Draft Report

Programme 24:

Western Channel Sole and Plaice

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Cefas, Lowestoft

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[1]Cefas seagoing observer

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Summary

During the months of August and September 2013, the beam trawler *Carhelmar* carried out the eleventh in a series of FSP surveys of Western Channel sole and plaice, extending the time series of the previous FSP surveys carried out during 2003–2012. The survey's main aim is to show trends in the distribution, abundance and age composition of sole and plaice, and to provide some information on bycatch species.

The survey design followed that of the 2012 survey, using 2 × 4 m beam trawls to survey both the western and eastern parts of the study survey area. The survey differed from that of 2003-2007, when a larger beam trawler, fishing 2 × 12 m beams, carried out the eastern part of the survey. The western area has been surveyed with a 2 × 4 m beam trawler throughout the time-series. The survey covered exclusively 45 western and 45 eastern core stations, for which consistent data were available for all previous years.

The index of abundance and biomass of Western Channel sole dropped to its lowest level in 2008. Since then, the biomass has seen an increase to its highest level of the time-series and abundance has increased to its second highest level of the time-series, shown in Figure 16 and Tables 1 and 3. The continued "recovery" could be in part attributed to a natural increase in recruitment to the fishery and/or the stocks may be improving due to measures brought into the fishery after this time under the Council Regulation (EC) No. 509/2007 multiannual plan for the sustainable exploitation of sole. The years 2007 to 2009 under this plan followed a recovery plan and subsequent years followed a management plan. The positive signs are that actual catch numbers shown in Table 4 are up by 26%, from 887 individuals caught in 2012 to 1100 in 2013.

The plaice biomass index also saw another increase to its highest level of the time-series. This is also the case for the index of abundance (Tables 2, 3 and Figure 16). This was helped by the incoming recruits, (age 1), in 2009 and 2010 passing through the fishery (Table 3). The large number of recruits found in the survey during 2009 and 2010 are also mirrored in modelled estimates of recruitment of the most recent ICES assessment conducted by WGCSE 2013.

The total catch of monkfish saw a slight increase on the 2012 catch, with 523 individuals caught in 2013, compared to 467 in 2012 (which was the second lowest catch of the time series). Catches of megrim reached a peak in 2011, decreasing again in both 2012 and 2013. Lemon sole catches increased again from 2012 to the second highest total of the time-series, with an increase from 518 fish in 2012 to 548 in 2013. This was similar to 2012, and is mainly the result of stations around Bigbury Head yielding good catches for the second year running. Cod were scarce throughout the survey; however there was an increase on last year's total with the 2013 survey yielding ten cod. The gear used in the survey is not the most appropriate for catching cod and the survey cannot therefore be representative of that species on the ground.

As in previous surveys, the age distribution for sole was broad, with ages of fish >15 years recorded in both survey legs; the oldest sole recorded was 19 years old, compared to last year's survey which recorded a 28 year old sole. Plaice age distribution, again, was much narrower, though one fish of age 18 years was caught on the western leg of the survey.

The trends in sole spawning-stock biomass (SSB) from the FSP surveys show similarities with the recent, steadily increasing trends shown by the ICES assessment. This is also true for plaice, which shows a significant jump in SSB to a level not seen in the 11 years of the survey thus far. The sudden reduction of SSB in 2008 for both stocks was followed by higher estimates in 2009, but overall interpretation of that dip requires caution because of the poor weather conditions and survey delay during that year.

Introduction

The Fisheries Science Partnership (FSP) is a collaborative programme of scientific research between the UK fishing industry and scientists. Since it was established in 2003, the programme has undertaken almost 100 projects, including investigations into fishing gear selectivity, examination of spatial patterns and catch compositions, and time-series of abundance of commercial species. A full description of the development and aims of, and reports from, the FSP programme can be found on the Cefas website (www.cefas.defra.gov.uk).

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 Committee for consideration. Charter vessels for *ad hoc* and time-series projects are selected through an open tendering procedure, and generally dispensations from the relevant quota and effort controls, as well as to fish in non-UK waters, are needed.

The Western Channel plaice and sole programme has been carried out every year since 2003 with the aim of investigating the abundance and size composition of plaice and sole. Building on the successes of the initial ten years of the programme, Defra allowed the programme's continuation into 2013.

This report presents and compares the findings from the 2013 FSP Western Channel Sole and Plaice project (FSP Programme 9). Its primary aim is to investigate the abundance, size and age composition of sole, *Solea solea*, and plaice, *Pleuronectes platessa*, in the Western English Channel (ICES Division VIIe). Additional data are collected on other commercial species such as cod (*Gadus morhua*), lemon sole (*Microstromus kitt*), megrim (*Lepidorhombus whiffiagonis*), and monkfish (*Lophius piscatorius*). Both the Eastern and Western surveys of the study area are carried out by one commercial beam trawler during late summer and early autumn. In all, there are 90 target stations equally spread over the western and eastern surveys that have been sampled consistently over all years, from 2003 to 2013. Historically, there were more stations but not all were sampled every year and the survey design was thus simplified to cover only the 90 core stations, maintaining the survey for the long term.

The western part of the study area was covered by the beam trawlers *Nellie* (2003 - 2004) and *Carhelmar* (2005 - present), both with 2 × 4 m beams.

From 2003 to 2007, the eastern part of the study area was covered by the comparably larger beam trawler *Lady T Emiel* with 2 × 12 m beams. Since 2008, *Lady T Emiel* has not been available to carry out the complete eastern survey, although in that year it did sample a smaller subset of eastern stations with the *Carhelmar* covering the rest of the eastern area. Fortunately, the catch of sole and plaice by *Lady T Emiel* and *Carhelmar* are reasonably comparable, providing that catch rates are quantified on a per m beam basis (number h^{-1} m $beam^{-1}$; note that the two vessels have 12 and 4 m beams, respectively). This was revealed by comparisons of the sole and plaice catch rates sampled by the two vessels at the same stations during 2008 (Engelhard *et al*., 2008b).

As the survey methodology was notably similar over the time-series, the consistency of the time-series meant that this was the first FSP dataset to be used as a tuning index for the formal ICES stock assessment (Western Channel plaice: see ICES, 2007, 2008). However, the survey time-series was not included in the assessment of the stock in 2009 (ICES, 2009), though it has since been reinstated for both target stocks.

Figure 1 shows the positions of all 90 core stations of the survey and Figures 2−7 the spatial distributions of sole, plaice and other commercially important species over the eleven years of the survey.

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.*, 2008a). This includes the time-series in number-at-age used in the ICES stock assessment, where consistency in the dataset is of particular importance.

Objectives

The objectives of the 2013 survey were to continue the time-series established in 2003 using the same survey design that has been followed since 2008 for FV *Carhelmar*. Specifically, they were:

- To repeat the Western Channel - West survey as carried out in 2003–2012 by FV *Nellie* and FV *Carhelmar*, using chain mat gear and 2 × 4-m beam trawls, during September 2013
- To repeat the Western Channel - East survey as carried out in 2003–2007 by FV *Lady T Emiel* (which used 2 × 12-m beam trawls) and 2008−2012 by FV *Carhelmar*, using 2 × 4-m beam trawls, during August 2013

The detailed operational plan for the survey was discussed at a meeting between Cefas and the skipper and company representatives in July 2013. The operational plan for the survey is given in Appendix 1. Trawling in 2013 was carried out under dispensation from the quota and days-at-sea regulations.

Methods

Vessels and gear

FV *Carhelmar* (BM23) is a steel-hulled twin-beam trawler of 22.2 m registered length, with an engine of 220 kW. Her home port is Plymouth, Devon, and she is owned by Interfish Ltd, Plymouth.

The FV *Carhelmar* fished with two Interfish 4-m beam trawls fitted with chain mats. Rubber discs were approximately 8” and 6” diameter, on 26 mm wire. The codend mesh was 82 mm (nominal 80 mm), constructed from 5.5 mm single-braid twine.

Survey design

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 survey (see Appendix 1 for the boundaries of these survey areas, as agreed upon in the operational plan). In previous years, as mentioned above, the western area had been covered by the smaller FV *Nellie* (2003–4) and then *Carhelmar* (2005 on), and the eastern area by the larger *Lady T Emiel* (2003–2007). In 2008, *Carhelmar* surveyed both areas (and as mentioned above, a subset of eastern stations was also sampled by *Lady T Emiel*), but from 2009 on, only the *Carhelmar* operated on that survey. As in previous years, all stations visited by *Carhelmar* were sampled during daylight.

The survey was restricted to core stations sampled consistently in previous years (see Appendix 1 for sampled station position details of both the western and eastern surveys areas).

Sorting and processing the catch

Standard methods employed by Cefas staff for sorting and recording catches on commercial fishing vessels were employed (see previous FSP reports, e.g. 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 but spread across the survey area, to allow the age composition of the catch 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 the 90 stations consistently sampled over the years. Catch rates are presented for the western and eastern survey areas separately.

For sole, plaice, lemon sole (*Microstomus kitt*), megrim (*Lepidorhombus whiffiagonis*), and monkfish (*Lophius piscatorius)*, mean length frequency distributions (numbers h^{-1} m $beam^{-1}$) were calculated separately for the western and eastern surveys, as averages over the distributions by station. Otoliths of sole and plaice as target species 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 obtained in 2003 to 2007 and reported recently 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*., 2008a), for the following reasons:

(i) they are now 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, and several of these were not sampled in all years);
(ii) several errata in station details for earlier years were rectified;
(iii) a combined-sex age–length key was used for both species (this was not done in all previous years);
(iv) 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 (the total number of otoliths read from this survey was 341).

Results

Fishing stations

The eastern area was surveyed by FV *Carhelmar* from 23 to 29 August 2013 with favourable weather conditions, and the western area, which was delayed by two days to allow strong winds to dissipate, was surveyed from 20 to 26 September 2013. On both surveys, Michael Manser was the observer and 88 of the 90 core stations used for the time-series index were sampled. Figure 1a shows the positions of the 45 western and 45 eastern core (or prime) stations, with the prime station numbers given in red and black numbers,

respectively. Figure 1b shows the same prime station locations, labelled according to their haul number. Thin lines connect consecutive hauls to give an approximate indication of the survey tracks. Mean haul duration was 60 min in both western and eastern surveys.

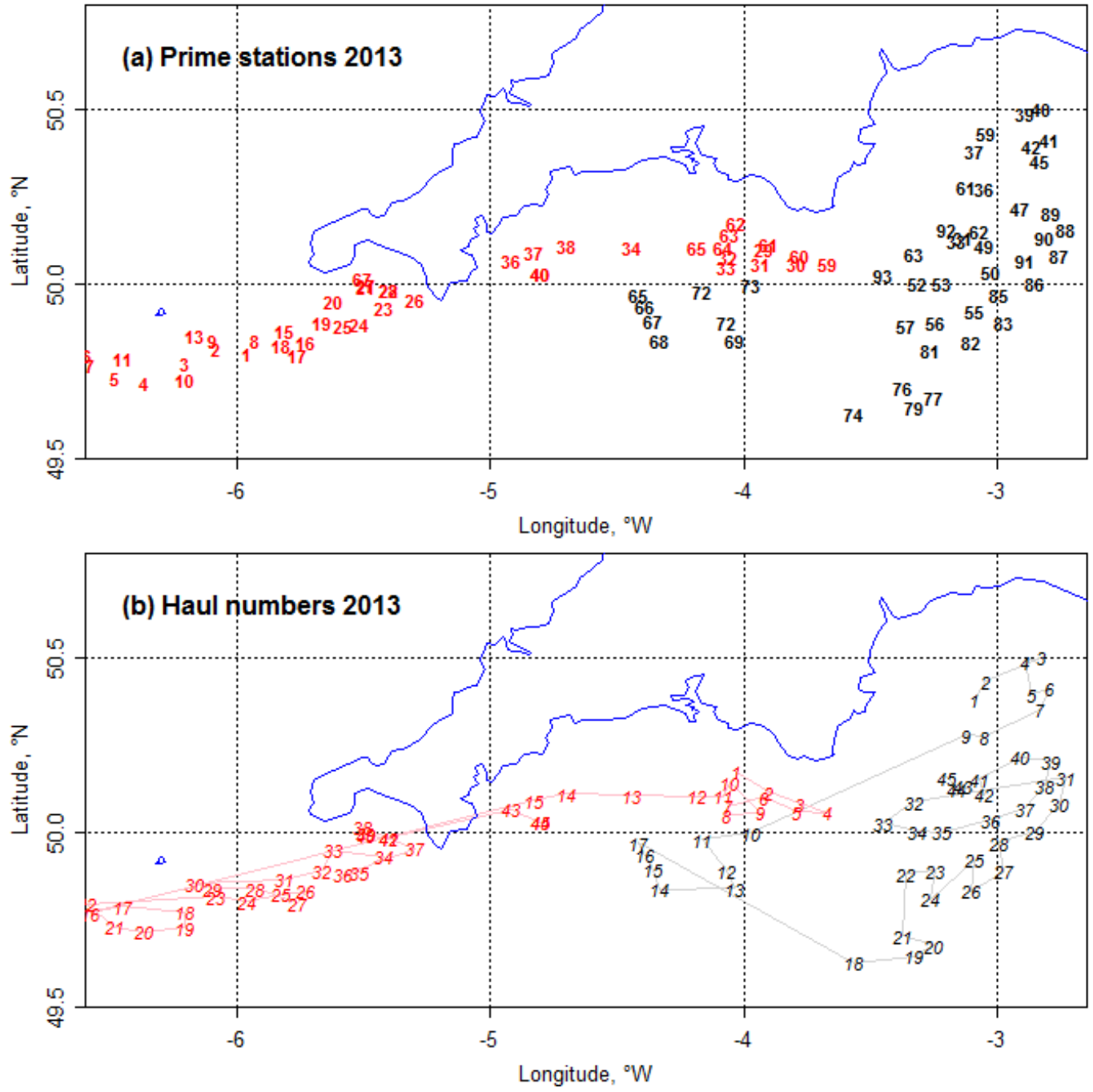

Figure 1. (a) Positions of the prime stations sampled by FV *Carhelmar* in 2013, distinguishing the western (red numbers, n = 45) and eastern (black numbers, n = 45) surveys. (b) Positions of the haul numbers sampled consecutively during the eastern, 23–29 August 2013 and western 20 – 26 September 2013 surveys, with thin lines connecting consecutive hauls to give approximate indications of the cruise tracks.

