

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

**2009 RESEARCH VESSEL PROGRAMME**

**REPORT: RV CEFAS ENDEAVOUR: SURVEY 17**

**STAFF:**

Parts 1

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Part 2 only

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**DURATION:** Part 1: 05–21 November. Part 2: 22 November–06 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, 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 take photographs of (a) fish species for the Photo-ID guide; (b) maturity stages of plaice (1 per cm for each sex).
3. To undertake comparative trawl sampling with RV *Corystes* (23–27 November)
4. To tag and release specimens of spurdog *Squalus acanthias*, smooth-hound *Mustelus* spp., tope *Galeorhinus galeus*, greater-spotted dogfish *Scyliorhinus stellaris* and selected skates and rays.
5. To collect information on the body dimensions of spurdog (and other dogfish) and post-mortem changes in length (J Ellis)

6. To collect otoliths from selected fish species (M Etherton)
7. To collect fishery acoustics information (J van der Kooij)
8. To record details of surface sightings of any marine mammals, sea turtles and pelagic fish, and record observations on jellyfish aggregations
9. To collect tissue samples from skates (Rajidae), cod, brill and turbot for genetic analyses
10. To collect the valves of scallop *Pecten maximus* (D. Palmer, Cefas)
11. To freeze any specimens of corkwing wrasse *Symphodus melops* (Halvor Knutsen, Norway)
12. To collect and cryopreserve biological material from fish species, and freeze or photograph voucher specimens of fish species (D. Rawson, University of Bedfordshire)
13. To sample the epibenthos in ICES Divisions VIIe-h with 2 m beam trawl

#### **NARRATIVE:**

RV Cefas Endeavour sailed from Lowestoft at 0930h on 5 November, and steamed southwards, with a shakedown tow undertaken with the rockhopper GOV trawl in the southern North Sea. Following the successful completion of this tow, the vessel continued steaming to the English Channel, reaching the first trawl station in the western English Channel at noon on 6 November. A second trawl station was fished that day, although this resulted in some gear damage (a hole in the belly of the net). The following day, a further three stations were fished successfully, although deteriorating weather conditions prevented sampling in the late afternoon and Cefas Endeavour steamed inshore, sheltering off Falmouth. The severe weather continued on 8 November, and so fishing continued on 9 November, with three stations around the Cornish peninsula fished without incident. A further four stations off the north coast of Devon were completed on 10 November and that night Cefas Endeavour steamed northwards to Cardigan Bay.

Sampling in Cardigan Bay commenced at first light on 11 November, with four trawl stations fished successfully, and a further three trawl stations offshore from the Llyn Peninsula and Anglesey fished the following day. The weather deteriorated during the course of the day, and after the third and final trawl station of the day Cefas Endeavour sheltered in Red Wharf Bay. Cefas Endeavour steamed northwards on the morning of 13 November, and the first trawl station was fished at first light. A further three trawl stations were fished that day, although the third trawl station of the day resulted in minor gear damage (damaged wing end on the port side of the net). The weather deteriorated that evening, and Cefas Endeavour dodged off the Irish coast.

On 14 November, Cefas Endeavour steamed over the tow near the Kish Bank to look for the presence of static gear, and when a clear tow was found, this site was sampled. Cefas Endeavour then steamed southwards to fish a further two stations off south-east Ireland. The following day the final two trawl stations in St George's Channel were fished and, after the rockhopper trawl was changed for the GOV trawl with the standard ground gear, one fine ground trawl station was completed at the north end of the Celtic Deep.

Given the poor weather forecast, Cefas Endeavour steamed northwards to start sampling the inshore grounds of the Irish Sea. Sampling commenced at first light on 16 November in Liverpool Bay and two trawl stations were successfully completed before deteriorating weather conditions prevented further fishing operations. A further four trawl stations in the north-eastern Irish Sea were successfully sampled the following day. The final station in area was completed on the morning of 18 November and Cefas Endeavour then steamed to the north-western Irish Sea and two stations west of the Isle of Man were completed before dusk. The weather deteriorated the following day and trawling at the final four Irish Sea stations could not be undertaken. Cefas Endeavour then steamed southwards and steamed along the southern coast of Ireland in poor weather that night. The weather improved on 20 November, and a further three trawl stations were fished successfully before Cefas Endeavour headed for a mid-cruise change of staff in Cork, docking at around 1730h. Given the poor forecast for the week, after discussions with colleagues in Belfast, it was decided not to undertake comparative sampling with RV Corystes planned for the following week.

Departure from Cork was planned on the morning of the 22<sup>nd</sup> November after the staff exchange, but due to very poor weather and sea conditions, Cefas Endeavour remained in port on 22-24 November and only sailed at 1300h on 25 November, with sailing delayed slightly due to a Customs inspection. With poor weather and residual weather in the Celtic Sea, Cefas Endeavour steamed back into the Irish Sea, and completed three stations off the east coast of Ireland, including Dundalk Bay and Dundrum Bay on 26 November. The following day, as weather conditions began to improve, the final Irish Sea trawl station was completed before Cefas Endeavour steamed southwards.

Sampling commenced at first light on 28 November off the south coast of Ireland, and three trawl stations were completed. Given the poor weather forecast for the Celtic Sea, Cefas Endeavour steamed eastwards to the Bristol Channel and fished two stations in Carmarthen Bay the following day. The catches at both of these sites included relatively large amounts of litter (plastics and fishing debris). The third trawl station of the day (prime station E14) resulted in major gear damage, and in deteriorating sea conditions Cefas Endeavour steamed northwards to shelter off the coast of South Wales whilst repairs were made to the net. Sampling commenced at first light on 30 November at the station south of Milford Haven, and a further two trawl stations were completed that day without incident.

With weather conditions set to improve the following day, Cefas Endeavour steamed south-west that night and fished the trawl station at Jones Bank on the morning of 1 December. The residual swell at the second sampling site was deemed too high to fish safely, although it was considered safe to deploy the 2m beam trawl, and so an epibenthic sample was collected. Following this sampling,

the sea state improved unexpectedly and so this site was then fished with the main trawl gear. With strong northerly winds forecast, Cefas Endeavour steamed northwards that night and commenced fishing the following day at a trawl station south of Ireland, working at two stations further offshore as the day progressed. A further three stations were fished successfully on 3 December and Cefas Endeavour steamed back to the western part of the survey grid that night.

After completing the first trawl station on 4 November, an additional tow was made to the north of the Labadie Bank whilst Cefas Endeavour worked eastwards, and a third station was then fished. The following morning a final trawl station was fished before Cefas Endeavour steamed towards the Bristol Channel.

Cefas Endeavour then steamed eastwards to dock in Swansea, docking at around 0900h on 6 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 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 ca. 25 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. The rockhopper trawl only sustained minor gear damage at two stations (hole in the belly at prime station G9 and damage to the portside wing end at prime station H2. The fine ground gear experienced severe gear damage at one station (E14).

### **STATIONS SAMPLED:**

Overall, 65 trawl stations in the survey area were fished as valid or additional tows. Twenty-eight of these were fished with the modified GOV with rockhopper ground gear and 37 with the standard ground gear (Figure 1).

The one station that resulted in major damage was not re-sampled, and the catch was not processed. Two stations resulted in less severe gear damage, one was treated as a valid sample and another as an additional tow (i.e. the catch was processed, but no otoliths were taken).

