

**Final Report**

***Programme 6:  
Western Channel Sole and Plaice***

Prepared by:

**Georg H. Engelhard, Bill Mulligan, Oliver Wade, Robert Bush  
and Mike Armstrong**

*Cefas, Lowestoft*



**December 2007**

## SUMMARY: Western Channel Sole and Plaice

The beam trawlers *Lady T Emiel* and *Carhelmar* were chartered during the period August–October 2007 for the fifth in a series of FSP surveys of Western Channel sole and plaice. Similar FSP surveys using the same design and fishing gear were carried out during August–October of 2003–2006. These were aimed to show trends in distribution, abundance and age composition of sole and plaice, and information on by-catch species.

Sole and plaice constituted 4.0% and 2.1% respectively of the total number of fish caught by both vessels. In all, 61 fish and shellfish species were caught. Only 118 cod were caught, less than 0.2% of the catches, but this was more than in each of the previous 4 years. The distribution of sole and plaice (opposite) has shown a consistent pattern since 2003.

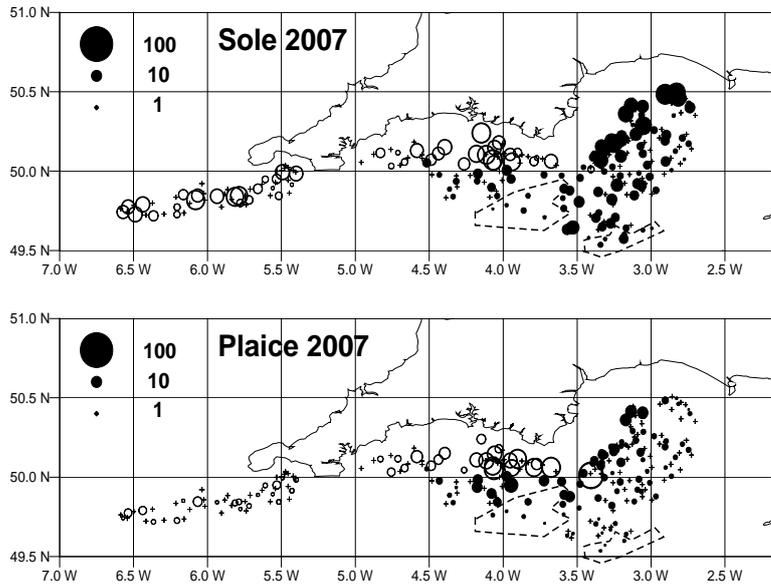
Catch rates of sole in 2007 were of comparable magnitude to those in the earlier surveys of 2003–2006 (see Table for catch rates by age and year). However, those for plaice were considerably lower than previously recorded during the FSP surveys; the decrease was more marked in the eastern survey.

The age composition of sole in the FSP surveys shows a broad range of ages, with fish >20 years old being recorded; this was less so in plaice (few fish >11 years observed). The relative age compositions of both sole and plaice in FSP surveys were broadly similar to those of the fishery landings in 2003–2006, and for sole, to those forecasted by ICES for 2007 (see bar chart). The trends in sole and plaice SSB from the FSP surveys are similar to the recent trend given by the ICES assessment. The FSP plaice SSB index was lower than in previous years, in line with the ICES forecast, but the latter is acknowledged to have high uncertainty.

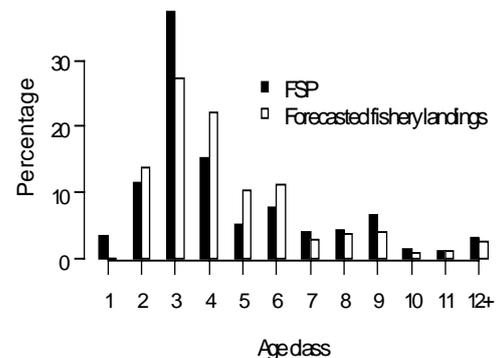
*Mean number caught per hour per metre beam during 2003–2007, averaged over eastern and western FSP surveys. The oldest age with data is a plus group in both species. An index of spawning-stock biomass (SSB) is also given ( $\text{kg h}^{-1} \text{m}^{-1}$ ).*

Age	SOLE					PLAICE				
	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
1	0.001	0.008	0.000	0.002	0.044	0.024	0.014	0.018	0.045	0.000
2	0.262	0.130	0.111	0.156	0.152	0.420	0.404	0.399	0.675	0.154
3	0.396	0.669	0.217	0.356	0.489	0.377	0.860	0.494	0.487	0.351
4	0.337	0.290	0.280	0.157	0.198	0.187	0.236	0.289	0.215	0.159
5	0.268	0.337	0.124	0.207	0.067	0.069	0.165	0.094	0.105	0.073
6	0.029	0.116	0.163	0.089	0.101	0.046	0.020	0.039	0.036	0.031
7	0.044	0.026	0.138	0.105	0.051	0.073	0.043	0.009	0.021	0.009
8	0.002	0.087	0.038	0.117	0.056	0.019	0.055	0.018	0.005	0.004
9	0.048	0.027	0.034	0.026	0.086	0.014	0.012	0.037	0.009	0.004
10/10+	0.039	0.008	0.015	0.021	0.017	0.010	0.006	0.014	0.015	0.009
11	0.042	0.012	0.020	0.017	0.014					
12+	0.026	0.034	0.053	0.042	0.041					
<b>Total</b>	<b>1.489</b>	<b>1.740</b>	<b>1.188</b>	<b>1.295</b>	<b>1.311</b>	<b>1.240</b>	<b>1.816</b>	<b>1.412</b>	<b>1.614</b>	<b>0.793</b>
<b>SSB index</b>	<b>0.339</b>	<b>0.373</b>	<b>0.336</b>	<b>0.314</b>	<b>0.290</b>	<b>0.308</b>	<b>0.440</b>	<b>0.345</b>	<b>0.315</b>	<b>0.201</b>

Catch rates of sole (top) and plaice (bottom) in 2007. Open circles, *Carhelmar*; solid circles, *Lady T Emiel*. Size of circles is proportional to catch rate.



Age composition of sole from the 2007 FSP survey, compared with ICES forecast for international landings in 2007.



## Introduction

The Fisheries Science Partnership (FSP) was established in 2003 to build relationships between fishermen and scientists, and to involve fishermen in the co-commissioning of science. The FSP is funded by the UK's Department for Environment, Food and Rural Affairs (Defra). Since its establishment, between 9 and 12 projects have been carried out annually, comprising a mixture of time-series surveys, fishing gear selectivity studies, examinations of spatial patterns of catch compositions, and work on predator-prey interactions. Reports for all completed FSP projects are available on the FSP page of the Cefas web site ([www.cefas.co.uk](http://www.cefas.co.uk)).

After the first two years of the programme, funding was assured by Defra for another three years. Industry proposals for FSP projects are typically developed at a port or regional level, refined and agreed with Cefas, before submission to the FSP's Steering Group for consideration. Charter vessels are selected through an open tendering procedure, and dispensations from the relevant quota and effort controls, and to fish in non-UK waters, are provided where appropriate.

Here we present results of FSP 2007/08 Programme 6, a survey on sole *Solea solea* and plaice *Pleuronectes platessa* in the Western English Channel, carried out by two commercial beam trawlers during 2007. The eastern part of the area was surveyed by FV *Lady T Emiel* (skipper Michael Sharp, observer Oliver Wade), from 21 August to 1 September 2007. The western part of the area was surveyed by FV *Carhelmar* (skipper Dave Murphy, observer Robert Bush), from 24 September to 6 October 2007. The survey represents the fifth in a time-series of FSP surveys of these stocks that commenced in 2003. Each year approximately the same area has been covered and the same fishing gear and towing practices have been used. In the western area FV *Nellie* was used in 2003–2004 and FV *Carhelmar* in 2005–2007; in the eastern area, *Lady T Emiel* has been used throughout the period 2003–2007. Full reports of the previous surveys (Cotter *et al.* 2004; Large *et al.* 2004; Armstrong *et al.* 2006; Roel *et al.* 2007) are available on the Cefas FSP web page ([www.cefas.co.uk/fsp](http://www.cefas.co.uk/fsp)).

## Objectives

The objective of Programme 6 in 2007 was to repeat the survey of sole and plaice in the Western Channel (ICES Division VIIe) carried out previously by the beam trawlers *Lady T Emiel*, *Nellie* and *Carhelmar*, using chain-mat gear. The survey was designed to provide the following information:

- Distribution patterns of sole, plaice and other commercial by-catch species
- Trends in abundance and age composition of sole and plaice
- Age/length information for sole, plaice, anglerfish and cod
- Amount of by-catch of species such as cod.

The detailed operational plan for the survey was discussed at a meeting between Cefas and the skippers or company representatives during early August. The operational plan for the *Lady T Emiel* survey is given in Appendix 1; the equivalent plan for the *Carhelmar* survey was essentially the same apart from the vessel/gear and area to be fished. Trawling was carried out under dispensation from the quota regulations. The vessels fished on the same stations, using the same gear and towing practices, as in the earlier years' FSP trips, the only

change being when the *Carhelmar* replaced the *Nellie* for the western part of the survey in 2005. The cruise narratives prepared by Cefas seagoing staff are reproduced in Appendix 2.

## Methods

### *Vessels and gear*

FV *Lady T Emiel* (BM2000) is a steel trawler of 29 m registered length, with a 747 kW engine. She fished with two 12-m beam trawls fitted with a heavy chain-mat running from the beam to the 18.5 m fishing line and designed to exclude rocks from the net. The codend mesh was 82 mm (nominal 80 mm) made from 5.5 mm single-braided twine. Rubber disks fitted on the fishing line were 10" diameter. The chain-mat trawl is usually towed at 3.8–4.0 knots. The warp:depth ratio was usually 6:1; because a 2:1 double purchase towing block was used on the gear, the actual ratio of the distance the gear was shot to depth was 3:1.

FV *Carhelmar* (BM23) is a steel trawler of 22.2 m registered length, with a 220 kW engine. She fished with two Interfish '4m beam' trawls (actual length just under 4.5 m), fitted with chain-mats. Rubber discs were approximately 8" and 6" diameter, on 26 mm wire.

### *Survey design*

The survey was designed to cover as large an area of the Western Channel sole and plaice fishing grounds as possible. The boundaries were agreed when drawing up the detailed operational plan (see Appendix 1). Tows were carried out at the same locations fished using chain-mat gear during the 2003–2006 FSP surveys. A number of additional tows were carried out towards the southern limits of the survey near the Hurd Deep in 2005, 2006 and 2007, to examine sole distribution and size composition there. The catch rates from those tows are excluded from the analysis of time-series data, but are included in the distribution plots. Some additional chain-mat tows were also made inshore in Lyme Bay in 2005 and 2006 at V-net stations fished in previous years, to collect additional data on young sole of the 2002 year class. These were repeated in 2007, but the data from those tows are also excluded from any analysis. A few additional tows carried out in 2006 to boost the otolith collection are also excluded from the abundance indices. All samples were collected during daylight.

### *Sorting and processing the catch*

Standard methods employed by Cefas staff for sorting and recording catches on commercial fishing vessels were employed (see FSP reports for 2004/05 for details). For each species retained for landing, the total volume of the catch (number of baskets) was recorded, and a length frequency was recorded for all or a sample of the fish. All species, whether retained or discarded, were measured at each haul. For the purpose of this report, the retained and discarded components were combined for the analysis. Where catches were sampled rather than fully sorted, an appropriate raising factor was determined in order to allow the total catch to be estimated. Otoliths of plaice and sole were collected from samples of fish taken across the survey area, to allow the age composition of the catches to be determined.

## Data analysis

Catch rates were calculated as numbers per hour towed and per metre of beam length, to standardise for the effects on catch of variable tow times and beam lengths. This convention has been adopted from previous FSP beam trawl surveys. Comparisons between years include only the tows using chain-mat gear in 2003 and 2004, for consistency with the 2005–2007 surveys. Only chain-mat stations that were sampled consistently for the whole period of the surveys were used for calculating abundance indices. Stations excluded from the analysis were the offshore ones done in the eastern area in 2005–2007 and the additional stations performed in 2006 with the purpose of collecting extra otolith samples.

The catch rates are here presented for the two vessels separately, as was done for the 2006 FSP report on these stocks. This differs from the 2003–2005 FSP reports where the data for both vessels were combined but shown separately for an eastern and a western area, divided by the 4°15'W meridian. Data from earlier years were reworked in the same format for consistency. Results are presented for the western surveys, undertaken by *Nellie* (2003–2004) and *Carhelmar* (2005–2007), and eastern surveys undertaken each year by *Lady T Emiel* (Figure 1).

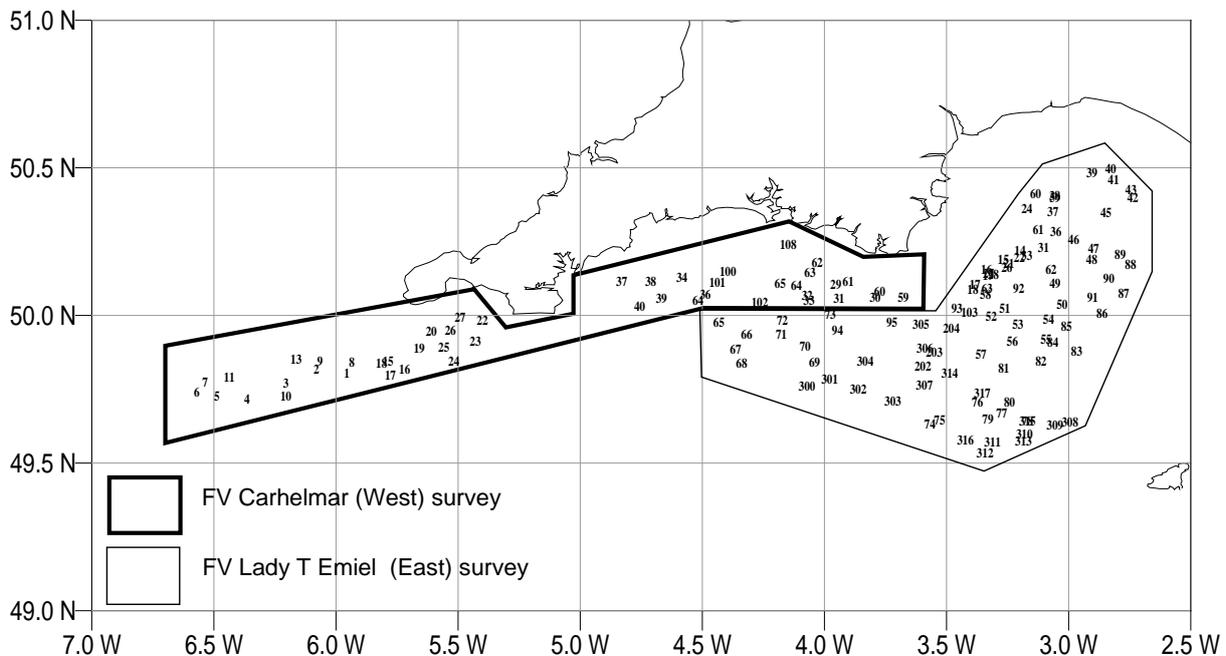


Figure 1. Shooting positions for all tows made by *Carhelmar* and *Lady T Emiel* (prime stations indicated). Western and eastern strata used for data analysis are indicated.

For sole, plaice, lemon sole *Microstomus kitt*, megrim *Lepidorhombus whiffiagonis*, and monkfish *Lophius piscatorius*, mean length frequency distributions (numbers  $\text{h}^{-1} \text{m}^{-1}$  beam) were calculated separately for the western and eastern surveys, as averages over the distributions by station. Otolith samples of sole and plaice were collected across all length classes to determine the proportion at age in each length class. This was compiled into age-length keys for the two species, which were applied to the standardised length frequencies to give numbers at age for each survey.

FSP reports prior to 2006 contained only length frequency data for sole and plaice caught in the survey in 2003. Otoliths taken during the 2003 FSP survey have subsequently been read, but numbers collected were inadequate to give reliable age composition data. The age-length keys for sole and plaice in the 2003 FSP survey were therefore augmented by data from the commercial fishery for sole and plaice in Quarters 3 and 4 in 2003. For sole, the age-length keys were compiled from combined-sex data for both surveys and quarters, after ascertaining that the sex ratio by length class in the 2003 FSP otolith collection was similar to observations from subsequent FSP surveys. For plaice, where length frequencies and otoliths were collected by sex in 2003, the survey and commercial fishery data were analysed separately for males and females. Indices by age class are presented separately for the eastern and western surveys, and combined indices are given as the unweighted mean of the indices for the two survey areas.

