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SURVEY REPORT FROM THE JOINT NORWEGIAN/RUSSIAN ECOSYSTEM SURVEY IN THE BARENTS SEA AUGUST-OCTOBER 2007

Volume 1

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SURVEY REPORT

FROM THE JOINT NORWEGIAN/RUSSIAN ECOSYSTEM SURVEY IN THE BARENTS SEA AUGUST – SEPTEMBER 2007

Volume 1

Preface

The fifth joint ecosystem survey was carried out during the period 1st of August to 30th of September 2007. This survey encompasses various surveys that previously have been carried out jointly or at national basis. Joint investigations include the 0-group survey, the acoustic survey for pelagic fish (previously known as the capelin survey), and the investigations on young Greenland Halibut north and east of Spitzbergen. Oceanographic investigations have always formed a part of these surveys, and studies on plankton have been included for many years. In recent years, observations of sea mammals, seabirds, bottom fishes and benthos have been included. Consequently, from 2003, these surveys were called “ecosystem surveys”.

The present volume of the survey report covers many but not all of aspects of the survey. The main focus is on the hydrographical conditions of the Barents Sea, the results from the 0-group investigations and from the acoustic investigation on pelagic fish (capelin, young herring, blue whiting and polar cod). Preliminary materials on sea mammals and seabird observations are also presented in volume 1 of the report. Results from the investigations on plankton, bottom fishes and benthos will not be covered entirely in this volume of the report since the data has not been fully analysed yet. The remaining results from these investigations will be presented in volume 2 of the survey report. The 1st volume of the report was made during a meeting between scientists participating in the survey, in Murmansk 1 -10 October.
A list of the participating vessels with their respective scientific crews is given in Appendix I.
Besides the participants on the vessels, the following specialists took part in preparing the survey report: from PINRO - K. Drevetnyak, Yu. Kovalev, E. Orlova, A. Dolgov; from IMR - J. E. Stiansen, B. Bogstad, S. Tjelmeland, K. Michalsen.

Synopsis

The main aim of the ecosystem survey was to map the distribution and abundance of the young and adult stages of several demersal and pelagic fish species, and in addition to gather information about hydrographical features, zooplankton, benthos, seabirds and sea mammals.

The water temperature in all observed areas was still higher (+0.7-+1.2 ^{0}C) than the long term mean but somewhat lower than in the same period 2006. The 2007 year-class of capelin and redfish are rich. 0-group of haddock, herring, eastern component of polar cod and sandeel are below average. 0-group of cod, Greenland halibut, saithe, long rough dab, wolffish and western component of polar cod were estimated to be poor.

The total capelin stock was estimated to be 1.9 million tonnes, which is 2.4 times higher than last year. About 0.84 million tonnes were assumed to be maturing. However, the stock is still at a low level compared to the long term mean.

The polar cod stock was estimated to be 1.2 million tonnes, which is less than last year but still higher than the long term mean.

The abundance of juvenile Norwegian spring spawning herring was estimated to 1.22 million tonnes. Large parts of the numberous 2004 year-class migrated to the southeastern part of the Barents Sea, usually dominated by younger year-classes.

Blue whiting of age groups 1 to 9, but mostly age 3 and 4, were observed in the western and southwestern parts of the surveyed area, and the biomass of this stock component was estimated to be 0.66 million tones, which is the third following year of decline since 2004, where the stock reached 1.4 mill. tonnes.

1 METHODS

Data on cruise tracks, hydrography, trawl catches, integrator values etc. were exchanged by e-mail between Norwegian vessels and Russian vessel “Smolensk” in August, and these data were used during the day-to-day planning of the survey. During September the exchange was discontinued due to a malfunction of the e-mail station on the Russian vessels. All Russian exchange of survey data were transmitted to G.O. Sars when the Russian surveys returned to port after the survey.

A team consisting of N.G. Ushakov (PINRO) together with E. Olsen and then H. Gjøsæter (IMR) on board “G.O. Sars” conducted a joint leadership over the investigations, undertaking a day-to-day planning of survey grid when necessary.

1.1 Hydrography

The oceanographic investigations consisted of measurements of temperature and salinity in depth profiles distributed over the total investigated area and along the sections Kola, Kanin, Fugløya-Bear Island, Vardø-North, North Cape-Bear Island and Bear Island-West. All vessels used CTD-probes.

The ocean currents between the surface and the bottom were measured with vessel-mounted Acoustic Doppler Current Profilers (ADCP) on the vessels Johan Hjort and G.O. Sars.

1.2 0-group fish investigations

The geographical distribution of 0-group fishes was estimated by the standard procedure which was first recommended in 1980 (Anon. 1980, Anon. 1983).

All vessels except “Vilnyus” used a small mesh mid-water trawl (“Harstadtrål”). Vilnyus used large trawl with opening 40 m. Due to that RV “Smolensk” and “Vilnyus” carried out trawl calibration after survey. Thereafter all data for “Vilnyus” were revised and recalculated.

The standard procedure consisted of tows at 3 depths, each of 0.5 nautical miles, with the headline of the trawl located at 0, 20 and 40 m. Russian vessels carried out additional tows at 60 and 80m, of 0.5 nm distance also, when the 0-group fish layer was recorded on the echo-sounder deeper than 60m or 80m. Only 3 trawls have been down in Norwegian vessels in this year.

The history of development of 0-group investigation and assessment method is described in details in earlier versions of the survey report (e.g. Anon. 2006, and ealier.).

1.3 Acoustic survey for pelagic fish

The survey area was equal to the total survey area covered during the ecosystem survey, i.e. the acoustic method was applied throughout the survey. All regions of the Barents Sea and adjacent areas of the Norwegian Sea were covered, with course lines 35 nautical miles apart.

All participating vessels used ER-60 echo sounders (with ER-60 software). The Norwegian vessels used LSSS (“Large scale survey system”, also called “El-trippel-S”), while the Russian vessels used FAMAS and BI-60 post-processing system. “G.O. Sars”, “J. Hjort” and “Jan Mayen” were equipped with transducers on adjustable keels that can be lowered in rough weather to avoid the damping effect of bubbles. Echo intensities per nautical mile were integrated continuously, and mean values per 1 (Norwegian vessels) or 5 (Russian vessels) nautical miles were recorded for mapping and further calculations. The echograms, with their corresponding s_A-values, were scrutinized every day. Contributions from the seabed, false echoes, and noise were deleted.

The corrected values for integrated echo intensity were allocated to species according to the trace pattern of the echograms and the composition of the trawl catches. Data from pelagic trawl hauls and bottom trawl hauls considered representative for the pelagic component of the stocks, which is measured acoustically, were included in the stock abundance calculations.

The echo sounders were watched continuously, and trawl hauls in addition to the predetermined hauls were carried out whenever the recordings changed their characteristics and/or the need for biological data made it necessary. Trawling was thus carried out both for identification purposes and to obtain biological observations, i.e., length, weight, maturity stage, stomach data, and age.

The vessels gave the s_A-values in absolute terms based on sphere calibrations, that is, as scattering cross section in m^2 per square nautical mile. The acoustic equipment of the vessels was calibrated by standard spheres (see Appendix 2).

1.3.1 Area coverage

The weather conditions were favourable during the first parts of the survey, while strong winds were prevailing during the second part. Various accidents like damage to the engine of “Johan Hjort” that took almost two weeks to repair, and a loss of trawl and later damage to the trawl winches on “G.O. Sars” that delayed and prevented trawling in some areas, and a partly suboptimal survey design for acoustic measurements lowered the quality of the survey. However, a total coverage of the Barents Sea was achieved. In 2007 the survey was started from the south. “Smolensk” and “Vilnyus” worked in the eastern and central parts of the Barents Sea.. “G.O. Sars” and “Johan Hjort” surveyed the western, northwestern and central parts while “Jan Mayen” observed areas around Spitsbergen. See Fig. 2.1-2.4 for details of the realized survey track.

1.3.2 Computations of the stock sizes

The computations of number of individuals and biomass per length-and age group of the pelagic fish stocks were done in the same way as in previous years. For details; see the 2006 cruise report (Anon.2006).

1.4 Bottom trawl survey

The number and biomass of fish per length- and age-group will be calculated from bottom trawl catches using the “swept-area” method with a strata system developed at IMR. These results will be presented in Vol. II of the report.

Acoustic registrations of bottom fish were carried out along all cruise tracks, with division of s_A-values by species based on trawl catches data.

1.4.1 Strata system used

A new strata system was constructed in 2004 covering the whole Barents Sea to include the total survey area. The new geographic system is also depth stratified using GEBCO depth data. Since this is the fifth total coverage of bottom fishes, it is not possible to compare the indices to corresponding indices in years before 2004. However, for the species cod, haddock and Greenland halibut, there are indices from approximately the same period in earlier years, at least for some regions of the Barents Sea. These indices will be presented in Vol. II of the report together with the age-based indices for 2007.

1.5 Plankton investigations

Data on phytoplankton abundance was obtained in several ways during the joint Russian-Norwegian Survey. On the Norwegian vessels G.O. Sars and Johan Hjort samples for chlorophyll ***a*** were obtained at nearly all CTD stations through filtration of water from water bottles at discrete depths from 0 – 100 m including a surface sample taken using a bucket. The total number of samples varied slightly depending on bottom depth at the specific localities. Phytoplankton was filtered using GFC filters, and samples were frozen for later analysis of chl **a** content at the IMR laboratory. For both vessels mentioned above phytoplankton nutrient samples were obtained from the same water bottles on most CTD stations, at depths from the surface to the bottom according to a predefined scheme as determined for the Ecosystem cruise and specific bottom depth of each station. On G.O. Sars a fluorometer was used as an additional instrument, connected to the CTD, logging chl ***a*** fluorescence as a continuous vertical profile along with temperature and salinity for all CTD stations. These data must however be calibrated with the help of chl ***a*** determined from the water bottle samples obtained at the same stations.

Samples for phytoplankton species composition and abundance have been obtained from the Norwegian vessels G.O. Sars and Johan Hjort. For every second or third station quantitative water samples were obtained from water bottles at 5, 10, 20 and 30 m depth. Immediate upon retrieval of the seawater rosette sampler, one 25 ml phytoplankton sample were taken from each bottle at the above mentioned depths. The samples were pooled in a dark light-protected 100 ml flask adding 2 ml lugol as fixative for later analysis. Slightly less frequent a 10 µm meshed phytoplankton net with a 0.1 m^2 opening was vertically operated from 0-30 m to obtain a qualitative phytoplankton sample. If the net itself showed no greenish colour (sign of phytoplankton) after retrieval, it was re-deployed once or twice to obtain a sufficient amount of phytoplankton to trace less abundant, but potentially important species. After gentle mixing of the water from the net cod-end, two dark light-protected 100 ml flasks were filled, each with approximately 80 ml seawater, then adding 2 ml lugol and 2.5 ml 20% formalin for fixation respectively.

On board the Russian vessels information on phytoplankton abundance was obtained through a semi-quantitative approach. The phytoplankton conditions were analyzed from the zooplankton samples by visual estimation of micro-algae concentration and frequency of cell occurrence using a 5-unit scale - single (1) to mass (5) occurrence. Phytoplankton composition was determined to genus.

Zooplankton sampling on the Norwegian vessels was carried out by WP-2 plankton nets with a 0.25m^2 opening and 180 µm mesh size. Usually two hauls were made at each station, one was taken from the bottom to the surface and the other one from 100 m to the surface. Additional stratified sampling was carried out daily by the Mocness multinet planktonsampler. In order to acquire a quantitative understanding of differences in mesozooplankton catches between the WP-2 and the Russian Juday net used for mesozooplankton sampling, a newly designed double net system holding both a WP-2 as well as a Russian Juday net was operated from the Norwegian vessel “G.O. Sars” during the later part of the joint Ecosystem survey in 2007. Samples were taken as often as time permitted, but due to lack of time during the cruise, it will probably be necessary to extend this comparison to other Barents Sea cruises in 2007/2008, beyond the joint Ecosystem survey. A total of 19 double net hauls were conducted, all hauls were conducted using a vertical haul speed of 0.5 m s^{-1}, although the intention was to also do comparisons for haul speeds of 0.8 m s^{-1}. The sampling on the Russian vessels was carried out by Juday-nets with 0.1 m^2 opening and 180 µm mesh size. Depth intervals for plankton sampling were bottom-0m and 50-0m on “Vilnyus” and bottom-0m, 100-0m and 50-0m- on “Smolensk”.

On board the Norwegian vessels samples (including those from the double net system), were normally split in two, one part was fixated in 4% borax neutralized formalin for species analysis and the other one was size-fractioned as follows; >2000 µm, 2000-1000 µm and 1000-180 µm size categories. These size-fractionated samples were weighed after drying at 60°C for 24 hours. Large organisms like medusa, krill, shrimps, amphipods, chaetognaths, fish and fish larvae were counted and their length or size measured separately before drying and weighting.

Processing of Juday net samples from the Russian vessels included preliminary species identification and abundance determination, including wet weight determination of biomass from each haul. A more detailed processing of species and stage composition as well as numerical abundance will be undertaken in the laboratory according to standard procedures. Dry weights will be derived using a conversion factor of 0.2. All zooplankton data will be presented as biomass or numbers per 1 m^2 surface.

Final plankton results will be presented in Vol. 2 of the survey report.

1.6 Stomach investigations

According to agreement at the Russian-Norwegian meeting in March 2006 capelin stomachs were collected at the Norwegian (G.O. Sars) and Russian vessels (Smolensk and Vilnyus) in August-September 2007.

Also stomach samples of cod were taken according to standard protocol on all participating vessels.

1.7 Marine mammals and seabirds investigations

Marine mammals and bird observations (species and numbers observed) were recorded onboard the Norwegian research vessels "G.O. Sars", "Johan Hjort" and "Jan Mayen" (only marine mammals) and the Russian research vessels "Vilnyus" and "Smolensk".

Onboard the Norwegian vessels visual observations were made by three observers from the vessel bridges; one dedicated for observing sea birds and two dedicated for observing marine mammals . The marine mammal observers covered approximately the front 90° sector (45° each) and the sea bird observer covering one 90° sector along the ship sides. While most species were recorded continuously along the cruise transects when steaming between stations, the ship-following seabird species (northern fulmars and gulls) were counted every 10 minutes. Onboard the Russian research vessels observations of marine mammals and sea birds were carried out by one observer covering a full sector of 180° from the roof of the bridge about 9-10 m above the sea surface level. Observers were only observing along transects between stations. All species were recorded continuously along the transects.

Observer's activity was limited by weather conditions. When the weather conditions were not sufficiently good for observations observation effort was stopped. Both observer activity and weather conditions were recorded.

1.8 Benthos observations

1.8.1 Purpose

The purpose of the benthos investigation was to

- Sample material for description of benthic habitats and communities in the Barents Sea from the bycatch of the Campelen trawl. This should lead to criteria for selection of suitable monitoring locations in the Norwegian EEZ and improved procedures for providing results on benthos relevant for an ecosystem approach to management of marine resources in the Barents Sea.
- To continue established time series of benthic community monitoring by grab together with 2m Beamtrawl sampling.
- Monitoring of the benthic communities state in the high red king crab concentration areas (RU in REZ).
- Make a environmental survey of "Nucula" (Hydro petroleum investigation))

1.8.2 Criteria for selection of sampling locations

Bycatch of invertebrates were recorded from all bottom trawl hauls of the Russian RV Vilnyus and Smolensk and the Norwegian RV G.O. Sars, Johan Hjort, Jan Mayen.

The sampling of the established time series was made by Norvegian side in RV G.O. Sars at locations already decided by PINRO from previously established monitoring stations.

Location of the monitoring stations for the red king crab impact to the benthos was based on PINRO benthic stations in 2003.

Selected stations of the "Nucula" field was based on detailed topographic map, whereas VMS satellite tracking data from the Norwegian Fisheries Directorate was used to identify areas with high fishing activity.

1.8.3 Gear and methods

The following gears were used during the ecosystem cruise:

- 2 m Beam trawl which is scraping the sea bottom
- van Veen grab which are taken a bite of the sediment (provides samples to quantify animals that live upon and in the sediments),

The combination of different sampling gear shall provide a picture of the surface living animals (video and trawl) and animals from inside the sediment (grab).

1.8.4 Bottom trawl

At G.O. Sars the benthic invertebrate bycatch from all hauls with bottom trawl (Campelen) was processed to species level onboard. Species difficult to identify was photographed and preserved in alcohol for later identification. All other animals were made available for MAR BANK for bio-prospecting. The "juvenile-sac" of the Campelen trawl was preserved and brought to Tromsø for later processing.

The other Norwegian vessels sorted and measured the bycatch into large invertebrate groups which consequently was recorded in REGFISK.

On the Russian vessels all or some of the bycatch was identified to species or sorted into larger taxa and consequently recorded in BIOFOX. More work need to be done in order to increase the availability to and standardizing benthos data from REGFISK and BIOFOX. The Campelen bottom trawling was lasting approximately 15 minutes and covered 10.000 to 13.000 m^2.

It is important that Russian and Norwegian RVs use the same system of larger invertebrate groups. The Norwegian grouping of invertebrates are given in appendix 6 (Russian names should be filled in later). A ranging of large invertebrate groups should be discussed by next meeting and should be used on Ecosystem Survey 2008.

1.8.5 van Veen grab

Quantitative collecting of macro-zoobenthos was carried out with 5 times 0,1 m^2 van Veen grabs at each of the established stations of benthic community monitoring selected by PINRO and in tree replication in red king crab monitoring stations. The samples were sieved in running seawater using a 1 mm sieve. Sieved bottom organisms with remains of sediments were fixed in 4% neutralized solution of formaldehyde. Borax was used as a buffer. Onboard RV Vilnyus, dominating species and forms of macro-zoobenthos were recorded in the observation log during sieving and fixing of the samples.

1.8.6 Epibenthos trawls

Qualitative sampling of zoobenthos in RV G.O. Sars was carried out with a small Beamtrawl. The Beamtrawl have an opening of 2 m and a inner cover in the net =10 mm mesh, cod-end = 4 mm mesh size.

Trawling duration was set to 5 min at a vessel speed of approximately 1.5 knots. During towing of Beamtrawl trawl a bottom area covering are approximately 463 m^2.

The samples were sieved trough 5 mm sieves. The samples from the Beamtrawl were fixed on 4% formaldehyde for sorting and identification in the laboratory on land.

1.8.7 Video survey

For the environmental studies on NUCULA, video records were provided onboard G.O. Sars with IMR's Campod. This is a platform consisting of a video camera with pan and tilt control, two lights, and a metal frame with weights, connected to a cable from the ship. The Campod is deployed while the ship is allowed to slowly drift with the current, and was kept close (1 - 2m) to the seabed for 120 minutes at approximately 0.5 knots (650-750 m^2). Logs for the deployments included GMT time, geographic positions, depth and general description of the habitat (substrate type and dominating epifauna) was made simulations.

2 RESULTS AND DISCUSSION

Altogether, the joint survey included 210 vessel-days, compared to 205 in 2006, 208 in 2005 and 215 in 2004. Altogether, the vessels sailed about 28000 nautical miles with observations of 430000 square nautical miles. In total, the Norwegian vessels carried out 557 trawl hauls and the Russian vessels 450 trawl hauls, so in total 1007 hauls were made during the survey (while 999 hauls were made in 2006).

Survey routes with trawl stations; environmentalnstations (hydrographical, plankton and sedimentation) and benthos sampling stations are shown in Fig. 2.1, 2.2 and 2.3, respectively.

The Russian and Norwegian delegations expressed their interest in the cooperation concerning the collection of oceanographic data on the standard sections to diminish the costs for research during the sea cruises. This cooperation realized in order of measurements made on standard sections by Norwegian and Russian vessels in correspondence areas. Thereafter results from both Norwegian and Russian standard sections are encluded below.

2.1 Hydrographical conditions

Figs. 2.1.1-2.1.6 shows the temperature and salinity conditions along the oceanographic sections: Kola, Kanin, North Cape-Bear Island, Bear Island-West, Vardø-North and Fugløya-Bear Island. The mean temperatures in the main part of these sections are presented in Table 2.1.1, along with historical data back to 1965. Anomalies have been calculated using the long-term mean for the period 1954-1990. Horizontal distribution of temperature and salinity are shown for depths of 0, 50, 100, 200 m and near the bottom in Figs. 2.1.7-2.1.14.

In general the temperature was well above the long-term mean throughout the Barents Sea. The surface water temperatures exceeded the long-term mean by 1.0-1.5°C on average in the whole investigated area (Fig. 2.1.13). Maximum positive temperature anomalies were observed north of 78° N and in the south-eastern and western parts of the Barents Sea, where temperatures could reach more than 3 degree above average. In the bottom layer, positive anomalies of water temperature were found practically in all the observed areas except along the slope at the western entrance (Fig. 2.1.14). Large areas had bottom temperatures of 1-1.5°C above average, and some smaller areas even around 2°C above average.

Compared to 2006 the surface temperature was lower (on average 0.8-1.8°C) near to Spitsbergen Archipelago, in the central part of the sea (between 24 and 40°E and to the south of 75°N), with the highest deviation between Bear and Hopen Islands (more than by 2°C lower in 2007). But the surface temperature was higher (on average 0.5-1.0°C) in northern, eastern and south-western parts, with the highest deviation to the north of 79°N and to the east of 47°E (more than 1.5°C higher in 2007). These high surface temperatures gave the maximum surface anomalies and were associated with shallow fresh surface layers due to increased spreading of coastal water in the south and ice-melt in the north. In the western parts the Norwegian Coastal Current has a spread northward almost all the way to 74° N (Fig. 2.1.8). Also in the south-eastern part there was a very fresh surface layer. North of 78° N the fresh surface layer comes from melting of ice. In addition to the small contribution from Barents Sea ice melt, melt water from the Arctic Ocean probably also has contributed, as the ice cover in the Arctic is at an extreme minimum this summer. The fresh surface waters produced shallow surface layers prohibiting mixing of the warmer coastal waters downwards in the south. In addition it confirmed the surface heating from the atmosphere to this shallow layer giving the high anomalies both in the south and the north. In contrast the temperatures at 50 m depth in the same areas are close to 1° C lower than last year (Fig. 2.1.9). The bottom temperatures were between approx. 0.7 and 0.9°C lower in 2007 than in 2006 near to the Spitsbergen Archipelago, in the coastal waters near Kola Peninsula as well as in the south-eastern Barents Sea except in the eastern part, where waters were warmer (on average 1.0°C) than in 2006. In the rest of the areas the bottom temperature in 2007 was the same as in 2006.

The water salinity below the surface layer in the survey area south of 74° N was in general slightly higher (by 0.1 on average) than the long-term mean. The highest salinity anomalies (more than 0.8) were observed between 76 and 79° N. These areas are in the borderline between Atlantic and Arctic water masses. The surface salinity near Novaya Zemlya was lower than the long-term mean by 0.7-0.9.

The maximum horizontal temperature gradients (0.1°C per kilometer) were observed for the Polar Front at a longitude of 35° E at 50 m depth (Fig. 2.1.15).

The Kola section is divided into three parts. The inner part represents the Murmansk Coastal Current and contains mostly coastal water masses, the central part represents the Murmansk Current and usually contains both coastal and Atlantic water masses, and the outer part represents the Central Branch of the North Cape Current and contains mostly Atlantic water masses. In the three parts the positive temperature anomalies in the 0-50 m layer were 1.3, 1.2 and 1.2°C, respectively. In the 0-200 m layer the corresponding anomalies were 0.9, 1.0 and 1.1°C.

The Kanin section is divided into two parts. The inner part represents the Kanin Current and had positive temperature anomalies of 0.8 and 0.7°C in the 0-50 m and 0-200 m layers, respectively. The outer part represents the Novaya Zemlya Current and had positive temperature anomalies of 1.3°C in the 0-200 m layer.

The Bear Island-West Section is divided into three parts representing the middle, east-marine and east-coastal branches of the Norwegian Current. Temperatures in the 0-50, 0-200 m and 0-500 m layers were all higher than average. The positive anomalies in all parts of the sections were 1.4-1.5° C in the 0-50 m layer, 1.2-1.3°C in the 0-200 m layer and 1.0-1.1°C in the 0-500 m layer.

The main part of the North Cape-Bear Island Section represents the North Cape Current, which mostly contains Atlantic water masses. The temperature anomalies in 0-50 m and 0-200 m layers were 1.2 and 1.0°C, respectively.

The southernmost part of the Fugløya-Bear Island section is in the Norwegian Coastal Current and the middle part in the North Cape Current. In the northern part the section cuts through the eastward flowing Bear Island Current and the eastward flowing water masses in the deeper part of the Bear Island Trench. Compared to 2006 the stratification in the upper waters in the section are stronger due to northward spreading of coastal water, producing a strong pycnocline at about 30 m depth (Fig. 2.1.6). Below the surface layer the Coastal Current is colder and saltier than in 2006, while the North Cape Current is colder and fresher. The mean temperature in the North Cape Current is about 0.75°C above the long-term mean for the period 1977-2004. The Bear Island Current and the outflow in the deepest part of the Bear Island Trench on the other hand, are warmer and saltier than last year. At least for the outflow south of the Bear Island Current this is probably due to the very high temperatures and salinities observed in the North Cape Current in the last years.

In south the Vardø-North section covers the Norwegian Coastal Current and the Murman Current containing both coastal and Atlantic water masses. North of this (about 72°15'-74°N) it cuts through the Central Branch of the North Cape Current that carries Atlantic Water eastwards south of the Central Bank. North of 74°30'N, the section cover the Northern Branch of the North Cape Current. This branch flows towards northeast on the west side of the Central Bank transporting Atlantic Water masses toward the Hopen Trench. In contrast to the Fugløya-Bear Island section, the Vardø-North section shows weaker stratification in the upper water masses compared to the situation in 2006 (Fig. 2.1.5). Both the Coastal Current and the Central Branch of the North Cape Current are colder and saltier than last year. The mean temperature in the Central Branch is about 0.7°C above the long-term mean for the period 1977-2004. The most pronounced difference from last year is that the Northern Branch going towards the Hopen Trench is much warmer (about 1°C) and saltier (about 0.1) at depths between 100 and 250 m.

The high sub-surface temperature in the Barents Sea is mostly due to the inflow of water masses with high temperatures from the Norwegian Sea. During the last 5-6 years the inflow to the Barents Sea has had high temperatures and been strong, and in particular the year of 2006 and the winter of 2006/2007 were warm. The high temperatures progress north-eastwards in the area giving the observed high anomalies in the north-eastern parts. In the inflow area, the decrease in temperature from last year might indicate that the inflow now is being reduced. It might however also be a temporarily decrease before the winter. The high temperature in the surface layer of the Barents Sea is in some areas clearly connected to a freshwater cap.

2.2 Distribution and abundance of 0-group fish

The distribution of various species of 0-group fish are shown in Figs. 2.2.1-2.2.11. Area based indices from 1965-2007 are shown in Table 2.2.1. Abundance indices from 1980-2007 are shown in Tables 2.2.2 - 2.2.3. The density grading in the figures is based on the catches, measured in number of fish per square nautical mile. More intensive coloring indicates dense concentrations. The coverage of 0-group fish distributions in all the observed areas was good. Length frequency distributions of the main species are given in Table 2.2.4.

2.2.1 Capelin

0-group capelin was widely distributed (Fig. 2.2.1) in the Barents Sea as in previous year, and sparsely around Spitsbergen. In this year the highest densities of capelin were observed in the east-central areas, while in west-central in 2006. In the central area 0-group capelin was mixed with 1-year olds as it usually found in south-eastern areas. Therefore it was complicated to allocate 0-group fish from mixed catches due to overlap in length distributions between age groups.

0-group capelin was larger than in recent years, probably indicating good feeding condition during the first summer.

Abundance of 0-group capelin in 2007 is somewhat below than that observed in 2006, but 2.5 times above the average level, so the 2007 year-class is very rich.

2.2.2 Cod

0-group cod was distributed (Fig. 2.2.2) in the central, western and north-western parts of the Barents Sea, as in previous years. In this year, contrasting to observations in 2006, denser concentrations of cod were distributed in central area. Cod almost disappeared from the eastern parts of the Barents Sea.
The individual size of the 0-group cod was lower than in the last three years. Abundance index of 2007 year-class slightly above the 2006 level, but only half the long term mean level. Therefore the 2007 year class of cod is poor.

2.2.3 Haddock

0-group haddock was found in the western and central parts in the Barents Sea, and distributed (Fig. 2.2.3) over a smaller area than in the last three years. In comparison to the last years scattered concentrations were found to the west, north and north-east of Spitsbergen. Dense concentrations were located in west-central area.

The individual size of the 0-group haddock was lower than in 2006, but higher than long term mean level. Abundance of 0-group haddock is much lower than the last five years and somewhat lower than the long term mean level.

2.2.4 Herring

0-group herring was distributed (Fig.2.2.4) in the central parts of the Barents Sea and observed over a smaller area than in previous years. Scattered concentrations of herring were found in the south-west and north-west of Spitsbergen. Dense concentrations were located between 20˚-27˚ E only.

Abundance of 0-group herring is one third of the 2006 abundance and somewhat below the long term mean level.

2.2.5 Polar cod

The eastern component of polar cod was distributed (Fig. 2.2.5) along southwestern and western coast of Novaja Zemlja and more widely in north direction. The denser concentrations were observed in the eastern and northeastern part of the surveyed area. The northern border of distribution was not observed, as usually.

Abundance index of this component is somewhat lower than in 2006 and about 70% of the long-term average level.

The western component of polar cod was found south, west and north of Spitsbergen, but with lower densities than in last year.

Abundance index of western component is somewhat higher than in 2006, but only about 30% of the long-term mean level. So the western component of polar cod is poor.

2.2.6 Saithe

Compared to the three last years the distribution (Fig. 2.2.6) of 0-group saithe was considerably smaller, and saithe were patchily distributed in the western part of the Barents Sea.

Abundance of 0-group saithe was very low, and the 2007 year-class was almost the equally poor as the 2005 year-class.

2.2.7 Redfish

In the west of the Barents Sea the geographical distribution (Fig. 2.2.7) of 0-group redfish was at least 2 times wider than in last year. Most of this distribution consisted of dense concentrations. Along western and northern coast of Spitsbergen 0-group redfish was found in smaller area and lower densities than in previous year.

The abundance index of redfish is the highest since 1985 and the 2007 year class can be assessed as very rich. It is difficult to determine the species of 0-group redfish. However, taxonomic identifications was attempted in some areas, and the conclusion was that most of the 0-group redfish was *Sebastes mentella*. Although this conclusion should be considered tentative, this result seems probable given the stock situation for redfish and their changes in recent years.

2.2.8 Greenland halibut

As in the previous two years, 0-group Greenland halibut were found (Fig. 2.2.8) to the west and south of Spitsbergen but in very small area and lower density. The 0-group index is much lower than average. 0-group halibut catches have a strong depending from catch depth, and uncertainty of 0-group Greenland halibut abundance estimation is quite large.

2.2.9 Long rough dab

Compared to the last year the distribution (Fig.2.2.9) of 0-group long rough dab was significantly smaller, and fishes were patchily distributed in the western and eastern parts of the Barents Sea and around Spitsbergen. The 2007 year-class of long rough dab seems to be below long term average level. But if extremely high indexes are excluded from time series, the 2007-index can be characterized as typical. Some 0-group LRD may have settled to the bottom and was not available for pelagic trawls.

2.2.10 Wolffish

As in last year, 0-group wolfish (in previous reports called as catfish) was found (Fig. 2.2.10) in some few catches south and north of Spitsbergen. No index is calculated for this species.

2.2.11 Sandeel

Compared to the previous year, the distribution (Fig. 2.2.11) area of 0-group sandeel in the western part of the Barents Sea slightly increased. Some low catches were also taken to the south-west and to the north of Spitsbergen. In the eastern and south-eastern parts of the sea gradual decrease of distribution area as well of density concentrations were observed.

No index is calculated for this species.

2.3 Distribution and abundance of pelagic fish

2.3.1 Capelin

2.3.1.1 Distribution

The geographical density distribution of the total stock and for age 1 fish is shown in Figs. 2.3.1 and 2.3.2. Total distribution area of the capelin was quite wide this year, covering most parts of the Barents Sea and to the west and north of Spitsbergen. The main concentrations were found east of the Hopen island and in the Central Bank area. Young capelin also had a wide distribution this year.

Sample echogram of capelin distributions are shown in Figure 2.3.3-2.3.4. In the latter a whale feeding on the capelin is visual.

2.3.1.2 Abundance estimate and size by age

A detailed stock size estimate is given in Table 2.3.1, and the time series of abundance estimates is summarized in Table 2.3.2. The main results of the abundance estimation in 2007 are summarized in the text table below. The 2006 estimate is shown on a shaded background for comparison.

Summary of stock size estimates for capelin

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2006	2005	1	221.7	60.1	4.2	4.8	928.1	289.0
2005	2004	2	54.8	21.7	15.5	16.1	848.2	348.6
2004	2003	3	3.7	5.6	27.5	24.8	101.3	138.2
2003	2002	4	0.1	0.3	28.1	30.6	3.8	10.5
Total stock in:								
2007	2006	1-4	280.3	87.7	6.7	9.0	1881.6	786.4
Based on TS value: 19.1 log L – 74.0, corresponding to $\sigma = 5.0 \cdot 10^7 \cdot L^{1.91}$								

The total stock is estimated at about 1.9 million tonnes, about 2.4 times higher than the stock estimated last year. This rate of increase is the same as observed from 2005 to 2006. About 45% (844 thousand tonnes) of this stock is above 14 cm and considered to be maturing. The 2006 year class (1-group) consists, according to this estimate, of about 220 billion individuals. This estimate is about 3.7 times higher than that obtained for the 1- group last year. The mean weight is estimated at 4.2 g, which is 0.6 g lower than that measured last year, but above the long-term average. The biomass of the 2006 year class is about 0.93 million tonnes. It should be kept in mind that, given the limitations of the acoustic method concerning mixed concentrations of small capelin and 0-group fish and near-surface distribution, the 1-group estimate might be more uncertain than that for older capelin.

The estimated number of fish in the 2005 year class (2-group) is about 55 billion, which is about 2.5 times higher compared of the 2004 year class measured last year. The mean weight at this age is 15.5 g (16.1 g in 2006), and consequently the biomass of the two years old fish is about 0.85 million tonnes. The mean weight is lower than last year but is 4.8 g above the long-term average (Table 2.3.2).

The 2004 year class is estimated at about 3.7 billion individuals with mean weight 27.5 g, giving a biomass of about 0.10 million tonnes. The mean weight is 8.5 g above the long-term average. The 2003 year class (now 4 years old) is estimated at 0.1 billion individuals. With a mean weight of 28.1 g this age group makes up only about 4 thousand tonnes. Practically no capelin older than four years was found.

2.3.1.3 Total mortality calculated from surveys

Table 2.3.3 shows the number of fish in the various year classes, and their "survey mortality" from age one to age two. As there has been no fishing on these age groups, the figures for total mortality constitute natural mortality only, and probably reflect quite well the predation on capelin. As can be seen from the table, the mortality was high prior to 1988, but then a substantial decrease occurred in 1988-89. This coincided with a considerable increase in the stock size caused by the rich 1989 year class. From 1990, the mortality again increased, up to 85% in 1992-93. This increase is in accordance with the observation of an increasing stock of cod, which were preying on a rapidly decreasing stock of capelin. The mortalities calculated for the period 1996-2002 varied between 20 and 52% and indicate a somewhat lower level of mortality. In 2003 a considerable increased natural mortality was observed, at the level (around 85%) observed in 1985-86 and in 1992-93 and this high level was continued from 2003 to 2005. In 2006, the natural mortality started to decrease again and in 2007 reached 9%. The results of the calculation for the year classes 1988, 1992, and 1994 shows, however, that either the one-group are underestimated or the two-group is overestimated these years. Knowing that the measurement of the 1-group is more uncertain than the older age groups due to limitations in the acoustic method, the first mentioned possibility is the most probable.

2.3.2 Polar cod

Compared to recent years, the polar cod distribution was almost completely covered. Only in the north-eastern areas a definite boundary of the polar cod distribution was not found. The geographical density distribution of the total stock and for age 1 fish is shown in Figs. 2.3.5 to 2.3.6. The main concentrations were found along west and south coast of Novaja Zemlja. During the trawl survey for Greenland halibut in the areas around Spitsbergen considerable amounts of polar cod was caught by bottom trawl in the studied areas. Towards Frans Josef Land it was found only in scattered concentrations. This situation is common during the autumn, when the polar cod stock is widely distributed in the northern part of the Barents Sea.

2.3.2.1 Distribution

Polar cod had a wide distribution in most northern areas. Northward of 77º N this species was found until 81º N and even further north between 10º and 55º E. Southward of 77º N polar cod distributed mainly to the east of 42º E. The densest registrations of polar cod were found in two areas: to the south of Novaja Zemlja and to the west of this archipelago from 76º N to 78°30´N between 45° - 50°E. Local concentrations were also observed near 78º N and 42º´E. Figure 2.3.7 shows typical acoustic registrations of polar cod.

2.3.2.2 Abundance estimation

The stock abundance estimate by age, number, and weight was calculated using the same computer program as for capelin. The geographical density distribution of polar cod is shown in Figs. 2.3.5-2.3.6.

A detailed estimate is given in Table 2.3.4, and the time series of abundance estimates is summarized in Table 2.3.5. The main results of the abundance in 2007 are summarized in the text table below. The 2006 estimate is shown on a shaded background for comparison.

Summary of stock size estimates for polar cod

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2006	2005	1	29.5	16.2	10.9	11.2	321.2	180.8
2005	2004	2	25.8	45.1	28.8	28.3	743.4	1277.4
2004	2003	3	3.2	12.1	45.1	36.9	145.8	445.9
2003+	2002+	4	0.3	0.7	61.6	51.6	19.6	37.2
Total stock in								
2007	2006	1-4	58.8	74.0	20.9	26.2	1230.1	1941.2
Based on TS value: 21.8 log L – 72.7, corresponding to $\sigma = 6.7 \cdot 10^7 \cdot L^{2.18}$								

The number of individuals in the 2006 year-class (the one-year-olds) is about 82% higher than the one- group measured last year. Therefore, the biomass of the 2006 year-class is 1.8 times higher even though their mean weight is 0.3 g lower than of the one-year-olds measured last year. The abundance of the 2005 year class (the two-year-olds) is 25.8 billions. This is almost 43 % lower than the two-group found last year with near the same mean weight. The biomass has, therefore, decreased 1.7 times compared to the 2004 year-class estimated last year. The three-years-old fish (2004 year class) is about 3.2 billions that is 3.8 times lower than the three-group estimated last year but has 8.2 g higher mean weight. Consequently, the biomass of this age group is on 3.1 times lower compared to that for the corresponding age group during the 2006 survey. The four-year-olds (2003 year class) are scarcely found and less numerous than in last year. Also there were fish with age 5 and 6 but in insignificant quantities. The total stock, estimated at 1.2 million tonnes, is somewhat below that in 2006 but corresponds to a stable population condition.

2.3.2.3 Total mortality calculated from surveys

Table 2.3.6 shows the “survey-mortality rates” of polar cod in the period 1985 to 2007. The mortality estimates are unstable during the whole period. Although unstable mortalities may indicate errors in the stock size estimation from year to year, the impression remains that there is a considerable total mortality on young polar cod. Prior to 1993, these mortality estimates represent natural mortality only, as practically no fishing took place. In the period 1993 to 2006 catches were at a level between 0 and 50 000 tonnes. Since there has been a minimum landing size of 15 cm (from 1998, 13 cm) in that fishery, a considerable amount of this could consist of two- and even one-year-olds, and this may explain some, but only a small part of the high total mortality. From 2003 to 2004 there are negative survey mortalities both for age groups 1-2 and for 2-3, confirming the impression expressed in the 2003 report that the 2003 estimate for various reasons was an underestimate. In 2006 in both age groups (1 - 2 and 2 - 3) natural mortality of polar cod was near 7% lower than it was found in previous year. From survey of current year the negative survey mortality for age groups 1-2 was again found when for age groups 2-3 survey mortality increased up to 93 %.

2.3.3 Herring

The youngest age groups (age 0+ to 3+) of the Norwegian spring spawning herring stock are found in the Barents Sea at irregular intervals. It is quite difficult to assess the stock size during autumn, due to various reasons. The age groups 1-3 are found mixed with 0-group herring, and other 0-group fish. In this year in the south-eastern areas it was problematic to separate the Norwegian spring spawning herring from local stock of herring from Pechora Sea. Since it is impossible to split Sa values from mixed concentrations, all age samplings were revised, and percents of Norwegian spring spawning and Cheshsko-pecherskaja herring were determined separately for each WMO square. Besides, the herring schools are partly found near the surface, even above the range of the echo sounders. The stock size estimates of herring may therefore be less reliable than those for capelin and polar cod.

2.3.3.1 Distribution

The distribution of young herring is shown in Figure 2.3.8. Total distribution area of herring in 2007 resembles that of the past few years and was divided into eastern and western components. Eastern juvenile herring with predominance of 3 year olds were distributed over a large area between 22°- 51°E and up to 72°30'N. West of 22°E 3 year olds and older herring dominated. The aggregations with highest density of young herring were recorded in the southern part of the sea between 22°- 28°E and 36º-49ºE. East of 40° E Norwegian springspawning herring were mixed with Cheshsko-pecherskaja herring, but east of 50° only the latter were found.

2.3.3.2 Abundance estimation

The estimated number and biomass of eastern (east of 22°E) herring from the Barents Sea per age- and length group is given in Table 2.3.7. The main results of the abundance estimation in 2007 are summarized in the text table below. The 2006 estimate is shown on a shaded background for comparison.

Summary of abundance estimates of the portion of the herring stock found in the Barents Sea.

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2006	2005	1	3.9	1.6	37.4	21.1	147.5	34.2
2005	2004	2	2.6	5.5	83.8	72.0	217.5	398.4
2004	2003	3	6.3	1.3	127.0	121.8	810.1	152.3
2003	2002	4	0.3	0.4	181.2	157.1	45.7	58.2
Total stock in:								
2007	2006	1-3	13.2	8.8	92.7	73.3	1220.9	643.0
Based on TS value: 20.0 log L – 71.9, corresponding to $\sigma = 8.1 \cdot 10^{-7} \cdot L^{2.00}$								

Total abundance was estimated at $13.2 \cdot 10^9$ fish and biomass at $1.2 \cdot 10^6$ t. Almost half of the stock (by numbers) was from the 2004 year-class. This estimate ($6.4 \cdot 10^9$) is higher than that obtained for this year class in 2006 ($5.5 \cdot 10^9$) but considerably lower than that obtained during May 2007 ($12.5 \cdot 10^9$). One possible explanation for this could be that different fractions of the total year class were included in the Barents Sea estimates at the different surveys. Difficulties with sampling herring representatively could also explain such inconsistencies. Normally, a majority of three years old herring leave the Barents Sea, but this year high densities of this age group was found in the eastern areas. This year, a couple of herring older than four years that had spawned once were found north of the Varanger peninsula.

2.3.4 Blue whiting

In the southwestern part of the Barents Sea blue whiting were observed as in previous years. The target strength used for blue whiting is uncertain, and the estimate should to a greater extent than the other estimates be considered as a relative quantity only.

2.3.4.1 Distribution

The distribution of blue whiting (all age groups) is shown in Figure 2.3.9. As in 2006 the distribution area stretches from the western border of the covered area east to the 34th eastern meridian.

2.3.4.2 Abundance estimation

The estimated number and biomass of blue whiting per age- and length group is given in Table 2.3.8. Total abundance was estimated to be 5.7 x 10^9 individual fish and the biomass to 0.66 x 10^6 t. This is slightly less than in 2006 (0.75 x 10^6 t), but only around half the biomass as in 2004 and 2005 (1.4 x 10^6 and 1.1 x 10^6, respectively). The main bulk of this stock component consisted of 2004-2003 year-classes at age 3-4. Older fish at age 5-7 were found in smaller quantities and only insignificant numbers of fish up to 9 year-olds were found.

2.4 Demersal fish

Figs. 2.4.1-2.4.12 shows the distribution of demersal fish. Appendix 3 lists the numbers of fish sampled during the survey and stomachs fish samples presented in Appendix 4. Biomass age-based assessments of main commercial fishes, as well as detailed analysis from taken samples, will be included in Vol. 2 of the survey report.

2.4.1 Cod

The distribution area (Fig. 2.4.1) of cod in the Barents Sea was covered completely. At this time of the year, towards the end of the feeding period, the distribution of cod is wide. Cod reach the limits of its natural habitat and could spread far north and east. Compared to last year the observations of cod distribution was more widely to northeast and southeast until to strait to Kara Sea. In other parts of the sea there were the same distribution as in 2006. Two main concentrations were observed: one was in the south-eastern areas from Murman Shallow to the slope of Goose Bank and Novaya Zemlya archipelago, and the other one was in the northern area – to the south-east and eastwards of Spitsbergen archipelago.

2.4.2 Haddock

The haddock distribution (Fig. 2.4.2) was absolutely covered by the survey. Haddock were distributed in the large area from coast to 81°N and to east until 57°E. But main dense concentrations were found between 38-44°E along Murman Coast and to the north from Bear Island. The basic tendency of haddock distribution was similar to the cod – more widely expantion to the east.

2.4.3 Saithe

The considerable concentration of saithe was not found during the survey. Compared to the survey in 2006, the distribution area (Fig. 2.4.3) was preliminary the same. Essentially, saithe were distributed in the warm water masses and along the coast of Norway and Russia between 18-41° E.

2.4.4 Greenland halibut

Mainly young age groups of Greenland halibut were observed (Fig. 2.4.4.-2.4.5) because the adult part of the stock was distributed outside of the survey area. Far north-eastern areas along the continental shelf, with depth more than 400 m, were not observed due to severe ice condition. Foremost concentrations were located in traditional places on slope around Bear-Hope Islands and in the deeper part around Spitsbergen until to Franz Josef Land archipelago.

In the central part of the Barents Sea catches of Greenland halibut were taken to the east until to 48° E (compared to 43° E in 2006).

2.4.5 Golden redfish (*Sebastes marinus*)

Sebastes marinus were distributed (Fig. 2.4.6) in the same part of the Barents Sea basin as in previous years. However, larger catches were taken in central parts than to the west of Spitsbergen. The main densities were detected between 73°-75° N and 25°-32° E.