Distribution patterns

Figures 2–7 show the standardised spatial distribution patterns of sole, plaice, lemon sole, megrim, monkfish and cod for the years 2003–2013. Note that the maps in reports prior to 2008 differ from those presented here, as since 2007, the analysis only uses the 90 core stations sampled over the entire time-series.

Sole were caught in all but two of the western tows and in 42 of 45 eastern tows in 2013. As in previous years, they were distributed fairly equally over the area. Areas of greater abundance tended to be located more inshore (Figure 2). Unlike in earlier years, a higher number of sole were caught east of the Scilly Isles in 2012 and 2013 giving a similar picture to that seen in 2003. Overall the spatial distribution in abundance of sole remains similar throughout the time-series, with minimal fluctuations.

Plaice (Figure 3) were caught in 37 of 43 western tows and in 43 of 45 eastern tows in 2013. Over the past two surveys there has been a dramatic increase in catches of plaice. As in previous years the main area of concentration in 2013 was Bigbury Head, but overall in 2013, there was a small increase in overall numbers of fish caught, from 1741 in 2012 to 2364 in 2013, with increased good catches from Lyme Bay making the difference.

Lemon sole (Figure 4) were caught in 41 of 43 western tows and in 37 of 45 eastern tows in 2013, and catches were up by just over 5%. The traditionally good areas west of the Scilly Isles still produced good numbers of lemon sole, but for 2012 and 2013, a number of the stations around Bigbury Head also provided good numbers where in the past very few were caught.

Megrim (Figure 5) were caught in 31 of 43 western tows and in only 3 of 45 eastern tows, a much lower number of stations than in 2012. This deeper water species was almost entirely caught in the western survey and during the 2013 survey the overall numbers caught were lower than in 2011 and 2012 with 1 702 and 1 609 respectively, compared to 1256 in 2013. However, it should be noted that 2011 was an exceptional year for megrim in these surveys.

Monkfish (Figure 6) were caught in 39 of 43 western tows and in 35 of 45 eastern tows in 2013. For 2013, the overall catches have increased from 2012 but remain at a low level in comparison with the previous high years of 2010 and 2011. Monkfish were present in fewer hauls than in 2011. The total numbers of fish caught increased slightly from 467 in 2012 to 523 in 2013 which is below the geometric mean of the time-series.

Cod (Figure 7) were caught in just 3 of 43 western tows and in 1 of 45 eastern tows in 2013, exactly the same number of tows as in 2011 and 2012. Few cod are caught throughout the survey time-series (the legend scale in Figure 7 differs from that in Figures 2–6), mainly due to the fact that this survey uses a beam trawl, which is not designed to catch and/or monitor cod.

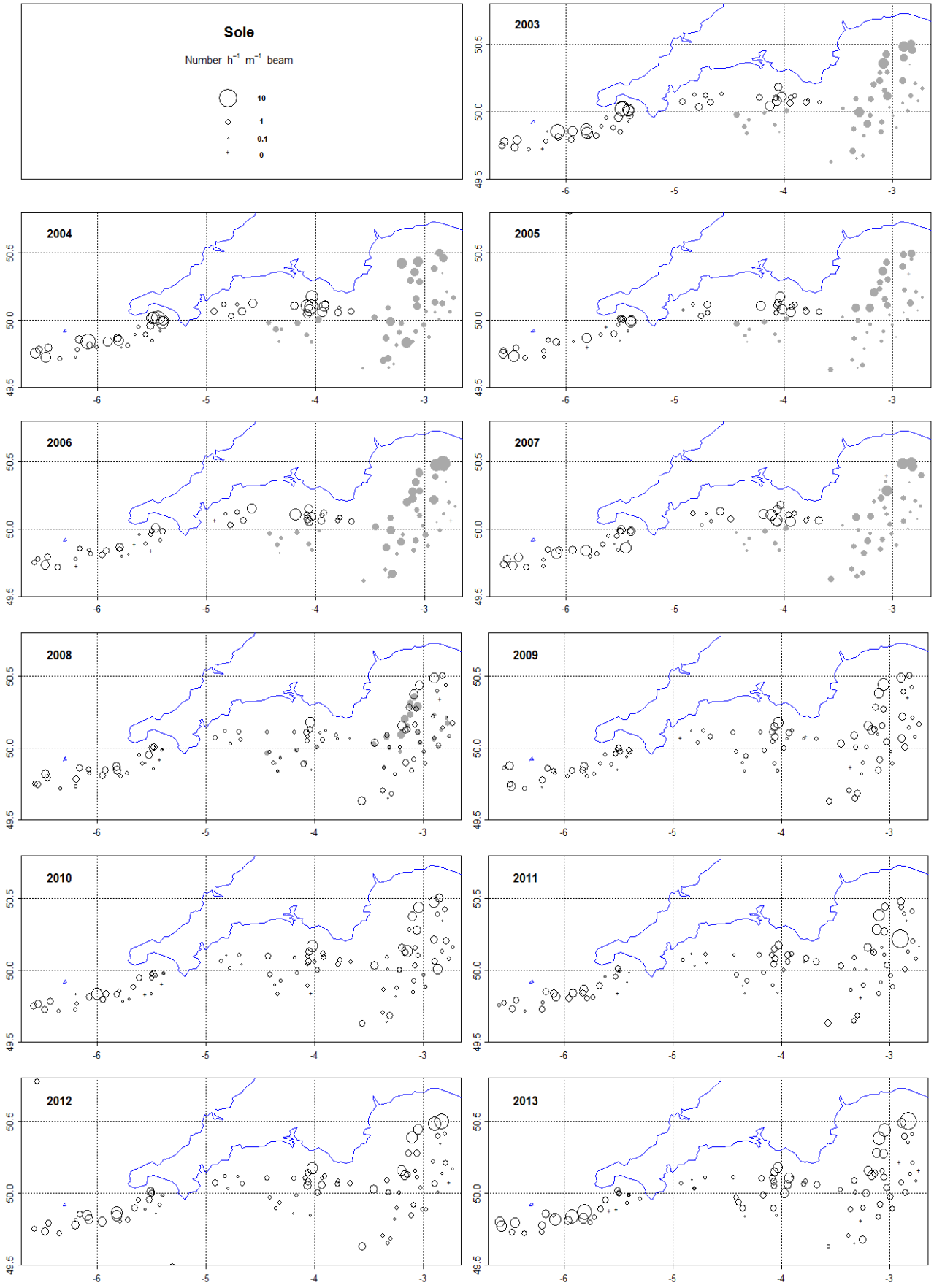

Figure 2. Sole catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–2013 (number h^{-1} m beam^{-1}). Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

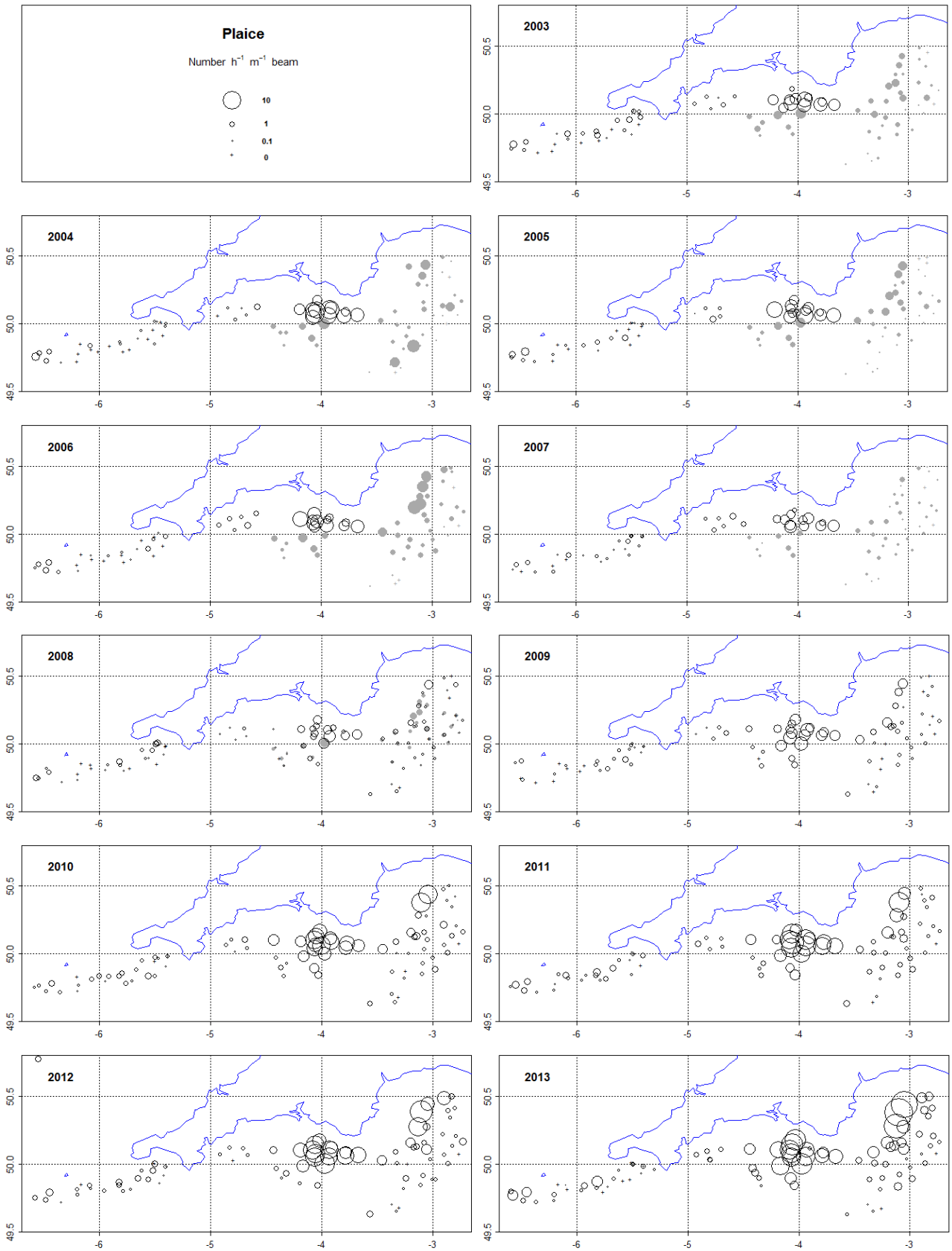

Figure 3. Plaice catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–2013 (number h^{-1} m beam^{-1}). Open circles: *Carhelmar* tows; filled circles: *Lady T Emiel* tows**.**

