The International Ecosystem survey in the Nordic Seas in May 2018

IESNS

R/V DANA Cruise No. 5/2018

Calibration of Echo-sounders

1/5 – 3/5 2018

International Acoustic Monitoring of Herring and Blue whiting

4/5 – 30/5 2018

Cruise participants

Calibration 1/5 – 3/5

Karl-Johan Staehr	Denmark (Cruise leader)
Torben Filt Jensen	Denmark
Ronny Sørensen	Denmark
Christian Petersen	Denmark

Acoustic monitoring 4/5 - 14/5

Karl-Johan Staehr	Denmark (Cruise leader)
Acoustic Torben Filt Jensen	Denmark
Acoustic Serdar Sakinan	Netherlands
Fishlab Kristin Öhman	Sweden
Fishlab Matthew Eade	United Kingdom
Fishlab Gert Holst	Denmark
Fishlab Peter Vingaard	Denmark
Tech. Ronny Sørensen	Denmark

Acoustic monitoring 15/5-30/5

Matthias Kloppmann	Germany (Cruise leader)
Acoustic Benoit Berges	Netherlands
Acoustic Sven Kupschus	United Kingdom
Fishlab Rickard Yngwe	Sweden
Fishlab Tobias Rapp	Ireland
Fishlab Helle Andersen	Denmark
Fishlab Nikolaj Kolding Pedersen	Denmark
Tech.Christian Petersen	Denmark

Cruise summary

Effective survey days	20 (+ 3 for calibration)
Mileage	Calibration 150 NM Steaming before start of transects 417 NM Monitoring 3356 NM Steaming for end port 1228 NM
Number of trawl hauls	29
Number of CTD stations	33
Number of WP2 stations	33
Number of biological samples – herring	582
Number of biological samples – blue whiting	498
Number of biological samples – mackerel	456
Remarks	

Introduction

The Norwegian spring spawning herring is a highly migratory and straddling stock carrying out extensive migrations in the NE Atlantic. After spawning, the main spawning areas being along the Norwegian west coast from 62°N to 65°N in February – March, the herring migrates NW-wards towards the Norwegian Sea feeding grounds. In general, the main feeding has taken place along the polar front from the island of Jan Mayen and NE-wards towards Bear Island. During the latter half of the 1990's there has been a gradual shift of migration pattern with the herring migrations shifting north and eastwards. In 2002 - 2004 this development seems to have stopped and the herring had more southerly distribution at the end of the feeding season than in 2001. After feeding, the herring concentrated in August in the northern parts of the Norwegian Sea prior to the southern migration towards the Vestfjord wintering area (68°N, 15°E). Since the winter 2002-2003 most of the stock seems to winter in the Norwegian Sea off Lofoten. In January the herring start their southerly spawning migrations.

Besides herring, abundant stocks of blue whiting and mackerel exploit the Norwegian Sea as an important feeding area. The blue whiting stock is currently supporting one of the largest fisheries of the Northeast Atlantic. The main spawning areas are located along the shelf edge and banks west of the British Isles. The eggs and larvae drift both northwards and southwards, depending on location and oceanographic conditions. The northward drift spreads juvenile blue whiting to all warmer parts of the Norwegian Sea and adjacent areas from Iceland to the Barents Sea. Adult blue whiting carry out active feeding and spawning migrations in the same area. Blue whiting has consequently an important role in the pelagic ecosystems of the area, both by consuming zooplankton and small fish, and by providing a resource for larger fish and marine mammals.

Background and objective of the survey

This survey is carried out in order to investigate distribution and migrations of the Atlanto-Scandian herring, blue whiting and other pelagic fish, and to produce a biomass index for herring and a recruitment index for blue whiting for the Working Group on Widely Distributed stocks (WGWIDE). Furthermore hydrographic conditions and plankton abundance in the Norwegian Sea and adjacent waters are monitored in order to investigate distribution and migration of herring and other pelagic fishes are influenced by environmental conditions.

This survey was coordinated with Norway as an international survey with participation of Norway, Iceland, Faroe Islands and the EU, where the Danish R/V Dana conducted the EU survey part. The acoustic survey tracks of Dana are shown in figure 1.
With the exceptions of 2002 and 2003 the survey is carried out since 1997 with participation of EU countries together with Norway, Russia, Iceland and the Faeroese Islands.

Calibration

The echo sounders were calibrated immediately before the survey at Bornö Island in the Gullmar Fjord, Sweden during the 1st May and 3rd May 2018. The calibration was performed according to the standard operation procedures as described in the WGIPS manual for three frequencies (18, 38 and 120 kHz).The calibration of the towed body split-beam transducer at 38 kHz was conducted

against a 60 mm copper sphere. Calibration of the three hull-mounted split-beam transducers at 18, 38, and 120 kHz were carried out against 63mm, 60 mm, and 23 mm copper spheres, respectively. The resulting calibration parameters are shown in Annex 1 and were used during the subsequent survey.

Materials and methods

Acoustic data

Acoustic data was collected with the EK60 using a 38 kHz splitbeam transducer, mounted in a towed body (paravane). During the acoustic survey along transects, echo integration was conducted continuously and the data was scrutinized using the LSSS software. During trawling, the EK60 using the hull mounted 38 kHz transducer was used to visualize the echo traces but the data were not logged. The echo sounder data during trawling were only informative for the scrutinizing process.

A biomass estimate will not be carried out based on data of this cruise 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 post cruise meeting in Copenhagen 20-22 June 2018 and in the WGIPS report of January 2018.

Similar to last year, intertransects were skipped, i.e. the towed body was hoisted up at the end of each transect and the distance to the next transect was travelled without echo integration. On reaching the next transect, the towed body was put in the water again and a new integrating section was started.

Hydrographical and zooplankton data

At fixed positions, a priory determined by ICES WGIPS, plankton samples were taken by means of vertical tows from 200 m or 5 m above the seabed to the surface with a WP2 equipped with 180 µm mesh. The biomass samples were oven-dried in size-class fraction of > 2000 µm, > 1000 µm, and > 180 µm, respectively, on board at 70 °C for 24 hours, and subsequently frozen for later dry weight determination at DTU Aqua.
At the same positions, CTD casts were carried out to a maximum depth of 1000 m or 5 m above the seabed with a Seabird CTD and rosette water sampler. The following parameters were measured: pressure (depth), temperature, conductivity (salinity) and oxygen. All together Dana carried out 37 CTD and 34 successful WP2 stations (Table 1, Figure 1)
Each day, water samples were taken at 1000 m and in one shallower layer for calibration of the CTD's conductivity sensor. Additionally, sea surface temperature, salinity and fluorescence were continuously monitored from the ship's bow intake and were stored along with information on meteorological conditions (e.g. wind direction, wind speed etc.) utilizing R/V Dana's hydrographic and meteorological data collection system.

Biological data

During the survey, fishing was carried out regularly on acoustic registrations to verify the species scrutinized and to give information about the size composition to be used in the biomass estimation. A pelagic trawl "*Turbo*", was used either at the surface or in midwater down to a maximum of 450 m depth. During most of the first part of the survey, the smaller "FOTØ" trawl was used instead because of a damage that occurred to the "Turbo" trawl during the second haul. The "Turbo" trawl was repaired during the half landing break in Bodø and could then be used again during the entire second part of the survey (Table 2, Figure 1).

Catches were sorted and weighed by species. Length measurements were taken for all species. For herring, blue whiting and mackerel samples of 50 fish were also randomly taken in order to determine individual length to weight relationships as well as age, sex and maturity. For age determination in herring, blue whiting and mackerel otoliths were taken and will be read at Aqua DTU. In total 582 individual herring, 498 blue whiting and 457 mackerel were sampled.

