

Final Report

Programme 10 : Celtic Sea sole and plaice

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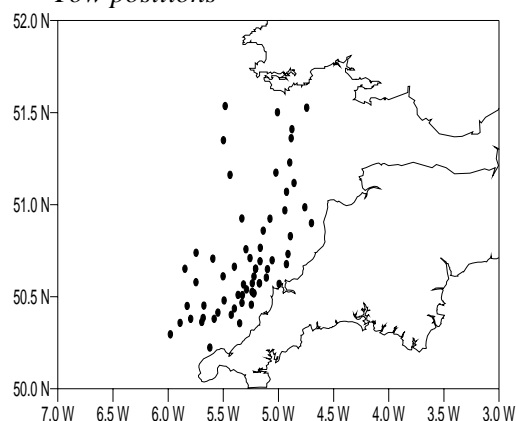
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CEFAS, Lowestoft*

June 2005.

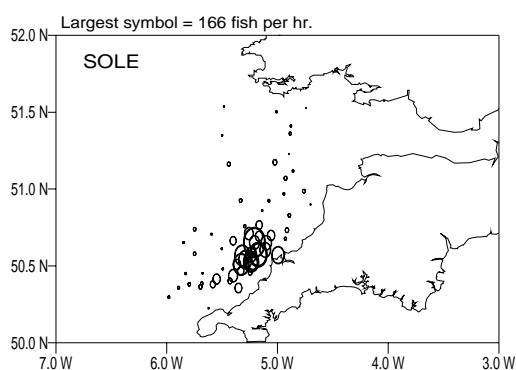
Summary

This report presents the results of an FSP survey of sole and plaice in ICES Divisions VIII f&g in the eastern Celtic Sea. The survey took place in February 2005 on FV Nellie, a commercial beam trawler. Sixty four hauls using twin 4-metre beams and 80 mm mesh codends were made off the north coasts of Cornwall and Devon and off the Bristol Channel.

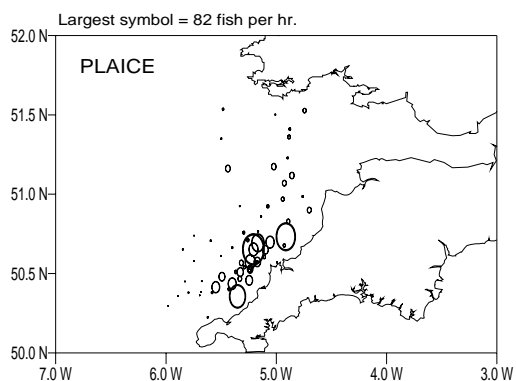
Tow positions



Catch rates of sole and plaice



Catch rates of sole were highest in a restricted area off the coast of north Cornwall. Most of the fish were large enough to be landed. There was a trend for sole to be larger in the catches near Cornwall than in the north of the survey region near Pembrokeshire.



Catch rates of plaice were also highest off the north coast of Cornwall. 55% of the fish were discarded. As with sole, the average size of fish tended to increase southwards towards Cornwall.

Although the highest sole and plaice catches occurred in the same general area off north Cornwall, the association is less clear at the scale of individual tows. Relatively large sole catches did not necessarily coincide with large catches of plaice.

The by-catch of cod was very small. Cod were caught at only 14 of the 64 tows, with most catches comprising only one or two fish

The mean catch rate of sole at each age class (in numbers per hour and as percentages) is given below, together with the percentage composition of the ICES forecast for international landings in 2005. The FSP catches had relatively more 4 and 7-year-olds, and fewer 3 and 6-year-olds, than forecasted by ICES for the annual landings.

	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10+
FSP 2005: nos/hr	0.00	0.37	6.28	14.24	6.02	3.31	9.95	2.12	0.26	0.81
FSP 2005: %	0.0	0.9	14.5	32.8	13.9	7.6	22.9	4.9	0.6	1.9
ICES forecast %	0.0	5.8	26.1	24.7	12.5	13.3	12.8	2.5	1.3	1.2

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 10, a survey of sole and plaice in ICES Divisions VIIIf&g in the eastern Celtic Sea, carried out in February 2005. The programme used the commercial beam trawler FV Nellie for 13 days between 15 and 27 February 2005. The work plan involved trawling under dispensation from the quota regulations.

The most recent ICES assessment of the VIIIf&g sole stock (ICES, 2005) indicates a long-term decline in spawning stock biomass (SSB) reaching a low point in the late 1990s before increasing rapidly to a level similar to that observed in the early 1980s. The recent increase followed a period of improved recruitment, particularly the 1998 year-class which is the strongest in the assessment series. The ICES assessment for VIIIf&g plaice shows a quite different pattern to that of sole, with a rapid increase in SSB from the late 1970s to the late 1980s, followed by an equally rapid decline to a low biomass in the 2000s caused by poor recruitment since the late 1980s (ICES, 2005).

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 aims of this study, as proposed by NFFO, were originally included in a proposal for a single survey of the western Channel and Celtic Sea stocks. The Western Channel survey was carried out separately (Programme 2; Large *et al.* 2004). The provisional, combined aims proposed by NFFO in June 2004 were:

- Provide indicative catch rates
- Identify range/distribution of target species using commercial gear
- Determine age and recruitment structure
- Monitor discard levels
- Investigate sole/plaice ratio
- Contribute and create time series
- Incorporate, if practicable, a beam trawl environmental panel study.

The VIIIf&g sole programme became a reserve programme and was subsequently agreed when it was determined that adequate resources were available to carry out the work. The consolidated aims of the VIIIf&g survey were to:

1. Investigate distribution and population structure of sole and plaice in VIIf&g.
2. Investigate sole/plaice catch ratios

Methods

Vessels, gears and areas fished

The FV Nellie (PZ10) is a steel trawler of 23 m reg. length with a 486 kW engine. Two 4-metre beam trawls fitted with chain mats were deployed. The footrope was 10.2 m and the fishing line was 11.2 m. Rubber discs were approximately 8" diameter. Cod-end mesh was 80 mm made with 5.5mm single braided twine. FV Nellie operated in the eastern Celtic Sea (ICES Divisions VIIf, g). The mid-points of the actual tows are shown in Figure 1.

