Centre for Environment Fisheries & Aquaculture Science

Cefas

RESEARCH VESSEL SURVEY REPORT

Survey: IESNS-UK 2023 (RESO 1/23)

Duration: 24/04/2023 – 06/05/2023 (13 days)

Vessel: FV Resolute BF50

STAFF:

Name	Role
Fabio Campanella	SIC/Acoustics
Samantha Barnett	SIC/Acoustics
Richard Humphreys	Fish sampling/CTD/Plankton
Matthew Eade	Fish sampling/CTD/Plankton
Nicola Hampton	Fish sampling/CTD/Plankton
Gary Burt	Fish sampling/CTD/Plankton

AIMS:

1 To carry out a section of the internationally coordinated IESNS survey (International Ecosystem Survey in the Nordic Sea), to estimate distribution, abundance and age structure of Spring-Spawning Herring *Clupea harengus* and blue whiting *Micromesistius poutassou* in
   a. To carry out a fisheries acoustic survey using 2 operating frequencies (38, 120) to map and quantify the small pelagic species community.
   b. To trawl for small pelagic species using a commercial mid-water trawl in order to obtain information on:
      - Species and size composition of acoustic marks
      - Age-composition and distribution, for small pelagic species
      - Length weight and maturity information of pelagic species
2 To collect zooplankton samples using a ring-nets with 200 µm, mesh size at fixed stations.
3 To collect water column profiles at fixed stations along the acoustic transect. A CTD (SAIV mini CTD) will be deployed to obtain measurements of environmental properties within the water column.
4 To collect 50 herring specimens on each trawl stations for a genetic study on the stock structure of this species.

Executive summary

- In April-June 2023, four research vessels and one hired commercial vessel participated in the International Ecosystem Survey in the Nordic Seas (IESNS); R/V Dana, Denmark (joint EU survey by Denmark, Germany, Ireland, The Netherlands and Sweden), R/V Jákup Sverri, Faroe Islands, R/V Árni Friðriksson, Iceland, R/V G.O. Sars, Norway and FV Resolute, United Kingdom (UK).
- The UK contributed to the IESNS survey by successfully running a survey that covered part of the southern section of the IESNS survey area onboard the FV Resolute.
- The main objective of the survey was to determine the distribution abundance and age structure of herring and blue whiting
- The survey was conducted onboard a commercial pelagic trawler. The experience and skills of the crew was crucial to successfully complete the survey
- Genetic analysis is planned to be performed on herring fin clips samples collected during the 2022 and 2023 survey to characterise the different stocks present in the survey area and the potential level of mixing with the Norwegian spring spawning herring.

Narrative

24/04/2023
Staff boarded the Resolute at 0900hr in Peterhead. After safety briefing and tour of the vessel, we sailed at 12:00 headed to the beginning of the first transect (off Faroe Island).
25/04/2023
Transiting to start of the first transect.
26/04/2023
We started the first transect (off Faroe) on 25/04 at around 1800hr. We didn't see anything on the shelf apart from a couple of small herring-like schools. At night we moved into deeper waters where we detected a layer of dispersed targets between 40-80 m. We fished on it (62˚ 17.24N, 03˚ 53.29W) and we caught 100% blue whiting (46 kg). In day light the layer moved deeper (200-300 m) and became more densely aggregated. We had another tow in the morning (62˚ 11.12N, 02˚ 31.50W) on the same layer and on some small dense schools at the surface (~40 m) that we saw while hauling. We caught blue whiting (18 kg), mackerel *Scomber scombrus* (35 kg), herring (41 kg) and few myctophids.
The weather was a bit fresh the day before but improving.
27/04/2023
We completed the first transect. We fished in the morning (62˚ 17.12N, 00˚ 24.90E) on a dispersed layer where we caught 40 kg of blue whiting. We tried to target some stronger targets at the surface (~20 m, likely herring) but we couldn't get the net that shallow. We kept seeing blue whiting throughout the day in mid water and close to the bottom when we moved to shallower waters. No sign of herring marks. We tried to fish again on a layer at 200 m (likely pearlside *Maurolicus muelleri*, 62˚ 18.94N, 02˚ 44.21E) but we had an issue with the fish sonar so we couldn't position the net at the right depth. We ended up with an empty codend. The issue was then resolved.
28/04/2023
We started the second acoustic transect. Not much on the sounder apart from a weak scattering layer at 250 m. We fished on it in the morning (63˚ 41.99N, 04˚ 03.39E) and we caught 1.5 kg of mackerel (39.5cm) and 2kg of herring (36.5cm) The weather was quite nice and we had a nice encounter with a pod of orcas *Orcinus orca* in the morning. During the night we fished at the surface (63˚ 41.23N, 00˚ 15.83E) and we caught ~200 kg of blue whiting and 20 kg of mackerel.
29/04/2023
Weather was very fresh causing poor data quality. No sign of herring, only just very weak scattering layer at ~80 m. We had to skip 2 CTD/plankton stations because of the weather and some drills NATO warships were running.
30/04/2023
We finished our second transect (63˚ 35.98N, 12˚ 22.5W) and we carried out a trawl (63˚ 34.97N, 12˚ 16.47W) on some dense marks close to the bottom at 350-400 metres. We caught half a basket of mixed blue whiting, herring and some spotted barracudina

