

Final Report

Programme 5 : Western Cod

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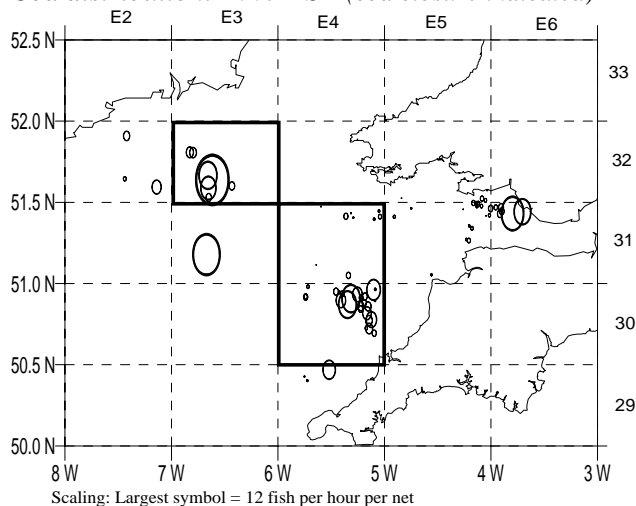
National Federation of Fishermen's Organisations

May 2005.

Summary

This report presents the results of the second in a series of FSP surveys of cod, haddock and whiting in the Bristol Channel and Celtic Sea. The first surveys took place in spring 2004 on FV Our Josie Grace, a commercial twin-rig trawler based in Ilfracombe. Programme 5 in 2005 used the same vessel for 24 days between 5 February and 11 March. Fishing with 85 mm mesh codends took place in the Bristol Channel and eastern Celtic Sea, as in 2004, but was also extended to cover western parts of the Celtic Sea south of Ireland (west of 6°W). These are referred to as the eastern and western areas, respectively.

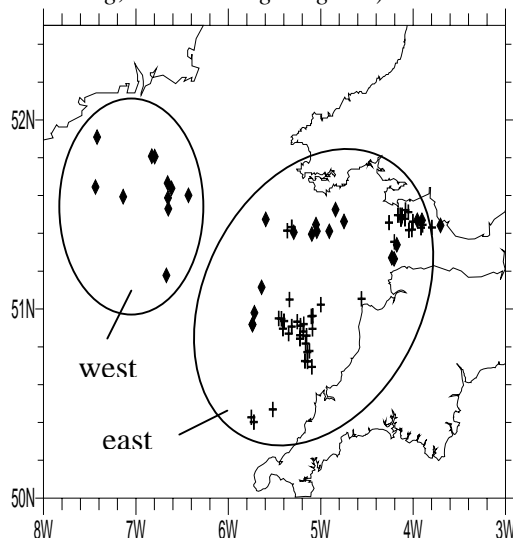
Cod distribution: 2005 FSP (cod closure indicated)



Cod in the eastern region in 2005 were predominantly 1-2 year olds whilst a broader age distribution was evident in the western region.

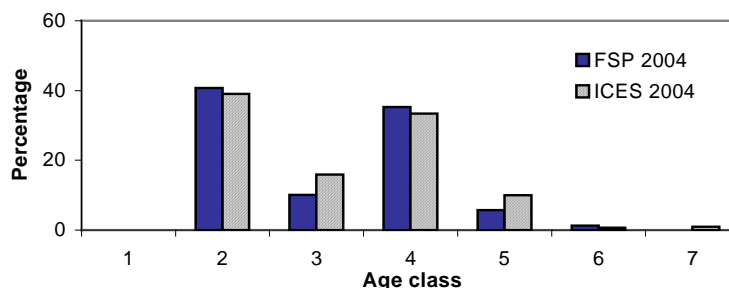
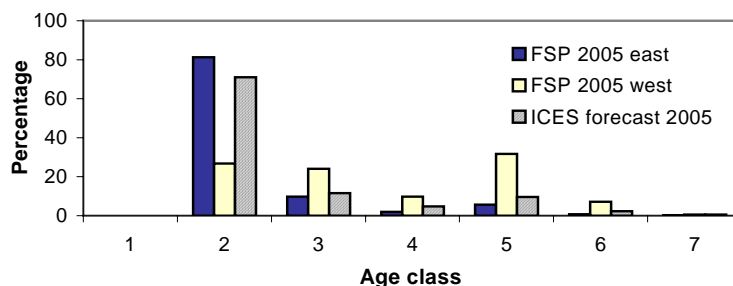
The age compositions for 2-year-old and older cod in the eastern region in 2004 and 2005 closely matched the most recent ICES forecasts for catches in 2004 and 2005 (see opposite). (1-year-olds are excluded from this analysis as they are caught mainly at the end of the year by commercial fleets).

Tow positions, 2005 FSP (diamonds: twin rig; crosses: single rig net.)

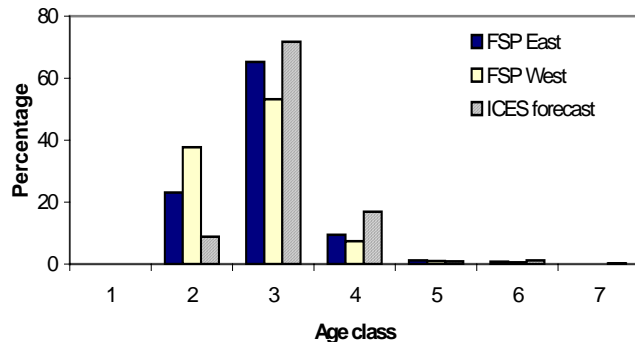


As in 2004, catch rates of cod, whiting and haddock in the eastern survey area were highest off the NW coast of Cornwall, and relatively high catch rates of cod were also recorded at the innermost stations in the Bristol Channel. The patch of cod off NW Cornwall in 30E4 is on a known spawning area. High catch rates of cod, haddock and to a lesser extent whiting were recorded at the most offshore stations in the western area. Rectangles 30E4, 31E4 and 32E3, closed to cod fishing in spring, include areas with relatively high FSP catch rates of cod.

Catch age compositions for 2+ cod: FSP and ICES

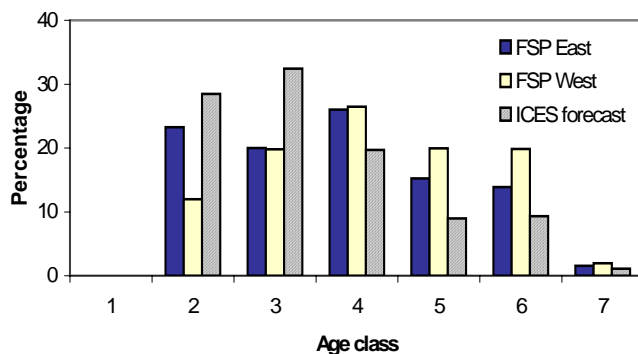


Catch age compositions for 2+ haddock: 2005 FSP and ICES



The 2004 FSP trip yielded high catch rates of haddock in the length range expected for 2-year-olds, reflecting ICES assessments showing a very strong 2002 year-class. In the 2005 FSP catches, 3-year-olds of the 2002 year-class were predominant, with 2-year-olds also being relatively abundant. Catch rates of haddock older than 4 years of age were very low. The most recent ICES forecast for catches in 2005 indicates a predominance of 3-year-olds.

Catch age compositions for 2+ whiting: 2005 FSP and ICES



A broad range of age classes of whiting was present in both the eastern and western region, with fish being relatively abundant up to six years of age. Comparison with the most recent ICES forecast is difficult because the ICES assessment does not include discards. However, the ICES catch forecast for 2005 also indicates a relatively broad age composition although with a higher incidence of 2-3 year olds than indicated by the FSP catches.

Abundance indices

The indices of abundance from the 2004 and 2005 surveys are given below as mean number of fish caught per hour per net. Haddock and whiting from the 2004 FSP trip have not yet been aged. The overall catch rate of cod in the eastern region was similar in 2004 and 2005.

Cod: 2004 & 2005 FSP

area	Year	1	2	3	4	5	6	7+	total
East of 6°W	2004	0.115	0.690	0.171	0.597	0.097	0.022	0.000	1.69
	2005	0.446	0.914	0.111	0.023	0.063	0.009	0.004	1.60
West of 6°W	2005	0.90	0.97	0.87	0.35	1.15	0.26	0.02	4.5

Haddock: 2005 FSP

area	Year	1	2	3	4	5	6	7+	total
East of 6°W	2005	1.95	2.30	6.49	0.94	0.13	0.09	0.00	11.9
West of 6°W	2005	9.47	13.26	18.69	2.61	0.35	0.23	0.00	44.6

Whiting: 2005 FSP

area	ayear	1	2	3	4	5	6	7+	total
East of 6°W	2005	1.34	5.68	4.89	6.37	3.73	3.40	0.38	25.8
West of 6°W	2005	0.38	3.16	5.22	6.98	5.27	5.24	0.51	26.8

Introduction

A Fisheries Science Partnership was established between Defra¹, CEFAS² and NFFO³ for the duration of financial year 2003/4 with funding from Defra. A second programme was established in 2004/5. The objectives of the FSP are to enable the fishing industry, in collaboration with CEFAS, to provide independent and verifiable data on fish stocks, fishery catches and gear selectivity in a number of priority fishing areas. Fishing vessels were chartered to fish commercially to obtain new data on the distribution, catch rate and size distribution of target species, and in some cases by-catch species. Nine primary projects were scheduled for 2004/5. The charter of suitable fishing vessels was arranged by the NFFO, and work plans were developed between NFFO, CEFAS and the vessel skippers. CEFAS deployed sea-going staff to record raw data that were subsequently returned to the laboratory at Lowestoft for input and analysis.

This report presents the results of FSP Programme 5, a survey of cod in the Bristol Channel and Celtic Sea carried out in spring 2005. The programme used the commercial twin-rig trawler FV Our Josie Grace (Ilfracombe) for 24 days between 5 February and 11 March 2005. The design of the western cod survey was arranged in collaboration with CEFAS and the skipper/owner of the vessel on 18 January, and the resultant work plan is given in Appendix 1.

Programme 5 repeated elements of an equivalent FSP programme carried out in Spring 2004 using FV Our Josie Grace in the Bristol Channel and eastern Celtic Sea (Cotter *et al.* 2004a). The spring 2005 FSP trip differed from the one in 2004 by including the western Celtic Sea to the southeast of Ireland.

The work plan involved trawling under dispensation from the quota regulations. Dispensations were also provided through the Foreign and Commonwealth Office for carrying out a survey in Irish waters.

1. Department of Environment, Food and Rural Affairs
2. Centre for Environment, Fisheries and Aquaculture Science
3. National Federation of Fishermen's Organisations

Objectives

The provisional key operational aims of Programme 5, as proposed by NFFO were to:

- Provide information on indicative catch rates
- Identify range/distribution of target species using commercial fishing gear
- Determine the age and recruitment structure
- Monitor discard levels
- Create time series data
- Compare results with previous survey and with current research vessel and ICES assessment of the stock

The final aims and survey design were developed in consultation with NFFO. The Work Programme for the surveys developed during these consultations is reproduced in Appendix 1. A consolidated cruise report prepared by the observers is reproduced in Appendix 2.

The consolidated aims are summarised below.

- To repeat a selection of trawl positions fished in 2004 to obtain information on the distribution of the target species, cod within ICES divisions VIIIf-g with particular emphasis on spawning cod distribution and abundance on the Trevose grounds.
- Extend survey into Irish waters to obtain further information on distribution of spawning / juvenile cod.
- To obtain data on indicative catch rates of the target species and other associated commercial fish.
- To quantify discards and retained catches at age of cod, haddock and whiting.
- To use data to build up a time series of information on species abundance and distribution in the area.

