ICES IBTSWG Report 2005

ICES Resource Management Committee
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Report of the International Bottom Trawl Survey Working Group (IBTSWG)

29 March – 1 April 2005

Hamburg, Germany

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer
H.C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Contents

Executive Summary

The International Bottom Trawl Working Group (IBTSWG) has its origin in the North Sea, the Skagerrak and the Kattegat where coordinated surveys have occurred since 1965. Since 1994, the IBTSWG assumes responsibility for coordinating western and southern division surveys. The Working Group tasks also include standardisation of sampling protocols and strategies.

The Working Group met in Hamburg from 29 March to 1 April 2005. There were 17 participants from 11 countries all involved in designing and conducting bottom trawl surveys.

North Sea and Eastern Atlantic Surveys

According to the preliminary indices for the North Sea 2005 quarter 1, sprat produced an excellent year class in 2004. Also the recruitment of mackerel seems to be high; however, this high value is driven by two very large catches and should be taken with caution. The indices of the other five species were in 2005 all well below the long-term average of the past 25 years.

Eastern Atlantic surveys data cannot be aggregated yet due to the different gear used according to the different type of ground covered and the lack of some conversion factors. The 2004 raw survey results are presented by mean of maps of abundance per haul in order to provide some preliminary information on distribution of adults and juveniles (for most commercial species) to assessment Working Groups.

Standardisation of gear

Standardisation of gears and protocols is a major issue in survey coordination. There is a general feeling among the Working Group members that little progress has been made within the IBTSWG on topics related to gear technology. This is due to the lack of expertise in gear technology within the group members, leaving the necessary work to be done to external members of the group, inside national institutes, where hierarchies of priorities often lead to postpone the completion of the necessary work.

In the 2004 statutory meeting, the Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas was renamed Study Group on Survey Trawl Standardisation with enlarged competences including new survey trawl design, design of survey trawl standardisation program, operational requirements for intercalibration studies and quality control.

Given that new situation and comments from WGSSDS in relation to catchability of the current gear, the Working Group decided that the terms of references related to gear technology should be dealt within the SGSTS.

Intercalibration

Preliminary results from two intercalibration experiments were presented. One between two GOVs rigged with two different groundgears, the other between two vessels with the same trawl and ground gear, but slightly different doors. Although the results are based on a small number of hauls, they show differences in selectivity that cannot be explained by the type of rigging or differences in efficiency related to a vessel effect. The WG recommends investigating further these potential problems.

Quality assurance of species identification

Groundfish surveys provide the most appropriate data for the examination of large-scale spatial and temporal analyses of fish communities. IBTSWG recognises that quality assurance procedures, for example fishing protocols, catch sampling and sub-sampling, and fish identification, should be in place to ensure that data collection is appropriate for community analyses

wherever practicable. Amongst actions undertaken by the WG, an application on CD-ROM is under development in order to provide a photo based international identification guide for fish, shellfish and benthos. Catch sampling protocols have been reviewed and recommendations made.

Progress on the Norwegian Survey trawl project

The objectives of this project are to develop a demersal trawl design that has potential for taking quantitative catches of fish in a survey area, and to evaluate the variability in gear performance and catch efficiency of the developed trawl design and its rigging. A prototype trawl was tested in a flume tank (scale 1:10). The tests gave a trawl height of 6–9 m, and a trawl width of about 30–40 m. Besides, a plate gear with 50 cm plates was compared with a 14" rock hopper gear. The future work will be testing of 1:2 scale trawls in April–May 2005, full scale testing in September–October 2005 and evaluation of the stability of gear performance and efficiency for target fish species in 2006 and 2007.

Datras database

Problems have been identified in the computation of North Sea indices within the new DATRAS database. Tests were conducted and as it is impossible to decide whatever the differences are due to change in data or in errors in calculation ICES HQ has decide to make a test dataset where the final indices are known and to carry further testing.

The protocol on access to the DATRAS database that was presented in the IBTSWG 2004 report was discussed and some minor alterations were suggested. IBTSWG agreed that access to various forms of IBTS data should be improved. Though IBTSWG were not able to agree a change to the current access policy at the meeting, and so that there would be no immediate change, they discussed potential policies and hope to propose a new access policy for 2006.

Review of the WKSAD report

Outcome from the WKSAD were discussed and recommendations were made on survey reporting format, estimates of precision and potential use of multivariate analysis of gear parameters and possibly environmental factors as measure of survey catchability.

Check of the ALK data per roundfish area

The analysis was done by ship and not by RF area as recommended in order to make it easier to track errors back to the source. The members of IBTS were provided with tables with all the problems found and where asked to investigate the problems and report back to ICES if update to the database are needed.

Stratification in Eastern Atlantic and Skagerrak

A stratification scheme was agreed for the Celtic Sea and the Bay of Biscay. It is hopped that these bathymetric strata can also be extended northwards off the western coasts of Ireland and Scotland. Comparable strata will be developed for the Irish Sea, though the sedimentary environment in this area will also be incorporated in strata design, as sediment type and bathymetry are key determinants for assemblages in this region.

For the Skagerrak area, results from a study on sensitivity of indices to changes in the sampling design were presented. The Working Group recommends Sweden to change their sampling design in the Skagerrak in their Q3 survey for three years and thereafter re-analyse the indices as a quality measure. The WG also suggest that Sweden analyse the relationship between species composition, bottom types and the proposed depth strata.

Miscellaneous studies and experimental designs

Conclusions from the CATEFA ("Combining Acoustic and Trawl data to Estimate Fish Abundance") project were presented to the WG. Based on the conclusions of the main analyses, recommendations were made on future research subjects key to achieving further progress on combining acoustic and trawls, and a protocol for combined trawl-acoustic surveys was submitted to the ICES IBTS Working Group for consideration. The WG concluded that given the results obtained till now and the extra-work/personnel needed it was not sensible to extend this protocol to all IBTS surveys although further investigation could be useful.

During the IBTS survey in February 2005, it was planned to reinforce IBTS larval survey by coupling the MIK net to an internal and fixed CUFES (Continuous Underway Fish Egg Sampler at 3m depth) available onboard the French Research Vessel "Thalassa". This pilot survey coupled both techniques (MIK and CUFES) to compare the number of species eggs caught and identified using both devices. At the moment, no results are yet available for lack of expertise in eggs identification and the IFREMER centre of Boulogne-sur-mer is looking for partners who would be interested in collaborating with it to increase the value of the CUFES survey.

1 Terms of reference and participation

The **International Bottom Trawl Survey Working Group** [IBTSWG] (Chair: J.-C. Mahé, France) will meet in Hamburg, Germany, from 29 March to 1 April 2005 to:

a) coordinate and plan North Sea and North-Eastern Atlantic surveys for the next twelve months;

b) further develop protocols and criteria to ensure standardization of all sampling tools and survey gears and review institutional checking lists;

c) investigate the adequacy of some fishing protocol defined in the IBTS manual from ancient studies with respect to the most recent data available from modern monitoring of gear performances;

d) review the GOV specifications with respect to the actual material available for construction;

e) review the progress made in the Norwegian survey trawl project;

f) review and comment on the new DATRAS database;

g) review the outcome of the Survey design and data analysis Workshop (WKSAD) in be held in Aberdeen, June 2004;

h) make a detailed check of the age/length/sex/maturity data for the last 3 years from the ICES database per roundfish area;

i) review the progress made in defining a stratification scheme for the Eastern Atlantic and the Skagerrak.

IBTSWG will report by 15 April 2005 for the attention of the Resource Management Committee.

The meeting was attended by:

Helle Andersen	Denmark
Palle Brogaard	Denmark
Finlay Burns	UK (Scotland)
Corina Chaves	Portugal
Ken Coull	UK (Scotland)
Siegfried Ehrich	Germany
Jim Ellis	UK (England)
Brian Harley	UK (England)
Joakim Hjelm	Sweden
Remment ter Hofstede	Netherlands
Lena Larsen	ICES Secretariat
Jean-Claude Mahé (Chair)	France
Ann-Christin Rudolphi	Sweden
Odd Smedstad	Norway
David Stokes	Ireland
Francisco Velasco	Spain
Yves Verin	France

2 Introduction

The International Bottom Trawl Working Group (IBTSWG) has its origin in the North Sea, the Skagerrak and the Kattegat where coordinated surveys have occurred since 1965. Initially these surveys only took place during the first quarter of the year, but between 1991 and 1996 coordinated surveys took place in all four quarters of the year. Pressure on ship time caused the number of surveys to be reduced and currently coordinated surveys in the North Sea are only undertaken in the first and third quarters.

The IBTSWG assumed responsibility for coordinating western and southern division surveys in 1994. Initially progress in coordination was slow but in the last few years there has been a marked improvement and whilst data exchange etc. is not at the level of that enjoyed in the North Sea, there is excellent cooperation between the participating institutes.

Standardisation of gears and protocols is a major issue in survey coordination. Over the most recent years, the Working Group attempted to address issues related to technical aspects of the gears, including technical specification and gear performance monitoring but with little progress made. Since the IBTSWG 2004 meeting, a dedicated Study Group was created to address more particularly these aspects and therefore the Working Group decided to redirect the ToRs b to d to this Study group with specific questions. More details are provided in Section 5 of this report.

3 Review of IBTSWG 2004 recommendations

3.1 Surveys planning and coordination

3.1.1 MIK recommendation

In 2004 IBTS reiterated the recommendation made in 2003 that "*all countries participating in the Quarter 1 survey in the North Sea, the Skagerrak and the Kattegat to use a MIK as specified in the IBTS Manual and to use a well balanced and calibrated flow-meter*". The flow-meter should be attached to the MIK-frame correctly. Since then, Scotland has sought advice from other participants of the Herring Working Group and the consensus view was that the Methot Net used by them was acceptable provided they could support their results with suitable flow-meter readings. Scotland has now obtained a suitable flow-meter and this was used during the quarter 1 survey of 2005. Finance has been requested from the 2005 – 2006 Budget and if granted, Scotland will purchase the MIK as specified in the IBTS manual.

3.1.2 GOV modification for UK 2004 survey

The changes to the gear presented to the WG and described above are against all recommendations and was considered by the group to likely have changes in the catchability and strongly recommends that they are abandoned.

This recommendation was implemented.

3.1.3 Intercalibration in the Eastern Atlantic

The IBTSWG recommended that some overlap in the Portuguese Groundfish Survey with the Spanish North Coast Survey and or the Spanish Gulf of Cadiz Survey be established in order to maintain a dataset for ongoing or future calibration work.

The Working Group was informed that this recommendation is in process to be implemented.

The only gear used in the IBTS North Eastern Atlantic area that has not been intercalibrated with a second gear is the Porcupine Baca, an inter-calibration experiment with the Irish survey in Western Ireland is thus recommended.

There is an internal request within the relevant institutes to move survey dates to facilitate this intercalibration.

3.1.4 ½ hr vs 1hr tow in Portuguese surveys

From this work it was concluded that a change in tow duration may lead to an interruption of the current CPUE series for blue whiting, horse mackerel, and probably also for other species with similar behaviour. The number or calibration hauls may be insufficient to assess the ef-

fect of tow duration on the relative length composition of the catches. Therefore the Working Group recommends to carryout additional parallel tows of 1 hour versus ½ hour duration during the Portuguese Groundfish Survey, noting that this will require additional ship time.

Not programmed yet, this recommendation is reiterated.

3.1.5 North Sea GOV specifications

Although it cannot be concluded that most of the changes are minor (e.g. slight increase in twine diameter) and would not affect the overall performance and catchability of the gear, the WG recommends that this should be investigated. A first step could be that these changes be investigated by mean of numerical simulation. It was also recommended to conduct a review the GOV specifications with respect to the actual material available for construction.

See Section 5.

3.1.6 Review of Age/length/sex/maturity data

It is therefore recommended that an investigation into the origin of all the missing values will be performed, in order to find out whether the data about age and maturity stage really hasn't been collected, or whether a problem has occurred, for instance in the transfer of the data from the institutes to ICES.

Finally, it is recommended to additionally check the age/length/sex/maturity data from the ICES database by round fish area.

See Section 9.

3.1.7 Depth stratification

The Working Group recommends Sweden to change their sampling design in the Skagerrak because Sweden is not covering the entire area. However, the WG recognises the problem with breaking a long time series and suggest that Sweden keeps as many hauls as possible from previous years but at the same time try to cover all rectangles with at least 1 haul where ever possible. It was also suggested that a sensitivity analysis should be made prior the change of sampling design. The WG has also noticed that Sweden has in some rectangles up to six hauls that could be allocated elsewhere.

See Section 10.

3.1.8 Quality control – species identification

It is recommended that the ICES Working Group on Fish Ecology (WGFE) is asked to comment on this issue.

See Section 5.3.

4 North Sea and Eastern Atlantic Surveys (ToR a)

4.1 Q1 North Sea

Six vessels participated in the quarter 1 survey in 2005: “Argos” (Sweden), “Dana” (Denmark), “Håkon Mosby” (Norway), “Scotia” (Scotland), “Thalassa” (France), “Tridens” (Netherlands), and “Walter Herwig III” (Germany). The survey covered the period January 17th to March 8th. In total, 380 GOV hauls and 523 MIK hauls were done (see Figure 4.1.1). Most rectangles were covered by the desired two or more GOV hauls. The number per rectangle of MIK hauls was often below the intended 4 hauls, but still the coverage of the MIK sampling can also be considered as good.

The preliminary indices for the 2005 quarter 1 survey are shown in Figure 4.1.2. According to these preliminary results, sprat produced an excellent year class in 2004, approximately 3 times higher than the long-term average since 1980.

Also the recruitment of mackerel seems to be good; however, the high index in 2005 is caused by only two extreme large catches of 1-group mackerel near the Shetland's (see Figure 4.1.3). If one neglect these two hauls, the value of the index of young mackerel in 2005 lies just below the long-term average.

The indices of the other five species were in 2005 all well below the long-term average of the past 25 years. The catch of 1-group herring was in the same order as in 2004, and accordingly much lower than in the previous four years. This confirms the low numbers of herring larvae caught during the 2003 and 2004 quarter 1 IBTS. The catches of young cod, whiting and Norway pout are merely about a quarter of the long-term average. The index of 1-group haddock is most disappointing in 2005, 10% of its long-term average.

MIK sampling showed a low abundance of herring larvae (see also Section 4.1.1).

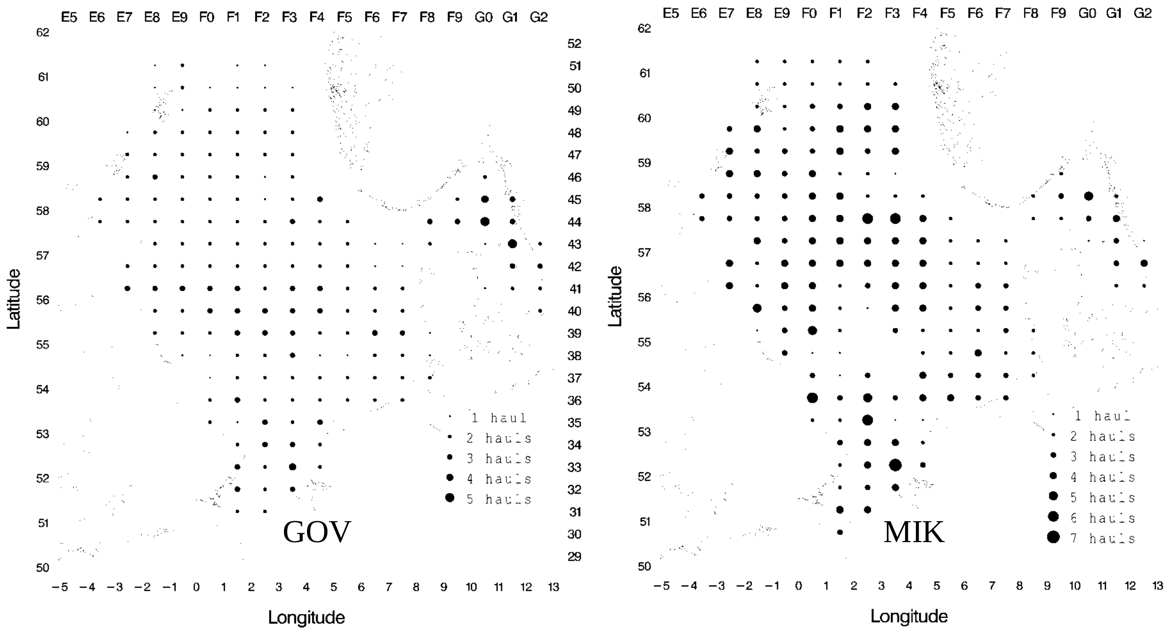
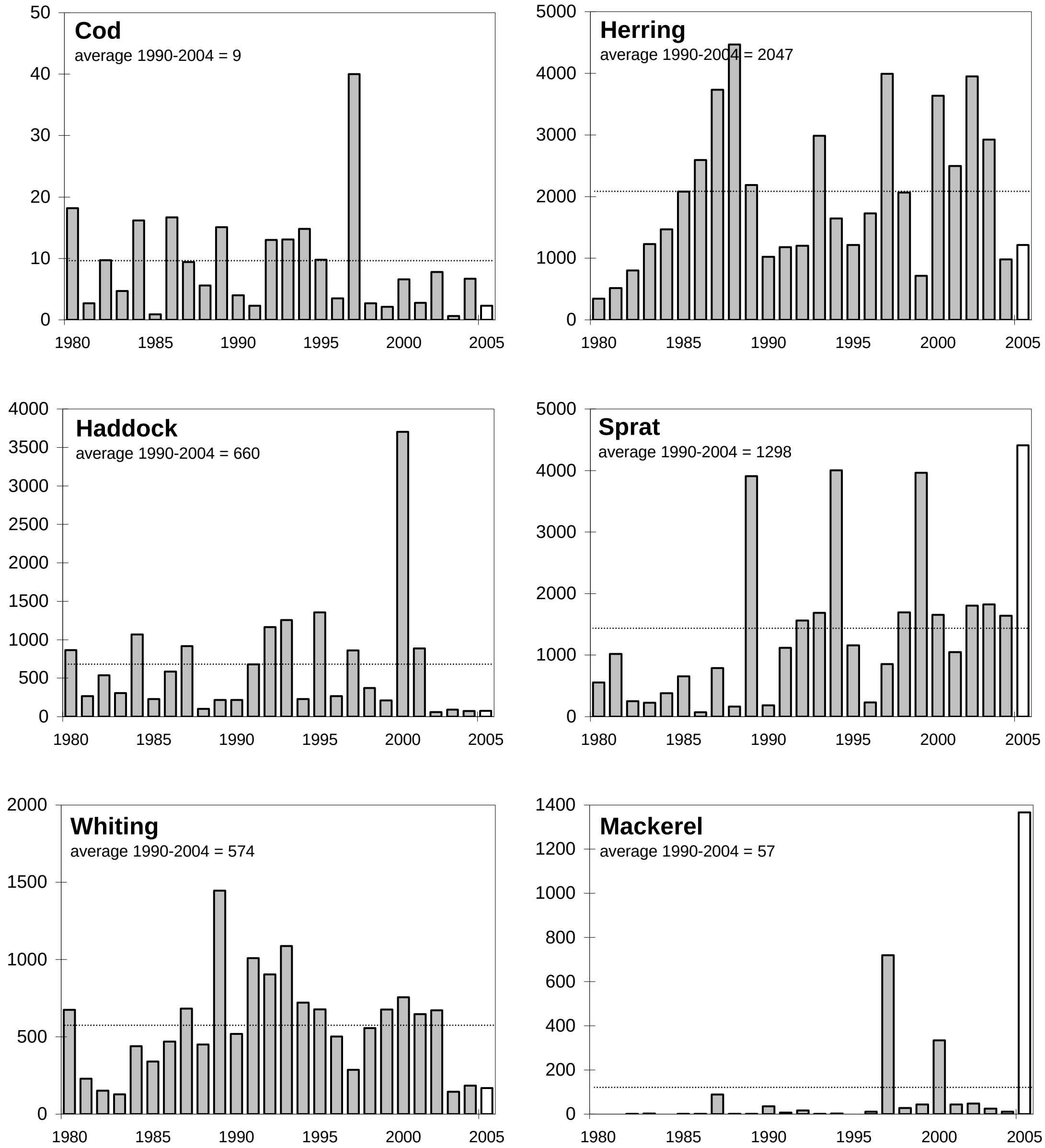
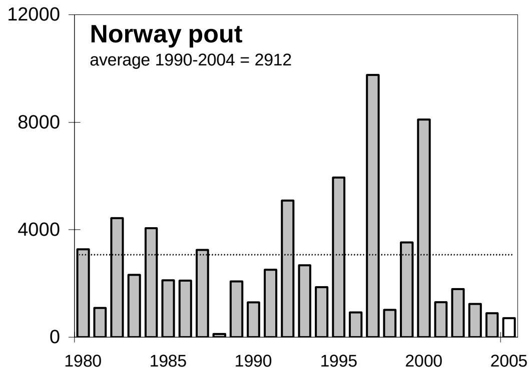


Figure 4.1.1: Number of hauls per ICES-rectangle with GOV (left) and MIK (right) during the IBTS Q1 2005.





	final 2004	preliminary 2005	average av 80-04
cod	6.7	**2.3**	9
haddock	72	**74**	660
whiting	184	**169**	574
Norway pout	893	**706**	2912
herring	979	**1213**	2047
sprat	1639	**4408**	1298
mackerel	10.4	**1366**	57

Figure 4.1.2: Time series of indices for 1-group (1-ring) fish caught during the quarter 1 IBTS survey in the North Sea. Indices for the last year are preliminary, and based on a length split of the catches.

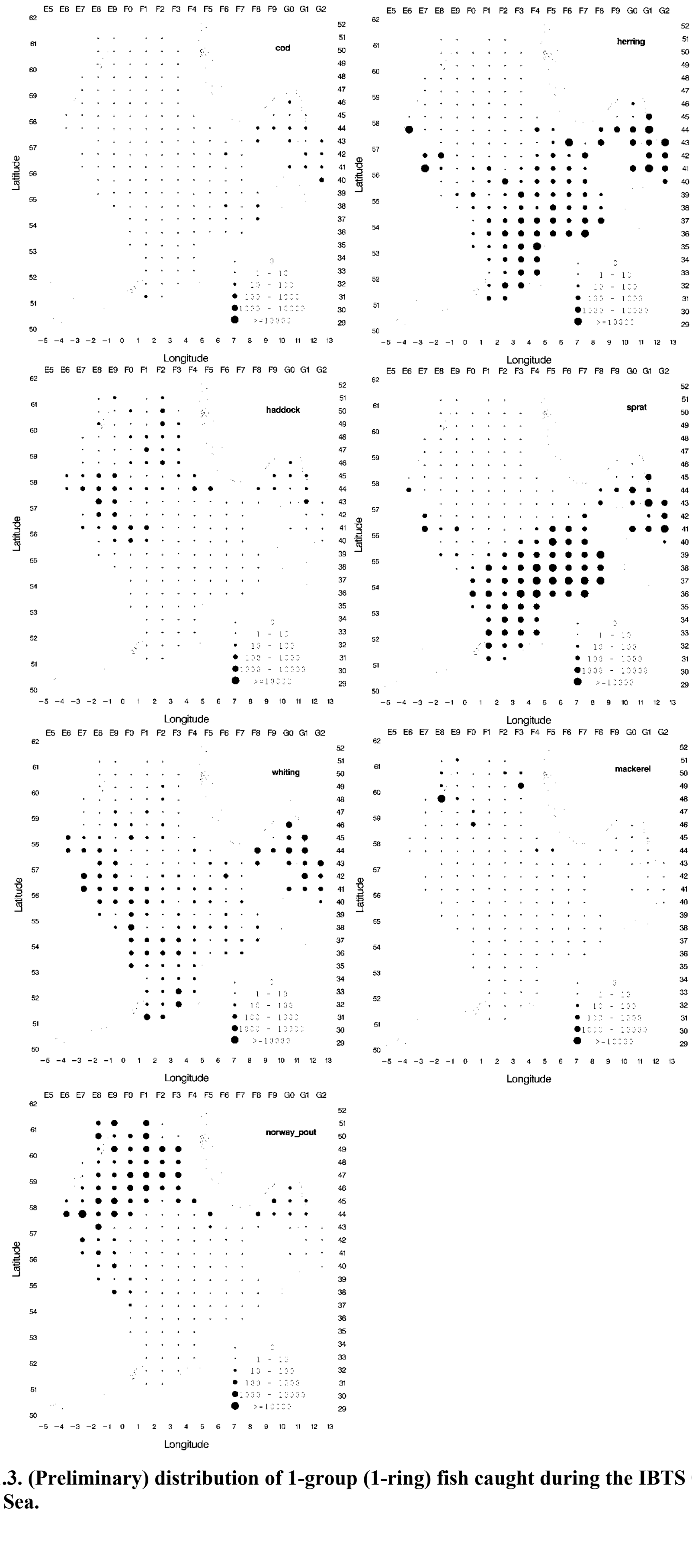


Figure 4.1.3. (Preliminary) distribution of 1-group (1-ring) fish caught during the IBTS Q1 2005 in the North Sea.

4.1.1 Exclusion of rectangles

Denmark has requested to drop the execution of GOV-hauls in rectangles in 37E9 and 38E8 since the bottom in these areas is very rough and causes serious damage to the gear. France mentions to have the same problem in these areas. It is taken into consideration that rectangle 38E8 has not been fished properly anyway in the past (Table 4.1.1), and the exclusion of the two rectangles only affects the calculation of indices for herring (37E9) and sprat (37E9 and 38E8) (Table 4.1.2).

The Working Group recommends excluding rectangles 37E9 and 38E8 from the IBTS quarter 1 GOV-program in the future due to rough grounds.

Table 4.1.1: Executed GOV-hauls since 1983 in rectangles 37E9 and 38E8 during the North Sea IBTS quarter 1 survey.

Rectangle	Country	Year	Quarter	HaulVal
37E9	SCO	1984	1	valid
	GFR	1985	1	valid
	FRA	1991	1	valid
	DEN	1992	1	valid
	FRA	1992	1	valid
	FRA	1993	1	valid
	FRA	1994	1	valid
	DEN	1995	1	valid
	FRA	1995	1	valid
	DEN	1996	1	valid
	FRA	1997	1	valid
	FRA	1998	1	valid
	FRA	2000	1	valid
	ENG	2001	1	valid
	FRA	2001	1	valid
	ENG	2002	1	valid
	FRA	2002	1	valid
	ENG	2003	1	valid
	NED	2004	1	valid
38E8	.	.	.	.

Rectangle	Country	Year	Quarter	HaulVal
37E9	NED	1984	1	invalid
	ENG	1985	1	invalid
	DEN	1999	1	invalid
	NED	2004	1	invalid
38E8	.	.	.	.

Table 4.1.2: Rectangles used in the calculation of 1-group indices.

species	37E9	38E8
herring	y	n
cod	n	n
haddock	n	n
whiting	n	n
npout	n	n
sprat	y	y
mackerel	n	n

4.1.2 NS Herring Assessment – MIK sampling

For the ICES Herring Assessment Working Group for the area south of 62°N (HAWG) the IBTS survey provides recruitment indices for herring and sprat. Examinations of the catch data from the 1st quarter IBTS have shown that catch during the surveys also indicates abundances of the adult stages of herring. As sampling at night with fine-meshed nets (MIK) was implemented from 1977 the catch of large herring larvae has been used for estimation of 0-ringer abundance in the survey area.

Indices of 2–5+ ringer herring abundances

Fishing gear and survey practices were standardised from 1983, and herring abundance estimates of 2–5+ ringers from 1983 onwards has shown the most consistent results in assessments of these age groups. This series is subsequently used in North Sea herring assessment.

Index of herring 1-ringer recruitment

The 1-ringer index of recruitment is based on trawl catches in the entire survey area. This year's estimate of the 2003 year class strength indicates a very low recruitment, among the lowest on record.

Figure 4.1.4 illustrates the spatial distribution of 1-ringers as estimated by the trawling in February 2003, 2004 and 2005. In 2005 the main concentrations of 1-ringers were found in the southeastern part of the North Sea.

Index of 0-ringer recruitment (MIK-index)

The estimate of the 2004 year class indicates a very low recruitment, of the same size as estimated for the last two year classes, 2002 and 2003. The 0-ringers were distributed westerly and southerly in the North Sea with highest concentrations in the southwestern areas (see Figure 4.1.5). However, compared to the preceding two year classes, which is also shown in Figure 4.1.5, the 0-ringers of this year class are distributed in a wider area of the North Sea.

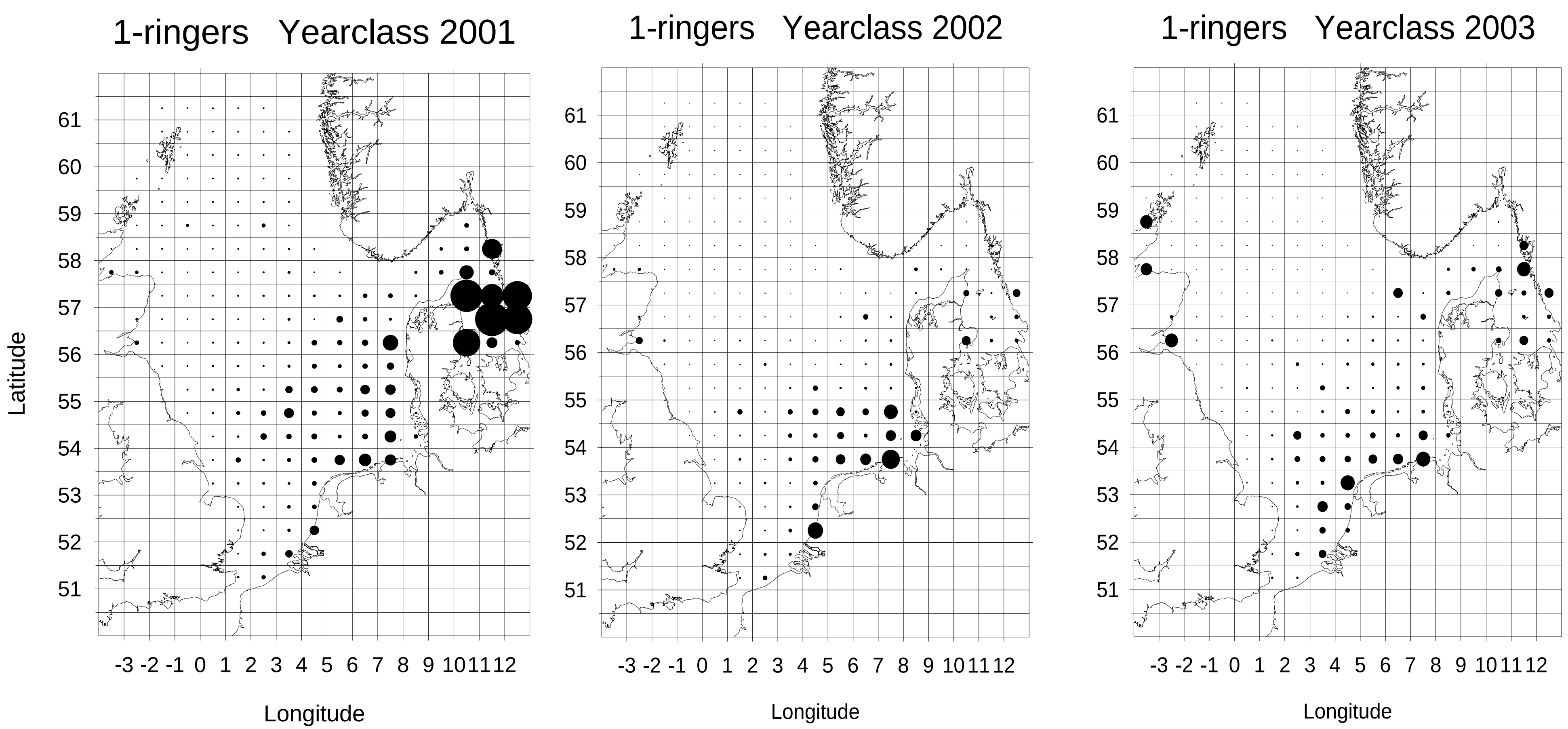


Figure 4.1.4: North Sea herring. Distribution of 1-ringer herring, year classes 2001–2003. Abundance estimates of 1-ringers within each statistical rectangle are based on GOV catches during IBTS in February 2003–2005. Areas of filled circles illustrate numbers per hour, the area of a circle extending to the border of a rectangle represents 45000 h^{-1}

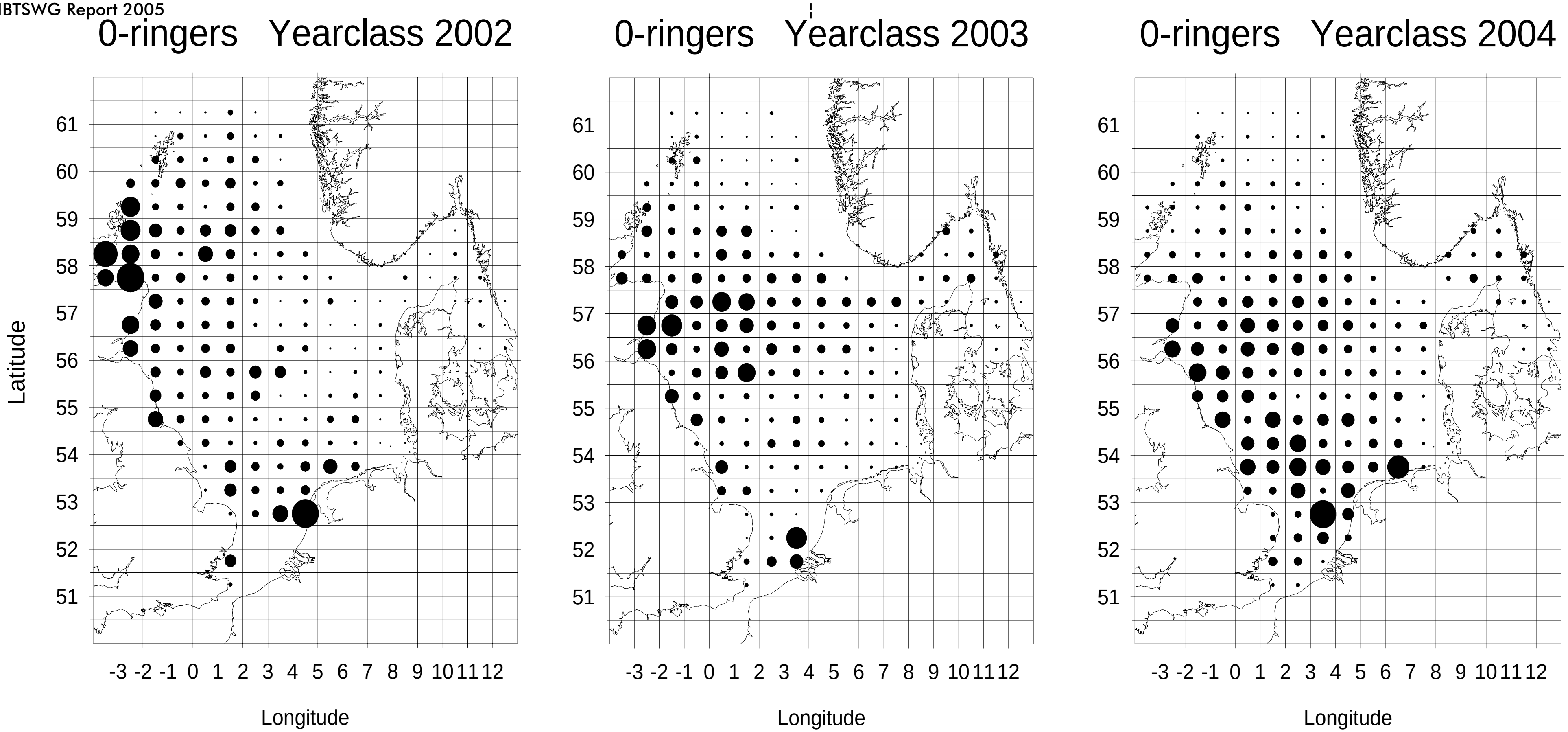


Figure 4.1.5: North Sea herring. Distribution of 0-ringer herring, year classes 2002–2004. Abundance estimates of 0-ringers within each statistical rectangle are based on MIK catches during IBTS in February 2003–2005. Areas of filled circles illustrate densities in no m^{-2}, the area of a circle extending to the border of a rectangle represents 1 m^{-2}.

4.1.3 Time series of 60 North Sea fish species based on IBTS–Q1 data

Based on the IBTS quarter 1 data series, RIVO (Netherlands) has calculated time series of 60 North Sea fish species for the years 1977 to 2004 (see table 4.1.3). The analysis has been restricted to the more common species, and to species that are of importance for the south-eastern North Sea. The series are based on average catches per roundfish area, all length classes combined (see Figure 4.1.6).

For each species, 9 plots are presented, based on a logarithmic scale: for roundfish areas 1 to 7 separately, for areas 8 and 9 combined, and for the average North Sea value (for area 1 to 7). This enables a comparison of the result per area with the total North Sea picture. Furthermore, for each species, the average North Sea catch is given on a linear scale. A short description of the results is given per species, including an indication of the overall North Sea trend.

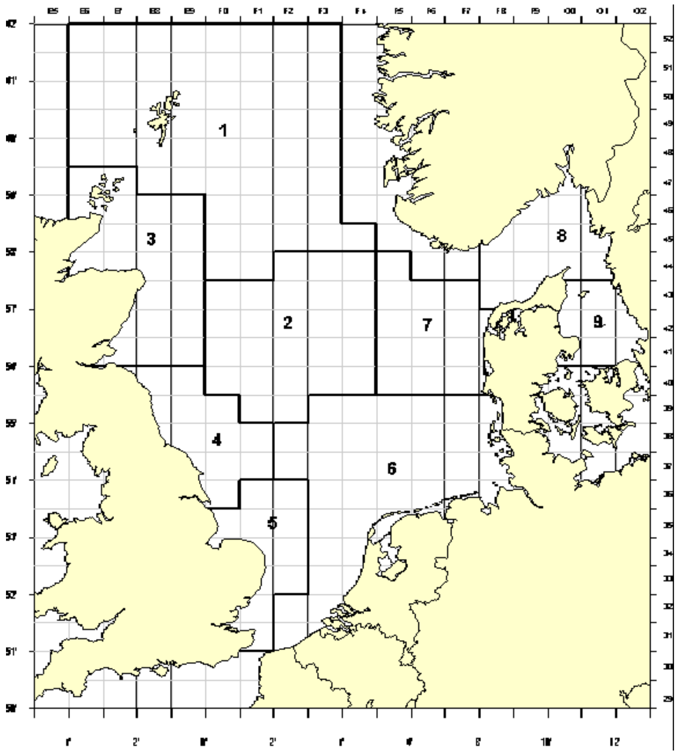


Figure 4.1.6: North Sea roundfish areas.

Table 4.1.3: Species of which time series have been analyzed (presented in taxonomical order).

1. Scyliorhinus canicula	*21. Pollachius virens*	*41. Trigla lucerna*
2. Squalus acanthias	*22. Trisopterus esmarki*	*42. Myoxocephalus scorpius*
3. Mustelus mustelus	*23. Trisopterus luscus*	*43. Agonus cataphractus*
4. Mustelus asterias	*24. Trisopterus minutus*	*44. Cyclopterus lumpus*
5. Raja radiata	*25. Ciliata mustela*	*45. Liparis liparis*
6. Raja naevus	*26. Gaidropsurus vulgaris*	*46. Lepidorhombus whiffiagonis*
7. Raja clavata	*27. Molva molva*	*47. Phrynorhombus norvegicus*
8. Raja montagui	*28. Enchelyopus cimbrius*	*48. Psetta maxima*
9. Alosa fallax	*29. Trachurus trachurus*	*49. Scophthalmus rhombus*
10. Clupea harengus	*30. Mullus surmuletus*	*50. Arnoglossus laterna*
11. Sardina pilchardus	*31. Echiichthys vipera*	*51. Glyptocephalus cynoglossus*
12. Sprattus sprattus	*32. Scomber scombrus*	*52. Hippoglossoides platessoides*
13. Engraulis encrasicolus	*33. Callionymus lyra*	*53. Hippoglossus hippoglossus*
14. Merluccius merluccius	*34. Callionymus reticulatus*	*54. Limanda limanda*
15. Gadiculus argenteus	*35. Callionymus maculatus*	*55. Microstomus kitt*
16. Gadus morhua	*36. Anarhichas lupus*	*56. Platichthys flesus*

17. Melanogrammus aeglefinus	*37. Helicolenus dactylopterus*	*57. Pleuronectes platessa*
18. Merlangius merlangus	*38. Sebastes viviparus*	*58. Buglossidium luteum*
19. Micromesistius poutassou	*39. Aspitrigla cuculus*	*59. Solea vulgaris*
20. Pollachius pollachius	*40. Eutrigla gurnardus*	*60. Lophius piscatorius*

Over the period investigated considerable changes have taken place in the composition of the fish community of the North Sea. In a number of species no long-term trend can be detected, but several others have increased over the observed period and some species have shown a decrease. Most of the species that increased have no or a rather low commercial value. The observed decreases are most likely due to a considerable fishing pressure, and some of the increases may be attributed to species that have filled gaps in the ecosystem. But also the effect of gradual climate changes may play a role, both regarding declining and increasing species.

Quite a number of species have shown a remarkable increase over the years 1977 to 2004: *Scyliorhinus canicula* (lesser-spotted dogfish), *Enchelyopus cimbrius* and *Ciliata mustela* (4- and 5-bearded rockling), *Scomber scombrus* (mackerel) and *Trachurus trachurus* (horse mackerel), *Echyichthus vipera* (lesser weever), possibly *Callionymus maculatus* (spotted dragonet), *Aspitrigla cuculus* and E*utrigla gurnadus* (red and grey gurnard), and the flatfish species *Limanda limanda* (dab), *Hippoglossoides platessoides* (American plaice), *Microstomus kitt* (lemon sole) and *Buglossidium luteum* (solenette). Except for mackerel and horse mackerel, these are mainly species for which no directed fishery exists.

A few species only have shown an increase approximately since 1990. These are *Mustelus asterias* (starry smooth hound), *Alosa fallax* (twaite shad), *Mullus surmuletus* (red mullet) and *Arnoglossus laterna* (scaldfish). *Engraulis encrasicolus* (anchovy) has increased since the mid 1990ies.

Some other species showed an increase during the first part of the time series and were later at a more or less stable level. These are *Clupea harengus* (herring), *Platichthys flesus* (flounder) and *Pleuronectes platessa* (plaice).

The few species that have shown a decrease are *Gadus morhua* (cod), *Squalus acanthias* (spurdog) and *Anarhichas lupus* (catfish). All three are large-sized species, the first one a major commercially important species while the latter two are landed as a bycatch and have a relatively low fecundity.

4.1.4 Participation in 2006

As yet, there are no signals that effort will decrease in 2006. The timing of the surveys will be broadly in line with recent years.

Denmark mentions that the DANA might be on a world cruise during the first quarter of 2007, although nothing can be confirmed yet. If the DANA is not able to join the IBTS quarter 1 in 2007, Denmark assures to execute the survey with another vessel, of course using the prescribed fishing equipment.

4.2 Q3 North Sea

Six vessels participated in the quarter three survey in 2004: "Dana" (Denmark), "Walter Herwig III" (Germany), "Håkon Mosby" (Norway), "Argos" (Sweden), "CEFAS Endeavour" (England) and "Scotia" (Scotland). In all, 340 valid GOV hauls were made, allowing full coverage of the survey area. The North Sea, Skagerrak and Kattegat quarter 3 surveys have now completed 15 years in its coordinated form. Table 4.2.1 shows the effort ascribed to this survey over the time series. Good coverage of the area had continued until 2000 when, unfortunately Sweden withdrew their vessel at very short notice. As a consequence the Skagerrak and Kattegat were not surveyed that year. Up to present only data from the separate Scottish and English elements of this survey have been used each year in the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). Towards satisfying a recommendation from the report of this Working Group in 2003, a spreadsheet has been made available containing preliminary data for the target species for the years 1998 to 2004.

Table 4.2.1: Number of valid hauls and days at sea per country for quarter 3 surveys 1991–2004 and number of days proposed for 2005.

Year		Denmark	France	Germany	Netherlands	Norway	Sweden	UK/England	UK/Scotland	Total
1991	Days				19		15	27	20	81
	Hauls				73		52	87	90	302
1992	Days		17	12	11		15	31	20	106
	Hauls		61	48	32		52	72	87	353
1993	Days		19		17		15	27	20	98
	Hauls		70		65		53	71	87	346
1994	Days		19		10		15	23	20	87
	Hauls		55		42		53	73	89	312
1995	Days				9		15	30	20	74
	Hauls				34		53	74	89	250
1996	Days		32	8	5		15	27	20	107
	Hauls		56	32	17		53	79	85	323
1997	Days			8	8		15	26	20	77
	Hauls			32	18		46	74	88	258
1998	Days	14		8			15	28	18	83
	Hauls	51		28			48	74	77	278
1999	Days	15		9		26	15	28	21	114
	Hauls	53		32		75	47	74	83	364
2000	Days	15		7		21		28	18	89
	Hauls	60		26		69		75	87	317
2001	Days	16		8		20	15	28	22	109
	Hauls	56		29		49	46	74	87	341
2002	Days	18		13		28	15	32	23	129
	Hauls	47		32		57	46	75	85	342
2003	Days	18		10		26	23	32	26	134
	Hauls	46		29		61	48	75	86	345
2004	Days	18		11		30	15	29	27	130
	Hauls	46		29		56	46	75	87	339
2005*	Days	18		11		30	15	32	27	130

***Preliminary**

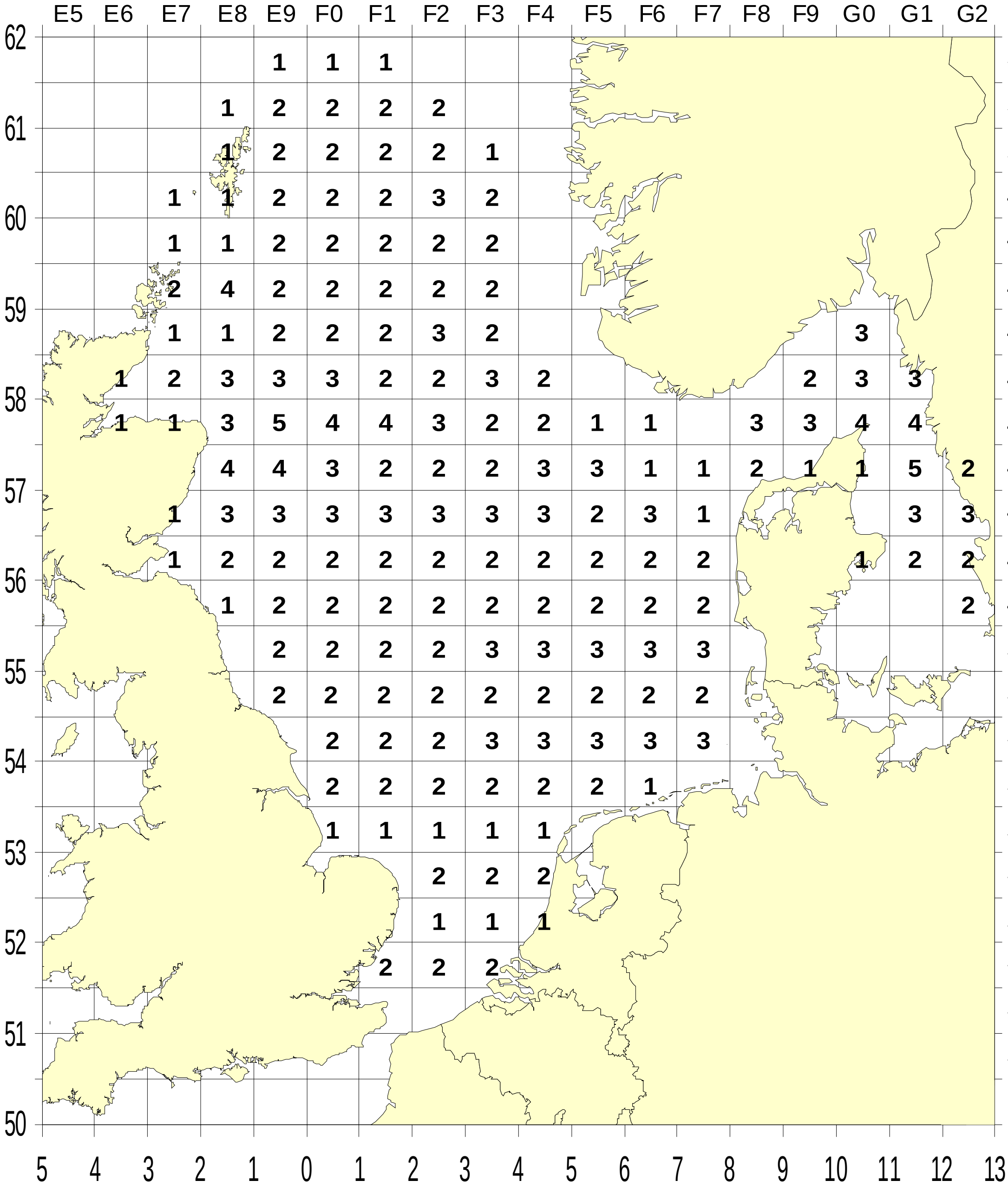


Figure 4.2.1: Plot of number of stations fished by rectangle by all participants of the 3rd Quarter IBTS survey 2004.

