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Survey report from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and adjacent waters, August–October 2017

D. Prozorkevich, G.O. Johansen G.O., and G.I. van der Meeren (Eds)

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Contents

1 BACKGROUND

Text by D. Prozorkevich and G.O. Johansen

The aim of the joint Norwegian/Russian ecosystem survey in the Barents Sea and adjacent waters, August-October (BESS) is to monitor the status of abiotic and biotic factors and changes of these in the Barents Sea ecosystem. The survey has since 2004 been undertaken annually in the autumn. The survey is conducted jointly by the Institute of Marine Research (IMR) in Norway and the Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO) in Russia.

The general survey plan and tasks were agreed upon at the annual IMR-PINRO Meeting in March 2017. It was decided to keep all the main tasks of the survey similar to previous years.

It was also decided to conduct the BESS 2017 by "classical scheme" from south to north, conduct some additional bottom trawl hauls for the demersal fish index estimation, and additional acoustic transects for the capelin stock size assessment.

Ship routes and other technical details were agreed by correspondence between the survey coordinators.

The survey was conducted by the Norwegian research vessels: *"G.O. Sars"*, *"Johan Hjort"*, and "*Helmer Hanssen"*, and the Russian vessel *"Vilnyus"*. Survey coordinators in 2017 was Dmitry Prozorkevich (PINRO) and Geir Odd Johansen (IMR). The scientists, technicians and guests taking part in the survey onboard the research vessels are listed in table 1 below.

We would like to express our sincere thanks to all the crew and scientific personnel onboard RVs "*Vilnyus*", "*G.O. Sars*", "*Johan Hjort*" and "*Helmer Hanssen*" for their dedicated work, as well as all the people involved in planning and reporting of BESS 2017.

Table 1. Vessels and participants in the Barents Sea Ecosystem Survey 2017.

Research vessel	Participants
”*Vilnyus*” (24.08–17.10)	Prozorkevich D.V. (cruise leader), Amelkin A.V., Benzik A.A., Bessonov A.A., Gavrilik T.N., Gubanishchev M.A., Harlin S.N., Klepikovsky R.N., Krivosheya P.V., Mullin U.N., Nosov M.A., Nosova T.B., Pankova N.V.
”*G.O. Sars*” (01.9–28.9)	Part 1 (01.9-13.9) Mehl S. (cruise leader), Sveistrup A.K., Sæverud A., Hermansen E., Mjanger H., Sivertsen T., Vindenes S., Kvinge B., Johnsen A.L., Custer A., Petersen M., Reeve M., Langhelle E., Hauge Thangstad T., Marum B., Ford J., Santiago Villalba J. Part 2 (13.9-28,9) Aglen A. (cruise leader), Beck I.M., Vedholm J., Aanestad Godiksen J., Myran H., Helle Danielsen H.E., Richardsen G., Holen F., Haugland T., Kolbeinson S., de Lange J., Martinussen M., Gustad E., Langhelle E., Hauge Thangstad T., Marum B., Ford J., Pavlenko A.
”*Johan Hjort*” (21.8-04.10)	Part 1 (21.8-13.9) Johansen G.O (cruise leader), Schmedling C.A., Odland E., Holm E., Huse I., Aas Tranang C., Drivenes L., Mjanger M., Tousgaard Rist Bogetveit F., Henriksen I., Rønning J., Rey A., McCallum G., Hunt Y., Zakarov D., Darmaraki S., Murray S. Part 2 (13.9-04/10) Skaret G. (cruise leader), Voronkov A., Skadal J., Wienerroither, R., Storaker A., Gabrielsen H., Lien G., Nygaard J.E., Alvarez J., Diaz J., Røttingen J., Erices J., Johannessen M., McCallum G., Hunt Y., Astakhov A., Murray S.
“*Helmer Hanssen*” (21.8-07.9)	Ingvaldsen R. (cruise leader), Lødemel H., Weissenberg E., Moksness I.E., Lie Guldbrandsen M., Menze S., Naustvoll L.-J., Eggen H., Johansen R.A., Gjøsæter H., Knutsen T., Lindal Jørgensen L., Haug T., Rolland A.B., Skavberg N.E., Eilertsen J.-T., Pedersen R., de Lange Wenneck T., Langhelle G.

2 SURVEY EXECUTION 2017

Text by D. Prozorkevich and G.O. Johansen

The 15th joint Barents Sea autumn ecosystem survey (BESS) was carried out during the period from 21th August to 17th October 2017. Research vessel tracks and trawl stations during the 2017 ecosystem survey are shown in Figure 2.1. Hydrography and plankton stations are shown in Figure 2.2.

The Russian vessel *"Vilnyus"* had planned to start the survey on August 10. However, due to various reasons, it started on August 24. Such a huge delay required that the cruise tracks was changed in the southern part of the sea.

Russian military exercises, which have already become traditional in this period in the Barents Sea, have closed a large area in the Russian EEZ. This significantly prevented navigation of the Russian research vessel and some of the survey area was not covered as well as planned.

The Norwegian vessels had not permission from the Russian authorities for carry out bottom trawling east of the delimitation line in the Loop hole in the Barents Sea, outside the economic zones. Thus, this survey area was covered by "*Vilnuys"*, requiring some extra survey time for check-point procedures.

Together, these factors created significant difficulties in the parts of the survey conduction and research. These difficulties mainly affected the monitoring of the 0-group fish and oceanography. The other survey tasks were done completely. The area of distribution of pelagic and bottom fish was synoptically covered, due to a well-coordinated survey working plan in 2017.

RV *"Vilnyus"* covered the Loophole and the rest of the Russian part of the Barents Sea. The Norwegian RVs covered the Norwegian part of the Barents Sea, with *"Johan Hjort"* in south and northeast, *"G.O. Sars"* covered in the central parts, and *"Helmer Hanssen"* the areas west, north and northeast of Svalbard (Spitsbergen).

The total vessel days in 2017 amounted to 146 days.

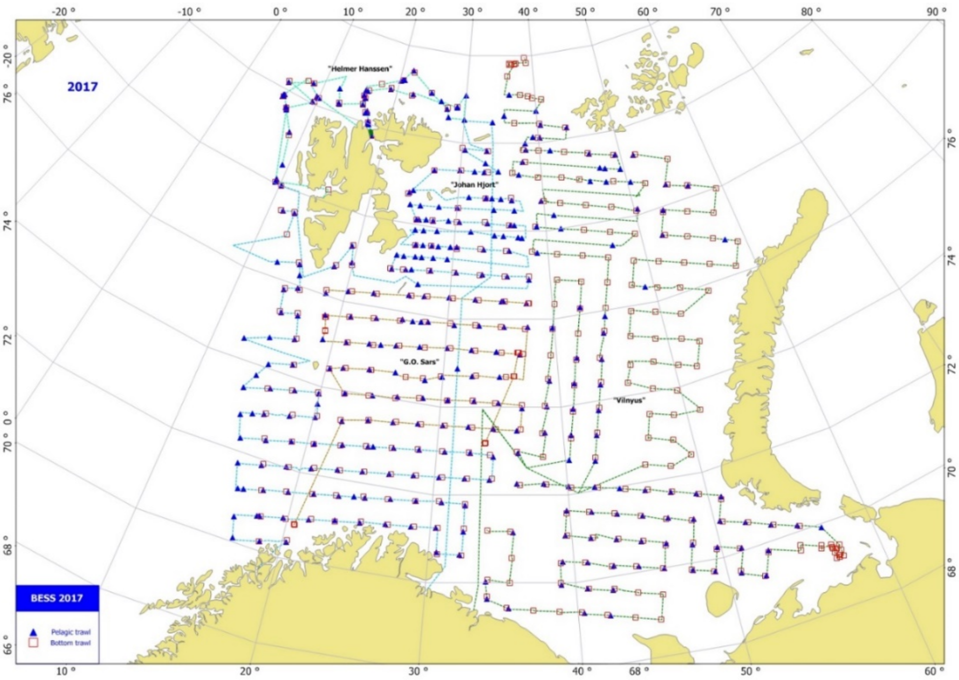

Figure 2.1 Ecosystem survey, August-October 2017. Research vessel tracks and trawl stations for pelagic and bottom trawl stations.

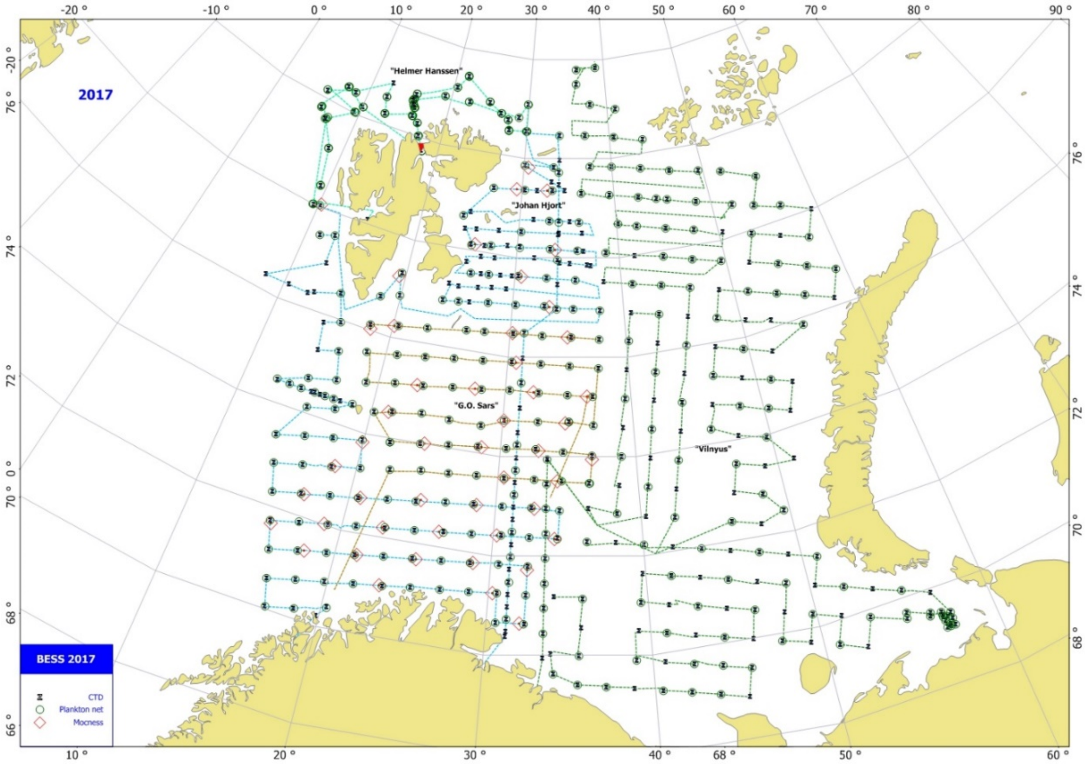

Figure 2.2 Ecosystem survey, August-October 2017. Hydrography and plankton stations.

2.1 Sampling methods

The sampling manual for 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 methodological and technical descriptions of equipment, the trawling and capture procedures by the samplings tools, and the methods that are used in calculating the abundance and biomass for the biota. The manual is continuously updated.

The trawl rigging on both bottom trawl (Campelen 1800) and pelagic trawl (Harstad) at Norwegian vessels was changed in BESS 2017. All Norwegian vessels were equipped with semi-pelagic trawl doors of type “Tyborøn 7a”. In addition, the sweeps were changed from steel wire to Dynema wire. This was done to standardize the rigging on all vessels and to accommodate the use of only one type of doors on each vessel. For the pelagic trawl, the sweep length was reduced, and the amount of flotation was increased, to ensure similar the same behaviour of the trawl as earlier.
There were some indications that the new rigging of the pelagic trawl led to problems positioning the trawl in the medium depth (20 m) during 0-group hauls. This will be investigated using the trawl sensor data from the 2017 survey and at a gear technology survey in autumn 2018.

2.2 Special investigations

The BESS is a useful platform for conducting additional studies in the Barents Sea. These studies can be testing of new methodology, sampling of data additional to the standard monitoring, or sampling of other types of data. It is imperative that the special investigations do not influence the standard monitoring activities at the survey. The special investigations vary from year to year, and below is a list of special investigation conducted on Russian Norwegian vessels at BESS 2017, with contact persons.

Fish pathology research

PINRO undertakes yearly investigations of fish pathology in Russian zone. The main purpose of the fish pathology research is annual estimation of epizootic state of main commercial fish species. The observations are entered into a databank on fish diseases and pathology. This investigation was started by PINRO in 1999.

Contact: A. Bessonov, PINRO.

Maturation of cod

BESS 2017 provided samples of cod gonads to investigate maturation of cod.

Contact: O. Kjesbu, IMR.

Samples of 0-group herring

BESS 2017 provided samples freezing samples of 0-group herring from 7-8 selected areas distributed in the Norwegian part of the Barents Sea. The aim is to establish the presence of distinct groupings within the 0-group Norwegian spring-spawning herring using otolith micro-chemistry and micro-structure analysis.

Contact: O. Kjesbu and V. Komyakova, IMR.

Parasites in benthos

This is part of a IMR coordinated project conducting a large survey for parasites in the Barents Sea. The aim is to collect data from all parts of the ecosystem (fish, benthos, zooplankton, marine mammals etc.). At BESS 2017 we sampled benthos species.

Contact: P. Arneberg, IMR.

Invertebrate benthos larvae

BESS 2017 provided a data on meroplankton from WP2 plankton nets for identification through molecular methods. The aim was to investigate on the seasonality of life cycles of marine benthic invertebrates in the Barents Sea.

Contact: B. Bluhm, University of Tromsø

Sampling of sea stars

At “G.O. Sars” there was mounted a holding tank for sea stars to enable live catches of different species. The aim was to provide living sea star specimens to be photographed for a web-based picture archive at Artsdatabanken, Norway. The picture archive is published here: https://www.artsdatabanken.no/Pages/229581.

Contact: A.K. Sveistrup, IMR.

Testing of snow crab bag

To improve the monitoring of snow crab, IMR initiated experiments in 2016 on attaching a bag under the bottom trawl for catching snow crab more efficiently. The experiment was continued at BESS 2017 and the results are reported as an own report.

Contact: A.M. Hjelset and A. Aglen, IMR

Radioactivity in Northern shrimp

BESS 2017 provided freezing samples of Northern shrimp from two areas (south and north) in the Barents Sea. These are used to study radioactivity in shell and muscle from raw and boiled specimens. This is a cooperation with The Norwegian Radiation Protection Authority (NRPA).

Contact: H.E. Heldal, IMR.

SI_ARCTIC

SI_ARCTIC is a strategic initiative at IMR aimed at describing changes in the Polar Sea as the ice retreats. SI_ARCTIC has conducted dedicated surveys west and north of Svalbard (Spitsbergen) from 2014, and in 2017 this investigation was part of BESS. The results are reported in: Toktrapport/Havforskningsinstituttet/ISSN 15036294/Nr. 5-2017 (in English),

(http://hi.no/filarkiv/2017/10/cruise_report_si_arctic_2017_final.pdf/nb-no).

Contact: R. Ingvaldsen, IMR

Aging of water masses

BESS 2017 provided water samples for determination of water age in different water masse in the Barents Sea. The aim is to investigate retention and circulation of different water masses, and geographical variation of this.

Contact: O. Titov, PINRO and J.E. Stiansen, IMR.

Water samples for ocean acidification studies

BESS 2017 provided water samples for analysis of ocean acidification in both Norwegian and Russian areas of the Barents Sea. Due to problems exchanging the samples, Russian samples was not analysed. Norwegian samples were restricted to the Vardø-Nord hydrographic section.

Contact: M. Chierici, IMR.

3 DATA MANAGEMENT

Text by D. Prozorkevich and G.O. Johansen

3.1 Databases

Huge amounts of data are collected during the ecosystem surveys. All data collected during the ecosystem survey are quality controlled and verified by specialists from IMR and PINRO during the survey. The data are stored in IMR and PINRO databases, with different formats at IMR and PINRO. However, the data are exchanged so that both institutions have access to each other's data in their respective databases (i.e. both institutes have the equal joint data).

All age readings and fish stomach analyses were finished by April 2018 and data have been download to joint databases.

A joint database ("Sjømil") for aggregated time series is accessible as a web resource; http://www.imr.no/sjomil/index.html.

3.1 Data application

The main aim of the survey are to cover the whole Barents Sea ecosystem geographically and provide survey data for commercial fish stock estimation. Stock estimation is particularly important for capelin, because capelin TAC is based on the survey result, and the Norwegian-Russian Fishery Commission determines TAC immediately after the survey. In addition, a broad spectre of physical variables, ecosystem components and pollution are monitored and reported. The survey data will be used by ICES working groups (AFWG, WGWIDE, NIPAG, WGCRAB, WGMME, WGIBAR and WGOH) as well as the Norwegian ecosystem status report on selected indicators from the Norwegian EEZ of the Barents Sea.

This BESS report is based on joint data and contains the main results of the monitoring. The survey report is published on the BESS web page (http://www.imr.no/tokt/okosystemtokt_i_barentshavet/nn-no), and will be assembled into a complete pdf-report when the main components are completed. This web page is dedicated to collating all information from the ecosystem survey, including all the previous reports, maps, etc. It will also include post-survey information, not included in the written report (e.g. plankton and fish stomach samples which need longer processing time). These additional data will be included into the web based report when ready.

4 MARINE ENVIRONMENT

4.1 Hydrography

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

4.1.1 Standard sections

Table 4.1.1.1 shows mean temperatures in the main parts of standard oceanographic sections of the Barents Sea, along with historical data back to 1965.

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. The mean Atlantic Water (50–200 m) temperature in the Fugløya–Bear Island Section was 0.5°C higher than the long-term mean for the period 1965–2017 (Table 4.1.1.1). Going further east to the Vardø–North Section, the mean Atlantic Water (50–200 m) temperature anomaly was 0.8°C. Both sections show that the temperatures were close to those in 2016.

The Kola and Kanin Sections cover the flow of Coastal and Atlantic waters in the southern Barents Sea. In August–September 2017, the Kanin Section was not carried out. The mean temperature of Atlantic waters in the central and outer parts of the Kola Section (upper, intermediate and deeper layers) in August 2017 was 0.6–1.0°C higher than the average (for the period 1951–2010) that was typical of warm years. In autumn 2017, seasonal cooling in the upper 50 m went slower (by 0.4°C per month) compared to the long-term mean cooling rate. Rates of seasonal increase in temperature of deeper layers (50–200 m) were close to the average. Compared to 2015, the active layer (0–200 m) in 2017 was colder in the central part of the section (by 0.2°C) and in the outer part (by 0.3°C). The mean salinity of Atlantic waters in the Kola Section (0–200 m) in August 2017 was 0.1 lower than the long-term (1951–2010) mean in its central part and close to the average in its outer part.

Arctic waters were, as usual, most dominant at 50 m depth north of 77°N (Fig. 4.1.2.3). The temperatures at depths of 50 and 100 m were higher than the long-term mean (on average, by 1.0 and 0.8°C respectively) in most of the Barents Sea. Negative anomalies were mainly found in the northern part of the sea and north of the Svalbard (Spitsbergen). Compared to 2016, the 50 m temperature was lower (on average, by 1.1°C) in most of the sea (six sevenths of the surveyed area) and the 100 m temperature was lower (on average, by 0.7°C) almost all over the Barents Sea. Positive differences in 50 m temperature between 2017 and 2016 took place only in some small areas located in the central and western Barents Sea.

The bottom temperature was in general 1.1°C above the average in most of the Barents Sea (Fig. 4.1.2.10). Negative anomalies (–1.0°C on average) were only observed in the northern sea and north of the Svalbard (Spitsbergen). Compared to 2016, the bottom temperature was on average 0.8°C lower in most of the Barents Sea. Bottom waters were slightly warmer (on average, by 0.2°C) than in 2016 only in the Eastern Basin and in the small area east of the Great Bank. In August–October 2017, the area occupied by water with temperatures below zero was larger than in the previous year and it was mainly located east of the Svalbard (Spitsbergen). The lowest bottom temperatures (below –1°C) were observed between the Great Bank and the Svalbard (Spitsbergen).

The surface salinity was on average 0.3 higher than the long-term mean in most of the Barents Sea (two thirds of the surveyed area) with the largest positive anomalies (>0.8) west of the Svalbard (Spitsbergen) as well as in the south-eastern and north-eastern sea (Fig. 4.1.2.11). Negative anomalies (–0.3 on average) were mainly observed in the southern and northern parts of the sea with the largest values north of Kanin Peninsula and north of the Svalbard (Spitsbergen). In August–October 2017, the surface waters were on average 0.3 fresher than in 2016 in 75% of the surveyed area with the largest negative differences in the northern (north of 77°N) and south-eastern (along Southern Island of the Novaya Zemlya and north of Kanin Peninsula) parts of the Barents Sea. Small positive differences in salinity between 2017 and 2016 (0.1 on average) were found in the central and western sea as well as north of Kolguev Island.

The bottom salinity was close to both the average and that in 2016 in most of the Barents Sea (Fig. 4.1.2.12). Significant anomalies were mainly found in shallow waters: negative – in the south-easternmost Barents Sea and east of the Svalbard (Spitsbergen), positive – over the Spitsbergen Bank and north of Kolguev Island.

The bottom salinity was close to both the average and that in 2016 in most of the Barents Sea (Fig. 4.1.2.12). Significant anomalies were mainly found in shallow waters: negative – in the south-easternmost Barents Sea and east of the Svalbard (Spitsbergen), positive – over the Spitsbergen Bank and north of Kolguev Island.

4.1.2 Geographic variation

Horizontal distributions of temperature and salinity are shown for depths of 0, 50, 100 m and near the bottom in Figs 4.1.2.1–4.1.2.8, and anomalies of temperature and salinity at the surface and near the bottom are presented in Figs 4.1.2.9–4.1.2.12. Anomalies have been calculated using the long-term means for the period 1931–2010.

The surface temperature was on average 1.1°C higher than the long-term mean in most of the Barents Sea (five sixths of the surveyed area) (Fig. 4.1.2.9). The largest positive anomalies (>2.0°C) were observed west of Bear Island, west and south of the Svalbard (Spitsbergen) Archipelago and in the south-eastern part of the sea. Negative anomalies took place in the south-western and northernmost Barents Sea as well as north of the Svalbard (Spitsbergen). Compared to 2016, the surface temperature was lower (by 1.0°C on average) in most of the Barents Sea (five sixths of the surveyed area), especially in the northern and eastern parts. The surface waters were on average 0.4°C warmer than in the previous year only in the western Barents Sea, especially in the areas where the largest positive anomalies were found in 2017.

