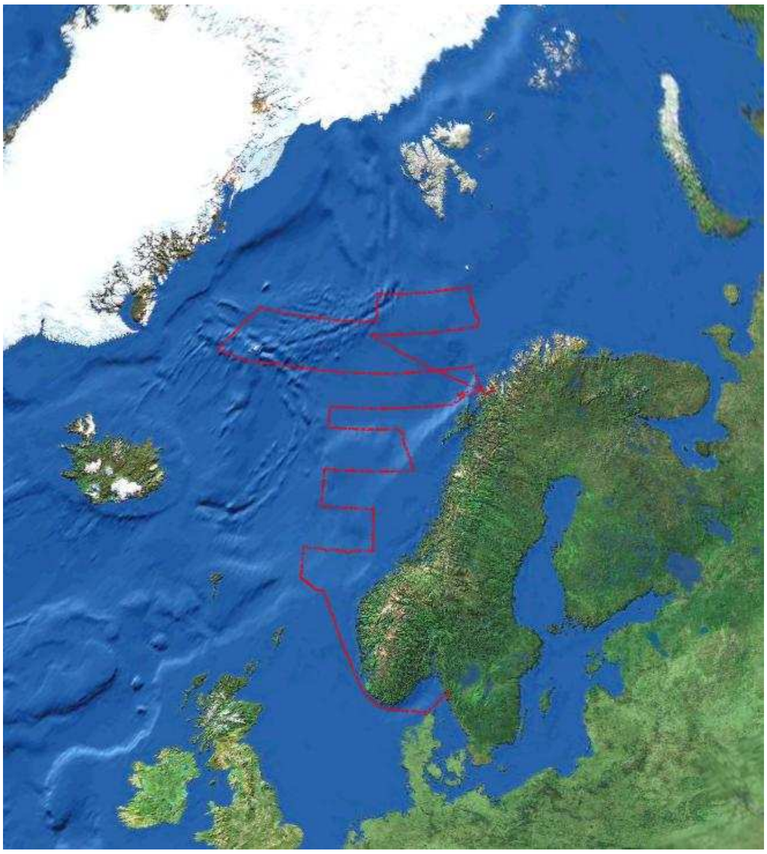
Preliminary Cruise report



The International Ecosystem survey in the Nordic Seas in May 2010

R/V DANA Cruise No. 3/2010

Calibration of Echo-sounders

27/4 – 29/4 2010

International Acoustic Monitoring of Herring and Blue whiting

30/4 – 25/5 2010

Cruise participants

Calibration 27/4 – 29/4

Bo Lundgren	Denmark (Cruise leader)
Bram Couperus	Netherlands (Ass. Cruise leader)
Torben Filt Jensen	Denmark
Peter Faber	Denmark
Thyge Dyrnesli	Denmark
Tommy Nielsen	Denmark
Jesper Knudsen	Denmark
Erik Petersen	Denmark
Steen Silberg	Denmark

Acoustic monitoring 30/4 - 12/5

Bram Couperus (Cruise leader) (acoustic)	Netherlands
Sascha Fassler (acoustic)	Netherlands
Bill Mulligan (acoustic)	England
Peter V. Larsen (plankton/fishlab)	Denmark
Susanne Hansen (plankton/fishlab)	Denmark
Björn Fagerholm(plankton/fishlab)	Sweden
Mark Etherton (plankton/fishlab)	England
Thyge Dyrnesli (technician)	Denmark

Acoustic monitoring 12/5-25/5

Karl-Johan Staehr (Cruise leader) (acoustic)	Denmark
Conor Ryan (acoustic)	Ireland
Torben Filt Jensen (acoustic)	Denmark
Frank I. Hansen (plankton/fishlab)	Denmark
Helle Andersen (plankton/fishlab)	Denmark
Fredrik Franzén (plankton/fishlab)	Sweden
Matthias Kloppmann (plankton/fishlab)	Germany
Thyge Dyrnesli (technician)	Denmark

Cruise summary

Effective survey days	19
Mileage	3745
Number of trawl hauls	21
Number of CTD stations	47
Number of WP2 stations	52
Number of biological samples - herring	265
Number of biological samples – blue whiting	17
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 on 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 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 28th and 29th April 2010. The calibration was performed according standard operation procedures as described in the WGNAPES/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 EK60 using a 38 kHz splitbeam transducer, mounted in a towed body (paravane). During trawling, acoustic data was collected by the EK60 using the hull mounted 38 kHz transducer: the recordings during trawling were only used for scrutiny of the echograms. Echo integration was conducted continuously and the data was scrutinized daily during the survey utilizing SIMRAD BI500 and LSSS software (only first half).

A biomass estimate will not be carried out based data of this cruise alone, but the data will be included in the survey's database from all participating vessels from which a biomass index will be calculated. The final estimate methodology is presented in the WGNAPES report of August 2010 (Hamburg).

3745 NM has been integrated and scrutinized along the cruise track (Figure 1)

Hydrographical and zooplankton data

For approximately every 60 nautical miles plankton samples were taken by means of vertical tows from 200 m to the surface with a WP2 equipped with 180 µm mesh. The sample was fractioned into three size groups (180 µm, 1000 µm and 2000 µm) of zooplankton for biomass estimation. The biomass samples were oven-dried on board at 70 °C for 24 hours, and subsequently frozen for later weight determination at DTU Aqua.

In the southern part of the survey area (up to 65°30 N) 6 extra WP2 stations were taken in between the standard stations. These plankton samples together with the standard samples were examined for mackerel eggs.

At the same positions as for standard plankton sampling, 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: depth (pressure), temperature,

Figure 1. Cruise track covered by R/V Dana from 2 May to 25 May 2010.