## Results

### *Fishing stations*

Details of position, date and time, along with total numbers of fish caught for ten commercial species (sole, plaice, lemon sole, megrim, monkfish, cod, brill, red gurnard, hake and red mullet) are given in Appendix 3. Figure 1 shows the shooting positions of each haul made by the vessels in 2007. The tow positions were as fished in the 2005 and 2006 FSP surveys. In all, 94 tows were carried out by *Lady T Emiel* and 50 tows by *Carhelmar* (Table 1)

**Table 1.** FSP “Western Channel sole and plaice” survey 2007. Synopsis of fishing activities.

Vessel	Dates (2007)	Number of hauls	Tow duration (min.) Average (range)
<i>Lady T Emiel</i>	21 August–1 September	94	61 (16–162)
<i>Carhelmar</i>	24 September–5 October	50	60 (60–60)

### *Distribution patterns*

Standardised plots of the distributions of sole, plaice, lemon sole, megrim and monkfish are shown for the 2003–2007 surveys in Figures 2–6. The scale on the charts for all years and species is the same (i.e. the same catch rate for any species and year is shown by circles of the same size on each plot). The dashed lines on each plot encompass the additional offshore tows carried out only from 2005 to 2007. In general, the distribution patterns of the five species remained consistent over the five years.

**Sole** (Figure 2) were caught in 142 of the 144 tows. Their distribution was very similar to that in previous years, with greatest numerical abundance at the more inshore locations and near the Scilly Isles.

**Plaice** (Figure 3) were caught in 134 of the 144 tows. Catch rates in the western part of the survey area were similar to those of previous years, but this contrasted with the eastern part (east of 4°W), where the catch rates were considerably lower than in 2006.

**Lemon sole** (Figure 4) were caught in 86 tows, with zero catches being most prevalent in the eastern part of the survey area. Catch rates were generally best in the area west of 3°30'.

**Megrim** (Figure 5) were caught in just 25 tows, almost entirely to the south and west of the Lizard (west of 05°30').

**Monkfish** (Figure 6) were taken in 114 tows. Catch rates were greatest in tows west of 05°30' each year, and in most years also at the most offshore stations in the eastern region, including the additional tows near the Hurd Deep fished during 2005–2007. The distribution pattern was very similar in 2003, 2005 and 2006, with much poorer catch rates recorded offshore in the eastern survey in 2004.

**Cod** were more often encountered than in each of the four previous years, and in 2007 were taken in 52 of the 144 tows (23 of 151 tows in 2006). They tended to be caught in the more offshore, eastern stations.

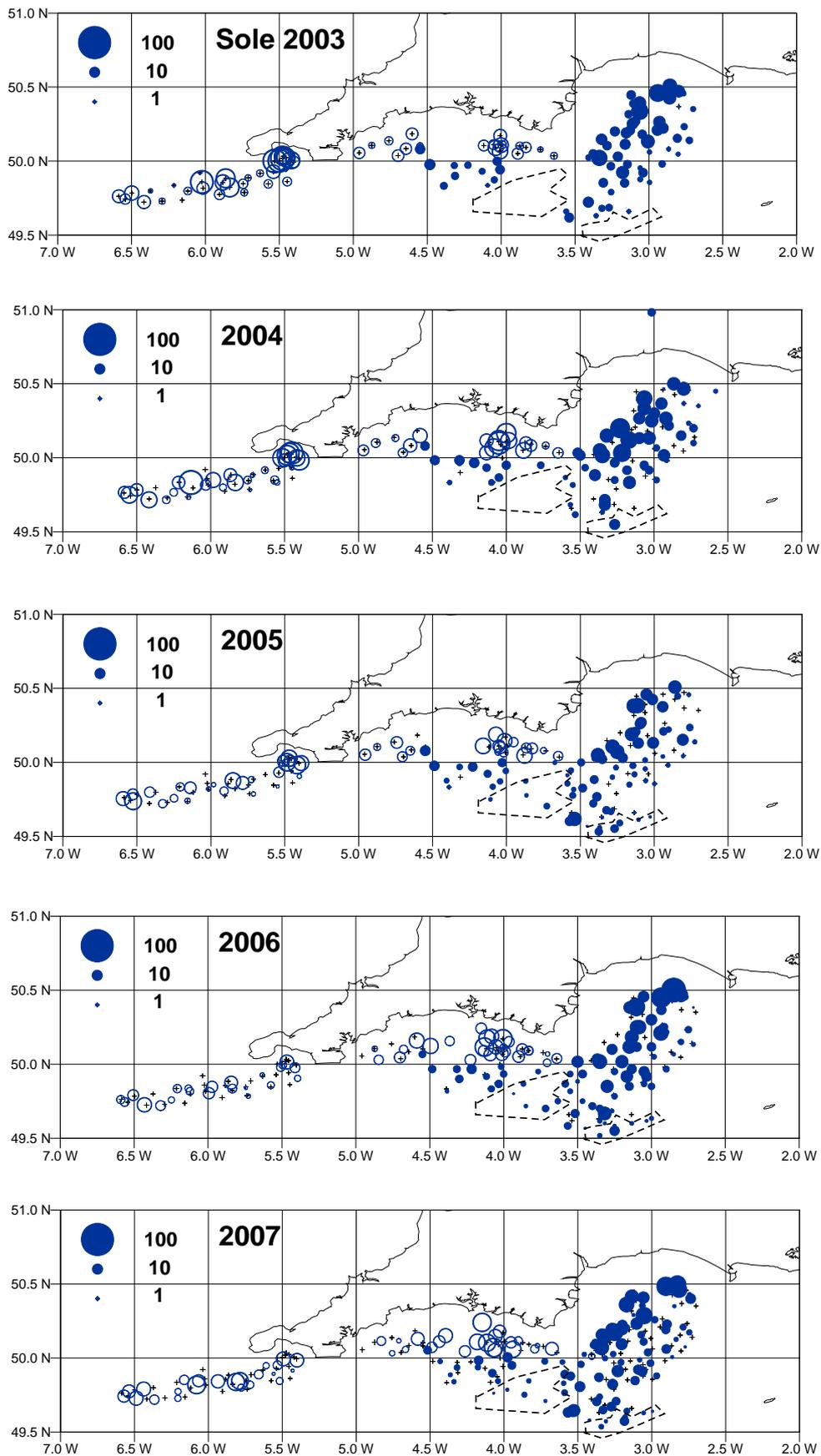


Figure 2. Catch rates of sole during FSP “Western Channel Sole and Plaice” surveys, 2003–2007 (open circles: *Nellie/Carhelmar*; filled circles: *Lady T Emiel*). Numbers per hour standardised to an 8-metre beam length. Dashed lines: additional offshore stations sampled only in 2005–2007.

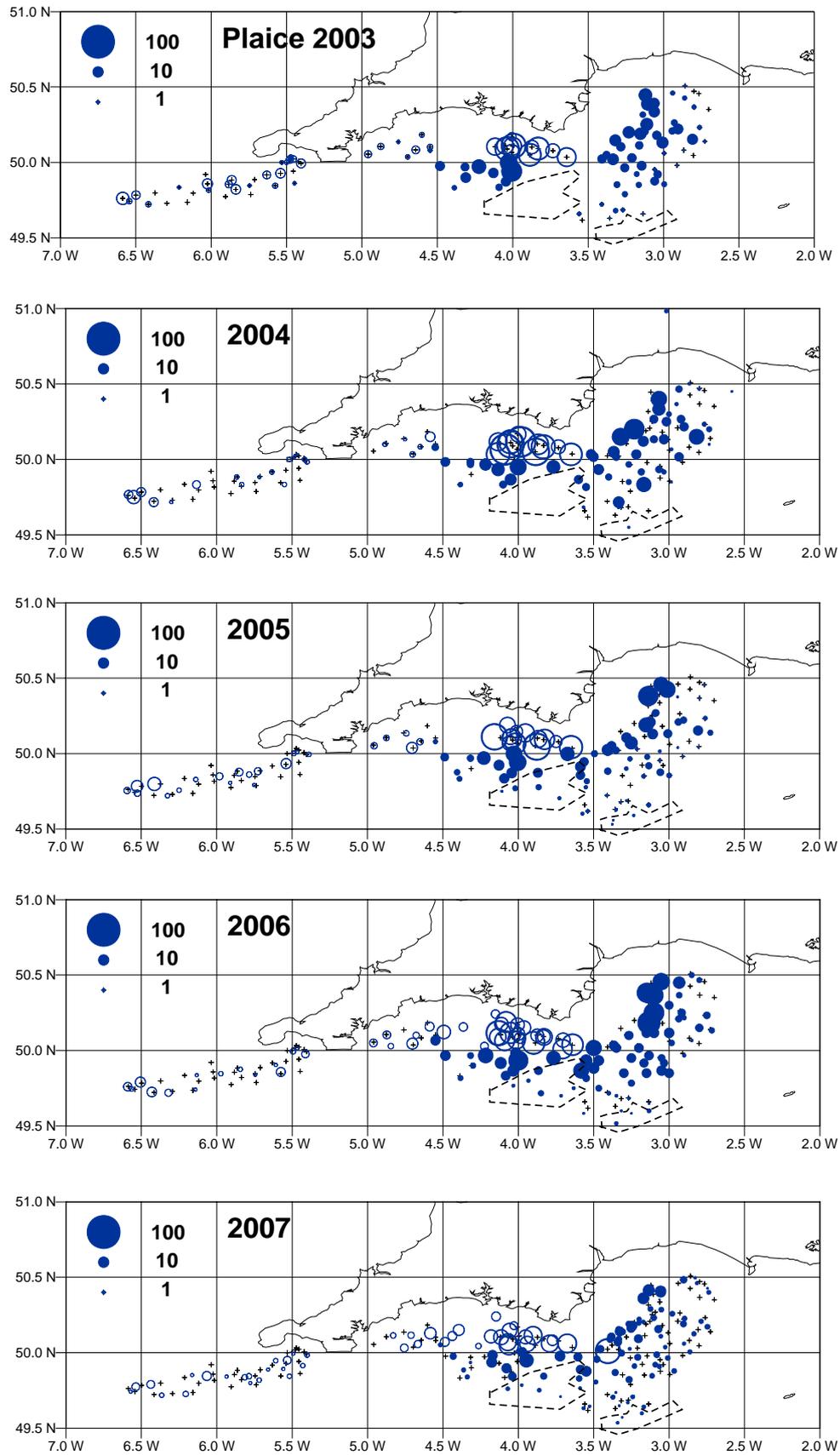


Figure 3. Catch rates of plaice during FSP “Western Channel Sole and Plaice” surveys, 2003–2007 (open circles: *Nellie/Carhelmar*; filled circles: *Lady T Emiel*). Numbers per hour standardised to an 8-metre beam length. Dashed lines: additional offshore stations sampled only in 2005–2007.

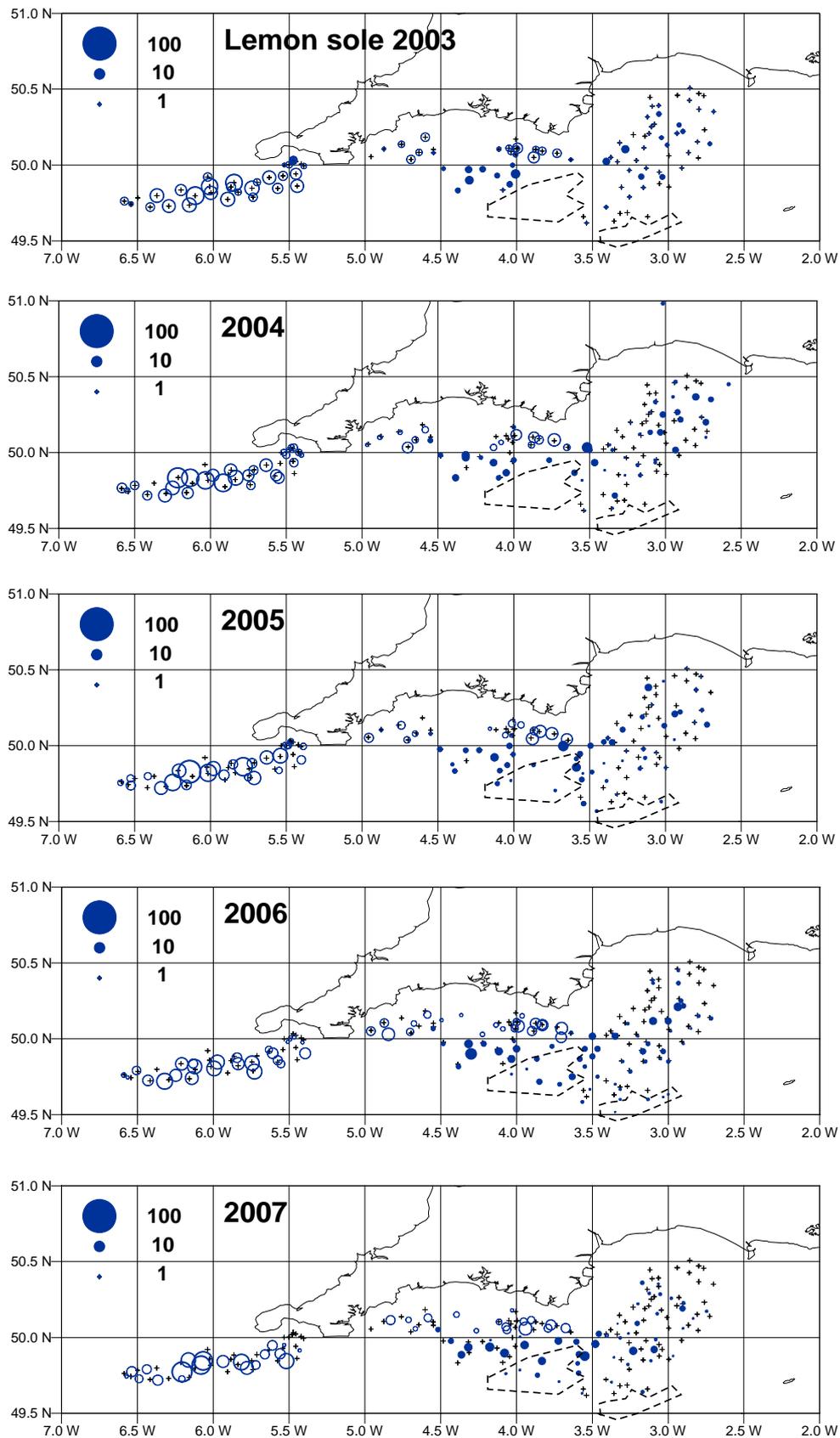


Figure 4. Catch rates of lemon sole during FSP “Western Channel Sole and Plaice” surveys, 2003–2007 (open circles: *Nellie/Carhelmar*; filled circles: *Lady T Emiel*). Numbers per hour standardised to an 8-metre beam length. Dashed lines: additional offshore stations sampled only in 2005–2007.