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 33 stations, and one beam trawl sample was taken in the Celtic Sea (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 3021 otoliths collected, biological parameters were also collected for 525 skates and 105 spurdog (Table 3).

**Gadiforms:** Cod *Gadus morhua* was caught at 25 of the valid and additional stations fished (Figure 4), with a maximum catch per unit effort (CPUE) of 34.9 kg.h<sup>-1</sup>. Cod were caught over much of the survey grid, although were not observed at those stations off Devon and Cornwall. Haddock *Melanogrammus aeglefinus* was captured at 49 stations (Figure 4), with the largest catches in the Celtic Sea, and the maximum CPUE was >320 kg.h<sup>-1</sup>. Whiting *Merlangius merlangus* was also abundant, especially in the Irish Sea. They were caught at 58 of the stations (Figure 4) and the maximum CPUE was >367 kg.h<sup>-1</sup>. Hake *Merluccius merluccius* was captured at 38 stations (Figure 4) and the maximum CPUE was 23.4 kg.h<sup>-1</sup>.

**Anglerfish:** Catches of anglerfish *Lophius piscatorius* (Figure 5) and black-bellied anglerfish *L. budegassa* were relatively low, with *L. piscatorius* caught at 22 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 9.1 kg.h<sup>-1</sup>. Megrim *Lepidorhombus whiffiagonis* was caught at 19 stations (Figure 5) and the maximum CPUE was 10.4 kg.h<sup>-1</sup>. Plaice *Pleuronectes platessa* was recorded at 40 stations (Figure 5), with good catches in Dundrum Bay, eastern Irish Sea and off south-eastern Ireland, with a maximum CPUE of ca. 90 kg.h<sup>-1</sup>. Catches of sole appeared higher in this years survey, and they were recorded at 19 stations with a maximum CPUE of nearly 19 kg.h<sup>-1</sup>.

**Pelagic fish:** Herring *Clupea harengus* was caught at 45 stations (Figure 6), with the highest CPUE >320 kg.h<sup>-1</sup>. Mackerel *Scomber scombrus* was only caught at 15 stations, with no large catches made. Indeed the highest CPUE for mackerel was only 4.75 kg.h<sup>-1</sup>. Catches of pilchard *Sardina pilchardus* were greatest in the western English Channel, and anchovy *Engraulis encrasicolus* were taken at 13 stations, including catches in the Solway Firth (Figure 6).

**Elasmobranchs:** Several tope *Galeorhinus galeus* were caught in the southern St George's Channel. Spurdog *Squalus acanthias* was caught at 20 stations, with the best catches in the north-western Irish Sea and Celtic Sea (Figure 7), with some of these catches comprised mostly of juveniles. Thornback ray *Raja clavata* was taken at 18 stations and this species was most abundant in the eastern Irish Sea, off southern Ireland and in the Bristol Channel, with a maximum CPUE of 81kg.h<sup>-1</sup> (Figure 7). One specimen of starry smooth hound that was caught in the Bristol Channel had several strands of monofilament (presumably from a gillnet) protruding from its body, although the specimen was in otherwise good condition.

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

**Ichthyological observations:** Overall, 92 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 three species not previously recorded in this cruise series, namely Ekstroms topknot *Phrynorhombus regius*, tadpole fish *Raniceps raninus* and two-spot clingfish *Diplecogaster bimaculatus*. Other unusual fishes caught included one specimen of sea trout (prime station A1), and specimens of common eel at prime stations E15 and F8, the latter site quite far offshore.

**Benthic observations:** The benthic by-catch was quantified at most 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 6. Most of the species observed are caught routinely in this survey. Some of the more noteworthy records were of a slipper lobster *Scyllarides latus* (prime station G12), a stone crab *Lithodes maja* (prime station F5), sponge crab *Dromia personata* (prime station H12) and the bivalve *Glossus humanus* (prime station E16).

**Miscellaneous studies:** Data on the relationship between length and total weight were collected for various fish and shellfish species.

## **(2) PHOTOGRAPHS OF FISH SPECIES AND PLAICE MATURITY STUDIES**

Photos of the maturity stages of 21 plaice were taken. Photographs of various fish species were taken for the development of the photo-identification guide.

## **(3) COMPARATIVE SAMPLING WITH RV CORYSTES**

Due to extremely poor weather conditions, it was decided not to undertake comparative trawling with RV Corystes.

## **(4) FISH TAGGING**

During the course of the survey, a total of 174 elasmobranchs (of five species) were tagged with Petersen discs and released, with summary details given in Table 7.

## **(5) POST-MORTUM CHANGES IN LENGTH AND BODY DIMENSIONS OF SPURDOG**

Most specimens of spurdog were tagged and released, and so no data on this were collected.

## **(6) OTOLITH COLLECTION**

Otoliths were collected from a variety of non-target fish species for the otolith collection.

## **(7) FISHERY ACOUSTICS**

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

## **(8) OBSERVATIONS ON MARINE MAMMALS, PELAGIC FISH AND JELLYFISH**

Sightings of marine mammals were identified to species level where possible. Common dolphins (*Delphinus delphis*) were the most frequently observed species, especially in the Celtic Sea. A small group of bottlenose dolphins (*Tursiops truncatus*) were observed north of Anglesey, with one common dolphin also observed in the area. There was one sighting of an unidentified whale species. These and all other sightings are summarised in Table 8.

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

## **(9) TISSUE SAMPLING OF SKATES, COD, BRILL AND TURBOT**

Tissue samples were collected for a total of 250 skates, including *L. naevus* (n = 22), *Raja brachyura* (n = 14), *R. clavata* (n = 142), *R. microcellata* (n = 18), *R. montagui* (n = 54), as well as cod (n = 81), brill (n = 22) and turbot (n = 8).

## **(10) COLLECTION OF SCALLOPS (*PECTEN MAXIMUS*)**

The flat valves of 39 specimens of scallop *Pecten maximus* were retained for age and growth studies.

## **(11) COLLECTION OF CORKWING WRASSE (*SYMPHODUS MELOPS*)**

No corkwing wrasse were caught during the course of the survey.

## **(12) TO COLLECT AND CRYOPRESERVE BIOLOGICAL MATERIAL FROM FISH SPECIES,**

Professor David Rawson, LIRANS Institute of Research in the Applied Natural Sciences, University of Bedfordshire, undertook the collection of fin clippings, muscle tissue explants and blood from specimens of 92 species of fish caught on the survey. Fin clips were processed, cryopreserved and stored in liquid nitrogen on board, in a condition that ensured cell survival and the ability to generate cell-line cultures on return to the LIRANS laboratories in Luton. The procedures involved tissue cleansing and contamination reduction, short term culture in antibiotic supplemented growth medium, cryoprotectant treatment and controlled slow cooling to -100°C (Grant Asymptote EF600 - Nitrogen free controlled rate freezer) before plunging and storage in liquid nitrogen at -196°C. Muscle explants from caudal peduncle region were processed to optimise the preservation of nuclear DNA. Tissue was macerated and stored for 60 minutes at room

temperature in DMSO-salt solution - 20% DMSO and 0.25M sodium-EDTA and NaCl to saturation, before transfer to -18°C freezer for long term storage. Blood samples were taken and applied to Whaman FTA Elute cards, chemically impregnated, resulting in the lysis of cells and denaturing of proteins upon contact, providing nucleic acids protection from microbial and fungal attack.