Arctozenus risso. We couldn't get to the school properly though as it was too risky to get close to the bottom at that depth. We transited to the next transect during the night (5 hours steam)

01/05/2023

Not much to report. Very little activity on the sounder. We had a trawl in the morning (64˚ 35.90N, 11˚ 37.21W) at the surface on not very convincing targets and we only caught a monkfish.

02/05/2023

We were steaming east on our last transect (64˚ 36.70N, 3˚ 10.63W) with some pretty good weather. We fished late night/early morning (64˚ 38.19N, 08˚ 10.56W) on few aggregations at 350 m but we couldn't see them anymore when we had the net deployed. We caught some herring likely at the surface on the way up (5 kg, 39.8cm). Few hours later we started to see some really nice herring aggregations at 50-100 m. We fished (64˚ 39.58N, 07˚ 32.31W) and we got a clear herring catch (400kg, 39.8cm). Before sunset we kept seeing weak aggregations at the surface and lots of fin whales *Balaenoptera physalus* around. We fished (64˚ 35.03N, 02˚ 08.33W) and we caught 100 % krill *Euphausia spp*.

03/05/2023

We approached the end of our last transect (current position: 64˚ 37.49N, 02˚ 10.67E) having really nice weather. We were in blue whiting territory with a continuous layer at 250 m (not very strong) which we fished in the morning (64˚ 32.89N, 00˚ 17.61W, 20 kg blue whiting 24.5 cm and some barracudina).

04/05/2023

The final transect was completed this morning at around 0900hr. We fished last night on some very dense schools at ~25-30 m that looked like herring. The catch was blue whiting. We had a bit of time left so we headed to the first RV Dana's transect where they spotted some herring schools and couldn't fish because of the weather. We scouted the area for few hours without detecting any herring-like schools, so no trawls were carried out. We also picked a station on our way south where CTD deployment wasn't successful.

05/05 /2023

Transiting to Fraserburgh

06/05/2023

We docked in Fraserburgh around 1300hr and all Cefas staff disembarked soon after.

Materials and methods

The survey was conducted onboard the commercial pelagic trawler FV Resolute from 24/04/2023 to 06/05/2023. Fisheries acoustics were recorded along the pre-designed transects (Figures 1-2) using a Simrad EK80 echosounder at the 2 operating frequencies (38, 200). The transducers were hull-mounted. The specific settings used for the acoustic sampling are listed in Table 1. An echosounder calibration was performed on the 22 April by

Echomaster in Peterhead harbour alongside the tanker jetty. The results of the calibration are listed in Table 1. The data were scrutinized using Echoview 13. Scrutinization was carried out according to an agreement at a PGNAPES scrutinizing workshop in Bergen in February 2009 (ICES 2009), and "Notes from acoustic Scrutinizing workshop in relation to the IESNS", Reykjavík 3-5 March 2015 (Annex 4 in ICES 2015). Generally, acoustic recordings were scrutinized on daily basis and species identified and partitioned using catch information, characteristic of the recordings, and frequency between integration on 38 kHz and on other frequencies by a scientist experienced in viewing echograms. Immediately after the 2023 survey an online IESNS post-survey Teams meeting (13-15 June 2023) was held to standardise the scrutiny and to agree with the rest of the IESNS participants on particularly difficult scrutiny situations encountered.