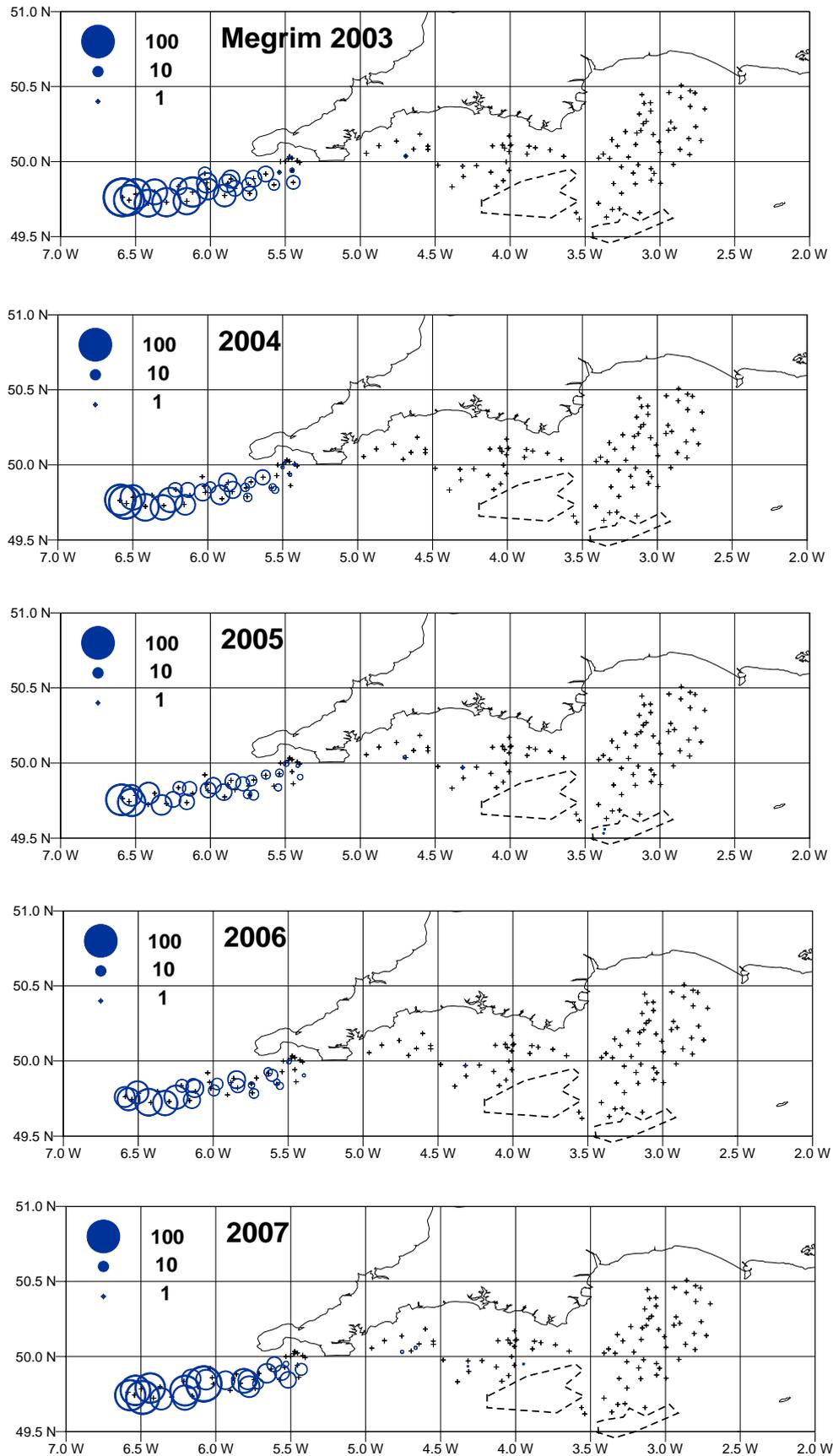


Figure 5. Catch rates of megrim during FSP “Western Channel Sole and Plaice” surveys, 2003–2007 (open circles: *Nellie/Carhelmar*; filled circles: *Lady T Emiel*). Numbers per hour standardised to an 8-metre beam length. Dashed lines: additional offshore stations sampled only in 2005–2007.

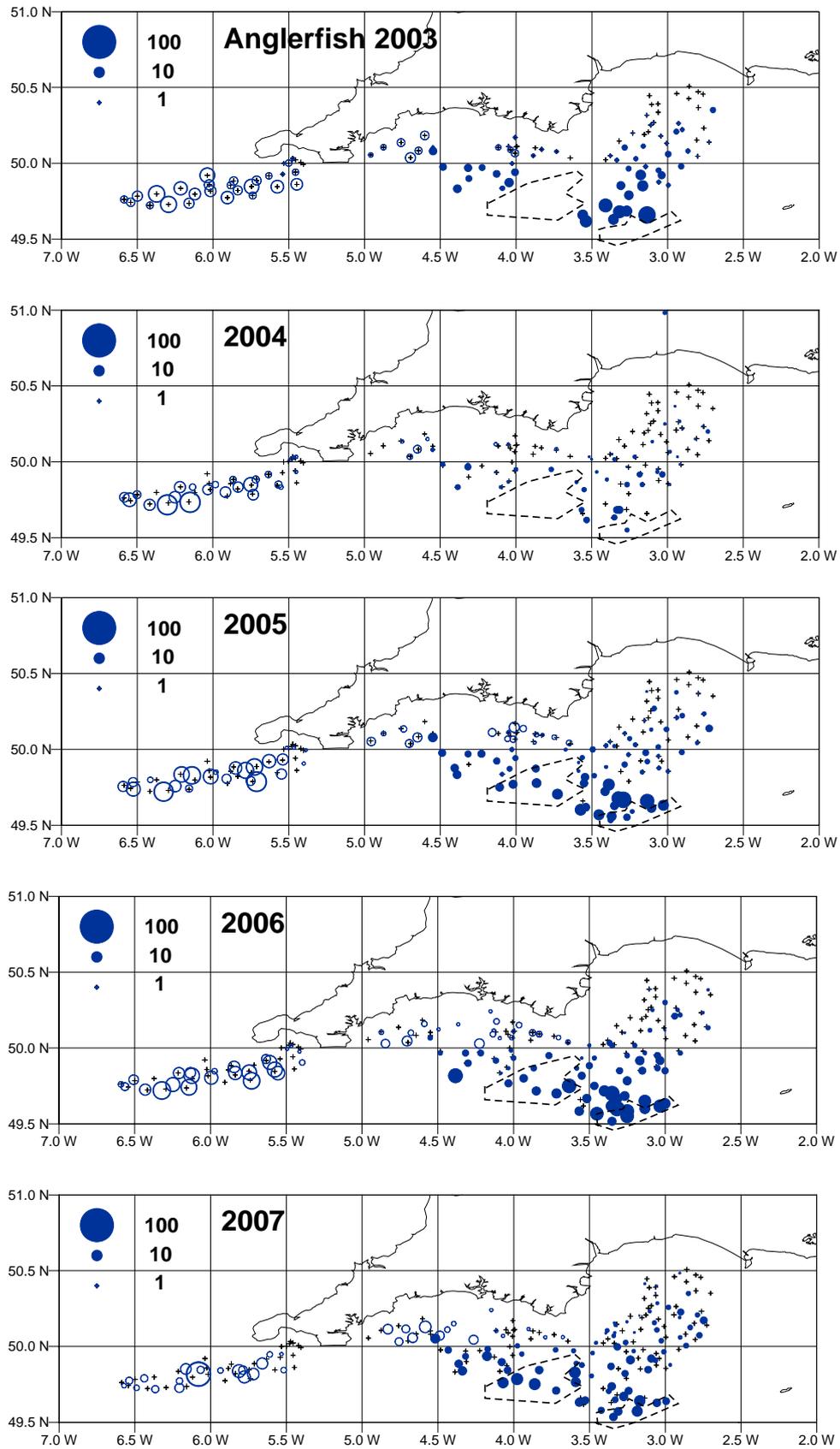


Figure 6. Catch rates of anglerfish during FSP “Western Channel Sole and Plaice” surveys, 2003–2007 (open circles: *Nellie/Carhelmar*; filled: *Lady T Emiel*). Numbers per hour standardised to an 8-metre beam length. Dashed lines: additional offshore stations sampled only in 2005–2007.

## Catch compositions

In the 2007 surveys, sole and plaice made up 4.0% and 2.1%, respectively, of the total number of fish and shellfish caught by *Lady T Emiel* and *Carhelmar* combined (Figures 7a, 7b). In the eastern survey (*Lady T Emiel*), 55 species of fish and shellfish were caught in total; for the western (*Carhelmar*) survey this number was 44. The three most abundant species in the eastern survey were lesser spotted dogfish *Scyliorhinus canicula*, poor cod *Trisopterus minutus* and red gurnard *Aspitrigula cuculus*, each constituting about 19–20% of the total number of fish and shellfish caught here. In the western survey, poor cod and common dragonet *Callionymus lyra* were most abundant (each about 16% of the total number) followed by red gurnard (12.2%) and lesser spotted dogfish (10.1%). Two cod were caught by *Carhelmar* and 116 by *Lady T Emiel*, comprising 0.014% and 0.242% of each vessel's total catch by number, confirming previous years' results that UK beam trawlers in this area have a very low by-catch of cod in this period. Their length averaged 44 cm (range 36–65 cm).

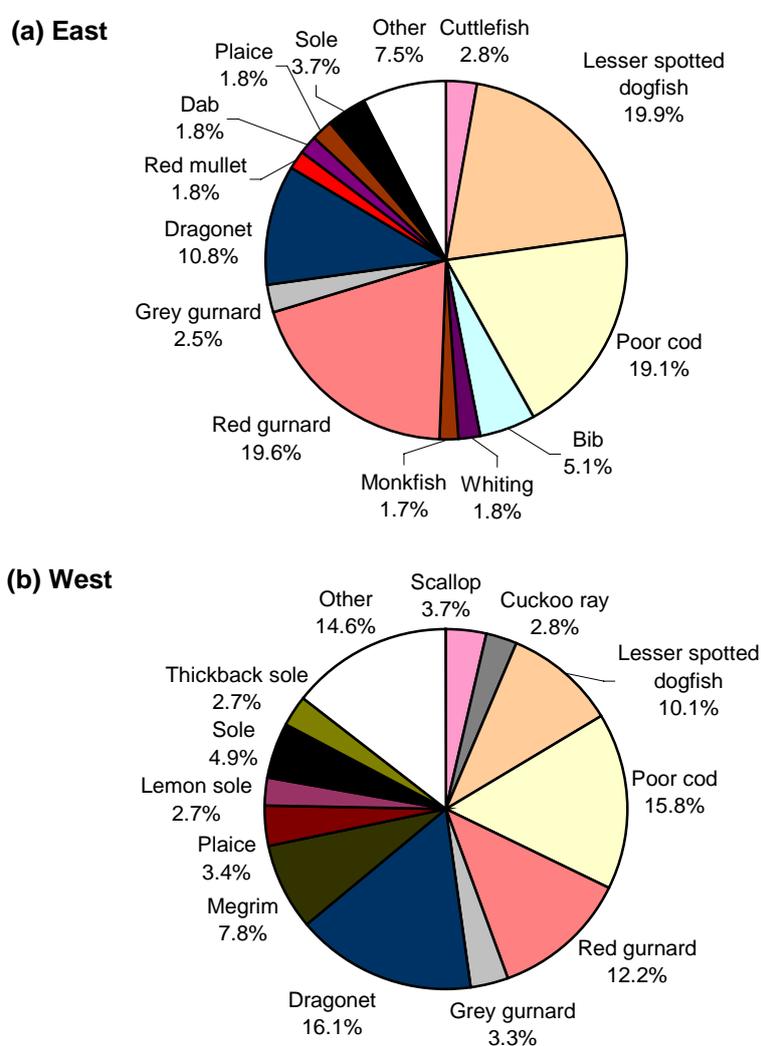


Figure 7. FSP “Western Channel Sole and Plaice” survey 2007: percentage catch composition by number, shown for the 12 most abundant species caught by (a) *Lady T Emiel* (eastern survey) and (b) *Carhelmar* (western survey).

### ***Length compositions***

Length distributions for sole, plaice, monkfish, lemon sole and megrim in the eastern and western survey areas were compared over the 5-year period of the surveys (Figures 8–12). Megrim was near-absent from the eastern survey area.

**Sole** (Figure 8). In the east, both catch rates and the overall length distribution remained fairly stable, although in 2004 and 2007 the distribution was slightly more towards smaller (~25–30 cm) fish than in 2003, 2005 and 2006. In the west, the overall length distribution has remained fairly constant, but the catch rates were much higher in 2003 and 2004 than in the following three years.

**Plaice** (Figure 9). In the east, the shape of the plaice length frequency distributions remained stable from 2003 to 2005, but catch rates in 2006 increased particularly for fish 24–35 cm long. This was, however, followed by a notable drop in the catch rate in 2007. In all years, plaice catch rates were better in the western than in the eastern survey. Plaice caught in the western survey in 2006 were several centimetres smaller, on average, than recorded in the period 2003–2005. In the west, plaice catch rates in 2007 were lower than in each of the previous four years, although the drop was not as marked as in the eastern survey.

**Monkfish** (Figure 10). The length compositions and the overall catch rates have differed substantially between the western and eastern strata in each year. A marked abundance of small anglerfish <25 cm long was recorded in 2004 in the western survey, and was also shown in the western anglerfish FSP survey (Walmsley *et al.* 2004). This indicated a relatively strong year-class entering the fishery in 2004. Further evidence of this stronger year-class was provided by the increased abundance of 25–35 cm fish in 2005, of 40–50 cm fish in 2006, and of 60–70 cm fish in 2007. This trend is evident also in the FSP western anglerfish survey in 2006 (Smith *et al.* 2006). These patterns were not evident in the eastern area, indicating that young anglerfish are more prevalent in the Celtic Sea and Western Approaches than in the English Channel. Similar length frequencies were observed in 2003, 2005, 2006 and 2007, with 2004 showing lower catch rates (also apparent in the distribution maps in Figure 6).

**Lemon sole** (Figure 11). The abundance and length composition of lemon sole were very different between the eastern and western surveys. Lemon sole were far more abundant in the west than in the east. This difference was especially marked for the relatively small (20–25 cm) lemon sole, which were frequently caught in the west but rarely taken in the east. In the west, catch rates of >25 cm lemon sole have been very constant over the five years, whereas those of 20–25 cm fish have been more variable (lowest in 2003).

**Megrim** (Figure 12) were commonly caught in the western, *Nellie* and *Carhelmar* surveys, but only very rarely in the eastern, *Lady T Emiel* surveys. In 2007, very marked abundance of 20–30 cm megrim was observed in the west implying a strong year-class entering the fishery, in line with previous year's predictions (Roel *et al.* 2007), based on above-average catch rates for 20–30 cm megrim observed in the 2006 FSP. Catch rates of megrim >30 cm have been relatively constant over the years.

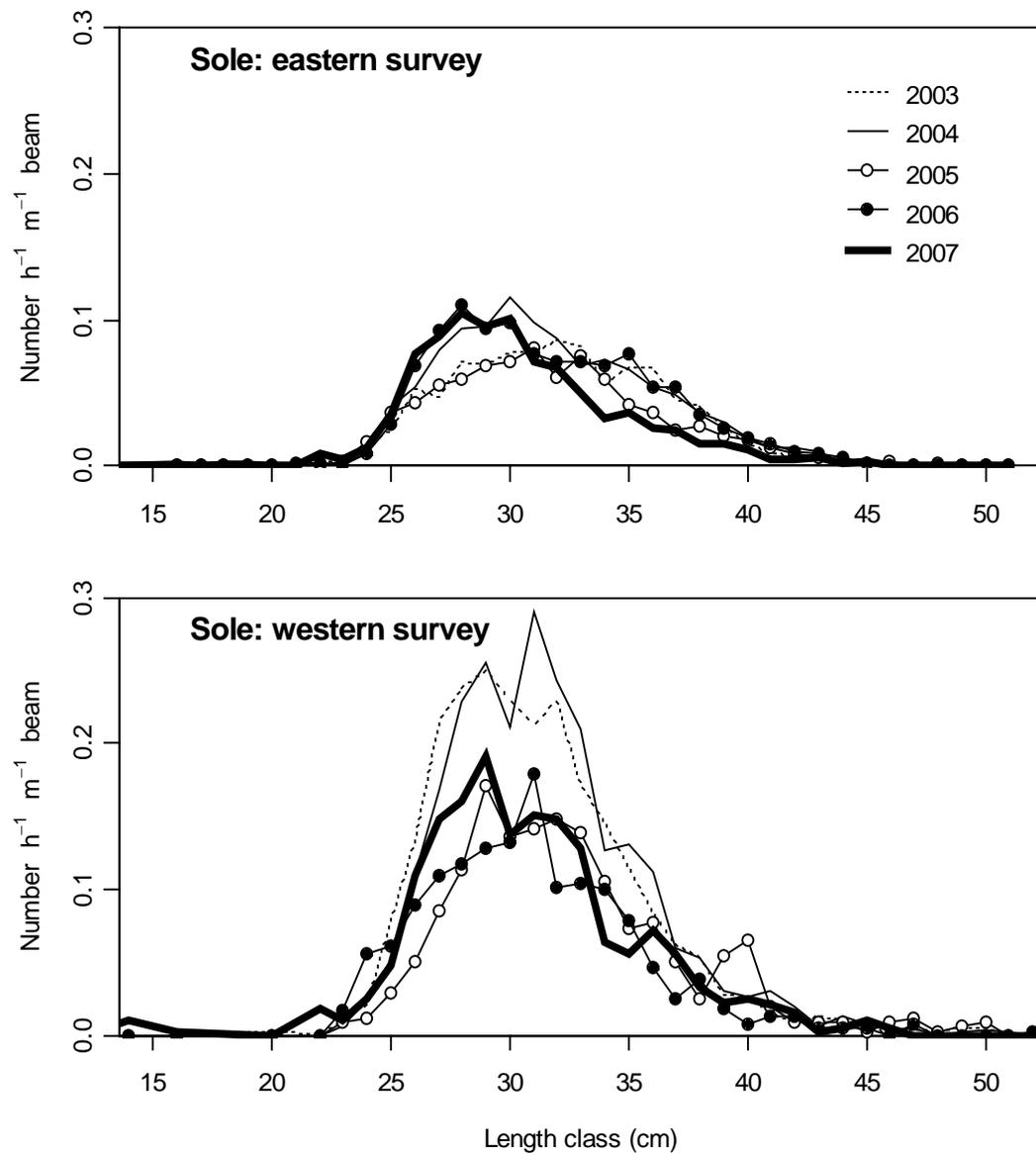


Figure 8. Length distributions of sole in “Western Channel Sole and Plaice” FSP surveys, 2003–2007. Figures represent the numbers caught per metre beam length per hour fished, by 1-cm length bin, averaged over all stations consistently sampled during the eastern and western surveys.