All trawl data were entered into the FiskeLine database and validated. The data were also stored in the WGNAPES formats and will be uploaded to the WGNAPES database at the Faeroes Institute of Marine Research at the end of the survey.

Itinerary of the survey

1 May 2018, 04.00 UTC	Leave Hirtshals for calibration of acoustic equipment at Bornö
3 May 2018, 18.00 UTC	Dock Hirtshals, end of calibration.
4 May 2018, 12.50 UTC	Leave Hirtshals for start of IESNS
6 May 2018, 00.35 UTC	Start monitoring at 62°19 N, 004°47 E
14 May 2017, 03.55 UTC	Stop monitoring at 66°44 N, 011°47 E, end of 1st of the survey
14 May 2017, 10.45 UTC	Dock Bodø for staff exchange
15 May 2018,13.00 UTC	Leave Bodø for start of the second part
15 May 2018, 22.10 UTC	Start monitoring at 66°22 N, 011°21 E
25 May 2018, 00.45 UTC	Stop monitoring at 73°00.6 N, 019°59 E, end of2nd part of the survey
30 May 2018, 05.02 UTC	Dock Hirtshals, end of survey

Log during the first half of the survey as reported during the survey to the other participating vessels:

06-05-2018 15.17 UTC. We started this night at 00.35 UTC at the eastern end of transect 1 in stratum 1 with a CTD to set our environment parameters in EK60. During the late morning we had a weak continues layer at 60-80 meters with some scatter read spots at 62 N 18.2, 002 E 9.9 we fished in the layer and got 20.0 kg HER (mean length 28.3 cm) and 6.5 kg MAC (mean length 26.1 cm). Else it has been scares with registrations. We expect to do a surface haul during the dark period to night. Our current position is 62 N 18.7, 001E 34.2.

07-05-2018 16.24 UTC. We had a trawl haul last night at 62N 18.3, 000W 41.5 in the surface with a catch of MAC 119.7 kg mean length 31.0 cm, WHB 66.5 kg mean length 25.3 cm and HER 6.8 kg mean length 28.4 cm. This afternoon we have started on transect 2 strata 1 going east. We have just

been fishing at scattered red marks in 25 m depth and got a catch of aprox. 250 kg HER and MAC 1/1. Our current position is 63 N 03.3, 001W 33.3.

08-05-2018 16.27 UTC The trawl haul we had last afternoon(63N 03, 001W 26) at scattered red marks in 25 m depth gave a total catch of 241 kg, HER 162 kg men length 28.9 and Mac 78 kg mean length 34.1. During the night we had a haul in the surface at 63N 02.7, 000E 10.9, containing HER 667 kg mean length 28.6 cm, MAC 179 kg mean length 32.2 cm and WBH 33 kg mean length 24.4 cm. This afternoon we had a haul at 325-375 m. The catch was total 9 kg, WHB 3 kg mean length 25.1 cm and different mesopelagic species. Our current position is 63 N 02.9, 003E 55.0 and we expect to end transect 2 strata 1 and will then steam for the eastern end of transect 5 in strata 1.

09-05-2018 15.00 UTC Last the night we had a haul in the surface at 63N 08.5, 005E 22.8, with a total catch of 76.1 kg, KRZ 58.4 kg, MAC 15.6 kg mean length 30.3 cm, HER 1.0 kg mean length 28.1 cm and the rest consisted of CPZ, LPR and jellyfish. We arrived at the eastern end of transect 2 strata 1 at 04 UTC this morning and have all day been steaming north-east for transect 5. Our current position is 64 N 42.5, 009E 24.1 and we expect to start at the eastern end of transect 5 strata 1 aprox 18.30 UTC to night.

10-05-2018 15.00 UTC Last night we started on transect 5 going west. During the night we had a trawl haul in the surface during the dark period at 65N 15.9, 008E 38.5 With a total catch of 43.6 kg consisting of KRZ 25.5 kg, LUM 10.2 kg and MAC 7.3 kg mean length 16.8 cm. At 65N 15.4, 006E 31.7 we had a trawl haul at 120-150 m with pure PLS. At the moment we are fishing at 350 m. Our current position is 65 N 15.6, 005E 40.6.

11-05-2018 15.00 UTC In the late afternoon yesterday we fished at 330-360 mat 65N 15.8, 005E 47.5 and got total 6 kg consisting of 1 kg WHB mean length 21.8 and the rest mesopelagic (NRK, KRZ, PLS, MPR and LPR). During the night we had a trawl haul in the surface during the dark period at 65N 15.9, 003E 58.1 With 249 kg MAC mean length 25.3 cm. At noon we had a haul at a haul at 65N 15.4, 002E 04.9 on the only layer we had except for the mesopelagic. A scattered layer between 200 and 250 m with a catch of 3 kg WBH mean length 26,3 cm. We will finalize transect 5 this evening and start at the western end of transect 7 strata 1 tomorrow morning. Our current position is 65 N 15.6, 000E 58.0.

12-05-2018 16.55 UTC Now we got the real herring. We had an inter transect haul last night at 66N 20.2,000E 03.0 in the surface and got 6 specimens of HER mean length 35.8 cm (and no MAC). We started at the western end of transect 7 strata 1 this morning and had a trawl haul at 66N 44.0, 001E 40.6 in 160-180 m with WHB 4.159 kg mean length 26.1 cm and HER 47.858 kg mean length 32.8 cm. We have just been fishing in 340-360 m at 66N 43.9, 002E14.6 with WHB 25.23 kg mean length 25.6 cm, HER 3 specimens mean length 33.3 cm and some mesopelagic. Our current position is 66 N 44.1, 003E 03.3.

13-05-2018 16.35 UTC Last night we had a haul in the surface at 66N 43.8, 004E 56.8 with HER 25.64 kg mean length 32.3 cm and MAC 414.3 kg mean length 35.5 cm. This morning we had a haul in 330 m at 66N 43.8, 006E 43.7 with WHB 2.4 kg mean length 24.0 cm. Finally we had a haul this afternoon in 130-140 m at 66N 44.0, 008E 23.4with 50 kg krill. Our current position is 66 N 43.8, 008E 35.1. We will finalize transect 7 stratum 1 tomorrow morning and then we will go to Bodö.

Integration on first half on the survey was ended 14thMay at 03.55 UTC at 66°44N, 11°47E. Bodø was entered at 14th May at 10.45 UTC for change of crew.

Conditions during first half of the survey:

The weather conditions were excellent through first half of the survey with wind speeds around 5 m/s only in short periods the wind has increased above 10-15 m/s.

All CTD and WP2 stations were successfully completed as planned along with 18 trawl hauls.

As the Turbo trawl was damaged after the second haul and due to safety problems by changing to the large trawl doors at sea the last 16 trawl hauls were made with the Fotö trawl.

Log during the second half of the survey as reported during the survey to the other participating vessels:

15-05-2018 The scientific as well as major part of the ship's crew was exchanged on the 15th May. Following safety briefings and an introduction, Dana sailed NW to the beginning of transect 9 of stratum 1 at 15:00 (13:00 UTC) from Bodø into calm seas. The position was reached at 22:01 UTC (all times hereafter given in UTC). Recording of echo registrations from the towed body started at 22:07. The first CTD and WP2 was conducted starting at 23:10 followed by a surface haul with the TURBO trawl.

16-05-2018 The first haul at the surface was finished at 01:11 and revealed only 2 Lumpsuckers. Acoustic logging started thereafter and continued until 12:00, only interrupted by another CTD/WP2 station. At 12:00, all work had to be suspended due to a severe storm until 23:50 when wind and wave had decreased to a tolerable measure.

