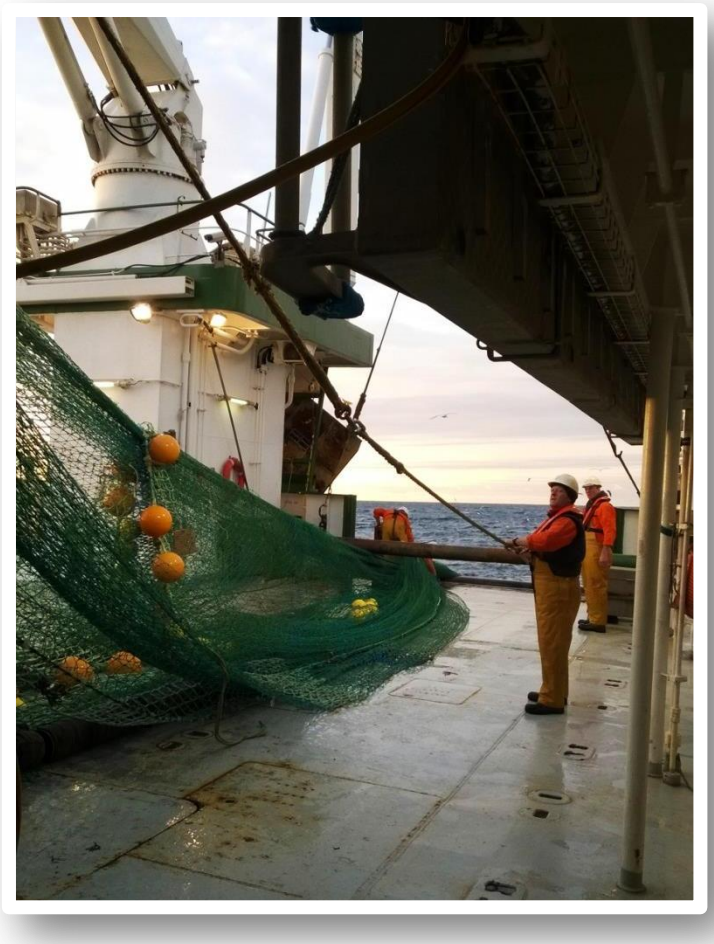
Fisheries Science Services
The Marine Institute
Galway

Co-ordinated by the International
Bottom Trawl Working Group, ICES
Copenhagen

FEAS Survey Series: 2014/01

Irish Groundfish Survey Cruise Report

December, 2014



Stokes, D., Gerritsen. H., O'Hea, B., Moore, S.J. & Dransfeld, L.

Primary objective: to generate fishery independent abundance indices for commercially exploited groundfish species in ICES divisions VIa, VIIb, VIIg & VIIj.

Summary/Abstract

The Irish Groundfish Survey forms part of the International Bottom Trawl Survey (IBTS) programme, an international survey effort coordinated by ICES (the International Council of the Exploration of the Sea). Over 42 days in the Autumn/Winter each year the survey collects demersal trawl and ancillary data in Irish waters to produce relative abundance indices for fisheries management. Results from 2014 are presented here and suggest a significant increase in numbers of juvenile haddock and whiting over the recent 5 year period in the northwest. In the Celtic Sea area horse mackerel numbers also show an increase. The other gadoid and pelagic species are within the normal inter-annual fluctuations.

Key Words

Groundfish Survey; Demersal otter trawl; CPUE; Relative indices; Fisheries resource management; GOV; IBTS

Suggested Citation

Stokes, D., Gerritsen. H., O'Hea, B., Moore, S.J. & Dransfeld, L., " Irish Groundfish Survey Cruise Report, Sept. 24th – Dec. 17th, 2014", Marine Institute 2014

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1. Introduction

The Marine Institute has conducted groundfish surveys to determine the distribution and abundance of commercial fish around Ireland since 1990. Historically, the surveys were carried out on commercial fishing vessels and later included small research ships. The Irish Groundfish Survey (IGFS) in its current form commenced in 2003 on the 65m research vessel, the *R.V. Celtic Explorer*.

The IGFS forms part of a co-ordinated International Bottom Trawl Survey programme (IBTS) under the umbrella of the International Council of the Exploration of the Sea (ICES). In Irish waters currently, France and Ireland cover the Celtic Sea area, Ireland covers the shelf West of Ireland, Ireland and the UK Scotland cover the north coast of Ireland and the UK Northern Ireland covers the Irish Sea (Fig 1).

Fisheries management often relies on commercial data to estimate the quantity of fish removed from a stock annually. In contrast, scientific surveys such as the IGFS provide data for juvenile fish not typically found in commercial data in order to predict what will be replenishing the stock in the coming year(s). In addition, areas outside of commercial hotspots are also monitored.

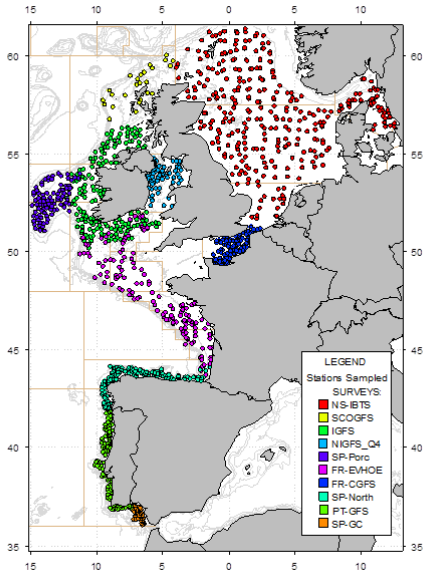


Fig 1. Map of the IGFS in the context of the other IBTS quarter 3&4 Surveys.

The IGFS contributes to Ireland's international obligation to supply scientific data that support the implementation of the Common Fisheries Policy (CFP). Data is collected under the Data Collection Framework (DCF), which is the main instrument used by the European Commission to collect scientific data for the CFP.

2. Survey objectives

Primary

The IGFS provides ICES assessment and science groups with consistent and standardised data for examining spatial and temporal changes in (a) the relative abundance and distribution of fish and fish assemblages; and (b) the biological parameters of commercial fish species, for stock assessment purposes.

The main objectives of the IGFS, as coordinated by the international bottom trawl surveys (IBTS), are:

a. To determine the relative abundance and distribution of pre-recruits for the main commercial species and provide recruitment indices;
b. To monitor changes in the stocks of commercial fish species independently of commercial fisheries data;
c. To monitor the distribution and relative abundance of all fish species and selected invertebrates;
d. To collect data for the determination of biological parameters for selected species.

Ancillary

To maximise the utility of work aboard a national marine research platform such as the *RV Explorer* however, a number of ancillary objectives are also undertaken:

a. To collect hydrographical information on the water column and the seafloor;
b. To collect information on the composition and quantities of litter items on the sea floor, as caught in the fish trawl;
c. To collect data on fish biology, invertebrates and or/the environment as specified by additional requests from international institutions and universities and as regarded practicable during the course of the survey.

3. Survey design

Station allocation

Much of the seabed is not flat or of soft sediment type (figure 2a) and thus not trawlable (see figure 2b). Within trawlable areas the availability of fish varies as does a trawl's ability to capture fish due to various technical, biological and environmental factors. Not every fish in the path of a trawl therefore will be captured and sampling design in IBTS surveys is underpinned by a strong emphasis on standardised sampling trawls and procedures. This helps ensure that changes in annual abundance seen in the catch data reflect a relative change in population abundance rather than a change in the trawl's ability to sample the population.

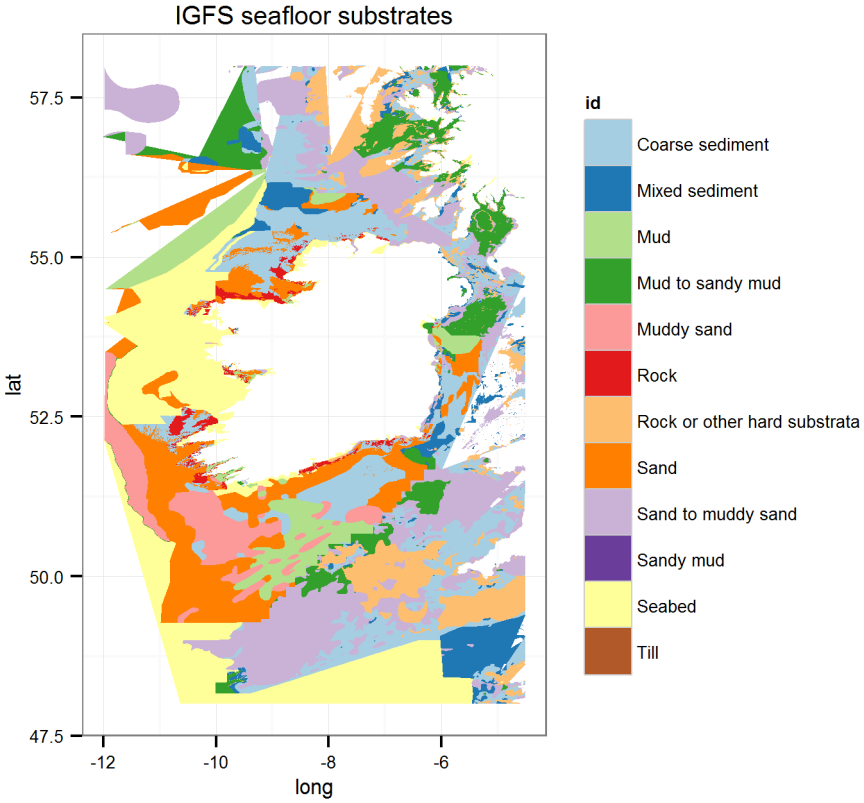


Fig. 2a Map of seafloor substrates around Ireland, based on collated seafloor habitat data as compiled by MESH Atlantic (see www.meshatlantic.eu)

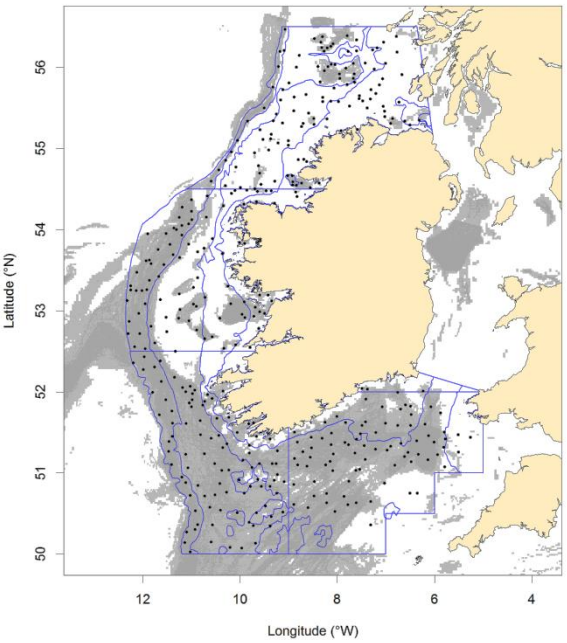


Fig. 2b Map of IGFS historic haul positions (black circles) in relation to commercial otter trawl activity (grey shaded area). Darker shading equates to higher commercial fishing intensity whilst little or no commercial activity can broadly be interpreted as challenging ground for demersal trawling.

The IGFS uses a semi-random depth stratified survey design. Potentially any trawlable ground within the survey area therefore should be sampled at some point and avoids artificially stable catch rates from persistent local hot/cold spots. In as far as is practicable, a minimum of 10 nautical miles is maintained between hauls to avoid repeat sampling of the same fish assemblage.

Stations are stratified according to ICES divisions (management units) as well as depth bands, culminating in 15 strata in total (Figure 3). Depth boundaries are 0-80m, 81-120m, 121-200m, 201-600m corresponding to Coastal, Medium, Deep and Slope respectively. Haul allocation per strata is proportional to the area. In total 170 stations are allocated annually at random from historical survey tow positions. The database of potential survey tows is also continually expanded whenever possible with new information from commercial and research fishing activity as well as multibeam data, all of which provides the important additional random element to the design.

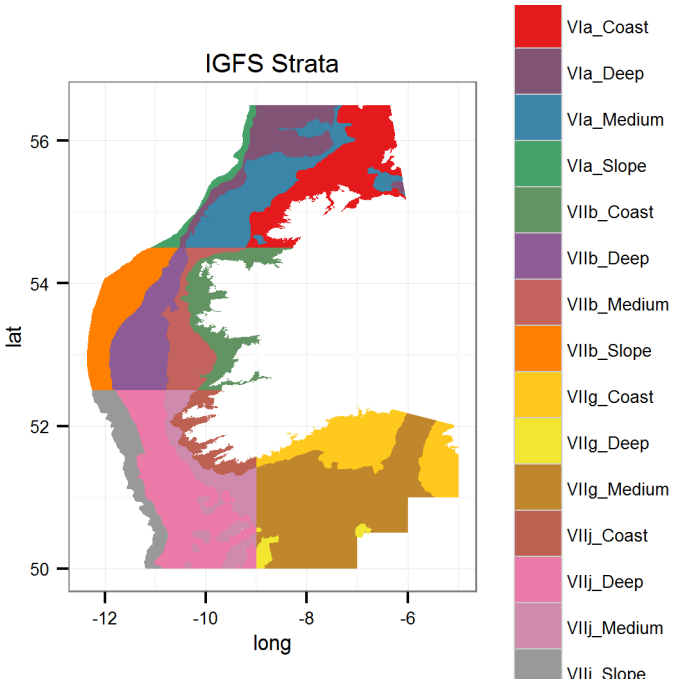


Fig. 3 Map of IGFS survey strata. Coastal strata = 0-80m; Medium strata = 81m-120m; Deep strata = 121m-200m; Slope strata = 201m-600m.

Sample allocation

Given that reproduction and recruitment of juveniles into the adult stock is seasonal in temperate waters, management of many commercially exploited fish stocks is based on numbers at age. Ageing fish is labour intensive relative to measuring lengths and therefore length frequency sampling carried out on survey is later allocated to age groups, where appropriate, based on smaller biological samples returned to the laboratory for ageing.

Up until 2007, targets for age samples were set on a length-stratified basis for each stratum. Generally this meant that no more than 5 individuals per 1cm size class per stratum would be sampled. However, this type of quota-sampling can introduce bias if the age structure within a stratum is not uniform. For example, it is possible that at a length of, say 20cm, 80% of fish are age 2 and 20% are age 3 on an inshore station, while on a station further offshore (within the same stratum) those proportions are 60% / 40%. With the old “quota-based" sampling, the samples are not equally spread out between hauls and this can be the source of bias. Therefore, sampling targets were set for each station (rather than each stratum) from 2008 onwards. In practice, this meant a sampling target of 1 fish per cm size class for each station. For species that have abundant catches of young fish that are likely to be all the same age, the size classes can be broadened, e.g. 1 fish per 5cm per station. For fish that are rare in the catches (e.g. cod), the targets will often be set to sample all fish, even if there are more than one per size class.

