

RESEARCH VESSEL SURVEY REPORT

RV CEFAS ENDEAVOUR

Survey: CEND 3/20.

1. STAFF:

Part 1 (17 – 29 February 2020)

Part 2 (1 – 17 March 2020)

Name	Role	Name	Role
Louise Straker Cox	SIC	Louise Straker Cox	SIC
Ben Hatton	2IC	Ben Hatton	2IC
Nicola Hampton	Sampler	Nicola Hampton	Sampler
Samuel Roslyn	Sampler	Samuel Roslyn	Sampler
Tom Woods	Sampler	Tom Woods	Sampler
Zachary Radford	Sampler	Zachary Radford	Sampler
Dan Clarke	Sampler	Dan Clarke	Sampler
Jim Ellis	SIC Support	Matthew Eade	Deckmaster
Mary Brown	Deckmaster	Charlotte Jennings	Deckmaster
Steve Shaw	Deckmaster	James Pettigrew	Sampler
Kirsty Bradley	Sampler	Nevena Almeida	Sampler
Charlotte Reeve	Sampler	Liséve Fierens	Sampler
Hannah Lloyd Hartley	Sampler	Lois Elvin	Sampler
Eleanor MacLeod	Sampler	Hannah Wolstenholme	Sampler
Cian Derbyshire	Irish Observer	Cian Derbyshire	Irish Observer

2. DURATION: 30 days (February 17 – March 17 2020)

3. LOCATION: Western English Channel & Celtic Sea (ICES Divisions 7.e–j)

4. AIMS:

PRIMARY AIMS:

4.1 To carry out an otter trawl survey of the demersal fisheries resources in the Celtic Sea and western English Channel (Figure 1) using a BT195 Jackson 575 monkfish trawl in order to collect appropriate data to inform assessments of the fish stocks and fish assemblages in the area. The main aims are to collect relevant data on the:

- a) Distribution, size composition and abundance of all fish and shellfish species caught;
- b) Age–length distribution of commercially important fish species;

- c) Individual length, weight, sex and maturity information for commercial fish species (in support of the EU Data Collection Regulation);
- d) Distribution of macrobenthos, gelatinous zooplankton and anthropogenic debris;
- e) Surface and bottom temperature and salinity data using CTD.

4.2 To collect multibeam data and fisheries acoustic data at three operating frequencies (38, 120 & 200 kHz) continuously throughout the survey. These data will be used to determine the spatial scale of various habitats and to aid the subsequent beam trawl survey fishing the same areas on the following survey (CEND 4/20).

SECONDARY AIMS:

- 4.3 To tag-and-release and collect dead specimens of various shark, skate and ray elasmobranch species including (a) deploying electronic and Peterson disc tags on starry smooth-hound *Mustelus asterias*, and where time allows, collecting vitality, reflex and injury data, augmenting data collected under EMFF project ENG1395), (b) deploying electronic and Petersen disc tags on tope *Galeorhinus galeus*, common (blue) skate *Dipturus batis*, undulate ray *Raja undulata* and blonde ray *Raja brachyura* where catches are sufficient to help inform on habitat use, nursery areas and migration patterns in support of Defra funded projects, (c) conventionally tag specimens of cuckoo ray (*Leucoraja naevus*), shagreen ray (*Leucoraja fullonica*), greater-spotted dogfish *Scyliorhinus stellaris* and spurdog *Squalus acanthias* to help inform on stock structure, (d) retain any dead specimens of tope, common skate, shagreen and blonde ray for biological studies and (e) sample dead female spurdog *Squalus acanthias* specimens to determine length, weight, maturity sex ratio of pups.
- 4.4 To collect additional biological information on the trawl catch in support of biological programmes, including (a) retention of any rare and unusual species, (b) length-weight data for unusual fish species and extreme sizes, (c) biological information from four-bearded rockling *Enchelyopus cimbrius* and wrasse (Labridae) (d) otoliths from uncommon species and extremes of length range as part of an on-going otolith reference collection, and (e) maturity stage photographs and to review maturity stage descriptions for John dory *Zeus faber*, black seabream *Spondyliosoma cantharus*, anglerfish *Lophius piscatorius* and black-bellied anglerfish *L. budegassa*, striped red mullet *Mullus surmuletus* and European seabass *Dicentrarchus labrax*, to further improve Cefas maturity keys.
- 4.5 All diadromous species (including allis shad *Alsoa alsoa*, twaite shad *Alsoa fallax* and lampreys (Petromyzontidae)) found dead on capture are to be frozen and returned to the lab for analyses, marking samples with the survey, station and date to support DiadES project.
- 4.6 To collect data on the feeding habits of selected fish species (including John dory and anglerfish by sampling stomachs and identifying associated prey species (data provided to DAPSTOM database).

- 4.7 To collect and freeze muscle (and liver) samples from selected longer-lived and higher trophic level fish species for subsequent contaminant analyses (ling *Molva molva*, spurdog, anglerfish, John dory, skates, whiting *Merlangius merlangus* and European hake *Merluccius merluccius*).
- 4.8 Collect a vertical ring net sample at the west Gabbard smartbuoy, contributing to the Lifeform project (Defra) as part of the UK monitoring network for zooplankton.
- 4.9 Collect, retain and filter surface water samples from Ferrybox underway water supply every 12 hours (or once a day) for subsequent nutrients (February) and chlorophyll (March) sampling in support of SLA25.

OPPORTUNISTIC AIMS:

- 4.10 To collect genetic samples from anglerfish, black-bellied anglerfish and European hake in support of the GECKA project.
- 4.11 To collect, freeze and retain a variety of whole, non-otolithed fish and shellfish species for subsequent use in Cefas outreach events and Cefas internal sampling training.
- 4.12 To collect, freeze and retain Atlantic cod (*Gadus morhua*) skeletons, and skeletons of morphologically similar species (saithe *Pollachius virens*, pollack *Pollachius pollachius*, whiting and bib *Trisopterus luscus*) for Cambridge University.

5. NARRATIVE:

All times given are in GMT

Part One: 15–29 February 2020

RV Cefas Endeavour (henceforth called RV Endeavour) was delayed in sailing from Lowestoft by 2.5 days due to Storm Dennis. RV Endeavour left her berth at 1500h, February 17 with 14 Cefas scientific staff and an observer from the Marine Institute (Ireland). Upon departure, the ship travelled 35 nm southwards to the Outer Gabbard (Outer Thames) where a plankton sample was collected at 1840h. The vessel then began the ca. 200 nm passage to the western Channel to commence the survey.

A standard station comprised of a trawl using a BT195 Jackson 575 monkfish trawl (hereafter referred to as the 'monkfish trawl'), a 100 mm cod-end (no liner), 16" rockhopper ground gear and Morgere Ovalfoil doors. The ground was checked beforehand using the multibeam, where needed. Sampling was conducted within a 1 nm radius of the selected fixed station and a tow was considered to be valid after successfully trawling for a distance of at least 1.5 nm (2 nm target, towing speed of 3–3.5 knots) with valid Scanmar net geometry sensor readings.

The catch from the monkfish trawl was separated by species and weighed and/or counted/measured. Biological data (length, weight, sex, maturity and, where appropriate, otoliths) were collected for selected commercial fish species. The ESM2 profiler and Niskin bottle was deployed twice per 24 hours, in order to collect oceanographic data (surface and bottom water samples taken for salinity). A CTD would also be used in this deployment if an updated Sound Velocity Profile (SVP) was needed for the calibration of the multibeam. Acoustic data from the EK60 sounder were recorded at 38 Khz, 120 Khz and 200 Khz, and multibeam data were recorded throughout the survey area. A mini-CTD was also attached to the headline of the trawl.

RV Endeavour arrived at the first station (CI7; Stratum 9; see Table 2 for a list of Strata) where valid deployments of the ESM2 profiler (with CTD and Niskin) and the monkfish trawl were completed. The tow yielded a 200 kg catch composed mostly of conger eel *Conger conger*, thornback ray *Raja clavata*, starry smooth-hound and undulate ray.

On 18 February, a trawl was successfully conducted at station LB6 (Stratum 7) resulting in a catch comprising of mainly thornback ray, conger eel and starry smooth-hound. The next day, RV Endeavour sampled two further stations in Stratum 7 (LB4 and LB5) before proceeding south and carrying out four tows in Stratum 9 (stations CI3, CI4, CI5 and CI6). Black seabream, common cuttlefish *Sepia officinalis* and red gurnard *Chelidonichthys cuculus* were the predominant species captured at CI3, with relatively smaller catches recorded at CI4 and CI5, where catches included conger eel, tope and greater-spotted dogfish (CI4) and undulate ray and blonde ray (CI5). Individuals of the two latter species were tagged with G5 electronic tags and released. Starry smooth-hound and lesser-spotted dogfish *Scyliorhinus canicula* comprised most of the catch composition at CI6.

By 20 February, RV Endeavour began work along the French coast completing sampling in Stratum 9 with successful tows at CI2 and CI1, followed by trawl deployments at BY8, BY9, BY6 and BY3 in Stratum 10. Tow length at BY8, BY6 and BY9 were reduced to 1.5 nm due to a poor sea state and erratic door sensor readings, and two hours was spent waiting for the sea state to calm prior to towing at BY6. Elasmobranchs were the most abundant component of the catch at most of these stations, with starry smooth-hound and lesser-spotted dogfish two of the main species at CI1. Red gurnard was present at both CI2, CI1 and BY3. Black seabream formed the largest proportion of the catch by weight at CI5 and at BY8, with starry smooth-hound constituting the largest amount at BY9 and BY6, as well as the second largest at BY8. Tope were also captured at BY9 and anglerfish at BY6. Conger eels comprised the largest species catch weight at BY3. A female blonde ray (104 cm) and two male starry smooth-hound (105 and 115 cm) were tagged electronically at BY6.

The following day, RV Endeavour steamed west to stations BY1 and SW12, SW11 and SW9 in Stratum 2 with strong, occasional gale force winds slowing transiting speeds. Whiting, red gurnard and small quantities of mackerel *Scomber scombrus*, hake, horse mackerel *Trachurus trachurus* and haddock *Melanogrammus aeglefinus* were the main species captured at BY1. The latter two species, as well as red gurnard, were also present at SW12 with red gurnard and haddock also present at SW11. After the ESM2 and Niskin were deployed at SW9, 30 knot

winds and >3 m swells prevented fishing and the decision was taken to move further west where improved weather conditions were expected.

RV Endeavour arrived at station SW3 in Stratum 2 at 1100h, 22 February where the deepest tow of the survey grid (ca. 200 m) was completed. This yielded a large catch (1.5 tonnes) of boarfish *Capros aper* as well as red gurnard, hake, and black-bellied anglerfish, as well as several striped red mullet *Mullus surmuletus*, three snipefish *Macroramphosus scolopax*, one Spanish ling *Molva macrophthalma* and two specimens of the starfish *Tethyaster subinermis* (Figure 14). Boarfish was also present at SW2 along with haddock and a 106 cm male common skate that was tagged and released. Four-spot megrim *Lepidorhombus boscii* were caught both at SW3 and SW2, with the tows at these stations reduced to 1.75 nm and 1.5 nm due to increasing winds and swell height. A small total catch (21 kg) was retrieved at SW1, comprising mostly mackerel and black-bellied anglerfish. Juvenile specimens of both species in the common skate-complex (blue skate *Dipturus batis* and flapper skate *D. intermedius*) were also observed.

Inclement weather slowed the transit to prime station NW7 (Stratum 1) overnight and, as conditions at the station proved unfavourable, RV Endeavour proceeded to stations NW6, NW5 and NW4. These stations produced catches mainly comprising of both species of anglerfish, haddock (NW5 and NW4 only), boarfish (NW5 only) and various elasmobranchs (including blue skate at NW6 and NW5 and shagreen ray at NW5). Due to increasing swell and wind, the tow distance at NW5 was reduced to 1.5 nm.

By the following day the vessel reached Stratum 3 where stations BC1 and BC2 were completed, after the swell had moderated. A small catch containing haddock and anglerfish was collected at BC1, with BC2 yielding a larger catch that contained mostly haddock and lesser-spotted dogfish. Work continued in this stratum on 25 February (stations BC4, BC3, BC7 and BC8), where elasmobranchs dominated the catches. Haddock was the main species by weight at BC4, cod, grey gurnard *Eutrigla gurnardus* and lesser-spotted dogfish were also in the catch. The latter species was also the largest component of the catch at BC7 where the tow was reduced to 1.5 nm due to a reduction in door sensor readings. Smaller quantities of thornback ray and plaice *Pleuronectes platessa* were recorded at BC3 while a larger catch (ca. 0.8 tonnes) was recorded at BC8. Most of the latter catch was comprised of starry smooth-hound, spotted ray *Raja montagui* and greater-spotted dogfish. Twenty-four greater-spotted dogfish (54-109 cm total length) were tagged with Peterson discs at this station.

RV Endeavour steamed west overnight, as gale force 9 south-westerly winds prevented trawling. Following temperance of the swell, two stations (NW9 and NW1) were sampled in Stratum 1. A small (88 kg) catch containing haddock, conger eel and witch *Glyptocephalus cynoglossus* was recorded at NW9, whilst mackerel constituted the majority of the catch weight at NW1. Work continued in this stratum on 27 February at stations NW2 and NW3. Similar quantities of haddock, hake and black-bellied anglerfish were caught at NW2 and this was the second deepest survey station (ca. 170 m). Most of the catch weight at NW3 was mackerel. The imminent arrival of Storm Jorge meant that RV Endeavour had to transit to Falmouth for docking earlier than was planned. The vessel docked at 0424h, 28 February for the scheduled mid-survey change of scientific staff.

Part Two: 1 – 17 March 2020

RV Endeavour sailed from Falmouth at 1100h, 1 March, transiting to IS4 within Stratum 5, in south-westerly force 5 winds. The majority of the catch comprised of haddock, spurdog and lesser-spotted dogfish. Haddock, whiting and pollock were caught at the next station (BC12; Stratum 3). The next day fishing was attempted at six further stations within Stratum 3, though valid tows were only achieved at BC11, BC16, BC15 and BC13. Relatively small catches were recorded at BC11 and BC16, with lesser-spotted dogfish, spotted ray and spurdog caught at both stations, as well as haddock (BC11) and blonde ray (BC16). The larger catches at BC15 and BC13 consisted primarily of elasmobranchs; starry smooth-hound and lesser-spotted dogfish at the former and spurdog, lesser-spotted dogfish and thornback ray at the latter. The larger female starry smooth-hounds examined were mostly found to contain full term pups. An additional station, BC18, was abandoned after the vessel came fast 3 minutes into the tow, and fishing was constrained at BC14 due the heavy presence of commercial static gear, cables to the north and south as well as rough ground to the east.

Trawling continued within Stratum 3 on 3 March at BC10. Freshening winds and sea conditions during the previous night caused RV Endeavour to wait before operations could commence at BC10, where most of the catch weight comprised lesser-spotted dogfish and spotted ray. Station BC9, then CD2, CD3 and CD4 within Stratum 4 as well as BC6 were also fished, where catches were between *ca.* 400-550kg. Haddock was recorded at all stations, with notable catches of lesser-spotted dogfish (BC9, CD2, CD3 and BC6), grey gurnard (BC9 and CD4) and spurdog (CD2 and CD3) also recorded.

The next day, a successful tow at BC5, yielded mostly haddock and lesser-spotted dogfish. This was followed by a valid haul at CD1 where both these species as well as starry smooth-hound and greater-spotted dogfish were recorded (five individuals of the latter species were tagged). This finished sampling in Stratum 4. RV Endeavour moved west back into Stratum 1 where sampling continued for the rest of the day at NW13, NW8, NW10 and NW7. Haddock and lesser-spotted dogfish were caught once again at NW13 as well as hake, whereas boarfish was the largest component by catch weight at NW8, alongside haddock, hake and black-bellied anglerfish. Comparatively small catches were taken at NW10 and NW7 that contained mainly Norway lobster *Nephrops norvegicus* (NW10), mackerel and black-bellied anglerfish (NW7). Common blue skate were captured at NW13 (three females between 26 and 103 cm), NW10 (males of 74–84 cm and females of 92–126 cm, with 4 fitted with electronic tags) and NW7 (3 females of 28–125 cm).

During the day it became apparent that RV Endeavour would have to transit towards dry dock in Falmouth to investigate noise originating from the propeller (tail shaft). This was scheduled for 1230h, 7 March. It was also discovered that the starboard split net drum had become inoperative and, as a result the codend was brought aboard using an alternative method for the next few days.

Due to the now-scheduled dry dock and the expected strong westerly and south-westerly winds forecast, the survey plan was modified, and no further ESM2 deployments were made

during 5 and 6 March due to time constraints. Consequently, RV Endeavour moved east towards Falmouth targeting stations in Stratum 1 (SW4, SW5, SW6 and SW8) en-route. Catches varied between stations, with a small catch of haddock, boarfish, mackerel and both species of anglerfish recorded at SW4. Boarfish were the majority of the catch at stations SW5 and SW6, the latter being over 1.6 tonnes. The tow distance at SW6 was shortened to 1.5 nm due to safety concerns in deteriorating weather. Another large catch (*ca.*1 tonne) mainly mackerel, also included one cushion star *Ceramaster granularis* and a blue-mouth redfish *Helicolenus dactylopterus*, was made at SW8, where the tow distance was reduced to 1.75 nm due to a 15 m decrease in door sensor readings after 1.5 nm. RV Endeavour was then informed that dry docking had been brought forward by 12 hours to 0030h, 7 March due to forthcoming unfavourable weather that could affect entry into the dry dock.

