

Final Report

North East Cod survey: 2003-2012

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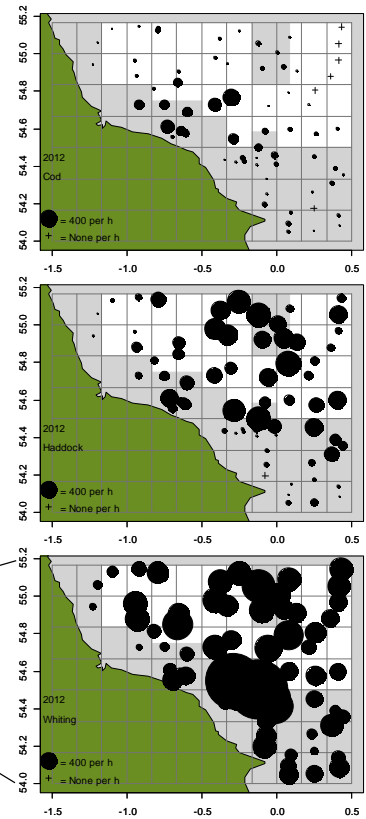
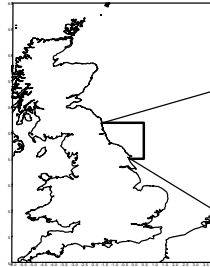
Summary: NE cod FSP survey 2003-2012

The trawler *Abbie Lee* was chartered in October 2012 to carry out the tenth in a series of FSP surveys of cod and other gadoids off the NE coast of England. Surveys since 2005 have utilised tows spread out over the survey area, with additional tows in defined areas with coarser seabed types (“hard” ground) where cod abundance is expected to be greatest.

Cod continue to be most abundant on or near hard ground. Haddock were once again mainly on the softer seabed sediments offshore. Whiting continue to show no clear relationship with seabed type.

Some of the features of cod, haddock and whiting populations given by ICES assessments for the North Sea as a whole are reflected in results from this FSP survey.

Distribution of cod, haddock and whiting in the 2012 FSP. Areas of spots are proportional to the numbers caught per hour. Shading within the grid lines indicates area with coarse seabed type. Same scale for all plots.



Mean catch rate by age: 2003–2012 FSP (mean number caught per hour).

(a) Cod

Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Age 0	0.0	0.0	2.6	0.3	0.0	0.0	0.6	0.0	0.0	0.1
Age 1	24.5	21.9	23.7	54.4	22.0	16.0	34.1	29.7	28.6	9.6
Age 2	38.0	5.9	6.8	9.4	18.3	9.1	11.4	7.2	12.9	9.6
Age 3	0.5	3.1	1.0	1.1	1.8	2.0	0.9	0.7	1.1	1.9
Age 4	0.5	1.0	0.1	0.6	0.0	0.1	0.1	0.3	0.1	0.2
Age 5	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Age 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Age 7+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	64	32	34	66	42	27	47	38	43	21

(b) Haddock (total 2003 = 34)

Year	'04	'05	'06	'07	'08	'09	'10	'11	'12
Age 0	0.0	1.8	0.3	0.0	0.3	0.1	0.1	0.0	0.0
Age 1	1.1	12.3	159.8	13.0	5.9	3.7	52.4	9.3	2.5
Age 2	12.8	9.0	10.7	137.5	16.8	7.5	9.2	123.0	11.3
Age 3	0.0	14.6	12.1	6.4	75.0	25.0	6.1	16.0	79.8
Age 4	3.0	3.6	5.4	0.8	2.6	27.7	7.7	6.1	3.7
Age 5	25.9	2.8	1.7	1.6	1.9	0.2	17.9	12.0	3.2
Age 6	0.3	31.3	5.4	0.1	0.4	0.3	2.1	8.1	3.8
Age 7+	0.0	0.0	3.7	4.6	0.1	0.2	0.9	0.3	4.5
Total	43	76	199	164	103	65	96	175	109

(c) Whiting (total 2003 = 88)

Year	'04	'05	'06	'07	'08	'09	'10	'11	'12
Age 0	0.0	2.4	0.1	0.0	0.7	0.4	0.0	0.0	0.0
Age 1	2.5	26.7	31.3	21.1	159.8	55.8	24.3	78.5	50.9
Age 2	14.1	19.9	48.1	32.2	59.3	254.1	32.6	71.1	81.2
Age 3	26.7	31.0	17.5	55.7	36.1	79.2	67.0	57.7	55.7
Age 4	16.4	166.5	11.6	5.4	30.8	39.9	38.8	117.7	20.7
Age 5	9.9	109.9	97.0	11.6	2.9	19.0	18.2	25.6	87.2
Age 6	3.2	55.6	45.4	53.4	4.6	0.8	5.5	16.7	16.1
Age 7+	1.3	24.0	42.7	39.0	20.8	15.6	10.2	3.2	7.0
Total	74	436	294	218	315	465	197	370	319

Catches of whiting have contained an above-average proportion-at-age of fish from the 2007 year class since 2008, indicating a notable abundance of that year class in the survey area, consistent with the ICES assessment, which estimates the year class as the strongest since that of 2001.

The FSP NE cod survey is an intensive autumn survey of the cod fishing grounds off the NE coast of England, covering a relatively small part of the overall distribution of cod, haddock and whiting in the North Sea. The survey provides comprehensive data on the abundance, distribution, size/age structure and species mix of demersal fish.

Introduction

The NE Coast cod survey is a designated time-series survey conducted since 2003 as part of the UK Fisheries Science Partnership (FSP). General background to the FSP Programme can be found at www.cefas.co.uk/fsp. The NE Coast cod surveys in 2003 and 2004 were largely exploratory, examining factors such as the effect of gear type and time of day on catch rates of cod and other species (Cotter *et al.*, 2004; Armstrong *et al.*, 2005). Subsequent surveys were conducted following an open tender for a vessel to carry out the surveys using specified gear during each of the years 2005–2007. The survey series thereafter continued on a similar basis following further open tenders covering the periods 2008–2010 and 2011 on (up to possibly 2013). The objective of the survey series is to provide year-on-year comparative information on distribution, relative abundance and size/age composition of NE coast cod and whiting. The surveys also provide data on catches of other species important to the NE coast fishery, including haddock.

The geographic limits of the survey were initially defined to encompass the main grounds for cod and allied species fished by bottom trawlers operating from ports such as Scarborough, Bridlington and Whitby on England's NE coast. The routine Cefas observer scheme clearly shows that vessels using whitefish otter trawls operate mainly on the strip of coarser sediments running along the coast, particularly between autumn and spring. (The area of coarse sediment is referred to as "hard ground" throughout this report.) Inshore hard ground provides a typical habitat for young cod up to 2–3 years old, which remain in the area until they mature, then migrate seasonally between feeding and spawning grounds. The immature cod are therefore present in such areas throughout the year. The FSP surveys of NE cod in 2003 and 2004 targeted mainly hard ground, with some stations farther offshore. The survey was redesigned in 2005 in collaboration with the vessel owner to provide broad coverage of a range of seabed types off the NE coast, at the same time allowing increased survey intensity on the hard ground. The same survey design was used in 2006 and 2007. A similar design, but with a coarser grid and fewer stations, was used in 2008 to allow for a ~10% curtailment of the survey concomitant with rising fuel costs, and that design was subsequently also used from 2009 to 2012.

This report presents the results of the 2012 survey and a comparison with the results obtained during the equivalent surveys of 2005–2011 and the more restricted data available for the 80 mm codend Whitby Jet trawl in 2003 and 2004. The survey in 2012 is the fifth consecutive one to have been carried out on the commercial trawler *Abbie Lee* (skipper John Hall) since the survey was redesigned in 2005; it took place from 1 to 23 October. The vessel was not the same as the one used from 2005 to 2007 (*Emulator*), but the same gear was used and a similar survey design followed. The equivalent FSP survey tows using the Whitby Jet trawl and 80 mm codend in 2004 were made by FV *Christina* (Armstrong *et al.*, 2004), and in 2003 by the fishing vessels *Abbie Lee* and *Emulator* (Cotter *et al.*, 2004).

The detailed operational plan for the 2012 survey is given in Appendix 1, and a post-cruise report, kindly provided by skipper John Hall, is reproduced in Appendix 2.

Methods

Vessel and trawl gear

FV *Abbie Lee* (WY211) is a steel-hulled trawler, overall length 18.25 m and breadth 6.11 m, with 298 kW main engine power. The vessel deployed a Whitby Jet otter trawl, a form of gear used extensively by vessels off the NE coast to fish for cod. The construction and rigging of the net were as follows:

Net: 84 ft (26 m) fishing line, 66 ft (20 m) headline. Codend mesh: 80 mm diamond, constructed from 4/5 mm double-braided twine. Lifting bag mesh 260 mm.

Ground Gear: 16” rockhoppers with 8” spacers in central 20 ft. 14” rockhoppers with 8” spacers in 20 ft on either side. 12 ft wing chains of 5/8” links.

Sweeps (Bridles): Top: 24 fathom (6.8 m) wire. Bottom: 24 fathom chain.

Doors: Poly Ice. 6’6”, 72 stone (458 kg).

Fishing characteristics: Estimated headline height: 12 ft. Door-to-door spread estimated at ~90 ft with 80 fathoms of warp out, and 98 ft with 100 fathoms out, towing at 3 knots.

Survey design

The survey was designed to achieve full coverage of potential cod habitats within the area covered by the main cod fishery off the NE coast of England, but placing additional trawling effort in areas where cod density was expected to be greatest. Broad spatial coverage was assured by dividing the survey area into 10 min (latitude) by 20 min (longitude) blocks, with two tows to be carried out in each block (note that for the 2005–2007 surveys, these specifications were 10’×10’ blocks, with one tow in each). In 2005, the vessel owner and skipper identified areas of hard ground where the best catch rates of cod were likely. An additional tow was therefore allocated to each of the rectangles containing these areas of hard ground. Some of the tows in 2005 could not be carried out because of the presence there of static gear or the absence of adequate information on clear tow paths. The number of tows per block was slightly modified for the years 2006–2012 to account for this issue (Appendix 1).

The same gear was originally intended to be used throughout the survey, regardless of ground type, but the use of tickler chains, attached to the gear for a number of tows conducted on soft ground, was noted during the 2008 survey. This modification of the gear had not been included in the gear description in the tender, and scientists were previously not made aware of it. Nevertheless, to remain consistent with previous reports, the analyses presented here do not make any allowance for the presence or absence of tickler chains on soft ground.

Sorting and processing the catch

Standard methods employed by Cefas staff for sorting and recording catches on commercial fishing vessels were followed (see the FSP reports for 2004 and 2005 for details). Length measures were carried out on the retained and the discarded components of the catch. Where catches were sampled rather than fully sorted, an appropriate raising factor was determined to allow the total catch to be estimated. Otoliths of cod, whiting and haddock

were collected from samples of fish taken across the survey area, to allow the age composition of the catches to be determined.

Analytical methods

Distribution patterns of cod, whiting, haddock, plaice and lemon sole were examined by compiling maps showing the mean numbers caught per hour towed at each station. The distribution of cod in length ranges comprising mainly 0-group (5–20 cm), 1-group (21–45 cm) and 2+ group fish (>45 cm) was also examined.

The “hard ground” and “soft ground” survey strata that formed the basis for the survey design were retained for comparisons of catch rate and length composition, because the survey intensity on the hard ground was intentionally greater (see Survey design section above). The patch of hard ground in the NE sector of the survey area was treated as being in the same stratum as the more-coastal area of hard ground.

The mean length composition (number caught per hour) of cod, haddock and whiting was calculated for each survey stratum. No distinction was made between landed and discarded fish because the data of interest are catch rates for all length and age classes in the catch. Further, discarding patterns may also be influenced by the vessel’s catches not counting against quota. In practice, though, discarding of the main commercial fish species was strongly influenced by minimum landing sizes (35 cm for cod, 30 cm for haddock, 27 cm for whiting). Market conditions also influenced the rate of discarding of whiting.

In order to calculate an average length frequency for the entire survey area, it was necessary to take into account the relative size of each survey stratum, based on the number of 10’×20’ rectangles sampled in each. As hard ground made up approximately 50% of the total area surveyed in the years 2005–2012, the mean length frequencies (numbers per hour) in hard-ground and soft-ground strata were averaged, with equal weighting.

Age compositions of cod, haddock and whiting were estimated by applying an age/length key to the mean length composition from each stratum. The age/length keys for each species were compiled from samples collected throughout the survey. No otoliths of haddock or whiting were collected during the 2003 FSP survey, so for that year only the length frequencies and total numbers caught per hour can be compared with the 2004–2012 survey results. The more-limited coverage of the grounds by the Whitby Jet trawl in 2003 and 2004 means that the catch rates for those years provide only a rough indication of abundance and age composition relative to the more extensive surveys in subsequent years.

Although catch weights were not recorded during the survey, the approximate total live weight of the catch of each fish species during the survey was calculated from the total raised length frequency for the survey tows, multiplied by the expected average weight of fish in each length class using a length–weight relationship. These catch-weight estimates therefore only approximate the landings recorded in the vessel logbook.

Results

Fishing stations

Details of the fishing activities of *Abbie Lee* are provided in Table 1, and the midpoints of tows are shown in Figure 1. The position, date and time, along with numbers of the main commercial species caught, are given by tow in Tables 1 and 2 of Appendix 3. Data for other species caught are held at Cefas.

Table 1. FSP 2012 Survey: North East cod. Details of fishing activities.

Vessel	Dates in 2012	Stations	Number of valid hauls	Fishing gear	Codend mesh (mm)	Tow duration (h) Median (range)
FV <i>Abbie Lee</i>	1–23 Oct	1–70	70	Whitby Jet trawl	80	2.00 (2.00–2.50)

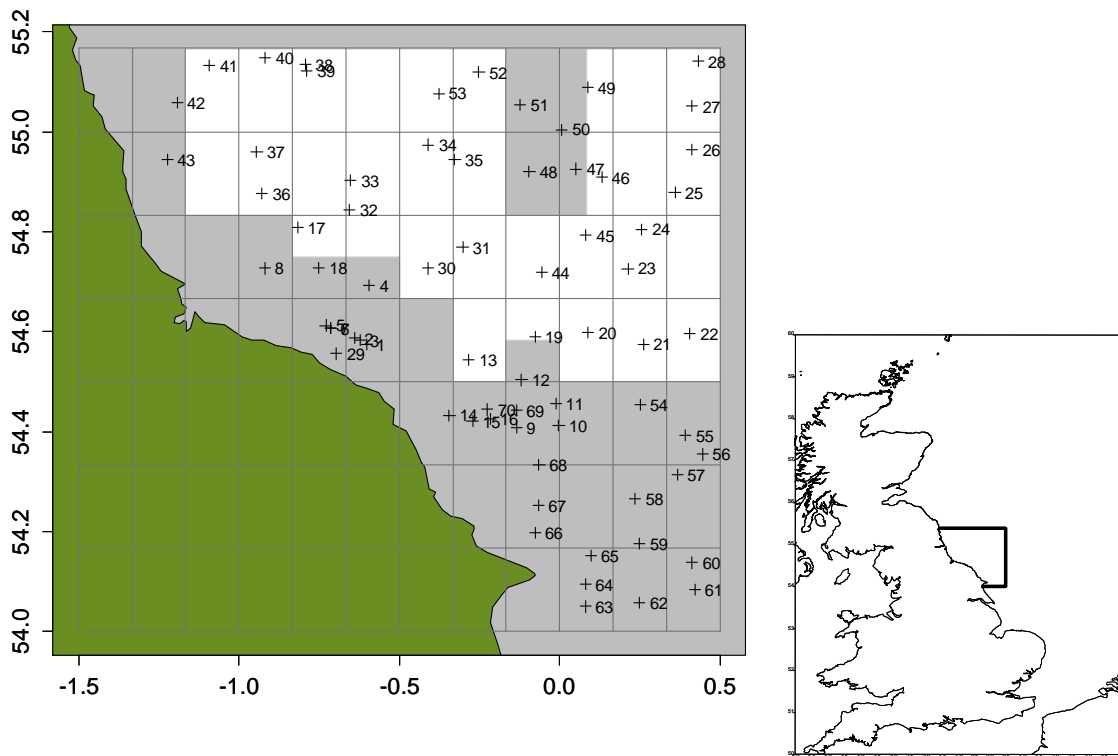


Figure 1 FSP NE cod survey in 2012: tow midpoint positions and numbers. The shaded area within the grid lines in this and subsequent plots represents hard ground, and the non-shaded area soft ground. Ground types are inferred from sediment charts and skipper’s knowledge. Note that, for ease of plotting, the grid pattern for 2012 in this and subsequent plots is kept consistent with that of previous surveys, but the survey design in 2012 was actually based on the grid pattern shown in Appendix 1.

Catch compositions

As in previous years, the largest catches in 2012 by weight were whiting, haddock and cod (Table 2), which together constituted 71% of the total estimated weight of fish taken during

the survey. The total catch weight of these three species combined was 20% less than in 2011, with whiting, haddock and cod down 10%, 26% and 28%, respectively. Lemon sole, dab, plaice, herring and grey gurnard made up a further 22% of the total catch weight in 2012, so together with the three target species constituted 93% of the total catch weight.

Table 2. Total estimated catch numbers and catch weight of fish species recorded during the 2012 NE cod survey. Percentages are also shown. Equivalent catch weights from the 2011 FSP are given.

Species	Total number in 2012	%	Total weight in 2012 (kg)	%	Total weight in 2011 (kg)
Whiting	43 822	42.6	10 234	33.4	11 417
Haddock	14 702	14.3	7 987	26.0	10 812
Cod	3 028	2.9	3 626	11.8	5 011
Lemon sole	10 653	10.4	2 213	7.2	1 235
Dab	11 988	11.7	1 791	5.8	1 162
Plaice	4 288	4.2	1 043	3.4	871
Herring	***	–	960	3.1	482
Grey gurnard	7 547	7.3	814	2.7	638
Mackerel	1 913	1.9	534	1.7	131
European lobster	***	–	314	1.0	115
Bib	1 614	1.6	302	1.0	1 031
Long rough dab	1 356	1.3	175	0.6	60
Common squids	***	–	114	0.4	250
Red gurnard	667	0.6	99	0.3	22
Edible crab	124	0.1	69	0.2	15
Common ling	37	0.0	44	0.1	39
Poor cod	577	0.6	41	0.1	282
European hake	42	0.0	41	0.1	100
Anglerfish	17	0.0	32	0.1	103
Bullheads and sculpins	151	0.1	31	0.1	–
Lesser spotted dogfish	44	0.0	30	0.1	23
Spotted ray	26	0.0	30	0.1	49
Saithe	25	0.0	21	0.1	11
Thornback ray	9	0.0	16	0.1	25
Tub gurnard	34	0.0	14	0.0	8
Cuckoo ray	11	0.0	12	0.0	3
Halibut	1	0.0	11	0.0	–
Tope shark	2	0.0	11	0.0	40
Sole	33	0.0	11	0.0	14
John Dory	12	0.0	9	0.0	5
Brill	10	0.0	8	0.0	21
Horse mackerel	24	0.0	8	0.0	53
Witch	29	0.0	7	0.0	6
Wrasses	6	0.0	6	0.0	–
Red mullet	22	0.0	6	0.0	8
Blonde ray	1	0.0	5	0.0	–
Pollack	2	0.0	4	0.0	3
Starry smoothhound	1	0.0	2	0.0	5
Turbot	1	0.0	2	0.0	13
Other	0	0.0	0	0.0	24
TOTAL	102 819		30 677		34 086

***For these species, numbers caught were not available, either for all or part of the retained or discarded catch.

Distribution patterns

Distribution maps for cod, haddock, whiting, plaice and lemon sole are provided in Figures 2–7. The plots all have the same scale relating the surface area of the symbols (spots) to numbers caught per hour.