4. Methodology

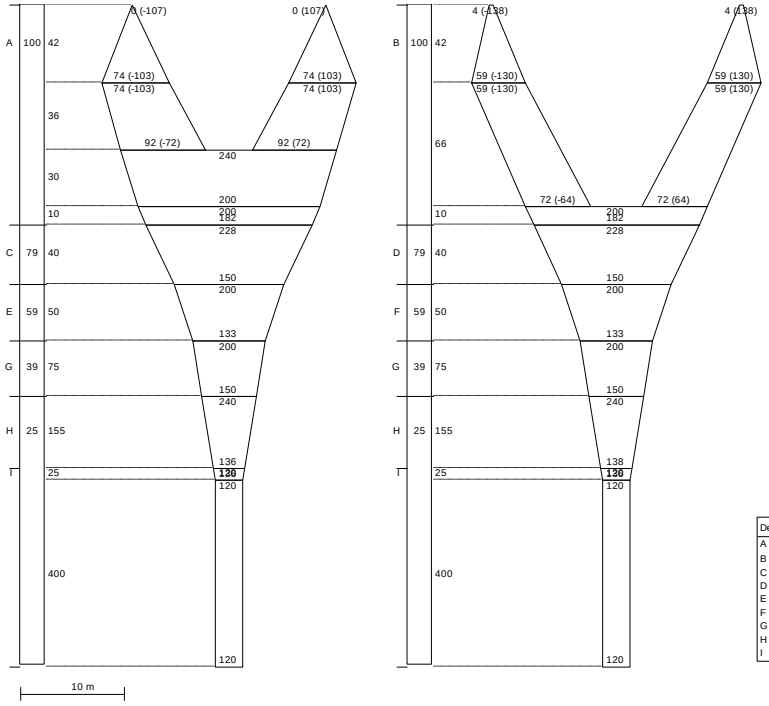
Technical description of the hauls

The trawl is towed for 30min at 4 knots ensuring good consistent contact with the seabed and a minimum headline height of 3.5m. All fish and commercial shellfish are sorted to species level prior to taking lengths and other biological measurements such as age, sex and maturity. Where species are abundant all or parts of the length frequency will be sub-sampled to ensure the final raised data is a true reflection of the length frequency of the catch. Weights and measurements are entered directly into an electronic measuring system in the fish-room with biological targets being flagged and met during this routine length frequency sampling.

Vessel and gear

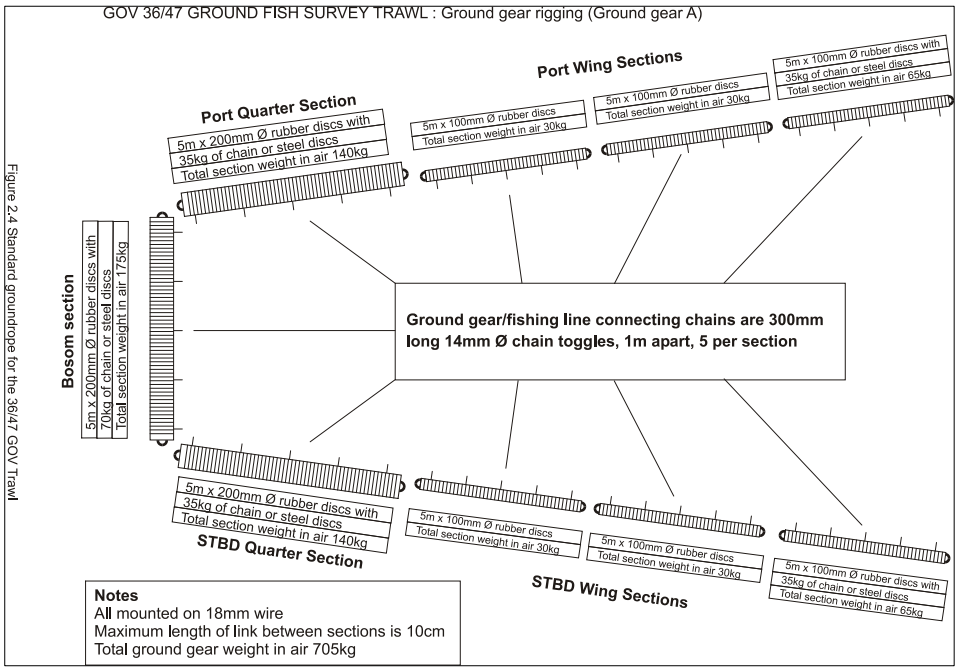
The IGFS is carried out on board the R/V *Celtic Explorer*, a 65 m vessel with 4320 KW engine power. The trawl used is a high headline “*Grande Overture Verticale*” (GOV 36/47), as is used throughout much of the shallow NE Atlantic shelf and North Sea areas within IBTS (See Figure 4). A nylon 20mm liner is used in the cod-end to retain juvenile fish. In line with IBTS recommendations, sweeps are lengthened to maintain trawl geometry in deeper water, from 55m up to depths of 80m to 110m in deeper water.

Due to the generally harder and more difficult trawling grounds off the northwest coast all hauls in Area VIa of the survey are carried out using a GOV rigged with 16”” hoppers to minimise gear damage (Fig 5). The remaining survey is completed using GOV’s in their more traditional A-gear configuration (8” disks centre).



Description	Material	Runnage (m/kg)	Mesh side (mm)	Diameter (mm)
A	PA	280	100	2.87
B	PA	140	100	4.5
C	PA	280	80	2.87
D	PA	180	80	3.8
E	PA	280	60	2.87
F	PA	180	60	3.8
G	PA	280	40	2.87
H	PA	280	25	2.87
I	PA	180	25	3.8

Figure 4. Net panels for the GOV 36/47 trawl gear used on the IGFS survey



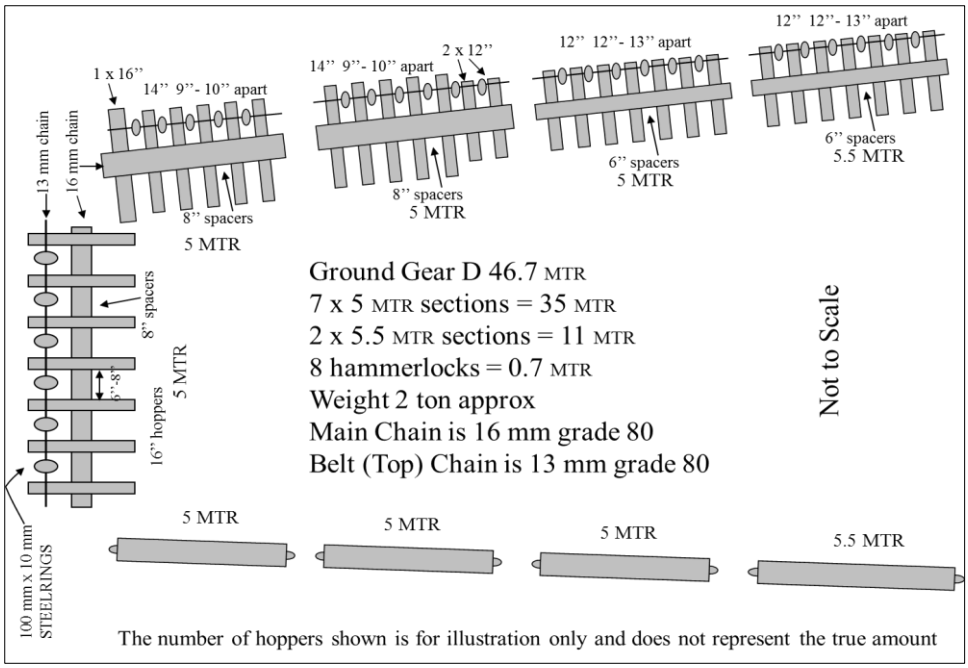


Figure 5 Standard A-type groundrope for the 36/47 GOV trawl groundgear 'A' top and groundgear D below.

Data QA and storage

All catch data for each haul is entered directly into Access databases via electronic measuring boards. A range of automated quality checks are run in the fish room after each haul to capture any erroneous records as early as possible.

Quality checked catch data for the day is then loaded on to a central secure server running SQLServer 2010. This survey database also contains the other positional and gear parameter meta-data for the tows. Raw navigation and gear monitoring information is also logged directly into SQLServer.

Additional sampling undertaken

i. CTD sampling

A HydroBios CTD is attached to the starboard trawl door for each fishing tow. This instrument collects Conductivity (analogous to salinity), Temperature and Depth information during the fishing tow which is subsequently downloaded on a daily basis and stored on a central server.

ii. Oceanographic sampling for the CaNDyFloSS project

The UK NERC funded CANDYFLOSS project is a work-package of the substantial Shelf Sea Biogeochemistry programme (SSB). For this project seawater samples were taken at 6 metres below the surface with the ship's CTD rosette once a day during the duration of the survey. The three parameters of interest were Nutrients,

Fig. 6 Locations of beam trawl (black triangle) and GOV (white triangle) comparison hauls on the South west coast of Ireland.

Dissolved Inorganic Carbon and Dissolved Organic Matter. The aim of the sampling was to look at fluxes of carbon dioxide into and out of the NW European shelf seas and at air-sea exchange. Partner organisations include the University of Liverpool, the UK MET Office, University of Bergen, Norway; the University of California as well as partners in Spain, Germany, Denmark, Scotland and France.

iii. Oceanographic transects

Three dedicated CTD transects are also carried out annually. These are located off the Northwest, Southwest and Southeast coasts to collect data on shelf currents. With the ship stationary the CTD rosette is lowered to just above the seabed before retrieval providing real time data of the vertical temperature and salinity profile. Sampling is repeated along these transects at 6 nautical mile intervals to provide data for spatial modelling of oceanographic currents.

iv. Collection of benthic invertebrates by beam trawl

As part of an internal review the inter-annual variability of the benthic component of the catch was reviewed. Being more suited for targeted benthic sampling a small beam trawl was used to compare directly the benthic species diversity within the GOV versus parallel tows using a beam trawl at selected locations (Fig. 6).

The invertebrate macro-fauna has routinely been recorded throughout the groundfish time series to the extent that resources and staff experience allow. The protocol involves sorting to as near species level as is practical prior to recording weights. In addition, for 2014, recording a count of individuals was trialled and will be evaluated prior to inclusion hereafter.

In order to review specific animal groups causing taxonomic identification problems between survey legs and years, a number of samples were sent externally to the Marine Institute for independent expert validation.

v. Seabass

Seabass sampling was carried out in the Celtic sea to assist with an M.Sc. programme. The work involved attaching of Floy tags to anaesthetised adult fish prior to releasing them back to sea. The data will be used to investigate stock distribution and migratory patterns in the Celtic Sea.

vi. Mackerel

A number of juvenile mackerel, between 15 and 22cm in length, were collected and frozen for subsequent stomach analysis by the Danish National Institute of Aquatic Resources.

vii. Sprat & Herring

A number of sprat and herring samples were collected for a Ph. D. study. The aim of the project is to describe the population structure, ecology and stock identity of *Sprattus sprattus* within the Celtic Sea Eco-Region. Sampling involved freezing >300g samples of sprat and >100g samples of herring from as many stations as possible.

viii. Sepiolids

All sepiolids were identified, counted and stored in alcohol. The samples are subsequently sent to the National Museum of Natural History in the Netherlands annually for formal identification as part of an ongoing sample request.

ix. Elasmobranchs

Genetic fin clip samples were collected from *Raja clavata* and stored in alcohol for a French study.

Various elasmobranchs such as Common Skate, Tope, Blue shark, Smooth Hound, Porbeagle and large Spurdog were tagged on an opportunistic basis using Jumbo rototags. Fish in good condition were quickly removed for measurement, tagging and release. Post survey, the tag data was sent to Inland Fisheries Ireland who manage the programme.

Egg cases for *Leucoraja circularis* and any skate species were identified but not retained.
A request was made to collect fin clip samples from any Blue shark encountered, however none were found.

x. Litter

All litter collected during trawl hauls is recorded by type, weight and volume. The litter categories are those agreed on by the IBTS Working Group.

xi. Seapens

Seapens from any hauls were collected for the UK Natural History Museum. The samples were frozen whole with the objective being to carry out population genetic analysis using microsatellite markers.

5. Scientific personnel

In total 38 Marine Institute staff, 3 students and 2 commercial trawl specialists were at sea during one or more legs of the 2014 groundfish survey (Table 1).

	Leg 1	Leg 2	Leg 3	Leg 4
	Hans Gerritsen (SiC)	**Brendan O'Hea (SiC)**	**Sara-Jane Moore (SiC)**	**Dave Stokes (SiC)**
	Dave Stokes	Dave Stokes	Mairead Sullivan	Ross Fitzgerald
	Orla Hanniffy	Gráinne Ní Chonchuir	Graham Johnston	Eoghan Kelly
	Debbi Pedreschi	Robert Bunn	Cormac Nolan	Gráinne Ní Chonchuir
	Ross Fitzgerald	Imelda Hehir	Macdara Ó Cuaig	Helen McCormick
	Eugene Mullins	Dylan Ward	Deirdre Lynch	Dermot Fee
	Aoife Mathews	Mossie Keith	Tobi Rapp	Dylan Ward
	Deirdre Lynch	Michael McAuliffe	Tomasz Szumski	Rebecca Treacy
	Sorcha Cronin O'Reilly	Leonie Dransfeld	Marcin Blaszkowski	Sinéad O'Brien
	John Power	Jennifer Doyle	Ross O'Neill	Sean O'Connor
	Dylan Ward	Dermot Fee	Joseph Cooney	Meadhbh Moriarty
	Michael McAuliffe	Sean O'Connor	Turloch Smith	Aoife Walsh
	Ciarán McKenna	Frankie Griffin*	Sarah Davie	Christina O'Toole
	Ger Dougal*		Frankie Griffin*	Ger Dougal*
Total	14	13	14	14

Table 1: Survey staffing on IGFS 2014, split by survey legs; *Fishing gear specialist.

6. Results

Timing and spatial coverage

Survey coverage in the north extends from the Donegal coast to the shelf edge and east to the coast of Scotland (ICES subdivision VIa South). Off the Irish west coast, the survey extends to the shelf edge (VIIb) and south into the Celtic Sea (Areas VIIg-j) (Fig 7.).

The more northerly ICES Area VIa is undertaken in late September and early October using a Rockhopper groundgear rig (gearcode D). The western and southern areas (VIIb,g&j) are carried out in three legs during November – December using a finer groundgear (gearcode A). See figure 7 for station positions in relation to survey legs. The number of days per leg as well as departure and arrival port is given in Table 2.

	Leg 1	Leg 2	Leg 3	Leg 4
Depart	24/09/2014	13/11/2014	25/11/2014	06/12/2014
From	Galway	Cork	Cork	Cork
Return	05/10/2014	24/11/2014	05/12/2014	17/12/2014
To	Cork	Cork	Cork	Galway
Days	11	11	10	11

Table 2. Timing and number of days per leg on IGFS 2014.

