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

2008 RESEARCH VESSEL PROGRAMME

REPORT: RV CEFAS ENDEAVOUR: SURVEY 19

STAFF:

Parts 1 and 2	Part 1 only	Part 2 only
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C Murray (Irish Whale and Dolphin Group)		
K Nisbet (University of Liverpool)		

DURATION: Part 1: 05–21 November. Part 2: 23 November–07 December 2008.

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), 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, shellfish, 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 (including gonadosomatic index for cod 40–70 cm)
   (d) Presence of litter
   (e) Environmental parameters (including CTD profiles and sediment samples) at trawl stations.

2. To take photographs of maturity stages of those fish species subject to biological sampling.

3. To undertake trawl sampling in the North Devon voluntary closed skate area north of Lundy.

4. To undertake comparative trawl sampling with DARD (25–28 November).

5. To tag and release specimens of spurdog *Squalus acanthias*, smooth-hound *Mustelus* spp., tope *Galeorhinus galeus* and greater-spotted dogfish *Scyliorhinus stellaris*.

6. To collect fishery acoustics information (J van der Kooij, Cefas).

7. To record details of surface sightings of any marine mammals, sea turtles and pelagic fish, and record observations on jellyfish aggregations (C Murray, IWDG).

8. To sample the epibenthos with 2m beam trawl and collect samples of marine invertebrates for genetic studies (K Nisbet, University of Liverpool).

9. To collect tissue samples and extra biological information from smoothhounds *Mustelus* spp. (E Farrell, University College Dublin).

10. To collect tissue samples from skates (Rajidae), spurdog (*Squalus acanthias*) and cod (*Gadus morhua*) for genetic analyses.

11. To collect the valves of scallop *Pecten maximus* (D. Palmer, Cefas).

NARRATIVE:

RV Cefas ENDEAVOUR sailed from Lowestoft at 23:30h on 05 November, and steamed overnight to the eastern English Channel, where a shakedown tow was undertaken off Hastings at 10:30 h the following day. Following the successful completion of this tow, Cefas ENDEAVOUR continued to steam westwards to the sampling grid in the western English Channel.

Cefas ENDEAVOUR commenced work at the first station at 06:15h on 07 November, with four fishing stations completed successfully, and a further two stations were fished the following day. With the weather conditions deteriorating, Cefas ENDEAVOUR then steamed to St Ives Bay, arriving at 20:00h and remained at anchor on 09 November.

Cefas ENDEAVOUR left St Ives Bay at 09:00h on 10 November, and successfully fished at three stations north of Cornwall before steaming northwards to St George's Channel. Poor weather conditions the following morning delayed sampling and only two stations of southeast Ireland were fished that day. With weather conditions improving on 12 November, Cefas ENDEAVOUR successfully fished at four stations in the southern part of St George's Channel, and three stations off the Welsh coastline the following day. Cefas ENDEAVOUR then worked westwards from Anglesey to the Irish coast on 14 November and completed the rockhopper stations in the southern Irish Sea the following day. That afternoon and evening, the GOV trawl with ground gear A (for fine ground) was rigged and Cefas ENDEAVOUR steamed southwards to the Celtic Deep.

Sampling with the fine ground gear commenced at first light on 16 November, and four stations were fished successfully. Cefas ENDEAVOUR steamed southwards that night and two stations in the southern Celtic Sea were fished successfully. On the third station of the day (F19), major net damage was sustained (portside lower wing and belly torn), and the spare net was rigged that evening. The following morning the next station (F16) was fished, and once again heavy damage was

sustained (belly out). Whilst the net was repaired Cefas ENDEAVOUR steamed slowly northwards and one station was fished that day, and Cefas ENDEAVOUR then steamed southwards over night. Three stations were fished successfully on 19 November, with the final tow yielding over two tonnes of boarfish. The following day Cefas ENDEAVOUR continued working northwards and three stations were fished successfully. On 21 November the propulsion failed during the first tow of the day, after approximately 11 minutes on the bottom, and with the engines and winches out of operation, the doors crossed. The trawl was brought aboard and checked, but had not sustained any damage. Cefas ENDEAVOUR then steamed northwards to undertake a tow off the southern coast of Ireland and then towards Cobh, mooring at 17:35 h.

Following a change of staff and repairs to the damaged trawl, Cefas ENDEAVOUR departed Cobh at 09:00h on 23 November, and steamed to the survey stations off southern Ireland, where three tows were completed successfully. The following day, in deteriorating sea conditions, stations off south-eastern Ireland were completed, although the final tow of the day (E5) resulted in gear damage. Given that net geometry readings did not indicate a snag, and that a good catch was made, it seemed likely that a large boulder in the belly of the net damaged the trawl on hauling, and the catch was processed (but classed as an additional tow). That evening, in poor weather and against a northerly swell, Cefas ENDEAVOUR steamed northwards through St George's Channel, to transfer a crew member to shore at Holyhead at 08:00h on 25 November. Subsequently Cefas ENDEAVOUR steamed eastwards to Liverpool Bay to rendezvous with RV CORYSTES and two comparative tows were undertaken on the survey grid. The following day, a further three comparative tows were completed, two of which were on the survey grid and the third an additional tow south of Douglas. Following the completion of this station, Cefas ENDEAVOUR steamed to Douglas where a replacement deck hand was brought aboard.

Further comparative tows with CORYSTES were undertaken on 27 November at stations in the NW Irish Sea, of which the tow outside Dundalk Bay was reduced to about 15 minutes due to the presence of static gear. The following day, comparative fishing with RV CORYSTES was undertaken at two stations, Dundrum Bay and an offshore site, with a good catch of herring and spurdog made at the latter station, before RV CORYSTES returned to Belfast. Cefas ENDEAVOUR then fished the final station in the NW Irish Sea before steaming north-east to the Solway Firth. Four stations in the North-eastern Irish Sea were fished successfully on 29 November, and Cefas ENDEAVOUR then steamed southwards to the Celtic Sea where two stations were fished successfully on 30 November, with severe gear damage on the third station of the day (E9). That evening the spare net was rigged and three stations were fished successfully the following day. On 02 December a further three stations were fished, the second tow was invalidated as the cod end tore on hauling, and a large catch of herring and mackerel was lost. Due to time constraints this station was not attempted again and Cefas ENDEAVOUR steamed towards the final station where a large catch (>7 tonnes) of herring and mackerel was brought aboard.

That evening Cefas ENDEAVOUR steamed towards the Bristol Channel where four stations were fished successfully on 03 December, although the tow duration was reduced at one station (E14) due to the presence of static gear. That evening

the rockhopper trawl was re-rigged in order to sample the proposed seasonal skate closure area and further rockhopper stations around Cornwall. Given the increasing southerly winds, Cefas ENDEAVOUR steamed to Ilfracombe to shelter. With winds increasing and veering south-westerly, and with the poor sea conditions expected to last the next few days, Cefas ENDEAVOUR steamed along the north coasts of Devon and Cornwall on 04 December and steamed through the English Channel the following day, docking at Lowestoft at approximately 15:00h on 06 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. Th Scanmar symmetry/water flow sensor was used in the centre of the headline, and the headline sensor offset to one side.

As per 2006, the rockhopper GOV was a polyethylene net, and the length of chain used to join the ground gear to the fish plate was 25 cm. The fine ground gear GOV trawl was also constructed of polyethylene, as also in 2007, and as per previous years, extra flotation was used instead of a kite and the toggle chains were set at 10 cm.

The rockhopper trawl sustained no major gear damage, although the fine ground gear experienced severe gear damage at four stations (E5, E9, F16, F19). Although these stations are mostly fine ground (as evidenced by the presence of *Nephrops* and other fine ground species), tows in the Celtic Sea have small patches of hard ground, and boulders were often taken in the belly of the net. Hence, strengthening the trawl through thicker twine in the lower panels and the inclusion of further tearing strips should be incorporated to the net design. Useful discussions were held between Cefas staff and fishing skippers regarding the gear, with several points highlighted that should help reduce gear damage and/or mending time. These points should be discussed at IBTSWG.