Cruise reports prepared by the observers are given in Appendix 2.

Figure 1

FSP 2004/5: Celtic Sea sole survey. Mid tow positions

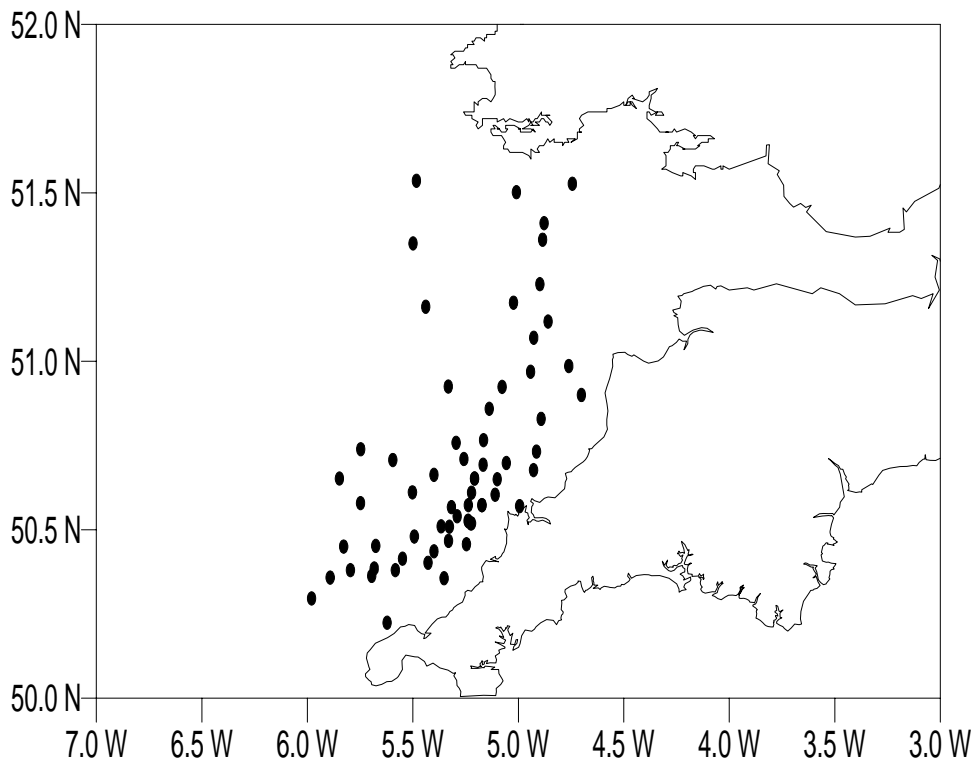


Table 1. FSP Programme 10: Celtic Sea sole and plaice. Details of fishing activities.

Cruise code	Vessel	Dates in 2005	Stns	No. hauls	Fishing gear	Cod-end mesh mm	Tow duration hrs. Average; (range)
Nell 1/05	FV Nellie	15-27 Feb	1-64	64	Twin 4-m beam trawl	80	1.07 (0.75 – 2.0)

Fishing and sampling methods

All sole and plaice were measured and classified as ‘discarded’ or ‘retained’ according to advice from the fishing crew. Otoliths from samples of sole 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 mean numbers of sole and plaice caught per hour of trawling were calculated and mapped to show the distribution pattern of each species.

The length structure of the catches is presented as the number in each 1-cm length class per hour.

Age compositions of sole were calculated by applying age-length keys to the corresponding length frequency distributions to give the mean number caught at each age per hour.

The association between sole and plaice was investigated by comparing overall distribution patterns as well as differences in catch rate at the scale of individual tows.

Results

Tow details

Details of position, date, time, gear and cod-end mesh sizes, along with numbers of fish caught for sole, plaice, and cod are shown in Appendix 1 for all hauls made by the FV Nellie in February 2005. Data for other species are held on the CEFAS data base. Mid tow positions are illustrated in Fig. 1. To allow comparison between tows of variable duration, the catch-rate for each tow was standardised to number of fish per hour of towing.

Distribution patterns

Numbers of sole and plaice caught per hour are mapped in Figures 2 and 3, along with the mean length of fish in each catch (in these plots, the size of the ellipses is proportional to the catch rate or the mean length at each location).

The largest catch rates of sole (Fig. 2a) were taken north-west and west of Padstow in North Cornwall. Up to 166 fish were caught per hour. The average was 43 fish caught per hour. The mean length of sole in the catches showed relatively little variation between tows, but

there appeared to be a slight trend from smaller fish in the north near Pembrokeshire to larger fish in the south west to the north of St. Ives (Fig. 2b).

The largest catch rates of plaice (Fig. 3a) were observed off the Cornish coast to the north-west and south-west of Padstow. Up to 82 fish were caught per hour. The average was 13 fish per hour. The mean length of plaice in the catches appeared more variable than for sole but there was a similar trend from small to large southwards from Pembrokeshire to the Cornish coast (Fig. 3b).

Length and age composition

Length frequency distributions for sole and plaice are shown in Figures 4 and 5. The figures show mean numbers caught and discarded per hour of trawling.

The length frequency of sole (Fig. 4a) showed a single mode (peak frequency) at 27 cm, and, less clearly, at approximately 38 cm. The length distributions for different age classes of sole, based on otolith readings, clearly showed that the mode at around 27 cm (Fig. 4a) was mostly composed of 4-year olds, and that the mode at around 38 was mostly 7-year olds. These age-classes represented a large proportion of the sole present in the survey area (Fig. 4b). Sole were discarded up to 25 cm in relatively small numbers.

The length frequency of plaice (Fig. 5) showed a single mode at 25 cm. Most of the plaice in length classes up to 26 cm were discarded, with some discarding also up to 28cm. Over all tows, 55% of plaice caught were discarded. Otoliths were not available for plaice.

By-catch of other species

Cod were caught at only 14 of the 64 tows, with most catches comprising only one or two fish. The average catch rate was 0.34 fish per hour. Approximately 40% of the cod were under-sized and discarded. Other species caught during the survey included: monk, hake, lemon sole and, occasionally, witch and megrim.