Methods

Vessels, gears and areas fished

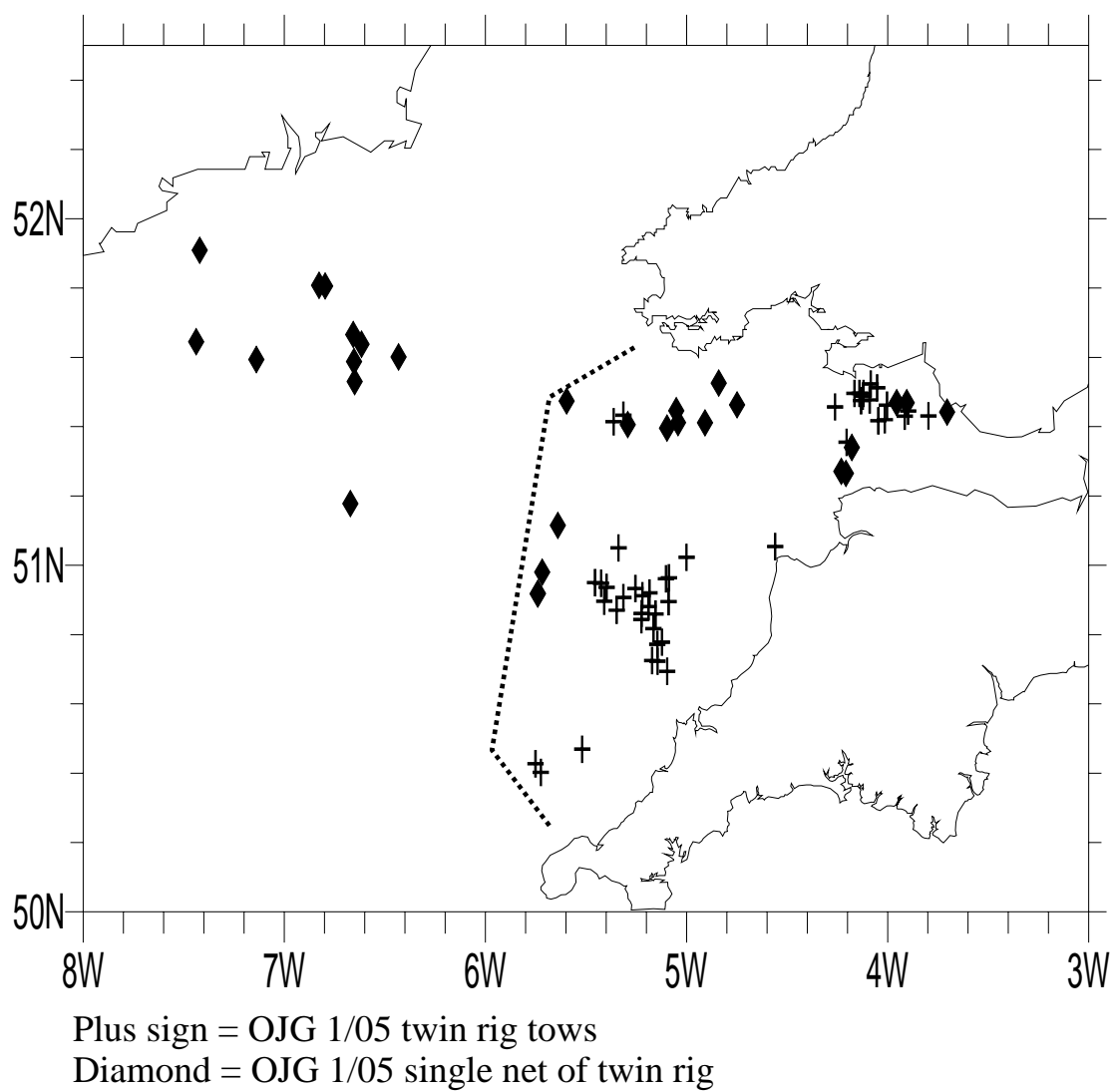
The FV Our Josie Grace (BD287) is a trawler of 14 m reg. length, gross tonnage 35, with a 221 kW engine.

The trawl used was a twin rig box trawl, maximum mesh size 150 mm, codend 85 mm single braided twine. Both nets were fitted with 12 to 14 inch rock hoppers. The trawl was fished with Bisons 7' 6" trawl doors. This was the same gear as used in the equivalent FSP survey in spring 2004 except that the starboard net then had 8 to 10 inch rock hoppers, i.e. smaller than those on the port net.

FV Our Josie Grace operated in the Bristol Channel and Celtic Sea (Divisions VIIIf, g) according to the work plan given in Appendix 1. The mid-points of the actual tows are shown in Figure 1.

In areas of strong tide, it was not possible to deploy the twin rig and the trawl gear was altered to fish one of the nets in a single-rig arrangement. The tows where single and twin rigs were deployed are indicated on Fig. 1.

Fig. 1. FSP 2005 Programme 5: Western Cod, spring 2005. Mid-tow positions.



Dotted line indicates western boundary of 2004 FSP cruise (see Appendix 1 for map of 2004 stations).

Table 1. FSP Programme 5: Western cod. Details of fishing activities. Note: “Single-rig demersal trawl” was one of the twin-rig nets fished as a single-rig.

Cruise code	Vessel	Dates in 2005	Stns	No. hauls	Fishing gear	Cod-end mesh mm	Tow duration hrs. Average; (range)
OJG 1/05	FV Our Josie Grace	6-8 Feb	1-10	10	Twin rig demersal trawl	85	3.8 (3.0 – 4.5)
OJG 1/05	FV Our Josie Grace	9 – 14 Feb	11-15	5	Twin rig demersal trawl	85	3.9 (2.5 – 4.5)
OJG 1/05	FV Our Josie Grace	15-18 Feb	16-25	10	Twin rig demersal trawl	85	4.1 (3.7- 4.5)
OJG 1/05	FV Our Josie Grace	19-20 Feb	26-30	5	Single-rig demersal trawl	85	4.05 (4.0-4.2)
OJG 1/05	FV Our Josie Grace	20-23 Feb	30-31 33-42	11	Twin rig demersal trawl	85	4.1 (3.5-4.8)
OJG 1/05	FV Our Josie Grace	23 Feb-2 Mar	43-59	17	Single-rig demersal trawl	85	4.0 (3.3-5.0)
OJG 1/05	FV Our Josie Grace	7-10 Mar	60-74	15	Twin rig demersal trawl	85	3.8 (2.0-4.25)
OJG 1/05	FV Our Josie Grace	10-11 Mar	75-78	4	Single-rig demersal trawl	85	3.8 (3.2-4.0)

Fishing and sampling methods

Sampling of all catches was carried out using standard methods employed by CEFAS. This entailed recording of the numbers and lengths of all the large or unusual fish that stand out from the rest of the catch, and sorting, counting and measuring a known fraction of the remaining catch of smaller fish. Numbers in the sample were then raised up to total numbers in the haul. The total catches of hauls 11-15, for which only one net of the twin trawl was sampled, were estimated by doubling the catch recorded for the net that was sampled. Data were recorded separately for fish discarded and retained for landing. Otoliths from samples of cod, haddock and whiting were taken to determine the age of the fish, and to allow the age composition of the catches to be calculated. Weighing facilities were not available on any of the vessels.

Data analysis

The number of cod, haddock, whiting and other species caught per hour of trawling per net, (i.e. standardised to one net of a twin-rig trawl as in the 2004 survey (Cotter et al, 2004)), was calculated for each tow and mapped to show the distribution pattern of each species.

The length structure of the catch was calculated as the number in each 1-cm length class per hour per net. Separate length frequency distributions were calculated for the area east of 6°W (to allow comparisons with the 2004 FSP trip) and the area west of 6°W.

Age compositions of cod were calculated for the eastern and western survey areas using separate age-length keys applied to the corresponding length frequency distributions. Haddock and whiting otoliths were collected almost entirely from the eastern region. The age composition for the western region was derived from the age-length-key for the eastern region applied to the mean length frequency for the west.

Results

Tow details

Details of position, date, time, tow duration, gear and cod-end mesh sizes, along with numbers of fish caught for nine commercial species are shown in Appendix 3 for all hauls made by the FV Our Josie Grace in spring 2005. Data for other species are available on the CEFAS database. Mid-tow positions are illustrated in Fig. 1.

Distribution patterns

Numbers caught per hour per net for cod, haddock, whiting and other commercial species are mapped in Figures 2 to 9, together with mean length in catch for some species.

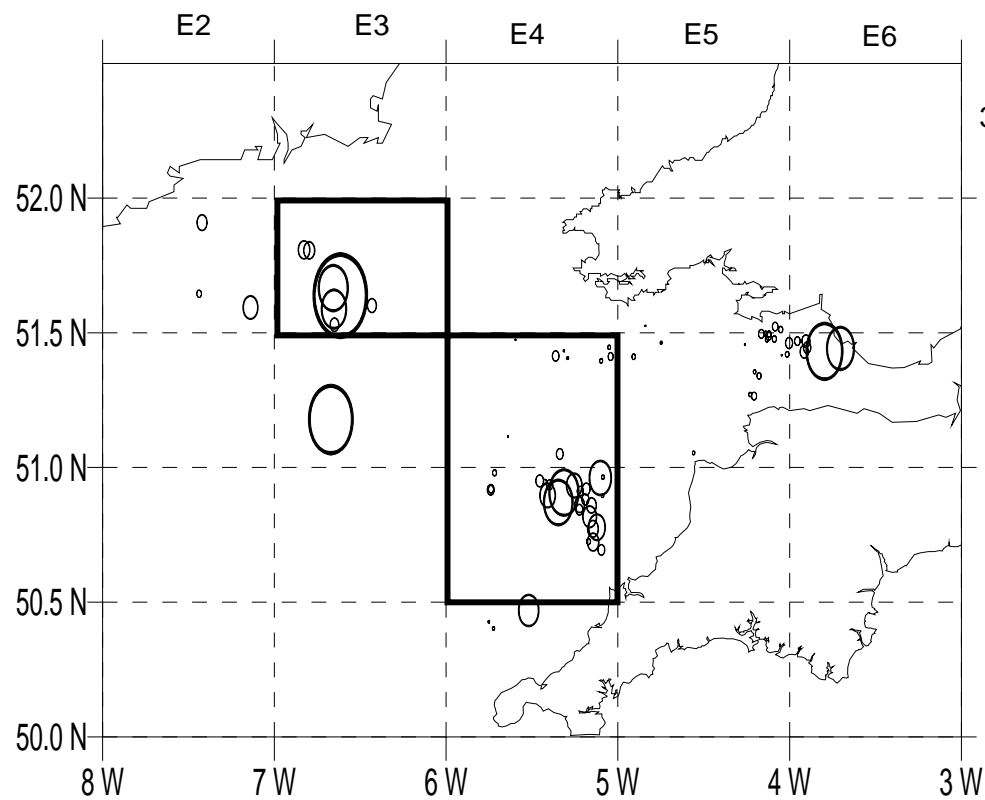
The largest catch rates of cod (Fig. 2a) in the eastern region were taken at the group of stations in ICES rectangle 30E4 off NW Cornwall and near Swansea Bay in the inner Bristol Channel. A similar distribution pattern was recorded in the 2004 survey. The highest catch rates of cod were taken at some stations in the central Celtic Sea (western region), an area not fished during the 2004 survey. Variations in mean length of cod in the catches showed that large cod occurred patchily throughout the east and western survey regions (Fig. 2b).

Catch rates of haddock (Fig. 3a) were generally larger than those of cod, and the areas with highest catch-rates of cod off NW Cornwall and in the western region also tended to have the highest catch rates of haddock. Few haddock were taken in the Bristol Channel. The mean length of haddock tended to be higher in the eastern than in the western region (Fig. 3b).

As with cod and haddock, high catch rates of whiting were recorded off NW Cornwall and at some stations in the western region. In contrast to haddock, whiting were also caught in the Bristol Channel near Swansea Bay.

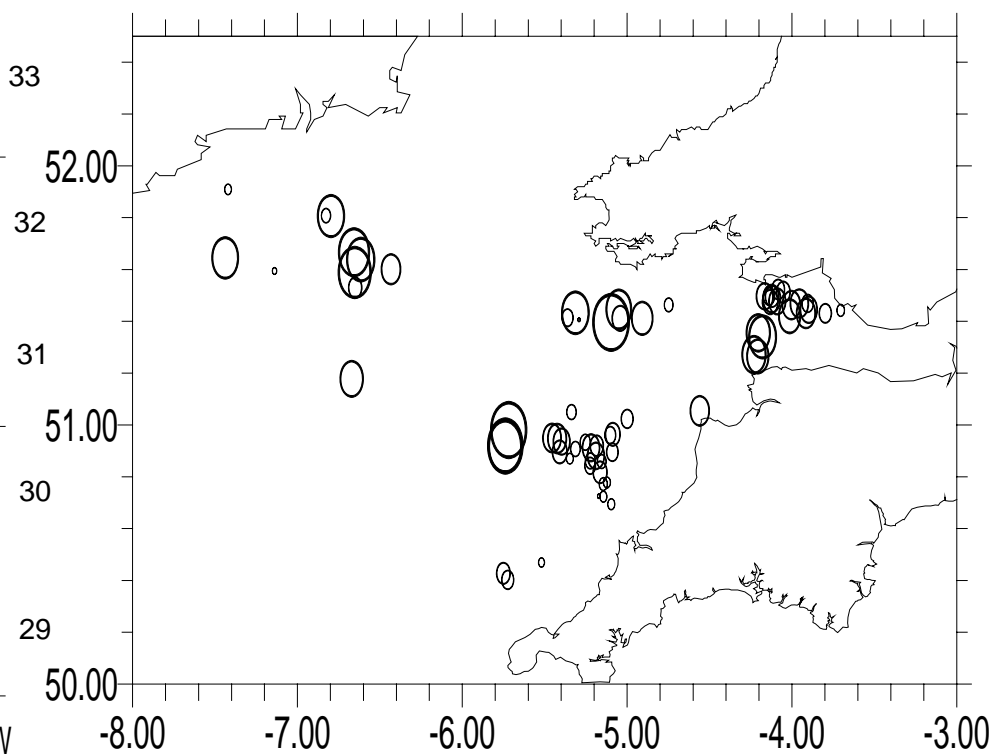
The distribution of plaice, lemon sole, monk, hake and sole during the survey is shown in Figures 5 – 9. Catch rates of these species were again high at the group of stations in 30E4 off NW Cornwall, indicating that this was an area of relatively high productivity for a wide range of demersal fish species.

