Centre for Environment Fisheries & Aquaculture Science

Cefas

RESEARCH VESSEL SURVEY REPORT

RV CEFAS ENDEAVOUR
Survey: C END 19- 2017.

STAFF:

Name	Role	Name	Role	Name	Role
Part 1		**Part 2**		**Part 3**	
Jeroen van der Kooij	SIC/acoustics	**Jeroen van der Kooij**	SIC/acoustics	**Jeroen van der Kooij**	SIC/acoustics
Elisa Capuzzo	2IC/hydro	**Elisa Capuzzo**	2IC/hydro	**Elisa Capuzzo**	2IC/hydro
Joana Silva	2IC/fish	**Joana Silva**	2IC/fish	**Joana Silva**	2IC/fish
Marc Whybrow	Tech	**Marc Whybrow**	Tech	**Marc Whybrow**	Tech
Richard Humphreys	Fish Lead	**Richard Humphreys**	Fish Lead	**Richard Humphreys**	Fish Lead
Sam Barnett	Plktn/fish	**Sam Barnett**	Plktn/fish	**Sam Barnett**	Plktn/fish
Sílvia Rodriguez-Climent	Acoustics	**Sílvia Rodriguez-Climent**	Acoustics	**Sílvia Rodriguez-Climent**	Acoustics
Hayden Close	Plankton	**Hayden Close**	Plankton	**Ben Hatton**	Fish
Andrew Bodle	Tech	**Andrew Bodle**	Tech	**Ian Holmes**	Fish
Matt Eade	Fish	**Piera Carpi**	Fish	**James Pettigrew**	Plktn/fish
Louise Cox	Fish	**Wendy Dawson**	Fish	**Clare Marshall**	Plankton
James Pettigrew	Plktn/fish	**Luke Aislabie**	Fish	**Pete Howlett**	ML observer
Pete Howlett	ML observer	**Clare Marshall**	Plankton	**Charlotte Altass**	ML observer
Phil Espin	ESAS observer	**Pete Howlett**	ML observer		
Rachel Coombes	ESAS observer	**Philip Dutt**	ESAS observer		
Julian Tilbury	PIA	**Simon Pinder**	ESAS observer		

DURATION: **29th Sept-4th November**
29th Sept-16th Oct (Pt 1); 16th-25th Oct (Pt 2); 25th Oct-4th Nov (Pt 3)

LOCATION: **Eastern Celtic Sea and Western Channel (ICES Subareas 27.7 e, f, g)**

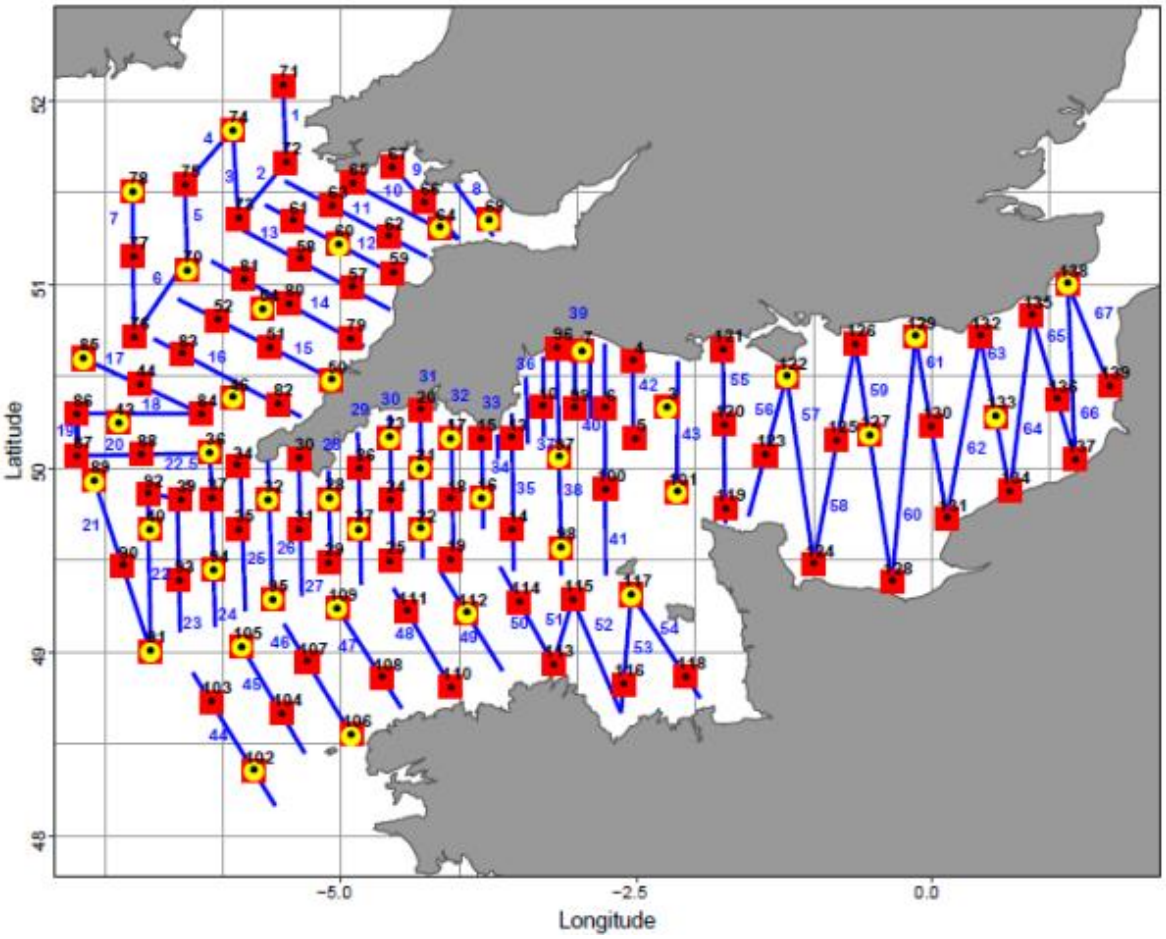

Figure 1. Overview of the planned survey area, with the acoustic transect (blue lines), plankton stations (red squares) and hydrographic stations (Yellow circles). Note that the area east of Longitude 2° W was a secondary aim.