17-05-2018 Work started again with a surface haul that was, due to the still harsh weather conditions, towed only for 30 minutes instead of the standard 1 hours. The catch consisted of 123 herring (11.2 kg), 1 mackerel and 2 salmon. Echo registration started thereafter but at a reduced speed through the still very rough see. During the day, weather conditions improved considerably and the ship was able to return to its normal survey speed of 10 knots. At 23:08 a midnight surface haul was started

18-05-2017 The surface haul was back on deck at 01:20 and contained 290 kg herring, 27 mackerel (5.3 kg) and 1 lumpsucker (1.9 kg). Operations continued on transect 9 of stratum 1 on the 18th May, commencing at 01:32 UTC. Another trawl haul was carried out later that morning starting at 03:43. It was targeted at a scattered layer of echoes in 220 m depth. That haul was back on deck at 05:00 and contained 83 kg herring (215 individuals), 6 barracudinas (0,16 kg), 1 lumpsucker (2,0 kg) 1 beaked redfish (0,8 kg) and 1 glacier lanternfish (0,002 kg). In the afternoon around 12:30, transect 9 in stratum 1 was completed and Dana turned northwards to steam to the start point of transect 11 of stratum 1. The transect was reached and started at 20:12.

19-05-2018 A surface haul was done starting at 23:21 UTC yesterday evening at 69°37.0' N; 001°21.3'E . Results: 1 Herring 17.5 cm, 42 g; 7 mackerel, mean length 16.4 cm, 260 g; 4 lumpsuckers 3.7 kg, 1 barracudina and 900 g *Gonatus* squids. We carried on at roughly the same spot with the standard CTD/WP2 station, then headed westwards. Weather turned rough again not permitting any fishing but we were still able to carry on with the towed body and record acoustic signals. After the second CTD/WP2 it was forgotten to start recording, which we only realized after 40 NM. It was decided to go back those 40 miles to that point and redo the whole part of the transect. The incident cost us at about 8 hours. The repetition started at around 21:02 UTC. At 22:05 a haul, targeting scattered but dense echoes at about 200 m depth, was done 69°40.6'N, 004°50.5'E. The catch consisted of 86.6 kg herring, mean length 30.4 cm, 1.6 kg deep sea redfish (*S. mentella*), 0.5 kg lumpsucker (1 specimen, 23 cm) and some mesopelagics.

20-05-2018 While carrying on along transect 11, the weather became rough again. Southerly to southwesterly winds increased during the morning hours and after midday generating a very rough sea state. The ship's speed had again to be reduced to 8 – 9 knots. Later that day, conditions improved a little and a trawl haul could be carried out on some dense echoes at 350 m depth. The haul startet at 22:22 UTC at 69°40.7' N, 012°34.1' E. We caught 87.6 kg blue whiting, mean length 26.0 cm, 1.4 kg deap sea redfish - 2 individuals of 39 cm each, and some mesopelagics

21-05-2018 The weather improved further overnight and before lunch, we were able to complete another haul at 370 - 380 m, targetting a band of dense echoes. That haul was started at 07:36 at 69°40.8' N, 014°33.0' E and brought 143 kg blue whiting mean length 23.9 cm, 9.9 kg saithe (3 fish: 51, 79 and 80 cm), 0,287 kg herring (7 youngsters, mean length 20.5 cm), a deap sea redfish (0,7 kg, 35 cm) and again some mesopelagics. After the haul, we carried on on transect 11 of stratum 1 and were able to finish the last CTD/WP2 station on that transect at 14:00. The transect was completed at 19:00 and Dana headed northeastward towards transect 2 of stratum 2.

22-05-2018 Transect 2 of stratum 2 was reached in the early morning hours at about 03:30 and logging the echograms could be started. However, acoustic data were, incidentally, not recorded and the transect had to be restarted at 06:30. The weather became more and more unpleasant during the day and the ship's speed had to be reduced several times to at last < 6 knots. At 17:32, logging had to be stopped for 3 hours, because the rough state of the sea didn't allow for carrying on anymore without risking a serious damage of the towed body. Logging restarted at 20:30, but the sea state was still too rough for fishing, which is why the midnight surface haul had to be omitted.

23-05-2018 Over the night, weather improved and we were also enabled to fish again. We did a trawl haul in the morning hours starting at 06:43 UTC targetting some loose echoes at 350 - 380 m depth. The catch was at 71°23.1' N, 012°54.8' E and consisted of 34.7 kg deep sea redfish, mean length 37.7 cm, 14.2 kg blue whiting, mean length 27.8 cm, and 2.8 kg herring, mean length 30.0 cm plus a few mesopelagics. We carried on along the transect until we reached our third CTD/WP2 station of that transect. Because of the lost time due to the bad weather, we decided to shorten the transect there and turn northwards towards transect 4 of stratum 2. However, before reaching the CTD/WP2 station, we encountered scattered echoes again at 250 - 320 m depth. We started another haul on those targets at 71°24.7' N, 011°03.7' E and caught 19.8 kg deep sea redfish, mean length 37.8 cm, and 11.9 kg blue whiting, mean length 27.6 cm, 25.8 kg herring, mean length 26.0 cm, as

well as 1.2 kg mesopelagics. The shortened transect 2 of stratum 2 was finished at 17:20 with completion of the CTD/WP2 station. We headed North thereafter.

24-05-2018 Our final transect, No. 4 in stratum 2, was reached at 01:55 and was started with a CTD/WP2 station. That station was completed at 03:39 and logging of echoes started thereafter. In the afternoon at 15:00, dense echoes at 350 – 360 m depth were registered and it was decided to trawl at these target. The haul started at 15:34 at 73°01.0'N, 016°51.8'E. The catch consisted of 42.3 kg haddock, 7.8 kg cod, 1 small blue whiting (24 cm, 0.08 kg), a small herring (21.5 cm, 0.08 kg), and 0.9 kg capelin. We then headed for the final CTD/WP2 station, which was competed at 22:45, and carried on logging until the end of the transect

25-05-2018 The end of transect 4 in stratum 2 was reached at 00:45, logging of echoes data stopped, and Dana headed southwards towards the Norwegian coast to seek shelter from an upcoming strong storm that was forecasted to reach the area later the same day.

Conditions during second half of the survey:

The good weather conditions of the first half did not continue for the second part. A couple of low pressure systems passed the survey area with strong winds. The resulting rough sea state forced us to reduce the logging speed and kept us from fishing several times. Also, all work had to be stopped at two occasions, because the sea state had become too rough. In the end, Dana was forced to shorten both northernmost transect by altogether roughly 156 NM.

16 out of 18 planned CTD and WP2 stations have been taken and 11 trawl hauls had been made.

Results

Catch composition

Table 2 gives information on trawling depth, speed, wire length and weather conditions during all fishery hauls while the catch composition of all trawl hauls is presented in Table 3. Distribution of trawl hauls is shown in Figure 1. During the first half of the survey, mackerel appeared to be abundant again in the shallower catches, even though not as dominant above herring as last year. Some mackerel were also found during the second half but in much lower numbers.

Distribution and density of herring and blue whiting

Distribution and densities of Herring and Blue Whiting along the survey track are presented in Figure 1(b). Compared to 2017, herring was more abundant in the southern part of the survey area and were considerably more numerous in the western parts of the central transect. However, herring were almost absent in the Northeast of the survey area. Abundance of blue whiting was lower than last year and highest densities seemed to occur further south. Towards the North, blue whiting occurrence was confined to areas closer to the coast in the warmer Atlantic waters.

