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

2018 RESEARCH VESSEL PROGRAMME
REPORT: RV CEFAS ENDEAVOUR: SURVEY 16/18

STAFF:

Part One (12-24 Sept)	Part Two (26 Sept-3 Oct)
S Shaw (SIC)	S Shaw (SIC)
S Walmsley (2IC)	S Walmsley (2IC)
I Holmes	I Holmes
G Eastley	G Eastley
D Brown	D Brown
C Reeve	C Reeve
L Mann	Z Radford
T Earl	M Desmond (Irish observer)
M Nicolaus	M Nicolaus
J Bignell	J Bignell
P Nelson	P Nelson
A Callaway	A Callaway
J Uzyczak	M Assuncao
S Losada	M Green
C Daumich	M Stone

DURATION: 12 September – 3 October 2018

LOCATION: Irish Sea (VIIa); Bristol Channel & Celtic Sea (VIIf&g)

AIMS:

1. To carry out a 4m beam-trawl survey of groundfish (Figure 3) to i) obtain fisheries independent data on the distribution and abundance of commercial flatfish species, and ii) derive age compositions of sole (*Solea solea*), plaice (*Pleuronectes platessa*), cod (*Gadus morhua*) and whiting (*Merlangius merlangus*) for use in stock assessments.
2. To collect biological data including maturity and weight at age of sole, plaice, lemon sole (*Microstomus kitt*) and other commercially important finfish species as part of CEFAS' requirements under the EU Data Collection Framework.
3. To determine the distribution and relative abundance of juvenile and adult sole and plaice.
4. To collect surface & bottom temperature/salinity data using CTD and Niskin Bottle.
5. To quantify epibenthos using 4m beam trawl by-catch.
6. Collect length/weight & maturity information using individual fish measurements, in support of the EU Data Collection Framework.
7. To collect surface sea-water samples for processing on return to Lowestoft for the analysis of tritium (AE001) (K Leonard - Cefas).

8. To collect fish samples in support of other Cefas and non-Cefas projects and training courses.
9. To collect samples of demersal fish using a Granton trawl for chemical analysis from the Irish Sea, Celtic Sea and Western English Channel in support of the Clean Seas Environmental Monitoring Program (CSEMP) (OSPAR Common indicator and UK specific Indicator assessments).
10. To collect fish samples at CSEMP sites for fish disease biochemical markers (e.g. EROD and bile metabolites analysis) (UK specific Indicator Assessments).
11. To sample representative CSEMP stations using day grab, for polycyclic aromatic hydrocarbons (PAHs), trace metal contaminants, organic contaminants (PCBs, PBDEs and HBCD), sediment particle size analysis (PSA), benthic fauna and marine litter ((OSPAR Common indicator and UK specific Indicator assessments).
12. To conduct marine litter surveys (OSPAR Common indicator and UK specific Indicator assessments) by collecting benthic litter information from the trawls and collecting sediment samples for litter analysis.

NARRATIVE: (All times **GMT**)

Cefas scientists joined Cefas Endeavour at 1900h, 12 September for sailing, departing Lowestoft at 2130h, 12 September. At 0205h 13 September, a ring net and water sample collection was carried out at the West Gabbard smart buoy location for the Pelagic sciences team at Cefas. On 13 September, survey briefing tool-box talks were held with the vessel officers and crew to discuss the survey operations followed by a general emergency muster drill.

At 1233h, a shakedown ESM2 logger and Niskin sampler ‘dip’ was successfully carried out at a position south of Seaford Head (7DBTS prime station 67). This was followed by successful shake-down beam trawl tow (beam number 3) at the same position to fully test the beam trawl deployment and the on-board fish sampling systems. The vessel recommenced the steam to the first survey stations in the Bristol Channel.

On 14 September at 1757h, the first water sample station to analyse for tritium levels was collected in the Bristol channel followed by a further 27 water samples off the fishing grid. On 15 September fishing commenced at first light 0550h, at prime station 117 South of Swansea Bay. A total of nine stations were successfully fished during daylight. Overnight, the CSEMP team commenced their survey, completing prime station 616 using both the Granton and Beam trawls to collect the required numbers of Dab (*Limanda limanda*). Before first light on 16 September, the wet lab was set up to continue the primary aim of the beam trawl survey. A total of 10 valid station were completed in Carmarthen Bay with some time lost due to the increasing problem of static gear reducing the plan by 2 stations. During the night CSEMP station 604 was sampling using the Granton trawl.

On 17 September, fishing commenced in the Bristol Channel Inner (BCI) sector at prime station 132. During the day the vessel worked to the south, towards Bideford Bay to gain shelter from a forecast storm. At the last station of the day (prime 505), a Marbled Electric Ray (*Torpedo marmorata*) was caught, this being the first recorded in the time series of the survey (1988-2018), Figure 1. Poor weather meant that Cefas Endeavour had to find

shelter behind Lundy Island for 48 hours, so no survey operations were possible on the 18 and 19 September.

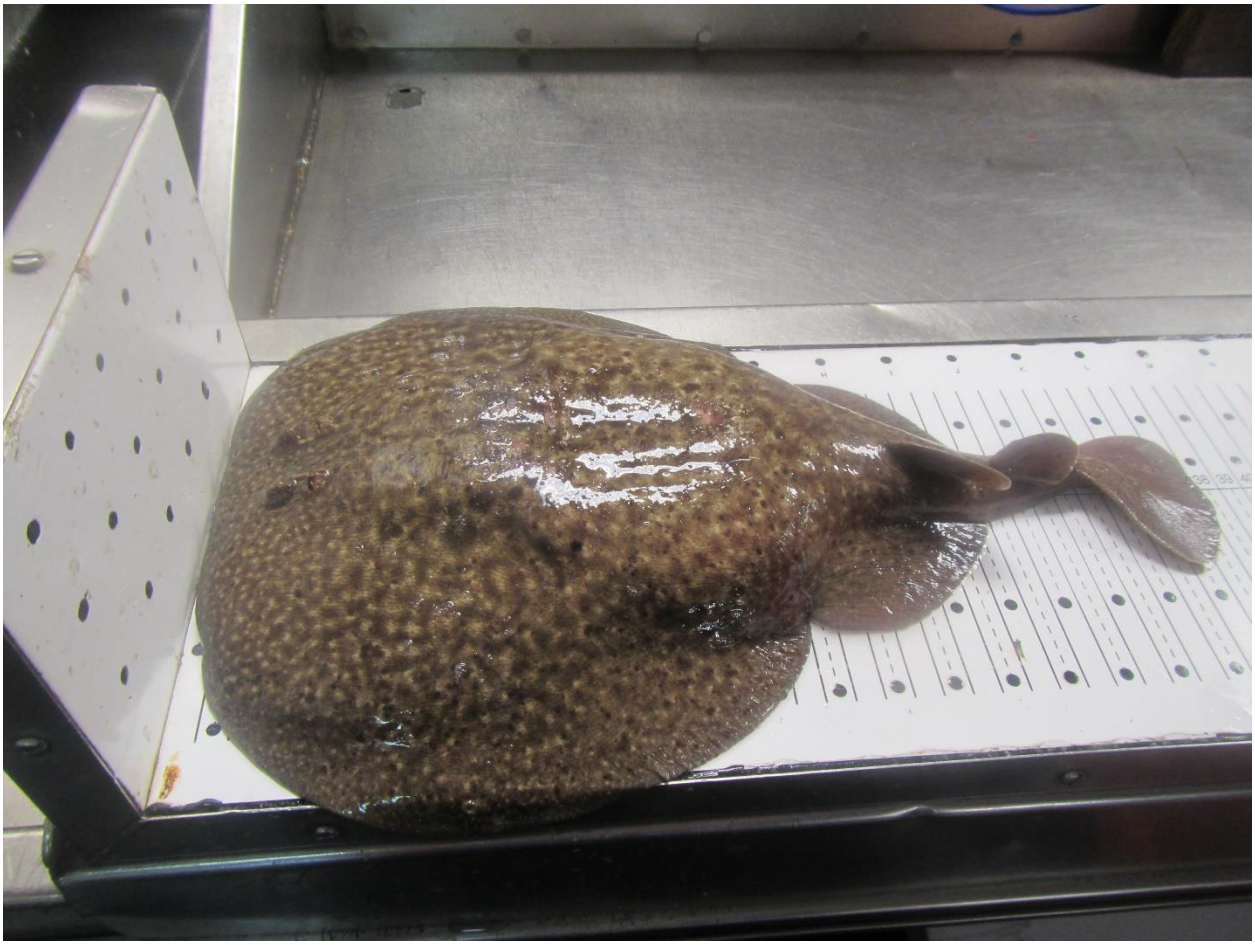


Figure 1 – Marbled Electric Ray (*Torpedo marmorata*) caught at prime station 505.

During the early hours of 20 September, the vessel left shelter to get on to prime station 112 for first light. Due to the movement of a sand bank, this tow was reduced in time and will have to be moved in the future. Only five stations were possible due to deteriorating weather meaning that one BCI station was left to complete during the second half of the trip. The vessel then transited to the east Irish coast to gain shelter for the following days survey operations. On 21 September, survey operations started in the St Georges Channel (SGC) sector in Dublin Bay and finished in the Irish Sea West (ISW) sector off Dundrum Bay with a total of seven stations being completed. Over night the CSEMP team worked on the outer Dundrum Bay station carrying out fishing with the Granton trawl. Once operations were complete the vessel transited to the next site, prime 19 in the Irish Sea North (ISN) sector.

On 22 September eight survey stations were completed during daylight and during the night the CSEMP team completed station 805 before transiting to the most northern stations on the survey. On 23 September was spent sampling the seven stations along the Scottish coast in ISN and as in previous years, it was difficult to find tows clear from static gear. No temperature and salinity were collected on this day. During the night, one CSEMP station was fished with the Granton trawl before a short transit to prime station 15. On 24 September, six stations were completed before the vessel docked in to Douglas at 1730h to take on supplies and have a crew changeover.

Cefas Endeavour departed Douglas at 1830h 25 September in to south west gales meaning the planned sediment grabs in Liverpool bay were not possible due to the poor sea state. At first light, prime station 4, Irish Sea South (ISS) sector was successfully sampled, this was followed by further 7 stations. After daylight operations, two CSEMP stations (706 and 796) were sampled using the beam trawl. On 27 September, eight beam trawl stations were successfully sampled completing the ISS survey grid. Overnight, CSEMP station (776) was completed before getting in to position for prime station 401 at first light. Six stations were completed on 28 September, due to distance away from sampling sites no CSEMP work was possible overnight.

On 29 September, five beam trawl stations were completed, during the steam to CSEMP station 649, at 1800h Holyhead coastguard tasked the Cefas Endeavour in the assistance of a yacht that was having difficulties. Arrival of the Pwllheli lifeboat on the scene meant that survey operations could resume, and the CSEMP team completed the work at station 649 overnight. On 30 September, the six stations in Cardigan bay were completed, Figure 2 shows the catch of two size classes of Queen Scallops (*Chlamys opercularis*) caught at prime station 443. During the night the weather deteriorated reducing the amount of time CSEMP staff were able to spend at station 654, with the vessel starting the transit to Ireland at 2029h.