Association between sole and plaice

The overall area of highest sole catches off north Cornwall coincided with the area of highest plaice catches (Figs 2a and 3a). However, at the scale of individual tows, the association was less clear. Although a positive relationship was evident between plaice and sole catches, there was substantial variability and tows with relatively large plaice catches did not necessarily have large catches of sole (Fig. 6).

Figure 2. FSP 2004/05: Celtic Sea sole survey. (a) number of SOLE caught per hour; (b) mean length of SOLE in catches.

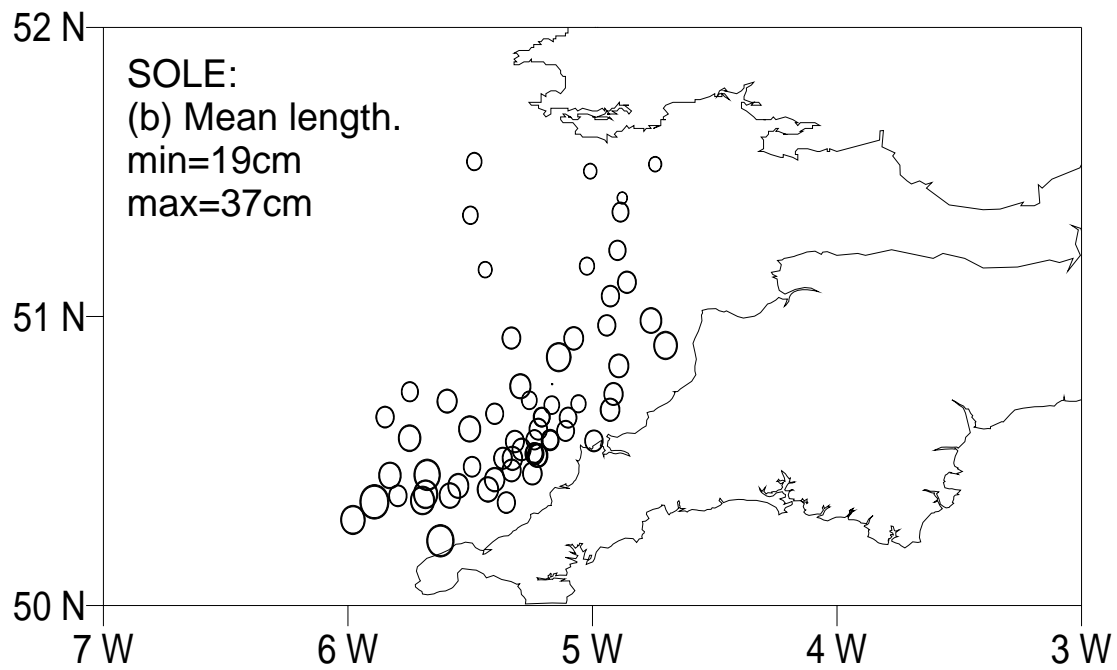
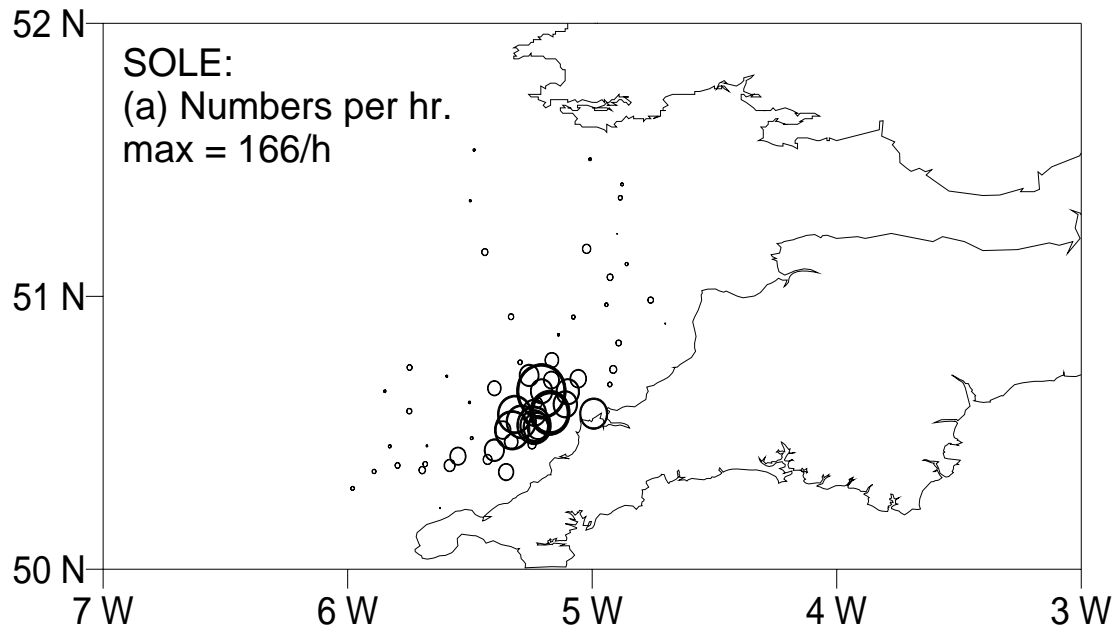


Figure 3. FSP 2004/05: Celtic Sea sole survey. (a) number of PLAICE caught per hour; (b) mean length of PLAICE in catches. (Mean lengths given separately by sex, where recorded).

