

*Final Report*

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

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## SUMMARY

### FSP Western Channel Sole and Plaice 2008

During September and October 2008, the beam trawlers *Carhelmar* and *Lady T Emiel* carried out the sixth in a series of FSP surveys of Western Channel sole and plaice. Similar FSP surveys were carried out during the months August–October of 2003–2007, and all aimed at showing trends in distribution, abundance and age composition of sole and plaice, and providing information on bycatch species.

The survey design was simplified from previous years' with the smaller,  $2 \times 4$  m beam trawler *Carhelmar* now surveying both the western and eastern study areas. This implied no change in survey design for the west, but previously the east had been surveyed by the larger *Lady T Emiel* ( $2 \times 12$  m beams). The survey was further limited to 45 western and 45 eastern 'core' stations, for which consistent data were available for all previous years. In addition to those, *Lady T Emiel* still sampled 28 of the 45 eastern prime stations about a month separate from when the same stations had been sampled by *Carhelmar*.

There was evidence that the *Lady T Emiel* and *Carhelmar* have highly similar sole catchabilities and fairly similar plaice catchabilities, provided that catch rates are quantified as the number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam length. This was indicated by close correspondence in plaice and especially sole catch rates and length distributions obtained during the 2008 *Lady T Emiel* and eastern *Carhelmar* surveys. This result provides encouragement for continuing to use this FSP time-series as one of the tuning indices in the ICES Western Channel plaice stock assessment, as was done in 2007 and 2008 (ICES 2007, 2008).

Catch rates of sole in the western area were less than in previous years, and those in the east slightly down on the previous year; nevertheless there was a very broad age distribution of sole. The catch rates of plaice in both the western and eastern areas were lower than in 2007 and considerably lower than throughout the years 2003–2006. Relatively high numbers of small (<25 cm) monkfish were taken, especially in the west. Cod were only caught in low numbers that were comparable to 2007, but were much less scarce than during the 2003–2006 surveys.

The age distribution for sole was broad (with ages of fish >20 years recorded in all survey legs), and that for plaice much narrower, with just 1 fish >10 year recorded. The relative age compositions of both sole and plaice were broadly similar to those in the commercial fishery landings, as reported by ICES (2008). The trends in sole and plaice spawning-stock biomass (SSB) from the FSP surveys were similar to the recent, steadily declining trends shown by the ICES assessment, especially if based on the eastern FSP surveys alone; the SSB trend based on the western FSP survey is suggestive of a steeper decline in both species than provided by the formal assessment.

## Introduction

We have now entered the sixth year of the Fisheries Science Partnership (FSP), originally 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). Building on the successes of the initial five years of the programme, Defra assured funding for another three years of the programme. Industry proposals for FSP projects are typically developed at a port or regional level, refined and agreed with Cefas, before submission to the FSP 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.

Here we present the latest results from the FSP “Western Channel Sole and Plaice” project (FSP Programme 6). It is a survey on sole *Solea solea* and plaice *Pleuronectes platessa* in the Western English Channel (ICES Division VIIe) carried out by two commercial beam trawlers. The survey forms part of a time-series beginning in 2003, and is carried out during late summer and early autumn. The survey methods were particularly consistent over the years 2003–2007, when the eastern part of the area was covered by the relatively large beam trawler *Lady T Emiel* (with  $2 \times 12$  m beams), and the western part of the area by the comparatively smaller,  $2 \times 8$  m beam trawlers *Nellie* (2003–2004) and *Carhelmar* (2005–2007). The consistency of the time-series has meant that this has been the first FSP dataset to be used as a tuning index for the formal ICES stock assessment (Western Channel plaice: see ICES, 2007, 2008).

Consistency was slightly compromised in 2008 owing to unforeseen circumstances (including high fuel prices and running costs) forcing us to adapt the survey design to account for the economics of running such surveys. For 2008, we chartered FV *Carhelmar* to survey both eastern and western areas, and plan to continue this simplified design in the coming years. This means no change in the survey vessel in the western area, but in the eastern area, FV *Lady T Emiel* surveyed for the first five years of the project. Therefore, and partly to allow a comparison between the two survey vessels, more than half the eastern stations sampled by FV *Carhelmar* were additionally occupied by FV *Lady T Emiel* this year (facilitating vessel catch comparison). For economic reasons too, we limited the sampling effort to those essential (or core) 45 western and 45 eastern stations where consistent data were available for all previous years in the time-series. Fortunately, those stations are largely identical to the ones used previously to provide a tuning series for the ICES Western Channel plaice stock assessment.

In this report we (1) show the positions of all 90 consistently sampled stations; (2) evolve spatial distributions of sole, plaice and other commercially important species over the six years of the survey, and (3) their length distributions and (4) sole and plaice age distributions; and (5) come up with estimates of changes over time in biomass of the Western Channel sole and plaice stocks.

We stress that, for consistency in the dataset presented and analysed, only the 90 stations sampled over all years are included. For earlier years, our results therefore differ in detail only from those presented in the earlier reports of this survey (Cotter *et al.*, 2004; Large *et al.*, 2004; Armstrong *et al.*, 2006; Roel *et al.*, 2007; Engelhard *et al.*, 2008). This includes the time-series in number-at-age used in the ICES stock assessment, where consistency in the dataset is of particularly high importance.

## Objectives

The objectives of the 2008 survey were, broadly speaking, to continue the time-series established, but allowing for some simplifications in the survey design to cope with the long-term sustainability of this survey, from an economic perspective. Specifically, they included:

For FV *Carhelmar*:

- To repeat the Western Channel—West survey as carried out previously in 2003–2007 by FV *Nellie* and FV *Carhelmar*, using chain mat gear and  $2 \times 4$ -m beam trawls, during September/October 2008
- To repeat the Western Channel—East survey as carried out previously in 2003–2007 by FV *Lady T Emiel* (which used  $2 \times 12$ -m beam trawls), but now using  $2 \times 4$ -m beam trawls, during September–October 2008

For FV *Lady T Emiel*:

- To carry out the 2008 Fisheries Science Partnership “Western Channel Sole and Plaice—East Survey” over 6–7 days, as a continuation of the 2003–2007 time-series, using the same gear previously employed ( $2 \times 12$ -m beam trawls, chain mat gear and diamond mesh)
- To compare day and night catch rates of sole and plaice, by fishing as many as possible of the targeted 45 stations by day and by night

The detailed operational plan for the survey was discussed at a meeting between Cefas and the skippers/company representatives on 22 August 2008. The operational plan for the *Carhelmar* survey is given in Appendix 1, and for the *Lady T Emiel* survey in Appendix 2. Trawling was carried out under dispensation from the quota and days-at-sea regulations. The cruise narratives prepared by Cefas seagoing staff are reproduced in Appendix 3.

## Methods

### *Vessels and gear*

FV *Carhelmar* (BM23) is a steel-hulled twin-beam trawler of 22.2 m registered length, with a 220 kW engine. Her home port is Plymouth, Devon, and she is owned by Interfish Ltd., Plymouth. She fished with two Interfish 4-m beam trawls fitted with chain mats. Rubber discs were approximately 8" and 6" diameter, on 26 mm wire.

FV *Lady T Emiel* (BM2000) is a steel twin-beam trawler of 29 m registered length, with a 747 kW engine. Her home port is Brixham, Devon, and she is owned by Seafield Emiel Trawlers, Brixham. 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 in both vessels was 82 mm (nominal 80 mm), constructed from 5.5 mm single-braid twine.

### *Survey design*

The operational plan of the survey is included in Appendix 1. The survey was designed to cover the major part of the Western Channel sole and plaice fishing grounds for UK vessels, and consisted of a western and eastern area (see Appendix 1 for the boundaries of these survey areas, as agreed upon in the operational plan). In previous years of the survey, as mentioned above, the western area had been covered by the smaller FV *Nellie* (2003–4) and *Carhelmar* (2005 on), and the eastern area by the larger *Lady T Emiel* (from 2003). In 2008 *Carhelmar* surveyed both areas, but for comparison, a subset of eastern stations was also sampled by *Lady T Emiel*. As in previous years, all stations visited by *Carhelmar* were sampled during daylight. However, to allow a comparison between day and night catch rates, we planned the eastern stations to be sampled by *Lady T Emiel* y both day and night. Unfortunately, for logistic reasons and poor weather during the survey, only two of the stations were sampled by night, so this report includes no day–night comparative analyses.

The survey was restricted to 45 western and 45 eastern stations also sampled consistently in previous years. See the Appendix for the latitudes and longitudes of these stations; in the first section of Results we show maps of the geographic locations of the stations.

### *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 (the number of baskets) was recorded, and a length frequency was drawn up for all or a sample of the fish. All species, whether retained or discarded, were measured from each haul. For the purpose of this report, the retained and discarded components were combined for analysis. Where catches were subsampled rather than fully sorted, an appropriate raising factor was determined in order to allow the total catch to be estimated. Otoliths of plaice, sole and cod were collected from samples of fish taken randomly 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. All analyses herein include data for just the 90 stations consistently sampled over the years. Catch rates are presented for the western and eastern survey areas (vessels) separately.

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. Otoliths of sole and plaice were collected across all length classes to determine the proportion at age in each length class. This information was compiled into age-length keys for the two species, which were applied to the standardised length frequencies to yield numbers at age for each survey. The age-length keys were combined for the two sexes in both species.

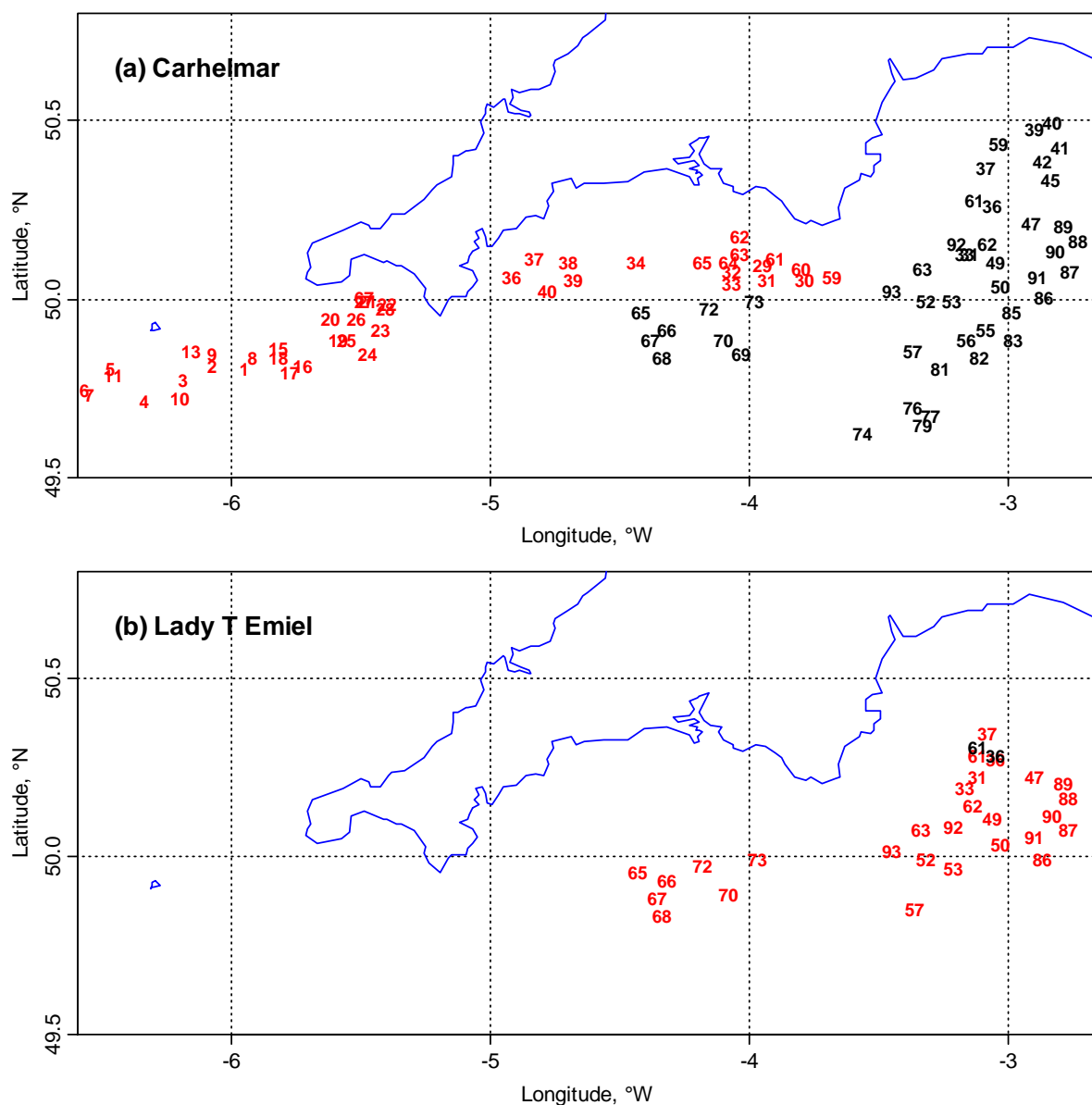
The length distributions and age frequencies thus obtained for the years 2003–2007 differ in detail from those reported in previous reports of this survey (Cotter *et al.*, 2004; Large *et al.*, 2004; Armstrong *et al.*, 2006; Roel *et al.*, 2007; Engelhard *et al.*, 2008), for the following reasons:

- (1) They are based *strictly* on those 45 western and 45 eastern ‘core’ stations sampled in all years of the survey (in earlier reports, 46 western and 62 eastern ‘core’ stations had been used, several of these not sampled in all years);
- (2) Several errata in station details for earlier years were rectified;
- (3) A combined-sex age-length key was used for both species (this was not done in all previous years’ reports);
- (4) Only otolith data collected during the FSP survey were used, i.e. for the year 2003 no additional otolith data from market samples were included (e.g., *contra* Roel *et al.*, 2007). This was on the grounds that this is to be a ‘purely’ FSP time-series of age distributions and that additional otoliths from the 2003 FSP survey were read later (total number of otoliths read from this survey,  $n = 341$ ).

# Results

## Fishing stations

The western study area was surveyed by FV *Carhelmar* over the period 22–29 September 2008, and the positions of the 45 prime stations sampled are indicated in Figure 1a (red numbers). The eastern area was surveyed by FV *Carhelmar* over the periods 2–8 October and 21–23 October; see Figure 1a (black numbers) for an overview of the 45 prime stations sampled. Mean haul duration was 59.2 min in the western, and 59.6 min in the eastern leg. FV *Lady T Emiel* sampled 28 of the 45 eastern prime stations during the period 1–4 September 2008 during daylight (Figure 1b, red); of those, 2 prime stations (36 and 61) were also sampled by night (Figure 1b, black). Average haul duration was 60.2 min.