4.2.1 Cruise summaries

A brief description of each cruise follows:

Denmark – The Dana sailed on 21st August and completed 46 IBTS stations, 42 with groundgear A and four with rock hopper gear. 46 CTD deployments were made.

Germany – The cruise of the "Walther Herwig III" started on the 26th of July and ended on the 26th of August 2004. The objectives were to participate in the Q3 IBTS in the North Sea and to monitor the fish fauna and the benthic epifauna in 6 small areas (part of the German Small-Scale Bottom Trawl Survey; GSBTS). At the allocated 29 stations of IBTS Q3 survey, the GOV in the standard version was used and a CTD combined with a water sampler was deployed to get temperature and salinity profiles and data on nutrients. The 2m-beamtrawl and the “van Veen” grab were also used to sample the benthic epi- and infauna as part of the EU-project MAFCONS.

Norway – The RV “Håkon Mosby” completed a total of 56 stations before 1 October. CTD was deployed at each station and at four hydrographical sections to collect temperature and salinity profiles. Benthic sampling work was carried out on 10 stations as part of the MAF-CON project. One of the main objectives of the survey is acoustic measurement of the saithe stock. Acoustic measurements are taken continually through the survey.

Sweden – The cruise of RV “Argos” started on 30 August. A total of 46 stations were completed, 27 in Skagerrak and 19 in Kattegatt. CTD was deployed at nearly all stations (not on stations very close to each other) and at seven hydrographical stations.

UK (England and Wales) – CEFAS Endeavour sailed on the 8th of August from Lowestoft and fished the 75 stations of the Quarter 3 IBTS survey. No major problems were encountered and all core stations were fished with the standard IBTS GOV rigged as specified in the North Sea IBTS manual revision VII. On every station temperature and salinity were taken using a continuous micro CTD unit.

UK (Scotland) – The Scotia sailed on 26 July 2004. A total of 87 survey stations were completed with 10 of the stations being sampled with both groundgear A and B as part of the continuing work on the MAFCON project. CTD was deployed at each station to collect temperature and salinity profiles. Benthic sampling work was carried out at 40 of the survey stations as part of the MAFCON project.

4.2.2 0-group plots

Plots of mean numbers of 0-group catches for cod, haddock, whiting, Norway pout, saithe, sprat and mackerel were produced from preliminary data obtained from individual institutes.

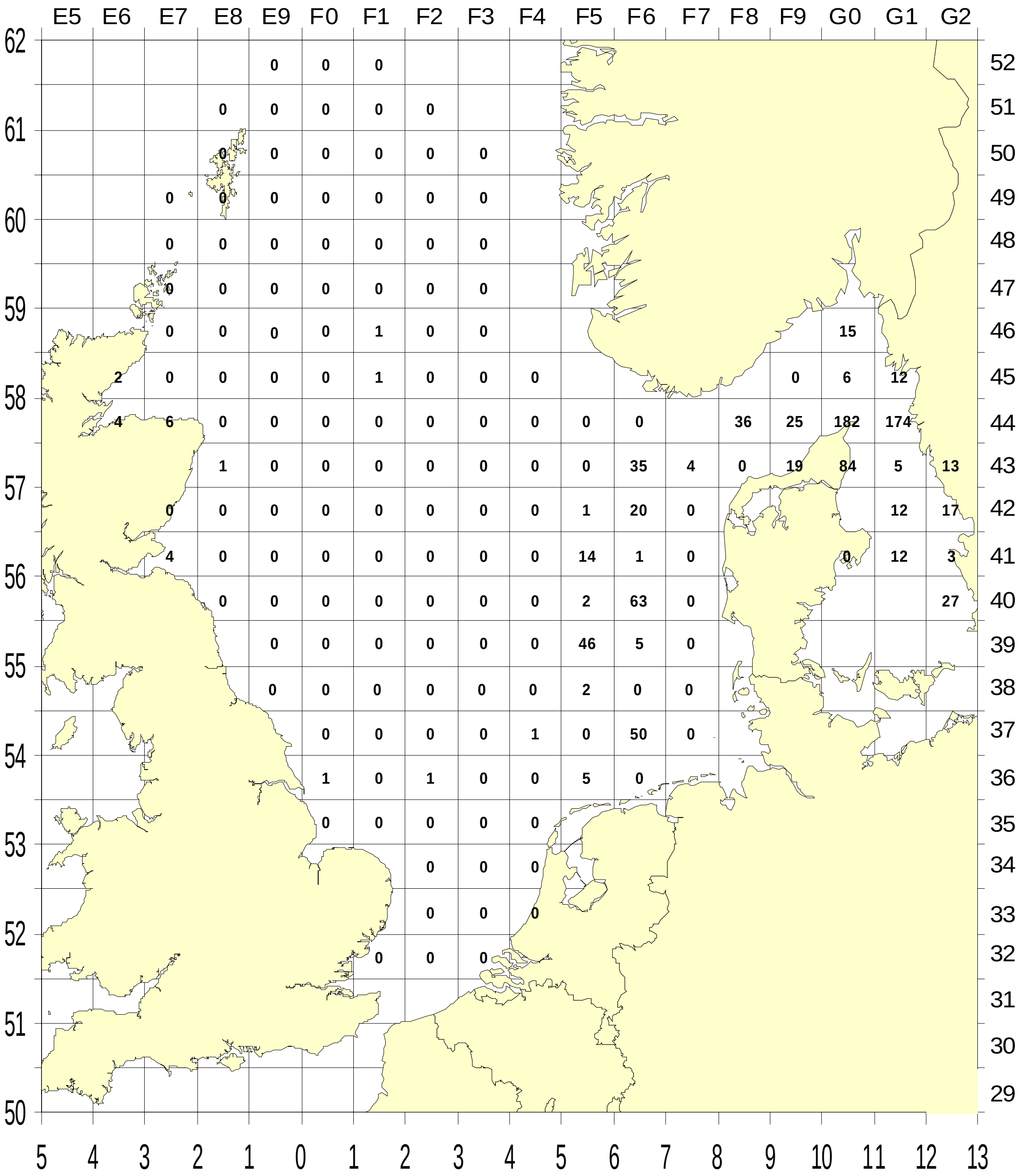


Figure 4.2.2: Plot of mean catch numbers per hour of O-group cod by rectangle.

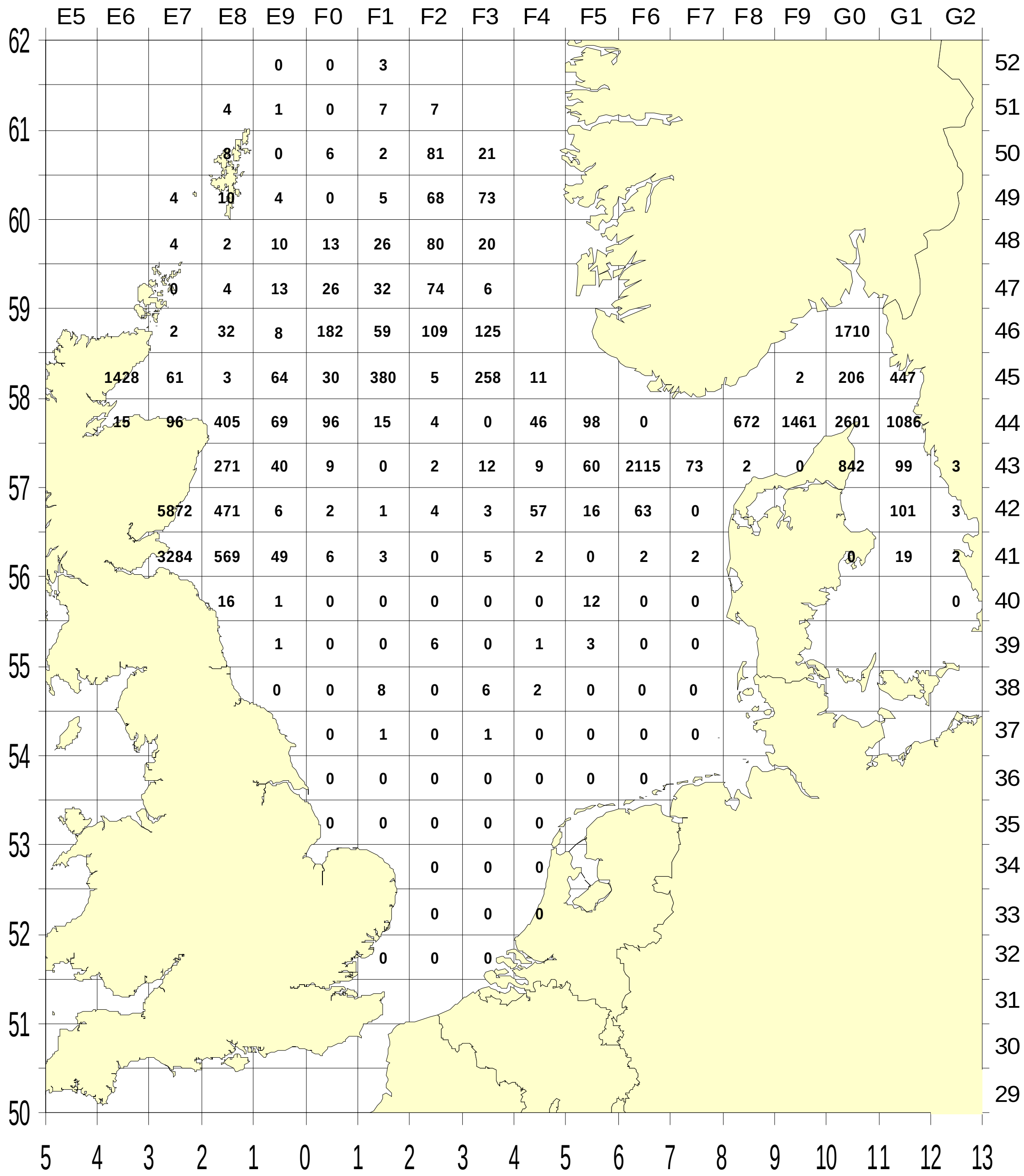


Figure 4.2.3: Plot of mean catch numbers per hour of O-group haddock by rectangle.

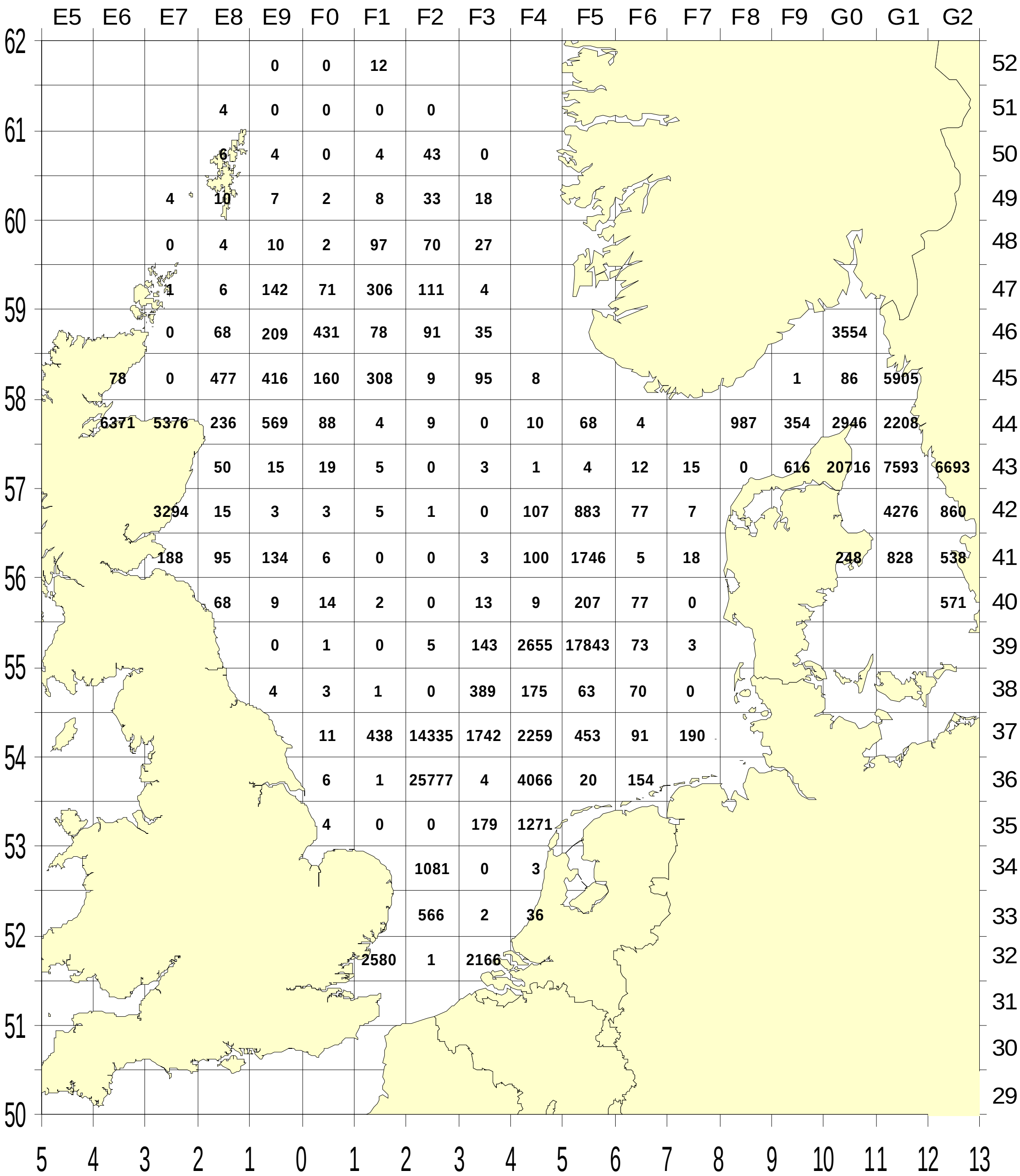


Figure 4.2.4: Plot of mean catch numbers per hour of O-group whiting by rectangle.

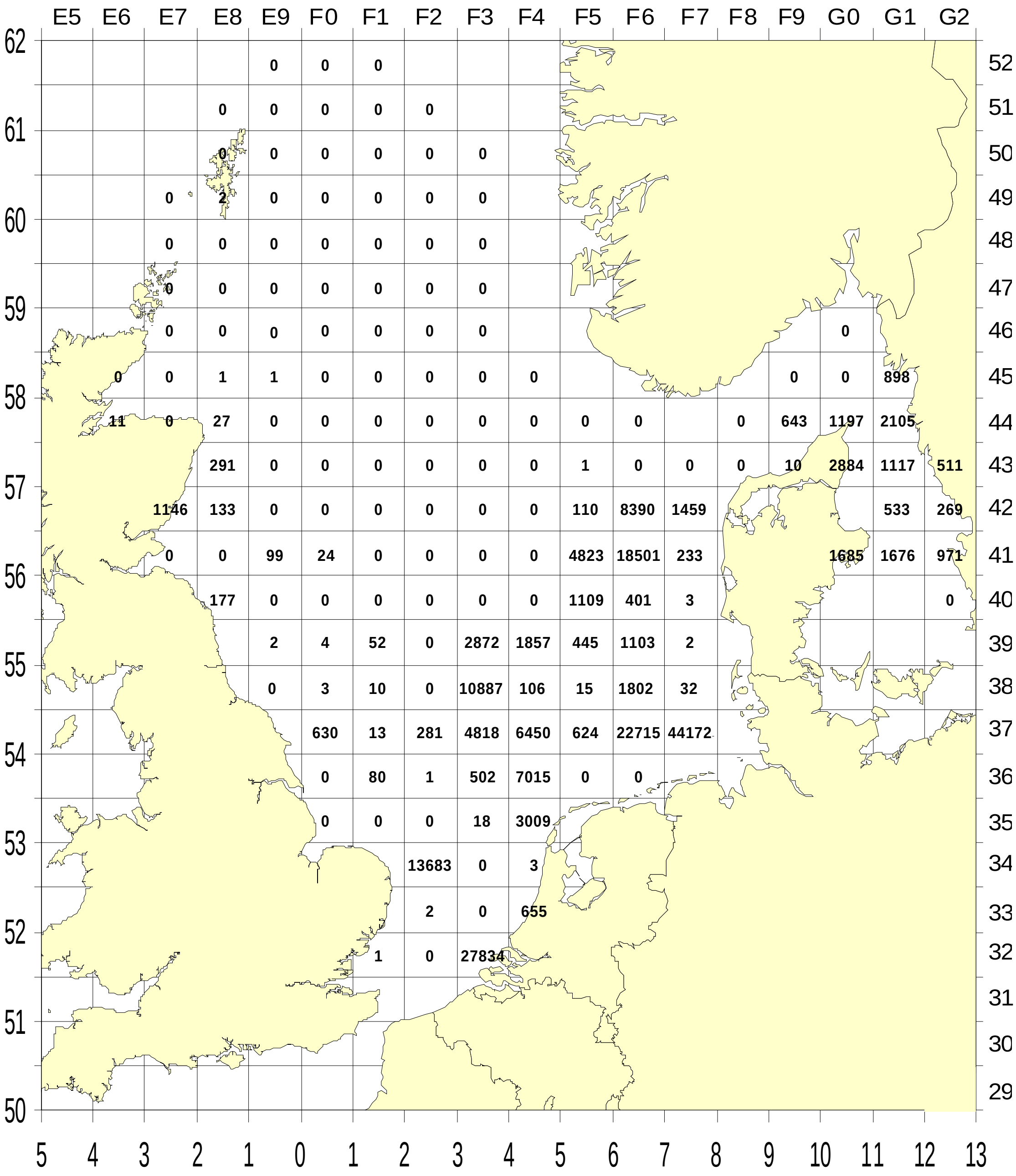


Figure 4.2.5: Plot of mean catch numbers per hour of O-group herring by rectangle.

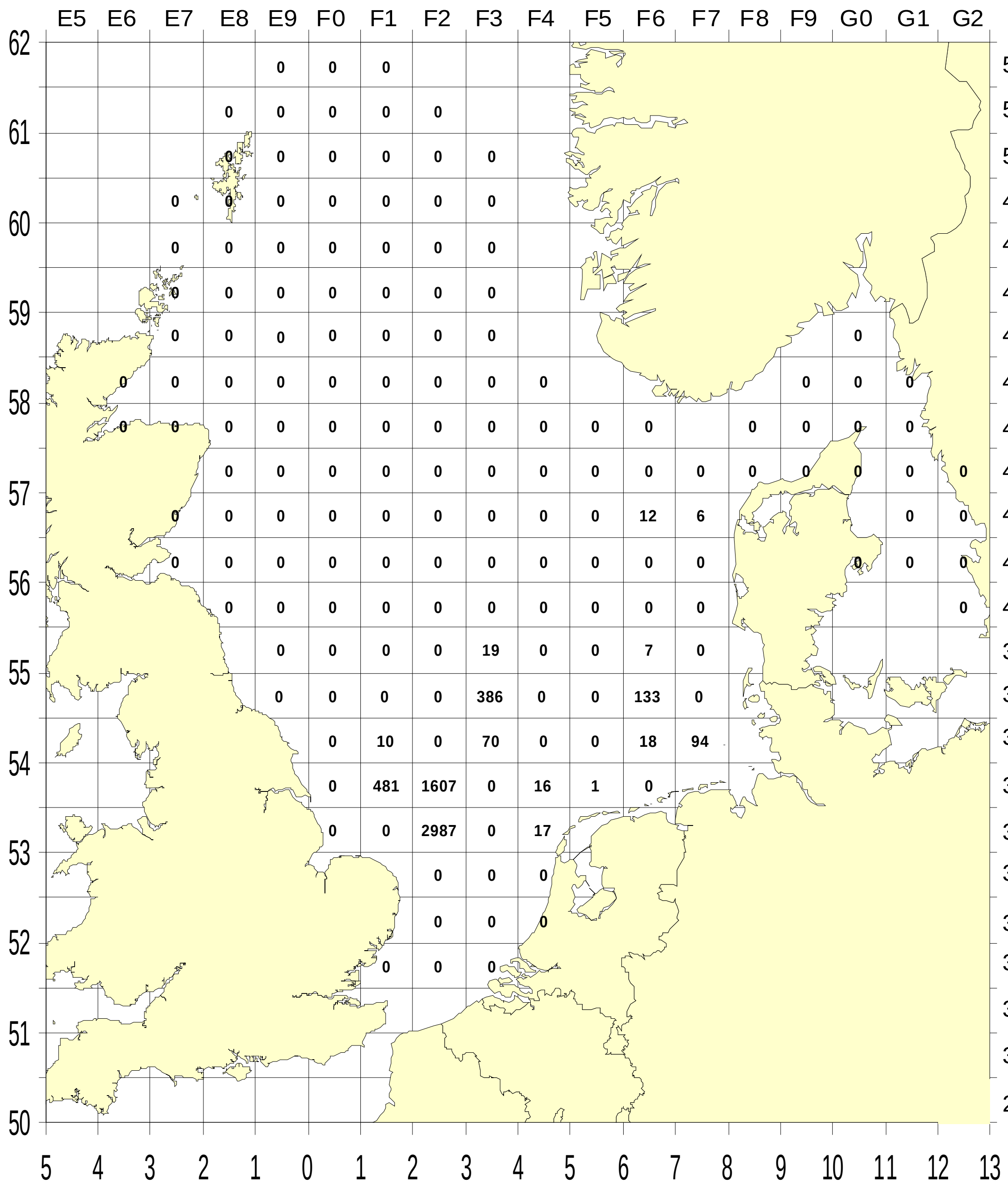


Figure 4.2.6: Plot of mean catch numbers per hour of O-group mackerel by rectangle.

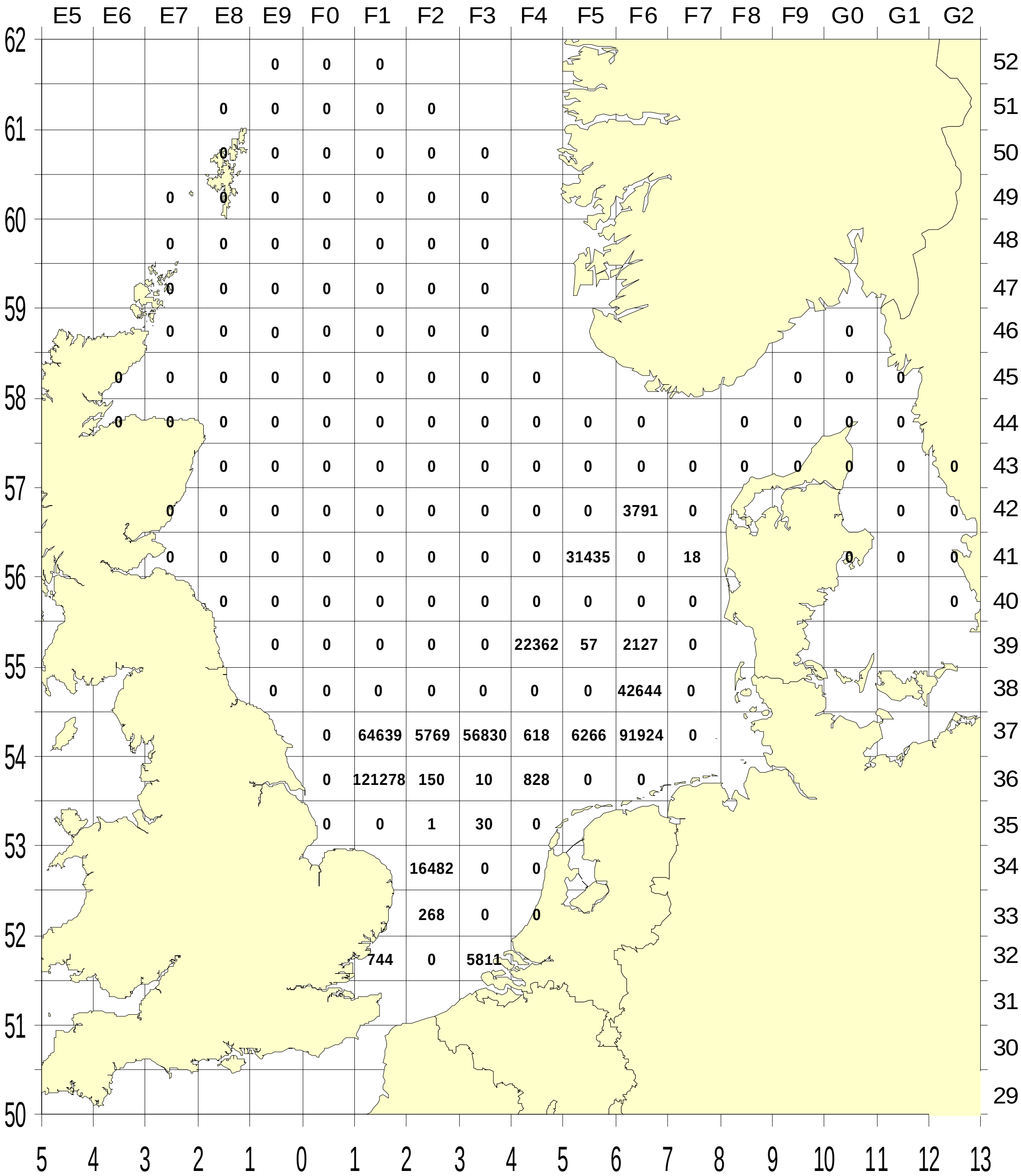


Figure 4.2.7: Plot of mean catch numbers per hour of O-group sprat by rectangle.

4.2.3 Participation in 2005

All the participants of the third quarter 2004 survey have advised that they will be participating fully in the programme in 2005. The timing of the surveys will be broadly in line with recent years except for Norway who will be starting their survey on 11 July, but still covering the allotted area. UK (Scotland) and UK (England and Wales) have indicated their willingness to participate in an exchange of staff between their IBTS surveys in quarter 3 2005 (England and Wales) and quarter 1 2006 (Scotland), therefore satisfying recommendations from earlier IBTSWG reports.

4.3 Eastern Atlantic

In 2004 a total of 13 IBTS groundfish surveys were carried out in the ICES Western and Southern Area of the Eastern Atlantic, with a total of 988 valid tows (Table 4.3.1). Weather coming into the 4th quarter was poor and affected the Spanish survey on the Porcupine in particular.

CEFAS encountered significant gear damage in the Irish Sea and Celtic Sea with their clean ground gear and reverted to the rockhopper rig. Some damage was reported off Brittany by the EVEHOE survey also, but little else out of the ordinary for other surveys.

Ireland implemented a rockhopper ground gear proposed at SGSTG in 2004 (Type – D), for area VIa. A short intercalibration was carried out between the R.V. Scotia and the R.V. Celtic Explorer during the relevant surveys. To tie in with the catchability of this gear and address concern around catchability in general raised at WGSSDS in 2004, the fishing line on the clean ground gear (Type – A) was also tied down.

The major trend in the catches was for an abundance of recruiting hake pretty much across the surveys.

Coordination for this year will focus on establishing an area of overlap between the Spanish and Portuguese surveys; circulation of ArcGIS shape files for stratification from ICES area VIa south to the Bay of Biscay; and pursue a temporal overlap and spatial overlap between the Porcupine and West of Ireland surveys for intercalibration purposes.

Table 4.3.1: Surveys completed in 2004 in the North-Eastern Atlantic area.

SURVEY	CODE	STARTING	ENDING	NO. VALID HAULS	INTERCAL.*
UK-Scotland Deep Water	-	25/08	7/09	26	
UK-Scotland Western (autumn)	SCOGFS04	11/11	3/12	79	
UK-Scotland Western (spring)	-	5/03	24/03	66	
UK-North Ireland	NIRGFS04	Dates not available			
Ireland – Groundfish Survey	IGFS04	30/10	21/11	161	
UK-England & Wales	CEFAS04	8/11	9/12	79	
France - EVHOE	EVHOE04	29/10	12/12	133	
France - Western Channel	CGFS04	2/10	31/10	95	
Spain - Porcupine	SP-P04	5/09	7/10	70	
Spain - North Coast	SPGFS04	16/09	23/10	120	
Spain - Gulf of Cádiz (Autumn)	SPGFP04	29/10	10/11	40	
Spain - Gulf of Cádiz (Spring)	SPGFP	4/03	11/03	40	
Portugal	PGFS04	21/10	19/11	79	

Table 4.3.2: Schedule of Western and Southern Area surveys for 2005.

SURVEY	CODE	STARTING	ENDING	NO. EXPECTED HAULS	INTERCAL.*
UK-Scotland Rockall & Deep Water	-	25/08/05	7/09/05	40	
UK-Scotland Western (autumn)	SCOGFS05	16/11/05	7/12/05	79	
UK-Scotland Western (spring)	-	16/02/05	8/03/05	61	
UK-North Ireland	NIRGFS05	Not available information			
Ireland – Groundfish Survey	IGFS05	30/10/05	23/11/05	160	
UK-England & Wales	CEFAS05	10/11/05	11/12/05	80	
France - EVHOE	EVHOE05	19/10/05	3/12/05	145	
France - Western Channel	CGFS05	2/10/05	31/10/05	95	
Spain - Porcupine	SP-P05	03/09/05	03/10/05	80	
Spain - North Coast	SPGFS05	10/09/05	17/10/05	120	
Spain - Gulf of Cádiz (Autumn)	SPGFP05	03/11/05	17/11/05	40	
Spain - Gulf of Cádiz (Spring)	SPGFP	28/02/05	11/03/05	40	
Portugal Spring	PGFS_1q	2/03/05	31/03/05	75	
Portugal	PGFS05	4/10/05	3/11/05	96	

4.3.1 Survey overviews

West of Scotland – Deep Water Survey (1204S)

Dates: 25 August – 7 September (14 days)

Cruise Leader: Kevin Peach

A total of 26 valid hauls were completed but winch failure meant that a total of 10 intended stations were not sampled. The TV sledge was deployed when weather conditions were favourable in order to investigate the occurrence of *Nephrops* on the upper shelf slope.

Western Division Bottom Trawl Survey - Quarter 1 2004 (0404s)

Dates: 5 – 24 March 2004 (20 days)

Cruise Leader: Kevin Peach

A total of 66 valid hauls were achieved with all survey stations being sampled as well as an additional 5 stations north west of Ireland and one on the northern edge of the survey area.

CTD deployed at each station for temperature and salinity profiles.

The NOAA Bottom Contact Sensor was deployed at each station with mixed results.

Western Division Bottom Trawl Survey - Quarter 4 2004 (1604S)

Dates: 11 Nov – 3 Dec 2004 (23 days)

Cruise Leader: Sandy Robb

A total of 79 valid hauls were achieved with only one survey station not being sampled.

CTD deployed at each station for temperature and salinity profiles.

Benthic sampling was successfully carried out at 25 stations as part of the MAFCON project.

Ireland

Survey summary

In 2004 the Irish Groundfish Survey (IGFS04) commenced on the 13th October and completed on the 21st November with one 12hr cruise break and no days lost to weather. The total number of stations sampled was 168 with 7 of those being categorised as invalid due to either damage or repeat tows for intercalibration purposes with the RV “Scotia”.

Stratification

Stratification was reviewed again using Multiple Regression Tree analysis (MRT) of the IGFS data from 2003, using bathymetry as the explanatory variable. This type of clustering gives a confidence estimate in contrast to earlier analysis carried out in 2003. It was concluded that three depth strata within each of the ICES management areas would account for much of the survey variance. This resulted in ICES areas being subdivided by the 75m, 125m and 200m contours resulting in 14 strata.

A total of 160 stations were allocated proportional to the area of each stratum. After each selection a 10 nautical mile buffer was placed around each station to avoid random clustering of samples and problems with spatially correlated samples leading to bias (Kingsley, 2004). The first 75% of the stations were sequentially selected at random from known clear tow positions from the 2003 survey, while the rest were allocated on a purely random basis whilst maintaining the spatial inhibition principle of the 10 nautical mile buffer zone. Where a random station fell within 10 nautical mi of a known survey tow that had not yet been selected, the survey tow was used. Where there was no historical or commercial information available the area to be surveyed was targeted for multibeam investigation during the non-fishing hours of dusk to dawn.

In 2003 a total of 4,536 nautical miles of multibeam data was acquired during the groundfish survey, out of which 22 new random station locations were successfully fished and added to the survey grid. Due to positive experiences in 2003 and certain staffing constraints it was felt that multibeam acquisition during normal daylight fishing operations was not a priority for IGFS04 and therefore generally restricted to targeted night time operations. Consequently, while only 2,992 nat. mi. of data was acquired in 2004, a further 23 new stations were successfully fished. A number of small, predefined MESH project and fisheries habitat areas were also investigated during the latter survey

Trawl gear

Type-D

In light of severe gear damage encountered during the first year of the new IGFS in 2003 and recommendations from SGSTG the Marine Institute undertook to build the Type-D hopper gear. While a significant amount of the damage was attributed to poor trawl construction by the manufacturer, it was felt a good opportunity at the start of a time series to design and test a modern hopper rig suitable for the GOV, or any demersal trawl, while rebuilding the nets. The hopper gear is limited to ICES area VIa on the IGFS and overlaps with the Scottish survey using a more standard Type-C gear. The smaller disks and tied down fishing line are more reflective of modern gear technology in the area and intended to address the concerns around catchability expressed by the WGSSDS1 and industry as well as those of handling coming from scientists and crew of the various RV's concerned.

Other than groundgear the GOV trawl was standard and deployed as normal with a three-bridle set up. During November of 2004 a total of 8 parallel tows were successfully undertaken between the Irish and Scottish research vessels (RV "Celtic Explorer" and the RV "Scotia II" respectively) off the Irish northwest coast and are reported in (Section 5.2.2).

Type–A

Concerns over the catchability of the GOV were raised again within the Marine Institute following the WGSSDS in June–July. It was felt that the fragility of the survey indices in relation to species such as cod and the initiation of a new time series and survey design in respect of the IGFS required and facilitated that catchability be addressed.

Understandable concerns over survey standardization and time series data was generally discussed under 'intercalibration' at WKSAD earlier in the year and generally seen as something to be managed by survey design. In other words, if the inevitable redundancy of sampling gear/technology is anticipated and reviewed on say a 10yr cycle, and ongoing intercalibration (parallel tows particularly) are built in to overlapping surveys annually, then incremental drift in sampling procedures may be arrested and moderate periodic changes facilitated with, hopefully, minimum disruption.

Tying down of the fishing line on the Type–A gear was felt appropriate in light of the above situation, and also should give a more seamless transition between the MI hopper net operating in VIa and the Type–A clean gear used on the rest of the survey (VIIa, b, g and j). Again, other than shortening the toggle chains to one link, no other changes were made to the net and it was deployed and behaved as normal.

Funding was sought, and tentatively agreed, to evaluate the affect of tying down the footrope on the GOV prior to the IGFS04, and again prior to the IBTS 2005 meeting, but unfortunately staffing became an overriding factor and the trials had to be postponed.

UK – England and Wales

RV CEFAS Endeavour undertook the Quarter 4 survey in the Irish Sea (VIIa) and southwest (VIIe-h) from 8 November to 9 December 2004. The survey commenced work off Cornwall where all stations were fished successfully with GOV with rockhopper ground gear (see ICES, 2003 for a description of the modifications made). Fishing was then undertaken in St George's Channel, also with the rockhopper rig. Once stations in this area were completed, the standard GOV (with ground gear A) was rigged, though extra buoyancy was used instead of a kite, and the toggle chains were reduced to ca. 10cm, in order to standardize with the Marine Institute.

The GOV with ground gear A was fished successfully on the muddy grounds in the north-western Irish Sea and on the inshore, sandy grounds of the Irish Sea (Dundrum Bay, Dundalk

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1 The low number of cod caught by the UK-WCGFS and FR-EVHOE surveys of the 2002 year-class (0 and 1 cod, respectively) indicate very low catchability of small recruiting year-classes on these surveys. At such levels of catchability the Working Group considers that the survey estimates are likely to be highly variable and therefore poor indicators of recruitment strength of small year classes. Similarly low year class strength has been observed in a quarter of the years in the time series. If similar recruitment strength continues it can be expected that these surveys will not be able to reliably estimate year class strength in 25% of future years. Better estimators of recruitment are therefore urgently required. [ICES CM 2005/ACFM:03]

Bay, Solway Firth and Liverpool Bay). Major gear damage occurred at stations in the central Irish Sea, where large catches of shell-gravel were taken. Stations in the northern Celtic Sea and outer Bristol Channel were also fished successfully with ground gear A, though after major gear damage at one station in the Celtic Sea, sampling reverted to the rockhopper ground gear.

A total of 79 valid tows were made with the two fishing gears. Fifty-six stations were fished successfully with the modified GOV with rockhopper ground gear (Table 4.3.1.1; Figure 4.3.1.1), with a further two tows not considered valid, as the door spread was reduced and the doors had fallen over for a period of the tow, and an additional two tows were undertaken to repeat stations previously fished with the standard ground gear. The GOV with standard ground gear was fished successfully at 23 stations (Table 4.3.1.1; Figure 4.3.1.1), and three tows classed as additional tows, including one tow where the belly of the net was torn, but most likely on hauling and two where the toggle chains were set at 30cm. Sediment samples were collected at 55 trawl stations (Figure 4.3.1.2). Various species of dogfish and ray (136 individuals) were tagged and released during the survey.

It is hoped that the 2005 survey will (a) continue the use of the GOV with rockhopper ground gear in spatially-defined areas where it is considered an appropriate gear, and (b) increase the number of stations fished with the standard ground gear.

Table 4.3.1.1: Summary of gear deployments.

GEAR	VALID	ADDITIONAL	INVALID	TOTAL
Rockhopper	56[(a)]	4[(b)]	0	60
Standard ground gear	23	3[(c)]	1	27
Shippek grab	55	0	0	55
2m beam trawl	12	0	0	12

(a|) Including 18 stations where the kite was used instead of additional flotation; (b) two tows were not declared valid due to doubts about net geometry, and two stations fished with the standard ground gear were repeated with the rockhopper trawl; (c) two tows were undertaken with the toggle chains set at 30cm, and were then repeated with reduced toggle chains, and one tow in which the belly of the net was ripped was not invalidated due to the large catch, suggesting that the net had likely torn on hauling.

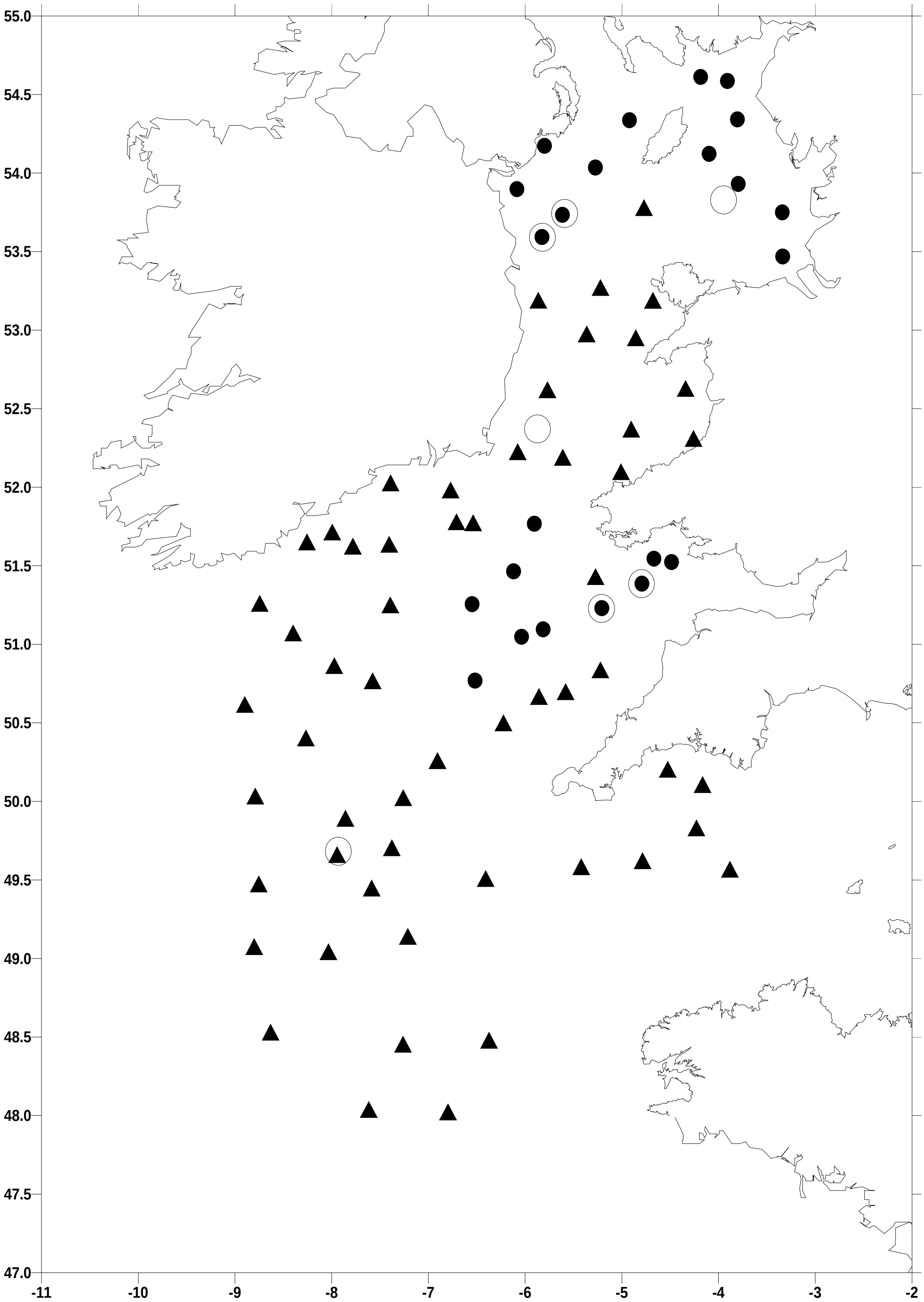


Figure 4.3.1.1: Map showing stations fished with GOV trawl with rockhopper ground gear (solid triangles) and standard ground gear (solid circles) and sites of additional tows (open circles).

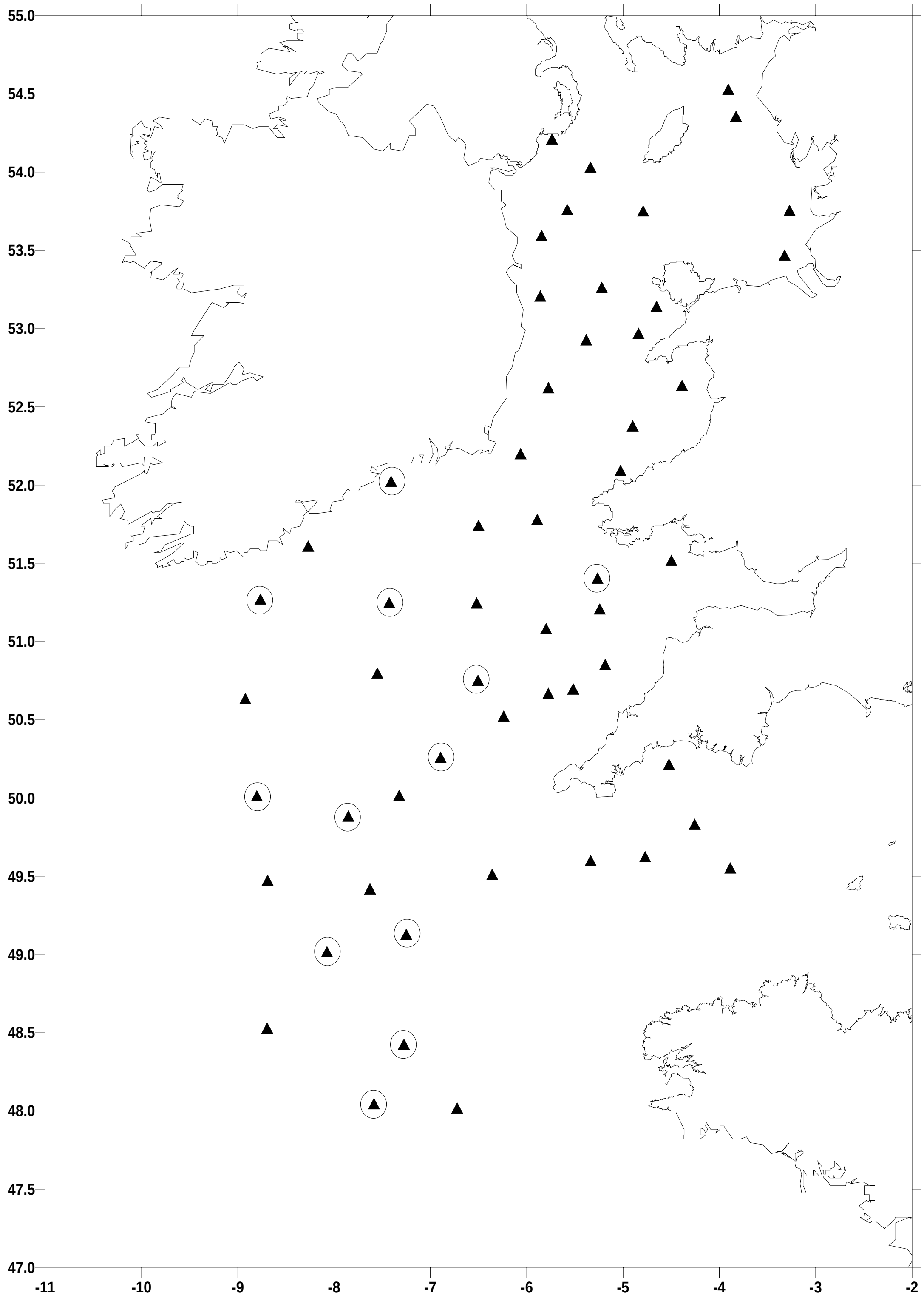


Figure 4.3.1.2: Study area indicating sites sampled with 2m-beam trawl (open circles), and shippek grab (solid triangles).

4.3.1.1 France

EVHOE survey

The EVHOE survey was conducted from 29th of October to 12th of December 2004 in the Bay of Biscay and the Celtic Sea. A total of 145 hauls, using GOV 36/47 bottom trawl, were completed on randomly chosen stations from a databank of expected valid tows. 133 of them were valid. CTD profiles have been achieved at trawling positions excepted when Sea Bird 19 was out of order. The table below summarizes the operations.

	Biscay South (Gs)	Biscay North (Gn)	Celtic South (Cs)	Celtic Centre (Cc)	Celtic North (Cn)	Total
N° hauls	19	51	27	34	14	145
N° valid	17	50	24	32	10	133
N° CTD	17	51	25	31	14	140
CTD valid	17	50	24	31	14	136

By geographical area, hauls were conducted in each available bathymetric strata described in table below.

Depth range	Stratum
0–30 m	1
31–80 m	2
81–120 m	3
121–160 m	4
161–200 m	5
201–400 m	6
401–600 m	7

Combining geographical and bathymetric strata, table below shows the display of the hauls conducted during EVHOE 2004 survey.

Depth strata	Gs	Gn	Cs	Cc	Cn
1	3	3			
2	4	4			7
3	3	17		8	7
4	3	21	16	19	
5	2	3	7	2	
6	2	1	2	3	
7	2	2	2	2	

The agenda of EVHOE survey was disrupted in the Northern Bay of Biscay, where French Naval exercises led to some changes in the chronology and reduced time available in stratum Gn6.