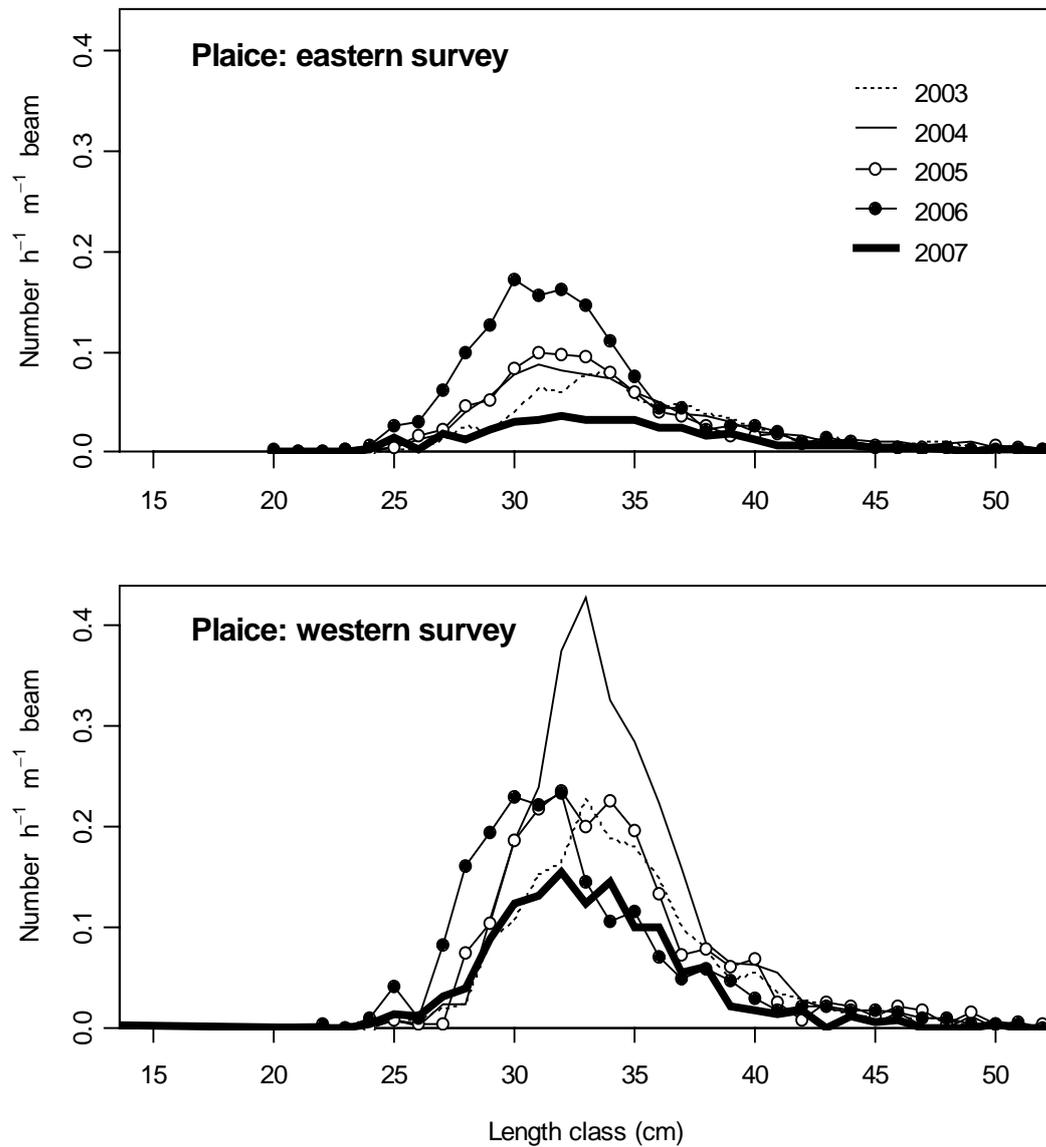


Figure 9. Length distributions of plaice in “Western Channel Sole and Plaice” FSP surveys, 2003–2007. Figures represent the numbers caught per metre beam length per hour fished, by 1-cm length bin, averaged over all stations consistently sampled during the eastern and western surveys.

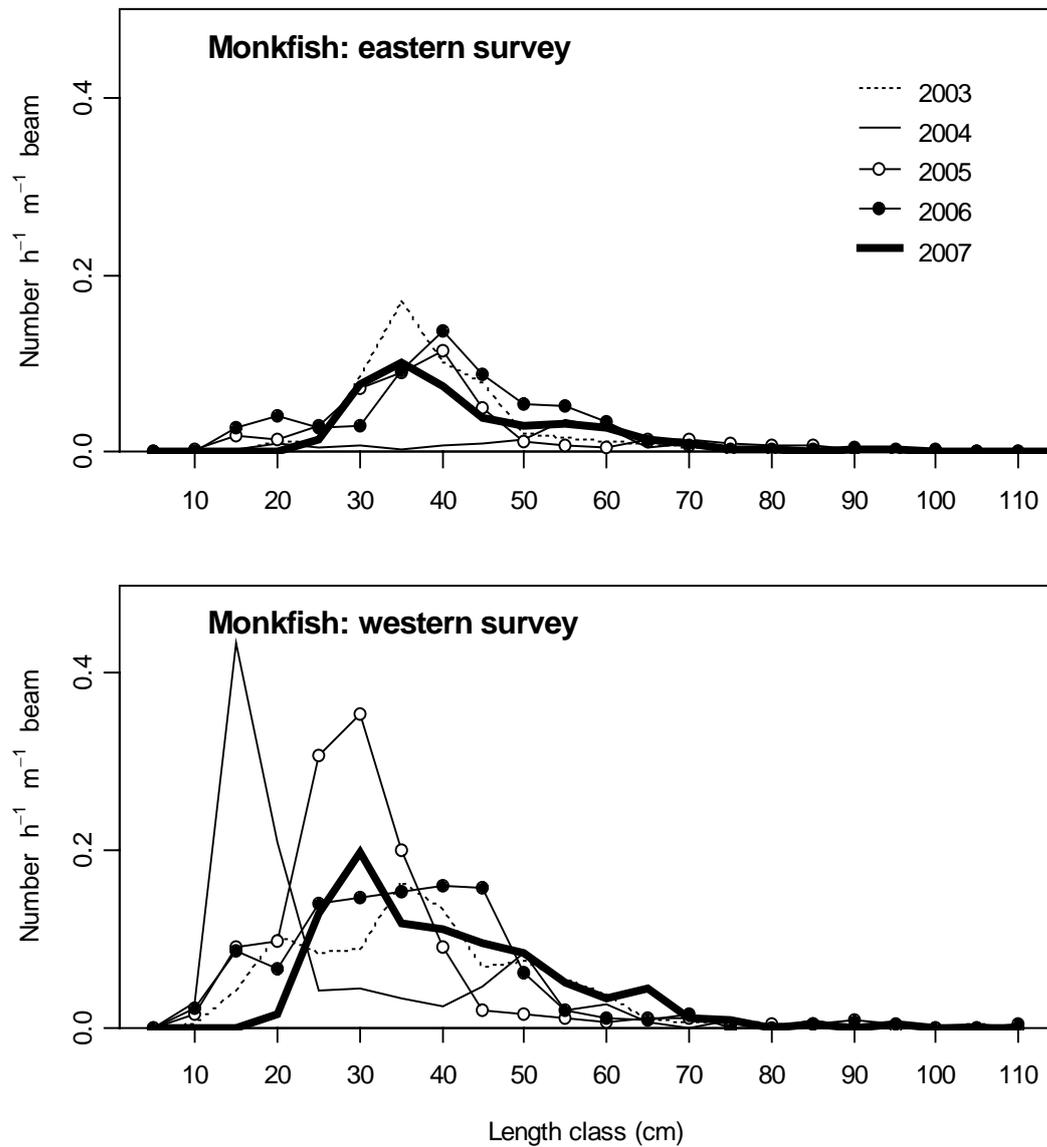


Figure 10. Length distributions of monkfish (*L. piscatorius*) in “Western Channel Sole and Plaice” FSP surveys, 2003–2007. Figures represent the numbers caught per metre beam length per hour fished, by 5-cm length bin, averaged over all stations consistently sampled during the eastern and western surveys.

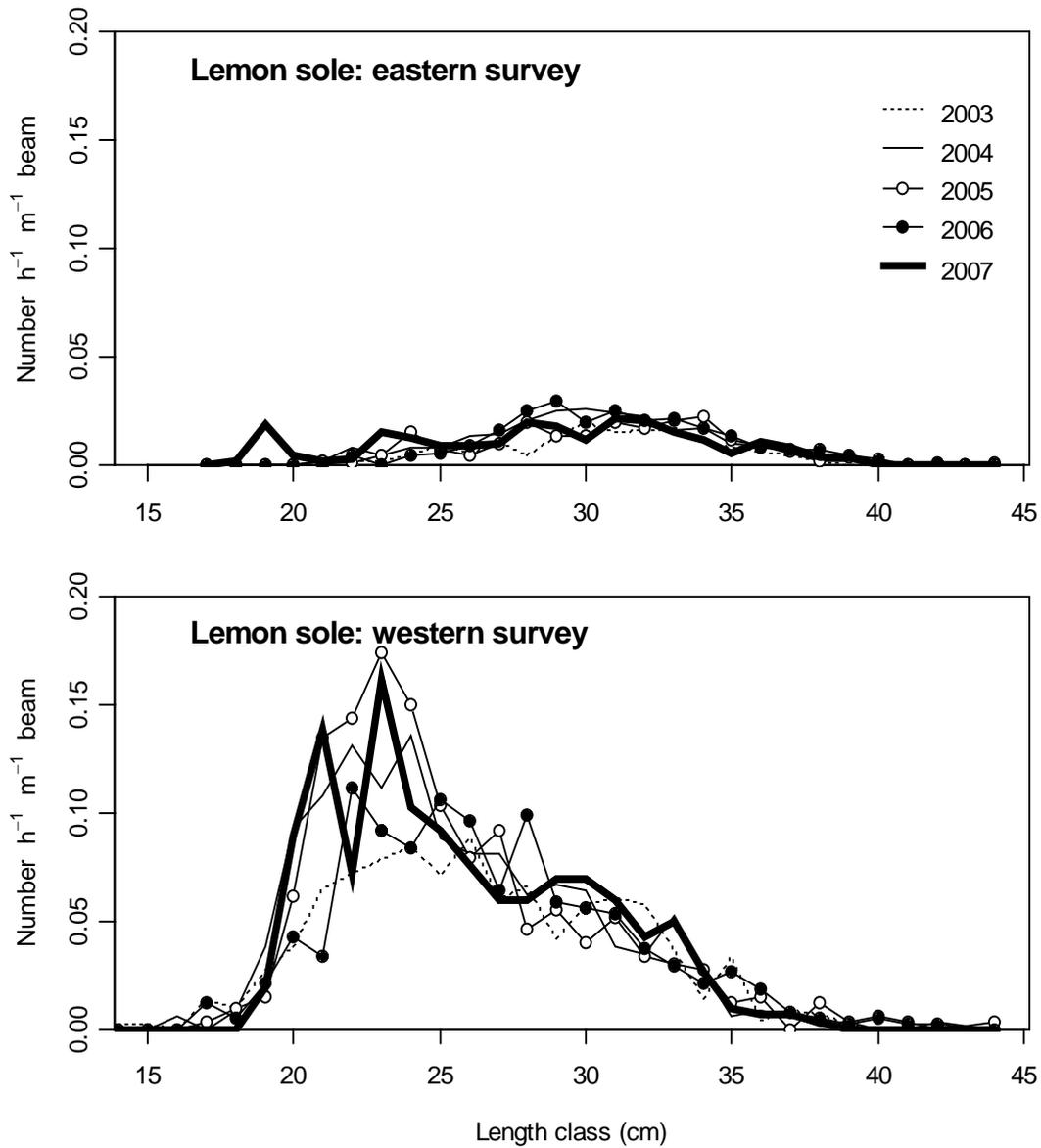


Figure 11. Length distributions of lemon sole in “Western Channel Sole and Plaice” FSP surveys, 2003–2007. Figures represent the numbers caught per metre beam length per hour fished, by 1-cm length bin, averaged over all stations consistently sampled during the eastern and western surveys.

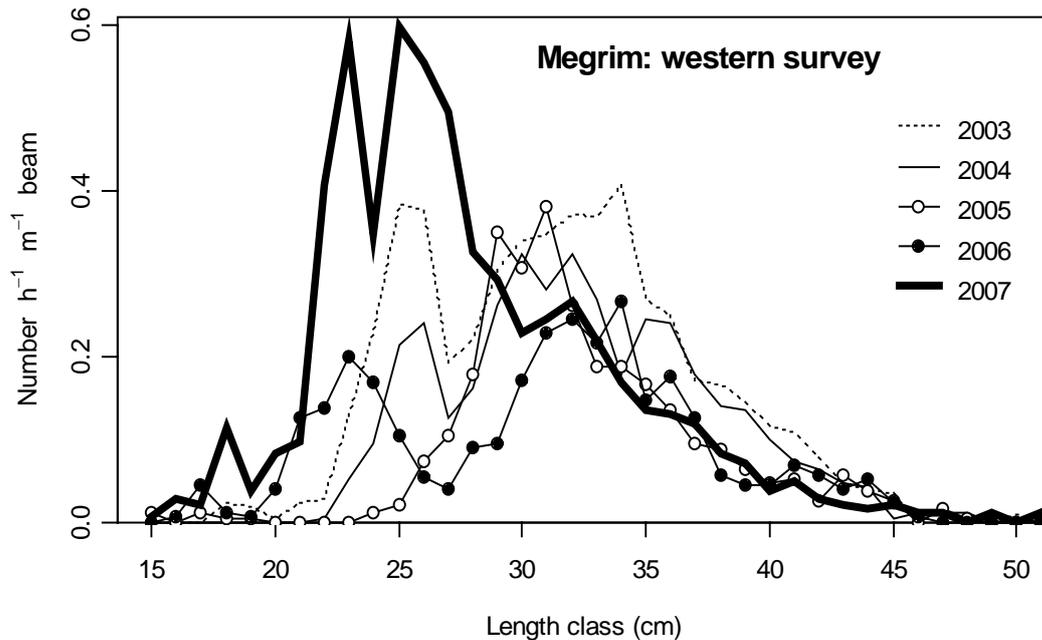


Figure 12. Length distributions of megrim in “Western Channel Sole and Plaice” FSP surveys, 2003–2007. Figures represent the numbers caught per metre beam length per hour fished, by 1-cm length bin, averaged over all stations consistently sampled during the western surveys.

