
# The International Ecosystem survey in the Nordic Seas in May 2013

## R/V DANA Cruise No. 5/2013

*Calibration of Echo-sounders*

**30/4 – 2/5 2013**

*International Acoustic Monitoring of Herring and Blue whiting*

**3/5 – 28/5 2013**

**Cruise participants**

**Calibration 30/4 – 2/4**

| | |
|---|---|
| Karl-Johan Staehr | Denmark (Cruise leader) |
| Torben Filt Jensen | Denmark |
| Ronny Sørensen | Denmark |
| Thyge Dyrnesli | Denmark |
| Christian Petersen | Denmark |
| Seabastian Frederik Westh Nielsen, Guest | |
| Lisbeth Bøjet, Guest | |

**Acoustic monitoring 2/5 - 15/5**

| | |
|---|---|
| Karl-Johan Staehr | Denmark (Cruiseleader) |
| Acoustic Torben Filt Jensen | Denmark |
| Acoustic Sven Gastauer | Netherlands |
| Fishlab Fredrik Nilsson | Sweden |
| Fishlab Louise Cox | United Kingdom |
| Fiashlab Peter Vingaard | Denmark |
| Fishlab Tom Svoldgaard | Denmark |
| Tech. Thyge Dyrnesli | Denmark |

**Acoustic monitoring 16/5-28/5**

| | |
|---|---|
| Bram Couperus | Netherlands (cruiseleader) |
| Acoustic Graham Johnston | Ireland |
| Acoustic Louise Cox | United Kingdom |
| Fishlab Martin Karlsson | Sweden |
| Fishlab Matthias Kloppmann | Germany |
| Fiashlab Helle Andersen | Denmark |
| Fishlab Frank Ivan Hansen | Denmark |
| Tech. Thyge Dyrnesli | Denmark |

**Cruise summary**

| | |
|---|---|
| Effective survey days | 20 |
| Mileage | 2263 (as scrutinized in LSSS) |
| Number of trawl hauls | 19 |
| Number of CTD stations | 43 |
| Number of WP2 stations | 43 |
| Number of biological samples - herring | 293 |
| Number of biological samples – blue whiting | 340 |
| 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 30th April and 2nd May 2013. 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. Calibration of the 120 kHz transducer had to be stopped due to heavy current and damage of the lines in the calibration rig. Therefore calibration parameters from last calibration had to be used for the 120 kHz echosounder.
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 LSSS software.

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 participating vessels from which a biomass index will be calculated. The final estimate methodology is presented at the post cruise meeting in Bergen 19-21 June 2013 and in the WGIPS report of January 2014 (Copenhagen).

2263 NM has been integrated and scrutinized along the cruise track.

*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 biomass samples were oven-dried on board at 70 °C for 24 hours, and subsequently frozen for later weight determination at DTU Aqua.
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, conductivity (salinity) and oxygen. All together Dana carried out 43 combined CTD and WP2 stations (Table 1, Figure 1)

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 "*Turbo*", was used either at the surface or in midwater down to a maximum of 450 m depth. A total of 19 trawl stations were carried out during the survey. (Table 2, Figure 1) During station 14 and 17 the large pelagic trawl was replaced by the Foto trawl, after it had been damaged in the previous trawl station (11).

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 293 individual herring, 340 blue whiting and 164 mackerel were sampled.

By request from vTI/SF in Hamburg redfish in the catch has been examined for stomach content, maturity, parasites and pigmentation. In total 13 specimens have been caught and sampled (as a comparison: 71 specimens in 2011, which consisted mainly of juveniles).

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 30$^{th}$ April at 07.00 UTC for calibration of acoustic equipment at Bornö in Sweden. All transducers were calibrated and Dana arrived in Hirtshals again at 2$^{nd}$ May at 17.00 UTC.

Dana left Hirtshals to start the acoustic survey on the 3$^{rd}$ May at 11.00 UTC.

Data monitoring was started at 04.00 UTC on 5$^{th}$ of May at 62°20 N, 02°45 E with a CTD and a WP2.

Due to a large number of new crew members and to measure the tension on the renovated trawl winches a test haul with the “turbo” midwater trawl were conducted right after the first CTD/WP2.
The test showed a tension of max 8-10 tons during a fishery at 300 meters, well within the maximum limits for the winches. As the test haul was at a depth of a layer at 330-350 the haul were extended to a one hour haul and used.

On the 6th May at 08.30 UTC on 63°50 N, 03°30 E when we had to pull the towed body for a CTD/WP2 station the wire were broken in the termination and the towed body was hanging in the electrical cable, but the towed body was salvaged safely. Luckily the weather permitted that the survey was continued by using the hull-mounted 38 kHz transducer during the repair of the towing wire. The towed body was back in operation on 7th May at 19.10 UTC on 65°21 N, 05°31 E.

On the 7th May at 00.00 UTC on 64°38 N, 07°05 E the lover panel of the “turbo” midwater trawl was torn during a surface haul. Therefore we had to shift to the Fotö midwater trawl during repair of the “turbo” trawl. The “turbo” midwater trawl was ready for operation in the morning of the 8th May.