Blood samples, fin clippings and the cell lines established from them, and the muscle explant material, will be held in the fish cryobank at LIRANS. The specimens from which blood, fin and muscle tissue were taken are to be held as voucher specimens in the British Museum of Natural History, London. The tissue samples and voucher specimens will form part of the global Frozen Ark programme, and also be available for genomic mapping as planned under the Genome 10K programme.

### **(13) EPIBENTHIC SAMPLING**

Only one site was sampled with 2m beam trawl, due to time and weather constraints. This catch was typical of the Celtic Sea, although one specimen of big-eye rockling was recorded.

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  
06 December 2009

SEEN IN DRAFT  
B Salter (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

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David Rawson  
JNCC ([offshoresurvey@JNCC.gov.uk](mailto:offshoresurvey@JNCC.gov.uk))

**TABLE 1:** Summary of gear deployments.



Gear	Valid	Additional	Invalid	Total
GOV (Rockhopper)	27	2 (a,b)	1 <sup>(c)</sup>	30
GOV (Standard ground gear)	36	1 (d)	1 (e)	38
Niskin Bottle/Mini CTD	32	-	-	33
2m beam trawl	1	-	-	1
			<b>Total</b>	<b>102</b>

(a) Includes one shakedown tow in the southern North Sea.

(b) Includes one haul where the net sustained gear damage (prime station G9).

(c) The net fouled at one station, which was then re-sampled.

(d) A new station was tried at the north of the Labadie Bank.

(e) The net sustained major gear damage at prime station E14.

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

Species	ICES Stock	Number collected
Cod <i>Gadus morhua</i>	VII a	55
	VII e-k	28
Haddock <i>Melanogrammus aeglefinus</i>	VII a	140
	VII b-k	384
Whiting <i>Merlangius merlangus</i>	VII a	230
	VII e-k	329
Hake <i>Merluccius merluccius</i>	Northern	212
Conger eel <i>Conger conger</i>	-	21
Ling <i>Molva molva</i>	-	12
Megrim <i>Lepidorhombus whiffiagonis</i>	VII b,c,e-k, VIII a,b,d	169
Lemon sole <i>Microstomus kitt</i>	-	146
Plaice <i>Pleuronectes platessa</i>	VII a	436
	VII e and VII f-g	301
Sole <i>Solea solea</i>	VII a	16
	VII e and VII f-g	105
Turbot <i>Psetta maximus</i>	-	8
Brill <i>Scophthalmus rhombus</i>	-	22
<sup>1</sup> Anglerfish <i>Lophius piscatorius</i>	VII a-k	42
Anglerfish <i>Lophius budegassa</i>	VII b-k	15
<sup>2</sup> Bass <i>Dicentrarchus labrax</i>	-	9
Red mullet <i>Mullus surmuletus</i>	-	4
Herring <i>Clupea harengus</i>	VII a	161
	Celtic Sea	163
Mackerel <i>Scomber scombrus</i>	Western	13
<b>Total</b>		<b>3021</b>

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

Species	Number examined for maturity
Common skate <i>Dipturus batis</i>	1
Shagreen ray <i>Leucoraja fullonica</i>	-
Cuckoo ray <i>Leucoraja naevus</i>	34
Blonde ray <i>Raja brachyura</i>	29
Thornback ray <i>Raja clavata</i>	211
Smalleyed ray <i>Raja microocellata</i>	104
Spotted ray <i>Raja montagui</i>	146
Spurdog <i>Squalus acanthias</i>	105
<b>Total</b>	<b>630</b>

<sup>1</sup> Includes ilicia

<sup>2</sup> Includes scales

**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 2009, but have been reported in earlier surveys.

Species	Stns	Species	Stns
Lamprey <i>Lampetra fluviatilis</i>	-	Whiting <i>Merlangius merlangus</i>	58
Spurdog <i>Squalus acanthias</i>	20	Blue whiting <i>Micromesistius poutassou</i>	42
Porbeagle <i>Lamna nasus</i>	-	Pollock <i>Pollachius pollachius</i>	2
Black-mouth dogfish <i>Galeus melastomus</i>	1	Saithe <i>Pollachius virens</i>	-
Lesser-spotted dogfish <i>Scyliorhinus canicula</i>	58	Norway pout <i>Trisopterus esmarki</i>	40
Greater-spotted dogfish <i>Scyliorhinus stellaris</i>	16	Bib <i>Trisopterus luscus</i>	9
Tope <i>Galeorhinus galeus</i>	8	Poor cod <i>Trisopterus minutus</i>	63
Starry smoothhound <i>Mustelus asterias</i>	28	Greater forkbeard <i>Phycis blennoides</i>	-
Smoothhound <i>Mustelus mustelus</i>	-	Tadpole fish <i>Raniceps raninus</i>	1
Common skate <i>Dipturus batis</i>	1	Spanish ling <i>Molva macrophthalma</i>	-
Cuckoo ray <i>Leucoraja naevus</i>	11	Ling <i>Molva molva</i>	8
Shagreen ray <i>Leucoraja fullonica</i>	-	Northern rockling <i>Ciliata septentrionalis</i>	2
Blonde ray <i>Raja brachyura</i>	11	5-bearded rockling <i>Ciliata mustela</i>	1
Thornback ray <i>Raja clavata</i>	19	4-bearded rockling <i>Enchelyopus cimbrius</i>	11
Smalleyed ray <i>Raja microocellata</i>	5	3-bearded rockling <i>Gaidropsarus vulgaris</i>	2
Spotted ray <i>Raja montagui</i>	27	Hake <i>Merluccius merluccius</i>	38
		Two-spotted clingfish <i>Diplecogaster bimaculata</i>	1
Electric ray <i>Torpedo nobiliana</i>	-	Garfish <i>Belone belone</i>	-
Stingray <i>Dasyatis pastinaca</i>	-	Skipper <i>Scomberesox saury</i>	-
Eel <i>Anguilla anguilla</i>	2	John dory <i>Zeus faber</i>	30
Conger eel <i>Conger conger</i>	15	Boarfish <i>Capros aper</i>	16
Allis shad <i>Alosa alosa</i>	-	Snake pipefish <i>Entelurus aequoreus</i>	1
Twaite shad <i>Alosa fallax</i>	-	Greater pipefish <i>Syngnathus acus</i>	4
Herring <i>Clupea harengus</i>	46	Blue mouth redfish <i>Helicolenus dactylopterus</i>	-
Sprat <i>Sprattus sprattus</i>	44	Red gurnard <i>Aspitrigla cuculus</i>	35
Pilchard <i>Sardina pilchardus</i>	10	Grey gurnard <i>Eutrigla gurnardus</i>	48
Anchovy <i>Engraulis encrasicolus</i>	13	Tub gurnard <i>Trigla lucerna</i>	21
Salmon <i>Salmo salar</i>	-	Streaked gurnard <i>Trigloporus lastoviza</i>	2
Sea trout <i>Salmo trutta</i>	1	Bullrout <i>Myoxocephalus scorpius</i>	1
Argentine <i>Argentina</i> sp.	24	Sea scorpion <i>Taurulus bubalis</i>	1
Pearlside <i>Maurolicus muelleri</i>	11	Norwegian bullhead <i>Taurulus lilljeborgi</i>	-
Black-bellied anglerfish <i>Lophius budegassa</i>	8	Pogge <i>Agonus cataphractus</i>	13
Anglerfish <i>Lophius piscatorius</i>	23	Lumpsucker <i>Cyclopterus lumpus</i>	-
Silvery pout <i>Gadiculus argenteus</i>	9	Sea snail <i>Liparis liparis</i>	3
Cod <i>Gadus morhua</i>	25	Montagu's sea snail <i>Liparis montagui</i>	-
Haddock <i>Melanogrammus aeglefinus</i>	49		