COD

Small cod <21 cm long (0-group fish), spawned in spring of the same year as the survey, were caught mainly in the northwestern corner of the survey area in 2005, but were less evident in 2006, absent or near-absent in 2007, 2008, 2010 and 2011, and caught in 23% of stations scattered throughout the survey area, but in small numbers, in 2009 (Figures 2a-b, top row). The presence of such small fish in the 2005 survey mirrored the very high densities of 0-group cod recorded along the east coast of Scotland in the North Sea IBTS quarter-3 and Scottish quarter-4 groundfish surveys (ICES Datras database; ICES–WGNSK, 2006), a pattern that has not been repeated since. This feature provided the first indications of a relatively strong 2005 year class.

The bulk of the FSP cod catches in 2005–2012 were fish 21–45 cm long, i.e. mainly 1-year-olds, which were most abundant on the inshore hard ground (Figures 2a-b, middle row). Catch rates of cod in this length range were generally better in 2006 than in the other years (see also Figure 8a), owing to the relative strength of the 2005 year class. Catch rates of 21–45 cm cod were particularly low in 2012.

Cod >45 cm long (mainly 2-year-olds and older) were most abundant at the more offshore tows on the hard ground in the southern part of the survey area in 2005–2007, but closer inshore towards the south in 2008, and more evenly spread over the hard ground from 2009 to 2012 (Figure 2a-b, bottom row). There were one or two relatively high-density hauls offshore on soft ground in the upper half of the survey area in 2012.

Cod catches on the soft ground were patchy and often very small. The small offshore patch of hard ground in the northeast part of the survey area had a catch rate of cod similar to that on the surrounding soft ground.

Comparison of cod distribution patterns between FSP surveys in 2003 and 2004 with those in 2005–2012 is restricted largely to the coastal area of hard ground area, where most of the Whitby Jet otter trawl tows in 2003 and 2004 were carried out (Figure 3). The 2005–2012 surveys yielded more complete coverage of the hard ground, but all surveys show the best overall catch rates of cod at stations close to the coast.

A statistical analysis of the impact of soft vs. hard grounds on catch rates of cod using identical gear configuration, based on data from this FSP survey time-series (2003–2008), was included in an EU project on joint data collection between scientists and the fishing industry (Darby *et al.*, 2009). That project concluded that catches of cod on soft ground are, generally, significantly smaller than those recorded on hard ground, but that there is no difference between trends on the hard and soft grounds.

HADDOCK

The distribution of haddock in the FSP surveys has been quite different from that of cod, with more patchy and often very low catch rates on the inshore hard ground, and consistently better catch rates on the offshore soft and hard grounds (Figure 4). Although there were fewer offshore tows using the Whitby Jet trawl in 2003 and 2004, a generally similar pattern to that of 2005–2012 is evident. The increased abundance of small haddock in 2006 also coincided with an extension of the distribution into the coastal hard ground, but catch rates remained low in the tows made closest to the coast. In 2007–2012 the distribution had become more offshore again.

WHITING

Catch rates of whiting were relatively high during all surveys from 2005 to 2009 and in 2011 to 2012, but lower in 2010. The distribution pattern in 2005 was similar to that of cod, with catch rates best on the inshore hard ground (Figure 5). From 2006 to 2008 and 2011 to 2012, whiting were more evenly spread out over the survey area, but in 2009 the best catch rates were again on inshore hard ground, as in 2005. In 2010, lower catch rates were recorded, and they were similar on the inshore hard ground and the soft ground farthest from the coast. The numbers of whiting caught in 2003 and 2004 were much smaller than in subsequent years, but were highest on some of the hard-ground tows close to the coast.

LEMON SOLE AND PLAICE

Lemon sole and plaice were in the top seven most abundant species in the total survey catch (by weight) in the 2005–2012 surveys, and were widespread across the survey area, but with no particular centre of distribution (Figures 6 and 7), although larger numbers of lemon sole were caught on inshore hard ground in the central to southern areas in the years 2008–2012. There was a tendency for the catch rates of both species to be relatively low in the northwestern part of the survey area and in the inshore southeastern part for plaice during all surveys.

Length and age compositions

COD

The average length frequencies of cod (in numbers caught per hour towed) in the FSP surveys in 2003–2012 have typically shown a dominance of fish ~30–45 cm long (Figure 8a), although a peak at this length range was not evident in 2012. A mode of 0-group cod <20 cm long was evident in 2005. Catch rates of cod >30 cm were better on the hard ground than on the soft ground in the 2005–2011 surveys (Figure 8b), but not in 2012.

The survey in 2003 indicated a dominance of 2-year-olds (2001 year class), whereas subsequent surveys were dominated by 1-year-olds, particularly in 2006 (Figure 9, Table 3). A relatively strong 2005 year class of cod is demonstrated by the elevated catch rates of 0-group fish in 2005, 1-group fish in 2006, and 2-group fish in 2007, and also by some other FSP surveys in the region (e.g. Large *et al.*, 2009). Overall, the catch rates in 2012 were below average for the series in terms of both total numbers (well below in this case) and total weight (Tables 3 and 6).

HADDOCK

Until 2009, length compositions of haddock were dominated by fish of the 2005 year class, but the distribution of the 2009 year class changed from a peak at >35 cm in 2009 to one at <30 cm in 2010, around 35 cm in 2011, and >35 cm in 2012 (Figure 10a). The general shape of the length compositions was similar on both hard and soft ground in the years 2005–2007, with more haddock on soft ground, but length compositions shifted towards larger haddock on hard ground than on soft ground in 2008–2009, indicating that larger fish were more abundant on hard ground and smaller fish on soft ground (Figure 10b). From 2010 to 2012, more haddock were once again found on soft ground.

The 1999 year class of haddock was strongly represented as 5-year-olds in 2004, 6-year-olds in 2005, and as fish 7+ years old in 2006 and 2007, but almost disappeared after 2007 (Figure 11, Table 4). The most prominent signal, however, is the strong 2005 year class of haddock, indicated by very high catch rates of 1-year-olds in 2006, 2-year-olds in 2007, 3 year-olds in 2008, 4 year-olds in 2009 and 5 year-olds in 2010. This year class was also present (in small numbers) as 0-group fish during the 2005 survey. Another relatively strong year class, that of 2009, first indicated by elevated levels of 1-year-olds in 2010, has now been confirmed by high levels of 2-year-olds in 2011 and 3-year-olds in 2012. Total catch rates of haddock (kg per h) in this short FSP time-series were lowest in 2003 and highest in 2011 (Table 6).

WHITING

Until 2007, the length compositions of whiting in FSP surveys always showed the same length mode, with a peak around 30 cm, but this mode shifted to the left with a peak around 25 cm in 2008 as a result of the 2007 year class, and shifted to >30 cm in 2010 (Figure 12a). The distribution in 2011 to 2012 was broader than in other years, but with a peak once more at ~30 cm in 2011, and a bimodal peak either side of 30 cm in 2012. Both the length composition and overall catch rate of whiting were similar on the hard and soft ground in 2006, 2007 and 2010 (Figure 12b). In 2005, catch rates on the hard ground were much higher than on the soft ground, although this finding is strongly influenced by two very large catches on hard ground (Figure 5). Catch rates of whiting were better on soft ground in 2008 and 2012, but better on hard ground in 2009 (as in 2005). The general shape of the length compositions was similar for the two ground types, except in 2011 where larger fish appeared to be more abundant on hard ground and smaller fish on soft ground (Figure 12b).

The age composition of whiting shows a consistent progression of modes following interannual trends in recruitment (Figure 13, Table 5). Catches in 2004 showed a substantial contribution of whiting 3–5 years old (the 1999–2001 year classes). These were also evident as 4–6-year-old fish in 2005, 5 years and older fish in 2006, 6 years and older fish in 2007, and fish 7+ years old in the years 2008–2010 (Figure 13, Table 5). The notable increase in catch rates since 2005 (Table 6) is due in large measure to the occurrence of these year classes of whiting as older fish. A prominent feature in recent surveys is the high catch rates of 1-year-old fish in 2008 and 2-year-old fish in 2009, 4-year-old fish in 2011, and 5-year-old fish in 2012, although catch rates of 3-year-old fish were notably lower in 2010 (Figure 13, Table 5); they indicate that the 2007 year class has been generally strong in the survey area. Therefore, although the overall catch rates by numbers and weight declined over the period 2005–2007 as the older whiting were removed by fishing and

natural mortality, they increased again in 2008 and 2009 with the enhanced contribution of the 2007 year class, and again in 2011 following lower levels in 2010 (Table 6).

Table 3. Summary of mean catch rates of cod (number caught per hour), by age class and FSP survey.

(a) Mean number per hour

Year	Age 0	age 1	age 2	age 3	age 4	age 5	TOTAL
2003	0.00	24.48	38.00	0.50	0.46	0.15	63.6
2004	0.00	21.87	5.87	3.06	1.00	0.00	31.8
2005	2.65	23.69	6.81	0.96	0.12	0.00	34.2
2006	0.29	54.44	9.36	1.10	0.59	0.06	65.8
2007	0.00	22.00	18.29	1.75	0.00	0.00	42.0
2008	0.01	16.04	9.07	1.95	0.09	0.00	27.2
2009	0.63	34.11	11.45	0.87	0.08	0.03	47.2
2010	0.00	29.68	7.23	0.68	0.26	0.09	37.9
2011	0.00	28.60	12.87	1.14	0.14	0.02	42.8
2012	0.09	9.63	9.58	1.95	0.22	0.03	21.5

(b) Percentage

Year	Age 0	age 1	age 2	age 3	age 4	age 5	TOTAL
2003	0.0	38.5	59.8	0.8	0.7	0.2	100
2004	0.0	68.8	18.5	9.6	3.1	0.0	100
2005	7.7	69.2	19.9	2.8	0.4	0.0	100
2006	0.4	82.7	14.2	1.7	0.9	0.1	100
2007	0.0	52.3	43.5	4.2	0.0	0.0	100
2008	0.0	59.0	33.4	7.2	0.3	0.0	100
2009	1.3	72.3	24.3	1.8	0.2	0.1	100
2010	0.0	78.2	19.1	1.8	0.7	0.2	100
2011	0.0	66.9	30.1	2.7	0.3	0.1	100
2012	0.4	44.8	44.6	9.1	1.0	0.1	100

Table 4. Summary of mean catch rates of haddock (number caught per hour), by age class and FSP survey.

(a) Mean number per hour

Year	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7+	Total
2004	0.0	1.1	12.8	0.0	3.0	25.9	0.3	0.0	43
2005	1.8	12.3	9.0	14.6	3.6	2.8	31.3	0.0	76
2006	0.3	159.8	10.7	12.1	5.4	1.7	5.4	3.7	199
2007	0.0	13.0	137.5	6.4	0.8	1.6	0.1	4.6	164
2008	0.3	5.9	16.8	75.0	2.6	1.9	0.4	0.1	103
2009	0.1	3.7	7.5	25.0	27.7	0.2	0.3	0.2	65
2010	0.1	52.4	9.2	6.1	7.7	17.9	2.1	0.9	96
2011	0.0	9.3	123.0	16.0	6.1	12.0	8.1	0.3	175
2012	0.0	2.5	11.3	79.8	3.7	3.2	3.8	4.5	109

(b) Percentage

Year	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7+	Total
2004	0.0	2.6	29.6	0.0	7.0	60.1	0.7	0.0	100
2005	2.4	16.3	11.9	19.4	4.8	3.8	41.4	0.0	100
2006	0.1	80.3	5.4	6.1	2.7	0.9	2.7	1.9	100
2007	0.0	8.0	83.9	3.9	0.5	1.0	0.0	2.8	100
2008	0.3	5.8	16.3	72.8	2.5	1.8	0.3	0.1	100
2009	0.2	5.7	11.6	38.6	42.8	0.4	0.5	0.3	100
2010	0.1	54.3	9.6	6.3	8.0	18.6	2.1	1.0	100
2011	0.0	5.3	70.4	9.1	3.5	6.9	4.6	0.2	100
2012	0.0	2.3	10.4	73.3	3.4	2.9	3.5	4.2	100

Table 5. Summary of mean catch rates of whiting (number caught per hour), by age class and FSP survey.

(a) Mean number per hour									
Year	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7+	Total
2004	0.0	2.5	14.1	26.7	16.4	9.9	3.2	1.3	74
2005	2.4	26.7	19.9	31.0	166.5	109.9	55.6	24.0	436
2006	0.1	31.3	48.1	17.5	11.6	97.0	45.4	42.7	294
2007	0.0	21.1	32.2	55.7	5.4	11.6	53.4	39.0	218
2008	0.7	159.8	59.3	36.1	30.8	2.9	4.6	20.8	315
2009	0.4	55.8	254.1	79.2	39.9	19.0	0.8	15.6	465
2010	0.0	24.3	32.6	67.0	38.8	18.2	5.5	10.2	197
2011	0.0	78.5	71.1	57.7	117.7	25.6	16.7	3.2	370
2012	0.0	50.9	81.2	55.7	20.7	87.2	16.1	7.0	319

(b) Percentage									
Year	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7+	Total
2004	0.0	3.3	19.0	36.1	22.2	13.3	4.3	1.7	100
2005	0.5	6.1	4.6	7.1	38.2	25.2	12.7	5.5	100
2006	0.0	10.7	16.4	6.0	3.9	33.0	15.4	14.6	100
2007	0.0	9.6	14.7	25.5	2.5	5.3	24.5	17.8	100
2008	0.2	50.7	18.8	11.5	9.8	0.9	1.5	6.6	100
2009	0.1	12.0	54.7	17.0	8.6	4.1	0.2	3.4	100
2010	0.0	12.3	16.6	34.1	19.7	9.3	2.8	5.2	100
2011	0.0	21.2	19.2	15.6	31.8	6.9	4.5	0.9	100
2012	0.0	16.0	25.5	17.5	6.5	27.4	5.0	2.2	100

Table 6. Summary of mean numbers and weight caught per hour, for all size classes of cod, haddock and whiting during the 2003–2012 FSP surveys.

(a) Numbers per hour										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cod	64	32	34	66	42	27	47	38	43	21
Haddock	34	43	76	199	164	103	65	96	175	109
Whiting	88	74	436	294	218	315	465	197	370	319

(b) kg per hour										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cod	53	27	23	38	31	25	32	28	36	27
Haddock	18	23	36	58	58	46	33	36	82	59
Whiting	19	16	101	66	53	59	97	45	82	74

Linkages between species

Catch rates of cod, haddock and whiting are patchy, and can vary considerably over relatively small distances. Plots of the catch rate of one species against that of another therefore show no relationship at the scale of individual tows (Figure 14).

The distribution maps for cod and haddock (Figures 2–4) clearly show that cod and haddock off the NE coast have different distribution patterns at a larger scale than the distance between tows. Vessels targeting haddock (or other species) on the soft-ground stations offshore during autumn would have lower catch rates of cod than those fishing on the hard ground closer to the coast.

In contrast to haddock, the larger-scale distribution of whiting has generally been similar to that of cod during the NE cod FSP surveys (Figures 2, 3 and 5). Any vessels targeting whiting on the inshore hard-ground stations would be likely to take a bycatch of cod unless

they were specifically able to target whiting in very restricted localities where cod were not present at the time.

Comparison with ICES results

The population of cod in the survey area determined by this FSP survey annually has primarily been 1- and 2-year-olds, with some 3- and 4-year-olds (Figure 9); older fish have been scarce. The relative strength of recent year classes of cod, as indicated by the time-series of FSP catch rates of 1-year-olds, has been similar to the trends given by the most recent ICES assessment (ICES–WGNSSK, 2012; Figure 15), arguably showing closer agreement than the 1-group indices for the whole North Sea from the ICES International Bottom Trawl Survey (IBTS) programme (ICES–WGNSSK, 2012), but year-class signals are divergent for all indices since the 2007 year class, and particularly in the final year, with a decline for the FSP estimate and increases for all the other estimates. All series indicate that the 2006 and 2007 year classes are roughly the same size and about half as abundant as the relatively strong 2005 year class. The “Codwatch” FSP project (www.cefas.co.uk/fsp) mapped the distribution of young cod of the 2005–2008 year classes using a fisher self-sampling scheme, and from a comparison of data for 1-year-olds in Q1 of 2007, 2008 and 2009, suggested that the 2006, 2007 and 2008 year classes of cod may all have been of comparable strength (Large *et al.*, 2009), and not particularly strong. The 2009 year-class peak in the ICES assessment, also reflected in the IBTS Q1 survey, is not evident in the FSP survey.

Haddock are widely distributed over the northern North Sea, and the FSP survey area covers just a small part of the range of the stock. It is possible that haddock become abundant off the NE coast of England when strong year classes are formed and that the geographic range of the stock expands as a consequence. Strong recruitment events should therefore show up prominently in the FSP data, and this is confirmed in Figure 15 for the strong 2005 and 2009 year classes. FSP results are consistent with those of the ICES assessment, indicating a series of poor recruitments following 2005, with stronger recruitment again in 2009, which was subsequently followed by poor recruitment in 2010 and 2011 (ICES–WGNSSK, 2012).

For whiting, all series (ICES assessment, FSP survey, IBTS quarters 1 and 3) indicate that the 2003–2006 year classes were weak, and information available for the 2002 year class indicates that it too was weak. These weak year classes followed several comparatively strong ones around the years 1998–2001 (ICES–WGNSSK, 2012) and explains the dominance of older whiting in the FSP catches (Figure 13). The ICES assessment and FSP survey both indicate a strong 2007 year class relative to the preceding weak ones, but there is less agreement with the IBTS surveys.