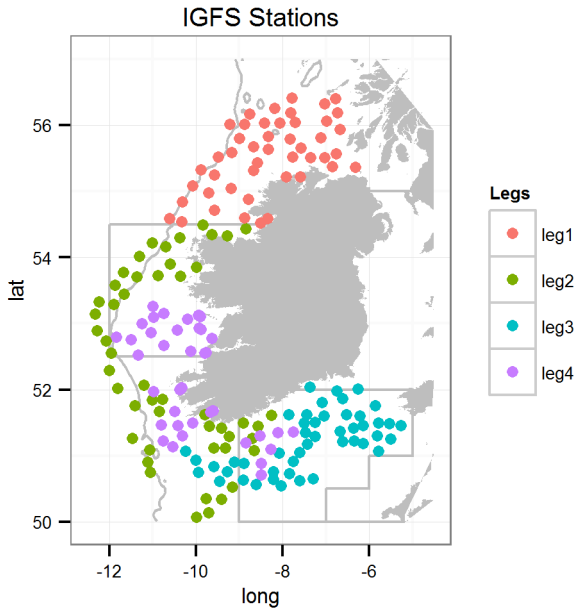


Fig. 7 Map of 2014 IGFS stations by survey legs, see table 2 for timing of survey legs.

Hauls – the sampling unit

Station targets in all areas were exceeded except for a 5% shortfall in the area west of Ireland due to weather in 2014 (Table 3). This translates to 68 hours on the seabed covering a distance of 628 Km and a swept area between the trawl doors of 65.75 Km^2.

Cruise	Area	GearCode	Target	Valid	Additional	Invalid	Total	% Stations Fished
IGFS2014	VIa	D	45	44	0	2	46	102
IGFS2014	VIIbc	A	38	35	0	1	36	95
IGFS2014	VIIg	A	48	50	1	1	52	108
IGFS2014	VIIj	A	40	41	0	0	41	103
		Total	171	170	1	4	175	102

Table 3: Stations completed and station targets by strata.

During IGFS 2014, one tow was lost during Leg 3 as a result of a torn net, but this was quickly repaired in a relatively short time as were other running repairs as they arose. Good polish on the sweeps and lower bridles was observed throughout the survey along with the metal parts of the trawl groundgear. It is important to ensure good ground contact is maintained and ongoing observations on the level of benthos in the catch is also important for ground truthing trawl contact with the seabed.

With the exception of 2.5 days lost on Leg 4 due to weather, weather conditions were very favourable. Both wind speed and vessel heave (vertical motion relative to wave height) was quite average for the time series (see Fig 8).

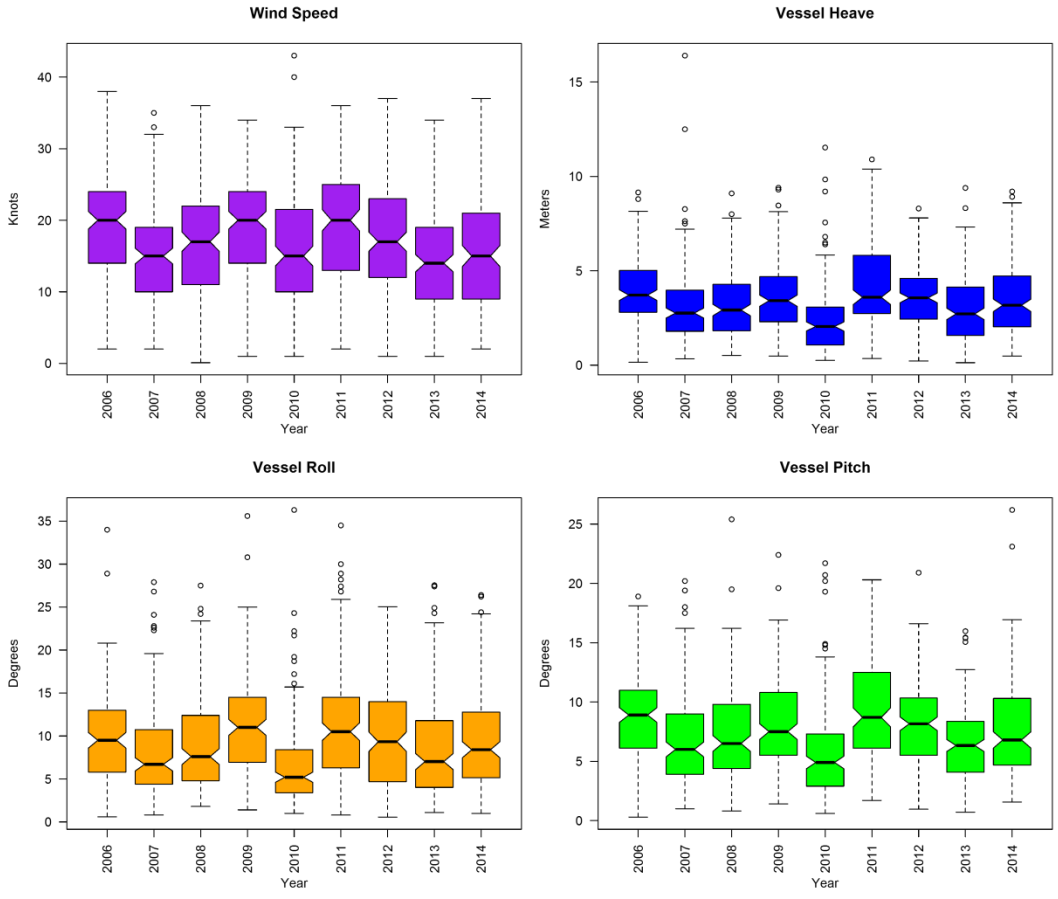


Fig 8 Boxplots for the recent time series of wind speed corrected for vessel speed (top left); vertical motion of the vessel in meters (heave) which is an indication of wave height (top right); vessel motion side to side (roll) in degrees (bottom left); and vessel roll along its axis (pitch) in degrees (bottom right). Where box notches overlap within a plot the measured values are not significantly different between those years.

As a consequence of overall good weather swept areas for the survey for each stratum were in line with normal operations over the time series. Figure 9 gives a breakdown by haul.

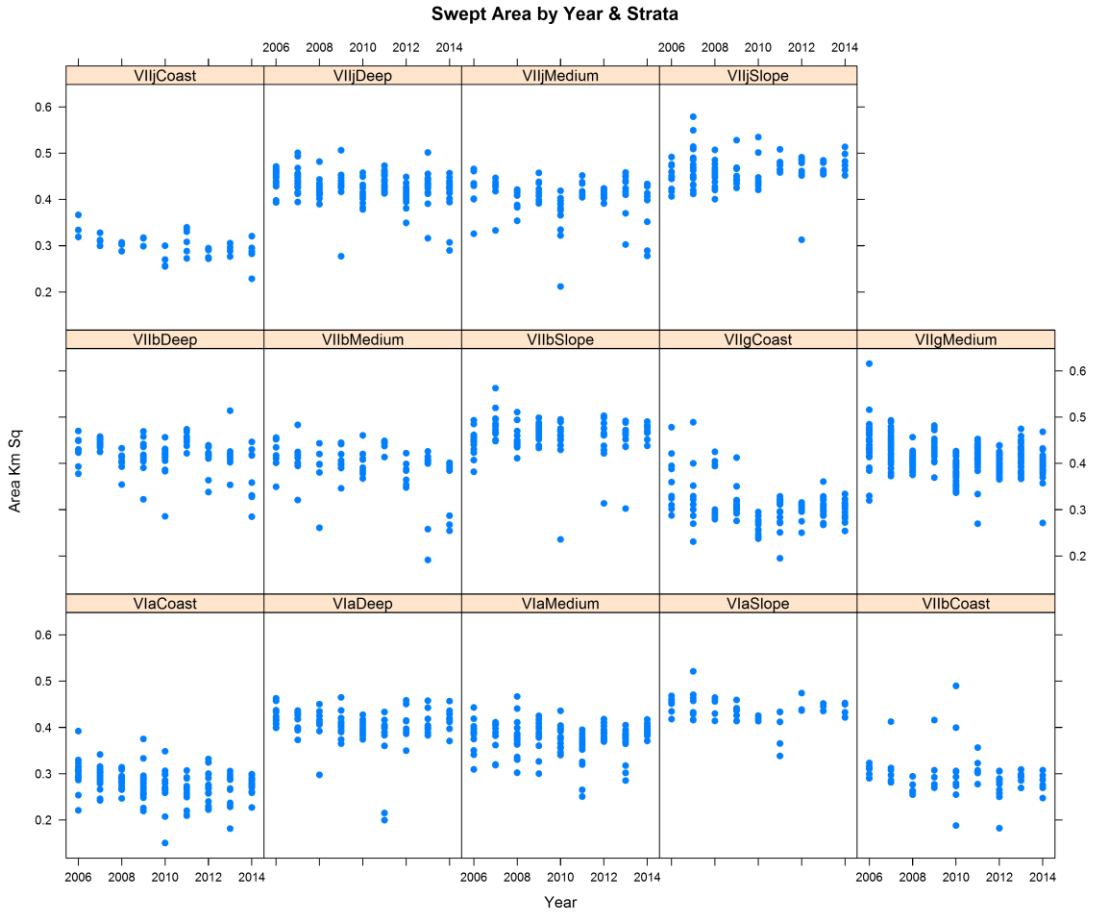


Fig 9. Swept areas per haul over the time series. Each panel presents data for a different survey stratum.

To avoid changes in catchability due to some species migrating vertically in the water column for feeding during hours of darkness, the surveys operate a strict daylight towing regime. Valid tows for the IGFS must fall within civil sunrise and sunset (Fig 10).

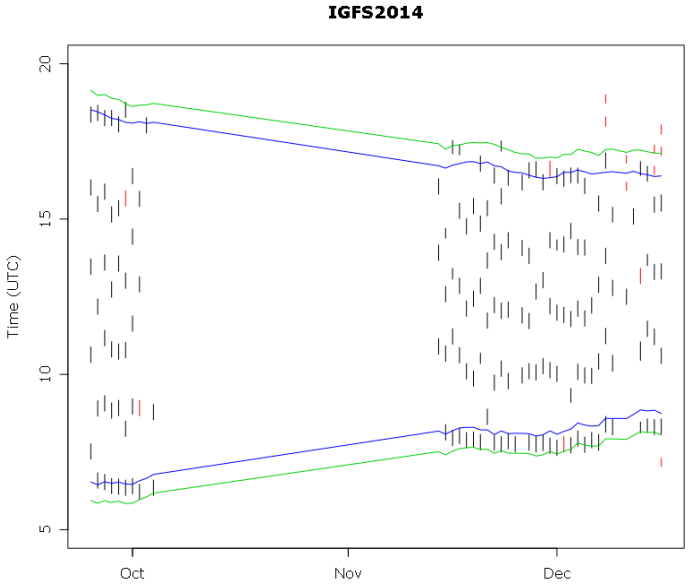


Fig 10. Shoot and haul times in relation to civil (green line) and official (blue line) sunrise and sunset. Durations in red indicate an invalid or additional tow (beam trawl for example), not included for stock assessment purposes.

Gear geometry monitored during the survey was also seen to be within expected values (see Fig 11).

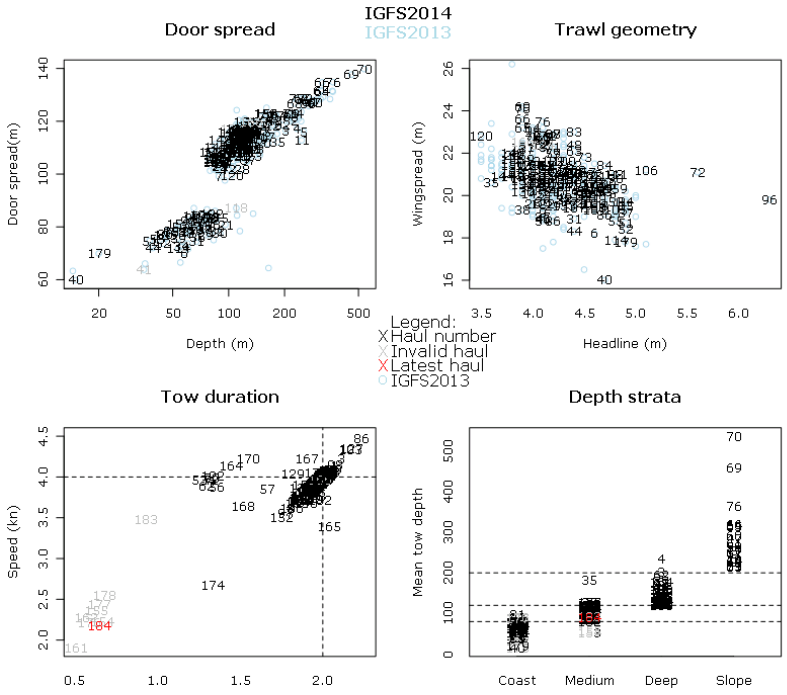


Fig 11. Trawl geometry quality control plots for IGFS2014 (haul numbers in black) in relation to IGFS2013 (grey). Top left shows door spread in relation to depth, the separate clusters of data relating to the change in sweep length at 80m depth. Top right displays headline height in relation to wingspread. Bottom left gives towed distance nmi in relation to vessel speed Kts; bottom right shows the depth in relation to the allocated strata.

Oceanography

The time series of satellite observed annual mean Sea Surface Temperature (SST) data for VIa and VII survey areas between 1982-2014 is given in figure 12. Monthly observations from the same data are presented in figure 13 and show a distinct shift in temperature with

latitude over the survey area. A slight dropping in temperature off the southwest coast in November can be seen to rise again slightly in December.