Figure 2 – Two size classes of Queen Scallops (*Chlamys opercularis*) caught at prime station 443 (162 large and 1017 small individuals)

On 1 October at the first station (prime 438), the warp deploying the ESM2 and Niskin parted on its retrieval. Survey operations paused whilst efforts to recover the equipment were made. Initial attempts to grapple for it failed and the decision was made to switch to the Granton trawl to give the best chance of retrieving the equipment. On the second tow this was achieved. Due to this loss of time, only three stations were completed, and no CSEMP work was possible overnight. On 2 October four stations were completed including the last in both SGC and BCI sectors to complete the primary survey grid. Overnight the CSEMP team completed their last shift sampling station 605.

The final survey fishing day (3 October) was spent fishing four out of the remaining eight survey stations in the Bristol Channel Outer (BCO) survey sector. The final survey fishing station was hauled at 1221h, 3 October and once the associated Niskin deployment had been completed, Cefas Endeavour headed to Swansea. During this period, scientists began the process of cleaning up and packing away all scientific equipment in readiness for docking. Due to time contraints, four stations were not possible to fish this year in the BCO sector, these stations were prime 511, 512, 513 and 533.

Cefas Endeavour docked in Swansea at 2342h, 3 October and the survey de-mobbed the following day.

RESULTS BY AIM:

Aims 1, 2 & 3

The survey gear was the standard 4m-beam trawl (Beam number 3 was used for all stations) with chain mat, flip-up ropes and the net was fitted with a 40mm cod-end liner. All fish and selected commercial shellfish were identified to species, weighed and measured with large catches of an individual species being sub-sampled.

A SAIV Micro CTD unit was attached to the headline on the 4m-beam trawl in order to record the temperature and salinity depth profile at each station fished. In addition, at the first and last fishing station most days, a surface water sample was taken simultaneously with a Niskin bottom water sample and an ESM2 logger profile.

All catch details and sample data were entered directly into the fisheries Electronic Data Capture (EDC) system and uploaded directly into the Fishing Survey System (FSS). Station details were manually entered into the FSS using information collected from the Transas bridge logging system and bridge logbook. The total number of survey otoliths/scales taken in each ICES Division are shown in Table 1.

Table 2 shows the top 10 species by both weight (kg) and number of individuals caught on the survey in the past three years. Table 3 shows a list of measured species caught during the survey and number of stations at which they were caught. The trawl survey covering the Irish Sea and Bristol Channel is divided up into six sectors consisting of 108 beam trawl tows, of which all bar four were successfully fished (Figure 3), including all ISN, ISS, ISW, SGC and BCI stations used for tuning data for the Working Group of the Celtic Seas Eco-region.

Table 4 shows the number of gear deployments undertaken on the survey.

A total of 14 prime stations – primes 27 and 28 (off Blackpool), 40 (Red Wharf Bay), 47, 53 and 54 outer Liverpool Bay), 313 (Tremadoc Bay), 214 (Skerries), 203 (Dundrum Bay), 220 (north of Dublin), 233 (south of Wicklow), 425 (midway Anglesey/IOM), 120 (Pembroke coast) and 501 (southwest of Milford Haven) were reduced from the standard 30-minute tow to either a 20 or 15-minute tow.

In addition, a total of 14 prime stations were hauled early – prime 116 (Outer Gower), 2 (Luce Bay), 409 (Irish Sea west deep), 104 (Rhossli Bay), 134 (Carmarthen Bay),136 (Caldey Bay), 129 (Bristol Channel), 122 (Mid Bristol Channel), 206 (Dundalk Bay), 3 (Wigtown Bay), 37 (Off Llandudno), 430 (Offshore Arklow), 440 (Offshore Dublin), 112 (Stackpole Head) and 7 (off Workington). All tow reductions were due to expected large catches of weed, broken shell or small flatfish, static gear over the tow, fading light or fishing a new tow location. A few stations were moved short distances to avoid undersea cables (an increasing problem in this busy sea area).

Table 1: Numbers of otolith/scale samples taken by ICES division

	VIIa	VIIf	VIIg	Total
Anglerfish (*Lophius piscatorius*)	30	18	17	65
Anglerfish (*Lophius budegassa*)	0	0	1	1
Black Sea Bream	1	0	0	1
Brill	8	4	3	15
Cod	116	8	1	125
Dab	136	113	23	272
Bass	3	64	0	67
Grey Gurnard	90	33	1	124
Red Gurnard	56	11	0	67
Tub Gurnard	56	18	0	74
Haddock	22	5	24	51
Hake	8	11	13	32
John Dory	13	8	5	26
Lemon Sole	58	20	7	85
Megrim	3	1	4	8
Plaice	1346	372	20	1738
Red Mullet	28	33	1	62
Sole	562	412	73	1047
Turbot	1	6	0	7
Whiting	126	38	20	184
Total	2663	1175	213	4051

Table 2: Summary of the main species caught over the entire survey
*Excludes SEI stations

Weight caught (kg)				**Number caught**			
	2018	2017	2016*		2018	2017	2016*
Lesser spotted dogfish	1055	808	885	Dab	10116	10108	16760
Plaice	932	959	1149	Plaice	7051	7848	10230
Dab	516	463	770	Sole	3392	2556	2201
Thornback ray	484	401	367	Solenette	2559	1805	3226
Sole	419	266	279	Whiting	2487	1865	2469
Spiny spider crab	171	361	216	Lesser spotted dogfish	2263	1601	1750
Whiting	98	84	97	Poor cod	2176	1209	2157
Spotted ray	90	110	115	Common dragonet	1848	1333	2159
Common dragonet	74	60	145	Grey gurnard	2121	856	1086
Starry smooth hound	67	99	59	Scaldfish	1377	1022	1412
TOTAL (All species)	**4546**	**3796**	**4611**	**TOTAL (All species)**	**40905**	**34528**	**49022**

Table 3: List of measured species caught during the survey and number of stations at which they were recorded.

Species	Stations	Species	Stations
Lophius piscatorius	35	*Pomatoschistus spp*	24
Loligo (alloteuthis) subulata	17	*Raja microocellata*	9
Blennius ocellaris	6	*Callionymus reticulatus*	1
Trisopterus luscus	21	*Pecten maximus*	12
Scophthalmus rhombus	12	*Maja squinado*	45
Raja brachyura	22	*Arnoglossus laterna*	57
Myoxocephalus scorpius	3	*Raja montagui*	59
Callionymus lyra	86	*Mustelus asterias*	32
Gadus morhua	33	*Callionymus maculatus*	6
Conger conger	10	*Solea solea*	86
Cancer pagurus	35	*Pegusa (solea) lascaris*	17
Sepia officinalis	9	*Buglossidium luteum*	55
Leucoraja naevus	17	*Sprattus sprattus*	3
Limanda limanda	85	*Taurulus bubalis*	1
Scyliorhinus stellaris	13	*Microchirus variegatus*	42
Dicentrarchus labrax	15	*Raja clavata*	70
Platichthys flesus	5	*Diplecogaster bimaculata*	2
Ctenolabrus rupestris	2	*Ammodytes tobianus*	4
Syngnathus acus	5	*Trigla (chelidonichthys) lucerna*	52
Hyperoplus lanceolatus	8	*Scophthalmus maximus (psetta maxima)*	4
Eutrigla (chelidonicthys) gurnardus	86	*Trachinus draco*	3
Aspitrigla (chelidonichthys) cuculus	28	*Echiichthys (trachinus) vipera*	23
Melanogrammus aeglefinus	23	*Merlangius merlangus*	81
Merluccius merluccius	13	*Glyptocephalus cynoglossus*	11
Trachurus trachurus	8	*Argentinidae*	1
Zeus faber	18	*Spondyliosoma cantharus*	1
Homarus gammarus	9	*Labrus bergylta*	1
Microstomus kitt	28	*Labrus mixtus (l. bimaculatus)*	1
Loligo vulgaris	23	*Enchelyopus cimbrius*	1
Scyliorhinus canicula	93	*Lesueurigobius friesii*	2
Necora puber	21	*Galeorhinus galeus*	1
Mullus surmuletus	25	*Belone belone*	2
Nephrops norvegicus	12	*Clupea harengus*	3
Zeugopterus (phrynorhombus) norvegius	4	*Scomber scombrus*	1
Trisopterus esmarki	10	*Lepidorhombus whiffiagonis*	6
Hippoglossoides platessoides	4	*Pollachius pollachius*	1
Pleuronectes platessa	90	*Zeugopterus punctatus*	1
Trisopterus minutus	65	*Torpedo marmorata*	1
Agonus cataphractus	32	*Micrenophrys (taurulus) lilljeborgi*	1
Capros aper	3	*Lophius budegassa*	1
Arnoglossus imperialis	1		

Table 4: Summary of gear deployments and sample collections

Gear	Valid	Additional	Invalid	Total
Standard 4m Beam trawl with cod end liner	104	0	3	107
Surface salinity samples	33	0	0	33
ESM2 profile+Niskin sea-bed water samples	32	0	1	33
Ring net sample	1	0	0	1
CSEMP deployments				
Granton trawl	16	0	0	16
Single standard 4m Beam trawl with cod end liner	17	0	0	17
Double standard 4m Beam trawl with cod end liner	3	0	0	3
Day grab	19	0	0	19

Abundances of pre-recruit and recruited plaice and sole in the Irish Sea and Bristol Channel are shown in Figures 4 and 5. As with previous surveys, pre-recruit plaice were most abundant off the east coast of Ireland and in inshore waters off North Wales and northwest England. Pre-recruit sole were most abundant in the Bristol Channel, particularly Carmarthen Bay and Bideford Bay and in inshore waters off north Wales and Liverpool Bay. Abundances of pre-recruit and recruited dab and lemon sole are shown in Figure 6 and Figure 7.

Please note that results for the BCO sector are an average over the 7 stations sampled out of the 11 prime stations in this area.

Plaice

Abundance by both catch numbers and catch weight in 2018 decreased for the second year from the high levels observed in 2013-2016 with the largest falls observed in the ISW, BCI and SGC sectors.

In BCI, both the catch numbers and weight caught decreased by 14% and 24% respectively, decreasing for the third year from the high levels observed in 2015. In BCO

the numbers of fish caught decreased by 30% from 2017 and the weight of fish caught fell by 26%. Plaice catches are below the survey high (2015) in both Bristol Channel survey sectors. Catch numbers of juvenile plaice (<22cm) in BCI/BCO have increased from 64 (2016) and 60 (2017) to 125 in 2018 and this was nearing the survey average (143) over the period 2001-18. Catch numbers of recruited plaice (>22cm) fell to 468 fish and is now below the survey average of 570.