Fig. 2a. Western cod FSP survey, spring 2005:
COD: Numbers caught per hour per net.
Rectangles closed to cod fishing in spring are indicated



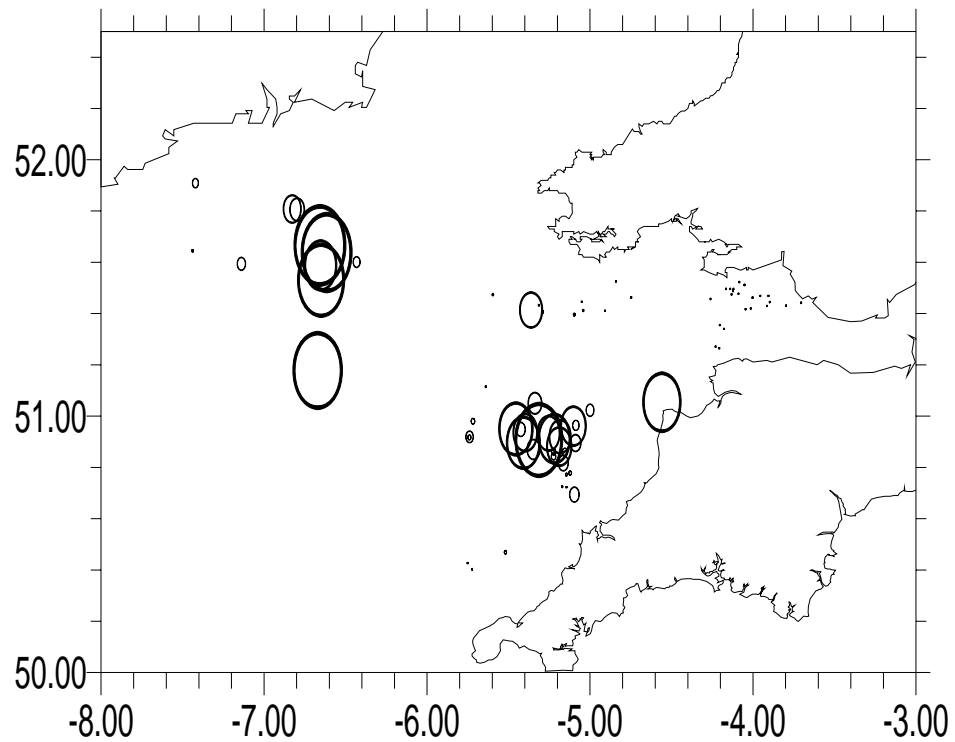
Circle = OJG 1/05 standardised to twin rig tows
 Scaling: Largest symbol = 12 fish per hour per net

Fig. 2b. Western cod FSP survey, spring 2005:
COD: Average length in catch



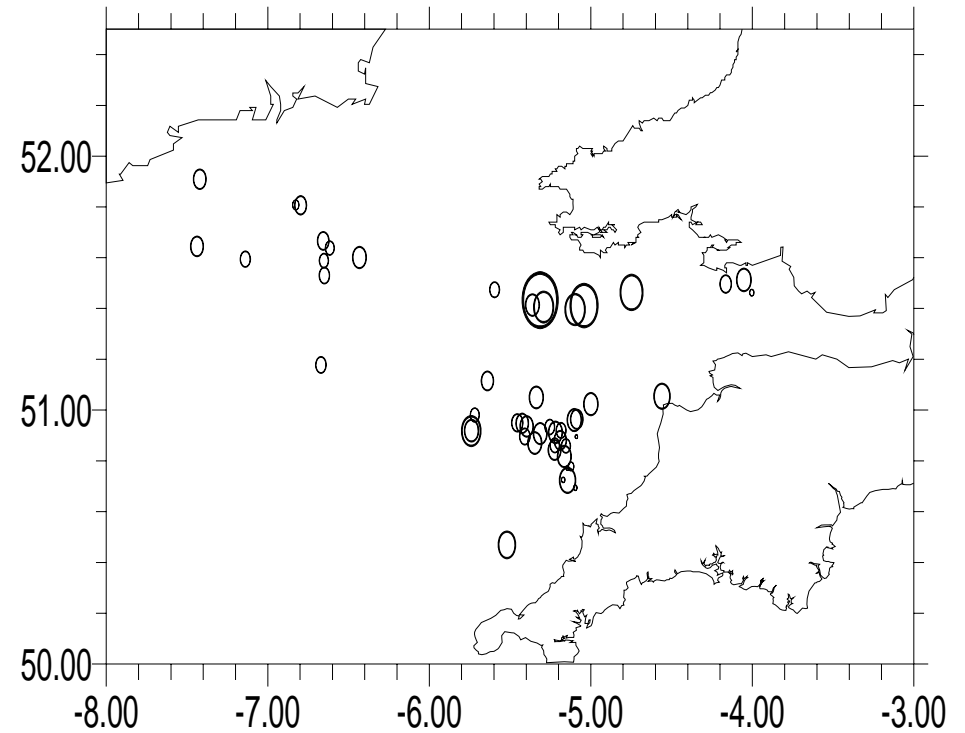
Circle = OJG 1/05
 Scaling: Smallest symbol = 27 cm
 Largest symbol = 90 cm

**Fig. 3a. Western cod FSP survey, spring 2005:
HADDOCK: Numbers caught per hour per net**



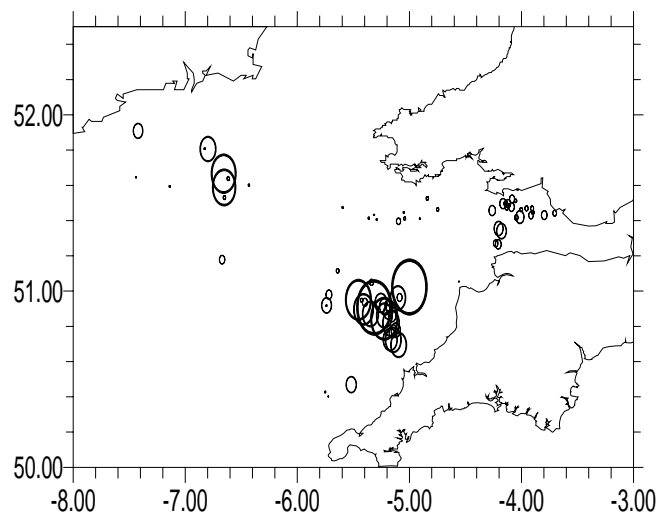
Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 90 fish per hour per net

**Fig. 3b. Western cod FSP survey, spring 2005:
HADDOCK: Average length in catch**



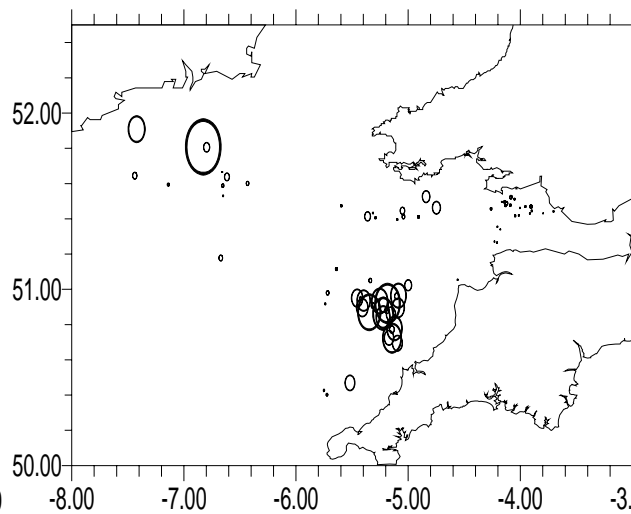
Circle = OJG 1/05
Scaling: Smallest symbol = 22 cm
Largest symbol = 64 cm

**Fig. 4. Western cod FSP survey, spring 2005:
WHITING: Numbers caught per hour per net**



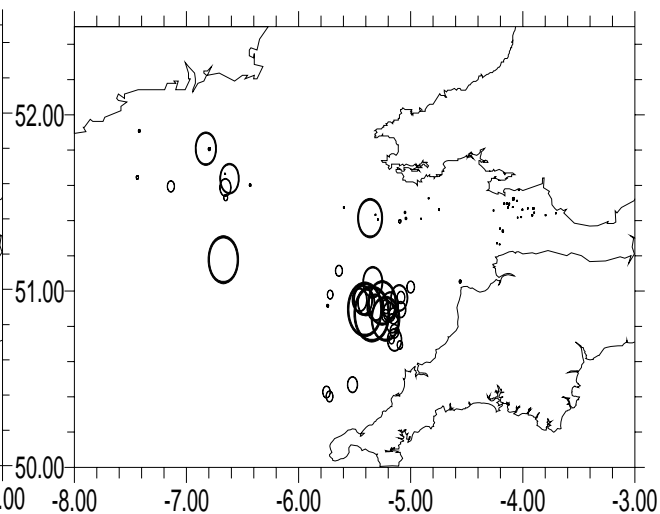
Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 124 fish per hour per net

**Fig. 5. Western cod FSP survey, spring 2005:
PLAICE: Numbers caught per hour per net**



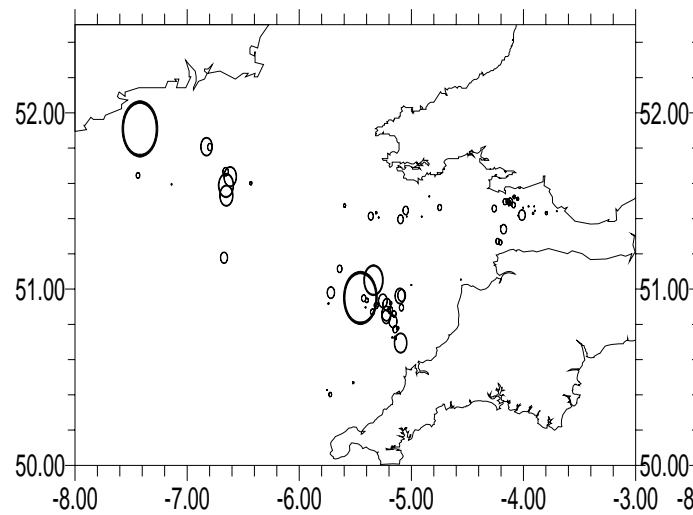
Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 39 fish per hour per net

**Fig. 6. Western cod FSP survey, spring 2005:
LEMON SOLE: Numbers caught per hour per net**



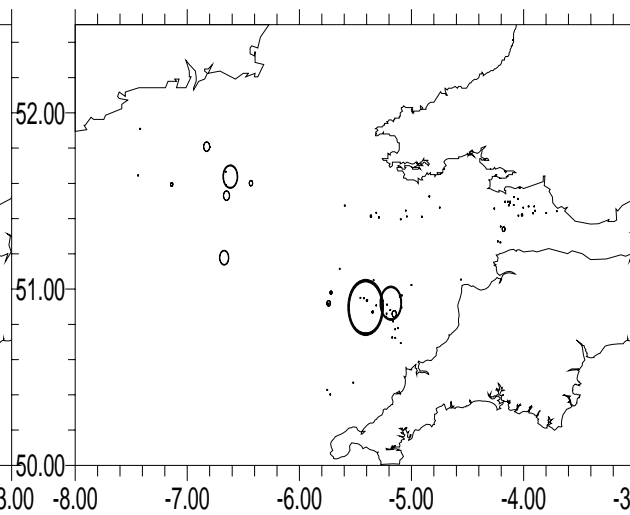
Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 65 fish per hour per net

**Fig. 7. Western cod FSP survey, spring 2005:
MONK: Numbers caught per hour per net**



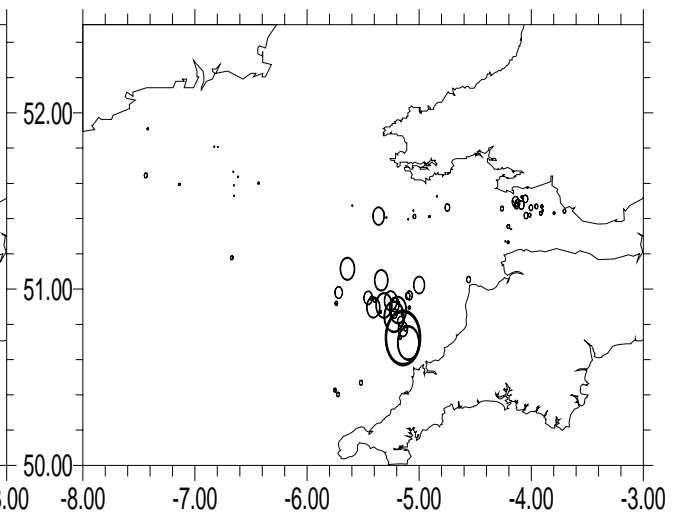
Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 5 fish per hour per net

**Fig. 8. Western cod FSP survey, spring 2005:
HAKE: Numbers caught per hour per net**



Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 6 fish per hour per net

**Fig. 9. Western cod FSP survey, spring 2005:
SOLE: Numbers caught per hour per net**



Circle = OJG 1/05 standardised to twin rig tows
Scaling: Largest symbol = 12 fish per hour per net

Length and age composition

Length frequency distributions for landed and discarded cod, whiting and haddock in the eastern and western regions are shown in Figures 10-12, together with the equivalent results for the stations in the eastern region in the spring 2004 survey (cruise OJG 1/04). The age compositions for the three species are also shown.