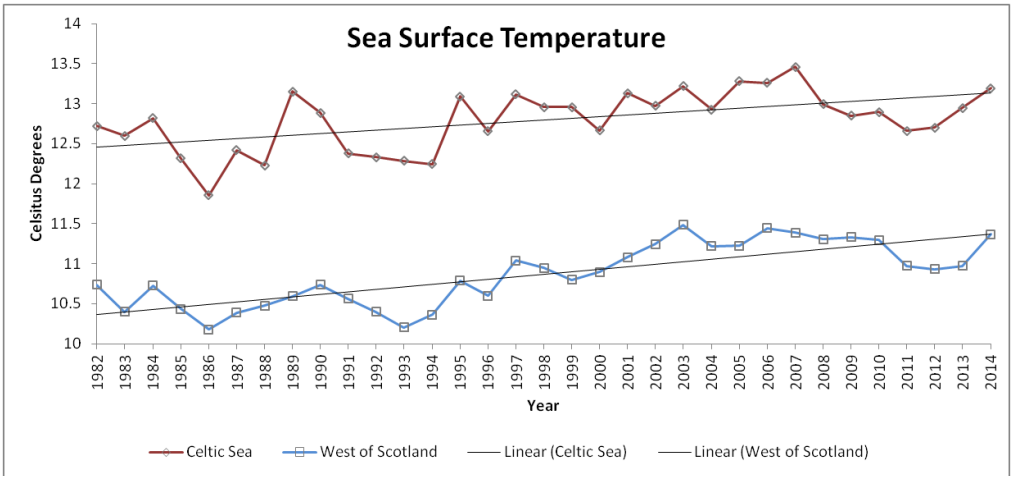


Fig.12 Time series of sea surface temperatures in the sampling area of the IGFS between 1982 and 2014 (AVHRR data from ftp://eclipse.ncdc.noaa.gov/pub/OI-daily-v2/NetCDF/)

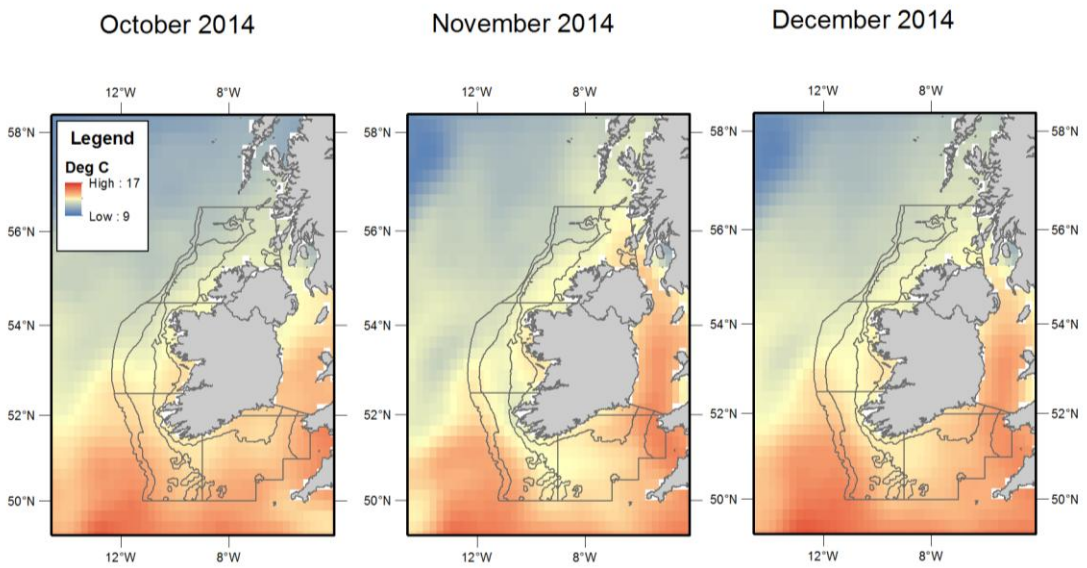


Fig. 13 Map of sea surface temperatures in the IGFS sampling area between October and December 2014 ((AVHRR data from ftp://eclipse.ncdc.noaa.gov/pub/OI-daily-v2/NetCDF/)

Catch interpretation

An age based relative index of abundance from a survey is primarily a useful indication of annual spawning success and potential recruitment into a particular stock. Secondly, the rate of commercial exploitation of the various age groups already exposed to fishing pressure can be estimated. In a wider context however, as discussed above, the "*relative*" nature of trawl efficiency means these indices are not absolute and may be a truer reflection of the *real* abundance in some survey areas compared to others. This is true for either age based or simple CPUE indices. In addition, the absence of a species from the catch does not confirm its absence from the survey area, simply the utility of this type of survey for sampling a particular species.

Overall then relative survey indices are a useful indicator of trends in abundance from one year to the next for species where catch rates are reasonably persistent. Caution must be used however when drawing comparisons between species or survey areas.

Catch overview

In 2014 91 fish species were encountered (fig.14), 19 shark and ray species, 9 squid and a further c.200 species or higher groupings of macro-invertebrates or algae. The highest number of species (fish, elasmobranch and squids) during a single haul was 41 at Haul 101. Mean catch weights per haul was 0.5t with a max of 10.9t at haul 179 (fig 15). Mean catch numbers per haul was 7.8k with a maximum of 70k at Haul 168 (fig 16). Total biomass and abundance per haul were highest northwest of Ireland and in the eastern Celtic Sea while lowest observations were southwest of Ireland (fig. 15 and 16).

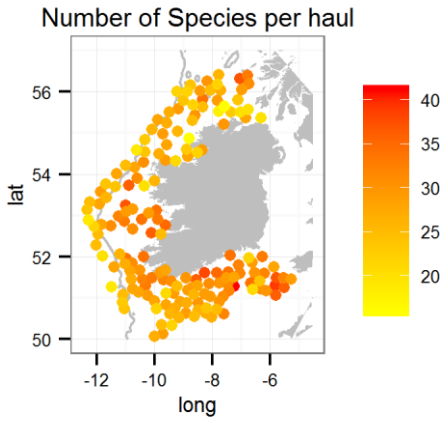
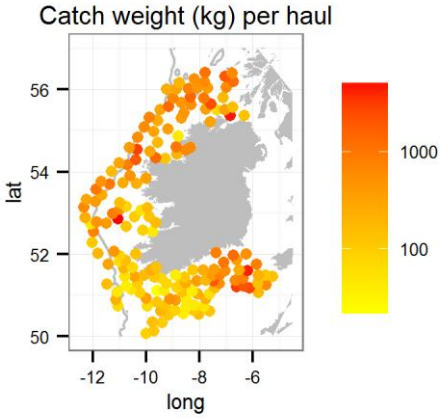


Fig. 14 Number of fish species per haul as sampled on IGFS 2014. Areas of high fish species numbers are the south eastern Celtic Sea, the west of Ireland and west of Scotland.

Fig. 15 Total fish biomass per haul (standardised to km^2) as sampled on IGFS 2014. Areas of high biomass are the south eastern Celtic Sea, the north western shelf edge and west of Scotland.



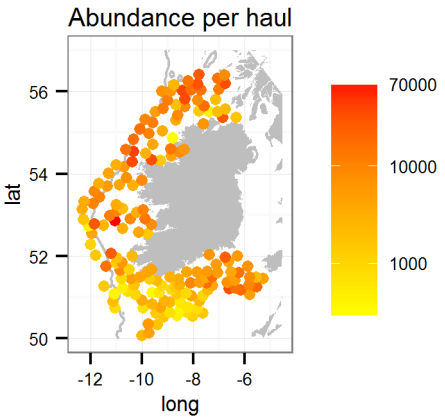


Fig. 16 Total fish abundance per haul (standardised to km^2) as sampled on IGFS 2014. Areas of high abundances are the south eastern Celtic Sea and the north and northwest of Ireland.

Top five species with highest biomass (mean catch weight in kg km-2 per haul)

Species	Catch Km^2
WHG	251
HAD	213
MAC	125
HER	123
HOM	119

Top five most abundant species (mean No km-2 per haul)

Species	No km^2
NOP	4109
WHB	3648
MAC	2100
WHG	2035
HOM	1674

Top five most widespread species (as No of hauls, where species occurred)

Species	Occurrence	% Occurrence
HOM	166	98
GUG	157	92
LSD	156	92
HKE	154	91
POD	152	89

Individual weight, age, sex and maturity (WASM) data was acquired for the 21 species listed in Table 4 with a sample count per species given under the appropriate sampling scheme.

Weight sex and maturity (WSM) data was collected for a further 10 species with length weight (LW) data simply being recorded for an additional 6 species. An explanation of the species codes can be found in Appendix 1.

Sampling levels for weight, age sex and maturity data.

Species	WASM	Species	WSM	Species	LW
HAD	2412	SDR	1468	POD	185
PLE	2212	THR	510	DAB	167
WHG	2012	GUG	393	NOP	117
MEG	1842	JOD	308	SYP	115
LEM	1228	DGS	292	LSS	108
HOM	1030	CUR	272	GSS	50
WHB	773	DFL	124		
HKE	668	DII	76		
MON	548	BLR	64		
MAC	476	COE	31		
SOL	432				
COD	401				
WIT	371				
HER	335				
WAF	283				
POK	247				
ESB	168				
LIN	122				
BLL	63				
POL	42				
TUR	39				
Total	15704		3538		742

Table 4. Sampling levels for biological data taken from individual fish. Weight, age, sex and maturity (WASM) is taken for most commercially exploited species, while weight sex and maturity (WSM) is recorded for other species not currently aged. Length weight data (LW) is collected periodically for additional species of interest to the fisheries management or research community. Sampling targets are set on a per haul basis with the exception of hake and grey gurnard which are collated over each survey strata.

An overview of the general trends from IGFS2014 is presented in Table 5. The most significant change in VIa was significantly increased numbers of juvenile haddock (265%) and whiting (340%) over the recent 5 year term. Biomass was not significantly increased however confirming that more, smaller and younger fish were the main cause. Monkfish too increased (216%) on 2013, but the 5 year average saw only half that difference.

In area VII horse mackerel (*Trachurus trachurus*) numbers show an increase (386%) over the recent five year period, while a slight decline (13.6%) on the previous year is observed. Cod and blue whiting both show a distinct increase on 2013, but over the 5 year term catches show a slight downward trend. The other gadoid and pelagic species are within the normal inter-annual fluctuations.

Biomass and number estimates									
			Biomass index			Number index			
Species	ICES Div	Valid tows	y_i	y_i/y_{i-1}	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$	y_i	y_i/y_{i-1}	$y_{(i,i-1)}/y_{(i-2,i-3,i-4)}$
			kg/Hr	%	%	No/Hr	%	%
Gadus morhua	VIa	44	7.8	117.5	3.5	7.3	55.0	40.3
Melanogrammus aeglefinus	VIa	44	185.2	67.1	24.4	2299.2	795.8	265.4
Clupea harengus	VIa	44	236.1	-16.4	3.7	1493.8	-39.4	38.1
Merluccius merluccius	VIa	44	24.6	-14.6	1.7	60.6	-51.5	4.9
Trachurus trachurus	VIa	44	191.2	81.9	-52.3	981.6	77.0	-52.6
Scomber scombrus	VIa	44	51.8	-88.6	15.1	681.5	-83.2	40.8
Lepidorhombus whiffiagonis	VIa	44	2.0	1.8	-3.0	5.9	-6.2	-21.4
Lophius piscatorius	VIa	44	3.9	658.7	-1.6	3.9	216.1	105.2
Pleuronectes platessa	VIa	44	11.4	-43.9	-4.5	77.2	-25.2	-17.4
Solea solea	VIa	44	0.6	77.5	-18.4	2.1	83.7	-34.2
Micromesistius poutassou	VIa	44	86.2	-16.1	12.2	4024.0	82.0	8.3
Merlangius merlangus	VIa	44	231.7	186.9	110.7	2497.1	87.5	340.4
Gadus morhua	VIIb	126	6.9	311.5	-46.5	3.8	583.2	-55.1
Melanogrammus aeglefinus	VIIb	126	154.2	33.5	-28.1	767.9	-52.0	16.8
Clupea harengus	VIIb	126	19.7	90.1	-68.6	164.6	20.9	-77.0
Merluccius merluccius	VIIb	126	23.6	-40.6	28.0	129.7	-56.8	-50.6
Trachurus trachurus	VIIb	126	53.1	15.8	113.3	1140.4	-13.6	386.4
Scomber scombrus	VIIb	126	82.4	-37.9	-29.4	1422.4	-36.0	-36.1
Lepidorhombus whiffiagonis	VIIb	126	3.2	8.9	-35.1	17.8	21.6	-37.4
Lophius piscatorius	VIIb	126	6.4	-20.4	11.0	7.9	73.6	15.6
Pleuronectes platessa	VIIb	126	10.6	-6.6	29.4	50.0	-11.4	2.3
Solea solea	VIIb	126	0.6	27.9	5.6	2.7	8.7	13.9
Micromesistius poutassou	VIIb	126	68.5	102.4	-4.5	2911.9	330.5	-3.9
Merlangius merlangus	VIIb	126	154.9	44.4	-10.0	962.9	-44.3	35.4

Legend

Increase

Decrease

<15% Change

y_i/y_{i-1} gives the biomass and abundance of the most recent year divided by the abundance of the previous year in %. This value gives an indication of short term change from the previous year.

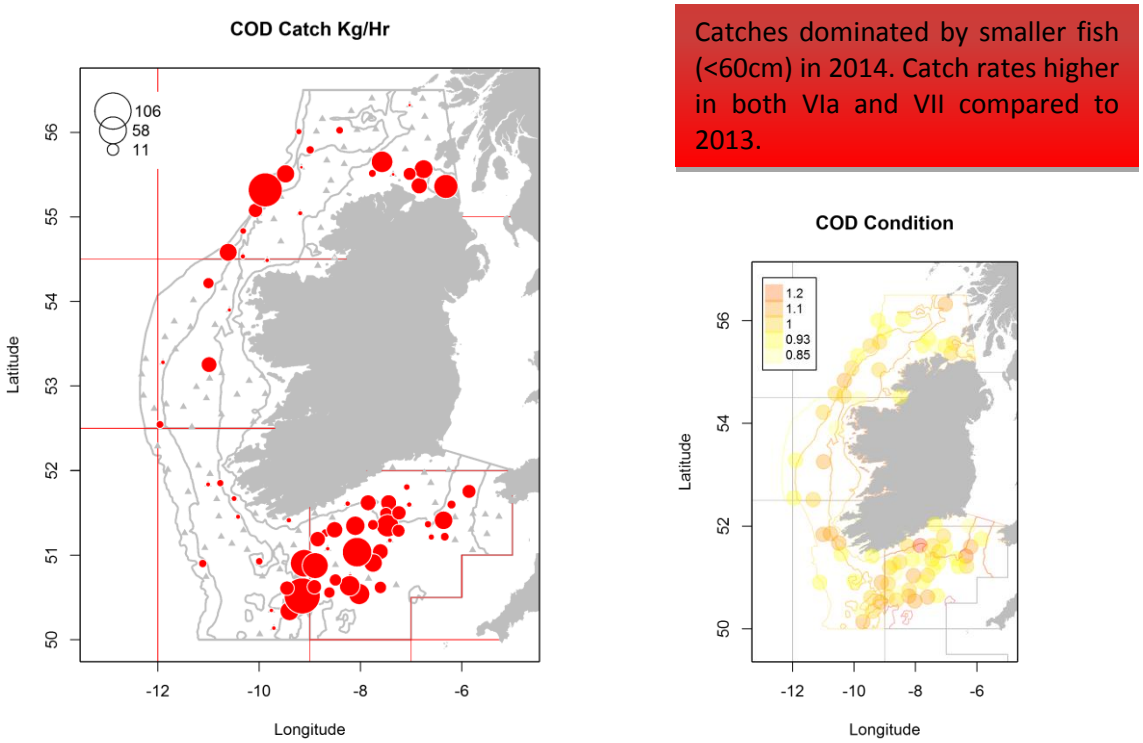
$y_{(i,i-1)}/Y(i-2,i-3,i-4)$ is mean biomass and mean abundance of the last two years divided by the mean of the previous three years as %. This value gives an indication of how much the biomass and abundance of a species has changed over the last five years. Orange indicates that the abundance has decreased by more than 15%, green indicates that the abundance has increased by 15% or more.

In four cases, both biomass and abundance are increasing over 15% in the last 5 years, while in six cases, biomass and abundance decreases are more than 15%.