In the Irish Sea, ISN plaice abundance increased in terms of numbers caught (1%) and by weight caught (9%). Catch numbers remain below the survey average whilst weight caught remained above (2001-18). In ISS, plaice catch numbers fell for the fourth year running with another fall of 13%, whilst catch weight decreased by 3%. Only weight measure of abundance was above the survey average (2001-18). In ISW, both catch numbers and weights decreased for the third year running with decreases of 28% and 21% respectively. These three survey sectors continue to be the most productive for plaice. Catch numbers in SGC fell by 11% from those observed in 2017 whilst catch weight also decreased by 3%.

Catch numbers of juvenile plaice (<22cm) in these four Irish Sea survey sectors decreased again in 2018 to the lowest level seen in 9 years, now falling 49% below the survey average observed (2001-18). Trends in survey catch rates over recent surveys are shown in Figure 8.

Sole

Abundance by catch number and weight increased in all survey sectors except in ISW (30% and 43% falls respectively) compared to 2017. The BCI survey sector continues to be the most productive but historically this sector was ‘matched’ by similar catch rates in the ISS survey sector, but this has ceased to be the case in the past 14 years despite recent increases.

In BCI, catch numbers and weight increased by 29% and 75% respectively compared to the 2017 survey and remain above the series average over period 2001-18. In BCO catch weight and number increased by 121% and by 96% compared to the 2017 survey. Catch numbers of juvenile sole in BCI/BCO (<22cm) were around 30% lower in 2018 (914 fish) than those seen in 2017 (1301 fish) and are still above average levels observed over the period 2001-18. Numbers of recruited sole (>21cm) caught increased 344% from 2017 (394 fish) to around 1360 fish this is the double the survey average of 612 fish (2001-2018).

In the Irish Sea, ISN catch numbers and catch weights both increased by 27% and 21% respectively compared to 2017 with both measures remaining above the series average and near the survey high (2001-18). In the ISS survey sector, an increase was observed in both catch weight and numbers (both 40%) compared to 2017 and increase to near the survey high (2001-18). ISW saw decreases in both catch numbers (30%) and catch weights (43%) and catches remain low compared to the ISS/ISN survey sectors. In SGC, catch numbers and weight increased by 25% and 27% respectively from those observed in 2017 and remain near the series average (2001-18). Recruited (>21cm) sole numbers (639) increased above the survey average (402) while juvenile (<21cm) sole numbers (479) remain above the survey average (288) observed over the period 2001-18. Trends in survey catch rates over recent surveys are shown in Figure 9.

Dab

Abundance of dab by catch number decreased in all survey sectors except ISS where a 28% increase was observed. The abundance by catch weight decreased in the all sectors except ISN, ISS and BCI. The most productive survey sectors remain ISS/ISN/ISW and the survey sectors of BCI/BCO generally see the smallest catches of dab.

In BCI catch numbers decreased by 9% and catch weight increased by 10% in 2018 and remain at average levels (2001-18). In BCO, abundance by number caught and weight decreased, but these changes were not comparable to previous years as not all stations were completed. Numbers of juvenile dab in BCI/BCO (<17cm) decreased in 2018 (237) compared to 2017 (534) and are below the survey average over the period 2001-18 (580). However, the numbers of recruited dab (>16cm) increased by 13% in 2018 (1253) compared to 2017 (1107) and remain above average.

In the Irish Sea, ISS catch numbers and catch weights both increased compared to the 2017 survey but remain below the abundance averages (2001-18). The survey sector ISN showed a small decrease in catch numbers but an increase in catch weights (-2% and 17% respectively) to those seen in 2017. ISW showed decreases in both catch weight and number. Both sectors currently have abundance at below average levels. In the SGC survey sector, catch numbers and weight decreased by 22% and 15% respectably and both measures remain around the survey average (2001-18).

The number of juvenile (<17cm) dab in the Irish Sea survey sectors decreased by 33% in 2018 compared to the previous survey and are at 41% of the average over the period 2001-18. Numbers of recruited dab (>16cm) increased by 25% in 2018 and are also observed as being below the survey average. Trends in survey catch rates over recent surveys are shown in Figure 10.

Lemon sole

Catch rates of lemon sole remain low in all survey sectors despite small increases in both catch numbers and catch weights in BCO, ISS and SGC survey sectors. In all survey sectors, both catch numbers and catch weights are either at or close to the series low over the period 2001-18.

In the Irish Sea, juvenile numbers (<20cm) increased from 11 in 2017 to 43 in 2018 and are now above average levels (2001-18). Numbers of recruited lemon sole (>19cm) in 2018 (33 fish) decreased from 2017 (39) and remain below the series average (61 fish).

In the Bristol Channel, juvenile numbers decreased in 2018 (12) from 2017 (26) and are currently below the series average (2001-18). Recruited lemon sole decreased by around 13% in 2018 (17) and are also observed as being below average levels. Trends in survey catch rates over recent surveys are shown in Figure 11.

Other species

Cod – total catch numbers in 2018 (150) were up compared to 2016 (46) and 2017 (39) of which 95% were juvenile (<21cm). In total, 139 Cod caught in 2018 were taken in the Irish Sea.

Bass (*Dicentrarchus labrax*) – total catch numbers in 2018 (74) were up compared to the survey average (10) and are now at the highest level over the survey times series. 96% of the Bass caught were below the minimum landing size of 42cm, the majority (71) were caught in the BCI sector with the remaining being captured in ISN.

Haddock (*Melanogrammus aeglefinus*) - total catch numbers in 2018 (430) were up compared to 2017 (270). Juvenile catch numbers (<21cm) in both the Irish Sea and the Bristol Channel were significantly higher than those observed in 2017, they are now above the survey average (2001-18).

Whiting - total catch numbers in 2018 (2487) were 24% up on those caught in 2017 (1865) with the similar increases observed in the Irish Sea and the Bristol Channel. Juvenile catch numbers (<21cm) increased by 28% from 2017 and remain below average (2001-18) in both the Bristol Channel and Irish Sea.

Thornback ray (*Raja clavata*) - total catch numbers in 2018 (835) were up compared to 2017 (662). Monk (*Lophius piscatorius*) total catch numbers in 2018 (100) increased toward the survey high in 2015 (109) and the proportion of these being juvenile fish (<21cm) was greater than those observed in 2017 (46% compared to 30% in 2017).

Lesser spotted dogfish (*Scyliorhinus canicula*)- total catch numbers in 2018 (2263) increased compared to 2017 (1601) with under 3% being juvenile (<35cm). The numbers of juvenile LSD caught in the Bristol Channel in 2018 (20) was just 32% of the average observed over the period 2001-18 (61). Juvenile LSD catches in the Irish Sea survey sectors (36) were also below the average caught over the period 2001-18 (78).

Total catch numbers of grey gurnard (*Eutrigla gurnardus*) in 2018 (2121) increased compared to 2017 (856) and the weight caught in 2018 (61kg) increased from 2017 (25kg). This was particularly evident in the Bristol Channel where numbers of 'adult' grey gurnard (>15cm) increased. Red gurnard (*Aspitrigla cuculus*) total catch numbers in 2017 (133) increased in 2018 (174) with a similar rise in catch weight observed.

Poor-cod (*Trisopterus minutus*) numbers in 2018 (2176) were up compared to 2017 (1209) and the proportion of smaller juvenile individuals (<12cm) increased compared to 2017. Pogge (*Agonus cataphractus)* catch numbers increased in 2018 by 20% with a fall in the weight caught also observed. Red mullet (*Mullus surmuletus)* catch numbers in 2018 (182) were high compared with the 2017 survey when 8 were caught, while total catch weight increased by 17% due to juvenile fish. Solenette (*Buglossidium luteum*) catch numbers in 2018 (2559) increased compared with the 2017 survey (1805). Starry Smoothhound (*Mustelus asterias*) catches decreased from 198 in 2017 to just 155 in 2018 with the decrease being due to fewer adult fish being caught in the Bristol Channel.

Note – Irish sea survey sectors are ISS/ISN/ISW/SGC and the Bristol Channel survey sectors are BCI/BCO.

Aim 4 - Surface and bottom water sampling

At the start and end of most survey days, a surface water salinity sample was taken using on-board sea-water supply taken from a depth of 4m. The starboard gantry with the 'hydrographic' wire was used in the collection of bottom water samples using a Niskin sampler and an ESM2 logger (S/N PR007). The sample was routinely taken at around 2-3m off the seabed. A total of 33 surface and 33 bottom salinity samples were collected.

Aim 5 – Epi-benthos

At 25 selected fishing stations, samples of the epi-benthic by-catches were sorted, identified and quantified. A standard operating procedure (SOP) for the processing of this by-catch was provided. Non-SOP benthic species were identified where on-board expertise allowed.

At all fishing stations on the survey, catches of 14 sentinel taxa of benthic invertebrates were recorded. The total weight of the remaining by-catch of epi-benthic invertebrates was recorded at all stations, benthic observations were recorded from the catches at non-benthic stations.

Aim 6 - Length weight & maturity information

Length weight and maturity information were collected for all fish that were biologically sampled and in addition three individual fish were measured to the millimetre and weighed to the single decimal gram. These extra fish were one 2-spot clingfish (*Diplecogaster bimaculate)*, one garfish (*Belone belone)* and one reticulated dragonet (*Callionymus reticulatus)*.

Aim 7 – Collection of water samples for analysis of tritium levels

A total of 9 one litre water samples were collected at fishing stations and further 28 in the Bristol channel off survey gride for the analysis of tritium levels.

Aim 8 - Additional sample collections

Additional samples were taken in support of other projects:

A) No rare or unusual species were caught on this survey.

B) A total of 13 nurse-hound (*Scyliorhinus stellaris*), 4 starry smooth-hound, 8 blonde ray (*Raja brachyura*) and 2 cuckoo ray (*Leucoraja naevus*), were tagged and released. J Ellis (Cefas, Lowestoft).

C) In total 3 sightings of marine mammals were recorded, all observations were pods of Common Dolphins.

D) No specimens of sea trout or any other diadromous species were caught and retained as part of the EU Interreg – Celtic Sea Trout Project.

E) Seven samples of fish and benthic species were frozen for subsequent species identification confirmation in the laboratory. J Ellis (Cefas, Lowestoft).

F) Fifty-eight samples of *Lophius piscatorious* flesh were collected and stored in vials containing RNA later. GECKA project (Genetic close-kin analysis on white anglerfish for abundance estimates in support of deep-sea fisheries management under the common fisheries policy, Azti tecnalia, Spain)

G) No collection of Shad (Allis or Twaite) or Lamprey was possible on the survey. A Walker (Cefas, Lowestoft)

H) At fourteen fishing stations, samples of whelk (*Buccinum undatum)* were collected for analysis as part of an on-going Cefas project. V Laptikhovsky (Cefas, Lowestoft)

I) Squid samples were collected at twelve fishing stations for species identification confirmation and further biological sampling in the laboratory. V Laptikhovsky (Cefas, Lowestoft)

J) Vitality assessments were carried out on ninety-four starry smooth-hounds, tests were conducted as soon as the fish was captured. S Phillips (Cefas, Lowestoft)

K) Eight dab were recorded as having a visible fish disease, details were taken with pictures. J Bignell (Cefas, Weymouth)

Litter by-catch information

Details of the by-catch of marine litter caught at all fishing stations was recorded. Litter by-catch was categorized by 'type', weighed, photographed and categorized by size at a total of 139 fishing stations (including CSEMP stations) with a total of 320 individual items being observed. In addition, details of any attached organisms were recorded. Photographs of all litter items were taken.

