

RESEARCH VESSEL SURVEY REPORT

RV CEFAS ENDEAVOUR
Survey: C END 14 - 2020

STAFF:

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DURATION: 27* July – 28 August 2020
(*including two days adhering to Government COVID19 testing regulations)

LOCATION: North Sea (ICES Divisions 4.a–c)

PRIMARY AIMS:

1. To carry out a groundfish survey of the North Sea as part of the ICES-coordinated IBTS, using a hybrid GOV trawl in order to obtain information on:
 - a) Distribution, size composition and abundance of all fish species caught.
 - b) Age–length distribution of selected species.
 - c) Distribution of fish in relation to their environment.
 - d) Distribution of macrobenthos and anthropogenic debris.
 - e) Surface and bottom temperature and salinity data using ESM2 profiler/mini-CTD logger and Niskin Bottle.
 - f) Length, weight and maturity information for individual fish, in support of the EU Data Regulation.
2. Collect surface sea water samples for Caesium/Tritium testing to be performed post-survey.
3. Conduct multiple tows to investigate king scallop (*Pecten maximus*) maturity in closed fishing grounds using Newhaven scallop dredges.

SECONDARY AIMS:

4. Tag and release specimens of starry smooth-hound (*Mustelus asterias*), greater-spotted dogfish (*Scyliorhinus stellaris*), spurdog (*Squalus acanthias*), tope (*Galeorhinus galeus*), common skate (*Dipturus batis* species-complex), and blonde ray (*Raja brachyura*), in support of the ICES Working Group for Elasmobranch Fishes work to inform on stock units for demersal elasmobranchs.
5. To freeze any unusual fish species for subsequent identification / verification in the laboratory, including specimens of eelpout (*Zoarces*, *Lycodes* and *Lycenchelys*), sea scorpions (Cottidae, sub-area IVa only), and any unusual fish species, which may also be used in otolith research.
6. To retain any dead specimens of tope and common skate for biological studies.
7. Retain any dead specimens of shad (*Alosa* spp.) and lamprey (Petromyzontiformes) for biological studies.
8. Collect fisheries acoustic continuously data at four operating frequencies (38 kHz, 120 kHz, 200 kHz and 333kHz), using the Simrad EK60 split beam sounder. The data will contribute to the existing 15-year time series of acoustic data for the North Sea.
9. Cetacean observations will be recorded where possible and sent to MARINELife and Sea Watch Foundation.
10. Identification, count, measure and weight all jellyfish caught in GOV trawl will allow the continuation of the North Sea August Jellyfish dataset started in 2012. As the dataset grows from year to year, this should allow the evaluation of changes in the jellyfish community and biomass with time.
11. Collect squid egg samples to map spawning grounds. This could be highly relevant in studying squid stock structure. Retain any specimens of *Loligo vulgaris* and all ommastrephid squids (*Illex*, *Todaropsis*, *Todarodes*) for maturity and age analysis.
12. To collect biological information from four-bearded rockling (*Enchelyopus cimbrius*), including length, weight and maturity data.
13. Retain any dead specimens of *Loligo* spp. and approximately 25 *Alloteuthis* for maturity and age analysis, respectively.
14. Collect, retain and filter surface water samples from Ferrybox underway water supply every 12 hours (or once a day) for subsequent chlorophyll sampling in support of SLA25.

NARRATIVE

All times stated are GMT.

After completing all government and CEFAS requirements for COVID19 protocol and testing, RV Cefas Endeavour, hereby referred to as CEND 14/20, sailed from Lowestoft at 0500hr on Wednesday 29 July. There were seven Cefas scientific staff on board.

A standard day consisted of collecting surface and bottom water at the start and end of the day to provide salinity samples and water samples for additional aims, along with deployment of an ESM2 profiler to measure additional parameters through the water column (temperature, salinity, fluorescence, light, turbidity and dissolved oxygen). Between these deployments, between three and four 30-minute tows with the standard IBTS rigged GOV (Grand Overture Verticale) trawl. Since 2014, the net used during this survey has been a polyethylene net with nylon sleeve and cod-end. Throughout the survey, fisheries acoustic data were collected continuously at three operating frequencies (38 kHz, 120 kHz and 200 kHz), using the Simrad EK60 split beam sounder.

By 0900hr on 29 July, the ship had arrived on prime station 4 ready for the “shakedown” tow, which would allow for the deployment of the gear, to check that all sensors were working correctly and to allow scientists and crew to familiarise themselves with their work areas. Following a “toolbox talk” the ESM2 profiler and Niskin water sampler were deployed and retrieved before proceeding with the GOV “shakedown” tow. After a few minor adjustments, a successful GOV trawl was completed, yielding the largest catch of the day (431 kg) and which consisted mainly of whiting (*Merlangius merlangus*, 382 kg – an increased catch weight compared to the 81 kg recorded in 2019). The vessel then continued eastwards to prime stations 5 and 6, successfully completing GOV trawls with relatively small catches consistent with the previous years’ catch compositions.

CEND 14/20 began the next day at prime station 9 and continued to move to the east through prime stations 9, 10, 11 and 12, ending the day north of the Dutch West Frisian islands. All stations samples were completed successfully. Relatively small catches were observed at prime stations 9, 10 and 11, with a large haul of sprat (*Sprattus sprattus*, 570 kg) observed at prime station 12. Of note were increasing numbers of “0 group” juvenile whiting throughout the day’s trawls.

Overnight, the ship headed southwards off the Dutch coast to prime station 3 and continued to work westwards towards the English coast over the day, successfully completing GOV trawls at prime stations 3, 2 and 1. Prime station 3 yielded the largest catch of the day (1681 kg) consisting mainly of horse mackerel (*Trachurus trachurus*, 929 kg) and pilchard (*Sardina pilchardus*, 590 kg). Of note, seven starry smooth-hounds were tagged and released (n = 2 at prime station 2 and n = 5 at prime station 1), as per survey aim 4. One twait shad (*Alosa fallax*, 0.598 kg) captured at prime station 1 was also retained for further study.

By first light on 1 August, CEND 14/20 was at prime station 8 and successfully completed the GOV trawl before heading west to prime station 7, where one spurdog (female, 3.8 kg, 95 cm total length, L_T) was tagged and released. While fishing at prime station 7, significant damage was sustained to the GOV trawl. While repairs were made, a new clear trawl site was located from DATRAS to the east of the original tow. Once repairs had been completed, fishing unfortunately had to be abandoned for the remainder of the day due to headline sensor issues.

The next day began with scallop dredging on the Dogger bank, as per primary survey aim 3, to provide evidence in support of emergency management measures to determine the proportion of animals still in spawning condition in eight ICES rectangles. This work was successfully completed over the next four days (Figure 1).

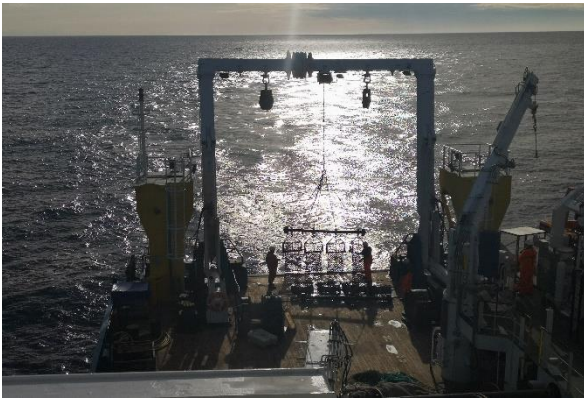


Figure 1. Dogger bank king scallop (*Pecten maximus*) sampling; first deployment and end of sampling.

Late afternoon on 5 August, CEND 14/20 finished all scallop dredge sites and returned to primary survey aim 1. This work was restarted with the repeat of prime station 7, where testing of the headline sensors and a successful GOV trawl were completed. This was the final station of the day due to fading light.

Overnight CEND 14/20 moved northwards to prime station 13 and completed a GOV trawl, before continuing to head east throughout the day, successfully completing prime stations 14, 15 and 16. Prime stations 13 and 14 consisted mainly of whiting and haddock (*Melanogrammus aeglefinus*) with prime stations 15 and 16 mainly yielding dab (*Limanda limanda*) and mackerel (*Scomber scombrus*). Of note, “0 group” cod (*Gadus morha*) and haddock were observed at prime stations 13 and 14.

The next day began at prime station 17 with CEND 14/20 working eastwards over the course of the day, completing prime stations 18 and 19. Relatively small catches were observed at prime stations 17 and 18, mainly consisting of dab, though prime station 20 yielded the largest catch of the day and the largest catch of the survey so far (2771 kg). This catch was comprised primarily of sprat (1579 kg) and herring (*Clupea harengus*, 1004 kg)

The survey continued at first light on 8 August at prime station 20 before heading north to prime stations 21, 30 and 29 with successful GOV trawls completed at each site. Catches at all stations were relatively small and similar in species composition, with dab, mackerel and grey gurnard (*Eutrigla gurnardus*) forming the majority of the catch. The largest catch of the day was at prime 30 (415 kg).