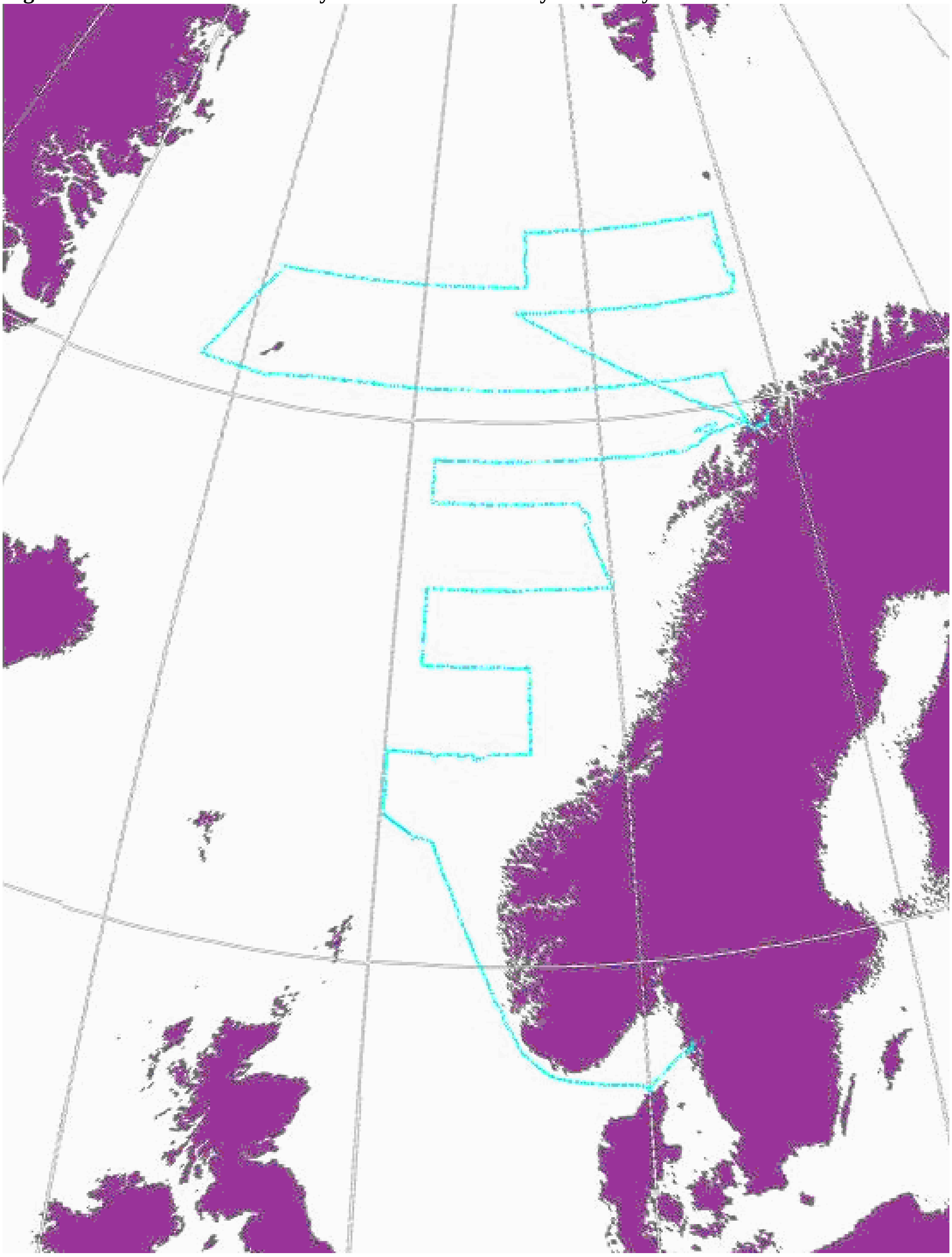
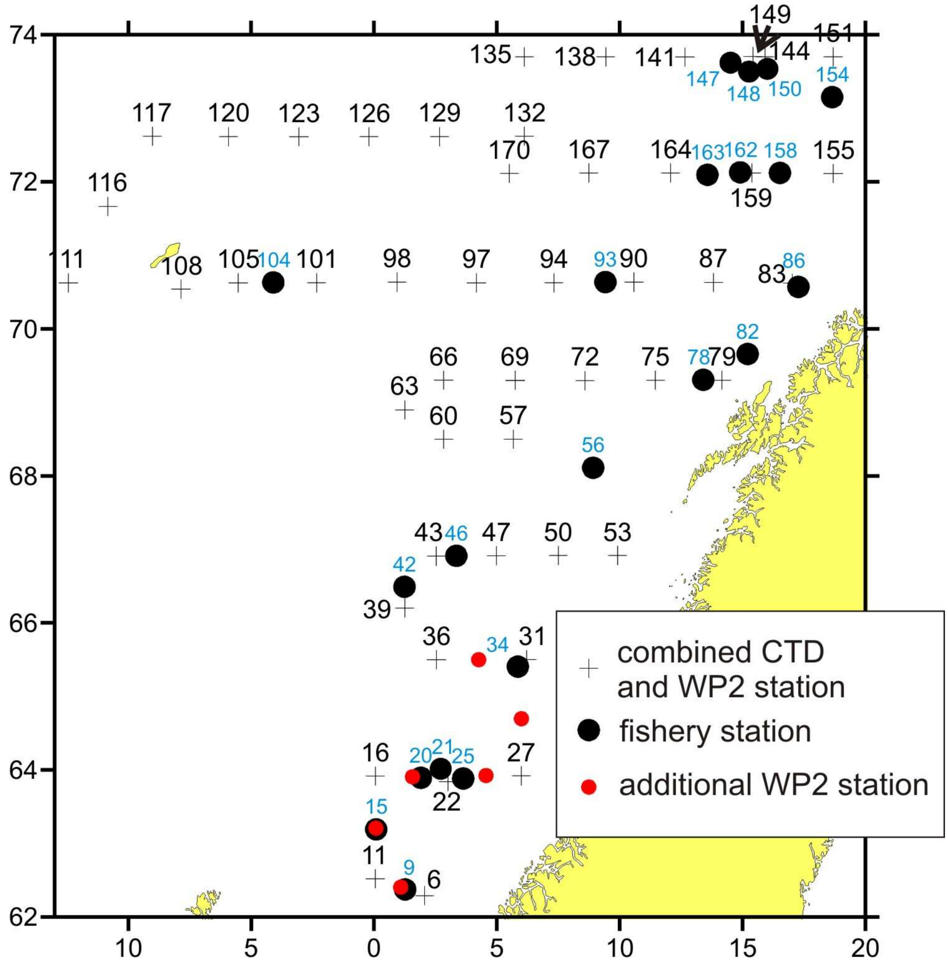


Figure 2. CTD stations, trawl stations and WP2 stations taken by R/V Dana from 2 May to 25 May 2010.



conductivity (salinity) and oxygen. All together Dana carried out 46 combined CTD and WP2 stations (Table 1 and 2, Figure 2).

Each day water samples were taken once close to the surface and at 1000 m depth in order to calibrate the conductivity sensor of the CTD unit. 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 analysis 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 "*Millionaire Trawl*", was used either at the surface or in midwater down to a maximum of 450 m depth. A total of 21 trawl stations were carried out during the survey. (Table 3, Figure 2)

Catches were sorted and weighed by species. Length measurements were taken for all species (up to a maximum of 400 specimens). For herring and blue whiting 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 scales and otoliths were sampled and mounted on microscope slices whereas in blue whiting only otoliths were taken. Scales and otoliths will be read at Aqua DTU. In total 265 samples of individual herring and 17samples of individual blue whiting were taken.

By request from vTI/SF in Hamburg has redfish in the catch been examined for stomach content, maturity, parasites and pigmentation. Only 2 specimens were caught, both in st.163.

By request of the planning committee of the Workshop on Sexual Maturity Staging of Herring and Sprat (WKMSHS) we have been asked to collect material. Material has been collected from 39 Herring (21 females and 18 males). Otoliths and perseverated ovaries has been stored and will be delivered to the committee.

All trawl data were entered into the Babelfisk database and validated. The data were also stored in the WGNAPES formats and sent by email to the WGNAPES database at the Faeroes at the end of the survey.

Itinerary of the survey

Dana left Hirtshals at the 27th April at 11.00 UTC for calibration of acoustic equipment at Bornö in Sweden. All transducers were calibrated and Dana arrived in Hirtshals again at 29th April at 16.27 UTC.

Dana left Hirtshals to start the acoustic survey on the 30th of April at 10.00 UTC. During steaming to the starting position at 67°18N – 2°03E the vessel had to sail against the wind, forcing the vessel to slow down to 6-8 knots. As a result the start of the survey was later than anticipated. Echo integration started at 4.30 UTC on 2nd of May at 62°18 N, 02°05 E. The planned intercalibration with Magnus Heinasson had to be cancelled due to a shortage of time for both Magnus Heinasson and Dana; also because MH reported that there was no fish at the intended meeting point.