2.4.6 Deep-water redfish (Sebastes mentella)

The main dense concentrations of *Sebastes mentella* were distributed (Fig. 2.4.7) in the same area as in 2006, and were found in western and north-western parts of the Barents Sea. Most concentrations were located along the shelf slope off the Bear - Hope islands and to the west of Spitsbergen. In addition the total distribution area has significantly expanded to the east of Spitsbergen.

2.4.7 Long rough dab

As in previous years, distribution (Fig. 2.4.8) of long rough dab was more wider than the other species. It was practically found in all areas, and its catches were quite significant in most cases. Catches of LRD were taken as far east as 60° E and north as 82° N.

2.4.8 Wolffishes

All of the three species - Atlantic wolffish (*Anarhichas lupus*), Spotted wolffish (*Anarhichas minor*) and Northern wolffish (*Anarhichas denticulatus*) had approximately the same catch rates.

Compared to 2006 Atlantic wolfish spread more widely (Fig. 2.4.9) and catches were higher, especially in west Spitsbergen area. Between Kanin Cape and Murman coast, as in last year, Atlantic wolfish were not found. It has been distributed into more open part of the Barents Sea.

Spotted wolfish was found in approximately the same densities (Fig. 2.4.10) as in 2006, but slightly to the north direction. Eastward of 46°E, as in last year, it was not found.

Northern wolfish distribution (Fig. 2.4.11) was similar to 2006 with small increasing in the west Spitsbergen area. The total catches were not changed compared to the last year.

2.4.9 Sand eel

The amount of sandeel was reduced compared to previous years. 0-group sand eel was observed (Fig. 2.4.12) in the south-eastern and eastern parts as well as in the central parts of the Barents Sea. Larger sandeel was observed in small quantities in bottom trawl scattered over the covered area. No abundance estimation was attempted.

2.5 Non-target fish species

An overview of total number of fish species (both commercial and non-commercial) found in the bottom trawl and the total fish biomass (both commercial and non-commercial) for each bottom trawl station are shown in Figs. 2.5.1-2.5.2.

A list of all fish species caught during the survey is given in Appendix 5. Some species were chosen as indicator species to demonstrate the distribution patterns of fishes from the different zoogeographic groups: the Thorny skate *Amblyraja radiate*, Norway pout *Trisopterus esmarkii* and Snake pipefish *Entelurus aequoreus*. More detailed descriptions will be found in volume 2 of the survey report. In addition to the three mentioned species catches by Campelen trawl for some other species are shown in Figures 2.5.6-2.5.7.

2.5.1 Thorny skate

As in 2006 this species was quite widely distributed in the Barents Sea excluding east and north east regions (Fig. 2.5.3). The catches were lower everywhere then in 2006. Only in south-west from Spitsbergen catches were some bigger. A strong correlation between negative anomalies of bottom temperature and catch level of skate was observed.

2.5.2 Norway pout

The species was distributed mainly in the southwestern part of the Barents Sea (Fig. 2.5.4). Foremost concentration of Norway pout was found around Norway coast between 18°-22° E. Only single specimens were found near the west coast of Spitsbergen. Compared to 2006, total distribution and catches of Norway pout are some decreased.

2.5.3 Snake pipefish

Snake pipefish (*Entelurus aequoreus)* were first registered in the Barents Sea ecosystem survey in 2005 following an expansion of the species range from the North Sea and northward through the Norwegian Sea (Beare et al., 2006). In 2006 the intrusion into the Barents sea expanded north to 80°N and east to 35°E, with some scattered observations further east. In 2007 the distribution area remains largely the same as in 2006 (Figure 2.5.5). Catch rates have been lower along the continental shelf slope, but higher in the south-central Barents Sea where the area of distribution has expanded slightly northeastwards. No scattered observations east of the main distribution area were observed in 2007.

2.6 Phytoplankton

Data on chlorophyll **a**, nutrients and phytoplankton species composition are now being processed and analyzed at the IMR laboratory. A summary and some preliminary results will be available for volume 2 of the report.

2.7 Zooplankton

The map of zooplankton sampling localities and sampling gear (Russian and Norwegian vessels) is shown in Fig. 2.2. The main results of zooplankton observations will be presented in volume 2 of Joint Ecosystem Survey Report after working up data in the laboratories.

From Fig. 2.2 it is apparent that the investigated area is covered very well as seen from a zooplankton point of view. The table below gives an overview of total zooplankton hauls for different types of zooplankton sampling gear during the Ecosystem survey. A total of 26 zooplankton samples were analyzed with respect to species composition and abundance onboard Johan Hjort and G.O. Sars during the Ecosystem cruise 2006.

Total number of zooplankton hauls obtained during the Norwegian and Russian surveys in the Barents Sea in August-October 2007.

Net	Norwegian ships		Russian ships	
	«G.O.Sars»	«J.Hjort»	«Vilnyus»	«Smolensk»
WP-2	177	85	-	-
Juday	-	-	122	234
Double net (WP-2 + Juday)	19	-	-	-
MOCNESS	21	21	-	-

A map of the zooplankton biomass distribution based on Norwegian data collected from the vessels Johan Hjort and G.O. Sars are presented in figure. 2.7.1. It is evident that a greater region of the Barents Sea has lower biomass compared to 2006 and that the influence of the higher biomass region of the western Barents Sea are less prominent. To complete the picture, Russian data will be added and presented in the volume 2 of the Joint Ecosystem Survey Report.

From the Norwegian vessels G.O. Sars a total of 177 WP-2 hauls (100-0m and bottom-0m) were conducted. Additionally a total of 19 double net hauls (WP-2 and Juday) were taken. From the other Norwegian vessels no Juday net was deployed. . Hauls taken by Johan Hjort west of the 500m depth contour is not included, nor are data from the 200-0m net hauls where bottom depth significantly exceeds 200m. From Johan Hjort a total of 99 hauls were conducted east of the 500m bottom contour in the Barents Sea. Of these only 85 hauls satisfied the extraction criteria for hauls 100-0m and bottom-0m (see also above).

Species composition, abundance and biomass from WP2 and Juday nets collected at the same stations in 2004 and 2005 have been partly analyzed and compared. Preliminary analysis has shown a significant variability in stage composition of key species of *Calanus*. A more extensive comparison and analysis are now being undertaken based on data from 2004 and 2005, including Russian data from 2006 where they exist to help quantify this variability. The agreement on comparative collection of zooplankton samples by WP-2 and Juday net on Norwegian and Russian vessels (c.f. Meeting in April 2005/May 2006) will be followed up by both parties with regard to working up samples, exchange of raw data, analysis and publication in relevant reports, symposia or international refereed journals. It is suggested that current and past effort is strengthened with additional sampling and also new approaches in future surveys with the ultimate goal of a unified sampling approach.

It was recommended for 2007, based on experience during field sampling in 2005 and from preliminary comparisons based on data from 2004 and the agreement outlined above, that a dual net system should be built that can hold both a WP2 and a Juday net for better performance and more efficient comparisons between the sampling gear. This was done during spring-summer 2007 and the new gear was deployed during the latter part of the G.O. Sars Barents Sea Ecosystem cruise 6-30 September 2007. Preliminary results from this gear comparison exercise will be presented in the Vol. 2 of the Joint Ecosystem Survey Report.

2.8 Marine mammals and seabirds

2.8.1 Marine mammals

A total of 804 observations of 2766 individuals of marine mammals comprising 14 identified species were recorded from the research vessels “Johan Hjort”, “G.O. Sars”, “Jan Mayen”, “Vilnyus” and “Smolensk”. The abundance of marine mammals is presented in the Table 2.8.1. The distributions are shown in Figures 2.8.1-2.8.3.

The most abundant species in terms of individuals were the white-beaked dolphins (50 % of total number of individuals observed), which were observed over large parts of the surveyed area but predominantly in the western and south-eastern Barents Sea. South of Spitsbergen a large pod (~150 individuals) of white-beaked dolphins was observed.

Other observations of toothed whales included killer whales, harbour porpoises and sperm whales. Killer whales were observed in different parts of the survey area; in south-western and northern parts of the Barents Sea, west and north-west of Spitsbergen, and close to Hopen island. Harbour porpoises were registrated in the southern and southen-eastern parts of the Barents Sea. The majority of sperm whales were observed along the continental slope towards the Norwegian Sea, although a single sperm whale was observed in the central Barents Sea far from the continental shelf break which is the primary habitat of this species.
Of the baleen whales (33% of the total number of individuals observed), humpback and minke whales were the most numerous. Humpback whales were observed east of Spitzbergen and close to Bear and Hopen Islands. Minke whales were observed throughout the survey area including eastern and south-eastern parts of the Barents Sea. Fin whales were observed in the western, central, northern parts of the Barents Sea, to the west from Spitsbergen, and there were also several sightings in the south-eastern area. One sei whale was observed in the western part of the Barents Sea, along the continental shelf break. Blue whales were observed to the South-West and North-West from Spitsbergen.

Among the seals the most abundant were harp seals, which were observed mainly north of 79^{o}N. A single hooded seal was observed along the southwestern part of the continental shelf break. Ringed seals were observed west of Spitsbergen and north at the ice-edge.

There were several sightings of walrus in the norhern part nearly 80^{o}N.

Two polar bears were observed to the west of Franz Josef Land.

2.8.2 Seabirds

During the ecosystem cruise 6099 observations of 18 084 individual birds from 32 species were recorded from the vessels “Vilnyus”, “Smolensk”, “Johan Hjort” and “G.O. Sars”. Northern fulmar, kittiwake and Brünnichs guillemot were the single most observed species comprising 31%, 26% and 18% of all observations, respectively. However, as northern fulmar and kittiwake are ship-followers, their numerical dominance may be overestimated. Number of observations and individuals by species are given in Table 2.8.2.

Northern fulmars were observed throughout the surveyed area (Fig. 2.8.4). Among the tubenosed birds (*Procellariformes*) also sooty shearwaters (41 indivdiuals), storm petrel (1 individual) and Manx shearwater (1 individual) were observed.

The distributions of the gull species are given in Fig. 2.8.4. Kittiwakes were the dominating gull in most parts of the Barents Sea. However, glaucous gulls dominated in the western areas between Bear Island and Spitsbergen, and were also numerous in south-eastern Barents Sea. Herring and black-backed gulls were common in the southern Barents Sea. Common gulls were observed in the south-eastern Barents Sea, while lesser-black-backed gulls were observed around Bear Island. Three observations of 4 ivory gulls were recorded in the northern end of the surveyed area.

The alcids were observed throughout the study area, but they were more numerous in western and northern Barents Sea than in eastern Barents sea (Fig. 2.8.5). However, species abundances and distributions varied geographically. Puffins dominated in the south-western areas, common guillemots in the south-east, and Brünnichs guillemots in the north. Also little auks and black guillemots were numerous in northern Barents Sea. Razorbills were only observed 3 times (3 individuals) outside Varanger.

Skuas were most abundant in central and northern Barents Sea (Fig. 2.8.6). Arctic skua dominated in the southwest, great skua around Bear Island while pomarine skua dominated in south-eastern, central and northern Barents Sea. Long-tailed skuas were observed throughout the southern Barents Sea, but in low numbers relative to the other skua species.

A blackbrowed albatross *Thalassarche melanophrys* was observed in the south-eastern Barents Sea August 29 (70^{o}56’N, 50^{o}17’E, Fig. 2.8.7). Blackbrowed albatrosses are the most abundant albatross species. Although generally inhabiting the southern hemisphere, the species is occasionally observed in the North-Atlantic. However, to our knowledge this is the first observation of blackbrowed albatross within the Barents Sea.

More anecdotal observations of other aquatic birds were also registered; Both black- and red-throated divers, gannets and European shags were observed in the southern Barents Sea, common eiders and Arctic terns were observed in central and southern Barents Sea, while the wader purple sandpiper was observed both in northern and southern Barents Sea. A few terrestrial species were also observed; snow buntings were met occasionally, and 2 ruddy turnstones were observed in western Barents Sea. Finally, a yellow wagtail visited GOS for a day in the central Barents Sea.

The observed distributions of marine mammals and birds shown in Figs. 2.8.1-2.8.7 are not effort corrected. Due to unfavourable weather and light conditions observers were active parts of the survey time only, which may yield biased distribution maps.

2.9 Benthos observations

The five vessels involved in the ecosystem survey sampled in different areas of the Barents Sea. Bottom trawl (Campelen) was used on all ships in the whole survey area. The biomass of invertebrates varied from 1 g. to 1988 kg. The modal group of hauls by the biomass bycatch range between 1-100 kg. (fig. 2.9.1.).

The eight animal groups Annelida, Bryozoa, Coelenterata, Crustacea, Echinodermata, Mollusca, Porifera and Varia were used for the benthic bycatch distribution analysis.
The total biomass of all registered invertebrate bycatch (exept Pandalus borealis “deep sea prawn”, Paralithodes camtschatica “king crab and Chionoecetes opilio “snowcrab”) was summarised per station and presented in figures 2.9.2. The biomass-hotspots were located on

the shallow banks and the continental slope. The low biomasses were in the central part of the Barents Sea.

The figures (Figs. 2.9.1 and 2.9.2) show that the sponges make up large part of the biomass in the south west of the research area, the echinoderms (sea stars, sea urchins, brittle stars, sea cucumbers and sea lilies) make up large proportions of the biomass in central and northern part of the Barents Sea. The crustacean biomass is to be found mainly in central and eastern parts of the Barents Sea. As the crustaceans, the molluscs (bivalves and snails) are present with their largest biomasses in the north eastern part of the Barents Sea.

King Crab (*Paralithodes camtschaticus*)

The distribution area for king crab was mainly located close to the coast (between 24-44° E) (fig. 2.9.3). High catches of king crab were caught in the eastern area. The western most record was from north of Porsangerfjorden. The maximum biomass of the king crab was registered on RV Vilnyus to north waste from the Kanin peninsula - 1988 kg. Several trawl stations close to the shore and inside the fjords need to be made in order to make a realistic distribution map of the red king crab. This is not possible with the large boats participating in the ecosystem cruise network.

Snow crab (*Chionoecetes opilio*)

The frequency of the snow crab was increased in year 2007 compare with the early years (fig. 2.9.4). This species was registered on 55 stations (compare with 3 stations in 2006) and was found farther north than last year in the eastern part of the Barents Sea. The biomass of the catches varied between 1 and 2344 g.

Shrimp (*Pandalus borealis*)

Northern shrimp was registered at 459 stations (fig. 2.9.5). The biomasses of the catches varied between 1 gram and 90.5 kg. Densest concentrations were found to the west, north, and east of Svalbard, and in the central parts of the survey area, particularly in the Hopen Deep. In shallow waters around the Spitsbergen Bank and in the eastern parts of the survey area shrimps were generally not found. In 2007 the mean catch rate of shrimp was estimated at 11.8 kg/nm, somewhat lower than the 2006 estimate at 16.6 kg/nm. Maximum shrimp catch rate recorded was 118 kg/nm.

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Table 2.1.1 Mean water temperatures in the main parts of standard oceanographic sections in the Barents Sea and adjacent waters in August-September 1965-2007. The sections are: Kola (70º30´N-72º30´N, 33º30´E), Kanin S(68º45´N-70º05´N, 43º15´E), Kanin N (71º00´N-72º00´N,43º15´E), North Cape-Bear Island (NCB, 71º33´N, 25º02´E – 73º35´N, 20º46´E), Bear Island – West (BW, 74º30´N, 06º34´E – 15º55´E), Vardø – North (VN, 72º15´N-74º15´N,31º13´E) and Fugløya – Bear Island (FB, 71º30´N, 19º48´E – 73º30´N, 19º20´E)

Year	Sections and layers (depth in metres)								
	Kola	Kola	Kola	Kanin S	Kanin N	NCB	BW	VN	FB
	0-50	50-200	0-200	0-bot.	0-bot.	0-200	0-200	50-200	50-200
1965	6.7	3.9	4.6	4.6	3.7	5.1	-	3.8	5.2
1966	6.7	2.6	3.6	1.9	2.2	5.5	3.6	3.2	5.3
1967	7.5	4.0	4.9	6.1	3.4	5.6	4.2	4.4	6.3
1968	6.4	3.7	4.4	4.7	2.8	5.4	4.0	3.4	5.0
1969	6.7	3.1	4.0	2.6	2.0	6.0	4.2	3.8	6.3
1970	7.8	3.7	4.7	4.0	3.3	6.1	-	4.1	5.6
1971	7.1	3.2	4.2	4.0	3.2	5.7	4.2	3.8	5.6
1972	8.7	4.0	5.2	5.1	4.1	6.3	3.9	4.6	6.1
1973	7.7	4.5	5.3	5.7	4.2	5.9	5.0	4.9	5.7
1974	8.1	3.9	4.9	4.6	3.5	6.1	4.9	4.3	5.8
1975	7.0	4.6	5.2	5.6	3.6	5.7	4.9	4.5	5.7
1976	8.1	4.0	5.0	4.9	4.4	5.6	4.8	4.4	5.8
1977	6.9	3.4	4.3	4.1	2.9	4.9	4.0	3.6	4.9
1978	6.6	2.5	3.6	2.4	1.7	5.0	4.1	3.2	4.9
1979	6.5	2.9	3.8	2.0	1.4	5.3	4.4	3.6	4.7
1980	7.4	3.5	4.5	3.3	3.0	5.7	4.9	3.7	5.5
1981	6.6	2.7	3.7	2.7	2.2	5.3	4.4	3.4	5.3
1982	7.1	4.0	4.8	4.5	2.8	5.8	4.9	4.1	6.0
1983	8.1	4.8	5.6	5.1	4.2	6.3	5.1	4.8	6.1
1984	7.7	4.1	5.0	4.5	3.6	5.9	5.0	4.2	5.7
1985	7.1	3.5	4.4	3.4	3.4	5.3	4.6	3.7	5.6
1986	7.5	3.5	4.5	3.9	3.2	5.8	4.4	3.8	5.5
1987	6.2	3.3	4.0	2.7	2.5	5.2	3.9	3.5	5.1
1988	7.0	3.7	4.5	3.8	2.9	5.5	4.2	3.8	5.7
1989	8.6	4.8	5.8	6.5	4.3	6.9	4.9	5.1	6.2
1990	8.1	4.4	5.3	5.0	3.9	6.3	5.7	5.0	6.3
1991	7.7	4.5	5.3	4.8	4.2	6.0	5.4	4.8	6.2
1992	7.5	4.6	5.3	5.0	4.0	6.1	5.0	4.6	6.1
1993	7.5	4.0	4.9	4.4	3.4	5.8	5.4	4.2	5.8
1994	7.7	3.9	4.8	4.6	3.4	6.4	5.3	4.8	5.9
1995	7.6	4.9	5.6	5.9	4.3	6.1	5.2	4.6	6.1
1996	7.6	3.7	4.7	5.2	2.9	5.8	4.7	3.7	5.7
1997	7.3	3.4	4.4	4.2	2.8	5.6	4.1	4.0	5.4
1998	8.4	3.4	4.7	2.1	1.9	6.0	-	3.9	5.8
1999	7.4	3.8	4.7	3.8	3.1	6.2	5.3	4.8	6.1
2000	7.6	4.5	5.3	5.8	4.1	5.7	5.1	4.2	5.8
2001	6.9	4.0	4.7	5.6	4.0	5.7	4.9	4.2	5.9
2002	8.6	4.8	5.8	4.0	3.7	-	5.4	4.6	6.5
2003	7.2	4.0	4.8	4.2	3.3	-	-	4.7	6.2
2004	9.0	4.7	5.7	5.0	4.2	-	5.8	4.8	6.4
2005	8.0	4.4	5.3	5.2	3.8	6.7	-	5.0	6.2
2006	8.3	5.3	6.1	6.1	4.5	-	5.8	5.3	6.9
2007	8.2	4.6	5.5	4.9	4.3	6.9	5.6	4.9	6.5
Average (1965-2007)	7.5	3.9	4.8	4.4	3.4	5.8	4.8	4.2	5.8

Table 2.2.1 Abundance indices (area method) of 0-group fish in the Barents Sea and adjacent waters in August-September 1965-2007

Year	Capelin[1]	Cod[2]	Haddock[2]	Herring[3]	Polar cod		Redfish	Greenland halibut	Long rough dab
					West	East			
1965	37	11	13	-		0	159	-	66
1966	119	2	2	-		129	236	-	97
1967	89	62	76	-		165	44	-	73
1968	99	45	14	-		60	21	-	17
1969	109	211	186	-		208	295	-	26
1970	51	1097	208	-		197	247	1	12
1971	151	356	166	-		181	172	1	81
1972	275	225	74	-		140	177	8	65
1973	125	1101	87	-		26	385	3	67
1974	359	82	237	-		227	468	13	93
1975	320	453	224	-		75	315	21	113
1976	281	57	148	-		131	447	16	96
1977	194	279	187	-	157	70	472	9	72
1978	40	192	110	-	107	144	460	35	76
1979	660	129	95	-	23	302	980	22	69
1980	502	61	68	-	79	247	651	12	108
1981	570	65	30	-	149	93	861	38	95
1982	393	136	107	-	14	50	694	17	150
1983	589	459	219	-	48	39	851	16	80
1984	320	559	293	-	115	16	732	40	70
1985	110	742	156	-	60	334	795	36	86
1986	125	434	160	-	111	366	702	55	755
1987	55	102	72	-	17	155	631	41	174
1988	187	133	86	-	144	120	949	8	72
1989	1330	202	112	-	206	41	698	5	92
1990	324	465	227	-	144	48	670	2	35
1991	241	766	472	-	90	239	200	1	28
1992	26	1159	313	-	195	118	150	3	32
1993	43	910	240	188	171	156	162	11	55
1994	58	899	282	120	50	448	414	20	272
1995	43	1069	148	73	6	0	220	15	66
1996	291	1142	196	378	59	484	19	5	10
1997	522	1077	150	390	129	453	50	13	42
1998	428	576	593	524	144	457	78	11	28
1999	722	194	184	242	116	696	27	13	66
2000	303	870	417	213	76	387	195	28	81
2001	221	212	394	77	110	146	11	32	86
2002	327	1055	412	315	179	588	28	34	173
2003	630	694	705	277	164	337	57	9	58
2004	288	983	977	639	62	355	98	29	35
2005	348	972	1103	205	154	273	247	8	89
2006	983	463	733	390	190	277	360	9	233
2007	779	606	405	154	40	266	562	2	72
1985-2007	364	683	371	279	113	293	318	16	115
1965-2007	317	495	258		107	248	372	16	96

[1] Assessment for 1965-1978 in Anon. 1980 and for 1979-1993 in Ushakov and Shamray 1995

[2] Indices for 1965-1985 for cod and haddock adjusted according to Nakken and Raknes (1996)

[3] Calculated by Prozorkevich (2001)

Table 2.2.2 0-group abundance indices (in millions) with 95% confidence limits, not corrected for catching efficiency

Year	Capelin			Cod			Haddock			Herring			Redfish		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	197278	131674	262883	72	38	105	59	38	81	4	1	8	277873	0	701273
1981	123870	71852	175888	48	33	64	15	7	22	3	0	8	153279	0	363283
1982	168128	35275	300982	651	466	835	649	486	812	202	0	506	106140	63753	148528
1983	100042	56325	143759	3924	1749	6099	1356	904	1809	40557	19526	61589	172392	33352	311432
1984	68051	43308	92794	5284	2889	7679	1295	937	1653	6313	1930	10697	83182	36137	130227
1985	21267	1638	40896	15484	7603	23365	695	397	992	7237	646	13827	412777	40510	785044
1986	11409	98	22721	2054	1509	2599	592	367	817	7	0	15	91621	0	184194
1987	1209	435	1983	167	86	249	126	76	176	2	0	5	23747	12740	34755
1988	19624	3821	35427	507	296	718	387	157	618	8686	3325	14048	107027	23378	190675
1989	251485	201110	301861	717	404	1030	173	117	228	4196	1396	6996	16092	7589	24595
1990	36475	24372	48578	6612	3573	9651	1148	847	1450	9508	0	23943	94790	52658	136922
1991	57390	24772	90007	10874	7860	13888	3857	2907	4807	81175	43230	119121	41499	0	83751
1992	970	105	1835	44583	24730	64437	1617	1150	2083	37183	21675	52690	13782	0	36494
1993	330	125	534	38015	15944	60086	1502	911	2092	61508	2885	120131	5458	0	13543
1994	5386	0	10915	21677	11980	31375	1695	825	2566	14884	0	31270	52258	0	121547
1995	862	0	1812	74930	38459	111401	472	269	675	1308	434	2182	11816	3386	20246
1996	44268	22447	66089	66047	42607	89488	1049	782	1316	57169	28040	86299	28	8	47
1997	54802	22682	86922	67061	49487	84634	600	420	780	45808	21160	70455	132	0	272
1998	33841	21406	46277	7050	4209	9890	5964	3800	8128	79492	44207	114778	755	23	1487
1999	85306	45266	125346	1289	135	2442	1137	368	1906	15931	1632	30229	46	14	79
2000	39813	1069	78556	26177	14287	38068	2907	1851	3962	49614	3246	95982	7530	0	16826
2001	33646	0	85901	908	152	1663	1706	1113	2299	844	177	1511	6	1	10
2002	19426	10648	28205	19157	11015	27300	1843	1276	2410	23354	12144	34564	130	20	241
2003	94902	41128	148676	17304	10225	24383	7910	3757	12063	28579	15504	41653	216	0	495
2004	16701	2541	30862	19157	13987	24328	19144	12649	25638	133350	94873	171826	849	0	1766
2005	41808	12316	71300	21532	14732	28331	33283	24377	42190	26332	1132	51532	12332	631	24034
2006	166400	102749	230050	7860	3658	12061	11421	7553	15289	66819	22759	110880	20864	10057	31671
2007	157913	87370	228456	9707	5887	13527	2826	1787	3866	22481	4556	40405	159159	44882	273436
Mean	66164			17746			3765			29377			66635		

Table 2.2.2 Continued

Year	Saithe			Gr halibut			Long rough dab			Polar cod (east)			Polar cod (west)		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	3	0	6	111	35	187	1273	883	1664	28958	9784	48132	9650	0	20622
1981	0	0	0	74	46	101	556	300	813	595	226	963	5150	1956	8345
1982	143	0	371	39	11	68	1013	698	1328	1435	144	2725	1187	0	3298
1983	239	83	394	41	22	59	420	264	577	1246	0	2501	9693	0	20851
1984	1339	407	2271	31	18	45	60	43	77	127	0	303	3182	737	5628
1985	12	1	23	48	29	67	265	110	420	19220	4989	33451	809	0	1628
1986	1	0	2	112	60	164	6846	4941	8752	12938	2355	23521	2130	180	4081
1987	1	0	1	35	23	47	804	411	1197	7694	0	17552	74	31	117
1988	17	4	30	8	3	13	205	113	297	383	9	757	4634	0	9889
1989	1	0	3	1	0	3	180	100	260	199	0	423	18056	2182	33931
1990	11	2	20	1	0	2	55	26	84	399	129	669	31939	0	70847
1991	4	2	6	1	0	2	90	49	131	88292	39856	136727	38709	0	110568
1992	159	86	233	9	0	17	121	25	218	7539	0	15873	9978	1591	18365
1993	366	0	913	4	2	7	56	25	87	41207	0	96068	8254	1359	15148
1994	2	0	5	39	0	93	1696	1083	2309	267997	151917	384078	5455	0	12032
1995	148	68	229	15	5	24	229	39	419	1	0	2	25	1	49
1996	131	57	204	6	3	9	41	2	79	70134	43196	97072	4902	0	12235
1997	78	37	120	5	3	7	97	44	150	33580	18788	48371	7593	623	14563
1998	86	39	133	8	3	12	27	13	42	11223	6849	15597	10311	0	23358
1999	136	68	204	14	8	21	105	1	210	129980	82936	177023	2848	407	5288
2000	206	111	301	43	17	69	233	120	346	116121	67589	164652	22740	14924	30556
2001	20	0	46	51	20	83	162	78	246	3697	658	6736	13490	0	28796
2002	553	108	998	51	0	112	731	342	1121	96954	57530	136378	27753	4184	51322
2003	65	0	146	13	0	34	78	45	110	11211	6100	16323	1627	0	3643
2004	1395	860	1930	70	28	113	36	20	52	37156	19040	55271	367	125	610
2005	55	36	73	9	4	14	200	109	292	6540	3196	9884	3216	1269	5162
2006	142	60	224	11	1	20	710	437	983	26016	9996	42036	2078	464	3693
2007	51	6	96	1	1	0	262	45	478	25883	8494	43273	2532	0	5134
Mean	192			30			591			37383			8871		

Table 2.2.3 0-group abundance indices (in millions) with 95% confidence limits, corrected for catching efficiency

Year	Capelin			Cod			Haddock			Herring		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	740289	495187	985391	276	131	421	265	169	361	77	12	142
1981	477260	273493	681026	289	201	377	75	34	117	37	0	86
1982	599596	145299	1053893	3480	2540	4421	2927	2200	3655	2519	0	5992
1983	340200	191122	489278	19299	9538	29061	6217	3978	8456	195446	69415	321477
1984	275233	161408	389057	24326	14489	34164	5512	3981	7043	27354	3425	51284
1985	63771	5893	121648	66630	32914	100346	2457	1520	3393	20081	3933	36228
1986	41814	642	82986	10509	7719	13299	2579	1621	3537	93	27	160
1987	4032	1458	6607	1035	504	1565	708	432	984	49	0	111
1988	65127	12101	118153	2570	1519	3622	1661	630	2693	60782	20877	100687
1989	862394	690983	1033806	2775	1624	3925	650	448	852	17956	8252	27661
1990	115636	77306	153966	23593	13426	33759	3122	2318	3926	15172	0	36389
1991	169455	74078	264832	40631	29843	51419	13713	10530	16897	267644	107990	427299
1992	2337	250	4423	166276	92113	240438	4739	3217	6262	83909	48399	119419
1993	952	289	1616	133046	58312	207779	3785	2335	5236	291468	1429	581506
1994	13898	70	27725	70761	39933	101589	4470	2354	6586	103891	0	212765
1995	2869	0	6032	233885	114258	353512	1203	686	1720	11018	4409	17627
1996	136674	69801	203546	280916	188630	373203	2632	1999	3265	549608	256160	843055
1997	189372	80734	298011	294607	218967	370247	1983	1391	2575	463243	176669	749817
1998	113390	70516	156263	24951	15827	34076	14116	9524	18707	476065	277542	674589
1999	287760	143243	432278	4150	944	7355	2740	1018	4463	35932	13017	58848
2000	140837	6551	275123	108093	58416	157770	10906	6837	14975	469626	22507	916746
2001	90181	0	217345	4150	798	7502	4649	3189	6109	10008	2021	17996
2002	67130	36971	97288	76146	42253	110040	4381	2998	5764	151514	58954	244073
2003	340877	146178	535575	81977	47715	116240	30792	15352	46232	177676	52699	302653
2004	53950	11999	95900	65969	47743	84195	39303	26359	52246	773891	544964	1002819
2005	148466	51669	245263	72137	50662	93611	91606	67869	115343	125927	20407	231447
2006	515770	325776	705764	25061	11469	38653	28505	18754	38256	294649	102788	486511
2007	480069	272313	687825	42628	26652	58605	8401	5587	11214	144002	25099	262905
Mean	226405			67149			10504			170344		

Table 2.2.3 Continued

Year	Saithe			Polar cod (east)			Polar cod (west)		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	21	0	47	203226	69898	336554	82871	0	176632
1981	0	0	0	4882	1842	7922	46155	17810	74500
1982	296	0	699	1443	154	2731	10565	0	29314
1983	562	211	912	1246	0	2501	87272	0	190005
1984	2577	725	4430	871	0	2118	26316	6097	46534
1985	30	7	53	143257	39633	246881	6670	0	13613
1986	4	0	9	102869	16336	189403	18644	125	37164
1987	4	0	10	64171	0	144389	631	265	996
1988	32	11	52	2588	59	5117	41133	0	89068
1989	10	0	23	1391	0	2934	164058	15439	312678
1990	29	4	55	2862	879	4846	246819	0	545410
1991	9	4	14	823828	366924	1280732	281434	0	799822
1992	326	156	495	49757	0	104634	80747	12984	148509
1993	1033	0	2512	297397	0	690030	70019	12321	127716
1994	7	1	12	2139223	1230225	3048220	49237	0	109432
1995	415	196	634	6	0	14	195	0	390
1996	430	180	679	588020	368361	807678	46671	0	116324
1997	341	162	521	297828	164107	431550	62084	6037	118131
1998	182	91	272	96874	59118	134630	95609	0	220926
1999	275	139	411	1154149	728616	1579682	24015	3768	44262
2000	851	446	1256	916625	530966	1302284	190661	133249	248072
2001	47	0	106	29087	5648	52526	119023	0	252146
2002	2112	134	4090	829216	496352	1162079	215572	36403	394741
2003	286	0	631	82315	42707	121923	12998	0	30565
2004	4779	2810	6749	290686	147492	433879	2892	989	4796
2005	176	115	237	44663	22890	66436	25970	9987	41953
2006	280	116	443	182713	73645	291781	15965	3414	28517
2007	286	3	568	191111	57403	324819	22803	0	46521
Mean	550			305082			73108		

Table 2.2.4 Length distributions (%) of 0-group fish in the Barents Sea and adjacent waters, August-September 2007

Length, cm	Cod	Haddock	Capelin	Herring	Saithe	Redfish	Polarcod	Grhalibut	LRD	Sandeel
1.0-1.4						0				
1.4-1.9						0,2				
2.0-2.4	0		0	0		0,5	0,1		1,8	
2.5-2.9	0,2	0	0,1	0		2	1		3,3	
3.0-3.4	0,9	0,2	1,3	0	1	5,4	6,7		51,5	0,1
3.5-3.9	0,9	0,5	2,7	0	1,8	14	17,6		36,8	0,1
4.0-4.4	1,7	0,5	7,4	0,1	6,2	22	28,3		5,2	0,4
4.5-.4.9	2,8	0,8	16,1	0,6	25,3	29,6	19,9		0,6	3,4
5.0-5.4	4,4	1	32,2	4,9	13,5	17,5	16,8			7
5.5-5.9	7,6	2	27,8	11,4	13,5	7,4	7,7	57		6,8
6.0-6.4	10,9	2,4	10,5	14,8	10	1,3	1,7	22,4		18,2
6.5-6.9	10,7	3,6	1,7	13,9	0,3	0	0,2	20,6	0,1	8,6
7.0-7.4	15	5,2	0,2	20,4	11,7		0		0,4	8,8
7.5-7.9	13,1	4,1	0,1	16,2	1,9				0,2	11,6
8.0-8.4	11,3	8,6		12,9	0,4					13,1
8.5-8.9	7,3	8,6		4,1	7,9					1,7
9.0-9.4	5,3	11,3		0,5	2,4					3,5
9.5-9.9	4,6	11,1		0						1
10.0-10.4	1	7,8								14,9
10.5-10.9	1	7,7								0,1
11.0-11.4	0,7	11								0,4
11.5-11.9	0,3	4,4			1,4					0,4
12.0-12.4	0,1	3,7			1,1					
12.5-12.9	0	2,5			0,9					
13.0-13.4		1,8			0,5					
13.5-13.9		0,8								
14.0-14.4		0,3								
14.5-14.9		0,1								
15.0-15.4		0,1								
15.5-15.9		0								
Mean length, cm	7,2	9,4	5,2	7,0	6,1	4,5	4,3	6,1	3,3	7,3

Table 2.3.1 Acoustic estimate of Barents Sea capelin, August-September 2007

Length (cm)	Age/Year class 1 2006	2 2005	3 2004	4+ 2003-	Sum (10^9)	Biomass (10^3 t)	Mean weight (g)
6.5 - 7.0	0.156				0.226	0.2	1.0
7.0 - 7.5	0.455				0.455	0.6	1.3
7.5 - 8.0	2.784				2.784	4.9	1.7
8.0 - 8.5	7.058				7.058	14.6	2.1
8.5 - 9.0	12.132				12.132	30.9	2.6
9.0 - 9.5	26.687				26.687	79.0	3.0
9.5 - 10.0	37.728				37.728	125.0	3.3
10.0 - 10.5	48.732	0.508			49.24	191.5	3.9
10.5 - 11.0	33.232	0.666			33.898	149.3	4.4
11.0 - 11.5	21.693	1.160			22.853	114.0	5.0
11.5 - 12.0	16.009	2.198			18.208	105.8	5.8
12.0 - 12.5	6.019	1.679	0.027		7.725	54.0	7.0
12.5 - 13.0	3.278	3.377	0.000		6.655	54.5	8.2
13.0 - 13.5	2.501	3.475	0.000		5.976	57.1	9.6
13.5 - 14.0	1.130	3.721	0.000		4.852	54.5	11.2
14.0 - 14.5	1.475	3.783	0.113		5.371	70.3	13.1
14.5 - 15.0	0.483	5.168	0.028		5.679	83.9	14.8
15.0 - 15.5	0.109	7.628	0.051		7.788	128.4	16.5
15.5 - 16.0	0.009	7.499	0.139		7.646	141.3	18.5
16.0 - 16.5		7.164	0.705		7.869	161.0	20.5
16.5 - 17.0		3.970	0.436		4.406	100.5	22.8
17.0 - 17.5		1.246	0.713	0.108	2.067	56.8	27.5
17.5 - 18.0		1.008	0.267	0.017	1.292	38.5	29.8
18.0 - 18.5		0.289	0.643	0.009	0.941	32.3	34.4
18.5 - 19.0		0.084	0.391	0.000	0.476	18.0	37.9
19.0 - 19.5		0.119	0.168	0.001	0.288	10.6	36.9
19.5 - 20.0		0.012	0.020		0.032	1.2	37.3
TSN (10^9)	221.67	54.75	3.70	0.14	280		
TSB (10^3 t)	928.1	848.2	101.3	3.8		1881.6	
Mean length (cm)	10.3	14.8	17.2	17.4	11.3		
Mean weight (g)	4.2	15.5	27.5	28.1			6.7
SSN (10^9)	2.076	37.970	3.674	0.135	43.855		
SSB (10^3 t)	28.4	710.3	101.1	3.8		843.7	

Based on TS value: 19.1 log L - 74.0, corresponding to $\sigma = 5.0 \cdot 10^{-7} \cdot L^{1.9}$

Table 2.3.2 Acoustic estimates of the Barents Sea capelin stock by age in August-September 1973-2007. Biomass (B) in 10^6 tonnes, average weight (AW) in grams. All estimates based on TS = 19.1Log L -74.0 dB

Age	1		2		3		4		5		Sum 1+
Year	B	AW	B	AW	B	AW	B	AW	B	AW	B
1973	1.69	3.2	2.32	6.2	0.73	18.3	0.41	23.8	0.01	30.1	5.16
1974	1.06	3.5	3.06	5.6	1.53	8.9	0.07	20.8	+	25	5.72
1975	0.65	3.4	2.39	6.9	3.27	11.1	1.48	17.1	0.01	31	7.80
1976	0.78	3.7	1.92	8.3	2.09	12.8	1.35	17.6	0.27	21.7	6.41
1977	0.72	2	1.41	8.1	1.66	16.8	0.84	20.9	0.17	22.9	4.80
1978	0.24	2.8	2.62	6.7	1.20	15.8	0.17	19.7	0.02	25	4.25
1979	0.05	4.5	2.47	7.4	1.53	13.5	0.10	21	+	27	4.15
1980	1.21	4.5	1.85	9.4	2.83	18.2	0.82	24.8	0.01	19.7	6.72
1981	0.92	2.3	1.83	9.3	0.82	17	0.32	23.3	0.01	28.7	3.90
1982[1]	1.22	2.3	1.33	9	1.18	20.9	0.05	24.9			3.78
1983	1.61	3.1	1.90	9.5	0.72	18.9	0.01	19.4			4.24
1984	0.57	3.7	1.43	7.7	0.88	18.2	0.08	26.8			2.96
1985	0.17	4.5	0.40	8.4	0.27	13	0.01	15.7			0.85
1986	0.02	3.9	0.05	10.1	0.05	13.5	+	16.4			0.12
1987[2]	0.08	2.1	0.02	12.2	+	14.6	+	34			0.10
1988	0.07	3.4	0.35	12.2	+	17.1					0.42
1989	0.61	3.2	0.20	11.5	0.05	18.1	+	21			0.86
1990	2.66	3.8	2.72	15.3	0.44	27.2	+	20			5.82
1991	1.52	3.8	5.10	8.8	0.64	19.4	0.04	30.2			7.30
1992	1.25	3.6	1.69	8.6	2.17	16.9	0.04	29.5			5.15
1993	0.01	3.4	0.48	9	0.26	15.1	0.05	18.8			0.80
1994	0.09	4.4	0.04	11.2	0.07	16.5	+	18.4			0.20
1995	0.05	6.7	0.11	13.8	0.03	16.8	0.01	22.6			0.20
1996	0.24	2.9	0.22	18.6	0.05	23.9	+	25.5			0.51
1997	0.42	4.2	0.45	11.5	0.04	22.9	+	26.2			0.91
1998	0.81	4.5	0.98	13.4	0.25	24.2	0.02	27.1	+	29.4	2.06
1999	0.16	4.2	1.01	13.6	0.27	26.9	0.09	29.3			1.53
2000	1.70	3.8	1.59	14.4	0.95	27.9	0.08	37.7			4.32
2001	0.37	3.3	2.40	11	0.81	26.7	0.04	35.5	+	41.4	3.62
2002	0.23	3.9	0.92	10.1	1.04	20.7	0.02	35			2.21
2003	0.20	2.4	0.10	10.2	0.20	18.4	0.03	23.5			0.53
2004	0.20	3.8	0.29	11.9	0.12	21.5	0.02	23.5	+	26.3	0.63
2005	0.10	3.7	0.19	14.3	0.04	20.8	+	25.8			0.33
2006	0.29	4.8	0.35	16.1	0.14	24.8	0.01	30.6	+	36.5	0.79
2007	0.93	4.2	0.85	15.5	0.10	27.5	+	28.1			1.88
Average	0.65	3.6	1.29	10.7	0.80	19.0	0.25	24.5	0.07	27.4	2.89

[1] Computed values based on the estimates in 1981 and 1983
[2] Combined estimates from multispecies survey and succeeding survey with "Eldjarn"

Table 2.3.3 Total mortality for capelin from age 1 to age 2 calculated from surveys

Year	Year class	Age 1 (10^9)	Age 2 (10^9)	Total mort. %	Total mort. Z
1984-1985	1983	154.8	48.3	69	1.16
1985-1986	1984	38.7	4.7	88	2.11
1986-1987	1985	6.0	1.7	72	1.26
1987-1988	1986	37.6	28.7	24	0.27
1988-1989	1987	21.0	17.7	16	0.17
1989-1990	1988	189.2	177.6	6	0.06
1990-1991	1989	700.4	580.2	17	0.19
1991-1992	1990	402.1	196.3	51	0.72
1992-1993	1991	351.3	53.4	85	1.88
1993-1994	1992	2.2	3.4	-	-
1994-1995	1993	19.8	8.1	59	0.89
1995-1996	1994	7.1	11.5	-	-
1996-1997	1995	81.9	39.1	52	0.74
1997-1998	1996	98.9	72.6	27	0.31
1998-1999	1997	179.0	101.5	43	0.57
1999-2000	1998	155.9	110.6	29	0.34
2000-2001	1999	449.2	218.7	51	0.72
2001-2002	2000	113.6	90.8	20	0.22
2002-2003	2001	59.7	9.6	84	1.83
2003-2004	2002	82.4	24.8	70	1.20
2004-2005	2003	51.2	13.0	75	1.39
2005-2006	2004	26.9	21.7	19	0.21
2006-2007	2005	60.1	54.8	9	0.09

Table 2.3.4 Acoustic estimate of polar cod in August-September 2007

Le	Age/Yearcl 1 2006	2 2005	3 2004	4 2003	5 2002	Sum (10^6)	Biomass (10^3 t)	Mean weight(g)
6.5 - 7.0	5					5	0.0	2.0
7.0 - 7.5	77					77	0.3	3.6
7.5 - 8.0	274					274	1.2	4.3
8.0 - 8.5	1280					1280	6.3	4.9
8.5 - 9.0	1693					1693	6.7	4.0
9.0 - 9.5	2663	3				2666	15.7	5.9
9.5 - 10.0	2766	392				3158	21.1	6.7
10.0 - 10.5	4159	880				5039	41.9	8.3
10.5 - 11.0	1838	2374				4212	38.2	9.1
11.0 - 11.5	2697	1447				4144	43.3	10.5
11.5 - 12.0	1867	1135				3002	33.8	11.2
12.0 - 12.5	2523	551				3074	43.0	14.0
12.5 - 13.0	2071	313	33			2418	37.1	15.4
13.0 - 13.5	2258	355	27			2640	42.7	16.2
13.5 - 14.0	1306	630	5			1941	36.1	18.6
14.0 - 14.5	910	1018	5			1933	40.9	21.2
14.5 - 15.0	540	1087	93			1721	37.5	21.8
15.0 - 15.5	357	1008	185			1549	39.6	25.6
15.5 - 16.0	181	1110	103			1394	39.0	28.0
16.0 - 16.5	15	1389	114			1518	45.8	30.2
16.5 - 17.0		1440	69	7		1516	44.8	29.5
17.0 - 17.5		1969	105			2074	73.3	35.3
17.5 - 18.0		1492	288			1779	70.8	39.8
18.0 - 18.5		1625	205	31		1861	78.4	42.1
18.5 - 19.0		1562	324			1886	83.4	44.2
19.0 - 19.5		1564	96			1660	77.8	46.8
19.5 - 20.0		984	597			1582	70.5	44.6
20.0 - 20.5		884	200	22		1107	57.9	52.3
20.5 - 21.0		172	446	19		637	36.6	57.5
21.0 - 21.5		259	92	59	6	416	27.6	66.4
21.5 - 22.0		134	33	87	3	257	16.1	62.6
22.0 - 22.5			150			150	11.6	77.2
22.5 - 23.0			57	2	2	61	4.7	76.1
23.0 - 23.5				30		31	2.0	66.3
23.5 - 24.0				11		11	0.9	82.0
24.0 - 24.5					2	6	0.6	95.8
24.5 - 25.0				29		29	2.2	76.0
25.0 - 25.5				1		1	0.1	117.0
25.5 - 26.0				1		1	0.1	122.0
26.0 - 26.5								
26.5 - 27.0								
27.0 - 27.5					3	3	0.3	108.0
27.5 - 28.0								
28.0 - 28.5								
28.5 - 29.0								
29.0 - 29.5					1		0.1	166.0
TSN(10^6)	29483	25778	3230	300	15	58807		
TSB(10^3 t)	321.2	743.4	145.8	18.5	1.3		1230.1	
Mean length (cm)	11.2	15.6	18.8	21.5	23.3	13.6		
Mean weight (g)	10.9	28.8	45.1	61.6	83			20.9

Based on TS value: 21.8 log L - 72.7, corresponding to $\sigma = 6.7 \cdot 10^{-7} \cdot L^{2.18}$

Table 2.3.5 Acoustic estimates of polar cod by age in August-September 1986-2007. TSN and TSB is total stock numbers (106) and total stock biomass (103 tonnes) respectively. Numbers based on TS = 21.8 Log L - 72.7 dB

Year	Age 1		Age 2		Age 3		Age 4+		Total	
	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
1986	24038	169.6	6263	104.3	1058	31.5	82	3.4	31441	308.8
1987	15041	125.1	10142	184.2	3111	72.2	39	1.2	28333	382.8
1988	4314	37.1	1469	27.1	727	20.1	52	1.7	6562	86.0
1989	13540	154.9	1777	41.7	236	8.6	60	2.6	15613	207.8
1990	3834	39.3	2221	56.8	650	25.3	94	6.9	6799	127.3
1991	23670	214.2	4159	93.8	1922	67.0	152	6.4	29903	381.5
1992	22902	194.4	13992	376.5	832	20.9	64	2.9	37790	594.9
1993	16269	131.6	18919	367.1	2965	103.3	147	7.7	38300	609.7
1994	27466	189.7	9297	161.0	5044	154.0	790	35.8	42597	540.5
1995	30697	249.6	6493	127.8	1610	41.0	175	7.9	38975	426.2
1996	19438	144.9	10056	230.6	3287	103.1	212	8.0	33012	487.4
1997	15848	136.7	7755	124.5	3139	86.4	992	39.3	28012	400.7
1998	89947	505.5	7634	174.5	3965	119.3	598	23.0	102435	839.5
1999	59434	399.6	22760	426.0	8803	286.8	435	25.9	91463	1141.9
2000	33825	269.4	19999	432.4	14598	597.6	840	48.4	69262	1347.8
2001	77144	709.0	15694	434.5	12499	589.3	2271	132.1	107713	1869.6
2002	8431	56.8	34824	875.9	6350	282.2	2322	143.2	52218	1377.2
2003	15434	114.1	2057	37.9	2038	63.9	1545	64.4	21074	280.2
2004	99404	627.1	22777	404.9	2627	82.2	510	32.7	125319	1143.8
2005	71675	626.6	57053	1028.2	3703	120.2	407	28.3	132859	1803.3
2006	16190	180.8	45063	1277.4	12083	445.9	698	37.2	74033	1941.2
2007	29483	321.2	25778	743.4	3230	145.8	315	19.8	58807	1230.1
Average	32788	251.3	15257	332.7	4345	158.2	595	31.4	53034	776.2

Table 2.3.6 Total mortality for polar cod from age 1 to age 2, and from age 2 to age 3, calculated from surveys.

