236	0.242	572.914
2.6500	1.4858	0.668	1533.349	2.226	3707.491	0.312	787.721	0.238	558.810
2.7000	1.5138	0.670	1529.956	2.215	3673.372	0.307	769.979	0.234	545.323
2.7500	1.5418	0.673	1526.648	2.204	3640.316	0.303	752.966	0.230	532.417
2.8000	1.5699	0.675	1523.423	2.194	3608.269	0.298	736.638	0.226	520.056
2.8500	1.5979	0.677	1520.277	2.183	3577.183	0.294	720.957	0.222	508.208
2.9000	1.6259	0.679	1517.208	2.173	3547.012	0.289	705.888	0.219	496.843
2.9500	1.6540	0.681	1514.211	2.163	3517.713	0.285	691.397	0.216	485.935
3.0000	1.6820	0.683	1511.286	2.154	3489.245	0.281	677.453	0.212	475.457
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSAS03
Date and time : 03MAY00:23:03
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.3522
F-max factor : 0.6446
F-0.1 reference F : 0.1975
F-max reference F : 0.3614
Recruitment : Single recruit

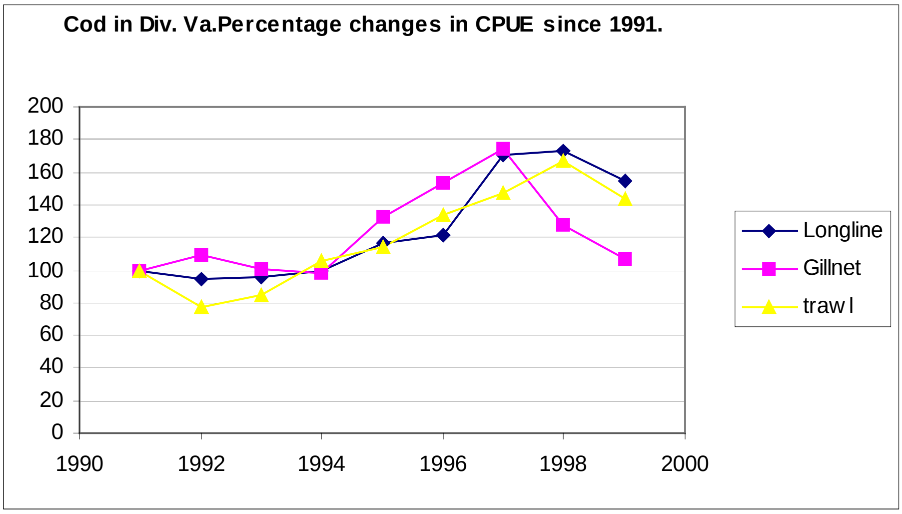


Figure 3.3.1. Cod at Iceland Division Va. Percentage changes in CPUE for the main gears since 199**1.**

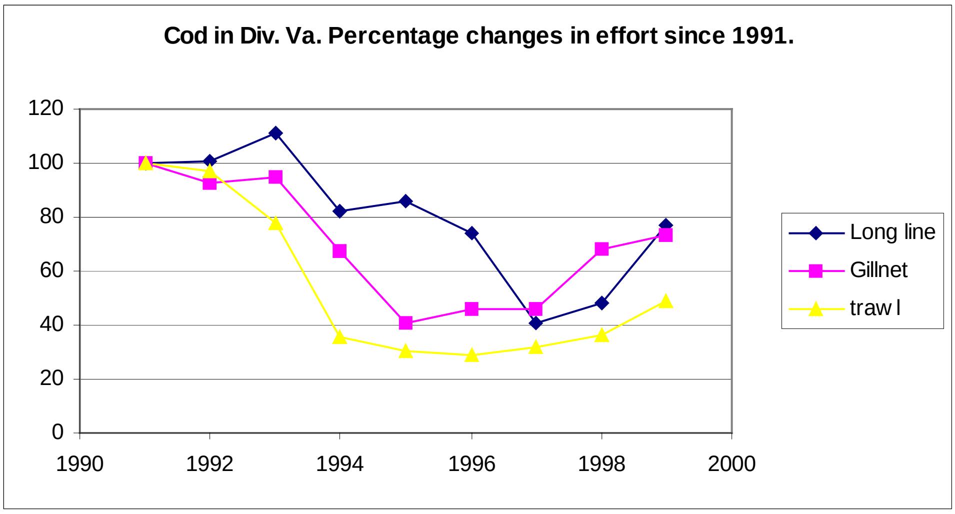


Figure 3.3.2. Cod at Iceland Division Va. Percentage changes in effort for the main gears since 1991.

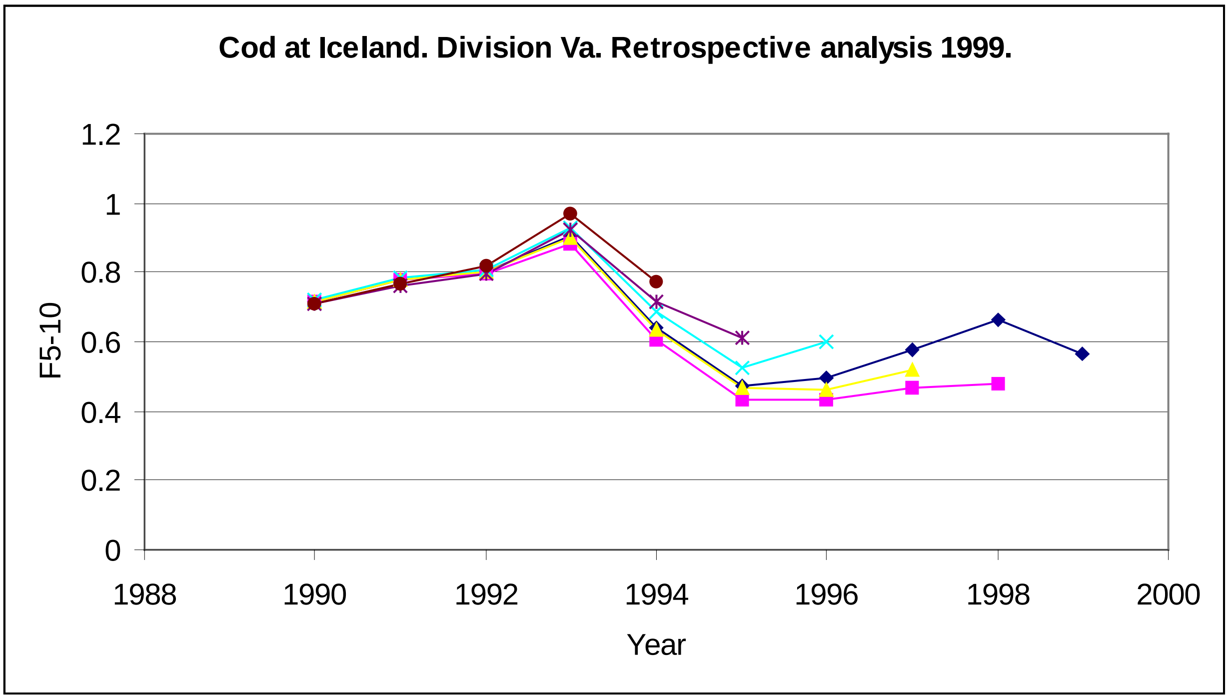


Figure 3.3.3. Cod at Iceland Division Va. Retrospective analysis of the XSA**.**

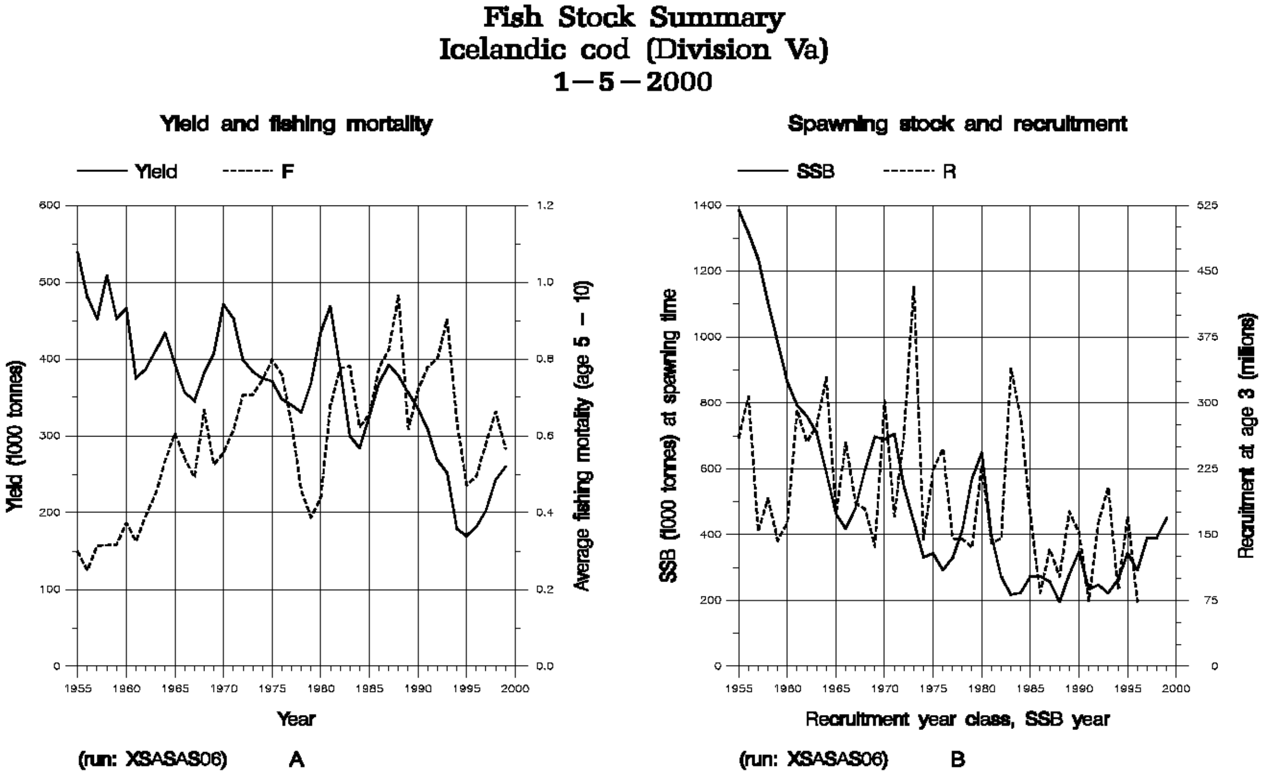


Figure 3.3.4

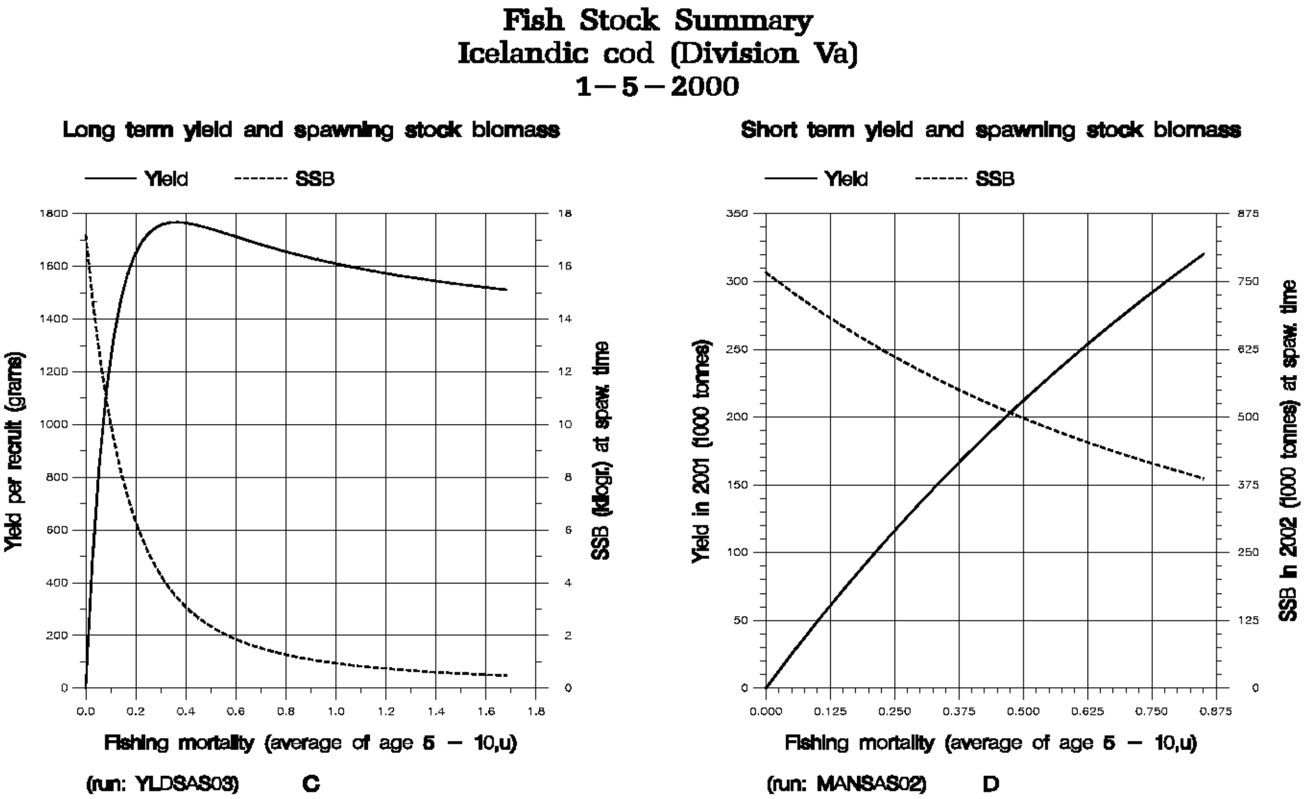


Figure 3.3.5

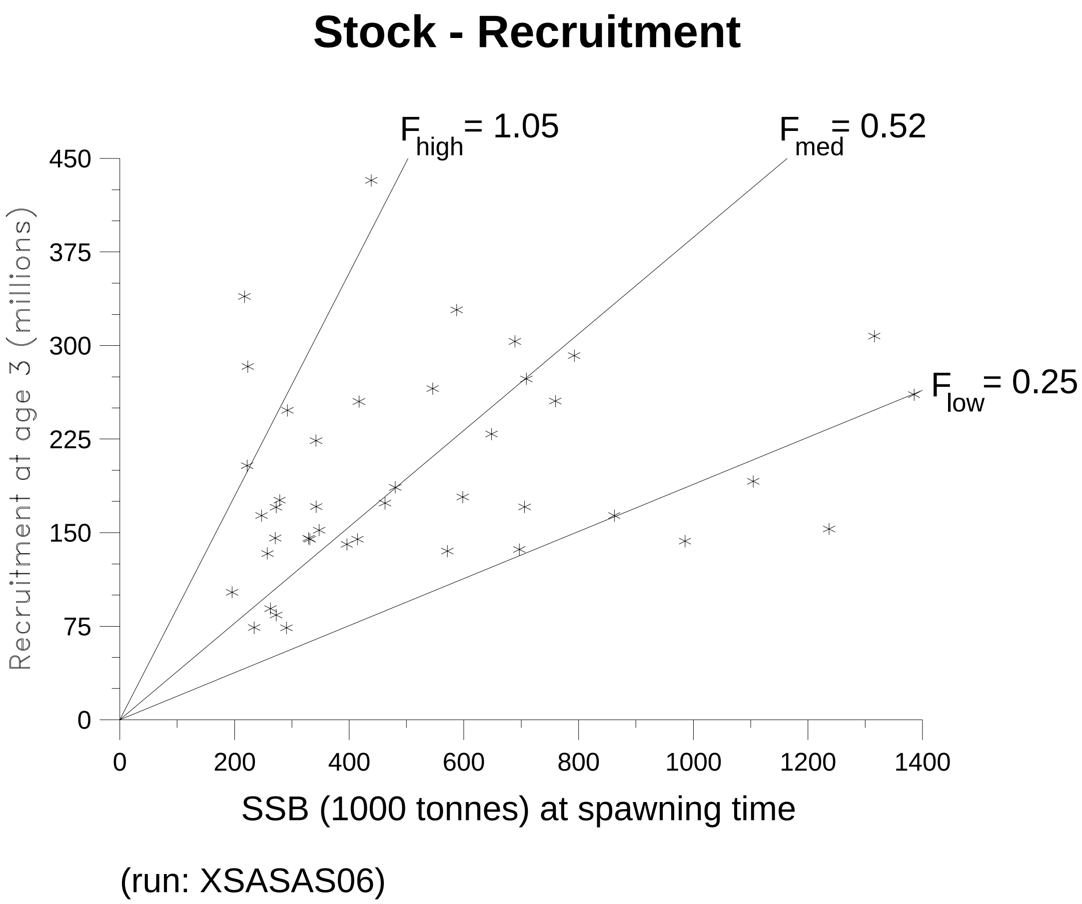

Stock - Recruitment
F high = 1.05
F med = 0.52
F low = 0.25
Recruitment at age 3 (millions)
450
375
300
225
150
75
0
0
200
400
600
800
1000
1200
1400
SSB (1000 tonnes) at spawning time
(run: XSASAS06)

Figure 3.3.6

2.4 Icelandic haddock

2.4.1 Introductory comment

Haddock (*Melanogrammus aeglefinus*) in Icelandic waters is only connected with other haddock stocks in that 0-group and occasionally young fish found in E-Greenland waters originate from the Icelandic stock. The species is distributed all around the Icelandic coast, principally in the relatively warm waters off the west and south coast, on fairly shallow grounds.

Icelandic haddock was assessed at the North-Western Working Group in 1970 and 1976 but otherwise assessments were conducted by the Marine Research Institute in Iceland until in 1999 when it was again assessed by the North-Western Working Group.

2.4.2 Trends in landings and fisheries

During the sixties haddock landings rose to the record level of around 100 000 t for several years (Figure 3.4.2.1). After that, landings fell to 40–60 000 t (Table 3.4.2.1). Historically landings by foreign fleets accounted for up to half of the total landed catch, but since 1976 landings by other nations have been negligible. The only other nation catching haddock in Icelandic waters are the Faroese. Haddock landings are subject to fluctuations, reflecting variability in stock biomass and recruitment which is very variable.

The landings in 1999 are estimated as 45 500 tonnes increasing from 41 500 t last year. In 1999, 58% of landings were by demersal trawl, 6% by Danish seine, 32% by long line and 4% by gillnets. The forecast from last year was 37 000 tonnes for the year 1999 so the landed catch exceeded the forecast by more than 8000 t. A large part of this increase in catch is due to unused quota from former years, but in the Icelandic quota system, part of unused quota can be transferred between years. Currently little quota is unused from last fishing year.

Although fleet composition has been relatively stable for many years, during this decade an increased proportion of landings have been by long line while the share by gill-netting has decreased. Between 1998 and 1999 the contribution of longline in the catch increased from 25 to 32%. This increase is due to increased longline effort where cod is probably the main target species.

2.4.3 Catch at age

Catch at age for 1999 for the Icelandic fishery is provided in Table 3.4.3.1. Catch at age is calculated by 3 fleets and two time intervals. The time intervals are January-May and June-December and the fleets are gill nets, long line and bottom trawl. Hand lines are included with the long line fleet. Danish seine (as well as minor units such as pelagic trawl and other gears which are dragged or hauled) are included in the trawl feet. The Faroese catch that is caught by long line is included in that category. Numbers sampled in 1999 are given below.

Gear	Total landings	Samples- length	Samples - aged
Longline	14635	8571	1684
Gillnets	1689	1725	464
Trawl	29517	101022	4939
Total	45841	111318	7088

2.4.4 Weight at age

Mean weight at age in the catch (Table 3.4.4.1) is computed for the same categories as the catch at age and then weighted by the share of the landings in each category.

Mean weight at age in the stock for 1978–1999 is given in Table 3.4.4.2. These data were calculated from the Icelandic groundfish survey. Weights for 1985–1992 were calculated using a length-weight relationship which is the mean of the years 1993–2000. Weights from 1993 onwards are based on weighing of fish in the groundfish survey each year. Stock weights prior to 1985 have been taken to be the mean of 1985-1999.

2.4.5 Maturity at age

Maturity at age is based on samples from the Icelandic groundfish survey for the years 1985–1999. For 1979–84, maturity at age is based on samples from the commercial fleet from the first 5 months of the year.

There was an increase in the proportion of mature fish at age after 1992. This development was especially notable for the youngest age group (2) but since 1994 there has been a gradual decline in the proportion mature at age 2. The proportion mature in 2000 is the lowest for many years. The maturity at age data are given in Table 3.4.5.1.

2.4.6 Stock Assessment

2.4.6.1 Tuning input

CPUE data, based on Icelandic trawler logbooks from 1970–1999, from the longline fleet from 1988 and from the gillnet fleet from 1988 are available (Figure 3.4.6.1.1). As seen in the picture the indices show different trends between 1998 and 1999, the longline CPUE goes down, the CPUE from all trawlers > 300 tons up, the index from all trawlers goes down and the CPUE from gillnets is steady.

The same fleets were used in tuning as last year, i.e., all trawlers, gillnets and the groundfish survey. GLIM indices based on settings where more than 50% of the catch was haddock (Stefansson 1988) were used for the gillnets but raw CPUE from tows where more than 70% of the catch was haddock for trawlers. Indices were age disaggregated according to catch in number for the gear.

The age disggregated survey indices from the groundfish survey are calculated with the Cochran method, using stratas following depth contours. The data is disaggregated by calculating age-length keys for two regions, north and south. To use the latest information available, survey abundance indices were moved back in time approximately 3 months. The resulting age disaggregated indices for the trawl, gillnet and the survey are given in Table 3.4.6.1.1.

2.4.6.2 Tuning and estimation of fishing mortality

The same XSA run as last year was used in the assessment, including survey indices along with bottom trawl and gillnet CPUE. The survey data covers the years 1985–2000 age groups 3–9; trawl 1993–1999 age groups 4–9 and gill nets 1993–1998 age groups 5–8 (Table 3.4.6.2.1).

Shrinkage was set to 2 years with SE as 0.5 as last year. Varying the shrinkage did not affect the results much.

Fishing mortalities are given in Table 3.4.6.2.2. The resulting mean F in 1999 for age groups 4–7 from the final run was 0.62. The plot of yield and fishing mortality (Figure 3.4.6.2.2) indicates that fishing mortality increased substantially in 1986 before falling slightly the following year and has been stable since then. A decrease in fishing mortality was expected in 1999 but as described in Section 3.1.2 the landings in 1999 exceeded forecast by 8000 tons (20%) keeping the fishing mortality in 1999 at the same level as in 1998.

2.4.6.3 Stock and recruitment estimates

The resulting stock size in numbers and summary table from the final XSA are given in Tables 3.4.6.3.1 and 3.4.6.3.2. The spawning stock and recruitment plot (Figure 3.4.6.2.2) shows that although SSB is highly variable - ranging from a low of 42 000 t in 1987 to a maximum of 110 000 t in 1982 - there are no trends. The spawning stock in 1999 is estimated to be 65 000 t, decreasing to 52 000 t in 2000, which is the second lowest since 1980. Part of this descrease is due to changes in maturity at age between the years 1999 and 2000.

2.4.7 Prediction of catch and biomass

2.4.7.1 Input data

The input data for the prediction is shown in Table 3.4.7.1.1.

For the short-term catch prediction and stock biomass calculations, the mean weight at age 3–8 in the catches were predicted using regression analysis, where the mean weight at age was predicted by the mean weight of the year class in the previous year. For the age groups 2, means of the years 1997–1999 were used.

For the stock weights survey weights for the year 2000 were used for that year, but for the years 2001 and 2002 mean weight at age was predicted by mean weight of the year class in the survey the previous year. The exploitation pattern was taken as the mean from 1997–1999, scaled to the level in 1999.

Recruitment for 1999, 2000 and 2001 was estimated using a prediction program (RCT3, as described in Section 3.3.7.3) with input from VPA runs and the survey (age groups 1–4), Tables 3.4.7.1.2 and 3.4.7.1.3. Recruitment for 2001 was taken to be the geometric mean of recruitment from 1978–1997. A TAC constraint of 39 000 t was applied to the prediction for 2000 as that is the forecasted catch for the year 2000.

For the long-term yield and spawning stock biomass per recruit, the exploitation pattern was taken as the mean relative fishing mortality from 1978–1997. Mean weight at age in the stock and the maturity ogive are means from 1985-1998. Mean weight at age in the catch is the mean from 1978–1998. Input data for long-term yield per recruit are given in Table 3.4.7.1.4.

2.4.7.2 Biological reference points

The yield and spawning stock biomass per recruit curves are shown in Figure 3.4.7.2.1.

Compared to the estimated fishing mortality of $F_{4–7}$ = 0.62 for 1998, F_{max} = 0.43 and $F_{0.1}$ = 0.29.

Yield per recruit at F_{max} corresponds to 0.89 kg (Table 3.4.7.2.1).

A plot of spawning stock biomass and recruitment from 1979-1999 is shown in Figure 3.4.7.2.2. The SSB-recruit reference points F_{med} and F_{high} are 0.47 and 1.43 respectively, where F_{high} is the fishing mortality rate with SSB/R equal to the inverse of the 90 th percentile of the observed R/SSB.

Since 1986 $F_{4–7}$ has exceeded F_{max} and for only 2 years since 1978 has $F_{4–7}$ been lower than F_{med}.

It is proposed that F_{pa} is set to the F_{med} value of 0.47.

2.4.7.3 Projection of catch and biomass

At the beginning of 2000, the total stock is estimated to be 103 000 t with a spawning stock of 52 000 t (Table 3.4.7.3.1) The forecasts from last year for the year 2000 were 110 000 for the total biomass and 68 000 t for the spawning stock. The discrepancy in total stock explained by commercial catch in 1999 exceeding predictions by 8000 t, while the change in the spawning stock is larger caused by lower maturity at age in 2000 than in prior years. This change in maturity at age is notthing to be worried about but raises the question taking mean maturity at age for some years instead of using estimated values each year.

With a catch of 39 000 t in 2000, fishing mortality is estimated to be 0.6, the stock biomass 112 000 t and the spawning stock biomass 64 000 t at the start of 2001. Assuming fishing mortality of 0.47 in 2001 (F_{med}) the catch in 2001 will be 31 500 t. At the start of the year 2002 the spawning stock biomass will then be 76 000 t and the total biomass will be 126 000 t.

2.4.8 Management considerations

For more than a decade fishing mortality on haddock has been high with $F_{4–7}$ between 0.6 and 0.7 since 1986. The advice in 1999 was based on F_{med} and if followed would have meant substantial reduction in fishing mortality while the real outcome was that the fishing mortality was at the same level as it has been.

The assessment results show that the 1996 and 1997 year classes are small, specially the 1996 year class. The 1998 and 1999 year classes are on the other hand above average. In the fishery year 2000–2001 the composition of the stock will be such that a large portion of it will be below landing size. To protect incoming recruitment fishing effort should be limited.

2.4.9 Comments on the assessment

The current assessment was done using the same settings as last year.

Fishing mortality on haddock increased after 1985 (Figure 3.4.6.2.2) The high fishing mortality was at least partly due to an overestimation of the stock biomass through the use of catch weights that are 20–25% higher than survey weights which have been used in the assessments of the last 2 years.

Work is currently being carried out in constructing a longer time series of data than used in the present assessment. Preliminary results are available back to 1960. It is not always easy to select which samples to use for calculating catch in numbers from the old data. Therefore 5 different sets of catch in number have been presented.

According to preliminary runs the fishing mortality was high (0.7) during the sixties and early seventies, but dropped to 0.4 in the late seventies with the introduction of the very good 1976 year class to the fishery at the same time as reduction of foreign catch. The fishing mortality in 1980 was 0.4 which is the lowest in the timeperiod and there are only 3 years since 1962 where the fishing mortality was below the proposed F_{pa} of 0.47. F_{crash} was larger than 1.3 irrespective of which data set was chosen. Therefore F_{crash} is an unsuitable candidate for F_{lim}.

The data were used to calculate reference points. F_{msy} varied from 0.53 to 0.61 and F_{med} from 0.51 to 0.62, depending on which data set was selected. This is to be contrasted with $F_{med} = 0.47$ obtained using data since 1980. The dataset having the best internal consistency according to the Shephard-Nicholson model gives $F_{med} = 0.525$ and $F_{msy} = 0.51$, both above the proposed F_{pa} of 0.47, but close to it.

The groundfish survey in the year 2000 gave the lowest ever abundance indices of adult haddock. Using the survey only in tuning gives $F_{4\text{–}7} = 0.8$ in 1999 compared to 0.62 in the 3 fleet run. Although catchability in the 2000 survey is considered to be low, the 2000 survey index is of concern. The autumn survey in October 1999 did on the other hand not show this reduction.

Table 3.4.2.1

HADDOCK Va								
Country	1978	1979	1980	1981	1982	1983	1984	1985
Belgium	807	1010	1144	673	377	268	359	391
Faroe Islands	2116	2161	2029	1839	1982	1783	707	987
Iceland	40552	52152	47916	61033	67038	63889	47216	49553
Norway	13	11	23	15	28	3	3	+
UK								
Total	43488	55334	51112	63560	69425	65943	48285	50933

HADDOCK Va								
Country	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	257	238	352	483	595	485	361	458
Faroe Islands	1289	1043	797	606	603	773	757	754
Iceland	47317	39479	53085	61792	66004	53516	46098	46932
Norway		1	+					
UK								
Total	48863	40761	54234	62881	67202	53774	47216	48144

HADDOCK Va						
Country	1994	1995	1996	1997	1998	1999
Belgium	248					
Faroe Islands	911	758	664	340	639	624
Iceland	58408	60061	56223	43245	40795	44557
Norway	1	+	4			
UK						
Total	59567	60819	56891	43585	41434	45481

Table 3.4.3.1 Haddock in division Va. Catch at age 1978-1999

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

At 3/05/2000 9:10

Catch numbers at age Numbers*10**-3

YEAR	1978	1979
AGE		
2	108	161
3	579	2066
4	2132	4047
5	7188	6559
6	4481	9769
7	1821	1887
8	627	474
9	94	61
0 TOTALNUM	17030	25024
TONSLAND	43488	55334
SOPCOF %	105	94

Catch numbers at age Numbers*10**-3

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	595	1	50	1	60	427	196	2237	133	78
3	1384	516	286	705	755	1773	3681	7559	10068	2603
4	11476	4929	2698	1498	4970	4981	3822	7500	15927	23077
5	4296	16961	10703	4645	1176	6058	4933	2696	5598	9703
6	3796	6021	14115	10301	4875	837	5761	2249	1260	3118
7	3730	2835	2288	8808	3772	1564	493	1194	1009	541
8	544	1810	1167	874	4446	2475	852	151	577	507
9	91	169	816	241	171	2212	898	208	58	144
0 TOTALNUM	25912	33242	32123	27073	20225	20327	20636	23794	34630	39771
TONSLAND	51112	63580	69325	65943	48285	50933	48863	40801	54236	62979
SOPCOF %	100	100	101	102	100	101	103	102	101	100

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Catch numbers at age Numbers*10**-3

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
2	446	2461	2726	218	280	2357	1467	1375	207	1077
3	2603	1282	7343	11617	3030	6327	8982	3690	8109	1455
4	7994	3942	4181	12642	27025	5667	7076	11127	5984	16897
5	23803	6711	4158	3167	10722	23357	4751	4885	8390	4844
6	6654	13650	3989	1786	1550	5605	13963	2540	2420	4982
7	857	2956	5936	1504	756	610	2446	4981	1502	942
8	167	398	1314	2263	404	263	228	692	1884	588
9	71	52	132	379	700	210	87	52	207	514
TOTALNUM	42595	31452	29779	33576	44467	44396	39000	29342	28703	31299
TONSLAND	67200	54732	47212	48844	59345	61131	56958	44053	41434	45841
SOPCOF %	100	100	100	100	101	102	100	100	100	101

Table 3.4.4.1 Haddock in Division Va. Mean weight at age in the catch 1978 – 1999.

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Catch weights at age (kg)

YEAR	1978	1979
AGE		
2	.6200	.6200
3	.9600	.9600
4	1.4100	1.4100
5	2.0300	2.0300
6	2.9100	2.9100
7	3.8000	3.8000
8	4.5600	4.5600
9	4.7200	4.7200
0 SOPCOFAC	1.0483	.9355

Catch weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	.8370	.5840	.3300	.6550	.9800	.5990	.8670	.4460	.4680	.7450
3	.8310	.6930	.8190	.9580	1.0410	1.0020	1.1870	1.0480	.8080	.8560
4	1.3060	1.0810	1.3650	1.4360	1.4760	1.7830	1.7550	1.6290	1.4740	1.1700
5	2.2070	1.6560	1.6490	1.8270	2.1050	2.2010	2.3770	2.3730	2.2300	2.0100
6	2.7380	2.2830	2.3290	2.3550	2.4600	2.7270	2.7100	2.9840	2.9340	2.8790
7	3.1880	3.2140	3.0120	2.8340	3.0280	3.4310	3.5910	3.5500	3.5450	4.1090
8	3.8430	3.4090	3.3840	3.5690	3.0140	3.7830	3.7600	4.4830	3.7690	4.0350
9	4.5060	4.0460	3.9650	4.3080	3.8070	4.0700	4.1350	4.6670	4.5740	4.7060
SOPCOFAC	1.0041	1.0015	1.0116	1.0193	1.0034	1.0134	1.0337	1.0167	1.0068	1.0042

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Catch weights at age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
2	.3570	.4090	.3200	.4200	.5680	.4750	.3870	.4500	.4750	.6160
3	.7160	.8680	.8560	.7560	.7200	.8740	.8410	.8290	.7020	.8660
4	1.0390	1.1110	1.2530	1.3720	1.0580	1.1450	1.1890	1.1920	1.1080	1.0960
5	1.5420	1.5460	1.5970	1.8700	1.7420	1.3660	1.5280	1.6630	1.6460	1.6380
6	2.4030	2.0350	2.0880	2.3600	2.3800	2.0790	1.8160	1.9340	2.2220	2.2050
7	3.4580	2.8490	2.5290	2.8880	2.7850	2.8530	2.6410	2.3600	2.4780	2.6810
8	4.1860	3.4640	3.1330	2.9750	3.4470	3.2510	3.4990	3.0590	2.8390	2.8630
9	4.9690	4.6420	4.0220	3.4420	3.1560	3.8990	3.5260	3.0100	3.3590	3.2990
SOPCOFAC	1.0024	1.0007	1.0040	1.0022	1.0057	1.0170	1.0043	1.0011	1.0014	1.0127

Table 3.4.4.2 Haddock in Division Va. Mean weight (kg) at age in the stock 1978 – 1998.

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Stock weights at age (kg)

AGE	1978	1979
2	.1850	.1850
3	.4750	.4750
4	.9010	.9010
5	1.4110	1.4110
6	2.0040	2.0040
7	2.5260	2.5260
8	3.2010	3.2010
9	3.2660	3.2660

Stock weights at age (kg)

AGE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	.1850	.1850	.1850	.1850	.1850	.2450	.2340	.1570	.1760	.1810
3	.4750	.4750	.4750	.4750	.4750	.5550	.6770	.5640	.4530	.4390
4	.9010	.9010	.9010	.9010	.9010	1.1580	1.1280	1.2110	.9690	.8850
5	1.4110	1.4110	1.4110	1.4110	1.4110	1.6290	1.9290	1.8250	1.8260	1.5020
6	2.0040	2.0040	2.0040	2.0040	2.0040	2.3490	2.3710	2.5960	2.6790	2.3800
7	2.5260	2.5260	2.5260	2.5260	2.5260	2.7360	3.1490	3.0200	3.0890	2.9870
8	3.2010	3.2010	3.2010	3.2010	3.2010	3.2130	3.2410	3.6260	3.4640	3.5030
9	3.2660	3.2660	3.2660	3.2660	3.2660	3.3020	3.6880	3.8180	3.2940	3.1940

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Stock weights at age (kg)

AGE	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
2	.1830	.1740	.1570	.1710	.1800	.1650	.1800	.1720	.2020	.2030	.1790
3	.4470	.4950	.4960	.3850	.4020	.4430	.4560	.4240	.4040	.4810	.5520
4	.8290	.9980	.9020	.8740	.7000	.7380	.8550	.8080	.7410	.7210	.8930
5	1.2380	1.3970	.3790	1.4920	1.2430	1.0530	1.0400	1.1950	1.2230	1.2000	1.1650
6	1.9620	1.8790	1.9260	1.8070	1.6890	1.8680	1.4370	1.4250	1.7250	1.9650	1.7760
7	2.6880	2.4900	2.3730	2.6170	1.6460	2.6240	2.1710	1.9190	2.0010	2.3780	2.6260
8	3.0800	3.7320	2.9320	2.6200	2.6970	5.2850	3.1720	2.3310	2.3200	2.7970	2.9110
9	3.3170	3.6420	3.6720	3.3460	1.9970	1.3130	4.7800	3.6860	3.0300	2.9070	3.1370

*Stock weights for the year 2000 are from the groundfish survey and used in predictions.

Table 3.4.5.1 Haddock in Division Va. Proportion mature at age 1978 – 1999.

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Proportion mature at age

AGE \ YEAR	1978	1979
2	.0000	.0000
3	.1300	.1300
4	.3000	.3000
5	.4600	.4600
6	.6800	.6800
7	.8600	.8600
8	.9600	.9600
9	1.0000	1.0000

Proportion mature at age

AGE \ YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	.0000	.0000	.0000	.0000	.0000	.0100	.0200	.0200	.0100	.0400
3	.1300	.1300	.1300	.1300	.1300	.1000	.1900	.1100	.2200	.2000
4	.3000	.3000	.3000	.3000	.3000	.4000	.4300	.4100	.3800	.5300
5	.4600	.4600	.4600	.4600	.4600	.4300	.6600	.5200	.7700	.7200
6	.6800	.6800	.6800	.6800	.6800	.7200	.8300	.7900	.7900	.8000
7	.8600	.8600	.8600	.8600	.8600	.6700	.8700	.7800	.9300	1.0000
8	.9600	.9600	.9600	.9600	.9600	.9200	.9500	1.0000	.9000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	.8900	.9900	.9600	1.0000	1.0000

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

Proportion mature at age

AGE \ YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
2	.1100	.0400	.0400	.1200	.2500	.1600	.1700	.0900	.0300	.0500	.1000
3	.2800	.2000	.1400	.3300	.3200	.4900	.3600	.4400	.4800	.3900	.2500
4	.5900	.5800	.4200	.4700	.5700	.4300	.5800	.6600	.6600	.6800	.3900
5	.8100	.7500	.7700	.6600	.7800	.7800	.6500	.7100	.7800	.7200	.6200
6	.8400	.8200	.8600	.8800	.8600	.8300	.7800	.7500	.7600	.7600	.8000
7	.9200	.9100	.8700	.9700	1.0000	.6900	.7300	.8600	.8500	.9000	.8700
8	.9000	.9400	.7100	.9300	.9000	1.0000	.9600	.8900	.8500	.7700	.8700
9	1.0000	1.0000	1.0000	.8500	1.0000	1.0000	.9800	1.0000	1.0000	.9200	1.000

*Data for the year 2000 is from the groundfish survey and used in predictions.

Table 3.4.6.1.1. Haddock in division Va. Tuning input for the XSA. Demersal traw and gillnet CPUE and groundfish survey indices.

```
Icelandic haddock (Division Va) (run name: XSAHOB03)
103
FLT12: Trawlers in Iceland 93-99 (Catch: Thousands) (Effort: Unknown)
1993 1999
1 1 0.00 1.00
4 9
   1.0    2365     453     189     169     253      46
   1.0    5603    1761     193      77      36      52
   1.0    1184    4874     880      75      31      11
   1.0    1441     953    2721     438      34       4
   1.0    2813    1288     576    1032     113      10
   1.0    1667    2286     591     268     315      35
   1.0    3392    1020    1002     195     124      94
FLT13: Gillnets 1992-1999 for assessment 2000 (Catch: Thousands) (Effort:
Unknown)
1992 1999
1 1 0.00 1.00
5 8
   0.1    14.3    39.4   120.7    67.1
   0.1    25.1    36.4    44.6    70.4
   0.1    51.7    28.7    11.8    17.8
   0.1    88.0   141.9    21.1    10.1
   0.1    33.8   170.4    60.4     6.7
   0.1    36.0    47.9   124.2    25.8
   0.1   129.5    44.5    37.7    54.1
   0.1    72.2   125.3    25.9    12.9
FLT14: survey 2000 (Catch: Thousands) (Effort: Unknown)
1984 1999
1 1 0.99 1.00
2 8
   0.1    18.4    23.7    26.6     3.7    11.0     4.9     5.6
   0.1    59.1    12.8    16.4    13.2     1.0     2.8     1.3
   0.1   163.6    57.1    13.2    11.2     8.1     0.6     1.3
   0.1   184.8    88.9    22.9     1.4     2.2     1.9     0.2
   0.1    41.6   146.8    44.9    12.7     0.8     0.8     0.4
   0.1    27.3    39.1    91.8    30.9     3.4     0.9     0.2
   0.1    41.6    17.8    20.3    32.5     7.7     0.3     0.1
   0.1   138.7    35.6    16.6    13.2    15.9     2.2     0.2
   0.1   252.9    88.8    11.3     3.9     1.7     4.5     0.9
   0.1    40.6   162.8    46.1     7.2     2.9     1.4     4.1
   0.1    48.8    20.7    68.4     8.1     1.4     0.1     0.4
   0.1   118.4    34.3    18.7    40.4     6.2     0.6     0.1
   0.1    49.6    54.6    10.4     7.0    11.2     1.4     0.1
   0.1   110.4    28.4    23.4     4.6     3.5     4.6     0.3
   0.1    25.8    98.2    12.9     9.6     1.4     1.7     1.0
   0.1    45.5     8.6    24.7     2.9     1.6     0.4     0.2
```

Table 3.4.6.2.1 Haddock in Division Va. XSA tuning diagnostic output.

```
Lowestoft VPA Version 3.1
   28/04/2000  15:43
 Extended Survivors Analysis
 Haddock Icelandic Va (run: XSAHOB03/X03)
 CPUE data from file fleet

 Catch data for  22 years. 1978 to 1999. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,     year, year,  age ,  age
 FLT12: Trawlers in I,   1993, 1999,   4,     9,   .000,  1.000
 FLT13: Gillnets 1992,   1992, 1999,   5,     8,   .000,  1.000
 FLT14: survey 2000 (,   1984, 1999,   2,     8,   .990,  1.000

 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years

 Catchability analysis :

      Catchability dependent on stock size for ages <    4

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  4

      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 =    .500

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting not applied


 Tuning converged after   25 iterations

 Regression weights
       ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000


 Fishing mortalities
    Age,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999

      2,  .022,  .034,  .018,  .006,  .007,  .035,  .043,  .017,  .013,  .030
      3,  .141,  .082,  .136,  .098,  .116,  .231,  .183,  .145,  .135,  .121
      4,  .355,  .330,  .416,  .365,  .345,  .330,  .439,  .363,  .370,  .457
      5,  .546,  .574,  .700,  .648,  .610,  .571,  .511,  .625,  .517,  .585
      6,  .667,  .710,  .829,  .758,  .787,  .770,  .826,  .572,  .744,  .675
      7,  .693,  .723,  .798,  .902,  .884,  .856,  .964,  .820,  .814,  .745
      8,  .812,  .838,  .857,  .841,  .655,  .924,  .964,  .822,  .885,  .919
      9,  .610,  .647,  .758,  .649,  .689,  .885,  .953,  .601,  .626,  .642


 XSA population numbers (Thousands)

                                 AGE
 YEAR ,         2,         3,         4,         5,         6,         7,         8,         9,

 1990 ,    2.25E+04, 2.18E+04, 2.96E+04, 6.25E+04, 1.51E+04, 1.89E+03, 3.32E+02, 1.72E+02,
 1991 ,    8.07E+04, 1.80E+04, 1.55E+04, 1.70E+04, 2.97E+04, 6.35E+03, 7.75E+02, 1.21E+02,
 1992 ,    1.71E+05, 6.39E+04, 1.36E+04, 9.13E+03, 7.82E+03, 1.19E+04, 2.52E+03, 2.75E+02,
 1993 ,    3.76E+04, 1.38E+05, 4.56E+04, 7.34E+03, 3.71E+03, 2.80E+03, 4.40E+03, 8.77E+02,
 1994 ,    4.17E+04, 3.06E+04, 1.02E+05, 2.59E+04, 3.14E+03, 1.42E+03, 9.29E+02, 1.55E+03,
 1995 ,    7.49E+04, 3.39E+04, 2.23E+04, 5.93E+04, 1.15E+04, 1.17E+03, 4.82E+02, 3.95E+02,
 1996 ,    3.85E+04, 5.92E+04, 2.20E+04, 1.31E+04, 2.74E+04, 4.37E+03, 4.07E+02, 1.57E+02,
 1997 ,    8.85E+04, 3.02E+04, 4.04E+04, 1.16E+04, 6.45E+03, 9.84E+03, 1.36E+03, 1.27E+02,
 1998 ,    1.74E+04, 7.12E+04, 2.14E+04, 2.30E+04, 5.09E+03, 2.98E+03, 3.55E+03, 4.91E+02,
 1999 ,    4.07E+04, 1.41E+04, 5.09E+04, 1.21E+04, 1.12E+04, 1.98E+03, 1.08E+03, 1.20E+03,
```

Table 3.4.6.2.1 (Continued)

```
 Estimated population abundance at 1st Jan 2000
    ,      0.00E+00, 3.23E+04, 1.02E+04, 2.64E+04, 5.51E+03, 4.67E+03, 7.70E+02, 3.53E+02,
 Taper weighted geometric mean of the VPA populations:
    ,      4.97E+04, 4.04E+04, 3.15E+04, 1.70E+04, 8.03E+03, 3.00E+03, 1.14E+03, 4.02E+02,

 Standard error of the weighted Log(VPA populations) :

    ,         .6830,    .7126,    .6744,    .7160,    .7858,    .8308,    .9151,   1.0162,
1

 Log catchability residuals.


 Fleet : FLT12: Trawlers in I

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     2 , No data for this fleet at this age
     3 , No data for this fleet at this age
     4 , 99.99, 99.99, 99.99,  -.19,  -.15,  -.18,   .07,   .10,   .22,   .10
     5 , 99.99, 99.99, 99.99,  -.25,  -.17,   .00,  -.15,   .33,   .17,   .04
     6 , 99.99, 99.99, 99.99,  -.45,  -.25,  -.04,   .24,   .03,   .36,   .07
     7 , 99.99, 99.99, 99.99,  -.26,  -.37,  -.22,   .28,   .26,   .11,   .17
     8 , 99.99, 99.99, 99.99,  -.33,  -.80,  -.18,   .09,   .03,   .12,   .39
     9 , 99.99, 99.99, 99.99,  -.50,  -.94, -1.04, -1.10,  -.12,  -.21,  -.10


 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,         7,         8,        9
 Mean Log q,   -2.4986,   -2.1418,   -2.0827,   -2.0494,   -2.0494,   -2.0494,
 S.E(Log q),     .1663,     .2040,     .2775,     .2690,     .3988,     .7608,


 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

  4,    1.12,    -.866,      1.55,     .92,      7,     .19,   -2.50,
  5,     .97,     .220,      2.36,     .92,      7,     .22,   -2.14,
  6,     .83,    1.465,      3.24,     .94,      7,     .21,   -2.08,
  7,     .79,    2.312,      3.29,     .96,      7,     .16,   -2.05,
  8,    1.01,    -.033,      2.11,     .84,      7,     .43,   -2.14,
  9,     .98,     .119,      2.70,     .83,      7,     .48,   -2.62,



 Fleet : FLT13: Gillnets 1992

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     2 , No data for this fleet at this age
     3 , No data for this fleet at this age
     4 , No data for this fleet at this age
     5 , 99.99, 99.99,  -.56,   .20,  -.36,  -.67,  -.15,   .09,   .64,   .73
     6 , 99.99, 99.99,  -.48,   .15,   .10,   .39,  -.27,  -.20,   .03,   .25
     7 , 99.99, 99.99,  -.25,   .24,  -.42,   .35,   .13,  -.02,  -.02,  -.02
     8 , 99.99, 99.99,   .74,   .22,   .32,   .53,   .30,   .38,   .19,  -.04
     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 ,         5,         6,         7,         8
 Mean Log q,   -3.1783,   -2.0360,   -1.5791,   -1.5791,
 S.E(Log q),     .5240,     .2887,     .2480,     .4165,
```

Table 3.4.6.2.1 (Continued)

```
 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

  5,    1.39,    -.927,       .65,     .50,      8,     .74,   -3.18,
  6,    1.09,    -.476,      1.44,     .84,      8,     .33,   -2.04,
  7,    1.07,    -.556,      1.11,     .91,      8,     .28,   -1.58,
  8,    1.02,    -.187,      1.13,     .93,      8,     .25,   -1.25,


 Fleet : FLT14: survey 2000 (

  Age  ,  1984,  1985,  1986,  1987,  1988,  1989
     2 ,  -.32,   .07,   .28,  -.22,  -.40,  -.23
     3 ,  -.08,  -.12,   .44,   .04,  -.17,  -.07
     4 ,   .11,   .08,   .49,   .28,   .17,   .12
     5 ,   .44,   .19,   .67,  -.77,   .65,   .57
     6 ,  1.03,  -.02,  1.08,  -.01,  -.31,   .50
     7 ,   .01,   .59,   .62,   .64,   .04,  1.00
     8 ,   .00,  -.31,   .94,   .44,   .29,   .16
     9 , No data for this fleet at this age

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     2 ,   .37,   .26,   .07,  -.18,  -.11,   .18,   .02,  -.07,   .16,  -.13
     3 ,  -.11,   .63,   .19,  -.08,  -.34,   .09,  -.11,  -.03,   .17,  -.32
     4 ,  -.09,   .33,   .17,   .31,  -.12,   .09,  -.38,  -.25,  -.20,  -.33
     5 ,  -.05,   .38,  -.09,   .69,  -.49,   .25,  -.06,  -.24,  -.30,  -.78
     6 ,   .11,   .21,  -.58,   .63,   .10,   .27,   .05,   .08,  -.43, -1.15
     7 ,  -.94,  -.13,   .03,   .42, -1.57,   .39,   .03,   .27,   .46,  -.65
     8 ,  -.18,  -.31,   .03,   .98,   .02,  -.44,  -.24,  -.49,  -.18,  -.56
     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 ,         4,         5,         6,         7,         8
 Mean Log q,   -4.3425,   -4.4680,   -4.5303,   -4.6162,   -4.6162,
 S.E(Log q),     .2617,     .4877,     .5401,     .6885,     .4638,


 Regression statistics :

 Ages with q dependent on year class strength

 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

  2,     .96,     .413,      4.39,     .91,     16,     .22,   -4.12,
  3,     .86,    1.186,      5.12,     .88,     16,     .27,   -4.24,

 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,    1.11,    -.821,      3.67,     .85,     16,     .30,   -4.34,
  5,     .98,     .102,      4.58,     .69,     16,     .50,   -4.47,
  6,    1.01,    -.066,      4.46,     .67,     16,     .58,   -4.53,
  7,     .93,     .292,      4.86,     .62,     16,     .67,   -4.62,
  8,     .86,    1.088,      5.00,     .86,     16,     .39,   -4.66,
1

 Terminal year survivor and F summaries :

 Age  2   Catchability dependent on age and year class strength

 Year class = 1997

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT13: Gillnets 1992,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT14: survey 2000 (,     28365.,   .300,      .000,    .00,   1,  .644,     .034

   P shrinkage mean  ,     40409.,    .71,,,,                        .118,     .024

   F shrinkage mean  ,     41289.,    .50,,,,                        .239,     .023
```

Table 3.4.6.2.1 (Continued)

```
 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     32342.,       .24,      .16,    3,    .643,   .030


 Age  3   Catchability dependent on age and year class strength

 Year class = 1996

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,        1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT13: Gillnets 1992,        1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT14: survey 2000 (,     9563.,   .219,       .237,   1.08,   2,  .747,     .129

   P shrinkage mean  ,     31485.,    .67,,,,                        .090,     .041

   F shrinkage mean  ,      7450.,    .50,,,,                        .163,     .163

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     10218.,       .19,      .24,    4,   1.269,   .121


1
 Age  4   Catchability constant w.r.t. time and dependent on age

 Year class = 1995

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,    29188.,   .300,       .000,    .00,   1,  .233,     .421
 FLT13: Gillnets 1992,        1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT14: survey 2000 (,    24177.,   .174,       .148,    .85,   3,  .635,     .490

   F shrinkage mean  ,     33939.,    .50,,,,                        .132,     .372

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     26419.,       .15,      .11,    5,    .724,   .457

 Age  5   Catchability constant w.r.t. time and dependent on age

 Year class = 1994

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,     6160.,   .216,       .090,    .42,   2,  .350,     .537
 FLT13: Gillnets 1992,    11410.,   .557,       .000,    .00,   1,  .060,     .325
 FLT14: survey 2000 (,     4558.,   .167,       .157,    .94,   4,  .456,     .674

   F shrinkage mean  ,      5684.,    .50,,,,                        .134,     .572

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      5513.,       .13,      .11,    8,    .864,   .585


 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 1993

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,     5210.,   .184,       .030,    .16,   3,  .371,     .623
 FLT13: Gillnets 1992,     6372.,   .273,       .140,    .51,   2,  .208,     .535
 FLT14: survey 2000 (,     3468.,   .171,       .217,   1.26,   5,  .290,     .833

   F shrinkage mean  ,      4058.,    .50,,,,                        .131,     .747
```

Table 3.4.6.2.1 (Continued)

```
 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      4673.,       .12,      .11,   11,    .876,   .675

Age  7   Catchability constant w.r.t. time and dependent on age

 Year class = 1992

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,       969.,   .182,       .058,    .32,   4,  .379,     .631
 FLT13: Gillnets 1992,       771.,   .218,       .022,    .10,   3,  .306,     .745
 FLT14: survey 2000 (,       562.,   .209,       .109,    .52,   6,  .163,     .923

   F shrinkage mean  ,       607.,    .50,,,,                        .152,     .877

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       770.,       .13,      .07,   14,    .536,   .745


 Age  8   Catchability constant w.r.t. time and age (fixed at the value for age)  7

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,       407.,   .185,       .101,    .54,   5,  .327,     .836
 FLT13: Gillnets 1992,       329.,   .215,       .041,    .19,   4,  .269,     .962
 FLT14: survey 2000 (,       275.,   .237,       .138,    .58,   7,  .198,    1.076

   F shrinkage mean  ,       391.,    .50,,,,                        .205,     .859

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       353.,       .14,      .06,   17,    .437,   .919


 Age  9   Catchability constant w.r.t. time and age (fixed at the value for age)  7

 Year class = 1990

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT12: Trawlers in I,       575.,   .228,       .065,    .29,   6,  .317,     .592
 FLT13: Gillnets 1992,       520.,   .224,       .116,    .52,   4,  .216,     .639
 FLT14: survey 2000 (,       486.,   .268,       .065,    .24,   7,  .145,     .672

   F shrinkage mean  ,       475.,    .50,,,,                        .322,     .683

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       516.,       .19,      .04,   18,    .214,   .642


1
1
```

Table 3.4.6.2.2 Haddock in division Va. Fishing mortality.