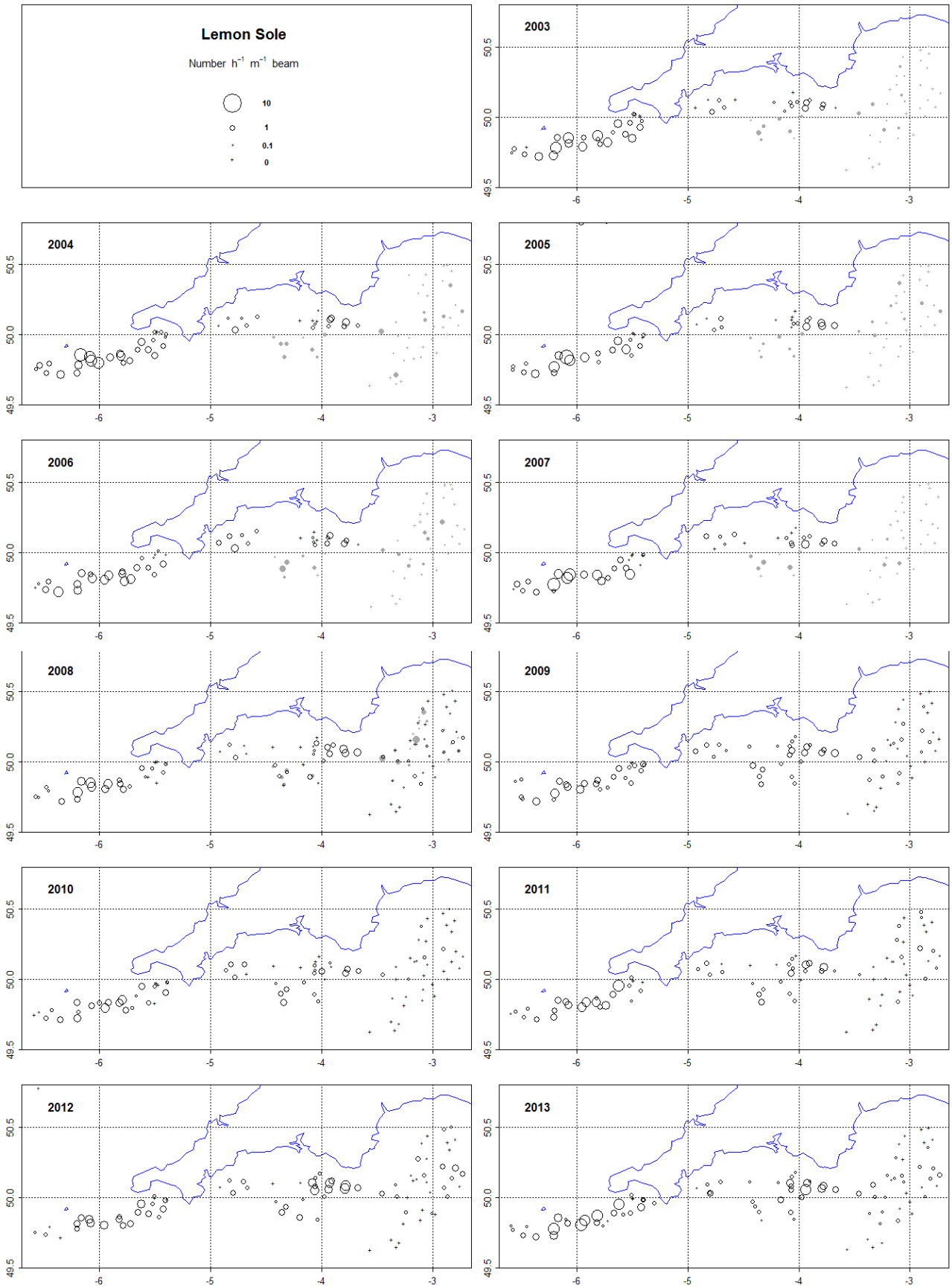

Figure 4. Lemon sole catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–2013 (number h^{-1} m beam^{-1}). Open circles: *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

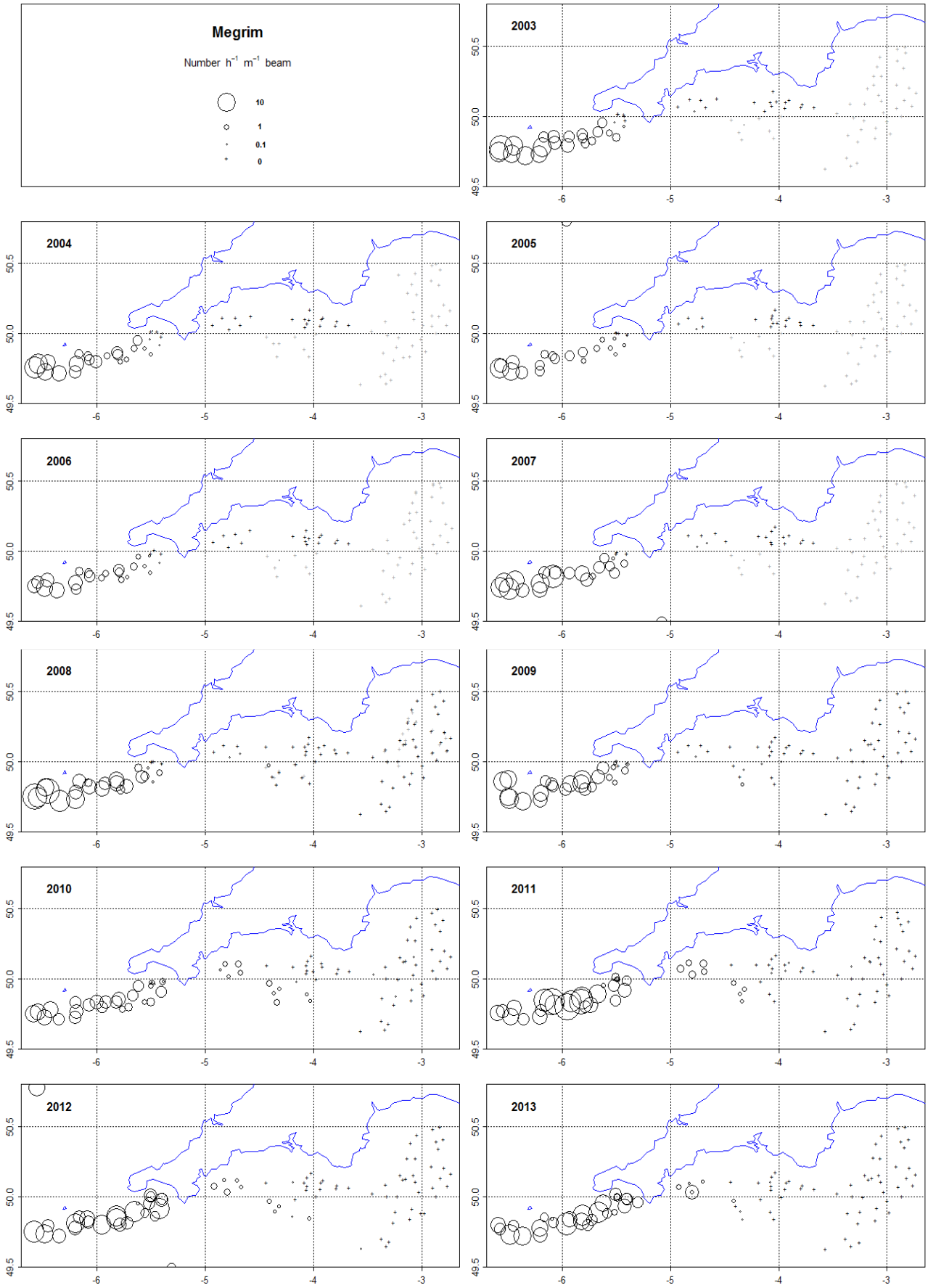

Figure 5. Megrim catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–20013 (number h^{-1} m beam^{-1}). Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

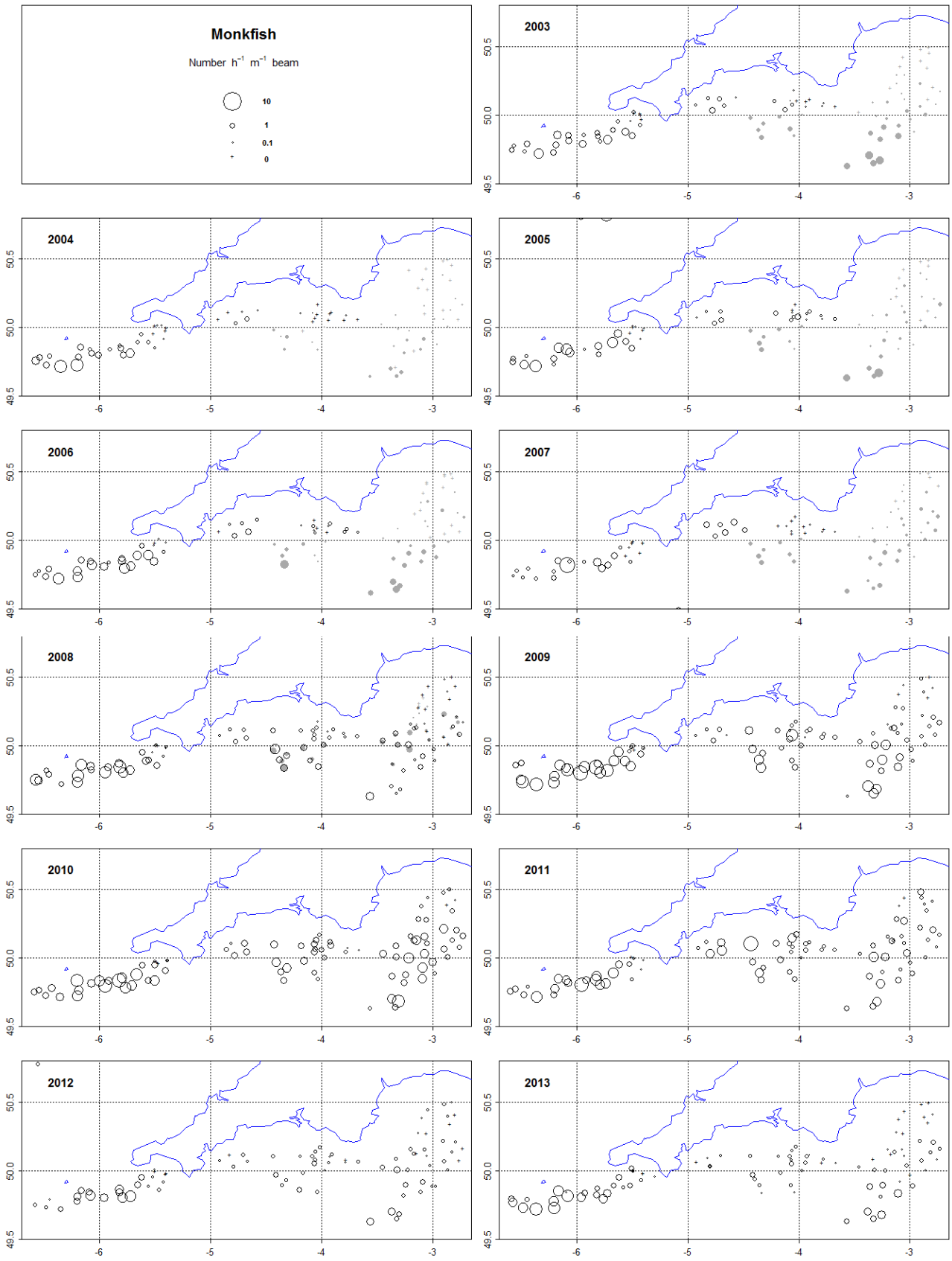

Figure 6. Monkfish catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–2013 (number h^{-1} m beam^{-1}). Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