Table 4.1.1.1. Mean water temperatures in the main parts of standard oceanographic sections in the Barents Sea and adjacent waters in August–September 1965–2017.

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	-	-	-	6.4
2012	8.2	5.3	6.0	6.2	5.2	-	-	5.1	6.4
2013	8.8	4.6	5.6	5.5	4.6	-	5.6	5.0	6.3
2014	8.0	4.6	5.4	4.5	4.1	-	-	5.2	6.1
2015	8.5	4.8	5.7	6.1	4.6	-	-	5.6	6.6
2016	-	-	-	-	5.5	-	-	5.1	6.5
2017	7.9	4.8	5.6	-	-	-	-	5.2	6.4
Average 1965–2017	7.6	4.0	4.9	4.5	3.6	5.8	4.8	4.4	5.9

*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)

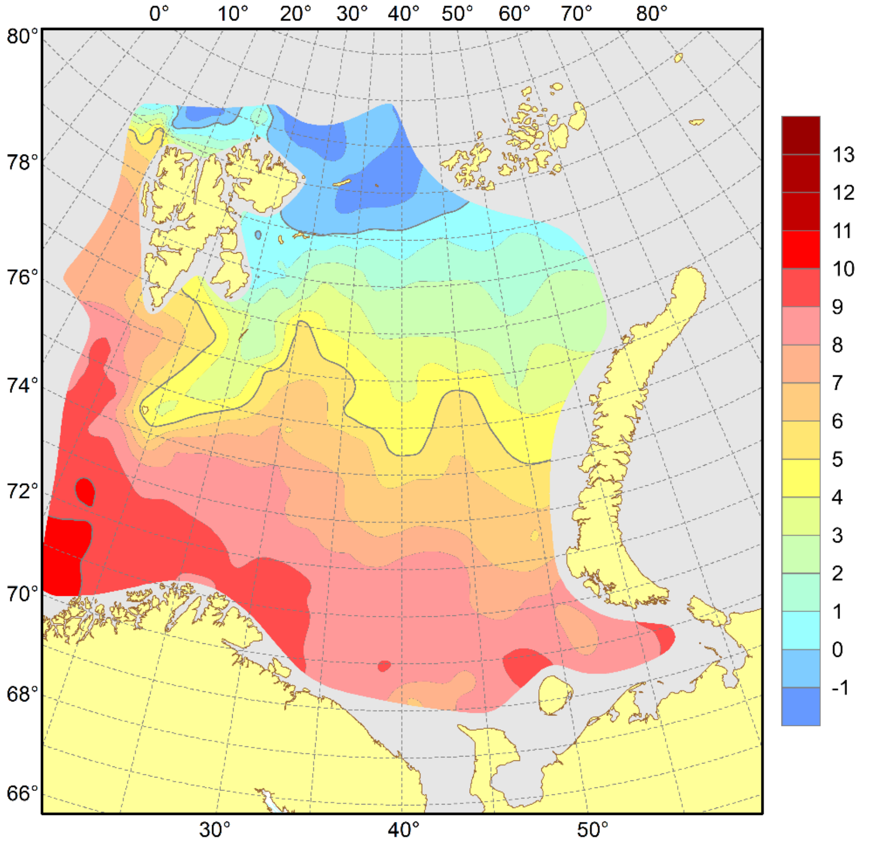

Figure 4.1.2.1 Distribution of surface temperature (°C), August–October 2017

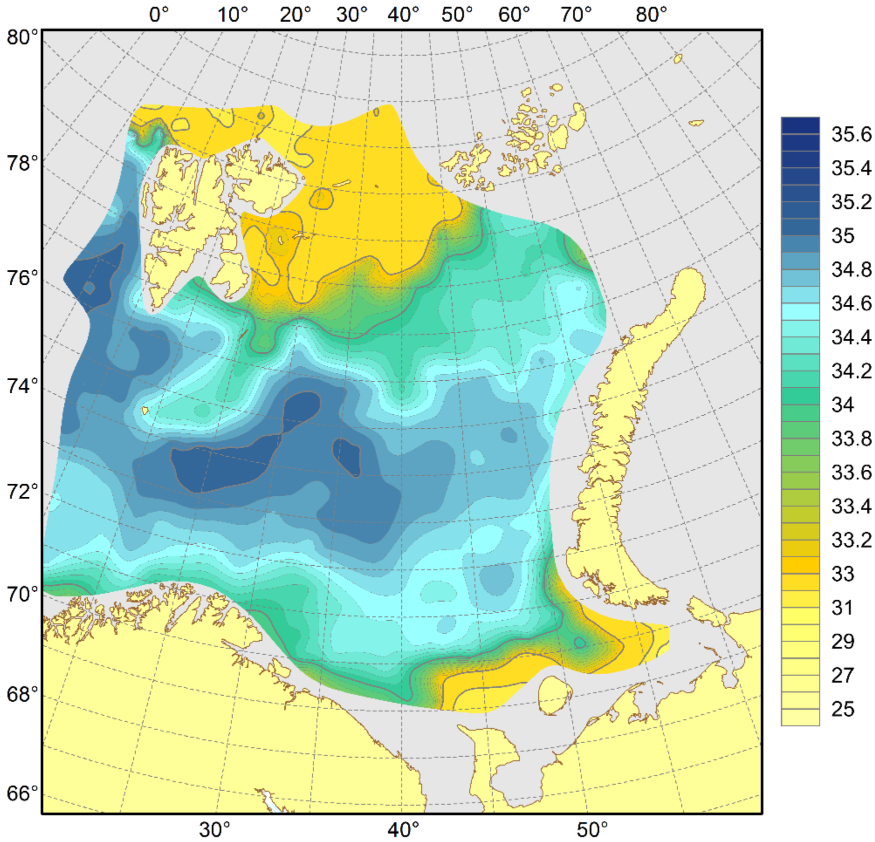

Figure 4.1.2.2. Distribution of surface salinity, August–October 2017

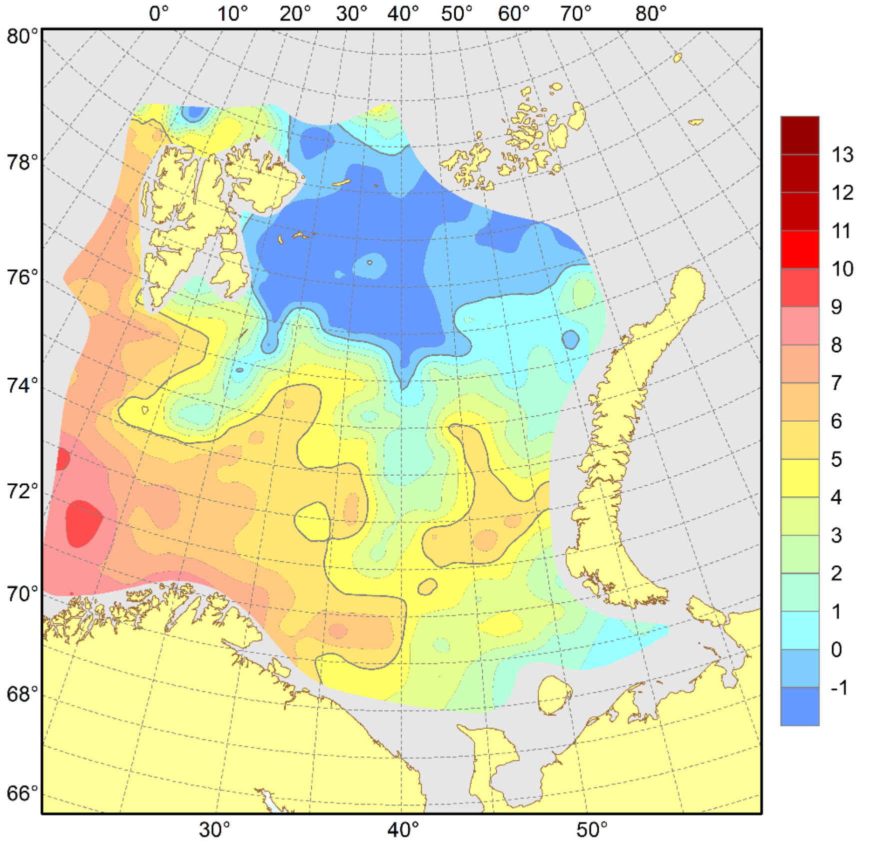

Figure 4.1.2.3. Distribution of temperature (°C) at the 50 m depth, August–October 2017

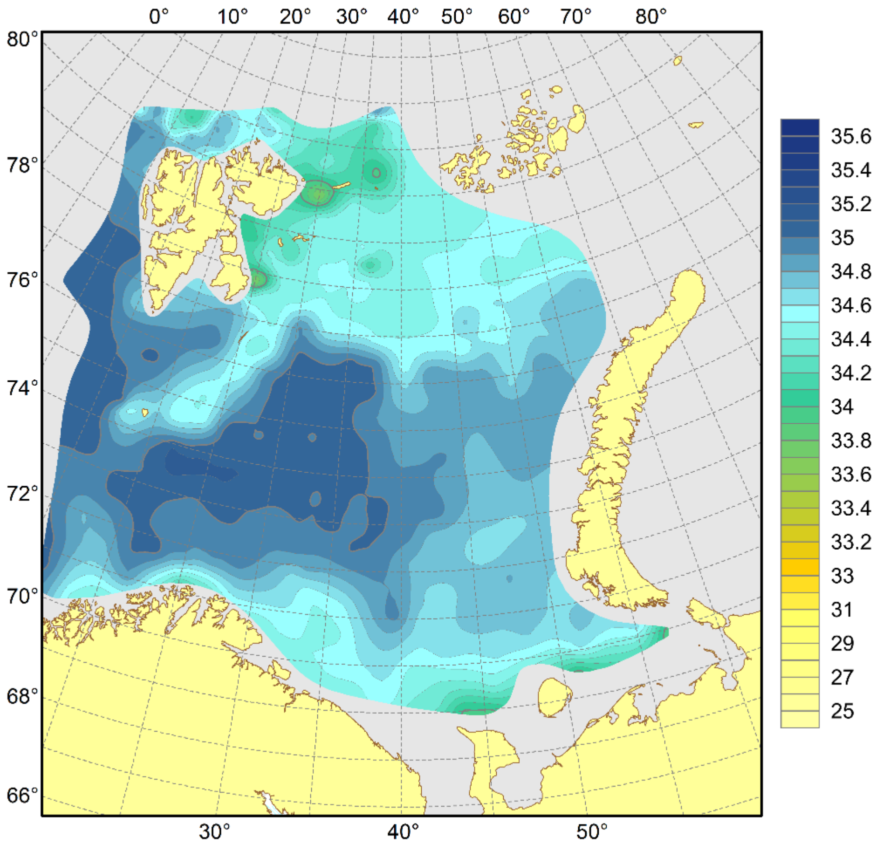

Figure 4.1.2.4. Distribution of salinity at the 50 m depth, August–October 2017

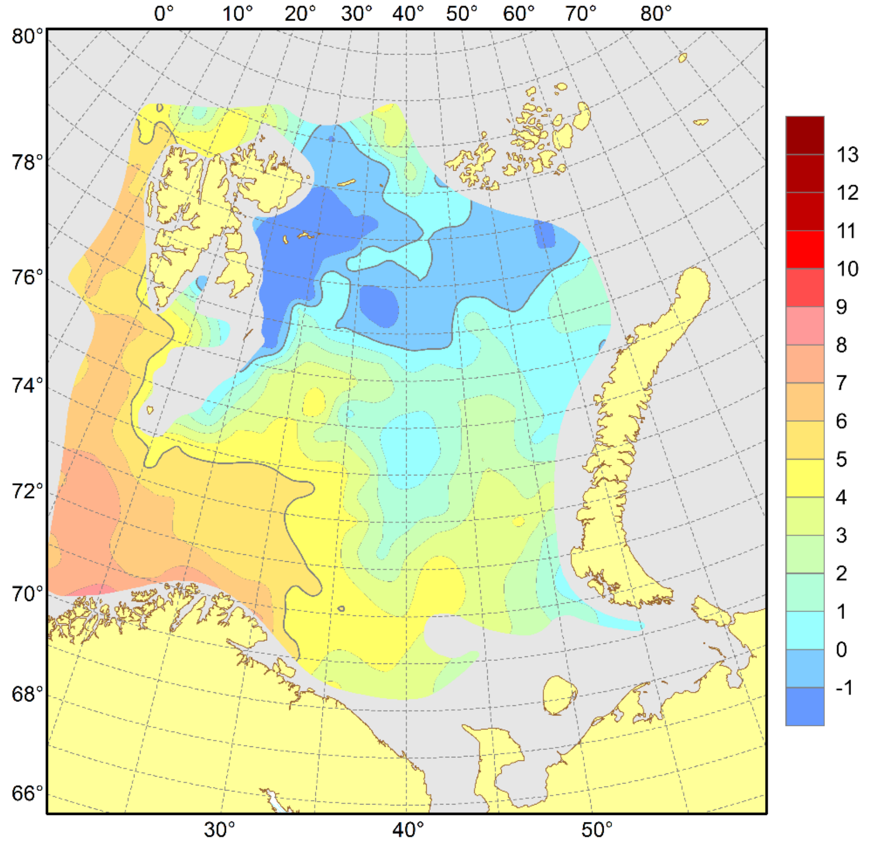

Figure 4.1.2.5. Distribution of temperature (°C) at the 100 m depth, August–October 2017

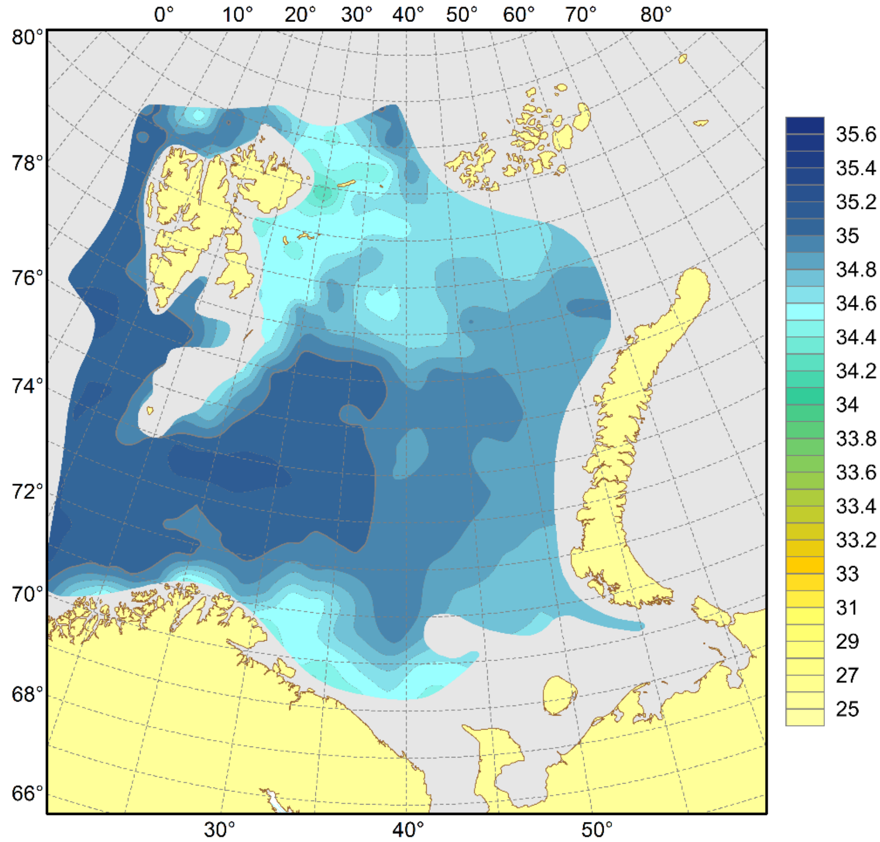

Figure 4.1.2.6. Distribution of salinity at the 100 m depth, August–October 2017

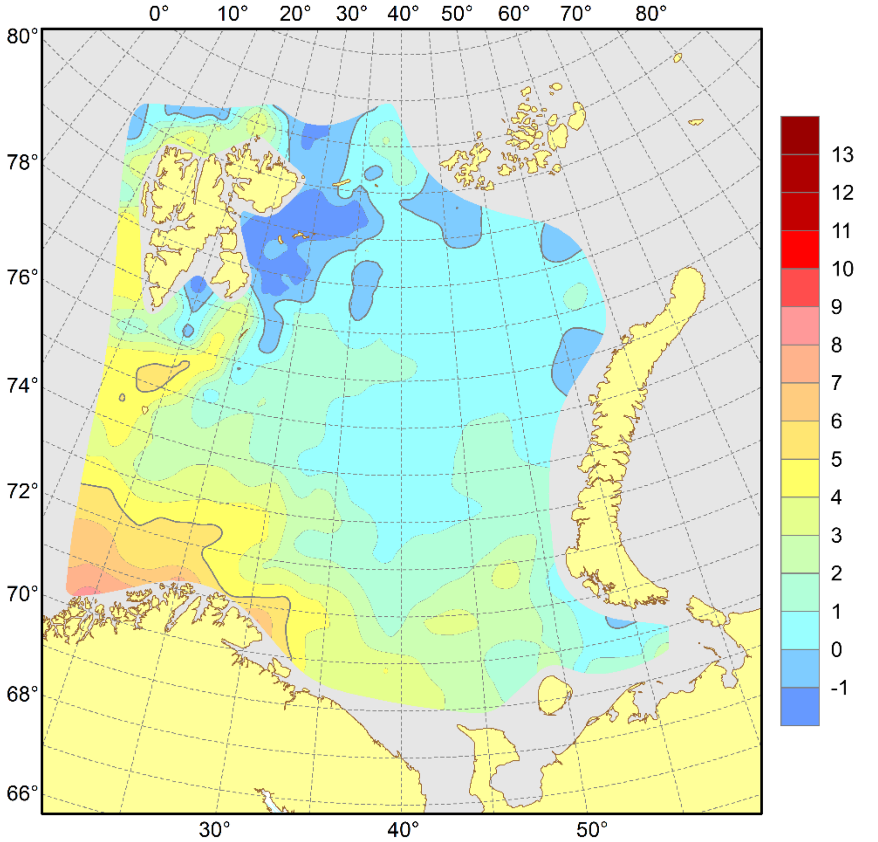

Figure 4.1.2.7. Distribution of temperature (°C) at the bottom, August–October 2017