Micro CTD

The SAIV Micro CTD unit was attached to the 4m-beam trawl to record the temperature, salinity and depth profile at each station fished and this was successful in recording data on all bar one fishing days. A total of 100 successful CTD data collections were made.

Aims 9 &10 – Dab sampling on CSEMP stations

In total, dab were caught at eleven out of the fifteen CSEMP fishing locations, using both the Granton and beam trawl(s), Figures 12 and 13. In total thirty-six tows were completed, and dab were collected for chemistry sampling before biomarkers work was conducted, Table 5 gives details of each trawl site catches and data recorded. In total 238 dab were screened for 14 different fish diseases that can be detected by visual examination, table 6.

A maximum of twenty dab from eight of the CSEMP fishing stations were also sampled for stomach contents. At eight of the stations water conductivity, temperature, depth and plankton community information was collected to provide additional knowledge on eutrophication.

Table 5. Overview of fish that were collected at each station for the various parameters

Date	Location	CSEMP code	Mid tow Lat decimal	Mid tow lon decimal	time shot	time haul	Chemistry	Biomarker
	Inner Lyme Bay	CSEMP 534					Not Fished	
	Off Eddystone	CSEMP 584					Not Fished	
	Liverpool Bay Trend	Trend					Not Fished	
	Liverpool Bay*	CSEMP 715					Not Fished by us	
16/09/2018	Camarthen Bay	CSEMP 616	**51.54142778**	**-4.595288889**	01:05	01:25	50 dab for chemistry	yes 20; additional 50 for FD
30/09/2018	South Cardigan Bay	CSEMP 654	**52.20511667**	**-4.466391667**	21:59	22:29	11 dab for chemistry	yes 8
30/09/2018	North Cardigan Bay	CSEMP649	**52.70857333**	**-4.538746667**	02:05	02:25	15 dab for chemistry	yes 20
27/09/2018	Red Wharf Bay	CSEMP 776	**53.35531667**	**-4.1354375**	21:26	21:46	25 dab for chemistry	yes 20; additional 20 for FD
26/09/2015	Liverpool Bay*	CSEMP 715	**53.40733333**	**-3.607666667**	16:58	17:28	20 dab for chemistry	NA
26/09/2018	Burbo Bight	CSEMP 706	**53.46143333**	**-3.397777778**	22:17	22:47	25 dab for chemistry	yes 20; 10 additional
27/09/2018	Morecambe Bay	CSEMP 796	**53.95184167**	**-3.3459**	03:30	04:00	15 dab for chemistry	yes 20
22/09/2018	SE Isle of Man	CSEMP 805	**54.06288333**	**-3.8758375**	23:09	23:34	15 dab for chemistry	None
23/09/2018	St Bees Head	CSEMP 769	**54.49765**	**-3.768877778**	22:16	22:46	50 dab for chemistry	yes 20; additional 50 for FD
03/10/2018	Celtic Deep	CSEMP 605	**51.1694**	**-5.702533333**	01:39	02:09	NA	NA
17/09/2018	West Lundy	CSEMP 604	**51.15762083**	**-5.433741667**	00:03	00:33	15 dab for chemistry	yes 20; but some under 20cm
21/09/2018	Outer Dundrum Bay”	CSEMP 815	**54.07003333**	**-5.6238**	21:05	21:35	7 dab for chemistry	NONE
21/09/2018	Fish Prime 203 near CSEMP Outer Dundrum Bay”	Cend 16/18 203 near Inner Dundrum Bay	**54.18716667**	**-5.7925**	16:03	16:18	50 dab for chemistry 14-17 cm	NA

*Liverpool Bay fish were taken from the near-by Prime Fishing station; “Outer Dundrum Bay fish were taken from the nearby Inner Dundrum Bay Prime Fishing station.

Table 6. Observed occurrences of 14 different fish disease in a total of 238 dab

Lymphocystis	Skin Ulcer	epidermal hyperplasia/papilloma	hyperpigmentation	liver disease - nodule/tumour	X-cell gill lesions	*Stephanostomum sp*	*Lepeophtheirus sp.*	*Acanthochondria sp.*	Nematodes	*Glugea sp*	Lateral lipoidosis	Skeletal deformity	fin rot/erosion
1	**5**	**5**	**38**	**5**	**0**	**3**	**87**	**12**	**11**	**21**	**0**	**1**	**0**

Aim 11 – CSEMP day grab sampling

Sediment samples for chemical analysis were collected at twelve stations, time restraints and weather conditions did not allow for all grab stations to be completed. A further, twelve sites were not possible to sample, figure 14. A breakdown on what was collected and where can be seen in table 7.

Table 7. Breakdown of samples collected at CSEMP sediment stations for various assessments using a day grab

STATION	ANALYSIS	Replicate	Water Depth (m)	Date	Time Sampled	Sediment Description	EUNIS Category
805	PSA/Metals	A2	36	22/09/2018	02:50	Muddy sand	Sand and muddy sand
805	Organics	A2	36	22/09/2018	02:50	Muddy sand	Sand and muddy sand
805	PSA/Metals	B1	36	22/09/2018	02:56	Muddy sand	Sand and muddy sand
805	Organics	B1	36	22/09/2018	02:56	Muddy sand	Sand and muddy sand
805_4	PSA/Metals	A1	29	22/09/2018	04:49	Mud	Mud and muddy sand
805_4	Organics	A1	29	22/09/2018	04:49	Mud	Mud and muddy sand
805_4	PSA/Metals	B1	29	22/09/2018	04:54	Mud	Mud and muddy sand
805_4	Organics	B1	29	22/09/2018	04:54	Mud	Mud and muddy sand
805_5	PSA/Metals	A1	30	23/09/2018	00:52	Mud	Mud and muddy sand
805_5	Organics	A1	30	23/09/2018	00:52	Mud	Mud and muddy sand
715_4	Organics	A2	48	28/09/2018	01:46	Slightly sandy muddy gravel	Mixed sediments
715_4	PSA/Metals	A3	48	28/09/2018	01:52	Slightly sandy muddy gravel	Mixed sediments
715_4	Organics	B1	48	28/09/2018	01:56	Slightly sandy muddy gravel	Mixed sediments
715_4	PSA/Metals	B2	48	28/09/2018	02:01	Slightly sandy muddy gravel	Mixed sediments
715_1	PSA/Metals	A1	44	28/09/2018	02:27	Gravelly muddy sand	Mixed sediments
715_1	Organics	A1	44	28/09/2018	02:27	Gravelly muddy sand	Mixed sediments
715_1	PSA/Metals	B1	44	28/09/2018	02:32	Gravelly muddy sand	Mixed sediments
715_1	Organics	B1	44	28/09/2018	02:32	Gravelly muddy sand	Mixed sediments
655_5	PSA/Metals	A1	19	30/09/2018	04:27	Mud	Mud and sandy mud
655_5	Organics	A1	19	30/09/2018	04:27	Mud	Mud and sandy mud
605	PSA/Metals	A1	96	02/10/2018	19:50	Mud	Mud and sandy mud
605	Organics	A1	96	02/10/2018	19:50	Mud	Mud and sandy mud
605	PSA/Metals	B1	96	02/10/2018	19:58	Mud	Mud and sandy mud
605	Organics	B1	96	02/10/2018	19:58	Mud	Mud and sandy mud
605_1	PSA/Metals	A1	103	02/10/2018	20:19	Mud	Mud and sandy mud
605_1	Organics	A1	103	02/10/2018	20:19	Mud	Mud and sandy mud
605_2	PSA/Metals	A1	100	02/10/2018	21:41	Mud	Mud and sandy mud
605_2	Organics	A1	100	02/10/2018	21:41	Mud	Mud and sandy mud
605_3	PSA/Metals	A1	107	02/10/2018	22:44	Mud	Mud and sandy mud
605_3	Organics	A1	107	02/10/2018	22:44	Mud	Mud and sandy mud

Aim 12 – Marine litter sampling (CSEMP)

Litter was sampled during the 36 fishing tows, in total 107 items of litter were caught. 10 tows did not have any litter in them, while one tow at North Cardigan Bay had 26

litter items in the trawl. These litter items have been included in the earlier results for the beam trawl survey.

Once again, our thanks go to the officers and crew of RV Cefas Endeavour for their help, support and advice given during this survey and it is largely due to their skill and co-operation that most survey aims were achieved again this year along with the safe recovery of the ESM2 logger.

Our thanks go to the ship and scientists for donating prizes for the Macmillan coffee morning, held on 28 September raising £260 for charity and the generous offer from P&O to match the money raised.

S Shaw (Scientist-in-charge)
07/11/2018

INITIALLED: IDH

DISTRIBUTION:

Survey participants +
I Holmes
W Dawson (Portfolio lead)
D Pettengell (For DCF)
Cefas Fisheries Survey's SICs/2ICs
Gary Burt (for Cefas Trim)
T Bailey
J Maitland (P&O)
B Salter (P&O)
Master (Cefas Endeavour)
FCO (for France & Republic of Ireland)
Marine Management Organisation (MMO)
Welsh Government (WG)
Devon & Severn IFCA
Cornwall IFCA
North Western IFCA