From the first haul on there were problems with the software of the Scanmar depth sensors. During the first haul, a haul at 400m, a lot of time was lost due to trials with the depth sensors. As it turned out during the rest of the first half of the trip, we were not able to sample the target marks other than at the surface.

During the first 3 days extra WP2 samples were taken for analysis on the quantity of mackerel eggs. From the 5th of May onwards it was decided to cancel these additional stations because of shortage in time. Also due to time, the western transects at 65°30 N, 66°54N, 68°30 N and 69°18 N, were shortened by 1°15 degrees longitude in the western end.

A slight damage on the towing cable of the towed body was discovered on the 7th of May at 16.30 UTC. Because of this damage and the increasing wind the vessel had to slow down again for a day. After inspection during better weather conditions, it was found the damage was not as bad as it first looked and it was decided that it would be possible to speed up again. A small repair was applied.

Integration on first half on the survey was ended 11th May at 05.59 UTC at 69°37N, 16°55E. Tromsø was entered at 11th May at 12.12 UTC for change of crew.

Dana left Tromsø at 12th May at 17.00 UTC. The work on second half of the survey was initiated at 13th May at 01.00 UTC on 70°37N, 17°01E with a CTD/WP2 station.

The survey continued west at a transect at 70*38 N. Shortly after initiating second half of the survey problems with the stern thruster occurred. The problems increased and a CTD/WP2 station at 70°38N, 04°10E had to be stopped in the middle of the station due to total fall out of the stern thruster. Problems were solved by moving parts from the front thruster to the stern thruster. This process gave a delay at 3-4 hours.

The original cruise transects were finalized 21 May at 18 UTC, due to the fact that very little fishing was carried out as there was no indication of fish on the echograms. In agreement with the international survey coordinator an additional transect 72°07 N, 18°40 E to 72°07 N, 05°03 E was added for Dana.

Integration was stopped 25 May at 70°02 N, 16°03 E at 21.30 UTC. The pilot was taken onboard at 03.58 UTC and the survey was ended in Tromsø at 06.25 UTC.

Results

Catch composition

The catch composition of all trawl hauls are presented in Table 4, Table 3 gives information on trawling position and depth. Distribution of trawl hauls is shown in Figure 2.

Distribution and density of herring and blue whiting

Distribution and densities of herring and blue whiting along the survey track are presented in Figure 3 and 4.

During the first half a lot of herring was recorded southwest of the Lofoten. In the southern part of the area covered, the echogram was dominated by a layer at 100-200 meters consisting of Pearlsides. During the northern most transect 69°18N no herring was encountered except between approximately 69°18N – 13°00E and 69°18N – 14°09E with a lot of herring schools at 20-100m.

On the second half of the survey herring was recorded east of 8° E and up to the shallower waters around Björnö. West of 5° E no concentrations of fish were seen.

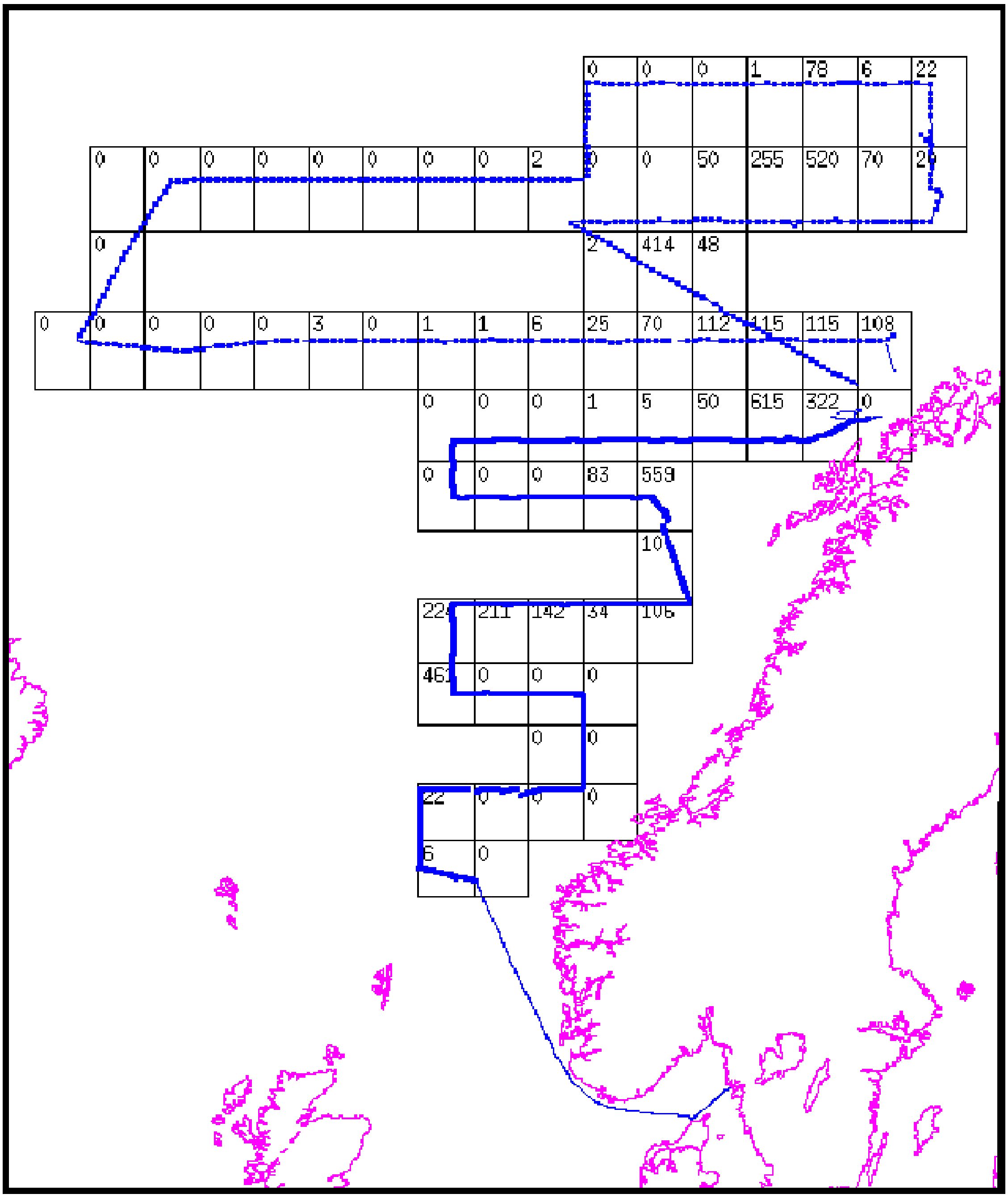


Figure 3: Distribution and densities of herring recorded by R/V Dana during 2 to 24 May 2010