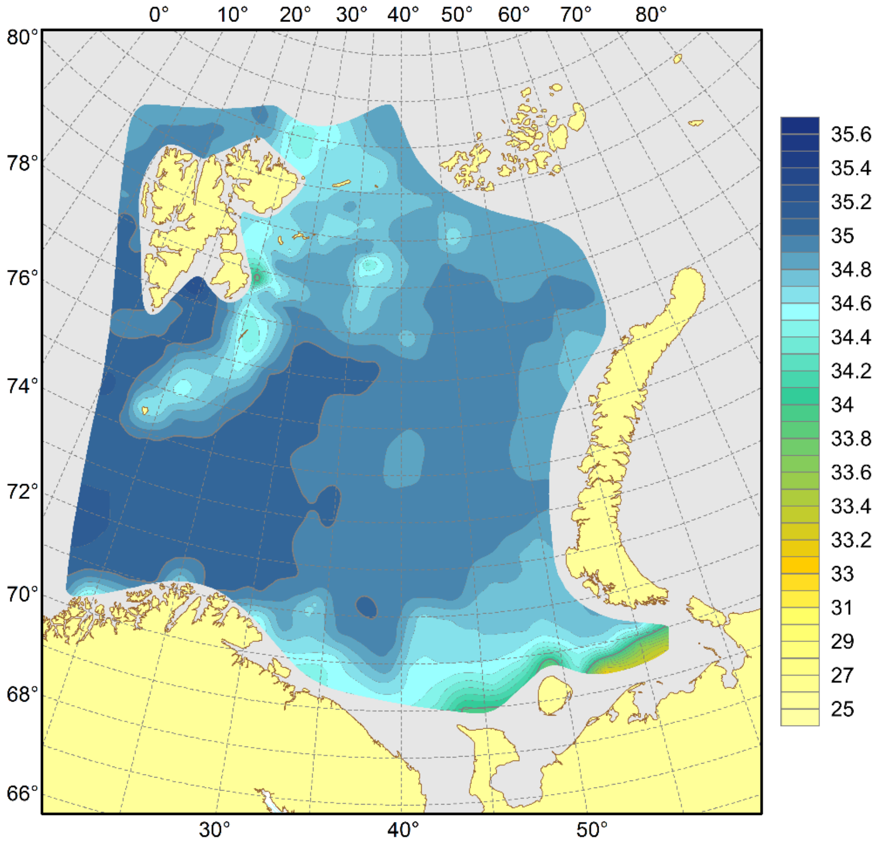

Figure 4.1.2.8. Distribution of salinity at the bottom, August–October 2017

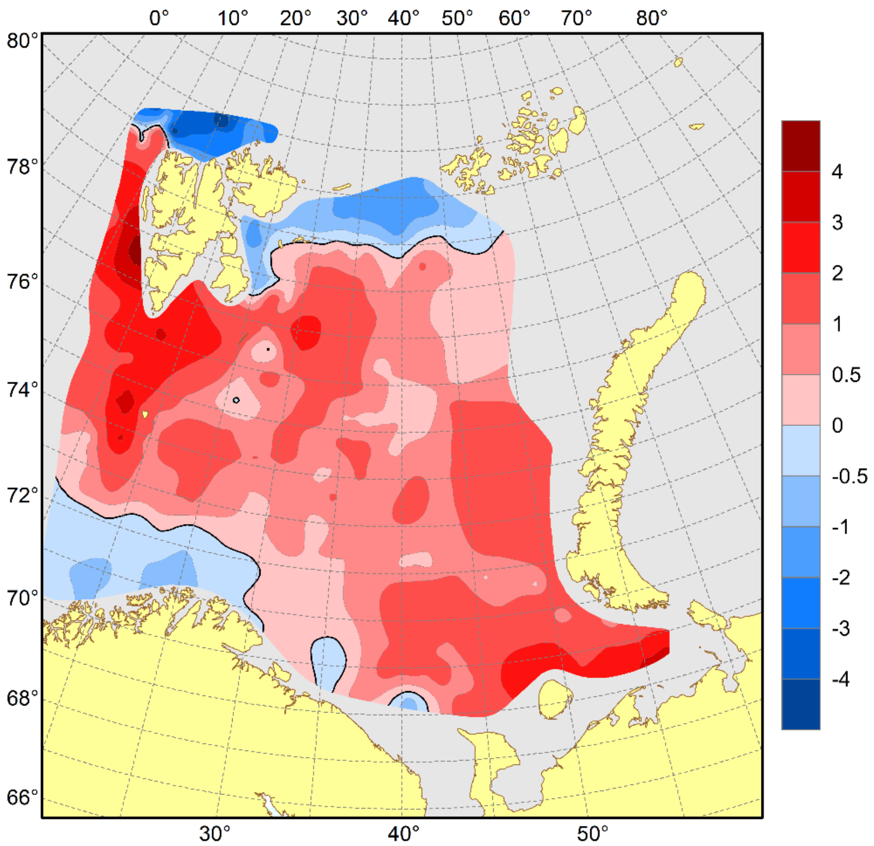

Figure 4.1.2.9. Surface temperature anomalies (°C), August–October 2017

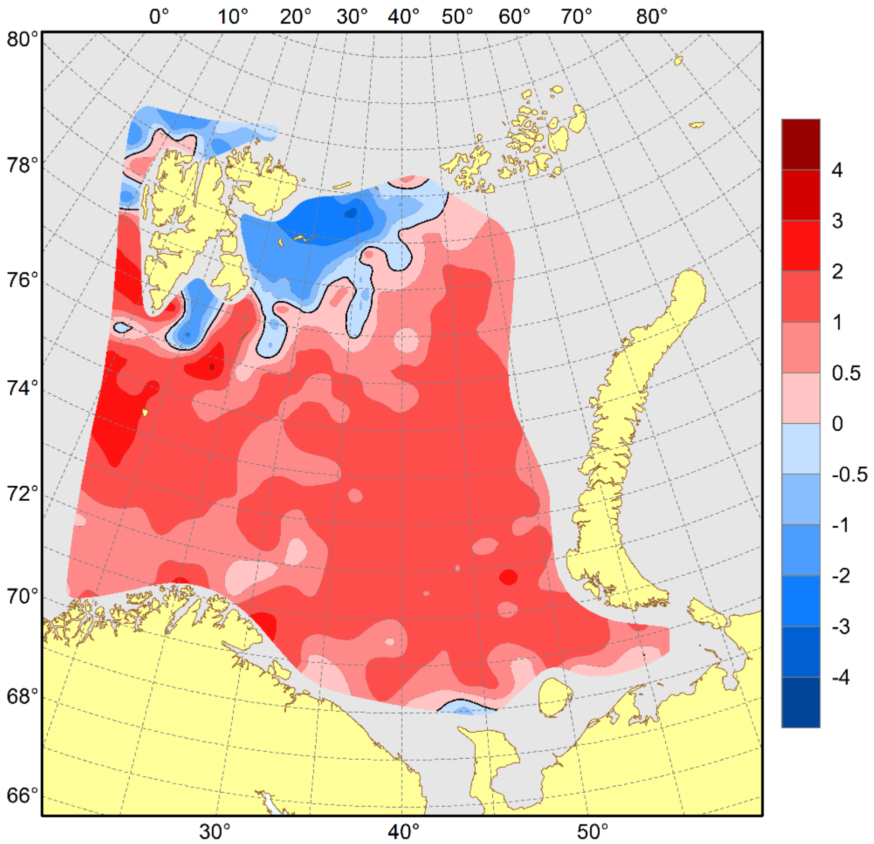

Figure 4.1.2.10. Temperature anomalies (°C) at the bottom, August–October 2017

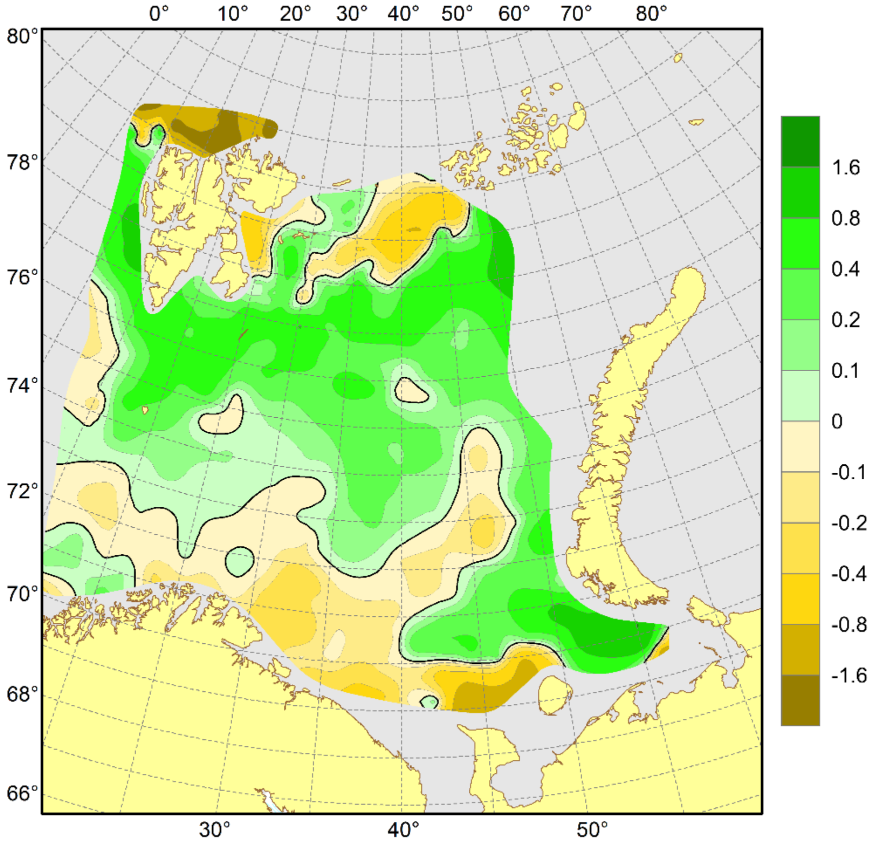

Figure 4.1.2.11. Surface salinity anomalies, August–October 2017

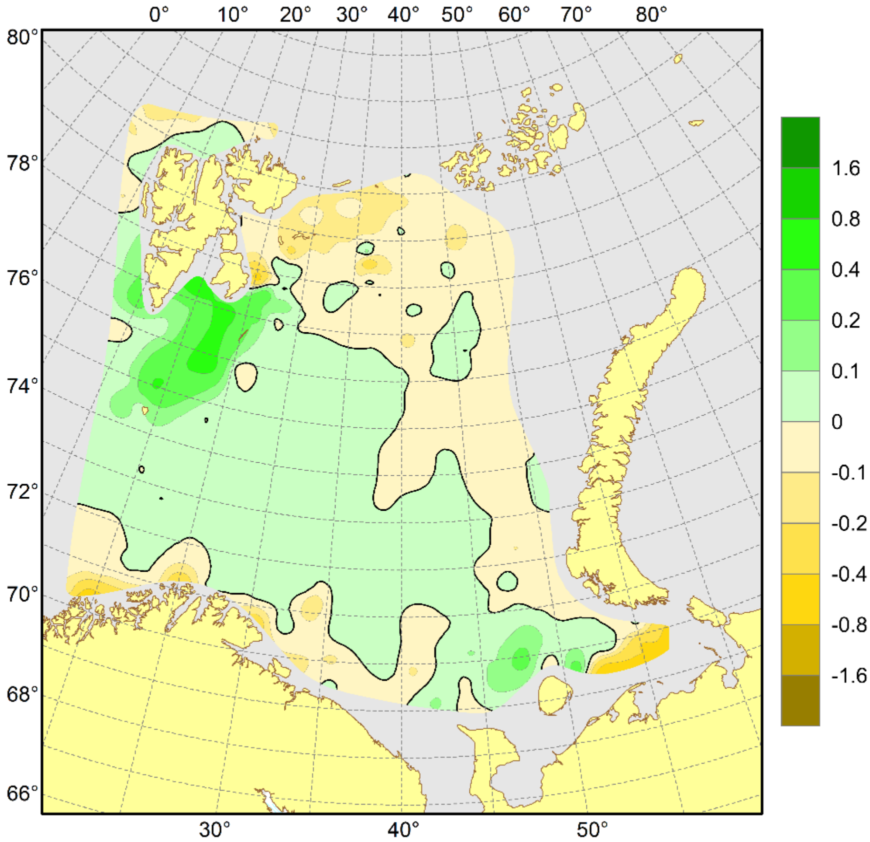

Figure 4.1.2.12. Salinity anomalies at the bottom, August–October 2017

4.2 Anthropogenic pollution

4.2.1 Marine litter

Text by T. Prokhorova and B.E. Grøsvik
Figures by P. Krivosheya

Anthropogenic litter on the surface (floating) and in trawls in 2017 was observed onboard all Russian and all Norwegian vessels.

Plastic dominated among anthropogenic pollutants on the water surface (71.3 % of observations) (Fig. 4.2.1.1). Due to currents, registered polluting objects could have been dumped directly in some areas and been brought in from other areas. Wood was registered in the 28.4 % of observations. Scattered objects of textile, paper, rubber and metal was observed occasionally.

Litter from fishery was registered in 23.5 % of plastic litter observations at the surface (Figure 4.2.1.2). Fishery litter was represented by ropes (OSPAR code 31), string and cord (32), pieces of nets (115), floats/buoys (37) etc.

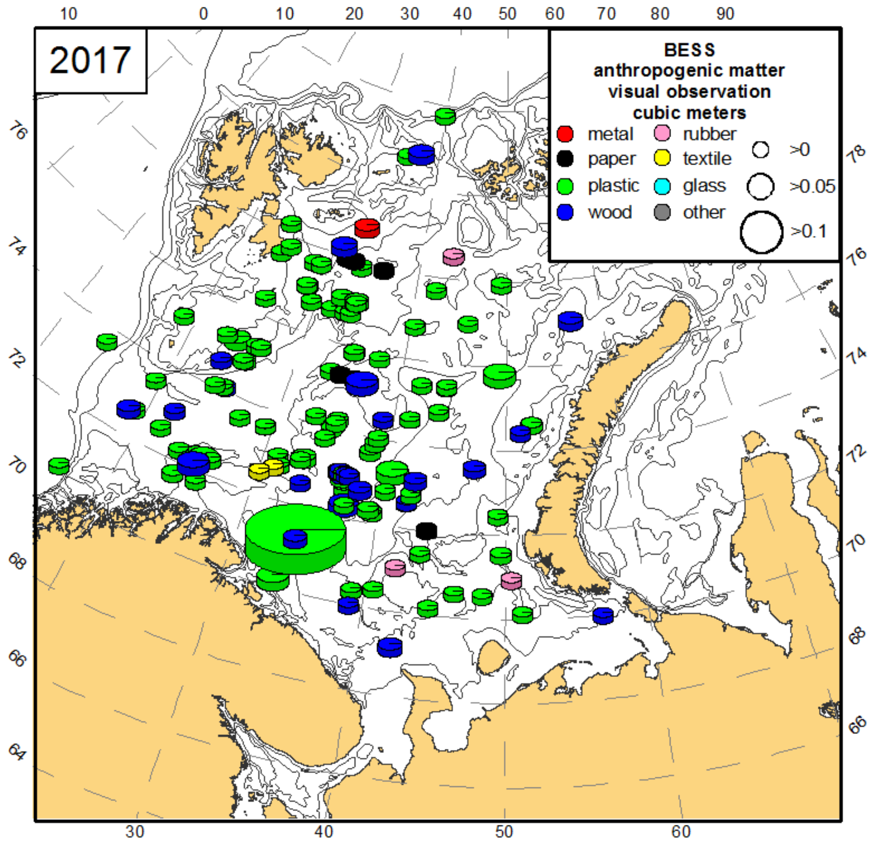

Figure 4.2.1.1 Type of observed anthropogenic litter (m³) at the surface in the BESS 2017

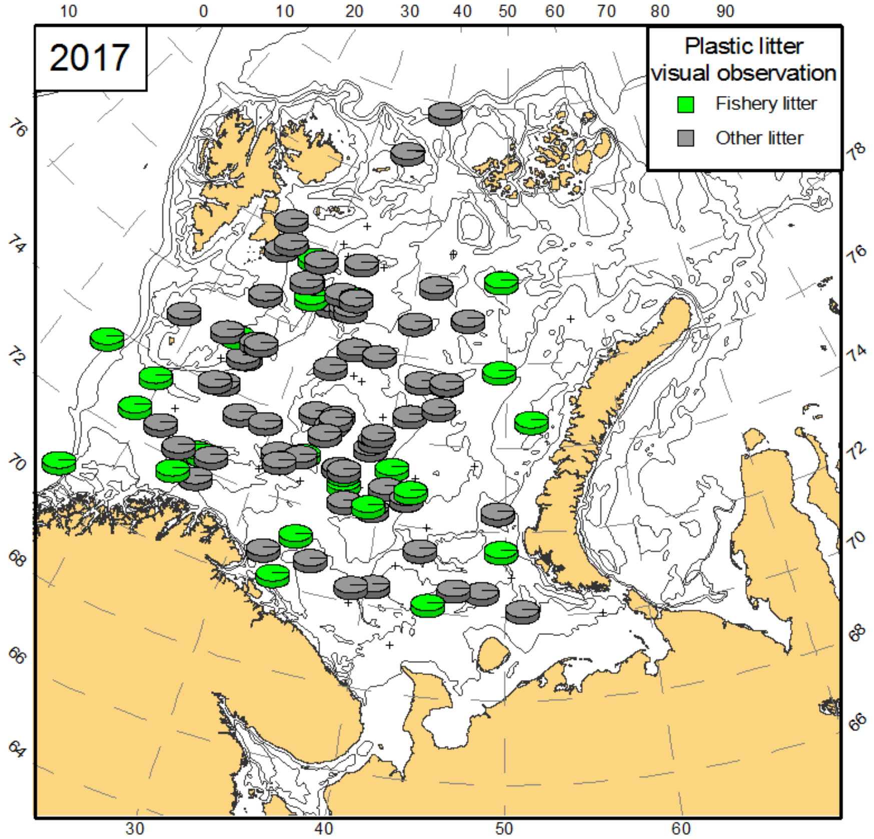

Figure 4.2.1.2 Fishery plastic proportion among the plastic litter observed at the surface in the BESS 2017 (crosses – occurrences of anthropogenic litter)

Anthropogenic litter was observed in 17,8 % of pelagic trawl stations (Fig. 4.2.1.3). As in previous years, plastic dominated from all anthropogenic matter in pelagic trawls (95 % of stations with observed litter). Weight of plastic litter in pelagic hauls was from 0.1 g to 21 kg with an average of 37 g (disregarding the single maximum catch of 21 kg). Considering the low catchability by pelagic trawl for low-density polymers, the real total amount of this matter in the Barents Sea could be much higher. Wood and metal litter was observed occasionally. We have not data from pelagic catches in the north-eastern part of the survey due to lack of pelagic trawl stations in this region.

Litter was observed throughout the survey in the bottom trawl catches (26.7 % of the bottom trawl stations) (Fig. 4.2.1.4). Plastic also dominated the litter content from the bottom trawls (90.4 % of stations with observed litter). Weight of plastic litter in bottom trawls was from 1 g to 15 kg with average of 52 g (disregarding the single maximum catch of 15 kg). Generally, catches of plastic litter in the bottom trawls were higher than in pelagic. Wood was registered in bycatch in shallow waters in the south-eastern part of the Barents Sea. 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. Textile, metal and rubber was observed among the bottom trawl catches sporadically.

Litter from fishery was a significant part of the plastic litter both in the pelagic and bottom trawls (43.3 % and 61.7 % respectively) (Figure 4.2.1.5).

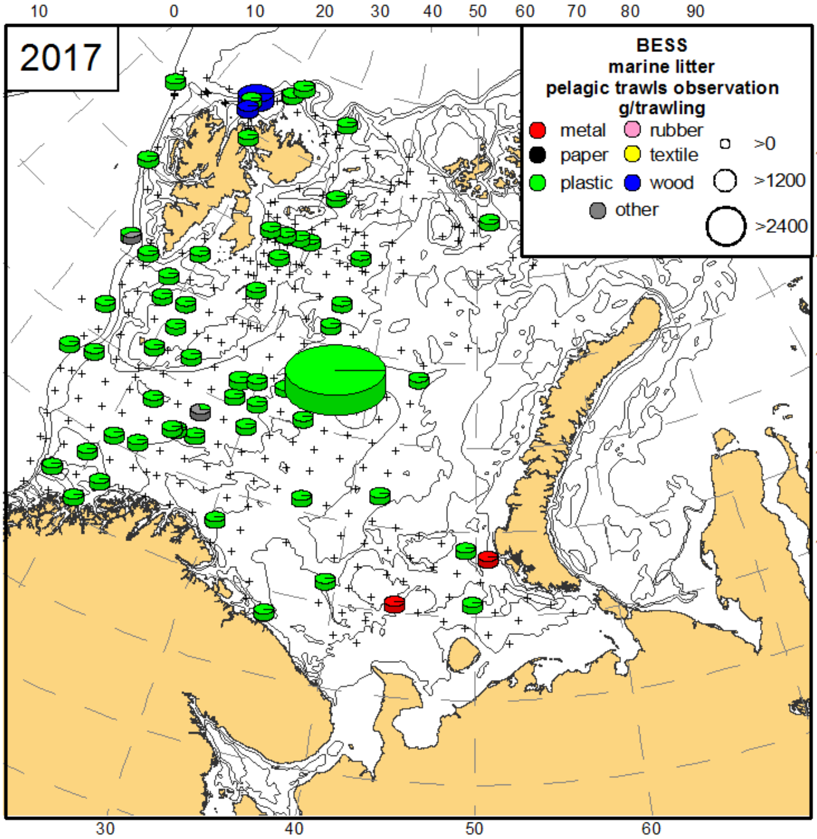

Figure 4.2.1.3 Type of anthropogenic litter collected in the pelagic trawls (g) in the BESS 2017 (crosses – pelagic trawl stations)

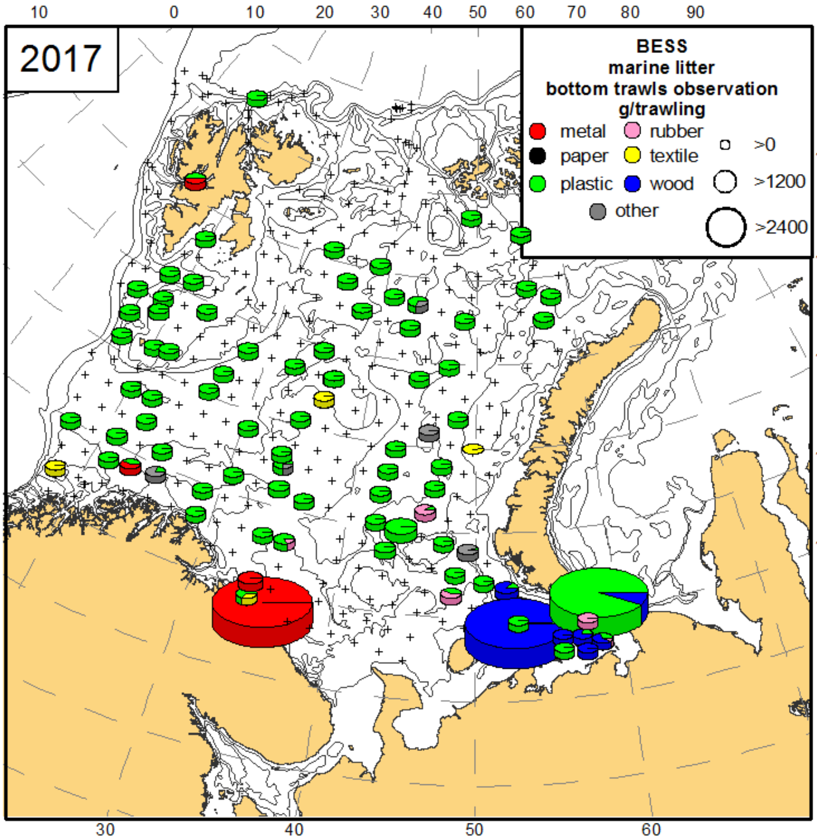

Figure 4.2.1.4 Type of anthropogenic litter collected in the bottom trawls (g) in the BESS 2017 (crosses – bottom trawl stations)

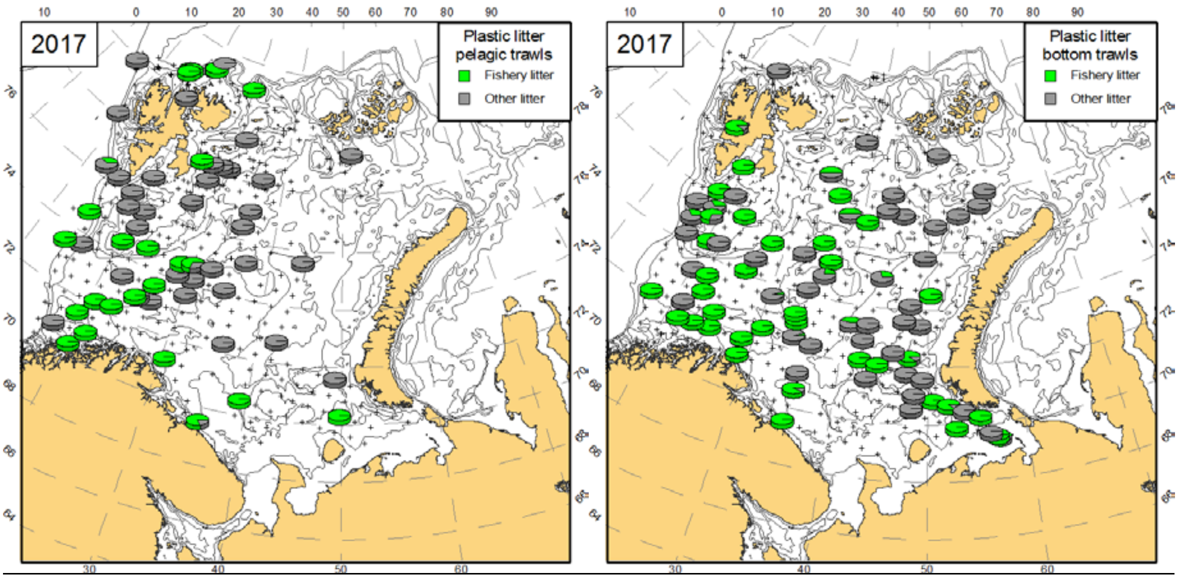

Figure 4.2.1.5 Fishery plastic proportion among the plastic litter collected in the pelagic (on the left) and bottom trawls (on the right) in the BESS 2017 (crosses – trawl stations)

4.2.2. Chemical pollution

Text by H.E. Heldal, J. Klungsøyr and A. Zhilin

Every third year, Institute of Marine Research (IMR) carries out sample collection in the Barents Sea for thorough investigations of the levels of contaminants in sea water, sediments and marine biota. The analyses include different hydrocarbons, persistent organic pollutants (POPs) (e.g. PCBs, DDTs, HCHs, HCB) and radionuclides. Monitoring of radionuclides focuses on cesium-137 (Cs-137), but levels of strontium-90 (Sr-90), plutonium-238 (Pu-238), plutonium-239,240 (Pu-239,240) and americium-241 (Am-241) are also determined in a selection of samples. In addition, samples of cod (*Gadus morhua*) are collected from the Bear Island area and along the coast of Finnmark twice a year for analyses of Cs-137. Monitoring of radionuclides is performed in close cooperation with the Norwegian Radiation Protection Authority (NRPA) within the national monitoring program “Radioactivity in the Marine Environment” (RAME).

