CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE LOWESTOFT LABORATORY, LOWESTOFT, SUFFOLK NR33 OHT

2011 RESEARCH VESSEL PROGRAMME

REPORT: RV CEFAS ENDEAVOUR: SURVEY 19

STAFF:

Parts 1&2	Part 1 only	Part 2 only
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DURATION: Part 1: 05–18 November. Part 2: 19 November–04 December 2011.

LOCATION: Irish Sea, Celtic Sea, English Channel.

AIMS

1. To carry out a trawl survey of the Irish Sea, Celtic Sea and western English Channel (ICES divisions VII a, e-j, Figure 1), using the modified GOV trawl with rockhopper ground gear on hard grounds and standard IBTS GOV trawl on fine grounds, as part of the west coast IBTS series and in support of the EU data regulations, to obtain information on:
   (a) Distribution, size composition and relative abundance of fish, cephalopods, and benthic invertebrates
   (b) Age-length distribution of commercial fish species for ICES WG input and biological studies
   (c) Biological parameters of selected species
   (d) Presence of litter
   (e) Environmental parameters (including CTD profiles) at trawl stations

2. To record details of surface sightings of any marine mammals, sea turtles and pelagic fish, and record observations on jellyfish aggregations

3. To tag and release specimens of spurdog *Squalus acanthias*, smooth-hound *Mustelus* spp., tope *Galeorhinus galeus,* greater-spotted dogfish *Scyliorhinus stellaris* and various skates (Rajidae)

4. To take photographs of maturity stages of brill *Scophthalmus rhombus* and turbot *Psetta maxima*, and any abnormal maturity stages (all species)

5. To collect samples of anchovy, pilchard and boarfish (up to 60 individuals per station to be frozen as quickly as possible) at sites across the survey area (J van der Kooij, CEFAS)

6. To collect any dead specimens of diadramous fish species (lamprey, shad, salmon, sea trout) (A Walker, CEFAS)

7. To sample the epibenthos in ICES Divisions VIIe-h with 2 m beam trawl

8. To collect fishery acoustics information (J van der Kooij, CEFAS)

9. To collect the valves of scallop *Pecten maximus* (D. Palmer, CEFAS)

10. To collect queen scallops (50–60 mm shell height) at selected stations in the Celtic Sea (n = 7 at each station) (I. McCarthy, Bangor University)

11. To collect multibeam data and associated biological and physical information (grab samples, underwater drop camera) from sites in the area.

12. To collect tissue samples from skates (except thornback, spotted and small-eyed ray) for genetic studies (A Griffiths, MBA) and to collect biological information from selected demersal elasmobranchs (M Gomes, University of Ulster)

13. To collect grab samples from a site in Liverpool Bay (CSEMP station 705, 53.471ºN, 3.260 ºW) for contaminant studies (J Barber, CEFAS)

14. To collect and freeze specimens of blue whiting for dietary studies (J Pinnegar, CEFAS)

15. To try and recover a lost lander (52º08.69'7N, 02º30.304'E) and a lost ESM2 logger (Irish Sea).

NARRATIVE

Staff travelled down to Portland on 04 November to join RV CEFAS ENDEAVOUR and the ship sailed at 09:30 on 05 November. A shakedown tow with the modified GOV with rockhopper ground gear was then undertaken at a site in the Great West Bay shortly after 13:00 and then RV CEFAS ENDEAVOUR steamed westwards overnight.

Fishing on the survey grid commenced at first light on 06 November, and three trawl stations south of Devon were completed successfully, with vertical profiles of the water column and bottom salinity samples also collected at the first and last trawl stations (a pattern of work undertaken most days). RV CEFAS ENDEAVOUR worked westwards the following day, with three stations fished successfully.

Given the reasonable long-term forecast, the GOV trawl with fine ground gear was rigged overnight, so that fine ground strata in the Celtic Sea could be surveyed. Sampling commenced at first light on 08 November, with three stations to the south-west of the survey grid fished successfully. A further four stations were fished the following day, with a large catch of boarfish made in the vicinity of the Jones Bank. Poor weather on 10 November meant that RV CEFAS ENDEAVOUR arrived late on station, and then the trawl was damaged whilst shooting. After repairs were made, the station was fished successfully. At the second tow of the

day the net geometry readings were erratic and so the trawl was retrieved, the cod-end emptied and the trawl re-shot. Given the delays during the course of the day, and that poor weather was expected, RV CEFAS ENDEAVOUR steamed eastwards to the Bristol Channel.

Two stations in Carmarthen Bay were fished successfully on the morning of 11 November, and a further two stations in the Outer Bristol Channel also completed. The following day stations in and around the Celtic Deep were completed, and CEFAS ENDEAVOUR worked to the west of the survey area on the 13-14 November. Stations off the coast of Cork were fished on 15 November, with RV CELTIC EXPLORER also fishing at the final station of the day. The following day RV CEFAS ENDEAVOUR and RV CELTIC EXPLORER undertook some comparative fishing at four stations off the south-eastern coast of Ireland, where once again large numbers of juvenile mackerel were seen. With a poor forecast, RV CEFAS ENDEAVOUR worked south of Milford Haven on the early morning of 17 November in order to collect further samples of skates. Although the first tow was successful, major gear damage was sustained as soon as the trawl was shot on another repeat tow, with the portside wing badly damaged and part of the headline lost. Repairs were made as RV CEFAS ENDEAVOUR steamed eastwards back to Cork. With strong southerly winds preventing safe working in the study area, RV CEFAS ENDEAVOUR docked earlier than planned, in the morning of the 18th, for a change of staff and to take on stores.

RV CEFAS ENDEAVOUR departed Cork at 09:30 on 20 November, and steamed to the inshore station off Cork. Given that RV CELTIC EXPLORER had caught several large boulders and suffered gear damage in the vicinity of this tow the week earlier, the tows were first examined with the multibeam. The first potential tow was considered to have an obstruction on, and a second tow was deemed trawlable and fished. Unfortunately, extensive gear damage was sustained, and RV CEFAS ENDEAVOUR steamed northwards to the Irish Sea that evening whilst repairs were undertaken. The following morning, three stations in the SE Irish Sea/Liverpool Bay area were fished successfully, and grab samples collected at CSEMP station 705 for contaminant analyses. That night RV CEFAS ENDEAVOUR steamed northwards and four stations in the eastern Irish Sea and Solway Firth were fished successfully on the 22 November. The final station in this area was completed at first light the following day, prior to steaming to the NW Irish Sea, where a further two stations were trawled successfully. Given increasing winds and deteriorating sea conditions on the 24 November, only two inshore stations (Dundrum and Dundalk Bays) could be fished. The two final stations in the NW Irish Sea were completed in poor sea conditions the following day, and RV CEFAS ENDEAVOUR then steamed southwards to the station near the Kish Bank whilst re-rigging the rockhopper trawl. Although there was insufficient time to fish that site, the area was examined for static gear, and a clear tow identified. This site was fished successfully at first light on the 26 November. Poor weather prevented further fishing that day, and RV CEFAS ENDEAVOUR anchored off Arklow that night.

The weather eased gradually over the following day, and four stations off the SW coast of Ireland were fished successfully on 27 November. With strong southerly gales predicted to start the following day, RV CEFAS ENDEAVOUR steamed south to the north coast of Cornwall, and worked eastwards along this stretch of coastline on 28 November, before steaming back to Cardigan Bay. Strong winds prevented

fishing the following day, and so RV CEFAS ENDEAVOUR dodged just offshore from Fishguard. The weather improved slightly the following day, and three stations in Cardigan Bay were fished successfully on 30 November. RV CEFAS ENDEAVOUR then steamed overnight to the Celtic Sea where a further two stations were fished, and then to the western English Channel on 2 December where one final station was fished, although extensive gear damage was sustained.

RV CEFAS ENDEAVOUR then steamed eastwards, collecting additional multibeam data near Dungeness, before reaching the southern North Sea. Attempts to trawl for the lost lander that was about 35 nm off Lowestoft were unsuccessful, and so RV CEFAS ENDEAVOUR steamed to Lowestoft, docking in the early hours of 04 December.

GEAR DESCRIPTIONS

The modified GOV with rockhopper ground gear was used on fishing grounds around the Cornish Peninsula, St George's Channel and central Irish Sea, whilst the standard ground gear was used on softer grounds in the Irish Sea, Celtic Sea and Bristol Channel. The Scanmar symmetry/water flow sensor was used in the centre of the headline, and the headline sensor offset to one side.