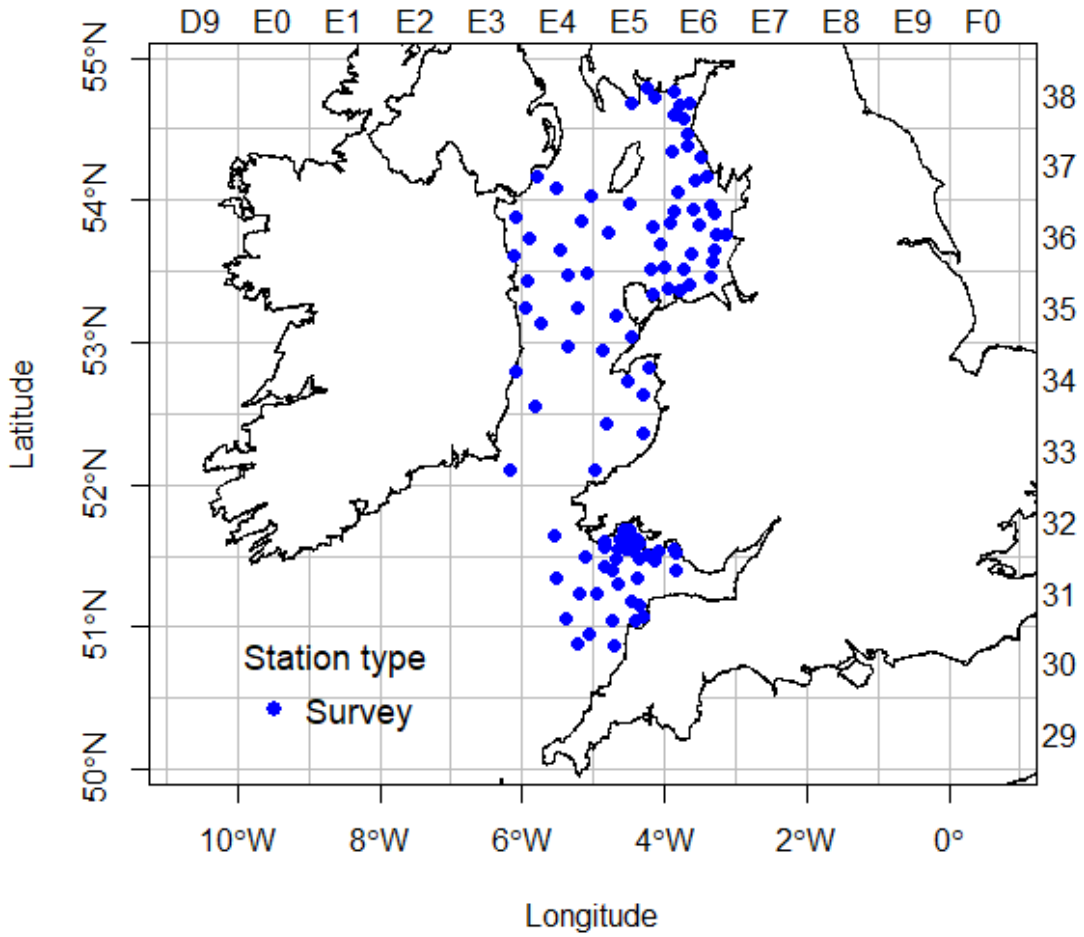
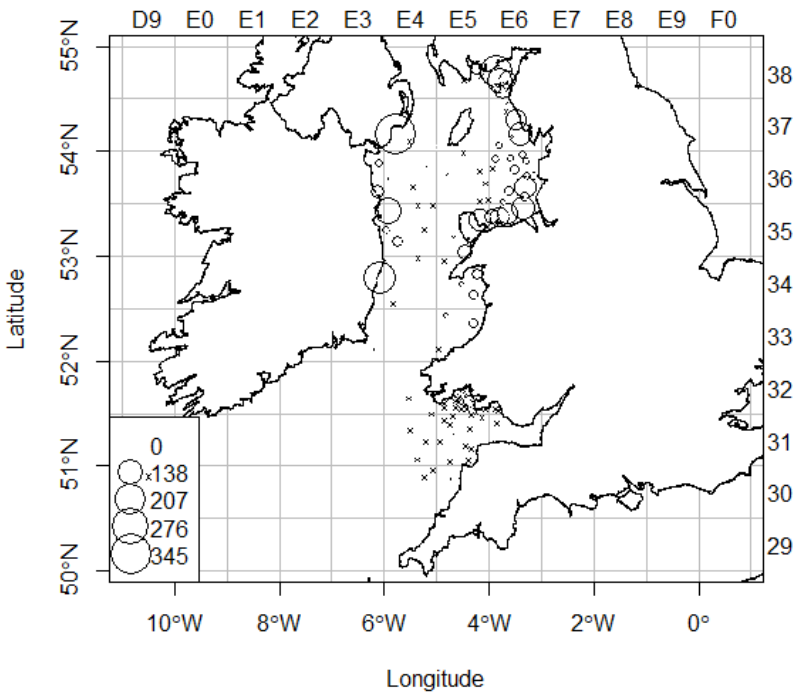


Figure 3: Beam trawl station positions for CEND 16/18.

a)



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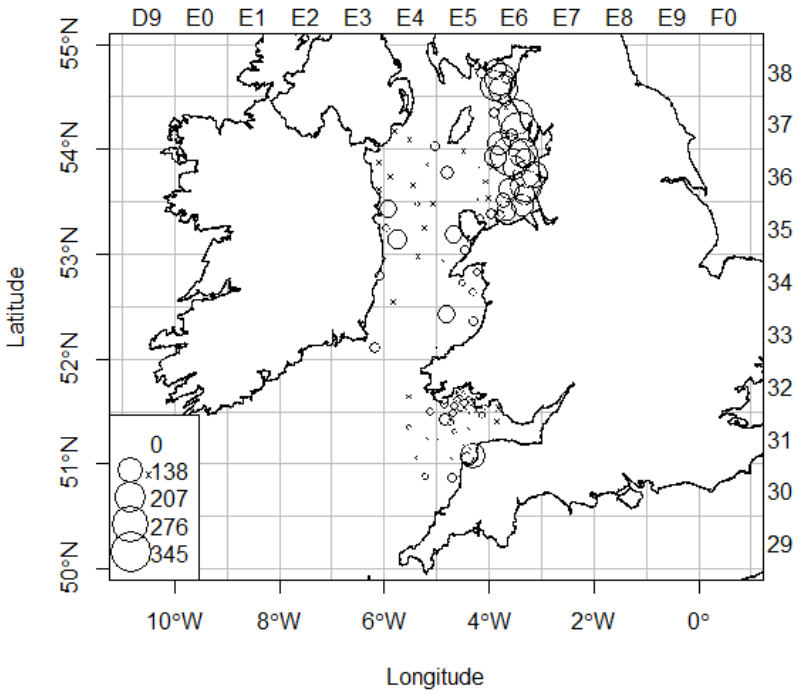
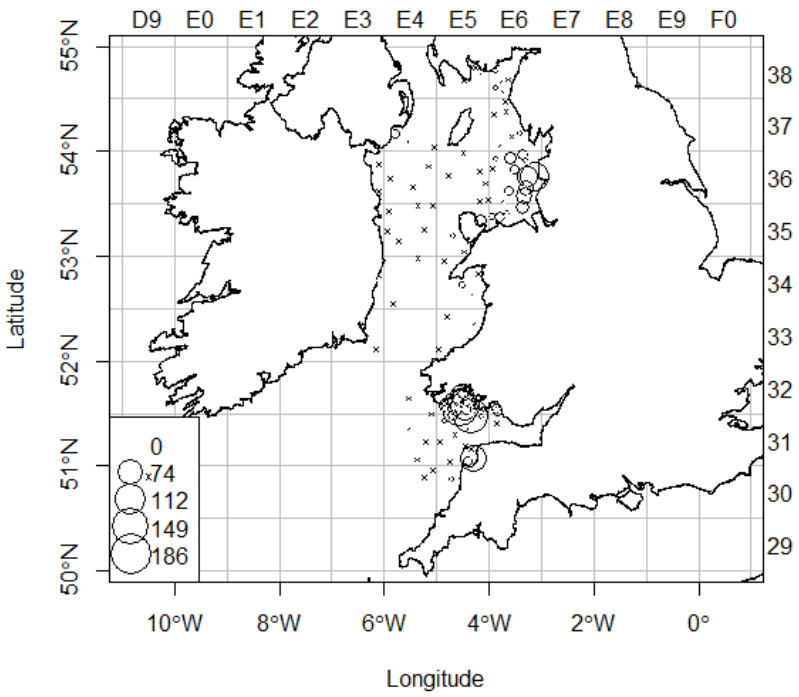


Figure 4: Abundance (number caught per 30-minute tow) of pre-recruit (a) (<21 cm TL) and recruited (b) (≥21 cm TL) - plaice.

a)



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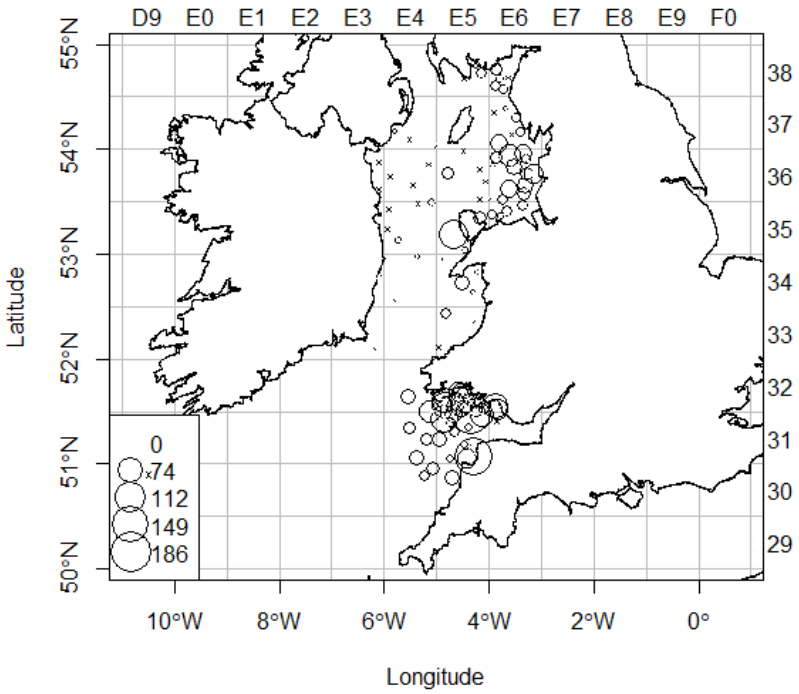
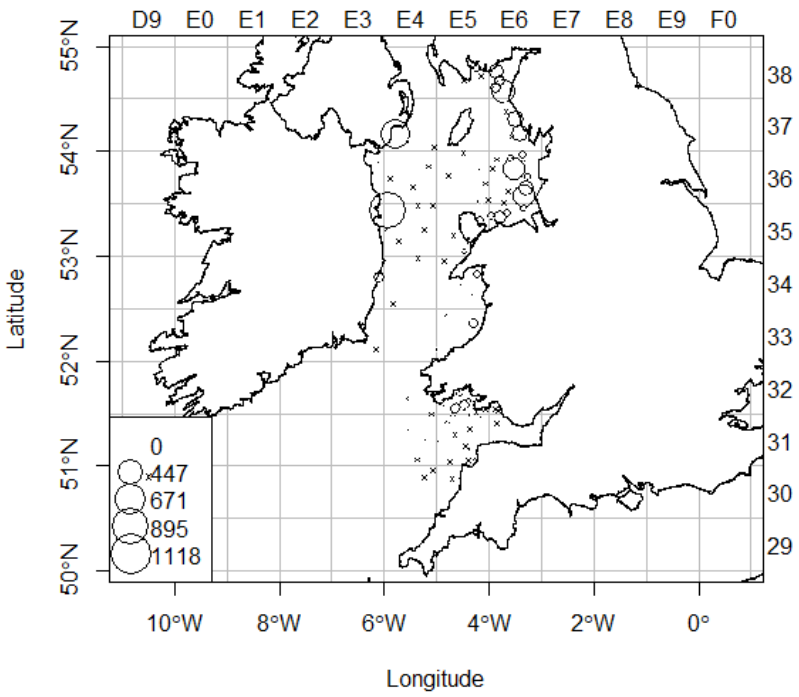