STATIONS SAMPLED:

Overall, 68 fixed trawl stations were fished. Twenty-four of these were fished with the modified GOV with rockhopper ground gear and 44 with the standard ground gear (Figure 1). One station resulted in major damage and was not re-sampled, though the catch and size composition was recorded at this station (it was classed as an additional tow) as the belly panel may have been damaged during hauling. An additional tow south of Dublin was also fished as part of the comparative fishing with RV CORYSTES. 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.

Vertical profiles with the mini CTD and Niskin bottle were collected at 40 stations, and eight beam trawl samples were taken in the Celtic Sea and St George's Channel (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 is summarised in Table 2. In addition to the 2,966 otoliths collected, biological parameters were also collected for 493 skates (Table 3).

Gadiforms: Cod *Gadus morhua* was caught at 16 of the valid and additional stations fished (Figure 4), with the best catches off southern Ireland (CPUE = 294 kg.h^{-1}). Haddock *Melanogrammus aeglefinus* was captured at 43 stations (Figure 4), and the maximum CPUE was >286 kg.h^{-1}. Whiting *Merlangius merlangus* was also abundant, being captured at 59 of the stations (Figure 4), and the maximum CPUE was >600 kg.h^{-1}. Hake *Merluccius merluccius* was captured at 42 stations (Figure 4), and the maximum CPUE was >58 kg.h^{-1}. .

Anglerfish: Catches of anglerfish *Lophius piscatorious* (Figure 5) and black-bellied anglerfish *L budegassa* were relatively low, with *L piscatorious* caught at 12 stations, mainly in the south-western parts of the survey grid.

Flatfish: Lemon sole *Microstomus kitt* was relatively common off southern Ireland and in the outer Bristol Channel (Figure 5), and the maximum CPUE was 10.5 kg.h^{-1}. Megrim *Lepidorhombus whiffiagonis* was caught at 21 stations (Figure 5) and the maximum CPUE was 10 kg.h^{-1}. Plaice *Pleuronectes platessa* was recorded at 32 stations (Figure 5), with good catches in Dundrum Bay, eastern Irish Sea and off south-eastern Ireland, with a maximum CPUE of >42 kg.h^{-1}.

Pelagic fish: Herring *Clupea harengus* was caught at 51 stations, with the largest catches off southern Ireland and in the north-western Irish Sea (Figure 6). Mackerel *Scomber scombrus* was caught at 30 stations, with the largest catch off southern Ireland. Catches of pilchard *Sardina pilchardus* were greatest in the western English Channel, and anchovy *Engraulis encrasicolus* were taken in lower numbers in the 2008 survey (Figure 6).

Elasmobranchs: Several tope *Galeorhinus galeus* were caught in the southern St George's Channel. Spurdog *Squalus acanthias* was caught at 18 stations, with the best catches in the north-western Irish Sea and Celtic Sea, with some of these catches comprised mostly of juveniles. Thornback ray *Raja clavata* was taken at 21 stations and were most abundant in the eastern Irish Sea (Figure 7).

Shellfish: Stations in the north-western Irish Sea, off Cumbria and in the Celtic Sea yielded good samples of *Nephrops.* Catches of northern squid *Loligo forbesi* were greatest off the north coast of Cornwall (Figure 7) and the *Illex* sp. was abundant at some stations in the Celtic Sea.

Ichthyological observations: Overall, 89 species of fish were recorded during the survey (Table 4), and most of the species caught were relatively common. Unusual fish species caught included a single specimen of porbeagle *Lamna nasus* in the Bristol Channel, two specimens of Spanish ling *Molva macophthalma* taken in the Celtic Sea, two specimens of skipper *Scomberesox saury* captured off southern Ireland and a single specimen of river lamprey *Lampetra fluviatilis* caught in the eastern Irish Sea.

Benthic observations: The benthic by-catch was quantified at all stations, although the benthos at several stations was sub-sampled. 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 5. Most of the species observed are caught routinely in this survey.

Miscellaneous studies: Data on the relationship between mantle length and total weight were collected for various species of squid, so as to provide additional data for condition factors. Data on the stomach contents of John Dory *Zeus faber* and some other fish species were also recorded.

(2) MATURITY STUDIES

Photos of the maturity stages of selected species were taken.

(3) TRAWL SAMPLING NW OF LUNDY

Poor weather prevented the sampling of the sites to the north and north-west of Lundy, although one station (E14) is on the border of this area.

(4) COMPARATIVE SAMPLING WITH RV CORYSTES

Ten stations in the Irish Sea were fished with RV CORYSTES alongside between 25-28 November, including nine standard stations and one additional station south of the Isle of Man (15 minutes tow duration). One of the standard stations was also fished for only 15 minutes due to the presence of static gear.

(5) FISH TAGGING

During the course of the survey, a total of 174 elasmobranchs (of seven species) were tagged with Petersen discs and released, with summary details given in Table 6 and release locations shown in Figure 8.

(6) FISHERY ACOUSTICS

Fishery acoustics data were collected for most days of the survey.

(7) OBSERVATIONS ON MARINE MAMMALS, PELAGIC FISH AND JELLYFISH

As this was a survey onboard a vessel of opportunity, the survey was conducted in ‘passing mode’ and cetaceans sighted were not approached. Sightings were identified to species level where possible, with species identifications being graded as definite, probable or possible. Common dolphins (*Delphis delphis*) were the most encountered species with one group estimated at more than 300 individuals in the Celtic Sea. Juveniles and calves were also sighted within these groups. There was one sighting of an unidentified whale species from a series of blows in the western English Channel. There was one probable sighting of a fin whale

(*Balaenoptera physalus*) west of the Bristol Channel, identified from a small dorsal fin. One definite sighting of a minke whale (*Balaenoptera acutorostrata)* was recorded in the Celtic Sea and a harbour porpoise (*Phocoena phocoena*) in the Irish Sea. These and all other sightings are summarised in Tables 7 and 8.

There were no surface sightings of large pelagic fish or jellyfish aggregations, though large numbers of *Rhizostoma* were caught at stations in the eastern Irish Sea.

(8) EPIBENTHIC SAMPLING

Eight sites were sampled with 2m-beam trawl (Figure 3), with most sampling in St George's Channel. Samples of the following species were collected for genetic studies: *Asterias rubens, Aphrodita aculeata, Pagurus bernhardus, Pagurus prideaux, Adamsia carciniopados, Crangon allmanni, Aequipecten opercularis, Pecten maximus* and *Alcyonium digitatum.* Additionally, samples of certain species most frequent on muddy habitats (e.g. *Alpheus glaber, Nucula sulcata* and *Goneplax rhomboides*) were also collected.

(9) BIOLOGICAL SAMPLING OF SMOOTHHOUNDS

Fin clips were taken for 50 starry smoothhound *Mustelus asterias*, and most of these were tagged and released.

(10) TISSUE SAMPLING OF SKATES , SPURDOG AND COD

Tissue samples were collected for a variety of skates, including *Dipturus batis* (n = 3), *Leucoraja fullonica* (n = 1); *L. naevus* (n = 25), *Raja brachyura* (n = 13), *R. clavata* (n = 118), *R. microocellata* (n = 22), *R. montagui* (n = 48); spurdog *Squalus acanthias* (n = 124) and cod *Gadus morhua* (n = 47).

(11) COLLECTION OF SCALLOPS (*PECTEN MAXIMUS*)

The flat valves of 26 specimens of scallop *Pecten maximus* were retained for age and growth studies.

We thank the officers and crew for all their hard work during the course of the survey.

J Ellis
06 December 2008

SEEN IN DRAFT
R McCurry (Master)
A Simpson (Senior Fishing Mate)

INITIALLED:
S Kupschus

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)

TABLE 1: Summary of gear deployments.