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

At 3/05/2000 13:39

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,
AGE		
2,	.0008,	.0021,
3,	.0185,	.0186,
4,	.0901,	.1734,
5,	.2658,	.4376,
6,	.7990,	.7039,
7,	1.1627,	.9920,
8,	1.8931,	1.2006,
9,	1.5483,	1.1093,
+gp,	1.5483,	1.1093,
0 FBAR 4- 7,	.5794,	.5767,

Table 8 Fishing mortality (F) at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	.0181,	.0001,	.0013,	.0000,	.0033,	.0114,	.0024,	.0149,	.0031,	.0032,
3,	.0226,	.0195,	.0405,	.0228,	.0344,	.1284,	.1282,	.1219,	.0862,	.0770,
4,	.1360,	.1046,	.1345,	.3068,	.2218,	.3310,	.4472,	.4163,	.4057,	.2902,
5,	.2817,	.3052,	.3461,	.3606,	.4220,	.4615,	.6437,	.6653,	.6363,	.4658,
6,	.4911,	.8141,	.4505,	.6657,	.8134,	.6094,	1.1431,	.6995,	.7754,	.9291,
7,	.6471,	.8637,	.8759,	.5688,	.5499,	.6772,	.9260,	.7784,	.8096,	.9529,
8,	.9098,	.7752,	1.1705,	1.0604,	.6393,	.8856,	1.0338,	.8447,	1.1884,	1.4494,
9,	.7863,	.8279,	1.0350,	.8230,	.5998,	.7852,	.9978,	.7771,	.9747,	1.1892,
+gp,	.7863,	.8279,	1.0350,	.8230,	.5998,	.7852,	.9978,	.7771,	.9747,	1.1892,
0 FBAR 4- 7,	.3890,	.5219,	.4518,	.4755,	.5018,	.5198,	.7900,	.6399,	.6568,	.6595,

1

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

At 3/05/2000 13:39

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
2,	.0223,	.0344,	.0178,	.0065,	.0075,	.0352,	.0434,	.0171,	.0161,	.0285,	.0205,
3,	.1419,	.0823,	.1365,	.0982,	.1165,	.2316,	.1823,	.1463,	.1326,	.1498,	.1429,
4,	.3572,	.3313,	.4181,	.3676,	.3470,	.3315,	.4401,	.3604,	.3742,	.4476,	.3941,
5,	.5520,	.5802,	.7053,	.6544,	.6166,	.5759,	.5151,	.6277,	.5102,	.5954,	.5778,
6,	.6870,	.7257,	.8461,	.7710,	.8037,	.7862,	.8409,	.5798,	.7517,	.6592,	.6635,
7,	.7224,	.7678,	.8355,	.9487,	.9182,	.8991,	1.0134,	.8543,	.8380,	.7609,	.8177,
8,	.9181,	.9185,	.9865,	.9368,	.7321,	1.0201,	1.0947,	.9326,	.9769,	.9867,	.9654,
9,	.8158,	.8491,	.9414,	.8976,	.8825,	1.1563,	1.2607,	.8072,	.8279,	.8028,	.8126,
+gp,	.8158,	.8491,	.9414,	.8976,	.8825,	1.1563,	1.2607,	.8072,	.8279,	.8028,	
0 FBAR 4- 7,	.5797,	.6013,	.7013,	.6854,	.6714,	.6482,	.7024,	.6055,	.6185,	.6158,	

1

Table 3.4.6.3.1.
1

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

At 3/05/2000 13:40

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR,	1978,	1979,
	AGE		
	2,	151699,	83850,
	3,	34955,	124103,
	4,	27339,	28095,
	5,	34038,	20454,
	6,	9001,	21364,
	7,	2928,	3315,
	8,	816,	749,
	9,	132,	101,
	+gp,	0,	0,
0	TOTAL,	260907,	282031,

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
	AGE										
	2,	36697,	9736,	42202,	30160,	19935,	41753,	89154,	167105,	47540,	26646,
	3,	68505,	29507,	7971,	34507,	24692,	16267,	33798,	72816,	134790,	38802,
	4,	99738,	54835,	23691,	6267,	27614,	19533,	11714,	24341,	52777,	101247,
	5,	19340,	71274,	40435,	16955,	3776,	18111,	11485,	6132,	13142,	28799,
	6,	10811,	11947,	43008,	23421,	9679,	2027,	9347,	4940,	2581,	5695,
	7,	8652,	5417,	4333,	22440,	9855,	3513,	902,	2440,	2009,	973,
	8,	1006,	3709,	1870,	1478,	10402,	4655,	1461,	293,	917,	732,
	9,	185,	332,	1399,	475,	419,	4494,	1572,	425,	103,	229,
	+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0	TOTAL,	244935,	186757,	164909,	135703,	106371,	110354,	159433,	278491,	253859,	203122,

1

Run title : Haddock Icelandic Va (run: XSAHOB03/X03)

At 3/05/2000 13:40

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 78-97	AMST 78-97
	AGE													
	2,	22397,	80388,	170680,	37441,	41618,	75355,	38211,	89667,	14351,	42384,	0,	50411,	65112,
	3,	21745,	17933,	63589,	137274,	30457,	33820,	59563,	29957,	72169,	11562,	33726,	39319,	50753,
	4,	29413,	15448,	13522,	45418,	101879,	22195,	21965,	40639,	21188,	51749,	8150,	29718,	38383,
	5,	62013,	16848,	9081,	7288,	25746,	58958,	13044,	11581,	23204,	11932,	27080,	18363,	24425,
	6,	14799,	29234,	7722,	3672,	3101,	11378,	27137,	6380,	5061,	11406,	5386,	9330,	12862,
	7,	1841,	6095,	11584,	2713,	1391,	1137,	4244,	9583,	2926,	1954,	4831,	3620,	5268,
	8,	307,	732,	2316,	4113,	860,	455,	379,	1261,	3339,	1036,	748,	1195,	1926,
	9,	141,	100,	239,	707,	1320,	339,	134,	104,	406,	1029,	316,	330,	647,
	+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	378,		
0	TOTAL,	152655,	166779,	278732,	238627,	206372,	203636,	164675,	189171,	142643,	133053,	80614,		

1

Table 3.4.6.3.2. Haddock in Division VA. summary.

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 7,
1978,	151699,	145804,	53205,	43488,	.8174,	.5794,
1979,	83850,	182549,	67479,	55334,	.8200,	.5767,
1980,	36697,	203827,	80966,	51112,	.6313,	.3890,
1981,	9736,	216371,	103433,	63580,	.6147,	.5219,
1982,	42202,	197680,	111476,	69325,	.6219,	.4518,
1983,	30160,	161441,	101585,	65943,	.6491,	.4755,
1984,	19935,	124580,	79372,	48285,	.6083,	.5018,
1985,	41753,	115551,	59576,	50933,	.8549,	.5198,
1986,	89154,	114648,	56174,	48863,	.8699,	.7900,
1987,	167105,	130849,	41446,	40801,	.9844,	.6399,
1988,	47540,	161203,	65862,	54236,	.8235,	.6568,
1989,	26646,	174472,	99279,	62979,	.6344,	.6595,
1990,	22397,	150371,	110005,	67200,	.6109,	.5797,
1991,	80388,	135024,	90718,	54732,	.6033,	.6013,
1992,	170680,	124004,	55664,	47212,	.8482,	.7013,
1993,	37441,	136699,	68800,	48844,	.7099,	.6854,
1994,	41618,	135535,	82919,	59345,	.7157,	.6714,
1995,	75355,	132961,	87344,	61131,	.6999,	.6482,
1996,	38211,	116435,	69580,	56958,	.8186,	.7024,
1997,	89667,	105604,	64108,	44053,	.6872,	.6055,
1998,	14351,	99696,	66006,	41434,	.6277,	.6185,
1999,	42384,	98746,	64481,	45841,	.7109,	.6158,
Arith. Mean ,	61771,	143820,	76340,	53710,	.7256,	.5996,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

Table 3.4.7.1.1

11:35 Wednesday, May 10, 2000
Icelandic haddock (Division Va)

Prediction with management option table: Input data

Year: 2000								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	80000.000	0.2000	0.1000	0.0000	0.0000	0.179	0.0185	0.587
3	36600.000	0.2000	0.2500	0.0000	0.0000	0.552	0.1400	0.856
4	10200.000	0.2000	0.3900	0.0000	0.0000	0.893	0.3884	1.238
5	28700.000	0.2000	0.6200	0.0000	0.0000	1.165	0.5825	1.547
6	5450.000	0.2000	0.8000	0.0000	0.0000	1.776	0.6759	2.157
7	4730.000	0.2000	0.8700	0.0000	0.0000	2.620	0.8420	2.701
8	693.000	0.2000	0.8700	0.0000	0.0000	2.911	1.0023	3.128
9	303.000	0.2000	1.0000	0.0000	0.0000	3.137	0.8971	3.154
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	78000.000	0.2000	0.0600	0.0000	0.0000	0.192	0.0185	0.587
3	.	0.2000	0.3800	0.0000	0.0000	0.455	0.1400	0.850
4	.	0.2000	0.6600	0.0000	0.0000	1.024	0.3884	1.228
5	.	0.2000	0.7700	0.0000	0.0000	1.330	0.5825	1.701
6	.	0.2000	0.8100	0.0000	0.0000	1.689	0.6759	2.064
7	.	0.2000	0.8900	0.0000	0.0000	2.291	0.8420	2.663
8	.	0.2000	0.8800	0.0000	0.0000	3.089	1.0023	3.141
9	.	0.2000	1.0000	0.0000	0.0000	3.004	0.8971	3.465
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	47000.000	0.2000	0.0600	0.0000	0.0000	0.191	0.0185	0.587
3	.	0.2000	0.3800	0.0000	0.0000	0.486	0.1400	0.850
4	.	0.2000	0.6600	0.0000	0.0000	0.844	0.3884	1.222
5	.	0.2000	0.7700	0.0000	0.0000	1.282	0.5825	1.690
6	.	0.2000	0.8100	0.0000	0.0000	1.813	0.6759	2.221
7	.	0.2000	0.8900	0.0000	0.0000	2.214	0.8420	2.591
8	.	0.2000	0.8800	0.0000	0.0000	2.879	1.0023	3.117
9	.	0.2000	1.0000	0.0000	0.0000	3.145	0.8971	3.480
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANEHJ01
Date and time: 01MAY00:16:43

Table 3.4.7.1.2 Haddock in division Va. Input file for the RCT3.

Iceland Haddock: VPA and groundfish survey data
4 23 2

'Yearcl'	'VPAage2'	'Surv4'	'Surv3'	'Surv2'	'Surv1'
1977	88	-11	-11	-11	-11
1978	37	-11	-11	-11	-11
1979	10	-11	-11	-11	-11
1980	42	-11	-11	-11	-11
1981	30	237	-11	-11	-11
1982	20	128	184	-11	-11
1983	42	571	591	327	-11
1984	89	889	1636	1085	282
1985	167	1468	1848	2963	1240
1986	48	391	416	407	223
1987	27	178	273	234	158
1988	22	356	416	319	106
1989	80	888	1387	1460	705
1990	169	1628	2529	2123	897
1991	37	207	406	372	185
1992	41	343	488	612	299
1993	75	546	1184	832	587
1994	38	284	496	712	358
1995	89	982	1104	1204	946
1996	-11	86	258	182	86
1997	-11	-11	454	865	231
1998	-11	-11	-11	910	812
1999	-11	-11	-11	-11	611

Table 3.4.7.1.3 Haddock in division Va. Output file from RCT3.

```
Analysis by RCT3 ver3.1 of data from file :

 Recrun5.dat

 Iceland Haddock: VPA and groundfish survey data

 Data for    4 surveys over   23 years :  1977 - 1999

 Regression type = C
 Tapered time weighting applied
 power =    3 over  20 years
 Survey weighting not applied

 Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as    .20
 Minimum of   3 points used for regression

 Forecast/Hindcast variance correction used.
```

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Surv4	.93	-1.71	.28	.856	15	4.47	2.43	.386	.188
Surv3	.91	-1.97	.22	.903	14	5.56	3.09	.279	.360
Surv2	.89	-1.77	.26	.870	13	5.21	2.84	.341	.241
Surv1	.91	-1.33	.32	.817	12	4.47	2.74	.435	.148
					VPA Mean =		4.01	.662	.064

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Surv4									
Surv3	.91	-1.99	.22	.904	14	6.12	3.60	.264	.418
Surv2	.89	-1.84	.26	.868	13	6.76	4.22	.304	.315
Surv1	.91	-1.32	.32	.819	12	5.45	3.62	.383	.198
					VPA Mean =		4.03	.652	.068

Table 3.4.7.1.3 (Continued)

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Surv4									
Surv3									
Surv2	.90	-1.91	.26	.866	13	6.81	4.26	.311	.538
Surv1	.90	-1.32	.32	.821	12	6.70	4.75	.393	.336
					VPA Mean =		4.04	.643	.126

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Surv4									
Surv3									
Surv2									
Surv1	.90	-1.31	.31	.823	12	6.42	4.47	.385	.731
					VPA Mean =		4.06	.634	.269

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1996	18	2.91	.17	.19	1.23		
1997	46	3.83	.17	.16	.91		
1998	80	4.39	.23	.18	.65		
1999	78	4.36	.33	.19	.32		

Table 3.4.7.2.1

11:35 Wednesday, May 10, 2000
Icelandic haddock (Division Va)

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	9188.886	3.326	7743.137	3.326	7743.137
0.0500	0.0311	0.106	314.085	4.987	7542.374	2.821	6159.668	2.821	6159.668
0.1000	0.0622	0.180	506.150	4.623	6434.360	2.479	5101.834	2.479	5101.834
0.1500	0.0933	0.233	630.031	4.355	5638.476	2.230	4347.980	2.230	4347.980
0.2000	0.1245	0.275	712.770	4.150	5039.435	2.041	3785.295	2.041	3785.295
0.2500	0.1556	0.308	769.306	3.985	4572.380	1.892	3350.373	1.892	3350.373
0.3000	0.1867	0.336	808.474	3.850	4198.051	1.771	3004.876	1.771	3004.876
0.3500	0.2178	0.359	835.778	3.736	3891.308	1.671	2724.288	1.671	2724.288
0.4000	0.2489	0.378	854.787	3.639	3635.313	1.586	2492.223	1.586	2492.223
0.4500	0.2800	0.395	867.887	3.555	3418.375	1.513	2297.323	1.513	2297.323
0.5000	0.3111	0.411	876.718	3.480	3232.127	1.450	2131.479	1.450	2131.479
0.5500	0.3422	0.424	882.428	3.414	3070.424	1.394	1988.752	1.394	1988.752
0.6000	0.3734	0.436	885.836	3.355	2928.655	1.345	1864.698	1.345	1864.698
0.6500	0.4045	0.447	887.538	3.301	2803.295	1.300	1755.930	1.300	1755.930
0.7000	0.4356	0.457	887.967	3.252	2691.600	1.260	1659.820	1.260	1659.820
0.7500	0.4667	0.466	887.447	3.207	2591.408	1.224	1574.305	1.224	1574.305
0.8000	0.4978	0.475	886.217	3.166	2500.989	1.191	1497.740	1.191	1497.740
0.8500	0.5289	0.483	884.462	3.127	2418.943	1.160	1428.800	1.160	1428.800
0.9000	0.5600	0.490	882.316	3.092	2344.127	1.132	1366.406	1.132	1366.406
0.9500	0.5911	0.497	879.887	3.058	2275.597	1.106	1309.671	1.106	1309.671
1.0000	0.6223	0.504	877.254	3.027	2212.567	1.082	1257.861	1.082	1257.861
1.0500	0.6534	0.510	874.480	2.997	2154.377	1.059	1210.361	1.059	1210.361
1.1000	0.6845	0.515	871.610	2.970	2100.470	1.038	1166.654	1.038	1166.654
1.1500	0.7156	0.521	868.683	2.943	2050.372	1.018	1126.302	1.018	1126.302
1.2000	0.7467	0.526	865.727	2.919	2003.676	1.000	1088.930	1.000	1088.930
1.2500	0.7778	0.531	862.763	2.895	1960.031	0.982	1054.220	0.982	1054.220
1.3000	0.8089	0.536	859.807	2.872	1919.135	0.966	1021.893	0.966	1021.893
1.3500	0.8400	0.540	856.874	2.851	1880.724	0.950	991.710	0.950	991.710
1.4000	0.8712	0.544	853.971	2.830	1844.567	0.935	963.464	0.935	963.464
1.4500	0.9023	0.548	851.107	2.811	1810.461	0.921	936.970	0.921	936.970
1.5000	0.9334	0.552	848.287	2.792	1778.226	0.907	912.070	0.907	912.070
1.5500	0.9645	0.556	845.514	2.774	1747.706	0.894	888.621	0.894	888.621
1.6000	0.9956	0.560	842.792	2.757	1718.758	0.882	866.499	0.882	866.499
1.6500	1.0267	0.563	840.121	2.740	1691.258	0.870	845.592	0.870	845.592
1.7000	1.0578	0.566	837.503	2.724	1665.094	0.859	825.802	0.859	825.802
1.7500	1.0889	0.570	834.939	2.709	1640.163	0.848	807.039	0.848	807.039
1.8000	1.1201	0.573	832.428	2.694	1616.376	0.837	789.224	0.837	789.224
1.8500	1.1512	0.576	829.970	2.679	1593.651	0.827	772.287	0.827	772.287
1.9000	1.1823	0.579	827.564	2.665	1571.913	0.818	756.162	0.818	756.162
1.9500	1.2134	0.582	825.210	2.652	1551.096	0.808	740.791	0.808	740.791
2.0000	1.2445	0.584	822.906	2.639	1531.138	0.799	726.122	0.799	726.122
2.0500	1.2756	0.587	820.652	2.626	1511.984	0.791	712.107	0.791	712.107
2.1000	1.3067	0.590	818.446	2.614	1493.582	0.783	698.702	0.783	698.702
2.1500	1.3378	0.592	816.287	2.602	1475.886	0.774	685.867	0.774	685.867
2.2000	1.3690	0.594	814.174	2.590	1458.854	0.767	673.566	0.767	673.566
2.2500	1.4001	0.597	812.106	2.579	1442.446	0.759	661.765	0.759	661.765
2.3000	1.4312	0.599	810.081	2.568	1426.625	0.752	650.435	0.752	650.435
2.3500	1.4623	0.601	808.098	2.557	1411.360	0.745	639.547	0.745	639.547
2.4000	1.4934	0.604	806.156	2.547	1396.617	0.738	629.074	0.738	629.074
2.4500	1.5245	0.606	804.254	2.537	1382.371	0.731	618.994	0.731	618.994
2.5000	1.5556	0.608	802.390	2.527	1368.593	0.725	609.284	0.725	609.284
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

```
Notes: Run name              : YLDLOA02
       Date and time         : 29APR00:18:30
       Computation of ref. F: Simple mean, age 4 - 7
       F-0.1 factor          : 0.2692
       F-max factor          : 0.6952
       F-0.1 reference F     : 0.1675
       F-max reference F     : 0.4326
       Recruitment           : Single recruit
```

Table 3.4.7.3.1

11:35 Wednesday, May 10, 2000
Icelandic haddock (Division Va)