The mean length frequency of cod in the eastern and western areas (Fig. 10a,b) showed modes (peak frequencies) within the length ranges 15 –35 cm (mainly 1-year-olds), 35 – 65 cm (mainly 2-year-olds) and 65 –105 cm (3-year-old and older cod). Catch rates of cod in the 65cm+ length groups were higher, on average in the western region, and this is reflected in the higher catch rates of 3-year-old and older fish in the west (Fig. 10c). The majority of cod in the eastern region were 1&2 year olds whilst 3-year-olds and 5-year-olds were common in the west (Fig. 10c). The mean length frequency of cod taken in the eastern region in the spring 2004 FSP trip indicated lower catch rates of cod <35cm and higher catch rates of cod >65cm compared with the survey of the eastern region in 2005 (Fig. 10a). The catches in 2004 were dominated by 2-year-olds and 4-year-olds (Fig. 10c). Two-year-olds in 2004 (35-65 cm) tended to be larger, on average, than in 2005 (Fig. 10a).

Length frequencies of haddock are shown in Figures 11a&b. Based on the age readings in 2005, fish less than 25cm comprised mainly 1-year-olds, and fish in the length range 25-35 cm comprised mainly 2-year-olds. Haddock over 35 cm were mainly 3 years of age and older. The 25-35 cm group comprised a larger fraction of the fish in the western region than in the east in 2005, and this is reflected in a relatively greater incidence of 2-year-olds in the west than in the east (Fig. 11c). Three-year-olds of the 2002 year-class were predominant in catches in both areas. The 2004 FSP trip yielded high catch rates of haddock in the length range 25-35 cm (Fig. 11a). These are likely to be mainly 2-year-olds, reflecting recent ICES assessments showing a very strong 2002 year-class of haddock in the Celtic Sea. Catch rates of haddock older than 4 years of age were very low in 2005.

Whiting exhibit a considerable overlap in the length distributions for different age groups, and this resulted in an overall length distribution with no clear modes (Figs 12a,b). Whiting less than 25 cm long were mainly one-year-olds, but were poorly represented in the catches. This probably reflects the selectivity characteristics of the 85mm mesh trawl net. A broad range of age classes of whiting was present in both the eastern and western region, with fish being relatively abundant up to six years of age (Fig. 12 c). Very few whiting otoliths were collected in the western region, and the age composition for the west was derived by applying the age-length-key for the eastern region to the mean length frequency for the west.

Patterns of discarding

Discarding of cod was mainly fish below MLS (35cm) (Figs 10a,b). Discarding of haddock took place up to 44cm, well above the MLS of 30cm (Figs 11a,b). Almost all whiting were discarded, and only the largest fish, caught in very small numbers, were retained (Figs 12a,b). It is not clear if these patterns are representative of the fleet, as the FSP vessel was fishing outside of quotas.

FSP survey indices by age class

The mean catch-rate (numbers per hour per net) was calculated for each age class of cod, haddock and whiting in the eastern and western region. The areas are kept separate as the

2004 survey covered only the eastern region. The indices are given in Table 2, and are plotted in the bottom panels of Figures 10-12. The overall catch rates of cod and haddock were higher in the western than in the eastern region partially as a result of the more extensive sampled areas with low catch rates in the east.

Table 2. Indices of abundance of cod, haddock and whiting, by age class, for FSP surveys in 2005 (cod, haddock and whiting) and 2004 (cod only). Indices are mean numbers caught per hour per net and are given separately for the eastern and western areas.

(a) Cod: 2005 FSP

age		1	2	3	4	5	6	7+	total
East of 6 ⁰ W	Nos/h/net	0.446	0.914	0.111	0.023	0.063	0.009	0.004	1.6
	%	28.4	58.2	7.1	1.5	4.0	0.6	0.3	100
West of 6 ⁰ W	Nos/h/net	0.90	0.97	0.87	0.35	1.15	0.26	0.02	4.5
	%	19.9	21.4	19.3	7.8	25.4	5.7	0.5	100

(b) Cod: 2004 FSP

age		1	2	3	4	5	6	7+	total
East of 6 ⁰ W	Nos/h/net	0.115	0.690	0.171	0.597	0.097	0.022	0.000	1.69
	%	6.8	40.8	10.1	35.3	5.7	1.3	0.0	100

(c) Haddock: 2005 FSP

age		1	2	3	4	5	6	7+	total
East of 6 ⁰ W	Nos/h/net	1.95	2.30	6.49	0.94	0.13	0.09	0.00	11.9
	%	16.4	19.4	54.6	7.9	1.1	0.7	0.0	100
West of 6 ⁰ W	Nos/h/net	9.47	13.26	18.69	2.61	0.35	0.23	0.00	44.6
	%	21.2	29.7	41.9	5.8	0.8	0.5	0.0	100

(d) Whiting: 2005 FSP

age		1	2	3	4	5	6	7+	total
East of 6 ⁰ W	Nos/h/net	1.34	5.68	4.89	6.37	3.73	3.40	0.38	25.8
	%	5.2	22.0	19.0	24.7	14.5	13.2	1.5	100
West of 6 ⁰ W	Nos/h/net	0.38	3.16	5.22	6.98	5.27	5.24	0.51	26.8
	%	1.4	11.8	19.5	26.1	19.7	19.6	1.9	100

Figure 10. Western cod FSP survey, spring 2005: COD (a) Length frequency distribution of catch and discards east of 6 deg W; also of catch from 2004 FSP (OJG 1/04) for comparison; (b) LFD West of 6 deg. W; (c) Age frequency distribution, both areas, plus OJG 1/04 age compositions (eastern area).

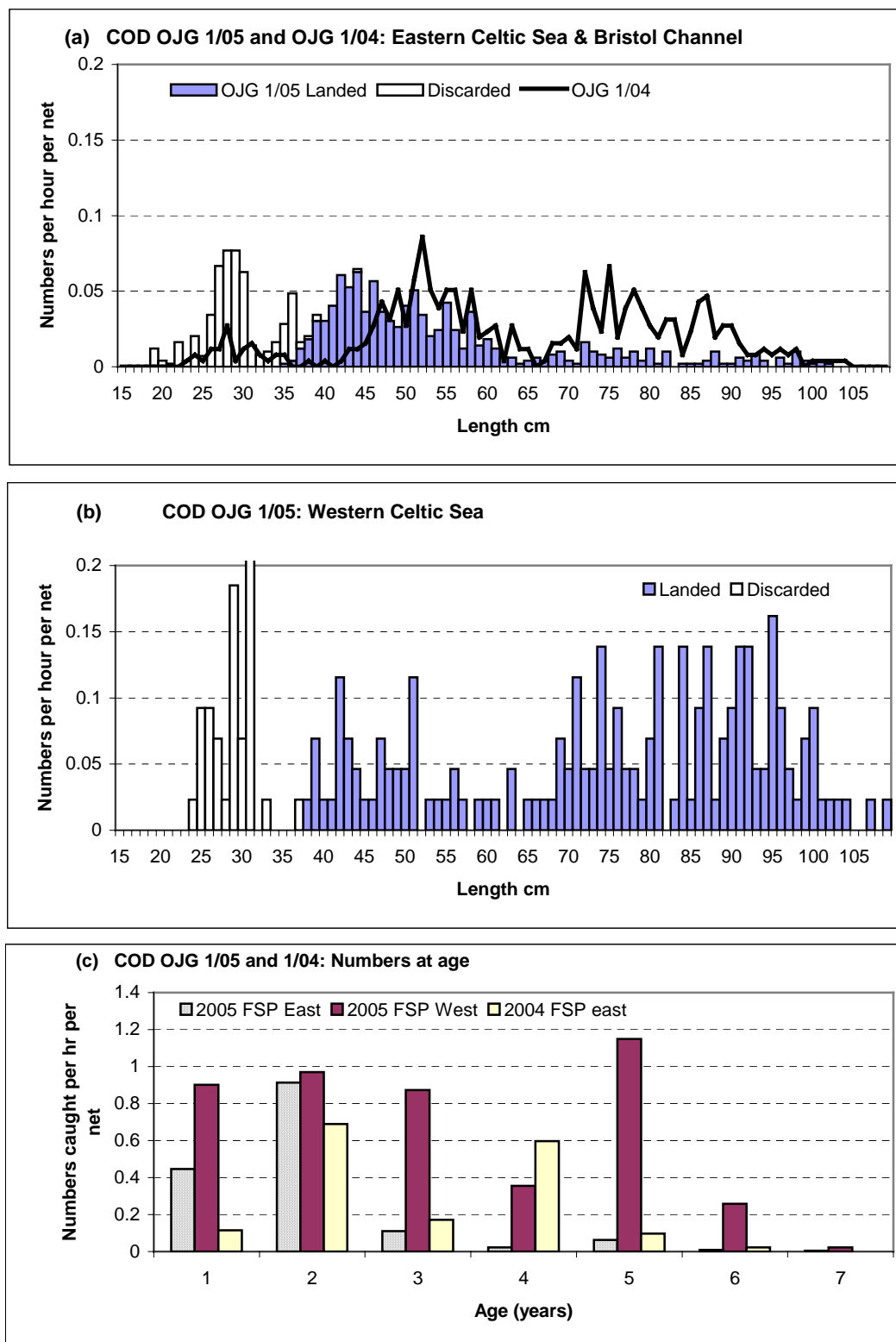


Figure 11. Western cod FSP survey, spring 2005: HADDOCK (a) Length frequency distribution of catch and discards east of 6 deg W; also of catch from OJG 1/04 for comparison; (b) LFD West of 6 deg. W; (c) Age frequency distribution, both areas.