The last monitoring was in 2015, when samples were collected from RV *“Johan Hjort”* and RV *“G.O. Sars”* in August and September. The next monitoring will take place in 2018, and the results from chemical analyses will be reported during 2019.

In 2017 PINRO continued the annual monitoring of pollution levels in the Barents Sea in accordance with the Russian national program. Samples of seawater, sediments and fish was collected and analysed for persistent organic pollutants (POPs) (e.g. PCBs, DDTs, HCHs, HCB) and heavy metals (e.g. lead, cadmium, mercury) and arsenic. The samples were collected from RV *"F.Nansen"* and *"Vilnus"* in May, September and December from the southern part of the Barents Sea and in the Svalbard (Spitsbergen) area. The results from the chemical analyses will be reported during 2018.

5 PLANKTON COMMUNITY

5.1 Phytoplankton, chlorophyll a and nutrients

Text by S. Larsen
Figure by S. Larsen

Phytoplankton samples from the Barents Sea Ecosystem cruise (2017) collected from depth of 10 metres by CTD casts, for 21 stations (Figure 5.1.1 and Table 5.1.1), were analysed for taxonomy and abundance. In addition, water samples taken at 50 metres depth for four of these stations were also analysed. All samples were fixed in Lugol's solution and analysed by Mona Ring Kleiven using the Utermöhl sedimentation method.

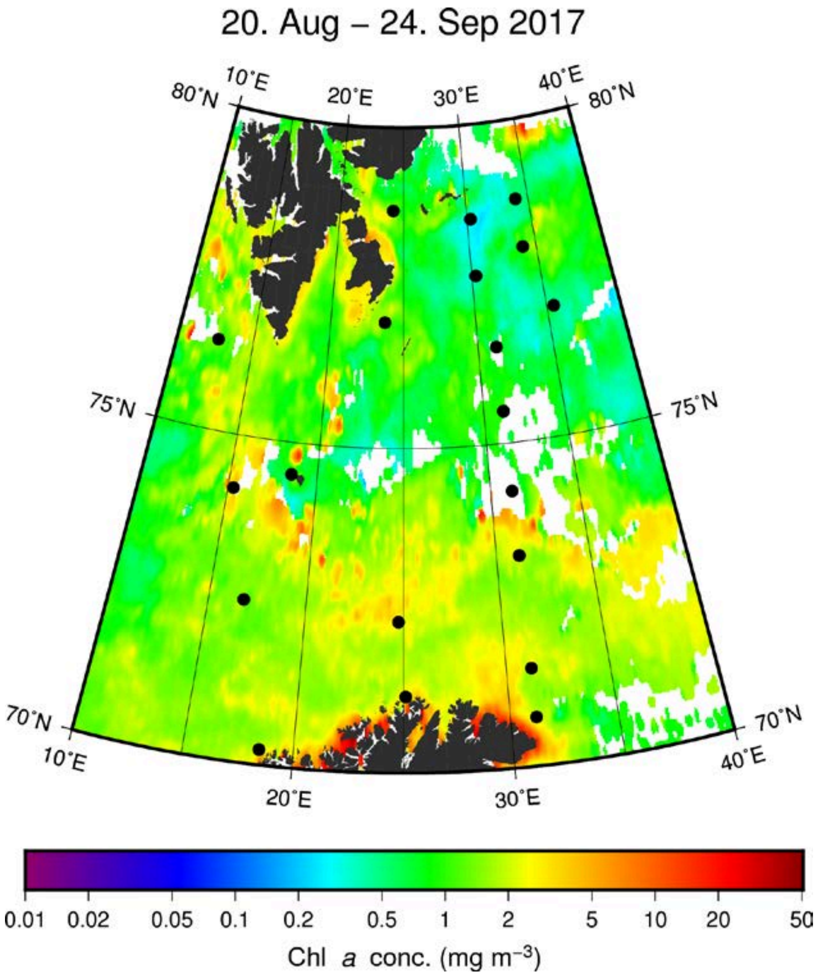

Figure 5.1.1. *MODIS satellite derived mean surface chlorophyll-a concentration during the Barents Sea Ecosystem Cruise (20. Aug – 24. Sep). White areas denote missing data due to cloud cover. Black dots indicate the locations sampled for phytoplankton abundance and taxonomy measurements. Note that due to spatial variations in cloud and satellite coverage over the period, sampling frequency and precision varies spatially.*

From the subsequent analysis of the ship samples, the dominant genera responsible were Cryptophyceae, Dinophyceae, Bacillariophyceae and unidentified flagellates (Table 5.1.1). East of Svalbard, where chlorophyll-a concentrations were comparatively low, unidentified flagellate species tended to dominate, though it should be noted that these waters were sampled later than those to the south, which may account for the taxonomic differences observed.

						10 metre sample cell concentrations (×1000 cell l^{-1})						
Station	lat.	long.	dd-mm-yy	U.flag	Monader	Cryptophyceae	Dinophyta	Diatom	Dictyophyceae	Haptophyta	Phaeocystis	Ciliate
371	70.2348	18.4422	22-08-17	47.5	0.0	52.9	8.5	198.2	0.0	0.0	0.0	20.0
378	71.1683	25.1083	25-08-17	18.4	0.0	9.7	7.2	159.5	0.0	0.0	0.0	2.5
400	72.3162	24.7593	31-08-17	81.0	0.0	224.6	146.7	186.5	0.0	0.0	0.0	1.6
415	72.4922	16.7937	04-09-17	116.6	0.0	543.2	6.4	93.6	0.0	0.0	0.0	7.9
425	74.1758	15.3028	07-09-17	278.6	0.0	179.3	9.7	15.8	0.0	0.0	0.0	1.0
427	74.5030	18.4957	08-09-17	15.7	0.0	0.0	0.6	5.0	0.0	0.0	0.0	0.2
444	76.3935	12.6855	10-09-17	216.0	0.0	104.8	5.2	110.4	15.2	15.1	0.0	2.6
456	77.0162	35.4797	17-09-17	17.8	0.0	36.7	2.8	12.1	6.6	4.0	0.0	0.1
462	76.9575	23.7290	18-09-17	10.8	0.0	108.0	26.6	98.1	0.4	0.0	0.0	2.6
470	77.6350	30.2868	20-09-17	23.8	0.0	2.2	0.7	73.6	0.0	0.0	0.0	0.8
495	78.5237	30.2805	25-09-17	0.0	145.8	3.2	0.4	0.2	0.0	0.0	0.0	0.5
504	78.7013	24.2017	27-09-17	33.5	0.0	0.0	0.4	4.3	2.6	2.5	0.0	0.3
513	80.4965	33.9960	29-09-17	1.1	0.0	0.3	0.4	0.0	0.0	0.0	0.0	0.2
519	78.7535	34.0123	29-09-17	70.2	0.0	2.2	0.1	0.2	0.0	0.0	0.0	0.4
521	77.9995	34.0027	30-09-17	37.8	0.0	6.5	0.9	127.4	0.0	0.0	0.0	1.2
524	76.5008	31.2180	30-09-17	37.8	0.0	3.2	1.4	0.9	0.9	0.8	0.0	0.6
526	75.4977	31.2188	01-10-17	141.5	0.0	4.3	0.3	0.2	0.0	0.0	0.0	0.3
529	74.2540	31.2175	01-10-17	0.0	123.1	0.0	1.6	7.7	0.0	0.0	0.0	0.8
533	73.2513	31.2207	01-10-17	104.8	0.0	9.7	0.9	8.5	0.0	0.0	0.0	0.5
540	71.5033	31.2200	02-10-17	204.1	0.0	37.8	6.3	3.1	0.0	0.0	0.0	0.6
543	70.7507	31.2158	02-10-17	34.6	0.0	14.0	10.6	5.0	0.4	0.0	0.0	0.5

						10 metre sample cell concentrations (×1000 cell l^{-1})						
Station	lat.	long.	dd-mm-yy	U.flag	Monader	Cryptophyceae	Dinophyta	Diatom	Dictyophyceae	Haptophyta	Phaeocystis	Ciliate
533	73.2513	31.2207	01-10-17	49.7	0.0	0.0	0.1	4.2	0.0	0.0	0.0	0.4
526	75.4977	31.2188	01-10-17	71.3	0.0	7.6	1.0	0.0	2.3	2.2	0.0	0.2
470	77.6350	30.2868	20-09-17	55.1	0.0	4.3	0.2	2.4	0.0	0.0	0.0	0.4
513	80.4965	33.9960	29-09-17	141.5	0.0	2.2	0.1	0.2	0.0	0.0	0.0	0.2

Table 5.1.1. Summary of the cell abundances for the main phytoplankton genera and ciliates (x 1000 cell l^{-1}) identified.

Nutrient and chlorophyll samples were collected from various depths at roughly 170 CTD stations. The nutrient samples (20 ml) were preserved with chloroform (200 μl), and thereafter kept at about 4°C until subsequent chemical analysis on shore at IMR. The chlorophyll-samples were collected by filtering 263 ml of seawater through glass-fibre filters, which were then frozen at about -18°C until subsequent extraction of pigments in acetone and thereafter fluorometric analysis in the IMR laboratory on shore. Analysis of concentrations of nitrate, nitrite, silicate and phosphate, along with chlorophyll and phaeopigments, will be finalised in spring 2018, and the results will be stored in IMR databases.

5.2 Mesozooplankton biomass and geographic distribution

Text by E. Bagøien, A. Dolgov, I. Prokopchuk, T. Knutsen and V. Nesterova

Figure by E. Bagøien

A total of 247 stations were sampled in the Norwegian and Russian sectors 2017 for monitoring of total mesozooplankton biomass in the entire Barents Sea. In the Norwegian sector the WP2 net was applied, while in the Russian sector the Juday net was used. Both gears were rigged with nets of mesh-size 180 μm, and hauled vertically from near the bottom to the surface. Previous investigations have shown that the total zooplankton biomass collected by the two gears are comparable.

The distribution of total mesozooplankton biomass in 2017 is shown in Figure 5.2.1. The average biomass estimated for 2017 when including both the Norwegian and Russian sectors (7.2 g dry-weight m^{-2}, st.dev. 5.7) is not directly comparable to the estimate for 2016 (6.6 g m^{-2}), since the area coverage differed between the two years. Challenges in covering "exactly" the same area across years are inherent in such large-scale monitoring programs. Inter-annual variation in ice-cover is one of several reasons for this. The biomass value presented here is the arithmetic average of all stations shown in Figure 5.2.1. The main difference in the survey coverage in 2017 versus 2016 was that a region between ca. 69-73 °N and 30-45 °E, just north of the Russian Kola peninsula, was not monitored in 2016.

The overall distribution patterns show similarities across years, although some inter-annual variability is apparent. In 2017, relatively high biomasses (> 10 g m^{-2}) were observed in the Bear Island Trench (southwestern region of the Barents Sea), north of Svalbard (Spitsbergen) and in the area south of Franz Josef Land, as well as in large parts of the easterly region surveyed including the South-eastern Basin. Relatively low biomasses (< 3 g m^{-2}) were registered in the westernmost area bordering the Norwegian Sea, in regions both south and east of Svalbard (Spitsbergen), as well as in the south-eastern corner of the survey area (Fig. 5.2.1). Compared to 2016, the most notable difference was the increased biomass in the easterly parts of the Barents Sea in 2017. However, a large area just north of the Kola peninsula was not covered in 2016, which complicates the comparison.

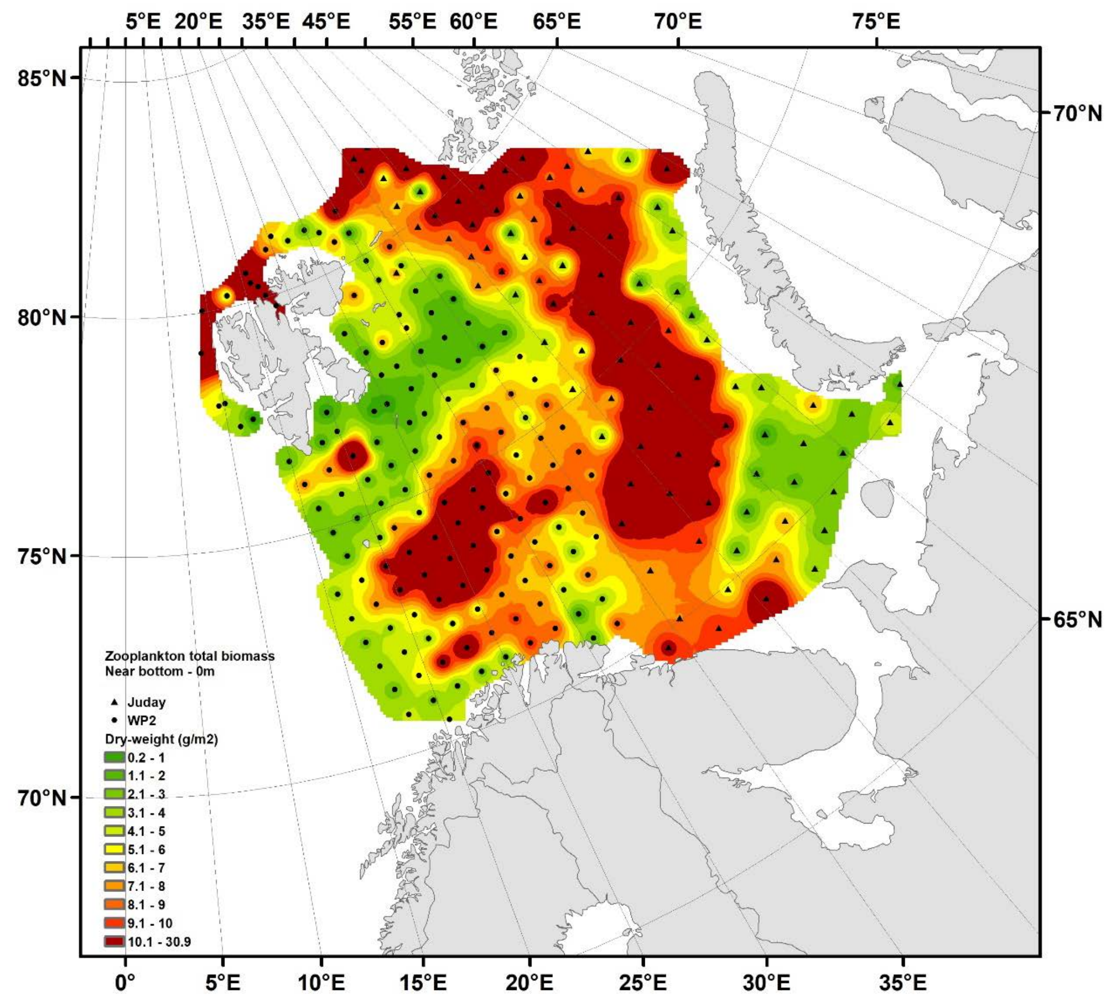

Figure 5.2.1. Distribution of total zooplankton biomass (g m^{-2}, dry-weight) in the near-bottom – 0 m layer during BESS 2017 - based on a total of 247 stations. The data visualized were collected by WP2-net (IMR) and Juday-net (PINRO), both with mesh-size 180 µm. Interpolation was made in ArcGIS v.10.5, module Spatial Analyst, using inverse data weighting (default settings).

Several factors may impact the levels of zooplankton biomasses in the Barents Sea, including;

- Advective supply of zooplankton from the Norwegian Sea – mediated by ocean currents
- Local zooplankton production rates - which are linked to temperature, nutrient conditions and primary production rates
- Predation from carnivorous zooplankters (jellyfish, krill, hyperiids, chaetognaths, etc.)
- Predation from planktivorous fish including capelin, young herring, polar cod, juveniles of cod, saithe, haddock, redfish
- Predation from marine mammals and seabirds

Spatial distributions of mesozooplankton biomass, and relationships with ecosystem components such as ocean currents, hydrography, and abundances/distributions of relevant predators will be evaluated in more detail in the ICES Working Group on the Integrated Assessments of the Barents Sea (WGIBAR).

5.3.3. Biomass indices and distribution of jellyfish

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

Estimates on distribution and abundances/biomass of gelatinous zooplankton are based on catches from the standard pelagic trawl in the upper 0-60 m water layer. Gelatinous zooplankton was sorted from all trawl catches, identified to the lowest taxonomic level possible and recorded as total wet weight per taxon.

In August-October 2017, lion's mane jellyfish (*Cyanea capillata*; Scyphozoa) was the most common jellyfish species, both with respect to weight and occurrence (average catch of 15 tonnes per sq nmi), and widely distributed in the entire survey area (Figure 5.3.3.1). The catches per station were higher than in 2015-2016, and ranged between 155 kg and 224 tons per sq nmi. High catches (> 10 tonnes per sq nmi) were taken on half of stations, which is higher than previous two years.

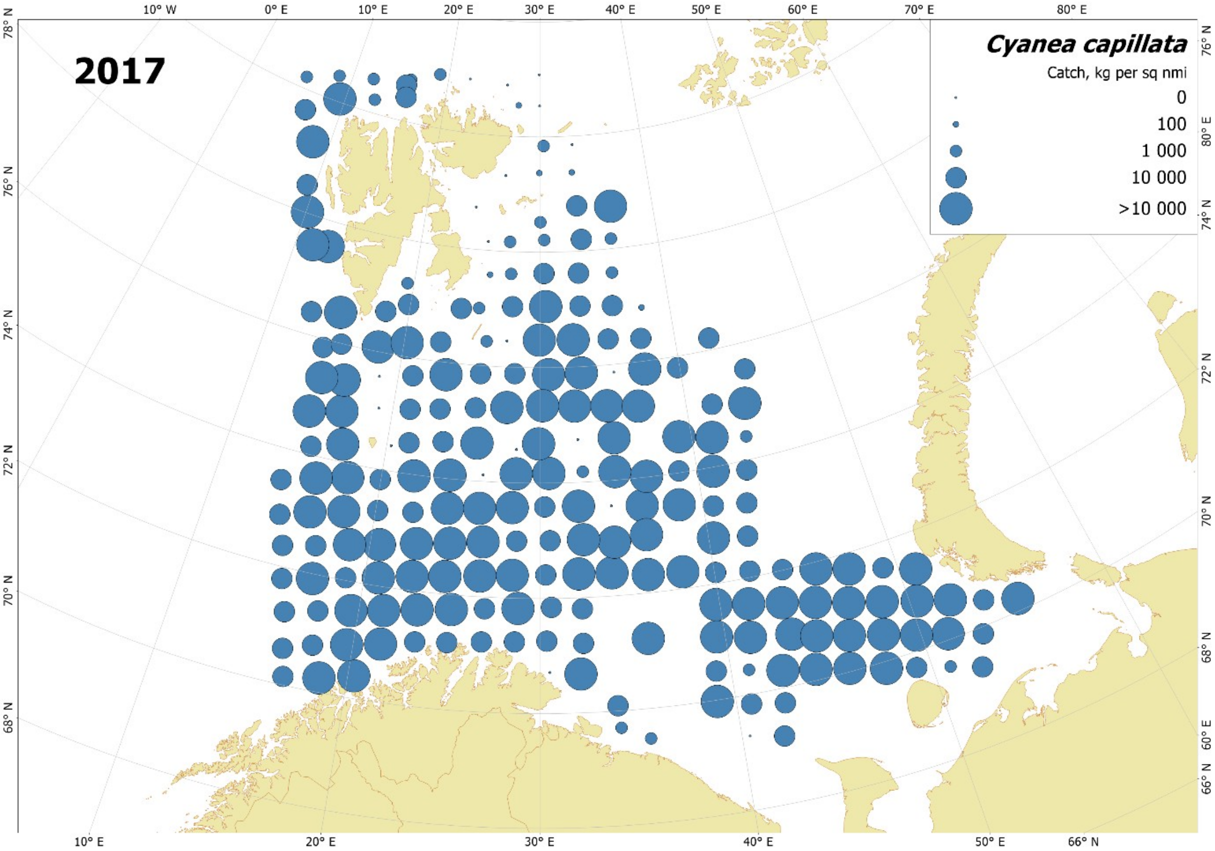

Figure 5.3.3.1. Distribution and catch (wet weight; kg per sq nmi) of *Cyanea capillata* in the Barents Sea, August-October 2017. Catches both day and night from standard pelagic trawl 0-60 m depth.

C. capillata was observed throughout the entire Barents Sea with the highest concentrations (>15 tonnes per sq nmi) in the central, southeastern area and along the western Svalbard (Spitsbergen) coast.

Blue stinging jellyfish (*Cyanea lamarckii*; Scyphozoa) is usually distributed outside the Barents Sea. *C. lamarckii* was most likely transported into the Barents Sea by Atlantic waters from the Norwegian Sea and Norwegian coast. The first observation of *C. lamarckii* in the Barents Sea was recorded during the BESS in autumn 2014. In 2017, *C. lamarckii* had similar distribution as in 2016 (Figure 5.3.3.2). *C. lamarckii* was recorded on 21 stations (9.2 % of the standard pelagic trawl station) in the western and southwestern Barents Sea. Single specimens were observed in pelagic catches with average catch of 0.04 kg per nmi.

Single specimens of helmet jelly (*Periphylla periphylla; Scyphozoa,* deep-water jellyfish) were caught on two stations on the western Barents Sea in 2017 (Figure 5.3.3.2). Distribution of helmet jelly in 2017 was similar to 2016. Only standard pelagic trawl stations are reported here, however helmet jelly was also taken also by bottom trawl.

Other species are not reported in the report due to technical challenges.