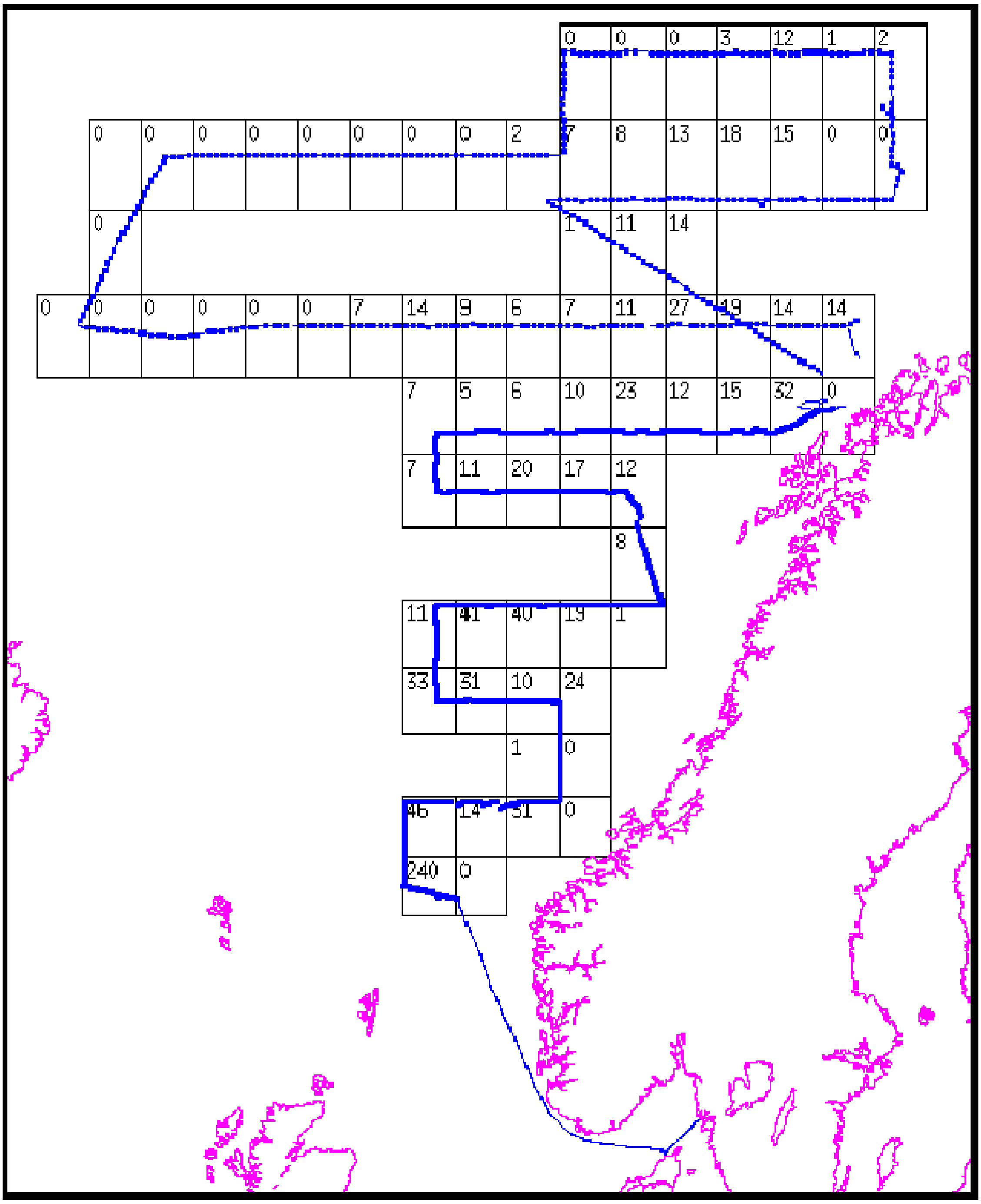


Figure 4: Distribution and densities of blue whiting recorded by R/V Dana during 2 to 24 May 2010

Mackerel

During the 2009 survey, for the first time spawning mackerel were encountered up to almost 68° N. This raised concerns about the northern margin of the spawning area, particularly for the 2010 mackerel egg survey that only covers the area up to 62°N. Therefore, WGMEGS requested participants in IESNS to sample mackerel eggs from there standard WP2 plankton tows supplemented by additional stations halfway between the standard ones. During this cruise 6 additional WP2 hauls were conducted, and all WP2 samples up to 67°N were examined for fish eggs. Furthermore, any mackerel that were encountered in the fishery hauls were examined for sex and maturity.

Adult mackerel were encountered in two fishery hauls at stations 15 and 25, altogether 72 kg or 263 individuals. They measured between 30 and 40 cm TL, the majority being between 32 and 35 cm TL. There were only 5 female and 1 male of maturity stages > 3 meaning that 97.8% of the mackerel had not yet reached the spawning stage. Consequently, only 1 mackerel egg of developmental stage 1a was encountered at WP2 station 29 (Figure 5). There were 109 other eggs in those examined samples of which the majority were eggs of pearlsides, *Maurolicus muelleri*.

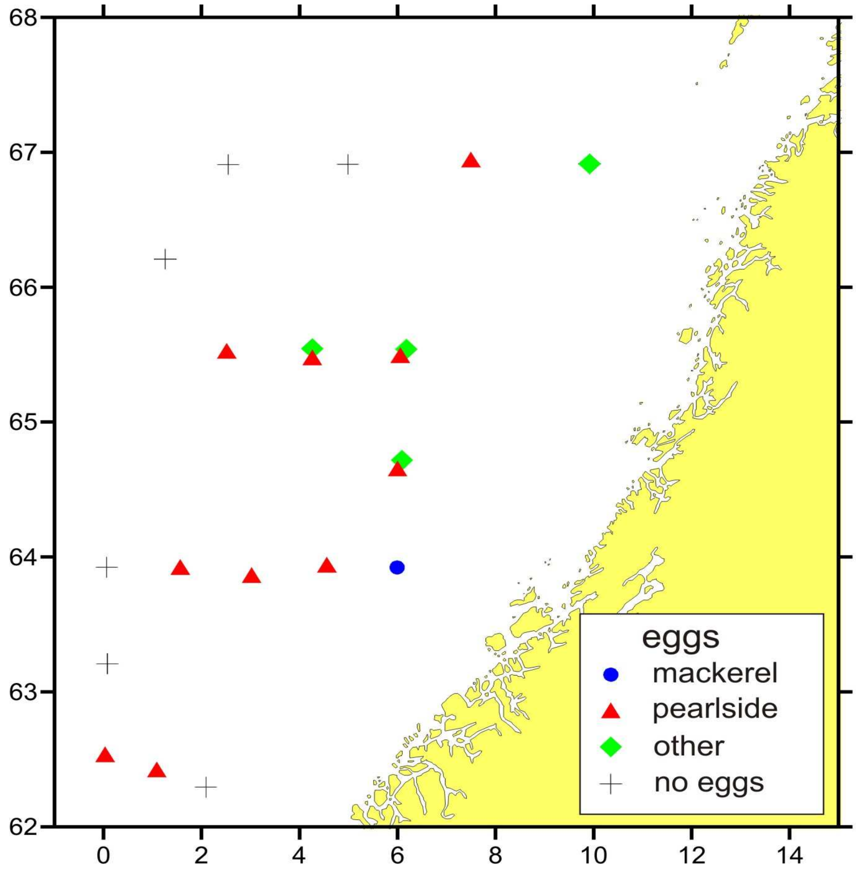


Figure 5: Findings of fish eggs in WP2 samples west of Norway

Hydrographic conditions

The observed temperature range during the cruise was again similar to that of previous cruises with surface values between 5 and > 8°C in the eastern part of the survey area decreasing to values < 0°C in the northwest of Jan Mayen. However and despite the similar range, temperatures in the North were distinctly cooler than in previous years. Particularly in the surface, the 7°C isothermal reached only up to approximately 68°N while in the past it could be encountered up to the northernmost parts of the survey area (Figure 6).