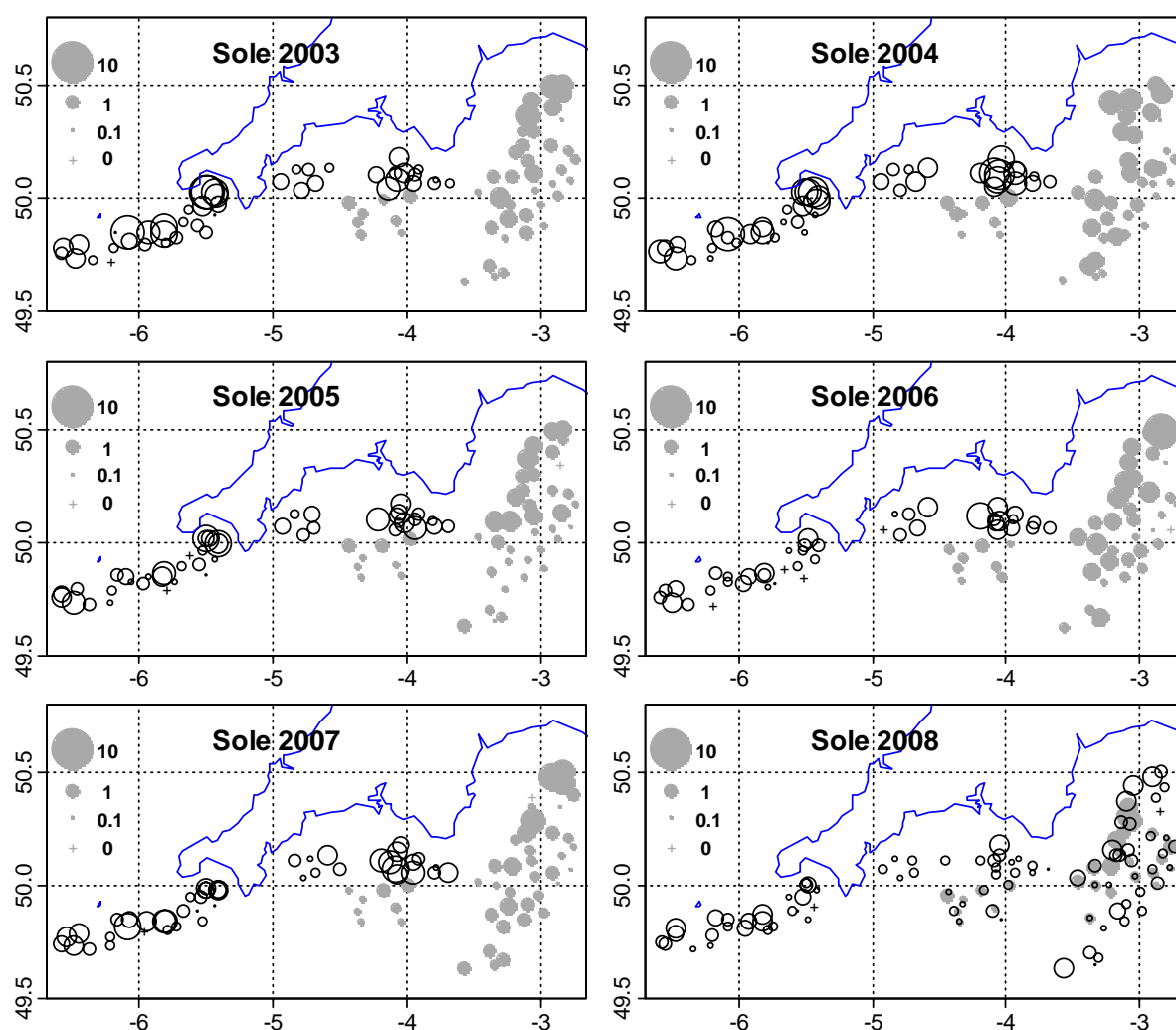


**Figure 1.** (a) Positions of the prime stations sampled by FV *Carhelmar* in 2008, distinguishing the western (red numbers,  $n = 45$ ) and eastern (black numbers,  $n = 45$ ) survey areas. (b) Positions of the prime stations sampled by FV *Lady T Emiel* in 2008, distinguishing hauls during daylight (red numbers,  $n = 28$ ) and darkness hours (black numbers,  $n = 2$ ).

### *Distribution patterns*

See Figures 2–7 for standardised distribution patterns of sole, plaice, lemon sole, megrim and monkfish over the years 2003–2008. Note that the maps for earlier years differ from similar figures in earlier years’ reports of this FSP, because only the 90 ‘core’ stations sampled over the entire time-series were included.

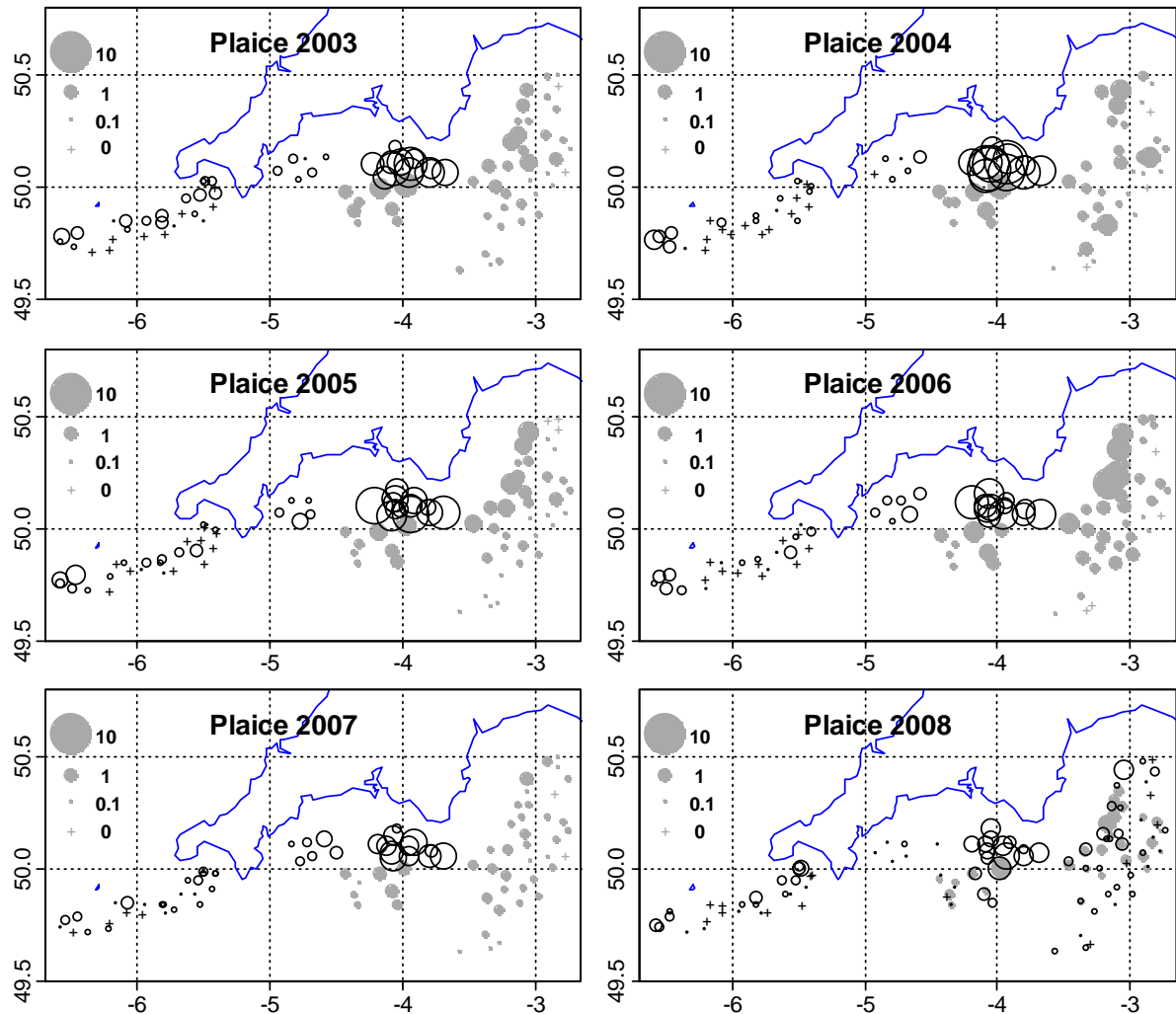
**Sole** were caught in 88 of 90 tows by *Carhelmar*, and in all 30 tows by *Lady T Emiel*. As in earlier years they were distributed fairly equally over the study area with higher numerical abundance closer inshore (Figure 2). They were less abundant around the Scilly Isles and south of Plymouth than in most of the earlier years’ surveys.



**Figure 2.** Catch rates of sole during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam. Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

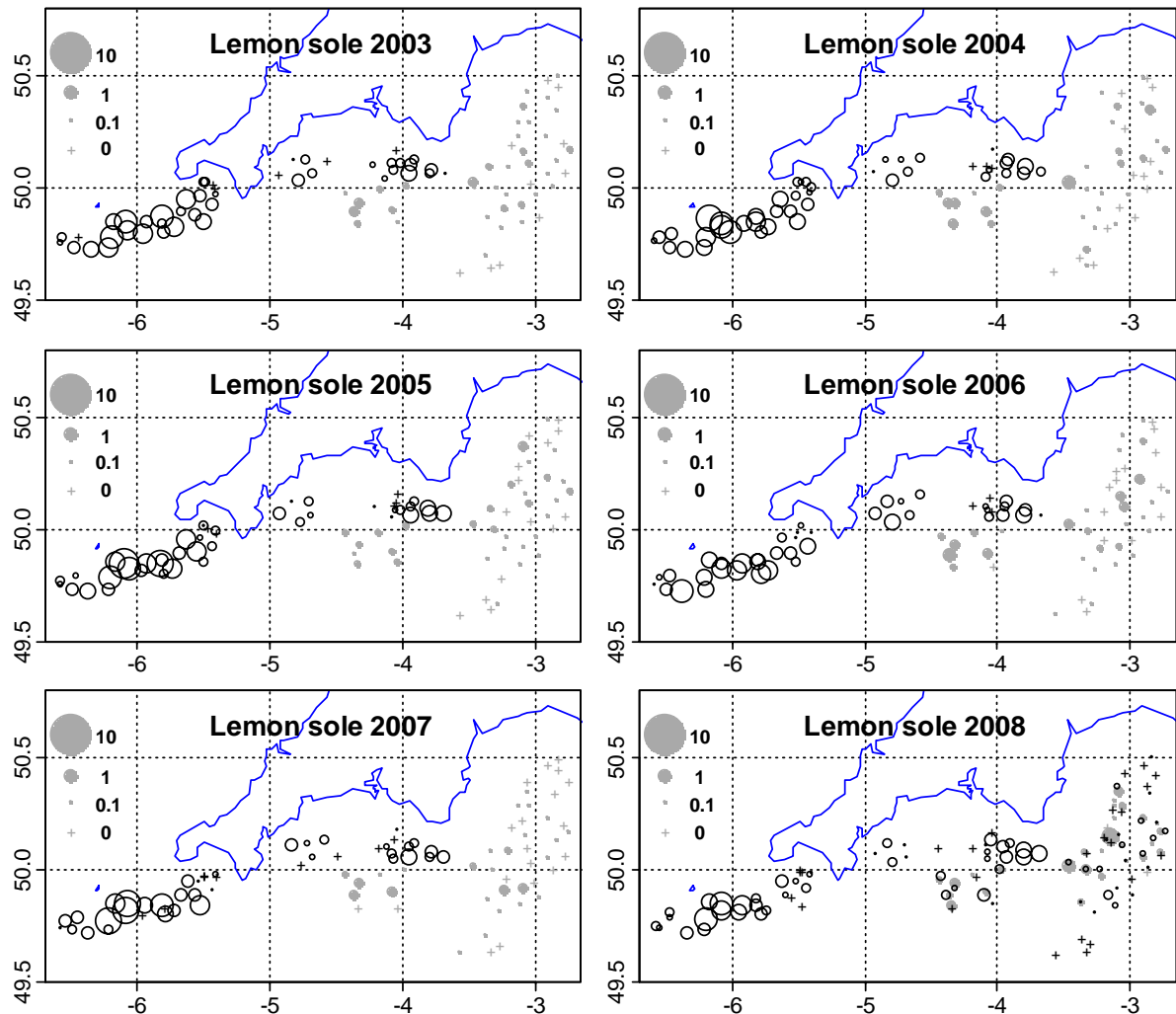


**Plaice** (Figure 3) were caught in 76 of 90 tows by *Carhelmar*, and in all 30 tows by *Lady T Emiel*. The catch rates were, as in 2007, generally very low throughout the survey area. The best catch rates were south of Bigbury Bay off Plymouth, but even there they were lower than in most earlier years of the survey.



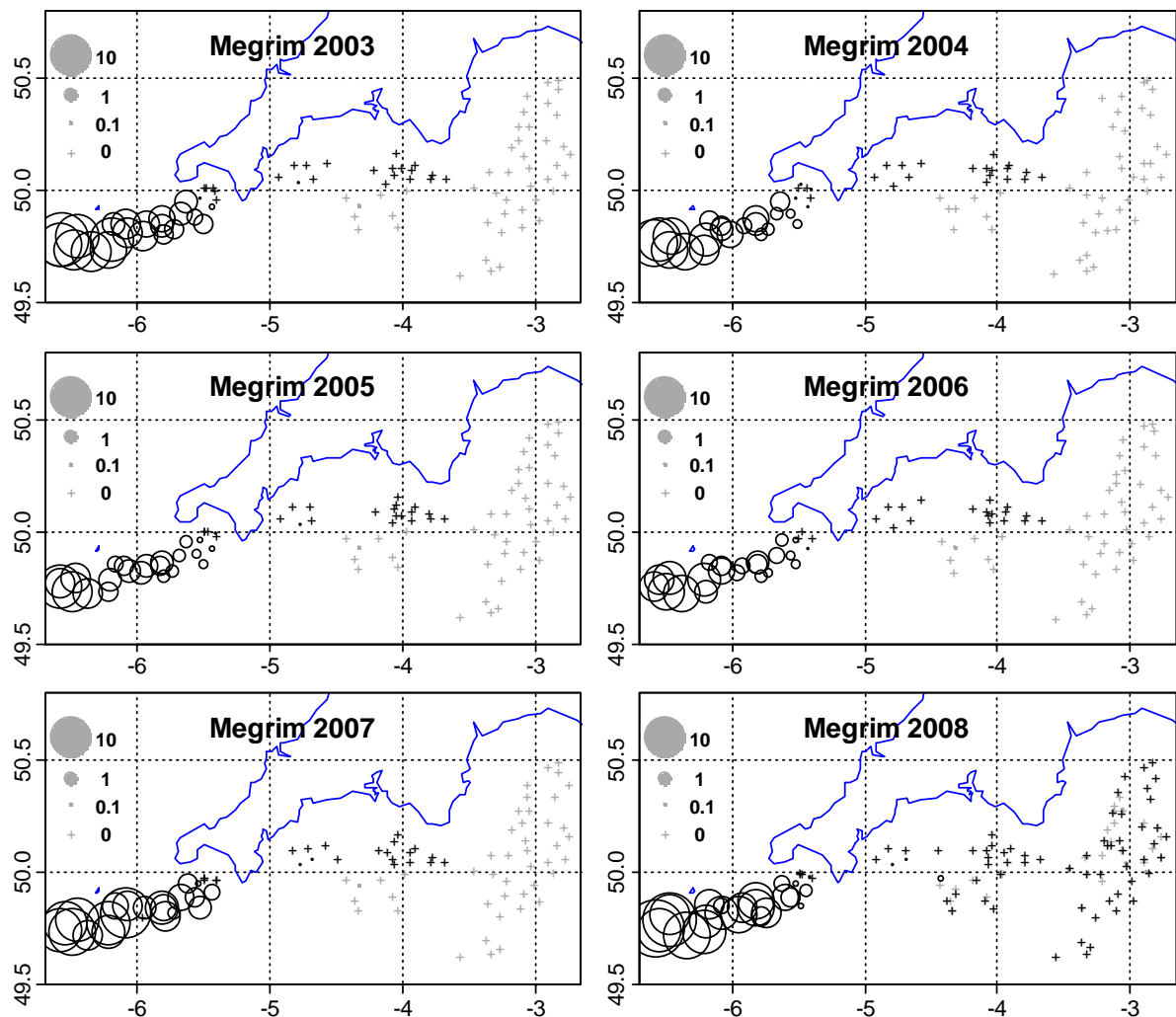
**Figure 3.** Catch rates of plaice during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam. Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

**Lemon sole** (Figure 4) were caught in 65 of 90 tows by *Carhelmar*, and in 28 of 30 tows by *Lady T Emiel*. Their catch rates were, as usual, higher in the western part of the survey area than in the east. The western stations revealed somewhat depressed catch rates than in all previous years, whereas the eastern stations revealed somewhat improved catch rates compared with 2007.