Gear	Valid	Additional	Invalid	Total
GOV (Rockhopper)	24	1 [(a)]	0	25
GOV (Standard ground gear)	44	2 [(b)]	6 [(C)]	52
Niskin Bottle/Mini CTD	40	-	-	40
2m beam trawl	8	-	-	8
			Total	**125**

(a) Shakedown tow
(b) Includes one haul where the net was damaged (possibly on hauling) and one extra comparative tow with RV CORYSTES
(c) Includes three stations where severe gear damage was sustained, one station that had a short tow duration due to the presence of static gear, one station where the propulsion and winches failed mid-tow and one station where the catch was lost when the cod end parted on hauling the net on board

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	8
	VII e-k	38
Haddock *Melanogrammus aeglefinus*	VII a	146
	VII b-k	340
Whiting *Merlangius merlangus*	VII a	223
	VII e-k	248
Hake *Merluccius merluccius*	Northern	268
Megrim *Lepidorhombus whiffiagonis*	VII b,c,e-k, VIII a,b,d	190
Lemon sole *Microstomus kitt*	–	100
Plaice *Pleuronectes platessa*	VII a	456
	VII e and VII f-g	230
Sole *Solea solea*	VII a	21
	VII e and VII f-g	52
Turbot *Psetta maximus*	–	11
Brill *Scophthalmus rhombus*	–	16
[1] Anglerfish *Lophius piscatorius*	VII a-k	18
Anglerfish *Lophius budegassa*	VII b-k	28
[2] Bass *Dicentrarchus labrax*	–	15
Red mullet *Mullus surmuletus*	–	4
Herring *Clupea harengus*	VII a	195
	Celtic Sea	154
Mackerel *Scomber scombrus*	Western	205
	Total	**2966**

[1] Includes ilicia
[2] Includes scales

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

Species	Number examined for maturity
Common skate *Dipturus batis*	3
Shagreen ray *Leucoraja fullonica*	1
Cuckoo ray *Leucoraja naevus*	42
Blonde ray *Raja brachyura*	15
Thornback ray *Raja clavata*	228
Smalleyed ray *Raja microocellata*	105
Spotted ray *Raja montagui*	99
Total	**493**

TABLE 4: 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 2008, but have been reported in earlier surveys.

Species	Stns	Species	Stns
Lamprey *Lampetra fluviatilis*	1	Haddock *Melanogrammus aeglefinus*	43
Spurdog *Squalus acanthias*	18	Whiting *Merlangius merlangus*	59
Porbeagle *Lamna nasus*	1	Blue whiting *Micromesistius poutassou*	31
Black-mouth dogfish *Galeus melastomus*	-	Pollock *Pollachius pollachius*	5
Lesser-spotted dogfish *Scyliorhinus canicula*	63	Saithe *Pollachius virens*	-
Greater-spotted dogfish *Scyliorhinus stellaris*	8	Norway pout *Trisopterus esmarki*	39
Tope *Galeorhinus galeus*	7	Bib *Trisopterus luscus*	8
Starry smoothhound *Mustelus asterias*	14	Poor cod *Trisopterus minutus*	65
Smoothhound *Mustelus mustelus*	-	Greater forkbeard *Phycis blennoides*	8
Common skate *Dipturus batis*	2	Spanish ling *Molva macrophthalma*	1
Cuckoo ray *Leucoraja naevus*	11	Ling *Molva molva*	7
Shagreen ray *Leucoraja fullonica*	1	Northern rockling *Ciliata septentrionalis*	6
Blonde ray *Raja brachyura*	8	5-bearded rockling *Ciliata mustela*	3
Thornback ray *Raja clavata*	21	4-bearded rockling *Enchelyopus cimbrius*	11
Smalleyed ray *Raja microocellata*	6	3-bearded rockling *Gaidropsarus vulgaris*	2
Spotted ray *Raja montagui*	19	Hake *Merluccius merluccius*	42
Electric ray *Torpedo nobiliana*	-	Garfish *Belone belone*	-
Stingray *Dasyatis pastinaca*	-	Skipper *Scomberesox saury*	1
Eel *Anguilla anguilla*	-	John dory *Zeus faber*	36
Conger eel *Conger conger*	11	Boarfish *Capros aper*	16
Allis shad *Alosa alosa*	-	Snake pipefish *Entelurus aequoreus*	5
Twaite shad *Alosa fallax*	1	Greater pipefish *Syngnathus acus*	9
Herring *Clupea harengus*	51	Blue mouth redfish *Helicolenus dactylopterus*	-
Sprat *Sprattus sprattus*	46	Red gurnard *Aspitrigla cuculus*	20
Pilchard *Sardina pilchardus*	17	Grey gurnard *Eutrigla gurnardus*	50
Anchovy *Engraulis encrasicolus*	17	Tub gurnard *Trigla lucerna*	23
Salmon *Salmo salar*	-	Streaked gurnard *Trigloporus lastoviza*	1
Sea trout *Salmo trutta*	-	Bullrout *Myoxocephalus scorpius*	-
Argentine *Argentina* sp.	29	Sea scorpion *Taurulus bubalis*	-
Pearlside *Maurolicus muelleri*	25	Norwegian bullhead *Taurulus lilljeborgi*	-
Black-bellied anglerfish *Lophius budegassa*	13	Pogge *Agonus cataphractus*	7
Anglerfish *Lophius piscatorius*	12	Lumpsucker *Cyclopterus lumpus*	-
Silvery pout *Gadiculus argenteus*	16	Sea snail *Liparis liparis*	8
Cod *Gadus morhua*	16	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 2008, but have been reported in earlier surveys.

Species	Stns	Species	Stns
Bass *Dicentrarchus labrax*	6	Jeffrey's goby *Buenia jeffreysi*	10
Bogue *Boops boops*	-	Crystal goby *Crystallogobius linearis*	2
Red seabream *Pagellus bogaraveo*	-	Black goby *Gobius niger*	-
Black seabream *Spondyliosoma cantharus*	-	Steven's goby *Gobius gasteveni*	-
Scad *Trachurus trachurus*	55	Rock goby *Gobius paganellus*	-
Red mullet *Mullus surmuletus*	4	Fries's goby *Lesueurigobius friesii*	4
Redband fish *Cepola rubescens*	4	Sand goby *Pomatoschistus* spp.	33
Corkwing wrasse *Crenilabrus melops*	-	Mackerel *Scomber scombrus*	30
Goldsinny wrasse *Ctenolabrus rupestris*	5	Four-spot megrim *Lepidorhombus boscii*	2
Ballan wrasse *Labrus bergylta*	-	Megrim *Lepidorhombus whiffiagonis*	21
Cuckoo wrasse *Labrus mixtus*	1	Turbot *Psetta maximus*	6
Lesser weever *Echiichthys vipera*	3	Brill *Scophthalmus rhombus*	8
Greater weever *Trachinus draco*	-	Norwegian topknot *Phrynorhombus norvegius*	-
Raitts sandeel *Ammodytes marinus*	-	Topknot *Zeugopterus punctatus*	-
Common sandeel *Ammodytes tobianus*	4	*Imperial scaldfish* Arnoglossus imperialis	2
Smooth sandeel *Gymnammodytes semisquamatus*	1	*Scaldfish* Arnoglossus laterna	20
Immaculate sandeel *Hyperoplus immaculatus*	4	Witch *Glyptocephalus cynoglossus*	16
Greater sandeel *Hyperopus lanceolatus*	7	Long-rough dab *Hippoglossoides platessoides*	25
Sand eel Ammodytidae indet.	4	Dab *Limanda limanda*	36
Common dragonet *Callionymus lyra*	35	Lemon sole *Microstomus kitt*	22
Spotted dragonet *Callionymus maculates*	21	Flounder *Platichthys flesus*	3
Reticulate dragonet *Callionymus reticulatus*	1	Plaice *Pleuronectes platessa*	32
Butterfly blenny *Blennius ocellaris*	-	Solenette *Buglossideum luteum*	14
Tompot blenny *Parablennius gattorugine*	-	Thickback sole *Microchirus variegatus*	26
Yarrell's blenny *Chirolophis ascanii*	-	Sand sole *Pegusa lascaris*	3
Butterfish *Pholis gunnellus*	-	Sole *Solea solea*	20
Transparent goby *Aphia minuta*	1	Triggerfish *Balistes capriscus*	-

TABLE 5: Taxonomic list of invertebrates caught during the survey.