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.9700	0.6035	102107	51996	39000	0.0000	0.0000	112450	63860	0	154506	100460
.	.	.	.	.	0.0500	0.0311	.	63860	2527	152150	98511
.	.	.	.	.	0.1000	0.0622	.	63860	4986	149860	96619
.	.	.	.	.	0.1500	0.0933	.	63860	7379	147633	94783
.	.	.	.	.	0.2000	0.1244	.	63860	9708	145469	93000
.	.	.	.	.	0.2500	0.1555	.	63860	11976	143364	91269
.	.	.	.	.	0.3000	0.1867	.	63860	14183	141316	89588
.	.	.	.	.	0.3500	0.2178	.	63860	16334	139324	87955
.	.	.	.	.	0.4000	0.2489	.	63860	18428	137386	86369
.	.	.	.	.	0.4500	0.2800	.	63860	20468	135500	84827
.	.	.	.	.	0.5000	0.3111	.	63860	22456	133664	83330
.	.	.	.	.	0.5500	0.3422	.	63860	24393	131877	81875
.	.	.	.	.	0.6000	0.3733	.	63860	26281	130138	80460
.	.	.	.	.	0.6500	0.4044	.	63860	28122	128444	79085
.	.	.	.	.	0.7000	0.4355	.	63860	29916	126794	77747
.	.	.	.	.	0.7500	0.4666	.	63860	31666	125187	76447
.	.	.	.	.	0.8000	0.4978	.	63860	33373	123621	75182
.	.	.	.	.	0.8500	0.5289	.	63860	35039	122096	73952
.	.	.	.	.	0.9000	0.5600	.	63860	36664	120609	72755
.	.	.	.	.	0.9500	0.5911	.	63860	38249	119160	71590
.	.	.	.	.	1.0000	0.6222	.	63860	39797	117747	70457
.	.	.	.	.	1.0500	0.6533	.	63860	41308	116370	69353
.	.	.	.	.	1.1000	0.6844	.	63860	42783	115026	68279
.	.	.	.	.	1.1500	0.7155	.	63860	44223	113716	67233
.	.	.	.	.	1.2000	0.7466	.	63860	45630	112438	66214
.	.	.	.	.	1.2500	0.7777	.	63860	47005	111191	65222
.	.	.	.	.	1.3000	0.8089	.	63860	48348	109974	64256
.	.	.	.	.	1.3500	0.8400	.	63860	49660	108787	63314
.	.	.	.	.	1.4000	0.8711	.	63860	50943	107627	62397
.	.	.	.	.	1.4500	0.9022	.	63860	52197	106495	61503
.	.	.	.	.	1.5000	0.9333	.	63860	53423	105390	60631
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
Notes: Run name             : MANEHJ01
       Date and time        : 01MAY00:16:43
       Computation of ref. F: Simple mean, age 4 - 7
       Basis for 2000       : TAC constraints
```

Figure 3.4.2.1 Haddock Division Va. Nominal landings (tonnes) 1950-1999.

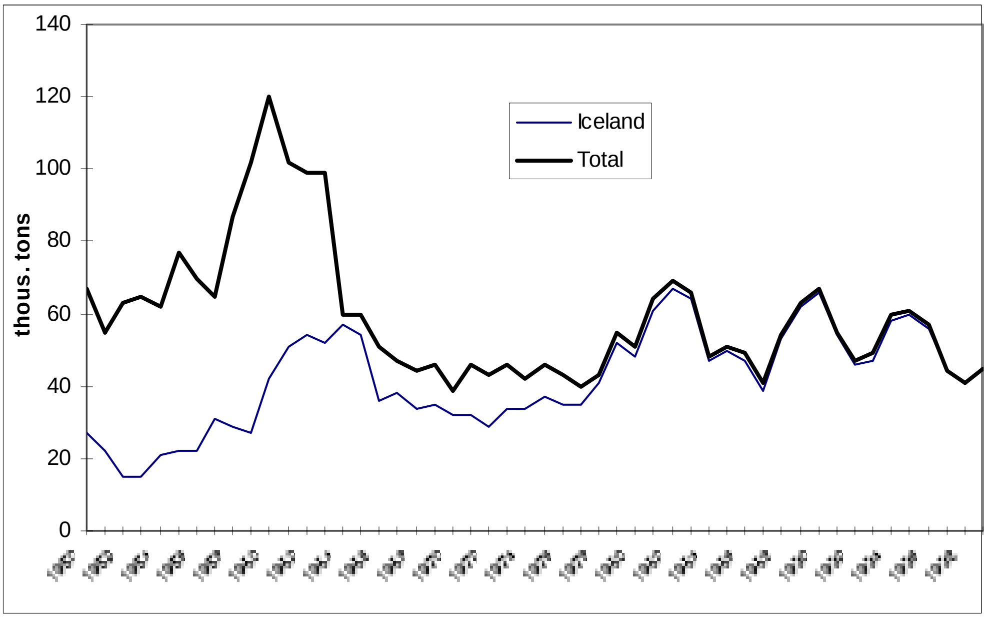


Figure 3.4.6.1.1. Development of CPUE for various fleets catching haddock.

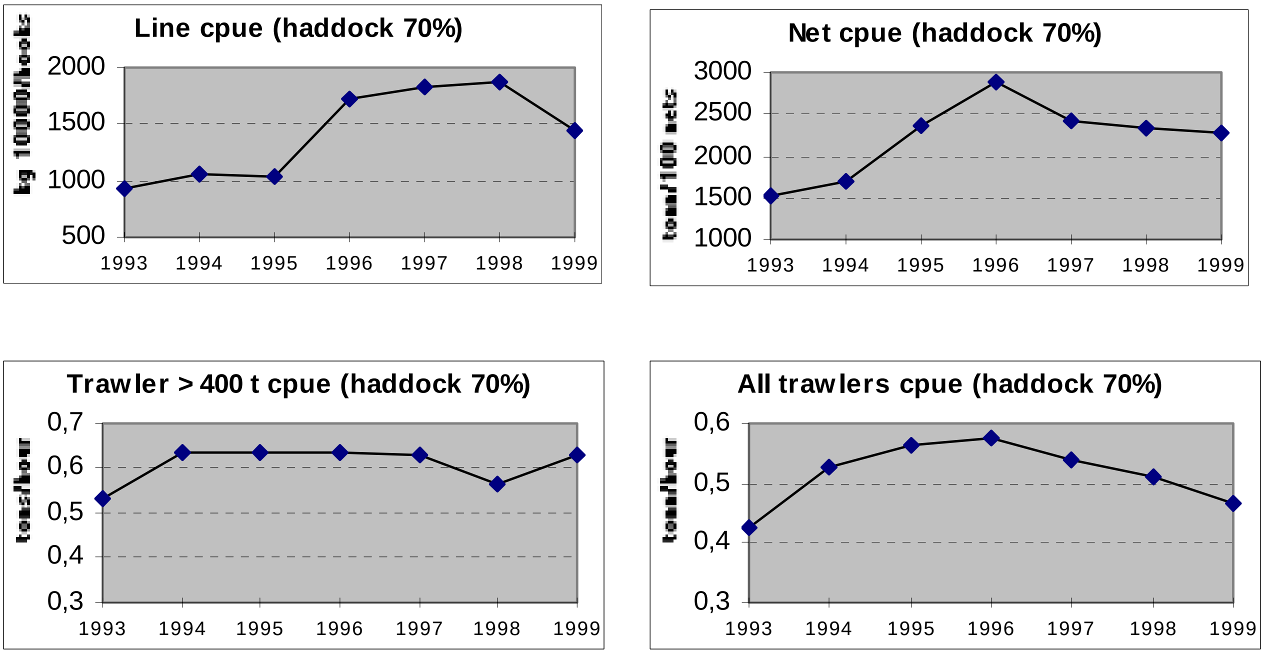
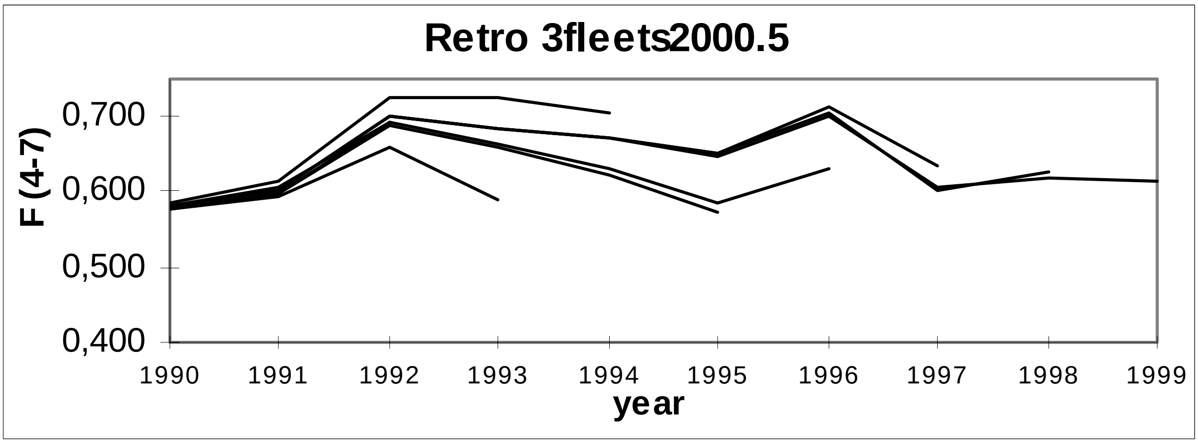


Figure 3.4.6.2.1 Haddock in Division Va. Retrospective analyses of the default XSA run.



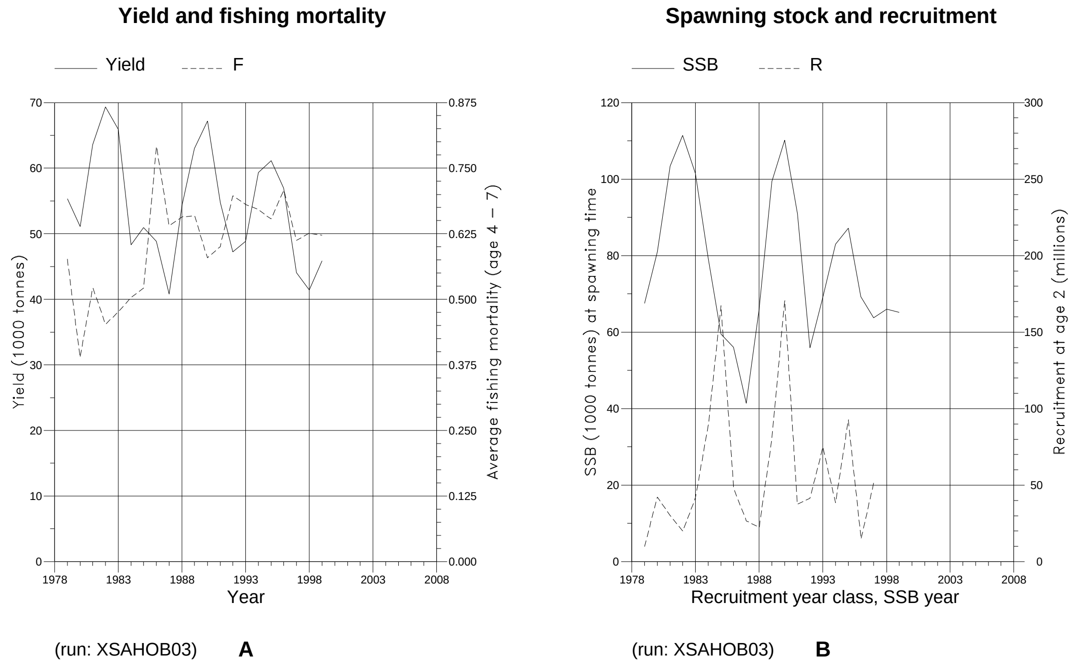


Figure 3.4.6.2.2 Summary plots of yield, fishing mortality, spawning stock and recruitment.

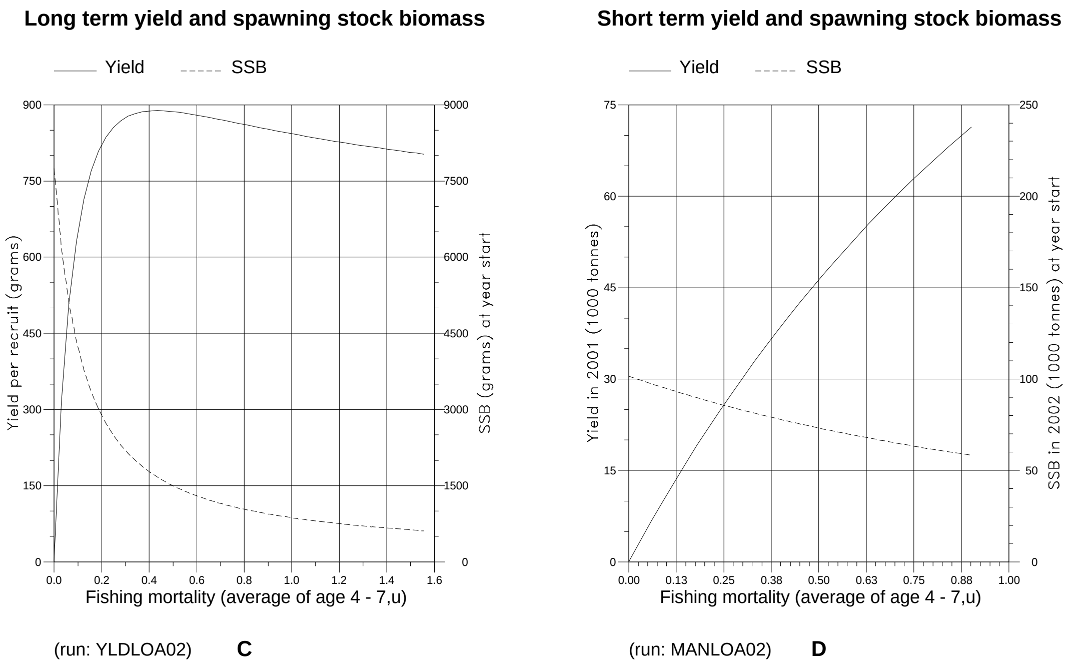


Figure 3.4.7.2.1 Summary plots of yield and spawning stock biomass per recruit.

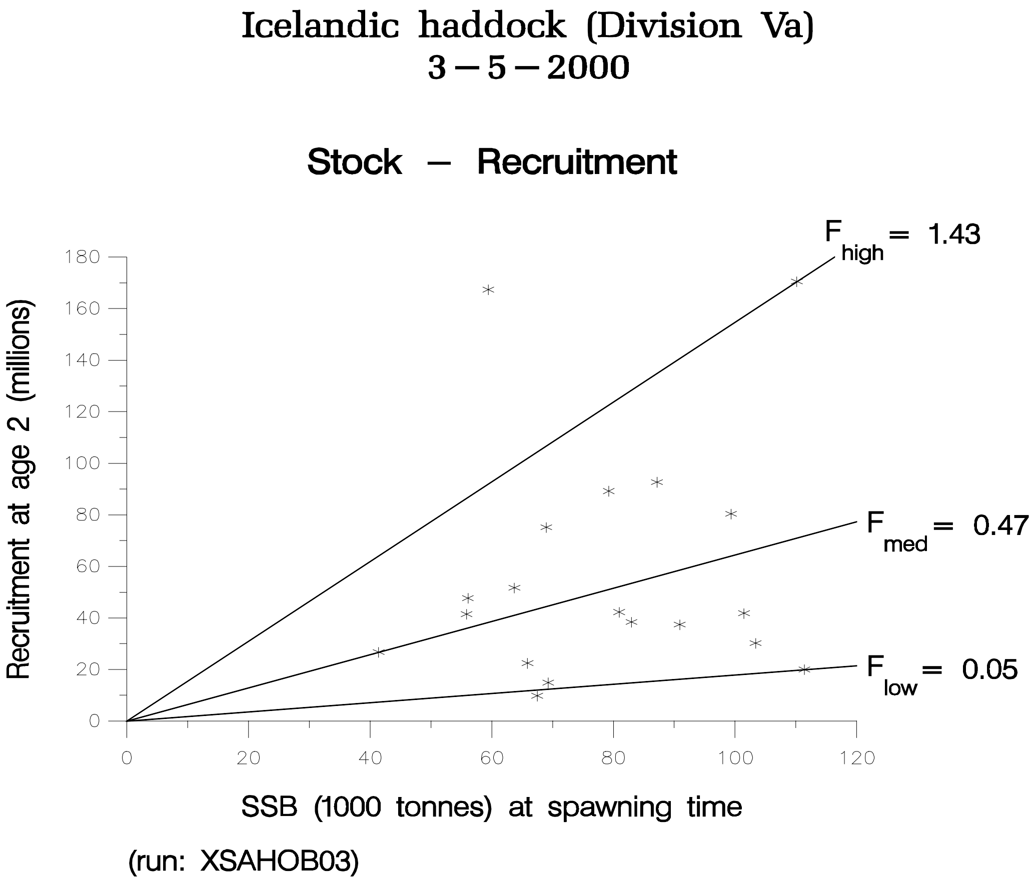


Figure 3.4.7.2.2 Haddock in Division Va. SSB-recruit plot.

3 THE COD STOCK COMPLEX IN GREENLAND (NAFO SUB-AREA 1 AND ICES SUB-AREA XIV) AND ICELANDIC WATERS (DIVISION Va)

3.1 Inter-relationship Between the Cod Stocks in the Greenland-Iceland Area

Tagging experiments carried out at Greenland and Iceland show that mature cod at West Greenland migrate to East Greenland. Tagging experiments at East Greenland also show that mature cod from that area migrate to Iceland (Tåning, 1937; Hansen, 1949; and Anon. 1971). On the other hand, immature cod seem not to emigrate from East Greenland to Iceland, but in some years immature cod migrate from East Greenland to the West Greenland stock (Anon. 1971). Tagging experiments at Iceland show that migration of cod from Iceland to Greenland waters occurs very seldom and can be ignored in stock assessments (Jonsson 1965, 1986). Migrations from Greenland waters to Iceland can, therefore, be regarded as a one-way migration.

In egg and larval surveys cod eggs have been found in an almost continuos belt from Iceland to East Greenland, along the East Greenland coast, round Cape Farewell and over the banks at West Greenland (Tåning 1937, Anon. 1963). From 0-group surveys carried out in the East Greenland-Iceland area since 1970, it becomes quite evident that the drift of 0-group cod from the Iceland spawning grounds to the different nursery areas at Iceland varies from year to year. The same applies to the drift of 0-group cod with the currents from Iceland to East Greenland (Table 4.1.1). In some years it seems that no larval drift has taken place to the Greenland area, while in other years some, and in some years like 1973 and 1984, considerable numbers drifted to East Greenland waters (Vílhjalmsson and Fridgeirsson 1976, Vílhjalmsson and Magnússon 1984, Sveinbjörnsson and Jónsson 1999). Since 1995, 0-group surveys were continued with the area coverage reduced to the Icelandic EEZ. However, the estimates of the 1997 and 1999 year classes are exceptionally high. More than 60% of the 0-group cod were distributed in northern areas off Iceland (Table 4.1.1).

The 1973 and 1984 year classes have been very important to the fisheries off both West and East Greenland. Tagging results have shown that when these two year classes became mature, they had migrated in large numbers from West to East Greenland and, to some extent, to the spawning area off the southwest coast of Iceland. This migration of mature cod from Greenland to Iceland influences the assessment of these stocks (Schopka, 1993) and it cannot therefore be ignored in the assessments.

Table 4.1.1 Abundance indices of 0-group cod from international and Icelandic 0-group surveys (Sveinbjörnsson and Jónsson, 1999) in the East Greenland/Iceland area, 1971-99 (except 1972 and 1995-96).

Year class	Dohrn Bank East Greenland	SE Iceland	SW Iceland	W Iceland	N Iceland	E Iceland	Total
1971	+	-	-	60	214	-	283
1973	135	10	107	96	757	86	1191
1974	2	-	-	22	30	+	54
1975	+	-	2	50	73	5	130
1976	5	9	30	102	2015	584	2743
1977	7	2	+	26	305	94	435
1978	2	-	+	169	335	47	552
1979	2	+	1	22	345	+	370
1980	1	2	+	38	507	10	557
1981	19	-	-	41	19	-	78
1982	+	-	+	7	4	-	11
1983	+	-	+	85	66	2	153
1984	372	5	+	200	826	369	1772
1985	32	+	+	581	197	2	812
1986	+	1	2	15	32	+	50
1987	7	-	1	2	61	10	81
1988	0	-	1	7	12	+	20
1989	1	-	3	7	30	+	41
1990	3	-	+	2	30	2	37
1991	+	-	-	+	5	+	6
1992	0	-	+	15	21	5	42
1993	1	-	+	36	116	2	155
1994	0	-	0	1	71	2	74
1997	4[1]	+	+	97	1007	46	1152
1998[2]		+	2	814	1799	137	2752
1999[2]		25	9	221	8255	898	9408

[1]) Figure reflects Dohrn Bank area only due to reduced survey area.
[2]) No estimate available for the Dohrn Bank-East Greenland area due to reduced survey area.

4 COD STOCKS IN THE GREENLAND AREA (NAFO AREA 1 AND ICES SUBDIVISION XIVB)

4.1 Cod off Greenland (offshore component)

Prior to 1996, the cod stocks off Greenland have been divided into West and East Greenland or treated as one stock unit for assessment purposes to avoid migration effects. Fjord populations (inshore) have always been included. In 1996, the offshore component off West and East Greenland, the so called Bank Cod, was assessed separately as one stock unit and distinguished from the inshore populations for the first time. The completion of a re-evaluation of available German sampling data for the offshore catches back to 1955 enabled such an analysis given in the 1996 North-Western Working Group report (ICES C.M.1996/Assess:15). Due to the severely depleted status of the offshore stock component, the directed cod fishery was given up in 1992, the final year in the VPA. Since then, no adequate data were available to update the assessment. Therefore, the present report includes the summary table and figures of the 1996 assessment only appended by long term management considerations and updated survey results and catch information.

4.1.1 Trends in landings and fisheries

Officially reported catches are given in Tables 5.1.1 and 5.1.2 for West and East Greenland including inshore catches, respectively. Landings as used by the working group are listed in Table 5.1.3 by inshore and offshore areas and gear for both West and East Greenland combined, their trends being illustrated in Figure 5.1.1. Until 1975, offshore landings have dominated the total figures by more than 90%. Thereafter, the proportions taken offshore declined to 40–50% and the most recent yields have been dominated by inshore landings since 1993. Otter trawl board catches (OTB) were most important throughout the time series for offshore fisheries. Miscellaneous gears, mainly long lines and gill nets, contributed 30–40% until 1977 but have disappeared since then.

Annual landings taken offshore averaged about 300 000 t during the period 1955–60. Until 1968, figures increased to a higher level between 330 000 t and of 440 000 t in 1962. Landings decreased sharply by 90% to 46 000 t in 1973. Subsequently, the landings dropped below 40 000 t in 1977 and were very variable. The level of 40 000 t was only exceeded during the periods 1980–83 and 1988–1990. Since 1970, there have been large changes in effort which increased during exploitation of the strong year classes born in 1973 and 1984. The offshore fishery was closed in 1986 and for the first 10 months in 1987. During 1990–92, the landings decreased from 100 000 t by 90% to 11 000 t. Since then, almost no directed cod fishery has taken place offshore and the reported landings varied from 112 t to 736 t. A total offshore catch amounting to 112 t was reported for 1999.

It is important to note that catch figures, especially since 1992, are believed to be incomplete due to unreported by-catches in the shrimp fishery which has recently expanded to all traditional areas of the groundfish fisheries. Discards of fin-fish by-catches were difficult to record due to the processing of the shrimp catch on board. A first assessment of the catch taken by the shrimp fishery amounted to 32 t or 110 000 individuals of cod in 1994. This estimate was added to the catch figures used by the Working Group for the 1992–95 period.

4.1.2 Results of the German groundfish survey

Annual abundance and biomass indices have been derived using stratified random groundfish surveys covering shelf areas and the continental slope off West and East Greenland. Surveys commenced in 1982 and were primarily designed for the assessment of cod (*Gadus morhua* L.). A detailed description of the survey design and determination of these estimates was given in the report of the 1993 North-Western Working Group (ICES C.M.1993/Assess:18) and Working Doc. 15. Figure 5.1.2 indicate names of the 14 strata, their geographic boundaries, depth ranges and areas in nautical square miles (nm^2). All strata were limited at the 3 mile line offshore except for some inshore regions in Strata 6.1 and 6.2 off East Greenland where there is a lack of adequate bathymetric measurements. In 1984, 1992, and 1994 the survey coverage was incomplete off East Greenland partly due to technical problems.

4.1.2.1 Stock abundance indices

Table 5.1.4 lists abundance and biomass indices for West and East Greenland, respectively and then combined for the years 1982–99. Trends of the abundance and biomass estimates for West and East Greenland were shown in Figures 5.1.3 and 5.1.4, respectively. These figures illustrate the pronounced increase in stock abundance and biomass indices from 23 million individuals and 45 000 tons in 1984 to 828 million individuals and 690 000 tons in 1987. This trend was the result of the recruitment of the predominating year classes 1984 and 1985, which were mainly distributed in the northern and the shallow strata 1.1, 2.1 and 3.1 off West Greenland during 1987–89. Such high indices were never observed in strata off East Greenland, although their abundance and biomass estimates increased during the period 1989–91 suggesting an eastward migration. During the period 1987–89, which were years with high abundance, the precision of survey indices was extremely low due to enormous variation in catch per tow data. Since 1988, stock abundance and biomass indices decreased dramatically by 99% to only 5 million fish and 6 000 tons in 1993. The 1999 survey results confirmed the severely depleted status of the stock.

4.1.2.2 Age composition

Age disaggregated abundance indices for West, and East Greenland and the total have been recalculated for the entire time series due to a software change and results are listed in Tables 5.1.5–7, respectively. Differences with previous estimates are within the magnitude of rounding errors only. In 1999, the stock structure off West Greenland was found to be composed almost exclusively of the pre-recruiting age groups 1 and 2 (86%). The age composition off East Greenland was found to be more diverse. Although the 1997 and 1998 year classes are the highest at age 1 since 1987 they are considered to be poor compared with the strong 1984 and 1985 year classes and therefore indicate only a very small recovery potential in the short term as derived from the regression between year class strengths at age 1 and 3 (Figure 5.1.5). The survey estimates for the 0-group are considered unrepresentative due to gear specifications and do not allow assessments of year class strength at older ages (Figure 5.1.5).

4.1.2.3 Mean weight at age

Mean weight of the age groups 1–10 years for West and East Greenland and weighted by abundance to the total were listed in Tables 5.1.8–10, respectively. Weight (g) at age calculations are based on the regression $f(x) = 0.00895x^{3.00589}$, x = length (cm), which has been determined on the basis of 3 482 individual measurements. The trends of these values are illustrated in Figure 5.1.6 for the period 1982–98. They revealed pronounced areal and temperature effects. Age groups 2–10 years off East Greenland were found to be bigger than those off West Greenland. Driven by the high abundance of cod off West Greenland, weighted mean length and weight for the age groups 1–5 displayed a decrease during 1986–87 and remained at low levels until 1991. Since then, the weight at age at ages 3 to 8 years increased significantly and remained at that high level in 1999.

4.1.3 Biological sampling of commercial catches

No commercial sampling data were available to assess recent catch in numbers, weight and maturity at age.

4.1.4 Results from the 1996 assessment

The historical stock status was assessed based on the terminal Fs derived from an XSA tuning run applying 1992 as the final year.

Trends in yield and fishing mortality are shown in Figure 5.1.7. An increasing trend in Fbar from 0.1 to 0.4 was determined during the period 1955–68. During the same period, the yield increased from a level of 280 000 t to 380 000 t but decreased drastically to 100 000 t in the early 70s. Thereafter, the fishing mortality was highly variable and seemed to be dependent on the changes in effort directed to the exploitation of individual strong year classes. Periods when Fbar for ages 5–8 years exceeded 0.5 were 1974–1977, 1980–1984 and 1988–1992.

Trends in spawning stock biomass and recruitment were shown in Figure 5.1.8. During 1955 to 1973, the spawning biomass decreased almost continuously from 1.8 million t to 110 000 t, a decrease of 94%. Thereafter, the spawning stock biomass averaged 50 000 t. During the period 1955–73 before the spawning stock decreased below 100 000 t, the recruitment at age 3 varied enormously between 4 million and 700 million and averaged 220 million. Since 1974, the spawning stock varied around the mean of 50 000 t and produced an average recruitment of 41 million representing a mean reduction by 95% and 80%, respectively. The long-term mean recruitment was not exceeded for 8 of the 19 years from 1955 to 1973, while it has been below that value for 17 of the 19 years since then. During the last 29 years, only 2 year classes have reached the long-term mean recruitment level at age 3, namely those produced in 1973 and 1984.

4.1.5 Estimation of management reference points

Input parameters for the estimation of long-term yield and spawning stock biomass per recruit are listed in Table 5.1.11 for age groups 3–12. Maturity and weight at age vectors were calculated as long-term means covering the period 1955–92. The natural mortality M was increased to 0.3 for age groups 5 and older to account for an emigration to Iceland. The exploitation pattern was derived as Fbar from the three most recent years from the final VPA. Determined F-factors for $F_{0.1}$ and F_{max} were scaled according to the mean reference F over the age groups 5–8. The resulting estimates of yield and spawning stock biomass per recruit are illustrated in Figure 5.1.9. The values of $F_{0.1}$ and F_{max} are indicated by arrows and amounted to 0.3 and 0.72, respectively. The lack of a well definite peak in the yield per recruit curve is due to increased natural mortality.

Recruitment at age 3 is plotted against the spawning stock biomass in Figure 5.1.10. F_{med} amounted to 0.09. The corresponding spawning stock biomass per recruit was as high as 4.5 kg. F_{high} amounted to 0.59 with the accompanied spawning stock biomass per recruit of 1.0 kg.

However, neither the determined Beverton & Holt nor the Ricker model fitted the observed recruitment-spawning stock biomass points well. The Beverton & Holt curve quickly reached the long-term mean recruitment level, affected by the strong 1973 and 1984 year classes related to low biomass values and the extremely poor year classes 1969–72 produced by spawning stock sizes exceeding 250 000 t. The Ricker curve did not reach a maximum over the available range of observed spawning stock sizes. This suggested that, during the period of investigation, the recruitment appeared at all times to be adversely affected by reductions in spawning stock biomass.

Given suitable environmental conditions, cod in the offshore areas of Greenland are considered to be self-sustaining. An example of restricted recruitment was identified for the period 1969–72 when a continued cold event off West Greenland and an almost complete recruitment failure was observed. Figure 5.1.10 indicates that the reduced recruitment was observed at a SSB of less than 1 000 000 t. Following the instructions given by the SGPAFM this value could be taken as the precautionary reference point B_{pa}. Given the depleted stock status, no limit and precautionary reference points for fishing mortality and biomass were proposed.

4.1.6 By-catch and discard of cod in the shrimp fishery

No information about the amount of by-catch and discard of cod in the shrimp fishery off East and West Greenland was available. Long-term simulations based on a recruitment model (Rätz *et al*., 1999) were carried out last year (ICES C.M.1998/ACFM:19) and indicated a significant adverse effect of even low fishing mortality of pre-recruits on the potential stock recovery.

4.1.7 Management considerations

The assessment of the offshore component of the cod stocks off Greenland revealed that over-fishing was a major cause for the collapse of this unit in the beginning of the 70s. Since that time, the spawning stock has remained below 100 000 t and has not been able to produce adequate recruitment. Only two strong year classes have been observed in 1976 and 1987 as 3 year olds. An increase in effort directed towards the 1973 and 1984 year classes resulted in high fishing mortality. Both year classes contributed only negligible amounts to the severely declined spawning stock. The most recent trend in the fishery and German survey data which were not included in this assessment, are consistent with this picture. Further, no indication of a significant stock recovery in the short-term was derivable based on the lack of strong pre-recruiting year classes. In the present situation, catches of young cod in the shrimp fishery should be kept to a minimum in order to increase the probability of stock recovery. No fishing should take place until a substantial increase in recruitment and biomass is evident.

4.1.8 Comments on the assessment

The present assessment is based on survey indices only due to the termination of the cod directed offshore fishery in 1992.

The VPA assessment conducted in 1996 was affected by several uncertainties in data as well as ecological factors. The effect of emigration was only directly covered for the 1973 and 1984 year classes and had been taken into account by an increase of the natural mortality to 0.3 for age groups 5 and older. The sampling of commercial catches was historically rather inconsistent and did not cover the 30% taken by miscellaneous gears, mainly longlines and gill nets up to 1977. Since 1991, catch at age and weight at age data had to be calculated using survey data. Maturity data were poorly reported implying uncertainties in spawning stock estimates.

No XSA tuning could be applied since 1997 when low levels in landings, effort and stock abundance were observed. The age disaggregated survey indices had to be adjusted to account for incomplete coverage of the survey area in 1992 and 1994.

Table 5.1.1 Nominal catch (tonnes) of Cod in NAFO Sub-area 1, 1986-1999 as officially reported to NAFO.

Country	1986	1987	1988	1989	1990	1991	1992
Faroe Islands	-	-	-	-	51	1	-
Germany	41	55	6.574	12.892	7.515	96	-
Greenland	6.549	12.284	52.135	92.152	58.816	20.238	5.723
Japan	11	33	10	-	-	-	-
Norway	2	1	7	2	948	-	-
UK	-	-	927	3780	1.631	-	-
Total	6.603	12.373	59.653	108.826	68.961	20.335	5.723
WG estimate	-	-	62.653 [2]	111.567 [3]	98.474 [4]	-	-

Country	1993	1994	1995	1996	1997	1998	1999 [1]
199Faroe Islands	-	-	-	-	-		
Germany	-	-	-	-	-		
Greenland	1.924	2.115	1.710	948	904	319	622
Japan	-	-	-	-	-		
Norway	-	-	-	-	-		
UK	-	-	-	-	-		
Total	1.924	2.115	1.710	948	904	319	622
WG estimate	-	-	-	-	-	-	-

[1]) Provisional data reported by Greenland authorities
[2]) Includes 3,000 t reported to be caught in ICES Sub-area XIV
[3]) Includes 2,741 t reported to be caught in ICES Sub-area XIV
[4]) Includes 29,513 t caught inshore

Table 5.1.2 Nominal catch (tonnes) of cod in ICES Sub-area XIV, 1986-1999 as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Faroe Islands	86	-	12	40	-	-	-
Germany	4.063	5.358	12.049	10.613	26.419	8.434	5.893
Greenland	606	1.550	345	3.715	4.442	6.677	1.283
Iceland	-	1	9	-	-	-	22
Norway	-	-	-	-	17	828	1.032
Russia				-	-	-	126
UK (Engl. and Wales)	-	-	-	1.158	2.365	5.333	2.532
UK (Scotland)	-	-	-	135	93	528	463
United Kingdom	-	-	-	-	-	-	-
Total	4.755	6.909	12.415	15.661	33.336	21.800	11.351
WG estimate	-	-	9.457 [1]	14.669 [2]	33.513 [3]	21.818 [4]	-

Country	1993	1994	1995	1996	1997	1998	1999 [5]
Faroe Islands	-	1	-	-	-		
Germany	164	24	22	5	39	128	13
Greenland	241	73	29	5	32	37	
Iceland	-	-	1	-	-		-
Norway	122	14	+	1 [5]	15 [5]	1	4
Portugal						31	-
Russia	-	-	-	-	-		
UK (Engl. and Wales)	163	-	-	-	-		
UK (Scotland)	46	-	-	-	-		
United Kingdom	-	296	232	181	284	149	95
Total	736	408	284	192	370	346	112
WG estimate	-	-	-	-	-	-	

[1]) Excluding 3,000 t assumed to be from NAFO Division 1F and including 42 t taken by Japan
[2]) Excluding 2,741 t assumed to be from NAFO Division 1F and including 1,500 t reported from other areas assumed to be from Sub-area XIV and including 94 t by Japan and 155 t by Greenland (Horsted, 1994)
[3]) Includes 129 t by Japan and 48 t additional catches by Greenland (Horsted, 1994)
[4]) Includes 18 t by Japan
[5]) Provisional data

Table 5.1.3 Cod off Greenland (offshore component). Catches (t) as used by the Working Group, inshore and offshore by gear based on Horsted (1994).

Year	inshore	Offshore Miscellaneous	offshore OBT	offshore total	total
1955	19787	117238	136028	253266	273053
1956	21063	121876	193593	315469	336532
1957	24790	104632	151666	256298	281088
1958	26684	121636	182516	304152	330836
1959	28184	97457	128777	226234	254418
1960	28708	115273	122859	238132	266840
1961	35164	140110	192007	332117	367281
1962	36283	168092	273598	441690	477973
1963	24173	138451	289143	427594	451767
1964	23106	118495	243714	362209	385315
1965	25209	133855	225150	359005	384214
1966	29956	149234	200086	349320	379276
1967	28277	132415	293519	425934	454211
1968	21215	64286	323800	388086	409301
1969	22119	36276	174031	210307	232426
1970	16114	16101	102196	118297	134411
1971	14039	25450	113207	138657	152696
1972	14753	29765	94730	124495	139248
1973	9813	16740	46141	62881	72694
1974	8706	18086	27695	45781	54487
1975	6779	13363	33692	47055	53834
1976	5446	8710	32157	40867	46313
1977	14964	10081	21726	31807	46771
1978	20295	4	26059	26063	46358
1979	36785	36	20056	20092	56877
1980	40122	0	57584	57584	97706
1981	40021	0	40266	40266	80287
1982	26934	2020	49827	51847	78781
1983	26689	3339	40991	44330	71019
1984	19967	5	22358	22363	42330
1985	8488	1	8499	8500	16988
1986	5320	2	6036	6038	11358
1987	8445	1	10836	10837	19282
1988	22814	7	49089	49096	71910
1989	38788	2	85946	85948	124736
1990	29513	948	99535	100483	129996
1991	18950	0	22966	22966	41916
1992	5723	0	11351	11351	17074
1993	1924	0	736	736	2660
1994	2115	0	408	408	2523
1995	1739	0	254	254	1993
1996	953	0	187	187	1140
1997	936	0	338	338	1274
1998	333	0	278	278	611
1999	622	0	112	112	734

Table 5.1.4 Cod off Greenland (offshore component). Abundance (1000) and biomass indices (t) for West, East Greenland and total by stratum, 1982-99. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance. () incorrect due to incomplete sampling.

	Abundance					Biomass				
YEAR	WEST	EAST	TOTAL	CI	Spawn. St.	WEST	EAST	TOTAL	CI	Spawn. St.
1982	92276	8090	100366	28	33592	128491	23617	152107	25	78466
1983	50204	7991	58195	25	23889	82374	34157	116531	25	57223
1984	16684	(6603)	(23286)	32	17531	25566	(19744)	(45309)	34	36246
1985	59343	12404	71747	33	16472	35672	33565	69236	39	44297
1986	145682	15234	160915	32	14244	86719	41185	127902	26	46864
1987	786392	41635	828026	59	25376	638588	51592	690181	63	66144
1988	626493	23588	650080	48	128208	607988	52946	660935	46	153387
1989	358725	91732	450459	59	311086	333850	239546	573395	46	438599
1990	34525	25254	59777	43	46705	34431	65964	100395	34	79021
1991	4805	10407	15213	29	6565	5150	32751	37901	36	18518
1992	2043	(658)	(2700)	50	574	607	(1216)	(1823)	69	1127
1993	1437	3301	4738	36	2321	359	5600	5959	41	4014
1994	574	(801)	(1375)	36	457	140	(2792)	(2930)	68	1744
1995	278	7187	7463	93	2215	57	15525	15581	155	9720
1996	811	1447	2257	38	592	373	3599	3973	56	2025
1997	315	4153	4469	75	3394	284	13722	14007	90	10385
1998	1723	1671	3394	54	1133	130	4348	4479	91	3820
1999	912	2769	3681	34	809	240	3917	4157	62	3004

Table 5.1.5 Cod off West Greenland (offshore component). Age disaggregate abundance indices (1000), 1982-1999.
*) calculated proportionally using age compositions reported by the ICES Working Group on Cod Stocks off East Greenland (ICES C.M.1984/Assess:5).

YEAR	0	1	2	3	4	5	6	7	8	9	10	11+	TOTAL
1982	0	176	884	33470	11368	32504	9528	2622	578	939	91	90	92250
*1983	0	0	1469	2815	26619	4960	10969	1882	992	317	168	13	50204
1984	159	5	38	2070	1531	9848	842	1873	87	186	27	0	16666
1985	831	38016	1481	948	6403	2833	7682	467	646	27	35	0	59369
1986	0	14148	112532	4089	903	6823	2095	4271	133	616	34	39	145683
1987	0	317	45473	692567	24230	5929	11813	1637	4006	0	366	30	786368
1988	0	257	3332	102767	510980	5425	613	1122	654	1274	32	35	626491
1989	12	204	2461	3565	93687	254002	3934	0	535	114	228	0	358742
1990	159	47	1007	3005	1244	21724	7221	47	0	0	0	19	34473
1991	0	293	224	476	1397	164	1894	317	6	0	0	0	4771
1992	0	263	1427	220	36	77	0	28	0	0	0	0	2051
1993	0	10	832	544	20	28	6	0	0	0	0	0	1440
1994	0	283	45	199	38	5	0	5	0	0	0	0	575
1995	0	0	241	16	22	0	0	0	0	0	0	0	279
1996	0	147	11	638	10	0	10	0	0	0	0	0	816
1997	0	12	27	15	263	0	0	0	0	0	0	0	317
1998	48	1642	0	0	5	25	0	0	0	0	0	0	1720
1999	29	401	392	87	7	0	6	0	0	0	0	0	922

Table 5.1.6 Cod off East Greenland (offshore component). Age disaggregate abundance indices (1000), 1982-1999.
*) calculated proportionally using age compositions reported by the ICES Working Group on Cod Stocks off East Greenland (ICES 1984/Assess:5). () incomplete sampling.

YEAR	0	1	2	3	4	5	6	7	8	9	10	11+	TOTAL
1982	0	0	239	841	1764	1999	1227	379	130	1392	73	72	8116
*1983	0	0	411	605	1008	1187	2125	1287	302	265	703	101	7994
(1984)	0	18	74	1342	657	1397	855	1617	407	103	36	95	6601
1985	230	1932	556	118	2494	2034	1852	785	2000	295	56	36	12388
1986	0	1397	3351	1693	551	2417	1120	2191	566	1627	116	139	15168
1987	0	13	13785	17788	3890	1027	1770	457	1571	187	1093	36	41617
1988	11	25	163	6982	11094	2016	480	1435	152	674	98	469	23599
1989	0	7	179	489	17396	63216	3021	294	4870	406	1795	42	91715
1990	0	38	80	551	462	5128	18012	265	72	251	0	349	25208
1991	0	106	377	394	685	147	3512	5035	81	37	11	9	10394
(1992)	15	44	77	74	69	54	47	143	52	0	0	6	581
1993	0	17	44	1857	370	279	278	88	272	95	0	0	3300
(1994)	0	87	0	29	261	143	87	145	0	29	0	0	781
1995	0	7	2523	1125	370	1730	450	141	460	36	217	125	7184
1996	0	0	0	502	258	295	255	60	77	0	0	0	1447
1997	0	0	37	28	1508	1611	566	236	140	0	0	19	4145
1998	63	240	192	21	45	462	435	156	43	0	0	0	1657
1999	191	632	665	417	138	302	179	200	0	35	24	0	2783

Table 5.1.7 Cod off Greenland (offshore component). Age disaggregate abundance indices (1000), 1982-1999.
*) calculated proportionally using age compositions reported by the ICES Working Group on Cod Stocks off East Greenland (ICES 1984/Assess:5). () incomplete sampling.

YEAR	0	1	2	3	4	5	6	7	8	9	10	11+	TOTAL
1982	0	176	1123	34311	13132	34503	10755	3001	708	2331	164	162	100366
*1983	0	0	1880	3420	27627	6147	13094	3169	1294	582	871	1140	58198
(1984)	159	23	112	3412	2188	11245	1697	3490	494	289	63	95	23267
1985	1061	39948	2037	1066	8897	4867	9534	1252	2646	322	91	36	71757
1986	0	15545	115883	5782	1454	9240	3215	6462	699	2243	150	178	160851
1987	0	330	59258	710355	28120	6956	13583	2094	5577	187	1459	66	827985
1988	11	282	3495	109749	522074	7441	1093	2557	806	1948	130	504	650090
1989	12	211	2640	4054	111083	317218	6955	294	5405	520	2023	42	450457
1990	159	85	1087	3556	1706	26852	25233	312	72	251	0	368	59681
1991	0	399	601	870	2082	311	5406	5352	87	37	11	9	15165
(1992)	15	307	1504	294	105	131	47	171	52	0	0	6	2632
1993	0	27	876	2401	390	307	284	88	272	95	0	0	4740
(1994)	0	370	45	228	299	148	87	150	0	29	0	0	1356
1995	0	7	2764	1141	392	1730	450	141	460	36	217	125	7463
1996	0	147	11	1140	268	295	265	60	77	0	0	0	2263
1997	0	12	64	43	1771	1611	566	236	140	0	0	19	4462
1998	111	1882	192	21	50	487	435	156	43	0	0	0	3377
1999	220	1033	1057	504	145	302	185	200	0	35	24	0	3705

Table 5.1.8 Cod off West Greenland (offshore component). Weighted mean weight (g., by stratum abundance) at age 1-10 years, 1982, 1984-1999.

YEAR	1	2	3	4	5	6	7	8	9	10