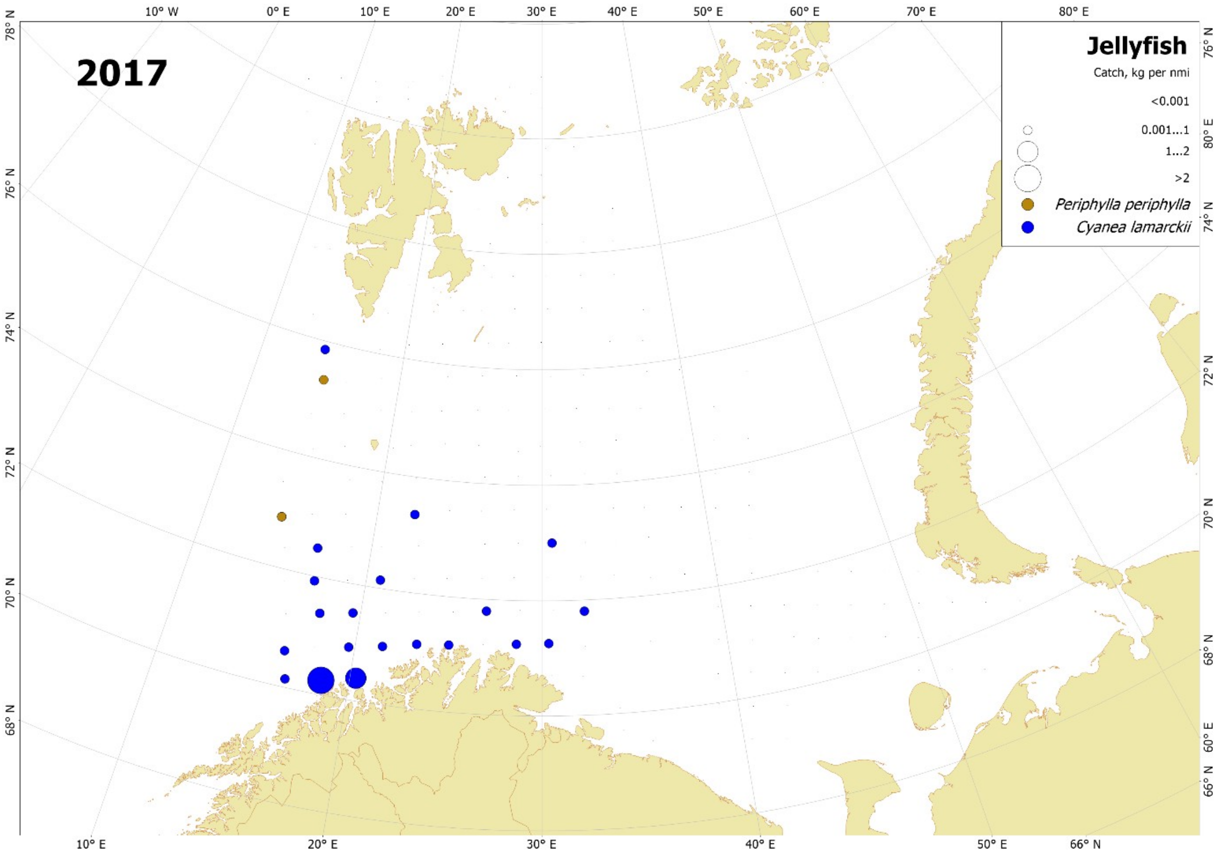

Figure 5.3.3.2. Distribution and catch (wet weight; kg per nmi) of *Cyanea lamarckii* and *Periphylla periphylla* in the Barents Sea, August-October 2017. Catches both day and night from standard pelagic trawl in the upper 0-60 m layer.

Long-term trends of the total biomass of *C. capillata* in upper water layers (0-60 m) of the Barents Sea are shown in figure 5.3.3.3.

In August-October 2017 biomass was estimated 4.6 million tons (Figure 5.3.3.3). This is the third highest observed and much higher than the long term means for 2011-2017 (1.3 million tons). The inter-annual variation in total biomass of gelatinous zooplankton, (dominated by

C. capillata) estimated from the BESS 1980-2017 is considerable, with high peaks in 2001 and 2014 (5 million tons) and minimum low in 1997 (0.02 million tons).

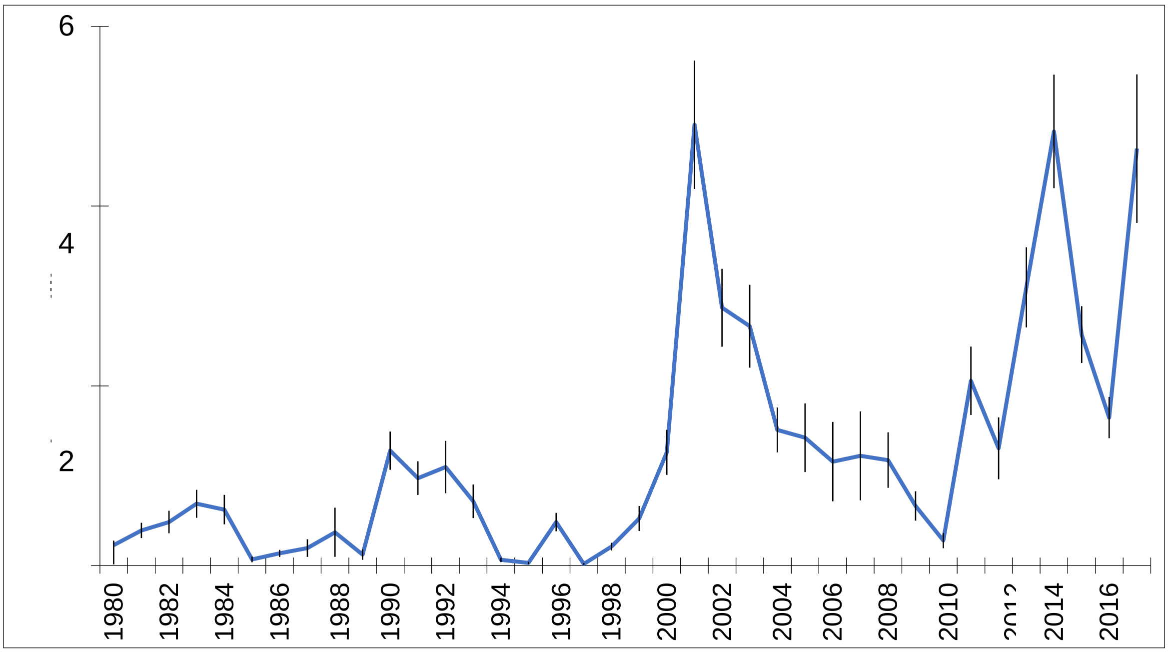

Figure 5.3.3.3. Estimated total biomass of jellyfish C. *capillata* in the survey area of BESS in August-October 1980-2017. 95% confidence interval indicated by grey line. Catches from Harstad trawl in the upper 0-60 m layer.

6 FISH RECRUITMENT (YOUNG-OF-THE-YEAR)

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

During this survey the main distribution of most of the 0-group species were covered. However, some parts in the central and eastern Barents Sea was not covered by "*Vilnyus*", and that will influence the abundance indices uncertainty.

The 2017-year classes of cod and haddock were estimated as strong. The 2017-year class of herring and saithe were close to the long term mean level. Poor year classes of capelin, polar cod, redfish, long rough dab and Greenland halibut were observed. Abundance indices calculated for nine 0-group commercial fish species from 1980-2015 are shown in Tables 6.1 and 6.2.

The total biomass of the six most abundant 0-group fish (cod, haddock, herring, capelin, redfish and polar cod) was close to 2 million tonnes in August-September, which is above the long term mean of 1.6 million tonnes. The 0-group biomass was mainly dominated by cod, herring and haddock in 2017 (Table 6.3).

Length measurements of 0-group fish taken on board indicated that the lengths of all 0-group fish species, except long rough dab, were higher than the long term mean (1980-2017), indicating sufficient feeding condition during the first summer of their life. Length frequency distributions of the main species are given in Table 6.4

Table 6.1. 0-group abundance indices (numbers in millions) with 95% confidence limits, not corrected for capture efficiency. Record high year classes in bold. Mean and median of the indices in the period 1980-2017 are given at the end of the table.

Year	Capelin			Cod			Haddock			Herring			Redfish		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	197278	131674	262883	72	38	105	59	38	81	4	1	8	277873	0	701273
1981	123870	71852	175888	48	33	64	15	7	22	3	0	8	153279	0	363283
1982	168128	35275	300982	651	466	835	649	486	812	202	0	506	106140	63753	148528
1983	100042	56325	143759	3924	1749	6099	1356	904	1809	40557	19526	61589	172392	33352	311432
1984	68051	43308	92794	5284	2889	7679	1295	937	1653	6313	1930	10697	83182	36137	130227
1985	21267	1638	40896	15484	7603	23365	695	397	992	7237	646	13827	412777	40510	785044
1986	11409	98	22721	2054	1509	2599	592	367	817	7	0	15	91621	0	184194
1987	1209	435	1983	167	86	249	126	76	176	2	0	5	23747	12740	34755
1988	19624	3821	35427	507	296	718	387	157	618	8686	3325	14048	107027	23378	190675
1989	251485	201110	301861	717	404	1030	173	117	228	4196	1396	6996	16092	7589	24595
1990	36475	24372	48578	6612	3573	9651	1148	847	1450	9508	0	23943	94790	52658	136922
1991	57390	24772	90007	10874	7860	13888	3857	2907	4807	81175	43230	119121	41499	0	83751
1992	970	105	1835	44583	24730	64437	1617	1150	2083	37183	21675	52690	13782	0	36494
1993	330	125	534	38015	15944	60086	1502	911	2092	61508	2885	120131	5458	0	13543
1994	5386	0	10915	21677	11980	31375	1695	825	2566	14884	0	31270	52258	0	121547
1995	862	0	1812	74930	38459	111401	472	269	675	1308	434	2182	11816	3386	20246
1996	44268	22447	66089	66047	42607	89488	1049	782	1316	57169	28040	86299	28	8	47
1997	54802	22682	86922	67061	49487	84634	600	420	780	45808	21160	70455	132	0	272
1998	33841	21406	46277	7050	4209	9890	5964	3800	8128	79492	44207	114778	755	23	1487
1999	85306	45266	125346	1289	135	2442	1137	368	1906	15931	1632	30229	46	14	79
2000	39813	1069	78556	26177	14287	38068	2907	1851	3962	49614	3246	95982	7530	0	16826
2001	33646	0	85901	908	152	1663	1706	1113	2299	844	177	1511	6	1	10
2002	19426	10648	28205	19157	11015	27300	1843	1276	2410	23354	12144	34564	130	20	241
2003	94902	41128	148676	17304	10225	24383	7910	3757	12063	28579	15504	41653	216	0	495
2004	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	90108	62788	117428	7235	4721	9749	70972	8393	133550	928	310	1547
2014	48933	5599	92267	102977	72975	132980	4185	2217	6153	16674	5671	27677	77658	35010	120306
2015	147961	87971	207951	8744	3008	14479	6005	2816	9194	11207	0	25819	101653	40258	163048
2016	274050	157185	390915	16872	9942	23801	4029	1952	6107	32956	15793	50119	12941	1713	24168
2017	72486	36535	108438	69371	46841	91901	9205	6081	12329	32112	11180	53045	43561	0	97558
Mean	93511			30280			4442			28586			60307		
Median	62721			17088			1760			19641			22075		

Table 6.1. Continued.

	Saithe			Gr halibut			Long rough dab			Polar cod (east)			Polar cod (west)		
Year	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	3	0	6	111	35	187	1273	883	1664	28958	9784	48132	9650	0	20622
1981	0	0	0	74	46	101	556	300	813	595	226	963	5150	1956	8345
1982	143	0	371	39	11	68	1013	698	1328	1435	144	2725	1187	0	3298
1983	239	83	394	41	22	59	420	264	577	1246	0	2501	9693	0	20851
1984	1339	407	2271	31	18	45	60	43	77	127	0	303	3182	737	5628
1985	12	1	23	48	29	67	265	110	420	19220	4989	33451	809	0	1628
1986	1	0	2	**112**	60	164	**6846**	4941	8752	12938	2355	23521	2130	180	4081
1987	1	0	1	35	23	47	804	411	1197	7694	0	17552	74	31	117
1988	17	4	30	8	3	13	205	113	297	383	9	757	4634	0	9889
1989	1	0	3	1	0	3	180	100	260	199	0	423	18056	2182	33931
1990	11	2	20	1	0	2	55	26	84	399	129	669	31939	0	70847
1991	4	2	6	1	0	2	90	49	131	88292	39856	136727	38709	0	110568
1992	159	86	233	9	0	17	121	25	218	7539	0	15873	9978	1591	18365
1993	366	0	913	4	2	7	56	25	87	41207	0	96068	8254	1359	15148
1994	2	0	5	39	0	93	1696	1083	2309	**267997**	151917	384078	5455	0	12032
1995	148	68	229	15	5	24	229	39	419	1	0	2	25	1	49
1996	131	57	204	6	3	9	41	2	79	70134	43196	97072	4902	0	12235
1997	78	37	120	5	3	7	97	44	150	33580	18788	48371	7593	623	14563
1998	86	39	133	8	3	12	27	13	42	11223	6849	15597	10311	0	23358
1999	136	68	204	14	8	21	105	1	210	129980	82936	177023	2848	407	5288
2000	206	111	301	43	17	69	233	120	346	116121	67589	164652	22740	14924	30556
2001	20	0	46	51	20	83	162	78	246	3697	658	6736	13490	0	28796
2002	553	108	998	51	0	112	731	342	1121	96954	57530	136378	27753	4184	51322
2003	65	0	146	13	0	34	78	45	110	11211	6100	16323	1627	0	3643
2004	**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
2014	1	0	2	10	3	16	309	89	528	2779	737	4820	746	79	1414
2015	47	0	101	27	2	52	575	361	789	128	18	237	6074	2001	10146
2016	3	0	7	6	1	12	601	0	1267	258	0	624	1180	128	2231
2017	127	2	252	8	1	14	72	27	117	43	0	106	1009	0	2795
Mean	161			26			514			30388			7850		
Median	54			14			190			9453			3932		

Table 6.2. 0-group abundance indices (numbers in millions) with 95% confidence limits, corrected for capture efficiency. LTM- long term mean of 1980-2017.

Year	Capelin			Cod			Haddock			Herring			Saithe			Polar cod (east)			Polar cod (west)			Polar cod Tot
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index
1980	740289	495187	985391	276	131	421	265	169	361	77	12	142	21	0	47	203226	69898	336554	82871	0	176632	286097
1981	477260	273493	681026	289	201	377	75	34	117	37	0	86	0	0	0	4882	1842	7922	46155	17810	74500	51037
1982	599596	145299	1053893	3480	2540	4421	2927	2200	3655	2519	0	5992	296	0	699	1443	154	2731	10565	0	29314	12008
1983	340200	191122	489278	19299	9538	29061	6217	3978	8456	195446	69415	321477	562	211	912	1246	0	2501	87272	0	190005	88518
1984	275233	161408	389057	24326	14489	34164	5512	3981	7043	27354	3425	51284	2577	725	4430	871	0	2118	26316	6097	46534	27187
1985	63771	5893	121648	66630	32914	100346	2457	1520	3393	20081	3933	36228	30	7	53	143257	39633	246881	6670	0	13613	149927
1986	41814	642	82986	10509	7719	13299	2579	1621	3537	93	27	160	4	0	9	102869	16336	189403	18644	125	37164	121513
1987	4032	1458	6607	1035	504	1565	708	432	984	49	0	111	4	0	10	64171	0	144389	631	265	996	64802
1988	65127	12101	118153	2570	1519	3622	1661	630	2693	60782	20877	100687	32	11	52	2588	59	5117	41133	0	89068	43721
1989	862394	690983	1033806	2775	1624	3925	650	448	852	17956	8252	27661	10	0	23	1391	0	2934	164058	15439	312678	165449
1990	115636	77306	153966	23593	13426	33759	3122	2318	3926	15172	0	36389	29	4	55	2862	879	4846	246819	0	545410	249681
1991	169455	74078	264832	40631	29843	51419	13713	10530	16897	267644	107990	427299	9	4	14	823828	366924	1280732	281434	0	799822	1105262
1992	2337	250	4423	166276	92113	240438	4739	3217	6262	83909	48399	119419	326	156	495	49757	0	104634	80747	12984	148509	130504
1993	952	289	1616	133046	58312	207779	3785	2335	5236	291468	1429	581506	1033	0	2512	297397	0	690030	70019	12321	127716	367416
1994	13898	70	27725	70761	39933	101589	4470	2354	6586	103891	0	212765	7	1	12	2139223	1230225	3048220	49237	0	109432	2188460
1995	2869	0	6032	233885	114258	353512	1203	686	1720	11018	4409	17627	415	196	634	6	0	14	195	0	390	201
1996	136674	69801	203546	280916	188630	373203	2632	1999	3265	549608	256160	843055	430	180	679	588020	368361	807678	46671	0	116324	634691
1997	189372	80734	298011	294607	218967	370247	1983	1391	2575	463243	176669	749817	341	162	521	297828	164107	431550	62084	6037	118131	359912
1998	113390	70516	156263	24951	15827	34076	14116	9524	18707	476065	277542	674589	182	91	272	96874	59118	134630	95609	0	220926	192483
1999	287760	143243	432278	4150	944	7355	2740	1018	4463	35932	13017	58848	275	139	411	1154149	728616	1579682	24015	3768	44262	1178164
2000	140837	6551	275123	108093	58416	157770	10906	6837	14975	469626	22507	916746	851	446	1256	916625	530966	1302284	190661	133249	248072	1107286
2001	90181	0	217345	4150	798	7502	4649	3189	6109	10008	2021	17996	47	0	106	29087	5648	52526	119023	0	252146	148110
2002	67130	36971	97288	76146	42253	110040	4381	2998	5764	151514	58954	244073	2112	134	4090	829216	496352	1162079	215572	36403	394741	1044788
2003	340877	146178	535575	81977	47715	116240	30792	15352	46232	177676	52699	302653	286	0	631	82315	42707	121923	12998	0	30565	95313
2004	53950	11999	95900	65969	47743	84195	39303	26359	52246	773891	544964	1002819	4779	2810	6749	290686	147492	433879	2892	989	4796	293578
2005	148466	51669	245263	72137	50662	93611	91606	67869	115343	125927	20407	231447	176	115	237	44663	22890	66436	25970	9987	41953	70633
2006	515770	325776	705764	25061	11469	38653	28505	18754	38256	294649	102788	486511	280	116	443	182713	73645	291781	15965	3414	28517	198678
2007	480069	272313	687825	42628	26652	58605	8401	5587	11214	144002	25099	262905	286	3	568	191111	57403	324819	22803	0	46521	213914
2008	995101	627202	1362999	234144	131081	337208	9864	1144	18585	201046	68778	333313	142	68	216	42657	5936	79378	619	25	1212	43276
2009	673027	423386	922668	185457	123375	247540	33339	19707	46970	104233	31009	177458	62	0	132	168990	70509	267471	154687	37022	272351	323677
2010	318569	201973	435166	135355	68199	202511	23669	14503	32834	117087	32045	202129	1066	362	1769	267430	111697	423162	12045	0	33370	279474
2011	594248	58009	1130487	448005	251499	644511	19114	14209	24018	83051	48024	118078	96	0	225	249269	100355	398183	4924	218	9629	254193
2012	988600	728754	1248445	410757	170242	651273	5281	2626	7936	177189	35046	2111493	229	5	453	25026	1132	48920	125306	0	357381	150332
2013	316020	127310	504731	385430	269640	501219	16665	11161	22169	289391	67718	511064	11	4	18	11382	0	29002	1011	262	1760	12393
2014	163630	31980	295280	464124	323330	604919	11765	6160	17371	136305	42164	230447	4	0	9	17349	5184	29515	5298	500	10096	22647
2015	457481	274631	640331	37474	17244	57704	15089	6204	23973	82749	0	190673	406	0	930	795	107	1484	49584	15385	83784	50380
2016	778784	479130	1078438	53796	30970	76622	5504	2791	8216	79439	38415	120464	10	0	21	1544	0	3718	9288	459	18117	10832
2017	213787	112459	315115	233275	150239	316310	19484	12902	26067	153763	34713	272813	379	18	740	256	0	599	6580	0	18044	70971
LTM	311542			117579			11944			162997			469			245447			63589			310724

Table 6.3. 0-group biomass indices (in thousand tonnes) of main species in 1993-2017. The indices are corrected for capture efficiency.

Year	Capelin	Cod	Haddock	Herring	Polar cod	Redfish	Total biomass, in MT
1993	3	475	34	1035	125	8	1680
1994	6	666	54	173	485	118	1501
1995	2	1546	14	12	0	27	1599
1996	98	919	34	438	145	0	1634
1997	82	657	12	352	85	0	1188
1998	51	117	168	988	45	0	1368
1999	158	32	39	440	185	0	853
2000	55	319	44	404	395	15	1232
2001	51	11	58	9	35	0	165
2002						0	0
2003	149	160	115	471	15	0	909
2004	33	317	686	2243	125	0	3404
2005	60	431	749	406	30	30	1707
2006	335	181	329	1321	85	53	2304
2007	312	123	69	275	0	2139	2919
2008	396	632	54	106	75	536	1800
2009	197	955	346	289	145	201	2134
2010	100	786	134	254	55	255	1584
2011	228	1855	215	151	60	0	2509
2012	519	1429	39	1156	65	144	3352
2013	151	957	241	1363	5	4	2721
2014	67	965	100	169	15	205	1520
2015	272	130	178	98	11	231	921
2016	713	248	264	661	4	58	1948
2017	147	961	258	454	4	100	1923
Mean	175	603	164	554	95	168	1759

Table 6.4. Length distribution (%) of 0-group fish in the Barents Sea in Autumn 2017.