As used since 2006, the rockhopper GOV was a polyethylene net, and the length of chain used to join the ground gear to the fish plate was ca. 75 cm. The fine ground gear GOV trawl was also constructed of polyethylene, as used since 2007, and as per previous years, extra flotation was used instead of a kite and the toggle chains were set at 10 cm.

Both trawls have had extra tearing strips fitted to minimise extensive gear damage. Both trawls sustained minor damage on shooting/hauling, with repairs undertaken promptly.

The rockhopper trawl only sustained minor gear damage for much of the survey, although extensive damage was sustained on the final station (G10). The fine ground gear experienced extensive gear damage at one station (E3), with gear damage also occurring at E13 during an additional tow.

STATIONS SAMPLED

Overall, 64 trawl stations in the survey area were fished as valid tows. 20 of these were fished with the modified GOV with rockhopper ground gear and 44 with the standard ground gear (Figure 1).

The relationships between net geometry measurements (headline height, wing spread and door spread) in relation to water depth are illustrated for the two gears in Figure 2.The trawl speed and symmetry sensor would only keep its charge for about 3 tows, and so failed on several tows.

Vertical profiles with the ESM2 logger and Niskin bottle samples were collected at 39 stations (Figure 3). The number of stations by gear are summarised in Table 1.

RESULTS

(1) TRAWL SURVEY

Otoliths and biological data were collected for commercially important fish species, and the numbers of each species/stock for which otoliths were collected are summarised in Table 2. In addition to the 3435 otoliths collected, biological information was also collected for 157 skates and 62 spurdog (Table 3).

Gadiforms: Cod *Gadus morhua* were caught at 31 of the 64 valid stations fished (Figure 4), with a maximum catch per unit effort (CPUE) of ca. 50 kg.h^{-1}. Cod were caught over much of the survey grid in the Celtic Sea, with smaller quantities taken in the Irish Sea. Haddock *Melanogrammus aeglefinus* were caught at 53 stations (Figure 4), with the largest catches in the north-eastern Celtic Sea, and the maximum CPUE was >700 kg.h^{-1}. Whiting *Merlangius merlangus* was also abundant, especially in the northern parts of the Irish Sea. They were caught at 52 of the stations (Figure 4) and the maximum CPUE was >850 kg.h^{-1}. Hake *Merluccius merluccius* was captured at 36 stations (Figure 4) and the maximum CPUE was ca. 136 kg.h^{-1}.

Anglerfish: Although catches of black-bellied anglerfish *L budegassa* were relatively low (as the survey is outside of the main area of distribution), anglerfish *Lophius piscatorious* were caught at 32 stations (Figure 5), mainly in the south-western parts of the survey grid, and the maximum CPUE was ca. 80 kg.h^{-1}.

Flatfish: Lemon sole *Microstomus kitt* was relatively common off southern Ireland and in the outer Bristol Channel (Figure 5), and the maximum CPUE was ca. 19 kg.h^{-1}. Megrim *Lepidorhombus whiffiagonis* was caught at 30 stations (Figure 5) and the maximum CPUE was ca. 16 kg.h^{-1}. Plaice *Pleuronectes platessa* was recorded at 36 stations (Figure 5), with good catches in Dundrum Bay, eastern Irish Sea and off south-eastern Ireland, with a maximum CPUE of ca. 77 kg.h^{-1}.

Pelagic fish: Herring *Clupea harengus* was caught at 45 stations (Figure 6), with the highest catches in the northern Irish Sea. Mackerel *Scomber scombrus* was caught at 38 stations, with a large catches of juveniles made in the western English Channel and off southern Ireland. Catches of pilchard *Sardina pilchardus* were greatest in the western English Channel, with only small numbers caught elsewhere. Anchovy *Engraulis encrasicolus* was taken at 25 stations with good catches in the western English Channel, off southern Ireland and in the Solway Firth (Figure 6).

Elasmobranchs: Several tope *Galeorhinus galeus* were caught in the southern St George's Channel and Irish Sea. Spurdog *Squalus acanthias* was caught at 17 stations, with the best catches in the north-western Irish Sea and Celtic Sea (Figure 7). Catches in the former area were comprised mostly of males and juveniles. Thornback ray *Raja clavata* was only taken at 10 stations and this species was most abundant in the north-eastern Irish Sea. Catches of *R. clavata* and *Raja microocellata* in the Bristol Channel appeared low in comparison to previous years. Similarly to last year, several specimens of common skate *Dipturus*

cf, *flossada* were recorded in the Celtic Sea, most of which were tagged and released.

Shellfish and cephalopods: Stations in the north-western Irish Sea, off Cumbria and in the Celtic Sea yielded good samples of *Nephrops* (Figure 7). Northern squid *Loligo forbesi* was widely distributed throughout the area (Figure 7).

Ichthyological observations: Overall, 85 species of fish were recorded during the survey (Table 4), and most of the species caught were relatively common, with the dominant taxa highlighted in Table 5. Unusual fish species caught included specimens of garfish *Belone belone,* big-eye rockling *Antonogadus macrophthalmus* and a porbeagle shark *Lamna nasus.*

Benthic observations: The epibenthic bycatch was quantified at most stations, although the benthos was sub-sampled at several stations. Due to time constraints, only the species observed were noted at some stations. Catches of invertebrates in the rockhopper GOV trawl were generally small, although more benthic invertebrates were captured with the standard ground gear, and echinoderms and crustaceans (shrimps, swimming crabs, spider crabs and hermit crabs) were the major taxa caught. A list of the invertebrates caught by the main survey trawls is given in Table 6. Most of the species observed are caught routinely in this survey. Unusual records included a specimen of mantis shrimp *Rissoides desmaresti* which was recorded in the Solway region, and two specimens of *Alpheus macrocheles* were taken in the southern St George's Channel. These records are both quite north for the species in question. One specimen of crawfish *Palinurus* was also caught during the survey.

Miscellaneous studies: Data on the relationship between length and total weight were collected for the various fish and shellfish species taken to augment data collected in recent years.

(2) MARINE MAMMALS AND JELLYFISH

Sightings of marine mammals were identified to species level where possible. Common dolphin (*Delphinus delphis*) was the most frequently observed species, especially in the Celtic Sea. There were some whale sightings this year (including a fin whale), with sea conditions in the Celtic Sea more conducive to sighting whales in comparison to some previous years. Cetacean sightings are summarised in Table 8.

There were no surface sightings of large pelagic fish or jellyfish aggregations, although large catches of jellyfish in the trawl were noted.

(3) FISH TAGGING

During the course of the survey, a total of 160 elasmobranchs (of 11 species) were tagged with Petersen discs and released. Summary details are given in Table 7.

(4) PHOTOGRAPHS OF MATURITY STAGES

No different maturity stages were encountered to previous years, and so no further photos were collected

(5) SAMPLING OF ANCHOVY, PILCHARD AND BOARFISH

Samples of whole anchovy, pilchard and boarfish were frozen and retained for subsequent biological studies.

(6) DIADRAMOUS FISH

One twaite shad was accidentally captured and, as the specimen was dead, it was retained for further study. No river lampreys or salmonids were encountered in the survey this year

(7) EPIBENTHIC SAMPLING

No 2 m beam trawling was undertaken in the survey area this year, as other work was undertaken at night.

(8) FISHERY ACOUSTICS

Fishery acoustics data were collected for nearly all of the survey period.

(9) SCALLOP SHELLS

The flat valves of scallop *Pecten maximus* shells were retained for those specimens caught.

(10) QUEEN SCALLOPS

Queen scallops (50–60 mm shell height) were retained and frozen from one station in the western English Channel, although this species is generally absent from the Celtic Sea grounds from which material was requested.

(11) SURVEYING OF POTENTAL SAC AREAS

As part of UK's international obligations there is a commitment to creating Marine Protected Areas to afford protection to certain species and habitats. The Joint Nature Conservation Committee (JNCC) and Natural England (NE) have recommended areas for Marine Conservation Zone designation (Figure 8), although these designations require supporting evidence to ensure their success. Supporting evidence can be collected using acoustic data (from multi-beam sonar), underwater camera and grab sampling for sediments and fauna.

This cruise was used to assess the effectiveness of using down time (during the night) on fishing surveys as a way of collecting additional data in areas of interest to support evidence gathering in those zones in and around the fishing survey grid. Despite poor weather and some long transits on some evenings, 20 grab stations and 29 camera stations were successfully undertaken, and 534 km of multi-beam data were collected.

(12) GENETIC SAMPLING OF SKATES

Tissue samples were collected for a range of skates and rays, and material for a PhD student project on stomach contents, isotopes and genetics were collected during the survey.

(13) GRAB SAMPLING

Five grab samples were collected from a site in Liverpool Bay (CSEMP station 705, 53.471ºN, 3.260 ºW) for contaminant studies.