The ICES assessment indicates a decline in spawning-stock biomass of whiting in the North Sea as a whole prior to the arrival of the 2007 year class (ICES–WGNSSK, 2012), whereas the FSP NE coast survey and English fishery catch rates on the NE coast indicate an increase in the abundance of older whiting since 2005 (Tables 5, 6). This is suggestive of a localized aggregation of adult whiting along the NE coast. The results of the time-series of annual North Sea Commission Fisheries Partnership Stock Surveys, giving fishers’ perceptions of relative trends in abundance of commercial fish species in different parts of the North Sea, also demonstrated that the trend of increasing whiting abundance prior to the

arrival of the 2007 year class was a phenomenon restricted to the NE coast area and the southern North Sea (Laurenson, 2008).

Discussion

The NE coast cod FSP project provides an intensive survey of a distinct fishing ground that covers a relatively small part of the overall distribution of cod, whiting and haddock in the North Sea. However, the area is of considerable importance for fishers working out of ports on the NE coast of England, and who are affected by management decisions made in the context of the entire North Sea fishery. The NSCFP stock survey (Laurenson, 2008; Napier, 2010) and data from large-scale trawl surveys using research vessels show regional differences in trends in fish abundance, particularly for whiting. This can lead to localized problems in managing mixed fisheries. Locally intensive trawl surveys, as carried out by this FSP project, using fishing gears typical of the fisheries, can provide valuable information on changes in abundance, distribution and species mixing affecting distinct, but localized, sectors of the fishing industry.

The 2005–2007 charter of *Emulator* and 2008–2012 charter of *Abbie Lee* specifically address the establishment of time-series data on abundance, age composition and distribution of cod and whiting off the NE coast of England, as well as providing data on other important species such as haddock. Similar FSP surveys of NE coast cod were carried out in 2003 and 2004 using the Whitby Jet otter trawl (Armstrong *et al.*, 2004; Cotter *et al.*, 2004). However, those projects had competing objectives, including comparison of catches using different gears and demonstration of day–night differences in catch rate. The focus on the survey element in the years 2005–2012 allowed greater coverage of the fishing grounds off the NE coast, and this proved highly successful in providing the most comprehensive set of data obtained so far on distribution, abundance and population structure of cod, whiting and haddock throughout this particular area.

The survey was originally designed to provide a compromise between the scientific requirement to provide full coverage of the potential habitats for cod off the NE coast, and industry's desire to demonstrate catch rates and catch compositions on the main fishing grounds. This was achieved by a two-stage design consisting of a broad geographic spread of tows (two per 10' latitude \times 20' longitude rectangle in the 2008–2012 surveys), and an additional tow in each rectangle in areas of hard ground identified by the vessel owner during the charter of *Emulator* as being the main habitat of cod in this region of the North Sea.

Some of the features of the cod, haddock and whiting populations given by ICES data for the North Sea as a whole are reflected in these FSP results for the NE coast. These include the relatively abundant 2005 year classes of cod and haddock, the large but declining contribution to catches of the 1999 year class of haddock since 2004, and more recently the stronger year classes of whiting in 2007 and haddock in 2009 relative to the preceding weak ones.

The indications of very poor recruitment of whiting from the 2002–2006 year classes has been reflected by a dominance of older whiting in the FSP catches until 2007. The increased abundance of whiting off the NE coast since 2005 has been a particularly strong signal, and it appears to reflect localized aggregation of older whiting from the 2001 and

earlier year classes along the NE coast, despite an apparent decline in abundance of adult whiting in the North Sea as a whole prior to the arrival of the 2007 year class. It has been inevitable that vessels targeting other demersal species in the area covered by the FSP survey have taken large bycatches of whiting, which has led to quota-uptake problems since 2005. The 2007 year class was abundant in the survey area in 2008 and 2009, and again in 2011 and 2012, with increased catch rates at age 1 in 2008, age 2 in 2009, age 4 in 2011 and age 5 in 2012, although catch rates at age 3 in 2010 were rather lower than expected given the previous and subsequent strong presence of this year class; this finding may be coincident with industry reports of up to a dozen French vessels operating off Flamborough Head targeting whiting throughout summer 2010.

Cod taken during the FSP surveys have been dominated by young fish 1–3 years old, which are likely to be mainly immature. The owner of the *Emulator* advised in 2006 that catches of cod >4 years old are more likely to be taken farther offshore than 50 miles. The main catches of big cod taken by Grimsby pair-teams during the 1970s, 1980s and 1990s were taken well offshore, implying that the current NE coast FSP survey area is mainly a juvenile area for cod.

Immature cod up to 3 years old mostly do not participate in spawning migrations, so are likely to remain in and around the hard ground throughout the year, to feed. Seasonal feeding aggregations can be found, for example, on patches of autumn-spawning herring. Subsequent dispersal of cod may reduce the catch rates at such feeding “hotspots”, but it is likely that immature fish then redistribute within the FSP survey area, with relatively few moving a long distance away from the area.

Cod have been maturing at progressively smaller sizes in the North Sea, and Yoneda and Wright (2004) showed that 75% of cod caught in Scottish inshore waters of the North Sea in the early 2000s were mature at a length of 50 cm. This implies that some cod along the east coast of the UK are now mature at 2 years of age and that a large proportion of 3-year-olds are mature. A significant portion of the 2005 year class of cod may therefore have migrated to offshore spawning sites, reducing their availability to inshore fishing vessels. This is one possible reason for the diminished contribution of the 2005 year class to FSP catches from 2008 on.

Of particular interest for implementation of management measures is how the coastal fisheries off the NE coast will be affected in the coming year by recent changes in year-class strength of the fish. The relative strength of the 2005 year class of cod led to a marked increase in availability of cod along the NE coast, causing quota-uptake and discarding problems, but that year class now no longer features in FSP catches. Although the ICES assessment estimates the 2009 year class of cod to be almost as strong as the 2005 year class, this has not been seen yet in the FSP survey results for this small survey area, which indicates that the 2008–2010 year classes were of a similar size, but smaller than the 2005 year class. The FSP survey estimates the 2011 year class to be the smallest in the time-series, contradicting the results of the ICES assessment, which show it as about the same size as the 2005 year class.

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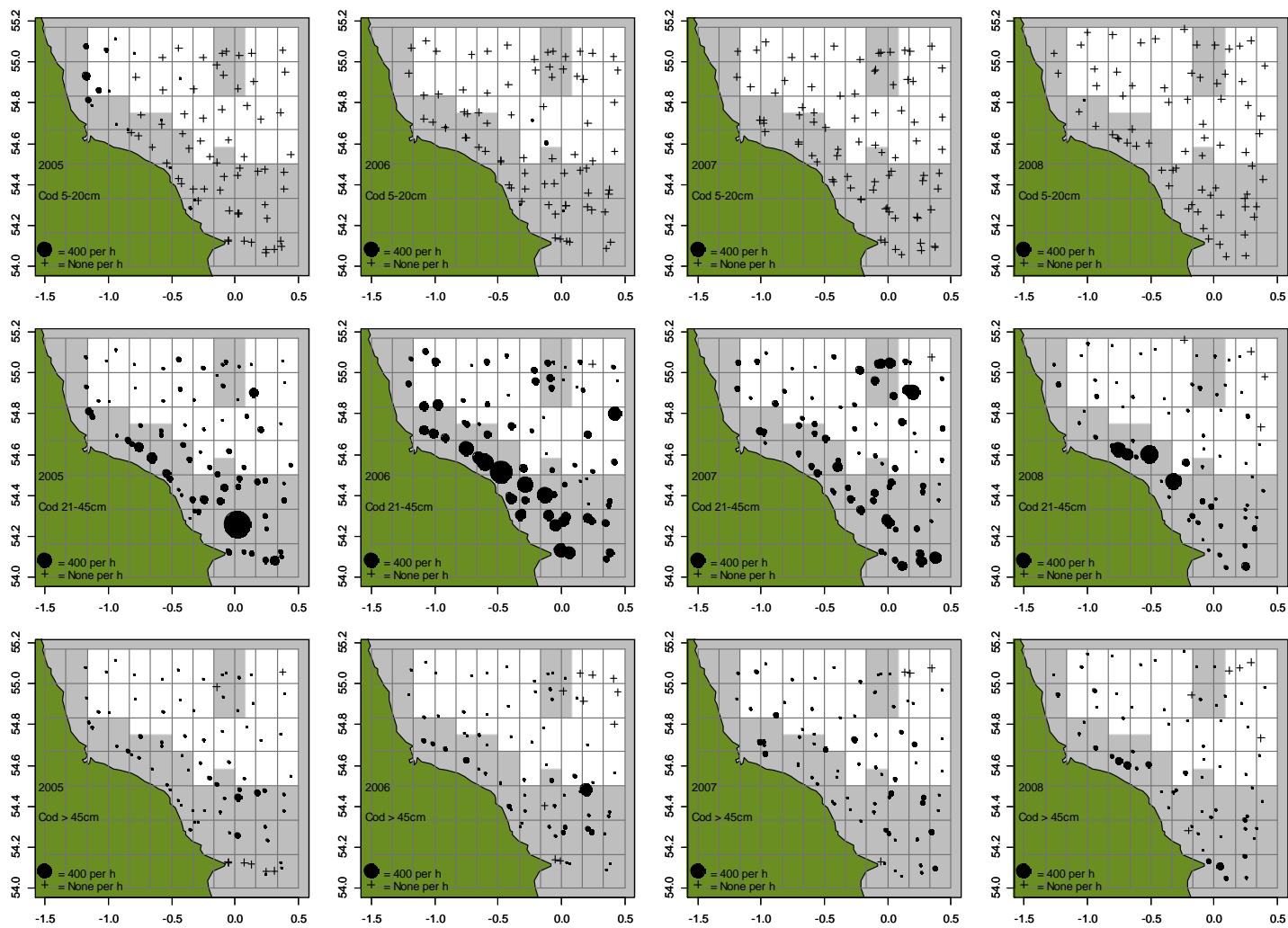


Figure 2a Distribution patterns of cod in three length ranges, 2005–2008. Sizes of spots (surface area) are proportional to the numbers caught per hour. Crosses indicate station positions. Same scale for all plots. Shaded areas represent “hard ground”.

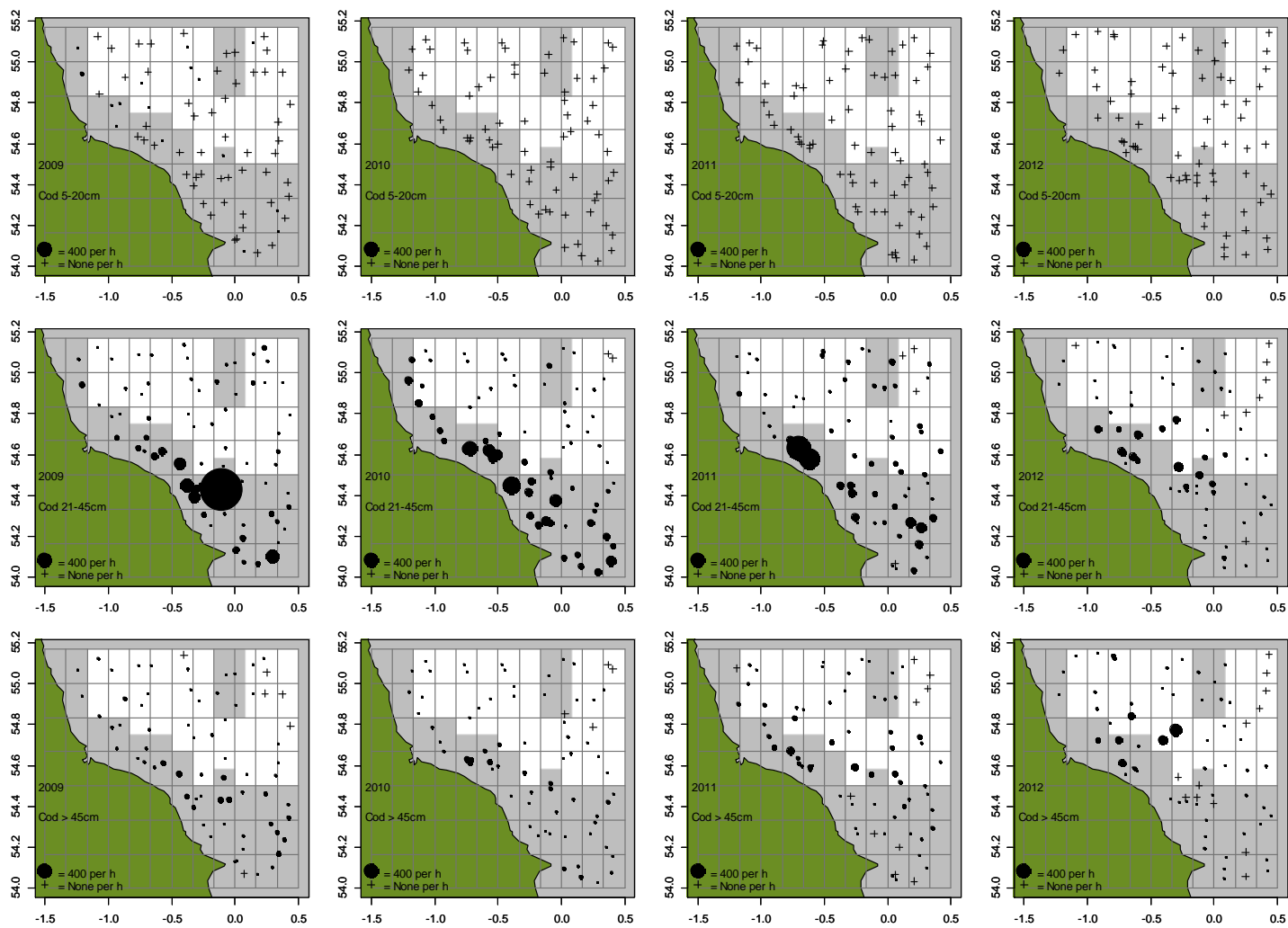


Figure 2b Distribution patterns of cod in three length ranges, 2009–2012. Sizes of spots (surface area) are proportional to the numbers caught per hour. Crosses indicate station positions. Same scale for all plots. Shaded areas represent “hard ground”.

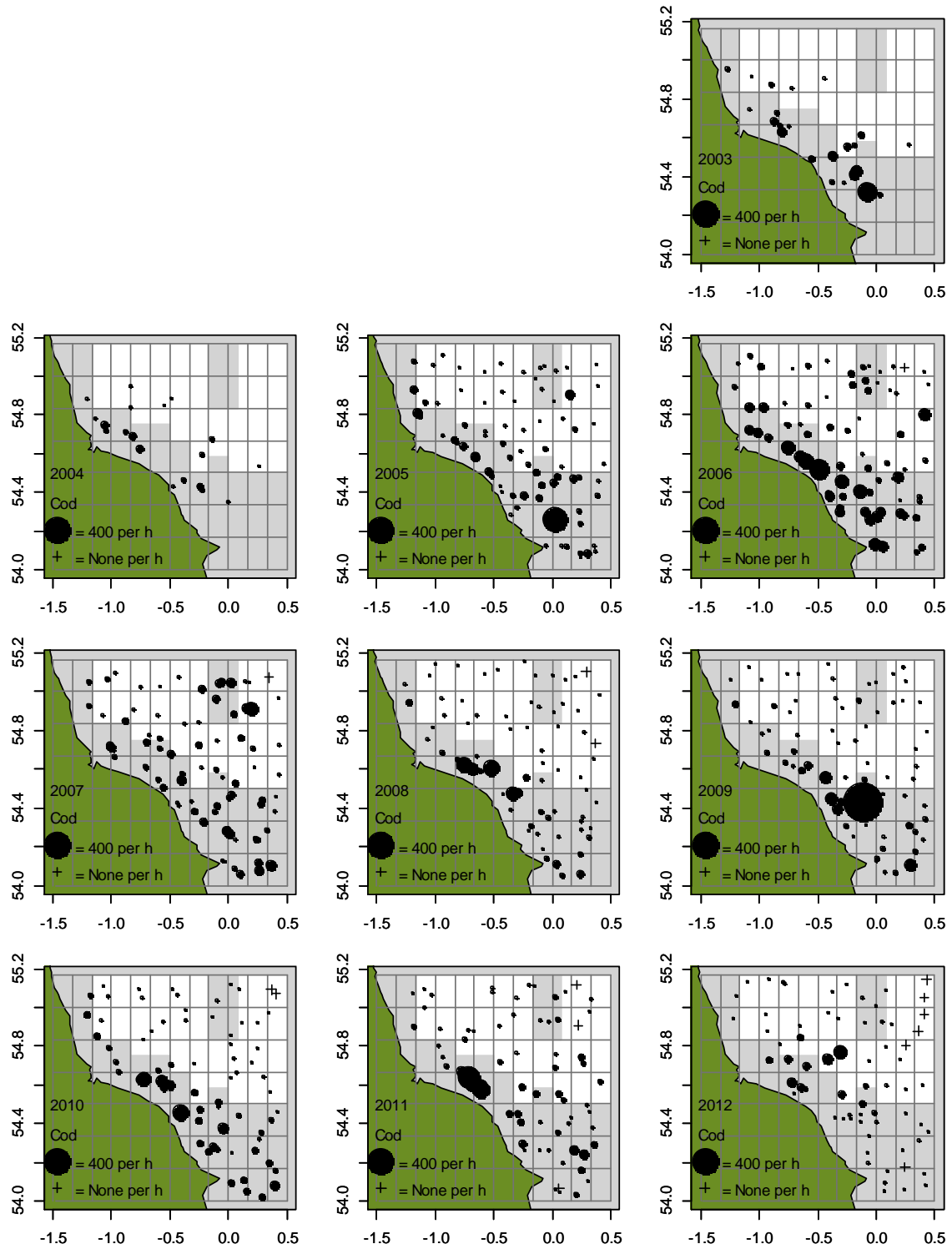


Figure 3 Distribution patterns of cod (all lengths) in the 2003–2012 NE cod FSP surveys. Sizes of spots (area) are proportional to numbers caught per hour. Crosses indicate station positions. Same scale for all plots. Shaded areas represent “hard ground”.