Since 1987, only the ground gear A of the IBTS Manual has been used during EVHOE surveys. This gear is suitable for fishing in the South and Central strata in the Bay of Biscay. Several stations in certain areas offshore from Brittany and in the Celtic Sea caught large stones and resulted in some damage to the net. One can wonder whether there is some natural changes in the nature of fishing grounds previously worked, or the increasing catches of large stones is a consequence of the use of heavy bottom ropes (Rockhoppers) by bottom trawlers in these areas.

No detailed pre-survey checklist for preparation of the fishing gears has been used before EVHOE 2004 due to the limited time availability, but gears were checked before the survey. In fact, at the end of a survey using GOV 36/47, all trawls available were checked in order to be landed in the same nominal conditions as they have been taken on board at the beginning of the survey.

Catches of valid hauls are sorted and weighted by species. Commercial gadoids, sharks and rays, commercial flatfish and crustaceans are sexed and weighed by sex. All species of fish and commercial invertebrates are measured. Then, hake, monkfish, megrim, sole, cod, whiting, haddock, ling, pollack are sampled for ageing.

Channel Ground Fish Survey (CGFS)

In 2004, The Channel Ground Fish Survey (CGFS) was conducted between the 2nd and the 31rst of October. A total of 95 hauls were done during this period.

Since 1988, the CGFS is carried out every year at the same period on the RV “Gwen Drez”, and the main objective is to estimate the recruitment and the abundance per age group of the main commercial fish species. The Eastern Channel and the southern part of the North Sea (Divisions VIId and IVc4) were divided in squares of 15’ latitude and 15’ longitude. In each square, the same hauls (two in coastal waters and one offshore) are fished every year. The haul duration is 30 minutes and fishing methods are standardized. (towing speed, warp length) The gear used is a GOV 19,70/25,90 with a 20mm mesh size double codend. At each station, all fish are sorted, weighed and measured, and otoliths or scales of the main commercial species (whiting, cod, pout, red gurnard and plaice) are collected.

Spain

As in earlier years, Spain carried out four surveys during 2004:

i) Porcupine Bank
ii) North Iberian Coast (Galicia and the Cantabrian Sea)
iii) Gulf of Cadiz in Spring
iv) Gulf of Cadiz in Autumn

The standard baca 36/40 was used in the three surveys in Spanish waters, while the Porcupine baca (40/52) was used on the Porcupine Bank. No detailed pre-survey checklist for preparation of the gears is used at the moment for Spanish surveys due to the lack of technicians to carry out the checking and the limited time availability, although a general review of gear condition is done by the vessel crew before the survey. The implementation of these checklists is deemed desirable, but how to obtain the required time and personnel to perform the checks still has to be considered. ITI monitoring of the gear was used in Porcupine survey, and Scanmar system has been used in almost all hauls of the Spanish coast surveys, this being the first time it has been monitored in the Gulf of Cadiz survey time series.

Regarding 4th quarter surveys, a total of 230 valid hauls were performed, 70 on the Porcupine Bank, 120 off Northern Spain, six of them covering the shallow and deep waters not included in the standard sampling area (less than 70 m and deeper than 500 m); and 40 in the Gulf of Cadiz area. Hauls on the Porcupine Bank and off Northern coast of Spain lasted 30 minutes, while Gulf of Cadiz stations lasted one hour. CTD casts were carried out in all the surveys (122 off Northern Spain, 58 on the Porcupine Bank and 27 in the Gulf of Cadiz). The number of hauls and CTD casts in the Porcupine survey was smaller than in previous years (80 hauls is the original design) due to the bad weather during the survey resulted in a loss of seven days work.

Spring survey in the Gulf of Cádiz follows the same methodology as the 4th quarter one, both in 2004 and 2005 a total of 40 hauls and 25 CTD casts were carried out.

As in previous surveys abundance and biomass indices have been estimated for the main commercial species in each area. These indices are estimated per age group for hake in all the surveys, for megrim and monkfish (black and white) in Northern Spain and Porcupine, and also for four-spotted megrim, horse mackerel, mackerel and blue whiting in the latter one.

Tagging programs have been carried out for small spotted catshark off northern Spain (1,225 individuals) and anglerfish on the Porcupine Bank (115 individuals).

During the Northern Spanish Survey in the Galician area additional sampling with a 3.5 beam trawl was performed to assess the impact of the Prestige oil spill (ECOPREST project) on the benthic species, and estimate the amount of oil deposited on the soft grounds along the Galician shelf. The sampling design for this gear was based on 10 transects distributed along the coast including 3 hauls at each one. A total of 30 valid hauls of 15 minutes were carried out. In addition, six hauls with a suprabenthic sledge were performed following the ECO-PREST protocols.

Portugal

In 2004 only the autumn groundfish survey (Quarter 4) was carried out, covering Division IXa in Portuguese continental waters. The RV “Capricornio” with a bottom trawl gear type FGAV019 with no roller on the groundrope was used. The area sampled extends from 41º 50’ N to 36º 41’ N and from 20 to 500 meters depth. Fishing operations were carried out during daylight, with 30 minute tows at a mean towing speed of 3.5 knots. A total of 79 valid fishing stations with 96 CTD sampling stations were performed during 19 fishing days. No checklist of the gear was performed.

The total catch of the survey was composed of 119 different fish species, 20 crustacean species and 17 cephalopod species. The most abundant species was blue whiting (*Micromessistus poutassou*), followed by snipefish (*Macroramphosus* spp.), which are distributed over the whole sampled area.

The abundance and biomass indices have been computed and showed higher values for hake (high recruitment), horse mackerel, mackerel and Norway lobster, while megrims, anglerfishes, Spanish mackerel, blue whiting and rose shrimp presented lower indices than the previous year.

4.3.2 Distribution of main commercial species in the Eastern Atlantic observed in Quarter 4, 2004

Although differences in catchability cannot be corrected at present by the use of conversion factors, raw numbers per hour of towing are presented, some using length splits to give rough estimates of recruit or pre-recruit distribution. These cannot be used however to identify differences of abundance per area. They will however and eventually be useful to identify relative year to year changes in distribution and abundance as the time series is extended.

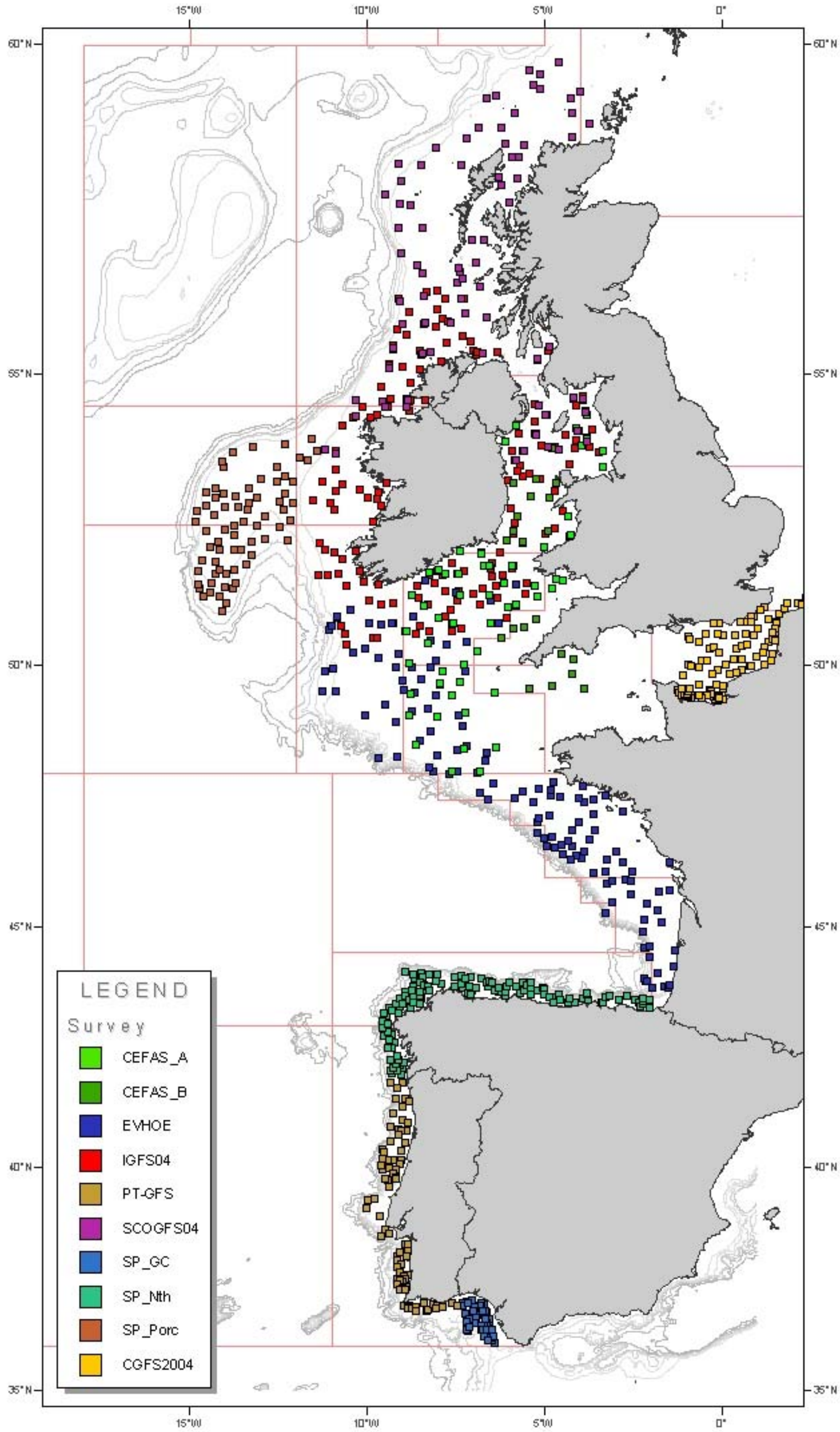


Figure 4.3.1.3: Station positions for the IBTS Surveys carried out in the Western and Southern Area in the autumn/winter of 2004.

Whiting <20cm

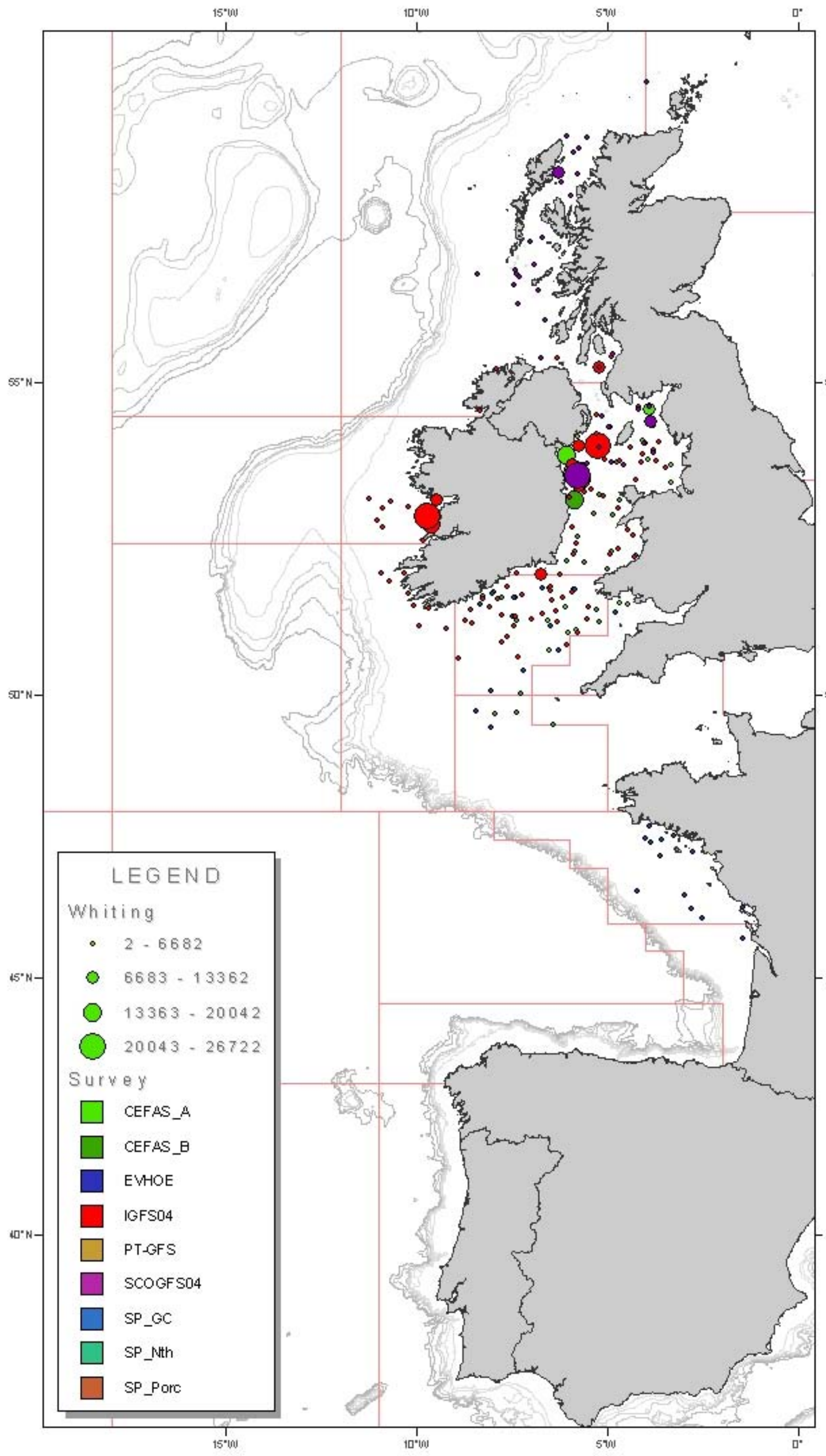


Figure 4.3.1.4: Catches in numbers per hour of 0-group whiting, *Merlangius merlangus* (<20cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

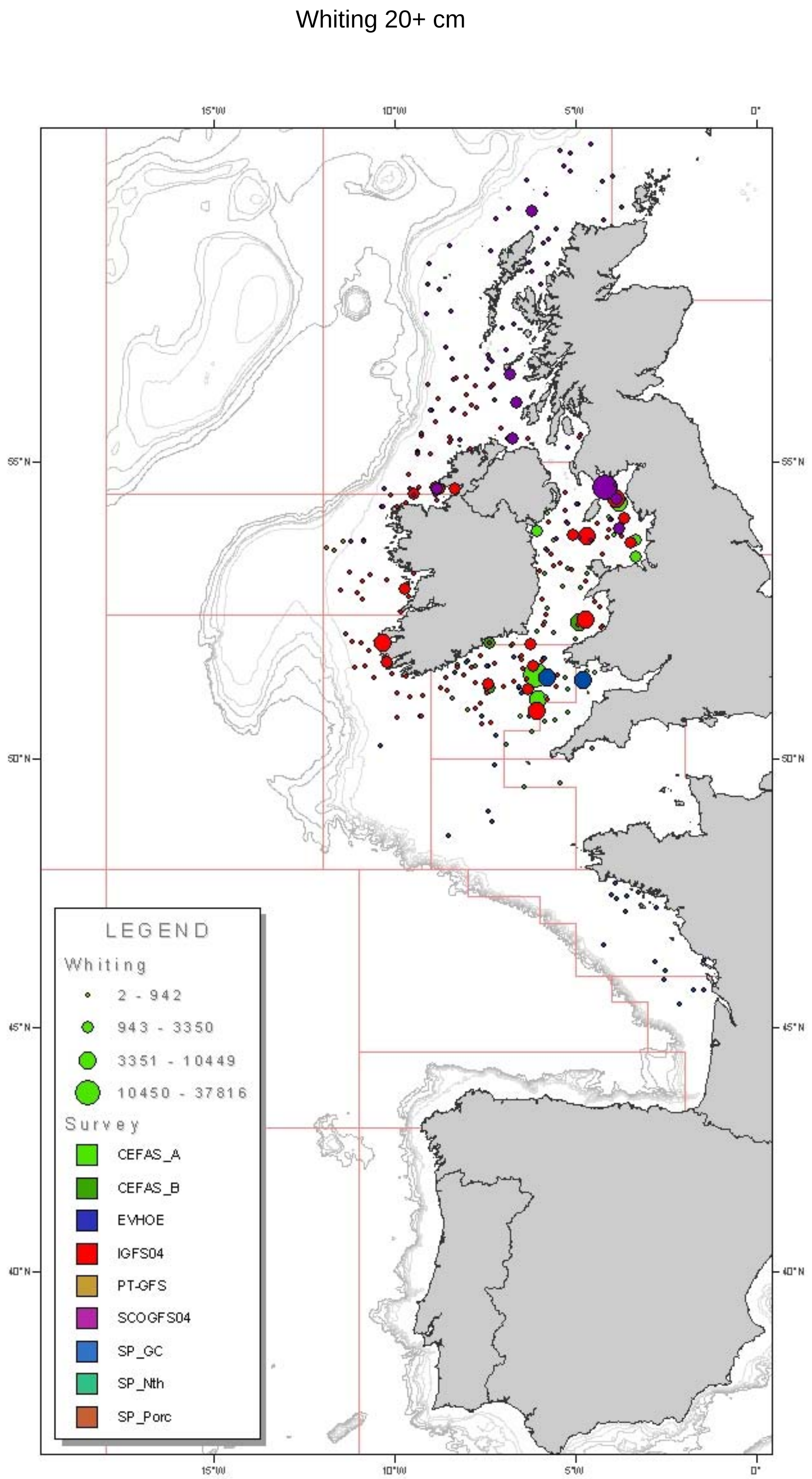


Figure 4.3.1.5: Catches in numbers per hour of 1+ whiting, *Merlangius merlangus* (≥20cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Haddock <20 cm

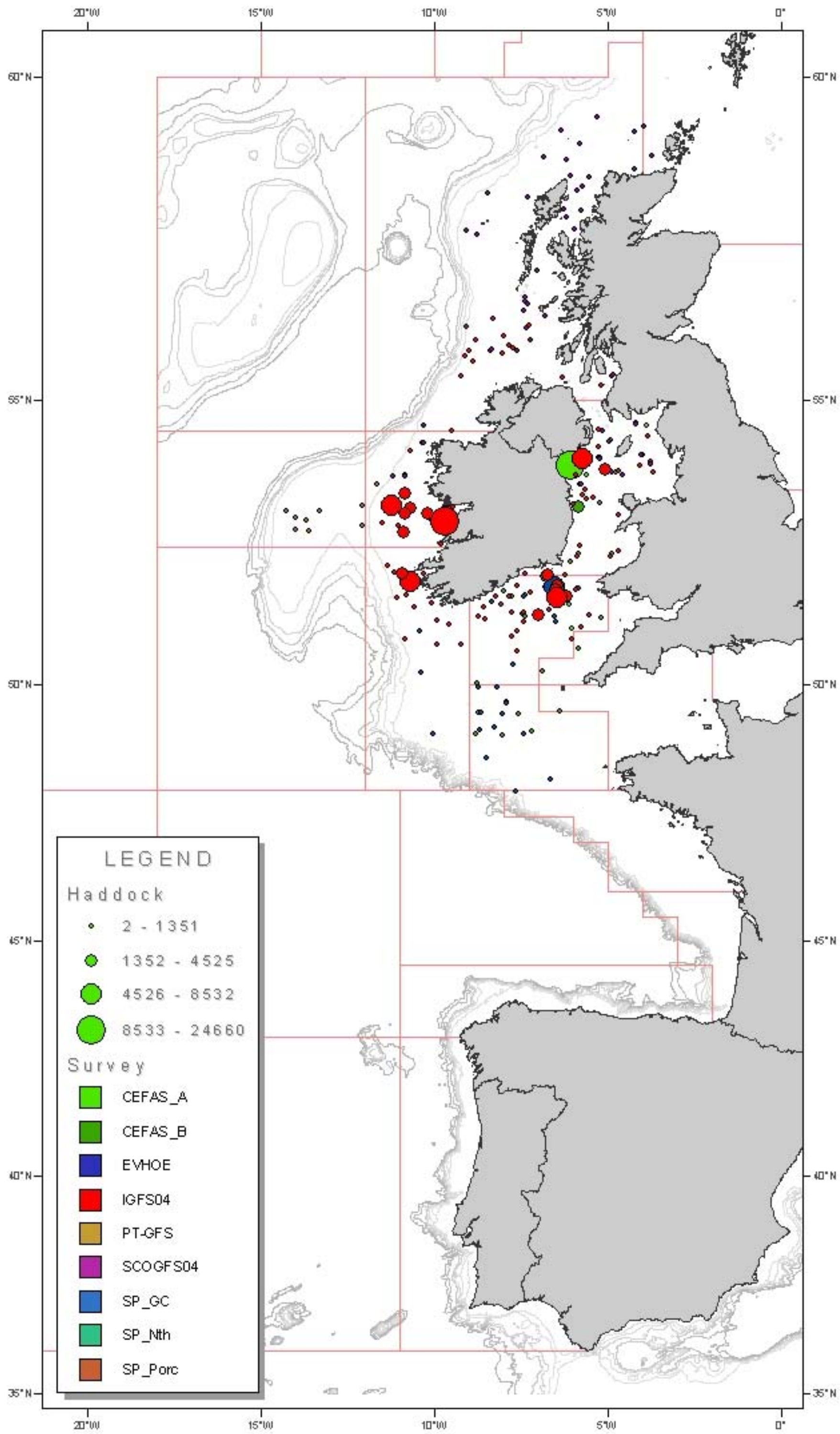


Figure 4.3.1.6: Catches in numbers per hour of 0-group haddock, *Melanogrammus aeglefinus* (<20cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Haddock 20+ cm

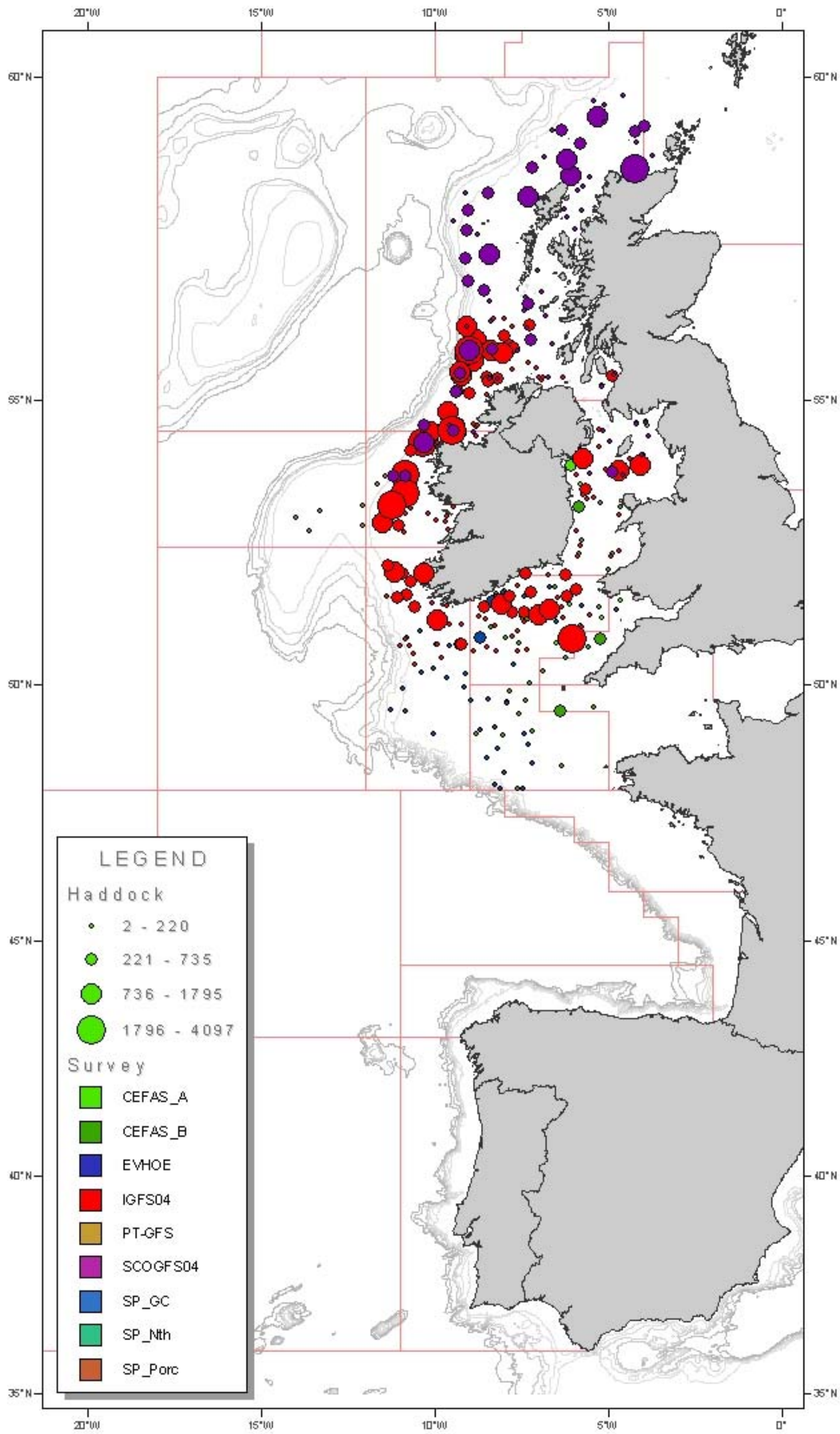


Figure 4.3.1.7: Catches in numbers per hour of 1+ haddock, *Melanogrammus aeglefinus* (≥20cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Cod <23 cm

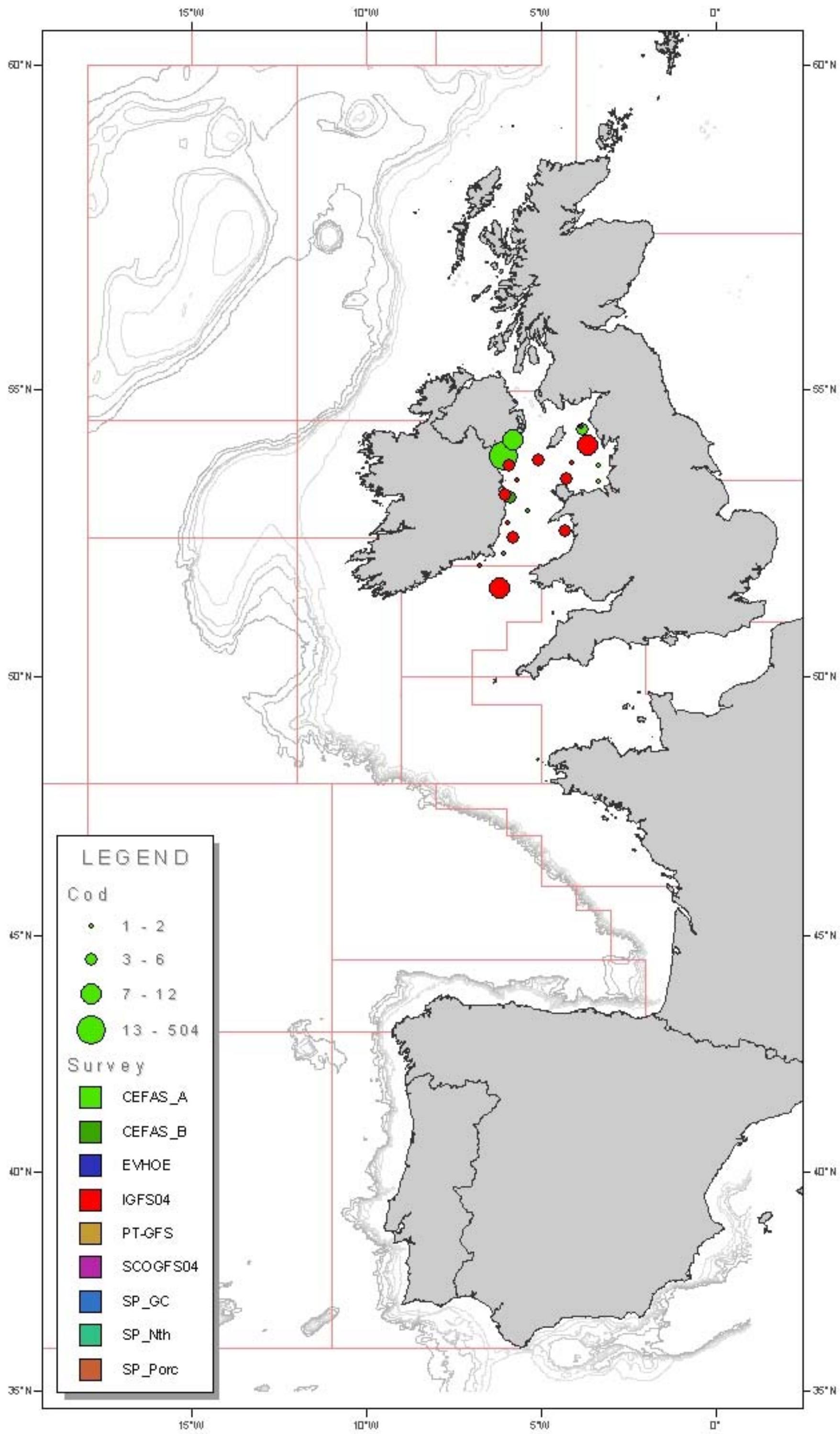


Figure 4.3.1.8: Catches in numbers per hour of 0-group cod, *Gadus morhua* (<23cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Cod 23+ cm

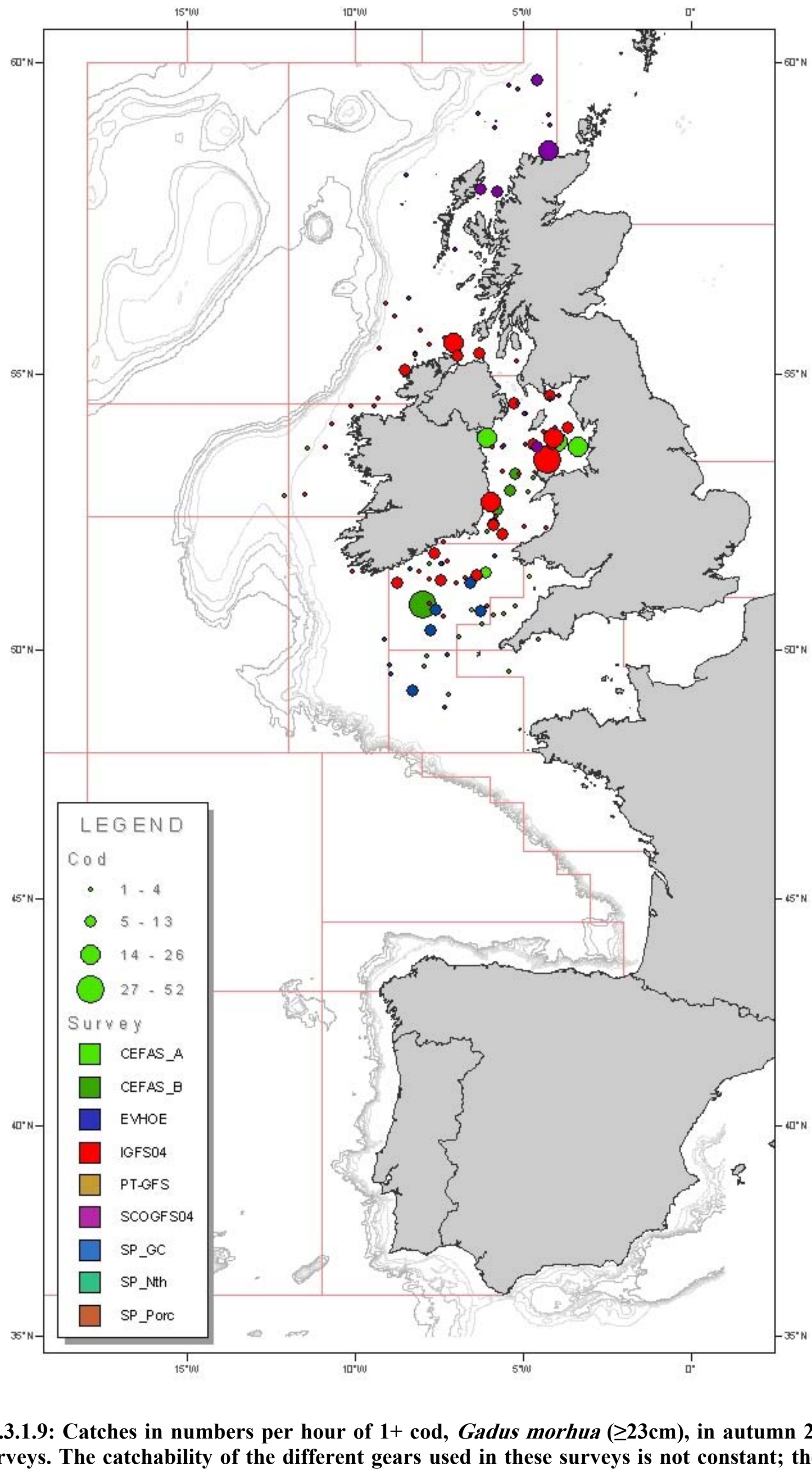


Figure 4.3.1.9: Catches in numbers per hour of 1+ cod, *Gadus morhua* (≥23cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Hake <20 cm

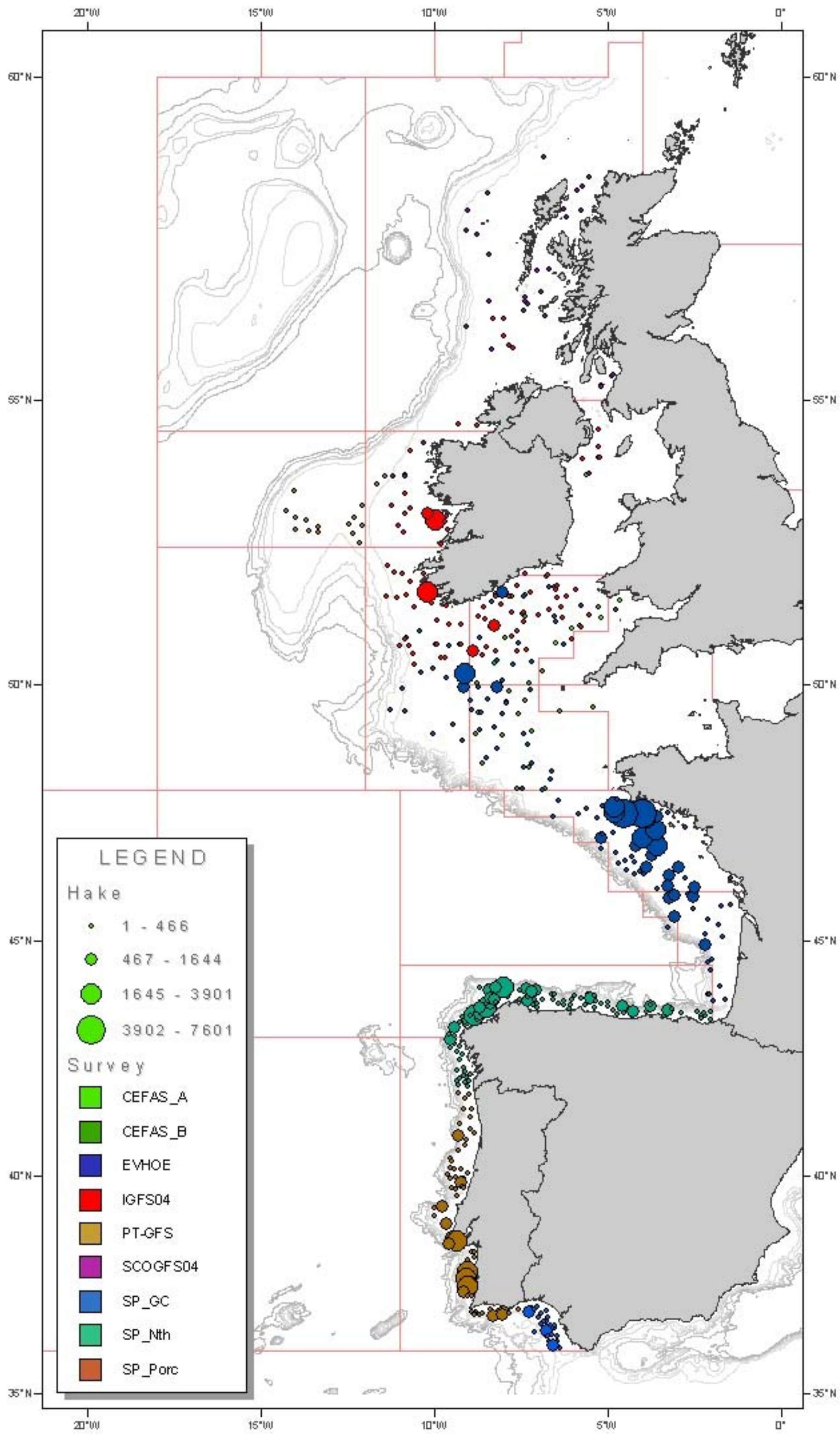


Figure 4.3.1.10: Catches in numbers per hour of 0-group hake, *Merluccius merluccius* (<20cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Hake 20+ cm

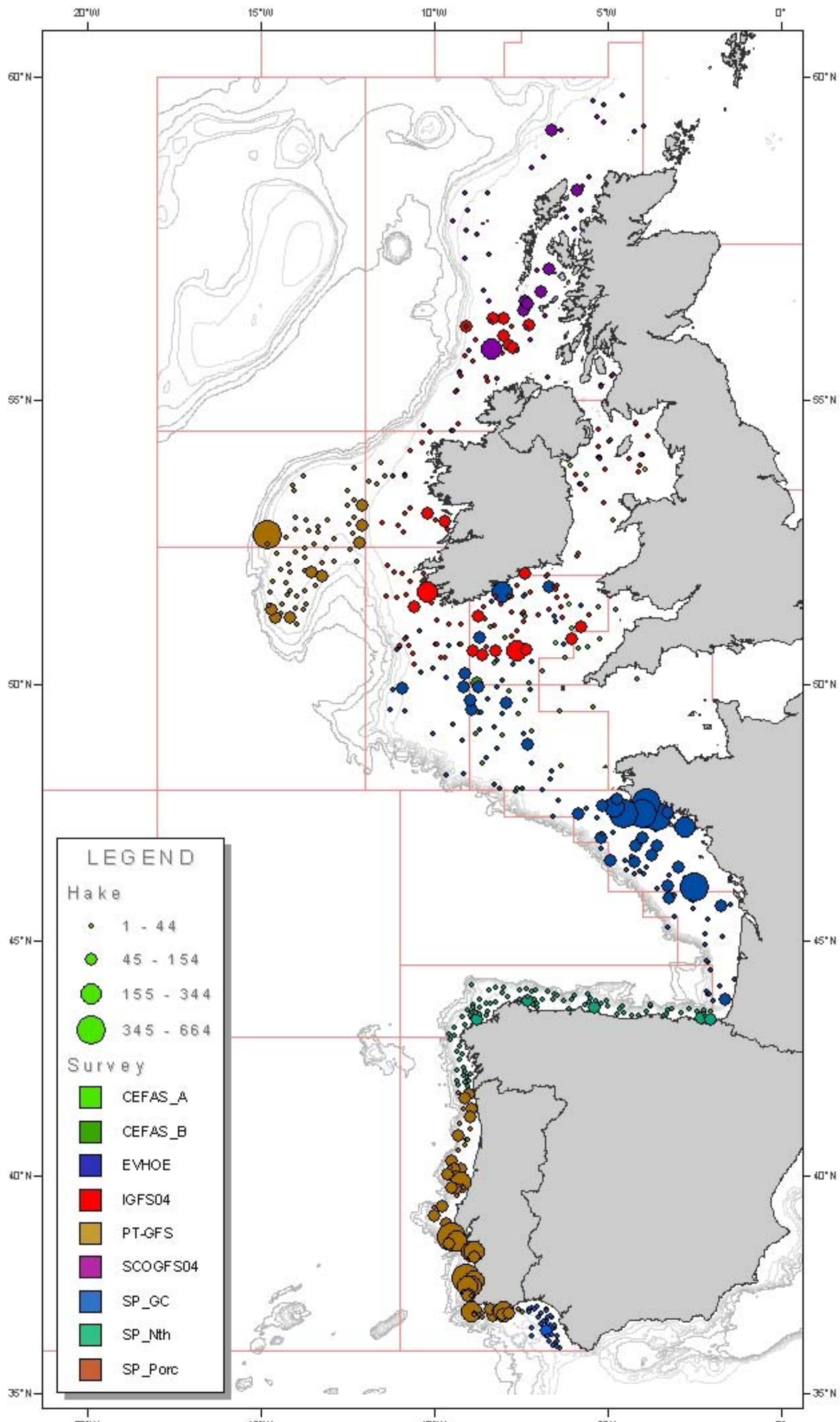


Figure 4.3.1.11: Catches in numbers per hour of 1+ hake, *Merluccius merluccius* (≥20cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Plaice <12 cm

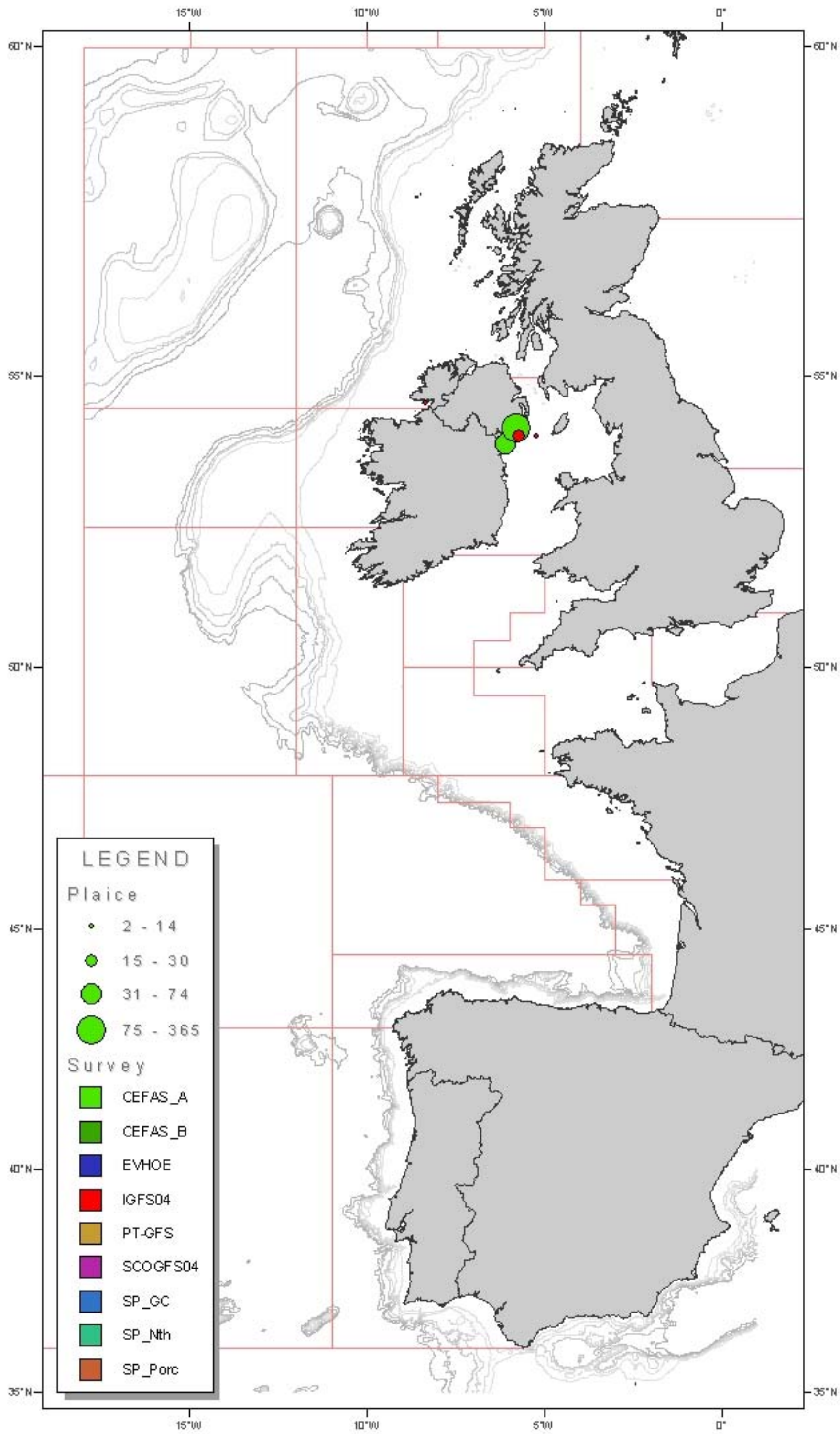


Figure 4.3.1.12: Catches in numbers per hour of 0-group plaice, *Pleuronectes platessa* (<12cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

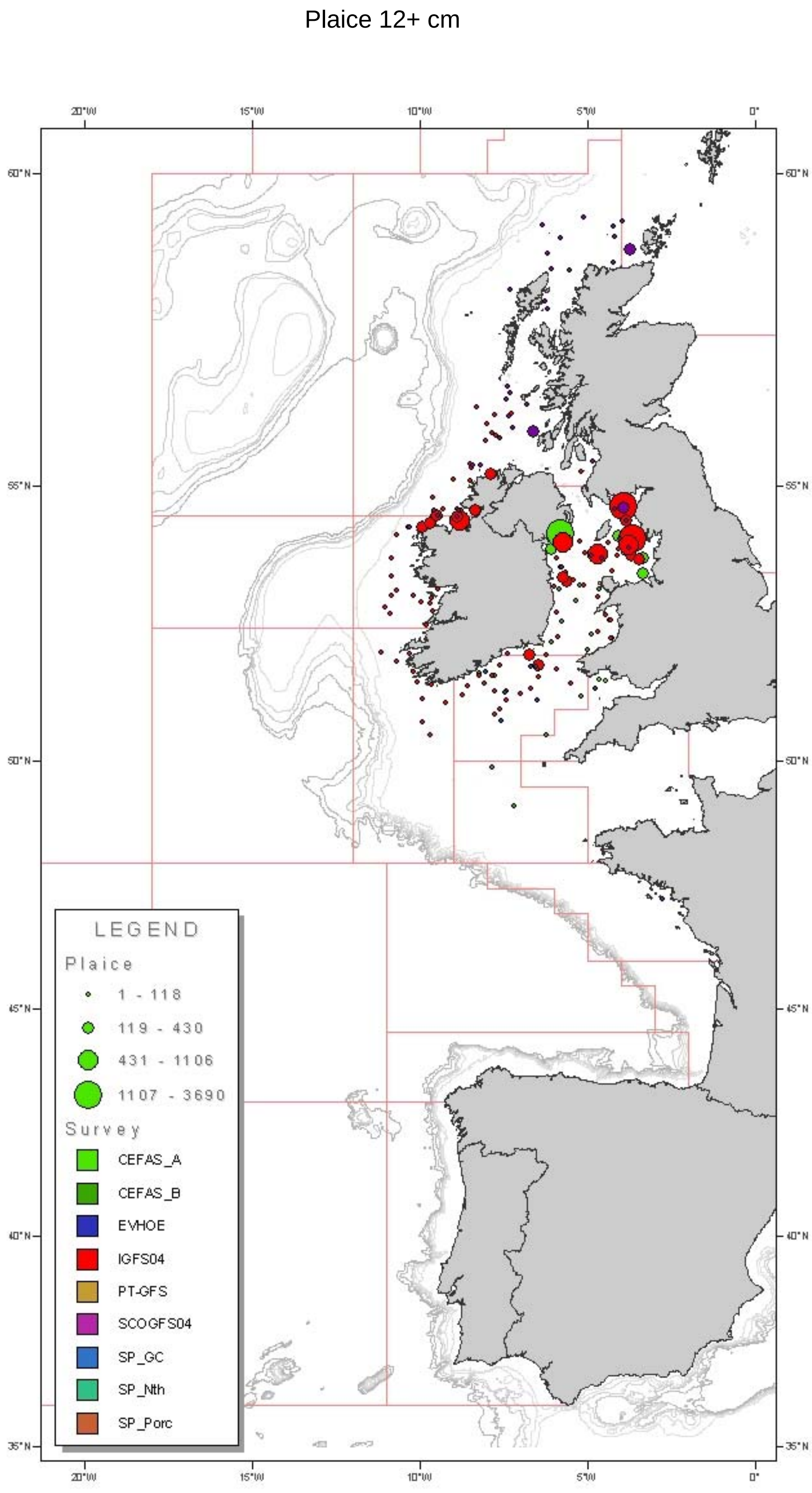


Figure 4.3.1.13: Catches in numbers per hour of 1+ plaice, *Pleuronectes platessa* (≥12cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Herring <17.5 cm