Length, mm	Cod	Haddock	Capelin	Herring	Saithe	Redfish	Polar cod	Gr. halibut	LRD	Sandeel
10 - 14 mm	0,00	0,01							2,03	
15 - 19 mm									7,77	
20 - 24 mm			0,26				0,06		5,94	
25 - 29 mm			0,95			0,35	1,22		27,58	
30 - 34 mm			1,56			3,01	0,67		27,23	0,12
35 - 39 mm		0,00	3,29			15,82	2,08		19,40	0,07
40 - 44 mm	0,05	0,00	10,32	0,04		45,30	11,17		7,82	0,17
45 - 49 mm	0,05	0,01	13,21	0,05		20,31	18,99		1,90	0,26
50 - 54 mm	0,09	0,03	20,47	0,24		10,87	43,57		0,33	0,59
55 - 59 mm	0,13	0,07	18,43	2,22	2,17	4,14	16,50			0,70
60 - 64 mm	0,95	0,21	22,82	11,80		0,21	4,28	10,63		1,50
65 - 69 mm	4,11	0,22	7,42	21,59	0,14		1,19	8,07		3,92
70 - 74 mm	14,85	0,44	1,26	18,90	2,56		0,27	6,36		4,94
75 - 79 mm	20,29	1,80		17,86	6,61			11,44		3,96
80 - 84 mm	17,84	2,70		12,33	10,22			55,43		1,88
85 - 89 mm	16,59	5,46		10,16	30,40			8,07		0,59
90 - 94 mm	11,59	11,57		4,01	10,79					1,13
95 - 99 mm	8,23	14,84		0,80	19,19					1,64
100 - 104 mm	2,62	9,05		0,00	12,11					0,78
105 - 109 mm	0,85	12,62		0,01	0,65					19,21
110 - 114 mm	0,92	13,04		0,01	0,34					19,16
115 - 119 mm	0,29	7,91		0,00	1,81					20,02
120 - 124 mm	0,17	5,70			1,34					19,37
125 - 129 mm	0,02	4,51			0,28					
130 - 134 mm	0,00	4,43			1,09					
135 - 139 mm	0,23	2,11								
140 - 144 mm	0,14	1,01			0,31					
145 - 149 mm		1,15								
150 - 154 mm		0,39								
155 - 159 mm		0,08								
160 - 164mm		0,37								
165 - 169mm		0,27								
Mean length, cm	8,3	10,7	5,4	7,4	9,1	4,4	5,0	7,7	2,9	10,4
Long term mean length, cm	7,6	9,3	4,8	7,1	9,0	3,9	4,1	6,3	3,3	5,9

6.1 Capelin (Mallotus villosus)

The 0-group capelin were distributed widely in the Barents Sea (Figure 6.1.1). The area in the eastern Barents Sea was not covered. High densities of 0-group capelin were found close to this area (6.1.1), and thus 0-group abundance index seems to be underestimated. More intensive colouring indicates denser concentrations. In 2017, the highest concentrations of capelin were found in the north-central Barents Sea, and was similar to 2016.

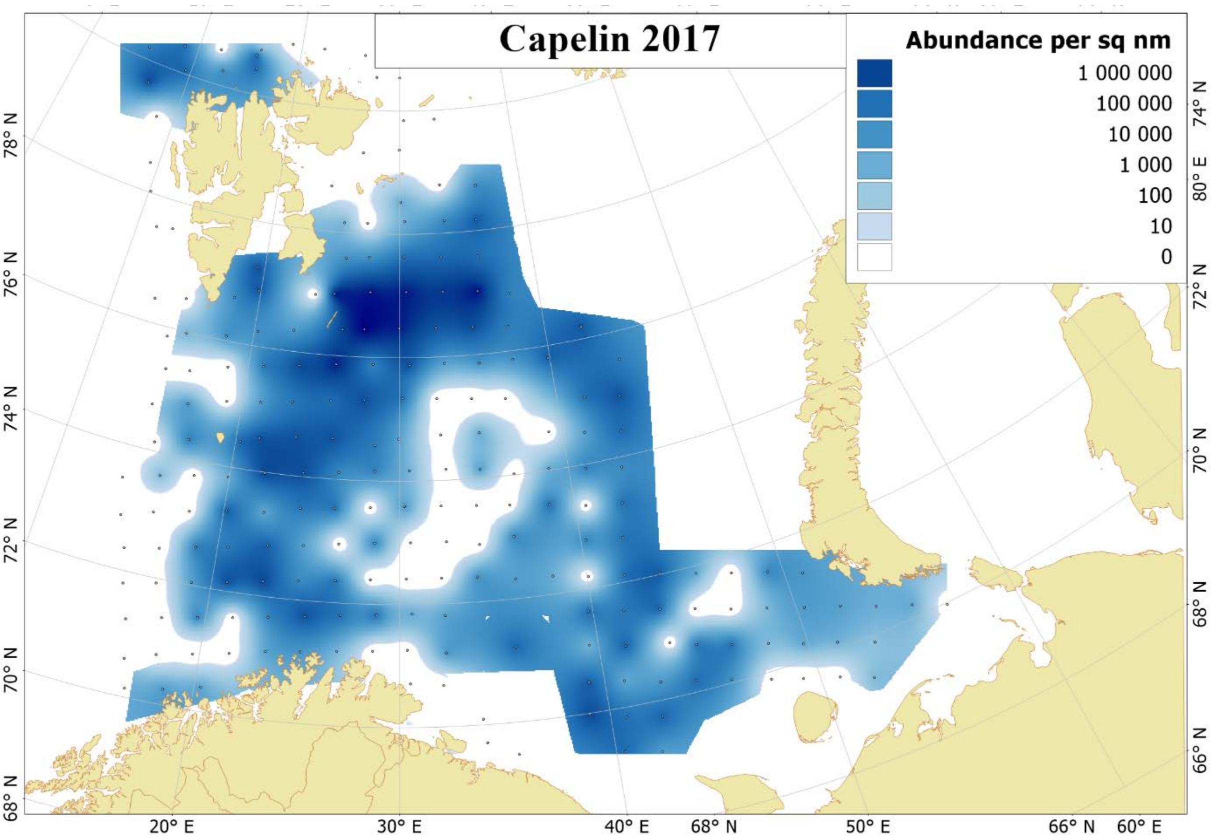

Figure 6.1.1. Distribution of 0-group capelin, August-October 2017 (nos. per sq. nml.).

The calculated density varied from 174 individuals to 10 million fish per square nautical mile, with mean density of 232 thousand fish per square nautical mile, which was much lower than in 2016.

The average length of capelin was 5.4 cm and was close to 2016 and larger than the long-term mean (1980-2017). The capelin length varied from 2 to 7.4 cm, however length of most of fish (85%) were between 4.0 to 6.4 cm. Generally, large individuals indicated good growth and thus sufficient feeding and living conditions during the first summer.

The 0-group capelin biomass was 147 thousand tonnes, which is below the long-term mean level (174 thousand tonnes for period 1993-2017). The capelin biomass is shown in Table 6.3.

The abundance index of 0-group capelin in 2017 was below the long term mean, and therefore, can be characterized as below the average.

6.2 Cod (*Gadus morhua*)

0-group cod were widely distributed in the surveyed area in 2017. The main dense concentrations were found in the central part of the Barents Sea (Fig. 6.2.1). The cod abundance index is underestimated in 2017 due to lack of coverage in the eastern Barents Sea.

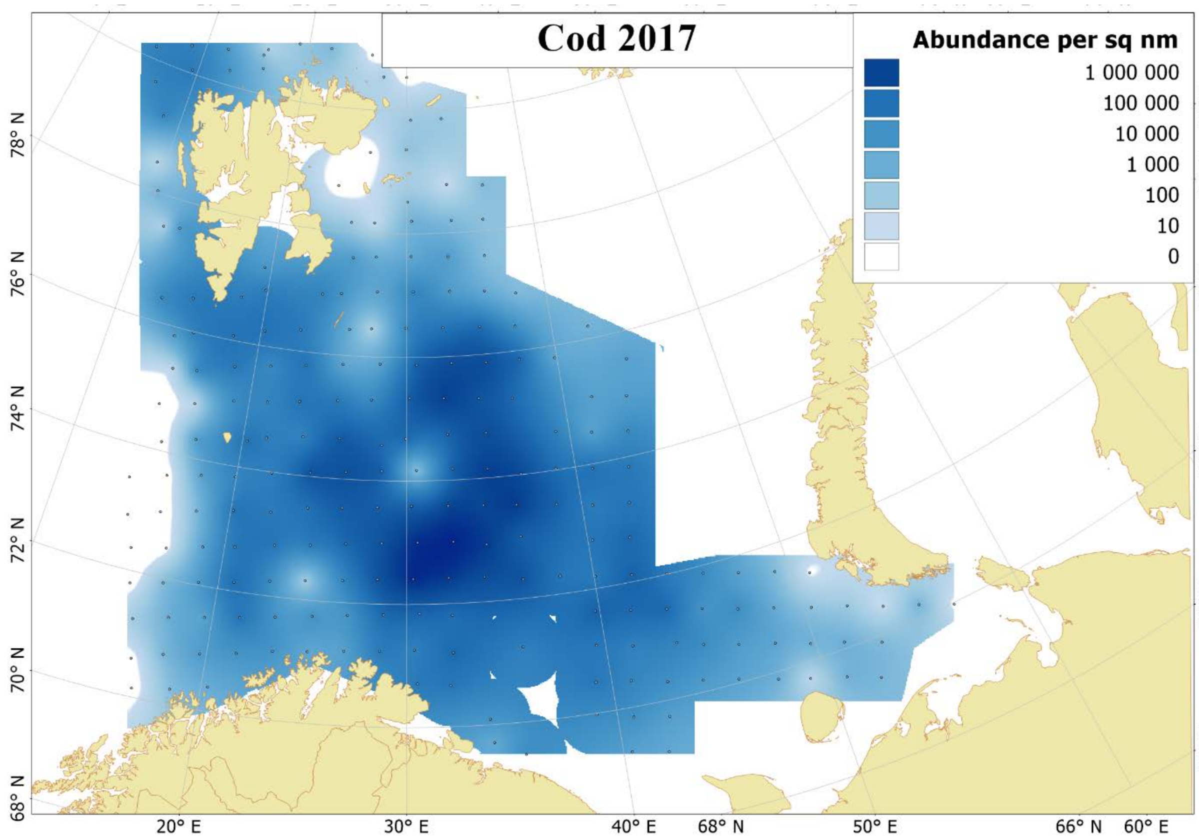

Figure 6.2.1. Distribution of 0-group cod, August-October 2017 (nos. per sq. nml.).

The calculated density was from 138 individuals to 6 million fish per square nautical mile, which was higher than in 2016. The mean density was 225 thousand fish per square nautical mile.

The lengths of 0-group cod were between 4 and 14.4 cm with a mean length of 8.3 cm, which is higher than the long term mean of 7.6 cm (Table 6.4). Most of the fish (89%) were between 7.0 and 9.9 cm.

The 0-group cod biomass was 961 thousand tonnes in August-September 2017, and was higher than the long term average (618 thousand tonnes for period 1993-2017, Table 6.3).

The abundance index of the 2017-year class is twice as high as the long term mean, and may thus be characterized as strong.

6.3 Haddock (*Melanogrammus aeglefinus*)

0-group haddock was distributed widely in the western and central part of the survey area in 2017 (Figure 6.3.1). The main dense concentrations were found in the southwestern Barents Sea. 0-group haddock distribution area was covered well in 2017.

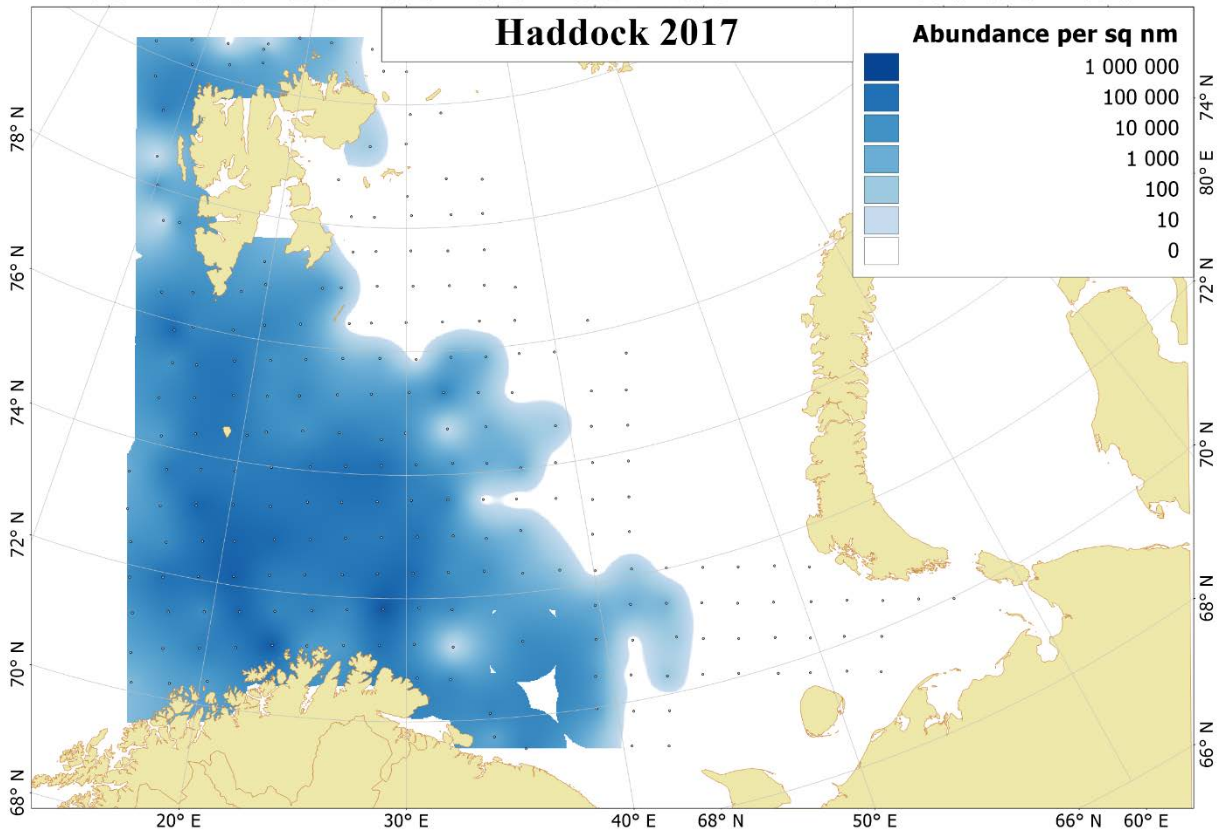

Figure 6.3.1. Distribution of 0-group haddock, August- October 2017 (nos. per. sq. nml.).

The calculated density varied between 46 individuals and 753 thousand fish per square nautical mile. The mean calculated density per per square nautical mile was 33 thousand fish.

In 2017, the length of 0-group haddock varied between 4.5 and 16.9 cm, while the length of most fish (61%) was between 9.0 and 11.9 cm (Table 6.4). The mean length of haddock was 10.7 cm and was higher than the long-term mean (9.3 cm for the period 1980-2017). The large 0-group haddock indicates good growth during the first summer and thus suitable living conditions for haddock in 2017.

The 0-group haddock biomass was 258 thousand tonnes and higher than the long-term mean (176 thousand tonnes for period 1993-2017, Table 6.3).

The number of fish belonging to the 2017-year class is 1.7 times higher than the long term mean and thus the 2017-year class can be characterized as strong.

6.4 Herring (*Clupea harengus*)

In 2017, herring distribution area was covered well. 0-group herring were distributed wider than in 2016. The main dense concentrations were found in the central part and close to the Finnmark coast (the northern Norway). In comparison to the previous years, high densities of herring were found south-west of Svalbard (Spitsbergen) (Fig. 6.4.1). 0-group herring distribution area was covered well in 2017.

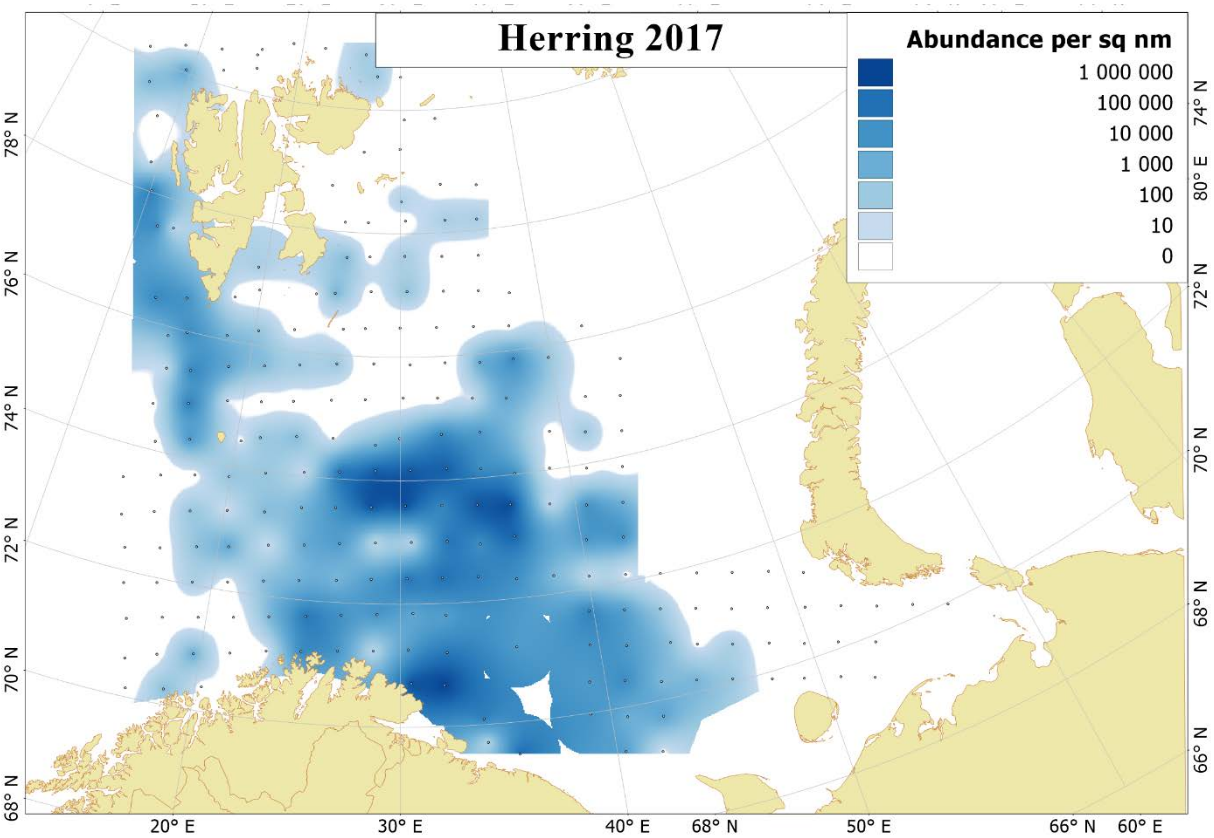

Figure 6.4.1. Distribution of 0-group herring, August- October 2017 (nos. per sq. nml.).

The calculated density varied from 147 individuals to 5.1 million fish per square nautical mile. The mean calculated density per trawl haul was 106 thousand fish per square nautical mile.

The length of 0-group herring varied between 4.0 and 11.4 cm, and most of the fish (93%) were between 6.0 and 8.9 cm long (Table 6.4). In 2017, the mean length of 0-group herring was 7.4 cm and it was close to long term mean (7.1 cm). The large 0-group herring indicates good growth during the first summer and thus suitable living conditions for juvenile herring in 2017.

The 0-group herring biomass was 454 thousand tonnes. This is lower than in 2016 and lower than the long term mean of 553 thousand tonnes (Table 6.3).

The abundance index of the 2017 year-class of herring was higher than in 2016, and close to the long term mean, and therefore, can be characterized as average.

6.5 Polar cod (*Boreogadus saida*)

As in previous years, the distribution of 0-group polar cod was split into two components: western and eastern Barents Sea (Figure 6.5.1). The western component was observed east and north for Svalbard (Spitsbergen). Polar cod of the eastern component usually distributes along the southern and western coast of Novaya Zemlya, however in 2017, the area west of Novaya Zemlya was not covered. Due to lack of coverage, the distribution and abundance indices observed in 2017 is most likely underestimated.

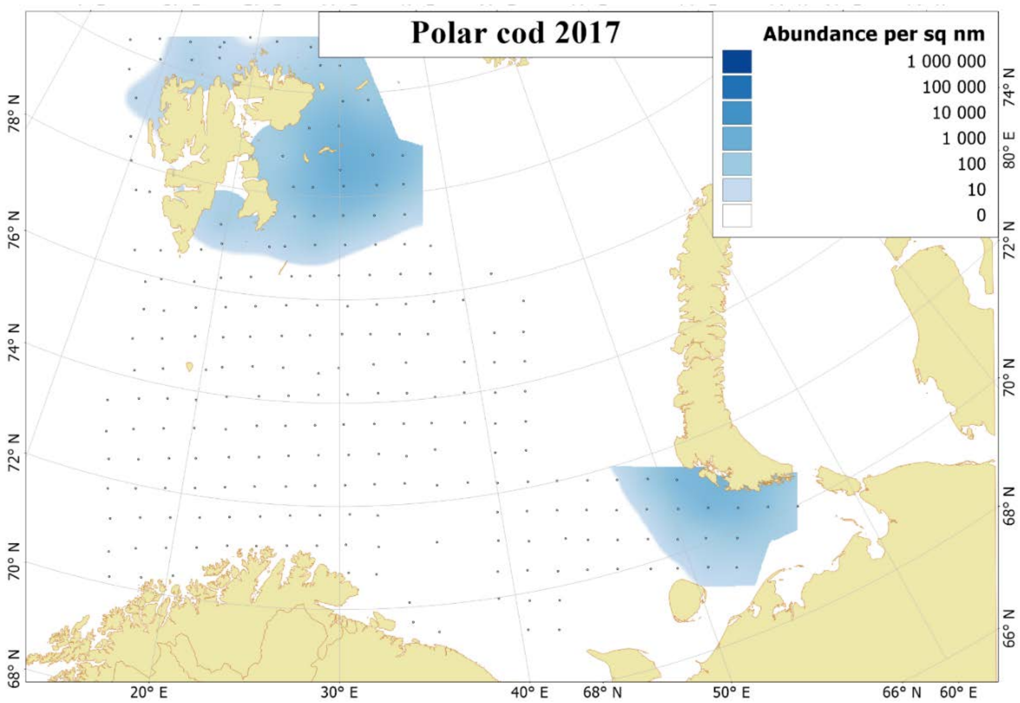

Figure 6.5.1. Distribution of 0-group polar cod, August-October 2017 (nos- per- sq- nml.).

The calculated density varied from 123 individuals to 419 thousand fish per square nautical mile. The mean calculated density was 2.3 thousand fish per square nautical mile, which is lower than in 2016.

The length of polar cod varied between 2 and 7.4 cm, and most of the fish (90%) were between 4.0 and 5.9 cm long (Table 6.4). The mean length of 0-group polar cod (5.0 cm) was higher than the long term mean of 4.1 cm.