AIMS:

1. Map, quantify and collect biological data on the small pelagic fish (SPF) community in the English Channel and Eastern Celtic Sea, using combination of fisheries acoustics and trawl (daylight). Specifically:
    i. 7e sprat biomass for stock assessment (ICES HAWG)
    ii. 7II sardine biomass for stock assessment (ICES WGHANSA)
    iii. Importance role of Mackerel Box for juvenile mackerel
2. Map and quantify the zooplankton community throughout the survey area using two mesh ringnets (at night). Specifically
    i. Sardine eggs (staged) and larvae (length) to map spawning habitat (1m diameter ringnet with 270 micron mesh)
    ii. Quantify zooplankton by size and taxonomic group (0.5 m diameter ringnet with 80 micron mesh)
3. Characterise the physical oceanographic properties (the pelagic habitat) of the survey area using CTD sensors (SAIV and ESM2) and by collection of water-sample from the Rosette (at night). Includes information on chlorophyll, oxygen, salinity, temperature, turbidity, and dissolved inorganic nutrients as well as the relevant QAQC samples for

calibration of the equipment. Water samples will be collected and fixed on board for analysis at sea or post-hoc.

4. Record mammal, bird and bluefin tuna observations to map and quantify the top predators in the survey area.
5. ESAS (European Seabirds At Sea) observations on critically endangered Balearic shearwaters and other seabirds by 2 ESAS trained observers during parts 1 and 2.
6. Continuously record Ferrybox Continuous CTD/Thermo-salinograph, including chlorophyll at 4 m depth during steaming.
7. Hourly measurements of the phytoplankton functional groups with online flow-cytometer, connected to the Ferrybox (collaboration with project JERICHO NEXT).
8. To continuous data on zooplankton with the continuous Plankton Image Analyser (PIA). Collaboration with Plymouth University.
9. To collect and freeze small pelagic fish specimens from different areas in survey for genetic study into stock structure of sardine, sprat and anchovy.
10. To collect and freeze up to 100 horse mackerel specimens at three different locations: eastern English Channel, Western English Channel and Bristol Channel

NARRATIVE:

All staff, bar M. Whybrow, set off at 7:00 from Lowestoft and joined the RV Cefas Endeavour in Swansea from 14:00 on the 28th of September. Two additional staff, T. Hull and S. Hare arrived also with the aim to set up a (rented) rosette which was due to arrive at 18:30 after delays with its release at customs (shipped from US). After several hours, it was concluded that there was a component missing and that the rosette was not compatible with the deck unit although adaptions could be made to fit (if the missing component was flown over). Most of the gear was unpacked and prepared for the survey. The echosounders were successfully calibrated two weeks prior to the survey off the Isle of Man. The RV left Swansea port at 23:30 making its way to the offshore transects where the acoustic lines would be started at first light on the 29th. On the first day of the survey, while running transects, when completing the set-up of plankton and oceanographic equipment in preparation for the night programme, it became clear that one of the sets of zooplankton nets contained the wrong size mesh, which prevented mesozooplankton samples from being taken during the first 2 days (only ichthyoplankton). During the second transect we deployed the first trawl which also acted as a "shakedown" tow. After a fine deployment of the gear, the Marport headline unit failed to provide readings to the bridge, i.e. the positioning of the net in relation to seabed was unknown. The following days, RV worked its way back into to the Bristol Channel towards Swansea where M. Whybrow was collected, as well as the missing zooplankton nets, by pilot boat at 16:30 on the evening of the 1st of October. The Marport issues were resolved on the morning of the 2nd of October and regular trawls were conducted, including in areas covered during the first three days. Although the worst of the gale warnings were elsewhere, fairly strong winds and swell limited survey coverage in the northern most area during the first week. However, the survey did progress, covering transects north of the Cornish Peninsula in westerly direction. Between the 9th and the 12th of October the area around the Isles of Scilly were covered after which the survey started transects in the western Channel (along the UK south-coast). On Sunday the 15th of October, after completion of most of the transects along the Eddystone Bay, the RV steamed into Fowey for a scheduled mid-survey break, where crew changed over and further changes in scientific staff took place. Sailing was delayed by 12 hours to the morning of the 17th of October, due to the aftermath of Storm Ophelia, and work resumed instantly. A second shakedown tow was conducted with new crew but some damage occurred which required swapping the trawl over for its (identical) replacement. On the evening of Thursday the 19th no CTD and plankton stations could be conducted due to the increasingly bad weather; some transects were run and trawls were conducted on the 20th but due to arrival of Storm Brian, the RV Cefas Endeavour spent most of Saturday the 21st sheltering off Torbay from the strong westerlies. Work resumed on the 22nd of October and for two days the high resolution transects in Lyme Bay were covered. At the end of the 23rd of October, the RV commenced its steam towards London, where she was scheduled to moor alongside the HMS Belfast on the 25th of October, for events in honour of Cefas' 20th anniversary. The RV left London at 18:45 to steam back to the study area where the survey was resumed on the morning of the 27th of October at the western most transects on the French side. Fair conditions ensured good progress for the next few days and all but transect 54 were completed by the end of the 1st of November. During the 2nd and 3rd of November the high resolution transects in Lyme Bay were repeated to examine the possible effects of the storms on sprat behaviour and distribution. At approximately 17:00 the RV steamed in easterly direction towards Lowestoft. At first light on the morning of the 4th of November, a tow was planned on sprat schools in ICES subarea 7d (off Dungeness) for biological and genetic samples. However, due to deteriorating weather conditions and issues with trawl deployment, this was abandoned at 9:00 am when the RV had to resume the steam back to meet the pilot off Lowestoft at 19:45.