Dysidea fragilis	*Hyas coarctatus*	*Sepia elegans*
Suberites sp.	*Eurynome aspera*	*Sepia officinialis*
Porifera (indet.)	*Inachus dorsettensis*	*Rossia macrosoma*
Nemertesia antennina	*Inachus leptochirus*	*Sepiola atlantica*
Lytocarpia myriophyllum	*Macropodia linaresi*	*Alloteuthis subulata*
Hydrozoa (indet.)	*Macropodia rostrata*	*Loligo forbesi*
Epizoanthus papillosus	*Macropodia tenuirostris*	*Illex* sp.
Alcyonium digitatum	*Maia squinado*	*Todaropsis eblanae*
Caryophyllia smithi	*Atelecyclus rotundatus*	*Eledone cirrosa*
Actinauge richardi	*Cancer pagurus*	*Pentapora foliacea*
Adamsia carciniopados	*Corystes cassivelaunus*	*Alcyonidium diaphanum*
Metridium senile	*Thia scutellata*	*Alcyonidium parasiticum*
Urticina felina	*Liocarcinus depurator*	*Cellaria* spp.
Anemone (indet.)	*Liocarcinus holsatus*	*Flustra foliacea*
Aphrodita aculeata	*Liocarcinus pusillus*	*Antedon bifida*
Hermione hystrix	*Macropipus tuberculatus*	*Astropecten irregularis*
Sabellaria spinulosa	*Necora puber*	*Luidia ciliaris*
Hyalinoecia tubicola	*Goneplax rhomboides*	*Luidia sarsi*
Maxmuelleri lankesteri	*Monodeus couchi*	*Stichastrella rosea*
Scalpellum scalpellum	*Pycnogonum littorale*	*Henricia oculata*
Cirolana cranchii	Polyplacophora (indet.)	*Anseropoda placenta*
Eurydice spp.	*Emarginula fissura*	*Porania pulvillus*
Epimeria conchilega	*Aporrhais pespelecani*	*Crossaster papposus*
Solenocera membranacea	*Calliostoma papillosum*	*Asterias rubens*
Alpheus glaber	*Calliostoma zizyphinum*	*Leptasterias muelleri*
Pasiphaea sivado	*Crepidula fornicata*	*Marthasterias glacialis*
Palaemon serratus	*Turritella communis*	*Ophiura albida*
Processa canaliculata	*Euspira fusca*	*Ophiura ophiura*
Pandalina brevirostris	*Polinices catena*	*Ophiocomina nigra*
Pandalus montagui	*Buccinum humphreysianum*	*Ophiothrix lutkeni*
Pandalus propinquus	*Buccinum undatum*	*Ophiothrix fragilis*
Dichelopandalus bonnieri	*Colus gracilis*	*Echinus acutus*
Spirontocaris lilljeborgi	*Neptunea antiqua*	*Echinus esculentus*
Crangon allmanni	*Scaphander lignarius*	*Psamechinus miliaris*
Crangon crangon	*Philine aperta*	*Echinocardium cordatum*
Philocheras echinulatus	*Archidoris pseudargus*	*Spatangus purpureus*
Philocheras trispinosus	*Nudibranchia* (indet.)	*Holothuroidea* (indet.)
Pontophilus spinosus	*Nucula sulcata*	*Botryllus schlosseri*
Homarus gammarus	*Glycymeris glycymeris*	*Ascidia conchilega*
Nephrops norvegicus	*Aequipecten opercularis*	*Ascidia mentula*
Anapagurus laevis	*Chlamys varia*	*Ascidiella aspersa*
Pagurus bernhardus	*Palliolum tigerinum*	*Ascidiella scabra*
Pagurus prideaux	*Pecten maximus*	*Ascidiacea* (indet.)
Pagurus variabilis	*Mytilus edulis*	
Galathea spp.	*Modiolus modiolus*	
Munida rugosa	*Acanthocardia* sp.	
Calocaris macandreae	*Astarte sulcata*	
Pisidia longicornis	*Chamelea gallina*	
Ebalia cranchii	*Clausinella fasciata*	
Ebalia tuberosa	*Timoclea ovata*	
Ebalia tumefacta	*Phaxus pellucidus*	

TABLE 6: Summary of elasmobranchs tagged and released.

Species/Sex	Female	Male
Spurdog *Squalus acanthias*	41	53
Greater spotted dogfish *Scyliorhinus stellaris*	10	6
Tope *Galeorhinus galeus*	3	9
Starry smoothhound *Mustelus asterias*	12	33
Common skate *Dipturus batis*	2	1
Shagreen ray *Leucoraja fullonica*	1	0
Blonde ray *Raja brachyura*	0	3
Total	**69**	**105**

TABLE 7: Summary of cetacean sightings recorded during survey hours.

Date	Time	Deg	Min	Deg	Min	Species	Number	Adult	Juv.	Calf	Behaviour 1	Behaviour 2	Behavior 3
08/11/2008	10:11	49	35.7	5	11.9	Unidentified Whale	1	1			Whale Blow		
08/11/2008	14:00	49	34.4	5	39.7	Common Dolphins	5	5			Fast swim	Leap Splashing	Bow Ride
14/11/2008	14:35	53	10.8	5	51.5	Harbour Porpoise	1	1			Slow Swim		
16/11/2008	08:56	51	39.9	5	58.2	Common Dolphins	15+	13+		2	Slow Swim	Bow Ride	
16/11/2008	10:14	51	28.3	6	6.8	Common Dolphins	2	2			Bow Ride		
16/11/2008	11:45	51	20.9	6	18.5	Common Dolphins	4	4			Bow Ride		
16/11/2008	14:45	51	7.3	6	14.6	Common Dolphins	8	4			Bow Ride		
16/11/2008	15:25	51	5.1	6	10.0	Common Dolphins	300+	10+			Slow Swim	Feeding	Fast swim
16/11/2008	15:25	51	2.3	6	2.8	Minke Whale	1	1			Whale Blow	Slow Swim	
17/11/2008	08:07	50	1.3	7	16.1	Common Dolphins	8+	8			Slow Swim	Leap Splashing	
17/11/2008	08:07	50	1.3	7	15.5	Common Dolphins	50+	50			Slow Swim		
17/11/2008	08:59	49	55.6	7	16.9	Common Dolphins	8	6		2	Slow Swim	Fast swim	
17/11/2008	08:59	49	54.1	7	17.6	Common Dolphins	8+	7+		1	Slow Swim	Fast swim	
17/11/2008	09:59	49	44.4	7	20.9	Common Dolphins	8+	8+			Slow Swim		
17/11/2008	09:59	44	42.8	7	21.4	Common Dolphins	4	5			Slow Swim		
17/11/2008	10:38	49	41.6	7	22.6	Common Dolphins	10+	10+			Slow Swim	Leap Splashing	Bow Ride
17/11/2008	10:58	49	42.3	7	22.8	Common Dolphins	15-20	15+	1	1	Slow Swim		
17/11/2008	11:42	49	43.7	7	23.9	Common Dolphins	c5	c5			Slow Swim		
17/11/2008	11:42	49	42.1	7	23.1	Common Dolphins	15	10	3	2	Slow Swim	Fast swim	
17/11/2008	14:14	49	13.1	7	10.4	Common Dolphins	4 to 6	4 to 6			Slow Swim	Fast swim	Bow Ride
17/11/2008	14:14	49	11.4	7	9.7	Common Dolphins	4 to 6	4 to 6			Slow Swim	Fast swim	Bow Ride
17/11/2008	14:14	49	9.5	7	8.7	Common Dolphins	3 to 5	4			Slow Swim	Fast swim	
18/11/2008	12:29	49	35.8	7	54.0	Common Dolphins	8 to 10	8 to 10			Fast swim	Leap Splashing	
18/11/2008	12:29	49	36.2	7	54.4	Common Dolphins	10 to 20	10 to 20			Fast swim	Leap Splashing	
18/11/2008	12:29	49	36.0	7	54.8	Common Dolphins	c15	c15			Fast swim	Leap Splashing	
18/11/2008	13:09	49	38.1	7	56.4	Common Dolphins	c10	c10			Fast swim		
18/11/2008	13:49	49	39.6	7	58.8	Common Dolphins	c8	c8			Fast swim		
18/11/2008	15:33	49	39.4	7	56.9	Common Dolphins	12	10	1	1	Fast swim	Leap Splashing	
18/11/2008	16:25	49	43.1	7	58.2	Common Dolphins	15	15			Fast swim	Leap Splashing	

TABLE 7 (continued): Summary of cetacean sightings recorded during survey hours.