On 6 March, a 0.5 tonne catch was sampled at SW10, which was composed primarily of spurdog. RV Endeavour then transited eastwards to BY2 in Stratum 10, however the strong north-westerly winds and increasing swell prevented fishing. The survey grid was left at 1300h and the vessel steamed towards Falmouth for the scheduled dry docking. A technical issue with the dry dock gates prevented closure upon arrival and RV Endeavour was moved to another berth. Due to inclement weather dry docking was delayed by 48 hours and pushed back until 1430h, 9 March. Cefas scientists departed on 10 March with the SIC and 2IC remaining onboard. RV Endeavour departed the dry dock at 2048h, 15 March to commence sea trials and propeller noise was still audible during these trials. Consequently, RV Endeavour moved to North of Queens berth and the SIC and 2IC travelled home on 17 March. Although plans were made to complete the survey, the outbreak of Coronavirus and associated restrictions on travel prevented the continuation of the survey.

6. RESULTS BY AIM:

Primary survey aims

6.1 Monkfish trawl (see section 4.1)

This aim was only partially completed because of the mechanical trouble with the vessel and frequent storm weather conditions which reduced the total available sampling time. COVID-19 prevented continuation of survey due to field-work restrictions imposed from 31 March.

A total of fifty-six valid stations were fished successfully during the survey (Figure 2, Figure 3, Table 1; Appendix 1), out of an initially planned 100 stations (of which 14 had been identified as secondary stations to be sampled if time permitted). The majority of these were conducted in the Celtic Sea (forty-two including one additional, primarily Strata 1-5), with sampling in two of the ten strata completed, six partially finished and two strata were not sampled at all (Table 2). One site could not be sampled due to a combination of static fishing gear and untrawlable ground preventing sampling, and another station was abandoned early in the tow as the vessel came fast.

The average net geometry sensor readings (Figure 4) indicate that the parameters were comparable with the two previous years. The linear relationships between headline height,

wing spread and door spread with depth appear slightly different in 2018 due to stations in deeper water not being fished that year, whilst the survey stations fished did include several in much shallower water.

The audible noise emanating from the propeller necessitated that the vessel was to go into dry dock, which resulted in loss of ten days of fishing time and was the main reason for the primary survey aim was not completed. Additionally, weather was a contributing factor with Storm Dennis causing a 2.5 day delay to sailing and further inclement weather, including Storm Jorge, impacting on the survey through its duration.

Ninety-Six different taxa were measured on the survey (Table 3), in addition to the benthic species also encountered (Table 4), with forty-seven commercial species sampled for biological information (Table 5). The relative abundance and distribution of selected species are shown in Figure 5–Figure 8, with the length-frequency distributions for these species shown in Figure 9–Figure 13.

6.1.1 Gadiformes

Haddock was the second highest species by catch weight, with 1.986 t caught across 37 stations (Figure 5). A total of 689 individuals were sampled for sagittal otoliths and biological information.

Whiting had a total catch weight approximately one quarter of that of haddock (505 kg) but was observed at more stations ($n = 43$, Figure 5). A total of 1831 whiting were measured, 500 of which were sampled biologically.

More than 300 kg of hake was caught which comprised of 518 individuals across 37 stations, 418 of which were sampled for biological information. Less cod was recorded (total catch weight = 117 kg) though all fish were biologically sampled ($n=51$; Figure 9).

6.1.2 Flatfish (Pleuronectiformes)

Plaice *Pleuronectes platessa* was the main flatfish species caught by weight (101 kg) and it was also observed on the highest number of stations (32; Figure 8). Though more individuals were measured (588), less were biologically sampled (250) than megrim *Lepidorhombus whiffiagonis* due to the biological sampling strategy for each species.

The biomass of megrim was similar to that of plaice (91 kg) and they were found at a comparable number of stations ($n = 30$; Figure 8). 434 individuals were measured, 349 of which were sampled biologically (Table 5).

Dover sole *Solea solea* (43 kg), lemon sole *Microstomus kitt* (38 kg) and four-spot megrim (8 kg) were other commercially-important flatfish species caught on the survey, recorded at 20, 25 and 10 stations respectively.

6.1.3 Elasmobranchs

Lesser-spotted dogfish were observed at every valid station apart from SW1 (98% occurrence; Figure 6) and was the third most important species by catch weight, with 1.861 t recorded during the survey.

Starry smooth-hound was also in the top five species (in terms of biomass), with a total catch weight exceeding 1 t (Table 3) and given the quantities caught, they were the most biologically sampled elasmobranch species (n= 799; Table 5). Additionally, they were also one of the most tagged species, see section 6.3.1.

Spurdog was not as abundant as lesser-spotted dogfish or starry smooth-hound, although they were also in the top 10 species by catch weight (920 kg) and the third most biologically sampled elasmobranch species (n = 436).

Spotted ray was recorded at the same number of stations as spurdog (24 hauls) and was the second most biologically sampled elasmobranch species (n = 724). Both spotted ray and thornback ray had total catch weights >375 kg. Blonde ray and undulate ray were the other skate species for which the sampled biomass exceeded 100 kg.

6.1.4 Pelagic fish

Though not a target species group for the survey, a range of pelagic fish were sampled

Mackerel was present at 40 stations (Figure 7) and in the top five species caught by catch weight (1.130 t). This was largely due to catches >100 kg at three stations, NW1, NW3 and SW8, the latter having the majority of mackerel caught for the whole survey (over 0.75 t). Horse mackerel was present at 37 stations, with a total biomass *ca.* 136 kg, with 1258 individuals measured.

Boarfish were the main species caught on the survey in terms of total biomass and were present at 21 stations, though most of the catch weight (3.161 t) was recorded at just two stations (SW3 and SW6).

Herring *Clupea harengus*, pilchard *Sardina pilchardus*, sprat *sprattus sprattus* and anchovy *Engraulis encrasicolus* were recorded in much smaller amounts (<1.4 kg).

6.1.5 Other fish species

With the monkfish trawl designed to catch anglerfish, both sub-species were important catch components and had a combined total catch weight of 0.5 t.

Anglerfish was the second most ubiquitous species (after lesser-spotted dogfish) and observed at 46 stations (82% occurrence; Figure 8) with 270 individuals measured (Figure 12) and 254

biologically sampled. Black-bellied anglerfish were less frequently caught (n = 27 stations) and less abundant.

More than 150 kg of black seabream were caught on the survey across 10 stations. These samples comprised 955 individuals (Figure 11), of which 207 were biologically sampled (Table 5). Approximately half of the total catch weight was recorded at one station (CI2; Figure 7).

European seabass *Dicentrarchus labrax* was also captured at 10 stations, but in smaller quantities. Several wrasse species were also collected including cuckoo wrasse *Labrus mixtus* (BC12 and BC6), baillons wrasse *Symphodus balloni* (BC13) and ballan wrasse *Labrus bergylta* (BY9).

Conger eel were captured at a similar number of stations (n=26), though they were in the top ten species caught (by catch weight; 405 kg). A total of 187 John dory were caught with a total biomass of 129 kg was measured and sampled for biological information.

In terms of gurnards, red gurnard and grey gurnard formed similar parts of the catch composition (363 kg and 336 kg, respectively), and were recorded at 35 and 38 locations respectively. Small quantities of tub gurnard (*Chelidonichthys lucerna*, 35 kg) and streaked gurnard (*Trigloporus lastoviza*, 5 kg) were also recorded.

6.1.6 Cephalopods and shellfish

With a catch weight of over 57 kg, common cuttlefish *Sepia officinalis* was the main cephalopod species caught, 67 were measured and biological information recorded from 65 specimens.

Northern squid *Loligo forbesii* was main squid species captured (16 kg), with curled octopus *Eledone cirrhosa* (n = 77; catch weight >17 kg) the only octopod species caught during the survey.

More than 75 kg of queen scallop *Aequipecten opercularis* were caught during the survey, and this was the most abundant bivalve species by weight and number (1680 measured and a further 1565 counted).

Norway lobster was another large portion of shellfish catches (n = ca. 2259; catch weight 53 kg) although most of this was captured at three stations (CD2, CD3 and NW10). Commercial crabs, including spider crab *Maja squinado* were also taken, albeit in lower quantities.

6.1.7 Ichthyological observations

Several species of note were captured on the survey (Figure 14) including four specimens of shagreen ray (NW6, NW7 and SW6; 58–68 cm L_T), four marbled electric ray *Torpedo marmorata* (BY6 and BY3; 19–48 cm L_T), three snipefish (SW3 and SW6; 15–18 cm L_T), two blue-mouth redfish (SW8 and SW3; 15–17 cm L_T), one common stingray *Dasyatis pastinaca* (BY9; 47 cm L_T) and one Spanish ling (SW3; 33 cm L_T).

6.1.8 Observations on macrobenthic catch

Overall, >100 macrobenthic taxa and taxa groups were recorded (Table 4). The main species in terms of catch weight, was the ascidian *Diazona violacea* and edible sea urchin *Echinus esculentus*. Spiny starfish *Marthasterias glacialis* and yellow boring sponge *Cliona celata* were also prominent species in the catches.

Three epibenthic species of more interest (Figure 14) were the brittlestar *Asteronyx loveni* (n=5; SW3, SW2, NW4 and NW2), the starfish *Tethyaster subinermis* (n = 3; SW3 and SW8) and one cushion star *Ceramaster granularis* (SW8).

6.1.9 Anthropogenic debris

Only thirteen of the fifty-six trawls stations had no litter observed. Plastics constituted the largest marine litter type collected in the monkfish trawl (Figure 15), with 86 pieces observed comprising 87% of the total (n=108).

Of note was a spurdog specimen entangled in a 12 cm mesh gill net (Station NW1; Figure 16).

6.2 Multibeam data (see section 4.2)

Acoustic data was collected at three operating frequencies (38, 120 & 200 kHz) throughout the survey for further extrapolation and analysis and accordingly the aim was fully completed for the monkfish trawl tows and 20 targeted sampling survey days.

Multibeam data were also recorded through Olex to aid subsequent surveys in these areas and raw data was logged continuously, with copies retained for subsequent analysis at the Cefas laboratory.

Secondary survey aims

6.3 Additional biological investigations on elasmobranchs (see section 4.3):

6.3.1 (a-c) Tagging

Overall, 109 elasmobranchs of 13 species were tagged with numbered Petersen discs and released during the course of the survey (Table 6). Positions of capture and release were recorded, as well as individual biological information. The main species tagged were greater-spotted dogfish (n = 42) and starry smooth-hound (n = 18), with eight common blue skate also tagged and released.

Of the tagged individuals, ten of these were tagged and released with data storage tags provided by Cefas Technology Ltd (model G5 with and without pop-off mechanism). The species tagged consisted of two blonde rays, one undulate ray, five common blue skates and

two starry smooth-hounds (Table 6). All electronic tagging procedures were conducted under UK Home Office Animals (Scientific Procedures) Act 1986 (ASPA) regulations, and under Project License P9D31EA7F (Protocol No 1 “Tagging by external attachment”).

6.3.2 (d) Additional biological sampling

Whilst every effort was made to release elasmobranchs alive, additional sampling was undertaken for some species if specimens were dead. Additional biological sampling was undertaken for blonde ray ($n = 8$) and undulate ray ($n = 1$) during the first part of the survey, with single specimens of blonde ray, female common blue skate and male tope frozen during the second part of the survey for subsequent examination.

6.3.3 (e) spurdog pups

Those female spurdog that could not be returned alive were examined for additional fecundity data ($n = 8$; 103–115 cm L_T), with a total of 90 pups recorded for their individual total length (mm), sex and total weight (0.1 g).

6.4 Additional biological investigations on teleosts (see section 4.4):

The aims were fully conducted for all survey days completed.

6.4.1. (a) Unusual Species

Three *Tethyaster subinermis* starfish and a cuckoo wrasse *Labrus mixtus* with predominantly female gonads but contained male testes were frozen and retained for subsequent analysis.

6.4.2 (b) Additional length-weight data

Further measurements (L_T in mm) and weight (0.1 g) were recorded for seven species ($n = 21$), including species rarely encountered such as snipefish, spanish ling and blue-mouth redfish. Other species included greater forkbeard *Phycis blennoides*, three-bearded rockling *Gaidropsarus vulgaris*, common topknot *Zeugopterus punctatus* and lesser flying squid *Todaropsis eblanae*.

6.4.3 (c) Four-bearded rockling *Enchelyopus cimbrius*:

No four-bearded rockling were captured during the survey.

6.4.4 (d) Otolith reference collection

Otoliths were collected from species of interest and retained for a reference collection including from snipefish.

6.4.5 (e) Maturity stage photographs

Photographs of various maturity stages from eight individual fish from four species were taken during the survey. Twenty-three images from black seabream of early maturity (n=16), late maturity (n=3) in females and the mature stage in males (n=3), as well as a comparative image of a male and female side by side were captured. The mature stage in female John dory (n=14) and European seabass (n=1) along with the same stage in male striped red mullet (n=6) were also photographed as well as the recovery stage of spent in the latter species (female, n=8).

6.5 Diadromous fish (see section 4.5)

No specimens were retained, with only a single twaite shad (45 cm) caught during the survey.

6.6 Dietary studies (see section 4.6)

Stomach contents was examined from 23 individual fish specimens from seven species during the first half of the survey, when trained staff were available. These comprised of blonde ray (n = 1), cod (n = 1), John dory (n = 3), spotted ray (n = 8), starry smooth-hound (n = 5), thornback ray (n = 2), and whiting (n = 3). These were analysed to ascertain stomach weight, stomach fullness, number of prey species including digestive state and length if applicable.

6.7 Contaminants in fish (see section 4.7)

The aim was completed for all conducted survey days with 149 samples collected from seven different species. Sampling was undertaken over 5 cm length intervals, so as to ensure representative coverage of the wider length range.

These samples included hake (n = 41; 15–94 cm L_T), spurdog (n = 33; 25–104 cm L_T), anglerfish (n = 26; 15–84 cm L_T), whiting (n = 22; 15–54 cm L_T), John dory (n = 14; 10–49 cm L_T), ling (n = 9; 50–89 cm L_T) and conger eel (n = 4; 90–104 cm L_T).

6.8 Ring net sample (see section 4.8)

The aim was fully completed. A vertical ring net sample was collected at the west Gabbard smartbuoy at the start of the survey, contributing to the Lifeform project (Defra) as part of the UK monitoring network for zooplankton.

6.9 Nutrient sampling (see section 4.9)

The aim was fully completed for all survey days conducted. Samples were collected every 12 hours during the survey, with 20 nutrients and 9 chlorophyll samples taken in total.

Opportunistic survey aims

6.10 Genetic sampling (see section 4.10)

The aim was completed for the Celtic Sea and western Channel for all the survey days conducted. Genetic samples were taken from anglerfish (n = 51), black-bellied anglerfish (n = 47) and hake (n = 56) in three sampling areas (C, D and E; Table 7). Samples were obtained to confirm the GECKA (Genetic close-kin analysis) hypothesis that black-bellied and white-bellied anglerfish could be hybridising and whether the species were being misidentified using morphology. Samples were preserved in RNAlater®

6.11 Miscellaneous studies (see section 4.12)

Two sets of whole fish samples were retained for use in subsequent Cefas outreach events, and a further two whole fish samples were collected for Cefas staff biological sampling training.

A single whiting skeleton and a single pollock frame were labelled, frozen and retained for subsequent collection by a Ph.D. student from the University of Cambridge, to be used within their reference collection for comparison to archaeological Atlantic cod vertebrae specimens from Medieval sites within the UK.

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I would like to express my gratitude to all the officers and crew of RV Cefas Endeavour for their invaluable assistance, advice and support given during this survey, which enabled as much of the survey to be completed as possible within the available timeframe. Additionally, my thanks also go to Pinbush and MIST staff who facilitated the delivery of equipment needed to conduct the survey. Finally, I would also like to extend my thanks to the Cefas scientists and observer who helped to deliver the survey aims. Your hard work, dedication and commitment was really appreciated and without your teamwork the survey aims would not have been delivered to the extent they were.

Louise Straker Cox
Scientist in Charge
03/04/2020

DISTRIBUTION:

BODC

AWSM

Participants of survey

Marine Operations

L Elvin (PM)

S Songer (PI)

P Falconer (PL)

Data Steward (Gary Burt)

Cefas Fisheries surveys SICs/2ICs

P&O Maritime - Pinbush

Fishing Skipper/Master Cefas Endeavour

FCO (Overseas EEZ's)

Table 1: Number of gear deployments, during the survey, by validity.

Deployment type	Valid	Additional	Invalid	Total
Jackson 575 Monk Trawl	56	0	1 ¹	57
Sound Velocity Profile	14	0	0	14
ESM2 Profiler and Niskin	8	0	0	8
200µm WP2 Plankton Ring Net	1	0	0	1

¹ BC18; abandoned 3 minutes into tow as vessel came fast

Table 2: Fixed stations fished successfully (shaded green). Survey strata are north-west Celtic Sea (NW), south-west Celtic Sea (SW), Bristol Channel (BC), Celtic Deep (CD), Isles of Scilly (IS), Eddystone Grounds (EG), Lyme Bay (LB), mid-Channel (MC), Channel Islands (CI) and Brittany (BY). Those stations to be sampled if time permitted (additional stations) given in parentheses.