The weather conditions during first half:
Weather conditions during first half of the survey were excellent until the 8th May only with short periods with wind speed above 10 m/s. An integration speed of around 10 knots could be kept all the time. From the morning on the 9th May the wind increased to 16-18 m/s and larger swells occurred. Speed had to be reduced to 6-8 knots and fishery was not possible for on the 66°51 N west-east transect. CTD and WP2 could be made during this period. From midnight the 9th May the wind decreased and excellent conditions lasted until the evening the 12th May when the wind increased again to wind speeds of 16-20 m/s and swells of 5-7 m from east. Therefore the speed had to be reduced going east on the transect at 69°50 N and 2 CTD/WP2 stations had to be canceled.
Normal survey speed was retained in the morning the 14th May at 09°37 E.

Integration on first half on the survey was ended 15th May at 05.33 UTC at 69°47N, 17°22E. Tromsø was entered at 15th May at14.30 UTC for change of crew.

Dana left Tromsø on 16th May at 1303 UTC and commenced the acoustic survey at 1724 UTC at 70°15 N, 20°06 E. Data monitoring was started at 2303 UTC on 16th of May at 71°10 N, 19°19 E with a CTD and a WP2.

At 2157 UTC on 20th May at 73°35 N, 19°37 E the towed body was recovered from the water as it was noted that the detections from the 38kHZ transducer were not displaying correctly. Water had infiltrated the electrical cable and the towed body was retained onboard for repair. Due to fine weather conditions the survey continued using the hull-mounted 38 kHz transducer during the repair of the towed body.

It was determined that the repairs of the towed body would take over a day to complete and the survey was stopped at 0235 UTC on 21st May at 74°35 N, 19°27 E near Bjørnøya (Bear Island). Dana stayed in the vicinity of the island until 1409 UTC and the survey recommenced at 74°37 N, 18°39 E using the hull-mounted 38 kHz transducer.

On 22nd May at 1425 UTC the repaired towed body was placed in the water at 74°40 N, 11°28 E and used for the remainder of the survey. The final CTD and WP2 stations were undertaken at 73°59 N, 08°44 E on 23rd May at 0301 UTC to complete the survey.

As the survey was completed ahead of schedule it was decided to return to the two cancelled CTD and WP2 stations from the first half of the survey. These were undertaken on 24th May at 0002 UTC at 69°50 N, 05°06 E and at 1317 UTC at 69°50 N, 08°07 E, ten days after omitting them on the first half transect.

The weather conditions during second half:
Weather conditions during second half of the survey were excellent. An integration speed of around 10 knots could be kept for the majority of the time. Only during the period from 0235 UTC on 21st May until 1425 UTC on 22nd was the speed adjusted to around 6 to 8 knots to prevent transmission loss from the hull-mounted 38 kHz transducer.

## Results

*Catch composition*

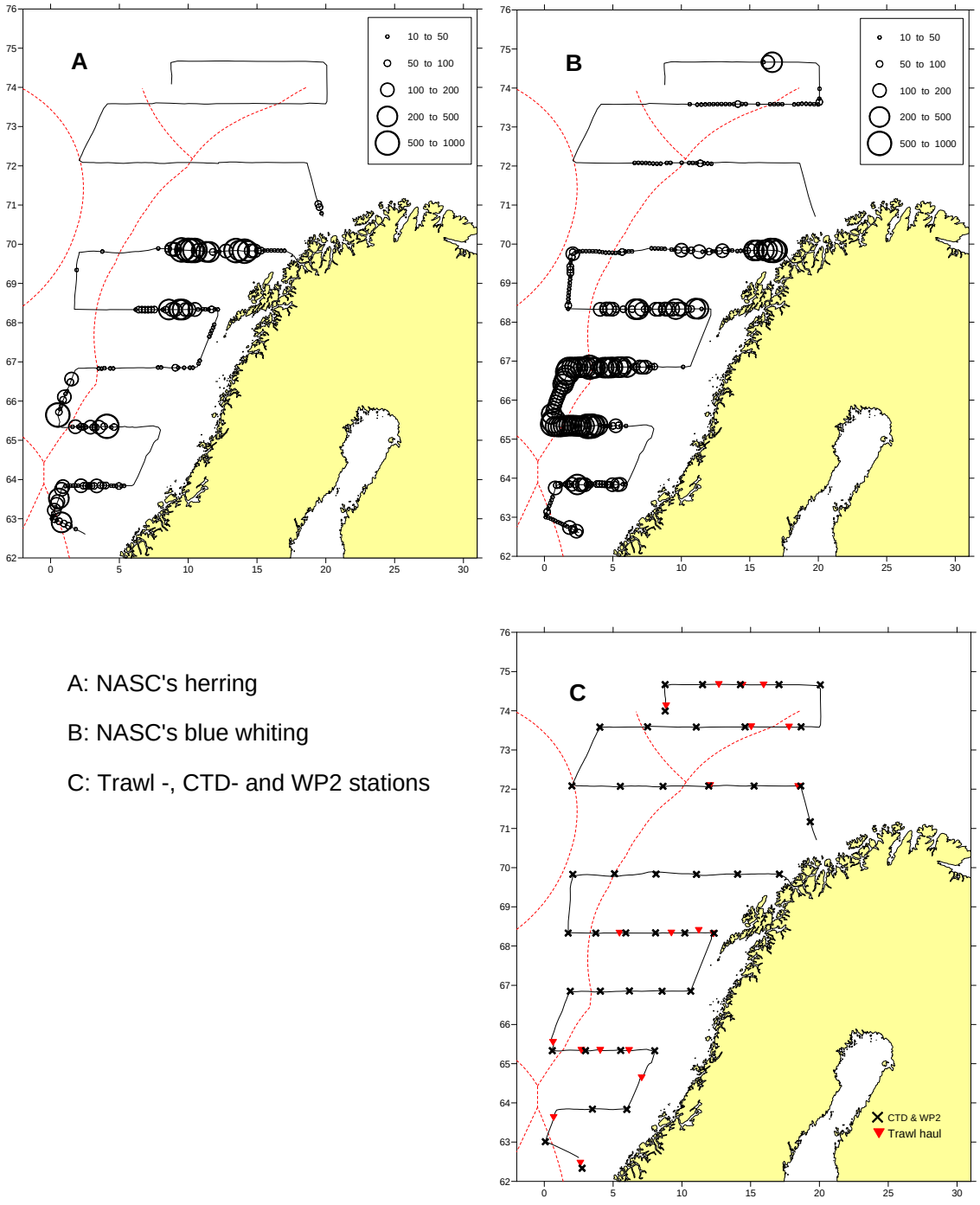
The catch composition of all trawl hauls are presented in Table 3, Table 2 gives information on trawling position and depth. Distribution of trawl hauls is shown in Figure 1.