(14) SAMPLING OF BLUE WHITING

Samples of blue whiting from various parts of the survey grid were frozen for subsequent analyses in the laboratory.

(15) RECOVERY OF LOST GEAR

Time and weather constraints hampered field studies in the central Irish Sea, and so it was not possible to try and recover a lost ESM2 logger. Attempts were made to retrieve the lost lander in the southern North Sea, but these attempts were unsuccessful.

We thank the officers and crew for all their hard work during the course of the survey, much of which was done in difficult sea conditions.

J Ellis
03 December 2011

SEEN IN DRAFT
T Byrne (Master)
G Richie (Senior Fishing Mate)

INITIALLED:
B Harley

DISTRIBUTION:
Basic list
Staff on Cruise

Ireland (via FCO)	France (via FCO)
Devon SFC	Cornwall SFC
Isles of Scilly SFC	South Wales SFC
North Wales & NW SFC	Cumbria SFC

Oliver Crimmen, Natural History Museum (E-mail: o.crimmen@nhm.ac.uk)
Sea Watch Foundation (E-mail: info@seawatchfoundation.org.uk)
Irish Whale and Dolphin Group (E-mail: enquiries@iwdg.ie)
Joint Nature Conservation Committee (e-mail: offshoresurvey@JNCC.gov.uk)

TABLE 1: Summary of gear deployments.

Gear	Valid	Additional	Invalid	Total
GOV (Rockhopper)	20	1 [(a)]	1[(b)]	22
GOV (Standard ground gear)	44	1[(c)]	1 [(d)]	46
Niskin Bottle/ESM2 logger	39	-	1	40
			Total	**108**

(a) Shakedown tow west of Portland.
(b) Gear damage sustained at station G10.
(c) Extra tow made at E13 to collect further samples of skates and rays, remaining catch not processed.
(d) Gear damage sustained at station E3.

TABLE 2: Number of commercial fishes for which biological information and otoliths were collected during the survey.

Species	ICES Stock	Number collected
Cod *Gadus morhua*	VII a	27
	VII e-k	78
Haddock *Melanogrammus aeglefinus*	VII a	90
	VII b-k	446
Whiting *Merlangius merlangus*	VII a	233
	VII e-k	340
Hake *Merluccius merluccius*	Northern	208
Conger eel *Conger conger*	-	2
Ling *Molva molva*	-	10
Megrim *Lepidorhombus whiffiagonis*	VII b,c,e-k, VIII a,b,d	284
Lemon sole *Microstomus kitt*	–	159
Plaice *Pleuronectes platessa*	VII a	411
	VII e and VII f-g	296
Sole *Solea solea*	VII a	5
	VII e and VII f-g	23
Turbot *Psetta maximus*	–	3
Brill *Scophthalmus rhombus*	–	12
Anglerfish *Lophius piscatorius*	VII a-k	72
Anglerfish *Lophius budegassa*	VII b-k	8
Bass *Dicentrarchus labrax*	–	17
Red mullet *Mullus surmuletus*	–	4
Red gurnard *Aspitrigla cuculus*		96
Grey gurnard *Eutrigla gurnardus*		122
Tub gurnard *Trigla lucerna*		51
Streaked gurnard *Triglaporus lastoviza*		-
Herring *Clupea harengus*	VII a	152
	Celtic Sea	139
Mackerel *Scomber scombrus*	Western	147
	Total	3435

TABLE 3: Number of elasmobranchs for which maturity data were collected.

Species	Number examined for maturity
Common skate *Dipturus batis*	4
Shagreen ray *Leucoraja fullonica*	1
Cuckoo ray *Leucoraja naevus*	10
Blonde ray *Raja brachyura*	13
Thornback ray *Raja clavata*	37
Smalleyed ray *Raja microocellata*	5
Spotted ray *Raja montagui*	87
Spurdog *Squalus acanthias*	62
Total	**219**

TABLE 4: Taxonomic list of fish species caught during the survey and the number of stations at which they were recorded (includes all tows, 65 valid and additional stations). Species indicated '-' were not recorded in 2011, but were reported in earlier surveys in this cruise series.

Species	Stns	Species	Stns
Lamprey *Lampetra fluviatilis*	-	Blue whiting *Micromesistius poutassou*	33
Spurdog *Squalus acanthias*	17	Pollock *Pollachius pollachius*	2
Porbeagle *Lamna nasus*	1	Saithe *Pollachius virens*	-
Black-mouth dogfish *Galeus melastomus*	-	Norway pout *Trisopterus esmarki*	39
Lesser-spotted dogfish *Scyliorhinus canicula*	61	Bib *Trisopterus luscus*	10
Greater-spotted dogfish *Scyliorhinus stellaris*	14	Poor cod *Trisopterus minutus*	55
Tope *Galeorhinus galeus*	9	Greater forkbeard *Phycis blennoides*	6
Starry smoothhound *Mustelus asterias*	16	Tadpole fish *Raniceps raninus*	-
Smoothhound *Mustelus mustelus*	-	Spanish ling *Molva macrophthalma*	-
Common skate *Dipturus batis*	3	Ling *Molva molva*	8
Cuckoo ray *Leucoraja naevus*	6	Big-eye rockling *Antonogadus macrophthalmus*	1
Shagreen ray *Leucoraja fullonica*	1	Northern rockling *Ciliata septentrionalis*	1
Blonde ray *Raja brachyura*	6	5-bearded rockling *Ciliata mustela*	1
Thornback ray *Raja clavata*	11	4-bearded rockling *Enchelyopus cimbrius*	7
Small-eyed ray *Raja microocellata*	3	3-bearded rockling *Gaidropsarus vulgaris*	-
Spotted ray *Raja montagui*	17	Hake *Merluccius merluccius*	36
Electric ray *Torpedo nobiliana*	-	Two-spotted clingfish *Diplecogaster bimaculata*	-
Stingray *Dasyatis pastinaca*	-	Garfish *Belone belone*	2
Eel *Anguilla Anguilla*	-	Skipper *Scomberesox saury*	-
Conger eel *Conger conger*	6	John dory *Zeus faber*	37
Allis shad *Alosa alosa*	-	Boarfish *Capros aper*	16
Twaite shad *Alosa fallax*	1	Snake pipefish *Entelurus aequoreus*	-
Herring *Clupea harengus*	46	Greater pipefish *Syngnathus acus*	2
Sprat *Sprattus sprattus*	40	Nilssons pipefish *Syngnathus rostellatus*	-
Pilchard *Sardina pilchardus*	9	Blue mouth redfish *Helicolenus dactylopterus*	-
Anchovy *Engraulis encrasicolus*	26	Red gurnard *Aspitrigla cuculus*	31
Salmon *Salmo salar*	-	Grey gurnard *Eutrigla gurnardus*	52
Sea trout *Salmo trutta*	-	Tub gurnard *Trigla lucerna*	16
Argentine *Argentina* sp.	23	Streaked gurnard *Trigloporus lastoviza*	-
Pearlside *Maurolicus muelleri*	6	Bullrout *Myoxocephalus scorpius*	3
Black-bellied anglerfish *Lophius budegassa*	5	Sea scorpion *Taurulus bubalis*	-
Anglerfish *Lophius piscatorius*	32	Norwegian bullhead *Taurulus lilljeborgi*	-
Silvery pout *Gadiculus argenteus*	3	Pogge *Agonus cataphractus*	14
Cod *Gadus morhua*	31	Lumpsucker *Cyclopterus lumpus*	-
Haddock *Melanogrammus aeglefinus*	53	Sea snail *Liparis liparis*	4
Whiting *Merlangius merlangus*	53	Montagu's sea snail *Liparis montagui*	-

Table 4 (continued): Taxonomic list of fish species caught during the survey and the number of stations at which they were recorded (includes all tows). Species indicated '-' were not recorded in 2010, but have been reported in earlier surveys in this series.