Stratum	Fixed station number																			Stations fished successfully	
1 (NW-)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	(17)	(18)	(19)	(20)	11
2 (SW-)	1	2	3	4	5	6	7	8	9	10	11	12	(13)	(14)	(15)	(16)	(17)				10
3 (BC-)	1	2	3	4	5	6	7	8	9	10	11	12	13	14 ²	15	16	(17)	(18) ³			15
4 (CD-)	1	2	3	4																	4
5 (IS-)	1	2	3	4	5	6	(7)														1
6 (EG-)	1	2	3	4	5																0
7 (LB-)	1	2	3	4	5	6	(7)														3
8 (MC-)	1	2	3	4	5	(6)															0
9 (CI-)	1	2	3	4	5	6	7														7
10 (BY-)	1	2	3	4	5	6	7	8	9												5
Total																			56		

² BC14: attempted to locate tow, but constrained by commercial fishing gear and rough ground

³ BC18: Invalid tow, abandoned 3 minutes into tow as vessel came fast

Table 3: Measured species caught in valid tows ranked in descending order of total catch weight

Common Name	Species Scientific Name	Cefas Code	Total Catch Weight (kg)
Boar fish	<i>Capros aper</i>	BOF	3507.351
Haddock	<i>Melanogrammus aeglefinus</i>	HAD	1987.699
Lesser-spotted dogfish	<i>Scyliorhinus canicula</i>	LSD	1861.042
European mackerel	<i>Scomber scombrus</i>	MAC	1130.252
Starry smooth-hound	<i>Mustelus asterias</i>	SDS	1120.305
Spurdog	<i>Squalus acanthias</i>	DGS	920.253
Whiting	<i>Merlangius merlangus</i>	WHG	505.051
Spotted ray	<i>Raja montagui</i>	SDR	453.829
European conger eel	<i>Conger conger</i>	COE	404.962
Thornback ray	<i>Raja clavata</i>	THR	386.323
Red gurnard	<i>Chelidonichthys cuculus</i>	GUR	363.285
Grey gurnard	<i>Eutrigla gurnardus</i>	GUG	335.935
European hake	<i>Merluccius merluccius</i>	HKE	317.607
Anglerfish (monkfish)	<i>Lophius piscatorius</i>	MON	308.618
Greater-spotted dogfish	<i>Scyliorhinus stellaris</i>	DGN	209.832
Black-bellied anglerfish	<i>Lophius budegassa</i>	WAF	197.368
Black seabream	<i>Spondyliosoma cantharus</i>	BKS	156.471
Blonde ray	<i>Raja brachyura</i>	BLR	151.610
Horse-mackerel	<i>Trachurus trachurus</i>	HOM	136.221
John dory	<i>Zeus faber</i>	JOD	129.469
Atlantic cod	<i>Gadus morhua</i>	COD	116.882
Undulate ray	<i>Raja undulata</i>	UNR	106.710
European plaice	<i>Pleuronectes platessa</i>	PLE	100.571
Cuckoo ray	<i>Leucoraja naevus</i>	CUR	93.628
Megrim	<i>Lepidorhombus whiffiagonis</i>	MEG	90.547
Common Blue skate	<i>Dipturus batis</i>	SKG	87.564
Small-eyed ray	<i>Raja microocellata</i>	PTR	66.716
Pollack	<i>Pollachius pollachius</i>	POL	64.260
Bib	<i>Trisopterus luscus</i>	BIB	63.709
Tope shark	<i>Galeorhinus galeus</i>	GAG	59.810
Barrel jellyfish ⁴	<i>Rhizostoma octopus</i>	BAR	59.725
Common cuttlefish	<i>Sepia officinalis</i>	CTC	57.617
Norway lobster	<i>Nephrops norvegicus</i>	NEP	53.311
Poor cod	<i>Trisopterus minutus</i>	POD	52.928
Dover sole	<i>Solea solea</i>	SOL	42.775
Dab	<i>Limanda limanda</i>	DAB	42.078
Lemon sole	<i>Microstomus kitt</i>	LEM	37.587
Witch	<i>Glyptocephalus cynoglossus</i>	WIT	37.421

⁴ Additional samples of 14.06 kg weight were not measured, as damage prevented accurate measurements

Table 3 (continued): Measured species caught in valid tows ranked in descending order of total catch weight

Common Name	Species Scientific Name	Cefas Code	Total Catch Weight (kg)
Tub gurnard	<i>Chelidonichthys lucerna</i>	TUB	34.587
Queen scallop ⁵	<i>Aequipecten opercularis</i>	QSC	32.845
Greater spider crab	<i>Maja squinado</i>	SCR	29.775
European seabass	<i>Dicentrarchus labrax</i>	ESB	27.665
Striped red mullet	<i>Mullus surmuletus</i>	MUR	19.990
Common ling	<i>Molva molva</i>	LIN	19.800
Northern squid	<i>Loligo forbesii</i>	NSQ	16.123
Blue whiting	<i>Micromesistius poutassou</i>	WHB	15.980
Turbot	<i>Scophthalmus maximus</i>	TUR	14.600
Common dragonet	<i>Callionymus lyra</i>	CDT	7.909
Four-spot megrim	<i>Lepidorhombus boscii</i>	LBI	7.889
Common skate-complex	<i>Dipturus</i> spp.	SKT	7.820
Blue jellyfish	<i>Cyanea lamarckii</i>	BLU	7.255
Moon jellyfish	<i>Aurelia aurita</i>	AUA	6.985
Norway pout	<i>Trisopterus esmarki</i>	NOP	5.740
Common spiny lobster	<i>Palinurus elephas</i>	SLO	5.414
Streaked gurnard	<i>Trigloporus lastoviza</i>	GUS	5.373
Great scallop	<i>Pecten maximus</i>	SCE	5.207
Shagreen ray	<i>Leucoraja fullonica</i>	SHR	5.160
European lobster	<i>Homarus gammarus</i>	LBE	4.800
European squid	<i>Loligo vulgaris</i>	LLV	3.830
Saithe	<i>Pollachius virens</i>	POK	3.778
Broadtail shortfin squid	<i>Illex coindetii</i>	SQI	3.492
Lesser flying squid	<i>Todaropsis eblanae</i>	OME	3.428
Marbled electric ray	<i>Torpedo marmorata</i>	MER	2.978
Flapper skate	<i>Dipturus intermedius</i>	SKF	2.663
Unidentified jellyfish	Scyphozoa	JEL	2.869
Argentine	<i>Argentina</i> spp.	ARG	2.378
Three-bearded rockling	<i>Gaidropsarus vulgaris</i>	TBR	2.115
Greater weever fish	<i>Trachinus draco</i>	WEG	1.970
Edible crab	<i>Cancer pagurus</i>	CRE	1.542
Brill	<i>Scophthalmus rhombus</i>	BLL	1.505
Greater forkbeard	<i>Phycis blennoides</i>	GFB	1.467
Herring	<i>Clupea harengus</i>	HER	1.363
Velvet swimming crab	<i>Necora puber</i>	MLP	1.281
Twaite shad	<i>Alosa fallax</i>	TAS	0.880
Long-rough dab	<i>Hippoglossoides platessoides</i>	PLA	0.878
Cuckoo wrasse	<i>Labrus mixtus</i>	CUW	0.873
Common squids	<i>Loligo</i> spp.	SQC	0.872

⁵ Additional samples totalling 42.485 kg were weighed and counted: 1565 individuals

Table 3 (continued): Measured species caught in valid tows ranked in descending order of total catch weight

Common Name	Species Scientific Name	Cefas Code	Total Catch Weight (kg)
Pink cuttlefish	<i>Sepia orbignyana</i>	SEO	0.816
Baillons wrasse	<i>Symphodus bailloni</i>	BLW	0.810
Crystal jellies ⁶	<i>Aequorea</i> spp.	CRI	0.809
Common stingray	<i>Dasyatis pastinaca</i>	SGR	0.790
Imperial scaldfish	<i>Arnoglossus imperialis</i>	ISF	0.732
Pilchard (sardine)	<i>Sardina pilchardus</i>	PIL	0.599
Topknot	<i>Zeugopterus punctatus</i>	TKT	0.583
Flounder	<i>Platichthys flesus</i>	FLE	0.420
European common squid	<i>Alloteuthis subulata</i>	ATS	0.252
Sprat	<i>Sprattus sprattus</i>	SPR	0.237
cu	<i>Labrus bergylta</i>	BNW	0.215
Blue-mouth redfish	<i>Helicolenus dactylopterus</i>	RBM	0.149
Snipefish	<i>Macrorhamphosus scolopax</i>	SNI	0.148
Lesser weever fish	<i>Echiichthys vipera</i>	WEL	0.095
Spanish ling	<i>Molva macrophthalma</i>	SLI	0.068
European anchovy	<i>Engraulis encrasicolus</i>	ANE	0.041
Flying squid	<i>Todarodes sagittatus</i>	SQE	0.020
Spotted dragonet	<i>Callionymus maculatus</i>	SDT	0.019
Common sandeel	<i>Ammodytes tobianus</i>	TSE	0.005

⁶ Additional samples of 0.024 kg weight were not measured, as damage prevented accurate measurements

Table 4: Non-measured species sampled from valid tows ranked in descending order of total catch weight (kg), including total numbers counted (or number of stations where the species was observed).

Common name	Scientific Name	Cefas code	Total weight (kg)	Count
Football ascidian	<i>Diazona violacea</i>	DIV	181.169	-
Edible sea urchin	<i>Echinus esculentus</i>	URS	75.411	301
Spiny starfish	<i>Marthasterias glacialis</i>	MAG	63.541	171
Yellow boring sponge	<i>Cliona celata</i>	CLI	47.515	-
Sponges	Porifera	PFZ	43.915	-
Whelk eggs	-	WES	21.997	-
Common whelk	<i>Buccinum undatum</i>	WHE	17.613	237
Curled octopus	<i>Eledone cirrhosa</i>	EDC	17.605	77
Anemone	<i>Actinauge richardi</i>	ACR	16.317	532
Common starfish	<i>Asterias rubens</i>	STH	11.725	321
Broken shell	-	BSL	8.531	-
Hermit in whelk	<i>Eupagurus bernhardus</i>	HIW	7.695	202
Benthos (unidentified)	-	BEN	7.520	-
Dead-mens fingers	<i>Alcyonium digitatum</i>	DMF	5.731	-
Rocks	-	ROK	4.872	-
Kelp	Laminarian algae (<i>phaeophyceae</i>)	LMX	4.264	-
Common sunstar	<i>Crossaster papposus</i>	CTP	4.060	118
Common sea mouse	<i>Aphrodite aculeata</i>	AAC	2.802	126
Seven-armed starfish	<i>Luidia ciliaris</i>	LDC	2.529	13
Green sea urchin	<i>Psammechinus miliaris</i>	PMM	2.323	279
-	<i>Tethyaster subinermis</i>	TYS	1.800	3
Anemone spp.	<i>Bolocera tuediae</i>	BCT	1.582	30
Sand star	<i>Astropecten irregularis</i>	API	1.548	62
Sea squirts	Ascidiacea	SSX	1.540	-
Sponge spp.	Polymastiidae	PMX	1.099	-
Sea cucumber	<i>Eostichopus regalis</i>	SSR	1.058	5
Sea squirt	<i>Ascidia mentula</i>	ASM	0.919	30
Red cushion star	<i>Porania pulvillus</i>	PPV	0.776	37
Sea cucumber	<i>Parastichopus tremulus</i>	STT	0.672	8
Anemone (unidentified)	-	AMU	0.599	30
Sea urchin	<i>Echinus acutus</i>	URA	0.550	18
Goose-foot star	<i>Anseropoda placenta</i>	PLM	0.509	31
Pink shrimp	<i>Pandalus propinquus</i>	PDP	0.481	111
Rosy starfish	<i>Stichastrella rosea</i>	SLR	0.466	25
Rose coral	<i>Pentapora foliacea</i>	PET	0.382	-
Horse mussel	<i>Modiolus modiolus</i>	HML	0.376	7
Common brittle star	<i>Ophiothrix fragilis</i>	OPF	0.342	412
Pink shrimp	<i>Pandalus montagui</i>	PRM	0.290	77
Barnacles (unidentified)	Balanomorpha	BEY	0.290	-

Table 4 (continued): Non-measured species sampled from valid tows ranked in descending order of total catch weight (kg), including total numbers counted (or number of stations where the species was observed).

Common name	Scientific Name	Cefas code	Total weight (kg)	Count
Sponge crab	<i>Dromia personata</i>	DRP	0.285	6
Bloody henry starfish	<i>Henricia oculata</i>	HEO	0.281	32
Luidia starfish spp.	<i>Luidia spp</i>	LUI	0.275	2
Hydroid	<i>Nemertesia ramosa</i>	NER	0.272	-
Hermit in <i>Adamsia</i>	<i>Pagurus prideaux in Adamsia</i>	HIA	0.266	15
Common swimming crab	<i>Polybius holsatus</i>	LMH	0.240	63
Purple heart urchin	<i>Spatangus purpureus</i>	SPG	0.235	2
Swimming crab	<i>Macropipus tuberculatus</i>	MPT	0.226	19
Hornwrack	<i>Flustra foliacea</i>	FAF	0.208	-
Gibbs spider crab	<i>Pisa armata</i>	PAA	0.175	23
Squat lobster	<i>Munida rugosa</i>	MNR	0.164	12
Dahlia anemone	<i>Urticina felina</i>	DHA	0.160	8
Heart cockle	<i>Glossus humanus</i>	GLO	0.151	1
Dog cockle	<i>Glycymeris glycymeris</i>	GLG	0.150	3
Swimming crab	<i>Liocarcinus depurator</i>	LMD	0.147	16
Ross worm colonies	<i>Sabellaria spinulosa</i>	RCL	0.139	-
Serpent star	<i>Ophiura ophiura</i>	OHT	0.131	24
Parchment worm tubes	<i>Chaetopterus spp.</i>	CVT	0.130	-
Sea lemon	<i>Archidoris pseudoargus</i>	ADP	0.125	16
Cushion star	<i>Ceramaster granularis</i>	CER	0.119	1
Slender spider crab	<i>Macropodia tenuirostris</i>	MCT	0.106	10
Sars' starfish	<i>Luidia sarsi</i>	LUS	0.103	11
Opisthobranch	<i>Scaphander lignarius</i>	SDL	0.102	4
Fan mussel	<i>Atrina fragilis</i>	AFR	0.092	1
Barnacles	<i>Cirrepedia spp.</i>	CIZ	0.091	-
Cushion star	<i>Poraniidae spp.</i>	PPY	0.083	1
Scorpion spider crab	<i>Inachus dorsettensis</i>	IND	0.078	26
Opisthobranch (unidentified)	Opisthobranchia	OPI	0.078	7
Hydroid (unidentified)	Hydroida	HYD	0.075	-
Plumose anemone	<i>Metridium senile</i>	PMA	0.058	2
Black brittlestar	<i>Ophiocomina nigra</i>	OPN	0.056	24
Toothed wrack	<i>Fucus serratus</i>	WRS	0.052	-
Slender-leg spider crab	<i>Inachus leptochirus</i>	INL	0.037	14
Sponge	<i>Suberites spp.</i>	SUB	0.034	-
Curly weed	<i>Alcyonidium diaphanum</i>	ALG	0.031	-
Atlantic mud shrimp	<i>Solenocera membranacea</i>	SOA	0.029	8
Saddle oysters	Anomiidae	AEP	0.029	2
Brittlestar	<i>Asteronyx loveni</i>	AOL	0.029	5
Ghost shrimp	<i>Pasiphaea spp.</i>	PAS	0.024	16

Table 4 (continued): Non-measured species sampled from valid tows ranked in descending order of total catch weight (kg), including total numbers counted (or number of stations where the species was observed).