1982	44	190	568	920	1770	2164	2962	4078	5065	6995
1983										
1984	68	136	379	807	1356	1990	2885	3600	4476	6177
1985	96	168	568	981	1475	2010	3121	3341	4408	4014
1986	72	325	498	1118	1697	2217	2784	3889	4159	4493
1987	37	223	697	926	1194	2154	2239	3028		3541
1988	38	211	456	1019	1145	1941	2949	2735	3630	4192
1989	36	159	423	796	1403	1443		2885	3229	4562
1990	38	114	334	599	909	1395	1111			
1991	50	139	356	649	926	1356	1743	920		
1992	75	230	379	668	938		2061			
1993	41	132	405	494	920	920				
1994	45	126	456	608	1111		2461			
1995		186	328	482						
1996	42	104	510	753		3645				
1997	68	334	375	994						
1998	50			1567	1516					
1999	77	340	612	1111		2822				

Table 5.1.9 Cod off East Greenland (offshore component). Weighted mean weight (g., by stratum abundance) at age 1-10 years, 1982, 1984-1999. () Incomplete sampling.

YEAR	1	2	3	4	5	6	7	8	9	10
1982		423	769	1419	2326	3498	4597	5523	6633	6500
1983										
(1984)	104	331	801	1807	2207	3014	3858	4936	4632	5445
1985	109	437	1038	1761	3161	3369	4459	4755	5824	7957
1986	88	375	915	1715	2674	4225	4159	4954	6030	6722
1987	33	283	640	885	1653	3600	4545	5120	6072	7684
1988		275	733	1770	3067	4291	4702	6500	6949	7418
1989	68	252	538	1118	2507	3690	3951	5027	5662	6457
1990	52	419	510	1145	1618	2625	3858	5702	6880	
1991	86	194	402	1173	1864	2315	3355	4374	5139	10198
(1992)	18	402	758	1575	3175	3028	3271	3469		
1993	81	353	728	1333	2315	2834	3600	4827	6135	
(1994)	41		1111	2271	3054	4791	4827		5742	
1995	68	249	430	1508	2949	4176	5233	5926	9645	7442
1996			717	1921	2461	3586	5120	5824		
1997		104	1525	1931	3454	4062	4562	4685		
1998	101	155	1045	1779	3028	3541	3858	6745		
1999	84	269	594	1173	2949	3735	4917		8522	9004

Table 5.1.10 Cod off Greenland (offshore component). Weighted mean weight (g., by stratum abundance) at age 1-10 years, 1982, 1984-1999. () Incomplete sampling.

YEAR	1	2	3	4	5	6	7	8	9	10
1982	44	230	572	975	1798	2293	3148	4324	5967	6767
1983										
(1984)	104	331	801	1807	2207	3014	3858	4936	4632	5445
1985	97	225	612	1173	2081	2239	3920	4374	5702	6219
1986	73	325	603	1326	1921	2822	3216	4738	5484	6177
1987	36	237	697	920	1259	2315	2649	3541	6072	6435
1988	61	214	471	1032	1550	2822	3858	3285	4614	6522
1989	37	164	437	845	1584	2250	3951	4791	5046	6219
1990	44	128	359	722	1025	2217	3299	5702	6880	
1991	58	172	375	801	1318	1941	3243	4014	5139	10198
(1992)	63	237	459	1208	1644	3028	3041	3469		
1993	64	141	644	1281	2154	2784	3600	4827	6135	
(1994)	44	126	518	1980	2962	4791	4738		5742	
1995	68	244	426	1427	2949	4176	5233	5926	9645	7442
1996	42	104	594	1864	2461	3586	5120	5824		
1997	68	180	1000	1761	3454	4062	4562	4685		
1998	56	155	1045	1761	2923	3541	3858	6745		
1999	82	294	594	1173	2949	3705	4917		8522	9004

Table 5.1.11 Cod off Greenland (offshore component). Input parameters in for calculations of yield and spawning stock biomass per recruit.

Age	WEIGHT (kg)	MATURITY	Exploit. pattern	M
3	0.815	0.001	0.154	0.2
4	1.255	0.004	0.425	0.2
5	1.863	0.15	0.643	0.3
6	2.549	0.449	0.931	0.3
7	3.295	0.795	1.07	0.3
8	4.157	0.946	1.145	0.3
9	4.967	0.99	1.267	0.3
10	5.836	1	1.027	0.3
11	6.447	1	1.027	0.3
12	7.09	1	1.027	0.3

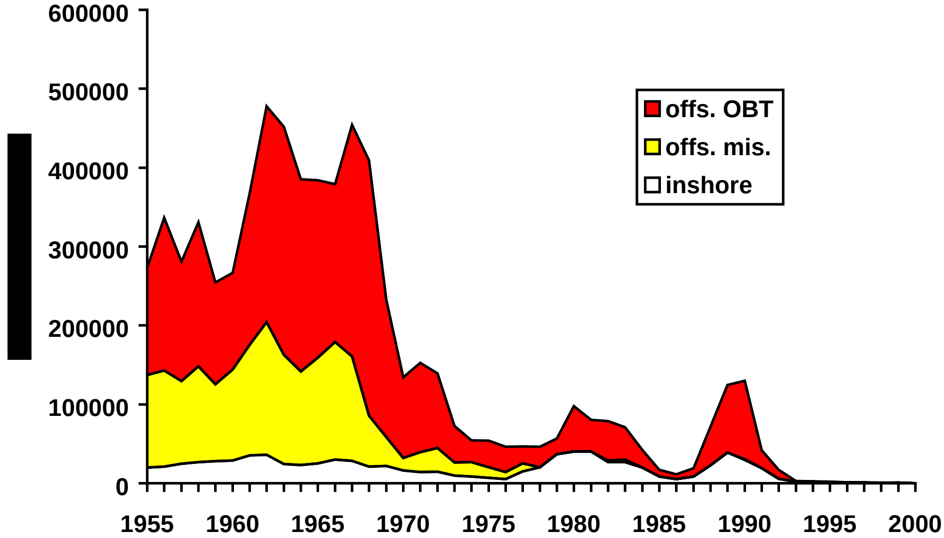


Figure 5.1.1 **Cod off Greenland. Catches 1955-99 as used by the Working Group, inshore and offshore by gear (Horsted,1994).**

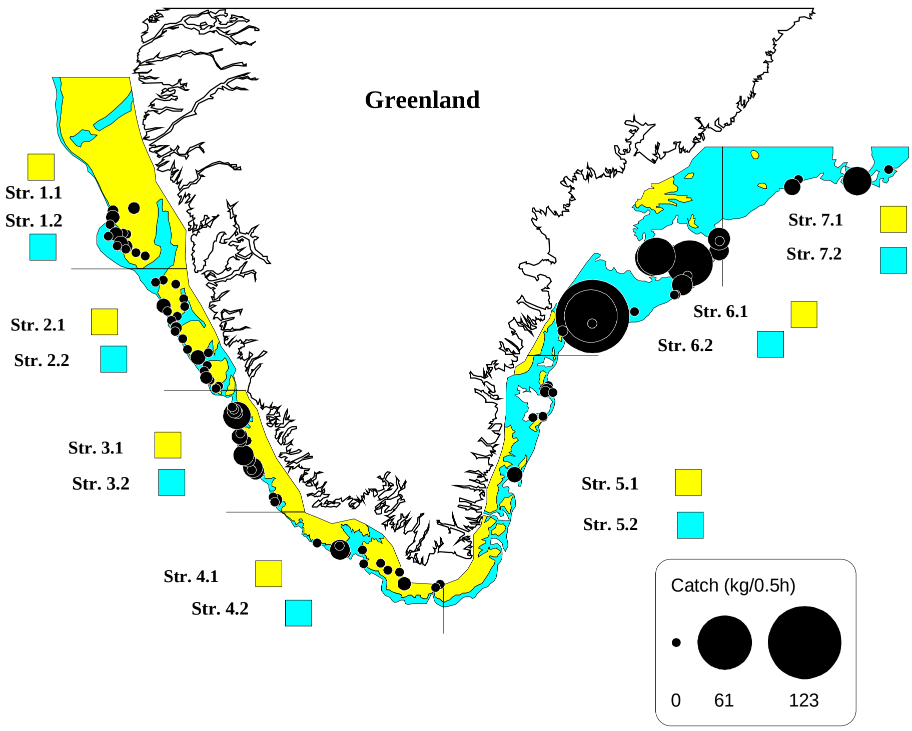


Figure 5.1.2 Cod off Greenland (offshore component). Survey area, stratification and position of hauls carried out in 1999.

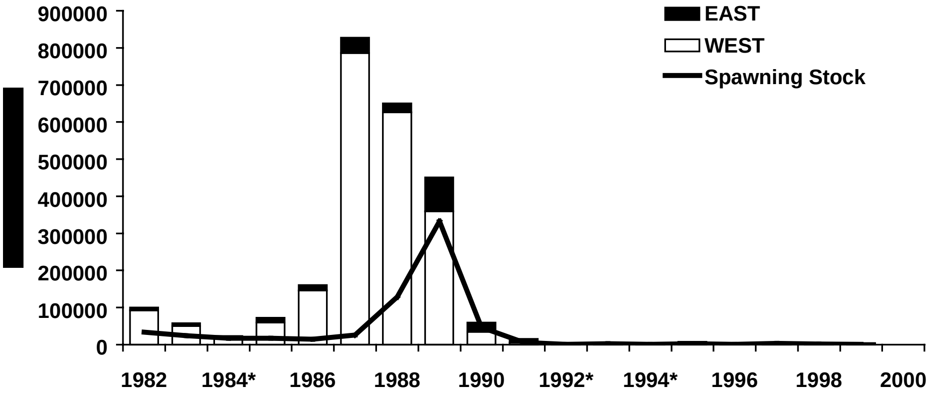


Figure 5.1.3 Cod off Greenland (offshore component). Aggregated survey abundance indices for West and East Greenland and spawning stock size, 1982-99. *) incomplete survey coverage.

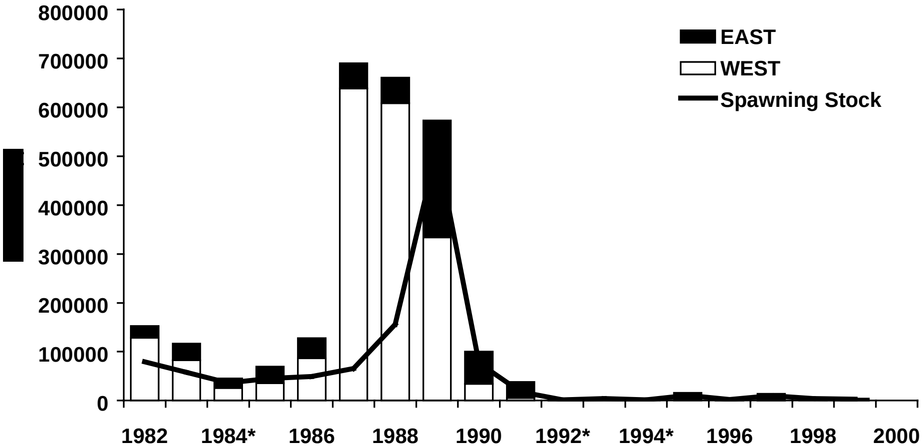


Figure 5.1.4 **Cod off Greenland (offshore component). Aggregated survey biomass indices for West and East Greenland and spawning stock biomass, 1982-99. *) incomplete survey coverage.**

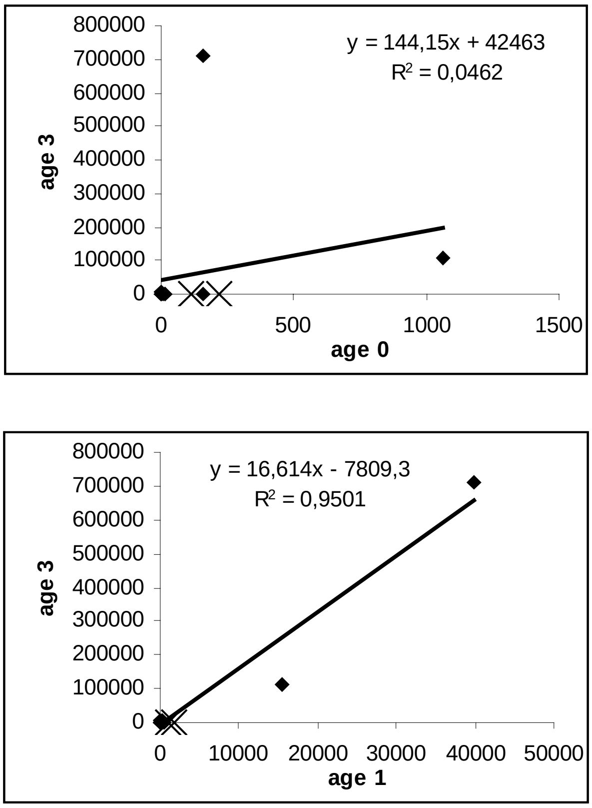


Figure 5.1.5 Cod off Greenland (offshore component). Use of 0 and 1 age group indices to predict year class strength at age 3. The x indicate the 1998 and 1999 year classes at age 0 and the 1997 and 1998 at age 1, respectively.

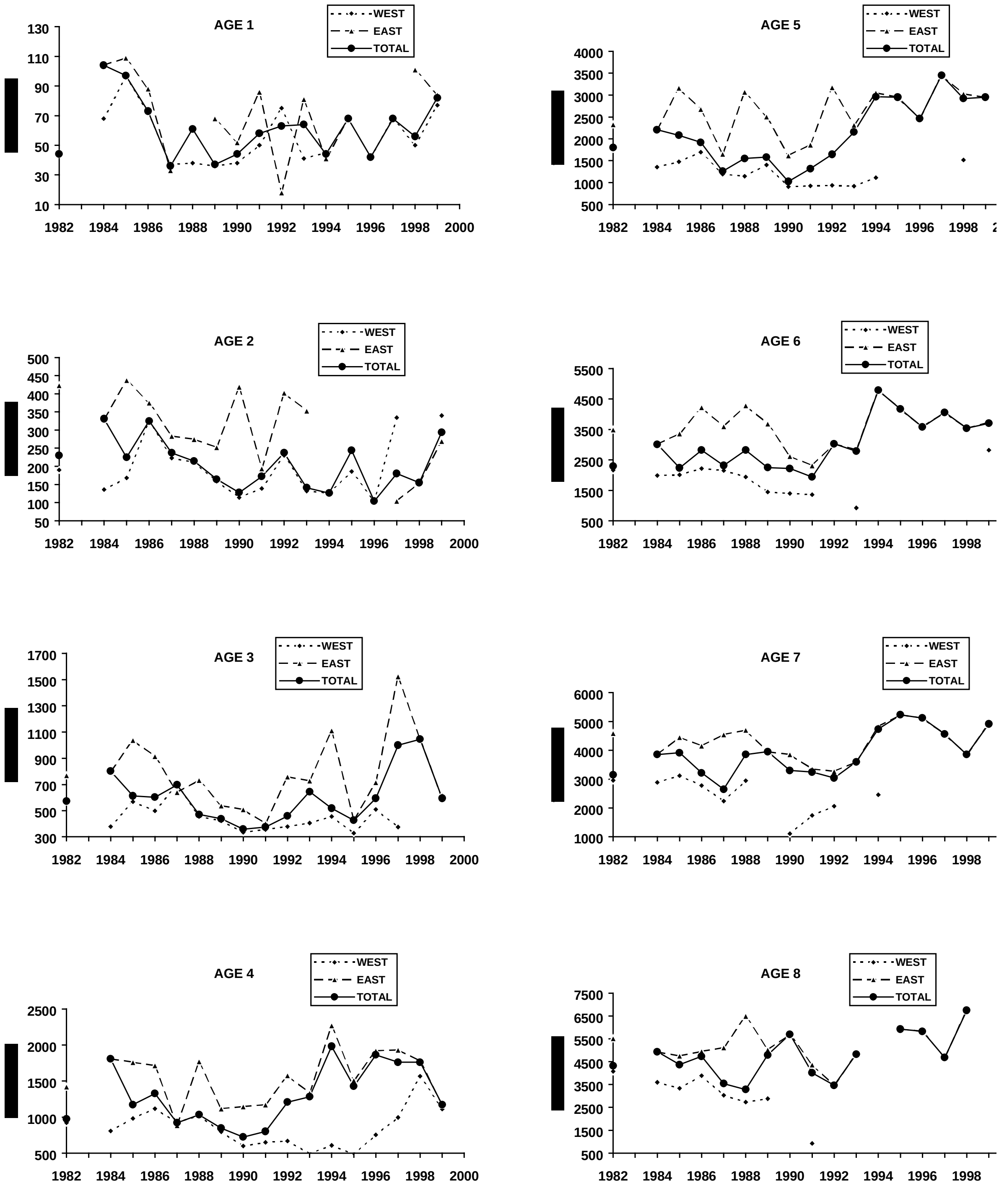


Figure 5.1.6 Cod off Greenland (offshore component). Weighted mean weight at age 1-10 years for West, East Greenland and total, 1982-99.

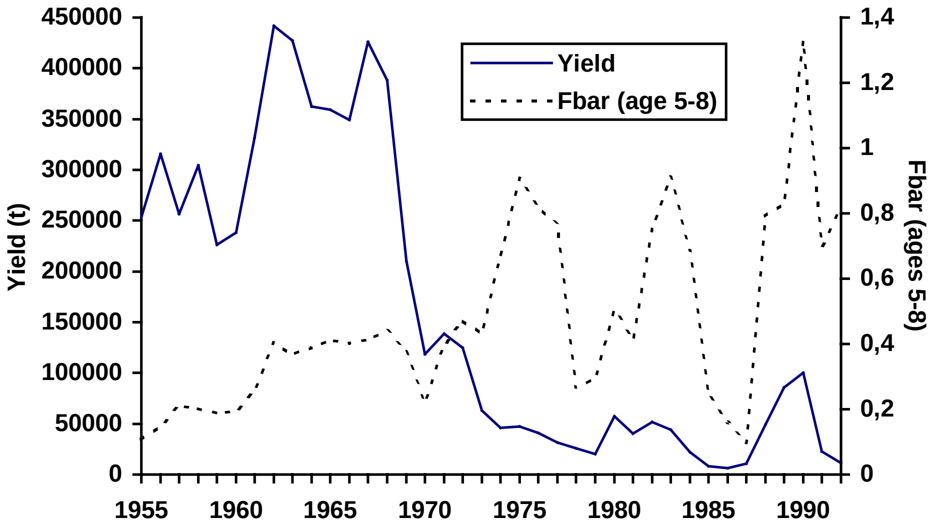


Figure 5.1.7 Greenland cod (offshore component). Trends in yield and fishing mortality.

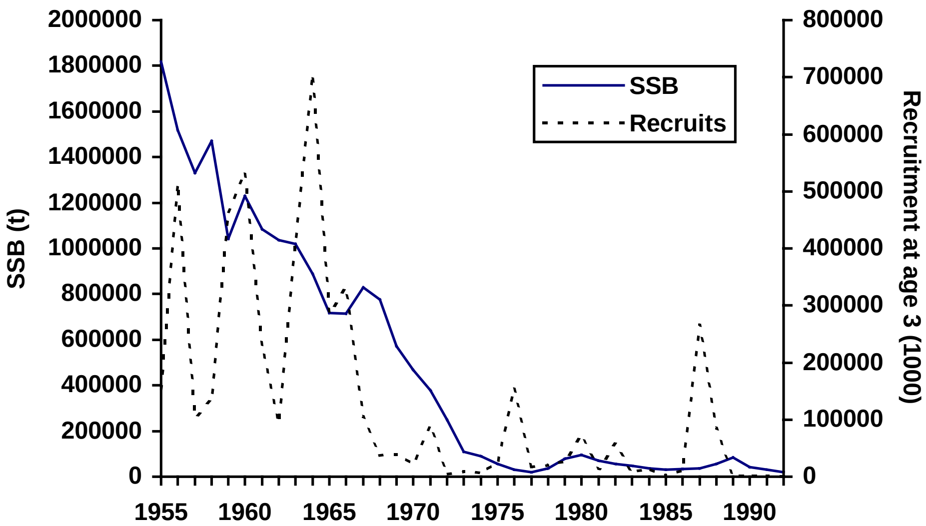


Figure 5.1.8 Greenland cod (offshore component). Trends in spawning stock biomass (SSB) and recruitment.

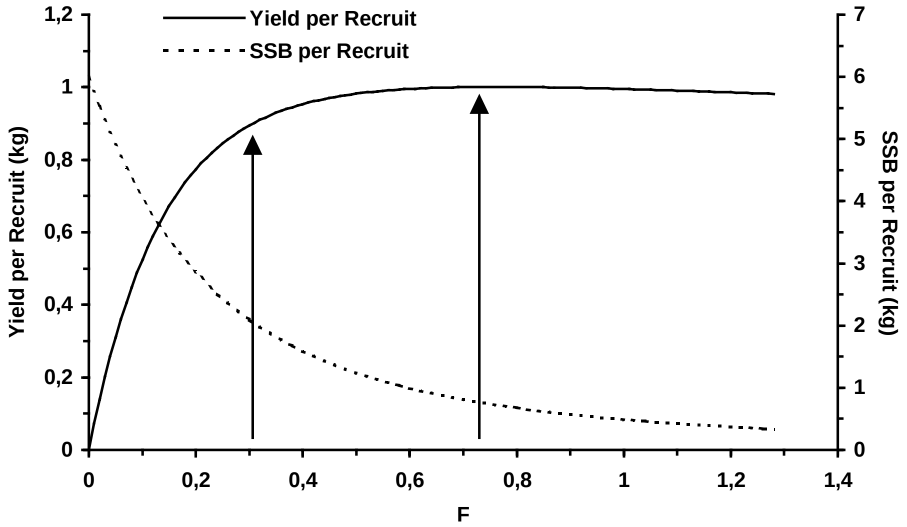


Figure 5.1.9 Greenland cod (offshore component). Long term yield and spawning stock biomass. $F_{0.1}$ reference age 5-8=0.297; F_{max} reference age 5-8=0.722.

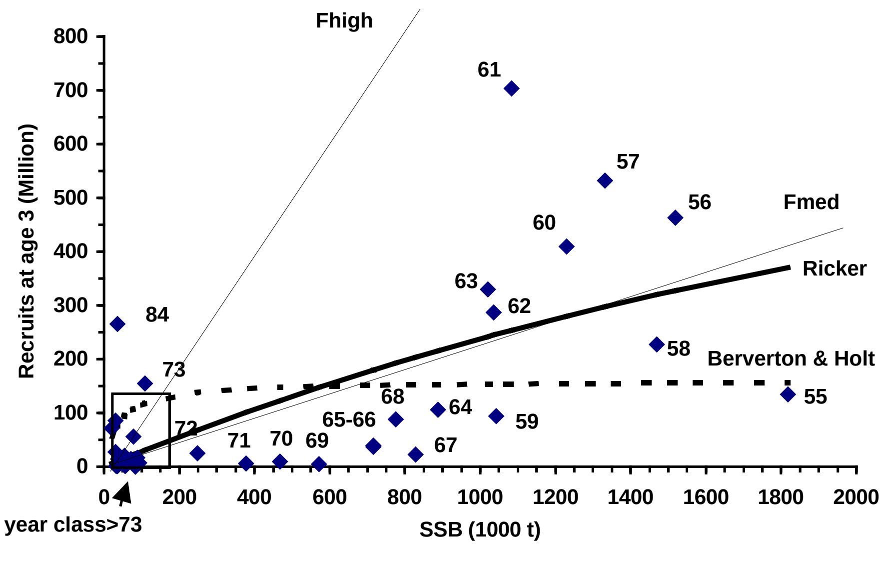


Figure 5.1.10 Greenland cod (offshore component). Spawning stock-recruitment plot for year classes 1955-89 and fitted recruitment curves. F_{med}=0.09 corresponding to a SSB/R=4.44 kg; F_{high}=0.59 corresponding to a SSB/R=0.98 kg.

4.2 Inshore cod stock off Greenland

In the last decade, the inshore cod fishery at West Greenland has contained cod from two different spawning areas. Icelandic cods spawned off South-western Iceland which in some years are carried by the Irminger current to settle off South Greenland, and local fjord populations. Spawning cod are found in several fjords of the West Greenland, especially in NAFO Divisions 1B, 1C and 1D. Although tagging experiments suggest a high degree of stationary for fjord populations, the recruitment seems to be correlated between the different fjords (Engelstoft 1997).

4.2.1 Trends in Landings and Effort

Historically, the inshore landings have been of limited importance as the inshore fisheries have accounted for only 5–10% of the total international catch. Annual landings of 15 000–20 000 t have been taken inshore during the period 1955–1973. Since then the landings have been varying consistently with the recruitment of strong year classes to the offshore fishery. High landings of about 50 000 t in 1980 and 1989 have been followed by periods of very low landings. In recent years the landings has decreased dramatically from about 2000 tons yearly in 1993–1995 to only 319 tons in 1998. In 1999 the catches increased again to 622 tons (Table 5.1.2).

The inshore fishery takes place from small vessels (< 40 GRT). Pound nets, gillnets and handlines are used to take about 95% of the inshore catch.

A commercial pound net CPUE series is available since 1992 (Table 5.2.1). The mean catch pr pound net setting has decreased from 804 t in 1994 to 284 in 1999.

4.2.2 West Greenland young cod survey

A survey using gangs of gill nets with different mesh-sizes (16.5, 18, 24, 28, and 33 mm) has been conducted since 1985. The objective of the program is to assess the abundance and distribution of pre-recruit cod in inshore areas of Greenland. The survey has usually been carried out in three inshore areas off West Greenland: Qaqortoq (NAFO Div. 1F), Nuuk (Div. 1D) and Sisimiut (Div. 1B). The Greenland inshore cod stock is not distributed in the Qaqortoq area, but occasional inflow of pre-recruited cod from East to West Greenland shows up here.

Analysis of the selectivity of the fleet of gill-nets has shown that selection is best for age 2 cod, whereas only the larger individuals of the age 1 cod are adequately selected. In the 1999 survey a total of 60 net settings were made. Nets were set at bottom and it was attempted to set the fleets at constant depths and to divide the survey effort evenly on the depth zones of 0–5 m, 5–10 m, 10–15 m, and 15–20 m. Technical problems caused that only one third of the survey area was covered in 1999.

An index of recruitment is calculated as the mean catch of 2-year old cod per 100 hours net setting taken by all five mesh sizes. The recruitment index is shown in Figure 5.2.1 and reveals a strong 1985 and 1987 year class, a moderate 1990-and 1993 year class and three successive weak year-classes in recent years. The very low 1997 class year might not be representative due to insufficient survey coverage.

4.2.3 Assessment

The available data for the Greenland inshore cod is not adequate to allow for a detailed analytical assessment of the stock, but the results of a general production model are presented.

A Schaefer general production model was fitted to the Greenland inshore cod landing data using the commercial pound net CPUE results for 1993 to 1997 as an index of stock biomass.

The model was fitted using Excel Solver to minimise the sum of squared residuals between the observed CPUE and the predicted CPUE where the predicted CPUE is given by:

$CPUEpred_t = B_t * q$

And the biomass is:

$B_{t+1} = B_t + (r*B_t*(1-B_t/k))-C_t$

Where C is the catch

Parameter values obtained last year were used as starting values. Parameter values achieved from the general production model are shown in Table 5.2.2. Observed and predicted CPUE-values are shown in figure 5.2.2.

The model parameters are not very stable and need to be constrained. The initial biomass B_t was constrained to be lower than the virgin biomass (k), r was constrained to be between zero and one, while q was constrained to be higher than 0.001.

The model implies FMSY of only 0.01, but the number of parameters is high compared to the number of data points. The decreasing CPUE and the present recruitment failure of the stock do however support this severe stock situation.

4.2.4 Biological reference points

No specific values can be put forward as reference points.

4.2.5 Management Considerations

The inshore fishery exploiting possible self-sustained local fjord populations off West Greenland has historically been small, and the fishery has never been constricted by catch regulations. The data presented indicate that the stock has undergone a series of recruitment failures in recent years. The latest year classes are all estimated to be very poor in the juvenile survey. No fishing should take place until a substantial increase in recruitment and biomass is evident.

Table 5.2.1 Greenland cod (inshore component). Landings, observed and predicted CPUE based on data from inshore pound net fishery.

Year	Predicted Biomass	Predicted CPUE	Observed CPUE	Ln (CPUE/B)	Observed Catch
1993	11226	664	730	-2.73	1924
1994	9331	591	768	-2.50	2215
1995	7151	490	600	-2.49	1710
1996	5478	438	536	-2.32	948
1997	4563	460	423	-2.38	904
1998	3690	489	248	-2.70	326
1999	3390	579	284	-2.48	622
2000	2793				

*predicted

Table 5.2.2 Input values and parameter values obtained from general production model.

Year of Assess.	Virgin Biomass	Rate of increase	Q	Init. Biomass
1999	11268	0,300	0,15	7428
2000	15515	0,01	0,08	11226

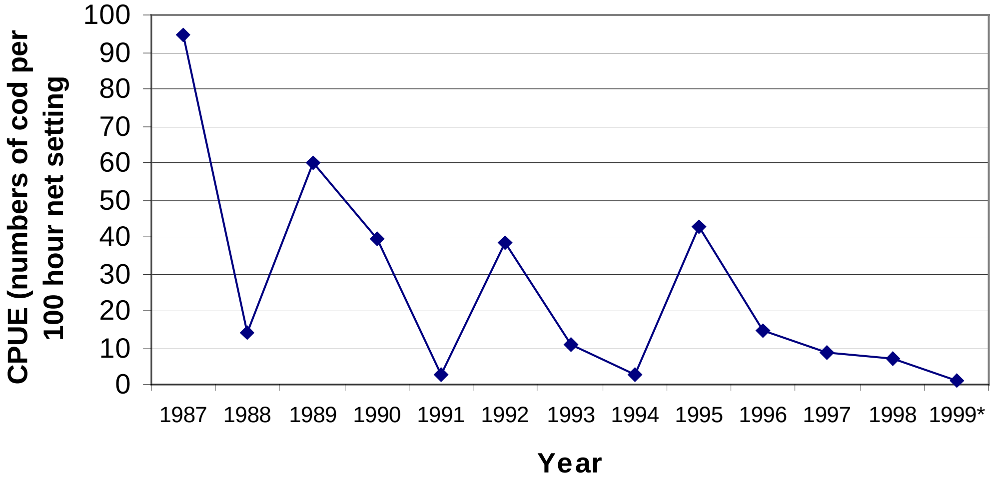


Figure 5.2.1 CPUE (number of age 2 cod caught per 100 hours net setting) in the Greenland Young cod survey 1987-1999. *) incomplete survey coverage.

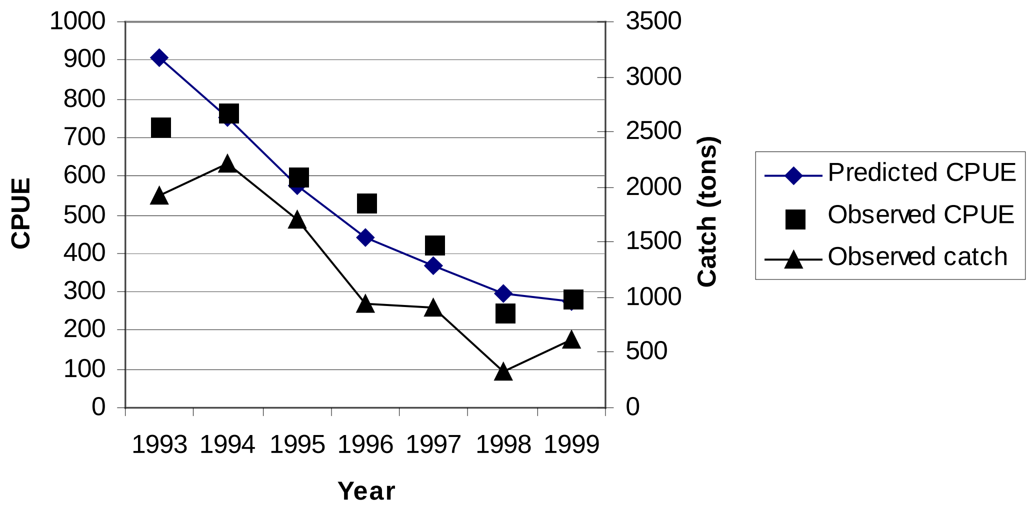


Figure 5.2.2 Greenland cod (inshore component). Observed and model-predicted CPUE rates.

5 GREENLAND HALIBUT IN SUB-AREAS V AND XIV

5.1 Landings, Fisheries and Fleet

Total annual landings in Divisions Va, Vb and Sub-area XIV are presented for the years 1981–1999 in Tables 6.1.1–6.1.5. During the period 1982–1986, landings were stable at about 31 000–34 000 t. In the years 1987–1989 landings increased to about 61 000 t, followed by a decrease to about 35 000 t in 1992. The landings increased to 41 000 t in 1993, but have thereafter decreased to 20 000 t in 1998 and 1999. Catches not officially reported to ICES have been included in the assessment.

Catches in Icelandic waters have, due to quota regulations, decreased from 37 000 t in 1990 to 11 000 t in 1998 and 1999. Faroese catches in Vb increased from of about 1 000 t in 1981–1991 to 6 500 t in 1996, where after it decreased to about 3 000 t in 1999. Catches in division XIVb have increased from below 1 000 t in 1987–1991 to 8 500 t in 1997, but have decreased again to 5 000 t in 1999. In 1999 no catches of Greenland halibut were reported in Sub-area XII.

Most of the fishery for Greenland halibut in Divisions Va, Vb and XIVb is a directed fishery, only minor catches in Va by Iceland, and in XIVb by Germany and the UK comes partly from a redfish fishery. A detailed description of the fishery performance and areas is given in ICES CM 1998/ACFM:19. No major changes were observed 1999.

5.2 Trends in Effort and CPUE

Catch rates of Icelandic bottom trawlers decreased for all fishing grounds during 1990–1995, but stabilised in 1995–1997. In 1998 an increase of 50% in CPUE was observed for all fishing grounds coinciding with a drastic reduction in effort (Table 6.2.1). A further increase of 15% was observed in 1999 . The increase in CPUE For the years 1990–1999 CPUE on the western fishing grounds have been about two to three times higher than for the other fishing grounds.

Indices of CPUE for the Icelandic trawl fleet for the period 1985–1999 (Table 6.2.1) are estimated from a GLIM multiplicative model, taking into account changes in the Icelandic trawl catch due to vessel, statistical square, month, and year effects. All hauls with Greenland halibut exceeding 50% of the total catch were included in the CPUE estimation. The CPUE indices from the Icelandic trawling fleet in Division Va were used to estimate the total effort for each year (y) for all the fleets operating on Greenland halibut in area V and XIV according to:

$$E_{y,V\&XIV} = Y_{y,V\&XIV} \big/ CPUE_{y,Va_{trawl}}$$

where E is total effort, Y are the total reported landings in region V and XIV.

The total effort increased up to 1989, decreased somewhat in the next two years, but increased steeply since 1991 to a maximum in 1996. In 1998 the effort was similar to that 1991. The effort decreased further in 1999. The CPUE was relatively stable in 1985–1989, but has declined sharply since then to a historic low in 1997. The CPUE declined by 70% from 1989 to 1997 but in 1999 it was around 45% of the maximum value.

For division XIVb, CPUE from logbooks in the years 1991–1999 were standardised using a multiplicative model taking into account locality, fleet, season and year. CPUE increased from 1991 to 1993 thereafter it remains relatively stable. In the same period the calculated effort has increased continuously until 1996 but has declined by 20% since then. However, the fishery in XIVb is new and catches have increased from below 500 tons annually before 1991 to 4500 to 8000 tonnes in the last four years. The fishery was therefore assumed to be in the process of learning in the beginning of the CPUE Series. However, the stability in CPUE in recent years is in accordance with observations from the Icelandic fleet.

5.3 Catch at Age

Age-length key for 1999 were from: The icelandic trawl fleet operating in Icelandic waters (120 sample, 1040 otoliths) and the German trawl fishery in Greenlandic waters (52 sample, 962 otoliths) These keys were used to obtain catch in number for the length samples for each of the following commercial fleets and areas:

Gear	Area	Landings	No. samples	No. fish	Key	ALK
Long line	Iceland	564	0	0	Va	ICE-BTRW
Bottom trawl	Iceland-west	7003	129	12212	Va	ICE-BTRW
Bottom trawl	Iceland-north & east	2083	28	2837	Va	ICE-BTRW
Bottom trawl	Iceland-southeast	1454	16	1692	Va	ICE-BTRW
Gill Net (&line)	Faroe Islands	3066	8	2008	Va	ICE-BTRW
Bottom trawl	Faroe Islands	1199	1	216	Va	ICE-BTRW
Long line	East Greenland	219	0	0	XIVb	ICE-BTRW
Bottom trawl	East Greenland	4779	60	3111	XIVb	GER-BTRW
Total		20366	242	22076		

In last year's assessment the age-length key from 1997 was used for the 1998 data because only a limited number of available otoliths were analysed. The 1998 data was therefore updated using an age-length key for 1998 (1237 otoliths samples) taken from the Icelandic trawl and longline fleet.

Length measurements from the Icelandic longline fleet were applied to the longline catch in East Greenland waters. The used length-weight relationship was $W = 0.01758 * L^{2.84387}$ for all fleets. The total catch in numbers (Table 6.3.1) was obtained from the sum of the above, weighted with the catch within each group. Apart from 1994 and 1996 to 1999 only Icelandic data has been available.

5.4 Weight at Age

The mean weight at age in 1999 (Table 6.4.1) was derived from the weighted average of the above groups. Weights at age in the catch are also used as weights at age in the stock.

5.5 Maturity at Age

Data on maturity at age were available for the years 1982–1984 and 1991–1995, based on samples from the Icelandic trawl fishery. Data on maturity at age for the years 1985–1990 were not available. The maturity at age for these years was therefore estimated by averaging the data from the years 1982–1984 and 1991 (Table 6.5.1). Due to unreliable data for 1994, 1993 data were applied to 1994. The data on maturity for 1996 to 1999 were based on information from the Icelandic October groundfish survey and the East Greenland June/July groundfish survey.

5.6 Survey information

An October groundfish survey in Icelandic waters covering the distributional area of Greenland halibut within the Icelandic EEZ was started in 1996. The survey is a fixed station stratified random survey consisting of 300 stations on the continental slope and shelf down to a depth of 1300 m. An increase in the fishable biomass of Greenland halibut (fish of length equal to or greater than 50 cm) is observed from 1996 to 1999 (Figure 6.6.1). Abundance indices of fish equal to or less than 50 cm has increased from the years 1996–97 to 1998–99.

The time series was considered to be too short to be used as a tuning fleet in the stock assessment.

5.7 Stock Assessment

5.7.1 Tuning and estimates of fishing mortality

Age-disaggregated CPUE values for age groups 7–12 over the period 1985–1999, obtained from the Icelandic trawling fleet operating in Division Va, were used in the XSA tuning process with the same settings as in last year's stock assessment. The diagnostics are presented in Table 6.7.1.1.

The terminal fishing mortalities from the accepted XSA run were used to run a traditional VPA. Natural mortality was assumed to be 0.15 and the proportions of F and M before spawning were set to 0. The results of this run are given in Tables 6.7.1.2.-4 and Figures 6.7.1.1 C and D.

5.7.2 Spawning stock and recruitment

Spawning stock biomass is shown in Table 6.7.1.4 and Figure 6.7.1.1.B. The spawning stock was between 70 and 80 000 t between 1978–1983, and increased to a maximum of 122 000 t in 1988. Since then it has declined to a low of 68 000 t in 1998. An increase is observed in 1999 to 72 000 t.

Estimates of recruitment at age 5 are shown in Table 6.7.1.4 and Figure 6.7.1.1.B. The long-term average for the period 1975–1999 is 31 million fish. The 1980 and 1981 year classes are the highest on record at about 46 million. Since then there has been a decline in recruitment with the size of the 1986 year class and onwards being below average. Estimates of the more recent year classes of 1993 and 1994 are thought to be unreliable, since they are just entering the fisheries and calculated VPA stock numbers thus based on few numbers.

5.8 Prediction of Catch and Biomass

5.8.1 Input data

The input data for the short-term prediction are given in Table 6.8.1.1. Mean weight at age is average from 1997-99 and the exploitation pattern is average fishing mortalities from 1997-1999 rescaled to the level of 1999. Maturity at age is the average of 1997–1999. Natural mortality was set to 0.15 and the proportions of F and M before spawning were set to 0. Year classes 1995–97 were set to the lower quartile value of the recruitment of the 1970–1992 year classes. This is a reflection of the recruitment being below average since the 1986 year class.

Since TAC for the Greenland EEZ has not been reached in 1999 and since fishing in the Icelandic area is regulated to not exceed 10 000 t for the current fishing year, a catch constraint of 20 000 t was applied to 2000. This is based on the expectance that the TAC constraint in Iceland will hold, and on the assumption that the catch in other areas remains the same as in 1999.

The Y/R calculation uses the mean weight and maturity at age averaged for the period 1975–1999. The exploitation pattern is based on an average exploitation pattern over the period 1975–1999 rescaled to the level of 1999 (Table 6.8.1.2).

1.1.2 Biological reference points

ACFM proposed a B_{lim} as B_{loss} = 50 000 t. This is the estimated SSB in the beginning of the 1975–1997 data series B_{pa} of 80 000 t was derived by using $B_{pa} = B_{lim}\, e^{1.645\sigma}$, where $\sigma = 0.3$. F_{pa} was defined as $F_{med} = 0.36$.

5.8.3 Projections of catch and biomass

At the beginning of 2000, the total stock is estimated to be 147 000 t, and the spawning stock 71 000 t (Table 6.8.3.1). The catch prediction of 20 000 tonnes in 2000 will result in an estimated fishing mortality of 0.25 and an estimated stock and spawning stock biomass of 151 000 and 72 000, respectively, in the beginning of 2001. Assuming an F in 2001 to be the same as in 2000, results in the stock remaining in a stable, although low, state in the beginning of 2002. A linear reduction in F from the proposed F_{pa} in accordance with the estimate of biomass in 2001 in relation to B_{pa} and B_{lim} results in F = 0.26 and catch of no more than 21 000 t in 2001. However, this will maintain the stock size at *status quo*. Rebuilding the stock above B_{pa} F in the short term requires a reduction in fishing mortality to below F = 0.14 corresponding to a catch of no more than 12 000 t.

5.9 Management Considerations

The Greenland halibut stock biomass has been falling from a peak in 1988. The fishing mortality has been substantially above $F_{0.1}$ since 1986 but is estimated to have been below or close to the currently defined F_{pa} since 1989. Recruitment has been continuously declining in the last two decades and SSB has declined considerably since the late 1980's. The decline in SSB seems to have halted in the last two years but is currently below B_{pa}. A combination of unreliable maturity data and age readings from recent years makes the current estimate of SSB more questionable and may impede its use in relation to Bpa and SSB as a reference point for management advice for the stock.

The stock recruitment relationship is highly negative (Figure 6.8.1), indicating that the highest recruitment is to be expected at low SSB. With respect to time, however, the recruitment in the beginning of the period (year classes 1975–1985) was above average (38 mill.), but recruitment in the latter part of the period (year classes 1986–1991) have been below average (26 mill.). The yield-per-recruit computations indicate that the obtainable yield at F_{pa} is 1.05 kg per recruit. The average yield from the year classes 1975–85 would be in the order of 40 000 t and for year classes 1986–96 27 000 t..

No formal agreement on the management of the Greenland halibut exists among the three coastal states, Greenland, Iceland and the Faeroe Islands. The regulation schemes of those states have previously resulted in catches well in excess of TAC's advised by ICES.

5.10 Comments on the Assessment

Analytical assessment were run with same settings as last year.

Biological features of the stock suggest a change in stock recruitment in the time series.

The terminal fishing mortality has been overestimated and the terminal SSB underestimated in the stock assessments of recent years. This, in addition to strong trends in the catchability in the tuning diagnostics, make the quality of the current assessment questionable. The change and expansion of the fisheries in the recent decade may account for part of the above observations.

The indices of fishable biomass from the Icelandic groundfish survey, which indicate an upward trend from 1996 to 1999 are contradictory to the observed decline in the total biomass over the same period from the current stock assessment.

Improved sampling of catch composition is needed. At present, information on age composition and maturation for all areas is insufficient. Recent age readings from Iceland show a downward shift in apparent growth rate of fish older than 9 years in 1998 and 1999 compared with 1996 and 1997. However these discrepancies do not seem to influence the current stock assessment greatly. Application of maturity at length key to the age-length key, as done in the past four years, may however add increased variability to the point estimator of SSB.

Indices of recruitment of Greenland halibut are an obvious prerequisite for sound management advice. Short-term predictions are based on assumed recruitment values.

The use of only one commercial fleet for tuning is a cause of concern since the fleet covers only a part of the total fishing area. Fleet data from Division XIVb may hopefully be included in future assessments. Although Iceland and Greenland have both initiated annual surveys on the Greenland halibut grounds within Division Va and XIVb, they will not become of use in stock assessment until 2001.Although some tagging experiments and stock discrimination analysis (DNA, electrophoresis, parasite burden, meristic studies) have been carried out in recent years, further understanding on the basic biology and stock structure of the Greenland halibut components in the area is needed.

Table 6.1.1. GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Sub-areas V, XII and XIV 1981-1999, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	767	1,532	1,146	2,502	1,052	853	1,096	1,378	2,319
France	8	27	236	489	845	52	19	25	-
Germany	3,007	2,581	1,142	936	863	858	565	637	493
Greenland	+	1	5	15	81	177	154	37	11
Iceland	15,457	28,300	28,360	30,080	29,231	31,044	44,780	49,040	58,330
Norway	-	-	2	2	3	+	2	1	3
Russia	-	-	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	19,239	32,441	30,891	34,024	32,075	32,984	46,622	51,118	61,156
Working Group estimate	-	-	-	-	-	-	-	-	61,396

Country	1990	1991	1992	1993	1994	1995	1996 [1]	1997 [1]	1998 [1]
Denmark	-	-	-	-	-	-	1	-	
Faroe Islands	1,803	1,566	2,128	4,405	6,241	3,763	6,148	4,971	3,817
France	-	-	3	2	-	-	29	11	8
Germany	336	303	382	415	648	811	3,368	3,342	3,056
Greenland	40	66	437	288	867	533	1,162	1,129	747
Iceland	36,557	34,883	31,955	33,987	27,778	27,383	22,055	18,569	10,728
Norway	50	34	221	846	1,173 [1]	1,810	2,157	1,939	1,367
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	109	811	513	1,436	386	218	190
UK (Scotland)	-	-	19	26	84	232	25	26	43
United Kingdom									
Total	38,813	36,890	35,259	40,780	37,305	36,006	35,755	30,242	20,360
Working Group estimate[2]	39,326	37,950	35,423	40,817	36,958	36,300	35,825	30,267	-

Country	1999 [1]
Denmark	
Faroe Islands	-
France	-
Germany	3,082
Greenland	-
Iceland	11,048
Norway	1,289
Russia	138
UK (Engl. and Wales)	-
UK (Scotland)	-
United Kingdom	301
Total	15,858
Working Group estimate[2]	20,371

1) Provisional data

2) Working group best estimates.

Table 6.1.2. GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Division Va 1981-1999, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	325	669	33	46	-	-	15	379	719
Germany	-	-	-	-	-	-	-	-	-
Greenland	-	-	-	-	-	-	-	-	-
Iceland	15,455	28,300	28,359	30,078	29,195	31,027	44,644	49,000	58,330
Norway	-	-	+	+	2	-	-	-	-
Total	15,780	28,969	28,392	30,124	29,197	31,027	44,659	49,379	59,049
Working Group estimate	-	-	-	-	-	-	-	-	59,272 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998 [1]
Faroe Islands	739	273	23	166	910	13	14	26	6
Germany	-	-	-	-	1	2	4	-	9
Greenland	-	-	-	-	1	-	-	-	
Iceland	36,557	34,883	31,955	33,968	27,696	27,376	22,055	16,766	10,580
Norway	-	-	-	-	-	-	-	-	
Total	37,296	35,156	31,978	34,134	28,608	27,391	22,073	16,792	10,595
Working Group estimate	37,308 [3]	35,413 [4]	-	-	-	-	-	-	

Country	1999
Faroe Islands	
Germany	13
Greenland	
Iceland	11,048
Norway	5
Total	11,066
Working Group estimate	11,108 [5]

1) Provisional data
2) Includes 223 t catch by Norway.
3) Includes 12 t catch by Norway.
4) Includes additional catch of 257 t by Iceland.
5) Includes 5 t by Faroe Islands, additional 37 t by Iceland and 0 t by Norway.

Table 6.1.3. GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Division Vb 1981-1999, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	442	863	1,112	2,456	1,052	775	907	901	1,513
France	8	27	236	489	845	52	19	25	...
Germany	114	142	86	118	227	113	109	42	73
Greenland	-	-	-	-	-	-	-	-	-
Norway	2	+	2	2	2	+	2	1	3
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	566	1,032	1,436	3,065	2,126	940	1,043	969	1,589
Working Group estimate	-	-	-	-	-	-	-	-	1,606 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	-	-	
Faroe Islands	1,064	1,293	2,105	4,058	5,163	3,603	6,004	4750	3660
France [6]	...	...	3 [1]	2	1	28	29	11	8 [1]
Germany	43	24	71	24	8	1	21	41	
Greenland	-	-	-	-	-	-	-	-	
Norway	42	16	25	335	53	142	281 [1]	42 [1]	114 [1]
UK (Engl. and Wales)	-	-	1	15	-	31	122		
UK (Scotland)	-	-	1	-	-	27	12	26	43
United Kingdom	-	-	-	-	-				
Total	1,149	1,333	2,206	4,434	5,225	3,832	6,469 [1]	4,870	3825
Working Group estimate	1,282 [3]	1,662 [4]	2,269 [5]	-	-		-	-	3826 [7]

Country	1999 [1]
Denmark	
Faroe Islands	
France [6]	
Germany	22
Greenland	
Norway	87
UK (Engl. and Wales)	
UK (Scotland)	
United Kingdom	75
Total	184
Working Group estimate	4265 [8]

1) Provisional data
2) Includes 17 t taken by France
3) Includes 133 t taken in Division IIa (Faroese waters).
4) Includes 317 t taken in Division IIa (Faroese waters) + France 12 t.
5) Includes 63 t taken in Division IIa (Faroese waters).
6) Quantity unknown 1989-1991.
7) Includes 3661 t taken in by Faroe Islands.
8) Includes 4078 t by Faroe Islands, 3 t by France.

Table 6.1.4. GREENLAND HALIBUT. Nominal catches (tonnes) by countries, in Sub-area XIV 1981-1999, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	-	-	-	-	-	78	74	98	87
Germany	2,893	2,439	1,054	818	636	745	456	595	420
Greenland	+	1	5	15	81	177	154	37	11
Iceland	-	-	1	2	36	17	136	40	+
Norway	-	-	-	+	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	+