*Distribution and density of herring and blue whiting*

Distribution and densities of herring and blue whiting along the survey track are presented in Figure 2.

Herring was found almost exclusively during the first part of the cruise, and except for the very beginning when a few small herring schools could be recorded waters were virtually devoid of herring during the second part. Two distinct areas of higher herring abundance could be detected in the southwestern and the northeastern part in the area of the first survey part (Fig. 2). The highest abundance values occurred, however, on the northernmost transect of that part of the survey. The catch of only 3 juvenile herring during the 2nd half of the survey in a surface tow at the western boundary of Barents Sea at 73°35'N, 15°02'E, may have indicated at some concentrations of herring in the area. Since no other haul revealed juvenile herring, it appears likely, that they were probably distributed closer to the coast and outside the target area. In the Barents Sea, southwest of Bear Island the echograms showed relatively high concentrations of haddock.

As with herring, highest blue whiting concentrations were encountered during the first part of the survey and particularly in the warmer waters that spread slightly northeastwards towards the coast at depth. This probably explains why on the northernmost transect of the first survey part blue whiting were most abundant closer to the coast while they were occurred more densely in the oceanic area in the South (Fig. 2). During the second part of the survey, on the 3 northernmost transects blue whiting were much less abundant than during the first part. The highest densities during that part of the survey were recorded on a small section of the northernmost transect in a narrow tongue of warmer waters east of Bear Island (Fig. 2).




A: NASC's herring

B: NASC's blue whiting

C: Trawl -, CTD- and WP2 stations

**Figure 2. Sailed transects, trawl -, plankton – and hydrographical stations and Nautical Area Scattering Coefficients (NASC's) assigned to herring and blue whiting.**

*Hydrographic conditions*

The observed temperature range during the cruise was slightly narrower than that of previous years with surface values between 5 in the North and > 7°C in the South decreasing to values < 3°C in the Northwest and northeast of Bear Island. Contrasting to previous years, in the southeastern survey area temperatures > 8°C were never observed. In the North temperatures were again slightly cooler than in the preceding years, and in the southwestern parts of the area, temperatures were higher than last year, and the polar front was not traceable in the top 200 m. In the surface, the 7°C isothermal reached only as far up north as south of 68°N, stretching further northwards only in a very narrow tongue along the coast at 50 – 100 m depth (figure 3) while in the past it could be encountered over a wider longitudinal range and in earlier years (before 2007) also far beyond the 70° latitude. Waters in the surface layer closer to the coast were cooler than at 50 m and also fresher, indicating at a discharge of cold waters from the land.

Over most 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 4). The magnitude of these layers varied with latitude. In the southern part of the survey area, Atlantic water could be detected down to about 500 m closer to the coast and down to at least 350 m in the more oceanic area. Along the coast, this layer remained of the same magnitude with respect to depth, but became cooler towards the North. Only at the most northern station, the influence of the Atlantic water was almost absent. Along the oceanic section, the Atlantic water layer became shallower at first but deepened again down to 600 m at 72° N. North of that Latitude the layer of Altantic water quickly became shallower and the influence of Arctic water became more prominent throughout the water column (figure 4). The latitudinal transect from the Barents Sea into the northern Norwegian Sea showed a stronger influence of Atlantic water in and immediately west of the Barents Sea boundary with a comparatively thick layer (down to > 400 m) of warmer water there.