In the eastern part of the survey area, the water column was clearly vertically structured into warmer water masses of Atlantic origin in the upper layers and cold Arctic waters at depth (Figure 7). The magnitude of these layers varied with latitude. In the southern part of the survey area, Atlantic water could be detected down to about 400 m. This layer deepened towards > 600 m at about 69°20’ N. North of that Latitude the layer of Atlantic water quickly became shallower and the influence of Arctic water became more prominent throughout the water column (Figure 7). The frontal area between cold arctic water and warmer Atlantic water was apparent at all depths from the surface and down to 200 m only in the northwest of the survey area. The front was clearly visible, running from 5° W southeast of Jan Mayen to about 5° E at the northern margin of the survey area. In the southern part of the survey area the front became apparent only at depths below 100 m. (Figure 6). The warmer North Atlantic water formed a rather narrow tongue that stretched far northwards with temperatures > 6 °C in the surface layers. With increasing depth this core of warm water quickly eroded being more confined to areas closer to the Norwegian coast and forming a narrow band of warmer water centered along the 15° meridian in the North.

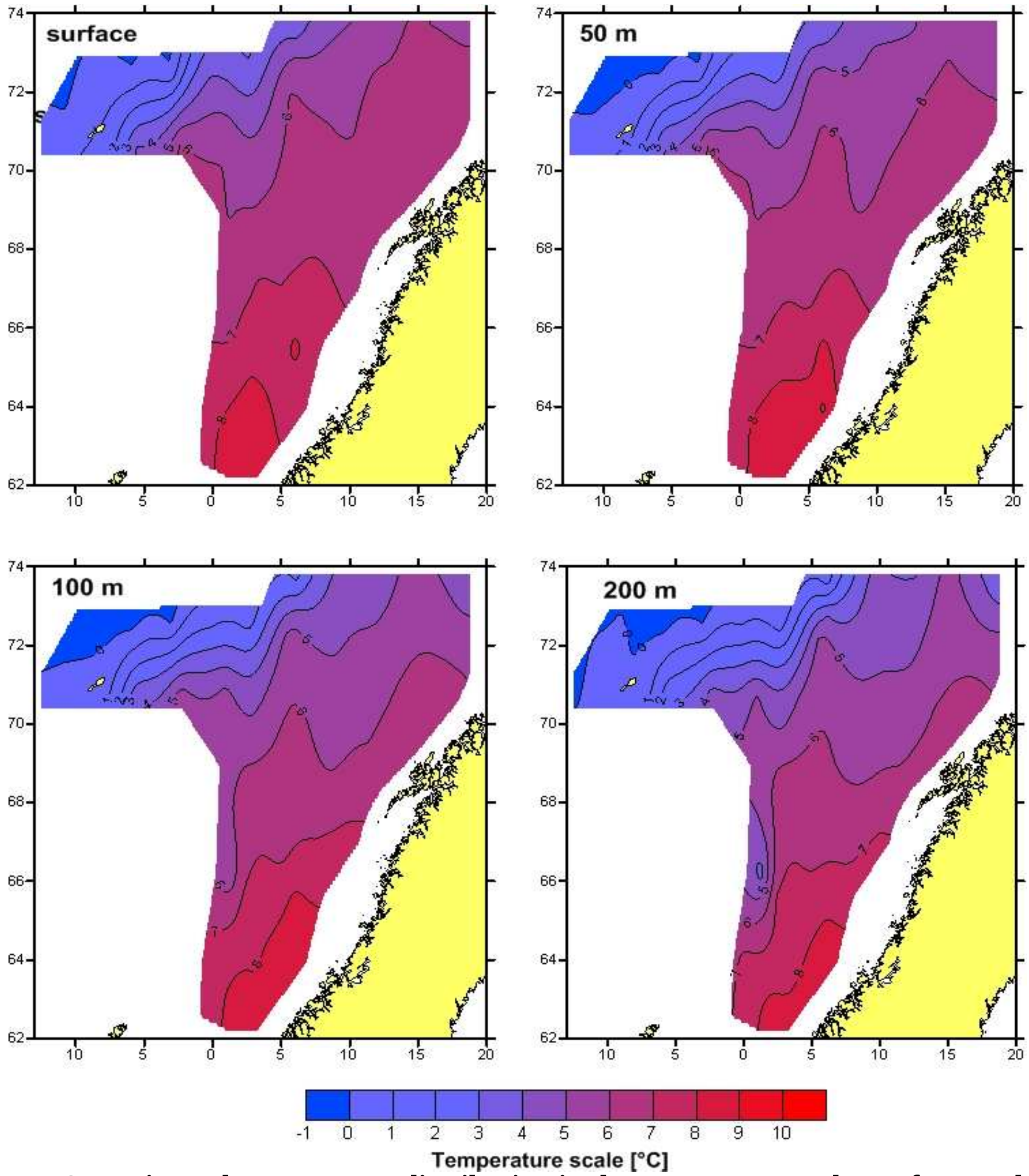


Figure 6: Horizontal temperature distribution in the survey area at the surface, and at 50m, 100m and 200m depth.

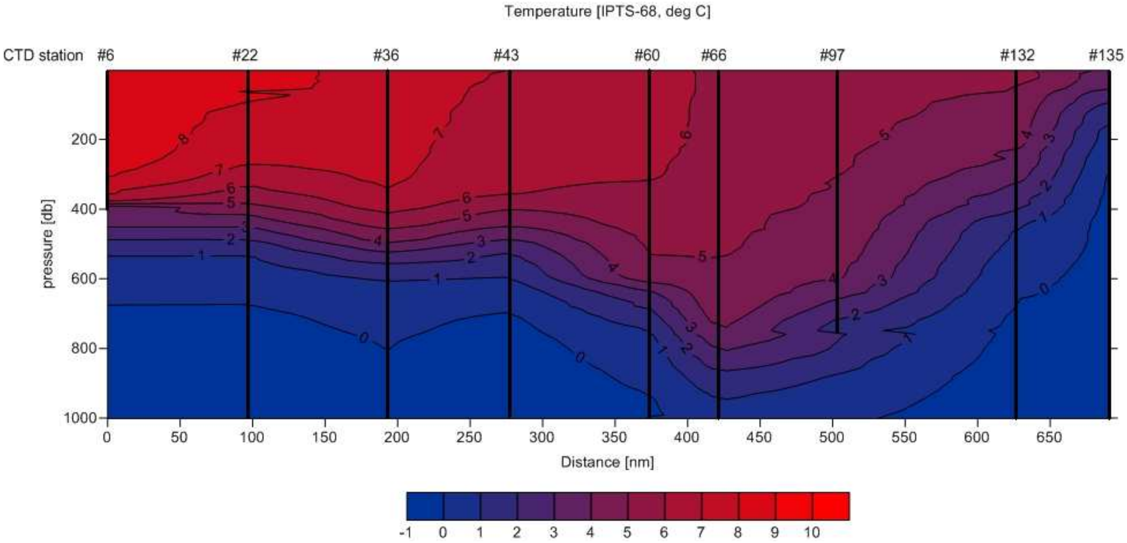


Figure 7: Vertical temperature distribution from South to North along approximately 2 - 5º E.