Fish sampling was performed using a commercial pelagic Jackson trawl (trawl dimension and characteristics listed in Table 1. Catches from trawl hauls were sorted and weighed; fish were identified to species level, when possible, and other taxa to higher taxonomic levels. A subsample of herring, blue whiting and mackerel were sexed, aged, and measured for length and weight, and their maturity status was estimated using established methods. An additional sample of fish was measured for length. Salient biological sampling protocols for trawl catches are listed in Table 1.

Table 1 – Details of the acoustic, biological and hydrographic sampling.

Acoustic		Sampling		Biology		
Echo sounder	Simrad EK80	**Pelagic trawl dimensions**		**Length measurements**	Herring	100
Frequency (kHz)	**38**,200	Circumference (m)	972		Blue whiting	100
Primary transducer	ES38-7	Vertical opening (m)	30-50		Mackerel	100
Transducer installation	Hull-mounted	Mesh size in codend (mm)	20		Other fish sp.	30
Transducer depth (m)	6	Typical towing speed (kn)	3.5-5	**Weighed, sexed and maturity determination**	Herring	50
Upper integration limit (m)	10	**Plankton sampling**			Blue whiting	50
Absorption coeff. (dB/km)	10	Sampling net	WP2		Mackerel	50
Pulse length (ms)	1.024	Standard sampling depth (m)	200		Other fish sp.	0
Transmitter power (W)	2000	**Hydrographic sampling**		**Otoliths/scales collected**	Herring	50
Angle sensitivity (dB)	18	CTD unit	SAIV SD208		Blue whiting	50

2-way beam angle (dB)	-20.7	Standard sampling depth (m)	250		Mackerel	50
Ts Transducer gain (dB)	26.75				Other fish sp.	0
s_A correction (dB)	-0.0691			**Genetic samples**	Herring	50
alongship:	6.32					
athw. ship:	6.40					
RMS	0.078					
Maximum range (m)	500					
Post processing software	Echoview					

Acoustic data were analysed to obtain the biomass estimates using the StoX software package (version 3.4.0) which has been used for some years now for WGIPS coordinated surveys. Estimation of abundance from acoustic surveys with StoX is carried out according to the stratified transect design model developed by Jolly and Hampton (1990). A biomass estimate will not be carried out based on data of this survey alone, but the data will be included in the survey's database from all IESNS participating vessels from which a biomass index will be calculated. The final estimate methodology is presented at the remote post cruise meeting 14-16 June 2022 and in the WGIPS report of January 2023.

The hydrographical and plankton stations are shown in Figure 1. Maximum sampling depth was 500 m. Zooplankton was sampled by WPII nets on all vessels, according to the standard procedure for the surveys. Mesh sizes was 200 µm. The net was hauled vertically from 200 m to the surface or from the bottom whenever bottom depth was less than 200 m. The samples were size fractionated by sieving the samples through 2000 µm and 1000 µm sieves, giving the size fractions 180/200 – 1000 µm, 1000 – 2000 µm, and > 2000 µm. The size-fractionated samples were then processed in the lab to obtain dry weight estimates.

Results and discussion

In total 3 acoustic transects were completed covering a total of 1345 nm of acoustic sampling unit. A total of 13 pelagic trawls were carried out to provide ground-truth information about species and size composition and to collect biological information (Figure 3). All trawls were all successful except for trawl 19 where no fish were caught. In addition, CTD and plankton sampling were performed on 20 fixed stations.

Surface waters in the northern and western part of the survey area were colder than the south-eastern area where a cold temperature front was detected (Figures 4-5). Surface

salinity was similar for most of the survey area except for the area close to the Norwegian coast where lower salinity was recorded (Figures 4-5). The zooplankton biomass (mg dry weight m-2) distribution in the upper 200 m is shown in Figure 6. The highest zooplankton biomass was found in the Iceland Sea in an area that overlaps with the cold water front.

Herring was primarily distributed around a small area 100 nm east of the Icelandic coast. This area was characterised by the presence of a cold water patch and by the highest plankton biomass measured on the whole survey. Herring aggregations consisted of small aggregations distributed near the surface during the night and at a depth ranging from 100 to 250 during daylight hours.