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	2,893	2,440	1,060	835	753	1,017	820	770	518
Working Group estimate	-	-	-	-	-	-	-	-	-

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	1	+	+
Faroe Islands	-	-	-	181	168	147	130	148	151
Germany	293	279	311	391	639	808	3,343	3,301	3,399
Greenland	40	66	437	288	866	533	1,162	1,129	747 [1,10]
Iceland	-	-	-	19	82	7	-	1,803	148
Norway	8	18	196	511	1,120	1,668 [1]	1,874 [1]	1,897 [1]	1,253 [1]
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	108	796	513	1405	264	218	190
UK (Scotland)	-	-	18	26	84	205	13		
United Kingdom	-	-	-	-	-	-	-		
Total	368	401	1,075	2,212	3,472	4,783	7,211	8,533	5940
Working Group estimate	736 [2]	875 [3]	1,176 [4]	2,249 [5]	3,125 [6]	5,077 [7]	7,283 [8]	8,558 [9]	

Country	1999 [1]
Denmark	
Faroe Islands	
Germany	3047
Greenland	
Iceland	
Norway	1197
Russia	138
UK (Engl. and Wales)	
UK (Scotland)	
United Kingdom	226
Total	4608
Working Group estimate	4998 [11]

1) Provisional data
2) Includes 370 t catches taken by Japan
3) Includes 315 t catch taken by Japan and 159 t by other countries as reported to Greenland.
4) Indicates additional catches taken by Germany (96 t) and UK (17 t) as reported to Greenland.
5) Indicates additional catches taken by Germany (37 t), Norway (238 t), UK (182 t) and Japan (62 t) as reported to Greenland.
6) Total reported to Greenlandic authorities are used in assessment: 159 t trawl (Norwegian charter), 205 t gillnets (Norwegian charter). 405t from Norway not included in working group estimate.
7) Includes 273 t offshore gillnets (Greenland charter)
8) Working group estimates as in Table 6.1.5. Includes 72 t by Germany
9) Includes additional catch of 25 t as reported by Norwegian authorities (1858 t inside 200 EEZ, 64 t outside EEZ)
10) Includes 138 t reported as area unknown.
11) Includes 125 t by Faroe Islands, 206 t by Greenland, additional 59 t by Norway.

Table 6.1.5. GREENLAND HALIBUT. Nominal catches (tonnes) by countries in Sub-area XII, as officially reported to the ICES.

Country	1996	1997	1998	1999
Faroe Islands		47		
Norway	2			
Total	2	47	-	-

Table 6.3.1 Catch numbers at age (Numbers*10**-3)

	YEAR	1975	1976	1977	1978	1979
	AGE					
	5	120	43	0	23	29
	6	800	296	34	91	197
	7	1775	584	671	347	1605
	8	1782	621	1727	1037	2253
	9	1259	431	2289	1214	3090
	10	926	240	834	848	1693
	11	464	121	420	567	880
	12	459	86	423	312	394
	13	279	37	174	232	246
	14	193	32	120	218	189
	15	137	14	28	114	147
	+gp	85	9	141	204	125
0	TOTALNUM	8279	2514	6861	5207	10848
	TONSLAND	23494	6045	16578	14349	23616
	SOPCOF %	126	100	100	100	101

Catch numbers at age **Numbers*10**-3**

	YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	AGE										
	5	47	26	8	10	83	125	245	182	129	499
	6	502	158	300	240	277	441	612	3123	742	1657
	7	1536	580	1140	1611	891	1018	1033	4863	2068	4485
	8	2630	1160	2451	2651	2139	2295	1942	2586	2985	5961
	9	3126	1430	2646	3060	3568	3454	2983	2156	3166	5763
	10	2324	1764	2456	2443	2800	2749	3097	3476	2966	3246
	11	1739	1299	1803	1693	1825	1452	1683	1847	1848	1601
	12	849	664	963	978	1134	627	820	1829	1761	1458
	13	578	435	609	424	588	423	550	886	1851	1237
	14	306	252	331	174	363	137	202	243	701	506
	15	143	176	195	37	92	36	59	31	216	362
	+gp	116	159	132	47	20	46	34	5	246	145
0	TOTALNUM	13896	8103	13034	13368	13780	12803	13260	21227	18679	26920
	TONSLAND	31252	19239	32441	30888	34024	32075	32984	46622	51118	61396
	SOPCOF %	99	100	100	101	99	103	101	98	101	100
	1										

Catch numbers at age Numbers*10**-3

	YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	AGE										
	5	188	289	17	44	78	503	178	86	122	85
	6	463	1225	421	397	672	1587	1488	549	688	593
	7	1513	1797	2023	1896	2197	3031	2908	2723	1429	894
	8	3515	2866	3262	5024	3815	3287	3181	2579	1948	1300
	9	4186	2935	2646	4324	3648	2608	2119	2331	1444	1416
	10	3143	2074	3019	2859	2330	1963	1755	1247	1371	1537
	11	1224	1130	1962	1539	1715	1548	1610	975	916	1219
	12	959	1072	1278	1412	990	1132	1216	937	620	835
	13	568	924	509	576	422	657	665	652	436	496
	14	358	554	144	136	371	444	548	374	244	414
	15	137	342	36	135	168	240	238	282	175	258
	+gp	61	82	56	14	177	232	503	700	258	371
0	TOTALNUM	16315	15290	15373	18356	16583	17232	16409	13435	9651	9418
	TONSLAND	39326	37950	35423	40817	36958	36300	35826	30267	20360	20366
	SOPCOF %	100	101	100	100	100	100	100	100	100	100
	1										

Table 6.4.1 Catch weights at age (kg)

YEAR	1975	1976	1977	1978	1979
AGE					
5	0.968	1.157	1.157	0.968	0.911
6	1.199	1.585	1.046	1.199	0.942
7	1.423	1.768	1.429	1.423	1.278
8	1.854	2.18	1.794	1.854	1.676
9	2.256	2.57	2.228	2.256	2.072
10	2.607	3.018	2.687	2.607	2.333
11	3.081	3.73	3.017	3.081	2.723
12	3.591	4.052	3.914	3.591	3.297
13	4.604	4.815	4.04	4.604	3.985
14	4.695	5.348	4.714	4.695	4.668
15	5.151	5.752	5.401	5.151	4.792
+gp	6.902	7.094	5.597	6.45	5.387
0 SOPCOFAC	1.255	1.0024	1.0008	0.9993	1.0124

Table 2 Catch weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
5	1.125	1.071	1.01	0.984	0.942	0.995	1.03	1.03	1.129	0.842
6	1.283	1.257	1.368	1.338	1.275	1.23	1.238	1.218	1.304	1.047
7	1.487	1.44	1.618	1.577	1.592	1.63	1.499	1.533	1.541	1.425
8	1.756	1.66	1.905	1.848	1.817	1.951	1.937	1.824	1.77	1.727
9	2.153	1.967	2.187	2.159	2.24	2.367	2.363	2.187	2.236	2.125
10	2.279	2.258	2.516	2.434	2.461	2.637	2.631	2.666	2.683	2.637
11	2.498	2.515	2.761	2.603	2.835	2.829	2.848	2.996	3.082	3.22
12	3.059	2.95	3.129	3.034	3.262	3.353	3.335	3.595	3.624	3.733
13	3.783	3.45	3.785	3.784	3.962	4.006	4.039	4.431	4.312	4.135
14	4.507	4.033	4.475	4.446	4.936	4.792	4.925	5.14	5.098	5.38
15	5.139	4.652	4.985	4.751	5.23	5.231	5.466	5.764	5.213	6.569
+gp	5.983	5.33	6.088	6.385	7.192	6.323	5.985	7.267	5.764	6.497
0 SOPCOFAC	0.9902	1.0024	0.9997	1.011	0.9937	1.0258	1.006	0.9785	1.0063	0.9999

1

Run title : G. halibut V & XIV (run: XSAJBO05/X05)

At 27/04/2000 19:18

Table 2 Catch weights at age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
5	1.029	1.001	1.016	0.991	1.163	0.95	1.101	0.919	0.807	0.861
6	1.21	1.247	1.256	1.249	1.254	1.213	1.124	1.107	1.086	0.953
7	1.572	1.472	1.401	1.401	1.488	1.413	1.346	1.334	1.363	1.288
8	1.79	1.81	1.718	1.685	1.736	1.703	1.649	1.64	1.658	1.565
9	2.126	2.088	2.049	1.982	2.15	2.028	1.925	1.881	1.886	1.739
10	2.536	2.44	2.436	2.425	2.352	2.279	2.342	2.24	2.167	2.012
11	3.214	2.935	2.868	2.952	2.736	2.643	2.595	2.538	2.415	2.351
12	3.693	3.737	3.478	3.429	3.082	2.992	3.013	2.846	2.844	2.634
13	4.448	4.401	4.51	4.479	3.607	3.568	3.515	3.385	3.173	3.031
14	5.197	5.022	4.681	6.043	4.242	4.068	4.123	4.359	4.237	3.532
15	5.891	5.991	6.01	5.832	5.293	5.302	4.996	4.851	4.656	3.874
+gp	6.049	6.412	5.128	2.756	6.087	5.614	5.845	5.8	5.424	5.271
0 SOPCOFAC	0.9998	1.0097	1.0033	1.001	1.0001	1.0014	1.0011	1.0044	1.0018	1

1

Table 6.5.1 Proportion mature at age

YEAR	1975	1976	1977	1978	1979
AGE					
5	0.000	0.000	0.000	0.000	0.000
6	0.030	0.030	0.030	0.030	0.030
7	0.100	0.100	0.100	0.100	0.100
8	0.350	0.350	0.350	0.350	0.350
9	0.770	0.770	0.770	0.770	0.770
10	0.960	0.960	0.960	0.960	0.960
11	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000
+gp	1.000	1.000	1.000	1.000	1.000

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
5	0.000	0.000	0.000	0.040	0.000	0.010	0.010	0.010	0.010	0.010
6	0.030	0.030	0.050	0.070	0.080	0.060	0.060	0.060	0.060	0.060
7	0.100	0.100	0.200	0.150	0.190	0.210	0.210	0.210	0.210	0.210
8	0.350	0.350	0.330	0.280	0.320	0.350	0.350	0.350	0.350	0.350
9	0.770	0.770	0.500	0.380	0.420	0.460	0.460	0.460	0.460	0.460
10	0.960	0.960	0.700	0.600	0.640	0.640	0.640	0.640	0.640	0.640
11	1.000	1.000	0.850	0.850	0.750	0.820	0.820	0.820	0.820	0.820
12	1.000	1.000	0.940	0.980	0.930	0.960	0.960	0.960	0.960	0.960
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
+gp	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1										

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
5	0.010	0.010	0.020	0.030	0.030	0.178	0.304	0.224	0.305	0.205
6	0.060	0.060	0.040	0.120	0.120	0.181	0.310	0.291	0.333	0.262
7	0.210	0.290	0.110	0.270	0.270	0.477	0.393	0.368	0.351	0.436
8	0.350	0.480	0.250	0.400	0.400	0.597	0.464	0.438	0.394	0.542
9	0.460	0.560	0.470	0.450	0.450	0.586	0.526	0.495	0.488	0.597
10	0.640	0.620	0.680	0.540	0.540	0.705	0.626	0.588	0.476	0.666
11	0.820	0.850	0.850	0.650	0.650	0.786	0.690	0.668	0.593	0.731
12	0.960	1.000	0.960	0.780	0.780	0.764	0.773	0.745	0.636	0.766
13	1.000	1.000	1.000	0.830	0.830	0.961	0.870	0.850	0.784	0.790
14	1.000	1.000	1.000	0.970	0.970	1.000	0.953	0.948	0.881	0.835
15	1.000	1.000	1.000	1.000	1.000	1.000	0.981	0.971	0.872	0.860
+gp	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.986	0.909	0.869

Table 6.7.1.1 Output from XSA

Extended Survivors Analysis

G. halibut V & XIV (run: XSAJBO05/X05)

CPUE data from file fleet

Catch data for 25 years. 1975 to 1999. Ages 5 to 16.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT02: VA	1985	1999	7	12	0	1

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 7

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 7

Catchability independent of age for ages >= 13

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 = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 26 iterations

1

Regression weights

	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997

Table 6.7.1.1. Cont'd

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5	0.005	0.011	0.001	0.002	0.003	0.021	0.009	0.005	0.005	0.004
6	0.016	0.042	0.019	0.019	0.029	0.076	0.076	0.032	0.048	0.03
7	0.068	0.075	0.085	0.106	0.134	0.167	0.183	0.184	0.105	0.077
8	0.19	0.168	0.179	0.296	0.303	0.286	0.25	0.232	0.184	0.124
9	0.328	0.227	0.218	0.359	0.343	0.33	0.285	0.276	0.186	0.187
10	0.393	0.253	0.363	0.364	0.316	0.295	0.365	0.255	0.245	0.292
11	0.297	0.225	0.381	0.3	0.366	0.337	0.396	0.334	0.285	0.339
12	0.38	0.434	0.403	0.491	0.303	0.414	0.456	0.398	0.347	0.43
13	0.529	0.729	0.357	0.3	0.249	0.319	0.43	0.446	0.307	0.487
14	0.343	1.558	0.216	0.143	0.304	0.423	0.452	0.433	0.281	0.506
15	0.379	0.606	0.333	0.305	0.249	0.311	0.398	0.418	0.349	0.507

1

XSA population numbers (Thousands)

YEAR	AGE 5	6	7	8	9	10	11	12	13	14
1990	3.79E+04	3.17E+04	2.49E+04	2.19E+04	1.61E+04	1.04E+04	5.13E+03	3.27E+03	1.49E+03	1.33E+03
1991	2.83E+04	3.24E+04	2.69E+04	2.00E+04	1.56E+04	9.99E+03	6.05E+03	3.28E+03	1.92E+03	7.57E+02
1992	2.61E+04	2.41E+04	2.68E+04	2.15E+04	1.46E+04	1.07E+04	6.67E+03	4.16E+03	1.83E+03	7.98E+02
1993	2.96E+04	2.24E+04	2.03E+04	2.12E+04	1.54E+04	1.01E+04	6.40E+03	3.92E+03	2.39E+03	1.10E+03
1994	2.74E+04	2.55E+04	1.89E+04	1.57E+04	1.36E+04	9.28E+03	6.03E+03	4.08E+03	2.07E+03	1.52E+03
1995	2.60E+04	2.35E+04	2.13E+04	1.43E+04	1.00E+04	8.28E+03	5.83E+03	3.60E+03	2.60E+03	1.39E+03
1996	2.18E+04	2.19E+04	1.87E+04	1.55E+04	9.22E+03	6.19E+03	5.31E+03	3.58E+03	2.05E+03	1.62E+03
1997	1.85E+04	1.86E+04	1.75E+04	1.34E+04	1.04E+04	5.97E+03	3.70E+03	3.07E+03	1.95E+03	1.15E+03
1998	2.52E+04	1.58E+04	1.55E+04	1.25E+04	9.17E+03	6.79E+03	3.98E+03	2.28E+03	1.78E+03	1.08E+03
1999	2.35E+04	2.16E+04	1.30E+04	1.20E+04	8.97E+03	6.55E+03	4.57E+03	2.57E+03	1.39E+03	1.12E+03

Estimated population abundance at 1st Jan 2000

0.00E+00	2.01E+04	1.80E+04	1.03E+04	9.13E+03	6.40E+03	4.21E+03	2.81E+03	1.44E+03	7.33E+02

Taper weighted geometric mean of the VPA populations:

2.83E+04	2.50E+04	2.14E+04	1.73E+04	1.26E+04	8.57E+03	5.47E+03	3.43E+03	1.97E+03	1.07E+03

Standard error of the weighted Log(VPA populations) :

0.253	0.2615	0.2731	0.2535	0.26	0.2399	0.2214	0.2521	0.3023	0.4098

YEAR	AGE 15
1990	4.68E+02
1991	8.11E+02
1992	1.37E+02

Table 6.7.1.1. Cont'd

1993	5.54E+02
1994	8.22E+02
1995	9.68E+02
1996	7.82E+02
1997	8.90E+02
1998	6.40E+02
1999	6.99E+02

Estimated population abundance at 1st Jan 2000

5.84E+02

Taper weighted geometric mean of the VPA populations:

5.22E+02

Standard error of the weighted Log(VPA populations) :

0.7361

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Log catchability residuals.

Fleet : FLT02: VA TRW CPU 19

Age	1985	1986	1987	1988	1989
7	0.04	-0.38	0.38	0.28	0.30
8	0.16	-0.34	-0.18	0.19	0.34
9	0.34	0.29	0.00	0.50	0.49
10	0.39	0.39	0.31	0.48	0.56
11	0.37	0.36	0.35	0.50	0.34
12	0.28	0.30	0.30	0.35	0.74

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
7	-0.11	-0.14	0.01	-0.23	-0.07	-0.14	-0.14	-0.13	0.17	0.29
8	0.21	0.16	-0.02	0.11	-0.02	-0.21	-0.38	-0.32	0.22	0.16
9	0.37	0.17	-0.14	0.00	-0.18	-0.30	-0.54	-0.36	0.10	0.14
10	0.27	0.08	0.03	-0.15	-0.36	-0.51	-0.45	-0.52	0.17	0.41
11	-0.03	0.04	-0.11	-0.39	-0.26	-0.49	-0.41	-0.22	0.31	0.55
12	-0.07	0.75	-0.10	-0.18	-0.71	-0.68	-0.53	-0.33	0.09	0.74

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Table 6.7.1.1. Cont'd

Age	7	8	9	10	11	12
Mean Log q	-6.1683	-5.4755	-5.1862	-5.0493	-5.0437	-4.8205
S.E(Log q)	0.2108	0.2349	0.3186	0.3888	0.3686	0.5218

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
7	0.97	0.144	6.3	0.64	15	0.21	-6.17
8	0.75	1.171	6.53	0.7	15	0.17	-5.48
9	0.58	2.253	6.97	0.75	15	0.16	-5.19
10	0.61	1.378	6.63	0.56	15	0.23	-5.05
11	1.12	-0.196	4.63	0.23	15	0.43	-5.04
12	1.92	-0.709	1.77	0.06	15	1.02	-4.82
1							

Terminal year survivor and F summaries :

Age 5 Catchability dependent on age and year class strength

Year class = 1994

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
P shrinkage	25036	0.26				0.785	0.003
F shrinkage	9069	0.5				0.215	0.009

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
20131	0.23	9.92	2	42.808	0.004

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Age 6 Catchability dependent on age and year class strength

Year class = 1993

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
P shrinkage	21359	0.27				0.77	0.025
F shrinkage	10257	0.5				0.23	0.052

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
18047	0.24	9.81	2	40.917	0.03

Table 6.7.1.1. Cont'd

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA	13775.0000	0.3000	0.0000	0.0000	1.0000	0.7200	0.0580
F shrinkage	4955.0000	0.5000				0.2800	0.1550

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
10346.0000	0.2600	0.5400	2.0000	2.1020	0.0770

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Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA	10778	0.212	0.007	0.03	2	0.823	0.106
F shrinkage	4214	0.5				0.177	0.252

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
9131	0.2	0.28	3	1.424	0.124

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA	6995	0.181	0.104	0.57	3	0.844	0.172
F shrinkage	3982	0.5				0.156	0.285

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
6405	0.17	0.15	4	0.877	0.187

1

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA	4228	0.168	0.156	0.93	4	0.834	0.291
F shrinkage	4134	0.5				0.166	0.296

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
4213	0.16	0.12	5	0.758	0.292

Table 6.7.1.1. Cont'd

Age 12 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA T	1390	0.16	0.202	1.26	6	0.786	0.443
F shrinkage	1647	0.5				0.214	0.385

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1441	0.17	0.17	7	1.009	0.43

Age 13 Catchability constant w.r.t. time and dependent on age

Year class = 1986

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA T	609	0.167	0.079	0.47	6	0.68	0.563
F shrinkage	1091	0.5				0.32	0.352

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
733	0.2	0.15	7	0.75	0.487

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 13

Year class = 1985

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA T	455	0.169	0.095	0.56	6	0.586	0.612
F shrinkage	830	0.5				0.414	0.38

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
584	0.23	0.17	7	0.746	0.506

Table 6.7.1.1. Cont'd

Age 15 Catchability constant w.r.t. time and age (fixed at the value for age) 13

Year class = 1984

Fleet	Es Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: VA T	273	0.169	0.097	0.57	6	0.476	0.63
F shrinkage	469	0.5				0.524	0.413

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
362	0.27	0.17	7	0.625	0.507

1
1

Table 6.7.1.2 Fishing mortality (F) at age

YEAR	1975	1976	1977	1978	1979
AGE					
5	0.005	0.002	0.000	0.001	0.001
6	0.048	0.015	0.002	0.004	0.009
7	0.152	0.043	0.042	0.020	0.094
8	0.256	0.069	0.162	0.079	0.164
9	0.299	0.086	0.364	0.155	0.335
10	0.356	0.080	0.225	0.210	0.317
11	0.238	0.067	0.186	0.222	0.330
12	0.365	0.060	0.331	0.195	0.224
13	0.790	0.042	0.156	0.288	0.219
14	0.676	0.175	0.177	0.282	0.379
15	0.488	0.085	0.216	0.240	0.295
+gp	0.488	0.085	0.216	0.240	0.295
0 FBAR 8-12	0.303	0.072	0.254	0.172	0.274

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
5	0.001	0.001	0.000	0.000	0.003	0.003	0.006	0.005	0.004	0.015
6	0.018	0.005	0.009	0.009	0.012	0.017	0.017	0.088	0.023	0.060
7	0.086	0.025	0.042	0.061	0.040	0.052	0.048	0.169	0.074	0.174
8	0.208	0.082	0.133	0.123	0.102	0.129	0.125	0.154	0.141	0.295
9	0.338	0.158	0.256	0.232	0.229	0.225	0.234	0.189	0.270	0.414
10	0.428	0.306	0.418	0.376	0.325	0.262	0.304	0.440	0.404	0.462
11	0.588	0.426	0.553	0.536	0.504	0.263	0.240	0.283	0.418	0.375
12	0.576	0.439	0.611	0.626	0.803	0.303	0.220	0.419	0.450	0.646
13	0.557	0.624	0.885	0.563	0.935	0.764	0.448	0.370	0.947	0.623
14	0.437	0.474	1.450	0.639	1.393	0.542	1.010	0.342	0.531	0.695
15	0.520	0.456	0.789	0.551	0.798	0.429	0.447	0.373	0.548	0.544
+gp	0.520	0.456	0.789	0.551	0.798	0.429	0.447	0.373	0.548	0.544
0 FBAR 8-12	0.428	0.282	0.394	0.379	0.393	0.237	0.225	0.297	0.337	0.438
1										

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99
AGE											
5	0.005	0.011	0.001	0.002	0.003	0.021	0.009	0.005	0.005	0.004	0.005
6	0.016	0.042	0.019	0.019	0.029	0.076	0.076	0.032	0.048	0.030	0.037
7	0.068	0.075	0.085	0.106	0.134	0.167	0.183	0.184	0.105	0.077	0.122
8	0.190	0.168	0.179	0.296	0.303	0.286	0.250	0.232	0.184	0.124	0.180
9	0.329	0.227	0.218	0.359	0.343	0.330	0.285	0.276	0.186	0.187	0.216
10	0.394	0.253	0.363	0.364	0.316	0.295	0.365	0.255	0.245	0.292	0.264
11	0.297	0.225	0.381	0.300	0.366	0.337	0.396	0.334	0.285	0.339	0.319
12	0.380	0.434	0.403	0.491	0.303	0.414	0.456	0.398	0.347	0.430	0.392
13	0.529	0.729	0.357	0.300	0.249	0.319	0.430	0.446	0.307	0.487	0.414
14	0.343	1.558	0.216	0.143	0.304	0.423	0.452	0.433	0.281	0.506	0.406
15	0.379	0.606	0.333	0.305	0.249	0.311	0.398	0.418	0.349	0.507	0.425
+gp	0.379	0.606	0.333	0.305	0.249	0.311	0.398	0.418	0.349	0.507	
0 FBAR 8-12	0.318	0.261	0.309	0.362	0.326	0.332	0.350	0.299	0.249	0.274	
1											

Table 6.7.1.3 Stock number at age (start of year) Numbers*10-3**

YEAR		1975	1976	1977	1978	1979
AGE						
	5	24537	25825	26124	27462	34673
	6	18407	21007	22188	22486	23615
	7	13606	15101	17807	19066	19269
	8	8494	10064	12455	14704	16088
	9	5252	5658	8086	9118	11694
	10	3333	3352	4470	4836	6722
	11	2360	2010	2663	3073	3376
	12	1619	1601	1617	1902	2119
	13	551	968	1298	1000	1348
	14	423	215	798	956	645
	15	383	185	156	576	620
+gp		236	119	781	1026	525
0 TOTAL		79199	86104	98442	106204	120694

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE											
	5	40591	40085	33617	29709	32757	46389	46627	41995	35819	37386
	6	29816	34893	34477	28927	25562	28118	39811	39905	35977	30710
	7	20143	25197	29886	29396	24675	21744	23792	33698	31449	30277
	8	15096	15912	21149	24666	23807	20411	17771	19519	24493	25150
	9	11757	10553	12620	15929	18770	18507	15439	13494	14401	18312
	10	7198	7219	7757	8407	10872	12846	12724	10521	9614	9458
	11	4215	4039	4577	4398	4969	6760	8506	8079	5831	5523
	12	2089	2014	2272	2267	2214	2584	4471	5760	5240	3304
	13	1459	1010	1118	1062	1044	854	1642	3088	3261	2876
	14	932	719	466	397	520	353	343	903	1835	1089
	15	380	518	385	94	180	111	177	107	552	929
+gp		306	465	258	119	39	141	101	17	624	369
0 TOTAL		133981	142626	148581	145371	145411	158817	171404	177087	169096	165385

1

Run title : G. halibut V & XIV (run: XSAJBO05/X05)

At 27/04/2000 19:18

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 75-97	AMST 75-97
AGE														
	5	37869	28272	26061	29635	27367	26001	21794	18481	25235	23480	0	31256	32134
	6	31715	32420	24066	22415	25466	23482	21912	18593	15827	21607	20131	26959	27651
	7	24895	26868	26768	20323	18925	21296	18739	17480	15494	12984	18047	22436	23061
	8	21899	20024	21458	21162	15733	14250	15517	13431	12519	12010	10346	17316	17968
	9	16117	15588	14576	15443	13554	10002	9216	10405	9168	8968	9131	12159	12804
	10	10415	9988	10693	10091	9280	8281	6190	5966	6793	6551	6405	7766	8271
	11	5129	6048	6673	6403	6033	5826	5307	3699	3978	4575	4213	4712	5022
	12	3269	3279	4157	3923	4083	3601	3578	3074	2279	2574	2807	2839	3045
	13	1491	1924	1828	2392	2067	2596	2049	1952	1776	1387	1441	1533	1690
	14	1328	757	798	1101	1525	1387	1625	1147	1075	1124	733	766	881
	15	468	811	137	554	822	968	782	890	640	699	584	365	469
+gp		207	193	212	57	862	931	1643	2196	939	998	879		
0 TOTAL		154802	146170	137428	133500	125716	118623	108353	97314	95723	96956	74717		

1

Table 6.7.1.4 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 5	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 8-12
1975	24537	122673	46780	23494	0.5022	0.3028
1976	25825	158172	53957	6045	0.112	0.0723
1977	26124	159831	65044	16578	0.2549	0.2536
1978	27462	176089	75982	14349	0.1888	0.1719
1979	34673	175696	76641	23616	0.3081	0.2738
1980	40591	212516	79079	31252	0.3952	0.4276
1981	40085	213924	73198	19239	0.2628	0.282
1982	33617	246430	80016	32441	0.4054	0.3941
1983	29709	240045	72399	30888	0.4266	0.3785
1984	32757	244028	83907	34024	0.4055	0.3926
1985	46389	268060	96332	32075	0.333	0.2365
1986	46627	286385	105252	32984	0.3134	0.2247
1987	41995	300662	116979	46622	0.3985	0.297
1988	35819	304017	122749	51118	0.4164	0.3367
1989	37386	270443	113052	61396	0.5431	0.4383
1990	37869	262454	99946	39326	0.3935	0.3179
1991	28272	249803	110613	37950	0.3431	0.2614
1992	26061	234477	90872	35423	0.3898	0.3086
1993	29635	229684	94692	40817	0.431	0.362
1994	27367	222812	90817	36958	0.4069	0.326
1995	26001	198144	108829	36300	0.3335	0.3324
1996	21794	183639	99047	35826	0.3617	0.3503
1997	18481	162647	85466	30267	0.3541	0.2992
1998	25235	145792	68451	20360	0.2974	0.2494
1999	23480	138779	71698	20366	0.2841	0.2742
Arith. Mean	31512	216288	87272	31589	0.3545	0.3026
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		
1						

Table 6.8.1.1

The SAS System 10:46 Friday, May 12, 2000

Greenland halibut in Sub-areas V and XIV

Prediction with management option table: Input data

Year: 2000								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
5	26000.000	0.1500	0.2450	0.0000	0.0000	0.862	0.0050	0.862
6	20131.000	0.1500	0.2950	0.0000	0.0000	1.049	0.0370	1.049
7	18047.000	0.1500	0.3850	0.0000	0.0000	1.328	0.1220	1.328
8	10346.000	0.1500	0.4580	0.0000	0.0000	1.621	0.1800	1.621
9	9131.000	0.1500	0.5270	0.0000	0.0000	1.835	0.2160	1.835
10	6405.000	0.1500	0.5770	0.0000	0.0000	2.140	0.2640	2.140
11	4213.000	0.1500	0.6640	0.0000	0.0000	2.435	0.3190	2.435
12	2807.000	0.1500	0.7160	0.0000	0.0000	2.775	0.3920	2.775
13	1441.000	0.1500	0.8080	0.0000	0.0000	3.196	0.4140	3.196
14	733.000	0.1500	0.8880	0.0000	0.0000	4.043	0.4060	4.043
15	584.000	0.1500	0.9010	0.0000	0.0000	4.460	0.4250	4.460
16+	879.000	0.1500	0.9210	0.0000	0.0000	5.498	0.4250	5.498
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
5	26000.000	0.1500	0.2450	0.0000	0.0000	0.862	0.0050	0.862
6	.	0.1500	0.2950	0.0000	0.0000	1.049	0.0370	1.049
7	.	0.1500	0.3850	0.0000	0.0000	1.328	0.1220	1.328
8	.	0.1500	0.4580	0.0000	0.0000	1.621	0.1800	1.621
9	.	0.1500	0.5270	0.0000	0.0000	1.835	0.2160	1.835
10	.	0.1500	0.5770	0.0000	0.0000	2.140	0.2640	2.140
11	.	0.1500	0.6640	0.0000	0.0000	2.435	0.3190	2.435
12	.	0.1500	0.7160	0.0000	0.0000	2.775	0.3920	2.775
13	.	0.1500	0.8080	0.0000	0.0000	3.196	0.4140	3.196
14	.	0.1500	0.8880	0.0000	0.0000	4.043	0.4060	4.043
15	.	0.1500	0.9010	0.0000	0.0000	4.460	0.4250	4.460
16+	.	0.1500	0.9210	0.0000	0.0000	5.498	0.4250	5.498
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
5	26000.000	0.1500	0.2450	0.0000	0.0000	0.862	0.0050	0.862
6	.	0.1500	0.2950	0.0000	0.0000	1.049	0.0370	1.049
7	.	0.1500	0.3850	0.0000	0.0000	1.328	0.1220	1.328
8	.	0.1500	0.4580	0.0000	0.0000	1.621	0.1800	1.621
9	.	0.1500	0.5270	0.0000	0.0000	1.835	0.2160	1.835
10	.	0.1500	0.5770	0.0000	0.0000	2.140	0.2640	2.140
11	.	0.1500	0.6640	0.0000	0.0000	2.435	0.3190	2.435
12	.	0.1500	0.7160	0.0000	0.0000	2.775	0.3920	2.775
13	.	0.1500	0.8080	0.0000	0.0000	3.196	0.4140	3.196
14	.	0.1500	0.8880	0.0000	0.0000	4.043	0.4060	4.043
15	.	0.1500	0.9010	0.0000	0.0000	4.460	0.4250	4.460
16+	.	0.1500	0.9210	0.0000	0.0000	5.498	0.4250	5.498
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANJBO06
Date and time: 01MAY00:16:48

Table 6.8.1.2

The SAS System 10:46 Friday, May 12, 2000

Greenland halibut in Sub-areas V and XIV

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
5	1.000	0.1500	0.0560	0.0000	0.0000	1.006	0.0040	1.006
6	.	0.1500	0.0990	0.0000	0.0000	1.209	0.0260	1.209
7	.	0.1500	0.2190	0.0000	0.0000	1.470	0.0830	1.470
8	.	0.1500	0.3780	0.0000	0.0000	1.780	0.1610	1.780
9	.	0.1500	0.5630	0.0000	0.0000	2.129	0.2360	2.129
10	.	0.1500	0.7180	0.0000	0.0000	2.467	0.2920	2.467
11	.	0.1500	0.8340	0.0000	0.0000	2.843	0.3080	2.843
12	.	0.1500	0.9130	0.0000	0.0000	3.331	0.3740	3.331
13	.	0.1500	0.9570	0.0000	0.0000	3.994	0.4480	3.994
14	.	0.1500	0.9820	0.0000	0.0000	4.694	0.5020	4.694
15	.	0.1500	0.9870	0.0000	0.0000	5.278	0.3850	5.278
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDJBO02
Date and time: 12MAY00:10:59

Table 6.8.3.1

The SAS System 10:46 Friday, May 12, 2000

Greenland halibut in Sub-areas V and XIV

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.9115	0.2499	147783	70907	20000	0.0000	0.0000	151797	72438	0	177184	88733
.	.	.	.	.	0.0500	0.0137	.	72438	1252	175842	87821
.	.	.	.	.	0.1000	0.0274	.	72438	2488	174519	86924
.	.	.	.	.	0.1500	0.0411	.	72438	3707	173214	86040
.	.	.	.	.	0.2000	0.0548	.	72438	4909	171927	85170
.	.	.	.	.	0.2500	0.0686	.	72438	6095	170658	84312
.	.	.	.	.	0.3000	0.0823	.	72438	7265	169406	83468
.	.	.	.	.	0.3500	0.0960	.	72438	8420	168171	82636
.	.	.	.	.	0.4000	0.1097	.	72438	9559	166953	81817
.	.	.	.	.	0.4500	0.1234	.	72438	10683	165751	81010
.	.	.	.	.	0.5000	0.1371	.	72438	11792	164566	80215
.	.	.	.	.	0.5500	0.1508	.	72438	12886	163397	79432
.	.	.	.	.	0.6000	0.1645	.	72438	13965	162243	78660
.	.	.	.	.	0.6500	0.1782	.	72438	15031	161106	77900
.	.	.	.	.	0.7000	0.1919	.	72438	16082	159983	77151
.	.	.	.	.	0.7500	0.2057	.	72438	17120	158875	76413
.	.	.	.	.	0.8000	0.2194	.	72438	18144	157783	75687
.	.	.	.	.	0.8500	0.2331	.	72438	19155	156704	74971
.	.	.	.	.	0.9000	0.2468	.	72438	20152	155641	74265
.	.	.	.	.	0.9500	0.2605	.	72438	21137	154591	73570
.	.	.	.	.	1.0000	0.2742	.	72438	22108	153555	72885
.	.	.	.	.	1.0500	0.2879	.	72438	23067	152533	72210
.	.	.	.	.	1.1000	0.3016	.	72438	24014	151524	71544
.	.	.	.	.	1.1500	0.3153	.	72438	24949	150529	70889
.	.	.	.	.	1.2000	0.3290	.	72438	25871	149546	70243
.	.	.	.	.	1.2500	0.3428	.	72438	26782	148577	69606
.	.	.	.	.	1.3000	0.3565	.	72438	27681	147620	68979
.	.	.	.	.	1.3500	0.3702	.	72438	28569	146675	68360
.	.	.	.	.	1.4000	0.3839	.	72438	29445	145743	67751
.	.	.	.	.	1.4500	0.3976	.	72438	30311	144823	67150
.	.	.	.	.	1.5000	0.4113	.	72438	31165	143915	66558
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJBO06
Date and time : 01MAY00:16:48
Computation of ref. F: Simple mean, age 8 - 12
Basis for 2000 : TAC constraints

Table 6.8.3.2

The SAS System 10:46 Friday, May 12, 2000
Greenland halibut in Sub-areas V and XIV

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.800	12523.370	2.614	7858.211	2.614	7858.211
0.0500	0.0137	0.047	143.499	5.670	12028.506	2.500	7404.496	2.500	7404.496
0.1000	0.0274	0.089	267.979	5.549	11571.753	2.394	6987.321	2.394	6987.321
0.1500	0.0411	0.126	375.941	5.436	11149.671	2.296	6603.341	2.296	6603.341
0.2000	0.0548	0.160	469.561	5.330	10759.161	2.204	6249.540	2.204	6249.540
0.2500	0.0686	0.191	550.728	5.230	10397.420	2.119	5923.198	2.119	5923.198
0.3000	0.0823	0.218	621.082	5.137	10061.917	2.039	5621.857	2.039	5621.857
0.3500	0.0960	0.243	682.049	5.050	9750.364	1.965	5343.298	1.965	5343.298
0.4000	0.1097	0.266	734.867	4.968	9460.693	1.896	5085.515	1.896	5085.515
0.4500	0.1234	0.286	780.610	4.890	9191.029	1.831	4846.694	1.831	4846.694
0.5000	0.1371	0.305	820.214	4.817	8939.676	1.771	4625.194	1.771	4625.194
0.5500	0.1508	0.322	854.488	4.748	8705.096	1.714	4419.528	1.714	4419.528
0.6000	0.1645	0.338	884.137	4.683	8485.896	1.660	4228.349	1.660	4228.349
0.6500	0.1782	0.352	909.772	4.622	8280.809	1.610	4050.438	1.610	4050.438
0.7000	0.1919	0.365	931.926	4.563	8088.688	1.563	3884.687	1.563	3884.687
0.7500	0.2057	0.377	951.059	4.508	7908.487	1.519	3730.091	1.519	3730.091
0.8000	0.2194	0.389	967.571	4.456	7739.258	1.477	3585.736	1.477	3585.736
0.8500	0.2331	0.399	981.811	4.406	7580.137	1.437	3450.794	1.437	3450.794
0.9000	0.2468	0.409	994.080	4.358	7430.337	1.400	3324.510	1.400	3324.510
0.9500	0.2605	0.418	1004.641	4.313	7289.141	1.365	3206.196	1.365	3206.196
1.0000	0.2742	0.426	1013.720	4.270	7155.895	1.331	3095.228	1.331	3095.228
1.0500	0.2879	0.434	1021.515	4.228	7030.003	1.299	2991.034	1.299	2991.034
1.1000	0.3016	0.441	1028.198	4.189	6910.920	1.269	2893.095	1.269	2893.095
1.1500	0.3153	0.448	1033.917	4.151	6798.146	1.241	2800.936	1.241	2800.936
1.2000	0.3290	0.455	1038.802	4.115	6691.228	1.213	2714.124	1.213	2714.124
1.2500	0.3428	0.461	1042.964	4.080	6589.746	1.188	2632.261	1.188	2632.261
1.3000	0.3565	0.467	1046.500	4.047	6493.319	1.163	2554.986	1.163	2554.986
1.3500	0.3702	0.473	1049.495	4.015	6401.596	1.139	2481.966	1.139	2481.966
1.4000	0.3839	0.478	1052.022	3.985	6314.255	1.117	2412.897	1.117	2412.897
1.4500	0.3976	0.483	1054.144	3.955	6231.000	1.096	2347.499	1.096	2347.499
1.5000	0.4113	0.488	1055.917	3.927	6151.559	1.075	2285.518	1.075	2285.518
1.5500	0.4250	0.492	1057.387	3.899	6075.683	1.055	2226.716	1.055	2226.716
1.6000	0.4387	0.497	1058.596	3.873	6003.139	1.037	2170.879	1.037	2170.879
1.6500	0.4524	0.501	1059.580	3.847	5933.717	1.019	2117.807	1.019	2117.807
1.7000	0.4661	0.505	1060.370	3.822	5867.220	1.001	2067.317	1.001	2067.317
1.7500	0.4799	0.509	1060.993	3.799	5803.468	0.985	2019.241	0.985	2019.241
1.8000	0.4936	0.512	1061.472	3.776	5742.292	0.969	1973.422	0.969	1973.422
1.8500	0.5073	0.516	1061.827	3.753	5683.538	0.954	1929.717	0.954	1929.717
1.9000	0.5210	0.520	1062.075	3.732	5627.062	0.939	1887.993	0.939	1887.993
1.9500	0.5347	0.523	1062.232	3.711	5572.733	0.925	1848.127	0.925	1848.127
2.0000	0.5484	0.526	1062.311	3.690	5520.427	0.911	1810.006	0.911	1810.006
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