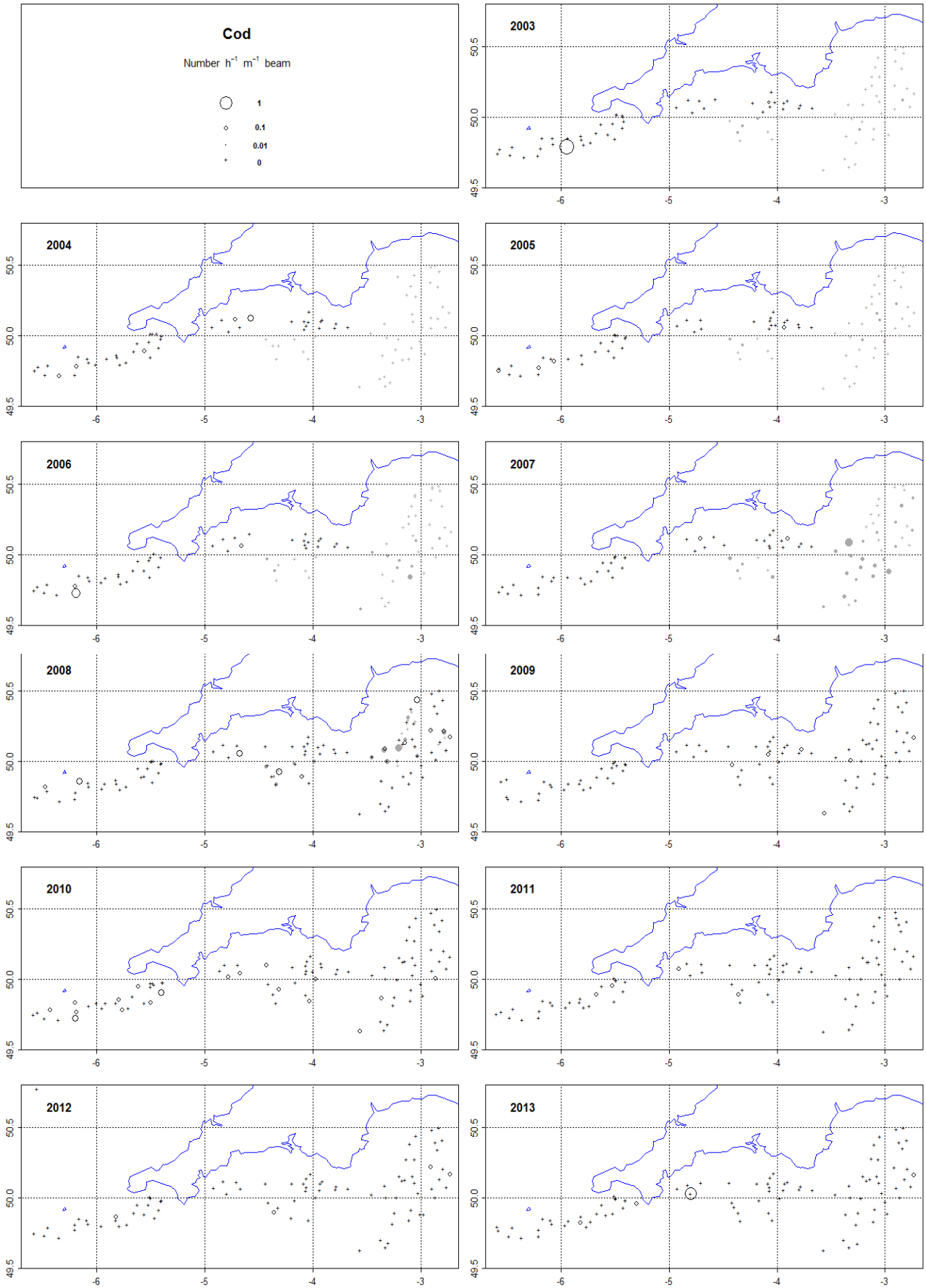

Figure 7. Cod catch rates during FSP "Western Channel Sole and Plaice" surveys, 2003–2013 (number h^{-1} m beam^{-1}). Open circles: *Nellie* and *Carhelmar* tows; filled circles: *Lady T Emiel* tows.

Length compositions

In the eastern survey, sole (Figure 8) catch rates and length distributions remained fairly stable throughout the period 2003–2013. From 2008, the western survey, however, saw a decrease in numbers per hour per meter beam to give similar length and catch compositions to that of the east. Since 2011 a modest increase is seen and catch rates for both eastern and western surveys are almost identical.

For 2013, the catch rates (expressed as catch per unit effort, CPUE) of plaice, shown in Figure 9, were slightly better than in 2012 in the both the eastern and western surveys. The western survey tends to fluctuate much more in length composition and catch rates with higher numbers overall. For both areas, the bulk of the catch would appear to be fish around 25−35 cm long, and catches were again up on the previous exceptional years of 2010, 2011 and 2012.

Lemon sole (Figure 10) is generally more common in the west of the area, though the numbers of lemon sole in the eastern survey were again higher in 2012 and 2013 than in 2011. In the western survey, catch rates were better than in 2012 and again comparable with those of the 2006 survey. Overall, the length distributions for both surveys have fluctuated over time but remain around 20 and 35 cm fish.

Megrim (Figure 11) catches were similar to that of previous surveys, restricted to the western area, and overall catches were slightly down on the previous year. In 2006, 2007 and 2008, marked abundance had been recorded for 21–24 cm, 22–28 cm and 26–32 cm megrim, respectively, in line with a strong year-class entering and passing through the fishery (Roel *et al*., 2007; Engelhard *et al*., 2008a, b). However, by 2012, that perceived strong year class was no longer evident, and overall numbers were down compared with those of 2011, the highest of the time-series. There were, however, signs of a good number of < 30 cm megrim in the fishery in both 2011 and 2012. The quantity of megrim caught in this series of surveys is now at its highest since the start of the time-series in 2003.

The strong year classes of monkfish in 2008 and 2009, shown in Figure 12, seem to have been fished out or were absent from the grounds in 2012, and only a small number of monk below 20 cm were observed. The overall catch rate has increased, however the overall number and CPUE for the eastern survey has declined and numbers would appear to be similar to those of 2007. The total number of monkfish caught increased slightly from 467 in 2012 to 523 in 2013.

Only ten cod (Figure 13) were caught in 2013, but again it should be noted that this beam trawl survey is not designed for monitoring this species.

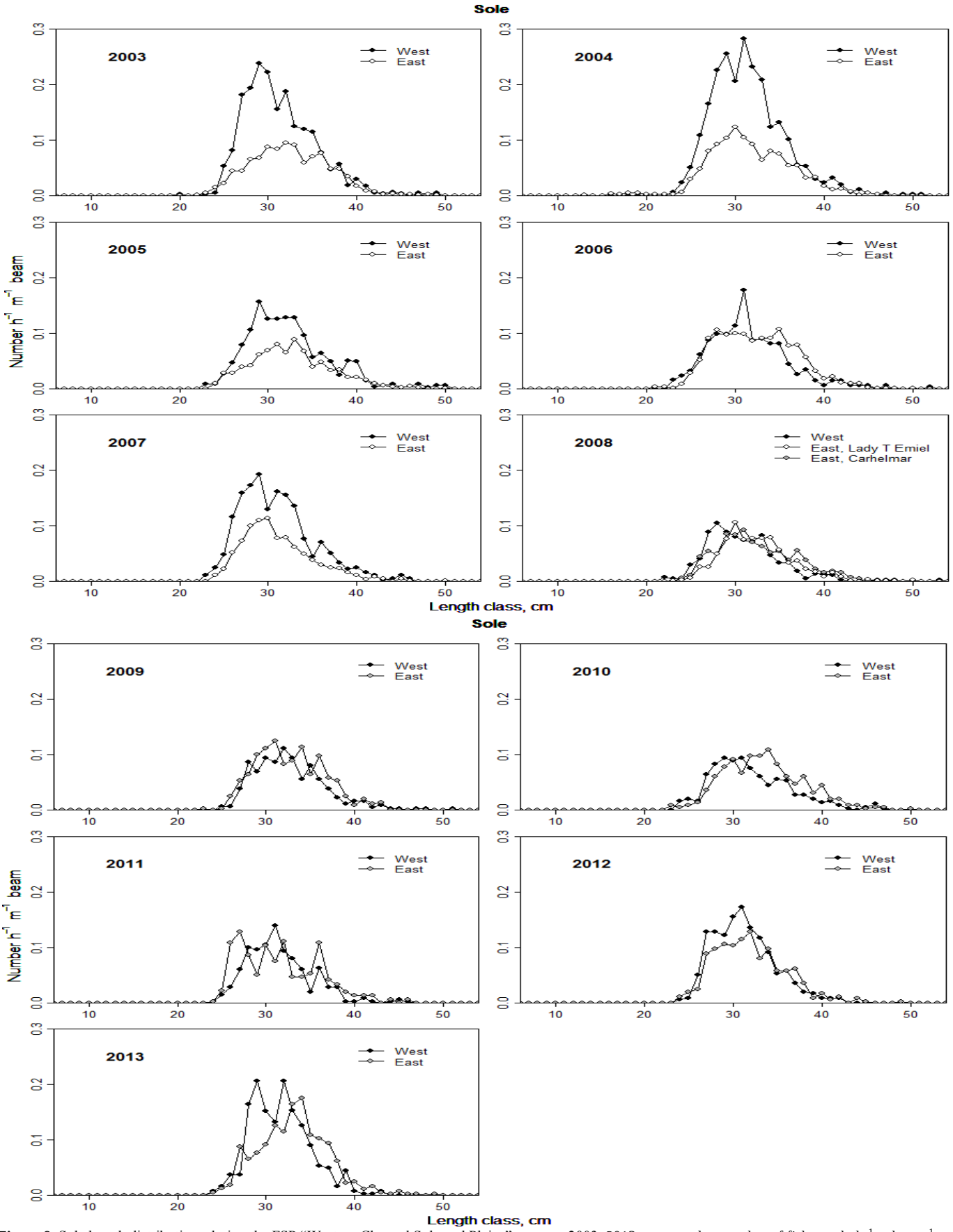

Figure 8. Sole length distributions during the FSP "Western Channel Sole and Plaice" surveys, 2003–2013, expressed as number of fish caught h^{-1} m $beam^{-1}$ per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys.

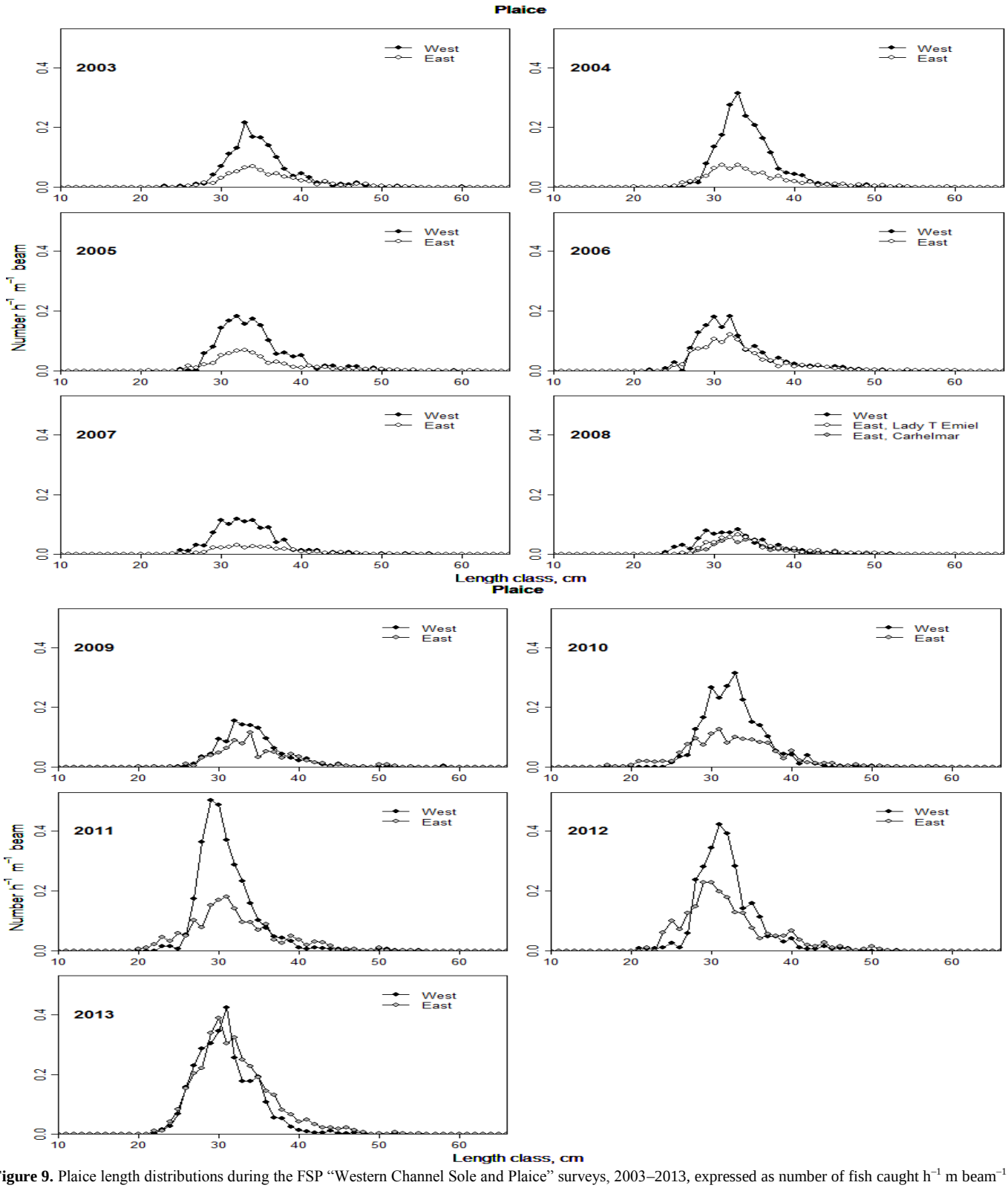

Figure 9. Plaice length distributions during the FSP "Western Channel Sole and Plaice" surveys, 2003–2013, expressed as number of fish caught h^{-1} m $beam^{-1}$ per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys.