Herring size ranged from 27.5 to 38 cm with a modal length of 32.7 cm (n = 244 fish measured). The age 6 year-class was the most abundant year-class in the area (n = 145 aged fish). (Figure 7)

Blue whiting was mainly distributed in the western part of the survey area (Figure 7) and on a small area east of the Icelandic coast. Blue whiting aggregations primarily consisted of continuous and dense layers distributed between 200-400 m depth in the water column. Blue whiting size ranged from 17.5 to 34.5 cm with an overall average size of 23.5 cm (n = 636 fish measured) (Figure 7). The total biomass estimate was 449,656 t (northern stratum: 261,872 t, southern stratum: 187,784 t) and a total number of 6.4 billion. 2-years-old was the most abundant age class observed in the catches (n = 333 aged fish).

Mackerel was caught in only 3 trawls on the western part of the survey area. The size ranged from 26 to 41 cm with an overall average of 35.2 cm (n = 244 fish measured) (Figure 10). 3-years-old was the most abundant age class observed in the catches (n = 107 aged fish). No further quantitative information can be drawn from these data as this survey was not designed to monitor mackerel.

Future work

Genetic analysis is planned to be performed on herring fin clip samples collected during the survey to characterise the different stocks present in the survey area and the potential level of mixing with the Norwegian spring spawning herring.

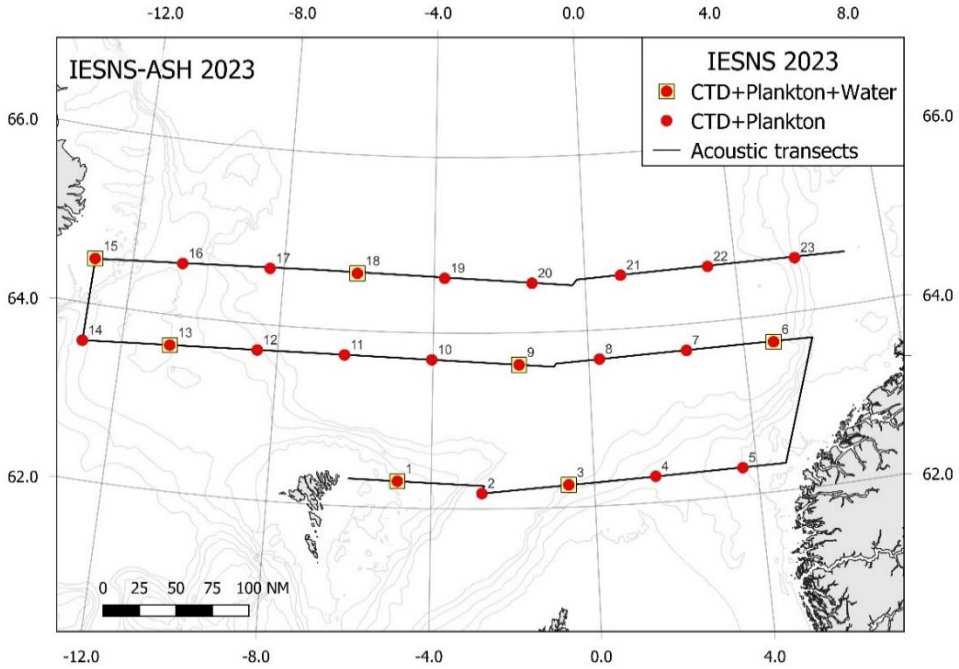

Figure 1 – Acoustic transects and location of hydrographic and plankton stations.