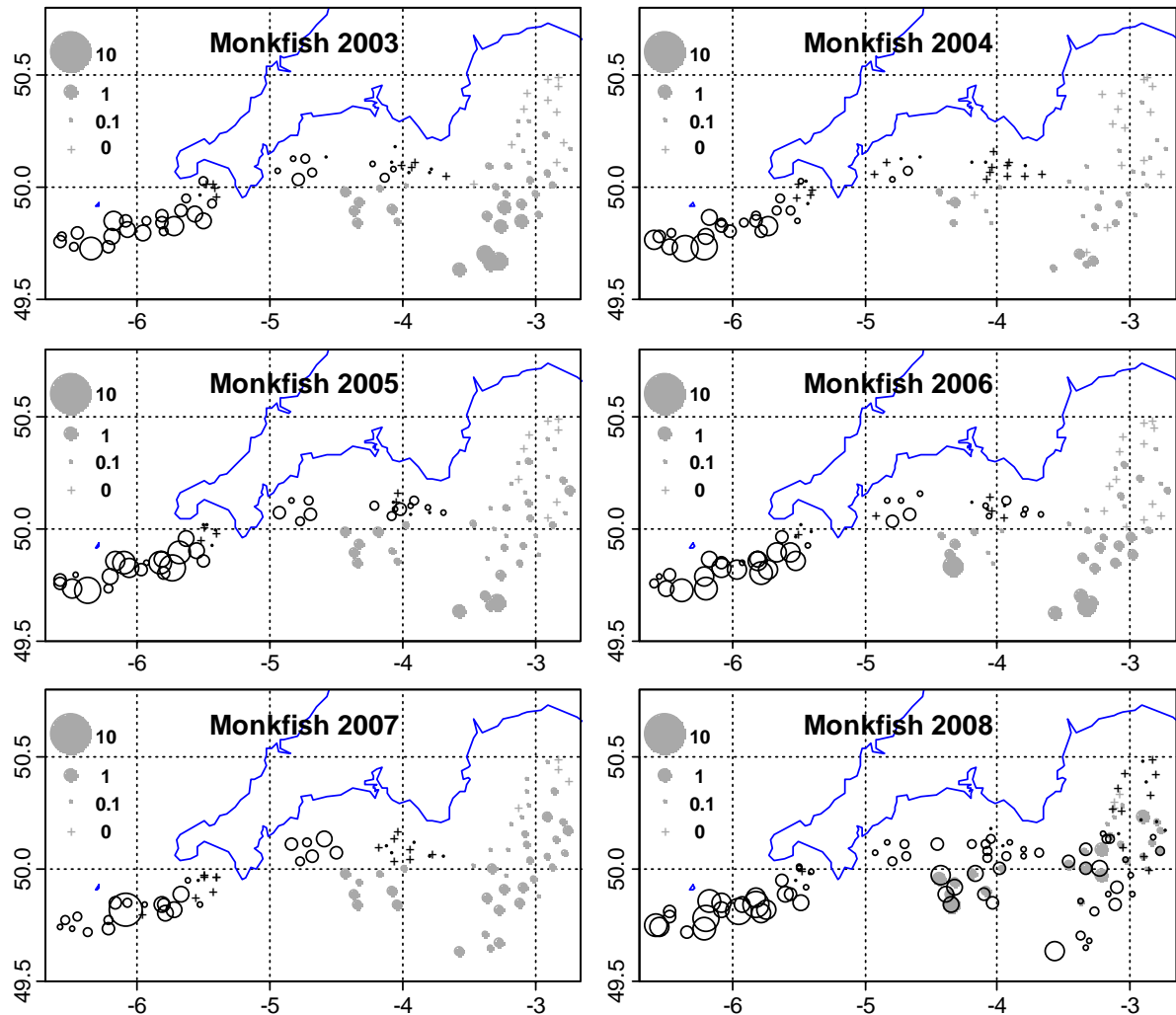
**Figure 4.** Catch rates of lemon sole during the FSP "Western Channel Sole and Plaice" surveys, 2003–2008, expressed as number of fish caught h<sup>-1</sup> m<sup>-1</sup> beam. Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

**Megrim** (Figure 5) were caught in just 26 of 90 tows by *Carhelmar* and in four of 30 tows by *Lady T Emiel*. It is a deeper water species and was almost entirely caught in the western survey area, generally with increasing catch rates westwards.



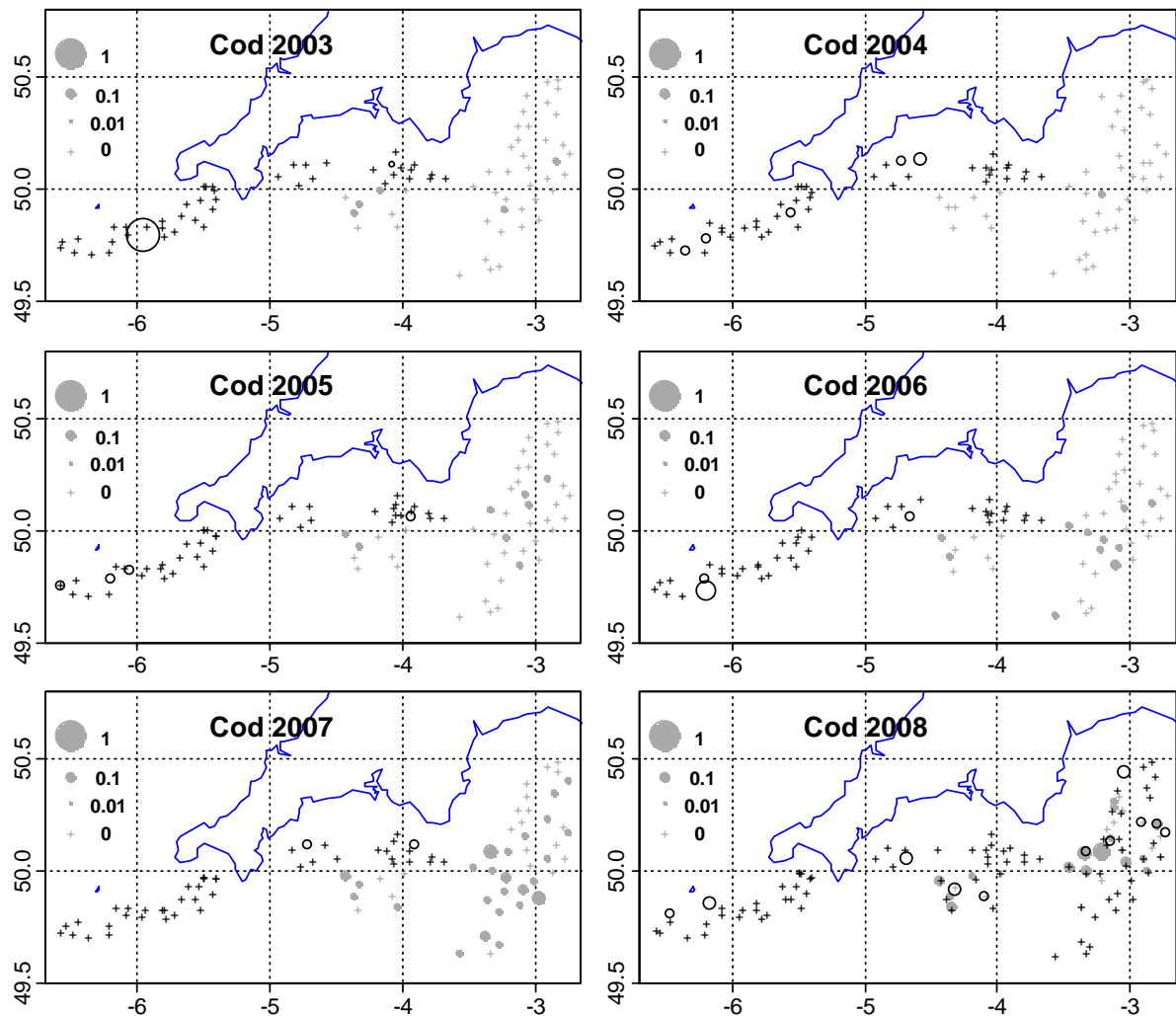
**Figure 5.** Catch rates of megrim during the FSP "Western Channel Sole and Plaice" surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam. Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

**Monkfish** (Figure 6) were caught in 79 of the 90 tows by *Carhelmar* and in 27 of the 30 tows made by *Lady T Emiel*. Their catch rates in most of the survey area were higher than in 2006 and 2007. The greater numerical abundance was especially the case for smaller fish (compare with Figure 12).



**Figure 6.** Catch rates of monkfish (anglerfish) during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as the number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam. Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

**Cod** (Figure 7) were caught in just 11 of the 90 tows made by *Carhelmar*, but in no fewer than 15 of the 30 tows made by *Lady T Emiel*. Although still only rarely caught by beam trawl (note that the scale differs from that in Figures 2–6), cod were encountered at comparable rates to last year, and were more common in the catches than in 2003–2006.

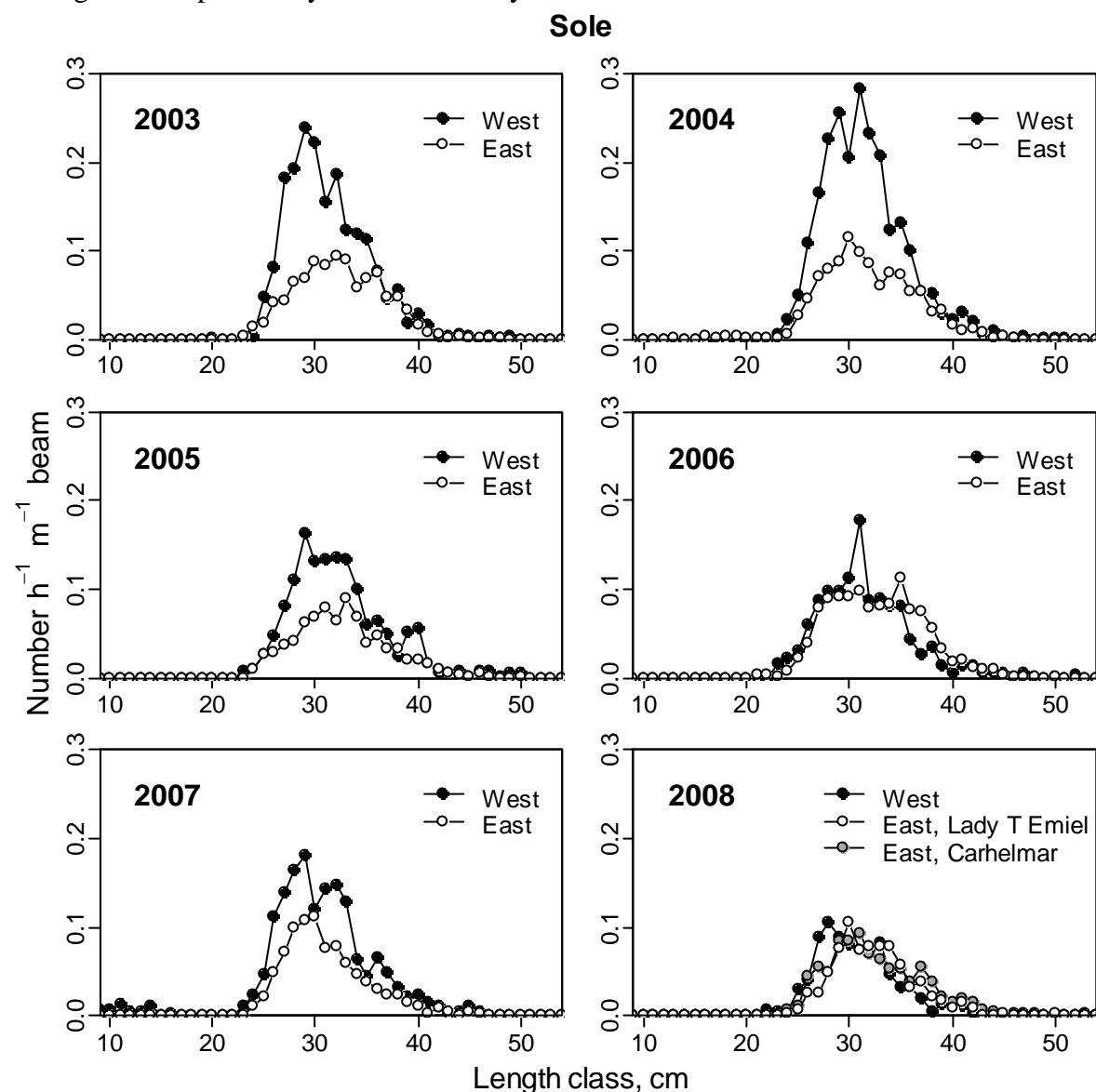


**Figure 7.** Catch rates of cod during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam. Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows. Note that the scale of the symbols differs (by a factor 10) with that in the previous five figures.

## Length compositions

**Sole** (Figure 8). In the east, sole catch rates and length distributions remained fairly stable throughout the period 2003–2008, as indicated by both the *Lady T Emiel* and eastern *Carhelmar* surveys, which yielded almost identical catch rates and length distributions. In the west, the relative length frequencies did not change much from that of the 2003–2007 surveys, but the overall catch rates declined quite substantially from those of 2003–2007.

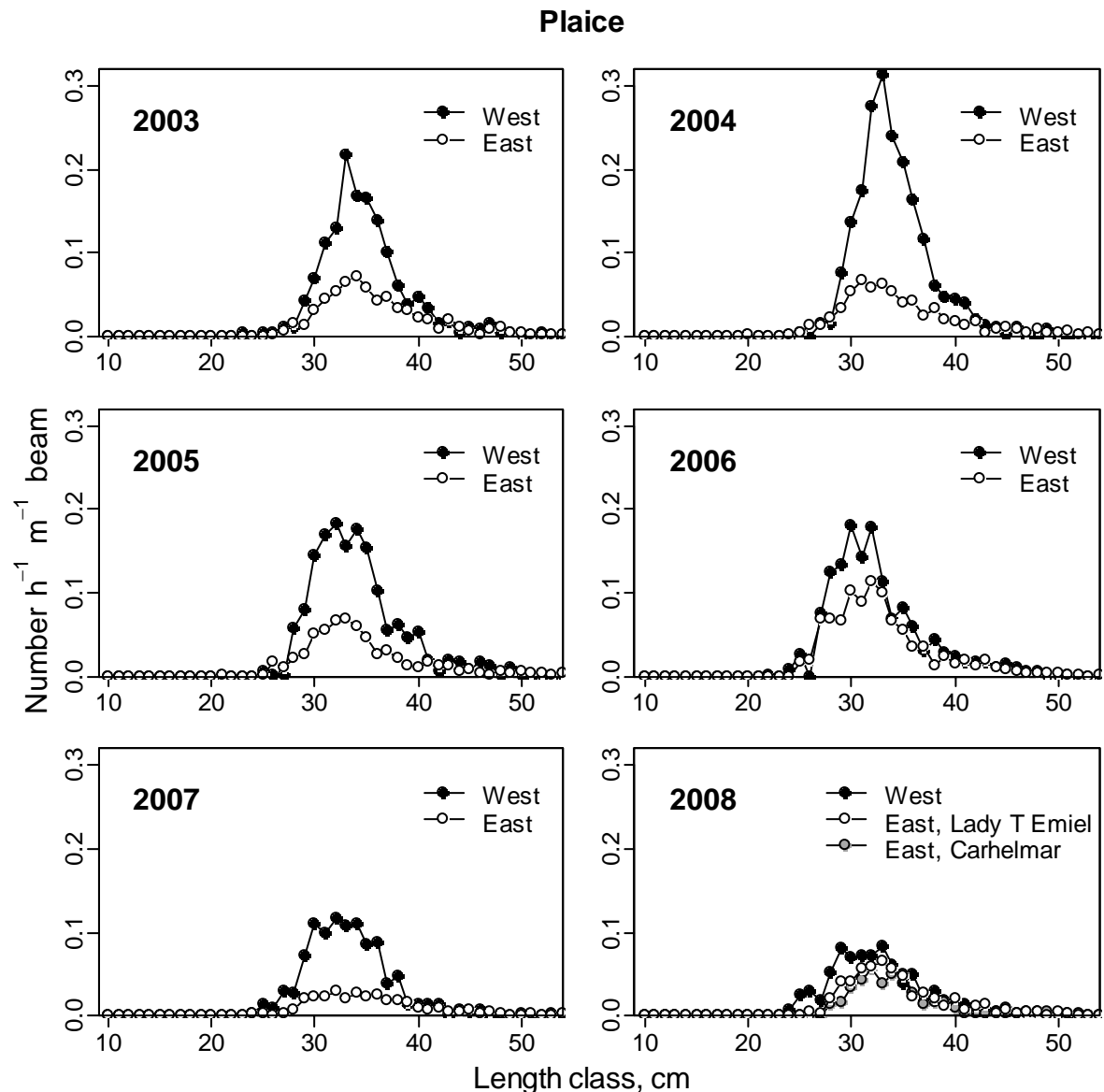
It is important to note that the 2008 *Lady T Emiel* survey (28 stations sampled by day) and eastern *Carhelmar* surveys (45 stations) carried out in the same area only about a month apart and with the same towing speeds, resulted in very similar sole catch rates and length distributions. This implies a similar catchability of sole by the two vessels (if expressed as numbers  $\text{h}^{-1} \text{m}^{-1}$  beam length), and also that the distributional and trend information obtained during this and previous years' FSP surveys will be consistent.