RESULTS:

Pelagic Ichthyofauna

After removing the off-transect data a total of ~2200 nautical miles of acoustic sampling units were collected for further analysis, which included duplication of the Lyme Bay transects. The transects in the eastern Channel, a secondary objective, could not be conducted due to time constraints. A total of 38 trawls were made with the mid-water trawl, providing a suitable source of species and length data to partition the acoustic data.

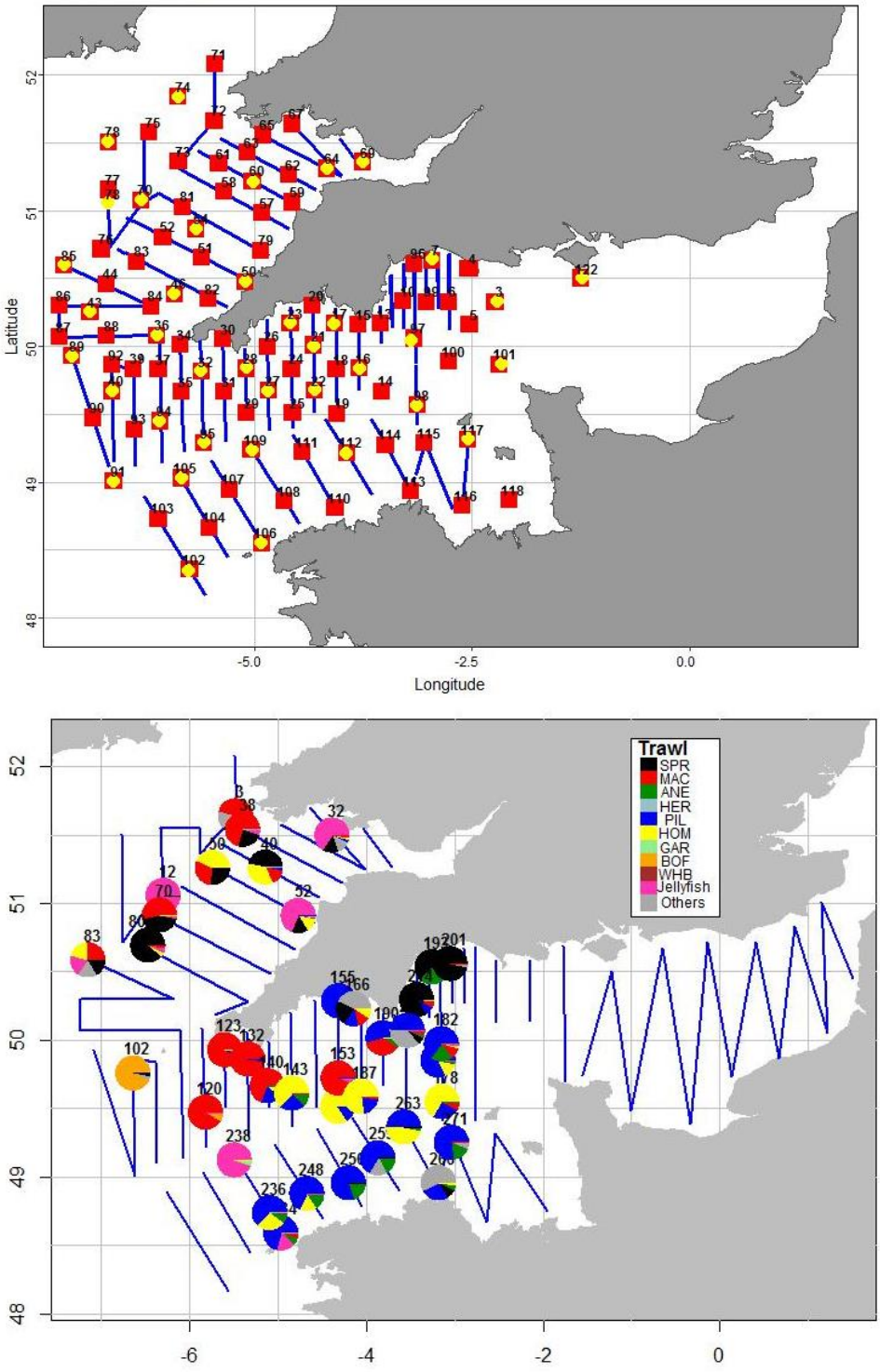

Figure 2. Overview map and detail of the survey area. Top: Acoustic transects (blue lines) and prime stations completed during PELTIC17. Bottom: Trawl catches (pies) with relative catch composition by key species. Three letter codes: SPR=sprat, MAC=mackerel, ANE=anchovy, HER=herring, PIL=sardine, HOM= horse mackerel, GAR=garfish, BOF=Boarfish, WHB=Blue whiting.