Year	Year class	Age 1 (10^9)	Age 2 (10^9)	Total mort. %	Total mort Z
1986-1987	1985	24.0	10.1	58	0.86
1987-1988	1986	15.0	1.5	90	2.30
1988-1989	1987	4.3	1.8	58	0.87
1989-1990	1988	13.5	2.2	84	1.81
1990-1991	1989	3.8	4.2	-	-
1991-1992	1990	23.7	14.0	41	0.53
1992-1993	1991	22.9	18.9	17	0.19
1993-1994	1992	16.3	9.3	43	0.56
1994-1995	1993	27.5	6.5	76	1.44
1995-1996	1994	30.7	10.1	67	1.11
1996-1997	1995	19.4	7.8	59	0.91
1997-1998	1996	15.8	7.6	52	0.73
1998-1999	1997	89.9	22.8	75	1.37
1999-2000	1998	59.4	20.0	66	1.09
2000-2001	1999	33.8	15.7	54	0.77
2001-2002	2000	77.1	34.8	55	0.80
2002-2003	2001	8.4	2.1	75	1.38
2003-2004	2002	15.4	22.7	-	-
2004-2005	2003	99.4	57.1	43	0.56
2005-2006	2004	71.7	45.1	37	0.48
2006-2007	2005	16.2	25.8	-	-

Year	Year class	Age 2 (10^9)	Age 3 (10^9)	Total mort. %	Total mort Z
1986-1987	1984	6.3	3.1	51	0.71
1987-1988	1985	10.1	0.7	93	2.67
1988-1989	1986	1.5	0.2	87	2.01
1989-1990	1987	1.8	0.7	61	2.57
1990-1991	1988	2.2	1.9	14	0.15
1991-1992	1989	4.2	0.8	81	1.66
1992-1993	1990	14.0	3.0	78	1.54
1993-1994	1991	18.9	5.0	74	1.33
1994-1995	1992	9.3	1.6	83	1.76
1995-1996	1993	6.5	3.3	51	0.68
1996-1997	1994	10.1	3.1	69	1.18
1997-1998	1995	7.8	4.0	49	0.67
1998-1999	1996	7.6	8.8	-	-
1999-2000	1997	22.8	14.6	36	0.44
2000-2001	1998	20.0	12.5	38	0.47
2001-2002	1999	15.7	6.4	59	0.90
2002-2003	2000	34.8	2.0	94	2.86
2003-2004	2001	2.1	2.6	-	-
2004-2005	2002	22.8	3.7	84	1.83
2005-2006	2003	51.7	12.1	77	1.50
2006-2007	2004	45.1	3.2	93	2.64

Table 2.3.7 Acoustic estimate of young herring in the Barents Sea, August-September 2007

Length (cm)			Age / Year class 1 2006	2 2005	3 2004	4+ 2003	Sum (10^6)	Biomass (10^3 t)	Mean weight (g)
11.5	-	12.0							
12.0	-	12.5	1				1	0.0	13.0
12.5	-	13.0	4				4	0.1	15.0
13.0	-	13.5	16				16	0.3	16.2
13.5	-	14.0	61				61	1.1	18.1
14.0	-	14.5	218				218	4.4	20.3
14.5	-	15.0	144				144	3.2	22.0
15.0	-	15.5	310				310	7.5	24.3
15.5	-	16.0	317				317	8.7	27.3
16.0	-	16.5	485				485	13.3	27.5
16.5	-	17.0	395				395	13.5	34.1
17.0	-	17.5	331				331	13.3	40.0
17.5	-	18.0	484				484	21.3	44.1
18.0	-	18.5	526				526	24.5	46.5
18.5	-	19.0	364				364	19.1	52.5
19.0	-	19.5	130	130			260	15.2	58.4
19.5	-	20.0	0	253			253	13.5	53.2
20.0	-	20.5	156	156			312	19.5	62.7
20.5	-	21.0		363			363	26.5	72.9
21.0	-	21.5		363			363	28.0	77.1
21.5	-	22.0		52			52	4.4	84.0
22.0	-	22.5		104			104	8.0	76.5
22.5	-	23.0		52			52	4.9	95.0
23.0	-	23.5		387			387	38.7	100.0
23.5	-	24.0		351			351	35.7	101.5
24.0	-	24.5		379	379		758	80.3	106.0
24.5	-	25.0		0	1555		1555	172.1	110.7
25.0	-	25.5		0	1244		1244	131.4	105.7
25.5	-	26.0		3	890		893	117.3	131.3
26.0	-	26.5			774		774	106.7	137.9
26.5	-	27.0			525		525	72.0	137.3
27.0	-	27.5			374		374	56.6	151.1
27.5	-	28.0			0	151	151	25.6	169.0
28.0	-	28.5			323	0	323	58.1	180.0
28.5	-	29.0			224	0	224	39.1	174.0
29.0	-	29.5			90	30	119	22.7	190.0
29.5	-	30.0				29	29	5.3	182.0
30.0	-	30.5				8	8	1.7	207.0
30.5	-	31.0				7	7	1.6	250.0
31.0	-	31.5				10	10	2.2	228.5
31.5	-	32.0				15	15	3.7	239.7
TSN (10^6)			3941	2595	6378	250	13164		
TSB(10^3 t)			147.5	217.5	810.1	45.7		1220.9	
Mean length (cm)			17	22	25.8	28.6	22.5		
Mean weight (g)			37.4	83.8	127	181.2			92.7

TS=20.0* log(L) - 71.9

Table 2.3.8 Acoustic estimate of blue whiting in the Barents Sea August-September 2007

Length (cm)	Age/Yearclass 1 2006	2 2005	3 2004	4 2003	5 2002	6 2001	7 2000	8 1999	9+ 1998	Sum (10^6)	Biomass (10^3 t)	Mean weight(g)
19.5 - 20.0	1									1	+	44.5
20.0 - 20.5										1	+	40.5
20.5 - 21.0	1	3								4	0.2	51.7
21.0 - 21.5		2								2	0.1	41.0
21.5 - 22.0		11								11	0.6	51.0
22.0 - 22.5		6								6	0.4	63.9
22.5 - 23.0		16								16	1.3	79.6
23.0 - 23.5		5	49	1						55	4.0	73.4
23.5 - 24.0		13	108	1						121	9.7	80.3
24.0 - 24.5		17	183							200	17.4	87.1
24.5 - 25.0		19	327							346	28.7	83.0
25.0 - 25.5		63	510							573	51.9	90.5
25.5 - 26.0			420	128						547	54.8	100.1
26.0 - 26.5		23	400	209						633	64.4	101.9
26.5 - 27.0		9	535	129	14	9				697	76.5	109.7
27.0 - 27.5		23	177	265	23					489	56.2	115.0
27.5 - 28.0			123	294		8				425	52.1	122.7
28.0 - 28.5		19	46	249	45					359	46.1	128.4
28.5 - 29.0		16	48	140	56					260	34.7	133.5
29.0 - 29.5			2	71	117					190	27.9	146.9
29.5 - 30.0				16	100	38				154	23.6	153.1
30.0 - 30.5			2	7	97	47				153	24.8	162.4
30.5 - 31.0				14	55	22				91	15.6	170.4
31.0 - 31.5			3	1	44	38	13			99	18.4	185.7
31.5 - 32.0				11	4	33	8			57	10.1	178.7
32.0 - 32.5			1	1	1	29	1			35	6.5	185.9
32.5 - 33.0				4	6	4	31			44	8.8	197.6
33.0 - 33.5				2		19	5			25	4.9	195.9
33.5 - 34.0					16	7				24	5.1	214.7
34.0 - 34.5					1	7	1		1	9	2.2	235.2
34.5 - 35.0					9					9	1.9	211.6
35.0 - 35.5								6	3	9	2.4	261.6
35.5 - 36.0							4	2	5	11	3.2	288.6
36.0 - 36.5									2	3	0.7	251.1
36.5 - 37.0							1	1		2	0.6	268.0
37.0 - 37.5												
37.5 - 38.0								1	1	2	0.6	318.5
38.0 - 38.5									+	+	0.1	331.4
38.5 - 39.0												
39.0 - 39.5									+	+	0.1	358.5
39.5 - 40.0									+	+	0.1	372.5
40.0 - 40.5												
40.5 - 41.0												
41.0 - 41.5												
41.5 - 42.0												
42.0 - 42.5												
42.5 - 43.0												
43.0 - 43.5									2	2	0.9	481.4
TSN(10^6)	3	245	2934	1544	588	262	65	11	13	5666		
TSB(10^3 t)	0.1	23.2	292.2	185.7	90.9	45.4	13.0	3.0	4.1		657.6	
Mean length (cm)	19.9	25.3	25.9	27.6	29.8	31.0	32.7	35.9	36.9	27.1		
Mean weight (g)	44.8	94.6	99.6	120.3	154.5	173.3	200.8	276.2	304.2			116.1

TS=21.8* lg(L) - 72.7

Table 2.8.1 Number of marine mammal observed during the ecosystem survey, August-September 2007

Class / suborder	Species name	Johan Hjort	GO Sars	Jan Mayen	Smolensk	Vilnyus	Total	%
Cetacea / baleen whales	Blue whale	2		1			**3**	**0.11**
	Sei whale	1					**1**	**0.04**
	Fin whale	123	33	54	19	3	**232**	**8.39**
	Humpback whale	25	107	13	138		**283**	**10.23**
	Minke whale	143	44	41	19	24	**271**	**9.80**
	Unidentified whale	74	14	2	21		**111**	**4.01**
Cetacea / toothed whales	Sperm whale	27	1	1			**29**	**1.05**
	Killer whale			50	12		**62**	**2.24**
	Harbour porpoise		1	8		32	**41**	**1.48**
	White-beaked dolphin	469	167	231	162	350	**1379**	**49.86**
	Dolphin spp.	172		3	2		**177**	**6.40**
Pinni-pedia	Harp seal			128	30		**158**	**5.71**
	Hooded seal	1					**1**	**0.04**
	Walrus			3			**3**	**0.11**
	Ringed seal			2			**2**	**0.07**
	Seal spp.		1	10			**11**	**0.40**
Other	Polar bear				2		**2**	**0.07**
Total		**1037**	**368**	**547**	**405**	**409**	**2766**	**100**

Table 2.8.2 Number of sea birds observed during the ecosystem cruise, August-September 2007

Species	No. of observations	No. of individuals
Northern fulmar	1283	5600
Manx shearwater	1	1
Storm petrel	1	1
Sooty shearwater	41	35
Lesser black-backed gull	49	156
Common gull	4	4
Ivory gull	3	4
Great black-backed gull	181	141
Glaucous gull	505	227
Herring gull	260	365
Kittiwake	883	4628
Razorbill	3	3
Puffin	482	549
Little auk	144	588
Black guillemot	28	63
Common guillemot	101	223
Brunnichs guillemot	1104	3278
Guillemot spp.	227	1099
Great scua	11	3
Long-tailed scua	18	16
Arctic scua	88	93
Pomarine scua	454	718
Scua spp.	146	173
Black-throated diver	1	2
Red-throated diver	2	4
Blackbrowed albatros	1	1
Arctic tern	27	27
Eider duck	4	6
Northern gannet	37	34
European shag	2	1
Snow bunting	1	2
Ruddy turnstone	2	1
Purple sandpiper	5	38
Yellow wagtail	1	1
Grand Total	6099	18083

6 FIGURES

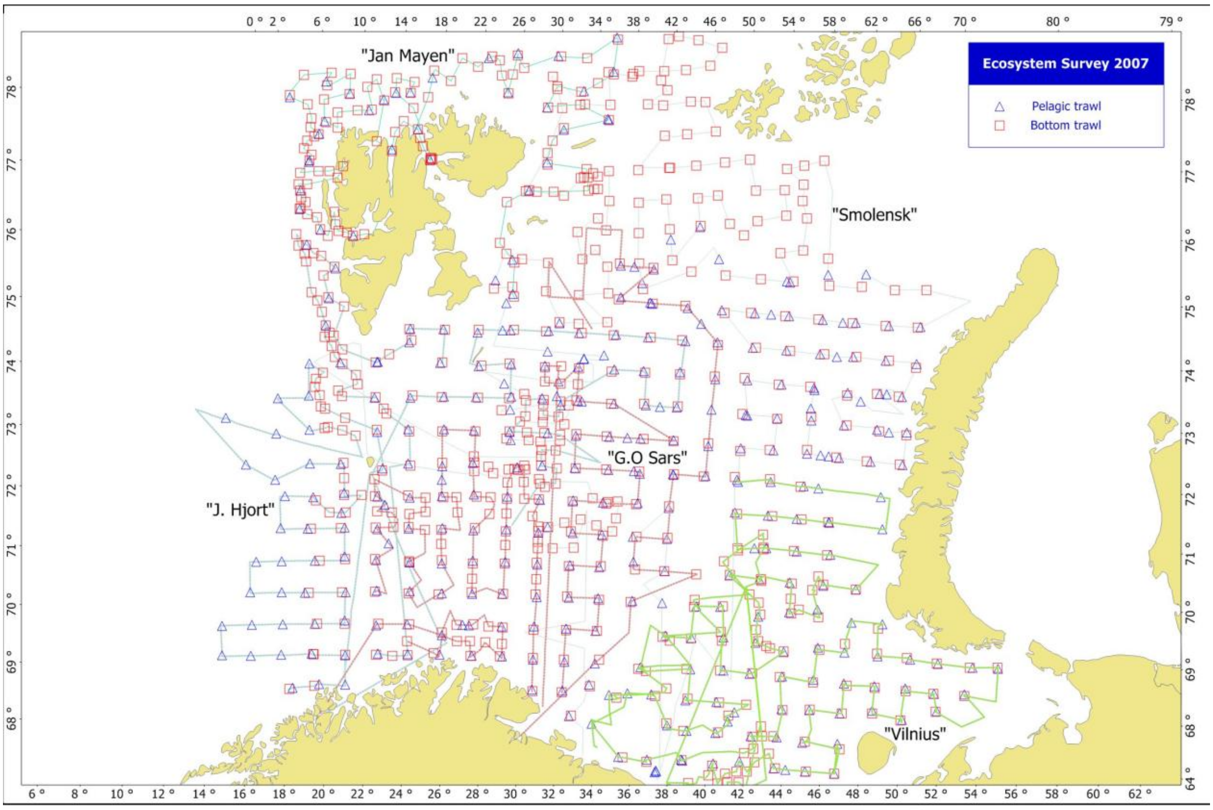

Figure 2.1 Trawl stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Vilnyus" and "Smolensk", August – September 2007

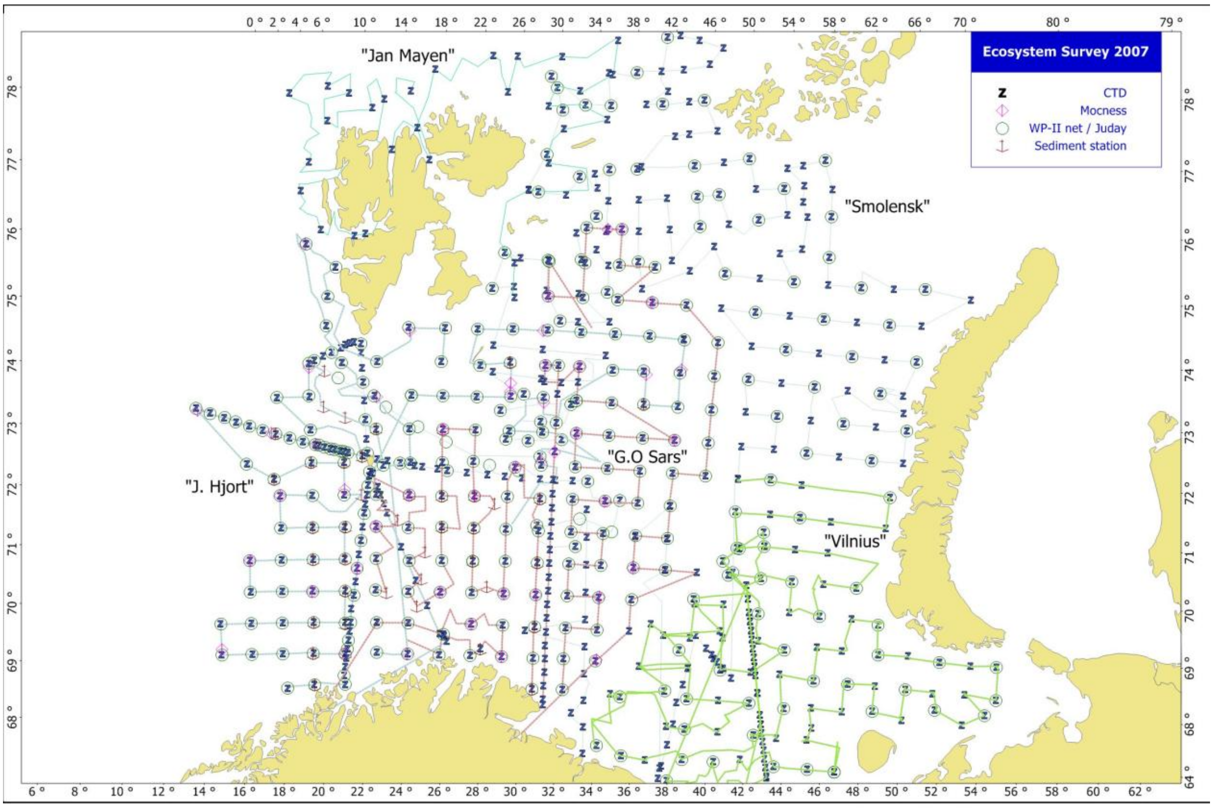

Figure 2.2 Environmental stations (hydrograhy, plankton and sedimentation) for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Vilnyus" and "Smolensk", August - September 2007

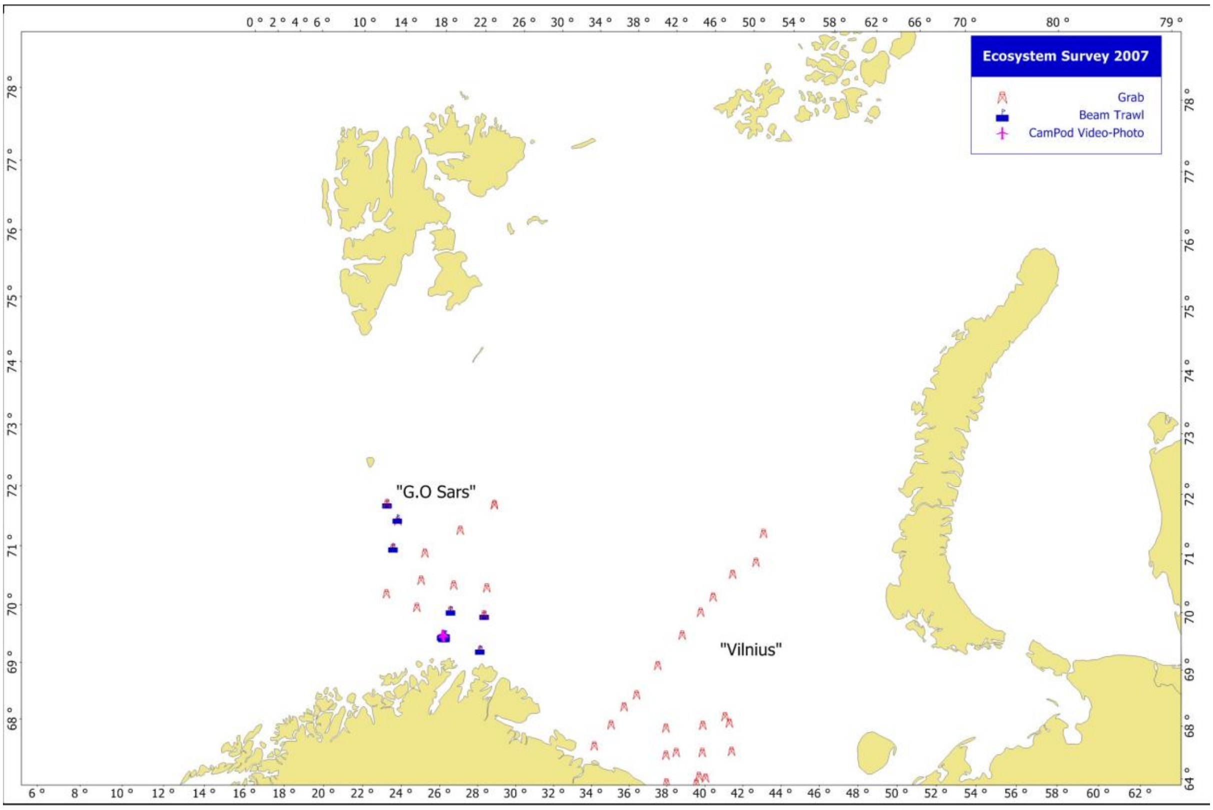

Figure 2.3 Benthos stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Vilnyus" and "Smolensk", August - September 2007

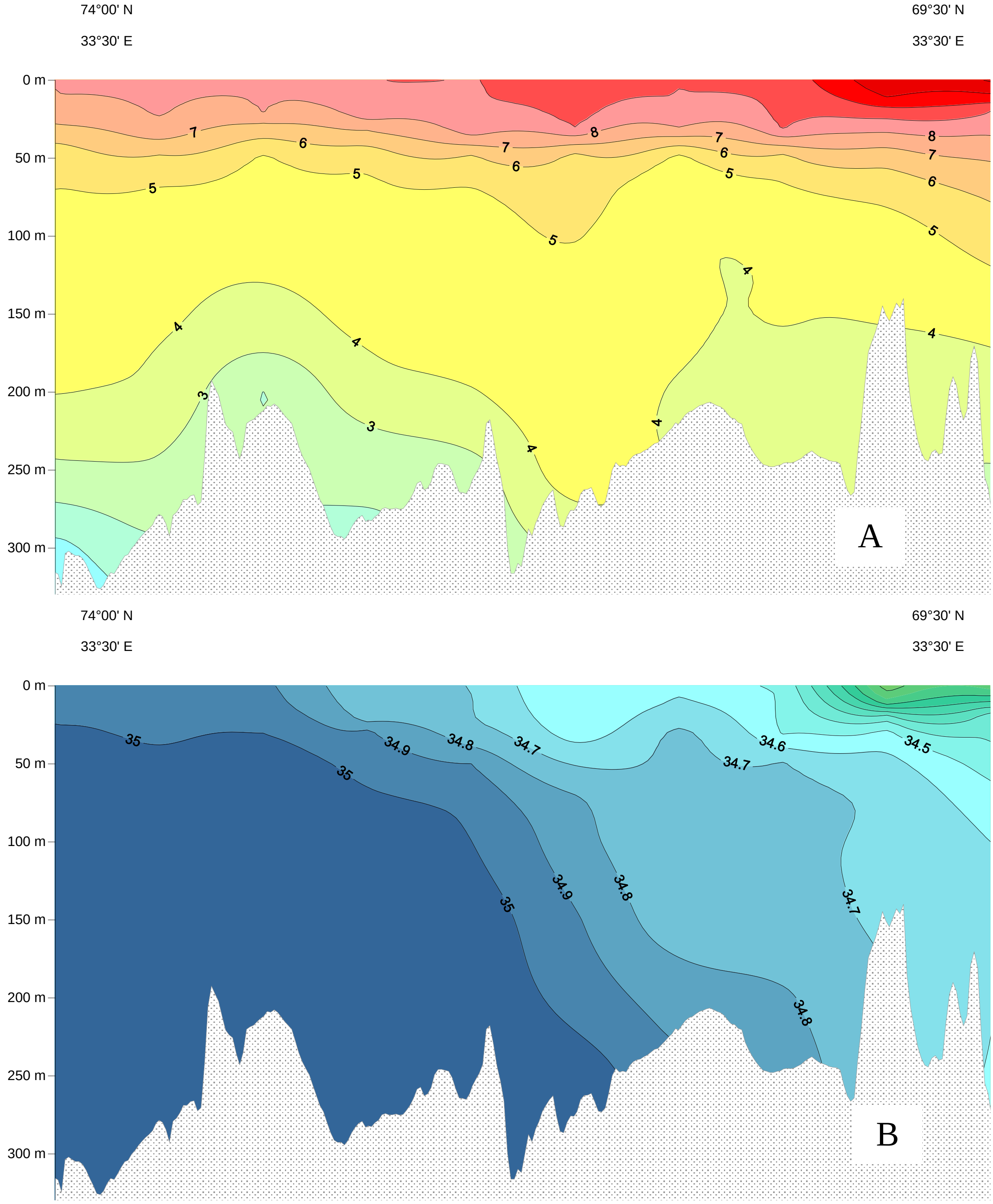

Figure 2.1.1. Temperature (A) and salinity (B) in the Kola Section, August-September 2007

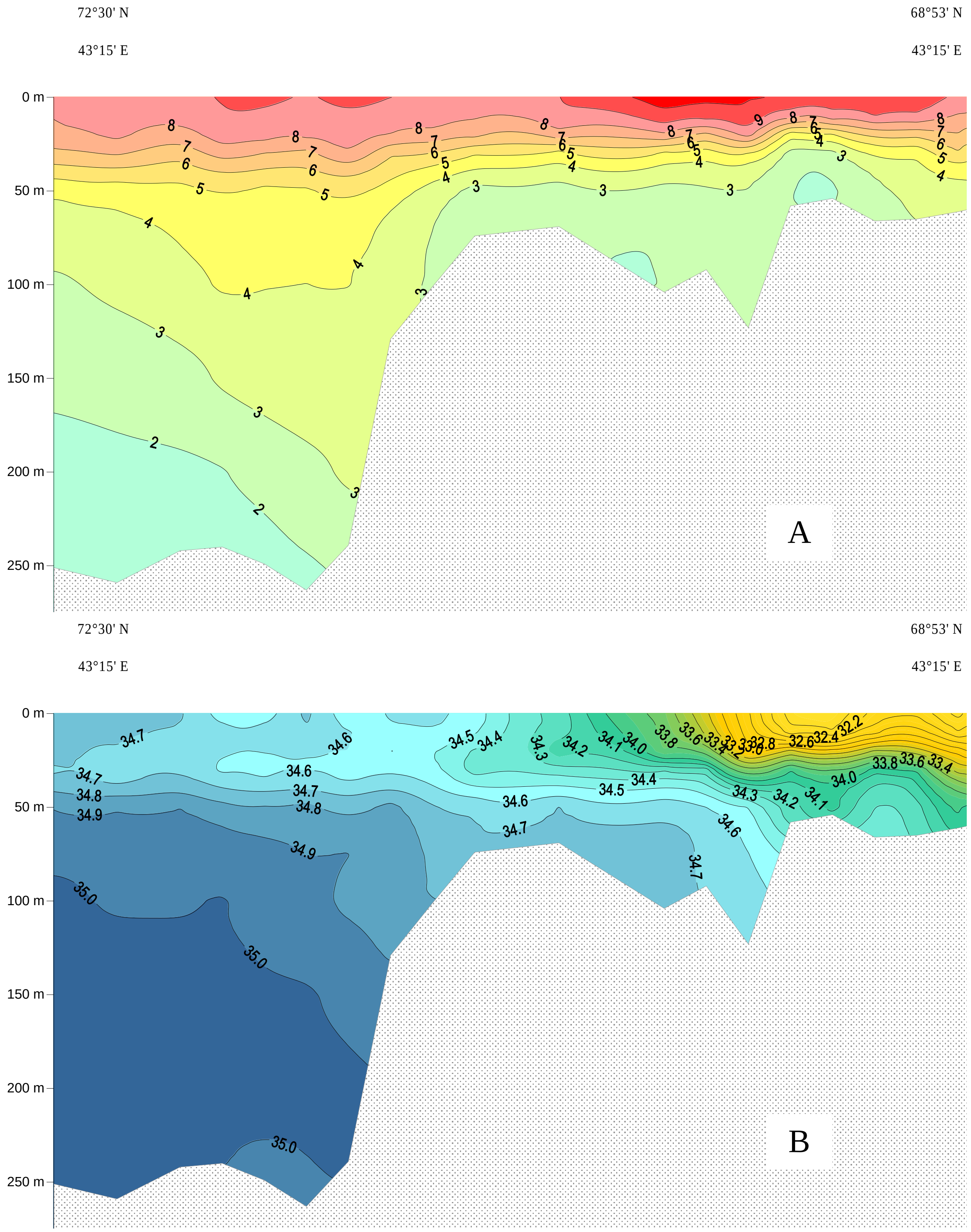

Figure 2.1.2. Temperature (A) and salinity (B) in the Kanin Section, August-September 2007

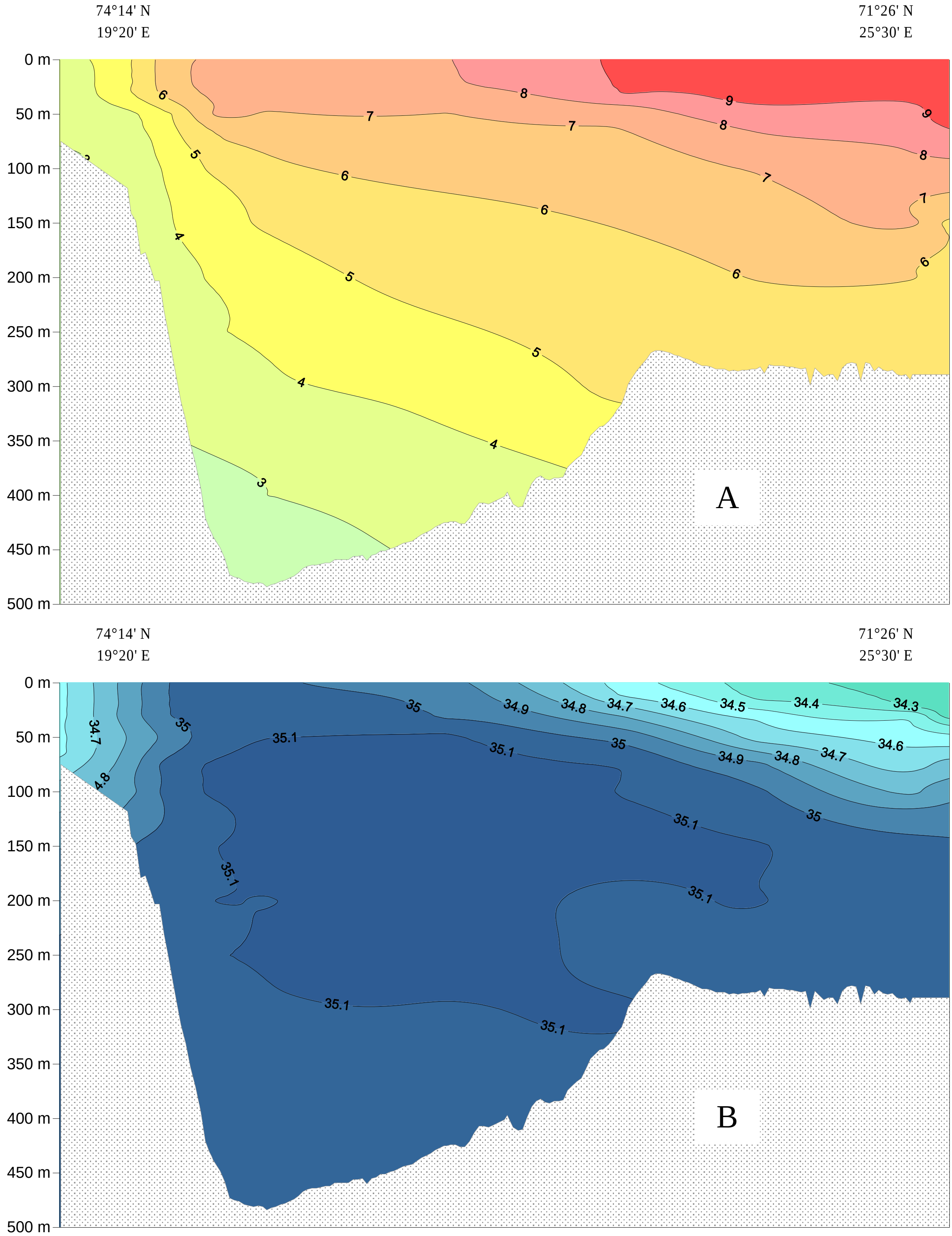

Figure 2.1.3 Temperature (A) and salinity (B) in the North Cape – Bear Island section, August-September 2007

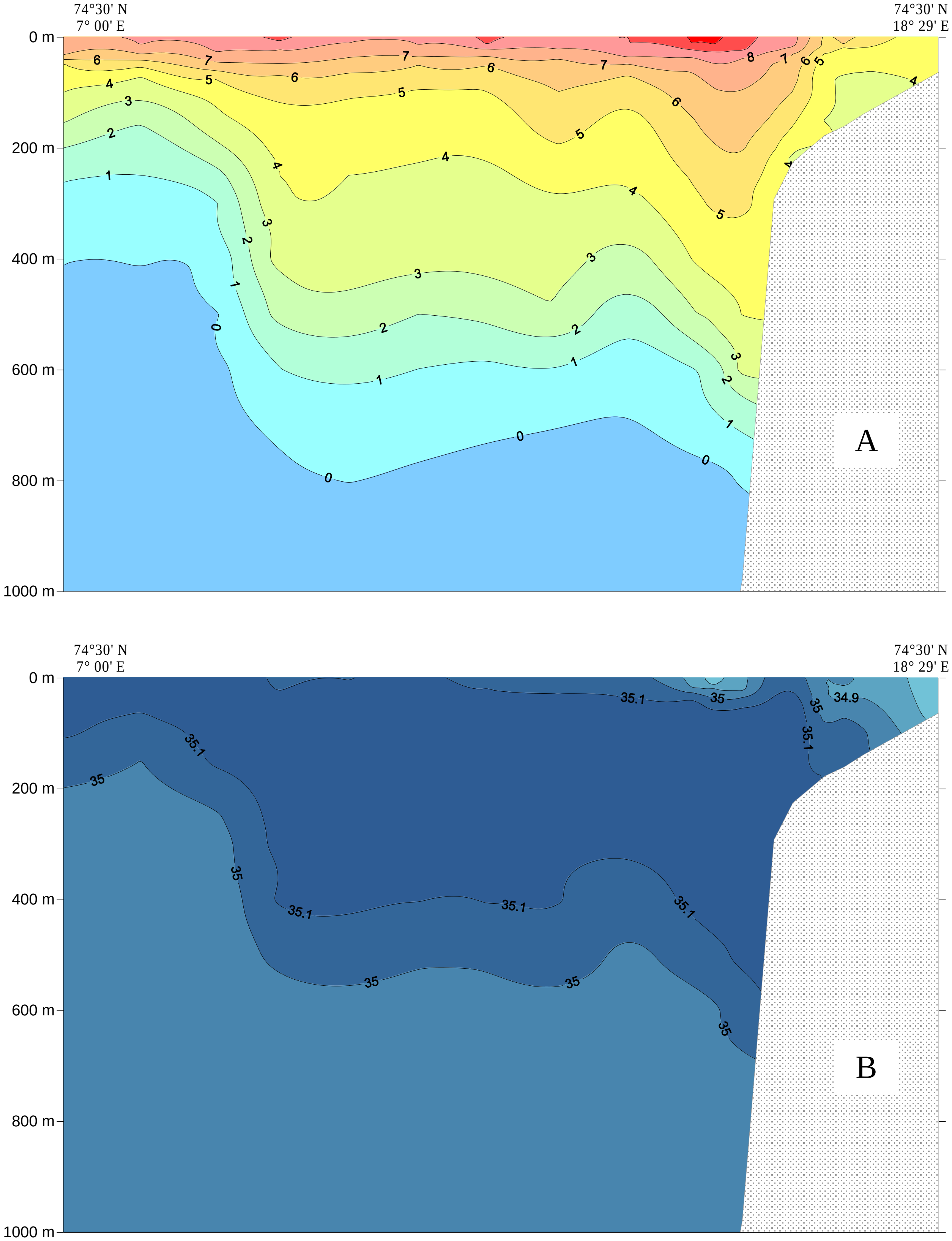

Figure 2.1.4 Temperature (A) and salinity (B) in the Bear Island - West Section, August-September 2007

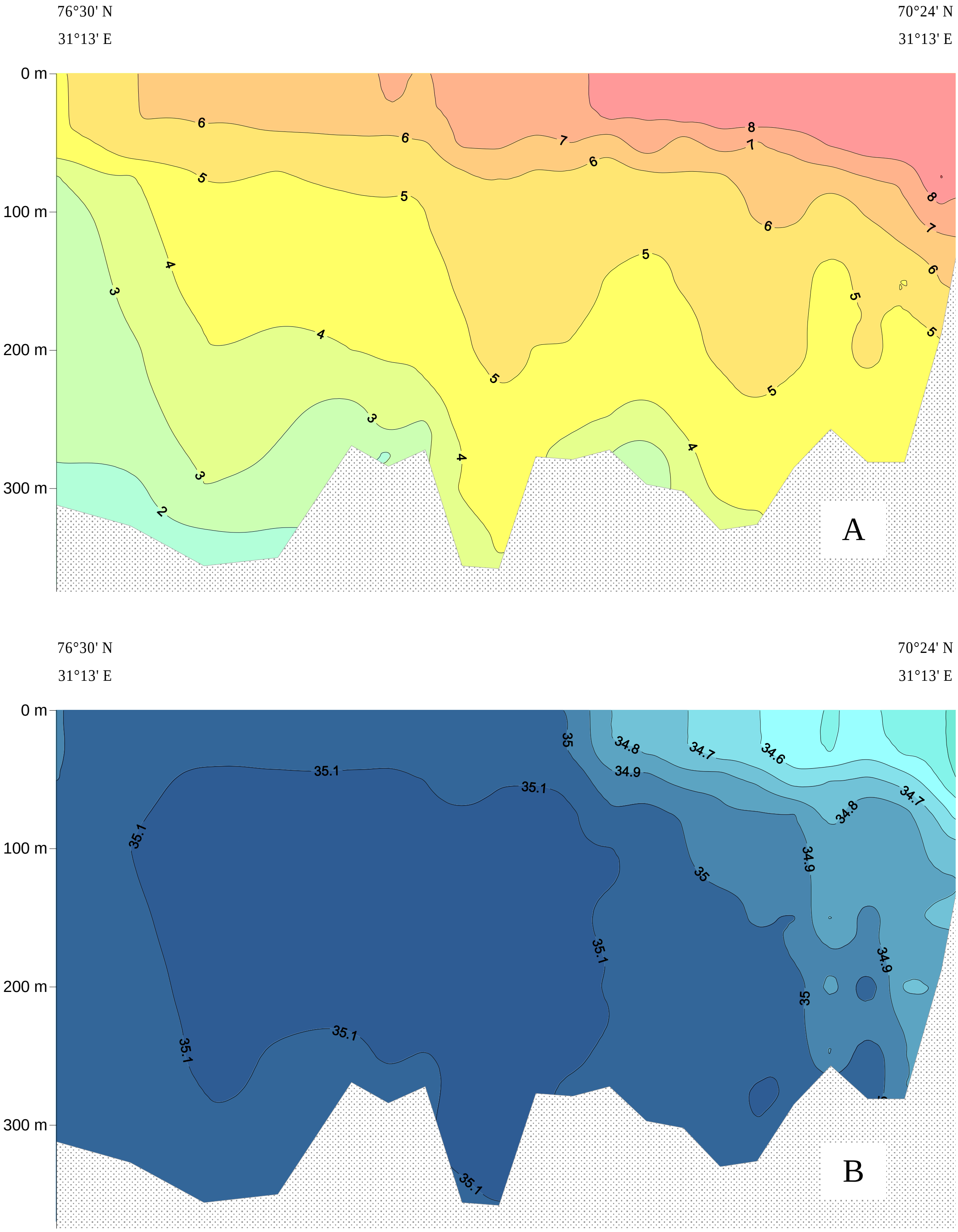

Figure 2.1.5 Temperature (A) and salinity (B) in the Vardø – North section, August-September 2007

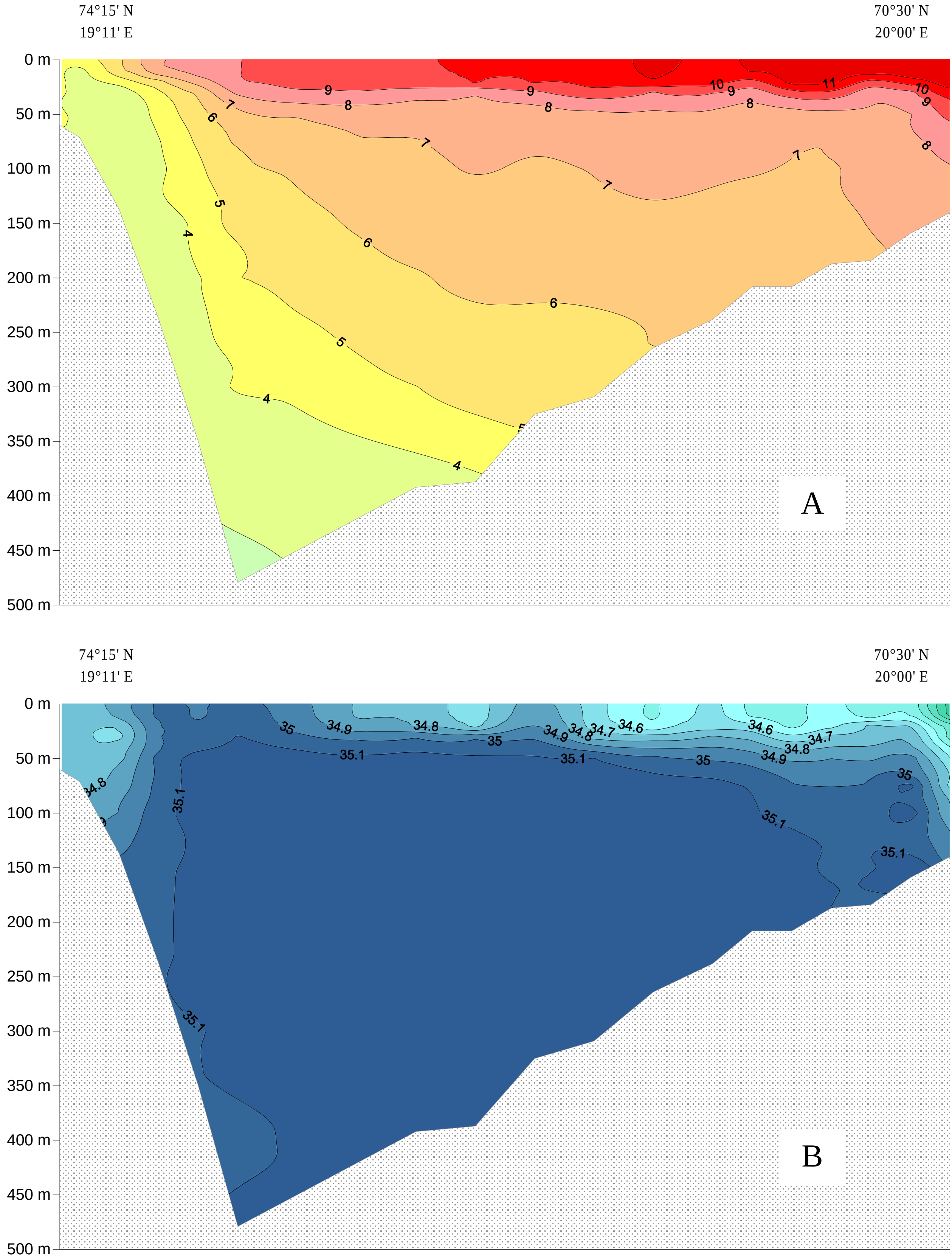

Figure 2.1.6 Temperature (A) and salinity (B) in the Fugløya – Bear Island section, August-September 2007