Through the scrutinizing process, most Herring marks were found as high intensity scattering marks in the first 50 m of the water column. Few marks were assigned to Herring at larger depths. Moat of the Herring marks were found in the southern transects (between 62°N and 63°N).

As for 2017, Blue whiting was particularly abundant in the southern part of the survey though patches were found consistently along all transects.

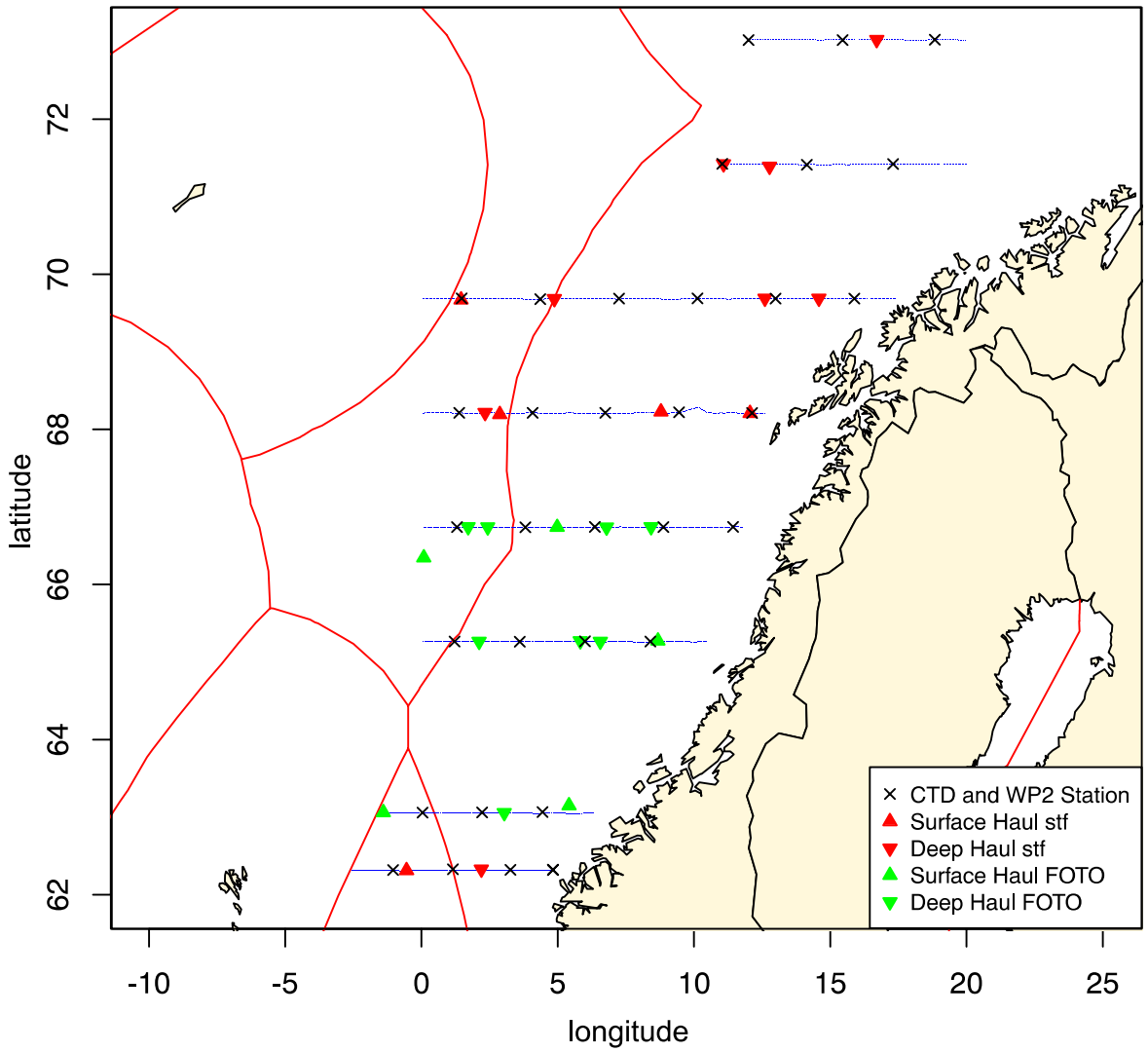
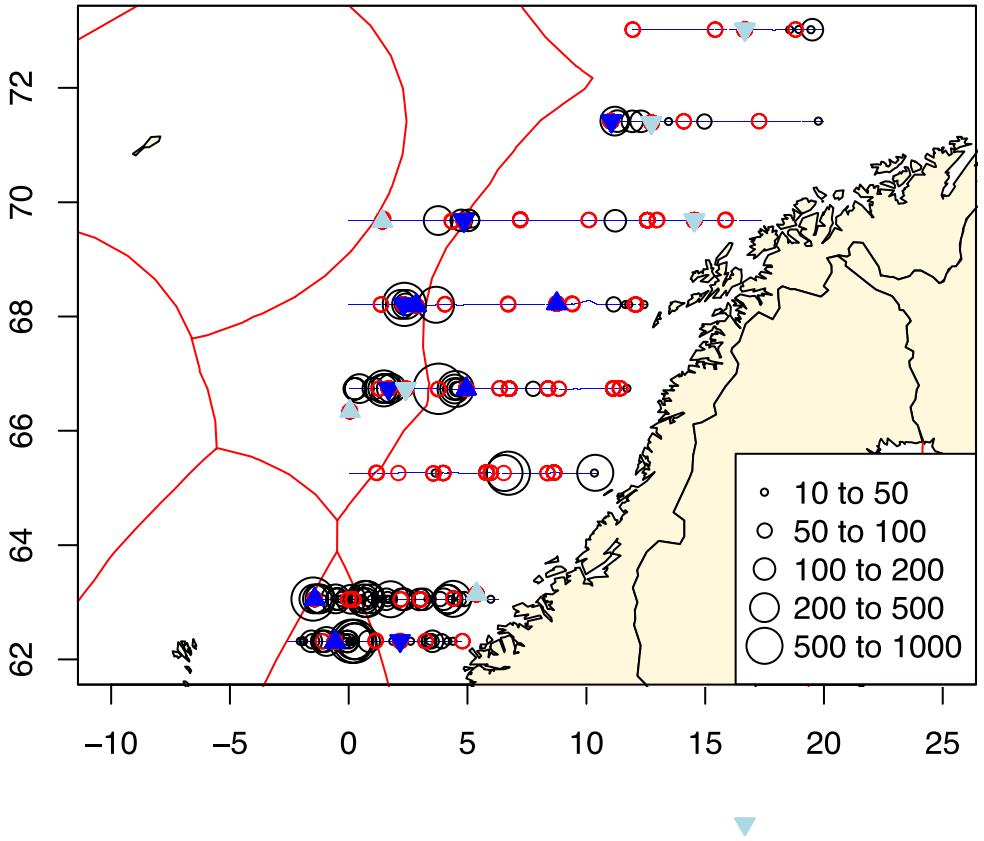


Figure 1a.Sailed transects and hydrographical stations and trawl hauls.



10 to 50
50 to 100
100 to 200
200 to 500
500 to 1000

Figure 1b.Sailed transects, trawl - and Nautical Area Scattering Coefficients (NASC's) assigned to herring and blue whiting. Triangles indicate trawl catches. Light blue > 5kg, Dark blue < 5kg; red, non-filled = no catch.