**Comments**

The oxygen measurements carried out routinely during the first half of the survey have a bias of +1 ml as the data were retrieved from sensor 1, which gives not the right values. During the second part of the survey (after Tromso) the oxygen measurements have been retrieved from sensor 2, which give the right values.

At present it is not clear what (three letter?) codes should be used for the delivering of the data to WGIPS. The set in use during the past years does not cover all species, which means that biological data on these species will be lost for the PGNAPES database. The issue should be discussed at WGIPS.

We had 1.5 day spare time this year, despite a visit at Bear Island. This is mainly due the lack of herring and blue whiting in the North and the good weather. Nevertheless, we think that the total transect length during the second half could be extended by approximately 150 nm (=1 day).

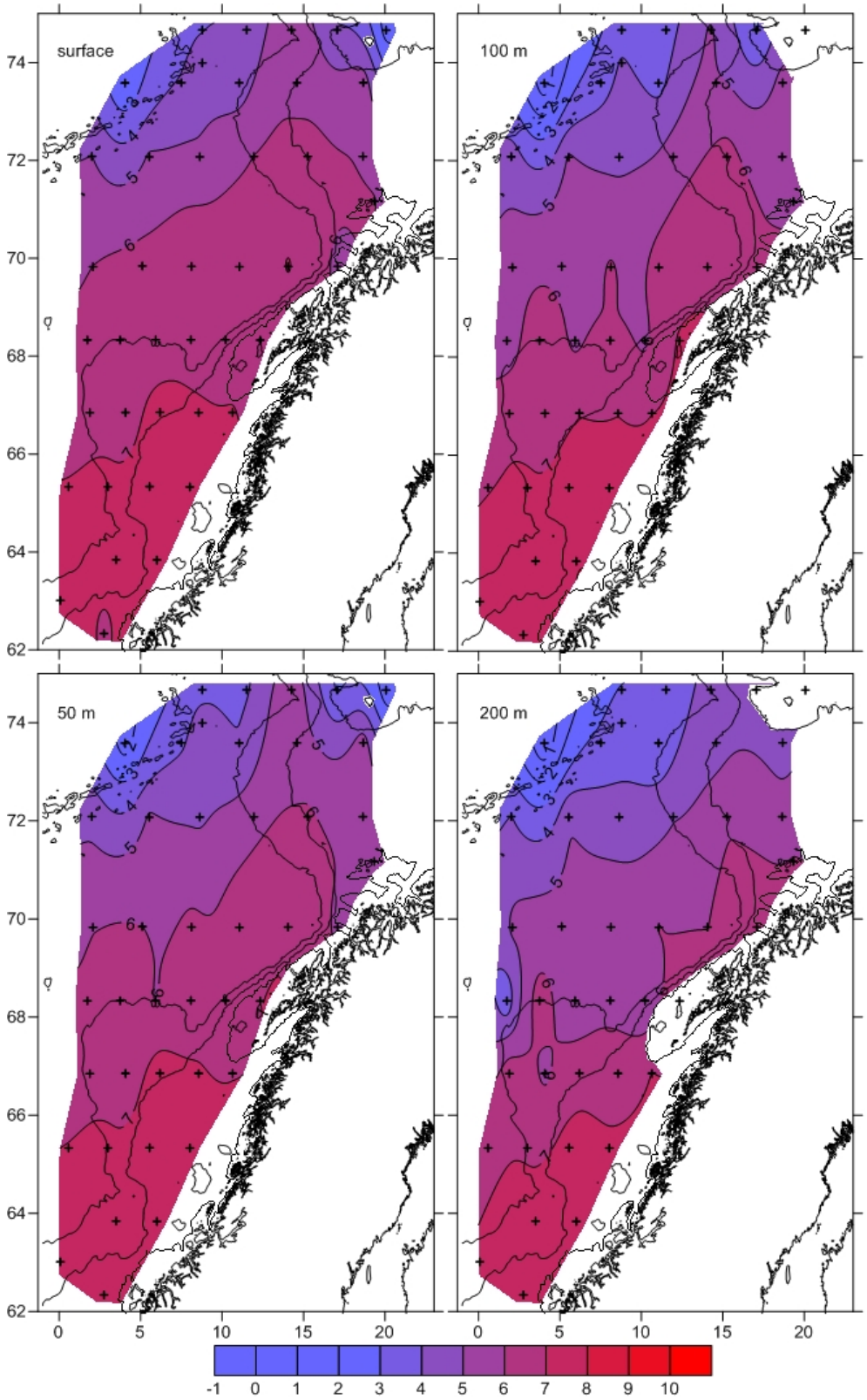



**Figure 3: Horizontal temperature distribution in the survey area at the surface, and at 50m, 100m and 200m depth.**

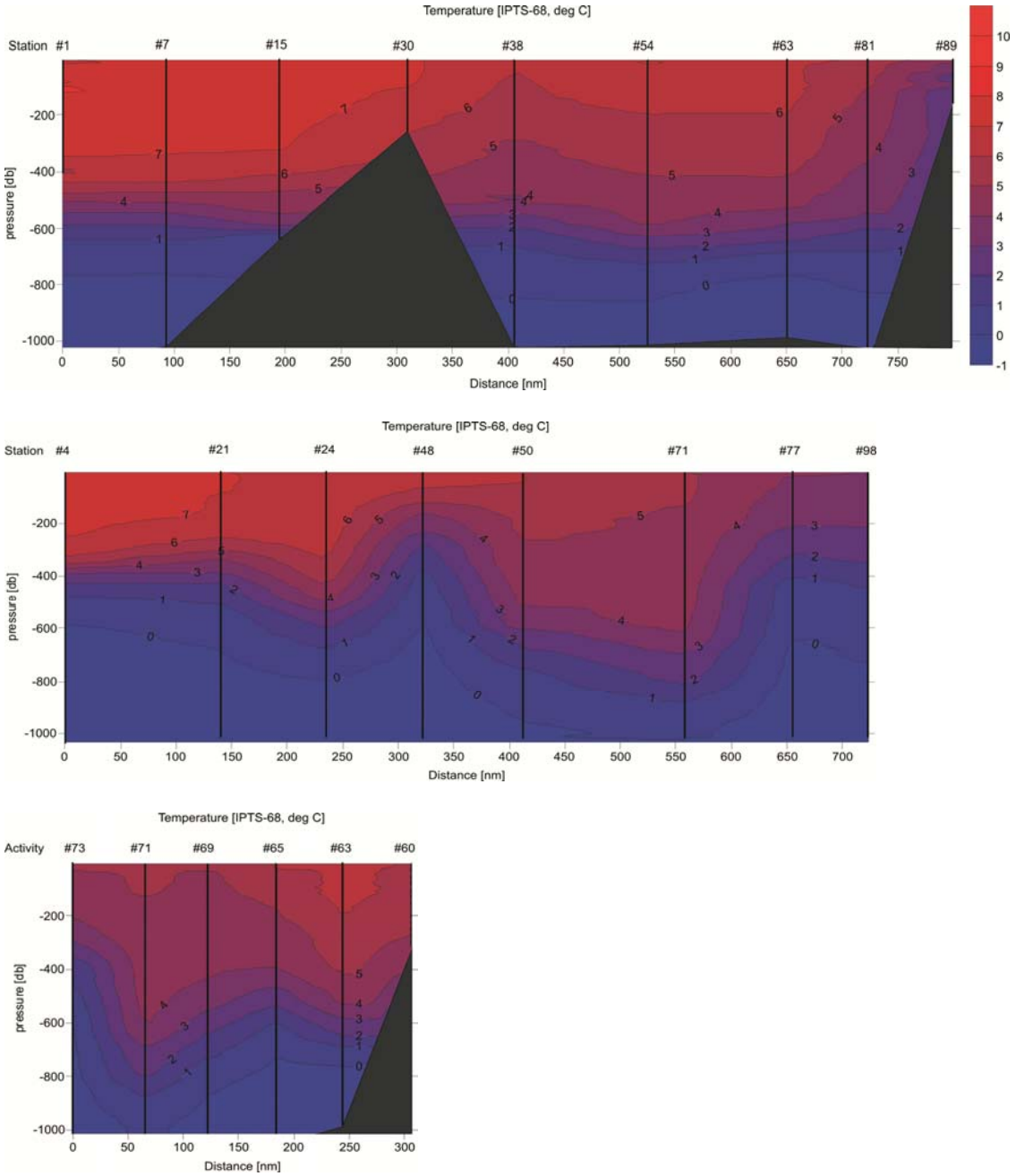



**Figure 4: Vertical temperature distributions from South to North along a coastal (top), an oceanic (middle), and along a latitudinal transect at 72°05'N (bottom, for position of selected stations see Figure 1).**

**Table 1: CTD and WP2 stations taken by R/V Dana during 2 to 28 May 2013. *Geographical position belonging to the CTD station. The position of the WP2 is slightly different, due to drift.**