### *Age compositions*

**Sole** (Figure 13). A broad age composition of sole has been evident in all five years of the FSP programme, with fish of 12 years and older still being relatively common. In most years, 3-year-old sole dominated the catches, with the exception of 2005, when 4-year-olds dominated. The latter represented the strong 2001 year-class, which showed a particularly marked peak in abundance in 2004 at age 3. Other above-average year-classes were the 1998 and especially 1999 year-classes, which showed up as elevated catch rates at ages 9 and 8 respectively in the 2007 surveys. The 2004 year-class (age 4 in 2007) also appears to be above-average, but to a slighter extent. Catch rates by age for the whole period 2003–2007 are also given by area in Table 2, and averaged over eastern and western surveys in Table 4. In 2007 the oldest sole sampled on *Carhelmar* and on *Lady T Emiel*, respectively, were 19 and 29 years old.

**Plaice** (Figure 14). The 2007 age distribution for plaice differed from previous years in that generally the catch rates were lower. This was especially noticeable for the 2-year-old plaice ( $<0.2$  fish  $\text{h}^{-1} \text{m}^{-1}$  beam, compared with about  $0.4$ – $0.6$  fish  $\text{h}^{-1} \text{m}^{-1}$  beam in previous years), suggesting that the 2005 year-class may be below-average. Although in 2006, the 2004 year-class was caught frequently as 2-year-olds, its catch rate as 3-year-olds in 2007 was rather low. At the higher ages (5 years and older), catch rates in 2007 did not stand out as much as being low. Generally, age distributions of plaice have been less broad than for sole. From the age distributions, two year-classes (1996 and 2001) stand out as strong; the 2004 year-class appeared above-average from the 2006 survey, but the 2007 survey does not provide such an indication. Catch rates by age for the period 2003–2007 are also given in Tables 3 and 4. In 2007 the oldest plaice sampled on *Carhelmar* and on *Lady T Emiel*, respectively, were 13 and 18 years old; very few plaice older than 11 years were caught.

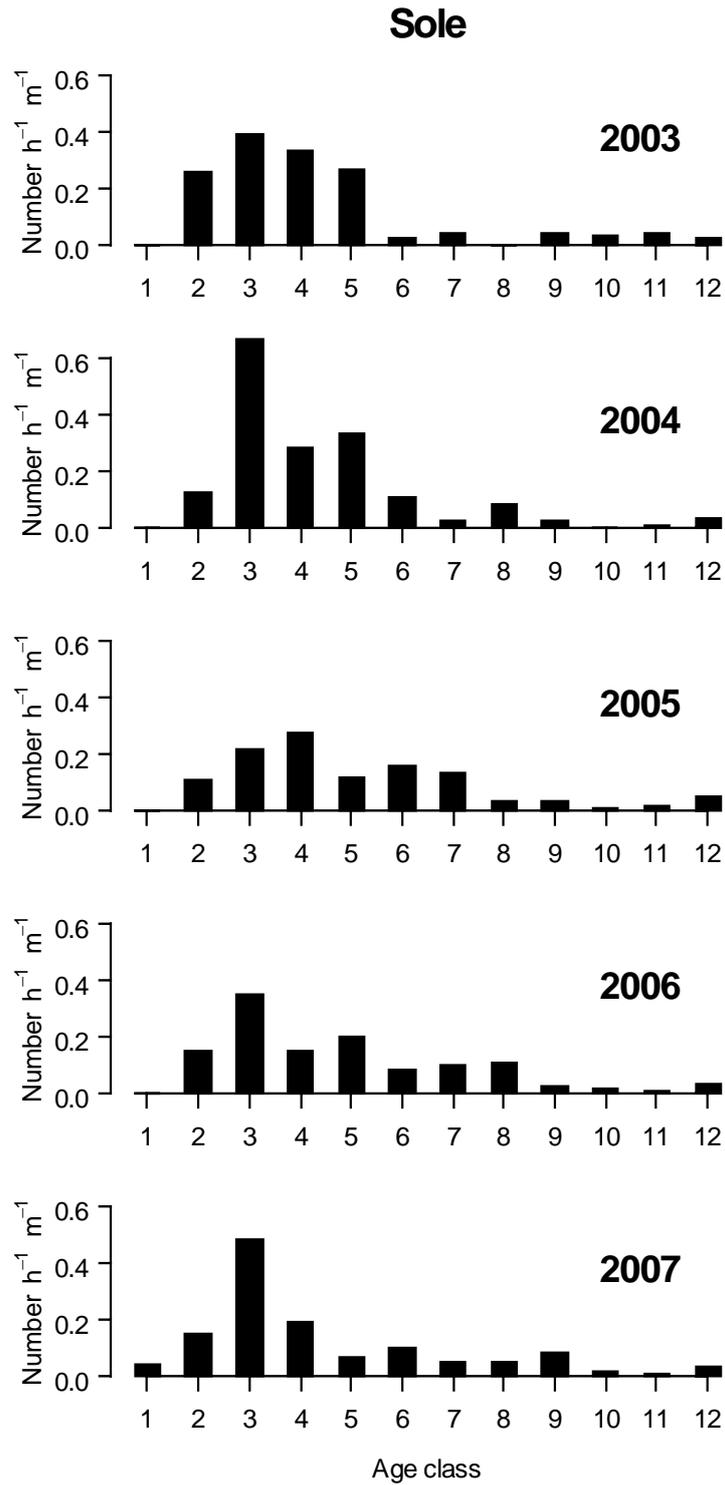


Figure 13. Mean number of sole of different ages caught per hour per metre beam length for both vessels combined (2003–2007). Age 10 is a plus-group including also the older ages.

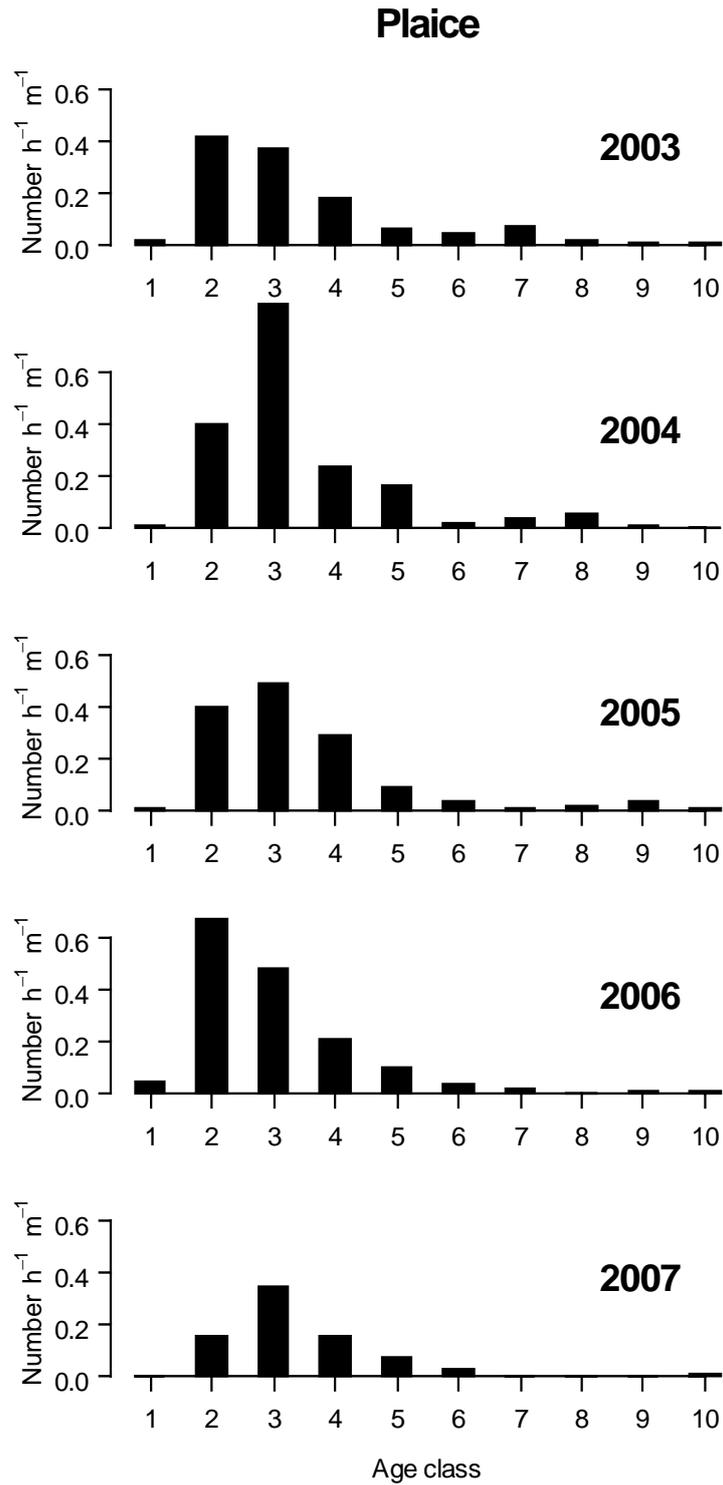


Figure 14. Mean number of plaice of different ages caught per hour per metre beam length for both vessels combined (2003–2007). Age 10 is a plus-group including also the older ages.

**Table 2.** Mean numbers of sole caught per hour per metre beam length, by age class and survey area during the 2003–2007 FSP “Western Channel Sole and Plaice” surveys. An index of spawning stock biomass is also shown (kg h<sup>-1</sup> m<sup>-1</sup> beam).

SOLE	East					West					
	Age	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
1	0.001	0.015	0.000	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.086
2	0.149	0.081	0.087	0.137	0.109	0.374	0.179	0.135	0.175	0.194	0.194
3	0.223	0.389	0.144	0.320	0.360	0.569	0.948	0.290	0.391	0.618	0.618
4	0.235	0.176	0.189	0.140	0.143	0.439	0.403	0.371	0.173	0.253	0.253
5	0.189	0.224	0.086	0.202	0.050	0.347	0.450	0.161	0.212	0.084	0.084
6	0.023	0.082	0.120	0.092	0.072	0.035	0.150	0.205	0.086	0.129	0.129
7	0.037	0.019	0.099	0.110	0.042	0.051	0.033	0.177	0.100	0.060	0.060
8	0.002	0.057	0.029	0.121	0.038	0.001	0.116	0.046	0.112	0.073	0.073
9	0.029	0.023	0.025	0.026	0.064	0.066	0.031	0.042	0.025	0.108	0.108
10	0.030	0.007	0.011	0.023	0.012	0.047	0.009	0.018	0.018	0.022	0.022
11	0.028	0.011	0.014	0.018	0.012	0.056	0.013	0.025	0.015	0.016	0.016
12+	0.020	0.020	0.037	0.043	0.029	0.031	0.048	0.068	0.040	0.052	0.052
Total	0.965	1.102	0.846	1.237	0.929	2.012	2.378	1.529	1.354	1.693	1.693
SSB index	0.236	0.245	0.239	0.314	0.213	0.441	0.502	0.433	0.315	0.366	0.366

**Table 3.** Mean numbers of plaice caught per hour per metre beam length, by age class and survey area during the 2003–2007 FSP “Western Channel Sole and Plaice” surveys. An index of spawning stock biomass is also shown (kg h<sup>-1</sup> m<sup>-1</sup> beam).

PLAICE	East					West					
	Age	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
1	0.016	0.010	0.019	0.041	0.000	0.033	0.018	0.017	0.049	0.000	0.000
2	0.236	0.197	0.233	0.557	0.076	0.604	0.611	0.565	0.793	0.232	0.232
3	0.199	0.326	0.267	0.394	0.166	0.556	1.394	0.722	0.581	0.536	0.536
4	0.106	0.097	0.149	0.170	0.085	0.268	0.374	0.430	0.260	0.233	0.233
5	0.041	0.078	0.051	0.080	0.049	0.097	0.253	0.136	0.130	0.097	0.097
6	0.030	0.014	0.023	0.028	0.028	0.063	0.026	0.056	0.045	0.034	0.034
7	0.052	0.023	0.005	0.016	0.009	0.094	0.063	0.014	0.026	0.009	0.009
8	0.013	0.043	0.013	0.004	0.004	0.024	0.067	0.024	0.006	0.005	0.005
9	0.012	0.011	0.026	0.007	0.004	0.017	0.014	0.049	0.011	0.003	0.003
10+	0.007	0.010	0.014	0.017	0.010	0.013	0.003	0.013	0.013	0.009	0.009
Total	0.712	0.808	0.799	1.314	0.430	1.769	2.824	2.025	1.914	1.155	1.155
SSB index	0.194	0.225	0.196	0.252	0.126	0.423	0.656	0.494	0.377	0.276	0.276

**Table 4.** Sole and plaice: mean catch per hour per metre beam length, averaged over eastern and western surveys during the 2003–2007 FSP “Western Channel Sole and Plaice” surveys (chain-mat gear only). An index of spawning stock biomass is also shown ( $\text{kg h}^{-1} \text{m}^{-1}$  beam).

Age	SOLE					PLAICE				
	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
1	0.001	0.008	0.000	0.002	0.044	0.024	0.014	0.018	0.045	0.000
2	0.262	0.130	0.111	0.156	0.152	0.420	0.404	0.399	0.675	0.154
3	0.396	0.669	0.217	0.356	0.489	0.377	0.860	0.494	0.487	0.351
4	0.337	0.290	0.280	0.157	0.198	0.187	0.236	0.289	0.215	0.159
5	0.268	0.337	0.124	0.207	0.067	0.069	0.165	0.094	0.105	0.073
6	0.029	0.116	0.163	0.089	0.101	0.046	0.020	0.039	0.036	0.031
7	0.044	0.026	0.138	0.105	0.051	0.073	0.043	0.009	0.021	0.009
8	0.002	0.087	0.038	0.117	0.056	0.019	0.055	0.018	0.005	0.004
9	0.048	0.027	0.034	0.026	0.086	0.014	0.012	0.037	0.009	0.004
10/10+	0.039	0.008	0.015	0.021	0.017	0.010	0.006	0.014	0.015	0.009
11	0.042	0.012	0.020	0.017	0.014					
12+	0.026	0.034	0.053	0.042	0.041					
Total	<b>1.489</b>	<b>1.740</b>	<b>1.188</b>	<b>1.295</b>	<b>1.311</b>	<b>1.240</b>	<b>1.816</b>	<b>1.412</b>	<b>1.614</b>	<b>0.793</b>
SSB index	0.339	0.373	0.336	0.314	0.290	0.308	0.440	0.345	0.315	0.201

## Discussion

Five years of FSP “Western Channel Sole and Plaice” surveys have now been carried out, covering a substantial area of ICES Division VIIe in a consistent manner during late summer/early autumn of 2003–2007 (see also Cotter *et al.* 2004; Large *et al.* 2004; Armstrong *et al.* 2006; Roel *et al.* 2007). They have provided a useful time-series of catch rates, age and length compositions of the commercially highly valuable Western Channel sole and plaice stocks on their typical fishing grounds, using vessels, gear and fishing methods characteristic of the flatfish fishery. Other commercially important species sampled consistently include monkfish, lemon sole and megrim. Of further interest are similar data for more than 50 additional species of fish and shellfish.

The fishing methods and within-year timing of the surveys stand out as consistent. In the western surveys, FV *Carhelmar* (engine power 220 kW, registered length 22.2 m) did replace FV *Nellie* (486 kW, 23 m) in 2005, and has sampled since that year, but effects on catchability will have been limited: most crucially, identical towing speed, tow duration and lengths of beams were maintained, and identical sampling stations were worked each year. In the east, FV *Lady T Emiel* has been used for the survey in all five years. In the eastern surveys, 61 stations were sampled repeatedly each year, and in the western surveys this number was 46; this provides a thorough spatial coverage of the area (see also Figures 1–6).

These aspects of the FSP “Western Channel Sole and Plaice” survey may have contributed to this being the first FSP programme where the data have actually been used for official ICES stock assessments—namely, those of Western Channel sole and plaice in 2007 (see ICES 2007; assessed by the ICES Southern Shelf Assessment Working Group, June 2007). This achievement was highlighted in an article in *Fishing News* (17 August 2007, p. 6).