Hydrographic conditions

Sea surface temperatures were between < 6 °C in the North and > 8°C in the South. Overall, the pattern of surface temperature distribution was comparable to those of last year in the same area: warmer waters in the South and East, colder waters North and West (Figure 2). While it appeared, that waters were again warmer as last year, this was only true for the immediate surface layer. The deeper layers were all about 0.5 – 1.0 °C cooler as last year (Figures 2, 3 & 4).
As in the previous years, the water column was clearly vertically structured into warmer water masses of Atlantic origin in the upper layers and cold Arctic waters at depth (Figures 3 & 4). The magnitude of these layers varied only slightly with latitude. In the southern part of the survey area, the layer of warmer Atlantic water could be detected down to about 500 m only close to the coast. In the oceanic area, this layer was only 400 – 450 m of magnitude decreasing to < 200 m at the westernmost stations. On the northernmost transect this warm Atlantic water layer reached deeper to > 600 m east of the 0-meridian but was much cooler than in the south.

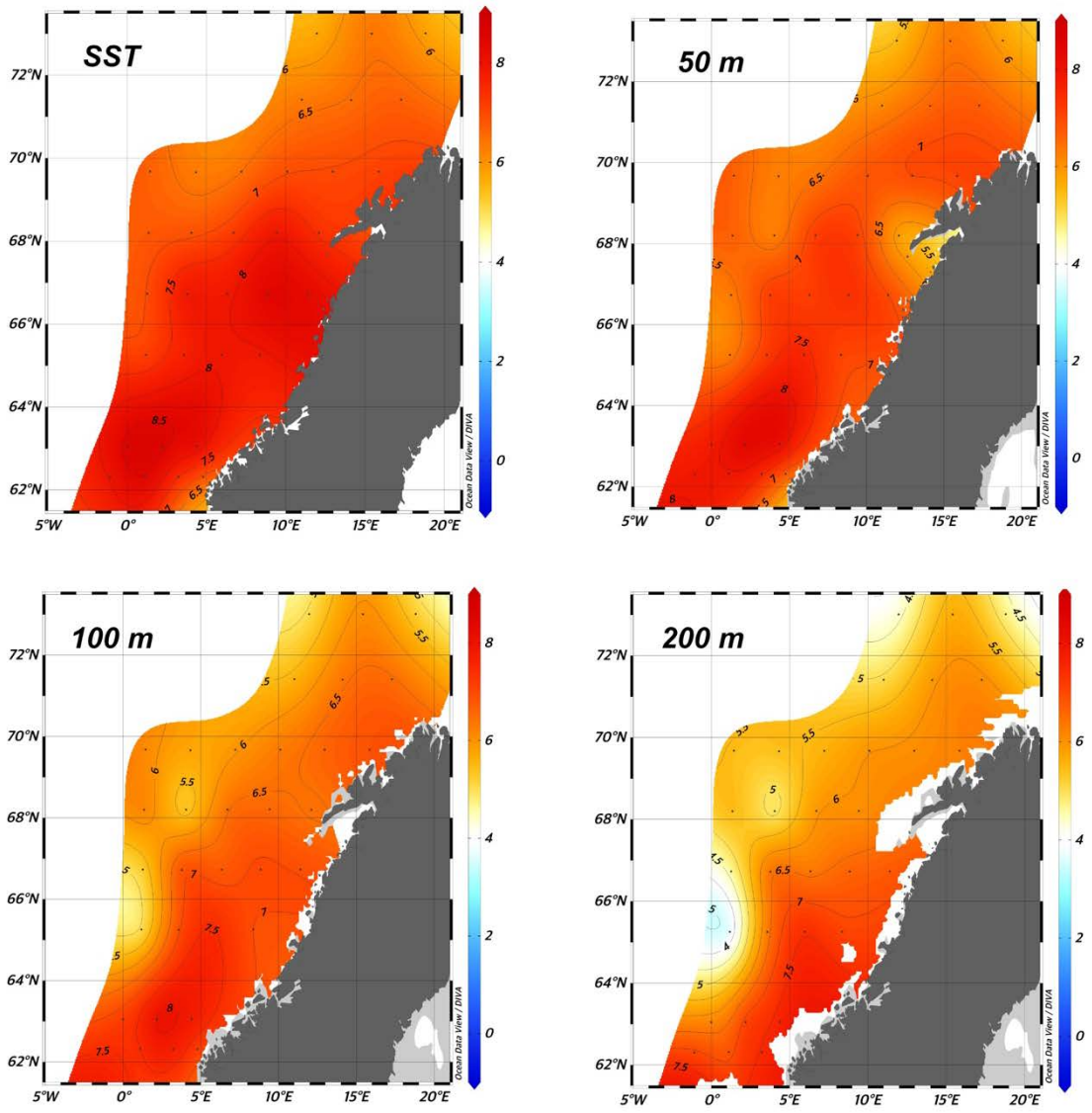


Figure 2: Horizontal temperature distribution interpolated from CTD data at selected depths: surface (top left), 50 m (top right), 100 m (bottom left), and 200 m (bottom right)

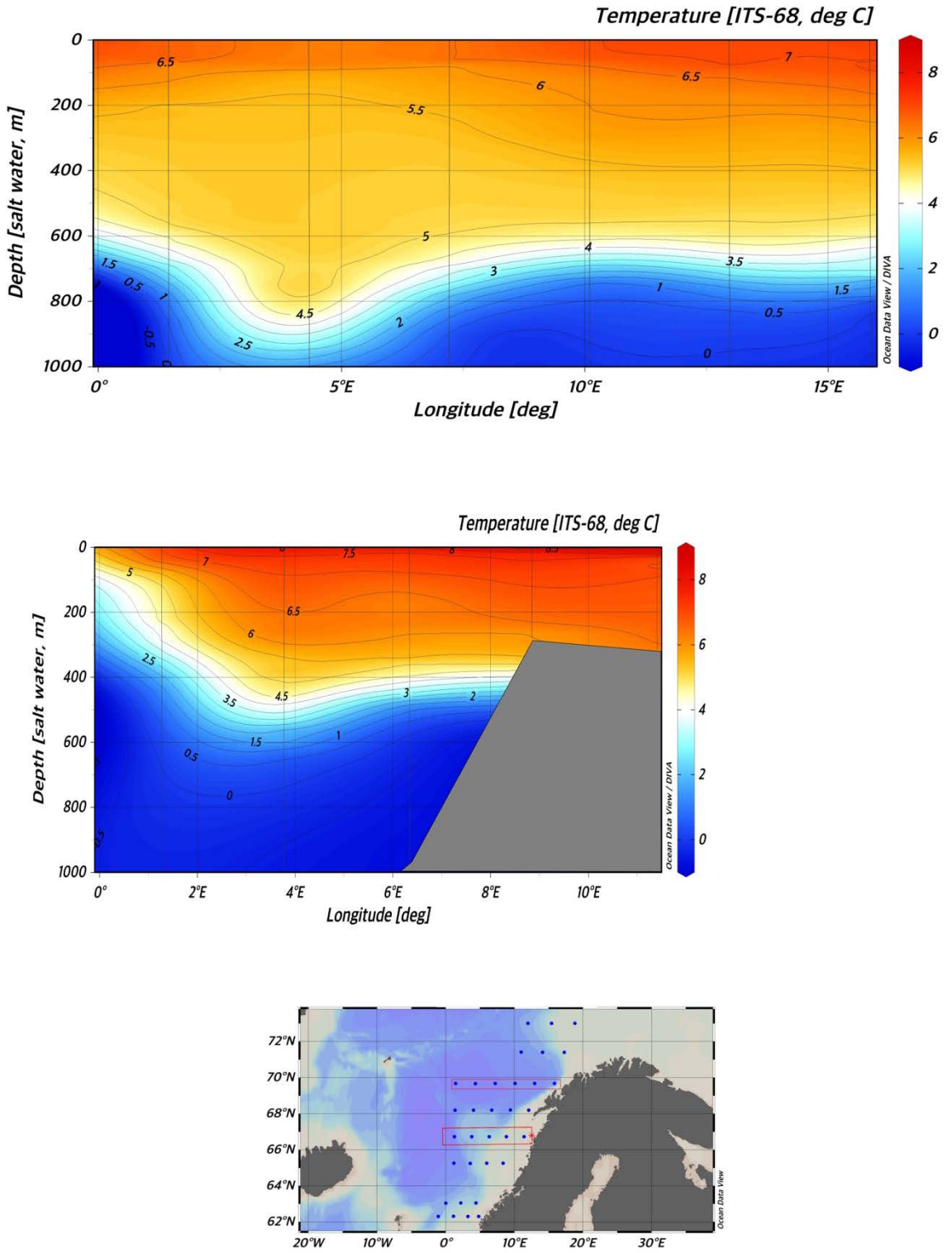


Figure 3: Vertical temperature distributions from South (bottom) to North (top) along 2 transects perpendicular to the coast. The latitudinal position of the transect can be seen in the map at the bottom.