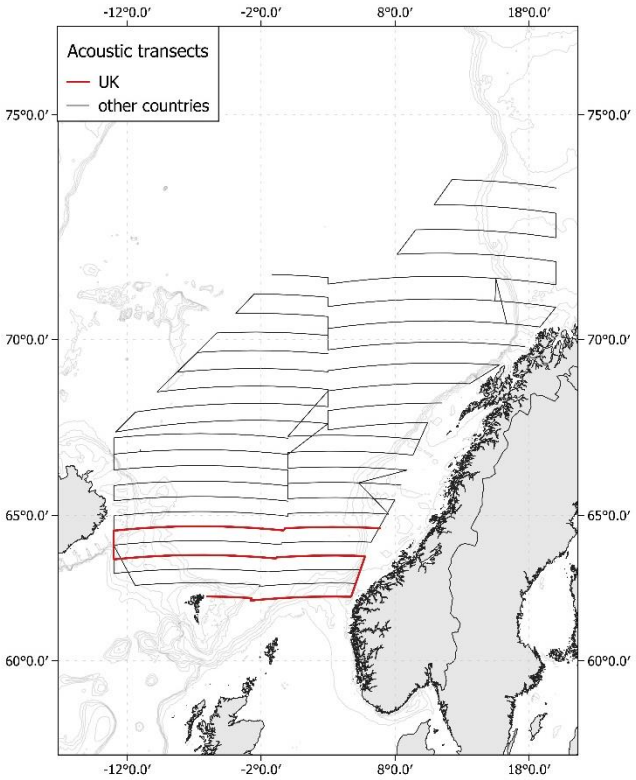

Figure 2 – Acoustic transects of the full 2023 IESNS survey (In red the transects run by the FV Resolute)

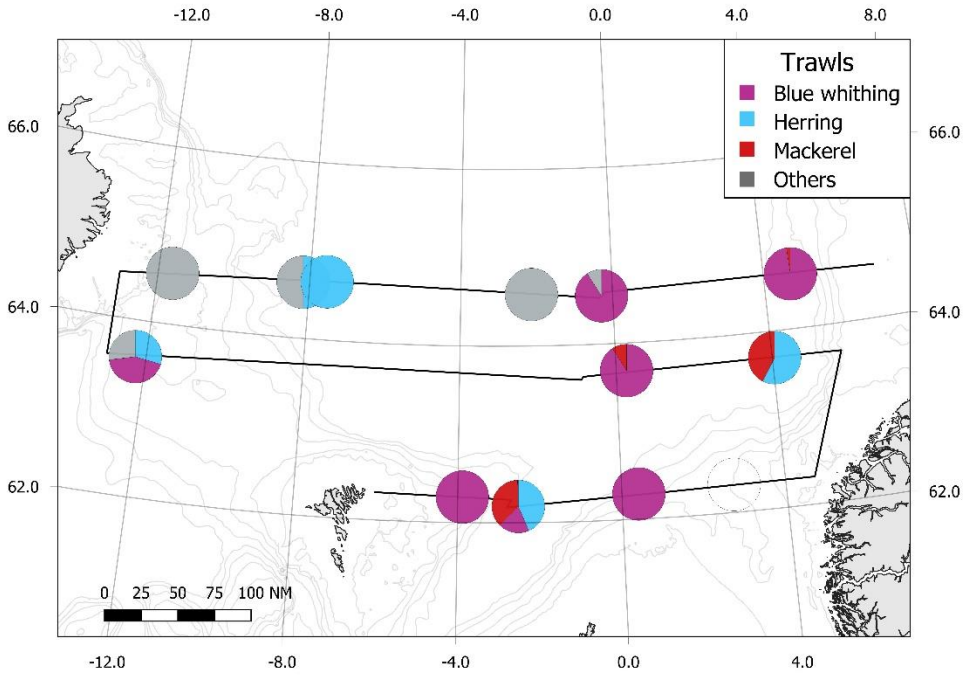

Figure 3 - Location and catch composition of the pelagic trawl stations.