**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 2009, but have been reported in earlier surveys.

Species	Stns	Species	Stns
Bass <i>Dicentrarchus labrax</i>	6	Jeffrey's goby <i>Buenia jeffreysi</i>	3
Bogue <i>Boops boops</i>	-	Crystal goby <i>Crystallogobius linearis</i>	1
Red seabream <i>Pagellus bogaraveo</i>	-	Black goby <i>Gobius niger</i>	-
Black seabream <i>Spondylisoma cantharus</i>	1	Steven's goby <i>Gobius gasteveni</i>	-
Scad <i>Trachurus trachurus</i>	54	Rock goby <i>Gobius paganellus</i>	-
Red mullet <i>Mullus surmuletus</i>	4	Fries's goby <i>Lesueurigobius friesii</i>	3
Redband fish <i>Cepola rubescens</i>	5	Sand goby <i>Pomatoschistus</i> spp.	26
Corkwing wrasse <i>Crenilabrus melops</i>	-	Mackerel <i>Scomber scombrus</i>	15
Goldsinny wrasse <i>Ctenolabrus rupestris</i>	6	Four-spot megrim <i>Lepidorhombus boscii</i>	-
Ballan wrasse <i>Labrus bergylta</i>	-	Megrim <i>Lepidorhombus whiffiagonis</i>	20
Cuckoo wrasse <i>Labrus mixtus</i>	1	Turbot <i>Psetta maximus</i>	4
Lesser weever <i>Echiichthys vipera</i>	7	Brill <i>Scophthalmus rhombus</i>	10
Greater weever <i>Trachinus draco</i>	3	Norwegian topknot <i>Phrynorhombus norvegicus</i>	6
Raitts sandeel <i>Ammodytes marinus</i>	-	Ekstroms topknot <i>Phrynorhombus regius</i>	3
Common sandeel <i>Ammodytes tobianus</i>	1	Topknot <i>Zeugopterus punctatus</i>	1
Smooth sandeel <i>Gymnammodytes semisquamatus</i>	-	Imperial scaldfish <i>Arnoglossus imperialis</i>	4
Immaculate sandeel <i>Hyperoplus immaculatus</i>	7	Scaldfish <i>Arnoglossus laterna</i>	16
Greater sandeel <i>Hyperopus lanceolatus</i>	6	Witch <i>Glyptocephalus cynoglossus</i>	18
Sand eel <i>Ammodytidae</i> indet.	4	Long-rough dab <i>Hippoglossoides platessoides</i>	24
Common dragonet <i>Callionymus lyra</i>	42	Dab <i>Limanda limanda</i>	37
Spotted dragonet <i>Callionymus maculates</i>	26	Lemon sole <i>Microstomus kitt</i>	32
Reticulate dragonet <i>Callionymus reticulatus</i>	3	Flounder <i>Platichthys flesus</i>	2
Butterfly blenny <i>Blennius ocellaris</i>	4	Plaice <i>Pleuronectes platessa</i>	40
Tompot blenny <i>Parablennius gattorugine</i>	-	Solenette <i>Buglossideum luteum</i>	17
Yarrell's blenny <i>Chirolophis ascanii</i>	1	Thickback sole <i>Microchirus variegates</i>	31
Butterfish <i>Pholis gunnellus</i>	-	Sand sole <i>Pegusa lascaris</i>	2
Transparent goby <i>Aphia minuta</i>	-	Sole <i>Solea solea</i>	20
		Triggerfish <i>Balistes capriscus</i>	-

**Table 5:** Dominant fish and invertebrates taken in the GOV with rockhopper and standard ground gears (sum of kg.h<sup>-1</sup>)

<b>Species</b>	<b>Rockhopper</b>	<b>Species</b>	<b>Standard</b>
Horse mackerel	999.8	Lesser-spotted dogfish	3492.9
Haddock	696.9	Whiting	3003.3
Whiting	646.7	Haddock	1691.0
Sprat	516.7	Dab	1330.4
Lesser-spotted dogfish	384.0	Sprat	1025.0
Poor cod	283.2	Herring	701.2
Norway pout	163.4	Norway pout	570.3
Tope	158.4	Plaice	501.8
Northern squid	146.3	Poor cod	477.3
John dory	139.1	Grey gurnard	432.6
Starry smooth-hound	138.1	Blue whiting	393.0
Queen scallop	109.9	Thornback ray	314.4
Pilchard	87.5	Spurdog	287.0
Blue whiting	85.3	Conger eel	260.5
Herring	85.1	Smalleyed ray	226.3
Greater-spotted dogfish	76.2	<i>Nephrops</i>	179.4
Conger eel	68.6	Cod	176.3
Spurdog	66.2	Spotted ray	148.9
Cod	38.9	Hake	137.1
Dab	37.5	Queen scallop	119.4
Hake	35.9	Horse mackerel	109.4