The abundance index for each component was calculated separately. The abundance of the eastern component was the lowest since 1996, while that of the western component was lower than in 2016 and approximately 8 times lower the long term mean (Table 6.2). The 0-group polar cod biomass was 4 thousand tonnes only, which is 24 time lower than the long term mean (Table 6.3). For several years the abundance indices of polar cod have been extremely low, indicating worse living conditions or/and significant reduction in the spawning biomass in the Barents Sea.

The number of fish belonging to the 2017-year class is very low and thus 2017 can be characterized as a weak year class.

6.6 Saithe (*Pollachius virens*)

0-group saithe was distributed wider than in 2016 and catches were larger. Most of the saithe was observed in the central part of the Barents Sea and slightly to south of the Svalbard (Spitsbergen). 0-group saithe distribution area is wider than the survey area and the distribution and abundance indices observed in 2017 is for the Barents Sea alone and most likely underestimated.

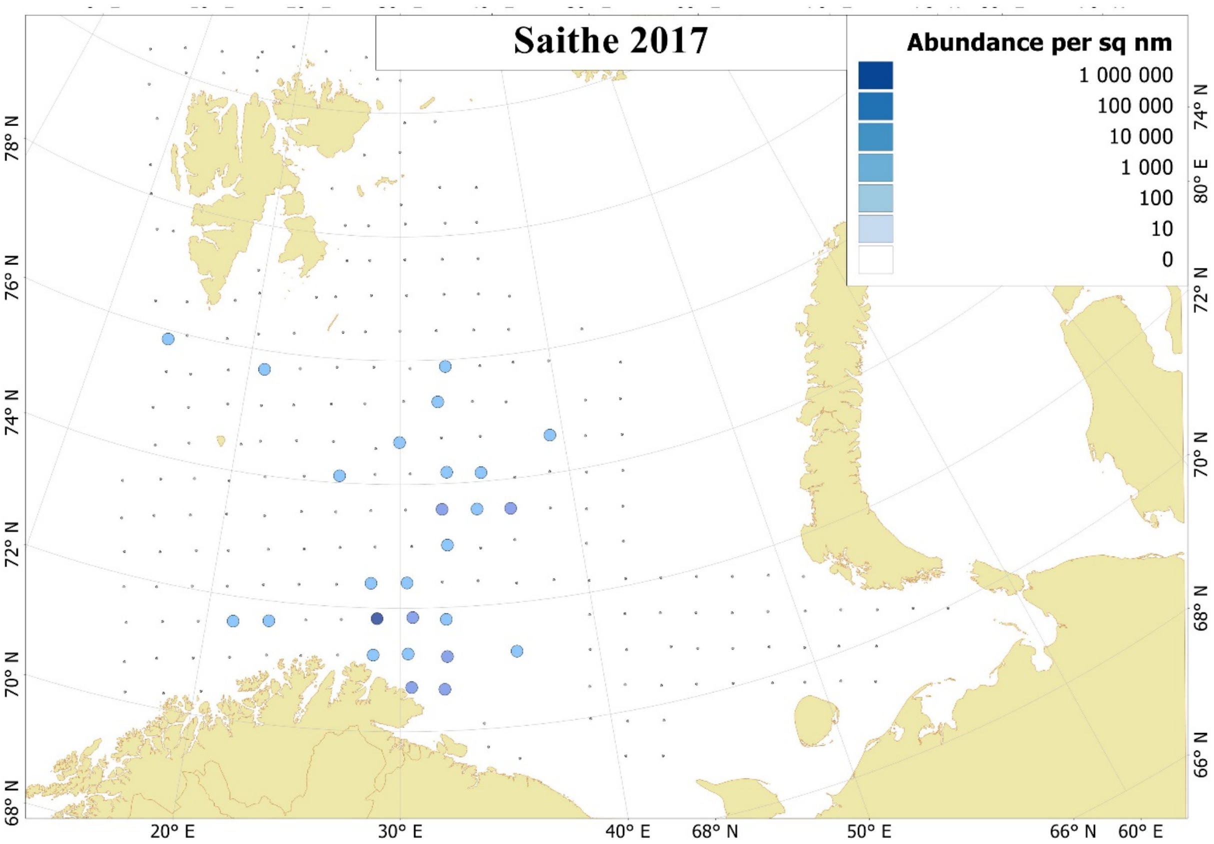

Figure 6.6.1. Distribution of 0-group saithe, August-October 2017 (nos. per. sq. nml.).

The calculated density was from 46 individuals to 55 thousand fish per square nautical mile, which was higher than in 2016. The mean density was 454 fish per square nautical mile.

The length of 0-group saithe was 5.5-14.4 cm. Most of the fish (83 %) was between 8.0 and 10.4 cm. The mean length of 0-group saithe in 2017 (9.1 cm) is comparable with the long-term mean length (9.0 cm).

The abundance index of 0-group saithe in 2017 (379 millions) is higher than in 2016 (10 millions), and slightly lower than the long-term mean of 1980-2017 (471 millions). Thus, the 2017-year class of saithe was estimated as average.

6.7 Redfish (mostly *Sebastes mentella*)

0-group redfish was distributed in the western part of the Barents Sea and around Svalbard (Spitsbergen) Archipelago in 2017 (Figure 6.7.1). The densest concentrations were found west of Svalbard (Spitsbergen). Since the distribution may be only partly covered, the 0-group abundance index seems to be underestimated.

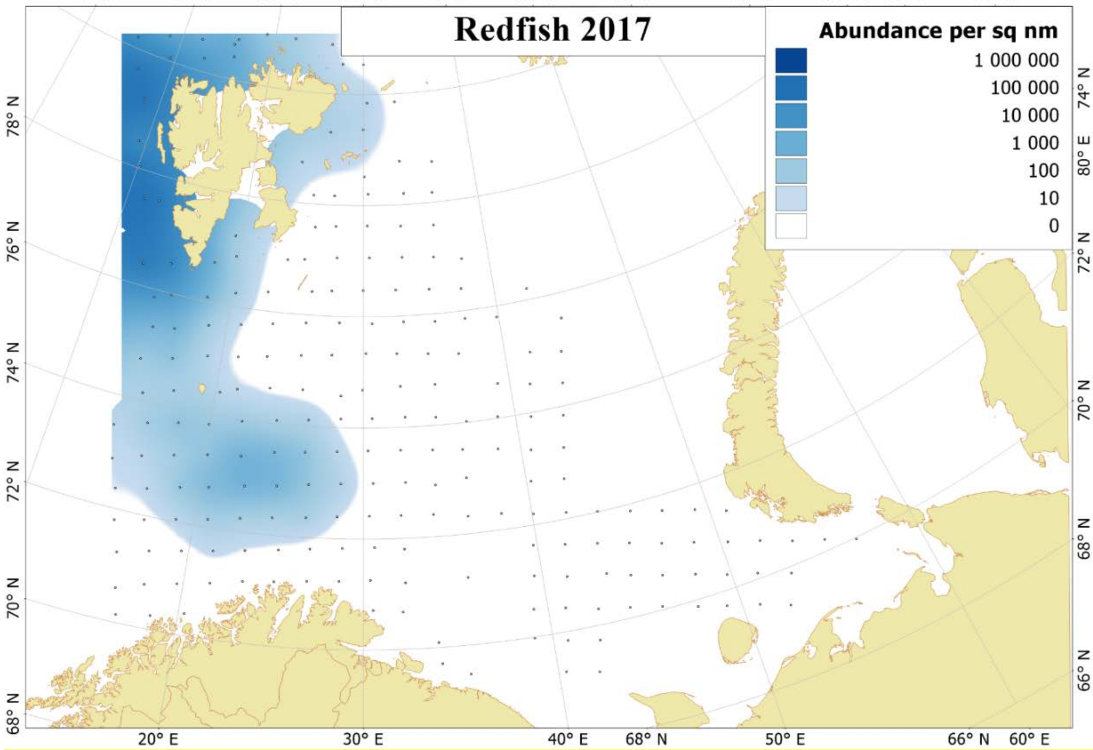

Figure 6.7.1. Distribution of 0-group redfishes (mostly *Sebastes mentella)*, August- October 2017.

The calculated density was between 30 individuals and 21 million fish per square nautical mile. Mean calculated density was 193 thousand fish per square nautical mile.

In 2017, the length of 0-group redfish was 2.5-6.4 cm and the mean fish length was 4.4 cm. Most of the fish (92%) were 3.5-5.4 cm long. The mean fish length is higher than the long term mean of 3.9 cm (Table 6.4).

In 2017, 0-group redfish biomass was 100 thousand tonnes and was lower than the long term mean (168 thousand tonnes, Table 6.3).

The abundance of 0-group redfish is lower than the long term mean. The 2017-yearclass can be characterized as weak. However, some 0-group fish may stay outside of the covered area, in the deeper Norwegian Sea, and therefore the 0-group abundance represents the Barents Sea only.

Since 2005, only low concentrations of 0-group Greenland halibut have been found. Greenland halibut were observed north and south of the Svalbard (Spitsbergen) in 2017, and only a few small catches were taken there (Figure 6.8.1). The survey did not cover the numerous Svalbard (Spitsbergen) fjords, where 0-group Greenland halibut are abundant, and therefore this index does not give the real recruitment numbers (at age 0+) to the stock.

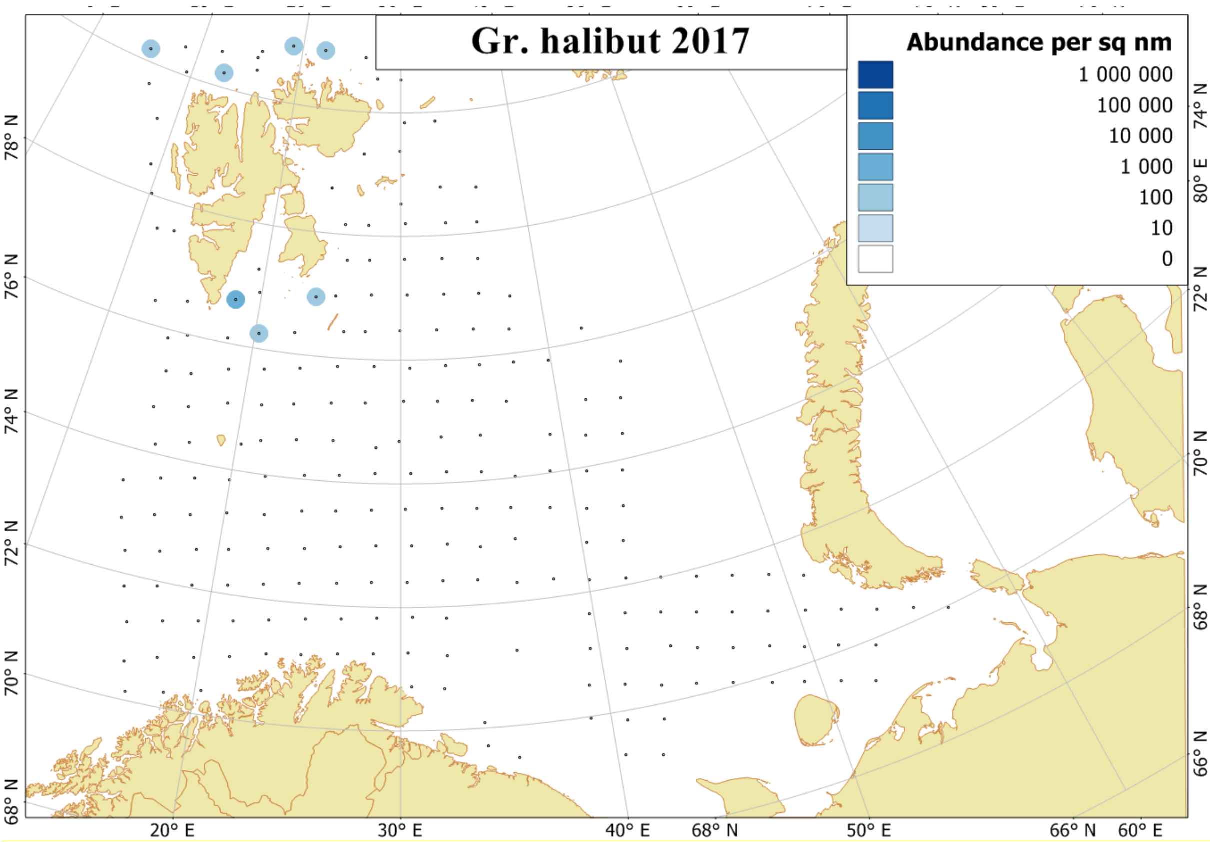

Figure 6.8.1. Distribution of 0-group Greenland halibut, August-October 2017.

Fish length varied between 6 and 8.9 cm, while most of the fish (67%) were between 7.5 and 8.4 cm. The mean length of fish was 7.7 cm, which is higher than the long term mean of 6.3 cm (Table 6.4).

The calculated density varied from 106 individuals to 1.4 thousand fish per square nautical mile.

In 2017, Greenland halibut abundance index (8 millions) was lower than the long term mean (26 millions). The 2017-year class can be characterized as weak. However, some 0-group fish may stay in the area, not covered by the survey area – in the Svalbard (Spitsbergen) fjords.

0-group long rough dab were observed at the survey boundaries in 2017 (Figure 6.9.1). The highest catches of long rough dab were taken in the south-eastern part of the Barents Sea. At few stations 0-group long rough dab were taken by bottom trawl, indicating that settlement had started. Thus, the abundance indices will be slightly underestimated in 2017.

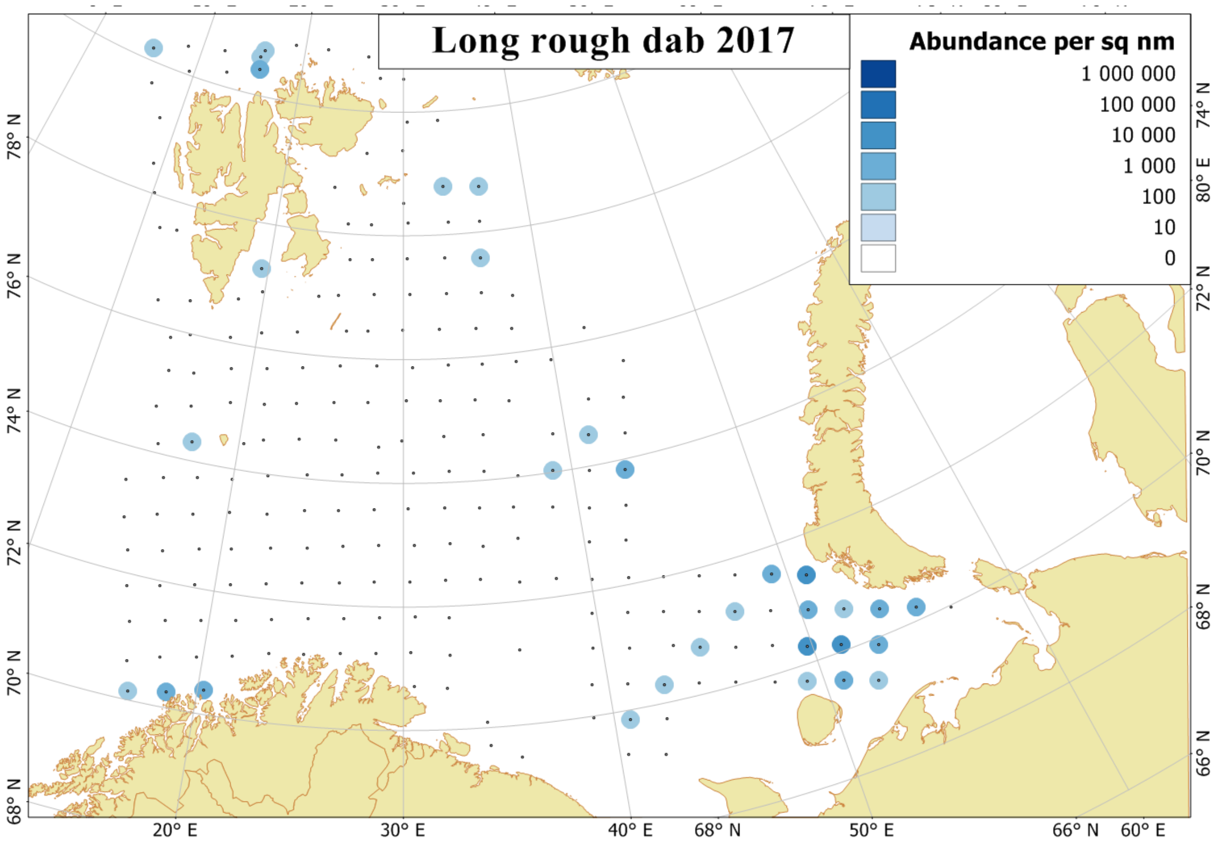

Figure 6.9.1. Distribution of 0-group long rough dab, August-October 2017.

The calculated densities ranged between 123 individuals and 13.4 thousand fish per square nautical mile with an average of 242 thousand fish per square nautical mile. That was higher than in 2014-2016.

Fish length varied between 1.0 and 5.4 cm (Table 6.4). Most of the fish (74 %) were between 2.5 and 3.9 cm. The mean length of fish was 2.9 cm and this is lower than the long term average (3.3 cm).

The long rough dab abundance in 2017 was the lowest since 2014 and lower than the long term mean. The 2017-year class can be characterized as weak.

6.10 Wolffishes (*Anarhichas sp.*)

There are three species of wolffish in the Barents Sea: Atlantic wolffish (*Anarhichas lupus*), Spotted wolffish (*Anarhichas minor*) and Northern wolffish (*Anarhichas denticulatus*). 0-group of Atlantic wolffish and Spotted wolffish were found during the survey in 2017 (Fig. 6.10.1). 0-group of Atlantic wolfish were mainly found in the northern and central part of the Barents Sea, while spotted wolfish were found at 4 stations in the western part.

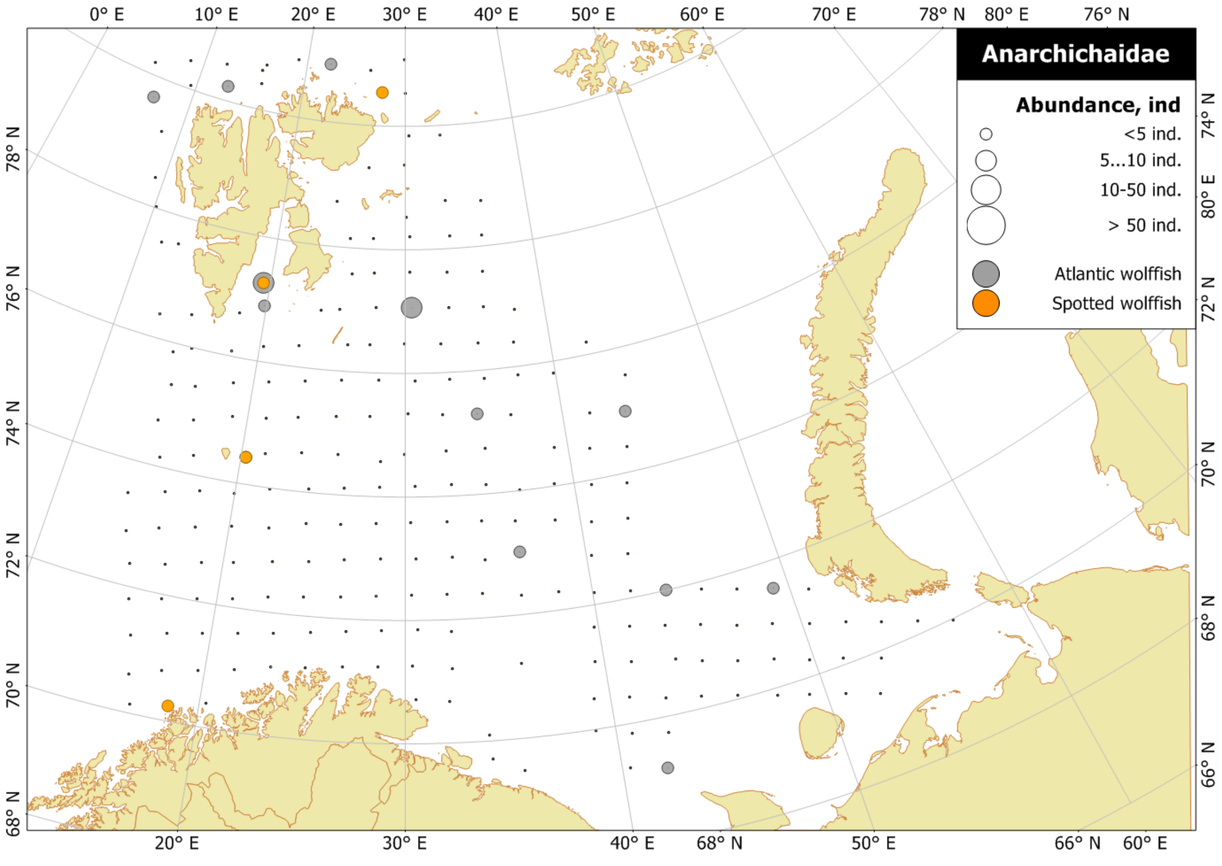

Figure 6.10.1. Distribution of 0-group wolffishes, August-October 2017.

The length of the 0-group Atlantic wolffish varied between 5.0-13.0 cm with an average of 7.7 cm, and length of spotted wolfish varied between 2.0-11.0 cm with an average of 6.8 cm.

No index is calculated for this species. But the distribution of 0-group of the 2017-year class was smaller than in 2016 and 2015.

6.11 Sandeel (*Ammodytes marinus*)

In 2017, 0-group sandeel were found in the western, central, south-eastern parts of the Barents Sea (Figure 6.11.1). The denser concentrations were found in the south-eastern areas. 0-group sandeel distributed more widely than in previous years.