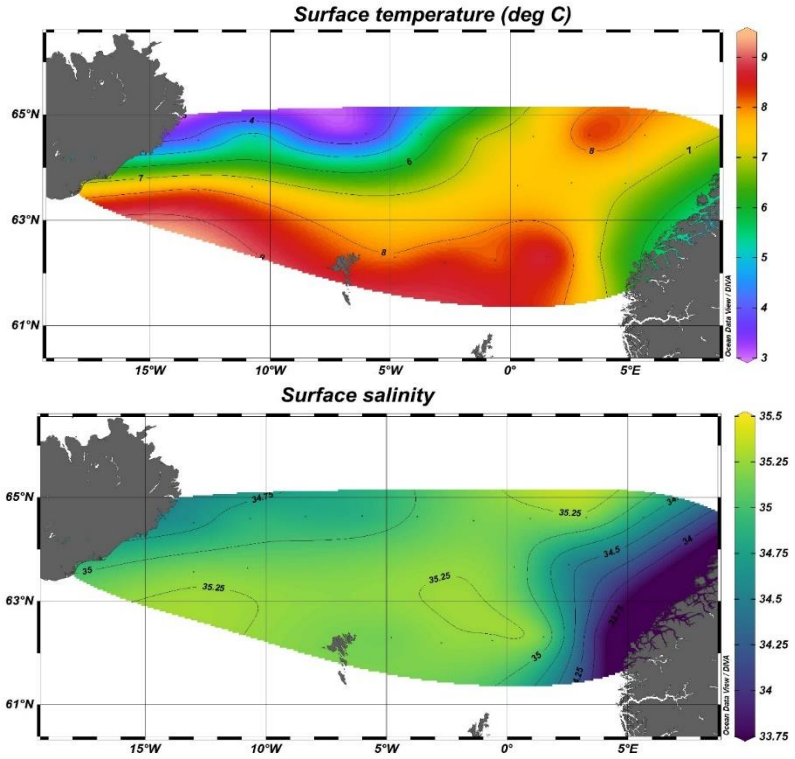

Figure 4 – Temperature (°C) and salinity (psu) at the subsurface (1-2 m depth) measured by the SAIV MiniCTD at the 19 sampling stations between 25 April and 7 May 2023.

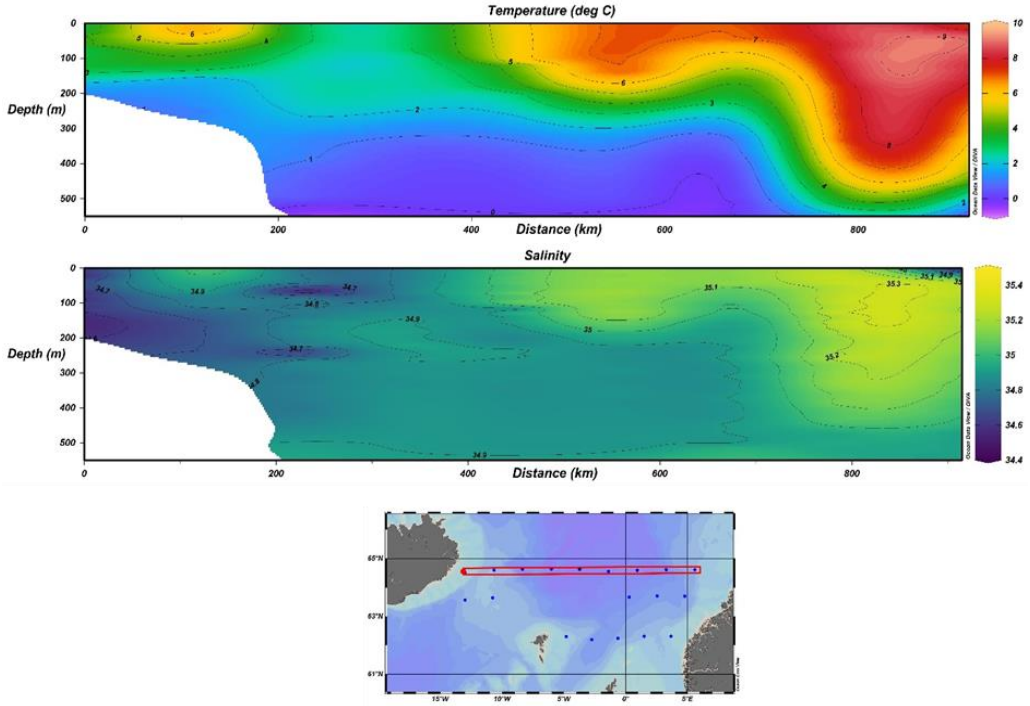

Figure 5 – Temperature and salinity sections of the water column up to 500 m estimated along the northernmost transect of the survey.