Beam trawl catches in the Western Channel contain a broad diversity of species, and in the 2007 FSP “Western Channel Sole and Plaice” surveys this was reflected by a total of 61 fish and shellfish species being caught. Sole and plaice made up 4.0% and 2.1%, respectively, of the total number caught by *Lady T Emiel* and *Carhelmar* combined (Figures 7a and 7b). This is somewhat less than in previous years (sole: ~5–8%; plaice: ~6–7%). Although this partly reflected a higher overall catch of all species combined in 2007, the relatively low catch rate of plaice this year is notable (cf. Figures 3, 9, 14).

Catch rates of cod were low, a total of just 118 fish, almost all on the eastern survey (~0.2% of the total number in 2007), confirming the previous year’s conclusion that UK beam trawlers in the area have a very low by-catch of cod (Roel *et al.* 2007). However, this number was appreciably higher than during each of the earlier FSP “Western Channel Sole and Plaice” surveys (ranging from 11 to 33 cod in 2003–2006). Tentatively, this may be considered a positive indication for this stock which historically has been at much higher levels (ICES 2007), but a firmer conclusion would need to be substantiated by more data, given that these beam trawl surveys were directed at monitoring flatfish primarily.

The distribution patterns and relative abundance of the main flatfish species and monkfish have been relatively constant over the five surveys of 2003–2007. Monkfish were not caught frequently in the eastern survey of 2004, compared with 2003 and 2005–2007 (Figures 6 and 10), but in 2004 many small (<24 cm) monkfish were observed in the western survey, in line with a larger cohort entering the fishery. In the following years, changes in monkfish length distributions in both surveys indicate that the growing fish distributed themselves over both areas (Figure 10).

In the western surveys, lower catch rates of sole were observed in 2005–2007 than in 2003 and 2004 (Figure 8b, Table 2), coinciding with the vessel change from FV *Nellie* to FV *Carhelmar*. It is unclear to what extent this relates to a change in sole abundance or to a change in catchability (a potentially lesser fishing power of FV *Carhelmar*), in spite of the identical towing speeds and durations, fishing gear and sampling stations. A change in catchability with vessel change would, however, likely also result in clear shifts in catch rates of other fish species, but no consistent shifts were observed for other species covered by this report (see also Roel *et al.* 2007). Further analysis across species, and of changes in catch rates within year-classes of sole and plaice, will be required to resolve this issue. Overall, if the 2007 results on sole for both surveys are compared with those of previous years, there are no indications of substantive change.

Perhaps the most surprising finding of the 2007 FSP “Western Channel Sole and Plaice” surveys was a significantly lower catch rate of plaice than in earlier years, in both western and eastern areas. The drop was most marked in the east where it applied to both smaller and larger plaice (Figure 9), although overall it appears to have especially concerned the younger ages in the catch (2- and 3-year-olds). A firm conclusion would need to be based on more extensive data and analysis; but these survey results certainly suggest that, currently, recruitment of Western Channel plaice to the fishery is relatively poor.

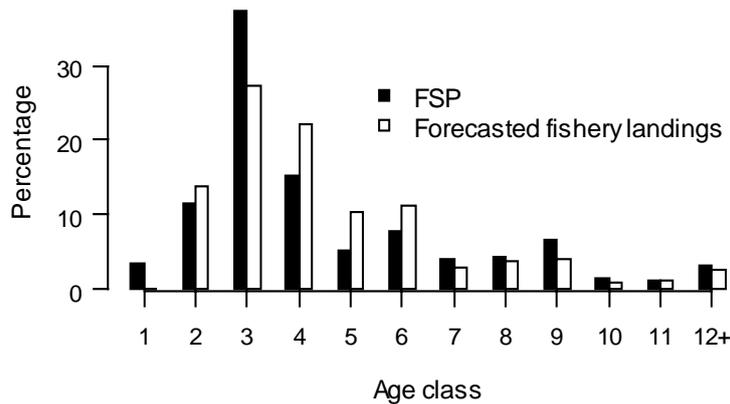


Figure 15. Comparison of the percentage age composition of the 2007 FSP catches of sole, with that of the forecasted international fishery landings from the Western Channel in 2007, as predicted by the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks (ICES 2007, p. 96).

#### *Comparison with ICES data*

The percentage age compositions for Western Channel sole in previous FSP surveys have been broadly similar to those of the international commercial fishery in the period 2003–2006 (Armstrong *et al.* 2006; Roel *et al.* 2007). For example, the 2001 year-class has been prevalent in the commercial landings and in the FSP data for 2003–2007 (Figure 13), e.g. as 3-year-olds in 2004 and as 5-year-olds in 2006. Figure 15 is a comparison of the age compositions in the 2007 FSP survey with that of the forecasted international fishery landings for 2007 (from ICES 2007). Again, the relative distributions are similar, and both the commercial landings and FSP data show local peaks in distribution for fish aged 3, 6, and 9 years. These ages, respectively, represent the 2004, 2001, and 1998 year-classes, which have also been estimated to be above-average in the ICES stock assessment (ICES 2007). Although discards are not included in the ICES figures, discarding of sole is generally low in the commercial fishery; the inclusion of discards in the FSP distribution may explain it having a slightly higher proportion of younger fish (Figure 15).

Although sole age distributions for 2007 were similar overall, two differences may be noted, in line with similar differences noted in previous years' comparisons of ICES and FSP age distributions. Both the 2002 and 2003 year-classes (respectively, 5 and 4 years old in 2007) were less represented in FSP data than in the ICES forecasts (Armstrong *et al.* 2006; Roel *et al.* 2007). This suggests that the ICES forecast may somewhat overestimate the strength of those specific year-classes (in line with the conclusion of Roel *et al.* 2007).

For Western Channel plaice, the FSP data on age compositions have over the past four years also been similar to those of the international commercial fishery in 2003–2005 and the ICES forecast for the fishery in 2006 (see Figure 16 in Armstrong *et al.* 2006, as well as Roel *et al.* 2007; and see ICES, 2006). For 2007 we were not able to compare the FSP age distribution for plaice with forecast fishery age distributions, on the grounds that the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks did not carry out a forecast for Western Channel plaice in 2007. The reasons for this were that the assessment for this stock suffers from a consistent bias in the estimation of  $F$  in the final 2–3 years (see ICES 2007, p. 125 for further details).

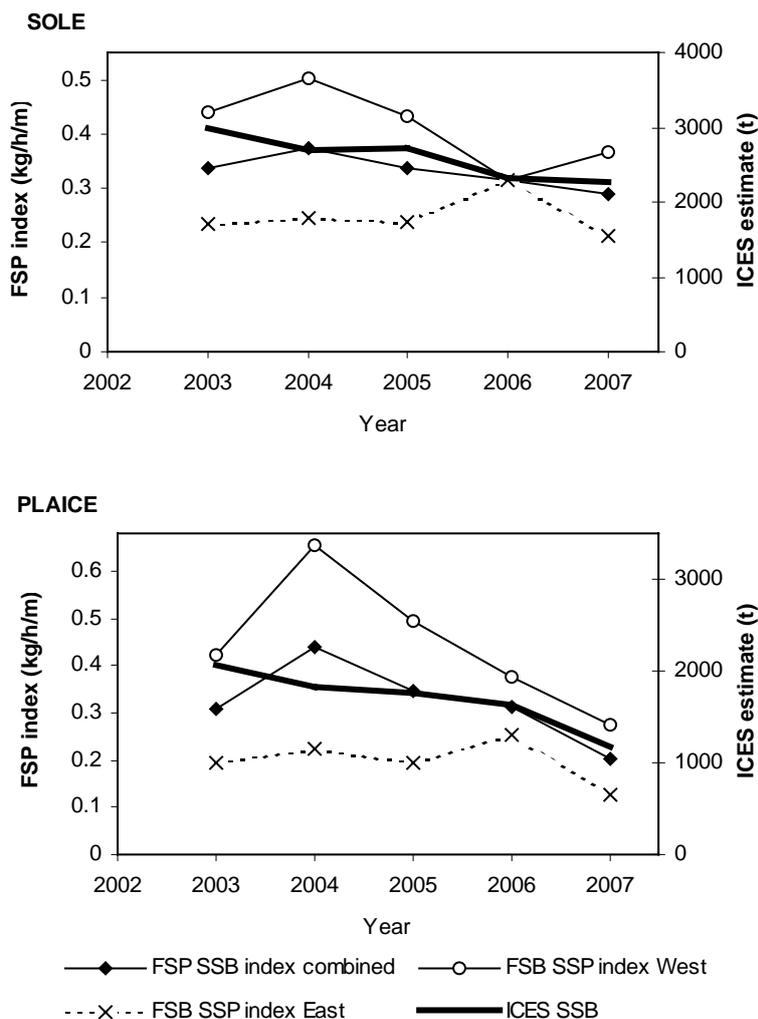


Figure 16. Comparison between trends in spawning-stock biomass (SSB) given by the FSP surveys and the most recent ICES assessments for the VIIe stocks of sole and plaice (ICES, 2007). FSP trends are given separately for the eastern and western surveys, and for the surveys combined. Note: the 2007 SSB forecast for plaice, taken from ICES (2006), is highly uncertain and only included for illustrative purposes; the Western Channel plaice stock forecast is currently dubious (ICES 2007), and was therefore not undertaken in 2007.

Trends in SSB were calculated from the FSP survey indices at age together with data on maturity and mean weights at age in the stock in each year (ICES, 2007). Values are given in Tables 2-4. The trends for sole from the combined eastern and western surveys are roughly in accord with the results of the current ICES assessment (Fig. 16), indicating a relatively stable SSB within the five years of surveys (especially suggested by the eastern, *Lady T Emiel* survey) towards a more irregular, on average somewhat declining, trend (especially suggested by the western, *Nellie/Carhelmar* survey). The ICES SSB estimates indicative of slow/gradual decrease are in line with the averages of the western and eastern FSP surveys. The change in survey vessel from the *Nellie* to the *Carhelmar* in 2005 may be a factor in the western survey trend, and requires further investigation as the FSP series lengthens.

The FSP indices of plaice SSB (Fig. 16) mostly reflect the downward trend over the period 2003–2007 given by the ICES assessment of the stock (Fig. 16), although the FSP estimate for the first year of the time-series is lower than expected from the ICES assessment. It should be noted again, however, that the 2007 SSB forecast for plaice as shown in Figure 16, taken from ICES (2006), is highly uncertain and only included for illustrative purposes; the Western Channel plaice forecast is currently dubious, and considered too inaccurate to be used as a basis for TAC calculations for 2007, and was therefore not undertaken in 2007 (and hence not included in ICES 2007). Accounting for the great uncertainty, last year's ICES SSB forecast for 2007, combined with the new FSP data, suggest that Western Channel plaice SSB has generally been declining in recent years, but that it requires further investigation.

## Acknowledgements

The skippers and crew of *Lady T Emiel* (2003–2007 surveys), *Carhelmar* (2005–2007 surveys) and *Nellie* (2003–2004 surveys) are warmly thanked for their enthusiastic co-operation and valuable contributions. The success of this programme has in large measure been due to the skills of skippers Mike Sharp (*Lady T Emiel*), Dave Murphy (*Carhelmar*) and Stephen Nowell (*Nellie*) and their knowledge of the fish stocks in the Channel. All staff at Cefas who contributed to this programme are thanked for their help. This programme was funded by Defra as part of the Fisheries Science Partnership.

## References

- Armstrong, M., Dann, J., Kupschus, S. and Shaw, S. 2006. Programme 6: Western Channel sole and plaice. Fisheries Science Partnership 2005/06. Final Report. 35 pp.
- Cotter, J., Bannister, C., Garrod, C., Boon, T. and Mills, C. 2004. Catches of sole, plaice and other species in south western waters by FV *Lady T Emiel*, FV *Nellie*, and by RV *Corystes*, autumn 2003. Fisheries Science Partnership 2003/04 Final report. 54 pp.
- ICES. 2006. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 27 June–6 July 2006, ICES Headquarters, Denmark. ICES CM 2006/ACFM:33.
- ICES. 2007. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 26 June–5 July 2007, ICES Headquarters, Denmark. ICES CM 2007/ACFM:28.
- Large, P., Dann, J., Kupschus, S., Armstrong, M., Cotter, J. and Bevan, D. 2004. Programme 2: Western Channel Sole and Plaice. Fisheries Science Partnership 2004/05 Final report. 35 pp.
- Roel, B., Dann, J., Velterop, R., Enever, R., Wade, O. and Armstrong, M. 2007. Programme 6: Western Channel sole and plaice. Fisheries Science Partnership 2006/07 Final report. 47 pp.
- Smith, M., Warnes, S., Forster, R., Mulligan, W., Whelpdale, P. and Dann, J. 2006. Programme 2: western Anglerfish. Fisheries Science Partnership 2006/07 Final Report. 43 pp.
- Walmsley, S., Warnes, S., Armstrong, M., Cotter, J., Dann, J., and Bevan, D. 2005. Programme 3: western Anglerfish. Fisheries Science Partnership 2004/05 Final Report. 58 pp.

**Appendix 1:** detailed work plan for eastern part of 2006 FSP survey (plan for *Carhelmar* survey differs in area fished)

## **Western Channel Sole (East): August 2007**

### ***Detailed Operation Plan*** (as agreed 2 August 2007)

VESSEL

FV Lady T Emiel (Skipper Mike Sharp)

## **OBSERVER**

Oliver Wade, Cefas  
Tel. (Newlyn) 01736 350653  
Tel. (Exeter) 01392 264606

## **OBJECTIVES**

1. To repeat the survey of sole in the western Channel (east) region carried out previously by FV Lady T Emiel during August-September 2003–2006, using chain mat gear

## **FISHING GEAR**

The fishing gear to be fitted and used is two 12 (twelve) metre beams with chain mat to be fished at about 4 knots at all of the depths within the defined area.

## **AREA OF OPERATION and TOW POSITIONS**

Fishing will be undertaken within British fishery limits and within the area bounded by straight lines joining: North of 49° 30'N and between 2° 30'W and 4°30'W (Area 'B' in figure attached at Annex 1).

Table 1 shows the positions of the 'prime stations' where tows are to be carried out during this 2007 FSP survey. These stations will be fished in the present survey, in an order to be decided by the skipper in consultation with the observer.

Time permitting, additional stations should be sought in the area south of the Eddystone, and just north of the Hurd Deep, in order to locate larger, older sole. Such stations should also be carried out during daylight.

## **PERIOD OF SURVEY**

The vessel will depart on Monday 20 August 2007 around 9:00 and commence fishing the same day at a suitable location. The duration of the trip will be two periods of six continuous days, with fishing activities distributed over each of the six days. There will be a maximum of two days, between the two six-day periods, in port to land fish and refuel.

## **FISHING ACTIVITIES**

Fishing will take place between dawn and dusk. Individual tows should cover the same distance as in the last two year's surveys, at approximately 4 knots over the ground, resulting in a typical tow duration of approx. 1 hour. In the event of very large catches requiring longer than normal processing, the time between hauling and shooting should be adjusted in consultation with the observer.

## **SORTING AND RECORDING THE CATCH**

It is important that the catches of sole, plaice, monk, cod and other commercial species are quantified as accurately as possible. The crew will be required to assist in sorting the catch as required by the observer and preparing any fish for sale. Standard CEFAS methods for sorting and measuring commercial fish catches at sea will be carried out. The entire catch should be available to the observer for sampling, and none discarded without being recorded. Generally the catch will be sorted into three general categories:

1. Large and rare fish e.g. cod, congers, skates, which may be landed or discarded but which can all be counted and measured (i.e. raising factor of 1.0).
2. The retained catch of other individuals of commercial species. The observer must be able to record the total number of boxes or baskets of retained fish of each species from each tow, and will carry out a length measure on either the whole catch (raising factor = 1.0) or a known sample of the catch (raising factor > 1.0).
3. Discarded fish of commercial and non-commercial species, other than those in category (1). It is vitally important that the total quantity of discarded fish is known, and that the observer can obtain a representative, random sample to be sorted to species and length measures carried out. This is best achieved by basketing up all the discarded fish, counting the baskets and taking a random sample of baskets for sorting and measuring. The raising factor is the total number of baskets of discarded fish divided by the number of baskets taken at random for sorting and measuring.