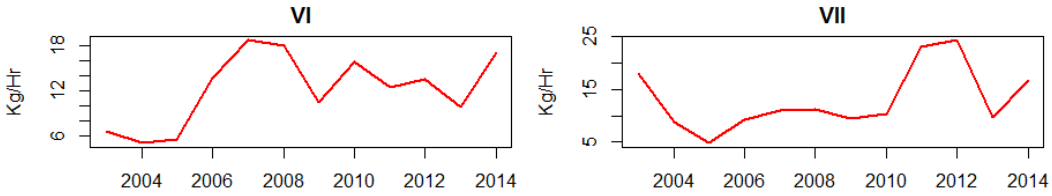
Table 5 gives % change in both weight and number of individuals between the most recent survey and the one previous. As a longer term view it also gives the ratio for the two most recent years compared to the prior three years . Caution is needed interpreting these trends in particular where species fluctuate highly as a large number moving from the top to the bottom of any fraction will have a significant impact obviously on the result.

Species overview: Cod

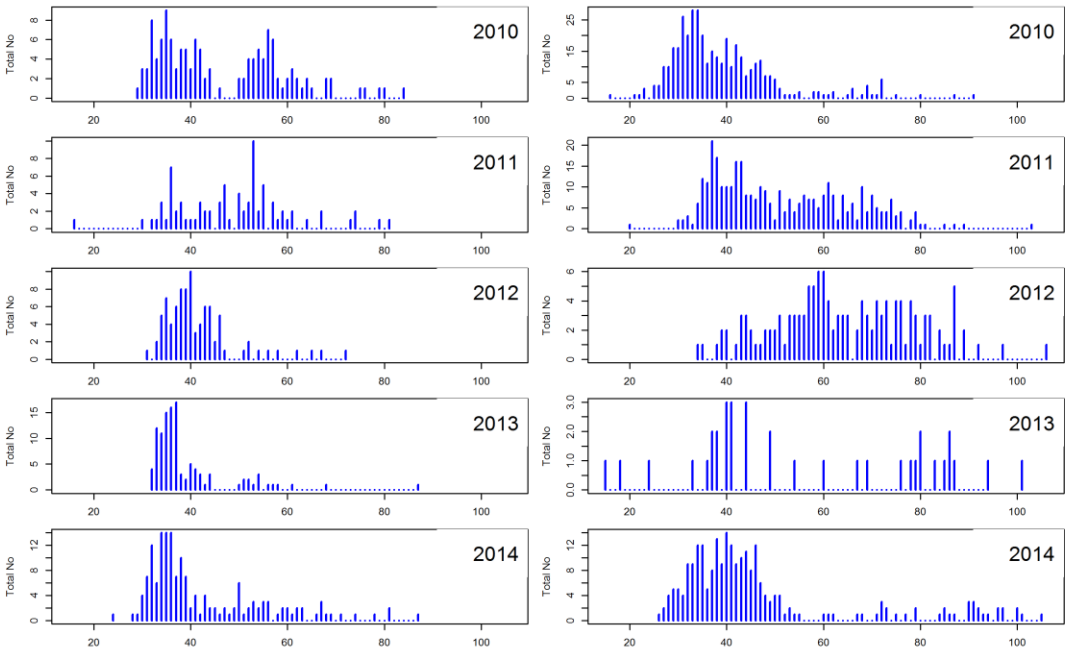
Catches dominated by smaller fish (<60cm) in 2014. Catch rates higher in both VIa and VII compared to 2013.



Survey catch rate in Kg/Hr (top left) with zero catch = grey triangle. Relationship between length and weight (top right). Higher numbers indicate a fish from this haul will be, on average, heavier for a given length.

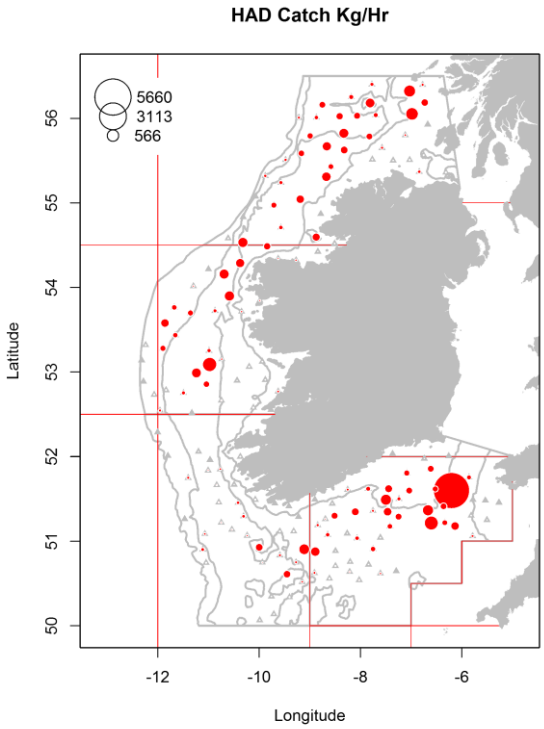


Catch in Kg per hour for VIa (above left) and area VII (above right) for the time series.

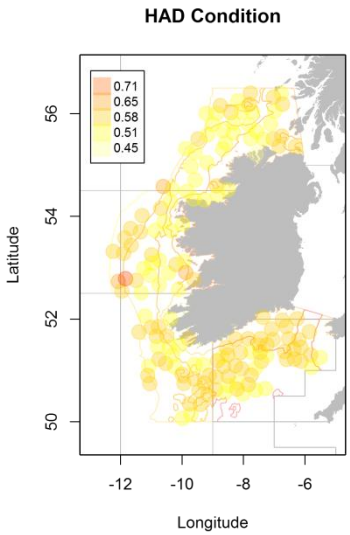


Catch in total number per length for VIa (above left) and area VII (above right) for the recent time series 2010-14.

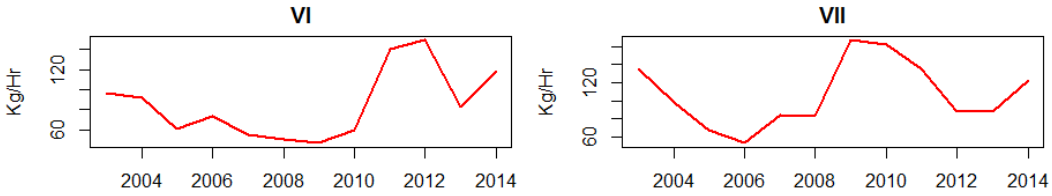
Species overview: Haddock



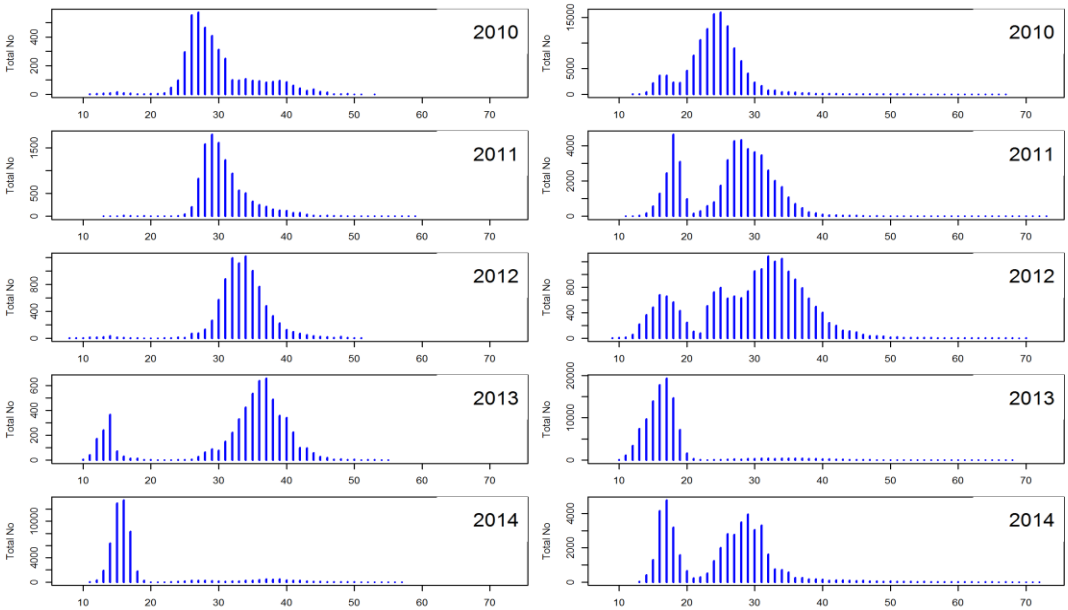
Catches dominated by juvenile fish in VIa 2014. Catch rates up in both VIa and VII from 2013.



Survey catch rate in Kg/Hr (top left) with zero catch = grey triangle. Relationship between length and weight (top right). Higher numbers indicate a fish from this haul will be, on average, heavier for a given length.

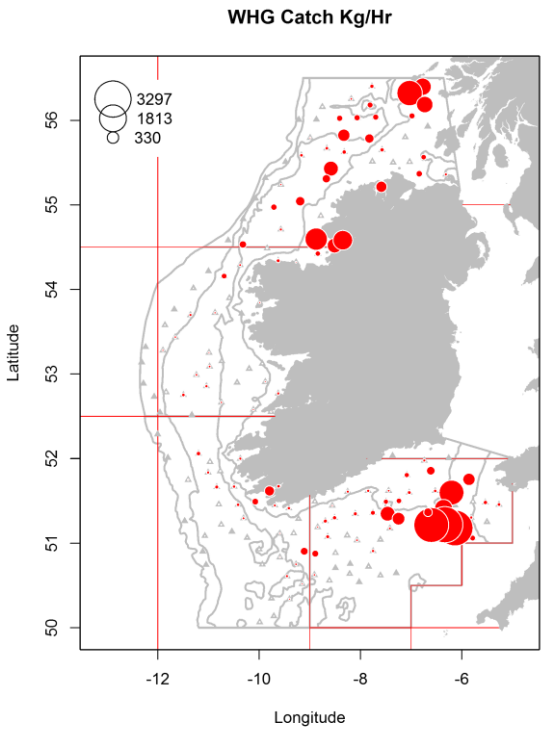


Catch in Kg per hour for VIa (above left) and area VII (above right) for the time series.

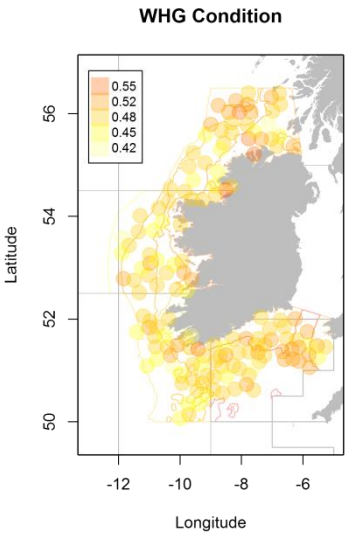


Catch in total number per length for VIa (above left) and area VII (above right) for the recent time series 2010-14. Vertical axes are not scaled so the abundance of small fish in VIa 2014 tend to swamp the normal levels of adult fish in the area.

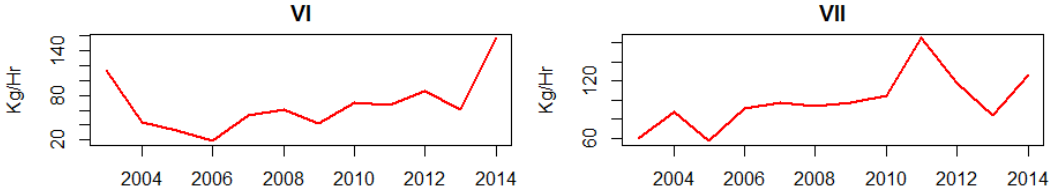
Species overview: Whiting



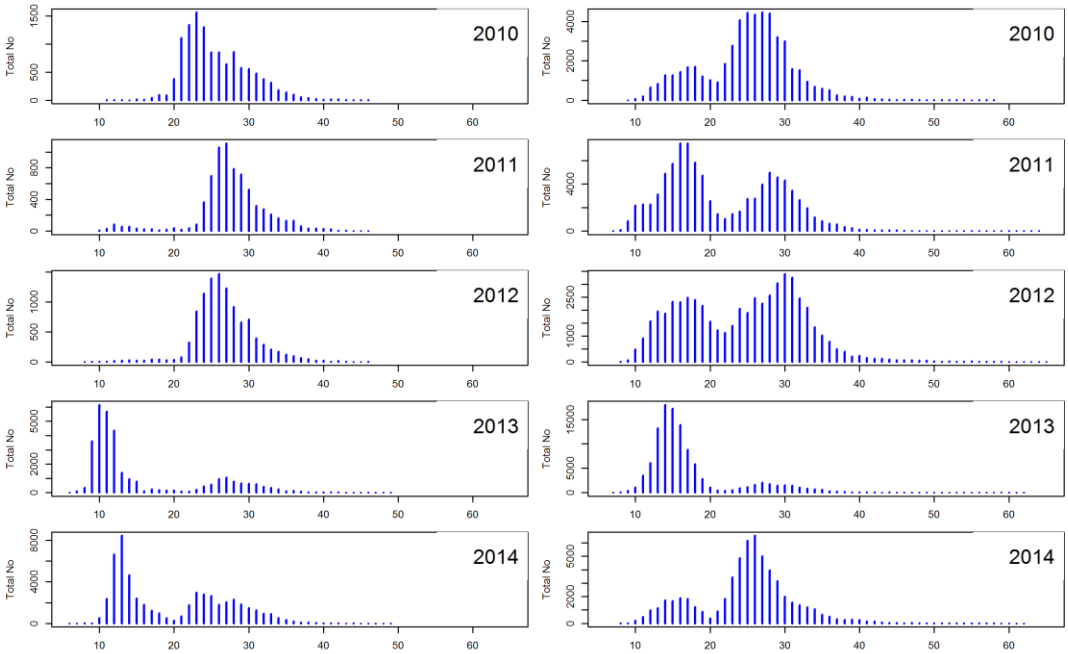
Catch rates up in both VIa and VII compared to 2013. Good length range throughout the survey area.



Survey catch rate in Kg/Hr (top left) with zero catch = grey triangle. Relationship between length and weight (top right). Higher numbers indicate a fish from this haul will be, on average, heavier for a given length.

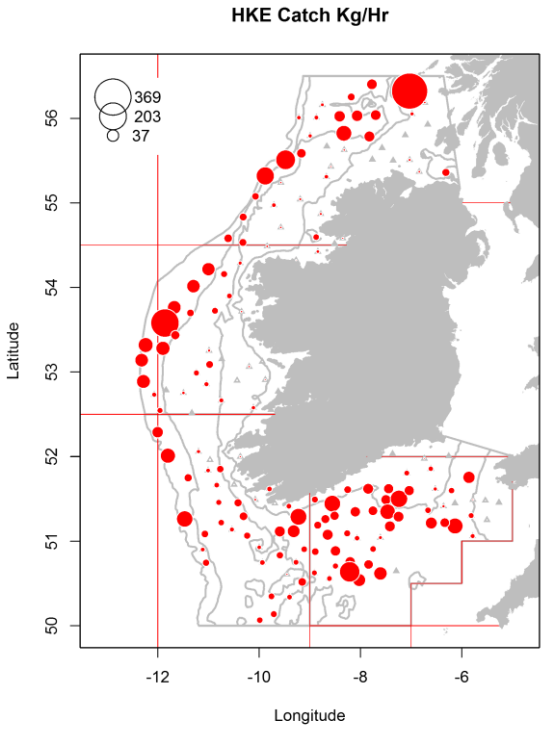


Catch in Kg per hour for VIa (above left) and area VII (above right) for the time series.