Preliminary results suggested typical species distribution. No age data were available at the time of writing.

Sprat (*Sprattus sprattus*) was found in most of the survey area although the length frequency distributions varied by area (Fig 3). Bristol Channel, Celtic Deep and Isles of Scilly, were dominated by smallest size classes. Coastal sprat from Lyme Bay, northern English Channel, was predominantly made up of large sprat. Small numbers of sprat were also found in the trawls conducted in French waters of the southern English Channel and these appeared to be of intermediate size. A total of 270 sprat specimens from five different locations were collected for genetic processing.

Sardine (*Sardina pilchardus*) distribution was comparable to previous years with the bulk of biomass in the English Channel (Fig 4). Unlike in 2016, fewer large sardines were found north of the Cornish Peninsula, although this could be due to the earlier coverage of the northern waters compared to previous years. Sardine dominated the species mix obtained in trawl catches conducted in the French waters of the English Channel, although acoustic densities were generally lower here than in the northern English Channel component. As was found for sprat, the very smallest size classes dominated the waters of the Bristol Channel whereas the biggest specimens were found in the northern waters of English Channel. French waters contained both small and intermediate size classes, but no larger specimens (Fig 5). A total of 200 sardine specimens from five different areas were collected for genetic processing.

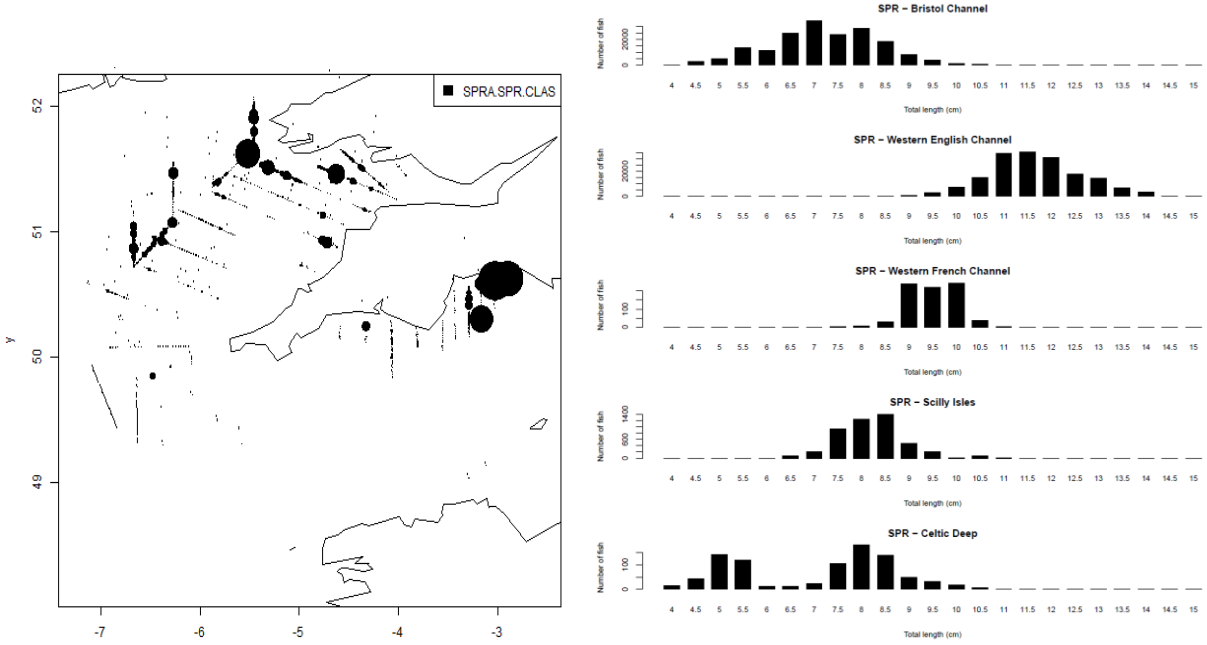

Figure 3. Acoustically derived sprat biomass distribution (left) and trawl-based length frequency histogram for sprat in each of the subareas of the Peltic survey (right). Please note that bubble size has not been standardised between species.