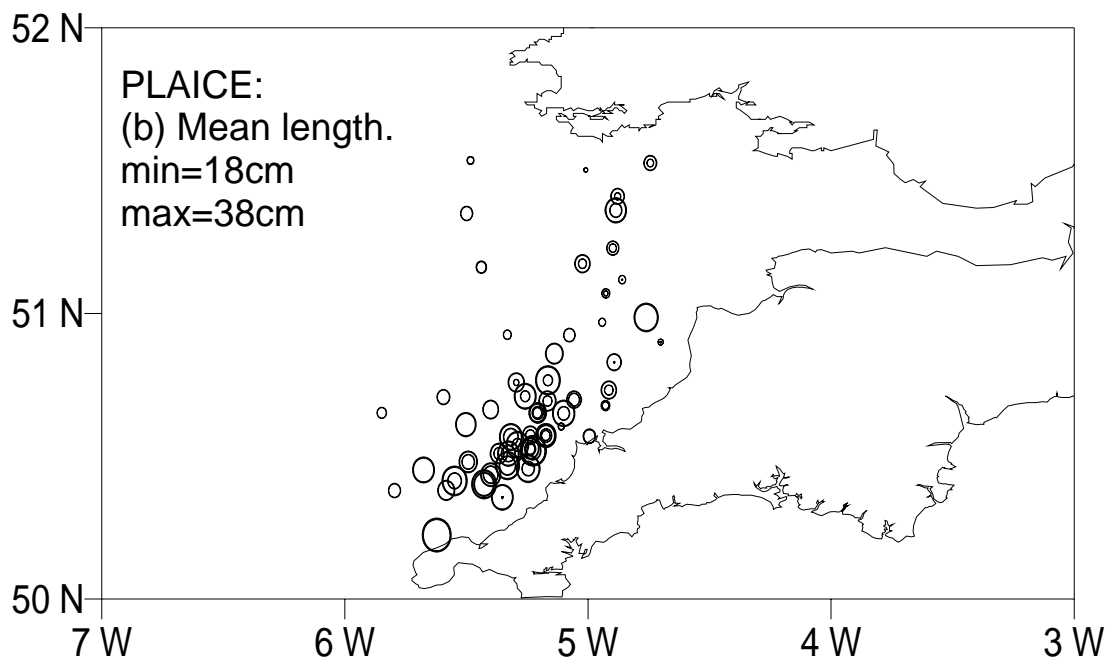
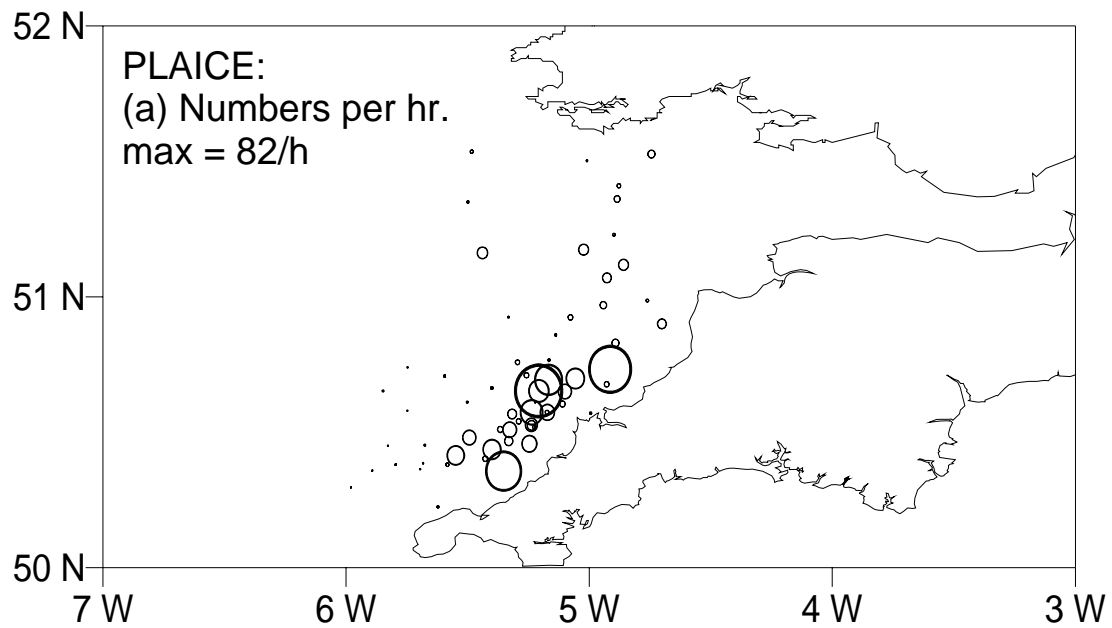
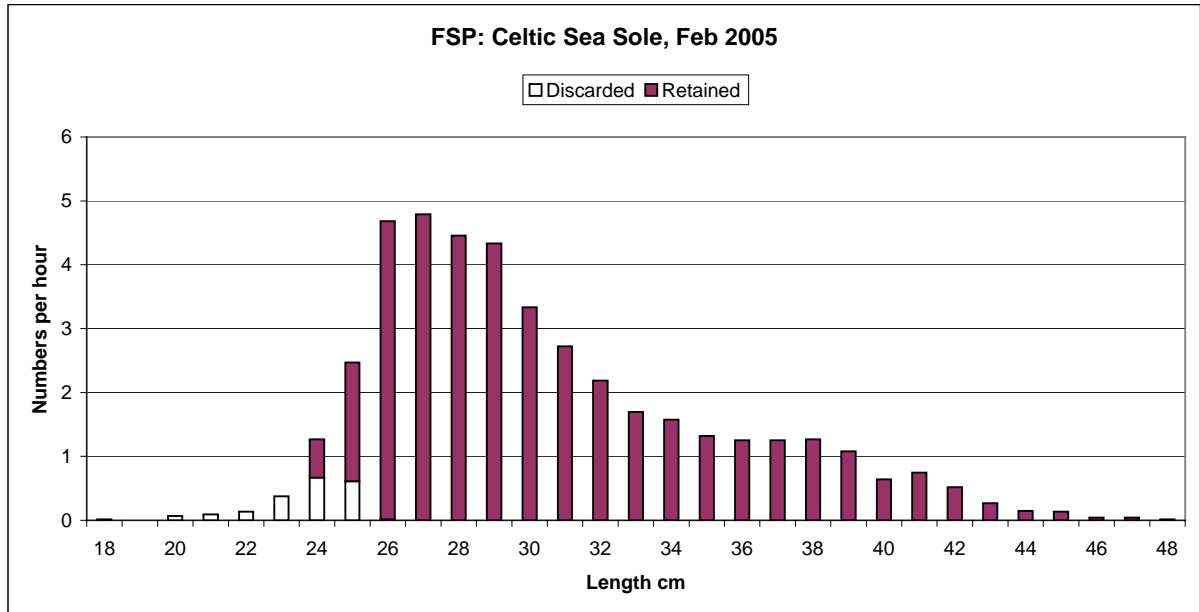