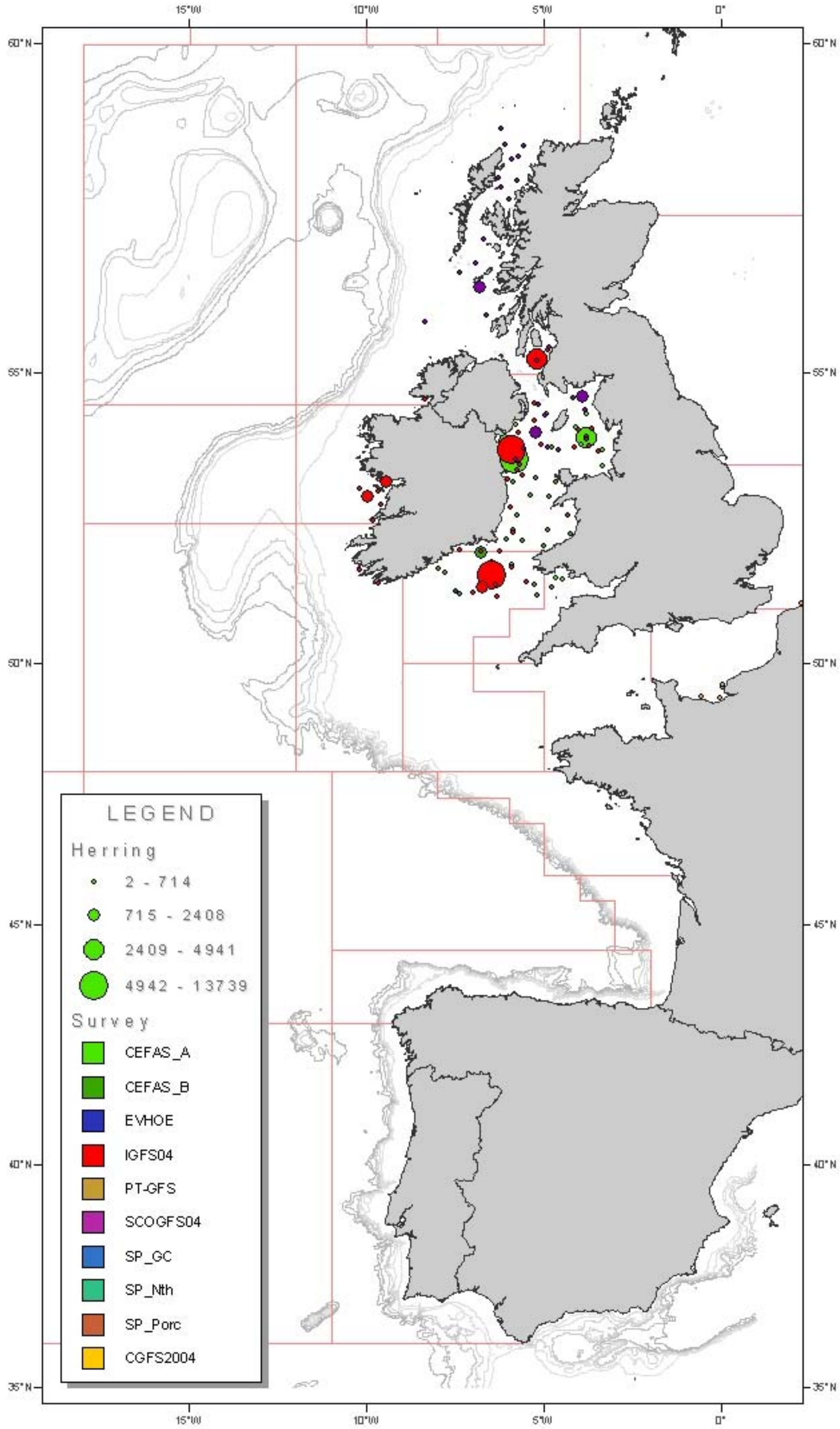


Figure 4.3.1.14: Catches in numbers per hour of 0-group herring, *Clupea harengus* (<17.5cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Herring 17.5+ cm

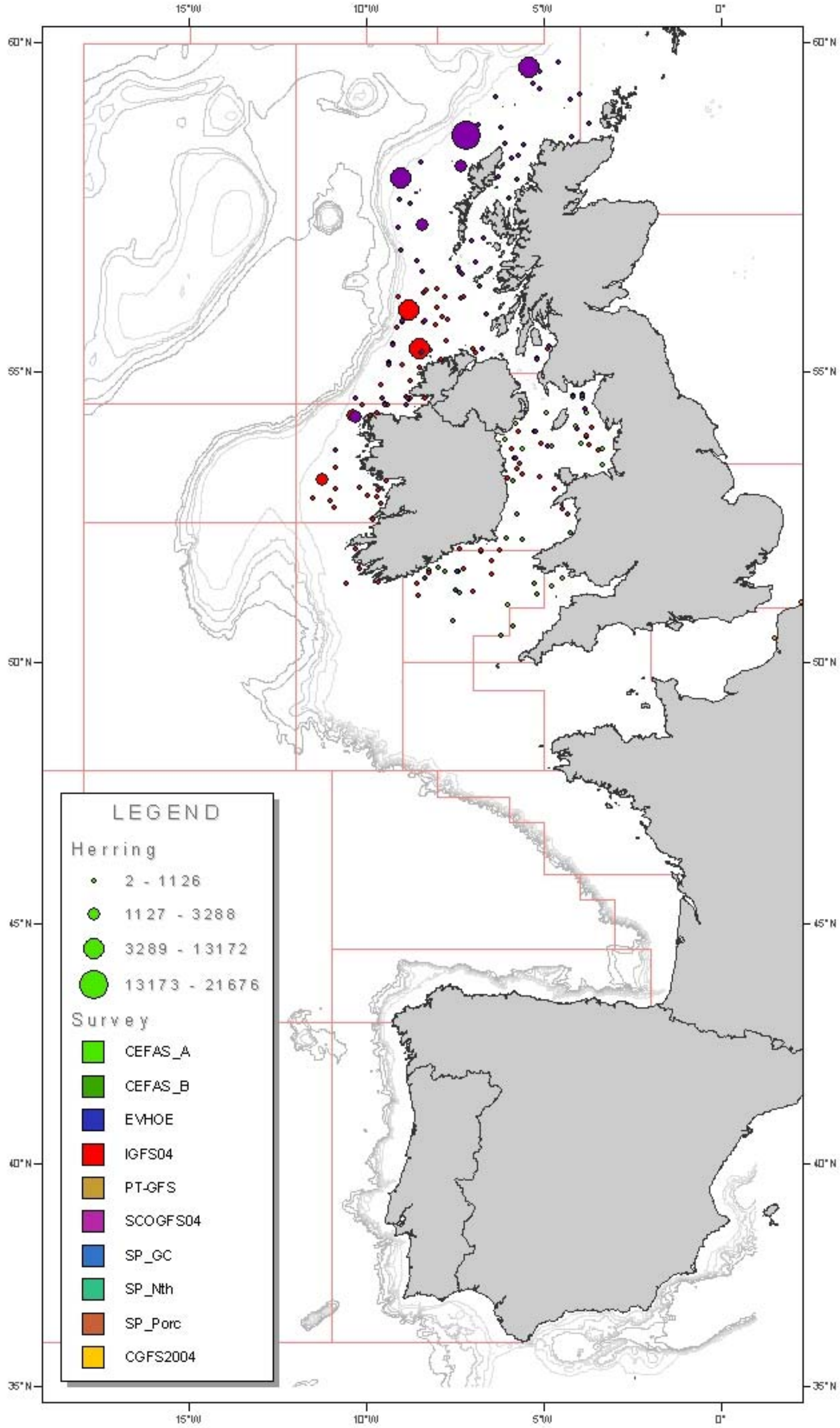


Figure4.3.1.15: Catches in numbers per hour of 1+ herring, *Clupea harengus* (≥17.5cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Mackerel <24 cm

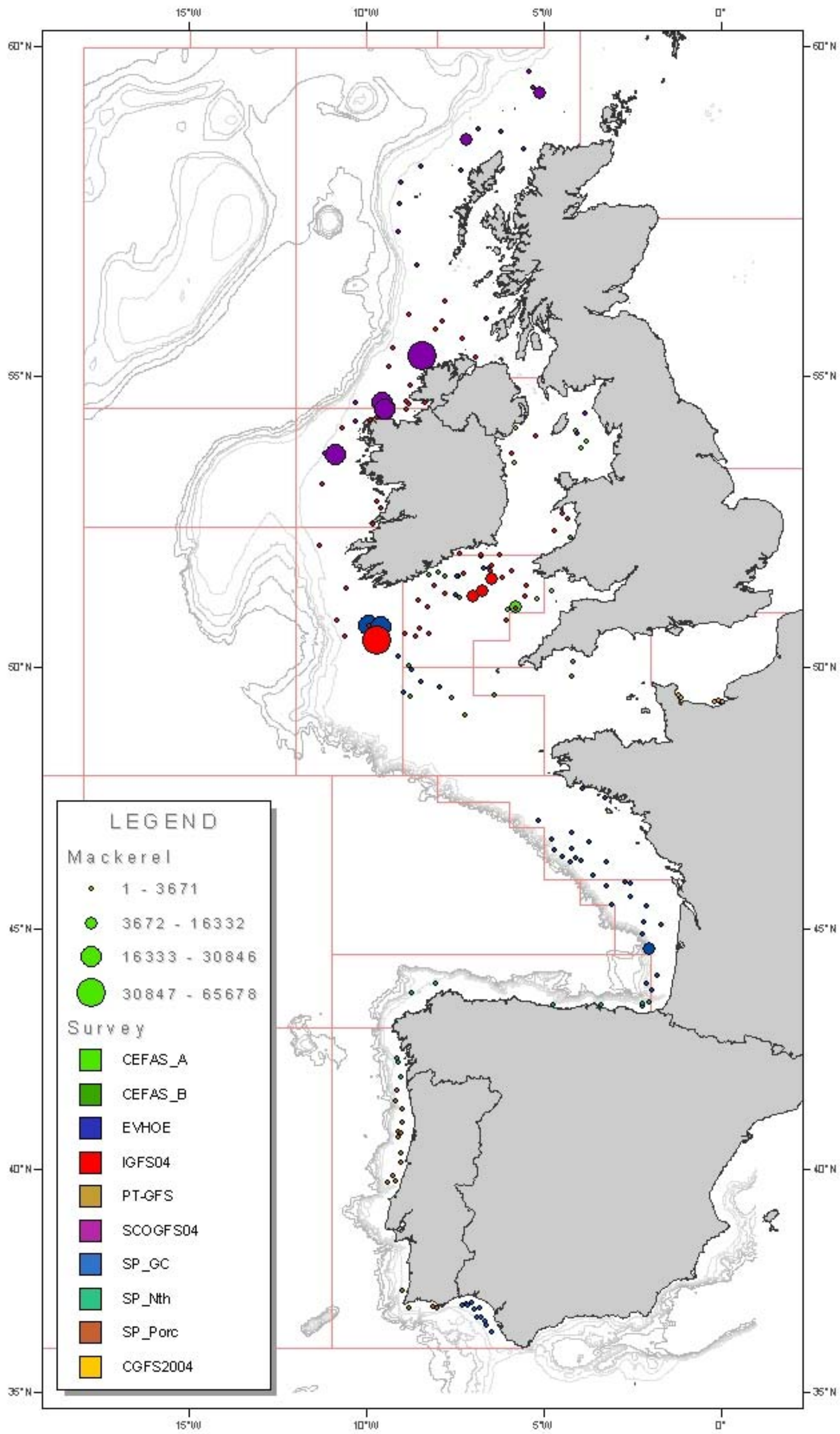


Figure 4.3.1.16: Catches in numbers per hour of 0-group mackerel, *Scomber scombrus* (<24cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Mackerel 24+ cm

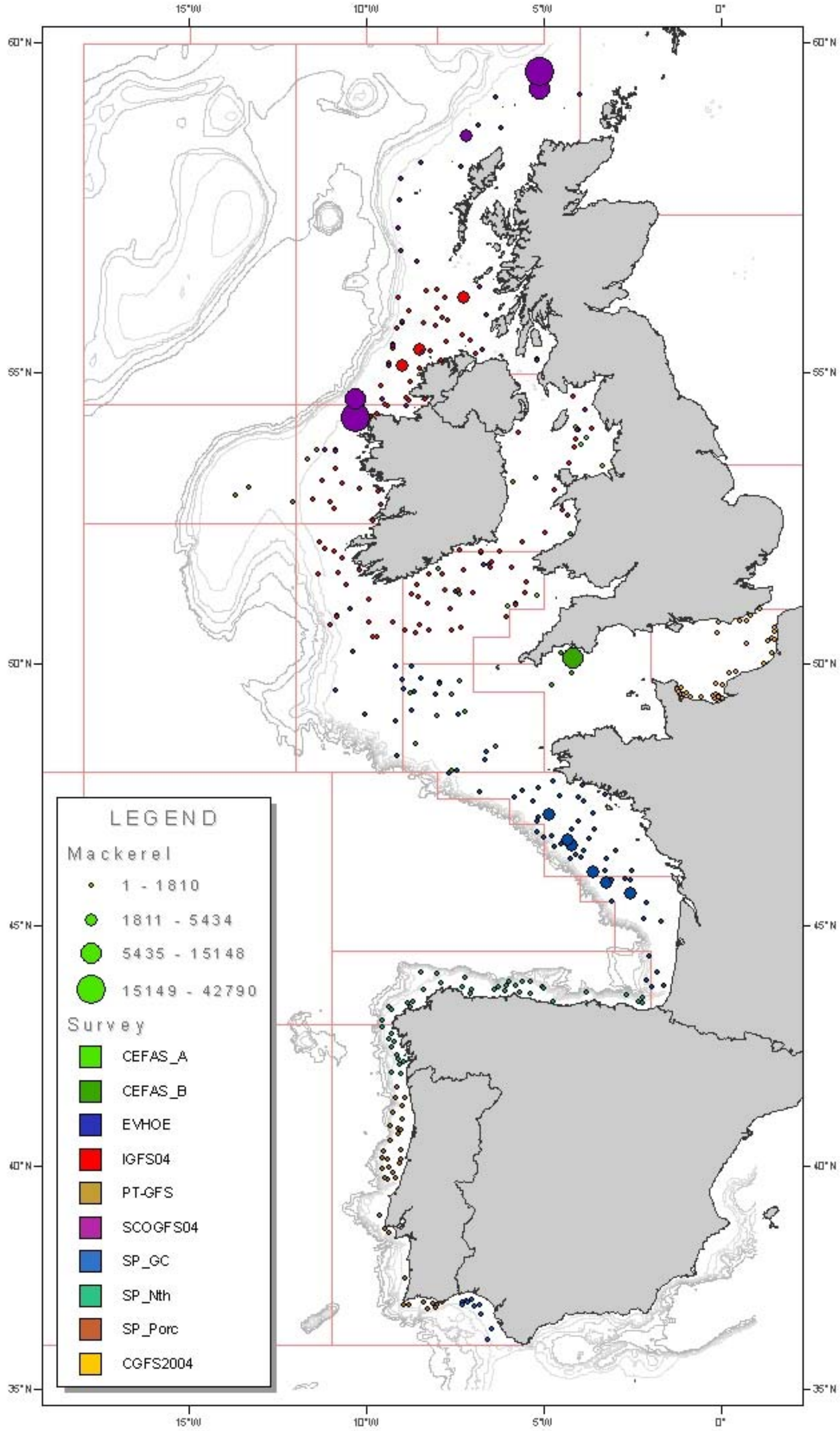


Figure 4.3.1.17: Catches in numbers per hour of 1+ mackerel, *Scomber scombrus* (≥24cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Horse mackerel <15 cm

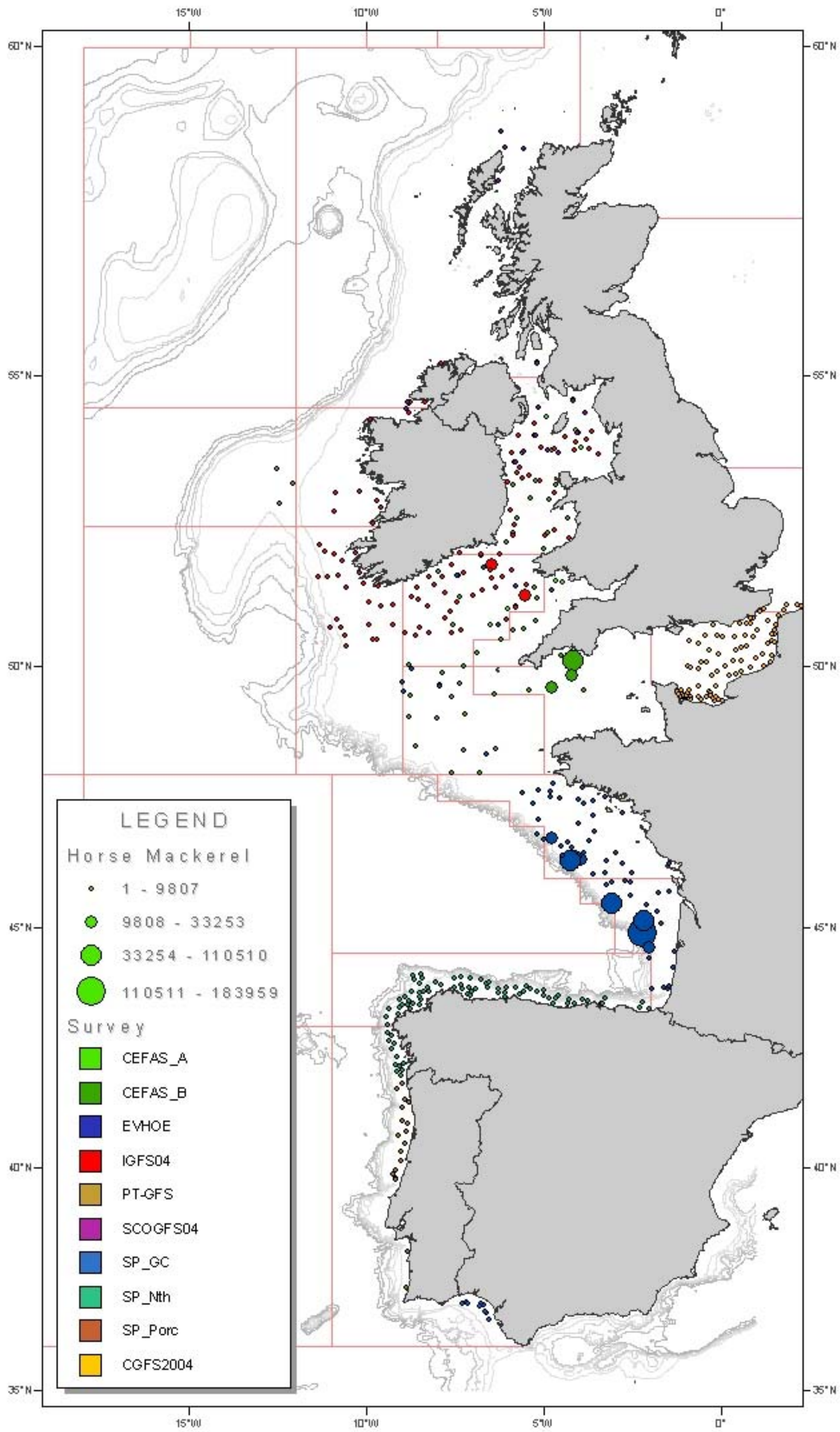


Figure 4.3.1.18: Catches in numbers per hour of 0-group horse mackerel, *Trachurus trachurus* (<15cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Horse mackerel 15+ cm

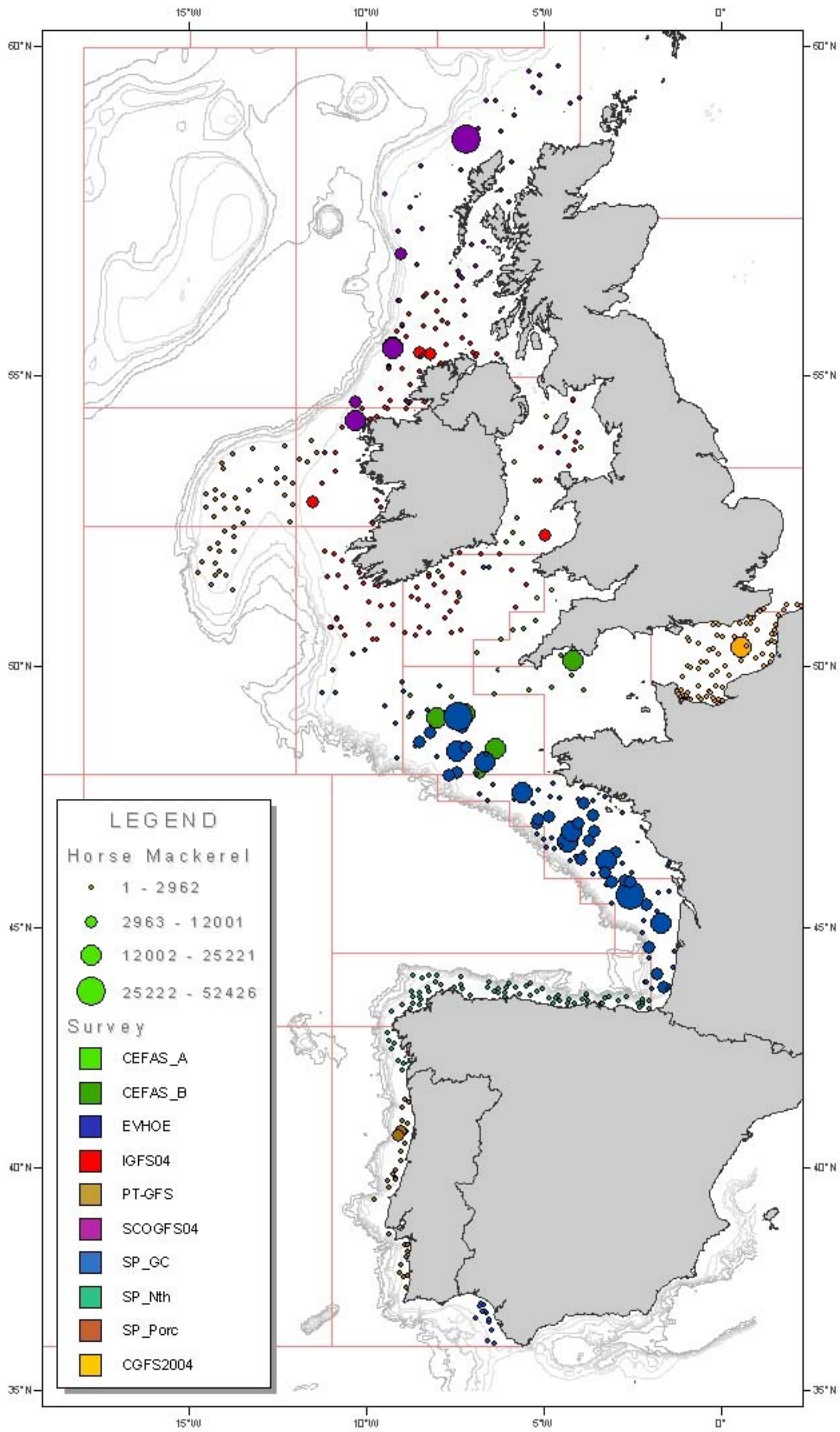


Figure 4.3.1.19: Catches in numbers per hour of 1+ horse mackerel, *Trachurus trachurus* (≥15cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Blue whiting <19 cm

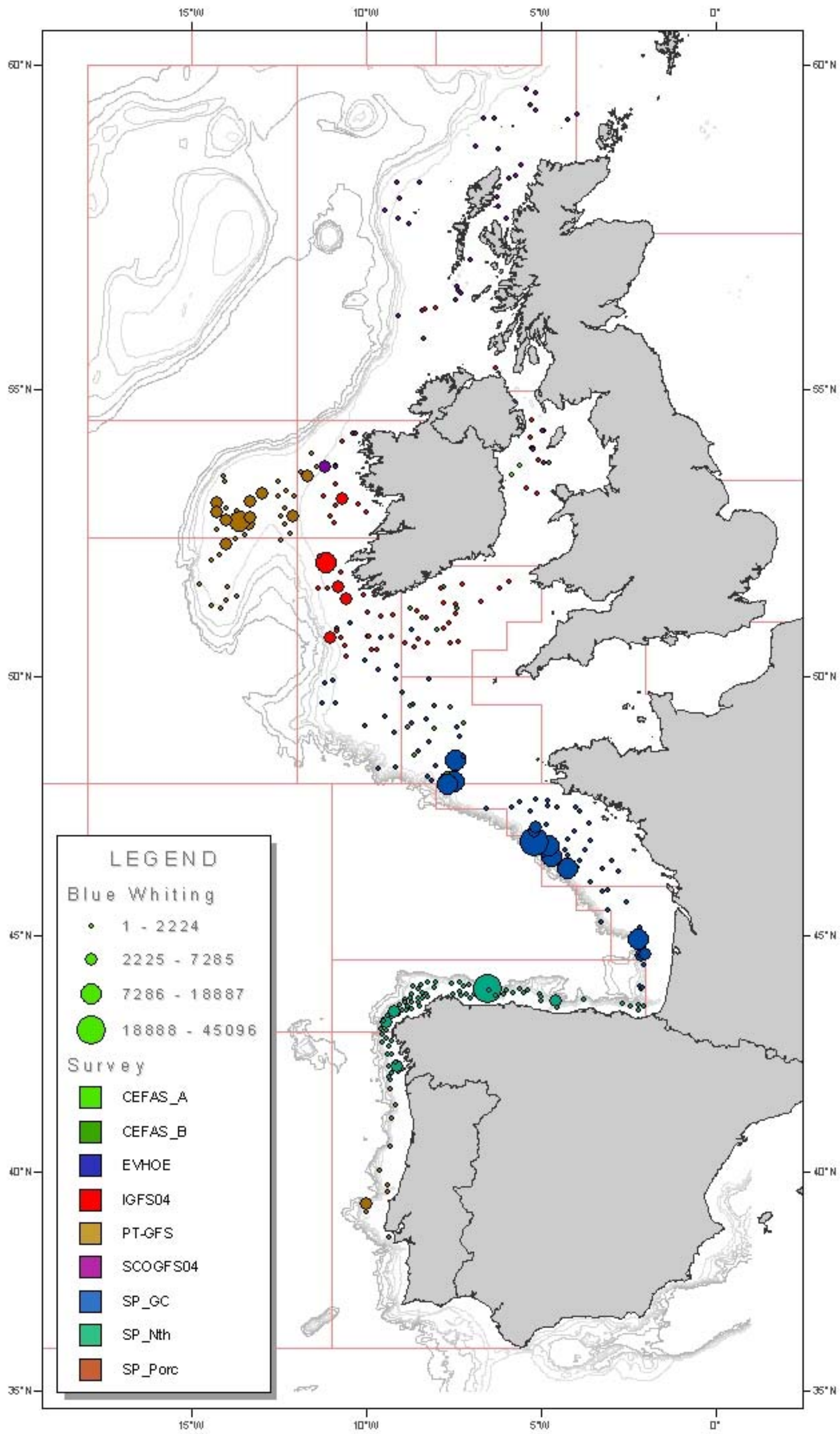


Figure 4.3.1.20: Catches in numbers per hour of 0-group blue whiting, *Micromesistius poutassou* (<19cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

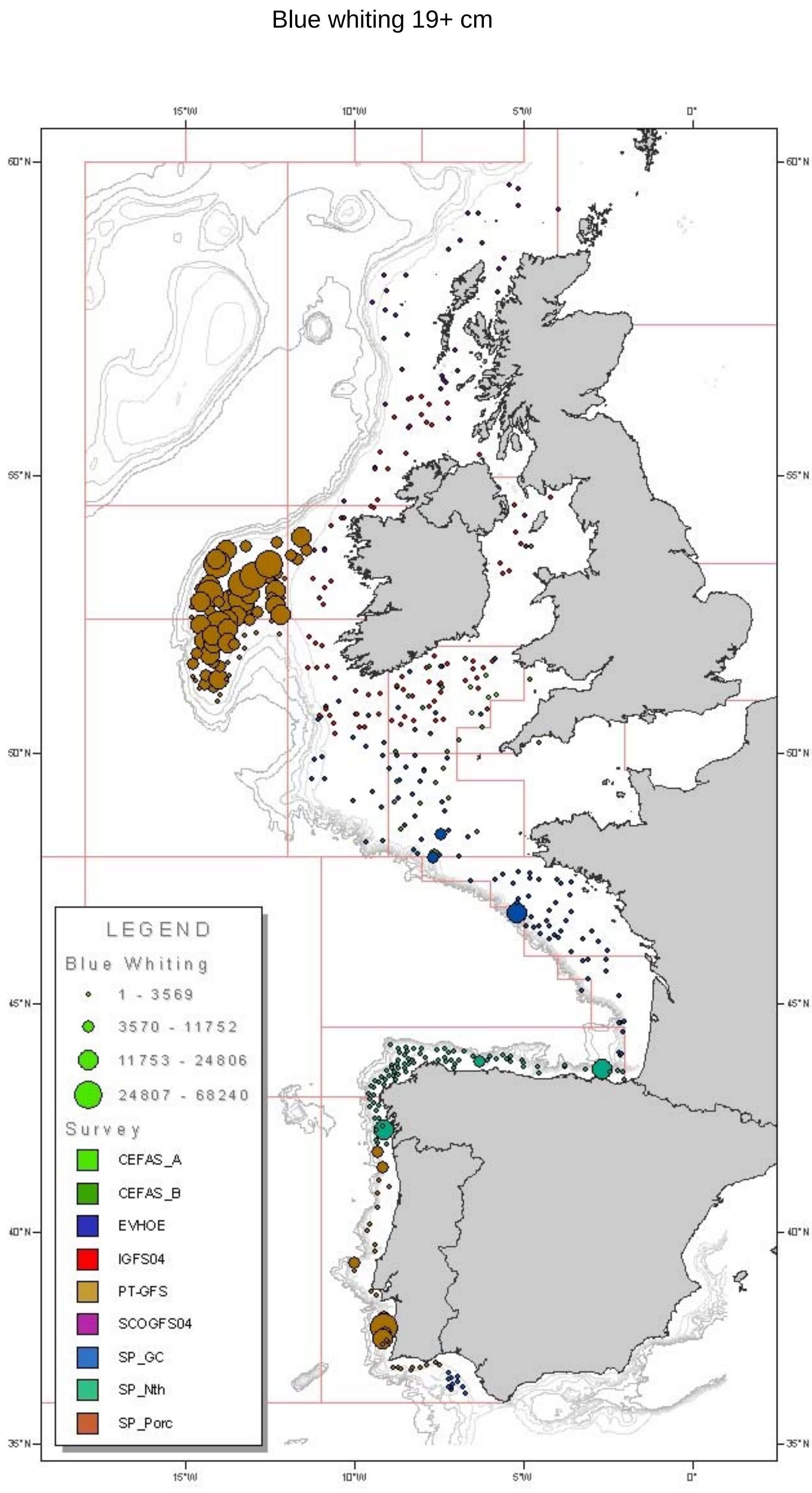


Figure 4.3.1.21: Catches in numbers per hour of 1+ blue whiting, *Micromesistius poutassou* (≥19cm), in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

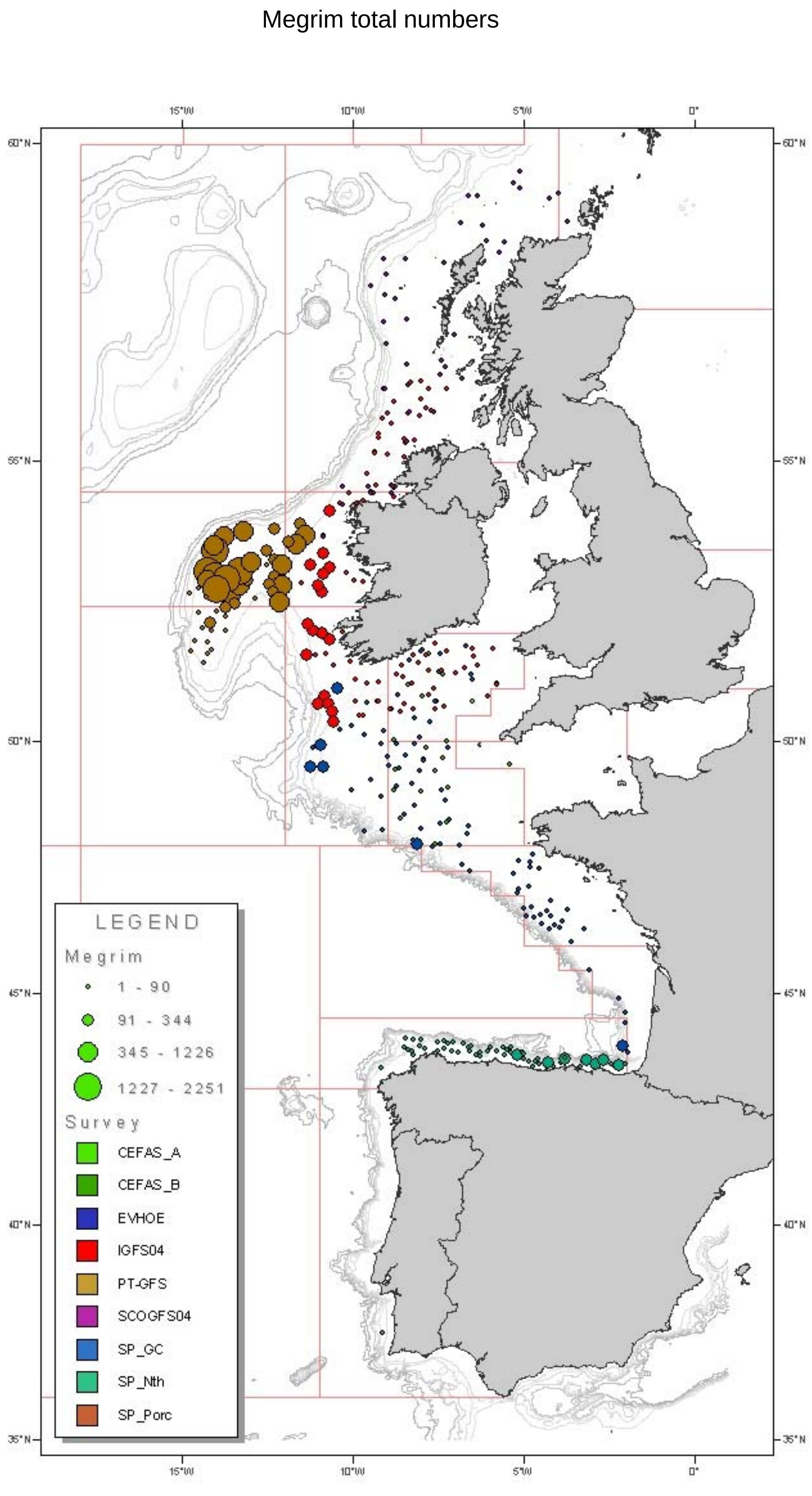


Figure 4.3.1.22: Catches in numbers per hour of, *Lepidorhombus whiffiagonis*, in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Four Spot Megrim total numbers

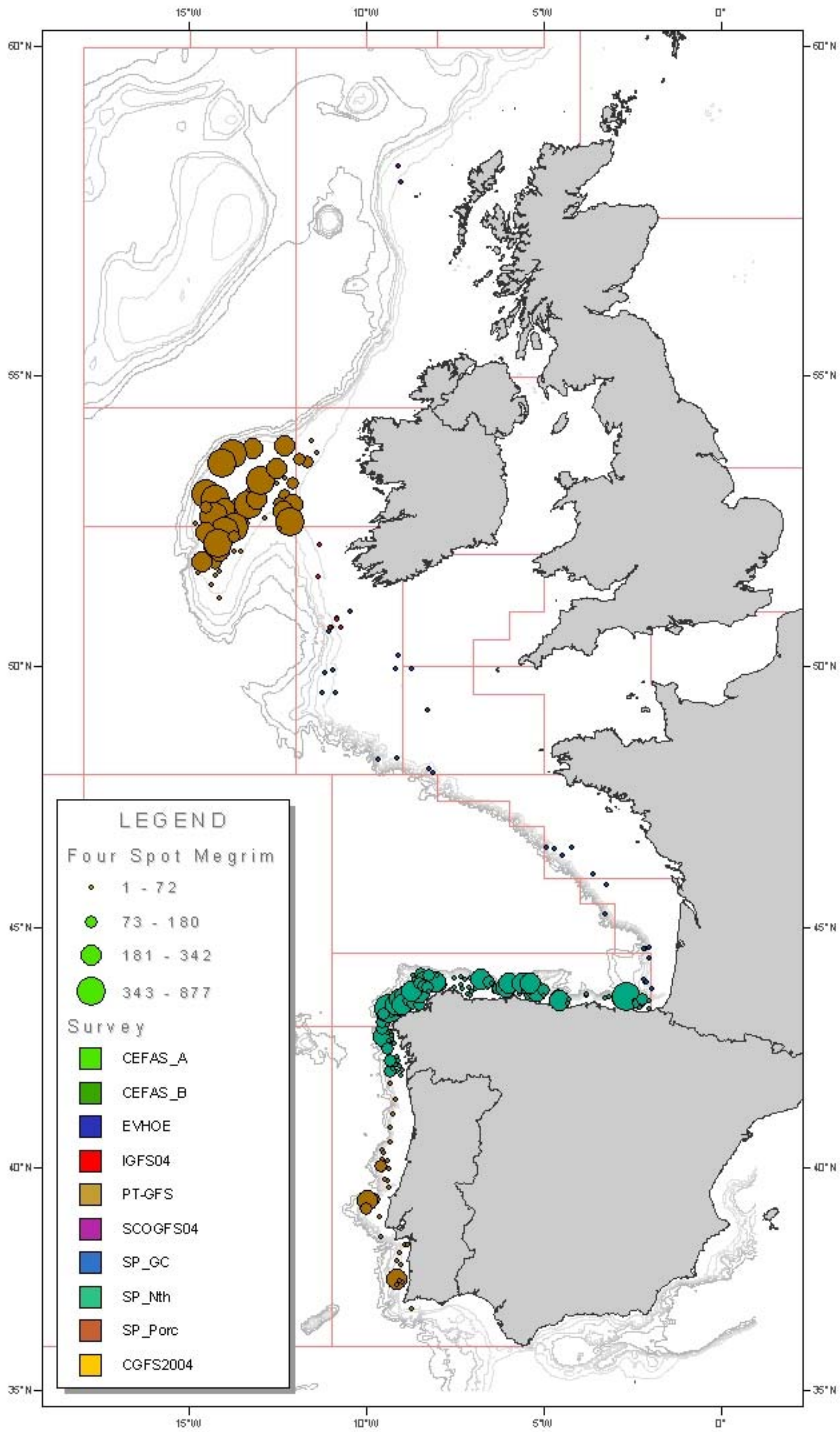


Figure 4.3.1.23: Catches in numbers per hour of four spot megrim, *Lepidorhombus boscii*, in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Monkfish total numbers

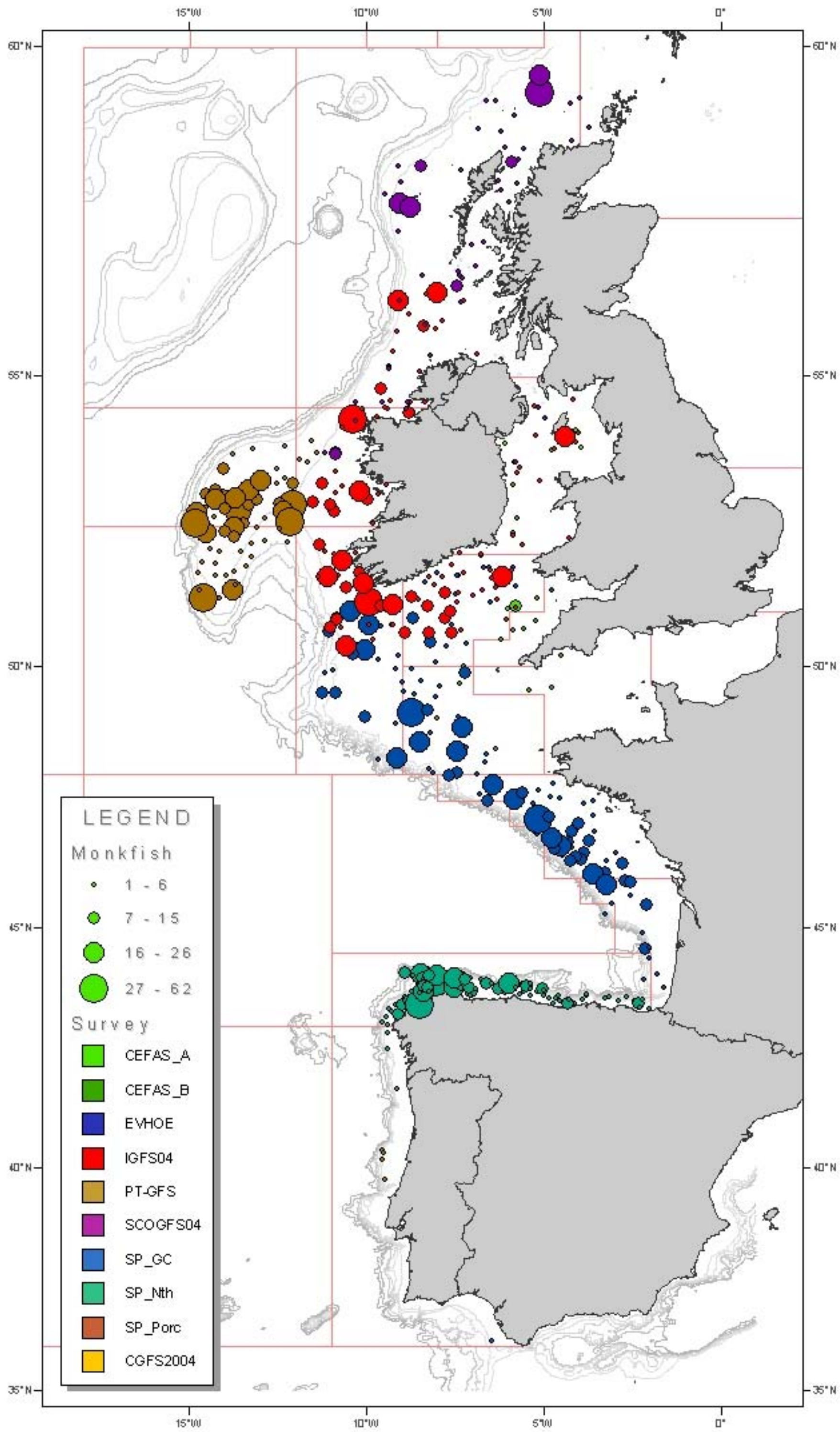


Figure 4.3.1.24: Catches in numbers per hour of monkfish, *Lophius piscatorius*, in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

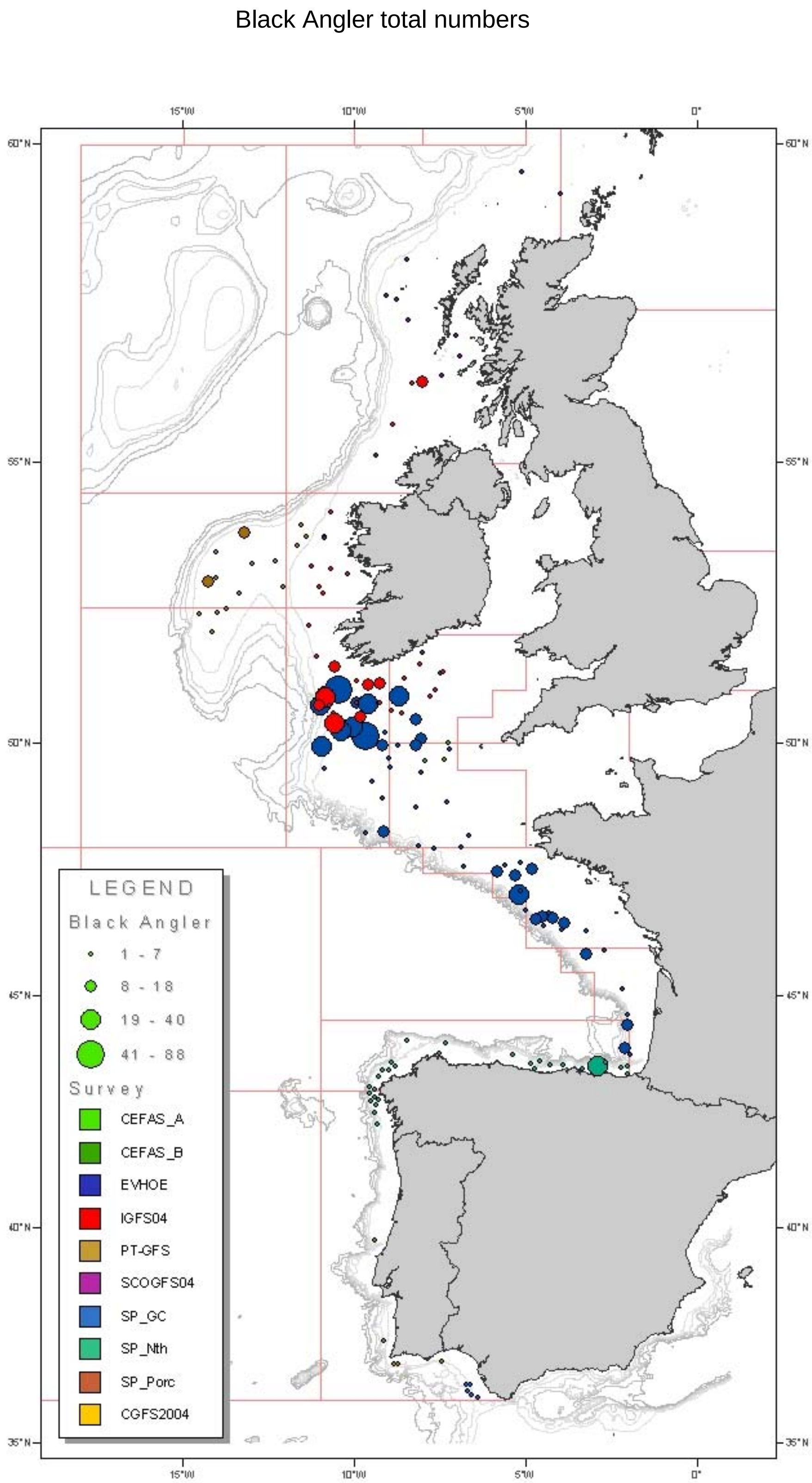


Figure 4.3.1.25: Catches in numbers per hour of black anglerfish, *Lophius budegassa*, in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

Nephrops total numbers

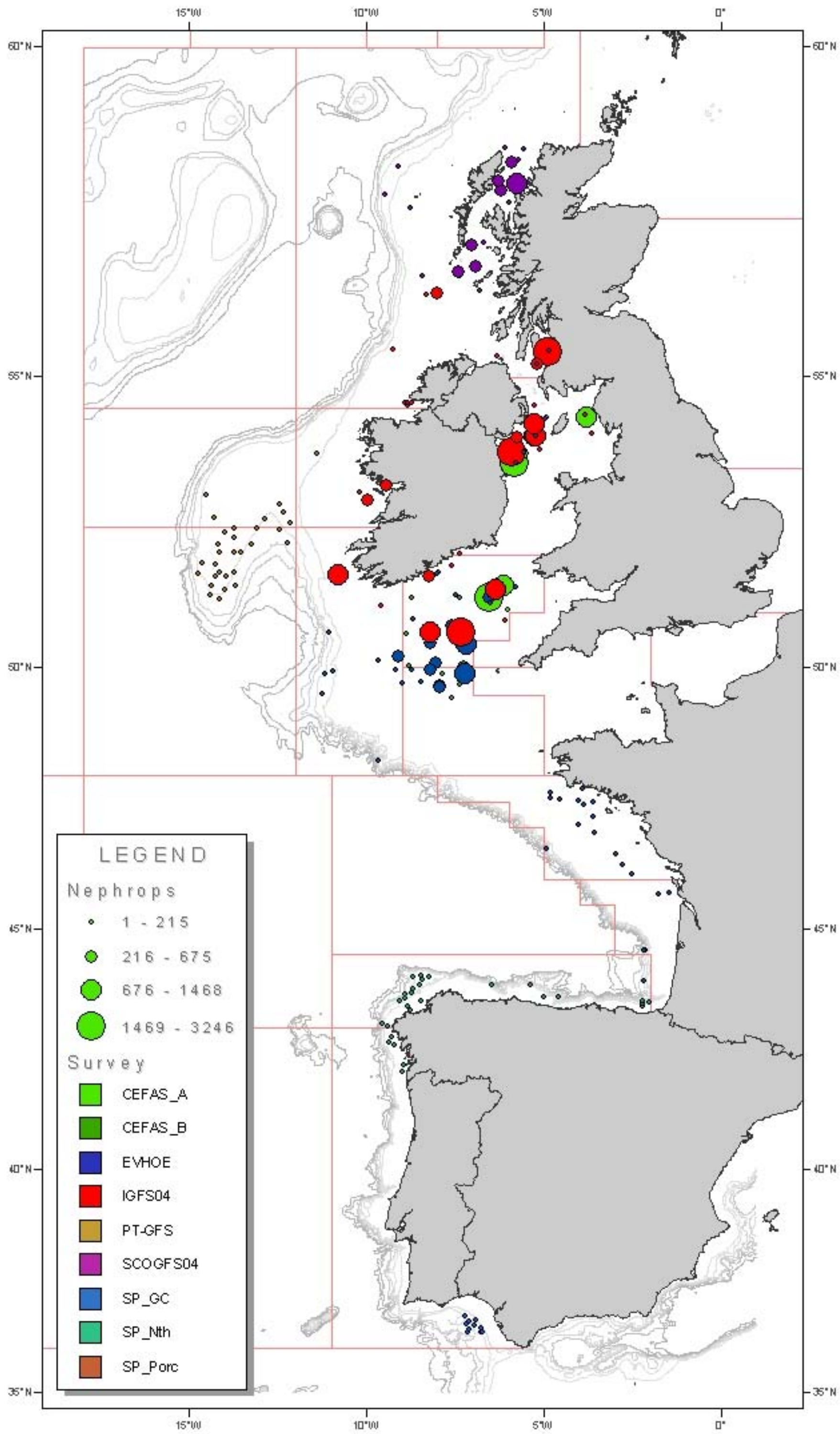


Figure 4.3.1.26: Catches in numbers per hour of *Nephrops*, *Nephrops norvegicus*, in autumn 2004 IBTS surveys. The catchability of the different gears used in these surveys is not constant; therefore these maps do not reflect proportional abundance in all the areas but within each survey.