19/11/2008	08:59	49	8.1	8	47.0	Common Dolphins	c10	10			Fast swim		
19/11/2008	11:20	49	28.5	8	47.4	Common Dolphins	c17	c17			Fast swim		
19/11/2008	11:40	49	28.5	8	46.0	Common Dolphins	c80	c80			Fast swim		
19/11/2008	13:29	49	36.7	8	26.4	Common Dolphins	8	8			Fast swim		
19/11/2008	13:29	49	38.2	8	23.6	Common Dolphins	8	6	2		Fast swim		
19/11/2008	13:49	49	20.9	8	20.9	Common Dolphins	16	16			Fast swim		
20/11/2008	08:00	50	3.3	8	46.3	Common Dolphins	8	8			Fast swim		
20/11/2008	11:10	50	21.6	8	18.8	Common Dolphins	50+	50+			Fast swim		
23/11/2008	10:44	51	35.7	8	15.0	Unidentified Dolphin	6	6			Fast swim	Bow Ride	
30/11/2008	09:45	51	20.2	5	24.7	Common Dolphins	4	4			Leap Splashing		
30/11/2008	10:05	51	15.5	5	32.4	Fin Whale	1	1			Slow Swim		
30/11/2008	10:05	51	15.5	5	32.4	Common Dolphins	8	5	3		Leap Splashing		
30/11/2008	12:30	51	1.5	5	49.4	Common Dolphins	4	4			Leap Splashing		
30/11/2008	12:50	51	0.2	5	53.4	Common Dolphins	8	6	2		Leap Splashing		
30/11/2008	12:50	50	59.4	5	56.0	Common Dolphins	10	10			Leap Splashing		
30/11/2008	12:50	50	58.0	6	0.3	Common Dolphins	c20	c20			Leap Splashing	Bow Ride	
01/12/2008	09:00	50	46.2	7	38.2	Common Dolphins	c5	5			Fast swim	Leap Splashing	
01/12/2008	09:00	50	46.2	7	38.2	Common Dolphins	c30	28	2		Fast swim	Leap Splashing	
01/12/2008	09:20	50	48.2	7	44.5	Common Dolphins	c8	8			Fast swim	Leap Splashing	
01/12/2008	12:42	50	59.9	8	16.1	Common Dolphins	c8	8			Fast swim	Leap Splashing	
02/12/2008	12:57	51	40.5	7	10.7	Common Dolphins	8	7	1		Fast swim	Leap Splashing	
02/12/2008	15:20	51	45.8	6	31.7	Common Dolphins	10	10			Fast swim	Leap Splashing	
02/12/2008	15:40	51	45.1	6	30.8	Common Dolphins	25	25			Fast swim	Leap Splashing	
03/11/2008	15:51	51	11.3	6	11.2	Common Dolphins	c5	c5			Slow Swim	Fast swim	

Table 8: Summary of cetacean sightings recorded outside logged survey hours.

Date	Time	Deg	Min	Deg	Min	Species	Number	Adult	Juv.	Calf	Behaviour 1	Behaviour 2	Behaviour 3
07/11/2008	09:16	50	6.5	4	6.0	Common Dolphin	5	5			Slow Swim		
08/11/2008	15:45	49	39.0	5	54.5	Common Dolphin	8	8			Bow Ride	Rest Milling	
17/11/2008	07:26	50	1.1	7	21.3	Common Dolphin	2	2			Slow Swim		
18/11/2008	08:34	49	26.1	7	39.0	Common Dolphin	50+	40	10		Fast Swim	Bow Ride	
18/11/2008	11:33	49	31.3	7	48.7	Common Dolphin	5	4	1		Fast Swim	Bow Ride	Rest Milling
18/11/2008	11:51	49	32.5	7	50.6	Common Dolphin	6	6			Fast Swim	Bow Ride	
19/11/2008	08:28	49	5.4	8	46.7	Common Dolphin	c7	7			Fast Swim		
19/11/2008	08:31	49	7.6	8	47.0	Common Dolphin	c7	7			Fast Swim		
19/11/2008	09:17	49	8.1	8	47.0	Common Dolphin	3	2	1		Fast Swim		
19/11/2008	09:22	49	10.9	8	47.1	Common Dolphin	5	5			Fast Swim		
19/11/2008	09:32	49	13.5	8	47.1	Common Dolphin	15	13	2		Fast Swim		
20/11/2008	13:40	50	31.1	8	29.3	Common Dolphin	10	10			Fast Swim		
21/11/2008	08:14	51	1.0	8	24.9	Common Dolphin	3	3			Fast Swim		
21/11/2008	09:54	51	1.3	8	23.1	Common Dolphin	c15	15			Fast Swim		
23/11/2008	11:40	51	35.7	8	15.0	Common Dolphin	12	12			Fast Swim		
23/11/2008	14:28	51	38.7	7	48.6	Common Dolphin	8	8			Fast Swim	Rest Milling	
01/12/2008	07:51	50	48.2	7	32.2	Common Dolphin	c50	c45	5		Fast Swim	Bow Ride	Rest Milling

FIGURE 1: Study area showing sites sampled with GOV trawl with rockhopper ground gear (filled squares: valid tows) and standard ground gear (filled circles: valid tows; open circles: additional tows; open asterix: invalid tows).

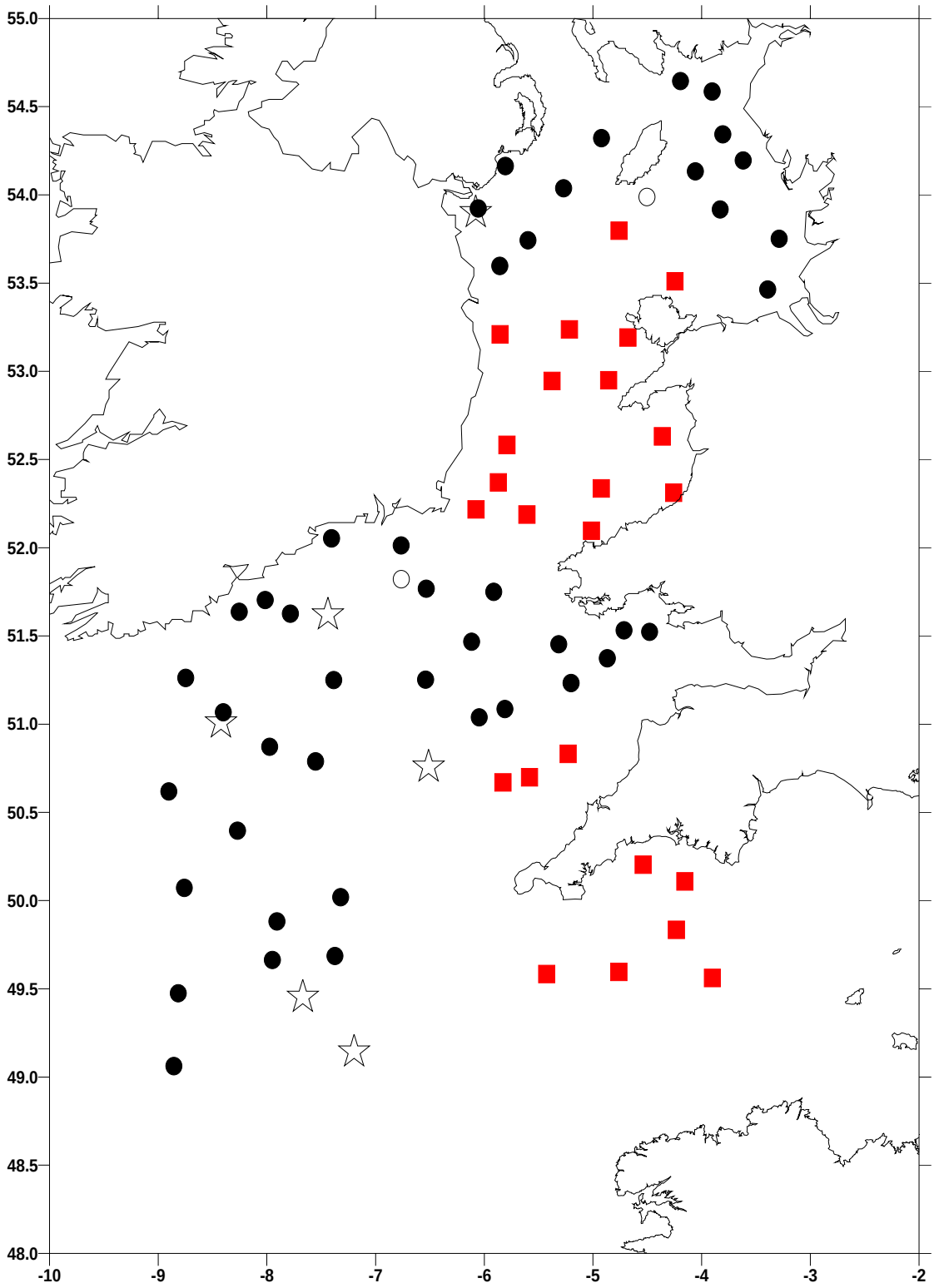

FIGURE 2: Graphs showing relationships between headline height, wing spread and door spread with depth for the GOV trawl with rockhopper ground gear (left hand panel) and standard ground gear (right hand panel) for 2008 (filled circles) and 2006-2007 (open circles).