Overnight, CEND 14/20 moved north to prime station 39 and completed a GOV trawl at first light before continuing west throughout the day, successfully completing prime stations 39, 38, 37 and 36. The catches at all four stations consisted of dab, grey gurnard and juvenile haddock, with the largest haul of the day at prime station 36 (1362 kg). Of note, juvenile and “0 group” cod were recorded on all four prime stations.

The next day began at prime station 49. During the GOV tow considerable damage was sustained, causing the station to be invalid and requiring substantial repair to the trawl. During repairs a new clear tow was found to the west of the original deployment and this was successfully completed after the net was mended. The survey continued with GOV deployments at prime stations 50 and 58, before failing light led to the end of the day. Of note, juvenile and “0 group” cod (Figure 2) were sampled at all three prime stations, with the highest catch weight at prime station 49 (17 kg). Additionally, wolf-fish (*Anarhichas lupus*) were recorded at both prime stations 49 (3.78 kg) and 50 (2.35 kg).



Figure 2. Juvenile and “0 group” cod (*Gadus morhua*) caught at prime station 49.

On the morning of 11 August, CEND 14/20 began the day at prime station 57, before heading west to prime station 56 and then south-east to prime station 48, successfully completing GOV trawls at all prime stations. Prime station 57 yielded mainly saithe (*Pollachius virens*) and Norway pout (*Trisopterus esmarkii*), with both catches at prime stations 56 and 48 consisting mainly of haddock. The largest catch of the day was at prime station 48 (993 kg) where the majority of the catch was haddock with a mix of adult (16 kg), juvenile (821 kg), and “0 groups” (2.74 kg). Of note, lantern sharks (*Etmopterus spinax*, $n = 2$) and blue-mouth redfish (*Helicolenus dactylopterus*, $n = 6$) were caught at prime station 57.

Overnight, CEND 14/20 traveled to prime station 42 for first light and moved west throughout the day to prime stations 43 and 44, before heading south west and finishing the day at prime station 35. GOV trawls were successfully completed at all prime stations with catch compositions consistent with previous years; herring at prime 42, with dab and haddock at prime stations 43, 44 and 35. The largest catch of the day was at prime station 43 (601 kg) consisting of haddock (100 kg) and dab (266 kg). One wolf-fish (3.11 kg) was recorded at prime station 43 and “0 group” haddock, whiting, cod, and Norway pout were caught in varying numbers throughout the day.

CEND 14/20 began the next day at prime station 28 and moved west throughout the day, successfully completing GOV trawls at prime stations 27, 26 and 25. Catch compositions at prime stations 26–28 were similar to the previous year. Sprat was most abundant at prime station 28, smaller catches of dab and grey gurnard were present at prime stations 27 and 26, but an unusually large catch (1114 kg) was captured at prime station 25 compared to previous surveys, comprising mainly herring (711 kg) and haddock (239 kg). Of note, snake blenny (*Lumpenus lampretaeformis*; Figure 3) and “0 group” gadoids were recorded at all prime stations throughout the day.



Figure 3. Snake blenny (*Lumpenus lampretaeformis*) from prime station 27.

14 August began at prime station 24 with a GOV trawl and continued west towards the English coast, successfully completing prime stations 23 and 22. Prime station 24 was the largest catch of the day (557 kg), and was comprised mainly of sprat (201 kg), with both prime stations 23 and 22 yielding mainly whiting and haddock. Of note, blue-mouth redfish was recorded at prime station 23, and “0 group” haddock and whiting at prime stations 23 and 22. Overnight CEND 14/20 traveled to prime station 77 for first light, completing a GOV trawl before moving north to prime station 31. Catches were small but consistent with previous years catch data from these prime stations, with mixed gadoids and epibenthos dominant in both catches. The largest catch of the day was at prime station 31 (302 kg). Of note, “0 group” haddock, whiting and Norway pout were recorded at both prime stations and one cuckoo ray (*Leucoraja naevus*) was tagged and released at prime station 31.

The next day began at prime station 40 and work then moved east to prime station 41 before heading north east to finish the day at prime station 46. All three prime stations yielded large catches with similar catch compositions, dominated by haddock, herring, mackerel and whiting, with the largest catch of the day at prime station 40 (1530 kg). Of note was the presence of aggregations of ross worm (*Sabellaria spinulosa*, 44 kg) and one moustache sculpin (*Triglops murrayi*; Figure 4) recorded at prime station 40.



Figure 4. Moustache sculpin (*Triglops murrayi*) caught at prime station 40.

On the morning of 17 August, CEND 14/20 began the day at prime station 47, before traveling north to prime station 55 and then moved west to prime station 54. The first GOV trawl of the day returned a relatively small catch (346 kg) of mixed juvenile gadoids and epibenthos, the latter comprised mainly purple heart urchins (*Spatangus purpureus*, 104 kg). Prime station 55 yielded the largest catch of the day (3053 kg) with herring the most abundant species (2681 kg) and prime station 54 (1366 kg) contained mainly herring (593 kg) and Norway pout (698kg).

Overnight, CEND 14/20 travelled north to prime station 62 for first light, before heading east throughout the day, also completing prime stations 63 and 64. Catches at prime stations 62 and 63 were characterised by herring, although Norway pout was the most abundant species at prime station 64 (841 kg). The largest catch of the day was at prime station 62 (2822 kg) with adult herring (2361 kg) composing much of the catch. The next day began at prime station 65, before CEND 14/20 moved north to prime station 70 and then west to finish the day at prime station 69. Both prime stations 65 (111 kg) and 69 (98 kg) produced relatively small catches of small gadoids and epibenthos. The largest catch of the day came at prime station 70 (1901 kg) with the most abundant species in the catch being herring (1505 kg) and horse mackerel (209 kg). "0 group" cod were present at all three prime stations and pearlides (*Maurolicus muelleri*, 0.036 kg) were recorded at prime station 65.

On 20 August CEND 14/20 began at one of the surveys most northerly and deepest sites, prime station 75, completing a GOV trawl before continuing west throughout the day, also sampling prime stations 74 and 73. All three prime stations yielded very similar catch compositions of mackerel, blue whiting (*Micromesistius poutassou*), Norway pout and epibenthos. The largest catch of the day was at prime station 75 (874 kg) consisting mainly of mackerel (616 kg). Several specimens of blackmouthed dogfish (*Galeus melastomus*) were caught at prime station 75 (Figure 5) and retained, as per secondary survey aim 5.



Figure 5. Blackmouthed dogfish (*Galeus melastomus*) caught at prime station 75.

Overnight, CEND 14/20 moved to prime station 72 (477 kg) north east of the Shetland Isles, before travelling west to prime station 71 (633 kg). The catches at both these sites were dominated by mackerel and horse mackerel. The vessel then steamed south-south-east to prime station 66 to attempt two GOV trawls. Due to the very similar geographical and temporal features of the tows, the decision was taken to perform two 20-minute GOV deployments, rather than regular 30-minute tows. The first deployment was successful, with a catch mainly of herring and haddock (613 kg total catch), although the second deployment resulted in damage to the GOV trawl, with substantial repairs required. Due to deteriorating weather conditions (Storm

Ellen) and limited hours of daylight, the decision was made to not repeat the station again. Cod were observed at all three completed stations (prime station 72: 30kg, 71: 30 kg, 66: 19 kg).

CEND 14/20 began the following day at prime station 68 and then moved west to prime station 67, before moving south-west and finishing the day on prime station 68. All three planned GOV tows were completed successfully, with herring and mixed gadoids the main catch components. The largest catch of the day was at prime station 61 (1764 kg, of which 912 kg were herring). Wolf-fish were caught at both prime stations 68 (n = 1; 6.0 kg) and 67 (n = 2; 17 kg; Figure 6).



Figure 6. Wolf-fish (*Anarhichas lupus*) caught at prime station 68.

On 23 August, CEND 14/20 began the day at prime station 60, before moving west to prime station 59 and then south-west, finishing the day at prime station 51. All three prime stations were completed successfully with haddock the most abundant species at all sites. All catches were large, with the highest catch weight of the day recorded at prime station 51 (1034 kg; of which 846 kg were haddock).

Overnight, CEND 14/20 streamed eastwards, with prime stations 52 and 53 completed the following day, before finishing the day on prime station 45. Large catches were recorded at all three prime stations, with juvenile haddock and whiting the most abundant species at prime station 52, whilst herring was predominant at prime stations 53 and 45. The largest catch of the day was at prime station 53 (2792 kg), with herring (2401 kg) the most abundant here. The total catch weight for these three prime stations was 5845 kg - the largest total daily catch weight of the survey.

The next day, CEND 14/20 fished at prime station 76 before moving southwards to prime station 33 and then west to finish the day at prime station 32. The catch weights and species compositions were similar at all three sites, with juvenile haddock and whiting the most abundant species. The largest catch of the day was at prime station 76 (413 kg; of which 168 kg was haddock and 72 kg were whiting). Of note, 43 juvenile spurdog (male: n = 22 (8.012 kg); female: n = 21 female (8.333 kg)) were recorded at prime station 76.