5 Survey protocols and standardization (ToRS b, c and d)

5.1 Gear related ToR – IBTS vs SGSTS

Standardisation of gears and protocols is a major issue in survey coordination. Over the most recent years, the examination of existing gear configurations has lead to the conclusion that there was a need to update the gear specifications and fishing protocol as they are described in the manual to reflect changes in the available material and monitoring devices.

In the 2004 statutory meeting, the Study Group on Survey Trawl Gear for the IBTS Western and Southern Areas was renamed Study Group on Survey Trawl Standardisation with enlarged competences including new survey trawl design, design of survey trawl standardisation program, operational requirements for intercalibration studies and quality control.

There is a general feeling among the Working Group members that little progress has been made within the IBTSWG on topics related to gear technology. This is due to the lack of expertise in gear technology within the group members, leaving the necessary work to be done to external members of the group, inside national institutes, where hierarchies of priorities often lead to postpone the completion of the necessary work.

Given that new situation and comments from WGSSDS in relation to catchability of the current gear, the Working Group decided to redirect the Terms of references c) and d) to the SGSTS with the following specific questions :

c) investigate the adequacy of some fishing protocol defined in the IBTS manual from ancient studies with respect to the most recent data available from modern monitoring of gear performances;

d) review the GOV specifications with respect to the actual material available for construction;

5.2 Comparative trawling

5.2.1 "Dana" – "Argos"

5.2.1.1 Introduction

Compared to the rest of the North Sea IBTS area, where generally two ships sample each ICES rectangle, Sweden is the only country sampling fish in the Skagerrak and Kattegatt area. Additionally, Skargerrak is much deeper and its typography is much more variable then the rest of the North Sea. In order to determine the catch efficiency of Argos, a set of calibration hauls were made in the western part of The North Sea. Due to bad weather only 11 hauls were possible during this week.

5.2.1.2 Method

The calibration hauls were performed during Q1 2005. The method used was parallel hauls with Dana slightly ahead of Argos. The distance between the two ships was approximately 0.1 nm. The IBTS manual was used both during trawling and for working up the catch. The biggest difference in the different trawl parameters was trawl height (Table 5.2.1.1).

Table 5.2.1.1: Trawl characteristics (average for the 10 hauls) for Dana and Argos.

	DANA	ARGOS
Speed (knots)	3.8	3.7
Height (m)	5.0	4.4
D distance (m)	80.1	84.0
Area (m^2)	397.0	366.6
Wire length (bias %)	6.4	5.3

5.2.1.3 Results

The preliminary analysis suggests that Argos and Dana have similar total catches and that the species diversity is also similar in each catch (Figure 5.2.1.1). Using bootstrap techniques strengthen this observation. There was a tendency that Argos caught more fish in deeper stations. When comparing length distributions for cod; plaice, American plaice; Grey gurnard; herring, dab; whiting (the most numerous species caught) caught by Argos and Dana there was a tendency that Argos caught more of the smaller fish compared to Dana and that Dana caught a bit more of the larger fish (Figure 5.2.1.2). This pattern was even more pronounced when using relative size (standardized to maximum length) (Figure 5.2.1.3). By comparing each species separately, it was obvious that there was no difference in length distributions for flat fish in the two vessels. The main difference in length distributions was mainly obvious in whiting, cod and herring.

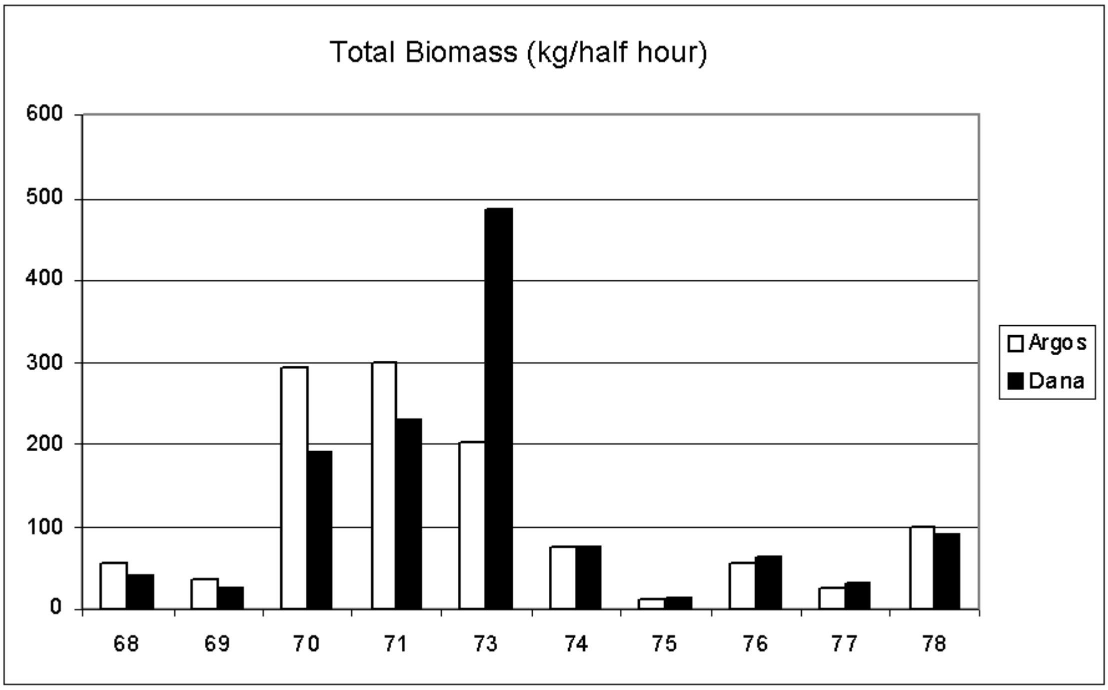


Figure 5.2.1.1: The total biomass per haul caught by Argos (black bars) and Dana (white bars).

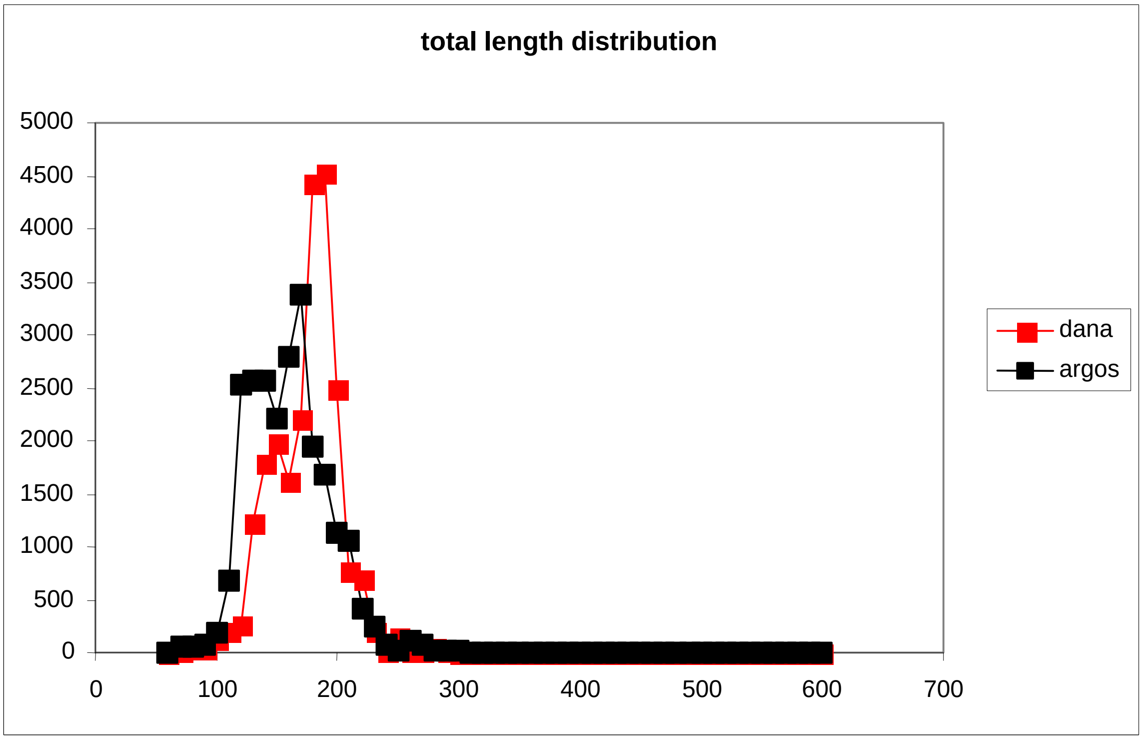


Figure 5.2.1.2: The total length distribution of cod; plaice, American plaice; grey gurnard; herring, dab and whiting.

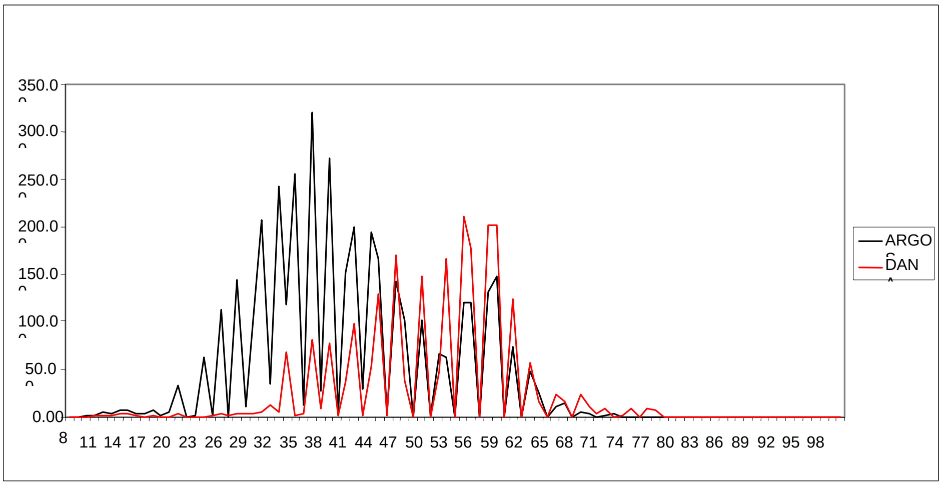


Figure 5.2.1.3: The relative size distribution for cod; plaice, American plaice; grey gurnard; herring, dab and whiting.

5.2.1.4 Discussion

The results suggest that the total catch rates of Argos and Dana are similar. However, Argos is catching more of the smaller fish compared to Dana. The difference in length distribution was not due to differences in catch rates on flatfish, implying that ground contact may be similar. The differences in catch rates on cod, whiting and herring suggests that there may be differences in selectivity possibly due to difference in trawl height.

5.2.1.5 Recommendations

The Working Group **recommends that** Sweden explore the difference between “Dana” and “Argos” further. The suggestion is that Argos will be allowed to do more calibration hauls with Dana during the Q1 survey 2006. During these calibration trials it was suggested that the trawls and trawl doors should be exchanged between the two ships in order to explore the vessel effect compared to trawl gear effects. Furthermore, the WG suggested that the parallel hauls should also be made with Argos slightly ahead of Dana.

5.2.2 IR/UK(“Scotia”)

5.2.2.1 Introduction

In November 2004 a limited comparative fishing study was undertaken to compare the catchabilities of two different configurations of the GOV research trawl during the quarter 4 bottom trawl surveys in ICES area VIa. FRS Marlab in Aberdeen uses groundgear ‘C’ during the quarter 1 and quarter 4 west coast surveys. This configuration is a more robust variant of the groundgear ‘B’ that is used in the northern stations during the quarter 1and 3 North Sea surveys. It differs from ‘B’ in having larger 21” bobbins in the bosom as well as a combination of 18” and 14” bobbins in the quarters. A 320mm toggle chain attaches the groundgear to the fishing line and the sweep length used is approximately 60m (including the backstrop). This heavier groundgear was developed to tackle the harder substrata encountered within area VIa. The Marine Institute (MI) in Galway uses a different variant again of the GOV in area VIa. In addition to having a slightly different groundgear configuration (16” bobbins in the bosom and a combination of 14” and 12” bobbins in the quarters) MI have the fishing line tied down onto the groundgear using 100mm steel rings. The result of this is virtually no gap between the groundgear and the fishing line. Sweep lengths are also changed according to trawl depth with 55m sweeps being used at depths <=75m, these are then switched to the 110m sweeps for deeper tows. It should be noted that all but one of the stations surveyed during the study were deeper than 75m.

5.2.2.2 Method

The aim of this study is to investigate differences in catchability of demersal fish species between both groundgears. This was achieved by conducting parallel trawls at eight predetermined stations. These stations were selected in depths ranging from 70 – 170m. During the trial over 11 tonnes of fish were sampled and in excess of 50 fish species were encountered. Catch compositions as well as catch weights for the most abundant species were then compared. Before analysis could commence it was first necessary to remove all the data for herring, horse mackerel, mackerel, sprat and boarfish. These are shoaling species and due to the unpredictability associated with their capture they should not be used in the analysis.

5.2.2.3 Catch Composition

In order to investigate any assemblage differences existing between the two vessels the catch weights as well as the length frequencies for several of the more abundant species were analyzed in more detail. The total catch weights recorded by each vessel for each of the paired hauls were displayed together with the individual species weights by haul for six of the most abundant species. A table of combined weights for these species is listed below in Table 5.2.2.1. T-tests were then performed on the haul catch weights for these species to test the null hypothesis (H=0) or no difference between trawl gear. The results from this are also displayed in Table 5.2.2.1.

Table 5.2.2.1: Total catch weights (in kg) of six abundant species for both vessels with resulting P – values from T – test.

Species	Celtic Explorer	Scotia	T–test P–value
Haddock	1325.04	493.05	0.0017
Whiting	286.73	163.82	0.056
Plaice	36.29	17.19	0.0479
Common Dab	17.96	18.17	0.685716
Poor Cod	109.959	40.14	0.0077
Grey Gurnard	49.96	21.05	0.005

Table 5.2.2.1 shows that out of the six abundant species analyzed all but one showed a significant disparity in catch weights in favour of the Celtic Explorer. The results of the T–test also support this with the majority of these species rejecting the null hypothesis at the $P < 0.005$ level. To investigate this further the length frequencies for these species were also examined and the length frequencies by haul for each of the six species can be viewed in the full report. (Located in Annex.1.) As might be expected these also highlight that the Celtic Explorer appears to have greater catchability than the FRS Scotia.

The next step was to try and establish whether there was also a size selectivity issue underlying this disparity, within each species. In order to examine any intraspecial selectivity between the gears it was necessary to reclassify the data for each species according to size class. For haddock and whiting these were defined using length splits derived from the age-length keys compiled during the survey. For the other species the length frequencies for both vessels were studied with splits being placed at natural breaks in the distributions. The results of this are shown below in Figure 5.2.2.1.

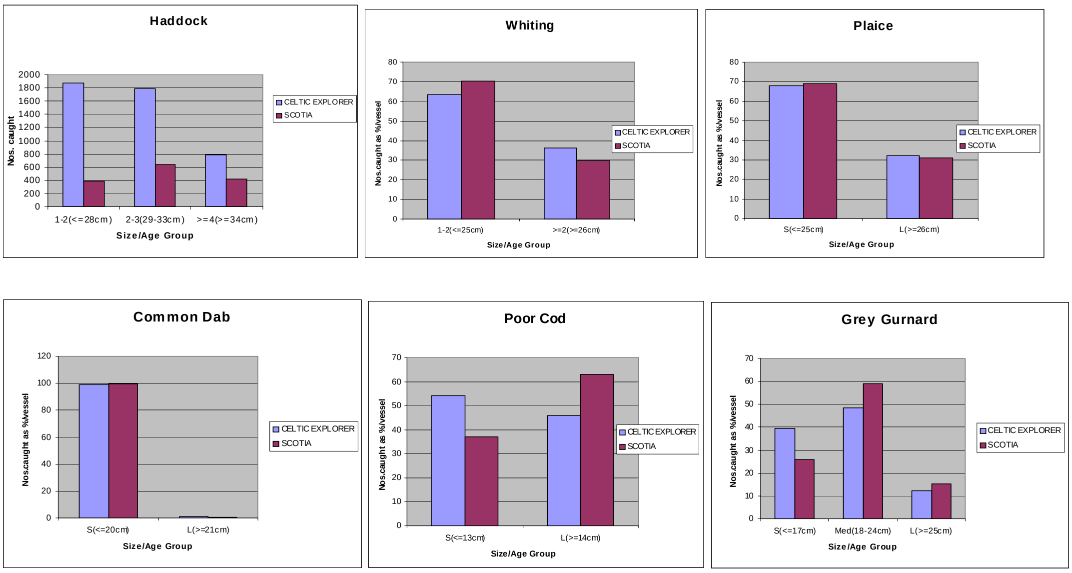


Figure 5.2.2.1: Results after reclassification of length frequency data for six species into size classes. Expressed as a percentage of the total species catch for each vessel.

As expected there is a significant difference in catchability between vessels for most of the selected species. In addition to this, haddock, poor cod and grey gurnard also appear to show significant differences regarding the numbers caught in the small size classes. (See Figure 5.2.2.1) The Celtic Explorer appears to catch not only more but significantly, a higher proportion of smaller fish for these species.

In order to try and test the hypothesis that the length frequencies for both vessels differ significantly it was necessary to perform a K-S test on the six selected species. Cumulative length frequency plots were created with the subsequent analysis being performed on the data using d-values obtained from the aforementioned plots. The test results are displayed on Table 5.2.2.2.

Table 5.2.2.2: Results of K-S test on the 6 selected species.

Species	D – value	Da	Ho (a=0.05)
Haddock	0.155	0.041	Rejected
Whiting	0.065	0.046	Rejected
Plaice	0.095	0.162	Accepted
Common dab	0.079	0.089	Accepted
Poor cod	0.175	0.048	Rejected
Grey gurnard	0.165	0.099	Rejected

These results support the hypothesis that for the highlighted species there appears to be a significant difference in the observed length frequencies between vessels. In the case of haddock, poor cod and grey gurnard this is further evidence that the Celtic Explorer is catching a higher proportion of the smaller size classes for these species. Contrastingly, plaice and common dab accepted the null hypothesis that proportionally there was very little difference between the length frequencies.

5.2.2.4 Discussion

This was an extremely limited study with only eight parallel hauls with which to try and make a comparison between the two research vessels and more specifically the fishing gear they were using. It does nevertheless throw up some rather interesting points. Firstly it is very clear that the modified GOV used by MI aboard the Celtic Explorer is much more efficient than the corresponding GOV with the 'C' groundgear as used by FRS aboard Scotia. Secondly there seems to be rather a lot of evidence to suggest that for certain species there is a selectivity issue in addition to that of catchability although more data is needed to examine this further. Possible reasons behind both these issues must lie firstly with the difference in sweep lengths used by both vessels. One would suspect a herding issue may be at least a partial cause regarding the greater efficiency of the Irish GOV. Secondly the removal of the toggle chain and the tying down of the fishing line onto the groundgear would also one might suspect be a contributory factor. Of course this also makes the inherent assumption that fish are escaping under the fishing line from the Scottish net. This may at least partially explain the catchability issue, however the issue of size selectivity remains a mystery and much more data is needed before any conclusions can be drawn.

5.2.2.5 Recommendations

The Working Group **recommends** that FRS and MI continue to build on this limited intercalibration study whilst also attempting to address the issues raised during the exercise. While recognising that opportunities for this sort of exercise are limited, (due mainly to constraints on resources) IBTS strongly encourages other participating countries to consider such exercises where survey area overlap exists.

5.3 Quality assurance of species identification and composition

5.3.1 Background

It has been highlighted that the IBTS has potential problems associated with the misidentification of selected taxa, primarily non-commercial fish species (Daan, 2001; ICES, 2005). Additionally, there are several taxa that member states report at a range of taxonomic levels (species, genus or family). Although these problems will have no impact on the assessment of commercial fish stocks, it does have implications on the utility of the IBTS dataset for studies on fish assemblages, including biodiversity studies and the derivation of metrics for fish communities (e.g. in relation to studies examining the impacts of fishing impacts and climate change). Potential problematic taxa in the North Sea and in the southern and western IBTS surveys include:

- Deep-water sharks (Squalidae)
- Smoothhounds (*Mustelus* spp.)
- Skates and rays (Rajidae)
- Shads (*Alosa* spp.)
- Argentines (*Argentina* spp.)
- Rocklings (Gadidae, Lotinae)
- Rat-tails (Macrouridae)
- Clingfishes (Gobiesocidae)
- Sticklebacks (Gasterosteidae)
- Myctophids (Myctophidae)
- Hatchet fish (Sternoptychidae)
- *Beryx* spp.
- *Hoplostethus* spp.
- Pipefish (Syngnathidae)
- Redfish (*Sebastes* spp.)
- Scorpion fish (*Scorpaena* sp.)
- Sea scorpions (Cottidae)
- Sand eels (Ammodytidae)
- Dragonets (*Callionymus* spp.)
- Wrasse (Labridae)
- Eelpouts (Zoarcidae)
- Snake blennies (Stichaeidae)
- Mullets (Mugilidae)
- Gobies (Gobidae)
- Sea breams (Sparidae)
- Horse mackerel (*Trachurus* spp.)
- Flatfish (certain sister taxa, e.g. *Bathysolea-Diclogoglossa*)

Groundfish surveys provide the most appropriate data for the examination of large-scale spatial and temporal analyses of fish communities for offshore EU waters, and therefore for the derivation of metrics with which to assess changes in the structure, function and diversity of fish communities.

IBTSWG recognises the fact that groundfish survey data are important for assessing the status of non-target fish species and fish communities as a whole, and that quality assurance procedures, for example fishing protocols, catch sampling and sub-sampling, and fish identification, should be in place to ensure that data collection is appropriate for community analyses wherever practicable.

5.3.2 Fish identification

IBTSWG considered that accurate identification of all fishes was important, though it was felt that this aspect of surveys could be compromised by several factors, including the availability of suitably experienced staff. The decline of taxonomic expertise was also regarded as a cause for concern.

IBTSWG **recommends** that the national fisheries laboratories take all necessary measures to ensure that appropriate levels of expertise in fish taxonomy and identification are maintained.

Additionally, there are several ways that the national fisheries laboratories could improve data quality for fish identification.

1) The development and dissemination of user-friendly keys (including photographic keys) for problematic taxa, which should improve data quality and also ensure comparability between national survey data sets (see below)

2) The more unusual species caught on surveys should be photographed and preserved or frozen for subsequent verification, with specimens deposited in national or regional museums where appropriate.

3) Laboratories could consider establishing and maintaining a reference collection of the fish species encountered in their surveys, with particular reference to problematic taxa and rare and unusual species.

4) Software for the input of catch data could include filters to flag those fish species that are outside their normal geographic, bathymetric range or outside normal size limits. The DATRAS database has such filters.

5) Better training for sea going staff to ensure taxonomic expertise is improved and that the need for correct fish identification is highlighted as an important element of the surveys. Testing procedures to ensure quality control should be recommended.

5.3.3 Workshop photo-collections for species identification

Over the last years, there has been a growing concern for the quality control of survey data. Important aspects of concern are correct species identification and proper recording of maturity stages. In order to facilitate this, several laboratories that are responsible for the conduct of research vessel surveys have set up photo-collections of fish, benthos and maturity stages. During the 2004 meeting of the IBTSWG in Lisbon it was agreed that a workshop should be held at RIVO (IJmuiden, Netherlands) to discuss the possibility to combine these photo-collections into one international set.

The principal goal is to create a “simple” application that can be used to easily show photos to help with identification (of fish, shellfish and benthos) and standardisation (maturity stages). Short and simple comments will give information on distinguishing features. The setup is based on a taxonomic tree-structure, using scientific species names, and with the option of giving names in other languages. The contributors to the workshop were not aware of existing software packages that would suit these purposes. The general agreement was that a simplified version of part of the program developed for input of survey data at RIVO might be a good starting point.

The intention is to provide the photo collection plus installer for the application on a CD-ROM. The CD should also contain a general description on the possibility to use the photos for other purposes. The copyright will remain with the photographer (or his/her laboratory). If someone should want to use the photos in a publication, the photographer should be contacted for permission.

It was agreed that RIVO would take the lead in the development of an application and in the exchange of material to be included. RIVO will make a list of available photos and send it around among the members of the IBTS Working Group before June 2005. This way all members can see which photos are needed to add to the international set.

5.3.3.1 Instructions for photos:

- In the right hand corner the name of the photographer should be included as embedded information: a copyright symbol, the name of the institute (acronym), the name of the photographer and the year, e.g. "© FRS Marine Laboratory/Finlay Burns/2004".

This text should be in black or white, in italics, and in Arial 10.

- Apart from the name of the photographer there should be no text on the photo, but distinguishing features may be highlighted by arrows or circles.
- There is no preference for a particular background used, but preferably a cm-scale should be visible.

5.3.3.2 Instructions for file names:

- The images should be JPEG files, with a critical resolution necessary for presentation on full screen: width of 15x20 cm, resolution 120, quality 7 (medium to high compression), and a size limit of approximately 150 kB.
- File names of fish or benthos species should consist of the scientific name and an image number, e.g.Gadus_morhua_01.jpg
- File names for maturity stages should consist of the scientific name, sex, stage, number, e.g. Gadus_morhua_M_1_01.

Example of a window displayed by the program on species level:

5.3.4 Catch sampling

For most IBTS surveys, the following procedure for catch sampling occurs:

Wherever possible, the entire catch is sorted, with fish and shellfish species identified to the lowest taxonomic level possible. In the case of larger catches a selection of species/size categories of species may be identified as being sufficiently abundant that they can be subsampled. In these cases the entire catch is examined, the pre-selected species/categories combined in a “mixed” sample, and individuals of all other species/categories removed. The “mixed” sample is then re-sorted into the component species/categories and raised appropriately.

In certain circumstances, however, some vessels may not be able to process all large catches as above, and may only sort a sample that is considered appropriate for estimating the relative abundance of the dominant species. In these circumstances, the entire catch is not examined for “rare” species and these data may not be appropriate for biodiversity studies. IBTSWG **recommends** that this method should be avoided wherever possible, and if particular catches are sorted by this method, then these catches be flagged accordingly. Hence, IBTSWG also **recommends** that the DATRAS database contains a field to highlight those catches that may be compromised for community studies.

5.3.5 Cephalopods identification

During the meeting Karsten Zumholz from the Leibniz Institute of Marine Sciences (IfM-Geomar) in Kiel/Germany presented a first draft of a species identification key for cephalopods in the North Sea. This guide is focussed on the needs of the ICES International Bottom Trawl Survey (IBTS) and aims to facilitate species determination of the most common cephalopods in the North Sea. Eleven species are included; representing all species that have been caught during IBTS cruises conducted by FRV “Walther Herwig III” in the years 1998 to

2004. A final version of the guide will be available in May this year and will be distributed between the IBTS participants before the start of the Q3 survey.

5.3.6 Other manuals and guides for taxonomic identification

In addition to improving the quality assurance of fish and shellfish identification, several laboratories are also collecting data on the non-commercial invertebrates captured during surveys (Table 5.3.1). To assist in the correct taxonomic identification of fish and marine invertebrates in the ICES areas, it was **recommended** that the IBTS manual contains a new appendix listing useful reference works for various taxa. Example texts are given below, though many regional keys are also available, and is hoped that an inventory of the field guides used during IBTS surveys is compiled for the 2006 meeting.

Table 5.3.1: Indication of the current sampling levels for fish, shellfish and non-commercial invertebrates by country (1 = Identification to species level and reported to ICES database; 2 = identification to species level and recorded on local/national database; 3 = Identification to family/genus level and reported to ICES database; 4 = identification to family/genus level and recorded on local/national database)

Country	Survey	Fish	Commercial Shellfish	Cephalopods	Benthos
UK(Scotland)	IBTS – Q1	1	1	2	4
UK(Scotland)	IBTS – Q3	1	1	2	4
UK(Scotland)	Western Q1	1	1	2	4
UK(Scotland)	Western Q4	1	1	2	4
France	Western Q4	1	1	2	-
Portugal	PGFS	2	2	2	-
Netherlands	IBTS – Q1	1	1	2	2
Germany	IBTS – Q1	1	1	2	-
Germany	IBTS – Q3	1	1	2	-
UK(England)	IBTS – Q3	1	1	2	2/4
UK(England)	Western Q4	2	2	2	2/4
Ireland	IGFS–Q4	1	1	1	4
Spain	Sp–Porc	2	2	2	2/4
Spain	Sp–North	2	2	2	2
Spain	Sp–G.Cadiz	2	2	2	2/4
Denmark	IBTS – Q1	1	1	3	-
Denmark	IBTS – Q3	1	1	3	-
Sweden	IBTS – Q1	1	1	2	2/4
Sweden	IBTS – Q3	1	1	2	2/4
Norway	IBTS – Q1	1	1	1/3	-
Norway	IBTS – Q3	1	1	1/3	-

A preliminary list of useful identification keys is given below, and it is hoped that this list can be expanded for next years report.

Fishes:

Wheeler, A. (1969). The fishes of the British Isles and North West Europe. Michigan State University Press, 613pp.

Wheeler, A. (1978). Key to the Fishes of Northern Europe. Frederick Warne, London. 380pp.

Whitehead, P.J.P., Bauchot, M.L., Hureau, J.-C., Nielsen, J. and Tortonese, E. (Eds.) (1984). Fishes of the North-eastern Atlantic and the Mediterranean, Vol. 1–3. UNESCO, Paris, 1473pp.

Marine invertebrates (general):

Hayward, P.J. and Ryland, J.S. (1990) The Marine Fauna of the British Isles and North-West Europe (two volumes). Clarendon Press, Oxford, 996pp.

Hayward, P.J., and Ryland, J.S. (1995) Handbook of the Marine Fauna of North-West Europe. Oxford University Press, 812pp.

Cnidarians:

Cornelius, P.F.S. (1995a) North-West European hydroids and their medusae Part 1. Synopses of the British Fauna (New Series) No. 50, 347pp.

Cornelius, P.F.S. (1995b) North-West European hydroids and their medusae Part 2. Synopses of the British Fauna (New Series) No. 50, 386pp. Manuel (1988) British Anthozoa. Synopses of the British Fauna (New Series) No. 18

Crustaceans:

Crothers, J. and Crothers, M. (1983) A Key to the Crabs and Crab-like Animals of British Inshore Waters. AIDGAP/Field Studies Council.

Falciai, L. and Minervini, R. (1995) Guia de los crustaceos decapodos de Europa. Ediciones Omega, Barcelona, 299pp.

Ingle, R.W. (1996) Shallow-water Crabs. Synopses of the British Fauna (New Series) No. 25, 243pp.

Naylor, E. (1972) British Marine Isopods. Synopses of the British Fauna

Mauchline, J (1984) Euphausiid, Stomatopod and Leptostracan Crustaceans. Synopses of the British Fauna (New Series) No 30, 91pp. Smaldon, G. Holthuis, L.B. and Fransen, C.J.H.M. (1993) Coastal Shrimps and Prawns. Synopses of the British Fauna (New Series) No. 15, 142pp.

Molluscs:

Graham, A. (1988) Molluscs: Prosobranch and Pyramidellid gastropods. Synopses of the British Fauna (New Series) No. 2 (Second Edition), 662pp.

Jones, A.M. and Baxter, J.M. (1987) Molluscs: Caudofoveata, Solenogastres, Polyplacophora and Scaphopoda. Synopses of the British Fauna (New Series) No. 37, 123pp.

Tebble, N. (1976) British Bivalve Seashells. BMNH

Thompson, T.E. (1988) Molluscs: Benthic Opisthobranchs. Synopses of the British Fauna (New Series) No 8, 356pp.

Picton, B.E., and Morrow, C. (1994) A Field Guide to the Nudibranchs of the British Isles. Marine Conservation Society, Immel Publishing Ltd., 128pp.

Echinoderms:

Mortensen, T. (1977) Handbook of the echinoderms of the British Isles. Clarendon Press, Oxford, 471pp.

Picton, B.E. (1993). A Field Guide to the Shallow Water Echinoderms of the British Isles Marine Conservation Society, Immel Publishing Ltd., 88pp.

Other taxa:

Gibbs, P.E. (1977) British Sipunculans. Synopses of the British Fauna. 35pp.

Millar, R.H. (1970) British Ascidians. Synopses of the British Fauna, 92pp.

5.4 New sampling strategy in Portuguese survey

A Workshop on Portuguese Groundfish Surveys was held in Lisbon, under the frame of the NEOMAV Portuguese Project(QCAIII/FEDER), action Key DAMEPAC – *Development and application of new methods on the estimation and prediction of abundance and catch of the fishery resources* under the Task 1: Analysis of the abundance indicators estimated from the commercial fishery or from the groundfish surveys and optimisation of the sampling design. Paulo Ribeiro (Federal University of Paraná, Brazil) and Michael Pennington (IMR, Bergen) were invited to attend to give their expertise in that area.

The terms of reference were:

a) Review the methods used by the Portuguese Groundfish surveys in space and time;

b) Investigate the use of systematic sampling designs based on geostatistical models for Portuguese Groundfish Surveys;

c) Investigate the compatibility between systematic sampling and stratified random sampling on Portuguese Groundfish Surveys context, regarding the construction of an abundance index time series.

The Portuguese autumn survey was based on a fixed station sampling scheme with 36 strata that were not sampled consistently and/or sometimes with 1 sample by strata. This produces difficulties in estimating the abundance in strata not sampled, and on the estimation of variance in strata with only one sample, since assuming variance to be 0 provides underestimated variances that introduce bias in the precision of the survey.

Various experiments have been done including estimation of abundance in strata not sampled, estimation of variance in strata with one haul, strata reduction, tow duration, geostatistical interpolation and inference, etc…

The reduction of the sampling area allows an increase in the number of sampling points and will increase the precision of the abundance estimates of recruits. It has been agreed that the sampling scheme to be adopted from 2005 onwards for Portuguese Autumn Survey (Quarter 4) survey should:

- Have a sampling depth from 20 to 500 m (instead of 750 m) once the main objective of the survey is to estimate recruitment indices for hake and horse mackerel;
- Use the NCT gear;
- Have tow duration of 30 minutes;
- A mixed sampling scheme composed by:

1) 66 trawl positions distributed over a fixed grid with 5’ per 5’ miles, corresponding to trawl positions already done.

2) 30 random trawl positions

The new sampling scheme allows performing the calculations with the former 36 strata. The old and new sampling grid are presented in Figure 5.4.1.

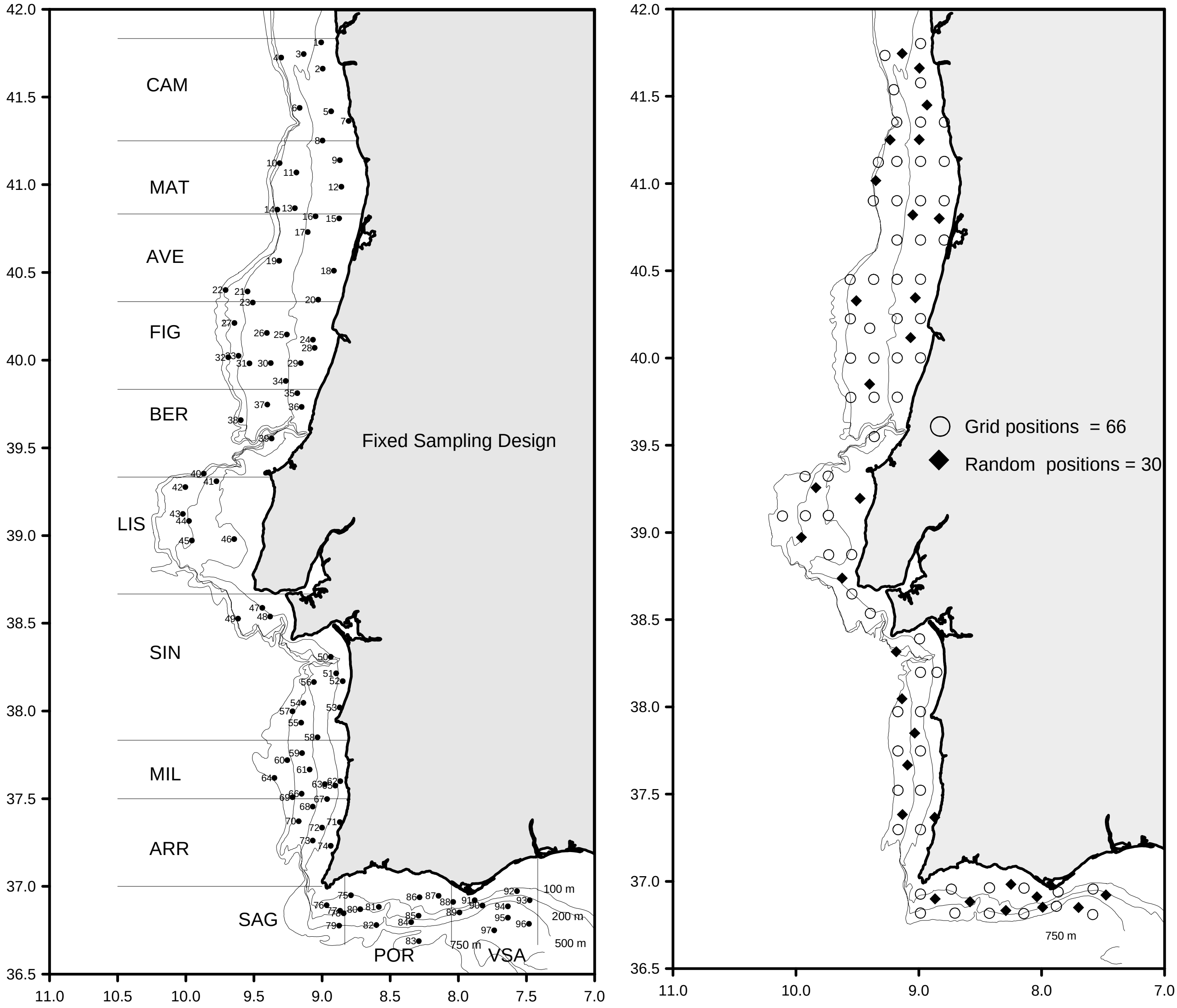


Figure 5.4.1: Old and New sampling design for Portuguese Groundfish Surveys.

5.5 Estimating precision of indices in IBTS survey

5.5.1 General

As a first step on how to work out how to describe precision in IBTS surveys, the WG compiled a set of tables, which shows the present survey design and if a precision measure is calculated. The WG agreed that all surveys should calculate and present a measure of precision in the future. However, a problem is that there are difficulties to calculate precision in surveys that use a semi fixed and fixed design. It was also decided that data should be analyzed to determine how precision should be calculated on catch rates and gear performance at the next WGIBTS meeting 2006.

SOUTHERLY Q2 AND 4	PORTUGAL	SPAIN (NORTH)	SPAIN (SOUTH)	SPAIN (SOUTH Q2)
Sampling strategy	(1) Fixed Stations (2) Mixed: systematic and random	Stratified random	Stratified random	Stratified random
How are stations allocated	(1) depth and geographical (2) fixed : regular grid 5'x5' miles. Random: selected from a clear tow database	by stratum, random selection from a databank of clear tows	by stratum, random selection from a databank of clear tows	by stratum, random selection from a databank of clear tows
Precision estimated on survey	(1) yes(2) yes	Yes	Yes	Yes
if yes describe how	(1) Stratified random sampling formulas (Cochran) (2) In evaluation: Systematic sampling formulas (Cochran) combined with random sampling?	Stratified random sampling formulas (Cochran)	Stratified random sampling formulas (Cochran)	Stratified random sampling formulas (Cochran)

(1) from 1989 to 2004.

(2) from 2005 onwards.

NORTH SEA Q 1 AND 3	DENMARK	FRANCE	GERMANY	NETHERLANDS Q1	NORWAY	SWEDEN	UK(SCOT)	UK(ENG) Q3
Sampling strategy	Choosing from "Clear tows file"	Semi-fixed stations	Semi fixed stations	Semi-fixed stations	Choosing from "Clear tows file"	Fixed stations	Semi-fixed stations	Fixed stations
How are stations allocated	By rectangle	by statistical rectangle within survey area	by statistical rectangle within survey area	by statistical rectangle within survey area	By rectangle	transects	by statistical rectangle within survey area	Rectangle
Precision estimated on survey	No	No	No	No	No	Yes	No	No
if yes describe how	N/A	N/A	N/A	N/A	N/A	CV on commercial species	N/A	N/A

Westerly (Q1,3 and 4)	France Q4	Ireland	UK(Scot)	Spain Q3	UK(Eng) Q4
Sampling strategy	Stratified random	Stratified random	Fixed stations	Stratified random	fixed
How are stations allocated	by stratum, random selection from a databank of clear tows	75% random historical, 25% random grid -> multi-beam/commercial data	by statistical rectangle within survey area	By stratum, random selection of squares and hauls within it	depth/area stratification
Precision estimated on survey	Yes	Yes	No	Yes	No
if yes describe how	Stratified random sampling formulas (Cochran)	Stratified random sampling formulas (Haddon)	N/A	Stratified random sampling formulas (Cochran)	N/A

5.5.2 Trawl parameters

In the past the trawl parameters like trawl height, door spread and trawl speed have been used to monitor the trawl during hauls. The recent development of trawl sensors allows a better understanding on how the trawl behaves generally. The trawl can be monitored during fishing and the collected data can be used to calculate exactly the swept area or swept volume and to decide if a haul is valid ore invalid. Two approaches were presented, a one-dimensional and a multidimensional. The one-dimensional approach describes a particular haul based on the different trawl parameters and can be compared with the overall average and the confidence limits. A multidimensional approach could be based on a Principal Component Analysis to combine the different trawl parameters and exploring the position in a multidimensional space. The multidimensional space could then include a confidence area or volume to determine the haul quality. The WG discussed how to use trawl parameter information in scientific way and how it could be used as a measure of trawl quality/precision and to determine if a particular haul should be valid or invalid. No consensus agreement was reached. However, the WG proposed that the different countries should bring data on trawl parameters to the next meeting, which would allow a formal analysis of the trawl parameters, and so we could decide how the different parameters should be used to increase the quality of sampling.

6 Progress on the Norwegian Survey trawl project (ToR e)

The objectives of the project are to develop a demersal trawl design that has potential for taking quantitative catches of fish in a survey area, and to evaluate the variability in gear performance and catch efficiency of the developed trawl design and its rigging.

The design criteria are a fixed fishing width with non-herding sweeps (wing spread = door spread = 25 m), a vertical trawl opening of approximately 7 m, non-selective trawl belly/codend for fish larger than 10 cm and minimal loss of “targets” under the trawl.

A prototype trawl design has a divided trawl belly, self-spreading plate ground gear, flexible kites on the side of the wings to spread the trawl, otter doors replaced by shearing weights, small meshes in the bottom panels of the wings and the belly and bigger meshes in the upper panel. This prototype was tested in a flume tank (scale 1:10). The tests gave a trawl height of 6–9 m, and a trawl width of about 30–40 m.

A plate gear with 50 cm plates was compared with a 14” rock hopper gear. 11 hauls were made with a twin trawl where a plate gear was mounted on the starboard side and rock hopper on the port side. Figure 6.1 shows the plate gear and Figure 6.2 shows the percentage of fish caught in the codend in relation to the fish entering the trawl (the sum of the fish in the codend and three bags under the trawl). The catches of especially small cod improved.

The future work will be testing of 1:2 scale trawl in April–May 2005, full scale testing in September–October 2005 and evaluation of the stability of gear performance and efficiency for target fish species in 2006 and 2007.

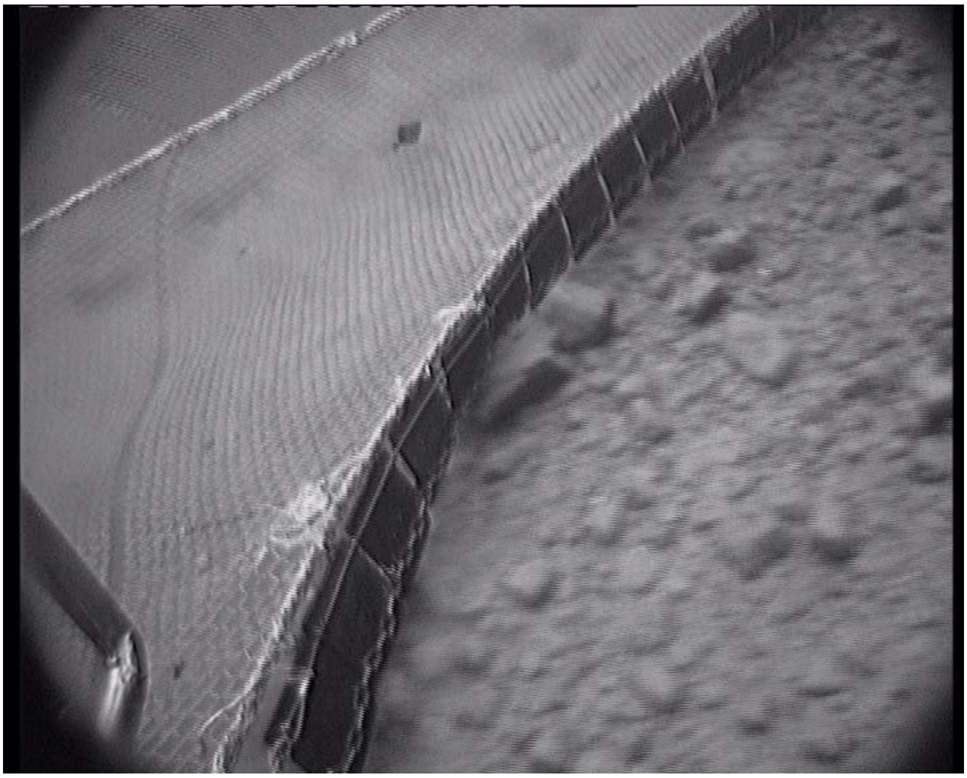


Figure 6.1: Plate ground gear of 50 cm plates.