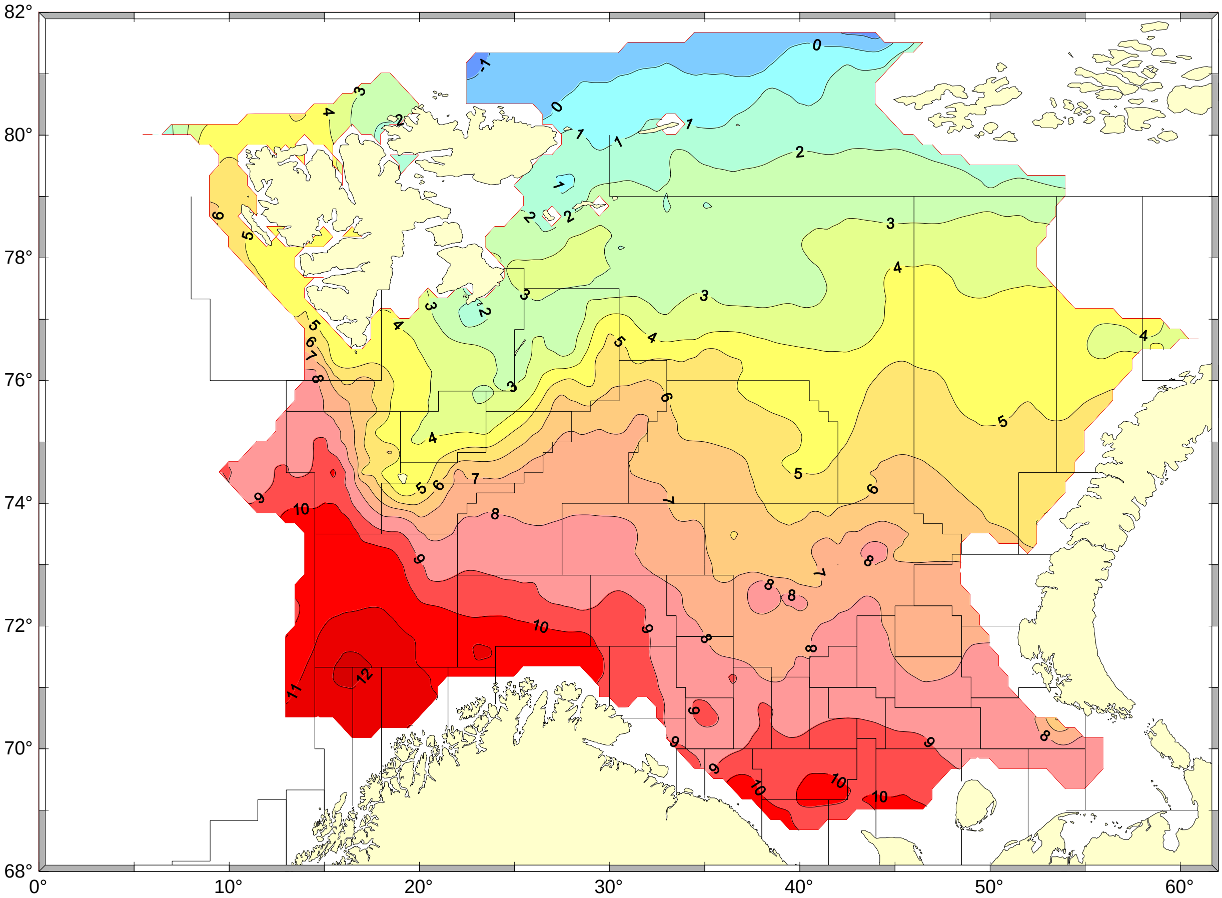

Figure 2.1.7 Distribution of surface temperature (°C), August-September 2007

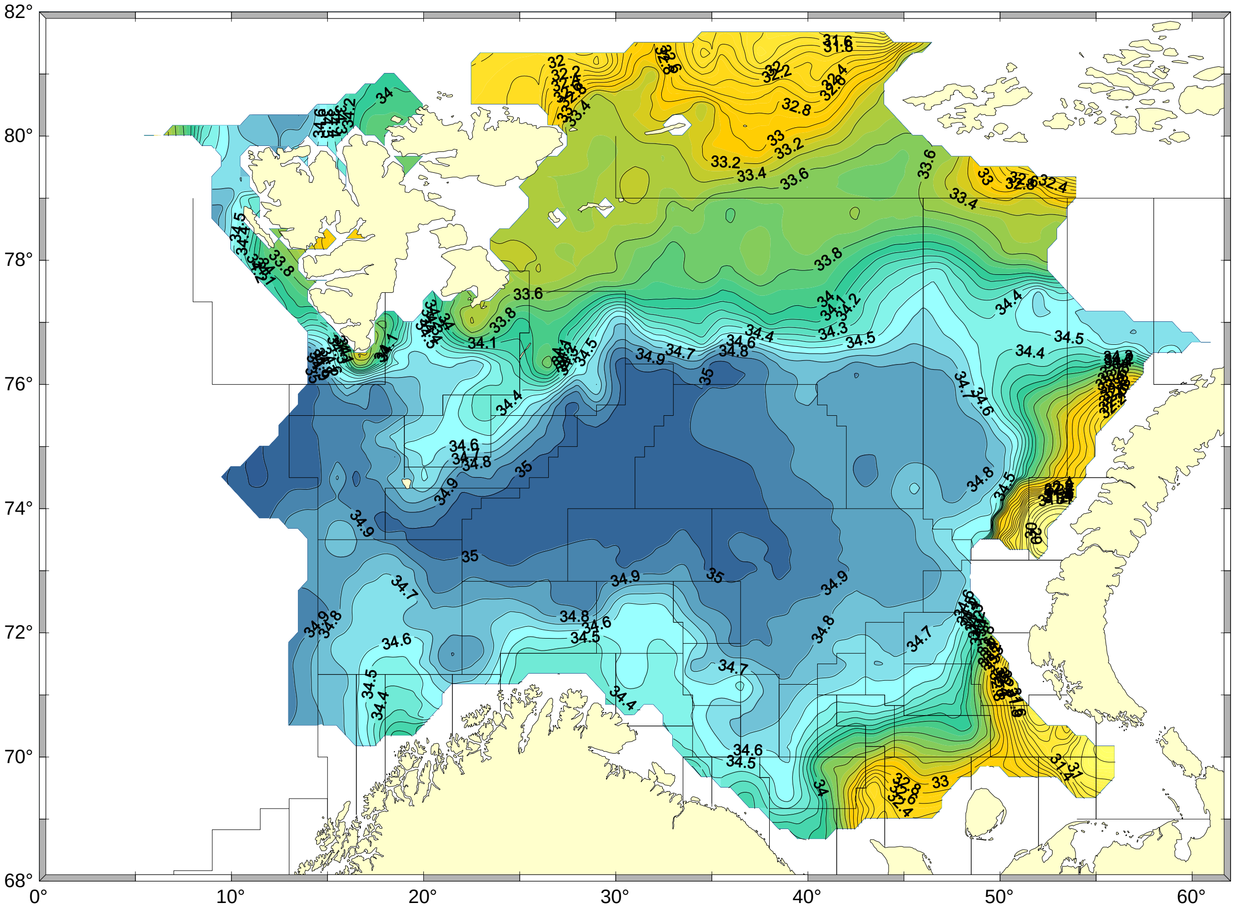

Figure 2.1.8 Distribution of surface salinity, August- September 2007

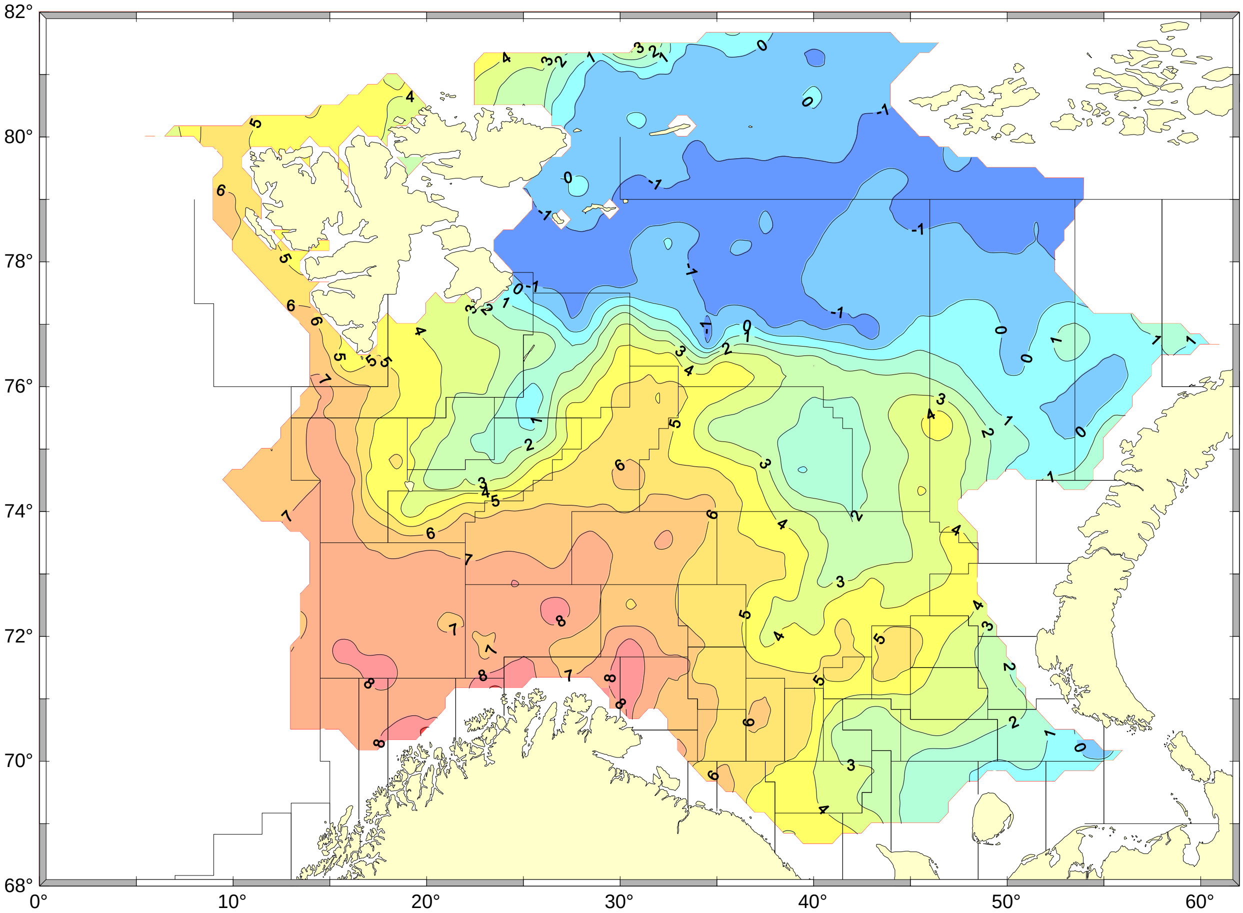

Figure 2.1.9 Distribution of temperature (°C) at the 50 m depth, August-September 2007

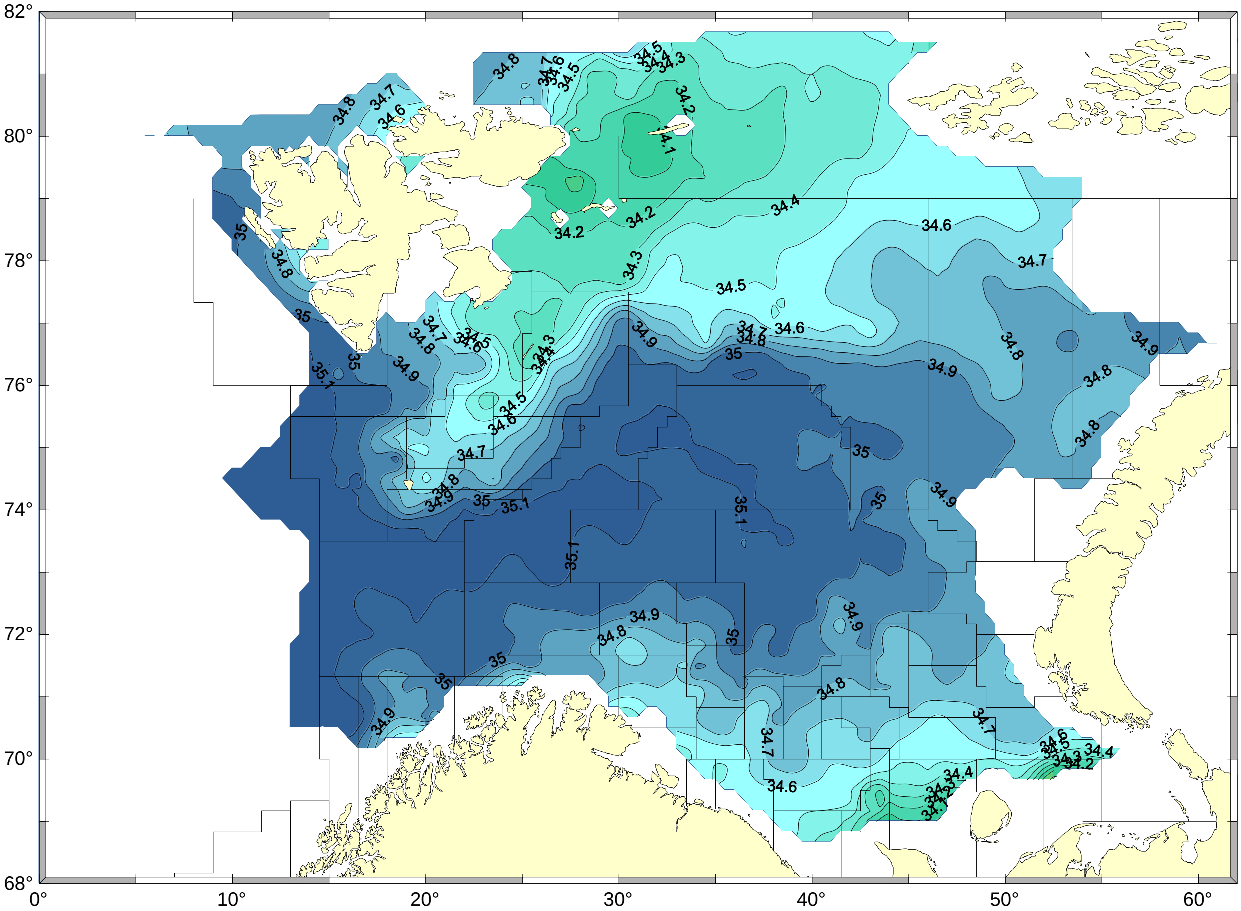

Figure 2.1.10 Distribution of salinity at the 50 m depth, August-September 2007

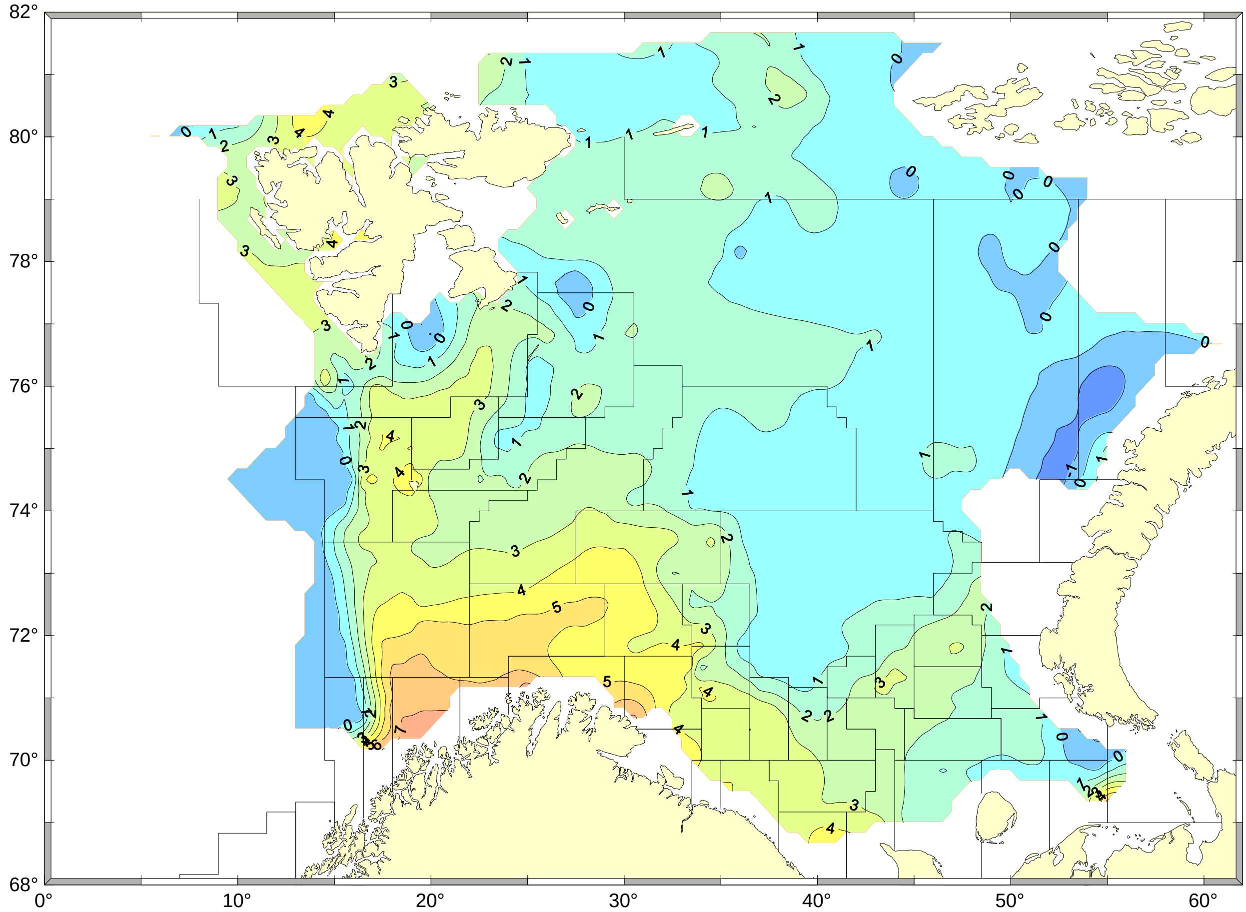

Figure 2.1.11 Distribution of temperature (°C) at the bottom, August-September 2007

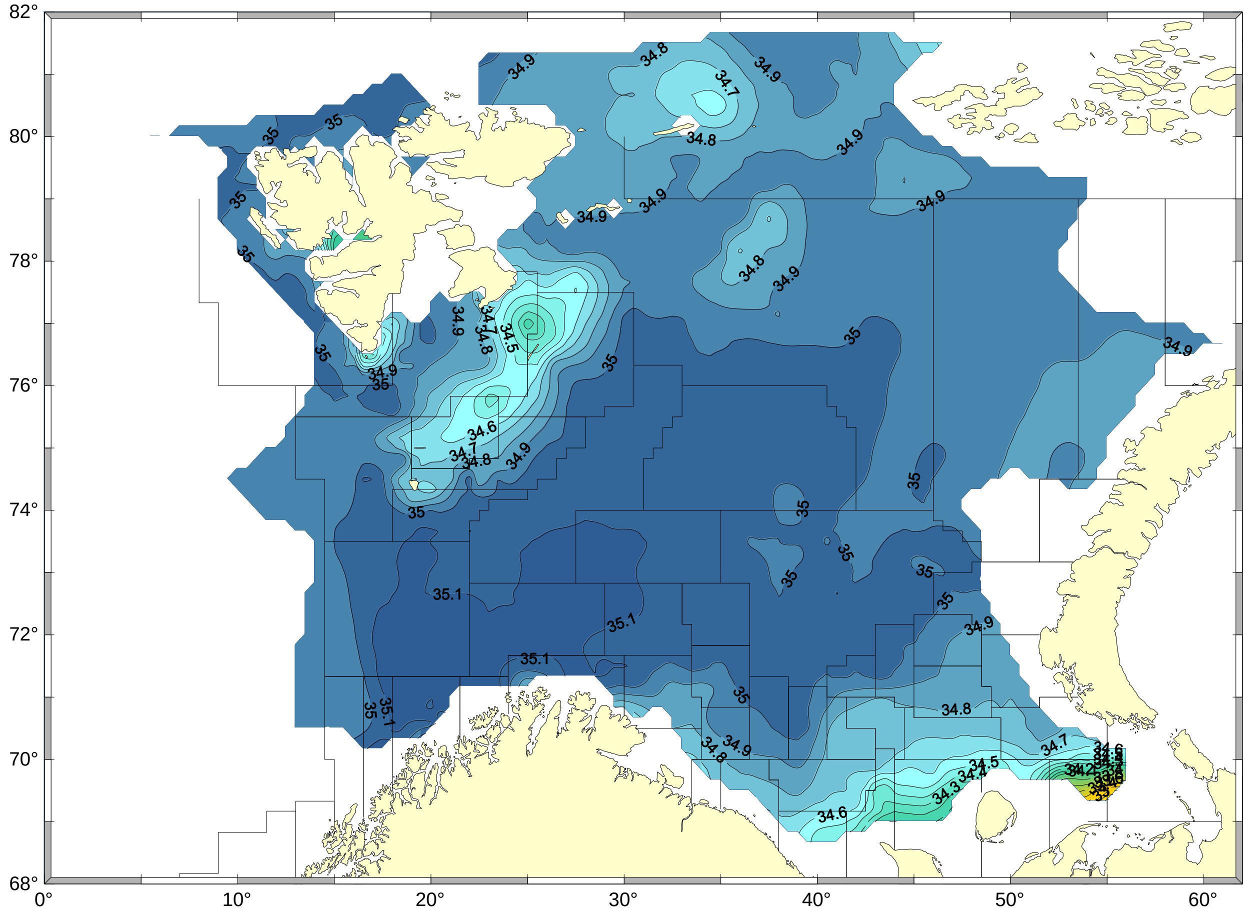

Figure 2.1.12 Distribution of salinity at the bottom, August-September 2007

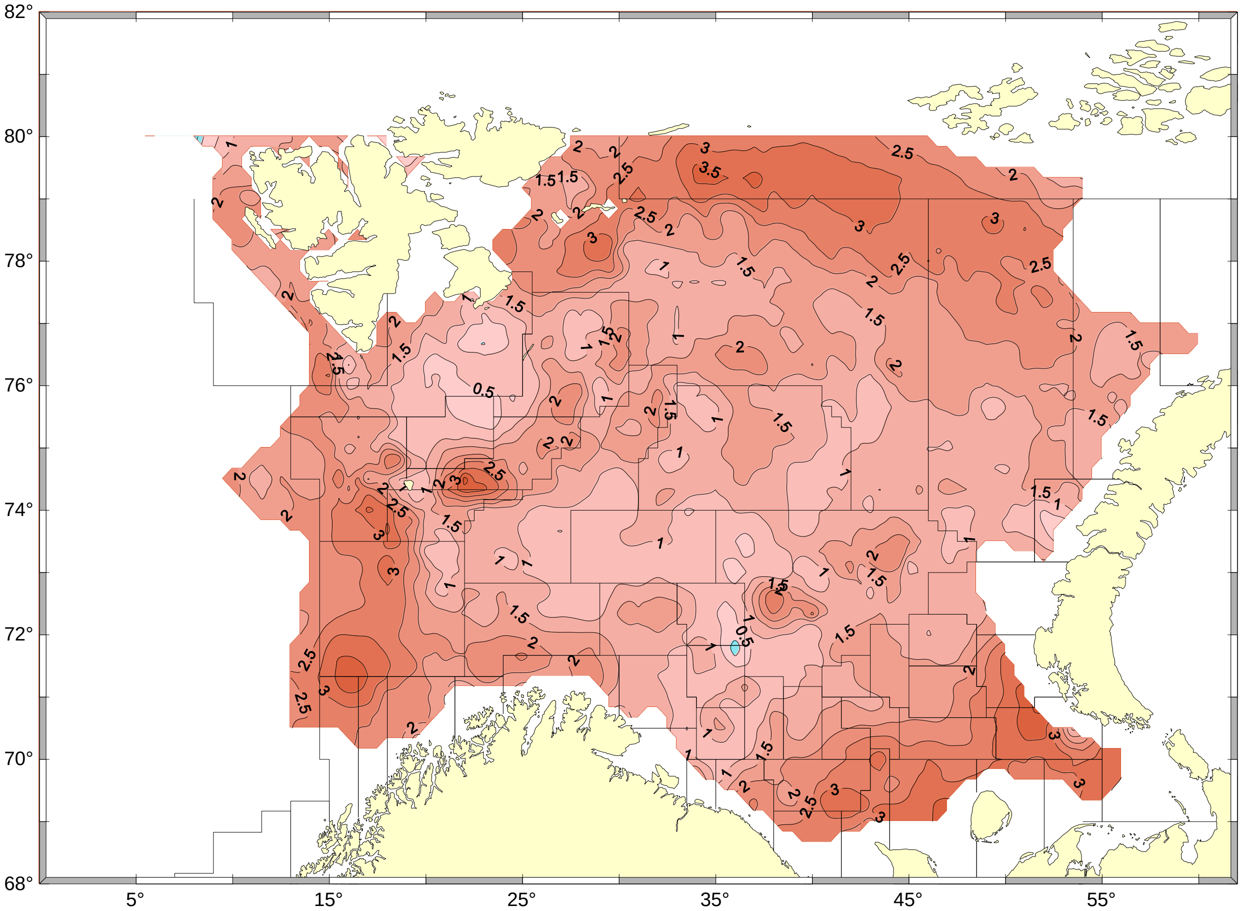

Figure 2.1.13 Surface temperature anomalies (°C), August-September 2007

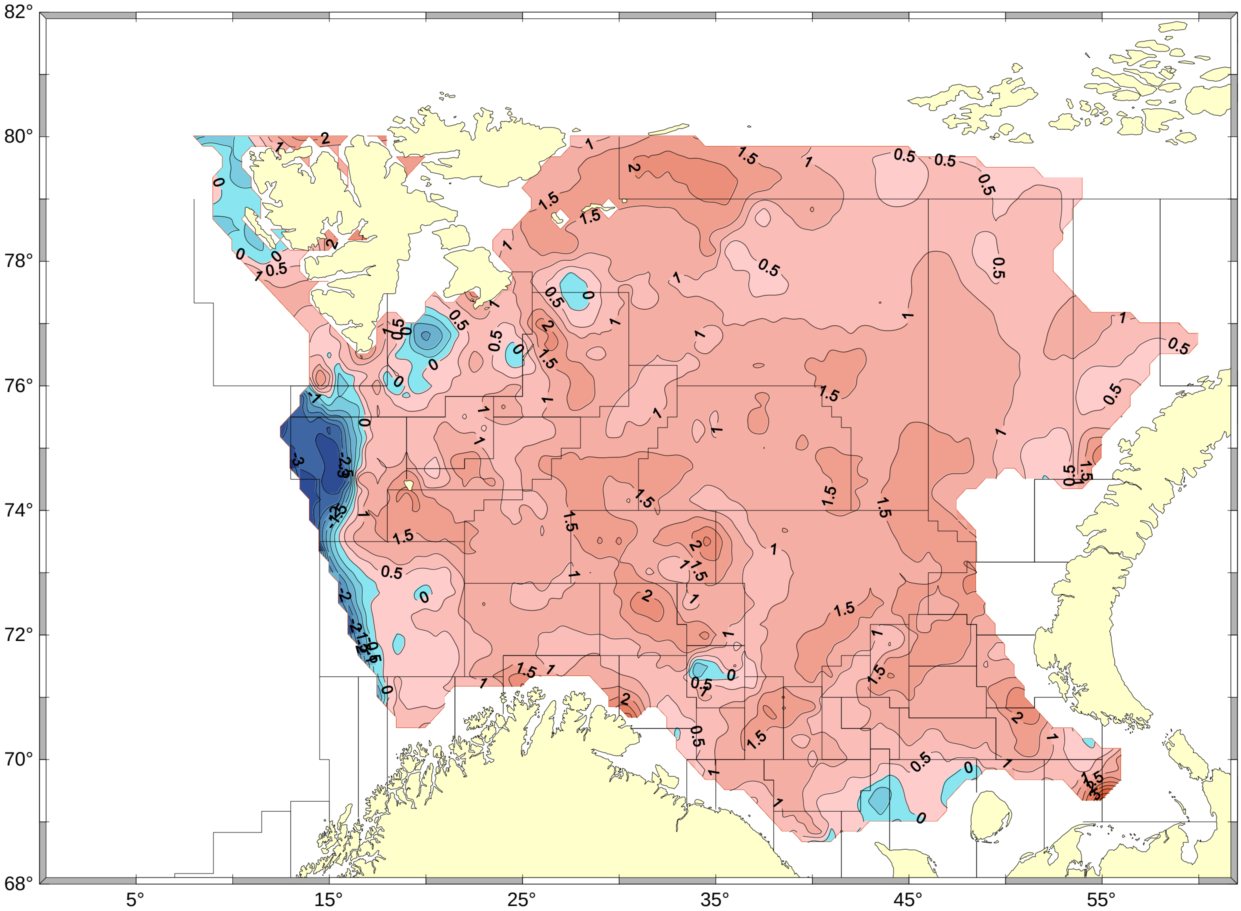

Figure 2.1.14 Temperature anomalies (°C) at the bottom, August-September 2007

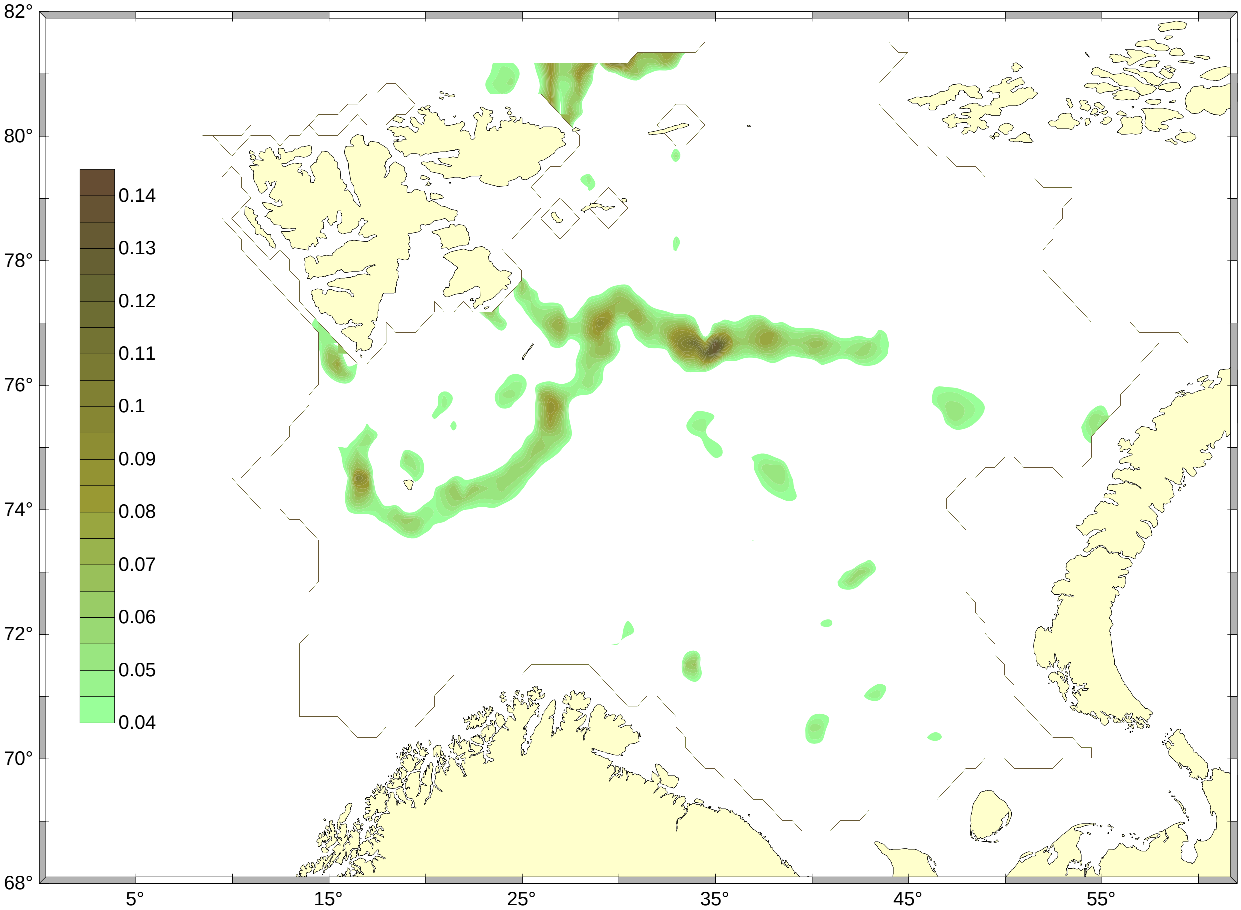

Figure 2.1.15 Temperature frontal zones at 50 m depth (areas with temperature gradients more than 0.04°C/km), August-September 2007