Fishing was then delayed by Storm Francis until late afternoon on 26 August. Once the storm had passed CEND 14/20 resumed the survey and successfully completed prime station 34, the final station of the survey. The prime station yielded a small catch (170 kg) that was comprised mainly of whiting (45 kg), long rough dab (*Hippoglossoides platessoides*, 35 kg) and juvenile haddock (22 kg). Of note, numbers of "0 group" cod

were recorded (68 individuals, 1.095 kg). Once the prime station was completed CEND 14/20 transited back to Lowestoft for 28 August, docking at approximately 0430hr.

Special thanks are given to the scientists and ship's crew of the RV Cefas Endeavour (CEND 14/20) for their enthusiasm and hard work throughout the survey.

RESULTS:

PRIMARY AIMS:

1. *To carry out a groundfish survey of the North Sea as part of the ICES coordinated IBTS...*

A valid haul with the GOV trawl was completed at 77 prime stations (Table 1; Figure 7). Three tows were deemed invalid due to gear damage, of which two were re-fished successfully. Prime station 66 was attempted twice by the United Kingdom, but due to substantial gear damage, the adverse effects of Storm Ellen and time constraints, the second attempt at prime station 66 had to be abandoned in favour of finishing the remainder of the survey. Surface and bottom salinity samples were collected at 48 sites by ESM2+Niskin.

Gear: The survey was fished using a GOV trawl (polyethylene trawl with a nylon sleeve and cod-end). GOV working trawl #1 was used for the entirety of the fishing survey. Net geometric sensors were used to monitor headline height, wing end distance and door distance (Figure 8).

Catches: At each station, the catch of each species was weighed and all fish, or representative sub-samples, were measured. Table 2 ranks the top 15 fish species by weight, compared to that seen over the previous four years, whilst Table 3 lists the species that were weighed and measured/counted across the survey's prime stations. Table 4 shows the number of fish sampled for age determination and other biological information. All data were recorded to computer database using Cefas' Electronic Data Capture system and uploaded to the Fishing Survey System (FSS). Figure 9 shows the length distribution of cod, haddock, whiting, saithe, Norway pout, herring, mackerel, sprat, plaice (*Pleuronectes platessa*) and hake (*Merluccius merluccius*), with the distribution and relative abundance (raised numbers per hour) of these species given in Figures 10–19.

Table 1: Gear deployments on the English IBTS Q3 2020 survey.

Gear	Valid	Additional	Invalid	Total
GOV (IBTS standard gear)	77	0	3	80
ESM2+Niskin	48	0	0	48
Scallop dredge	25	0	0	25

Table 2: Top 15 fish species (by total catch weight) in 2020 and corresponding catch weights in preceding years.

English name	Scientific name	2020 weight (kg)	2019 weight (kg)	2018 weight (kg)	2017 weight (kg)	2016 weight (kg)
Herring	<i>Clupea harengus</i>	16338	4545	10380	24963	34945
Haddock	<i>Melanogrammus aeglefinus</i>	8252	2746	2266	2845	2525
Whiting	<i>Merlangius merlangus</i>	4940	3652	3943	2858	2468
Mackerel	<i>Scomber scombrus</i>	3861	2237	2336	2365	3450
Norway pout	<i>Trisopterus esmarkii</i>	3513	1198	1086	2793	1813
Dab	<i>Limanda limanda</i>	3218	3532	3364	3201	3587
Sprat	<i>Sprattus sprattus</i>	2730	5859	1983	1868	2367
Horse mackerel	<i>Trachurus trachurus</i>	1986	3542	1635	4395	1905
Grey gurnard	<i>Eutrigla gurnardus</i>	782	768	1359	1108	1301
Pilchard	<i>Sardina pilchardus</i>	601	13	44	1	6
Long-rough dab	<i>Hippoglossoides platessoides</i>	370	315	395	397	305
Blue Whiting	<i>Micromesistius poutassou</i>	370	240	296	620	281
Cod	<i>Gadus morhua</i>	340	312	371	723	753
Plaice	<i>Pleuronectes platessa</i>	283	374	561	425	506
Saithe	<i>Pollachius virens</i>	271	955	1907	2563	2349

Table 3: Fish, cephalopods and commercial shellfish caught and number of prime stations where they were recorded.

Species	Common Name	Stns	Species	Common Name	Stns
<i>Aequipecten opercularis</i>	Queen scallop	7	<i>Maurolicus mulleri</i>	pearlside	4
<i>Agonus cataphractus</i>	Pogge (Armed bullhead)	11	<i>Melanogrammus aeglefinus</i>	Haddock	59
<i>Alloteuthis subulata</i>		22	<i>Merlangius merlangus</i>	Whiting	72
<i>Alosa fallax</i>	Twait shad	1	<i>Merluccius merluccius</i>	Hake	26
<i>Amblyraja radiata</i>	Starry ray	25	<i>Microchirus variegatus</i>	Thickback sole	2
<i>Ammodytes marinus</i>	Lesser sandeel	1	<i>Micromesistius poutassou</i>	Blue whiting	13
<i>Ammodytes tobianus</i>	Small Sandeel	2	<i>Microstomus kitt</i>	Lemon sole	62
<i>Anarhichas lupus</i>	Wolf-fish	7	<i>Molva molva</i>	Common ling	12
<i>Arctica islandica</i>	ocean quahog	1	<i>Mullus surmuletus</i>	Red mullet	13
Argentinidae	Argentines	34	<i>Mustelus asterius</i>	Starry smooth-hound	5
<i>Arnoglossus laterna</i>	Scaldfish	19	<i>Myoxocephalus scorpius</i>	Bullrout	2
<i>Aspitrigula cuclis</i>	Red gurnard	4	<i>Myxine glutinosa</i>	Hagfish	6
<i>Buglossidium luteum</i>	Solonette	21	<i>Necora puber</i>	Velvet swimming crab	1
<i>Callionymus lyra</i>	Common dragonette	42	<i>Nephrops norvegicus</i>	Norway lobster	35
<i>Callionymus maculatus</i>	Spotted dragonette	28	Octopodidae		19
<i>Cancer pagurus</i>	Edible crab	18	<i>Pecten maximus</i>	Scallop	6
<i>Capros aper</i>	Boarfish	2	<i>Pholis gunnellus</i>	Butterfish	1
<i>Clupea harengus</i>	Herring	69	<i>Phycis blennoides</i>	Greater forkbeard	1
<i>Dicentrarchus labrax</i>	European sea bass	3	<i>Platichthys flesus</i>	Flounder	2
<i>Enchelyopus cimbrius</i>	Four-bearded rockling	13	<i>Pleuronectes platessa</i>	Plaice	59
<i>Engraulis encrasicolus</i>	European anchovy	7	<i>Pollachius virens</i>	Saithe	16
<i>Etmopterus spinax</i>	velvet belly	1	<i>Raja clavata</i>	Thornback ray	7
<i>Eutrigula gurnardus</i>	Grey gurnard	71	<i>Raja montagui</i>	Spotted ray	8
<i>Gadiculus argenteus</i>	Silvery pout	9	<i>Rossia macrostoma</i>		11
<i>Gadus morhua</i>	Cod	47	<i>Sardina pilchardus</i>	Pilchards	8
<i>Galeus melastomus</i>	Black-mouth dogfish	2	<i>Scomber scombrus</i>	European mackerel	65
<i>Glyptocephalus cynoglossus</i>	Witch	19	<i>Scophthalmus maximus</i>	Turbot	8
<i>Gobius</i> spp.	Gobies	2	<i>Scophthalmus rhombus</i>	Brill	6
<i>Helicolenus dactylopterus</i>	Blue-mouth redfish	23	<i>Scylliorhinus canicula</i>	Lesser spotted dogfish	20
<i>Hippoglossoides platessoides</i>	American plaice (long rough dab)	52	Sepiolidae		8
<i>Hippoglossus hippoglossus</i>	Halibut	1	<i>Solea solea</i>	Dover sole	2
<i>Homarus gammarus</i>	Lobster	1	<i>Sprattus sprattus</i>	Sprat	30
<i>Hyperoplus lanceolatus</i>	Greater sandeel	14	<i>Squalus acanthias</i>	Spurdog	11
<i>Illex coindetii</i>	Northern shortfin squid	35	<i>Todaropsis eblanae</i>	Lesser flying squid	2
<i>Lepidorhombus whiffiagonius</i>	Megrim	18	<i>Trachinus draco</i>	greater weever	2
<i>Leucoraja naevus</i>	Cuckoo ray	11	<i>Trachinus vipera</i>	Lesser weever	15
<i>Limanda limanda</i>	Dab	65	<i>Trachurus trachurus</i>	Horse mackerel	50
<i>Lithodes maja</i>	Stone crab	9	<i>Trigla lucerna</i>	Tub gurnard	10
<i>Loligo forbesi</i>	Northern squid	33	<i>Triglops murrayi</i>	Moustache sculpin	1
<i>Lophius budegassa</i>	Black-bellied anglerfish	3	<i>Trisopterus esmarki</i>	Norway pout	38
<i>Lophius picatorius</i>	Anglerfish (monkfish)	36	<i>Trisopterus luscus</i>	Bib pouting	3
<i>Lumpenus lampretaeformis</i>	Snake blenny	6	<i>Trisopterus minutus</i>	Poor cod	22
<i>Maja squinado</i>	European spider crab	1	<i>Zeus faber</i>	John dory	1

Table 4: Number of biological samples taken by species.