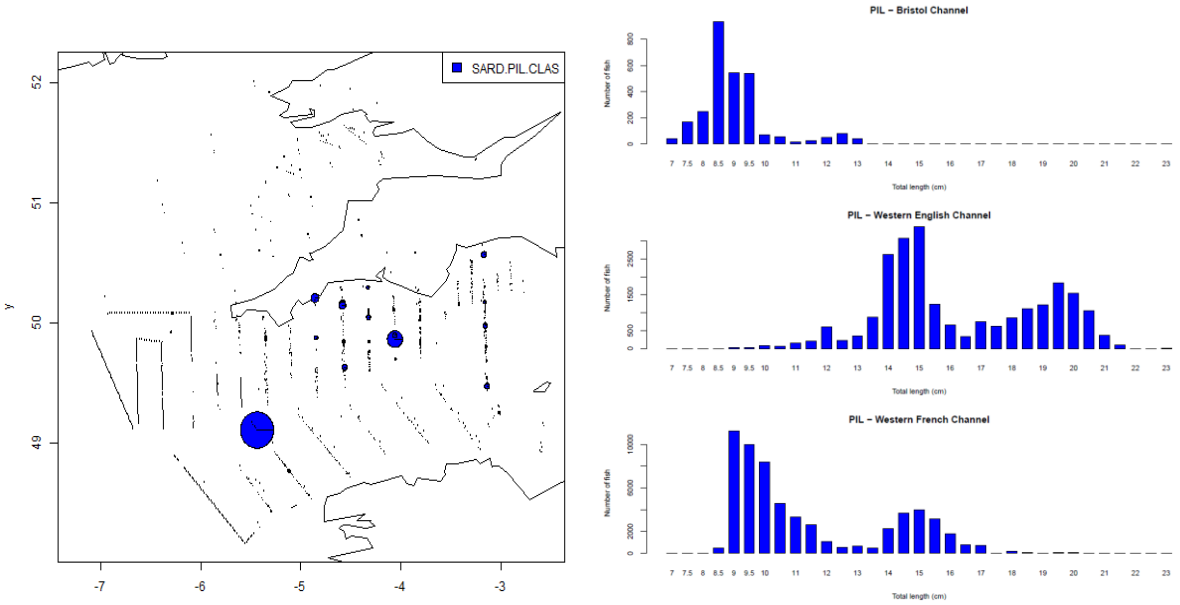

Figure 4. Acoustically derived sardine biomass distribution (left) and trawl-based length frequency histogram for sardine in each of the subareas of the Peltic survey. Please note that bubble size has not been standardised between species.

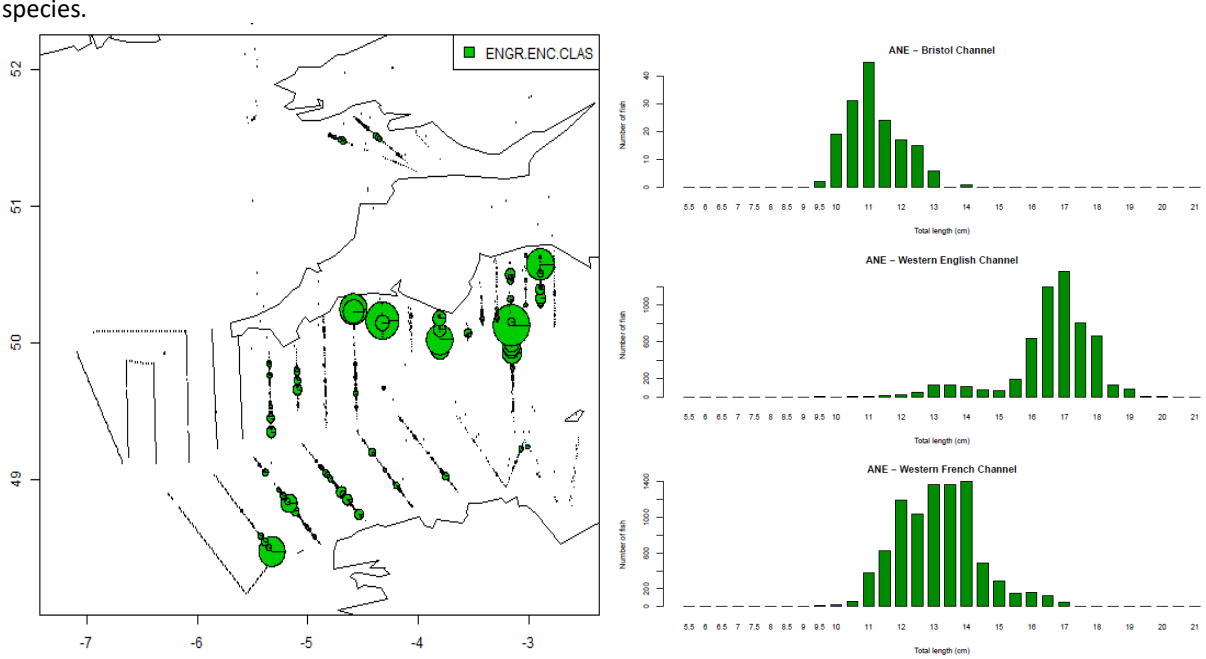

Figure 5. Acoustically derived anchovy biomass distribution (left) and trawl-based length frequency histogram for anchovy in each of the subareas of the Peltic survey. Please note that bubble size has not been standardised between species.

Anchovy (*Engraulis encrasicolus*) distribution was comparable to previous years although preliminary results suggested a lower biomass. Coverage in the French waters demonstrated consistent presence in species mix. Again, northern English Channel specimens included the largest end intermediate specimens whereas on the French side, intermediate anchovy dominated, with anchovy in the inner Bristol Channel comprising of the smallest size specimens (Fig 5).

Zooplankton

Samples of mesozooplankton and ichthyoplankton communities were collected at 92 and 99 stations using 80 and 270 micron ringnets, respectively. Preliminary results on the distribution of sardine eggs

suggested a similar distribution as found in previous years with key spawning areas on both side of the Cornish Peninsula (Fig 6). The distribution of sardine larvae was comparable, with similar location of the hotspots. For the first time during Peltic, plankton samples were collected on the southern half of the English Channel; both eggs and larvae were found here although in relatively low densities. Size information and taxonomic group of zooplankton samples collected at the same stations, will be obtained by Zooscan processing back in the lab.

For the duration of the survey, the Plankton Image Analyser (PIA) was run to collect images on zooplankton.