Species	Stns	Species	Stns
Bass *Dicentrarchus labrax*	9	Jeffrey's goby *Buenia jeffreysi*	8
Bogue *Boops boops*	-	Crystal goby *Crystallogobius linearis*	3
Red seabream *Pagellus bogaraveo*	-	Black goby *Gobius niger*	-
Black seabream *Spondyliosoma cantharus*	2	Steven's goby *Gobius gasteveni*	1
Scad *Trachurus trachurus*	47	Rock goby *Gobius paganellus*	-
Red mullet *Mullus surmuletus*	3	Fries's goby *Lesueurigobius friesii*	1
Redband fish *Cepola rubescens*	3	Sand goby *Pomatoschistus* spp.	30
Corkwing wrasse *Crenilabrus melops*	-	Mackerel *Scomber scombrus*	39
Goldsinny wrasse *Ctenolabrus rupestris*	1	Four-spot megrim *Lepidorhombus boscii*	-
Ballan wrasse *Labrus bergylta*	-	Megrim *Lepidorhombus whiffiagonis*	30
Cuckoo wrasse *Labrus mixtus*	-	Turbot *Psetta maximus*	2
Lesser weever *Echiichthys vipera*	8	Brill *Scophthalmus rhombus*	5
Greater weever *Trachinus draco*	2	Norwegian topknot *Phrynorhombus norvegius*	2
Raitts sandeel *Ammodytes marinus*	-	Ekstroms topknot *Phrynorhombus regius*	-
Common sandeel *Ammodytes tobianus*	2	Topknot *Zeugopterus punctatus*	-
Smooth sandeel *Gymnammodytes semisquamatus*	-	Imperial scaldfish *Arnoglossus imperialis*	6
Immaculate sandeel *Hyperoplus immaculatus*	5	Scaldfish *Arnoglossus laterna*	16
Greater sandeel *Hyperopus lanceolatus*	2	Witch *Glyptocephalus cynoglossus*	11
Sand eel Ammodytidae indet.	2	Long-rough dab *Hippoglossoides platessoides*	25
Common dragonet *Callionymus lyra*	40	Dab *Limanda limanda*	36
Spotted dragonet *Callionymus maculates*	27	Lemon sole *Microstomus kitt*	27
Reticulate dragonet *Callionymus reticulates*	4	Flounder *Platichthys flesus*	2
Butterfly blenny *Blennius ocellaris*	1	Plaice *Pleuronectes platessa*	37
Tompot blenny *Parablennius gattorugine*	-	Solenette *Buglossideum luteum*	13
Yarrell's blenny *Chirolophis ascanii*	-	Thickback sole *Microchirus variegatus*	31
Butterfish *Pholis gunnellus*	-	Sand sole *Pegusa lascaris*	-
Transparent goby *Aphia minuta*	-	Sole *Solea solea*	16
		Triggerfish *Balistes capriscus*	-

Table 5: Dominant fish and invertebrates taken in the GOV with rockhopper (top) and standard ground gear (bottom) for 2009-2011(sum of $kg.h^{-1}$)

Rockhopper catches					
Species	**2009**	**Species**	**2010**	**Species**	**2011**
Horse mackerel	999.8	Horse mackerel	2455.1	Mackerel	7911.8
Haddock	696.9	Haddock	2089.4	Haddock	1143.5
Whiting	646.7	Mackerel	1870.7	Horse mackerel	503.6
Sprat	516.7	Sprat	1219.5	Whiting	465.3
S. canicula	384.0	Pilchard	580.1	Herring	372.9
Poor cod	283.2	Whiting	487.5	*S. canicula*	293.1
Norway pout	163.4	*S. canicula*	405.4	Poor cod	142.9
Tope	158.4	Poor cod	203.6	Pilchard	125.7
Northern squid	146.3	Blue whiting	122.9	Sprat	112.7
John dory	139.1	*H. immaculatus*	113.7	Northern squid	90.6
M. asterias	138.1	Grey gurnard	103.6	Blue whiting	76.6
Queen scallop	109.9	*M. asterias*	93.2	Tope	65.2
Pilchard	87.5	Herring	90.9	Cod	65.0
Blue whiting	85.3	Cod	86.0	Red gurnard	63.9
Herring	85.1	Northern squid	81.8	Anchovy	58.6
S. stellaris	76.2	Spurdog	56.0	John dory	53.7
Conger eel	68.6	John dory	50.1	*M. asterias*	40.7
Spurdog	66.2	Queen scallop	45.5	Grey gurnard	39.2
Cod	38.9	Red gurnard	41.3	Spurdog	37.7
Dab	37.5	*S. stellaris*	41.1	Queen scallop	35.0
Hake	35.9	Norway pout	39.2	Pollock	31.6

Standard GOV					
Species	**2009**	**Species**	**2010**	**Species**	**2011**
S. canicula	3492.9	Whiting	1799.3	Mackerel	3769.2
Whiting	3003.3	Haddock	1668.8	Whiting	2705.8
Haddock	1691.0	*S. canicula*	1478.9	Sprat	1745.4
Dab	1330.4	Herring	1076.2	Norway pout	1402.6
Sprat	1025.0	Norway pout	1075.7	Boarfish	1356.6
Herring	701.2	Sprat	947.1	Haddock	1306.1
Norway pout	570.3	Dab	686.6	*S. canicula*	955.7
Plaice	501.8	Blue whiting	470.9	Herring	569.0
Poor cod	477.3	Mackerel	327.5	Blue whiting	351.8
Grey gurnard	432.6	Plaice	264.1	Dab	272.9
Blue whiting	393.0	Poor cod	199.7	Plaice	209.6
Thornback ray	314.4	Thornback ray	167.3	Grey gurnard	193.4
Spurdog	287.0	Hake	165.2	Hake	166.4
Conger eel	260.5	Grey gurnard	122.5	Cod	157.9
Small-eyed ray	226.3	Cod	120.4	Northern squid	142.4
Nephrops	179.4	Spurdog	104.0	Poor cod	133.4
Cod	176.3	*Nephrops*	94.5	Anchovy	127.4
Spotted ray	148.9	Conger eel	87.5	Anglerfish	117.0
Hake	137.1	Anglerfish	80.2	*Nephrops*	97.4
Queen scallop	119.4	Starfish	66.6	Megrim	67.5
Horse mackerel	109.4	Long-rough dab	53.5	Spurdog	53.9

TABLE 6: Taxonomic list of invertebrates recorded during the survey.

PORIFERA		*Palaemon serratus*	✓
Axinella infundibulifornis		*Processa* spp.	✓
Phakellia ventilabrum		*Pandalus montagui*	✓
Suberites sp.	✓	*Pandalus propinquus*	✓
Haliclona oculata	✓	*Dichelopandalus bonnieri*	✓
Cliona celata		*Spirontocaris lilljeborgi*	✓
Dysidea fragilis	✓	*Crangon allmanni*	✓
Porifera (indet.)	✓	*Crangon crangon*	✓
		Philocheras echinulatus	✓
HYDROZOA		*Pontophilus spinosus*	✓
Hydrallmania falcata	✓		
Nemertesia antennina	✓	**ANOMURA**	
Nemertesia ramosa	✓	*Homarus gammarus*	✓
Lytocarpia myriophyllum	✓	*Nephrops norvegicus*	✓
Hydrozoa (indet.)	✓	*Scyllarides latus*	
		Lithodes maja	
ANTHOZOA		*Anapagurus laevis*	✓
Epizoanthus papillosus	✓	*Pagurus bernhardus*	✓
Alcyonium digitatum	✓	*Pagurus prideaux*	✓
Caryophyllia smithi	✓	*Pagurus variabilis*	✓
Actinauge richardi	✓	*Galathea* spp.	✓
Adamsia carciniopados	✓	*Munida rugosa*	✓
Bolocera tuediae	✓	*Calocaris macandreae*	✓
Calliactis parasitica	✓	*Pisidia longicornis*	✓
Metridium senile	✓		
Urticina felina	✓	**DECAPODA**	
Anemone (indet.)	✓	*Ebalia tuberosa*	✓
		Dromia personata	
ANNELIDA		*Hyas araneus*	
Aphrodita aculeata	✓	*Hyas coarctatus*	✓
Hermione hystrix		*Eurynome aspera*	✓
Sabellaria spinulosa	✓	*Inachus dorsettensis*	✓
Hyalinoecia tubicola	✓	*Inachus leptochirus*	✓
Serpula vermicularis		*Macropodia linaresi*	
Chaetopterus (tubes)	✓	*Macropodia rostrata*	✓
Pontobdella muricata	✓	*Macropodia tenuirostris*	✓
		Pisa armata	
CIRRIPEDIA		*Maja brachydactyla*	✓
Scalpellum scalpellum	✓	*Atelecyclus rotundatus*	✓
		Cancer pagurus	✓
ISOPODA		*Corystes cassivelaunus*	✓
Cirolana cranchii	✓	*Liocarcinus corrugatus*	
Idotea linearis		*Liocarcinus depurator*	✓
		Liocarcinus holsatus	✓
STOMATOPODA		*Liocarcinus marmoreus*	
Rissoides desmaresti	✓	*Liocarcinus pusillus*	✓
		Macropipus tuberculatus	✓
NATANTIA		*Necora puber*	✓
Solenocera membranacea		*Goneplax rhomboids*	✓
Alpheus glaber	✓	*Monodeus couchi*	✓
Alpheus macrocheles	✓	*Pilumnus hirtellus*	✓
Pasiphaea sivado	✓		

TABLE 6: Taxonomic list of invertebrates caught during the survey.