English Name	Number of samples taken
Haddock	1685
Whiting	1638
Plaice	1229
Herring	1209
Mackerel	426
Cod	339
Norway pout	333
Lemmon Sole	235
Dab	228
Grey gurnard	221
Hake	202
Four-bearded rockling	199
Saithe	132
Anglerfish (monkfish)	77
Witch	36
Common ling	31
Red mullet	29
Red gurnard	20
Tub gurnard	16
Turbot	11
Brill	7
Black-bellied anglerfish	4
John Dory	1
Starry ray	103
Spurdog	73
Cuckoo ray	34
Spotted ray	24
Thornback ray	24
Starry smooth-hound	18
Wolf fish	9
Black-mouth dogfish	6
Velvet belly	2
Total	8601

Gadiformes

Cod catches during this year's survey (Table 2) were slightly up (340kg) on last year's five-year low, although not too dissimilar to that of 2019 (312 kg) and 2018 (371 kg). This was also true of their distribution (Table 3), seen on four more stations than last year (47, compared to 43 in 2019). Whilst total weight was up from 2019 the number of individuals caught across the survey was slightly down (640, compared to 651 in 2019). Many of the cod caught this year (263 individuals) were <15 cm. Combined with a second year class (23–38 cm, n = 244 individuals; Figure 9a) these juveniles made up 79.2% of the total catch for this year's survey. As a result, 37.5% of this year's catch <12 cm was not sampled for age (assigned "0 group"). However, with 2019's "0-group" cod now over 12 cm more biological samples were collected this year, with 339 taken, compared to 310 in 2019 (Table 4).

The total recorded haddock was at a five year high of 8.252 t, nearly three times more than the previous year (2.746 t). Haddock were caught at 59 prime stations, two less than in 2019. The large catch increase resulted in 1685 haddock otoliths being collected, compared to 1323 last year, across a larger length range (7–56 cm in 2019 compared to 7–68 cm in 2020). The abundance in "0 group" and juvenile haddock last year has continued and was evident in the length distribution observed from the survey, with 2 distinct year classes (7–17 cm and 18–29 cm; Figure 9b) making up ~97% of the haddock caught. Haddock <12 cm were caught at 49 prime stations out of the 59 total during this year's survey.

The total whiting catch weight was at a five-year high (4.940 t, compared to 3.652 t in 2019). It remained the most widely seen fish species on the survey, caught at 72 of the 77 prime stations fished, two fewer than last year. The increase in catch weight and large abundance at stations was reflected in the increased biological samples collected (1628 in 2020 compared to 1417 in 2019). Like haddock, two distinct length classes were seen in the length distribution plot (4–14 cm ("0 group") and 15–27 cm; Figure 9c) making up 93% of the whiting caught this year. Whiting <12 cm were caught at 60 of the 77 prime stations this year.

The total saithe catch weight was at a 5-year low, with only 271 kg recorded in 2020 – less than a third of what was recorded in 2019 (955 kg). It was noticeable that no large catches of saithe were recorded at any single station, as had also been seen in recent years. In total, 132 otoliths were collected (compared to 195 the previous year). Despite the much reduced total catch weight, saithe was seen across as many stations as 2019 (n = 16).

Norway pout catches were at a five-year high this year, with catch weight higher than that seen in 2019 by 2315 kg. The distribution was similar to previous years, with Norway pout caught at 38 prime stations. The limited length range of Norway pout meant that similar numbers of otoliths were collected as previous years. As with haddock and whiting, Norway pout had two distinct cohorts (4–11 cm and 11–18 cm; Figure 9e).

Hake caught this year was the lowest total weight for five years (162 kg) and were no longer in the top 15 fish species by catch weight (ranked 18). This follows a declining trend since 2016 (when 1.084 t were caught). The distribution of hake was, however, slightly up, being seen at 26 prime stations, compared to 24 last year. The number of individuals caught (and the number biologically sampled) in 2020, n = 210 (n = 202), was lower than in 2019, n = 256 (n = 232).

Pleuronectiformes

Plaice catches were down again on the previous five-year low in 2019, with catch weight down to 283 kg compared to 374 kg last year. This was despite the presence remaining very similar for the last three years at 59 stations (60 stations in 2019, 2018 and 2017). Maturity stages for plaice remained mixed as recorded in 2019, with stages at this time of year normally spent. Maturing, hyaline and running individuals were recorded, which may be an indication to why catch rates have dropped for the past three years from staggered recruitment. Despite the reduced catch weight this year the numbers of otoliths taken remained very similar to 2019 with, 1229 taken, compared to 1221 last year.

Total lemon sole catch weight this year was 250 kg, which was slightly down compared to the 278 kg caught in 2019, moving out of the top 15 species by catch weight. This decrease was despite lemon sole being recorded at more stations this year (62), compared to last (59). Despite a lower abundance, the same number of biological samples were collected as the previous year (235 collected in both 2020 and 2019). Dab catch weights were down (3218 kg compared to 3532 kg in 2019), but over an increased distribution (65 stations this year, compared to 63 last) and number of otoliths taken were very similar to last the previous year (229, compared to 230 last year).

Pelagic fish

The most marked change in catch weight in this year's survey compared to previous years was with herring and sprat. Herring total catch weight 16.338 t, some 12 t more than seen in 2019, returning them to the highest species catch weight on the survey (after being ranked below sprat in 2019). The most notable reason for this difference has been an increase in large maturing herring catches at multiple stations. The increased catch weight was mirrored by a wider distribution (recorded at 69 stations, compared to 64 in 2019), although the numbers of otoliths collected were similar (1209, compared to 1207 last year). It is worth noting that large herring catches were also recorded further north than in previous years (prime stations 52, 53 and 45), with some as far north as prime station 62 (2361 kg).

Conversely, sprat catches were nearly half this year compared to what was observed during the 2019 survey, with 2.73 t caught in total, much closer to that seen in 2018. This can be attributed to a lower number of stations with catch weight over 100 kg (four, compared to eight last year), plus only one station with a catch over one tonne (1586 kg), which made up 58% of the sprat caught the survey. This is despite a slightly wider distribution compared to last year, with sprat recorded at 30 stations (compared to 28 last year).

Mackerel catch weights were at a five-year high, with 3.86 t total catch weight recorded (compared to 2.237 t in 2019 and 2.336 t in 2018). There was also an increased distribution, with mackerel recorded at 65 stations (c.f. 59 station in 2019). The increase also resulted in an increased number of otoliths collected (426, compared to 384 last year). Total horse mackerel catches in 2020 (1.986 t) were lower than observed in 2019 (3.542 t) although it is worth noting that nearly half of this weight came from just a single tow at prime station 3 (932 kg). Presence was recorded at 50 stations this year, similar to the 52 stations in 2019. Pilchard catch weights were in the top 15 species this year for the first time (601 kg), although nearly all this weight came from one haul (prime station 3; 590 kg).

Elasmobranchs

301 kg of elasmobranchs were caught this year, which is a decrease of 301 kg to that seen in 2019. Lesser-spotted dogfish (*Scyliorhinus canicula*) was the main elasmobranch in terms of catch weight (139 kg) down 91 kg on 2019, followed by starry ray *Amblyraja radiata* (121 kg). Of note this year was the capture of two velvet bellies at prime station 75. A total of 14 elasmobranchs were tagged with Petersen discs and released with starry smooth hound the most tagged species (n = 7). Although a few individuals of *Dipturus* spp. had been seen in recent years, none were caught during the 2020 survey.

Cephalopods and commercial shellfish

After a high abundance in 2019 (245 kg), northern squid (*Loligo forbesi*) had a much lower total catch of 25 kg this year, although it should be noted that 166 kg of last year's catch came from a single station; prime station 51. Large adults were still noticeably absent, with 95% of the individuals recorded under 13 cm. No European common squid were recorded this year, but northern shortfin squid (*Illex coindetii*) abundance and catch weights were up slightly to that seen in 2019 at 10.6kg (seen at 35 prime stations compared to 30 in 2019). Curled octopus (*Eledone cirrhosa*) catch weights have declined significantly to that seen last year, with only 19 individuals recorded compared to 98 in 2019.

Edible crab (*Cancer pagurus*) catch weight was down from 72 kg last year to 30 kg, despite being observed at 28 stations this year, compared to 25 prime stations in 2019). Velvet swimming crab (*Necora puber*) catches were similar to that seen in 2019 (10 kg compared to 11 kg last year) but only one European lobster (*Homarus gammarus*) was caught on the survey this year (1 kg, prime station 31). Of note this year was a juvenile European spider crab (*Maja squinado*) recorded at prime station 2.