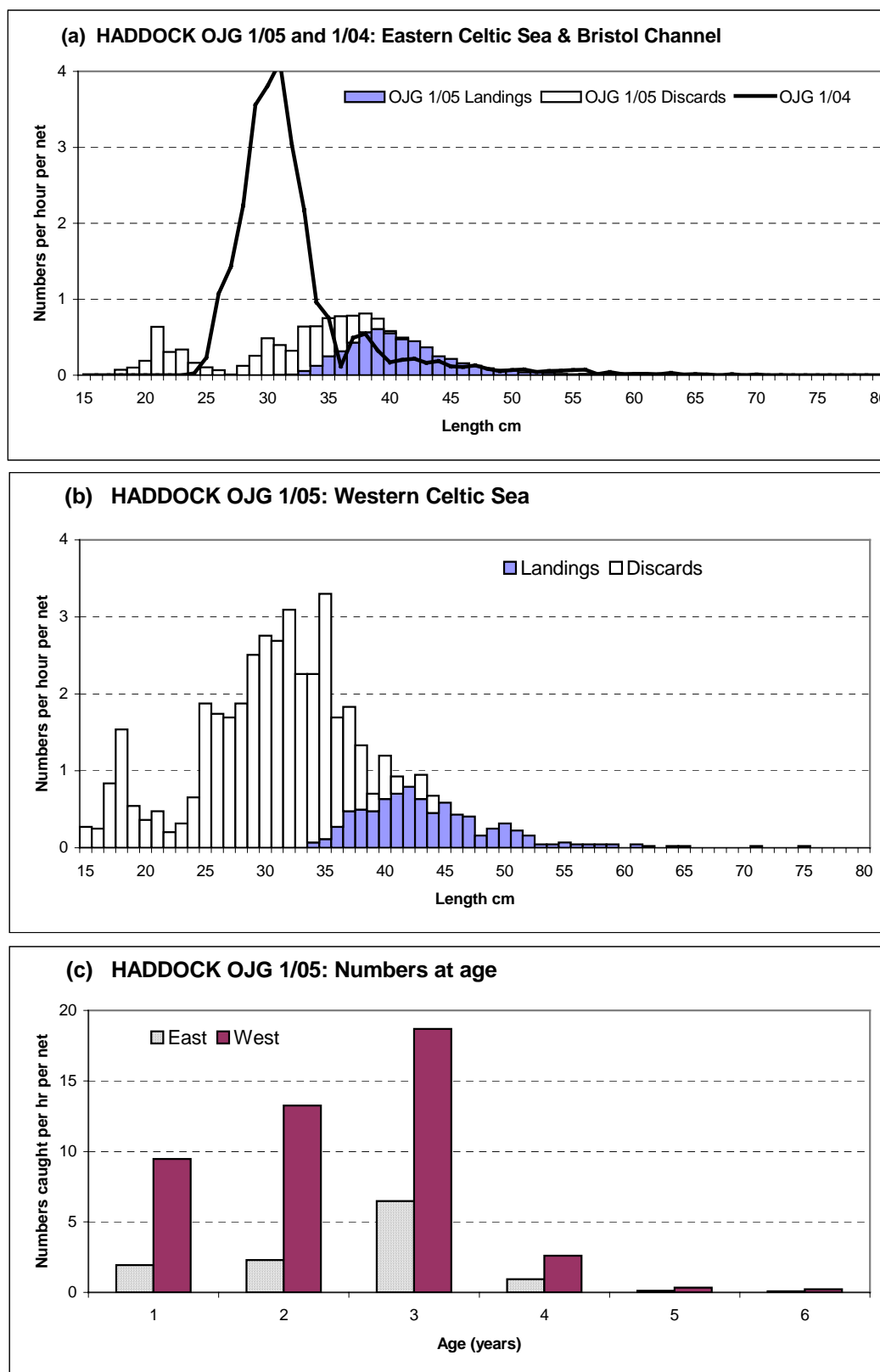
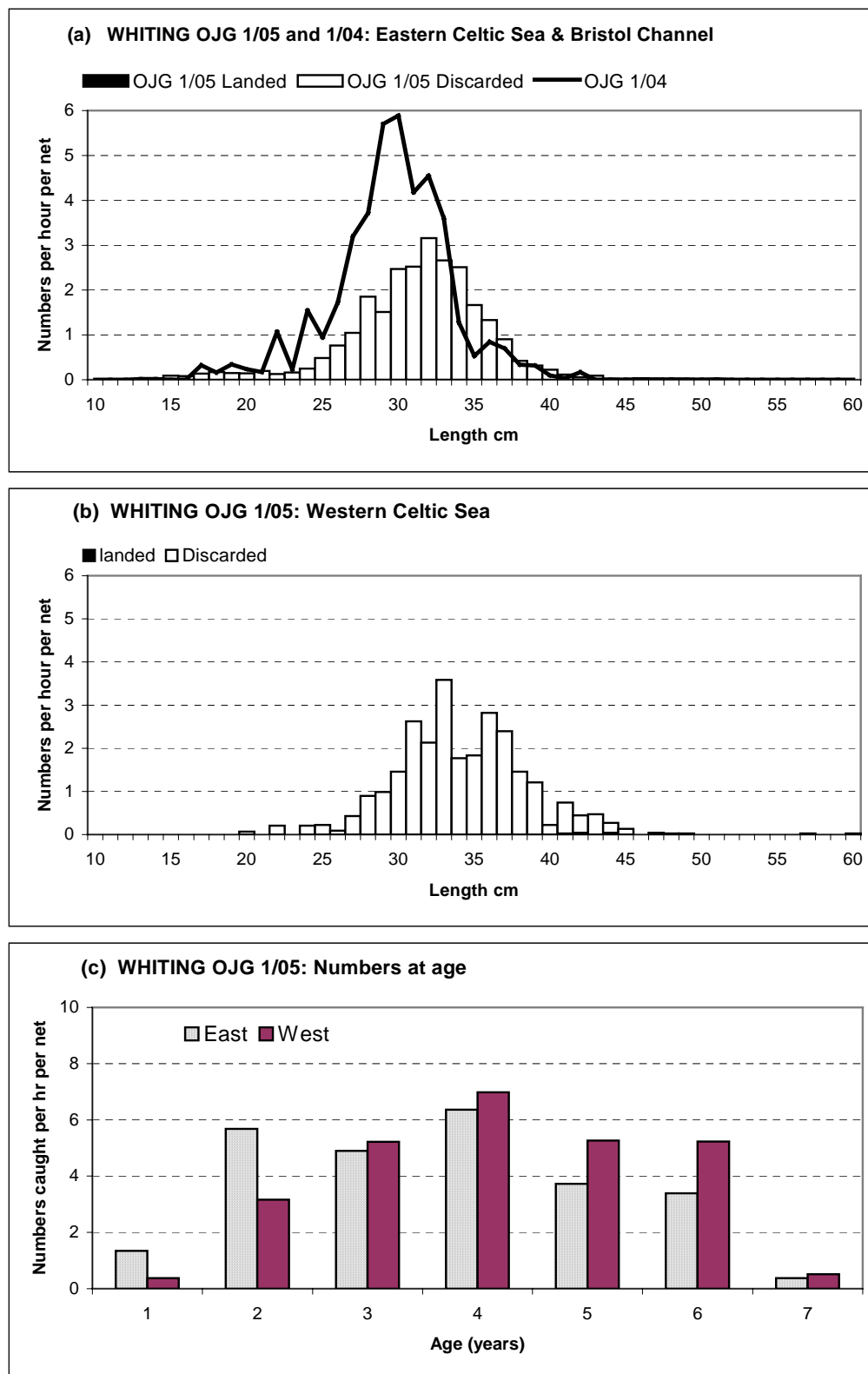


Figure 12. Western cod FSP survey, spring 2005: WHITING (a) Length frequency distribution of catch and discards east of 6 deg W; also of catch from OJG 1/04 for comparison; (b) LFD West of 6 deg. W; (c) Age frequency distribution, both areas.



Discussion and Recommendations

Comparison with ICES assessments

The most recent ICES assessments and forecasts for Celtic Sea cod, haddock and whiting were carried out by the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks at its meeting in 2004 (ICES, 2005). The Working Group carried out assessments based on commercial fishery catches and research surveys. The assessments give population numbers at the start of 2004, and these are also projected through to 2005 with assumptions concerning fishing mortality in 2004 and recent recruitment. For cod, the percentage age compositions in the FSP trips in 2004 and 2005 can be compared with the ICES forecasts for the fishery in 2004 and 2005. The age compositions of 2-year-old and older cod from FSP tows in the eastern region are very similar to the ICES forecasts (Fig. 13a). (One-year-olds are excluded as they are mainly caught at the end of the year.) This provides confirmation of the ICES assessment of the relative strengths of year-classes of cod contributing to the fishery catches at present. The ICES results for 2005 are more similar to the FSP age compositions in the east than in the west.

The 2004 FSP trip yielded high catch rates of haddock in the length range 25-35 cm, reflecting ICES assessments showing a very strong 2002 year-class. The most recent ICES forecast indicates a continued dominance by 2002 year-class fish as 3-year-olds in 2005. This is also evident in the FSP results for 2005 although the relative abundance of younger haddock was higher in the FSP trips than in the ICES forecast (Fig. 13b). This may reflect an absence of discards estimates in the ICES assessment, which will result in fewer 2-year-olds in the landings than in the total catch.

Comparison of FSP results for whiting with the most recent ICES forecast is particularly difficult because the ICES assessment does not include discards, and relatively large numbers of whiting are discarded in fisheries using mesh size less than 100mm. However, both the FSP results and the ICES forecast for landings in 2005 indicate a relatively broad age composition although with a higher incidence of 2-3 year olds in the ICES forecast than indicated by the FSP catches.

Evaluation of the FSP surveys

The close correspondence of FSP age compositions with ICES catch forecasts for 2004 and 2005 suggests that the FSP survey is potentially capable of providing useful time-series data, if continued in a standardised manner.

The distribution of tows during the 2004 and 2005 FSP trips was far more clumped than would be the case with a research vessel survey, reflecting the distribution of known fishing grounds. If the surveys were to be continued with this design to provide time-series data, a more sophisticated analysis of the data would be required to avoid the results being affected by changes in numbers of tows in each area from one year to the next. This would involve defining finer-scale survey strata corresponding to known fishing grounds and other areas with typically different catch-rates and species compositions, and making separate abundance indices for each. The area-based indices would then need to be combined in some objective manner.

The presence of only one observer imposed limitations on the extent to which individual catches could be sorted and measured. This resulted in only one net of the twin rig being

sorted in some circumstances, and catches of the smaller, more abundant species being sub-sampled. Catches of the main target species, cod, are likely to be estimated with good precision due to the relatively small numbers in the catch resulting in a large fraction of the cod being recorded and measured.

The 2005 survey was more informative about stocks of roundfish in the Celtic Sea than the survey in 2004 because of the extension westwards into the Celtic Sea. It is not clear if the greater correspondence between ICES forecasts and FSP data for the eastern region compared with the west reflects the more comprehensive sampling in the east, or an insufficient coverage of the cod population in the west. Whilst the extension to the western Celtic Sea would be sensible in any future surveys if the aim is to provide information on cod over as much of the Celtic Sea stock as possible, better coverage of the spawning population off SE Ireland may be needed. Although spawning areas for cod occur off the NW coast of Cornwall and off SE Ireland (Brander, 1994), the extent to which the cod in these can be considered as separate stocks is not clear.

The use of 85 mm mesh cod-ends led to high discarding of many species in this FSP programme. Although the use of 100 mm cod-ends would have reduced discarding during the survey with minimal impact on survey indices for 2-year-old and older cod, data for whiting and the younger age-classes of haddock would have been reduced.

Swapping between single-rig and twin-rig nets according to tidal state occurred during both the 2004 and 2005 FSP trips. As it is not known if a net fished as a single rig would have the same catch rate as the same net fished in a twin rig, there is a potential additional source of variation in the survey indices due to the net swapping. From a scientific perspective, the use of a single-rig throughout would have resulted in more manageable catches for sampling and a possibly greater consistency of catch rates (nos. per hour per net) between tows. The volume of discards would also have been smaller.

Timing and location of the survey in relation to cod spawning

Important spawning grounds for Celtic Sea cod are located off NW Cornwall and SE Ireland (Brander, 1994). Cod spawning in these regions could potentially disperse widely after spawning, and cod from adjacent stocks may mix to some extent with Celtic Sea cod outside the spawning season. Hence, the FSP programme should ideally be timed to coincide with the period in the spawning season when the bulk of the NW Cornwall spawning population is present in the survey area. The survey, which took place from 5 February to 11 March in 2005, probably coincided with the first half of the spawning season for cod off NW Cornwall. Egg surveys carried out by CEFAS in 1990 (un-published data) showed that spawning was well underway by mid March and extended into early April (Fig. 14). The skipper of *Our Josie Grace* considered the FSP survey to be early (Appendix 2), implying that cod catches were expected to improve as spawning progressed.

Most spawning in 1990 was in ICES rectangles 30E4 and 31E4, coinciding with the area of highest catch-rates of adult cod in the 2004 and 2005 FSP trips. These two rectangles, together with 32E3, have been closed to cod fishing during spring since 2005. Adult cod taken in the western Celtic Sea region were in the process of spawning, showing that spawning grounds extend well into the Celtic Sea. The presence of fixed nets off SE Ireland prevented fishing over a larger area of the spawning grounds in the west.

Acknowledgements

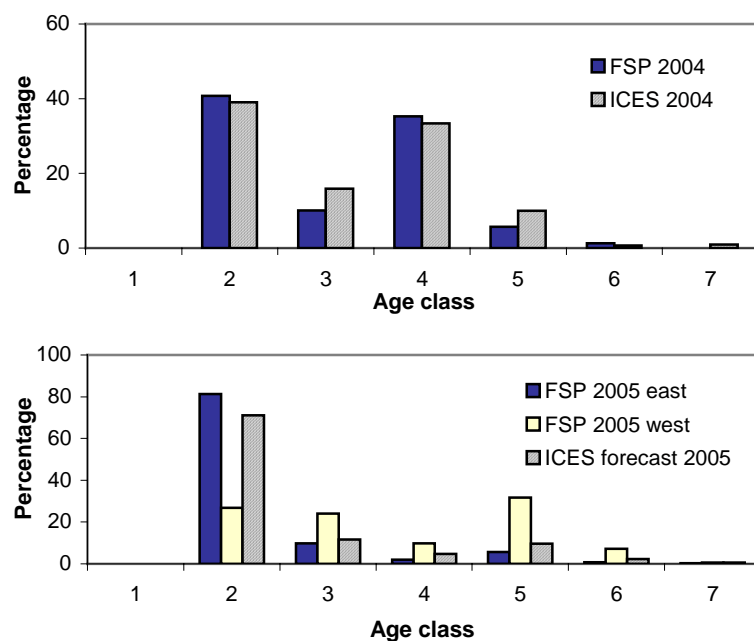
The skippers and crew of the FV Our Josie Grace are warmly thanked for making their vessels available for charter during this FSP programme, and for their willing cooperation during the trips. Staff at CEFAS involved in data capture and processing of otoliths are thanked for their valued contribution. The FSP programme was funded by Defra.

References

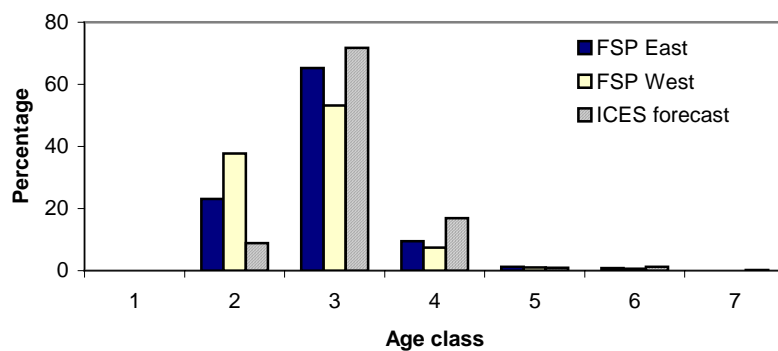
- Brander, K.M. 1994. The location and timing of cod spawning around the British Isles. ICES Journal of Marine Science, Vol. 51. No.1, February 1994, pp.71-89.
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- ICES. 2005. Report of the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks. ICES CM 2005/ACFM:07

Fig. 13. Comparison of the percentage age composition of cod, haddock and whiting given for 2004 and 2005 by the most recent ICES catch forecasts (ICES, 2005), with the age compositions recorded during FSP trips in 2004 and 2005. One-year-olds are excluded as they are mostly caught at the end of the year.