**Figure 8.** Length distributions of sole during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys, and for 2008, the eastern surveys carried out by FV *Carhelmar* and *Lady T Emiel* are shown separately.

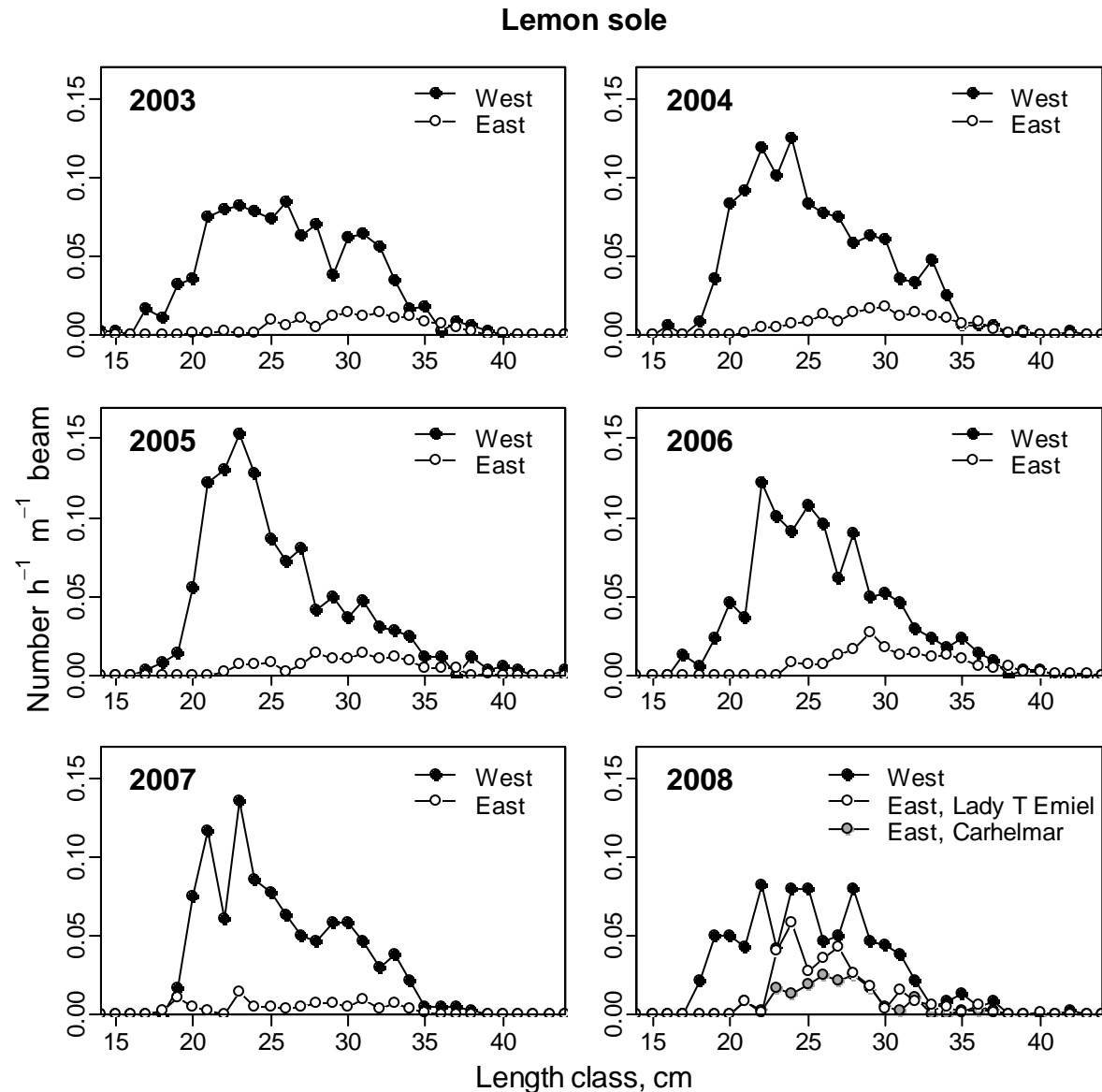
**Plaice** (Figure 9). The catch rates of plaice were generally low, in the west the lowest since the start of this FSP survey in 2003, indicating a long-term decline in plaice in this part of the survey area. In the east, the catch rates were up from the very low levels of the 2007 survey, but mainly the consequence of there being more smaller plaice (but fewer larger plaice). Nevertheless the plaice catch rates in the east were still far lower than in 2003–2006.

Plaice catch rates (expressed as number  $\text{h}^{-1} \text{m}^{-1} \text{beam}$ ) were fairly similar in the 2008 *Lady T Emiel* and eastern *Carhelmar* surveys covering the same area, although slightly higher in the former; relative length frequencies were almost identical. This indicates that the plaice catchabilities of the two vessels are reasonably comparable.



**Figure 9.** Length distributions of plaice during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1} \text{beam}$  per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys, and for 2008, the eastern surveys carried out by FV *Carhelmar* and *Lady T Emiel* are also shown separately.

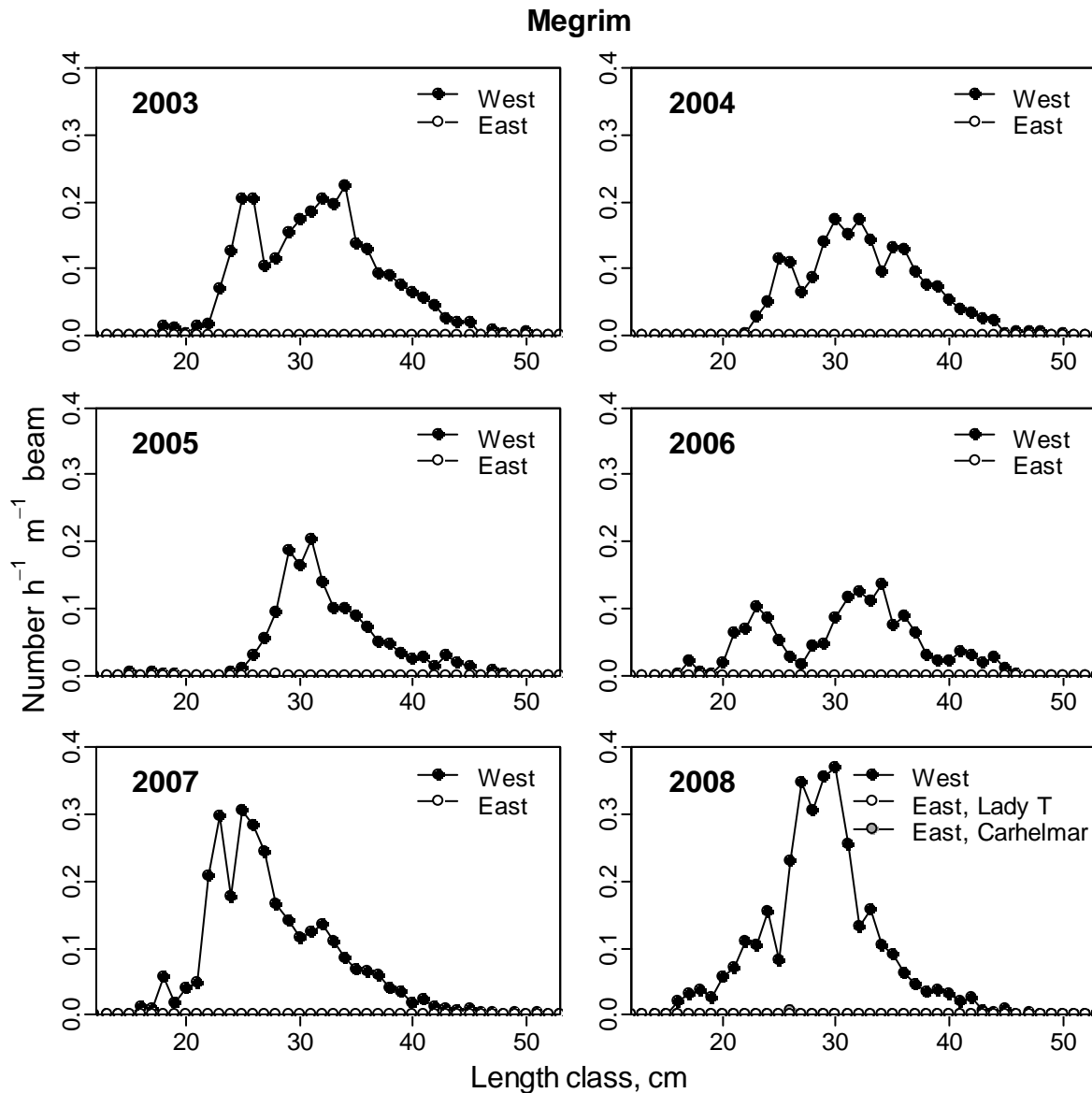
**Lemon sole** (Figure 10). As usual, lemon sole catch rates were higher in the west than in the east, but although the western catch rates were lower than in previous years, those in the east increased (indicated by both eastern surveys of 2008). The depressed catch rates in the west reflected fewer <25 cm lemon sole in the catches, a size class that was abundant in the area throughout the years 2004–2007.



**Figure 10.** Length distributions of lemon sole during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys, and for 2008, the eastern surveys carried out by FV *Carhelmar* and *Lady T Emiel* are also shown separately.

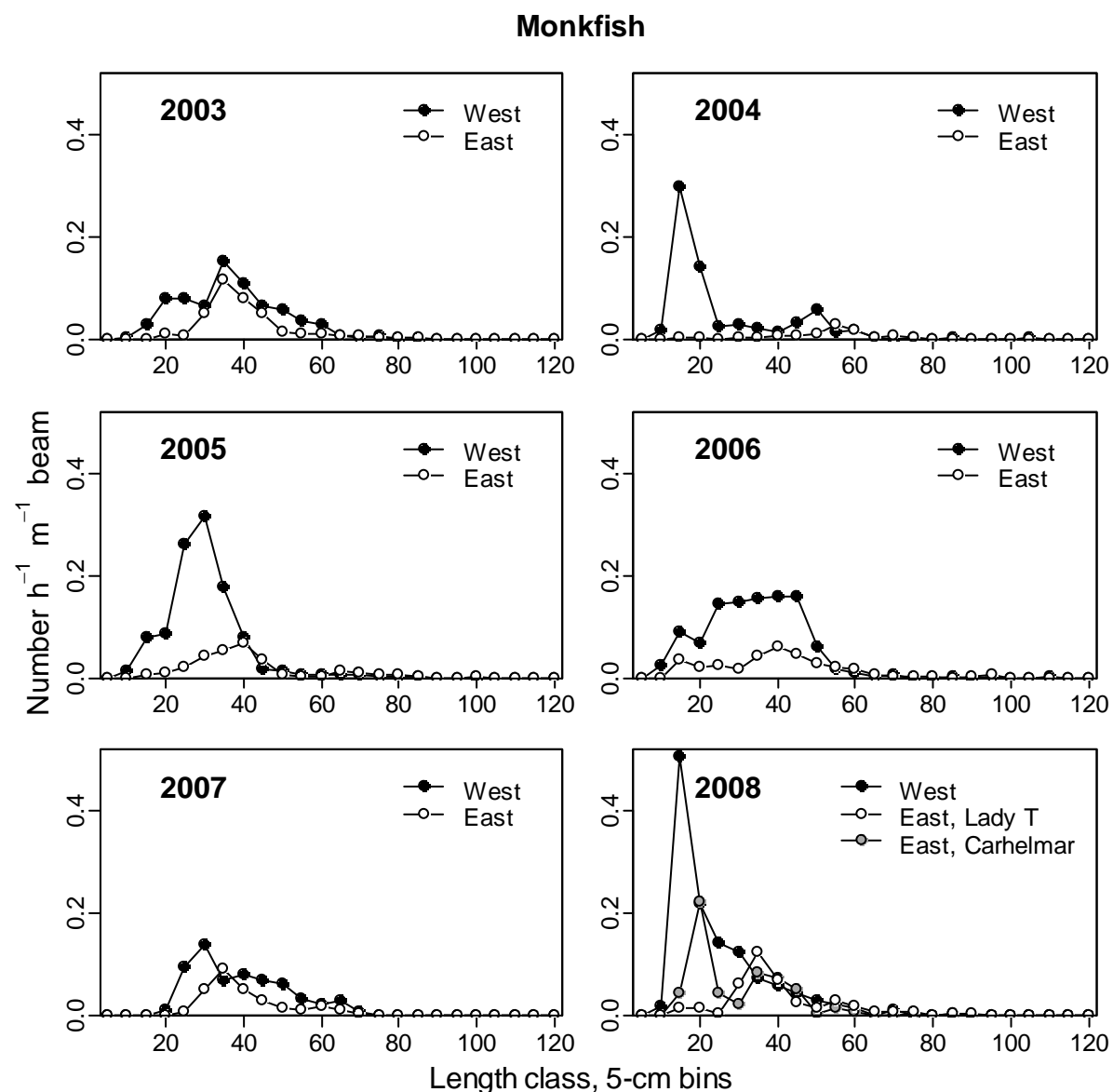


**Megrim** (Figure 11). Megrim are typically virtually restricted to the western survey (in 2008, just 6 fish were caught in the east compared with 1221 in the west). In 2006 and 2007, marked to very marked abundance had been recorded for 21–24 cm and 22–28 cm megrim, respectively, in line with a strong year-class entering the fishery (Roel *et al.*, 2007; Engelhard *et al.*, 2008). In the 2008 survey this strong year-class was reflected in a very marked abundance of 26–32 cm megrim, which dominated the length distribution.