Ichthyological observations

81 fish species were recorded on the survey this year, four less than in 2019. Species of note were the moustache sculpin, blue-mouth redfish and halibut (*Hippoglossus hippoglossus*) and large wolf-fish (up to 93 cm L_T).

Macrobenthos

142 taxa of macrobenthos were recorded on this year's survey. The sand star *Astropecten irregularis* was the most widely distributed, with presence recorded at 55 of the 77 prime stations.

Marine Litter

Litter was recorded at 66 out of the 77 stations completed, with 11 prime stations having no litter by-catch in the GOV trawl. As can be seen in Figure 20, 231 individual pieces of litter were detailed, reduced from the 303 seen in 2019, with plastics comprising 82% of the total incidences.

2. *Collect surface sea water samples for Caesium/Tritium testing to be performed post-survey.*

36 out of the 38 targeted stations had surface water samples collected. Two samples were missed due to time constraints surrounding delivery of primary aim 1.

3. *Conduct multiple tows to investigate king scallop (*Pecten maximus*) maturity in closed fishing grounds using Newhaven scallop dredges.*

Scallop dredges were used with two 3 m beams (port and starboard) and 4 scallop dredges on each beam, catches from both sides being recorded separately. In total, 25 tows were completed between 2 and 5 August, with 795 individual king scallops assessed for maturity.

SECONDARY AIMS:

4. *Tag and release specimens... in support of the ICES Working Group for Elasmobranch Fishes work to inform on stock units for demersal elasmobranchs. (J Ellis – Cefas, Lowestoft)*

Of the species targeted for tagging, 14 individuals were deemed appropriate to attach Petersen discs and release. As stated above, starry smooth-hound was tagged the most (n = 7). Two spurdog also was tagged. In addition, opportunity presented itself for two cuckoo rays and three spotted rays (*Raja montagui*) to also be tagged.

5. *To freeze any unusual fish species for subsequent identification / verification in the laboratory, ..., which may also be used in otolith research. (J Ellis – Cefas, Lowestoft)*

Thirteen species of unusual fish/epibenthos were retained for further analysis, including greater weever fish (*Trachinus draco*), velvet belly and hagfish (*Myxine glutinosa*). In addition, dead specimens of wolf-fish were sampled for otoliths as part of the development of a reference collection.

6. *To retain any dead specimens of tope and common skate for biological studies. (J Ellis – Cefas, Lowestoft)*

No tope or common skate were caught on this year's survey.

7. *Retain any dead specimens of diadromous fish for the DiadES Interreg project (T Basic, Cefas, Lowestoft)*

One specimen of twait shad that was dead on capture was retained.

8. Collect fisheries acoustic continuously data at four operating frequencies (38 kHz, 120 kHz, 200 kHz and 333kHz), using the Simrad EK60 split beam sounder. (J Van Der Kooij – Cefas, Lowestoft)

Acoustics data were recorded continuously throughout the survey for three of the four operating frequencies. Unfortunately, 333 kHz was not available.

9. Cetacean observations will be recorded where possible and sent to MARINELife and the SeaWatch Foundation.

With no dedicated marine mammal observer on board, observations were limited to *ad hoc* sightings by bridge crew and SICs. This resulted in limited sightings: white beaked dolphins (*Lagenorhynchus albirostris*) near prime stations 36, 46, 47 and 54. Short fin pilot whales (*Globicephala macrorhynchus*) were sighted near prime station 46.

10. Identification, count, measure and weight all jellyfish caught in GOV trawl will allow the continuation of the North Sea August Jellyfish dataset started in 2012 (S Pitois – Cefas, Lowestoft)

In total, 5060 individual jellyfish were measured on the survey (Table 5), comprising five species. Lion’s mane (*Cyanea capillata*) was the most abundant with a total catch weight of 285 kg, and also had the largest size range (3.5–47 cm; 4–3355 g). This was noticeably lower than the total catch weight recorded in 2019 (444 kg). Blue (*Cyanea lamarckii*), compass (*Chrysaora hysoscella*), crystal (*Aequorea* spp.) and moon jellyfish (*Aurelia aurita*) were much lower in catch weight than lion’s mane, but otherwise were comparably similar, with 27.23 kg, 24.69 kg, 15.71 kg and 24.97 kg caught, respectively.

Table 5. Details of jellyfish caught and measured during the survey.

Scientific Name	English Name	Total weight caught (g)	No. measured	Minimum length (cm)	Maximum length (cm)	Minimum weight (g)	Maximum weight (g)
<i>Aurelia aurita</i>	Moon jellyfish	24970	228	2.5	20.0	6	325
<i>Cyanea lamarckii</i>	Blue jellyfish	27234	1161	1	15.5	1	132
<i>Chrysaora hysoscella</i>	Compass jellyfish	24968	237	4	30.0	2	485
<i>Aequorea</i> spp.	Crystal jellyfish	15717	178	4	11.5	4	41
<i>Cyanea capillata</i>	Lion’s mane jellyfish	28509	808	3.0	44.5	4	3355

11. *Collect squid egg samples to map spawning grounds. This could be highly relevant in studying squid stock's structure. Retain any specimens of Loligo vulgaris and all ommastrephid squids (Illex, Todaropsis, Todarodes) for maturity and age analysis, respectively. (V Laptikovksy – Cefas, Lowestoft)*

No squid eggs were caught during the 2020 survey. Twenty-eight samples of northern shortfin squid, three lesser flying squid (*Todaropsis eblanae*) and 25 *Alloteuthis subulata* were retained for further analysis.

12. *To collect biological information from four-bearded rockling Enchelyopus cimbrius. Including length, weight and maturity information. (L Cox – Cefas, Lowestoft)*

Specimens of four-bearded rockling (n = 199) caught during the survey were processed for biological information and otoliths collected whilst on board.

13. *Collect chlorophyll samples to test for nutrients from the surface water collected once a day for the ASMIAC project. (N Greenwood – Cefas, Lowestoft)*

Forty-two chlorophyll samples were collected from surface water at the first and last prime station each day throughout the survey as dusk permitted.

14. *Zooplankton plankton sampling using ringnets to collect samples from the Gabbard smart buoy site. (S Pitois – Cefas, Lowestoft)*

A ringnet deployment at the West Gabbard site was not completed due to time constraints.

15. *Collect suitable examples of benthic organisms from a select number of prime stations to test for Paralytic Shellfish Poisoning toxins.*

Benthic organisms were retained at all 43 targeted prime stations, with additional samples taken from other areas as time allowed.

Richard Humphreys & Ben Hatton
Scientists in Charge
04/09/20

DISTRIBUTION:

Participants of survey
 Marine Operations
 D Pettengell (PM)
 I Holmes (PI)
 C Leech (PL)
 S Kupschus
 Cefas Fisheries surveys SICs/2ICs
 Cefas CDP (Gary Burt)
 AWSM - Pinbush
 Fishing Skipper/Master Cefas Endeavour
 FCO (Overseas EEZ's)