```
Notes: Run name              : YLDJBO02
       Date and time         : 12MAY00:10:59
       Computation of ref. F: Simple mean, age 8 - 12
       F-0.1 factor          : 0.7984
       F-max factor          : Not found
       F-0.1 reference F     : 0.2189
       F-max reference F     : Not found
       Recruitment           : Single recruit
```

a)

b)

c)

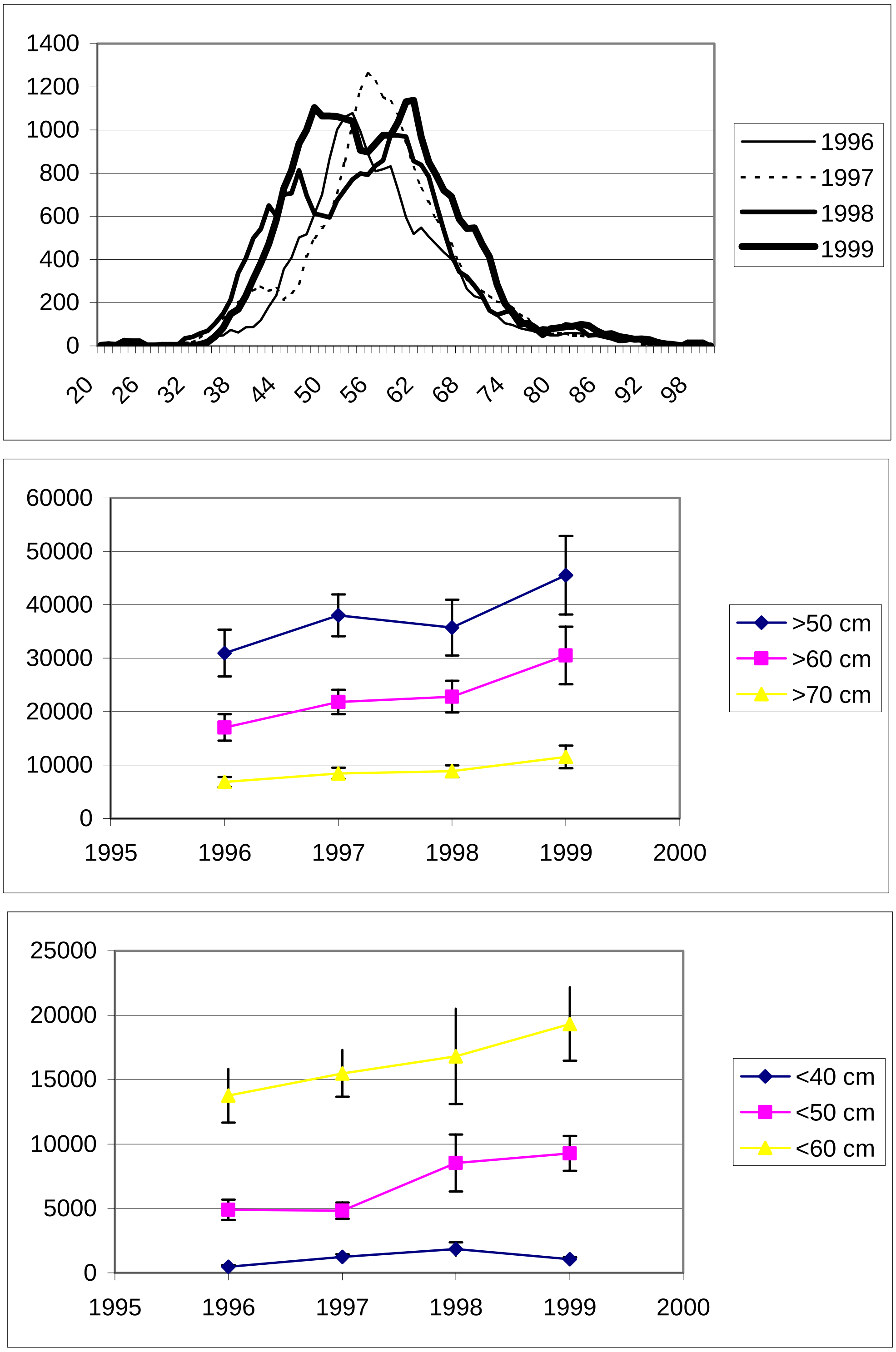

Figure 6.6.1. Greenland halibut in Icelandic fall groundfish survey: a) length distribution,
b) biomass indices by lengths larger than indicated, c) abundance indices by lengths smaller than indicated

Fish Stock Summary
Greenland halibut in Sub – areas V and XIV
27 – 4 – 2000

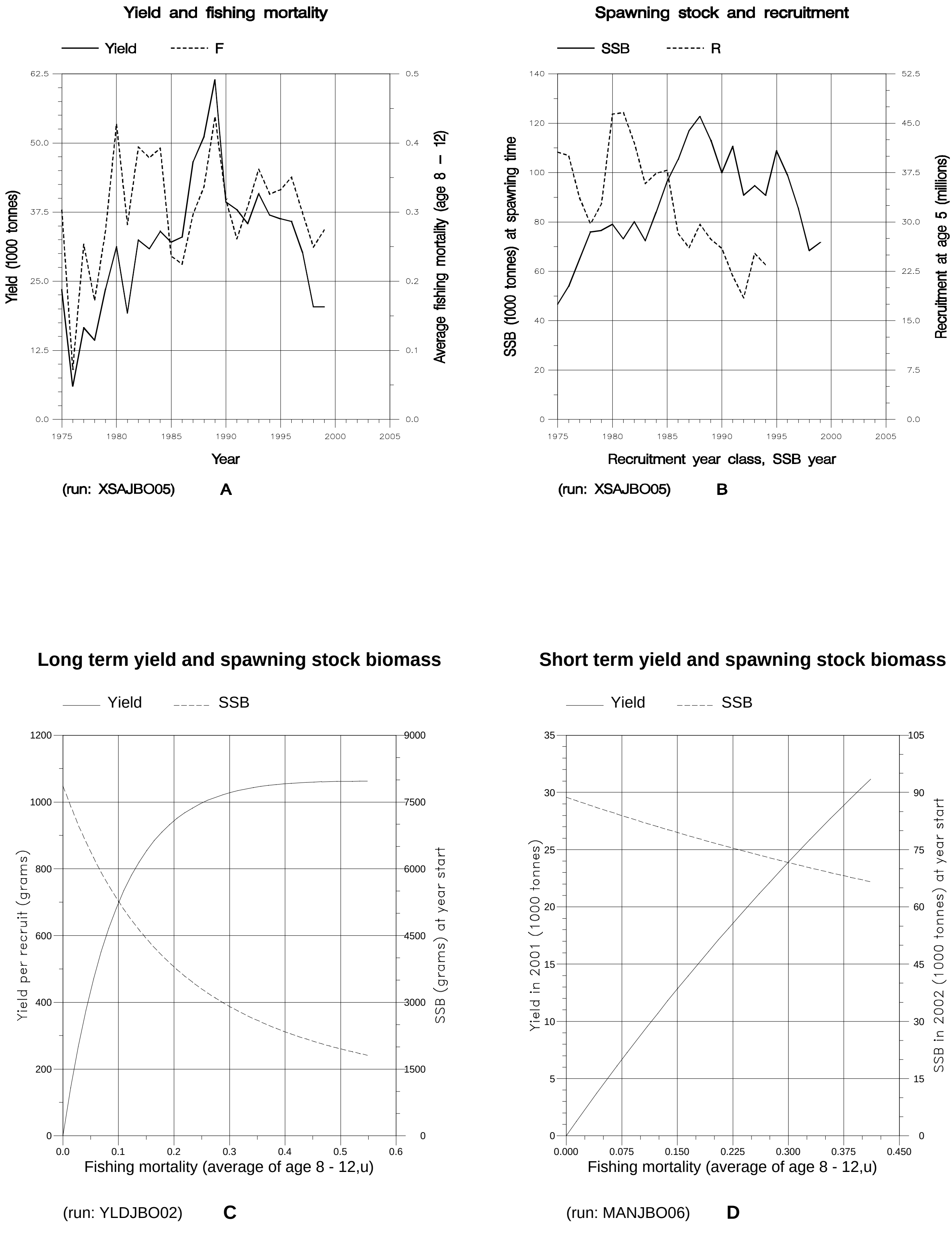

Figure 6.7.1.1

Figure 6.8.1 Greenland Halibut in Sub-areasV and XIV

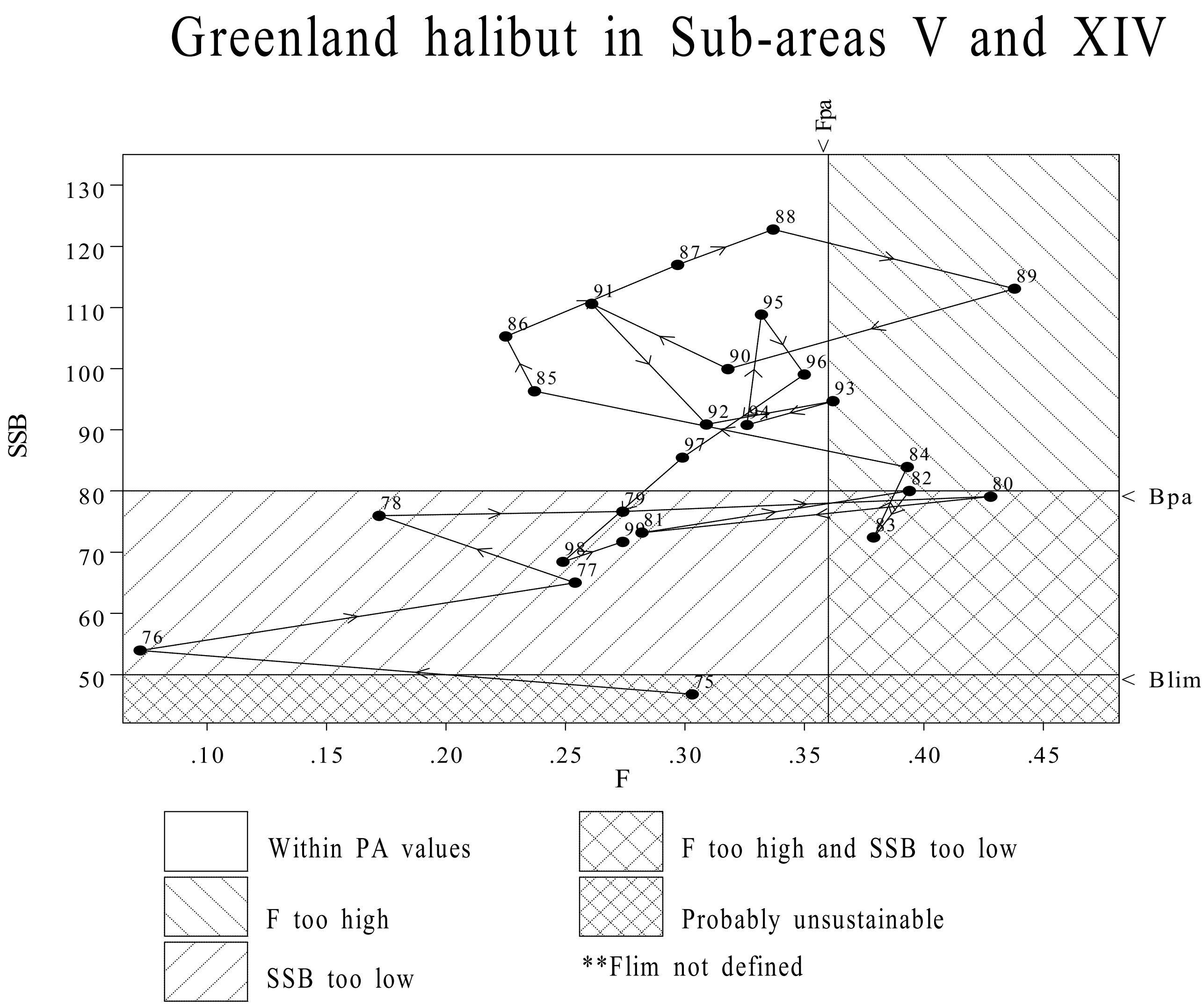

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Figure 6.8.2

6 REDFISH IN SUB-AREAS V, VI, XII AND XIV

The genus *Sebastes* is very common and widely distributed in the North Atlantic. It is found off the coast of Britain, along Norway in the Barents Sea and Spitzbergen, off the Faroe Islands, Iceland, East - Greenland, West - Greenland, and along the east coast of North America from Baffin Island South to Cape Cod). All *Sebastes* species are viviparous. The extrusion of the larvae takes place in late winter - late spring/early summer but copulation occurs in autumn-early winter.

6.1 Description of problems regarding stock identity of the species and stocks in the area

In ICES Divisions V, VI, XII and XIV there are at least 3 species of redfish, *S. marinus*, *S. mentella* and *S. viviparus*. The latter has only been of minor commercial value. Iceland has started to fish *S. viviparus* in 2 small areas south of Iceland at depths of 150 - 250 m. The landings of *S. viviparus* decreased from 1,160 t in 1994 to 994 in 1998 and to 494 t in 1999.

In areas assessed by the NWWG, one stock of *S. marinus* exists in the area of East Greenland - Iceland - Faroes. Large redfish, *S. marinus* type named “Giant”, have been recorded and fished in different areas of the entire *S. marinus* distribution area including the Reykjanes Ridge. However, the fishery in 1996–1997 has not continued and there was no reporting of the “Giant” type redfish in 1999. Due to uncertainties related to the stock identification of “Giants”, the NWWG recommends to collect separately all biological and fisheries data for future considerations.

During last years the existence of more than one stock of *S. mentella* in the area was discussed. Historically *S. mentella* was fished on the shelves and banks of Faroe Islands, Iceland and East Greenland and was considered as one stock. With the start of a new pelagic fishery in the open Irminger Sea in 1982, a new stock was defined for management purposes for *S. mentella* inhabiting the Irminger Sea. In 1992, the Study Group on Redfish Stocks distinguished between these types as deep-sea *S. mentella* and oceanic *S. mentella*. In early 90’s, the pelagic fishery in the open Irminger Sea moved to deeper layers beyond 500 m and some researchers considered that some of the fish caught below 500 m were different to those living above 500 m but resembling more the deep-sea *S. mentella* living on the shelves. This new type of *S. mentella* living below 500 m has been called “pelagic deep-sea *S. mentella*”.

It is not known if these types are more than one stock and different hypotheses have been put forward:

The **single stock hypothesis** suggests that all *S.mentella* from Faroes Island to Greenland constitute one stock, segregated according to age/size.

The **two stock hypothesis** suggests that the *S. mentella* living on the shelves (deep-sea *S. mentella*) and that living in deeper pelagic waters of Irminger Sea (pelagic deep-sea *S. mentella*) constitute one stock unit which is separated from the oceanic *S. mentella* living in upper layers of the Irminger Sea.

The **three stock hypothesis** support the idea that each of the described components constitutes a distinct stock.

As stated above, the uncertainty about stock identity is still high, and has not changed significantly since last year. The group was also asked to “comment on the possible relationship between pelagic “deep sea” *Sebastes mentella* and the *Sebastes mentella* fished in demersal fisheries on the continental shelf and slope.” This question deals with one or two of the hypothesis regarding the stock structure of *S.mentella*. There are indications in favour of each of the three hypothesis, but as the uncertainties in the structure of the stocks has not changed, the Working Group could not highlight this part of the discussion, and therefore only refer to earlier discussion on this matter. There are activities in various laboratories working on this issue. In January a EU-funded project started and the aim is to investigate the stock structure of redfish in areas V, XII and XIV. The project is developed to coordinate and support the international research activities directed towards the most important questions related to the biology and exploitation of the highly migratory and straddling redfish resources. According to its title, the proposal is divided into the three main workpackages: 1. “Population structure”, 2. “Reproductive strategies” and 3. “Abundance and demography”. It is the hope of the Working Group that this project will solve some of the questions regarding the stock structure of the redfish in that area.

6.2 Nominal Catches and Splitting of the Landings in Stocks

The official statistics sent to ICES do not report catch figures specified by species/stocks (Tables 7.2.1. - 7.2.5).

Therefore, based on various information from different laboratories, the catches were split into species/stock (Table 7.2.6).

The technique and data for such splitting was described in the 1998 NWWG report.

6.3 Abundance and distribution of 0-group and juvenile redfish

Available data on distribution patterns of 0-group and juvenile *S. marinus* indicate that there are nursery grounds in Icelandic and Greenland waters only, while no nursery grounds are known around the Faroe Islands. In the 1983 Redfish Study Group report (ICES C.M. 1983/G:3) and in Magnússon and Jóhannesson (1997) the distribution of *S. marinus* 0-group at East Greenland was evaluated, showing that there are considerable amounts of *S. marinus* at East Greenland mixed with *S. mentella* (Magnússon et al., 1988 and 1990) in variable proportions in different sub-areas and periods (Sigurðsson, WD1 in ICES CM 1998/G:3). In Icelandic waters, nursery areas for *S. marinus* are found mostly west and north of Iceland at depths between 50 and approximately 350 m, but also in the south and east (ICES C.M. 1983/G:3; Einarsson, 1960; Magnússon and Magnússon 1975; Pálsson *et al.* 1997). As the length (age) increases, migration of young *S. marinus* along the north coast to the west coast takes place towards the most important fishing areas around Iceland.

Indices for 0-group redfish in the Irminger Sea and at East Greenland areas were available from the Icelandic 0-group surveys from 1970 – 1995. Thereafter, the survey was discontinued. Above or average year class strengths were observed in 1972, 1973–74, 1985–91, and in 1995.

Abundance, biomass indices and length compositions have been derived using German annual groundfish surveys covering shelf areas and the continental slope off West and East Greenland down to 400 m depth (Stransky and Rätz, WD 8). Due to difficult identification, the juvenile redfish (< 17 cm) were not classified to species level but treated as a single unit called *Sebastes spp.* Trends in survey abundance for juvenile redfish (< 17 cm) are shown in Figure 7.3.1 for West and East Greenland, respectively. Since 1993, small and unspecified redfish were very abundant and distributed mainly off East Greenland. The 1999 low survey results are similar to those observed in the late 1980's.

6.4 Discards and by-catch of small redfish

6.4.1 Discards of redfish in East and West Greenland

An offshore shrimp fishery with small meshed trawls (44 mm) began in the early 1970s off the west coast of Greenland and expanded to the east coast in the beginning of the 1980s, mainly on the shallower part of Dohrn Bank and on the continental shelf from 65° N to 60° N. Observer samples derived from the Greenland Fishery Licence Control revealed that the shrimp fishery at both West and East Greenland takes small redfish as a by-catch but there was no information available to quantify the by-catches and their length composition in latest years.

6.4.2 Regulations of small redfish by-catch at East and West Greenland

Present regulation concerning by-catches in the Greenland shrimp fishery permit a by-catch maximum of 10% of the total catch per each haul by weight. In 1994, a new arrangement with observers on board the vessels was implemented to strengthen the enforcement of the regulations and improve the reliability of the log-books.

The Redfish Box was created in 1981 off East Greenland as recommended by ACFM to protect that part of the nursery area of redfish (*S. marinus* and *S. mentella*) against the directed cod and redfish trawl fishery. Currently, the redfish box is effective also to the shrimp fishery.

Bearing in mind the declining fishery and biomass of *S. mentella* and *S. marinus* in all areas, and increased interest of fishing redfish, concern must be expressed on the discard of small redfish of both species wherever it takes place.

The Working Group therefore keeps recommendations from previous year to introduce the following measures for prevent young redfish by-catch and discards:

- legislate the mandatory use of a "fish grid" for the shrimp fisheries as is the case in the Barents Sea, in Icelandic and Canadian East cost waters and in the NAFO Regulatory Area.

- permit the temporary closure of areas when the by-catch of small fish exceeds a defined percentage as enforced at Iceland and in the Barents Sea.

6.5 Special Requests

In the ToR for, the Working Group there are several questions regarding stock structure, distribution and fishery information of *S.mentella* in the area. The following paragraphs deal with ToR c, e, f and g. Under different redfish chapters the Working Group also deals with these questions in more detail.

ToR c) Detailed descriptions of the fishery of different nations are given in chapters 8.2, 9.2 and 10.2. To summarise the pelagic redfish fishery, it can be said that in the period 1982–1992 the fishery extended mainly from April to August, mostly in international waters at depths less than 500 m. In the period 1993–1996 the fishing season was prolonged considerably, and moved more towards greater depths. Since then, the fishery has moved to more northerly waters in the first months of the fishing seasons (until June; area Va and XIV), generally fishing at depths deeper than 500 m depths with high effort concentrated along the Icelandic EEZ. In the third quarter of the year the fishing has, in general, moved towards the southern part of the area fishing mostly at depths above 500 m, within area XII, both outside and inside the Greenlandic EEZ.

ToR e) During the meeting several working documents dealing with the problem were presented. Two of these, working documents 14 and 23, supported the single stock hypothesis based on information on parasites and pigment patches and on a general overview of the distribution pattern for different life stages. Information from the acoustic survey in 1999 and information from German Groundfish surveys in E-Greenland (WD 8 and 23) as well as the German catches (WD 5) supports the idea that the continental shelf of E-Greenland is the nursery area for all *S.mentella* in areas V, XII and XIV, including pelagic occurrences.

ToR f) Limited information is available for describing distribution of the stock(s) in the area. The information from various acoustic estimates in recent years only describes the distribution at one time of the year (acoustic estimate in June/July). Information from the fishery of various nations can neither be used alone as a description of the distribution. Therefore, these sources are probably not representative for the distribution of the different possible stock components. In chapter 10, a short description of the seasonal distribution from the 1999 international acoustic survey is given and description of the fishery is also available there for the last year (10.2). More detailed description of the fishery is given in working documents 4, 6, 7, 12, 19 and 25. Compared with previous results, the pelagic redfish above 500 meters was found more westerly and southerly distributed in the 1999 acoustic survey (June/July) into the NAFO Division 1F of southwest Greenland (see Figure 10.3.2).

ToR g) An update of the stock development of the pelagic redfish is given in chapter 10. The main new features are a continuation of the reduction in survey biomass above 500 m depth, a more south-westerly distribution pattern during the second half of 1999 and the observed recruitment originated from the East Greenland continental slope. The associated risks in overexploitation of the different stock components managed under a common TAC cannot be quantified due to a lack of comparable quantitative stock indicators and adequate production estimates. Given the uncertainties about stock delimitations and abundance, dense concentrations of the high international fishing effort in terms of area, season and depth might cause severe local depletion effects.

Based on the information given above and information described in previous working group reports, the NWWG stresses that there are still uncertainties in the stock structure of *S.mentella* in ICES Divisions V, XII and XIV (see Figure 7.1). In accordance with the precautionary approach the units must, until the problem has been clarified, be treated in such a way that each of the possible components will not be overexploited. This implies that fishing effort and catches should be spread out.

Table 7.2.1. REDFISH. Nominal catches (tonnes) by countries, in Division Va 1986-1999, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Belgium	423	398	372	190	70	146	107
Faroe Islands	144	332	372	394	624	412	389
Germany	-	-	-	-	-	-	-
Iceland	85,992	87,768	93,995	91,536	90,891	96,770	94,382
Norway	2	7	7	1	-	-	-
Total	86,561	88,505	94,746	92,121	91,585	97,328	94,878
WG estimate	*86,670*	*88,505*	*94,762*	*92,121*	*91,585*	*97,328*	*96,846*

Country	1993	1994	1995	1996	1997	1998	1999 [1]
Belgium	96	50	-	-	-	-	-
Faroe Islands	438	202	521	309	242	280	
Germany	-	46	229	233	-	284	428
Iceland [2]	96,577	95,091	89,474	67,757	73,976	108,830	67,132
Norway	-	-	-	134 [1]	-	-	18
Total	97,111	95,389	90,224	68,433	74,218	108,994	67,578
WG estimate	*99,714*	*110,861*	*91,767*	*72,909*	*89,519*	*110,498*	*104,938*

1) Provisional
2) Oceanic *S. mentella* not included in the officially reported catches

Table 7.2.2 REDFISH. Nominal catches (tonnes) by countries, in Division Vb 1986-1999, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Denmark	36	176	8	-	+	-	-
Faroe Islands	15,224	13,477	12,966	12,636	10,017	14,090	15,279
France	752	819	582	996	909	473	114
Germany [2]	5,142	3,060	1,595	1,191	441	447	450
Iceland	-	-		21			
Norway	2	5	5	-	21	20	34
Russia							15
UK (E/W/NI)	-	-		-	+	3	21
UK (Scotland)							8
United Kingdom							
Total	21,156	17,537	15,156	14,844	11,388	15,033	15,921
WG estimates	*21,476*	*17,538*	*15,508*	*15,068*	*11,737*	*15,037*	*15,993*

Country	1993	1994	1995	1996	1997	1998	1999 [1]
Denmark	-	-	-	-	-		
Faroe Islands	9,687	8,872	7,978	7,286	7,199	6,484	
France [1]	32	90	111	62	98	110	
Germany [2]	239	155	91	189	36	-	207
Norway	16	34	36	35 [1]	25 [1]	39 [1]	40
Russia	44	3	-	-	-	-	-
UK (E/W/NI)	28	1	2	40	+	4	
UK (Scotland)	1	18	24	43	36	27	
United Kingdom							61
Total	10,047	9,173	8,242	7,655	7,394	6,664	308
WG estimates	*10,422*	*9,173*	*8,251*	*7,655*	*7,397*	*6,654*	*6,730*

1) Provisional
2) Former GDR and GFR until 1991

Table 7.2.3 REDFISH. Nominal catches (tonnes) by countries, in Sub-area VI 1986-1999, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Faroe Islands	-	-	1	61	-	22	6
France	480	1,032	1,024	726	684	483	127
Germany	24	-	16	1	6	8	-
Ireland	-	-	-	-	-	-	1
Norway	14	2	1	2	5	+	4
UK (Engl. and Wales)	2	3	75	1	29	12	4
UK (Scotland)	10	17	6	6	6	40	32
Total	530	1,054	1,123	797	730	565	174
WG estimates	*530*	*1,054*	*1,123*	*797*	*730*	*565*	*174*

Country	1993	1994	1995	1996	1997	1998	1999 [1]
Faroe Islands	-	-	2		12		
France [1]	268	555	529	489	395	297	
Germany	77	87	5	9	1	1	
Ireland	1	-	4		10		
Norway	3	2	1	6[1]	5[1]	3[1]	8
Portugal						1	
Russia							243
UK (E/W/NI)	4	9	105	54	19	12	
UK (Scotland)	94	118	500	603	518	364	
United Kingdom							765
Total	447	771	1,146	1,161	960	678	1,016
WG estimates	*447*	*771*	*1,146*	*1,711*	*960*	*678*	*1,016*

1) Provisional

Table 7.2.4 REDFISH. Nominal catches (tonnes) by countries, in Sub-area XII 1986-1999, as officially reported to ICES and/or FAO.

Country	1986	1987	1988	1989	1990	1991	1992
Bulgaria	-	-	-	-	1,617	-	628
Estonia	-	-	-	-	-	-	1,810
Faroe Islands	-	-	-	-	-	-	-
France							
Germany	-	-	-	353	7	62	1,084
Greenland	-	-	-	567	-	-	9
Iceland	-	-	-	-	185	95	361
Latvia	-	-	-	-	-	-	780
Lithuania	-	-	-	-	-	-	6,656
Netherlands							-
Norway	-	-	-	-	249	726	380
Poland	-	-	-	112	-	-	-
Portugal							
Russia[2]	24,131	2,948	9,772	15,543	4,274	6,624	2,485
Spain							
UK(E/WNI)							
UK (Scotland)	-	-	-	-	-	-	-
Ukraine	-	-		-	-	-	-
Total	24,131	2,948	9,772	16,575	6,332	7,507	14,193
WG estimates	*24,131*	*2,948*	*9,772*	*17,233*	*7,039*	*10,061*	*23,249*

Country	1993	1994	1995	1996	1997	1998	1999[1]
Bulgaria	3,216						
Estonia	6,365	17,875	16,854	7,092	3,720	3,968	2,108
Faroe Islands	4,026	2,896	3,467	3,127	3,822	1,793	
France						3	
Germany	6,459	6,354	9,673	4,391	8,866	9,746	8,204
Greenland	710	-	1,856	3,537	-	1,180	
Iceland	8,098	17,892	19,577	3,613	3,856	1,311	45
Japan			1,148	416	31	31	
Latvia	6,803	13,205	5,003	1,084	-	-	
Lithuania	7,899	7,404	22,893	10,649		1,769	
Netherlands	-	-	13		-	-	
Norway	5,911	4,514	3,893	1,010[1]	2,699[1]	263	1,083
Poland	-	-			662	12	
Portugal						503	
Russia	4,106	10,489	34,730	606	-	89	5,982
Spain			20	410	1,155	1,814	
UK(E/WNI)				33	-		
UK(Scotland)				13	-		
UK	+	-				-	
Ukraine	2,782	5,561	3,185	518			188
Total	56,375	86,190	122,312	45,590	49,103	22,482	17,610
WG estimates	*72,529*	*94,189*	*132,039*	*42,630*	*19,843*	*22,449*	*24,294*

1) Provisional

2) Former USSR until 1991

Table 7.2.5 REDFISH. Nominal catches (tonnes) by countries, in Sub-area XIV 1986-1999, as officially reported to ICES and/or FAO.

Country	1986	1987	1988	1989	1990	1991	1992
Bulgaria	11,385	12,270	8,455	4,546	1,073	-	-
Denmark	-	-	-	-	-	-	-
Faroe Islands	5	382	1,634	226	-	115	3,765
Germany, Dem. Rep,	8,574	7,023	22,582	8,816			
Germany, Fed. Rep.	5,584	4,691					
Germany					11,218	9,122	7,959
Greenland	9,542	670	42	3	24	42	962
Iceland	-	-	-	814	3,726	7,477	12,982
Norway	-	-	-	-	6,070	4,954	14,000
Poland	149	25	-	-			
Russia [2]	60,863	68,521	55,254	7,177	3,040	2,665	1,844
UK (Engl. and Wales)	-	-	-	5	39	219	178
UK (Scotland)	-	-	-	-	3	+	28
United Kingdom			-	-	-	-	-
Total	96,102	93,582	87,967	21,587	25,193	24,594	41,718
WG estimates	*96,102*	*95,824*	*91,676*	*24,520*	*31,261*	*28,400*	*48,513*

Country	1993	1994	1995	1996	1997	1998	1999 [1]
Bulgaria	-						
Denmark	-	-					
Faroe Islands	3,095	164	8	298	123	47	
Germany	26,969	22,406	9,702	16,996	11,610	9,709	8,935
Greenland	264	422	2,936	2,699	193	296	
Iceland [3]	11,650	29,114	8,947	49,381	33,820	6,441	43,062
Norway	8,351	2,546	2,890	6,286 [1]	433 [1]	864 [1]	4,205
Poland					114		
Portugal	-	1,887	5,125	2,379	3,674	4,133	4,302 [4]
Russia	6,560	13,917	9,439	45,142	36,930	25,748	11,571
Spain			4,534	3,897	7,552	2,763	
UK (E/W/NI)	241	138	48	247	28	43	
UK (Scotland)	8	4	10	6			
United Kingdom	-						68
Total	57,138	70,598	43,639	127,331	94,477	50,044	67,841
WG estimates	*57,269*	*59,776*	*43,141*	*134,594*	*88,070*	*55,395*	*49,197*

1) Provisional data.
2) Former USSR until 1991.
3) Officially reported catches includes Oceanic redfish caught in Subdivision Va.
4) Reported as V/XII/XIV

Table 7.2.6. Proportions used for splitting the 1999 REDFISH landings between *S.marinus* and *S.mentella* stocks.

Area	Va			Vb		VI		XII		XIV		
Species/stoc	*S.mar.*	*S.ment.* deep-sea	*S.ment.* oceanic	*S.mar.*	*S.ment.* deep-sea	*S.mar.*	*S.ment.* deep-sea	*S.ment.* deep-	*S.ment* oceani	*S.mar.*	*S.ment.* deep-sea	*S.ment.* oceanic
Estonia									1.00			
Faroes	1.00			0.21	0.79				1.00			1.00
France					1.00							
Germany	0.10	0.90			1.00				1.00		0.09	0.91
Greenland			1.00						1.00			1.00
Iceland	0.39	0.27	0.34						1.00			1.00
Lithuania												
Norway				1.00		1.00			1.00			1.00
Portugal												1.00
Russia							1.00		1.00			1.00
Spain									1.00			1.00
UK	0.10	0.90		1.00		1.00			1.00	0.10	0.90	

In Sub-area XIV the landings for Germany, Greenland and UK have been splitted between *S.marinus* and deep-sea *S.mentella* according to the German surveys.
For Faroe Islands, Germany, Iceland, Norway and Russia the splitting in most areas has been based on biological information presented to the Working Group and/or from log-books.

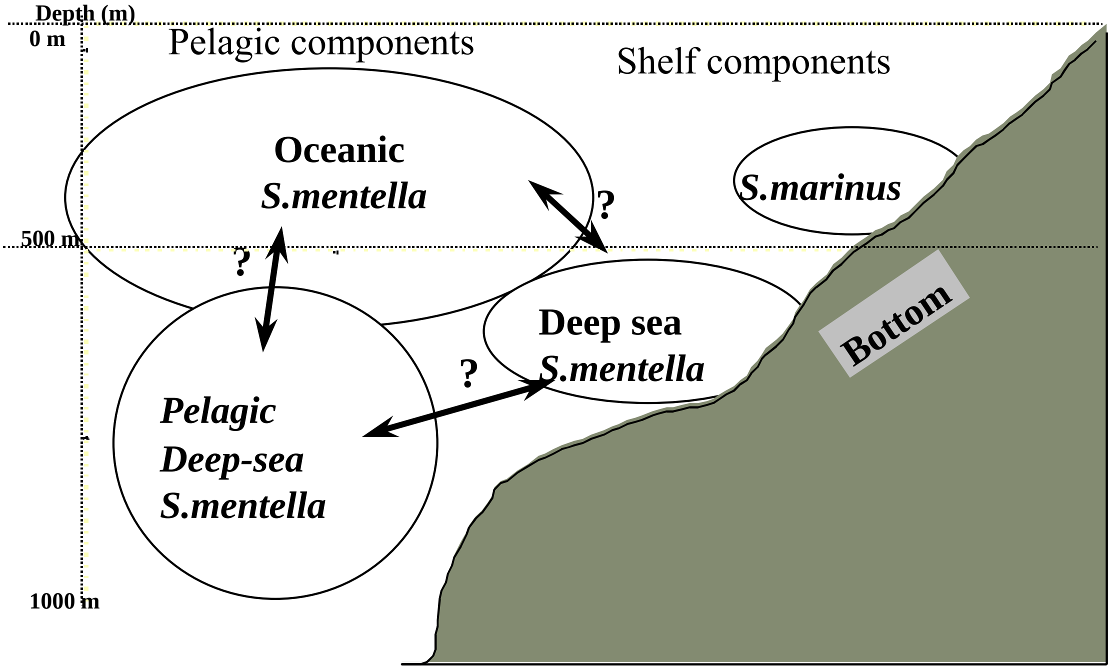


Figure 7.1 Schematically possible relationship between different stocks of redfish in the Irminger Sea and along the continental slope of E-Greenland-Iceland-Faroe Island.

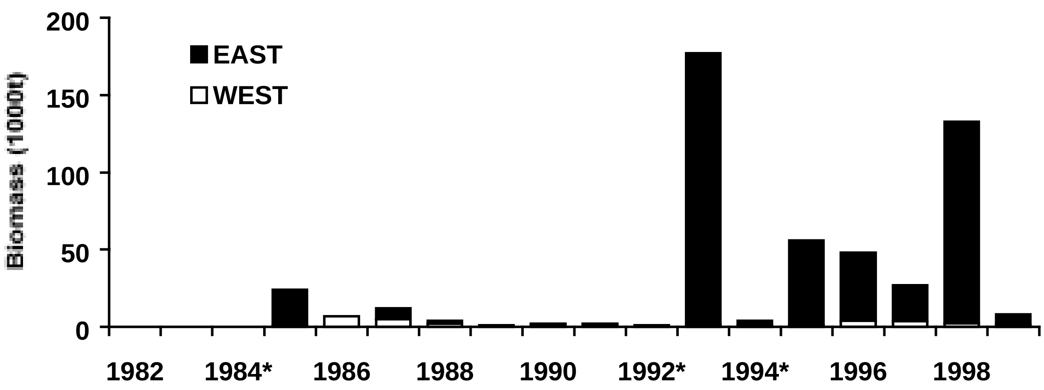


Figure 7.3.1 *Sebastes spp.* (<17 cm). Survey abundance indices for East and West Greenland as derived from the German groundfish survey, 1982-99. *) incomplete survey coverage.

7 SEBASTES MARINUS

7.1 Landings and Trends in the Fisheries

The total catch of golden redfish (*S. marinus*) (Divisions Va, Vb, in the Sub-areas VI and XIV) decreased from about 130 000 t in 1982 to about 40 000 t in 1997 and 1998 (Table 8.1.1). The catch in 1999 was about 42 000 t. The decline from 1982 of about 70% has more or less been continuous. Since 1990 the overall decrease in the catch has been about 45%. The increase in 1999, compared to 1998 is due to increased catches in Sub-area Va (Table 8.1.1).

In Division Va catches have declined from about of 63 000 t in 1990 t, stabilising around 34 000-36 000 t in 1996-1998. In 1999 an increase to about 40 000 t was observed. The low catch in 1994 was partly due to area closures imposed on the fishery by Iceland in order to reduce the catches of *S. marinus*. However, landings in 1995 increased to approximately 42 000 t, despite these area closures. The catches of *S. marinus* in Va in the period 1996-1999 are the lowest since 1978. The length distributions in the Icelandic landings in 1989-1999 along with measurements from the commercial trawler fleet are shown in Figure 8.1.1. The location and number of measured fish by statistical square is given in Figure 8.1.2. About 90-95% of the total *S. marinus* catches in area Va have in recent years been taken by bottom trawlers (both fresh fish and freezer trawlers; length 48-65 m) targeting on redfish. The remainder is taken by different gears, and partly as bycatch in the gillnet and longline fishery. In 1999, as in previous years, most of the catches were taken along the shelf of W, SW and to SE of Iceland, mostly between 12ºW and 27ºW.

In Division Vb, catches were highest in 1985 (approx. 9 000 t). Catches showed a declining trend to about 2,100 t in 1991, and have since remained at a level of 2,300-2,600 t (Table 8.1.1). In 1999 only 1,400 t were caught, which is a historic low. Most of the *S. marinus* -catches in Vb have been taken by pair trawlers and single trawlers (< 1000 HP). No length distribution from the catches was available for 1999.

The catches in Sub-area VI increased since 1978, reaching almost 600 t in 1987. A decline was observed to a low of 40 t in 1992. In 1995-1996 the catches again reached more than 600 t, the highest catches observed in the whole period (Table 8.1.1). The provisional catch in 1999 is about 773 t**.** Trawlers have taken the major proportion of the catches. No length distribution was available from the catch.

In Sub-area XIV catches have been more variable than in the other Sub-areas and Divisions. Since the highest catch on record in 1982 (31 000 t), a rapid decrease was observed to about 2 000 t in 1985. During the next 10 years catches varied between 600 and 4 200 t. In 1995-1997 almost no directed fishery for *S. marinus* nor *S. mentella* occurred. A minor directed fishery occurred in 1998 and catches increased to 175 t. In 1999 the catch is estimated to be 7 t. Large bottom trawlers participated in the directed fishery. Some bycatch is reported from the shrimp fishery in the area.

The following text-table shows the fishery related sampling by gear type and Divisions.

	Area	Gear	Landings	Nos. samples	Nos. fish measured
S. marinus	Va	Bottom trawl	40,000	253	52131
	Vb	Bottom trawl	1,400	0	0
	XIV	Bottom trawl	7	0	0
	VI	Bottom trawl	773	0	0

7.2 Assessment

7.2.1 Trends in CPUE and survey indices

Figure 8.2.1 shows the *S. marinus* abundance index with 95% confidence intervals using Icelandic groundfish survey (IGS), data (<400 m depth). The index is a biomass index of the fishable stock, computed by using a fishable stock ogive. The index (see Pálsson *et.al*, 1989) is stratified and the stratification is based on depth intervals shown in Figure 8.2.3. In Table 8.2.1 the contribution of each strata to the index is given. The index indicates a decrease in the fishable biomass from 1999, comparable to 1996-1998. The lowest index was in 1995, only about 30% of the maximum in 1987. The increase in the survey index in 1999 is not supported by the results in March 2000, and might indicate that the survey estimate in 1999 could have been an overestimate.

Length distribution from IGS shows that the peak in the length distribution (Figure 8.2.4) which has been followed during the last years (first in 1987) now has reached the fishable stock. This peak can clearly be seen as a maximum around 36-37 cm in the length distributions of the catches (Figure 8.1.1). This is in accordance with earlier years, showing a growth of about 1.5-2 cm each year. The increase in the survey index in 1995-1999 therefore reflects the recruitment of a strong year class (1985 year class). This indication of strong year class is also confirmed by age readings, which have been going on since 1998. Based on the age readings, the 1985 year class have been dominating the catches since 1995 (Figure 8.2.2), and in 1999 that yearclass contributed with almost 42% of the total catch in Va. The survey results have also shown that 1990/1991 year classes are strong, and might be at similar size as the 1985 year class was at similar age.

Indices of CPUE for the Icelandic trawl fleet for the period 1985-1999 are estimated from a GLIM multiplicative model, taking into account changes in the Icelandic trawl catch due to vessel, statistical square, month and year effects. All hauls at depths above 500 m with redfish, exceeding 10% of the total catch were included in the CPUE estimation (Figure 8.2.5). Also, a simple CPUE was calculated (sum of catch / sum of hours trawled for each year, each haul where redfish exceeded 10% of the total catch in each haul). The results from the trawler fleet also reflect the situation shown in the groundfish survey. Although the CPUE has been low in recent years it increased in 1997 and has since been relatively stable although a decline was observed in 1999.

In summary, the Icelandic groundfish survey as well as the CPUE data seem to indicate a considerable decline in the fishable biomass of *S. marinus* during the period from 1986 to 1994. The stock seems to have started to recover in 1995 - 2000 but it is still low. Large proportion of the catches in recent years is caught from one yearclass.

In Division Vb, CPUE of *S. marinus* were available from the Faeroes groundfish survey 1983- After an increase in the period from 1995-1998 there is decrease in 1999 and 2000. The results also indicate a high variation in the series, and on average, only 43 hauls are behind the value each year (20-61 hauls). The value in 1999 and 2000 is only about 70% of the average value for the whole period since (Figure 8.2.6).

For the period 1982-99, abundance and biomass indices from the German groundfish survey for *S. marinus* >17 cm) are illustrated in Figures 8.2.7 and 8.2.8. From 1986-1995, an almost continuous reduction in survey biomass has occurred. However, in 1998 a weak signal of possible recovery was shown but the latest survey results do not support this signal. It can be taken from Figures 8.2.7 and 8.2.8 that the redfish were mainly distributed off East Greenland, while the minor abundance and biomass indices off West Greenland decreased to almost zero. The length frequencies from the German groundfish survey in 1998 are illustrated for West and East Greenland in Figures 8.2.9. The adults seem to remain almost depleted. Growth increments of single cohorts and the annual abundance and biomass indices at West - and East Greenland for the period 1992-1998 were presented in WP 8.

During the annual Greenland halibut survey (400-1500m) in XIVb in June/July 1999, *S. marinus* was only observed between 400 and 600 m. Total biomass of the species was estimated to about 2000 t, compared to 692 t in 1998. The total abundance was estimated to $5{,}400 \times 10^6$ in 1999, which was an increase from 1998 ($1{,}541 \times 10^6$). The length distribution ranged from 18 to 63 cm.

7.2.2 Alternative assessment methods

During previous meetings, the working group have tried an age-production model which has been described in Stefánsson and Sigurðsson (ICES C.M. 1997/DD:10). Applying the model to *S. marinus* the model showed the same general trend in the fishable biomass as the Icelandic groundfish survey and it seems to be able to reflect the peak in the recruitment of the assumed 1985 and 1990 year classes. At the 1999 working group meeting, an alternative model (BORMICON(BOReal MIgration and CONsumption model)) was applied to the *S. marinus* stock. The model is described in WD 18 in ICES CM 1999/ACFM:17 and in Stefánsson and Pálsson (1997). BORMICON is a simulation- and estimation model developed at the Marine Research Institute.

The model has been developed further since last year, with the main change occurring in the part that spreads the growth where a beta binomial distribution has been added. The main changes have been that an additional year has been incorporated, and most importantly the number of otholiths read has increased.

The model is designed as multispecies - multiarea model but can also be used as a single species model as was done for the *S. marinus*. The main characteristics that distinguish the model from most stock assessment model is that it stores the number and mean weight of fish in each age and length group, not only in each age group as traditional models do. After the growth has been modelled, the growth is then distributed. Then, certain proportion of the fishes does not grow, some proportion grows one length group, some proportion 2 length groups etc.

All fleets (predators) in the model have length based selection pattern. This means that fleets catch only the largest individuals of each recruiting age group and therefore affect mean weight at age. The model does not use catch in number directly as input data but rather length distributions, otolith samples and other data used to calculate catch in numbers. An objective function is then used to minimise the discrepancy between the model output and these data. This means that the model can use data that are not sampled regularly enough to calculate catch in number. Several runs were done, using two types of fleets:

1) The total amount calculated by the fleet is specified and it is distributed on different length groups according to abundance and the selection pattern. The same proportion is caught of each age group in a length group.

2) The proportion caught (approximate fishing mortality for short time steps) is specified. This proportion is then multiplied by the selection pattern so it is only for the length groups that are fully recruited that this proportion is caught. Fishing mortality refers to this proportion.

In calculation for the past, the total amount caught is specified, but in simulations into the future proportion caught (the fishing mortality) is specified. The formulation used is a relatively simple one and its main characteristics are:

- One area
- Two fleets catching each species, a commercial fleet and a survey. Selection patterns of both fleets are described by a logit function, whose parameters are estimated
- Growth is described by the von Bertalanffy's function.

Data used in the objective function to be minimised are:

- Length distributions from commercial catch and survey
- Age length keys p(*a*/L) from commercial catch and survey
- Length disaggregated survey indices
- Mean length at age from survey, and commercial catches
- Understocking (Not enough biomass exists to cover the catch).

Estimated parameters are then:

- Initial number in each age group
- Recruitment each year
- Parameters in the growth equation
- Selection patterns of commercial fleet and survey. Two parameters for each fleet.

Simulation period is from 1970 to 2000. Two time steps are used each year.

Natural mortality is set to 0.15 for the youngest decreasing gradually to 0.05 for age 5 and older. Also alternatives with other values on natural mortalities (M=0.1 for age 5+) were tested. They gave worse fit, and are therefore not incorporated here. The ages used are 1 to 30 years. The oldest age is treated as a plus group. Recruitment was at age 1. Prior to 1989 length at recruitment was 7.1 cm, but 8.1 cm in later years. This was supposed to reflect length of the 1985 and 1990 year classes in the groundfish survey.

Figures 8.2.10 and 8.2.11 shows length and weight at age according to the model. The model results this year indicate faster growth than the runs made in 1999 did. The results shown are based on a run using M = 0.05 for age 5+, alternative 1 using age-length keys and mean length at age from read otoliths while alternative 2 does not incorporate these information. The alternatives are identical in other respects. Estimated selection patterns are shown in figure 8.2.12.

Figure 8.2.13 shows estimated recruitment as age 1 (M = 0.05). The main indicator for recruitment is the groundfish survey, which does not indicate that any strong yearclass is on the way after the 1990/1991 year class. Here the 1990/91 year class comparable with the 1985 year class. Much less data are available to estimate the recruitment prior to 1985.

Simulations were used to determine the value of F_{max}. A yearclass was started in 1970 and caught using fixed fishing mortality and the estimated selection pattern. The total yield from the yearclass was then calculated. The simulations were executed for 30 and 40 years. F_{max} was calculated to 0.2 using 30 years simulation time and 0.165 using 40 years. F here is not fishing mortality but close to it when small time steps are used or mortalities are small. It is also the mortality of a fish where the selection is 1.

Two different catch options were tested in the future simulations, fixed catch and fixed value of fishing mortality. As may be seen on figure 8.2.14 the catchable biomass will increase in the nearest future, for F between 0.15-0.3, but thereafter, the biomass will decrease again as there are no sign of strong recruitment from the survey data. Also, the catches (Figure 8.2.15) will increase in next years, for al F's between 0.15 and 0.3, but in all cases decrease thereafter.

As said above, a fixed catch was also tested for future simulations. One of the disadvantage of fixed TAC is too much effort in periods where a high proportion of the strong recruiting yearclass is close to the minimum landing size, which could lead to an increasing discard. Figures 8.2.16 – 8.2.18 show the results of simulation using fixed catch after the year 2000. The runs shows similar as for fixed F. In next 4 years catchable biomass will increase for all cases up to 50 000 t but the total biomass will at the end of the period be lower than it is now for catches exceeding about 35 000 t annually.

From the above mentioned runs, it is clear that if the groundfish survey is to be accepted as a measure of recruitment, no new year class will show up in the catch until 2010 so the 1985 and 1990 year classes need to be preserved at least until then.

7.2.3 State of the stock and catch projections

All available survey information and CPUE data from Division Va show that the *S. marinus* stock decreased considerably to the lowest recorded biomass in 1995. A slow improvement in fishable biomass has, however, been seen in the most recent years due to improved recruitment. During the last few years, the 1985 year class has contributed significantly to the fishable stock, and the 1990 year class is expected to contribute significantly to the fishable biomass in next years. In Division Vb the CPUE from the Faroes groundfish survey shows an increase in last years but the catches are still at low level. The adult stock of *S. marinus* in Sub-area XIV has nearly been depleted in the most recent years. There are no indications of any considerable recruitment in the area.

The Icelandic groundfish survey indices *(*U) may be assumed to be related to overall biomass *(*B) by a simple linear relationship *(U=k*B). If catches in time, t, are assumed to be proportional to stock size and effort *(Y=cE*B), then it follows that catch over survey index is proportional to effort *(Y/U=a*E, see Table 8.2.3) and this allows a one-year prediction of catch assuming a *status-quo* effort level.

Although calculated confidence limits in the groundfish survey is quite low, year to year variation in catchability/availability will affect the results drastically while using only the last observation value as a basis for extrapolation of catches in the coming year, based on a constant effort. By using a running average over few years (3 as a minimum), one would reduce the variation in the catch prediction, based on the above assumptions.

The following text table gives the running mean of the IGS index given in Table 8.2.3.

	Year													
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3 year running average	1097	1053	986	810	704	567	493	464	406	438	471	539	598	577

By assuming same effort in 2001 as it was in 1999 the predicted catch in Va will be around **33 000 t** using the following formula:

Catch 2001 = Average **Survey index** 1998-2000 * **Effort** 1999,

By applying only last survey index and assuming same effort as 1999 the catch of *S. marinus* in 2001 will be about 29 000 t in Va. By using a running average the variation in catch projections, due to year to year variation in the survey index is reduced. As the BORMICON model shows nearly identical results as the three year running average, the WG suggest to use the running average which, assuming unchanged effort, gives a catch of 33 300 t in Va in 2001.

Based on the BORMICON model the fishable biomass will increase in the next few years, but will decrease thereafter for every catch option above 35 000 t (or all F's above 0.2). This is due to the poor recruitment after the 1990/91 year class. The model shows that by fishing at a low F (0.165) the variation in the catches will be from about 27 000 t in 2001 to about 45 000 t in 2006 with an average catch of close to 35 000 t during the period. The fishable biomass will be almost the same at the end of the period whether a constant TAC, or a constant F is chosen. Except the results of next years surveys (or CPUE) deviates from what is described in the BORMICON model, a TAC of about 35 000 t in next 5 years would keep the fishable stock size above U_{Pa} at the end of that period.

In Division Vb the CPUE from the Faroes survey shows a similar trend as the Icelandic (increase in 1996-1998, but decrease in 1999 and 2000), but in Sub-area XIV the fishable stock of *S. marinus* is almost depleted.

In order to protect the new incoming year class, any fishing effort on this component should be kept low to allow the stock to rebuild. It should also be kept in mind that, based on the groundfish survey there is no indication of new, strong, year classes after the 1990 year class. Therefore as described in 8.2.2, the year classes, 1985 and 1990 needs to be preserved, since it is unlikely that other year classes than these will contribute substantially to catches in the next years. Therefore, the Working Group recommends **that the effort should not be increased.**

7.3 Biological reference points

S. marinus is mainly caught in Division Va and the relative state of the stock can be assessed through survey and CPUE index series from that Division. ACFM accepted the proposal of the working group of defining reference points in terms of current state with respect to $U_{lim} = U_{max}/5$ and U_{pa} = 60% of U_{max}. U_{pa} corresponds to the fishable biomass associated with the last strong year class. Based on survey data, the highest recorded biomass was reached in 1987. Based on these definitions, the stock has been below, but close to U_{pa} during the last years. Based on the BORMICON model the corresponding values for reference points (for the period 1985-1999) are then U_{max}= 250 (in 1985); U_{lim}= 50 and U_{pa}= 150, and the stock seems to have been below U_{pa} in the period from 1993- 1996. The survey index series is only available back to 1985.

7.4 "Giant" *S. marinus.*

In March 1996 a new fishery with longlines and gillnets started on the Reykjanes Ridge deeper than 500 meters. In addition to traditional bottom longlines, vertical longlines were used on the steep sea mountains. One or two vessels also used gillnets. One of the main species caught in this fishery were the "giant" *Sebastes marinus* (see chapter 7.1). The main fishery has taken place from within the Icelandic EEZ (north to approx. 63°N) and southwards in international waters to approx. 56°N, although occasionally "giant" redfish have been caught south to 52°30'N. ACFM decided in 1997 to treat all *S. marinus* in ICES Sub-areas V, XII and XIV, including the 'giant', as one management unit.

The only landing statistics presented in 1996 were by Iceland, the Faroes and Norway (Table 8.4.1). The total reported landings of "giant" *S. marinus* taken by these countries in Sub-areas XII and XIV in 1996 was 900 t. The fishery since then decreased, with only minor catches reported by Norway in 1997 and there were no reporting of "giant" catch in 1998 and in 1999. There was however a considerable fishing effort on the Reykjanes in 1997, but the target demersal species seems to have been Greenland halibut and other deep sea species. Taking all available information and knowledge into account, it is the view of the Working Group that the demersal *S.marinus* caught on the Reykjanes Ridge in international waters, of which nearly 100% have been documented to belong to a separate genetic pool, the 'giants', should be managed separately and in a very conservative and cautious way.

The *S. marinus* caught in the depth between 400 and 600 m in area XIVb by the annual Greenland halibut survey could be of the giant type as this was the case in the samples collected during a gillnet fishery in 1995 (Johansen *et al*. 2000).

Table 8.1.1. *S. marinus*. Landings (in tonnes) by area used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Total
1978	31,300	2,039	313	0	15,477	49,129
1979	56,616	4,805	6	0	15,787	77,214
1980	62,052	4,920	2	0	22,203	89,177
1981	75,828	2,538	3	0	23,608	101,977
1982	97,899	1,810	28	0	30,692	130,429
1983	87,412	3,394	60	0	15,636	106,502
1984	84,766	6,228	86	0	5,040	96,120
1985	67,312	9,194	245	0	2,117	78,868
1986	67,772	6,300	288	0	2,988	77,348
1987	69,212	6,143	576	0	1,196	77,127
1988	80,472	5,020	533	0	3,964	89,989
1989	51,852	4,140	373	0	685	57,050
1990	63,156	2,407	382	0	687	66,632
1991	49,677	2,140	292	0	4,255	56,364
1992	51,464	3,460	40	0	746	55,710
1993	45,890	2,621	101	0	1,738	50,350
1994	38,669	2,274	129	0	1,443	42,515
1995	41,516	2,581	606	0	62	44,765
1996	33,558	2,318	663	0	59	36,598
1997	36,342	2,839	542	0	37	39,761
1998	36,771	2,565	379	0	109	39,825
1999 [1]	39,824	1,436	773	0	7	42,040

1) Provisional

Table 8.2.1. Index on fishable stock of *S. marinus* in the Icelandic groundfish survey by depth.

Depth interv / year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
< 100m	7	2	2	1	1	2	2	1	1	1	0	1	1	2	1	2
100-200m	91	86	124	95	101	68	76	62	48	58	36	44	60	57	56	47
200-400m	140	180	150	110	118	81	53	59	50	51	45	76	71	71	107	69
400-500m	24	12	10	4	11	22	8	9	17	1	11	21	34	3	44	8
Total 0 - 400m	237	268	276	206	220	151	130	122	98	110	81	121	133	130	164	117
Total	262	281	287	228	234	187	141	133	117	112	93	143	166	133	208	125

Table 8.2.2. *S. marinus*. Catch in Va in weight (tonnes) by age.

Year/ Age	**1995**	**1996**	**1997**	**1998**	**1999**
7	59		59	61	
8	199	354	261	226	466
9	1201	808	613	586	1287
10	9265	3622	1042	1264	1320
11	2885	8943	3036	1044	1889
12	1223	2072	11261	2981	2739
13	3582	1300	2709	11168	2432
14	5855	1459	1375	1830	16642
15	6488	4398	3413	1835	966
16	1492	5641	3699	2138	1214
17	819	921	2348	3338	1785
18	438	388	817	2001	2895
19	1065	268	630	1322	1661
20	1008	337	1186	946	1193
21	464	1210	474	461	292
22	825	1033	622	373	205
23	1246	803	741	763	458
24	792		595	1007	220
25	1101		728	651	806
26	429		312	491	230
27	249		138	955	593
28	674		250	672	102
29				69	172
30	157		34	320	266
Total	41516	33558	36342	36501	39833

Table 8.2.3. *S. marinus* Results from the Icelandic groundfish survey in Va, total catch in Va and effort towards *S. marinus*.

Year	Survey index	Catch (Va)	Effort
1985	1000	67,312	67
1986	1129	67,772	60
1987	1163	69,212	60
1988	867	80,472	93
1989	928	51,852	56
1990	637	63,156	99
1991	549	49,677	91
1992	515	51,464	100
1993	415	45,890	111
1994	462	38,669	84
1995	341	41,516	122
1996	511	33,558	66
1997	559	36,342	65
1998	547	36,771	67
1999	689	39,824	58
2000	494		

Table 8.4.1 Catches of "giant" *S. marinus* in Divisions XII and XIV. No catches are reported in 1998-1999.

	XII		XIV	
	1996	1997	1996	1997
Norway	76	21	750	22
Faroes[1]			80	
Total	76	21	830	22

1) Includes area XII

Catch figures for other areas or nations are not available for the meeting.

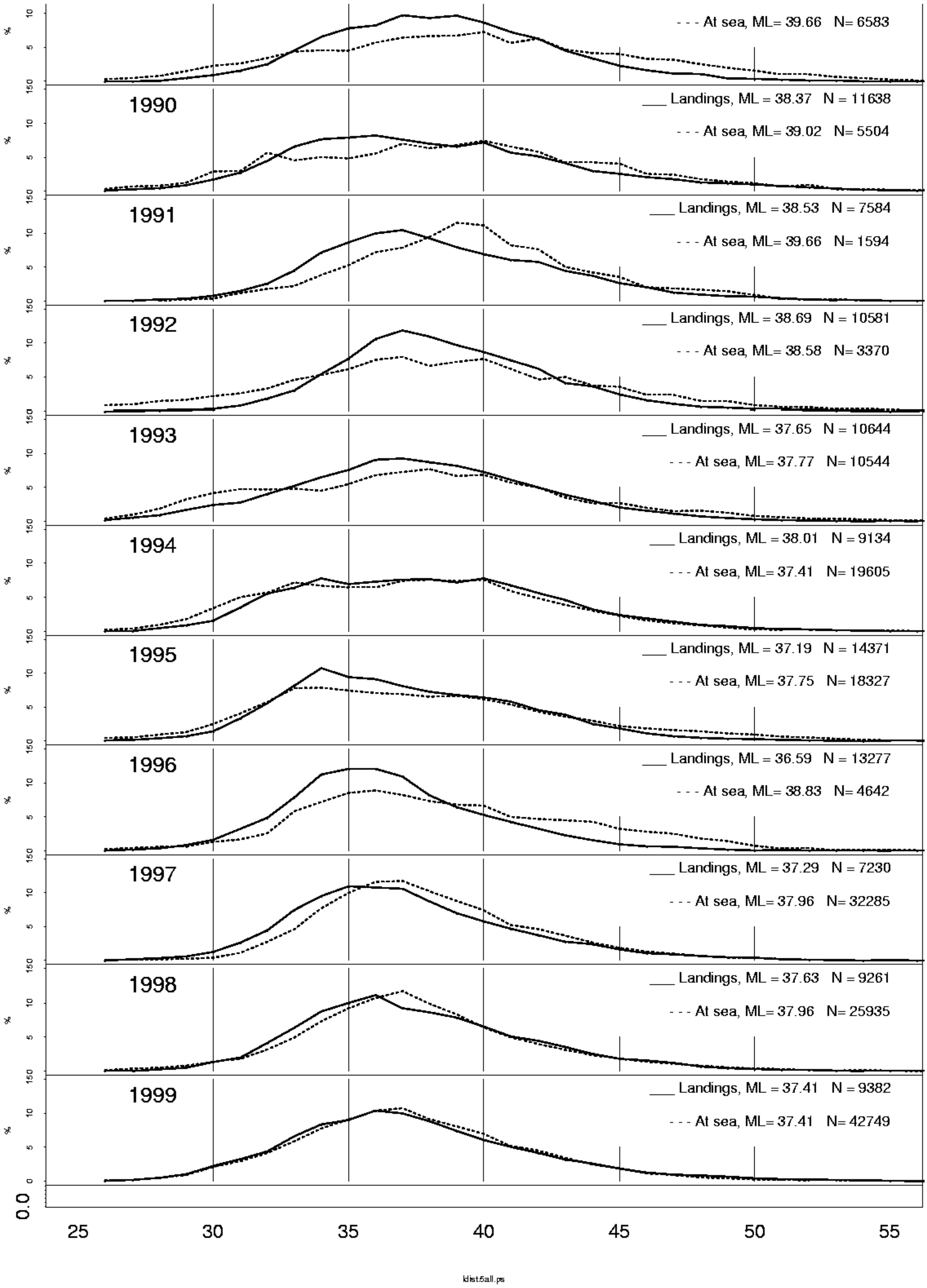


Figure 8.1.1. *S. marinus*. Length distribution from Icelandic landings and from samples taken at sea from the trawler fleet 1989-1999.

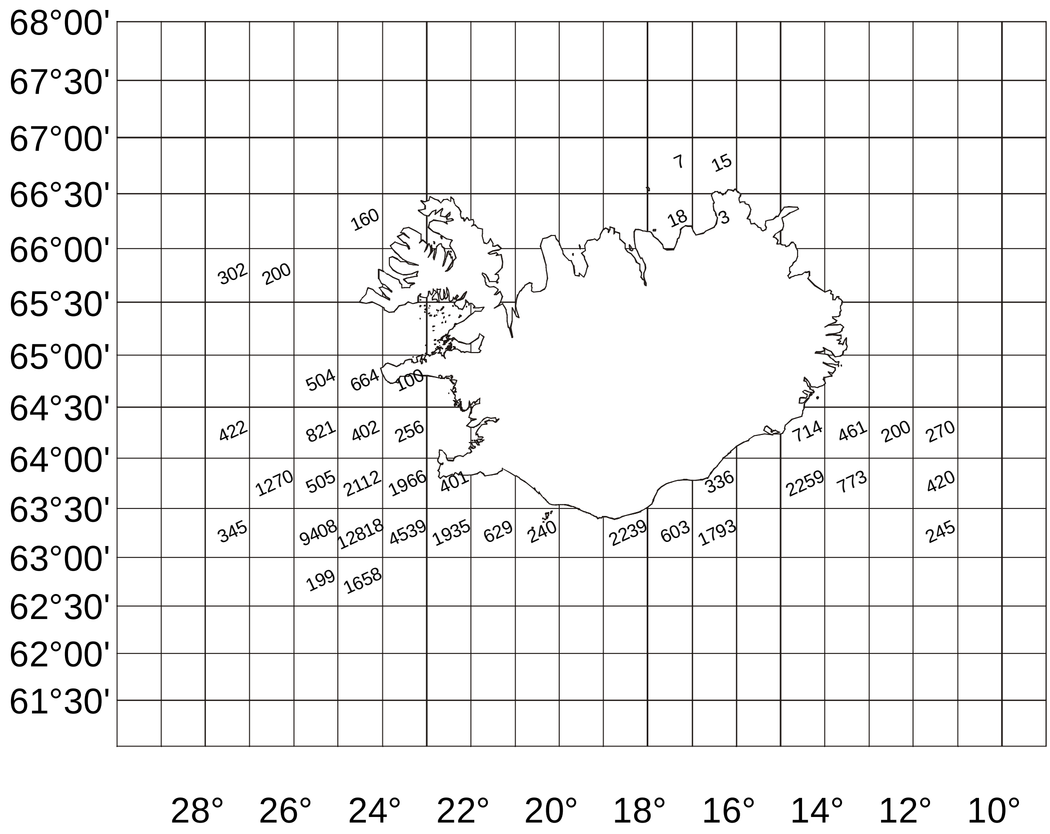


Figure 8.1.2. Number of measrured *S. marinus* from Icelandic catch in 1999 by statistical square.

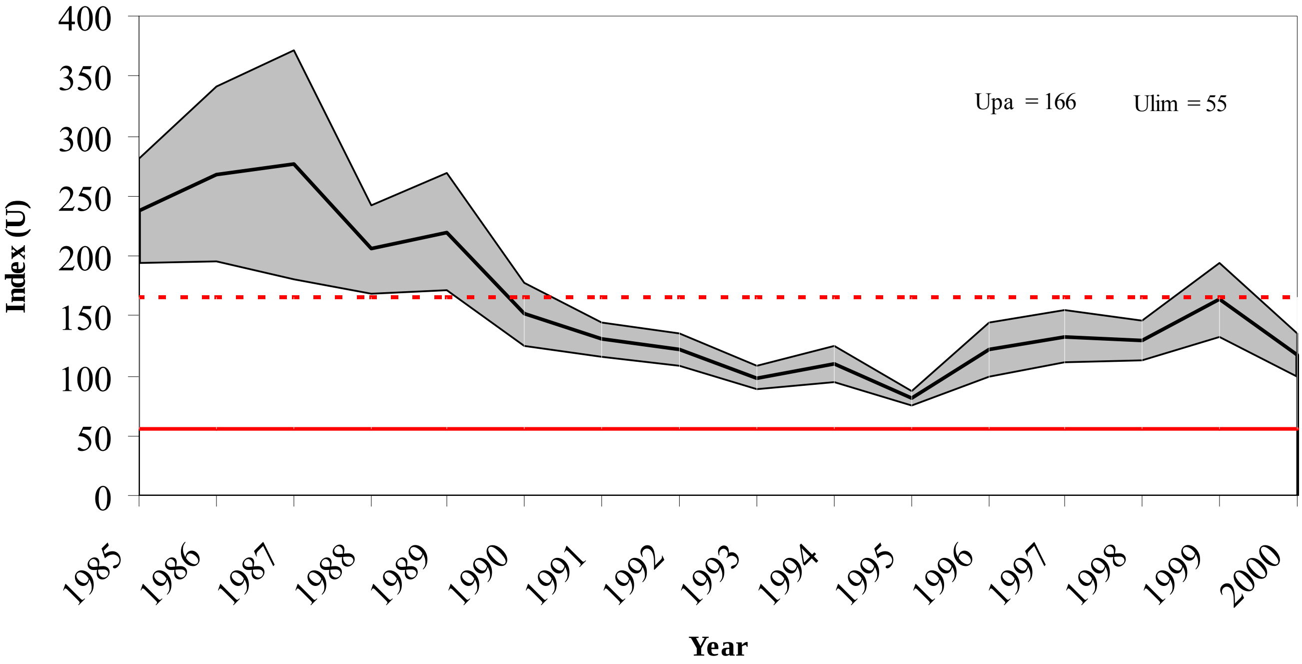


Figure 8.2.1. Index on fishable stock of *S. marinus* from Icelandic groundfish survey and 95% confidence intervals. The index is based on all strata at depths from 0-400 m.

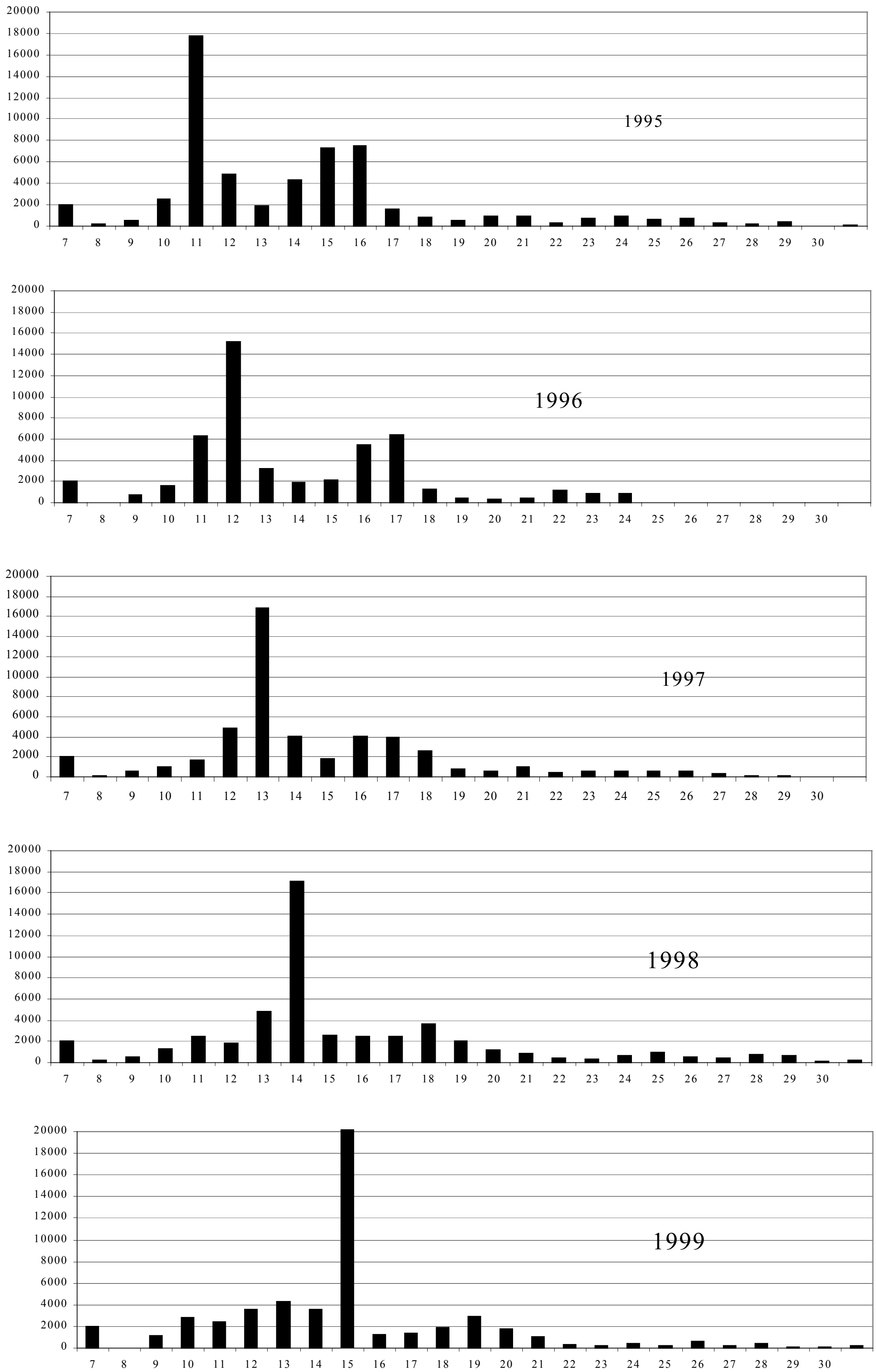


Figure 8.2.2. *S. marinus.* Catch in number by age in Sub-division Va, based on samples from the catch.

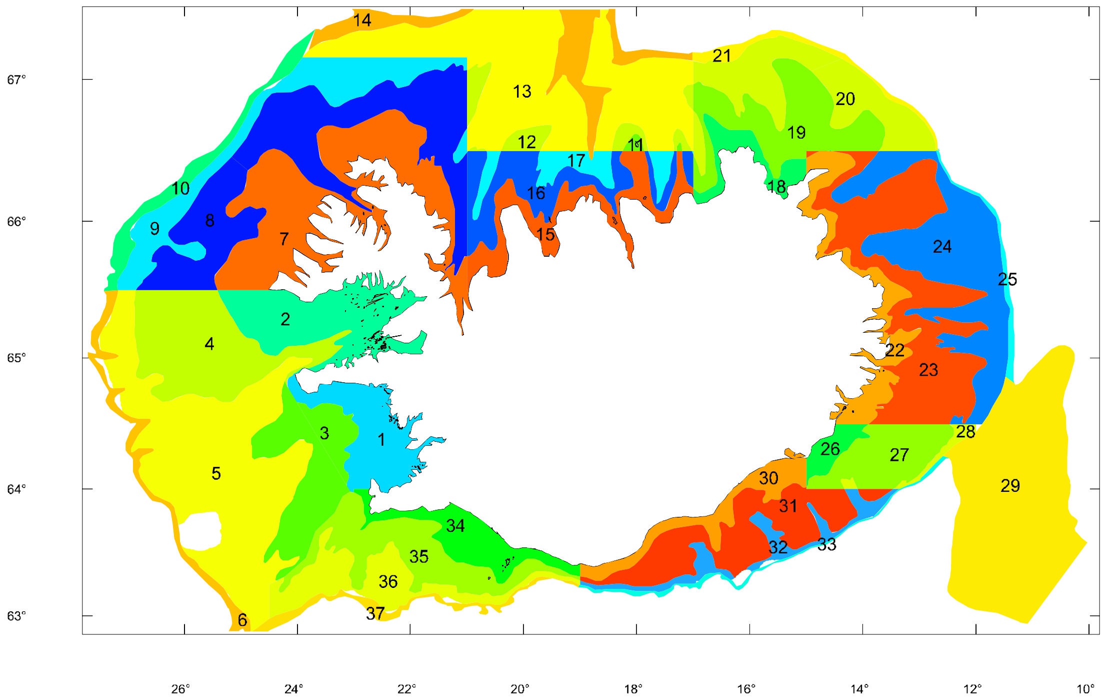


Figure 8.2.3. Stratification in the Icelandic groundfish survey by depth down to 500 m. The numbers show stratified index (Palsson *et al.* 1989). See also table 8.2.1.

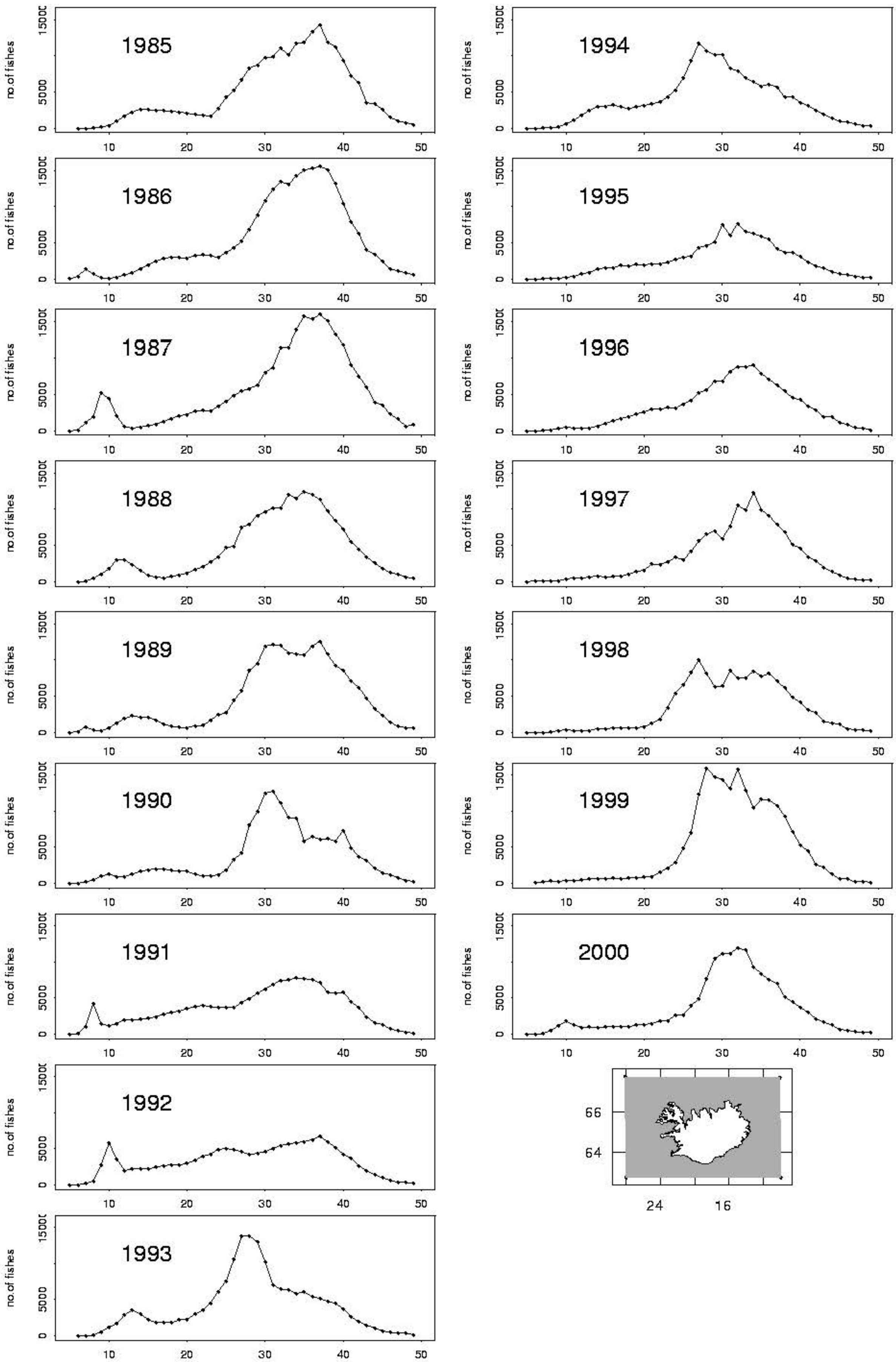


Figure 8.2.4. Length distribution of *S. marinus* in the Icelandic groundfish survey.

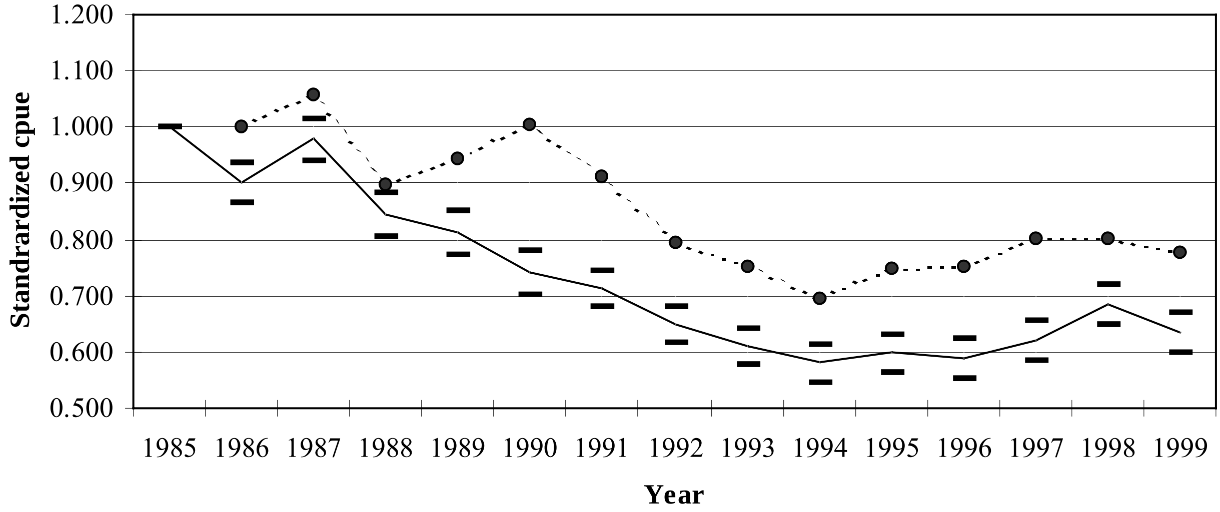


Figure 8.2.5. CPUE in *S. marinus* from Icelandic trawlers, both based on results from GLIM model 1985-1999 (solid line with 95% CV) and based on simple mean of hauls where *S. marinus* catch compose 50% or more of the total catch in each haul (dotted line since 1986).

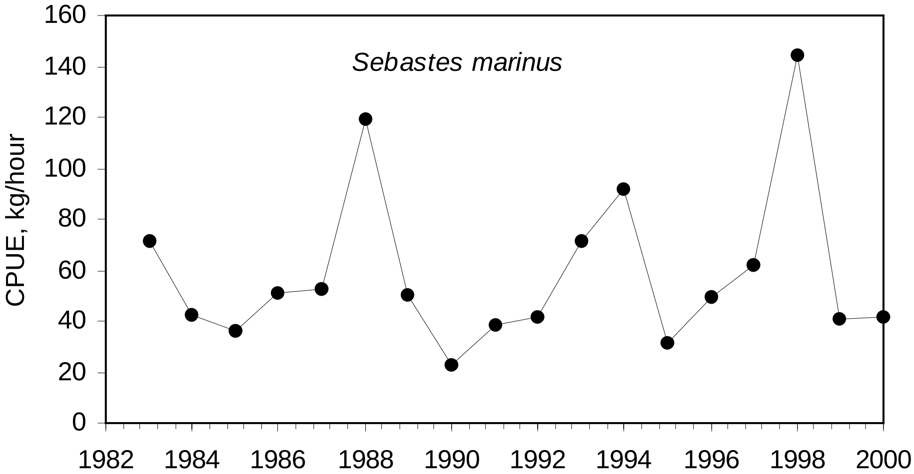


Figure 8.2.6. CPUE of *S. marinus* in the Faeroes groundfish survey 1983-2000.

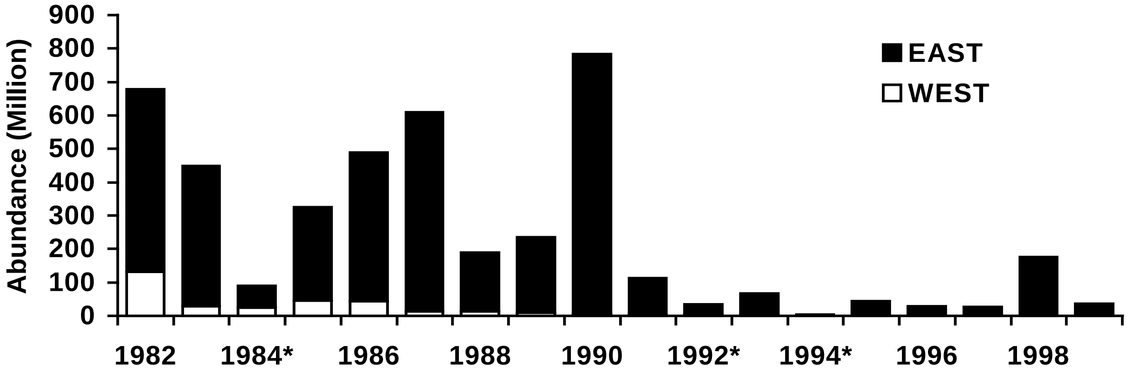


Figure 8.2.7 *S. marinus* (≥17 cm). Survey abundance indices for East and West Greenland, 1982-99. *) incomplete survey coverage.

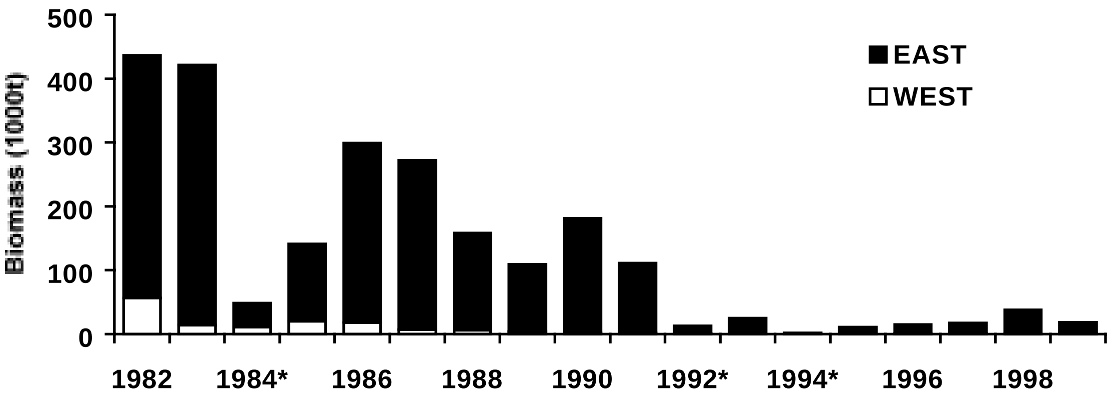


Figure 8.2.8. *S. marinus* (≥17 cm). Survey biomass indices for East and West Greenland, 1982-99. *) incomplete survey coverage.

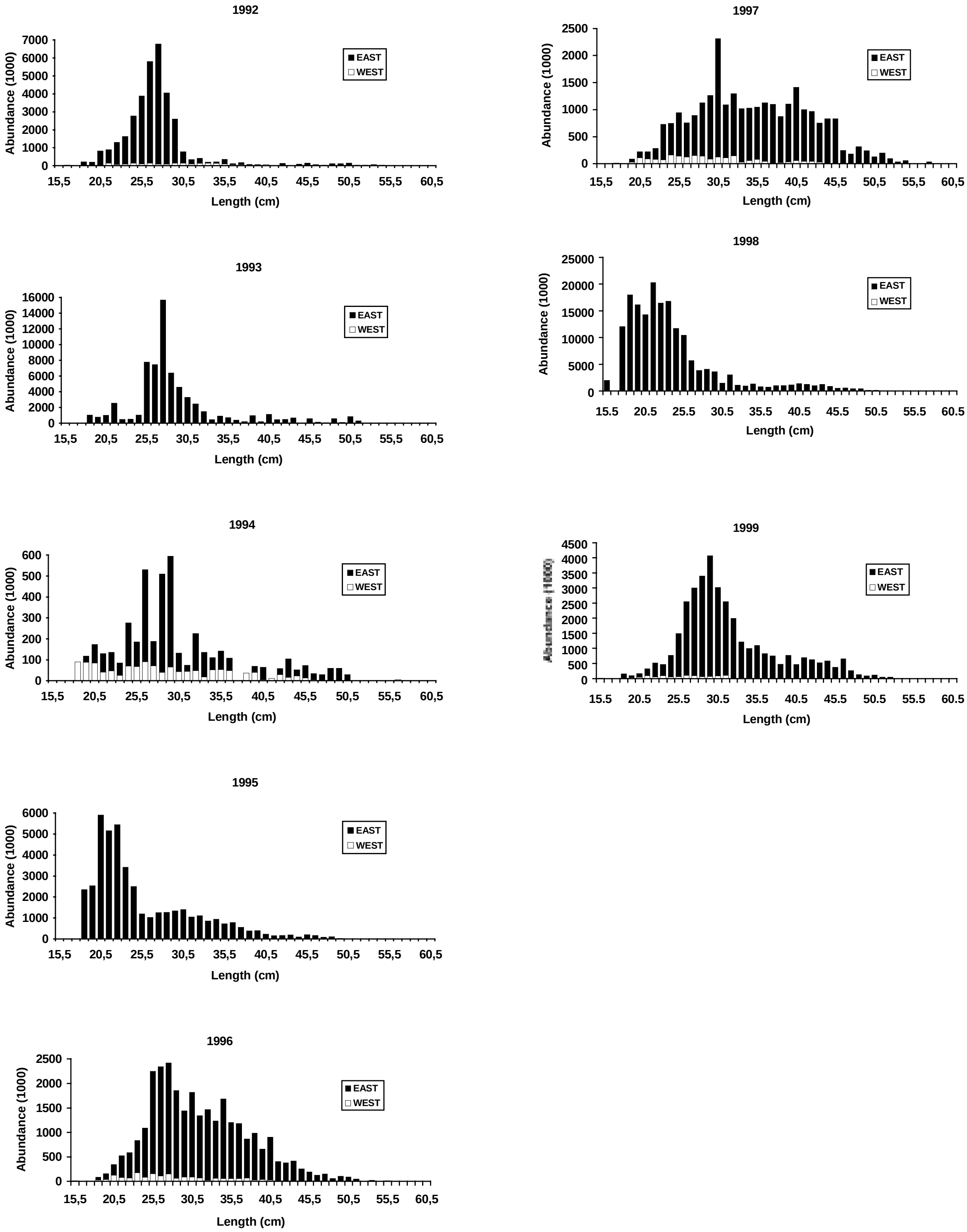


Figure 8.2.9.*S marinus* (≥17 cm). Length frequencies for East an West Greenland, 1992-99, as derived from the German groundfish survey.

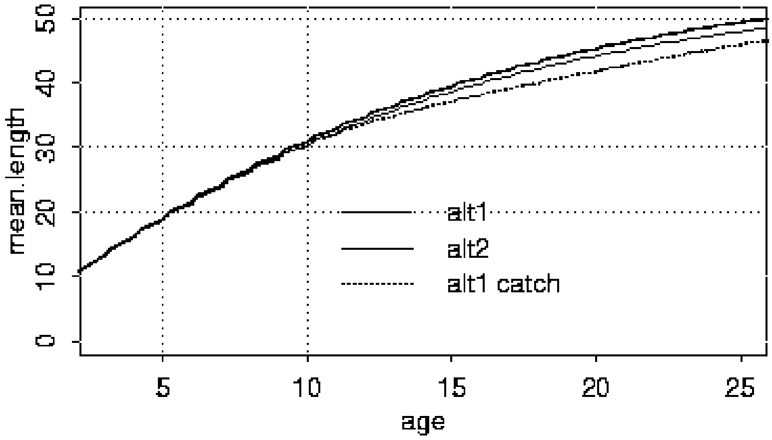


Figure 8.2.10. Mean length of *S. marinus* according to the BORMICON model. Alternative 1 incorporates age readings while alternative 2 does not. The figure also demonstrates the effect of catch on length at age.

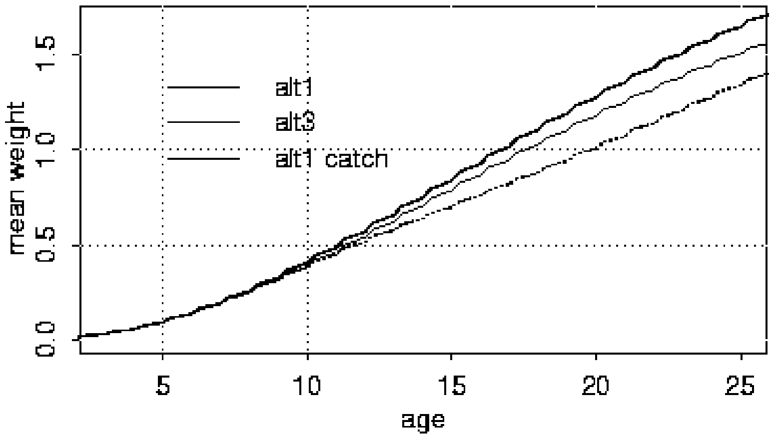


Figure 8.2.11. Mean weight (in Kg) of *S. marinus* according to the BORMICON model. Alternative 1 incorporates age readings while alternative 3 does not. The figure also demonstrates the effect of catch on weight at age.

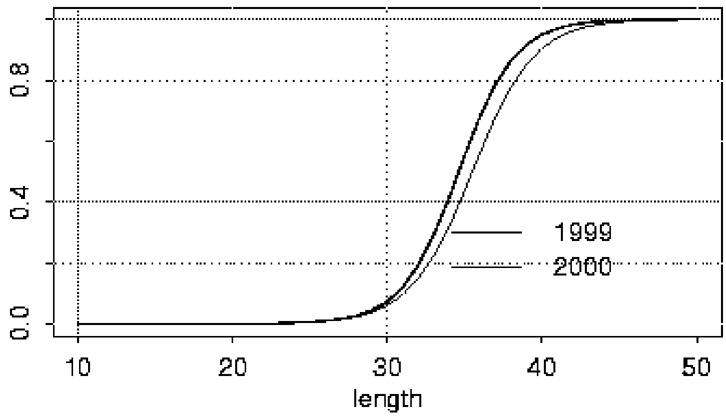


Figure 8.2.12. Estimated selection pattern of the commercial fleet according to the BORMICON model. The results from last years run are also drawn, for comparison.

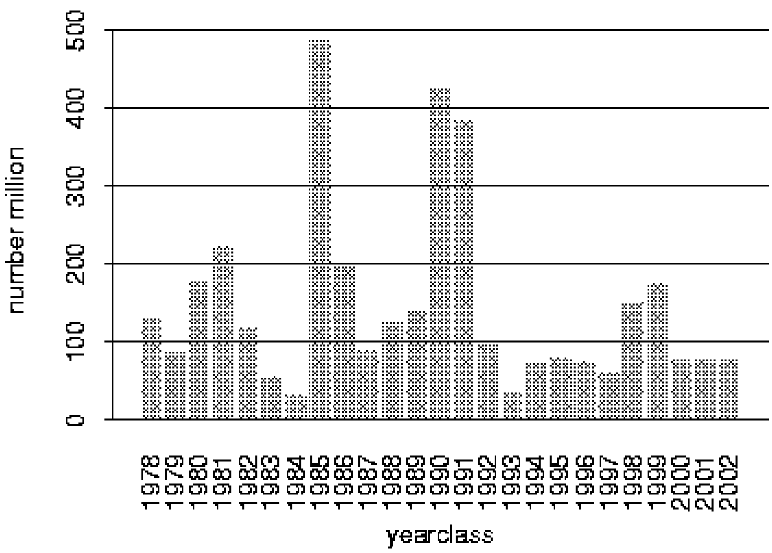


Figure 8.2.13. Recruitment of *S. marinus* estimated by the BORMICON model which are used in the future simulations.

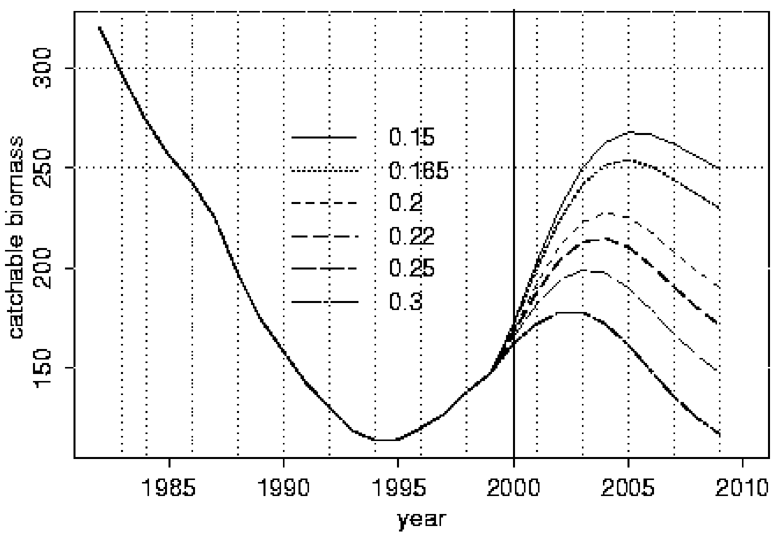


Figure 8.2.14. Estimated catchable biomass of *S. marinus* based on different fishing mortalities after 1999 as computed by the BORMICON model. Fishing mortality here refers to fish with selection 1 given in Figure 8.2.12.

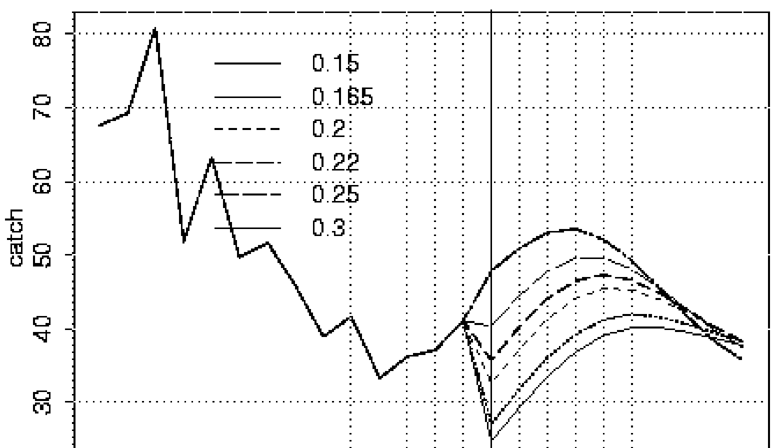


Figure 8.2.15. Landings of *S. marinus* in the period 1985-1999 and modeled future catch, based on different fishing mortalities after 1999. As described earlier the fishing mortality here refers to fish with selection 1 (Figure 8.2.12).

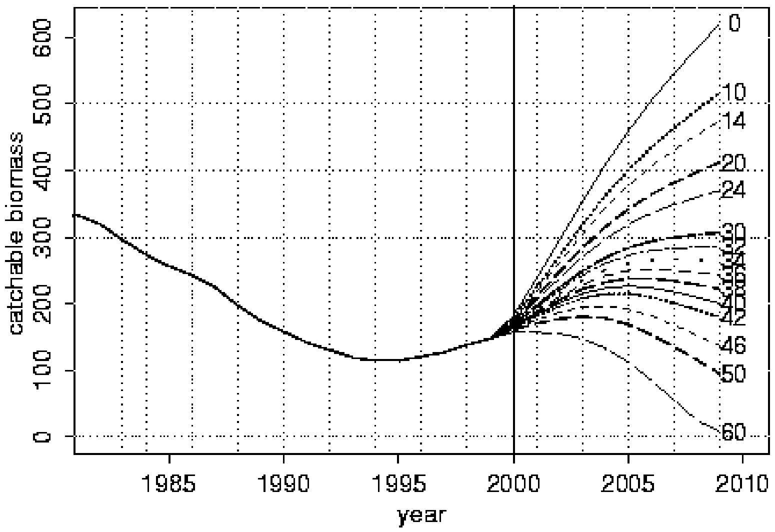


Figure 8.2.16. Catchable biomass of *S. marinus* for different catch options. Text at the end of each curve demonstrates amount caught each year from 2000 to 2010.

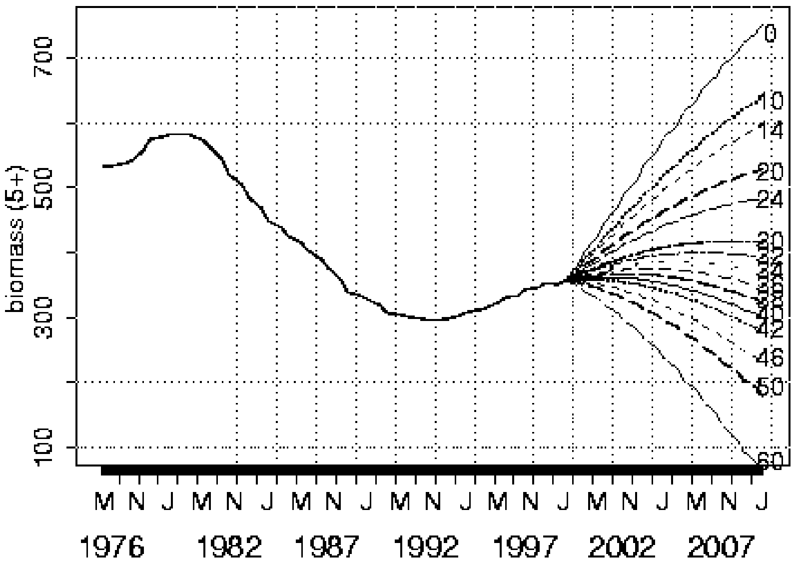


Figure 8.2.17. Total biomass of *S. marinus* for different catch options. Text at the end of each curve demonstrates amount caught each year from 2000 to 2010.

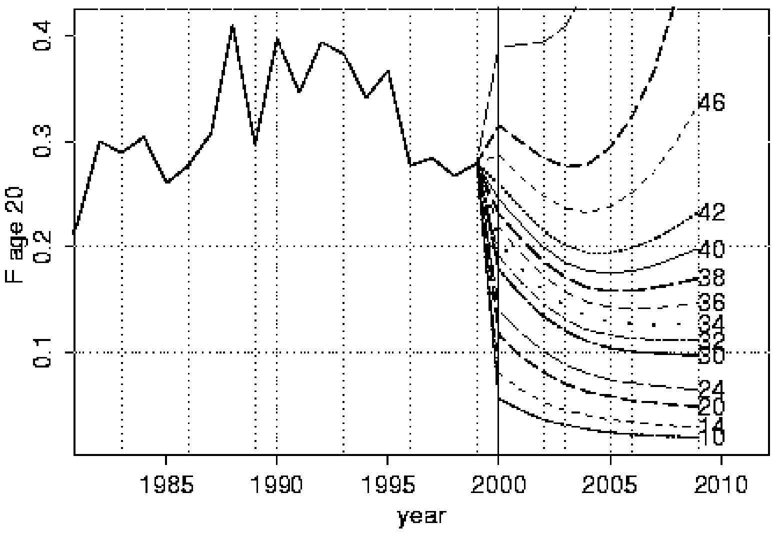


Figure 8.2.18. Fishing mortality of age 20 *S. marinus* for different catch options. Text at the end of each curve demonstrates amount caught each year from 2000 to 2010.

8 DEEP-SEA *S. MENTELLA* ON THE CONTINENTAL SHELF

Traditionally, the *S. mentella* on the shelves and banks around the Faroe Islands, Iceland and at East Greenland have been treated as one stock unit, with a common area of larval extrusion to the SW of Iceland, a drift of the pelagic fry towards the nursery areas on relatively shallow waters at East Greenland, and feeding and copulation areas on the shelves and banks around Faroe Islands, Iceland and at East Greenland. In Faroese waters spawning has been observed in some years to the south and west of the islands, implying that there could be a local component in the area; no nursery areas have, however, been found so far (Reinert, 1990). A relationship to other ICES areas (II and IV) have also been suggested (Reinert *et al.,* 1992; Reinert and Lastein, 1992). The question of a possible relationship between the deep-sea *S. mentella* on the shelf in Subareas V and XIV and the pelagic deep-sea *S.mentella* in the Irminger Sea has been raised several times. The ICES Working Group in 1999 on the Application of Genetics in Fisheries and Mariculture (WGAGFM) states that the presence of significant genetic differences between these two deep-sea components indicate probably distinct genetic stocks. The NWWG therefore continues treating the deep-sea *S.mentella* on the shelf as a separate self-contained stock unit. For management purposes the Icelandic authorities separate the deep-sea *S. mentella* on the shelf (some of which are caught in pelagic trawls) from the pelagic *S.mentella* in the Irminger Sea (both oceanic and pelagic deep-sea type) by straight lines through three positions (Figure 9.1.1).

8.1 Landings and Trends in the Fisheries

The total annual landings of deep-sea *S. mentella* from Divisions Va and Vb and Sub-areas VI and XIV varied considerably in the 1980s mainly from 30 000 to 60 000 t. In 1990, the landings were 44 000 t, and reached 67 000 t in 1991, decreased slightly in 1992 (63 000 t) but increased to about 83 000 t in 1994. Since then the landings have decreased to approximately 35,000 t in 1999. In summary, the average annual landings in the period from 1991-1994 increased substantially from the average in the 1980s (42 000 t), but is now (1999) the lowest catch since 1988 (Table 9.1.1).

From Division Va, total landings decreased from 33,000 t in 1998 to about 29 000 t in 1999, and has been decreasing druing the last years from the record high catches in 1994 of 57 000 t. In the 1980s landings varied from 10 000–40 000 t. From 1990 to 1994 the landings doubled from 28 000 t to 57 000 t. This increase in the catch coincides with the introduction of large pelagic trawls used by a part of the Icelandic fleet during the autumn and early winter months. This fishery has now decreased to less than 10% of the 1994 level due to low catch rates. About 90–95% of the total deep-sea *S.mentella* catches in area Va in 1999 have been taken by bottom trawlers (both fresh fish and freezer trawlers). Length distributions from the Icelandic catches in 1989-1999 are shown in Figure 9.1.2. A decrease in the mean length of the landed fish is seen in recent years. In Division Va the proportion of redfish below 33 cm in the catches is not allowed to exceed 20% in numbers, unless the fishing area may be closed.

In Division Vb annual catches of deep-sea *S. mentella* varied from 5 000–8 000 t until 1984. Then catches increased rapidly to about 15 000 t in 1986. The catches declined again to 9 000 t in 1990. They increased to about 13 000 t 1991. Since then they have remained very low and the catches in 1999 of 5 300 t is an increase from 1997-1998, but still among the lowest catch since early 1970s (Table 9.1.1). Length distributions of the Faroes catches from Division Vb in 1998-1999 are given in Figure 9.1.3.

In Sub-area VI the annual catches were highest in 1980 (1 100 t), but have varied from 130 - 640 t during recent years, except for 1996 when the catches were about 1 050 t, the highest recorded catch in the series since 1980 (Table 9.1.1).

In Sub-area XIV, annual catches have varied considerably. In the beginning of the 1980s, the landings were between 10 000-15 000 t, but then decreased to 6 000 t in 1987-1992 and increased to 19 000 t in 1994. At that time the fleet was mainly fishing very small redfish. Since then there has been a drastic decrease to 200 t in 1997 when the only catches taken were bycatches in the shrimp fishery. In 1998, however, Germany started again a directed fishery on the juveniles in this area (Figure 9.1.4) and this resulted in a total catch of about 1 400 t. This fishery continued in 1999 but the total catch was only about 800 t, although the effort was similar as in 1998.

The 1999 biological sampling from catch and landings of deep-sea *S.mentella* from the continental shelf in each Division and by gear type is shown in the text table below.

Area	Gear	Landings	Nos. samples	Nos. fish measured
Area	Gear	Landings (t)	No. samples	No. measurements
Va	Pelagic trawl	800	4	1000
Va	Bottom trawl	27,000	141	28478
Vb	Bottom trawl	5294	65	7264
XIVb	Bottom trawl	804	29	3606

8.2 Assessment

8.2.1 Trends in CPUE and survey indices

CPUE of the Icelandic trawler fleet for deep-sea *S. mentella* in Division Va is based on bottom trawl tows taken below 500 m depth and where the total catches of redfish compose a certain percentage of the total catch in each tow. Data prior to 1986 are poor. In the period from 1986-1990 CPUE was rather stable. From 1989 to 1993 CPUE declined by about 45% (see text table below and Figure 9.2.1), and it has remained rather low and stable since then. The 1999 value showed an increase from 529 kg/h to 643 kg/h (about 20%). Indices of CPUE for the Icelandic trawl fleet for the period 1986-1999 are also estimated from a GLIM multiplicative model, taking into account changes in the Icelandic trawl catch due to vessel, statistical square, month and year effects. All hauls with redfish at depths above 500 m, exceeding 50% of the total catch were included in the CPUE estimation (Figure 9.2.1a). The results of the GLIM model does not support the increase in CPUE shown when only calculating average cpue from the raw data calculated (sum of catch / sum of hours trawled for each year each haul where redfish exceeding 10% of the total catch in each haul). The GLIM model shows more or less a continuous reduction during the whole period since 1986, with only two exceptions, in 1988 and 1995. The reduction from 1998 to 1999 is 2% and the 1999 value is only about 45% of the 1986 value.

Year	CPUE 50 %_GLIM	CPUE 10% Raw	Total landings (t) in Va	Effort Glim / raw
1986	1000	943	18,898	19 / 20
1987	912	974	19,293	21 / 20
1988	914	886	14,290	16 / 16
1989	857	974	40,248	47 / 41
1990	846	804	28,429	34 / 35
1991	814	770	47,651	59 / 62
1992	705	611	43,414	62 / 71
1993	588	547	51,221	87 / 94
1994	547	488	56,720	104 / 116
1995	562	514	48,708	87 / 95
1996	524	489	34,741	66 / 71
1997	496	560	37,876	76 / 68
1998	445	498	32,821	74 / 66
1999	438	606	28,791	66 / 47

The effort in Division Va in the time when the stock was considered in stable condition i.e., from 1986-1990 was 20 000–40 000 hours. During the period since 1986, the effort increased drastically until 1994. Since then, the effort has decreased by less than 10% each year on average (the advice of ICES has been a 25% reduction annually since 1995). The effort in 1999 is about 60% of the peak in 1994. Icelandic groundfish survey in Division Va only covers depths down to approx. 500 m and there seem not to be any nursery grounds of major importance in Division Va, these results add little to the current stock evaluation. A recently started deep-water survey (approx. 500–1200 m) around Iceland in autumn may, however, add valuable information about the fishable stock of deep-sea *S.mentella* in near future.

In Division Vb a CPUE-series (1985–1997) of deep-sea *S. mentella* was presented in the 1997 Working Group report. The series shows a decrease since 1993, which seems to have stabilized below 50% of the maximum in the time series. Information on CPUE from Vb were not available to the Working Group in 1998 and 1999.

In Division XIV all redfish catches in the period 1982-1997 was as a bycatch. In 1998 and 1999, there was a direct fishery for redfish along the continental slope of East Greenland where *S.mentella* was the targeted species. The effort was similar in both years, and the CPUE in 1998 was about 638 kg/h but decreased to only 352 kg/h in 1999.

Survey abundance and biomass indices from the German groundfish survey for deep sea *S. mentella* (> = 17 cm) are broken down by stratum at West and East Greenland and illustrated in Figures 9.2.2–9.2.3. The surveys in 1991, 1993 and 1995–1997, when the whole area was covered, registered high abundance of deep-sea *S.mentella* at East-Greenland. The survey results show recruiting juveniles only while mature deep sea *S. mentella* are almost absent. The 1998 and 1999 survey had also a full coverage, but the results indicate a continuous downward trend in abundance and biomass since the 1997 peak. The record high values measured in 1997 mainly composed of fish with a mean length of about 25 cm. This dominant year class had in the 1998 survey grown to about 27 cm but it is difficult, from the length distributions, to follow the growth between 1998 and 1999 surveys (Fig. 9.2.4). Since there was no significant commercial fishery for this species at East- Greenland at present, the decrease in the survey indicates an emigration out of the area. The origin of these very abundant recruits and to which fishing area they recruit is uncertain but there are indications that they both recruit to the fishery within Division Va, but also to the pelagic redfish in the Irminger Sea.

8.2.2 State of the stock

All CPUE indices shows a drastic reduction from a highs in the late 80s but some indices indicate that it seems to have stabilised in the 90s at or below 50% of the maximum. The GLIM index indicates a more or less continuos reduction since 1986. Fishermen report of less *S.mentella* in the fishing areas Southwest and West of Iceland. New recruits have entered the fishable biomass in recent years. There are indications that recruitment to the fishable stock (in Division Va) comes from East-Greenland. It is, however, uncertain to what extent the juvenile *S.mentella* currently at East-Greenland will recruit to this stock.

In Division Vb development in CPUE resembles that in Division Va, i.e., the CPUE seems to have stabilized at or below 50% of the maximum in the time series (1985–1997).

Based on survey results the SSB of deep-sea *S.mentella* on the continental shelf in area XIV remains severely depleted. The strong recruiting cohort(s) observed in 1993-97 emigrated in 1998-99 and partly recruited to the oceanic redfish stock.

8.3 Catch projections

It is possible to compute effort as well as a TAC corresponding to different reductions in effort for deep-sea *S. mentella* by using a similar method as described above for *S. marinu*s, although for the deep-sea *S. mentella,* the survey index is replaced by CPUE index. The management advice given in the recent years was to reduce the effort by 25 % until the stock displays indications of an increase in adult biomass from the present low level. It was expected that a 25% reduction in effort would lead to catches of 22 000 t in Division Va in 2001.

Catch 2001 = CPUE 99 * **Effort** 99 ***0.75**

8.4 Biological reference points

The relative state of the stock can be assessed through survey and CPUE index series (U) from the commercial fishery, which imply a maximum, U_{max}, as well as the present state. Given these data, it has been proposed by ACFM that reference points be defined in terms of the current state with respect to $U_{lim} = U_{max}/5$ and $U_{pa} = U_{max}/2$. Based on these definitions, the stock could be considered close to or below U_{pa}.

8.5 Management considerations

The two types of pelagic redfish in the Irminger Sea (i.e., the oceanic and the pelagic deep-sea *S.mentell*a) in the present context are treated separately from the deep-sea *S. mentella* on the continental shelf. It can, however, not be excluded that there may be a relationship between the demersal deep-sea *S. mentella* on the continental shelves of the Faroe Islands, Iceland, Greenland and the pelagic deep-sea *S. mentella* in the Irminger Sea and this should be considered in the management of this stock (see also chapter 7.5).

The management strategy to reduce the effort in Division Va by 25 % until the stock shows an increase in adult biomass from the current low biomass should be maintained. The annual catch should not exceed 22 000 t.

Since the deep-sea *S.mentella* in Division Va and Division Vb belong to the same stock, a similar reduction in effort as in Division Va is recommended also for Division Vb.

In Sub-area XIV the Working Group recommends maximum protection of the juveniles and **no directed** fishery in order to maximise the probability of stock recovery to safe biological limits.

Table 9.1.1 Deep-sea *S. mentella* on the continental shelf. Landings (in tonnes) by area used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Total
1978	3,902	7,767	18	0	5,403	17,090
1979	7,694	7,869	819	0	5,131	21,513
1980	10,197	5,119	1,109	0	10,406	26,831
1981	19,689	4,607	1,008	0	19,391	44,695
1982	18,492	7,631	626	0	12,140	38,889
1983	37,115	5,990	396	0	15,207	58,708
1984	24,493	7,704	609	0	9,126	41,932
1985	24,768	10,560	247	0	9,376	44,951
1986	18,898	15,176	242	0	12,138	46,454
1987	19,293	11,395	478	0	6,407	37,573
1988	14,290	10,488	590	0	6,065	31,433
1989	40,269	10,928	424	0	2,284	53,905
1990	28,429	9,330	348	0	6,097	44,204
1991	47,651	12,897	273	0	7,057	67,879
1992	43,414	12,533	134	0	7,022	63,103
1993	51,221	7,801	346	0	14,828	74,196
1994	56,720	6,899	642	0	19,305	83,566
1995	48,708	5,670	540	0	819	55,737
1996	34,741	5,337	1,048	0	730	41,856
1997	37,876	4,558	418	0	199	43,050
1998	33,125	4,089	298	3	1,376	38,890
1999 [1]	28,590	5,294	243	0	865	34,992

1) Provisional data.

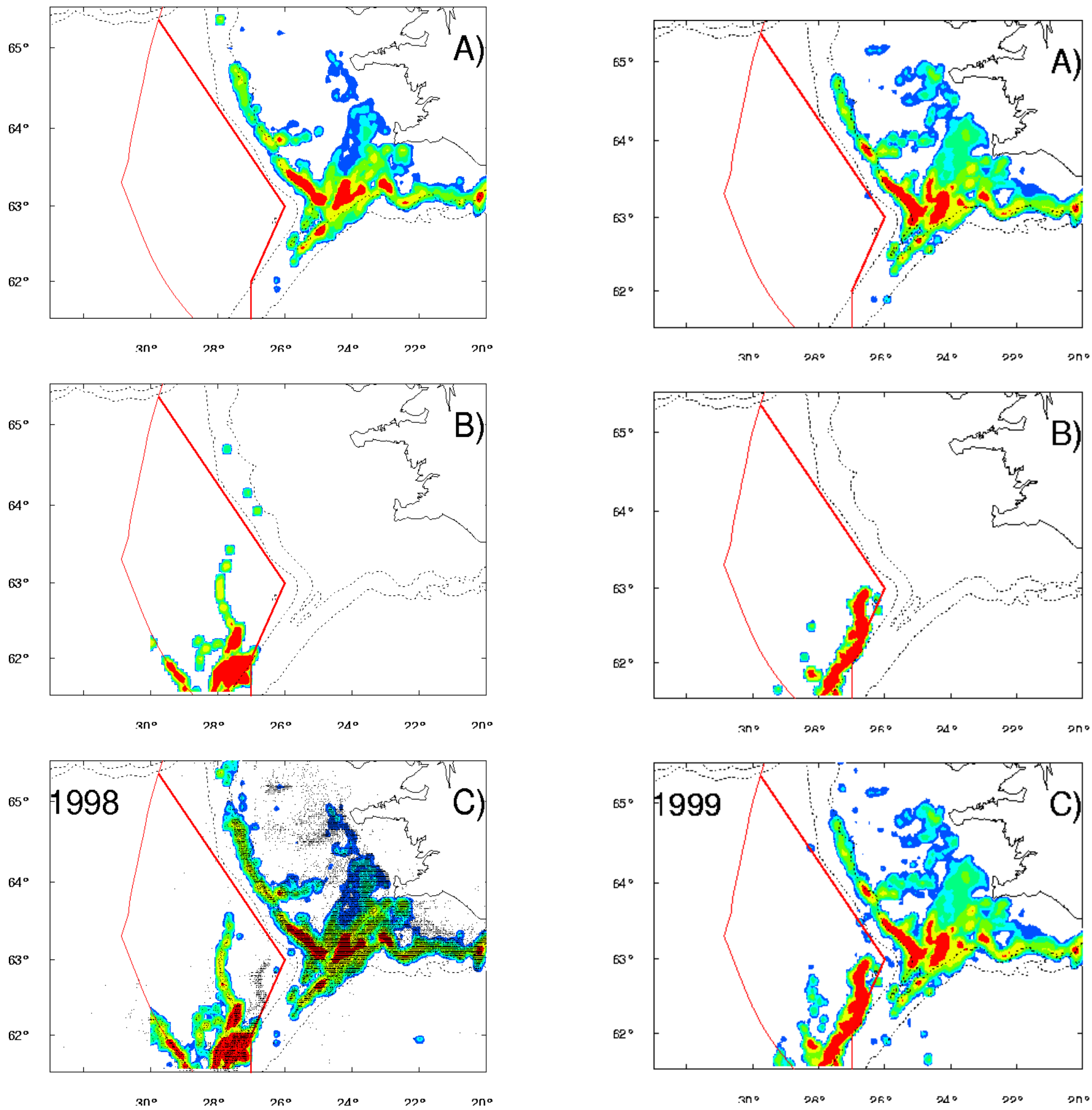


Figure 9.1.1. Map showing the line used by Icelandic authorities to separate the landing statistics between deep-sea. The figures also show the fishing grounds of demersal fishing for redfish (a), the oceanic redfish fishery in 1998 and in 1999 (b) and all redfish fishery (c), as record in the log-books.