Common name	Scientific Name	Cefas code	Total weight (kg)	Count
Circular crab	<i>Atelecyclus rotundatus</i>	ALR	0.021	2
Hydroid	<i>Nemertesia antennina</i>	NEA	0.019	-
Edible mussel	<i>Mytilus edulis</i>	MUS	0.018	2
Sea cucumber (unidentified)	<i>Holothuroidea</i>	HTZ	0.016	1
Common brown shrimp	<i>Crangon crangon</i>	CSH	0.013	11
Little cuttlefish	Sepiolidae	SPY	0.012	5
Prideaux's hermit crab	<i>Pagurus prideaux</i>	PEX	0.011	2
Hermit in <i>Suberites</i>	<i>Pagurus</i> spp. in <i>Suberites</i>	HIS	0.011	1
Brown shrimp	<i>Crangon allmanni</i>	CGA	0.009	6
Common prawn	<i>Palaemon serratus</i>	CPR	0.009	1
-	<i>Ascidia conchilega</i>	ASD	0.008	-
Lutken's brittlestar	<i>Ophiothrix luetkeni (luetkeni)</i>	OPU	0.008	5
Hermit crab	<i>Pagurus variabilis</i>	PEV	0.008	2
Xanthid crab (unidentified)	Xanthidae	XAN	0.007	4
Sea slug	<i>Tritonia hombergi</i>	TNH	0.007	1
Variiegated scallop	<i>Chlamys varia</i>	CHV	0.006	1
Sponge	<i>Haliclona oculata</i>	HAO	0.006	-
Wracks (unidentified)	<i>Fucus</i> spp.	FUX	0.005	-
Tall seapen	<i>Funiculina quadrangularis</i>	FAQ	0.005	2
Sea slug (unidentified)	Nudibranchia	NBX	0.004	1
Whip shrimp	<i>Dichelopandalus bonnieri</i>	PDB	0.004	1
Contracted spider crab	<i>Hyas coarctatus</i>	HYC	0.003	1
Friendly bladed shrimp	<i>Spirontocaris lilljeborgii</i>	SPL	0.003	1
Marine leech	<i>Pontobdella muricata</i>	PDM	0.002	1
Sickle hydroid	<i>Hydrallmania falcata</i>	HYH	0.002	-
Pheasant tail hydroid	<i>Lytocarpia myriophyllum</i>	HYL	0.002	-
Squat lobster	<i>Galathea</i> spp.	GLX	0.001	1
Shrimp	<i>Processa</i> spp.	PCY	0.001	1
Pea crab	<i>Pinnotheres pisum</i>	PEA	0.001	1
Common sea spider	<i>Pycnogonum littorale</i>	PGL	0.001	1
Long clawed porcelain crab	<i>Pisidia longicornis</i>	PIS	0.001	1
Hairy crab	<i>Pilumnus hirtellus</i>	PNH	0.001	1

Table 5: Numbers of each species sampled for biological information by sex.

Common Name	Scientific Name	Cefas code	F	M	U	Total
Species sampled for length, weight, sex, maturity and collection of otoliths						
Haddock	<i>Melanogrammus aeglefinus</i>	HAD	379	310	-	689
Whiting	<i>Merlangius merlangus</i>	WHG	297	200	3	500
European hake	<i>Merluccius merluccius</i>	HKE	181	225	22	428
Megrim	<i>Lepidorhombus whiffiagonis</i>	MEG	218	131	-	349
Anglerfish (monkfish)	<i>Lophius piscatorius</i>	MON	135	113	6	254
European plaice	<i>Pleuronectes platessa</i>	PLE	148	102	-	250
Black seabream ⁷	<i>Spondyliosoma cantharus</i>	BKS	137	65	5	207
Black-bellied anglerfish	<i>Lophius budegassa</i>	WAF	107	88	5	200
European mackerel	<i>Scomber scombrus</i>	MAC	73	59	1	133
Witch	<i>Glyptocephalus cynoglossus</i>	WIT	93	30	-	123
Striped red mullet ⁷	<i>Mullus surmuletus</i>	MUR	69	48	1	118
Lemon sole	<i>Microstomus kitt</i>	LEM	65	30	-	95
Tub gurnard	<i>Chelidonichthys lucerna</i>	TUB	51	34	-	85
Dover sole	<i>Solea solea</i>	SOL	59	14	-	73
Four-spot megrim	<i>Lepidorhombus boscii</i>	LBI	27	32	-	59
Atlantic cod	<i>Gadus morhua</i>	COD	29	22	-	51
European seabass ⁷	<i>Dicentrarchus labrax</i>	ESB	12	17	-	29
Pollack	<i>Pollachius pollachius</i>	POL	12	12	-	24
Streaked gurnard	<i>Trigloporus lastoviza</i>	GUS	13	7	-	20
Sprat	<i>Sprattus sprattus</i>	SPR	10	8	-	18
Herring	<i>Clupea harengus</i>	HER	7	7	-	14
Pilchard (sardine)	<i>Sardina pilchardus</i>	PIL	7	7	-	14
Common ling	<i>Molva molva</i>	LIN	5	6	-	11
Turbot	<i>Scophthalmus maximus</i>	TUR	3	3	-	6
European anchovy	<i>Engraulis encrasicolus</i>	ANE	1	1	1	3
Cuckoo wrasse	<i>Labrus mixtus</i>	CUW	1	2	-	3
Brill	<i>Scophthalmus rhombus</i>	BLL	-	2	-	2
Baillons wrasse	<i>Symphodus balloni</i>	BLW	-	1	-	1
Saithe	<i>Pollachius virens</i>	POK	1	-	-	1

⁷ Scales also collected from these species

Table 5 (continued): Numbers of each species sampled for biological information by sex and area.

Common Name	Scientific Name	Cefas code	F	M	U	Total
Species sampled for length, weight, sex and maturity only (otoliths not collected)						
Starry smooth-hound	<i>Mustelus asterias</i>	SDS	333	466	-	799
Spotted ray	<i>Raja montagui</i>	SDR	353	371	-	724
Spurdog	<i>Squalus acanthias</i>	DGS	217	219	-	436
Thornback ray	<i>Raja clavata</i>	THR	155	86	-	241
John dory ⁸	<i>Zeus faber</i>	JOD	112	74	1	187
European conger eel ⁹	<i>Conger conger</i>	COE	1	3	115	119
Cuckoo ray	<i>Leucoraja naevus</i>	CUR	59	48	-	107
Common cuttlefish	<i>Sepia officinalis</i>	CTC	20	35	10	65
Greater-spotted dogfish	<i>Scyliorhinus stellaris</i>	DGN	19	43	-	62
Common blue skate	<i>Dipturus batis</i>	SKG	25	14	-	39
Small-eyed ray	<i>Raja microocellata</i>	PTR	19	18	-	37
Undulate ray	<i>Raja undulata</i>	UNR	11	19	-	30
Flapper skate	<i>Dipturus intermedius</i>	SKF	3	2	-	5
Shagreen ray	<i>Leucoraja fullonica</i>	SHR	1	3	-	4
Marbled electric ray	<i>Torpedo marmorata</i>	MER	1	1	-	2
Common stingray	<i>Dasyatis pastinaca</i>	SGR	1	-	-	1
Common skate-complex	<i>Dipturus spp.</i>	SKT	-	1	-	1
Blonde ray	<i>Raja brachyura</i>	BLR	34	36	-	70
Tope shark	<i>Galeorhinus galeus</i>	GAG	1	6	-	7

Table 6: Total number of elasmobranchs tagged using Peterson discs during the survey, including minimum and maximum lengths and associated electronic tags where applicable.

Common Name	Scientific Name	Cefas Code	Length Range (cm)	No. Tagged	No. Tagged Electronically
Greater-spotted dogfish	<i>Scyliorhinus stellaris</i>	DGN	61-111	42	-
Starry smooth-hound	<i>Mustelus asterias</i>	SDS	86-115	18	2
Spurdog	<i>Squalus acanthias</i>	DGS	76-123	9	-
Cuckoo ray	<i>Leucoraja naevus</i>	CUR	51-66	8	-
Common Blue skate	<i>Dipturus batis</i>	SKG	74-126	8	5
Tope shark	<i>Galeorhinus galeus</i>	GAG	119-135	6	-
Undulate ray	<i>Raja undulata</i>	UNR	57-87	6	1
Blonde ray	<i>Raja brachyura</i>	BLR	66-104	5	2
Small-eyed ray	<i>Raja microocellata</i>	PTR	70-79	2	-
Shagreen ray	<i>Leucoraja fullonica</i>	SHR	58-59	2	-
Marbled electric ray	<i>Torpedo marmorata</i>	MER	48-48	1	-
Spotted ray	<i>Raja montagui</i>	SDR	59-59	1	-
Common skate-complex	<i>Dipturus spp</i>	SKT	106-106	1	-

⁸ No otoliths were extracted from John Dory as this species is not aged using sagittal otoliths

⁹ Conger eels generally sampled for individual length and weight, before release (four dead individuals fully processed)

Table 7: Total number of GECKA project samples collected in each sampling area during the first and second parts of the survey. Associated ICES Areas are given in the parentheses.

Common name	Scientific name	Cefas Code	Sampling Area						Total
			C (VIIe)		D (VIIa, f and g)		E (VIIj and K)		
			1 st	2 nd	1 st	2 nd	1 st	2 nd	
European hake	<i>Merluccius merluccius</i>	HKE	1	4	4	12	35	-	56
Anglerfish (monkfish)	<i>Lophius piscatorius</i>	MON	10	-	19	6	16	-	51
Black-bellied anglerfish	<i>Lophius budegassa</i>	WAF	-	5	3	10	29	-	47

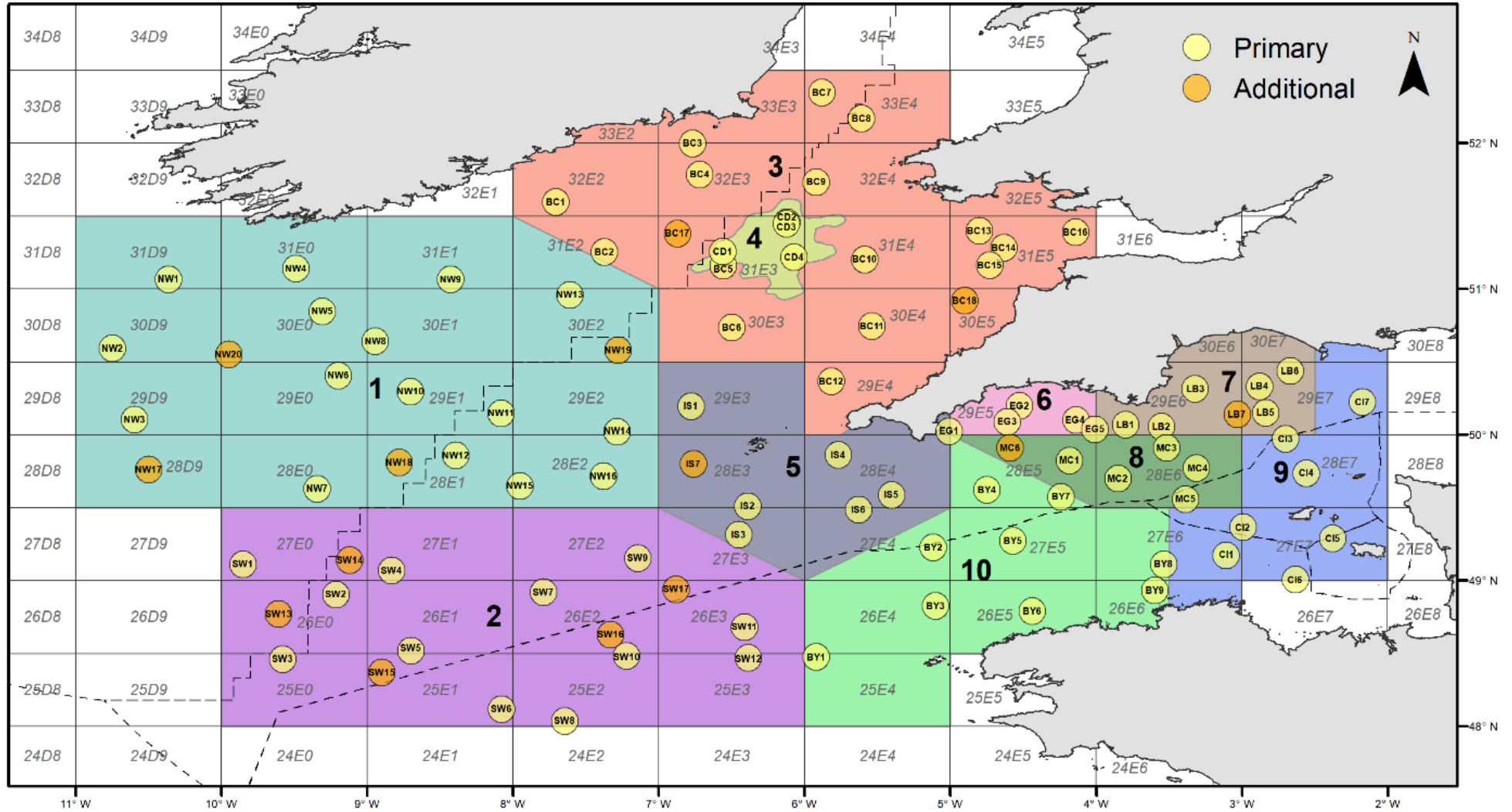


Figure 1: Map of the survey area showing strata, primary and additional stations for survey CEND 3/20

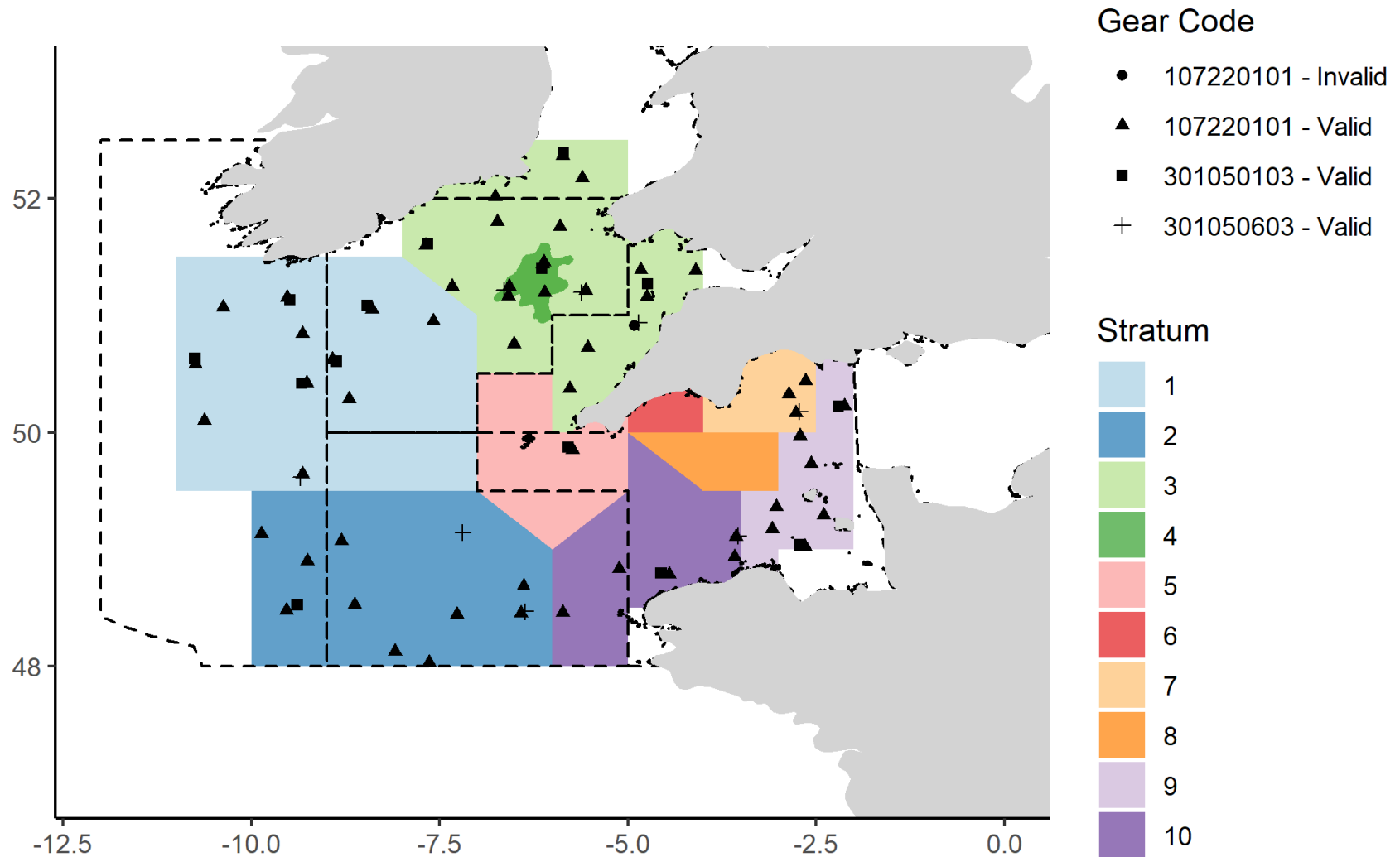


Figure 2: Map of survey area showing station positions sampled with the Jackson monkfish trawl (107220101), ESM2 and Niskin (301050603) and SVP (301050103) for survey CEND 3/20.