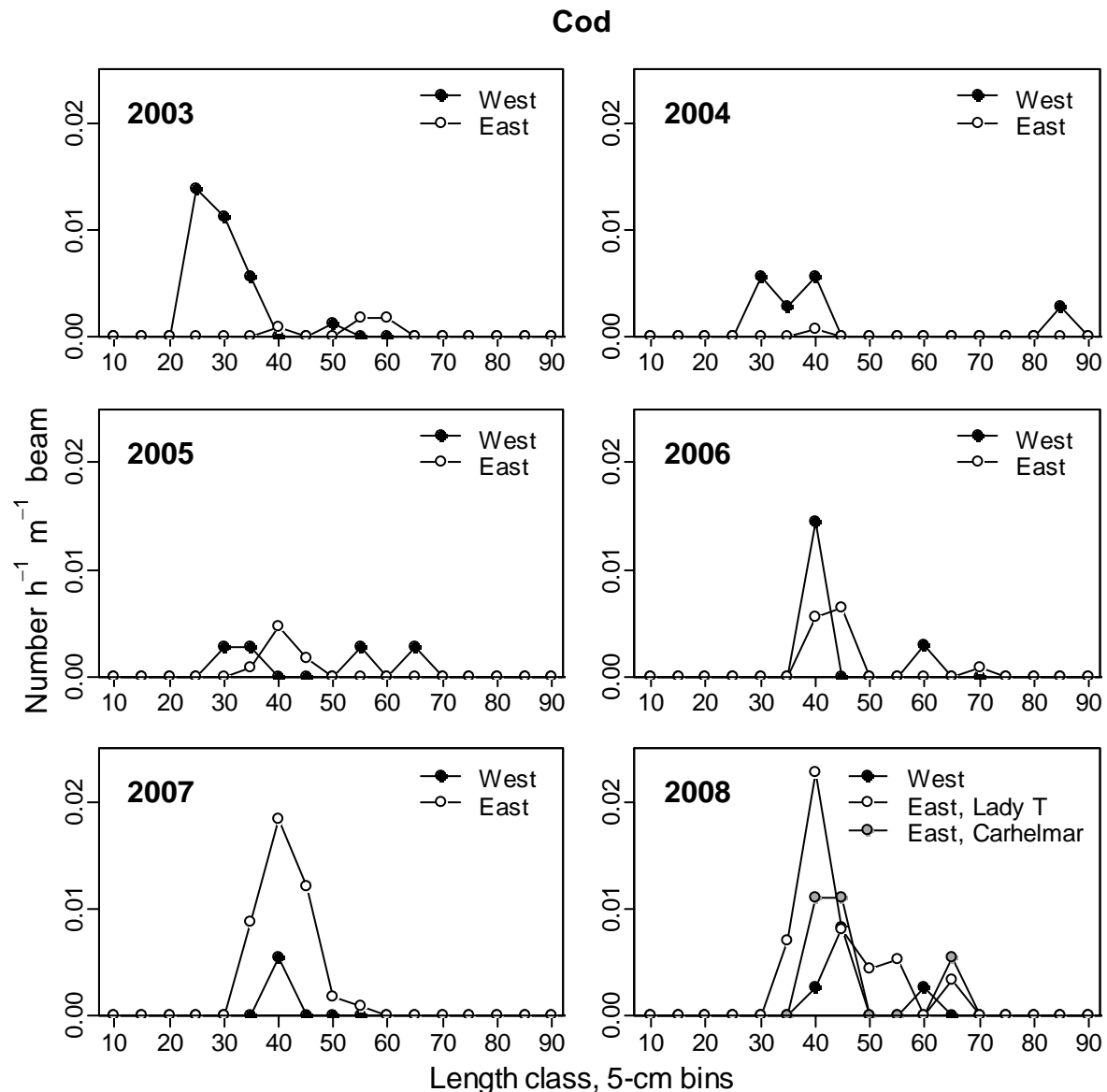
**Figure 11.** Length distributions of megrim during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as the number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys, and for 2008, the eastern surveys carried out by FV *Carhelmar* and *Lady T Emiel* are shown separately.

**Monkfish** (Figure 12). In the west, small (<25 cm) monkfish far outnumbered bigger fish, indicating that a strong year-class is entering the fishery. Much fewer small monkfish were observed in both eastern surveys. The situation in 2008 seems to be similar to that of 2004, although in that year hardly any larger (>30 cm) monkfish were recorded. In 2008, larger (>30 cm) monkfish were caught at approximately equal rates during the western and eastern surveys.



**Figure 12.** Length distributions of monkfish during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam per 5-cm length bin. Length distributions are shown separately for the western and eastern surveys, and for 2008, the eastern surveys carried out by FV *Carhelmar* and *Lady T Emiel* are also shown separately.

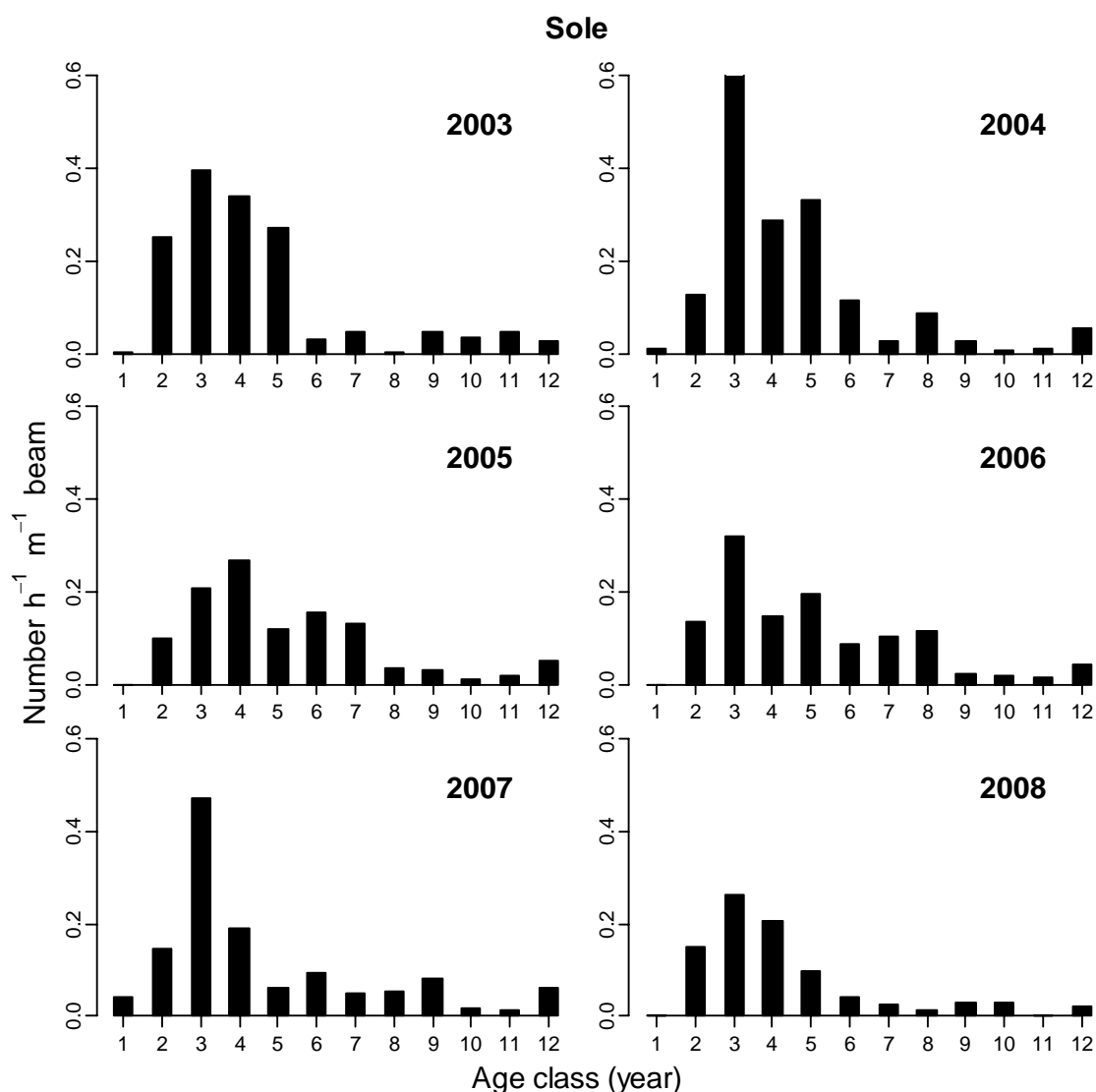
**Cod** (Figure 13). Although cod are rarely caught on this survey, their overall catch rates (as observed over the 90 ‘core’ sampling stations) were slightly up from 2007, and considerably up from the years 2003–2006. Whereas in 2007 almost all cod at ‘core’ stations had lengths <50 cm, several fish of 55–69 cm were caught this year.



**Figure 13.** Length distributions of cod during the FSP “Western Channel Sole and Plaice” surveys, 2003–2008, expressed as number of fish caught  $h^{-1} m^{-1} beam$  per 5-cm length bin. Length distributions are shown separately for the western and eastern surveys, and for 2008, the eastern surveys carried out by FV *Carhelmar* and *Lady T Emiel* are shown separately. Note very different y-axis scaling compared with Figures 8–12.

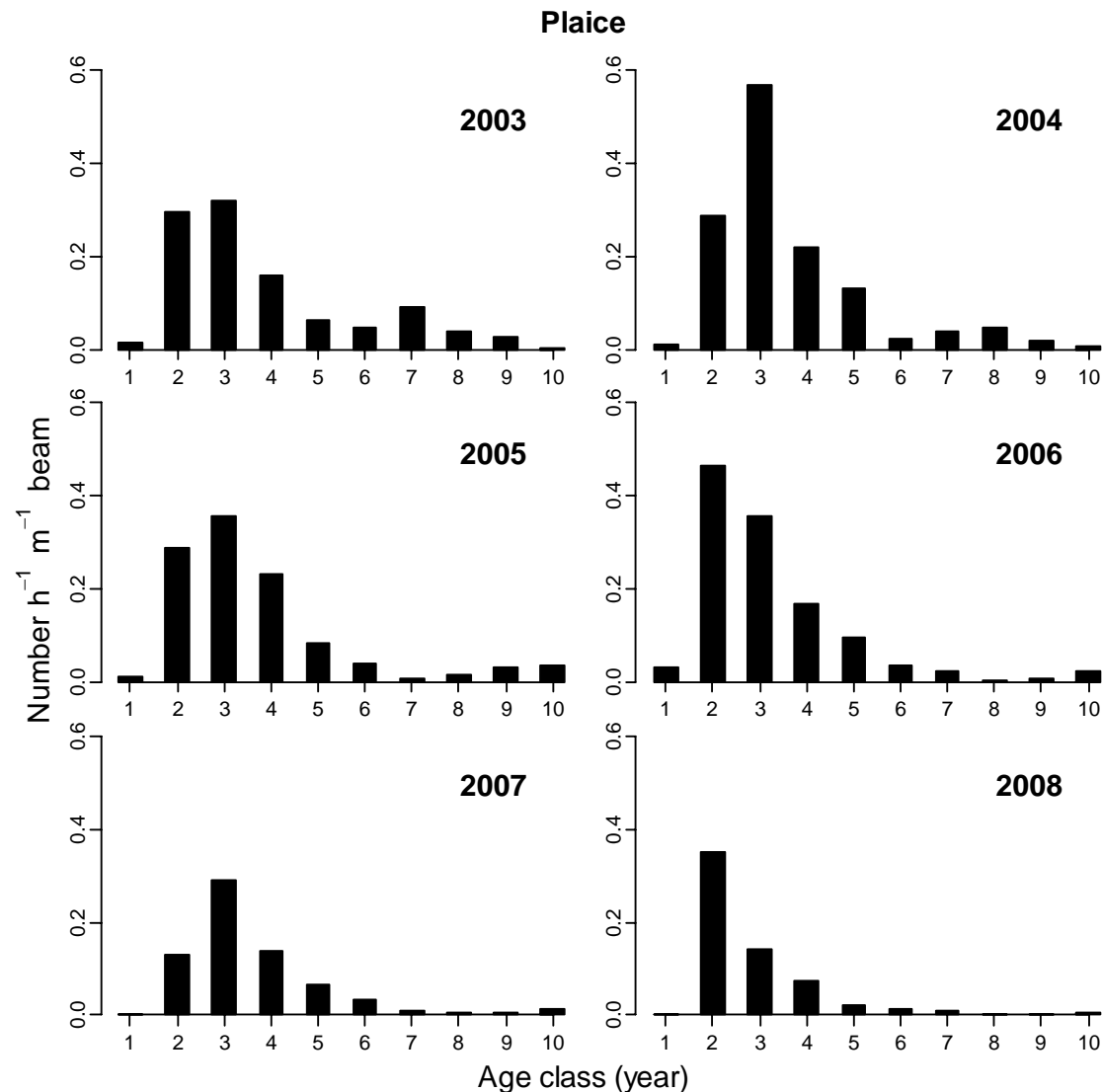
## Age compositions

**Sole** (Figure 13). As in the five previous years of this FSP survey, the age composition of sole in 2008 was again broad, with fish of 12 years and older still fairly common. Three-year-olds were the biggest age-group, as in most of the earlier years except 2005, but less dominant than in 2004 and 2007 (when they represented the above-average 2001 and 2004 year-classes, respectively). The above-average 2004 year-class showed up in the 2008 survey as an age-4 group approaching the age-3 group in numerical abundance. In terms of older sole, the 2008 FSP age distribution revealed two earlier, seemingly above-average year-classes, those of 1998 and 1999; they showed up as elevated catch rates at ages 10 and 9, respectively. Catch rates by age for 2003–2008 are given by area in Table 1, and averaged over eastern and western surveys in Table 3. The oldest sole sampled in the 2008 *Lady T Emiel* and western and eastern *Carhelmar* surveys were 25, 25 and 21 years old, respectively.



**Figure 14.** Mean number of sole of different age caught per hour per metre beam length for both vessels combined (2003–2007). Age 12 is a plus-group that includes the older ages.

**Plaice** (Figure 15). In 2008 the plaice catch rates were lower than in 2003–2006, but comparable with those of 2007. Two-year-old plaice dominated the length distribution, with few 3-year-old plaice observed (whereas in 2007, the 3-year-olds dominated), in line with the 2005 year-class being of below-average strength. Plaice now showed a far narrower age distribution than sole; very few plaice of 6 years and older were caught in 2008. The oldest plaice sampled in the 2008 *Lady T Emiel* and western and eastern *Carhelmar* surveys were just 12, 9 and 8 years old, respectively, which contrasted sharply with the oldest sole observed in each of these surveys all with ages of >20 years. Plaice catch rates by age for the period 2003–2008 are given in Tables 2 and 3.



**Figure 15.** Mean number of plaice of different age caught per hour per metre beam length for both vessels combined (2003–2008). Age 10 is a plus-group including also the older ages.

**Table 1.** Mean numbers of sole caught per hour per metre beam length, by age class and survey area during the 2003–2008 FSP “Western Channel Sole and Plaice” surveys. An index of spawning-stock biomass (SSB) is also shown ( $\text{kg h}^{-1} \text{m}^{-1}$  beam).

SOLE	East						West					
	2003	2004	2005	2006	2007	2008	2003	2004	2005	2006	2007	2008
Age												
1	0.001	0.019	0.000	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.082	0.000
2	0.144	0.078	0.073	0.114	0.100	0.120	0.359	0.178	0.128	0.158	0.189	0.181
3	0.231	0.372	0.138	0.285	0.347	0.250	0.557	0.932	0.276	0.355	0.596	0.278
4	0.248	0.171	0.183	0.137	0.141	0.220	0.428	0.400	0.353	0.157	0.241	0.191
5	0.204	0.220	0.085	0.204	0.048	0.113	0.338	0.445	0.154	0.191	0.079	0.087
6	0.025	0.081	0.122	0.096	0.068	0.046	0.034	0.150	0.195	0.080	0.123	0.037
7	0.040	0.020	0.100	0.119	0.039	0.033	0.049	0.033	0.167	0.092	0.058	0.021
8	0.002	0.057	0.027	0.128	0.039	0.017	0.001	0.113	0.045	0.103	0.070	0.011
9	0.029	0.023	0.025	0.027	0.062	0.036	0.065	0.030	0.040	0.023	0.103	0.022
10	0.029	0.007	0.012	0.025	0.013	0.034	0.044	0.009	0.016	0.017	0.022	0.026
11	0.032	0.011	0.014	0.019	0.010	0.002	0.057	0.012	0.022	0.015	0.017	0.001
12+	0.021	0.032	0.038	0.049	0.045	0.028	0.030	0.077	0.067	0.038	0.076	0.020
<b>Total</b>	<b>1.006</b>	<b>1.091</b>	<b>0.817</b>	<b>1.208</b>	<b>0.913</b>	<b>0.897</b>	<b>1.962</b>	<b>2.378</b>	<b>1.461</b>	<b>1.228</b>	<b>1.656</b>	<b>0.876</b>
SSB index	0.249	0.250	0.238	0.324	0.214	0.207	0.431	0.517	0.412	0.288	0.364	0.169

**Table 2.** Mean numbers of plaice caught per hour per metre beam length, by age class and survey area during the 2003–2008 FSP “Western Channel Sole and Plaice” surveys. An index of spawning-stock biomass (SSB) is also shown ( $\text{kg h}^{-1} \text{m}^{-1}$  beam).