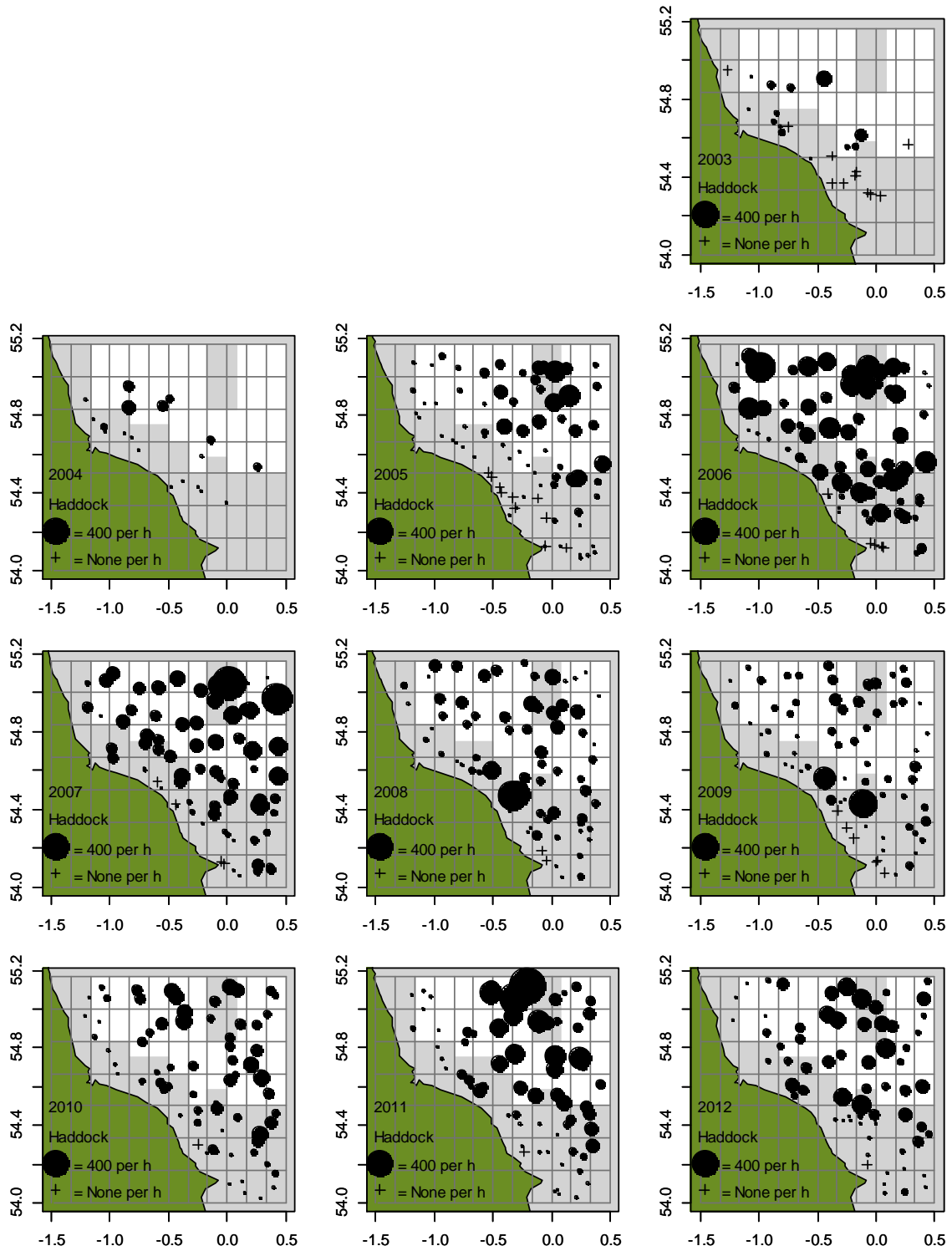


Figure 4 Distribution patterns of haddock (all lengths) in the 2003–2012 NE cod FSP surveys. Sizes of spots (area) are proportional to numbers caught per hour. Crosses indicate station positions. Same scale for all plots. Shaded areas represent “hard ground”.

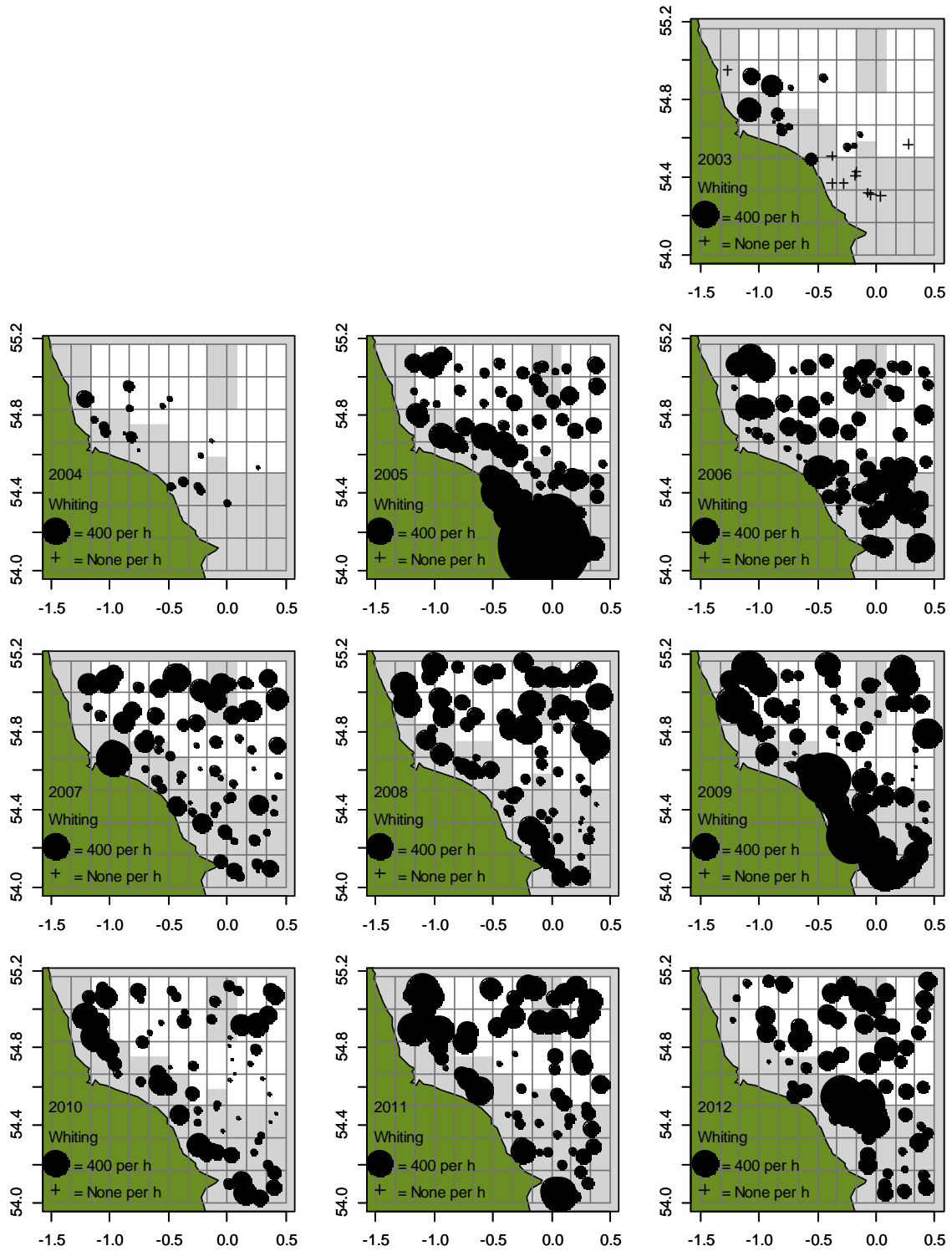


Figure 5 Distribution patterns of whiting (all lengths) in the 2003–2012 NE cod FSP surveys. Sizes of spots (area) are proportional to numbers caught per hour. Crosses indicate station positions. Same scale for all four plots. Shaded areas represent “hard ground”.

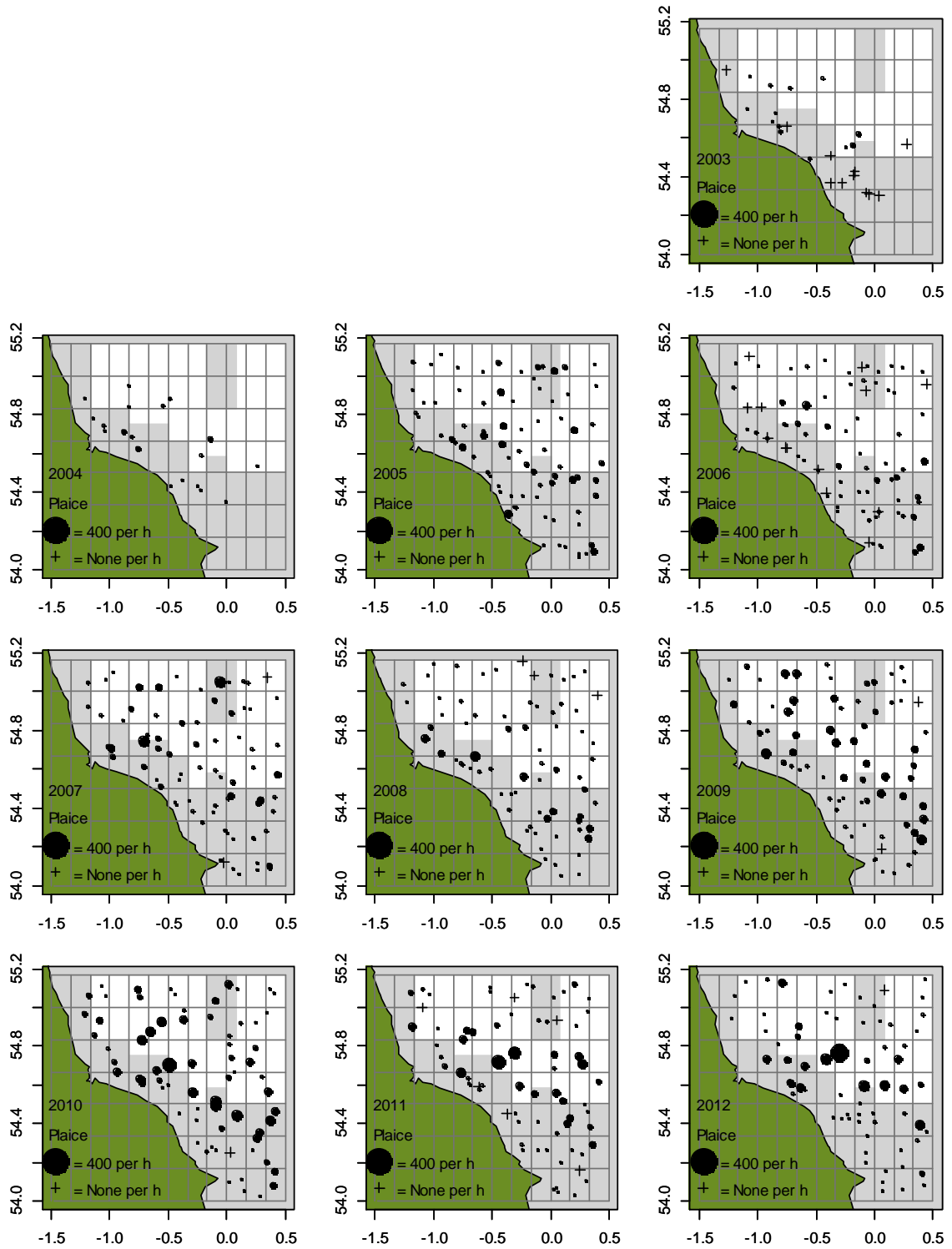


Figure 6 Distribution patterns of plaice (all lengths) in the 2003–2012 NE cod FSP surveys. Sizes of spots (area) are proportional to numbers caught per hour. Crosses indicate station positions. Same scale for all plots. Shaded areas represent “hard ground”.

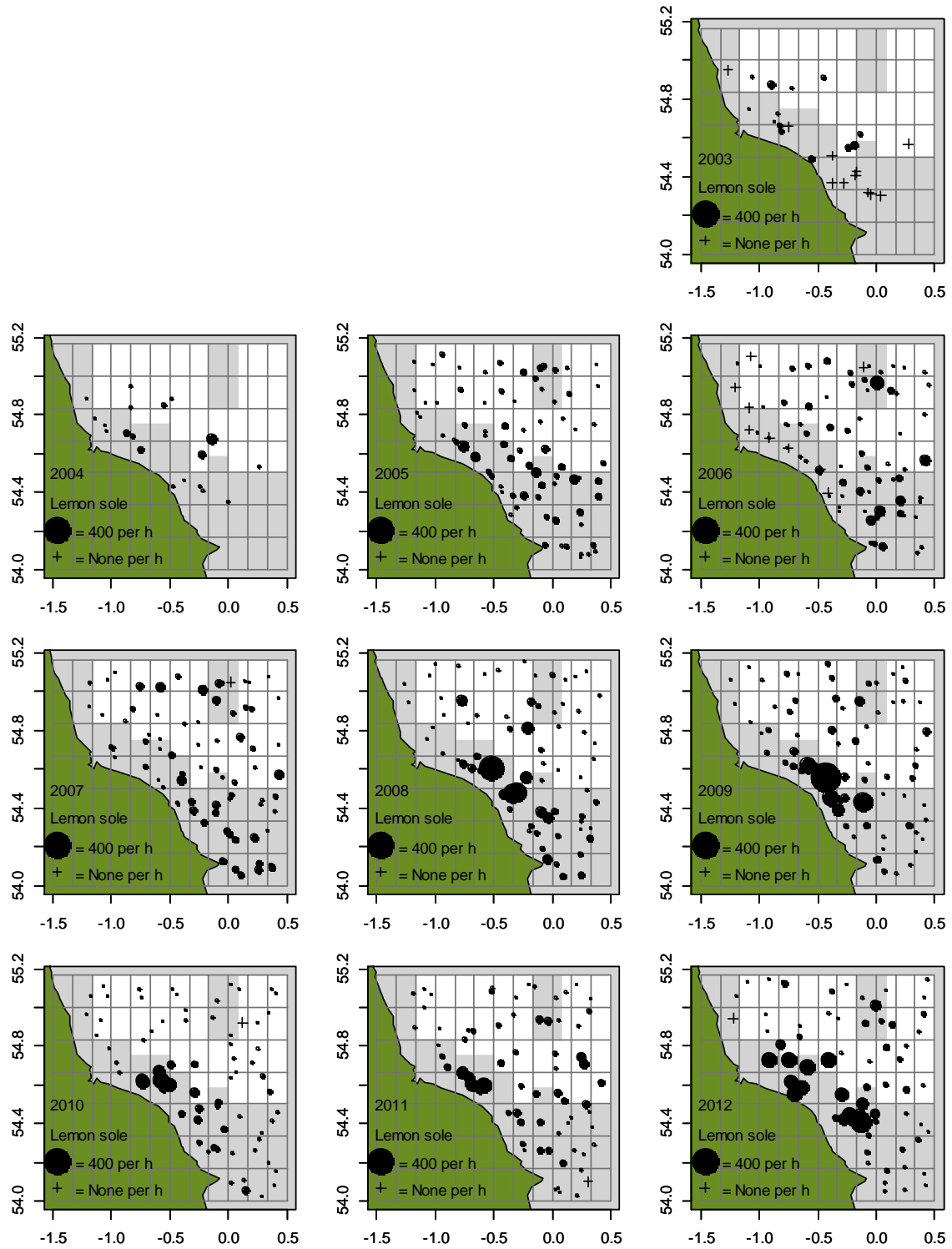


Figure 7 Distribution patterns of lemon sole (all lengths) in the 2003–2012 NE cod FSP surveys. Sizes of spots (area) are proportional to numbers caught per hour. Crosses indicate station positions. Same scale for all plots. Shaded areas represent “hard ground”.

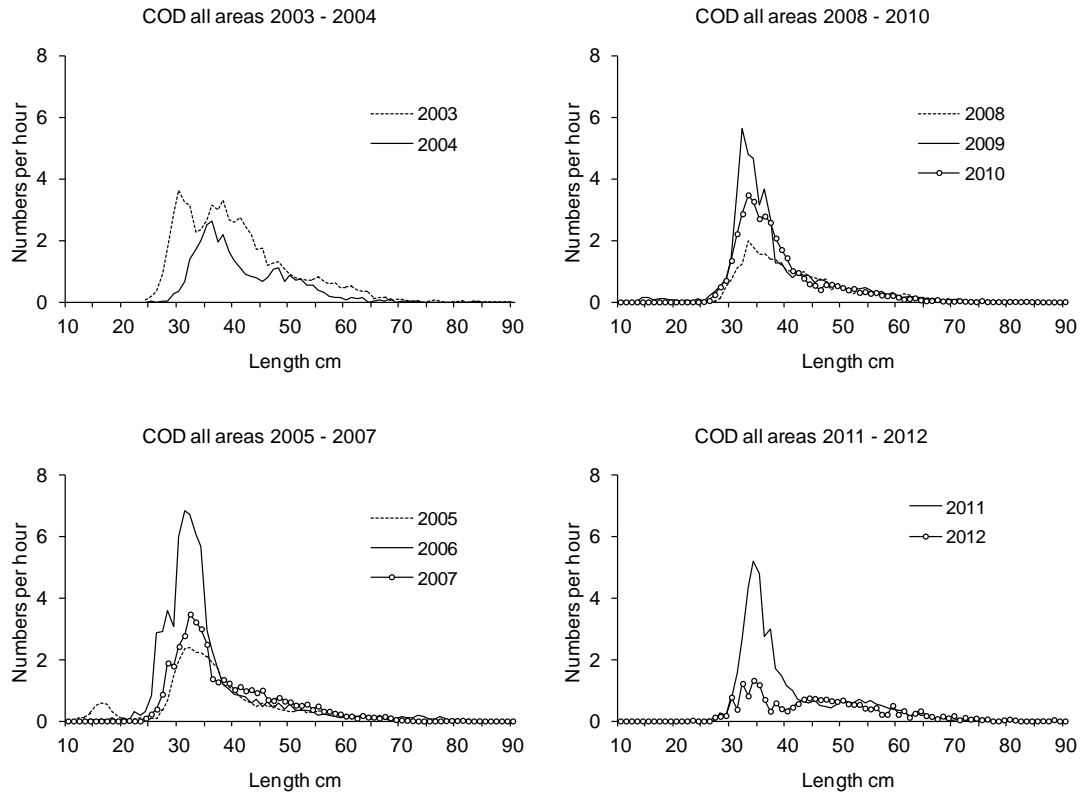


Figure 8a Mean length frequencies of cod during the NE cod FSP surveys (numbers per hour), for all areas combined in 2003–2004, 2005–2007, 2008–2010 and 2011–2012.