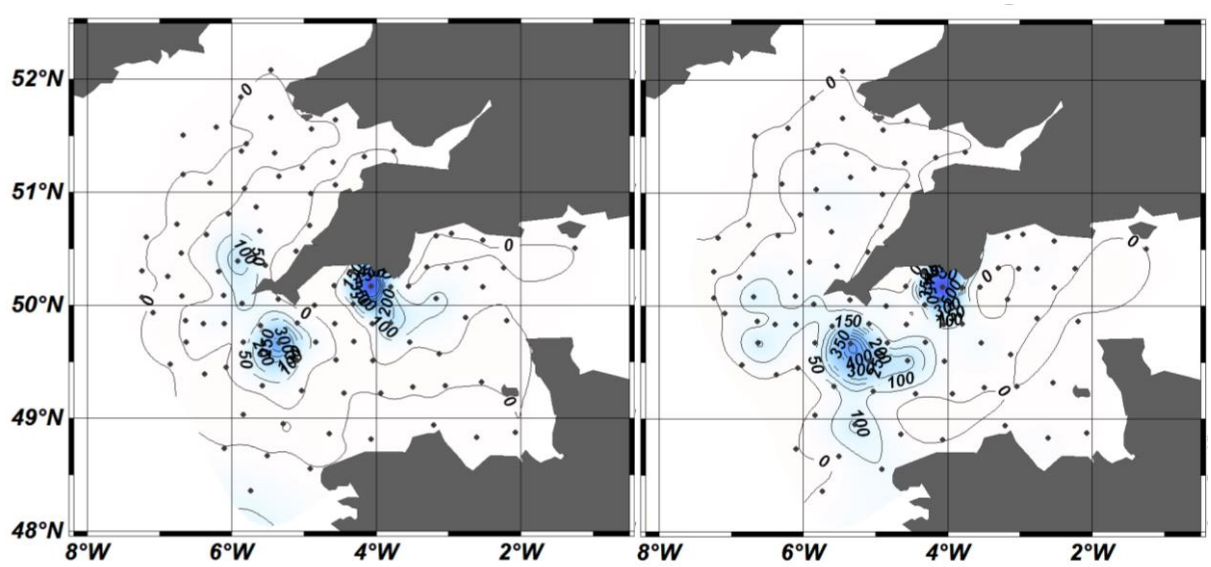

Figure 6. Sardine egg densities in m^2 (left) and larvae (right) as sampled during the 2017 Peltic survey.

Physical Oceanography

A SAIV mini CTD was deployed at the 99 zooplankton stations, providing information on temperature and salinity. At a subset of 37 stations, an ESM2 CTD data logger, equipped with PAR, oxygen, turbidity and fluorescence sensors, was deployed. At these 37 stations (Table 1), further samples were collected for analysis of phytoplankton and microzooplankton populations, dissolved oxygen, salinity, phytoplankton pigments concentration (including chlorophyll-a) and dissolved inorganic nutrients concentration (nitrate, nitrite, ammonium, phosphate, silicate). During the third part of the survey a Rosette, mounted with a SeaBird CTD, was used for live measurements of temperature and salinity of the water column and for water sampling. Water at the subsurface (4 m) was continuously monitored by the Ferrybox, which recorded temperature, salinity, fluorescence, turbidity, and oxygen. Furthermore, a flow cytometer, connected to the Ferrybox, carried out measurements of abundance and size of the phytoplankton community every hour.

Dissolved oxygen samples were analysed on board with a Microwinkler; while salinity and inorganic nutrient samples will be analysed at the Lowestoft Laboratory. Chlorophyll and pigments samples were stored at -80 °C and will be analysed with HPLC (High Performance Liquid Chromatography) at DHI (Denmark). Phytoplankton samples will be processed at the Lowestoft Laboratories, using an inverted microscope.

Table 1. Number of samples / vertical profiles conducted during the survey.

	Total
Salinity	40
Dissolved oxygen (triplicates)	36
Chlorophyll/Pigments analysis	37
Inorganic nutrients	37
Phytoplankton	37
Microzooplankton	37
Mesozooplankton (80 µm)	92
Mesozooplankton (270 µm)	99
CTD profiles with Rosette	10
CTD profiles with ESM2	38
CTD profiles with SAIV MiniCTD	99