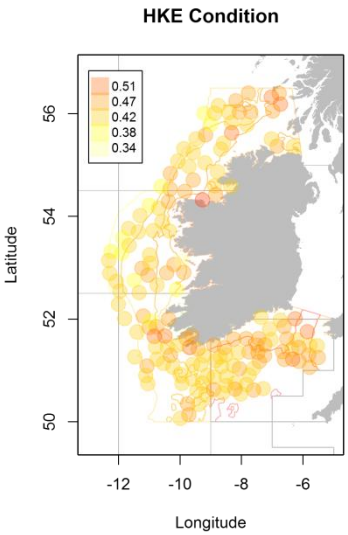


Catch in total number per length for VIa (above left) and area VII (above right) for the recent time series 2010-14.

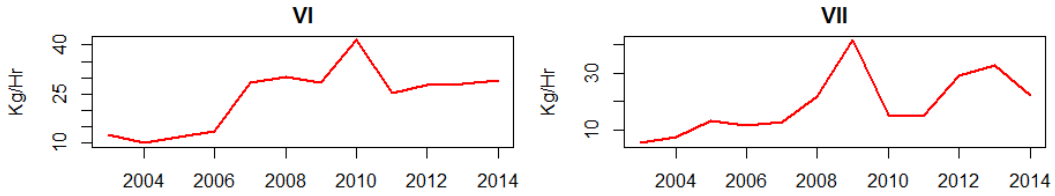
Species overview: Hake



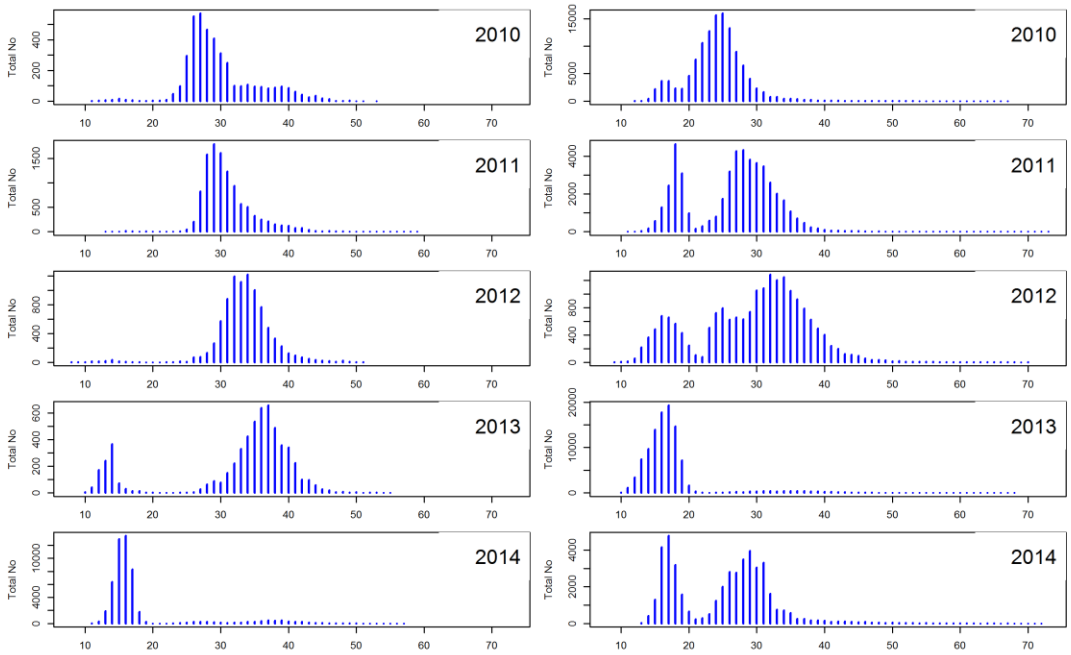
Larger fish restricted to area VII in 2014 in contrast to 2013. Catch rates down slightly in area VII.



Survey catch rate in Kg/Hr (top left) with zero catch = grey triangle. Relationship between length and weight (top right). Higher numbers indicate a fish from this haul will be, on average, heavier for a given length.



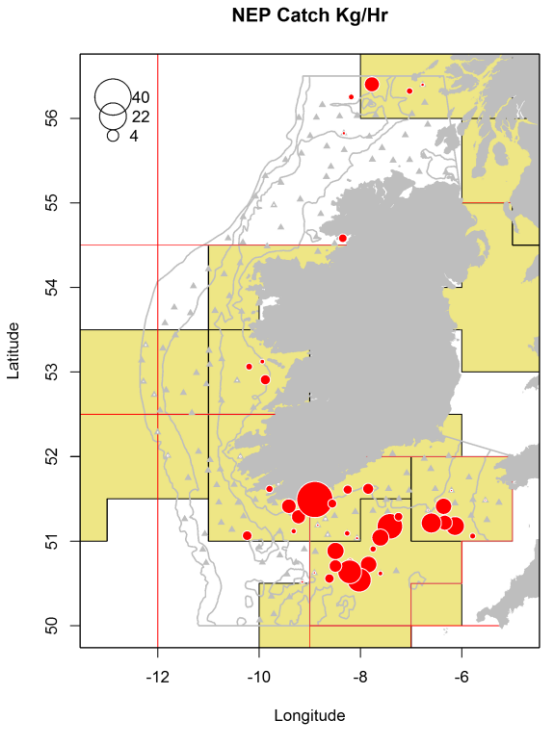
Catch in Kg per hour for VIa (above left) and area VII (above right) for the time series.

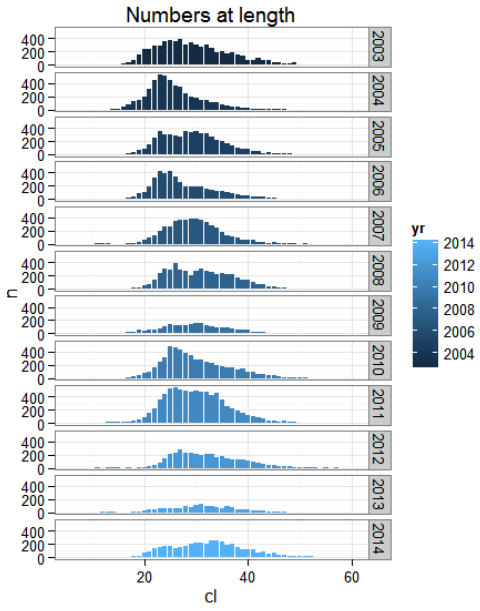


Catch in total number per length for VIa (above left) and area VII (above right) for the recent time series 2010-14.

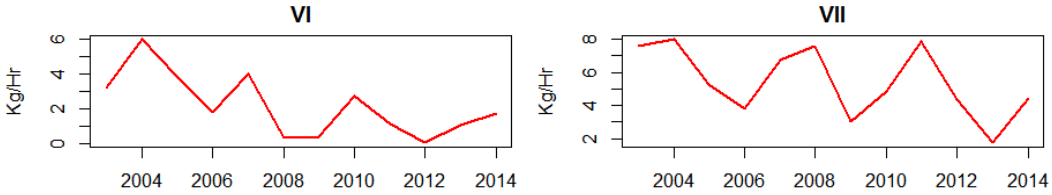
Species overview: Nephrops

Larger fish restricted to area VII in 2014 in contrast to 2013. Catch rates down slightly in area VII.





Survey catch rate in Kg/Hr (top left) including Functional Areas (yellow) and zero catches = grey triangles.

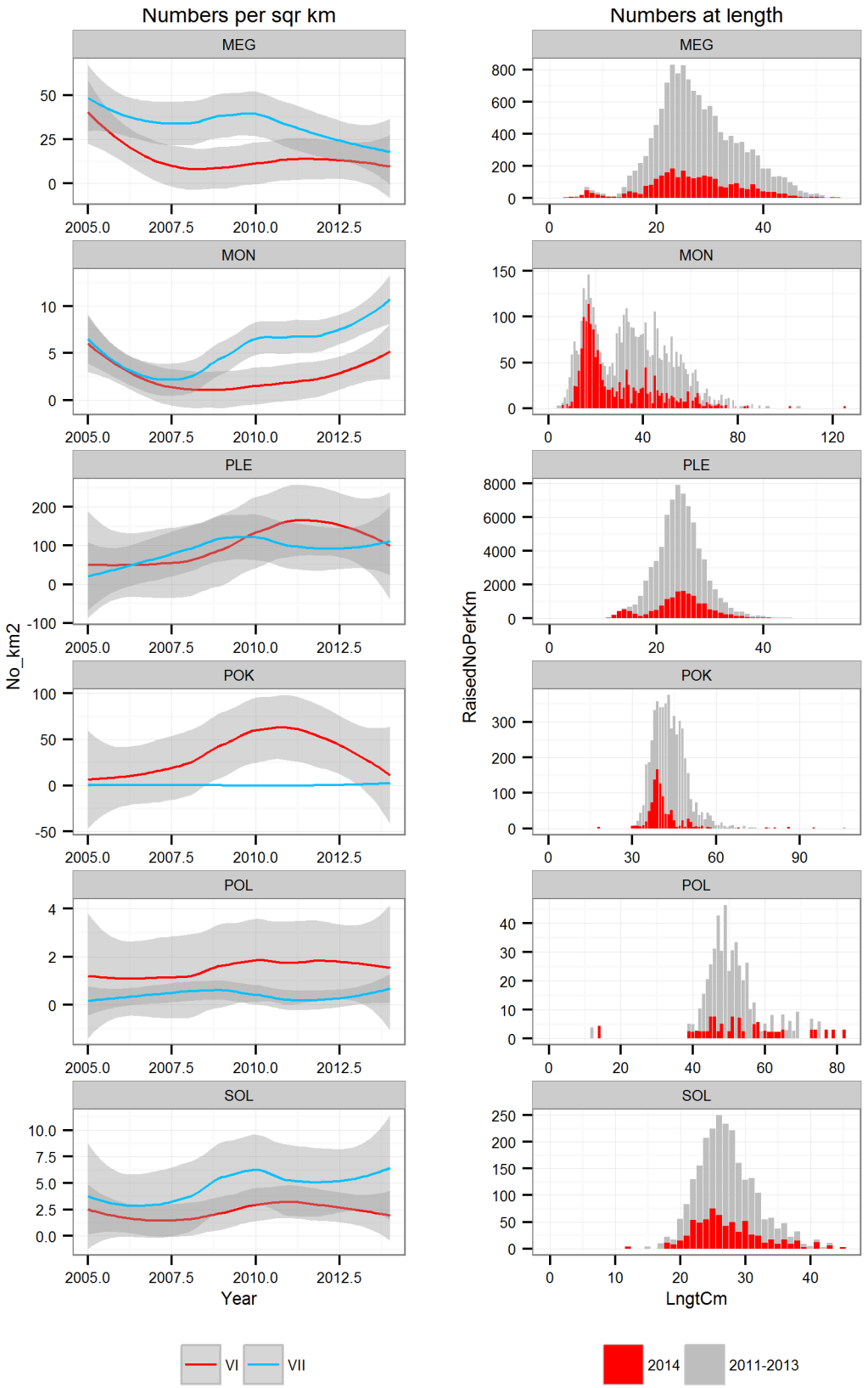


Catch in Kg per hour for VIa (above left) and area VII (above right) for the time series.

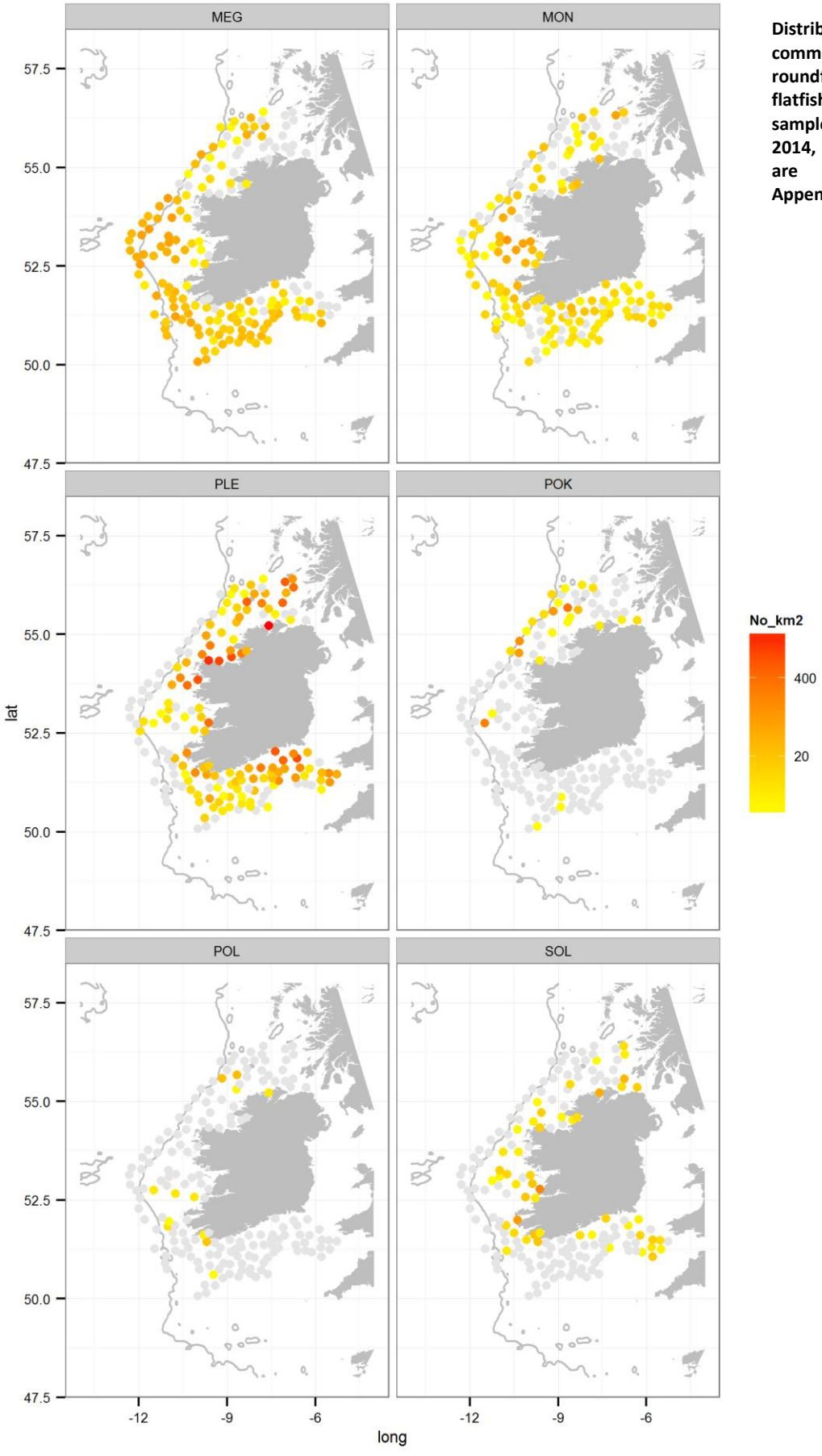
Fishing Ground	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Aran			1135	443		189	666	18	95	56	81	180
Banana	1411			251	10	4	4	780	5		40	419
Bantry Bay									255	210	332	40
Cork Channels			121	66	76	10	76	50	7	18	155	46
E Irish Sea	58	92										
E Stanton	207	250	45	101	26			152				68
Galley Ground 1				71			25		246	3	52	99
Galley Ground 2									1181	406	264	126
Galley Ground 3						1259		120	7			615
Galley Ground 4	556	69	222			34		1	138	51	18	104
Galway Bay				659	1	185	236	43	278	12	210	
Labadie, Jones & Cockburn	114		970	1009	1137	1603	88	1241	2190	1199	90	994
Outside fishing grounds	1570	2294	1072	321	881	860	469	2743	1488	286	421	393
Porcupine				7								
S Stanton			15	36		4						
Slyne Head			34					173	298	24	2	
Smalls	388		1684	1501	2794	893	715	315	1869	1372	108	1282
SW Slope				1			1	1		1		
western Irish Sea	1925	2292										
Grand Total	**6229**	**4997**	**5298**	**4466**	**4925**	**5041**	**2280**	**5637**	**8057**	**3638**	**1773**	**4366**

Catch in total number per length for VIa (above left) and area VII (above right) for the recent time series 2010-14.