PROSOBRANCHIA		**BRYOZOA**	
Diodora graeca		*Pentapora foliacea*	✓
Aporrhais pespelecani		*Alcyonidium diaphanum*	✓
Calliostoma papillosum		*Alcyonidium parasiticum*	✓
Calliostoma zizyphinum	✓	*Cellaria* spp.	✓
Turritella communis	✓	*Porella compressa*	✓
Euspira fusca	✓	*Flustra foliacea*	✓
Polinices (Euspira) catena	✓	*Bryozoa* indet.	✓
Buccinum humphreysianum	✓		
Buccinum undatum	✓	**ASTEROIDEA**	
Colus gracilis		*Astropecten irregularis*	✓
Neptunea antique	✓	*Luidia ciliaris*	✓
		Luidia sarsi	✓
OPISTHOBRANCHIA		*Stichastrella rosea*	✓
Scaphander lignarius	✓	*Henricia oculata*	✓
Philine aperta	✓	*Anseropoda placenta*	✓
Aplysia punctata		*Porania pulvillus*	✓
Pleurobranchus membranaceus	✓	*Crossaster papposus*	✓
Archidoris pseudargus	✓	*Asterias rubens*	✓
Tritonia hombergi	✓	*Leptasterias muelleri*	
Dendronotus frondosus	✓	*Marthasterias glacialis*	✓
Nudibranchia (indet.)	✓		
		OPHIUROIDEA	
BIVALVIA		*Ophiura albida*	✓
Nucula sulcata		*Ophiura ophiura*	✓
Glossus humanus		*Ophiothrix lutkeni*	✓
Arctica islandica		*Ophiothrix fragilis*	✓
Aequipecten opercularis	✓		
Chlamys varia		**ECHINOIDEA**	
Palliolum tigerinum	✓	*Echinus acutus*	✓
Pecten maximus	✓	*Echinus esculentus*	✓
Modiolus modiolus	✓	*Psamechinus miliaris*	✓
Mytilus edulis		*Echinocardium cordatum*	✓
Acanthocardia sp.	✓	*Spatangus purpureus*	
Astarte sulcata			
Laevicardium crassum	✓		
Timoclea ovata		**HOLOTHUROIDEA**	
Circomphalus casina	✓	Holothuroidea (indet.)	✓
CEPHALOPODA			
Sepia elegans	✓	**ASCIDIACEA**	
Sepia officinialis	✓	*Botryllus schlosseri*	✓
Sepia orbignyana	✓	*Ascidia conchilega*	✓
Rossia macrosoma	✓	*Ascidia mentula*	✓
Sepiola atlantica	✓	*Ascidiella aspersa*	
Alloteuthis subulata	✓	*Ascidiella scabra*	✓
Loligo forbesi	✓	Ascidiacea (indet.)	
Illex spp.	✓		
Todaropsis eblanae	✓	**PYCNOGONIDA**	
Eledone cirrosa	✓	*Pycnogonum littorale*	✓

TABLE 7: Summary of elasmobranchs tagged and released.

Species/Sex	Female	Male	
Spurdog *Squalus acanthias*	15	16	31
Porbeagle *Lamna nasus*	1		1
Greater spotted dogfish *Scyliorhinus stellaris*	14	8	22
Tope *Galeorhinus galeus*	6	10	16
Starry smoothhound *Mustelus asterias*	9	30	39
Common skate *Dipturus batis (=D. flossada*)	1	2	3
Cuckoo ray *Leucoraja naevus*	2	3	5
Blonde ray *Raja brachyura*	7	6	13
Thornback ray *Raja clavata*	12	7	19
Small-eyed ray *Raja microocellata*	3		3
Spotted ray *Raja montagui*	6	2	8
Total		**160**	

TABLE 8: Summary of cetacean sightings recorded during survey hours.

Date	Time	Species	Total number	Activity	Latitude	Longitude
6/11/11	10:00	Whale (indet.)	1-2	Whales off the port side of the vessel. Spouts were observed, although no accurate identification made.	50º 06’	04º 08’
7/11/11	07:20	Common dolphins	Ca. 6	Alongside vessel at prime station G6	49º 37’	04º 45’
7/11/11	15:30	Common dolphins	6-10	Alongside vessel at prime station G11. Larger group (50+) further off	49º 31’	06º 20
8/11/11	15:30	Common dolphins	Unknown	Small group of dolphins alongside vessel on transit to prime station F15 and on station	49º 28’	08º 49’
10/11/11	08:30	Common dolphins	6-10	Small group of dolphins alongside vessel near Stn F10	50º 02’	08º 47’
12/11/11	07:30	Common dolphins	10+	Small group of dolphins alongside vessel at Stn E15	51º 44’	05º 55’
12/11/11	14:30	Common dolphins	5+	Small group of dolphins alongside vessel at Stn E10	51º 00’	06º 03’
14/11/11	08:00	Common dolphins	6-10	Small group of dolphins alongside vessel at Stn F5	50º 52’	08º 00’
14/11/11	10:30	Common dolphins	Unknown	Small group of dolphins alongside vessel at Stn F4	51º 03’	08º 24’
14/11/11	16:15	Common dolphins	Unknown	Small group of dolphins alongside vessel at Stn F7	50º 38’	08º 57’
15/11/11	14:30	Common dolphins	3-5	Small group of dolphins alongside vessel at Stn E2	51º 43’	07º 59’
16/11/11	07:45	Common dolphins	Unknown	Small group of dolphins alongside vessel at Stn D1	52º 02’	07º 23’
16/11/11	16:00	Common dolphins	6-10	Small group of dolphins alongside vessel at Stn E6	51º 45’	06º 31’
20/11/11	15:00	Fin whale and common dolphins	5-6	A fin whale sighted with a small group of common dolphins ‘bow-riding’ in front of the whale, near prime station E3	51º 37’	07º 46’
28/11/11	-	Common dolphins	<10	Small groups of dolphins alongside vessel during the the course of the day when working at prime stations G1-G4	50º 30’ to 50º 30’	06º 13’ to 05º 11’

FIGURE 1: Study area showing sites sampled with GOV trawl with rockhopper ground gear (filled squares: valid tows; open square: additional tow) and standard ground gear (filled circles: valid tows; open circle: additional tow). Invalid tows marked with an asterisk.