The observer will collect samples of sole, plaice and cod for age determination, and will remove both otoliths and record the cruise reference, tow number, species, fish length, and sex.

## OTOLITH TARGETS

Target numbers will be 325 sole otoliths, 325 plaice otoliths, and otoliths for all cod sampled (unless cod catch is very large), to be distributed over 4 ‘major length groups’ as follows:

Species	Length	Nos otoliths	Remark
Sole	0-29	50	About one 0-29 cm sole otolith at random every 4 tows
	30-34	100	About one 30-34 cm sole otolith at random every tow
	35-44	150	About one-two 35-44 cm sole otolith at random every tow
	45+	25	Probably all 45+ cm sole that are sampled
Plaice	0-29	25	About one 0-29 cm plaice otolith at random every 2 tows
	30-34	100	About one 30-34 cm plaice otolith at random every tow
	35-44	150	About one-two 35-44 cm plaice otolith at random every tow, but all 35+ cm male plaice
	45+	50	Probably all 45+ cm plaice that are sampled
Cod	All	All	All cod at each station unless catch is very large

These are to be spread out over the entire area (see ‘Remark’ in the above table to help achieving this).

The observer will maintain an otolith tally to make sure there aren’t any gaps appearing (i.e. 1-cm length classes missing) due to non-random sampling, and to ensure that, within each of the above ‘major length groups’, samples are evenly distributed over the 1-cm length classes.

## DATA TO BE RECORDED BY SKIPPER

The observer will provide recording sheets on which the skipper will record the following details for each tow:

- Date
- Tow number
- Shooting and hauling times
- Shooting and hauling positions (latitude and longitude)
- Time and position at any significant change in tow direction
- Other relevant information (e.g. tidal state, weather conditions)

The skipper should provide full details of the gear and rigging. At the end of the survey, the skipper should provide an electronic copy of the tow tracks from the plotter.

## DATA TO BE RECORDED BY OBSERVER

The observer must ensure that all catch composition, length frequencies and raising factors are fully and correctly entered on the recording sheets, and that all bridge log sheets and biological sampling sheets are collated at the end of each sampling day. Any significant deviations from the survey plan should be reported to CEFAS by the observer.

# CRUISE REPORT

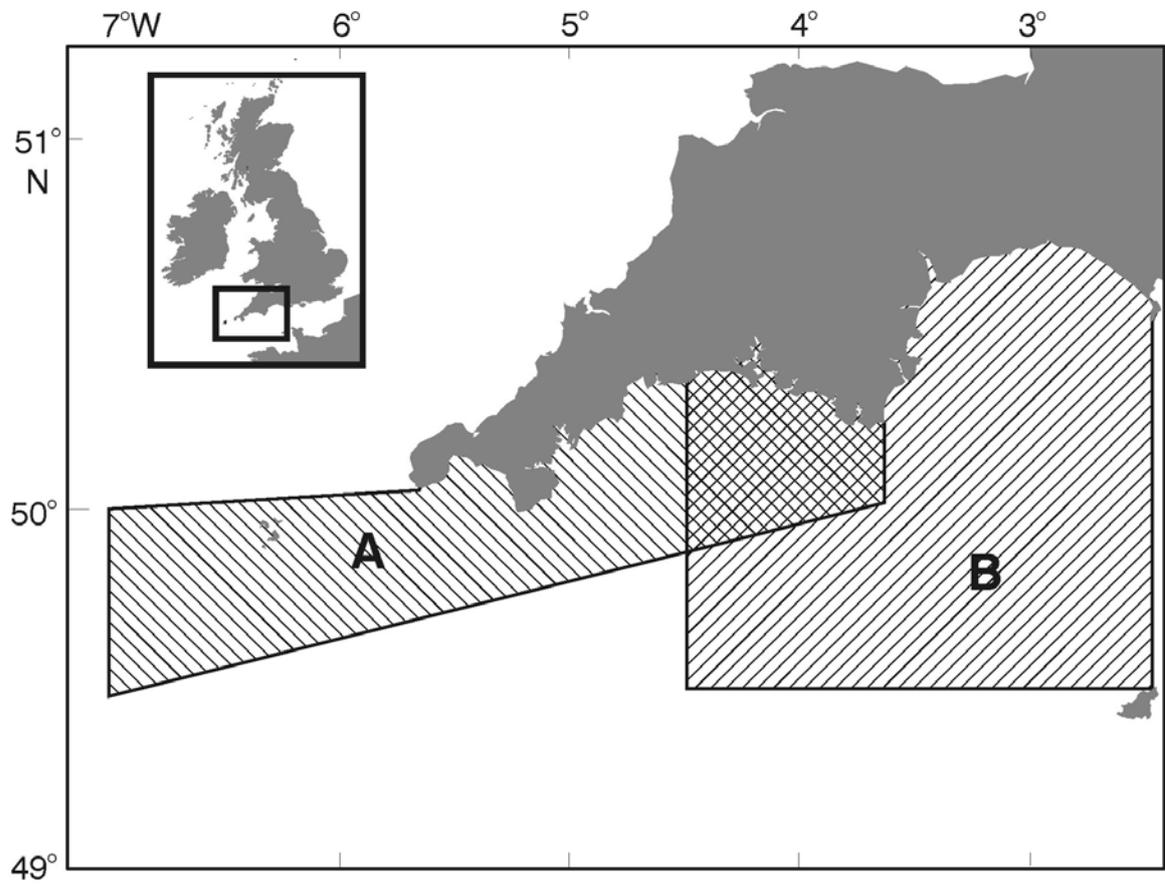
The observers will maintain a diary of activities, including an electronic copy where possible, and a draft cruise report in standard CEFAS format will be prepared for submission to CEFAS immediately after the cruise. The cruise narrative should be written at sea and read and agreed by the skipper (report will bear the sentence “seen in draft by skipper”).

Signed:

..... (skipper)                      .....(date)

.....(CEFAS)                      .....(date)

**Annex 1.** Map of the area within which sampling will be required. This survey will take place in area "B".



## **Appendix 2      Survey narratives**

Part 1. Eastern Survey, *prepared by Oliver Wade*

**Vessel:** FV *Lady T Emiel*, Brixham beam trawler

**Skipper:** Mike Sharp

**Cefas Staff:** Oliver Wade

**Period:** 21 August – 1 September 2007

The original sailing date of 20 August was postponed till the following morning due to a gale from the northeast. *Lady T Emiel* sailed from Brixham at 5:00 the following morning and steamed several hours south to the Hurd Deep. We proceeded to fish the stations around here for the next couple of days. The weather gradually improved and by Thursday 23 August was very fine. *Lady T Emiel* landed back into Brixham at 16:00 on 25 August having completed 41 stations which were all the furthest away from Brixham. Otoliths were collected from 177 soles, 142 plaice, and all cod encountered.

The second week of the survey began at 9:00 on Monday 27 August. We fished gradually west to pick up a couple of stations that we had been unable to complete during the previous week. On Tuesday 28 August we were boarded by the navy checking catch composition and mesh sizes. For the remainder of the week we fished all the stations within Lyme Bay and we landed back into Brixham at 16:00 on 1 September.

During the entire survey 94 stations were sampled. Otoliths were taken from a total of 353 soles, 326 plaice, and 83 cod.

## Part 2. Western Survey, *prepared by Robert Bush*

**Vessel:** FV *Carhelmar*, Plymouth beam trawler

**Skipper:** Dave Murphy

**Cefas Staff:** Robert Bush

**Period:** 24 September – 6 October 2007

FV *Carhelmar* sailed from Plymouth late on the afternoon of 24 September. One tow was carried out soon after leaving port to get crew and sampler up to speed. Under the skipper's instruction, the vessel then steamed west overnight to commence fishing at first light. The survey was split into two sections, both of six days duration. The first half was spent on the further westerly marks making good use of the fine weather. The number of hauls averaged 5-6 per day, there were no invalid tows and catches were considered adequate by the skipper. *Carhelmar* docked Saturday afternoon of 29 September at Plymouth.

Fishing commenced again on the following Monday. The second half of the trip went without any problems, covering the remainder of the hauls. As the majority of the hauls had taken place on the first half, the average number for the second half was between 3-4 a day. The *Carhelmar* docked back in Plymouth on Saturday 6 October.

During the trip we experienced very good weather with the exception of the first couple of days where winds were in the region F5. The gear fished well and all the tows were valid and no gear damage was reported.

A note should be made that the skipper (Dave Murphy) and crew were extremely helpful and competent during the entire study, once the catch was sorted they offered assistance in the collection of the otoliths, which made my job far easier and meant that I had acceptable rest times.

## Appendix 3

*Lady T Emiel* 2007. Tow details.

Tow number	Prime station	ICES rectangle	Shot lat. (°N)		Shot lon. (°W)		Haul lat. (°N)		Haul lon. (°W)		Depth (m)	Duration (min.)	Date	Shoot time
1	204	28E6	49	59	3	30	49	56	3	28	67	63	21-Aug-07	08:22
2	203	28E6	49	54	3	31	49	51	3	35	71	53	21-Aug-07	09:56
3	306	28E6	49	52	3	35	49	55	3	35	72	44	21-Aug-07	11:08
4	202	28E6	49	50	3	38	49	49	3	33	73	59	21-Aug-07	12:36
5	314	28E6	49	50	3	29	49	47	3	29	70	39	21-Aug-07	14:01
6	307	28E6	49	47	3	33	49	45	3	38	72	52	21-Aug-07	15:08
7	303	28E6	49	43	3	43	49	42	3	43	73	60	21-Aug-07	16:35
8	74	28E6	49	40	3	34	49	36	3	34	73	62	21-Aug-07	18:40
9	75	28E6	49	37	3	33	49	40	3	31	73	58	21-Aug-07	20:02
10	316	28E6	49	34	3	28	49	35	3	23	73	55	22-Aug-07	06:25
11	311	28E6	49	35	3	15	49	34	3	22	107	72	22-Aug-07	08:06
12	312	28E6	49	32	3	23	49	33	3	18	99	60	22-Aug-07	09:40
13	313	28E6	49	34	3	15	49	35	3	7	100	72	22-Aug-07	11:07
14	308	28E6	49	37	3	3	49	40	2	57	100	73	22-Aug-07	12:52
15	309	28E6	49	39	3	0	49	37	3	6	102	67	22-Aug-07	14:38
16	310	28E6	49	36	3	8	49	35	3	14	104	65	22-Aug-07	16:00
17	78	28E6	49	37	3	12	49	40	3	8	76	65	22-Aug-07	17:40
18	315	28E6	49	37	3	12	49	40	3	8	73	65	22-Aug-07	17:40
19	76	28E6	49	43	3	25	49	41	3	20	69	60	23-Aug-07	06:00
20	79	28E6	49	38	3	21	49	40	3	18	69	56	23-Aug-07	07:35
21	77	28E6	49	40	3	14	49	41	3	19	71	52	23-Aug-07	09:10
22	80	28E6	49	41	3	16	49	44	3	13	70	56	23-Aug-07	10:30
23	317	28E6	49	43	3	21	49	46	3	21	71	52	23-Aug-07	12:18
24	57	28E6	49	53	3	24	49	51	3	18	69	70	23-Aug-07	14:10
25	81	28E6	49	51	3	16	49	47	3	15	69	65	23-Aug-07	15:35
26	82	28E6	49	51	3	11	49	51	3	3	66	75	23-Aug-07	17:25
27	83	28E7	49	51	3	0	49	54	2	56	67	75	23-Aug-07	19:00
28	302	28E6	49	44	3	52	49	47	3	52	71	45	24-Aug-07	06:00
29	304	28E6	49	49	3	48	49	52	3	52	70	70	24-Aug-07	07:20
30	301	28E6	49	48	3	56	49	46	4	1	73	57	24-Aug-07	09:08
31	300	28E5	49	46	4	2	49	45	4	6	76	46	24-Aug-07	10:18
32	69	28E6	49	51	3	59	49	50	4	5	74	69	24-Aug-07	12:08
33	68	28E5	49	51	4	17	49	50	4	23	76	60	24-Aug-07	14:15
34	67	28E5	49	52	4	24	49	54	4	19	78	60	24-Aug-07	15:40
35	66	28E5	49	54	4	19	49	58	4	19	73	67	24-Aug-07	16:55
36	65	28E5	49	59	4	23	49	59	4	29	73	65	24-Aug-07	18:25
37	64	29E5	50	2	4	29	50	5	4	33	71	66	24-Aug-07	19:56
38	70	28E5	49	52	4	3	49	55	4	7	73	65	25-Aug-07	06:00
39	71	28E5	49	56	4	8	49	57	4	14	72	66	25-Aug-07	07:15
40	72	28E5	49	58	4	14	49	60	4	7	69	67	25-Aug-07	08:40
41	73	28E5	49	60	4	2	50	1	3	55	71	65	25-Aug-07	10:22
42	46	29E7	50	15	3	2	50	16	2	56	55	60	27-Aug-07	11:00
43	47	29E7	50	15	2	52	50	13	2	56	72	50	27-Aug-07	13:30
44	48	29E7	50	13	2	54	50	9	2	54	58	60	27-Aug-07	14:50
45	90	29E7	50	6	2	52	50	9	2	48	63	65	27-Aug-07	16:25
46	88	29E7	50	8	2	44	50	12	2	46	61	63	27-Aug-07	18:02
47	89	29E7	50	14	2	46	50	11	2	49	60	65	27-Aug-07	19:25
48	56	28E6	49	54	3	17	49	55	3	11	69	60	28-Aug-07	06:00
49	55	28E6	49	55	3	9	49	55	3	2	69	45	28-Aug-07	07:20

Tow number	Prime station	ICES rectangle	Shot lat. (°N)	Shot lon. (°W)	Haul lat. (°N)	Haul lon. (°W)	Depth (m)	Duration (min.)	Date	Shoot time
50	84	28E6	49 53	3 3	49 57	3 4	69	55	28-Aug-07	08:40
51	85	28E6	49 57	3 4	49 59	2 57	66	60	28-Aug-07	09:50
52	86	29E7	49 59	2 54	50 2	2 49	63	60	28-Aug-07	11:05
53	87	29E7	50 3	2 49	50 6	2 44	60	70	28-Aug-07	12:20
54	91	29E7	50 5	2 52	50 2	2 57	63	60	28-Aug-07	14:15
55	50	29E7	50 4	2 59	50 1	3 4	64	50	28-Aug-07	15:40
56	54	28E6	49 60	3 1	49 59	3 9	67	74	28-Aug-07	16:57
57	53	28E6	49 59	3 9	49 58	3 16	69	67	28-Aug-07	18:20
58	94	28E6	49 56	4 0	49 58	3 53	75	67	29-Aug-07	06:25
59	95	28E6	49 57	3 46	49 60	3 41	71	60	29-Aug-07	08:05
60	305	28E6	49 60	3 39	49 57	3 34	70	60	29-Aug-07	09:25
61	93	29E6	50 1	3 30	50 1	3 24	66	60	29-Aug-07	11:15
62	52	28E6	50 1	3 21	49 58	3 17	64	60	29-Aug-07	12:40
63	51	29E6	50 1	3 18	50 2	3 13	65	65	29-Aug-07	14:15
64	49	29E6	50 5	3 6	50 8	3 1	62	60	29-Aug-07	16:15
65	62	29E6	50 11	3 2	50 8	3 6	63	60	29-Aug-07	17:44
66	92	29E6	50 7	3 10	50 4	3 15	67	65	29-Aug-07	19:05
67	58	29E6	50 3	3 23	50 6	3 18	67	60	30-Aug-07	06:00
68	63	29E6	50 6	3 17	50 5	3 23	67	130	30-Aug-07	07:20
69	18	29E6	50 5	3 24	50 5	3 24	67	60	30-Aug-07	08:50
70	17	29E6	50 5	3 24	50 7	3 22	63	40	30-Aug-07	10:15
71	16	29E6	50 8	3 21	50 11	3 19	62	45	30-Aug-07	11:05
72	15	29E6	50 11	3 18	50 12	3 14	60	50	30-Aug-07	12:00
73	14	29E6	50 12	3 13	50 14	3 11	57	45	30-Aug-07	13:00
74	24	29E6	50 30	3 9	50 13	3 11	56	16	30-Aug-07	14:47
75	33	29E6	50 13	3 11	50 11	3 9	58	160	30-Aug-07	13:20
76	22	29E6	50 11	3 11	50 13	3 13	59	43	30-Aug-07	16:15
77	21	29E6	50 12	3 16	50 10	3 13	61	42	30-Aug-07	17:18
78	26	29E6	50 10	3 13	50 9	3 17	61	40	30-Aug-07	18:20
79	27	29E6	50 9	3 18	50 8	3 21	49	40	30-Aug-07	19:10
80	19	29E6	50 7	3 19	50 10	3 20	63	52	31-Aug-07	06:00
81	28	29E6	50 8	3 22	50 9	3 15	64	41	31-Aug-07	07:15
82	31	29E6	50 13	3 8	50 15	3 5	60	45	31-Aug-07	08:35
83	61	29E6	50 19	3 9	50 16	3 6	58	60	31-Aug-07	10:00
84	36	29E6	50 16	3 5	50 18	3 1	57	45	31-Aug-07	11:15
85	45	29E7	50 20	2 54	50 22	2 48	52	70	31-Aug-07	12:35
86	43	29E7	50 24	2 43	50 27	2 46	48	65	31-Aug-07	14:10
87	40	29E7	50 29	2 48	50 30	2 51	41	35	31-Aug-07	15:35
88	41	29E7	50 28	2 48	50 27	2 50	46	23	31-Aug-07	16:47
89	42	29E7	50 25	2 32	50 23	2 57	51	55	31-Aug-07	17:30
90	37	29E6	50 20	3 4	50 22	3 4	55	162	31-Aug-07	19:03
91	39	30E7	50 27	2 56	50 31	2 52	45	60	1-Sep-07	08:30
92	38	29E6	50 26	3 1	50 23	3 6	53	55	1-Sep-07	10:35
93	59	29E6	50 24	3 3	50 24	3 3	52	60	1-Sep-07	11:50
94	60	29E6	50 27	3 7	50 23	3 9	48	55	1-Sep-07	13:05

### Appendix 3 continued

*Lady T Emiel* 2007. Catch numbers per tow for 10 selected species (data for other species are held on the Cefas data base).