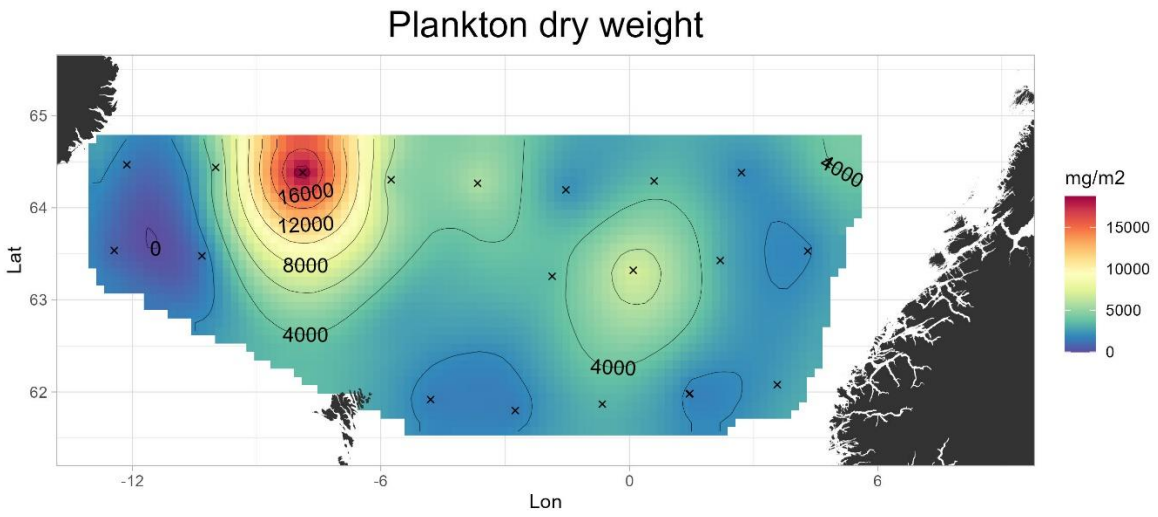

Figure 6 – Distribution of zooplankton biomass (mg dry weight m-2) in the upper 200 m.

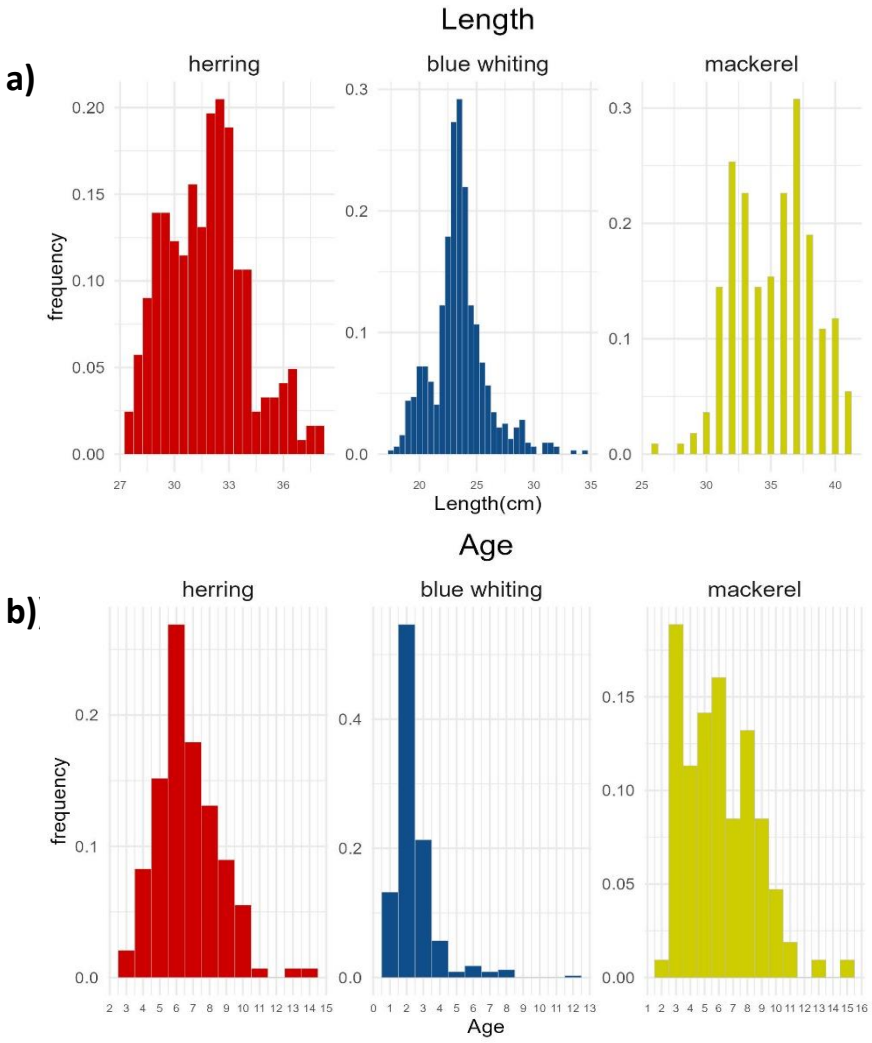

Figure 7 – Length (a) and age (b) frequency distribution for herring, blue withing and mackerel derived from the pelagic trawl catches.