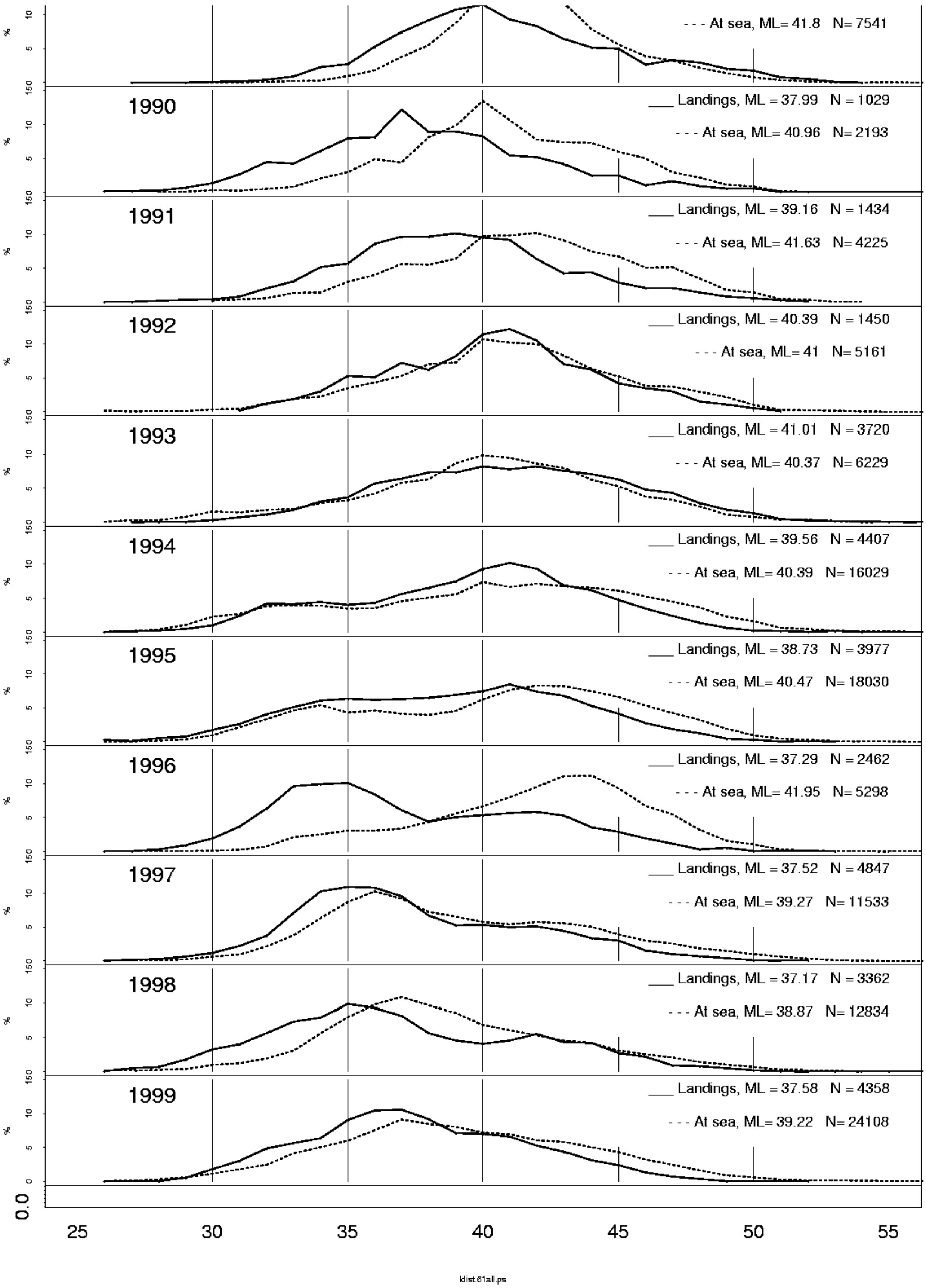


Figure 9.1.2. Length distributions of deep-sea *S.mentella* catch and landings from the Icelandic bottom trawl fishery in 1989-1999.

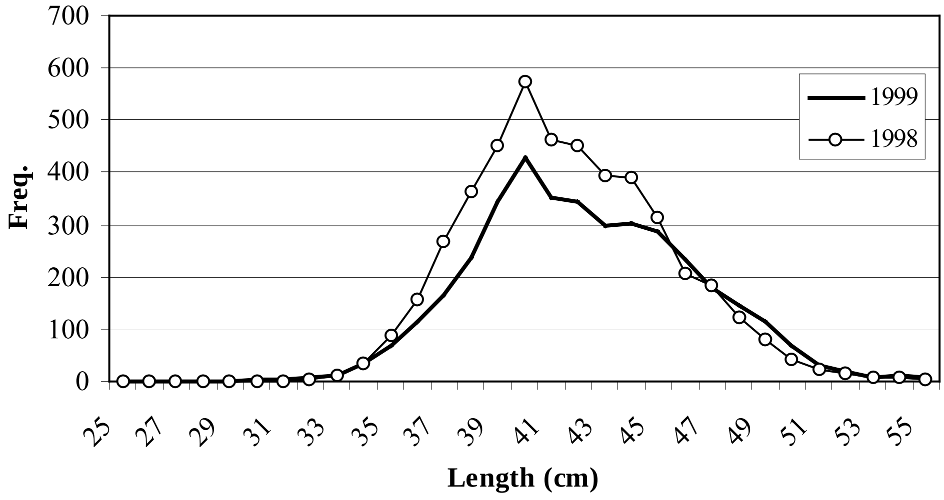


Figure 9.1.3. Length distribution of deep-sea *S.mentella* caught by Faroes otterboard trawlers in Division Vb in 1998 and 1999.

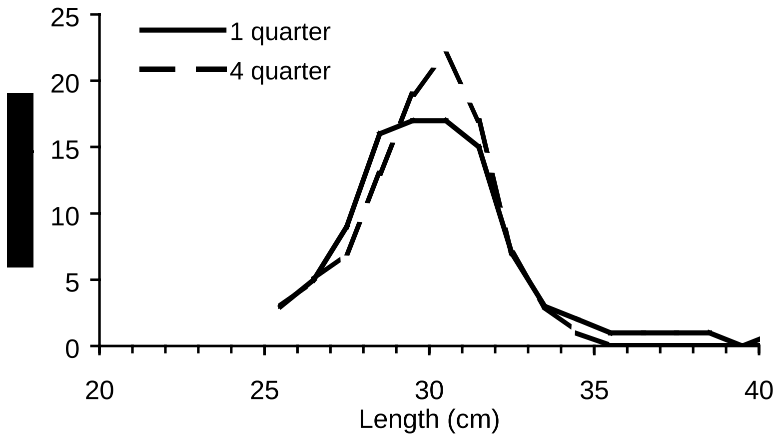
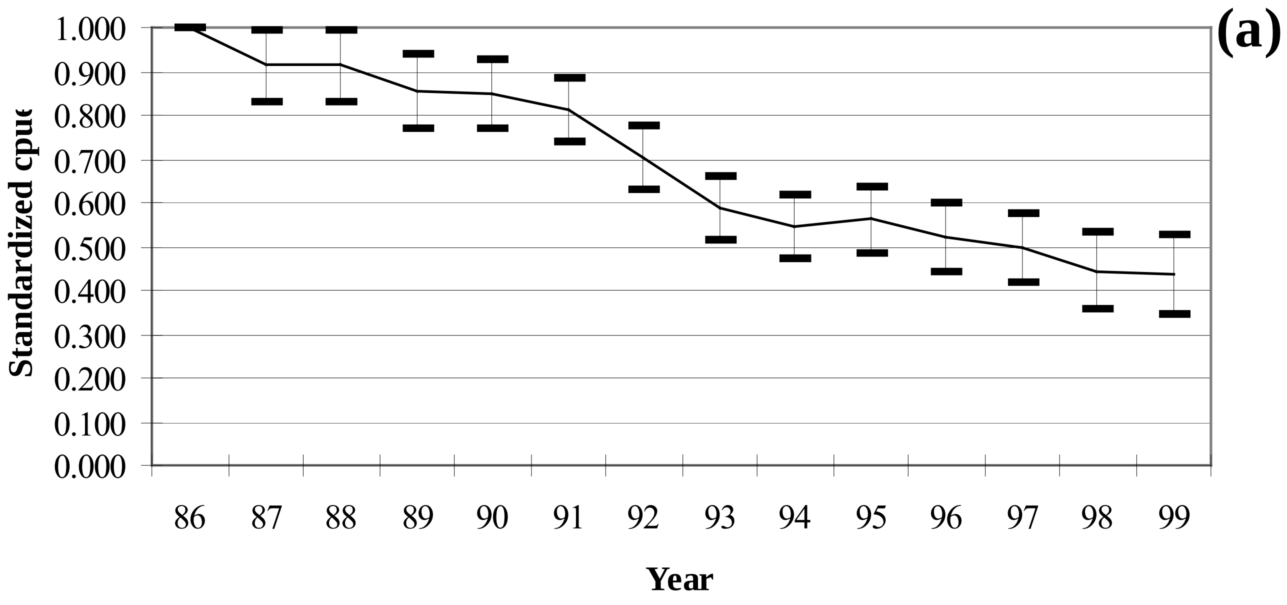


Figure 9.1.4 . Length distribution of deep-sea *S.mentella* caught by German bottom trawl fishery in Division XIVb in the first and fourth quarter 1999.



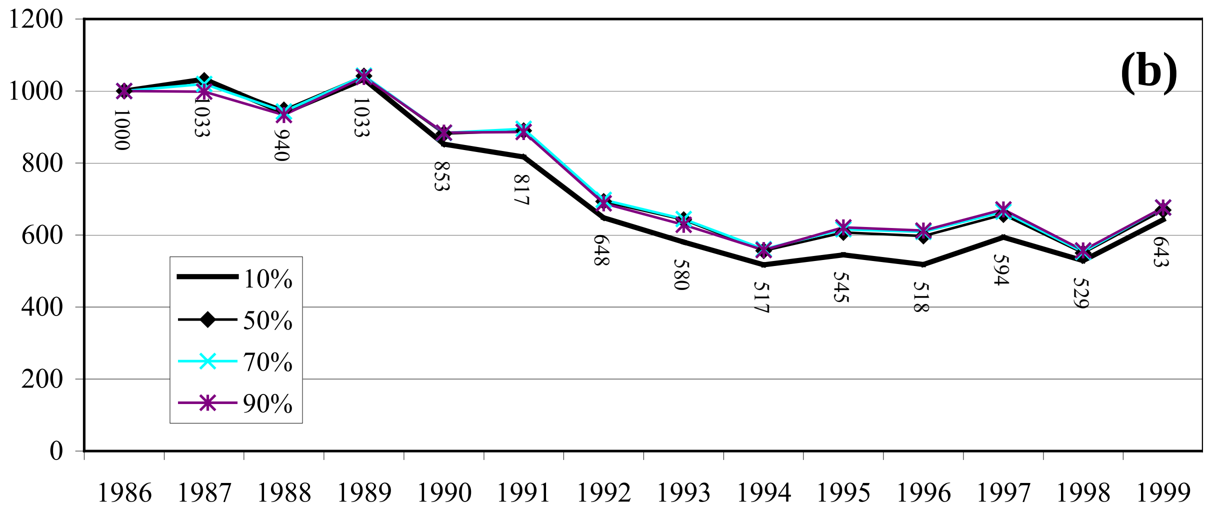


Figure 9.2.1. CPUE, relative to 1986, from the Icelandic bottom trawl fishery for deep-sea *S.mentella* on the continental shelf, based on a GLIM model (a) and based on simple mean (b). The GLIM model shows the modelled development using GLIM including hauls where redfish deeper than 500 m compose 50% ore more of the total catch in each haul. Simple mean means CPUE calculated on hauls where redfish deepet than 500 m compose 10% (50 70 or 90% lines are also shown) or more of the total catch in each haul.

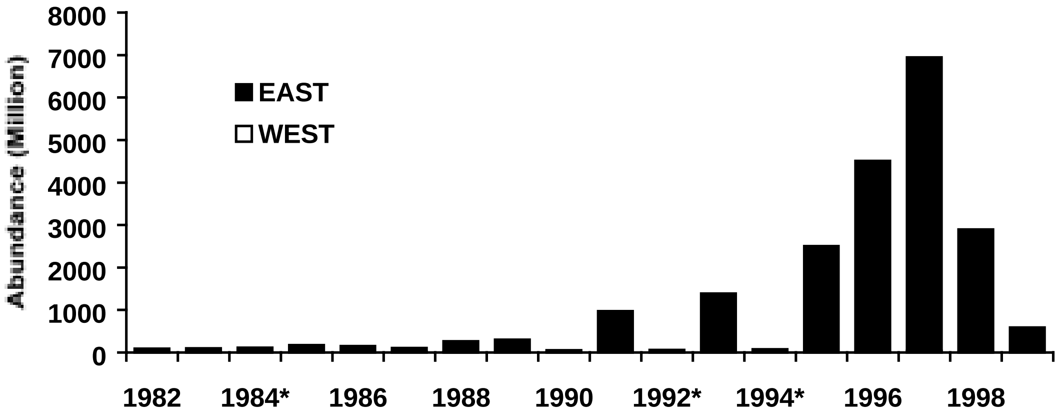


Figure 9.2.2. Deep-sea *S. mentella* (>=17 cm) on the continental shelf. Survey abundance indices for East and West Greenland as derived from the German groundfish survey, 1982–99. *) incomplete survey coverage.

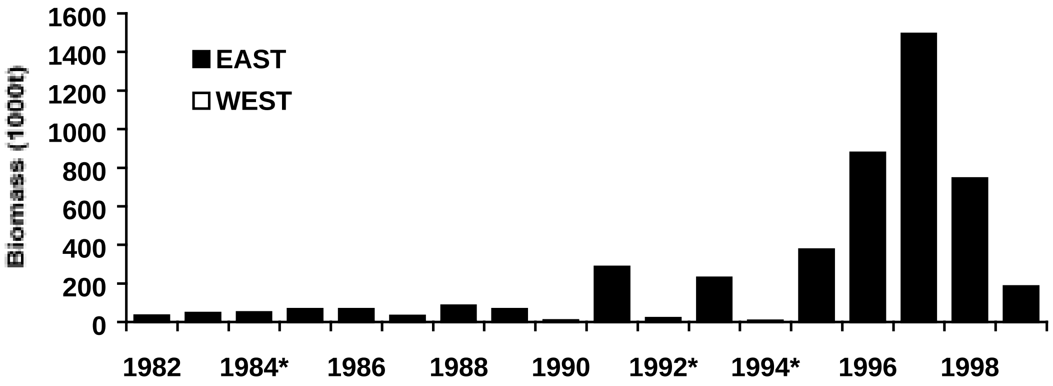


Figure 9.2.3. Deep-sea *S. mentella* (>=17 cm) on the continental shelf. Survey biomass indices for East and West Greenland as derived from the German groundfish survey, 1982–99. *) incomplete survey coverage.

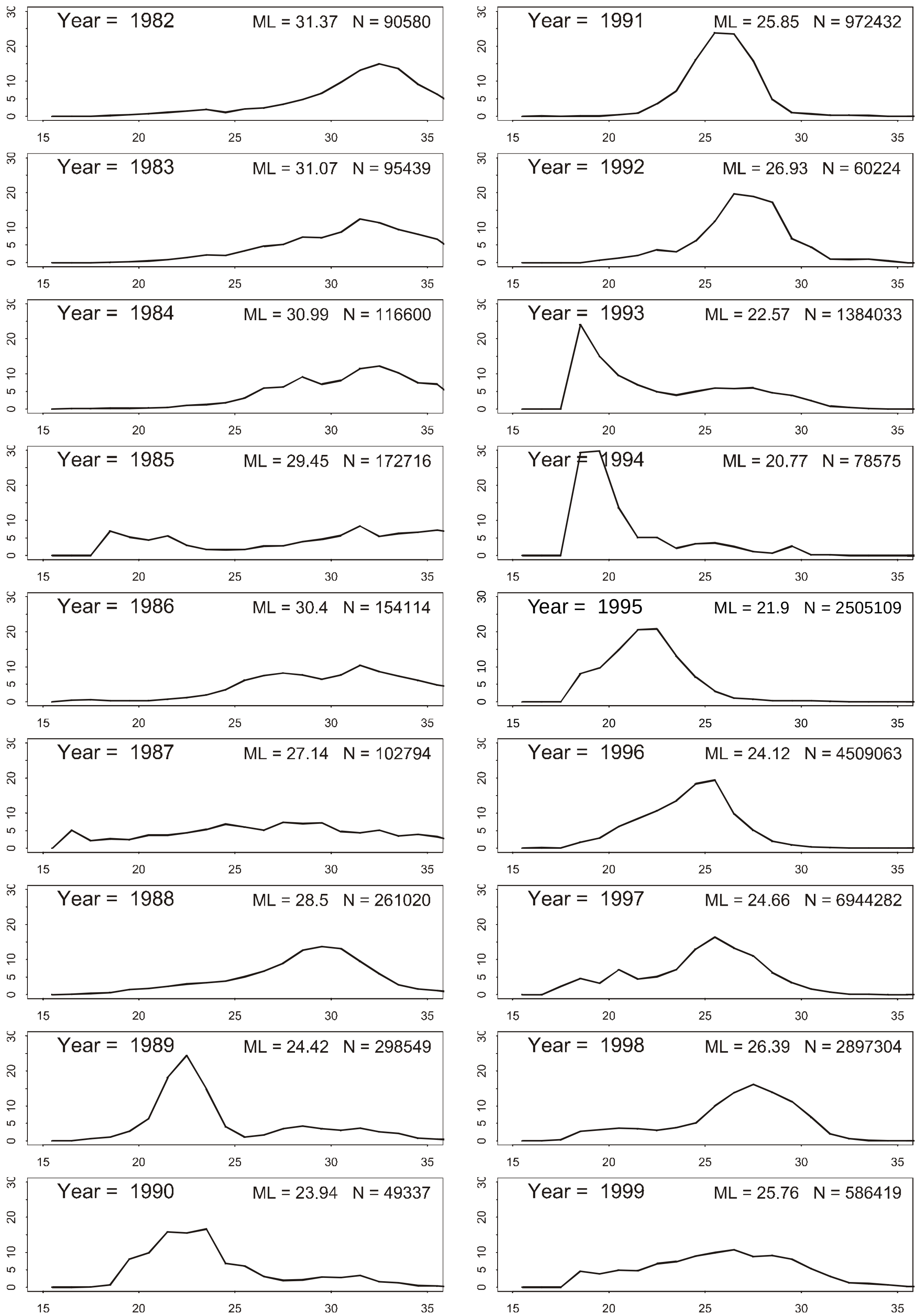


Figure 9.2.4. Deep-sea *S. mentella* (15-35 cm) on the continental shelf. Length composition off Greenland as derived from the German groundfish survey, 1982–1999.

9 PELAGIC SEBASTES MENTELLA

This section includes information on the pelagic fishery for *S. mentella* above and below 500 m in the Irminger Sea (Sub-area XII, parts of Division Va and Sub-area XIV).

Under chapter 7.3, comments are made on special requests in the ToR. Aside from what is said there, the WG refers to last years reports on the matter of stock/delineation in the area.

9.1 Fishery

9.1.1 Historical development of the fishery

Russian trawlers started fishing pelagic S. *mentella* in 1982. Vessels from Bulgaria, the former GDR and Poland joined those from Russia in 1984. Total catches increased from 60 600 t in 1982 to 105 000 t. in 1986. Since 1987, the total landings decreased to a minimum in 1991 of 25 000 t. The main reason for this decrease was a reduction in fishing effort, especially by the Russian fleet. Since 1989, the number of countries, participating in the pelagic S. *mentella* fishery gradually increased. As a consequence, total catches have also increased and reached the historically highest level in 1996 at 180 000 t (Tables 10.1.1–10.1.2). In 1998 and 1999, the WG estimate of the catch has been between 110 000 and 120 000 t, respectively.

In the period 1982–1992, the fishery was carried out mainly from April to August. In 1993–1994, the fishing season was prolonged considerably, and in 1995 the fishery was conducted from March to December. In 1997 and 1998, the main fishing season occurred during the second quarter. Few trawlers conducted their fishery during the whole year. The fleets participating in this fishery have continued to develop their fishing technology, and most trawlers now use large pelagic trawls ("Gloria"-type) with vertical openings of 80–150 m. The vessels have operated in 1998 and 1999 at a depth range of 200 to 950 m, but mainly deeper than 600 m.

The following text table summarises the available information from fishing fleets in the Irminger Sea in 1999:

Russia	20 factory trawlers of five types , ranged from 2500 to 4500 hp
Iceland	25 factory trawlers and 1 freshfish trawlers
Norway	2 factory trawlers
Greenland	1 factory trawler
Spain	6 factory trawlers
Germany	9 factory trawlers
Faroes	1 factory trawler and 6 freshfish trawlers

A summary of the catches by depth by nation as estimated by the Working Group is given in Table 10.1.3.

9.1.2 Description on the fishery of various fleets

9.1.2.1 Faroes

The Faroese fishery for pelagic redfish in the Irminger Sea and adjacent waters started in 1986. In the first years, only 1-2 trawlers participated in the fishery. Fishing depths were mainly above 500 m although some trials were made down to about 700 m. From 1992 onwards, several trawlers have made trips to this area fishing almost exclusively below 5-600 m. Logbook information from 1998 and 1999 was available to the WG.

In 1998, 7 trawlers have reported fishery in the area from 10 April to 17 July and again 10-25 October (1 trawler); all hauls were deeper than 600 m. In addition, 2 trawlers fished within the Greenlandic EEZ from 7 August to 9 October; fishing depths were shallower than 600 m.

In 1999, the Faroese fishery in the international parts of the Irminger Sea started on 18 April and continued until 19 August. 5 trawlers participated in the fishery and all hauls were deeper than 600 m. From 9 July to 10 September, two of the trawlers fished within the Greenlandic EEZ; all hauls were shallower than 600 m.

9.1.2.2 Germany

Compared with 1995, the effort increased significantly from 14,000 hours to 18 500 and 18 600 hours in 1996 and 1997, respectively. In 1998, the total effort decreased again by 15 % to 15 800 hours but increased in 1999 by 12% to 17 700 hours. As usual, the majority of the 1999 effort was applied during the second and third quarters. Annual catches increased from 18 900 tons by 13 % to 21 300 t in 1996 and decreased slightly by 4 % to 20 400 tons in 1997. A continued decrease by 12% to 18 000 tons in 1998 and by 9 % to 16 500 tons in 1999 was reported. During 1995-1998, the overall (unstandardised) CPUE decreased from 2 055 kg/h by 37 % to 1,301 kg/h and further by 26 % to 970 kg/h in 1999. The quarterly breakdown revealed that the catch rates in ICES Division XIV in the second quarter remained fairly stable while the reductions mainly occurred in the third and fourth quarter in ICES Division XII both inside the Greenland EEZ and the international water. Given the technical, temporal, geographical and depth changes of the fishing activities, the relevance of the estimated reduction in CPUE as indicator of stock abundance remained difficult to assess.

Since 1995, the fishery displayed a significant seasonal pattern in terms of geographical distribution and fishing depth. During the first and second quarters, the fleets operated mainly in the international zone of ICES Division XIV and the mean depth of the catches exceeded regularly 500 m. During summer and fall, the fishery targeted the depth layer at 200-350 m in ICES Division XII both within the Greenland EEZ and international waters. In the third and fourth quarter of 1999, a movement of the fleet to a limited area SE off Cape Farewell was apparent (WD 19).

In 1991-1998, the catches taken during the third and fourth quarters show almost identical single-modal fish size distributions with smaller and dominating males. In the second and third quarter in 1999, a clear recruitment signal was recorded for the first time with fish at around 28-30 cm in length occurring at all depths. The fish caught during the second quarters in 1996-1999 were bigger and displayed bimodal size frequency distribution due to either sexual dimorphism and or dominant year classes.

9.1.2.3 Greenland

Greenland was fishing in the same area as Iceland (see below).

9.1.2.4 Iceland

Catches in 1995-1999 were usually concentrated in the area between the Greenlandic EEZ and the Reykjanes Ridge, and since 1996 the catches have mostly been taken close to or inside the 200 mile boundary Southwest of Iceland. In recent years, the fishery has started in April close to the Icelandic 200 mile boundary and then moved in northward direction in May-July. In the springtime and until June, the largest proportion of the catches were taken at depths exceeding 500 m. In 1998, the fishery expanded further north in July, August and September. In 1999, similar happened except that the fishery did not continue close to the shelf of Iceland in July-September, as it did in 1998. Instead, the few vessel that had quota left at that time, moved to south-west, to the area SE of Cape Farewell (Division XII), where they fished above 500 m depth (WD 12). Icelandic trawlers fished mainly at a depth of 600-800 m during the period 1995-1998 (Figure 10.1.1).

9.1.2.5 Norway

Norway has not contributed substantially to this fishery in latest years. Information on the fishery in 1998 and 1999, however, indicates a depth shift in the fishery, from fishing 95% of its catch above 500 m in 1998 to fishing entirely in the layer below 500 m in 1999 (WD 4). The catches in 1999 were taken in areas XII and XIV from April to August, with a share of about 2:3.

9.1.2.6 Russia

In 1999, the Russian fleet conducted the pelagic fishery for the Irminger Sea redfish in April-November (WD 25). Up to 20 trawlers participated in the fishery. 60 % of the annual catch and 51 % of annual effort were registered in May-June. The fishery started in April in traditional fishing areas near the border of the Icelandic EEZ. The fleet moved southward during the third quarter. The fleet distribution in June-August was wider than usual, with a maximum number of 9 fishing areas in July. The CPUE for most types of the trawlers was similar to that reached in previous years.

9.1.2.7 Spain

Spain has participated in the fishery since 1995. There is limited information available for the Working Group on the fishery, except for 1998 and 1999.

In 1998, a total of 6 Spanish vessels have been fishing pelagic redfish in the Irminger Sea area, in Divisions XII and XIVb (WD 21 of the 1999 NWWG) from March to October. In the second quarter, this fleet was fishing >500 m, while the fishing depth in the third quarter was varied between 300-900 m.

In 1999, a total of 6 Spanish vessels have been fishing pelagic redfish in the Irminger Sea area, in Divisions XII and XIVb (WD 6). The fishing activity was monitored by a scientific observer who visited successively two of those vessels from April to the end of June. During this period, all the hauls surveyed were made in Division XIVb and in depths >500 m. The fishery of the Spanish fleet continued until September and there are reasons to believe that the fishing area in the third quarter was similar to what was observed by e.g. Germany. The fishing depth in the third quarter, however, was <500.

9.1.2.8 Other nations

No information on the fishing areas, seasons and depths of the fleets of other nations was available for the Working Group.

9.1.3 Discards

Prior to 1996, Icelandic landings of oceanic redfish have been raised by 16% due to discards of redfish infected with *Sphyrion lumpi*. This value of was based on measurements from 1991−1993 when the fishery was mostly on depths above 600 m. During the 1997 fishing season measuring was made on discard from different depths and on 10 different vessels in the period from May to July, showing discard rate of 10% which was then added to the landings in 1996 and 1997. A new measurement from 1998 shows that the discard rate has decreased to 2%. This new value was used for raising the Icelandic catches in 1998 and 1999.

Norwegian fishermen currently report approximately 3% discards of redfish infected with the parasite. This percentage has in recent years become less due to a change in the production from Japanese cut to mainly fillets at present.

No information on possible discards was available from other countries participating in this fishery.

9.1.4 Trends in landings and fisheries

A Working Group estimate of catches in 1999 is estimated to be about 109 000 tonnes, which is at similar level as it has been since 1997. In 1995 and 1996, the catches amounted 176 000 and 180 000, respectively, representing the highest catches on record (Table 10.1.1-10.1.2). The actual catches in 1999 might increase due to the lack of reporting from some countries participating in the fishery.

At the beginning of the fishery in 1982, catches of pelagic redfish were reported from both Sub-areas XII and XIV. But most of the catches were taken in Sub-area XII (40 000-60 000 t) until 1985, then the greater part of the catches were reported from Sub-area XIV. The landings from Sub-area XII were again in the majority in 1994 and in 1995 with 94 000 t and 129 000 t landed respectively. In 1996−1999, the main part of the total catch was taken from Sub-area Va and Division XIV (Table 10.1.1).

Pelagic *S. mentella* fishery in Division Va started in 1992. The catch varied from 2 000-14 000 from 1992-1995. Since 1995, the catches in Va have increased to 41 000 and 37 000 t in 1998 and 1999, respectively (Table 10.1.1).

Length distributions of pelagic *S. mentella* from German, Icelandic, Russian and Spanish commercial catches were reported for 1999 and are given in Figure 10.1.2.

The 1999 biological sampling from catches and landings of pelagic *S.mentella* in each Division and by gear type is shown in the text table below.

Country	Area	Gear	Landings (t)	No. of samples	No. of fish measured
Germany	XII	Pelagic	8205	12	8676
Germany	XIV	Pelagic	8128	27	10850
Iceland	XII	Pelagic	3162	9	594
Iceland	XIV and Va	Pelagic	40751	85	5851
Russia	XII and XIV	Pelagic	17577	?	12599
Spain	XIV	Pelagic	10332	69	15253

9.1.5 Age readings

Several nations have increased their effort to age pelagic redfish, using different ageing methods and thus making a comparison of age readings difficult.

From the catches in 1999 and also from the acoustic survey in 1999, it is clear that a new cohort is entering into the fishable stock of pelagic redfish. This cohort (probably not more than 1-2 year-classes) could therefore be used as a basis for investigating different methods for age readings. As more nations have now started to investigate the problems of age readings, a workshop similar to that held in 1995 (ICES 1996) is needed for comparison.

9.2 Assessment

9.2.1 Acoustic assessment

Trawl-acoustic surveys have for many years been carried out in the Irminger Sea and adjacent waters. Because of the limited depth range coverage (down to 500 meters) the surveys have mainly covered the oceanic *S.mentella*, and should therefore only be used as an index for this component.

An international acoustic survey of pelagic was carried out in the Irminger Sea and adjacent waters in June/July 1999 with participation of Iceland, Germany and Russia. The acoustically estimated biomass of the oceanic *S. mentella* in upper 500 m of the water column was 0.6 mill. t, compared with 2.2 and 1.6 mill t in 1994 and 1996, as estimated from the catches, respectively (Table 10.2.1) The observed decrease in survey abundance is very drastic and exceeds the removed biomass by a factor of 2. The area covered in the 1999 survey was the most extensive in the time series, but covered only a portion of the current horizontal distribution of the oceanic stock. Therefore, the estimate of 0.6 mill t is considered an underestimate.

The summer 1999 survey provided for the first time an estimate on the abundance of the pelagic deep sea *S. mentella* (>500 m depth) on the order of 0.5 million tonnes (Table 10.2.2). Hydrographic observations indicated that the highest concentrations of redfish below 500 were associated with eddies and fronts.

The stock above 500 m was observed more south-westerly and deeper than it has been during former acoustic surveys in this decade. During the same period, a gradual increase in temperature in the observation area has been observed (WD 22, Fig. 10.2.4). This may have influenced the distribution pattern of the redfish in June-July 1999 as the highest concentrations were found in the colder, i.e. southwestern part of the survey area.

Length distributions indicate recruitment both above and below 500 m depth. The length of these pre-recruits were similar to the length of the abundant juveniles growing up at the shelf of East Greenland.

The following text table gives the results of acoustic estimates during the period 1991-1999.

Year	*Acoustic estimate down to 500 m (thousand tonnes)*	*Area surveyed, thousand sq. nautical miles*
1991	2235	105
1992	2165	190
1993	2556	120
1994	2190	190
1995	2481	167
1996	1600	256
1997	1240	159
1999	614	296

9.2.2 CPUE

In Table 10.2.3, the CPUE series for Bulgarian, German, Icelandic, Norwegian, Russian, and Spanish fleets are given. Table 10.2.4 gives catches, effort and CPUE by depth for the Icelandic fleet during the period 1989–1999. As can be seen from the table, more than 90 % of the Icelandic catches were taken below 500 m in last years. In Figure 10.2.2, the development of CPUE in three depth intervals is illustrated graphically. The figure shows that after a constant decrease in the CPUE from 1994-1997, there was a slight increase in CPUE at depths below 500 m in the last year, but there has been a more or less continuous reduction in the layer above 500 m since 1996. Figure 10.2.3 shows the overall CPUE from different fleets in recent years.

The German data on CPUE in second quarter (mainly fishing from the lower layer in area XIVb) also show a slight increase in the last year, compared with 1998 (Figure 10.2.5). In the third and forth quarter of the year, the fishery in last years has mostly been from depths not exceeding 500 m in area XII. In that layer, the results show continuos decreasing trend during the recent years.

9.2.3 Ichthyoplankton assessment

The traditional ichthyoplanktonic survey, conducted by Russia in 1982-1995 has not been carried out in 1995. The historical series of ichthyoplanktonic surveys was presented in last year's Working Report.

9.2.4 State of the stock

The 1999 survey indicated a continued reduction in the stock abundance and biomass above 500 m. The estimated biomass of 600 000 t is interpreted as being biased downward due to significant changes in horizontal and vertical stock distribution patterns. A similar negative trend can be derived from the CPUE series reported from some of the major fishing fleets fishing above 500 m. Given the technical, seasonal, geographical and depth changes of the fishing activities, the relevance of the estimated reduction in CPUE as indicator of stock abundance remains difficult to assess both above and below 500 m. The CPUE data do, however, indicate a more stable stock situation below 500 m. A biomass index of around 500 000 t was estimated below 500 m, based on the 1999 survey results.

Although there is considerable uncertainty related with the used stocks' indicators, the stock is indicated to be at or below the level of 50% of the virgin biomass of around 3 million tonnes (= MBAL). Based on the survey biomass estimates, the recent catches although being significantly reduced from a high level in 1994-1996 might be above the 5 % exploitation rate being previously considered as sustainable.

For the first time, a considerably high recruitment was observed in the length distribution data from the international hydroacoustic survey in the Irminger Sea in June/July 1999 in the layers above and below 500 m. This recruitment is likely to originate from the East Greenland shelf, since the high numbers of young redfish observed during 1995-1997 disappeared from the East Greenland shelf in the past 2 years.

9.3 Management considerations

Considering the uncertainty related to definition of stock units, action must be taken in accordance with the precautionary approach and attempts be made to assess each stock component separately until better knowledge on the relationship between each stock or stock components are known. Such assessment must be based on what information is currently available. Furthermore, there exists considerable concern about the precision of the used stocks indicators.

Based on the continuous downward trends in survey indices and CPUE, a further reduction of the present catch level is advised.

9.4 Precautionary approach

Based on the status of the knowledge of the stock(s) in the area, the Working Group could not come up with any new information on reference points in addition to last year's report.

Table 10.1.1 Pelagic *S. mentella*. Landings (in tonnes) by area as used by the Working Group. Due to the lack of area reportings for some countries, the exact share in Divisions XII and XIV is just approximate in latest years.

Year	Va	Vb	VI	XII	XIV	Total
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	39,783	20,798	60,581
1983	0	0	0	60,079	155	60,234
1984	0	0	0	60,643	4,189	64,832
1985	0	0	0	17,300	54,371	71,671
1986	0	0	0	24,131	80,976	105,107
1987	0	0	0	2,948	88,221	91,169
1988	0	0	0	9,772	81,647	91,419
1989	0	0	0	17,233	21,551	38,784
1990	0	0	0	7,039	24,477	31,516
1991	0	0	0	10,061	17,089	27,150
1992	1,968	0	0	23,249	40,745	65,962
1993	2,603	0	0	72,529	40,703	115,835
1994	15,472	0	0	94,189	39,028	148,689
1995	1,543	0	0	132,039	42,260	175,842
1996	4,610	0	0	42,553	132,975	180,138
1997	15,301	0	0	19,822	87,812	122,935
1998	40,612	0	0	22,446	53,910	116,968
1999 [1]	36,524	0	0	24,294	48,294	109,113

1) Provisional data

Table 10.1.2 Pelagic *S. mentella* catches (in tonnes) by countries used by the Working Group.

Year	Bulgaria	Canada	Estonia	Faroes	France	Germany [3]	Greenland	Iceland	Japan	Latvia	Lithuania	Netherland	Norway	Poland	Portugal	Russia [2]	Spain	UK	Ukraine	Total
1978																				
1979																				
1980																				
1981																				
1982														581		60,000				60,581
1983						155										60,079				60,234
1984	2,961					989								239		60,643				64,832
1985	5,825					5,438								135		60,273				71,671
1986	11,385			5		8,574								149		84,994				105,107
1987	12,270			382		7,023								25		71,469				91,169
1988	8,455			1,090		16,848										65,026				91,419
1989	4,546			226		6,797	567	3,816						112		22,720				38,784
1990	2,690					7,957		4,537					7,085			9,247				31,516
1991			2,195	115		571		8,783					6,197			9,289				27,150
1992	628		1,810	3,765	2	6,447	9	15,478		780	6,656		14,654			15,733				65,962
1993	3,216		6,365	7,121		17,813	710	22,908		6,803	7,899		14,990			25,229			2,782	115,835
1994	3,600		17,875	2,896	606	17,152		53,332		13,205	7,404		7,357		1,887	17,814			5,561	148,689
1995	3,800	602	16,854	5,239	226	18,985	1,856	34,631	1,237	5,003	22,893	13	7,457		5,125	44,182	4,555		3,185	175,843
1996	3,500	650	7,092	6,271		21,245	3,537	62,903	415	1,084	10,649		6,658		2,379	45,748	7,229	260	518	180,138
1997		111	3,720	3,945		20,476		41,276	31				3,179	886	3,674	36,930	8,707			122,935
1998			3,968	7,474		18,047	1,463	48,519	31		1,768		1,139	12	4,133	25,837	4,577			116,968
1999 [1]			2,108	4,656		16,335	4,269	43,923					5,417	6	4,302	17,577	10,332	188		109,113

1) Provisional data.
2) Former USSR until 1991.
3) Former GDR and GFR.

Table 10.1.3 Pelagic *S. mentella* landings (in tonnes) in 1999 by countries and depth (A), and in 1996-1999 by depth (B). (Working Group figures and/or as reported to NEAFC).

A.	Total	not splitted	shallower than 600 m	deeper than 600 m
Estonia	2,108	100 %		
Faroes	4,656			100 %
Germany	16,335		50 %	50 %
Iceland	43,923		10 %	90 %
Norway	5,417		9 %	91 %
Portugal	4,302	100 %		
Russia	17,577	100 %		
Greenland	4,269		10 %	90 %
Spain	10,332		18 %	82 %
Total	108,919	23,987	15,334	69,598

Derived from effort data

B.	Total	not splitted	shallower than 600 m	deeper than 600 m
1996	180 138	43 %	14 %	43 %
1997	122	37 %	20 %	43 %
1998	119	14 %	20 %	66 %
1999	109	22 %	14 %	64 %

Table 10.1.4. Results of dividing the Icelandic pelagic redfish catch according to the Icelandic samples from the fishery.

Year	Total catch	Catch oceanic	Catch deep sea	Not classified	% oceanic
1995	34631	24976	9521	134	72%
1996	62903	28361	32737	1805	46%
1997	41272	15001	26271	0	36%
1998	48519	4932	40824	446	11%
1999	43923	10102	33821	0	23%

Table 10.2.1

Biomass, abundance and area coverage for pelagic redfish *Sebastes mentella* at depth down to 500 m. Results from international acoustic surveys conducted in 1994, 1996 and 1999. Sub area are shown on Figure 10.2.1.

		Sub area					
Year		A	B	C	D	E	Total
1994	Total numbers (millions)	1109	1964	-	95	328	3496
	Biomass ('000 t)	673	1228	-	63	226	2190
	Total area (nm^2)	75307	88132	-	7342	18348	189129
1996	Total numbers (millions)	1055	1217	-	57	265	2594
	Biomass ('000 t)	639	749	-	33	155	1576
	Total area (nm^2)	89198	112086	-	11409	38852	252546
1999	Total numbers (millions)	123	609	27	71	336	1165
	Biomass ('000 t)	72	317	16	42	167	614
	Total area (nm^2)	106688	138865	6291	6291	37988	296122

Table 10.2.2 Biomass, abundance and area coverage for pelagic redfish *Sebastes mentella* at depth between 500 and 950 m. Results from international acoustic surveys in 1999. Sub areas are shown on Figure 10.2.1

	Sub area						
	A	B	C	D	E	Total	Units
Total numbers	217	314	11	25	72	638	Thous.
Area covered	11524	124014	8403	4201	27435	274577	Nm^2
Mean weight	864	795	945	554	505		g
Total weight	187	249	10	14	36	497	Thous. tonnes

Table 10.2.3 Pelagic *S. mentella*. Catch per unit effort (t/h) by country in Sub-areas XII and XIV.

Year	Bulgaria	Germany[2]	Iceland	Norway	USSR-Russia (BMRT)	Spain
1982	-	-	-	-	1.99	-
1983	-	-	-	-	1.60	-
1984	1.25	-	-	-	1.48	-
1985	1.85	-	-	-	1.68	-
1986	2.04	-	-	-	1.35	-
1987	1.22	0.79	-	-	1.10	-
1988	0.82	1.28	-	-	1.00	-
1989	-	0.70	1.11	-	1.00	-
1990	-	0.89	1.02	1.09	0.99	-
1991	-	-	1.52	1.42	0.80	-
1992	-	-	1.66	1.79	0.63	-
1993	-	-	3.27	2.02	0.63	-
1994	-	-	2.64	2.83	1.70	-
1995	-	2.06	2.00	2.05	1.00	-
1996	-	1.45	1.74	1.20	1.30	-
1997	-	1.31	1.11	0.66	-	0.83
1998	-	1.30	1.56	0.75	-	0.87
1999[1]	-	0.97	1.55	0.96		1.37[3]

1 Preliminary
2 1987-1990 reported as GDR (FVSIV)
3 CPUE data for April-July only (CPUE for August-September is unknown but usually lower than in quarter 2)

Table 10.2.4 Catch, trawling time and CPUE of pelagic redfish by depth intervals since 1989 as reported in log-books from the Icelandic fleet.

Data	Depth range	89	90	91	92	93	94	95	96	97	98	99
Sum of Catch	100-199	226	839	2035	908		12		1	121		12
	200-299	279	415	1336	2115		611	2874	2165	453	130	1921
	300-399	174	315	1408	3021	2402	863	1572	75	1693	886	2776
	400-499		7	951	385	1950	1298	1141	537	792	278	282
	500-599			24	915	3515	9463	2960	3674	2390	2092	1187
	600-699				757	2539	12149	10402	12203	12548	11792	9935
	700-799				113	33	1210	4083	19093	10246	16785	20922
	800-899						252	50	1370	466	252	1073
	900+			6				88	326		76	421
Sum of Hours	100-199	300	844	1564	847		9		16	96		22
	200-299	152	367	1009	1447		325	2019	949	303	122	2459
	300-399	161	318	738	1221	428	269	656	78	1111	501	2642
	400-499		13	420	228	483	424	439	475	929	321	300
	500-599			49	776	1329	3233	1471	2910	2453	1736	1118
	600-699				405	937	4866	4840	8095	10948	8663	7200
	700-799				36	15	586	2080	9196	9506	9151	10828
	800-899						73	25	577	500	182	503
	900+			46				46	318		130	216
CPUE (t/h)	100-199	0.75	0.99	1.30	1.07		1.31		0.08	1.26		0.57
	200-299	1.83	1.13	1.32	1.46		1.88	1.42	2.28	1.49	1.07	0.78
	300-399	1.08	0.99	1.91	2.47	5.61	3.21	2.40	0.96	1.52	1.77	1.05
	400-499		0.53	2.27	1.69	4.04	3.06	2.60	1.13	0.85	0.87	0.94
	500-599			0.48	1.18	2.64	2.93	2.01	1.26	0.97	1.20	1.06
	600-699				1.87	2.71	2.50	2.15	1.51	1.15	1.36	1.38
	700-799				3.14	2.28	2.07	1.96	2.08	1.08	1.83	1.93
	800-899						3.44	2.00	2.37	0.93	1.39	2.13
	900+			0.12				1.93	1.02		0.59	1.95

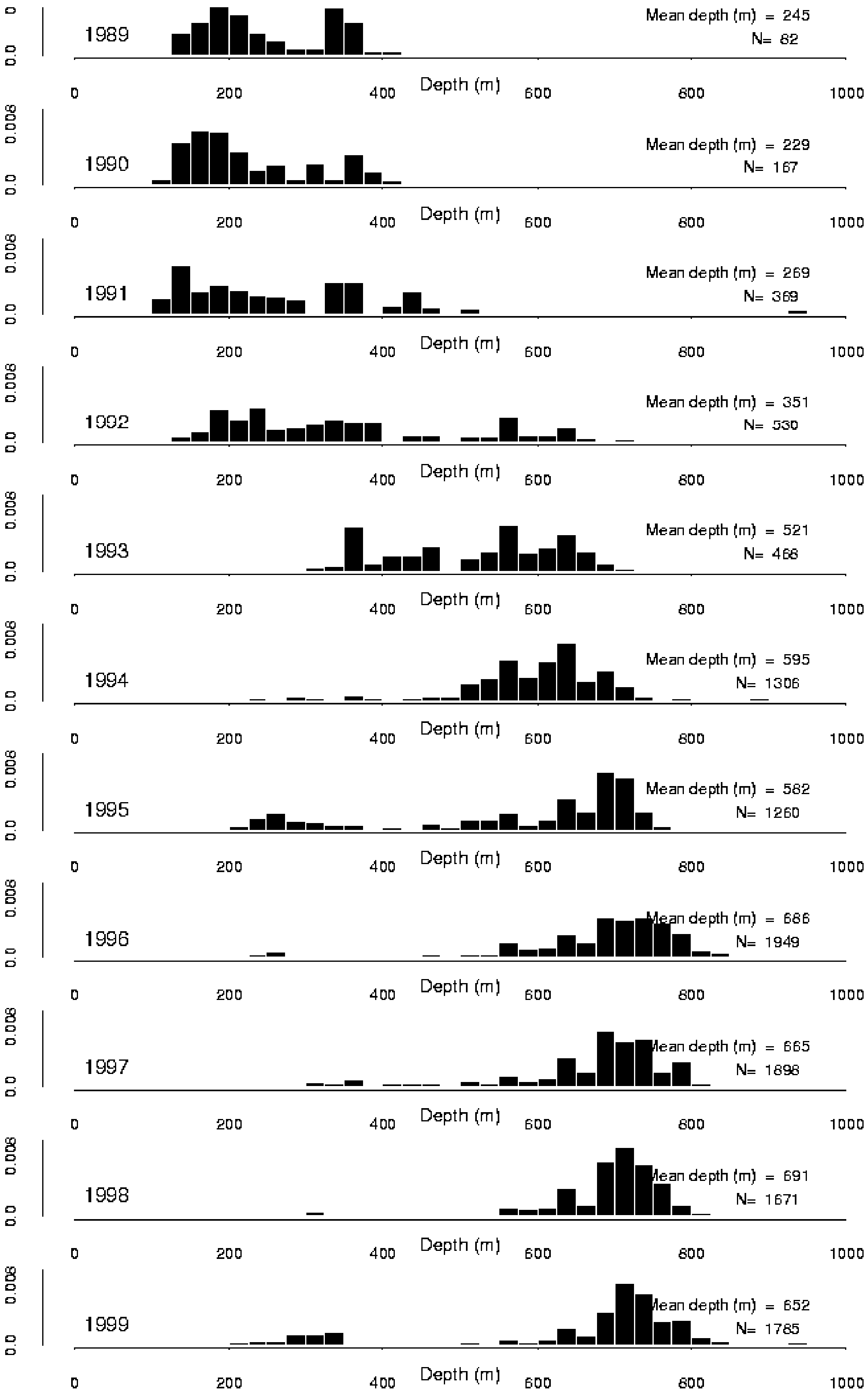


Figure 10.1.1. Depth distribution of Icelandic trawl hauls for pelagic redfish as reported in the log-books since Iceland began its pelagic redfish fishery in 1989.

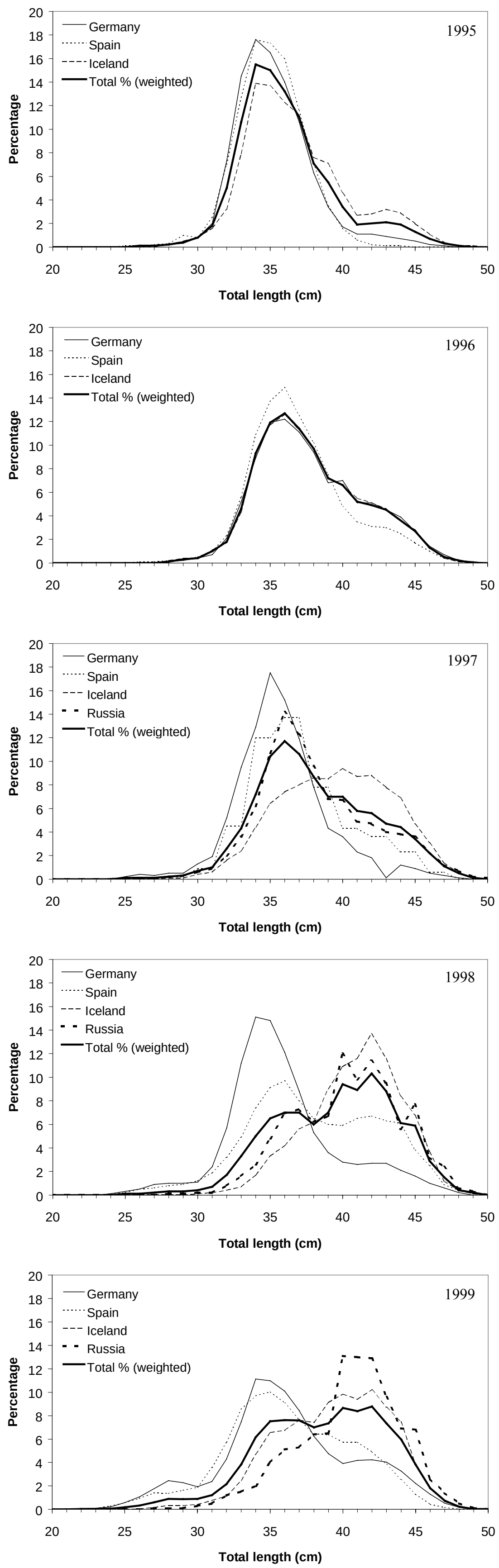


Figure 10.1.2. Length distributions from landings of pelagic *S. mentella* in 1995-1999.

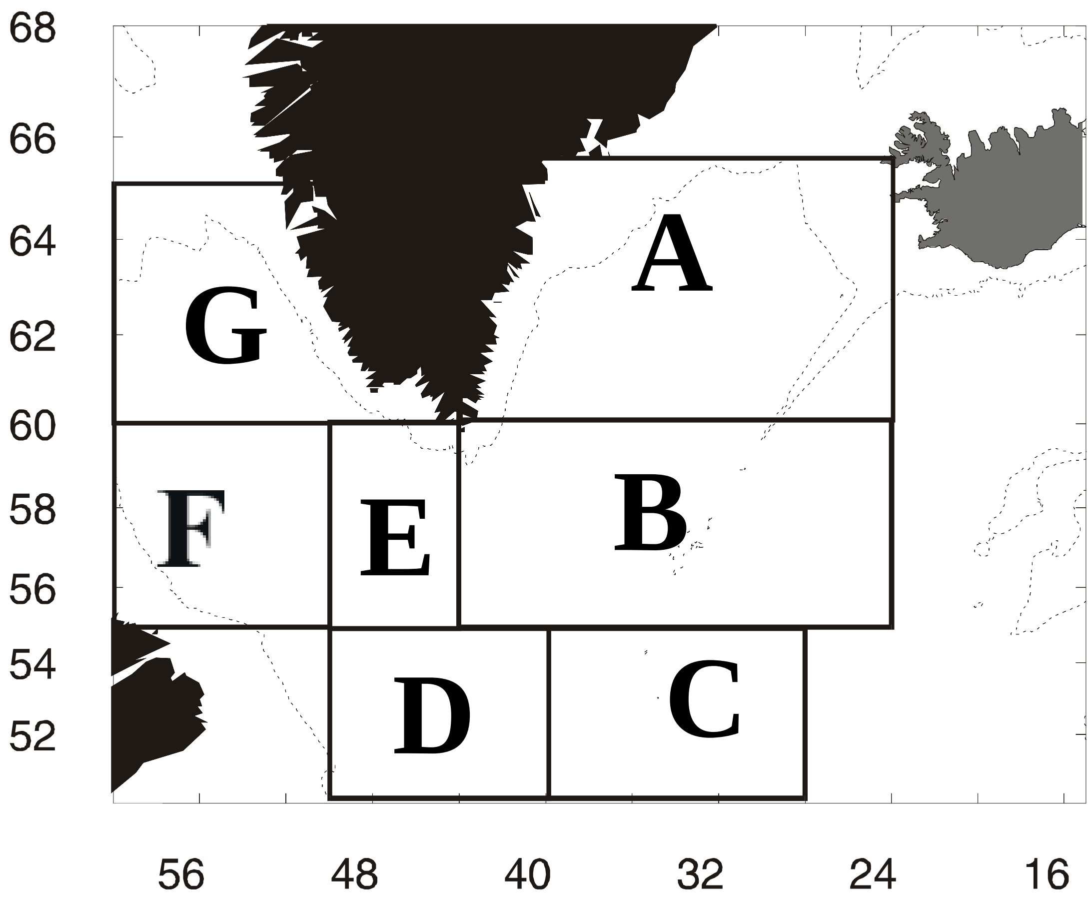


Figure 10.2.1. Sub-areas used on international surveys for redfish in the Irminger Sea and adjacent waters.

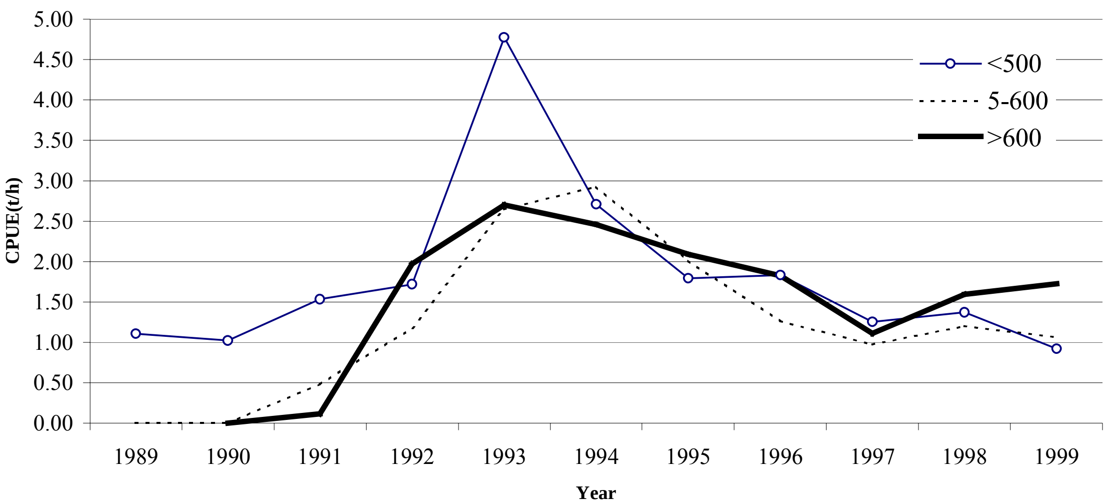


Figure 10.2.2. Catch per unit effort in the pelagic redfish fishery for the Icelandic fleet for different depth intervals.

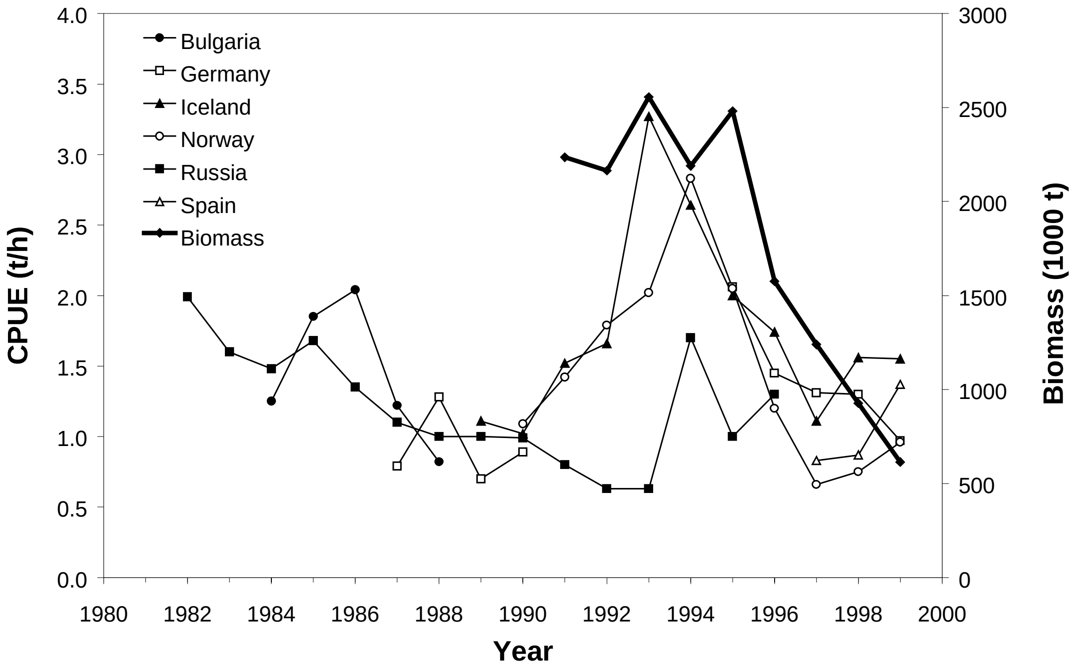


Figure 10.2.3. Trends in CPUE of pelagic *S. mentella* in the Irminger Sea and estimated acoustic biomass.

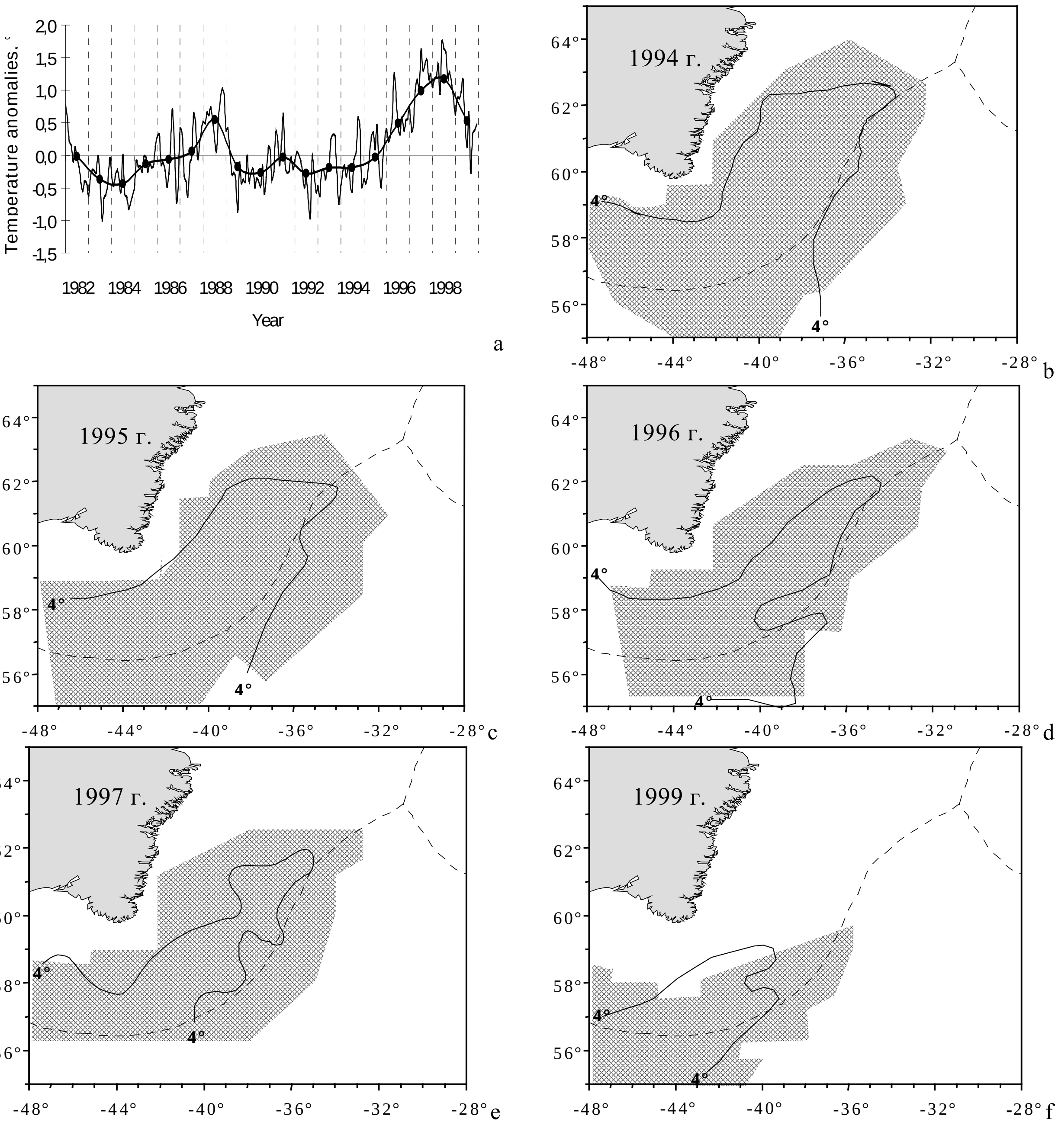


Fig. 10.2.4. Monthly and annual (marked) anomalies SST on the feeding ground (a). Locations of mean values of area back scattering strength of redfish more than 10 m^2/nm^2 at depths above 500 m and 4°C isotherm on 200 m in the Irminger Sea in June/July 1994-1999 (b-f).

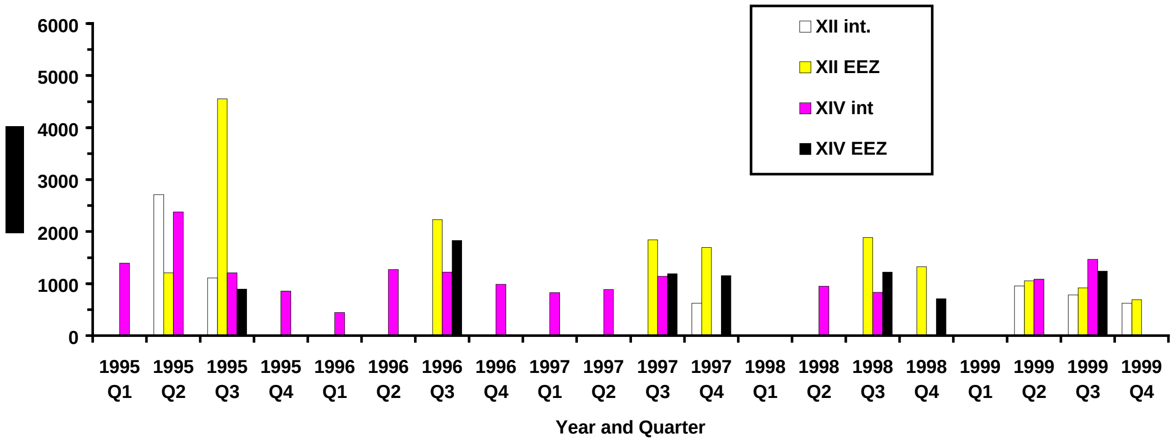


Figure 10.2.5. Unstandardized mean CPUE (kg/h) of the German fleet for oceanic *S. mentella* by year, quarter and area (international waters and Greenlandic EEZ in ICES Div. XII and XIV).

10 WORKING DOCUMENTS AND REFERENCES

28 working documents were presented to the Working Group during the meeting as listed below.

1. Jesper Boje, The fishery for Greenland halibut in ICES Div. XIVb in 1999.
2. Ole A.Jørgensen, Survey for Greenland halibut in ICES Div. 14B, June-July 1999
3. Petur Steingrund, Preliminary assessment of Faroe Plateau cod.
4. Åge Høines and Kjell H. Nedreaas, Information about the Norwegian fishery for pelagic *Sebastes mentella* in the Irminger Sea, *S.marinus* and Greenland halibut in ICES Sub-areas XII and XIV in 1998 (revised) and 1999 (provisional).
5. Christoph Stransky, Migration of juvenile deep-sea redfish (*Sebastes mentella* Travin) from the East Greenland shelf into the central Irminger Sea.
6. Fernando Gonzalez, Report of the fishing activity sand sample catch of the spanish fleet in ICES Div. XII and XIVb in 1999.
7. Hans-Joachim Rätz, Data on German catches and effort for Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes marinus* and deep sea *S. mentella*), and Atlantic cod (*Gadus morhua*) in ICES Div. Va, Vb, Via and XIV, 1995-99.
8. Christoph Stransky & Hans-Joachim Rätz, Groundfish results for *Sebastes marinus* L., deep-sea *S. mentella* and juvenile redfish (*Sebastes spp*.) off Greenland 1982-1999.
9. Hans-Joachim Rätz, Groundfish survey results for cod off Greenland (offshore component) 1982-99.
10. Thorsteinn Sigurdsson, Preliminary assessment on *Sebastes marinus* in ICES Sub-divisions V, VI and XIV with some additional figures and tables.
11. Thorsteinn Sigurdsson, Preliminary assessment on *Sebastes mentella* in ICES Sub-divisions V, VI and XIV with some additional figures and tables.
12. Thorsteinn Sigurdsson, Information on the Icelandic fishery of Oceanic redfish (*S.mentella* TRAVIN); information based on log-book data and sampling from the commercial fishery (ToR c,e,f).
13. Thorsteinn Sigurdsson and John Mortensen, Distribution pattern of pelagic redfish (S. mentella, Travin) in relation to thermohaline changes in the Irminger Sea and adjacent waters in 1990-99. Draft abstract.
14. Yu,I. Bakay, Parasites and pigmented patches as indicators of intraspecific structure of *Sebastes mentella* in the Irminger Sea.
15. Jákup Reinert, Faroe Haddock: Preliminary Assessment
16. Jákup Reinert,. Some information on redfish in ICES Division Vb.
17. Bjarni Mikkelsen, Preliminary assessment of Faroe Saithe 1999.
18. Kjell H. Nedreaas and Svend Lemvig, Age composition of pelagic *Sebastes mentella* in the Irminger Sea based on samples collected Norwegian commercial catches in 1999.
19. Hans-Joachim Rätz and Christoph Stransky, On the German fishery and biological characteristics of Oceanic Redfish (*Sebastes mentella* Travin) 1991-99.
20. Jens .Jakob Engelstoft, Inshore cod stock off West Greenland.
21. S.P.Melnikov and A.A.Vaskov, Vertical structure and a mechanism of formation of deepwater redfish in the Reykjanes ridge area.
22. A.P.Pedchenko, Specification of oceanographic conditions of the Irminger Sea and their influence on the distribution of feeding redfish in 1999.
23. Fran Saborido-Rey and Dolores Garabana, An overview of the population structure and ecology of redfish species in the Irminger Sea and adjacent waters.
24. Höskuldur Björnsson, A view on the Icelandic haddock.
25. V.N.Shibanov and V.I.Vinnichenko, Preliminary information about Russian fishery for the oceanic *S.mentella* in ICES Sub-areas XII and XIV in 1999 and biological sampling from the commercial catches.
26. Einar Hjörleifsson, Greenland halibut.
27. Sigfus A. Schopka, Cod at Iceland (Division Va).

28. Sigurdur Jonsson, Saithe in Icelandic waters/Division Va.

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