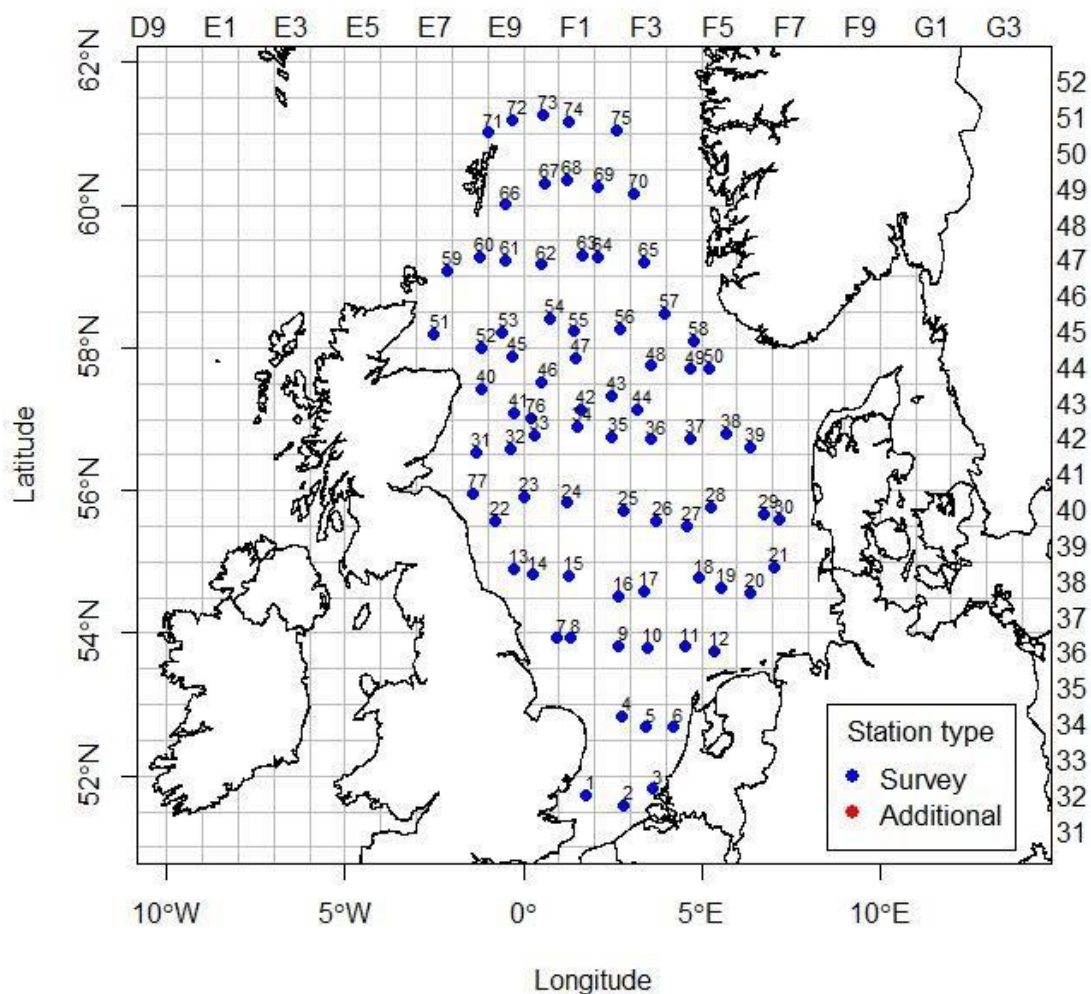


Figure 7. Deployment positions for valid and additional GOV trawl stations giving prime station numbers.

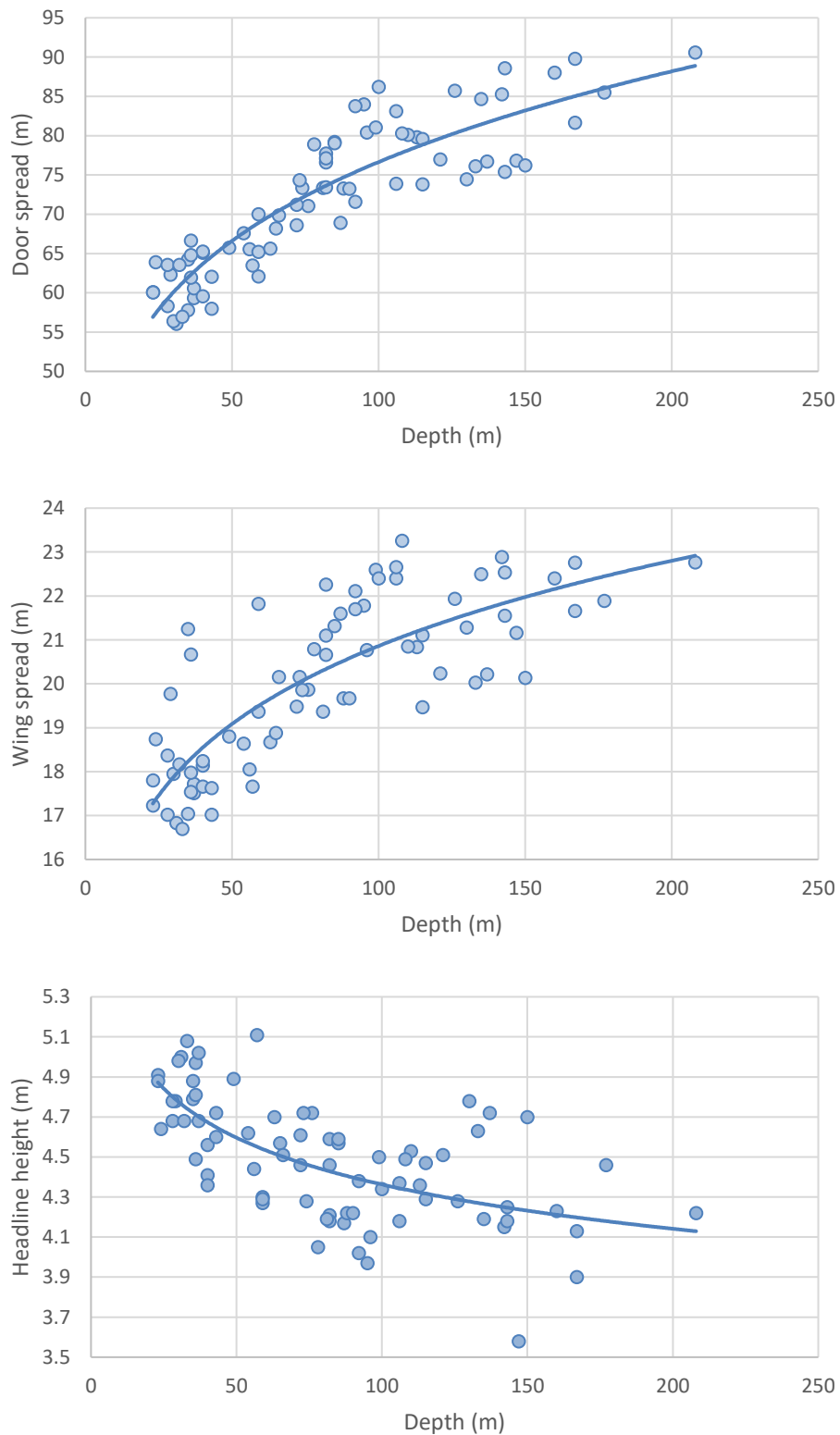


Figure 8. Relationships between door spread, wing spread and headline height with water depth (valid tows only).

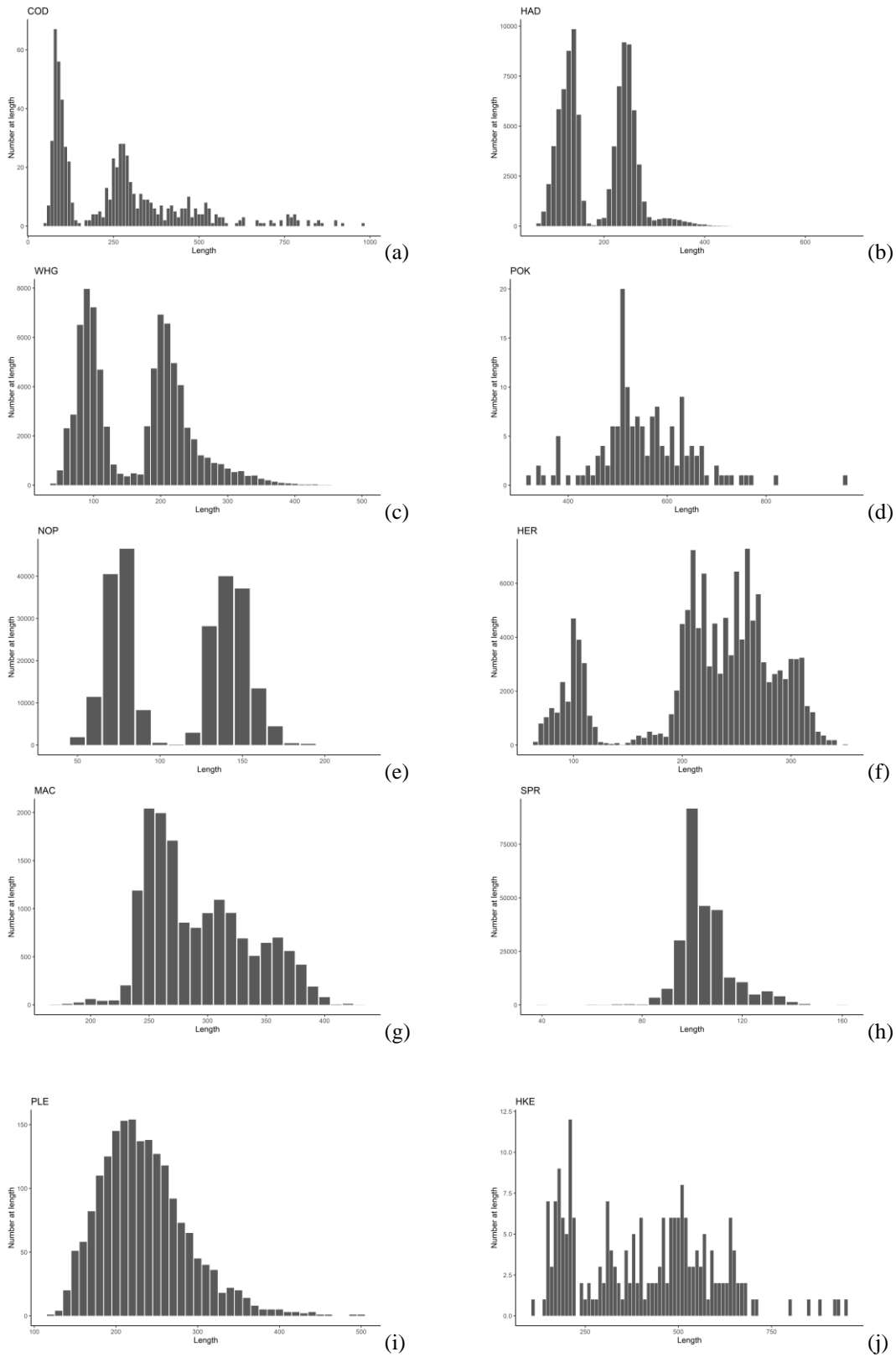


Figure 9. Length distribution plots for (a) cod, (b) haddock, (c) whiting, (d) saithe, (e) Norway pout, (f) herring, (g) mackerel, (h) sprat, (i) plaice and (j) hake.