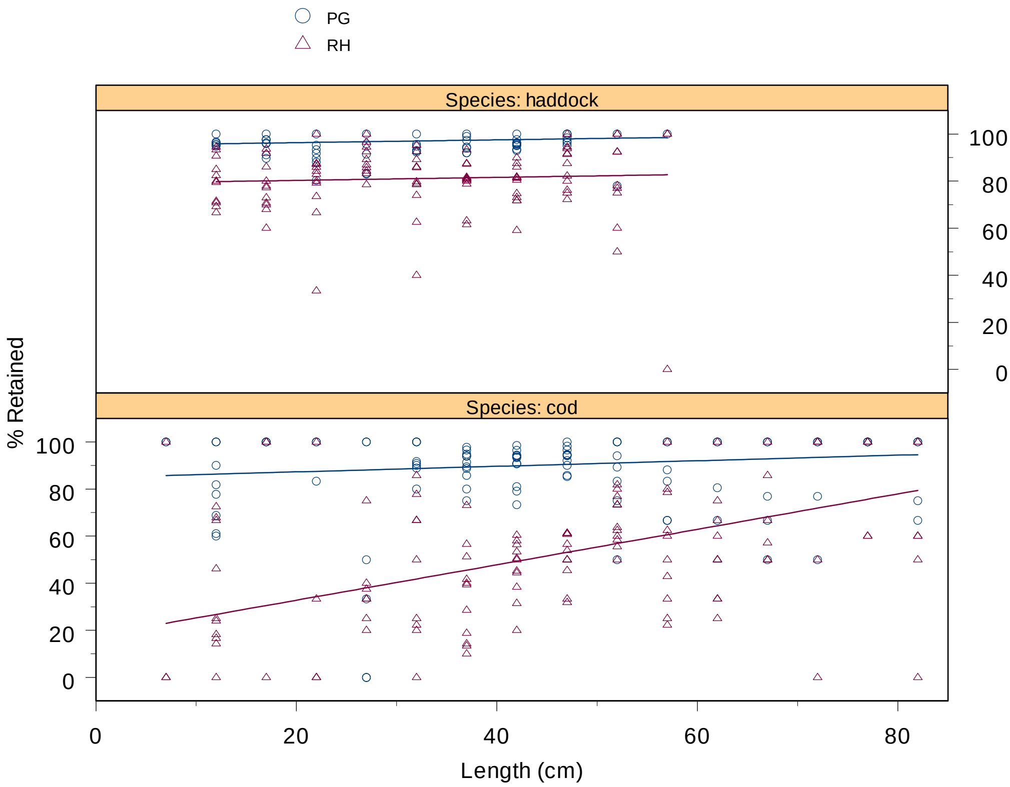


Figure 6.2: Percentage of fish caught in relation to fish entering the trawl. PG (blue circles)=Plate gear, RH (red triangles)=Rock hopper gear.

7 DATRAS database (ToR f)

7.1 Data consistency problems

The main concern regarding the new DATRAS database is if the system does the correct calculations.

ICES HQ has checked the calculations by comparing:

1) Raw data in the database with calculated CPUE by age and haul data
2) Raw data in the database with calculated CPUE by length and haul data
3) CPUE by age and haul data from DATRAS with the old calculated CPUE by age and haul data
4) Mean CPUE by age and rectangle from DATRAS and the old mean CPUE by age and rectangle
5) New indices with old indices

Point 1 and 2 have been done for all species in quarter 1 for the years 1983 to 2004 and showed that the DATRAS database did have some errors which were corrected and the checks were redone and they now show that the calculations of the CPUE by age and length are correctly done.

Comparing new and old calculated data has only been done for Norway pout and herring. The result for Norway pout indices can be found in table 7.1.1. Some years the indices are equal in the two dataset, however, in some years there are differences. These have been investigated further and there were found problems in the data after resubmission to ICES. These data problems are presented to the national countries and should be sorted out as fast as possible.

Table 7.1.1:

Difference between new and old indices					
Year	age1	age2	age3	age4	Total diff
1983	67.946	36.014	0.47	0.328	104.758
1984	-888.488	16.809	5.097	0.038	-866.544
1985	0.032	0.044	-0.02	-0.059	-0.003
1986	57.037	11.801	0.698	-0.008	69.528
1987	73.973	15.204	3.8	0.449	93.426
1988	-0.094	0.12	-0.006	0.093	0.113
1989	66.035	5.241	5.557	0.069	76.902
1990	-0.024	-0.021	-0.004	0.034	-0.015
1991	61.522	-54.998	-4.475	-0.305	1.744
1992	10.805	24.505	0.981	0.082	36.373
1993	-0.095	-0.027	0.009	0.007	-0.106
1994	31.344	0.738	0.196	-0.128	32.15
1995	0.229	0.238	-0.253	-0.031	0.183
1996	3.136	-2.817	-0.361	0.035	-0.007
1997	10.538	-6.594	-3.629	-0.197	0.118
1998	10.841	-0.932	-7.882	-0.881	1.146
1999	-0.044	-0.012	-0.036	0.026	-0.066
2000	0.115	0.064	-0.008	0.037	0.208
2001	-0.329	-0.032	-0.014	0.024	-0.351
2002	-3.991	-0.215	0.007	0.02	-4.179

When comparing the herring data it was not as straight forward and some of the data problems the Norway pout analysis were found again. As it is impossible to decide whatever the differences are due to change in data or in errors in calculation ICES HQ has decide to make a test dataset where the final indices are known. The DATRAS system should be able to reproduce the indices. Whatever difference there might be to the new and old indices will then be due to change in data or data not following the standard described in the IBTS manual but where the old IBTS database have had some undocumented exceptions.

7.2 ICES Policy on access to DATRAS

The protocol on access to the DATRAS database that was presented in last year's report was discussed and some minor alterations were suggested. IBTS agreed that access to various forms of IBTS data should be improved. Though IBTS were not able to agree a change to the current access policy at the meeting, and so that there would be no immediate change, they discussed potential policies and hope to propose a new access policy for 2006. For further information on access policy (e.g. forms for requesting data and "health warnings" for the data), see ICES (2004).

To structure data access, three IBTS survey/area combinations were distinguished, the countries participating in these combinations and whether data were submitted to the database:

COUNTRY	NORTH SEA	WESTERN(1)	SOUTHERN	DATA IN DATABASE
Denmark	X			X
England/Wales	X	X		X
France	X	X	X	X
Germany	X			X
Ireland		X		
Netherlands	X			X
Norway	X			X
Portugal			X	
Scotland	X	X		X
Spain		X	X	
Sweden	X			X

Notes

[1] This does not include the porcupine survey due to the Spanish data regulation.

Within each of these survey/area combinations there was agreement on the data access policy. This is shown in the table below, which distinguishes four user categories:

1) Institutes that have supplied data to the database.
2) ICES Assessment Working Groups
3) Other ICES Working Groups
4) Public and other parties that request data, typically for research purposes.

and the following three data types:

1) Standard maps and graphs: Per survey/area combination for all relevant ages of species for which assessments are conducted. Maps will show bubble plots indicating abundance per ICES rectangle or per haul. Time series of the indices and a graph showing the proportion of the age-groups will be generated. These will be available for 8 commercial species (cod, haddock, whiting, herring, sprat, mackerel, saithe and Norway pout).
2) Aggregated data: A query of the database using pivot tables. Based on these tables, plots and graphs can be made on an interactive basis. The minimum level of aggregation differs between survey/area combinations.

- ICES rectangle: IBTS in the North Sea, Skagerrak, Kattegat and the BTS in the North Sea, Channel and Irish Sea
- Stratum: IBTS western and southern divisions
- Subdivision and stratum: BITS Baltic Sea

3) Un-aggregated (raw) data. These are: catch (numbers at length and/or numbers at age) data on a haul-by-haul basis, and SMALK (Sex, Maturity, Age-Length-Keys) data per individual.

Data access for the four "User categories" and "Data types" can be organized according to the following matrix, and includes "Free access", "password protected access" and "access to extracted data after granted request".

TYPE OF DATA	USER CATEGORY			
	National Fisheries Institutes (data suppliers)	ICES Assessment WGs	Other ICES WGs	Public and other parties
Standard maps and graphs (8 commercial species)	Free access	Free access	Free access	Free access
Aggregated data (by ICES rectangle) (4,5)	Free access	Free access	Free access	Free access
Aggregated data (by ICES rectangle) for other species and times	Password protected(1)	Password protected3)	Receive data after request to ICES	If request granted by ICES
Raw data	Password protected(1)	Password protected(3)	Receive data after request to ICES (2,3)	After request granted by national contact person (2)

Notes:

[1] For those survey/area combinations that the laboratory contributes to, otherwise by request

[2] If access to raw data is given, ICES (IBTSWG) and the national fisheries laboratories supplying the data retain "intellectual property", hence if data are to be used for publications, authors must liaise with IBTS members to ensure that both data analysis and interpretation are appropriate

[3] ICES Assessment WGs that use IBTS data should provide IBTSWG with feedback regarding the utility of the survey data for the species/stock in question, so that IBTS know which data are performing well

[4] Data would be available for the following dominant species: gadoids (*Gadus morhua, Melanogrammus aeglefinus, Merlangius merlangus, Trisopterus esmarki, Trisopterus minutus, Merluccius merluccius, Molva molva, Pollachius virens*), flatfish (*Limanda limanda, Hippoglossoides platessoides, Microstomus kitt, Pleuronectes platessa, Glyptocephalus cynoglossus, Lepidorhombus whiffiagonis*), other demersal species (*Eutrigla gurnardus, Lophius piscatorius, Lophius budegassa, Echiichthys vipera, Amblyraja radiata, Raja clavata, Scyliorhinus canicula*) and certain pelagic fishes (*Clupea harengus, Scomber scombrus, Trachurus trachurus, Sprattus sprattus*).

[5] Data will only be freely available from 1983, and excluding more historical data and the three most recent years data.

8 Review of the WKSAD report (ToR g)

The **Workshop on Survey Design and Analysis** [WKSAD] met in Aberdeen, Scotland, from 21–25 June 2004 with the following term of reference:

a) review methods of designing and analysing fisheries surveys;

b) summarise the current methods used for survey design and analysis;

c) investigate where there are similar design and analysis problems;

d) identify areas of agreement and specific areas of work where progress could be made;

e) prepare work plans for identified areas of development;

f) investigate methods to deal with intercalibration studies of fishing gears and survey vessels.

Some of the main topics discussed are outlined below:

8.1 Survey designs

1) **Area to be surveyed**: survey area should extend beyond stock boundaries. **Sampling allocation:** High population abundance in an area generally implies high variance. Therefore it may be prudent to stratify the survey and allocate increased sampling to these areas to improve precision. When allocating samples with a stratified or non stratified survey, there are broadly three approaches:Random/Pseudo Random – randomisation ensures samples are independent and simple statistical formulae available for mean and variance can be used. However, estimates for mean abundance for a purely random survey are not as precise as those from a systematic or random stratified design.

- Systematic – is where samples are located along a regular predictable grid e.g. many acoustic surveys use a series of parallel, evenly spaced transects. It is possible to introduce randomisation here as the transects are fixed only in relation to one another so that a random geographic start point, for example, ensures that in theory any geographic point within the survey area could be sampled. Formulas random sampling may, however, result in biased estimates of variance when applied to systematic designs.Fixed – where inter annual trends are the objective, fixed stations can be argued to be best, provided there is persistence. Mean abundance is biased within the year, but not between years. Variance can be estimated for autocorrelated populations with geostatistics regardless of survey design, if spatial structure can be described by the variogram.**Data analysis**

1) **Abundance:** various working groups have concluded that arithmetic or weighted geometric mean are as often as good as other more complex estimates such as GLMs, robust estimators, geostatistics etc.**Skewed data:** fish data is generally highly positively skewed with a number of extreme values and a high frequency of 0's. There are transformations/models (e.g. negative binomial, lognormal, delta-lognormal….) to deal with the resulting high variances. Model assumptions must be met however, therefore careful selection is required (see referenced reviews by Pennington, Smith in WKSAD report).**Extreme values:** Some studies discussed suggest that where extreme values are present the arithmetic mean is less precise than other methods and implies that there is some conflicting evidence in the literature. It was recommended there be a review of Extreme Value Statistics used by mathematical geologists in relation to this topic.**Variance estimation:** Many methods are proposed for sampling error, but there is growing interest in year to year survey error (incl. vessel power, instrument error, gear catchability). Assessment of North Sea herring is a rare example of where the inverse variance of the survey index is actually used as a weighting in the model.Generally speaking, in the presence of positive autocorrelation a more pre-

cise estimate will usually be gained from implementing a stratified random or systematic survey design. A range of real and simulated data would suggest that optimal sampling allocation will obviously depend on the distribution of the population under investigation. However, systematic can provide the most precise estimate of the mean while random stratified often provides better estimate of precision.

To evaluate some the performance of some of the generalised approaches above on a single dataset it was decided that two simulated populations would be constructed and various survey designs used to extract samples from them and compare mean abundance, precision and construct distribution maps. The two populations will have different levels of autocorrelation as well as a general geographic trend.

8.3 Uses of survey data

VPA estimates of cohort size based on commercial catch data tend to be very variable and reduce in size as data is added each year, up until the point that cohort leaves the fishery, sometimes referred to as the "Retrospective Problem". Much of this stems from the unpredictable relationship between commercial data and the population from which it comes due to changes in the levels and distribution of effort and so. In contrast, there is a far more predictable relationship between survey data and the stock being sampled where effort is normally standardised using a set of sampling protocols. Surveys, therefore, often track converged estimates quite well and it may be more sensible to use the converged estimates of historical catch data to tune survey data rather than the converse, which is generally the current practice.

An example of this was presented where Converged VPA estimates for NE Arctic cod (1981–1995) were used to calibrate the 4th quarter Barents Sea Survey. The survey is then compared to the converged estimates in subsequent years (Figure 8.3.1).

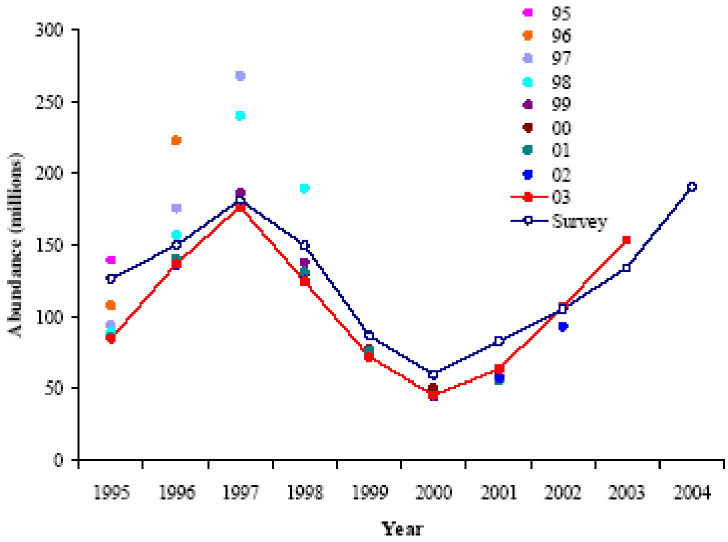


Figure 8.3.1: Calibrated survey estimates (connected open circles), ICES, 2003 estimates (connected solid circles) and the 1995–2002 ICES annual assessments (unconnected solid circles) of the total number of Northeast Arctic cod ages 7 and older.

8.4 WKSAD Recommendations

1) Evaluate analyses of estimates of the abundance, associated variance, and density maps, from surveys of a simulated fish population whose abundance is known.
2) Evaluate alternative analyses of several survey datasets.
3) Review the state of knowledge regarding the effect of trawl duration on fish catch rate with a view to considering a reduction in sample trawl duration.
4) Evaluate analyses of covariate data which could provide improved precision of abundance estimates.

5) Review methods for combining surveys of the same resource using different methods.

6) Evaluate the sensitivity of methods to estimate biological parameters in terms of analytical assumptions and measurement error.

Additionally the WKSAD group recommended

a) Inclusion of ***systematic sampling (with stratification) or stratified random sampling should be considered*** in the designing of a fish survey. In the presence of positive local autocorrelation, a more precise estimate of the population mean will usually be obtained by systematic sampling or stratified random sampling than by simple random sampling.

b) ***Information from the commercial fishing industry should be considered***, where appropriate, to provide guidance on survey design (e.g., in the definition of strata).

c) ***Efforts should be made to maximise the number of samples taken***, if survey precision needs to be enhanced. This may be achieved by shortening towing times or by using instruments in as efficient a manner as possible. Consideration should be given to the effect of shortened tow times to establish if this is a practical and effective course of action.

d) ***Information additional to that of fish density should be collected*** on surveys, particularly when that information is related (covariate) and can be collected more extensively. Incorporation of appropriate covariates (habitat, environment) can lead to improved precision of the abundance estimate, provided that a good relationship exists, and that the covariate is known at more sample locations than the fish density. Ideally, the covariate should be known at all locations where the fish density is interpolated to (i.e., the whole survey area).

e) **Means to provide *direct estimates of abundance*** from surveys should be investigated. Calibrating a survey time series using historical catch data may generate more robust abundance estimates (in recent time periods) than a catch-at-age analysis due to problems associated with the accuracy of catch data.

f) **All *publicly funded surveys should include a description of their estimation procedures in their reports***, particularly those benefiting from EC funding and those carried out under the auspices of ICES. Survey reporting practises vary considerably and, in some cases, the methods used to estimate abundance are not described.

g) **The design effect and the effective sample size should be reported whenever** possible to give a measure of the efficiency of a survey design, and the sampling unit over which the data were gathered (the ‘support’) should be explicitly stated. The design effect is a measure of the efficiency of a survey. It is calculated as the ratio of the variance of the estimated mean for the actual design (and variance estimator employed) and the expected variance obtained under simple random sampling. The effective sample size is the number of samples selected by simple random sampling that would be required to achieve the same precision obtained with n samples under the actual complex sampling design.

h) **Survey *precision should be reported as the relative standard error*** (100% × standard error / estimate). The term coefficient of variation (CV) is ambiguous and should be avoided.

8.5 Recommendations

1) The IBTS should review a number of existing survey reporting formats with a view to proposing a standard format for IBTS surveys for next year.

2) Institutes should include precision estimates in conjunction with reported indices of abundance.

3) It is recommended that an estimate of precision in the form of relative standard area be incorporated into the ICES Datras database.

4) The potential for a simple multivariate analysis of gear parameters and possibly environmental factors to be used as a measure of survey catchability be discussed

at WKSAD and SGSTS by IBTS participants. This may flag a survey year, or number of stations within a survey that have high precision, but be biased or inaccurate due to a number of confounding gear or environmental parameters.

9 Check of the ALK data per roundfish area (ToR h)

As a follow-up on last year's report (Lisbon 2004) an analysis was made on missing SMALK data and outliers in the age length keys (ALK) for the years 2000 to 2004. The analysis was done by ship and not by RF area as recommended in order to make it easier to track errors back to the source.

The analysis showed that sprat and mackerel were mostly only aged due to difficulties in determining sex and maturity. However, the analysis also showed a number of missing age, maturity and sex a in a number of species that seem like errors.

A number of errors were found in the ALK data (e.g. age 33 for cod and age 0 in first quarter) and a number of potential problems were pointed out (e.g. the age length distribution various between countries for certain species).

The members of IBTS were provided with tables with all the problems found and where asked to investigate the problems and report back to ICES if update to the database are needed.

10 Stratification in the Eastern Atlantic and Skagerrak (ToR i)

10.1 Stratification in the eastern Atlantic

Given the range of habitat types in southern and western areas, and the steep bathymetric gradient along the edge of the continental shelf, stratification in many of the eastern North Atlantic surveys is based primarily on the interpretation of ecologically-meaningful strata (e.g. as determined by cluster analyses of catches).

The following geographical and bathymetric strata were developed for the Celtic Sea (Poulard and Mahé, 2004), following cluster analyses of IFREMER catch data. The distribution of the strata is illustrated in Figure 10.1.

Area	Geographical area
Cc	Celtic Sea (central)
Cn	Celtic Sea (North)
Cs	Celtic Sea (South)
Gn	Bay of Biscay (North)
Gs	Bay of Biscay (South)

Depth stratum	Depth range
1	<30 m
2	31 – 80 m
3	81 – 120 m
4	121 – 160 m
5	161 – 200 m
6	201 – 400 m
7	401 – 600 m

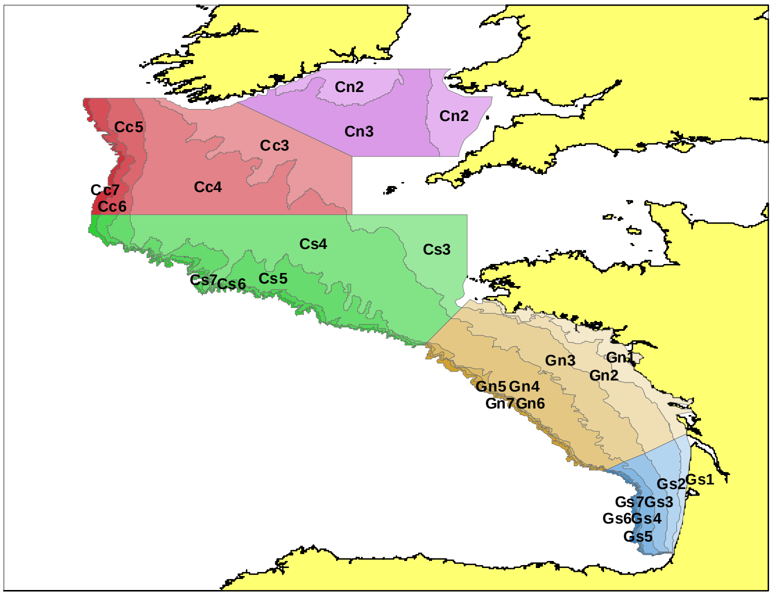


Figure 10.1: Distribution of strata in the Bay of Biscay and Celtic Sea (IFREMER).

The division between the Southern and Central Celtic Sea (49.5ºN) represents a faunal boundary, with many northern fish species having a southern boundary latitude in this region, and it is also the northern limit for many southern fish species. Such patterns are also evident for epibenthic assemblages (Ellis *et al.*, 2002b).

The division between the North and Central Celtic Sea extends south-easterly from south-eastern Ireland. Although the differences between areas Cn3 and Cc3 include bathymetric differences (Cn3 is generally <100 m, and Cc3 is generally >100 m), the meandering nature of the 100m-depth contour in this area was considered as potentially confusing for survey design.

Whereas the nations operating in this region reached general agreement on this stratification, it was agreed that minor modifications would be required. Such changes would include:

- The original northern limit of the Northern Celtic Sea was 52ºN (i.e. the boundary between ICES Divisions VIIa and VIIg). It was agreed to extend the boundary so that it extends from the coast of Pembrokeshire (52ºN) to southeastern Ireland (ca. 52.2ºN), as fish in this area will form part of Celtic Sea stocks.
- The regions Cc3 and Cc4 would be subdivided into eastern and western zones, with a longitudinal boundary of 9ºW (i.e. the boundary between VIIg and VIIj).
- Those areas of the western English Channel (VIIe) Celtic Sea and Bristol Channel surrounding the Scilly Isles and Cornwall would form a new stratum, though the rocky nature of these grounds means that this stratum would be sampled with a rockhopper ground gear.

It is expected that these strata will be revised in GIS format for the 2005 surveys. Furthermore, it is hoped that these bathymetric strata can also be extended northwards off the western coasts of Ireland and Scotland. Comparable strata will be developed for the Irish Sea, though the sedimentary environment in this area will also be incorporated in strata design, as sediment type and bathymetry are key determinants for assemblages in this region (Ellis *et al.*, 2000, 2002a; Ellis and Rogers, 2004). Possible strata could include inshore sandy areas (generally less than 30–40m deep, with subdivisions for eastern and western areas) and the muddy *Nephrops* grounds in the North-western Irish Sea, which can be sampled with standard ground gear; hard grounds in St George’s Channel, which would be sampled with another grid of rockhopper stations, and the coarse shell-gravel habitats in the central Irish Sea (>35m).

In addition to extending and agreeing strata for this region, and providing shape files for GIS, it was also suggested that descriptions of each strata, including area (nm^2), habitat type, and scientific rationale, should be provided as important supporting information for those working groups using the survey data.

An example of one possible format is:

STRATA CODE	DEPTH RANGE	AREA (NM^2)	DESCRIPTION
Cn1	<30m	-	Inshore waters of the Celtic Sea and Outer Bristol Channel. Some trawlable grounds, but many inshore areas rocky, and no extensive areas off southern Ireland. Not currently sampled by IFREMER but CEFAS sample some of these areas in the Bristol Channel (VIIf).
Cn2	31–80m	4052	Grounds 31–80m deep, off southeastern Ireland and the Outer Bristol Channel. Good catches of whiting and haddock in this area.
Cn3	81–100m	6386	Grounds generally 81–100m. As the 100m–depth contour meanders in this area, the borders for this area are XX in the west to to XX and eastwards along XX latitude. This area includes the Celtic Deep, where good catches of *Nephrops* and gadoids can be made.
Cc3	101–120m	5909	Mostly between 101–120m, though due to the meandering nature of the 100m–depth contour, there is a straight border between this and Cn3. As this strata straddles ICES Divisions VIIg and VIIj, the strata will be sub-divided into eastern and western areas.
Cc4	121–160m	8162	Grounds between 121–160m north of 49.5°N. As this strata straddles ICES Divisions VIIg and VIIj, the strata will be sub-divided into eastern and western areas.

10.2 A spatial and depth-stratified sampling design in the Skagerrak area

10.2.1 Introduction

Compared to the rest of the North Sea IBTS area, the Skagerrak is much deeper and its typography is much more variable. Additionally, the spatial coverage by Sweden has not covered all the different rectangles in the area, and at the same time over sampled other rectangles. This study was a development of a previous study and as a result of the recommendation by the WG. The objective of this study was to do a sensitivity analysis of a change in sampling design. The objective in general was to have a more homogenous distribution of hauls (covering the whole area) and at the same time distribute hauls according to the proportional area of different depths in the Skagerrak.

10.2.2 Methods

The analysis was based on the hauls made the first quarter with the standard GOV trawl between the years 1993 and 2003. The depth strata used was the same as in the previous study (ICES, 2004a). No consideration has been given to the fact that the substrate may differ in different areas of the Skagerrak. The preliminary analysis suggests that Argos is under-sampling depth strata 20–40 m and 151–200 m, but over-sampling depth strata 61–80 m and 101–150 m. The analysis was performed on combined set of 32 different species and a second set on the main commercial species including cod haddock, whiting, plaice and herring. The analysis was done in three steps: the first step was to test how sensitive the overall biomass index and the commercial biomass index is to a reduction of number of random stations. The aim of the second set of analysis was to compare the two original indices with a depth stratified haul design but also to a combination of depth stratified and spatial design. Including only hauls that matched the proportional depth in the Skagerrak allowed a comparison between the original index and a depth-stratified design. This allowed only 20 – 22 hauls could be used in the bootstrap procedure. Including only hauls that matched the proportional depth and at the same time allowed only 18 – 20 hauls to be used in the bootstrap procedure. The aim of the third set of analysis was to explore if a depth stratified haul design but also to a combination of depth stratified and spatial design would affect the proportion of different size classes (< and > 350 mm) of the commercial species caught. In general the procedure used here is based on only sampled stations and will only allow a lower number of stations than would be used during a real new survey design.

10.2.3 Results

The preliminary analysis suggests that both overall biomass index (32 species) and the index based on only commercial species are very sensitive to a reduction of haul stations. When more than 9 of the 27 stations are removed the index collapses and for example the trend disappears and the variation is not overlapping with the original calculated index (Figure 10.2.1). The index on commercial fish showed a similar pattern.

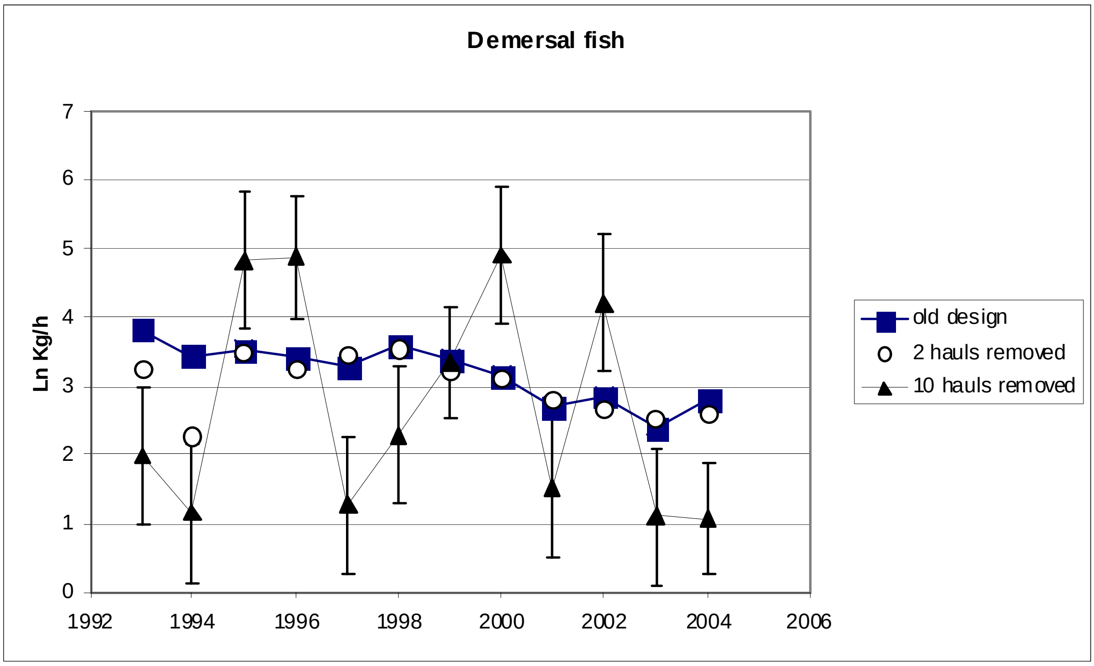


Figure 10.2.1: A comparison between the used index (32 species combined) and two examples if a new indexes if stations are removed in the Skagerrak area.

In comparison, the spatial and the combined spatial and depth stratified design were fairly similar in tracking the old design even though the only consisted of fewer hauls (Figure 10.2.2).

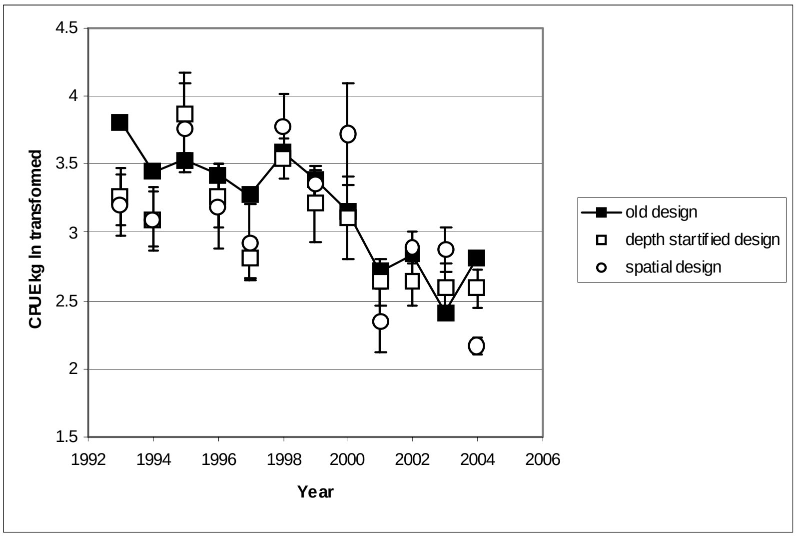


Figure 10.2.2: A comparison between the used index (32 species combined, old design) and two examples if a new indexes in a only depth stratified design and one with a combination of a depth stratified design and spatial design (spatial design).

The index on commercial fish showed a similar pattern. Furthermore, there was little difference between spatial and the combined spatial and depth-stratified spatial design. The comparison between the relative proportion of small and large fish (< and >350 mm) suggest that actually there is little difference between the bootstrapped indices and the original index, even though the spatial design resulted in that proportion of larger fish increased compared to the old design.

10.2.4 Discussion

This analysis was made using only available data, which restricts the interpretation of the results and the analyses suggest that changing the sampling design may affect the time series. However, the bootstrapped indices are in line with the used index on both the commercial and the 32 species combined. Surprisingly, the depth stratified design and the combined spatial depth stratified design are quite similar even though they were made up from different haul numbers. It might be explained by the fact that the indices are insensitive to a reduction of hauls.

10.2.5 Recommendations

The Working Group **recommends** Sweden to change their sampling design in the Skagerrak in their Q3 survey for three years and thereafter re-analyse the indices as a quality measure. The WG also suggest that Sweden analyse the relationship between species composition, bottom types and the proposed depth strata.

11 Miscellaneous studies and experimental designs

11.1 The CATEFA project

11.1.1 Introduction

The EU project N° Q5RS–2001–02038: “Combining Acoustic and Trawl data to Estimate Fish Abundance” (CATEFA) has ended in October 2004. The final report was submitted to the commission and will be available soon on the CATEFA website: http://www.cg.ensmp.fr/~bez/catefa

For this 3 years project, the participants were:

- Centre de géostatistique, Fontainebleau (Coordinator)
- Marine Laboratory (Aberdeen)
- Institute of Marine Research (Bergen)
- Centre for Environment, Fisheries and Aquaculture Science (Lowestoft)
- Queen’s University of Belfast
- Institut Français de Recherche pour l’Exploitation de la Mer (Boulogne-sur-mer)

11.1.2 Objectives

The principal objective of this project was to develop and apply appropriate combination methodologies for the effective use of both acoustic and trawl data from bottom trawl surveys. This is in recognition that bottom trawl surveys are the most important, fisheries independent, data source used in stock assessment of commercial groundfish in European waters. The inclusion of simultaneously collected acoustic survey data, with its more resolved sampling structure, could potentially improve the precision and accuracy of these surveys at little extra cost.

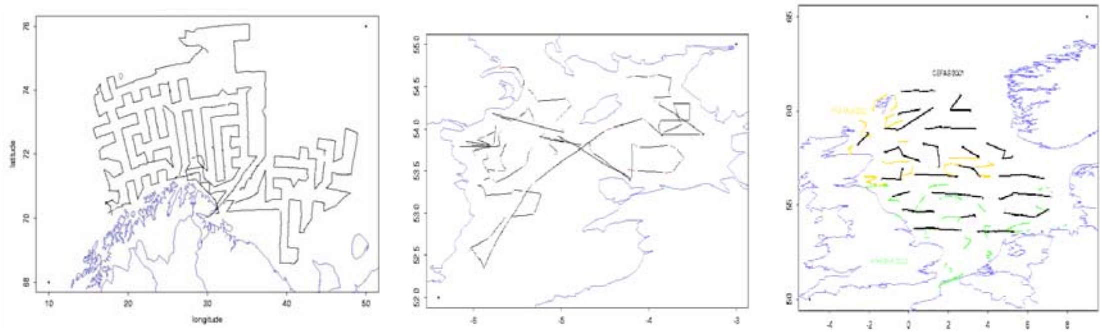
Within this overall aim, the project had four main objectives:

- To determine the relationships between the acoustic and trawl data at various levels of disaggregation.
- To develop mathematical models to calculate new combined stock abundance indices.
- To test the performance of these new indices within the stock assessment process.
- To provide survey designs which allow optimum collection of both types of data.

11.1.3 Methods

The survey data sets available to the partners for the project were (Figure 11.1.1):

- The combined acoustic and bottom trawl survey for cod and haddock in the Barents Sea; 1985–2000.
- International bottom trawl survey (IBTS) in the North Sea (Scotland); 1995–2000
- International bottom trawl survey (IBTS) in the North Sea (France); 2000 – 2003
- International bottom trawl survey (IBTS) in the North Sea (England); 2000– 2002
- Northern Irish bottom trawl surveys in the Irish Sea; 1992–2000



Barents Sea **Irish Sea** **North Sea**

Figure 11.1.1: The three study areas.

For all surveys, a Simrad EK500 scientific echosounder was used, with a 38kHz split-beam transducer. Acoustic data were acquired both during and between stations. Elementary Sampling Distance Units (ESDU) – the horizontal (along track) bins for integration of the acoustic data - were set at approximately 2 nautical miles for the on station data, and at 0.5 or 0.1 nautical miles for the between station data.

During the first 6 months of the project, data were prepared and stored in a common data base. The fish capture data from all hauls carried out during the surveys was stored in the formats required for the project. Fish catch data were analysed to provide five quantities per species; Number Caught, Root Mean Square Length, Mean Target Strength, Mean Weight and NASC equivalent (Nautical Area Scattering Coefficient).

Before being stored in the common CATEFA data base, the acoustic data quality was controlled.

11.1.4 Results

The main objective of the CATEFA project was to develop and apply appropriate methodology for combining acoustic and standard bottom trawl data in to a single abundance index. The work was driven by the premise that the inclusion of simultaneously collected acoustic survey data, with its more resolved sampling structure, could potentially improve the precision and accuracy of the trawl-based abundance index used in the stock assessment of commercial groundfish. The project partners applied a number of analytical approaches to the problem. Details of the specific results of these approaches have been disseminated at length in the work package reports, scientific literature publication and conference presentations.

Here are some main conclusions from the all the analyses done during CATEFA project:

- *Combination of trawl and acoustic data to a single abundance index is possible, but reliable application to stock assessment is unrealistic at this stage.*

All the analytical methods successfully combined acoustic and trawl data to a single index and provided more highly resolved spatial distribution maps with reduced local and global variances, indicating clearly that the gain in data richness resulted in an increase of precision. However, founded on poor relationships, model predictions are similarly weak; indicating that at present, improved quantification of trawl data through combination of acoustic data may not be worthwhile in the context of the annual demersal stock assessment process.

- *Spatial variables had strong explanatory power*

Direct relationships between acoustic abundance and trawl catches improved when space was taken into account. Geostatistics and GAM analyses clearly revealed the importance of the spatial dependence on predictions. Depth, longitude and latitude were found to be key variables important for predicting the trawl catches from fuzzy logic and artificial neural network models.

- *Links between trawl and acoustic data were strongest in the Barents Sea*

In all models, the relationship between trawl and acoustic data was stronger in the Barents Sea than the Irish Sea and North Sea. If the signal/noise ratio is low, relationships between trawl and acoustics are easily masked. Long time series are required to be able to extract more of the signal. This appears to one factor why better relationships were observed in Barents Sea where the number of surveys, spatial coverage and hence the number of samples are far greater than in the North Sea and Irish Sea.

- *Differences in gear efficiencies / fraction of the stock sampled*

Differences in the efficiency of acoustic and trawl sampling tools undoubtedly play a large part in accounting for the variability masking the connection between the two. Depth appears to be a key factor influencing the relative efficiencies of trawl and acoustics. The average depth of the Barents Sea survey area is about 250 m, whilst in the North Sea survey it is 65 m. As a consequence, the footprint of the acoustic bean in the Barents Sea is much larger and samples a much larger proportion of the area sampled by the trawl (Fig 11.1.2). However, counter to this is the fact in deep water the trawl is much farther behind the vessel, providing more time for fish to avoid (although they may avoid less in deep water) or greater chance of the gear being less well aligned with the path of the transducer. An interesting feature of the results from the North Sea is that depth was a strong predictor of trawl catches in all the individual species (and second best for demersals). Whilst many species do indeed show strong depth preferences, another factor for consideration is the warp length to bottom depth ratio; a critically important factor influencing the performance of trawls. Perhaps the model results are simply reflect gear effects rather than a true depth effect? Unfortunately warp length was not included as an input variable in the analysis so it is not possible to differentiate.

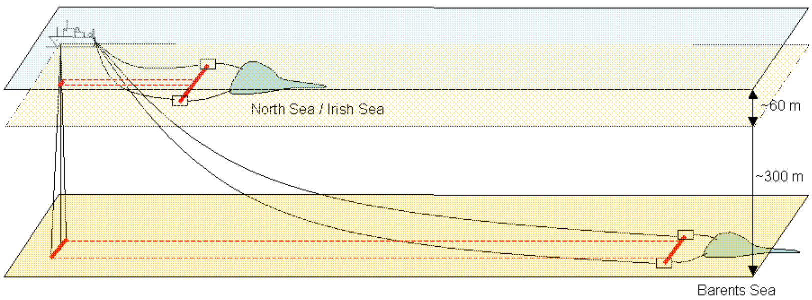


Figure 11.1.2: Differences in the acoustic and trawl sample areas in relation to water depth.

Depth also impacts the acoustic performance by its influence on noise. In the southern North Sea depths as shallow as 30 m are common, resulting in significant noise in the acoustic data when the weather is rough. Further to the north between Scotland and Norway the depth increases to ~ 200 m, and noise becomes less of problem. The much greater depths in the Barents Sea lead to a smaller percentage of the water column containing noise due to bad weather.

11.1.5 Application of results to survey design

The aim of the last work package (WP 9: Application of results to survey design) was to consider how best to apply the findings of the analyses to future surveys and their data collection programmes.

Based on the conclusions of the main analyses, recommendations were made on future research subjects key to achieving further progress on combining acoustic and trawls, and a protocol for combined trawl-acoustic surveys was submitted to the ICES IBTS Working Group for consideration.

11.1.6 Protocol for the Collection of Acoustic Data in combination with IBTS

11.1.6.1 Combined Trawl –Acoustic Surveys

Benefits

Acoustic data from a suite of technologies are used routinely around the world to augment trawl survey data. Combining acoustic methods with the International Bottom Trawl Surveys can provide:

1) A near-independent estimate of abundance for groundfish accessible to acoustics, e.g., cod, haddock, whiting, Norway pout; available at little additional operational cost that be used as an additional tuning series for stock assessment;

2) More highly resolved maps of the distribution of fish groundfish assemblages accessible to acoustics provided by continuous recording during day and night. Distribution maps act as useful visual tools for monitoring the changing distribution patterns of stocks;

3) Tools to help determine catchability coefficients of trawl gear by quantifying how avoidance and herding effect influence the fraction of fish available to trawl gear;

4) Insight to how the catch composition integrated over the trawl track is influenced by the physical attributes of the seabed the local scale distribution of fish;

5) Detailed observation of trawl sites where gear fouling occurs, and hence could be avoided.

6) A non-destructive method of data collection that has very low impact on stocks or the environment and hence can be used effectively in closed areas or sensitive ecosystems.

Process

Combined acoustic-trawl surveys may be viewed as a process (Figure 11.1.3). The combined echo sounder and echo integrator system is calibrated in an absolute sense by the standard-target method. Echo integrator data are judged, or allocated to particular species and size compositions within species, on the basis of trawl data. The age-length key is similarly derived from trawl data. The weighted size composition and standard target strength-fish length relationship is used to convert the measurements of acoustic density to numerical estimates of fish density and mass.

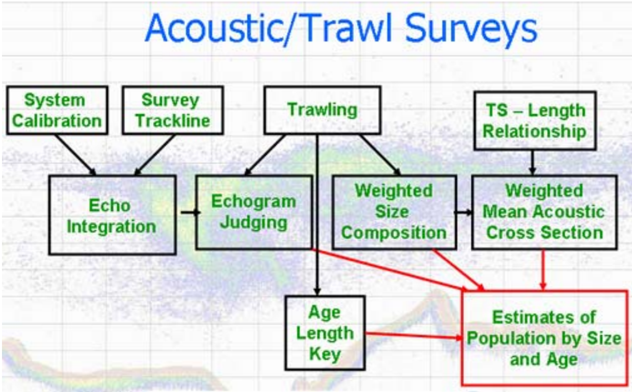


Figure 11.1.3: The combined trawl-acoustic survey process.

Protocol for the Collection of Acoustic Data in combination with IBTS

The basic technical and operational procedures are well established and in routine use around the world (see Maclennan and Simmonds, 1992). Below we highlight the specific requirements and opportunities for the collection of acoustic data during IBTS.

		PROCESS/ STEPS	REQUIREMENTS	DURATION
1. SETUP				
	1.1	Calibration	Calm water location of sufficient depth (at least 30 m)	Up to 1 day. (at start of survey).
2. DATA COLLECTION				
	2.1	Operating Frequencies	all available (commonly used include 18, 38, 120 and 200 kHz)	Continuous data collection during the entire survey
	2.2	Stabilisation	stabilised for pitch and roll	
	2.3	Recording threshold	minimum possible appropriate for water column and bottom detection	
	2.4	Scrutiny of echograms	On board by acoustician according to established guidelines	
	2.5	Seabed features	Bathymetry and roughness collected using multibeam and/or sidescan sonar	Continuous preferable but data volume dependent
	2.6	Sediment classification	Acoustic Ground Discrimination (AGDS) (e.g. QTC, Roxanne, mulibeam, sidescan)	Continuous preferable but data volume dependent
	2.7	Currents	Current profiles using Acoustic Doppler Current Profiler (ADCP)	
	2.8	Efficient recording	Synchronization of acoustic instruments (to avoid interference)	
	2.9	Trawl monitoring	Performance in respect of height, spread, offsets, warp length, bottom contact	
	2.10	Database	Combining acoustic and trawl data with time coordination between recording systems. Metadata extracted for mapping?	
3. PROCESSING				
	3.1	Echograms	Bottom referenced with so best resolution close to the bottom.	
	3.2	Bottom offset (back-step)	Minimum possible given quality of recording	
	3.3	Horizontal resolution	Elementary Distance Sampling Unit (EDSU) not to exceed the trawl tow distance	
	3.4	Thresholds	-60 to -80 dB. Define as appropriate.	
	3.5	Target Strength	Where possible derive from in situ measurements	
	3.6	Region definitions	Use layers (line relative regions) and or school regions as appropriate	
	3.7	Database	Record outputs as standard for developing database	
4. REPORTING				
	4.1	Standardized reporting	Cruise reports standardized. Tables giving the equivalent Nautical Area Scattering Coefficient (NASC) from associated trawls.	

11.1.7 IBTSWG comments

The WG concluded that given the results obtained till now and the extra-work/personnel needed it was not sensible to extend this protocol to all IBTS surveys although further investigation could be useful.

11.2 The Continuous Underway Fish Egg Sampler (CUFES)

During the IBTS survey in February 2005, it was planned to reinforce IBTS larval survey by coupling the MIK net to an internal and fixed CUFES (Continuous Underway Fish Egg Sampler at 3m depth) available onboard the French RV “Thalassa”. The CUFES is already used routinely onboard this ship during acoustic surveys in the Bay of Biscay. This pilot survey coupled both techniques (MIK and CUFES) to compare the number of species eggs caught and identified using both devices. About 65 samples were made during this survey. A few transect were also sampled over 10 minutes intervals to assess the appropriate sampling intensity. Later, providing a good collaborative framework is found, the CUFES could be as a routine procedure to collect eggs along the survey route and aim to map the spawning areas of the different species which eggs could be identified in the southern North Sea at that time of the year. At the moment, no results are yet available for lack of expertise in eggs identification and the IFREMER centre of Boulogne-sur-mer is looking for partners who would be interested in collaborating with it to increase the value of the CUFES survey.

12 Recommendations

12.1 Recommendations from the IBTS 2004 meeting not implemented

½ hr vs 1hr tow in Portuguese surveys

From this work it was concluded that a change in tow duration may lead to an interruption of the current CPUE series for blue whiting, horse mackerel, and probably also for other species with similar behaviour. The number or calibration hauls may be insufficient to assess the effect of tow duration on the relative length composition of the catches. Therefore the Working Group recommends to carry additional parallel tows of 1 hour versus ½ hour duration during the Portuguese Groundfish Survey, noting that this will require additional ship time.

12.2 IBTS2005 recommendations

Section 4.1.1

The Working Group recommends to exclude rectangles 37E9 and 38E8 from the IBTS quarter 1 GOV-program in the future due to rough grounds.

Section 5.2.1

The Working Group recommends Sweden to explore the difference between Dana and Argos further. The suggestion is that Argos will be allowed to do more calibration hauls with Dana during the Q1 survey 2006. During these calibration trials it was suggested that the trawls and trawl doors should be exchanged between the two ships in order to explore the vessel effect compared to trawl gear effects. Furthermore, the WG suggested that the parallel hauls should also be made with Argos slightly ahead of Dana.