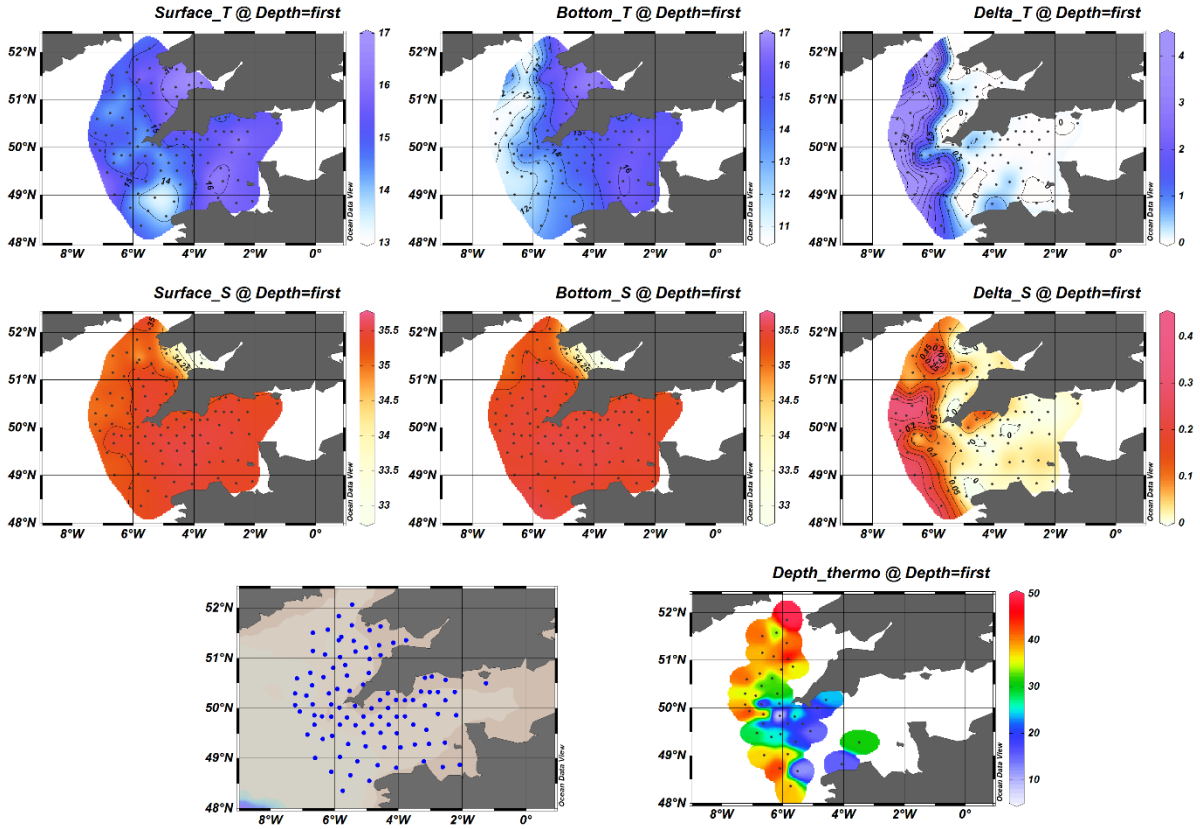

Figure 7. Temperature (T, °C, top) and salinity (S, middle) distribution at the surface (left) and bottom (centre) as recorded by the SAIV MiniCTD at the 99 sampling stations. The difference in temperature (Delta_T, right) and salinity (Delta_S) between surface and bottom is also given, together with depth of the thermocline (Depth_thermo), at the stratified stations (Delta_T > 0.5 °C).

The preliminary results demonstrate the typical autumn conditions in the Celtic Sea. The highest sea surface temperatures were found in the Western English Channel (Fig 7, Table 2). Due to increased survey

coverage, a patch of cooler surface water, visible on satellite images in the previous survey years, could this year be sampled using ship-borne sensors. The boundary layer where the patch of cooler water meets the warmer waters of the English Channel and the Celtic Sea was marked by a series of frontal systems, which were visible in satellite images throughout the month of October, until the start of November (not shown).

The lowest bottom temperatures were found at offshore stations in the Celtic Sea (minimum 10.6 °C; Table 2 and Fig 7). The western component of the survey areas was thermally stratified (Delta_T > 0.5 °C; Fig 2), while coastal stations, and stations in the English Channel were vertically mixed (Fig 2). The difference between surface and bottom temperatures was highest at offshore stations in the Celtic Sea (4.3 °C, Table 2). The stratified waters in the north showed deeper thermocline depth (> 30 m) compared to those stations south of the Cornish peninsula (minimum of 7 m; Table 2 and Fig 7).

Table 2. Summary statistics (minimum, maximum, mean, standard deviation, and number of observations) of temperature and salinity measurements, recorded by the SAIV MiniCTD at the 99 sampling stations. Column titles are the same as in Figure 2.

	Surface_T	Bottom_T	Surface_S	Bottom_S	Delta_T	Delta_S	Depth_thermo
Min	13.35	10.60	32.83	32.86	0.00	0.00	7.00
Max	16.69	16.69	35.52	35.53	4.31	0.40	50.00
Mean	15.10	14.07	35.25	35.33	1.05	0.08	30.71
StDev	0.66	1.72	0.37	0.37	1.43	0.10	10.57
Number	99	99	99	99	99	99	40

Salinity showed little variations within the survey area, except for the inner stations of the Bristol Channel (lowest salinity of 32.83; Table 2 and Fig 7), which is influenced by riverine outflow. Some stations in the Celtic Sea showed evidence of a halocline with slightly higher bottom salinity compared to the surface (0.4 difference; Table 2 and Fig 7).

Surface distribution of chlorophyll concentration was estimated by fluorometers on the Ferrybox and mounted on the ESM2 profiler. Due to cloud cover throughout most of the survey, remote sensed images of ocean colour (MODIS, algorithm OC3 from Neodaas.co.uk; PML) provided limited additional information. However, data collected during a brief cloud-free spell (6th October), showed two areas with higher chlorophyll concentration (Eddystone/Mount Bay and south of the Isles of Scilly) which matched the location of subsurface fluorescence measurements recorded by the Ferrybox and high concentrations of *Coscinodiscus* (a centric diatom) in the ringnets (Fig 8).