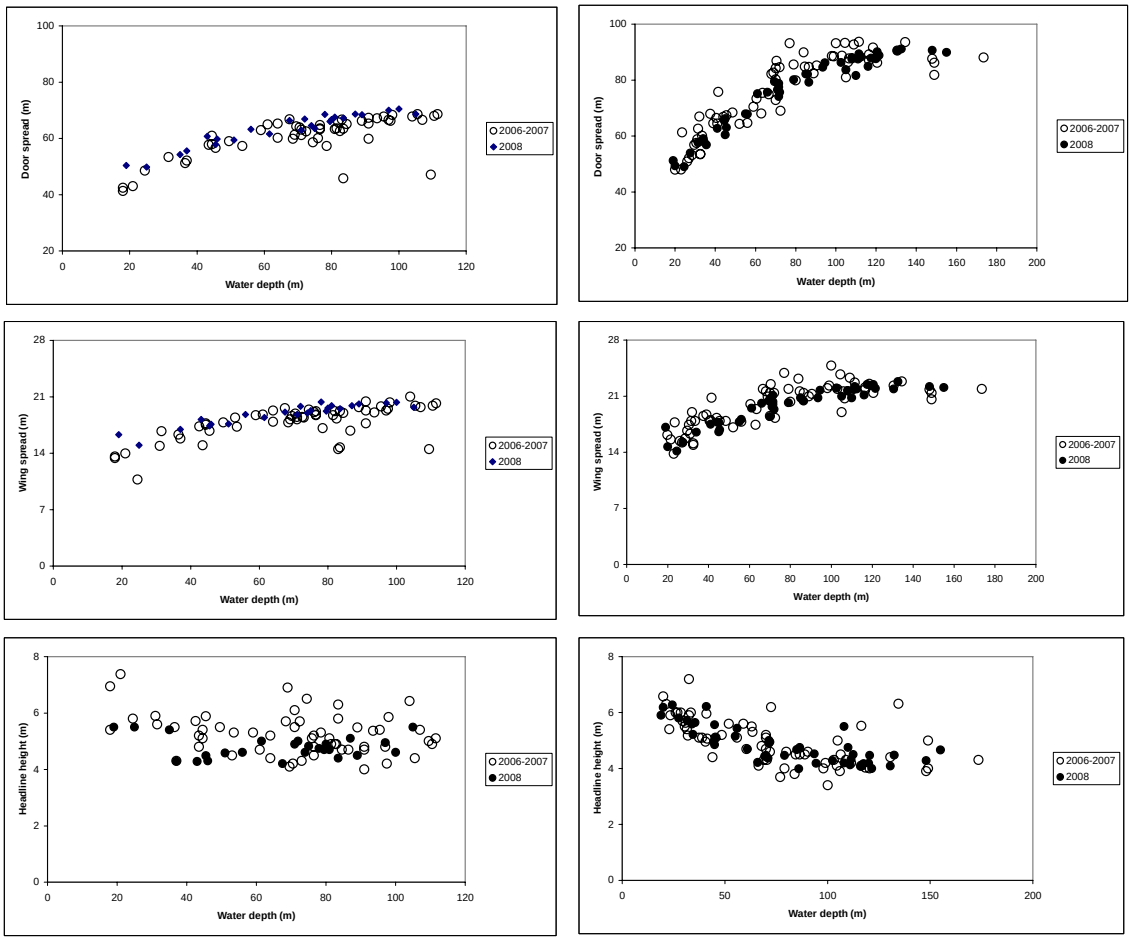

FIGURE 3: Study area indicating sites sampled with mini CTD and niskin bottle (triangles), and 2m-beam trawl (open square).

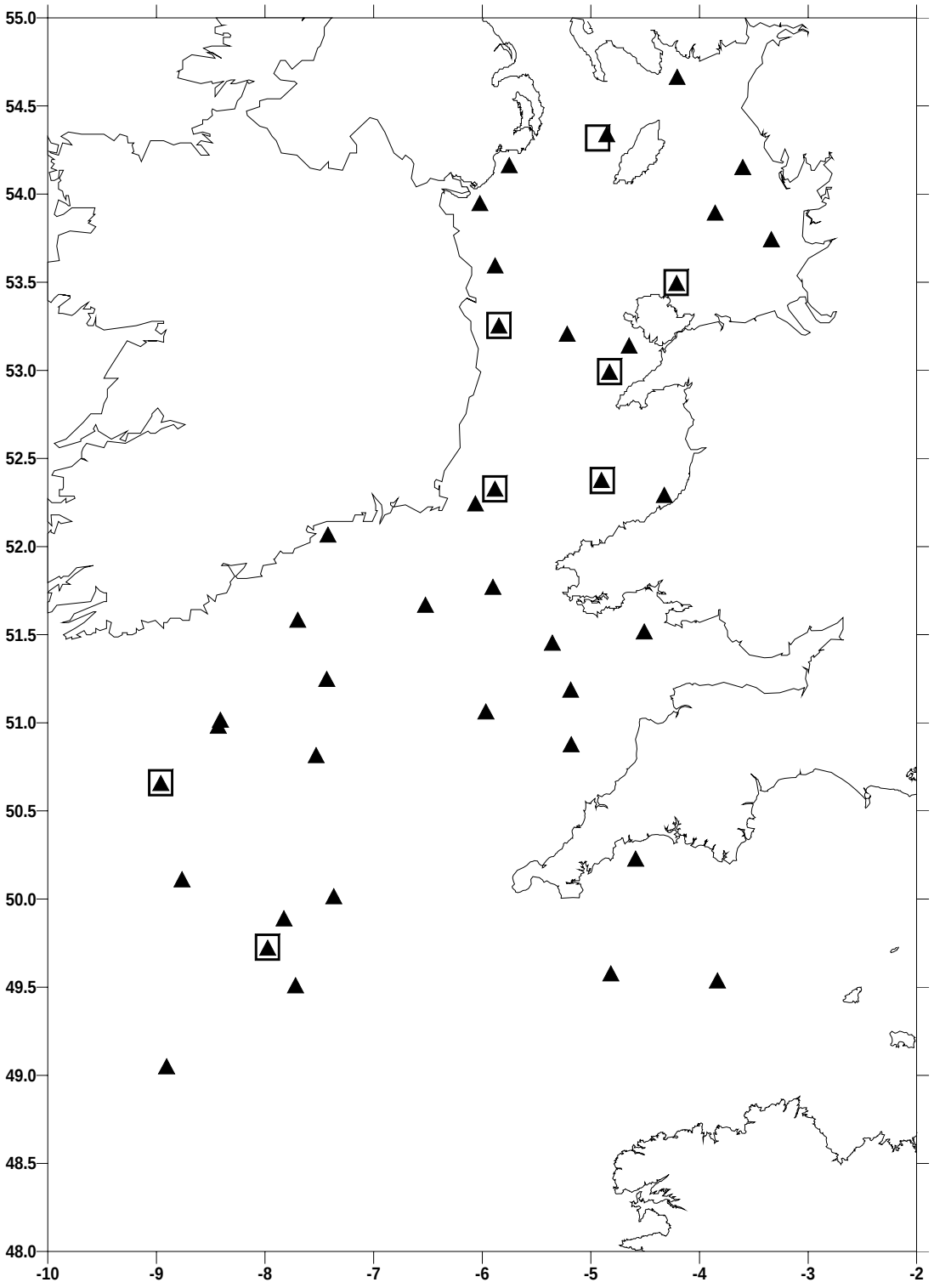

FIGURE 4: Distribution and relative abundance (no. per hour) of cod (COD), haddock (HAD), whiting (WHG) and hake (HKE). Refer to Figure 1 for which ground gear was used.