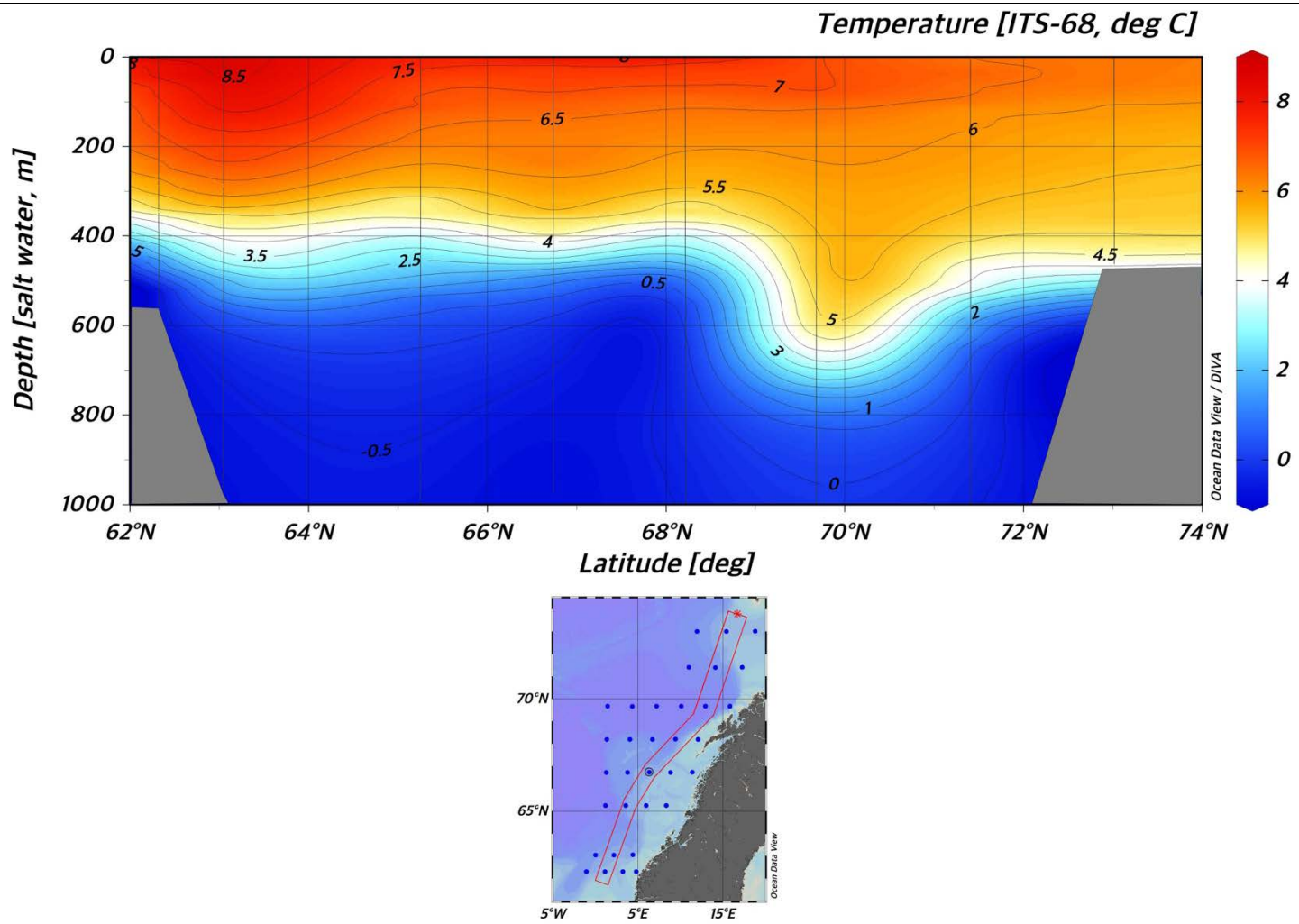


Figure 4: Vertical temperature distributions from South to North along an arbitrarily chosen transect parallel to the Norwegian coast. The selected stations can be seen in the map at the bottom.