Figure 5: Abundance (number caught per 30-minute tow) of pre-recruit (a) (<21 cm TL) and recruited (b) (≥21 cm TL) - sole.

a)



b)

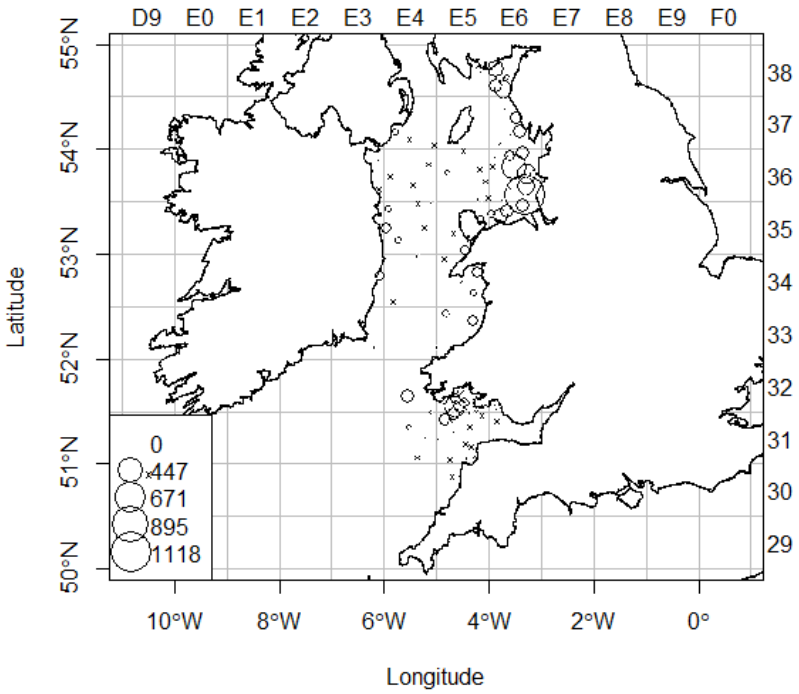
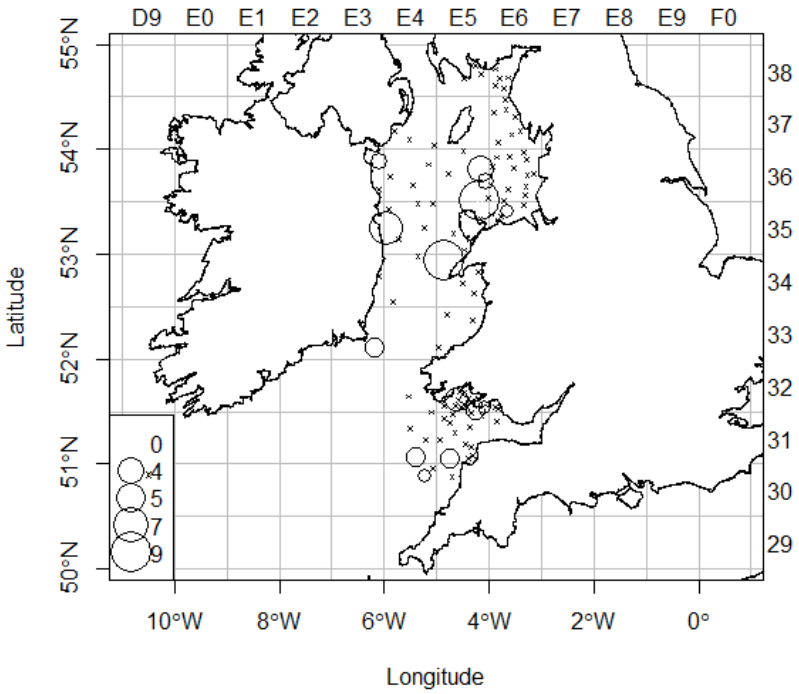


Figure 6: Abundance (number caught per 30-minute tow) of pre-recruit (a) (<16 cm TL) and recruited (b) (≥16 cm TL) - dab.

a)



b)

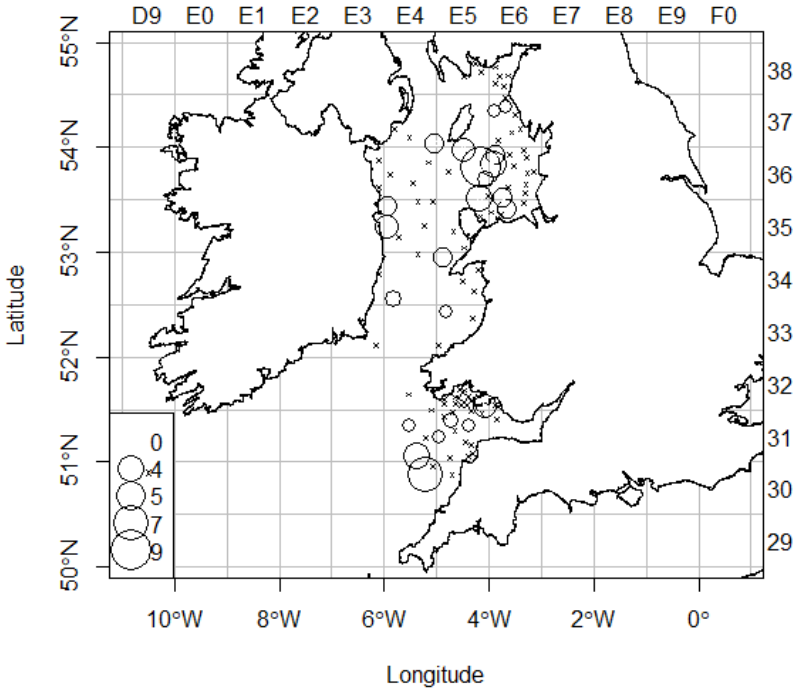


Figure 7: Abundance (number caught per 30-minute tow) of pre-recruit (a) <19 cm TL) and recruited (b) (≥19 cm TL) - lemon sole.

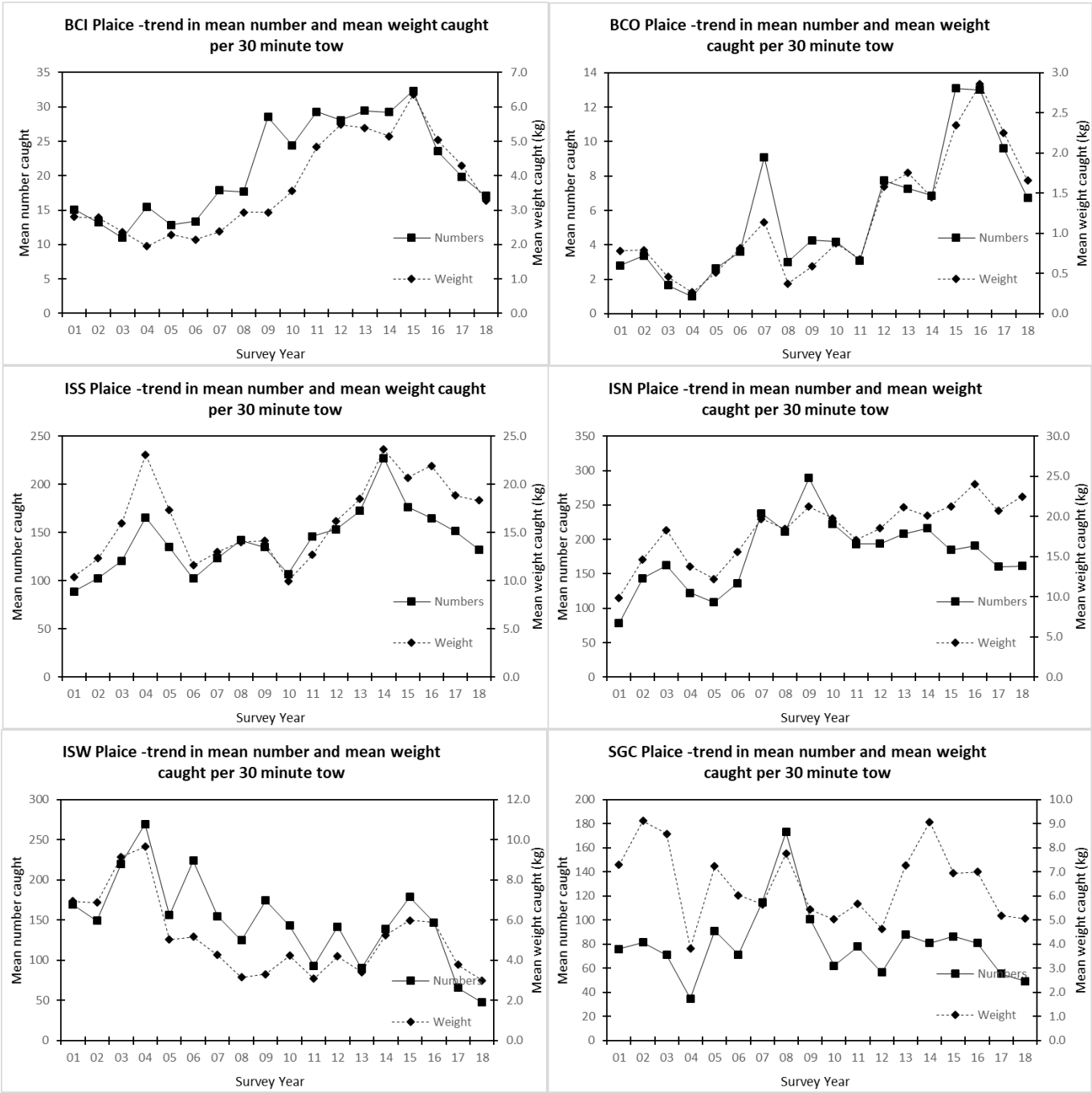


Figure 8: Mean number and weight of plaice (*Pleuronectes platessa*) caught per 30-minute tow - by survey area