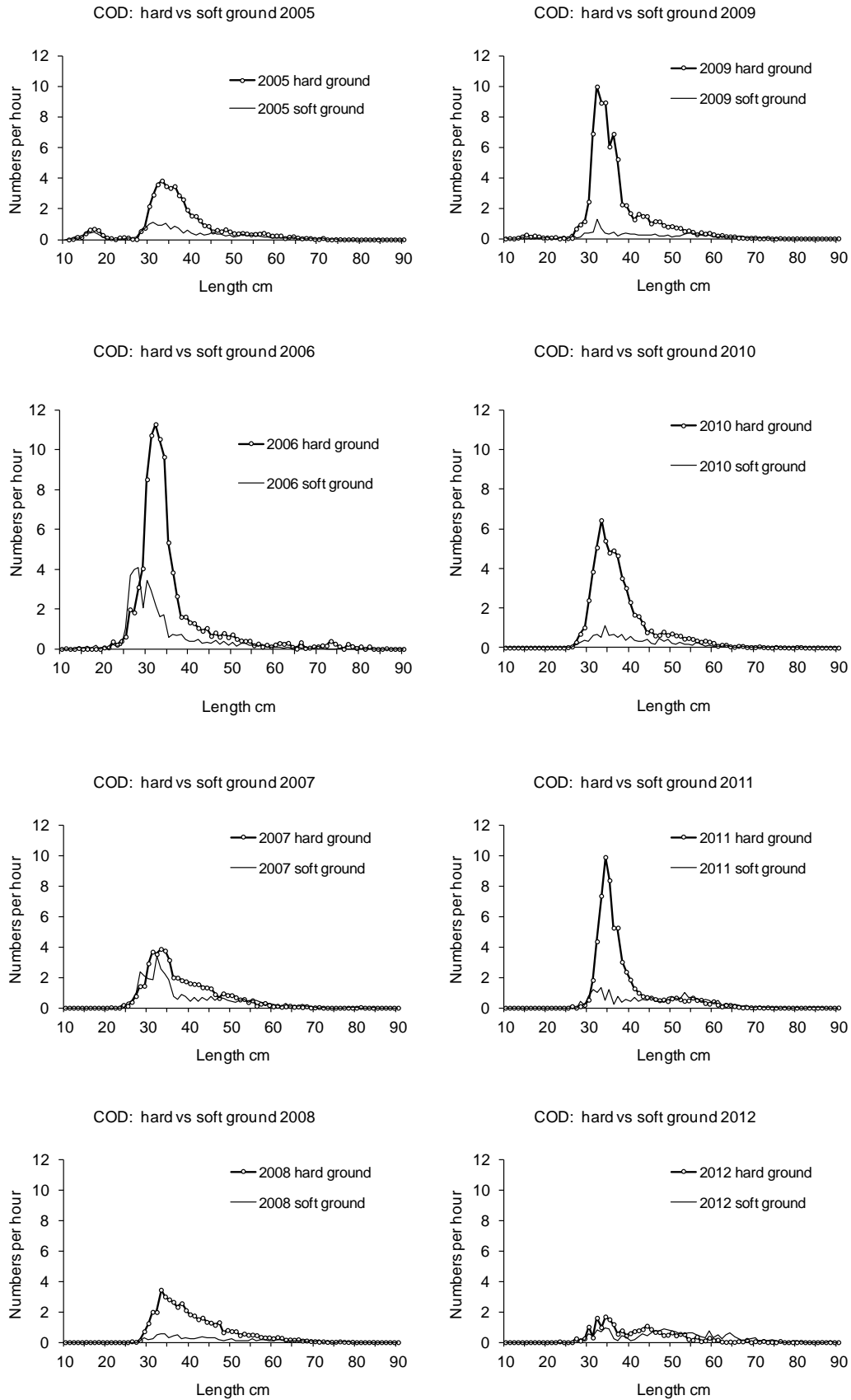


Figure 8b Mean length frequencies of cod during the NE cod FSP surveys (numbers per hour), showing comparisons between hard-ground and soft-ground tows in the years 2005–2012 (see Figure 1 for ground types).

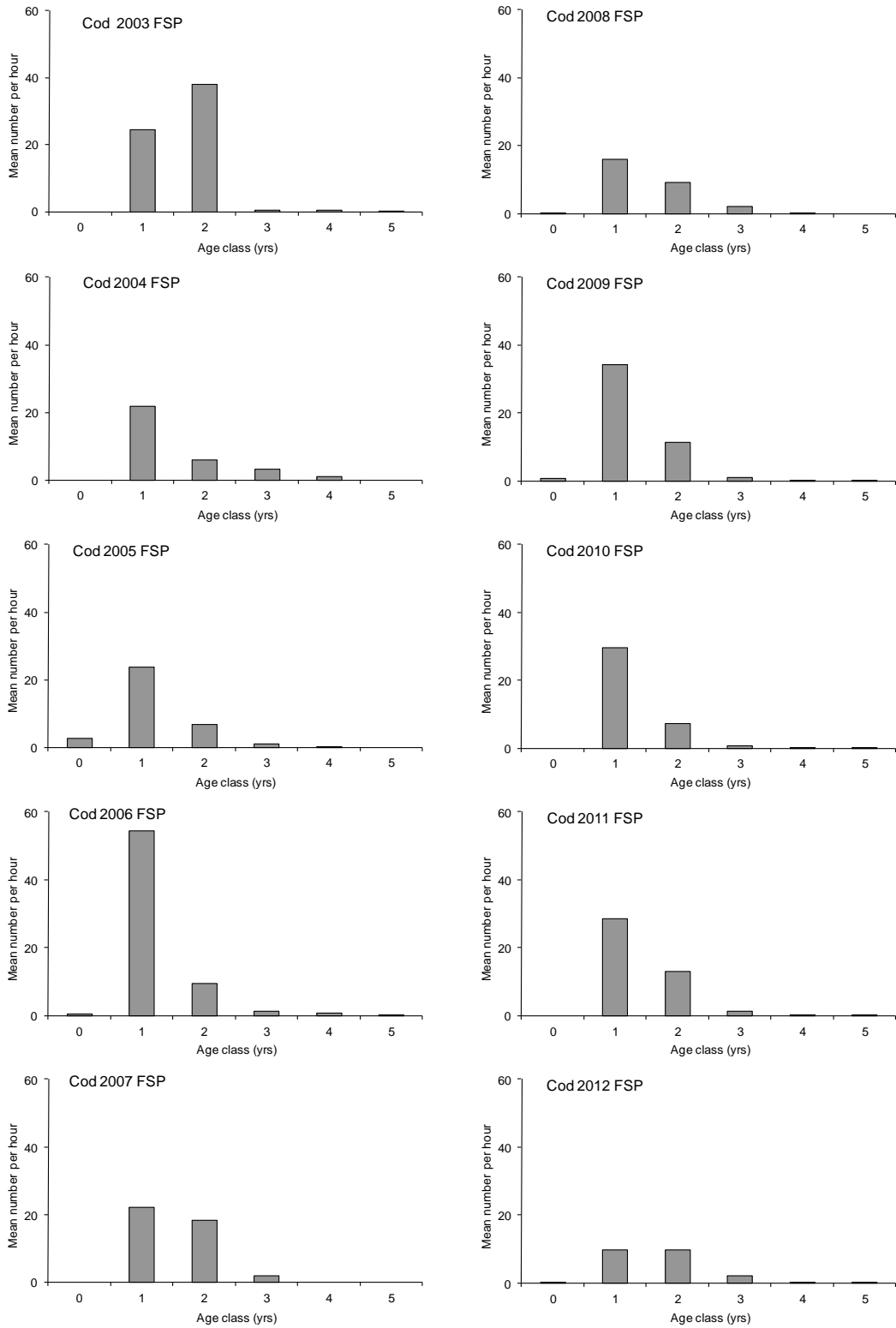


Figure 9 Mean catch rates of cod during the 2003–2012 FSP surveys, by age class (all areas combined).

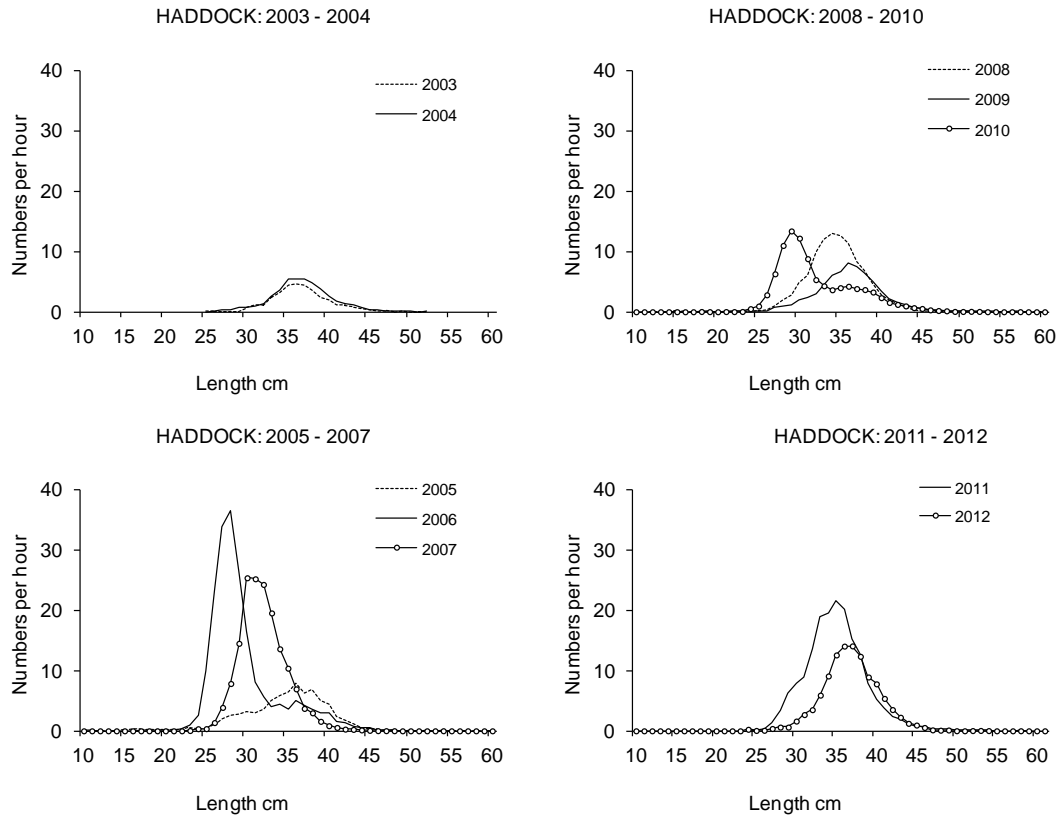


Figure 10a Mean length frequencies of haddock during the NE cod FSP surveys (numbers per hour), for all areas combined in 2003–2004, 2005–2007, 2008–2010 and 2011–2012.

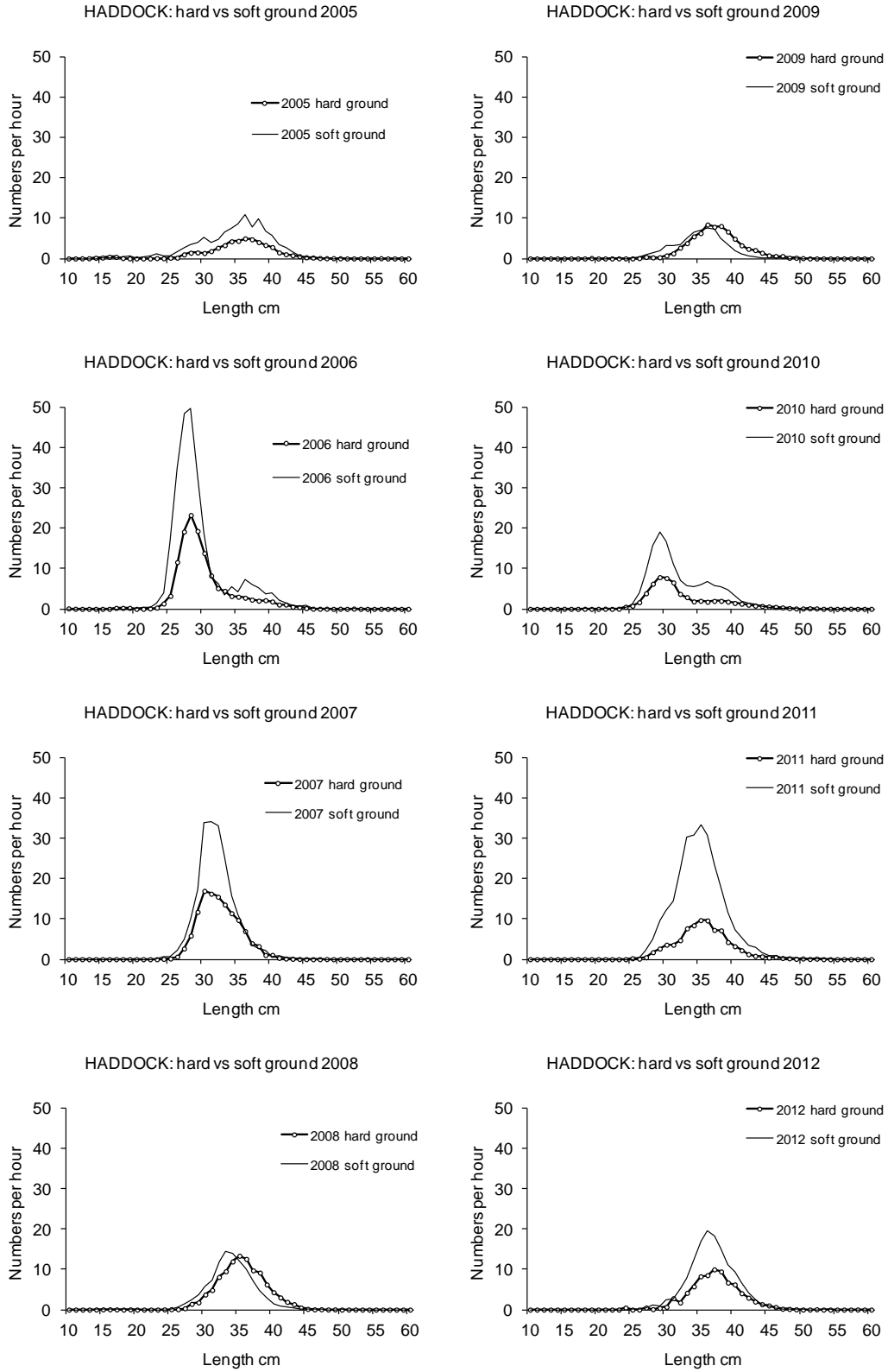


Figure 10b Mean length frequencies of haddock during the NE cod FSP surveys (numbers per hour), showing comparisons between hard-ground and soft-ground tows, 2005–2012 (see Figure 1 for ground types).

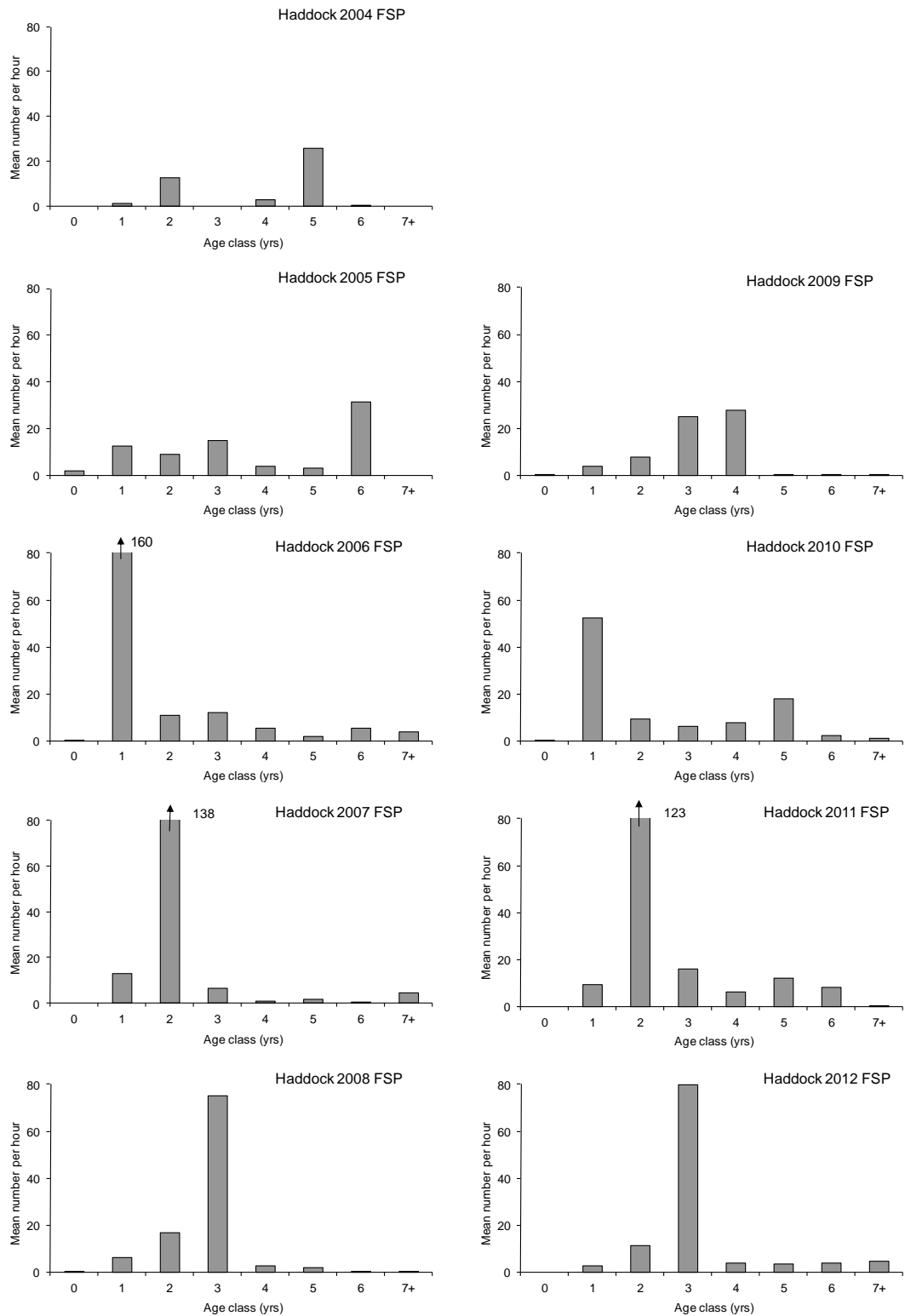


Figure 11 Mean catch rates of haddock during the 2004–2012 FSP surveys, by age class (note the truncation of the 1-group in 2006 and the 2-group in 2007 and 2011).