Figure 10. Lemon sole length distributions during the FSP "Western Channel Sole and Plaice" surveys, 2003–2013, expressed as number of fish caught h^{-1} m $beam^{-1}$ per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys.

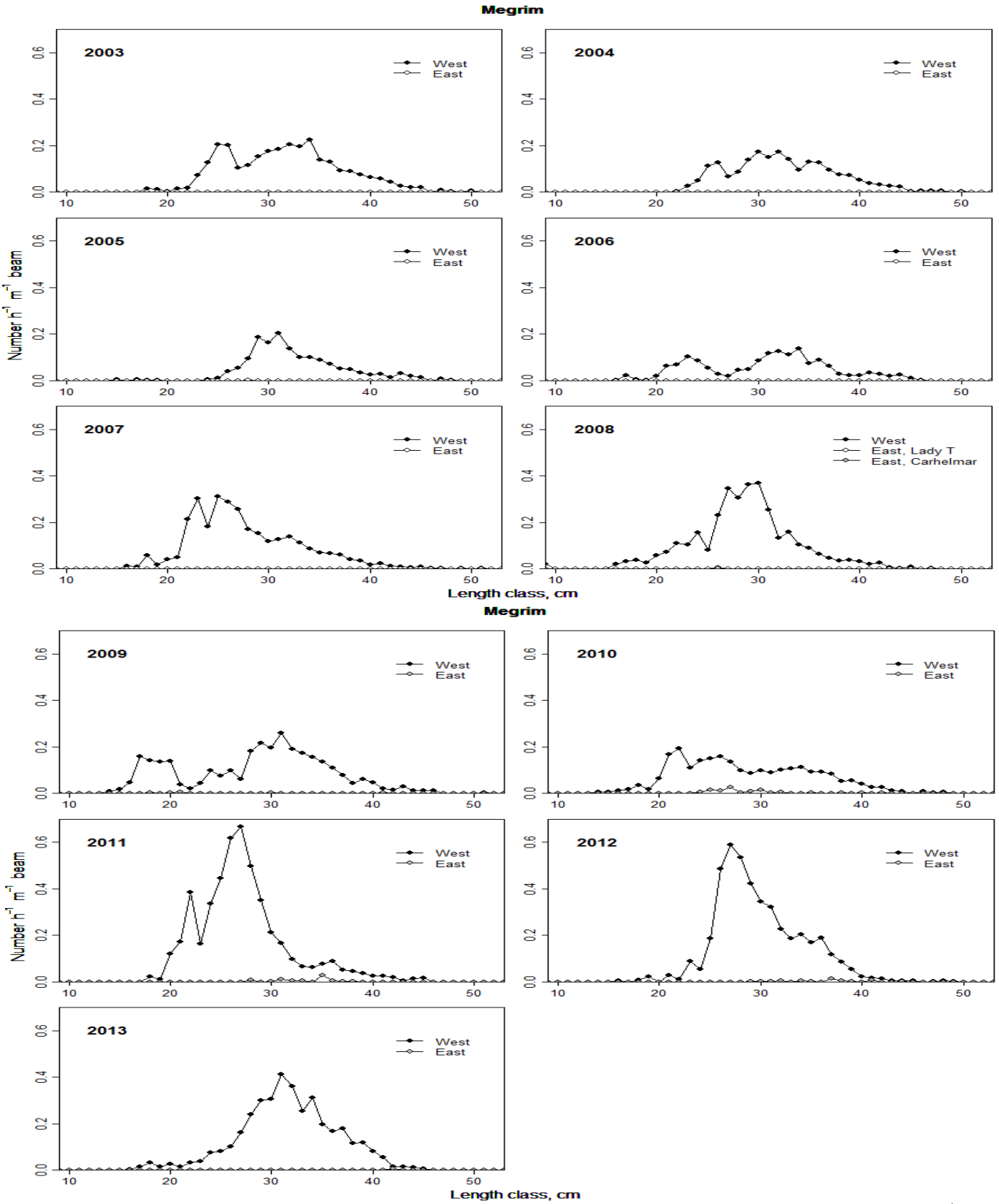

Figure 11. Megrim length distributions during the FSP "Western Channel Sole and Plaice" surveys, 2003–2013 expressed as number of fish caught h^{-1} m $beam^{-1}$ per 1-cm length bin. The length distributions are shown separately for the western and eastern surveys.

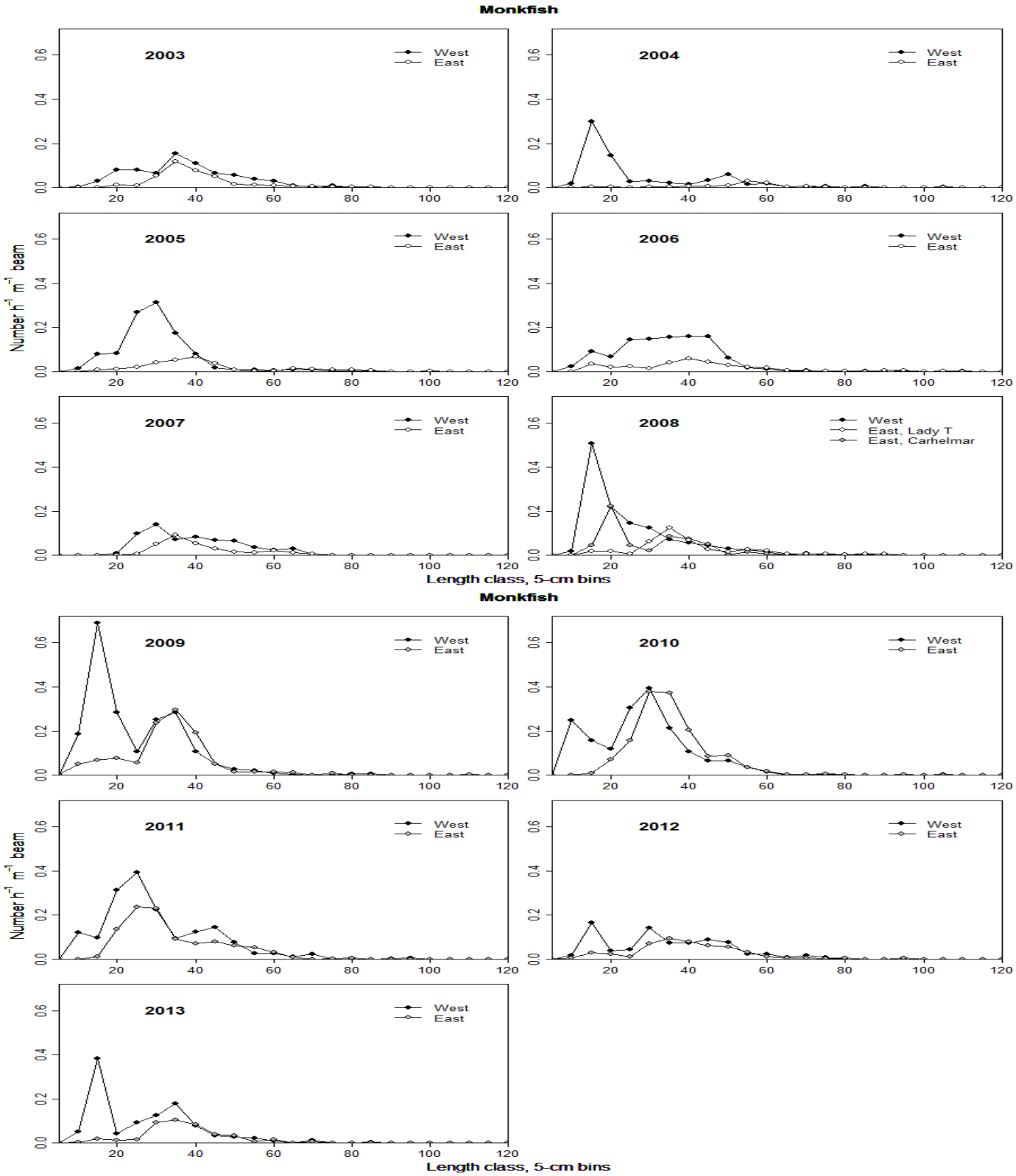

Figure 12. Monkfish length distributions during the FSP "Western Channel Sole and Plaice" surveys, 2003–2013, expressed as number of fish caught h^{-1} m $beam^{-1}$ per 5-cm length bin. The length distributions are shown separately for the western and eastern surveys.

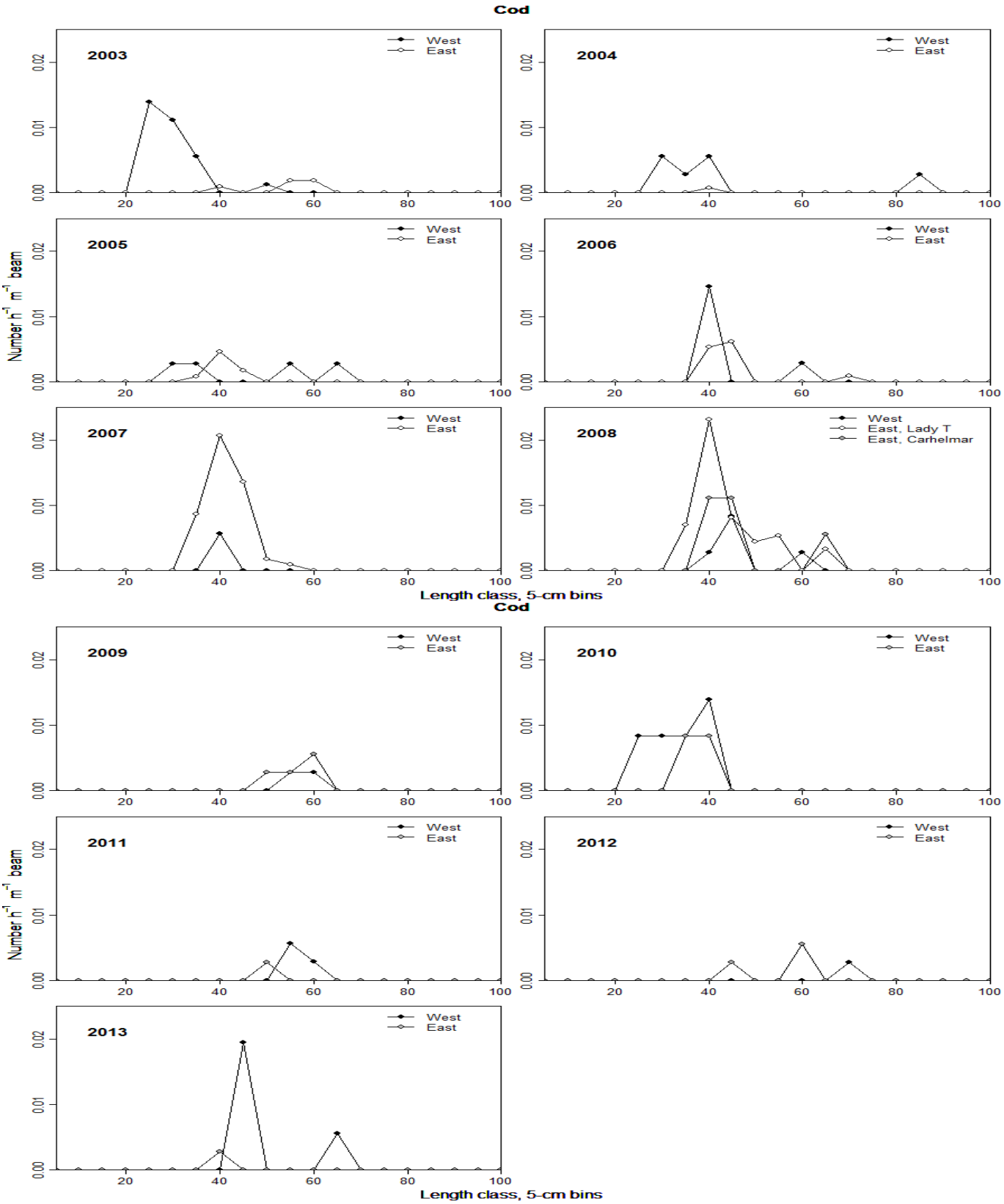

Figure 13. Cod length distributions during the FSP "Western Channel Sole and Plaice" surveys, 2003–2013, expressed as number of fish caught h^{-1} m $beam^{-1}$ per 5-cm length bin. The length distributions are shown separately for the western and eastern surveys.