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

<i>Phakellia ventilabrum</i>	<i>Lithodes maja</i>	<i>Laevicardium crassum</i>
<i>Suberites</i> sp.	<i>Ebalia tuberosa</i>	<i>Timoclea ovata</i>
<i>Haliclona oculata</i>	<i>Dromia personata</i>	<i>Sepia elegans</i>
<i>Cliona celata</i>	<i>Hyas coarctatus</i>	<i>Sepia officinalis</i>
<i>Porifera</i> (indet.)	<i>Eurynome aspera</i>	<i>Rossia macrosoma</i>
<i>Hydrallmania falcata</i>	<i>Inachus dorsettensis</i>	<i>Sepiola atlantica</i>
<i>Nemertesia antennina</i>	<i>Inachus leptochirus</i>	<i>Alloteuthis subulata</i>
<i>Lytocarpia myriophyllum</i>	<i>Macropodia linaresi</i>	<i>Loligo forbesi</i>
<i>Hydrozoa</i> (indet.)	<i>Macropodia rostrata</i>	<i>Illex</i> sp.
<i>Epizoanthus papillosus</i>	<i>Macropodia tenuirostris</i>	<i>Todaropsis eblanae</i>
<i>Alcyonium digitatum</i>	<i>Pisa armata</i>	<i>Eledone cirrosa</i>
<i>Caryophyllia smithi</i>	<i>Maia squinado</i>	<i>Pentapora foliacea</i>
<i>Actinauge richardi</i>	<i>Atelecyclus rotundatus</i>	<i>Alcyonidium diaphanum</i>
<i>Adamsia carciniopados</i>	<i>Cancer pagurus</i>	<i>Alcyonidium parasiticum</i>
<i>Bolocera tuediae</i>	<i>Corystes cassivelaunus</i>	<i>Cellaria</i> spp.
<i>Calliactis parasitica</i>	<i>Liocarcinus corrugatus</i>	<i>Porella compressa</i>
<i>Metridium senile</i>	<i>Liocarcinus depurator</i>	<i>Flustra foliacea</i>
<i>Urticina felina</i>	<i>Liocarcinus holsatus</i>	<i>Astropecten irregularis</i>
<i>Anemone</i> (indet.)	<i>Liocarcinus marmoreus</i>	<i>Luidia ciliaris</i>
<i>Aphrodita aculeata</i>	<i>Liocarcinus pusillus</i>	<i>Luidia sarsi</i>
<i>Hermione hystrix</i>	<i>Macropipus tuberculatus</i>	<i>Stichastrella rosea</i>
<i>Sabellaria spinulosa</i>	<i>Necora puber</i>	<i>Henricia oculata</i>
<i>Hyalinoecia tubicola</i>	<i>Goneplax rhomboides</i>	<i>Anseropoda placenta</i>
<i>Serpula vermicularis</i>	<i>Monodeus couchi</i>	<i>Porania pulvillus</i>
<i>Scalpellum scalpellum</i>	<i>Diodora graeca</i>	<i>Crossaster papposus</i>
<i>Cirolana cranchii</i>	<i>Aporrhais pespelecani</i>	<i>Asterias rubens</i>
<i>Idotea linearis</i>	<i>Calliostoma papillosum</i>	<i>Marthasterias glacialis</i>
<i>Solenocera membranacea</i>	<i>Calliostoma zizyphinum</i>	<i>Ophiura albida</i>
<i>Alpheus glaber</i>	<i>Turritella communis</i>	<i>Ophiura ophiura</i>
<i>Pasiphaea sivado</i>	<i>Euspira fusca</i>	<i>Ophiothrix lutkeni</i>
<i>Palaemon serratus</i>	<i>Polinices catena</i>	<i>Ophiothrix fragilis</i>
<i>Processa canaliculata</i>	<i>Buccinum humphreysianum</i>	<i>Echinus acutus</i>
<i>Pandalus montagui</i>	<i>Buccinum undatum</i>	<i>Echinus esculentus</i>
<i>Pandalus propinquus</i>	<i>Colus gracilis</i>	<i>Psamechinus miliaris</i>
<i>Dichelopandalus bonnieri</i>	<i>Neptunea antiqua</i>	<i>Echinocardium cordatum</i>
<i>Spirontocaris lilljeborgi</i>	<i>Scaphander lignarius</i>	<i>Holothuroidea</i> (indet.)
<i>Crangon allmanni</i>	<i>Philine aperta</i>	<i>Botryllus schlosseri</i>
<i>Crangon crangon</i>	<i>Archidoris pseudargus</i>	<i>Ascidia conchilega</i>
<i>Philocheras echinulatus</i>	<i>Tritonia hombergi</i>	<i>Ascidia mentula</i>
<i>Pontophilus spinosus</i>	<i>Dendronotus frondosus</i>	<i>Ascidiella aspersa</i>
<i>Homarus gammarus</i>	<i>Nudibranchia</i> (indet.)	<i>Ascidiella scabra</i>
<i>Nephrops norvegicus</i>	<i>Nucula sulcata</i>	<i>Ascidiacea</i> (indet.)
<i>Scyllarides latus</i>	<i>Glossus humanus</i>	
<i>Anapagurus laevis</i>	<i>Aequipecten opercularis</i>	
<i>Pagurus bernhardus</i>	<i>Chlamys varia</i>	
<i>Pagurus prideaux</i>	<i>Palliolum tigrinum</i>	
<i>Pagurus variabilis</i>	<i>Pecten maximus</i>	
<i>Munida rugosa</i>	<i>Modiolus modiolus</i>	
<i>Calocaris macandreae</i>	<i>Acanthocardia</i> sp.	
<i>Pisidia longicornis</i>	<i>Astarte sulcata</i>	

**TABLE 7:** Summary of elasmobranchs tagged and released.

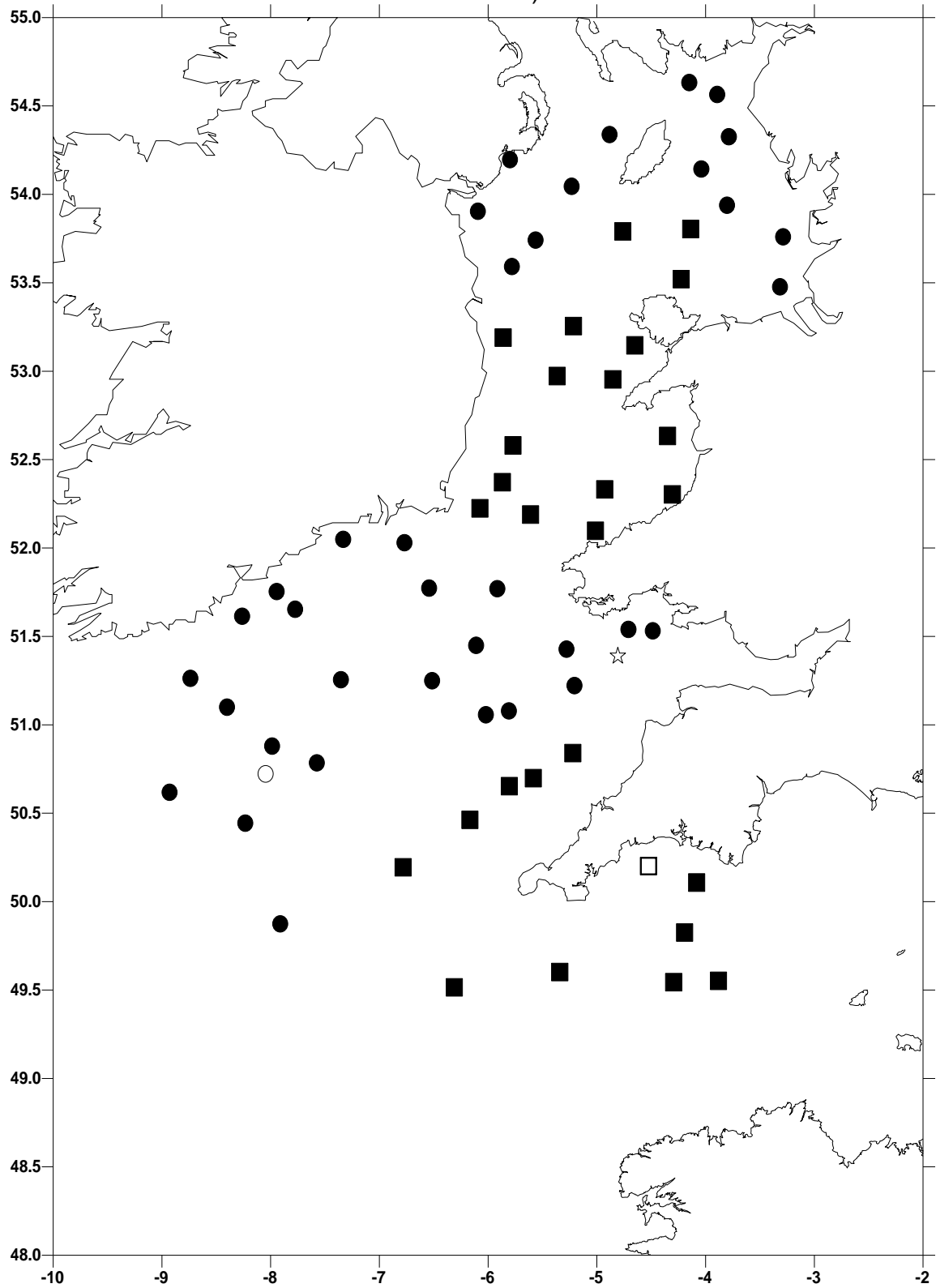
Species/Sex	Female	Male
Spurdog <i>Squalus acanthias</i>	26	47
Greater spotted dogfish <i>Scyliorhinus stellaris</i>	8	12
Tope <i>Galeorhinus galeus</i>	5	9
Starry smoothhound <i>Mustelus asterias</i>	35	29
Blonde ray <i>Raja brachyura</i>	2	1
<b>Total</b>	<b>174</b>	