(a) COD



(b) HADDOCK



(c) WHITING

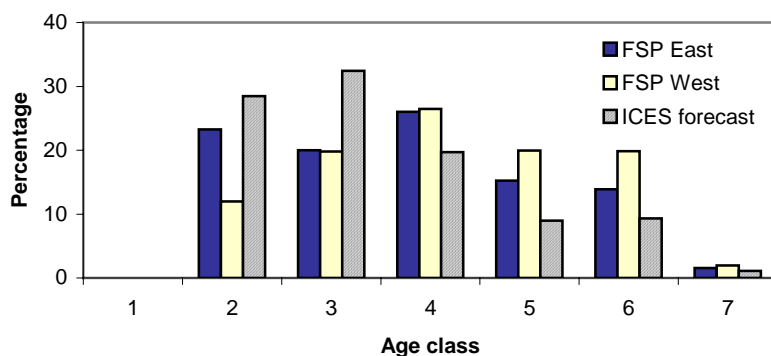
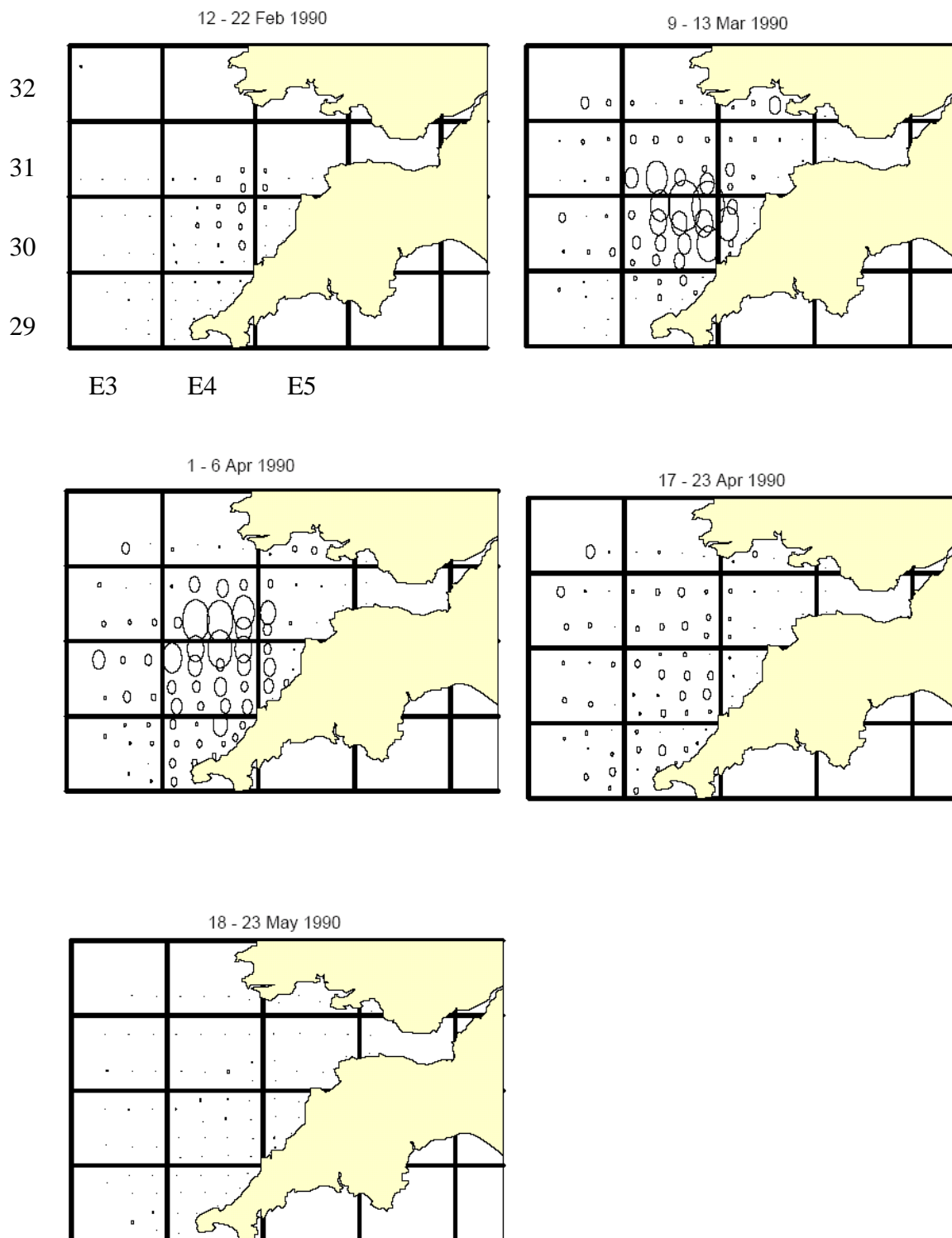


Figure. 14. Distribution of early-stage cod eggs (1.3mm diameter and above) during spring 1990, from sampling by CEFAS (unpublished data).

Distribution of cod eggs (eggs > 1.3mm) in the Bristol Channel in 1990



Appendix 1

FISHERIES SCIENCE PARTNERSHIP 2004 PROGRAMME 5: Western Cod

Cruise Programme

Vessel: Our Josie Grace

Duration:- commence 5th February 2005 for 24 days made up of a number of trips of varying duration.

Area: Bristol Channel and Celtic Sea (ICES Divisions 107f-g)

Gear: Twin rigged demersal trawl with 85 mm cod end mesh and rock-hopper ground gear.

Staff:- Natasha Bunn (Pt1 until 18th February)
Steve Shaw (pt2 18th February until completion)

Aims:-

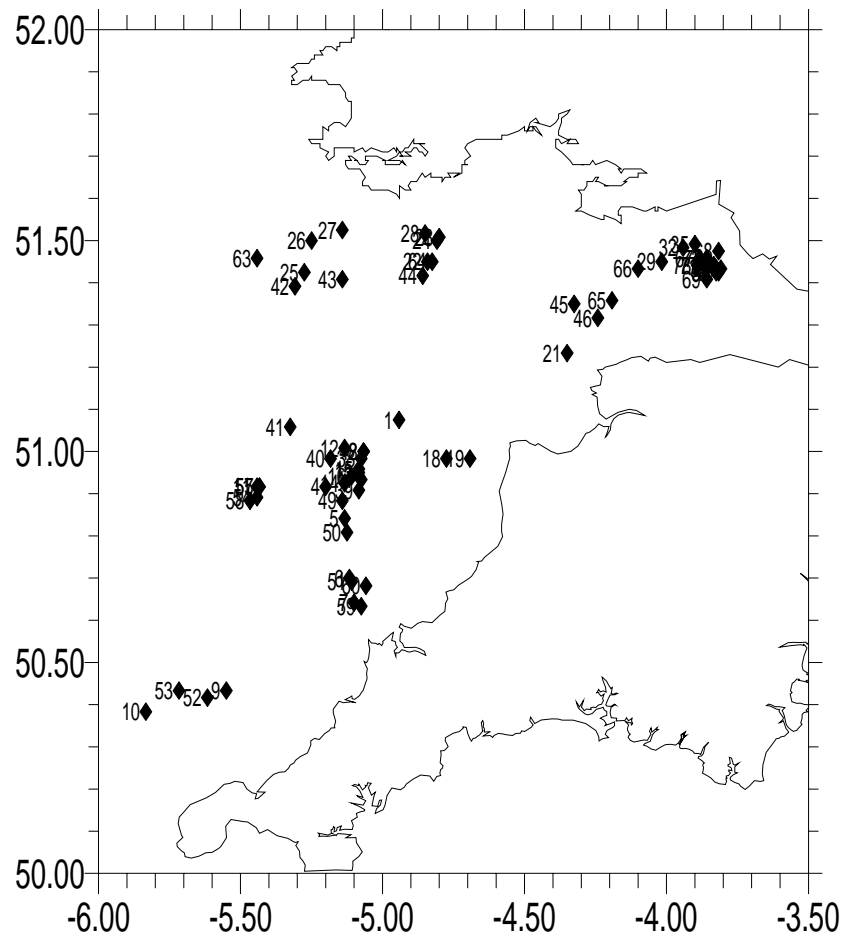
- To repeat a selection of stations which were fished on the 2004 survey to be agreed with Skipper and to increase the geographical range of the survey into Irish waters at locations obtained by the Skipper (see Figs 1&2).
- To obtain information on indicative catch and discard rates.
- To obtain biological data from the retained and discarded catches.

Methods

- Tows should be of commercial length (3 to 4 hours). Longer tows can be carried out at night to enable a reasonable period of continuous sleep for the scientific staff.
- Quantify catches of retained and discarded fish at each location.
- Record gear details and parameters at each location.
- Measure main commercial species from the retained and discarded catches in particular cod, haddock and whiting.
- Measure other species as time permits or as a minimum record of number of individuals either from total catch or from a measured sub-sample of both discards and retained.
- Sort a minimum of 1 basket of discarded fish to obtain catch composition details, and record the raising factor to estimate total discards.
- Collect otoliths throughout the length range for cod, haddock and whiting. A minimum of 200 cod and 100 each of haddock and whiting are required for the trip. The date species, length and station number are the minimum requirement for otolith packets. Sex and maturity should be recorded whenever possible.
- Record data on sheets provide in NFFO folder in conjunction with skipper.
- Record lengths and raising factors on measurement sheets
- All data should be input into FSS on the laptop provided either between stations or at a time convenient to the scientific staff. Training will be given prior to the cruise.

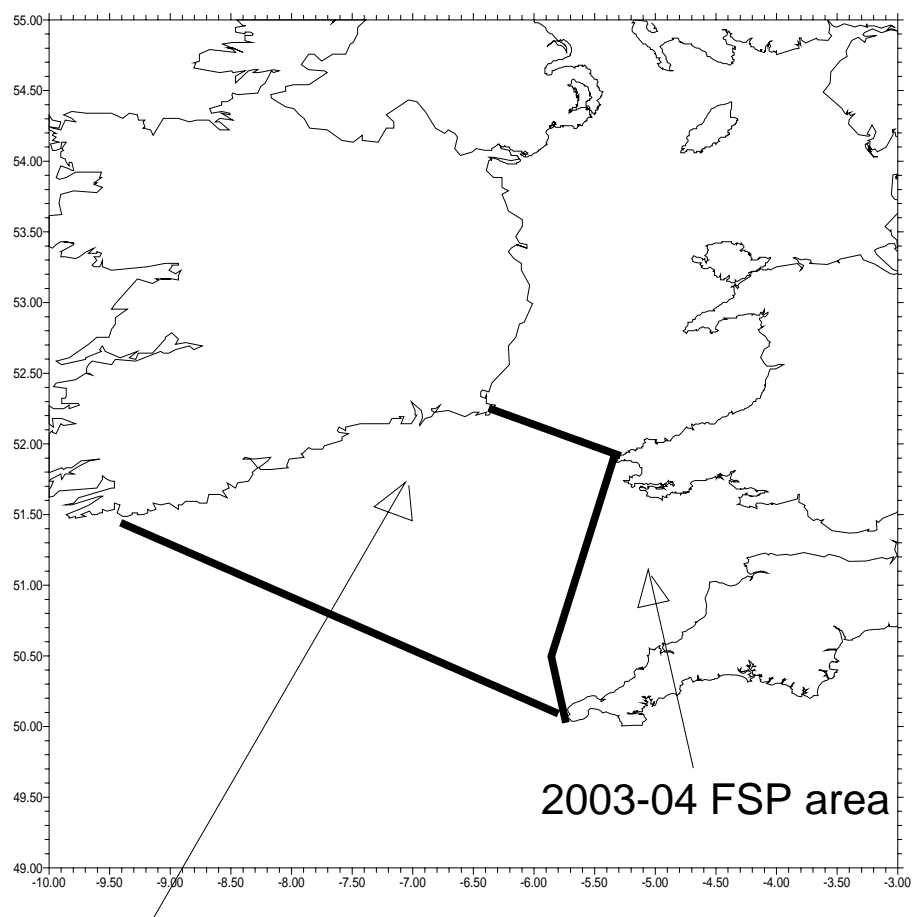
John Dann 25th January 2005

Fig. 1.
E Celtic Sea FSP trawl survey, spring 2004:
Station positions



Diamond = OJG 1/04

Fig. 2. Boundaries for Feb/March 2005 FSP. Coverage will include the north Cornwall cod spawning grounds and Bristol Channel as in 2004, and additional coverage of the cod spawning and fishing grounds off SE Ireland.



Area for additional stations
in Feb/March 2005, particularly
towards Irish Coast.

Appendix 2. Consolidated cruise report by observers (text only).