Table 1: CTD and WP2 stations taken by R/V Dana during 1 to 30 May 2018

Station	Station Type	Year	status	Month	Day	Hour	Min	Latitude decimal	Longitude decimal	Bottom depth (m)	Wind direction	Wind speed
1	CTD	2018	Successful	5	5	12	56	60.2382	4.2267	292.5	150.9	10.2
2	SEA	2018	Fail	5	5	14	23	60.4377	4.2302	285.6	153.6	13.9
3	SEA	2018	Successful	5	5	16	20	60.7876	4.2284	330.3	165.5	11.6
4	SEA	2018	Fail	5	6	0	32	62.3096	4.7911	26.7	186.5	16.0
5	SEA	2018	Successful	5	6	0	47	62.3149	4.7888	190.7	195.8	13.7
6	SEA	2018	Successful	5	6	5	52	62.3128	3.2311	364.5	317.2	3.7
7	WP2	2018	Successful	5	6	6	28	62.3184	3.2319	361.1	321.1	6.7
9	SEA	2018	Successful	5	6	16	39	62.3185	1.1168	357.3	145.6	6.5
10	WP2	2018	Successful	5	6	17	29	62.3280	1.1391	575.7	139.5	6.9
12	SEA	2018	Successful	5	7	4	1	62.3097	-1.0773	1540.2	255.6	7.0
14	SEA	2018	Successful	5	7	20	34	63.0503	0.0028	1499.3	131.3	11.4
15	WP2	2018	Fail	5	7	21	54	63.0461	-0.0095	1496.2	120.4	9.4
16	WP2	2018	Successful	5	7	22	1	63.0462	-0.0110	1495.8	119.9	8.1
18	SEA	2018	Successful	5	8	6	46	63.0518	2.1930	479.6	158.9	14.1
19	WP2	2018	Successful	5	8	7	58	63.0422	2.1814	975.6	158.6	13.1
21	SEA	2018	Successful	5	8	17	48	63.0564	4.4056	919.8	164.3	17.2
22	WP2	2018	Successful	5	8	18	59	63.0670	4.4035	919.7	176.6	15.6
25	SEA	2018	Successful	5	10	2	17	65.2566	8.3635	40.6	139.3	6.2
26	WP2	2018	Successful	5	10	3	5	65.2540	8.3692	318.5	161.0	7.0
28	SEA	2018	Successful	5	10	13	8	65.2591	5.9665	515.2	164.5	3.5
29	WP2	2018	Successful	5	10	13	53	65.2614	5.9656	515.1	163.4	4.1
32	SEA	2018	Successful	5	11	2	11	65.2536	3.5716	149.0	229.1	5.2
33	WP2	2018	Successful	5	11	3	32	65.2470	3.5514	1265.3	216.7	4.5
35	SEA	2018	Successful	5	11	12	55	65.2570	1.1816	2967.0	122.3	5.9
36	WP2	2018	Successful	5	11	14	13	65.2630	1.1613	2970.8	121.8	3.9
38	SEA	2018	Successful	5	12	5	22	66.7323	1.2692	2553.7	77.3	6.5
39	WP2	2018	Successful	5	12	6	38	66.7374	1.2905	2499.9	72.9	8.8
42	SEA	2018	Successful	5	12	18	35	66.7283	3.7811	1377.5	161.7	1.9
43	WP2	2018	Successful	5	12	19	52	66.7193	3.7596	1379.8	141.2	2.2
45	SEA	2018	Successful	5	13	4	11	66.7346	6.3314	982.6	211.8	3.8
46	WP2	2018	Successful	5	13	5	22	66.7410	6.3651	983.7	203.5	5.8
49	SEA	2018	Successful	5	13	17	16	66.7310	8.8441	280.6	344.5	1.9
50	WP2	2018	Successful	5	13	17	49	66.7297	8.8452	280.1	340.4	1.9
52	SEA	2018	Successful	5	14	1	56	66.7343	11.4005	318.8	45.4	6.3
53	WP2	2018	Fail	5	14	2	29	66.7386	11.4136	320.4	50.5	6.3
54	WP2	2018	Successful	5	14	2	56	66.7401	11.4295	321.0	59.8	4.4
55	SEA	2018	Successful	5	15	23	10	68.2028	12.0993	145.6	56.9	6.7
56	WP2	2018	Successful	5	15	23	33	68.2016	12.0966	146.4	50.8	6.1
58	SEA	2018	Successful	5	16	8	3	68.2110	9.4204	2155.5	175.4	15.6
59	WP2	2018	Successful	5	16	9	19	68.2260	9.3958	2212.1	177.7	15.0
61	SEA	2018	Successful	5	17	10	11	68.2044	6.7141	1897.4	236.0	5.1
62	WP2	2018	Successful	5	17	11	34	68.2210	6.6989	1961.0	249.9	4.0
63	SEA	2018	Successful	5	17	18	11	68.2046	4.0464	1766.1	247.8	10.4
64	WP2	2018	Successful	5	17	19	29	68.2130	4.0563	1814.6	243.0	9.2
67	SEA	2018	Successful	5	18	8	6	68.2042	1.3545	2912.2	199.6	12.9
68	WP2	2018	Successful	5	18	9	17	68.2063	1.3619	2905.7	195.4	11.3
70	SEA	2018	Successful	5	19	1	27	69.6798	1.4425	3228.2	262.7	15.9
71	WP2	2018	Successful	5	19	2	47	69.7058	1.4540	3229.7	259.2	19.5
72	SEA	2018	Successful	5	19	10	31	69.6701	4.3243	3221.4	250.3	13.9
73	WP2	2018	Successful	5	19	11	50	69.6529	4.3561	3221.9	250.0	15.6
75	SEA	2018	Successful	5	20	5	4	69.6768	7.2157	3150.6	185.2	15.3
76	WP2	2018	Successful	5	20	6	17	69.6909	7.2102	3150.6	178.7	17.2
77	WP2	2018	Successful	5	20	6	47	69.6964	7.2271	3149.4	182.1	16.4
78	SEA	2018	Successful	5	20	14	6	69.6800	10.0932	2939.5	227.4	11.7
79	WP2	2018	Successful	5	20	15	24	69.6860	10.1077	2938.4	231.2	13.7
81	SEA	2018	Successful	5	21	1	10	69.6770	12.9601	2796.9	218.4	11.9
82	WP2	2018	Successful	5	21	2	26	69.6865	12.9843	2792.5	216.8	9.4
84	SEA	2018	Successful	5	21	12	7	69.6777	15.8505	1335.9	214.9	10.0
85	WP2	2018	Successful	5	21	13	24	69.6939	15.8758	1422.9	217.5	12.3
86	SEA	2018	Successful	5	22	11	48	71.4119	17.2712	307.4	227.1	11.8
87	WP2	2018	Successful	5	22	12	22	71.4134	17.2740	306.8	231.8	10.4
88	SEA	2018	Successful	5	23	1	14	71.4044	14.1072	1786.5	282.6	9.2
89	WP2	2018	Successful	5	23	2	28	71.4116	14.1053	1779.7	297.3	8.6
92	SEA	2018	Successful	5	23	15	37	71.4141	11.0033	318.1	185.7	11.9
93	WP2	2018	Successful	5	23	16	52	71.4181	11.0220	2434.2	196.2	12.6
94	SEA	2018	Successful	5	24	1	50	73.0111	11.9673	1761.1	229.4	12.4
95	WP2	2018	Successful	5	24	3	8	73.0217	11.9433	1767.3	250.8	14.6
96	SEA	2018	Successful	5	24	10	3	73.0108	15.4192	466.5	257.9	11.9
97	WP2	2018	Successful	5	24	10	47	73.0169	15.4315	467.2	261.2	14.5
99	SEA	2018	Successful	5	24	21	29	73.0163	18.8035	417.4	263.5	8.6
100	WP2	2018	Successful	5	24	22	5	73.0215	18.8083	423.0	275.2	8.8