Discussion

Scrutiny

The scrutiny of the acoustic data has been executed on the BI500. Almost no schools of blue whiting have been recorded. Hence the NASC's that have been assigned to blue whiting are all based on individual targets in deeper layers. The percentage NASC's assigned to blue whiting was between 15-70 percent at -69 db threshold. It should be emphasized that any blue whiting estimations during this survey are based on these stray individual blue whiting at depth while the distribution between blue whiting and other mesopelagic fish can not be derived from the fish catches. Hence NASC's assigned to blue whiting are very rough estimates if not assumptions. Relative biases made during the scrutiny process are therefore most likely in the order of magnitude of hundreds of percents. Now that the blue whiting stock is very low, the survey estimates has fallen beyond a reasonable level of confidence and current sampling techniques are now inadequate to detect blue whiting appropriately.

Scrutiny of herring did not encounter any problems.

Table 1: CTD stations taken by R/V Dana during 2 to 24 May 2010

Cruise	Station	year	Log	Month	Day	Hour	Min	Latitude	Longitude	WinDir	WinSpeed
201003	6	2010	0	5	2	2	43	62.17.404 N	002.03.586 E	309.5	8.58
201003	11	2010	0	5	2	17	0	62.31.190 N	000.03.170 E	335.6	9.11
201003	16	2010	0	5	3	5	54	63.55.087 N	000.03.239 E	307.9	9.98
201003	22	2010	0	5	3	19	27	63.50.407 N	003.00.741 E	327.7	9.32
201003	27	2010	0	5	4	7	46	63.55.224 N	005.59.682 E	286	4.8
201003	31	2010	0	5	4	18	32	65.30.069 N	006.00.017 E	311.1	4.57
201003	36	2010	0	5	5	6	16	65.29.982 N	002.32.351 E	120.9	3.04
201003	39	2010	0	5	5	15	2	66.12.050 N	001.15.183 E	32.2	4.84
201003	43	2010	0	5	6	2	43	66.54.656 N	002.32.106 E	4.7	6.91
201003	47	2010	0	5	6	13	5	66.54.906 N	004.59.342 E	171.2	6.01
201003	50	2010	0	5	6	20	32	66.55.008 N	007.29.986 E	187.2	4.11
201003	53	2010	0	5	7	3	42	66.54.968 N	009.54.981 E	169.1	5.38
201003	57	2010	0	5	8	0	38	68.30.033 N	005.40.413 E	307.4	9.36
201003	60	2010	0	5	8	10	25	68.29.930 N	002.50.157 E	293.2	5.49
201003	63	2010	0	5	8	18	20	68.53.946 N	001.15.131 E	253.5	10.42
201003	66	2010	0	5	9	1	57	69.18.136 N	002.50.010 E	31.4	6.09
201003	69	2010	0	5	9	10	13	69.17.901 N	005.44.680 E	8.8	7.22
201003	72	2010	0	5	9	18	23	69.17.842 N	008.35.100 E	291.8	3.32
201003	75	2010	0	5	10	2	1	69.17.941 N	011.26.883 E	104.7	7.41
201003	79	2010	0	5	10	12	53	69.18.001 N	014.09.800 E	57.5	9.57
201003	83	2010	0	5	13	0	59	70.37.384 N	017.01.165 E	186.6	10.64
201003	87	2010	0	5	13	12	39	70.37.924 N	013.48.841 E	173.8	4.8
201003	90	2010	0	5	13	20	46	70.38.093 N	010.34.718 E	68.4	6.85
201003	94	2010	0	5	14	6	11	70.37.684 N	007.19.507 E	40.9	13.09
201003	97	2010	0	5	14	14	18	70.37.519 N	004.10.318 E	51.5	15.83
201003	98	2010	0	5	14	21	48	70.38.063 N	000.56.493 E	53.1	12.14
201003	101	2010	0	5	15	9	31	70.37.572 N	002.20.106 W	60.5	7.33
201003	105	2010	0	5	15	20	18	70.37.513 N	005.31.625 W	48	6.38
201003	108	2010	0	5	16	2	39	70.32.424 N	007.51.379 W	44.7	6.9
201003	111	2010	0	5	16	13	25	70.37.508 N	012.26.387 W	17	3.4
201003	116	2010	0	5	17	2	5	71.40.015 N	010.49.816 W	9.5	8.95
201003	117	2010	0	5	17	11	23	72.37.180 N	009.01.004 W	57.5	14.11
201003	120	2010	0	5	17	19	39	72.36.974 N	005.55.537 W	74.6	12.66
201003	123	2010	0	5	18	2	29	72.36.782 N	003.03.586 W	177.2	9.47
201003	126	2010	0	5	18	9	31	72.36.934 N	000.12.223 W	202.6	6.42
201003	129	2010	0	5	18	16	33	72.36.996 N	002.39.859 E	163.1	5.09
201003	132	2010	0	5	19	0	15	72.37.205 N	006.07.056 E	158.6	9.53
201003	135	2010	0	5	19	8	7	73.42.070 N	006.07.000 E	169.3	11.79
201003	138	2010	0	5	19	15	27	73.41.993 N	009.26.300 E	195.4	11.59
201003	141	2010	0	5	19	22	17	73.41.908 N	012.39.545 E	199.9	8.91
201003	144	2010	0	5	20	5	28	73.42.008 N	015.54.823 E	259.4	4.49
201003	149	2010	0	5	20	15	7	73.42.288 N	015.25.516 E	85.2	3.97
201003	151	2010	0	5	21	1	6	73.42.104 N	018.41.496 E	57.7	4.35
201003	155	2010	0	5	21	17	38	72.06.793 N	018.41.703 E	184.8	7.39
201003	159	2010	0	5	22	5	31	72.07.119 N	015.23.102 E	208.8	9.51
201003	164	2010	0	5	22	21	31	72.07.211 N	012.04.564 E	282.3	9.71
201003	167	2010	0	5	23	6	6	72.07.258 N	008.44.653 E	284.6	11.3
201003	170	2010	0	5	23	14	45	72.06.843 N	005.30.182 E	311	15.55