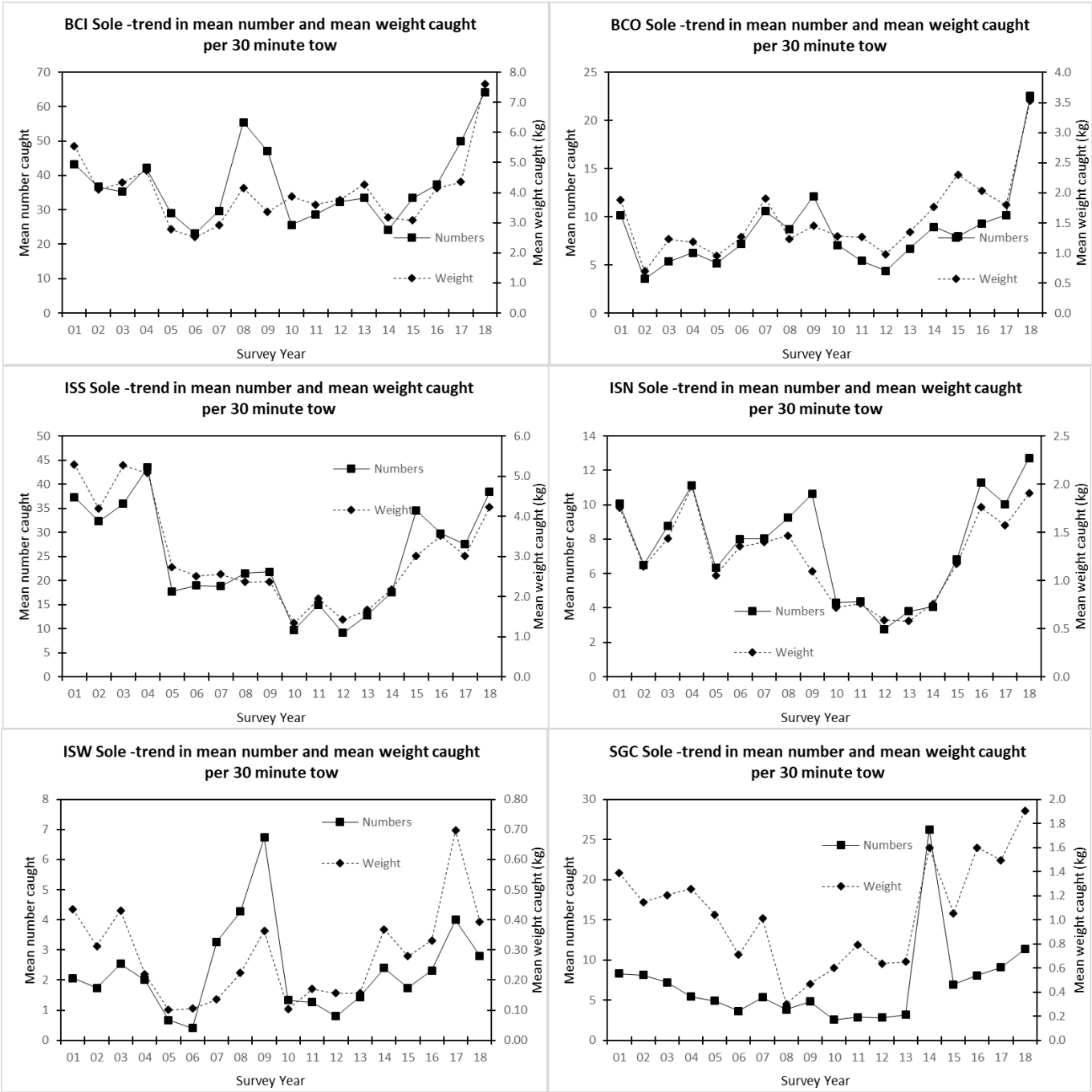


Figure 9: Mean number and weight of sole (*Solea solea*) caught per 30-minute tow - by survey area.

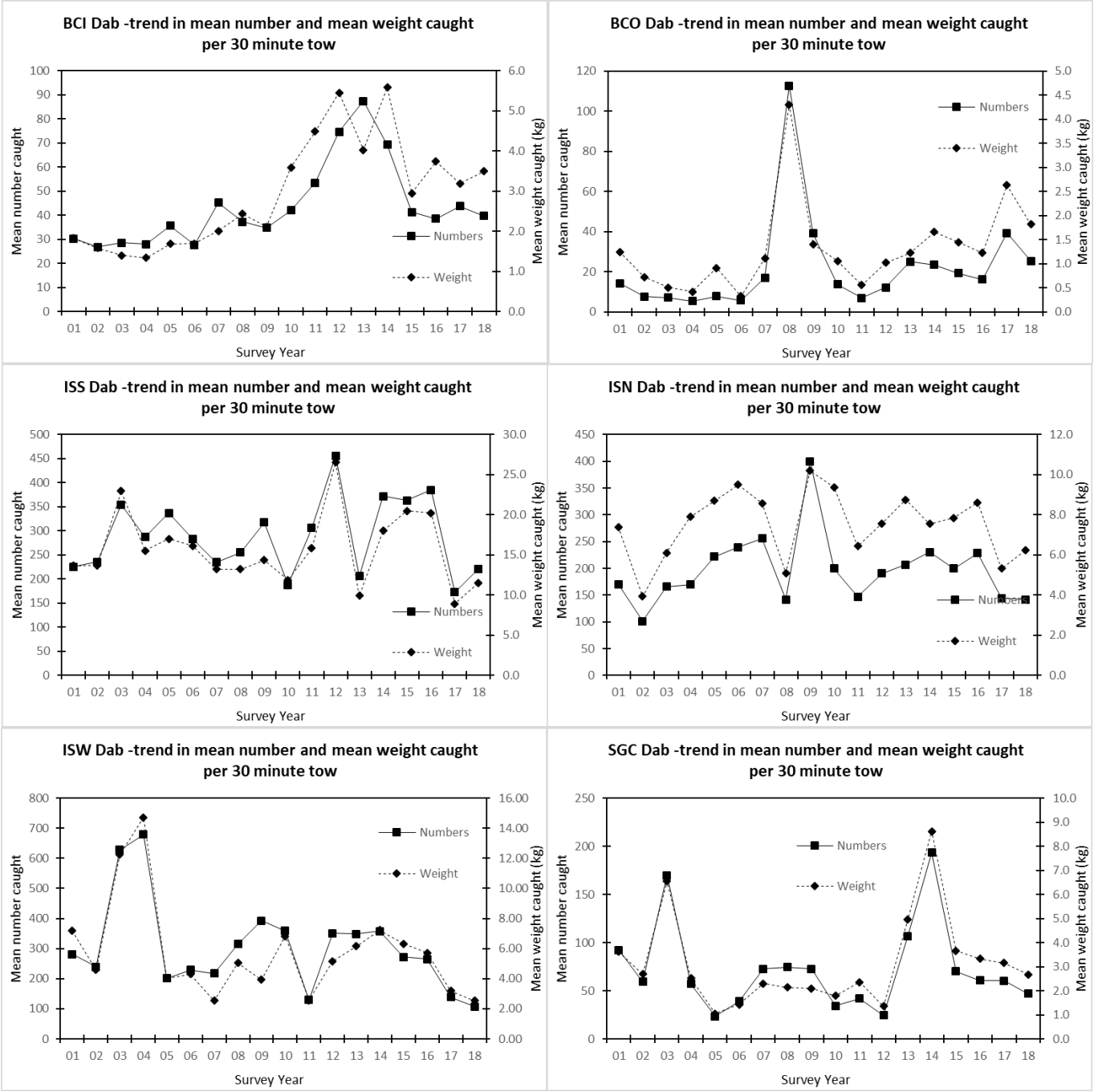


Figure 10: Mean number and weight of dab (*Limanda limanda*) caught per 30-minute tow - by survey area per 30-minute tow.

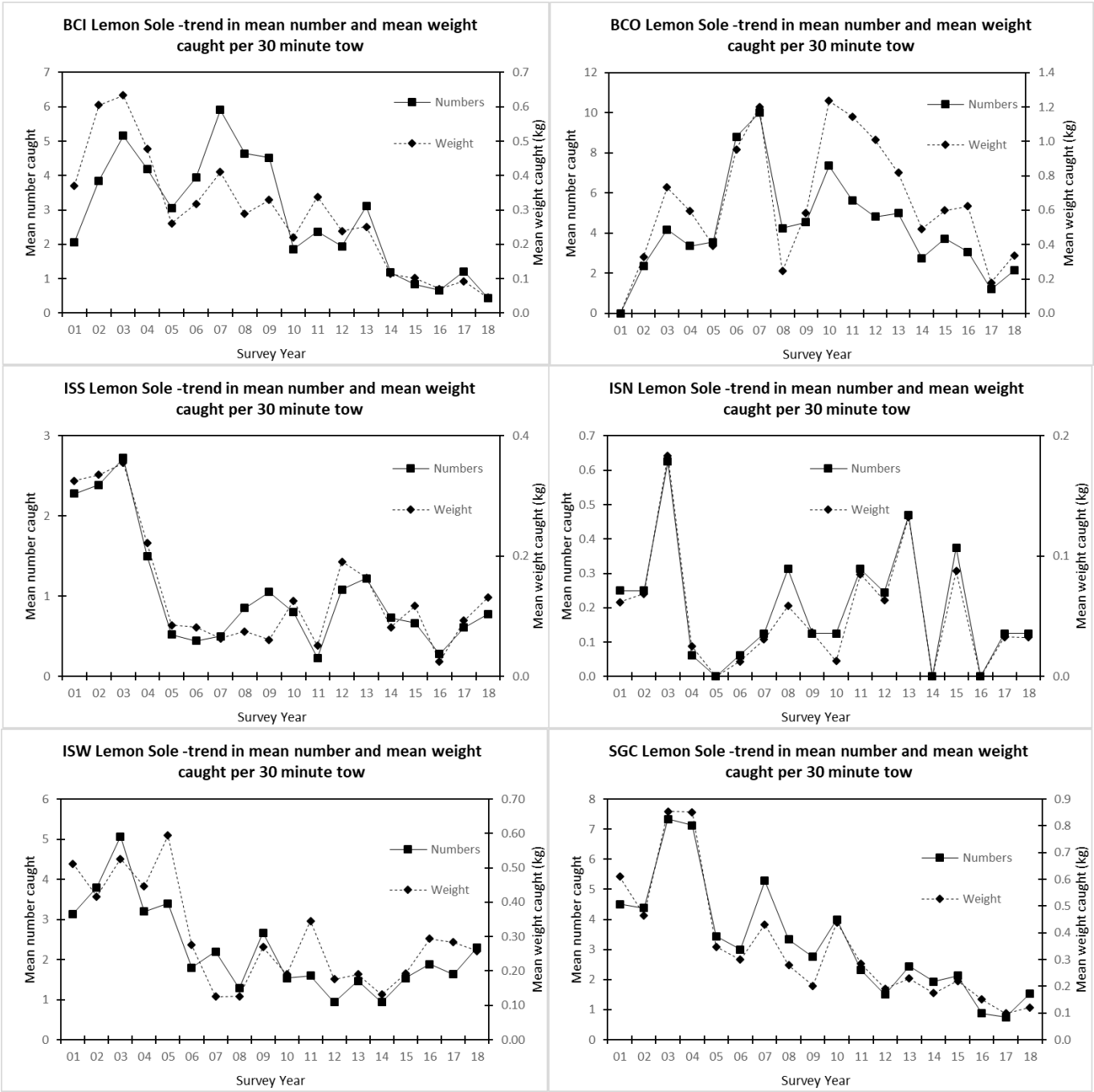


Figure 11: Mean number and weight of lemon sole (*Microstomus kitt*) caught per 30-minute tow - by survey area per 30-minute tow.