THE CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE,

LOWESTOFT LABORATORY, SUFFOLK, NR33 0HT, ENGLAND

FISHERIES SCIENCE PARTNERSHIP 2004 PROGRAMME 5: Western cod (Bristol Channel and Celtic Sea)

Cruise Report

Vessel: FV Our Josie Grace

Duration:- 5 February - 12 March 2005.

Area: Bristol Channel and Celtic Sea (Divisions VIIIf, g)

Gear: Demersal twin-rig trawl

Staff:- N. Bunn (CEFAS) (5 Feb – 18 Feb)
S. Shaw (CEFAS) (19 Feb – 11 Mar)

Aims:-

- To repeat a selection of stations which were fished on the 2004 survey to be agreed with Skipper and to increase the geographical range of the survey into Irish waters at locations obtained by the Skipper (see Figs 1&2 of Appendix 1).
- To obtain information on indicative catch and discard rates.
- To obtain biological data from the retained and discarded catches.

Narative

Part 1 5th – 9th February 5 days

NB joined the vessel and sailed from Ilfracombe at 16:00 on the 5th with skipper Marcus White in charge and steamed over night to grounds West to South West of Lundy (50 mile steam). 4 hauls were completed on the 6th in areas around Lundy and the “Tanker”. 30 Cod were retained and 2 discarded with most below 50cm in length. Large hauls of Haddock were also recorded in these tows (Retained 114, 87, 213, 170 Discarded 40, 30, 95, 174 respectively). The next 3 hauls were fished W-SW of Trevoise with different length of warp shot for each tow. French Trawlers and Beam trawlers were in the area. 22 Cod were caught in the first tow with 7 discarded. Lots of Whiting were caught (312) with all being discarded because of the very poor market value in North Devon. This is the same for Haddock; only large fish are retained because small fish make very poor money on the market. Lesser Spotted Dogfish, Bull Huss, Smooth Hounds and Gurnards are all kept for pot bait because they fetch a good price due to shellfish potting (Mainly Whelks at this time of year).

Hauls 5 to 7 were good for Lemon soles but had very few Cods, haul 7 was cut short because the net became fast. After these poor hauls the Skipper decided to steam back to

ground around Padstow. Haul 8 and 9 were towed on the North West Padstow ground, catching good quantities of Haddock and Whiting. 41 Cod were retained from these hauls and 1 discarded. The boat then moved to the ground called "G's + G's" where 522 Haddock and 3 Cod were retained and no discards were measured. All the hauls above were fished with a Twin rig consisting of two Box Trawls with 86mm single braid Cod ends and were spread by 500kg Bison doors. The final two hauls of this trip were fished with just one of the nets from the twin rig as the boat steamed into the Bristol Channel where there is more tidal flow. The last two hauls were towed North of Ilfracombe and only caught 4 Cod and discarded 84 and 56 Whiting respectively. The Boat then sailed into Ilfracombe where it docked at 18:00 on the 9th. The majority of Fish landed were Rays (Blond, Spotted, Thornback and Painted) and Lesser Spotted Dogfish.

Otoliths Collected

- Cod 57
- Haddock 29
- Whiting 26

Part 2 14th – 18th February 5 days

NB spent 4 days in Ilfracombe due to strong South Westerly gales. She then sailed at 09:00 on the 14th with Marcus White acting as Skipper. The Boat steamed for half a day until it reached ground called "Scar weather Bank" where the first three tows were fished with a single net. The Catches for these tows were low with mainly Rays being retained and Whiting being discarded. 18 Cod were retained while 18 were also discarded. The boat then moved ground to work just South of Wales. The fourth tow (haul 16) used the twin rig but the skipper realised the middle warp had slipped during the tow and so the gear was not fished square. Mostly Rays and Whiting were caught and only 4 Cod were retained and 1 discarded. The next 4 tows were fished with Twin rig gear on the same ground and the main catch was Rays and Whiting, very few Cod were caught.

On the 16th the refrigeration unit in the fish room broke down, this forced the skipper to decide to sail into Milford Haven at 10:00am to get it repaired, the boat departed the harbour at 14:00 the same day to resume fishing West of Lundy. 4 hauls were towed on this ground with the main species caught being Haddock and Whiting. In the last two hauls on this ground 13 and 19 Cod were retained, 1 and 10 were discarded. For the final haul of the trip the boat steamed to ground just South of Milford Haven. This haul only caught 1 Cod; the main species caught were Rays and Lesser Spotted Dogfish. The Skipper had the view that the poor Cod fishing was due to it being too early in the year but had been hearing from Irish Skippers that they have started to see more Cod to the West. The boat arrived and landed in Milford Haven at 10:00 on the 18th.

Otoliths collected

- Cod 76
- Haddock 28
- Whiting 19

Part 3 19th – 23rd February 5 days

SS travelled down to Milford Haven to take over from NB. SS arrived at 18:00 and sailed with the boat at 06:30 on the 19th with Marcus White acting as skipper. Poor weather delayed the first tow until 10:30 but if the boat had not sailed on the morning tide it could not sail for another 12 hours. The first 5 tows of this trip (haul 26 to 30) were fished with a single net due to rough grounds and large tides. The first two hauls were towed South of Milford

and then moved onto “SW Bricks”, “Man ‘o’ Beer” and “Roundabout”. These five hauls were very good for Rays and Dogfish but were very poor for Cod only 9 were caught.

For the rest of the trip except for the last haul the twin rig was used. Haul 31 was fished South of Wales and mainly caught Whiting and Rays. Haul 32 became fast after being in the water for 10 minutes so there was very few fish so this haul was not sampled. The next tow was on the “23 Line” and again was good for Rays and Whiting and only 6 Cod were caught. The next 4 hauls (34 – 37) were fished on the “Scar” ground or near. These hauls were a bit more successful for Cod with 97 caught between the tows, the other main species caught were Whiting and again they were all discarded due to poor prices on the market. The following four hauls (38 – 41) were fished South of Wales close to land to get lea of the shore because the wind had freshened. Ray and Whiting were again the majority of the catch and only 25 Cod were caught during these 4 tows.

The final 2 tows were carried out in the “Box” Mid Channel (final tow with single net). Very few Cod were caught but on haul 42, 26 Spurdogs were caught. The last haul was very poor. The skipper decided to head back to Ilfracombe to finish the trip. The trip was ended at 18:00 on the 23rd.

Otoliths Collected

- Cod 85
- Haddock 12
- Whiting 113

Part 4 26th February – 2nd March 5 days

SS sailed on Our Josie Grace at 09:40 on the 26th with Scott Wharton Acting as skipper. Scott decided to take this trip because it was decided to try ground South of Ireland where Irish skippers have been reporting good Cod fishing. After gaining tow information from Irish Skipper the skipper started the 97-mile steam (13.5 Hours) to the ground. Fishing vessels were spotted to the South of the closed area on the steam over, also pods of Dolphins and porpoises were seen during the whole trip.

The Celtic sea closed area cause a lot of conversations over the VHF between the Irish Skippers because they wanted this closed area but Belgium Beam Trawlers were allowed into this area during the closed period and also the British Beam Trawl fleet were allowed in at the end of the closed period. Fishermen are not happy about this because they believe the Belgium Beam fleet are catching Cod and this was shown a few years ago when the Belgium’s were complaining about having to discard large quantities of over quota Cod. They think this closed area should be for all fishing vessels except for Pot gear.

The skipper decided to use a single rig for the duration of this trip because he had never fished on this ground and did not know where any snags were. An Irish skipper gave the best position to find the Cod and the first tow was done on this ground. This tow was very successful for Cod and Haddock with the average size of Cod being a lot larger. The majority of Cod were Mature, Hyaline or Running showing this ground is used for breeding. The skipper towed to the North and South and found that the Cod did not extend very far. The Skipper did several tows on the ground where he caught the Cod and said that if this were a commercial trip he would fish his twin rig and expect around a 1000kg of Cod per day. The Skipper also towed to the West of this ground and found that there were not very many Cod to the West but he could not fish a large area because of Irish Netters being in the area. The Skipper went North to the inshore ground where he caught very few fish but had a quarter a basket of Nephrops. From the ground with the congregation of Cod the Skipper towed East up to the edge of the Celtic deeps and caught very few Cod he then decided to go back over to ground just West of Wales and Fish the British side of the Celtic Sea. The last 4 hauls were

towed through the “Smalls” and the South West of Milford. The fishing in this area was very good for rays but very few Cod, Haddock and Whiting were caught. The skipper said that “the fishing in this area is not very good when the winds come from the NE – NW” the wind started to freshen as the trip ended. The Vessel then steamed the 30 miles back to Ilfracombe and docked at 20:00 on the 2nd. SS was asked to tag and release some Cod from this trip but this was not possible because all the cod caught were caught in deeper water and their swim bladders were burst as they were hauled causing them to die. SS decided to collect more Cod otoliths so that an ALK could be gathered for the grounds South of Ireland.

Otoliths collected

- Cod 143
- Haddock 27
- Whiting 1

Part 5 7th – 11th March 5 days

For 5 days the weather was bad so the boat could not sail and as soon as the wind had dropped the tides were too small to sail so in the end the vessel sailed at 03:00 on the 7th of March with Marcus White as skipper. Marcus started fishing North of Padstow with the twin rig. He did two tows in this area with Haddock, Whiting, Plaice and Lemon Sole being the main species caught. There were several Beam Trawlers working in this area targeting the Sole and Lemon Sole and the Navy were boarding these vessels. The next 9 hauls were towed in areas called “H’s + E’s” and “I’s + F’s” and mainly caught Lemon Sole, Haddock, Whiting, Plaice and Sole (during the dark). Each haul had several Cod caught numbering from 10 to 20 fish but being on average smaller than the Cod caught the Irish side (last trip).

The next 4 hauls were on grounds called the “Tanker”. The skipper noted that the fishing for this time of year is very poor. Sole, Haddock, Whiting and Lemon Sole were mainly caught and very few Cod were caught. The skipper decided to steam 20 miles to the West to fish on harder ground so he decided to fish a single net for the last 4 hauls of this trip. On the steam to the new ground the crew found a large hole in the belly of the net and spent several hours fixing this hole (the hole would have affected the previous tows). The first tow had a good quantity of John Dory (76 fish) very little else was caught. The last 3 hauls were very poor with mostly Whiting being caught and very few Cod. The skipper decided to steam home back to Ilfracombe to complete all the trips totalling 25 days. SS Got of the boat at 18:00 on the 11th and travelled back to Lowestoft the following day.

Otoliths Collected

- Cod 41
- Haddock 100
- Whiting 12

Other Details

Total otoliths collected over 25 days

- Cod 401
- Haddock 196
- Whiting 171

At the start and end of each trip Newly SFI were contacted by the scientist on board to give details of the trip. The Scientist also had to contact Grant Course or John Cotter in Lowestoft to let them know when the boat was sailing or landing for safety reasons. The skipper stated on their logbooks that the trips were Celtic Sea Cod survey so that all fish landed would not be booked to their quota.

Appendix 3: Western cod FSP survey, FV Our Josie Grace, Feb-Mar 2005: Station and catch details for 9 selected species of fish.

Abbreviations: COD N=cod numbers, HAD=haddock, WHG=whiting, PLE=plaice, LEM = lemon sole, MON = anglerfish, HKE = hake, MEG = megrim, SOL = sole..