Section 5.2.2

The Working Group recommends that FRS and MI continue to build on this limited intercalibration study whilst also attempting to address the issues raised during the exercise. While recognising that opportunities for this sort of exercise are limited, (due mainly to constraints on resources) IBTS strongly encourages other participating countries to consider such exercises where survey area overlap exists.

Section 5.3.2

IBTSWG recommends that the national fisheries laboratories take all necessary measures to ensure that appropriate levels of expertise in fish taxonomy and identification are maintained.

Section 5.3.5

In certain circumstances, however, some vessels may not be able to process all large catches as above, and may only sort a sample that is considered appropriate for estimating the relative abundance of the dominant species. In these circumstances, the entire catch is not examined for "rare" species and these data may not be appropriate for biodiversity studies. IBTS recommend that this method should be avoided wherever possible, and if particular catches are sorted by this method, then these catches be flagged accordingly. Hence, IBTS also recommend that the DATRAS database contains a field to highlight those catches that may be compromised for community studies.

Section 5.3.6

To assist in the correct taxonomic identification of fish and marine invertebrates in the ICES areas, it was recommended that the IBTS manual contains a new appendix listing useful reference works for various taxa.

Section 8

The IBTS should review a number of existing survey reporting formats with a view to proposing a standard format for IBTS surveys for next year.

Institutes should include precision estimates in conjunction with reported indices of abundance.

It is recommended that an estimate of precision in the form of relative standard area be incorporated into the ICES Datras database.

The potential for a simple multivariate analysis of gear parameters and possibly environmental factors to be used as a measure of survey catchability be discussed at WKSAD and SGSTS by IBTS participants. This may flag a survey year, or number of stations within a survey that have high precision, but be biased or inaccurate due to a number of confounding gear or environmental parameters.

Section 10.2

The Working Group recommends Sweden to change their sampling design in the Skagerrak in their Q3 survey for three years and thereafter re-analyse the indices as a quality measure. The WG also suggest that Sweden analyse the relationship between species composition, bottom types and the proposed depth strata.

13 Suggested ToRs for 2006

Considering the time needed for discussion in some of the key issues and the addition of a TOR on which the WG will need a full day to achieve its goal, the WGF propose to meet one extra day in 2006 with the following TORs.

The **International Bottom Trawl Survey Working Group** [IBTSWG] (Chair: J.-C. Mahé, France) will meet in Lysekil, Sweden (or Copenhagen [2]), from 27 to 31 of March 2006 to:

a) coordinate and plan North Sea and North-Eastern Atlantic surveys for the next twelve months;

b) agree on a standard reporting format and report on the results of the most recent surveys for species of interest to assessment WG.

c) further develop standardization of all sampling strategies, computation of indices and estimation of precision;

d) review the findings from the a) SGSTS and b) WKSAD in respect to issues relevant to IBTS and respond

e) review progress made in DATRAS database with respect to the computation of indices and data access policy;

f) complete the shape files and supporting information for the agreed strata in the Eastern Atlantic.

g) coordinate the production and dissemination of identification keys for North Sea, and southern and western IBTS groundfish surveys [3].

IBTSWG will report by 15 April 2006 for the attention of the Resource Management Committee.

14 References

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ICES. 2004a. Report of the International Bottom Trawl Survey Working Group. ICES CM 2004/D:05, 128pp.

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2 To be agreed after the SGSTS meeting

3 to be dealt with on 31 March 2005

ICES. 2004b. Report of the Workshop on Survey Design and Data Analysis (WKSAD). ICES CM 2004/ B:07, 261pp.

ICES. 2005. Report of the Working Group on Fish Ecology. ICES CM 2005/In prep.

Poulard J.-C. and J.-C. Mahé, 2004. Structure and spatial distribution of fish assemblages in the Celtic sea. WD for IBTSWG, Lisbon 2004, 14p.

Annex 1: List of participants

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Jean Claude Mahé (Chair)	IFREMER 8, rue François Toullec F-56100 Lorient France	+33 2 97 87 3818	+33 2 97873836	jcmahe@ifremer.fr
Finlay Burns	Fisheries Research Services Marine Laboratory P.O. Box 101 Victoria Road Aberdeen AB11 9DB United Kingdom	+44 1224 295376	+44 1224 295511	burnsf@marlab.ac.uk
Jim Ellis	CEFAS Lowestoft Laboratory Lowestoft Suffolk NR33 0HT United Kingdom	+44 1502 524300	+44 1502 524225	j.r.ellis@cefas.co.uk
Brian Harley	CEFAS Lowestoft Laboratory Lowestoft Suffolk NR33 0HT United Kingdom	+44 1502 524254	+44 1502 524254	b.m.harley@cefas.co.uk
Ken Coull	Fisheries Research Services Marine Laboratory P.O. Box 101 Victoria Road Aberdeen AB11 9DB United Kingdom	+44 1224 295399	+44 1224 295511	coullka@marlab.ac.uk
Odd Smedstad	Institute of Marine Research P.O. Box 1870 Nordnes N-5817 Bergen Norway	+47 55238683	+47 55238687	odd.smedstad@imr.no
Palle Brogaard	DIFRES Danish Institute for Fishery Research Charlottenlund Castle DK-2920 Charlottenlund Denmark	+45 33 96 33 98	+45 33 96 33 33	pb@dfu.min.dk
Helle Andersen	DIFRES Danish Institute for Fishery Research Charlottenlund Slot DK-2920 Charlottenlund Denmark	+45 33 96 32 42	+45 33 96 33 33	ha@dfu.min.dk
Lena Larsen	ICES Palægade 2-4 1261 Copenhagen K	+45 33154225	+45 33386700	lena@ices.dk
Yves Vérin	IFREMER 150, Quai Gambetta F-62200 Boulogne-sur-Mer France	+33 321995600	+33 3995601	yves.verin@ifremer.fr

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Siegfried Ehrich	Bundesforschungsanstalt f. Fischerei Institut für Seefischerei Palmaille 9 D-22767 Hamburg Germany	+494038905-179	+494038905-263	Siegfried.ehrich@ish.bfa-fisch.de
Francisco Velasco	Instituto Español de Oceanografía Laboratorio de Santander Apdo 240 E-39080 Santander Spain	+34 942 291060	+34 942 275072	francisco.velasco@st.ieo.es
David Stokes	The Marine Institute Fisheries Res. Centre Abbotstown Dublin 15 Ireland	+353 1 822 8200	+353 1 820 5078	David.stokes@marine.ie
Remment ter Hofstede	Netherlands Institute for Fisheries Research Haringkade 1 P.O. Box 68 NL-1970 AB IJmuiden Netherlands	+31 255 564686	+31 255 564644	Rement.terhofstede@wur.nl
Corina Chaves	IPIMAR Avenida de Brasilia P-1449-006 Lisbon Portugal	+351 213 027 093	+351 213 025 948	corina@ipimar.pt
Joakim Hjelm	National Board of Fisheries Insitute of Marine Research, P O Box 4, Turistgatan 4, SE-453 21 Lysekil, Sweden	+46 (0) 523 18751	+46 (0)52313977	Joakim.hjelm@fiskeriverket.se
Ann-Christin Rudolphi	National Board of Fisheries Institute of Marine Research, P O Box 4, Turistgatan 4, SE-453 21 Lysekil, Sweden	+46 (0) 523 18724	+46 (0)52313977	Ann-christin.rudolphi@ fiskeriverket.se

Annex 2: Working documents presented to the IBTSWG 2005 meeting

Comparative Study between Celtic Explorer and Scotia during the Quarter 4 IBTS survey in area VIa

Finlay Burns and David Stokes

Email: burnsf@marlab.ac.uk,

Introduction

In November 2004 a limited comparative fishing study was undertaken to compare the catchabilities of two different configurations of the GOV research trawl during the quarter 4 bottom trawl surveys in ICES area VIa. FRS Marlab in Aberdeen uses groundgear 'C' during the quarter 1 and quarter 4 west coast surveys. This configuration is a more robust variant of the groundgear 'B' that is used in the northern stations during the quarter 1and 3 North Sea surveys. It differs from 'B' in having larger 21" bobbins in the bosom as well as a combination of 18" and 14" bobbins in the quarters. A 320mm toggle chain attaches the groundgear to the fishing line and the sweep length used is approximately 55m (including the backstrop). This heavier groundgear was developed to tackle the harder substrata encountered within area VIa. The Marine Institute (MI) in Galway use a different variant again of the GOV in area VIa. In addition to having a slightly different groundgear configuration (16" bobbins in the bosom and a combination of 14" and 12" bobbins in the quarters) MI have the fishing line tied down onto the groundgear using 100mm steel rings. The result of this is virtually no gap between the groundgear and the fishing line. Sweep lengths are also changed according to trawl depth with 55m sweeps being used at depths <=75m, these are then switched to the 110m sweeps for deeper tows. It should be noted that all but one of the stations surveyed during the study were deeper than 75m.

Method

The aim of this study is to investigate differences in catchability of demersal fish species between both groundgears. This was achieved by conducting parallel trawls at eight predetermined stations. These stations were selected in depths ranging from 70 – 170m, their positions along with the haul numbers are shown in Figure 1. During the trial over 11 tonnes of fish were sampled and in excess of 50 fish species were encountered. Catch compositions as well as catch weights for the most abundant species were then compared. Before analysis could commence it was first necessary to remove all the data for herring, horse mackerel, mackerel, sprat and boarfish. These are shoaling species and due to the unpredictability associated with their capture they should not be used in the analysis.

Cluster Analysis

A simple cluster analysis was performed on all sixteen hauls using the catch weights for all species. The results of this can be seen in Figure 2. From the dendrogram it can clearly be seen that the data separates out into three spatially separated clusters. Cluster 1 encompasses all the deeper offshore stations and the species assemblage is markedly different from clusters 2 and 3 which comprise the shallower stations nearer the Irish Coast. It is worth noting that within each cluster there appears to be no separation according to groundgear type; rather assemblage also appears to be geographically distinct within each cluster. (see Figure 3.)

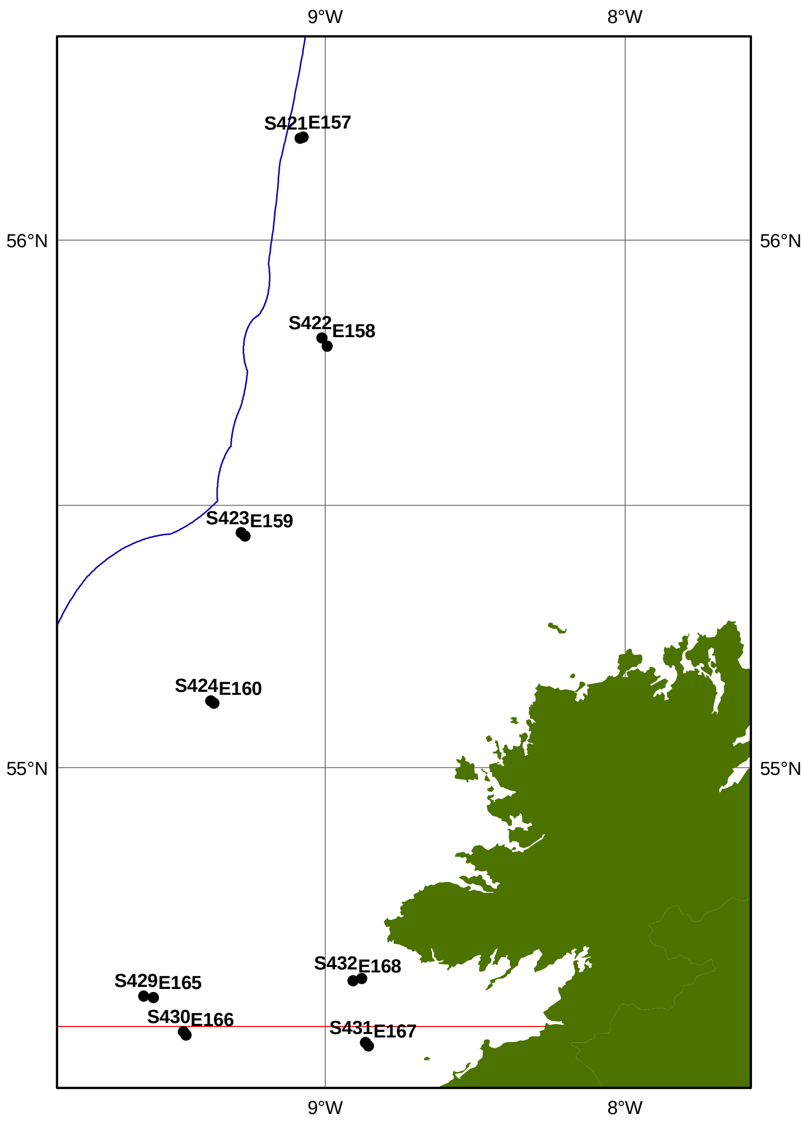


Figure 1: Location of stations.

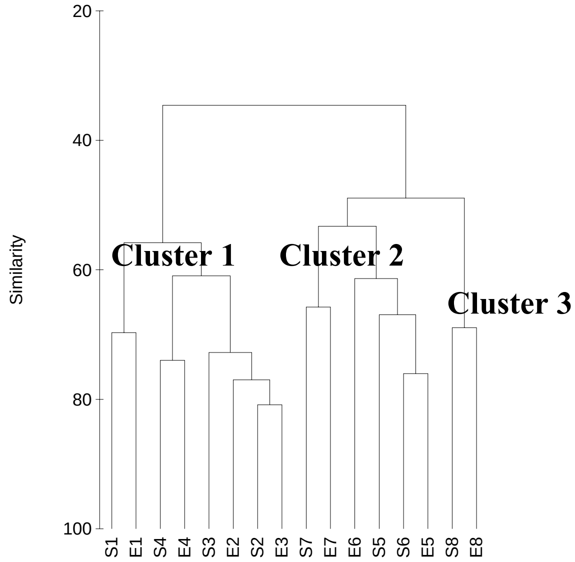


Figure 2: Results of the cluster analysis. Note that station 8 is distinct enough from the other two to be clustered separately.

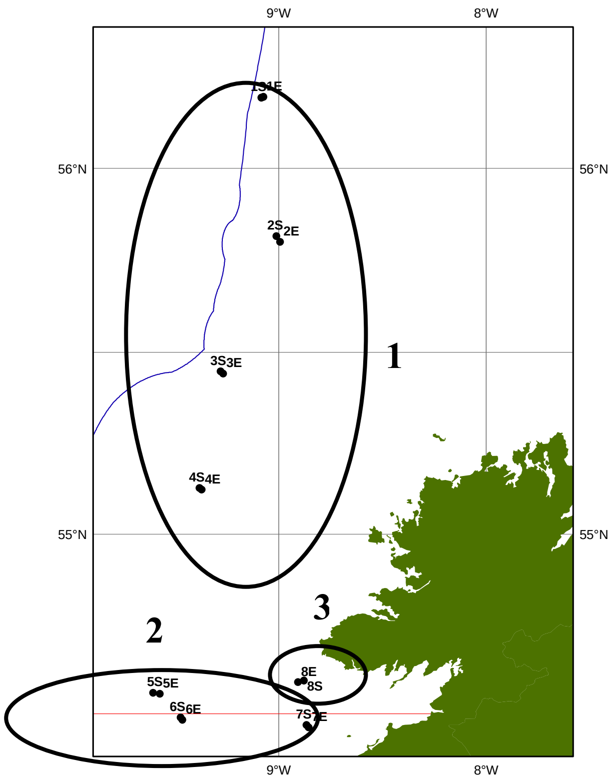


Figure 3: Location of the three spatially distinct species clusters.

Catch Composition

In order to investigate any assemblage differences existing between the two vessels the catch weights as well as the length frequencies for several of the more abundant species were analyzed in more detail. The total catch weights recorded by each vessel for each of the paired hauls are displayed in Figure 4 together with the individual species weights by haul for six of the most abundant species. The combined weights for these species are listed below in Table 1. T-tests were then performed on the haul catch weights for these species to test the null hypothesis (H=0) or no difference between trawl gear. The results from this are also displayed in Table 1.

Table 1: Total catch weights (in kg) of six abundant species for both vessels with resulting P – values from T – test.

Species	Celtic Explorer	Scotia	T-test P-value
Haddock	1325.04	493.05	0.0017
Whiting	286.73	163.82	0.056
Plaice	36.29	17.19	0.0479
Common Dab	17.96	18.17	0.685716
Poor Cod	109.959	40.14	0.0077
Grey Gurnard	49.96	21.05	0.005

Table 1 shows that out of the six abundant species analyzed all but one showed a significant disparity in catch weights in favour of the Celtic Explorer. The results of the T-test also support this with the majority of these species rejecting the null hypothesis at the $P < 0.005$ level. To investigate this further the length frequencies for these species were also examined and the length frequencies by haul for each of the six species can be found in Annex.1. As might be expected these also highlight that the Celtic Explorer appears to have greater catchability than the FRS Scotia.

The next step was to try and establish whether there was also a size selectivity issue underlying this disparity, within each species. In order to examine any intraspecial selectivity between the gears it was necessary to reclassify the data for each species according to size class. For haddock and whiting these were defined using length splits derived from the age-length keys compiled during the survey. For the other species the length frequencies for both vessels were studied with splits being placed at natural breaks in the distributions. The results of this are shown in Figure 5.

Figure 4: Catch Weights for each of the parallel hauls. (excluding pelagics and boarfish)).

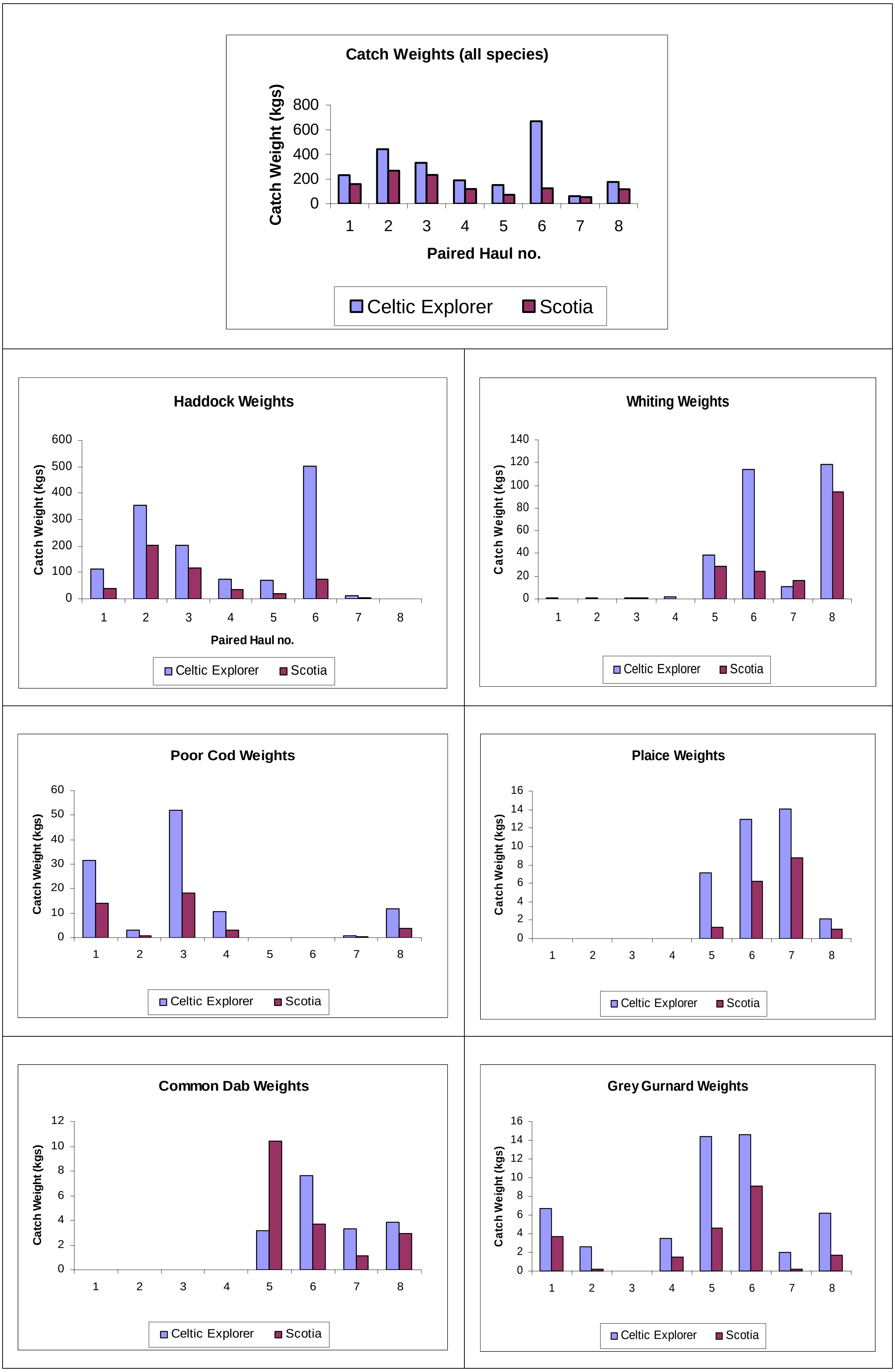
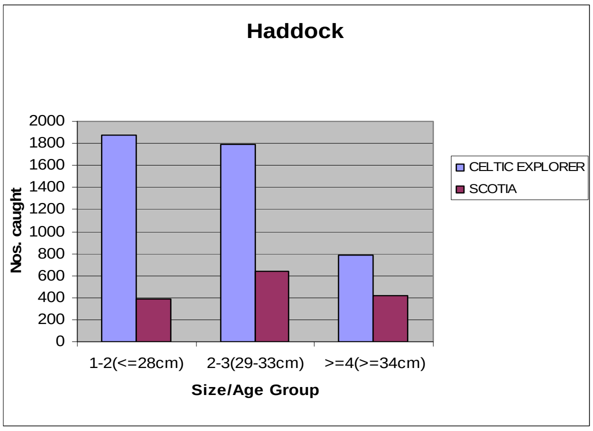
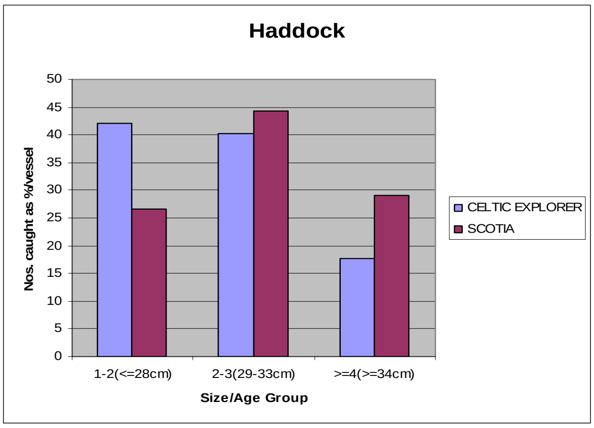
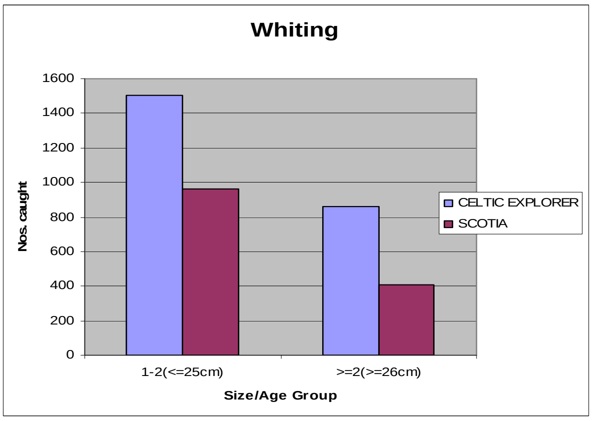
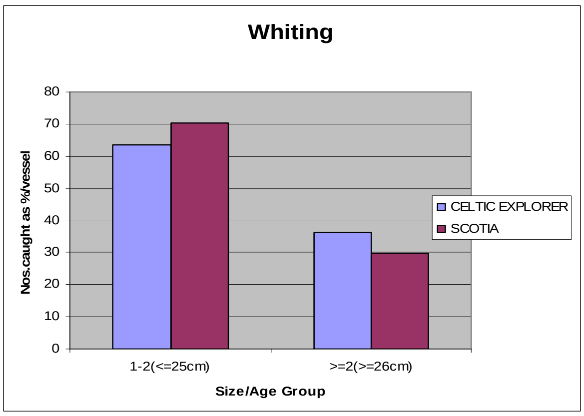


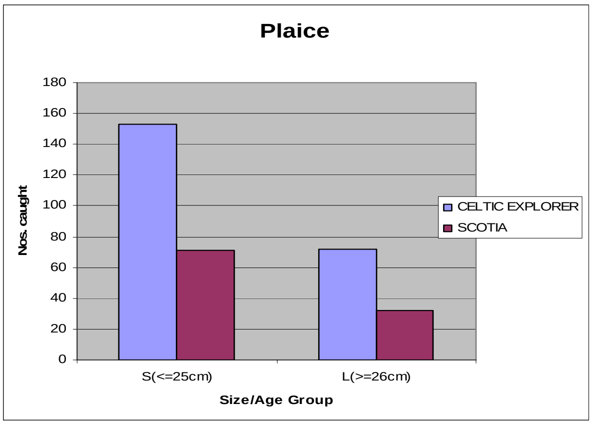
Figure 5: Results after reclassification of length frequency data for six species into size classes. Expressed first as numbers caught and then as a percentage of the total species catch for each vessel.

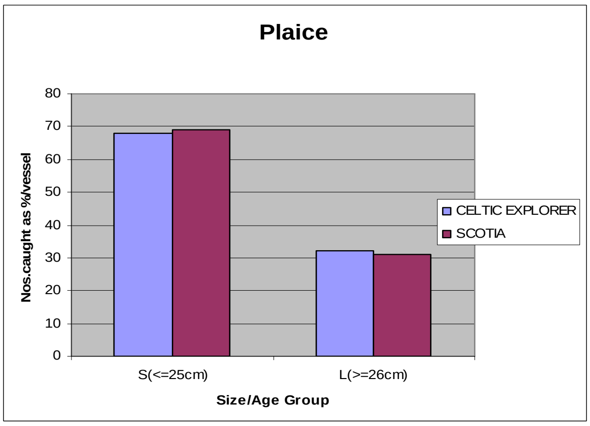


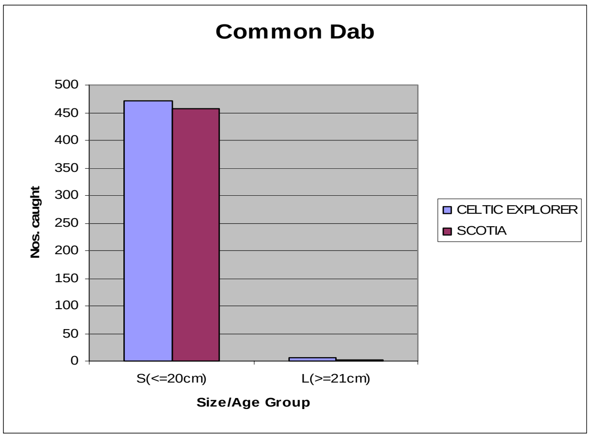


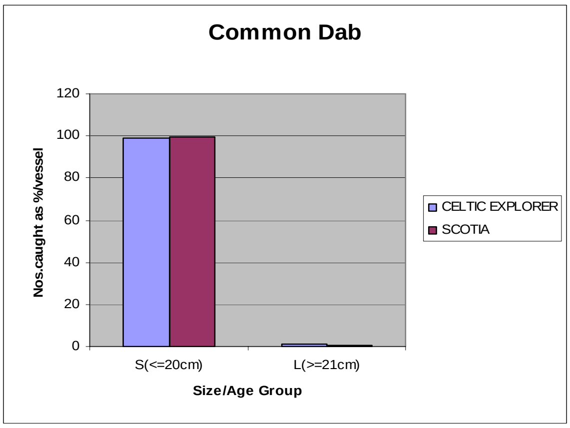


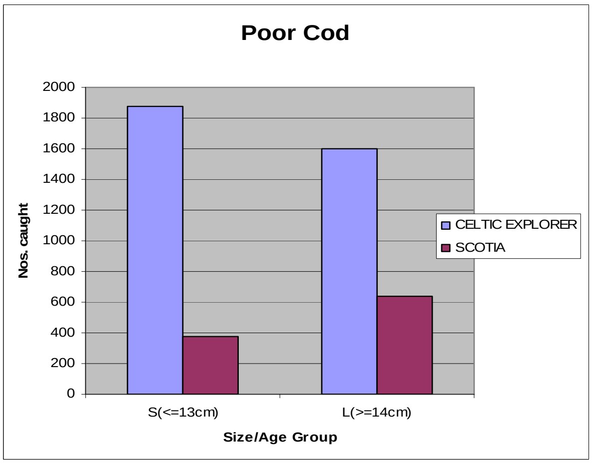


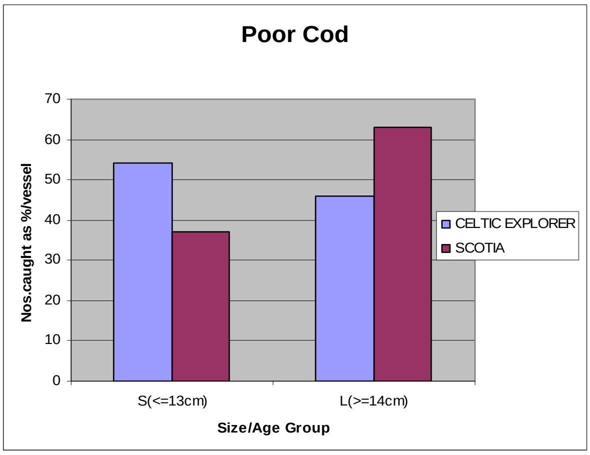

Plaice
Nos. caught
180
160
140
120
100
80
60
40
20
0
S(<=25cm)
L(>=26cm)
Size/Age Group
CELTIC EXPLORER
SCOTIA

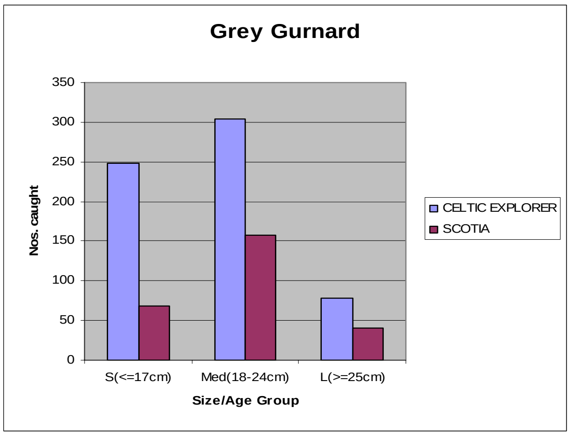

Plaice
Nos.caught as %/vessel
80
70
60
50
40
30
20
10
0
S(<=25cm)
L(>=26cm)
Size/Age Group
CELTIC EXPLORER
SCOTIA


Common Dab
Nos. caught
Size/Age Group
S(<=20cm)
L(>=21cm)
CELTIC EXPLORER
SCOTIA


Common Dab
Nos.caught as %/vessel
Size/Age Group
S(<=20cm)
L(>=21cm)
CELTIC EXPLORER
SCOTIA


Poor Cod
Nos. caught
Size/Age Group
S(<=13cm)
L(>=14cm)
CELTIC EXPLORER
SCOTIA


Poor Cod
Nos.caught as %/vessel
Size/Age Group
S(<=13cm)
L(>=14cm)
CELTIC EXPLORER
SCOTIA


Grey Gurnard
Nos. caught
350
300
250
200
150
100
50
0
S(<=17cm)
Med(18-24cm)
L(>=25cm)
Size/Age Group
CELTIC EXPLORER
SCOTIA

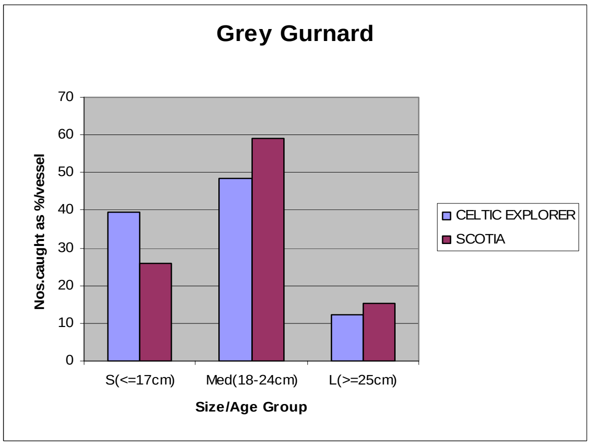

Grey Gurnard
Nos.caught as %/vessel
70
60
50
40
30
20
10
0
S(<=17cm)
Med(18-24cm)
L(>=25cm)
Size/Age Group
CELTIC EXPLORER
SCOTIA

Figure 5, emphasises further the differences in catchability between vessels that exist for almost all of the selected species. In addition to this, haddock, poor cod and grey gurnard also appear to show significant differences regarding the numbers caught in the small size classes. The Celtic Explorer appears to catch not only more but significantly, a higher proportion of smaller fish for these species. (A more generalised picture is seen in Figure 6 that plots the total combined length frequency including all species for both vessels.)

In order to try and test the hypothesis that the length frequencies for both vessels differ significantly it was necessary to perform a K-S test on the six selected species. Cumulative length frequency plots were created with the subsequent analysis being performed on the data using d-values obtained from the aforementioned plots. The test results are displayed on Table 2.

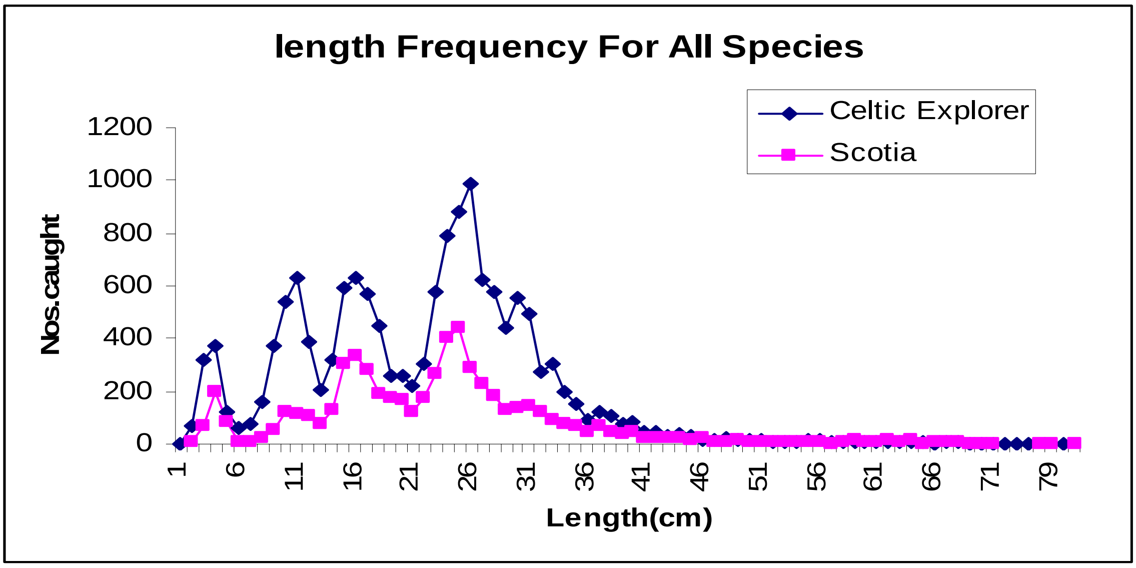


Figure 6: Combined length frequency for all species (excluding pelagics and boarfish).

Table 2: Results of K-S test on the 6 selected species.

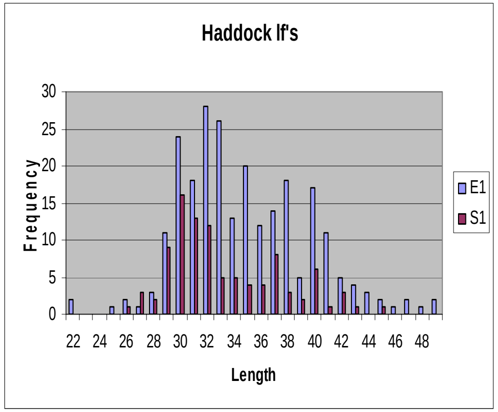
SPECIES	D – VALUE	D_A	HO (A=0.05)
Haddock	0.155	0.041	Rejected
Whiting	0.065	0.046	Rejected
Plaice	0.095	0.162	Accepted
Common dab	0.079	0.089	Accepted
Poor cod	0.175	0.048	Rejected
Grey gurnard	0.165	0.099	Rejected

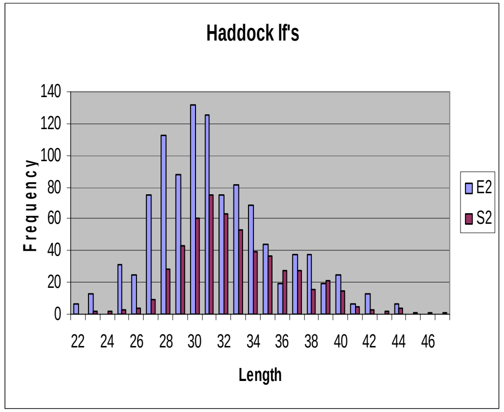
These results support the hypothesis that for the highlighted species there appears to be a significant difference in the observed length frequencies between vessels. In the case of haddock, poor cod and grey gurnard this is further evidence that the Celtic explorer is catching a higher proportion of smaller size classes for these species. Contrastingly, plaice and common dab accepted the null hypothesis that that proportionally there was very little difference between the length frequencies.

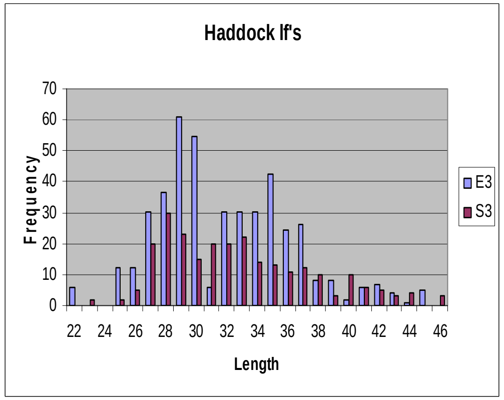
Discussion

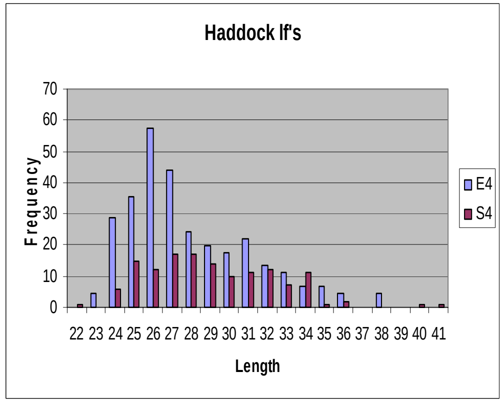
This was an extremely limited study with only eight parallel hauls with which to try and make a comparison between the two research vessels and more specifically the fishing gear they were using. It does nevertheless throw up some rather interesting points. Firstly it is very clear that the modified GOV used by MI aboard the Celtic Explorer is much more efficient than the corresponding GOV with the ‘C’ groundgear as used by FRS aboard Scotia. Secondly there seems to be rather a lot of evidence to suggest that for certain species there is a selectivity issue in addition to that of catchability although more data is needed to examine this further. Possible reasons behind both these issues must lie firstly with the difference in sweep lengths used by both vessels. One would suspect a herding issue may be at least a partial cause regarding the greater efficiency of the Irish GOV. Secondly the removal of the toggle chain and the tying down of the fishing line onto the groundgear would also one might suspect be a contributory factor. Of course this also makes the inherent assumption that fish are escaping under the fishing line from the Scottish net. This may go some way to explaining the differences in catchability that exist between the two gears. What is less clear is the cause of the size selectivity issue that seems to exist for the species mentioned. There is very little or no literature on the behaviour of poor cod or grey gurnard for any size range which sheds any light on the sort of behaviour these species exhibit within the net. Such evidence exists for haddock which points to them displaying an upwards movement when turning back towards the net. (Sangster and Main, 1979) Therefore assuming similar headline height for both vessels during the parallel tows there seems no other reason other than a herding issue to explain the disparity. Even assuming this is the case why should Scotia catch proportionately less small individuals than the Celtic explorer. Ultimately this study throws up more questions than it provides answers for. However if this study can be used as a platform for further analysis, coupled with a commitment to build on the existing dataset it may start to yield more answers.

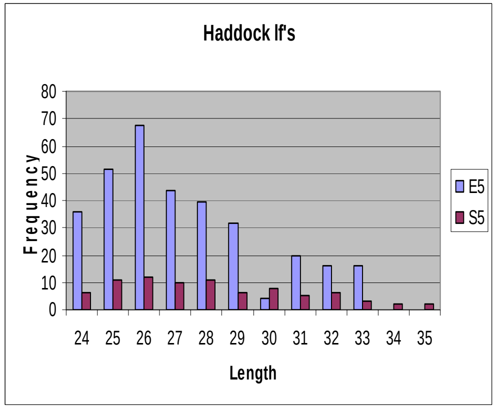
Annex.1. Length Frequencies for selected species. haddock