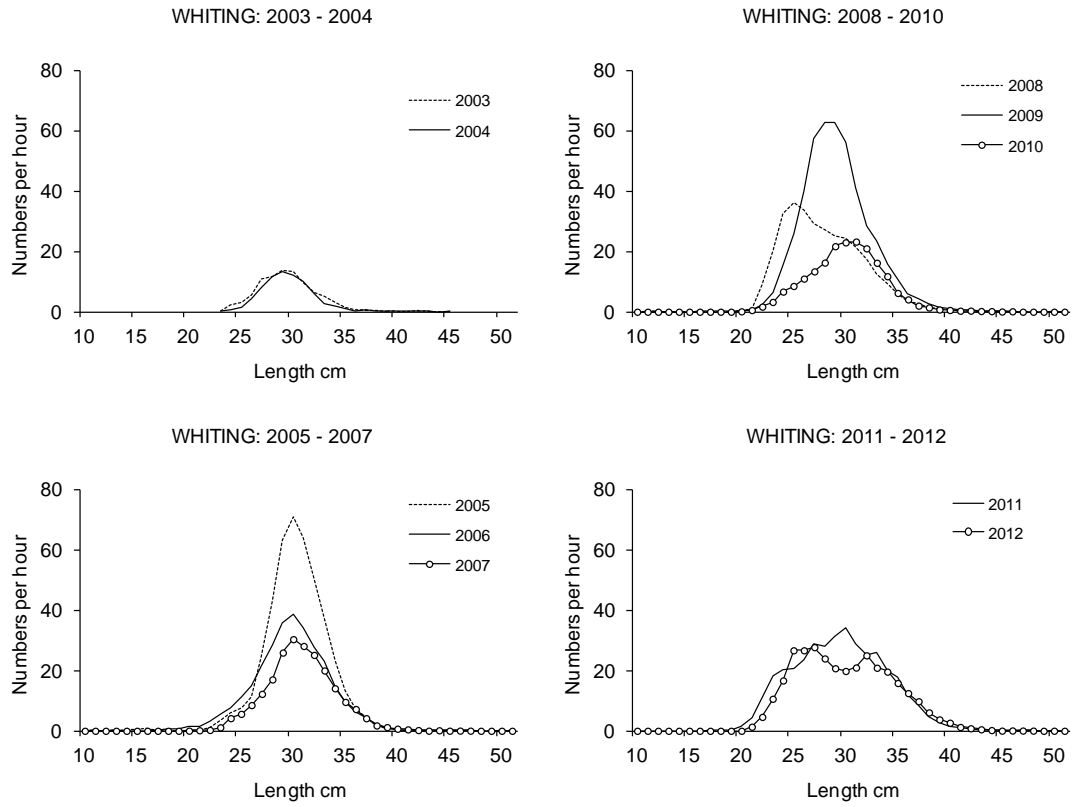


Figure 12a Mean length frequencies of whiting during the NE cod FSP surveys (numbers per hour), for all areas combined in 2003–2004, 2005–2007, 2008–2010 and 2011–2012.

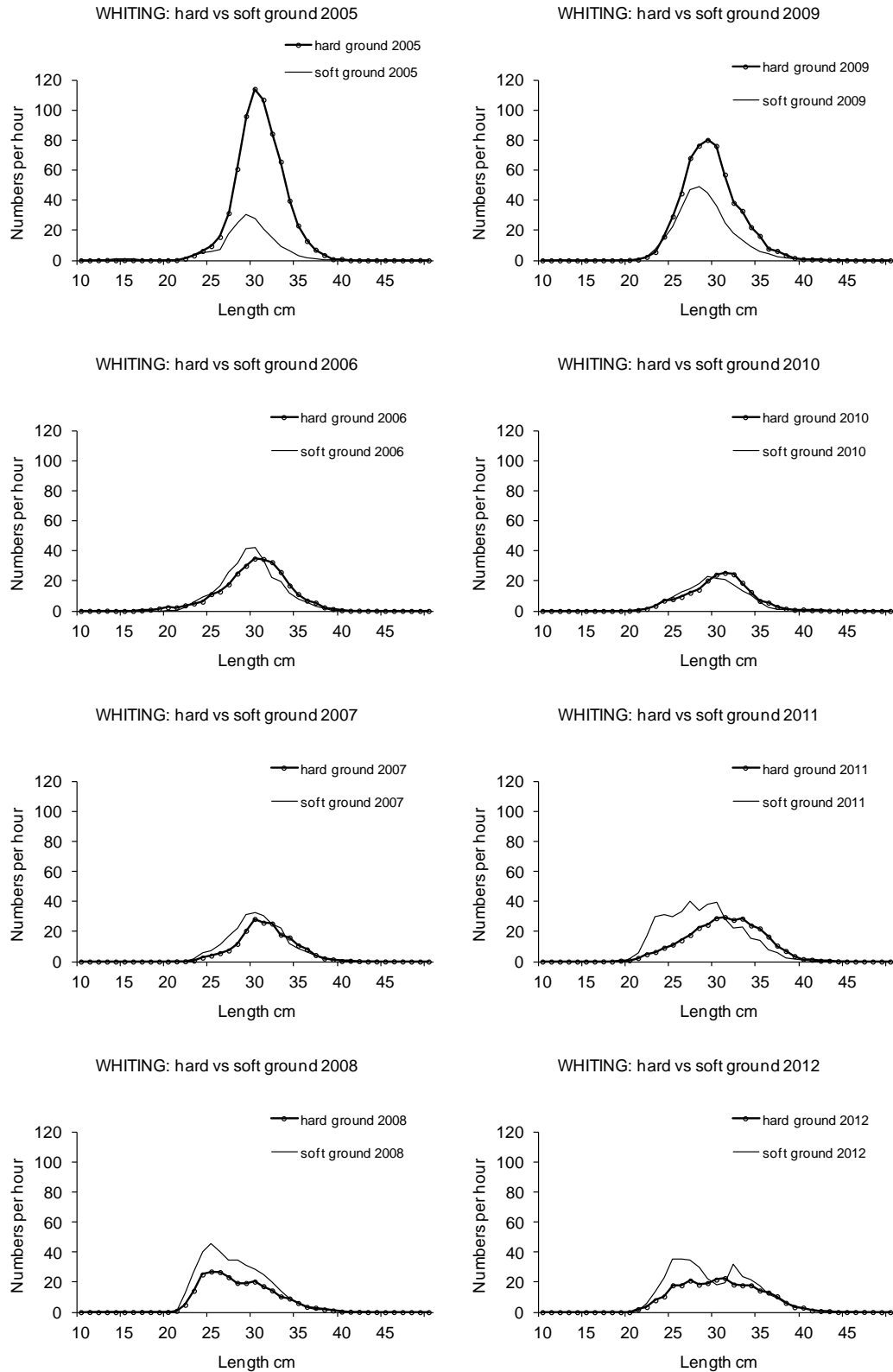


Figure 12b Mean length frequencies of whiting during the NE cod FSP surveys (numbers per hour), showing comparisons between hard-ground and soft-ground tows in the years 2005–2012 (see Figure 1 for ground types).

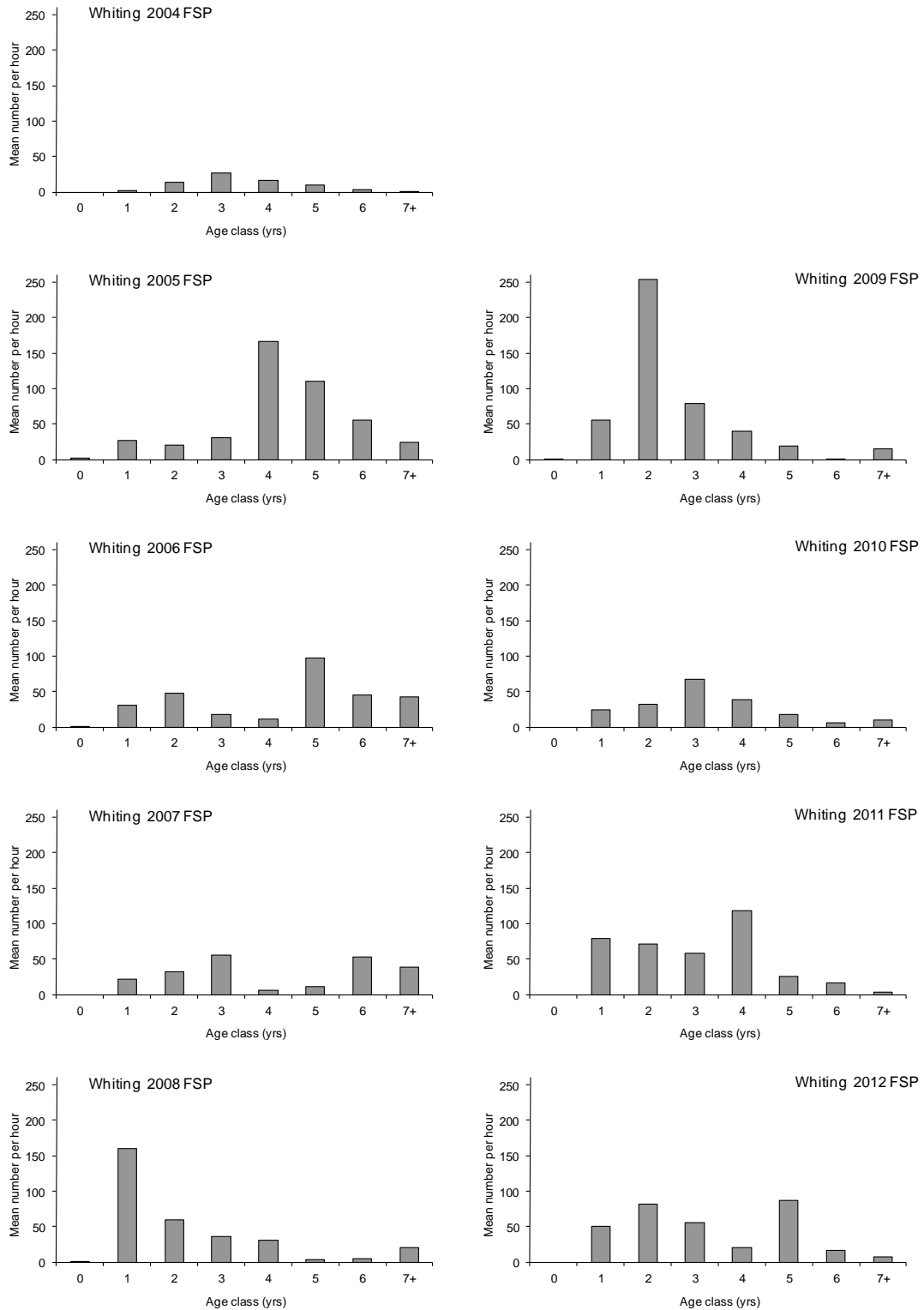
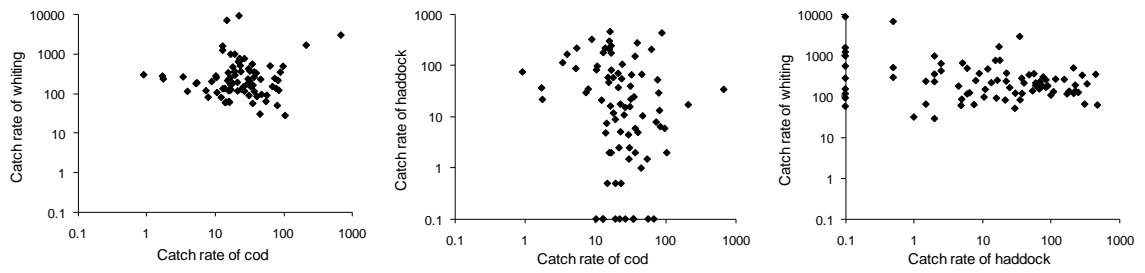
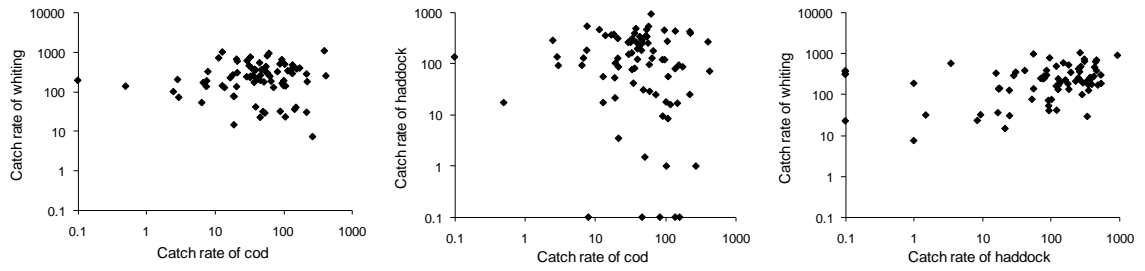


Figure 13 Mean catch rates of whiting during the 2004–2012 FSP surveys, by age class.

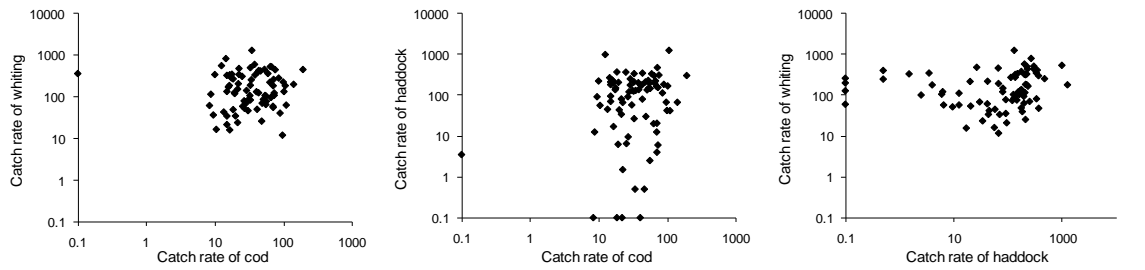
(a) 2005 FSP



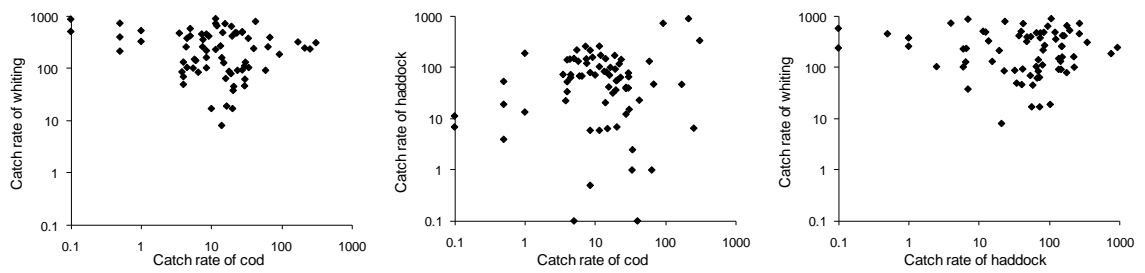
(b) 2006 FSP



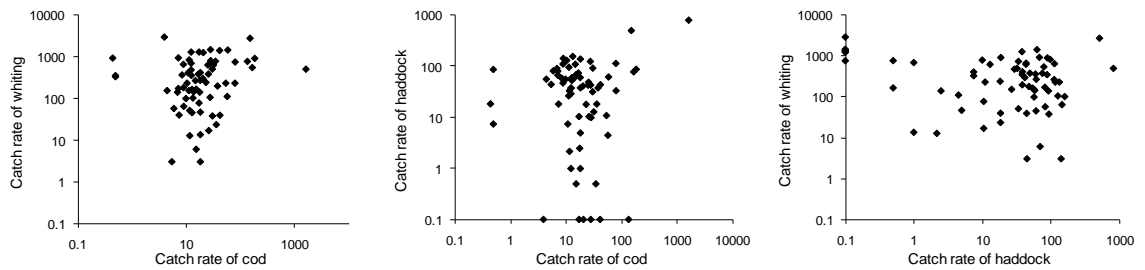
(c) 2007 FSP



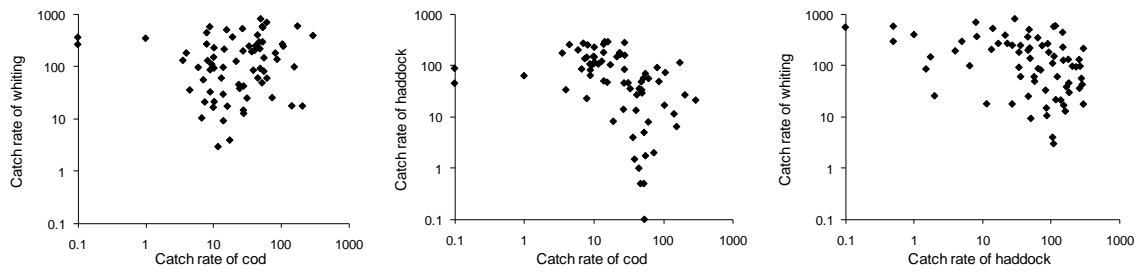
(d) 2008 FSP



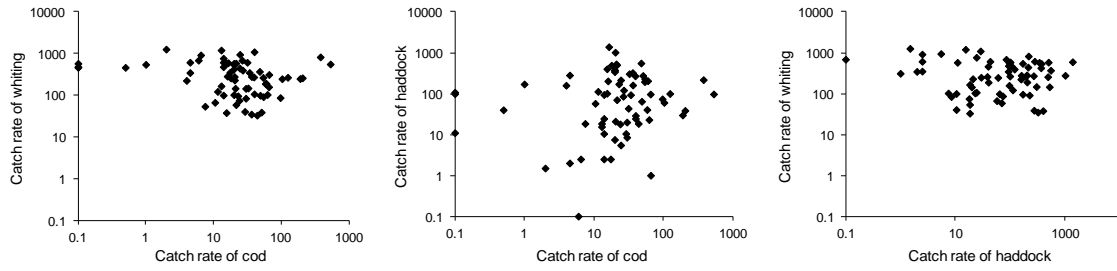
(e) 2009 FSP



(f) 2010 FSP



(g) 2011 FSP



(h) 2012 FSP

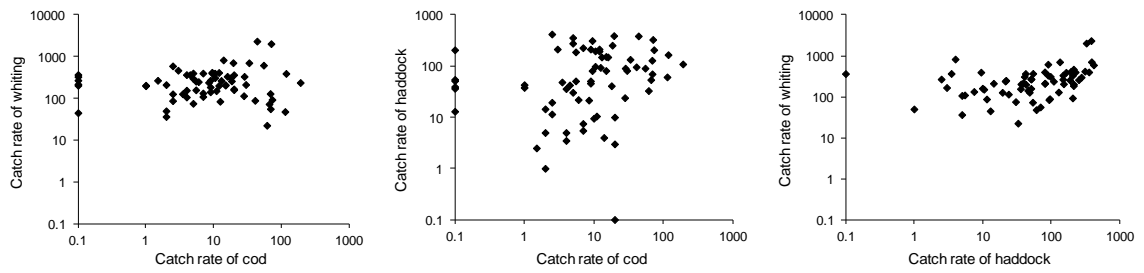


Figure 14 Relationships between the catch rates of cod, whiting and haddock, by tow, during the 2005–2012 FSP surveys. Note the logarithmic scales on the axes.