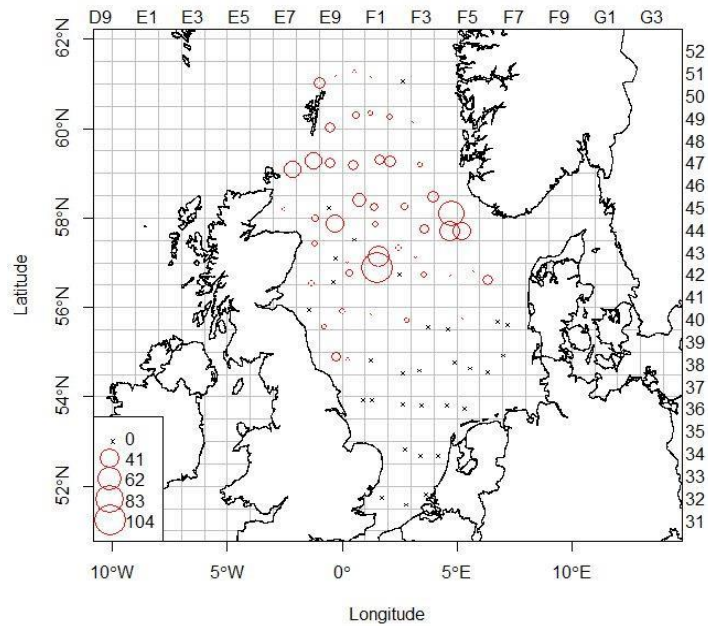


Figure 10. Distribution and relative abundance of cod (*Gadus morhua*) across the survey.

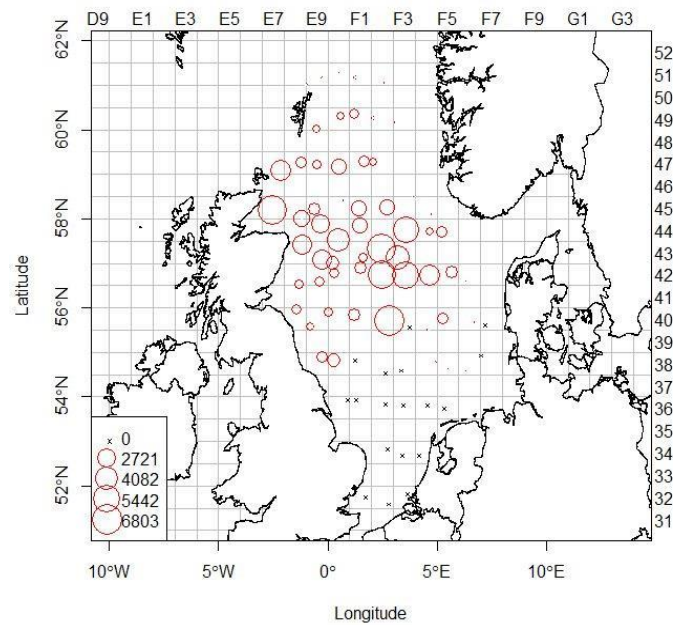


Figure 11. Distribution and relative abundance of haddock (*Melanogrammus aeglefinus*) across the survey.

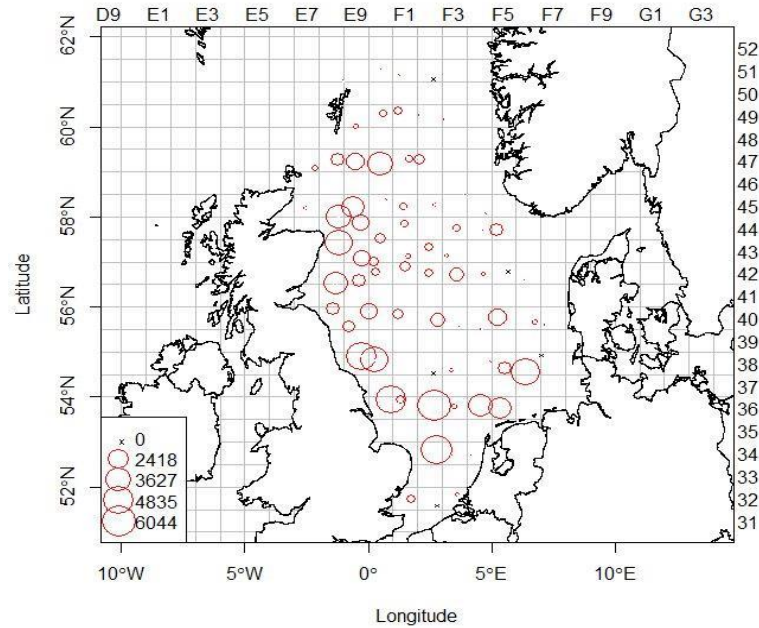


Figure 12. Distribution and relative abundance of whiting (*Merlangius merlangus*) across the survey.

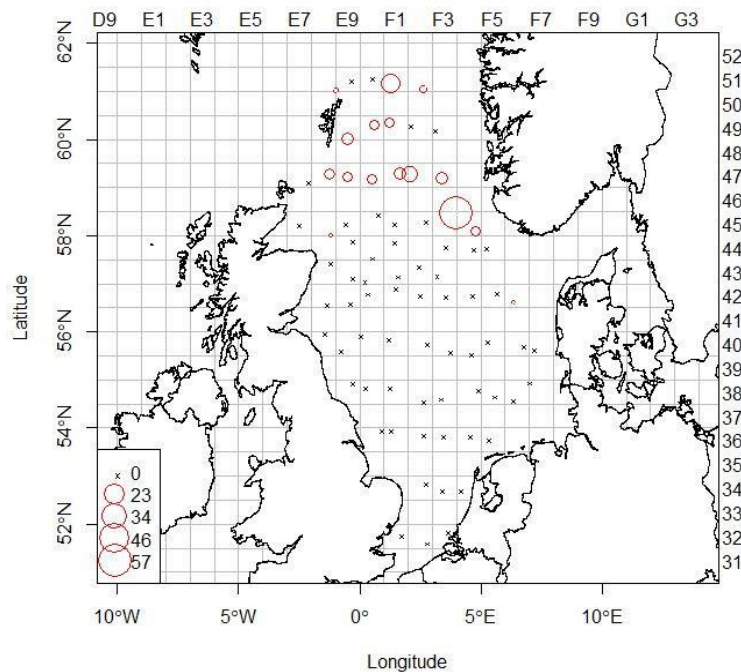


Figure 13. Distribution and relative abundance of saithe (*Pollachius virens*) across the survey.

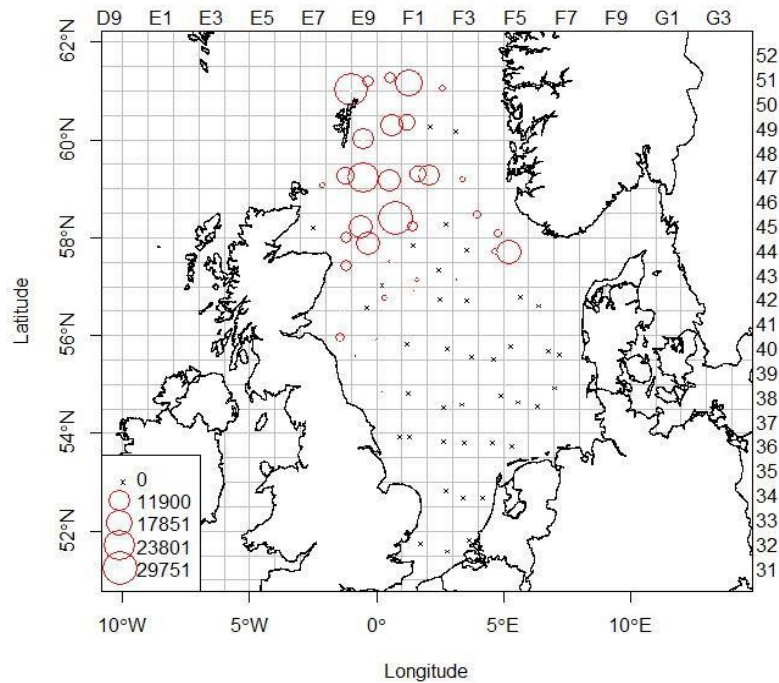


Figure 14. Distribution and relative abundance of Norway pout (*Trisopterus esmarkii*) across the survey.