Table 2: WP2 stations taken by R/V Dana during 2 to 24 May 2010

Cruise	Station	year	Month	Day	Hour	Min	Latitude	Longitude	WinDir	WinSpeed
201003	7	2010	5	2	3	35	62.17.555 N	002.04.769 E	311.4	8.62
201003	12	2010	5	2	18	6	62.31.150 N	000.02.290 E	335.6	9.11
201003	17	2010	5	3	6	56	63.55.293 N	000.03.825 E	313.9	9.12
201003	23	2010	5	3	20	42	63.50.734 N	003.01.200 E	341.5	6.83
201003	28	2010	5	4	8	12	63.55.260 N	005.59.539 E	256.8	5.67
201003	32	2010	5	4	18	59	65.30.295 N	006.00.058 E	308.8	4.96
201003	37	2010	5	5	7	21	65.30.427 N	002.31.131 E	125.5	4.42
201003	40	2010	5	5	16	13	66.12.443 N	001.15.496 E	31.1	4.45
201003	44	2010	5	6	3	56	66.54.535 N	002.32.563 E	355.7	4.12
201003	48	2010	5	6	14	21	66.54.719 N	004.59.353 E	167.5	4.08
201003	51	2010	5	6	21	49	66.55.479 N	007.29.892 E	170	5.89
201003	54	2010	5	7	4	14	66.54.868 N	009.55.083 E	169.3	5.81
201003	58	2010	5	8	1	48	68.30.349 N	005.41.402 E	284.2	8.37
201003	61	2010	5	8	11	40	68.30.082 N	002.51.522 E	294.5	5.53
201003	64	2010	5	8	19	28	68.53.596 N	001.15.624 E	277.9	7.91
201003	67	2010	5	9	3	7	69.18.643 N	002.48.724 E	26.3	8.63
201003	70	2010	5	9	11	27	69.18.422 N	005.43.646 E	11.3	11.71
201003	73	2010	5	9	19	28	69.17.954 N	008.35.382 E	292	2.93
201003	76	2010	5	10	3	12	69.17.043 N	011.24.724 E	87.7	7.33
201003	80	2010	5	10	14	7	69.17.538 N	014.10.622 E	60.2	9.13
201003	84	2010	5	13	2	10	70.37.163 N	017.02.339 E	192.5	8.57
201003	89	2010	5	13	14	16	70.39.409 N	013.49.832 E	154	4.41
201003	92	2010	5	13	22	0	70.38.280 N	010.34.847 E	60.9	6.84
201003	95	2010	5	14	7	20	70.36.935 N	007.21.020 E	44.5	13.01
201003	100	2010	5	14	23	11	70.37.214 N	000.56.959 E	55.6	10.53
201003	102	2010	5	15	10	49	70.37.459 N	002.19.316 W	56.8	8.6
201003	106	2010	5	15	21	28	70.37.223 N	005.30.640 W	42.2	7.29
201003	109	2010	5	16	3	58	70.31.710 N	007.50.335 W	51	6.98
201003	113	2010	5	16	14	57	70.37.194 N	012.28.622 W	22.3	3.39
201003	114	2010	5	17	1	36	71.40.169 N	010.49.590 W	352	5.61
201003	118	2010	5	17	12	39	72.36.620 N	009.00.967 W	47.9	12.36
201003	122	2010	5	17	20	48	72.36.529 N	005.56.042 W	79	11.98
201003	124	2010	5	18	3	44	72.37.314 N	003.05.693 W	187.8	11.85
201003	127	2010	5	18	10	46	72.37.439 N	000.13.201 W	202	8.05
201003	131	2010	5	18	17	57	72.37.008 N	002.37.585 E	156.3	7.36
201003	133	2010	5	19	1	24	72.37.924 N	006.07.787 E	165.2	10.37
201003	136	2010	5	19	9	13	73.42.207 N	006.05.140 E	170.9	11.09
201003	140	2010	5	19	16	48	73.41.750 N	009.25.882 E	204	10.87
201003	143	2010	5	19	23	43	73.42.486 N	012.39.563 E	199	8.31
201003	145	2010	5	20	6	7	73.42.327 N	015.54.198 E	257.7	4.91
201003	152	2010	5	21	1	31	73.42.042 N	018.41.021 E	56.6	3.91
201003	157	2010	5	21	18	17	72.07.106 N	018.41.646 E	192.1	7.52
201003	160	2010	5	22	6	41	72.07.541 N	015.22.672 E	224.6	8.08
201003	166	2010	5	22	22	56	72.07.156 N	012.05.717 E	284.6	8.15
201003	168	2010	5	23	7	21	72.08.499 N	008.46.863 E	281.8	11.2
201003	172	2010	5	23	17	24	72.06.918 N	005.32.844 E	306.7	14.6

Table 3: Fishing stations taken by R/V Dana during 2 to 24 May 2010

Cruise	Station	year	Month	Day	Hour	Min	Latitude	Longitude	WinDir	WinSpeed	GroundSpeed	wireLength	trawlgap	Door sprd.	Duration	Fishing Depth	Total Catch
201003	9	2010	5	2	10	14	62.22.480 N	001.17.750 E	335.6	9.11	4.22	1100	20	138	61	100	30.400
201003	15	2010	5	2	23	16	63.11.471 N	000.05.221 E	321.8	12.59	4.4	350			60	20-30	33.526
201003	20	2010	5	3	12	54	63.53.611 N	001.54.367 E	352.4	15.77	4.3	370			60	20-30	0.000
201003	21	2010	5	3	17	39	63.53.937 N	003.00.047 E	355.3	8.17	3.2		22	120	48	100-170	525.019
201003	25	2010	5	3	23	20	63.53.037 N	003.37.763 E	337.2	5.85	3.9	350			60	20-30	250.000
201003	34	2010	5	4	20	20	65.29.732 N	005.51.160 E	292.7	5.56	3.5	470	20	100	30	50	31.400
201003	42	2010	5	5	19	0	66.29.459 N	001.14.517 E	344.9	5.06	4.2	300	16	110	60	20-30	27.800
201003	46	2010	5	6	7	5	66.54.773 N	003.21.179 E	96	3.52	3.7	830		125	60	200	2.034
201003	56	2010	5	7	12	23	68.06.580 N	008.55.273 E	216.4	13.14	4.9	380		118	45	100	3.866
201003	78	2010	5	10	8	48	69.18.447 N	013.23.938 E	63.4	8.89	3.9	685	20	116	60	90	94.451
201003	82	2010	5	10	23	21	69.39.486 N	015.12.388 E	81.2	8.49	3.8	400	19	110	60	20	449.995
201003	86	2010	5	13	3	17	70.37.239 N	017.05.618 E	191.6	13.07	3.9	260	20	95	59	30-40	0.000
201003	93	2010	5	14	0	46	70.38.115 N	009.25.181 E	45.7	9.98	4	247	20	92	60	20-30	0.000
201003	104	2010	5	15	15	52	70.37.854 N	004.06.002 W	46.3	6.13	1.8	470	25	105	62	150-170	12.504
201003	147	2010	5	20	8	17	73.42.407 N	015.15.200 E	257	3.6	0.9	400	20		108	20-30	1.454
201003	148	2010	5	20	11	44	73.42.501 N	015.14.093 E	28.3	1.83	3.8	1050	20	120	118	190	3.480
201003	150	2010	5	20	17	26	73.42.980 N	015.22.816 E	121.7	1.96	3.7	1700			62	420	3.247
201003	154	2010	5	21	7	43	73.09.122 N	018.38.954 E	153.2	6.02	2.8	460	20	120	137	160-180	0.000
201003	158	2010	5	21	23	36	72.07.276 N	016.31.363 E	217.3	6.18	3.5	1060	20	130	120	270-290	153.500
201003	162	2010	5	22	8	49	72.07.716 N	014.54.138 E	221	5.75	3.7	350	20	120	102	20-50	0.000
201003	163	2010	5	22	14	48	72.05.730 N	013.34.268 E	291.6	8.49	2.6	1400			118	340-400	11.503

Table 4: Catch composition in trawl stations taken by R/V Dana during 2 to 24 May 2010