Cruise	Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	COD_N	HAD_N	WHG_N	PLE_N	LEM_N	MON_N	HKE_N	MEG_N	SOL_N
OJG 1/05	1	Twin rig 85mm	85	-5.28	51.08	-5.39	51.02	06-Feb-05	05:00	3.50	10	164	88	18	254	19	0	0	32
OJG 1/05	2	Twin rig 85mm	85	-5.36	50.99	-5.49	50.90	06-Feb-05	09:30	4.00	4	120	58	15	275	5	0	0	6
OJG 1/05	3	Twin rig 85mm	85	-5.48	50.91	-5.24	51.92	06-Feb-05	14:00	4.00	11	315	21	48	365	5	1	0	31
OJG 1/05	4	Twin rig 85mm	85	-5.23	50.92	-5.15	50.84	06-Feb-05	18:30	4.08	12	354	252	34	186	5	0	0	48
OJG 1/05	5	Twin rig 85mm	85	-5.46	50.51	-5.58	50.43	07-Feb-05	06:15	4.50	41	24	318	95	163	1	0	0	8
OJG 1/05	6	Twin rig 85mm	85	-5.61	50.42	-5.84	50.38	07-Feb-05	11:20	3.00	2	0	0	8	73	2	0	2	5
OJG 1/05	7	Twin rig 85mm	85	-5.83	50.39	-5.67	50.47	07-Feb-05	15:00	3.00	1	0	10	5	80	0	0	0	4
OJG 1/05	8	Twin rig 85mm	85	-5.15	50.76	-5.17	50.88	08-Feb-05	06:25	4.08	25	136	477	27	181	9	0	0	17
OJG 1/05	9	Twin rig 85mm	85	-5.18	50.89	-5.03	51.03	08-Feb-05	11:00	4.00	40	351	429	34	246	11	1	0	11
OJG 1/05	10	Twin rig 85mm	85	-5.02	51.04	-4.10	51.06	08-Feb-05	15:30	4.00	3	528	0	2	20	0	0	0	10
OJG 1/05	11	Stbd side of twin rig 85mm	85	-4.25	51.33	-4.10	51.35	09-Feb-05	06:30	2.50	2	0	84	0	4	2	1	0	0
OJG 1/05	12	Stbd side of twin rig 85mm	85	-4.12	51.35	-4.34	51.20	09-Feb-05	09:20	4.17	2	0	60	0	1	2	0	0	0
OJG 1/05	13	Stbd side of twin rig 85mm	85	-4.04	51.49	-3.77	51.45	14-Feb-05	15:00	3.50	6	0	32	7	4	0	0	0	2
OJG 1/05	14	Stbd side of twin rig 85mm	85	-3.70	51.44	-3.71	51.44	14-Feb-05	19:00	4.00	25	0	46	1	1	0	0	0	3
OJG 1/05	15	Stbd side of twin rig 85mm	85	-3.74	51.45	-4.17	51.49	14-Feb-05	23:30	4.50	5	0	45	3	1	0	0	0	4
OJG 1/05	16	Twin rig 85mm	85	-4.21	51.49	-4.03	51.50	15-Feb-05	05:00	4.00	6	0	138	2	2	5	0	0	7
OJG 1/05	17	Twin rig 85mm	85	-4.03	51.51	-4.21	51.47	15-Feb-05	09:40	4.00	9	0	39	18	1	3	0	0	12
OJG 1/05	18	Twin rig 85mm	85	-4.22	51.45	-4.05	51.50	15-Feb-05	14:20	4.00	5	0	87	8	4	0	0	0	12
OJG 1/05	19	Twin rig 85mm	85	-4.03	51.53	-4.07	51.50	15-Feb-05	19:00	4.50	7	2	54	5	2	2	0	0	14
OJG 1/05	20	Twin rig 85mm	85	-4.05	51.50	-4.23	51.49	16-Feb-05	00:00	4.50	6	0	104	13	6	4	0	0	20

Appendix 3: Western cod FSP survey, FV Our Josie Grace, Feb-Mar 2005: Station and catch details for 9 selected species of fish.

Cruise	Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	COD _N	HAD _N	WHG _N	PLE _N	LEM _N	MON _N	HKE _N	MEG _N	SOL _N
OJG 1/05	21	Twin rig 85mm	85	-4.93	51.09	-5.07	50.96	16-Feb-05	19:15	3.75	1	95	930	55	101	0	0	0	28
OJG 1/05	22	Twin rig 85mm	85	-5.53	50.88	-5.29	50.92	17-Feb-05	06:00	3.75	26	437	518	94	478	0	43	0	34
OJG 1/05	23	Twin rig 85mm	85	-5.24	50.92	-5.13	50.92	17-Feb-05	10:40	4.33	14	326	220	241	266	2	30	10	4
OJG 1/05	24	Twin rig 85mm	85	-5.16	50.92	-5.35	50.95	17-Feb-05	15:50	4.17	29	325	350	148	430	10	0	0	36
OJG 1/05	25	Twin rig 85mm	85	-5.41	51.42	-5.22	51.45	18-Feb-05	04:10	4.50	1	2	3	4	3	1	0	0	0
OJG 1/05	26	Single rig box trawl 85mm SB	85	-4.95	51.47	-5.15	51.43	19-Feb-05	10:30	4.17	2	0	6	19	7	3	0	0	0
OJG 1/05	27	Single rig box trawl 85mm SB	85	-5.14	51.42	-4.94	51.40	19-Feb-05	15:00	4.00	4	4	21	10	7	0	0	0	3
OJG 1/05	28	Single rig box trawl 85mm SB	85	-4.97	51.40	-5.23	51.39	19-Feb-05	19:30	4.00	2	7	53	2	13	3	0	0	0
OJG 1/05	29	Single rig box trawl 85mm SB	85	-4.78	51.55	-4.90	51.50	20-Feb-05	05:00	4.00	0	0	26	32	1	0	0	0	0
OJG 1/05	30	Single rig box trawl 85mm SB	85	-4.60	51.50	-4.90	51.43	20-Feb-05	09:30	4.08	1	2	26	35	3	2	0	0	6
OJG 1/05	31	Twin rig 85mm	85	-4.27	51.49	-4.25	51.42	20-Feb-05	19:30	4.00	0	0	174	10	3	5	0	0	7
OJG 1/05	33	Twin rig 85mm	85	-4.18	51.42	-3.85	51.42	21-Feb-05	00:45	4.42	6	0	246	3	1	8	1	0	6
OJG 1/05	34	Twin rig 85mm	85	-3.84	51.42	-3.99	51.44	21-Feb-05	05:45	4.25	15	0	125	2	5	1	0	0	6
OJG 1/05	35	Twin rig 85mm	85	-4.02	51.45	-3.77	51.44	21-Feb-05	10:45	4.17	13	0	59	5	2	0	0	0	2
OJG 1/05	36	Twin rig 85mm	85	-3.77	51.43	-3.82	51.43	21-Feb-05	15:30	3.50	58	0	131	0	3	2	0	0	3
OJG 1/05	37	Twin rig 85mm	85	-3.83	51.43	-4.18	51.49	21-Feb-05	19:45	4.08	12	1	66	2	2	0	0	0	9
OJG 1/05	38	Twin rig 85mm	85	-4.09	51.50	-4.08	51.55	22-Feb-05	05:30	4.00	9	0	130	16	19	2	0	0	3
OJG 1/05	39	Twin rig 85mm	85	-4.04	51.51	-4.29	51.49	22-Feb-05	10:30	4.00	9	1	174	1	6	4	0	0	1
OJG 1/05	40	Twin rig 85mm	85	-4.26	51.49	-3.92	51.46	22-Feb-05	15:15	4.50	7	0	170	10	2	4	0	0	16
OJG 1/05	41	Twin rig 85mm	85	-3.92	51.46	-4.17	51.37	22-Feb-05	20:15	4.00	0	0	86	6	1	0	0	0	10
OJG 1/05	42	Twin rig 85mm	85	-4.24	51.35	-4.17	51.36	23-Feb-05	01:30	4.75	4	0	295	1	3	0	0	0	7
OJG 1/05	43	Single rig box trawl 85mm SB	85	-4.20	51.19	-4.22	51.34	23-Feb-05	07:30	5.00	5	0	98	1	0	2	0	0	2
OJG 1/05	44	Single rig box trawl 85mm SB	85	-6.59	51.59	-6.72	51.74	26-Feb-05	23:35	4.17	28	373	361	0	1	3	0	0	0

Appendix 3: Western cod FSP survey, FV Our Josie Grace, Feb-Mar 2005: Station and catch details for 9 selected species of fish.

Cruise	Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	COD _N	HAD _N	WHG _N	PLE _N	LEM _N	MON _N	HKE _N	MEG _N	SOL _N
OJG 1/05	45	Single rig box trawl 85mm SB	85	-6.73	51.74	-6.86	51.87	27-Feb-05	04:15	3.33	8	83	184	21	9	2	0	0	0
OJG 1/05	46	Single rig box trawl 85mm SB	85	-6.87	51.87	-6.78	51.74	27-Feb-05	08:05	4.33	11	133	8	169	167	7	4	0	0
OJG 1/05	47	Single rig box trawl 85mm SB	85	-6.66	51.70	-6.57	51.57	27-Feb-05	14:50	3.42	42	300	24	17	120	6	8	4	0
OJG 1/05	48	Single rig box trawl 85mm SB	85	-6.58	51.57	-6.71	51.49	27-Feb-05	18:45	4.33	8	352	30	2	28	8	4	1	0
OJG 1/05	49	Single rig box trawl 85mm SB	85	-6.67	51.52	-6.64	51.66	27-Feb-05	23:45	4.25	24	237	345	8	86	9	0	7	0
OJG 1/05	50	Single rig box trawl 85mm SB	85	-7.00	51.60	-7.28	51.59	28-Feb-05	08:50	3.33	11	45	7	5	42	0	1	3	1
OJG 1/05	51	Single rig box trawl 85mm SB	85	-7.29	51.59	-7.59	51.70	28-Feb-05	12:35	4.42	4	7	0	19	14	2	0	3	4
OJG 1/05	52	Single rig box trawl 85mm SB	85	-7.46	51.80	-7.39	52.02	28-Feb-05	19:05	4.58	10	43	150	84	11	23	0	0	1
OJG 1/05	54	Single rig box trawl 85mm SB	85	-6.75	50.75	-6.59	51.60	01-Mar-05	06:35	4.17	42	356	75	15	232	4	6	5	3
OJG 1/05	55	Single rig box trawl 85mm SB	85	-6.57	51.60	-6.29	51.60	01-Mar-05	11:30	4.17	8	46	12	10	8	1	2	1	1
OJG 1/05	56	Single rig box trawl 85mm SB	85	-5.73	51.52	-5.46	51.43	01-Mar-05	19:45	4.17	0	5	8	4	4	1	0	0	0
OJG 1/05	57	Single rig box trawl 85mm SB	85	-5.44	51.43	-5.14	51.39	02-Mar-05	00:35	4.67	1	8	7	4	2	0	0	0	0
OJG 1/05	59	Single rig box trawl 85mm SB	85	-4.98	51.40	-4.83	51.42	02-Mar-05	08:00	4.67	3	0	3	6	0	0	0	0	1
OJG 1/05	60	Twin rig 85mm	85	-5.01	50.93	-5.17	50.86	07-Mar-05	09:45	4.08	3	148	25	110	151	5	0	3	4
OJG 1/05	61	Twin rig 85mm	85	-5.15	50.85	-5.10	50.71	07-Mar-05	14:30	4.00	30	28	254	135	48	2	0	0	9
OJG 1/05	62	Twin rig 85mm	85	-5.10	50.69	-5.19	50.76	07-Mar-05	19:00	4.00	20	2	445	165	209	2	0	0	98
OJG 1/05	63	Twin rig 85mm	85	-5.22	50.77	-5.23	50.92	07-Mar-05	23:55	4.17	12	57	791	128	436	10	0	0	57

Appendix 3: Western cod FSP survey, FV Our Josie Grace, Feb-Mar 2005: Station and catch details for 9 selected species of fish.

Cruise	Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	COD _N	HAD _N	WHG _N	PLE _N	LEM _N	MON _N	HKE _N	MEG _N	SOL _N
OJG 1/05	64	Twin rig 85mm	85	-5.26	50.94	-5.36	50.88	08-Mar-05	05:00	2.00	27	329	490	14	124	2	0	0	22
OJG 1/05	65	Twin rig 85mm	85	-5.35	50.86	-5.34	50.88	08-Mar-05	07:45	4.00	53	174	450	203	523	4	1	10	4
OJG 1/05	66	Twin rig 85mm	85	-5.35	50.89	-5.44	50.98	08-Mar-05	12:45	4.25	11	358	144	124	263	3	1	0	6
OJG 1/05	67	Twin rig 85mm	85	-5.42	51.00	-5.49	50.90	08-Mar-05	18:15	4.00	13	472	722	98	216	38	0	0	23
OJG 1/05	68	Twin rig 85mm	85	-5.32	50.91	-5.12	50.92	09-Mar-05	00:15	2.75	7	305	204	56	89	6	0	0	17
OJG 1/05	69	Twin rig 85mm	85	-5.11	50.96	-5.06	50.97	09-Mar-05	04:00	4.25	4	87	140	146	117	9	0	0	16
OJG 1/05	70	Twin rig 85mm	85	-5.09	50.94	-5.22	50.78	09-Mar-05	09:00	4.00	17	64	204	79	149	4	5	12	2
OJG 1/05	71	Twin rig 85mm	85	-5.19	50.75	-5.15	50.70	09-Mar-05	14:00	2.75	4	4	272	56	52	0	0	0	4
OJG 1/05	72	Twin rig 85mm	85	-5.12	50.65	-5.07	50.74	09-Mar-05	17:45	4.25	12	135	468	92	80	15	0	0	64
OJG 1/05	73	Twin rig 85mm	85	-5.07	50.75	-5.22	50.79	09-Mar-05	22:45	4.25	20	16	240	41	135	5	0	5	27
OJG 1/05	74	Twin rig 85mm	85	-5.21	50.80	-5.23	50.92	10-Mar-05	03:45	4.25	18	53	469	193	117	11	0	0	17
OJG 1/05	75	Single rig box trawl 85mm SB	85	-5.73	50.87	-5.75	50.97	10-Mar-05	15:45	3.50	5	15	5	2	8	0	0	0	0
OJG 1/05	76	Single rig box trawl 85mm SB	85	-5.75	50.97	-5.73	50.87	10-Mar-05	19:45	4.00	4	48	136	0	2	0	2	0	3
OJG 1/05	77	Single rig box trawl 85mm SB	85	-5.74	50.90	-5.70	51.06	11-Mar-05	00:15	4.00	3	21	78	10	39	4	1	0	10
OJG 1/05	78	Single rig box trawl 85mm SB	85	-5.69	51.08	-5.59	51.15	11-Mar-05	04:45	3.25	0	1	27	5	40	2	0	1	16