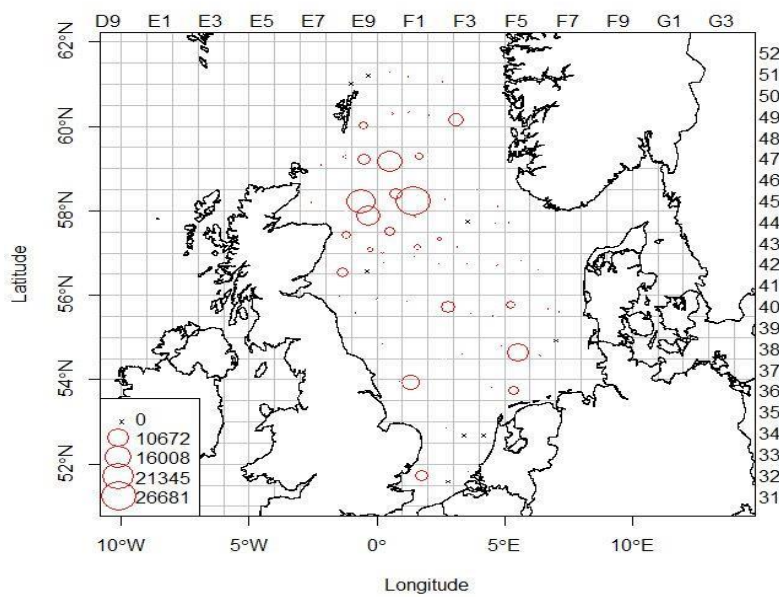


Figure 15. Distribution and relative abundance of herring (*Clupea harengus*) across the survey.

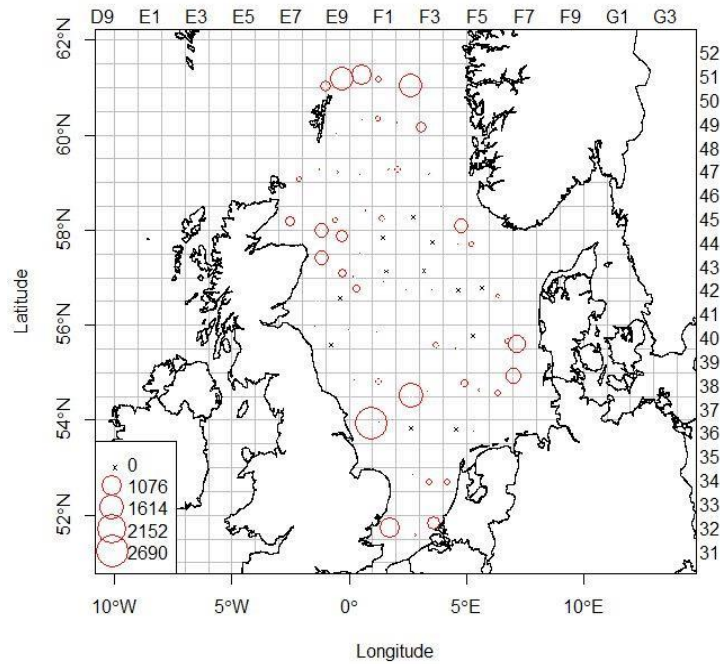


Figure 16. Distribution and relative abundance of mackerel (*Scomber scombrus*) across the survey.

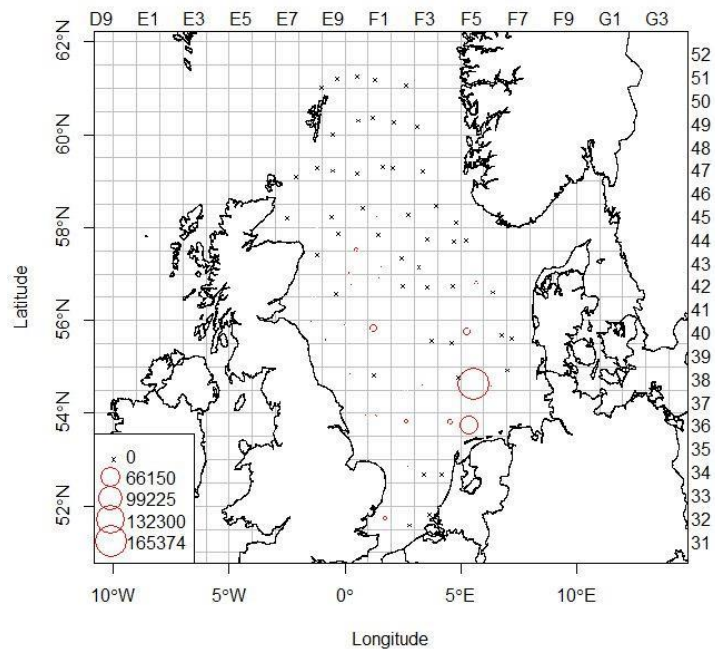


Figure 17. Distribution and relative abundance of sprat (*Sprattus sprattus*) across the survey.

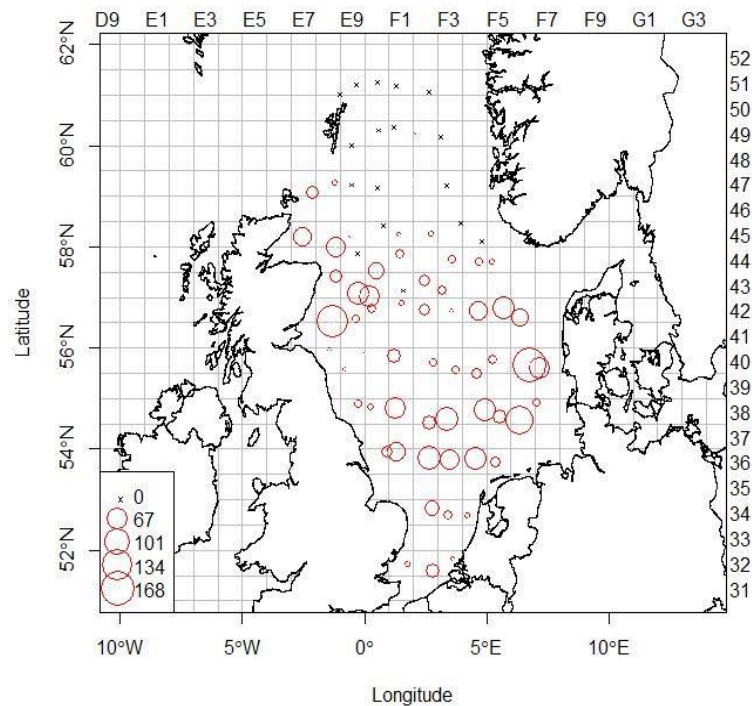


Figure 18. Distribution and relative abundance of plaice (*Pleuronectes platessa*) across the survey.

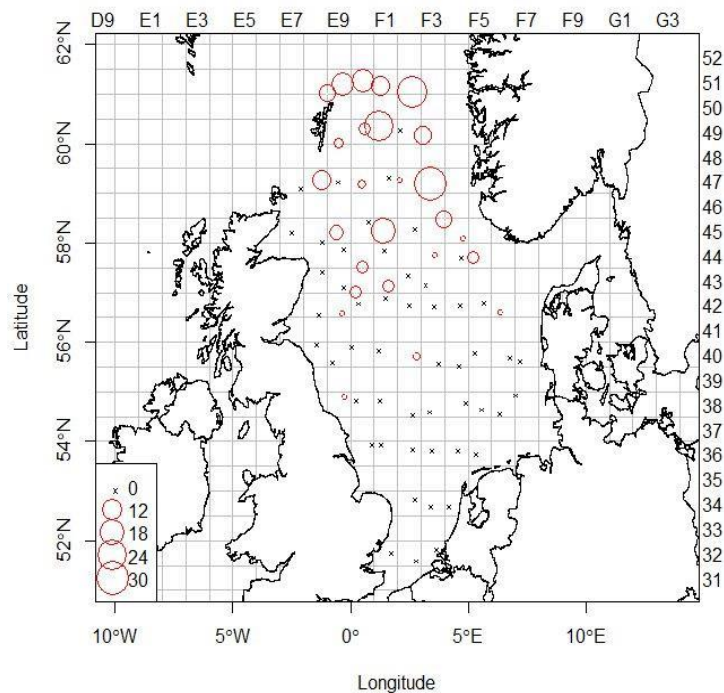


Figure 19. Distribution and relative abundance of hake (*Merluccius merluccius*) across the survey.

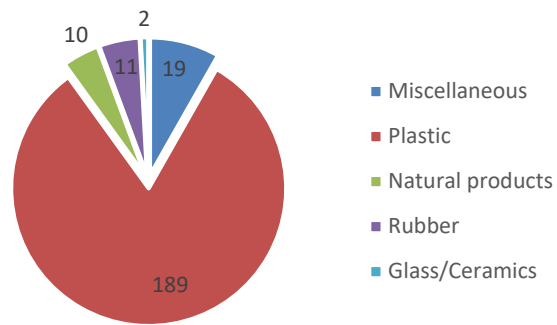


Figure 20. Marine litter collected during the English IBTS-Q3 trawl survey in 2020 (n = 231).