Tow number	Prime station	Sole	Plaice	Lemon sole	Megrim	Monk	Cod	Brill	Red gurnard	Hake	Red mullet
1	204	13	12	15	0	4	1	3	99	0	11.5
2	203	18	24	19	0	6	2	1	297	0	0
3	306	15	15	7	0	4	2	2	261	0	0
4	202	6	9	4	0	32	2	4	317	8	5
5	314	19	3	0	0	3	1	3	122	0	5
6	307	9	2	5	0	20	1	1	128	0	11
7	303	3	1	1	0	15	0	1	152	0	0
8	74	28	3	1	0	19	1	0	173	0	10
9	75	42	2	0	0	14	11	0	201	0	0
10	316	2	0	0	0	10	0	0	52	0	0
11	311	4	1	0	0	21	0	0	104	0	6
12	312	7	2	0	0	16	0	1	48	0	0
13	313	26	0	0	0	34	0	0	93	0	6
14	308	2	0	0	0	16	1	0	121	0	6
15	309	5	0	0	0	18	0	0	75	0	4
16	310	8	3	0	0	5	0	5	64	0	8
17	78	3	1	3	0	33	1	5	165	0	6
18	315	11	4	0	0	11	1	2	115	0	0
19	76	21	5	1	0	7	3	8	131	0	0
20	79	17	1	0	0	9	0	7	46	0	7
21	77	20	2	0	0	17	1	6	124	0	10.5
22	80	17	4	0	0	13	3	2	162	0	8
23	317	9	1	0	0	14	2	0	120	0	2
24	57	26	13	1	0	14	2	1	190	0	2
25	81	32	12	2	0	12	1	1	258	0	13
26	82	27	8	2	0	16	2	2	358	0	0
27	83	14	8	1	0	3	6	0	225	0	0
28	302	6	3	4	0	25	2	3	131	0	0
29	304	7	13	17	0	19	5	5	242	0	4
30	301	3	2	1	0	33	1	0	207	0	0
31	300	1	3	1	0	22	1	1	64	3	0
32	69	9	20	0	0	15	2	2	132	0	1
33	68	6	5	0	0	20	0	0	132	1	1
34	67	5	5	13	0	16	1	0	114	0	0
35	66	11	2	18	1	11	1	0	51	2	6
36	65	7	12	8	0	13	3	0	78	8	0
37	64	20	5	7	0	25	4	0	28	0	0
38	70	19	26	19	0	16	0	0	107	1	9
39	71	10	31	21	0	24.5	0	0	145.5	1	0
40	72	25	29	1	0	10	0	0	93	1	0
41	73	28	27	1	0	6	0	0	54	0	7
42	46	12	7	2	0	6	0	3	172	0	0
43	47	20	5	2	0	9	1	1	170	0	4
44	48	20	10	8	0	2	1	2	158	0	12
45	90	6	6	1	0	7	0	1	104	0	4
46	88	9	7	2	0	14	1	1	183	0	0
47	89	12	6	0	0	6	0	0	77	0	63
48	56	39	6	15	0	18	2	0	147	0	10

Tow number	Prime station	Sole	Plaice	Lemon sole	Megrim	Monk	Cod	Brill	Red gurnard	Hake	Red mullet
49	55	19	5	9	0	11	2	0	192	0	8
50	84	25	5	0	0	6	11	4	156	0	1
51	85	14	6	0	0	6	1	0	75	0	1
52	86	3	5	0	0	7	0	1	155	0	0
53	87	2	0	0	0	10	0	0	112	0	9
54	91	23	3	1	0	4	1	0	312	0	48
55	50	13	3	0	0	5	0	0	58	0	12
56	54	7	12	3	0	0	0	8	225	0	8
57	53	12	12	0	0	4	3	6	219	0	35
58	94	21	58	18	1	6	3	1	99	0	0
59	95	11	27	13	0	6	1	0	170	0	0
60	305	7	19	8	0	5	2	4	127	1	3
61	93	6	16	8	0	3	2	2	182	0	18
62	52	8	11	2	0	12	2	0	97	1	0
63	51	10	3	1	0	7	1	2	117	0	22
64	49	15	4	0	0	6	0	1	1	0	0
65	62	14	15	2	0	5	1	5	143	0	10
66	92	39	20	6	0	1	1	2	86	0	12
67	58	60	16	0	0	4	2	0	36	0	6
68	63	51	20	1	0	4	10	0	12	0	16
69	18	16	10	0	0	1	0	0	0	0	27
70	17	8	11	0	0	3	0	0	0	0	5
71	16	32	6	0	0	1	0	1	0	0	0
72	15	42	8	0	0	0	0	0	0	0	1
73	14	21	4	1	0	0	0	4	0	0	2
74	24	17	9	1	0	0	0	2	0	0	0
75	33	32	10	0	0	1	0	3	6	0	0
76	22	30	4	0	0	0	4	1	3	0	1
77	21	49	17	0	0	0	0	0	0	0	0
78	26	36	13	0	0	1	0	3	4	0	0
79	27	24	15	0	0	2	0	1	10	0	0
80	19	33	10	0	0	0	0	1	0	0	9
81	28	24	6	0	0	0	0	1	22	0	4
82	31	29	7	0	0	2	0	1	0	0	9
83	61	3	7	2	0	0	0	2	0	0	12
84	36	58	5	2	0	2	0	2	32	0	4
85	45	4	0	0	0	6	2	0	15	0	51
86	43	6	1	0	0	0	0	1	36	1	23
87	40	50	1	0	0	0	0	0	0	0	53
88	41	27	1	0	0	0	0	0	56	0	76
89	42	26	4	0	0	0	1	0	40	0	44
90	37	27	1	3	0	1	0	1	0	0	7
91	39	98	12	0	0	1	0	0	72	0	24
92	38	35	29	0	0	0	0	4	6	0	64
93	59	0	24	0	0	1	0	3	0	0	1
94	60	48	32	0	0	1	0	3	4	4	0

## Appendix 3 continued

Carhellar 2007. Tow details.

Tow number	Prime station	ICES rectangle	Shot lat. (°N)		Shot lon. (°W)		Haul lat. (°N)		Haul lon. (°W)		Depth (m)	Duration (min.)	Date	Shoot time
1	108	29E5	50	15	4	9	50	14	4	9	30	60	24-Sep-07	18:55
2	34	29E5	50	10	4	36	50	6	4	35	38	60	25-Sep-07	06:46
3	39	29E5	50	5	4	38	50	2	4	42	40	60	25-Sep-07	08:15
4	40	29E5	50	2	4	42	50	2	4	49	40	60	25-Sep-07	09:28
5	36	29E5	50	3	4	6	50	6	4	53	36	60	25-Sep-07	11:20
6	37	29E5	50	6	4	53	50	8	4	47	36	60	25-Sep-07	12:32
7	38	29E5	50	6	4	41	50	8	4	45	38	60	25-Sep-07	14:22
8	101	29E5	50	7	4	30	50	6	4	23	40	60	25-Sep-07	16:54
9	100	29E5	50	8	4	21	50	10	4	27	38	60	25-Sep-07	19:07
10	20	28E4	49	59	5	36	49	55	5	37	38	60	26-Sep-07	07:04
11	19	28E4	49	54	5	36	49	52	5	43	42	60	26-Sep-07	08:22
12	18	28E4	49	52	5	46	49	49	5	52	46	60	26-Sep-07	09:57
13	1	28E4	49	48	5	54	49	48	6	1	47	60	26-Sep-07	11:22
14	2	28E3	49	49	6	2	49	49	6	8	47	60	26-Sep-07	12:48
15	13	28E3	49	50	6	13	49	52	6	7	47	60	26-Sep-07	14:30
16	9	28E3	49	50	6	7	49	51	6	1	48	60	26-Sep-07	16:05
17	8	28E4	49	51	5	60	49	50	5	53	48	60	26-Sep-07	17:21
18	10	28E3	49	44	6	9	49	43	6	15	54	60	27-Sep-07	06:45
19	4	28E3	49	43	6	19	49	43	6	25	54	60	27-Sep-07	08:14
20	5	28E3	49	43	6	26	49	44	6	33	54	60	27-Sep-07	09:29
21	6	28E3	49	44	6	34	49	45	6	35	53	60	27-Sep-07	10:47
22	7	28E3	49	46	6	35	49	47	6	30	53	60	27-Sep-07	12:06
23	11	28E3	49	47	6	29	49	47	6	23	50	60	27-Sep-07	13:22
24	3	28E3	49	46	6	16	49	47	6	9	52	60	27-Sep-07	15:28
25	17	28E4	49	49	5	50	49	47	5	43	49	60	27-Sep-07	18:27
26	15	28E4	49	50	5	50	49	52	5	44	46	60	28-Sep-07	06:43
27	16	28E4	49	51	5	44	49	47	5	42	48	60	28-Sep-07	07:57
28	24	28E4	49	50	5	34	49	52	5	29	45	60	28-Sep-07	10:00
29	23	28E4	49	54	5	24	49	56	5	27	37	60	28-Sep-07	11:50
30	25	28E4	49	52	5	34	49	56	5	33	40	60	28-Sep-07	13:45
31	26	28E4	49	56	5	33	49	58	5	31	36	60	28-Sep-07	14:55
32	21	28E4	49	59	5	30	49	59	5	30	32	60	28-Sep-07	16:12
33	27	28E4	49	60	5	30	49	60	5	30	32	60	28-Sep-07	17:21
34	67	28E4	49	59	5	30	49	59	5	30	33	60	29-Sep-07	05:03
35	22	28E4	49	59	5	25	49	60	5	24	30	60	29-Sep-07	06:45
36	28	28E4	49	59	5	23	49	59	5	25	30	60	29-Sep-07	07:56
37	62	29E5	50	11	4	0	50	11	4	4	32	60	1-Oct-07	15:49
38	63	29E5	50	11	4	4	50	7	4	3	35	60	1-Oct-07	17:02
39	64	29E5	50	7	4	1	50	6	4	13	41	60	2-Oct-07	07:27
40	65	29E5	50	7	4	8	50	6	4	14	39	60	2-Oct-07	08:55
41	102	29E5	50	4	4	19	50	2	4	13	41	60	2-Oct-07	10:56
42	103	29E6	50	1	3	5	50	0	3	44	39	60	2-Oct-07	14:30
43	59	29E6	50	5	3	43	50	2	3	39	38	60	3-Oct-07	09:25
44	30	29E6	50	2	3	46	50	5	3	49	40	60	3-Oct-07	12:29
45	60	29E6	50	6	3	50	50	4	3	43	38	60	3-Oct-07	14:48
46	33	29E5	50	4	4	1	50	2	4	7	40	60	4-Oct-07	08:28
47	32	29E5	50	3	4	5	50	5	4	3	40	60	4-Oct-07	10:51
48	31	29E6	50	3	3	53	50	4	3	60	40	60	5-Oct-07	09:41
49	29	29E6	50	7	4	1	50	6	3	54	39	60	5-Oct-07	11:29
50	61	29E6	50	6	3	52	50	8	3	56	38	60	5-Oct-07	13:06

### Appendix 3 continued

*Carhelmar* 2007. Catch numbers per tow for 10 selected species.

Tow number	Prime station	Sole	Plaice	Lemon sole	Megrim	Monk	Cod	Brill	Red gurnard	Hake	Red mullet
1	108	34	8	0	0	1	0	0	21	0	0
2	34	17	13	6	0	13	0	0	90	3	1
3	39	4	5	2	1	9	0	0	30	0	0
4	40	3	6	0	1	6	0	0	54	2	0
5	36	11	8	0	0	8	0	0	18	1	0
6	37	8	3	8	0	9	0	0	23	9	0
7	38	2	4	3	0	6	1	0	69	2	0
8	101	14	8	0	0	3	0	0	102	0	0
9	100	20	12	3	0	2	0	0	37	0	0
10	20	4	2	9	22	3	0	1	63	9	0
11	19	8	1	8	36	12	0	1	94	21	0
12	18	30	3	24	58	16	0	0	40	28	0
13	1	0	0	0	0	0	0	0	0	0	0
14	2	32	0	32	124	56	0	0	28	20	0
15	13	9	1	20	35	11	0	1	48	12	0
16	9	15	8	33	40	5	0	0	0	9	0
17	8	18	1	14	33	3	0	0	0	3	0
18	10	4	3	4	60	8	0	0	26	10	0
19	4	9	2	10	47	5	0	0	6	0	0
20	5	20	0	6	110	3	0	0	16	13	0
21	6	15	1	1	92	2	0	0	7	0	0
22	7	17	6	10	88	5	0	0	0	4	0
23	11	20	6	8	88	5	0	0	21	12	0
24	3	4	0	38	89	4	0	0	60	27	0
25	17	5	1	16	44	14	0	0	0	12	0
26	15	29	3	0	36	7	0	0	55	12	0
27	16	6	2	7	11	13	0	0	96	0	0
28	24	5	2	22	26	3	0	1	54	2	0
29	23	1	2	1	14	0	0	1	46	0	1
30	25	1	1	10	22	0	0	2	21	0	0
31	26	8	6	1	3	1	0	2	33	1	0
32	21	10	4	0	0	0	0	0	8	12	0
33	27	20	1	0	0	0	0	1	10	2	0
34	67	13	2	0	0	0	0	2	0	0	0
35	22	19	2	0	0	0	0	1	4	2	0
36	28	12	3	3	0	0	0	2	0	6	0
37	62	16	6	1	0	0	0	0	0	0	1
38	63	19	21	0	0	0	0	0	9	0	2
39	64	30	22	3	0	1	0	0	30	0	0
40	65	25	17	0	0	0	0	0	0	0	1
41	102	13	3	2	0	8	0	0	52	0	0
42	103	4	59	1	0	0	0	0	135	0	6
43	59	17	34	8	0	1	0	0	12	0	4
44	30	7	28	6	0	1	0	2	19	0	4
45	60	2	11	10	0	0	0	2	28	0	6
46	33	19	37	6	0	0	0	0	45	3	1
47	32	35	28	6	0	1	0	1	75	1	1
48	31	27	23	16	0	0	0	1	40	4	0
49	29	13	19	5	0	0	0	1	36	0	0
50	61	7	31	5	0	1	1	4	33	0	1