| Station CTD | Station WP2 | year | Month | Day | Hour | Min | Lat* | Lon* | Wind direction | Wind speed |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2013 | 5 | 5 | 4 | 1 | 62,334533 | 2,75095 | 249.7 | 9,18 |
| 4 | 5 | 2013 | 5 | 5 | 17 | 16 | 63,009783 | 0,0778666 | 223.6 | 14,43 |
| 7 | 8 | 2013 | 5 | 6 | 8 | 39 | 63,840566 | 3,5007166 | 223.2 | 10,54 |
| 9 | 10 | 2013 | 5 | 6 | 16 | 38 | 63,835533 | 5,9989 | 240.2 | 12,32 |
| 12 | 13 | 2013 | 5 | 7 | 7 | 5 | 65,329616 | 8,0263166 | 268.2 | 11,41 |
| 15 | 16 | 2013 | 5 | 7 | 17 | 41 | 65,336283 | 5,5524 | 301.9 | 1,9 |
| 18 | 19 | 2013 | 5 | 8 | 5 | 12 | 65,33125 | 2,9981333 | 115.5 | 6,46 |
| 21 | 22 | 2013 | 5 | 8 | 15 | 42 | 65,331633 | 0,5833 | 121.1 | 10,4 |
| 24 | 25 | 2013 | 5 | 9 | 5 | 14 | 66,847033 | 1,8897 | 88.4 | 12,3 |
| 26 | 27 | 2013 | 5 | 9 | 14 | 21 | 66,849616 | 4,0752333 | 80.3 | 12,13 |
| 28 | 29 | 2013 | 5 | 9 | 22 | 38 | 66,85525 | 6,1883833 | 77.3 | 12,35 |
| 30 | 31 | 2013 | 5 | 10 | 6 | 12 | 66,849233 | 8,563 | 97.2 | 6,9 |
| 32 | 33 | 2013 | 5 | 10 | 11 | 48 | 66,850383 | 10,643866 | 155.2 | 6,51 |
| 34 | 35 | 2013 | 5 | 10 | 21 | 56 | 68,327316 | 12,3373 | 73.6 | 2,25 |
| 38 | 39 | 2013 | 5 | 11 | 10 | 18 | 68,333716 | 10,214116 | 124.2 | 2,46 |
| 41 | 42 | 2013 | 5 | 11 | 19 | 16 | 68,336533 | 8,0862833 | 98.1 | 4,17 |
| 43 | 44 | 2013 | 5 | 12 | 1 | 19 | 68,333383 | 5,9248166 | 110.7 | 5,47 |
| 46 | 47 | 2013 | 5 | 12 | 10 | 20 | 68,331483 | 3,7448 | 114.5 | 7,93 |
| 48 | 49 | 2013 | 5 | 12 | 16 | 18 | 68,331316 | 1,7365166 | 126.4 | 8,54 |
| 50 | 51 | 2013 | 5 | 13 | 5 | 7 | 69,828433 | 2,0770166 | 95.4 | 14,33 |
| 52 | 53 | 2013 | 5 | 14 | 13 | 12 | 69,827083 | 11,062233 | 90.5 | 6,36 |
| 54 | 55 | 2013 | 5 | 14 | 20 | 43 | 69,833183 | 14,050583 | 77.7 | 6,14 |
| 56 | 57 | 2013 | 5 | 15 | 4 | 7 | 69,833233 | 17,0875 | 127.2 | 8,98 |
| 58 | 59 | 2013 | 5 | 16 | 23 | 8 | 71,169116 | 19,331316 | 140.2 | 6,52 |
| 60 | 61 | 2013 | 5 | 17 | 5 | 41 | 72,08095 | 18,64075 | 171.6 | 3,29 |
| 63 | 64 | 2013 | 5 | 17 | 15 | 12 | 72,08095 | 15,2488 | 215.5 | 6,51 |
| 65 | 67 | 2013 | 5 | 17 | 22 | 50 | 72,080266 | 11,9525 | 251.7 | 11,53 |
| 69 | 70 | 2013 | 5 | 18 | 9 | 24 | 72,074416 | 8,6281833 | 297.5 | 9,48 |
| 71 | 72 | 2013 | 5 | 18 | 16 | 32 | 72,072183 | 5,5318333 | 325.7 | 8,53 |
| 73 | 74 | 2013 | 5 | 19 | 0 | 4 | 72,083133 | 2,00665 | 299.4 | 2,09 |
| 75 | 76 | 2013 | 5 | 19 | 10 | 42 | 73,5831 | 4,0404666 | 324.9 | 2,52 |
| 77 | 78 | 2013 | 5 | 19 | 17 | 46 | 73,589083 | 7,50435 | 326.3 | 4,73 |
| 79 | 80 | 2013 | 5 | 20 | 0 | 57 | 73,5846 | 11,045866 | 123.5 | 2,59 |
| 81 | 82 | 2013 | 5 | 20 | 8 | 7 | 73,587383 | 14,590183 | 94.7 | 2,59 |
| 85 | 86 | 2013 | 5 | 20 | 19 | 40 | 73,589783 | 18,666133 | 103.5 | 6,49 |
| 87 | 88 | 2013 | 5 | 21 | 6 | 3 | 74,661616 | 20,06355 | 67.6 | 3,79 |
| 89 | 90 | 2013 | 5 | 21 | 16 | 36 | 74,6663 | 17,059133 | 68.4 | 10,35 |
| 92 | 93 | 2013 | 5 | 22 | 0 | 44 | 74,666383 | 14,255166 | 78.2 | 13,99 |
| 96 | 97 | 2013 | 5 | 22 | 12 | 58 | 74,667483 | 11,5061 | 99.2 | 13,84 |
| 98 | 99 | 2013 | 5 | 22 | 18 | 54 | 74,666966 | 8,7843666 | 113.2 | 12,25 |
| 101 | 102 | 2013 | 5 | 23 | 3 | 0 | 73,993866 | 8,7852333 | 158 | 1,33 |
| 103 | 104 | 2013 | 5 | 24 | 6 | 2 | 69,844033 | 5,10625 | 348.9 | 7,68 |
| 105 | 106 | 2013 | 5 | 24 | 13 | 17 | 69,833633 | 8,1222166 | 351.9 | 8,05 |