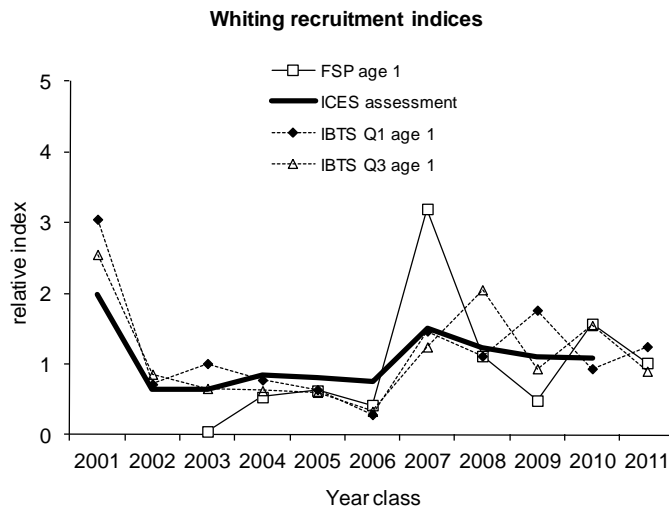
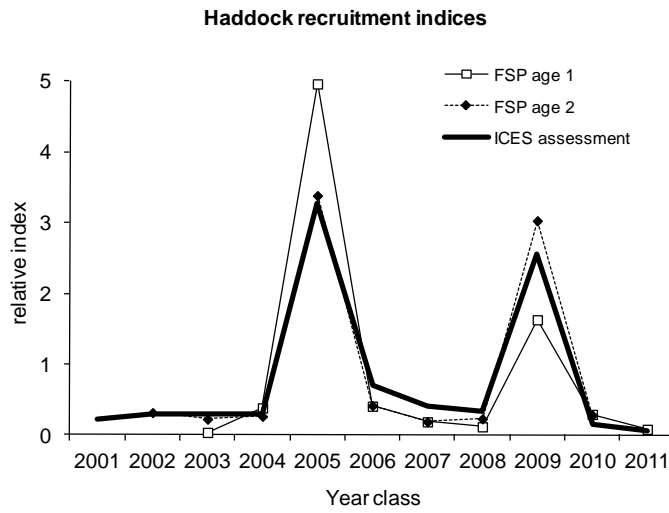
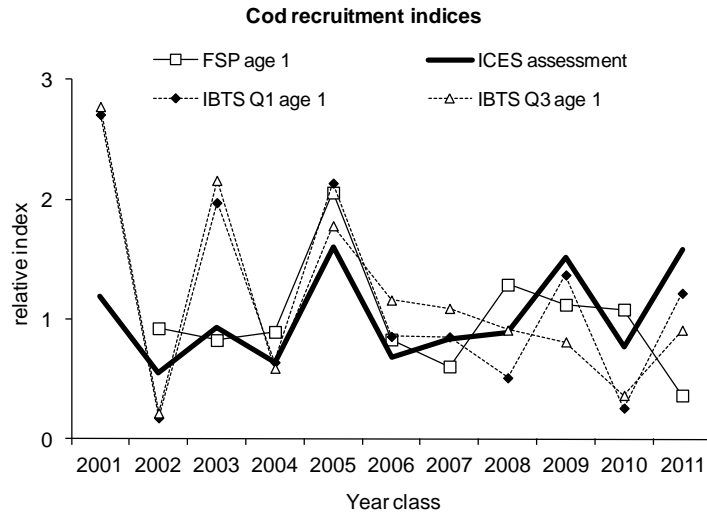


Figure 15 Relative strengths of recent year classes of cod, haddock and whiting as indicated by the most recent ICES assessment (ICES–WGNSSK, 2012) and by the FSP NE cod survey indices at age 1 (cod and whiting) and ages 1 and 2 (haddock). The ICES International Bottom Trawl survey indices (Q1 and Q3) for cod and whiting at age 1 are also shown. All indices have been standardized to the average for years common to all series for each species.

Appendix 1: Detailed operation plan

VESSEL

FV Abbie Lee (WY211)
Skipper: John Hall

OBSERVER

John Hingley

DEPARTURE DATE AND LOCATION

1 October 2012, Whitby

OBJECTIVE

To repeat the survey of NE coast cod carried out in 2005-2011 in order to provide information on distribution, relative abundance and size/age composition of cod and whiting, and the catch compositions throughout the survey area.

FISHING GEAR

The fishing gear must be a Whitby Jet whitefish otter trawl of type, dimensions, construction, rigging and fishing characteristics as close as possible to gear used in previous FSP surveys of NE cod. (Gear details in tender document). Codend mesh size will be 80mm.

AREA OF OPERATION and TOW POSITIONS

Fishing operations will be carried out on fishing grounds between the latitudes 54° N and 55° 10' N to the West of 30' E (See attached chart).

The tows will be spread out over the area to provide information on catch-rate, size/age composition and species catch composition from as many different locations as possible within the area where the fishery takes place, and not necessarily at identical locations to tows made in the previous FSP trips.

Annex 1 shows the survey area divided into 10-minute (longitude) x 20-minute (latitude) rectangles. To obtain as much information as possible from the core fishing areas, whilst ensuring that there is enough information from surrounding areas to allow the distribution pattern to be adequately mapped, the survey will be designed as follows. Two areas are defined:

1. a “core” area of rectangles covering harder seabed types, with potentially the highest catch rates of cod, where 3 tows per rectangle will be carried out, and
2. a surrounding area of softer seabed in which catch-rates of cod are expected to be lower than in the core area, and where 2 tows will be carried out per rectangle.

The numbers of tows per rectangle are indicated in Annex 1. The tows in each rectangle should cover different parts of the rectangle to ensure good coverage in each rectangle. This is particularly important because rectangles are now larger than in FSP surveys prior to 2008.

PERIOD OF SURVEY

The vessel will depart at 8am on Monday 1st October 2012. The duration of the trip will be 20 continuous days with up to 2 days during this period in port to land fish and refuel.

WORKING PATTERN

- Tow duration: 2 hours on average.
- The observer, with help from crew, must have adequate time to carry out the scientific work on a catch before the next catch is brought on board.
- The survey will take place during day and night.
- The observer must have sufficient rest periods (up to 8 hours per day in one or two periods).
- All tows will form part of the survey and must be sampled by the observer as per the sampling requirements.
- The crew should be available to help the observer

It is expected that around 70 tows will be carried out over 18 days of fishing, depending on weather.

SORTING AND RECORDING THE CATCH

It is important that the catches of cod, haddock, whiting 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. congers and skates, which may be landed or discarded but which can all be counted and measured (i.e. raising factor of 1.0).
2. The retained catch of other individuals of commercial species. The observer must be able to record the total number of boxes or baskets of retained fish of each species from each tow, and will carry out a length measure on either the whole catch (raising factor = 1.0) or a known sample of the catch (raising factor > 1.0).
3. Discarded fish of commercial and non-commercial species, other than those in category (1). It is vitally important that the total quantity of discarded fish is known, and that the observer can obtain a representative, random sample to be

sorted to species and length measures carried out. This is best achieved by basketing up all the discarded fish, counting the baskets and taking a random sample of baskets for sorting and measuring. The raising factor is the total number of baskets of discarded fish divided by the number of baskets taken at random for sorting and measuring.

The observer will collect samples of cod, haddock and whiting for age determination, and will remove both otoliths where possible and record the cruise reference, tow number, species, fish length, and (if possible) sex. Target numbers of otoliths will be:

Cod: 400 otoliths
Haddock: 200 otoliths
Whiting: 200 otoliths

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 (i.e. avoid over-sampling of large or small fish in some areas to make up otolith quotas). For cod, the sampling should aim for at least 5 otoliths per 1-cm length class, but no more than 3 otoliths per length class per station. For haddock and whiting, at least 5 otoliths per 1-cm length class are to be collected, but no more than 3 otoliths per station.

The observer will maintain an otolith tally.

DATA TO BE RECORDED AND SUPPLIED 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, seabed type (hard or soft).

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.

It should be noted that 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. The submission of landings / sales notes to Cefas is a new requirement from 2011.

DATA TO BE RECORDED BY OBSERVER

The observer must ensure that all catch composition, length frequencies and raising factors are fully and correctly entered on the recording sheets, and that all bridge log

sheets and biological sampling sheets are collated at the end of each sampling day. Any significant deviations from the survey plan should be reported to Cefas by the observer.

CRUISE REPORT

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

Signed:

.....John Hall.....(skipper) September 2012.....(date)

.....José De Oliveira.....(CEFAS) September 2012....(date)

Appendix 2: Skippers Report: Abbie Lee CEFAS Northeast England Survey October 2012

(Box references e.g. AB3 refer to grid reference on Detailed Operation Plan, A box reference refers to a box that falls entirely within the reference, but where there is more than 1 possible box linked to the reference, additional information is provided to distinguish them; e.g. C3-d “down” distinguished from C3-u “up”. Similarly -l is “left”, -r is “right”).

Commencing 1st October 2012

General comments

Tows 1-3 Box CD4.

Three hauls in this sector. Mixed fish on hard ground. Signs of herring.

Tow 4 Box C3-d.

Haul number 4 was on very hard ground. Same results: mixed fish.

Tows 5-7 Box BC4.

Hauls in this sector were a better sample of fish. Very hard ground again. Doing the best I can to get in for pots.

Tow 8 Box AB3

One tow. Towed across tide. Very hard ground. Mixed fish.

Tows 9-11 Box E5

Towed in and out. Hard ground. Small fish. Whittings.

Tow 12 Box E4-dl

This was a one-tow sector. There, a lot more bulk of whittings.

Tow 13 Box D4

This was a one-tow sector again. More small whiting.

Tows 14-16 Box CD5

It was very poor fishing in this sector. Nothing but queens.

Tows 17-18 Boxes C3-u, C3-d

Two tows towed. Hard ground. Better fish.

Tows 19-20 Box E4-ur

Towed off into deep water. A lot of small squid. Poor fishing.

Tows 21-22 Box F4

Towed off into shady ground. More signs of mixed fish.

Tows 23-24 Box F3

Towed into deep water. Poor fishing. Water very clear.

Tows 25-26 Box F2

Towing still in deep water. Nothing to be seen in this area.

Tows 27-28 Box F1

Deep water. Very poor. Nothing but a herring. Turbo went on engine. Going in for repairs.

Tow 29 Box BC4

Could not work area for pots. Made up tow in another area. Poor results; nothing but herring.

Tows 30-31 Box D3

This sector was a lot better for mixed, mainly codlings.

Tows 32-33 Box C2

We towed into deeper water. Still getting mixed.

Tows 34-35 Box D2

Towed from deep to shallower water. More signs of haddock.

Tows 36-37 Box B2

Towed north into deeper water. Prawn grounds. Poor fishing.

Tows 38-39 Box C1

Towed from deep water onto shored ground. More haddock.

Tows 40-41 Box B1

Towed into deep water. Prawn grounds. No fish at all. In the dark.

Tow 42 Box A1

This sector was very bad. No fish at all.

Tow 43 Box A2

This sector was the same as the last one. No fish at all. In the dark.

Tows 44-45 Box E3

Towed out onto ground. Deep water into shallow. More haddocks.

Tow 46 Box E2-r

This sector was not very good for fish. Towing in to next area.

Tows 47-48 Box E2-l

This sector was better for haddock and whiting. Not much sign of codling.

Tow 49 Box E1-r

This sector was on mild ground. Nothing but a herring.

Tows 50-51 Box E1-l

This sector was in deep water, but hard ground. More whiting and haddocks.

Tows 52-53 Box D1

Towed onto harder ground. There was more mixed fish.

Tows 54-56 Box F5

This sector was on hard ground. There was not a lot of fish, but it was mixed.

Tows 57-59 Box F6

This sector was on hard ground. Poor fishing due to scallop boats tearing ground to bits.

Tows 60-62 Box F7

This sector was very poor fishing. More lobys than fish. Hard ground.

Tows 63-65 Box E7

This sector was on hard ground. Not a lot of fish, but was mixed.

Tows 66-68 Box E6

This sector was full of pots, as was sector D6. Had to tow north all the way to get 70 tows in. Poor fishing. Thick of fog for two days.

Tows 69-70 Boxes E5, CD5

Mixed sectors. These areas were not very good.

More detailed tow-by-tow comments

tow	date shot	Box ref	Box class	Tow validity	Detailed Comments
1	01-Oct-12	CD4	IH	Y	Towed south into tide then NW with tide. Hard ground. Mixed fish with herrings.
2	01-Oct-12	CD4	IH	Y	Towed down NW turned round went south into tide again. Mixed fish.
3	01-Oct-12	CD4	IH	Y	Towed north, then south. Hard ground. Mixed fish again.
4	01-Oct-12	C3-d	IH	Y	Towed down onto hard ground. Mixed fish.

tow	date shot	Box ref	Box class	Tow validity	Detailed Comments
5	03-Oct-12	BC4	IH	Y	Towed into the tide. Hard ground, big flood. Mixed fish.
6	03-Oct-12	BC4	IH	Y	Towed into ebb tide. On hard ground. Less fish, mixed.
7	03-Oct-12	BC4	IH	Y	Towed with ebb, then round into tide. Hard ground. Better fish.
8	03-Oct-12	AB3	IH	Y	Towed into tide, down NW. On ground. Poor fishing.
9	04-Oct-12	E5	IH	Y	Towed across tide. On ground. Small fish.
10	04-Oct-12	E5	IH	Y	Towed out easterly, across tide. Again hardish ground. Small fish.
11	04-Oct-12	E5	IH	Y	Towed with ebb tide. Hard ground. Small fish, mainly whiting.
12	04-Oct-12	E4-dl	IH	Y	Towed with ebb. Hard ground. Small fish, whittings, more bulk.
13	04-Oct-12	D4	S	Y	Towed into tide. Broken ground. Good haul of small fish, mainly whiting.
14	05-Oct-12	CD5	IH	Y	Towed two hours south, with flood. On ground. Very poor fishing.
15	05-Oct-12	CD5	IH	Y	Towed into tide. Hard ground. Very poor again.
16	05-Oct-12	CD5	IH	Y	Towed afore tide. Hardish ground. Poor fishing.
17	05-Oct-12	C3-u	S	Y	Towed down NW with tide. Hard ground. Mixed fish.
18	05-Oct-12	C3-d	IH	Y	Towed with flood. Hard ground. Mixed fish.
19	08-Oct-12	E4-ur	S	Y	Towed out easterly across tide. Broken ground. Mixed fish.
20	08-Oct-12	E4-ur	S	Y	Towed across tide in deep water. Broken ground. Poor fishing.
21	08-Oct-12	F4	S	Y	Towed across tide. Again broken ground, onto hard. Mixed fish.
22	08-Oct-12	F4	S	Y	Towed out again across tide. Shady ground. Mixed fish.
23	09-Oct-12	F3	S	Y	Towed down and in with tide. Broken ground. Mixed fish again.
24	09-Oct-12	F3	S	Y	Towed into tide. Mild ground. Poor fishing.
25	09-Oct-12	F2	S	Y	Towed into tide. Deep water. Very poor fishing.
26	09-Oct-12	F2	S	Y	Towed north with ebb. Deep water. Poor again.
27	09-Oct-12	F1	S	Y	Towed with ebb. Mild ground. More bulk.
28	09-Oct-12	F1	S	Y	Towed with ebb tide. Deep water. Very poor fishing.
29	11-Oct-12	BC4	IH	Y	Towed one more in this area in place of area 3C. This full of pots. Towed on ground. Nothing but herring.
30	13-Oct-12	D3	S	Y	Towed with ebb. Hard ground. Mixed fish.
31	13-Oct-12	D3	S	Y	Towed across tide. Hard ground to soft. Mixed fish again.
32	13-Oct-12	C2	S	Y	Towed NW across tide. Broken ground. Mixed fish.
33	13-Oct-12	C2	S	Y	Towed with tide onto ground. Mixed fish.
34	13-Oct-12	D2	S	Y	Towed off into deeper water. Soft ground. More signs of haddocks.
35	13-Oct-12	D2	S	Y	Towed out of deep water, into 38 fathoms. Harder ground. Haddocks again.
36	15-Oct-12	B2	S	Y	Towed into deep water. Very soft ground. Poor fishing.
37	15-Oct-12	B2	S	Y	Towed into flood tide. Deeper water again. Soft ground. Poor fish.
38	15-Oct-12	C1	S	Y	Towed into tide into shallower water. Broken ground. More signs of haddocks.
39	15-Oct-12	C1	S	Y	Towed down into last of flood, onto hard ground. Poor signs.
40	15-Oct-12	B1	S	Y	Towed across tide into deeper water. Soft. Poor fishing again.
41	15-Oct-12	B1	S	Y	Towed in across tide. Still deep water. Prawn grounds. No fish.
42	16-Oct-12	A1	IH	Y	Towed into 29 fathoms. Harder ground. Still no fish.
43	16-Oct-12	A2	IH	Y	Towed south and in with flood. Harder ground. Poor fishing.
44	18-Oct-12	E3	S	Y	Towed out across tide, onto harder ground. More haddocks.
45	18-Oct-12	E3	S	Y	Towed out again across tide, onto harder ground. Haddock again.
46	18-Oct-12	E2-r	S	Y	Towed with ebb tide. On ground. Not very good fishing.
47	18-Oct-12	E2-l	OH	Y	Towed south into tide. Deep water. Mild ground onto harder ground. Better signs of haddocks.
48	18-Oct-12	E2-l	OH	Y	Tide changed. Towing into flood. Now harder ground. More haddock and whiting.
49	19-Oct-12	E1-r	S	Y	Towed south with flood. Mild ground. Nothing but a herring.
50	19-Oct-12	E1-l	OH	Y	Towed in again. Harder ground into deeper water. More small fish.
51	19-Oct-12	E1-l	OH	Y	Towed NW with ebb. Deeper water again. Some hard in deep water. More bulk of fish.
52	19-Oct-12	D1	S	Y	Towed in along pipe. Deep water. Better haddock.

tow	date shot	Box ref	Box class	Tow validity	Detailed Comments
53	19-Oct-12	D1	S	Y	Towed south with flood. Hard ground. Haddocks and whiting.
54	21-Oct-12	F5	IH	Y	Towed SE with flood. Hardish ground. Mixed fish.
55	21-Oct-12	F5	IH	Y	Towed out. Hard ground. Poor fishing.
56	21-Oct-12	F5	IH	Y	Towed across tide. Hard ground. Then in with tide.
57	21-Oct-12	F6	IH	Y	Towed in on ground. Ebb tide. More signs of whiting and haddocks.
58	21-Oct-12	F6	IH	Y	Towed south with flood. Tide came fast. Time nearly up. Mud. Mixed fish.
59	22-Oct-12	F6	IH	Y	Towed out easterly into weather. Hard ground. Poor fishing.
60	22-Oct-12	F7	IH	Y	Towed out again. On ground. Poor fishing.
61	22-Oct-12	F7	IH	Y	Towed in across tide. Hard ground. No fish.
62	22-Oct-12	F7	IH	Y	Towed into land, across tide. Hard ground. Very poor.
63	22-Oct-12	E7	IH	Y	Towed into shallow water, across tide. Hard ground. Mixed fish.
64	22-Oct-12	E7	IH	Y	Towed out north, into tide. Hard ground. Mixed fish.
65	23-Oct-12	E7	IH	Y	Towed westerly with ebb tide. Hard ground. Mixed fish.
66	23-Oct-12	E6	IH	Y	Towed into tide flood. Hard ground. More whittings.
67	23-Oct-12	E6	IH	Y	Towed out across tide. Broken ground. More whiting.
68	23-Oct-12	E6	IH	Y	Towed north. A lot of pots in this area. Having to improvise. Broken ground. Poor fish.
69	23-Oct-12	E5	IH	Y	Towed all the way north with ebb. Mixed fish. Hard ground.
70	23-Oct-12	CD5	IH	Y	Towed in westerly. Hard ground. Poor fishing.