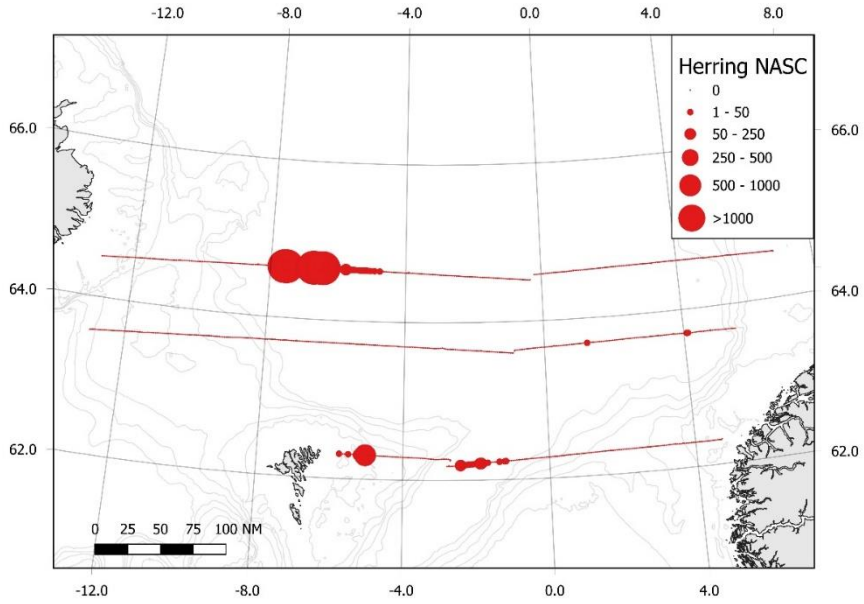

Figure 8 - Distribution of herring in terms of NASC values (m^2/nm^2) averaged for every 1 nautical mile.

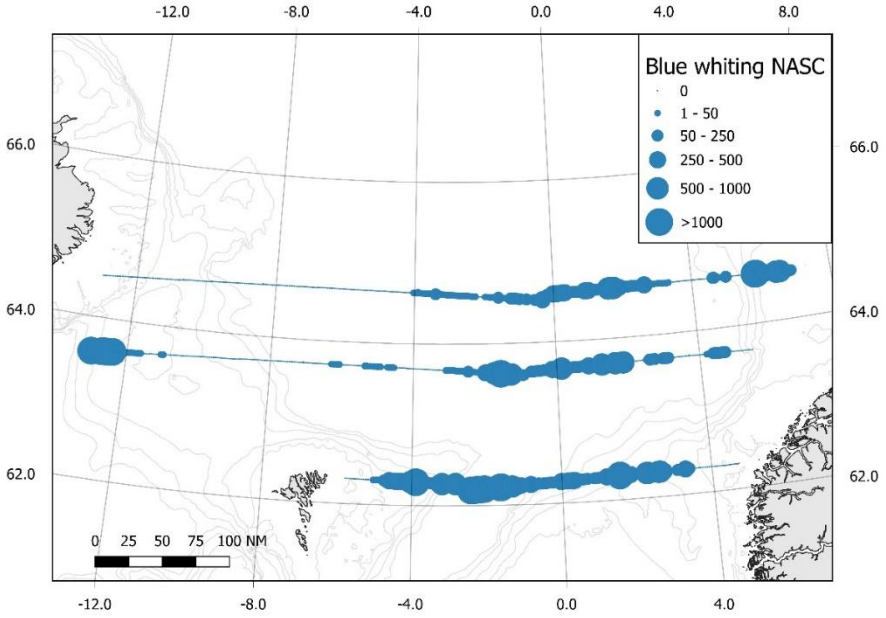

Figure 9 - Distribution of blue whiting in terms of NASC values (m^2/nm^2) averaged for every 1 nautical mile.