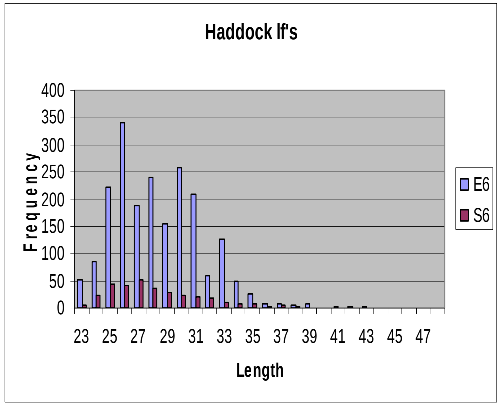


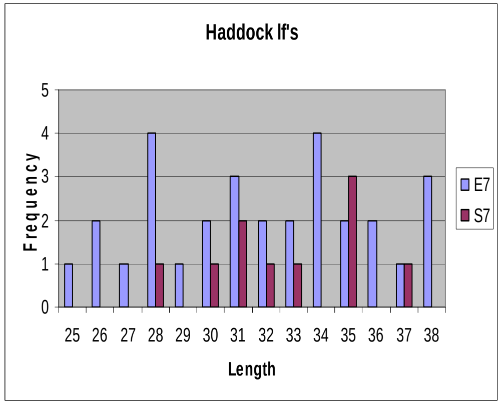


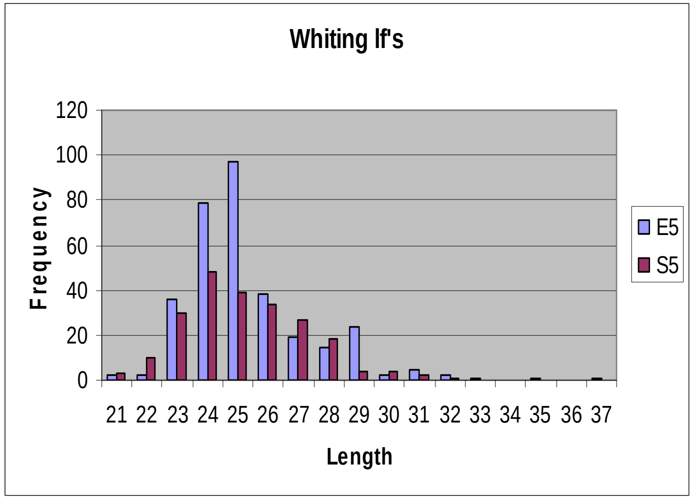








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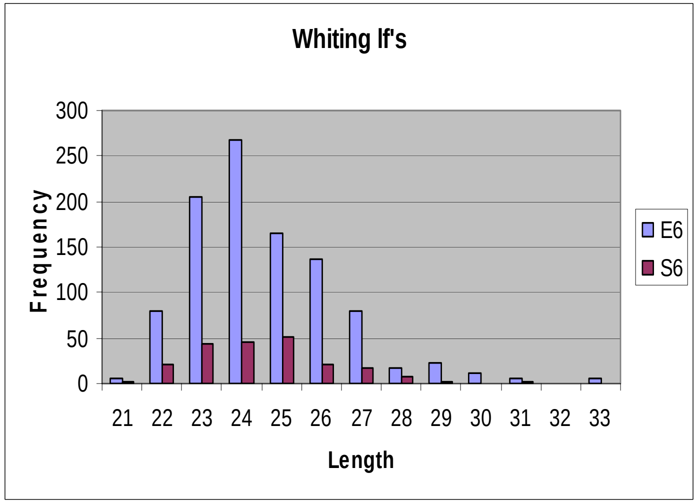
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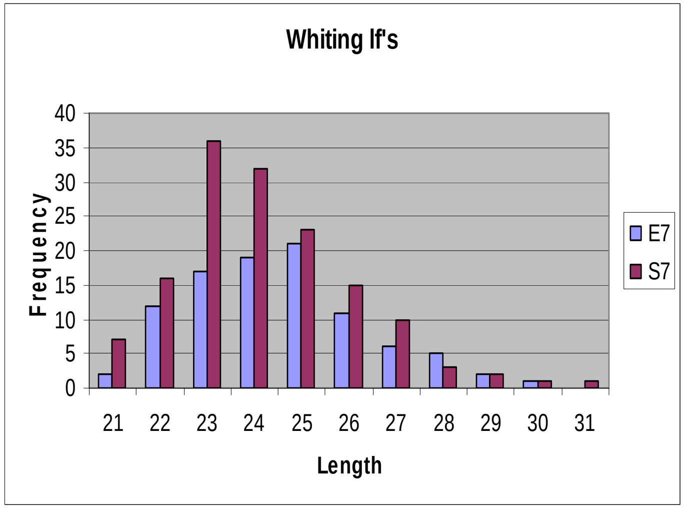
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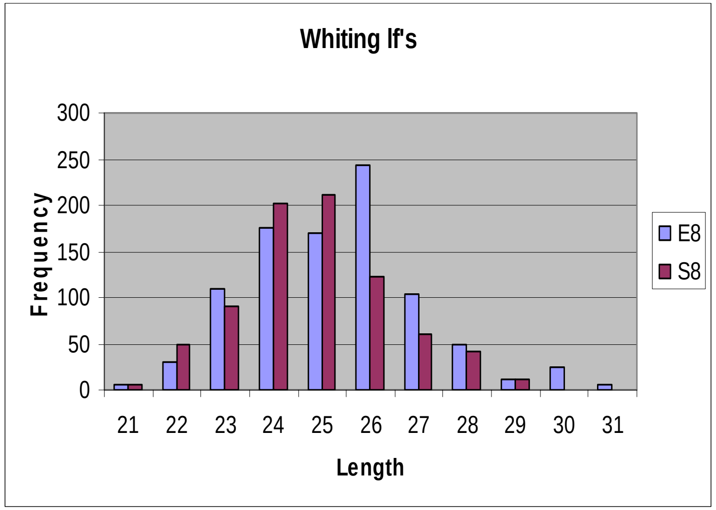
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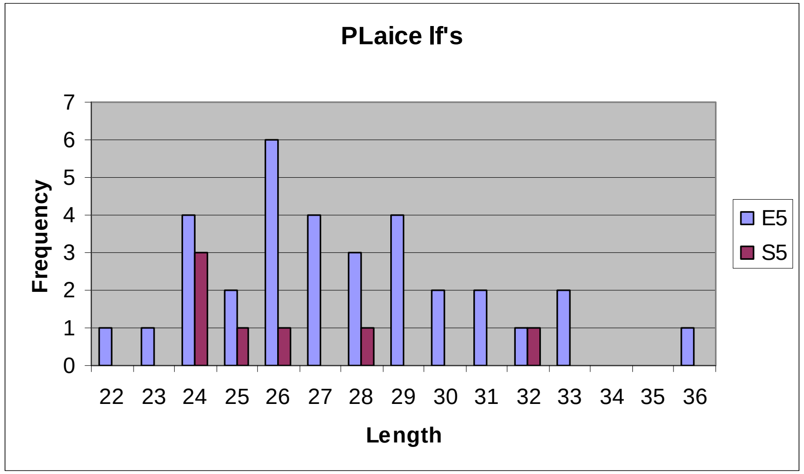
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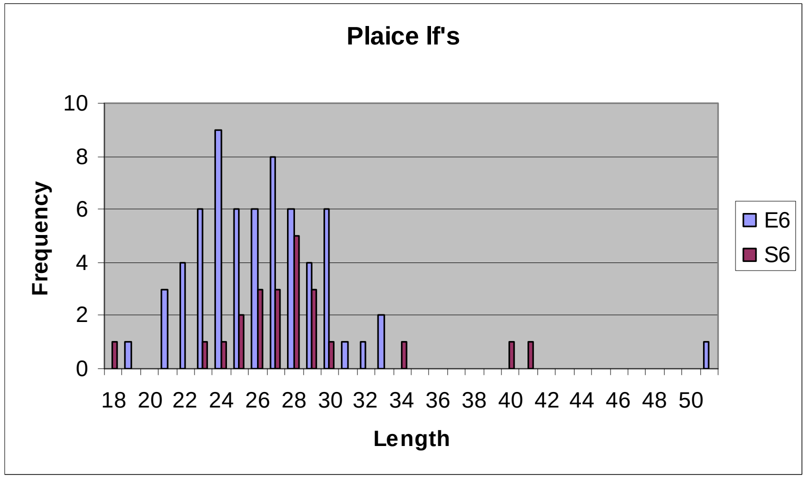
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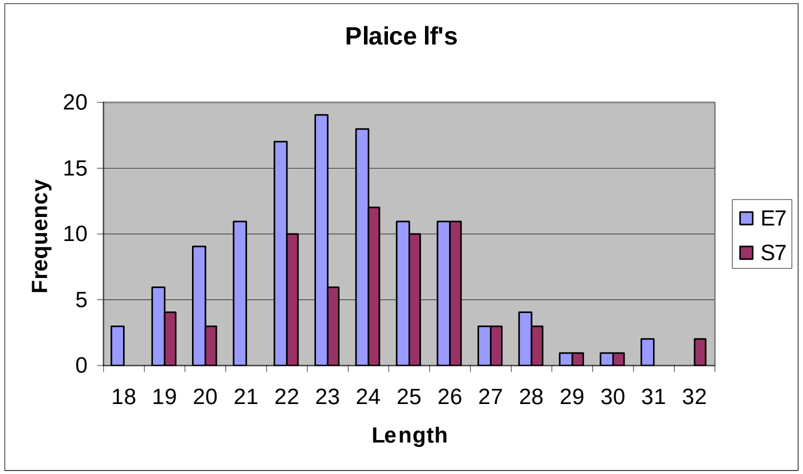
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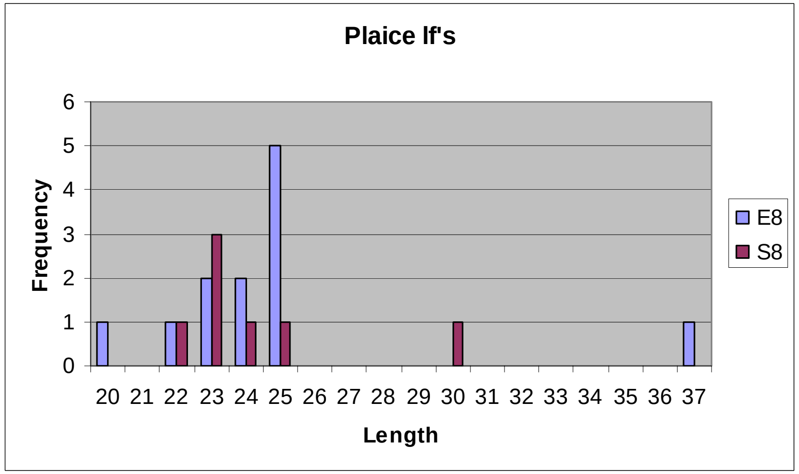
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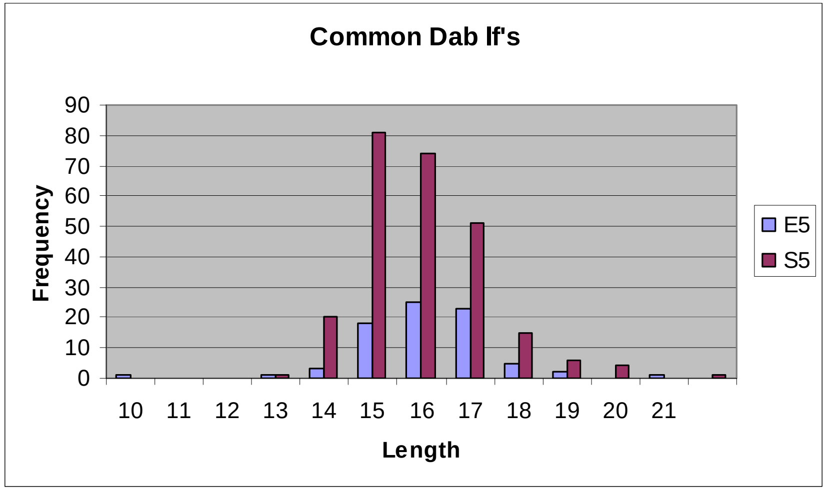
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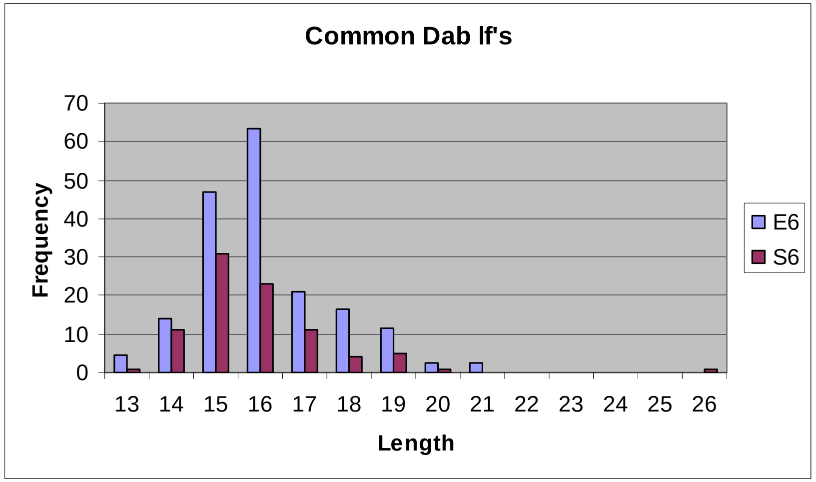
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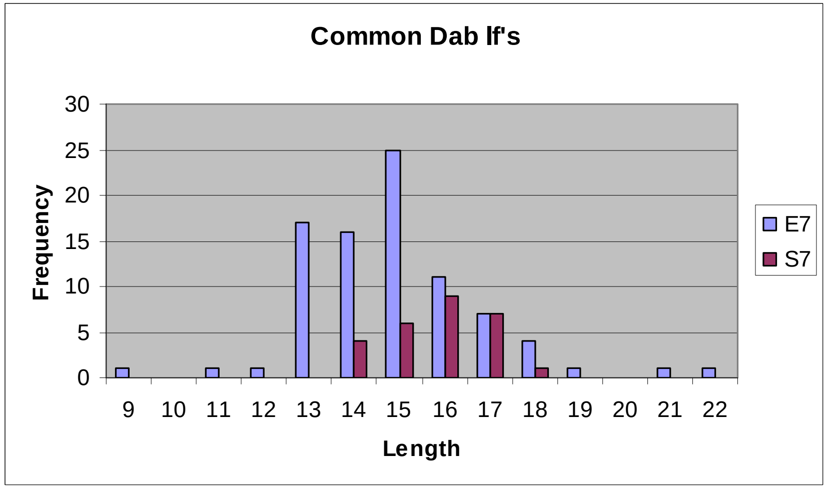
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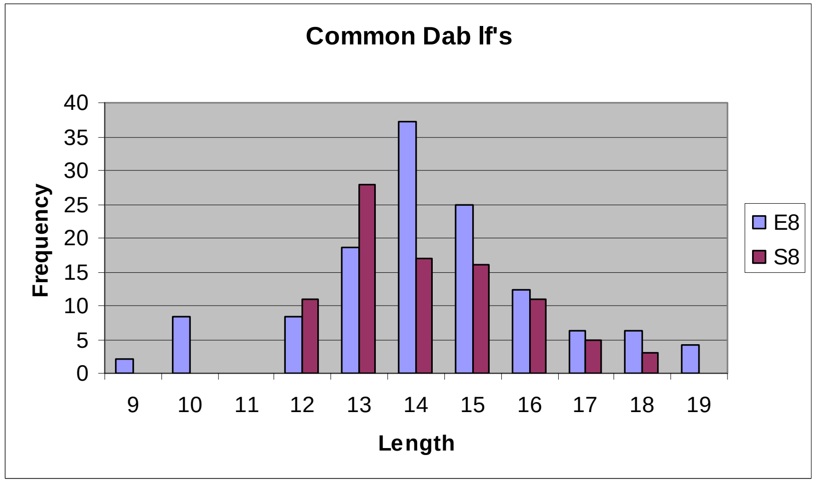
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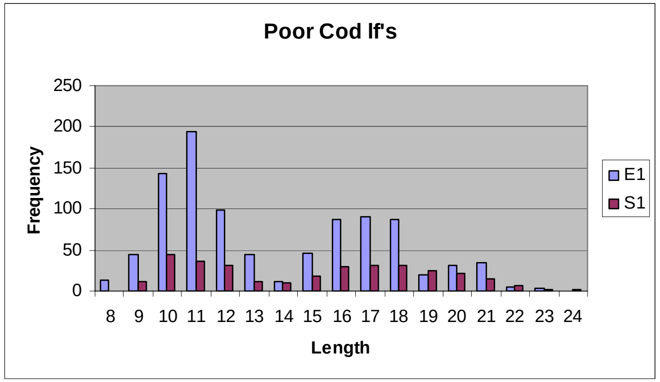
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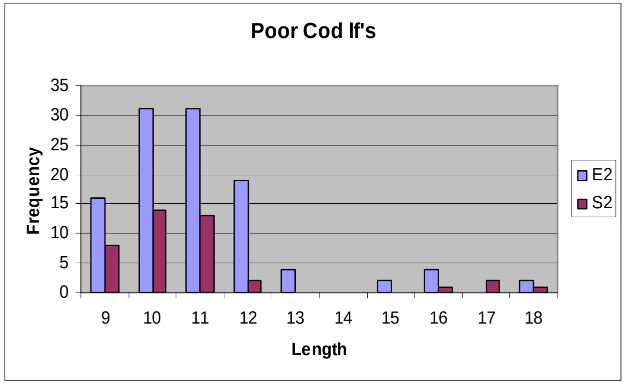
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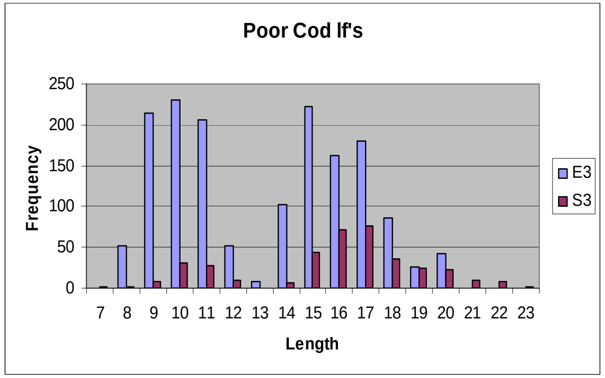
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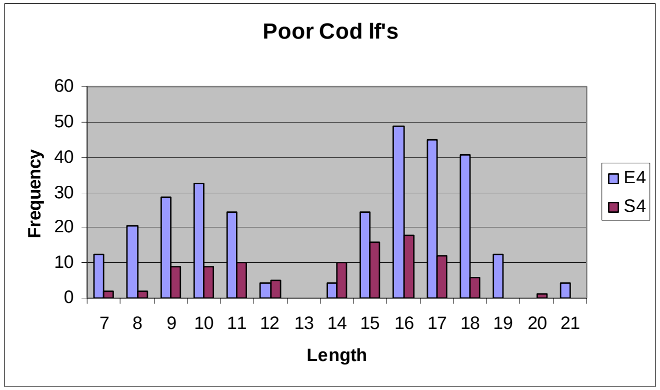
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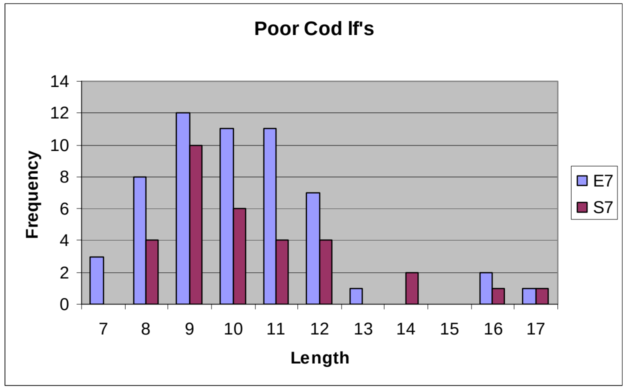
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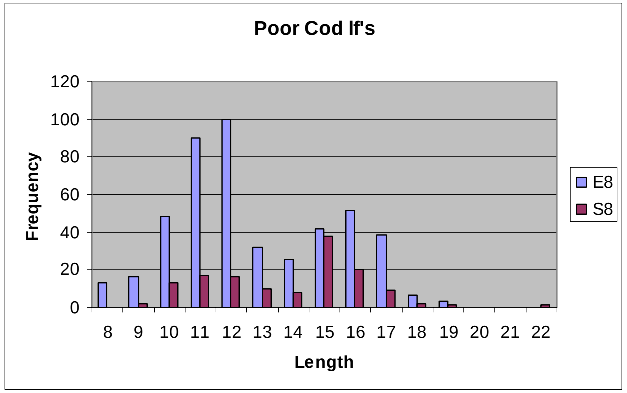
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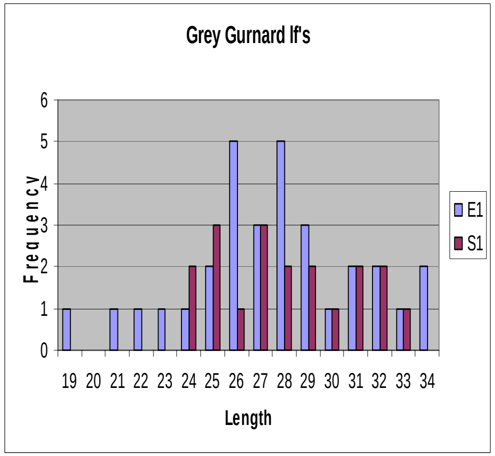
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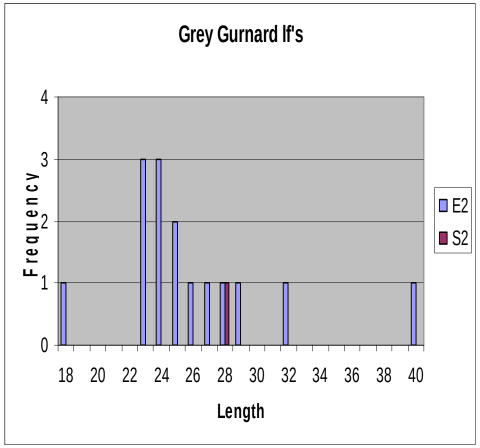
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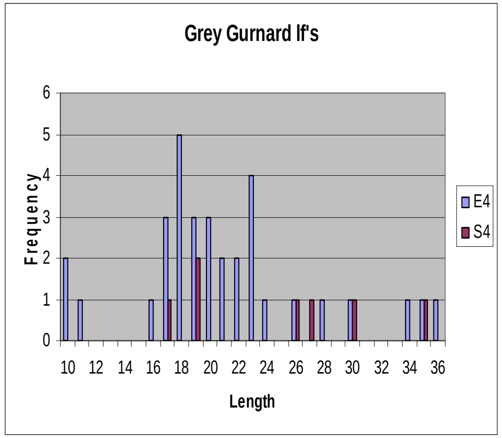
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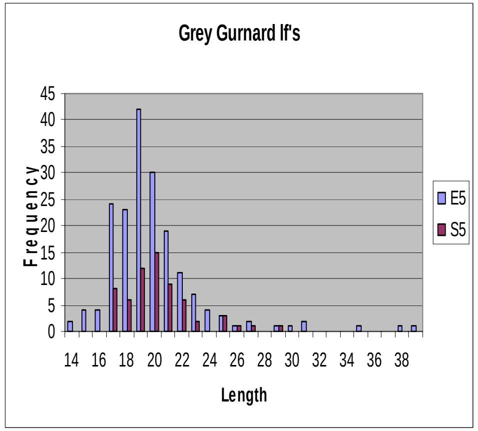
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Frequency
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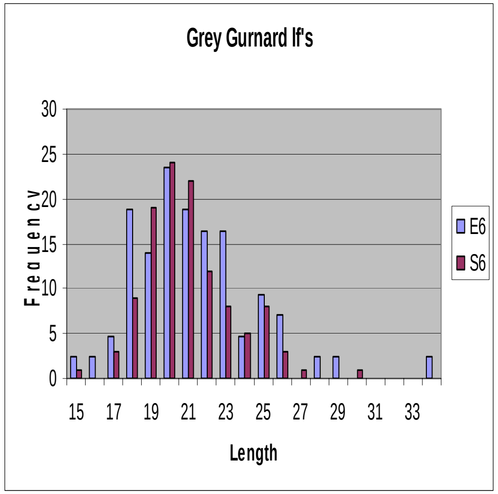
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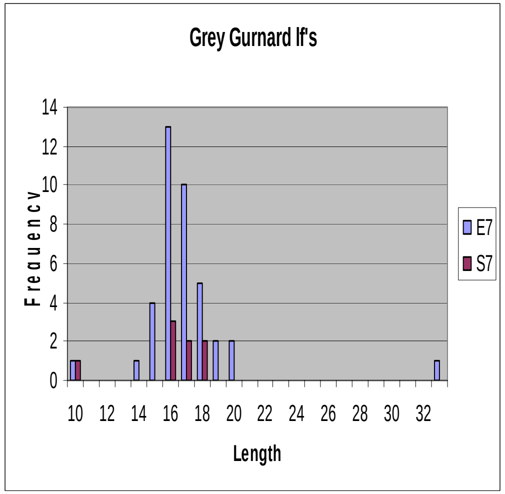
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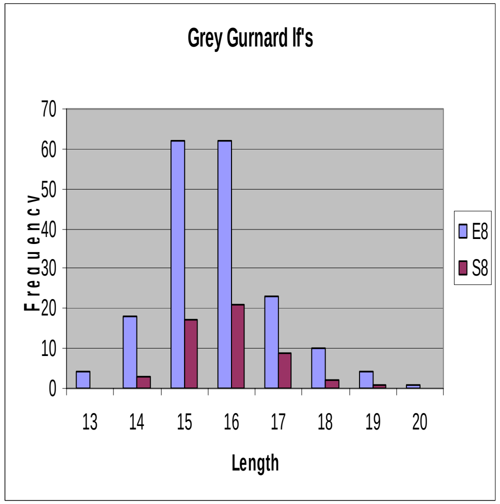
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Frequency
Length
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S8

PORTUGUESE GROUNDFISH ACTIVITIES IN 2004/2005

Corina Chaves & Fátima Cardador

IPIMAR, Lisbon, Portugal

AUTUMN GROUNDFISH SURVEY

The 2004 Portuguese Autumn Groundfish Survey was carried out during the 4th quarter in Portuguese waters (Division IXa), from 21st October to 19th November, with 19 fishing days accounting a total of 79 valid hauls (Figure 1) and 96 CTDs sampling stations conducted. The survey methodology was the same as in 2003, with the exclusion of the 500-750 m depth strata. The total number of valid hauls by depth was as follows:

Table 1 - Total number of valid hauls by depth.

Survey	20-100 m	101-200 m	201-500 m	Total
Autumn 2004	24	32	23	79

The catch was composed of 119 different fish species, 20 crustacean species and 17 cephalopod species. The most abundant species was blue whiting (*Micromessistus poutassou*), followed by snipefish (*Macroramphosus* spp.) which distributes over the whole sampled area. Biological parameters (length, weight, status of maturity among others) and hard structures (otoliths and *illicia*) were collected for several species.

ABUNDANCE AND BIOMASS INDICES

Abundance (number per hour), biomass indices (kg per hour) and their standard deviations were computed for the whole surveyed area. These indices are presented for the main commercial species: hake, horse mackerel, blue whiting, mackerel and Spanish mackerel, megrims, anglerfish, rose shrimp (*Parapenaeus longirostris*) and Norway lobster. The results are shown in Table 2.

Table 2 – Non-standardised indices of abundance in Autumn 2004 survey.

Species	kg/hour	CV	N/hour	CV
Hake	17.3	0.08	376.5	0.10
Four-spot megrim	1.3	0.17	17.4	0.16
Megrim	0.0	0.76	0.0	0.76
Black anglerfish	0.2	0.56	0.1	0.57
White anglerfish	0.2	0.33	0.1	0.35
Blue whiting	77.6	0.19	1114.5	0.19
Horse mackerel	19.1	0.31	385.5	0.31
Mackerel	7.8	0.34	61.9	0.35
Spanish mackerel	0.3	0.20	1.7	0.20
Norway lobster	0.1	0.50	3.6	0.35
Rose shrimp	0.03	0.18	3.9	0.13

EU PNAB/Data Collection Programme has funded participation to IBTSWG and all activities, with the exception of the Workshop on Portuguese Groundfish Surveys that was supported by NeoMAv.

The evolution of the abundance and biomass indices were plotted since 1999 (Figure 2a and 2b) to show evolution patterns.

Hake achieved the highest abundance index in the series in 2004; this is due to high recruitment, generating an increase trend.

Blue whiting presents a decreasing trend but has not achieved its lowest indices in 2004. It remains the most abundant species in Portuguese continental coast with 78 kg/h (1114 ind./h).

The abundance and biomass indices for four-spot-megrim and anglerfishes in 2004, have lowered down from 2003, but still remains high values comparing with the time series. That fact may be due to the CAR fishing gear which catch better benthic species. Four-spot megrim had an average of 0,09 kg/h (1 ind./h) in 1999-2002 and in 2003 and 2004 achieved 1,6 and 1,3 kg/h (23 and 17 ind./h), respectively and anglerfishes had an average of 0,03 kg/h (0,04 ind./h) in 1999-2002 and achieved 0,3 and 0,2 kg/h (0,22 and 0,13 ind./h) in 2003 and 2004.

Horse mackerel and Norway lobster are the only species with an increase since 2002 both in number and weight. This increase is not only visible from the previous year, but also against the mean.

Rose shrimp catches have been declining continuously since 1999, attaining in 2004 its lower value with 0,03 kg/h.

The abundance index was also computed by length class for each species. Figure 3 shows these results for hake, horse mackerel, blue whiting, mackerel and megrims in 2003 and 2004 for differences.

Hake presents a skewed left distribution with recruits achieving high values, while for length above 21 cm presents the same values of the previous year.

Horse mackerel presents higher values for length classes 17 to 19 cm, while remaining distribution remains the similar values from the previous year.

Blue whiting showed a high recruitment index in 2003 that is not shown in 2004 since length composition corresponding to 1-year class individual achieved similar values from the previous year.

Mackerel presents higher indices for length classes corresponding to 0 age group, while the 1-year group as values similar to the previous year.

Megrims, which are better sampled with the net used in 2003 and 2004, show no significant differences between 2003 and 2004.

GEOGRAPHICAL DISTRIBUTION

The geographical distribution is presented in number per hour tow for age 0 group (<17 cm) and others for hake (Figure 4). Others maps will be presented by the western group. Hake recruits have extended their distribution area to the whole surveyed area.

WORKSHOP ON PORTUGUESE GROUNDFISH SURVEYS

On December 2004, the Workshop on Portuguese Groundfish Surveys was carried out under the frame of the NEOMAV Portuguese Project, action Key DAMEPAC – *Development and application of new methods on the estimation and prediction of abundance and catch of the fishery resources* under the Task 1: Analysis of the abundance indicators estimated from the commercial fishery or from the groundfish surveys and optimisation of the sampling design. Paulo Ribeiro (Federal University of Paraná, Brazil) and Michael Pennington (IMR, Bergen) were invited to attend to give their expertise in that area.

The terms of reference were:

a) Review the methods used by the Portuguese Groundfish surveys in space and time;

b) Investigate the use of systematic sampling designs based on geostatistical models for Portuguese Groundfish Surveys;

c) Investigate the compatibility between systematic sampling and stratified random sampling on Portuguese Groundfish Surveys context, regarding the construction of an abundance index time series.

Portuguese Autumn survey was based on a fixed station sampling scheme with 48 strata. But strata sampled are not constant and sometimes there is only 1 sample by strata. This produces two difficulties: How to estimate abundance in strata not sampled; and How to estimate variance in strata with only one sample? Assuming variance to be 0 in such strata provides highly underestimated variances that can totally biased the precision of the survey.

During that week, various experiments have been done including estimation of abundance in strata not sampled, estimation of variance in strata with 1 haul, geostatistical interpolation, inference, strata reduction, tow duration, etc… After some discussion it has been agreed that the sampling scheme to be adopted from 2005 onwards for Quarter 4 survey should:

- Have a sampling depth from 20 to 500 m (instead of 750 m) once the main objective of the survey is to estimate recruitment indices for hake and horse mackerel;
- Use the NCT gear;
- Have tow duration of 30 minutes;
- A mixed sampling scheme composed by:
  1) sampling scheme with 66 trawl positions distributed over a fixed grid with 5' per 5' miles, corresponding to trawl positions already done.
  2) 30 random trawl positions

The new sampling scheme allows performing the calculations with the former 48 strata. The old and new sampling grid are presented in Figure 5.

FISH IDENTIFICATION

IPIMAR started a series of courses on species identification with the production of some identification keys based of photographs and some simple key factors for identification.

NEW QUARTER 1 SURVEY

A new survey series started in March 2005 and is still occurring in the Portuguese Continental waters. The main objective is to estimate the distribution and abundance of hake in spawning season. The sampling scheme used is a simplification of the new sampling scheme to be adopted with:

- tow duration set to 60 minutes;
- bottom trawl gear type FGAV019, with no rollers in the groundrope;
- 50 grid stations + 25 random

Those differences are due for adults from different species can be caught, so longer hauls allows less fishing stations.

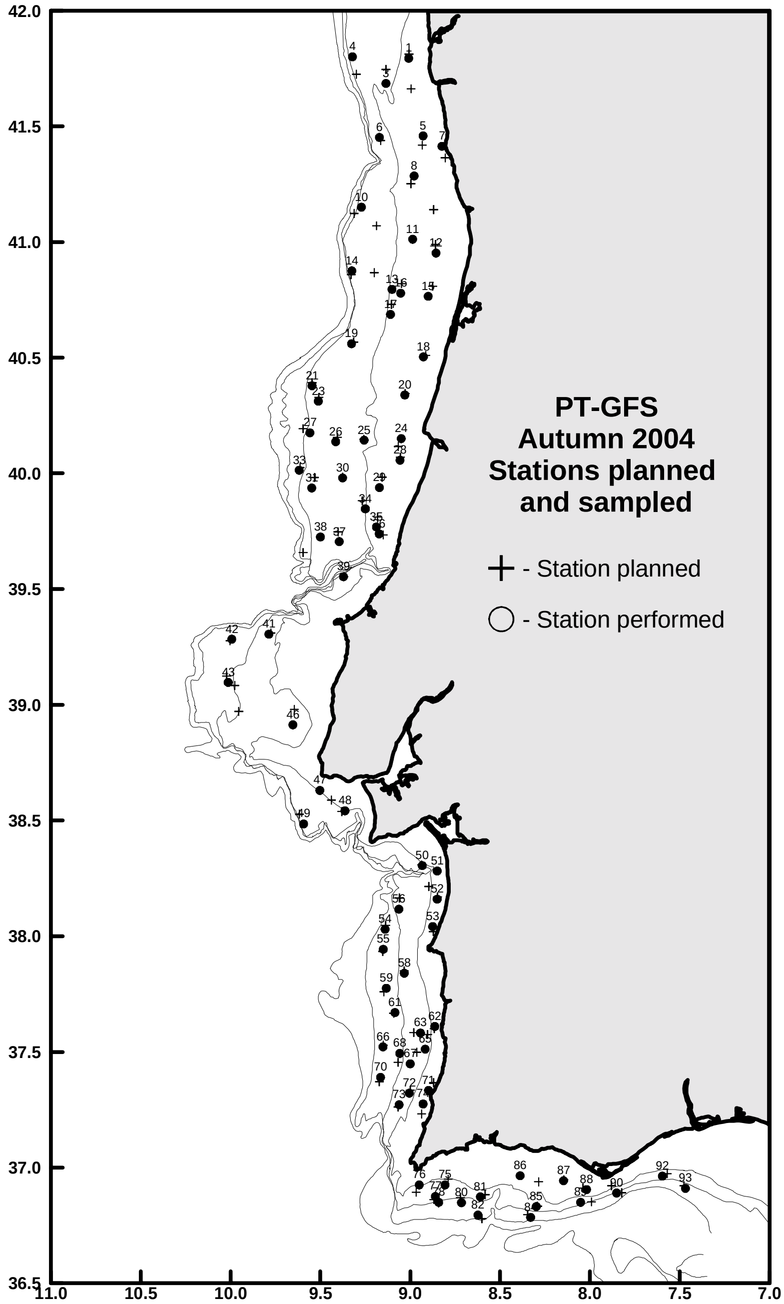

Figure 1 – Location of fishing sampling stations.

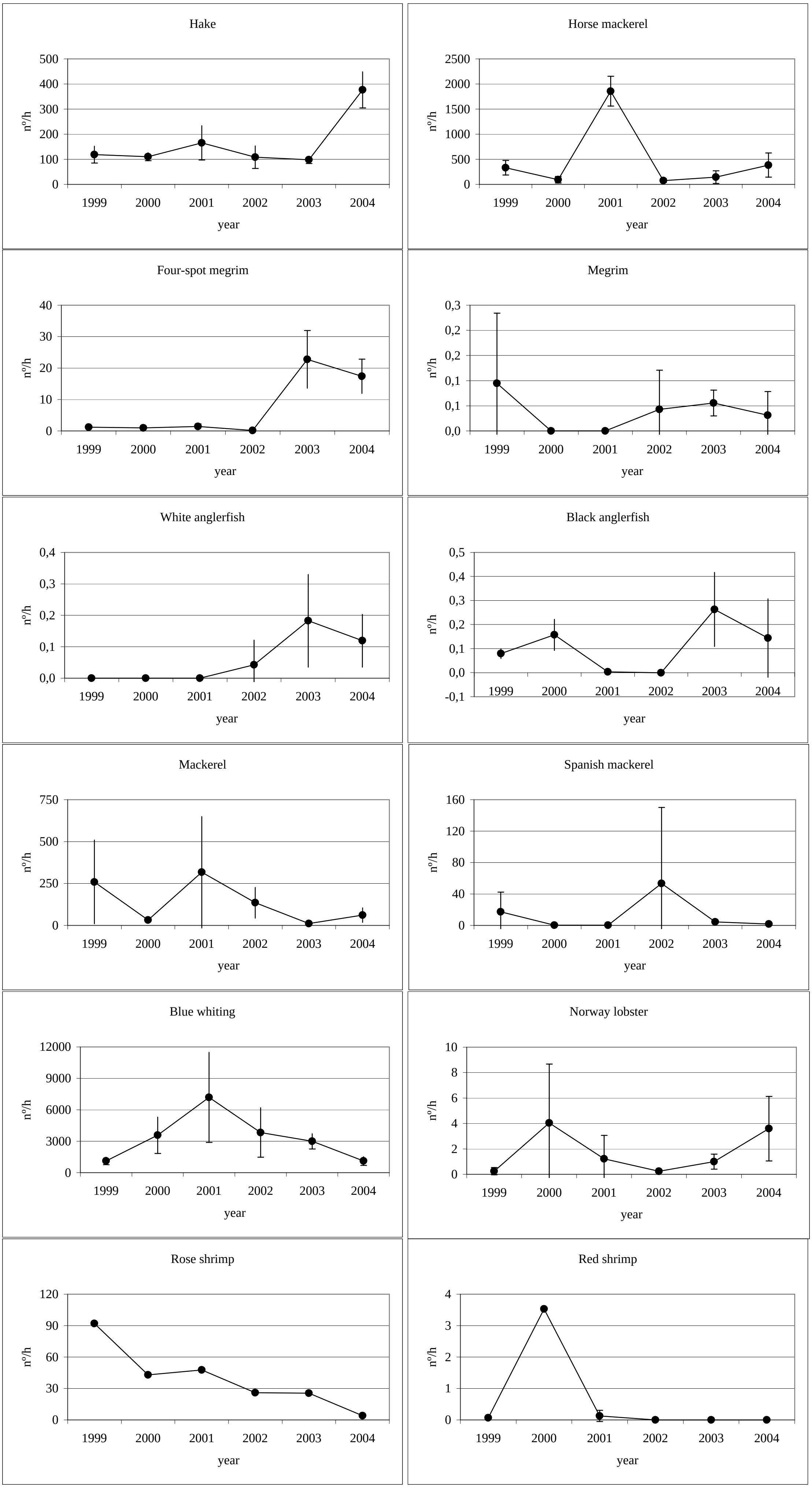

Figure 2 a - Evolution of the abundance indices for Autumn surveys from 1999 to 2004.

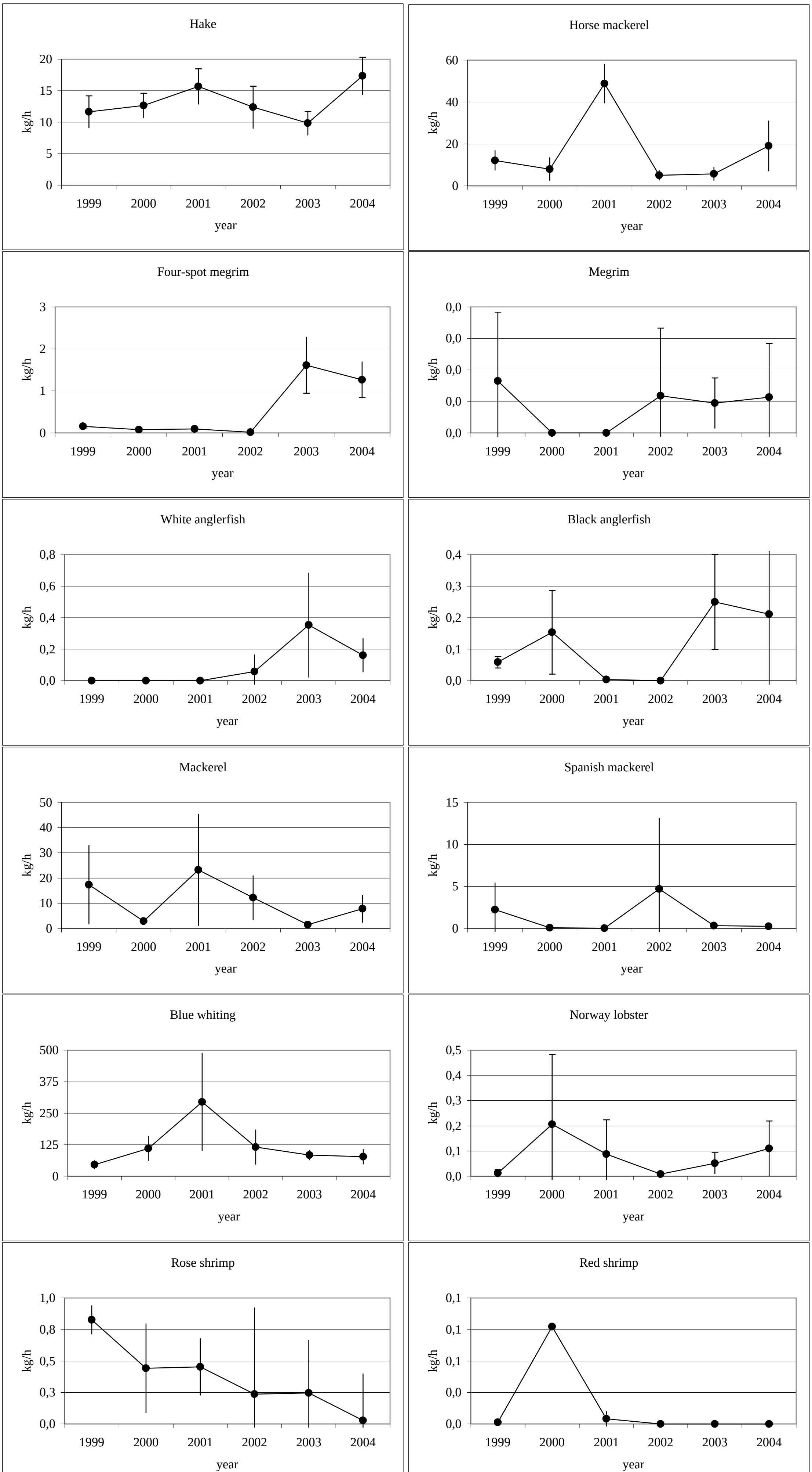

Figure 2 b - Evolution of the biomass indices for Autumn surveys from 1999 to 2004.

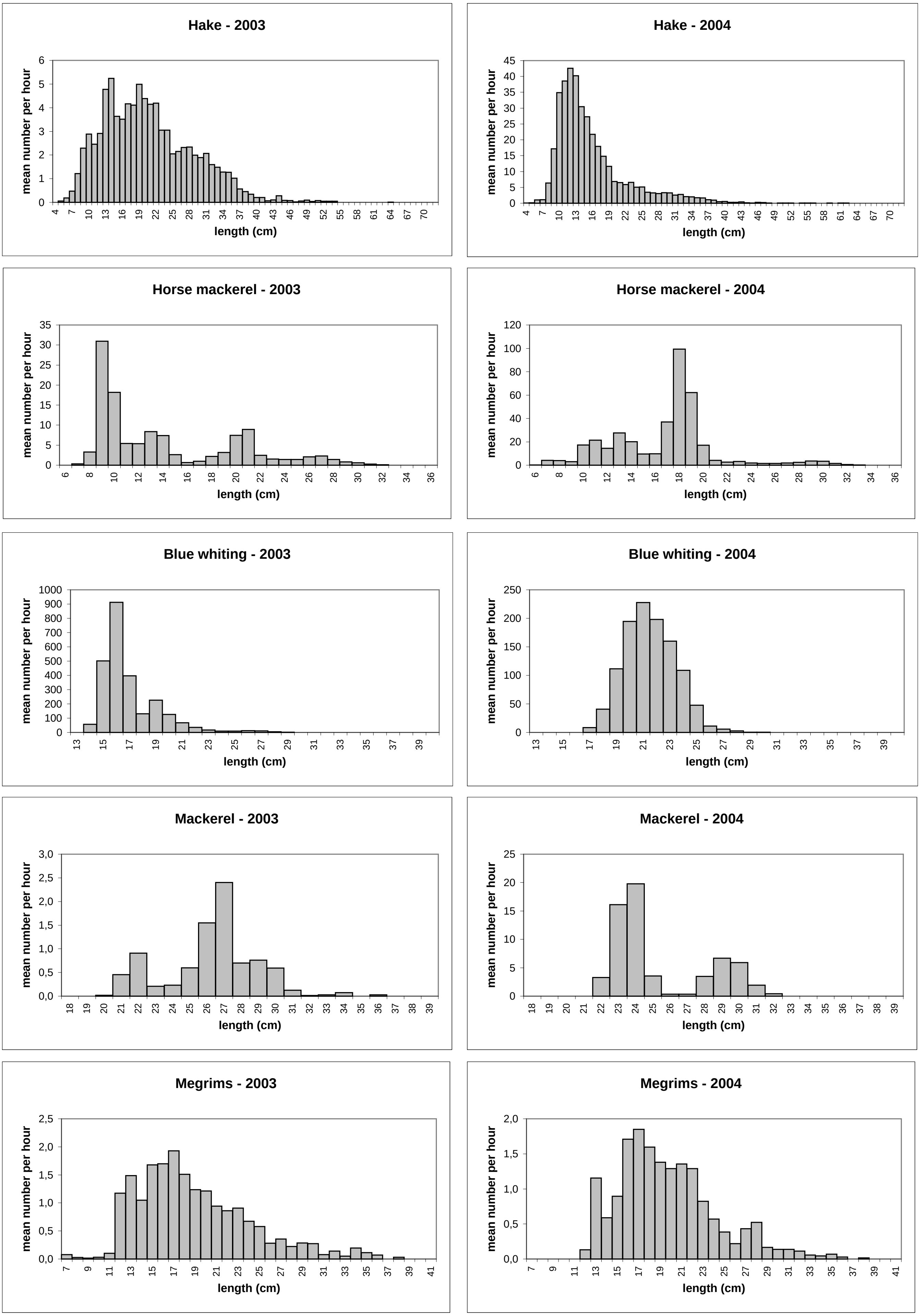

Figure 3 - Abundance index by length class.

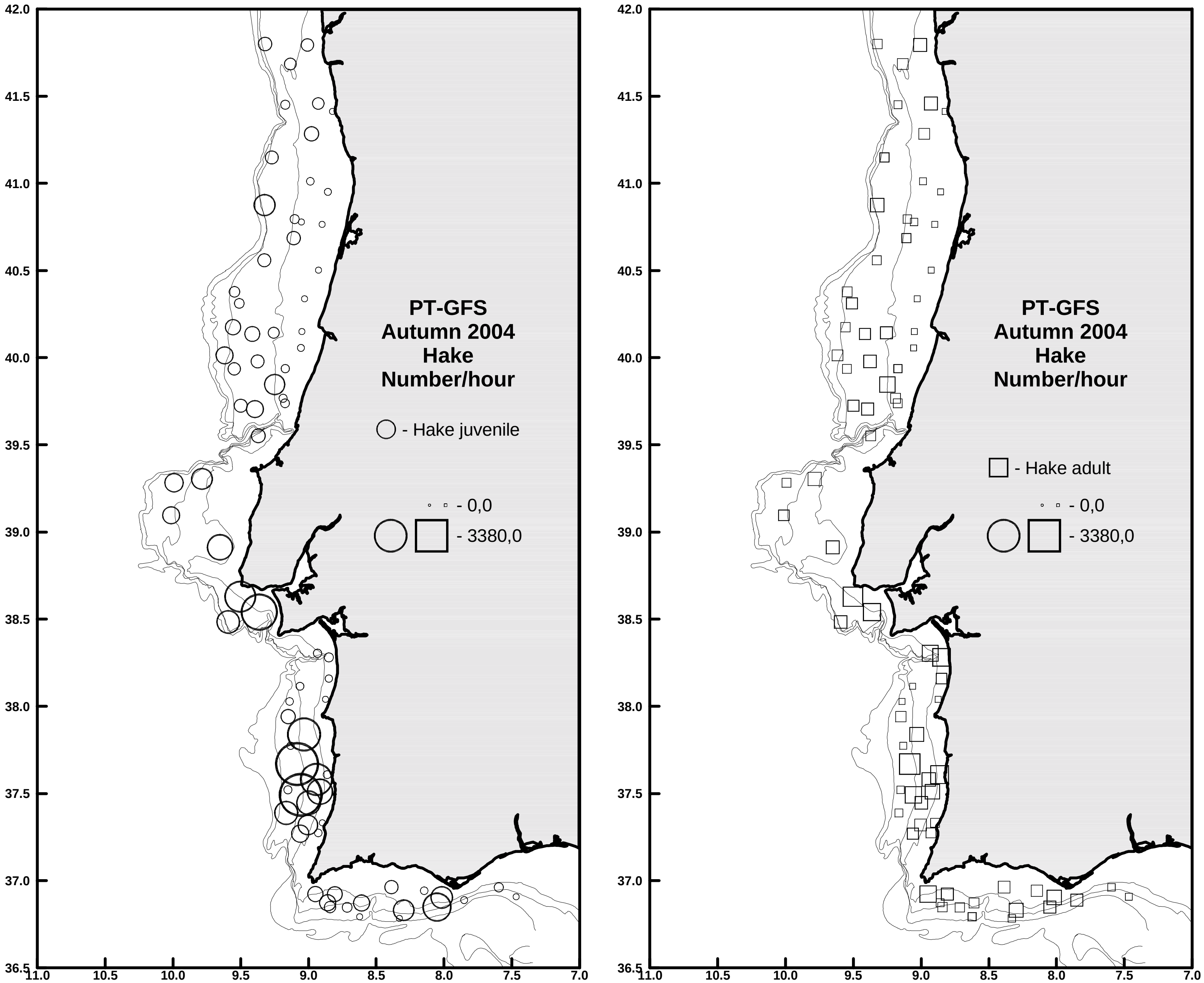

Figure 4 - Hake distribution in Autumn 2004.

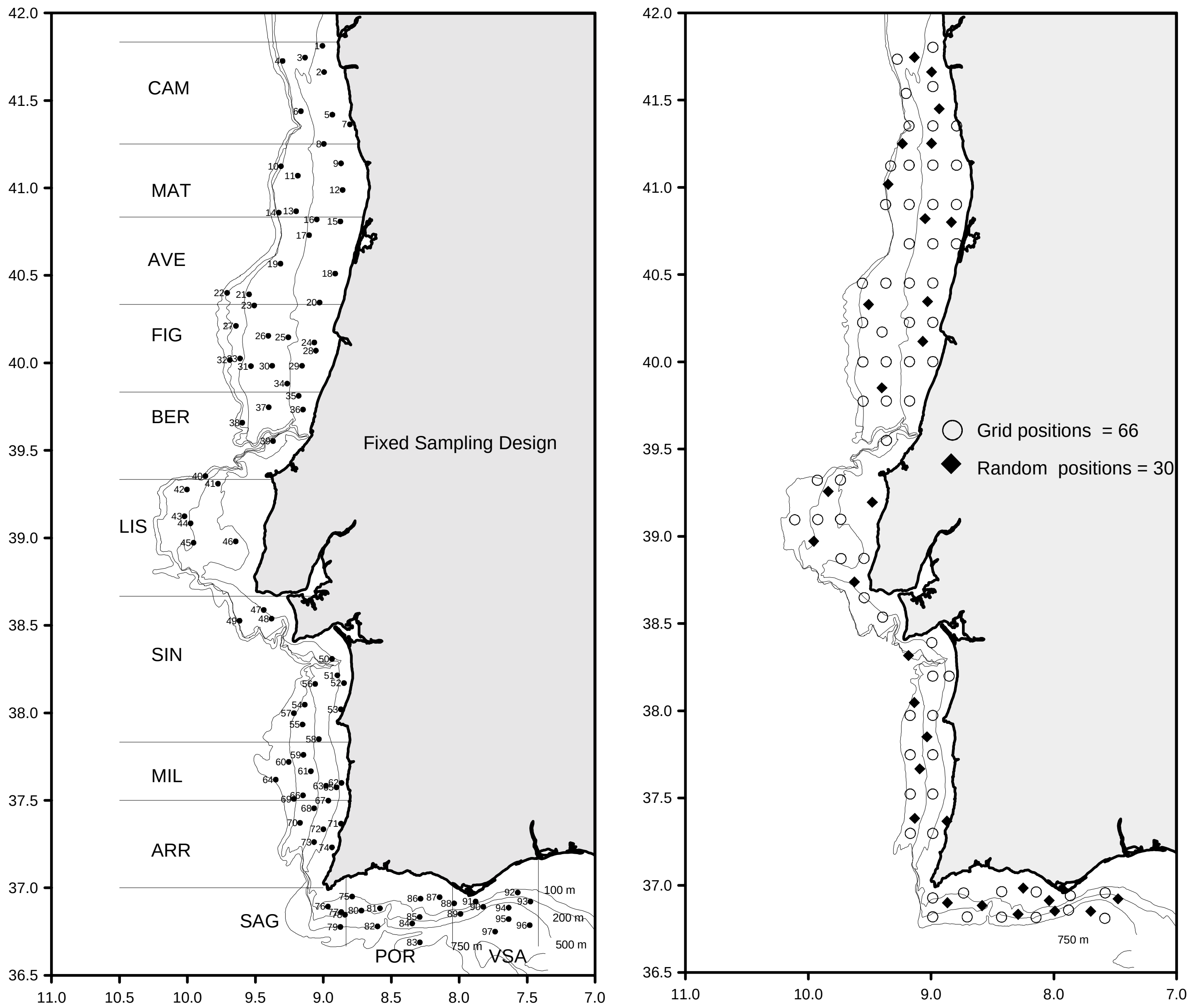

Figure 5 – Old and New sampling design for Portuguese Groundfish Surveys.