IMR / PINRO

JOINT REPORT SERIES

4

2013

Survey report

from the joint Norwegian/Russian ecosystem Survey in the Barents Sea and adjacent waters, August – October 2013

Editor: Tatiana Prokhorova

Polar Research Institute of Marine Fisheries and Oceanography

Institute of Marine Research - IMR

Polar Research Institute of Marine Fisheries and Oceanography - PINRO

This report should be cited as:
Prokhorova, T. (Ed.). 2013. Survey report from the joint Norwegian/Russian ecosystem survey in the Barents Sea and adjacent waters, August-October 2013. IMR/PINRO Joint Report Series, No. 4/2013. ISSN 1502-8828, 131 pp.

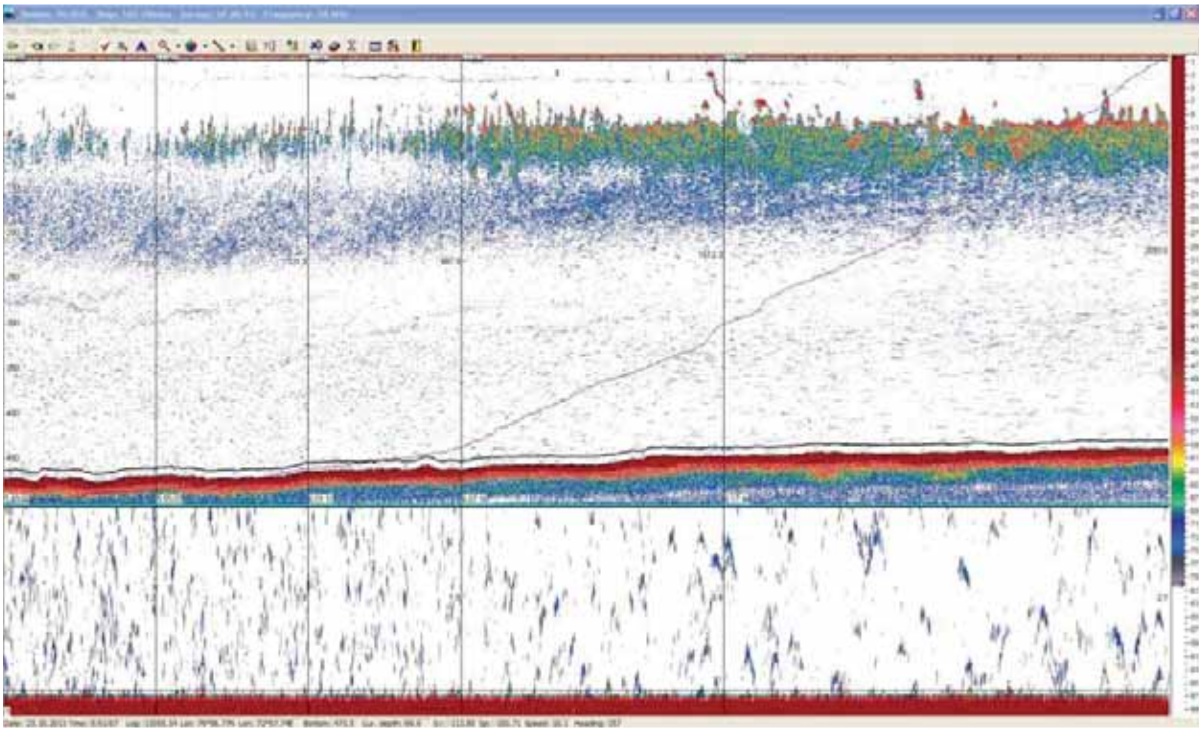
The chapters of this report should be cited as:
Author's names. 2013. *Chapter's name*. In: Prokhorova, T. (Ed.) Survey report from the joint Norwegian/Russian ecosystem survey in the Barents Sea and adjacent waters, August-October 2013. IMR/PINRO Joint Report Series, No.4/2013. ISSN 1502-8828, 131 pp.

Survey report

from the joint Norwegian/Russian ecosystem Survey in the Barents Sea and adjacent waters, August – October 2013

Editor: Tatiana Prokhorova
Polar Research Institute of Marine Fisheries and Oceanography

Authors in alphabetical order:
Aasen, A., Alvarez, J., Dalpadado, P., Dolgov, A., Engås, A., Eriksen, E., Fosså, J.H., Gjøsæter, H., Ingvaldsen, R., Johannesen, E., Jørgensen, L.L., Klepikosky, R., Knutsen, T., Krivosheya, P., Lubin, P., Mashnin, A., Mauritzen, M., Nesterova, V., Orlova, E., Pavlenko, A., Prokhorova, T., Prokopchuk, I., Prozorkevich, D., Rønning, J., Trofimov, A., Wenneck, T., Øvredal, J.T.



Mixed concentration of the Barents Sea capelin and polar cod (79°57'N 72°58'E, 23 October 2013). The World has changed…

Murmansk, December 2013

Polar research Institute of Marine Fisheries and Oceanography (PINRO)

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

Content

1 Background

The 10th joint Barents Sea autumn ecosystem survey (BESS) was carried out during the period from 9th August to 31st October 2013. The state of the ecosystem of the Barents Sea, the northern Kara Sea and a part of the Arctic basin was observed during the survey.

The survey plan and tasks were agreed upon at the annual IMR-PINRO Meeting in March 2013 and the almost joint collaborative tasks were executed according to this plan.

Research vessel tracks during the 2013 ecosystem survey are shown in Figure 1.1. Trawl, hydrography and plankton stations are shown in Figures 1.2 and 1.3.

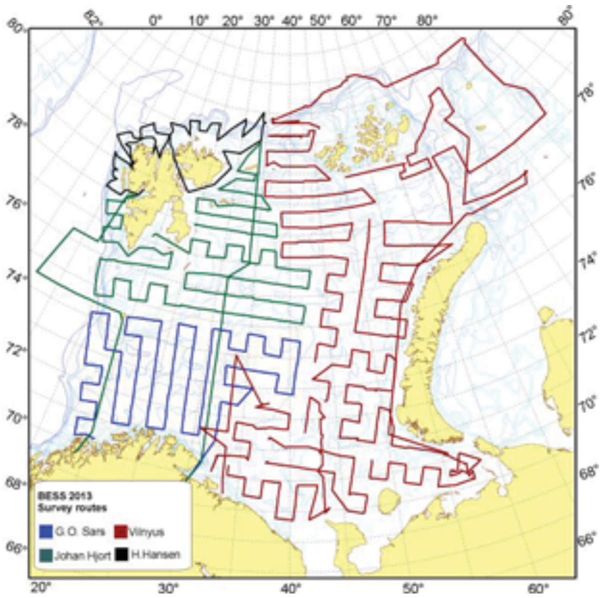


Figure 1.1. Ecosystem survey, August-October 2013. Research vessel tracks.

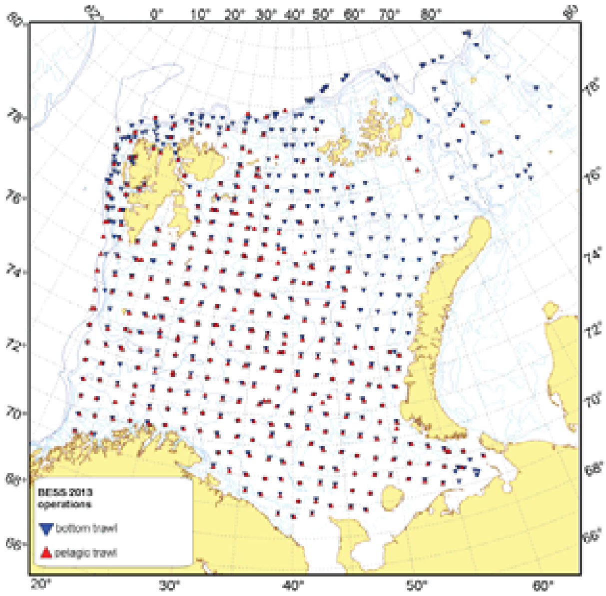


Figure 1.2. Ecosystem survey, August-October 2013. Trawl stations.

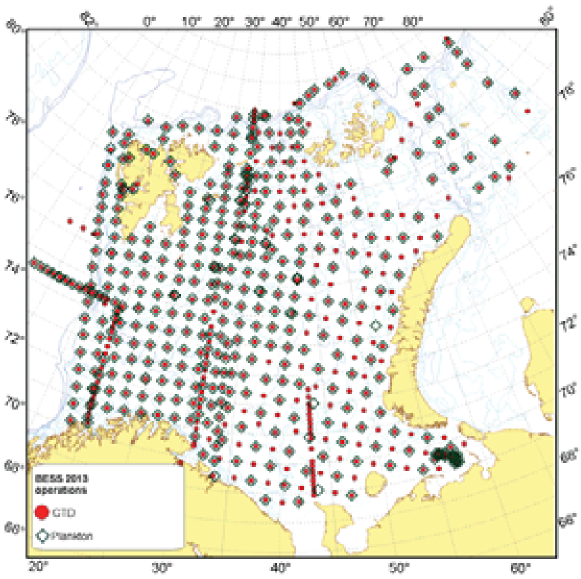


Figure 1.3 Ecosystem survey, August-October 2013. Hydrography and plankton stations.

At the beginning of the survey (14.08-21.08), research vessel "Johan Hjort" carried out two oceanographic sections (Bear Island–West and Fugløya–Bear Island) and the special investigation on inter-calibration of plankton nets (Juday and WP2). The inter-calibration was conducted on 20th August 2013 in a fjord of the west part of Spitsbergen (78°07'N and 13°12'E) over a depth of 250 m. At the end of the survey (27.09-01.10), "Johan Hjort" conducted the special investigation on the trials of inner net to reduce clogging of Harstad trawl-net by small fish. Reports from these special investigations will be presented later on the website (http://www.imr.no/tokt/okosystemtokt_i_barentshavet/nn-no). During 21.08-27.09 "Johan Hjort" worked in the central and northern Barents Sea within NEEZ executing ecosystem investigations and capelin survey.

Other two Norwegian research vessels "G.O. Sars" and "Helmer Hanssen" traditionally investigated the central and southern Barents Sea within NEEZ ("G.O. Sars", 24.08-17.09) and areas north of the Spitsbergen/Svalbard Archipelago ("Helmer Hanssen", 19.08-30.08).

Russian research vessel "Vilnyus" (09.08-01.11) began the ecosystem survey in the southeastern Barents Sea and then continued to cover the REEZ from south to north. A large area in the REEZ was closed for sailing due to military activity in the second decade of August. It led to the loss of time and violation of the survey synchrony. Moreover "Vilnyus" lost some time because of bunkering with fuel. This caused the late beginning of capelin investigations and receiving results for capelin stock assessment only in mid-October. In October, "Vilnyus" investigated the northern Kara Sea and areas north of Franz Josef Land.

In 2013, all research vessels spent more days on the survey than in 2012 (178 vs 154) due to "Vilnyus" had extra-days. But most of these extra-days were the bunkering and time loss during the military activity. So the quantity of working days the 2013 survey was approximately the same as in 2012. But the surveyed area in 2013 was larger than in the previous year due to the investigations in the northern Kara Sea and areas north of Franz Josef Land.

In general, all the tasks have been completed, and the weather conditions were favorable for the work.

This report covers most of the survey aspects but not all of them. The content will be updated and available on the Internet (www.imr.no). A website dedicated to collating all information from the ecosystem survey including all the previous reports, maps, etc. is currently under preparation (http://www.imr.no/tokt/okosystemtokt_i_barentshavet/nn-no). Post-survey information which is not included in the written report may also be found at this website.

The scientists and technicians taking part in the survey onboard the research vessels and executing an enormous work on data collection are listed in Appendix 1.

Sampling manual of this survey has been developed since 2004 and published on the Ecosystem Survey homepage by specialist and experts from IMR and PINRO (http://www.imr.no/tokt/okosystemtokt_i_barentshavet/sampling_manual/nb-no). This manual includes the metrological and technical issues, describes equipments, the trawling and capture procedure by the samplings tools being used during the survey, and present the methods that are used in calculating the abundance and biomass for the biota. This manual is also in a process of being continuously updated.

2 Data monitoring

Text by H. Gjøsæter

Huge amounts of data are collected during the ecosystem surveys. Most data will add to those from earlier surveys to form time series, while some data belong to special investigations conducted once or to projects of short duration. Another way of classifying data is distinguishing between joint data, i.e. data collected jointly by IMR and PINRO, and data collected by visiting researchers from other institutions, using the survey vessels as a platform for data collection without being part of the overall aim with this survey.

Joint data are owned by IMR and PINRO and this joint ownership is realized through a full exchange of data during and after the survey. Since the data infrastructure is different at IMR and PINRO (see below), the data are converted to institute-specific formats before they are entered into databases on the institutes. However, some aggregated time series data are entered into a joint database called “Sjømil”, which is present both at IMR and PINRO. These data are also accessible outside of these two institutions, see below.

2.1 Data use

Joint data are contained in the databases of both PINRO and IMR and are freely accessible to all inside the institutions. At IMR, the management of the data is left to NMD, (Norsk Marint Datasenter = Norwegian marine data centre) which is a part of IMR. Norway and Russia have quite different data policy in general and this affects the accessibility to the data from outside of these institutions. In Norway, access is in principle granted to everyone for use in research while in Russia access to data collected by one institution for other persons or institutions is highly restricted. This also affects the management of data at IMR, since data collected by PINRO as part of a joint project with IMR can be used by researchers at IMR but cannot be distributed to third parties. In effect, the total amount of joint data cannot be distributed from IMR, and persons or institutions interested in using these data will have to contact IMR for access to Norwegian data and PINRO for access to Russian data.

2.2 Databases

IMR is now developing a new data-infrastructure through the project S2D. Old databases are replaced by a new family of databases administered by NMD. Although the data are split on several databases, for instance one for acoustic data, one for biological data, another for physical and yet another for chemical data, they are linked through a common reference database and all data can be seen through a common user interface. At PINRO they are also planning to move their data into a new set of databases but at present all data are placed in one database for all kinds of data. In addition to these institutional data repositories a joint database for some selected time series of aggregated data has been developed, called "Sjømil". At present this database is present at IMR and PINRO, and the IMR database is accessible to the outside world through a web interface http://www.imr.no/sjomil/index.html . This database is general and has data from many other monitoring programs and from other areas than the Barents Sea.

3 Monitoring of marine enviroment

3.1 Hydrography

Text by A. Trofimov and R. Ingvaldsen
Figures by A. Trofimov and R. Ingvaldsen

3.1.1 Oceanographic sections

Figure 3.1.1 shows the temperature and salinity conditions along the standard oceanographic sections: Fugløya–Bear Island, Vardø–North, Kola, and Kanin. The mean temperatures in the main parts of these sections are presented in Table 3.1.1, along with historical data back to 1965. Anomalies have been calculated using the long-term means for the periods 1954–1990 (Kanin Section) and 1951–2010 (Kola Section).

The Fugløya–Bear Island and Vardø–North Sections cover the inflow of Atlantic and Coastal water masses from the Norwegian Sea to the Barents Sea. In 2013 the Vardø–North Section was extended northwards to 81°N, thus also covering the Arctic water masses in the northern Barents Sea. The mean Atlantic Water (50–200 m) temperature in the Fugløya–Bear Island Section was 0.4°C higher than the long-term mean for the period 1965–2013 (Table 3.1.1). Going further east to the Vardø–North Section, the mean Atlantic Water (50–200 m) temperature anomaly increased and reached 0.7°C. Both sections show a temperature decrease compared to 2012.

The Kola and Kanin Sections cover the flow of Coastal and Atlantic waters in the southern Barents Sea. In August 2013, the mean temperature in the upper 50 m along the Kola Section was 1.6–2.1°C higher than usual and 0.7–1.5°C higher than that in 2012. The surface layer temperatures were anomalously high and reached an absolute maximum (since 1951). In the intermediate waters, temperatures were 0.4–0.7°C higher than usual and 0.8°C lower than in the previous year. Only in the inner part of the section, these waters were slightly (by 0.1°C) warmer than in 2012. The shallow inner part of the Kanin Section had a temperature of 5.5°C in the 0–bottom layer, that was 1.3°C higher than the average and 0.6°C lower than in 2012. The outer part had a temperature of 4.6°C in the 0–200 m, that was 1.1°C higher than the long-term mean for the period 1965–2013 and 0.6°C lower than in 2012.

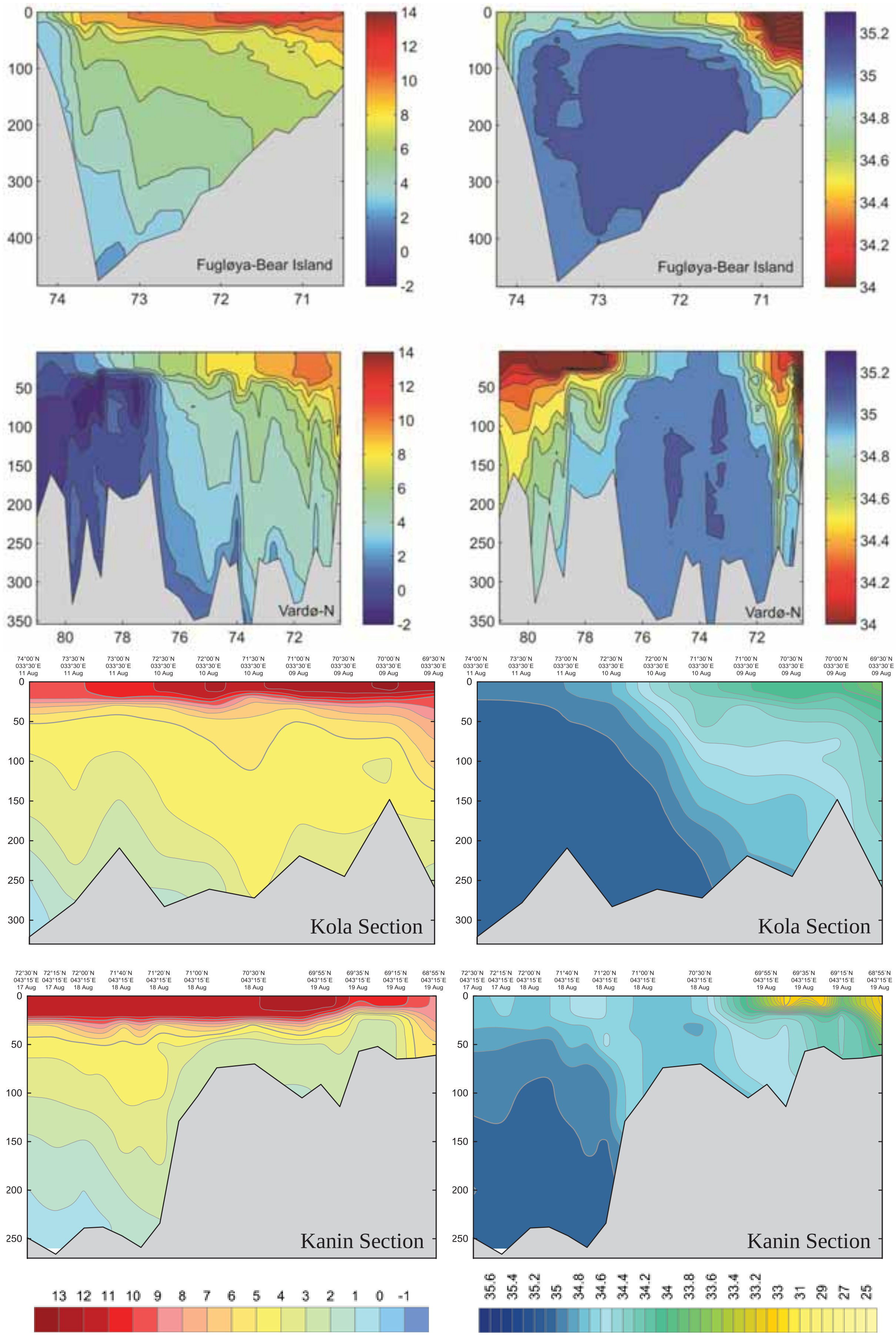


Figure 3.1.1. Temperature (°C, left panels) and salinity (right panels) along oceanographic sections in August–September 2013

Table 3.1.1. Mean water temperatures in the main parts of standard oceanographic sections in the Barents Sea and adjacent waters in August–September 1965–2013. The sections are: Kola (70º30´N – 72º30´N, 33º30´E), Kanin S (68º45´N – 70º05´N, 43º15´E), Kanin N (71º00´N – 72º00´N, 43º15´E), North Cape – Bear Island (NCBI, 71º33´N, 25º02´E – 73º35´N, 20º46´E), Bear Island – West (BIW, 74º30´N, 06º34´E – 15º55´E), Vardø – North (VN, 72º15´N – 74º15´N, 31º13´E) and Fugløya – Bear Island (FBI, 71º30´N, 19º48´E – 73º30´N, 19º20´E).

Year	Section and layer (depth in metres)								
	Kola	Kola	Kola	Kanin S	Kanin N	NCBI	BIW	VN	FBI
	0–50	50–200	0–200	0–bot.	0–bot.	0–200	0–200	50–200	50–200
1965	6.7	3.9	4.6	4.6	3.7	5.1	-	3.8	5.2
1966	6.7	2.6	3.6	1.9	2.2	5.5	3.6	3.2	5.3
1967	7.5	4.0	4.9	6.1	3.4	5.6	4.2	4.4	6.3
1968	6.4	3.7	4.4	4.7	2.8	5.4	4.0	3.4	5.0
1969	6.7	3.1	4.0	2.6	2.0	6.0	4.2	3.8	6.3
1970	7.8	3.7	4.7	4.0	3.3	6.1	-	4.1	5.6
1971	7.1	3.2	4.2	4.0	3.2	5.7	4.2	3.8	5.6
1972	8.7	4.0	5.2	5.1	4.1	6.3	3.9	4.6	6.1
1973	7.7	4.5	5.3	5.7	4.2	5.9	5.0	4.9	5.7
1974	8.1	3.9	4.9	4.6	3.5	6.1	4.9	4.3	5.8
1975	7.0	4.6	5.2	5.6	3.6	5.7	4.9	4.5	5.7
1976	8.1	4.0	5.0	4.9	4.4	5.6	4.8	4.4	5.8
1977	6.9	3.4	4.3	4.1	2.9	4.9	4.0	3.6	4.9
1978	6.6	2.5	3.6	2.4	1.7	5.0	4.1	3.2	4.9
1979	6.5	2.9	3.8	2.0	1.4	5.3	4.4	3.6	4.7
1980	7.4	3.5	4.5	3.3	3.0	5.7	4.9	3.7	5.5
1981	6.6	2.7	3.7	2.7	2.2	5.3	4.4	3.4	5.3
1982	7.1	4.0	4.8	4.5	2.8	5.8	4.9	4.1	6.0
1983	8.1	4.8	5.6	5.1	4.2	6.3	5.1	4.8	6.1
1984	7.7	4.1	5.0	4.5	3.6	5.9	5.0	4.2	5.7
1985	7.1	3.5	4.4	3.4	3.4	5.3	4.6	3.7	5.6
1986	7.5	3.5	4.5	3.9	3.2	5.8	4.4	3.8	5.5
1987	6.2	3.3	4.0	2.7	2.5	5.2	3.9	3.5	5.1
1988	7.0	3.7	4.5	3.8	2.9	5.5	4.2	3.8	5.7
1989	8.6	4.8	5.8	6.5	4.3	6.9	4.9	5.1	6.2
1990	8.1	4.4	5.3	5.0	3.9	6.3	5.7	5.0	6.3
1991	7.7	4.5	5.3	4.8	4.2	6.0	5.4	4.8	6.2
1992	7.5	4.6	5.3	5.0	4.0	6.1	5.0	4.6	6.1
1993	7.5	4.0	4.9	4.4	3.4	5.8	5.4	4.2	5.8
1994	7.7	3.9	4.8	4.6	3.4	6.4	5.3	4.8	5.9
1995	7.6	4.9	5.6	5.9	4.3	6.1	5.2	4.6	6.1
1996	7.6	3.7	4.7	5.2	2.9	5.8	4.7	3.7	5.7
1997	7.3	3.4	4.4	4.2	2.8	5.6	4.1	4.0	5.4
1998	8.4	3.4	4.7	2.1	1.9	6.0	-	3.9	5.8
1999	7.4	3.8	4.7	3.8	3.1	6.2	5.3	4.8	6.1
2000	7.6	4.5	5.3	5.8	4.1	5.7	5.1	4.2	5.8
2001	6.9	4.0	4.7	5.6	4.0	5.7	4.9	4.2	5.9
2002	8.6	4.8	5.8	4.0	3.7	-	5.4	4.6	6.5
2003	7.2	4.0	4.8	4.2	3.3	-	-	4.7	6.2
2004	9.0	4.7	5.7	5.0	4.2	-	5.8	4.8	6.4
2005	8.0	4.4	5.3	5.2	3.8	6.7	-	5.0	6.2
2006	8.3	5.3	6.1	6.1	4.5	-	5.8	5.3	6.9
2007	8.2	4.6	5.5	4.9	4.3	6.9	5.6	4.9	6.5
2008	6.9	4.6	5.2	4.2	4.0	6.2	5.1	4.8	6.4
2009	7.2	4.3	5.0	-	4.3	-	-	5.2	6.4
2010	7.8	4.7	5.5	4.9	4.5	-	5.4	-	6.2
2011	7.6	4.0	4.9	5.0	3.8	-	-	5.1	6.4
2012	8.2	5.3	6.0	6.2	5.2	-	-	5.7	6.4
2013	8.8	4.6	5.6	5.5	4.6	-	5.6	5.0	6.3
Average 1965–2013	7.5	4.0	4.9	4.5	3.5	5.8	4.8	4.3	5.9

3.1.2 Spatial variation

Horizontal distributions of temperature and salinity are shown for depths of 0, 50, 100 m and near the bottom in Figures 3.1.2–3.1.9, and anomalies of temperature at the surface and near the bottom are presented in Figures 3.1.10–3.1.11. Anomalies have been calculated using the long-term means for the period 1929–2007.

The surface temperatures were much higher (on average by 2.0–3.3°C) than the long-term mean all over the Barents Sea with the highest positive anomalies (> 3.0°C) mainly in the south-eastern sea, south of Spitsbergen and east of Hopen Island, between 75°45' and 77°45'N (Figure 3.1.10). Compared to 2012, the surface temperatures were much higher (by 1.3–2.7°C) in most of the Barents Sea, especially in its central and southern parts. Only in the north-eastern sea, the temperatures were lower (by 0.3–0.8°C) than in the previous year.

Arctic waters were, as usual, most dominant in the 50 m depth layer north of 77°N (Figure 3.1.4). The temperatures were mainly higher than the long-term mean (by 0.6–1.6°C) but lower than those in 2012 (by 0.5–1.3°C).

The temperatures in the depths below 100 m were in general above the average (by 0.5–1.2°C) but lower than those in 2012 (by 0.5–1.2°C) throughout the Barents Sea (Figure 3.1.11). The area occupied by water with temperatures below zero was much larger than in the previous year. The high temperature in the Barents Sea is mostly due to the inflow of water masses with high temperatures from the Norwegian Sea as well as due to stronger-than-usual seasonal warming of the surface waters in the Barents Sea during summer.

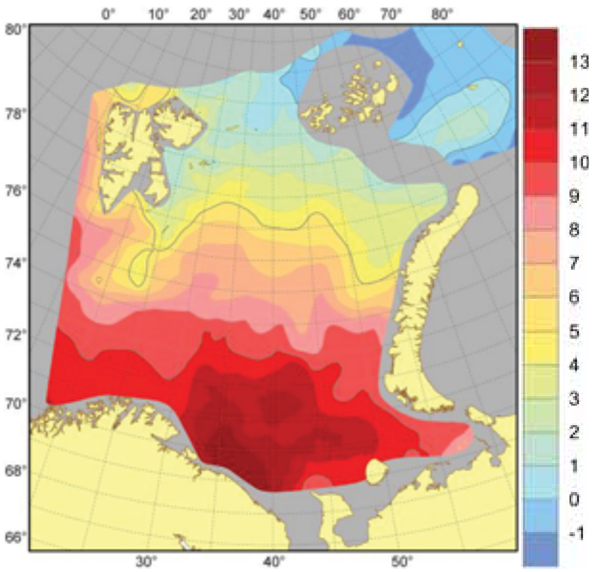


Figure 3.1.2. Distribution of surface temperature (°C), August–October 2013.

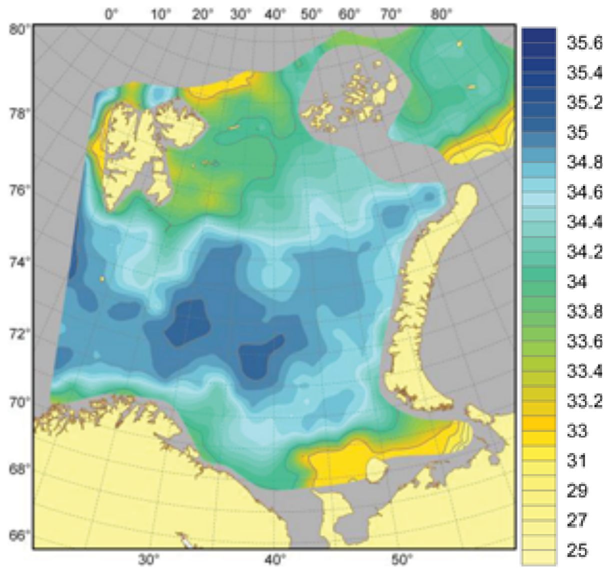


Figure 3.1.3. Distribution of surface salinity, August–October 2013.

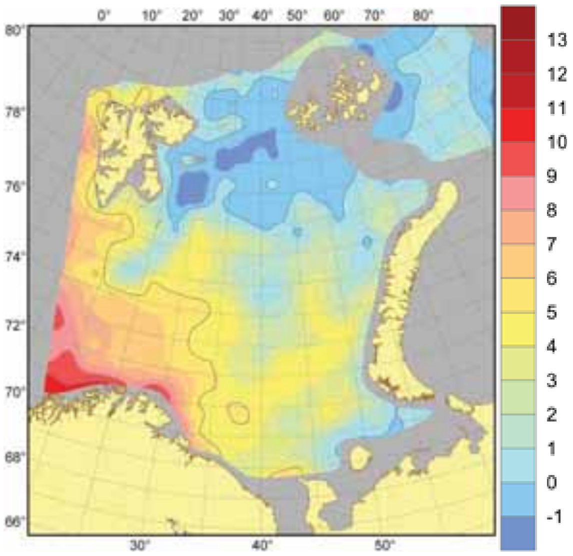


Figure 3.1.4. Distribution of temperature (°C) at the 50 m depth, August–October 2013.

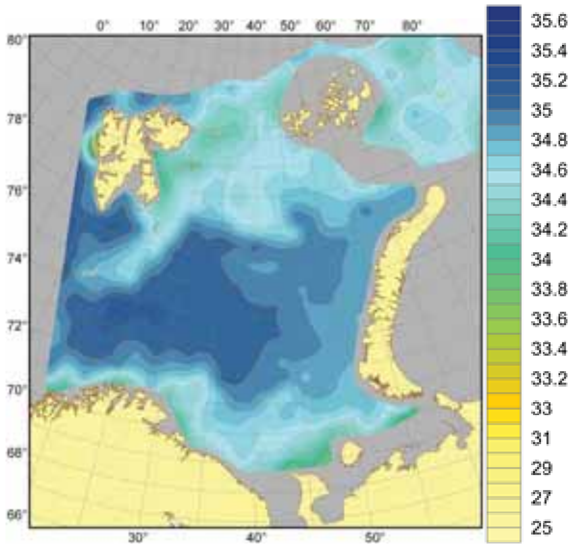


Figure 3.1.5. Distribution of salinity at the 50 m depth, August–October 2013.

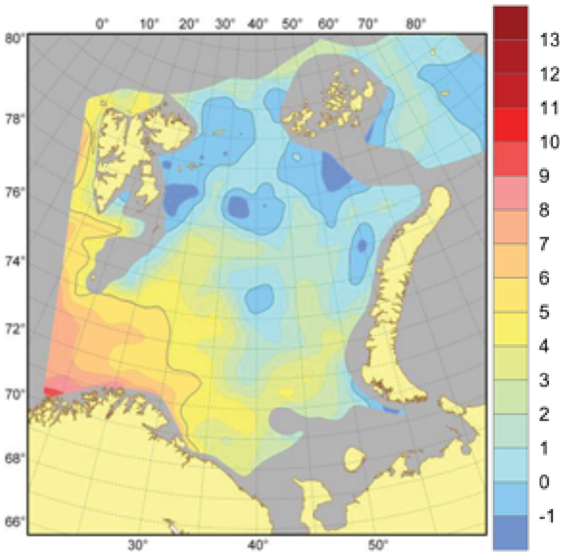


Figure 3.1.6. Distribution of temperature (°C) at the 100 m depth, August–October 2013

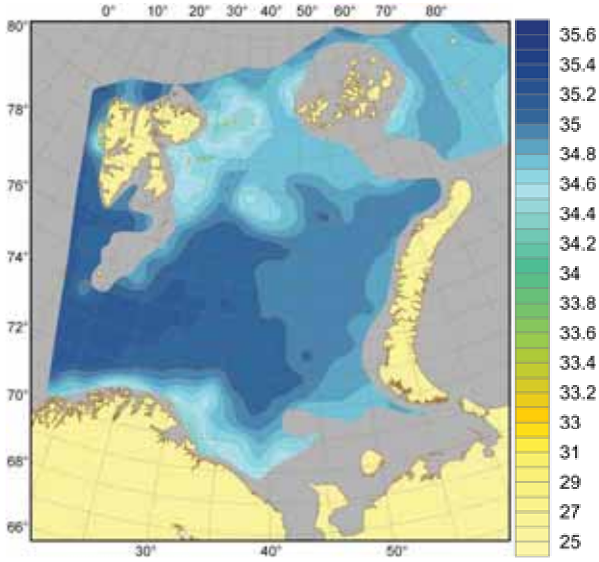


Figure 3.1.7. Distribution of salinity at the 100 m depth, August–October 2013

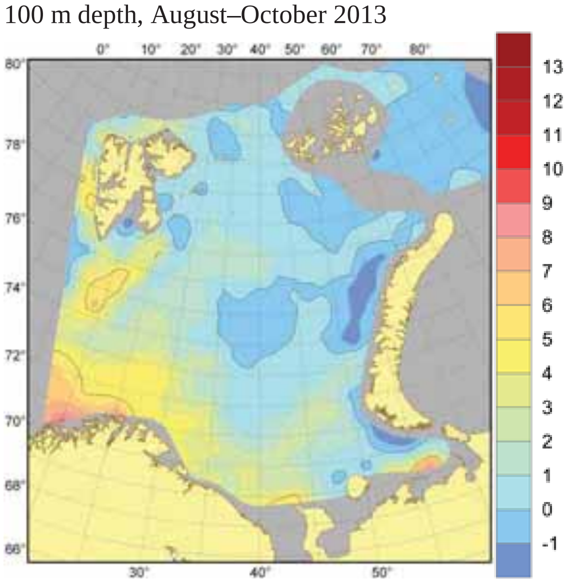


Figure 3.1.8. Distribution of temperature (°C) at the bottom, August–October 2013.

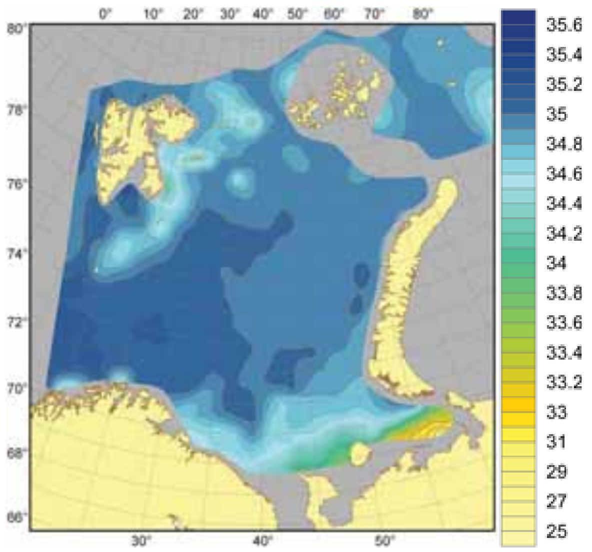


Figure 3.1.9. Distribution of salinity at the bottom, August–October 2013

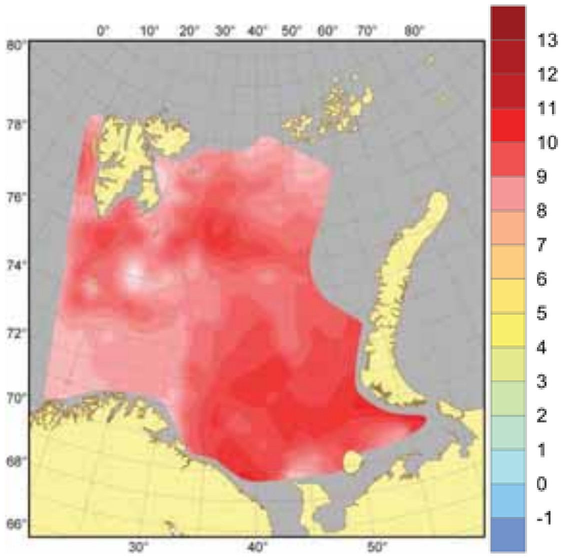


Figure 3.1.10. Surface temperature anomalies (°C), August–September 2013

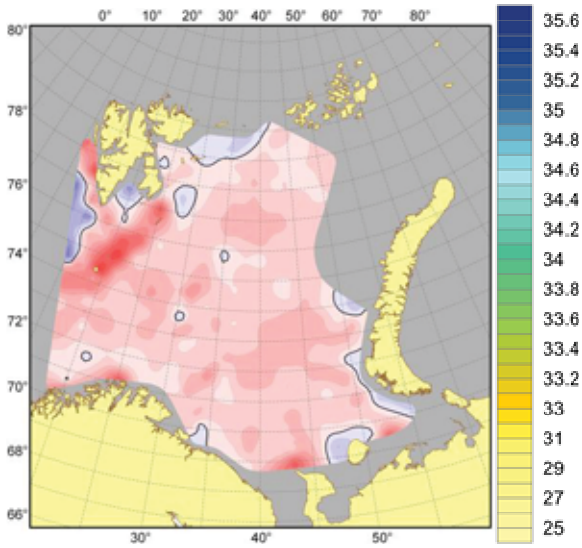


Figure 3.1.11. Temperature anomalies (°C) at the bottom, August–September 2013

3.2 Pollution

3.2.1 Anthropogenic matter

Text by T. Prokhorova
Figures by P. Krivosheya

As in the previous years, surface investigations and trawl catches demonstrated that the areas of intensive fishery and navigation were the most polluted.

Plastic prevailed among floating man-made garbage and distributed along the main currents (Figure 3.2.1.1). These pollutants were probably brought into the Barents Sea by ocean currents. So, the main plastic concentration in the surveyed area was observed between 69° and 74°N and between 25° and 45°E – the area being under the influence of the North Cape and Murman Currents. Plastic might be brought further northwards and eastwards by the Novaya Zemlya and Kolguev-Pechora Currents. Floating timbers were observed in all investigated areas. Metal, rubber and paper were observed among floating garbage sporadically.

As in 2010-2012, plastic prevailed among man-made garbage in trawl catches (Figure 3.2.1.2). Matter was observed in bottom trawls more frequently than in pelagic trawls, where garbage occurred mainly in the central Barents Sea. Moreover, pelagic trawl catchability is low for small density polymer materials so the amount of the anthropogenic garbage in the Barents Sea may be larger than that observed.

The occurrence of plastic in the bottom trawl catches increased in the northwest and southeast, which correspond to the directions of the main currents. It should be noted that a small amount of plastic was in trawls in the northeast, where wood prevailed. The wood might be brought to the area by ocean currents from the eastern seas because of the timber-rafting from the Siberian rivers, as well as it might be lost from ships. The wood was also observed in the southwest Barents Sea. This phenomenon is observed annually.

Other types of anthropogenic matter (metal, paper, rubber, textile, glass) were observed in the trawl catches sporadically.

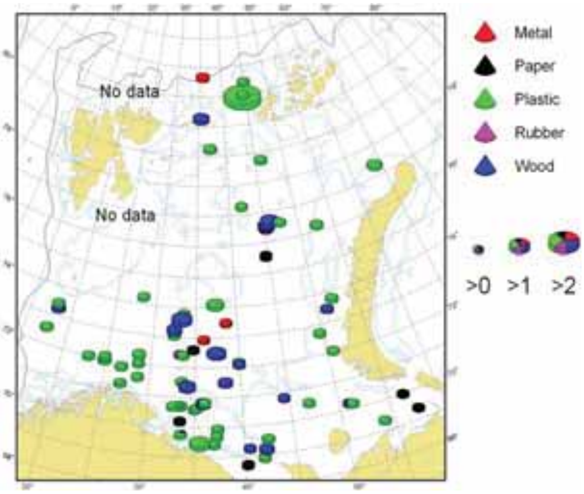


Figure 3.2.1.1. Type of observed anthropogenic matter (m3) at the surface in the Barents Sea in 2013.

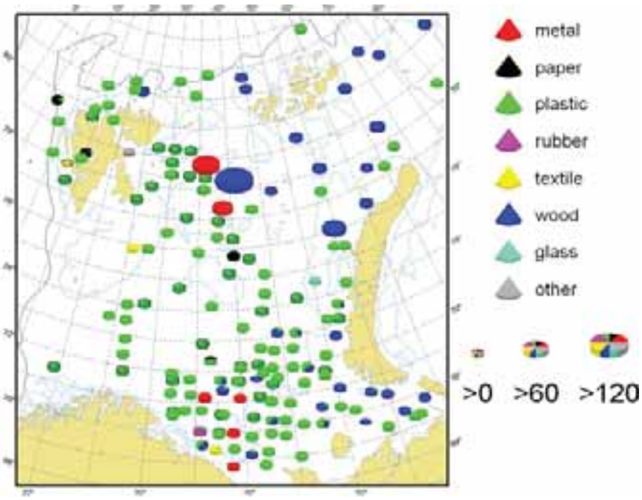


Figure 3.2.1.2. Types of garbage collected in the pelagic and bottom trawls (g) in the Barents Sea in 2013. Legend: symbols with contours show garbage in pelagic trawls, symbols without contours show garbage in bottom trawls.

Potential dangerous for the environment objects were seldom presented in the observations (Figure 3.2.1.3). In the majority of cases only inactive objects were found, which do not effect on the environment directly harmful. On the other hand, big lumps of threads, lines and nets, which might be dangerous for sea organisms, were found (Figures 3.2.1.4, 3.2.1.5).

Figure 3.2.1.3. Potential dangerous for the environment objects were seldom presented.

Figure 3.2.1.4. Lump of thread which cod was tangled in.

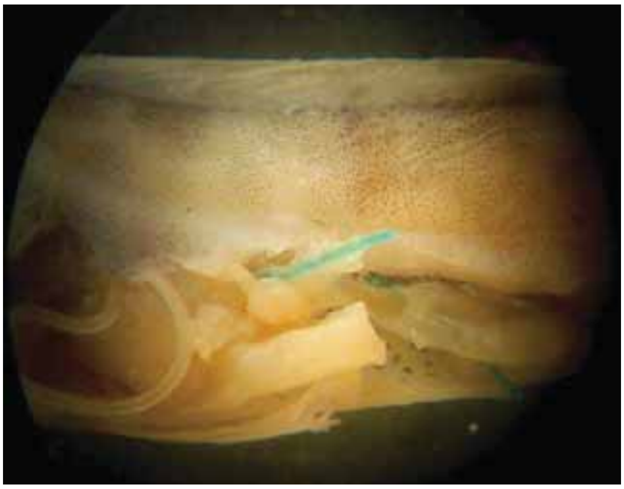


Figure 3.2.1.5. Fishing line in the intestines of 0-group Atlantic wolfish.

4 Monitoring the plankton community

4.1 Zooplankton

4.1.1 Calanus composition at the Fufløya-Bear Island (FB) transect

Text and figures by P. Dalpadado and J. Rønning

The stations in the FB transect are taken at fixed positions located at the western entrance to the Barents Sea. The numbers of sampled stations are normally 5 to 8 depending on weather conditions. In this report, four stations, representing different water masses (coastal; Atlantic; and mixed Atlantic/Arctic Water) from 1995 to 2012, have been analyzed for species composition of the two most abundant species C. finmarchicus, and C. glacialis.

C. helgolandicus is quite similar in appearance especially to C. finmarchicus, but is a more southerly species with a different spawning period. C. helgolandicus has in recent years become more frequent in the North Sea and southern parts of the Norwegian Sea (Svinøy transect), and it is expected that it could potentially increase its abundance in the western part of the Barents Sea in the years to come. Results so far seem to indicate that the abundance of C. helgolandicus at the western entrance to the Barents Sea is rather low and has remained more or less unchanged during the study period (not shown).

Though C. finmarchicus display inter-annual variations in abundance, comparison of abundance during three periods shows that there no marked changes in abundance over time (Figure 4.1.1.1, Table 4.1.1.1). The highest abundances of C. finmarchicus were recorded in 2010 over the whole transect except for the northernmost locality at 74º00'N, where the abundance was considerably lower (Figure 4.1.1.2). On average over all years since 2004, it is the locality at 73º30'N that shows the highest number of individuals. As expected C. glacialis has its highest abundance at the two northernmost stations, localities that are typical of a mixture of Atlantic and Arctic waters. The highest mean abundance (ca 15000 no.m-2) was observed for the year 1997(not shown). The most stable occurrence and the highest average abundance are found at the northernmost locality a 74º00'N having a mixture of Atlantic and

Arctic water masses. Also C. glacialis is subject to large inter-annual variations, and its abundance during 2008 and 2009 of year is considerably well below what can be considered the long-term mean for the two northernmost localities. For C. glacialis there seem to be a decrease in abundance after 2000 (Table 4.1.1.1). The lowest average abundance for C. hyperboreus was recorded during 2007-2012 (49 no.m-2) compared to 2001-2006 (179 no.m-2) and 1995-2000 (108 no.m-2).

Table 4.1.1.1. Avearge abundnace of the 3 *Calanus* species (no.m^{-2}) for 3 different periods from 1995 to 2012.

Period	*C. finmarchicus*	*C. glacialis*	*C. hyperboreus*
1995-2000	27234	1877	108
2001-2006	20518	517	179
2007-2012	36201	407	49

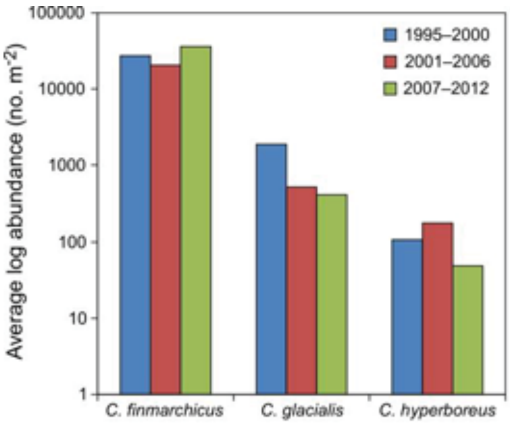


Figure 4.1.1.1. Abundance of Calanus species at the FB section during three periods: 1995-2000, 2001-2006 and 2007-2012.

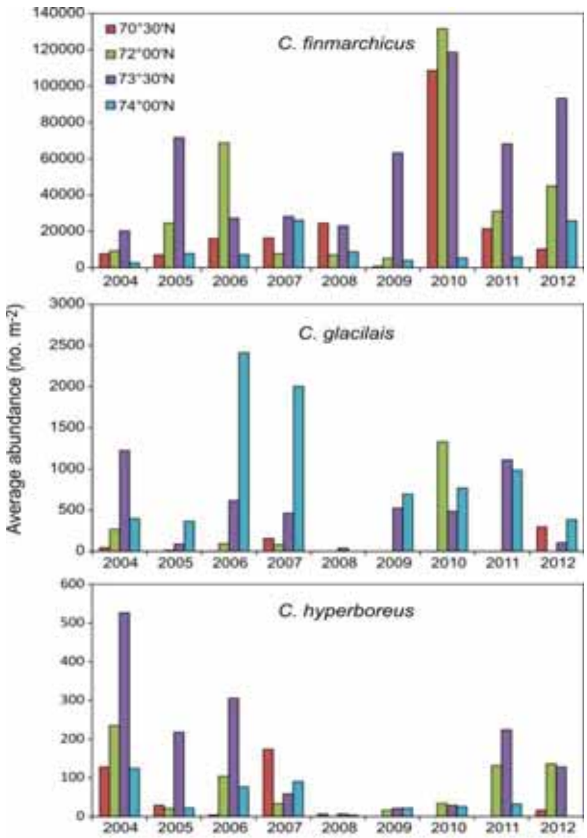


Figure 4.1.1.2. Development of copepod abundance along the FB section during the period 2004 - 2012. On a few occasions, when stations were lacking at a particular position, stations closest to that position were analyzed.

4.1.2 Spatial distribution and biomasses

Text by E. Orlova, P. Dalpadado, T. Knutsen, I. Prokopchuk and A. Dolgov
Figures by P. Dalpadado

Horizontal distribution of mesoplankton in 2013 is shown in Figure 4.1.2.1. Average biomass of zooplankton in 2013 was below the long-term mean. However, distribution of biomass attributed to zones was typical. Maximum biomass (more than 10 g dry weight m-2) was recorded within a relatively large area in the northeast. Minimal biomass (2-6 g • m-3) was distributed relatively evenly over the rest of the area, and only a small area in the centre between 70°N and 75°N having high biomass was prominent.

According to the Norwegian data, average biomass of zooplankton in the western and central Barents Sea in 2013 was estimated at 5.2 g • m-2. It was well lower than in previous years (2006-2010) and close to that in 2011 when it also was very low (5.9 g • m-2).

According to the Russian data, average biomass of mesozooplankton in the eastern and northeastern Barents Sea in 2013 was traditionally rather high, 10.1 g • m-2, and above the biomass in 2011-2012 (7.7-8.8 g • m-2), however it was lower than that in 2010 (11.2 g • m-2).

Aggregated Russian and Norwegian data suggest that average biomass of zooplankton within the entire area, due to high biomass in the northeast, was 7.6 g • m-2.

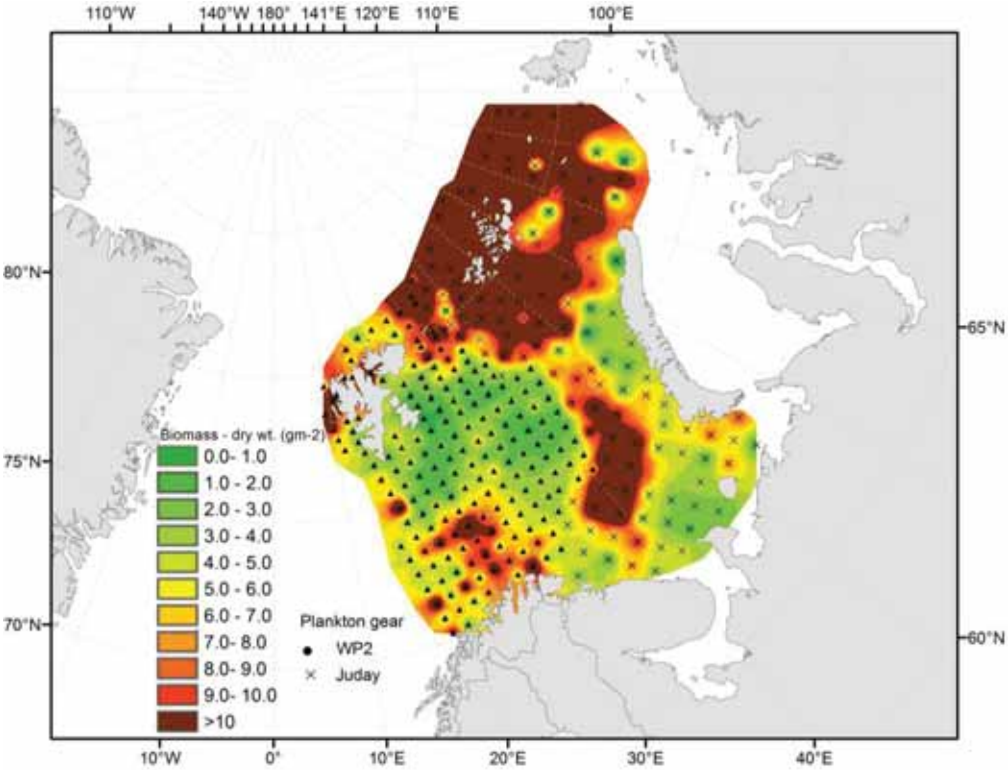


Figure 4.1.2.1. Distribution of zooplankton (dry weight, g • m-2) from bottom-0 m in 2013. Data based on Norwegian WP2 and Russian Juday net samples (IMR/PINRO).

4.1.3 Biomass indices of macroplankton (krill and jellyfish)

4.1.3.1 Distribution and amount of larger krill

Text by E. Eriksen, P. Dalpadado and A. Dolgov
Figures by E. Eriksen

In 2013 krill (group without species identifications) were distributed in the western, eastern areas and north for Svalbard/Spitsbergen (Figure 4.1.3.1.1). The highest catches were taken during the night, with average of 13.23 gram per m2. The number of the night stations was half of the day stations during the survey (Table 4.1.3.1.1). During the night most of krill migrate to upper water layer, and therefore better available for the capturing.

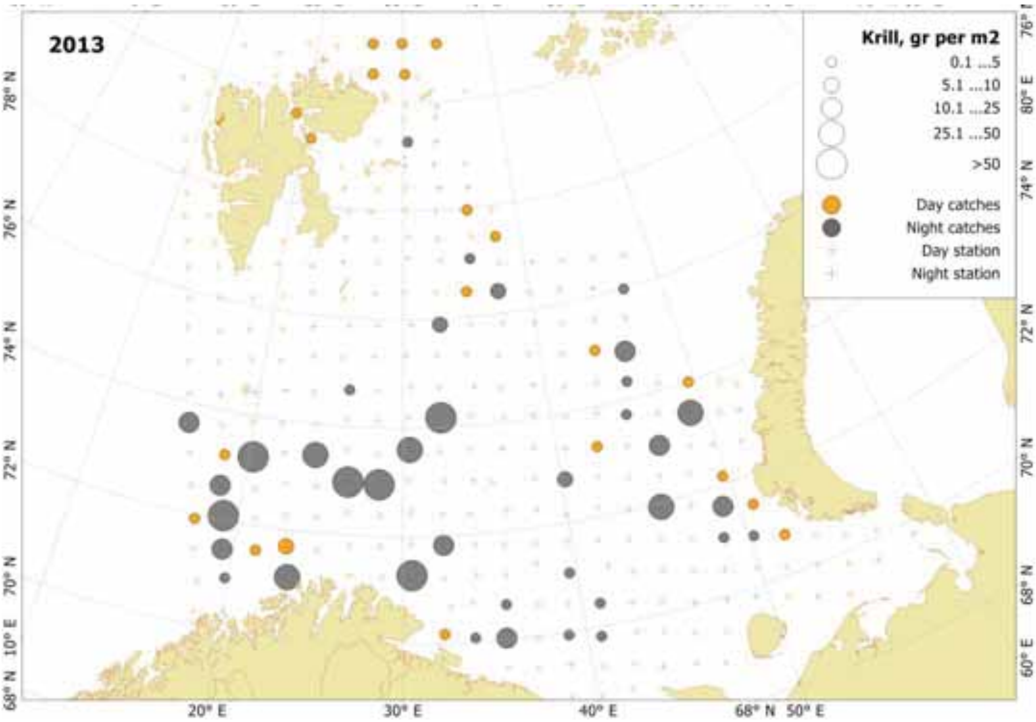


Figure 4.1.3.1.1. Krill distribution, based on trawl stations covering 0-60m, in the Barents Sea in August-September 2013

In 2013 the biomass of krill was almost twice higher than long term mean (8.8 million tonnes) and was 17 million tonnes after the heavy feeding summer season. In 2013 the biomass of krill continued to decrease since 2008.

During the survey no catches with amphipods were taken.

Table 4.1.3.1.1. Day and night catches (gramm per m2) of krill taken by the pelagic trawl within 0-60 m.

Year	Day			Night		
	N	Mean g/m^2	Std Dev	N	Mean g/m^2	Std Dev
1980	237	1.49	11.38	90	4.86	23.96
1981	214	1.19	9.14	83	7.95	21.53
1982	192	0.18	1.19	69	6.29	22.57
1983	203	0.32	2.76	76	0.39	1.91
1984	217	0.15	1.64	66	1.72	9.17
1985	217	0.07	0.54	75	0.8	4.42
1986	229	3.03	11.7	76	11.9	37.82
1987	200	4.9	22.44	88	3.82	13.08
1988	207	2.69	30.16	81	11.84	55.84
1989	296	1.99	8.45	129	3.71	13.01
1990	283	0.11	0.76	115	1.18	6.32
1991	284	0.03	0.33	124	7.03	25.11
1992	229	0.11	1.18	77	0.92	2.92
1993	194	1.21	6.69	79	2.23	7.36
1994	175	3.01	10.23	72	7.27	18.78
1995	166	4.86	18.86	80	9.13	34.46
1996	282	4.34	26.62	118	9.32	21.53
1997	102	4.12	22.71	167	3.58	12.94
1998	176	2.24	16	185	5.68	23.95
1999	140	1.5	9.64	90	4.64	13.09
2000	202	1.52	9.53	67	3.54	11.49
2001	212	0.07	0.63	66	5.77	19.6
2003	203	1.26	9.54	74	2.84	11.23
2004	229	0.34	2.94	80	6.49	22.47
2005	314	3.5	30.53	86	9.02	24.78
2006	227	1.23	6.66	103	9.66	31.54
2007	192	1.79	10.93	112	9.04	39.29
2008	199	0.11	1.02	77	16.92	43.57
2009	241	0.42	2.56	131	10.29	25.02
2010	198	1.76	13	105	14.98	43.35
2011	212	0.13	0.69	95	19.46	77.7
2012	243	4	12.35	84	11.48	34.21
2013	222	0.11	0.88	83	13.23	41.96
1980-2013	216	1.63		94	7.18	

4.1.3.2 Distribition and biomass of jellyfish, mostly Cyanea capillata

Text by E. Eriksen, T. Prokhorova, A. Dolgov and J.H. Fosså
Figures by E. Eriksen

In the 2013 jellyfish (mostly Cyanea capillata) were found entire the Barents Sea. Jellyfish biomass increased from the south west to the north east and south east, reflecting the direction of the main currents in the Barents Sea (Figure 4.1.3.2.1). It seems that higher surface temperature and wider area of Atlantic Water most likely influenced positively jellyfish biomass and distribution in 2013. The highest catches were taken in the eastern and central areas, and some of catches were more than 15 tonnes per nautical mile. Cyanea capillata as boreal species distributes not only in the warm Atlantic Water, but also in the mixed waters.

The calculated biomass of the jellyfish taken by pelagic trawl in the 0-60 m was 3.1 million tonnes in the Barents Sea in August-September (Figure 4.1.3.2.2). It is 3 times higher than in 2012 and 3.5 times higher long term mean (1980-2013). In 2013 jellyfish biomass was at the level of the early 2000s.

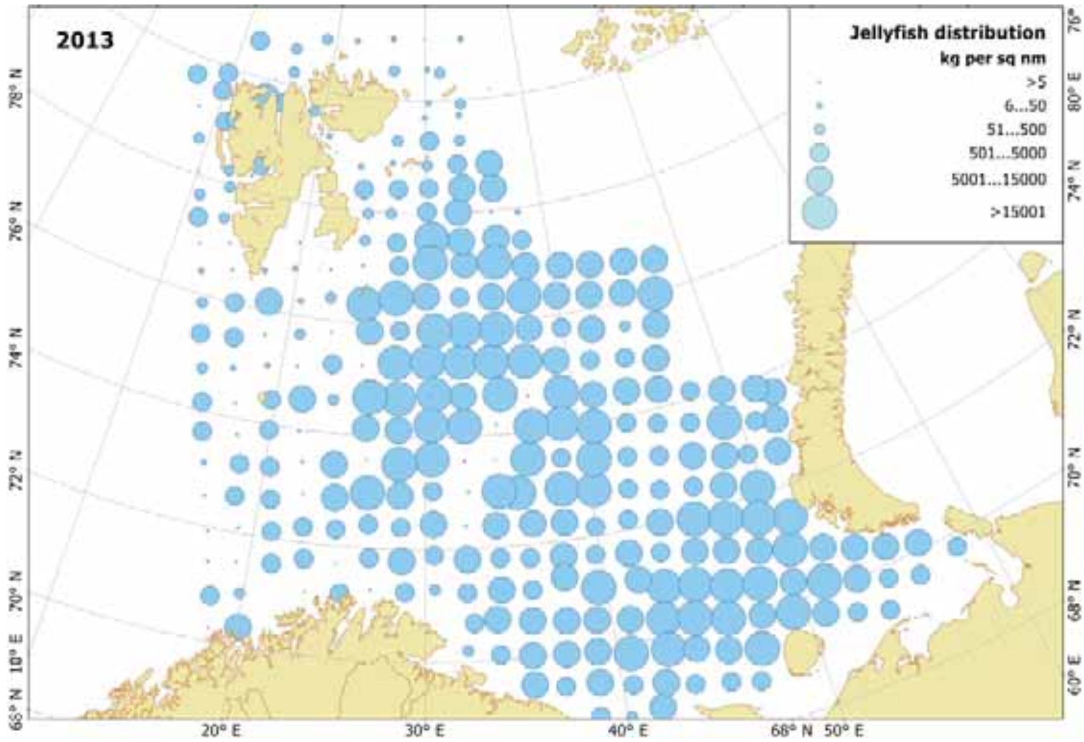


Figure 4.1.3.2.1. Distribution of jellyfish, August-September 2013.

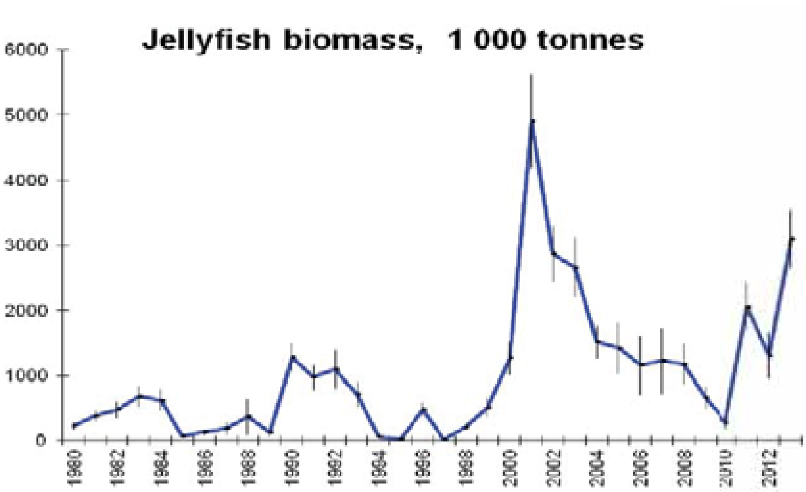


Figure 4.1.3.2.2. Jellyfish biomass in 1000 tonnes with 95% confidence interval for the period 1980-2013, August-September 2013.

The jellyfish preys on zooplankton, fish eggs and fish larvae. Cyanea capillata lives approximately 1 year. They utilize an unknown (but probably sufficient) amount of plankton during the summer period to reached so high biomasses in a few months. Therefore, jellyfish role in trophic webs of the Barents Sea should be closely studied.

5 Monitoring the pelagic fish community

5.1 Fish recruitment: fish distribution and abundance/biomass indices

Text by E. Eriksen, T. Prokhorova and D. Prozorkevich
Figures by E. Eriksen

During this survey the 0-group of several fish species were covered incompletely in the north-eastern part due to limited time (Figure 5.1.1.1, 5.1.2.1, 5.1.5.1). In a few cases 0-group fish distributed deeper that 100 m, and therefore were not catched. Therefore the estimation of 0-group cod, capelin and polar cod has some uncertainty.

The 2013 year classes of cod, herring and haddock were estimated as a strong. The 2013 year class of capelin is close to the long term mean level, while Greenland halibut year class is below the average level. Poor year classes of redfish, saithe, long rough dab and polar cod were observed. Abundance indices calculated for nine 0-group commercial fish species from 1980-2012 are shown in Tables 5.1.1 and 5.1.2.

The total biomass of the four most abundant 0-group fish (cod, haddock, herring and capelin) reached 2.4 million tonnes in August-September, which is somewhat higher than in 2012 and much higher than long term mean. Herring contributed to almost half of the total 0-group fish biomass. Most of the biomass distributes in the central part of the Barents Sea. Biomass indices calculated for four 0-group fish species from 1993-2013 are shown in Table 5.1.3.

Length measurements of 0-group fish taken on board indicated that the lengths of most of 0-group fish for cod, capelin, saithe, redfish and long rough dab were lower than the long term mean (1980-2013), while 0-group haddock, herring, polar cod and sandeels were larger in size. Length frequency distributions of the main species are given in Table 5.1.4.

Table 5.1.1. 0-group abundance indices (in millions) with 5% confidence limits, not corrected for capture efficiency. Record high year classes in bold. LTM – long term mean of 1980-2013.

Year	Capelin			Cod			Haddock			Herring			Redfish		
	Index	Confidence limit		Index	Confidence limit		Index	Confidence limit		Index	Confidence limit		Index	Confidence limit	
1980	197278	131674	262883	72	38	105	59	38	81	4	1	8	277873	0	701273
1981	123870	71852	175888	48	33	64	15	7	22	3	0	8	153279	0	363283
1982	168128	35275	300982	651	466	835	649	486	812	202	0	506	106140	63753	148528
1983	100042	56325	143759	3924	1749	6099	1356	904	1809	40557	19526	61589	172392	33352	311432
1984	68051	43308	92794	5284	2889	7679	1295	937	1653	6313	1930	10697	83182	36137	130227
1985	21267	1638	40896	15484	7603	23365	695	397	992	7237	646	13827	412777	40510	785044
1986	11409	98	22721	2054	1509	2599	592	367	817	7	0	15	91621	0	184194
1987	1209	435	1983	167	86	249	126	76	176	2	0	5	23747	12740	34755
1988	19624	3821	35427	507	296	718	387	157	618	8686	3325	14048	107027	23378	190675
1989	251485	201110	301861	717	404	1030	173	117	228	4196	1396	6996	16092	7589	24595
1990	36475	24372	48578	6612	3573	9651	1148	847	1450	9508	0	23943	94790	52658	136922
1991	57390	24772	90007	10874	7860	13888	3857	2907	4807	81175	43230	119121	41499	0	83751
1992	970	105	1835	44583	24730	64437	1617	1150	2083	37183	21675	52690	13782	0	36494
1993	330	125	534	38015	15944	60086	1502	911	2092	61508	2885	120131	5458	0	13543
1994	5386	0	10915	21677	11980	31375	1695	825	2566	14884	0	31270	52258	0	121547
1995	862	0	1812	74930	38459	111401	472	269	675	1308	434	2182	11816	3386	20246
1996	44268	22447	66089	66047	42607	89488	1049	782	1316	57169	28040	86299	28	8	47
1997	54802	22682	86922	67061	49487	84634	600	420	780	45808	21160	70455	132	0	272
1998	33841	21406	46277	7050	4209	9890	5964	3800	8128	79492	44207	114778	755	23	1487
1999	85306	45266	125346	1289	135	2442	1137	368	1906	15931	1632	30229	46	14	79
2000	39813	1069	78556	26177	14287	38068	2907	1851	3962	49614	3246	95982	7530	0	16826
2001	33646	0	85901	908	152	1663	1706	1113	2299	844	177	1511	6	1	10
2002	19426	10648	28205	19157	11015	27300	1843	1276	2410	23354	12144	34564	130	20	241
2003	94902	41128	148676	17304	10225	24383	7910	3757	12063	28579	15504	41653	216	0	495
2004	16901	2619	31183	19408	14119	24696	19372	12727	26016	**136053**	97442	174664	862	0	1779
2005	42354	12517	72192	21789	14947	28631	**33637**	24645	42630	26531	1288	51774	12676	511	24841
2006	168059	103577	232540	7801	3605	11996	11209	7413	15005	68531	22418	114644	20403	9439	31367
2007	161594	87683	235504	9896	5993	13799	2873	1820	3925	22319	4517	40122	156548	46433	266663
2008	288799	178860	398738	52975	31839	74111	2742	830	4655	15915	4477	27353	9962	0	20827
2009	189747	113135	266360	54579	37311	71846	13040	7988	18093	18916	8249	29582	49939	23435	76443
2010	91730	57545	125914	40635	20307	60962	7268	4530	10006	20367	4099	36636	66392	3114	129669
2011	175836	3876	347796	**119736**	66423	173048	7441	5251	9631	13674	7737	19610	7026	0	17885
2012	**310519**	225728	395311	105176	37917	172435	1814	762	2866	26480	299	316769	58535	0	128715
2013	94673	28224	161122	90101	62782	117421	7245	4731	9759	70972	8394	133551	928	310	1547
LTM	88529			28020			4276			29215			60466		

Table 5.1.1. Continued.

Year	Saithe			Greenland halibut			Long rough dab			Polar cod (east)			Polar cod (west)		
	Index	Confidence limit		Index	Confidence limit		Index	Confidence limit		Index	Confidence limit		Index	Confidence limit	
1980	3	0	6	111	35	187	1273	883	1664	28958	9784	48132	9650	0	20622
1981	0	0	0	74	46	101	556	300	813	595	226	963	5150	1956	8345
1982	143	0	371	39	11	68	1013	698	1328	1435	144	2725	1187	0	3298
1983	239	83	394	41	22	59	420	264	577	1246	0	2501	9693	0	20851
1984	1339	407	2271	31	18	45	60	43	77	127	0	303	3182	737	5628
1985	12	1	23	48	29	67	265	110	420	19220	4989	33451	809	0	1628
1986	1	0	2	**112**	60	164	**6846**	4941	8752	12938	2355	23521	2130	180	4081
1987	1	0	1	35	23	47	804	411	1197	7694	0	17552	74	31	117
1988	17	4	30	8	3	13	205	113	297	383	9	757	4634	0	9889
1989	1	0	3	1	0	3	180	100	260	199	0	423	18056	2182	33931
1990	11	2	20	1	0	2	55	26	84	399	129	669	31939	0	70847
1991	4	2	6	1	0	2	90	49	131	88292	39856	136727	38709	0	110568
1992	159	86	233	9	0	17	121	25	218	7539	0	15873	9978	1591	18365
1993	366	0	913	4	2	7	56	25	87	41207	0	96068	8254	1359	15148
1994	2	0	5	39	0	93	1696	1083	2309	**267997**	151917	384078	5455	0	12032
1995	148	68	229	15	5	24	229	39	419	1	0	2	25	1	49
1996	131	57	204	6	3	9	41	2	79	70134	43196	97072	4902	0	12235
1997	78	37	120	5	3	7	97	44	150	33580	18788	48371	7593	623	14563
1998	86	39	133	8	3	12	27	13	42	11223	6849	15597	10311	0	23358
1999	136	68	204	14	8	21	105	1	210	129980	82936	177023	2848	407	5288
2000	206	111	301	43	17	69	233	120	346	116121	67589	164652	22740	14924	30556
2001	20	0	46	51	20	83	162	78	246	3697	658	6736	13490	0	28796
2002	553	108	998	51	0	112	731	342	1121	96954	57530	136378	27753	4184	51322
2003	65	0	146	13	0	34	78	45	110	11211	6100	16323	1627	0	3643
2004	**1400**	865	1936	72	29	115	36	20	52	37156	19040	55271	341	101	581
2005	55	37	74	10	4	15	200	109	291	6545	3202	9888	3231	1283	5178
2006	139	56	221	11	2	21	707	434	979	26016	9997	42036	2112	465	3760
2007	53	6	100	1	0	2	262	46	479	25883	8494	43273	2533	0	5135
2008	45	22	69	6	0	13	956	410	1502	6649	845	12453	91	0	183
2009	22	0	46	7	4	10	115	51	179	23570	9661	37479	21433	5642	37223
2010	402	126	678	14	8	20	128	18	238	31338	13644	49032	1306	0	3580
2011	27	0	59	20	11	29	58	23	93	37431	15083	59780	627	26	1228
2012	69	2	135	30	16	43	173	0	416	4173	48	8298	17281	0	49258
2013	3	1	5	21	13	28	5	0	14	1634	0	4167	148	28	268
LMT	175			28			529			33868			8509		

Table 5.1.2. 0-group abundance indices (in millions) with 5% confidence limits, corrected for capture efficiency. Record high year classes in bold. LTM – long term mean of 1980-2013.

	Capelin			Cod			Haddock			Herring			Saithe			Polar cod (east)			Polar cod (west)		
Year	Index	Confidence limit		Index	Confidence limit		Index	Confidence limit		Index	Confidence limit		Index	Confidence lim		Index	Confidence limit		Index	Confidence limit	
1980	740289	495187	985391	276	131	421	265	169	361	77	12	142	21	0	47	203226	69898	336554	82871	0	176632
1981	477260	273493	681026	289	201	377	75	34	117	37	0	86	0	0	0	4882	1842	7922	46155	17810	74500
1982	599596	145299	1053893	3480	2540	4421	2927	2200	3655	2519	0	5992	296	0	699	1443	154	2731	10565	0	29314
1983	340200	191122	489278	19299	9538	29061	6217	3978	8456	195446	69415	321477	562	211	912	1246	0	2501	87272	0	190005
1984	275233	161408	389057	24326	14489	34164	5512	3981	7043	27354	3425	51284	2577	725	4430	871	0	2118	26316	6097	46534
1985	63771	5893	121648	66630	32914	100346	2457	1520	3393	20081	3933	36228	30	7	53	143257	39633	246881	6670	0	13613
1986	41814	642	82986	10509	7719	13299	2579	1621	3537	93	27	160	4	0	9	102869	16336	189403	18644	125	37164
1987	4032	1458	6607	1035	504	1565	708	432	984	49	0	111	4	0	10	64171	0	144389	631	265	996
1988	65127	12101	118153	2570	1519	3622	1661	630	2693	60782	20877	100687	32	11	52	2588	59	5117	41133	0	89068
1989	862394	690983	1033806	2775	1624	3925	650	448	852	17956	8252	27661	10	0	23	1391	0	2934	164058	15439	312678
1990	115636	77306	153966	23593	13426	33759	3122	2318	3926	15172	0	36389	29	4	55	2862	879	4846	246819	0	545410
1991	169455	74078	264832	40631	29843	51419	13713	10530	16897	267644	107990	427299	9	4	14	823828	366924	1280732	281434	0	799822
1992	2337	250	4423	166276	92113	240438	4739	3217	6262	83909	48399	119419	326	156	495	49757	0	104634	80747	12984	148509
1993	952	289	1616	133046	58312	207779	3785	2335	5236	291468	1429	581506	1033	0	2512	297397	0	690030	70019	12321	127716
1994	13898	70	27725	70761	39933	101589	4470	2354	6586	103891	0	212765	7	1	12	2139223	1230225	3048220	49237	0	109432
1995	2869	0	6032	233885	114258	353512	1203	686	1720	11018	4409	17627	415	196	634	6	0	14	195	0	390
1996	136674	69801	203546	280916	188630	373203	2632	1999	3265	549608	256160	843055	430	180	679	588020	368361	807678	46671	0	116324
1997	189372	80734	298011	294607	218967	370247	1983	1391	2575	463243	176669	749817	341	162	521	297828	164107	431550	62084	6037	118131
1998	113390	70516	156263	24951	15827	34076	14116	9524	18707	476065	277542	674589	182	91	272	96874	59118	134630	95609	0	220926
1999	287760	143243	432278	4150	944	7355	2740	1018	4463	35932	13017	58848	275	139	411	1154149	728616	1579682	24015	3768	44262
2000	140837	6551	275123	108093	58416	157770	10906	6837	14975	469626	22507	916746	851	446	1256	916625	530966	1302284	190661	133249	248072
2001	90181	0	217345	4150	798	7502	4649	3189	6109	10008	2021	17996	47	0	106	29087	5648	52526	119023	0	252146
2002	67130	36971	97288	76146	42253	110040	4381	2998	5764	151514	58954	244073	2112	134	4090	829216	496352	1162079	215572	36403	394741
2003	340877	146178	535575	81977	47715	116240	30792	15352	46232	177676	52699	302653	286	0	631	82315	42707	121923	12998	0	30565
2004	53950	11999	95900	65969	47743	84195	39303	26359	52246	773891	544964	1002819	4779	2810	6749	290686	147492	433879	2892	989	4796
2005	148466	51669	245263	72137	50662	93611	91606	67869	115343	125927	20407	231447	176	115	237	44663	22890	66436	25970	9987	41953
2006	515770	325776	705764	25061	11469	38653	28505	18754	38256	294649	102788	486511	280	116	443	182713	73645	291781	15965	3414	28517
2007	480069	272313	687825	42628	26652	58605	8401	5587	11214	144002	25099	262905	286	3	568	191111	57403	324819	22803	0	46521
2008	995101	627202	1362999	234144	131081	337208	9864	1144	18585	201046	68778	333313	142	68	216	42657	5936	79378	619	25	1212
2009	673027	423386	922668	185457	123375	247540	33339	19707	46970	104233	31009	177458	62	0	132	168990	70509	267471	154687	37022	272351
2010	318569	201973	435166	135355	68199	202511	23669	14503	32834	117087	32045	202129	1066	362	1769	267430	111697	423162	12045	0	33370
2011	594248	58009	1130487	448005	251499	644511	19114	14209	24018	83051	48024	118078	96	0	225	249269	100355	398183	4924	218	9629
2012	988600	728754	1248445	410757	170242	651273	5281	2626	7936	177189	35046	2111493	229	5	453	25026	1132	48920	125306	0	357381
2013	316020	127310	504731	385430	269640	501219	16665	11161	22169	289391	67718	511064	11	4	18	11382	0	29002	1011	262	1760
LTM	300732			108215			11824			168872			500			273737			68989		

Table 5.1.3. Biomass indices of 0-group capelin, cod, haddock and herring (in thousand tonnes).

Year	Capelin	Cod	Haddock	Herring	Total biomass
1993	3	475	34	1035	1547
1994	6	666	54	173	898
1995	2	1546	14	12	1573
1996	98	919	34	438	1489
1997	82	657	12	352	1103
1998	51	117	168	988	1323
1999	158	32	39	440	668
2000	55	319	44	404	822
2001	51	11	58	9	130
2002					
2003	149	160	115	471	894
2004	33	317	686	2243	3279
2005	60	431	749	406	1647
2006	335	181	329	1321	2166
2007	312	123	69	275	779
2008	396	632	54	106	1189
2009	197	955	346	289	1788
2010	100	786	134	254	1274
2011	228	1855	215	151	2449
2012	519	1429	39	1156	3143
2013	151	957	241	1363	2712
Mean	149	628	172	594	1544

Table 5.1.4. Length distribution (%) of 0-group fish in the Barents Sea and adjacent waters.

Length, mm	Cod	Haddock	Capelin	Herring	Saithe	Redfish	Polar cod	Gr. halibut	LRD	Sandeel
10 - 14 mm										
15 - 19 mm						1.9				
20 - 24 mm			0.7			14.1				
25 - 29 mm			4.8			17.2			20.0	
30 - 34 mm			10.1			20.4	0.7		48.9	
35 - 39 mm			13.8			20.1	1.8	0.6	26.7	0.2
40 - 44 mm		0.1	14.6			11.9	16.9		4.4	0.0
45 - 49 mm	0.2	0.1	9.2	0.3	11.8	11.9	41.5			0.1
50 - 54 mm	1.9	0.3	10.5	1.1		2.3	30.7	5.6		2.2
55 - 59 mm	5.4	0.7	21.8	4.7		0.1	7.7	19.9		2.3
60 - 64 mm	14.6	0.5	12.2	13.3	7.0		0.7	29.0		4.5
65 - 69 mm	22.0	1.2	2.2	9.7			0.1	28.9		4.0
70 - 74 mm	19.8	2.6		6.2	12.9			11.9		27.8
75 - 79 mm	15.2	2.9		7.8	7.0			3.2		23.6
80 - 84 mm	9.0	4.7		8.2				0.8		22.4
85 - 89 mm	6.1	6.4		9.0	12.8					8.4
90 - 94 mm	2.7	8.5		23.4	5.5					2.5
95 - 99 mm	2.0	8.8		14.3	12.2					1.2
100 - 104 mm	0.4	6.8		1.4						0.4
105 - 109 mm	0.3	7.3		0.4						0.2
110 - 114 mm	0.1	8.7		0.1	14.2					0.1
115 - 119 mm	0.1	11.3								
120 - 124 mm		9.3			16.6					
125 - 129 mm		7.3								
130 - 134 mm		4.6								
135 - 139 mm		3.8								
140 - 144 mm		2.1								
145 - 149 mm		1.2								
150 - 154 mm		0.5								
155 - 159 mm		0.3								
160 - 164 mm		0.1								
Mean length, cm	7.2	10.7	4.6	8.0	8.8	3.4	4.6	6.3	3.1	7.4
Long term mean length, cm	7.6	9.1	4.8	7.1	9.2	3.8	4.0	6.2	3.4	5.7

5.1.1 Capelin (*Mallotus villosus*)

The 0-group capelin was observed further eastwards from Svalbard/Spitsbergen Archipelago than in 2012 (Figure 5.1.1.1). At the same time, no capelin was found in the south, west and north for Svalbard/Spitsbergen Archipelago. The survey could not identify boundaries for capelin distribution in the north-east, which will influence abundance indices. The density legend in the figure is based on the catches, measured as number of fish per square nautical mile. More intensive colouring indicates denser concentrations. In 2013 more dense concentrations were observed along Murman coast and in the central parts of the Barents Sea.

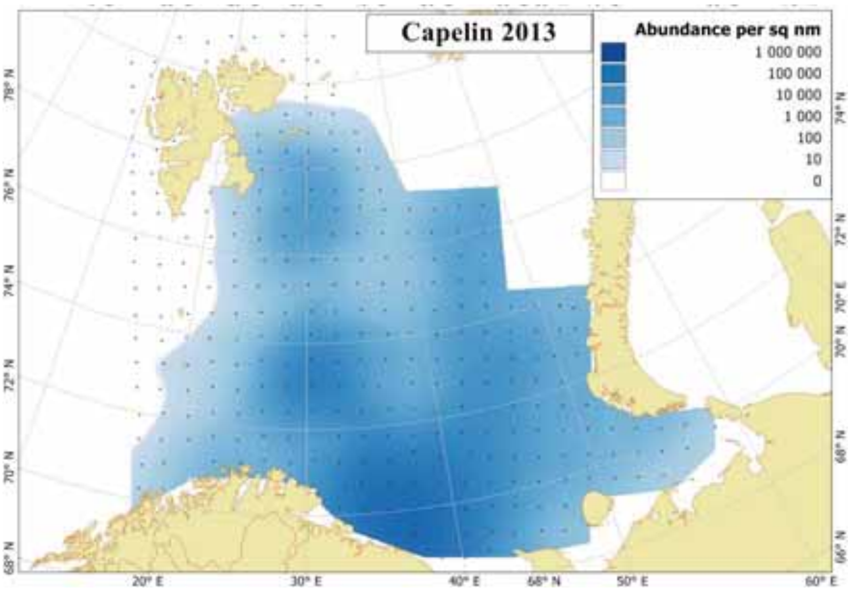


Figure 5.1.1.1. Distribution of 0-group capelin, August-September 2013.

The calculated density varied from 162 to 24 million fish per square nautical mile. Mean catch per trawl was 1 323 fish, that is one third of the 2012 value.

Length of 0-group capelin was mostly lower than 6 cm, and therefore 0-group and older fish was easy to split. An average length was 4.6 cm that lower than in 2012 (5.0 cm) and long term mean (4.8 cm).

The 0-group capelin biomass was about 151 thousand tonnes, and this is less than one third of the 2012 value and approximately at the long term level (149 thousand tonnes for period 1993-2013). The capelin biomass is shown in Table 5.1.3.

Most of the 0-group capelin likely originates from late spring spawning, however unknown part of 0-group capelin of 3 cm body length or less were most likely from summer spawning. These small fish distributed mostly in the southern Barents Sea (Figure 5.1.1.2). This part consist 15 % of the total 0-group index. This small 0-group capelin may probably have a worse condition for overwintering due to less time to grow up during the first feeding season.

The abundance index of 0-group capelin in 2013 was one third of that in 2012 and is close to the long term mean so 2013 year class was found as average.

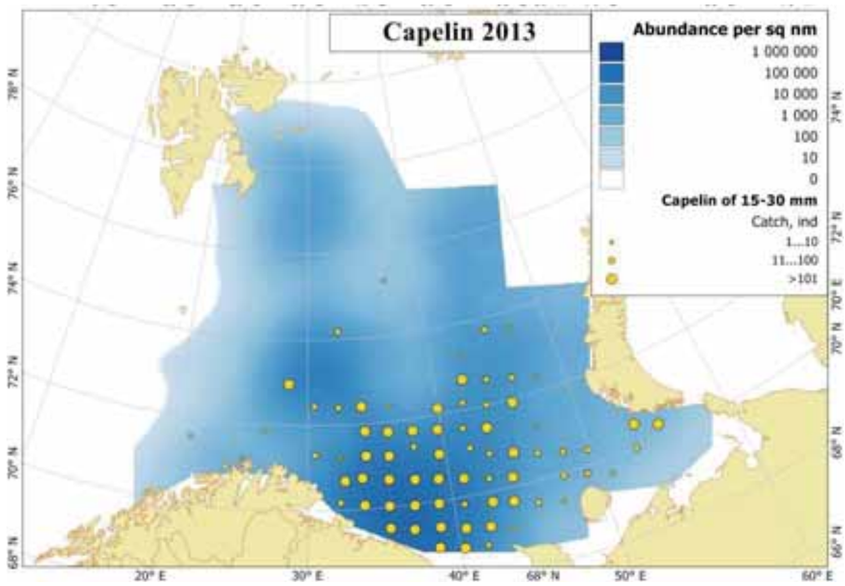


Figure 5.1.1.2. Distribution of small 0-group capelin of 15-30 mm body length, August-September 2013.

5.1.2 Cod (*Gadus morhua*)

0-group cod was widely distributed in 2013 (Figure 5.1.2.1). In comparison to 2012 0-group cod was observed further to the east from Svalbard/Spitsbergen Archipelago. The main dense concentrations were found in the central part of the sea, north and west than in 2012, between 72-77˚N and 18-33˚E. The survey could not identify boundaries for cod distribution in the north-east where significant cod concentration was registered by echosounder. 0-group cod were distributed further north-eastwards than usually, and overwintering condition there are unknown. Moreover during recent years the 0-group cod were observed by demersal haul outside of standard coverage by pelagic hauls, therefore an increase of coverage by pelagic hauls is needed eastwards in the northern area. Some areas to west of central Novaya Zemlya Archipelago were also not covered but cod density there was low and had little influence on abundance indices.

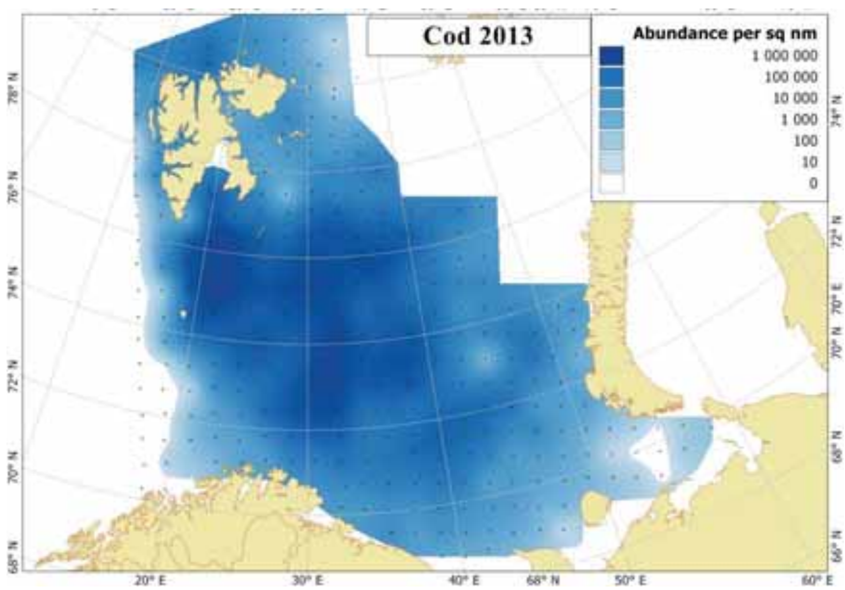


Figure 5.1.2.1. Distribution of 0-group cod, August-September 2013.

The calculated density was from 185 to 7.2 million fish per square nautical mile. The mean catch was 1359 fish per trawl haul, which is similar to that observed in 2012.

The lengths of 0-group cod was between 4.5 and 11.5 cm. Most of the fish were between 5.5 and 8.5 cm, with a mean length of 7.2 cm and it is lower than in 2012 and long term level (Table 5.1.4). Thus in 2013 generally fewer fish were observed and fish were smaller than in 2012, indicating worse living condition during summer 2013.

The 0-group cod biomass of 957 thousand tonnes is lower than in 2012 but higher than the mean average level (Table 5.1.3). The abundance index of 2013 year class is some lower than in 2012 but still much higher than long-term mean, therefore 2013 year class may be characterized as strong.

5.1.3 Haddock (*Melanogrammus aeglefinus*)

0-group haddock was widely distributed in the western part of the survey area between 10° E and 48 °E in 2013 and it was wider than in previous year (2012), especially south of the Svalbard/Spitsbergen Archipelago (Figure 5.1.3.1).

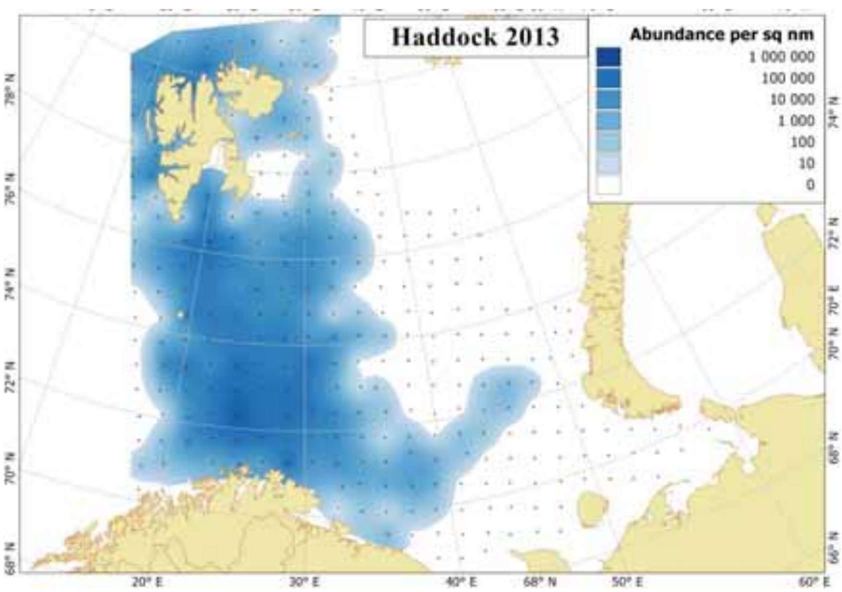


Figure 5.1.3.1. Distribution of 0-group haddock, August-September 2013.

The calculated density varied between 175 and 637 thousand fish per square nautical mile. The mean catch per trawl was 109 fish, which is 5 times higher than in 2012.

The length of 0-group haddock varied between 4.0 and 16.0 cm, while the length of most fish was between 8.0 and 13.5 cm (Table 5.1.4). The mean length of haddock was 10.7 cm, which is higher than in 2012 (9.3 cm) and the long-term mean (9.1 cm). The large 0-group haddock may most likely indicate suitable leaving conditions for haddock in 2013.

The 0-group haddock biomass was about 241 thousand tonnes and it is 6 times higher than in 2012 and 1.4 times higher than the long term mean (for period 1993-2012) (Table 5.1.3).

The number of fish belonging to the 2013 year class is much higher than in 2012, above the long-term mean and comparable the level of 2010-2011.

5.1.4 Herring (*Clupea harengus*)

0-group herring were distributed as in 2012 from southeast to northwest of the Barents Sea in 2013. However, herring has widely distribution in the central part of the sea in comparison to 2012. The main dense concentration of herring was located in the central area: between 71-75˚N and 24-35˚E (Figure 5.1.4.1).

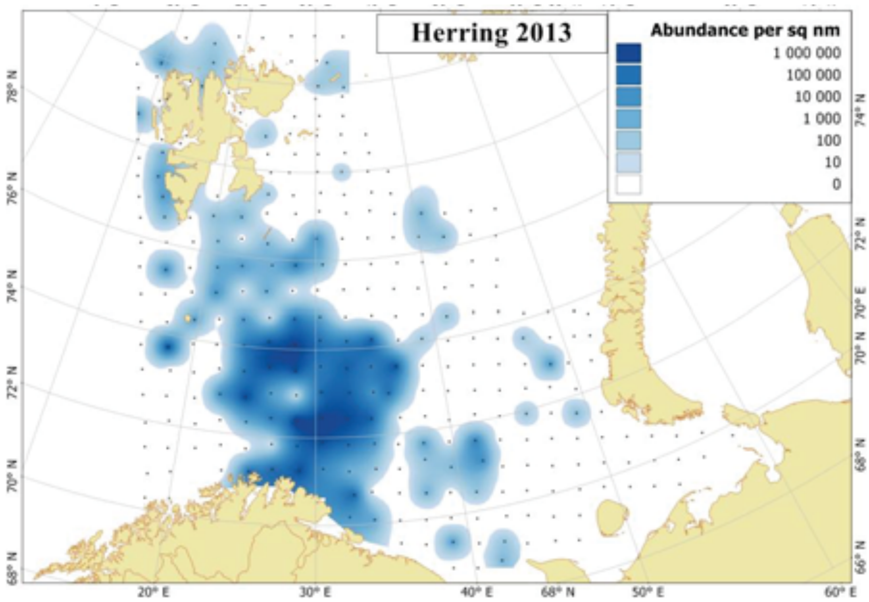


Figure 5.1.4.1. Distribution of 0-group herring, August-September 2013.

The mean catch per trawl haul was 1044 fish. The calculated density varied from 112 to 23 million fish per square nautical mile.

The length of herring varied between 4.5 and 11.0 cm, and most of the fish were 5.5-9.5 cm long (Table 5.1.4). In 2013 the mean length of 0-group herring was similar to that in the early 1990s and early 2000s, and was 8.0 cm. The mean fish length is rather higher than in 2012 (6.6 cm) and the long term mean (7.1 cm), indicating good living condition during summer 2013. During the herring larvae surveys in April 2012 and 2013 the mean size of the herring larvae was 13.5 mm which was the highest observed and the majority of larvae (91.4 %) was at the 2a stage, corresponding to 10-24 days old larvae, versus 47.3 % in 2012 (Stenevik et al. 2012, 2013). So early spawning and extremely high surface water temperature in summer 2013 may be the reasons for the observed high mean length.

The 0-group herring biomass was 1363 thousand tonnes due to an abundant year class and larger fish size than in 2012 (Table 5.1.3). Since 2006 no strong year classes have been occurred, that probably can be a consequence of the negative larva survival in Norwegian Sea on the drift ways. The 2013 year-class of herring is close to the 2006 level, and higher than long average level therefore can be characterized as strong. It may positively affect to the recruitment of the fishable stock.

5.1.5 Polar cod (*Boreogadus saida*)

As in previous years, the distribution of 0-group polar cod was split into two components, western and eastern (Figure 5.1.5.1). The western component was observed east and north-east of Svalbard/Spitsbergen Archipelago, although in 2012 it was found around the whole Archipelago. Polar cod of the eastern component distributes usually along the western coast of Novaya Zemlya. The surveys did not covered the northern part along the Novaya Zemlya due to limited time. The eastern component is usually denser than the western. However, in 2013 only low densities were observed from both locations.

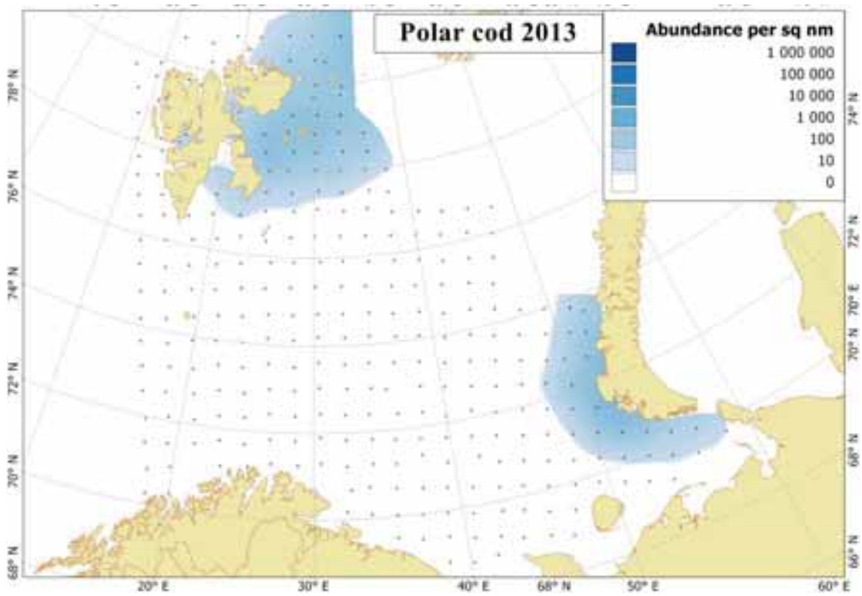


Figure 5.1.5.1. Distribution of 0-group polar cod, August-September 2013.

The length of polar cod varied between 3.0 and 6.5 cm, and most of the fish were between 4.0 and 5.5 long (Table 5.1.4). The mean length of 0-group polar cod was 4.6 cm (as in 2012), and it is higher than the long term mean of 4.0 cm.

The abundance index for each component was calculated separately. Calculated abundance of the eastern component was low: less than half the 2012 value and less than 5% of the long-term average level (Table 5.1.1). The abundance index of western component was also much lower than in 2012 and long-term mean. Low estimated abundance of polar cod indicated probably both not suitable spawning and living conditions, and redistribution of spawning stock and therefore 0-group in the northern area due to less ice coverage during 2013.

5.1.6 Saithe (*Pollachius virens*)

Single specimens of 0-group saithe were found in the central, south and north western part of the Barents Sea (Figure 5.1.6.1).

The maximum calculated density was only 441 fish per nautical mile. Both density and catch rates were lower than in 2012.

The length of 0-group saithe varied between 4.5 and 12.0 cm. The mean length of saithe was 8.8 cm. This was the same level as in 2012 and some lower than the long term mean of 9.2 cm (Table 5.1.4).

Since 2005 (except in 2010) abundance indices of 0-group saithe have been lower than the long-term average. The 2013 year class is less than 5% of the 2012 year class and much lower than the long term mean. The 2013 year class of saithe in the Barents Sea may be characterized as poor. The index of 0-group saithe in the Barents Sea is only a minor part of the total 0-group abundance, and therefore not representative as recruitment (at age 0) for the saithe stock.

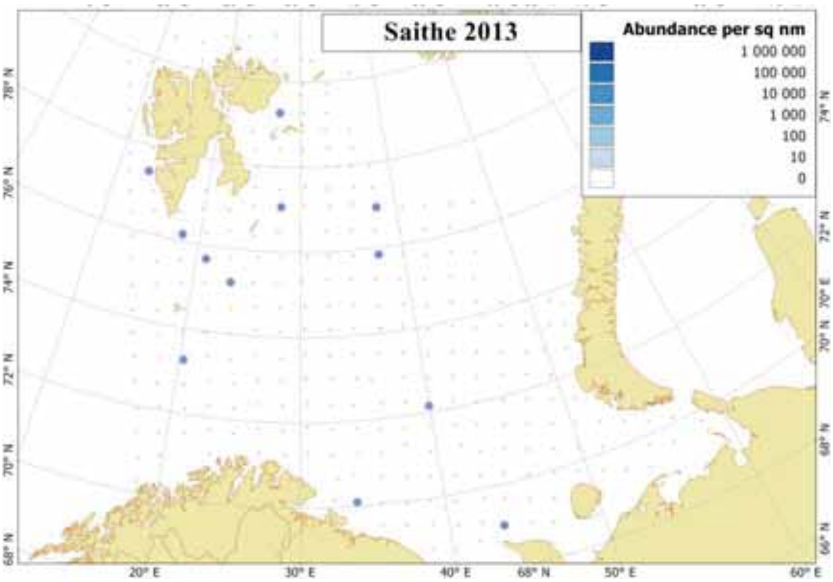


Figure 5.1.6.1. Distribution of 0-group saithe, August-September 2013.

5.1.7 Redfish (mostly *Sebastes mentella*)

0-group redfish was distributed in 3 areas in the western part of the Barents Sea: from the north western and south of the Svalbard/Spitsbergen Archipelago and along the Norway coast between 70 °N and 73 °N (Figure 5.1.7.1). The densest concentrations were located in the southern part of distribution.

Mean catch per trawl haul was 15 fish, which is 53 times less than in 2012. The calculated density was between 175 and 230 thousand fish per square nautical mile.

In 2013 the mean fish length was 3.4 cm. This mean fish length is lower than in 2012 (4.2 cm) and long term mean of 3.8 cm. Very small 0-group of redfish (1.5-2.5 cm) was found at the 71°49’ N 34°18’ E what probably can indicate late spawning.

The abundance of 0-group redfish is less then 2 % of that in 2012 and the long-term average. So the 2012 year-class can be characterized as poor.

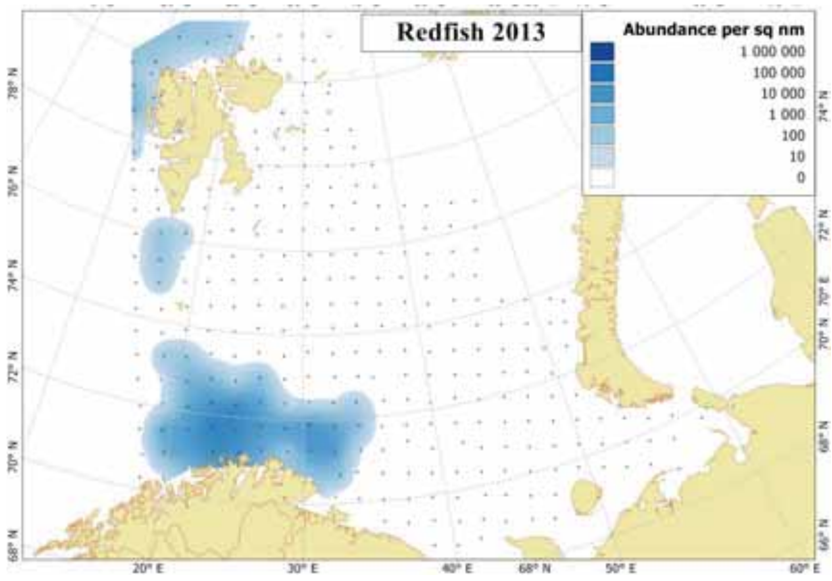


Figure 5.1.7.1. Distribution of 0-group redfish, August-September 2013.

5.1.8 Greenland halibut (*Reinhardtius hippoglossoides*)

As in the previous five years, 0-group Greenland halibut of very low densities were found in 2013. In 2013 as in 2012 Greenland halibut were observed to the north and in small areas south of Svalbard/Spitsbergen (Figure 5.1.8.1). Northern and western part of the 0-group halibut distribution area was not covered by the survey. Moreover the survey not covered numerous of Svalbard/Spitsbergen fjords, where 0-group Greenland halibut are abundant, and therefore this index may not give indication of real recruitment (at age 0) to the stock. However, this may reflect the minimum abundance index of the year-class strength in the surveyed area.

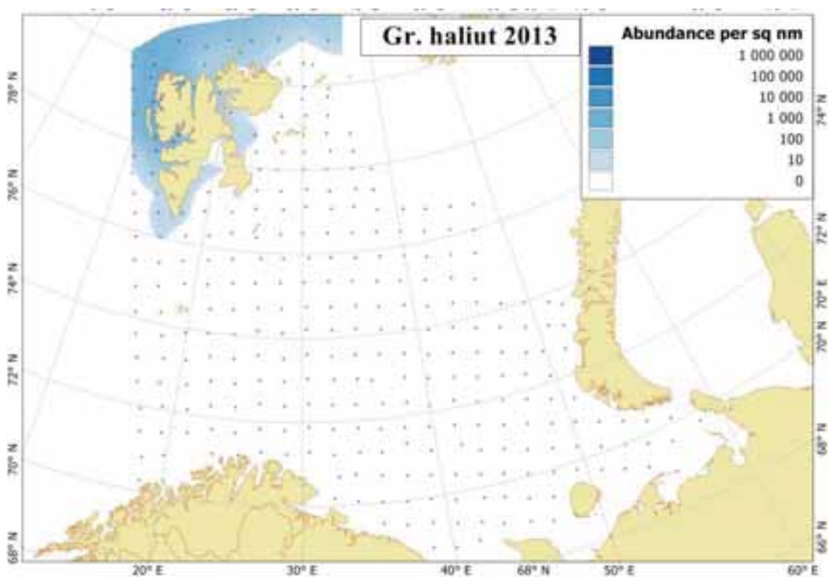


Figure 5.1.8.1. Distribution of 0-group Greenland halibut, August-September 2013.

Fish length varied between 3.5 and 8.0 cm, while most of the fish were between 5.0 and 6.5 cm. The mean length of fish was 6.3 cm which is approximately the same as in 2012 (6.6 cm) and the long term mean (6.2 cm) (Table 5.1.4).

The highest calculated density concentration was only 3.1 thousand fish per square nautical mile. The average concentration of 74 fish per square nautical mile is 25 % less than in 2012. Maximal catch per station was 21 fish.

From 2007 to 2012 abundance of Greenland halibut continuously increased, but 2013 year-class index is below the long term average level.

5.1.9 Long rough dab (*Hippoglossoides platessoides*)

0-group long rough dab were found only at 6 stations in the south and east of surveyed area (Figure 5.1.9.1). 0-group long rough dab settles to the bottom, when fish reach length of 3 cm. The high surface temperature may probable lead to earlier settlement, however it cannot explain the record low abundance in 2013.

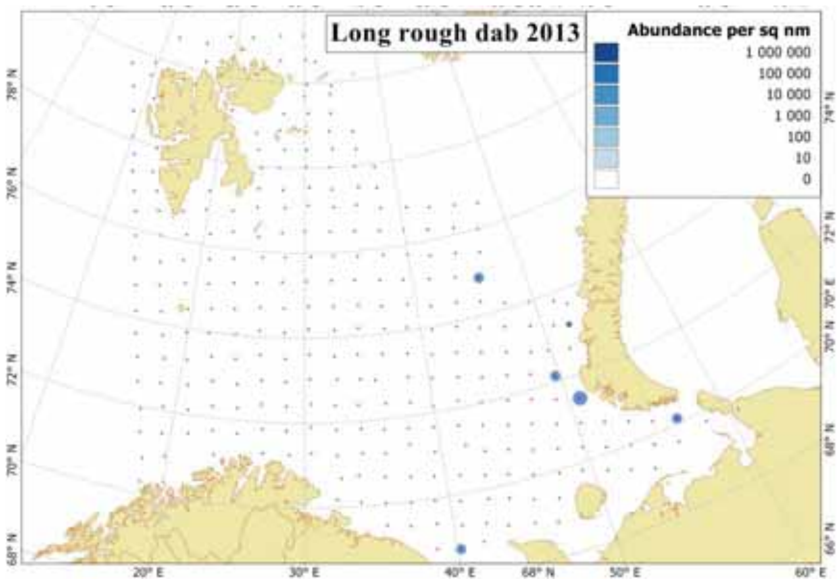


Figure 5.1.9.1. Distribution of 0-group long rough dab, August-September 2013.

The highest calculated density concentration was only 3.1 thousand fish per square nautical mile.

Fish length varied between 2.5 and 4.0 cm (Table 5.1.4). The mean length of fish was 3.1 cm. This is approximately the same as in 2012 (2.9 cm) and slightly below than the long-term average (3.4 cm).

Long rough dab index in 2013 was the lowest ever recorded. It is less than 1 % of the long-term mean so can be characterized as very poor.

5.1.10 Wolffishes (Anarhichas sp.)

There are three species of wolffish found in the Barents Sea: Atlantic wolffish (Anarhichas lupus), Spotted wolffish (Anarhichas minor) and Northern wolffish (Anarhichas denticulatus). Due to very low catches of each species, all the catches were lumped together into a larger group (Genus), whose distribution is shown in the map (Figure 5.1.10.1). Low catches were taken in the north and south from Svalbard/Spitsbergen Archipelago.

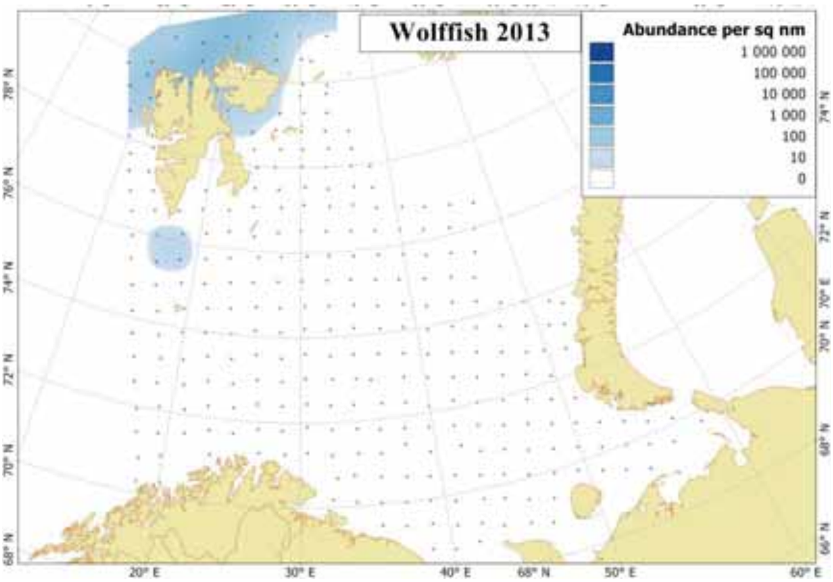


Figure 5.1.10.1. Distribution of 0-group wolffishes, August-September 2013.

The calculated density was from 147 to 17.7 thousand fish per square nautical miles, with an average of 133 fish per square nautical miles. This is higher than in 2012.

No index is calculated for this species. But the distribution and abundance of 0-group 2013 year class is larger than in 2012.

5.1.11 Sandeel (Ammodytes marinus)

The species A*mmodytes marinus* and A*mmodytes tobianus* belong to the Family Ammodytidae in the Barents Sea. The *Ammodytes marinus* species is widely distributed in the sea, while *Ammodytes tobianus* was found to be very rare; being only distributed along the northern Norwegian coast. Thus figure 5.1.11.1. only shows the distribution of A*mmodytes marinus*.

In 2013 0-group sandeels were found in two separate areas: the north of Finmark coast, between 71 °N and 75 °N, 20 °E and 35 °E and in the southeast part of the Barents Sea. The denser concentrations were found in the southern part. In 2012 0-group sandeel were found in the south of Svalbard/Spitsbergen Archipelago.

The calculated density was from 162 to the 1.1 million fish per square nautical miles, with an average of 5.9 thousand fish per square nautical miles. The mean catch was 32 fish per trawl haul. Mean density and mean catch was much lower than in 2012.

Fish otoliths were taken at stations when it was difficult to separate of 0-group sandeel from older fish. The most fish have length 6.8-8.5 cm (Table 5.1.4). Average length in 2013 was 7.4 cm that is higher than in 2012 (6.2 cm) and long term mean (5.7 cm).

The calculated abundance of 2457 million individuals and biomass 1 229 tonnes is lower than both the long term level and the 2012 value (see "Biodiversity" section Table 8.2.1.1).

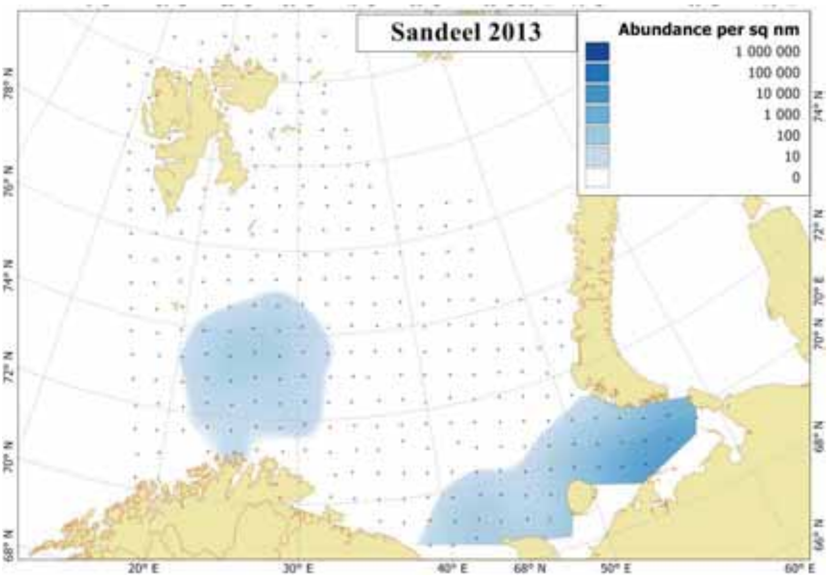


Figure 5.1.11.1. Distribution of 0-group A. marinus, August-September 2013.

5.1.12 Mackerel (Scomber scombrus)

In the Barents Sea 0-group mackerel have been observed during the survey in some years, causing drift of mackerel larvae in to the Barents Sea. The scattered concentrations of 0-group mackerel were found between 70 °N – 72°30' N and 29 °E – 35 °E (Figure 5.1.12.1). So far to the east 0-group mackerel were distributed only in 1972 (Anon., 2004). Spawning distribution of mackerel has expanded towards the north and northwest, but most of the eggs are still produced in the historical core spawning area. The expansion seems to be less related to changes in the environmental conditions, than to the increase in stock size (ICES, 2013). At the same time warm Atlantic Water were observed in the southern Barents Sea in 2013, indicating stronger currents. Thus both spawning stock biomass and stronger current influenced the occurrence of 0-group mackerel in the Barents Sea.

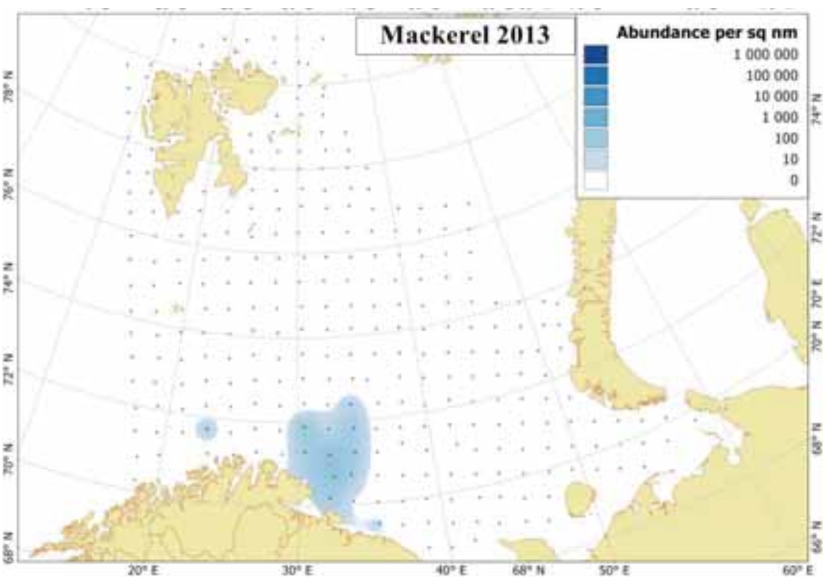


Figure 5.1.12.1. Distribution of 0-group mackerel, August-September 2013.

0-group mackerel were observed at 12 stations during the survey. The calculated mean density was 212 fish per square nautical miles, and the highest catch was as high as 275 fish per station.

Fish length varied between 2.5 and 7.0 cm (Table 5.1.4). The mean length of fish was 4.2 cm and it is close to the long term mean (4.3 cm).

No index is calculated for mackerel.

5.1.13 Blue whiting (*Micromesistius poutassou*)

Only 2 individuals of 0-group blue whiting of 6.8 cm body length were caught in the southern part of the survey area (Figure 5.1.13.1). No index is calculated for blue whiting.

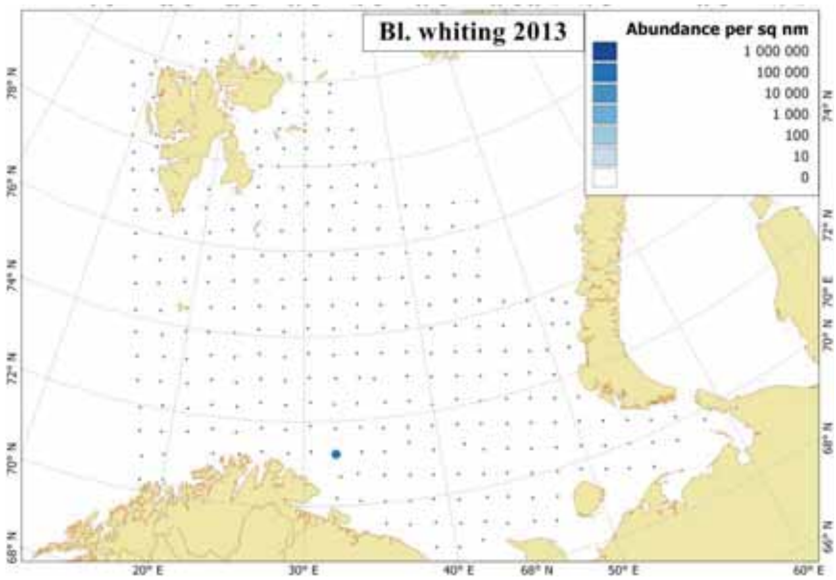


Figure 5.1.13.1. Distribution of 0-group blue whiting, August-September 2013.

5.2 Pelagic fish abundance and distribution

Text by D. Prozorkevich and H. Gjøsæter
Figures by D. Prozorkevich and J. Alvarez

Number of fish sampled during the survey is presented in Appendix 2.

5.2.1 Capelin (*Mallotus villosus*)

Distribution

The geographical density distribution of capelin of age group 1 and total stock are shown in Figs. 5.2.1.1 and 5.2.1.2. The total distribution area of capelin was similar to that found in 2008-2011, but with some notable changes. Low concentrations of capelin were detected in the areas to the west of the Svalbard/Spitsbergen archipelago, but no capelin were found north of the archipelago. However, the distribution area reached north of 82ºN to the east of 35ºE in the central part of Barents Sea and up to 75°E in north-eastern part. In contrast to 2012, some high concentrations were found south-east of Franz Josef Land, reaching 80ºN, 70ºE. This is the northeastern most observation of capelin in the Barents Sea area during the 41 year's history of autumn capelin investigations (Fig. 5.2.1.2). The main dense concentrations were found to the north-east of the Hopen Island and northwards beyond the King Karls Land, and stretching eastward to about 52ºE. Young capelin were mainly found to the south of 77ºN, and dense concentrations were located eastward of the Hopen island stretching south-eastwards near the Central Bank. The area of young capelin distribution was shifted about 180 nautical miles to north compared to the long-term average. A sample echogram of capelin distribution in the north-eastern area is shown in Fig. 5.2.1.3

Abundance estimate and size by age

A detailed stock size estimate is given in Table 5.2.1.1, and the time series of abundance estimates is summarized in Table 5.2.1.2. The capelin stock size estimate is used as input to the stock assessment and prognosis model for capelin (CapTool). The mature part of the stock is basis for the prognosis of spawning stock in spring 2014, where also mortality induced by predation enters into the calculations. The work concerning assessment and quota advice for capelin is dealt with in a separate report that will form part of the ICES Arctic Fisheries Working Group report for 2014.

The main results of the abundance estimation in 2013 are summarized in Table 5.2.1.3. The 2012 estimate is shown on a shaded background for comparison. The total stock is estimated at about 4 million tonnes. It is about 10% higher than the stock estimated in 2012 and higher than the long term mean level (about 3 million tonnes, Table 5.2.1.2). About 37 % (1.5 million tonnes) of this stock has length above 14 cm and considered to be maturing. The mature stock was reduced considerably from 2012 to 2013 due to lower individual growth in length (Fig.5.2.1.4).

The 2012 year class (1-year group) consists, according to this estimate, of about 225 billion individuals. This estimate is much higher than that obtained for the 1- year group last year, is the highest since the 1999 year class, and is above the long-term mean (about 200 billion). The mean weight (3.7 g) is 0.5 g lower than that measured last year and somewhat below the long-term average. The biomass of the 2012 year class is about 1 million tonnes, which is the highest since the 1999 year class, and 30% above the long term mean. 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-year group estimate might be more uncertain than that for older capelin.

The estimated number for the 2011 year class (2-year group) is about 216 billion, which is about 27% higher than the size of the 2010 year class measured in 2012. The mean weight of this group in 2013 is 8.4 g. This mean weight is lower than in 2012 (8.8 g), and is more than two grams below the long-term average (Table 5.2.1.2). The biomass of the 2-year group is about 1.8 million tonnes in 2013; a value which is above the long term average.

The 2010 year class is estimated at about 60 billion individuals; a figure that is 30% lower than the estimated size of three-year-olds in 2012. This age group with mean weight 16.0 g (about 3.5 g below the long-term average) has a biomass of about 0.9 million tonnes, which is equal to the long-term average. The 2009 year class (now 4 years old) is estimated at about 7 billion individuals. With a mean weight of 23.2 g, this age group makes up about 160 thousand tonnes, is about three times higher than the estimate of this age group last year, and is somewhat smaller than the long term average. Practically no capelin older than four years was found.

Table 5.2.1.1. Barents Sea capelin. Acoustic estimate in August-October 2013.

Length (cm)	Age/Year class				Sum	Biomass	Mean weight
	1	2	3	4			
	2012	2011	2010	2009	(10^9)	(10^3 t)	(g)
6.0 - 6.5	1.024				1.024	0.922	0.9
6.5 - 7.0	1.730				1.730	1.903	1.1
7.0 - 7.5	4.344				4.344	4.778	1.1
7.5 - 8.0	12.645				12.645	22.761	1.8
8.0 - 8.5	30.055				30.055	60.110	2.0
8.5 - 9.0	61.374	0.390			61.764	142.057	2.3
9.0 - 9.5	79.927	2.370			82.297	238.661	2.9
9.5 - 10.0	42.733	4.087			46.820	149.824	3.2
10.0 - 10.5	40.521	10.544			51.065	199.154	3.9
10.5 - 11.0	22.475	15.130			37.605	169.223	4.5
11.0 - 11.5	12.320	27.673	0.019		40.012	212.064	5.3
11.5 - 12.0	7.060	28.854	2.166		38.080	239.904	6.3
12.0 - 12.5	4.119	31.049	0.634	0.119	35.921	258.631	7.2
12.5 - 13.0	2.897	26.210	3.056		32.163	270.169	8.4
13.0 - 13.5	0.783	23.589	3.975		28.347	280.635	9.9
13.5 - 14.0	0.215	13.341	6.620	0.333	20.509	233.803	11.4
14.0 - 14.5	0.236	11.342	7.285	0.425	19.288	244.958	12.7
14.5 - 15.0		8.042	9.034	0.349	17.425	257.890	14.8
15.0 - 15.5		6.022	6.625	0.637	13.284	224.500	16.9
15.5 - 16.0		4.240	7.013	0.413	11.666	221.654	19.0
16.0 - 16.5		2.114	5.324	0.831	8.269	181.091	21.9
16.5 - 17.0		0.541	3.562	1.157	5.260	128.870	24.5
17.0 - 17.5		0.610	2.609	0.870	4.089	113.265	27.7
17.5 - 18.0		0.034	1.083	1.241	2.358	68.146	28.9
18.0 - 18.5		0.007	0.190	0.395	0.592	19.832	33.5
18.5 - 19.0			0.003	0.255	0.258	8.617	33.4
19.0 - 19.5				0.051	0.051	1.989	39.0
19.5 - 20.0				0.006			29.1
20.0 - 20.5							
TSN (10^9)	324.458	216.189	59.198	7.082	0.004	606.931	
TSB (10^3 t)	1036.3	1810.9	944.1	164.3	0.1		3955.7
Mean length (cm)	9.47	12.44	14.84	16.45	19.75	11.13	
Mean weight (g)	3.19	8.38	15.95	23.19	29.10		
SSN (10^9)	0.236	32.952	42.728	6.630	0.004	82.540	
SSB (10^3 t)	3.0	523.1	785.3	159.6	0.1		1470.8

Table 5.2.1.2. Barents Sea capelin. Acoustic estimates of the stock by age in autumn. Biomass (B) in 106 tonnes, average weight (AW) in grams. All estimates based on TS = 19.1Log L -74.0 dB.

Year	Age										Sum 1+
	1		2		3		4		5		
	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	5.73
1975	0.65	3.4	2.39	6.9	3.27	11.1	1.48	17.1	0.01	31	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	1.41	8.1	1.66	16.8	0.84	20.9	0.17	22.9	4.80
1978	0.24	2.8	2.62	6.7	1.20	15.8	0.17	19.7	0.02	25	4.25
1979	0.05	4.5	2.47	7.4	1.53	13.5	0.10	21	+	27	4.16
1980	1.21	4.5	1.85	9.4	2.83	18.2	0.82	24.8	0.01	19.7	6.71
1981	0.92	2.3	1.83	9.3	0.82	17	0.32	23.3	0.01	28.7	3.90
1982	1.22	2.3	1.33	9	1.18	20.9	0.05	24.9			3.78
1983	1.61	3.1	1.90	9.5	0.72	18.9	0.01	19.4			4.23
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	0.01	15.7			0.86
1986	0.02	3.9	0.05	10.1	0.05	13.5	+	16.4			0.12
1987	0.08	2.1	0.02	12.2	+	14.6	+	34			0.10
1988	0.07	3.4	0.35	12.2	+	17.1					0.43
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	0.65	4.2	1.38	13.6	0.71	26.9	0.03	29.3			2.77
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
2006	0.29	4.8	0.35	16.1	0.14	24.8	0.01	30.6	+	36.5	0.79
2007	0.93	4.2	0.85	15.5	0.10	27.5	+	28.1			1.88
2008	0.97	3.1	2.80	12.1	0.61	24.6	0.05	30.0			4.43
2009	0.42	3.4	1.82	10.9	1.51	24.6	0.01	28.6			3.76
2010	0.74	3.0	1.30	10.2	1.43	23.4	0.02	26.3			3.50
2011	0.50	2.4	1.76	9.7	1.21	21.9	0.23	29.1			3.71
2012	0.54	3.7	1.37	8.8	1.62	18.5	0.06	25.0			3.59
2013	1.04	3.2	1.81	8.4	0.94	15.9	0.16	23.2	0.00	29.10	3.96
Average	0.67	3.57	1.37	10.63	0.88	19.36	0.21	24.91	0.06	28.13	3.05

Table 5.2.1.3. Table on summary of stock size estimates for capelin.

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2012	2011	1	324.5	145.9	3.2	3.7	1036.3	536.1
2011	2010	2	216.2	156.4	8.4	8.8	1810.9	1373.3
2010	2009	3	59.2	87.6	16.0	18.5	944.1	1619.6
2009	2008	4	7.1	2.3	23.2	25.0	164.3	56.7
Total stock in:								
2013	2012	1-4	606.9	392.1	6.5	9.1	3955.7	3585.7
Based on TS value: 19.1 log L – 74.0, corresponding to $\sigma = 5.0 \cdot 10^7 \cdot L^{1.91}$								

Table 5.2.1.4. Barents Sea capelin. Survey mortalities 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
2005-2006	2004	26.9	21.7	19	0.21
2006-2007	2005	60.1	54.8	9	0.09
2007-2008	2006	221.7	231.4	-	-
2008-2009	2007	313.0	166.4	47	0.63
2009-2010	2008	124.0	127.9	-	-
2010-2011	2009	247.7	181.1	27	0.31
2011-2012	2010	209.6	156.3	25	0.29
2012-2013	2011	145.9	216.2	-	-

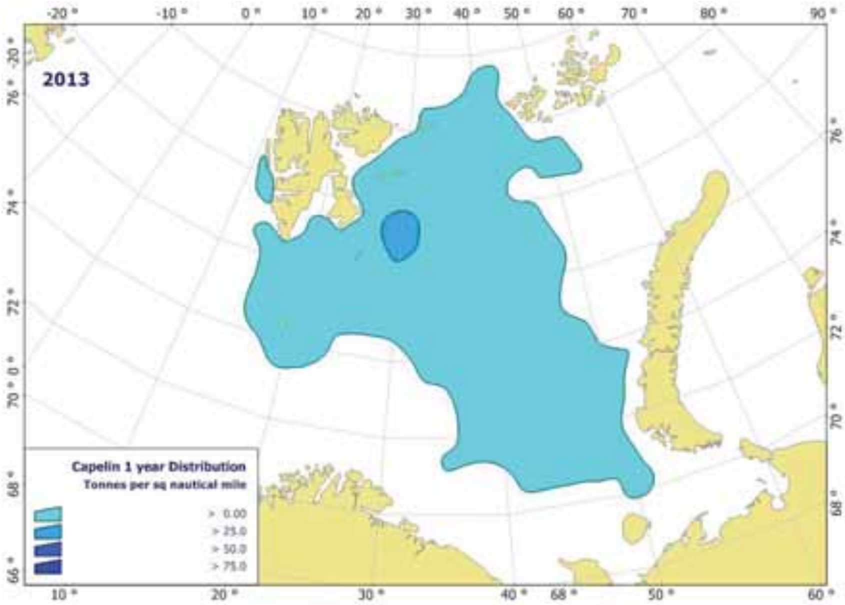


Figure 5.2.1.1. Estimated density distribution of 1-year-old capelin (t/sq nautical mile), August-October 2013.

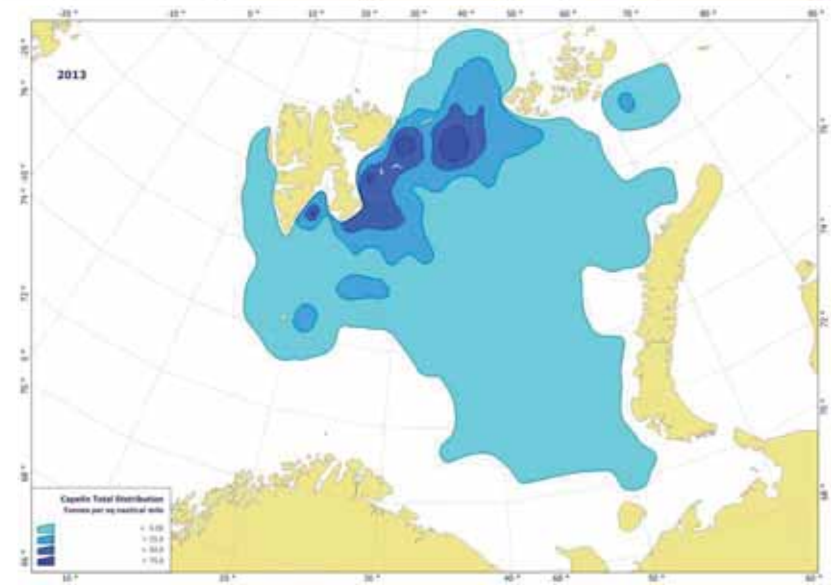


Figure 5.2.1.2. Estimated total density distribution of capelin (t/sq nautical mile), August-October 2013.

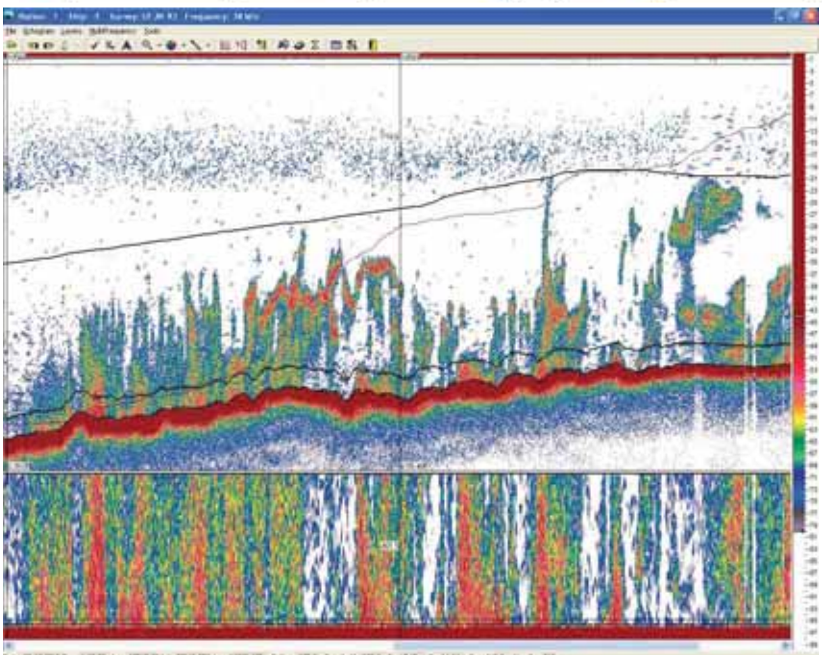


Figure 5.2.1.3. Echograms of capelin schools in area 79°40'N 61°39'E.

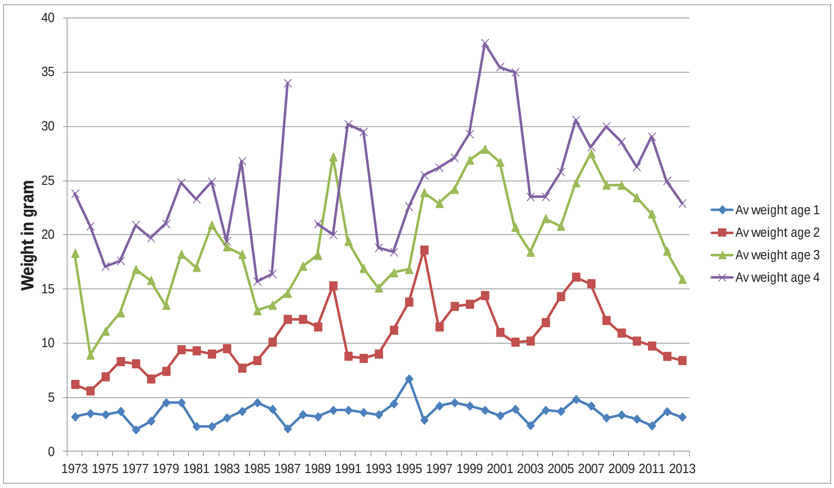


Figure 5.2.1.4. Weight at age (grams) for capelin from capelin surveys and BESS.

5.2.2 Polar cod (Boreogadus saida)

Distribution

The coverage was increased towards the northeast this year, and polar cod was found in these areas not covered in previous years. Polar cod distribution and migrations in this area is poorly known. . The Barents Sea polar cod population may be distributed far to the northeast. The existence of a separate polar cod population in the areas east of the Barents Sea should not be excluded. Some spawning places have been found in a shallow water area at 77°00’-77°30’ N 75°-80° E. Thus, there could be reasons to define Kara sea polar cod as a separate population.

On the other hand, less polar cod was found in the traditional distribution area in the northern and the eastern Barents Sea. The polar cod stock was widely distributed in the northern and eastern parts of the Barents Sea, but densities were low as in previous year. The total geographical density distribution of polar cod inside the survey area is shown in Fig. 5.2.2.1.

The main concentrations of adult fish were found along the south coast of Novaya Zemlya and south and east of Franz Josef Land. Practically no concentrations were observed to the west and to the east of Svalbard/Spitsbergen archipelago. Figure 5.2.2.2 shows a typical acoustic registration of polar cod near the Novaya Zemlya.

Abundance estimation

The stock abundance estimate by age, number, and weight was calculated using the same methods as for capelin. The area coverage towards north and east was slightly larger this year compared to previous years. To be able to compare this year’s estimate with the time series made based on previous survey coverage, the calculation has been made separately for the standard survey area in the Barents Sea and for the additional areas covered this year.

A detailed estimate is given in Table 5.2.2.1, and the time series of abundance estimates is summarized in Table 5.2.2.2. The main results of the abundance in 2013 are summarized in table 5.2.2.3. Results from the additional calculation made for the north-eastern area outside Barents Sea and ICES Region I is shown in Table 5.2.2.5.

The following summarizes the results from the Barents Sea component: The number of individuals in the 2012 year-class (the one-year-olds) is only 16% the size of the one-group measured in 2012. The mean weight is similar, and therefore, the biomass of one-year-olds is also 16% of that estimated for the one-group in 2012. The abundance of the 2011 year class (the two-year-olds) is 4.3 billions, it is the same corresponding age groups found in 2012, while the mean weight was similar to that in 2012. The biomass, therefore, was reduced insignificantly compared to the 2010 year-class estimated in 2012. The three-years-old fish (2010 year class) is increased by more than 2 times by number compared to the three-group estimated in 2012. The mean weight is somewhat lower, and the biomass of this age group is much higher than that for the corresponding age group during the 2012 survey. The four-year-olds (2009 year class) were scarce, and have a lower mean weight than for the four-year-olds in 2012. No fish of age 5 or higher were found. The total stock, estimated at 0.34 million tonnes, is nearly same to that found in 2012.

After the decrease of the polar cod stock size in 2012, it has stabilized on a lower level. Age groups 2+ were obviously underestimated in 2012, but in any case significant increase in natural mortality and stock size reduction in recent years have been observed.

Total mortality calculated from surveys

Table 5.2.2.4 shows the "survey-mortality rates" of polar cod in the period 1985 to 2013. The mortality estimates are unstable during the whole period. Although unstable mortalities may indicate errors in the stock size estimation from year to year due to incomplete coverage and other reasons, the impression remains that there is a considerable total mortality on young polar cod. Prior to 1993, these mortality estimates represented natural mortality only, as practically no fishing took place. In the period 1993 to 2006 catches were at a level between 1 and 50 000 tonnes. Since there has been a minimum landing size of 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. Negative survey mortalities were registered for age groups 1-2 from 2003-2004, 2006-2007 and 2009-2010. This same pattern was is repeated in 1998-1999, 2003-2004 and 2012-2013 for age group 2-3, confirming the previously expressed impression that, for some years and for various reasons, population numbers might have been underestimated. These anomalous years aside, the survey mortalities have been quite stable in period up to 2011. After 2011 occurred growth in natural mortalities and in same time were very low 0-group generations. This could be consequences of climate changes in Barents Sea, ice border distribution, predation from other species, or other reasons.

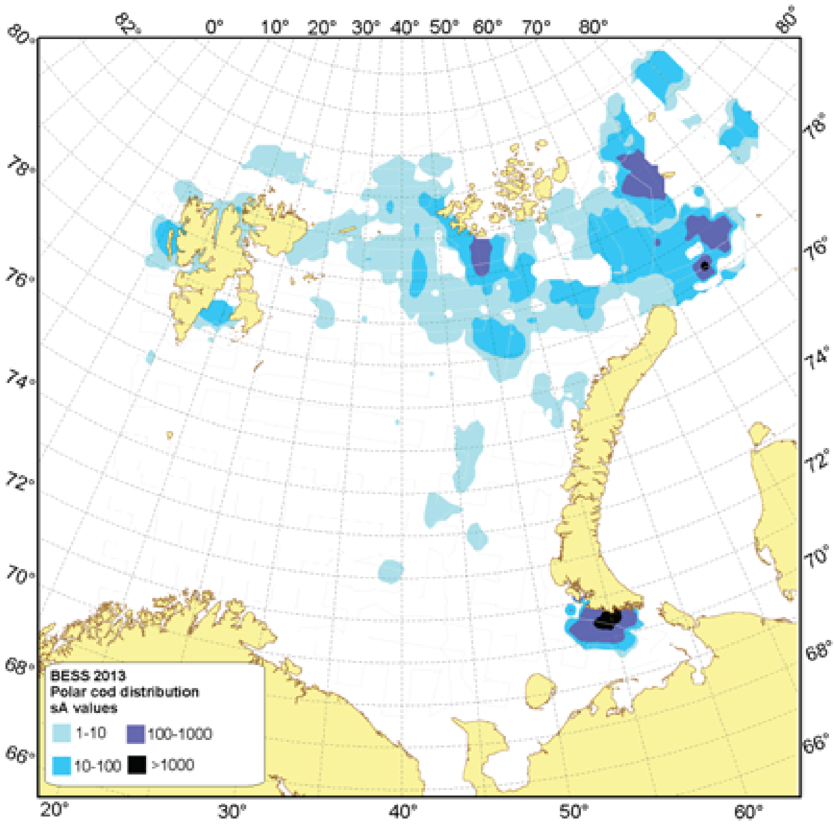


Figure 5.2.2.1. Estimated total density distribution of polar cod (SA values), August-October 2013.

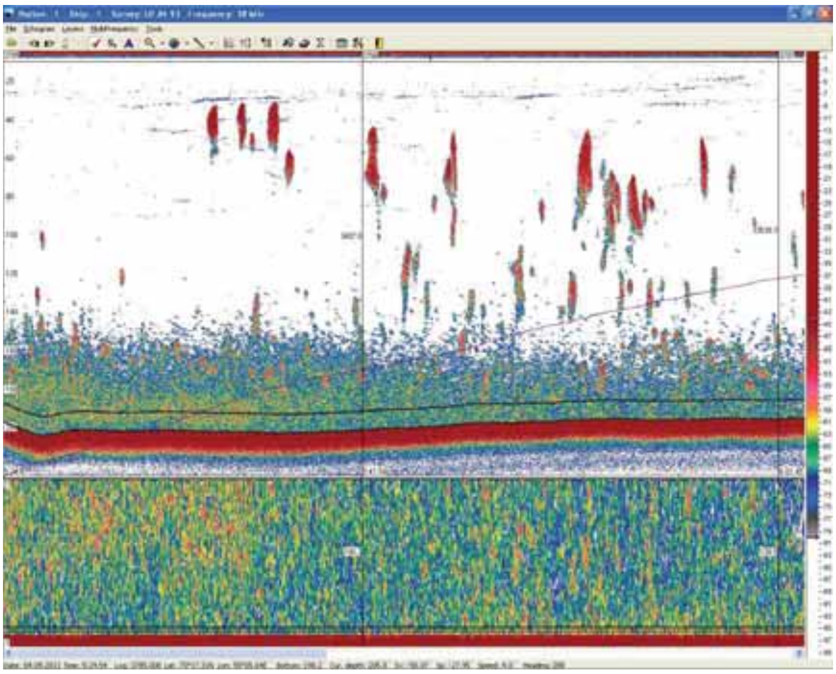


Figure 5.2.2.2. Echogram of polar cod to the south of Novaya Zemlya (70º17´N 55º05E), 04.09.2013.

Table 5.2.2.1. Barents Sea polar cod. Acoustic estimate in August-October 2013.

Length (cm)		Age/Yearclass				Sum (106)	Biomass (10-3 t)	Mean weight (g)
		1 2012	2 2011	3 2010	4 2009			
6,5	- 7,0	2				2	0.0	2.1
7.0	- 7.5	1				1	0.0	2.5
7.5	- 8.0	26				26	0.1	3.1
8.0	- 8.5	37				37	0.1	3.9
8.5	- 9.0	88				88	0.3	3.6
9.0	- 9.5	108				108	0.5	4.5
9.5	- 10.0	215				215	1.3	6.0
10.0	- 10.5	304				304	2.1	7.1
10.5	- 11.0	366	61			428	3.3	7.6
11.0	- 11.5	372	1			373	3.2	8.6
11.5	- 12.0	387	2			389	3.8	9.8
12.0	- 12.5	153	47			200	2.2	10.9
12.5	- 13.0	87	131			217	2.7	12.6
13.0	- 13.5	47	126			172	2.5	14.3
13.5	- 14.0	9	292	2		303	5.5	18.1
14.0	- 14.5	3	402	3		407	7.7	19.0
14.5	- 15.0	3	837	1		842	17.8	21.1
15.0	- 15.5	2	586	151		739	16.9	22.8
15.5	- 16.0	4	531	186		721	17.3	24.0
16.0	- 16.5	1	257	447		704	19.2	27.3
16.5	- 17.0	0	371	317		688	19.5	28.4
17.0	- 17.5	1	566	51		618	20.1	32.5
17.5	- 18.0		7	584		591	19.8	33.5
18.0	- 18.5		9	881		890	35.5	39.9
18.5	- 19.0		1	860		860	37.5	43.6
19.0	- 19.5		0	500		500	20.8	41.5
19.5	- 20.0		92	457		549	26.2	47.8
20.0	- 20.5			181	90	272	13.4	49.3
20.5	- 21.0			202	67	270	14.6	54.0
21.0	- 21.5			187	0	187	9.6	51.7
21.5	- 22.0			109	0	109	6.9	62.9
22.0	- 22.5			62	0	63	4.1	65.0
22.5	- 23.0			21	0	21	1.5	72.6
23.0	- 23.5			41	0	41	2.7	65.0
24.5	- 25.0				21	21	1.6	79.0
26.5	- 27.0				1	1	0.1	116.3
TSN(106)		2216	4317	5243	180	11956	–	–
TSB(103 t)		18.1	102.2	210.3	9.9	–	340,5	–
Mean length (cm)		10.9	15.3	18.5	21.0	16,0	–	–
Mean weight (g)		8.2	23,7	40,1	54,9	–	–	28,5

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

Table 5.2.2.2. Barents Sea polar cod. Acoustic estimates by age in August-October. TSN and TSB is total stock numbers (10^6) and total stock biomass (10^3 tonnes) respectively.

Year	Age 1		Age 2		Age 3		Age 4+		Total	
	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
1986	24038	169.6	6263	104.3	1058	31.5	82	3.4	31441	308.8
1987	15041	125.1	10142	184.2	3111	72.2	39	1.2	28333	382.8
1988	4314	37.1	1469	27.1	727	20.1	52	1.7	6562	86.0
1989	13540	154.9	1777	41.7	236	8.6	60	2.6	15613	207.8
1990	3834	39.3	2221	56.8	650	25.3	94	6.9	6799	127.3
1991	23670	214.2	4159	93.8	1922	67.0	152	6.4	29903	381.5
1992	22902	194.4	13992	376.5	832	20.9	64	2.9	37790	594.9
1993	16269	131.6	18919	367.1	2965	103.3	147	7.7	38300	609.7
1994	27466	189.7	9297	161.0	5044	154.0	790	35.8	42597	540.5
1995	30697	249.6	6493	127.8	1610	41.0	175	7.9	38975	426.2
1996	19438	144.9	10056	230.6	3287	103.1	212	8.0	33012	487.4
1997	15848	136.7	7755	124.5	3139	86.4	992	39.3	28012	400.7
1998	89947	505.5	7634	174.5	3965	119.3	598	23.0	102435	839.5
1999	59434	399.6	22760	426.0	8803	286.8	435	25.9	91463	1141.9
2000	33825	269.4	19999	432.4	14598	597.6	840	48.4	69262	1347.8
2001	77144	709.0	15694	434.5	12499	589.3	2271	132.1	107713	1869.6
2002	8431	56.8	34824	875.9	6350	282.2	2322	143.2	52218	1377.2
2003	15434	114.1	2057	37.9	2038	63.9	1545	64.4	21074	280.2
2004	99404	627.1	22777	404.9	2627	82.2	510	32.7	125319	1143.8
2005	71675	626.6	57053	1028.2	3703	120.2	407	28.3	132859	1803.3
2006	16190	180.8	45063	1277.4	12083	445.9	698	37.2	74033	1941.2
2007	29483	321.2	25778	743.4	3230	145.8	315	19.8	58807	1230.1
2008	41693	421.8	18114	522.0	5905	247.8	415	27.8	66127	1219.4
2009	13276	100.2	22213	492.5	8265	280.0	336	16.6	44090	889.3
2010	27285	234.2	18257	543.1	12982	594.6	1253	58.6	59777	1430.5
2011	34460	282.3	14455	304.4	4728	237.1	514	36.7	54158	860.5
2012	13521	113.6	4696	104.3	2121	93.0	119	8.0	20457	318.9
2013	2216	18.1	4317	102.2	5243	210.3	180	9.9	11956	340.5
Average	30374	241.7	15401.2	350.0	4774	183.2	558	29.9	51039	806.7

Based on TSvalue = 21.8 Log L - 72.7 dB

Table 5.2.2.3. Summary of stock size estimates for polar cod.

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2012	2011	1	2,2	13.5	8,2	8.4	18,1	113.6
2011	2010	2	4,3	4.7	23,7	22.2	102,2	104.3
2010	2009	3	5,2	2.1	40,1	43.8	210,3	93.0
2009	2008	4	0,2	0.1	54,9	67.2	9,9	8.0
Total stock in								
2013	2012	1-4	12.0	20.5	28.5	15.6	340.5	318.9

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

Table 5.2.2.4. Barents Sea polar cod. Survey mortalities for age transitions 1-2 (top) and 2-3 (bottom)

Year	Year class	Age 1 (10^9)	Age 2 (10^9)	Total mort. %	Total mort Z
1986-1987	1985	24.0	10.1	58	0.87
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	-11	-0.10
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	60	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	1.39
2003-2004	2002	15.4	22.7	-47	-0.39
2004-2005	2003	99.4	57.1	43	0.55
2005-2006	2004	71.7	45.1	37	0.46
2006-2007	2005	16.2	25.8	-59	-0.47
2007-2008	2006	29.5	18.1	39	0.49
2008-2009	2007	41.7	22.2	47	0.63
2009-2010	2008	13.2	18.3	-39	-0.33
2010-2011	2009	27.3	14.5	47	0.63
2011-2012	2010	34.4	4.6	87	2.01
2012-2013	2011	13,5	4,3	68	1,14

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	0.94
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	79	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	49	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	-16	-0.15
1999-2000	1997	22.8	14.6	36	0.45
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	-24	-0.21
2004-2005	2002	22.8	3.7	84	1.82
2005-2006	2003	51.7	12.1	77	1.45
2006-2007	2004	45.1	3.2	93	2.65
2007-2008	2005	25.8	5.9	77	1.48
2008-2009	2006	18.1	8.3	54	0.78
2009-2010	2007	22.2	13.0	41	0.54
2010-2011	2008	18.3	4.7	74	1.36
2011-2012	2009	14.5	2.1	85	1.92
2012-2013	2010	4,7	5,2	-	-

Table 5.2.2.5. Polar cod outside ICES Region I. Acoustic estimate in August-October 2013.

Length (cm)	Age/Year class 2012	2011	2010	Sum (10^6)	Biomass (10^3 t)	Mean weight (g)
	1	2	3			
6.5-6.9	0.7			0.68	0.001	1.05
7.0-7.4	2.6			2.57	0.005	1.80
7.5-7.9	16.2			16.22	0.041	2.50
8.0-8.4	26.1			26.13	0.076	2.90
8.5-8.9	30.0			29.99	0.126	4.20
9.0-9.4	58.4			58.39	0.280	4.80
9.5-9.9	218.1			218.09	1.156	5.30
10.0-10.4	379.9			379.92	2.508	6.60
10.5-10.9	664.4			664.37	5.116	7.70
11.0-11.4	697.4			697.38	6.486	9.30
11.5-11.9	711.8	59.4		771.18	7.866	10.20
12.0-12.4	587.0			587.05	7.045	12.00
12.5-12.9	352.0	50.3		402.33	5.834	14.50
13.0-13.4	201.0	100.3		301.32	4.821	16.00
13.5-13.9	121.3	272.6		393.86	6.932	17.60
14.0-14.4	24.8	394.9		419.66	8.519	20.30
14.5-14.9		605.2		605.19	14.161	23.40
15.0-15.4		643.9		643.94	15.583	24.20
15.5-15.9		610.6		610.57	17.340	28.40
16.0-16.4		442.6		442.60	13.455	30.40
16.5-16.9		379.4		379.37	12.102	31.90
17.0-17.4		185.4	18.6	204.00	7.201	35.30
17.5-17.9		103.7	9.4	113.08	4.342	38.40
18.0-18.4		22.4	29.9	52.30	2.139	40.90
18.5-18.9		22.2	22.2	44.33	1.884	42.50
19.0-19.4		8.4	8.4	16.77	0.827	49.30
19.5-19.9			13.5	13.53	0.678	50.10
20.0-20.4		7.3		7.28	0.393	54.00
20.5-20.9						
21.0-21.4			0.5	0.47	0.028	59.85
TSN(10^6)	4091.7	3908.5	102.4	8102.6		
TSB(10^3 t)	11.2	15.1	18.2	13.2		
Mean length (cm)	41.1	101.6	4.3		146.9	
Mean weight (g)	10.0	26.0	42.0			18.1

TS = 21.8 * lg(L) - 72.7

5.2.3 Herring (*Clupea harengus*)

Although some older herring are found outside the coast of western Finnmark, only young Norwegian spring spawning (NSS) herring is present in the Barents Sea. At age 3-4 the Barents Sea herring migrates to the Norwegian Sea, where it spends the rest of its adult life. Thus the number of young herring in the Barents Sea is characterized by large fluctuations and abrupt changes.

In some cases it is difficult to assess the young herring stock size during autumn. The main problem is with the distribution of herring schools close to the surface, being above the range of the echo sounders. This however, has not posed problems to stock measurements of herring in recent years. It is also problematic to get representative samples of fish schooling near the surface, which causes uncertainty in the age distribution of the stock size estimate.

Distribution

In 2013, only very scattered concentrations of herring were found from Nordkapp eastwards to Novaya Zemlya (Figure 5.2.3.1). Herring of ages between 1 and 4 was registered, with 1-year-olds being dominant in numbers and 2-year-olds in biomass.

Abundance estimation

The estimated number and biomass of NSS herring for total age- and length groups are given in Table 5.2.3.1. The time series of estimates is shown in Table 5.2.3.2. Table 5.2.3.3 summarizes the main results of the abundance estimates of 1-4 years old herring for 2013 compared to 2012. The 2012 estimates are shown on a shaded background for comparison.

The total abundance of herring aged 1-4 years covered during the survey was estimated at 12.8 billion individuals (about 3 times higher than the value estimated in 2012). The biomass of 0.5 million tonnes is about 80% higher than in 2012, since the overall mean weight is much lower this year. This is first of all an effect of a younger age distribution in 2013. During recent years, the amount of young herring entering the Barents Sea has been low (table 5.2.3.2), and the estimated stock size in 2013, though being much higher than last year, is only about half of the average stock size during the period 1999 to 2013.

Table 5.2.3.1. Norwegian spring spawning herring. Acoustic estimate in the Barents Sea in August-October 2013.

Length (cm)	Age / Year class 1	2	3	4	5	6	7+	Sum (10^6)	Biomass (10^3 t)	Mean weight (g)
	2011	2010	2009	2008	2007	2006	2005-			
11.5 - 12.0								17	0.1	8.0
12.0 - 12.5								66	0.7	11.0
12.5 - 13.0	330							330	5.0	15.0
13.0 - 13.5	913							913	12.8	14.0
13.5 - 14.0	972							972	15.2	15.6
14.0 - 14.5	493							493	9.6	19.5
14.5 - 15.0	282							282	5.7	20.2
15.0 - 15.5	578							578	13.2	22.8
15.5 - 16.0	1017							1017	24.7	24.3
16.0 - 16.5	418							418	11.7	28.1
16.5 - 17.0	337							337	11.0	32.6
17.0 - 17.5	159							159	5.5	34.7
17.5 - 18.0	133							133	5.0	37.4
18.0 - 18.5	1091							1091	42.8	39.2
18.5 - 19.0	934	934						1868	80.1	42.9
19.0 - 19.5		770						770	40.0	51.9
19.5 - 20.0		778						778	40.5	52.1
20.0 - 20.5		177						177	11.1	62.5
20.5 - 21.0		439		8				447	28.8	64.5
21.0 - 21.5		176						176	12.9	73.3
21.5 - 22.0		332						332	22.8	68.7
22.0 - 22.5		514						514	37.8	73.5
22.5 - 23.0		133						133	10.5	79.0
23.0 - 23.5		183						183	17.6	96.0
23.5 - 24.0		442						442	42.4	96.0
24.0 - 24.5								0	0.0	
24.5 - 25.0		89						89	10.2	115.0
25.0 - 25.5		62						62	7.8	125.5
25.5 - 26.0			27					27	3.2	118.0
26.0 - 26.5			37	13				50	6.5	129.5
26.5 - 27.0								0	0.0	
27.0 - 27.5			27					27	4.6	169.0
27.5 - 28.0			1	1				2	0.3	160.9
28.0 - 28.5				27				27	4.8	178.0
28.5 - 29.0								0	0.0	
29.0 - 29.5								0	0.0	
29.5 - 30.0				8				8	1.6	200.7
TSN(10^6)	7657	5029	92	57				12835		
TSB(10^3 t)	202.2	322.0	12.7	8.8					545.6	
Mean length (cm)	15.8	20.7	26.4	26.9				17.8		
Mean weight (g)	26.4	64.0	138.1	153.9						42.5

TS=20.0· log(L) - 71.9

Table 5.2.3.2. Norwegian spring spawning herring. Acoustic estimates by age in autumn 1999-2013. TSN and TSB are total stock numbers (10^6) and total stock biomass (10^3 t).

Age	1		2		3		4+		Sum	
Year	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
1999	48759	716	986	31	51	2			49795	749
2000	14731	383	11499	560					26230	943
2001	525	12	10544	604	1714	160			12783	776
2002									0	0
2003	99786	3090	4336	220	2476	326			106597	3636
2004	14265	406	36495	2725	901	107			51717*	3251.9*
2005	46380	984	16167	1055	6973	795			69520	2833
2006	1618	34	5535	398	1620	211			8773	643
2007	3941	148	2595	218	6378	810	250	46	13164	1221
2008	30	1	1626	77	3987*	287.3*	3222.6*	373.1*	8866	738
2009	2	48	433	52	1807	287	1686	393	5577	815
2010	1047	35	215	34	234	37	428	104	2025	207
2011	95	3	1504	106	6	1			1605	109
2012	2031	36	1078	66	1285	195			4394	296
2013	7657	202	5029	322	92	13	57	9	12835	546
Average	17204.6	435.5	7003.0	461.9	1961.4	245.2	605.3	137.9	23011.7	965.2

- including older age groups not shown in the table
** - including Kanin herring

Table 5.2.3.3. 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)	
2012	2011	1	7.66	2.03	26.4	17.8	202.2	36.1
2011	2010	2	5.03	1.08	64.0	60.9	322.0	65.6
2010	2009	3	0.09	1.29	138.1	151.5	12.7	194.6
2009	2008	4	0.06	0	153.9	0	8.8	0.0
Total stock in:								
2013	2012	1-4	12.84	4.39	17.8	67.4	545.6	296.4

Based on TS value: 20.0 log L – 71.9, corresponding to σ = 8.1·10-7 · L2.00

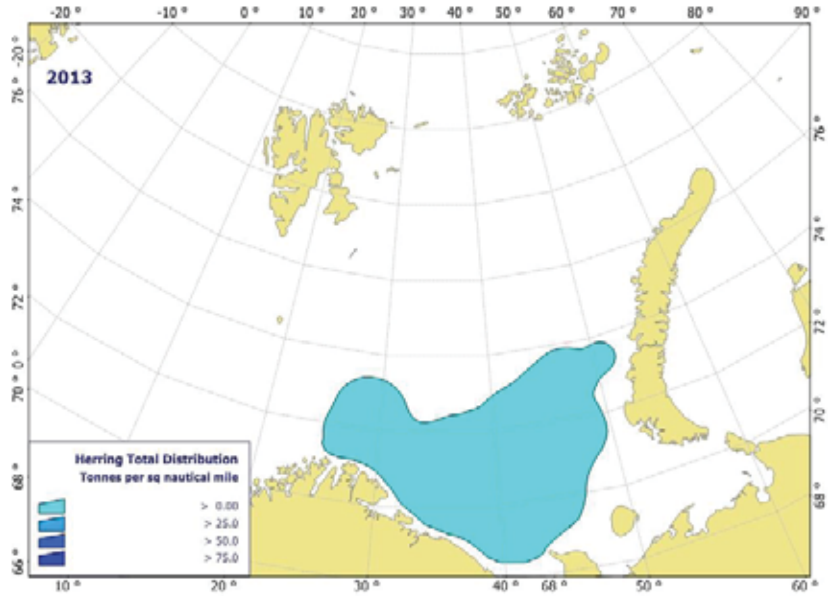


Figure 5.2.3.1. Estimated total density distribution of herring (t/nautical mile2), August-October 2013.

5.2.4 Blue whiting (Micromesistius poutassou)

As in previous years, blue whiting was observed in the western part of the Barents Sea. The target strength used for blue whiting during the ecosystem surveys in the Barents Sea differ from the new TS value now used in the main blue whiting surveys west of the British Isles and in the Norwegian Sea. The time series in the Barents Sea will be recalculated using the new TS when time allows. Consequently, the estimates should, to a greater extent than the other estimates, be considered as a relative measure.

Distribution

The distribution of blue whiting (all age groups) is shown in Figure 5.2.4.1. As in previous years the distribution area stretches eastward from the western boarder of the covered area up to 30˚E and from northern coast of Norway up to 77°N to the west of Spitsbergen/Svalbard archipelago.

Abundance estimation

The estimated number and biomass of blue whiting per age- and length group is given in Table 5.2.4.1 Total abundance was estimated to be 3.7 billion individuals and the biomass to 0.41 million tonnes. The stock in 2013 is totally dominated by fish aged 2 years. The total abundance and biomass are somewhat lower than in 2012. Since 2003-2004, when more than one million tonnes of blue whiting was found in this area, there has been a steady decline in biomass (Table 5.2.4.2), and the age distribution has been shifted towards older fish. This trend appears to be reversed in 2012 and 2013, with the four youngest age groups and in particular, the 2011 year class, being more abundant during the last two years.

Table 5.2.4.1. Blue whiting. Acoustic estimate in the Barents Sea in August-October 2013.

Length (cm)	Age/Yearclass									Sum (10^6)	Biomass (10^3 t)	Mean weigt (g)
	1	2	3	4	5	6	7	8	9+			
	2011	2010	2009	2008	2007	2006	2005	2004				
20.5 - 21.0		6								6	0.3	45.7
21.0 - 21.5		27								27	1.4	50.0
21.5 - 22.0		52								52	2.9	55.5
22.0 - 22.5		106								106	6.0	57.0
22.5 - 23.0		206	9							215	13.1	61.1
23.0 - 23.5		327	0							327	21.8	66.7
23.5 - 24.0		324	123							447	31.5	70.5
24.0 - 24.5	5	305	120							430	33.0	76.8
24.5 - 25.0		249	82							331	27.3	82.5
25.0 - 25.5		280	1							281	25.0	88.8
25.5 - 26.0		178	59	8						245	23.0	93.7
26.0 - 26.5		132	31	16	25					204	20.3	99.5
26.5 - 27.0		67	17							84	9.2	109.8
27.0 - 27.5		47	9	4		8				68	8.0	118.2
27.5 - 28.0		2	45							47	5.9	124.9
28.0 - 28.5		17	11	4						32	4.3	135.6
28.5 - 29.0		7	10							17	2.4	142.1
29.0 - 29.5		6	0	21						27	3.9	146.2
29.5 - 30.0		13	3				3			19	3.0	160.0
30.0 - 30.5		3	8	11				6		28	4.4	157.7
30.5 - 31.0			28							28	4.8	170.0
31.0 - 31.5							40			40	7.4	186.2
31.5 - 32.0			40	6			3			49	9.2	186.9
32.0 - 32.5		7	13	4	4				10	38	7.3	191.8
32.5 - 33.0		3			1		4	35	11	54	11.5	213.4
33.0 - 33.5				8			15	39		62	13.6	219.1
33.5 - 34.0							25	18	1	44	10.0	226.2
34.0 - 34.5						14	1	7	24	46	11.1	241.5
34.5 - 35.0						20	12	3	20	55	13.3	241.9
35.0 - 35.5					8	1	19	25	5	58	16.0	275.8
35.5 - 36.0						20	10		13	43	11.2	261.0
36.0 - 36.5					2	4	27	12	3	48	13.9	290.5
36.5 - 37.0					16		2	9	6	33	8.9	268.8
37.0 - 37.5				3	3	4	5	5	8	28	8.6	306.2
37.5 - 38.0							8	7		15	5.1	337.9
38.0 - 38.5									7	7	2.4	347.3
38.5 - 39.0									6	6	2.1	346.5
39.0 - 39.5									4	4	1.3	319.1
39.5 - 40.0										0	0.0	
40.0 - 40.5						3				3	1.1	382.9
TSN(10^6)	5	2364	609	85	59	74	174	166	71	3654		
TSB(10^3 t)	0.4	188.3	61.8	12.7	11.5	18.2	41.9	40.1	17.9		405.6	
Mean length (cm)	24.3	24.4	26.0	29.3	31.7	34.6	34.1	34.2	34.8	26.4		
Mean weight (g)	76.8	79.7	101.5	149.7	194.5	245.9	240.8	241.8	252.6	111.0		
TS=21.8· log(L) - 72.7												

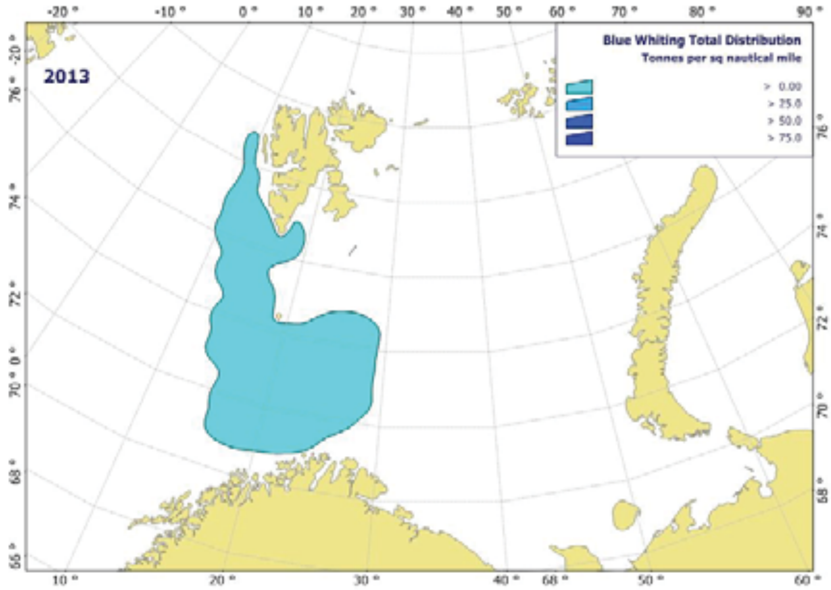


Figure 5.2.4.1. Estimated total density distribution of blue whiting (t/nautical mile2), August-October 2013.

6 Monitoring the demersal community

6.1 Fish community

Text by D. Prozorkevich and H. Gjøsæter
Figures by D. Prozorkevich

Figures 6.1.1.1-6.1.11.1 shows the distribution of demersal fish. The numbers of fish sampled during the survey are presented in Appendix 2.

6.1.1 Cod (*Gadus morhua*)

At this time of the year, towards the end of the feeding period, the distribution of cod is wide. The distribution area of cod in the Barents Sea (Figure 6.1.1.1) was extended to the areas southeast of Franz Josef Land, where large cod was found at 79°30N/66°-69°E in the middle of October after the main part of the survey was finished. It was located in the intermediate layer up to St. Anna Trough. The most eastern observation of cod in the area was east of the St. Anna Trough at 79°E, which is an easterly record for cod distribution. The total distribution of cod was similar to that in the previous two years. The main concentrations were observed in the northern Barents Sea between 30° and 50°E. The maximum catch was 2835 kg per nautical mile. Cod biomass index increased in 2013 compared to the previous year (Table 6.1.1).

Table 6.1.1. Preliminary abundance (N, 10^6) and biomass (B, 10^3 t) estimates of some demersal fish (without 0-group).

Year		**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Atlantic wolffish	N	14	15	26	42	25	20	17	20	22	↑27
	B	7	6	11	11	14	8	17	13	9	↑30
Spotted wolffish	N	12	11	12	12	13	9	7	9	13	↓13
	B	31	92	46	42	51	47	37	47	83	↑84
Northern wolffish	N	3	3	2	3	3	3	3	6	8	↑12
	B	26	26	19	25	22	31	25	42	45	↑52
Long rough dab	N	2957	2910	3705	5327	3942	2600	2520	2507	4563	↑4932
	B	311	280	378	505	477	299	356	322	584	↓565
Plaice	N	52	19	36	120	57	21	34	36	21	↑36
	B	43	11	19	55	29	13	21	26	13	↑29
Norway redfish	N	39	110	219	64	24	17	26	83	114	↑233
	B	4	15	19	10	4	2	2	9	12	↑25
Golden redfish	N	13	23	16	20	42	12	22	14	32	↑75
	B	9	11	16	11	17	11	4	5	8	↑20
Deep-water redfish	N	263	336	526	796	864	1003	1076	1271	1587	↑1608
	B	106	143	219	183	96	213	112	105	196	↑256
Greenland halibut	N	182	358	430	296	153	191	186	175	209	↓160
	B	39	53	77	86	76	90	150	88	86	↑94
Haddock	N	757	1211	3518	4307	3263	1883	2222	1068	1193	↓734
	B	261	342	659	1156	1246	1075	1457	890	697	↓570
Saithe	N	36	31	28	70	3	33	5	9	14	↑18
	B	41	26	49	98	7	29	9	10	13	↑33
Cod	N	1513	1012	1539	1724	1857	1593	1651	1658	2576	↓2379
	B	1074	499	810	882	1536	1345	2801	2205	1837	↑2132
Norway pout	N	620	1026	1838	2065	3579	3841	3530	5976	3089	↓2267
	B	13	14	32	61	97	131	103	68	105	↓40
Thorny skate	N	47	26	34	40	50	47	28	37	88	↓37
	B	30	17	27	32	42	37	24	29	53	↓34
Atlantic poacher	N	338	227	271	301	228	179	97	284	592	↓474
	B	3	2	3	3	2	1	1	2	5	↓4
Gelatinous snailfish	N	255	1081	876	783	256	274	442	704	922	↓314
	B	3	5	12	12	5	4	6	11	5	7
Vahl’s eelpout	N	64	61	109	88	42	56	34	25	53	↓22
	B	2	1	2	2	1	2	1	+	1	↓+
Pale eelpout	N	46	7256	77	81	118	42	16	54	257	↓180
	B	+	34	1	1	2	1	+	1	2	↓2
Bigeye sculpin	N	1307	1478	936	1458	1289	741	629	1562	4568	↓1483
	B	4	4	8	12	11	7	5	17	34	↓5
Ribbed sculpin	N	194	241	966	70	144	26	25	29	88	↑2479
	B	1	2	3	1	2	+	1	+	1	↑40
Moustache sculpin	N	45	496	308	241	262	149	26	81	93	↓93
	B	+	2	3	2	2	1	+	1	1	↓+

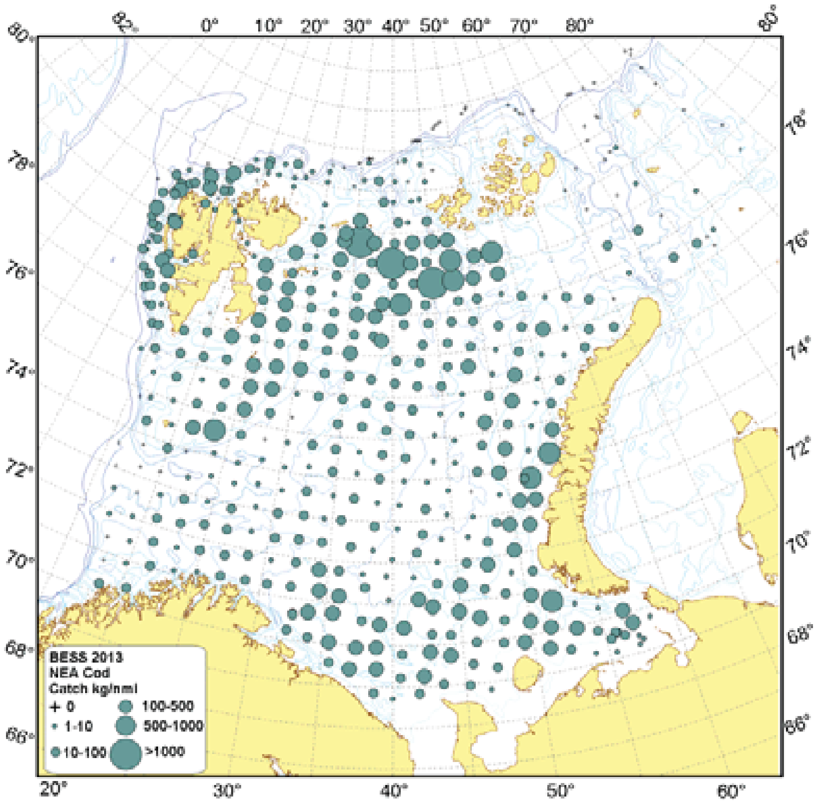


Figure 6.1.1.1. Distribution of cod (*Gadus morhua*), August-October 2013.

6.1.2 Haddock (*Melanogrammus aeglefinus*)

The distribution of haddock was completely covered. Haddock was widely distributed in the southern Barents Sea from the Norwegian coast to 58°E (Figure 6.1.2.1). In the western part of the sea, haddock was observed west of Spitsbergen and between Bear Island and Hopen. In the south-eastern Barents Sea, it was found in shallow areas up to 15-17 m depth as usual. The main concentrations of haddock were found between 40° and 45°E in the southern Barents Sea and around Hopen. Compared to the previous two years, the area of haddock distribution decreased and its catches were lower in 2013. The highest catch rate was 821 kg per nautical mile. As a result, the biomass of haddock deviated sharply from those in the previous two years (Table 6.1.1).

6.1.3 Saithe (*Pollachius virens*)

The survey covered only a small part of saithe distribution along the coast of Norway (Figure 6.1.3.1). Compared to the previous year, the area with saithe decreased significantly. Saithe was only distributed west of 25°E despite the fact that the Barents Sea coastal waters were quite warm. Catches of saithe were slightly higher than in 2012. The maximum catch was 212 kg per nautical mile. Abundance and biomass of saithe within the surveyed area increased in 2013 compared to 2012.

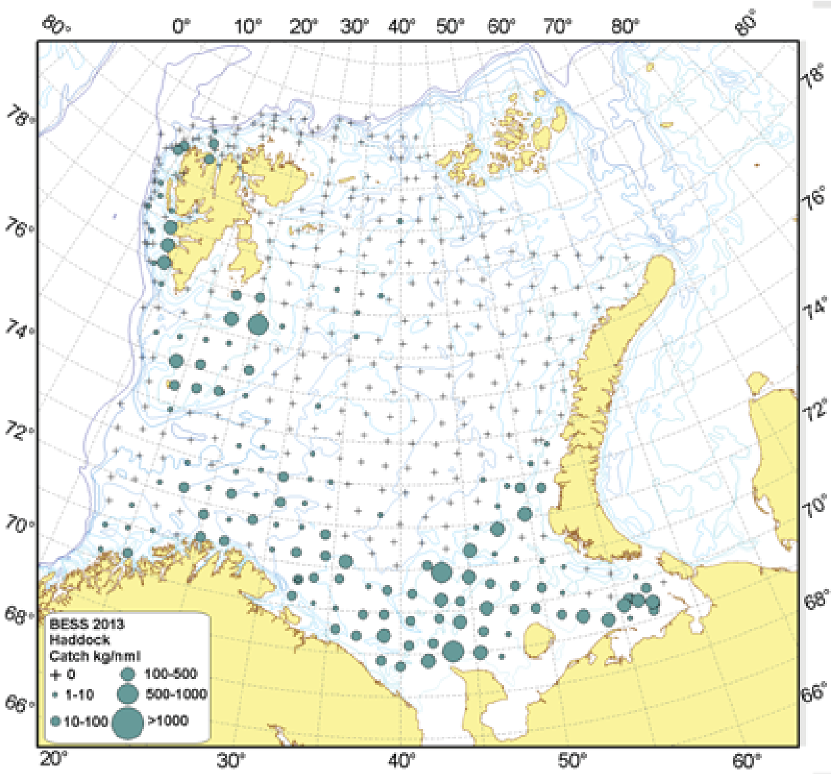


Figure 6.1.2.1. Distribution of haddock (*Melanogrammus aeglefinus*), August-October 2013.

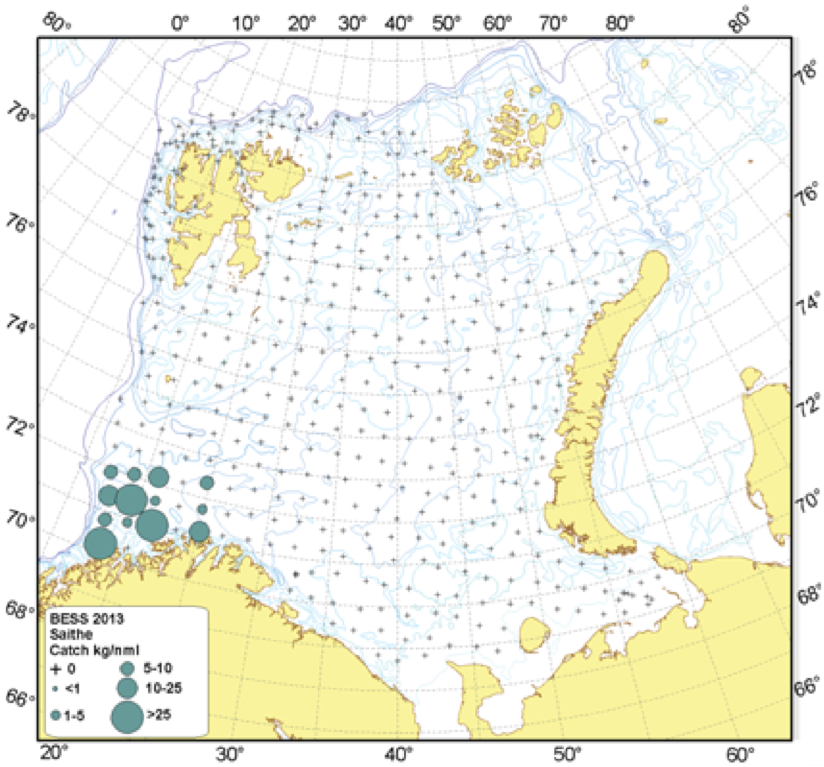


Figure 6.1.3.1. Distribution of saithe (*Pollachius virens*), August-October 2013.

6.1.4 Greenland halibut (*Reinhardtius hippoglossoides*)

During the survey, mainly young age groups of Greenland halibut were observed. The adult part of the stock was probably distributed outside of the survey area. Compared to previous years the investigation area was expanded significantly further northeast. Greenland halibut were distributed along the shelf slope from western Barents Sea to the northern Kara Sea (Figure 6.1.4.1). It was registered in all catches in deep-water areas of the Barents Sea also. The greatest catch by numbers was registered east of Franz Josef Land and was 445 individuals (38 kg) per nautical mile. The maximum catch by weight was 64 kg per nautical mile and was taken south of Spitsbergen. Compared to last year, the number of small halibut in catches decreased significantly, while the number of large fish increased. The total estimate (Table 6.1.1) is 160 million individuals or 94 thousand tonnes. Calculations have been done for the standard survey area only, and the small region east of 75°E is not included.

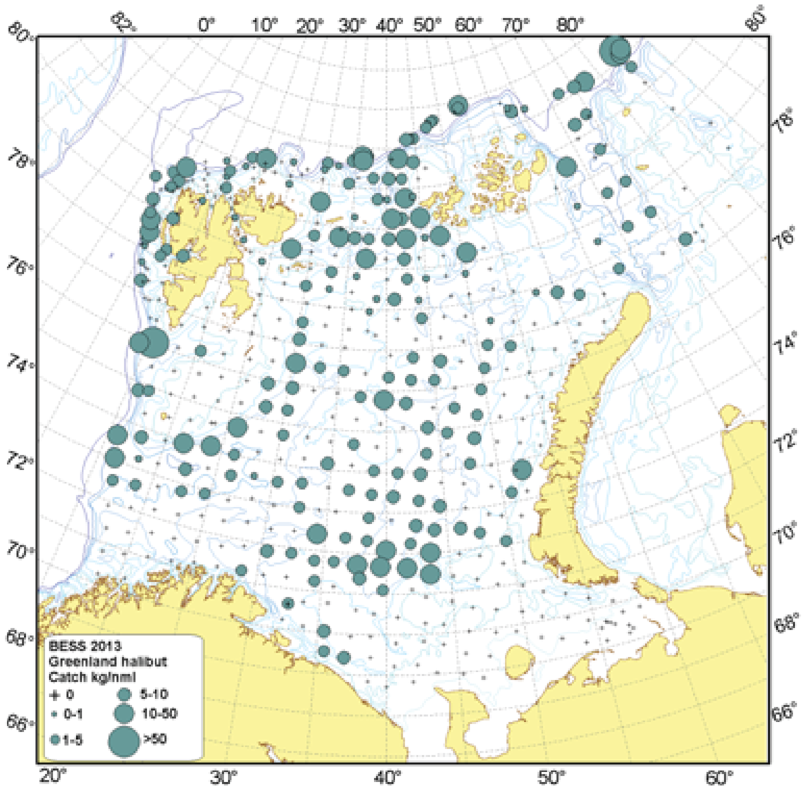


Figure 6.1.4.1. Distribution of Greenland halibut (*Reinhardtius hippoglossoides*), August- October 2013.

6.1.5 Golden redfish (*Sebastes marinus*)

In general, in 2013, golden redfish was distributed in the same part of the Barents Sea as in 2011 and 2012, as well as along the shelf slope north and west of Spitsbergen, and in deeper waters in the south-eastern Barents Sea (Figure 6.1.5.1). However, in recent years, catches of golden redfish increased considerably in the eastern areas. Thus, young redfish was found at 70°N/37°15 E and its catch was 255 individuals (24 kg) per nautical mile. The maximum catch of golden redfish (37 kg per nautical mile) was in the south-western part of the surveyed area. Abundance and biomass of S. marinus within the surveyed area continued increasing and was doubled in 2013 compared to the previous year (Table 6.1.1).

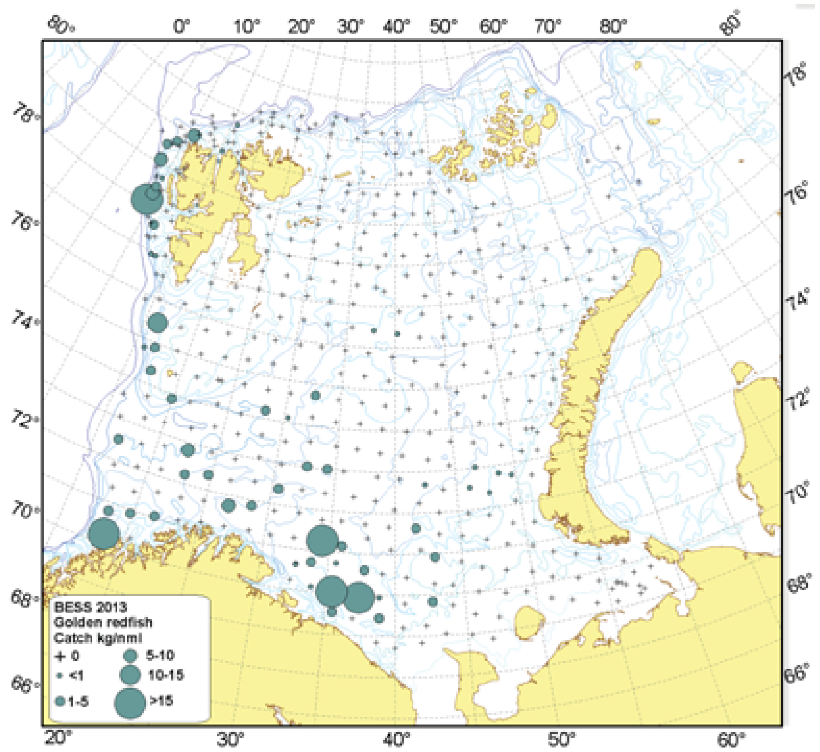


Figure 6.1.5.1. Distribution of golden redfish (*Sebastes marinus*), August-October 2013.

6.1.6 Deep-water redfish (*Sebastes mentella*)

Deep-water redfish was widely distributed in the Barents Sea. Single catches of redfish occurred eastward up to 85°E (Figure 6.1.6.1). Young age groups were found mainly in the eastern Barents Sea. The main concentrations of deep-water redfish were found, as usual, in the western and north-western Barents Sea, and west of Spitsbergen, where catches of deep-water redfish reached 328 kg per nautical mile. The survey area covered mainly the distribution of young age groups. However, abundance of redfish in the Barents Sea increased slightly during the last years. Compared to 2012, the biomass of deep-water redfish increased considerably (Table 6.1.1.).

6.1.7 Norway redfish (*Sebastes viviparus*)

Norway redfish was distributed in the south-western Barents Sea (Figure 6.1.7.1), as it was in the previous years. Some individuals were observed eastward up to 40°E and west of Spitsbergen and Bear Island. It was extraordinary and it was never observed before during these surveys. As a rule, catches of Norway redfish were small, but one catch in the western area reached 204 kg (1366 individuals) per nautical mile.

6.1.8 Long rough dab (*Hippoglossoides platessoides*)

As in the previous years, long rough dab was found all over the surveyed area and catches were generally high (Figure 6.1.8.1). Relatively low concentrations were only observed in the south-western Barents Sea along the coast of Norway. Long rough dab is still the most abundant species by number in the Barents Sea. In 2013, its abundance was estimated to be 4.9•109 individuals and its biomass – 557 thousand tonnes (Table 6.1.1). The mean catch of long rough dab was 8.3 kg per nautical mile and the maximum catch reached 176 kg per nautical mile. Compared to the previous year, long rough dab biomass decreased slightly and its abundance increased. Lots of small fish was observed in trawl catches especially in the eastern areas.

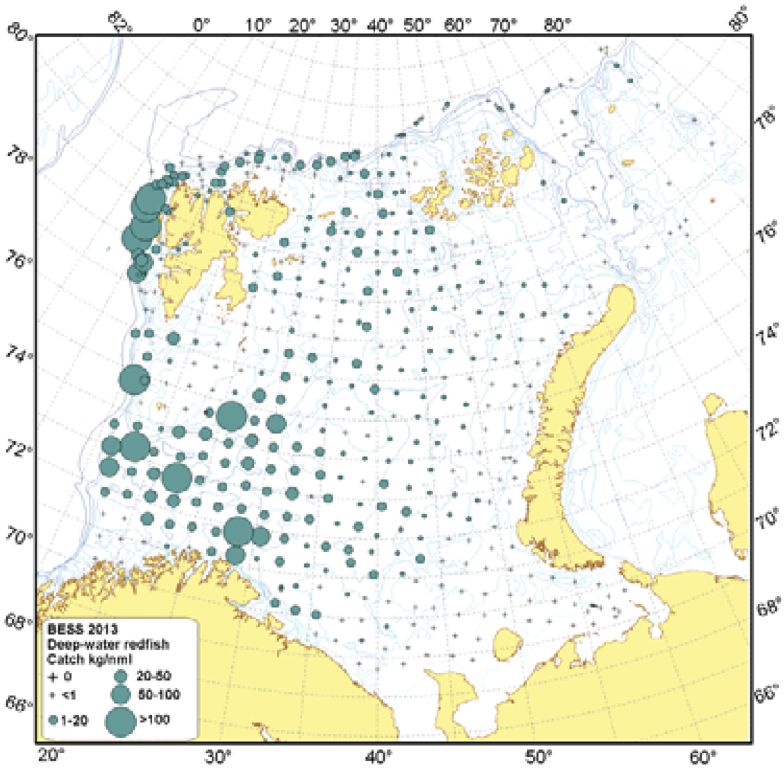


Figure 6.1.6.1. Distribution of deep-water redfish (*Sebastes mentella*), August-October 2013.

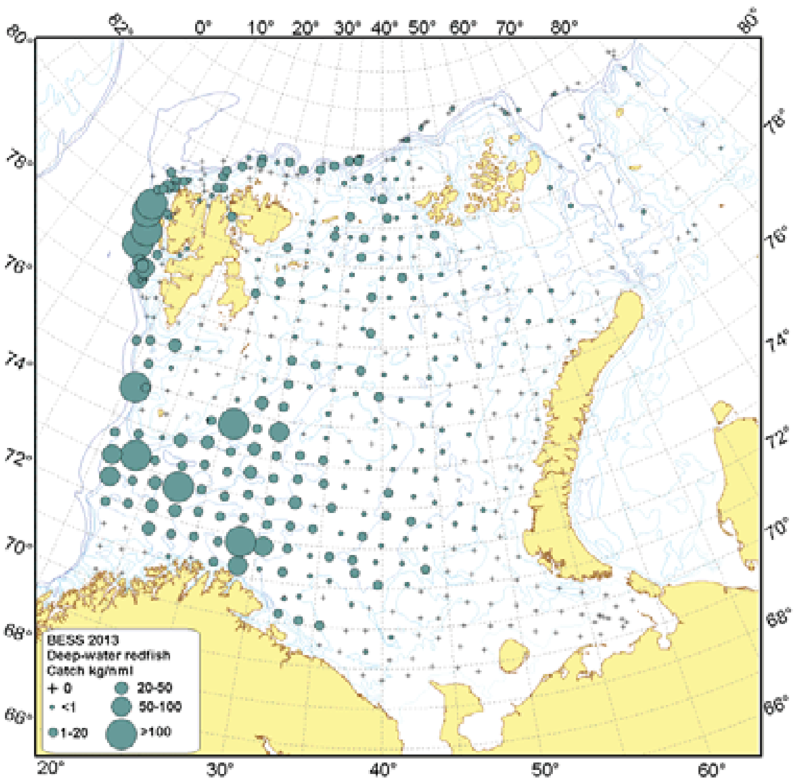


Figure 6.1.7.1. Distribution of Norway redfish (*Sebastes viviparus*), August-October 2013.

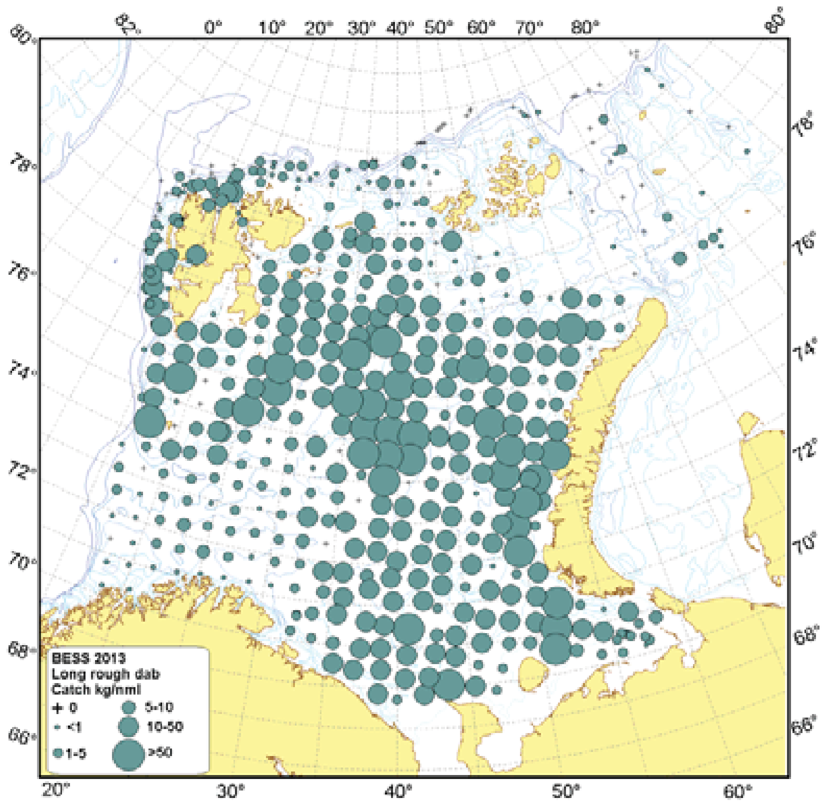


Figure 6.1.8.1. Distribution of long rough dab (*Hippoglossoides platessoides*), August-October 2013.

6.1.9 Wolffishes (Anarhichas sp.)

Three species of wolffish: Atlantic wolffish (*Anarhichas lupus*), Spotted wolffish (*Anarhichas minor*) and Northern wolffish (*Anarhichas denticulatus*) were found in the survey area.

The distribution of Atlantic wolffish was similar to that in 2012 except the area between Spitsbergen and Franz Josef Land where Atlantic wolffish was not found. The main catches of Atlantic wolffish were in shallow areas in the central Barents Sea, west of Spitsbergen and near Bear Island (Figure 6.1.9.1). The largest catch (82 kg (23 individuals) per nautical mile) was at 71°15'N 45°E. Compared to the previous year, abundance of Atlantic wolffish increased slightly in 2013, but its biomass increased thrice (up to 29 thousand tonnes) due to significant higher mean length and weight this year (Table 6.1.1).

The distribution of spotted wolffish in 2013 was very similar to that in 2011 and 2012 (Figure 6.1.9.2). Large catches of spotted wolffish were taken north-east of Bear Island, as well as in shallow areas in the south-eastern and central Barents Sea. Single catches occurred in the west and along the shores of the Novaya Zemlya Archipelago. The largest catch (112 kg) was obtained near Bear Island. The biomass of spotted wolfish was close to that in 2012 and was estimated to be 84 thousand tonnes (Table 6.1.1).

In 2013, the distribution of northern wolffish was similar to that in 2012 (Figure 6.1.9.3). Large catches were south and west of Spitsbergen and in the central Barents Sea. There were no catches in the north-eastern areas, excluding one individual to the north from Novaya Zemlya. The maximum catch of northern wolffish was 59 kg per nautical mile. Compared to

2012, abundance and biomass of northern wolffish increased slightly in 2013: the biomass was 52 thousand tonnes (Table 6.1.1).

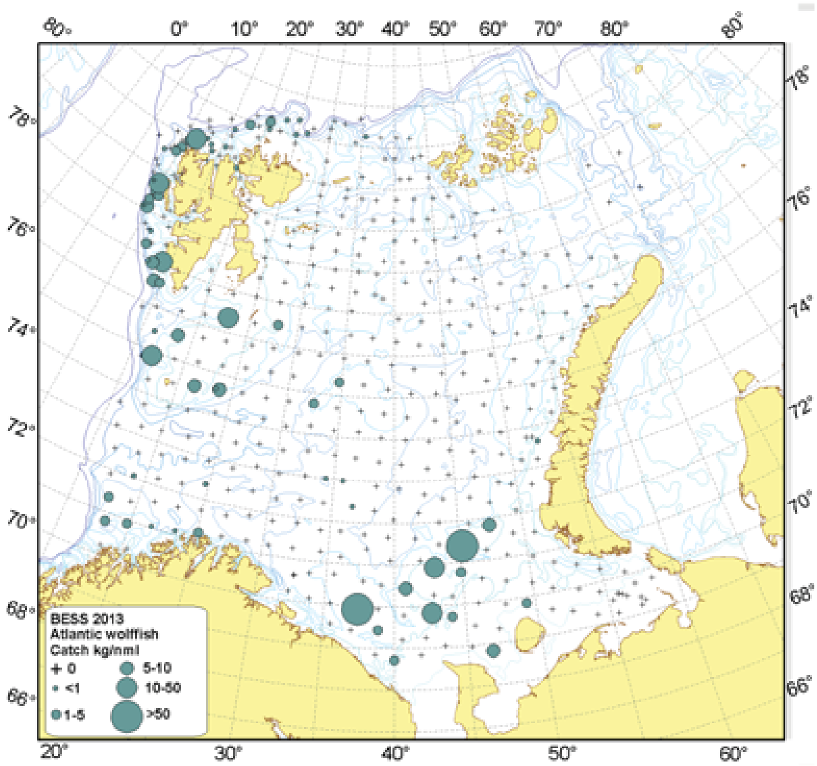


Figure 6.1.9.1. Distribution of Atlantic wolffish (*Anarhichas lupus*), August-October 2013.

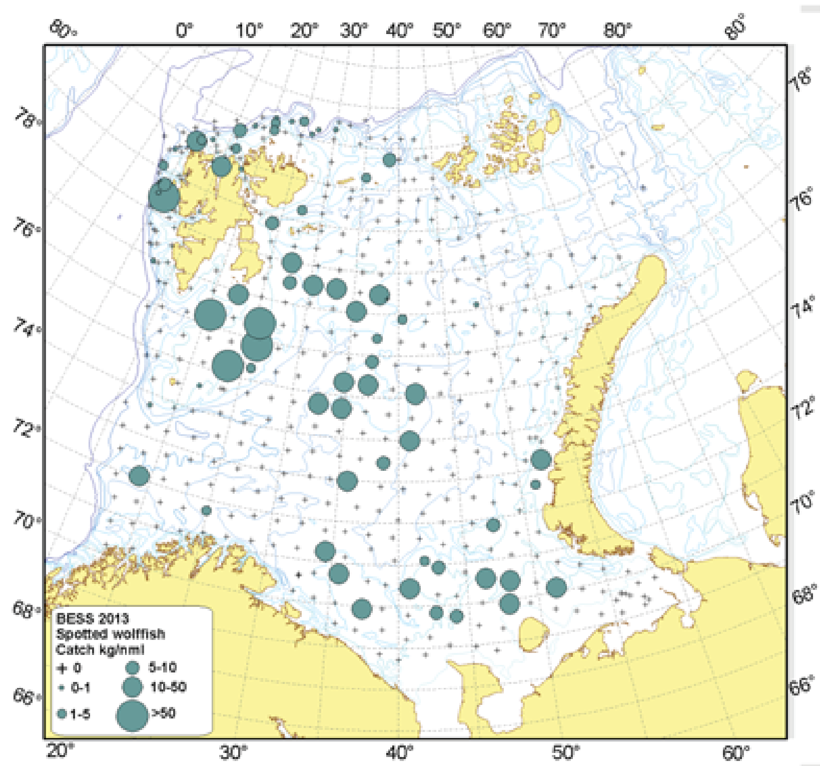


Figure 6.1.9.2. Distribution of spotted wolffish (*Anarhichas minor*), August-October 2013.

.

In 2013, the distribution of northern wolffish was similar to that in 2012 (Figure 6.1.9.3). Large catches were south and west of Spitsbergen and in the central Barents Sea. There were no catches in the north-eastern areas, excluding one individual to the north from Novaya Zemlya. The maximum catch of northern wolffish was 59 kg per nautical mile. Compared to 2012, abundance and biomass of northern wolffish increased slightly in 2013: the biomass was 52 thousand tonnes (Table 6.1.1).

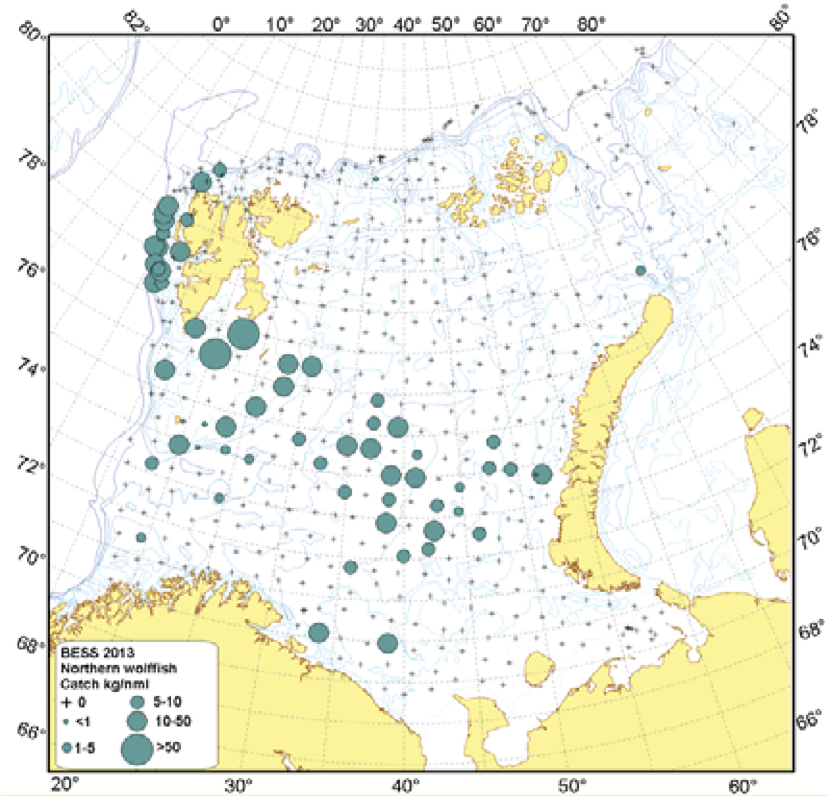


Figure 6.1.9.3. Distribution of northern wolffish (Anarhichas denticulatus), August-October 2013.

6.1.10 Plaice (*Pleuronectes platessa*)

Plaice was distributed mainly between 37° and 45°E in the southern Barents Sea. There were no catches along the Norwegian coast in 2013 (Figure 6.1.10.1). Compared to the previous year, catches were slightly larger. The maximum catch was 68 kg (83 individuals) per nautical mile. Therefore, abundance of plaice in the survey area was 1.7 times higher than in 2012 and its biomass was 2.2 times higher (Table 6.1.1).

6.1.11 Norway pout (*Trisopterus esmarkii*)

The main concentrations of Norway pout were observed in the south-western Barents Sea (Figure 6.1.11.1). A few individuals of Norway pout were found west and north of Spitsbergen, up to 80°N. Norway pout was distributed eastward up to 49°E in the southern Barents Sea. Compared to 2012, the distribution area of Norway pout was reduced and the main concentrations of Norway pout were located farther west along the coast of Norway. In 2013, catches of Norway pout were lower than in the previous year, and, as a result, its abundance and biomass were also lower (Table 6.1.1).

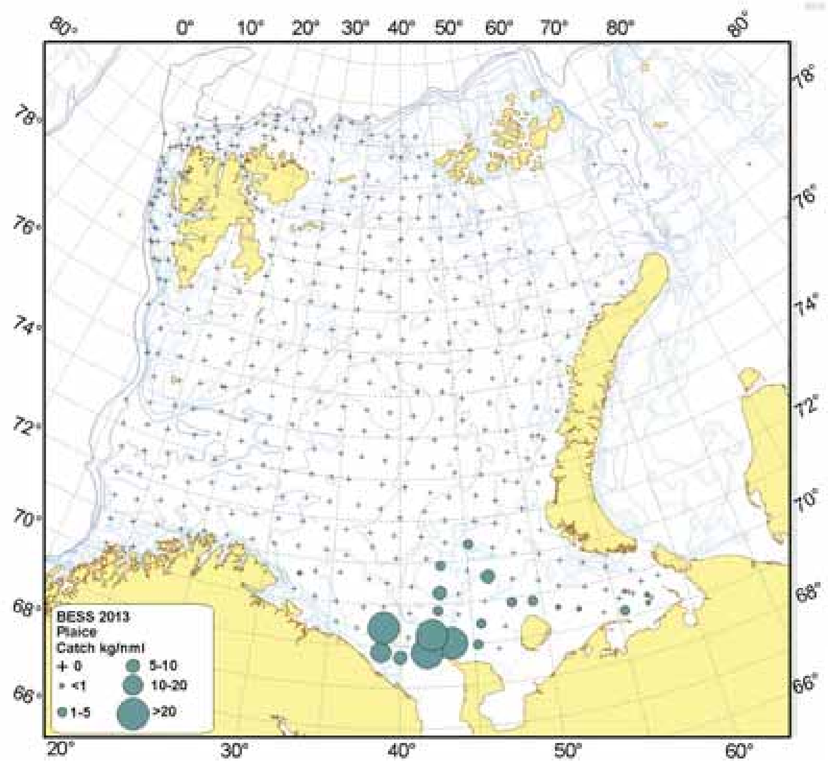


Figure 6.1.10.1. Distribution of plaice (*Pleuronectes platessa*), August-October 2013.

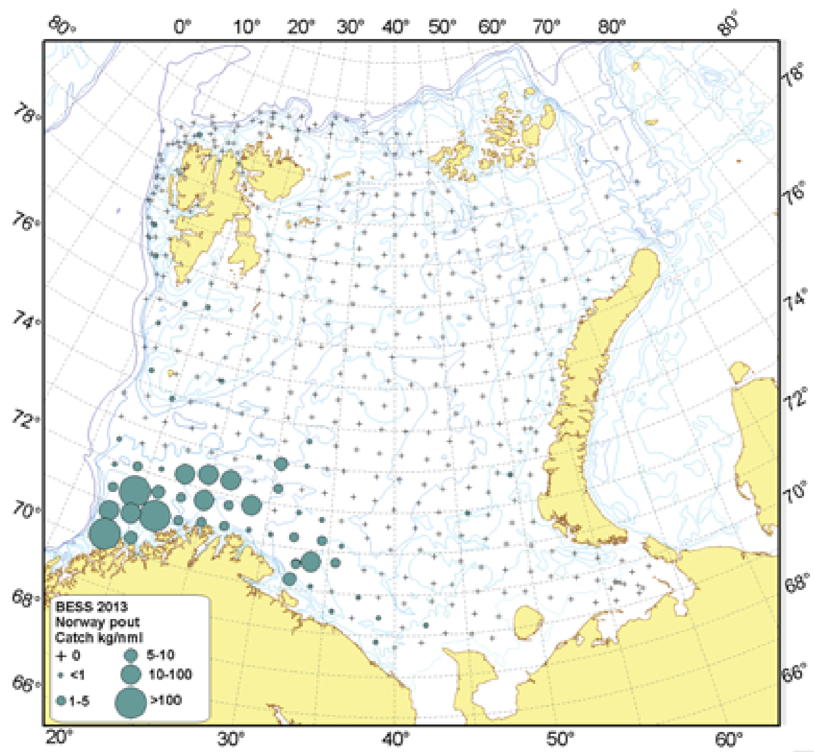


Figure 6.1.11.1. Distribution of Norway pout (*Trisopterus esmarkii*), August-October 2013.

6.1.12 Abundance and biomass estimation of demersal fish

Preliminary estimates of abundance and biomass of demersal fish were done at the end of the survey. Definitive results will be presented after age reading. Preliminary estimates from 2004-2013 are presented in Table 6.1.1.

As seen from Table 6.1.1, numbers and biomass of demersal fish varies annually. These changes are significant for some species and negligible for other. For species, which distribution area is only partly covered by the survey, the fluctuations shown in Table 6.1.1 may partly reflect the variable coverage, which again reflects changes in distribution and migrations from year to year. The variable relationship between biomass and abundance is caused by the age composition of the stocks; when stronger year classes result in higher relative rates of young fish, this lead to increased numbers and decreased biomass of the stocks.

The calculated indices of some species, e.g. Greenland halibut, also depend on area coverage outside the basic survey area. The variable coverage is a result of ice conditions or additional planned investigations in areas adjacent to the Barents Sea. Commercial fishery has strong influence on some species numbers.

Nevertheless, abundance indices allow for investigations of total fish quantity dynamics in the Barents Sea. Some non-commercial species can be indicators of the ecosystem state since their numbers are changing by natural reasons only (see sections 7.2.2 "Species – indicators" and 7.2.3 "Bio-geographic group"). Fluctuation in abundance numbers for different fish species could be signalling changes in ecosystem conditions.

In 2013, large-sized and commercial important fish (excluding haddock) and fish-predators increased, while numbers of most of the demersal small-sized forage-fishes decreased (with Ribbed sculpin exception, which biomass huge increased in 40 times). This could be a sign of present high consumption rates of the large fish in this ecosystem.

6.2 Benthos community

Text by P. Lubin, L. Lindal Jørgensen and A. Mashnin
Figures by D. Prozorkevich and P. Lubin

6.2.1 Monitoring the Northern shrimp (*Pandalus borealis*)

Northern shrimp was recorded in 390 of the 493 catches of bottom trawl (Figure 6.2.1.1). The catch of the northern shrimp ranged from 1 g to 102.796 kg. Average catch of northern shrimp was 7.734±0.468 kg. The amount of shrimp in 1 kg was 62-660 individuals. The average sample size was 217±12 individuals per kg.

Maximum catches of shrimp were recorded at depths of 200 to 400 m. Length of the shrimps carapace ranged from 7 to 31 mm. Size and sex structure of the shrimp in the eastern part of the study area is shown in Figure 6.2.2.2.

The dominant part of the northern shrimp population in the study area consisted of males (64%) with a carapace length of 13 to 23 mm (Fig 6.2.2.2). Females which did not participate in spawning, were presented as individuals with a carapace length of 20 mm to 25 mm and made up 12%.

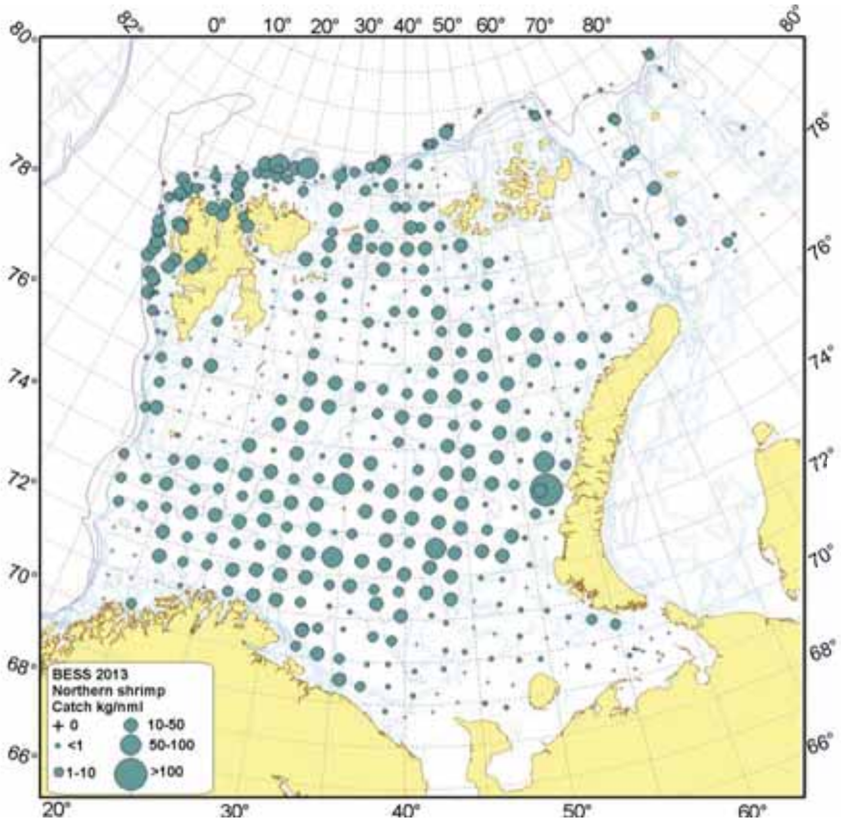


Figure 6.2.1.1. Distribution and the biomass (kg/nml) of the Northern shrimp in the Barents Sea ecosystem survey 2013.

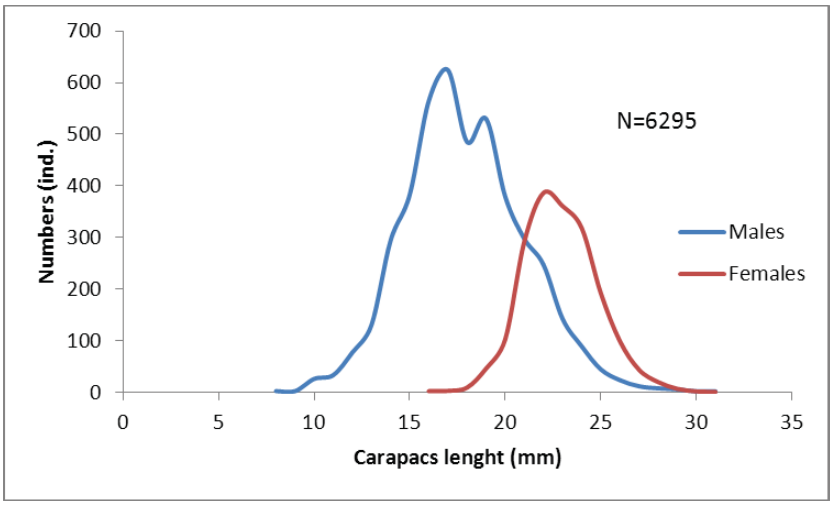


Figure 6.2.1.2. Size and sex structure of catches of the Northern shrimp in the study area.

6.2.2 Distribution of the Red King crab (*Paralithodes camtschaticus*)

The red King crab was recorded at 10 stations in the southern part of the Barents Sea for the period of ecosystem survey in 2013. The weight of the catch ranged from 0.570 kg to 343.268 kg (Figure 6.2.2.1). The average trawl catch of king crab was 43±33 kg.

6.2.3 Distribution of the Snow crab (*Chionoecetes opilio*)

Snow crab (*Chionoecetes opilio*) was recorded at 131 stations. The biomass of the snow crab catch ranged from 1.5 g to 189.288 kg (Figure. 6.2.3.1). The average catch was 10.06±2.22 kg. The highest amounts of snow crab (2004 individuals in 189.288 kg) was observed on the north west of Novaya Zemlya.

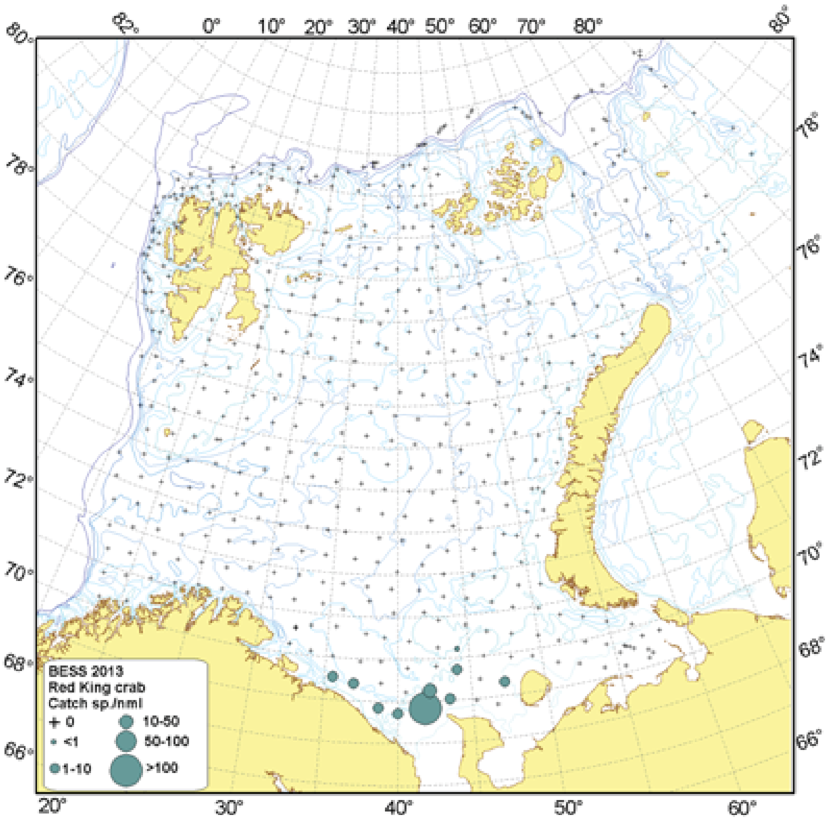


Figure 6.2.2.1. The distribution and number of individuals per nml of the Red King crab in the Barents Sea during the ecosystem survey 2013.

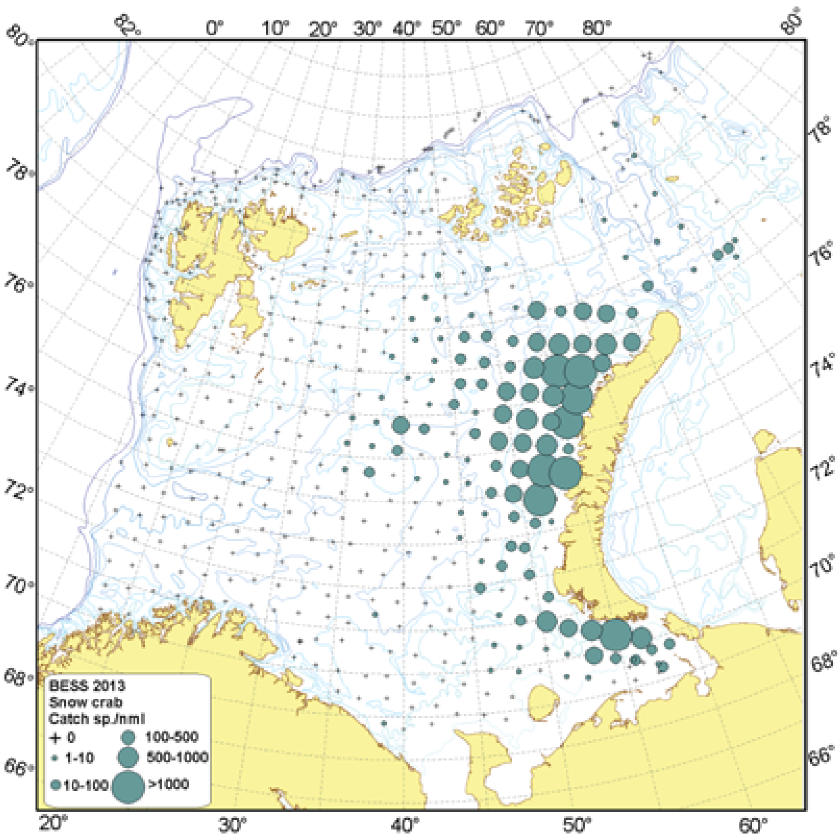


Figure 6.2.3.1. Distribution and numbers of individuals per nml of the Snow crab in the Barents Sea during the ecosystem survey 2013.

7 Monitoring of interactions by diet study

7.1 Trophic studies of capelin and polar cod

Text by by P. Dalpadado, E. Orlova, I. Prokopchuk, B. Bogstad, A. Dolgov and A. Rey
Figures by P. Dalpadado

In the Barents Sea, diet data for capelin (*Mallotus villosus*) and polar cod (*Boreogadus saida*) were collected during the Joint Norwegian-Russian ecosystem survey in August-September respectively during the period 2005-2012 and 2007-2012. IMR generally takes stomach samples from 10 fish at each station, while PINRO samples more fish (up to 50) at fewer stations. Because Russian data on stomach content are in wet weight and Norwegian data in dry weight, a wet weight/dry weight conversion factor of 5.0 was applied.

The size of the capelin ranged from 6.5 to 19.5 cm and for polar cod ranged from 5.5 to 27.0 cm. In the Norwegian data, the fish is measured to the nearest 0.5 cm (rounding downwards), while in the Russian data the fish is measured to the nearest 0.1 cm, but in the data conversion they were rounded to the nearest 0.5 cm (rounding downwards). For analysis of the variation of diet by size, the following size groups were used: for capelin below and above 12.0 cm, and for polar cod below and above 17.0 cm. The diet data of capelin from 2005 is based on few stations compared to other years and is mainly from the north central and eastern parts of the Barents Sea.

Eight years (2005-2012) of capelin diet was examined from the Barents Sea where capelin is a key forage species, especially of cod (Gadus morhua). The capelin stock size has been relatively high during the last 6 years (ca. 3.8 million tonnes), exerting a high predation pressure on zooplankton. The PINRO/IMR mesozooplankton distribution shows low plankton biomass in the central Barents Sea which in a way also reflected in the total stomach fullness index, which has decreased especially since 2009, with the lowest in 2012. In the Barents Sea, a pronounced shift in the diet from copepods to krill, mostly Thysanoessa inermis was observed (especially in larger capelin >12.0 cm, not shown), with krill being the largest contributor to the diet weight in most years (Figure 7.1.1). Probably it results to decreasing of feeding intensity of capelin, especially since 2009. Amphipods contributed a small amount to the diet of capelin. The migration of capelin into northerly areas (>80 °N) are observed in the recent years due to more ice free area, which may make capelin more accessible to the arctic zooplankton.

The diet data from 2005 to 2012 indicate that polar cod mainly feed on copepods, amphipods (mainly hyperiids, occasionally gammarids) and euphausiids, and to a lesser degree on other invertebrates (Figure 7.1.2). Large polar cod may also prey on fish. Similar to capelin, the total stomach fullness index decreased since 2009 and was the lowest in 2012.

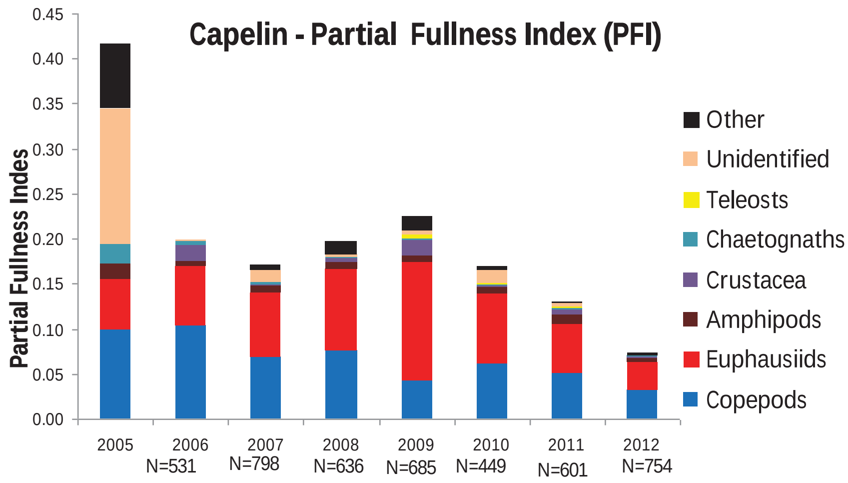


Figure 7.1.1. Diet composition and feeding intensity of capelin in the Barents Sea in 2005-2012.

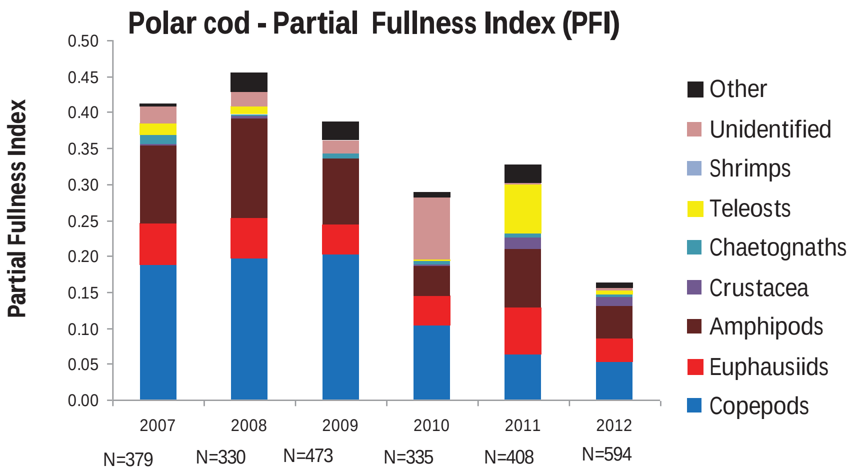


Figure 7.1.2. Diet composition and feeding intensity of polar cod in the Barents Sea in 2005-2012.

8 Monitoring of biodiversity

8.1 Invertebrate biodiversity

Text by P. Lubin, L. Lindal Jørgensen and A. Mashnin
Figures by P. Lubin and A. Mashnin

During the ecosystem survey 2013 (Russian research vessel “Vilnyus”) 47 quantity grab-samples were taken from 10 stations on the transect “Kola meridian” (long term monitoring series since 1930).

8.1.1 Megabenthos bycatch in bottom trawls

According to the analysis of megabenthos bycatch in bottom trawls at the four participating vessels in ecosystem survey in 2013, 576 taxa of benthic invertebrates were identified, where 385 taxa were identified to the species level. The taxa belonged to 312 genera, 205 families, 87 orders, 30 classes and 15 phyla (Table 8.1.1.1). The highest number of taxa was recorded at R/V “Helmer Hanssen” (western and northern part of Svalbard), followed by R/V “Vilnyus” in the eastern part of the Barents Sea.

Table 8.1.1.1. Amount of benthic taxa identified in the ecosystem survey 2013.

Taxon	“Vilnyus” Russian (east) Barents Sea	“G.O. Sars” Southern Barents Sea	“Helmer Hanssen” Svalbard W and N	“Johan Hjort” Northern Barents Sea
Phylum	13	12	15	14
Class	24	23	27	27
Order	64	67	79	68
Family	123	126	156	132
Genus	142	138	186	155
Species	180	167	240	203
Total taxa	290	238	313	277

Arthropoda had the highest number of taxa (132 taxa, i.e. 32% of the total number of taxa recorded by the trawling in the Barents Sea 2013, Figure 8.1.1.1), followed by Mollusca (123 taxa) and Echinodermata (76 taxa). The phyla Nemertini was presented by the lowest number of taxa (1 taxon). The most common species and taxa were S*abinea septemcarinata, Ctenodiscus crispatus*, Porifera g. sp.

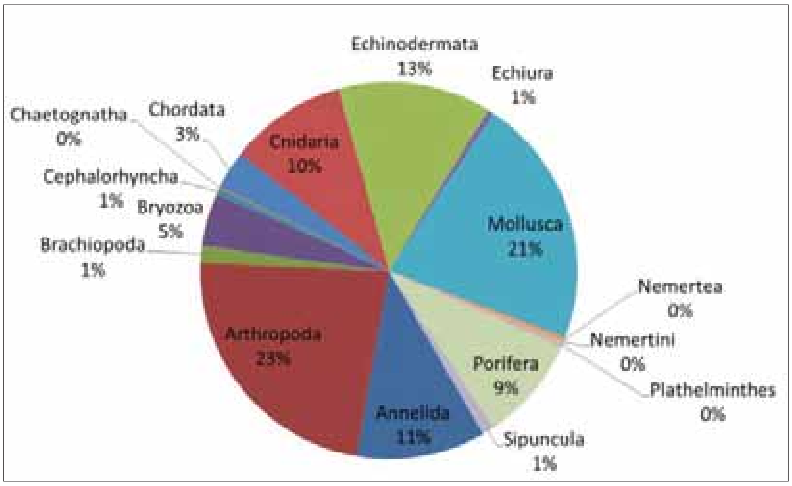


Figure 8.1.1.1. The contribution of taxa per invertebrate group in the bottom trawl by-catch by the data of ecosystem survey 2013 (%).

Biodiversity (number of taxa)

The number of taxa in the trawl catches ranged from 3 to 66 with an average of 25±1 taxa. The highest number of taxa (60 taxa) was recorded north east of Svalbard/Spitsbergen (close to Kong Karls Land, south of Nordaustlandet) (Figure 8.1.1.2).

The area north of the Finmark coast and in the south-eastern part of the Barents Sea (The Kanin peninsula, Kolguev island) were characterized by low number of taxa (>4 taxa per trawl).

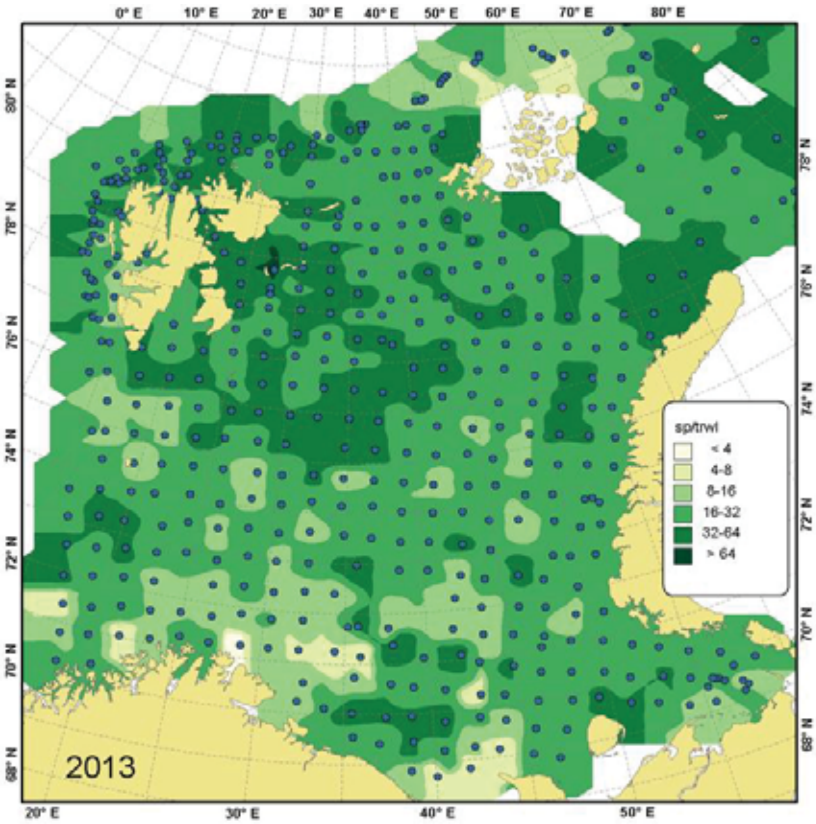


Figure 8.1.1.2. The number of taxa per nautical mile in the Barents Sea in the ecosystem survey 2013.

Abundance (number of individuals)

Average number of invertebrate encountered in the by-catch, was 4126±520 individuals per mile trawling. Minimum catch was recorded on the vessel "Helmer Hanssen" in the north-eastern part of the archipelago of Spitsbergen/Svalbard, and was 8 individuals per mile of trawling.

Maximum catch was taken by the vessel "Johan Hjort" in the area of the Bear Island and counted 145 091 individuals and Microcosmus glacialis made up the largest part of these individuals (Figure 8.1.1.3).

The largest areas with high abundance of megazoobenthos were noted in the north-eastern part of the Barents Sea. In the southern and the south-eastern areas a maximum of 100 individuals were recorded per mile of trawling.

Biomass

Maximum catch of megabenthos (6.6 tonnes) was recorded north of Franz Josef Land, at the Svalbard Bank, and in the south western Barents Sea. The smallest catch (23.7 g) was recorded in the north-east of Spitsbergen on 1082 m depth (Figure 8.1.1.4). The average biomass of the Barents Sea megabenthos was 71±19 kg per mile of trawling.

According to the ecosystem survey 2013, as well as the results of previous research, there is a tendency of increasing prevalence of Echinodermata (biomass by-catch) from south-west to north-eastern Barents Sea (Figure 8.1.1.5). Sponges dominated in biomass in the southwest

Barents Sea and on the continental slope vest and north of Svalbard and all the way east to Franz Josef Land. Sponges were mainly represented by the species of the genus Geodia. A high dominance of Mollusca (Buccinidae indet) was recorded in the area of the Hopen Island.

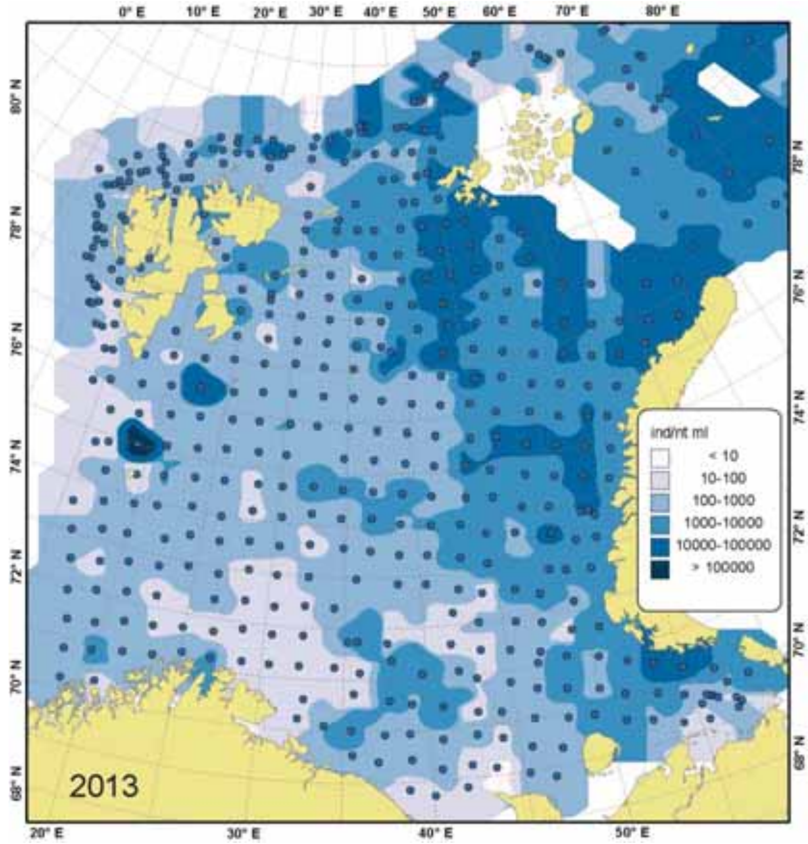


Figure 8.1.1.3. The extrapolated number of individuals of megabenthos in the Barents Sea in the ecosystem survey 2013.

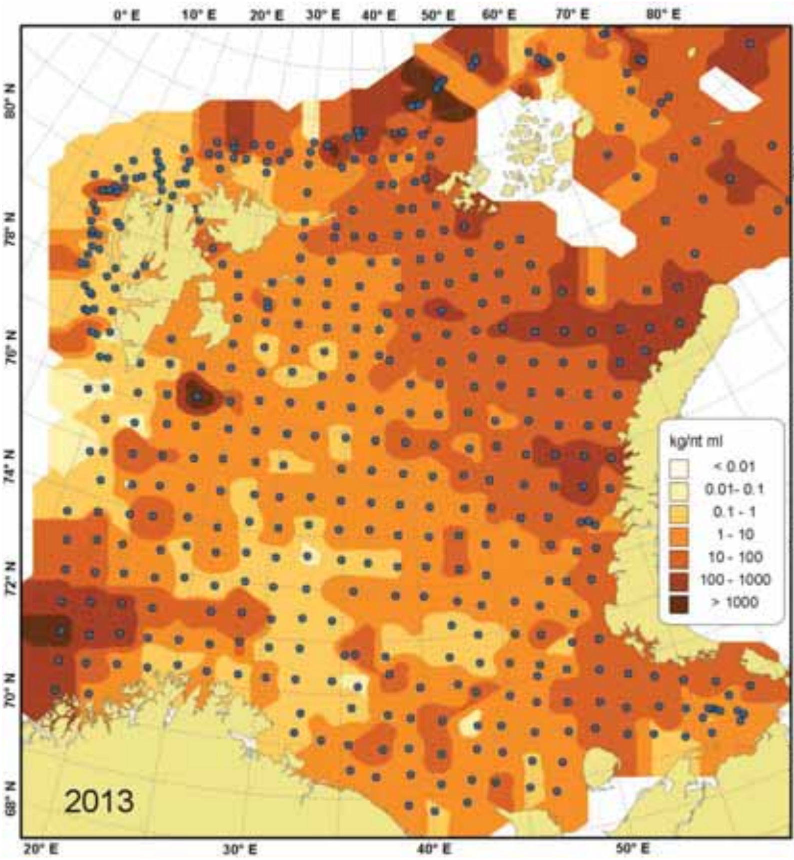


Figure 8.1.1.4. Biomass distribution of megabenthos in the Barents Sea in the ecosystem survey 2013.

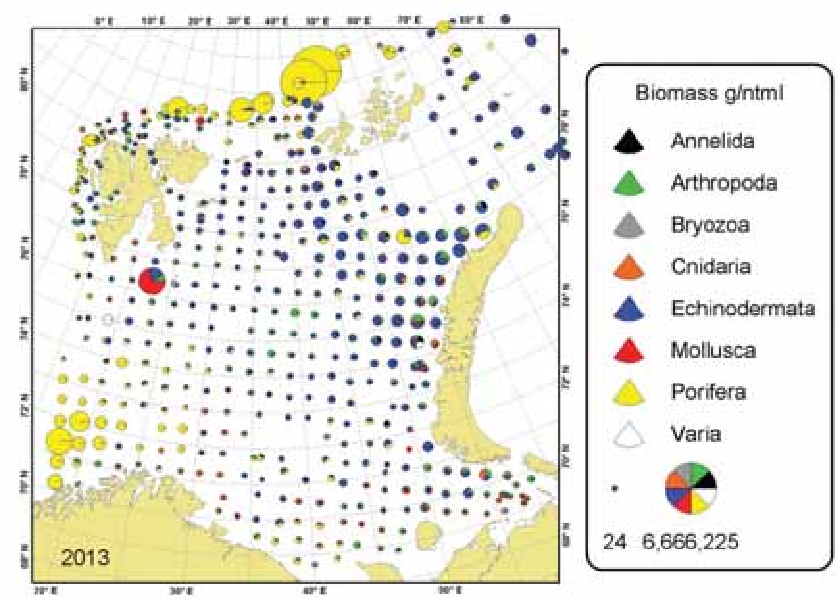


Figure 8.1.1.5. Biomass distribution of main taxonomic groups per station in the Barents Sea during the ecosystem survey 2013.

8.1.2 Distribution and amount of *Gonatus fabricii*

Text by E. Eriksen and T.Prokhorova

Figures by E. Eriksen

Gonatus fabricii is a by-catch in the pelagic catches, taken in the 0-group stations. As previous years, Gonatus fabricii was distributed in the western parts of the Barents Sea. Few low catches were taken west and east for Svalbard/Spitsbergen archipelago in 2013 (Figure 8.1.2.1).

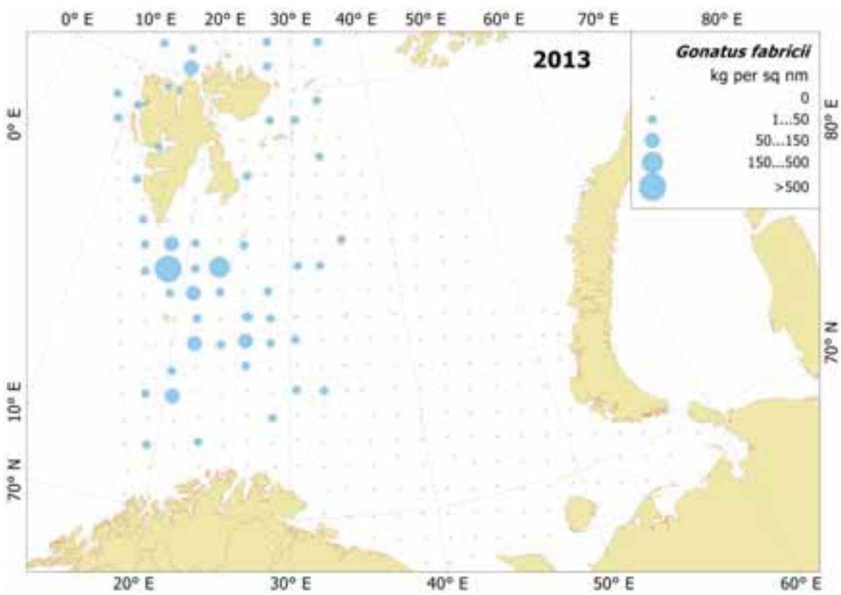


Figure 8.1.2.1. Distribution of *Gonatus fabricii*, August-September 2013.

The biomasses varied from some grams to 89 kg per square nautical miles with an average of 1.7 kg. The calculated biomass reached 629 tonnes in the Barents Sea in 2013, which is lower than in 2012 and at the same level as 2010 and 2011.

8.2 Fish biodiversity

8.2.1 Small non-target fish species

Text by T. Prokhorova, E. Eriksen, A. Dolgov and A. Trofimov
Figures by E. Eriksen and T. Prokhorova

Despite the distribution and biology of the non-commercial fish species of the Barents Sea and their role in the ecosystem being investigated since mid-1990s (e.g. Dolgov, 1994; Wienerrother et al., 2011; Wienerrother et al., 2013 etc), their distribution patterns, abundance and biomass is poorly studied (Eriksen at al., 2012). Since 2012 abundance and biomass of pelagically distributed juveniles of fish species from the families Agonidae, Ammodytidae, Cottidae, Liparidae, Myctophidae and Stichaeidae (called "small fishes" here) were calculated for the period 1980-2009. Due to mistakes in calculation program and database we have updated the program and database and recalculated indices for the period 1990-2012. Table 8.2.1.1 reports new (corrected) abundance and biomass indices for the period 1990-2013.

In 2013 as the each family taken separately biomass, and the total biomass of small fishes (1.5 thousand tonnes, representing the juveniles from these families) was much lower than in 2012 and the long term mean (4.3 thousand tonnes). The average biomass of 0-group fish of the most abundant species (capelin, cod, haddock, herring) for 1993-2013 was 2.4 million tonnes, so the small fishes in 2013 were only 0.06 % of the most abundant 0-group fish. However, small fishes can be locally important in some Barents Sea areas (like Svalbard/Spitsbergen or southeastern Barents Sea) as components of the food web.

<u>Agonidae</u> were mostly represented by Leptagonus decagonus. L. decagonus was distributed on the small area to the east of Svalbard/Spitsbergen. Single catches were observed in the Stor Fjord and close to the Novaya Zemlya Archipelago (Figure 8.2.1.1). In the the north eastern part of the standard survey area 0-group L. decagonus was found only in 2012, but not in 2013. The estimated indices showed that abundance and biomass decreased from 2006 and were lowest in 2013. In 2013 agonids were approximately 30 times lower than long term mean of 202 millions (abundance) and 61 tonnes (biomass) (Table 8.2.1.1). Abundance and biomass indices of Agonidae decrease from 2009 (Table 8.3.1.1). Possible reason for this is the increased heat in the Barents sea due to both high surface water temperature and inflow water volume in the Barents sea (e.g. by the Norwegian current) (Figure 8.2.1.2). Thus excessive heat could result to shift in distribution of their spawning stock and 0-group northwards.

<u>Ammodytidae</u> were mostly represented by Ammodytes marinus and in 2013 were observed at the same area at the western and south eastern area as in 2012 (Figure 8.2.1.1). In 2013 estimated abundance and biomass were low and consisted 2.5 billion individuals and 1.2 thousand tonnes, respectively. That is 3.5 times lower than in 2012 and 2.4 times lower than long term mean. Such decreasing of indices in 2013 was most likely due to decreasing of A. marinus abundance in the core area, south eastern Barents Sea, where A. marinus is usually abundant.

Table 8.2.1.1. Abundance indices (AI) (in million individuals) and biomass (B) (in tonnes) of pelagically distributed juveniles from families Agonidae, Ammotydae, Liparidae, Cottidae, Myctophidae and Stichaeidae. LTM means long term mean for the period 1990-2013.

Year	**Agonidae**		**Ammodytidae**		**Cottidae**		**Liparidae**		**Myctophidae**		**Stichaeidae**		**Total biomass**
	AIc	B	AIc	B	AIc	B	AIc	B	AIc	B	AIc	B	
1990	37	11	2099	1050	195	58	0	0	40	18	830	415	1552
1991	179	54	1733	866	2799	840	404	141	6	3	1565	783	2686
1992	85	25	1367	683	230	69	36	12	293	132	456	228	1150
1993	10	3	3425	1712	71	21	15	5	1536	691	0	0	2433
1994	808	242	33168	16584	3992	1198	11	4	13	6	0	0	18034
1995	39	12	4562	2281	93	28	2	1	40	18	3	2	2341
1996	117	35	7791	3895	310	93	35	12	274	123	0	0	4159
1997	32	9	3393	1697	282	85	184	65	12	5	1591	796	2656
1998	112	33	471	236	289	87	99	35	14	6	805	403	799
1999	388	116	1630	815	2460	738	865	303	12	5	1062	531	2508
2000	336	101	8549	4274	887	266	464	163	219	98	2129	1065	5967
2001	75	23	1052	526	206	62	97	34	153	69	681	340	1053
2002	20	6	3259	1630	37	11	46	16	17	8	0	0	1670
2003	33	10	692	346	795	239	10	4	1	1	56	28	626
2004	186	56	4321	2160	354	106	213	75	102	46	81	41	2484
2005	407	122	14379	7190	859	258	3241	1134	42	19	602	301	9023
2006	542	163	25708	12854	0	0	3004	1051	0	0	2027	1014	15081
2007	312	94	839	419	683	205	2001	700	30	13	272	136	1568
2008	121	36	200	100	9	3	26	9	76	34	382	191	374
2009	458	137	10912	5456	3338	1001	1029	360	438	197	4815	2408	9560
2010	253	76	721	360	170	51	267	93	35	16	4390	2195	2792
2011	150	45	1844	922	61	18	938	328	27	12	4227	2113	3439
2012	149	45	8694	4347	211	63	936	327	585	263	7674	3837	8883
2013	7	2	2457	1229	36	11	38	13	281	127	199	100	1481
LTM	**202**	**61**	**5969**	**2985**	**765**	**230**	**582**	**204**	**177**	**80**	**1410**	**705**	**4263**

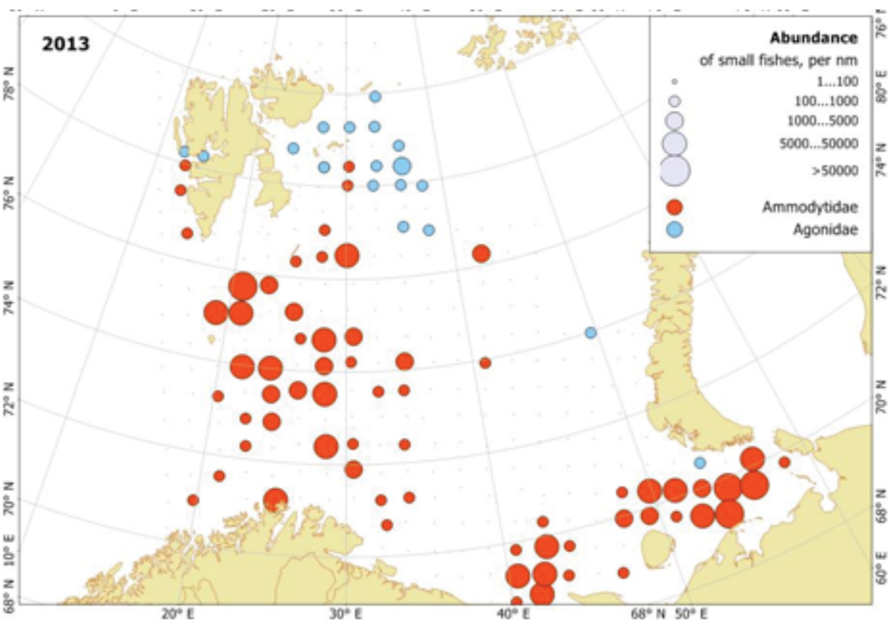


Figure 8.2.1.1. Distribution of Agonidae and Ammodytidae, August-September 2013.

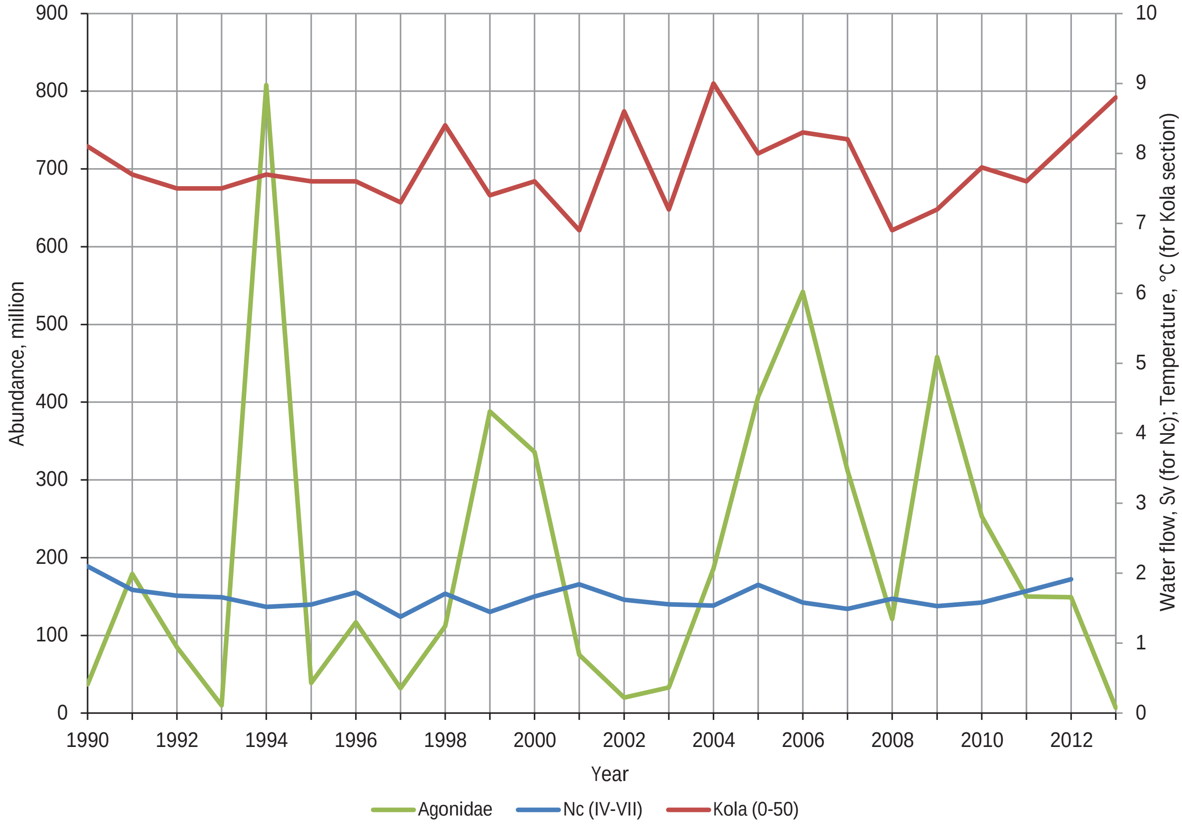


Figure 8.2.1.2. Abundance index of Agonidae (in millions), water flow by Norwegian current for April-July (Sv) and water temperature on the Kola section in the layer 0-50 m in August-September (°C) in 1990-2013.

Stichaeidae included Lumpenus lampraetaeformis, Leptoclinus maculatus and Anisarchus medius, while Lumpenus fabricii is rare in the Barents Sea (Figure 8.2.1.3). Therefore the total biomass was presented only for the first three species (Table 8.2.1.1). In 2013 Stichaeidae were observed in the same area as in 2012, but densities were much lower. Moreover, the area along Novaya Zemlya between 74 °N to 77°N, where Stichaeidae usually distributes was not cover due to limited time in 2013. In 2013 abundance and biomass of Stichaeidae were almost 40 times lower than in 2012 and 7.1 times lower than long term mean of 1.4 billion (abundance) and 705 tonnes (biomass). The survey not covered numerous of Svalbard/Spitsbergen fjords, where 0-group Stihaeidae are numerous, and therefore this index is not indicate the actual recruitment (at age 0) to the stock. However, indices correspond to the minimum abundance and biomass of the year-class strength in the surveyed area.

Cottidae were represented by Myoxocephalus scorpius, Triglops nybelini, Triglops pingelii and Triglops murrayi. In 2013 Cottidae were found only west, north and east of Svalbard/Spitsbergen, and were absent in south and south west of Svalbard/Spitsbergen, where they usually distributed (Figure 8.2.1.4). Cottids abundance and biomass were very low and was almost 6 times lower than in 2012 and approximately 21 times lower than long term mean of 765 millions (abundance) and 230 tonnes (biomass) (Table 8.2.1.1).

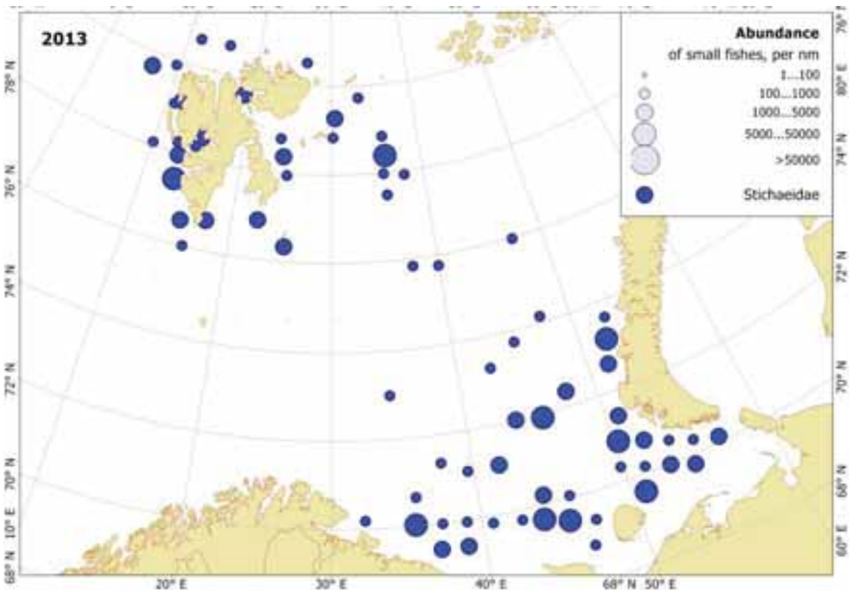


Figure 8.2.1.3. Distribution of Stichaeidae, August-September 2013.

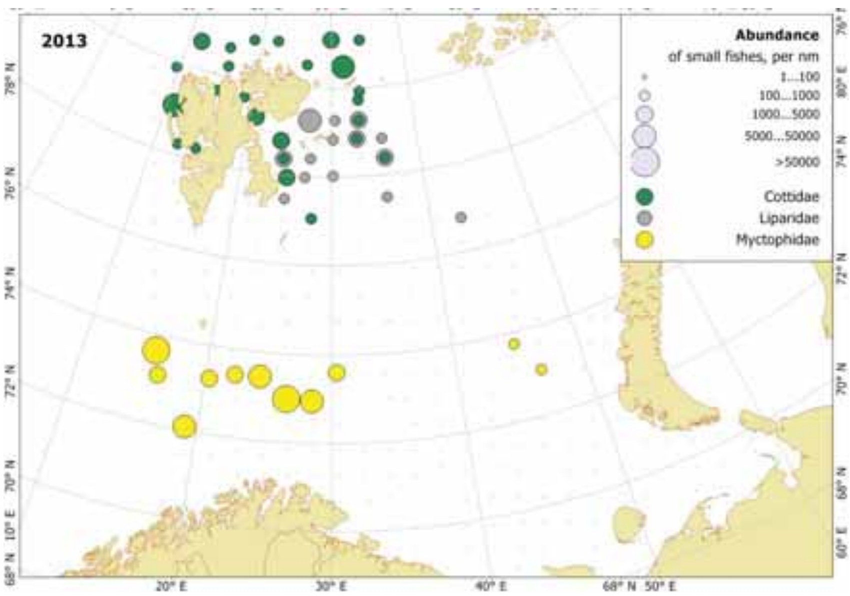


Figure 8.2.1.4. Distribution of Cottidae, August-September 2013.

Liparidae were represented by Liparis fabricii and Liparis bathyarcticus, while L. fabricii mostly dominated. In 2013 Liparidae distributed only west off Svalbard/Spitsbergen (Figure 8.2.1.4). Both species belong to the arctic biogeographic group. Moreover, area along Novaya Zemlya between 74 °N to 77°N, where liparids usually distributed, was not cover due to limited time in 2013. Liparids distributed on the much smaller area than in 2012 most likely due to extremely warm temperature condition in the upper water layer in 2013. Abundance and biomass was 38 million and 13 tonnes, respectively. That was approximately 25 times lower than in 2012 and 15 times lower than long time mean (Table 8.2.1.1). Comparing the abundance index of Liparidae and the inflow water volume by the Northern brunch of the North Cape current, it was observed that in some cases high Liparidae abundance was found in years with low water flow (2009, 2011, 2012) and vice versa (Figure 8.2.1.5). This is due to Barents Sea Liparidae are Arctic species which probably redistribute to northwards outside the survey area (e.g., the catches of adult individuals in 2013 were in 3 times less than in 2012).

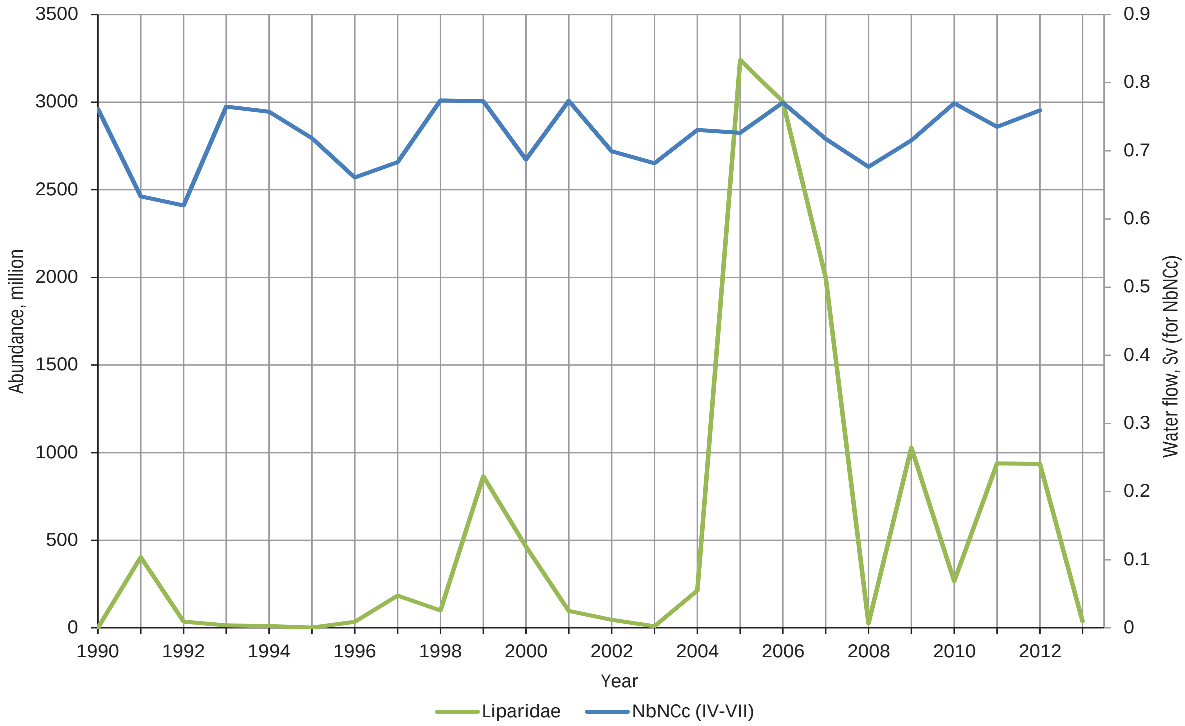


Figure 8.2.1.5. Abundance index of Liparidae (in millions) and water flow by Northern brunch of the North Cape current for April-July (Sv) 1990-2013.

Myctophidae were represented by Notoscopelus kroyeri and Benthosema glaciale in 2013, and were observed between 72 °N and 74 °N in the eastern and western part of the survey area (Figure 8.2.1.4). Biomass and abundance of pelagically distributed myctophids in 2013 were 281 millions and 127 tonnes, respectively. That was 2.1 times lower than in 2012 and 1.6 times higher than long term mean (Table 8.2.1.1). Myctophidae widely distributed in the whole North Atlantic. Thus, index of Myctophidae is only some part which distributes in the Barents Sea. Moreover, Myctophids generally have high trawl avoidance and therefore their abundance and biomass indices not provided the reliable estimations of actual recruitment to the stock (Kaartvedt, Staby, Aksnes, 2012). However, they may reflect the minimum indices of the year-class strength in the surveyed area each year.

8.2.2 Species-indicators

By T. Prokhorova, A. Dolgov, P. Krivosheya and E. Johannesen
Figures by P. Krivosheya

Thorny skate (*Amblyraja radiata*) and Arctic skate (A*mblyraja hyperborea*) are selected as indicator species to study how fishes from different zoogeographic groups, respond to changes of their environment. Thorny skate belongs to the boreal zoogeographic group and is widely distributed in the Barents Sea except the most north-eastern areas, while Arctic skate belongs to the arctic zoogeographic group and is distributed in the coldwater northern area.

In 2013, as in the previous years, thorny skate was widely distributed in the surveyed area. This species distributed from the southeast to the northwest in the area of the warm currents influence (Figure 8.2.2.1, see Figure 3.1.8 in the section 3.1 “Hydrography”). Thorny skate distributed within a depth of 17-450 m and the highest biomass concentrations were observed at depth 50-150 m (36.5 % of total biomass) and 200-300 m (31.9 %). The mean catch was 0.5 kg per nm and 0.6 individuals per nm, that’s lower than in 2012 (0.7 kg per nm and 1.3 individuals per nm). The estimated total biomass of thorny skate in 2013 (34,2 thousand tonnes) was in 1.5 times lower than in 2012 (52.6 thousand tonnes). At the same time abundance of thorny skate in 2013 (38 million individuals) was in 2.3 times lower than in 2012 (88 million individuals) due to higher mean weight in 2013 (0.84 kg versus 0.56 kg in 2012).

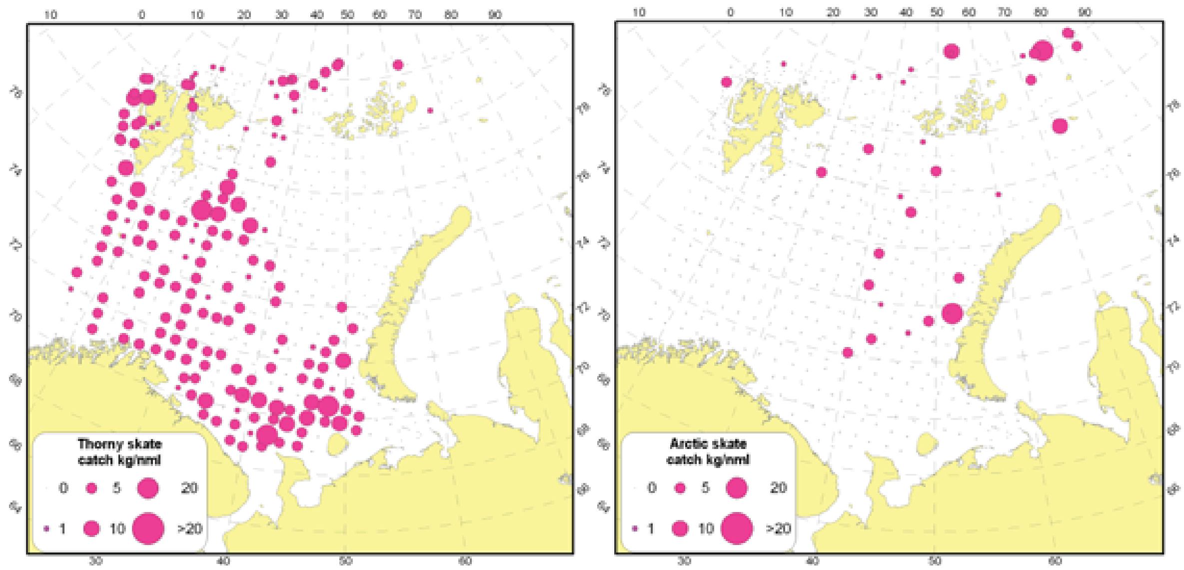


Figure 8.2.2.1. Distribution of thorny skate (Amblyraja radiata) and arctic skate (Amblyraja hyperborea), August-October 2013.

Arctic skate was mainly found in deep trenches at sub-zero temperatures in the northwest and central Barents Sea (Figure 8.2.2.1, see Figure 3.1.8 in the section 3.1 “Hydrography”). Arctic skate was distributed within a depth 150-1100 m and the highest biomass was observed at 150-300 m (41.7 %) and 1000-1050 m (23.9 %). The mean catches in terms of biomass and abundance in 2013 (0.1 kg per nautical mile and 0.07 individuals per nm) were lower than in 2012 (0.25 kg per nm and 0.2 individuals per nm), probably, due to the larger area investigated in 2013. The estimated total biomass of arctic skate in 2013 was 4 thousand tonnes and abundance 2.9 million individuals and it is lower than in 2012 (7.9 thousand tonnes and 6 million individuals).

8.2.3 Zoogeographic groups

By T. Prokhorova, A. Dolgov, P. Krivosheya and E. Johannesen
Figures by P. Krivosheya

During the 2013 ecosystem survey 97 fish species from 28 families were recorded in the catches, and 10 species were identified up to the level higher than genus (Appendix 2). All recorded species were divided into the 6 zoogeographic groups: south boreal, boreal, mainly boreal, arctic-boreal, mainly arctic and arctic according to the Andriyashev and Chernova (1994) and Mecklenburg et al. (2010). Table 8.2.3.1 represents average and maximum number of fish of different zoogeographic groups which were caught during the survey. Only bottom trawl data were used. Commercial species were excluded from the analysis. Both demersal (including bentho-pelagic) and pelagic (neritopelagic, epipelagic, bathyalpelagic) species were considered (Andrijashev and Chernova, 1994, Parin, 1968, 1988).

Widely distributed (only white barracudina Arctozenus risso represents this group), south boreal (e.g. silvery pout *Gadiculus argenteus*, anglerfish *Lophius piscatorius*) and boreal (e.g. moustache sculpin *Triglops murrayi*, round ray *Rajella fyllae*) species were mostly distributed over the south western part of the survey area and along the Finnmark and Murman coast in the area influenced by warm Atlantic Water, Norwegian Coastal Water and Murman Coastal Water (Figure 8.2.3.1). Catches of fish from these groups were rather low – not higher than 259 individuals per nautical mile (Table 8.2.3.1).

Mainly boreal species (e.g. three-spined stickleback *Gasterosteus aculeatus*, lumpfish *Cyclopterus lumpus*, greater eelpout *Lycodes esmarkii*) were widely distributed over the whole survey area except the north eastern part (Figure 8.2.3.1). Positive temperature anomalies were observed near the bottom throughout the Barents Sea in 2013. This can explain this wide distribution of the south boreal, boreal and mainly boreal species. Catches of fish from the mainly boreal group exceeded other group and reached 6.3 thousand individuals per nautical mile (Table 8.2.3.1). Due to we analysed commercial species only and most of the Barents sea commercial species (cod, haddock, capelin, herring, wolffishes etc.) belong to this group, catch of mainly boreal group fish would greatly increase.

Arctic-boreal (e.g. ribbed sculpin *Triglops pingelii*, atlantic poacher *Leptagonus decagonus*), mainly arctic (e.g. arctic staghorn sculpin *Gymnocanthus tricuspis*, variegated snailfish *Liparis bathyarcticus*, slender eelblenny *Lumpenus fabricii*) and arctic (e.g. arctic rockling *Gaidropsarus argentatus*, bigeye sculpin *Triglops nybelini*, arctic alligatorfish *Ulcina olrikii*) species were distributed mostly in cold waters influenced by Arctic Water, Spitsbergen Bank Water, Novaya Zemlya Coastal Water and Pechora Coastal Water. Catches of fish belonging to the arctic-boreal group reached 3.3 thousand individuals per nautical mile, mainly arctic group 656 individuals per nautical mile and arctic group 3.8 thousand individuals per nautical mile (Table 8.2.3.1). Due to only non-commercial species were analysed, inclusion of polar cod belonging to the arctic group would increase the average and maximum catch of this group fish considerably.

Table 8.2.3.1. Average and maximum catch (individuals per nautical mile) of non-commercial fish belonging to the different zoogeographic groups (only bottom trawl data were used, both pelagic and demersal species are inkluded).

Zoogeographic group	Average catch	Maximum catch
Widely distributed	0.2	45
South boreal	0.5	171.4
Boreal	5.95	258.6
Mainly boreal	38.5	6282.7
Arctic-boreal	14.2	3326.9
Mainly arctic	5.9	656.3
Arctic	52.2	3822.7

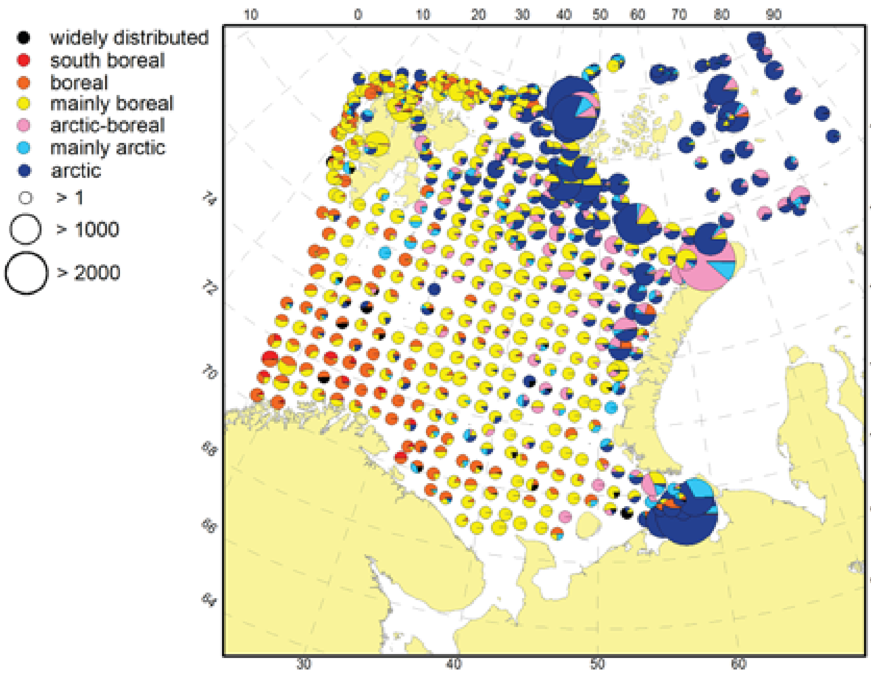


Figure 8.2.3.1. Distribution of non-commercial fish species from different zoogeographic groups during the ecosystem survey 2013. Size of circle corresponds to abundance (thousand individuals per nautical mile, only bottom trawl were used, both pelagic and demersal species are included).

8.2.4 Rarely found species

By T. Prokhorova, A. Dolgov, P. Krivosheya and E. Johannesen

Figures by P. Krivosheya

Some uncommon species were observed in the Barents Sea during the ecosystem survey in 2013 (Figure 8.2.4.1). Most of these were observed along the border of the surveyed area and belong to the ecosystems which border the Barents Sea (e.g. witch flounder Glyptocephalus cynoglossus which is distributed on both sides of the Atlantic Ocean, black seasnail Paraliparis bathybius and threadfin seasnail Rhodychthys regina which are distributed in the Arctic polar basin).

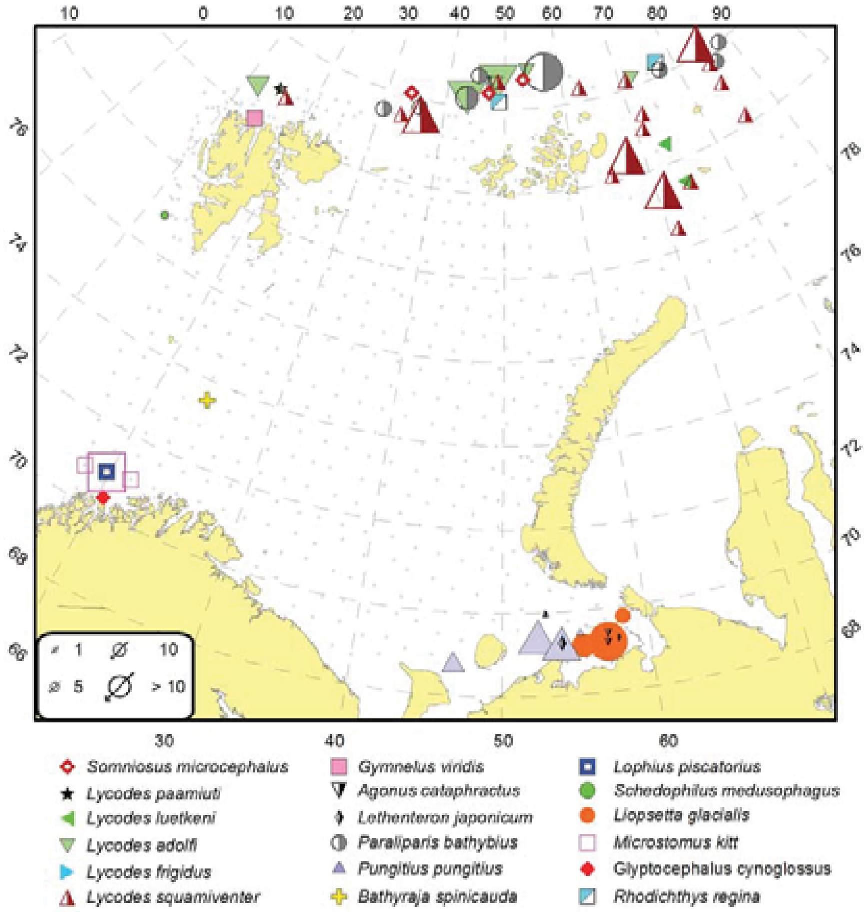


Figure 8.2.4.1. Distribution of species that are rare in the Barents that were found in the survey area in 2013.

9 Marine mammals and seabird monitoring

9.1 Marine mammals

Text by M. Mauritzen and R. Klepikovsky
Figures by M. Mauritzen

In total 1485 individuals of 12 identified species of marine mammals were observed in August-October 2013. A summary of the observations is presented in Table 9.1.1 and Figures 9.1.1-9.1.3. As in previous years, the most often observed species was white-beaked dolphins (about 55% of all registrations). Groups of white-beaked dolphins were observed in the southern Atlantic Water and up to 81°N by Franz Josef Land. Compared to earlier years (e.g. 2003-2007), the dolphin distribution have shifted northwards, with fewer observations in Atlantic Water and more observations north of the polar front. The toothed whales were also represented by killer whales, harbour porpoises and sperm whales. The sperm whales were observed in association with the Bear Island Trough, but also in the shallower south central Barents Sea. Small groups of harbour porpoises were observed in the southern and the eastern Barents Sea up to 73°N. Killer whales were observed in the north, in the southwest and south of Storfjorden, in the Svalbard archipelago.

Among the baleen whales, minke whales, humpback whales and fin whales were most frequently observed (about 38% of all observations). As in 2012, the number of minke whale observations was low, whereas the number of humpback whales observed was relatively high. These whales were predominantly observed in dense concentrations on the banks east of the Svalbard archipelago, while fewer individuals were observed in the central and the south-eastern parts of the Barents Sea compared to previous years. Six blue whales were observed along the northern shelf break and in the Hinlopen straight.

Few seals were observed during the ecosystem survey. Harp seals were recorded around the Svalbard archipelago, and along the northern shelf break at 81°N. Walruses were single animals observed at 80°N, north of west Spitsbergen and between Svalbard and Franz Josef Land. Also the bearded seals were observed along the northern shelf break.

Table 9.1.1. Number of marine mammal individuals observed from the research vessels "Johan Hjort", "Helmer Hanssen", "G.O. Sars", and "Vilnyus" during the ecosystem survey 2013.

Order / suborder	**Name of species (English)**	**Johan Hjort**	**Helmer Hanssen**	**G.O. Sars**	**Vilnyus**	**Total**	**%**
Cetacea/ Baleen whales	Blue whale	-	6	-	-	6	0.40
	Fin whale	65	26	19	17	127	8.55
	Humpback whale	275	6	2	40	323	21.75
	Minke whale	74	9	5	33	121	8.15
	Unidentified whale	-	2	-	-	2	0.13
Cetacea/ Toothed whales	Sperm whale	1	-	5	1	7	0.47
	Killer whale	6	-	6	1	13	0.88
	Harbour porpoise	-	-	-	31	31	2.09
	White-beaked dolphin	241	112	291	170	814	54.81
	Harp seal	26	4	-	6	36	2.42
	Bearded seal	-	1	-	-	1	0.07
Pinnipedia	Walrus	1	-	-	1	2	0.13
Other	Polar bear	-	-	-	2	2	0.13
Total sum		**689**	**166**	**328**	**302**	**1485**	**100**

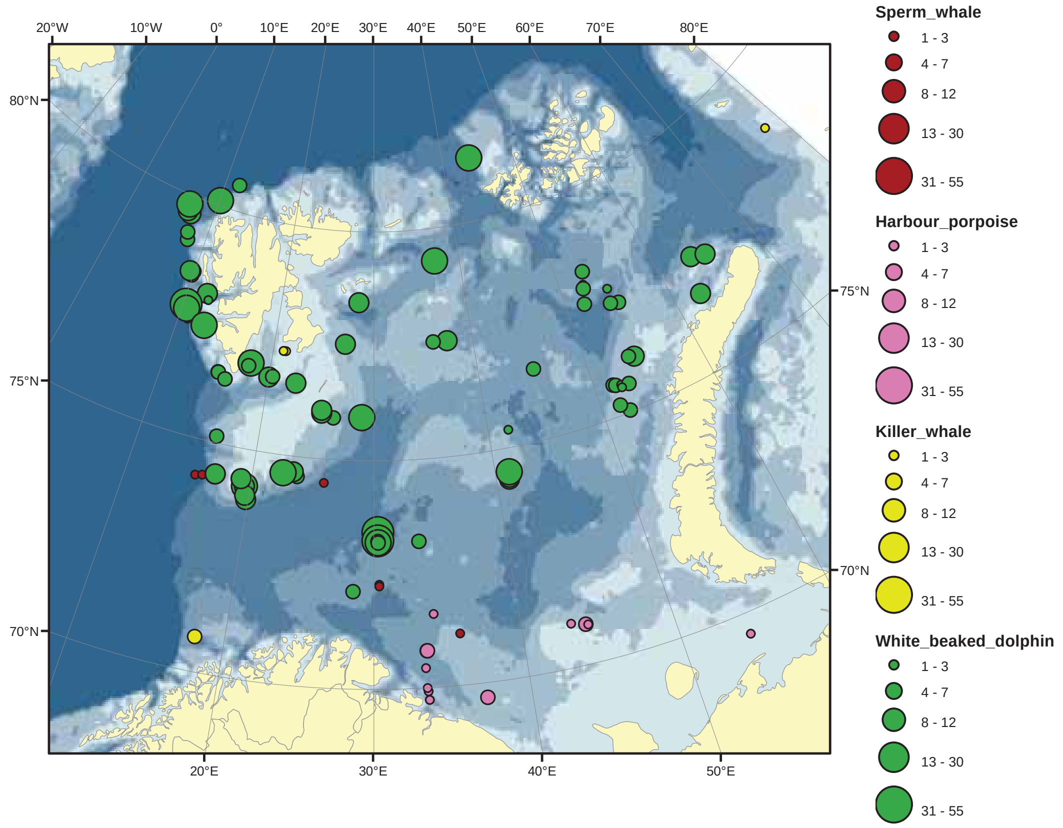


Figure 9.1.1. Distribution of toothed whales observed in August-October 2013.

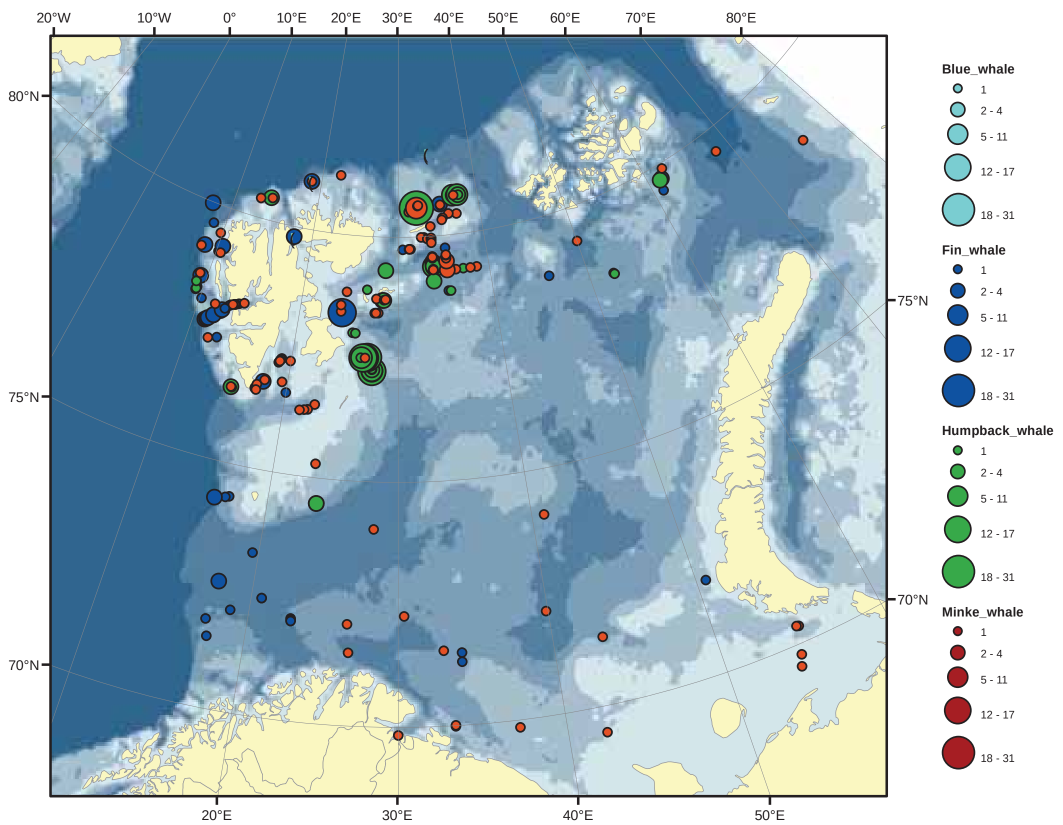


Figure 9.1.2. Distribution of baleen whales observed in August-October 2013.

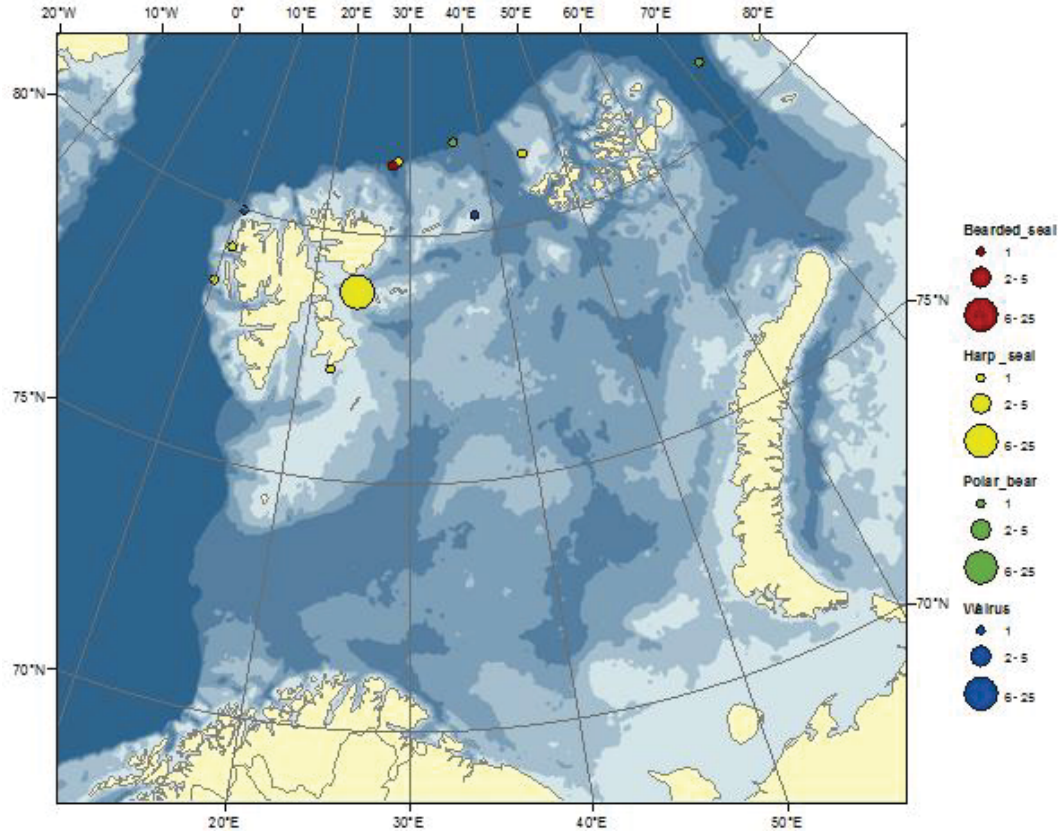


Figure 9.1.3. Distribution of pinnipeds and polar bears observed in August-October 2013.

9.2 Seabird observations

Text by M. Mauritzen and R. Klepikovsky
Figures by M. Mauritzen

Seabird observations were carried out by standardized strip transect methodology. Birds were counted from the vessel's bridge while the ship was steaming at a constant speed of ca. 10 knots. All birds seen within an arc of 300 m from directly ahead to 90° to one side of the ship were counted. On the vessels "Helmer Hanssen", "G.O. Sars" and "Johan Hjort", birds following the ship i.e. "ship-followers", were counted as point observations within the sector every ten minutes. Ship-followers included the most common gull species and Northern fulmar. Total transect length covered by the Norwegian vessels ("Helmer Hanssen", "G.O. Sars" and "Johan Hjort") was 6294 km. Total transect length covered by "Vilnyus" was 8630 km.

A total of 85 772 birds belonging to 32 different species were counted (Table 9.2.1). The density of seabirds was somewhat lower than in 2012, most notably in the southern areas (Figure 9.2.1). Similar to previous surveys, the highest density of seabirds was found north of the polar front. These areas were dominated by Brünnich's guillemots (Uria lomvia), little auk (Alle alle), kittiwake (Rissa tridactyla) and Northern fulmar (Fulmarus glacialis).

The distribution of the different species was similar to the distribution in previous surveys (Figure 9.2.1). Alcids were observed throughout the study area but the abundance and species distribution varied geographically. Little auks were found in the northern area, Brünnich's guillemots were found in the central and northern area, Atlantic puffins (Fratercula arctica) were found in the western area and common guillemots (Uria aalge) were found in the south-eastern area. Among the ship-followers, black-backed gulls (Larus marinus) and herring gull (Larus argentatus) were found in the south, close to the coast. Glaucous gull (Larus hyperboreus) was found in small numbers in the central western area, kittiwakes were found in high density in the north-east, while Northern fulmars were encountered in highest numbers in the west and south.

Table 9.2.1. List of species encountered during the survey in 2013. Note that ship-followers were counted differently on the Norwegian and Russian vessels.

English name	Scientific name	Norwegian vessels	Russian vessel
Razorbill	*Alca torda*	0	1
Little auk	*Alle alle*	199	364
Pipit sp.	*Anthus sp.*	0	1
Brent goose	*Branta bernicla*	0	5
Purple sandpiper	*Calidris maritima*	1	4
Black guillemot	*Cephus grylle*	33	33
Ringed plover	*Charadrius hiaticula*	0	20
Atlantic puffin	*Fratercula arctica*	649	60
Northern fulmar*	*Fulmarus glacialis*	56178	4194
Herring gull*	*Larus argentatus*	2571	120
Heuglin's gull*	*Larus heuglini*	0	65
Glaucous gull*	*Larus hyperboreus*	263	133
Great black-backed gull*	*Larus marinus*	3237	104
Red-breasted Merganser	*Mergus serratus*	0	5
Northern gannet	*Morus bassanus*	14	4
Western Yellow Wagtail	*Motacilla flava*	0	3
Ivory gull	*Pagophila eburnea*	1	63
Cormorant	*Phalacrocorax sp.*	0	1
Great cormorant	*Phalacrocorax carbo*	1	0
Snow bunting	*Plectrophenax nivalis*	3	2
Sooty shearwater	*Puffinus griseus*	10	4
Manx Shearwater	*Puffinus puffinus*	0	1
Black-legged kittiwake	*Rissa tridactyla*	3947	2915
Common eider	*Somateria mollissima*	0	7
King eider	*Somateria spectabilis*	0	2
Long-tailed skua	*Stercorarius longicaudus*	2	1
Arctic skua	*Stercorarius parasiticus*	140	47
Pomarine skua	*Stercorarius pomarinus*	103	305
Great skua	*Stercorarius skua*	21	1
Unident. Skua	*Stercorarius sp.*	6	0
Arctic tern	*Sterna paradisaea*	296	6
Common guillemot	*Uria aalge*	13	42
Brünnich's guillemot	*Uria lomvia*	2980	6453
Unspec. guillemot	*Uria* spp.	92	46
Total		70760	15012

*Ship followers

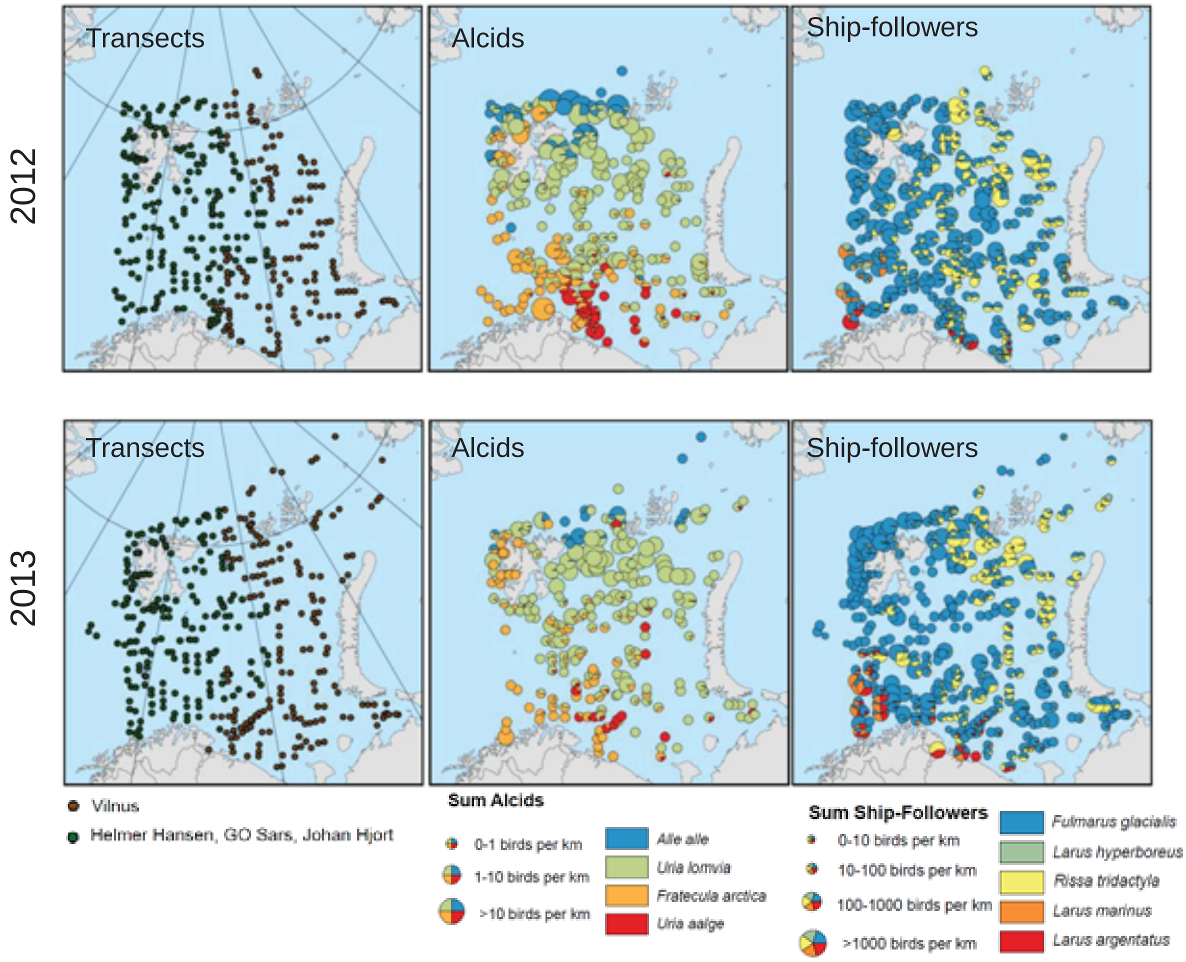


Figure 9.2.1. Seabird observations in 2012 (top) and 2013 (bottom). Left panel: positions of transects, middle panel: distribution of auks, right panel: distribution of ship-followers (gulls and fulmar).

10 Special investigations

10.1 Standardization of survey equipment and testing of DeepVision

10.1.1 Trials of inner net to reduce clogging of Harstad trawl-net by small fish

Text by A. Engås, E. Eriksen, A. Pavlenko, T. Prokhorova, J.T. Øvredal, A. Aasen
Figures by A. Engås and A. Pavlenko

Introduction

The DeepVision camera system has been developed by Scantrol AS to register and identify organisms that pass the system during trawling (Rosen et al., 2013). During a cruise with the R/V "Johan Hjort" in connection with the Joint Norwegian/Russian Ecosystem survey in the Barents Sea in 2012, the DeepVision system was installed between the extension and the codend of the Harstad trawl used for sampling in the upper pelagic zone.

The trials showed that it was possible to identify, quantify and measure the length of most of the individual fish that passed the DeepVision system during trawling (Rosen et al., 2013). When the trawl was hauled after standard trawling procedures had been completed (trawling at three depths), the observations showed that significant numbers of 0-group polar cod and Greenland halibut had passed the camera system, particularly at the surface. On the basis of these observations, we assumed that these were fish that had been snagged in the meshes ahead of DeepVision during trawling and had come loose when the net was hauled. When the trawl was brought on board, fish were found still snagged in the net, particularly in the smaller meshes (60 and 80 mm).

The reason that snagged fish come loose and pass the DeepVision system, particularly near the surface, is that the net is both slackened and tightened during this phase of hauling (for instance, when the trawl-doors reach the gallows), and this tends to release the fish. Wave motion at the surface can also affect the trawl net in ways that cause the fish to be released.

Variations in hauling procedures and weather conditions can thus influence how many fish are released from the meshes, and thus also the total catch and the index that is calculated on the basis of the catch rate. The fact that fish become snagged in the meshes also indicate that an unknown number also pass out through the meshes of the trawl and are not retained in the catch.

In the Norwegian krill fishery in the Antarctic, the problem of krill clogging the meshes during towing was solved by the addition of fine-mesh inner nets that were mounted only at the leading edge to the outer net (200 mm mesh). The inner nets are produced in 8m-long sections that overlap by about 1.5 m. Since the sections are only attached at the leading edge to the outer net, the water flow keeps them in movement, thus preventing krill clogging.

During the 2012 cruise, measurements of the geometry of the Harstad trawl showed that the vertical and horizontal dimensions of the mouth of the trawl changed with warp length and depth. For example, the vertical opening was reduced from 16 m to about 10 m when the headline was lowered from the surface to a depth of 30 m. In order to be able to trawl on the surface using current techniques and equipment, a short warp length is required, which means that the trawl doors are unable to spread the trawl sufficiently. This leads to a high vertical opening and a narrow horizontal spread at the surface. As the warp length is increased, the spread of the doors and trawl wing increases, thus reducing the vertical opening of the net. These changes in the geometry of the net probably mean that the efficiency of the trawl is not constant at different depths.

The principal aim of this cruise was to test whether an inner net similar to that used in the Antarctic could prevent clogging and the loss of small organisms during towing of the Harstad trawl. We also wished to test whether lightweight Spectra sweep instead of a wire sweep could reduce the problem of insufficient spread at the surface, such as we had observed during the cruise in 2012.

Materials and methods

The trials were carried out in September 2013 on board R/V “Johan Hjort” off the coast of Finnmark. A total of 13 hauls were made with a Harstad trawl. The trawls were rigged with the same combination of warps, floats and weights as for the Joint Ecosystem Survey, except for hauls 11 – 13 (see below).

Scanmar trawl instrumentation was used to measure the trawl geometry at various positions and for measurements of the speed of the trawl through the water. For measurements of water velocity in the extension, the sensor was mounted on a frame such that the distance from the sensor to the net was about 30 cm. A GoPro underwater camera without artificial lighting was used to monitor the inner nets and observe the behaviour of the fish and other organisms.

Hauls 1 – 4 and 9 – 10:
A no. 36 Harstad trawl was used for these hauls. For hauls 1 – 4, the trawl was rigged with a 30 m codend with a 22 mm mesh. For the rearmost 9.8 m, netting with an 8 mm mesh was used (mounted inside the 22 mm mesh).

Four inner nets (8 mm mesh), each 6 m long, were used (Figure 10.1.1.1). The front part of the leading inner net was mounted about 2.5 m from the front part of the 120 mm mesh of the trawl-net itself (Figure 10.1.1.2). The panels overlapped by about 1.5 m, and the end of the rearmost inner net was about 1.5 m inside the codend.

For hauls 9 and 10, the trawl was rigged in the same way as for hauls 1 - 4, except that the codend was constructed of 8 mm mesh netting (a protective cover was mounted outside the net).

Hauls 5 – 8 and 11 – 13:
A no. 32 Harstad trawl was used for these hauls. For hauls 5 - 8 and 11 - 13, the trawl was rigged in the same way as for hauls 1 - 4, except that inner nets were not rigged in the panels from 120 mm mesh and further back to the codend. The aims of hauls 5 – 8 was to observe whether the inner nets ahead of the codend affected trawl geometry and water flow in that area.

During haul 13, tests were carried out to map the effects on the geometry and position of the trawl in the water column when 80 m Spectra sweeps were rigged.

Results and discussion

The underwater observations showed that the inner nets functioned as intended (Figure 10.1.1.3). The inner nets, particularly their rear parts, were in continuous motion, which meant that small organisms did not become snagged during towing. The mesh size of only 8 mm also prevented small fish from escaping from the net.

Measurements of the geometry of the two trawls, both with and without the inner nets mounted, showed that it was very similar when the leading inner net was mounted on the trawl itself (about 2.5 m in front of the rear end of the 120 mm mesh panel).

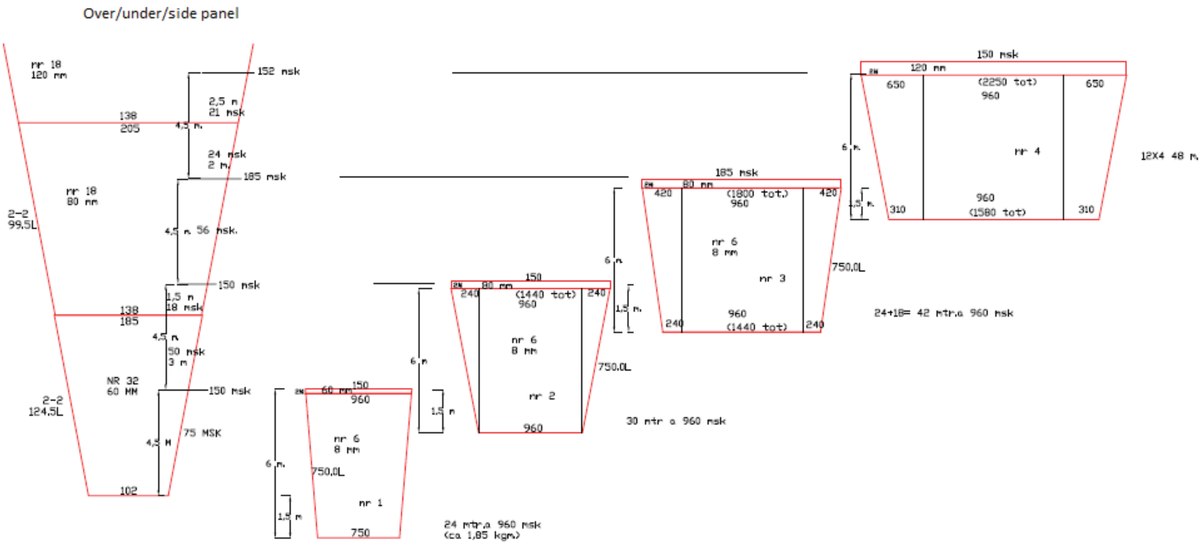


Figure 10.1.1.1 Drawing of extension of the Harstad trawl and the four inner nets. Mounting positions of inner nets in extension of the trawl are indicated

Figure 10.1.1.2. Front part of the inner net mounted to the 120 mm mesh of the trawl net itself.

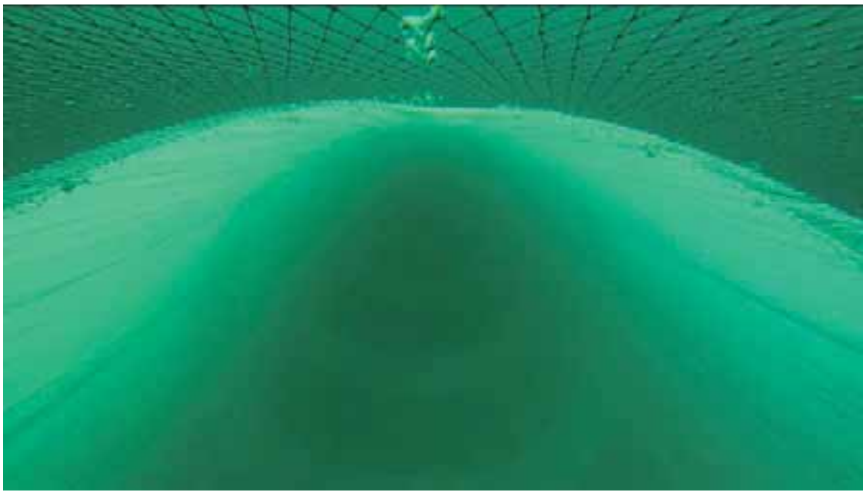


Figure 10.1.1.3. Observation of the front part of the inner net mounted to the 120 mm mesh of the trawl net itself (looking towards the codend).

With a warp length of 150 m, the vertical opening was about 6 m in this area, while the horizontal opening was around 5 m. At the entrance to the codend, the geometry changed; with the inner nets installed, the vertical and horizontal openings were about 3.6 m and 3.4 m respectively, while without the nets they were 1.5 m and 1.4 m respectively. The difference in the dimensions of the opening at the entrance to the codend was also observed via the video camera.

These measurements and observations show that the fine-mesh inner net helps to increase entrance diameter of the codend (Figure 10.1.1.4). In the area where the inner nets are mounted, the trawl is cut at a high angle, and we believe that the increased dimensions are due to a combination of the high angle and the fine mesh, which balloons out as it is drawn through the water.

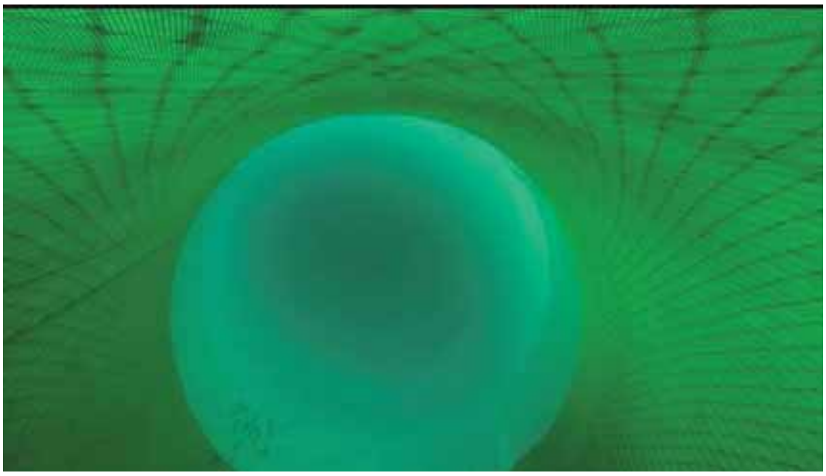


Figure 10.1.1.4. Observation of the aft part of the last inner net (front entrance of the codend, looking towards the trawl opening). Small herring observed in the lower left part of the picture.

Water flow sensors mounted at the headline and the rear of the trawl (in the areas of 120 mm mesh where the inner net was mounted and the entrance of the codend) showed that there was no difference in flow by position on with and without the inner nets.

Catch rates were low in these trials. The underwater observations made during hauls 1 – 4, in which the inner nets were deployed, showed that capelin fry were carried by the flow when they passed the end of the last inner net (about 1.5 m inside the codend) and through the 22 mm meshes in the codend at the end of the final inner net. Clogging by capelin fry was also demonstrated in this area, when the trawl was brought on deck. In order to prevent this from happening, a codend with a mesh of only 8 mm was successfully deployed in the remaining hauls.

The trials using the Spectra (light synthetic) bridles (length: 80 m) showed that it was possible to trawl with the headline at the surface with a warp length of up to 170 m. Using wire bridles (standard length: 120 m) the headline could only be kept at the surface with warp length of approximately 80 m. Due to problems with the trawl instrumentation, the vertical and horizontal openings of the trawl were not measured during the trials with Spectra sweeps.

The way ahead

The trials using inner nets attached to the leading edge of the actual trawl functioned according to expectations. The fine-meshed inner nets were in continuous motion during towing, and prevented the trawl from becoming clogged by fish and other organisms, and also hindered fish losses through the meshes.

In further efforts to develop a representative sampling trawl for the upper pelagic zone, the following objectives should be achieved: the trawl must maintain a constant geometry at all depths sampled and should have a well-defined catch area that does not become clogged or lose organisms.

The trawls used in the Antarctic krill fisheries used a large-meshed (200 mm) outer net as a framework to attach the leading edge of the inner nets. By using a similar outer net with large (200 mm or more) square meshes in a four-panel trawl, two objectives can be achieved: a) the trawl's maximum horizontal spread will be limited by the bar length of the meshes in the mouth area. By using trawl doors with a high spread capability in combination with short Spectra sweeps, this can be obtained during surface trawling and the net geometry will not change when either depth or warp length increase. If Spectra sweeps are used in place of wire sweeps, trawling just behind the vessel in the propeller wake can be avoided; b) the narrow-mesh inner nets used in the above-mentioned trials were mounted on the outer net from an area that covers a given height and width, which thus constitutes the catch area for small fish, within which losses through the meshes and clogging fish are minimised.

In order for the new trawl design to efficiently also capture large fish the size of the trawl mouth must be found. Due to towing resistance, it will not be possible to deploy inner nets to cover an similar area to that in the Harstad trawl. If the trawl mouth needs to be similar in size to the Harstad trawl it would be possible to use square meshes ahead of the inner nets in order to obtain an effective trawl opening for large fish. With square meshes, the chances of fish clogging the net will be reduced to a minimum (based on previous trials).

10.2 Nets inter calibration

10.2.1 Methods of the plankton nets inter calibration

Text by I. Prokopchuk and P. Dalpadado
Figures by I. Prokopchuk

In August 2013 on board of the Norwegian R/V "Johan Hjort" it was planned to conduct specialized work on inter calibration of plankton sampling gears used at the ecosystem cruises in the Barents Sea. Juday net (opening diameter 0.11 m2, mesh size 180 μm) is used at PINRO and WP2 (opening diameter 0.25 m2, mesh size 180 μm) is used at IMR as well as MOCNESS, a multiple opening/closing net and environmental sensing system for sampling zooplankton (Wiebe et al., 1976; 1985) (opening diameter 1 m2, mesh size 180 μm). To make simultaneous vertical hauls Juday and WP2 nets were mounted on a frame previously made at IMR (Figure 10.2.1.1).

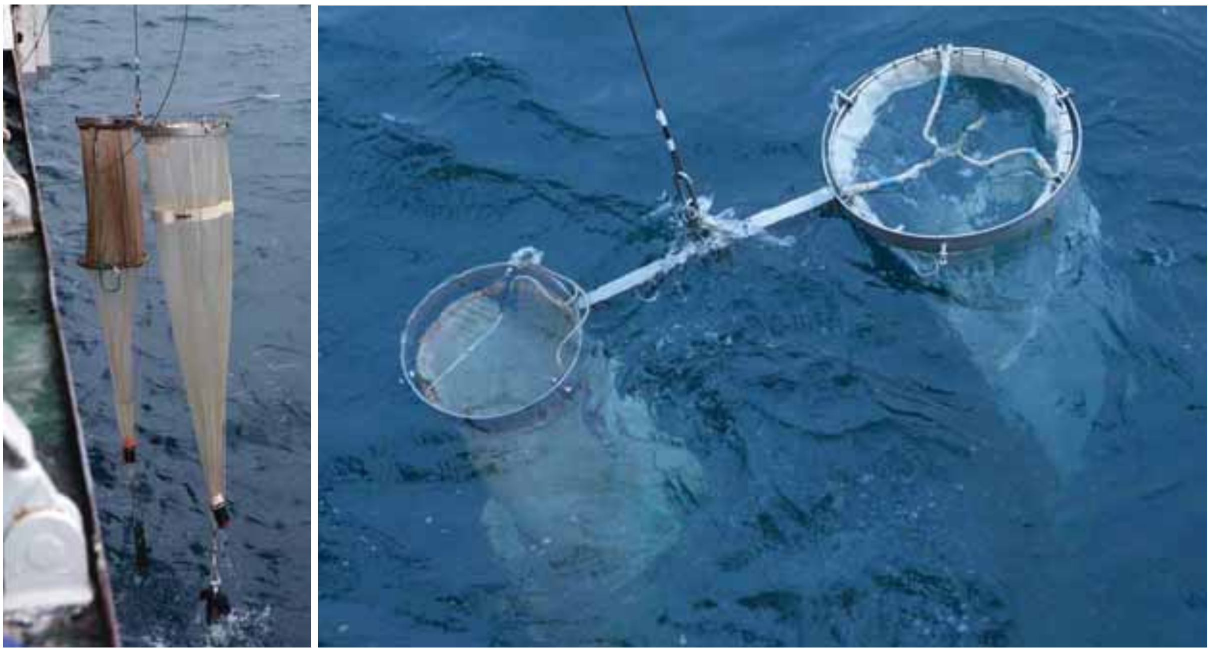


Figure 10.2.1.1. The frame with Juday and WP2 nets for simultaneous catch of plankton.

The inter calibration was conducted on 20 August 2013 in the fjord of the west part of Spitsbergen (78°07’N and 13°12’E) over depth 250 m. Sampling was started at 1 a.m. At first, an oceanography station with collecting water for nutrients and chlorophyll a, and phytoplankton sampling were carried out. Thereupon it was done the first set of plankton sampling by Juday and WP2 nets, vertical hauls from the bottom to the surface. There were conducted 10 replicates with hauling speed of 0.5 m/s and 10 replicates with the speed of 1.0 m/s. The second set of plankton sampling was started at noon and 10 replicates with hauling speed of 0.5 m/s and 10 replicates with the speed of 1.0 m/s were made. After each sampling set by Juday and WP2 nets, plankton was collected using MOCNESS at the layers bottom-100, 100-50, 50-25 and 25-0 m. In total 80 samples by Juday and WP2 nets and 8 samples by MOCNESS were collected. Preliminary samples processing on board of the R/V was conducted according to standard procedures accepted at IMR. All the samples were delivered to IMR at the end of the cruise.

10.2.2 Preliminary results of the inter calibration of Juday and WP2 nets

Text by I. Prokopchuk and V. Nesterova
Figures by I. Prokopchuk

In October 2013 species composition and plankton abundance of 20 plankton samples (10 pair samples) were analyzed. The samples were collected during inter-calibration of Juday and WP2 nets in August 2013 on board of RV “J. Hjort”. 10 samples were collected with the hauling speed 0.5 m • s-1 and 10 samples were collected with the speed 1.0 m • s-1.
Results of the inter calibration Juday and WP2 nets showed low variability between samples (Figure 10.2.2.1). The values of plankton biomass (dry weight, mg•m-3) by Juday and WP2

nets catches were very similar. Plankton biomass was 16 % higher by WP2 net catches, than by Juday net catches, and in some cases it was 9 % higher by Juday net catches. Biomass of plankton, sampled with the hauling speed of 1.0 m • s-1 (samples 11-15) was 36 % higher than that sampled with the speed of 0.5 m • s-1 (samples 1-5) by Juday net catches and 40 % higher by WP2 nets catches.

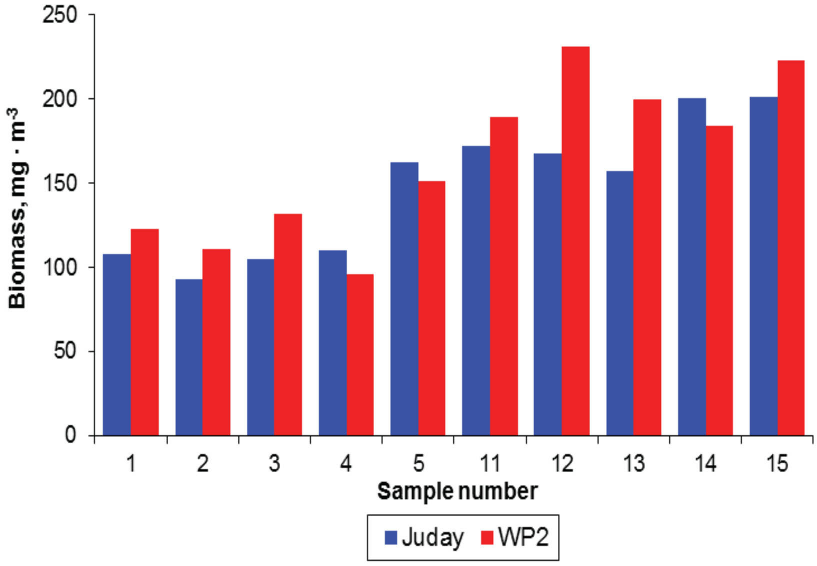


Figure 10.2.2.1. Plankton biomass (d weight, mg • m-3) variability in the area of inter-calibration of Juday and WP2 nets. Samples 1-5 were collected with the speed 0.5 m • s-1 and samples 11-15 were collected with the speed 1.0 m • s-1.

Total abundance of plankton substantially varied between samples, especially at the hauling speed 0.5 m • s-1 (Figure 10.2.2.2A). Plankton abundance in 4 of 5 pair samples collected at the speed 0.5 m • s-1 was higher by WP2 net catches. At the speed 1.0 m • s-1 plankton abundance in 3 of 5 pair samples was higher for Juday net catches, and in 2 pair samples abundance was almost equal (Figure 10.2.2.2A).

Copepods were dominant group of plankton in terms of abundance (Figure 10.2.2.2B). Their abundance varied between samples and comprised 61-88 % of total plankton abundance by Juday net catches and 40-83 % by WP2 net catches. Plankton abundance was higher by Juday net catches in 3 of 5 pair samples collected at the speed 0.5 m • s-1, and in 4 of 5 pair samples at the speed 1.0 m • s-1 (Figure 10.2.2.2B). The most numerous were small copepods of genus Oithona (mainly Oithona similis) (Figure 10.2.2.3). Their abundance was 48-73 % of the total copepods abundance by Juday net catches and 41-85 % by WP2 net catches. Three Calanus species (C. glacialis, C. hyperboreus, and C. finmarchicus) were presented in the samples, but the most numerous one was C. finmarchicus and dominated in plankton biomass. Its abundance varied from 7 to 28 % by Juday net catches and from 6 to 24 % by WP2 net catches. Abundance of Pseudocalanus sp. not exceeded 14 %.

In conclusion it is necessary to note, that in order to make proper analysis of the data and statistical calculations, processing all 80 samples (40 pair samples) is required. Presented preliminary results are based on analysis of 20 samples (10 pair samples). In order to reduce discrepancy of samples processing, all the samples should be processed by the same specialists.

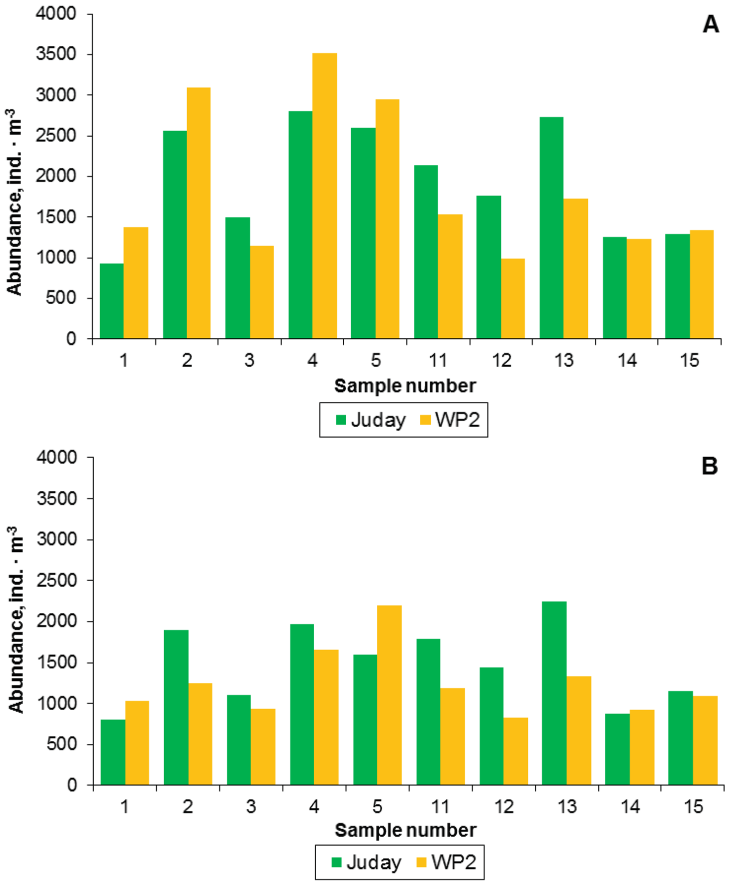


Figure 10.2.2.2. Total plankton abundance (A) and copepods abundance (B) (ind. · m^{-3}) by Juday and WP2 nets catches.

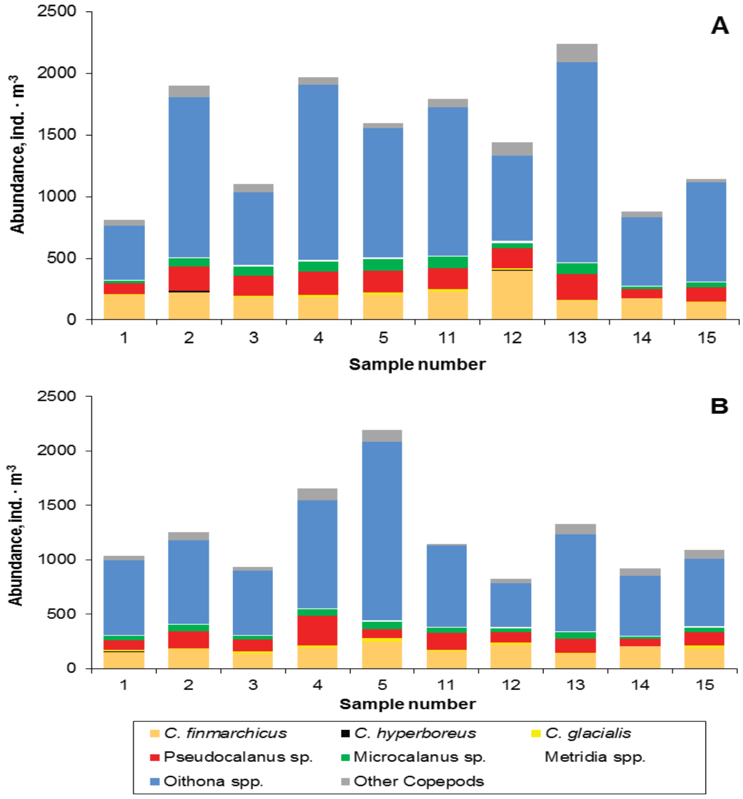


Figure 10.2.2.3. Copepods abundance (ind. • m-3) by Juday (A) and WP2 (B) nets catches.

11 Technical report

From 2003, the survey has been part of a joint Barents Sea autumn ecosystem survey (BESS), designed and carried out in cooperation between the Institute of Marine Research (IMR), Norway and the Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO). Most aspects of the ecosystem are covered, from physical and chemical oceanography, pollution, garbage, phytoplankton and zooplankton to fish (both young and adults), sea mammals, benthic invertebrates and birds.

The 10th joint Barents Sea autumn ecosystem survey (BESS) was carried out during the period from 9th August to 31st October 2013. The state of the ecosystem of the Barents Sea, the northern Kara Sea and a part of the Arctic basin was observed during the survey. Three Norwegian ("Johan Hjort", "G.O. Sars" and "Helmer Hanssen") and one Russian ("Vilnys") research vessels participated in the BESS in 2013. All research vessels spent more days on the survey than in 2012 (178 vs 154) due to "Vilnyus" had extra-days. But most of these extra-days were the bunkering and time loss during the military activity. So the quantity of working days the 2013 survey was approximately the same as in 2012. But the surveyed area in 2013 was larger than in the previous year due to the investigations in the northern Kara Sea and areas north of Franz Josef Land. In general, all the tasks have been completed, and the weather conditions were favorable for the work.

"Technical Report" presentes all types of deviations from the standards presented in the "Sampling Manual". In addition to the standard monitoring of the Barents Sea, several studies and experiments are carried out.
(http://www.imr.no/tokt/okosystemtokt_i_barentshavet/sampling_manual/nb-no).

11.1 Deviations from the standards presented in the "Sampling Manual"

Text by T. Wenneck and D. Prozorkevich
Equipment:
1: Differences in trawl rigging and trawl procedure between PINRO and IMR vessels as well as among all the vessels of both institutes are present. So both pelagic and bottom trawls need calibrating.

11.2 Special investigations

Some special investigations were carried out during the Ecosystem survey in the Barents Sea in 2013. Description of aim, methods and some results of special investigations are given in chapters 10.1 Standardization of survey equipment and testing of DeepVision and 10.2 Nets inter calibration.

12 Acknowlegements

Preparing and conducting of ecosystem survey requires an enormous effort and knowledge. Every year in survey large number of people involved.

Special thanks to crew of research vessels “Helmer Hanssen”, “Johan Hjort”, “G.O.Sars” and “Vilnyus” for ensuring the investigation and good work.

We are thankful to the scientific staffs both in Norway and Russia that have organized and participated in the surveys and those in Institutes who have analysed the samples.

We thank Alexander Trofimov, Nikolay Ushakov and Irina Prokopchuk for help with English translates and remarks.

We also thank The Barents Sea Program at the IMR and PINRO for funding.

13 References

Andriyashev, A.P. and N.V. Chernova, 1994 Annotated list of fishlike vertebrates and fish of the arctic seas and adjacent waters. V. Ichthyol. 34(4): 435-456 (in Russian)

Anon., 2004. IMR/PINRO 2/2004 Proceedings international 0-group fish survey Barents sea 1965-1997 part 2. IMR/PINRO Joint Report Series, No. 2/2004. pp. 90-102

Dolgov AV. 1994. Some aspects of biology of non-target fish species in the Barents Sea. ICES C.M. 1994/O:12. 23 pp.

Eriksen E., Prokhorova T., and Johannesen E. 2012. Long term changes in abundance and spatial distribution of pelagic Agonidae, Ammodytidae, Liparidae, Cottidae, Myctophidae and Stichaeidae in the Barents Sea. In: M. Ali (ed.) Diversity of Ecosystems, ISBN: 978-953-51-0572-5, InTech, Croatia, pp. 107-126

ICES. 2013. Report of the Ad hoc Group on the Distribution and Migration of Northeast Atlantic Mackerel (AGDMM). ICES CM 2013/ACOM:58. 215 pp.

Jørgensen. L. and Rosen, S. 2012. Arctic and boreal benthic process and function (ArcProFun) and Deep Sea Vision. In: Eriksen, E. (Ed.) Survey report from the joint

Norwegian/Russian ecosystem survey in the Barents Sea August-October 2012. IMR/PINRO Joint Report Series, No. 2/2012. ISSN 1502-8828, 193 pp.

Kaartvedt, S., Staby, A.and Aksnes, D. L. 2012 Efficient trawl avoidance by mesopelagic fishes causes large underestimation of their biomass. Mar. Ecol. Prog. Ser., 456: 1–6.

Mecklenburg CW, Møller PR, Steinke D (2010) Biodiversity of arctic marine fishes: taxonomy and zoogeography. Mar Biodivers 41:109–140 and Online Resources 1–5. doi:10.1007/s12526-010-0070-z

Parin,N.V. 1968. Ichthyophauna of the oceanic pelagial. “Nauka”, Moscow, 185 pp. (in Russian)

Parin, N.V. 1988. Fishes of the open ocean. “Nauka”, Moscow. 272 pp. (in Russian)

Rosen, S., Jörgensen, T., Hammersland-White, D and Holst, J.C. 2013. DeepVision: a stereo camera system provides highly accurate counts and lengths of fish passing inside a trawl. Canadian Journal of Fisheries and Aquatic Sciences, 2013, 70(10): 1456-1467.

Stenevik E.K., Alvarez J., Gill HA and Rey A. 2012. Cruise report from RV “Håkon Mosby” 28.03-12.04.2012. Distribution and abundance of Norwegian spring spawning herring larvae on the Norwegian shelf in March - April 2012

Stenevik E.K., Alvarez J., Karlson S. and Rey A. 2013. Cruise report from RV “Håkon Mosby” 02 - 18.04.2013. Distribution and abundance of Norwegian spring spawning herring larvae on the Norwegian shelf in April 2013

Wiebe P.H., Burt K.H., Boyd S.H., Morton A.W. A multiple opening/closing net and environmental sensing system for sampling zooplankton // Journal of Marine Research. –1976. – Vol. 34. – pp. 313–326

Wiebe P.H., Morton A.W., Bradley A.M., Backus R.H., Craddock J.E., Cowles T.J., Barber V.A., Flierl G.R. New developments in the MOCNESS, an apparatus for sampling zooplankton and micronekton // Marine Biology. – 1985. – Vol. 87. – pp. 313-323

Wienerroither R. at al. 2011. Atlas of the Barents Sea Fishes. IMR/PINRO Joint Report Series 1-2011. ISSN 1502-8828. 272 pp.

Wienerroither R. at al. 2013. Atlas of the Barents Sea Fishes based on the winter survey. IMR/PINRO Joint Report Series 2-2013. ISSN 1502-8828. 220 pp.

Appendix 1. Vessels and participants of the Ecosystem survey 2013

Prepared by P. Krivosheya and T. Wenneck

Research vessel	Participants
"Vilnyus" (09.08- 01.11)	D. Prozorkevich (cruise leader), A. Amelkin, V. Barakov (16.09-01.11), A. Benzik, N. Ibragimova, S. Ivanov (09.08-13.09), Y. Kalashnikov, S. Kharlin, R. Klepikovsky, P. Krivosheya, I. Malkov, A. Mashnin (16.09-01.11), M. Nosov, A. Trofimov, V. Vyaznikova (09.08-13.09).
"G.O. Sars" (23.08 – 19.09)	Part 1 (23.08 – 11.09) S. Mehl (cruise leader), I. Beck, O. Didenko, J. Ford, G. Franze, P. Fossum, A. Golikov, T. Haugland, I. Henriksen, Y. Hunt, K. Kvile, B. Kvinge, A. Rey, J. Røttingen, T. Sivertsen, J. Skadal, I. Slipko, T. Thangstad, A. Staby. Part 2 (11.09 – 19.09) P. Fossum (cruise leader), B. Axelsen, G. Bakke, J. Ford, A. Golikov, T. Haugland, K. Kvile, B. Kvinge, J. Lange, A. Rey, H. Senneset, J. Skadal, Ø. Sørensen, E. Strand.
"Johan Hjort" (14.08 – 01.10)	Part 1 (14.08 – 21.08) J. Rønning (cruise leader), L. Drivenes, J. Erices, M. Mjanger, S. Murray, I. Prokopchuk. Part 2 (21.08 – 11.09) E. Johannesen (cruise leader), A. Aasen, R. Degree, L. Drivenes, O. Dyping, J. Erices, E. Hermansen, A. Kristiansen, C. Landa, G. McCallum, M. Mjanger, S. Murray, T. Prokhorova, J. Rønning, B. Røttingen, A. Storaker, O. Zimina. Part 3 (11.09 – 27.09) J. Alvarez (cruise leader), E. Holm, A. Johnsen, S. Karlson, S. Kolbeinson, B. Krafft, M. Martinussen, G. McCallum, F. Midtøy, S. Murray, M. Nilsen, J. Nygaard, T. Prokhorova, B. Røttingen, J. Vedholm, A. Voronkov, J. Wilhelmsen, O. Zimina. Part 4 (27.09 – 01.10) E. Eriksen (cruise leader), A. Aasen, A. Engås, E. Holm, J. Nygaard, J. Øvredal, A. Pavlenko, T. Prokhorova, J. Rønning, J. Wilhelmsen.
"Helmer Hanssen" (19.08 – 01.09)	Part 1 (19.08 – 01.09) T. Wenneck (cruise leader), A. Abrahamsen, I. Ahlquist, A. Golikov, E. Grønningsæter, C. Irgens, A. Johnsen, T. Klevjer, A. Knag, E. Langhelle, G. Langhelle, G. Richardsen, S. Seim, K. Sunnanå, A. Sveistrup.

Appendix 2. Sampling of fish in the Ecosystem survey 2013

Prepared by P. Krivosheya and T. Prokhorova

Species are divided into **boreal** (includes widely distributed, south boreal, boreal and mainly boreal zoogeographic groups), **arctic** (includes arctic and mainly arctic zoogeographic groups) and **arctic-boreal**. Black genus name (Genus sp.) means that fish was identified only to the genus level and species of this genus belong to different zoogeographic groups. Length measurements present samples from bottom and pelagic trawl catches.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Agonidae	**Leptagonus decagonus/ Atlantic poacher**				12.8 (2-22)
	No of stations with samples	104	133	237	
	Nos. length measured	565	1464	2029	
	Nos. aged	-	59	59	
	Ulcina olrikii/ Arctic alligatorfish				6.5 (4-10)
	No of stations with samples	1	34	35	
	Nos. length measured	2	570	572	
	Nos. aged	-	-	-	
	Agonus cataphractus/ Hooknose				7.5 (7-8)
	No of stations with samples	-	2	2	
	Nos. length measured	-	2	2	
	Nos. aged	-	-	-	
Ammodytidae	**Ammodytes marinus/ Lesser sandeel**				8.7 (3-23)
	No of stations with samples	49	28	77	
	Nos. length measured	438	639	1077	
	Nos. aged	-	-	-	
Anarhichadidae	**Anarhichas sp./ Wolffish**				5.5 (5-6)
	No of stations with samples	2	-	2	
	Nos. length measured	2	-	2	
	Nos. aged	-	-	-	
	Anarhichas denticulatus/ Northern wolffish				71.5 (4-119)
	No of stations with samples	50	16	66	
	Nos. length measured	85	19	104	
	Nos. aged	-	11	11	
	Anarhichas lupus/ Atlantic wolffish				22.4 (3-86)
	No of stations with samples	79	17	96	
	Nos. length measured	495	89	584	
	Nos. aged	-	4	4	
	Anarhichas minor/ Spotted wolffish				33.1 (1-122)
	No of stations with samples	70	20	90	
	Nos. length measured	297	33	330	
	Nos. aged	-	9	9	
Argentinidae	**Argentina silus/ Greater argentine**				18.7(6-44)
	No of stations with samples	35	1	36	
	Nos. length measured	374	1	375	
	Nos. aged	5	-	5	
Centrolophidae	**Schedophilus medusophagus/ Brown ruff**				46.0
	No of stations with samples	1	-	1	
	Nos. length measured	1	-	1	
	Nos. aged	-	-	-	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Clupeidae	**Clupea harengus harengus/Atlantic herring**				9.1 (4-37)
	No of stations with samples	74	30	104	
	Nos. length measured	3559	655	4214	
	Nos. aged	485	102	587	
	Clupea pallasii suworowi/ Kanin herring				16.1 (4-29)
	No of stations with samples	-	13	13	
	Nos. length measured	-	991	991	
	Nos. aged	-	152	152	
	Clupea harengus/ Herring				6.8 (4-10)
	No of stations with samples	25	-	25	
	Nos. length measured	593	-	593	
	Nos. aged	-	-	-	
Cottidae	**Artediellus atlanticus/ Atlantic hookear sculpin**				7.6 (3-16)
	No of stations with samples	169	148	317	
	Nos. length measured	1975	2247	4222	
	Nos. aged	-	33	33	
	Gymnocanthus tricuspis/Arctic staghorn sculpin				11.8 (5-21)
	No of stations with samples	6	36	42	
	Nos. length measured	13	489	502	
	Nos. aged	-	115	115	
	Icelus bicornis/ Twohorn sculpin				6.0 (2-14)
	No of stations with samples	29	68	97	
	Nos. length measured	455	171	626	
	Nos. aged	-	33	33	
	Icelus spatula/ Spatulate sculpin				8.0 (4-14)
	No of stations with samples	5	16	21	
	Nos. length measured	9	110	119	
	Nos. aged	-	29	29	
	Myoxocephalus scorpius/ Shorthorn sculpin				4.6 (2-17)
	No of stations with samples	16	5	21	
	Nos. length measured	78	11	89	
	Nos. aged	-	4	4	
	Triglops murrayi/ Moustache sculpin				10.0 (3-17)
	No of stations with samples	74	26	100	
	Nos. length measured	490	131	621	
	Nos. aged	-	-	-	
	Triglops nybelini/ Bigeye sculpin				9.0 (3-14)
	No of stations with samples	39	103	142	
	Nos. length measured	433	3439	3872	
	Nos. aged	-	25	25	
	Triglops pingelii/ Ribbed sculpin				11.6 (2-19)
	No of stations with samples	21	36	57	
	Nos. length measured	154	453	607	
	Triglops sp./				3.9 (3-5)
	No of stations with samples	5	2	7	
	Nos. length measured	30	2	32	
	Nos. aged	-	-	-	
Cyclopteridae	**Cyclopterus lumpus/ Lumpsucker**				21.8 (3-50)
	No of stations with samples	119	36	155	
	Nos. length measured	426	97	523	
	Nos. aged	-	-	-	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Cyclopteridae	**Eumicrotremus derjugini/ Leatherfin lumpsucker**				5.2 (2-11)
	No of stations with samples	5	7	12	
	Nos. length measured	24	19	43	
	Nos. aged	-	-	-	
	Eumicrotremus spinosus/ Atlantic spiny lumpsucker				6.1 (2-10)
	No of stations with samples	20	9	29	
	Nos. length measured	77	49	126	
	Nos. aged	-	10	10	
Gadidae	**Arctogadus glacialis/ Arctic cod**				16.0 (6-24)
	No of stations with samples	6	14	20	
	Nos. length measured	13	19	32	
	Nos. aged	-	18	18	
	Boreogadus saida/ Polar cod				11.9 (2-29)
	No of stations with samples	144	202	346	
	Nos. length measured	5131	15124	20255	
	Nos. aged	945	620	1565	
	Eleginus nawaga/ Atlantic navaga				17.3 (6-31)
	No of stations with samples	-	13	13	
	Nos. length measured	-	1795	1795	
	Nos. aged	-	199	199	
	Enchelyopus cimbrius/ Fourbeard rockling				9.3 (2-27)
	No of stations with samples	6	-	6	
	Nos. length measured	6	-	6	
	Nos. aged	-	-	-	
	Gadiculus argenteus/ Silvery pout				11.9 (5-18)
	No of stations with samples	12	2	14	
	Nos. length measured	87	3	90	
	Nos. aged	-	-	-	
	Gaidropsarus argentatus/ Arctic threebearded rockling				25.8 (13-38)
	No of stations with samples	2	3	5	
	Nos. length measured	3	3	6	
	Nos. aged	-	3	3	
	Gadus morhua/ Atlantic cod				16.1 (3-130)
	No of stations with samples	425	336	761	
	Nos. length measured	54521	20798	75319	
	Nos. aged	1676	2638	4314	
	Melanogrammus aeglefinus/ Haddock				27.2 (1-76)
	No of stations with samples	305	125	430	
	Nos. length measured	8328	6787	15115	
	Nos. aged	386	922	1308	
	Merlangius merlangus/ Whiting				8.3 (4-47)
	No of stations with samples	16	-	16	
	Nos. length measured	138	-	138	
	Nos. aged	-	-	-	
	Micromesistius poutassou/ Blue whiting				26.7 (6-41)
	No of stations with samples	79	3	82	
	Nos. length measured	2739	3	2742	
	Nos. aged	2035	1	2036	
	Molva molva/ Ling				105.0
	No of stations with samples	1	-	-	
	Nos. length measured	1	-	-	
	Nos. aged	-	-	-	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Gadidae	**Pollachius virens/ Saithe**				53.0 (4-105)
	No of stations with samples	22	4	26	
	Nos. length measured	163	4	167	
	Nos. aged	-	-	-	
	Trisopterus esmarkii/ Norway pout				16.6 (3-24)
	No of stations with samples	43	21	64	
	Nos. length measured	1314	720	2034	
	Nos. aged	-	-	-	
Gasterosteidae	**Gasterosteus aculeatus/ Threespine stickleback**				6.7 (5-9)
	No of stations with samples	1	37	38	
	Nos. length measured	2	352	354	
	Nos. aged	-	-	-	
	Pungitius pungitius/ Ninespine stickleback				6.2 (5-12)
	No of stations with samples	-	5	5	
	Nos. length measured	-	19	19	
	Nos. aged	-	-	-	
Liparidae	**Careproctus sp./ Snailfish**				8.9 (3-19)
	No of stations with samples	43	12	55	
	Nos. length measured	72	42	114	
	Nos. aged	-	-	-	
	Careproctus micropus/				9.0 (5-18)
	No of stations with samples	-	21	21	
	Nos. length measured	-	77	77	
	Nos. aged	-	2	2	
	Careproctus ranula/ Scotian snailfish				9.1 (5-13)
	No of stations with samples	-	20	20	
	Nos. length measured	-	48	48	
	Nos. aged	-	3	3	
	Careproctus reinhardti/ Sea tadpole				11.2 (1-25)
	No of stations with samples	-	66	66	
	Nos. length measured	-	225	225	
	Nos. aged	-	22	22	
	Liparis fabricii/ Gelatinous snailfish				8.9 (2-18)
	No of stations with samples	43	86	129	
	Nos. length measured	290	1544	1834	
	Nos. aged	-	128	128	
	Liparis bathyarcticus/ Variegated snailfish				11.0 (1-29)
	No of stations with samples	12	38	50	
	Nos. length measured	32	79	111	
	Nos. aged	-	6	6	
	Liparis liparis/ Striped seasnail				10.0 (7-14)
	No of stations with samples	1	2	3	
	Nos. length measured	1	3	4	
	Nos. aged	-	-	-	
	Liparis sp./ Sea snail				2.5 (2-3)
	No of stations with samples	1	-	1	
	Nos. length measured	2	-	2	
	Nos. aged	-	-	-	
	Liparis tunicatus/ Kelp snailfish				13.5 (13-14)
	No of stations with samples	-	2	2	
	Nos. length measured	-	2	2	
	Nos. aged	-	-	-	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Liparidae	**Paraliparis bathybius/ Black seasnail**				19.7 (16-26)
	No of stations with samples	2	8	10	
	Nos. length measured	5	33	38	
	Nos. aged	-	6	6	
	Rhodichthys regina/ Threadfin seasnail				22.0 (21-23)
	No of stations with samples	-	2	2	
	Nos. length measured	-	3	3	
	Nos. aged	-	2	2	
Lophiidae	**Lophius piscatorius/ Anglerfish**				
	No of stations with samples	1	-	-	-
	Nos. length measured	-	-	-	
	Nos. aged	-	-	-	
Lotidae	**Brosme brosme/ Cusk**				36.7 (6-70)
	No of stations with samples	20	1	21	
	Nos. length measured	57	6	63	
	Nos. aged	-	3	3	
Macrouridae	**Macrourus berglax/ Rough rat-tail**				16.9 (3-25)
	No of stations with samples	5	-	5	
	Nos. length measured	13	-	13	
	Nos. aged	-	-	-	
Myctophidae	**Benthosema glaciale / Glacier lanternfish**				5.5 (3-8)
	No of stations with samples	5	29	34	
	Nos. length measured	17	77	94	
	Nos. aged	-	-	-	
	Notoscopelus sp./				2.9 (1-8)
	No of stations with samples	4	-	4	
	Nos. length measured	30	-	30	
	Nos. aged	-	-	-	
Osmeridae	**Mallotus villosus/ Capelin**				9.6 (1-20)
	No of stations with samples	314	278	592	
	Nos. length measured	17674	14720	32394	
	Nos. aged	3513	1007	4520	
	Osmerus mordax dentex/ Rainbow smelt				16.4 (7-25)
	No of stations with samples	-	12	12	
	Nos. length measured	-	549	549	
	Nos. aged	-	89	89	
Paralepididae	**Arctozenus risso/ White barracudina**				25.1 (17-39)
	No of stations with samples	24	14	38	
	Nos. length measured	119	26	145	
	Nos. aged	-	5	5	
Petromyzontidae	**Lethenteron camchaticumicum/ Arctic lamprey**				32.5 (31-36)
	No of stations with samples	-	3	3	
	Nos. length measured	-	4	4	
	Nos. aged	-	-	-	
Pleuronectidae	**Glyptocephalus cynoglossus/ Witch flounder**				40.0
	No of stations with samples	1	-	1	
	Nos. length measured	1	-	1	
	Nos. aged	-	-	-	
	Hippoglossoides platessoides/ Long rough dab				19.4 (2-56)
	No of stations with samples	216	216	432	
	Nos. length measured	5966	20050	26016	
	Nos. aged	-	312	312	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Pleuronectidae	**Limanda limanda/ Dab**				22.4 (6-39)
	No of stations with samples	-	8	8	
	Nos. length measured	-	205	205	
	Nos. aged	-	62	62	
	Microstomus kitt/ Lemon sole				31.3 (28-34)
	No of stations with samples	3	-	3	
	Nos. length measured	12	-	12	
	Nos. aged	-	-	-	
	Pleuronectes glacialis/ Arctic flounder				16.6 (12-22)
	No of stations with samples	-	5	5	
	Nos. length measured	-	63	63	
	Nos. aged	-	45	45	
	Pleuronectes platessa/ European plaice				39.6 (19-61)
	No of stations with samples	-	20	20	
	Nos. length measured	-	260	260	
	Nos. aged	-	22	22	
	Reinhardtius hippoglossoides/ Greenland halibut				29.4 (3-86)
	No of stations with samples	136	113	249	
	Nos. length measured	1076	1551	2627	
	Nos. aged	212	1036	1248	
Psychrolutidae	**Cottunculus microps/ Polar sculpin**				12.6 (4-23)
	No of stations with samples	14	48	62	
	Nos. length measured	15	304	319	
	Nos. aged	-	48	48	
	Cottunculus sadko/ Sadko sculpin				11.0 (10-13)
	No of stations with samples	-	2	2	
	Nos. length measured	-	6	6	
	Nos. aged	-	2	2	
Rajidae	**Amblyraja hyperborea/ Arctic skateA**				44.4 (16-82)
	No of stations with samples	6	30	36	
	Nos. length measured	9	41	50	
	Nos. aged	-	-	-	
	Amblyraja radiata/ Thorny skate				39.5 (6-65)
	No of stations with samples	97	70	167	
	Nos. length measured	201	214	415	
	Nos. aged	-	-	-	
	Bathyraja spinicauda/ Spinetail ray				110.0
	No of stations with samples	1	-	1	
	Nos. length measured	1	-	1	
	Nos. aged	-	-	-	
	Rajella fyllae/ Round ray				29.2 (9-51)
	No of stations with samples	17	-	17	
	Nos. length measured	25	-	25	
	Nos. aged	-	-	-	
Salmonidae	**Salmo salar/ Atlantic salmon**				29.2 (25-35)
	No of stations with samples	2	3	5	
	Nos. length measured	2	3	5	
	Nos. aged	-	3	3	
Scombridae	**Scomber scombrus/ Atlantic mackerel**				8.2 (2-41)
	No of stations with samples	8	7	15	
	Nos. length measured	45	22	67	
	Nos. aged	-	-	-	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Scorpaenidae	Sebastes norvegicus/ Golden redfish				22.9 (6-64)
	No of stations with samples	37	22	59	
	Nos. length measured	256	321	577	
	Nos. aged	177	62	239	
	Sebastes mentella/ Deepwater redfish				17.9 (5-48)
	No of stations with samples	165	114	279	
	Nos. length measured	6772	2078	8850	
	Nos. aged	532	232	764	
	Sebastes sp./ Redfish				5.8 (1-20)
	No of stations with samples	129	2	131	
	Nos. length measured	2242	34	2276	
	Nos. aged	-	-	-	
	Sebastes viviparus / Norway redfish				16.8 (5-31)
	No of stations with samples	23	3	26	
	Nos. length measured	708	3	711	
	Nos. aged	-	2	2	
Squalidae	Somniosus microcephalus/ Greenland shark				275.7 (219-326)
	No of stations with samples	-	3	3	
	Nos. length measured	-	3	3	
	Nos. aged	-	-	-	
Sternoptychidae	Maurolicus muelleri/ Pearlside				3.8 (1-7)
	No of stations with samples	21	7	29	
	Nos. length measured	178	30	208	
	Nos. aged	-	-	-	
Stichaeidae	Anisarchus medius/ Stout eelblenny				14.4 (4-27)
	No of stations with samples	18	14	32	
	Nos. length measured	121	93	214	
	Nos. aged	-	-	-	
	Lumpenus fabricii/ Slender eelblenny				22.2 (13-30)
	No of stations with samples	-	10	10	
	Nos. length measured	-	184	184	
	Nos. aged	-	21	21	
	Leptoclinus sp., Lumpenus sp./				14.0
	No of stations with samples	-	1	1	
	Nos. length measured	-	1	1	
	Nos. aged	-	-	-	
	Leptoclinus maculates/ Daubed shanny				10.9 (2-20)
	No of stations with samples	157	134	291	
	Nos. length measured	2838	622	3460	
	Nos. aged	-	-	-	
	Lumpenus lampretaeformis/Snake blenny				19.8 (4-38)
	No of stations with samples	94	48	142	
	Nos. length measured	193	731	924	
	Nos. aged	-	21	21	
Zoarcidae	Gymnelus retrodorsalis/ Aurora unernak				11.9 (9-16)
	No of stations with samples	10	11	21	
	Nos. length measured	16	24	40	
	Nos. aged	-	-	-	
	Gymnelus viridis/ Fish doctor				9.0
	No of stations with samples	1	-	-	
	Nos. length measured	1	-	-	
	Nos. aged	-	-	-	
	Lycodes adolfi/ Adolf's eelpout				15.7 (9-29)
	No of stations with samples	1	6	7	
	Nos. length measured	5	149	154	
	Nos. aged	-	51	51	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Zoarcidae	Lycodes esmarkii/ Esmark's eelpout				28.4 (8-61)
	No of stations with samples	15	2	17	
	Nos. length measured	29	4	33	
	Nos. aged	-	-	-	
	Lycodes eudipleurostictus/ Doubleline eelpout				21.6 (7-34)
	No of stations with samples	10	19	29	
	Nos. length measured	14	253	267	
	Nos. aged	-	72	72	
	Lycodes frigidus/ Glacial eelpout				21.0
	No of stations with samples	1	-	1	
	Nos. length measured	1	-	1	
	Nos. aged	-	-	-	
	Lycodes gracilis/ Vahl's eelpout				17.3 (3-32)
	No of stations with samples	65	18	83	
	Nos. length measured	398	125	523	
	Nos. aged	-	28	28	
	Lycodes luetkenii/ Lutken's eelpout				18.3 (12-23)
	No of stations with samples	-	2	2	
	Nos. length measured	-	3	3	
	Nos. aged	-	2	2	
	Lycodes paamiuti/ Paamiut eelpout				16.7 (14-21)
	No of stations with samples	1	-	1	
	Nos. length measured	3	-	3	
	Nos. aged	-	-	-	
	Lycodes pallidus/ Pale eelpout				13.8 (4-29)
	No of stations with samples	26	90	116	
	Nos. length measured	61	900	961	
	Nos. aged	-	68	68	
	Lycodes polaris/ Canadian eelpout				15.1 (9-27)
	No of stations with samples	-	16	16	
	Nos. length measured	-	153	153	
	Nos. aged	-	21	21	
	Lycodes reticulatus/ Arctic eelpout				19.3 (7-65)
	No of stations with samples	10	44	54	
	Nos. length measured	15	263	278	
	Nos. aged	-	41	41	
	Lycodes rossi/ Threespot eelpout				13.4 (6-35)
	No of stations with samples	30	63	93	
	Nos. length measured	91	421	512	
	Nos. aged	-	21	21	
	Lycodes seminudus/ Halfnaked eelpout				18.3 (7-46)
	No of stations with samples	5	54	59	
	Nos. length measured	10	478	488	
	Nos. aged	-	100	100	
	Lycodes squamiventer/ Scalebelly eelpout				18.6 (11-33)
	No of stations with samples	2	17	19	
	Nos. length measured	3	96	99	
	Nos. aged	-	20	20	

Appendix 2 cont.

Family	Latin name/ English name	Norwegian vessels	Russian vessel	Total	Length, cm mean (min-max)
Zoarcidae	**Lycodes sp./ Eelpout**				5.0
	No of stations with samples	1	-	1	
	Nos. length measured	1	-	1	
	Nos. aged	-	-	-	
	Lycodonus flagellicauda/ Clue tail eelspout				17.0 (16-18)
	No of stations with samples	1	-	1	
	Nos. length measured	3	-	3	
	Nos. aged	-	-	-	
	Lycenchelys kolthoffi/ Checkered wolf eel				18.1 (13-32)
	No of stations with samples	3	7	10	
	Nos. length measured	3	14	17	
	Nos. aged	-	-	-	
	Lycenchelys muraena/ Moray wolf eel				19.0 (14-25)
	No of stations with samples	-	5	5	
	Nos. length measured	-	11	11	
	Nos. aged	-	5	5	
	Lycenchelys sarsii/ Sars' wolf eel				15.3 (12-19)
	No of stations with samples	3	-	3	
	Nos. length measured	4	-	4	
	Nos. aged	-	-	-	
	Lycenchelys sp. /				22.0 (21-23)
	No of stations with samples	-	3	3	
	Nos. length measured	-	3	3	
	Nos. aged	-	2	2	

Appendix 3. Invertebrate sampling in ecosystem survey 2013

Prepared by P. Lubin and A. Mashnin

Scientific vessels, which participated on the 2013 Ecosystem survey in the Barents Sea: GOS-G.O.Sars, HH-Helmer Hanssen, JH-Johan Hjort and VI-Vilnyus

Phylum	Class	Order	Family	Species	Author	GOS	HH	JH	VI	Total
Porifera				*Porifera* g. sp.		31	32	57	114	234
	Calcarea			*Calcarea* g. sp.			1			1
		Calcarea	Sycettidae	*Sycon* sp.			2	6		8
	Demospongiae	Astrophorida	Geodiidae	*Geodia atlantica*	(Stephens, 1915)	2				2
				Geodia barretti	Hentschel, 1929	16	16			32
				Geodia macandrewii	Bowerbank, 1858	15	8			23
				Geodia sp.			4		15	19
			Pachastrellidae	*Thenea muricata*	(Bowerbank, 1858)	15	11	8	1	35
				Thenea sp.		11	6			17
			Stellettidae	*Stelletta normani*	Sollas, 1880		2			2
				Stryphnus ponderosus	Bowerbank, 1866	10	12			22
			Tetillidae	*Tetilla cranium*	(O.F. Mueller, 1776)	7	11	1		19
				Tetilla polyura	Schmidt, 1870	7	2	4	6	19
				Tetilla sp.		1				1
		Axinellida	Axinellidae	*Axinella* sp.		4	1			5
				Axinella ventilabrum	(Johnston, 1842)	1				1
				Phakellia sp.		6	13	2	2	23
		Dendroceratida	Darwinellidae	*Aplysilla* sp.		1				1
		Hadromerida	Polymastiidae	*Polymastia boletiformis*	(Lamarck, 1815)	2	8			10
				Polymastia mammillaris	(Mueller, 1806)				5	5
				Polymastia sp.		4	11		40	55
				Polymastia thielei	Koltun, 1964			1	7	8
				Polymastia uberrima	(Schmidt, 1870)	8	1	7	8	24
				Quasillina brevis	(Bowerbank, 1861)	1				1

Porifera	Demospongiae			*Radiella grimaldi*	(Topsent, 1913)	11	2	15	14	42
				Radiella hemisphaericum	(Sars, 1872)	16	5	2		23
				Sphaerotylus borealis	(Swarchevsky, 1906)		1			1
				Tentorium semisuberites	(Schmidt, 1870)	8	16	5	8	37
				Tentorium sp.		1				1
			Stylocordylidae	*Stylocordyla borealis*	(Loven, 1866)	1	1	2	2	6
			Suberitidae	*Suberites ficus*	(Johnston, 1842)	1	6		7	14
				Suberites sp.		1				1
			Tethyidae	*Tethya aurantium*	(Pallas, 1766)			1		1
				Tethya citrina	Sarà & Melone, 1965	4	10			14
		Halichondriida	Halichondriidae	*Halichondria panicea*	(Pallas, 1766)		1			1
				Halichondria sp.			22			22
		Haplosclerida	Haliclonidae	*Haliclona* sp.		3	30		7	40
				Haliclona ventilabrum	(Fristedt, 1887)				3	3
		Poecilosclerida	Cladorhizidae	*Asbestopluma pennatula*	(Schmidt, 1875)	2	5			7
				Asbestopluma sp.		2				2
				Chondrocladia sp.		2				2
				Cladoriza sp.			3			3
			Coelosphaeridae	*Histodermella* sp.		12	15			27
			Hamacanthidae	*Hamacantha implicans*	Lundbeck, 1902.				3	3
			Mycalidae	*Mycale lingua*	(Bowerbank, 1866)	1	2			3
				Mycale sp.		10	3	1		14
			Myxillidae	*Forcepia* sp.			2			2
				Iophon piceus	(Vosmaer, 1881)		2			2
				Myxilla brunnea	Hansen, 1885	1				1
				Myxilla incrustans	(Johnston, 1842)				6	6
				Myxilla sp.			3			3
			Tedaniidae	*Tedania suctoria*	Schmidt, 1870			2		2

Cnidaria	Anthozoa			*Anthozoa* g. sp.					7	7
		Actiniaria		*Actiniaria* g. sp.		1	4	2	150	157
			Actiniidae	*Bolocera tuediae*	(Johnston, 1832)	6	3	1		10
				Urticina sp.		11				11
			Actinostolidae	*Actinostola callosa*	(Verrill, 1882)	7	7			14
				Actinostola sp.		3		8	1	12
				Glandulactis spetsbergensis	(Carlgren, 1913)		2			2
				Stomphia coccinea	(O.F. Mueller, 1776)		4			4
			Edwardsiidae	*Edwardsiidae* g. sp.					1	1
			Hormathiidae	*Hormathia digitata*	(O.F. Mueller, 1776)	35	14	20	41	110
				Hormathia digitata m. josephi josephi	Zhiubicas, 1977		1			1
				Hormathia digitata m. parasitica parasitica	Danielssen, 1890	4	14	24		42
				Hormathia sp.				1	3	4
			Liponematidae	*Liponema multicornis*	(Verrill, 1879)	1		3	1	5
		Alcyonacea	Isididae	*Isidella lofotensis*	Sars, 1868		6			6
			Nephteidae	*Drifa glomerata*	(Verrill, 1869)	1	32	34	109	176
				Duva florida	(Rathke, 1806)	7	10	18	8	43
				Gersemia fruticosa	(M. Sars, 1860)	1		1		2
				Gersemia rubiformis	(Ehrenberg, 1834)	11	7	25	26	69
				Gersemia sp.				3	33	36
		Gorgonacea	Paragorgiidae	*Paragorgia arborea*	(L., 1758)		1			1
		Pennatulacea	Umbellulidae	*Umbellula encrinus*	(L., 1758)		11		31	42
		Scleractinida	Flabellidae	*Flabellum* sp.		2				2
		Zoanthacea		*Zoanthacea* g. sp.		5	2			7
			Epizoanthidae	*Epizoanthidae* g. sp.				8	1	9
				Epizoanthus incrustatus	(Dueben & Koren, 1847)			1		1
				Epizoanthus sp.		7	3	1	12	23

Cnidaria	Hydrozoa			*Hydroidea* g. sp.				7	41	48
				Hydrozoa g. sp.			3		15	18
		Athecata	Candelabridae	*Candelabrum* sp.				4		4
			Tubulariidae	*Tubularia indivisa*	L., 1758	2				2
				Tubularia sp.		2				2
		Limnomedusae	Monobrachiidae	*Monobrachium parasitum*	Mereschkowsky, 1877		7			7
		Thecaphora	Campanulariidae	*Campanulariidae* g. sp.				1		1
				Orthopyxis integra	(McGillivray, 1842)		1			1
			Campanulinidae	*Lafoeina maxima*	Levinsen, 1893		7			7
			Haleciidae	*Halecium muricatum*	(Ellis & Solander, 1786)		5	22		27
				Halecium sp.		6	1		10	17
			Lafoeidae	*Grammaria abietina*	(M. Sars, 1850)		9	2		11
				Grammaria sp.			2			2
				Lafoea fruticosa	(M. Sars, 1850)		3			3
				Lafoea grandis	Hincks, 1874		1			1
				Lafoea sp.		1	21	15		37
			Laodiceidae	*Ptychogena lactea*	A. Agassiz, 1865			3		3
			Plumulariidae	*Nemertesia antennina*	(L., 1758)		3			3
			Sertulariidae	*Abietinaria abietina*	(L., 1758)		6	30	2	38
				Abietinaria sp.			1	1		2
				Diphasia fallax	(Johnston, 1847)		1			1
				Diphasia sp.				1		1
				Hydrallmania falcata	(L., 1758)			2		2
				Sertularia mirabilis	(Verrill, 1873)			5		5
				Sertularia sp.				3		3
				Symplectoscyphus tricuspidatus	(Alder, 1856)			2		2
				Thuiaria articulata	(Pallas, 1766)			4		4
				Thuiaria carica	Levinsen, 1893			1		1

Cnidaria	Hydrozoa	Thecaphora	Sertulariidae	*Thuiaria lonchitis*	Naumov, 1960				1	1
				Thuiaria obsoleta	(Lepechin, 1781)			5		5
Plathelminthes	Scyphozoa	Semaeostomeae	Cyaneidae	*Cyanea capillata*	(L., 1758)			24		24
				Plathelmintes g. sp.				5		5
	Turbellaria			*Turbellaria* g. sp.				5		5
Annelida	Hirudinea			*Hirudinea* g. sp.					1	1
	Polychaeta			*Polychaeta* g. sp.		3	2	29	105	139
		Amphinomida	Euphrosinidae	*Euphrosine armadillo*	M. Sars, 1851	6				6
				Euphrosine sp.			14	7		21
		Capitellida	Maldanidae	*Maldane arctica*	Detinova, 1985		4			4
				Maldane sarsi	Malmgren, 1867		1			1
				Maldanidae g. sp.			4	3	1	8
				Nicomache lumbricalis	(Fabricius, 1780)				1	1
				Nicomache sp.			2			2
				Notoproctus oculatus	Arwidsson, 1906				1	1
		Chaetopterida	Chaetopteridae	*Spiochaetopterus typicus*	M. Sars, 1856	7	16	18	51	92
		Eunicida	Lumbrineridae	*Lumbrineris* sp.		2	4		2	8
			Onuphidae	*Nothria hyperborea*	(Hansen, 1878)	1		12	7	20
				Nothria sp.		4	6			10
		Flabelligerida	Flabelligeridae	*Brada granulata*	Malmgren, 1867	17	4	10	5	36
				Brada inhabilis	(Rathke, 1843)	24	17	38	34	113
				Brada sp.				7	23	30
				Brada villosa	(Rathke, 1843)	2	3			5
				Diplocirrus hirsutus	(Hansen, 1879)		2			2
				Diplocirrus sp.					2	2
				Flabelligera affinis	M. Sars, 1829			9		9
				Pherusa plumosa	(O.F. Mueller, 1776)			4		4
				Pherusa sp.			1			1
		Opheliida	Opheliidae	*Ophelina acuminata*	Oersted, 1843				1	1

Annelida	Polychaeta		Scalibregmidae	*Polyphysia crassa*	(Oersted, 1843)			3	1	4
				Polyphysia sp.		5				5
		Phyllodocida	Aphroditidae	*Aphrodita* sp.					1	1
				Laetmonice filicornis	Kinberg, 1855	4				4
			Glyceridae	*Glycera* sp.			1			1
			Nephtyidae	*Nephtyidae* g. sp.		2	1	1		4
				Nephtys sp.		1	13	13	7	34
			Nereididae	*Nereis pelagica*	L., 1761	1	1			2
				Nereis zonata	Malmgren, 1867	1	2			3
			Phyllodocidae	*Phyllodoce groenlandica*	Oersted, 1842		1			1
				Phyllodoce sp.			1			1
			Polynoidae	*Harmothoe* sp.		36	37		61	134
				Lepidonotus sp.					1	1
				Lepidonotus squamatus	(L., 1767)				1	1
				Polynoidae g. sp.		1	2	49	25	77
		Sabellida	Sabellidae	*Branchiomma arcticum*	(Ditlevsen, 1937)		4			4
				Chone sp.					2	2
				Euchone analis	(Kroeyer, 1856)				1	1
				Euchone papillosa	(M. Sars, 1851)	1	5			6
				Sabellidae g. sp.		3	5	4	7	19
			Serpulidae	*Chitinopoma serrula*	(Stimpson, 1854)		2			2
				Filograna implexa	Berkeley, 1827		5			5
				Placostegus tridentatus	(Fabricius, 1779)	3				3
				Protula globifera	(Theel, 1879)		2			2
				Protula tubularia	(Montagu, 1803)		5			5
			Spirorbidae	*Bushiella (Jugaria) similis*	(Bush, 1905)		2			2
				Circeis armoricana	Saint- Joseph, 1894		4			4
				Circeis spirillum	(L., 1758)		2			2
				Spirorbidae g. sp.			1		1	2

		Terebellida	Ampharetidae	*Ampharete* sp.			1		2	3
				Ampharetidae g. sp.			2	1		3
			Pectinariidae	*Pectinaria auricoma*	(O.F. Mueller, 1776)				4	4
				Pectinaria hyperborea	(Malmgren, 1865)	2	6		3	11
				Pectinaria sp.		2			7	9
			Terebellidae	*Amphitrite cirrata*	(O.F. Mueller, 1771)		1			1
				Amphitrite sp.			1			1
				Pista maculata	(Dalyell, 1853)		5	7	2	14
				Pista sp.			2			2
				Terebellidae g. sp.		11	1	2	5	19
				Thelepus cincinnatus	(Fabricius, 1780)		3			3
Sipuncula	Sipunculidea			*Sipunculidea* g. sp.		1	1		18	20
		Golfingiiformes	Golfingiidae	*Golfingia margaritacea margaritacea*	(M. Sars, 1851)		2			2
				Golfingia sp.				3	2	5
				Golfingia vulgaris vulgaris	(Blainville, 1827)		1			1
				Nephasoma diaphanes diaphanes	(Gerould, 1913)		1			1
			Phascolionidae	*Phascolion strombus strombus*	(Montagu, 1804)	9	13	12	3	37
Cephalorhyncha	Priapulida	Priapulomorpha	Priapulidae	*Priapulidae* g. sp.					18	18
				Priapulopsis bicaudatus	(Koren & Danielssen, 1868)			4	4	8
				Priapulus caudatus	Lamarck, 1816	2	2			4
Echiura	Echiurida	Echiuroinea		*Echiurida* g. sp.					2	2
			Bonelliidae	*Hamingia arctica*	Danielssen & Koren, 1881	10	3	5	8	26
			Echiuridae	*Echiurus echiurus echiurus*	(Pallas, 1767)				3	3
Nemertini	Enopla	Monostilifera	Emplectonematidae	*Cryptonemertes actinophila*	(Bürger, 1904)		2			2
		Polystilifera	Dinonemertidae	*Dinonemertes alberti*	(Joubin, 1906)		2			2
	Nemertini			*Nemertini* g. sp.			8	11	17	36
Arthropoda	Cirripedia			*Cirripedia* g. sp.			1			1
		Thoracica	Balanomorpha	*Balanus balanus*	(L., 1758)		3	14	23	40
				Balanus crenatus	Bruguiere, 1789	1	3	1	2	7

Arthropoda	Cirripedia	Thoracica		*Balanus sp.*		1			10	11
			Scalpellidae	*Ornatoscalpellum stroemii*	(M. Sars, 1859)		5			5
				Tarasovium cornutum	(G.O. Sars, 1879)	1				1
	Malacostraca	Amphipoda		*Amphipoda* g. sp.				6		6
			Acanthonotozomatidae	*Acanthonotozoma cristatum*	(Ross, 1835)		1	1		2
			Amathillopsidae	*Amathillopsis spinigera*	Heller, 1875		1		6	7
			Ampeliscidae	*Ampelisca eschrichti*	Kroeyer, 1842		1	11		12
				Ampelisca sp.				1		1
				Ampeliscidae g. sp.				1		1
				Byblis gaimardi	(Kroeyer, 1846)			1		1
			Atylidae	*Atylus smittii*	(Goes, 1866)			8		8
			Calliopiidae	*Cleippides quadricuspis*	Heller, 1875		4		8	12
				Cleippides sp.					16	16
				Halirages fulvocinctus	(M. Sars, 1858)		1			1
			Caprellidae	*Aeginina longicornis*	(Kroeyer, 1843)			1		1
				Caprellidae g. sp.				1		1
			Corophiidae	*Neochela monstrosa*	(Boesk, 1861)		1			1
			Epimeriidae	*Epimeria loricata*	G.O. Sars, 1879	24	26	28	18	96
				Paramphithoe hystrix	(Ross, 1835)	4	14	29	8	55
			Eusiridae	*Eusirus cuspidatus*	Kroeyer, 1845	1	2	3	4	10
				Eusirus holmi	Hansen, 1887		5		2	7
				Rhachotropis aculeata	(Lepechin, 1780)		19	22	1	42
				Rhachotropis helleri	A. Boeck, 1871			1		1
				Rhachotropis sp.					3	3
			Gammaridae	*Gammaridae* g. sp.					3	3
				Gammarus sp.					14	14
			Hyperiidae	*Hyperiidae* g. sp.				2		2
				Themisto abyssorum	Boeck, 1870		4			4
				Themisto libellula	(Lichtenstein,1882)		27	5	13	45

Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Anonyx bispinosus*	Steele,1967		4			4
				Anonyx lilljeborgii	Boeck, 1870	4				4
				Anonyx nugax	(Phipps, 1774)		17	32	11	60
				Anonyx sarsi	Steele, Brunel, 1986		3			3
				Anonyx sp.				2	47	49
				Eurythenes gryllus	(Lichtenstein, 1822)		5			5
				Lysianassidae g. sp.		1	1	1	1	4
				Onisimus sp.		2				2
				Socarnes bidenticulatus	(Bate, 1858)			2		2
				Tmetonyx cicada	(Fabricius, 1780)	2	1	4		7
			Oedicerotidae	*Acanthostepheia malmgreni*	(Goes, 1866)	5	5	24	15	49
				Arrhis phyllonyx	(M. Sars, 1858)			2		2
				Paroediceros lynceus	(M. Sars, 1858)		1			1
			Stegocephalidae	*Phippsiella similis*	(G.O. Sars, 1891)		7			7
				Stegocephalopsis ampulla	(Phipps, 1774)		10	2		12
				Stegocephalus inflatus	Kroeyer, 1842	7	13	31	54	105
				Stegocephalus sp.					6	6
		Cumacea		*Cumacea* g. sp.		3			1	4
			Diastylidae	*Diastylis glabra*	Zimmer, 1926				1	1
				Diastylis goodsiri	Bell, 1855		3	3		6
		Decapoda		*Natantia* g. sp.		1				1
			Crangonidae	*Crangonidae* g. sp.					1	1
				Pontophilus norvegicus	M. Sars, 1861	36	16	12		64
				Sabinea sarsi	Smith, 1879	5	21	11	3	40
				Sabinea septemcarinata	(Sabine, 1821)	29	44	72	186	331
				Sabinea sp.		2				2
				Sclerocrangon boreas	(Phipps, 1774)		22	12	45	79
				Sclerocrangon ferox	(G.O. Sars, 1821)	4	19	38	97	158
			Galatheidae	*Munida bamffica*	(Pennant, 1777)	21				21

Arthropoda	Malacostraca		Hippolitydae	*Bythocaris biruli*	(Kobjakova, 1964)		2		10	12
				Bythocaris irene	Retovsky, 1946		1			1
				Bythocaris payeri	(Heller, 1875)		2	1	5	8
				Bythocaris simplicirostris	G.O. Sars, 1869				3	3
				Bythocaris sp.					11	11
				Eualus gaimardi	(Milne-Edwards, 1837)			11	33	44
				Eualus gaimardi belcheri	(Bell, 1855)		3	6		9
				Eualus gaimardi gaimardi	(Milne-Edwards, 1837)		4	2		6
				Eualus sp.					4	4
				Lebbeus polaris	(Sabine, 1821)	20	37	50	59	166
				Spirontocaris lilljeborgii	(Danielssen, 1859)				1	1
				Spirontocaris sp.					6	6
				Spirontocaris spinus	(Sowerby, 1802)	10	20	34	28	92
			Hoplophoridae	*Hymenodora glacialis*	(Buchholz, 1874)		6			6
			Lithodidae	*Lithodes maja*	(L., 1758)	4		1		5
				Paralithodes camtschaticus	(Tilesius, 1815)				3	3
			Majidae	*Chionoecetes opilio*	(Fabricius, 1788)	4		11	50	65
				Hyas araneus	(L., 1758)	7	10	18	67	102
				Hyas coarctatus	Leash, 1815	19				19
				Hyas sp.			1		7	8
			Paguridae	*Pagurus bernhardus*	(L., 1758)	2	8			10
				Pagurus pubescens	(Kroeyer, 1838)	5	1	17	77	100
				Pagurus sp.				1		1
			Pandalidae	*Atlantopandalus propinqvus*	(G.O. Sars, 1870)		10	1		11
				Pandalus borealis	Kroeyer, 1837	66	65	63	179	373
				Pandalus montagui	Leach, 1814	12	3	1		16
			Pasiphaeidae	*Pasiphaea multidentata*	Esmark, 1886	1			21	22
				Pasiphaea tarda	Krøyer, 1845		9			9
			Sergestidae	*Eusergestes arcticus*	(Kroeyer, 1855)				2	2

Arthropoda	Malacostraca	Euphausiacea	Euphausiidae	*Euphausiidae* g. sp.				1	2	3
				Meganyctiphanes norvegica	(M. Sars, 1857)		29	1	29	59
				Thysanoessa inermis	(Kroeyer, 1846)			2		2
		Isopoda		*Isopoda* g. sp.					1	1
			Aegidae	*Aega psora*	L., 1758	6	1			7
				Aega sp.		4	1			5
				Rocinela danmoniensis	Leach, 1818	2				2
				Syscenus sp.		1				1
			Cirolanidae	*Natatolana borealis*	(Lilljeborg, 1851)	1				1
			Eurycopidae	*Munnopsurus giganteus*	(G.O. Sars, 1877)		2			2
			Idotheidae	*Saduria sabini*	(Kroeyer, 1849)	8		7	58	73
				Saduria sibirica	(Birula, 1896)				3	3
			Munididae	*Munida* sp.				2		2
				Munida tenuimana	Sars, 1872	1				1
			Munnopsidae	*Munnopsis typica*	M. Sars, 1861			1		1
			Paranthuridae	*Calathura brachiata*	(Stimpson, 1854)			1		1
		Mysidacea	Boreomysidae	*Boreomysis arctica*	(Kroeyer, 1861)		2			2
	Pycnogonida	Pantopoda		*Pycnogonida* g. sp.					10	10
			Callipallenidae	*Pseudopallene brevicolis*	G.O. Sars, 1891	2		3		5
				Pseudopallene malleolata	(G.O. Sars, 1879)			3		3
			Colossendeidae	*Colossendeis angusta*	G.O. Sars, 1877		2		14	16
				Colossendeis proboscidea	(Sabine, 1824)	1	1	1	15	18
				Colossendeis sp.					43	43
			Nymphonidae	*Boreonymphon abyssorum*	(Norman, 1873)	7	16	21		44
				Boreonymphon ossiansarsi	Knaben, 1972	1		7		8
				Boreonymphon sp.		3				3
				Nymphon elegans	Hansen, 1887	1		10		11
				Nymphon gracilipes	Heller, 1875		1	25		26
				Nymphon grossipes	(Fabricius, 1780)		5	7		12

Arthropoda	Pycnogonida			*Nymphon hirtipes*	Bell, 1853	9	32	62		103
				Nymphon hirtum	(Fabricius, 1780)		4			4
				Nymphon leptocheles	G.O. Sars, 1888		1			1
				Nymphon longimanum	Sars, 1888			1		1
				Nymphon longitarse	Kroeyer, 1845		3			3
				Nymphon macronyx	G.O. Sars, 1877			1		1
				Nymphon mixtum	Kroeyer, 1844-45			7		7
				Nymphon schimkewitschi	Losina-Losinsky, 1929		6			6
				Nymphon serratum	G.O. Sars, 1879	2		4		6
				Nymphon sp.		14		6	13	33
				Nymphon stroemi stroemi	Kroeyer, 1845	9	16	4		29
				Nymphonidae g. sp.					90	90
			Pycnogonidae	*Pycnogonum litorale*	(Strom, 1762)	1				1
Mollusca				*Mollusca* g. sp.			1			1
	Bivalvia	Cardiiformes	Cardiidae	*Cardiidae* g. sp.					1	1
				Cerastoderma edule	(L., 1758)				1	1
				Clinocardium ciliatum	(Fabricius, 1780)	12	7	18	56	93
				Serripes groenlandicus	(Bruguiere, 1789)			1	13	14
			Myidae	*Mya* sp.					7	7
				Mya truncata	L., 1767			2	2	4
			Tellinidae	*Macoma calcarea*	(Gmelin, 1791)			2	10	12
				Macoma sp.					4	4
		Cuspidariiformes	Cuspidariidae	*Cuspidaria arctica*	(M. Sars, 1859)	1	2	8	19	30
				Cuspidaria sp.		2				2
		Luciniformes	Astartidae	*Astarte borealis*	Schumacher, 1817			1	18	19
				Astarte crenata	(Gray, 1842)		8	16	77	101
				Astarte sp.		24		12	3	39
			Hiatellidae	*Hiatella arctica*	(L., 1767)		5	13	21	39
		Mytiliformes	Arcidae	*Bathyarca glacialis*	(Gray, 1842)	24	17	9	6	56

				Bathyarca pectunculoides	(Scacchi, 1834)	4	2			6
				Bathyarca sp.					13	13
			Mytilidae	*Modiolus modiolus*	(L., 1758)				5	5
				Musculus laevigatus	(Gray, 1824)			8	1	9
				Musculus niger	(Gray, 1824)			1		1
				Musculus sp.				1	3	4
				Mytilus edulis	L., 1758				3	3
				Mytilus sp.					2	2
		Nuculiformes	Nuculanidae	*Nuculana pernula*	(Mueller, 1779)			2	1	3
				Nuculana sp.					1	1
			Yoldiidae	*Yoldia hyperborea*	(Torell, 1859)		1	4		5
				Yoldiella intermedia	(M. Sars, 1865)				1	1
		Pectiniformes	Pectinidae	*Chlamys islandica*	(O.F. Mueller, 1776)	11	23	28	68	130
				Chlamys sulcata	(O.F. Mueller, 1776)				3	3
				Pseudamussium septemradiatum	(Mueller, 1776)	14				14
			Propeamussiidae	*Arctinula greenlandica*	(Sowerby, 1842)	11	12	15	33	71
				Cyclopecten imbrifer	(Lovén, 1846)		2			2
	Cephalopoda	Octopoda		*Octopoda* g. sp.					1	1
			Bathypolypodinae	*Bathypolypus arcticus*	(Prosch, 1849)	4	12	10	22	48
				Benthoctopus sp.					5	5
			Cirroteuthidae	*Cirroteuthis muelleri*	Eschricht, 1836		2			2
		Sepiida	Sepiolidae	*Rossia moelleri*	Steenstrup, 1856		1			1
				Rossia palpebrosa	Owen, 1834	9	8	10	32	59
				Rossia sp.				1	51	52
		Sepiolida	Sepiolidae	*Sepietta oweniana*	(d'Orbigny, 1841)	1				1
		Teuthida		*Teuthida* g. sp.					5	5
			Gonatidae	*Gonatus fabricii*	(Lichtenstein, 1818)	16	30	8	5	59
			Ommastrephidae	*Todarodes sagittatus*	(de Lamarck, 1798)				3	3
				Todaropsis eblanae	(Ball, 1841)				1	1

	Gastropoda			*Gastropoda* g. sp.					19	19
		Bucciniformes	Beringiidae	*Beringius ossiani*	(Friele, 1879)	3		2	4	9
			Buccinidae	*Aulacofosus brevicauda*	(Deshayes, 1832)	1				1
				Buccinidae g. sp.					1	1
				Buccinum angulosum	Gray, 1839				9	9
				Buccinum belcheri	Reeve, 1855				2	2
				Buccinum ciliatum ciliatum	(Fabricius, 1780)		1	2	7	10
				Buccinum elatior	(Middendorff, 1849)		2	3	37	42
				Buccinum finmarchianum	Verkruezen, 1875		1	17		18
				Buccinum fragile	Verkruezen in G.O. Sars, 1878		8		2	10
				Buccinum glaciale	L., 1761			3	15	18
				Buccinum hydrophanum	Hancock, 1846	4	10	15	62	91
				Buccinum micropoma	Jensen in Thorson, 1944			5		5
				Buccinum polare	Gray, 1839				5	5
				Buccinum sp.		5		3	7	15
				Buccinum undatum	L., 1758			1	18	19
				Colus altus	(S. Wood, 1848)			2	9	11
				Colus holboelli	(Moeller,1842)	3	1			4
				Colus islandicus	(Mohr, 1786)	9	6	5	51	71
				Colus kroyeri	(Moeller,1842)			4	1	5
				Colus pubescens	(Verrill, 1882)	2		7		9
				Colus sabini	(Gray, 1824)	6	3	3	60	72
				Colus sp.		2		6	59	67
				Colus turgidulus	(Jeffreys, 1877)	4		5		9
				Eggs Buccinidae g. sp. sp.					1	1
				Neptunea communis	(Middendorff, 1901)				8	8
				Neptunea denselirata	Brogger, 1901	7		5	23	35
				Neptunea despecta	(L., 1758)	5	1	1	11	18
				Neptunea sp.					2	2

	Gastropoda			*Neptunea ventricosa*	(Gmelin, 1789)				10	10
				Pyrulofusus deformis	(Reeve, 1847)			1	1	2
				Turrisipho dalli	(Friele in Tryon, 1881)				1	1
				Turrisipho lachesis	(Moerch, 1869)	2	1	7	2	12
				Turrisipho sp.		3			29	32
				Volutopsis norvegicus	(Gmelin, 1790)	4	2	7	14	27
			Muricidae	*Boreotrophon* sp.				2		2
				Boreotrophon truncatus	(Stroem, 1767)		1			1
		Cephalaspidea		*Opistobranchia* g. sp.		1				1
			Philinidae	*Philine finmarchica*	G.O. Sars, 1878	7	8		2	17
				Philinidae g. sp.		1		33		34
			Scaphandridae	*Scaphander punctostriatus*	(Mighels & Adams, 1842)				12	12
				Scaphander sp.		1				1
		Cerithiiformes	Naticidae	*Bulbus smithi*	Brown, 1839	12		1	8	21
				Cryptonatica affinis	(Gmelin, 1791)		9	6	29	44
				Lunatia pallida	(Broderip & Sowerby, 1829)	1	3	14	15	33
				Lunatia sp.					1	1
				Naticidae g. sp.				1		1
			Velutinidae	*Limneria undata*	(Brown, 1838)	3	3	6	2	14
				Onchidiopsis glacialis	(M. Sars, 1851)	2	5	1		8
				Onchidiopsis sp.					1	1
				Velutina sp.				7		7
				Velutina velutina	(Mueller, 1776)		3			3
		Coniformes	Turridae	*Propebela turricula*	(Montagu, 1803)		1			1
		Nudibranchia		*Nudibranchia* g. sp.			4	28	17	49
			Aeolidiidae	*Aeolidia papillosa*	(L., 1762)				10	10
				Aeolidia sp.					1	1
			Aldisidae	*Aldisia* sp.			4			4
			Cadlinidae	*Cadlina laevis*	(L., 1767)		5			5

	Gastropoda		Dendronotidae	*Dendronotus frondosus*	(Ascanius, 1774)		1			1
				Dendronotus robustus	Verrill, 1870	1	3		24	28
				Dendronotus sp.		1		14	4	19
			Onchidoridiae	*Onchidoridae* g. sp.		7				7
			Onchidorididae	*Acanthodoris pilosa*	(Abildgaard in Müller, 1789)		2			2
		Patelliformes	Tecturidae	*Capulacmaea radiata*	(M. Sars, 1851)		1	2	11	14
		Pleurotomariiformes	Fissurellidae	*Puncturella noachina*	(L., 1771)		1			1
		Trochiformes	Calliostomatidae	*Calliostoma formosum*	(McAndrews & Forbes, 1847)	1	1			2
			Liotiidae	*Moelleria costulata*	(Moeller, 1842)				1	1
			Trochidae	*Margarites costalis*	(Gould, 1841)		2		7	9
				Margarites groenlandicus groenlandicus	(Gmelin, 1790)	1	2	5	2	10
				Margarites olivacea	(Brown, 1827)		1			1
				Margarites sp.		2		5	4	11
	Polyplacophora			*Polyplacophora* g. sp.				2	1	3
		Chitonida	Tonicellidae	*Tonicella marmorea*	(Fabricius, 1780)		1			1
		Lepidopleurida	Hanleyidae	*Hanleya hanleyi*	J.E. Gray, 1857	3	1			4
	Solenogastres			*Solenogastres* g. sp.		4	2			6
		Cavibelonia	Proneomeniidae	*Proneomenia sluiteri*	Huebrecht, 1880	1	2	2		5
				Proneomenia sp.			1			1
				Proneomenia thulensis	Thiele, 1900			3		3
Echinodermata	Asteroidea	Forcipulatidae	Asteriidae	*Asterias rubens*	L., 1758		3		15	18
				Asteriidae g. sp.			1	1	1	3
				Icasterias panopla	(Stuxberg, 1879)	12	14	31	106	163
				Leptasterias arctica	(Murdoch, 1885)				3	3
				Leptasterias groenlandica	(Steenstrup, 1857)		7			7
				Leptasterias muelleri	(M. Sars, 1846)		4	3		7
				Leptasterias sp.			3	8	14	25
				Stephanasterias albula	(Stimpson, 1853)			2		2
				Stichastrella rosea	(O.F. Mueller, 1776)	1				1

Echinodermata	Asteroidea			*Urasterias linckii*	(Mueller & Troschel, 1842)	10	6	29	108	153
		Notomyotida	Benthopectinidae	*Pontaster tenuispinus*	(Dueben & Koren, 1846)	38	10	48	126	222
		Paxillosida	Astropectinidae	*Bathybiaster vexillifer*	(W. Thomson, 1873)		1		13	14
				Leptychaster arcticus	(M. Sars, 1851)	18	3	3	2	26
				Psilaster andromeda	(Mueller & Troschel, 1842)	2			9	11
			Ctenodiscidae	*Ctenodiscus crispatus*	(Retzius, 1805)	44	30	68	148	290
		Spinulosida	Echinasteridae	*Henricia* sp.		37	40	24	77	178
		Valvatida	Goniasteridae	*Ceramaster granularis granularis*	(Retzius, 1783)	14	3	1	3	21
				Ceramaster sp.					1	1
				Hippasteria phrygiana phrygiana	(Parelius, 1768)	7	3		27	37
				Pseudarchaster parelii	(Dueben & Koren, 1846)	1				1
			Poraniidae	*Poraniomorpha bidens*	Mortensen, 1932			1		1
				Poraniomorpha hispida	(Sars, 1872)	6	4	2		12
				Poraniomorpha sp.					1	1
				Poraniomorpha tumida	(Stuxberg, 1878)	2	5	13	58	78
				Tylaster willei	Danielssen & Koren, 1881				1	1
		Velatida	Korethrasteridae	*Korethraster hispidus*	W. Thomson, 1873	1	3	4		8
			Pterasteridae	*Hymenaster pellucidus*	W. Thomson, 1873	2	10	5	25	42
				Pteraster militaris	(O.F. Mueller, 1776)	16	11	19	45	91
				Pteraster obscurus	(Perrier, 1891)	1	8	6	28	43
				Pteraster pulvillus	M. Sars, 1861	10	26	14	7	57
				Pteraster sp.		1	1		1	3
			Solasteridae	*Crossaster papposus*	(L., 1768)	5	12	17	72	106
				Lophaster furcifer	(Dueben & Koren, 1846)	2	10	10	32	54
				Solaster endeca	(L., 1771)	2		4	71	77
				Solaster sp.		3		6		9
				Solaster syrtensis	Verrill, 1894	2	4	3		9
	Crinoidea	Bourgueticrinida	Bathycrinidae	*Bathycrinus carpenteri*	(Danielssen & Koren, 1877)		1			1
		Comatulida	Antedonidae	*Heliometra glacialis glacialis*	(Owen, 1833)	1	21	25	77	124

Echinodermata	Crinoidea			*Poliometra prolixa*	(Sladen, 1881)		5	3	1	9
	Echinoidea	Echinoida	Echinidae	*Echinus acutus*	Lamarck, 1816	3				3
				Echinus sp.		14				14
			Strongylocentrotidae	*Strongylocentrotus droebachiensis*	O.F. Mueller, 1776		6	6	16	28
				Strongylocentrotus pallidus	(G.O. Sars, 1871)	2	47	43	101	193
				Strongylocentrotus sp.		13	1	4	4	22
		Pourtalesioida	Pourtalesiidae	*Pourtalesia jeffreysi*	Thomson, 1872		1			1
		Spatangoida	Spatangidae	*Brisaster fragilis*	(Dueben & Koren, 1846)	10		1	1	12
	Holothuroidea	Apodida	Chiridotidae	*Chiridota laevis*	(Fabricius, 1780)	1				1
			Myriotrochidae	*Myriotrochinae* g. sp.					1	1
				Myriotrochus rinkii	Steenstrup, 1851	6		15	4	25
				Myriotrochus sp.			1		4	5
		Aspidochirotida	Stichopodidae	*Stichopus tremulus*	(Gunnerus, 1767)	11				11
		Dendrochirotida	Cucumariidae	*Cucumaria frondosa*	(Gunnerus, 1867)	2	1	3	10	16
				Thyonidium drummondi	(Thompson, 1840)		1		1	2
				Thyonidium sp.				2	2	4
			Phyllophoridae	*Pentamera calcigera*	(Stimpson, 1851)				1	1
				Phyllophoridae g. sp.				1	17	18
			Psolidae	*Psolus phantapus*	Strussenfelt, 1765	3	2	3	20	28
				Psolus sp.		1			16	17
				Psolus squamatus	(O.F. Muller, 1776)		3			3
		Molpadiida	Caudinidae	*Eupyrgus scaber*	Luetken, 1857		3	1		4
			Molpadiidae	*Molpadia arctica*	von Marenzeller, 1878		6		12	18
				Molpadia borealis	(M. Sars, 1859)	23		28	68	119
				Molpadiidae g. sp.					17	17
	Ophiuroidea	Euryalida	Gorgonocephalidae	*Gorgonocephalus arcticus*	(Leach, 1819)		3	32	51	86
				Gorgonocephalus eucnemis	(Mueller & Troschel, 1842)		11	11	78	100
				Gorgonocephalus sp.		2	2	1	18	23
		Ophiurida	Ophiacanthidae	*Ophiacantha bidentata*	(Retzius, 1805)	17	34	66	99	216

Echinodermata	Ophiuroidea		Ophiactidae	*Ophiopholis aculeata*	(L., 1767)	26	56	69	60	211
			Ophiomyxidae	*Ophioscolex glacialis*	Mueller & Troschel, 1842	5	15	48	79	147
			Ophiuridae	*Ophiocten gracilis*	(G.O. Sars, 1871)				13	13
				Ophiocten sericeum	(Forbes, 1852)	4	5	14	5	28
				Ophiopleura borealis	Danielssen & Koren, 1877			22	96	118
				Ophiura robusta	(Ayers, 1851)		1	8		9
				Ophiura sarsi	Luetken, 1855	32	46	44	103	225
				Ophiura sp.		3				3
				Stegophiura nodosa	(Luetken, 1854)				3	3
Brachiopoda				*Brachiopoda* g. sp.					4	4
	Rhynchonellata	Rhynchonellida	Hemithyrididae	*Hemithyris psittacea*	(Gmelin, 1790)	5	1	10	11	27
		Terebratulida	Cancellothyrididae	*Terebratulina retusa*	(L., 1758)	9	20	4		33
				Terebratulina sp.					1	1
			Dallinidae	*Dallina septigera*	(Lovén, 1846)	3				3
				Glaciarcula spitzbergensis	(Davidson, 1852)	2	1			3
			Macandreviidae	*Macandrevia cranium*	(Mueller, 1776)	6	3			9
			Terebratulidae	*Liothyrella arctica*	(Friele, 1877)	1				1
Bryozoa	Gymnolaemata			*Bryozoa* g. sp.			2	6	58	66
		Cheilostomida	Bicellariidae	*Bugula* sp.				3		3
				Dendrobeania sp.			1		1	2
			Celleporidae	*Cellepora* sp.			16	13	5	34
			Flustridae	*Flustra* sp.				26	31	57
				Securiflustra securifrons	(Pallas, 1766)			13		13
			Membraniporidae	*Membranipora membranacea*	(L., 1767)	1				1
				Membranipora sp.		1				1
			Myriaporidae	*Myriapora coarctata*	(M. Sars, 1863)		18	1		19
			Reteporidae	*Retepora beaniana*	King, 1846	8		5		13
				Retepora sp.		3	11	1	1	16
				Sertella septentrionalis	Jullen, 1933		7	2		9

Bryozoa	Gymnolaemata		Rhamphostomellidae	*Rhamphostomella* sp.			2			2
			Schizoporellidae	*Myriozoella* sp.				2		2
			Scrupariidae	*Eucratea loricata*	(L., 1758)	1	6	13	7	27
			Smittinidae	*Parasmittina jeffreysii*	(Norman, 1903)			1		1
				Porella sp.			3	4	3	10
				Smittinidae g. sp.				1		1
		Ctenostomata	Alcyonidiidae	*Alcyonidium disciforme*	Smitt, 1872				11	11
				Alcyonidium gelatinosum	(L., 1767)			56	16	72
				Alcyonidium sp.			19		6	25
		Cyclostomata	Corymboporidae	*Defrancia lucernaria*	(M. Sars, 1851)		2			2
			Diastoporidae	*Diplosolen intricarius*	(Smitt, 1872)	1	8	3		12
			Horneridae	*Hornera* sp.		3				3
				Stegohornera lichenoides	(L., 1758)		31	8	1	40
			Lichenoporidae	*Lichenopora* sp.				2		2
Chaetognatha	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta* sp.			1			1
Chordata	Ascidiacea			*Ascidiacea* g. sp.			19	15	68	102
		Aplousobranchia	Didemnidae	*Didemnum albidum*	(Verrill, 1871)			2		2
				Didemnum roseum	M. Sars, 1851		4			4
				Didemnum sp.		7	8			15
			Polycitoridae	*Eudistoma vitreum*	(Sars, 1851)	4	41			45
			Polyclinidae	*Synoicum tirgens*	Phipps, 1774			1		1
		Phlebobranchia	Ascidiidae	*Ascidia prunum*	(Mueller, 1776)			10		10
				Ascidia sp.		15	1			16
			Cionidae	*Ciona intestinalis*	(L., 1767)		1		18	19
				Ciona sp.					1	1
		Stolidobranchia	Molgulidae	*Molgula* sp.			10	1		11
			Pyuridae	*Halocynthia pyriformis*	(Rathke, 1806)	1		1		2
				Microcosmus glacialis	(M. Sars, 1859)			4		4
			Styelidae	*Botryllus schlosseri*	(Pallas, 1776)	12		14		26

Chordata	Ascidiacea			*Dendrodoa aggregata*	(Rathke, 1806)		2			2
				Dendrodoa sp.		1				1
				Styela coriacea	(Alder & Hancock, 1848)	2	1			3
				Styela rustica	(L., 1767)		3	1	6	10
				Styela sp.					2	2
Total						1613	2281	2837	5966	12679

JOINT REPORT

Institute of Marine Research
Nordnesgaten 50,
5817 Bergen
Norway

Polar Research Institute of Marine Fisheries and Oceanography (PINRO)
6 Knipovich Street,
183763 Murmansk
Russia