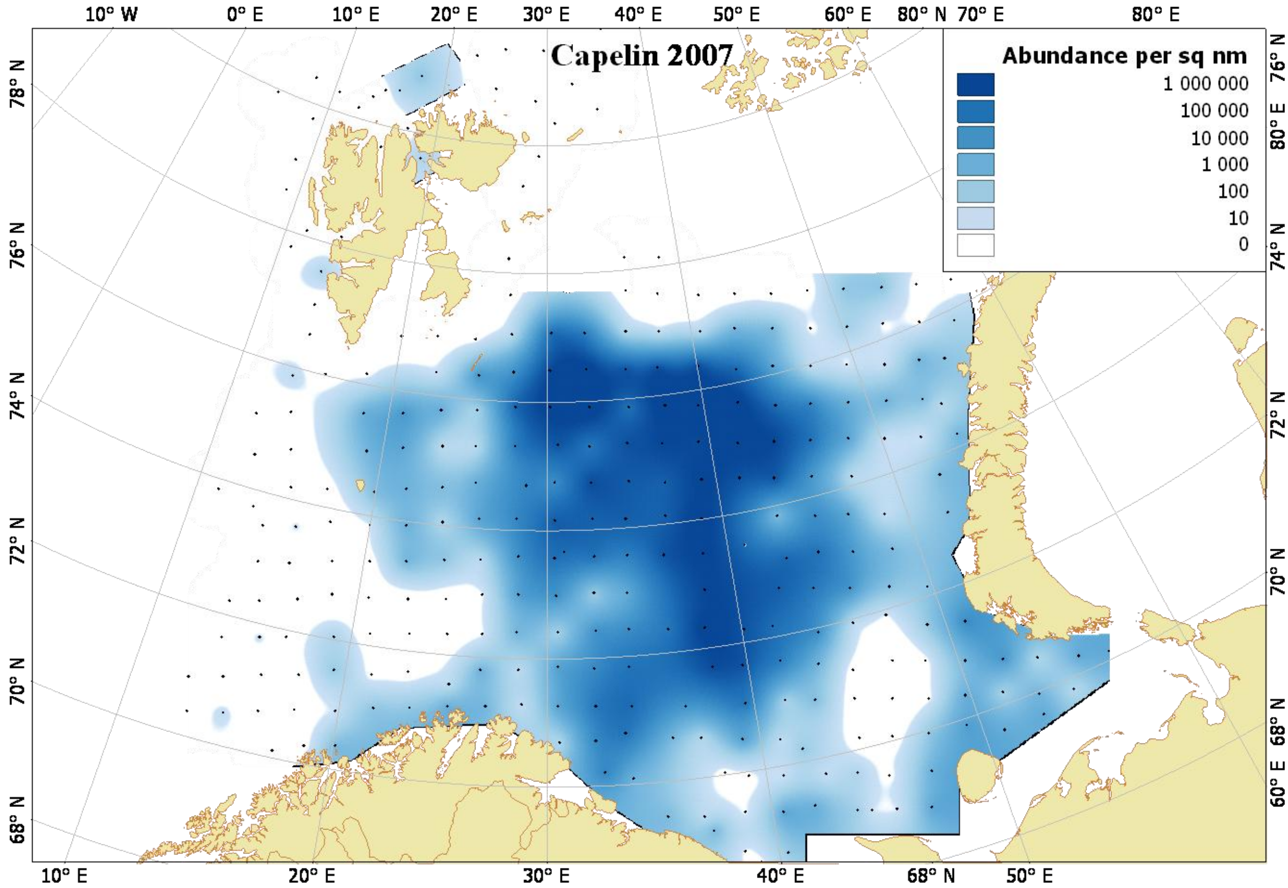

Figure 2.2.1 Distribution of 0-group capelin, August-September 2007

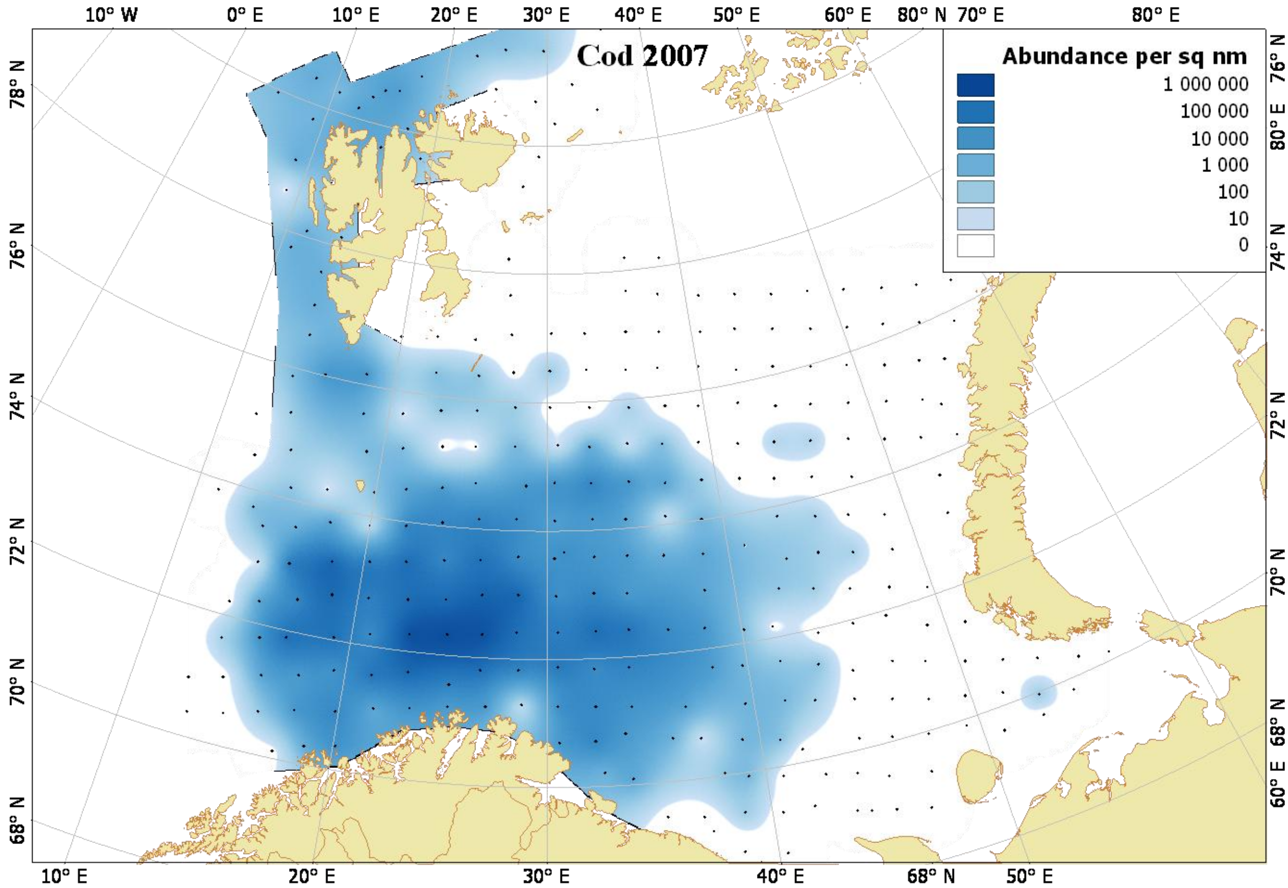

Figure 2.2.2 Distribution of 0-group cod, August-September 2007

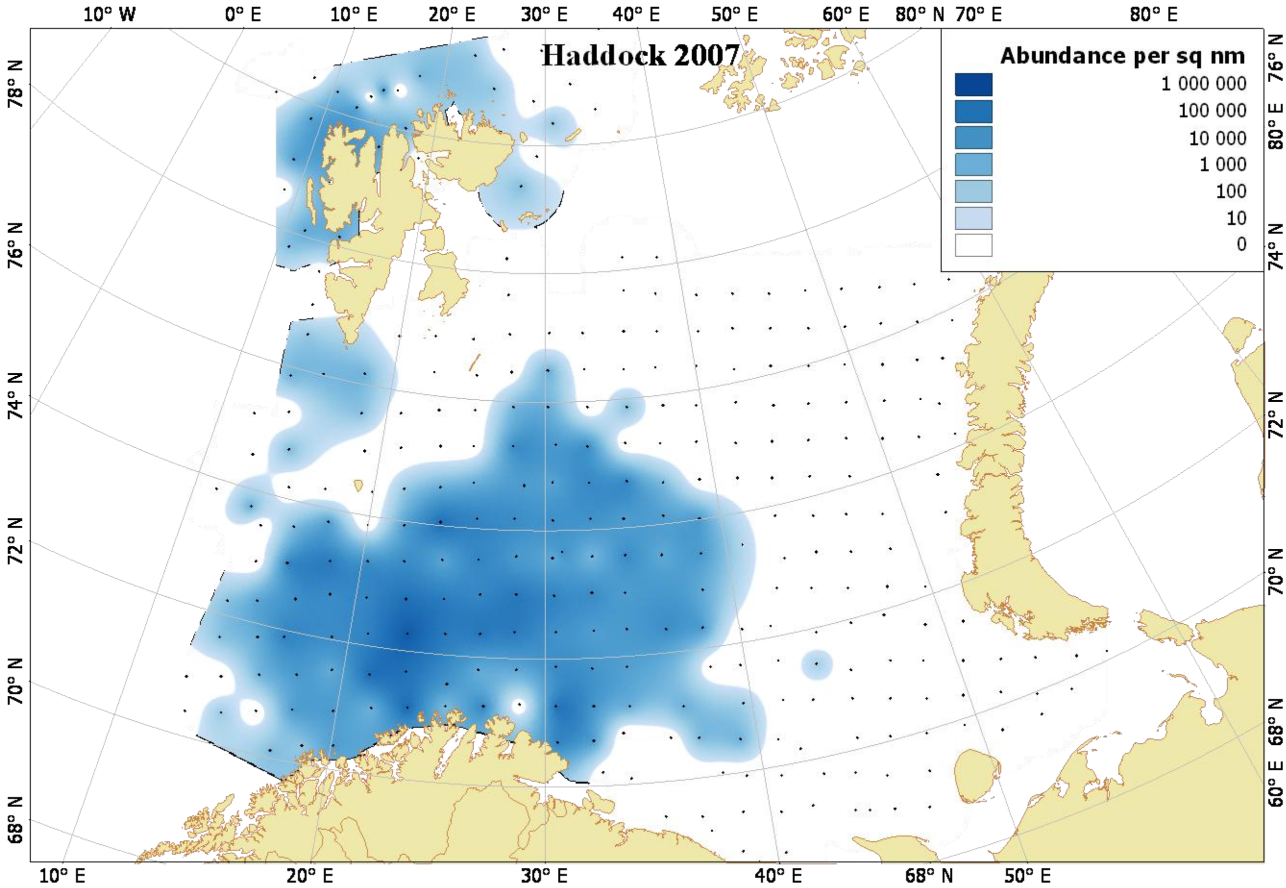

Figure 2.2.3 Distribution of 0-group haddock, August-September 2007

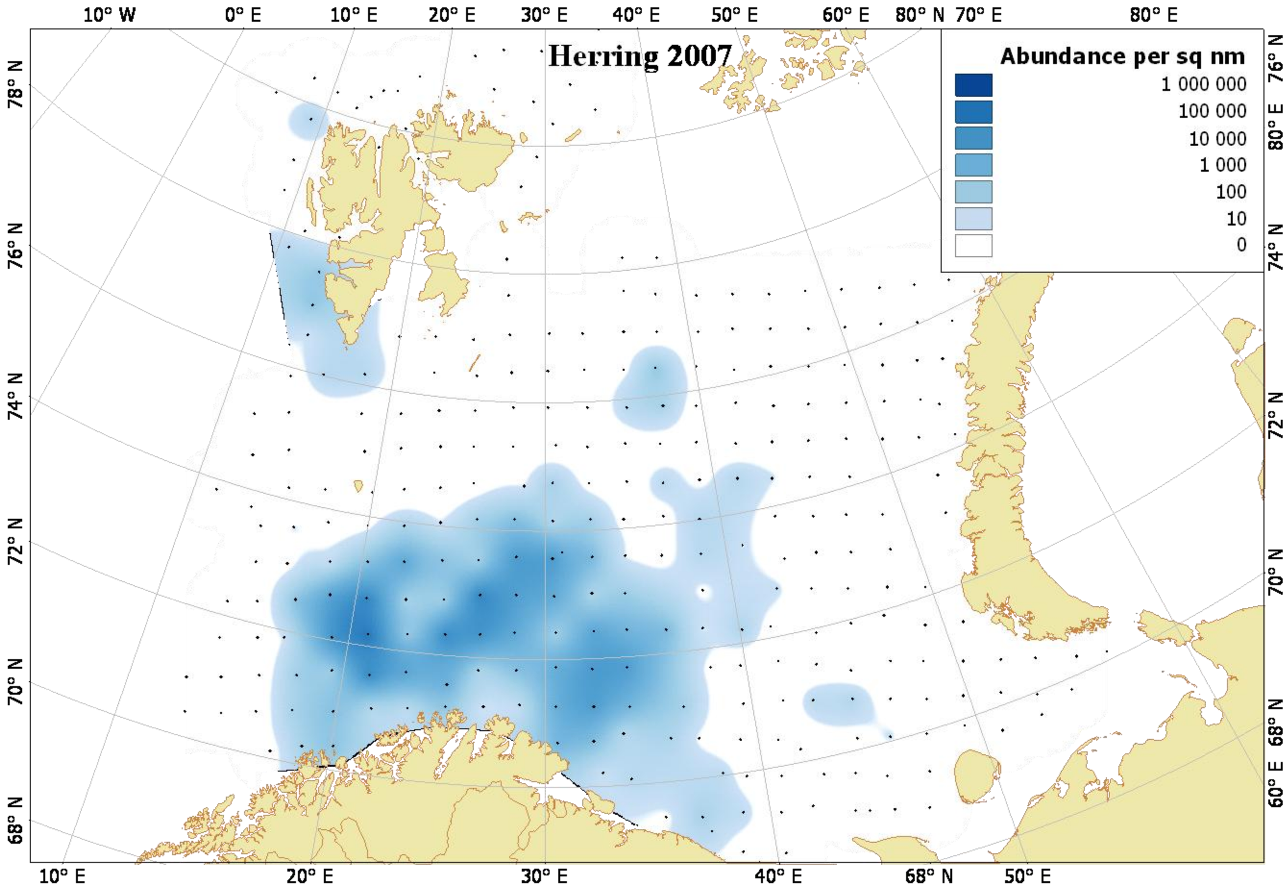

Figure 2.2.4 Distribution of 0-group herring, August-September 2007

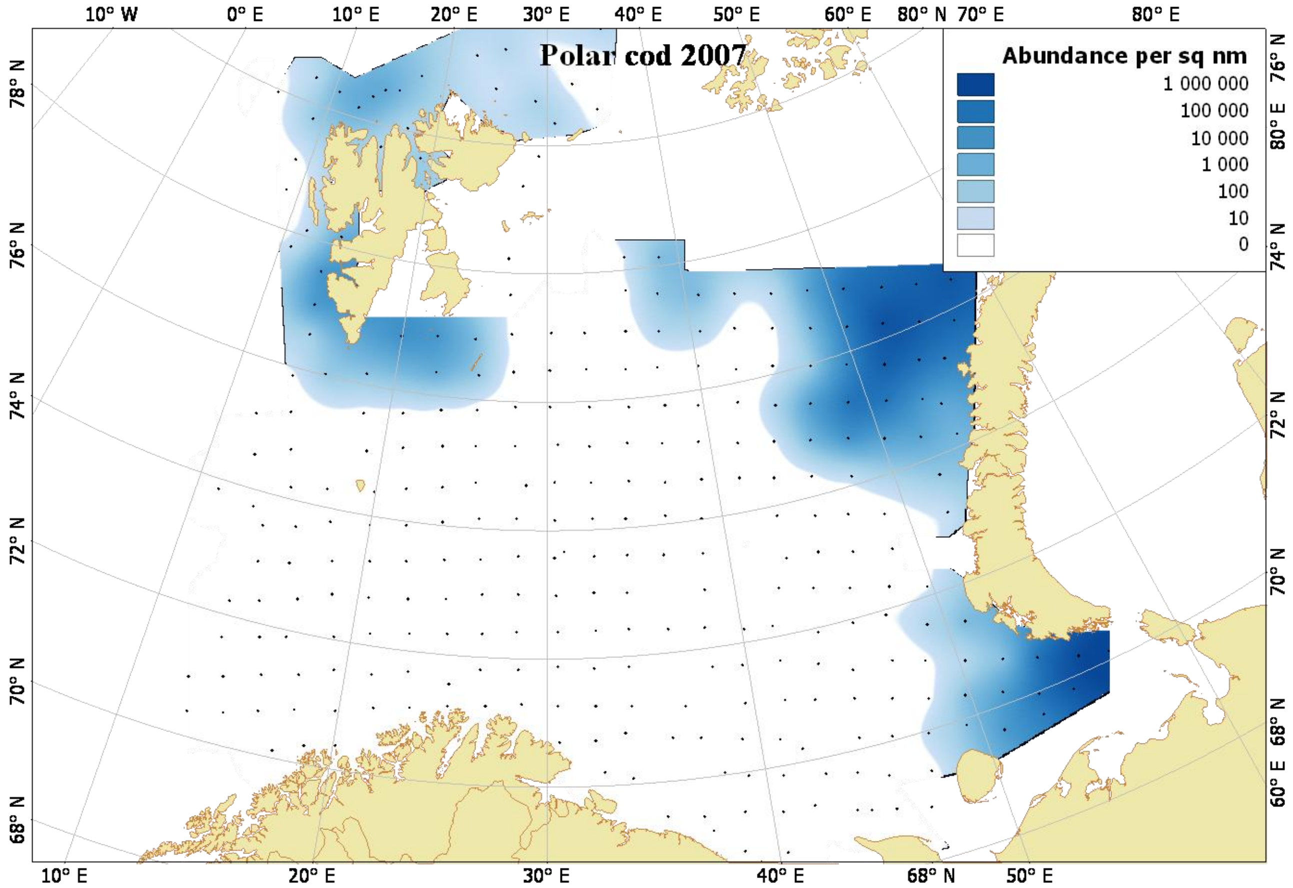

Figure 2.2.5 Distribution of 0-group polar cod, August-September 2007

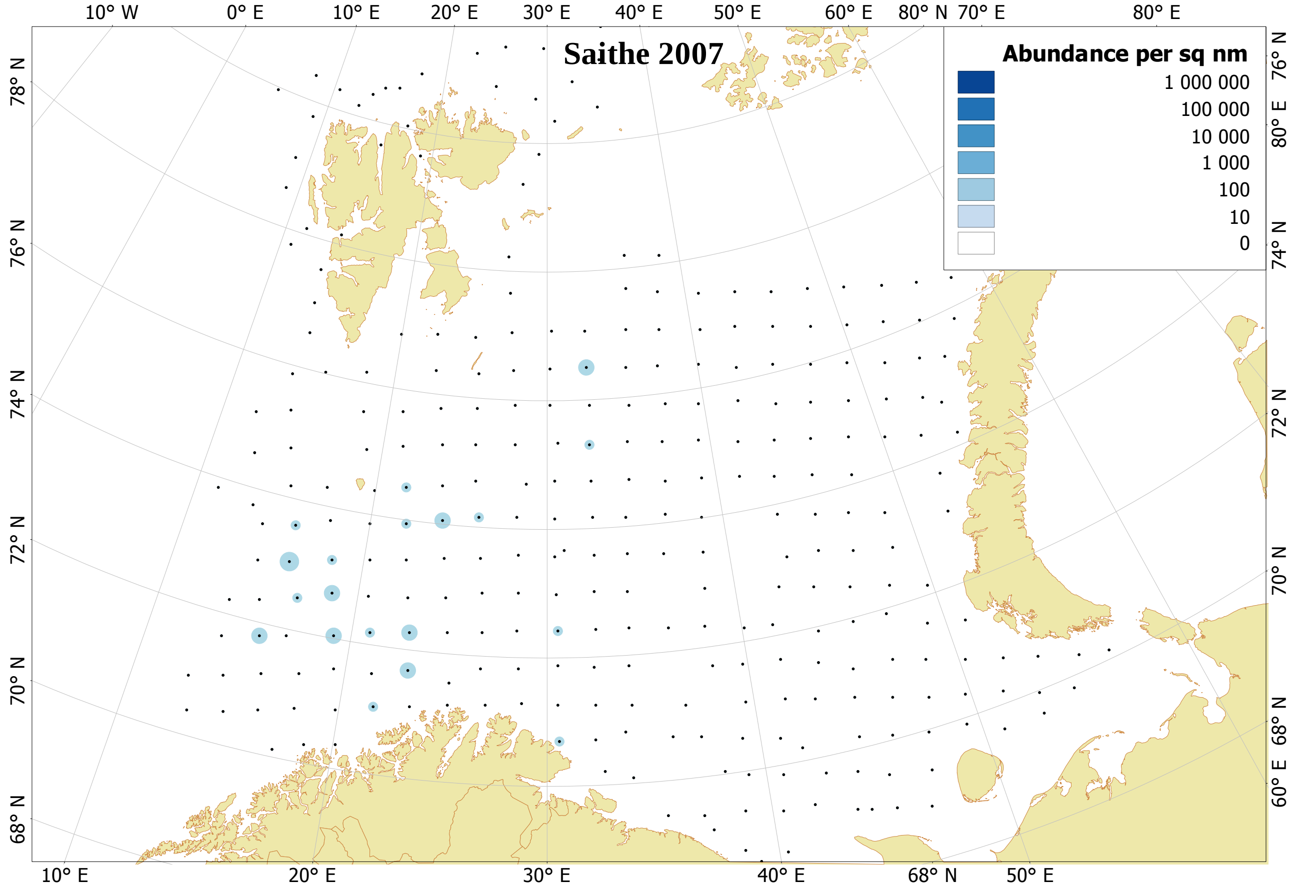

Figure 2.2.6 Distribution of 0-group saithe, August-September 2007

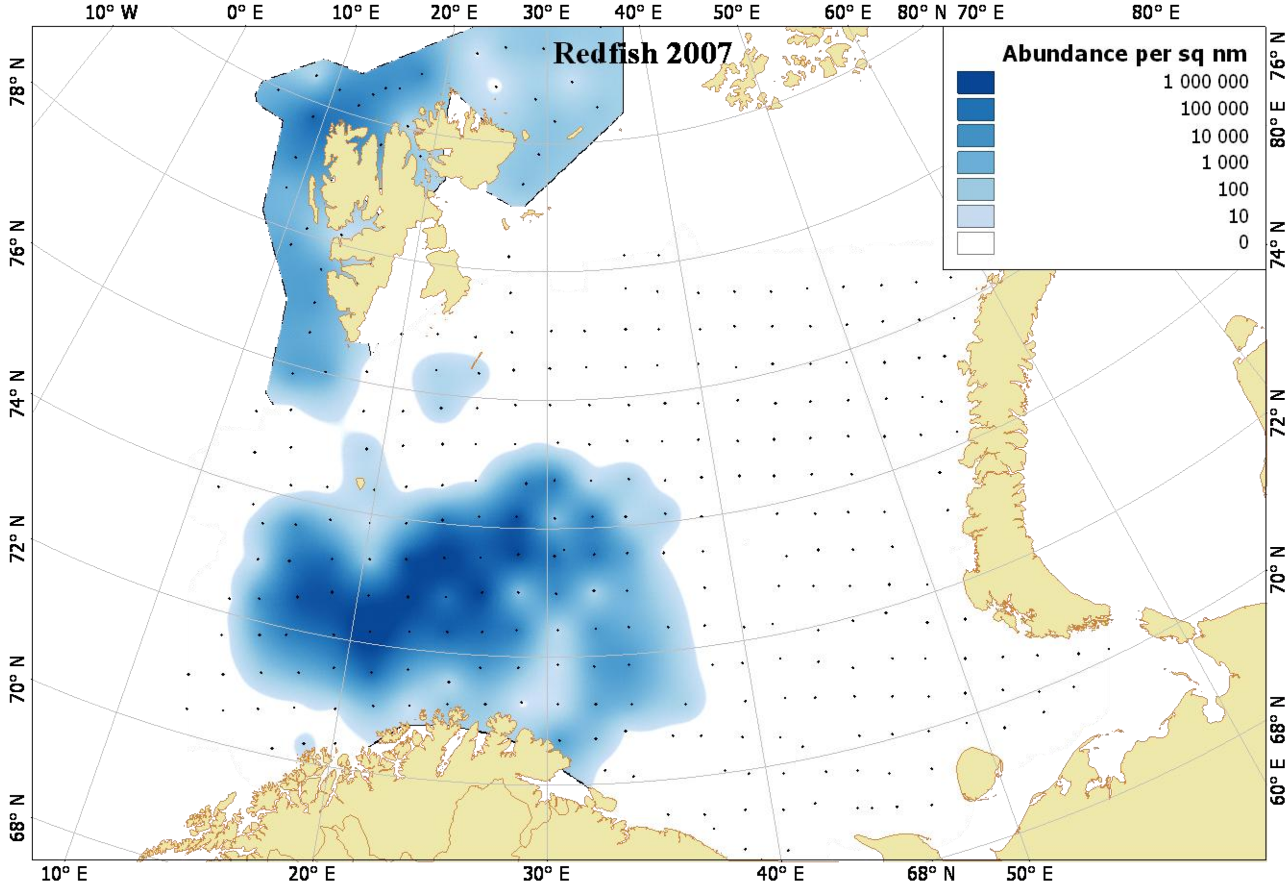

Figure 2.2.7 **Distribution of 0-group redfish, August-September 2007**

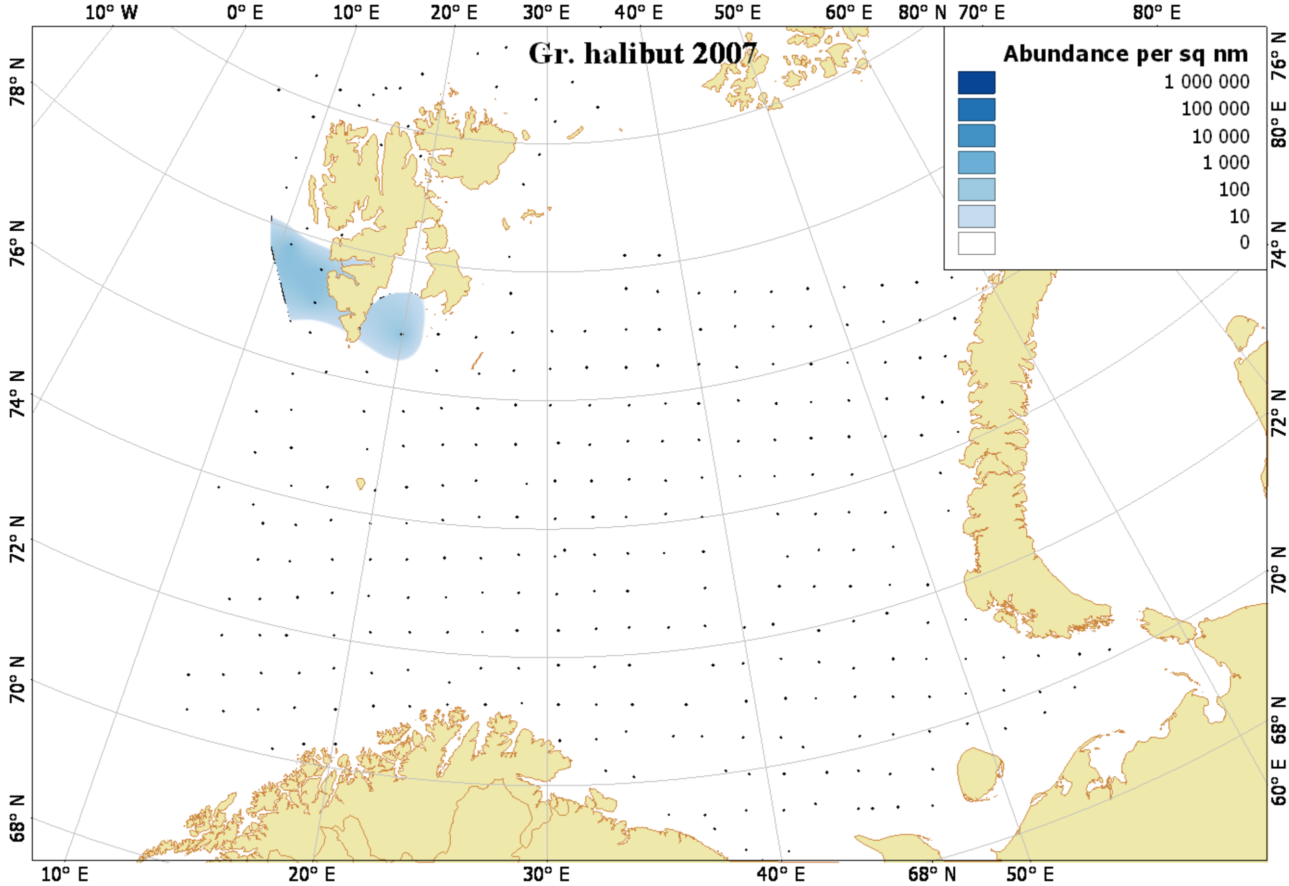

Figure 2.2.8 **Distribution of 0-group Greenland halibut, August-September 2007**

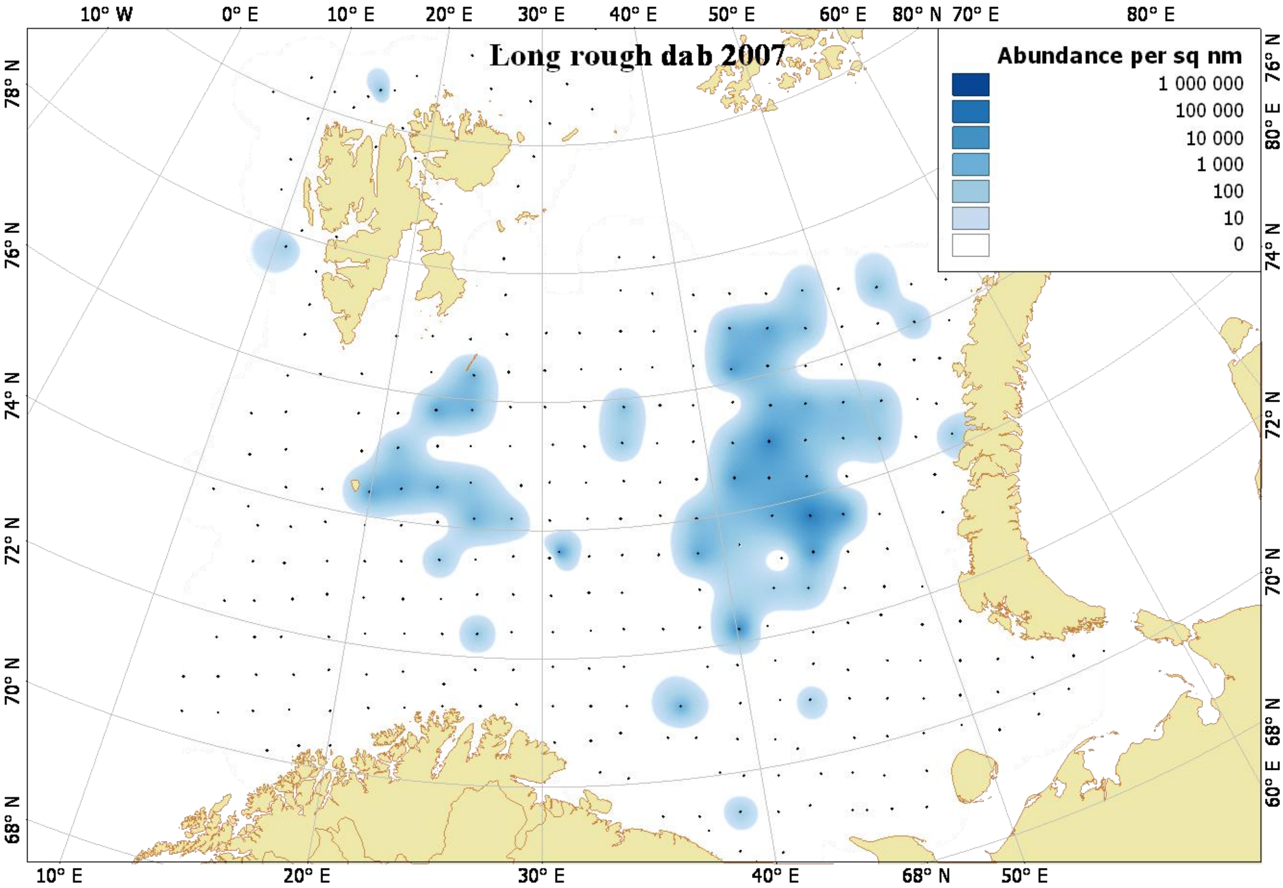

Figure 2.2.9 Distribution of 0-group long rough dab, August-September 2007

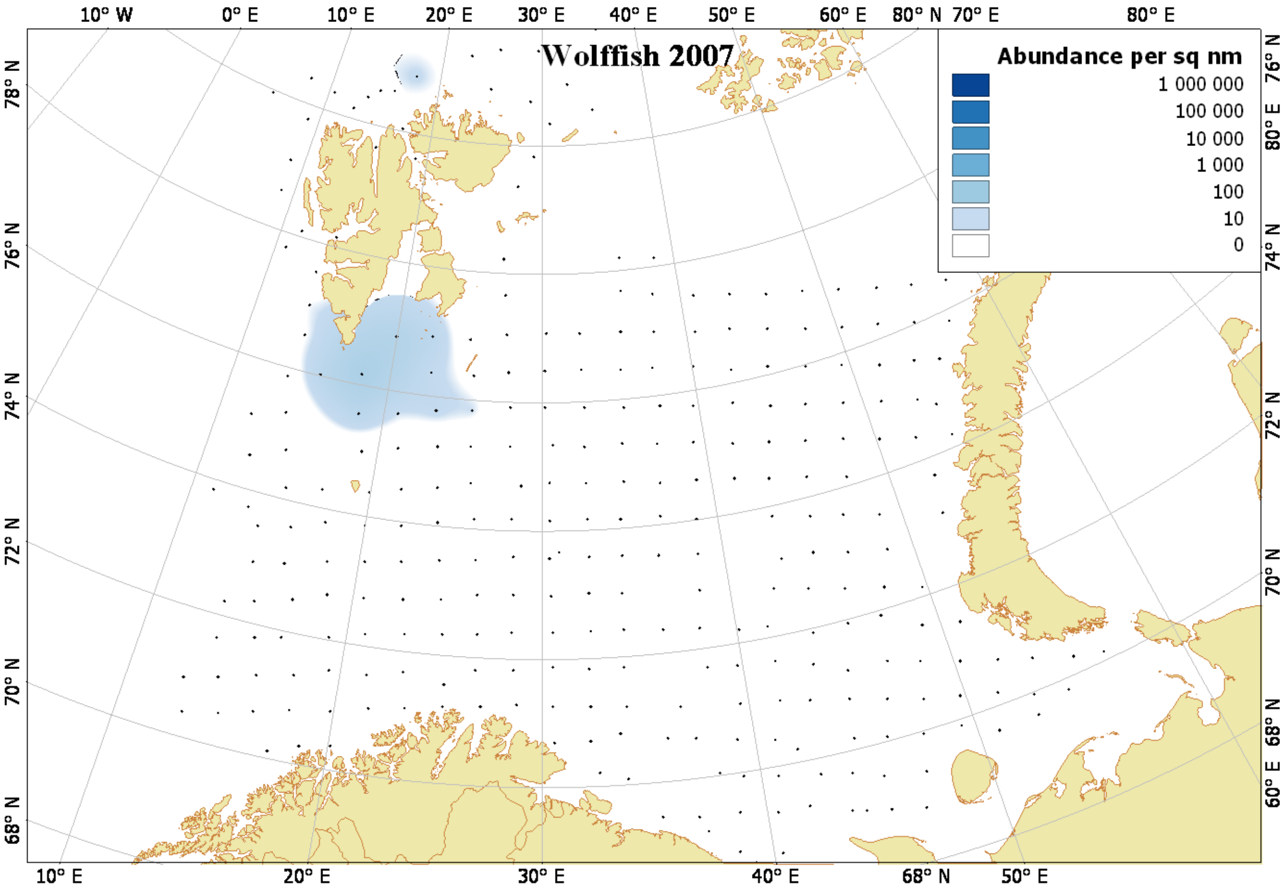

Figure 2.2.10 Distribution of 0-group wolffish, August-September 2007

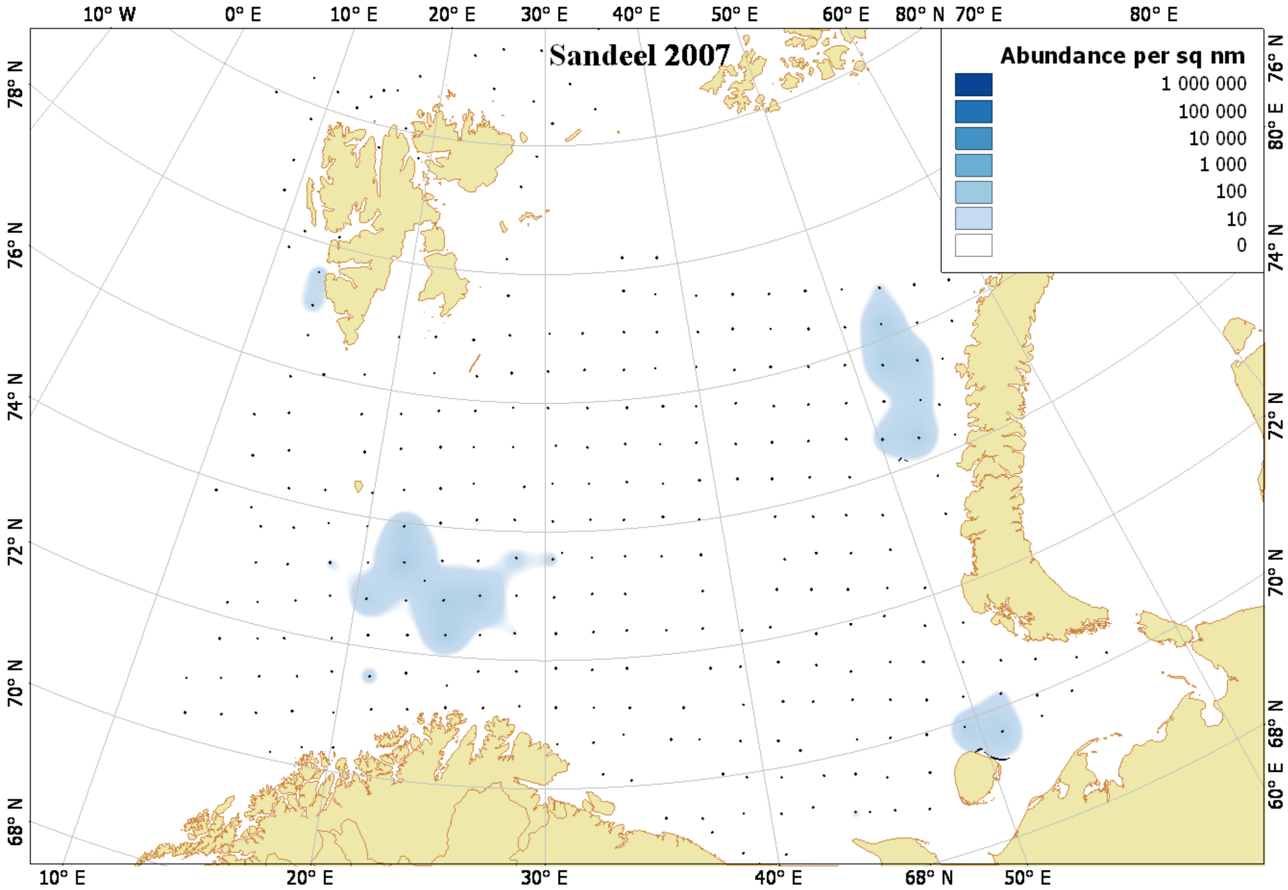

Figure 2.2.11 Distribution of 0-group sandeel, August-September 2007

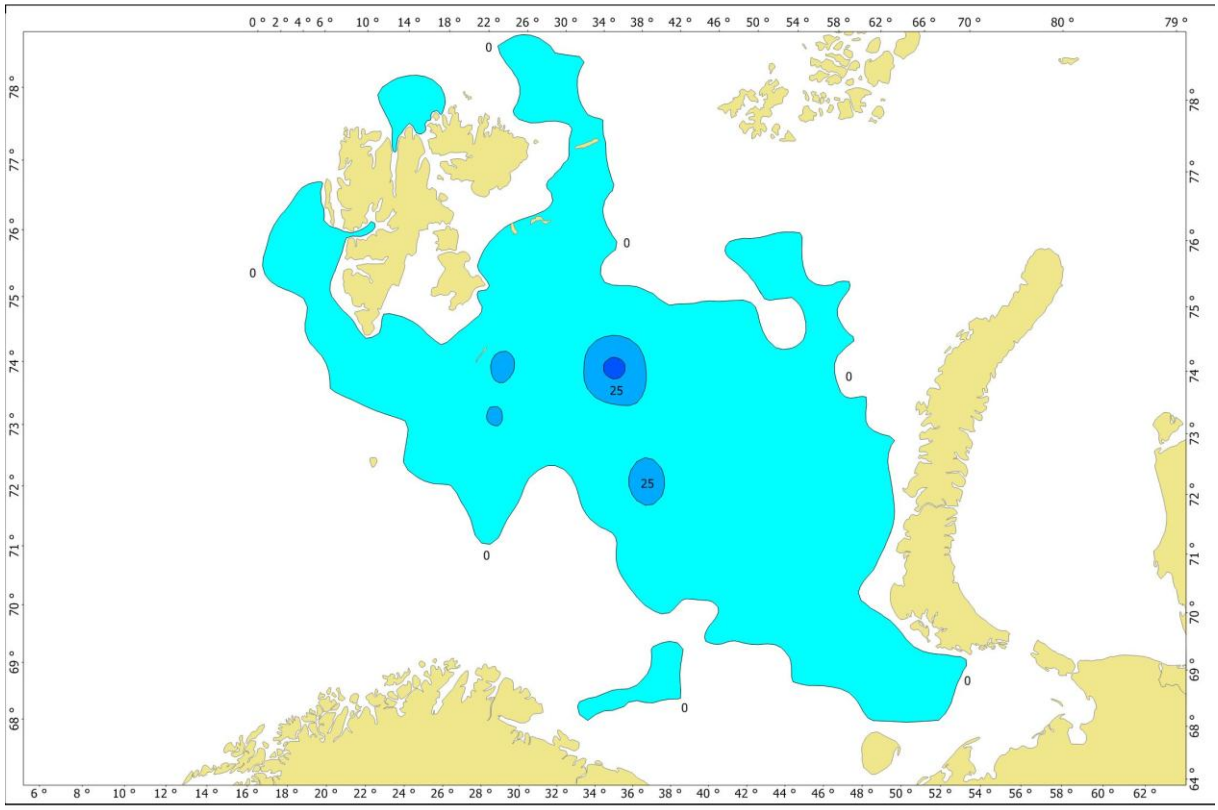

Figure 2.3.1 Estimated density distribution of one-year-old capelin (t/ nautical mile2), August-September 2007

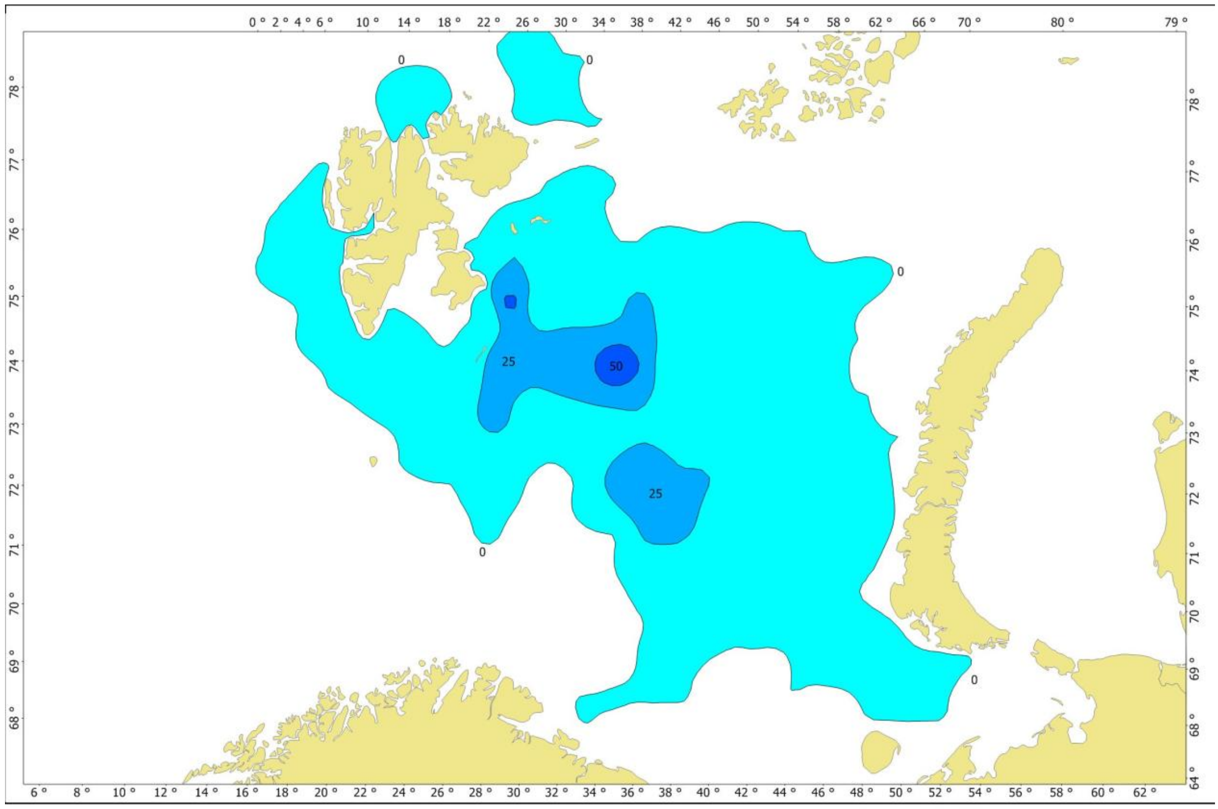

Figure 2.3.2 Estimated total density distribution of capelin (t/ nautical mile^2), August-September 2007

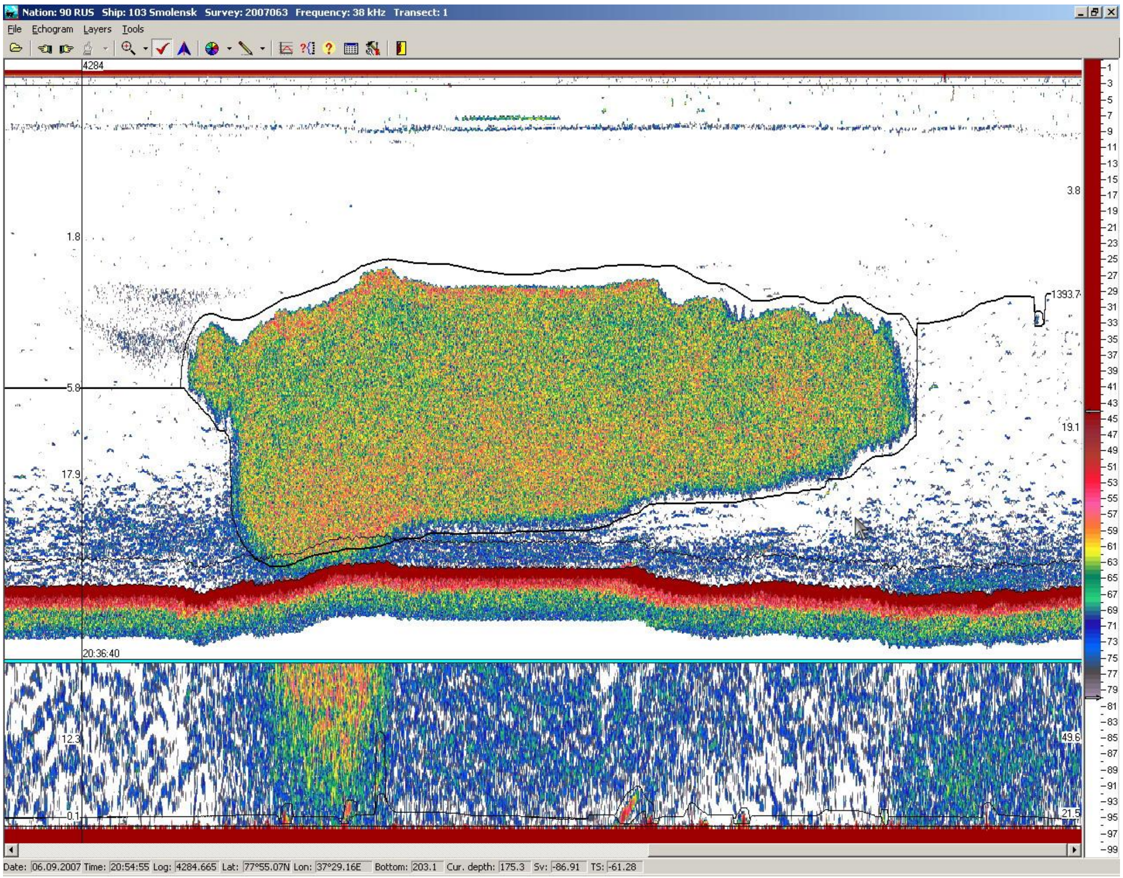

Figure 2.3.3 Echo-records of capelin. This school contains approximately 1000-2000 tonnes

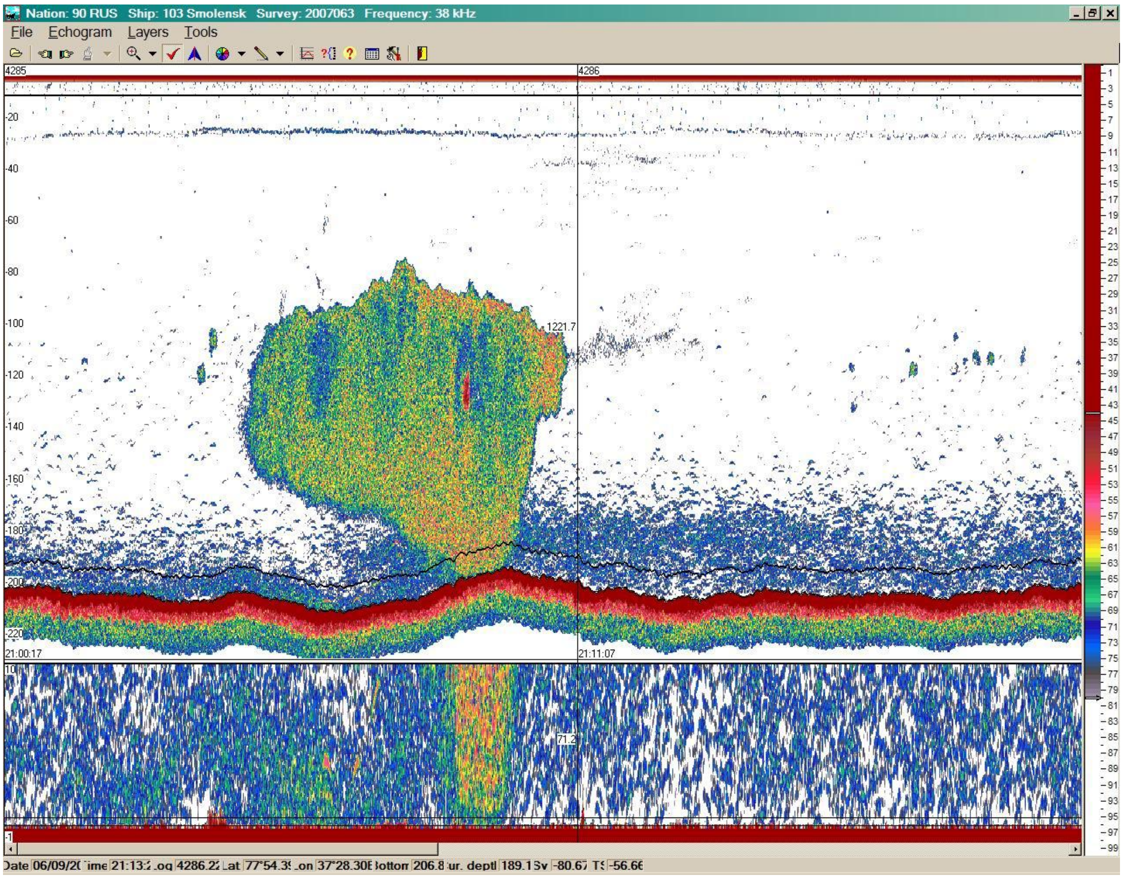

Figure 2.3.4 Echo-records of capelin. The red color in the middle of the school shows a whale eating the capelin

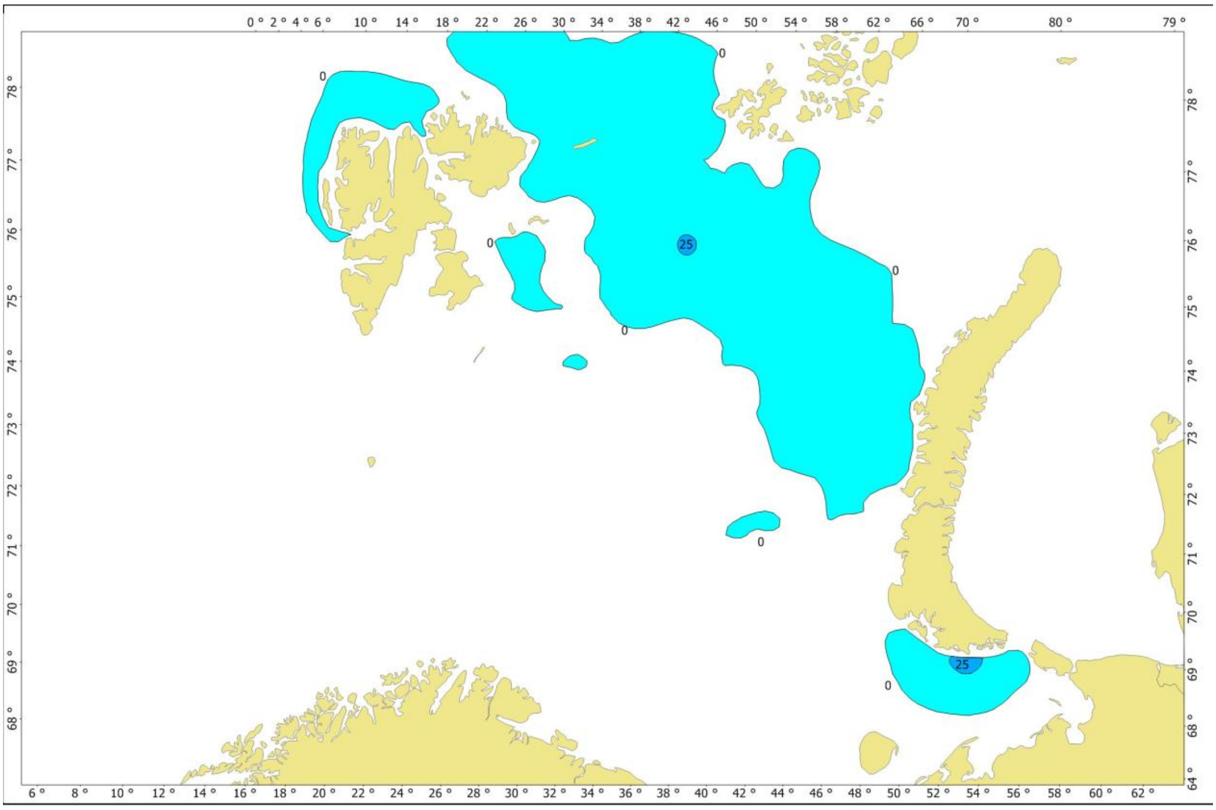

Figure 2.3.5 Estimated density distribution of one year old polar cod (t/ nautical mile²), August-September 2007

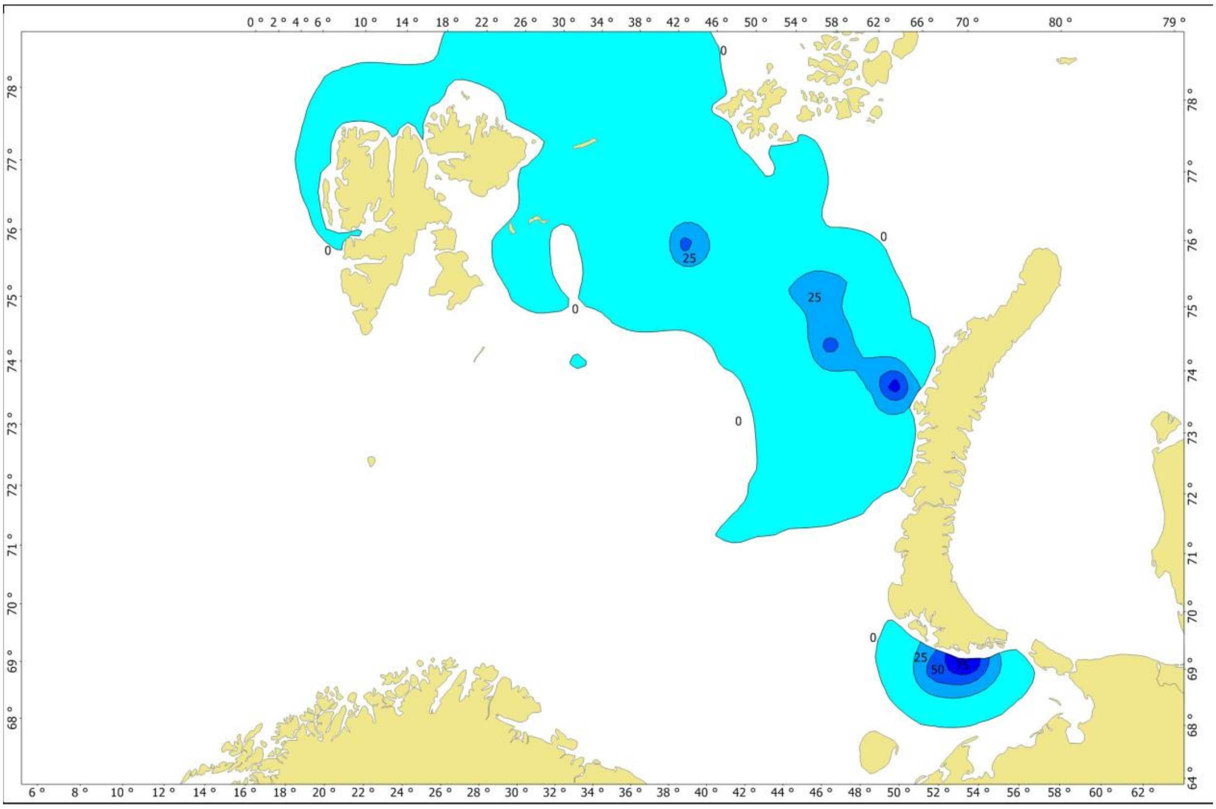

Figure 2.3.6 Estimated total density distribution of polar cod (t/ nautical mile²), August-September 2007