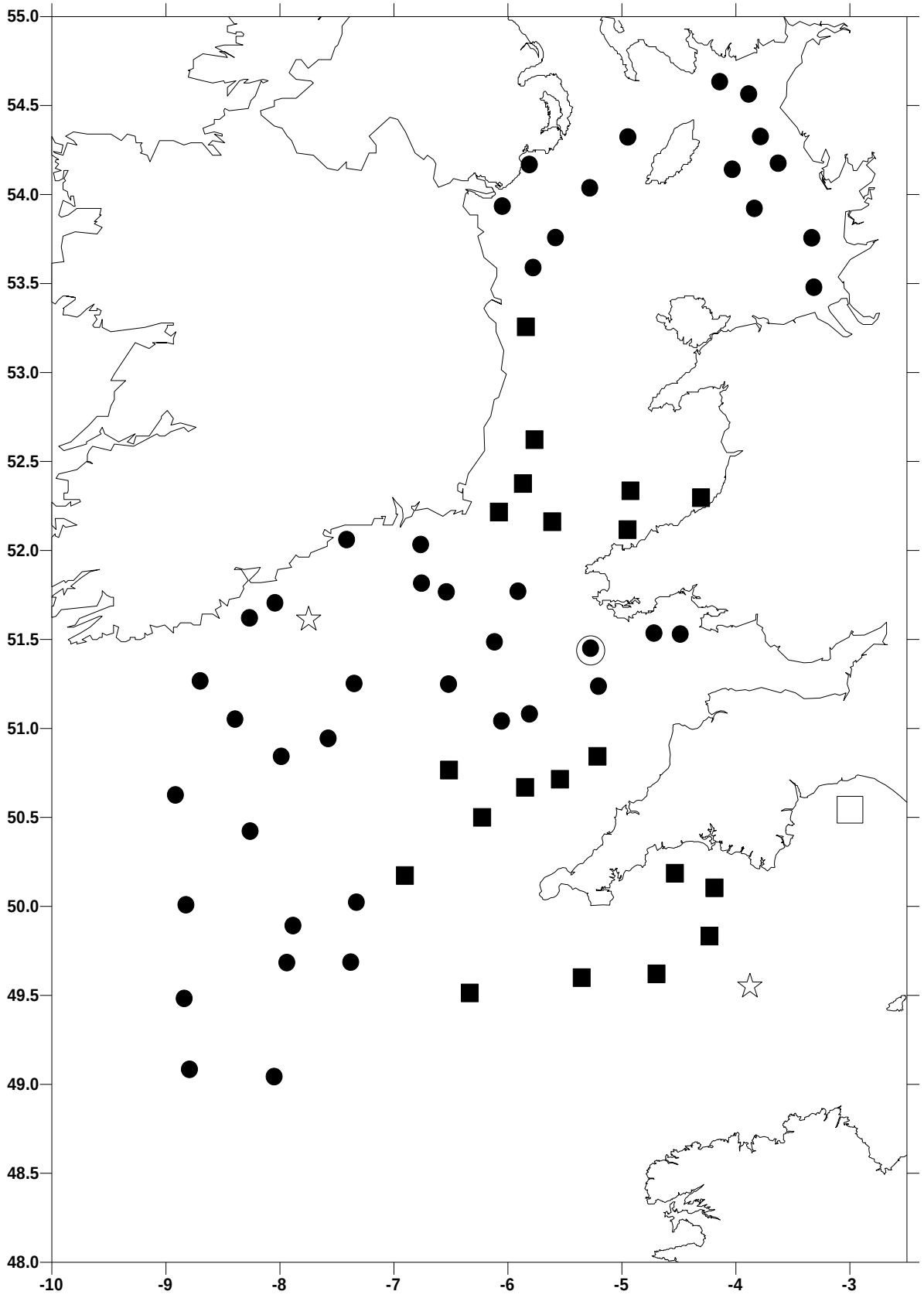

FIGURE 2: Graphs showing relationships between headline height, wing spread and door spread with depth for the GOV trawl with rockhopper ground gear (left hand panel) and standard ground gear (right hand panel) for 2011 (filled circles) and 2006-2010 (open circles).

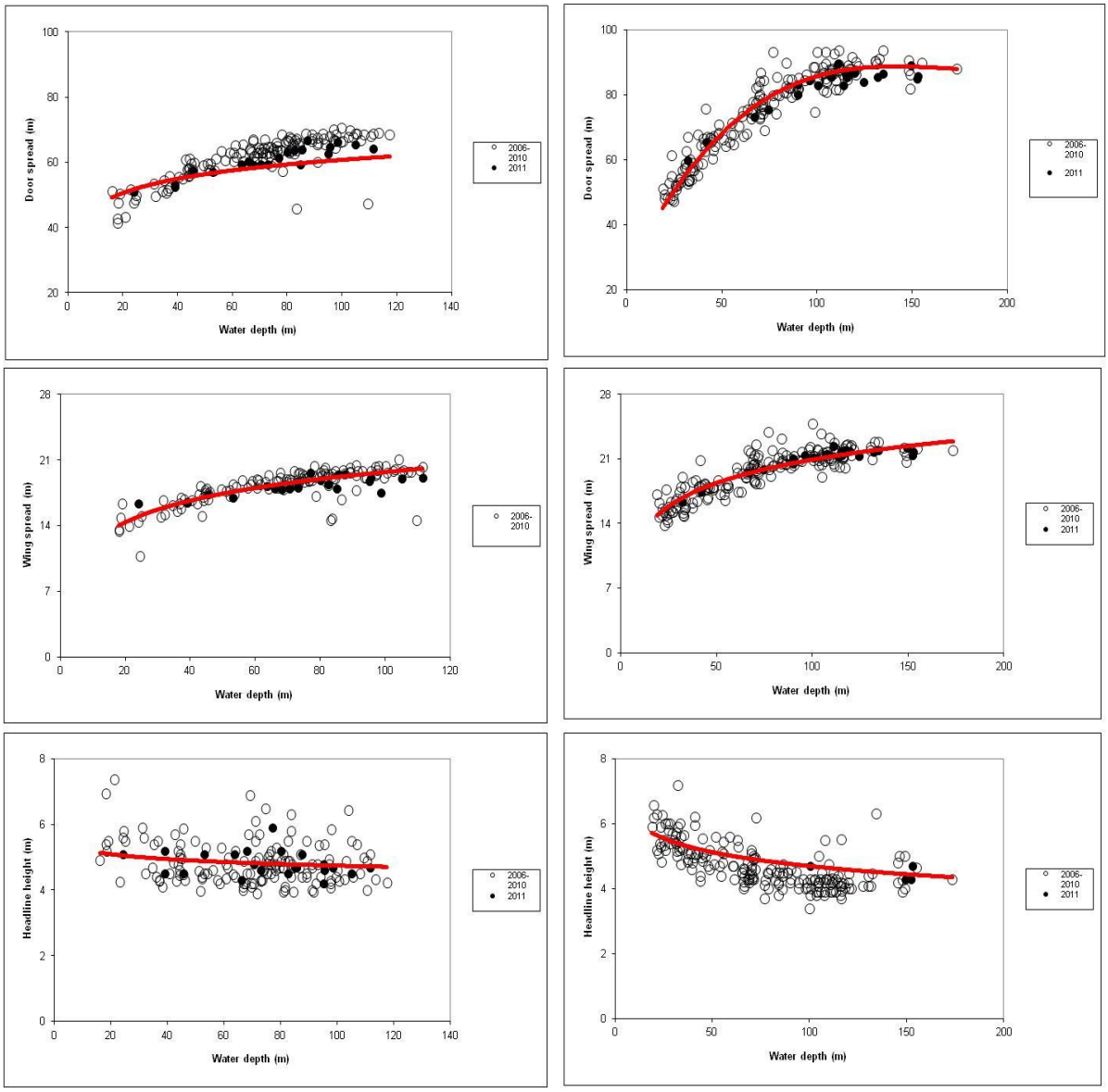

FIGURE 3: Study area indicating sites sampled with ESM2 logger and Niskin bottle.

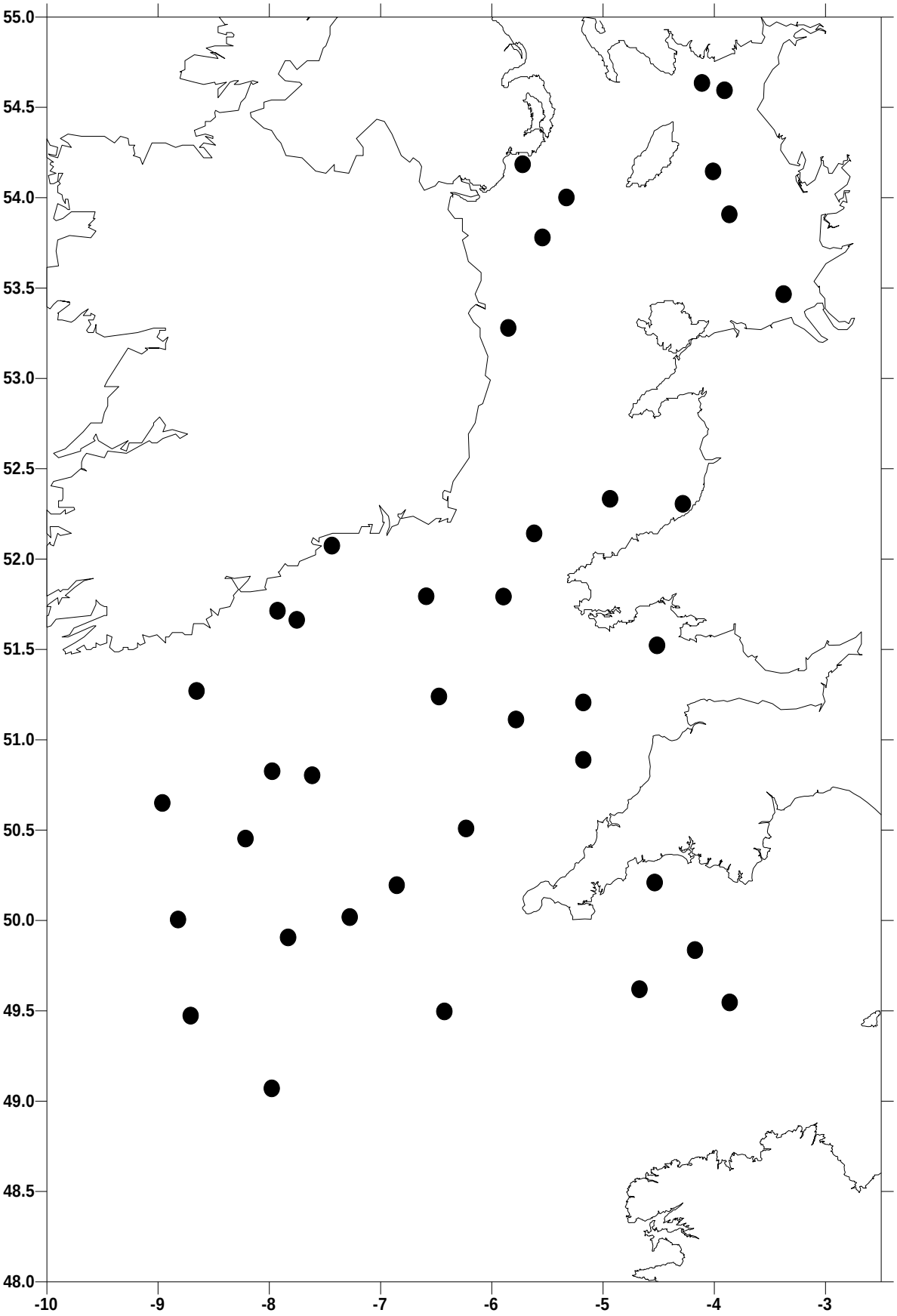

FIGURE 4: Distribution and relative abundance (no. per hour) of cod, haddock, whiting and hake. Refer to Figure 1 for which ground gear was used.