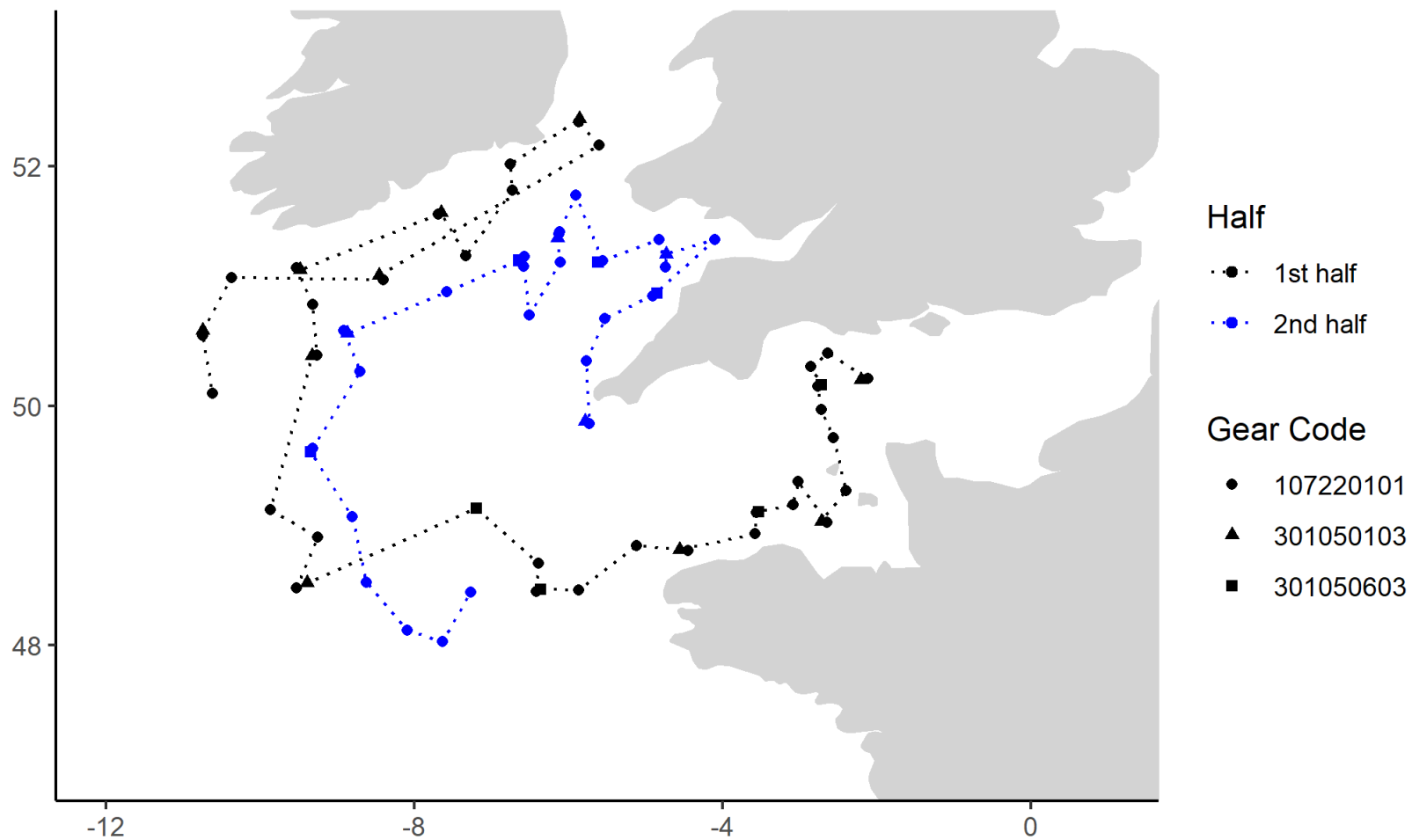


Figure 3 Survey track showing deployment with the Jackson monkfish trawl (107220101), ESM2 and Niskin (301050603) and SVP (301050103) for survey CEND 3/20.

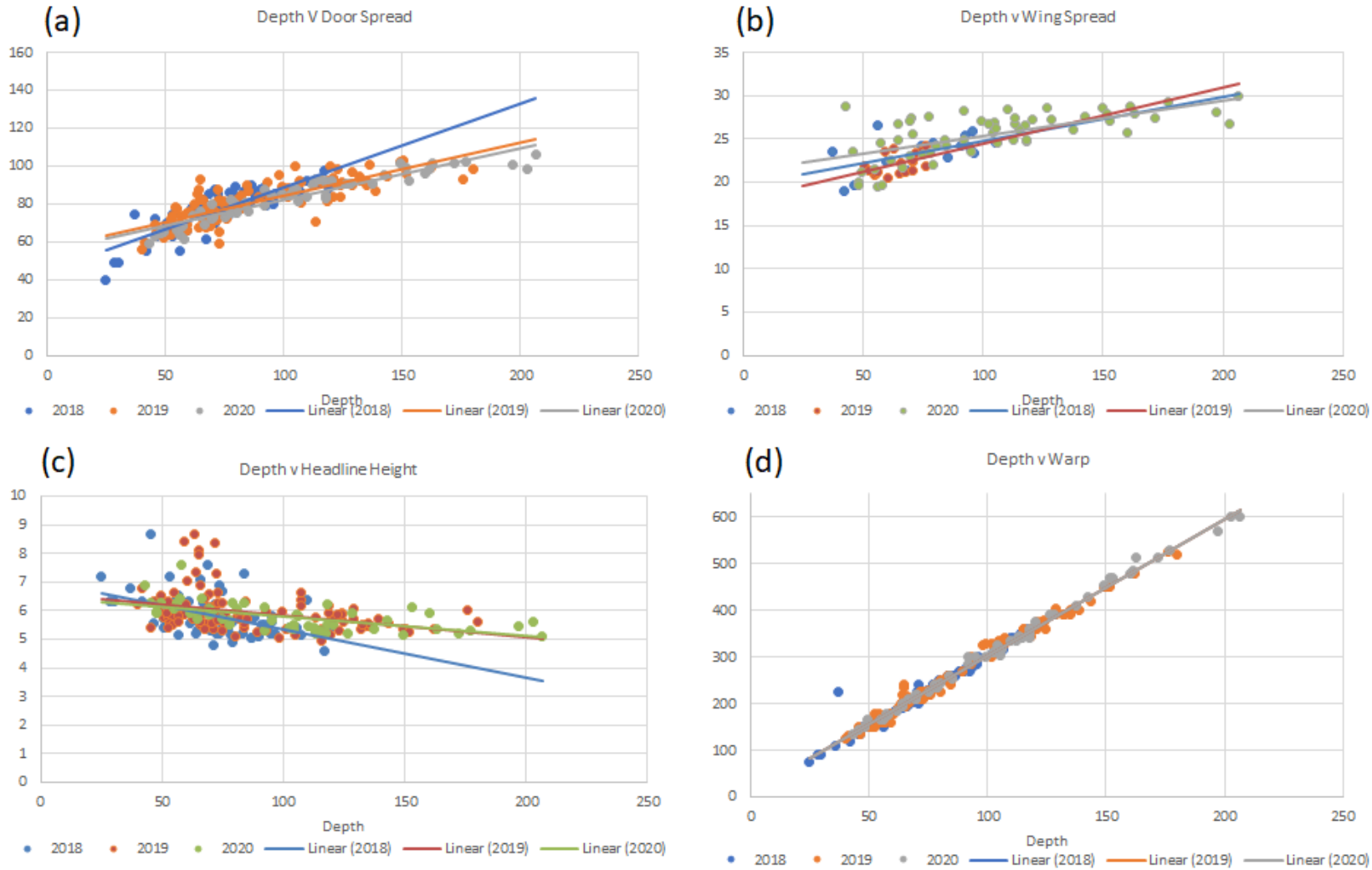


Figure 4: Average net geometry sensor readings from 2018, 2019 and 2020 southwest otter trawl surveys, showing (a) door spread by depth, (b) wing spread by depth, (c) headline height by depth and (d) warp length by depth.

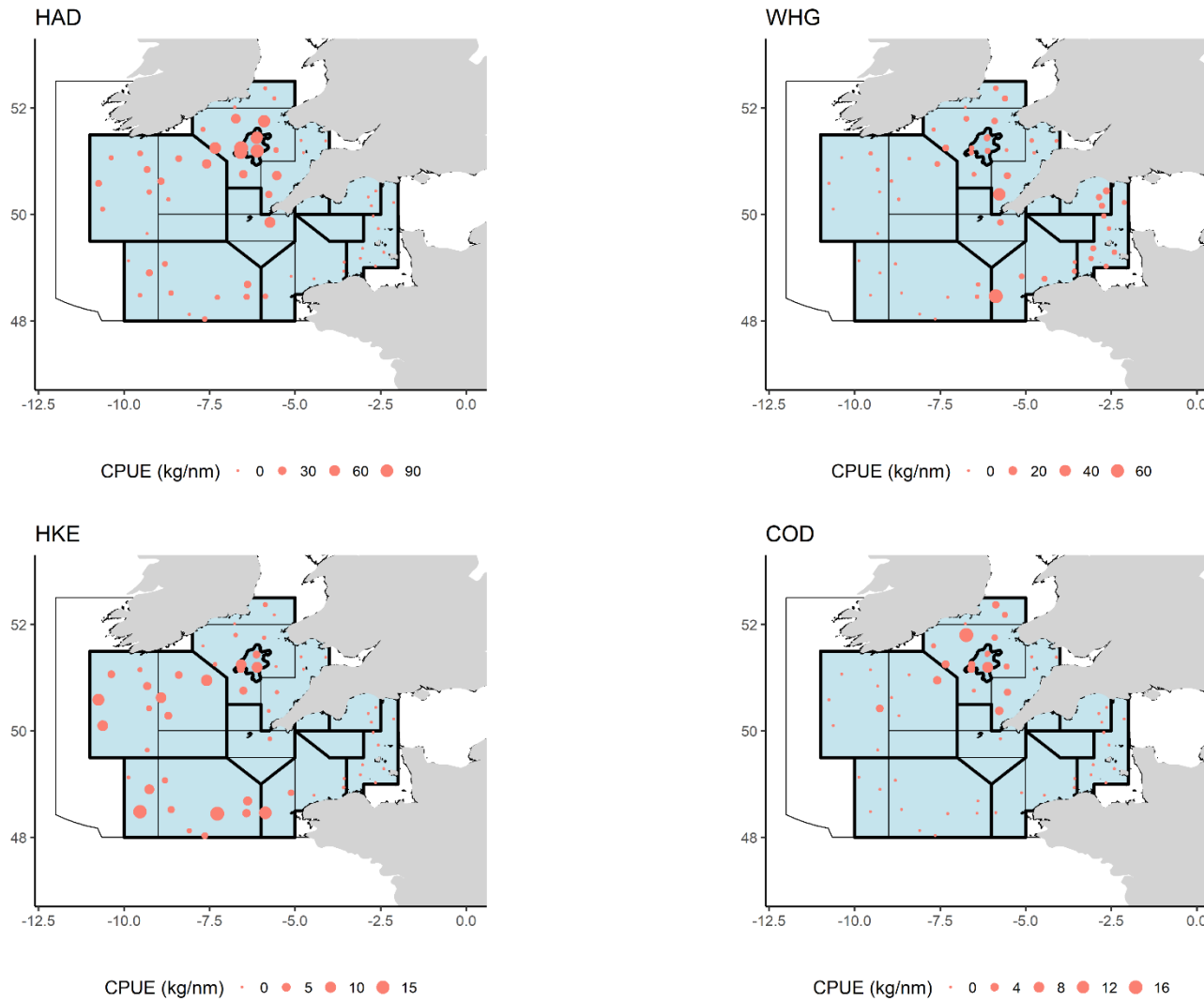


Figure 5: Distribution and relative abundance of selected fish species caught by station (HAD =haddock; WHG = whiting; HKE = hake; COD = cod).

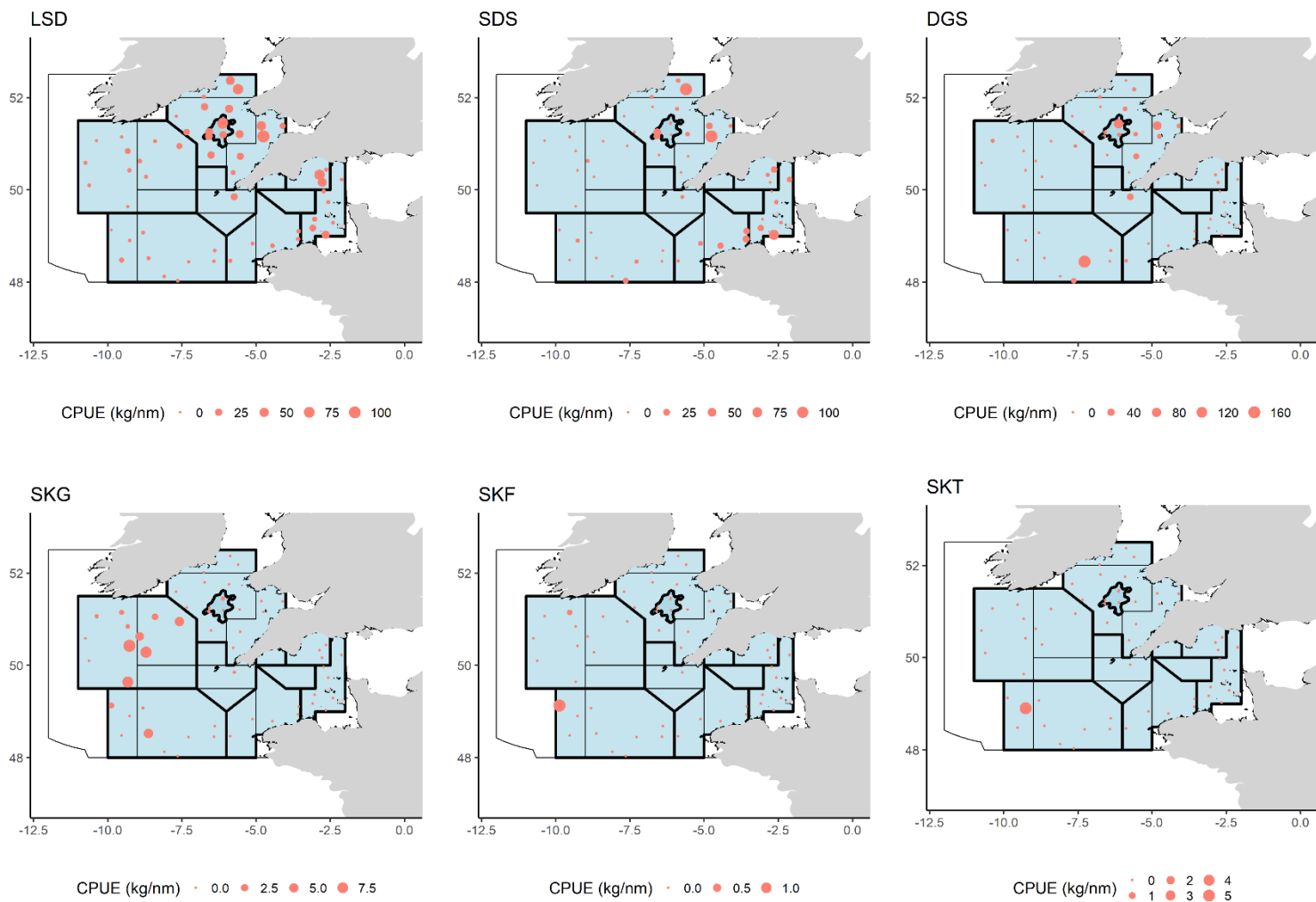


Figure 6: Distribution and relative abundance of selected fish species caught by station (LSD =lesser-spotted dogfish; SDS =starry smooth-hound; DGS =spurdog; SKG =common blue skate; SKF =flapper skate; SKT =common skate-complex).

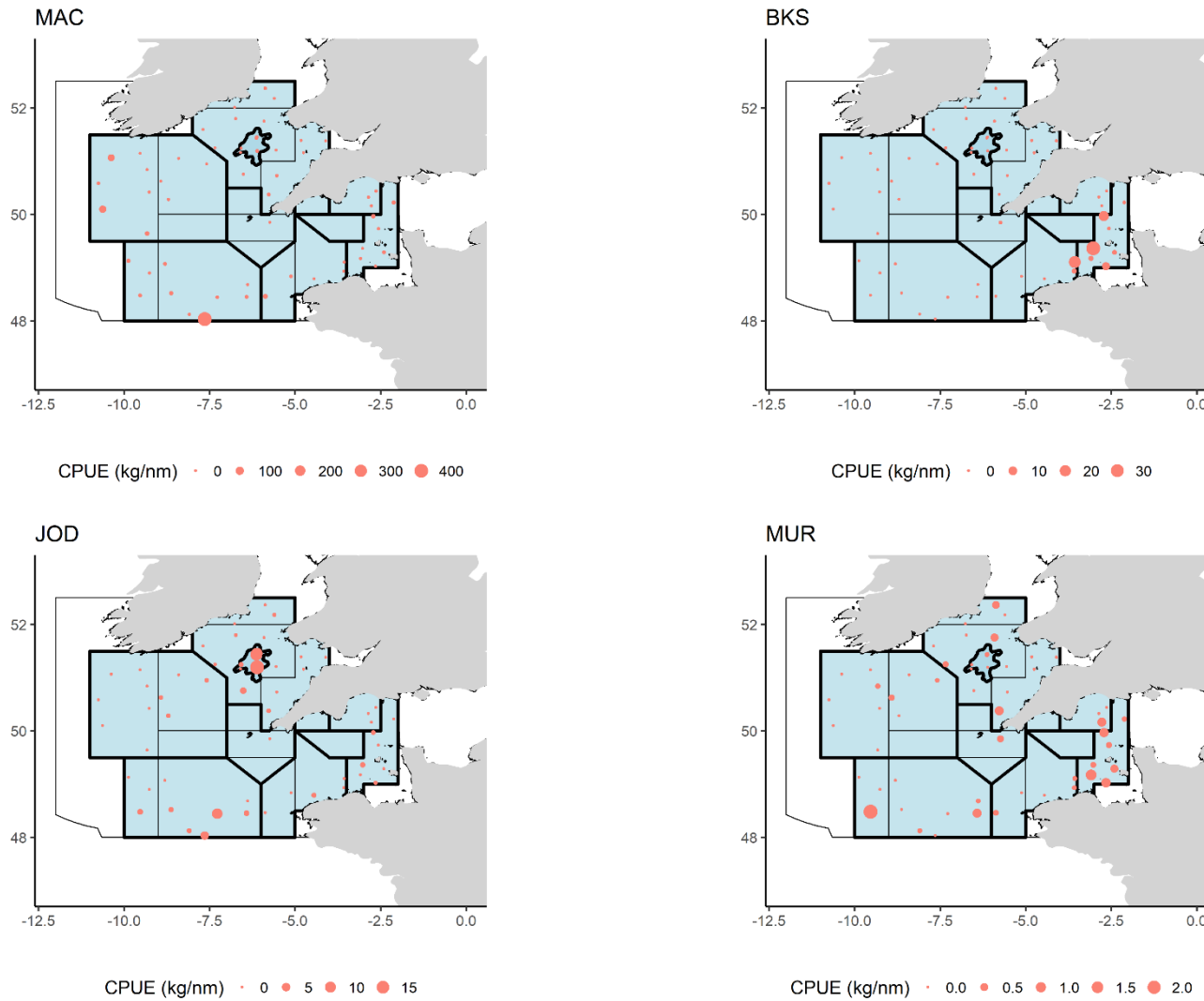


Figure 7: Distribution and relative abundance of selected fish species caught by station (MAC =mackerel; BKS = black seabream; JOD = John dory; MUR = striped red mullet).