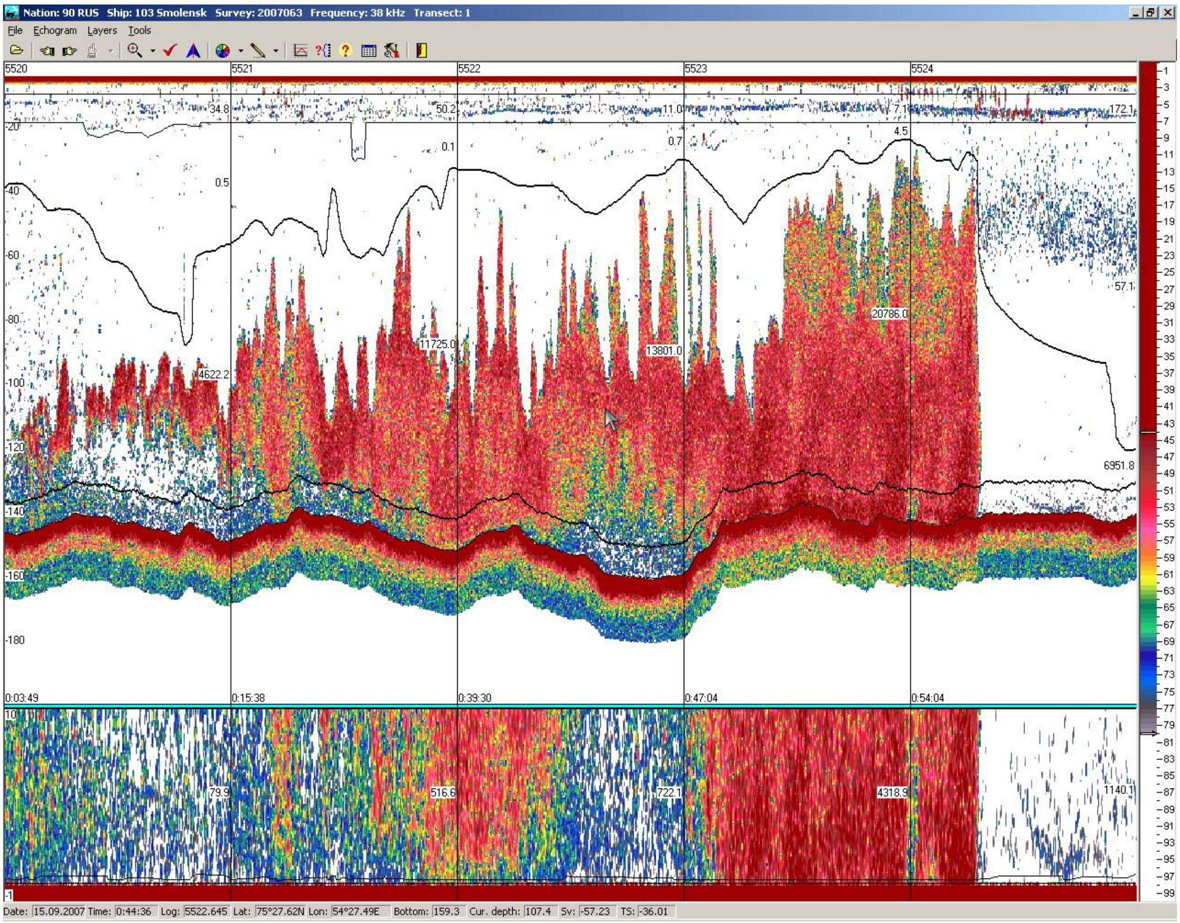

Figure 2.3.7 Typical echo-records of polar cod in eastern Barents Sea

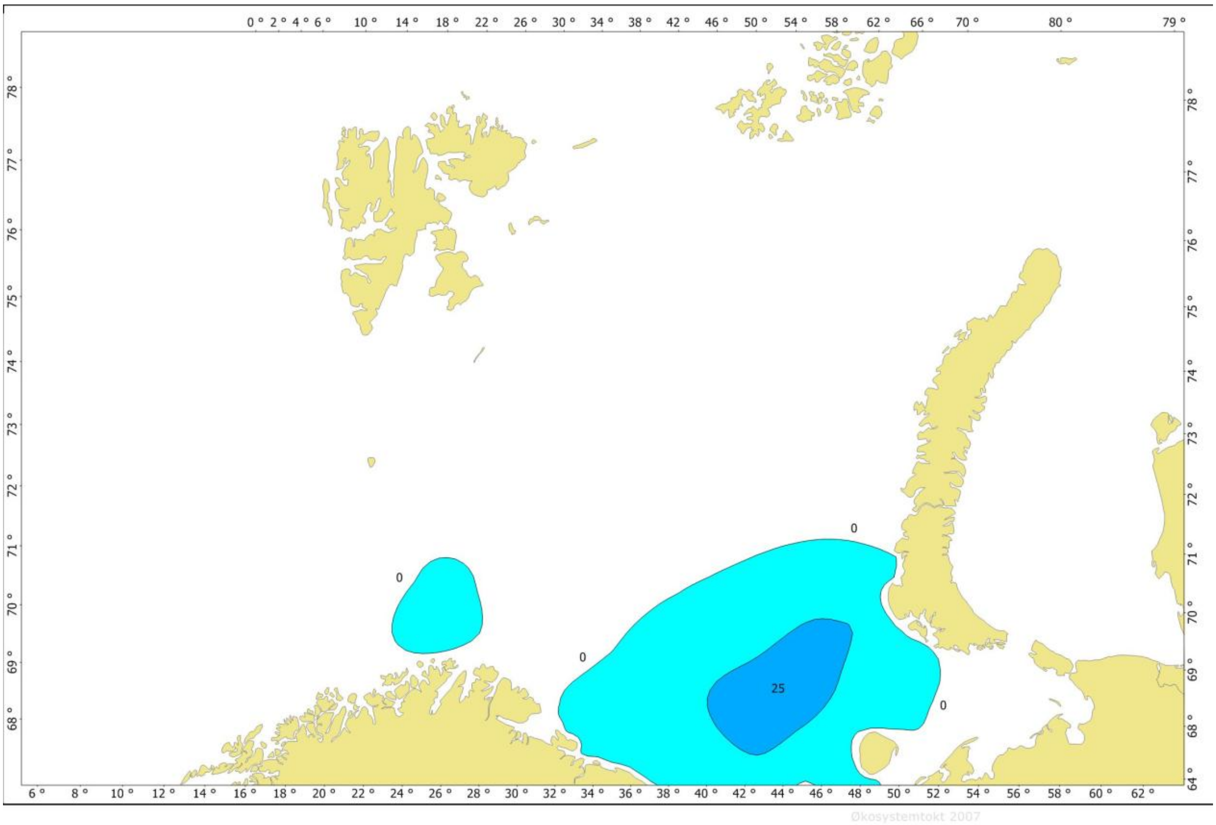

Figure 2.3.8 Estimated total density distribution of herring (t/ nautical mile^2), August-September 2007

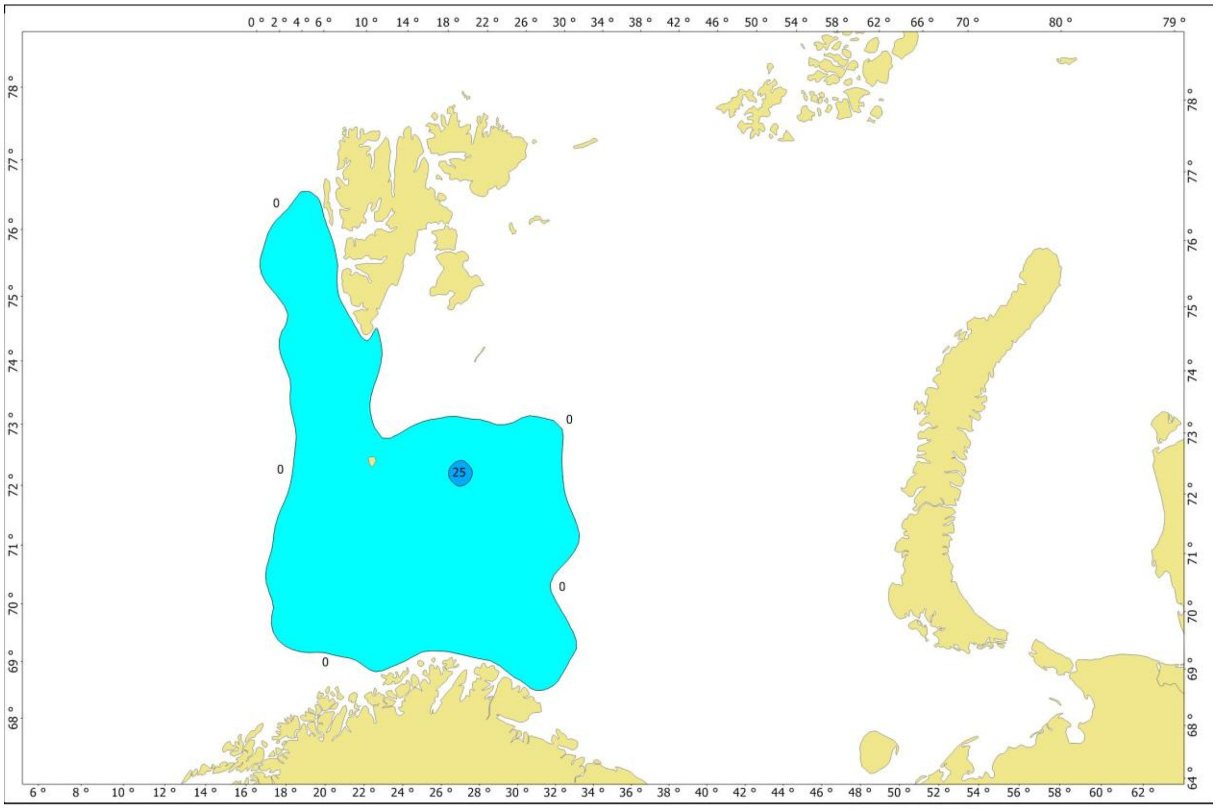

Figure 2.3.9 Estimated total density distribution of blue whiting (t/ nautical mile^2), August-September 2007

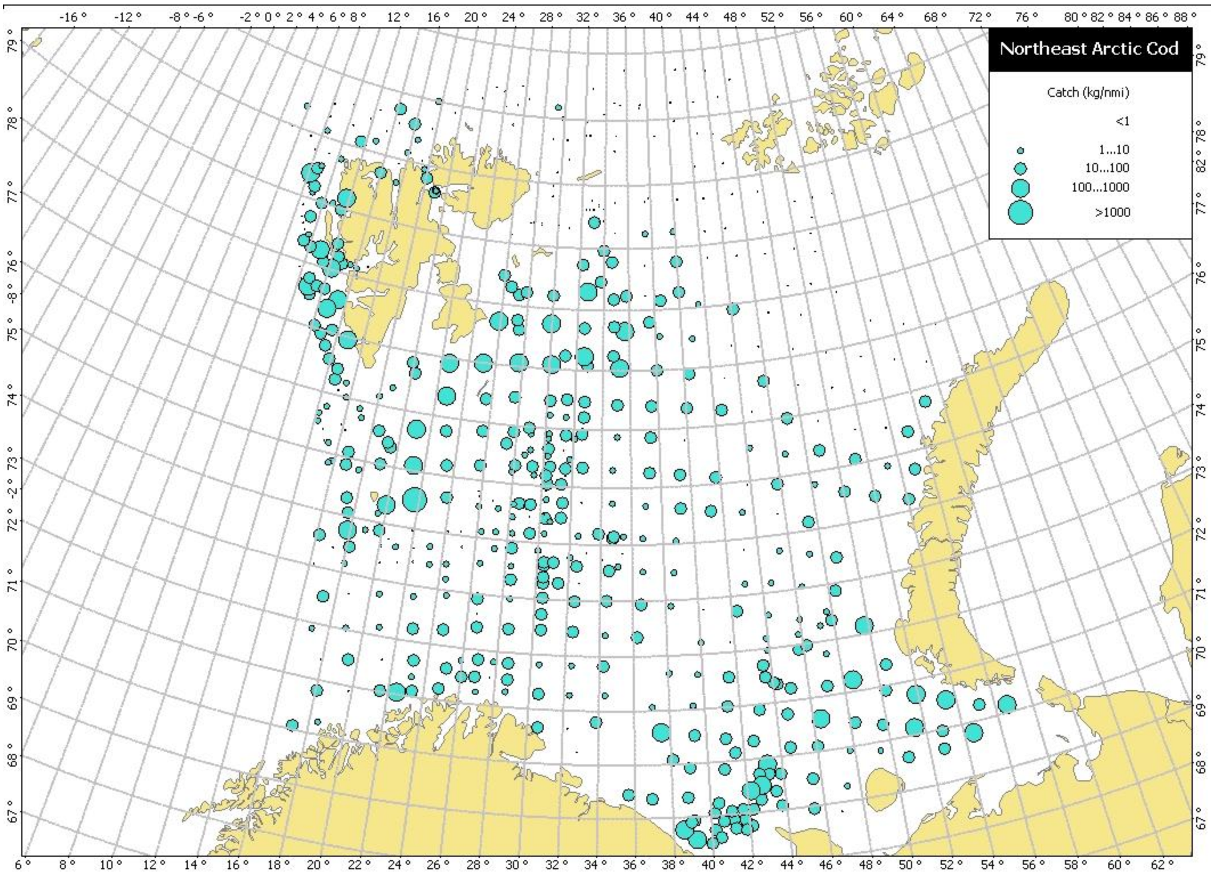

Figure 2.4.1 Distribution of cod, August-September 2007

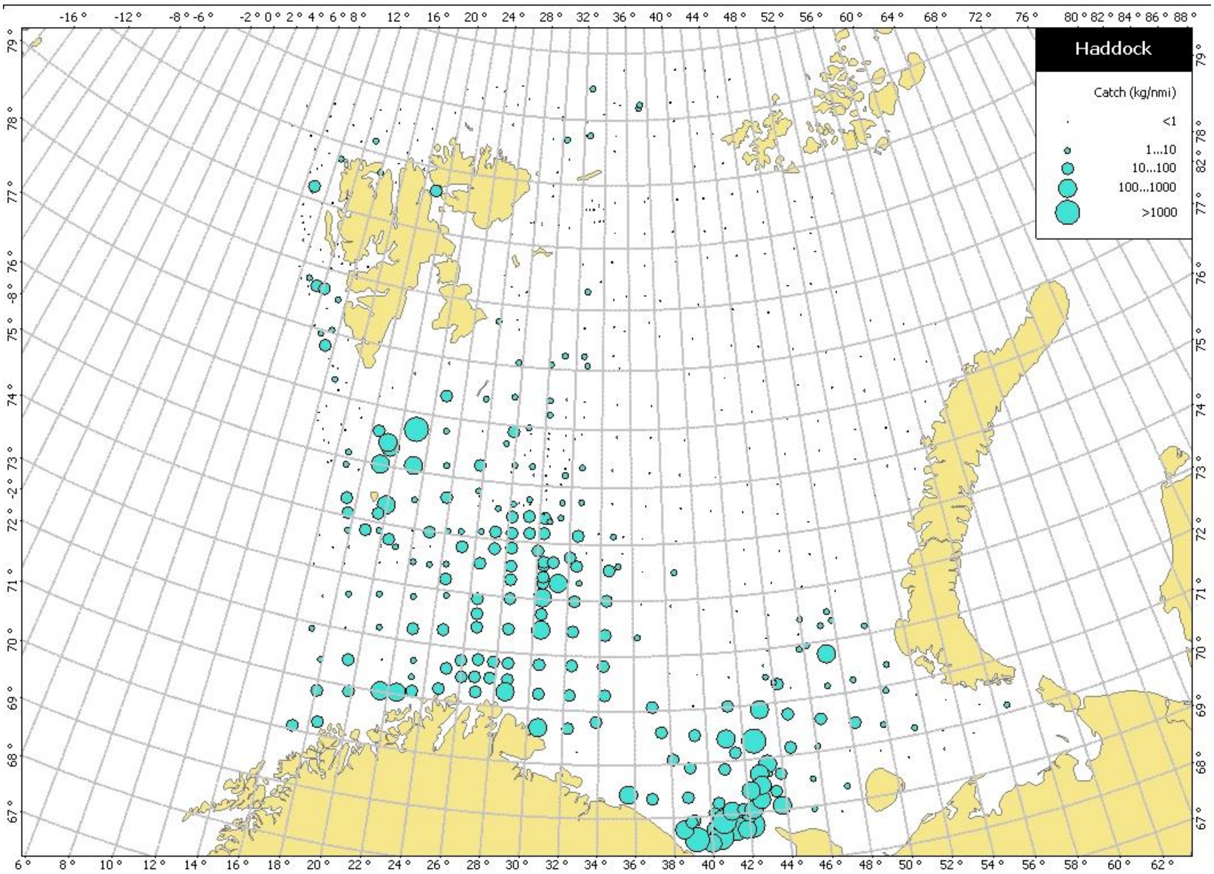

Figure 2.4.2 Distribution of haddock, August-September 2007

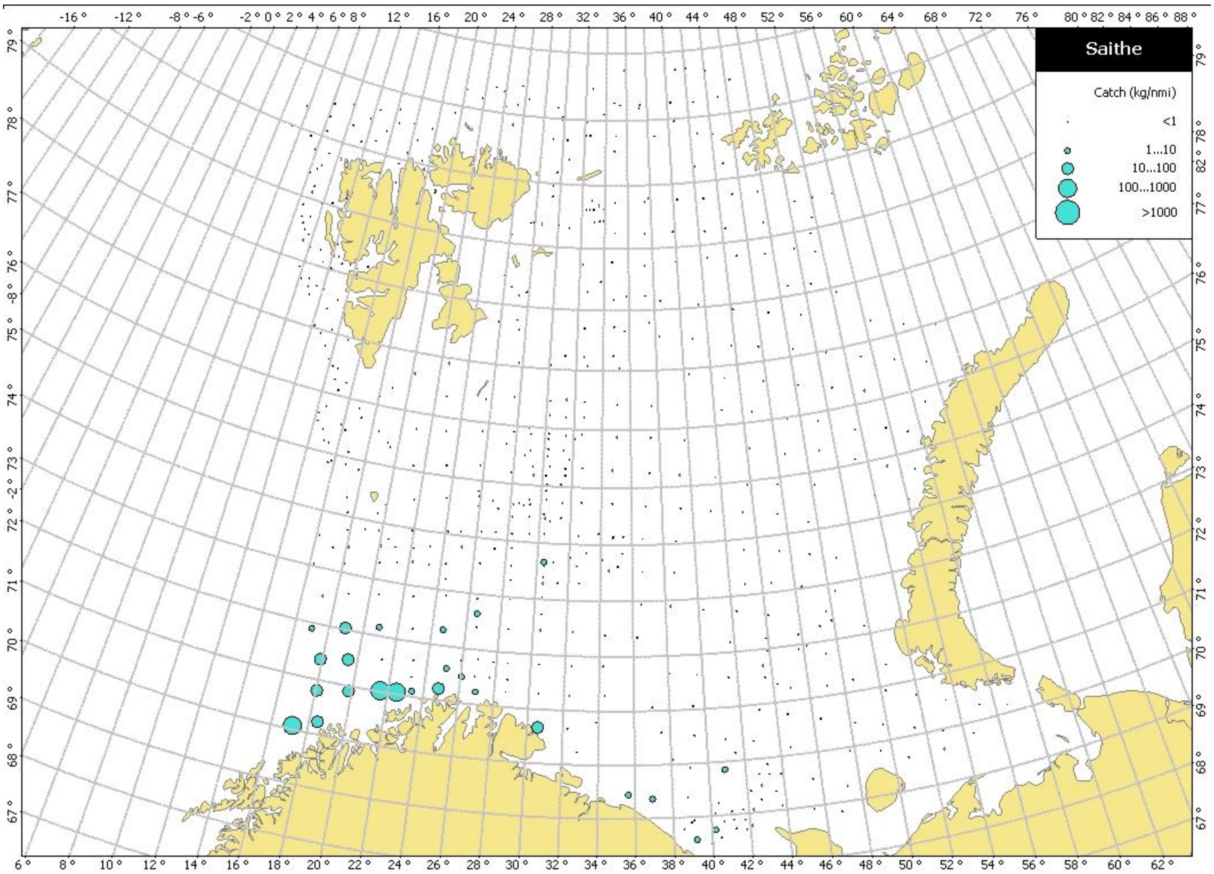

Figure 2.4.3 Distribution of saithe, August-September 2007

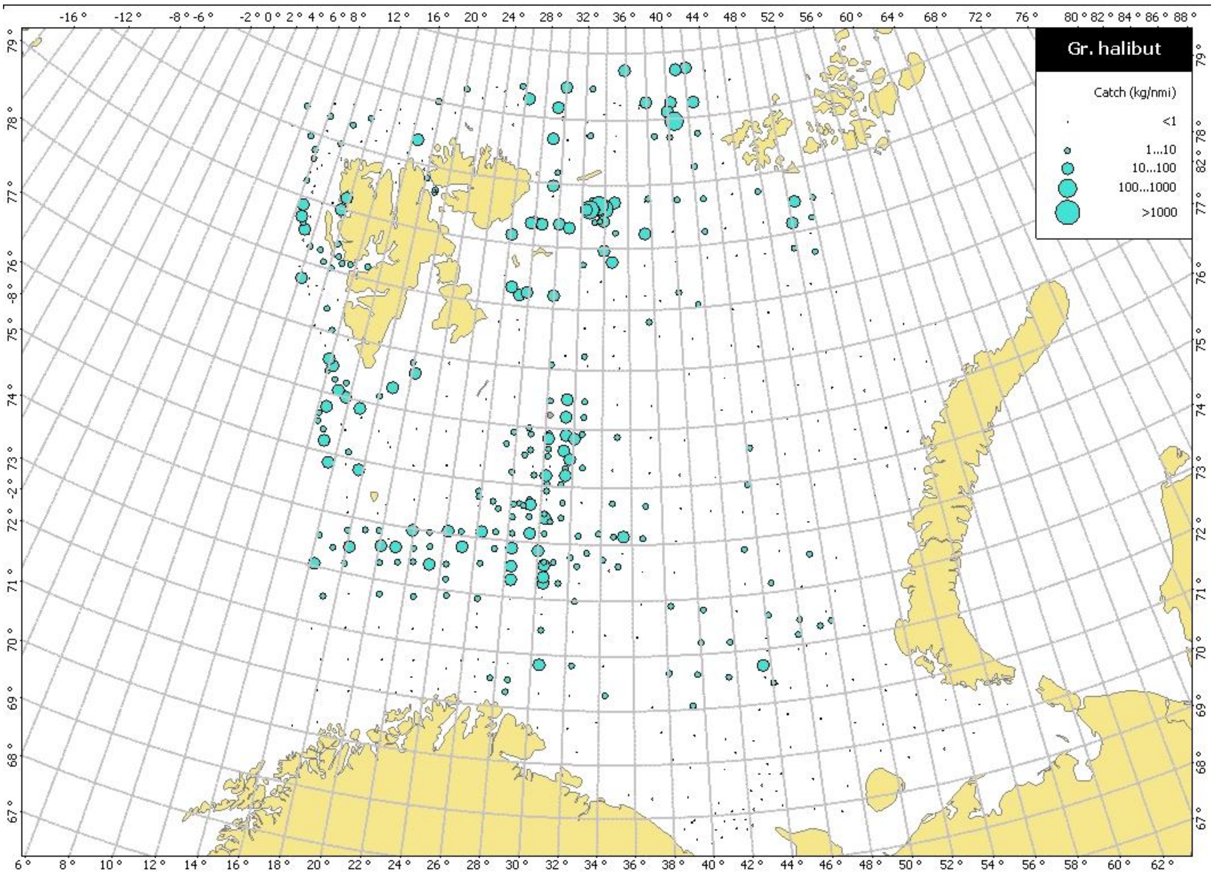

Figure 2.4.4 Distribution of Greenland halibut (WCPUE, based on weight of fish), August-September 2007

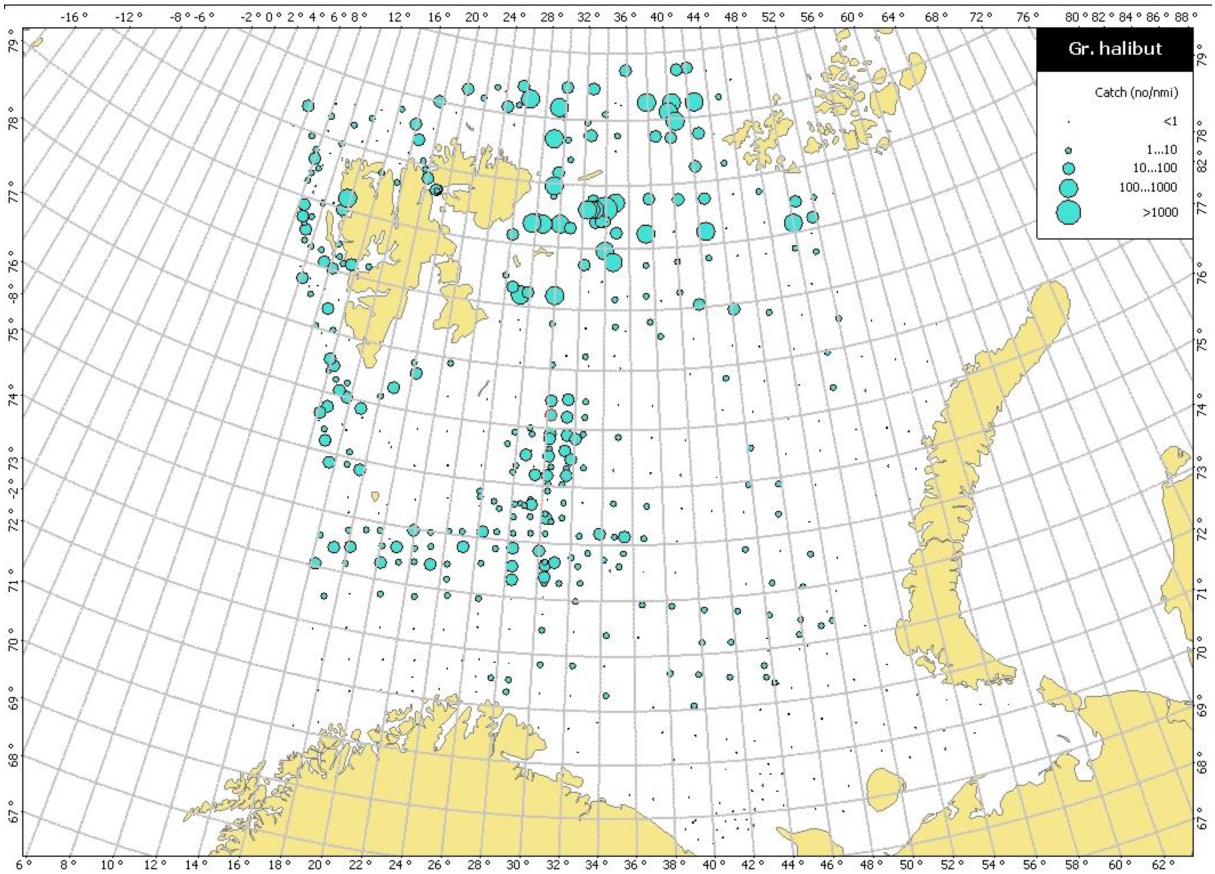

Figure 2.4.5 Distribution of Greenland halibut (NCPUE, based on number of fish), August-September 2007