**Table 2: Fishing stations taken by R/V Dana during 2 to 28 May 2013**

| Station | StType | year | Month | Day | Hour | Min | Lat | Lon | WinDir | Wind speed | Ground speed (knots) | Fishing time (min) | Wire length (m) | Gear depth (m) | Catch weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | stf | 2013 | 5 | 5 | 7 | 22 | 62.464117 | 2.625350 | 229.2 | 9.5 | 3.9 | 45 | 1425 | 325 | 18.2 |
| 6 | stf | 2013 | 5 | 5 | 23 | 19 | 63.626317 | 0.680683 | 216.3 | 11.8 | 4.2 | 30 | 300 | 10 | 2296.0 |
| 11 | stf | 2013 | 5 | 6 | 23 | 58 | 64.638683 | 7.077367 | 251 | 9.8 | 4 | 31 | 300 | 10 | 17.3 |
| 14 | FOTO | 2013 | 5 | 7 | 14 | 26 | 65.339367 | 6.161200 | 294.8 | 9.5 | 4 | 30 | 1050 | 120 | 6.1 |
| 17 | FOTO | 2013 | 5 | 7 | 23 | 39 | 65.340550 | 4.067167 | 231.7 | 3.7 | 4.4 | 60 | 301 | 10 | 285.0 |
| 20 | stf | 2013 | 5 | 8 | 8 | 16 | 65.342933 | 2.695650 | 105.7 | 9.4 | 2.7 | 73 | 550 | 60 | 3.5 |
| 23 | stf | 2013 | 5 | 8 | 19 | 7 | 65.543067 | 0.636033 | 106.5 | 11.6 | 3.5 | 60 | 1440 | 220 | 741.0 |
| 36 | stf | 2013 | 5 | 10 | 22 | 57 | 68.312800 | 12.300667 | 71.9 | 4.3 | 3.7 | 60 | 300 | 10 | 37.1 |
| 37 | stf | 2013 | 5 | 11 | 5 | 40 | 68.399000 | 11.227150 | 100.1 | 3.7 | 4 | 63 | 900 | 275 | 11.2 |
| 40 | stf | 2013 | 5 | 11 | 14 | 36 | 68.333167 | 9.236033 | 136.1 | 1.4 | 3.5 | 59 | 1250 | 300 | 224.7 |
| 45 | stf | 2013 | 5 | 12 | 4 | 41 | 68.327167 | 5.462283 | 135.3 | 5.2 | 3.3 | 61 | 950 | 250 | 423.0 |
| 62 | stf | 2013 | 5 | 17 | 8 | 1 | 72.068233 | 18.450683 | 145.8 | 4.5 | 4.2 | 60 | 600 | 20 | 2430.1 |
| 68 | stf | 2013 | 5 | 18 | 1 | 5 | 72.092483 | 12.060617 | 254.7 | 14.1 | 2.9 | 60 | 318 | 10 | 12.4 |
| 83 | stf | 2013 | 5 | 20 | 10 | 35 | 73.591300 | 15.040950 | 121.7 | 4.5 | 4 | 60 | 324 | 10 | 11.8 |
| 84 | stf | 2013 | 5 | 20 | 16 | 48 | 73.584333 | 17.790083 | 111.3 | 5.5 | 3.6 | 60 | 1424 | 250 | 190.0 |
| 91 | stf | 2013 | 5 | 21 | 20 | 3 | 74.659800 | 15.940367 | 62.7 | 13.3 | 4.1 | 89 | 1770 | 375 | 8.1 |
| 94 | stf | 2013 | 5 | 22 | 3 | 11 | 74.649900 | 14.402167 | 86.3 | 12.8 | 4.4 | 60 | 350 | 10 | 38.3 |
| 95 | stf | 2013 | 5 | 22 | 9 | 43 | 74.671333 | 12.687067 | 91.2 | 14.8 | 3.8 | 60 | 330 | 10 | 53.9 |
| 100 | stf | 2013 | 5 | 22 | 23 | 54 | 74.124983 | 8.857900 | 159.3 | 2.5 | 3.5 | 60 | 330 | 10 | 71.6 |