Multiple species overviews: Commercial round and flatfish

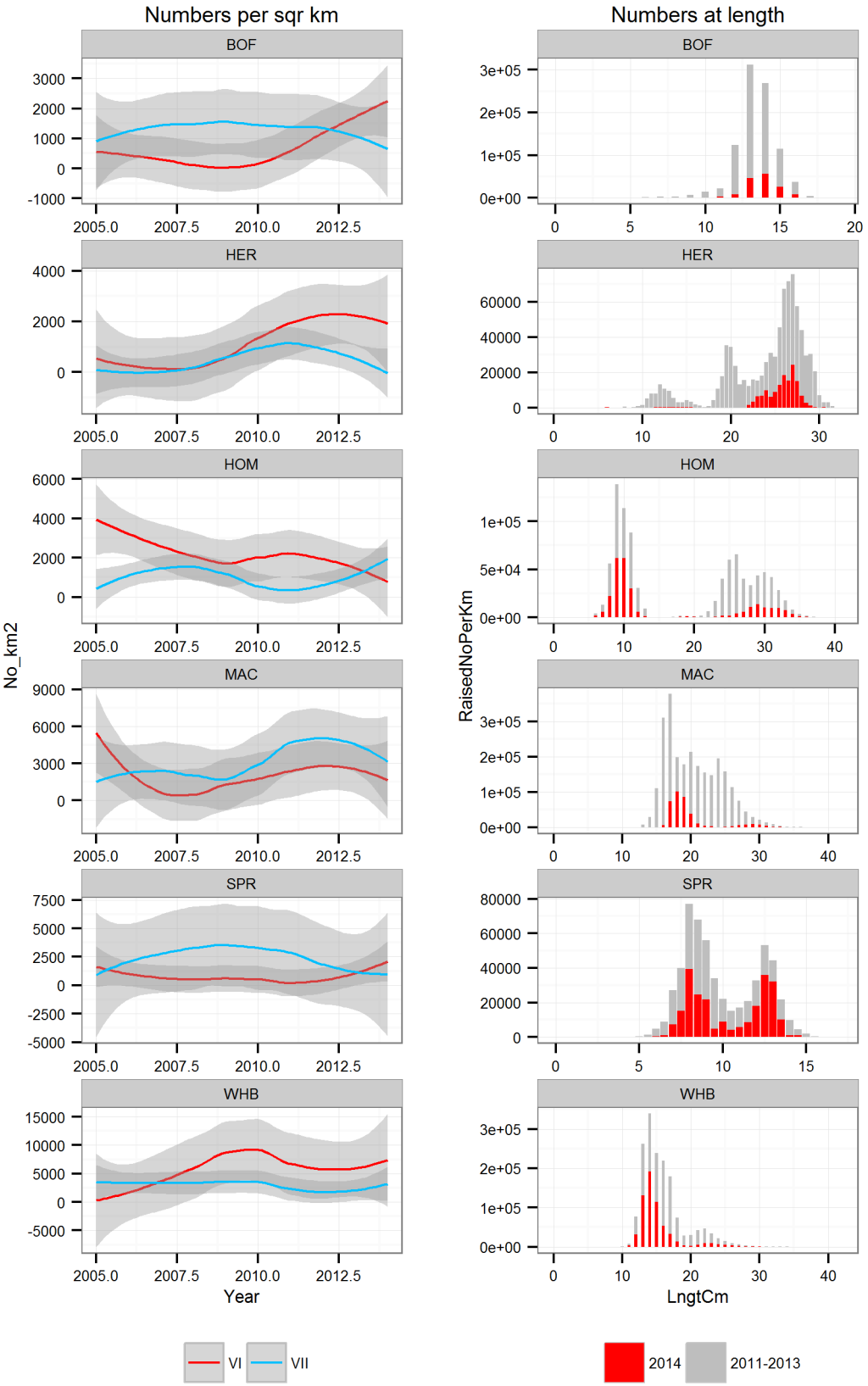


Abundance time series of six commercial roundfish and flatfish species, sampled on IGFS, as No per km^2 between 2005 and 2014, with LOESS smoothed means by strata in ICES divisions VI and VII (left panel); length frequencies of the same species for IGFS 2014 superimposed on their cumulative length frequencies of the previous three years (right panel). Species codes are listed in Appendix 1.

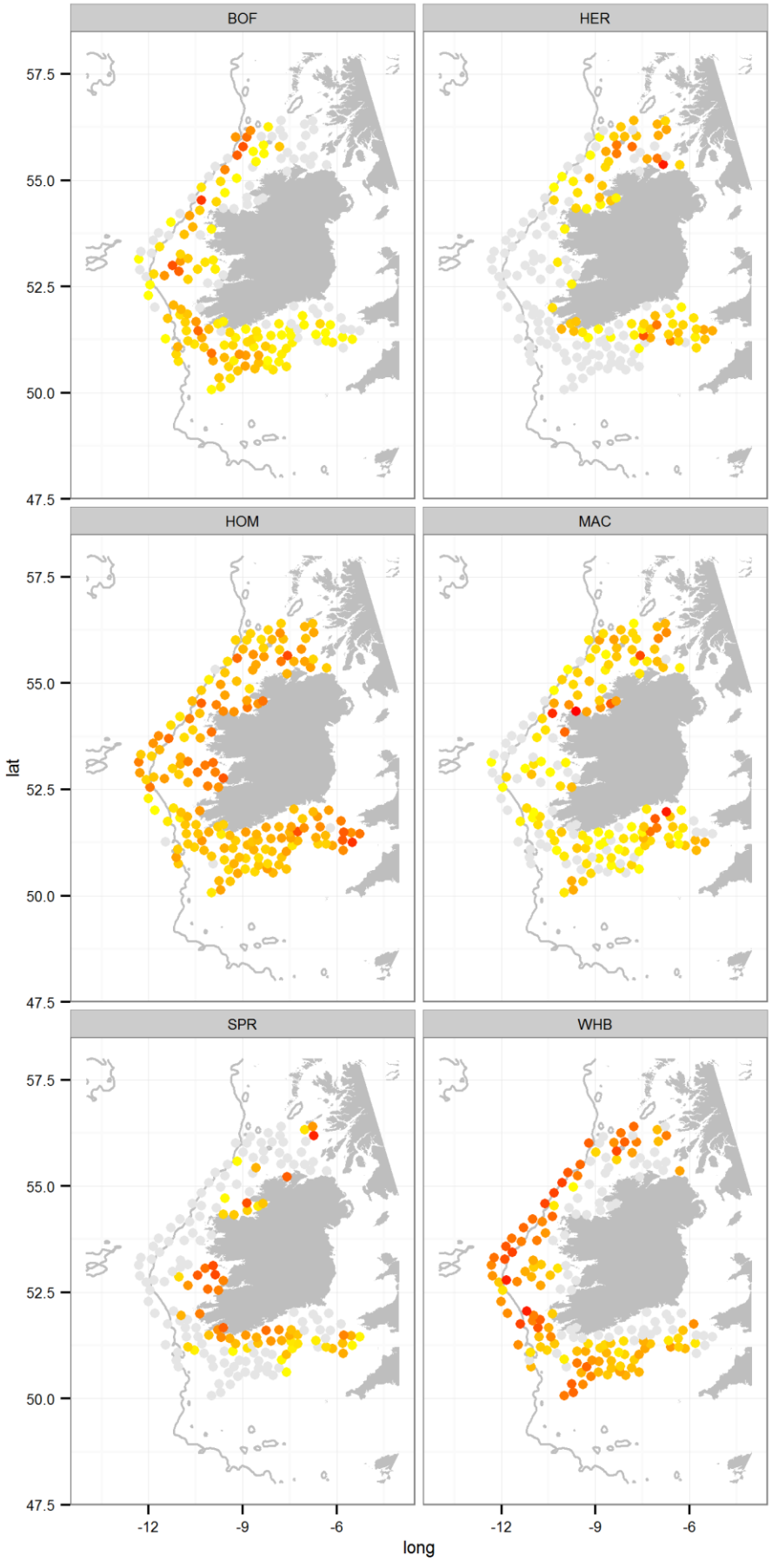


Distribution of six commercial roundfish and flatfish species as sampled on IGFS 2014, species codes are listed in Appendix 1.

Multiple species overviews: Pelagics

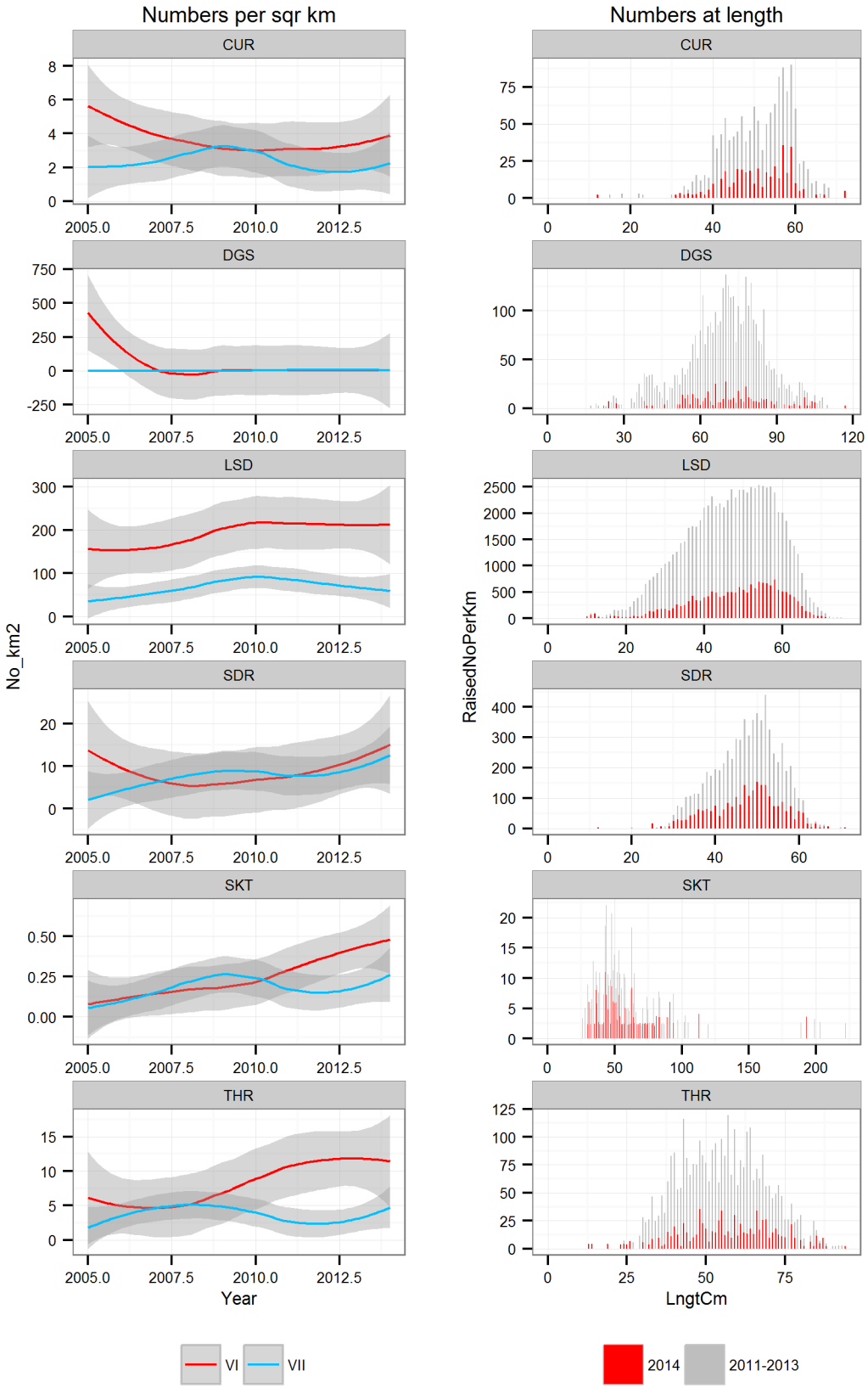


Abundance time series of six key pelagic species, sampled on IGFS, as No per km^2 between 2005 and 2014, with LOESS smoothed means by strata in ICES divisions VI and VII (left panel); length frequencies of the same species for IGFS2014 superimposed on their cumulative length frequencies of the previous three years (right panel). Species codes are listed in Appendix 1.