Age compositions

In all, otoliths were collected from 225 and 174 sole in the eastern and western surveys of 2013, respectively. As in previous years, there was a broad age distribution (Figure 14), with fish >10 years old encountered, though less frequently than in previous years. The oldest sole recorded was a male 34 cm long aged at 19 years old, (the 2012 survey saw a sole recorded at 28 years with length 49 cm). The dominant age groups in 2013 were again the 3-, 4- and 5- year olds, with the mean abundances of 4- and 5-year-old fish increasing from those seen 2012. Sole catch rates by age for 2003–2013 are given by area in Table 1, and averaged over eastern and western surveys in Table 3.

Plaice (Figure 15). In all, otoliths were collected from 381 and 273 plaice in the eastern and western surveys of 2013, respectively. Plaice catch rates have increased to their highest level of the time-series with age three and four year olds dominating the catch. The age distribution is relatively narrow when compared with the much broader age distribution of sole. Plaice catch rates by age for the period 2003–2012 are given in Tables 2 and 3.

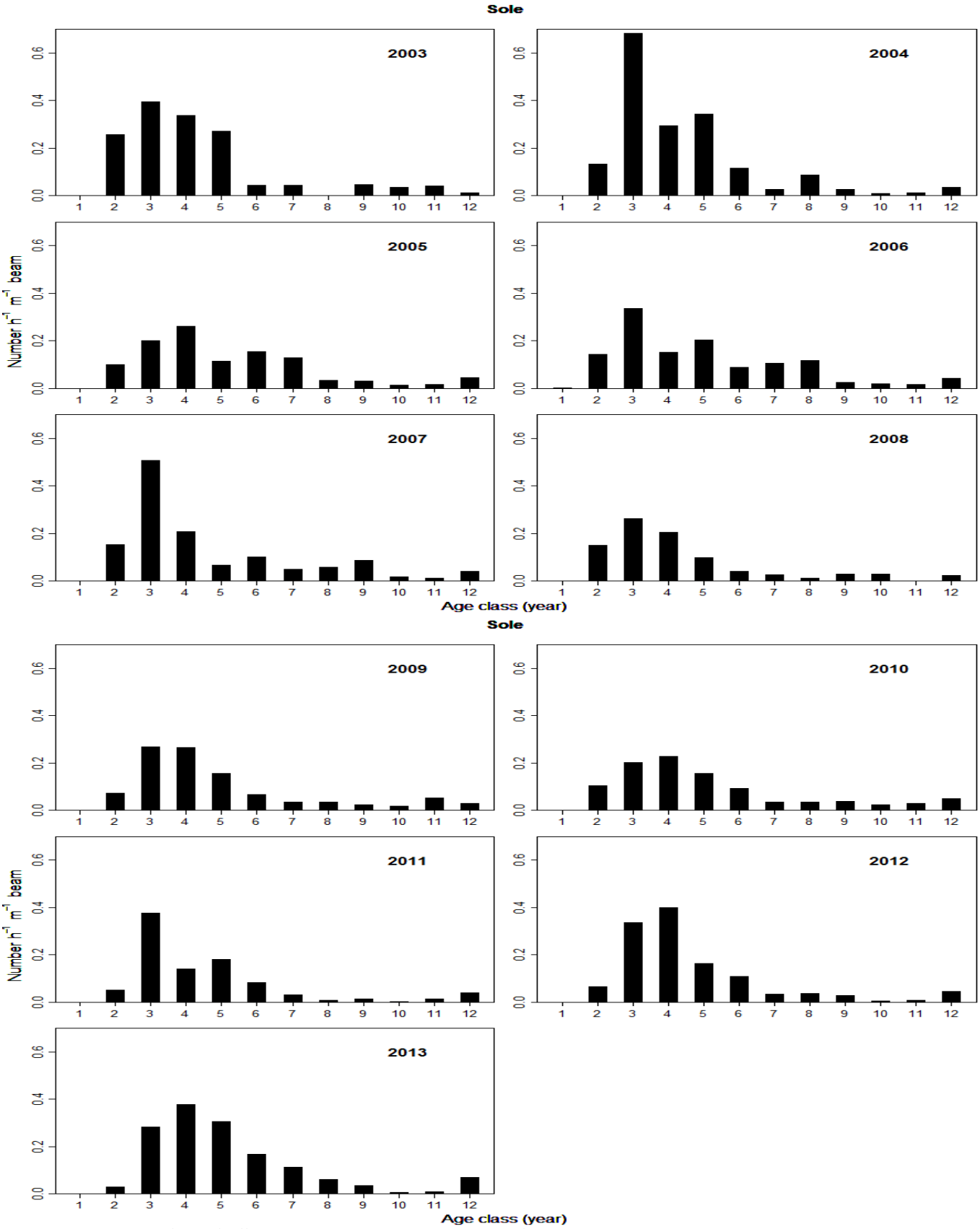

Figure 14. Mean number of sole of different ages caught per hour per metre beam for the eastern and western surveys combined (2003–2013). Age 12 is a plus-group that includes older ages.

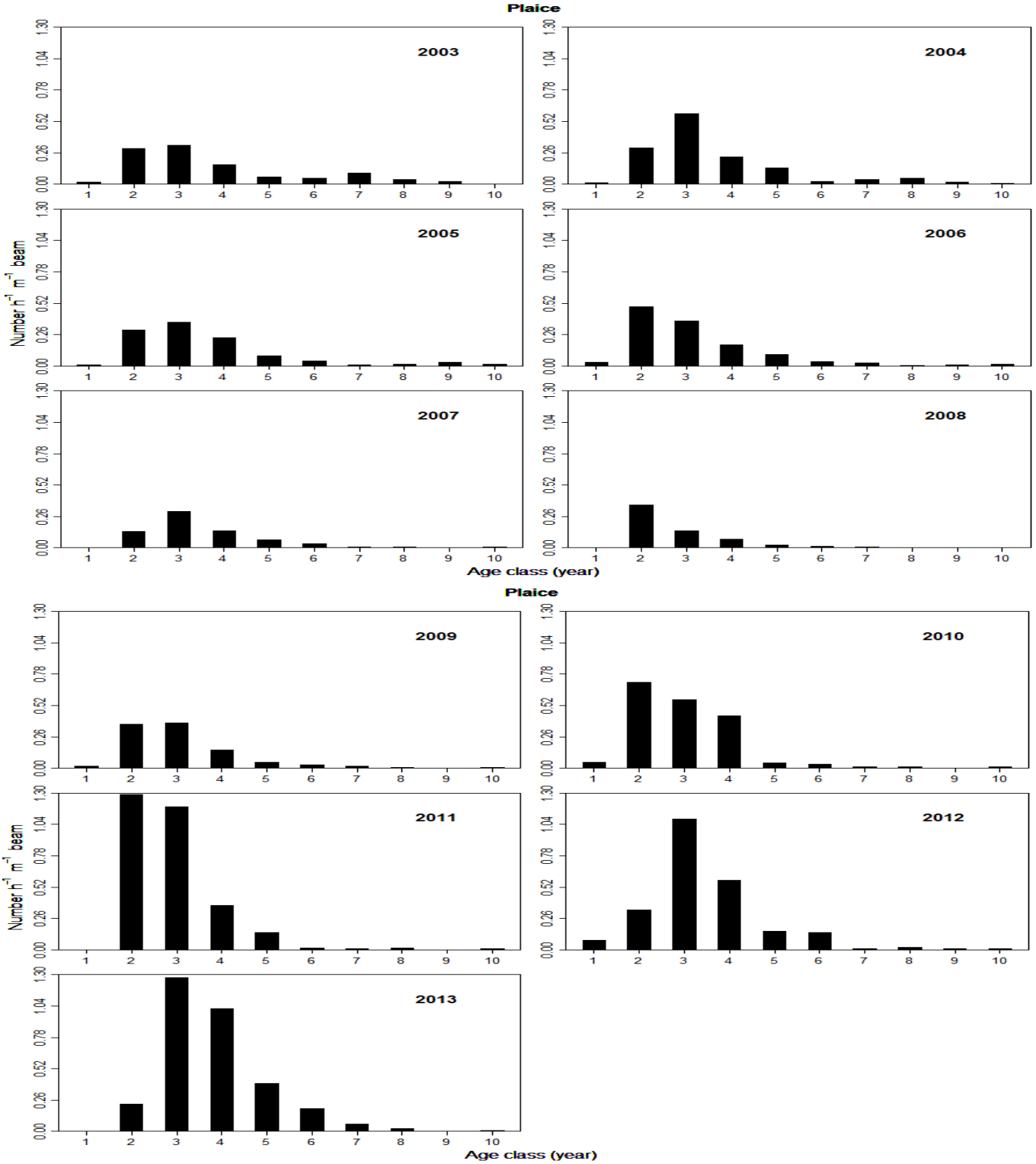

Figure 15. Mean number of plaice of different ages caught per hour per metre beam for the eastern and western surveys combined (2003–2013). Age 10 is a plus-group that includes older ages.

Table 1. Mean numbers of sole caught per hour per metre beam length, by age class and survey area during the 2003–2013 FSP "Western Channel Sole and Plaice" surveys. An index of spawning-stock biomass (SSB) is also shown (derived from catch rates expressed as kg h^{-1} m $beam^{-1}$).

Sole	East											West										
Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0.001	0.019	0.000	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2	0.150	0.079	0.076	0.133	0.101	0.120	0.077	0.093	0.000	0.060	0.019	0.364	0.180	0.129	0.158	0.199	0.181	0.069	0.114	0.051	0.069	0.041
3	0.235	0.379	0.140	0.315	0.353	0.250	0.292	0.190	0.085	0.286	0.225	0.562	0.947	0.277	0.355	0.639	0.278	0.243	0.213	0.376	0.384	0.344
4	0.252	0.173	0.185	0.146	0.144	0.220	0.299	0.249	0.376	0.360	0.352	0.434	0.403	0.354	0.157	0.261	0.191	0.234	0.204	0.142	0.438	0.404
5	0.207	0.223	0.085	0.214	0.049	0.113	0.169	0.179	0.166	0.155	0.300	0.344	0.450	0.154	0.191	0.085	0.087	0.142	0.134	0.180	0.175	0.312
6	0.025	0.081	0.122	0.100	0.069	0.046	0.074	0.110	0.199	0.106	0.178	0.034	0.150	0.195	0.080	0.130	0.037	0.057	0.075	0.084	0.113	0.156
7	0.040	0.020	0.100	0.122	0.040	0.033	0.038	0.040	0.106	0.035	0.120	0.049	0.033	0.168	0.092	0.061	0.021	0.032	0.028	0.032	0.034	0.108
8	0.002	0.058	0.027	0.131	0.040	0.017	0.038	0.042	0.053	0.042	0.072	0.001	0.115	0.045	0.103	0.074	0.011	0.032	0.028	0.009	0.033	0.052
9	0.029	0.023	0.025	0.027	0.063	0.036	0.022	0.043	0.009	0.034	0.044	0.065	0.030	0.040	0.023	0.111	0.022	0.023	0.031	0.015	0.020	0.030
10	0.029	0.007	0.012	0.025	0.013	0.034	0.021	0.032	0.018	0.006	0.010	0.044	0.009	0.016	0.017	0.023	0.026	0.017	0.016	0.002	0.005	0.003
11	0.032	0.011	0.014	0.019	0.010	0.002	0.061	0.035	0.007	0.007	0.011	0.057	0.012	0.022	0.015	0.018	0.001	0.042	0.021	0.015	0.008	0.010
12+	0.011	0.020	0.036	0.048	0.031	0.028	0.030	0.059	0.054	0.047	0.079	0.013	0.047	0.063	0.038	0.053	0.020	0.027	0.039	0.040	0.044	0.062
Total	**1.012**	**1.093**	**0.822**	**1.285**	**0.913**	**0.897**	**1.119**	**1.072**	**1.073**	**1.139**	1.411	**1.967**	**2.378**	**1.461**	**1.228**	**1.656**	**0.876**	**0.919**	**0.903**	**0.946**	**1.324**	**1.520**
SSB index	0.245	0.243	0.238	0.338	0.208	0.206	0.315	0.355	0.376	0.298	0.45	0.422	0.500	0.410	0.290	0.371	0.169	0.234	0.259	0.239	0.320	0.431

Table 2. Mean numbers of plaice caught per hour per metre beam length, by age class and survey area during the 2003–2013 FSP "Western Channel Sole and Plaice" surveys. An index of spawning-stock biomass (SSB) is also shown (derived from catch rates expressed as kg h^{-1} m $beam^{-1}$).