**Table 3: Catch composition in trawl stations taken by R/V Dana during 2 to 26 May 2011**

| Station | Latitude | Longitude | Fishing Depth | *Anarhichas denticulatus* | *Arctozenus risso* | *Argentina sphyraena* | *Argyropelecus olfersi* | *Benthosema glaciale* | *Cephalopoda sp.* | *Clupea harengus* | *Cyclopterus lumpus* | *Etmopterus spinax* | *Euphausiidae sp.* | *Gadus morhua* | *Invertebrata* | *Mallotus villosus* | *Maurolicus muelleri* | *Melanogrammus aeglefinus* | *Micromesistius poutassou* | *Notoscopelus elongatus* | *Pollachius virens* | *Scomber scombrus* | *Scyphozoa sp.* | *Sebastes mentella* | *Trisopterus esmarkii* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 62.27.847 N | 002.37.521 E | 325 | | 0.018 | | 0.006 | 0.018 | | 0.372 | | | 2.369 | | | | 1.635 | | 7.295 | 5.240 | | 0.366 | 0.846 | | |
| 6 | 63.37.579 N | 000.40.841 E | 10 | | | | | | | 2086.453 | | 0.316 | | | | | | | 11.320 | | | 197.892 | | | |
| 11 | 64.38.321 N | 007.04.642 E | 10 | | | 0.008 | | | 0.006 | | | | 17.091 | | | | 0.228 | | | | | | | | |
| 14 | 65.20.362 N | 006.09.672 E | 120 | | | | | | | | | | 5.691 | | | | 0.371 | | | | | | 0.076 | | |
| 17 | 65.20.433 N | 004.04.030 E | 10 | | 0.016 | | | | | 123.200 | | | | | | | | | 0.062 | | | 161.708 | | | |
| 20 | 65.20.576 N | 002.41.739 E | 60 | | | | | | 0.006 | 0.540 | 0.646 | | | | | | | | | | | 1.968 | 0.306 | | |
| 23 | 65.32.584 N | 000.38.162 E | 220 | | 0.098 | | | | | 313.989 | | | | | | | | | 424.142 | | | | 2.764 | | |
| 36 | 68.18.768 N | 012.18.040 E | 10 | | 0.020 | | | | | 6.472 | 10.805 | | 14.254 | | | | | 5.534 | | | | | | | |
| 37 | 68.23.940 N | 011.13.629 E | 275 | | | | | | | | | | 0.120 | | | | | | 2.763 | | 8.215 | | 0.134 | | |
| 40 | 68.19.990 N | 009.14.162 E | 300 | | 0.444 | | | 0.320 | | 212.415 | | | | | | | | 6.385 | 0.314 | | | | 4.038 | 0.810 | |
| 45 | 68.19.630 N | 005.27.737 E | 250 | | 0.526 | | | 0.010 | 0.020 | 382.670 | 1.040 | | | | | | | 7.400 | 27.201 | | | | 1.190 | 2.910 | |
| 62 | 72.04.094 N | 018.27.041 E | 20 | | 0.046 | | | | | | 2.032 | | | | | 2.322 | 0.004 | 2424.662 | 0.462 | | | | | 0.536 | |
| 68 | 72.05.549 N | 012.03.637 E | 10 | | | | | | 0.200 | | 11.400 | | | | | | | | | | | | | 0.848 | |
| 83 | 73.35.478 N | 015.02.457 E | 10 | | | | | | 0.052 | 0.124 | 10.100 | | | | 0.005 | 1.502 | | | | | | | | | |
| 84 | 73.35.060 N | 017.47.405 E | 250 | | 0.232 | | | 0.002 | 0.014 | | 9.400 | | 8.957 | 8.800 | | 137.287 | | 14.334 | 9.876 | | | | | 1.104 | |
| 91 | 74.39.588 N | 015.56.422 E | 375 | | 2.080 | | 0.001 | 0.678 | 0.330 | | 1.292 | | | | | 0.016 | 0.003 | | 2.574 | | | | | 1.090 | 0.012 |
| 94 | 74.38.994 N | 014.24.130 E | 10 | | 0.722 | | | 0.002 | 1.550 | | 34.300 | | | | | 0.200 | 0.001 | | 0.098 | | | | | 1.414 | |
| 95 | 74.40.280 N | 012.41.224 E | 10 | 0.001 | | | | | | | 53.100 | | | | | | | | | | | | | 0.766 | |
| 100 | 74.07.499 N | 008.51.474 E | 10 | | | | | | 5.158 | | 22.280 | | 44.145 | | | | | | | | | | | | |
| Grand Total (kg) | | | | 0.001 | 4.202 | 0.008 | 0.007 | 1.030 | 7.336 | 3126.235 | 156.395 | 0.316 | 92.628 | 8.800 | 0.005 | 139.859 | 2.242 | 2458.315 | 486.107 | 5.240 | 8.215 | 361.935 | 9.354 | 9.478 | 0.012 |

**Annex 1 - Calibration report.**

| | |
|---|---|
| **Transceiver Menu** | |
| Frequency | 38 kHz |
| Sound speed | 1462 $m.s^{-1}$ |
| Max. Power | 2000 W |
| Equivalent two-way beam angle | -20.5 dB |
| Default Transducer Sv gain | 25.17 dB |
| 3 dB Beamwidth | 6.8° |
| TS of sphere | -33.6 dB |
| Range to sphere in calibration | 9.0 m |
| Measured NASC value for calibration | 22100 $m^2/nmi^2$ |
| Calibration factor for NASCs | 1.00 |
| Absorption coeff | 6.862 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 |