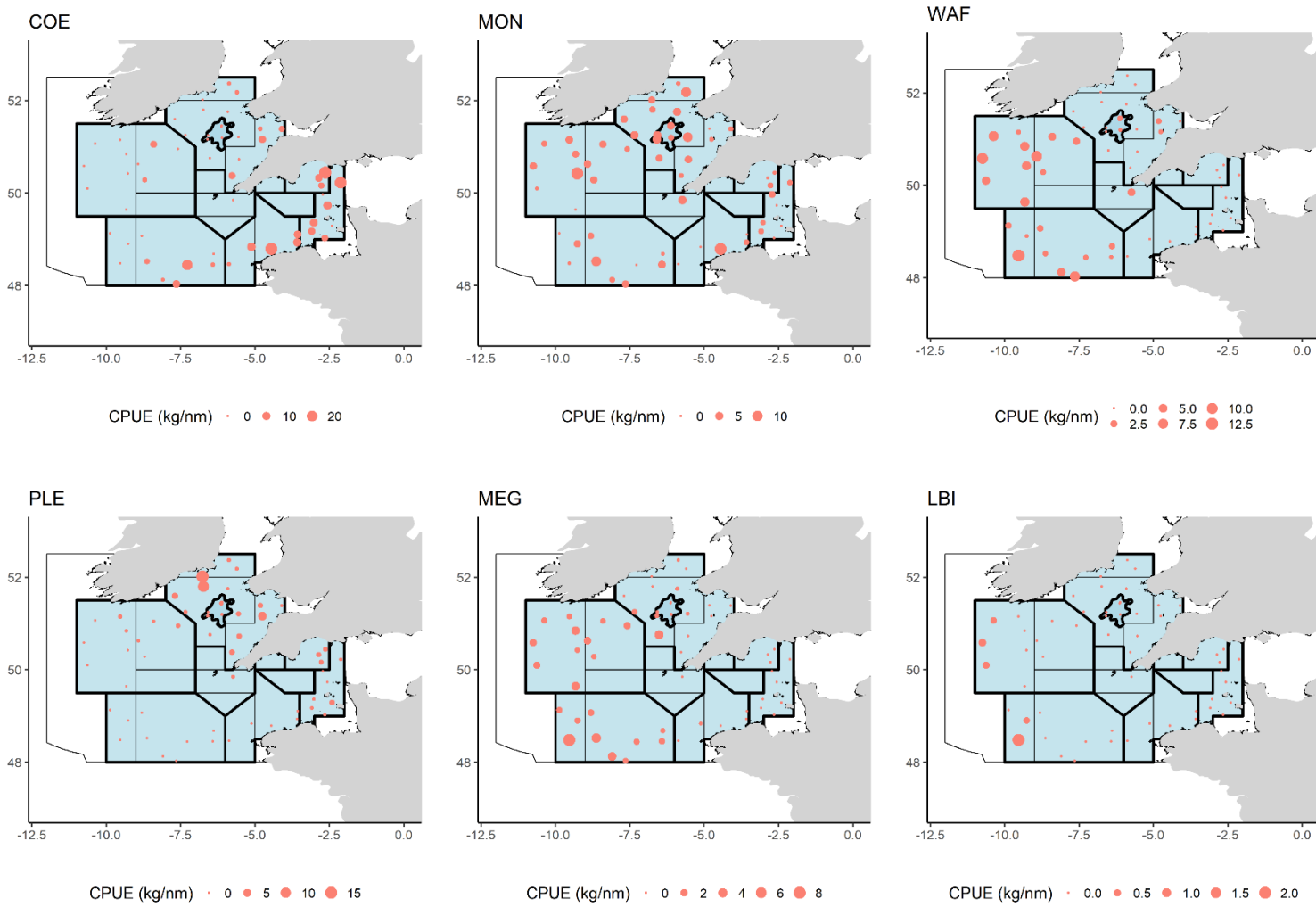


Figure 8: Distribution and relative abundance of selected fish species caught by station (COE = conger eel; MON = anglerfish; WAF = black-bellied anglerfish; PLE = plaice; MEG = megrim; LBI = four-spot megrim).

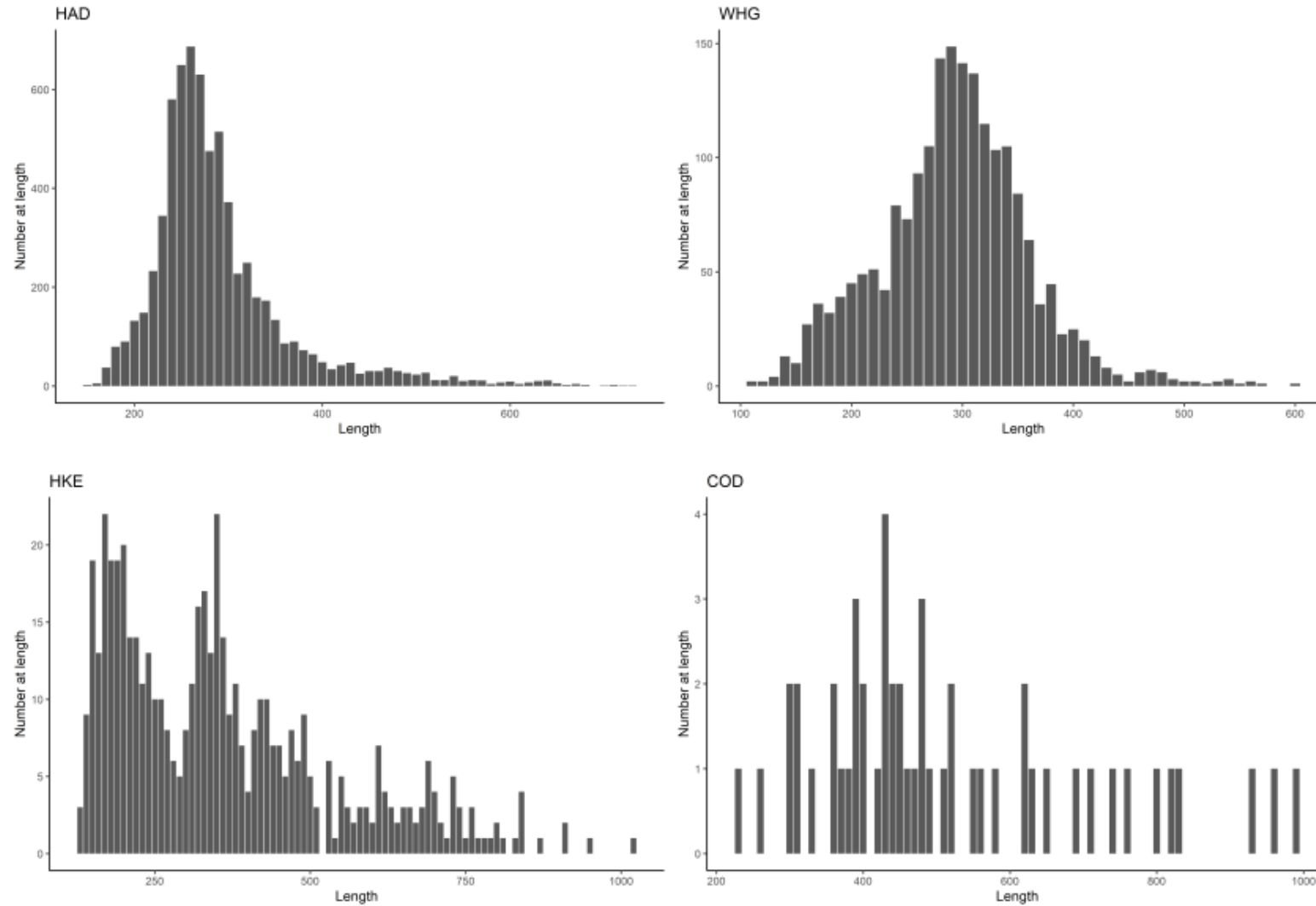


Figure 9: Length-frequency distributions (mm) of selected fish species during the (HAD =haddock; WHG = whiting; HKE = hake; COD = cod).

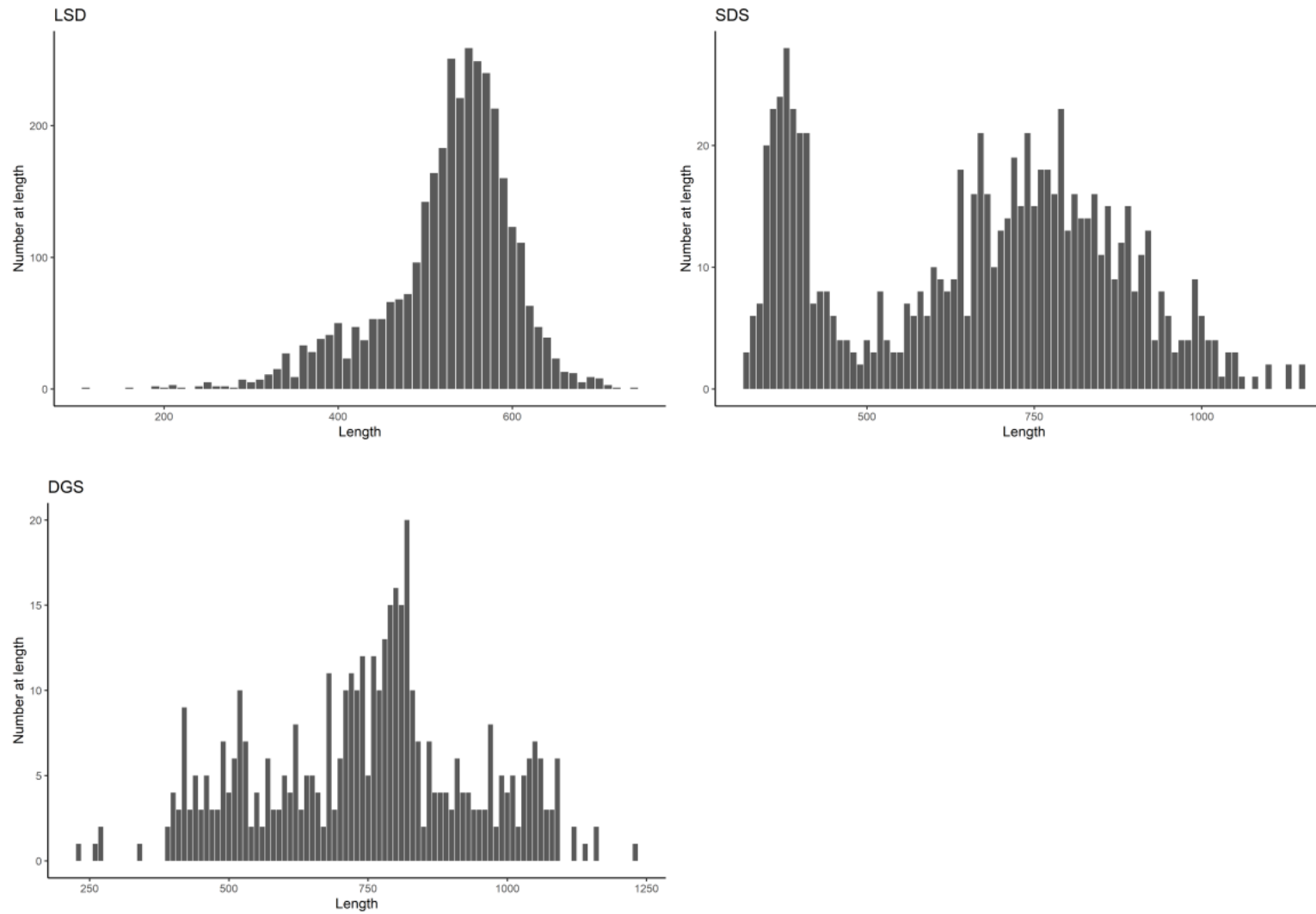


Figure 10: Length-frequency distributions (mm) of selected fish species during the survey (LSD =lesser-spotted dogfish; SDS =starry smooth-hound; DGS =spurdog).

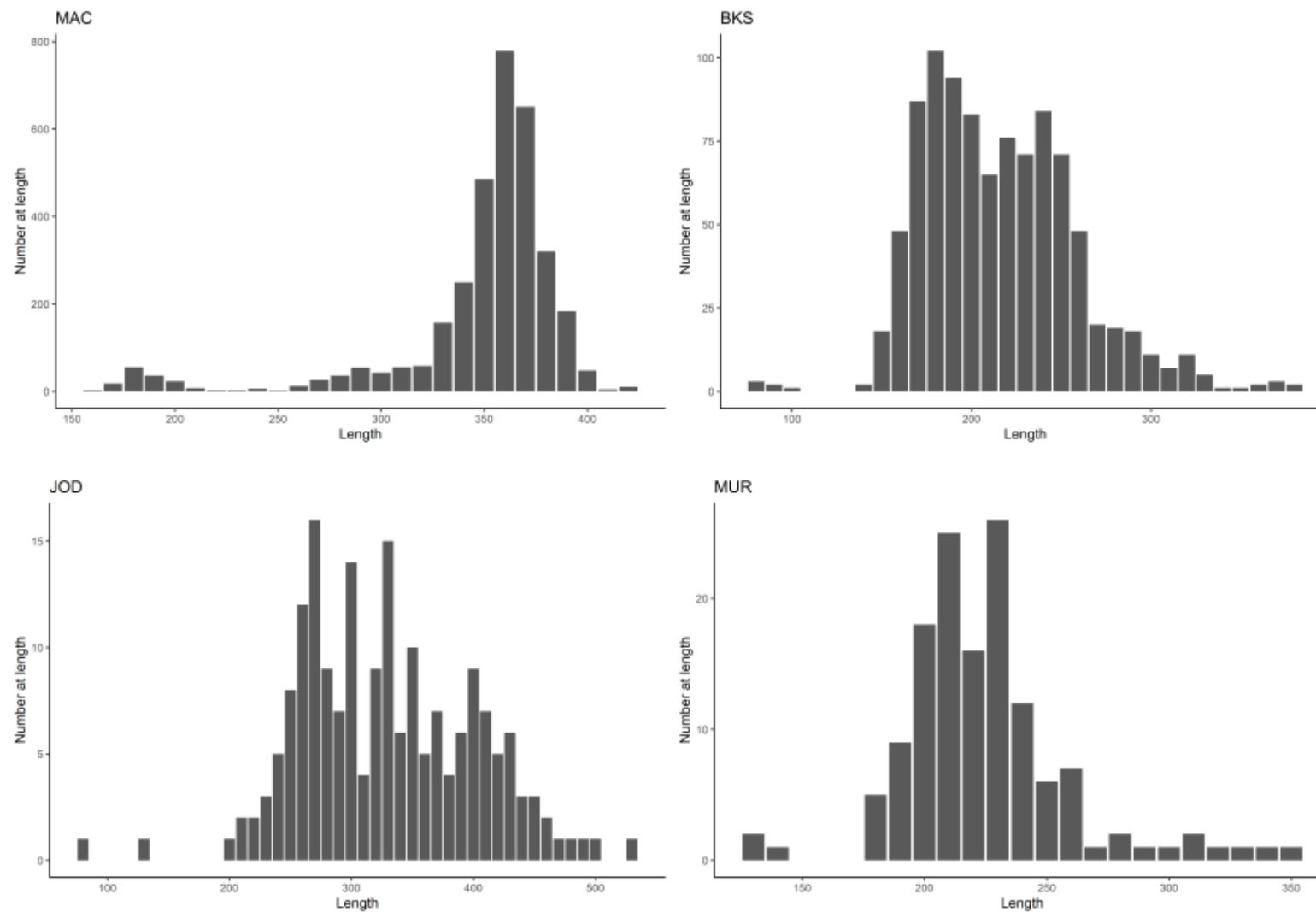


Figure 11: Length-frequency distributions (mm) of selected fish species during the survey (MAC =mackerel; BKS = black seabream; JOD = John dory; MUR = striped red mullet).