PLAICE	East						West					
	2003	2004	2005	2006	2007	2008	2003	2004	2005	2006	2007	2008
Age												
1	0.010	0.010	0.010	0.027	0.000	0.002	0.019	0.009	0.013	0.034	0.000	0.001
2	0.166	0.155	0.165	0.363	0.054	0.221	0.424	0.419	0.414	0.568	0.209	0.477
3	0.180	0.243	0.190	0.294	0.124	0.104	0.460	0.890	0.520	0.420	0.459	0.180
4	0.100	0.101	0.129	0.142	0.068	0.064	0.217	0.336	0.334	0.197	0.209	0.084
5	0.042	0.070	0.050	0.081	0.044	0.022	0.080	0.188	0.119	0.109	0.091	0.023
6	0.037	0.015	0.025	0.032	0.026	0.014	0.057	0.030	0.057	0.038	0.041	0.013
7	0.063	0.022	0.006	0.023	0.009	0.012	0.118	0.053	0.014	0.029	0.011	0.005
8	0.029	0.041	0.014	0.005	0.004	0.003	0.047	0.053	0.018	0.007	0.008	0.001
9	0.022	0.013	0.021	0.007	0.004	0.001	0.029	0.025	0.042	0.010	0.006	0.002
10+	0.001	0.011	0.026	0.024	0.012	0.004	0.003	0.003	0.043	0.026	0.019	0.009
<b>Total</b>	<b>0.649</b>	<b>0.681</b>	<b>0.637</b>	<b>0.998</b>	<b>0.344</b>	<b>0.448</b>	<b>1.455</b>	<b>2.005</b>	<b>1.575</b>	<b>1.437</b>	<b>1.053</b>	<b>0.794</b>
SSB index	0.212	0.191	0.189	0.234	0.104	0.088	0.413	0.485	0.431	0.315	0.256	0.124

**Table 3.** Sole and plaice: mean catch per hour per metre beam length, averaged over eastern and western surveys during the 2003–2008 FSP “Western Channel Sole and Plaice” surveys (chain-mat gear only). An index of spawning-stock biomass (SSB) is also shown ( $\text{kg h}^{-1} \text{m}^{-1}$  beam).

Age	SOLE						PLAICE					
	2003	2004	2005	2006	2007	2008	2003	2004	2005	2006	2007	2008
1	0.000	0.010	0.000	0.002	0.041	0.000	0.015	0.010	0.012	0.030	0.000	0.002
2	0.252	0.128	0.100	0.136	0.144	0.150	0.295	0.287	0.290	0.465	0.131	0.349
3	0.394	0.652	0.207	0.320	0.471	0.264	0.320	0.566	0.355	0.357	0.292	0.142
4	0.338	0.285	0.268	0.147	0.191	0.205	0.159	0.218	0.231	0.170	0.138	0.074
5	0.271	0.332	0.119	0.198	0.064	0.100	0.061	0.129	0.085	0.095	0.067	0.022
6	0.030	0.115	0.158	0.088	0.096	0.041	0.047	0.022	0.041	0.035	0.034	0.013
7	0.044	0.027	0.134	0.105	0.049	0.027	0.090	0.038	0.010	0.026	0.010	0.009
8	0.002	0.085	0.036	0.116	0.055	0.014	0.038	0.047	0.016	0.006	0.006	0.002
9	0.047	0.027	0.032	0.025	0.083	0.029	0.025	0.019	0.032	0.008	0.005	0.002
10/10+	0.036	0.008	0.014	0.021	0.017	0.030	0.002	0.007	0.034	0.025	0.016	0.006
11	0.045	0.012	0.018	0.017	0.013	0.002						
12+	0.025	0.054	0.052	0.043	0.060	0.024						
<b>Total</b>	<b>1.484</b>	<b>1.735</b>	<b>1.139</b>	<b>1.218</b>	<b>1.284</b>	<b>0.886</b>	<b>1.052</b>	<b>1.343</b>	<b>1.106</b>	<b>1.217</b>	<b>0.698</b>	<b>0.621</b>
SSB index	0.340	0.383	0.325	0.306	0.289	0.188	0.312	0.338	0.310	0.274	0.180	0.106

## Discussion

This is the sixth FSP “Western Channel Sole and Plaice” survey carried out successfully, so contributing to this collaborative project between fishers and scientists and providing a consistent series of beam trawl surveys in the Western Channel (see also Cotter *et al.*, 2004; Large *et al.*, 2004; Armstrong *et al.*, 2006; Roel *et al.*, 2007; Engelhard *et al.*, 2008). 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 include monkfish, lemon sole and megrim. Of further interest are similar data for more than 50 additional species of fish and shellfish.

Up to now the fishing methods and within-year timing have stood out as being consistent, but the changed economic circumstances of 2008 (including much higher fuel prices and running costs) forced us to adapt the survey design to some extent. In previous years the  $2 \times 4$  m beam trawlers *Nellie* (2003–2004; engine power 486 kW, registered length 23 m) and *Carhelmar* (2005 on; 220 kW, 22.2 m) covered the western survey area, and the  $2 \times 12$  m beam trawler *Lady T Emiel* (2003–2007) covered the eastern area, each of the three vessels using identical towing speeds and tow durations; in total, about 120 stations were sampled in each year (though not all stations in all years). In 2008 this survey design was simplified to the *Carhelmar* covering both areas and sampling 45 stations in each—although a subset of 28 eastern stations was also sampled by *Lady T Emiel*. We argue that this has only marginally compromised the consistency of the time-series, on the following grounds:

- (1) The towing speeds and haul durations have remained consistent throughout, and the gear has essentially remained the same except for the switch from  $2 \times 12$  to  $2 \times 4$  m beam;
- (2) The *Lady T Emiel* and *Carhelmar* appear to have highly similar sole catchabilities and fairly similar plaice catchabilities, *provided* that catch rates are quantified as number of fish caught  $\text{h}^{-1} \text{m}^{-1}$  beam length. This is indicated by the very similar catch rates and length distributions obtained during the 2008 *Lady T Emiel* and eastern *Carhelmar* surveys, which covered the same area about a month apart. For sole, see Figures 2 and 7; for plaice, see Figures 3 and 8 (and see also Figures 9 and 11 for lemon sole and monkfish).
- (3) The reduction in the number of stations to 45 in each area was based on a selection of those stations consistently sampled in all previous years, and excludes any stations that were not sampled regularly; it also excludes some of the earlier stations that were at virtually identical positions.
- (4) The simpler and more economic design is just as valuable scientifically as earlier surveys, for less cost and hence more value for money.

We stress further that the close proximity in time of the 2008 *Lady T Emiel* and eastern *Carhelmar* surveys provided us a very good opportunity to ‘calibrate’ the two surveys (and we are planning to do further statistical modelling on this in the near future), an opportunity that is not always provided in fisheries research surveys.

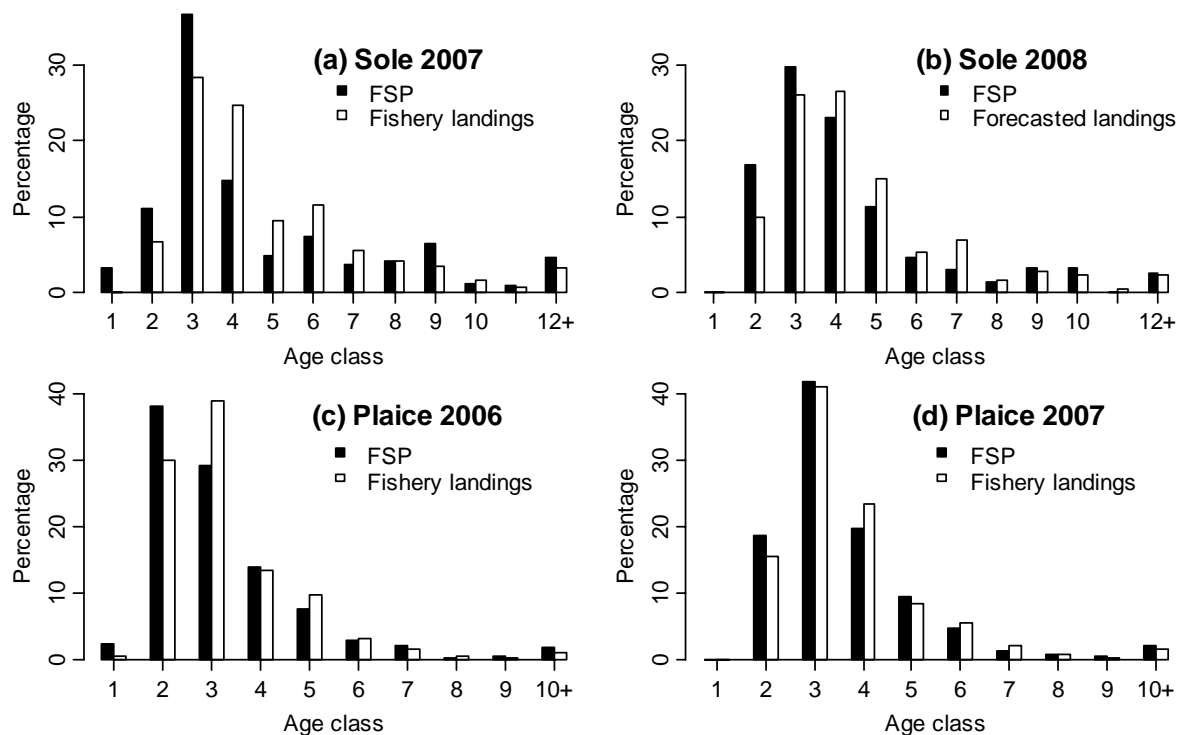
### *Comparison with ICES data*

We have reported broadly similar percentage age compositions for Western Channel sole and plaice in FSP surveys compared with those of international commercial fishery landings

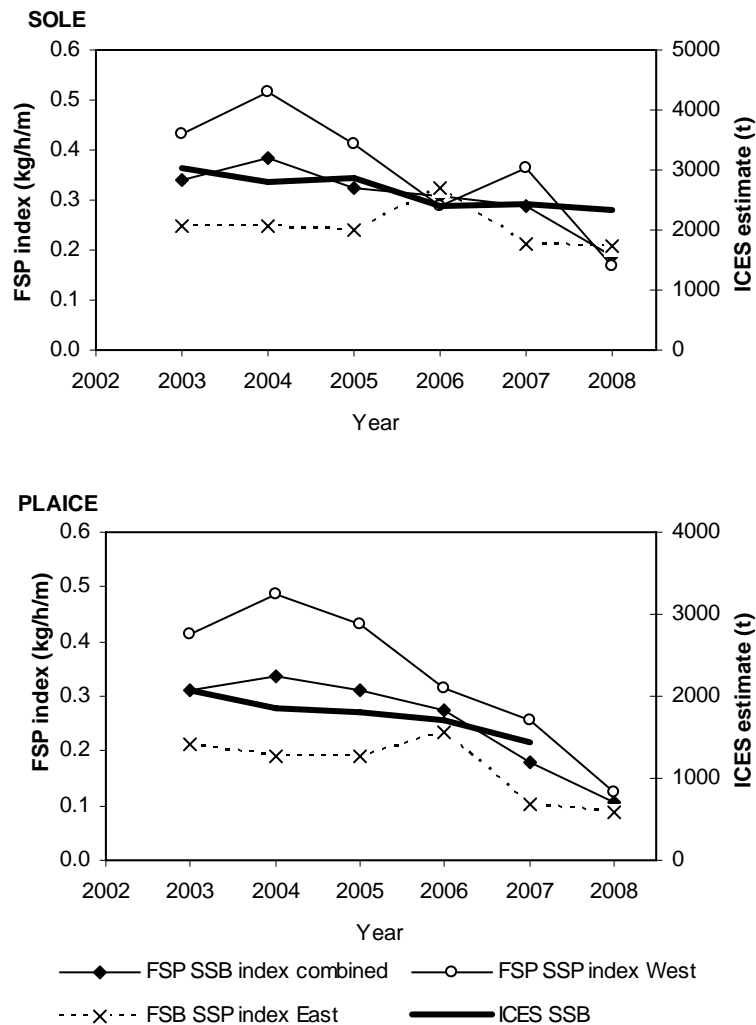


(Armstrong *et al.*, 2006; Roel *et al.*, 2007; Engelhard *et al.*, 2008). The same conclusion comes from a re-analysis of the age distributions for the most recent years, for which international landings data or estimates are available (Figure 16; landings data from ICES, 2008). For sole, Figures 16a and 16b compare 2007 and 2008 FSP age distributions with those for the 2007 reported international landings and the 2008 forecast international landings; the FSP age distribution mainly differs in having somewhat more fish of younger age class, which is in line with the inclusion of discards in the FSP data. Both the commercial landings and FSP data show local peaks in distribution for fish aged 3, 6 and 9 years in 2007, and 4, 6 and 10 years in 2008; these represent the 2004, 2001, and 1998 year classes, which have also been estimated to be above-average in the ICES stock assessment (ICES, 2008).

For plaice, no forecast for 2008 international landings was made by the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks (ICES, 2008), so Figures 16c and 16d compare the 2006 and 2007 FSP age distributions with those for the international landings reported for those years. The FSP and commercial age distributions are more similar than in the case of sole (apart from the FSP including relatively more smaller fish, again because the FSP catches include small fish that might be discarded by the commercial fishery), and the similarity is especially striking for the year 2007.



**Figure 16.** Comparisons between the percentage sole and plaice age distributions obtained during 2006–2008 FSP surveys, with those in the international fishery landings from the Western Channel, as reported or forecast by the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks (ICES, 2008): (a) 2007 sole FSP catches compared with the 2007 commercial fishery landings (ICES, 2008, p. 50); (b) 2008 sole FSP catches compared with the 2008 forecast international fishery landings (ICES, 2008, p. 86); (c) 2006 plaice FSP catches compared with the 2006 commercial fishery landings (ICES, 2008, p. 120); (d) 2007 plaice FSP catches compared with the 2007 commercial fishery landings (ICES, 2008, p. 120).



**Figure 17.** Comparison between trends in spawning-stock biomass (SSB) found by the FSP surveys and the most recent ICES assessments for the VIIe stocks of sole and plaice (ICES, 2008). FSP trends are given separately for the eastern and western surveys, and for the surveys combined. Note: no 2007 SSB forecast was available for plaice, because the Western Channel plaice stock forecast is currently considered dubious (ICES, 2008), so was not provided in 2008.

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, 2008). Values are given in Tables 1–3 (bottom rows). The trends for sole from the combined eastern and western surveys are in broad terms in accord with the results of the current ICES assessment (Figure 17), indicating a relatively stable but slightly declining SSB within the six years of surveys (especially suggested by the eastern surveys) towards a more irregular and more declining trend (especially suggested by the western surveys). The ICES SSB estimates are indicative of a slow/gradual decrease and are in line with the averages of the western and eastern FSP surveys. However, it cannot be excluded that the change in survey vessel from the *Nellie* to the *Carhelmar* in 2005 may be a factor in the western survey trend.