Figure 4. Celtic Sea FSP survey, February 2005: SOLE a) Length frequency distribution of catch; b) Age frequency distribution.

a)



b)

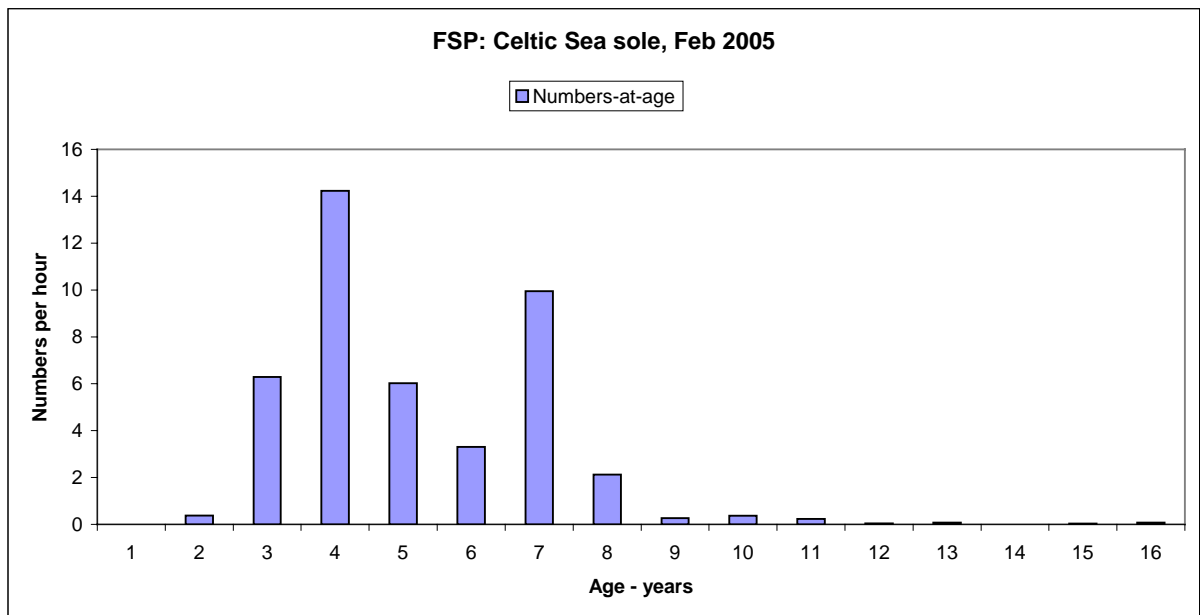


Figure 5. Celtic Sea FSP survey, February 2005: PLAICE Length frequency distribution of catch.

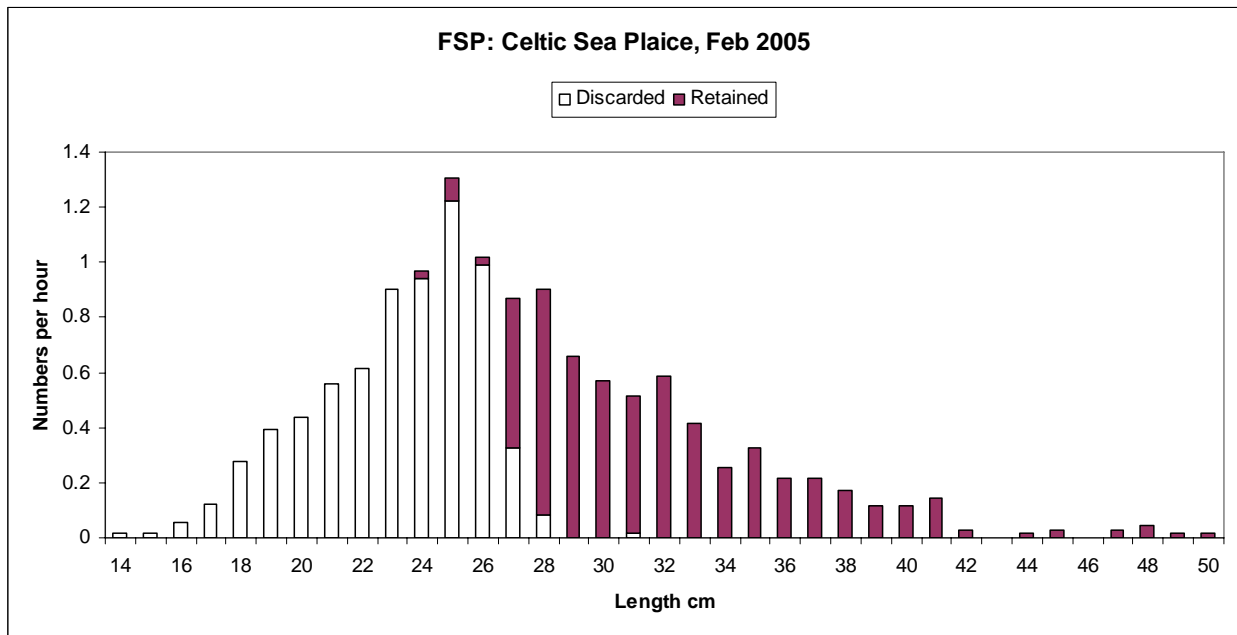
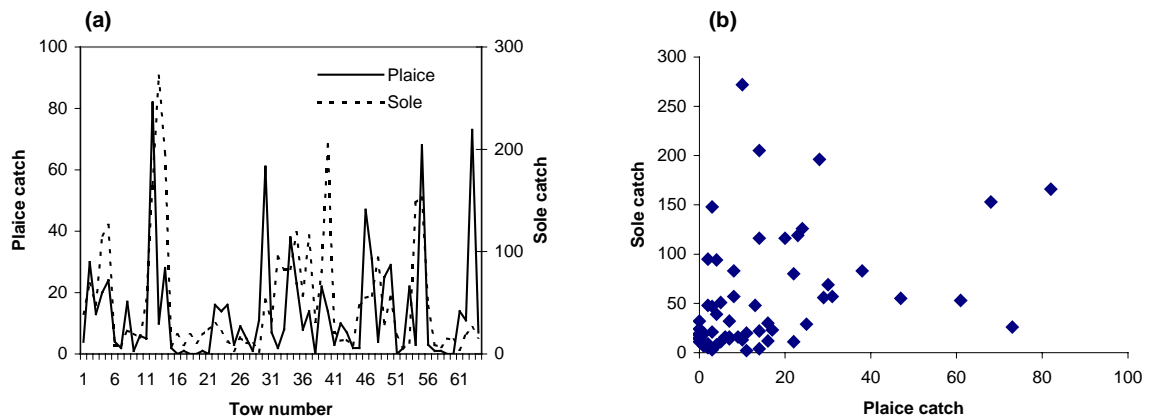