Table 2: Fishing stations taken by R/V Dana during 1 to 30 May 2018

Country	Vessel	Cruise	Station	Gear	Month	Day	Hour	Min	Lat_decimal	Lon_decimal	WinDir (deg)	Wind Speed (m/s)	Towing speed knots	Towing Time (min)	Catch weight (kg)	gear Depth (8m)
DK	OXBH	201805	8	stf	5	6	11	42	62.31910	2.16180	241.2	3.0	4.3	60.2	26.9	80
DK	OXBH	201805	11	stf	5	6	23	18	62.30508	-0.58000	330.6	5.8	3.8	60.2	9.2	0
DK	OXBH	201805	13	FOTØ	5	7	14	52	63.05220	-1.43255	140.6	5.2	3.8	59.9	194.4	15
DK	OXBH	201805	17	FOTØ	5	7	23	24	63.04562	0.18182	132.3	10.2	3.9	60.0	240.5	NA
DK	OXBH	201805	20	FOTØ	5	8	11	56	63.04722	3.00442	137.4	12.7	4.3	59.9	76.1	350
DK	OXBH	201805	23	FOTØ	5	8	23	45	63.14200	5.37980	195.9	12.8	4.4	59.9	879.0	0
DK	OXBH	201805	24	FOTØ	5	9	23	21	65.26465	8.64247	140.8	10.1	3.9	60.1	43.6	0
DK	OXBH	201805	27	FOTØ	5	10	8	35	65.25713	6.52792	182.3	4.7	4.0	60.2	1.9	125
DK	OXBH	201805	30	FOTØ	5	10	15	53	65.26293	5.79228	173.8	4.5	4.0	60.0	5.9	360
DK	OXBH	201805	31	FOTØ	5	10	23	9	65.25910	3.96987	201.2	7.2	4.5	60.0	250.0	NA
DK	OXBH	201805	34	FOTØ	5	11	8	25	65.25648	2.08122	181.8	6.4	4.0	60.0	2.8	210
DK	OXBH	201805	37	FOTØ	5	11	23	13	66.33735	0.04990	121.3	7.5	4.3	60.0	3.4	0
DK	OXBH	201805	40	FOTØ	5	12	8	34	66.73367	1.67697	69.1	5.5	4.0	59.9	53.3	180
DK	OXBH	201805	41	FOTØ	5	12	13	18	66.73098	2.39855	30.9	6.6	4.5	60.0	29.7	350
DK	OXBH	201805	44	FOTØ	5	12	23	7	66.73022	4.94623	251.1	5.0	4.1	60.0	59.9	0
DK	OXBH	201805	47	FOTØ	5	13	7	29	66.72992	6.75553	214.9	3.1	3.5	60.0	6.7	325
DK	OXBH	201805	48	FOTØ	5	13	14	1	66.73415	8.39055	49.4	0.6	4.1	60.2	440.0	135
DK	OXBH	201805	51	FOTØ	5	13	23	7	66.73545	11.14250	16.9	6.2	4.2	60.2	49.8	NA
DK	OXBH	201805	57	stf	5	16	0	11	68.20047	12.02233	61.2	5.7	3.0	60.1	7.3	10
DK	OXBH	201805	60	stf	5	17	0	35	68.21977	8.75573	204.2	11.0	3.8	29.9	12.5	10
DK	OXBH	201805	65	stf	5	17	23	32	68.18528	2.84018	239.9	10.9	4.0	60.1	298.0	10
DK	OXBH	201805	66	stf	5	18	3	43	68.20638	2.30008	226.9	8.7	3.2	45.5	86.5	210
DK	OXBH	201805	69	stf	5	18	23	21	69.66432	1.41687	213.8	11.8	3.0	60.1	5.0	10
DK	OXBH	201805	74	stf	5	19	22	5	69.67608	4.84212	154.0	6.6	3.9	76.5	93.7	210
DK	OXBH	201805	80	stf	5	20	22	22	69.67947	12.56872	224.1	9.8	3.9	40.0	15.5	300
DK	OXBH	201805	83	stf	5	21	7	36	69.67992	14.55008	234.5	12.1	3.3	60.0	160.0	381
DK	OXBH	201805	90	stf	5	23	6	50	71.38227	12.73812	294.1	4.7	3.6	60.1	59.2	350
DK	OXBH	201805	91	stf	5	23	13	13	71.41173	11.04825	213.5	6.3	3.6	60.2	66.5	350
DK	OXBH	201805	98	stf	5	24	15	34	73.01633	16.67228	255.9	13.0	4.0	60.2	53.2	330

Table 3: Catch composition in trawl stations taken by R/V Dana during 1 to 30 May 2018

Station	Latitude	Longitude	average Depth (m)	Total catch (kg)	*Arctozenus risso*	*Argentina silus*	*Benthosema glaciale*	Cephalopoda	*Clupea harengus*	*Cyclopterus lumpus*	*Euphausiidae sp.*	*Eutrigla gurnardus*	*Gadiculus argenteus*	*Gadus morhua*	*Mallotus villosus*	*Maurolicus muelleri*	*Melanogrammus aeglefinus*	*Micromesistius poutassou*	*Notoscopelus elongatus*	*Pollachius virens*	*Salmo salar*	*Scomber scombrus*	Scyphozoa sp.	*Sebastes mentella*
8	62.19.146 N	002.09.708 E	80	26.9	0.0	0.0	0.0	0.0	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0
11	62.18.305 N	000.34.800 W	0	9.2	0.0	0.0	0.1	0.0	6.8	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	66.5	0.0	0.0	0.0	119.7	0.0	0.0
13	63.03.132 N	001.25.953 W	15	194.4	0.0	0.0	0.0	0.0	162.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.9	0.0	0.0
17	63.02.737 N	000.10.909 E	0	240.5	0.0	0.0	0.0	0.0	664.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.4	0.0	0.0	0.0	180.8	0.0	0.0
20	63.02.833 N	003.00.265 E	350	76.1	0.2	0.0	3.2	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.1	0.0	0.0	0.0	0.0	0.0
23	63.08.520 N	005.22.788 E	0	879.0	0.0	0.0	0.1	0.6	1.0	0.0	58.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.6	0.4	0.0
24	65.15.879 N	008.38.548 E	0	43.6	0.0	0.0	0.0	0.0	0.0	10.2	25.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.6	0.0
27	65.15.428 N	006.31.675 E	125	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	65.15.776 N	005.47.537 E	360	5.9	1.3	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0	1.0	0.0	0.0	2.6	0.0	0.0	0.0
31	65.15.546 N	003.58.192 E	0	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	248.8	0.0	0.0
34	65.15.389 N	002.04.873 E	210	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0
37	66.20.241 N	000.02.994 E	0	3.4	0.0	0.0	0.0	0.0	1.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	66.44.020 N	001.40.618 E	180	53.3	0.0	0.0	0.0	0.0	47.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	1.3	0.0
41	66.43.859 N	002.23.913 E	350	29.7	0.6	0.5	0.5	0.0	0.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	25.2	0.0	0.0	0.0	0.0	1.2	0.7
44	66.43.813 N	004.56.774 E	0	59.9	0.0	0.0	0.0	0.0	25.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	411.3	0.0	0.0
47	66.43.795 N	006.45.332 E	325	6.7	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	2.4	0.0	3.8	0.0	0.0	0.1	0.0
48	66.44.049 N	008.23.433 E	135	440.0	0.0	0.0	0.0	0.0	0.0	0.0	49.1	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	66.44.127 N	011.08.550 E	0	49.8	0.0	0.0	0.0	0.0	0.5	18.1	40.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
57	68.12.028 N	012.01.340 E	10	7.3	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	68.13.186 N	008.45.344 E	10	12.5	0.0	0.0	0.0	0.0	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.4	0.0	0.0
65	68.11.117 N	002.50.411 E	10	298.0	0.0	0.0	0.0	0.0	290.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0
66	68.12.383 N	002.18.005 E	210	86.5	0.2	0.0	0.0	0.0	83.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
69	69.39.859 N	001.25.012 E	10	5.0	0.0	0.0	0.0	0.9	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
74	69.40.565 N	004.50.527 E	210	93.7	0.3	0.0	0.7	0.0	86.6	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	1.6
80	69.40.768 N	012.34.123 E	300	15.5	0.4	0.0	0.6	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0	3.6	1.4
83	69.40.795 N	014.33.005 E	381	160.0	0.1	0.0	0.4	0.1	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	142.1	0.0	9.9	0.0	0.0	6.3	0.7
90	71.22.936 N	012.44.287 E	350	59.2	0.3	0.0	1.4	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2	0.0	0.0	0.0	0.0	5.8	34.7
91	71.24.704 N	011.02.895 E	350	66.5	0.5	0.0	0.9	0.0	25.8	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0	0.0	0.0	7.3	19.8
98	73.00.980 N	016.40.337 E	330	53.2	0.3	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.0	7.8	0.9	0.0	42.4	0.1	0.0	0.0	0.0	0.0	1.4	0.0

Annex 1 - Calibration report.

Annex 1 - Calibration report for the towed body mounted transducer used for abundance estimation.

Transceiver Menu	
Frequency	38 kHz
Sound speed	1466.4 $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-20.5 dB
Default Transducer Sv gain	25.55 dB
3 dB Beamwidth	6.8°
TS of sphere	-33.6 dB
Range to sphere in calibration	11.24 m
Measured NASCvalue for calibration	22100 m^2/nmi^2
Calibration factor for NASCs	1.00
Absorption coeff	8.197 dB/km
Log Menu	
Distance	1,0 n.mi. using GPS-speed
Operation Menu	
Ping interval	1 s
Analysis settings	
Bottom margin (backstep)	1.0 m
Integration start (absolute) depth	7 - 9 m
Range of thresholds used	-85 dB