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

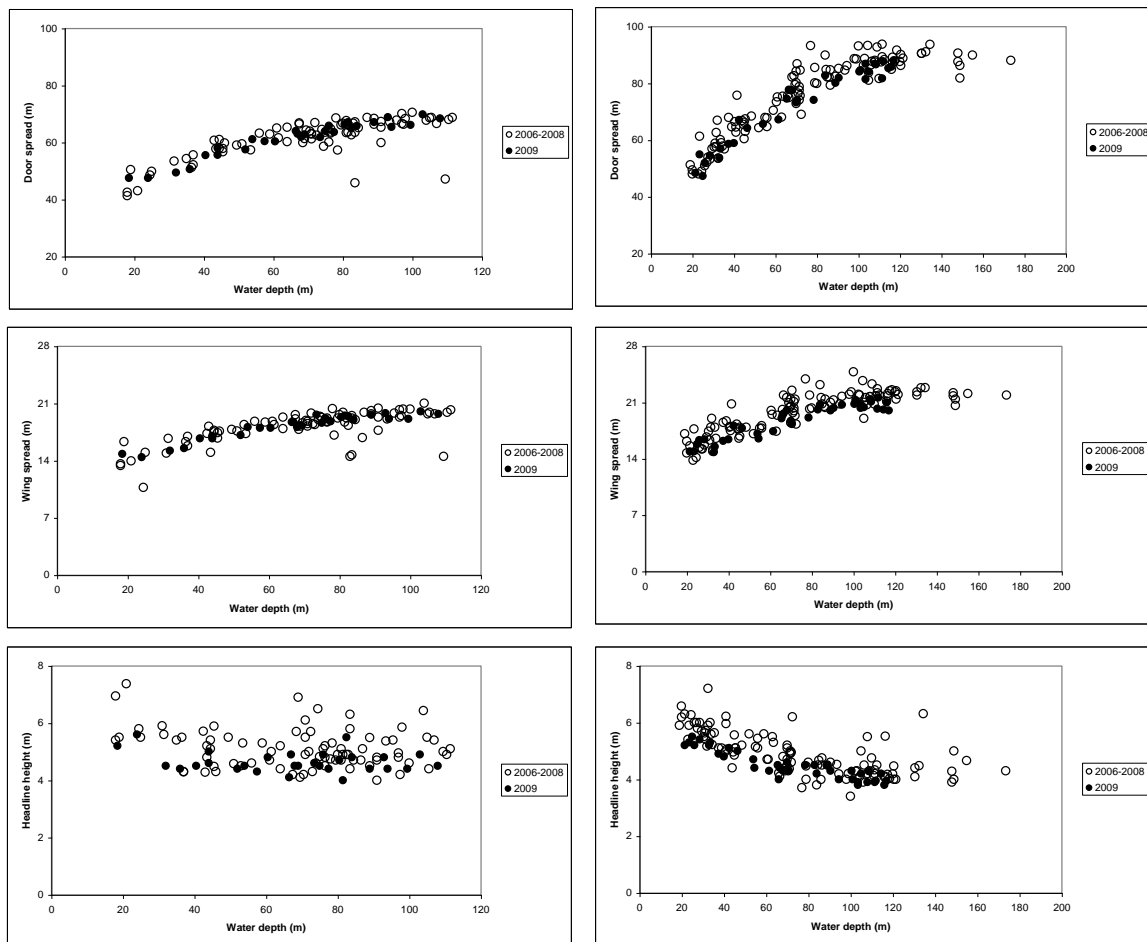
Date	Time	Station	Prime	Species	Numbers	Comments	Latitude		Longitude		
6/11/09	13:30	2	G8	Common dolphins	-	Small group					
9/11/09	08:50	-	-	Common dolphins	3-4		49	33.40	05	41.10	W
9/11/09	10:00	10	G5	Common dolphins	6-7	Off starboard quarter	49	32.10	06	01.40	W
9/11/09	11:10	11	G11	Common dolphins	2	Alongside boat whilst towing					W
10/11/09	10:00	-	-	Unidentified whale	-		50	37.60	05	57.60	W
10/11/09	16:40	After 16	G1	Common dolphins	-	Off port side					
12/11/09	16:15			Bottlenose dolphins	5+	Off starboard side. Red wharf Bay - Anglesey					
28/11/09	16:00	73	E6	Common dolphins	15-20	Bow riding whilst steaming. Several juveniles and 2 calves	51	44.56	06	29.94	W
30/11/09	15:40	Near E11		Common dolphins	2-3	Bow riding whilst steaming	51	05.10	05	39.80	W
30/11/09	14:00	79	31E4	Common dolphins	3-5		51	15.03	05	12.10	W
02/12/09	14:10	90	F5	Common dolphins	6-10	Near bow whilst fishing	50	51.08	08	01.55	W
03/12/09	14:30	95	E16	Common dolphins	50+	Bow riding whilst steaming	51	25.85	06	07.15	W
04/12/09	08:00-11:00	97	F7	Common dolphins	10-20	Alongside vessel during shooting, fishing, hauling and then steaming	50	37.45	08	52.18	W
04/12/09	15:15			Common dolphins	10-20	Small group alongside whilst steaming to F6					
05/12/09	08:05	102	E10	Common dolphins	50-100	Surrounding vessel during shooting and fishing					