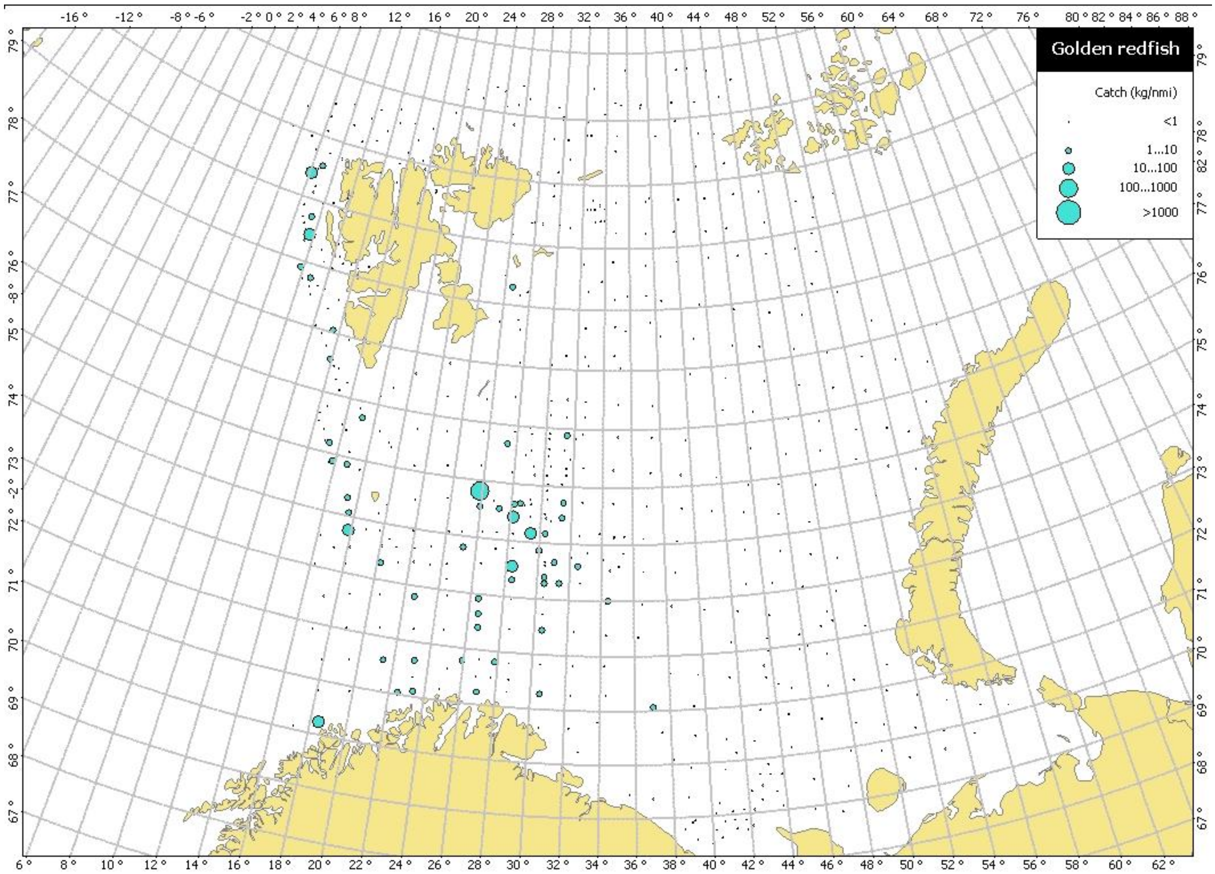

Figure 2.4.6 Distribution of *Sebastes marinus*, August-September 2007

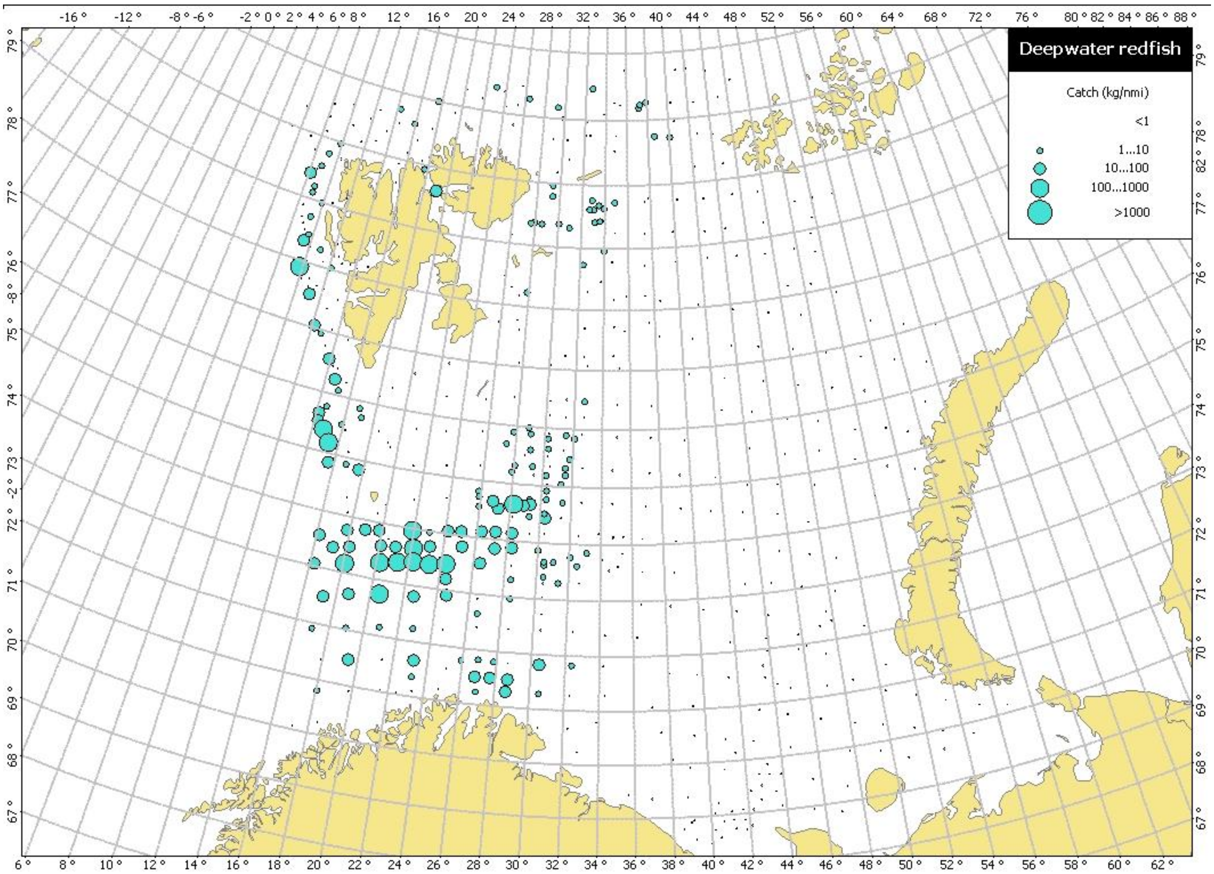

Figure 2.4.7 Distribution of *Sebastes mentella*, August-September 2007

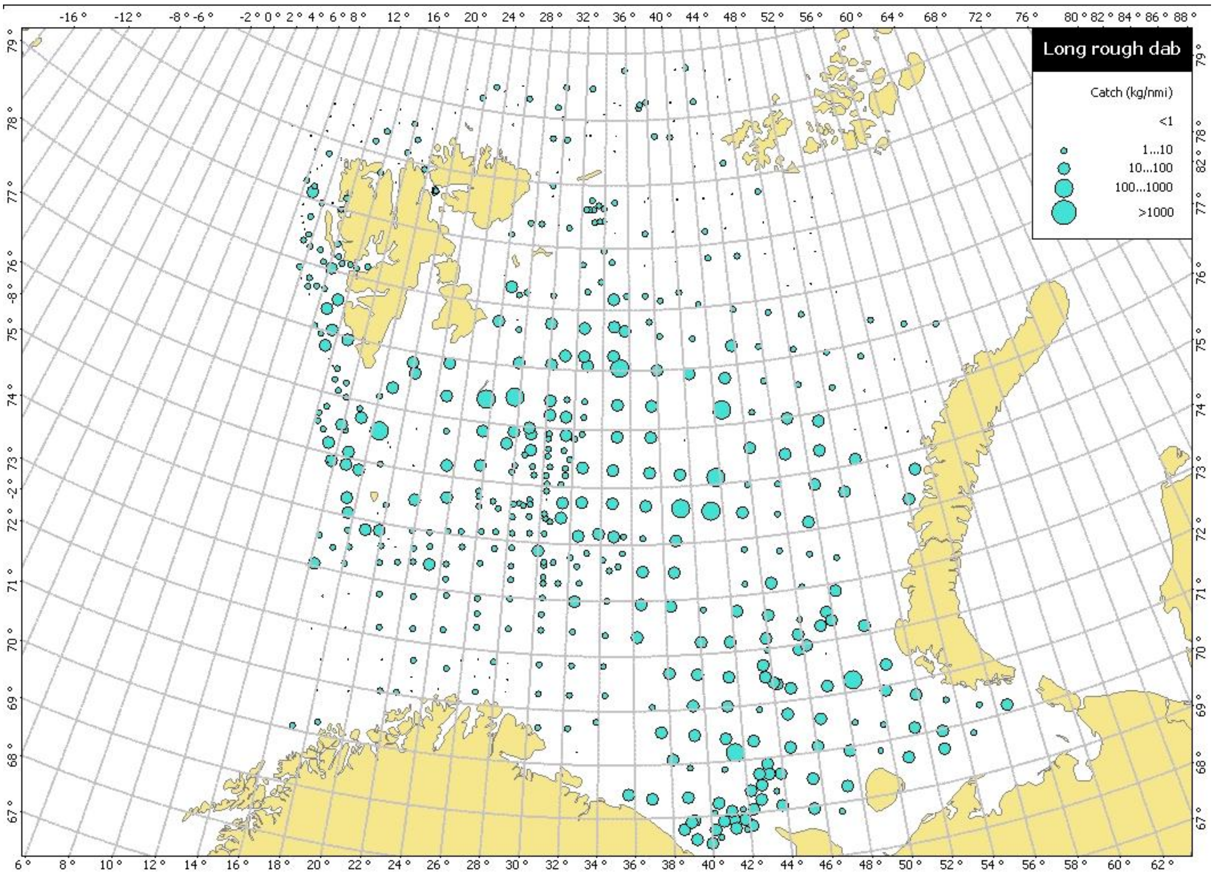

Figure 2.4.8 Distribution of long rough dab, August-September 2007

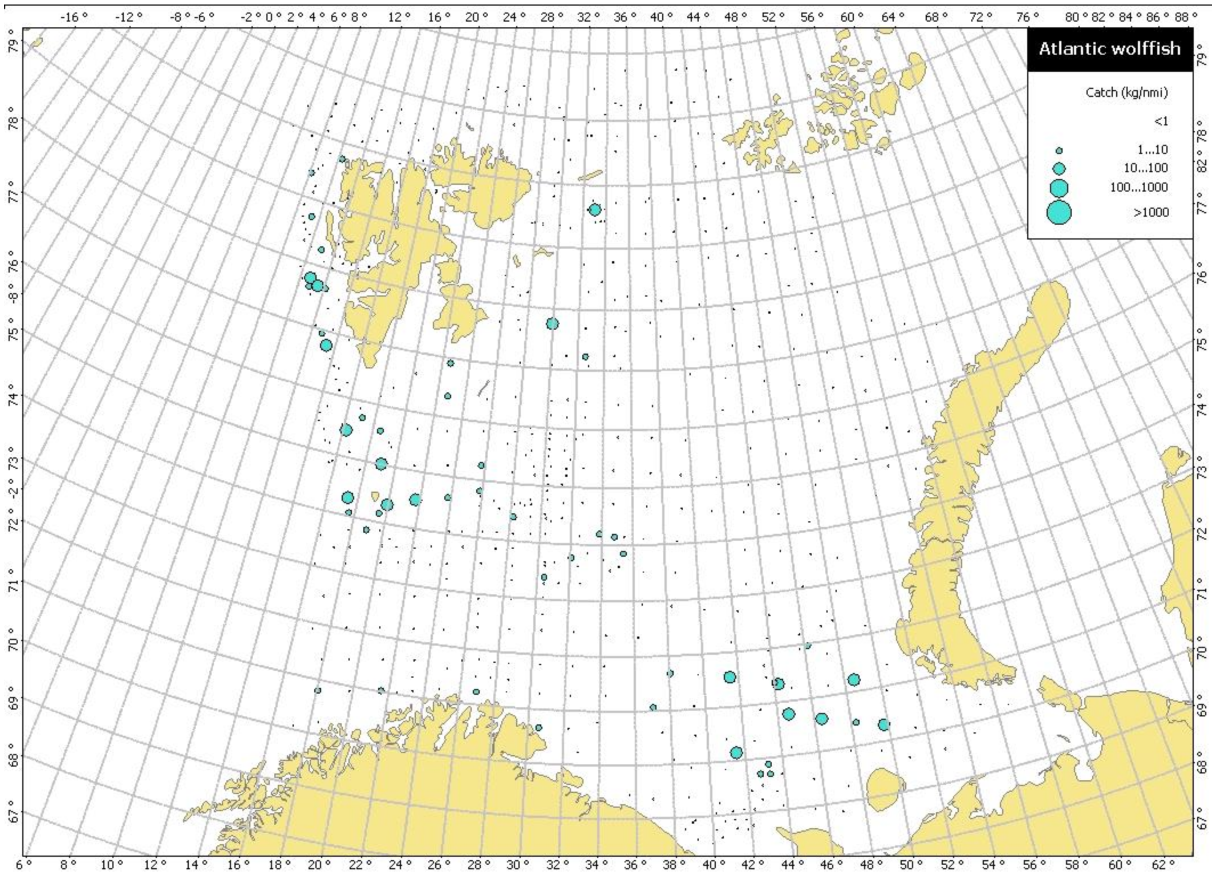

Figure 2.4.9 Distribution of Atlantic wolffish, August-September 2007

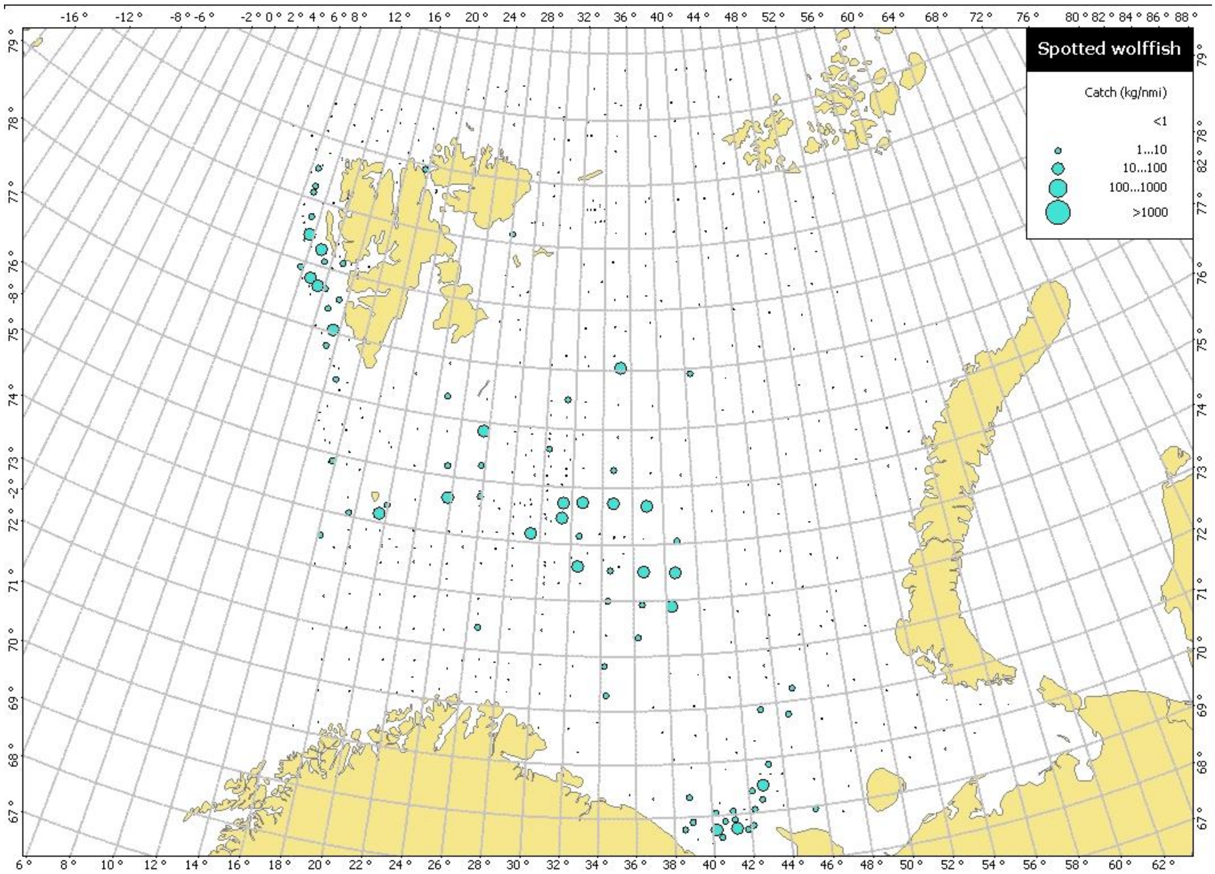

Figure 2.4.10 Distribution of spotted wolffish, August-September 2007

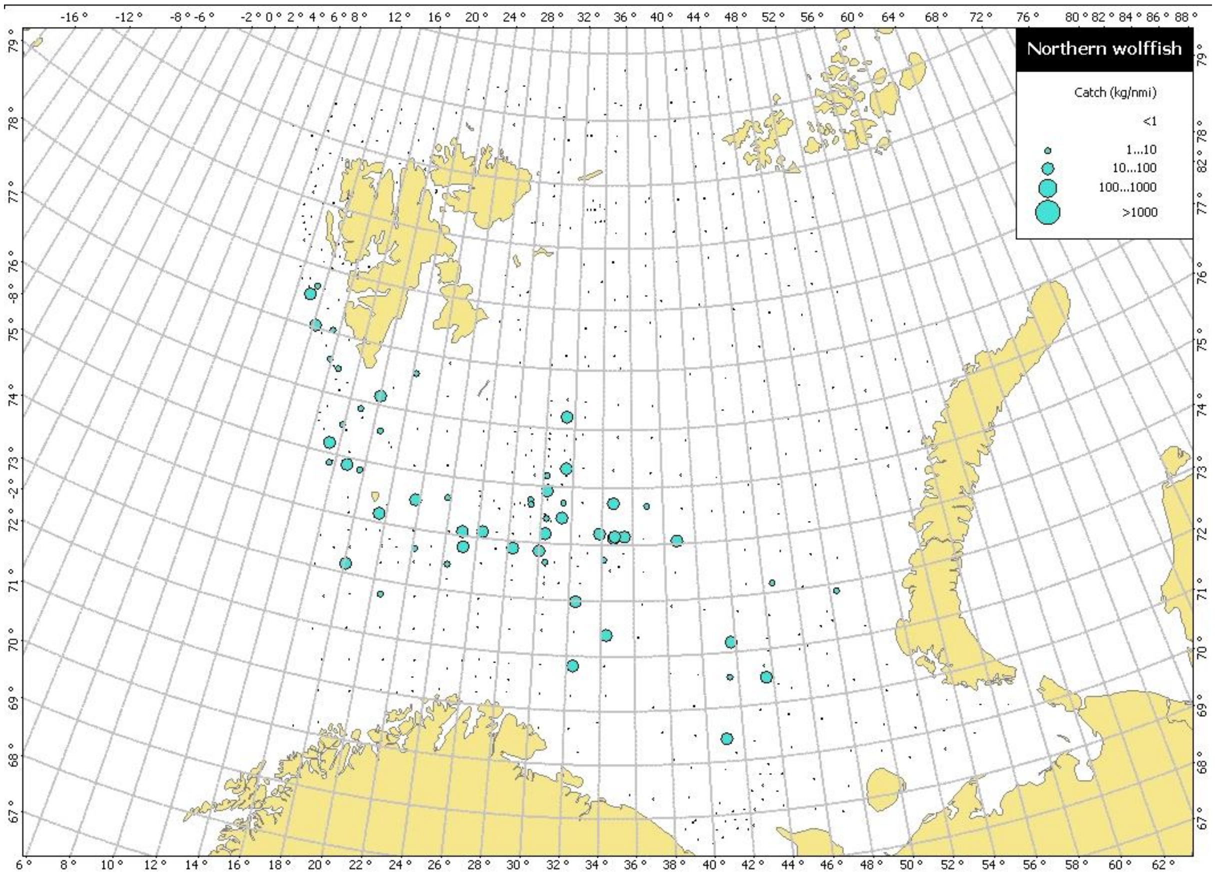

Figure 2.4.11 Distribution of northern wolffish, August-September 2007

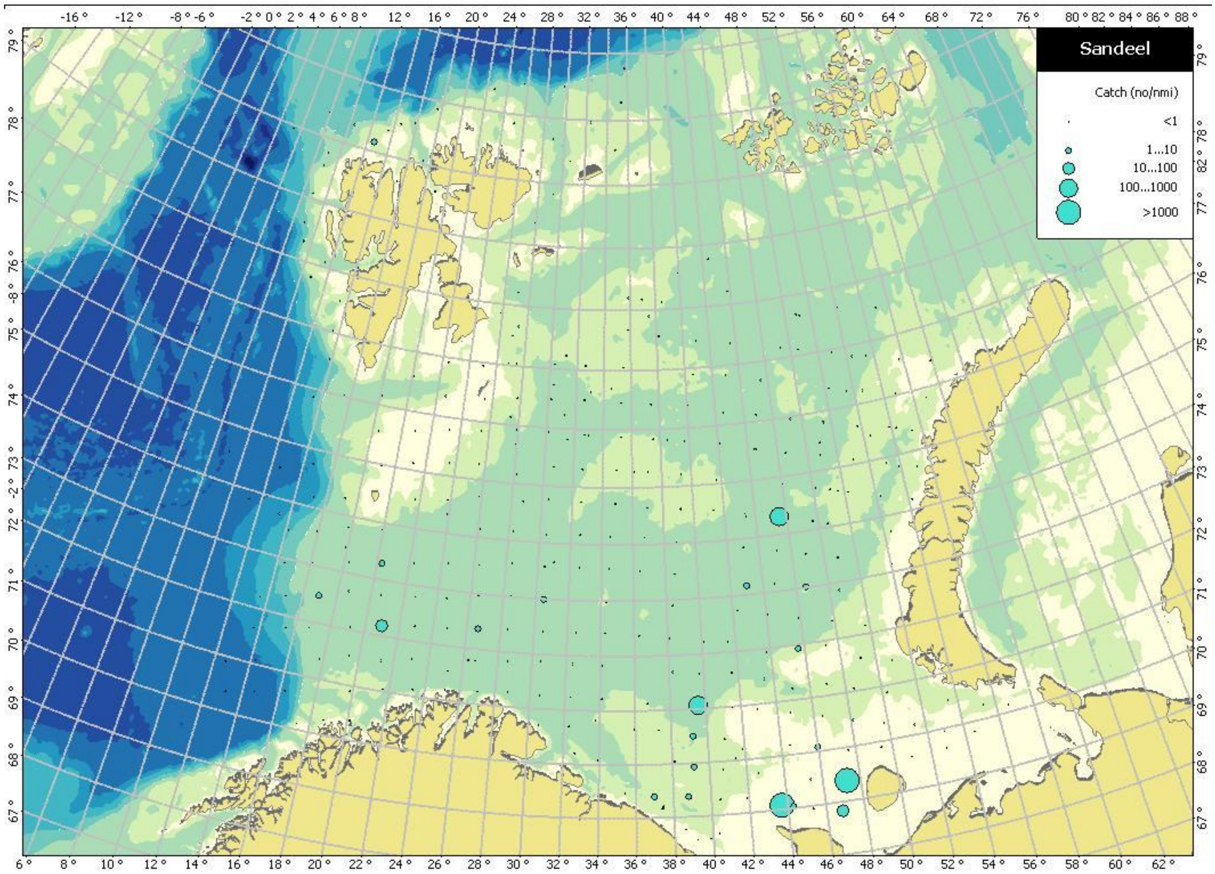

Figure 2.4.12 Distrubution of sandeel, August-September 2007

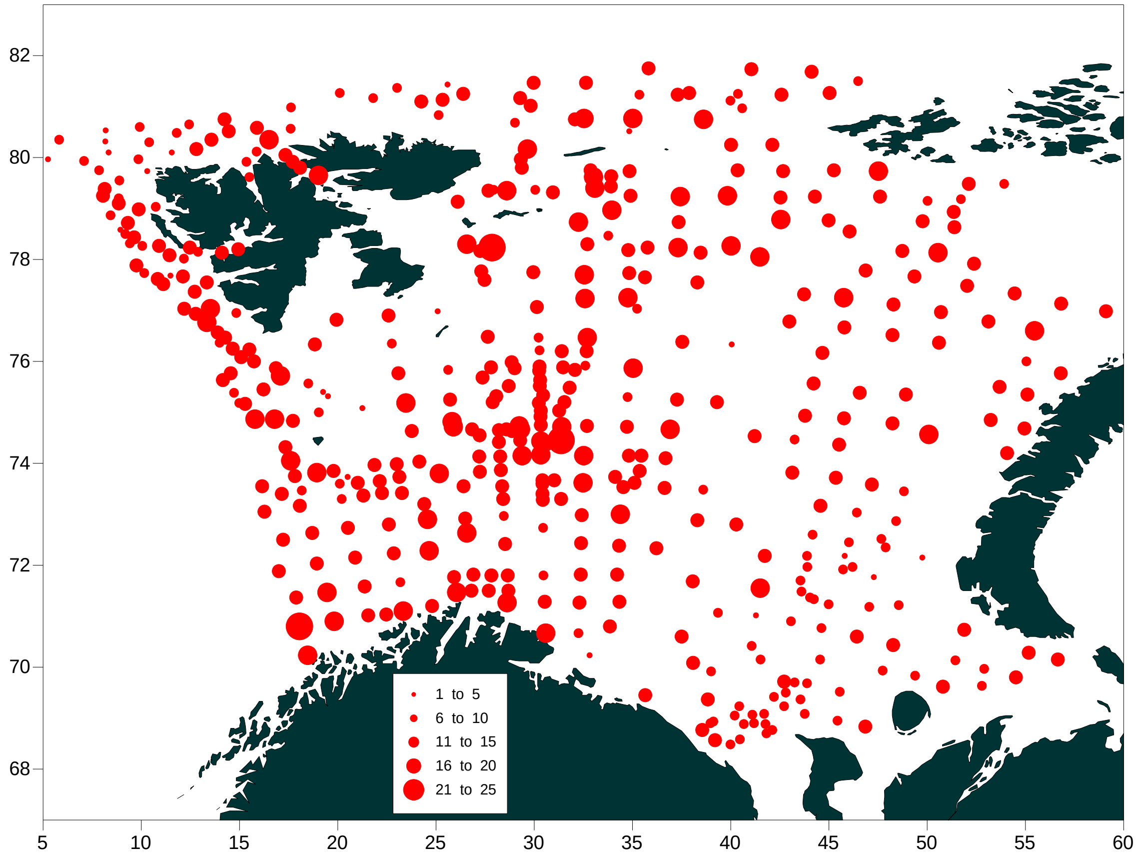

Figure 2.5.1 Total number of fish species per station (bottom trawl)

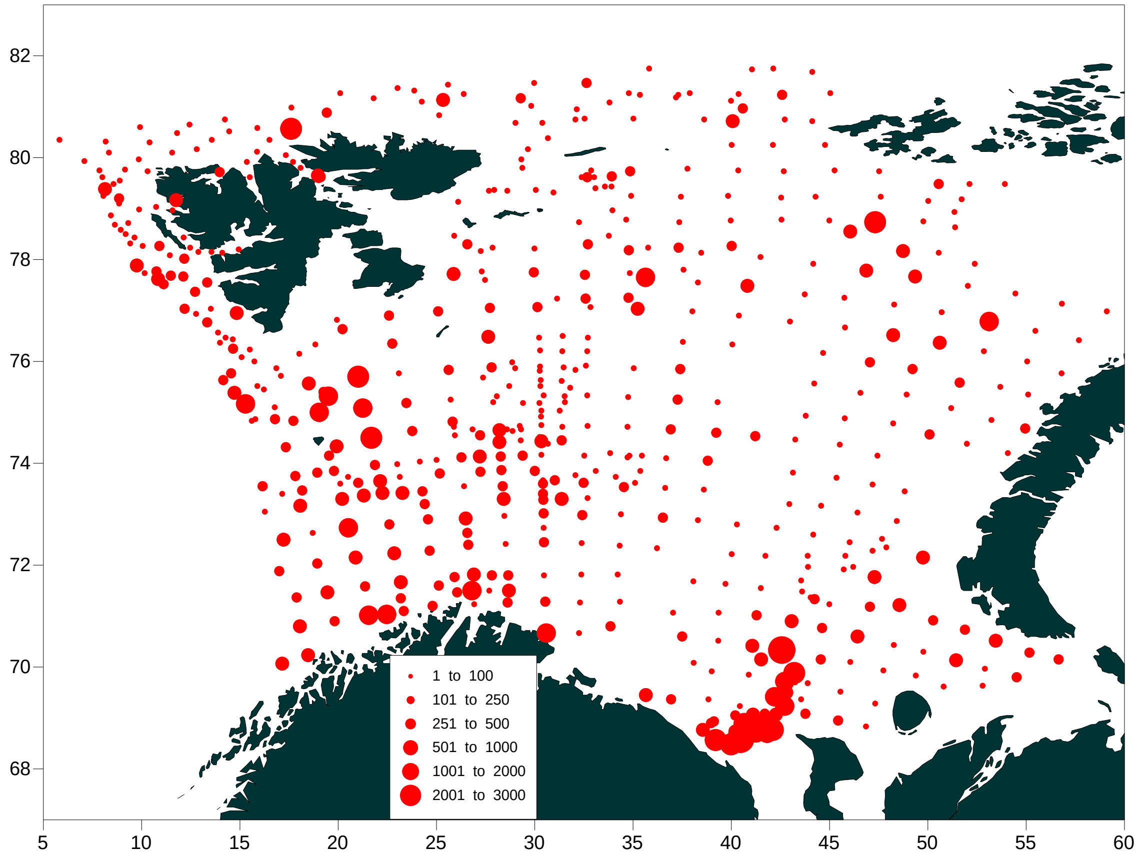

Figure 2.5.2 Total fish biomass per station (all species combined) in kg per nautical mile towed

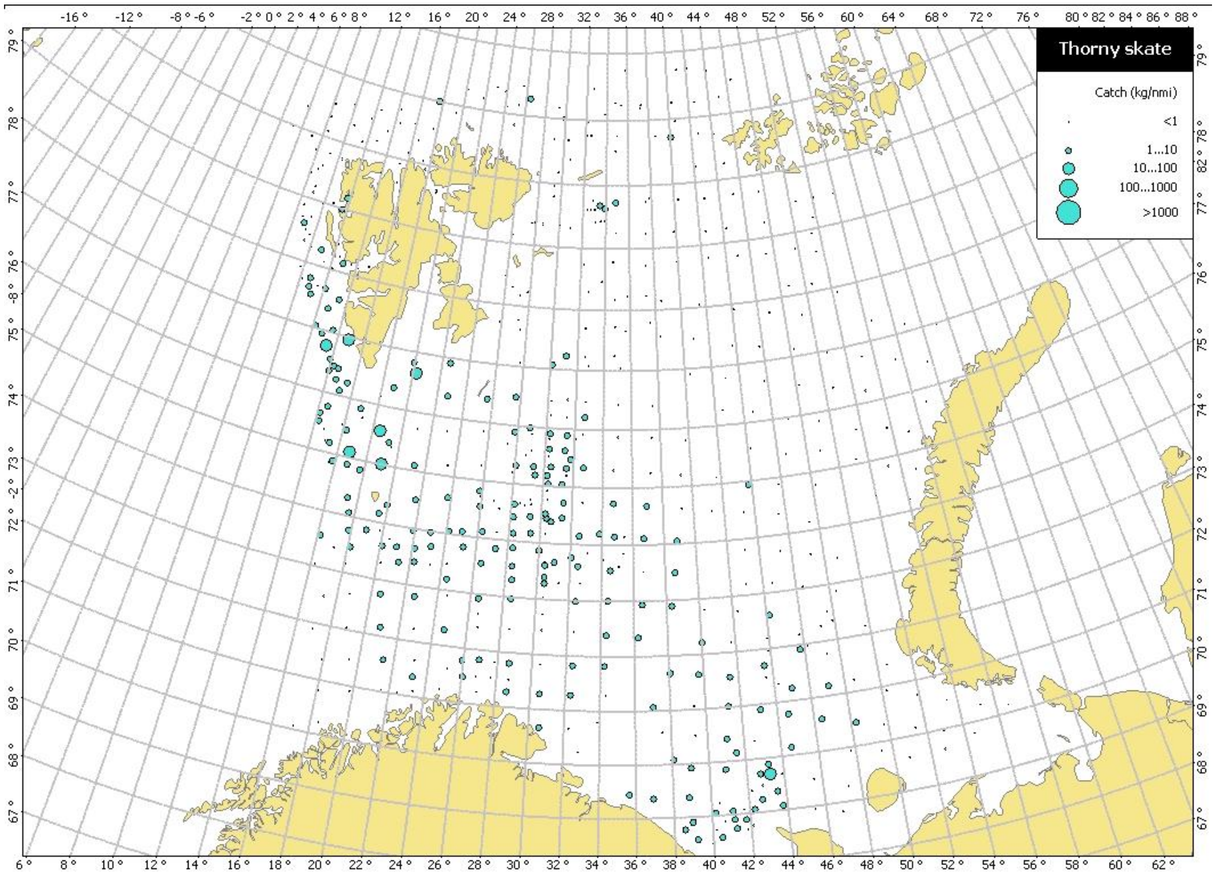

Figure 2.5.3 Distribution of thorny skate, August-September 2007

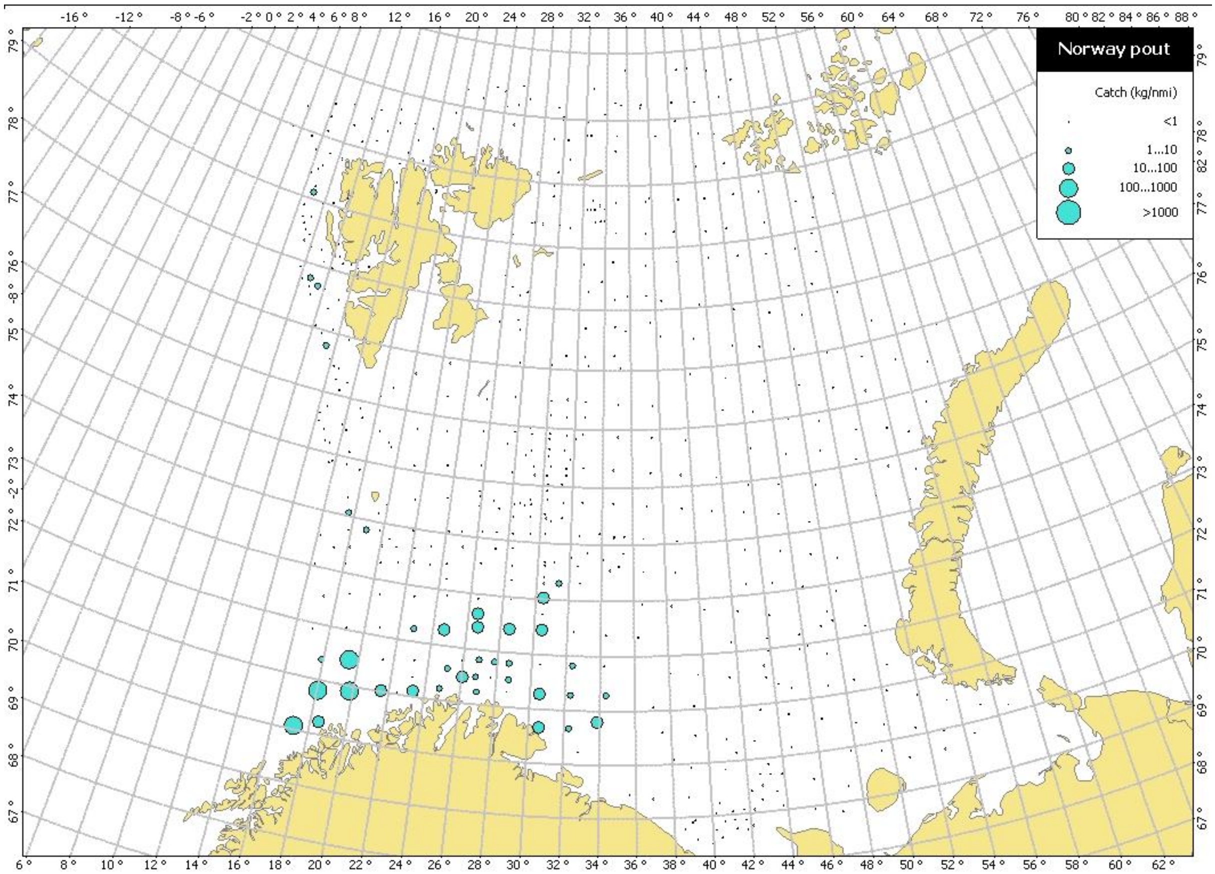

Figure 2.5.4 Distribution of Norway pout, August-September 2007

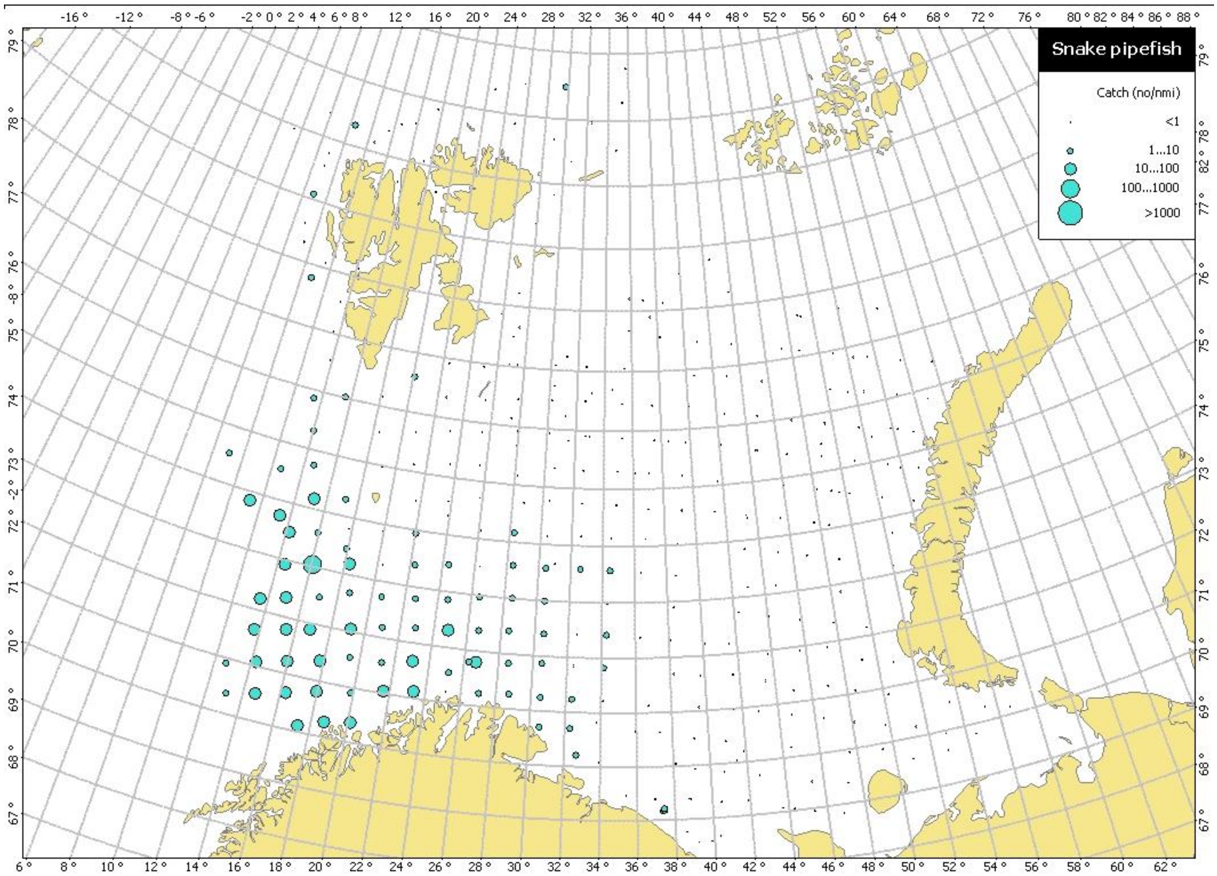

Figure 2.5.5 Distribution of snake pipefish (*Entelurus aequoreus*), August-September 2007

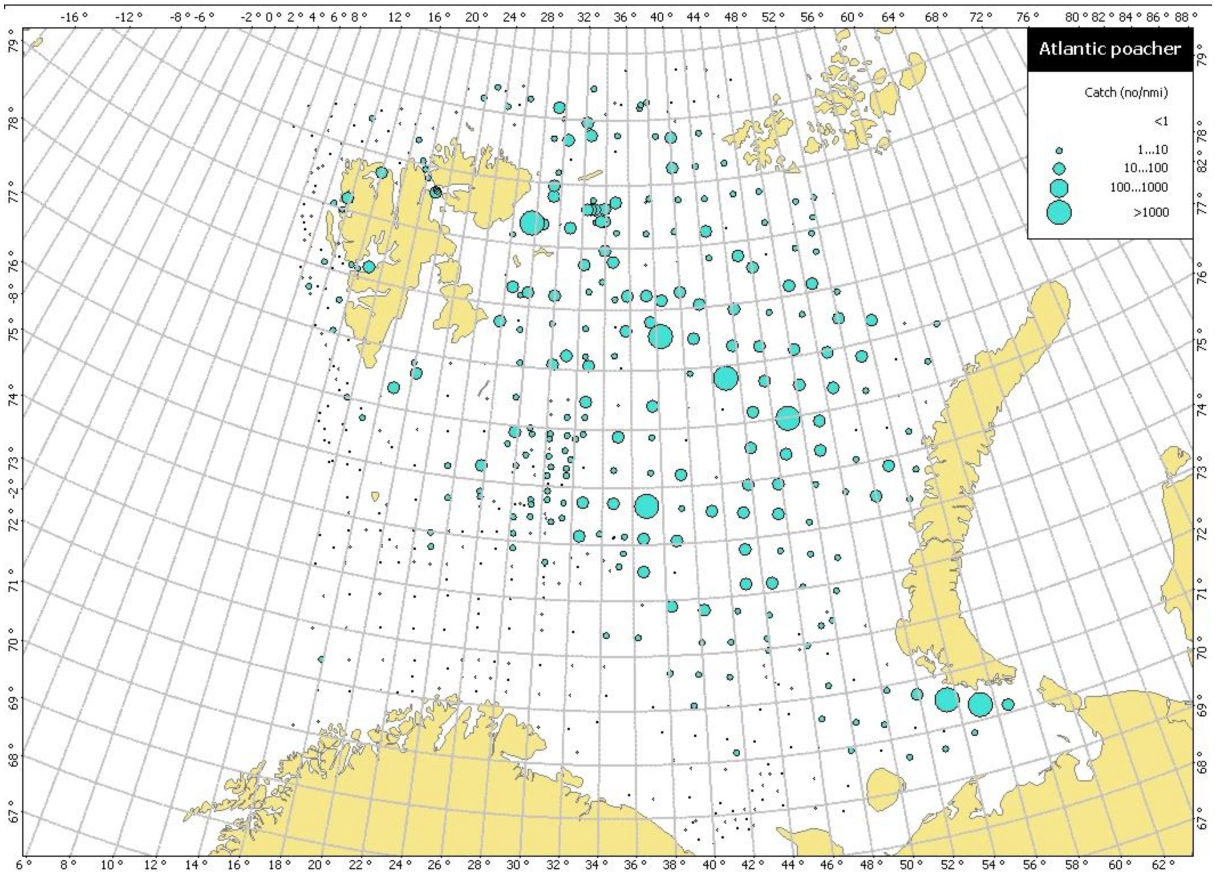

Figure 2.5.6 Distrubution of Atlantic poacher, August-September 2007

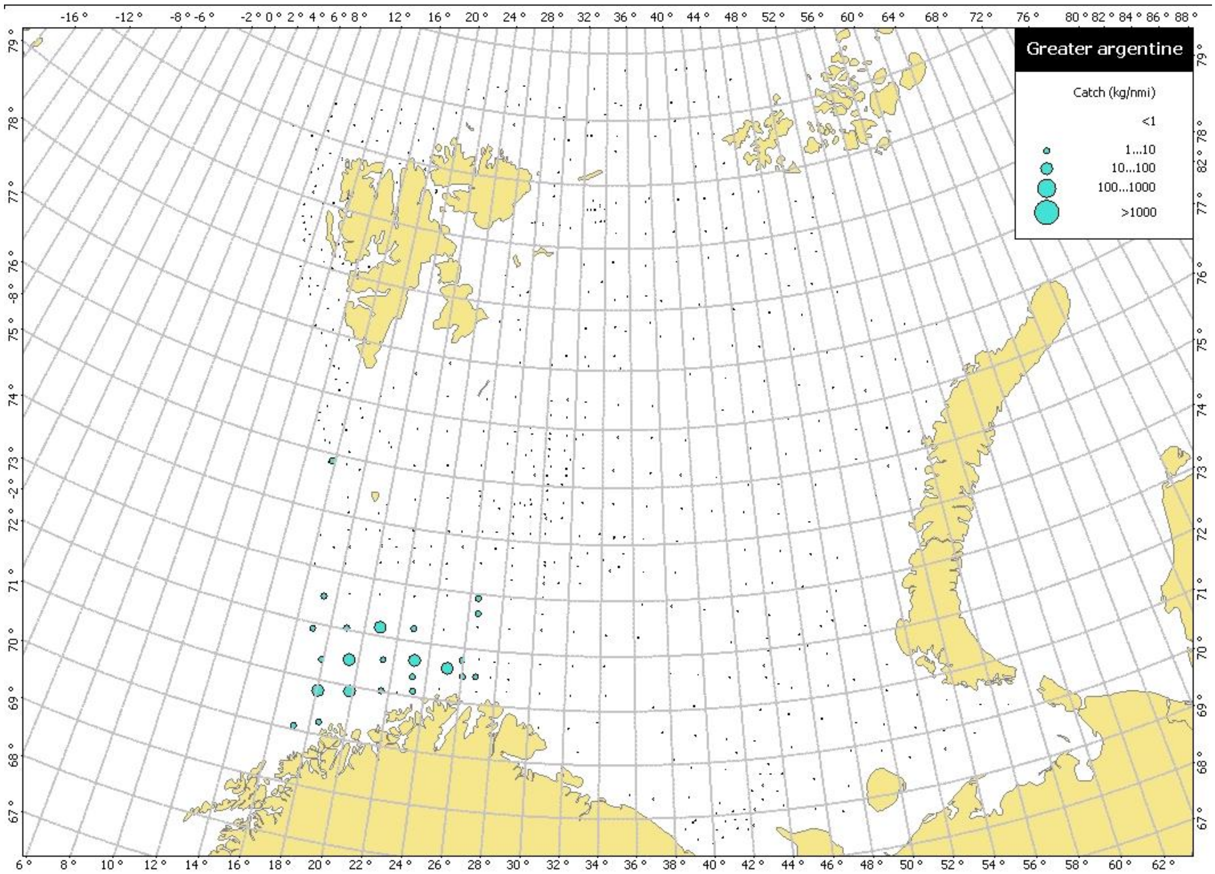

Figure 2.5.7 Distrubution of greater argentine, August-September 2007

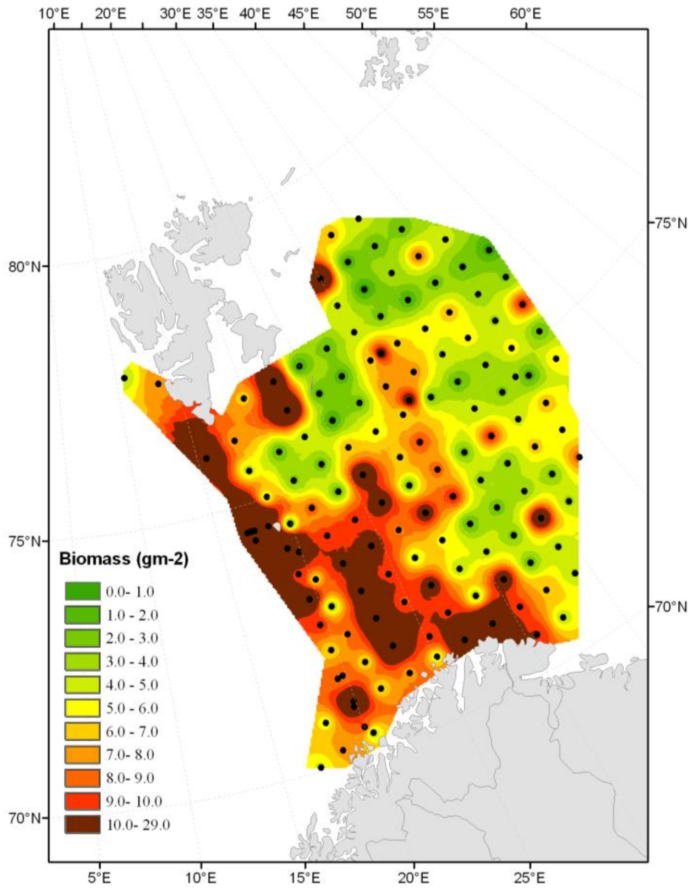

Figure 2.7.1 Zooplankton biomass during the Barents Sea Ecosystem cruise in August-September 2007 from WP2 net samples as monitored from Norwegian vessels only

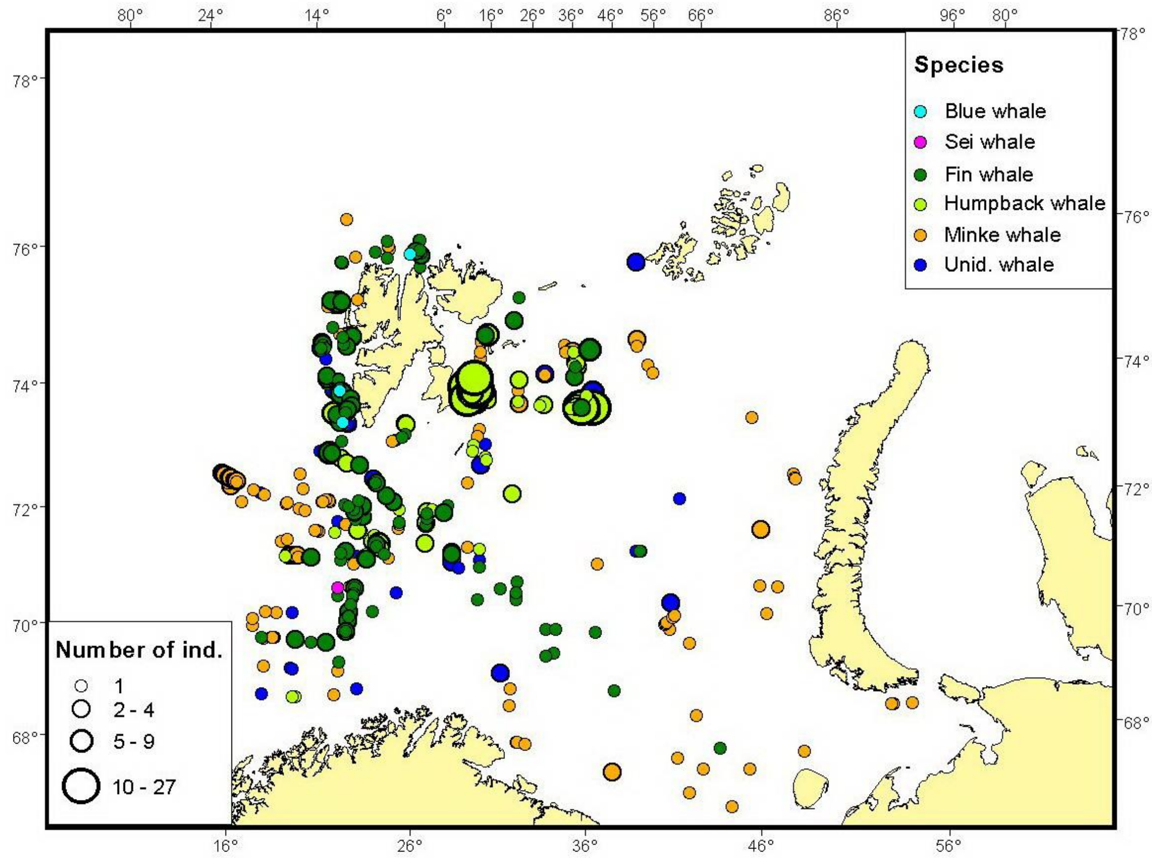

Figure 2.8.1 Distribution of baleen whales observed in August-September 2007

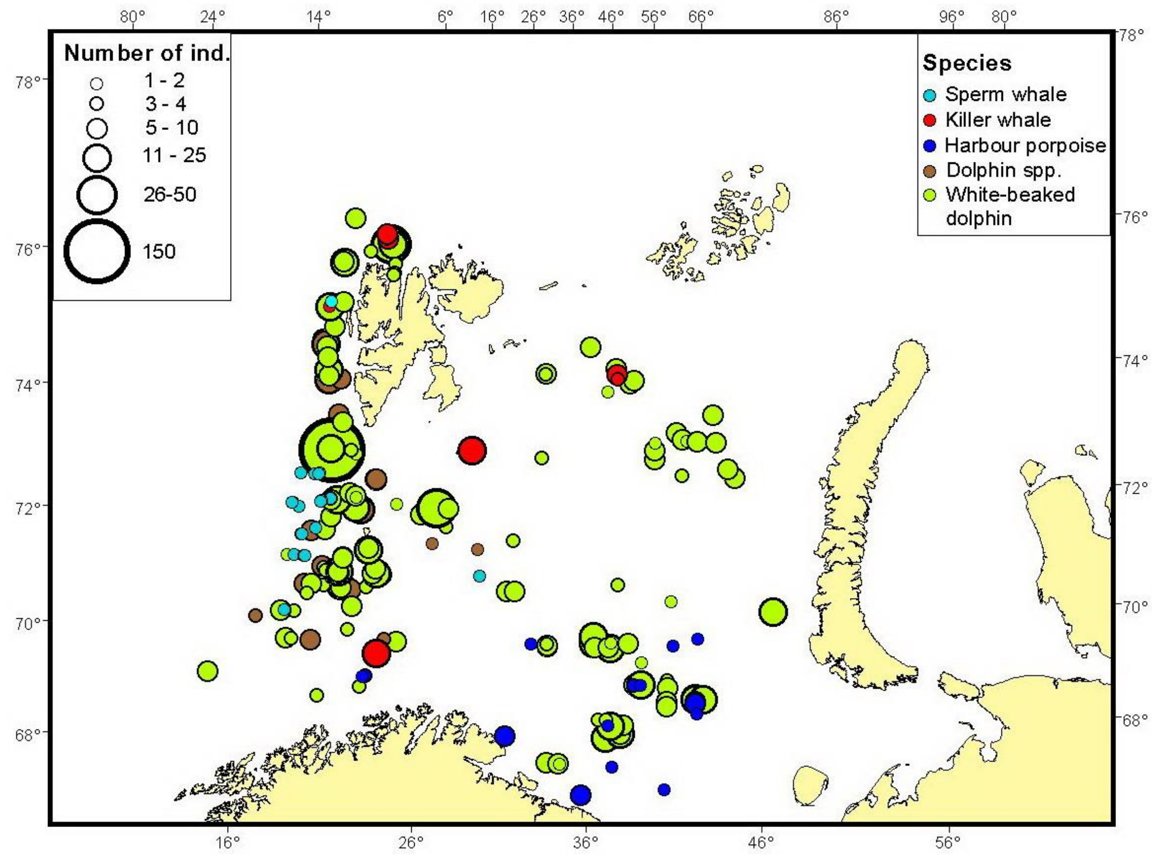

Figure 2.8.2 Distribution of toothed whales observed in August-September 2007

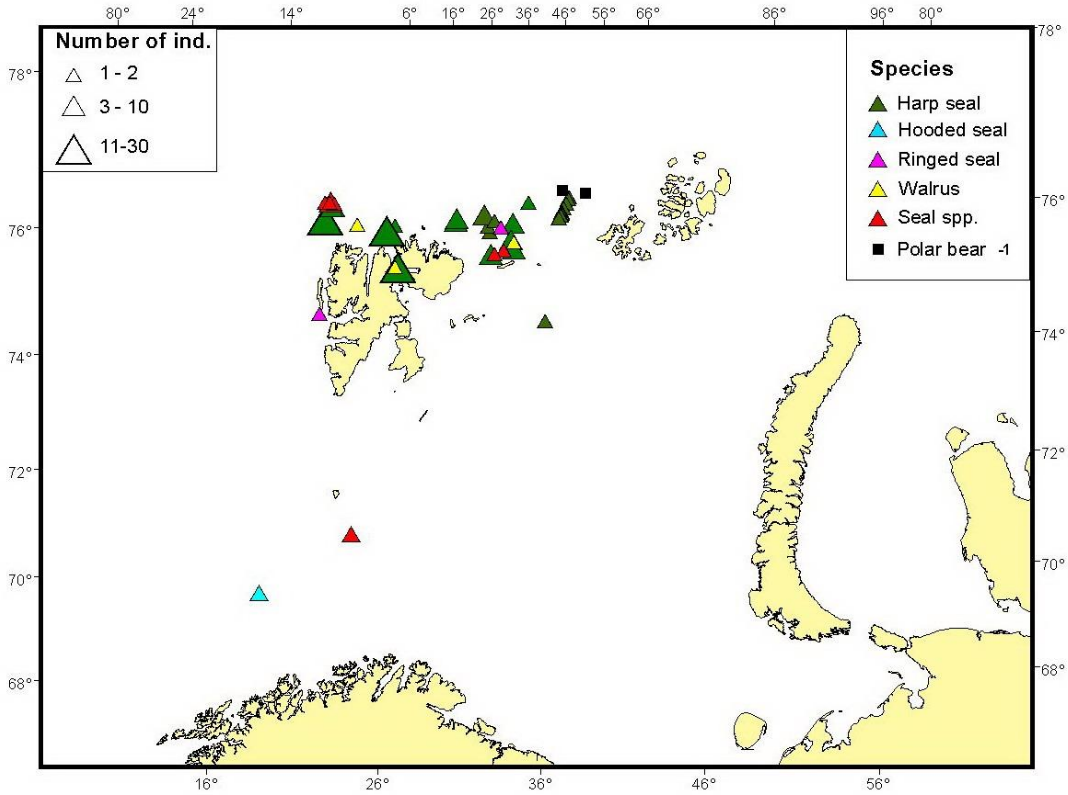

Figure 2.8.3 Distribution of seals observed in August-September 2007

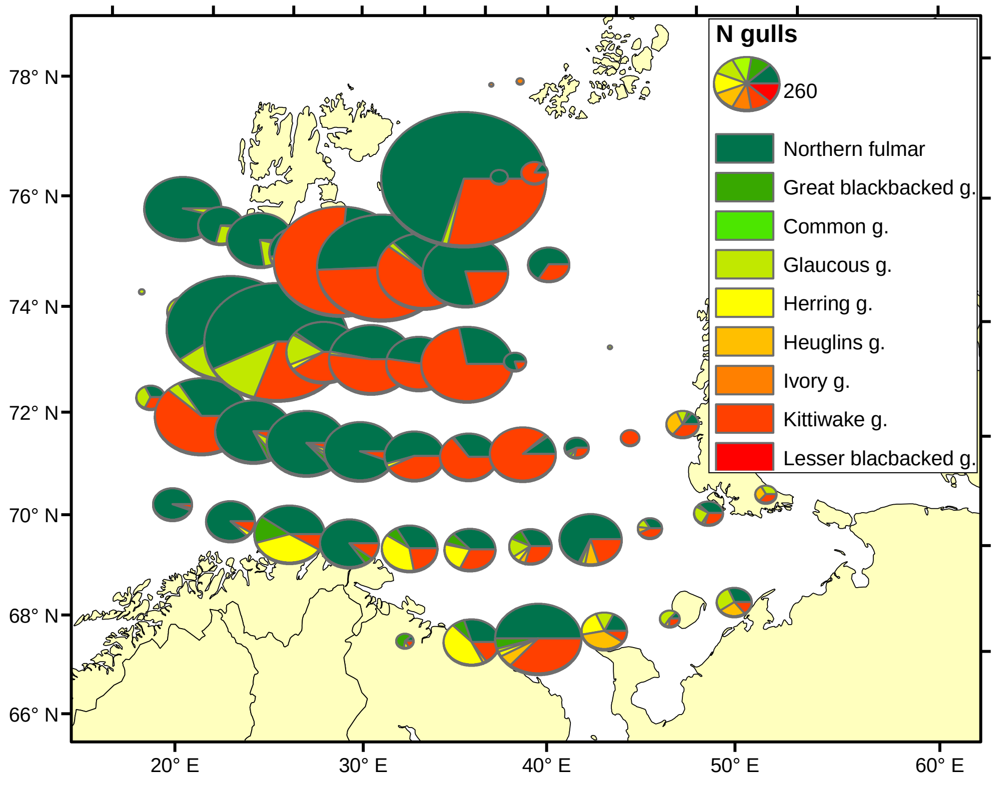

Figure 2.8.4 Distribution of northern fulmars and 7 gull species observed in August-September 2007 in the Barents Sea by observers on board the research vessels "Smolensk", "Vilnyus", "Johan Hjort" and "G.O. Sars". Pie size reflects total number of birds observed, and colours reflect the different species observed, as shown in the figure legend

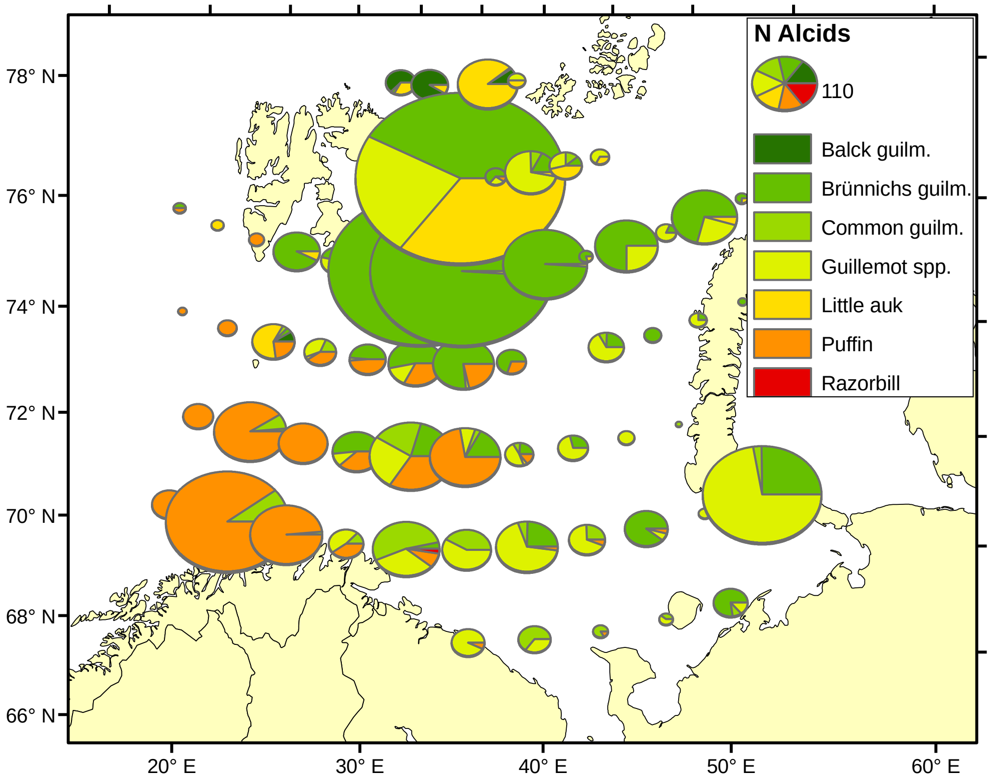

Figure 2.8.5 Distribution of the 6 species of alcids and non-specified guillemots (guillemot spp.) observed in August-September 2007 in the Barents Sea by observers on board the research vessels "Smolensk", "Vilnyus", "Johan Hjort" and "G.O. Sars". Pie size reflects total number of birds observed, and colours reflect the different species observed, as shown in the figure legend