Figure 6. Association between catches of plaice and sole. (a): numbers caught per tow. (b): scatter plot of sole vs plaice catch numbers per tow.



Discussion

The survey extended over a sufficiently large area, with a sufficient distribution of tows, to effectively map out the distribution of sole and plaice. The areas with highest catch rates of sole and plaice were quite localised, and centred on the inshore waters of the north Cornwall coast. Although the highest sole and plaice catches occurred in the same general area off north Cornwall, the association was less clear at the scale of individual tows. Relatively large plaice catches did not necessarily coincide with large catches of sole. As this represents a single snapshot in time, the persistence of any fine-scale spatial segregation of sole and plaice cannot be evaluated without repeating the tows at different times of year.

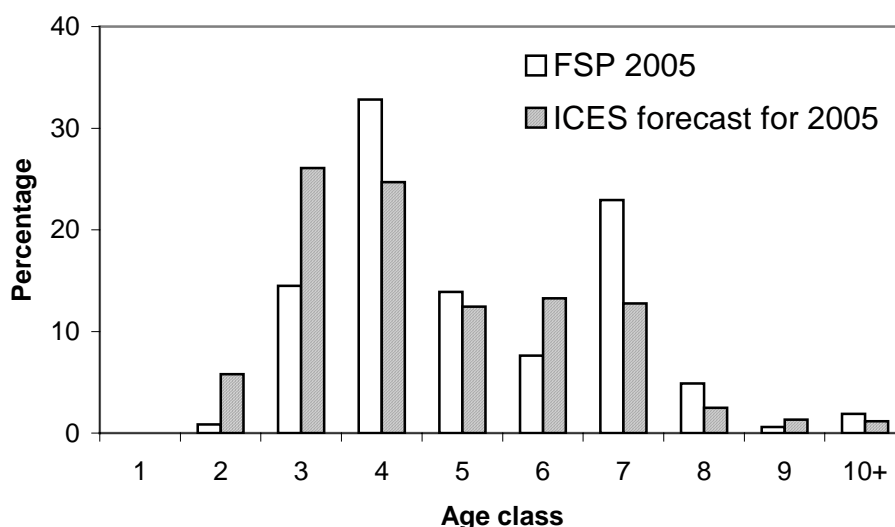
A broad age composition of sole was evident, with fish up to 16 years of age present in the FSP catches in 2005. The percentage composition of the FSP catches of sole show some broad similarities with the ICES forecast for the international fishery in 2005 (ICES, 2005; Fig. 7 and Table 2). However, the FSP catches had relatively more 4 and 7-year-olds, and fewer 3 and 6-year-olds, than forecasted by ICES for the annual landings. Although the ICES forecast indicated a greater contribution by 2-year-olds than given by FSP, the ICES value was based on an assumption that the year class was of average strength, as there were no direct observations. The ICES assessment indicates that the 1998 year-class was the strongest observed in the series starting from 1970, and this finding is supported by the large catch of 7-year-olds in the FSP survey.

The by-catch of cod was very small during this survey. Cod were caught at only 14 of the 64 tows, with most catches comprising only one or two fish.

Table 2. Mean catch rate of sole at each age class (in numbers per hour and as percentages), and the percentage composition of the ICES forecast for international landings in 2005.

	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10+
FSP 2005: nos/hr	0.00	0.37	6.28	14.24	6.02	3.31	9.95	2.12	0.26	0.81
FSP 2005: %	0.00	0.86	14.49	32.83	13.89	7.63	22.94	4.88	0.60	1.87
ICES forecast %	0.00	5.79	26.08	24.70	12.45	13.27	12.76	2.47	1.32	1.15

Figure 7. Comparison of percentage (by number) of sole in the FSP catches in 2005, and the ICES forecast for the international fishery in 2005.



Acknowledgements

The skipper and crew of the FV Nellie are warmly thanked for making their vessel 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

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- Large, P., Dann, J., Kupschus, S., Armstrong, M., Cotter, J. and Bevan, D. 2004. Programme 2: Western Channel Sole and Plaice. CEFAS/NFFO Fisheries Science Partnership 2004/05 Final report. 35pp.

Appendix 1: Celtic Sea sole FSP survey, FV Nellie, Feb 2005: Station and catch details for 3 selected species of fish (other species are on CEFAS data base). Abbreviations: COD_N=cod numbers, PLE=plaice, SOL=sole.

Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	PLE_N	SOL_N	COD_N
1	2x 4m beam+mat 80mm	80	-5.63	50.37	-5.54	50.39	15-Feb-05	10:55	1.00	4	39	0
2	2x 4m beam+mat 80mm	80	-5.44	50.42	-5.36	50.45	15-Feb-05	13:10	1.00	30	69	0
3	2x 4m beam+mat 80mm	80	-5.36	50.45	-5.30	50.48	15-Feb-05	14:30	1.00	13	48	0
4	2x 4m beam+mat 80mm	80	-5.27	50.51	-5.21	50.55	15-Feb-05	16:10	1.00	20	116	0
5	2x 4m beam+mat 80mm	80	-5.21	50.55	-5.14	50.59	15-Feb-05	17:30	1.00	24	126	1
6	2x 4m beam+mat 80mm	80	-5.50	51.57	-5.47	51.50	16-Feb-05	06:30	1.00	4	8	2
7	2x 4m beam+mat 80mm	80	-5.50	51.38	-5.49	51.32	16-Feb-05	08:40	1.00	2	8	1
8	2x 4m beam+mat 80mm	80	-5.46	51.19	-5.42	51.13	16-Feb-05	11:00	1.00	17	23	1
9	2x 4m beam+mat 80mm	80	-5.35	50.95	-5.31	50.90	16-Feb-05	13:40	1.00	1	20	0
10	2x 4m beam+mat 80mm	80	-5.32	50.80	-5.27	50.72	16-Feb-05	15:35	1.00	6	16	1
11	2x 4m beam+mat 80mm	80	-5.27	50.73	-5.24	50.70	16-Feb-05	17:00	0.75	5	51	0
12	2x 4m beam+mat 80mm	80	-5.24	50.67	-5.18	50.63	16-Feb-05	18:00	1.00	82	166	2
13	2x 4m beam+mat 80mm	80	-5.21	50.55	-5.14	50.59	16-Feb-05	20:00	2.00	10	272	0
14	2x 4m beam+mat 80mm	80	-5.27	50.50	-5.21	50.55	16-Feb-05	23:15	2.00	28	196	0
15	2x 4m beam+mat 80mm	80	-5.58	50.68	-5.61	50.73	17-Feb-05	07:10	1.00	2	8	1
16	2x 4m beam+mat 80mm	80	-5.71	50.76	-5.78	50.72	17-Feb-05	09:10	1.00	0	19	2
17	2x 4m beam+mat 80mm	80	-5.83	50.68	-5.86	50.62	17-Feb-05	10:55	1.00	1	9	0
18	2x 4m beam+mat 80mm	80	-5.79	50.59	-5.71	50.56	17-Feb-05	12:45	1.00	0	19	0
19	2x 4m beam+mat 80mm	80	-5.83	50.48	-5.83	50.42	17-Feb-05	15:00	1.00	0	11	0
20	2x 4m beam+mat 80mm	80	-5.83	50.39	-5.76	50.36	17-Feb-05	16:25	1.00	1	19	0
21	2x 4m beam+mat 80mm	80	-5.73	50.36	-5.66	50.36	17-Feb-05	17:50	1.00	0	24	0
22	2x 4m beam+mat 80mm	80	-5.02	51.21	-5.03	51.14	18-Feb-05	06:45	1.00	16	30	0

Appendix 1 cont.: Celtic Sea sole FSP survey, FV Nellie, Feb 2005: Station and catch details for 3 selected species of fish.

Abbreviations: COD_N=cod numbers, PLE=plaice, SOL=sole.

Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	PLE_N	SOL_N	COD_N
23	2x 4m beam+mat 80mm	80	-4.96	51.09	-4.90	51.05	18-Feb-05	08:25	1.00	14	22	0
24	2x 4m beam+mat 80mm	80	-4.86	51.09	-4.86	51.15	18-Feb-05	10:10	1.00	16	12	0
25	2x 4m beam+mat 80mm	80	-4.89	51.20	-4.90	51.26	18-Feb-05	12:00	1.00	3	3	0
26	2x 4m beam+mat 80mm	80	-4.88	51.33	-4.89	51.39	18-Feb-05	13:55	1.00	9	16	0
27	2x 4m beam+mat 80mm	80	-4.89	51.41	-4.87	51.41	18-Feb-05	15:15	1.00	5	11	0
28	2x 4m beam+mat 80mm	80	-4.98	51.50	-5.04	51.50	18-Feb-05	17:10	1.00	1	10	5
29	2x 4m beam+mat 80mm	80	-4.79	51.53	-4.70	51.52	19-Feb-05	07:10	1.00	11	2	0
30	2x 4m beam+mat 80mm	80	-5.30	50.35	-5.40	50.36	22-Feb-05	13:45	1.00	61	53	0
31	2x 4m beam+mat 80mm	80	-5.41	50.36	-5.45	50.44	22-Feb-05	15:05	1.00	7	32	0
32	2x 4m beam+mat 80mm	80	-4.95	50.52	-5.04	50.62	23-Feb-05	06:50	1.00	2	95	1
33	2x 4m beam+mat 80mm	80	-5.06	50.61	-5.16	50.60	23-Feb-05	08:05	1.00	8	83	0
34	2x 4m beam+mat 80mm	80	-5.19	50.59	-5.29	50.56	23-Feb-05	09:20	1.00	38	83	0
35	2x 4m beam+mat 80mm	80	-5.29	50.54	-5.36	50.48	23-Feb-05	10:45	1.00	23	119	0
36	2x 4m beam+mat 80mm	80	-5.38	50.48	-5.36	50.54	23-Feb-05	12:20	1.00	8	57	0
37	2x 4m beam+mat 80mm	80	-5.37	50.57	-5.27	50.57	23-Feb-05	13:50	1.00	14	116	0
38	2x 4m beam+mat 80mm	80	-5.26	50.59	-5.19	50.63	23-Feb-05	15:15	1.00	0	32	0
39	2x 4m beam+mat 80mm	80	-5.14	50.63	-5.06	50.67	23-Feb-05	16:55	1.00	22	80	0
40	2x 4m beam+mat 80mm	80	-5.29	50.54	-5.29	50.54	23-Feb-05	20:05	2.00	14	205	0
41	2x 4m beam+mat 80mm	80	-4.72	50.98	-4.80	51.00	24-Feb-05	07:00	1.00	3	21	0
42	2x 4m beam+mat 80mm	80	-4.89	50.98	-5.00	50.96	24-Feb-05	08:35	1.00	10	13	0
43	2x 4m beam+mat 80mm	80	-5.03	50.94	-5.12	50.90	24-Feb-05	09:50	1.00	7	14	0
44	2x 4m beam+mat 80mm	80	-5.14	50.89	-5.13	50.83	24-Feb-05	11:10	1.00	2	9	0

Appendix 1 cont.: Celtic Sea sole FSP survey, FV Nellie, Feb 2005: Station and catch details for 3 selected species of fish.