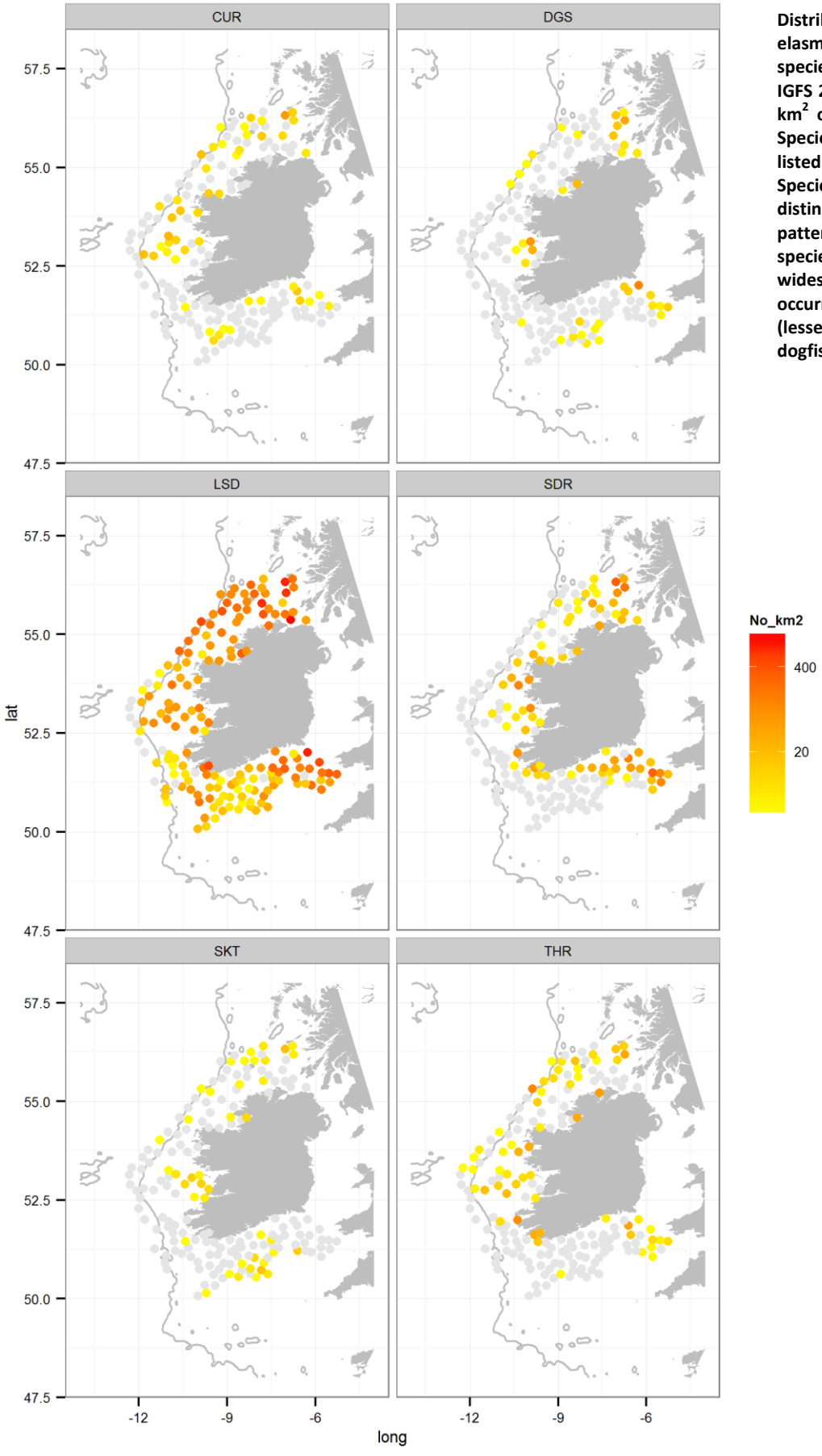
Distribution of 6 pelagic species, sampled on IGFS 2014 as No per km^2 on a log scale. Species codes are listed in Appendix 1. MAC (mackerel) and HOM (horse mackerel) show widespread distribution, boar fish and blue whiting are concentrated on the shelf edge and herring and sprat are more abundant inshore.

Multiple species overviews: Elasmobranchs



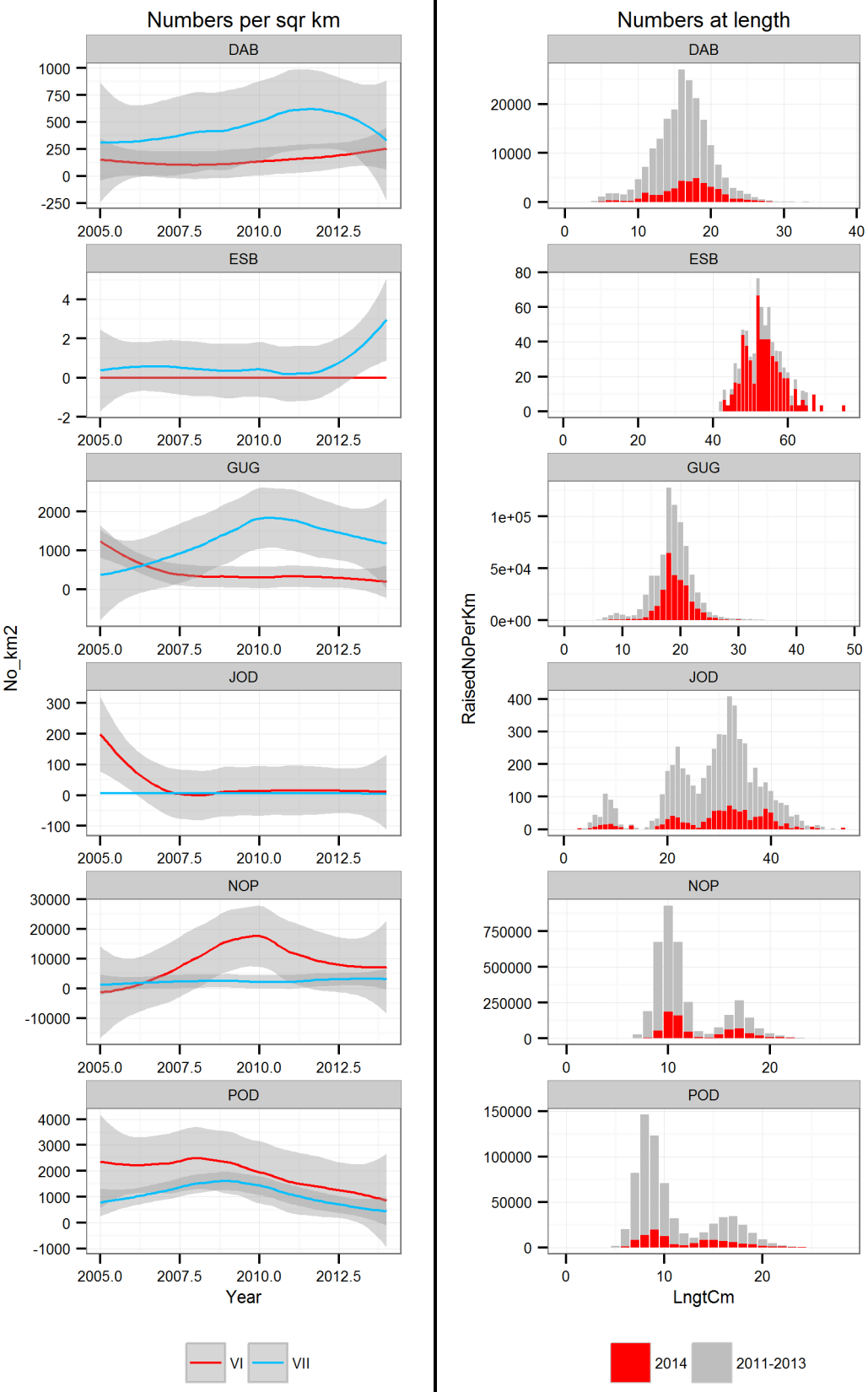
Abundance time series of six elasmobranch species, sampled on IGFS, as No per km^2 between 2005 and 2014, with LOESS smoothed means by strata in ICES divisions VI and VII (left panel); length frequencies of the same species for IGFS2014 superimposed on their cumulative length frequencies of the previous three years (right panel). Species codes are listed in Appendix 1.

Multiple species overviews: Elasmobranchs

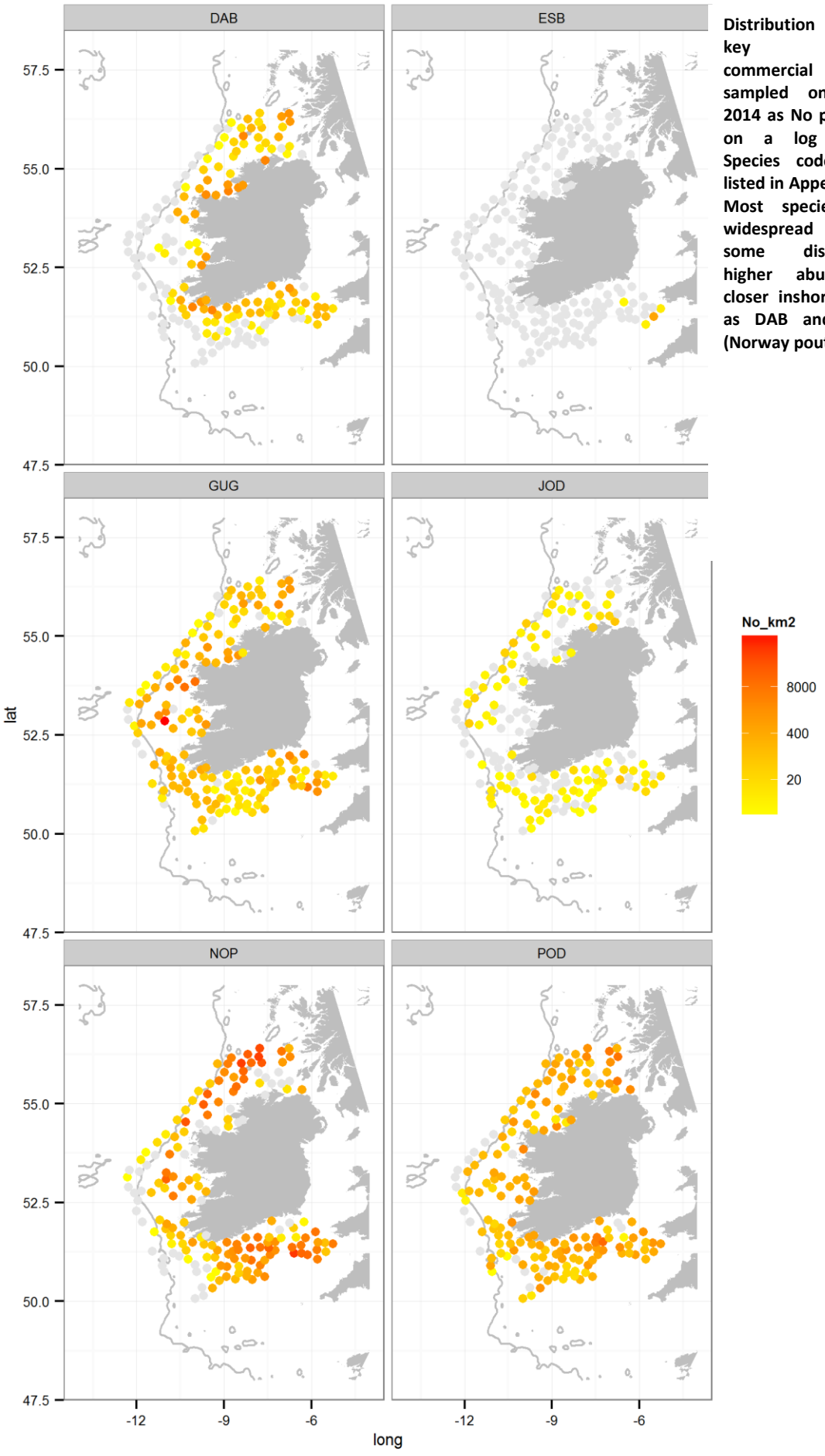


Distribution of six elasmobranch species, sampled on IGFS 2014 as No per km^2 on a log scale. Species codes are listed in Appendix 1. Species show distinct distribution patterns for most species with widespread occurrence for LSD (lesser spotted dogfish).

Multiple species overviews: Non-commercial species



Abundance time series of six non-commercial species, sampled on IGFS, as No per km^2 between 2005 and 2014, with LOESS smoothed means by strata in ICES divisions VI and VII (left panel); length frequencies of the same species for IGFS2014 superimposed on their cumulative length frequencies of the previous three years (right panel). Species codes are listed in Appendix 1.



Distribution of six key non-commercial species sampled on IGFS 2014 as No per km^2 on a log scale. Species codes are listed in Appendix 1. Most species are widespread with some displaying higher abundance closer inshore such as DAB and NOP (Norway pout).

7. Acknowledgements

This “eagerly awaited” IGFS2014 Survey Report is the culmination of much data, calibration, protocols, more protocols and quality checks over many hours at sea and back on land. Here we take the opportunity to acknowledge folks who underpin that substantial body of work annually. Our reliance on their collective and individual experience, commitment and good humour cannot be over stated.

From the skippers and crew of the Celtic Explorer who both support and thankfully actively engage with the survey process, to the students who bring an energy and quizzical nature to long days in the fish room. The work of the MI fisheries technical staff, both Galway and regional based is critical to completing the survey as well as the other MI scientists and management charged with ensuring the survey is of a standard to be of relevance to current marine resource management.

Thanks are due to the Oceanographic and Seabed Mapping sections of the MI for their continued support with the less biological data and very expensive equipment! Likewise Research Vessel Operations Team and P&O Maritime Services for their commitment in getting us to sea, and keeping us there!

Finally, we want to acknowledge the significant role played by our industry sourced gear specialists. Their skill, experience and tenacity continue to help translate the often protocol driven science of fisheries surveys into a reality, as well as encouraging some reality driven science back into the protocols!

8. Appendix

Tables of species codes used in report

Commercial:

HAD	Haddock	*Melanogrammus aeglefinus*
WHG	Whiting	*Merlangius merlangus*
HKE	European hake	*Merluccius merluccius*
COD	Atlantic cod	*Gadus morhua*

Elasmobranchs:

SDR	Spotted ray	*Raja montagui*
THR	Thornback ray (roker)	*Raja clavata*
CUR	Cuckoo ray	*Leucoraja naevus*
BLR	Blonde ray	*Raja brachyura*
PTR	Smalleyed (painted) ray	*Raja microocellata*
SHR	Shagreen ray	*Leucoraja fullonica*
SAR	Sandy ray	*Leucoraja circularis*
UNR	Undulate ray	*Raja undulata*
LSD	Lesser spotted dogfish	*Scyliorhinus canicula*
DGS	Spurdog	*Squalus acanthias*
SKT	Common skate	

Pelagics:

WHB	Blue whiting	*Micromesistius poutassou*
SPR	Sprat	*Sprattus sprattus*
HOM	Horse-mackerel (scad)	*Trachurus trachurus*
BOF	Boar fish	*Capros aper*
HER	Herring	*Clupea harengus*
GSS	Gt silver smelt	*Argentina silus*
ARG	Argentines	Argentinidae
MAC	(european) mackerel	*Scomber scombrus*

Non commercial

NOP	Norway pout	*Trisopterus esmarki*
POD	Poor cod	*Trisopterus minutus*
GUG	Grey gurnard	*Eutrigla (chelidonicthys) gurnardus*
DAB	Dab	*Limanda limanda*
JOD	John dory	*Zeus faber*
ESB	Seabass	*Dicentrarchus labrax*

Commercial Demersal and flat

PLE	European plaice	*Pleuronectes platessa*
MEG	Megrim	*Lepidorhombus whiffiagonis*
POK	Saithe	*Pollachius virens*
LBI	Four spot megrim	*Lepidorhombus boscii*
MON	Anglerfish (monk)	*Lophius piscatorius*
SOL	Sole (dover sole)	*Solea solea*