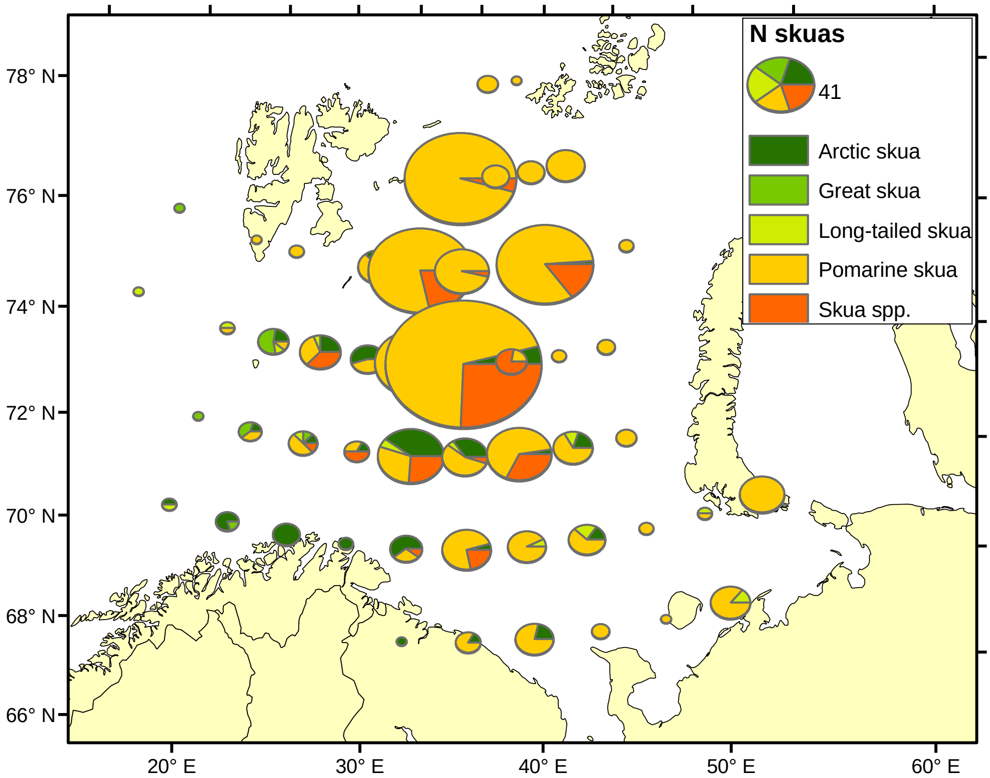

Figure 2.8.6 Distribution of the 4 species of skuas and non-specified skuas (skua spp.) observed in August-September 2007 in the Barents Sea by observers on board the research vessels "Smolensk", "Vilnyus", "Johan Hjort" and "G.O. Sars". Pie size reflects total number of birds observed, and colours reflect the different species observed, as shown in the figure legend

Figure 2.8.7 Photograph of Blackbrowed albatross (right) observed together with northern fulmars (left) in south-eastern Barents Sea August 29, 2007, at position 70°56'N and 50°17'E. Photograph is taken by Roman Klepikovskiy

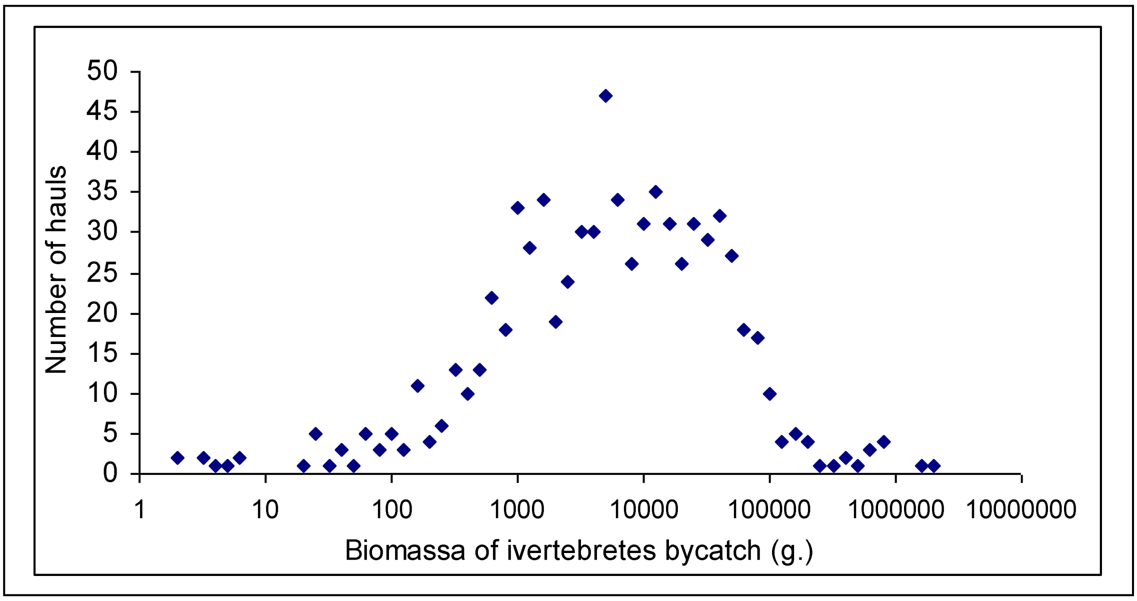

Figure 2.9.1 Number of trawl hauls (Campelen bottom trawl) of a specific catch weight of invertebrates (g) taken by in August September 2007

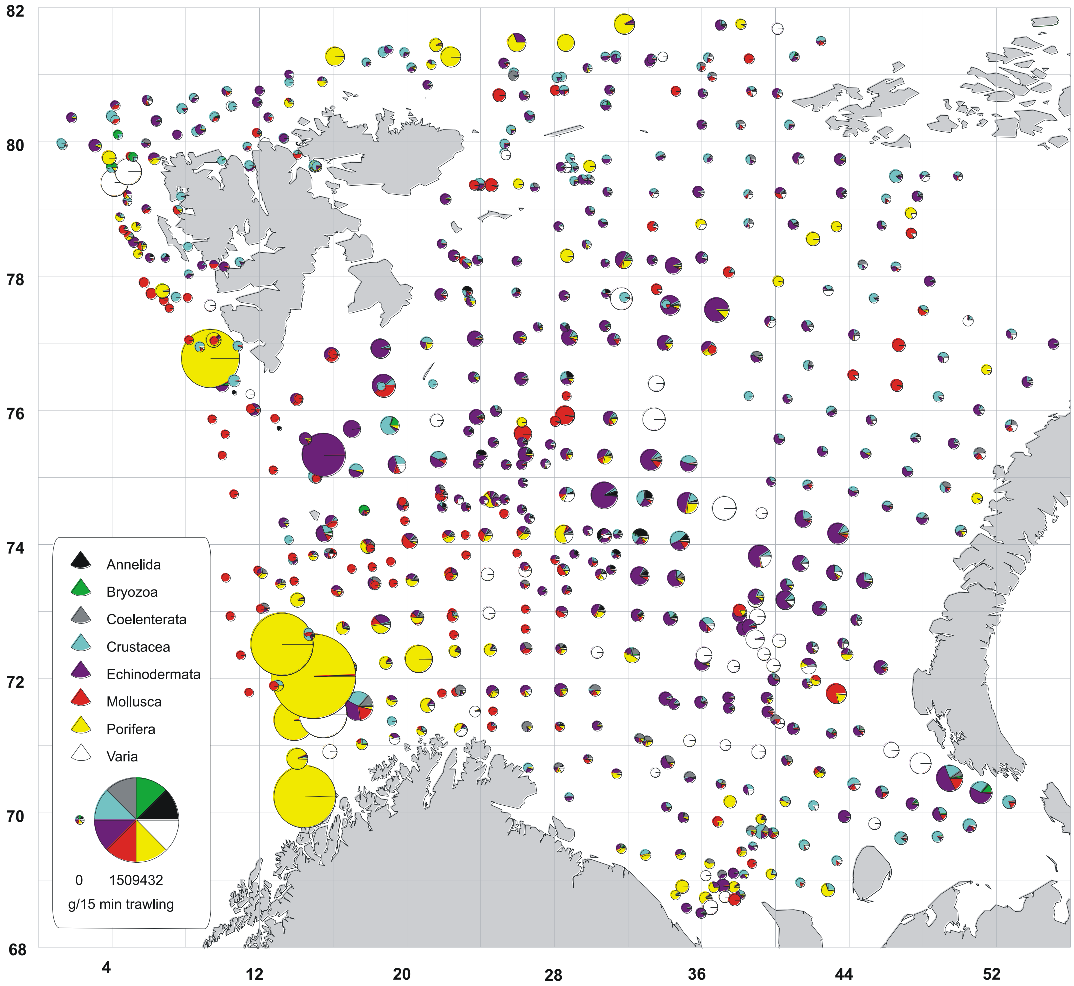

Figure 2.9.2 The benthos bycatch biomass distribution in the Barents Sea in August-September 2007

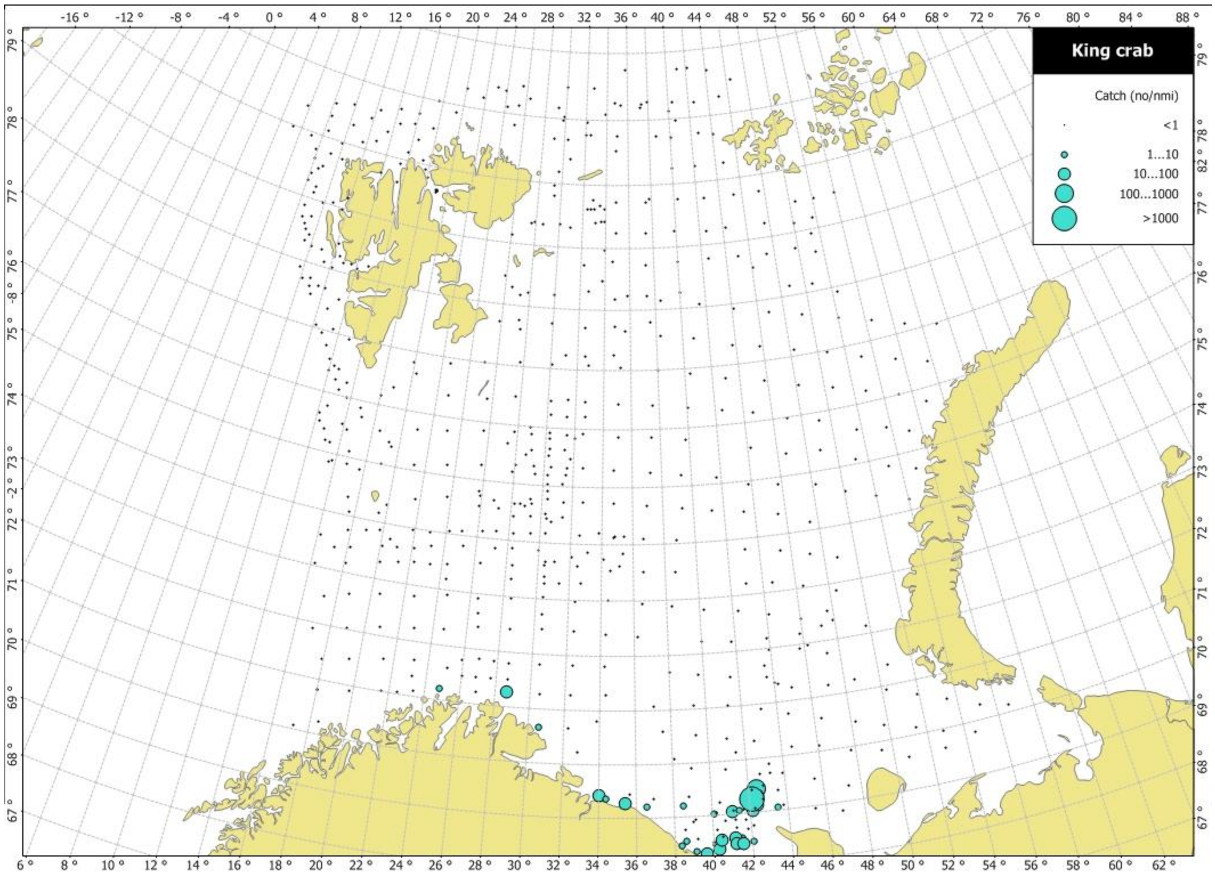

Figure 2.9.3 Distribution of king crab (*Paralithodes camtschaticus*) in Campelen bottom trawl. Standardized to kg/hour of trawling, August-September 2007

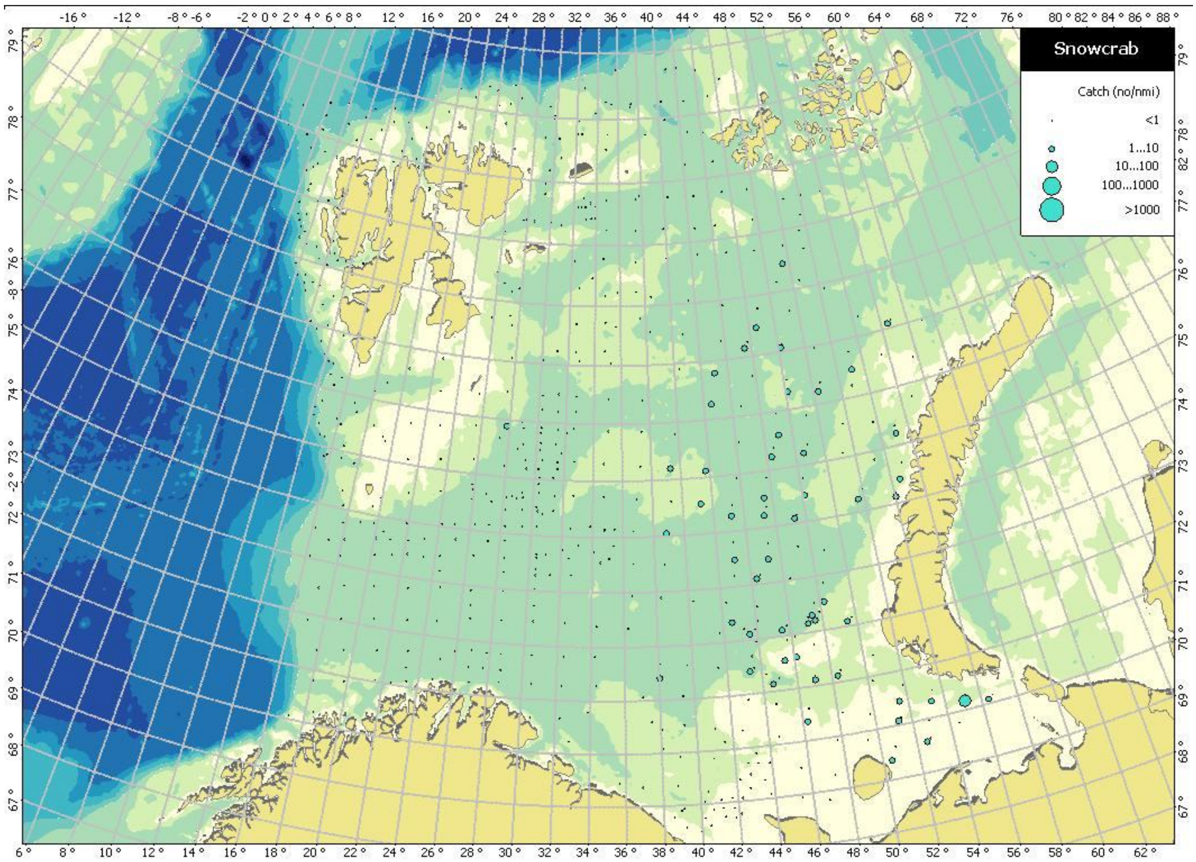

Figure 2.9.4 Distribution of snow crab (*Chionoecetes opilio*) in Campelen bottom trawl. Standardized to kg/hour of trawling, August-September 2007

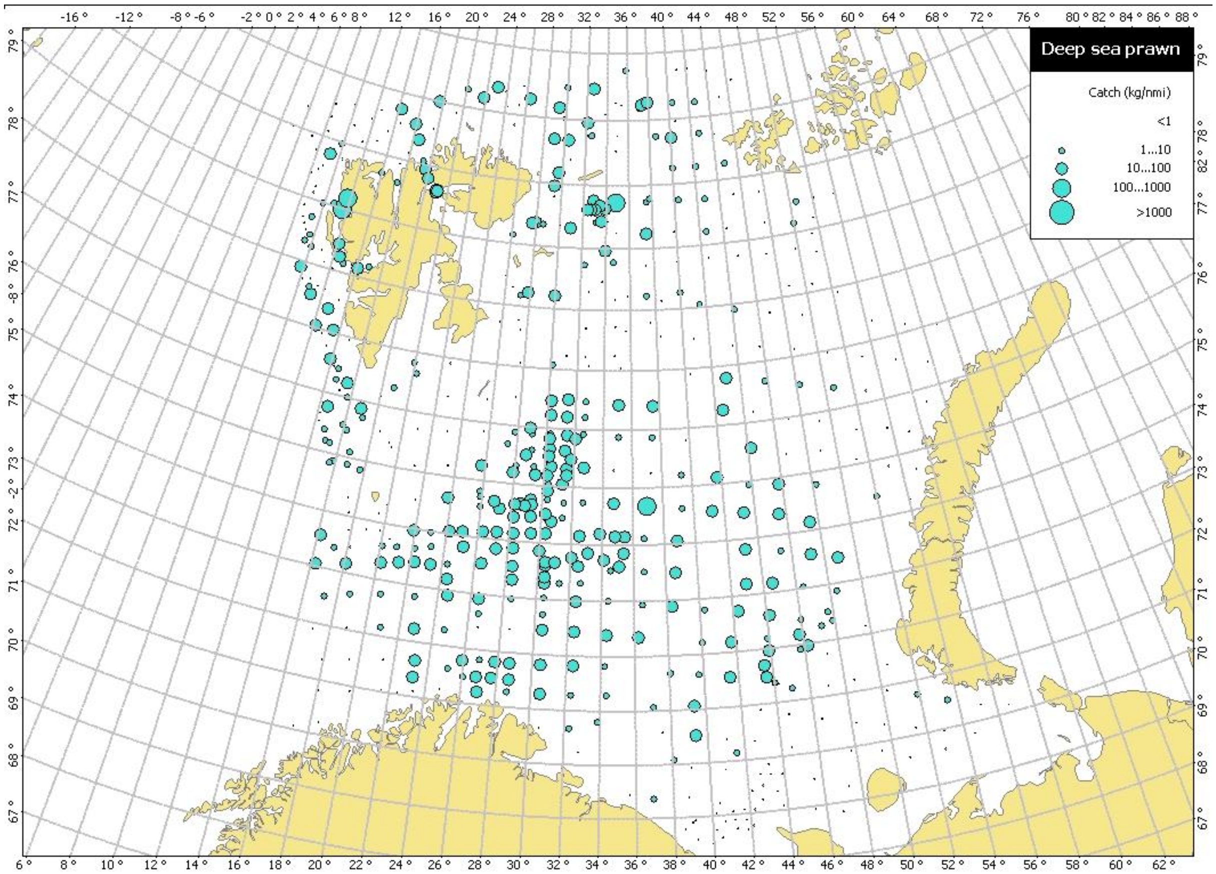

Figure 2.9.5 Distribution of Northern Shrimp (*Pandalus borealis*),based on bottom trawl, August-September 2007

7 APPENDIXCES

APPENDIX 1

Ecosystem survey 2007

Research vessel	Participants
"Smolensk" (07.08-28.09)	N.E. Ibragimova, V.A. Ivshin, S.N. Kharlin, N.N. Lukin, N.V. Mukhina, P.A. Murashko, D.V. Prozorkevich (cruise leader), T.A. Prokhorova, M.O. Rybakov, V.G. Sergeev, I.I. Trofimov.
"Vilnyus" (06.08-23.09)	A. Amelkin, I. Dolgolenko (cruise leader), V.A. Ignashkin,R.A. Klepikovskiy, A. Kuzmichov, P. Lyubin, I. Manushin, I. Prokopchuk, A. Semenov, T. Sergeeva, V. Shurupov, E. Timofeevskaja
"G.O. Sars" (14.08-30.09)	**Part 1 (14-20/08):** L. Austgulen, K. Bakkeplass, I.M. Beck, B. Ellertsen, A. Fuglevik, H. Græsdal, M. Irgens, R. Johansen, L.L. Jørgensen, B. Kvinge, N. Mikkelsen, H. Myran, E. Olsen (cruise leader), I. Orellana, P. Pahr, M. Reeve, J. Rønning, H. Sando, A. Sikorski, B. Skjold, A. Steinsland, S. Subbey, T. Thangstad, N. Ushakov, J. Wangenstein, K. Westrheim. **Part 2 (22/08-05/09):** L. Austgulen, K. Bakkeplass, I.M. Beck, B. Ellertsen, H. Græsdal, T. Haugland, M. Irgens, R. Johansen, L.L. Jørgensen, B. Kvinge, H. Myran, E. Olsen (cruise leader), I. Orellana, P. Pahr, M. Reeve, H. Sando, B. Skjold, S. Subbey, T. Thangstad, N. Ushakov, T. Sivertsen, Th. Sivertsen, K. Westrheim, R. Ølson **Part 3 (06-30/09):** J. Alvarez, O. Arnøy, G. Bakke, M. Dahl, E. Eriksen, K.A. Fagerheim, H. Gjøsæter (cruise leader), M. Irgens, E. Johannesen, M. Johannessen, T. Knutsen, G. McCallum, M. Mauritzen, B. Røttingen, J. Røttingen, N. Ushakov.
"J. Hjort" (01-31.08) and (14-26.09)	**Part 1 (01-20/08):** O. N. Aarbakke, J. Alvarez (cruise leader), K. M. Bringslid, B. Endresen, C. Forså, E. Grønningsæter, I. Henriksen, E. Hermansen, A. Husebø, D. Johannes, T. Jåvold, A.-Ch. Knag, H. Larsen, E. Levesque, M. Mjanger, J.E. Nygård, S. Seim, G. Tveit, **Part 2 (21-31/08):** S. Aanes (cruise leader), H. Emmel, J. Erices, C. Forså, E. Grønningsæter, E. Gustad, J. Erices, H.Ø. Hansen, S. Kolbeinsson, A. Leithe, F. Midtøy, J. F. Nilsen, G. Nilsson, G. Richardsen, Ø. Torgersen, R. Torvanger, M. Vecchione. **Part 3 (14-26/09):** J. Erices, C. Forså, B.E. Grøsvik, H.Ø. Hansen, I. Henriksen, S. Kolbeinson, J.H. Nilsen, G. Nilsson, A. Rey, G. Richardsen, S.Mehl (cruise leader),Ø. Tangen, Ø. Torgersen, J.F. Wilhelmsen
"Jan Mayen" (10.09-27.09)	**Part 1 (10-27/09):** N.M. Bersås, A. Carbonniere, P. Dahl, E. Hermansen, J. Kristiansen, G. Langhelle, H. Larsen, C. Longo, A. Sæverud, L. Solbakken, A. Strobel, A. Sæverud, W. Richardsen, T. de L. Wenneck (cruise leader).

APPENDIX 2

Ecosystem survey 2007

SPHERE CALIBRATION OF ECHOSOUNDERS, ER60,
(on copper sphere CU60, TS=33,6 dB, at frequency 38 kHz)

Research vessel	G.O. Sars	Johan Hjort	Jan-Mayen	Smolensk	Vilnyus
Type of echosounder	ER60	ER60	ER60	ER60	ER60 (2.1.2)
Date	26.10.2006	03.02.2007	12.09.2006	8.08.2007	05.08.2007
Place	Kaldfjorden Tromsø	Fagervika, Seiland		Ura-guba Bay	70°38.3/29°46.6
Bottom depth (m)	86	32		28	52
Depth to sphere (m)	17-23	24-28	17-23	18	21
Temperature (ºC)				8.7	8.12
Salinity (‰)				33.2	34.3
TS of sphere (dB)	-33.6	-33.65	-33.6	-33.6	-33.6
Transducer type	ES38B	ES38B	ES38B	ES38B	ES38B
Transducer depth (m)	0	0	0	0	0
Real sphere depth (m)		26.0	20		21
Sound velocity (m/sec)	1480.0	1464.0	1453.0	1482.7	1486
Absorption coefficient (dB/km)	9.7	9.9	9.9	9.64	9.875
Pulse length (Short/Med./Long, ms)	1.024	1.024	1.024	1.024	1.024
Bandwidth (Wide/Narrow)	2.425 kHz	2.425 kHz	2.425 kHz	2.43 kHz	2.43 kHz
Maximum power (W)	2000	2000	2000	2000	2000
Transmit power (W)	2000	2000	2000	2000	2000
Angle sensitivity	21.9	21.9	21.9	21.9	21.9
2-way Beam Angle (10lgΨ , dB)	-20.8	-21.0	-20.6	-20.76	-20.60
Adjusted Sv Transducer Gain (dB)	-0.65 (Sa corr.)	-0.57	-0.71	-0.7	-0.64
Adjusted TS Transducer Gain (dB)	25.53	26.78	26.08	26.05	26.26
3-dB Beamwidth Alongship (deg.)	7.07	7.12	7.01	6.99	7.07
3-dB Beamwidth Athwartship (deg.)	7.01	7.07	7.17	6.96	7.03
Alongship (fore/aft.) Offset (deg.)	-0.12	-0.06	-0.06	-0.02	0.02
Athwartship Offset (deg.)	-0.09	0.12	-0.01	0.02	-0.04
Theoretical Sa (m /nm)					
Measured Sa (m /nm)					
$Sa=\sigma*1852^2/(r^2\Psi)$ $\sigma=4\pi*10^{0,1\ TS}$					

APPENDIX 3

Sampling of fish

	Norwegian vessels	Russian vessels	Sum
Capelin			
No of samples	235	318	553
Nos. length measured	14198	18964	33162
Nos. aged	2661	2217	4878
Polar cod			
No of samples	167	238	405
Nos. length measured	5136	24662	29798
Nos. aged	824	855	1679
Herring			
No of samples	105	78	183
Nos. length measured	2842	4043	6885
Nos. aged	231	553	784
Blue whiting			
No of samples	142	20	162
Nos. length measured	8587	1100	9687
Nos. aged	270	134	404
Cod			
No of samples	433	291	724
Nos. length measured	14935	11864	26799
Nos. aged	1041	2147	3188
Haddock			
No of samples	363	221	584
Nos. length measured	18363	52988	71351
Nos. aged	505	1153	1658
Redfish (*Sebastes marinus*)			
No of samples	47	18	65
Nos. length measured	347	158	505
Nos. taken for age	73	41	114
Redfish (*Sebastes mentella*)			
No of samples	239	94	333
Nos. length measured	6970	4283	11253
Nos. taken for age	209	260	469
Saithe			
No of samples	40	12	52
Nos. length measured	506	73	579
Nos. taken for age		71	71
Greenland halibut			
No of samples	324	136	460
Nos. length measured	2661	5648	8309
Nos. taken for age	1124	960	2084
Atlantic wolffish (Anarhichas lupus)			
No of samples	65	33	98
Nos. length measured	422	49	471
Spotted wolffish (*Anarhichas minor*)			
No of samples	70	30	100
Nos. length measured	157	92	249
Northern wolffish (*Anarhichas denticulatus*)			
No of samples	42	18	60
Nos. length measured	56	21	77
Long rough dab			
No of samples	309	311	620
Nos. length measured	10713	31231	41944

Length measurements include 0-group samples. Demersal fishes will be aged after the survey.

APPENDIX 4

Sampling of fish stomachs

	Norwegian vessels	Russian vessels	Sum
Capelin			
No of samples	59	61	120
Nos. stomachs sampled	-	2192	-
Polar cod			
No of samples	20	32	52
Nos. stomachs sampled	-	855	-
Herring			
No of samples	0	22	22
Nos. stomachs sampled	0	517	517
Blue Whiting			
No of samples	0	7	7
Nos. stomachs sampled	0	134	134
Cod			
No of samples	228	185	413
Nos. stomachs sampled	-	2097	2097
Haddock			
No of samples	70	105	175
Nos. stomachs sampled	-	1153	1153
Redfish (*Sebastes marinus*)			
No of samples	0	6	6
Nos. stomachs sampled	0	41	41
Redfish (*Sebastes mentella*)			
No of samples	0	32	32
Nos. stomachs sampled	0	260	260
Saithe			
No of samples	0	11	11
Nos. stomachs sampled	0	71	71
Greenland halibut			
No of samples	0	120	120
Nos. stomachs sampled	0	959	959
Plaice			
No of samples	0	77	77
Nos. stomachs sampled	0	327	327
Spotted wolffish (*Anarhichas minor*)			
No of samples	0	6	6
Nos. stomachs sampled	0	9	9
Northern wolffish (*Anarhichas denticulatus*)			
No of samples	0	3	3
Nos. stomachs sampled	0	3	3
Long rough dab			
No of samples	0	56	56
Nos. stomachs sampled	0	966	966
Thorny skate			
No of samples	0	13	13
Nos. stomachs sampled	0	26	26
Arctic skate			
No of samples	0	3	3
Nos. stomachs sampled	0		
Trisopterus esmarki			
No of samples	0	3	3
Nos. stomachs sampled	0	56	56
Triglops murrayi			
No of samples	0	7	7
Nos. stomachs sampled	0	40	40
Triglops pingeli			
No of samples	0	1	1

Nos. stomachs sampled	0	15	15
Careproctus reinhardti			
No of samples	0	25	25
Nos. stomachs sampled	0	53	53
Gymnacanthus tricuspis			
No of samples	0	6	6
Nos. stomachs sampled	0	61	61
Myoxocephalus scorpius			
No of samples	0	2	2
Nos. stomachs sampled	0	3	3
Cottunculus sadko			
No of samples	0	19	19
Nos. stomachs sampled	0	31	31
Cottunculus microps			
No of samples	0	4	4
Nos. stomachs sampled	0	6	6
Eumicrotremus spinosus			
No of samples	0	3	3
Nos. stomachs sampled	0	7	7
Eumicrotremus derjugini			
No of samples	0	3	3
Nos. stomachs sampled	0	3	3
Lycodes seminudis			
No of samples	0	2	2
Nos. stomachs sampled	0	5	5
Lycodes reticulatus			
No of samples	0	10	10
Nos. stomachs sampled	0	55	55
Lycodes vahli gracilis			
No of samples	0	4	4
Nos. stomachs sampled	0	21	21
Liparis gibbus			
No of samples	0	24	24
Nos. stomachs sampled	0	90	90
Liparis fabricii			
No of samples	0	16	16
Nos. stomachs sampled	0	95	95
Leptagonus decagonus			
No of samples	0	24	24
Nos. stomachs sampled	0	111	111

APPENDIX 5

Preliminary list of all fish species recorded at the ecosystem survey 2007 (IMR and PINRO), sorted alphabetically according to the Latin name of the family. Name, catch rate (wcpue) in kg per nautical towed (demersal trawl), number of demersal trawl stations where the species has been caught (stas., total number of stations for the survey 581) and average length (cm) with range from specimens caught in demersal trawl. Specimen classified to family or genus is marked in bold

Family	Latin name	English name	wcpue	stas	Length (cm)
Agonidae	Leptagonus decagonus	Atlantic poacher	0.082	249	14.1 (3.75;24.5)
Agonidae	Ulcina olrikii	Arctic alligatorfish	0.004	29	6.6 (3.5;10.5)
Ammodytidae	**Ammodytidae**	**Sand lances**	**0.000**	**4**	**7.9 (5.5;10.5)**
Ammodytidae	Ammodytes tobianus	Small sandeel	0.000	1	6.5 (6.5;6.5)
Anarhichadidae	Anarhichadidae	Wolffish	0.000	4	9.3 (7.75;10.25)
Anarhichadidae	Anarhichas denticulatus	Northern wolffish	1.351	54	84.6 (56.5;119.5)
Anarhichadidae	Anarhichas lupus	Atlantic wolffish	0.743	87	35.9 (6.5;111.5)
Anarhichadidae	Anarhichas minor	Spotted wolffish	1.176	92	49.8 (8.5;128.5)
Argentinidae	Argentina silus	Greater argentine	0.421	41	24.6 (7.5;47.5)
Chimaeridae	Chimaera monstrosa	Rabbit fish	0.024	1	55.7 (45.5;62.5)
Clupeidae	Clupea harengus	Atlantic herring	0.146	51	23.4 (4.75;32.25)
Cottidae	**Cottidae****	**Sculpins**	**0.005**	**45**	**7.3 (3.25;17.5)**
Cottidae	Artediellus atlanticus	Atlantic hookear sculpin	0.167	350	8.7 (1.45;17.5)
Cottidae	Gymnocanthus tricuspis	Arctic staghorn sculpin	0.052	24	12.7 (7.5;19.5)
Cottidae	Icelus bicornis	Twohorn sculpin	0.021	28	7.6 (3.5;16.5)
Cottidae	Myoxocephalus scorpius	Shorthhorn sculpin	0.011	11	15.3 (8.5;38.5)
Cottidae	**Triglops sp.**		**0.024**	**45**	**8.8 (2.25;16.5)**
Cottidae	Triglops murrayi	Moustache sculpin	0.055	101	10.2 (4.25;16.5)
Cottidae	Triglops nybelii	Bigeye sculpin	0.268	156	9.1 (2.75;15.5)
Cottidae	Triglops pingelii	Ribbed sculpin	0.000	8	10.5 (3.5;14.5)
Cyclopteridae	Cyclopteropsis mcalpini		0.000	2	5 (4.5;5.5)
Cyclopteridae	Cyclopterus lumpus	Lumpsucker	0.067	16	29.5 (9.5;45.5)
Cyclopteridae	Eumicrotremus derjugini	Leatherfin lumpsucker	0.001	3	7.9 (1.25;11.5)
Cyclopteridae	Eumicrotremus spinosus	Atlantic spiny lumpsucker	0.007	34	34 (22.5;42.5)
Gadidae	Arctogadus glacialis	Arctic cod	0.000	3	14.5 (12.5;16.5)
Gadidae	Boreogadus saida	Polar cod	13.273	282	13.6 (3.25;29.25)
Gadidae	Gadiculus argenteus	Silvery pout	0.063	20	13.5 (7.5;23.5)
Gadidae	Gadus morhua	Atlantic cod	28.790	446	39.3 (4.25;119.5)
Gadidae	Melanogrammus aeglefinus	Haddock	44.442	334	30.9 (3.75;100.5)
Gadidae	Merlangius merlangus	Whiting	0.003	5	33.7 (31.5;35.5)
Gadidae	Micromesistius poutassou	Blue whiting	14.184	154	28.2 (9.75;43.25)
Gadidae	Pollachius pollachius	Pollack	0.008	2	43.5 (30.5;54.5)
Gadidae	Pollachius virens	Saithe	2.653	26	59.6 (8.5;91.5)
Gadidae	Trisopterus esmarkii	Norway pout	1.789	81	17 (5.5;27.5)
Gasterosteidae	Gasterosteus aculeatus	Three-spined stickleback	0.002	20	7.1 (4.5;8.5)
Liparididae	**Liparididae****		**0.002**	**65**	**5 (2.25;20.5)**
Liparidae	**Careproctus sp.****	**Snail fish**	**0.024**	**129**	**11.7 (5.5;23.5)**
Liparidae	Liparis fabricii	Gelatinous snailfish	0.370	120	9.5 (3.75;21.5)
Liparidae	Liparis gibbus	Variagated snailfish	0.036	64	13.3 (3.55;27.5)
Liparidae	Liparis liparis	Striped sea snail	0.000	1	5.5 (5.5;5.5)
Liparidae	Paraliparis bathybius		0.001	4	21.1 (16.5;28.5)
Liparididae	Rhodichthys regina		0.000	2	22.2 (16.5;26.5)
Lophiidae	Lophius piscatorius	Anglerfish	0.003	1	45.5 (45.5;45.5)
Lotidae	Brosme brosme	Cusk	0.194	25	38.1 (12.5;73.5)

Lotidae	Enchelyopus cimbrius	Fourbeard rockling	0.001	9	17.7 (8.5;29.5)
Lotidae	Gaidropsarus argentatus	Arctic rockling	0.008	10	26.8 (19.5;38.5)
Lotidae	Gaidropsarus vulgaris*	Three-bearded rockling	0.000	1	12.5 (11.5;13.5)
Lotidae	Molva molva	Ling	0.007	2	63 (53.5;72.5)
Macrouridae	Macrourus berglax	Rough rattail	0.064	17	18.7 (5.5;29.5)
Microstomatidae	Nansenia groenlandica		0.000	1	16.5 (16.5;16.5)
Myctophidae	**Myctophidae**	**Laternfish**	**0.000**	**25**	**5.7 (3.25;9.5)**
Myctophidae	Benthosema glaciale	Glacier lanternfish	0.000	2	6.2 (5.5;6.5)
Myctophidae	Myctophum punctatum	Spotted lanternfish	0.000	8	6.1 (5.5;6.5)
Osmeridae	Mallotus villosus	Capelin	3.966	242	13.5 (2.75;19.75)
Paralepididae	**Paralepididae**		**0.000**	**2**	**25.2 (24.5;25.5)**
Paralepididae	Paralepis coregonoides*	Sharpchin barracudina	0.001	7	26 (23.5;28.5)
Paralepidida**e**	Arctozenus risso	Ribbon barracudina	0.013	67	24.4 (18.5;28.5)
Phycidae	Phycis blennoides*	Greater forkbeard			
Pleuronectidae	Glyptocephalus cynoglossus	Witch	0.013	3	39.5 (32.5;50.5)
Pleuronectidae	Hippoglossoides platessoides	Long rough dab	12.000	517	22.3 (2.25;49.5)
Pleuronectidae	Hippoglossus hippoglossus	Halibut	0.023	2	67.8 (53.5;89.5)
Pleuronectidae	Limanda limanda	Dab	0.182	15	28.1 (18.5;39.5)
Pleuronectidae	Microstomus kitt	Lemon sole	0.032	7	27.6 (15.5;42.5)
Pleuronectidae	Pleuronectes platessa	Europeian plaice	2.968	32	36.9 (24.5;60.5)
Pleuronectidae	Reinhardtius hippoglossoides	Greenland halibut	5.498	303	33.5 (4.05;90.5)
Psychrolutidae	**Psychrolutidae****	**Fatheads**	**0.005**	**29**	**12.7 (4.5;21.5)**
Psychrolutidae	Cottunculus microps	Polar sculpin	0.014	59	12.5 (4.5;52.5)
Rajidae	Amblyraja hyperborea	Arctic skate	0.130	35	40.1 (15.5;77.5)
Rajidae	Amblyraja radiata	Thorny skate	1.218	264	38.5 (8.5;60.5)
Rajidae	Bathyraja spinicauda	Spinetail ray	0.098	8	77.6 (45.5;138.5)
Rajidae	Dipturus batis	Blue skate	0.004	2	41.5 (15.5;62.5)
Rajidae	Dipturus oxyrinchus*		0.009	1	84.5 (84.5;84.5)
Rajidae	Raja clavata*		0.000	1	13.5 (13.5;13.5)
Rajidae	Rajella fyllae	Round ray	0.012	21	25.4 (9.5;56.5)
Salmonidae	Samlo salar	Salmon			
Scombridae	Scomber scombrus	Atlantic mackerel			
Scophthalmidae	Lepidorhombus whiffiagonis	Megrim	0.000	1	25.5 (24.5;26.5)
Scorpaenidae	**Sebastes sp.**	**Redfishes**	**0.200**	**130**	**9.8 (2.25;16.5)**
Scorpaenidae	Sebastes marinus	Golden redfish	0.696	66	35.5 (8.5;59.5)
Scorpaenidae	Sebastes mentella	Deepwater redfish	9.194	279	22.7 (3.75;56.5)
Scorpaenidae	Sebastes viviparus	Norway redfish	0.334	36	19.2 (7.5;36.5)
Squalidae	Somniosus microcephalus	Greenland shark	2.028	5	286.9 (200.5;330.5)
Sternoptychidae	Maurolicus muelleri	Pearlside	0.000	6	5.9 (4.5;7.5)
Stichaeidae	**Lumpenus sp.**		**0.000**	**6**	**5.8 (3.75;9.5)**
Stichaeidae	Anisarchus medius	Stout eelblenny	0.002	22	14.4 (8.5;30.5)
Stichaeidae	Leptoclinus maculatus	Daubed shanny	0.089	261	12.4 (5.25;25.5)
Stichaeidae	Lumpenus lampretaeformis	Snake blenny	0.118	143	22.8 (6.5;42.5)
Syngnathidae	Entelurus aequoreus	Snake pipefish	0.000	20	7.8 (4.5;9.5)
Triglidae	Eutrigla gurnardus	Gurnard			
Zoarcidae	**Zoarcidae**	**Eelpouts**	**0.005**	**4**	**13.1 (4.5;21.5)**
Zoarcidae	Gymnelus retrodorsalis	Aurora unernak	0.000	11	12.3 (9.5;15.5)
Zoarcidae	Gymnelus viridis	Fish doctor	0.000	4	13.3 (12.5;14.5)
Zoarcidae	Lycenchelys kolthoffi		0.000	8	18.2 (14.5;22.5)
Zoarcidae	Lycodes adolfi		0.000	1	13.5 (6.5;22.5)
Zoarcidae	Lycodes esmarki	Esmark's eelpout	0.087	37	36.9 (8.5;70.5)
Zoarcidae	Lycodes eudipleurostictus	Double line eelpout	0.032	43	20.6 (7.5;83.5)
Zoarcidae	Lycodes gracilis	Vahl's eelpout	0.109	152	19.2 (7.5;35.5)
Zoarcidae	Lycodes pallidus	Pale eelpout	0.044	128	15.3 (6.5;31.5)
Zoarcidae	Lycodes polaris	Canadian eelpout	0.018	17	19 (6.5;38.5)
Zoarcidae	Lycodes reticulatus	Arctic eelpout	0.117	97	20.4 (7.5;64.5)

Zoarcidae	Lycodes rossi	Threespot eelpout	0.028	82	17.9 (8.5;61.5)
Zoarcidae	Lycodes seminudus	Longear eelpout	0.042	73	20 (8.5;45.5)
Zoarcidae	Lycodes squamiventer	Sars wolf eel	0.002	7	19.4 (10.5;37.5)
Zoarcidae	Lycodonus flagellicauda		0.000	2	14.5 (13.5;15.5)

* Needs confirmation, unusual species for the Barents Sea

** *Iculus spatula*, *Cottunculus sadko*, *Careproctus reinhardti*, *C. ranula*, *C. microps*, and *Liparis tunicatus* registred to species on Russian vessels, but only to genus/family in this table.

APPENDIX 6

Latin name	English name	Norwegian name	Russian name
PORIFERA	Sponges	SVAMPER	Губки
HYDROIDER	Hydroids	HYDROIDER	Гидроиды
ALCYONIIDAE	Soft corals	ÅTTEARMETE KORALLDYR	Мягкие кораллы
ACTINIARIA	Sea anemones	SJØANEMONER	Актинии
MADREPORIA	Stony corals	STEINKORALLER	Мадрепоровые кораллы
POLYCHAETA	Polychaets	BØRSTEORMER	Полихеты
SIPUNCULIDA	Sipunculids	PØLSEORMER	Сипункулиды
PRIAPULIDA	Priapolids	PRESTEPIKK	Приапулиды
NEMERTINI	Nemetins	SLIMORMER	Немртины
ECHIURA	Echiurans	SNABELORMER	Ехиуриды
PYCNOGONIDA	Sea spiders	HAVEDDERKOPPER	Морские пауки
CIRRIPEDIA	Barnecles	RUR	Усоногие раки
MYSIDA	Mysids	PUNGREKER	Мизиды
CUMACEA	Cumaceans	KOMMAKREPS	Кумовые раки
ISOPODA	Isopods	ISOPODA	Изоподы
AMPHIPODA	Amphipods	AMFIPODER	Бокоплавы
NATANTIA	Prawns	REKER	Креветки
BRACHYURA	Crabs	KRABBER	Крабы
ANOMURA	Squat lobsters	TROLLKREPS	Крабоиды
POLYPLACOPHORA	Chitons	SKALLUS	Хитоны
BIVALVIA	Bivalves	MUSLINGER	Двустворчатые моллюски
SCAPHOPODA	Scaphopods	SJØTENNER	Лапатоногие моллюски
GASTROPODA	Snailes	SNEGLER	Брюхоногие моллюски
CEPHALOPODA	Cephalopods	BLEKKSPRUTER	Головоногие моллюски
BRACHIOPODA	Brachiopods	ARMFØTTINGER	Плеченогие
BRYOZOA	Bryozoans	MOSDYR	Мшанки
CRINOIDEA	Sea liljes	SJØLILJER	Морские лилии
ASTEROIDEA	Sea stars	SJØSTJERNER	Морские звезды
OPHIUROIDEA	Brittlestars	SLANGESTJERNER	Офиуры
ECHINOIDEA	Sea urchins	KRÅKEBOLLER	Морские ежи
HOLOTHUROIDEA	Sea cucumbers	SJØPØLSER	Голотурии
ASCIDIACEA	Sea squirts	SEKKEDYR	Асцидии

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