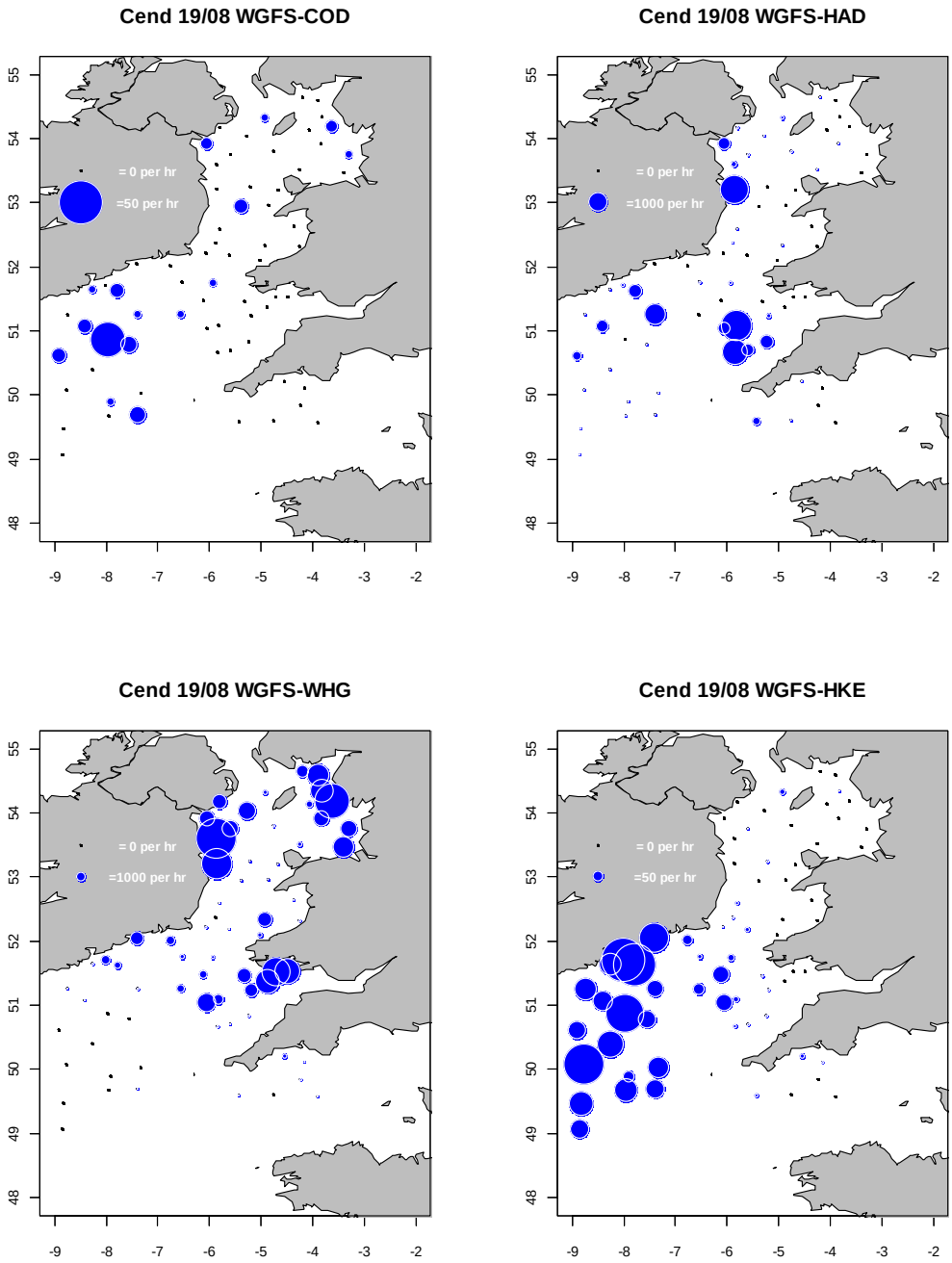

FIGURE 5: Distribution and relative abundance (no. per hour) of anglerfish (MON), lemon sole (LEM), megrim (MEG) and plaice (PLE). Refer to Figure 1 for which ground gear was used.

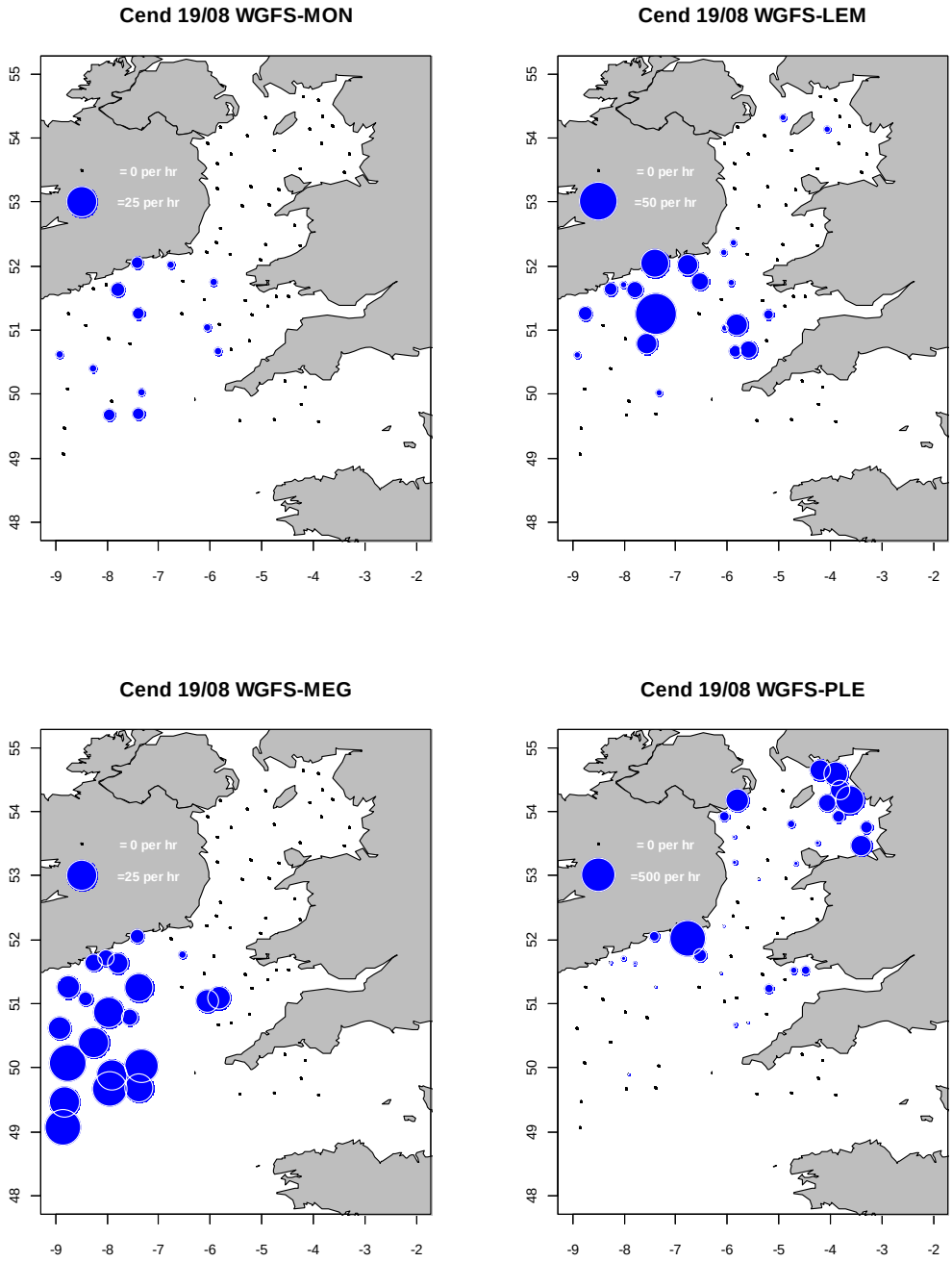

FIGURE 6: Distribution and relative abundance (no. per hour) of herring (HER), mackerel (MAC), anchovy (ANE) and pilchard (PIL). Refer to Figure 1 for which ground gear was used.