The FSP indices of plaice SSB (Figure 17) mostly reflect the downward trend over the period 2003–2008 given by the ICES assessment of the stock (Figure 17), although they tend to provide a slightly more pessimistic view of stock status: both western and eastern SSB indices provided by the FSP for the years 2007–2008 are lower than for all previous years.

The 2007 SSB estimate made by ICES (2008) was, accordingly, lower than for all previous years. Unfortunately no 2008 SSB forecast by ICES was available; the Western Channel plaice forecast is currently considered to be dubious and too inaccurate to be used as a basis for TAC calculations for 2008, so was not provided in 2008 (and hence not included in the document ICES, 2008). Accounting for the uncertainty, the declining estimates as indicated by both ICES (2008) and the FSP surveys, suggest that Western Channel plaice SSB has generally been declining in recent years, requiring further investigation.

## Acknowledgements

We thank the skippers and crew of *Lady T Emiel* (2003–2008 surveys), *Carhelmar* (2005–2008 surveys) and *Nellie* (2003–2004 surveys) for their enthusiasm, cooperation and valued contributions to the surveys. The success of the programme has in large measure been due to the skills of skippers Mike Sharp (*Lady T Emiel*), Gerald Podschies and Dave Murphy (*Carhelmar*) and Stephen Nowell (*Nellie*) and their knowledge of the fish stocks in the Channel. All staff at Cefas who contributed to the programme are thanked for their help. The 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.
- Engelhard, G.H., Mulligan, B., Wade, O., Bush, R. and Armstrong, M. 2008. Programme 6: Western Channel sole and plaice. Fisheries Science Partnership 2007/08. Final Report. 40 pp.
- 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.
- ICES. 2008. Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks (WGSSDS), 30 April–6 May 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:12.
- 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.

## **Appendix 1**      Detailed work plan for 2008 western and eastern *Carhelmar* survey

### **VESSEL**

Vessel name:      **Carhelmar**  
RSS:                **B10649**  
PLN:                **BM 23**  
Skipper's name:   **Gerald Podschies**

### **OBSERVER**

Julian P. Martin  
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### **OBJECTIVES**

- To carry out the 2008 Fisheries Science Partnership Survey “Western Channel Sole & Plaice” over 15 days, as a continuation of the 2003–2007 time-series
- To repeat the Western Channel—West survey as carried out previously in 2003–2007 by FV *Nellie* and FV *Carhelmar*, using chain mat gear and 2 x 4-m beam trawls, during September–October 2008
- To repeat the Western Channel—East survey as carried out previously in 2003–2007 by FV *Lady T Emiel* (which used 2 x 12-m beam trawls), but now using 2 x 4-m beam trawls, during September–October 2008
- It is of primary importance to cover all 45 stations of the Western Channel—West survey consistently with previous years, and of secondary importance to cover the 45 stations of the Western Channel—East survey

### **FISHING GEAR**

The fishing gear to be fitted and used is two Interfish 4-m beam trawls fitted with chain mats, and rubber discs of approximately 8" and 6" diameter, on 26 mm wire. These are to be fished at about 4 knots at all of the depths within the defined area. The codend to be used has an 82 mm diamond mesh (nominal 80 mm), made from 5.5 mm single-brided twine.

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

Fishing will be undertaken within British fishery limits and within both areas “A” (“West”) and “B” (“East”) shown in Annex 1.

Annex 2 shows the positions of the ‘prime stations’ where tows are to be carried out during this 2008 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.

## **PERIOD OF SURVEY**

The vessel will depart on Monday 22 September 2008 around 9:00 and commence fishing the same day at a suitable location. The duration of the trip will be either 3 periods of 5 continuous days, with fishing activities distributed over each of the 5 days, or 2 periods of each about 6–9 days. There will be a maximum of 4 days, between each of these 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 previous 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).

- 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 otolith 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 280 sole otoliths (160 in area “West”, 120 in area “East”), 280 plaice otoliths (160 in area “West”, 120 in area “East”), and otoliths for all cod sampled (unless cod catch is very large), to be distributed over 4 ‘major length groups’ approximately as follows:

Species	Length	Nos otoliths	Remark
Sole	0-29	30	About one 0-29 cm sole otolith at random every 3 tows
	30-34	100	About one 30-34 cm sole otolith at random every tow
	35-44	120	About one-two 35-44 cm sole otoliths at random every tow
	45+	30	Probably all 45+ cm sole that are sampled
Plaice	0-29	30	About one 0-29 cm plaice otolith at random every 3 tows
	30-34	90	About one 30-34 cm plaice otolith at random every tow
	35-44	120	About one-two 35-44 cm plaice otoliths at random every tow
	45+	40	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, with roughly 40% and 60% in the ‘East’ and ‘West’ parts of the survey (see ‘Remark’ in the above table to help achieving this; generally the subsampling practices of the otoliths should follow the working methods routinely applied by the observers).

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**

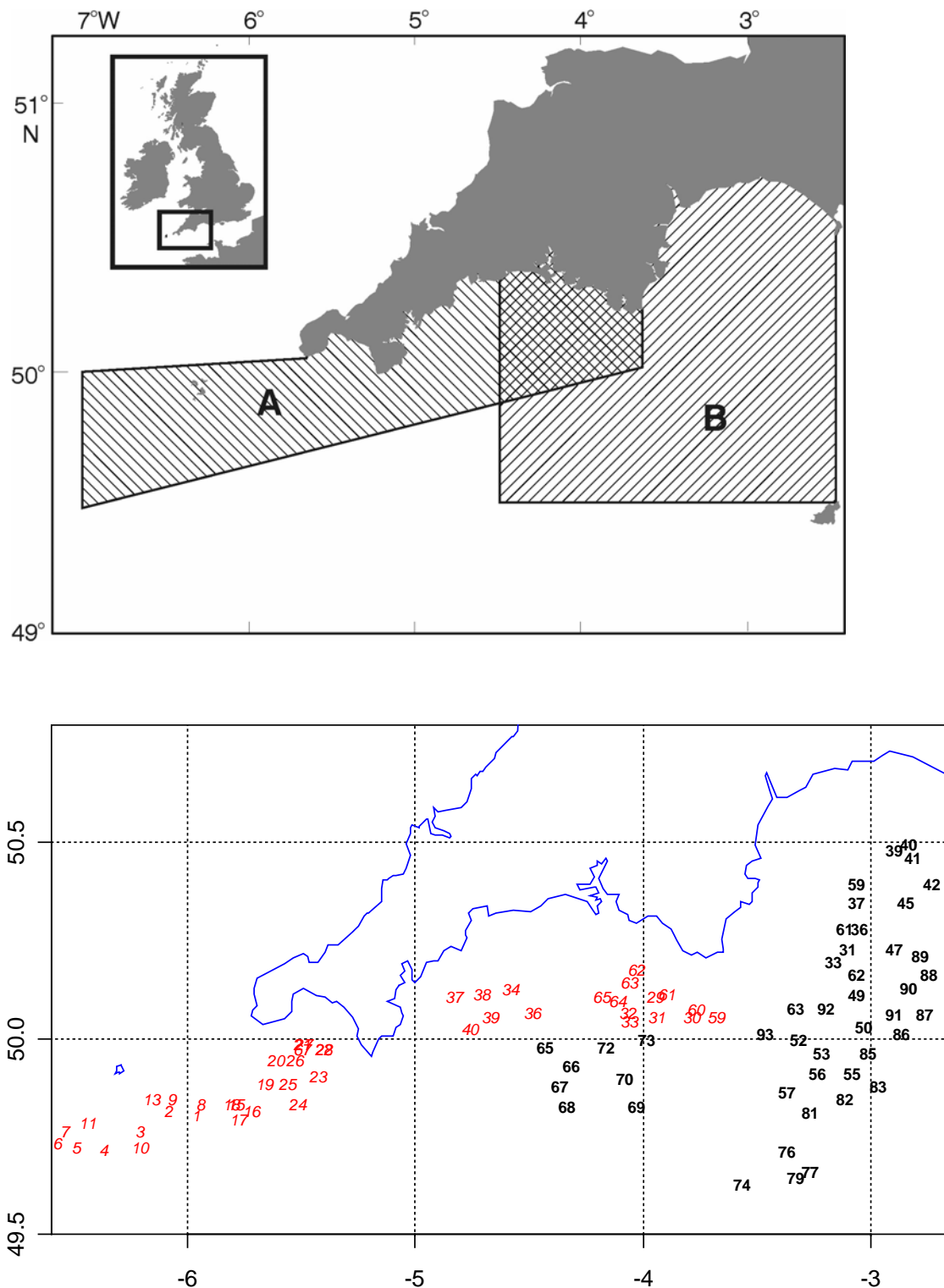
The observer will maintain a diary of activities, including an electronic copy where possible, and a draft cruise report in standard Cefas format will be prepared for submission to Cefas immediately after the cruise. The cruise narrative should be written at sea and read and agreed by the skipper (report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

Signed:

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

.....(Cefas)                      ..... (date)

**Annex 1.** *Upper panel:* Map of the area within which sampling will be required. This survey will take place in both areas A (West) and B (East). *Lower panel:* Positions of prime stations in areas A (West: Italics, red) and B (East: regular font, black).





**Annex 2.** Positions of ‘prime stations’ where 1-hour tows are to be carried out, in an order to be decided by the skipper in consultation with the observer. *Note:* it is of primary importance to sample all 45 stations in the area “West”, and of secondary importance to sample all 45 stations in area “East”.

Area	Prime station	Latitude (°N)	Longitude (°W)	Latitude (decimal °N)	Longitude (decimal °E)
West	W1	49° 48.2'	5° 58.1'	49.80	-5.97
West	W2	49° 49.1'	6° 4.3'	49.82	-6.07
West	W3	49° 46.7'	6° 11.9'	49.78	-6.20
West	W4	49° 43.2'	6° 21.6'	49.72	-6.36
West	W5	49° 43.8'	6° 28.9'	49.73	-6.48
West	W6	49° 45'	6° 34.7'	49.75	-6.58
West	W7	49° 46.6'	6° 33'	49.78	-6.55
West	W8	49° 50.5'	5° 55.6'	49.84	-5.93
West	W9	49° 50.6'	6° 4.8'	49.84	-6.08
West	W10	49° 43.8'	6° 12.2'	49.73	-6.20
West	W11	49° 47.4'	6° 27.1'	49.79	-6.45
West	W13	49° 51.2'	6° 9.8'	49.85	-6.16
West	W15	49° 51.6'	5° 48.4'	49.86	-5.81
West	W16	49° 49.1'	5° 43.4'	49.82	-5.72
West	W17	49° 48'	5° 47.2'	49.80	-5.79
West	W18	49° 50.6'	5° 48.6'	49.84	-5.81
West	W19	49° 53.4'	5° 40'	49.89	-5.67
West	W20	49° 57.1'	5° 37.3'	49.95	-5.62
West	W21	50° 0.6'	5° 27.7'	50.01	-5.46
West	W22	49° 58.8'	5° 24.2'	49.98	-5.40
West	W23	49° 55.1'	5° 25.7'	49.92	-5.43
West	W24	49° 50.9'	5° 30.4'	49.85	-5.51
West	W25	49° 53.4'	5° 33.5'	49.89	-5.56
West	W26	49° 57.5'	5° 31.3'	49.96	-5.52
West	W27	50° 0.2'	5° 29.8'	50.00	-5.50
West	W28	49° 59.7'	5° 24.3'	50.00	-5.41
West	W29	50° 6.2'	3° 56.2'	50.10	-3.94
West	W30	50° 3.7'	3° 47.4'	50.06	-3.79
West	W31	50° 3.6'	3° 56.3'	50.06	-3.94
West	W32	50° 4.7'	4° 3.7'	50.08	-4.06
West	W33	50° 2.9'	4° 4.8'	50.05	-4.08
West	W34	50° 7.4'	4° 27.8'	50.12	-4.46
West	W36	50° 4.2'	4° 50.3'	50.07	-4.84
West	W37	50° 7.1'	4° 49.8'	50.12	-4.83
West	W38	50° 7.2'	4° 42.8'	50.12	-4.71
West	W39	50° 3.7'	4° 40.4'	50.06	-4.67
West	W40	50° 1.9'	4° 46.4'	50.03	-4.77
West	W59	50° 3.8'	3° 40.6'	50.06	-3.68
West	W60	50° 5'	3° 46.9'	50.08	-3.78
West	W61	50° 7.2'	3° 54.4'	50.12	-3.91
West	W62	50° 9.6'	4° 2.2'	50.16	-4.04
West	W63	50° 7.7'	4° 2.6'	50.13	-4.04
West	W64	50° 6.4'	4° 4.9'	50.11	-4.08
West	W65	50° 6.4'	4° 11.8'	50.11	-4.20
West	W67	50° 0.5'	5° 29.3'	50.01	-5.49

## Annex 2 (continued)

Area (stratum)	Prime station	Latitude (°N)	Longitude (°W)	Latitude (decimal °N)	Longitude (decimal °E)
East	E31	50° 7.7'	3° 9.4'	50.13	-3.16
East	E33	50° 7.6'	3° 10.2'	50.13	-3.17
East	E36	50° 17.3'	3° 2.8'	50.29	-3.05
East	E37	50° 21.5'	3° 4.9'	50.36	-3.08
East	E39	50° 29.1'	2° 53.8'	50.49	-2.90
East	E40	50° 29.9'	2° 50.3'	50.50	-2.84
East	E41	50° 27.5'	2° 49.4'	50.46	-2.82
East	E42	50° 23.6'	2° 52.2'	50.39	-2.87
East	E45	50° 21'	2° 50.2'	50.35	-2.84
East	E47	50° 12.5'	2° 54.4'	50.21	-2.91
East	E49	50° 6.5'	3° 3.2'	50.11	-3.05
East	E50	50° 2.5'	3° 1.1'	50.04	-3.02
East	E52	49° 59.8'	3° 18.7'	50.00	-3.31
East	E53	49° 58.2'	3° 12.5'	49.97	-3.21
East	E55	49° 55.2'	3° 5.3'	49.92	-3.09
East	E56	49° 54.6'	3° 13.7'	49.91	-3.23
East	E57	49° 52.2'	3° 21.4'	49.87	-3.36
East	E59	50° 25.4'	3° 3.3'	50.42	-3.06
East	E61	50° 17.3'	3° 7.2'	50.29	-3.12
East	E62	50° 9.4'	3° 4.4'	50.16	-3.07
East	E63	50° 5.3'	3° 19.8'	50.09	-3.33
East	E65	49° 58.7'	4° 25.8'	49.98	-4.43
East	E66	49° 55.9'	4° 19.2'	49.93	-4.32
East	E67	49° 53.8'	4° 21.6'	49.90	-4.36
East	E68	49° 50.3'	4° 20.2'	49.84	-4.34
East	E69	49° 50.6'	4° 2.3'	49.84	-4.04
East	E70	49° 53.8'	4° 4.7'	49.90	-4.08
East	E72	49° 58.9'	4° 10.3'	49.98	-4.17
East	E73	50° 0.1'	3° 58.4'	50.00	-3.97
East	E74	49° 37.8'	3° 34.1'	49.63	-3.57
East	E76	49° 42.1'	3° 22.2'	49.70	-3.37
East	E77	49° 40.3'	3° 16.7'	49.67	-3.28
East	E79	49° 38.9'	3° 19.8'	49.65	-3.33
East	E81	49° 48.8'	3° 15.7'	49.81	-3.26
East	E82	49° 50.6'	3° 6.4'	49.84	-3.11
East	E83	49° 52.8'	2° 58.1'	49.88	-2.97
East	E85	49° 58'	3° 0.1'	49.97	-3.00
East	E86	50° 0.4'	2° 51.7'	50.01	-2.86
East	E87	50° 4.3'	2° 46.1'	50.07	-2.77
East	E88	50° 10.2'	2° 43.9'	50.17	-2.73
East	E89	50° 12.5'	2° 47.3'	50.21	-2.79
East	E90	50° 7.6'	2° 50.3'	50.13	-2.84
East	E91	50° 3.5'	2° 53.9'	50.06	-2.90
East	E92	50° 9.5'	3° 12.1'	50.16	-3.20
East	E93	50° 1.3'	3° 27.5'	50.02	-3.46

## **Appendix 2**      Detailed work plan for 2008 *Lady T Emiel* survey

### **VESSEL**

Vessel name:            **Lady T Emiel**  
RSS:                    **B12151**  
PLN:                    **BM 2000**  
Skipper's name:        **Mike Sharp**

### **OBSERVER**

Julian P. Martin & Jonathan Ashworth  
Cefas Newlyn  
Tel. 01736 350653  
julian.martin@cefas.co.uk, jonathan.ashworth@cefas.co.uk

### **OBJECTIVES**

- To carry out the 2008 Fisheries Science Partnership “Western Channel Sole & Plaice—East Survey” over 6–7 days, as a continuation of the 2003–2007 time-series, using the same gear as previously employed by FV *Lady T Emiel* (2 x 12-m beam trawls, chain mat gear and diamond mesh)
- To compare day and night catch rates of sole and plaice, by fishing 45 ‘core’ stations both during daylight and at night
- Time permitting, sample all 61 ‘core’ stations that are currently used in the ICES Western Channel plaice stock assessment tuning series

### **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. These are to be fished at about 4 knots at all of the depths within the defined area. The codend to be used has an 82 mm diamond mesh (nominal 80 mm), made from 5.5 mm single-brided twine.