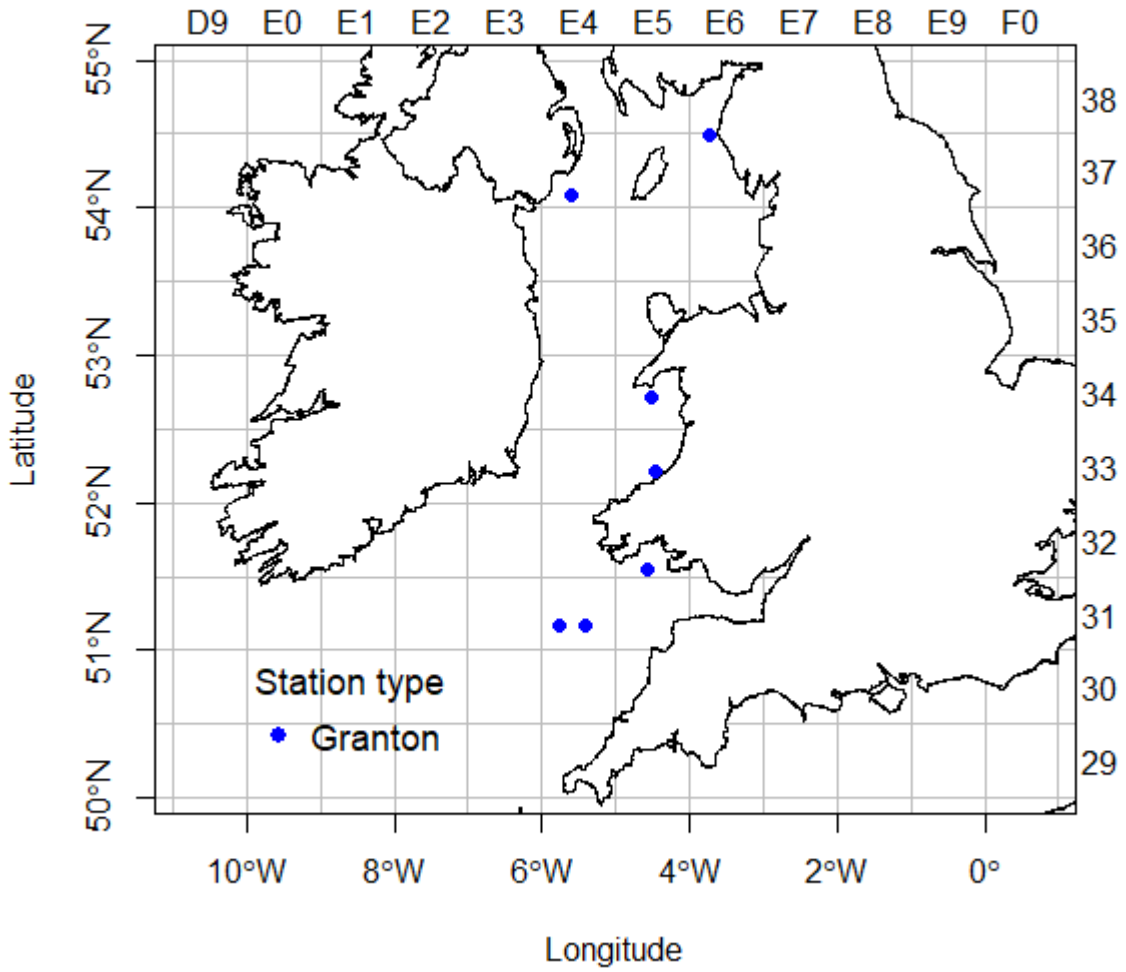


Figure 12: Granton trawl station positions for CSEMP work on CEND 16/18.

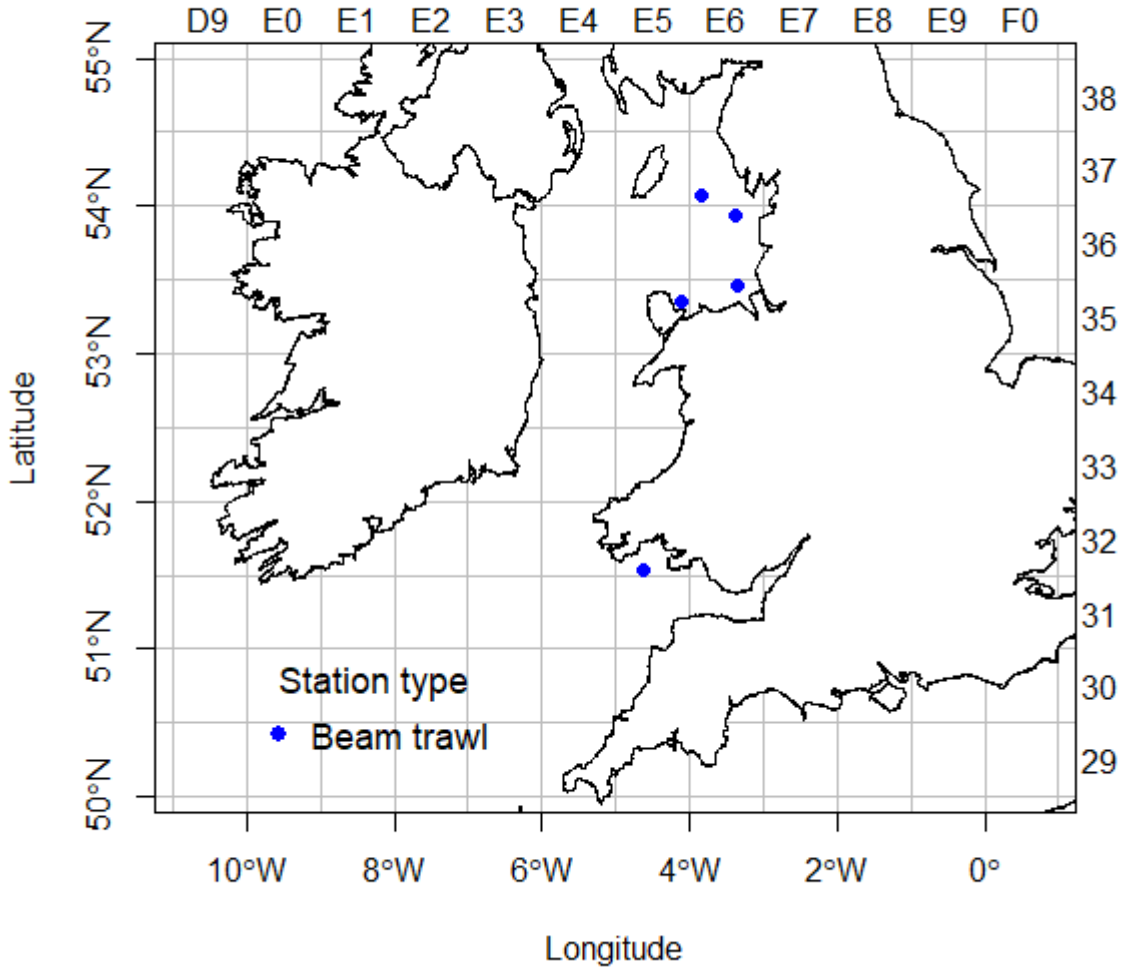


Figure 13: Beam trawl station positions for CSEMP work on CEND 16/18.

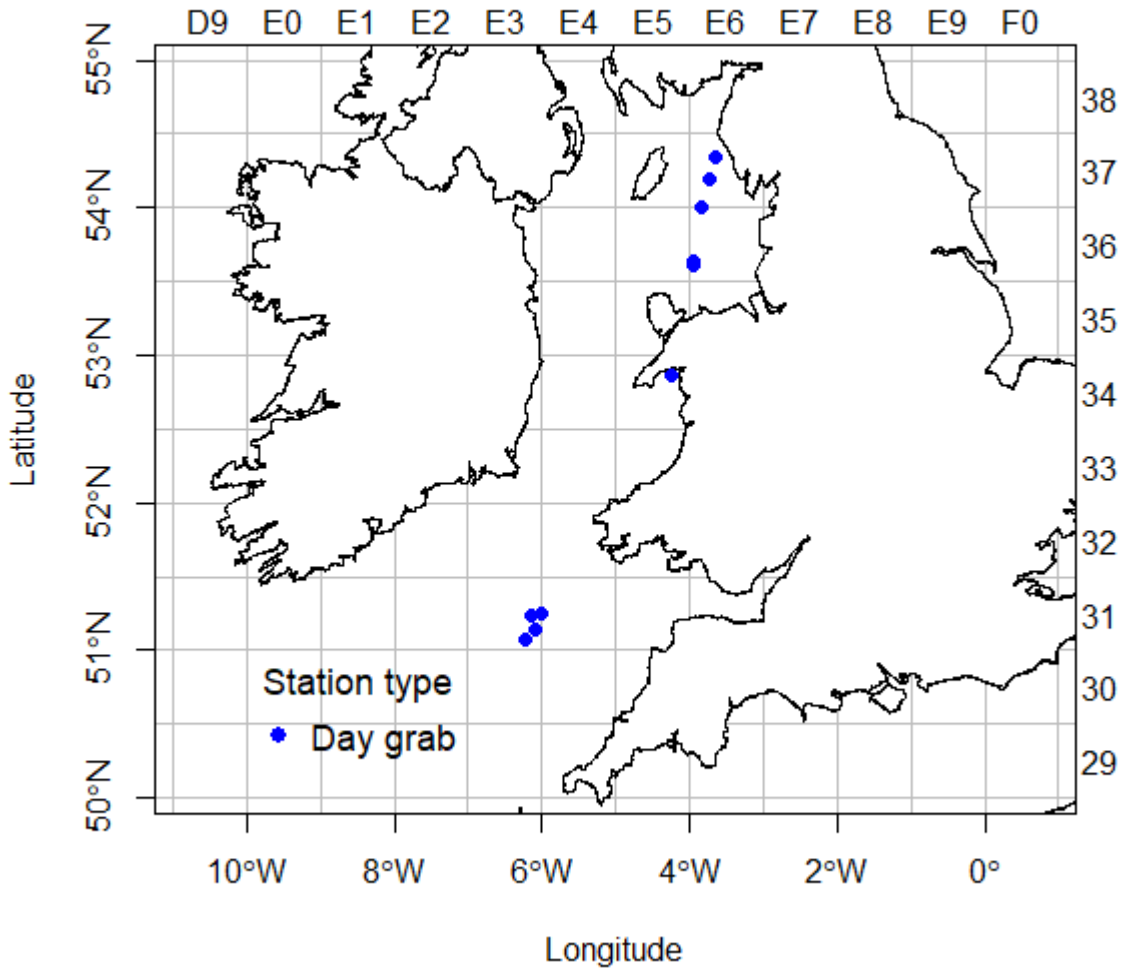


Figure 14: Day grab station positions for CSEMP work on CEND 16/18.