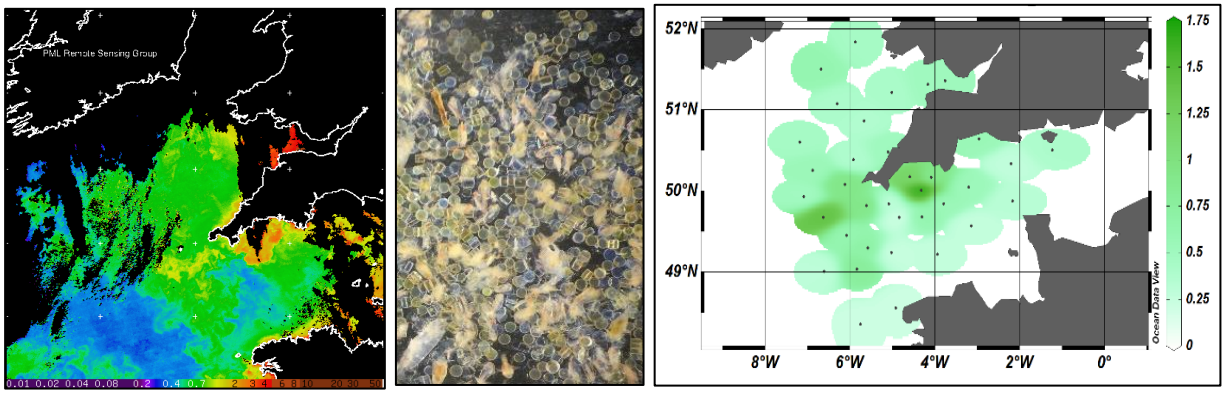

Figure 8. Evidence of autumn bloom in the Celtic Sea and Western approaches; from left to right: surface chlorophyll concentration from MODIS (OC3 algorithm) from Neodaas.co.uk (PML) on 6th October 2017; centric diatom *Coscinodiscus* sp. identified at the microscope in mesozooplankton samples; subsurface fluorescence concentration recorded by the Ferrybox at the 37 Water stations.

Observer data: Marine Mammal, Birds and large pelagic fish

For the third year running, two different but complimentary approaches were taken to record birds and marine mammals. On one bridge wing, two experienced JNCC-accredited European Seabirds At Sea (ESAS) surveyors employed an effort-based distance sampling straight-line transect survey following strict ESAS methodology. On the other bridge wing, a single experienced volunteer MARINElife surveyor employed an effort-based 300m box methodology (as used on the majority of MARINElife's other surveys). As a result, a 180° beam-to-beam scan area was surveyed along every transect line.

In total 56 bird species were recorded during the transects with gannets and guillemots the most abundant in terms of encounters as well as numbers. Preliminary results suggested that numbers of Balearic Shearwater, *Puffinus mauretanicus*, a target species of the survey, was around 99 individuals. This was similar to 2016 although the distribution was very different. In 2016 (and previous years) the main concentration of sightings of this species was west of Lundy and along transects off the north Devon coast. This year the only concentrations were off the south coast of Cornwall and the northwest corner of Brittany, the latter included in the survey for the first time in 2017. It is possible that this was due to the survey covering the Celtic Sea and Bristol Channel two weeks earlier than in previous years, as this species is thought to migrate from French coastal waters to overwinter in the Bristol Channel. Observations of significant numbers off the north Cornwall coast a week or so after Peltic had surveyed the area in the aftermath of Storm Brian, support this.

Table 3. Observations of marine mammals during Peltic 17

Species	Scientific Name	# Individuals	# Encounters
Fin Whale	*Balaenoptera physalus*	11	3
Fin Whale (probable)	*Balaenoptera physalus*	20	7
Northern Minke Whale	*Balaenoptera acutorostrata*	1	2
Risso's Dolphin	*Grampus griseus*	17	1
Common Bottlenose Dolphin	*Tursiops truncates*	21	3
White-beaked Dolphin	*Lagenorhynchus albirostris*	3	2
Short-beaked Common Dolphin	*Delphinus delphis*	3274	250
Harbour Porpoise	*Phocoena phocoena*	88	41
Unidentified dolphin sp.	*Odontocete sp.*	31	6
Grey Seal	*Halichoerus grypus*	3	1

At least 8 species of marine mammals were observed (Table 3), with Common dolphins the most abundant. Numbers of tuna observations increased again from 2016, even considering the larger survey area coverage in 2017. More than 40 different feeding observations were seen (Table 4).

Table 4. Observations of other species during Peltic 17

Species	Scientific Name	Number of Individuals
Leatherback Turtle	*Dermochelys coriacea*	1
Basking Shark	*Cetorhinus maximus*	1
Ocean Sunfish	*Mola mola*	1
Atlantic Bluefin Tuna	*Thunnus thynnus*	c. 500

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Summary

Peltic17 constituted the 6th autumn survey on small pelagic fish and their ecosystem in the waters of the western English Channel and eastern Celtic Sea. This year, the survey was extended beyond the area covered between 2012 and 2016, which focussed solely on the Mackerel Box. In 2017 survey coverage included the French waters of western English Channel. The survey commenced on the 29th of September and ran for 34 effective survey days, starting in the Bristol Channel working into the English Channel. The 2200 nautical miles of effective acoustic coverage were supplemented with 38 valid trawls which provided details on species composition and biological information. A mix of pelagic species were found in newly sampled French waters generally consisting of sardine with smaller contribution of anchovy and sprat. The size of these specimens was generally smaller than those found in the northern waters of the Channel. Compared to 2016, less sardine biomass was found north of the Cornish Peninsula and slightly values in the English Channel. Anchovy biomass decreased compared to 2017. Sprat biomass had increased in Lyme Bay (English Channel) compared to the low biomass estimate from 2016. Sardine egg- and larval maps showed similar geographical areas of sardine spawning compared to previous years with the waters at the mouth of the English Channel being most important. Of particular note were the approximately 40 separate observations of feeding Atlantic Bluefin Tuna. Oceanographic conditions were comparable to the average values of the time series.

Jeroen van der Kooij
Scientist In Charge
23rd Nov 2017

SEEN IN DRAFT

Master:
Senior Fishing Mate:

INITIALLED:

DISTRIBUTION: