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SURVEY REPORT

FROM THE JOINT NORWEGIAN/RUSSIAN ECOSYSTEM

SURVEY IN THE BARENTS SEA

AUGUST – OCTOBER 2005

Volume 1

Preface

The third joint ecosystem survey was carried out during the period 1st of August to 5th of October 2005. 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 Spitsbergen. 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 report from the survey will cover many but not all the aspects of the survey. 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 fully covered in this volume of the report since the data has not been fully analyzed yet. The complete 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 10-14th October.

A list of the participating vessels and aircraft with their respective scientific crews is given in Appendix I.

Besides the participants on the vessels, the following specialists took part in in preparing the survey report: K. Drevetnyak (PINRO), I. Trofimov (PINRO), E. Orlova (PINRO), G. Rudneva (PINRO), V. Nesterova (PINRO); J. E. Stiansen(IMR), B. Bogstad (IMR), M. Mauritzen (IMR).

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 higher (+0.5-1 ^{0}C) than the long term mean but somewhat lower than in the same period 2004.

The 2005 haddock yearclass is very rich. The 2005 yearclass of cod, herring, capelin and is near the average level. 0-group of the western component of polar cod is below the average level. 0-group of Greenland halibut, redfish, saithe and the eastern component of polar cod were estimated to be poor.

The total capelin stock was estimated to be 0.3 million tonnes, which is 50% lesser than last years estimate. About 0.17 million tonnes were assumed to be maturing.

The polar cod stock was estimated to be 1.8 million tonnes, which is 0.7 million tonnes higher then last year.

Juvenile Norwegian spring spawning herring was estimated in the southern part of the Barents Sea to be 2.8 million tonnes.

Blue whiting of age groups 1 to 9 were observed in the western and southwestern parts of the surveyed area, and the biomass of this stock component was estimated to be 1.1 million tonnes.

1 METHODS

1.1 Hydrography

The hydrographical investigations consisted of measurements of temperature and salinity in depth profiles along sections and distributed over the total investigated area. All vessels used CTD-zondes. For the first time it was agreed to carry out Norwegian and Russian oceanographic section by the vessels operating in the same area. Russian vessel sampled Norwegian sections in REEZ, but unfortunately the Russian Bear island-west section was not sampled by R/V "Johan Hjort". This cooperation should be improved and continue in future.

1.2 0-group fish investigations

The geographical distribution of 0-group fishes was estimated with a small mesh mid-water trawl ("Harstadtrål"). All vessels, which participated in the survey in 2005, used this type of mid-water trawl which was first recommended in 1980 (Anon. 1983). 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. Additional tows at 60 and 80m, also of 0.5 nm distance, were made when the 0-group fish layer was recorded deeper than 60m or 80m on the echo-sounder. Trawling procedure was standardised in accordance with the recommendations made in 1980. A smaller sized pelagic trawl was used during the first 20 years of the 0-group investigations. After 1985 the present gear has been used regularly. In the mid 1990s, Nakken and Raknes (1996) recalculated the indices from the first 20 years. Their new indices are based upon an estimate of how many 0- group cod and haddock that would have been caught if the new equipment had been used during the whole period from 1965. The indices of cod and haddock recalculated by Nakken and Raknes (1996) have been incorporated in the 0-group reports since 2001. Prozorkevich (2001) calculated abundance indices for 0-group herring since 1993. The new type of 0-group indices was presented for the first time in volume 2 of last years report and are revised and presented in this report. These indices, which are given both with and without correction for catching efficiency, are calculated by the method of stratified sample mean. This new method allows for confidence limits to be calculated, and makes better use of the total data than the indices used hitherto have made. When the new method has been carefully scrutinized and compared to previous methods, the new indices are meant to replace the Area Index after a short period of overlap between the two methods. The Logarithmic Index is discontinued from this year.

Most of the stations this year were taken 32-35 nautical miles apart. Area based abundance indices (ABI) were estimated by using the computer program Map Viewer. Mean values of abundance indices were calculated both for the period 1985-2005 and for the whole period 1965–2005.

1.2.1 Stratified sample mean estimator

The number of fish per nm^2, $\rho_{s,l}$, at length, l, at each station, s, are estimated by the following equation

$$\rho_{s,l} = \frac{f_{s,l} \cdot Keff}{a_s}$$

where $f_{s,l}$ is the calculated frequency of length l at station s, *Keff* is the correction functions defined below, and a_s is the swept area found by

$$a_s = \frac{d_s \cdot ws}{1852}$$

where ws is the wingspread of the trawl and is set to 20 m and d_s is the effective trawl distance found as trawl total distance divided on the number of depth steps.

The stratified swept area estimate, is given by

$$\bar{y}_{st} = \sum_{i=1}^{L} A_i \bar{y}_i$$

where L is the number of strata, A_i is the covered area in the i-th stratum, and $\bar{y}_i$ is the average density in stratum i. The estimated variance of the stratified mean $\bar{y}_{st}$ is

$$\mathrm{var}(\bar{y}_{st}) = \sum_{i=1}^{L} A_i^2 \frac{s_i^2}{n_i}$$

where

$$s_i^2 = \frac{\sum_{s=1}^{n_i} (y_{i,s} - \bar{y}_i)^2}{n_i - 1}$$

The standard error of $\bar{y}_{st}$ is given by

$$\mathrm{se}(\bar{y}_{st}) = \sqrt{\mathrm{var}(\bar{y}_{st})}$$

and the confidence limits CL are found by

$$CL = \bar{y}_{st} \pm 1.96 \cdot \mathrm{se}(\bar{y}_{st})$$

The area is stratified by 22 strata (Fig. 2.5). To find the coverage of a stratum, the station positions are loaded into GIS software. A buffer zone of 20 nm is added to the border of the outer trawl points. The conic projection Albers equal-area, with center latitude at 75°N, center longitude at 30°E, and standard latitudes at 70° and 80°N, is used for area estimation.

The sampling trawl is highly selective for 0-group fish according to its species and length. It is possible to estimate the special correction function *Keff* for trawl capture efficiency by regressions on fish densities received during trawling and acoustic registrations of relatively "pure" concentrations. Correction functions for three species types are:

$$Keff_{gadoids} = 17.065 * \exp(-0.1932 * l)$$

$$Keff_{capelin} = 7.2075 * \exp(-0.1688 * l)$$

$$Keff_{herring} = 357.23 * \exp(-0.6007 * l)$$

where l is the length in cm. These correction functions can be applied directly to the observed length frequencies at each station. But since the functions above give unreasonably high numbers as l decreases, it was decided to set for $l < 4$ cm $Keff_{gadoids}$ constant to 8, $Keff_{herring}$ constant to 30 and $Keff_{capelin}$ constant to 4. There is currently no correction function for other fish species.

1.3 Acoustic survey for pelagic fish

A team consisting of N.G. Ushakov (PINRO) together with S. Aanes, 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.

Data on cruise tracks, hydrography, trawl catches, integrator values etc. were exchanged by use of e-mail, and these data were used during the day-to-day planning of the survey.

The survey area was chosen based on general knowledge of the distribution of the target species, and on information about fish distribution from the first parts of the ecosystem survey.

The main area of capelin distribution were surveyed with course lines 32-35 nautical miles apart. In area of maximal capelin densities there were made extra tracks with course lines 15 nautical miles apart. All regions of the Barents Sea and adjacent areas of the Norwegian Sea were covered.

All participant vessels used ER-60 echo sounders (with ER-60 software, version 2.1.1). The Norwegian vessels had BEI, while the Russian vessels used FAMAS and BI-60 post-processing system. Also "G.O. Sars", "J. Hjort" and "Jan Mayen" was 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 5 nautical miles were recorded for mapping and further calculations. The echograms, with their corresponding s_A-values, were scrutinised 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 trawling was 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.

In total, the Norwegian vessels carried out 706 trawl hauls and the Russian vessels carried out 402 trawl hauls, so in total 1108 hauls were made during the survey (while 1000 hauls were made in 2004). 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 II).

1.3.1 Area coverage

The weather conditions were favourable during most parts of the survey, and consequently, an almost total coverage of the Barents Sea by a dense survey grid was achieved. In 2005 the survey was started from the south. “Smolensk” and “F. Nansen” surveyed the eastern, north-eastern areas, central part of the Barents Sea and shallow areas to the south and north-east of Spitsbergen. “G.O. Sars” and “Johan Hjort” surveyed the western, north-western and central parts while “Jan Mayen” observed northern, north-western and north-eastern areas of Spitsbergen. Altogether, total survey carried out 208 vessel/days that is one week less than in 2004.

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 made using the stock size estimation program “BEAM” built on SAS GIS and developed at IMR. A strata system, dividing the Barents Sea in squares of 1º (latitude) x 2º (longitude), was used as basis for the calculation.

The mean s_A-value in each basic square was converted to fish area density ρ_A using the relation

and number of fish was found by multiplying with the area of the square. Numbers were converted to biomass by multiplying with observed mean fish weight in each length group.

The target strength relation for *capelin* is given by:

corresponding to a σ -value of $5.00 \cdot 10^{-7} \cdot L^{1.91}$

The target strength relation for *polar cod* and *blue whiting* is given by:

$$TS = 10 \cdot \log(\frac{\sigma}{4\pi}) = 21.8 \cdot \log L - 72.7$$

corresponding to a σ -value of $6.7 \cdot 10^{-7} \cdot L^{2.18}$

The target strength relation for *herring* is given by:

$$TS = 10 \cdot \log(\frac{\sigma}{4\pi}) = 20.0 \cdot \log L - 71.9$$

corresponding to a σ -value of $8.1 \cdot 10^{-7} \cdot L^{2.00}$

1.4 Bottom trawl survey

The number and biomass of fish per length group were calculated from bottom trawl catches using the “swept-area” method with a strata system developed at IMR. Number at age of cod, haddock and Greenland halibut 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 Swept area analysis of bottom fishes

Length based indices for each sub-area was estimated using the method of (Jakobsen *et al.* 1997). For each trawl station and length, fish density was estimated by:

$$P_{s,l} = \frac{f_{s,l}}{a_{s,l}},$$

where:

$P_{s,l}$ is the number of fish/n.m.^{2} observed at station *s* (length *l*)

$f_{s,l}$ is the estimated frequency of length *l*

$a_{s,l}$ is swept area given by

$$a_{s,l} = \frac{d_s * EW_l}{1852}$$

d_s is towed distance (n.m.) and EW_l is the length dependent effective swept width.

For Greenland halibut, redfish, long rough dab and the wolffishes, there is no available estimate of the length dependent effective swept width, so it was set to 25 m, independent of fish length and trawl depth.

Based on (Dickson 1993a; Dickson 1993b), length dependent effective fishing width for cod and haddock was included in the calculations where EW was:

$$EW_l = \alpha * l^{\beta} \quad \text{for} \quad l_{\min} < l < l_{\max}$$

$$EW_l = EW_{l_{\min}} = \alpha * l_{\min}^{\beta} \quad \text{for} \quad l \le l_{\min}$$

$$EW_l = EW_{l_{\max}} = \alpha * l_{\max}^{\beta} \quad \text{for} \quad l \ge l_{\max}$$

The parameters used for cod and haddock are given in the following table:

Species	α	β	$l_{\min}$	$l_{\max}$
Cod	5.91	0.43	15 cm	62 cm
Haddock	2.08	0.75	15 cm	48 cm

Point observations for fish density based on length (*l*) was summed up in 5 cm length groups denoted by $p_{s,l}$. Stratified abundance indices for each length group and strata were generated using

$$L_{p,l} = \frac{A_p}{S_p} * \sum P_{s,l}$$

where:

$L_{p,l}$ is the index for stratum *p*, length group *l*

A_p area (n.m.^{2}) of stratum *p*

S_p is the number of stations in stratum *p*

For each subarea, the total number of fish in each 5cm length group was estimated by summing over all strata in the sub area, and the total number of fish in each age group in the area was estimated using an age/length key. Finally, the total index for each length and age class is the sum of the values for all sub areas.

For each year, an age/length key was estimated for each stratum. All age samples for a stratum were used. Age samples from a length group was weighted by the index of the number of fish in the 5 cm length group within a stratum divided by the number of age samples in the length group:

$$w_{p,l} = \frac{L_{p,l}}{n_{p,l}} ,$$

where $n_{p,l}$ is the number of age samples in stratum *p* and length group *l*.

The proportion of age *a* at length *l* was estimated using

$$P_a^{(l)} = \frac{\sum_p n_{p,a,l} * w_{p,l}}{\sum_p n_{p,l} * w_{p,l}}$$

where $P_a^{(l)}$ is the weighted proportion of age *a* in length group *l* in stratum *p*,

and $n_{p,a,l}$ is the number of age samples of age *a* in length group *l*.

The sum of the weighted factors in a sub area is the abundance index for the total number of fish in the sub area. The number of fish at age was estimated by:

$$N_a = \sum_p \sum_l L_{p,l} * P_a^{(l)}$$

Average length and weight at age was estimated using (only shown for weight):

$$W_a = \frac{\sum_p \sum_l \sum_j W_{p,a,l,j} * w_{p,l}}{\sum_p \sum_l \sum_j w_{p,l}} ,$$

where $W_{p,a,l,j}$ is the weight for sample *j* in length group *l* in stratum *p* and age *a*.

1.4.2 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 second 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 2005.

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, the number of samples varying 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.

For the first time this year, 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 additional quantitative water samples were obtained from the water bottles at 5, 10, 20 and 30 m depth. Immediate upon retrieval of the seawater rosette sampler, two 20 ml phytoplankton samples were taken from each bottle at the above mentioned depths. The samples from the two series were kept separate as they were pooled in two dark light-protected 100 ml flasks. The first series was fixated by adding 2 ml lugol, while the second series was fixated using 2.5 ml 20% formaldehyde. 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 4 ml 20% formaldehyde 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. During the last part of the Norwegian vessel RV G.O. Sars survey, a Russian Juday net having a 0.106 m^2 opening area was also used along with WP2 net as part of a sampling comparison exercise.

The sampling on the Russian vessels was carried out by Juday-nets with 0.1 m^2 opening and 180 µm mesh size in depth intervals, bottom-100m, 100-50m and 50-0m. Additional sampling was carried out by WP-2 on “F. Nansen”.

On board the Norwegian vessels samples 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, shrimp, fish and fish larvae were counted and their length or size measured separately before drying and weighing.

Zooplankton samples collected onboard the Russian vessels at the stations where both WP-2 and Juday net was taken were size-fractionated and dried as on the Norwegian vessels. Otherwise, the 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.

In 2005 it was the intention from the research vessel G.O. Sars to conduct a restricted experiment on acoustic classification and categorization of zooplankton using a Linux implementation of the Bergen Echo Integrator system (BEI). The aim was to sample selected echo registrations by a variety of sampling gear, including a newly developed macro-plankton trawl with the Multisampler mounted, Mocness, WP2 and pelagic trawl and compare catches from these various gears with independent categorization derived by the BEI system. However, due to an incomplete implementation of specific modules of the Linux BEI system, this exercise could not be undertaken as planned. The macro-plankton trawl was however, used on three occasions with the Multisampler mounted to verify acoustic registrations in various parts of the water column.

Final plankton results will be presented in 2^{nd} volume of the survey report.

1.6 Stomach investigations

According to agreement at the Russian-Norwegian meeting in March 2005 capelin stomachs were collected at the Norwegian (G.O. Sars) and Russian vessels (Smolensk and F. Nansen) in August-September 2005. Near 400 capelin stomachs were collected by Norwegian and Russian vessels. The samples were collected and treated as was discussed at the Meeting in April 2005. All samples were fixated in 4% formalin until later analysis in the laboratory at PINRO. Stomachs will be processed by PINRO zooplankton specialists according to standard procedures. The results will be presented in March 2006.

Stomach samples of blue whiting were sampled on the Norwegian vessels. At each station one stomach pr. 5cm length category was sampled and frozen for later analysis at the IMR lab.

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

1.7 Sea mammals and birds investigations

Marine mammals and bird observations (species and numbers observed) were registered onboard R/V “G.O. Sars”, “J. Hjort”, from Norwegian side, and “F. Nansen”, “Smolensk”, from Russian side.

Onboard Norwegian R/Vs observations were made by three observers (one sea bird and two marine mammal observers) simultaneously from vessel bridges, the marine mammal observers covering a 180° sector (90° each) and the sea bird observer covering one 90° sector. The ship-following sea bird species, such as gulls and northern fulmars, were counted every half hour.

Onboard Russian R/Vs, observations of marine mammals and sea birds were carried out onboard “F. Nansen” and of marine mammals only onboard “Smolensk”. Observations onboard both vessels were carried out by one observer from the vessel top point about 12-15 m above sea surface covering 360°.

Observer activity was limited by weather conditions. When the weather conditions were not sufficient for good quality observations (wave height more than 6 on the Beaufort Scale or reduced visibility due to fog or precipitation) observations were not carried out. Observes were active along transects only, and not during station work.

During September 19. – 29. observations of marine mammals and birds (distribution, specified and counted) were carried out onboard Russian research aircraft An-26 “Arktika”, as in previous years. Two observers covered both sides of the aircraft sides along swaths equivalent to two flight altitudes. Methods for aerial observations for marine mammals and birds, including requirements for weather conditions, are described in detail in the 2004 Survey Report (2nd Volume).

1.8 Benthos observations

1.8.1 Purpose

The purpose of the benthos investigation was to

1) sample material for description of benthic habitats and communities in the Barents Sea,
2) evaluate different sampling methods, and
3) to continue established time series of benthic community monitoring.

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.

1.8.2 Criteria for selection of sampling locations

In general the distribution of locations for benthic sampling was integrated in the survey lines of the different vessels. Bycatch of invertebrates were recorded from all bottom trawl hauls. Criteria for the selection of locations for special benthic sampling varied between the ships and the two institutions. For the Russian part of the Ecosystem survey the locations were already decided from previously established monitoring stations. The main part of the Norwegian benthic survey was carried out with RV GO Sars. The three most important criteria for selection of locations along the survey line were representation of 1) different geographic regions, 2) different topographic structures, and 3) areas with different degrees of fishing intensity. Additionally, in the eastern part of the survey area locations were selected where red king crab previously had been recorded.

A detailed topographic map (based on a compilation of available bathymetry data from Olex) of the Norwegian sector was used to identify topographic structures (sea floor elevations, breaks and trenches, etc), whereas VMS satellite tracking data from the Norwegian Fisheries Directorate was used to identify areas with high fishing activity.

1.8.3 Gears and methods

PINRO and IMR had a slightly different approach to the benthic survey due to different history of benthic research. In the Norwegian part of the Barents Sea mapping is essential to evaluate the representativity of results on the benthos. It was decided to use a set of different gears with different sampling characteristics in order to provide a broad picture of the benthos. GO Sars was selected for this purpose since it could operate seabed inspection equipment as well as grab, sled, and trawl.

Table 2.8.1 gives an overview of the different gears used onboard the five research vessels involved in the ecosystem survey.

The following gears were used during the ecosystem cruise:

- Video rig (documents benthic habitats and megafauna),
- Beam trawl and Sigsby trawl (collect animals that live on the seafloor),
- van Veen grab (provides samples to quantify animals that live upon and in the sediments),
- RP-sled (samples organisms that live right above and on the seabed).

The combination of different sampling gear provides a good picture of the sampled habitats and their fauna.

1.8.4 Bottom trawl

For most hauls with bottom trawl (Campelen) benthic invertebrate bycatch was processed onboard, but a few samples from GO Sars were preserved or documented photographically for later identification.

Large forms of invertebrates (Asteroidea, Holoturoidea, Ophiuroidea and Porifera) were sorted out from the fish catch on deck onboard F Nansen. Smaller forms were sorted into species and taxonomic groups from the whole or a fraction of the remaining bycatch. The sorted organisms were counted and weighted (wet weight). Onboard GO Sars only Porifera was sorted out on deck. Other benthic invertebrates were sorted out from the whole or a fraction of the total catch.

1.8.5 van Veen grab

Quantitative collecting of macro-zoobenthos was carried out with van Veen grabs. The grab used onboard F. Nansen had a standard size covering a seabed area of 0.1 m^2, whereas a larger grab (sampling area of 0.25 m^2) was used onboard GO Sars. Five replicate samples were collected with the small grab, and three replicates with the large. The size of the samples was recorded either as filling degree (F. Nansen) or volume (GO Sars). Type of bottom sediments was examined visually and a small subsample was collected from each grab onboard GO Sars. The samples were sieved in running seawater using a smallest mesh size of 0.5 mm (F Nansen) and 1 mm (GO Sars). Sieved bottom organisms with remains of sediments were fixed in 4% neutralized solution of formaldehyde. Borax was used as a buffer. Onbord F Nansen, 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 was carried out with a modified Sigsby trawl (F Nansen) and a small beamtrawl (GO Sars). The Sigsby trawl had a steel frame of 1x0.35 m. The mesh size of the inner cover in the net was 10 mm, with a codend part with 5 mm mesh size knotless netting.

The beamtrawl had an opening of 2 m and a net similar to the Sigsby trawl (inner cover in the net =10 mm mesh, codend = 4 mm mesh size).

Trawling duration was set to 5 or 10 min at a vessel speed of 1,5 knots. The samples were sieved trough 10 and 5 mm (F Nansen) or 5 and 2 mm (GO Sars) sieves. Organisms collected in the Sigsby trawl were sorted out and processed onboard. Dominating invertebrates were counted and length measured. Organisms that required further taxonomic identification were fixed in 75% ethyl alcohol and 4% formalin for later examination. The samples from the beamtrawl were fixed on 4% formalin for sorting and faunistic identification in the laboratory on land.

1.8.7 Epibenthic sled (RP-sled)

For a description of the RP-sled (Rothlisberg-Pearcy epibenthic sled) collects epibenthic organisms from the sediment surface to height of about 50 cm above the sedbed. The net (mesh size = 0.5 mm) has a cod end similar to large plankton nets. Sampling was performed with a wire length of 1,5 – 2 times water depth with a speed close to 1 knot. The duration of the hauls standardised to 20 min. The sample was carefully washed out from the cod end and net in to a large bucket. The samples were sifted using 0.5 mm as the smallest mesh size. Most of the crustaceans were separated from the sample by repeated procedures of flotation (decantation) of the water trough fine (0.5 mm) sieve. The remaining sample was fractionated using different sized sieves (e.g. 8 mm, 4 mm, 2 mm, 500 um) depending on the composition of the sample. The fractions were fixed separately in 4% formaldehyde.

1.8.8 Video survey

Video records were provided onboard GO Sars with IMR's own tethered video camera (TVC). 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 TVC is deployed while the ship is allowed to slowly drift with the current, and was kept close (1 - 2m) to the seabed for at least 20 minutes. Logs for the deployments included GMT time, geographic positions, depth and general description of the habitat (substrate type and dominating epifauna).

2 RESULTS AND DISCUSSION

Survey routes with trawl stations; hydrographical stations, plankton stations and benthos sampling stations are shown in Fig. 2.1, 2.2, 2.3 and 2.4 respectively.

2.1 Hydrographical conditions

Figs. 2.1.1-2.1.4 show the temperature and salinity conditions along the oceanographic sections: Kola, Kanin, North Cape-Bear Island and Bear Island-West. The mean temperatures in the main part of these sections are presented in Table 2.1.1. 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. 2.1.5-2.1.14.

In general the temperature was above the long-term mean throughout the Barents Sea. The surface water temperatures were higher than the long-term mean by 0.8-1.3°C on average in the whole investigated area. Maximum positive anomalies were observed near Sørkapp and to the west of Cape Kanin. However, in the south-western part of the survey area the temperatures were slightly higher than normal, and in the south-eastern part negative anomalies (on average -0.5°C) were found. The distribution of the bottom temperature had the same features as at the surface but with smaller anomalies. In the bottom layer, positive anomalies of water temperature were found practically in all the observed areas except in the south-eastern part, where waters with negative temperature anomalies (down to -1.2°C) were distributed to 46°E and 72°N.

The water salinity in the survey area was in general close to the long-term mean except for saltier surface waters in the south-eastern and northern parts of the Barents Sea, and also near the Kanin Peninsula.

The maximum horizontal temperature gradients (0.20-0.35°C per nautical mile) were observed for the Polar Front south-east of Bear Island and west of Sørkapp at 50 m depth.

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 temperature anomalies in the 0-50 m layer were 1.1, 0.8 and 0.7°C, respectively. In the 0-200 m layer the corresponding anomalies were 0.9, 0.7 and 0.7°C. The Kanin section is divided into two parts. The inner part represents the Kanin Current and had positive temperature anomalies of 1.0°C in both the 0-50 m and 0-200 m layers. The outer part represents the Novaya Zemlya Current and had positive temperature anomalies of 0.6°C in the 0-200 m layer. 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 1.1 and 0.9°C, respectively. 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 high. The anomalies in all three parts for all three depth layers ranged between 1.0 and 1.3°C.

Compared to 2004 the surface temperature generally was lower (on average 0.5-1.5°C), with the highest deviation in the south-western part (more than by 2°C lower in 2005). Contrary, the bottom temperatures were between approx. 0.1 and 1.2°C higher in 2005 than in 2004 in most of the Barents Sea.

The high temperature in the Barents Sea is mostly due to the inflow of water masses with high temperatures from the Norwegian Sea. In addition, prevailing southern, southwestern and southeastern wind in the north of the sea during the survey promoted the penetration of the warmer and saltier water masses northward.

2.2 Distribution and abundance of 0-group fish and *Gonatus fabricii.*

The distribution of various species of 0-group fish are shown in Figs 2.2.1 – 2.2.9. Abundance indices are shown in tables 2.2.1 to 2.2.3. The density grading is based on catches, measured in number of fish per square nautical mile. More intensive colouring indicates denser concentrations. Length frequency distributions of the main species are given in Table 2.2.4. The coverage of 0-group fish distributions towards the north was good, but the western borders for some of the 0-group distributions were not completely allocated.

2.2.1 Capelin

Capelin was distributed mainly in the eastern areas, but scattered concentrations were also observed south of Spitsbergen. Dense concentrations were found in a wider area than last year. Total abundance of 0-group capelin is above 2004, but again below the long-term average level.

2.2.2 Cod

0-group cod had a wide distribution area, but compared to 2004 there was a displacement to the west and north-west. Dense concentrations were found between 12º-38º E. Low densities in the eastern areas were found in patchy distributions only. Abundance of 0-group cod was on an average level and near the same as in 2004.

2.2.3 Haddock

The total distribution of 0-group haddock was similar to last year, but with higher densities. Dense concentrations of 0-group haddock were registered in large areas in the western Barents Sea and west of Spitsbergen. Both the area index and the stratified sample mean index shows that haddock, once again, has produced a yearclass at a record high level.

2.2.4 Herring

0-group herring was distributed in scattered concentrations mostly. Dense concentrations were found in a small area in the central Barents Sea and only one catch south-west of Spitsbergen Distribution area in the central Barents Sea and west of Spitsbergen has slightly decreased compared to last year. Only patchy distributions were observed to the east and along the coast. Abundance of herring 0-group is much lower than in 2004 and slightly below the average level for the period 1980-2005.

2.2.5 Polar cod

The eastern component has near the same distribution as in 2004 but at lower densities. The distribution of 0-group polar cod seems to extend even further north than the covered survey area. However, abundance of eastern polar cod seems to be poor.

Western component of 0-group polar cod had near the same distribution west of Spitsbergen as last year, with a small area of dense concentration. South and east of Spitsbergen, both scattered and dense concentrations were found in a wider area. Results from the two methods differ regarding to the long term mean, but the abundance of the western component of polar cod was stronger than in 2004.

2.2.6 Saithe

Total distribution area of 0-group saithe was drastically decreased compared to the last year. Saithe was found in the central area in scattered concentrations only. The yearclass is below the long term average and can be characterised as weak.

2.2.7 Redfish

Gradual increasing of dense concentrations as well as total distribution area was observed in the central part of the Barents Sea and to the west and north of Spitsbergen. The abundance was higher than in the last ten years but not above the long-term average.

2.2.8 Greenland halibut

0-group Greenland halibut were only found in low concentrations west and north of Spitsbergen. The total abundance index is much weaker than in 2004 and below the average level. Although the distribution is not completely covered, the 2005 yearclass of Greenland halibut seems to be poor.

2.2.9 Long rough dab

No areas with dense concentrations were found. Scattered densities were distributed mainly in eastern part of the Barents Sea and in larger areas than previous years. A slight increase of scattered distributions in the Spitsbergen area were also observed. The 2005 yearclass seems to be weak.

2.2.10 Wolffish

As in 2004, wolffish were only found in scattered concentrations around Spitsbergen, and in the south-eastern part of the Barents Sea. Additionally, a small area was found near the Norwegian coast. No index is calculated for these species and due to the low concentration, a distribution map was not found necessary.

2.2.11 Sandeel

In the south-eastern part of the Barents Sea, areas with dense and scattered registrations had increased significantly increased compared to 2004 and was similar to the distribution in 2003. In the central region there was only one area with scattered concentration. No index is calculated for this species and due to the low concentration, a distribution map was not found necessary.

2.2.12 Gonatus

0-group *Gonatus fabricii* were found only in two small areas, one west of Spitsbergen and another in the western part of the Barents Sea. No index is calculated for this species and due to the low concentration, a distribution map was not found necessary.

2.3 Distribution and abundance of pelagic fish

Appendix 3 lists the number of fish sampled during the survey.

2.3.1 Capelin

2.3.1.1 Distribution

The geographical density distribution of the total stock and for age 1 fish are shown in Figs. 2.3.1 and 2.3.2. Total distribution of capelin was located in the central and south-eastern parts of the Barents Sea. The main concentrations were found between 74º40' and 78°N and from 26° to 45°E. Small isolated areas with very scattered echo recordings were located to the west of Spitsbergen and northwards of 79ºN between 38º and 47ºE. The northern boundary of the main distribution area was located at near the same latitude as it was found last year and extended north to 78°40'N to the east of Spitsbergen. Small scattered echo recordings were observed even further north; up to 81°40'N near 40°E. In areas with higher densities of larger capelin large numbers of harp seals and humpback whales were observed. Young capelin were distributed mainly to the south of 76°N in scattering layers near the bottom at daytime and near surface during night. In south-eastern part there were often caught significant quantity of young capelin, where echo-recordings were absent. (See section 4, experimental issues).

Echogram of capelin distribution is shown in Figure 2.3.3.

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 2005 are summarised in the text table below. The 2004 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)**	
2004	2003	1	26.9	51.2	3.7	3.8	99.6	195.3
2003	2002	2	13.0	24.8	14.3	11.9	185.9	293.9
2002	2001	3	1.8	5.6	20.8	21.5	36.8	121.4
2001	2000	4	0.07	0.7	25.8	24.2	1.7	17.4
Total stock in:								
2005	2004	1-4	41.8	82.3	7.8	7.6	324.0	628.0
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 0.3 million tonnes, about 50% lesser than the stock estimated last year. About 54% (174 thousand tonnes) of this stock is above 14 cm and considered to be maturing. The 2004 year class (1-group) consists, according to this estimate, of about 27 billion individuals. This estimate is about 50% lower than that obtained for the 1-group last year. The mean weight is estimated at 3.7 g, which is near the same as that measured last year, and the long-term average. The biomass of the 2004 year class is about 0.1 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 2003 year class (2-group) is about 13 billion, about half the size of the 2002 year class measured last year. The mean weight at this age is 14.3 g (11.9 g in 2004), and consequently the biomass of the two years old fish is about 0.2 million tonnes. The mean weight is higher than in recent years and is 3.9 g above the long-term average (Table 2.3.2).

The 2002 year class is estimated at about 1.8 billion individuals with mean weight 20.8 g, giving a biomass of about 0.04 million tonnes. The mean weight is lower than that for the 2004, but is 2.2 g above the long-term average. The 2001 year class (now 4 years old) is estimated at 0.07 billion individuals. With a mean weight of 25.8 g this age group makes up only about 2 thousand tonnes. A few capelin older than four years were found.

Since 2003 the joint Russian-Norwegian 0-group and pelagic fish surveys became a part of an ecosystem survey. In addition to pelagic trawl stations a lot of bottom trawl stations were included. It allows to investigate to what extent the biomass of capelin is underestimated due to that especially older fish are distributed close to the bottom and could not be seen by echosounder. A new time series of capelin assessment which has been started in 2004, and including the “bottom” component of the stock has been continued. Results of capelin bottom component assessment by a swept area method will included in volume 2 of joint survey report. “Traditional” capelin index time series based on acoustic estimation only and used for capelin stock assessment and reference points were continued without changes.

2.3.1.3 Mortality

Table 2.3.4 shows the number of fish in the various year classes, and their “survey mortality” from age one to 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. 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 northern areas a definite boundary of the polar cod distribution area was not found. During the trawl survey for Greenland halibut in the areas around Spitsbergen and between Novaja Zemlja – Frans Josef Land, considerable amounts of polar cod was caught in bottom trawl in the studied areas. 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

The geographical density distribution of the total stock and for age 1 fish are shown in Figs. 2.3.4 to 2.3.5. The densest registrations of polar cod were found in a wide area between 73º - 76ºN and 42º - 53ºE. Main centres of gravity were observed along 74º30'N between 42º - 53ºE and at 75º30'N, 43ºE. This species had a wide distribution, mainly to the east of 37ºE. Local concentrations were registered around Spitsbergen also. Figure 2.3.6 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. 2.3.4-2.3.5.

A detailed estimate is given in Table 2.3.5, and the time series of abundance estimates is summarized in Table 2.3.6. The main results of the abundance estimation in 2005are summarised in the text table below. The 2004 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)	
2004	2003	1	71.7	99.4	8.7	6.3	626.6	627.1
2003	2002	2	57.1	22.8	18.0	17.8	1028.2	404.9
2002	2001	3	3.7	2.6	32.5	31.3	120.2	82.2
2001	2000	4	0.2	0.4	43.6	55.3	7.6	24.6
Total stock in								
2005	2004	1-4	132.9	125.3	13.6	9.1	1803.3	1143.8

Based on TS value: 21,8.1 log L – 72.7, corresponding to $\sigma = 6.7 \cdot 10^{7} \cdot L^{2.18}$

The number of individuals in the 2004 year class (the one-year-olds) is about 28% lower than the one- group measured last year, but their mean weight is 2.4 gram higher. The biomass is, therefore, near the same level as that of the one-year-olds measured last year. The abundance of the 2003 year class (the two-year-olds) is 57.1 billions. This is almost 2.5 times higher than the two-group found last year with about the same mean weight. The biomass has, therefore, increased 2.5 times compared to the 2002 year class estimated last year. The three-years-old fish (2002 year class) is about 3.7 billions that is 42% larger than the three-group estimated last year and has 1.2 g higher mean weight. Consequently, the biomass of this age group has increased with about 46% compared to that for the corresponding age group during the 2004 survey. The four-year-olds (2001 year class) are scarcely found and even less than in last year. The total stock, estimated at 1.8 million tonnes, is at the same level as in 2001 and 1.6 times larger than the biomass estimated last year. The reason for the dramatic increase in biomass for polar cod might be that the area of distribution was much better covered this year compared to last year.

2.3.2.3 Mortality

Table 2.3.7 shows the "survey-mortality rates" of polar cod in the period 1985 to 2005. 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 2005 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.

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 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, and these age groups are difficult to catch in the sampling trawl used during this survey. Besides, the herring schools are partly found near the surface, above the range of the echo sounders. The stock size estimates of herring are therefore considered less reliable than those for capelin and polar cod.

2.3.3.1 Distribution

The distribution of young herring is shown in Figure 2.3.7. According to the distribution herring was divided into east and west components. Eastern juvenile herring with predominance of 1 year olds were distributed over a large area between 25° and 44°E and up to 75°N. West of 25°E there were dominated 3 year olds and older herring dominated. Aggregations with highest density of young herring were recorded in the southern part of the sea between 32° and 43°E. Further east of 46°E as in 2004 there were not found any registrations east of 46°E. The distribution area of herring in 2005 resembles that of the past few years.

2.3.3.2 Abundance estimation

The estimated number and biomass of eastern (east of 25°E) herring from the Barents Sea per age- and length group is given in Table 2.3.8. The main results of the abundance estimation in 2005 are summarised in the text table below. The 2004 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)	
2004	2003	1	46.4	12.3	21.2	28.5	983.7	406.4
2003	2002	2	16.2	36.5	65.2	74.7	1054.5	2.725.3
2002	2001	3	7.0	0.9	114.0	118.3	795.2	106.6
Total stock in:								
2005	2004	1-3	69.5	51.7	40.8	62.9	2833.4	3.251.9
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 69 x 10^9 fish and biomass at 2.8 x 10^6 t. The majority of fish (about 67 % by number) was from the 2003 year class. According to these results, the 2001 year class has left the Barents Sea and was found during survey in Norwegian Sea. Incompatibility between age 2 in this year and age 1 in the previous year may be explained by underestimation of young herring below 12 cm length in 2004. It has been strong mix with 0-group, so this length limit (12 cm) was determined.

2.3.4 Blue whiting

In the southwestern part of the Barents Sea blue whiting were observed as in last year. In recent years, the blue whiting have seemingly expanded its distribution area towards northeast, partly entering the Barents Sea. A quantitative estimation of this species has normally not been attempted during this survey, since only a small part of the total distribution area of this species is covered. Nevertheless, this species is now a major component of the Barents Sea ecosystem, and consequently, it was decided to make a stock size estimate of the covered part of the stock during the current survey. 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 2.3.8. As in 2004 the distribution area stretches from the western border of the covered area east to a line between North Cape and Spitsbergen. In addition, lower concentrations were detected along the coast of Finnmark east to Vardø.

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 at 15 x 10^9 fish and biomass at 1.1 x 10^6 t, compared to 1.4 x 10^6 t in 2004. The main bulk of this stock component consisted of 2000-2004 yearclasses at age 1-5. Older fish at age 6-9 were found in small quantites and insignificant numbers of fish up to 15 years of age were found.

2.4 Demersal fish

Figures 2.4.1-2.4.15 and Tables 2.4.1-2.4.11 show the distribution and abundance of demersal fish. Appedix 3 lists the numer of fish sampled during the survey.

2.4.1 Cod (Fig. 2.4.1 and Table 2.4.1)

The total distribution area of cod in the Barents Sea was covered. 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 single fishes were caught as far north as 80-82° N. Two main concentrations were observed; one in the south-eastern areas from Murman Shallow to the slope of Goose Bank and Novaya Zemlya archipelago, and the other in the northern area south-eastwards and eastwards of Spitsbergen archipelago. Compared to the observations last year very small changes were found in the distribution patterns in 2005. The abundance of cod between 10 and 40 cm was about the same as last year, while the abundance of cod > 40 cm was considerably lower than last year.

2.4.2 Haddock (Fig 2.4.2 and Table 2.4.2)

The haddock distribution was covered well by the survey. Haddock were distributed in the warm water masses and along the coast of Norway and Russia between 17-47°E and to a lesser degree to the west of Spitsbergen. Dense concentrations were found between 35-44°E along Murman Coast and to the north of Norwegian coast. The catches of haddock as well as the distribution area increased considerably in 2005 comparing to the survey in 2004. The abundance of haddock increased considerably from last year. Most of the increase is in the length groups 15-24 cm, corresponding mainly to age 1 fish.

2.4.3 Saithe (Fig 2.4.3)

Saithe were distributed in the warm water masses and along the coast of Norway and Russia between 18-40° E, with a single observation as far east as 47° E. The catches of saithe were observed near Spitsbergen (77-78° N). Compared to the survey in 2004, the eastern border of its distribution and the area with the highest densities moved eastwards in 2005.

2.4.4 Greenland halibut (Fig 2.4.4 and Table 2.4.3)

Mainly young age groups of Greenland halibut were observed because the adult part of the stock was distributed outside of the survey area. Main concentrations were located in the deeper part of the Spitsbergen slope and in the area between Spitsbergen and Franz Josef Land archipelago, as well as between Bear Island and Hopen Island. Catches of Greenland halibut were taken as far east as 61° E and north as 82° N. The catches of Greenland halibut increased in all areas in 2005 compared to the survey in 2004. The abundance of Greenland halibut increased considerably, mainly due to an increase in the abundance of 10-19 cm fish.

2.4.5 Redfish (*Sebastes marinus* and *Sebastes mentella*) (Fig. 2.4.5-2.4.6 and Table 2.4.4-2.4.5)

Redfish were only distributed in the western and northern parts of the survey area. Most dense concentrations were located along the shelf slope from the Norwegian coast to west of Spitsbergen. In all other areas, including the area between Spitsbergen and Franz Josef Land archipelago, redfish was only found in scattered densities. The abundance of *S. mentella* was close to that estimated last year. The abundance of *S. marinus* was slightly higher than last year, but is very low compared to the abundance of *S. mentella*.

2.4.6 Long rough dab (Fig. 2.4.7 and Table 2.4.6)

The distribution of long rough dab was wider than the distribution of 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 62° E and north as 82° N. The abundance of long rough dab decreased slightly compared to 2004.

2.4.7 Wolffishes (Fig. 2.4.8-2.4.10 and Table 2.4.7-2.4.9)

The abundance of Atlantic wolffish was the same as last year, while the abundance of spotted and northern wolffish decreased slightly.

2.4.8 Non-target species (Figs 2.4.11-2.4.15, Tables 2.4.10-2.4.12)

Totally 89 fish species from 30 families occurred in the trawl catches during the survey. A list of the species and ecological and zoogeographic characteristics is given in Appendix 4. The highest number of species was observed in the families Zoarcidae (11 species), Gadidae (9 species), Cottidae (8 species) and Pleuronectidae (7 species).

Five species were chosen as indicator species to demonstrate the distribution patterns of fishes from the different zoogeographic groups – mainly Arctic sea tadpole *Careproctus reinhardti*, arcto-boreal Atlantic poacher *Leptagonus decagonus*, mainly boreal hook-ear sculpin

Artediellus atlanticus and thorny skate *Amblyraja radiata* and boreal european Norway pout *Trisopterus esmarkii*.

2.4.8.1 Sea tadpole (Fig. 2.4.11)

This species was distributed mostly in the central and northern Barents Sea. The biggest catches were observed near the southern and eastern coast of Spitsbergen and in the area between Spitsbergen and Franz Josef Land archipelago.

2.4.8.2 Atlantic poacher (Fig. 2.4.12, Table 2.4.10)

The species was distributed mostly in the central and northern Barents Sea. The biggest catches were observed near the southern and eastern coast of Spitsbergen and in the central open part of the Barents Sea. The species is practically absent in the warm water in the southwestern part of the sea. Its distribution is similar to the distribution of cold water. The abundance decreased slightly from 2004 to 2005.

2.4.8.3 Hook-ear sculpin (Fig. 2.4.13)

The species is widely distributed in the Barents Sea. The biggest catches were observed in the northern Barents Sea (near the southern and eastern coast of Spitsbergen and in the area between Spitsbergen and Franz Josef Land archipelago).

2.4.8.4 Thorny skate (Fig. 2.4.14, Table 2.4.11)

The species was widely distributed in the Barents Sea excluding the northern areas near Franz Josef Land archipelago, as well as the western Norwegian coast. The biggest catches were observed in the central part of the Barents Sea, in the area between Spitsbergen and the Bear Island as well as in the southeastern part of the Barents Sea near the Kanin Peninsula.

2.4.8.5 Norway pout (Fig 2.4.15)

The species was distributed only in the southwestern part of the Barents Sea near Norway and to a lesser extent along the Murman coasts. Its distribution is similar to the distribution of the warmest Atlantic water. Single specimens were found near the southern coast of Spitsbergen.

2.5 Phytoplankton

Data on fluorescence, chlorophyll **a**, nutrients and phytoplankton species composition data 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.

2.6 Zooplankton

The map of zooplankton sampling localities and sampling gear (Russian and Norwegian vessels) is shown in figure 2.3. 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 figure 2.3 it is apparent that the investigated area is covered reasonably 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.

Total number of zooplankton hauls obtained during the Norwegian and Russian surveys in the Barents Sea in August-October 2005.

Net	Norwegian ships		Russian ships	
	«G.O.Sars»	«J.Hjort»	«F.Nansen»	«Smolensk»
WP-2	201	123	21	-
Juday	10	-	228	101
MOCNESS	34	27	-	-

In figure 2.6.1 an overview of zooplankton biomass (wet-weight mg/m^3) from the Russian vessel Fridtjof Nansen in the upper 0-50 m by Juday net is shown. We observe that biomass from mid August to September in different areas of the survey were rather high and that a marked downward seasonal shift in the vertical distribution of zooplankton also took place (not shown).

Biomass data collected by Norwegian and Russian vessels from stations where WP2 and Juday both have been used will be compared as soon as all relevant data are available. Secondly, species composition and abundance from WP2 and Juday nets collected at the same stations in 2004 and 2005 will be analyzed and compared. Preliminary analysis has shown a significant variability in stage composition of key species of *Calanus*. A more extensive comparison and analysis should therefore be undertaken to help quantify this variability, based on data from 2004 and 2005. 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) will be followed up by both parties with regard to working up samples, exchange of raw data, analysis and publication in relevant reports or international refereed journals. It is suggested that the agreement is strengthened with additional sampling and also new approaches in future surveys with the ultimate goal of a unified sampling approach.

It is recommended, based on experience during field sampling in 2005 and from preliminary comparisons based on data from 2004, that a Bongo-like rig 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 way the problems concerning variability between consecutive net hauls can be reduced.

2.7 Sea mammals and birds

A total of 622 observations of 5 564 individuals of marine mammals comprising 17 species were recorded from RVs “Johan Hjort”, G.O. Sars, “F. Nansen”, “Smolensk” and the aircraft “Arktika”. Number of marine mammals observed by species is listed in Table 2.7.1. The most abundant species in terms of individuals were harp seals (49% of total number of individuals observed), due to one observation of 2000 individuals made on board “F. Nansen”, and dolphins, of which white-beaked dolphins were the predominant species (23% of total number of individuals observed). Of the baleen whales (10% of total number of individuals observed), minke and fin whales were most numerous (Table 2.7.1).

Minke whales had the widest distribution among the baleen whales as they were observed both on and off the shelf and throughout the survey area (Fig. 2.7.1). Humpback and fin whales were observed on the shelf or the shelf break west of Spitsbergen, and while humpback whales were observed both in the northern and southern Barents Sea, fin whales were more restricted to the central and northern Barents Sea. Sei whales, normally considered as a southern deep-sea species, were observed both west and east of Svalbard and in the central Barents Sea. Finally, one observation of the rare bowhead whale was recorded east of Svalbard in the northern Barents Sea. Both sei and bowhead whales were observed in open water, about 120 nautical miles from the sea ice edge. The dolphins, predominantly comprising white-beaked dolphins, were observed throughout the Barents Sea. In contrast, sperm whales were only observed off the shelf break, mainly south of Bear Island (Fig. 2.7.2). Harp seals were observed east of Svalbard only, close to the sea ice edge (Fig. 2.7.2).

Around 6000 observations of 115 218 sea birds comprising 29 species were recorded onboard the vessels “G. O. Sars”, “Johan Hjort”, “F. Nansen” and the aircraft “Arktika” (Table 2.7.2). The procellarids were the most abundant species group in terms of individuals observed (59 586) due to high abundances of northern fulmars, while the alcids were the most abundant group in terms of observations (7 773). The most abundant single species was the northern fulmar with 59 499 individuals recorded (Table 2.7.2).

The alcids were observed throughout the study area, but the abundance and species distribution varied geographically (Fig. 2.7.3). Number of individuals increased northwards and eastwards. In the south-western Barents Sea puffins and common guillemots dominated, the central areas were dominated by brünnich’s guillemots and the northern areas by brunnich’s guillemots, little auks and black guillemots. Little auks were generally closer to Svalbard than the brunnich’s guillemots. Furthest north black guillemots were observed in high concentrations.

The gulls and the northern fulmars are ship-followers, and hence their observed distribution will be influenced by the presence of the ships. Figure 2.7.4 show the distribution of these species as observed from the aircraft “Arktika” (mainly northern fulmars and kittiwakes) and the vessels “G.O. Sars” and “Johan Hjort” (based on counts every half-hour). Northern fulmars were observed in most of the study area, although they dominated the abundances in the western part. Kittiwakes dominated the abundances in the eastern and northern areas. Great black-backed gulls and herring gulls were observed in the southern Barents Sea, while ivory gulls were observed only in the extreme north. A few glaucous gulls were observed in the central Barents Sea, around Bear Island and southern Svalbard.

Four species of skuas were observed; great, pomarine, long-tailed and arctic skua (Fig. 2.7.5). Numbers of skuas increased towards the north and east, with arctic skuas dominating the southern areas and pomarine and great skuas dominating the northern areas.

The observed distributions of marine mammals and birds shown in Figs. 2.7.1-2.7.5 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.

2.8 Benthos investigations

The five vessels involved in the ecosystem survey sampled in different areas of the Barents Sea. Bottom trawl (Campelen) was used on all ships (see table below) in the whole survey area, but only F. Nansen and GO Sars had taxonomic experts participating on the cruise. The southeastern part of the survey area and the area around Svalbard was sampled with grab (van Veen) and small trawls (Sigsby and Beam trawl). Video rig and epibenthic sled (RP sled) were only used onboard GO Sars (see table 2.8.1).

The samples collected with all gears except bottom trawl are currently being processed at PINRO and IMR. The bycatch data from the Russian vessels is already punched into databases. Unfortunately, the recorded bycatch data from GO Sars is not completely finished at this point. A preliminary species list of bycatch invertebrates recorded onboard the different ships is provided in Appendix 5.

There was a tendency to decreased number of species in larger trawl samples (Fig. 2.8.1).

This can best be explained by the fractionation of large samples. More analysis of the bycatch data is needed to understand the potential and limitation of this survey technique.

The number of identified taxa in the bycatch material was in total 313 (see table below). Only 10 taxa were recorded on all five vessels. Of these, only two were identified to species level (*Pandalus borealis* and *Sclerocrangon ferox*).

Figure 2.8.2 shows the biomass distribution of benthic invertebrates in the Barents Sea caught as by-catch in the bottom trawl.

Number of identified and unidentified invertebrate species recorded in the bycatch onboard the five research vessels involved in the ecosystem survey.

	Vessels				
Equipment	*GO Sars*	*Johan Hjort*	*Jan Mayen*	*Fritjof Nansen*	*Smolensk*
Number of identified taxa	117	72	40	176	77
Identified species (% of total taxa number)	34	42	7	71	58

King Crab (*Paralithodes camtschaticus*) – figure 2.8.4

The distribution area for king crab was mainly located close to the coast (between 27-45° E). High catches of king crab were caught in the eastern area. The westernmost record was from north of Porsangerfjorden.

Snow crab (*Chionoecetes opilio*) (figure 2.8.3)

Snow crab was registrated only on two stations between 30º and 40º E, and 71º and 73º N. Standardised to hours of trawling the catch was around 2-3 kg.

Shrimp (*Pandalus borealis*) figure 2.8.5

Shrimp was distributed practically all over the surveyed areas. The larger size shrimp were mainly found in the northern part of the survey area.

3 ECOLOGICAL CONSIDERATIONS

During the ecosystem survey major components of the ecosystem are monitored synoptically. Traditionally the results of these are presented and treated separately, but then the potential to gleam insight into the ecology of the Barents Sea ecosystem is not utilized to the full extent. The synoptic data from this ecosystem survey provides a unique opportunity to study ecological interactions between species and the relationships between the physical processes and species distribution.

There is a great need for such ecological knowledge when implementing ecosystem-based management. Therefore preliminary analyses of ecological interactions will be included in volume 2 of the survey report. However, the ecological analysis cannot be started until data from surveyed components of the ecosystem are available. In volume 2 of the cruise report we plan to carry out the following preliminary ecological analyses: 1) Estimate and map species overlap between for key prey and predator species, 2) Map biodiversity, also in relation to physical processes, 3)Estimate and map species distribution in relationship to physical processes and habitat for key species and processes.

4 EXPERIMENTAL WORK. SWEPT AREA METHOD FOR CAPELIN ESTIMATION BY PELAGIC TRAWL.

As known, the acoustic method possibilities for fish detection as in “near the bottom”, as in “near the surface” layers, are too much limited according to “the echosounder acoustic dead zone”. In this connection the trawl method (or swept area method) is often applied for the density estimation of fish, distributed close to bottom or close to surface.

As in previous years, for the south-east part of the Barents Sea in August 2005 the “close to surface” capelin distribution was typical, especially at night time. It often brought to the situations when the catches of capelin in the near-surface pelagic hauls had achieved several hundreds specimen but acoustic s_A values was being about zero. So the using of the trawl method for capelin estimation in the near-surface layers looked enough adjustable in this case. Based on the r/v “Smolensk” data, the near-surface capelin estimations by the trawl and acoustic methods were made for the south-east part of the Barents Sea.

Acoustic estimation was made by the classical method using the mean s_A values per WMO squares and of summarized capelin length distribution for the all area. The trawl estimation was made by using of the usual “swept area method”, taking in attention the regular distribution of the pelagic hauls positions 35 nm each from other by the formula for each 35x35 nm^2 square:

$$N_i = \frac{Catch_i \cdot 1852 \cdot 35 \cdot 35 \cdot K_i \cdot K_{TR}}{L_{eff} \cdot D_{TR}} ,$$

where N_i – abundance of the i-length group fishes inside of each 35x35 nm^2 square;

$Catch_i$ – the number of the i-length group fishes in the trawl catch;

K_i – theoretical length-dependant catchability index assumed for the sampling trawl (Mamylov, 2004);

$K_{TR} = (H_{TRmax} + dH_{TR} – H_{TRmin})/dH_{TR}$ (the number of trawl horizons for each haul);

Leff – the horizontal trawl opening assumed to be equal 15 meters

D_{TR} – distance of trawling (nm).

The results of the capelin estimation by the acoustic and trawl methods are in the table below.

It’s seen that the trawl method gives more than 3 times higher capelin abundance compared to the acoustic method.

Capelin estimation results in the south-east part of the Barents Sea by the acoustic and the pelagic trawl methods (Total area 127088 sq.nm)

			Acoustic estimation		Trawl estimation	
L,cm	q	w, g	N, 10^6	W, tonn	N, 10^6	W, tonn
5.7	92	0.5	47.9	25.6	163.8	87.5
6.2	1128	0.7	513.3	367.5	1754.9	1256.4
6.7	3771	0.9	1497.8	1404.4	5120.9	4801.5
7.2	5704	1.2	1935.6	2331.1	6617.5	7969.8
7.7	5526	1.5	1672.1	2543.5	5716.7	8696.0
8.2	5898	1.9	1558.7	2951.0	5329.0	10089.2
8.7	6517	2.3	1508.3	3508.3	5156.6	11994.5
9.2	7182	2.8	1448.8	4092.9	4953.2	13993.2
9.7	6454	3.4	1242.4	4219.3	4247.7	14425.2
10.2	5725	4.0	964.9	3902.9	3299.0	13343.7
10.7	3874	4.8	570.1	2723.5	1949.1	9311.3
11.2	2409	5.6	309.2	1731.2	1057.0	5918.9
11.7	1054	6.5	118.1	770.0	403.9	2632.7
12.2	478	7.5	46.6	351.5	159.4	1201.8
12.7	148	8.7	12.7	109.8	43.3	375.3
13.2	68	9.9	5.8	57.7	19.9	197.2
13.7	65	11.3	5.6	62.8	19.0	214.6
14.2	152	12.8	13.0	166.3	44.5	568.4
14.7	74	14.4	6.3	91.3	21.6	312.1
15.2	117	16.2	10.0	162.1	34.2	554.4
15.7	76	18.1	6.5	117.9	22.2	403.0
16.2	40	20.2	3.4	69.2	11.7	236.5
16.7	4	22.5	0.3	7.7	1.2	26.3
17.2	9	24.9	0.8	19.2	2.6	65.6
17.7	0	27.5	0.0	0.0	0.0	0.0
18.2	0	30.3	0.0	0.0	0.0	0.0
18.7	1	33.3	0.1	2.8	0.3	9.7
TOTAL:			13498.3	31789.7	46149.2	108685.1

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Tables

Table 2.1.1. Mean water temperature[1)] in the main parts of standard oceanographic sections in the Barents Sea and adjacent waters in August-September 1965-2005. The sections are: Kola[2)] (column 1-3), Kanin (column 4[3)]-5[4)]), North Cape-Bear Island (column 6[5)]), Bear Island – West (column 7[6)]), Vardø – North (column 8), Fugløya – Bear Island (column 9).

Year	Section and layer (depth in metres)								
	1	2	3	4	5	6	7	8	9
	0-50	50-200	0-200	0-bot.	0-bot.	0-200	0-200	0-200	0-200
1965	6.7	3.9	4.6	4.6	3.7	5.1	-	-	-
1966	6.7	2.6	3.6	1.9	2.2	5.5	3.6	-	-
1967	7.5	4	4.9	6.1	3.4	5.6	4.2	-	-
1968	6.4	3.7	4.4	4.7	2.8	5.4	4	-	-
1969	6.7	3.1	4	2.6	2	6	4.2	-	-
1970	7.8	3.7	4.7	4	3.3	6.1	-	-	-
1971	7.1	3.2	4.2	4	3.2	5.7	4.2	-	-
1972	8.7	4	5.2	5.1	4.1	6.3	3.9	-	-
1973	7.7	4.5	5.3	5.7	4.2	5.9	5	-	-
1974	8.1	3.9	4.9	4.6	3.5	6.1	4.9	-	-
1975	7	4.6	5.2	5.6	3.6	5.7	4.9	-	-
1976	8.1	4	5	4.9	4.4	5.6	4.8	-	-
1977	6.9	3.4	4.3	4.1	2.9	4.9	4	3.6	4.9
1978	6.6	2.5	3.6	2.4	1.7	5	4.1	3.2	4.9
1979	6.5	2.9	3.8	2	1.4	5.3	4.4	3.6	4.7
1980	7.4	3.5	4.5	3.3	3	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	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	4.5	3.6	5.9	5	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	2.7	2.5	5.2	3.9	3.5	5.1
1988	7	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	3.9	6.3	5.7	5.0	6.3
1991	7.7	4.5	5.3	4.8	4.2	6	5.4	4.8	6.2
1992	7.5	4.6	5.3	5	4	6.1	5	4.6	6.1
1993	7.5	4	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	-	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	4.7	5.6	4	5.7	4.9	4.2	5.9
2002	8.6	4.8	5.8	4	3.7	-	5.4	4.6	6.5
2003	7.2	4	4.8	4.2	3.3	-	-	4.7	6.2
2004	9	4.7	5.7	5	4.2	-	5.8	4.8	6.4
2005	8	4.4	5.3	5.2	3.8	6.7	-[7)]	5.0	6.5
Average	7.5	3.9	4.8	4.3	3.3	5.8	4.7	4.2	5.8

[1)] Earlier presented temperatures have been slightly adjusted (Tereshchenko, 1992).
[2)] Murmansk Current; Kola section (70º30´N-72º30´N, 33º30´E)
[3)] Kanin section (68º45´N-70º05´N, 43º15´E)
[4)] Kanin section (71º00´N-72º00´N,43º15´E)
[5)] North Cape Current; North Cape-Bear Island section (71º33´N, 25º02´E – 73º35´N, 20º46´E)
[6)] West Spitsbergen Current; Bear Island – West section (74º30´N, 06º34E – 15º55´E).
[7)] The temperature wasn't evaluated because the Bear Island – West section was carried out with station positions that differed from the conventional.

Table 2.2.1. Abundance indices (area method) of 0-group fish in the Barents Sea and adjacent waters in August-September 1965-2005

Year	Capelin[1]	Cod[2]	Haddock[2]	Herring[3]	Polar cod West	Polar cod East	Redfish	Greenland halibut	Long rough dab
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
1985-2005	315	698	352		114	295	305	18	111
1965-2005	290	494	243		106	247	368	18	94

[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	217 454	149 174	285 735	66	38	94	67	42	93	5	1	9	282 673	0	707 218
1981	110 142	59 430	160 855	49	34	65	14	7	22	3	0	9	156 507	0	371 639
1982	181 125	45 504	316 745	498	359	638	537	390	683	49	12	87	169 453	10 618	328 287
1983	100 817	54 303	147 331	3 979	1 746	6 213	1 362	895	1 830	32 830	12 326	53 334	53 589	26 931	80 247
1984	73 228	45 396	101 061	5 905	1 900	9 911	1 285	877	1 692	4 258	1 570	6 946	43 094	14 054	72 133
1985	24 191	0	48 833	15 113	7 622	22 605	692	397	987	7 858	1 389	14 328	319 308	119 797	518 818
1986	13 519	668	26 370	1 870	1 289	2 450	472	273	672	9	0	18	110 738	0	228 698
1987	600	134	1 066	167	85	250	128	77	179	2	0	5	24 678	13 351	36 006
1988	28 826	5 975	51 678	526	301	751	393	155	630	8 946	3 366	14 526	68 636	43 844	93 429
1989	258 741	205 163	312 318	718	412	1 024	175	120	230	4 113	1 407	6 819	16 016	7 667	24 364
1990	36 041	24 438	47 643	6 616	3 550	9 682	1 139	838	1 440	4 541	0	9 493	92 985	50 944	135 025
1991	55 879	25 342	86 417	11 082	7 997	14 166	3 961	2 966	4 956	79 417	41 631	117 203	38 620	0	78 044
1992	116	0	248	45 546	24 813	66 278	1 678	1 200	2 155	39 073	22 509	55 636	13 810	0	36 539
1993	257	72	442	26 917	14 421	39 414	1 217	824	1 611	68 077	4 138	132 016	5 717	0	13 927
1994	9 237	905	17 569	26 762	13 870	39 654	1 940	1 025	2 854	18 918	0	40 609	53 599	0	123 179
1995	614	0	1 412	89 604	45 220	133 988	540	275	805	1 700	611	2 790	16 516	3 373	29 660
1996	47 055	24 214	69 896	70 783	46 761	94 804	1 066	796	1 336	59 120	29 516	88 724	27	8	47
1997	57 585	24 634	90 535	68 060	50 188	85 932	626	432	819	46 833	21 013	72 652	147	0	296
1998	35 881	23 090	48 671	6 798	4 310	9 287	5 993	3 739	8 247	79 577	44 037	115 118	746	9	1 483
1999	88 855	48 623	129 088	1 364	151	2 577	1 154	378	1 931	16 525	2 116	30 934	41	15	66
2000	39 380	590	78 170	26 112	13 948	38 276	2 945	1 883	4 008	49 710	3 342	96 078	7 539	0	16 907
2001	5 212	639	9 786	981	188	1 775	2 016	1 293	2 739	852	152	1 553	6	1	11
2002	20 722	11 632	29 811	19 128	11 086	27 170	1 848	1 274	2 421	23 494	12 217	34 772	132	22	243
2003	130 672	68 070	193 273	19 098	11 174	27 021	8 643	4 481	12 805	31 400	17 390	45 410	192	0	412
2004	20 737	5 641	35 834	22 420	16 392	28 448	20 081	13 354	26 808	138 995	98 698	179 291	1 024	0	2 105
2005	47 256	16 240	78 272	21 427	14 610	28 245	33 785	24 796	42 774	26 361	1 151	51 571	12 370	665	24 074
Mean	61 698			18 907			3 606			28 564			57 237		

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	5	57	17	97	1 183	869	1 497	0	0	0	14 767	0	35 894
1981	0	0	0	69	42	95	517	253	780	302	140	464	5 398	2 108	8 689
1982	137	0	364	40	11	70	861	577	1 146	0	0	1	308	0	680
1983	244	83	404	39	20	57	433	263	603	1 406	0	3 256	6 180	0	13 218
1984	760	221	1 299	31	18	45	45	31	59	123	0	313	3 236	788	5 684
1985	14	0	28	45	28	63	282	120	445	20 346	5 399	35 292	839	0	1 692
1986	1	0	2	115	62	167	7 218	5 149	9 288	8 490	2 873	14 107	2 113	129	4 096
1987	1	0	1	37	24	50	837	436	1 238	7 791	0	18 096	77	33	122
1988	17	4	29	8	3	13	198	111	285	403	8	798	4 722	0	10 104
1989	1	0	3	2	1	3	175	95	254	228	0	489	17 293	2 350	32 236
1990	10	1	20	3	0	5	54	25	83	384	97	671	32 403	0	72 485
1991	4	2	5	3	0	7	83	49	118	62 589	28 607	96 572	40 526	0	116 372
1992	162	88	237	9	0	18	130	20	239	7 153	0	14 371	10 083	1 542	18 624
1993	372	0	927	4	2	7	51	22	80	13 235	3 458	23 012	8 380	1 385	15 376
1994	3	0	5	39	0	93	1 823	1 155	2 490	189 989	100 120	279 857	5 485	0	12 090
1995	172	75	269	19	5	32	261	43	478	0	0	0	28	2	53
1996	146	63	228	6	3	9	43	2	84	74 321	46 479	102 162	4 925	0	12 253
1997	81	38	124	5	3	7	97	44	150	32 700	17 919	47 481	7 711	623	14 799
1998	78	33	123	8	3	12	27	13	42	12 442	7 336	17 549	10 307	0	23 356
1999	134	66	202	16	10	23	107	1	212	131 108	83 614	178 601	3 134	502	5 766
2000	209	114	304	39	14	65	216	105	327	112 525	64 870	160 179	24 526	15 767	33 286
2001	21	0	46	52	11	93	78	0	165	0	0	0	16 492	0	36 246
2002	322	186	457	61	0	142	755	352	1 158	97 154	57 155	137 153	30 117	5 580	54 654
2003	348	0	824	14	0	30	122	66	178	10 821	5 700	15 943	2 739	197	5 281
2004	1 426	859	1 993	81	23	140	37	19	55	33 277	14 843	51 710	317	88	546
2005	54	36	73	9	4	13	189	95	283	5 823	2 526	9 119	3 367	1 269	5 464
Mean	181			31			609			31 639			9 826		

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

Year	Capelin			Cod			Haddock			Herring			Saithe			Polar cod (east)			Polar cod (west)		
	Abundance index	Confidence limit		Ab. index	Confidence lim.		Ab. index	Confidence lim.		Ab. index	Confidence lim.		Ab. index	Confidence lim.		Ab. index	Confidence lim.		Ab. index	Confidence lim.	
1980	809 193	553 831	1 064 555	316	167	465	309	190	427	93	25	161	21	0	47	0	0	0	126 699	0	307 667
1981	428 316	228 724	627 909	277	195	358	71	31	111	38	0	86	0	0	0	2 479	1 147	3 810	48 351	19 163	77 538
1982	611 698	152 679	1 070 717	2 581	1 893	3 269	2 296	1 690	2 902	798	219	1 378	266	0	665	3	0	6	2 751	0	6 070
1983	332 287	173 699	490 875	15 863	7 716	24 011	4 453	3 220	5 686	121 992	28 954	215 030	420	130	709	1 406	0	3 256	55 760	0	120 841
1984	168 660	103 049	234 270	20 342	5 689	34 995	3 753	2 572	4 934	18 193	1 301	35 084	1 006	332	1 680	123	0	313	26 718	6 475	46 962
1985	73 436	726	146 146	63 561	31 160	95 962	2 463	1 535	3 392	30 140	6 135	54 146	34	4	64	84 185	23 055	145 316	6 907	0	14 133
1986	56 472	4 969	107 976	9 675	6 654	12 695	2 071	1 228	2 915	112	31	193	4	0	9	64 160	21 966	106 355	18 414	0	37 224
1987	2 302	471	4 133	1 036	497	1 574	749	459	1 039	50	0	112	4	0	10	64 879	0	148 667	652	273	1 032
1988	92 075	16 757	167 392	2 668	1 547	3 789	1 687	616	2 758	62 354	21 253	103 455	31	11	50	2 721	56	5 386	41 910	0	91 010
1989	881 764	702 020	1 061 507	2 781	1 659	3 903	665	461	868	17 640	8 202	27 078	11	0	23	1 593	0	3 393	156 778	17 601	295 955
1990	115 198	77 600	152 796	23 609	13 304	33 915	3 081	2 278	3 885	7 925	621	15 228	28	3	53	2 774	668	4 880	250 497	0	558 091
1991	164 819	73 881	255 757	41 545	30 446	52 644	14 216	10 877	17 556	270 770	103 481	438 060	9	4	14	580 649	262 623	898 675	293 904	0	841 007
1992	349	0	743	169 569	92 199	246 939	4 889	3 343	6 435	88 619	51 003	126 236	332	161	504	47 171	0	94 701	81 776	12 754	150 797
1993	776	161	1 391	96 425	52 852	139 998	3 107	2 141	4 072	328 180	2 398	653 963	1 050	0	2 551	97 783	24 623	170 943	71 105	12 557	129 653
1994	20 987	1 942	40 032	86 942	45 935	127 950	5 191	2 922	7 459	131 190	0	273 976	6	0	13	1 212 620	548 275	1 876 966	49 512	0	109 966
1995	2 067	0	4 743	279 395	134 482	424 308	1 366	694	2 038	14 320	5 680	22 960	473	210	735	0	0	0	217	12	423
1996	143 826	73 868	213 783	278 201	185 042	371 361	2 618	1 980	3 257	568 532	269 319	867 745	471	197	745	611 412	383 278	839 546	46 883	0	116 490
1997	196 013	84 792	307 235	298 365	221 488	375 242	2 058	1 412	2 704	468 285	173 000	763 571	350	166	534	289 215	155 738	422 691	63 047	6 053	120 041
1998	88 035	48 283	127 788	24 066	15 780	32 352	14 160	9 429	18 891	474 513	274 346	674 681	164	80	249	17 195	8 796	25 595	95 558	0	220 902
1999	294 999	150 183	439 814	4 406	987	7 826	2 782	1 041	4 523	36 959	13 919	59 999	272	136	408	1 164 168	734 544	1 593 792	26 605	4 450	48 760
2000	140 131	5 619	274 643	108 728	58 115	159 341	11 003	6 913	15 092	470 181	23 065	917 297	863	456	1 270	889 767	509 481	1 270 052	205 736	141 129	270 343
2001	19 895	3 266	36 523	4 552	934	8 171	5 431	3 719	7 142	10 243	1 839	18 646	48	0	107	0	0	0	144 870	0	315 443
2002	21 887	12 610	31 164	33 939	21 774	46 104	4 380	2 944	5 816	93 210	13 660	172 759	517	300	734	97 154	57 155	137 153	234 204	47 674	420 734
2003	458 890	235 602	682 178	89 964	52 287	127 641	33 050	17 840	48 260	192 343	69 648	315 038	2 705	0	7 090	82 300	42 482	122 118	14 595	1 032	28 157
2004	69 251	22 963	115 539	77 737	56 183	99 291	41 646	28 141	55 152	799 415	546 550	1 052 281	4 869	2 786	6 952	259 201	113 764	404 638	2 437	667	4 206
2005	154 692	54 006	255 378	71 955	50 378	93 532	92 889	68 915	116 862	125 719	19 941	231 496	173	112	234	39 715	18 247	61 183	27 431	9 833	45 028
Mean	205 693			69 558			10 015			166 608			543			215 872			80 512		

Table 2.2.4. Length distributions (%) of 0-group fish in the Barents Sea and adjacent waters, August-October 2005.

Length, cm	Cod	Haddock	Capelin	Herring	Saithe	Redfish	Polarcod	Grhalibut	LRD	Sandeel
1.5-1.9						0.02	0.88		0.22	
2.0-2.4			0.02			0.05	4.07		8.21	
2.5-2.9	0.00		0.17	0.00		0.20	3.37		16.32	1.72
3.0-3.4	0.18	0.05	0.71			5.40	3.83		26.94	5.90
3.5-3.9	0.27	0.01	4.00			26.29	10.12	14.29	30.03	16.31
4.0-4.4	0.44	0.05	23.66	0.06	0.37	45.97	16.22	28.02	15.45	21.25
4.5-4.9	0.40	0.10	36.70	0.42		19.43	23.16	10.43	2.69	12.31
5.0-5.4	0.41	0.23	24.33	3.25	1.36	2.64	27.05	21.56	0.13	16.98
5.5-5.9	0.48	0.46	9.28	3.53	4.40		11.29	5.07		12.01
6.0-6.4	1.38	0.79	1.05	4.03	3.08			2.53		11.25
6.5-6.9	2.87	1.32	0.05	7.69	5.59			2.53		1.23
7.0-7.4	6.72	2.08	0.01	22.60	5.53			9.75		0.85
7.5-7.9	11.39	4.50	0.01	34.40	7.93			5.81		0.04
8.0-8.4	19.57	7.38	0.00	17.96	7.74					0.08
8.5-8.9	19.01	11.08		5.20	5.97					0.04
9.0-9.4	17.06	14.20		0.61	12.46					0.01
9.5-9.9	10.93	16.45		0.19	13.78					
10.0-10.4	4.36	12.81		0.04	5.09					0.01
10.5-10.9	2.81	11.72		0.00	6.94					0.01
11.0-11.4	1.27	8.60		0.00	6.80					0.00
11.5-11.9	0.23	4.36		0.00	7.25					0.00
12.0-12.4	0.03	2.08			4.02					
12.5-12.9	0.09	1.12			1.31					
13.0-13.4	0.09	0.38								
13.5-13.9		0.19			0.40					
14.0-14.4	0.02	0.05								
14.5-14.9		0.01								
Tot.catch	7512	8926	3250	2105	214	1100	4061	20	497	941
Mean length (cm)	8.55	9.65	4.73	7.42	9.06	4.11	4.38	5.05	3.23	4.53

Table 2.3.1. Acoustic estimate of Barents Sea capelin, August-September 2005

Length (cm)			Age/Year class				Sum	Biomass	Mean
			1	2	3	4+	(10^6)	(10^3 t)	weight (g)
			2004	2003	2002	2001-			
6.5	-	7.0	797				797	0.8	1.0
7.0	-	7.5	1559				1559	1.6	1.0
7.5	-	8.0	2148				2148	3.5	1.6
8.0	-	8.5	1592				1592	1.6	1.0
8.5	-	9.0	1687				1687	2.0	1.2
9.0	-	9.5	1745				1745	4.6	2.7
9.5	-	10.0	2457	3			2460	8.1	3.3
10.0	-	10.5	4030	5			4035	16.9	4.2
10.5	-	11.0	4542	72			4613	22.2	4.8
11.0	-	11.5	3169	3			3172	17.6	5.5
11.5	-	12.0	2555	326			2880	17.7	6.1
12.0	-	12.5	453	405			858	6.5	7.6
12.5	-	13.0	86	1287	10		1382	12.0	8.7
13.0	-	13.5	0	1346	21		1367	13.8	10.1
13.5	-	14.0	85	1710	39		1834	21.1	11.5
14.0	-	14.5	12	1783	56		1851	24.5	13.2
14.5	-	15.0	21	1843	99	4	1966	30.4	15.5
15.0	-	15.5		1746	202	2	1950	33.5	17.2
15.5	-	16.0		1138	530	1	1668	32.2	19.3
16.0	-	16.5		762	333	13	1109	24.5	22.1
16.5	-	17.0		452	209	31	693	16.8	24.3
17.0	-	17.5		98	153	4	255	7.2	28.3
17.5	-	18.0		44	85	2	131	3.7	28.6
18.0	-	18.5		2	25	10	37	1.2	33.5
18.5	-	19.0				1	1	0.0	34.3
19.0	-	19.5				1	1	0.0	37.3
TSN (10^6)			26938	13025	1762	69	41794		
TSB (10^3 t)			99.6	185.9	36.8	1.7		324.0	
Mean length (cm)			9.9	14.4	16.0	16.8	11.5		
Mean weight (g)			3.7	14.3	20.8	25.8			7.8
SSN (10^6)			33	7868	1692	69	9662		
SSB (10^3 t)			0.5	136.0	36.0	1.7		174.3	

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 autumn 1973-2005.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	5.14
1974	1.06	3.5	3.06	5.6	1.53	8.9	0.07	20.8	+	25.0	5.73
1975	0.65	3.4	2.39	6.9	3.27	11.1	1.48	17.1	0.01	31.0	7.81
1976	0.78	3.7	1.92	8.3	2.09	12.8	1.35	17.6	0.27	21.7	6.42
1977	0.72	2.0	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	25.0	4.25
1979	0.05	4.5	2.47	7.4	1.53	13.5	0.10	21.0	+	27.0	4.16
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	0.32	23.3	0.01	28.7	3.90
1982[1]	1.22	2.3	1.33	9.0	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			4.23
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	0.01	15.7			0.86
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			0.10
1988	0.07	3.4	0.35	12.2	+	17.1					0.43
1989	0.61	3.2	0.20	11.5	0.05	18.1	+	21.0			0.86
1990	2.66	3.8	2.72	15.3	0.44	27.2	+	20.0			5.83
1991	1.52	3.8	5.10	8.8	0.64	19.4	0.04	30.2			7.29
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	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			0.19
1996	0.24	2.9	0.22	18.6	0.05	23.9	+	25.5			0.50
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			2.78
2000	1.70	3.8	1.59	14.4	0.95	27.9	0.08	37.7			4.27
2001	0.37	3.3	2.40	11.0	0.81	26.7	0.04	35.5	+	41.4	3.63
2002	0.23	3.9	0.92	10.1	1.04	20.7	0.02	35.0			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			0.32
Average	0.66	3.6	1.33	10.4	0.84	18.6	0.26	24.2	0.07	27.4	3.02

[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. Survey mortalities for capelin from age 1 to age 2

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

Table 2.3.4 Acoustic estimate of polar cod in August-September 2005

	Age/Year class							
Length(cm)	1	2	3	4	5	Sum	Biomass	Mean Weight
	2004	2003	2002	2001	2000	(10^6)	(10^3)	(g)
6.5 - 7.0	14					14	0.0	2.2
7.0 - 7.5	68					68	0.1	2.0
7.5 - 8.0	168					168	0.4	2.5
8.0 - 8.5	539					539	1.7	3.2
8.5 - 9.0	1042	19				1061	3.9	3.7
9.0 - 9.5	2332	231				2563	11.8	4.6
9.5 - 10.0	5804	141				5946	32.8	5.5
10.0 - 10.5	11997	163	2			12162	84.3	6.9
10.5 - 11.0	13361	944	3			14307	113.7	7.9
11.0 - 11.5	15953	642				16595	156.0	9.4
11.5 - 12.0	9078	1566	9			10653	112.4	10.6
12.0 - 12.5	4888	4988	2			9878	111.9	11.3
12.5 - 13.0	4231	3789	5			8025	105.0	13.1
13.0 - 13.5	2063	5672	1			7736	110.3	14.3
13.5 - 14.0	100	6890	55	2		7046	114.5	16.2
14.0 - 14.5	12	9046	41	1		9101	158.7	17.4
14.5 - 15.0	20	6498	39	1		6558	127.5	19.4
15.0 - 15.5	3	6674	658			7335	161.9	22.1
15.5 - 16.0		4102	527			4629	112.4	24.3
16.0 - 16.5		2766	613	2		3381	86.3	25.5
16.5 - 17.0		1654	116			1770	55.4	31.3
17.0 - 17.5		594	462	7		1063	31.7	29.8
17.5 - 18.0		335	211	7		552	19.3	34.9
18.0 - 18.5		201	182	53		437	16.3	37.3
18.5 - 19.0		92	56	2		150	6.3	41.7
19.0 - 19.5		52	128	13		193	8.2	42.7
19.5 - 20.0		3	24	35		63	2.6	41.4
20.0 - 20.5		11	187	17	10	224	10.3	46.1
20.5 - 21.0			109	7		116	6.2	53.3
21.0 - 21.5			29			29	1.8	60.9
21.5 - 22.0			2		7	9	0.6	61.6
22.0 - 22.5			108	12		120	7.3	61.0
22.5 - 23.0			76	1		77	6.7	86.9
23.0 - 23.5			60	10	4	73	5.4	73.7
23.5 - 24.0					95	95	7.4	77.3
24.0 - 24.5				1		1	0.1	100.5
24.5 - 25.0							0.0	86.0
25.0 - 25.5					91	91	8.7	95.1
25.5 - 26.0							0.0	83.0
26.0 - 26.5					1	1	0.2	115.7
26.5 - 27.0					4	4	0.4	108.3
27.0 - 27.5								
27.5 - 28.0								115.9
28.0 - 28.5								
28.5 - 29.0	0	0	0	0	21	21	2.8	137.4
TSN(10^6)	71675	57073	3703	173	234	132859		
TSB(10^3 tonnes)	626.6	1028	120.2	7.6	20.7		1803.3	
Mean length (cm)	11	14.1	17.2	19.4	24.6	12.6		
Mean weight (g)	8.7	18	32.5	43.6	88.4			13.6

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 1986-2005. 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
Average	33618	254.8	13767	285.5	3959	143.8	589	31.1	51984	717.8

Table 2.3.6. Survey mortalities for polar cod from age 1 to age 2, and from age 2 to age 3.

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

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

Table 2.3.7. Acoustic estimate of young herring in the Barents Sea August-September 2005

	Age/Year class					
Length (cm)	1 2004	2 2003	3 2002	Sum (106)	Biomass (103 t)	Mean Weight (g)
10.5 - 11.0	50			50	0.4	7.0
11.0 - 11.5	1345			1345	11.4	8.5
11.5 - 12.0	681			681	7.1	10.4
12.0 - 12.5	1623			1623	19.4	11.9
12.5 - 13.0	2732			2732	35.4	13.0
13.0 - 13.5	3995			3995	66.7	16.7
13.5 - 14.0	5018			5018	90.9	18.1
14.0 - 14.5	7353			7353	139.9	19.0
14.5 - 15.0	6326			6326	137.5	21.7
15.0 - 15.5	5956			5956	140.3	23.5
15.5 - 16.0	4085			4085	102.8	25.2
16.0 - 16.5	2316			2316	64.4	27.8
16.5 - 17.0	2792			2792	87.1	31.2
17.0 - 17.5	689	18		706	23.4	33.1
17.5 - 18.0	823			823	29.4	35.8
18.0 - 18.5	429	201		630	25.5	40.5
18.5 - 19.0	12	939		951	44.0	46.2
19.0 - 19.5	78	1512		1590	78.7	49.5
19.5 - 20.0		1690		1690	85.4	50.6
20.0 - 20.5		2495	355	2850	162.2	56.9
20.5 - 21.0		1776	110	1886	119.2	63.2
21.0 - 21.5		2667		2667	182.7	68.5
21.5 - 22.0		1551	177	1728	125.2	72.5
22.0 - 22.5	77	1770	25	1872	156.8	83.8
22.5 - 23.0		653	387	1040	90.3	86.9
23.0 - 23.5		562	634	1195	112.6	94.2
23.5 - 24.0		73	1008	1080	105.0	97.2
24.0 - 24.5		196	786	982	102.0	103.9
24.5 - 25.0		66	690	756	84.9	112.3
25.0 - 25.5			938	938	116.1	123.8
25.5 - 26.0			662	662	92.7	139.9
26.0 - 26.5			569	569	87.6	154.1
26.5 - 27.0			259	259	39.2	151.6
27.0 - 27.5			274	274	48.9	178.5
27.5 - 28.0			49	49	8.2	167.1
28.0 - 28.5			52	52	10.0	193.4
TSN(106)	46380	16167	6973	69520		
TSB(103) tonnes	983.7	1054.5	795.2		2833.4	
Mean length (cm)	14.6	20.9	24.4	17.0		
Mean weight (g)	21.2	65.2	114			40.8
					TS=20.0* lg(L) - 71.9	

Table 2.3.8. Acoustic estimate of blue whiting in the Barents Sea August-September 2005

	Age/Year class											
Length (cm)	1	2	3	4	5	6	7	8	9+	Sum	Biomass	Mean Weight
	2004	2003	2002	2001	2000	1999	1998	1997	1996-	(106)	(103 t)	(g)
15.0 - 16.0	60									60	1.0	16.1
16.0 - 17.0	675									675	13.4	19.8
17.0 - 18.0	1411									1411	31.9	22.6
18.0 - 19.0	1470									1470	38.4	26.1
19.0 - 20.0	716	28								744	24.3	32.7
20.0 - 21.0	433	33	88							553	23.1	41.7
21.0 - 22.0	97	542	14							653	33.7	51.7
22.0 - 23.0		819	161							981	60.8	62.0
23.0 - 24.0	2	859	730							1591	110.0	69.1
24.0 - 25.0	6	431	960	5						1402	109.7	78.3
25.0 - 26.0		30	1210	340						1579	142.8	90.4
26.0 - 27.0		16	573	539	74	31				1233	126.1	102.3
27.0 - 28.0		14	390	360	96	0				859	98.3	114.4
28.0 - 29.0			74	323	279	0				676	86.3	127.7
29.0 - 30.0			6	175	249	96				526	72.1	137.3
30.0 - 31.0				61	178	26				265	41.4	156.3
31.0 - 32.0					85	78	7			170	28.5	167.5
32.0 - 33.0				4	64	45	4			116	22.0	188.5
33.0 - 34.0					9	14	27	4		53	10.5	196.1
34.0 - 35.0							10	13		23	5.3	224.7
35.0 - 36.0					3		5	3		11	2.8	256.9
36.0 - 37.0									5	5	1.4	272.8
37.0 - 38.0									1	1	0.2	253.3
38.0 - 39.0											0.1	367.0
39.0 - 40.0												336.0
40.0 - 41.0												
41.0 - 42.0												533.7
42.0 - 43.0												581.5
43.0 - 44.0												
44.0 - 45.0												
45.0 - 46.0												
46.0 - 47.0												
47.0 - 48.0												
48.0 - 49.0											0.1	575.0
TSN(106)	4871	2770	4205	1807	1037	290	53	20	6	15058		
TSB(103t)	132	180	363	203	145	44.7	10.7	4.6	1.8		1084.1	
Mean length	18.3	23	25.1	27.3	29.4	30.5	33.6	34.5	40.4	23.2		
Mean weight	27	65	86.3	112	140	154	203	226	382			72

TS=21.8* lg(L) - 72.7

Table 2.4.1 Cod swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ Area	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total
I(NEEZ +SVA)	76.1	115.1	88.4	15.9	13.8	18.9	14.6	6.5	4.9	5.2	7.7	6.5	3.3	2.6	5.5	384.8
I(REEZ)	1.8	58.3	65.4	15.9	33.4	49.7	53.7	25.2	17.1	15.5	16.8	12.0	5.4	5.2	4.9	380.3
IIa	12.2	10.2	5.9	1.0	1.2	1.8	3.0	1.5	1.4	1.1	1.4	1.1	0.7	1.1	0.8	44.4
IIb	41.1	61.0	133.3	42.2	33.2	45.0	43.3	23.3	22.2	28.0	21.4	11.0	4.2	2.7	3.0	514.9
Total	131.2	244.5	292.9	74.9	81.5	115.4	114.7	56.5	45.7	49.8	47.2	30.6	13.7	11.6	14.2	1324.3

Time series of swept area estimates for the total distribution area (millions)

Length/ year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total	Biomass (1000 tonnes)
2004	444.3	307.0	168.1	203.2	109.3	58.4	95.9	170.1	184.8	117.3	56.2	44.2	41.2	29.8	35.3	2065.0	1328.3
2005	131.2	244.5	292.9	74.9	81.5	115.4	114.7	56.5	45.7	49.8	47.2	30.6	13.7	11.6	14.2	1324.3	680.3

Table 2.4.2 Haddock swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ Area	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total
I(NEEZ+SVA)	30.1	35.5	52.6	42.7	8.7	7.1	6.1	3.2	2.5	1.4	0.9	0.3	0.1	191.2
I(REEZ)	0.0	1.7	173.9	58.9	46.5	184.6	135.1	60.9	30.3	14.8	5.6	0.6	0.4	713.2
IIa	13.4	7.1	116.7	115.6	13.4	10.1	5.4	5.1	3.8	2.8	1.3	0.3	0.6	295.6
IIb	20.0	26.3	101.0	71.4	4.0	3.6	4.2	6.1	3.0	2.9	1.8	0.8	0.2	245.2
Total	63.6	70.5	444.2	288.6	72.5	205.4	150.8	75.3	39.6	21.8	9.5	2.1	1.3	1445.1

Time series of swept area estimates for the total distribution area (millions)

Length/ year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total	Biomass (1000 tonnes)
2004	17.3	72.4	120.0	123.2	198.7	87.9	96.8	70.1	59.0	31.5	13.1	3.4	0.9	894.4	396.7
2005	63.6	70.5	444.2	288.6	72.5	205.4	150.8	75.3	39.6	21.8	9.5	2.1	1.3	1445.1	436.8

Table 2.4.3 Greenland halibut swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ area	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+	Total
I(NEEZ+SVA)	0.5	29.0	7.2	2.6	3.8	7.4	4.2	2.8	2.1	0.7	0.6	0.5	61.4
I(REEZ)	0.4	86.4	20.9	6.8	16.2	15.6	4.0	1.4	0.8	0.1	0.0	0.0	152.5
IIa	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.6	0.6	1.3	1.0	0.9	5.1
IIb	0.7	34.3	21.3	3.5	5.6	10.3	9.7	6.9	4.6	2.3	0.8	0.7	100.9
Total	1.6	149.7	49.4	12.9	25.6	33.6	18.5	11.8	8.0	4.5	2.5	2.0	319.9

Time series of swept area estimates for the total distribution area (millions)

Length/ year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+	Total	Biomass (tonnes)
2004	9.3	13.1	21.5	42.9	27.4	10.1	7.0	4.6	4.8	3.9	1.4	1.9	148.0	34584
2005	1.6	149.7	49.4	12.9	25.6	33.6	18.5	11.8	8.0	4.5	2.5	2.0	319.9	57486

Table 2.4.4 Sebastes marinus swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ area	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+	Total
I(NEEZ+SVA)	0.11	0.00	0.00	0.23	0.51	0.42	0.21	0.46	0.37	0.00	0.00	0.08	2.39
I(REEZ)	0.09	0.04	0.32	0.00	0.64	0.49	0.70	0.65	0.18	0.00	0.06	0.00	3.18

IIa	0.10	1.31	2.21	5.62	1.89	0.95	0.82	1.27	0.55	0.06	0.00	0.08	14.85
IIb	0.00	0.04	0.00	0.03	0.22	0.37	0.28	0.19	0.19	0.04	0.00	0.00	1.35
Total	0.30	1.40	2.53	5.88	3.27	2.23	2.01	2.57	1.28	0.10	0.06	0.16	21.77

Time series of swept area estimates for the total distribution area (millions)

Length/ year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+	Total	Biomass (tonnes)
2004	0.00	0.11	0.72	0.98	1.73	2.92	2.21	1.86	0.88	0.24	0.09	0.26	12.00	8450
2005	0.30	1.40	2.53	5.88	3.27	2.23	2.01	2.57	1.28	0.10	0.06	0.16	21.77	10177

Table 2.4.5 *Sebastes mentella* swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ area	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total
I(NEEZ+SVA)	3.00	1.28	2.38	2.94	5.49	3.58	3.16	0.09	0.00	21.91
I(REEZ)	3.38	0.66	0.13	0.04	0.06	0.00	0.06	0.00	0.00	4.34
IIa	2.84	3.09	4.26	11.30	78.54	61.59	0.99	0.04	0.00	162.64
IIb	5.50	1.82	6.98	9.39	15.18	57.16	36.78	0.90	0.00	133.71
Total	14.72	6.86	13.75	23.67	99.27	122.32	40.99	1.03	0.00	322.60

Time series of swept area estimates for the total distribution area (millions)

Length/ year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total	Biomass (1000 tonnes)
2004	2.45	19.22	15.80	14.49	31.16	153.56	76.85	3.20	0.02	316.75	124.9
2005	14.72	6.86	13.75	23.67	99.27	122.32	40.99	1.03	0.00	322.60	130.1

Table 2.4.6 Long rough dab swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ area	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total
I(NEEZ+SVA)	90.4	275.9	154.6	84.2	76.6	46.1	33.1	19.7	1.4	781.9
I(REEZ)	161.9	308.4	287.3	216.5	122.6	61.0	50.7	23.5	2.1	1234.0
IIa	3.5	18.8	13.5	14.4	28.6	15.6	2.8	0.7	0.1	97.9
IIb	71.8	153.5	145.7	121.7	95.1	62.2	33.0	8.7	0.3	691.9
Total	327.5	756.5	601.0	436.7	322.8	184.9	119.6	52.7	3.8	2805.6

Time series of swept area estimates for the total distribution area (millions)

Length/ year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total	Biomass (1000 tonnes)
2004	237.6	824.6	681.4	519.6	407.9	222.7	133.5	61.6	7.4	3096.2	335.9
2005	327.5	756.5	601.0	436.7	322.8	184.9	119.6	52.7	3.8	2805.6	283.5

Table 2.4.7 Atlantic wolffish swept area estimate (thousands) by region and length group from ecosystem survey in August-September 2005

Length/ area	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total
I(NEEZ+SVA)	115	763					47	21	78	39	34	90	22	144	1353
I(REEZ)	49	97							127	64	369	655	479	974	2814
IIa	1639	734	1089	323	121	29		16		106	107				4164
IIb	588	455	373	353	287	157	133	94	87	59	24	320	394	946	4270
Total	2390	2049	1462	676	408	186	180	132	292	267	535	1065	895	2064	12601

Time series of swept area estimates for the total distribution area (thousands)

Length/ year	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total	Biomass (tonnes)
2004	2398	1695	1461	565	436	209	172	182	322	1200	700	1051	609	1537	12536	21489
2005	2390	2049	1462	676	408	186	180	132	292	267	535	1065	895	2064	12601	26518

Table 2.4.8 Spotted wolffish swept area estimate (thousands) by region and length group from ecosystem survey in August-September 2005

Length/ area	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total
I(NEEZ +SVA)	112			196		273		82	376	90	575	324	163	614	2803
I(REEZ)	143	140		252	826		637	709	286	143	109		143	143	3530
IIa	766	601	99	165											1631
IIb	1258	1680	683	473	204	400	57	84	250	161	12	242		87	5591
Total	2279	2421	782	1085	1030	673	694	875	912	394	695	566	306	844	13555

Time series of swept area estimates for the total distribution area (thousands)

Length/ year	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Total	Biomass (tonnes)
2004	1635	828	1181	705	551	739	761	843	1663	1416	1068	1084	311	752	13535	20537
2005	2279	2421	782	1085	1030	673	694	875	912	394	695	566	306	844	13555	17092

Table 2.4.9 Northern wolffish swept area estimate (thousands) by region and length group from ecosystem survey in August-September 2005

Length/ area	<55	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100+	Total
I(NEEZ+SVA)				181	102	102		369	82	305	47	1186
I(REEZ)					77				77	348		501
IIa				72	118	41					132	363
IIb	20		66	185	49	63	135	17	27	58	303	922
Total	20		66	438	345	206	135	386	186	710	481	2971

Time series of swept area estimates for the total distribution area (thousands)

Length/ year	<55	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100+	Total	Biomass (tonnes)
2004	48	11	127	156	116	262	367	180	286	615	747	2913	30306
2005	20		66	438	345	206	135	386	186	710	481	2971	27138

Table 2.4.10 Atlantic poacher swept area estimate (millions) by region and length group from ecosystem survey in August-September 2005

Length/ area	<5	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	Total
I(NEEZ +SVA)		0.0	0.1	0.1	1.0	2.5	8.5	6.9	15.8	21.8	35.7	35.5	15.4	4.7	1.5	149.4
I(REEZ)	1.5	3.2	2.8	4.6	6.7	10.0	9.1	14.2	14.3	14.8	9.1	3.9	0.9	0.5	0.3	96.0
IIa													0.0	0.1	0.1	0.2
IIb		0.0	0.1	0.2	0.1	1.4	2.4	2.5	3.3	5.5	6.7	7.1	4.5	4.1	3.6	41.6
Total	1.5	3.3	3.0	4.9	7.8	13.9	20.0	23.6	33.3	42.2	51.6	46.5	20.9	9.4	5.5	287.1

Time series of swept area estimates for the total distribution area (millions)

Length/ year	<5	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	Total	Biomass (tonnes)
2004	0.0	0.5	2.7	8.3	16.3	15.5	18.4	39.0	39.1	35.2	52.7	45.3	34.9	11.4	6.3	325.4	3020
2005	1.5	3.3	3.0	4.9	7.8	13.9	20.0	23.6	33.3	42.2	51.6	46.5	20.9	9.4	5.5	287.1	2252

Table 2.4.11 Thorny skate swept area estimate (thousands) by region and length group from ecosystem survey in August-September 2005

Length/ area	10-13	14-17	18-21	22-25	26-29	30-33	34-37	38-41	42-45	46-49	50+	Total
I(NEEZ +SVA)	361	402	290	534	822	1199	316	1852	1019	797	1702	9292
I(REEZ)	151	40	143	143	143	143	356	207	904	369	2676	5275
IIa	1180	28	0	0	76	205	271	60	421	658	791	3690
IIb	604	994	807	805	1095	906	779	874	582	1159	1895	10499
Total	2294	1464	1240	1482	2136	2453	1721	2992	2927	2983	7064	28756

Time series of swept area estimates for the total distribution area (thousands)

Length/ year	10-13	14-17	18-21	22-25	26-29	30-33	34-37	38-41	42-45	46-49	50+	Total	Biomass (tonnes)
2004	1928	2998	2637	2921	5207	4628	3932	4302	5060	5909	11491	51014	37867
2005	2294	1464	1240	1482	2136	2453	1721	2992	2927	2983	7064	28756	21546

Table 2.7.1. Number of marine mammal individuals observed from the research vessels Johan Hjort, G.O. Sars, Smolensk and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005.

Class / suborder	Name of species (english)	Johan Hjort	GOSars	Smolensk	Nansen	AN-26 "Arktika"	Total	%
Cetacea / baleen whales	Minke whale	37	73	7	9	22	**148**	**2.66**
	Sei whale	0	0	0	14	0	**14**	**0.25**
	Fin whale	46	60	0	9	0	**115**	**2.07**
	Humpback whale	15	22	16	135	11	**199**	**3.58**
	Bowhead Whale	0	0	2	0	0	**2**	**0.04**
	Unidentified whale	2	0	5	33	20	**60**	**1.08**
	Unidentified large whale	16	16	0	0	0	**32**	**0.58**
Cetacea / toothed whales	Sperm whale	35	22	0	0	0	**57**	**1.02**
	Killer whale	28	0	0	3	2	**33**	**0.59**
	White-beaked dolphin	0	526	42	987	45	**1600**	**28.76**
	Harbour porpoise	0	2	0	0	0	**2**	**0.04**
	Common dolphin	0	0	1	0	0	**1**	**0.02**
	Unid. dolphin	252	30	0	37	0	**319**	**5.73**
Pinnipedia	Harp seal	0	0	0	2504	234	**2738**	**49.21**
	Ringed seal	0	0	0	0	9	**9**	**0.16**
	Bearded seal	0	0	0	0	2	**2**	**0.04**
	Walrus	0	0	0	109	112	**221**	**3.97**
	Grey Seal	0	0	1	0	0	**1**	**0.02**
	Unidentified seal	0	0	0	0	5	**5**	**0.09**
	Polar bear	0	0	0	2	3	**5**	**0.09**
	Unid. mammal	0	0	0	0	1	**1**	**0.02**
Total sum		**431**	**751**	**74**	**3842**	**466**	**5564**	**100.00**

Table 2.7.2. Number of sea bird individuals observed from the research vessels Johan Hjort, G.O. Sars and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005.

Species (latin)	Species (english)	G.O. Sars	Johan Hjort	F. Nansen	Arktika	Total	Prop. of total
Alle alle	Little auk	968	0	452	0	**1420**	**1,2**
Cepphus grylle	Black guillemot	6	0	164	0	**170**	**0,1**
Fratercula Arktika	Puffin	228	306	33	0	**567**	**0,5**
Uria aalge	Common guillemot	58	34	85	0	**177**	**0,2**
Uria lomvia	Brünnich's guillemot	2308	627	1431	0	**4366**	**3,8**
Alca torda	Razorbill	1	0	3	0	**4**	**0,0**
Alcidae sp.	Unident. alcids	197	37	502	333	**1069**	**0,9**
Larus argentatus	Herring gull	208	0	38	0	**246**	**0,2**
Larus hiperboreus	Glaucous gull	13	12	175	0	**200**	**0,2**
Larus marinus	Great black-backed gull	291	0	48	0	**339**	**0,3**
Pagophila eburnea	Ivory gull	0	0	206	0	**206**	**0,2**
Rissa tridactyla	Kittiwake	1850	348	40996	1267	**44461**	**38,6**
Larus sp.	Unident. Gulls	0	0	0	81	**81**	**0,1**
Stercorarius longicaudus	Long-tailed skua	10	0	2	0	**12**	**0,0**
Stercorarius parasiticus	Arctic skua	155	27	18	0	**200**	**0,2**
Stercorarius pomarinus	Pomarine skua	278	29	93	0	**400**	**0,3**
Stercorarius skua	Great skua	150	1	11	0	**162**	**0,1**
Stercorarius sp.	Unident. skua	389	2	0	2	**393**	**0,3**
Fulmarus glacialis	Northern fulmar	1715	346	40564	16874	**59499**	**51,6**
Puffinus griseus	Sooty shearwater	42	36	9	0	**87**	**0,1**
Sterna paradisaea	Arctic tern	22	17	12	0	**51**	**0,0**
Sterna hirundo	Common tern	19	0	0	0	**19**	**0,0**
Phalacrocorax aristotelis	European shag	0	2	0	0	**2**	**0,0**
Phalacrocorax carbo	Cormorant	0	1	0	1	**2**	**0,0**
Sula bassana	Northern gannet	9	6	5	0	**20**	**0,0**
Branta leucopsis	Barnacle goose	0	0	4	0	**4**	**0,0**
Calidris maritima	Purple sandpiper	1	8	0	0	**9**	**0,0**
Charadrius hiaticula	Ringed plover	0	0	1	0	**1**	**0,0**
Gavia Arktika	Black-throated diver	0	0	2	0	**2**	**0,0**
Plectropenax nivalis	Snow bunting	1	0	0	0	**1**	**0,0**
Acrocephalus sp.	Warbler sp.	1	0	0	0	**1**	**0,0**
	Undident. birds	0	0	0	1055	**1055**	**0,9**
Total		**8920**	**1839**	**84854**	**19613**	**115226**	**100,0**

Table 2.8.1 Overview of benthos samples collected with different gear used onboard the five research vessels involved in the ecosystem survey. Number of replicates is given in parenthes.

	Vessels				
Equipment	*GO Sars*	*Johan Hjort*	*Jan Mayen*	*Fritjof Nansen*	*Smolensk*
Grab (0.1 m^2)				58 (282)	
Grab (0.25 m^2)	12 (50)				
RP sled	11				
Video rig	23				
Sigsby trawl				60	
Beam trawl	18				
Campelen trawl	122	80	20	90	154

FIGURES

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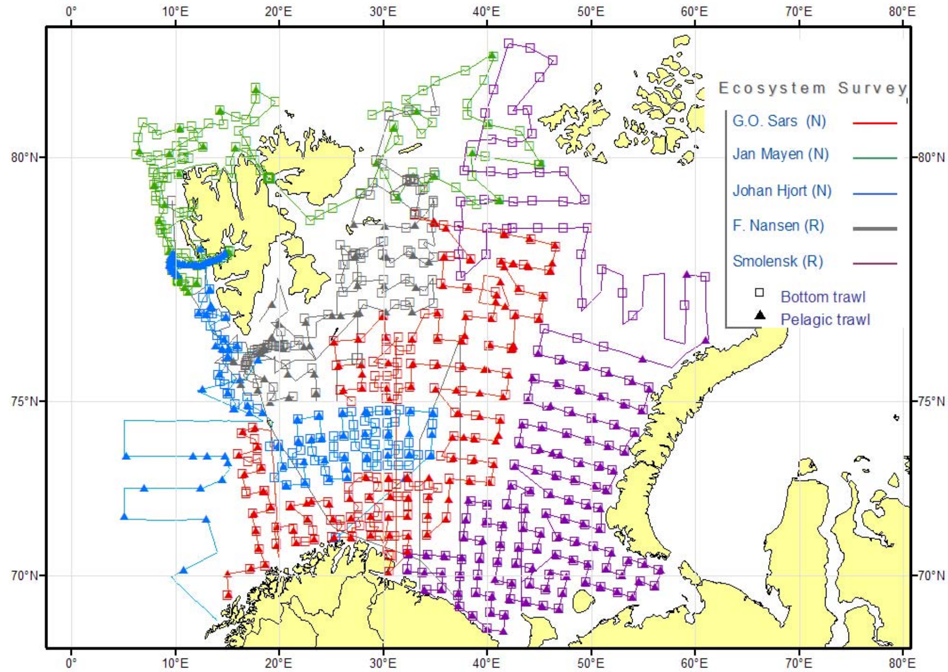


Figure 2.1 Trawl stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Fr.Nansen" and "Smolensk" August - October 2005.

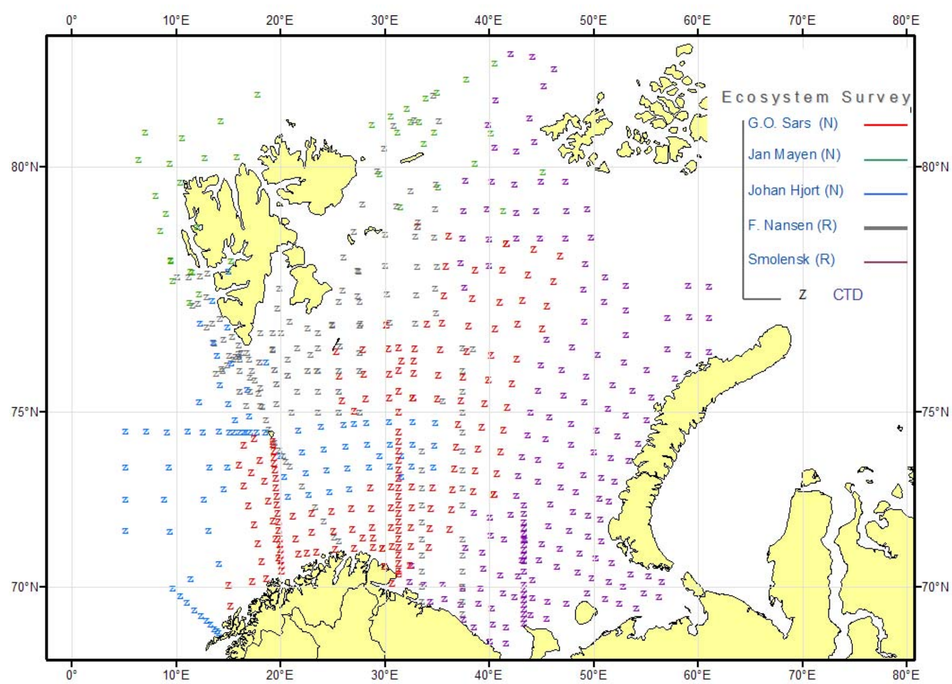


Figure 2.2 Hydrographic stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Fr. Nansen" and "Smolensk" August - October 2005

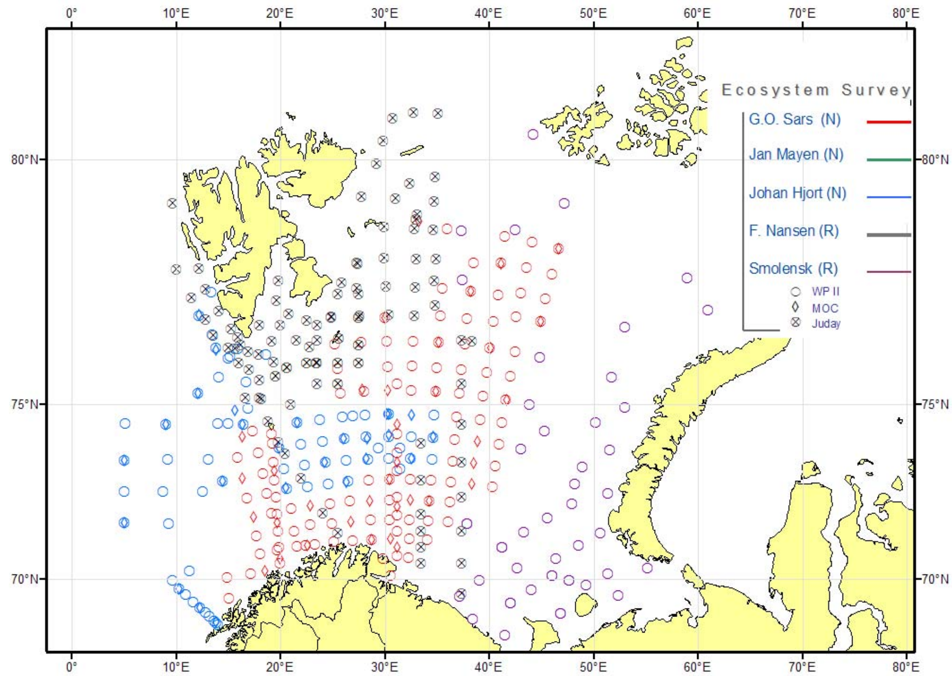


Figure 2.3 Plankton stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Fr. Nansen" and "Smolensk" August - October 2005

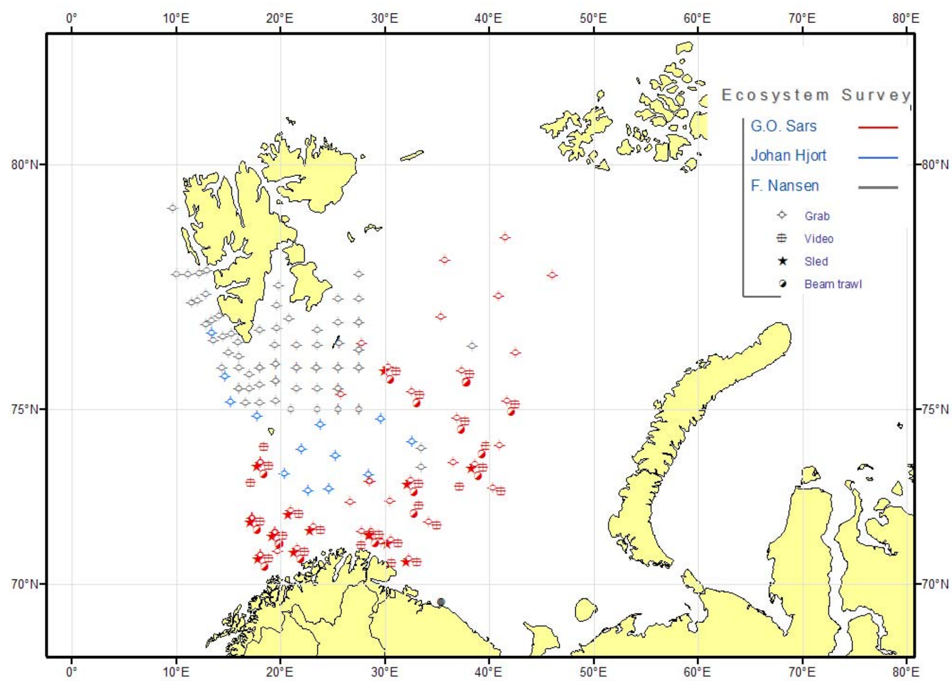


Figure 2.4 Benthos stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Fr. Nansen" and "Smolensk" August - October 2005

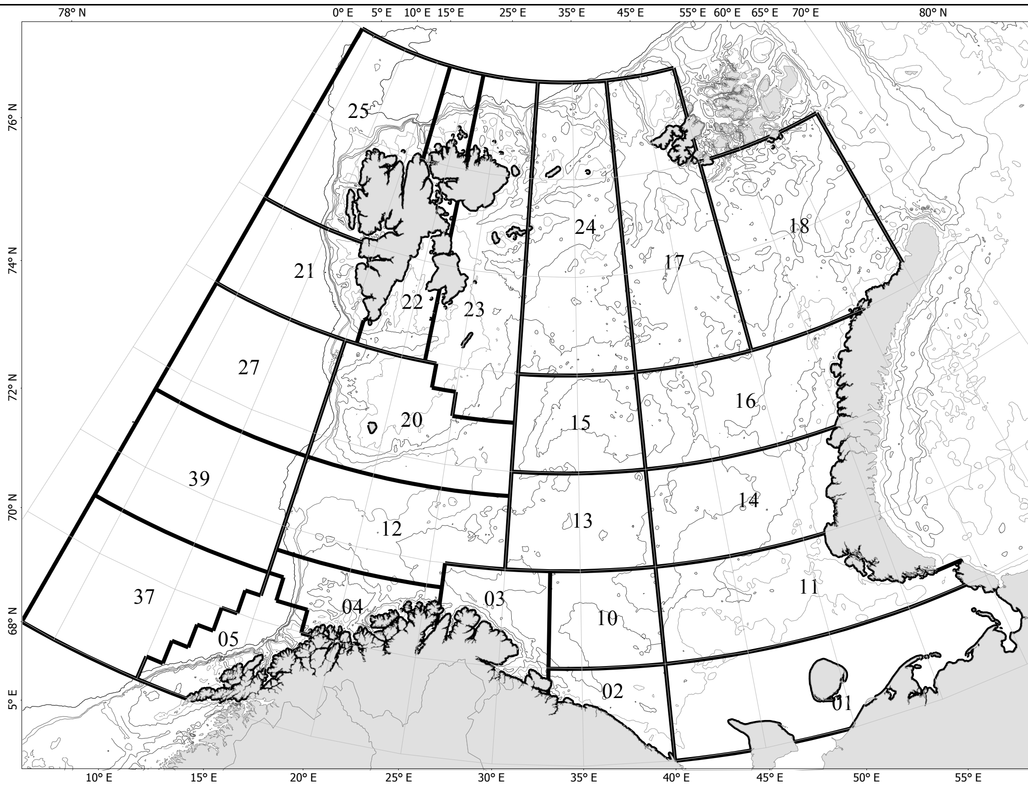
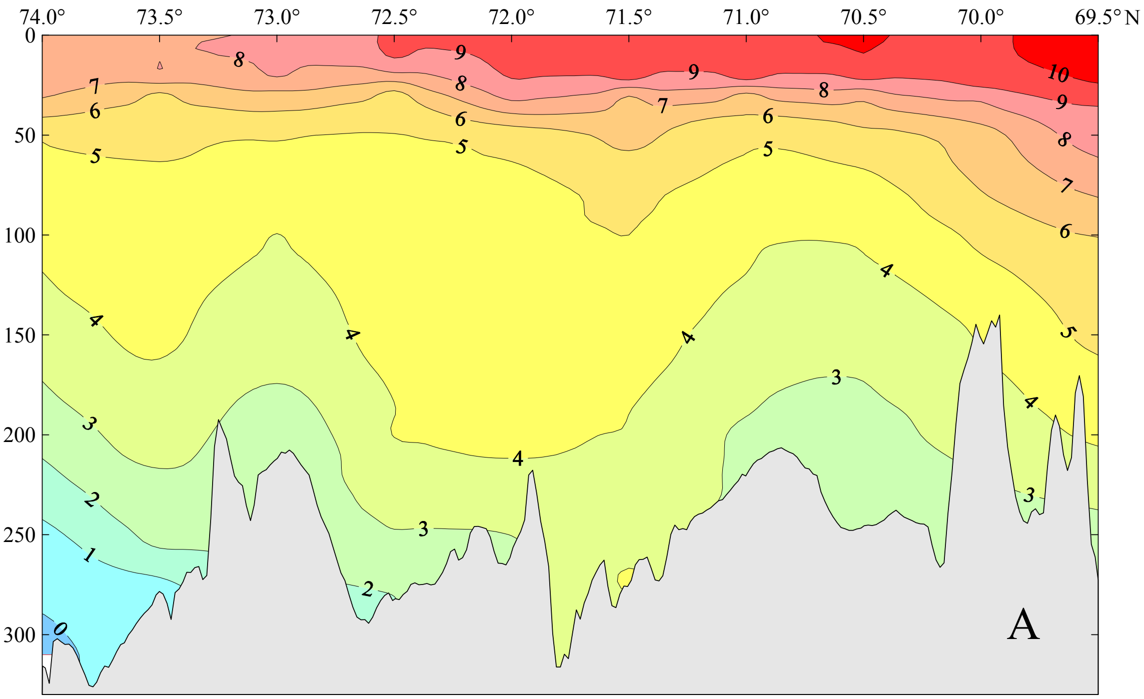


Figure 2.5 Strata-system used in 0-group stratified sample mean estimations.



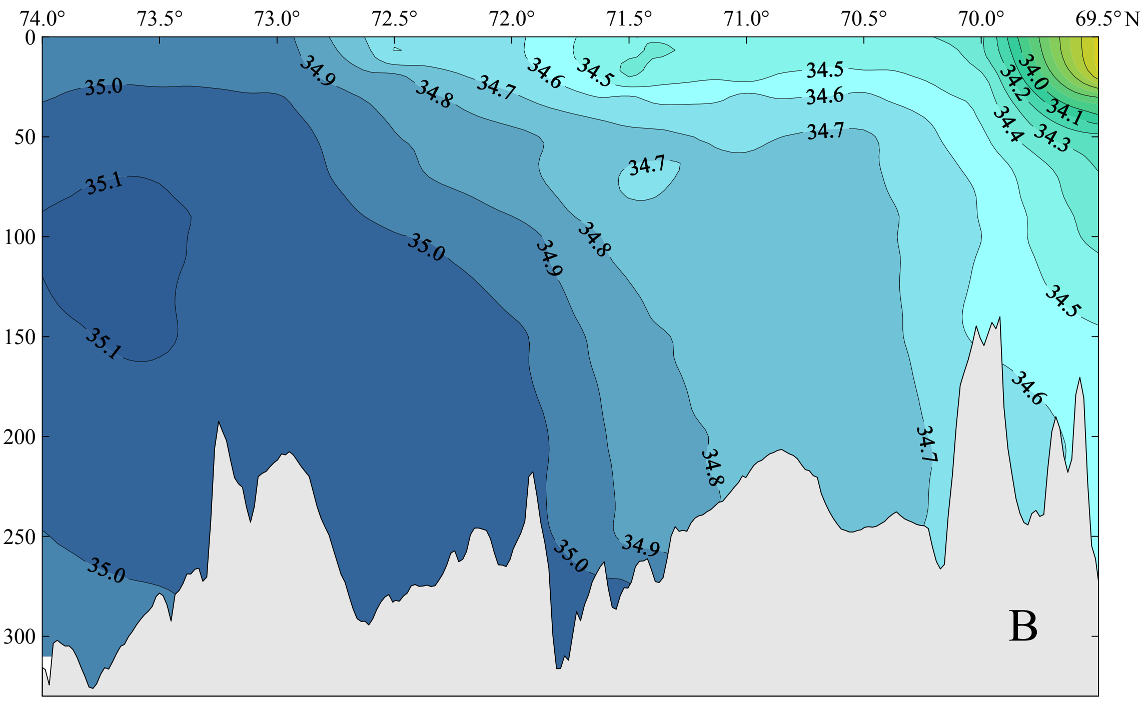


Figure 2.1.1. Temperature (A) and salinity (B) in the Kola Section

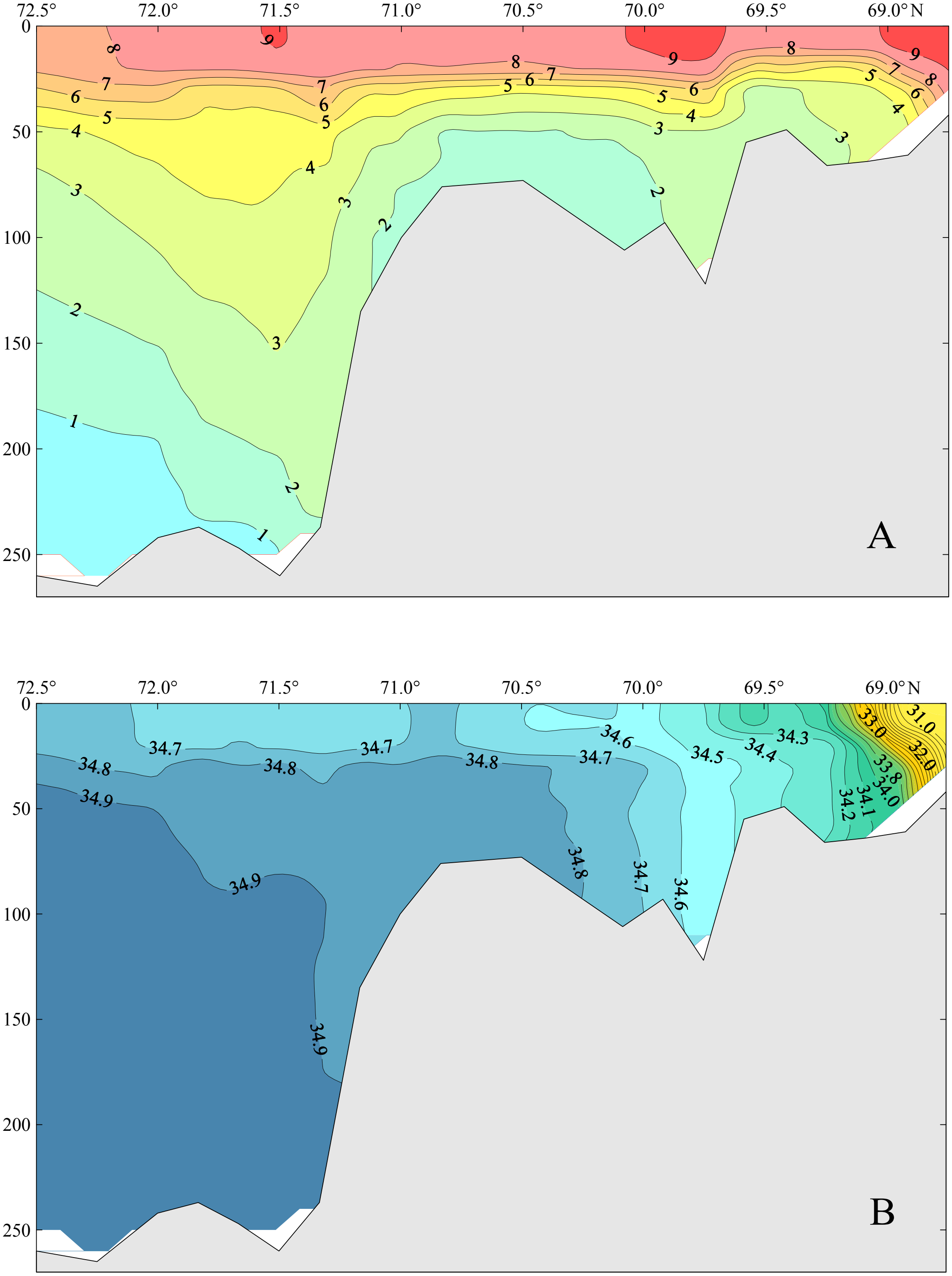


Figure 2.1.2. **Temperature (A) and salinity (B) in the Kanin Section**

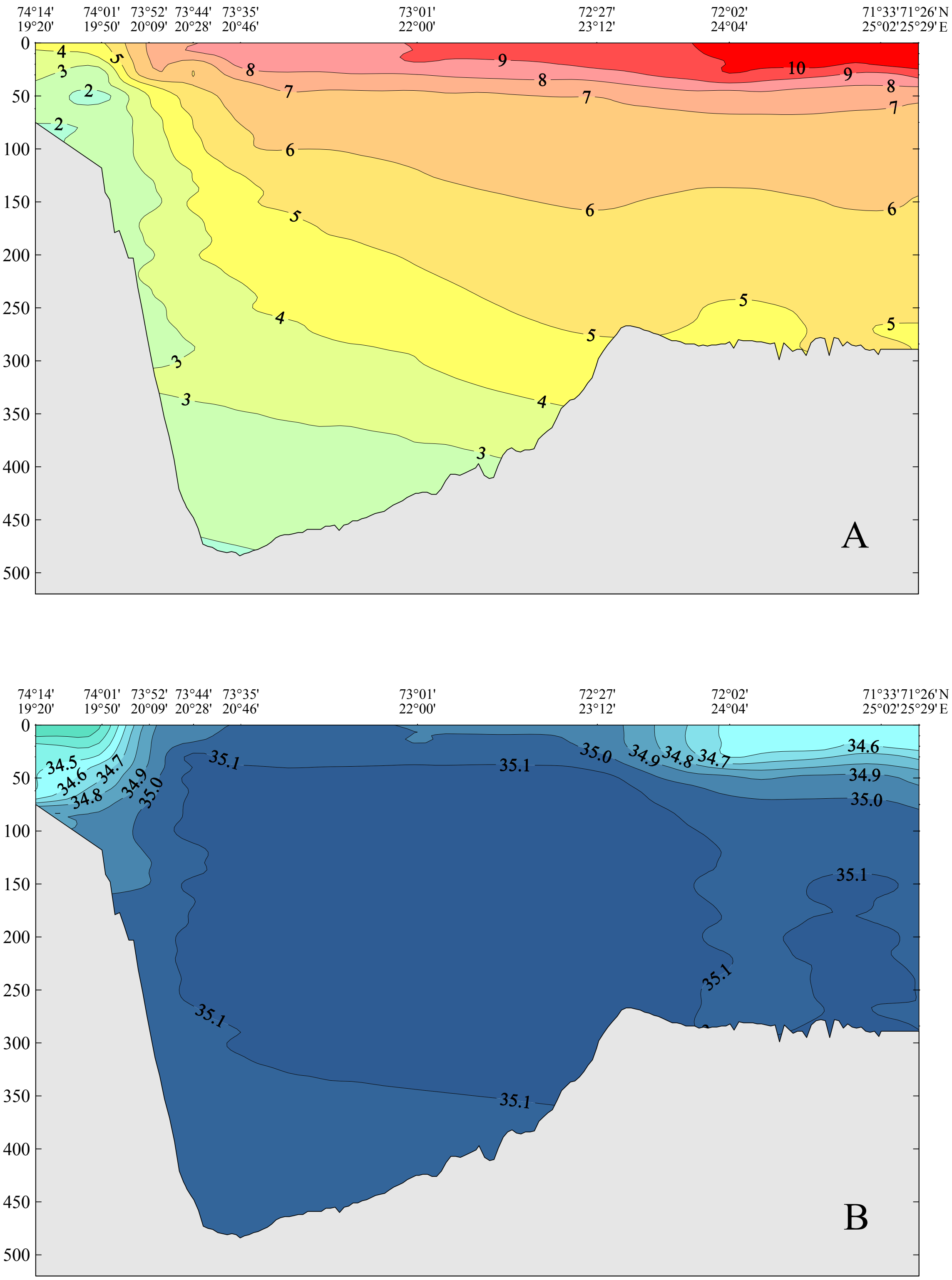


Figure 2.1.3. Temperature (A) and salinity (B) in the North Cape - Bear Island Section

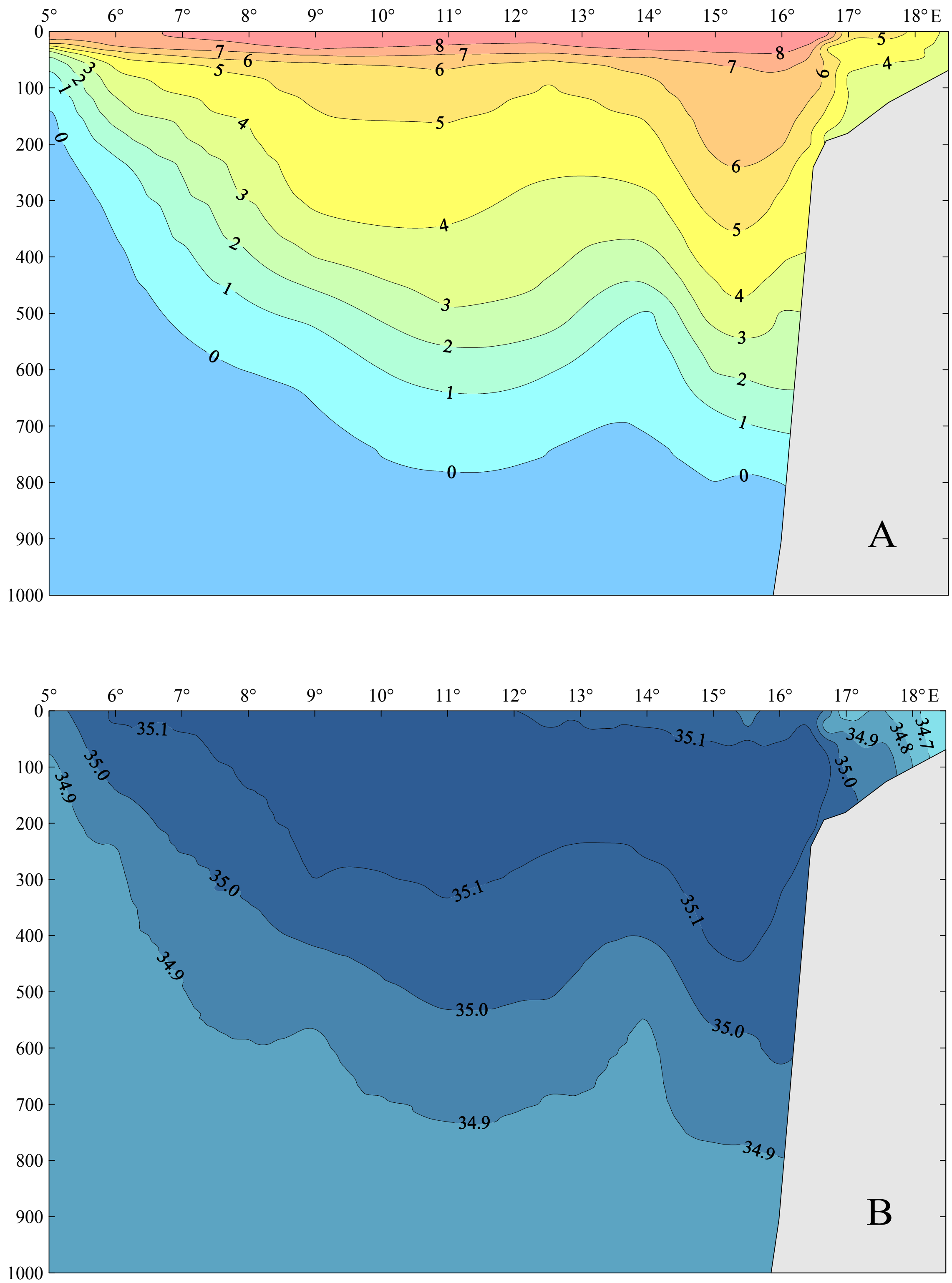


Figure 2.1.4. Temperature (A) and salinity (B) in the Bear Island - West Section

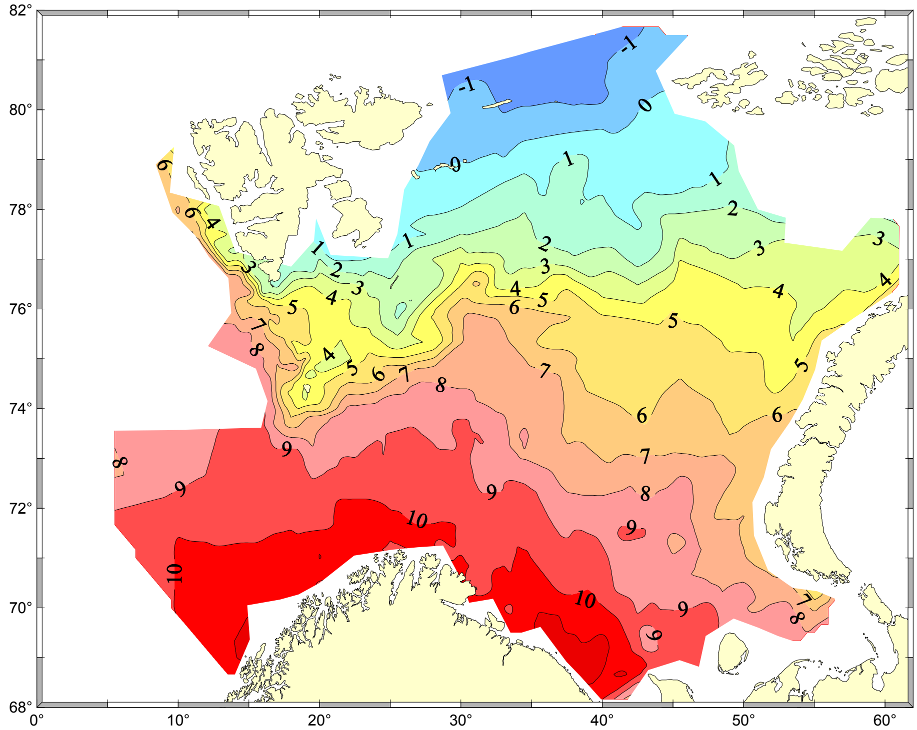


Figure 2.1.5. Distribution of surface temperature (°C), August-October 2005

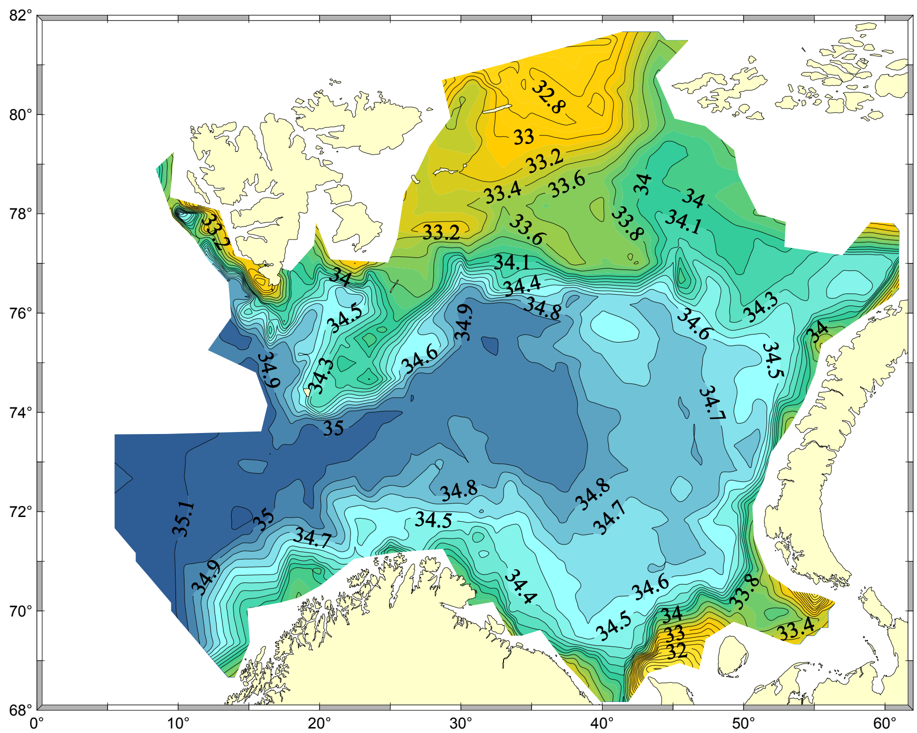


Figure 2.1.6. Distribution of surface salinity, August-October 2005

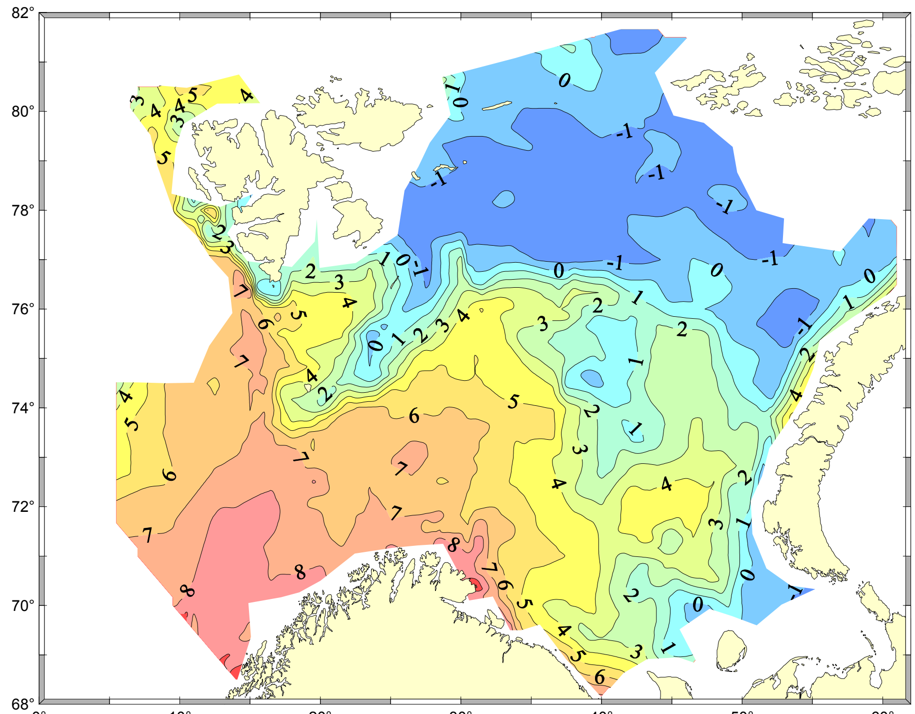


Figure 2.1.7. **Distribution of temperature (°C) at 50 m depth, August-October 2005**

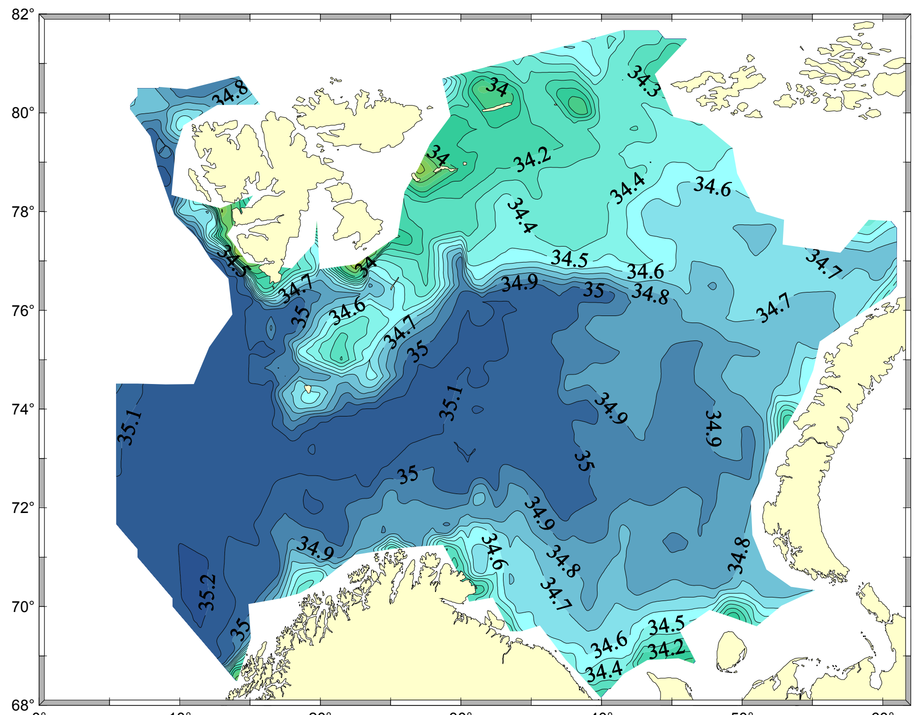


Figure 2.1.8. **Distribution of salinity at 50 m depth, August-October 2005**

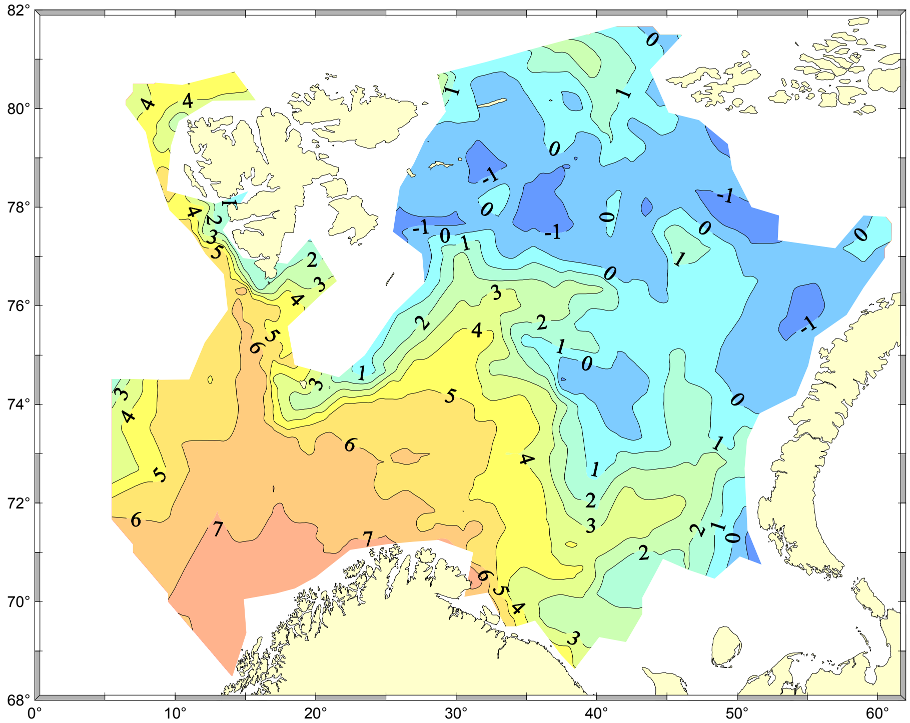


Figure 2.1.9. **Distribution of temperature (°C) at 100 m depth, August-October 2005**

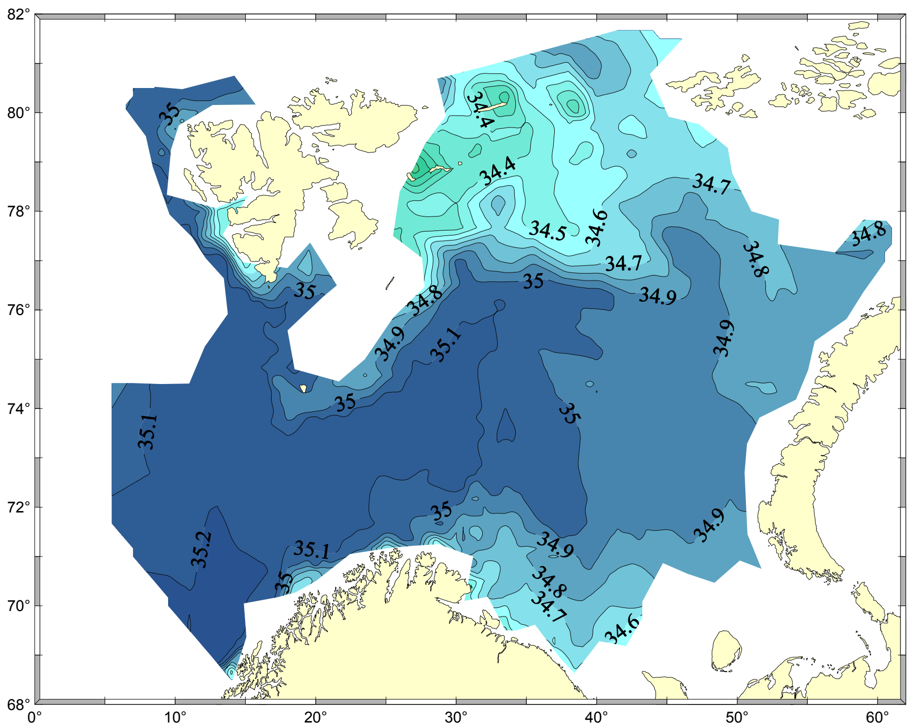


Figure 2.1.10 **Distribution of salinity at 100 m depth, August-October 2005**

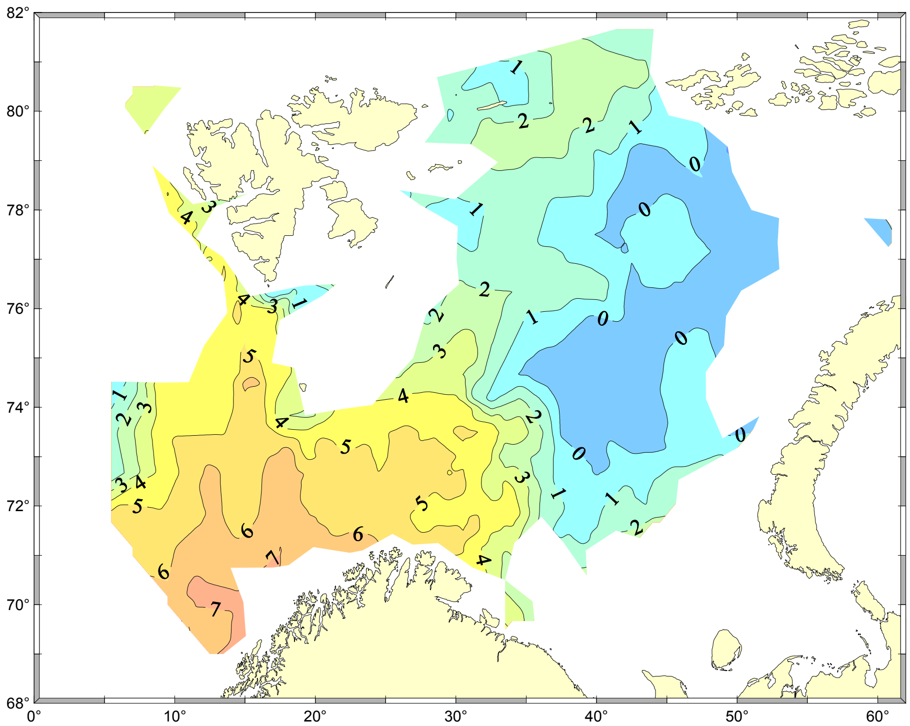


Figure 2.1.11 Distribution of temperature (°C) at 200 m depth, August-October 2005

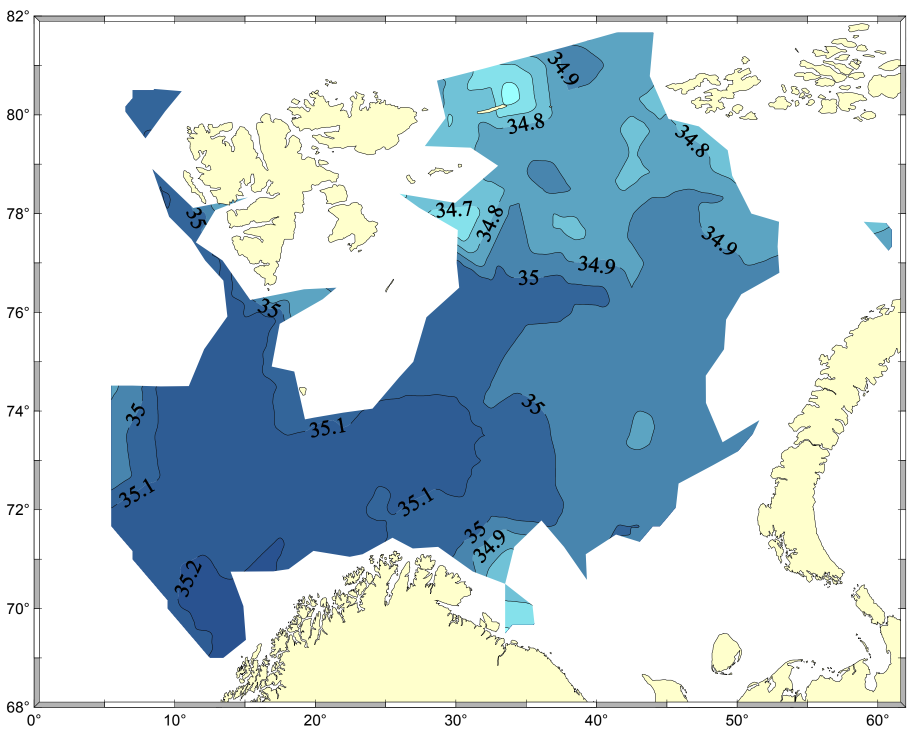


Figure 2.1.12 Distribution of salinity at 200 m depth, August-October 2005

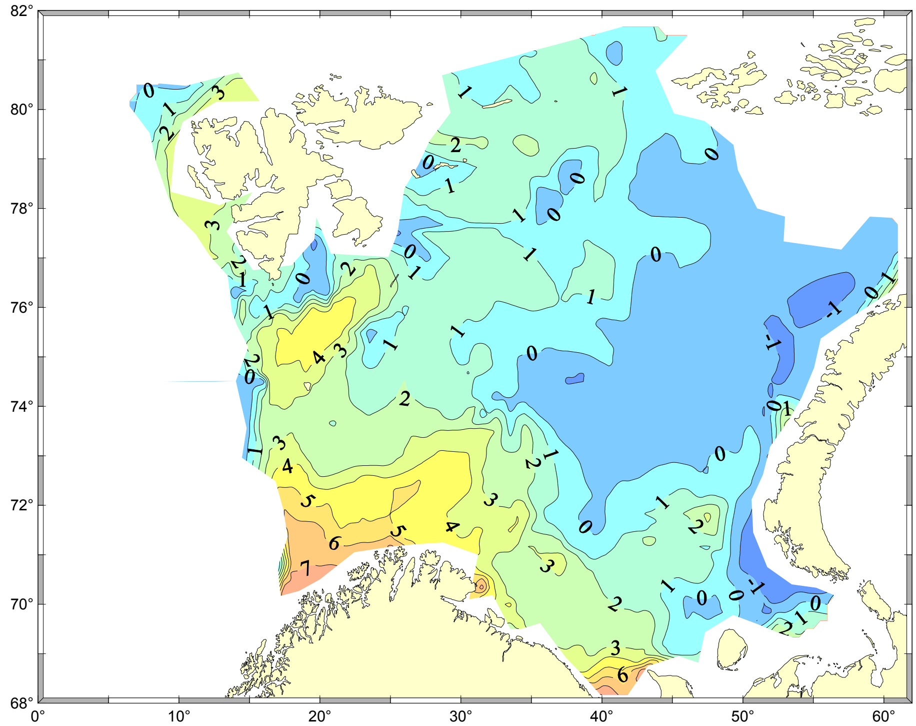


Figure 2.1.13 Distribution of temperature (°C) at the bottom, August-October 2005

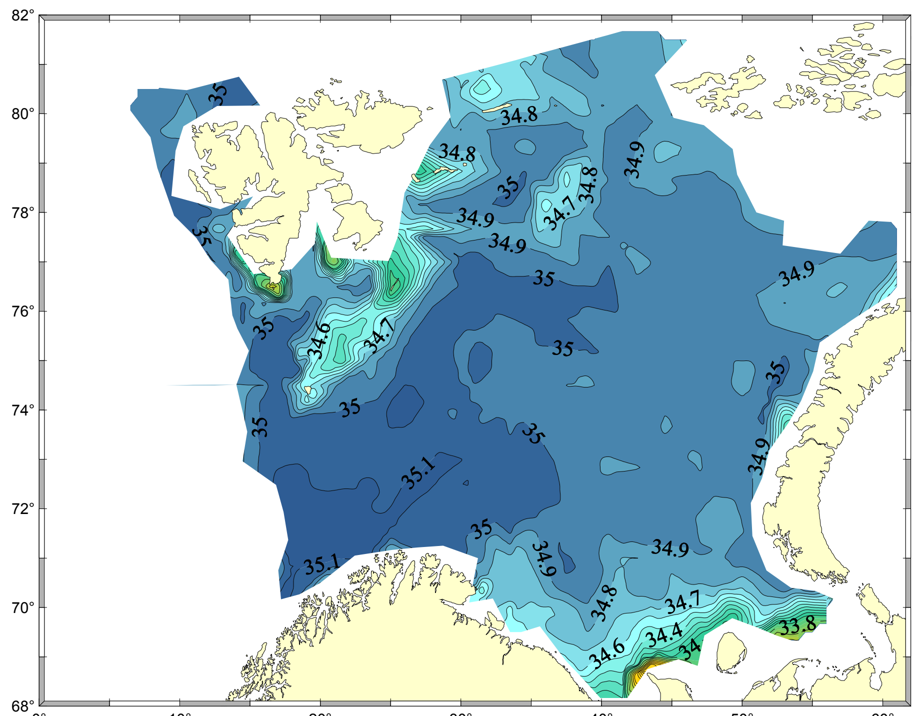


Figure 2.1.14 Distribution of salinity at the bottom, August-October 2005

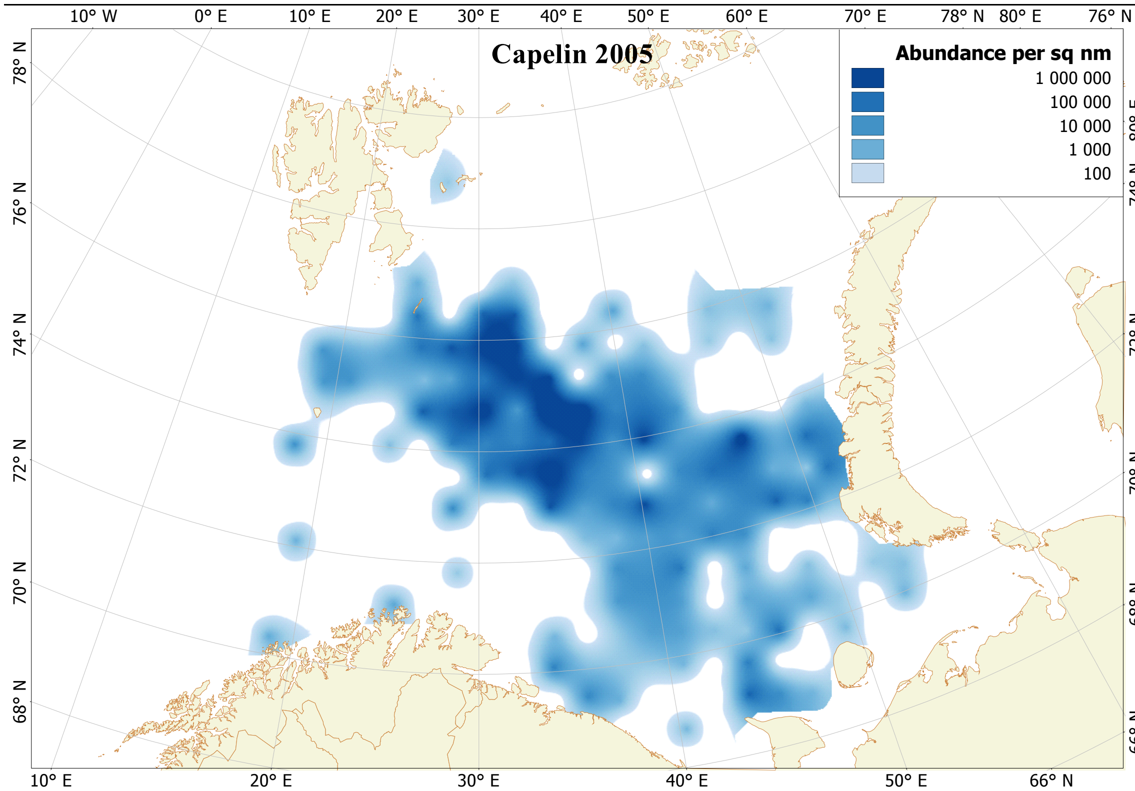


Figure 2.2.1 Distribution of 0-group capelin autumn 2005

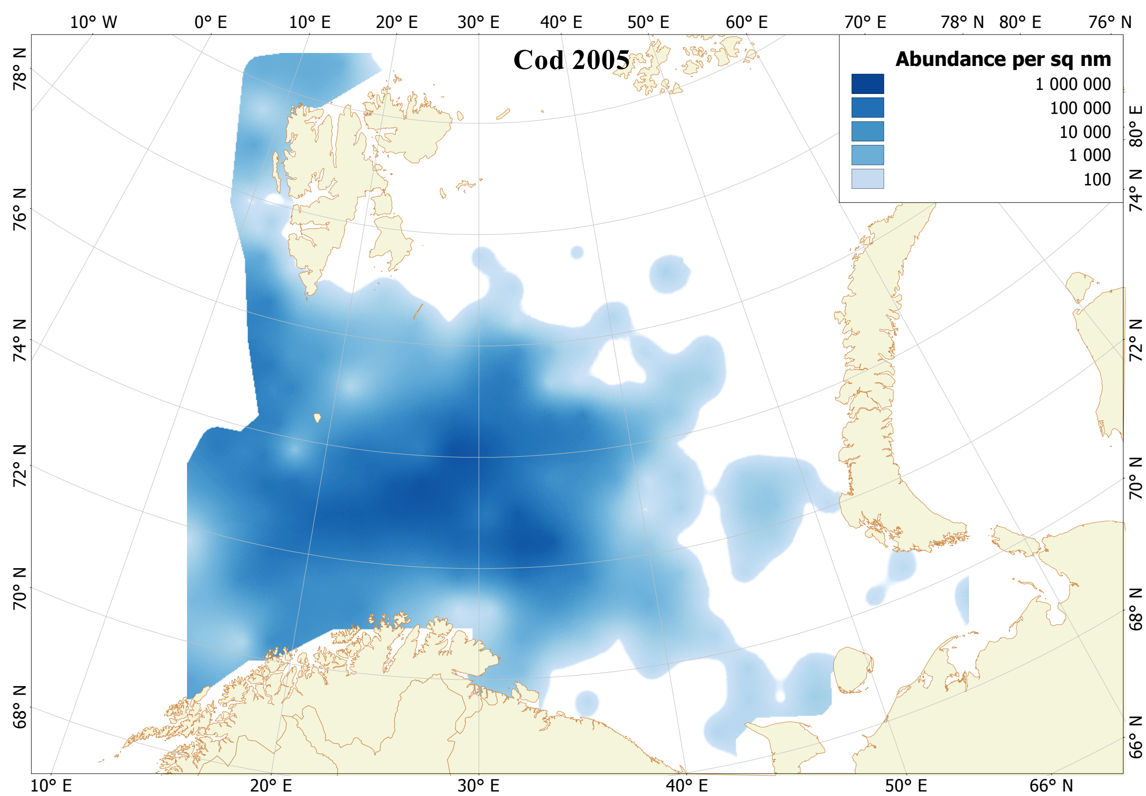


Figure 2.2.2 Distribution of 0-group cod autumn 2005

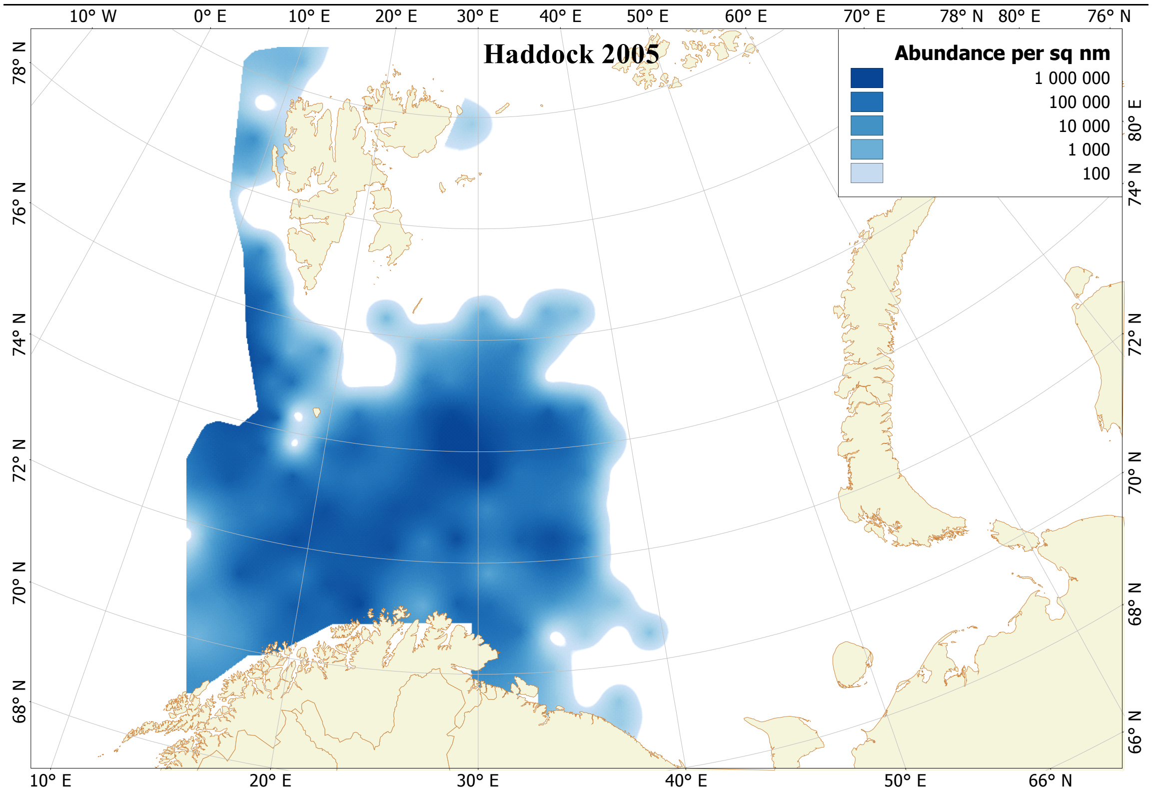


Figure 2.2.3 Distribution of 0-group haddock autumn 2005

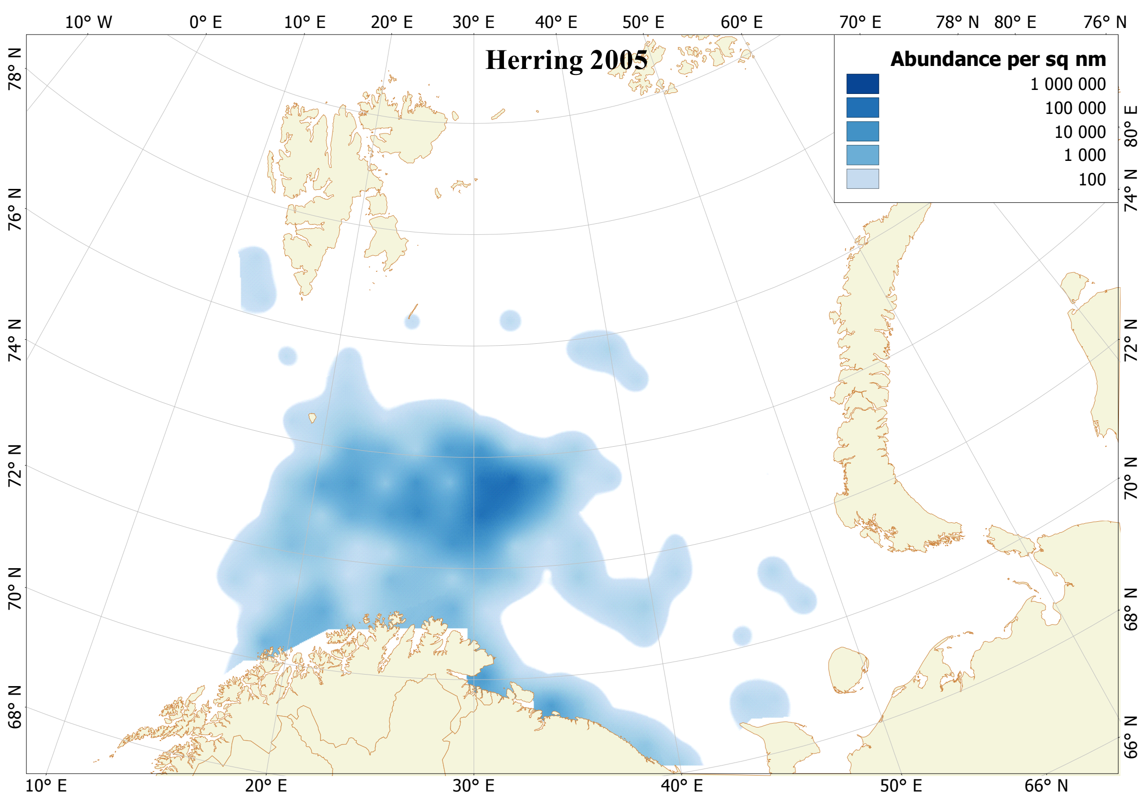


Figure 2.2.4 Distribution of 0-group herring autumn 2005

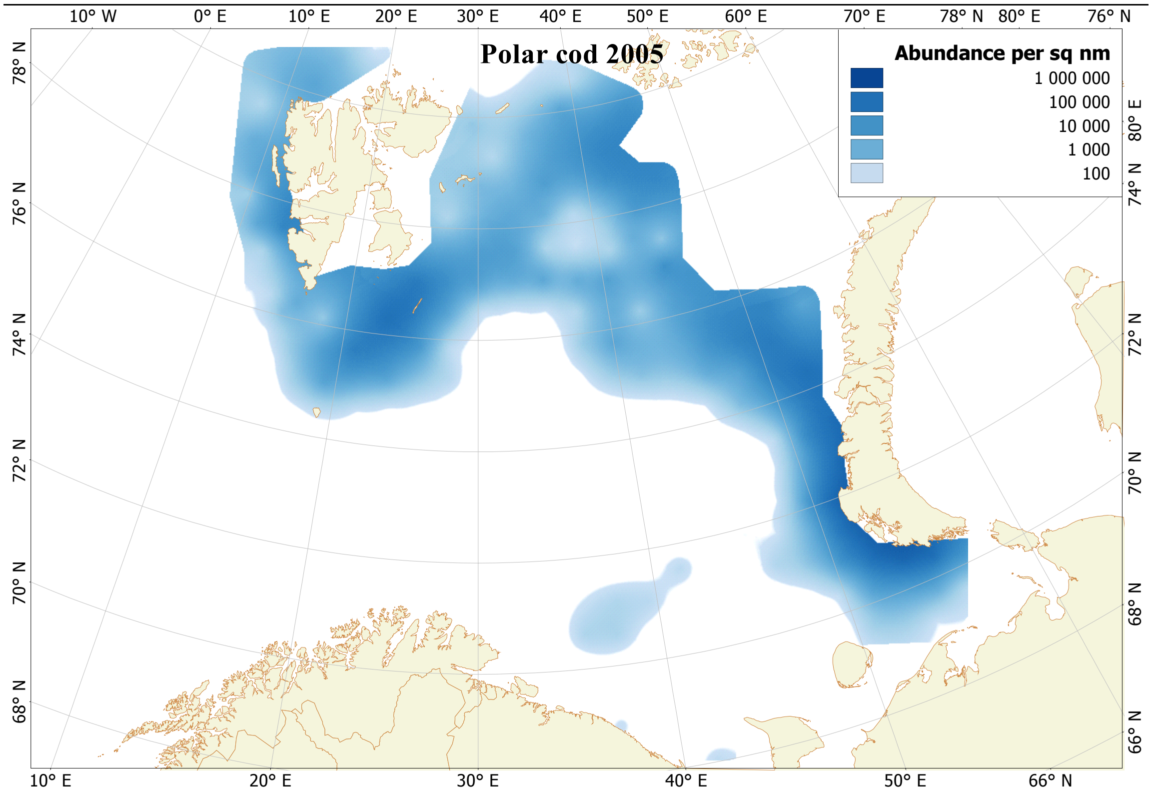


Figure 2.2.5 Distribution of 0-group polar cod autumn 2005

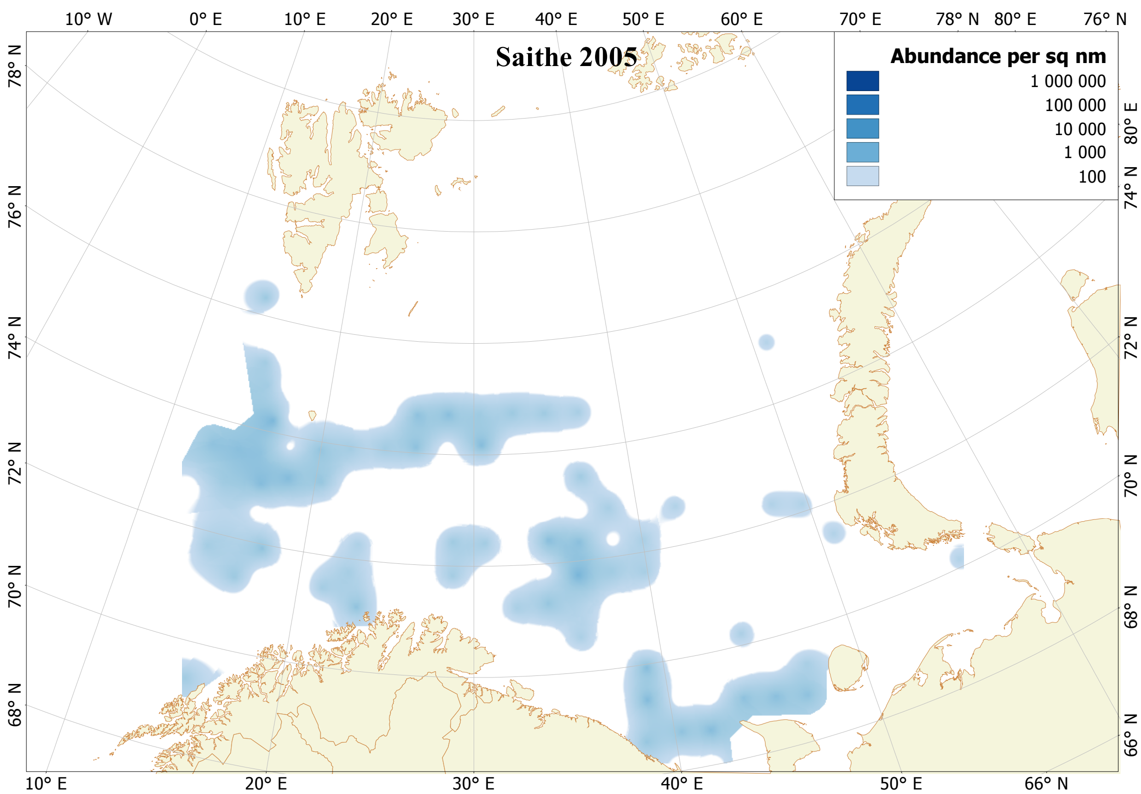


Figure 2.2.6 Distribution of 0-group saithe autumn 2005

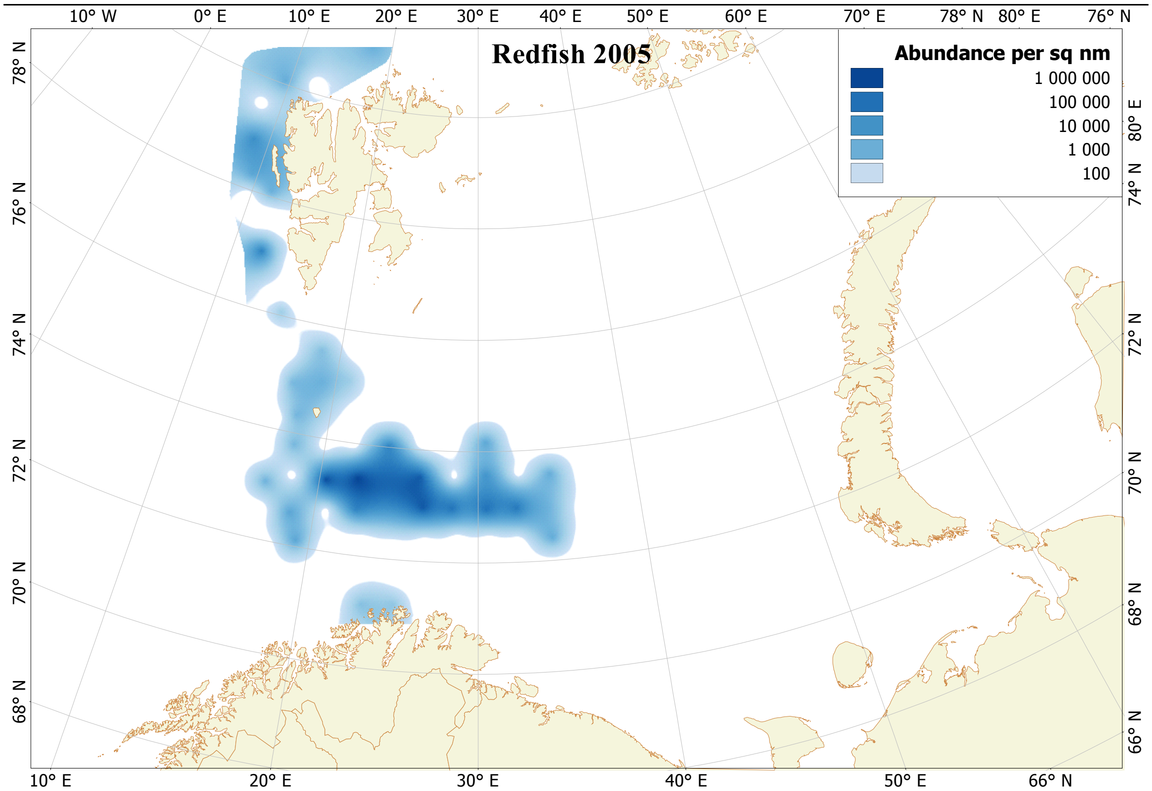


Figure 2.2.7 Distribution of 0-group redfish autumn 2005

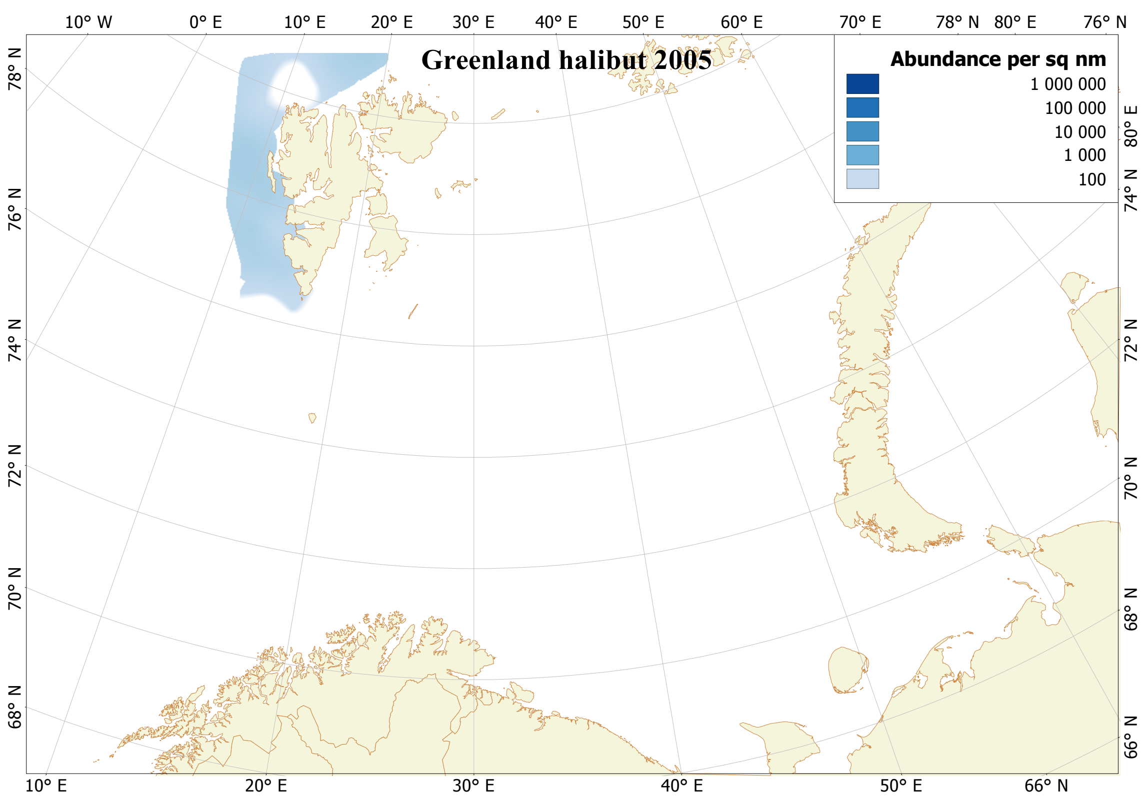


Figure 2.2.8 Distribution of 0-group Greenland halibut autumn 2005

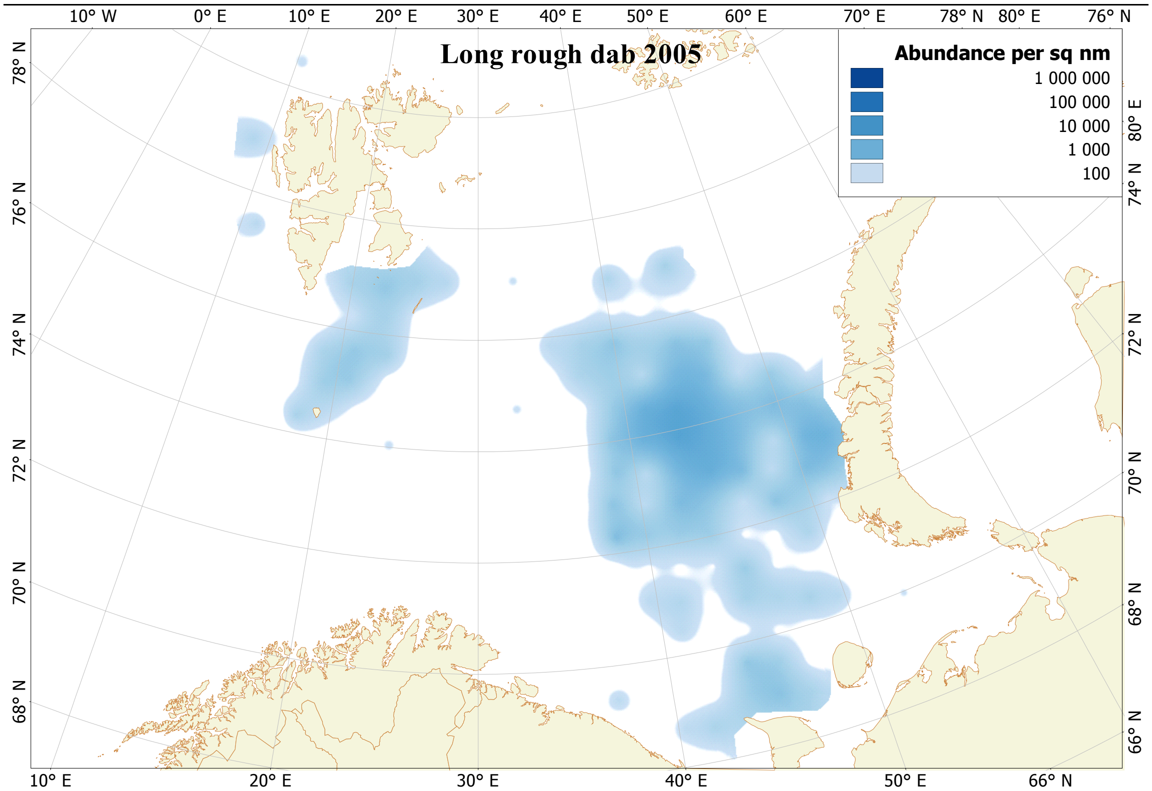


Figure 2.2.9 Distribution of 0-group long rough dab autumn 2005

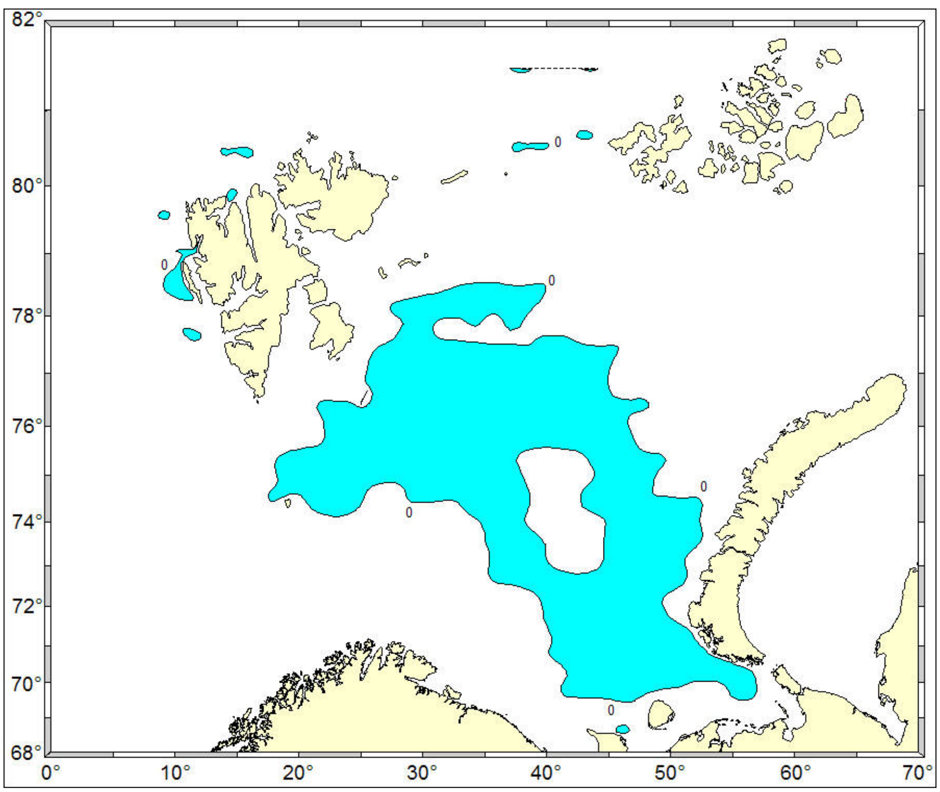


Figure 2.3.1 Estimated density distribution of one-year-old capelin (t/ nautical mile^2) August - October 2005.

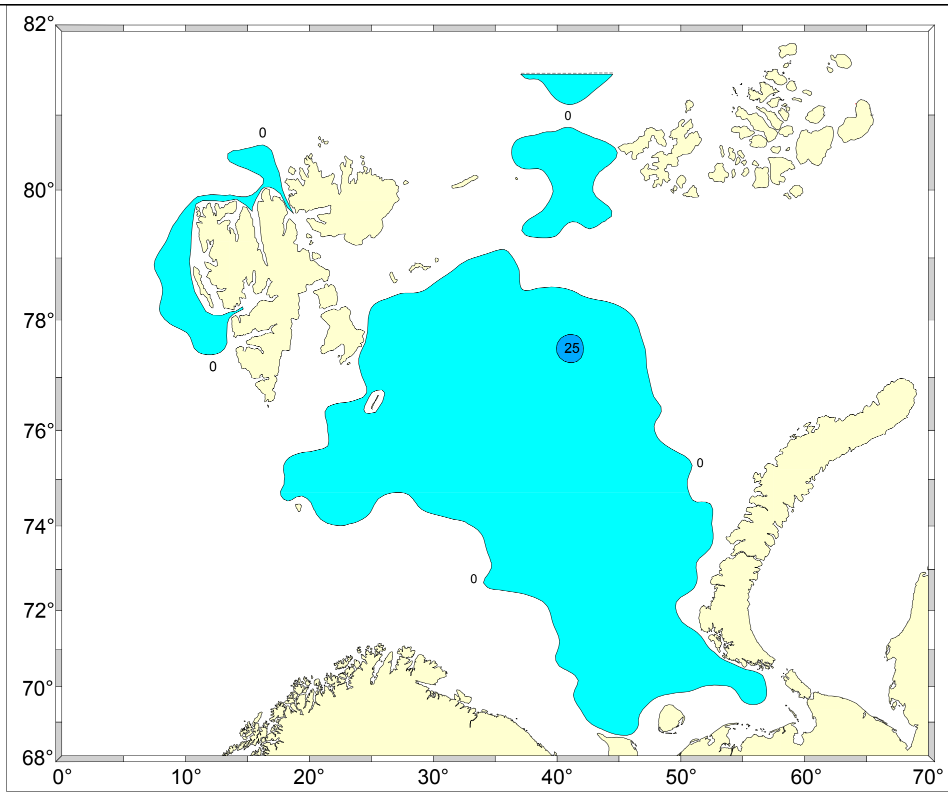


Figure 2.3.2 Estimated total density distribution of capelin (t/ nautical mile^2) August - October 2005.

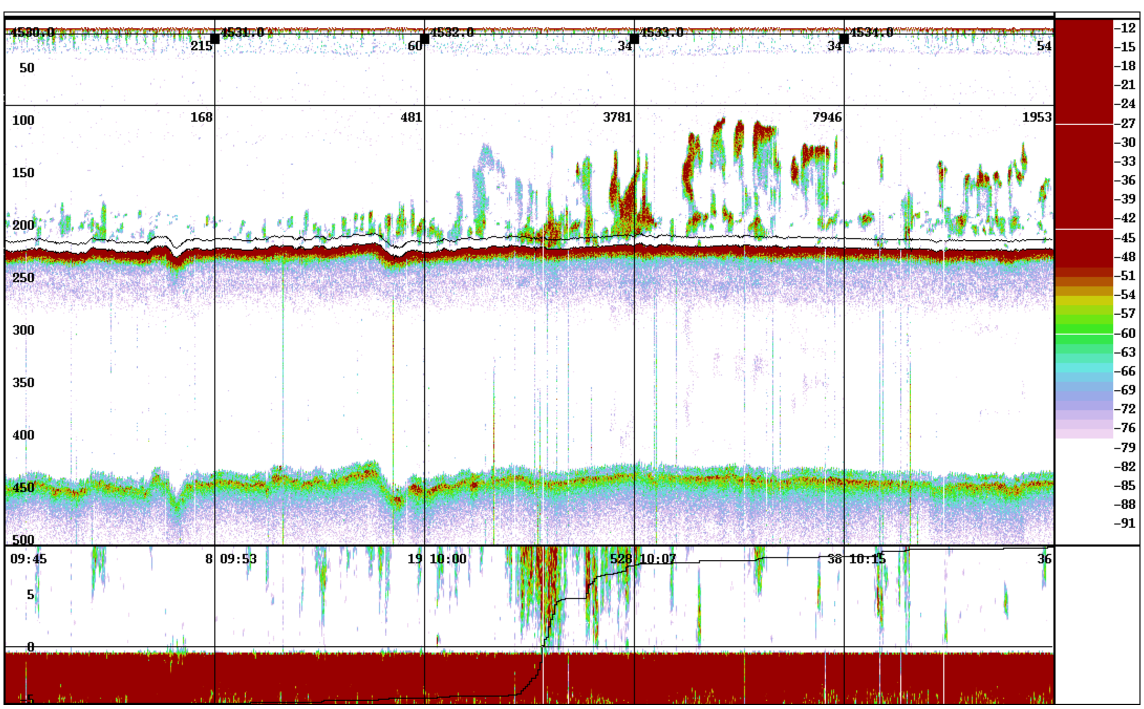


Figure 2.3.3 Typical echo-records of capelin in the northeastern Barents Sea.

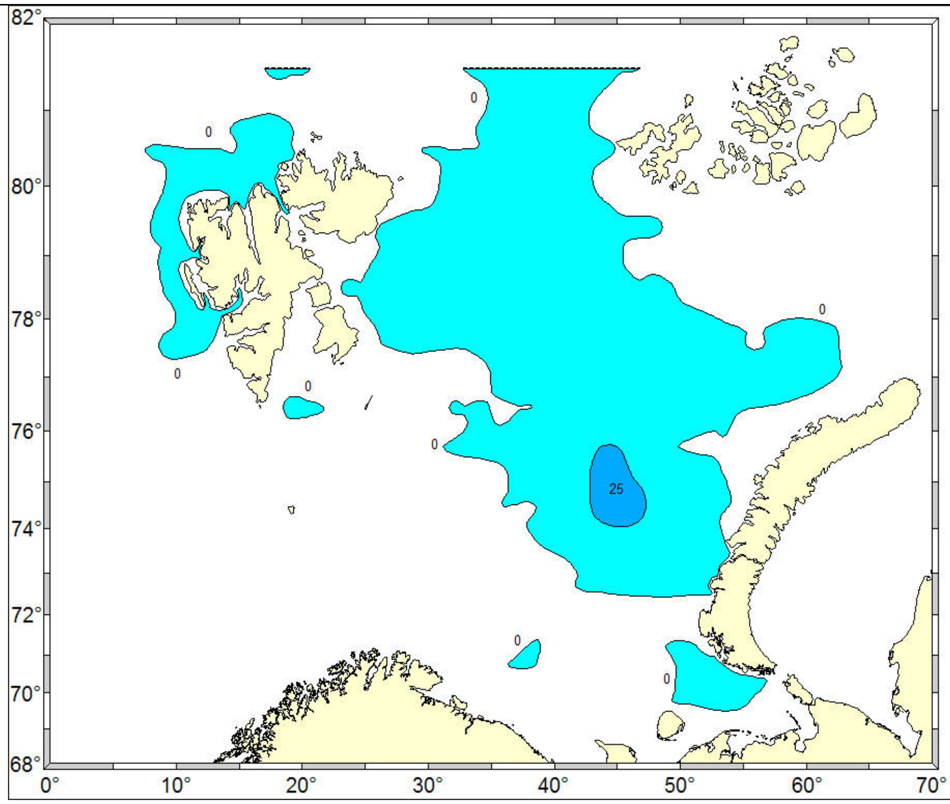


Figure 2.3.4 Estimated density distribution of one year old polar cod (t/ nautical mile^2) August - October 2005.

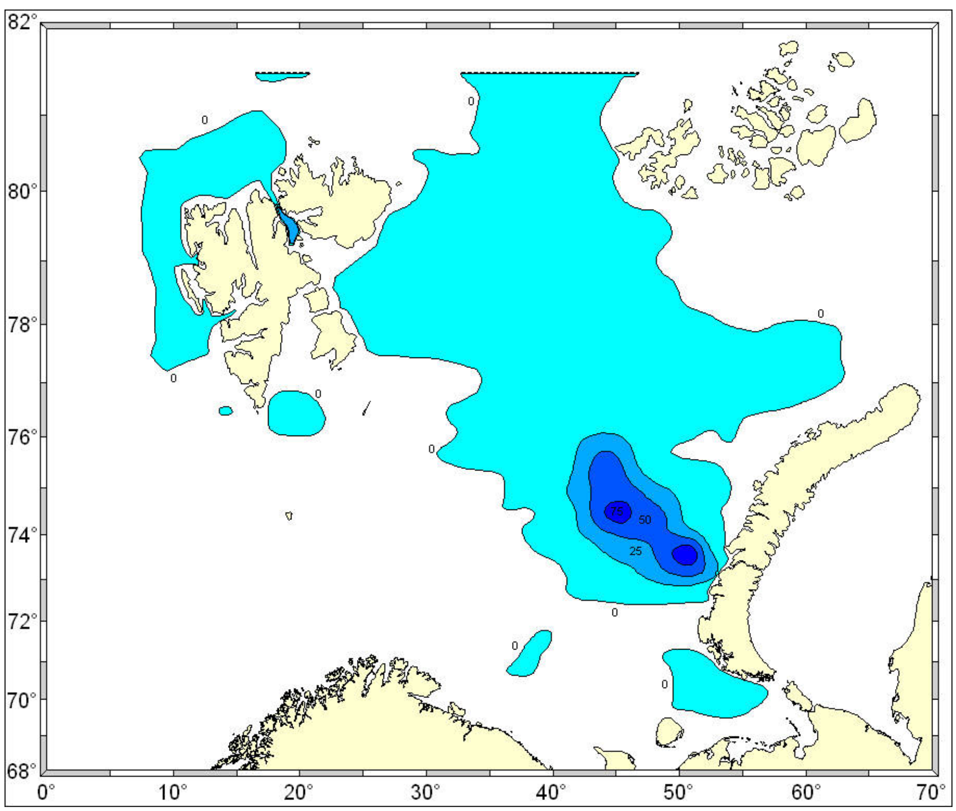
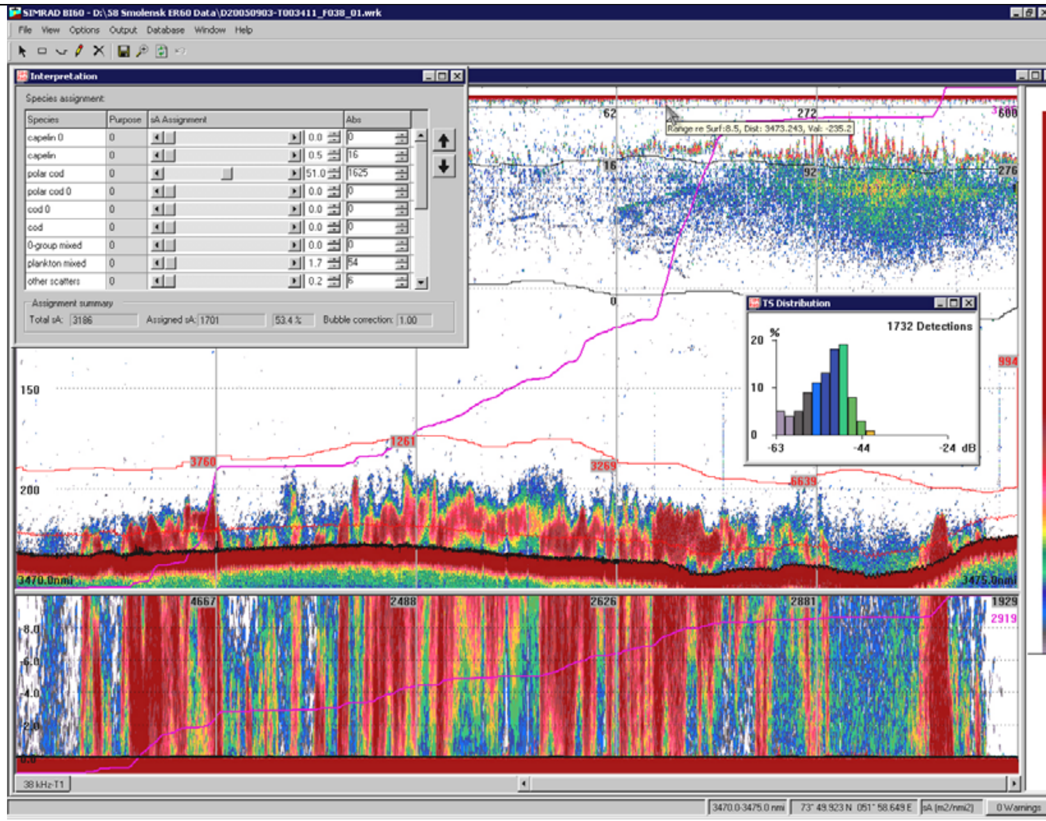


Figure 2.3.5 Estimated total density distribution of polar cod (t/ nautical mile^2) August - October 2005.



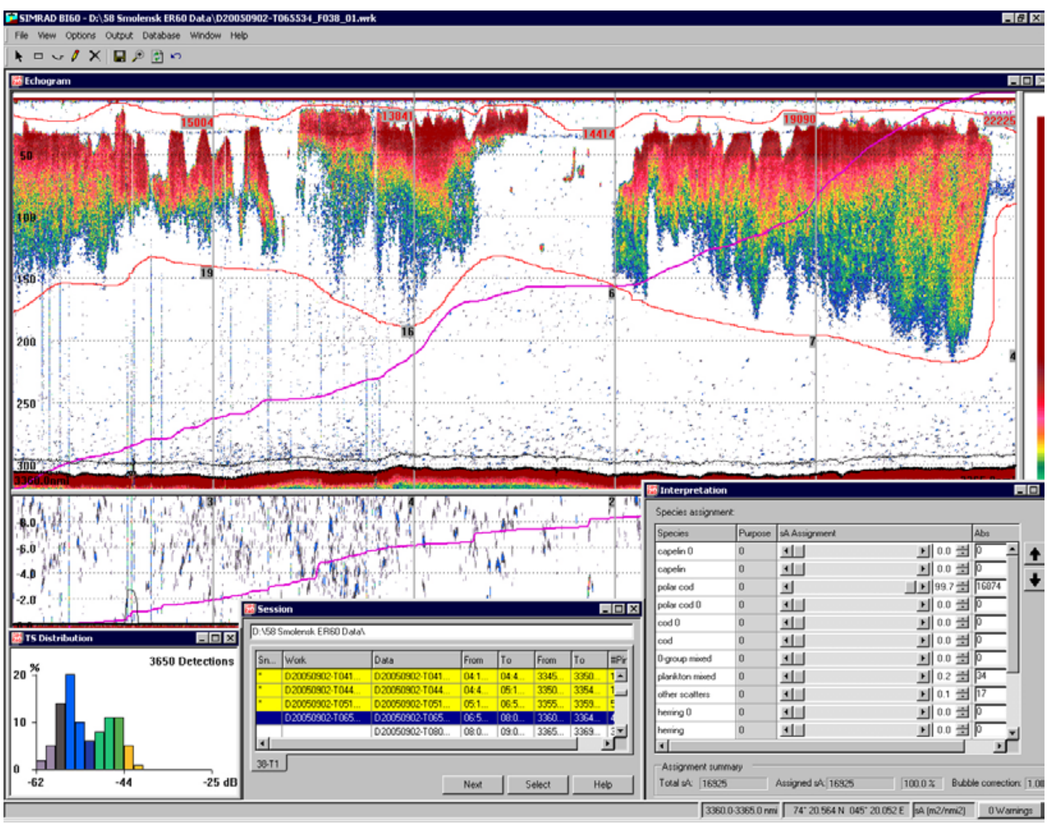


Figure 2.3.6 Typical echo-records of polar cod in eastern Barents Sea

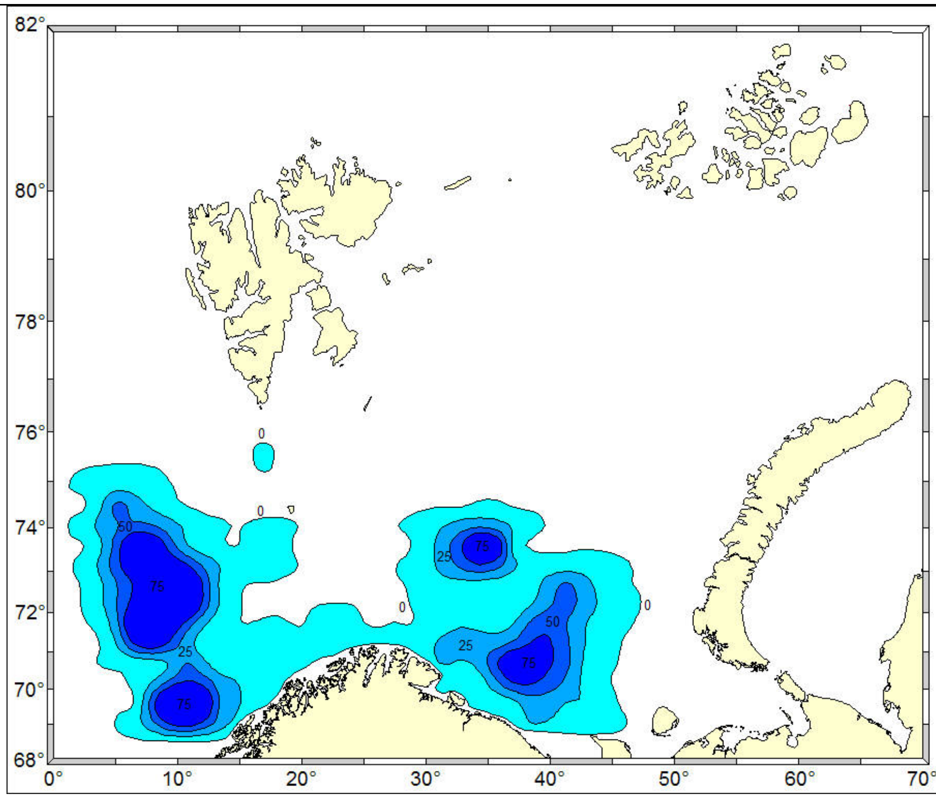


Figure 2.3.7 Estimated total density distribution of herring (t/ nautical mile²) August – October 2005.

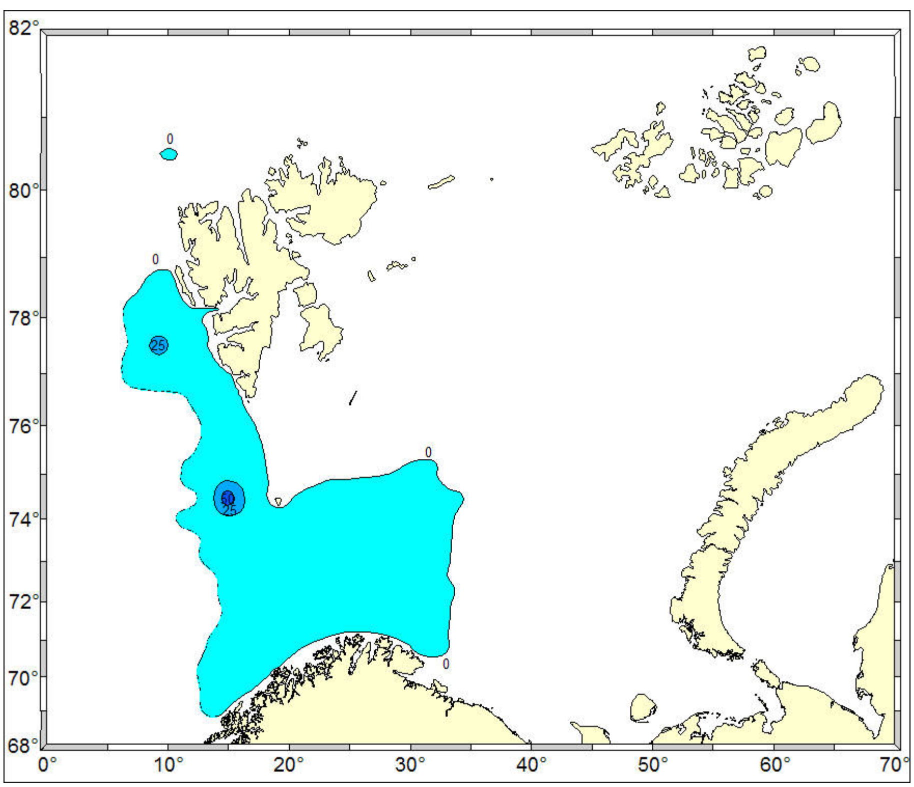


Figure 2.3.8 Estimated total density distribution of blue whiting (t/ nautical mile²) August – October 2005.

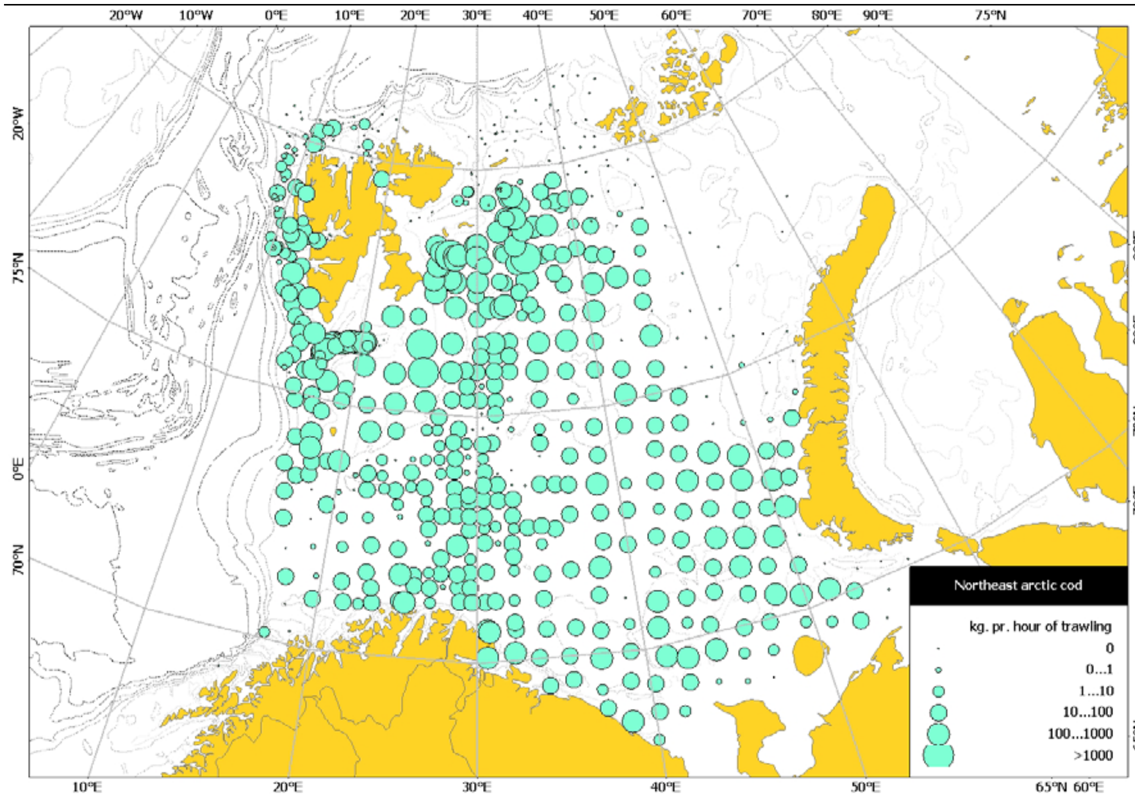


Figure 2.4.1 Distribution of cod.

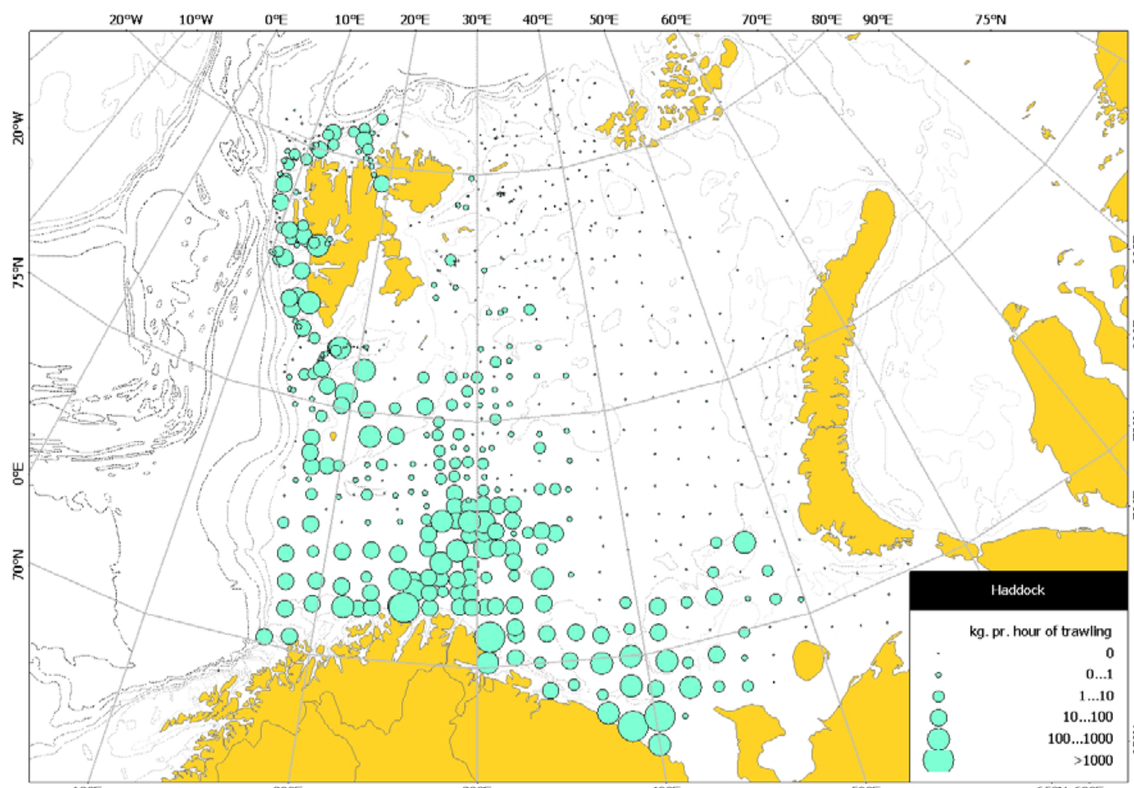


Figure 2.4.2 Distribution of haddock

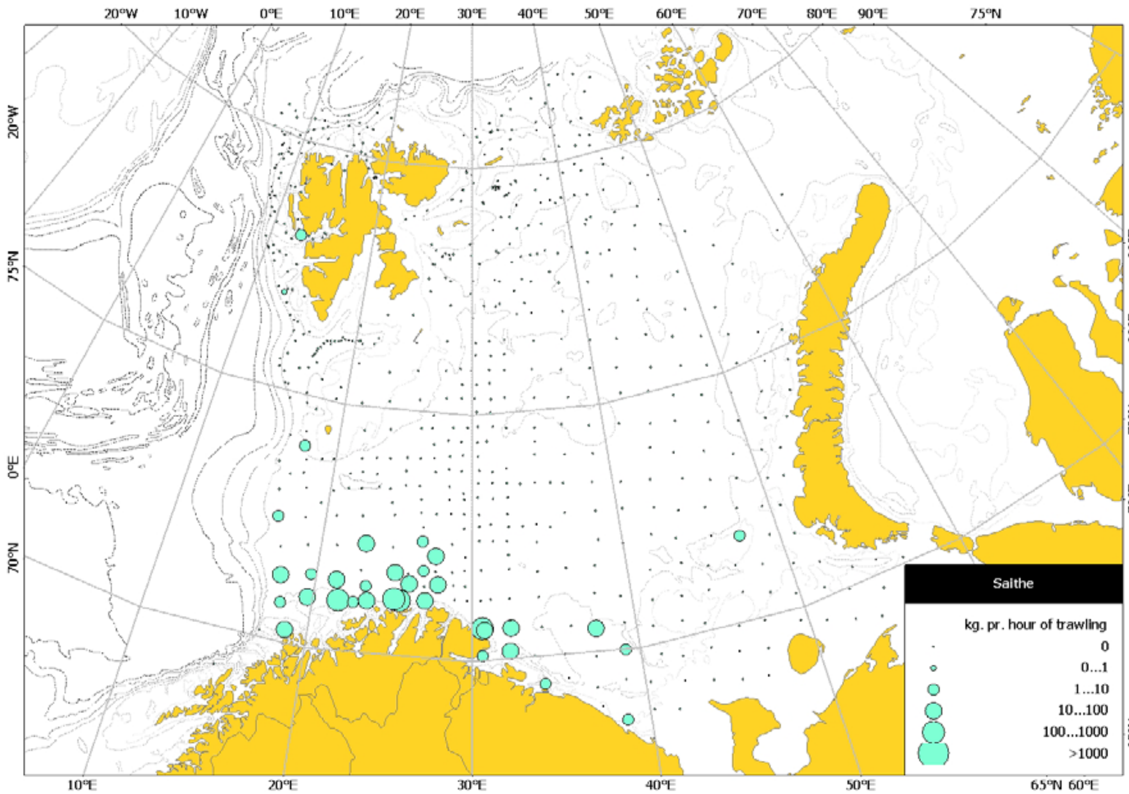


Figure 2.4.3 Distribution of saithe

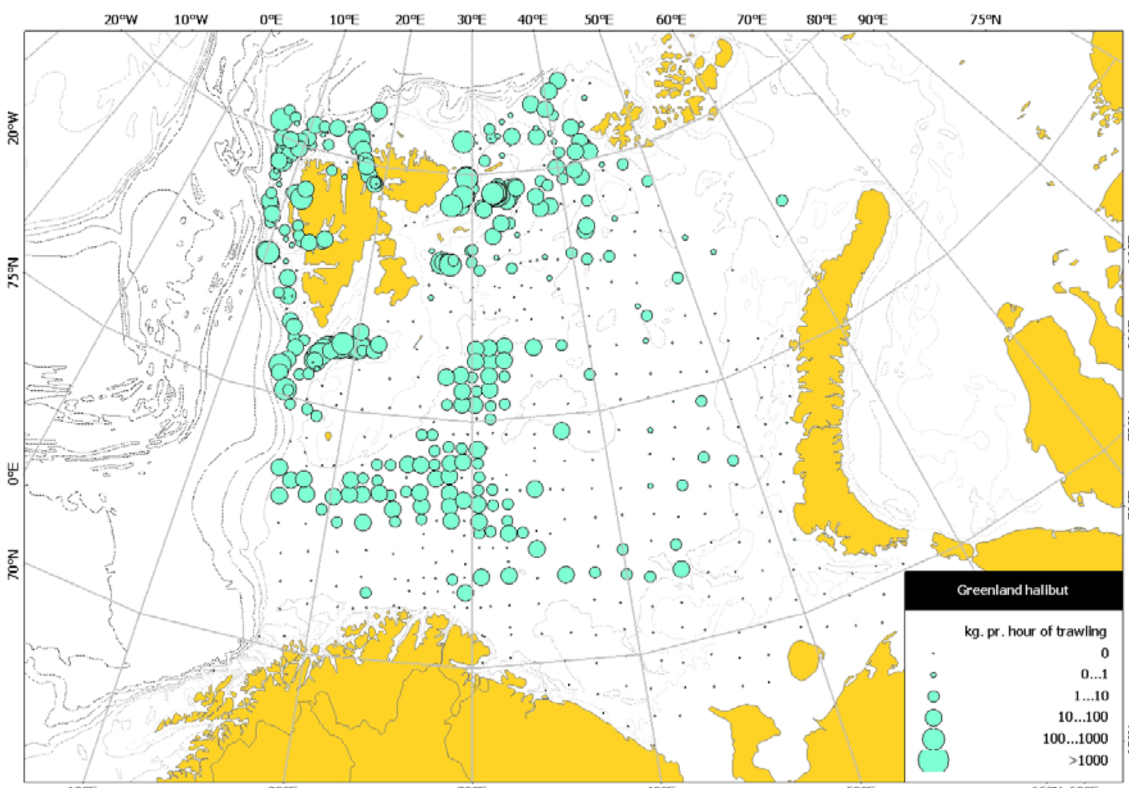


Figure 2.4.4 Distribution of Greenland halibut

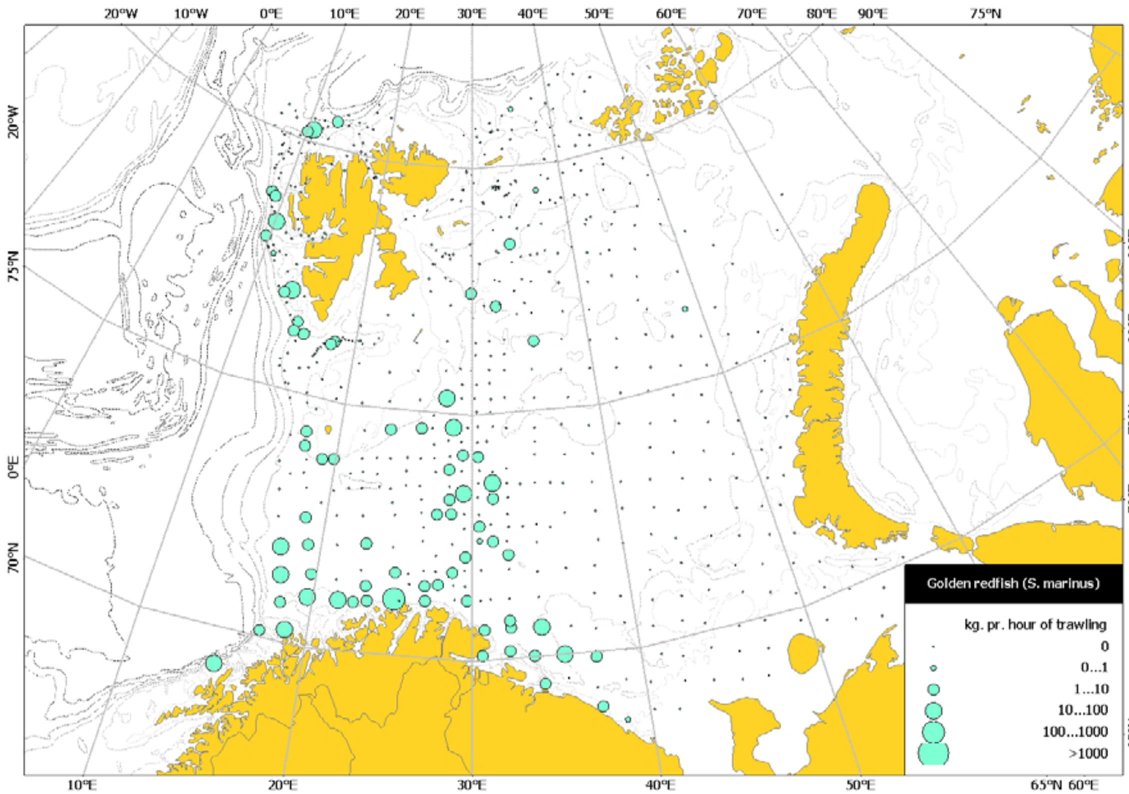


Figure 2.4.5 Distribution of *Sebastes marinus*

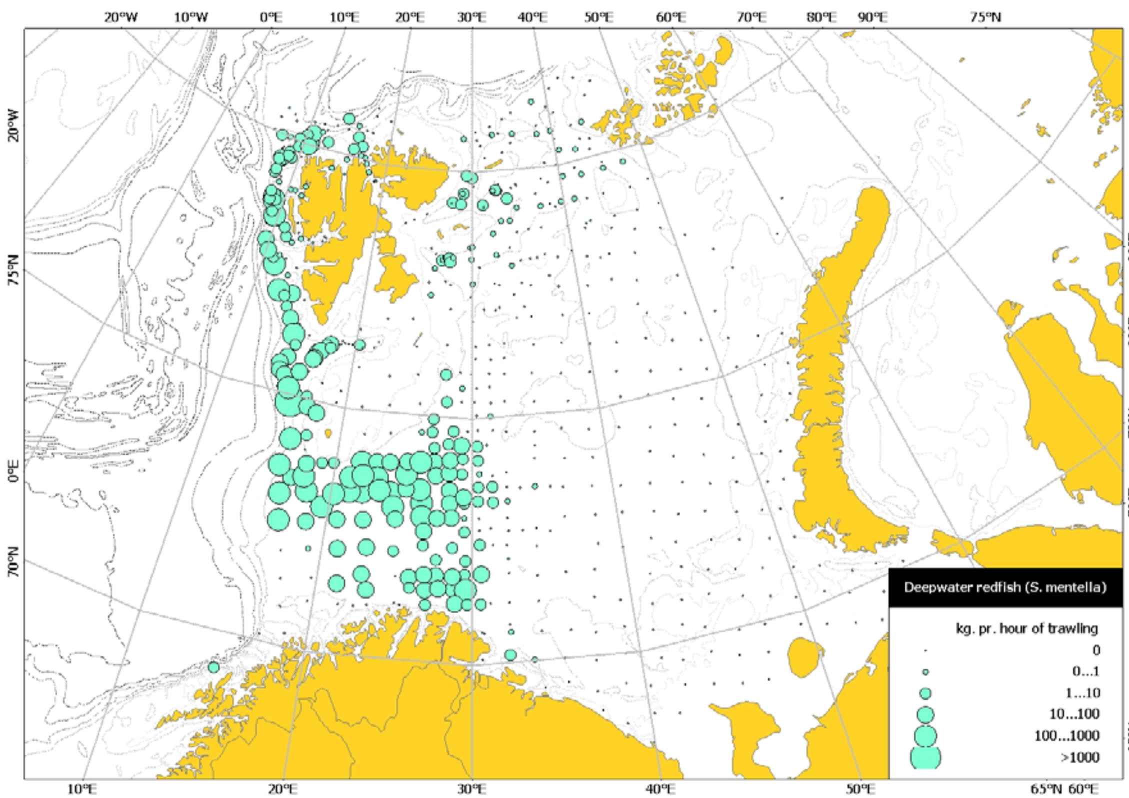


Figure 2.4.6 Distribution of *Sebastes mentella*

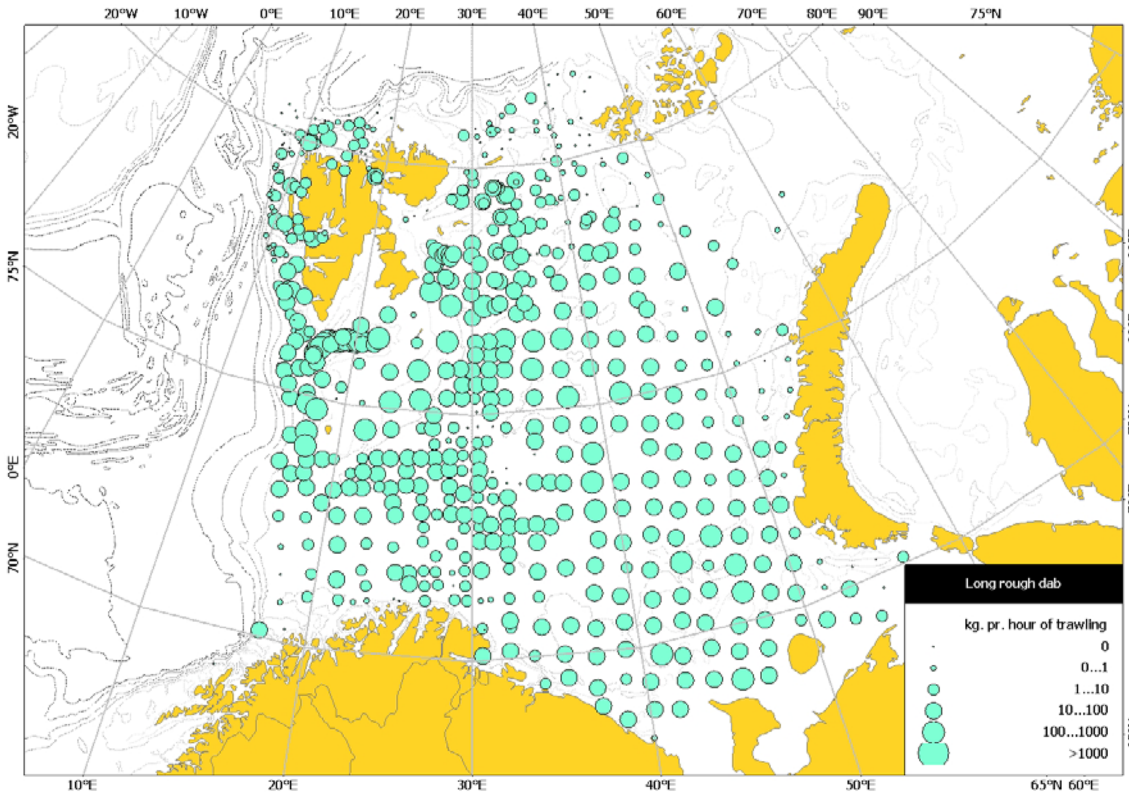


Figure 2.4.7 Distribution of long rough dab

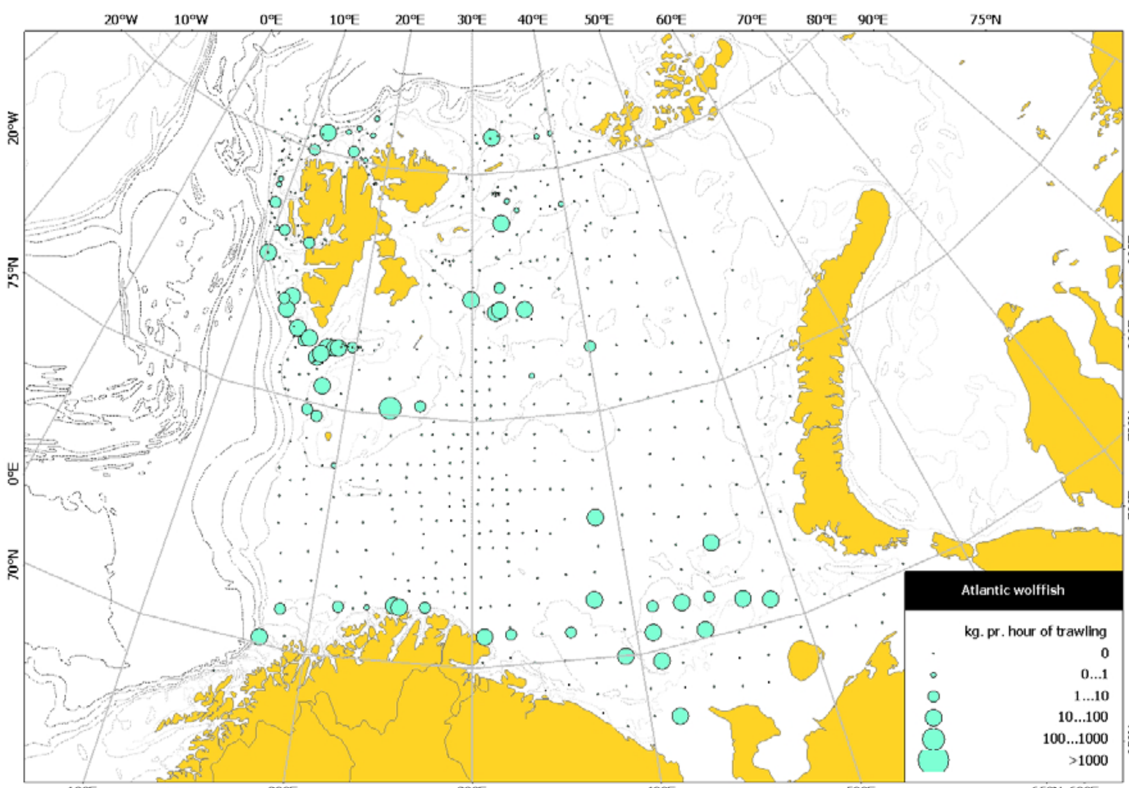


Figure 2.4.8 Distribution of Atlantic wolffish

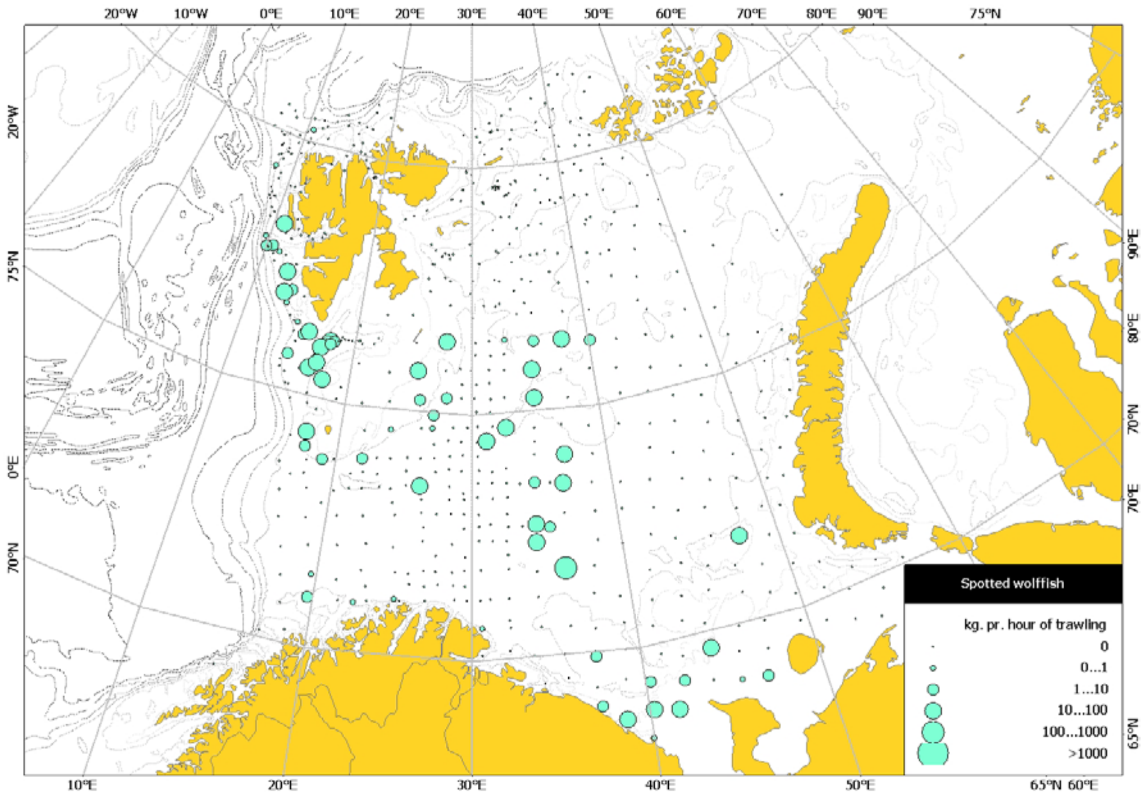


Figure 2.4.9 Distribution of spotted wolffish

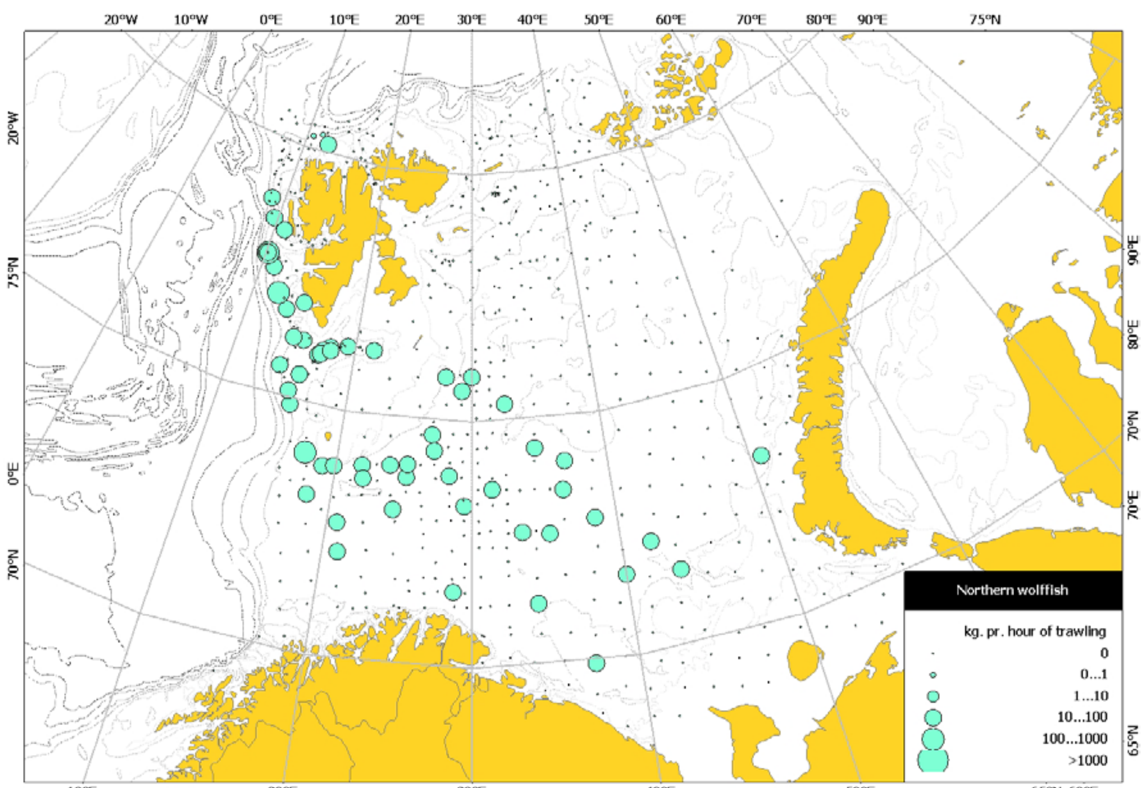


Figure 2.4.10 Distribution of northern wolffish

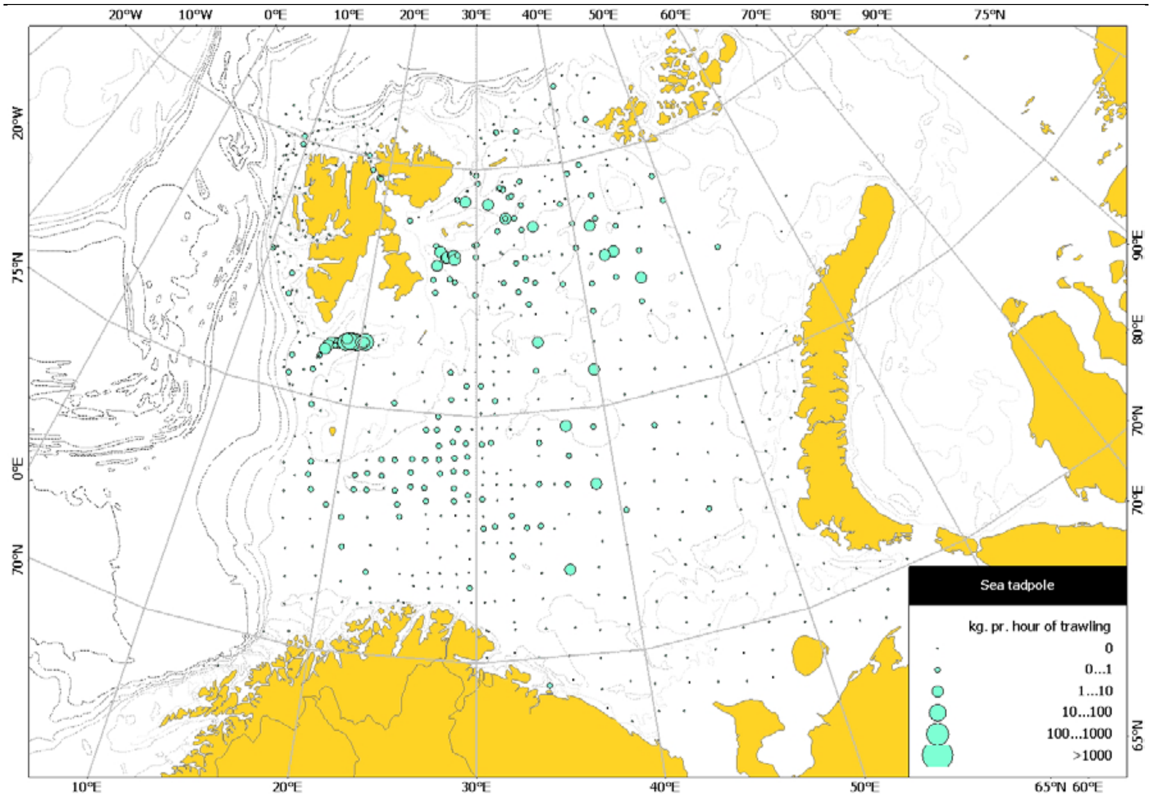


Figure 2.4.11 Distribution of sea tadpole

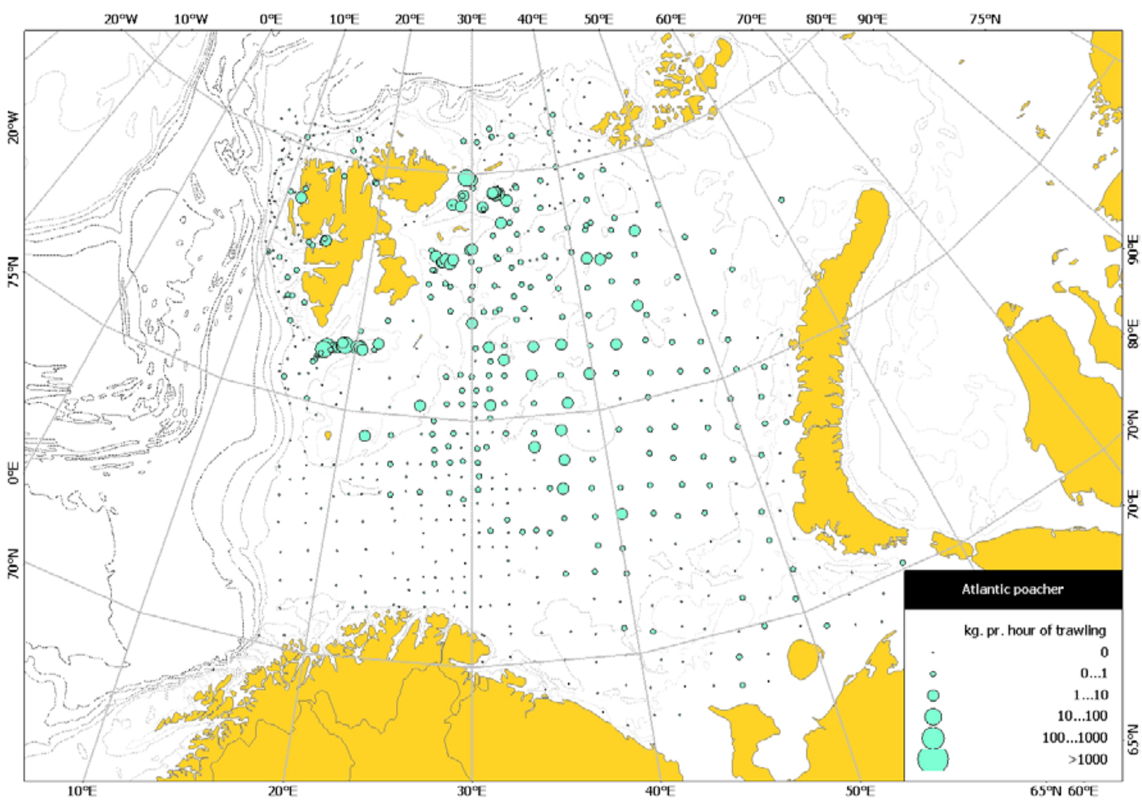


Figure 2.4.12 Distribution of Atlantic poacher

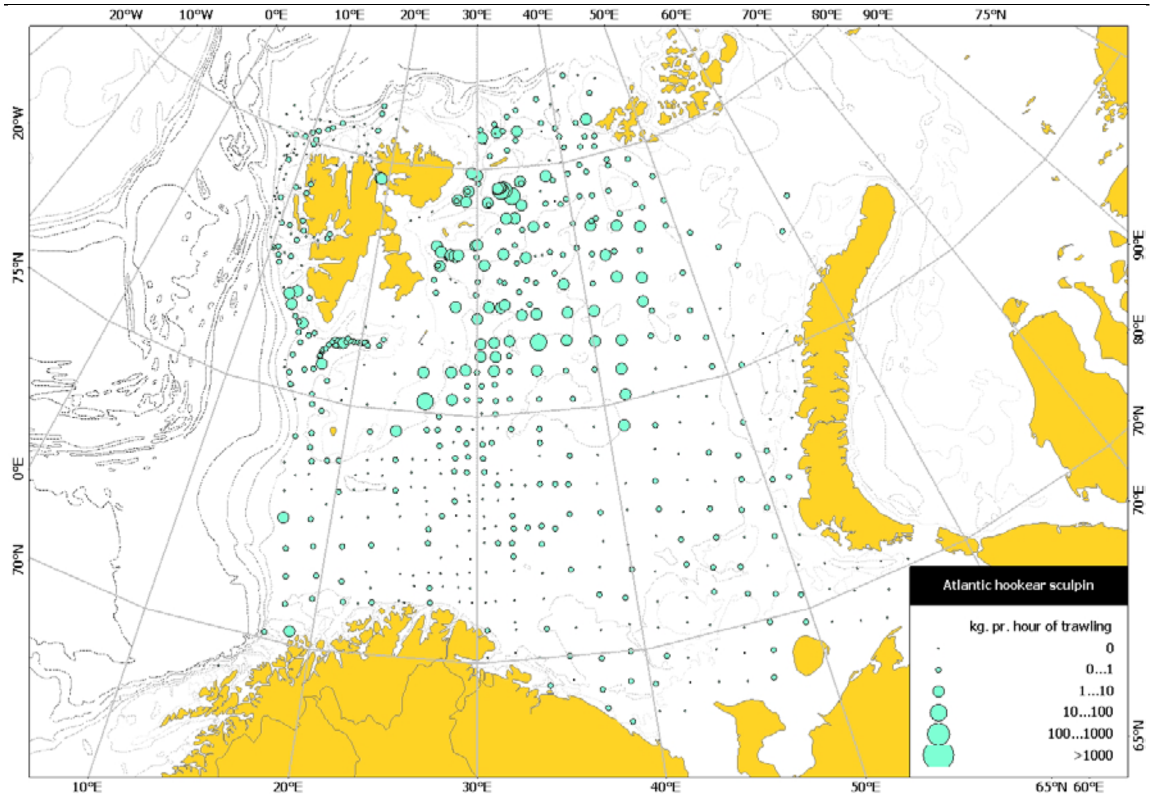


Figure 2.4.13 Distribution of hook-ear sculpin

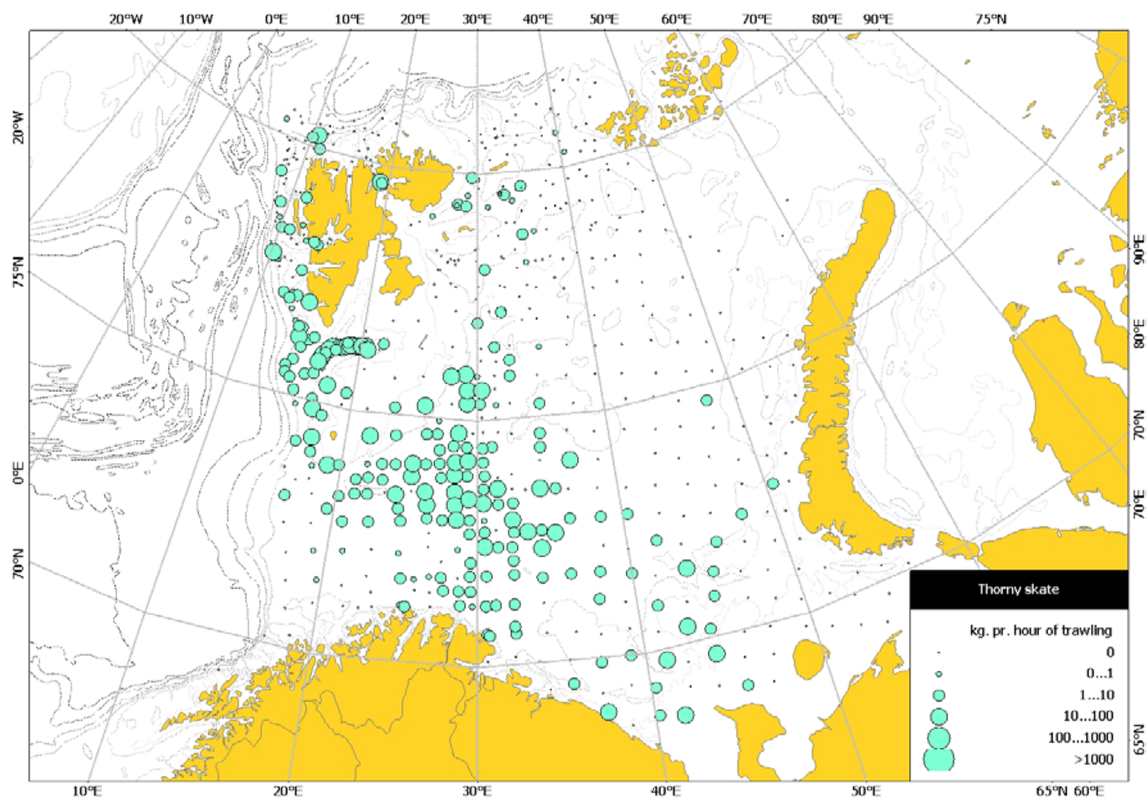


Figure 2.4.14 Distribution of thorny skate

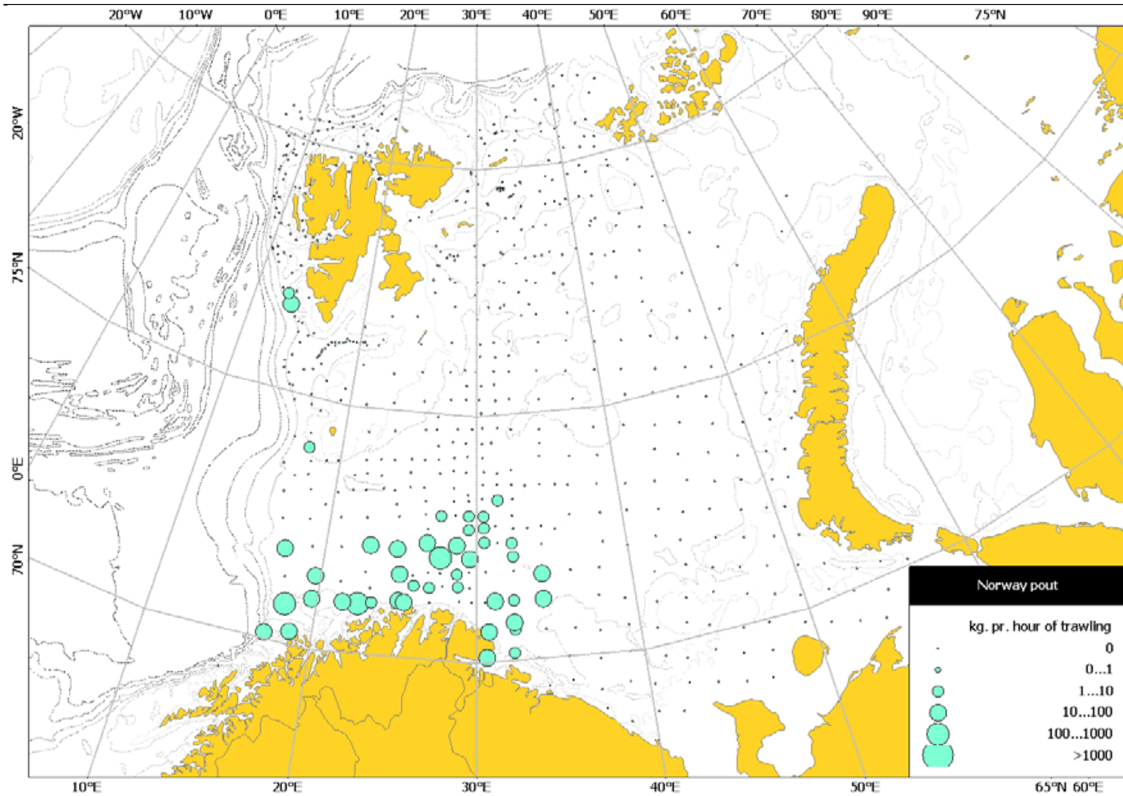


Figure 2.4.15 Distribution of Norway pout

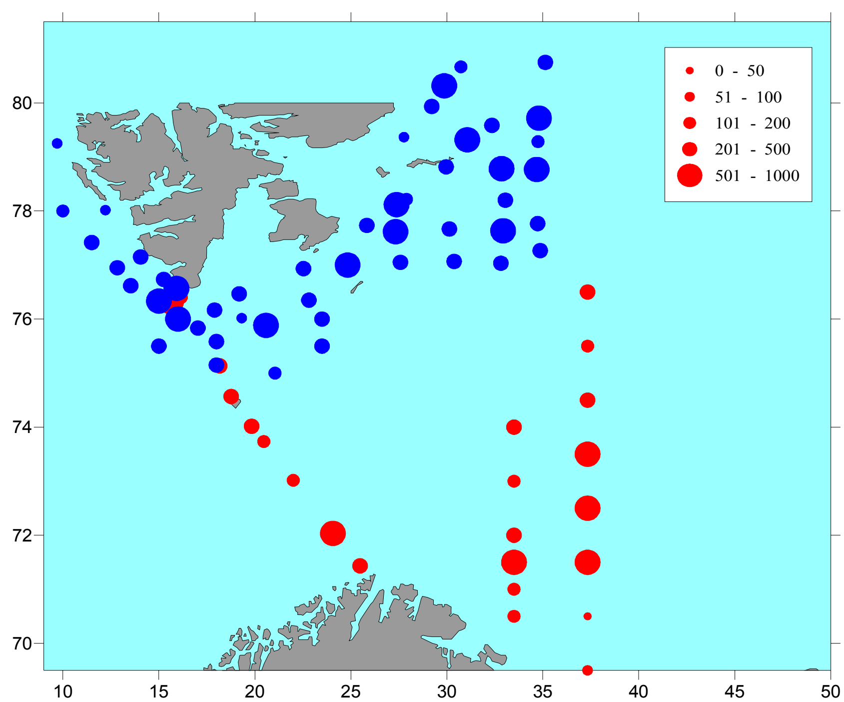


Figure 2.6.1 Zooplankton biomass wet-weight (mg/m^3) in the layer 0-50 m during August (red) and September (blue) 2005 collected by Juday-net ("F. Nansen").

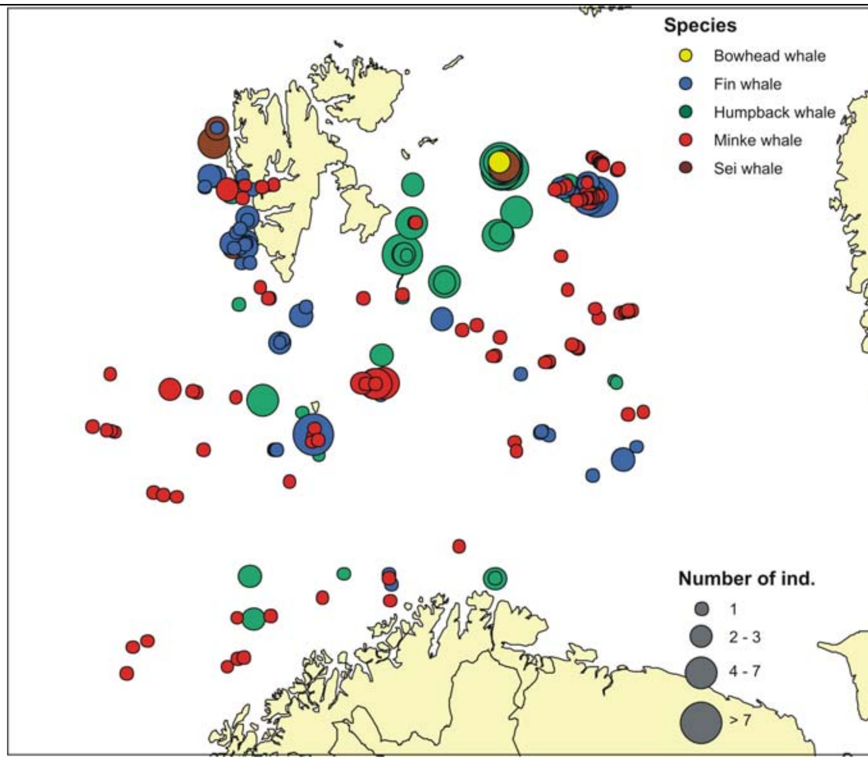


Figure 2.7.1 Distribution of baleen whale observations from the research vessels Johan Hjort, G.O. Sars, Smolensk and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005.

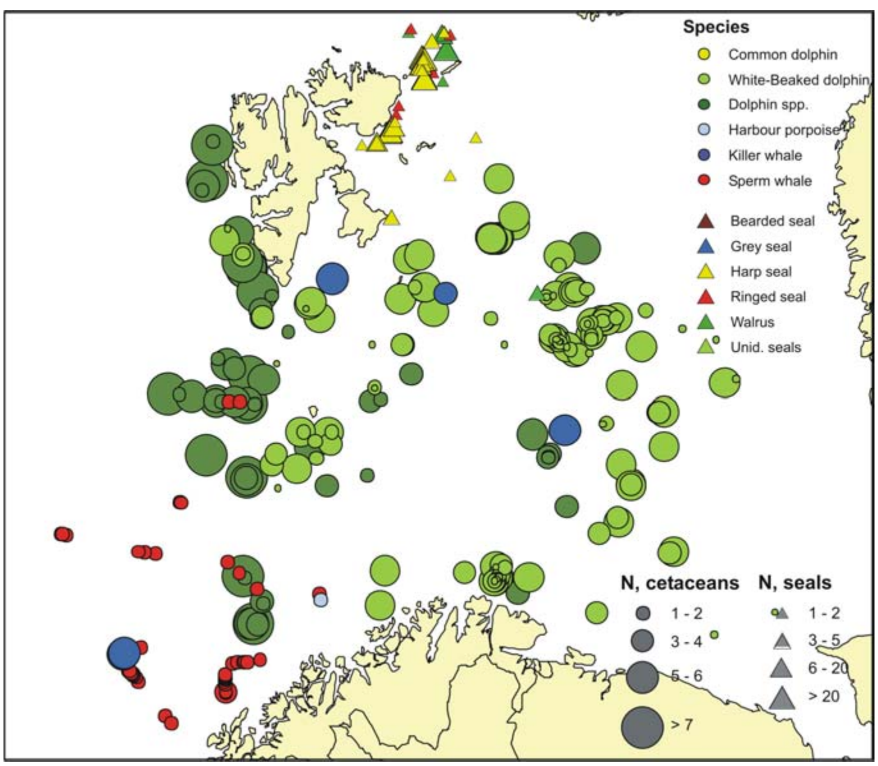


Figure 2.7.2 Distribution of seals and toothed whale observations from the research vessels Johan Hjort, G.O. Sars, Smolensk and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005.

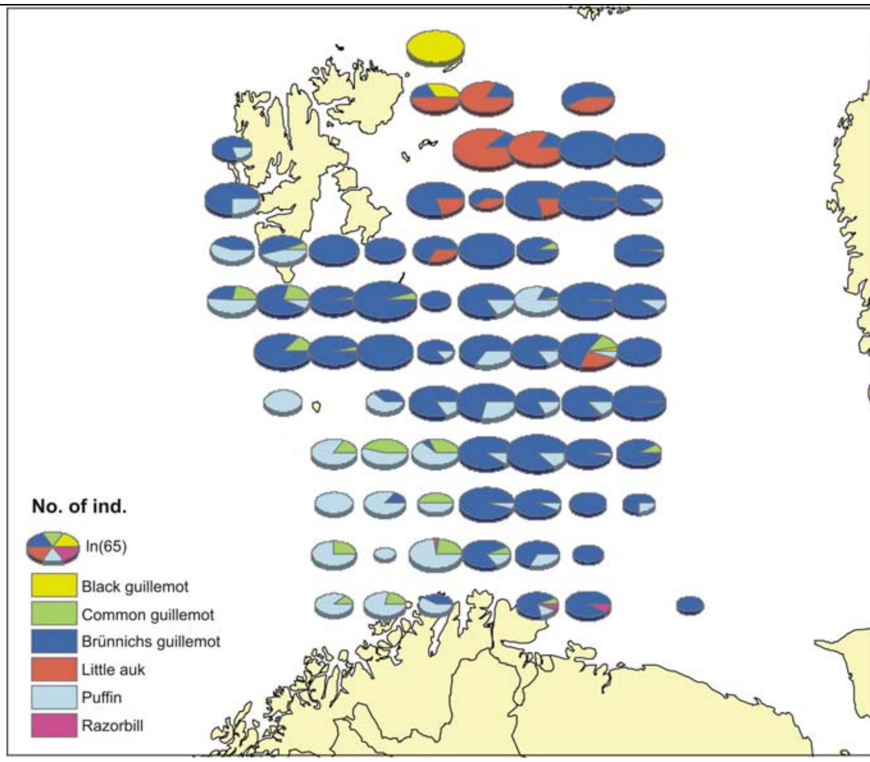


Figure 2.7.3 Distribution of Alcid observations from the research vessels Johan Hjort, G.O. Sars and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005. The pie size reflects total number of individuals observed within 100x100 km grid cells (logarithmic scale).

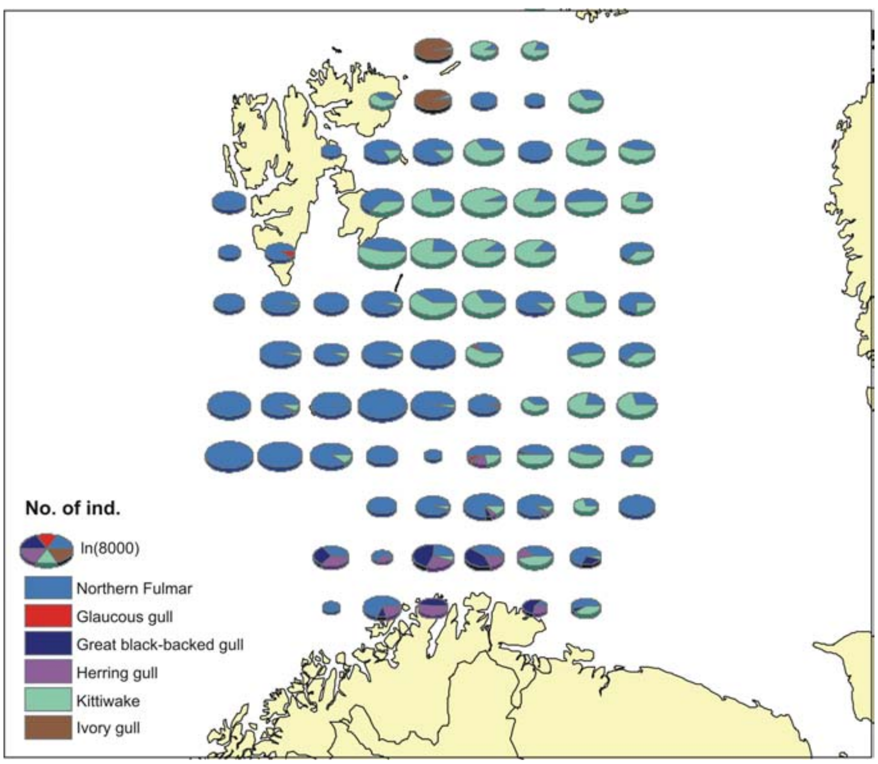


Figure 2.7.4 Distribution of northern fulmar and gull observations from the research vessels Johan Hjort, G.O. Sars and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005. The pie size reflects total number of individuals observed within 100x100 km grid cells (logarithmic scale).

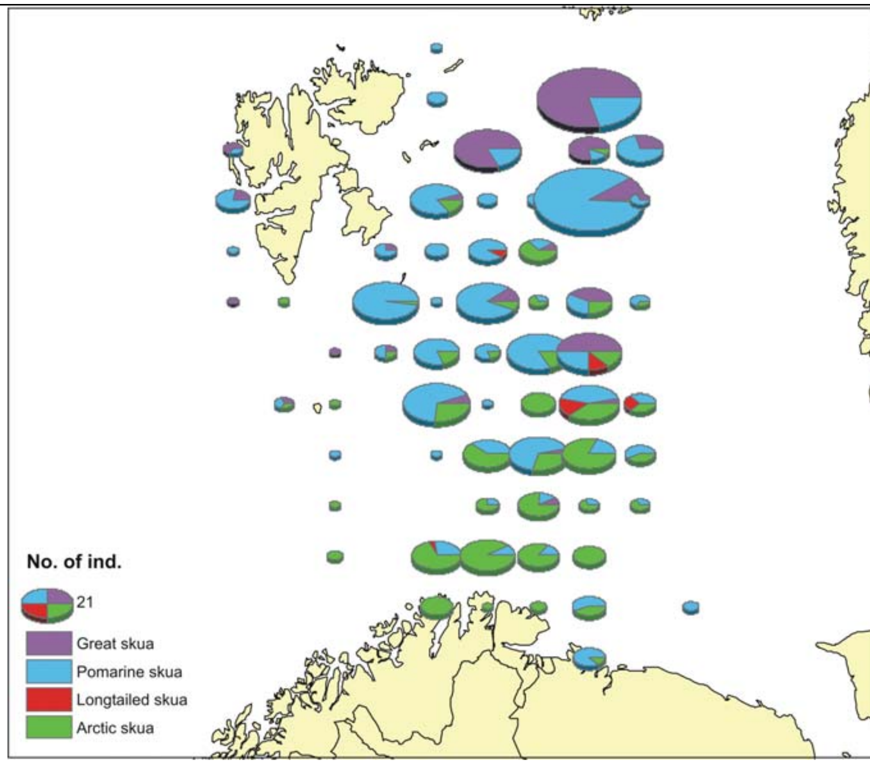


Figure 2.7.5 Distribution of skuas as observed from the research vessels Johan Hjort, G.O. Sars and F. Nansen, and the aircraft Arktika during the ecosystem survey 2005. The pie size reflects total number of individuals observed within 100x100 km grid cells.

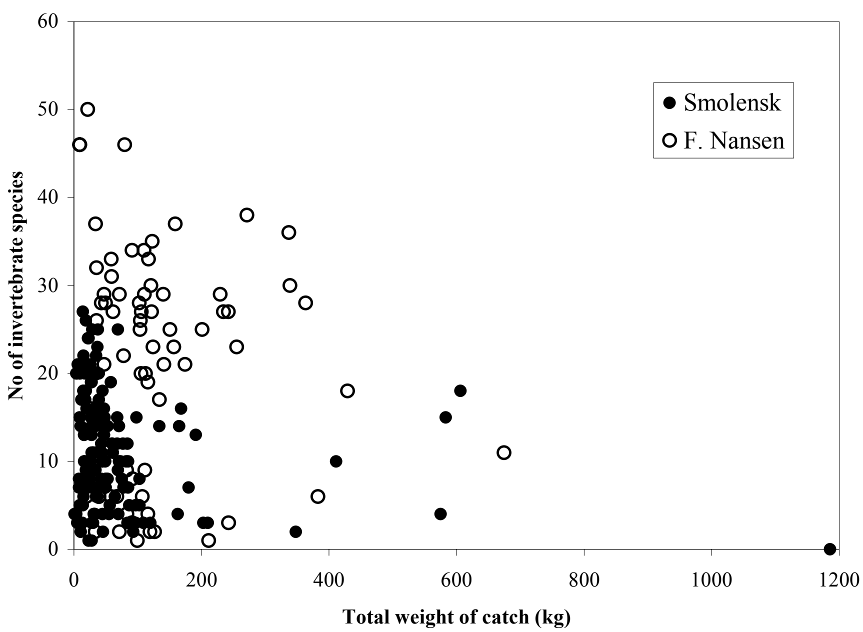


Figure 2.8.1 The relationship between number of invertebrate species and size of trawl catch.

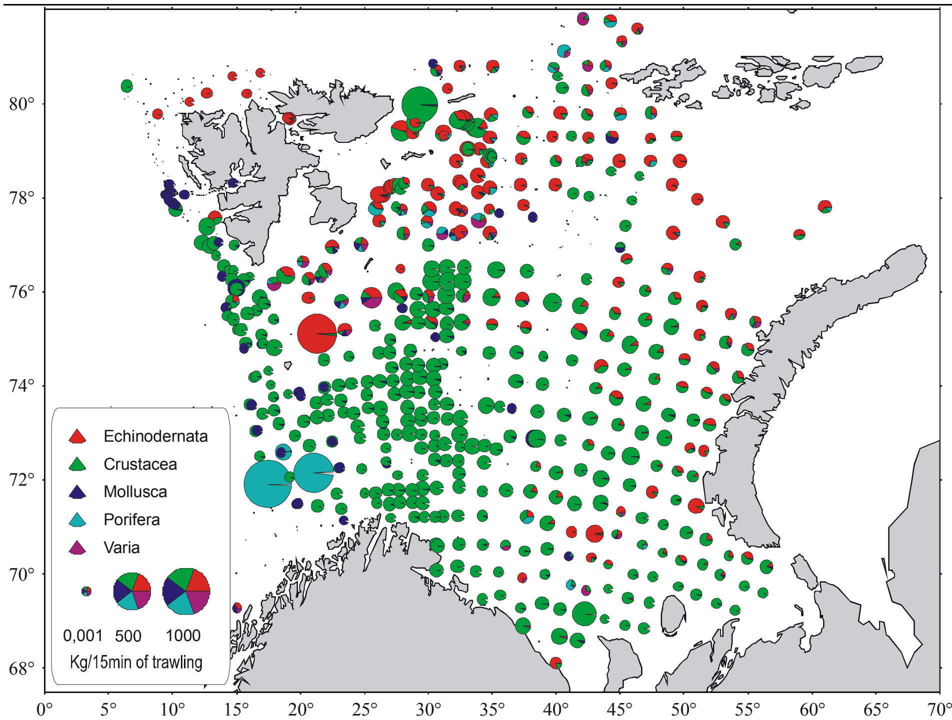


Figure 2.8.2. Distribution of biomass of invertebrate bycatch in Campelen bottom trawl within the survey area. Different dominant taxonomic groups are indicated with different colours.

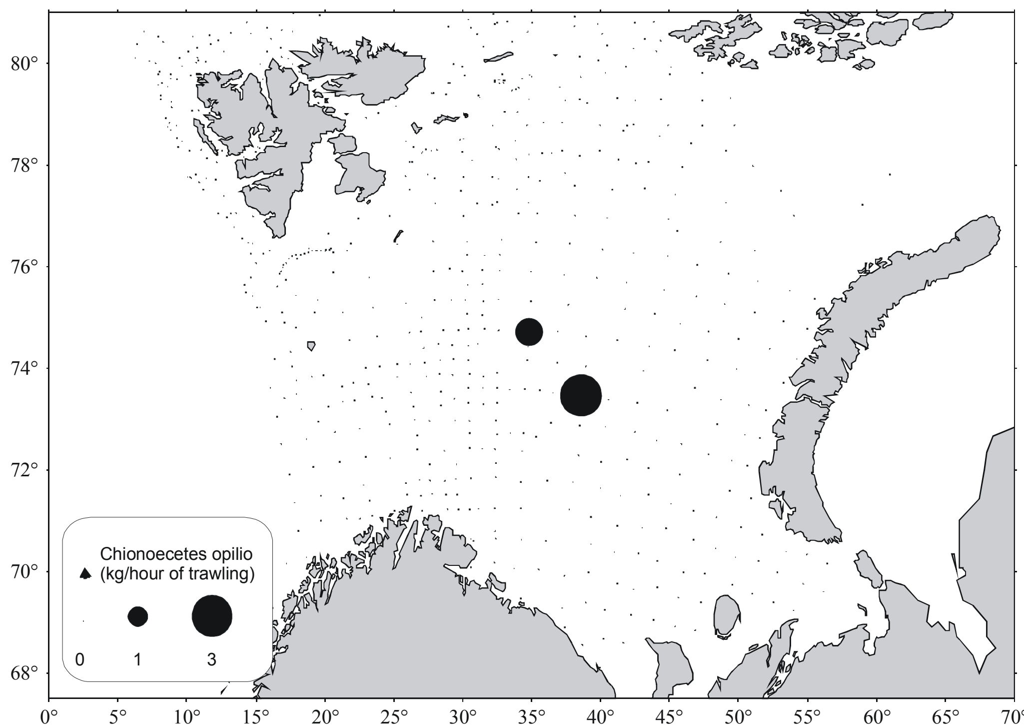


Figure 2.8.3 Distribution of snow crab (*Chionoecetes opilio*) in Campelen bottom trawl. Standardised to kg/hour of trawling.

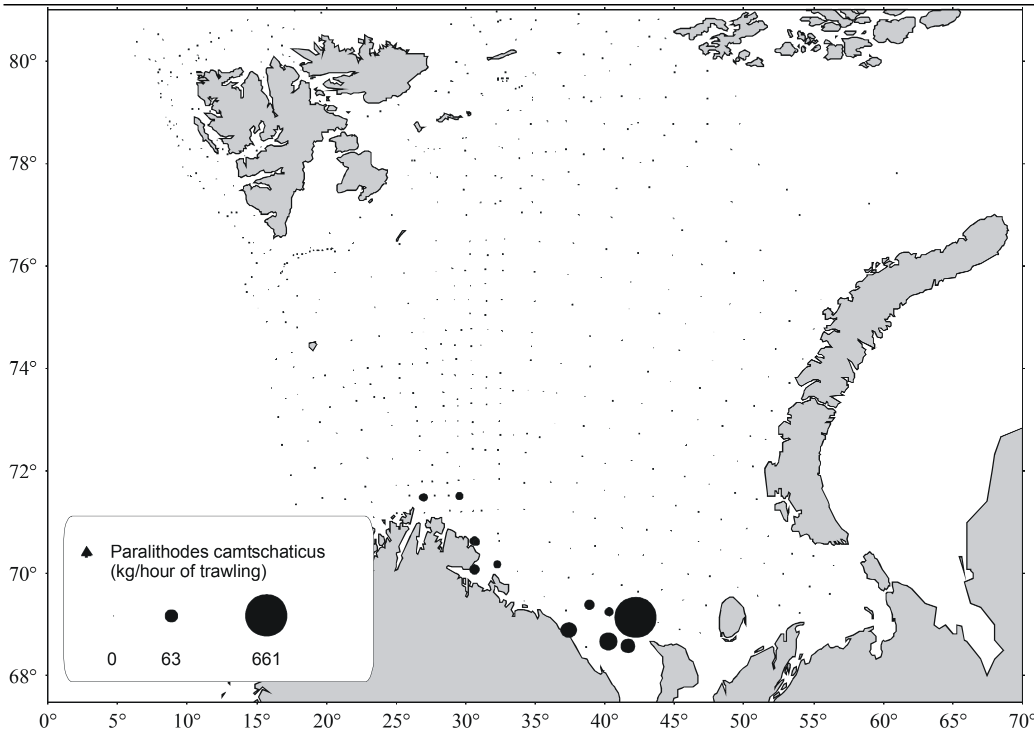


Figure 2.8.4 Distribution of king crab (*Paralithodes camtschaticus*) in Campelen bottom trawl. Standardised to kg/hour of trawling.

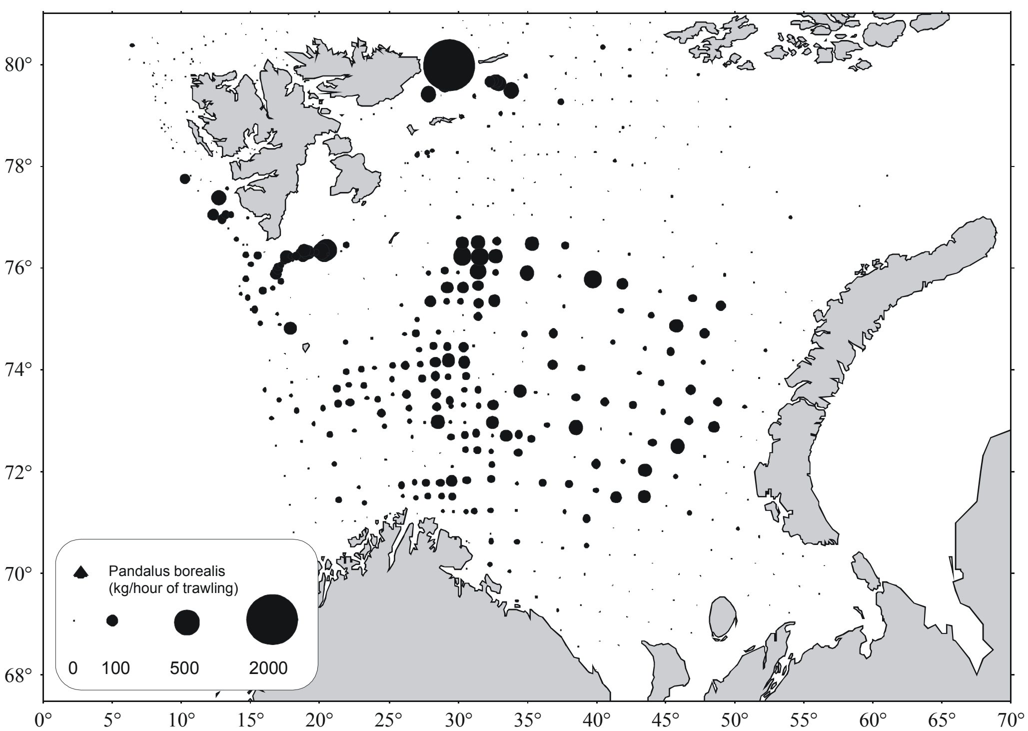


Figure 2.8.5 Distribution of deep-sea (*Pandalus borealis*) in Campelen bottom trawl. Standardised to kg/hour of trawling.

APPENDIX 1

Ecosystem survey 2005

Research vessel	Participants
"Smolensk" (09.08-26.09)	I. Goljak, V. IvshinV. Kapralov, V. Mamylov, N. Mukhina, T.Prokhorova, D. Prozorkevich (cruise leader), S. Ratushnyy, O.Sazhenkov, A. Trofimov, V. Zelinsky, G. Zuikov,
"F. Nansen" (17.08-05.10)	A. Amelkin, N. Anisimova, I. Dolgolenko (cruise leader), N.Epifanova, T. Gavrilik, V. Guzenko, V. Ignashkin, S.Kharlin, R. Klepikovsky, P. Lyubin (from 30/8), I. Manushin, I.Samsonova, V. Sergeev, F. Shevchenko, V. Skljar, V.Tataurov, O. Vavilina
"G.O. Sars" (06.08-30.09)	**Part 1 (06/08-14/08):** S. Aanes (cruise leader), J. Alsvåg, J. Alvarez, J. Andersen, M. Dahl, M. Fonn, T. Haugland, P.J. Helgesen, B. Skjold, H. Kaponen, T. Knutsen, G. McCallum, P. Pahr, S. Subbey, N. Ushakov. **Part 2(15/08-23/08):** S. Aanes (cruise leader), J. Alvarez, J. Andersen, M. Dahl, J. Erices, T. Haugland, P.J. Helgesen, B. Skjold, H. Kaponen, P. Liebig, G. McCallum, P.B. Mortensen, P. Pahr, L. Rey, S. Subbey, N. Ushakov. **Part 3 (24/08-12/09):** O.O. Amøy, L. Austgulen, L. Doksæller, E. Olsen (cruise leader), I.M. Beck, M. Dahl, J. Erices, A. Frydendal, H. Græsdal, T. HovlandL.L. Jørgensen, P. Liebig, U. Lindstrøm, G. McCallum, J. Røttingen, A.B. Skiftesvik, N. Ushakov. **Part 4 (13/09-30/09):** J. Alvarez, G. Dingsør, B. Endresen, E. Eriksen, K.A. Fagerheim, H. Gjøsæter (cruise leader), J. Gwynn, D. Howell, P.J. Helgesen, G. McCallum, T. KnutsenM. Mauritzen, B. Røttingen, A. Steinstand, B.V. Svendsen, T. Haugland, N. Ushakov.
"J. Hjort" (01.08-08.09)	**Part 1 (01-14/08):** J.C. Holst (cruise leader), Ø. Tangen, E.S. Meland, K.B. Eriksen, B. Ellertsen, B. Endresen, P. Dahl, C. Forså **Part 2 (15.08-08/09):** K. Nedreaas (cruise leader), K. Sunnannå, V. Anthonypillai, F. Midtøy, K.B. Eriksen, J.H. Nilsen, B. Ellertsen, M. Johannessen, P. Dahl, C. Forså, E. Grønningsæter, G. Bakke, G. Tveit, H.Ø. Hansen
"Jan Mayen" (04.08-20.08 and 12.09-24.09)	**Part 1 (04-20/08** O.T. Albert (cruise leader), A. Harbitz, T.D.L. Wenneck, S. Kleiven, H. Fitje, G. Langhelle, J. Kristiansen, A.K. Abrahamsen, J. Størkersen, **Part 2 (12-24/09):** Å. Høines (cruise leader), F. Uiblein, T.D.L. Wenneck, L. Solbakken, H. Larsen, A. Sæverud, E. Hermanssen, A.L. Johnsen, W. Richardsen, W. Rafter
Aircraft "Arktika" (19.09-29.09)	V. Assioutenko, A. Lisovsky, I. Shafikov, V. Tereschenko, V. Zabavnikov (scientific leader)

APPENDIX 2

Ecosystem survey 2005

SPHERE CALIBRATION OF ECHOSOUNDERS EK-500, ER60

(on copper sphere CU60, TS=33,6 dB, at frequency 38 kHz)

Research vessel	G.O. Sars	Johan Hjort	Jan-Mayen	Smolensk	F. Nansen
Type of echosounder	ER60	ER60	ER60	EK60	EK60
Date	14.04.2005	18.08.2005	15.08.2005	11.08.2005	13.10.2004
Place	Ugdalseide	Coles bay Spitsbergen	Coles bay, Spitsbergen	69°13' N 35°10' E	69°13' N 35°10' E
Bottom depth (m)	88		41	42	52
Depth to sphere (m)	20.8	19.0	37	30.57	27.4
Temperature (ºC)	5.31	3.5	1.0	10.1	3,5
Salinity (‰)	31.96	32.7	34.0	32.6	33,9
TS of sphere (dB)	-33.6	-33.7	-33.6	-33.6	-33.6
Transducer type	ES38B	ES38B	ES38B	ES38B	ES38B
Transducer depth (m)	5.5	0		0	0
Real sphere depth (m)		19.0		30.57	27.40
Sound velocity (m/sec)	1471.2	1464.0	1453.0	1485	1467
Absorption coefficient (dB/km)	9.321	9.782	9.32	9.76	10.1
Pulse length (Short/Med./Long, ms)	1.024	1.024	1.024	1.024	1.024
Bandwidth (Wide/Narrow)	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	-20.73
Adjusted Sv Transducer Gain (dB)	-0.65 (Sa corr.)	-0.67	-0.66	-0.70 (Sa corr.)	-0.59 (Sa corr.)
Adjusted TS Transducer Gain (dB)	25.68	26.83	26.08	25.60	25.75
3-dB Beamwidth Alongship (deg.)	7.02	7.09	6.91	6.99	6.98
3-dB Beamwidth Athwartship (deg.)	6.96	7.07	7.11	6.96	7.02
Alongship (fore/aft.) Offset (deg.)	-0.11	-0.07	-0.06	-0.02	-0.04
Athwartship Offset (deg.)	-0.14	0.12	-0.02	0.02	-0.02
Theoretical Sa (m /nm)				2432	2962
Measured Sa (m /nm)				2411	2865
$Sa=\sigma*1852^2/(r^2\Psi)$ $\sigma=4\pi*10^{0,1\ TS}$					

APPENDIX 3

Sampling of fish

	Norwegian vessels	Russian vessels	Sum
Capelin			
No of samples	338	220	558
Nos. length measured	10155	12470	22625
Nos. aged	2600	1077	3677
Polar cod			
No of samples	405	220	625
Nos. length measured	14425	64085	78510
Nos. aged	2005	1414	3419
Herring			
No of samples	125	75	200
Nos. length measured	4048	2805	6853
Nos. aged	680	368	1048
Blue Whiting			
No of samples	196	7	203
Nos. length measured	8082	2403	10485
Nos. aged	812	205	1017
Cod			
No of samples	530	285	815
Nos. length measured	17548	8373	25921
Nos. aged	1615	1150	2765
Haddock			
No of samples	474	124	598
Nos. length measured	19825	4934	24759
Nos. aged	1069	283	1352
Redfish (*Sebastes marinus*)			
No of samples	65	15	80
Nos. length measured	363	39	402
Nos. taken for age	166	14	180
Redfish (*Sebastes mentella*)			
No of samples	200	60	260
Nos. length measured	5740	888	6628
Nos. taken for age	996	1	997
Saithe			
No of samples	78	37	115
Nos. length measured	527	87	614
Nos. taken for age	25	8	33
Greenland halibut			
No of samples	464	73	537
Nos. length measured	6327	12326	18653
Nos. taken for age	681	697	1378
Atlantic wolffish (Anarhichas lupus)			
No of samples	56	34	90
Nos. length measured	318	73	391
Spotted wolffish (*Anarhichas minor*)			
No of samples	48	34	82
Nos. length measured	103	99	202
Northern wolffish (*Anarhichas denticulatus*)			
No of samples	50	12	62
Nos. length measured	63	14	77
Long rough dab			
No of samples	388	343	731
Nos. length measured	9190	24238	33428

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

APPENDIX 4

List of the Barents Sea fish species caught during the ecosystem survey 2005.

№	Species	Ecologic group	Zoogeographic group
	Cephalaspidomorphi		
	Petromyzontiformes		
	Petromyzontidae		
1.	Petromyzon marinus Linnaeus, 1758	Anadromous	Southboreal atlantic
2.	Lethenteron camtschaticum (Tilesius, 1811)	Anadromous	Mainly boreal
	Elasmobranchii		
	Squaliformes		
	Squalidae		
3.	Somniosus microcephalus (Bloch et Schneider 1801)	Near bottom pelagic	Mainly boreal
	Rajiformes		
	Rajidae		
4.	Bathyraja spinicauda (Jensen, 1914)	Bottom	Mainly boreal
5.	Raja clavata Linnaeus, 1758	Bottom	
6.	Rajella fyllae (Lütken, 1888)	Bottom	Boreal atlantic
7.	Amblyraja hyperborea (Collett, 1879)	Bottom	Arctic
8.	Amblyraja radiata (Donovan, 1808)	Bottom	Mainly boreal
	Holocephali		
	Chimaeriformes		
	Chimaeridae		
9.	Chimaera monstrosa Linnaeus, 1758	Near bottom	Boreal european
	Teleostomi		
	Clupeiformes		
	Clupeidae		
10.	Clupea harengus Linnaeus, 1758	Nerito-pelagic	Mainly boreal
11.	Clupea pallasii suworowi Rabinerson, 1927	Nerito-pelagic	Mainly boreal
	Salmoniformes		
	Argentinidae		
12.	Argentina silus (Ascanius, 1775)	Bathypelagic	Boreal atlantic
	Osmeridae		
13.	Mallotus villosus (Müller, 1776)	Nerito-pelagic	Mainly boreal
	Salmonidae		
14.	Salmo salar Linnaeus, 1758	Anadromous	Mainly boreal
	Stomiiformes		
	Sternoptychidae		
15.	Maurolicus muelleri (Gmelin, 1789)	Bathypelagic	Boreal atlantic
	Aulopiformes		
	Paralepididae		
16.	Arctozenus risso (Bonaparte, 1840)	Bathypelagic	Widely distributed
	Myctophiformes		
	Myctophidae		
17.	Benthosema glaciale (Reinhardt, 1838)	Bathypelagic	Mainly boreal
18.	Myctophum punctatum		
	Gadiformes		
	Macrouridae		
19.	Coryphaenoides rupestris Gunnerus, 1765	Near bottom	Boreal atlantic
20.	Macrourus berglax Lacepede, 1810	Near bottom	Boreal atlantic
	Gadidae		
21.	Boreogadus saida (Lepechin, 1774)	Cryopelagic	Arctic
22.	Eleginus navaga (Pallas, 1811)	Near bottom pelagic	Arctic
23.	Gadiculus argenteus thori Schmidt, 1914		
24.	Gadus morhua Linnaeus, 1758	Near bottom pelagic	Mainly boreal
25.	Melanogrammus aeglefinus (Linnaeus, 1758)	Near bottom pelagic	Mainly boreal
26.	Merlangius merlangus (Linnaeus, 1758)	Near bottom pelagic	Southboreal european
27.	Micromesistius poutassou (Risso, 1826)	Nerito-pelagic	Mainly boreal
28.	Pollachius virens (Linnaeus, 1758)	Nerito-pelagic	Mainly boreal
29.	Trisopterus esmarkii (Nilsson, 1855)	Nerito-pelagic	Mainly boreal
	Lotidae		

30.	Brosme brosme (Ascanius, 1772)	Near bottom	Mainly boreal
31.	Enchelyopus cimbrius (Linnaeus, 1766)	Near bottom	Boreal atlantic
32.	Gaidropsarus argentatus (Reinhardt, 1838)	Near bottom	Arctic
33.	Gaidropsarus ensis (Reinhardt, 1837)	Near bottom	Boreal atlantic
34.	Molva molva (Linnaeus, 1758)	Near bottom	Boreal atlantic
	Phycidae		
35.	Phycis blennoides (Bruennich, 1768)	Near bottom pelagic	Southboreal european
	Lophiiformes		
	Lophiidae		
36.	Lophius piscatorius Linnaeus, 1758	Bottom	Southboreal atlantic
	Gasterosteiformes		
	Gasterosteidae		
37.	Gasterosteus aculeatus Linnaeus, 1758	Nerito-pelagic	Mainly boreal
	Syngnathiformes		
	Syngnathidae		
38.	Syngnathidae spp.		
	Scorpaeniformes		
	Sebastidae		
39.	Sebastes marinus (Linnaeus, 1758)	Near bottom pelagic	Mainly boreal
40.	Sebastes mentella Travin, 1951	Near bottom pelagic	Mainly boreal
41.	Sebastes viviparus Kröyer, 1844	Near bottom	Boreal atlantic
	Cottidae		
42.	Artediellus atlanticus Jordan et Evermann, 1898	Bottom	Mainly boreal
43.	Gymnocanthus tricuspis (Reinhardt, 1830)	Bottom	Mainly arctic
44.	Icelus bicornis (Reinhardt, 1840)	Bottom	Mainly arctic
45.	Icelus spatula Gilbert et Burke, 1912	Bottom	Arctic boreal
46.	Myoxocephalus scorpius (Linnaeus, 1758)	Bottom	Mainly boreal european
47.	Triglops murrayi Günther, 1888	Bottom	Boreal atlantic
48.	Triglops nybelini Jensen, 1944	Bottom	Arctic
49.	Triglops pingelii Reinhardt, 1837	Bottom	Arctic boreal
	Psychrolutidae		
50.	Cottunculus microps Collett, 1875	Bottom	Mainly arctic
51.	Cottunculus sadko Essipov, 1937	Bottom	Arctic
	Agonidae		
52.	Leptagonus decagonus (Bloch et Schneider, 1801)	Bottom	Arctic boreal
53.	Ulcina olrikii (Lütken, 1876)	Bottom	Arctic
	Cyclopteridae		
54.	Cyclopterus lumpus Linnaeus, 1758	Near bottom pelagic	Mainly boreal atlantic
55.	Eumicrotremus derjugini Popov, 1926	Bottom	Arctic
56.	Eumicrotremus spinosus (Müller, 1777)	Bottom	Arctic
	Liparididae		
57.	Careproctus ranula (Goode et Bean, 1880)	Near bottom	Arctic
58.	Careproctus reinhardti (Kröyer, 1862)	Near bottom	Arctic
59.	Liparis fabricii Kröyer, 1847	Near bottom	Arctic
60.	Liparis gibbus Bean, 1881	Bottom	Mainly arctic
61.	Liparis liparis (Linnaeus, 1766)	Bottom	Boreal european
	Perciformes		
	Zoarcidae		
62.	Gymnelus sp.	Bottom	Arctic
63.	Lycenchelys kolthoffi Jensen, 1903	Bottom	Arctic
64.	Lycodes esmarki Collett, 1875	Bottom	Mainly boreal atlantic
65.	Lycodes eudipleurostictus Jensen, 1901	Bottom	Arctic
66.	Lycodes frigidus Collett, 1878	Bottom	Arctic
67.	Lycodes pallidus Collett, 1878	Bottom	Arctic
68.	Lycodes polaris (Sabine, 1824)	Bottom	Arctic
69.	Lycodes reticulatus Reinhardt, 1835	Bottom	Arctic
70.	Lycodes rossi Malmgren, 1864	Bottom	Arctic
71.	Lycodes seminudis Reinhardt, 1837	Bottom	Arctic
72.	Lycodes vahli gracilis Sars, 1867	Bottom	Mainly boreal european
	Stichaeidae		
73.	Anisarchus medius (Reinhardt, 1837)	Bottom	Boreal atlantic
74.	Lumpenus fabricii (Valenciennes, 1836)	Bottom	Mainly arctic
75.	Lumpenus lampretaeformis (Walbaum, 1792)	Bottom	Mainly boreal european
76.	Leptoclinus maculatus (Fries, 1837)	Bottom	Mainly boreal atlantic
	Anarhichadidae		
77.	Anarhichas denticulatus Kröyer, 1845	Near bottom	Mainly boreal atlantic
78.	Anarhichas lupus Linnaeus, 1758	Bottom	Mainly boreal atlantic
79.	Anarhichas minor Olafsen, 1772	Bottom	Mainly boreal atlantic

	Ammodytidae		
80.	Ammodytes marinus Raitt, 1934	Bottom	Mainly boreal european
81.	Ammodytes tobianus Linnaeus, 1758	Bottom	Boreal european
	Scombridae		
82.	Scomber scombrus Linnaeus, 1758	Neritopelagic	Southboreal atlantic
	Pleuronectiformes		
	Pleuronectidae		
83.	Glyptocephalus cynoglossus (Linnaeus, 1758)	Bottom	Mainly boreal atlantic
84.	Hippoglossoides platessoides (Fabricius, 1780)	Bottom	Mainly boreal european
85.	Hippoglossus hippoglossus (Linnaeus, 1758)	Bottom	Mainly boreal atlantic
86.	Limanda limanda (Linnaeus, 1758)	Bottom	Mainly boreal european
87.	Microstomus kitt (Walbaum, 1792)	Bottom	Boreal european
88.	Pleuronectes platessa Linnaeus, 1758	Bottom	Mainly boreal european
89.	Reinhardtius hippoglossoides (Walbaum, 1792)	Bottom	Mainly boreal atlantic

APPENDIX 5

	NAN	SMOL	GOS	JH	JM		NAN	SMOL	GOS	JH	JM		NAN	SMOL	GOS	JH	JM		NAN	SMOL	GOS	JH	JM
PORIFERA						Alcyonacea g. spp.	+			+	+	Sabellidae g.sp.	+					Pandalidae g. sp.			+		+
Axinella sp.			+			*Alcyonium* sp.					+	*Spiochaetopterus typicus*	+					*Pandalina* sp.			+		
Calcarea g. sp.					+	Anthozoa g. spp.				+	+	*Spiochaetopterus typicus*				+		*Pandalus borealis*	+	+	+	+	+
Geodia sp.			+			*Bolocera* sp.				+		*Terrebelidae g. sp.*			+			*Pandalus montague triden*		+			
Geodia barretti			+			*Capnella* sp.			+			*Travisia forbesii*	+					*Pandalus propinquus*			+		
Geodia macandrewii			+			*Drifa glomerata*	+		+			**HIRUDINEA**						*Pandalus sp.*			+		
Phakellia sp.	+		+			*Duva florida*	+					Hirudinea g. sp.	+					*Paralithodes camtschatica*		+			
Phakellia ventilabrum			+			*Eunephthia* sp.		+				**ECHIURA**						*Pasiphaea multidentata*			+		
Polymastia mammilaris		+				*Eunephthya* sp.	+					Echiura g. sp.				+		*Pasiphaea sivado*	+				
Polymastia thielei	+					*Flabellum* sp.			+			*Bonellia viridis*			+			*Pasiphaea* sp.		+			+
Polymastia sp.			+			*Gersemia fruticosa*	+					*Hamingia arctica*	+			+		*Pontophilus norvegicus*		+			
Radiella grimaldii	+					*Gersemia rubiformis*	+					**SIPUNCULA**						*Pontophilus* sp.			+		
Porifera g. spp.	+	+	+	+	+	Gorgonacea g. sp.					+	*Phascolosoma margaritaceum*		+				*Sabinea sarsi*		+		+	
Tentorium semisuberites	+					*Hormathia digitata*	+		+			Sipunculida g. sp.	+		+			*Sabinea septemcarinata*	+	+	+	+	
CNIDARIA						*Lophelia* sp.			+			**PYCNOGONIDA (PANTOPODA)**						*Sabinea* sp.	+	+	+		
Cnidaria g. spp.				+	+	*Metridium senile*	+					*Nymphon glaciale*			+			*Sclerocrangon boreas*	+	+			
Hydrozoa						*Umbellula incrinus*		+				Pantopoda g. spp.	+	+		+	+	*Sclerocrangon ferox*	+	+	+	+	+
Abietinaria abietina	+					*Urticina (Tealia) felina lofotensis*	+					**CRUSTACEA**						*Sclerocrangon* sp.	+		+		+
Abietinaria filicula	+					**NEMERTEA (=NEMERTINI)**						Crustacea g. spp.				+	+	*Spirontocaris liljeborgi*			+		
Campanularia volubilis	+					Nemertini g. spp.	+		+	+		**Euphausiacae**						*Spirontocaris* sp.	+		+		
Dicoryne conferta	+					**PRIAPULIDA**						Euphausiidae g. sp.		+				*Spirontocaris spinus*	+	+		+	
Eudendrium capillare	+					*Priapulopsis bicaudatus*	+	+				*Meganyctiphanes norvegica*		+				**Amphipoda**					
Eudendrium vaginatum	+					*Priapulus caudatus*	+					**Cirripedia**						*Acanthostepheia behringiensis*	+				
Halecium beani	+					*Priapulus* sp.	+					Balanomorpha g. sp.					+	*Amathillopsis spinigera*	+				
Halecium marsupiale	+					**ANNELIDA**						*Balanus balanus*	+					*Ampelisca* sp.	+				
Halecium muricatum	+					Vermes indet.		+	+			*Balanus crenatus*	+					Amphipoda g. spp.	+		+	+	+
Hydroidea g. sp.	+		+			**POLYCHAETA**						*Balanus* sp.	+					*Anonyx nugax*	+				
Lafoea fruticosa	+					Aphroditidae g.sp.	+					**Decapoda**						*Anonyx* sp.	+	+			
Modeeria plicatile	+					*Aphrotite aculeata*			+			Brachiura g. spp.			+	+	+	*Cleippides quadricuspis*		+			
Obelia longissima	+					*Brada granulata*				+		*Bythocaris payeri*		+				*Epimeria cornigera*				+	
Pennatulacea g. sp.				+	+	*Brada inhabilis*	+		+			*Chionoecetes opilio*		+				*Epimeria loricata*	+				
Rhizocaulus verticillatus	+					*Brada* sp.	+					Crangonidae g. sp.		+	+	+	+	Gammaridae g. sp.		+			+
Sertularella gigantea	+					*Brada villosa*	+		+			*Eualus gaimadi*		+				*Gammarus wilkitzkii*	+				
Sertularia mirabilis	+					Flabelligeridae g. sp.			+			*Gerion trispinosus*				+		Hyperiidae g. sp.		+			
Sertularia tenera	+					*Harmothoe* sp.			+			*Hyas araneus*	+		+			*Onisimus* sp.	+				
Staurophora mertensii		+				*Lumbrineris* sp.	+					*Hyas coarctatus*			+			*Rhachotropis aculeata*	+				
Symplectoscyphus tricuspidatus	+					Nephthyidae g. sp.			+		+	*Hyas* sp.		+		+	+	*Rhachotropis* sp.		+			
Thuiaria articulata	+					*Nephtys* sp.	+					*Lebbeus polaris*	+	+				*Stegocephalus inflatus*	+			+	
Thuiaria breitfussi	+					*Nothria hyperborea*	+					*Lithodes maja*						*Stegocephalus* sp.	+	+	+		
Thuiaria carica	+					*Paramphithoe hystrix*				+		*Munida sarsi*			+			*Themisto* sp.		+			
Thuiaria cupressoides	+					*Pectinaria hyperborea*	+					Paguridae g. sp.			+	+	+	**Isopoda**					
Thuiaria laxa	+					*Pectinaria* sp.			+	+		*Pagurus bernhardus*			+			*Cirolana borealis*			+		
Anthozoa						Polychaeta g. spp.	+	+	+	+	+	*Pagurus pubescens*	+	+				*Idothea* sp.			+		
Actiniaria g. spp.	+	+	+	+	+	Polynoidae g. sp.			+	+		*Pagurus* sp.	+					Idotheidae g. sp.		+			

	NAN	SMOL	GOS	JH	JM
Isopoda g. spp.			+	+	+
Saduria sabini	+			+	
Saduria sp.			+		
Cumacea					
Cumacea g. sp.		+			
MOLLUSCA					
Mollusca g. sp.	+			+	
Gastropoda					
Beringius ossiani	+				
Buccinidae g. sp.			+		
Buccinum elatior	+				
Buccinum finmarchianum	+				
Buccinum hydrophanum	+				
Buccinum sp.	+		+		
Buccinum undatum	+				
Capulacmaea radiata	+				
Colus altus	+				
Colus holboelli	+				
Colus islandicus	+				
Colus sabini	+			+	
Colus sp.			+		
Cryptonatica clausa	+				
Gastropoda eggs	+				
Gastropoda g. spp.	+	+	+	+	+
Lunatia pallida	+				
Neptunea antiqua			+		
Neptunea denselirata	+				
Neptunea despecta	+			+	
Neptunea sp.			+		+
Nudibranchia g. spp.	+	+	+	+	+
Onchidiopsis glacialis	+				
Philine finmarchica	+				
Philine sp.	+				
Polinices sp.			+	+	
Scaphander lignaris			+		
Scaphander sp.			+		
Tachyrhynchus reticulatus	+				
Turrisipho lachesis	+				
Velutina sp.	+				
Volutopsis norvegicus	+				
Bivalvia					
Arctinula greenlandica	+				
Arctinula sp.					
Astarte borealis	+				
Astarte crenata	+			+	

	NAN	SMOL	GOS	JH	JM
Astarte crenata subaequilastera	+				
Astarte sp.			+	+	
Astartidae g. sp.	+				
Bathyarca glacialis	+			+	
Bathyarca glacialis arctica	+				
Bathyarca sp.			+		
Bivalvia g. spp.	+	+	+	+	+
Cardium sp.			+	+	
Chlamya sp.			+		
Chlamys islandica	+	+			+
Clinocardium ciliatum	+	+			
Cuspidaria arctica	+	+			
Cuspidaria sp.			+		
Cuspidaria subtorta			+		
Hiatella arctica	+				
Musculus discrepans		+			
Mya truncata			+		
Palliolum striatum			+		
Pecten sp.			+		
Portlandia sp.			+		
Psammobiidae g. sp.				+	
Pseudomussium septemradiata			+		
Scaphopoda					
Scaphopoda g. sp.	+	+			
Cephalopoda					
Bathypolipus arcticus	+				
Cephalopoda g. spp.					+
Gonatus fabricii	+	+			
Octopoda g. sp.		+			
Rossia glaucopis	+				
Rossia macrosoma		+			
Rossia sp.	+				
Sepiola sp.			+		
Teuthida g. sp.		+			
BRACHIOPODA					
Brachiopoda g. spp.	+		+	+	
Macandrevia sp.			+		
Rhynchonella psittacea		+			
Terebratulina sp.			+		
BRYOZOA					
Alcyonidium disciforme		+			
Alcyonidium gelatinosum	+	+			
Alcyonidium sp.	+				
Bryozoa g. spp.	+		+	+	+
Reteporella sp.			+		

	NAN	SMOL	GOS	JH	JM
ECHINODERMATA					
Echinodermata g. spp.				+	
Holothuroidea					
Cucumaria frondosa	+	+			
Holothuroidea g. spp.			+	+	+
Molpadia borealis	+				
Myriotrochus rinkii	+				
Myriotrochus sp.	+				
Psolus phantapus	+				
Psolus sp.			+		
Stichopus tremulus			+		
Thyonidium drummondi	+				
Echinoidea					
Brisaster fragilis				+	
Echinoidae g. sp.			+		
Echinoidea g. sp.		+			
Echinoidea g. sp. (irregularia)					+
Echinoidea g. sp. (regularia)				+	+
Echinus sp.			+		
Spatangoida g. sp.			+	+	
Spatangus purpureus			+		
Strongylocentrotus droebachiensis	+			+	
Strongylocentrotus pallidus	+				
Strongylocentrotus sp.	+				
Asteroidea					
Asterias riubens		+			
Asterias sp.			+		
Asteroidea g. spp.	+	+	+	+	+
Astropecten sp.			+		
Ceramaster granularis			+		
Ceramaster sp.			+		
Crossaster papposus	+	+	+	+	
Ctenodiscus crispatus	+	+	+	+	
Henricia sp.	+		+	+	
Hippasterias phrygiana			+	+	
Hymenaster pellucidus	+	+			
Icasterias panopla	+	+			
Korethraster hispidus	+				
Leptasterias sp.	+	+			
Lophaster furcifer	+	+			
Luidia sarsi			+		
Luidia sp.			+		
Marthasterias glacialis			+		
Pontaster tenuispinus	+	+	+	+	
Porania sp.			+		

	NAN	SMOL	GOS	JH	JM
Poraniomorpha hispida	+				
Poraniomorpha sp.	+				
Poraniomorpha tumida	+	+		+	
Pseudarchaster sp.			+		
Psilaster andromeda		+			
Pteraster militaris	+	+			
Pteraster obscurus	+			+	
Pteraster pulvillus		+			
Pteraster sp.	+				
Solaster endeca		+	+	+	
Solaster glacialis				+	
Solaster sp.	+		+	+	
Solaster syrtensis	+	+			
Urasterias linckii	+	+		+	
Ophiuroidea					
Amphiuridae g. sp.				+	
Gorgonocephalis caputmedusae			+		
Gorgonocephalus arcticus	+				
Gorgonocephalus eucnemis	+				
Gorgonocephalus sp.	+	+	+		+
Ophiacantha bidentata	+				
Ophiocten sericeum	+				
Ophiopholis aculeata	+		+	+	
Ophiopleura borealis	+				
Ophioscolex glacialis	+				
Ophiura sarsi	+		+		
Ophiura sp.			+	+	
Ophiuroidea g. spp.	+	+	+	+	+
Crinoidea					
Antedonidae g. sp.			+		
Crinoidea g. sp.		+	+	+	+
Heliometra glacialis					
Poliometra prolixa	+				
HEMICHORDATA					
Enteropneusta					
Enteropneusta g. sp.				+	
CHORDATA					
Ascidiacea					
Ascidiacea g. spp.	+	+	+		
Ciona intestinalis	+				
Hyalocynthia pyriformis	+			+	

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JOINT REPORT

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