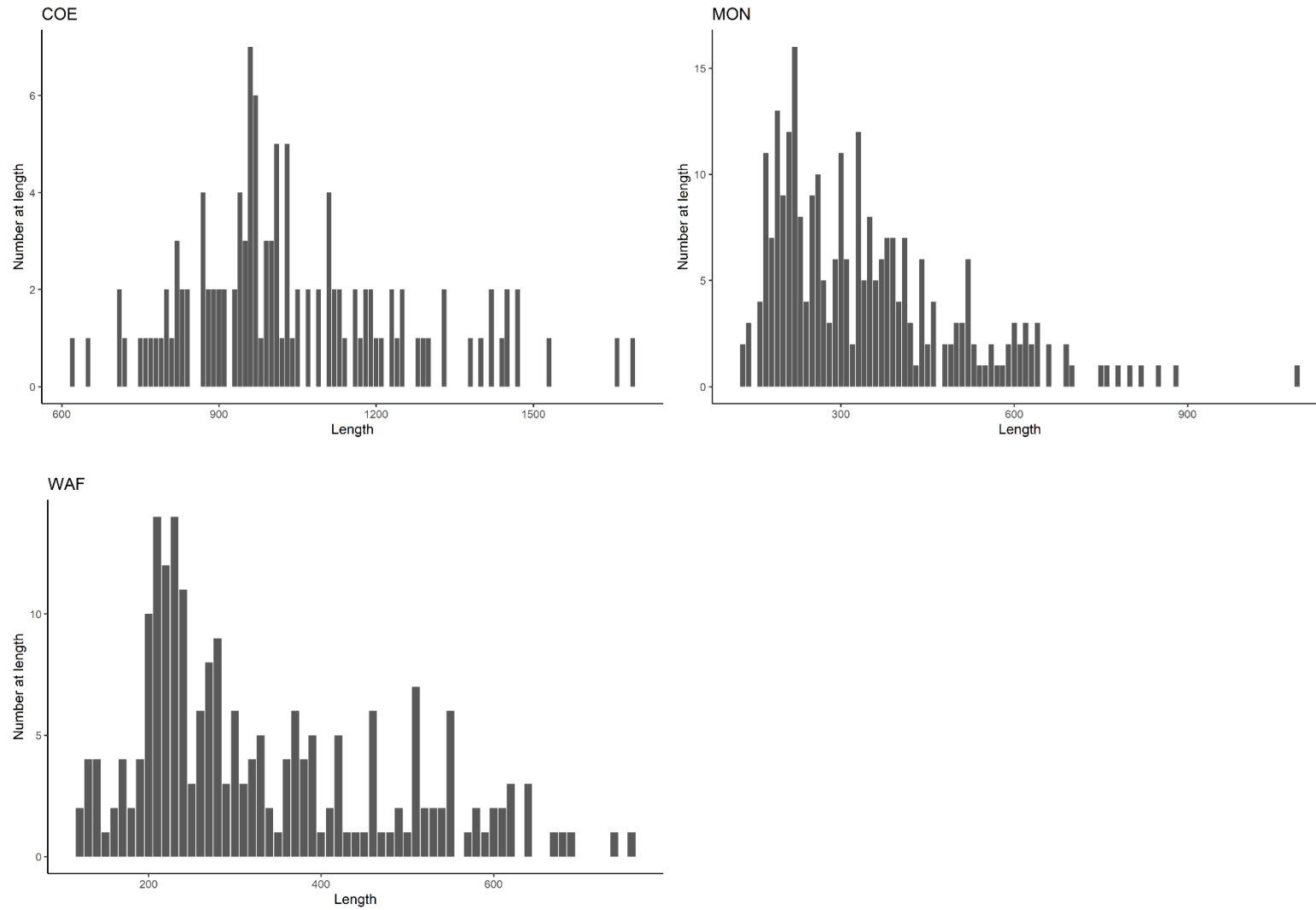


Figure 12: Length-frequency distributions (mm) of selected fish species during the survey (COE = conger eel; MON = anglerfish; WAF = black-bellied anglerfish).

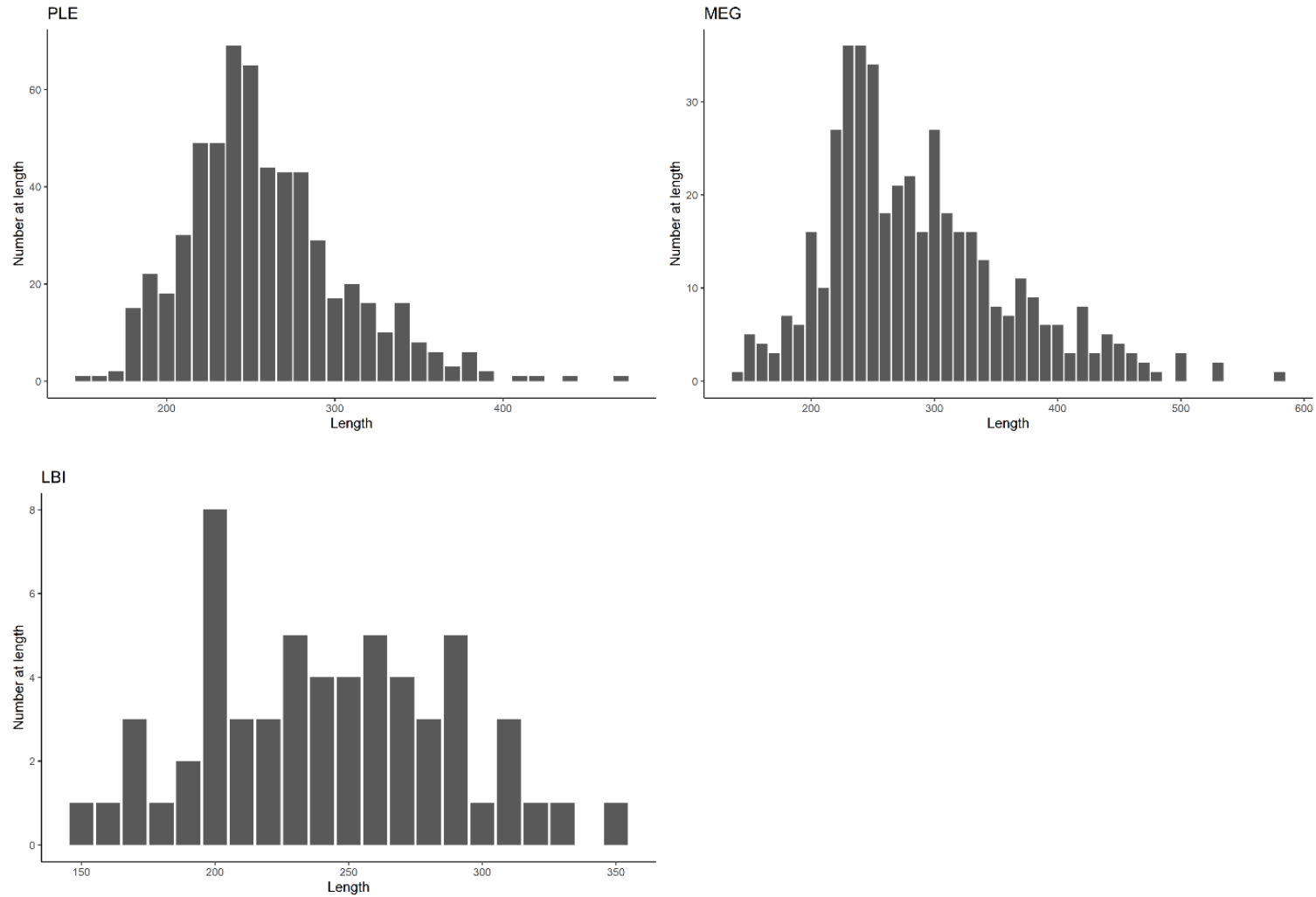


Figure 13: Length-frequency distributions (mm) of selected fish species during the survey (PLE = plaice; MEG = megrim; LBI = four-spot megrim).

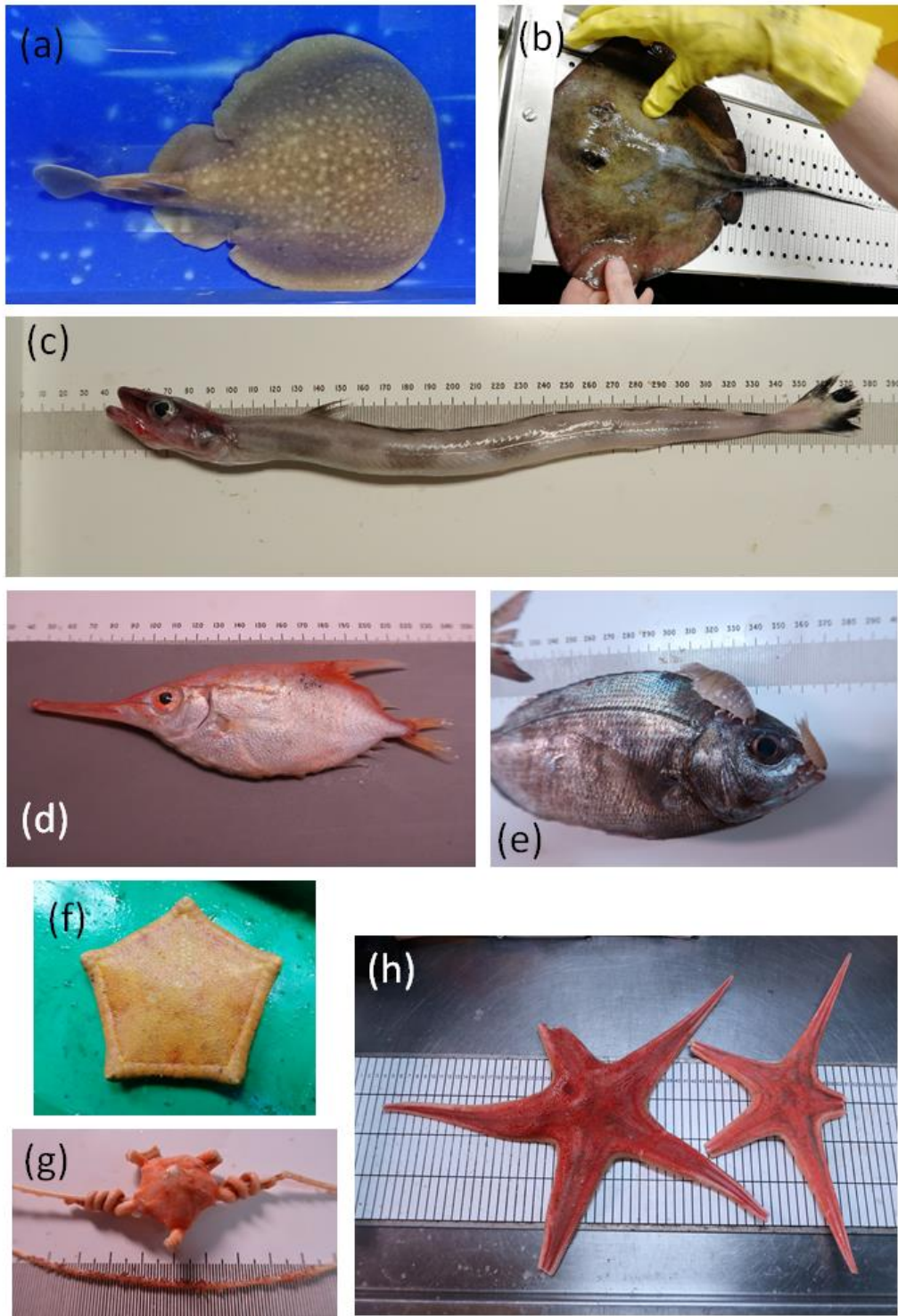


Figure 14: Unusual species recorded during the CEND 03/20 trawl survey, showing (a) Marbled electric ray *Torpedo marmorata*, (b) Common stingray *Dasyatis pastinaca*, (c) Spanish ling *Molva macrophthalmalma*, (d) Snipe-fish *Macrorhamphosus scolopax*, (e) black seabream *Spondyliosoma cantharus* with cymothoid isopod, (f) Cushion star *Ceramaster granularis*, (g) Brittlestar *Asteronyx loveni* on the seapen *Funiculina quadrangularis* and (h) Starfish *Tethyaster subinermis*.

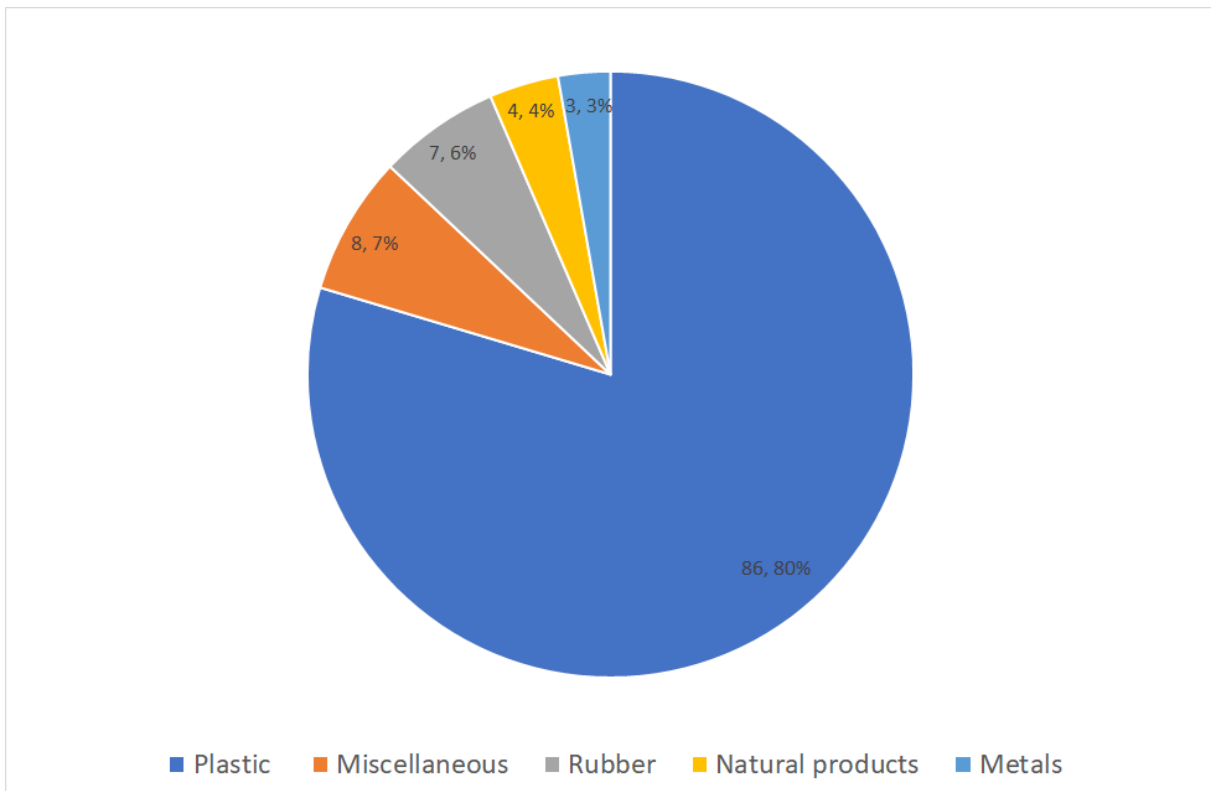


Figure 15: Marine litter recorded during the survey (CEND 03/20)



Figure 16: Trawl-caught spurdog *Squalus acanthias* which had been enmeshed in gillnet (CEND 03/20).

APPENDIX 1: STATION DETAILS

The table below summarises the gear deployments during survey CEND 3/20, including the gear, validity code (Val.), positions, depth and selected environmental parameters.

Stn.	Prime	Date & Time Shot	Decimal Degrees				E/W	Dist. (nm)	Log (nm)		Depth (m)		Tide		Wind		Sea Ht. m	Swell		Barom.	Gear	Val.
			Shot		Haul				Shot	Haul	Shot	Haul	Dir	Spd.	Dir.	Spd.		Dir.	Ht.			
			Lat	Lon	Lat	Lon																
1	-	17/02/2020 18:40	51.954666	2.126333	51.95467	2.126333	E	-	37.5	37.5	43	43	63	0.1	200	24	1	200	1.5	1019	200µm plankton net	A
2	CI7	18/02/2020 18:08	50.219666	2.205833	50.21967	2.205833	W	-	258.2	258.2	55	55	94	0.6	250	40	2	250	2	1028	ESM2 profiler/Niskin/SVP	V
3	CI7	18/02/2020 18:45	50.222166	2.145833	50.22717	2.094166	W	2	260.9	262.9	60	55	248	0.3	250	40	2	250	2	1028	Jackson monkfish trawl	V
4	LB6	18/02/2020 23:31	50.4365	2.662	50.44183	2.610333	W	1.9	293.8	295.7	48	48	304	1.2	290	24	1.5	270	1.5	1029	Jackson monkfish trawl	V
5	LB4	19/02/2020 02:41	50.3135	2.84	50.334	2.881	W	2	310.8	312.8	55	55	67	0.5	290	20	1.8	270	1.5	1029	Jackson monkfish trawl	V
6	LB5	19/02/2020 05:06	50.175666	2.72	50.17567	2.72	W	-	327	327	62	62	78	0.9	290	22	1.8	270	1.5	1032	ESM2 profiler/Niskin	V
7	LB5	19/02/2020 05:34	50.167833	2.746166	50.1595	2.796333	W	2	328.4	330.4	62	61	82	0.8	290	19	1.5	270	1.5	1033	Jackson monkfish trawl	V
8	CI3	19/02/2020 08:09	49.965	2.7435	49.97133	2.690833	W	2	344.9	346.9	65	64	266	0.3	270	18	1.5	270	1.5	1034	Jackson monkfish trawl	V
9	CI4	19/02/2020 11:06	49.720166	2.580833	49.74233	2.542666	W	2	365.9	367.9	87	81	226	1.2	260	16	1.5	270	1.5	1034	Jackson monkfish trawl	V
10	CI5	19/02/2020 15:45	49.287833	2.377833	49.29067	2.428666	W	2	403.4	405.4	54	58	51	1	250	24	1.5	270	1	1031	Jackson monkfish trawl	V
11	CI6	19/02/2020 19:16	49.037	2.716833	49.037	2.716833	W	-	425.8	425.8	47	47	304	1.3	230	23	1.5	270	1	1031	ESM2 profiler/Niskin/SVP	V
12	CI6	19/02/2020 19:49	49.036833	2.665833	49.01217	2.631333	W	1.9	428	429.9	49	47	299	1.1	210	21	1.5	270	1	1031	Jackson monkfish trawl	V
13	CI2	19/02/2020 23:59	49.365333	3.049666	49.36483	2.998666	W	2	461.3	463.3	67	66	182	1.1	240	22	1.5	270	1	1027	Jackson monkfish trawl	V
14	CI1	20/02/2020 02:43	49.171833	3.061	49.17267	3.112	W	2	477.5	479.5	69	71	109	1.8	210	24	2	250	2	1025	Jackson monkfish trawl	V
15	BY8	20/02/2020 06:00	49.1135	3.533	49.1135	3.533	W	-	497.1	497.1	78	78	278	0.5	220	28	2	250	2	1023	ESM2 profiler/Niskin	V
16	BY8	20/02/2020 06:48	49.101	3.582	49.11083	3.547	W	1.5	501.7	503.2	78	77	263	0.8	220	30	2	250	2.3	1023	Jackson monkfish trawl	V
17	BY9	20/02/2020 09:26	48.933	3.5985	48.93283	3.560333	W	1.5	519.6	521.1	70	69	274	1.1	220	30	2	260	2.5	1023	Jackson monkfish trawl	V
18	BY6	20/02/2020 17:58	48.796833	4.556666	48.79683	4.556666	W	-	564.4	564.4	98	98	250	0.8	300	36	2.3	270	3	1030	ESM2 profiler/Niskin/SVP	V
19	BY6	20/02/2020 18:50	48.786166	4.465833	48.79133	4.428666	W	1.5	568.9	570.4	93	91	251	1.3	13	13	2	270	2.5	1035	Jackson monkfish trawl	V
20	BY3	20/02/2020 23:34	48.828833	5.102333	48.841	5.135333	W	1.6	598.9	600.5	106	106	338	0.3	280	18	2	280	2	1037	Jackson monkfish trawl	V
21	BY1	21/02/2020 05:37	48.457833	5.8515	48.4675	5.885	W	2	644.7	646.7	118	118	170	0.6	250	26	2	290	2	1038	Jackson monkfish trawl	V
22	SW12	21/02/2020 08:47	48.468666	6.361833	48.46867	6.361833	W	-	665.5	665.5	130	130	228	0.8	230	23	2	280	2	1037	ESM2 profiler/Niskin	V
23	SW12	21/02/2020 09:59	48.443333	6.431	48.46067	6.403666	W	1.5	672.3	673.8	116	120	285	0.5	240	22	2	280	2	1038	Jackson monkfish trawl	V
24	SW11	21/02/2020 13:05	48.6935	6.366333	48.6745	6.407833	W	2	691.7	693.7	136	139	62	0.6	260	24	2	270	2.3	1037	Jackson monkfish trawl	V
25	SW9	21/02/2020 20:02	49.142	7.194	49.142	7.194	W	-	736.7	736.7	130	130	260	0.6	250	30	2	270	3.3	1034	ESM2 profiler/Niskin	V
26	SW3	22/02/2020 11:10	48.522	9.392166	48.522	9.392166	W	-	831.9	831.9	159	159	295	0.2	250	20	2	260	3	1035	ESM2 profiler/Niskin/SVP	V
27	SW3	22/02/2020 12:49	48.472	9.553833	48.48567	9.507833	W	2	842.6	844.6	217	189	3	0.4	250	16	1.5	270	2.5	1036.5	Jackson monkfish trawl	V

Stn.	Prime	Date & Time Shot	Decimal Degrees				E/W	Dist. (nm)	Log (nm)		Depth (m)		Tide		Wind		Sea Ht. m	Swell		Barom.	Gear	Val.
			Shot		Haul				Shot	Haul	Shot	Haul	Dir	Spd.	Dir.	Spd.		Dir.	Ht.			
			Lat	Lon	Lat	Lon																
28	SW2	22/02/2020 16:55	48.902666	9.279	48.903	9.241	W	1.5	874.2	875.7	163	160	102	0.3	230	12	1.5	300	2.2	1035.5	Jackson monkfish trawl	V
29	SW1	22/02/2020 21:31	49.124833	9.8485	49.135	9.8905	W	1.7	906.6	908.3	156	150	261	0.6	230	35	2	280	2.5	1032	Jackson monkfish trawl	V
30	NW6	23/02/2020 14:20	50.4175	9.333333	50.4175	9.333333	W	-	1023.3	1023.3	130	130	48	0.4	300	8	1.5	270	2.7	1032	ESM2 profiler/Niskin/SVP	V
31	NW6	23/02/2020 14:51	50.420666	9.294	50.42233	9.241666	W	2.1	1025	1027.1	129	128	58	0.5	300	NA	1.5	270	2.5	1031	Jackson monkfish trawl	V
32	NW5	23/02/2020 18:40	50.8385	9.342166	50.84883	9.305833	W	1.5	1056	1057.5	119	116	109	0.3	NA	NA	1	270	2.5	1029	Jackson monkfish trawl	V
33	NW4	23/02/2020 21:55	51.154333	9.553833	51.14367	9.503333	W	2	1083.2	1085.2	110	115	235	0.5	230	27	1.5	270	2.5	1025	Jackson monkfish trawl	V
34	NW4	23/02/2020 23:26	51.133333	9.486166	51.13333	9.486166	W	-	1087.5	1087.5	116	116	251	0.4	230	30	2	260	2.5	1024	ESM2 profiler/Niskin/SVP	V
35	BC1	24/02/2020 13:56	51.592666	7.714	51.60217	7.662333	W	2	1202.9	1204.9	80	81	342	0.1	250	22	2	250	3	1017	Jackson monkfish trawl	V
36	BC1	24/02/2020 15:24	51.610333	7.658	51.61033	7.658	W	-	1207.1	1207.1	82	82	49	0.3	290	20	2	250	2.7	1017	ESM2 profiler/Niskin/SVP	V
37	BC2	24/02/2020 18:21	51.2495	7.3095	51.246	7.362333	W	2.1	1234.9	1237	91	93	73	0.4	270	28	2	260	3	1018	Jackson monkfish trawl	V
38	BC4	24/02/2020 23:32	51.785	6.716166	51.8115	6.7485	W	2.1	1281	1283.1	69	70	234	0.2	270	28	1.5	260	2	1017	Jackson monkfish trawl	V
39	BC3	25/02/2020 02:00	51.997	6.768	52.0295	6.754833	W	2	1295.5	1297.5	55	44	251	1.6	270	32	1.7	260	2	1015	Jackson monkfish trawl	V
40	BC7	25/02/2020 08:13	52.392333	5.8565	52.39233	5.8565	W	-	1349.5	1349.5	76	76	20	2.6	270	26	2	250	2.2	1011	ESM2 profiler/Niskin/SVP	V
41	BC7	25/02/2020 08:50	52.378333	5.865333	52.35367	5.871833	W	1.5	1351.1	1352.6	78	80	27	2.4	270	32	2.5	240	2.2	1010	Jackson monkfish trawl	V
42	BC8	25/02/2020 11:45	52.192666	5.609833	52.15983	5.602	W	2	1368.5	1370.5	95	95	38	0.3	260	26	2.5	250	2.2	1009	Jackson monkfish trawl	V
43	NW9	26/02/2020 11:39	51.085333	8.463666	51.08533	8.463666	W	-	1522	1522	101	101	241	0.6	280	18	1.5	270	2	1022	ESM2 profiler/Niskin/SVP	V
44	NW9	26/02/2020 12:16	51.061	8.423	51.0415	8.380166	W	2	1524.2	1526.2	103	105	247	0.5	280	16	1.5	270	2	1022	Jackson monkfish trawl	V
45	NW1	26/02/2020 21:26	51.06905	10.345333	51.06367	10.39783	W	2	1605.9	1607.9	140	145	195	0.4	80	10	1	270	2.5	1009	Jackson monkfish trawl	V
46	NW2	27/02/2020 01:30	50.6295	10.749	50.6295	10.749	W	-	1640.4	1640.4	170	170	288	0.7	20	18	1.7	280	2.2	1008	ESM2 profiler/Niskin/SVP	V
47	NW2	27/02/2020 02:05	50.6	10.748166	50.56583	10.74383	W	2.1	1642.1	1644.2	171	173	306	0.7	20	18	1.7	280	2.2	1009	Jackson monkfish trawl	V
48	NW3	27/02/2020 05:55	50.100833	10.646666	50.1	10.59467	W	2	1674.4	1676.4	160	160	67	0.2	350	12	1.7	280	2.2	1014	Jackson monkfish trawl	V
49	IS4	01/03/2020 15:43	49.8715	5.788333	49.8715	5.788333	W	-	1957.5	1957.5	82	82	304	0.6	265	24	1.5	250	2	1001	ESM2 profiler/Niskin/SVP	V
50	IS4	01/03/2020 16:14	49.857	5.759	49.84117	5.713833	W	2	1959.1	1961.1	84	86	318	0.7	265	24	1.5	250	2	1000	Jackson monkfish trawl	V
51	BC12	01/03/2020 20:34	50.370166	5.796333	50.38017	5.7465	W	2	1999.2	2001.2	71	70	51	0.3	270	12	1.5	250	2	995	Jackson monkfish trawl	V
52	BC11	02/03/2020 00:24	50.712166	5.545666	50.73933	5.515	W	2	2023.8	2025.8	75	75	238	0.4	350	10	1.2	250	1.7	994	Jackson monkfish trawl	V
53	BC18	02/03/2020 04:19	50.937833	4.857	50.93783	4.857	W	-	2055.7	2055.7	55	55	259	0.3	0	14	1.2	250	1.5	995	ESM2 profiler/Niskin	V
54	BC18	02/03/2020 05:02	50.9135	4.910333	50.914	4.907833	W	0.1	2060.5	2060.6	58	58	71	0.2	0	14	1.2	250	1.5	995	Jackson monkfish trawl	I
55	BC16	02/03/2020 10:23	51.385666	4.076166	51.384	4.1295	W	1.9	2108.7	2110.6	42	44	117	0.4	290	20	2	280	1.5	1002	Jackson monkfish trawl	V
56	BC14	02/03/2020 13:43	51.2665	4.737333	51.2665	4.737333	W	-	2135.3	2135.3	56	56	264	0.7	280	24	2	280	1.8	1003	ESM2 profiler/Niskin/SVP	V
57	BC15	02/03/2020 16:52	51.163333	4.723	51.151	4.772666	W	2	2156.7	2158.7	48	43	256	0.2	290	26	2	280	1.7	1006	Jackson monkfish trawl	V
58	BC13	02/03/2020 20:00	51.394166	4.800833	51.38133	4.85	W	2	2178.5	2180.5	65	64	76	0.7	290	27	2	270	2	1006	Jackson monkfish trawl	V
59	BC10	03/03/2020 01:01	51.196	5.618	51.196	5.618	W	-	2212.3	2212.3	80	80	303	0.2	270	18	2	260	2	1008	ESM2 profiler/Niskin	V
60	BC10	03/03/2020 01:27	51.2035	5.582833	51.21467	5.532666	W	2	2213.7	2215.7	79	77	292	0.2	270	20	2	260	2	1009	Jackson monkfish trawl	V
61	BC9	03/03/2020 06:04	51.738666	5.9125	51.77067	5.897333	W	2	2252.1	2254.1	114	116	206	0.8	280	18	1.7	260	2	1009	Jackson monkfish trawl	V
62	CD2	03/03/2020 09:48	51.4585	6.101	51.446	6.136166	W	1.6	2277.1	2278.7	114	112	71	0.1	290	20	2	250	2	1012	Jackson monkfish trawl	V
63	CD3	03/03/2020 11:41	51.449833	6.120666	51.41867	6.1395	W	2	2285.4	2287.4	114	113	34	0.4	290	22	2	260	2	1015	Jackson monkfish trawl	V

Stn.	Prime	Date & Time Shot	Decimal Degrees				E/W	Dist. (nm)	Log (nm)		Depth (m)		Tide		Wind		Sea Ht. m	Swell		Barom.	Gear	Val.
			Shot		Haul				Shot	Haul	Shot	Haul	Dir	Spd.	Dir.	Spd.		Dir.	Ht.			
			Lat	Lon	Lat	Lon																
64	CD3	03/03/2020 13:17	51.400166	6.141	51.40017	6.141	W	-	2289.5	2289.5	112	112	2	0.3	290	20	2	260	2	1015	ESM2 profiler/Niskin/SVP	V
65	CD4	03/03/2020 15:02	51.1835	6.124833	51.20817	6.089	W	2	2305	2307	106	103	273	0.2	280	15	1.5	260	2	1017	Jackson monkfish trawl	V
66	BC6	03/03/2020 19:28	50.77	6.5175	50.73817	6.501	W	2	2342.5	2344.5	99	100	235	0	250	12	1	270	1.5	1020	Jackson monkfish trawl	V
67	BC5	03/03/2020 23:29	51.16	6.562	51.16533	6.614166	W	2	2374.8	2376.8	102	109	36	0.2	240	16	0.7	260	1.5	1019	Jackson monkfish trawl	V
68	CD1	04/03/2020 01:39	51.258833	6.558333	51.23217	6.590666	W	2	2386.5	2388.5	112	108	21	1	220	12	1	260	1.2	1018	Jackson monkfish trawl	V
69	CD1	04/03/2020 03:08	51.212666	6.6445	51.21267	6.6445	W	-	2391.3	2391.3	101	101	352	0.3	150	12	1	260	1	1018	ESM2 profiler/Niskin	V
70	NW13	04/03/2020 06:50	50.939166	7.562833	50.9575	7.607	W	2	2431.3	2433.3	103	102	271	0.1	120	15	1	220	1	1011	Jackson monkfish trawl	V
71	NW8	04/03/2020 12:37	50.605333	8.874666	50.60533	8.874666	W	-	2486.9	2486.9	120	120	84	0.2	30	15	1	240	1.7	1013	ESM2 profiler/Niskin/SVP	V
72	NW8	04/03/2020 13:13	50.614166	8.900166	50.6335	8.943166	W	2	2489.2	2491.2	121	120	100	0.2	50	18	1.2	240	1.7	1013	Jackson monkfish trawl	V
73	NW10	04/03/2020 16:49	50.300833	8.705333	50.26633	8.703833	W	2.1	2516.5	2518.6	123	130	242	0.4	80	14	1.5	240	2	1012	Jackson monkfish trawl	V
74	NW7	04/03/2020 22:27	49.653833	9.302666	49.631	9.34	W	2	2562.3	2564.3	148	151	53	0.3	50	15	1.2	240	2	1011	Jackson monkfish trawl	V
75	NW7	05/03/2020 00:00	49.614666	9.347	49.61467	9.347	W	-	2566.6	2566.6	148	148	87	1.7	40	22	1.5	240	2	1009	ESM2 profiler/Niskin	V
76	SW4	05/03/2020 03:54	49.066166	8.8315	49.0765	8.783	W	2	2607	2609	155	148	194	0.3	20	36	1.7	50	1.5	1007	Jackson monkfish trawl	V
77	SW5	05/03/2020 08:28	48.534833	8.6185	48.51183	8.634	W	1.5	2642.9	2644.4	177	177	306	0.3	0	30	2.5	20	2.5	1012	Jackson monkfish trawl	V
78	SW6	05/03/2020 13:22	48.115166	8.0705	48.13517	8.111333	W	2	2684.7	2686.7	189	224	144	0.1	310	30	2.3	350	2.8	1016	Jackson monkfish trawl	V
79	SW8	05/03/2020 17:32	48.026333	7.619833	48.0415	7.657166	W	1.8	2715.3	2717.1	191	203	144	0.1	320	25	2	350	2.7	1015	Jackson monkfish trawl	V
80	SW10	05/03/2020 22:53	48.424333	7.287333	48.45917	7.255166	W	2	2754.5	2756.5	163	163	25	0.6	290	30	2.5	340	2.5	1012	Jackson monkfish trawl	V