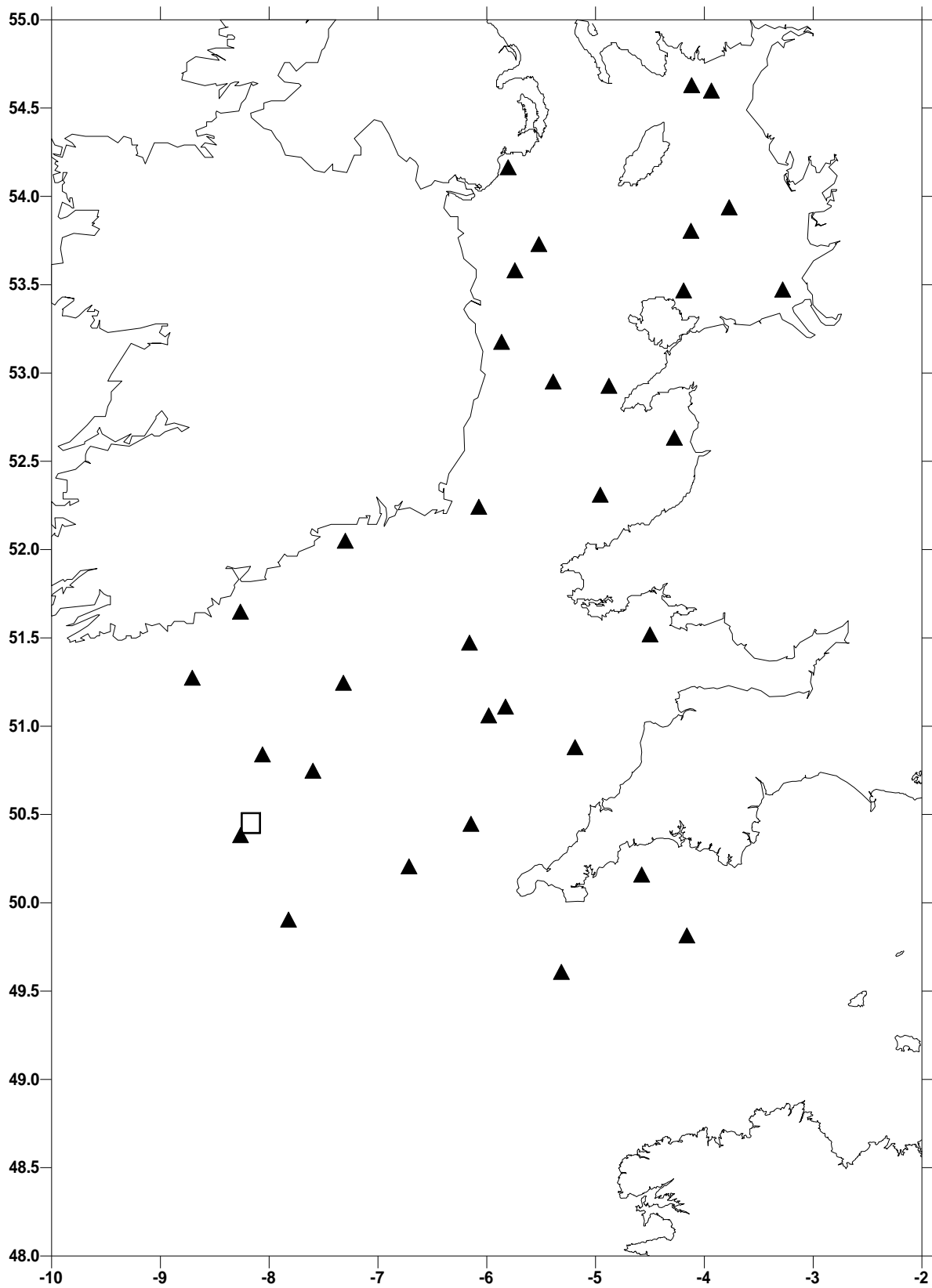
**FIGURE 1:** Study area showing sites sampled with GOV trawl with rockhopper ground gear (filled squares: valid tows, open square additional tow) and standard ground gear (filled circles: valid tows; open circles: additional tows; open star: invalid tows).



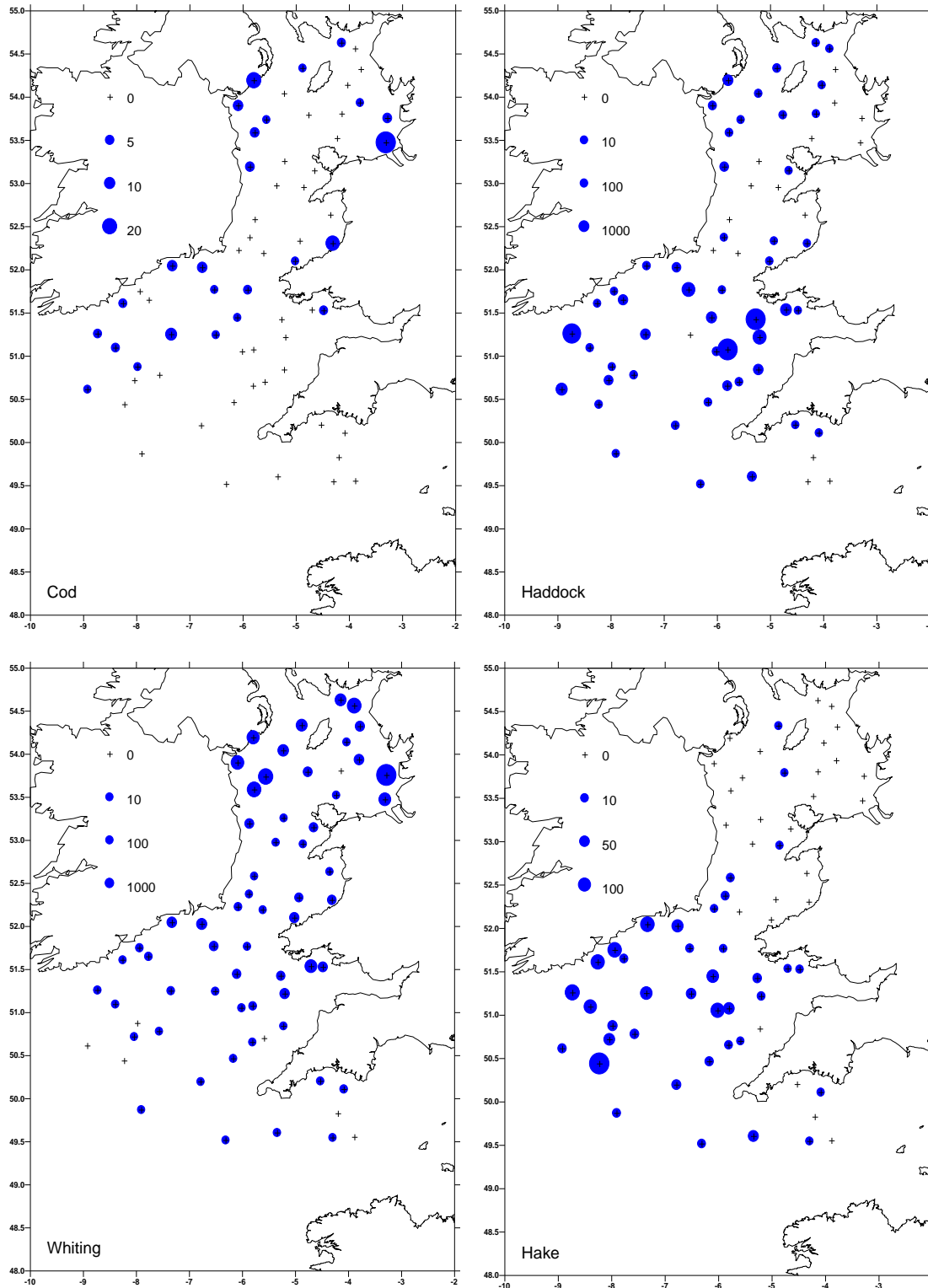
**FIGURE 2:** Graphs showing relationships between headline height, wing spread and door spread with depth for the GOV trawl with rockhopper ground gear (left hand panel) and standard ground gear (right hand panel) for 2009 (filled circles) and 2006-2008 (open circles).