Concluding remarks

Overall, the fishing has been mixed. It has been a good survey. We have had a lot more trouble with pots this year; had to miss a couple of areas out – we have towed elsewhere to make them up. I would like to thank Spike and John for their understanding to get done before weather breaks. It has been very foggy for two days and fresh N to NE winds

Thanks
John Hall

Skipper FV Abbie Lee
October 2012

Appendix 3 Table 1. FSP NE cod survey, 2012. Shooting and hauling details.

tow	ICES		date shot	time shot	shot		shot longitude	shot EW	date haul	time haul	haul		haul longitude	haul EW	duration h	
	rect	date shot			latitude	longitude					latitude	longitude				
1	38E9	01-Oct-12	09:10	54	34.4	0	35.7	W	01-Oct-12	11:10	54	34.5	0	36.5	W	2.00
2	38E9	01-Oct-12	11:40	54	34.9	0	37.3	W	01-Oct-12	13:40	54	35.6	0	39.5	W	2.00
3	38E9	01-Oct-12	14:15	54	35.9	0	39.4	W	01-Oct-12	16:15	54	34.1	0	35.4	W	2.00
4	38E9	01-Oct-12	17:15	54	40.0	0	33.0	W	01-Oct-12	19:15	54	43.1	0	38.2	W	2.00
5	38E9	03-Oct-12	06:35	54	35.7	0	41.5	W	03-Oct-12	08:35	54	37.8	0	46.0	W	2.00
6	38E9	03-Oct-12	09:15	54	36.9	0	44.7	W	03-Oct-12	11:15	54	36.0	0	41.1	W	2.00
7	38E9	03-Oct-12	11:40	54	35.8	0	41.7	W	03-Oct-12	13:40	54	37.0	0	44.0	W	2.00
8	38E9	03-Oct-12	14:40	54	41.0	0	51.2	W	03-Oct-12	16:40	54	46.2	0	59.1	W	2.00
9	37E9	04-Oct-12	08:15	54	24.2	0	9.5	W	04-Oct-12	10:15	54	24.7	0	6.7	W	2.00
10	37F0	04-Oct-12	10:45	54	24.7	0	5.6	W	04-Oct-12	12:45	54	24.7	0	5.3	E	2.00
11	38E9	04-Oct-12	13:15	54	24.6	0	6.1	E	04-Oct-12	15:15	54	30.1	0	7.5	W	2.00
12	38E9	04-Oct-12	15:45	54	30.1	0	7.3	W	04-Oct-12	17:45	54	30.3	0	7.0	W	2.00
13	38E9	04-Oct-12	18:30	54	30.1	0	10.0	W	04-Oct-12	20:30	54	35.2	0	24.1	W	2.00
14	37E9	05-Oct-12	06:30	54	28.8	0	23.1	W	05-Oct-12	08:30	54	23.1	0	18.1	W	2.00
15	37E9	05-Oct-12	09:00	54	23.5	0	18.4	W	05-Oct-12	11:00	54	27.1	0	14.2	W	2.00
16	37E9	05-Oct-12	11:30	54	27.0	0	14.0	W	05-Oct-12	13:30	54	24.1	0	12.0	W	2.00
17	38E9	05-Oct-12	15:00	54	42.0	0	50.0	W	05-Oct-12	17:00	54	55.1	0	48.1	W	2.00
18	38E9	05-Oct-12	17:30	54	42.3	0	40.2	W	05-Oct-12	19:30	54	45.0	0	50.0	W	2.00
19	38E9	08-Oct-12	12:30	54	34.6	0	9.3	W	08-Oct-12	14:30	54	36.1	0	0.0	E	2.00
20	38F0	08-Oct-12	15:00	54	36.2	0	0.4	E	08-Oct-12	17:00	54	35.5	0	10.2	E	2.00
21	38F0	08-Oct-12	17:30	54	35.3	0	10.7	E	08-Oct-12	19:30	54	33.7	0	20.6	E	2.00
22	38F0	08-Oct-12	19:55	54	33.6	0	21.2	E	08-Oct-12	21:55	54	37.9	0	27.5	E	2.00
23	38F0	09-Oct-12	06:00	54	40.9	0	13.5	E	09-Oct-12	08:00	54	46.2	0	12.0	E	2.00
24	38F0	09-Oct-12	08:30	54	46.5	0	12.4	E	09-Oct-12	10:30	54	50.1	0	18.3	E	2.00
25	38F0	09-Oct-12	11:00	54	50.3	0	19.0	E	09-Oct-12	13:00	54	55.1	0	24.1	E	2.00
26	39F0	09-Oct-12	13:30	54	55.4	0	24.4	E	09-Oct-12	15:30	55	0.3	0	25.0	E	2.00
27	39F0	09-Oct-12	15:30	55	0.4	0	25.0	E	09-Oct-12	17:30	55	5.7	0	24.6	E	2.00
28	39F0	09-Oct-12	18:00	55	6.3	0	24.1	E	09-Oct-12	20:00	55	10.7	0	27.8	E	2.00
29	38E9	11-Oct-12	07:00	54	30.3	0	42.8	W	11-Oct-12	09:00	54	36.4	0	40.8	W	2.00
30	38E9	13-Oct-12	07:00	54	40.1	0	27.1	W	13-Oct-12	09:00	54	47.1	0	22.2	W	2.00

Appendix 3 Table 1 contd.

tow	ICES		time shot	shot		shot longitude	shot EW	shot		haul latitude	haul longitude	haul EW	duration h			
	rect	date shot		latitude	longitude			date haul	time haul							
31	38E9	13-Oct-12	09:00	54	47.1	0	22.1	W	13-Oct-12	11:00	54	45.1	0	14.2	W	2.00
32	38E9	13-Oct-12	13:00	54	50.1	0	34.5	W	13-Oct-12	15:00	54	51.1	0	44.1	W	2.00
33	38E9	13-Oct-12	15:30	54	50.2	0	44.2	W	13-Oct-12	17:30	54	58.1	0	34.1	W	2.00
34	38E9	13-Oct-12	18:30	54	57.8	0	30.1	W	13-Oct-12	20:30	54	59.1	0	19.1	W	2.00
35	38E9	13-Oct-12	21:00	54	59.3	0	19.1	W	13-Oct-12	23:00	54	54.0	0	20.1	W	2.00
36	38E9	15-Oct-12	09:45	54	50.1	0	53.4	W	15-Oct-12	11:45	54	55.1	0	58.1	W	2.00
37	38E9	15-Oct-12	12:00	54	55.2	0	58.2	W	15-Oct-12	14:00	55	0.0	0	55.1	W	2.00
38	39E9	15-Oct-12	15:00	55	10.0	0	50.1	W	15-Oct-12	17:00	55	6.1	0	45.1	W	2.00
39	39E9	15-Oct-12	17:30	55	5.0	0	45.0	W	15-Oct-12	19:30	55	9.7	0	49.6	W	2.00
40	39E8	15-Oct-12	20:00	55	9.2	0	50.0	W	15-Oct-12	22:00	55	8.5	1	0.3	W	2.00
41	39E8	15-Oct-12	22:30	55	9.0	1	1.3	W	16-Oct-12	00:30	55	7.0	1	9.8	W	2.00
42	39E8	16-Oct-12	01:00	55	6.6	1	10.1	W	16-Oct-12	03:00	55	0.4	1	13.1	W	2.00
43	38E8	16-Oct-12	03:30	54	59.7	1	13.0	W	16-Oct-12	05:30	54	53.6	1	13.8	W	2.00
44	38E9	18-Oct-12	08:00	54	41.2	0	8.9	W	18-Oct-12	10:00	54	45.1	0	2.1	E	2.00
45	38F0	18-Oct-12	10:30	54	45.0	0	2.7	E	18-Oct-12	12:30	54	50.1	0	7.1	E	2.00
46	38F0	18-Oct-12	13:00	54	50.9	0	7.8	E	18-Oct-12	15:00	54	58.1	0	8.0	E	2.00
47	38F0	18-Oct-12	15:30	54	59.0	0	8.2	E	18-Oct-12	17:30	54	52.1	0	2.2	W	2.00
48	38E9	18-Oct-12	18:00	54	52.3	0	5.7	W	18-Oct-12	20:00	54	58.1	0	5.7	W	2.00
49	39F0	19-Oct-12	05:00	55	9.9	0	5.2	E	19-Oct-12	07:00	55	0.9	0	5.2	E	2.00
50	39F0	19-Oct-12	07:30	55	0.4	0	4.9	E	19-Oct-12	09:30	55	0.1	0	4.1	W	2.00
51	39E9	19-Oct-12	10:00	55	0.2	0	4.7	W	19-Oct-12	12:00	55	6.2	0	10.1	W	2.00
52	39E9	19-Oct-12	12:30	55	6.2	0	10.1	W	19-Oct-12	14:30	55	8.1	0	20.1	W	2.00
53	39E9	19-Oct-12	15:00	55	9.1	0	20.1	W	19-Oct-12	17:00	55	0.1	0	25.1	W	2.00
54	37F0	21-Oct-12	09:40	54	29.2	0	11.0	E	21-Oct-12	11:40	54	25.3	0	19.2	E	2.00
55	37F0	21-Oct-12	12:00	54	24.9	0	20.0	E	21-Oct-12	14:00	54	22.1	0	26.9	E	2.00
56	37F0	21-Oct-12	14:30	54	22.3	0	30.0	E	21-Oct-12	16:30	54	20.2	0	26.1	E	2.00
57	37F0	21-Oct-12	17:00	54	20.1	0	25.9	E	21-Oct-12	19:30	54	17.5	0	18.2	E	2.50
58	37F0	21-Oct-12	20:00	54	17.4	0	17.3	E	21-Oct-12	22:00	54	14.4	0	10.9	E	2.00
59	37F0	22-Oct-12	06:00	54	11.1	0	10.8	E	22-Oct-12	08:00	54	10.0	0	19.1	E	2.00
60	37F0	22-Oct-12	08:30	54	9.6	0	19.8	E	22-Oct-12	10:30	54	6.9	0	29.8	E	2.00

Appendix 3 Table 1 contd.

tow	ICES		Date shot	time shot	shot				date haul	time haul	haul				duration h		
	rect				shot latitude	shot longitude	EW	haul latitude			haul longitude	EW					
61	37F0		22-Oct-12	11:00	54	6.1	0	29.6	E	22-Oct-12	13:00	54	3.9	0	21.0	E	2.00
62	37F0		22-Oct-12	13:30	54	3.8	0	20.2	E	22-Oct-12	15:30	54	3.0	0	9.6	E	2.00
63	37F0		22-Oct-12	16:00	54	3.1	0	8.7	E	22-Oct-12	18:00	54	2.9	0	0.9	E	2.00
64	37F0		22-Oct-12	18:30	54	3.3	0	0.9	E	22-Oct-12	20:30	54	8.1	0	8.7	E	2.00
65	37F0		23-Oct-12	05:40	54	8.2	0	9.7	E	23-Oct-12	07:40	54	10.0	0	2.0	E	2.00
66	37E9		23-Oct-12	08:00	54	10.3	0	2.3	W	23-Oct-12	10:00	54	13.4	0	6.9	W	2.00
67	37E9		23-Oct-12	10:30	54	13.4	0	6.3	W	23-Oct-12	12:30	54	16.9	0	1.7	W	2.00
68	37E9		23-Oct-12	13:00	54	16.9	0	1.3	W	23-Oct-12	15:00	54	23.0	0	6.4	W	2.00
69	37E9		23-Oct-12	15:45	54	23.4	0	6.7	W	23-Oct-12	17:45	54	29.8	0	9.5	W	2.00
70	37E9		23-Oct-12	18:30	54	23.4	0	6.6	W	23-Oct-12	20:30	54	29.9	0	20.4	W	2.00

Appendix 3 Table 2. Total numbers of fish caught per tow for selected species (those with the highest weight retained¹; data for other species are on the Cefas FSP database). Key for species code is at end of table.

tow	HAD	WHG	COD	LEM	HER ²	GUG	DAB	PLE	MAC	SQC ³	BIB	GUR	PLA	HKE	MON	SDR	LIN	THR	TUB	HAL
1	163	427	60	60		84	288	48		5	18	42	120							
2	108	146	133	390		56	228	122		7	63	92	196					1	16	
3	192	178	82	434		72	320	170	4		44	64	138			9				
4	258	259	138	500		54	384	159	12	5	108	36	162		2	4	2			
5	122	96	228	462		30	132	124			62	40	8	1						
6	48	230	56	394		15	295	92		5	36	14	85		1		10			
7	414	186	147	308		8	9	40			19	11	16			5				
8	66	45	123	524		8	78	172			12	14	16							
9	7	736	8	892		50	1115	24	15				122							
10	8	1655	28	81		44	320	31	126			16	78							
11	269	1415	67	198	20	114	698	7	40		12		66							
12	772	4670	88	304		68	528	8	8	5	120	12	16							
13	657	4061	142	439	20	460	1740	15	280		20	80	140							
14	39	255	5	87	18	48	110	5		4		2	4	1						
15	10	214	8	303		7	144	17												
16	21	303	22	362		46	122	12	4			16	38							
17	92	285	18	229	10	77	169	22	4		2	8	5		1					
18	140	112	139	552	88	40	114	90			32	8	6			1				
19	181	668	57	108	36	318	216	267	12	2		6					2			
20	163	422	30	53	14	486	90	210	124											
21	299	533	26	111	12	550	124	152		1										
22	427	372	18	39		123	39	80		2				1						
23	102	318	11	63			33	170		1		174		1						
24	103	541		36	7	42	44	41	16				7	5						
25	79	436		37	24	24	18	22	6				6							
26	73	408		65	12	25	8	27					12	1						
27	413	659		19	78	38	102	4					12	1						
28	109	738		27	24		136	5		1			24	1						
29	102	540	18	542	110	4	194	30	2		94	8								
30	332	786	236	519		186	48	276			12	24				1	12			

Appendix 3 Table 2 contd.

to w	HAD	WHG	COD	LEM	HER ²	GUG	DAB	PLE	MAC	SQC ³	BIB	GUR	PLA	HKE	MON	SDR	LIN	THR	TUB	HAL
31	219	476	384	42		135	17	688	52				12			2				
32	181	1239	110	52		200	15	78	150					1	1	2				
33	197	622	21	23		87	12	96	36						1					
34	626	837	19	31		11	16	13						2						
35	555	598	10	19		4		10			12				2					
36	162	804	19	22		23	8	7	10				8	1	1					
37	19	792	20	12		27		15	42								1			1
38	306	412	30	20		29		23	3	1				1			1			
39	82	618	36	102		96	6	148	12	2			12				1			
40	72	312	8	8				46			16				1					
41	23	175	5	3		3	4	2					3	1	1					
42	2	100	4	12				16			4			1					3	
43	10	73	4			4		3					3	2					1	
44	427	938	6	50		1140		77		2				1			1		1	
45	840	1192	5	104		138	30	47	90	6			10							
46	376	513	11	116		14	18	47	78								1			
47	508	520	37	72		33	6	22	138		12				1					
48	390	827	24	108	18	48	6	23	63	1					1					
49	85	734	9	24		16	6			4					1					
50	394	795	21	248		190	8	26	218	2	16									
51	782	1420	39	34		38		9	36	1				2			2			
52	716	802	10	16		63		4	89					3						
53	454	800	14	55	36	12		10	180		24		24	2	2					
54	428	404	24	34		320	68	49	7	20	8									
55	187	169	25	19		108	30	186			222									
56	97	256	7	12		99	2	16					2					1		
57	375	838	40	82		287	151	38							1		1		2	
58	61	151	10	69		99	7	9		12	12						2			
59	26	90		38		270	18	9											1	
60	15	267	14	4		175	180	64								1	1	1		

Appendix 3 Table 2 contd.

tow	HAD	WHG	COD	LEM	HER ²	GUG	DAB	PLE	MAC	SQC ³	BIB	GUR	PLA	HKE	MON	SDR	LIN	THR	TUB	HAL	
61	5	537	3	15		200	280	1													
62	86	399	2	29		16	38	12	11		18		3								
63	43	480	17	30		92	76	9						4		1		3		3	
64	6	335	40	33		50	368	2			100			3				3		3	
65	11	220	14	72		60	108	5		1	80			1							
66		731	40	28		5	61	4		1	46			4							3
67	44	500	12	56		51	42	5			103										
68	29	424	4	78		38	51	9			247										
69	76	410	2	276		54	2050	6	45					1							1
70	20	321	40	467		235	460	12			40										

¹ Note for European Lobsters (not shown), none of the retained catch (around 308 kg) or discarded catch (around 6 kg) was sampled for lengths, so numbers caught are not available.

² Note for Herring (HER), no length samples were taken for the retained catch (total of around 28 baskets, estimated at 886 kg in total), so numbers caught are an underestimate.

³ Note for Common Squids (SQC), a total of around 102kg retained catch were not sampled for length, so numbers caught are an underestimate.

Key to species codes:

HAD	Haddock	GUG	Grey gurnard	BIB	Bib	SDR	Spotted ray
WHG	Whiting	DAB	Dab	GUR	Red gurnard	LIN	Ling
COD	Cod	PLE	Plaice	PLA	Long rough dab	THR	Thornback ray
LEM	Lemon sole	MAC	Mackerel	HKE	Hake	TUB	Tub gurnard
HER	Herring	SQC	Common squids	MON	Anglerfish	HAL	Halibut