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

Fishing will be undertaken within British fishery limits and within area “B” (“East”) shown in Annex 1.

Annex 2 shows the positions of the 'prime stations' where tows are to be carried out during this 2008 FSP survey. In the present survey these stations will be fished twice, once during day and once by night, in an order to be decided by the skipper in consultation with the observers.

## **PERIOD OF SURVEY**

The vessel will depart on Monday 1 September 2008 around 9:00 and commence fishing the same day at a suitable location. The duration of the trip will be 6 or 7 days as required for the completion of the survey.

## **FISHING ACTIVITIES**

Each station will be sampled by day, and by night. The sampling work around the clock is made possible through the presence of 2 observers onboard who will divide their time amongst themselves as they see it most suitable and in accordance with EU work hours directives. Individual tows should cover the same distance as in the previous 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(s).

## ***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:

4. 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).
5. 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).
6. 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 otolith 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 160 sole otoliths, 160 plaice otoliths (plaice are first sexed, then sampled for otoliths), and otoliths for all cod sampled (unless cod catch is very large), to be distributed over 4 ‘major length groups’ approximately as follows:

Species	Length	Nos otoliths	Remark
Sole	0-29	25	About one 0-29 cm sole otolith at random every 4 tows
	30-34	40	About one 30-34 cm sole otolith at random every 2 tows
	35-44	70	About one-two 35-44 cm sole otolith at random every 2 tows
	45+	25	Probably all 45+ cm sole that are sampled
Plaice	0-29	25	About one 0-29 cm plaice otolith at random every 4 tows
	30-34	50	About one 30-34 cm plaice otolith at random every 2 tows
	35-44	60	About one 35-44 cm plaice otolith at random every 2 tows
	45+	25	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 about equally over the sampling stations and can be collected during day or night (see ‘Remark’ in the above table as a suggestion to help achieving this; generally the subsampling practices of the otoliths should follow the working methods routinely applied by the observers).

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 OBSERVERS**

The observers 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**

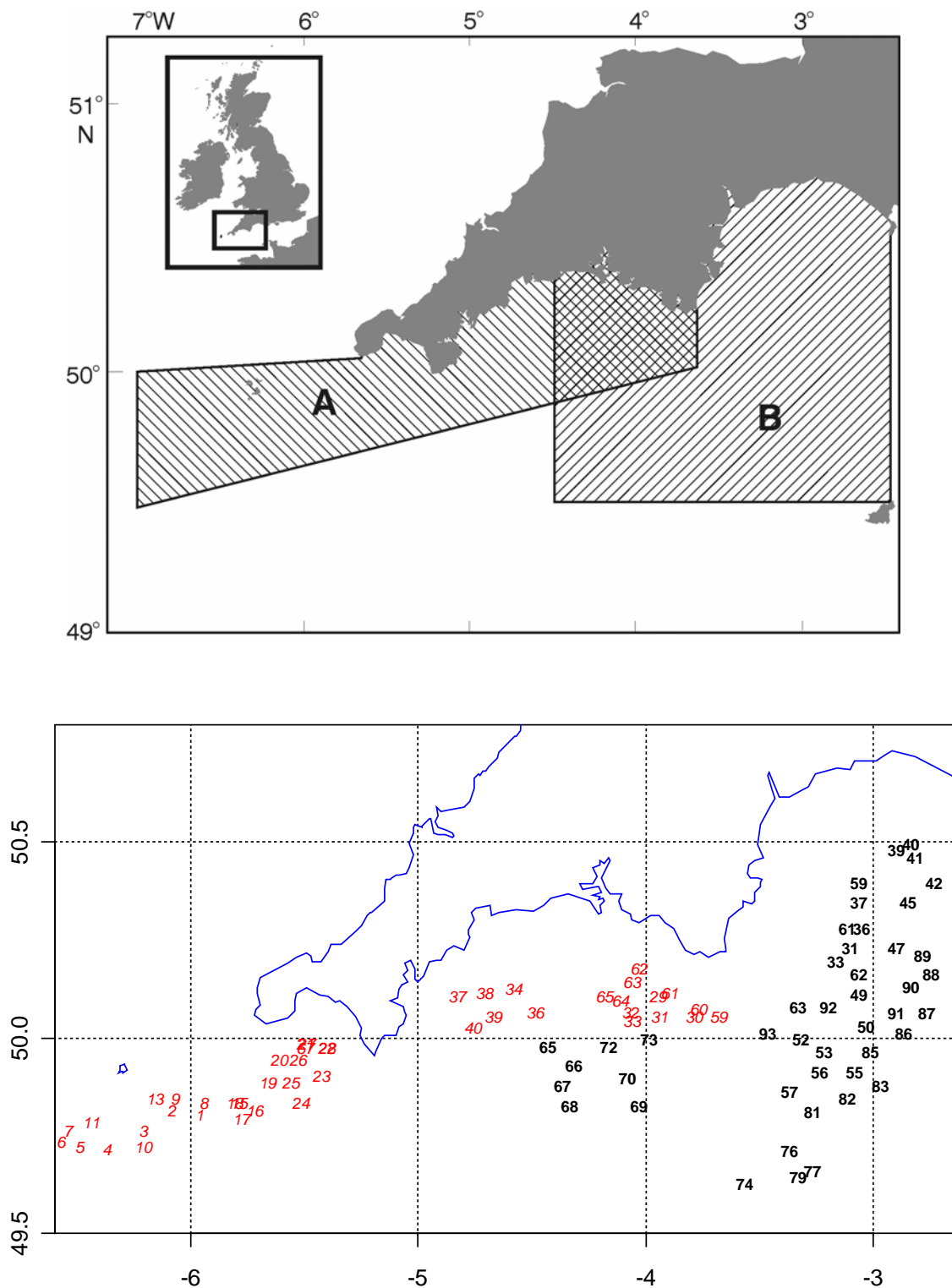
The observers will maintain a diary of activities, including an electronic copy where possible, and a draft cruise report in standard Cefas format will be prepared for submission to Cefas immediately after the cruise. The cruise narrative should be written at sea and read and agreed by the skipper (report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

Signed:

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

.....(Cefas)                      ..... (date)

**Annex 1.** *Upper panel:* Map of the area within which sampling will be required. This survey will take place in area B (*East*). *Lower panel:* Positions of prime stations in area B of this survey (*East*: regular font, black), with also indicated the prime stations in area A (*West*: red Italics font).



**Annex 2.** Positions of the 45 ‘core prime stations’ that each shall be sampled twice (by day and night) as 1-hour tows. The order is to be decided by the skipper in consultation with the observer.

Area (stratum)	Prime station	Latitude (°N)	Longitude (°W)	Latitude (decimal °N)	Longitude (decimal °E)
East	E31	50° 7.7'	3° 9.4'	50.13	-3.16
East	E33	50° 7.6'	3° 10.2'	50.13	-3.17
East	E36	50° 17.3'	3° 2.8'	50.29	-3.05
East	E37	50° 21.5'	3° 4.9'	50.36	-3.08
East	E39	50° 29.1'	2° 53.8'	50.49	-2.90
East	E40	50° 29.9'	2° 50.3'	50.50	-2.84
East	E41	50° 27.5'	2° 49.4'	50.46	-2.82
East	E42	50° 23.6'	2° 52.2'	50.39	-2.87
East	E45	50° 21'	2° 50.2'	50.35	-2.84
East	E47	50° 12.6'	2° 56.2'	50.21	-2.94
East	E49	50° 6.5'	3° 3.2'	50.11	-3.05
East	E50	50° 2.5'	3° 1.1'	50.04	-3.02
East	E52	49° 59.8'	3° 18.7'	50.00	-3.31
East	E53	49° 58.2'	3° 12.5'	49.97	-3.21
East	E55	49° 55.2'	3° 5.3'	49.92	-3.09
East	E56	49° 54.6'	3° 13.7'	49.91	-3.23
East	E57	49° 52.2'	3° 21.4'	49.87	-3.36
East	E59	50° 25.4'	3° 3.3'	50.42	-3.06
East	E61	50° 17.3'	3° 7.2'	50.29	-3.12
East	E62	50° 9.4'	3° 4.4'	50.16	-3.07
East	E63	50° 5.3'	3° 19.8'	50.09	-3.33
East	E65	49° 58.7'	4° 25.8'	49.98	-4.43
East	E66	49° 55.9'	4° 19.2'	49.93	-4.32
East	E67	49° 53.8'	4° 21.6'	49.90	-4.36
East	E68	49° 50.3'	4° 20.2'	49.84	-4.34
East	E69	49° 50.6'	4° 2.3'	49.84	-4.04
East	E70	49° 53.8'	4° 4.7'	49.90	-4.08
East	E72	49° 58.9'	4° 10.3'	49.98	-4.17
East	E73	50° 0.1'	3° 58.4'	50.00	-3.97
East	E74	49° 37.8'	3° 34.1'	49.63	-3.57
East	E76	49° 42.1'	3° 22.2'	49.70	-3.37
East	E77	49° 40.3'	3° 16.7'	49.67	-3.28
East	E79	49° 38.9'	3° 19.8'	49.65	-3.33
East	E81	49° 48.8'	3° 15.7'	49.81	-3.26
East	E82	49° 50.6'	3° 6.4'	49.84	-3.11
East	E83	49° 52.8'	2° 58.1'	49.88	-2.97
East	E85	49° 58'	3° 0.1'	49.97	-3.00
East	E86	50° 0.4'	2° 51.7'	50.01	-2.86
East	E87	50° 4.3'	2° 46.1'	50.07	-2.77
East	E88	50° 10.2'	2° 43.9'	50.17	-2.73
East	E89	50° 12.5'	2° 47.3'	50.21	-2.79
East	E90	50° 7.6'	2° 50.3'	50.13	-2.84
East	E91	50° 3.5'	2° 53.9'	50.06	-2.90
East	E92	50° 9.5'	3° 12.1'	50.16	-3.20
East	E93	50° 1.3'	3° 27.5'	50.02	-3.46



**Annex 3.** Positions of 16 additional ‘prime stations’ that if extra time is available and once each of the 45 stations in Annex 2 have been sampled twice, can optionally be sampled twice (by day and night) as 1-hour tows. The order is to be decided by the skipper in consultation with the observer.

Area (stratum)	Prime station	Latitude (°N)	Longitude (°W)	Latitude (decimal °N)	Longitude (decimal °E)
East	E38	50° 23.2'	3° 6.2'	50.39	-3.10
East	E43	50° 27'	2° 46'	50.45	-2.77
East	E46	50° 12.5'	2° 54.4'	50.21	-2.91
East	E48	50° 13'	2° 54'	50.22	-2.90
East	E51	50° 1'	3° 12'	50.02	-3.20
East	E54	49° 58'	3° 8'	49.97	-3.13
East	E58	50° 2'	3° 22'	50.03	-3.37
East	E60	50° 23'	3° 8.9'	50.38	-3.15
East	E64	50° 4'	4° 33'	50.07	-4.55
East	E71	49° 55'	4° 7'	49.92	-4.12
East	E75	49° 40'	3° 31'	49.67	-3.52
East	E78	49° 39'	3° 8'	49.65	-3.13
East	E80	49° 41'	3° 16'	49.68	-3.27
East	E84	49° 52'	3° 3'	49.87	-3.05
East	E94	49° 56'	4° 0'	49.93	-4.00
East	E95	49° 57'	3° 46'	49.95	-3.77

## **Appendix 3**      Survey narratives

*Prepared by Julian Martin*

Part 1. *Lady T Emiel* Survey,

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

**Skipper:** Mike Sharp

**Cefas Observers:** Julian Martin and Gary Dunlin

**Period:** 1–4 September 2008

*Lady T Emiel* sailed from Brixham in the early morning of 1 September 2008 and commenced fishing at the first station at 8:30. On the first day of the survey she sampled at 5 stations during daytime. Two of these stations were re-sampled during the night (between 22:00–0:00). On the 2, 3 and 4 September, respectively, 8, 8 and 7 stations were sampled during daytime; no further night time samples were taken.

The weather was initially fairly good, but deteriorated over the survey period (hampering night-time sampling), so that in the evening of 4 September it was decided to break up early and return to Brixham.

During the entire survey 28 stations were sampled by day, 2 stations by night. Otoliths were collected from 59 soles, 53 plaice, and all 21 cod encountered.

## Part 2. *Carhelmar* Surveys (West and East)

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

**Skipper:** Gerald Podschies

**Cefas Staff:** Julian Martin

**Period:** four legs:

Leg 1—Western stations, hauls 1–45: 22–29 September 2008

Leg 2—Eastern stations, hauls 1–16: 2–4 October 2008

Leg 3—Eastern stations, hauls 17–33: 6–8 October 2008

Leg 4—Eastern stations, hauls 34–45: 21–23 October 2008

The western stations were all surveyed in a single leg during generally good weather. FV *Carhelmar* sailed from Plymouth in the afternoon of 22 September. One tow was carried out in the early evening of the same day. *Carhelmar* docked in the morning of 29 September at Plymouth.

During this western survey, a total of 45 stations were sampled by daytime. In total, otoliths were collected from 151 soles, 155 plaice and 10 cod.

The eastern survey was carried out in 3 legs. *Carhelmar* initially sailed from Plymouth around 5:00 in the morning of 2 October, and sampled 16 stations until the morning of 4 October. However, the skipper was then obliged to seek shelter from a Southerly gale/storm force 9–10, docking in Brixham on the 4<sup>th</sup> and most of the 5<sup>th</sup>. *Carhelmar* then sailed from Brixham again late at night (23:50) on the 5<sup>th</sup> and sampled the next 17 stations until the 8<sup>th</sup> October. The vessel was then expected back in Plymouth to prepare for another survey it was chartered for. For completing the final leg of our FSP survey, *Carhelmar* sailed again from Plymouth around noon on 21 October. It then completed the last 12 stations and, again owing to bad weather conditions, docked in Brixham (not Plymouth) at approximately 18:00 on 23 October.

Over the entire eastern survey, 45 stations were sampled (all during daytime) and otoliths were collected from 180 soles, 90 plaice and 11 cod.