Station	Latitude	Longitude	Fishing depth	Fishing depth	Argyropelecus olfersi	Benthosema glaciale	Schedophilus medusophagus	Cephalopoda sp.	Clupea harengus	Cyclopterus lumpus	Euphausiidae sp.	Maurolicus muelleri	Melanogrammus aeglefinus	Micromesistius poutassou	Scomber scombrus	Sebastes mentella	Grand Total
9	62.22.480 N	001.17.750 E	100									30.40002					30.400
15	63.11.471 N	000.05.221 E	20-30						19.6		4.766			1.318	7.842		33.526
20	63.53.611 N	001.54.367 E	20-30														0.000
21	63.53.937 N	003.00.047 E	100-170					0.3		0.316	18.728	505.6747					525.019
25	63.53.037 N	003.37.763 E	20-30			19.23113	1.196		0.182		165.1905				64.2		250.000
34	65.29.732 N	005.51.160 E	50									31.40004					31.400
42	66.29.459 N	001.14.517 E	20-30						27.8								27.800
46	66.54.773 N	003.21.179 E	200						2.034								2.034
56	68.06.580 N	008.55.273 E	100						3.866								3.866
78	69.18.447 N	013.23.938 E	90						93.00749	0.002			1.442				94.451
82	69.39.486 N	015.12.388 E	20						449.1312	0.864							449.995
86	70.37.239 N	017.05.618 E	30-40														0.000
93	70.38.115 N	009.25.181 E	20-30														0.000
104	70.37.854 N	004.06.002 W	150-170							3.204	9.3						12.504
147	73.42.407 N	015.15.200 E	20-30							1.454							1.454
148	73.42.501 N	015.14.093 E	190	0.054				0.09					3.336				3.480
150	73.42.980 N	015.22.816 E	420	0.69		0.007		0.01			0.158		1.828	0.554			3.247
154	73.09.122 N	018.38.954 E	160-180														0.000
158	72.07.276 N	016.31.363 E	270-290										153.5				153.500
162	72.07.716 N	014.54.138 E	20-50														0.000
163	72.05.730 N	013.34.268 E	340-400		0.001	0.42004		0.012	8.124		0.172			1.344		1.43	11.503
Grand Total				0.744	0.001	19.658	1.196	0.412	603.745	5.840	198.315	567.475	160.106	3.216	72.042	1.430	1634.179

Annex 1 - Calibration report.

Transceiver Menu	
Frequency	38 kHz
Sound speed	1470 m.s^{-1}
Max. Power	2000 W
Equivalent two-way beam angle	-20.5 dB
Default Transducer Sv gain	25.05 dB
3 dB Beamwidth	6.7°
Calibration details	
TS of sphere	-33.6 dB
Range to sphere in calibration	12.6 m
Measured NASC value for calibration	13500 m^2/nmi^2
Calibration factor for NASCs	1.00
Absorption coeff	7,727 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	-70 dB

Annex 2 -

Comparison exercise of post-processing software: BI500 and LSSS

During the first half of the EU part of the 2010 Atlanto-Scandian herring acoustic survey, acoustic data were scrutinized and results exported in parallel, using two different post-processing software packages. Next to the BI500 package, which has been used on this survey so far for data analysis, the newly available LSSS (Large Scale Survey System; Christian Michelsen Research AS, Bergen, Norway) software was tried out. The aim was to identify differences between the two systems and determine potential advantages of using the later software.

One of the most obvious differences between BI500 and LSSS is actually linked to a disadvantage of the BI500 software, which can only run satisfactorily on older computers that have lower processing power. While computer technology is constantly evolving, there is thus always a need to keep an older machine on board to be able to run BI500. This approach brings with it vulnerability since there would be no suitable hardware available at short notice should the "BI500 computer" experience problems. LSSS can easily run on modern computers.

In terms of functionality, LSSS provides at least the same services that BI500 does. However, while BI500 offers more of a "step-by-step" approach, where data can for example only be analysed by individual 5nm sampling intervals, LSSS is designed more flexible. All the tools (echogram display, expanded bottom, map, species allocation, frequency response, TS distribution) are available in the same window in LSSS, which allows a much more integrated and quicker workflow. Another advantage of LSSS is that it allows the user to scrutinize intervals of arbitrary length (basically from the width of single pings to the length of the whole survey). This is especially useful for the survey area of the Norwegian Sea, where scattering layers of similar species composition extend over several kilometres. Such layers can therefore be observed as a whole and scrutinized easily with LSSS. Additionally, differences between layers appear more obvious and layer distinction is thus facilitated - resulting in more consistency and reduced misallocation of species. The advantage is a large reduction in time required for scrutiny, as data collected within a 24 hour period can typically be analysed within 1-2 hours.

Results from the data collected on the first half of the survey were obtained using both the BI500 and LSSS software. Total NASC values associated to herring differed by less than 4%. However, it has to be noted that individual software packages were operated by different scientists. Discrepancies were therefore mostly due to subjectivity in scrutinisation, which is by nature a high source of error in acoustic surveys. Let alone issues associated with data scrutiny, the two software packages will not produce different results if the same data are analysed. Given the various advantages over the BI500 system, it has to be concluded that acquisition and use of LSSS on future surveys will be highly beneficial.

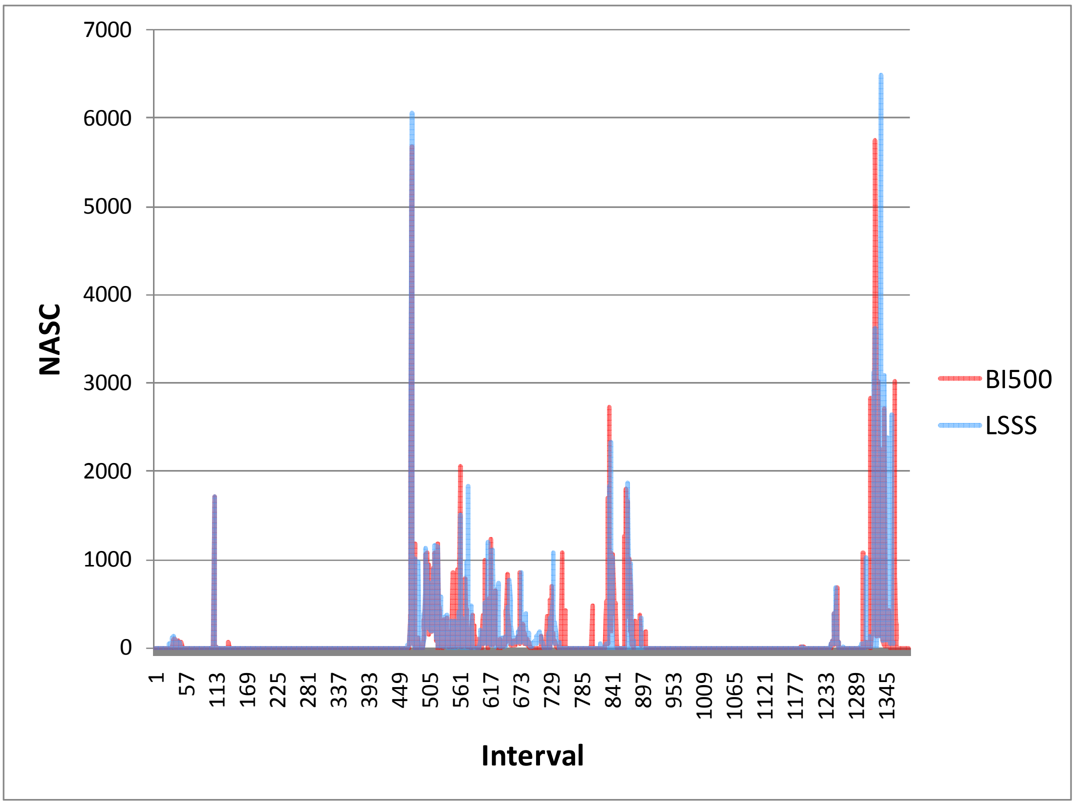


Figure 1. NASC values by 5nm interval allocated to herring on the first half of the EU part of the 2010 Atlanto-Scandian herring acoustic survey. Analysis of the data was done using either the BI500 (red) or LSSS (blue) software. Note that the two software systems were operated by different scientists. This resulted in slight discrepancies in NASC values by interval, due to subjectivity in scrutinizing.