Abbreviations: COD_N=cod numbers, PLE=plaice, SOL=sole.

Stn	Gear	Mesh mm	Shot Lon	Shot Lat	Haul Lon	Haul Lat	Date shot	Time shot	Tow hrs	PLE_N	SOL_N	COD_N
45	2x 4m beam+mat 80mm	80	-5.16	50.79	-5.17	50.74	24-Feb-05	12:40	1.00	2	48	1
46	2x 4m beam+mat 80mm	80	-5.19	50.72	-5.14	50.67	24-Feb-05	13:55	1.00	47	55	0
47	2x 4m beam+mat 80mm	80	-5.10	50.69	-5.01	50.71	24-Feb-05	15:20	1.00	31	57	0
48	2x 4m beam+mat 80mm	80	-5.18	50.53	-5.27	50.51	25-Feb-05	08:20	1.00	4	94	0
49	2x 4m beam+mat 80mm	80	-5.04	50.48	-5.45	50.44	25-Feb-05	10:10	1.00	25	29	0
50	2x 4m beam+mat 80mm	80	-5.50	50.42	-5.60	50.41	25-Feb-05	11:35	1.00	29	56	0
51	2x 4m beam+mat 80mm	80	-5.64	50.40	-5.73	50.37	25-Feb-05	13:05	1.00	0	18	0
52	2x 4m beam+mat 80mm	80	-5.67	50.01	-5.58	50.43	25-Feb-05	15:05	1.00	2	5	0
53	2x 4m beam+mat 80mm	80	-5.52	50.46	-5.46	50.50	25-Feb-05	16:55	1.00	22	11	0
54	2x 4m beam+mat 80mm	80	-5.18	50.53	-5.27	50.51	25-Feb-05	19:55	2.00	3	148	1
55	2x 4m beam+mat 80mm	80	-5.24	50.67	-5.17	50.63	26-Feb-05	06:00	2.00	68	153	3
56	2x 4m beam+mat 80mm	80	-5.36	50.68	-5.44	50.65	26-Feb-05	09:00	1.00	3	47	0
57	2x 4m beam+mat 80mm	80	-5.47	50.63	-5.54	50.59	26-Feb-05	10:20	1.00	1	9	0
58	2x 4m beam+mat 80mm	80	-5.64	50.47	-5.72	50.44	26-Feb-05	12:35	1.00	1	7	0
59	2x 4m beam+mat 80mm	80	-5.87	50.38	-5.91	50.33	26-Feb-05	14:45	1.00	0	15	0
60	2x 4m beam+mat 80mm	80	-5.97	50.32	-5.99	50.27	26-Feb-05	16:30	1.00	0	14	0
61	2x 4m beam+mat 80mm	80	-4.71	50.92	-4.70	50.88	27-Feb-05	06:50	1.00	14	4	0
62	2x 4m beam+mat 80mm	80	-4.89	50.86	-4.89	50.80	27-Feb-05	09:10	1.00	11	20	0
63	2x 4m beam+mat 80mm	80	-4.89	50.76	-4.94	50.70	27-Feb-05	10:45	1.00	73	26	0
64	2x 4m beam+mat 80mm	80	-4.97	50.68	-4.89	50.68	27-Feb-05	12:15	1.00	7	16	2

APPENDIX 2. CRUISE REPORT

THE CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE,
LOWESTOFT LABORATORY, SUFFOLK

FISHERIES SCIENCE PARTNERSHIP 2004

CRUISE REPORT: Programme 10, VIIf&g sole and plaice

- VESSEL:** F.V. Nellie.
- SKIPPER:** Stephen Knowles
- CEFAS STAFF:** Part 1. Steve Warnes; Part 2: Sven Kupschus
- DURATION:** 15 – 27 February 2005
- LOCALITY:** Eastern Celtic Sea (Bristol Channel to North Cornwall).
- GEAR:** Twin 4-m beam trawls.
- AIMS:** 1. Investigate distribution and population structure of sole and plaice in VIIf&g.
2. Investigate sole/plaice catch ratios

NARRATIVE: (All times are BST)

Part one: 15/2/05 to 21/02/05

The vessel sailed at 06:30 on 15/2/05

Started work off Pendeen in ICES Rectangles 29E4 at 1055 30E4. In order to take advantage of the good weather, it was decided to work north on the outside stations. Due to the fact that the net fleet was working outside the 6 degree line, it was not possible to work that row of rectangles. Work continued until 08:10 19/2/05 when NW gales caused work to stop. Nellie then steamed to shelter in Milford Haven, leaving again on the 20/02/05. The weather again prevented further work and the vessel steamed for Newlyn docking at 05:30 21/02/05. 29 stations were completed. There were very low catch rates of anything other than sole

Stratified otolith collection – was aiming for 10 per cm (max 5 from first half of cruise) would have achieved this if the weather had held. There was not enough space to use a balance in anything other than very good weather due to the available space on board.

Part two: 22/02/05 to 27/02/05

Sailed from Newlyn at 8:00 on Tuesday, steaming around to the Trevoise fishing grounds during the first half of the day. Sampling started at 13:45 on the inshore fishing grounds under worsening weather conditions. Over the following two days the fishing grounds inside the 12 mile limit were sampled intensely followed by a day of sampling outside the limit just south west of Lundy, before sailing into Padstow on Friday the 25th in an attempt to deal with some entanglement on the propeller. Set sail again at 6:00 on the 26th to continue sampling outside the 12 mile limit further to the SW. On the 27th sampling attempts were made in the inshore areas to the north east of the main fishing ground. Only a small number of stations could be sampled in the area due to obstructions on the seabed. The Nellie returned to Padstow for landing on the afternoon of the 27th.

Catches consisted predominantly of sole followed by a persistent presence of lemon sole, most of which were usually too small to be marketable, with a patchy numbers of plaice encountered, with numbers of small plaice being higher on the inshore stations. A few monk and some witches were found on the deeper stations, with some small monk recruits being encountered.

The predominant benthic invertebrates were starfish and sea urchins, the ratio usually being correlated to depth (urchins being associated with the deeper stations).