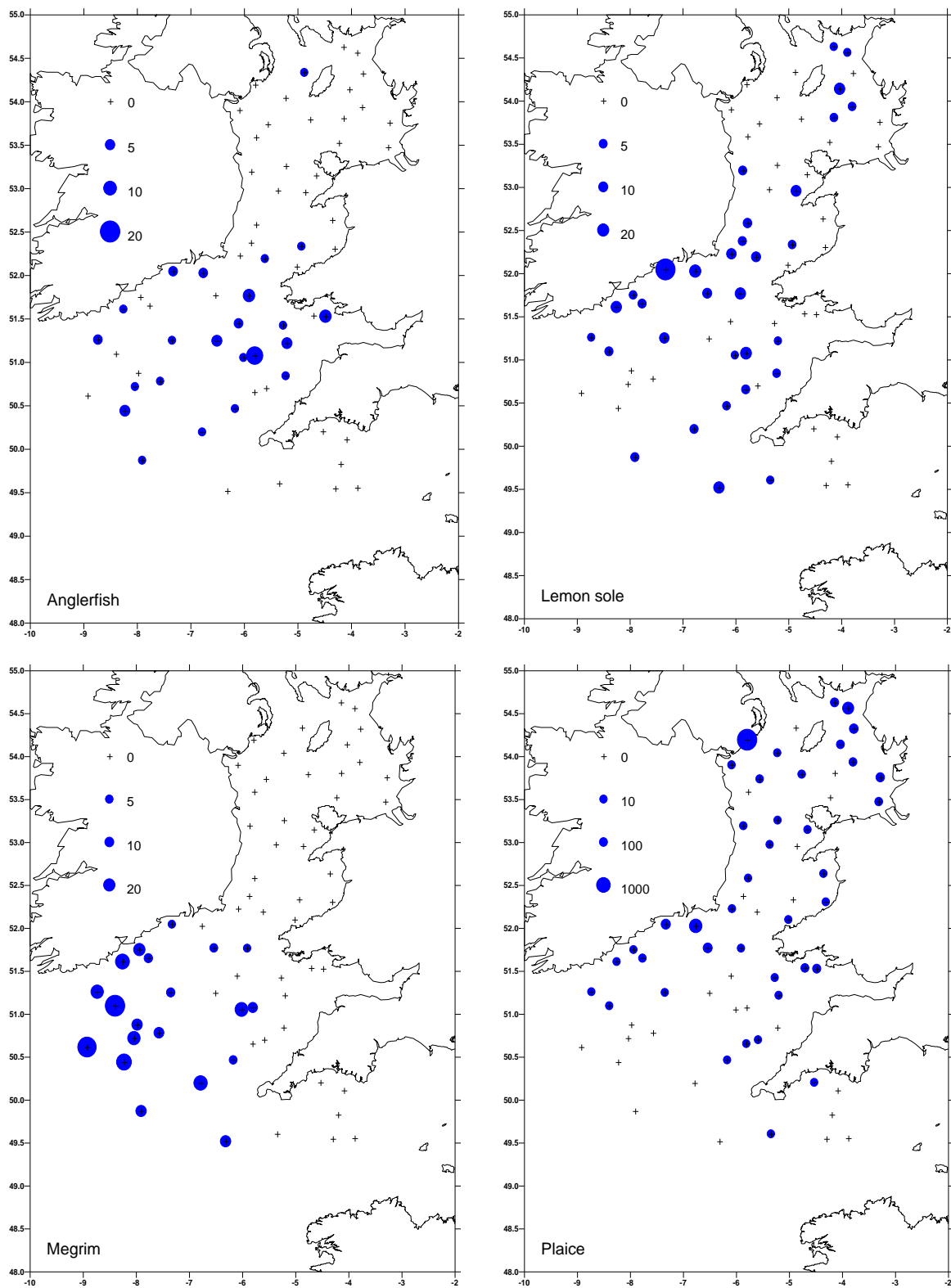
**FIGURE 3:** Study area indicating sites sampled with mini CTD and niskin bottle (triangles), and 2m-beam trawl (open square).



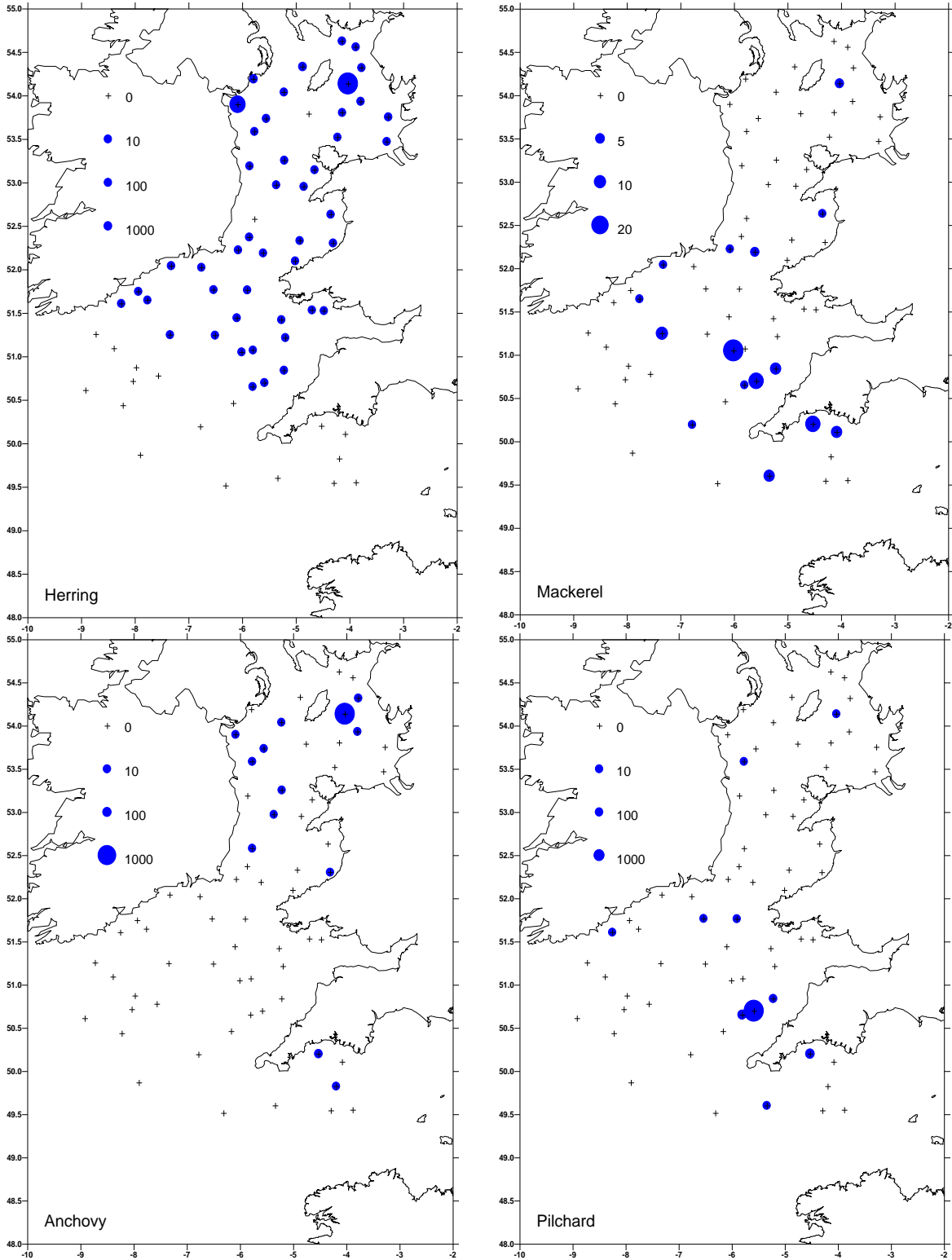
**FIGURE 4:** Distribution and relative abundance (no. per hour) of cod (COD), haddock (HAD), whiting (WHG) and hake (HKE). Refer to Figure 1 for which ground gear was used.



**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.