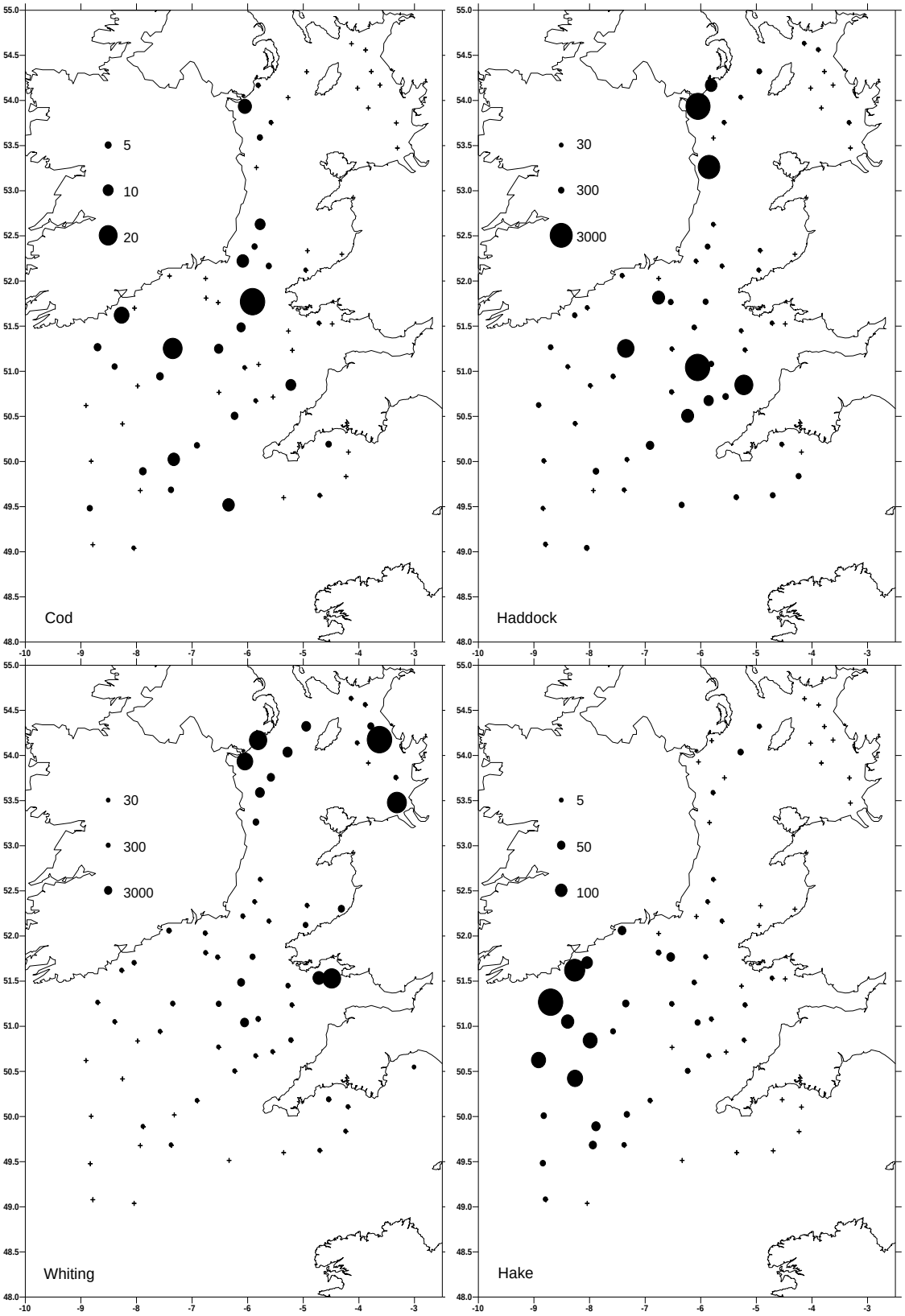

FIGURE 5: Distribution and relative abundance (no. per hour) of anglerfish, lemon sole, megrim and plaice. Refer to Figure 1 for which ground gear was used.

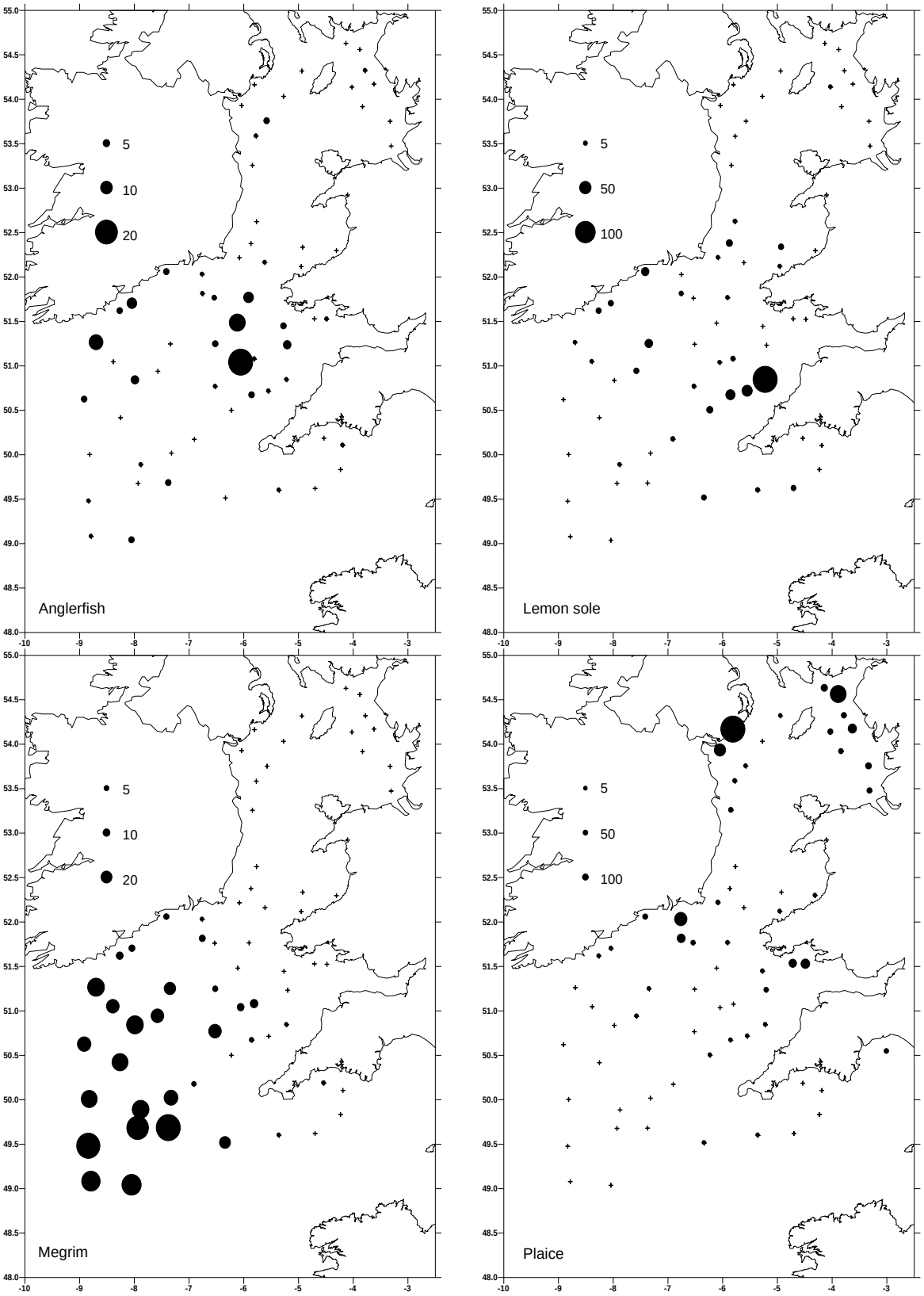

FIGURE 6: Distribution and relative abundance (no. per hour) of herring, mackerel, anchovy and pilchard. Refer to Figure 1 for which ground gear was used.