Plaice	East											West										
Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0.010	0.010	0.011	0.028	0.000	0.002	0.023	0.0972	0.000	0.120	0.002	0.019	0.009	0.014	0.034	0.000	0.001	0.016	0.000	0.000	0.037	0.002
2	0.167	0.156	0.169	0.392	0.054	0.224	0.282	0.5067	0.618	0.320	0.238	0.424	0.419	0.423	0.592	0.210	0.483	0.442	0.916	1.288	0.343	0.215
3	0.180	0.243	0.195	0.316	0.126	0.105	0.290	0.3908	0.571	0.858	1.262	0.460	0.891	0.529	0.434	0.463	0.182	0.456	0.743	1.840	1.310	1.285
4	0.100	0.102	0.132	0.149	0.068	0.064	0.130	0.3389	0.240	0.465	1.09	0.217	0.337	0.339	0.200	0.210	0.084	0.175	0.533	0.368	0.687	0.942
5	0.042	0.070	0.051	0.084	0.044	0.022	0.050	0.0377	0.146	0.137	0.463	0.080	0.189	0.121	0.110	0.092	0.023	0.048	0.055	0.145	0.170	0.329
6	0.037	0.015	0.026	0.033	0.026	0.014	0.030	0.0325	0.017	0.135	0.23	0.057	0.030	0.058	0.039	0.041	0.013	0.026	0.036	0.016	0.148	0.147
7	0.063	0.023	0.006	0.023	0.009	0.012	0.020	0.0125	0.014	0.014	0.084	0.118	0.053	0.014	0.030	0.011	0.005	0.018	0.015	0.009	0.006	0.036
8	0.029	0.041	0.014	0.006	0.004	0.003	0.008	0.0117	0.013	0.022	0.036	0.047	0.053	0.018	0.007	0.008	0.001	0.004	0.009	0.018	0.016	0.016
9	0.022	0.013	0.021	0.007	0.004	0.001	0.003	0.0028	0.003	0.011	0.008	0.029	0.025	0.043	0.010	0.006	0.002	0.003	0.003	0.001	0.011	0.003
10+	0.001	0.008	0.016	0.017	0.010	0.000	0.001	0.0137	0.008	0.015	0.008	0.003	0.000	0.016	0.013	0.011	0.000	0.007	0.009	0.011	0.007	0.004
Total	**0.651**	**0.682**	**0.639**	**1.055**	**0.344**	**0.448**	**0.836**	**1.444**	**1.630**	**2.097**	**3.419**	**1.455**	**2.008**	**1.575**	**1.469**	**1.053**	**0.794**	**1.194**	**2.317**	**3.696**	**2.733**	**2.980**
SSB index	0.212	0.189	0.180	0.237	0.103	0.084	0.186	0.289	0.320	0.449	1.059	0.413	0.484	0.407	0.307	0.251	0.113	0.235	0.443	0.588	0.581	0.838

Table 3. Sole and plaice: mean catch per hour per metre beam length, averaged over eastern and western surveys during the 2003–2013 FSP "Western Channel Sole and Plaice" surveys (chain-mat gear only). An index of spawning-stock biomass (SSB) is also shown (derived from catch rates expressed as kg h^{-1} m $beam^{-1}$).

	Sole											Plaice										
Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0.000	0.010	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.010	0.012	0.031	0.000	0.002	0.019	0.049	0.000	0.079	0.002
2	0.257	0.130	0.102	0.146	0.150	0.150	0.094	0.104	0.026	0.065	0.030	0.295	0.288	0.296	0.492	0.132	0.354	0.362	0.711	0.953	0.331	0.226
3	0.399	0.663	0.208	0.335	0.496	0.264	0.246	0.201	0.231	0.335	0.285	0.320	0.567	0.362	0.375	0.294	0.143	0.373	0.567	1.206	1.084	1.274
4	0.343	0.288	0.269	0.152	0.203	0.205	0.227	0.227	0.259	0.399	0.378	0.159	0.220	0.235	0.175	0.139	0.074	0.153	0.436	0.304	0.576	1.016
5	0.276	0.337	0.119	0.202	0.067	0.100	0.127	0.157	0.173	0.165	0.306	0.061	0.130	0.086	0.097	0.068	0.022	0.049	0.046	0.146	0.154	0.396
6	0.030	0.115	0.159	0.090	0.100	0.041	0.052	0.092	0.142	0.109	0.167	0.047	0.022	0.042	0.036	0.034	0.013	0.028	0.034	0.017	0.141	0.188
7	0.044	0.027	0.134	0.107	0.051	0.027	0.032	0.034	0.069	0.034	0.114	0.090	0.038	0.010	0.027	0.010	0.009	0.019	0.014	0.012	0.010	0.060
8	0.002	0.087	0.036	0.117	0.057	0.014	0.025	0.035	0.031	0.038	0.062	0.038	0.047	0.016	0.006	0.006	0.002	0.006	0.010	0.016	0.019	0.026
9	0.047	0.027	0.032	0.025	0.087	0.029	0.030	0.037	0.012	0.027	0.037	0.025	0.019	0.032	0.008	0.005	0.002	0.003	0.003	0.002	0.011	0.005
10/10+	0.036	0.008	0.014	0.021	0.018	0.030	0.025	0.024	0.01	0.006	0.007	0.002	0.004	0.016	0.015	0.010	0.000	0.004	0.011	0.010	0.011	0.006
11	0.045	0.012	0.018	0.017	0.014	0.002	0.022	0.028	0.011	0.008	0.010											
12+	0.012	0.034	0.049	0.043	0.042	0.024	0.027	0.049	0.047	0.046	0.070											
Total	**1.490**	**1.736**	**1.142**	**1.257**	**1.284**	**0.886**	**0.908**	**0.987**	**1.010**	**1.232**	**1.466**	**1.053**	**1.345**	**1.107**	**1.262**	**0.698**	**0.621**	**1.015**	**1.881**	**2.663**	**2.415**	**3.200**
SSB index	0.334	0.372	0.324	0.314	0.289	0.188	0.275	0.307	0.308	0.309	0.441	0.312	0.336	0.294	0.272	0.177	0.099	0.211	0.366	0.454	0.515	0.949

Catch compositions

The dominant species in the catch by total number of fish caught during the survey (Table 4) has fluctuated between sole, plaice and megrim with the most recent years being dominated by plaice with a contribution of more than 30% of the catch. Total numbers and mean numbers caught per hour of plaice reached its highest level of the time-series in 2013. During the first two years of the survey, sole contributed ~ 34-39% by number of these six commercially important species, but since 2009 its proportion of the catch dropped to below 19%. Mean number per hour has shown an increase since 2010, its lowest level of the time-series. Following a decline to its lowest level of the time-series in 2010, lemon sole has increased back to the levels seen at the beginning of the time-series. Megrim numbers increased to its highest level of the time series in 2011 and has since declined in number and mean number caught per hour thereafter. Catch rates of monkfish generally varied through the time-series, with the total number caught per year fluctuating between 372 and 1147. Much like monkfish, catches of cod also varied through the time-series, with the total number caught per year fluctuating between 3 and 55.

Table 4. Absolute catch numbers, relative catch (within these species) and approximate average catch per h for six commercially important species, 2003–2013.

	Sole	**Plaice**	**Lemon sole**	**Megrim**	**Monkfish**	**Cod**
Total Catch number						
2003	1824	1286	535	1014	646	17
2004	2178	1602	625	735	372	7
2005	1328	1207	559	559	715	12
2006	1617	1543	560	544	722	20
2007	1550	779	486	1081	582	55
2008	1203	853	580	1231	989	52
2009	733	731	430	1094	1126	6
2010	711	1354	332	904	1147	20
2011	715	1645	402	1702	944	3
2012	887	1741	518	1609	467	4
2013	1100	2364	548	1256	523	10
Proportion (%) of total number caught (all 6 species)						
2003	34.3	24.1	10.0	19.1	12.2	0.3
2004	39.5	29.1	11.1	13.4	6.8	0.1
2005	14.2	12.9	5.9	59.3	7.6	0.1
2006	32.3	30.8	11.2	10.9	14.4	0.4
2007	34.2	17.2	10.7	23.9	12.7	1.2
2008	24.5	17.4	11.8	25.1	20.2	1.1
2009	17.8	17.7	10.4	26.6	27.3	0.1
2010	15.9	30.3	7.4	20.3	25.6	0.4
2011	13.2	30.5	7.4	31.3	17.4	0.1
2012	17.0	33.3	9.9	30.8	8.9	0.1
2013	18.4	39.0	9.7	23.3	9.4	0.2
Approximate mean number caught per hour						
2003	20.1	13.7	5.9	11.3	7.2	0.2
2004	23.5	17.3	7.0	8.3	4.1	0.1
2005	15.4	13.9	6.2	6.2	7.9	0.1
2006	20.8	18.8	6.3	6.0	8.2	0.2
2007	17.6	8.3	5.4	12.0	6.3	0.5
2008	10.2	7.1	4.9	10.2	8.2	0.4
2009	8.2	8.1	4.8	12.2	12.5	0.1
2010	7.9	15.0	3.7	10.0	12.7	0.2
2011	8.2	18.9	4.6	19.6	10.9	0.0
2012	9.9	19.3	5.8	17.9	5.2	0.0
2013	11.8	26.1	5.7	13.8	5.7	0.1

Discussion

This is the eleventh successful FSP Western Channel Sole and Plaice survey carried out, adding a new year to the time-series of beam trawl surveys in the Western Channel built up through collaborative efforts between fishers and scientists (see also Cotter *et al*., 2004; Large *et al*., 2004; Armstrong *et al*., 2006; Roel *et al*., 2007; Engelhard *et al*., 2008a, 2008b, 2009; Bush *et al*., 2010, 2011, 2012). The programme has now provided a time-series of catch rates, age and length compositions of the commercially important and 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. Also of interest, are data collected for more than 50 additional species of fish and shellfish.

For this survey, 88 of the 90 core stations used for the time-series index were sampled, all fished by the beam trawler *Carhelmar* using her own 2 × 4 m beams and rigged to their own fishing practices. This was in line with the survey design introduced in 2008, which was simplified relative to earlier years in order to promote consistency as well as cost and efficiency savings, but also as a result of a lack of availability of one of the two vessels involved previously. It implies no significant change for the western leg of the survey, which throughout the time-series has been carried out by a 2 × 4 m beam trawler (2003–2004: *Nellie*, engine power 486 kW, registered length 23 m; 2005–2012: *Carhelmar*, 220 kW, 22.2 m). For the eastern survey, however, there is a difference from 2003–2007, when the larger 2 × 12 m beam trawler *Lady T Emiel* covered the eastern survey area; this vessel was not available to carry out the full survey from 2008 on, although in that year she did sample a subset of stations, allowing catchability comparisons.

It is important to bear in mind the change in vessel in the eastern survey in 2008. As pointed out in the report for 2008 (Engelhard et al., 2008b), this may be argued to have only marginally compromised the consistency of the time-series, on the grounds that (i) towing speeds and haul durations remained constant throughout, and that the gear remained essentially the same except for the switch from 2 × 12 m to 2 × 4 m beam; (ii) catchability comparisons between *Carhelmar* and *Lady T Emiel* in 2008 revealed similar sole and plaice catch rates, provided that catch per unit effort is expressed as numbers per hour per metre beam length; (iii) sorting and sampling procedures have remained the same, and the survey now covers exclusively those stations consistently sampled in all years 2003–2011 (and now in 2012 too).

This year's FSP eastern survey was conducted with favourable weather conditions. The western leg was delayed for two days at the start of the survey to allow some strong winds to disappear. Both legs of the survey were conducted within the desired time-period.

Comparisons with ICES data

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, 2011 for sole and 2009 for Plaice. 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 over the period 2003–2013 (Figure 16). However, the FSP SSB estimates for 2008 indicated a decline whereas ICES sought to increase this figure. The drop in SSB for that year could be the result of very poor weather conditions that led to both parts of the survey being considerably delayed. Both the poor weather and the delay could have resulted in a significantly reduced catch rate that year, rendering the 2008 FSP estimates lower than the ICES estimates. The increases in the FSP SSB estimates from 2008 onwards for both sole and plaice are of note (the latter species more evidently so), because even taking into account the poor fishing year of 2008, the FSP SSB values appear to

be increasing. One would suggest a note of caution here, however, in that the trends for both stocks were a slow/gradual decline from 2003 to 2007 or 2008, before this more recent modest sign of improvement from 2009.