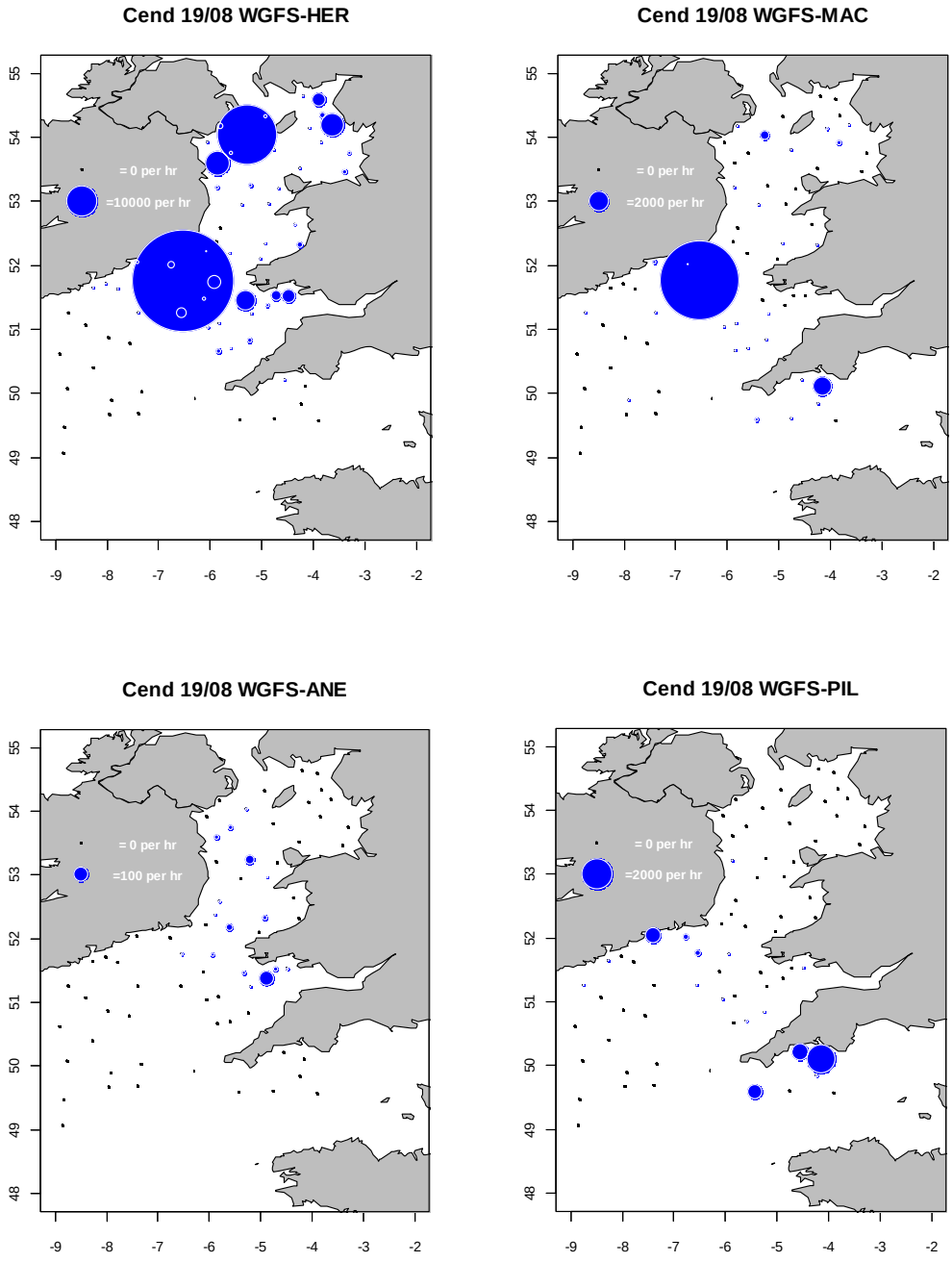

FIGURE 7: Distribution and relative abundance (no. per hour) of spurdog (DGS), thornback ray (THR), *Nephrops* (NEP), and northern squid (NSQ). Refer to Figure 1 for which ground gear was used.

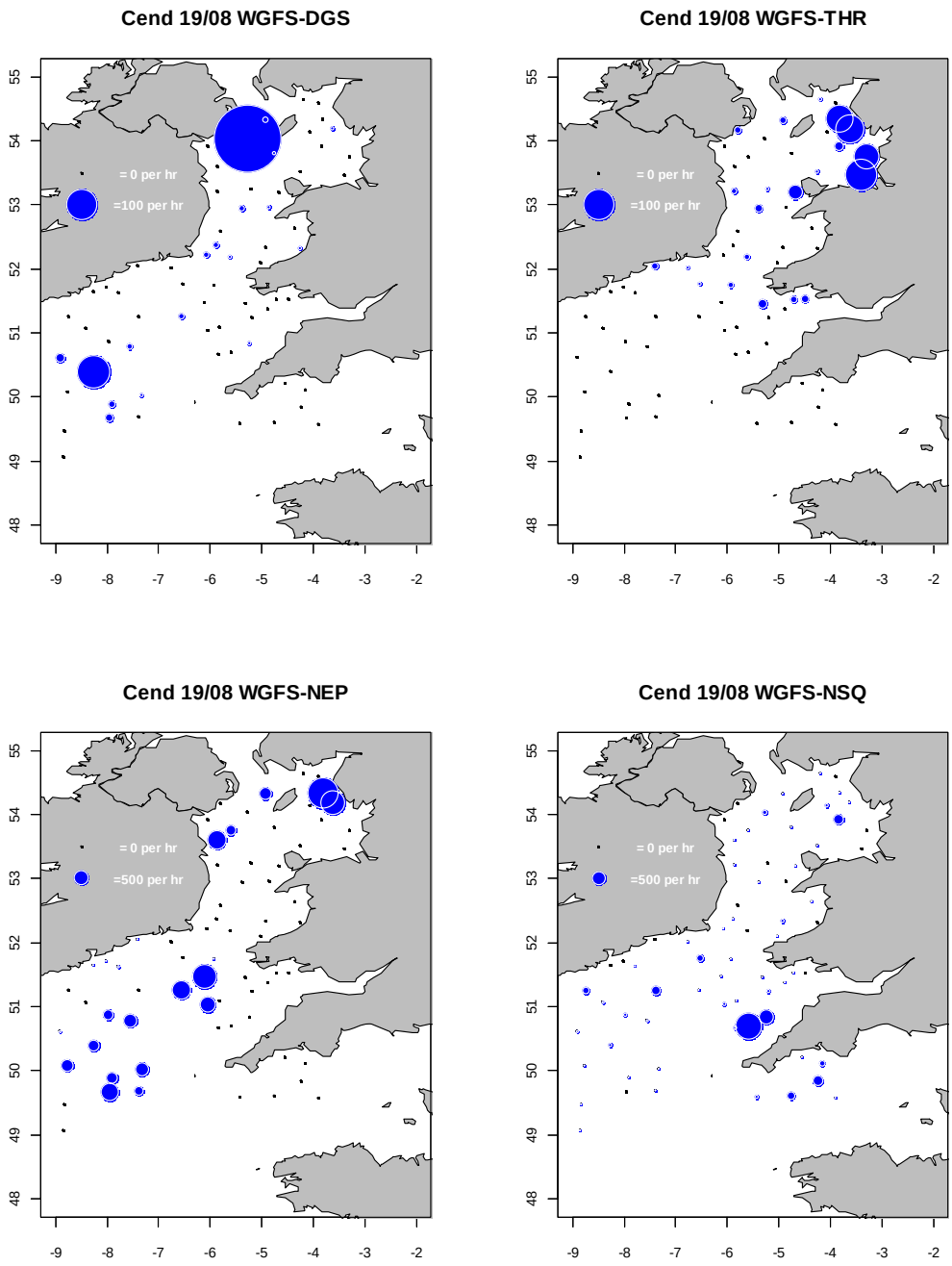

FIGURE 8: Study area and sites where elasmobranchs were tagged and released (Maximum symbol size is 59 fish).