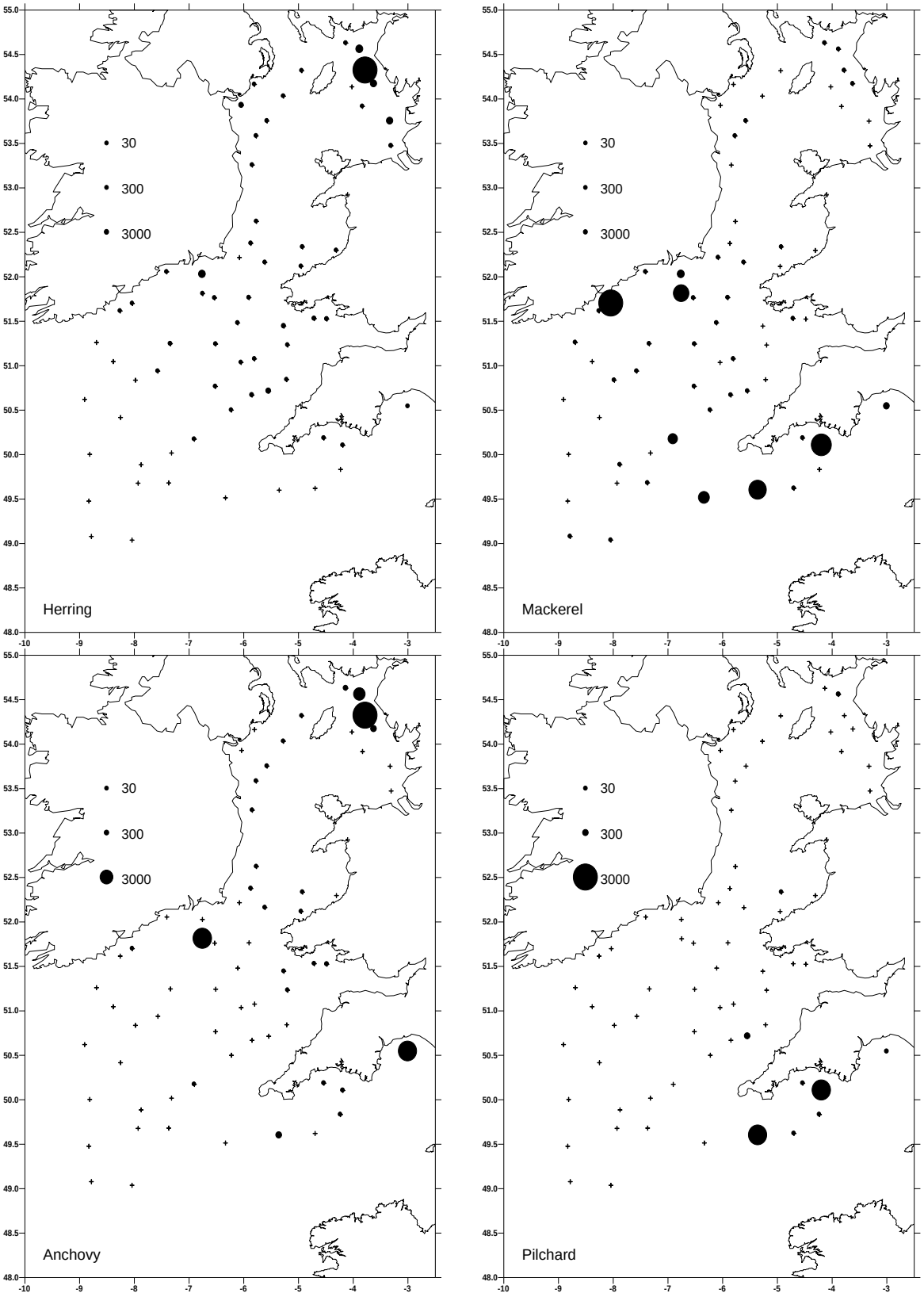

FIGURE 7: Distribution and relative abundance (no. per hour) of spurdog, thornback ray, *Nephrops*, and northern squid. Refer to Figure 1 for which ground gear was used.

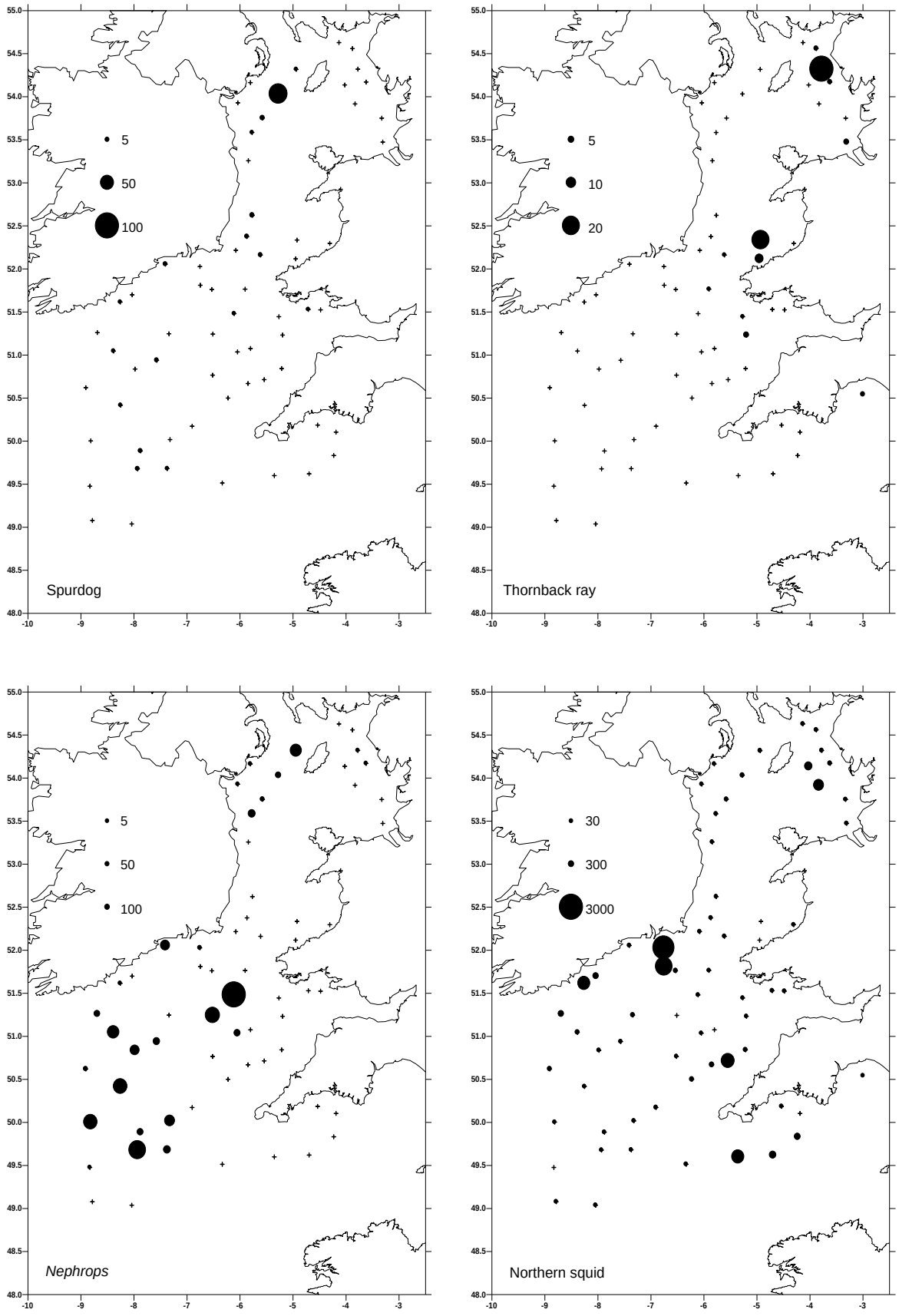

FIGURE 8: Distribution of sites of interest in the southern part of the survey grid.