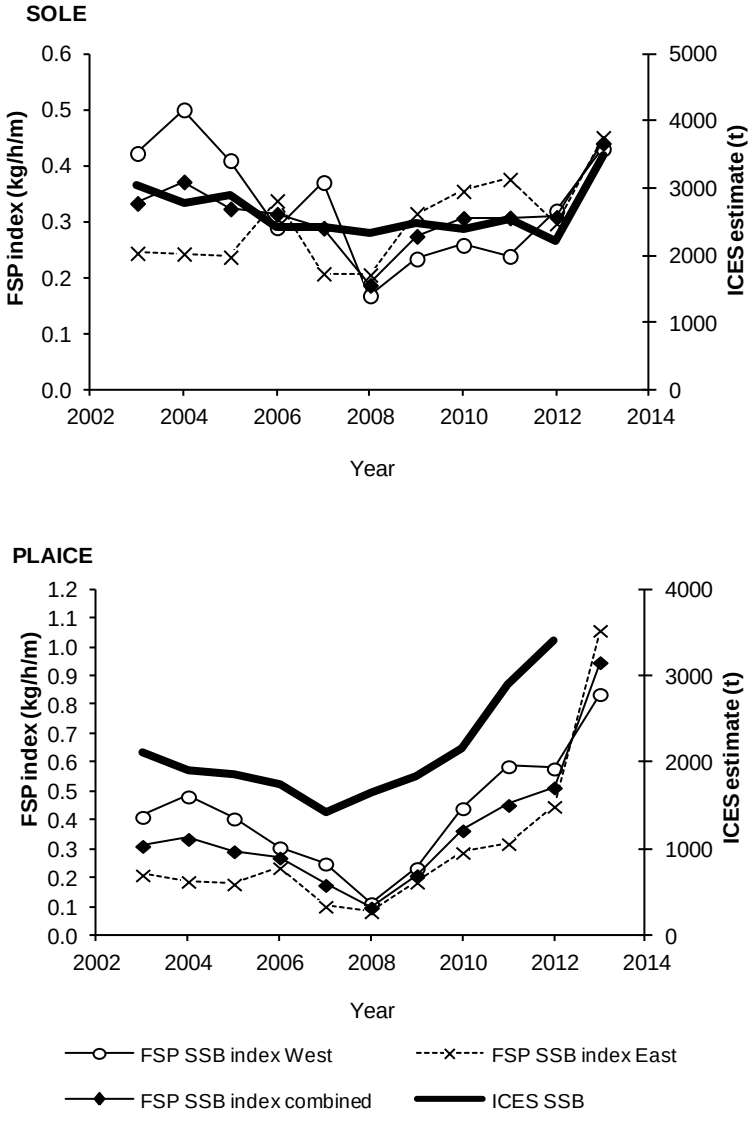

Figure 16. Comparison between trends in the index of spawning-stock biomass (SSB) found by the FSP surveys and the most recent ICES assessments for the VIIe stocks of sole and plaice (ICES, 2013). FSP trends are given separately for the eastern and western surveys, and for the surveys combined.

Acknowledgements

We thank the skippers and crew of *Lady T Emiel* (2003–2008 surveys), *Carhelmar* (2005–2013 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. We also thank all staff at Cefas who contributed to the programme for their help. The programme was funded by Defra as part of the Fisheries Science Partnership.

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Appendix 1. Detailed Operational plan for 2013 western Channel Sole and Plaice FSP

Fisheries Science Partnership 2013/14

Western Channel Sole & Plaice - East and West Surveys: ***August/September 2013***

Detailed Operation Plan

VESSEL

Vessel name:	**Carhelmar**
RSS:	**B10649**
PLN:	**BM 23**
Skipper:	**Gerald Podschies**
Company:	**Interfish Ltd, Cattedown Road, Plymouth PL4 0RW**
Fleet manager:	**Andrew Pillar**

OBSERVERS

Michael Manser

OBJECTIVES

To repeat the Fisheries Science Partnership Survey "Western Channel Sole & Plaice" over approximately 15 days, as a continuation of the 2003–2012 time-series; this includes 2 legs:

a. 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 (as in 2008) using 2 x 4-m beam trawls, during approximately 20–30 August 2011, covering the same 45 stations as in 2012
b. To repeat the Western Channel—West survey as carried out previously in 2003–2010 by FV *Nellie* and FV *Carhelmar*, using chain mat gear and 2 x 4-m beam trawls, during appr. 20–30 September 2011, covering the same 45 stations as in 2010

FISHING GEAR

Two Interfish 4 m beam trawls fitted with chain mats, and rubber discs of approximately 8" and 6" diameter, on 26 mm wire. 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-braided 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 were carried out during the 2009 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 Eastern Leg is scheduled to take place from 23th – 29th August 2013, and the Western Leg from 20th – 26th September 2013. Slight adjustment of these dates may be needed to accomodate for bad weather etc. The total duration of both trips will be approximately 15 days.

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 typical tow duration of 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.

In case of concern of sanding up of the net (as may happen at some softer-ground stations in Lyme Bay), this may be avoided through a somewhat reduced towing time, or (less preferably) by splitting a 1 hour tow into 2 half-hour tows the catch of which is to be treated as a single haul. The station position may be slightly shifted consistently with what was done in 2008. This applies to the Eastern stations 37, 39, 40, 41, 42, 45 and 59, in an area known as the 'Gravel Pit'.

SORTING AND RECORDING THE CATCH

It is important that the catches of sole, plaice, monkfish, 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:

a. 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).
b. 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) or a known-proportion sample of the catch (raising factor > 1).
c. Discarded fish of commercial and non-commercial species, other than those in category (a). 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 and length measures carried out. This is best achieved by basketing up 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 300 pairs of sole and 300 pairs of plaice otoliths (about evenly distributed over areas “West” and “East”), and otoliths for all cod sampled (unless cod catch is very large).

These are to be spread out over the entire area. Collections should be made across the length range at each tow to avoid over-sampling of large or small fish in different areas. For sole, sampling should aim for 10-15 otoliths per 1-cm length class, but no more than 3 otoliths per length class per station for fish in the length range 26–44 cm. All otoliths from sole of 45cm and over are to be collected. For plaice, 10 otoliths per length class per sex are to be collected, but no more than 3 otoliths per station per sex. All otoliths from male plaice of 35cm and over and females of 50cm and over are to be collected.

The observer will maintain an otolith tally to make sure there aren’t any gaps appearing (i.e. 1-cm length classes missing)

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.

Under the dispensation requirements, the skipper should keep logbooks in the usual way. All pages relating to the FSP trip should be annotated "Western Channel Plaice and Sole study 2013". Copies of the logbook sheets and sales notes relating to the survey should be forwarded to Robert Bush as soon after the trip as possible. 95% of the total agreed price (including VAT) will be paid on completion of the vessel hire and submission of landings / sales notes to Cefas (if applicable to the FSP project).

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 NARRATIVE

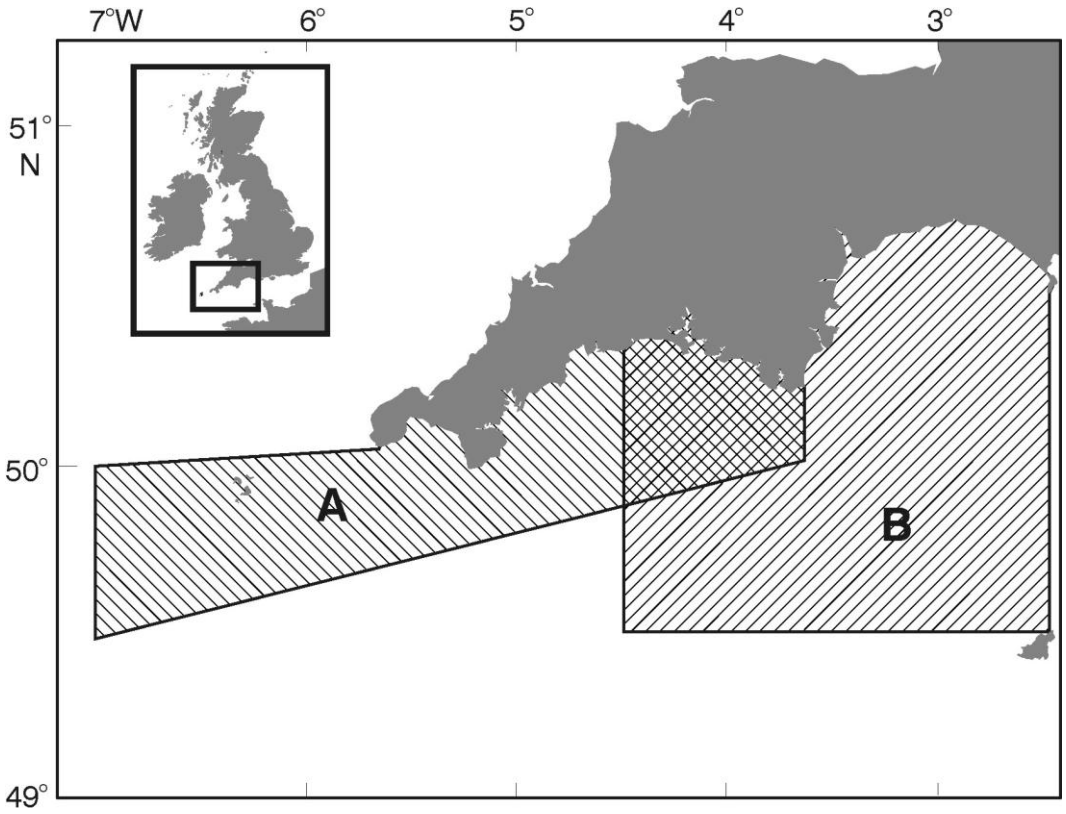
The observer will maintain a diary of activities, including an electronic copy where possible, and a draft cruise report in standard Cefas format will be prepared for submission to Cefas immediately after the cruise. The cruise narrative should be written at sea and read and agreed by the skipper (report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

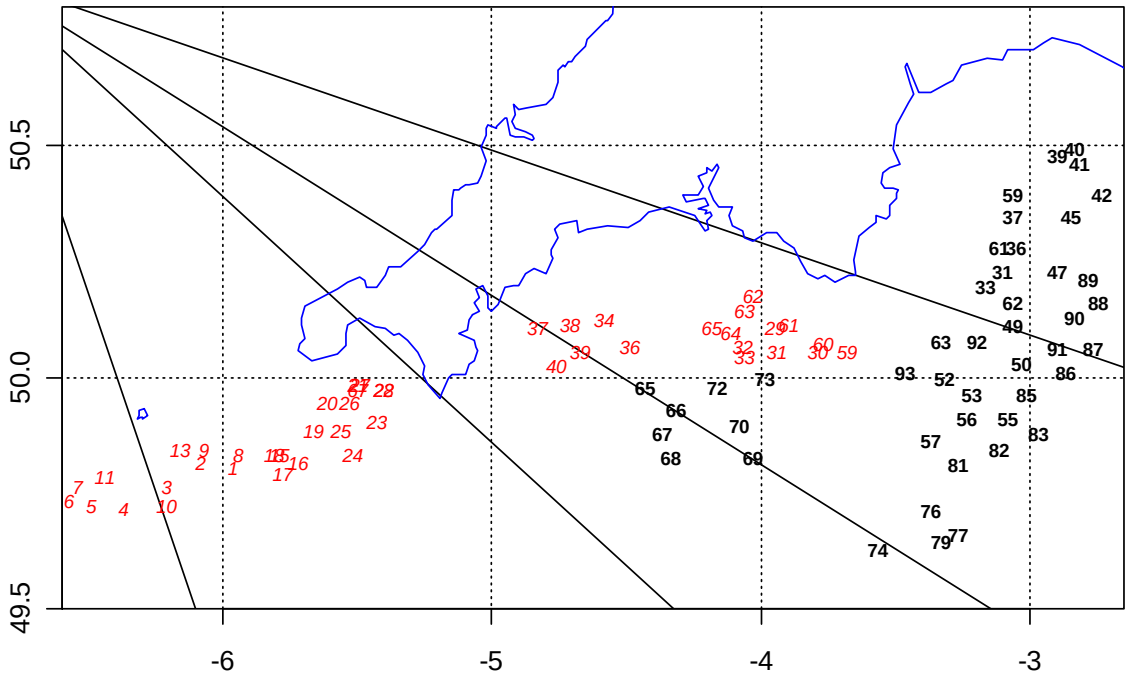
Signed:

…….. (Interfish) ……. (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.

Area (stratum)	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: Cruise narrative

Appendix 3: Comments from Interfish