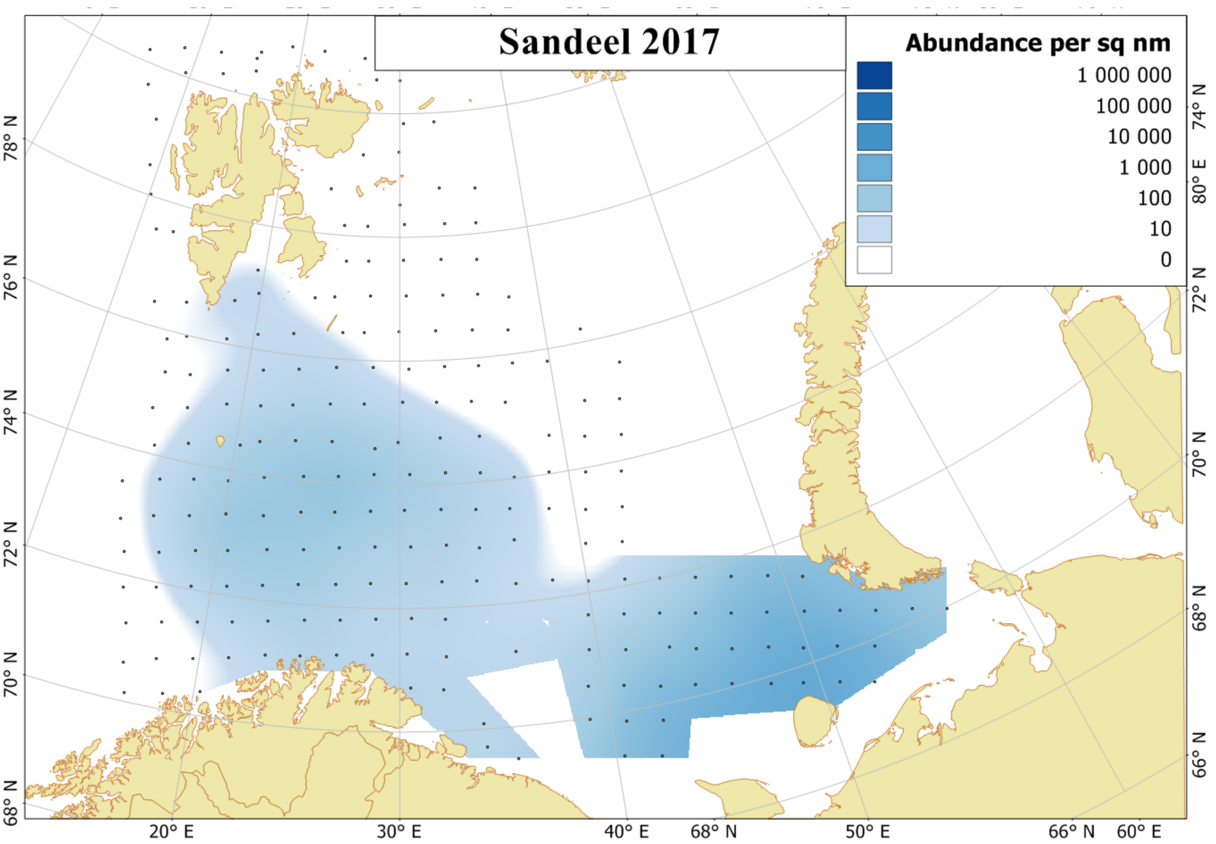

Figure 6.11.1. Distribution of 0-group sandeel, August-October 2017.

The calculated density was from 46 individuals to 4.2 million fish per square nautical mile, with an average of 25 thousand fish per square nautical miles.

The fish length varied between 3.0 to 12.4 cm with average of 10.4 cm, which is higher than in 2012-2016 and higher than the long term mean (5.9 cm).

Abundance index of 0-group sandeel is presented in the chapter 9.1.

7 COMMERSIAL PELAGIC FISH

Text by D. Prozorkevich, G.Skaret
Figures by J. Alvarez, G. Skaret

7.1 Capelin (*Mallotus villosus*)

7.1.1 Geographical distribution

The geographical distribution of capelin recordings is shown in Figure 7.1.1.1. The distribution was much wider than in 2016, and capelin schools were recorded up to 81°30 N between Svalbard (Spitzbergen) and Franz Josef Land. The majority of capelin was found to the southeast of the King Karls Land. Capelin was typically recorded as high density schools in the pelagic zone (figure 7.1.1.2), but mature capelin was also observed in small numbers in the bottom layer for a significant proportion of the survey area. Young capelin (1-year-olds) were mainly found in the western part of survey area.

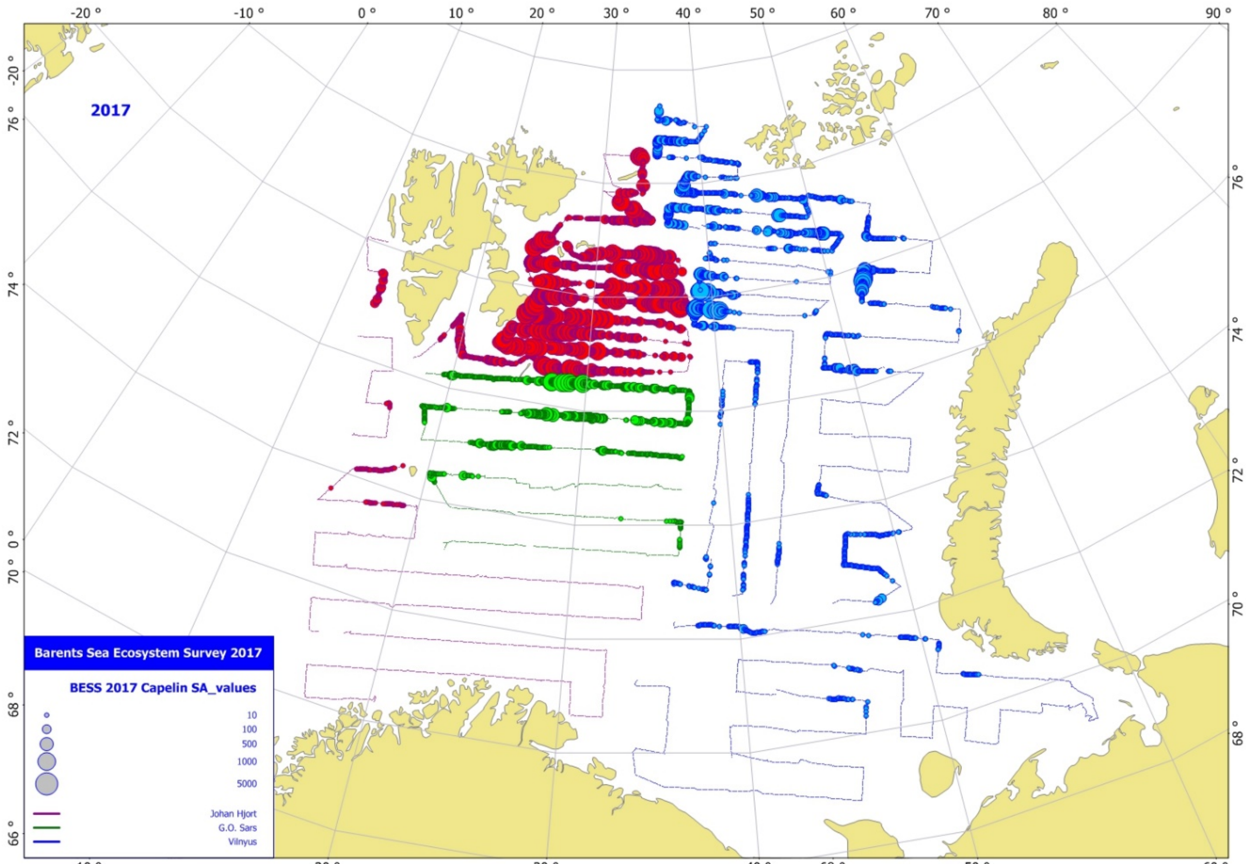

Figure. 7.1.1.1 Estimated geographical distribution of capelin in autumn 2017. Circle sizes correspond to S_A values per nautical mile.

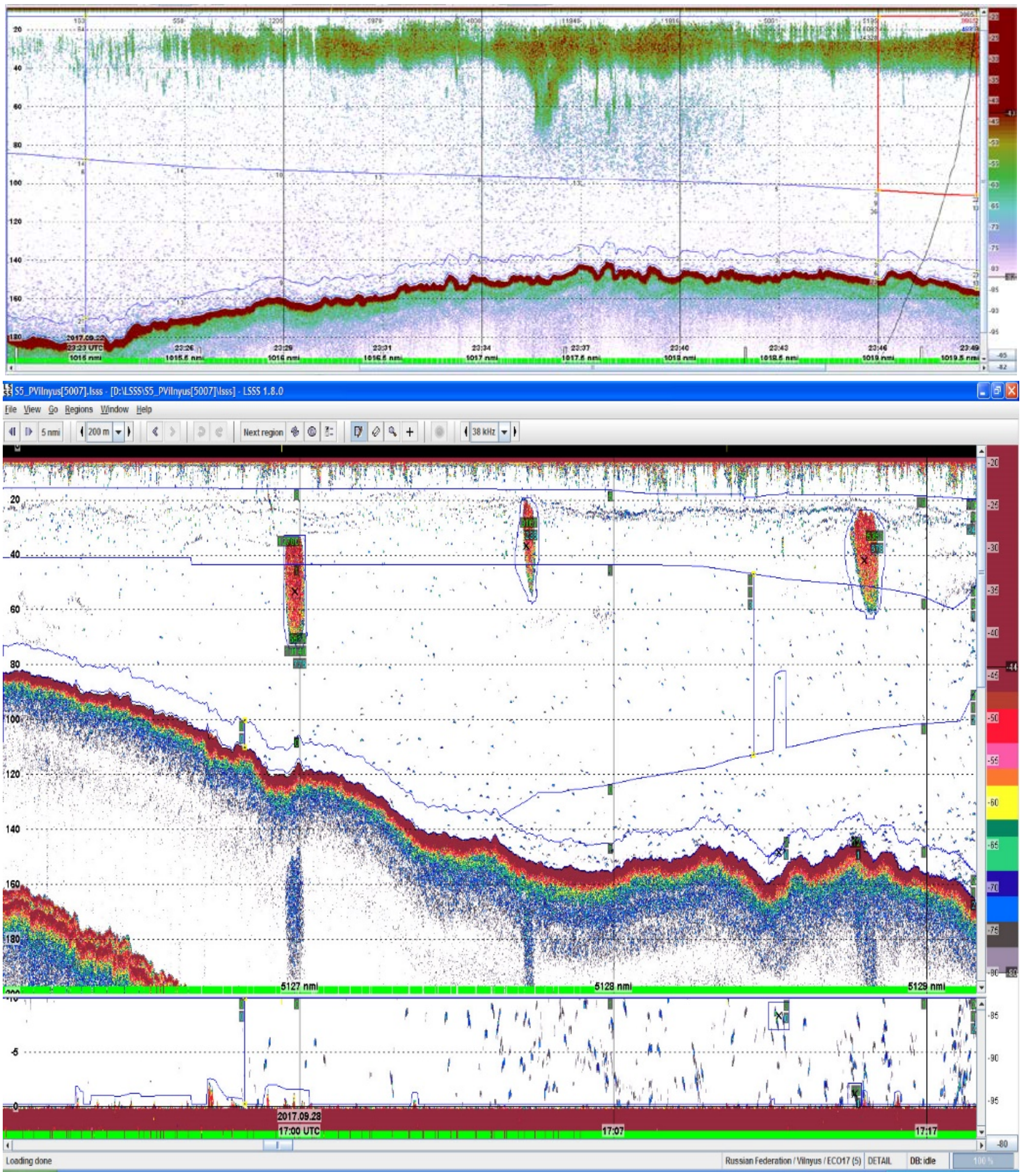

Figure. 7.1.1.2 Typical echo recordings of capelin in the area east of King Karls Land (above) and south-west of Franz Josef Land (below).

7.1.2 Abundance by size and age

A detailed summary of the acoustic stock estimate is given in Table 7.1.2.1, and the time series of abundance estimates is summarized in Table 7.1.2.2. A comparison between the estimates in 2017 and 2016 is given in the table 7.1.2.3 with the 2016 estimate shown on a shaded background.

The total stock is estimated to about 2.5 million tonnes, which is close to the long term mean level (2.9 million tonnes), and 7.5 time higher than stock size estimated for 2016. About 69 % (1.72 million tonnes) of the 2017 stock has length above 14 cm and is therefore considered to be maturing.

The 2015 year class was four times as abundant in 2017 as in 2016, and the 2014 year class twice as abundant. Such a significant increase in abundance at age of capelin can only be explained by an underestimation of the stock in the 2016 survey. Possible reasons for the error in the 2016 assessment will be discussed later.

The average weight of the most abundant age groups 2+ and 3+ slightly decreased compared to last year (figure 7.1.2.2), which is probably associated with stock growth.

A more detailed description of biology and stock development of the Barents Sea capelin can be found in the reports of the ICES Working Group on integrated assessment of the Barents Sea (WGIBAR).

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 2018.

Table 7.1.2.1 Barents Sea capelin. Summary of results from the acoustic estimate in August-October 2017.

Length (cm)	Age group / year class				Sum (10^9)	Biomass (10^3 t)	Mean, weight (g)
	1 (2016)	2 (2015)	3 (2014)	4 (2013)			
7.0 - 7.5	0.253				0.253	0.25	1.0
7.5 - 8.0	0.410				0.410	0.67	1.6
8.0 - 8.5	1.327				1.327	2.25	1.7
8.5 - 9.0	5.646				5.646	13.02	2.3
9.0 - 9.5	13.332				13.332	36.80	2.8
9.5 - 10.0	14.841				14.841	46.69	3.2
10.0 - 10.5	16.392	0.565			16.957	62.94	3.7
10.5 - 11.0	11.707	0.651			12.358	54.46	4.4
11.0 - 11.5	10.004	1.239			11.243	56.91	5.1
11.5 - 12.0	4.079	2.790			6.869	41.39	6.0
12.0 - 12.5	3.105	6.808			9.913	71.24	7.2
12.5 - 13.0	1.613	10.864			12.476	103.49	8.3
13.0 - 13.5	1.414	14.585	0.018		16.017	151.45	9.5
13.5 - 14.0	0.435	12.575	0.123	0.001	13.133	141.60	10.8
14.0 - 14.5	1.020	15.045	0.339		16.404	202.78	12.4
14.5 - 15.0	0.343	14.520	0.154		15.016	215.70	14.4
15.0 - 15.5	0.180	14.339	0.596		15.116	246.18	16.3
15.5 - 16.0	0.224	12.442	1.877		14.543	268.39	18.5
16.0 - 16.5	0.077	8.318	2.648	0.082	11.125	234.58	21.1
16.5 - 17.0		4.115	2.718	0.094	6.927	162.23	23.4
17.0 - 17.5		3.077	3.460	0.010	6.547	174.59	26.7
17.5 - 18.0		1.031	1.835	0.055	2.921	85.79	29.4
18.0 - 18.5		0.618	1.819	0.015	2.451	79.83	32.6
18.5 - 19.0		0.099	0.927	0.111	1.137	39.35	34.6
19.0 - 19.5		0.058	0.206	0.038	0.302	11.66	38.6
20.0 - 20.5			0.049	0.0001	0.049	1.94	39.4
TSN (10^9)	86.403	123.738	16.769	0.405	227.315		
TSB (10^3 t)	369.7	1708.1	417.4	11.1		2506.2	
Mean length (cm)	10.15	14.14	16.69	17.39	12.8		
Mean weight (g)	4.28	13.8	24.89	27.27			11.03
SSN (10^9)	1.844	73.661	16.628	0.405	92.538		
SSB (10^3 t)	26.23	1267.63	417.63	11.60		1723.097	

Target strength estimation based on formula: TS= 19.1 log (L) – 74.0

Table 7.1.2.2. Barents Sea capelin. Acoustic estimates of the stock by age in autumn 1973-2017. Biomass (B) in 10^6 tonnes. average weight (AW) in grams. All estimates based on TS = 19.1 log (L) -74.0 dB

Year	Age										
	1		2		3		4		5		Sum
	B	AW	B	AW	B	AW	B	AW	B	AW	B
1973	1.69	3.2	2.32	6.2	0.73	18.3	0.41	23.8	0.01	30.1	5.16
1974	1.06	3.5	3.06	5.6	1.53	8.9	0.07	20.8	+	25	5.72
1975	0.65	3.4	2.39	6.9	3.27	11.1	1.48	17.1	0.01	31	7.80
1976	0.78	3.7	1.92	8.3	2.09	12.8	1.35	17.6	0.27	21.7	6.41
1977	0.72	2	1.41	8.1	1.66	16.8	0.84	20.9	0.17	22.9	4.80
1978	0.24	2.8	2.62	6.7	1.20	15.8	0.17	19.7	0.02	25	4.25
1979	0.05	4.5	2.47	7.4	1.53	13.5	0.10	21	+	27	4.15
1980	1.21	4.5	1.85	9.4	2.83	18.2	0.82	24.8	0.01	19.7	6.72
1981	0.92	2.3	1.83	9.3	0.82	17	0.32	23.3	0.01	28.7	3.90
1982	1.22	2.3	1.33	9	1.18	20.9	0.05	24.9			3.78
1983	1.61	3.1	1.90	9.5	0.72	18.9	0.01	19.4			4.24
1984	0.57	3.7	1.43	7.7	0.88	18.2	0.08	26.8			2.96
1985	0.17	4.5	0.40	8.4	0.27	13	0.01	15.7			0.85
1986	0.02	3.9	0.05	10.1	0.05	13.5	+	16.4			0.12
1987	0.08	2.1	0.02	12.2	+	14.6	+	34			0.10
1988	0.07	3.4	0.35	12.2	+	17.1					0.42
1989	0.61	3.2	0.20	11.5	0.05	18.1	+	21.0			0.86
1990	2.66	3.8	2.72	15.3	0.44	27.2	+	20.0			5.82
1991	1.52	3.8	5.10	8.8	0.64	19.4	0.04	30.2			7.30
1992	1.25	3.6	1.69	8.6	2.17	16.9	0.04	29.5			5.15
1993	0.01	3.4	0.48	9.0	0.26	15.1	0.05	18.8			0.80
1994	0.09	4.4	0.04	11.2	0.07	16.5	+	18.4			0.20
1995	0.05	6.7	0.11	13.8	0.03	16.8	0.01	22.6			0.20
1996	0.24	2.9	0.22	18.6	0.05	23.9	+	25.5			0.51
1997	0.42	4.2	0.45	11.5	0.04	22.9	+	26.2			0.91
1998	0.81	4.5	0.98	13.4	0.25	24.2	0.02	27.1	+	29.4	2.06
1999	0.65	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			4.32
2001	0.37	3.3	2.40	11.0	0.81	26.7	0.04	35.5	+	41.4	3.62
2002	0.23	3.9	0.92	10.1	1.04	20.7	0.02	35.0			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			0.33
2006	0.29	4.8	0.35	16.1	0.14	24.8	0.01	30.6	+	36.5	0.79
2007	0.93	4.2	0.85	15.5	0.10	27.5	+	28.1			1.88
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	+	29.1	3.96
2014	0.32	3.0	0.95	8.9	0.64	16.3	0.04	20.3			1.95
2015	0.14	4.0	0.40	10.6	0.20	16.2	0.09	20.4	+	28.1	0.84
2016	0.12	3.9	0.12	15.3	0.08	25.2	0.004	24.7			0.33
2017	0.37	4.3	1.7	13.8	0.42	24.5	0.011	27.3			2.51
Average	0.63	3.59	1.32	10.77	0.83	19.46	0.19	24.76	0.06	28.13	2.91

Table 7.1.2.3. Table on summary of acoustic stock size estimates for capelin in 2016-2017.

Year class		Age	Numbers (10^9)		Mean weight (g)		Biomass (10^3 t)	
2016	2015	1	86.4	31.69	4.28	3.9	369.7	124.7
2015	2014	2	123.74	8.07	13.8	15.3	1708.1	123.7
2014	2013	3	16.77	2.99	24.9	25.2	417.4	75.2
2013	2012	4	0.41	0.17	27.3	24.7	11.1	4.1
Total stock in:								
2017	2016	1-4	227.32	42.91	11.03	7.6	2506.2	327.7

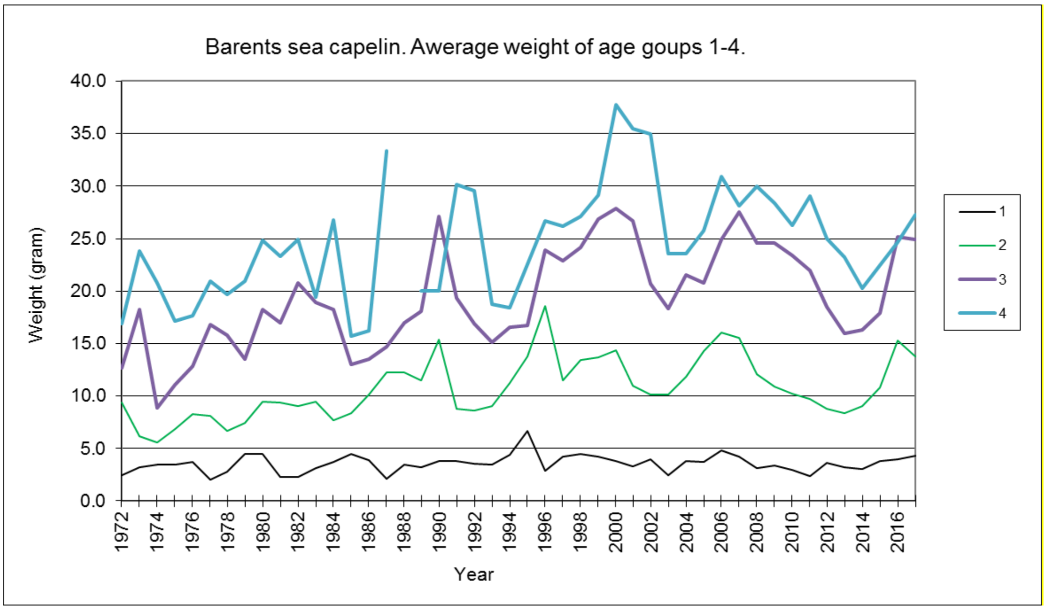

Figure 7.1.2.1. Weight at age (grams) for capelin from capelin surveys (prior to 2003) and BESS.

7.2 Polar cod (*Boreogadus saida*)

7.2.1 Geographical distribution

Polar cod had a fairly widespread distribution in the Barents Sea. As in previous years, the main concentrations were found in the north-eastern parts of the survey area, north of 78°N (Fig.7.2.1.1). Overall, polar cod density was lower than last year, but in some areas, there were dense concentrations (Fig.7.2.1.2). To the southwest of Franz Josef Land, polar cod was mixed with capelin and they had very similar appearance on the acoustic recordings. Many pelagic target hauls were needed to attempt to discriminate between the two. Scattered concentrations of polar cod were found along the south coast of Novaya Zemlya and near the Svalbard (Spitsbergen) archipelago.

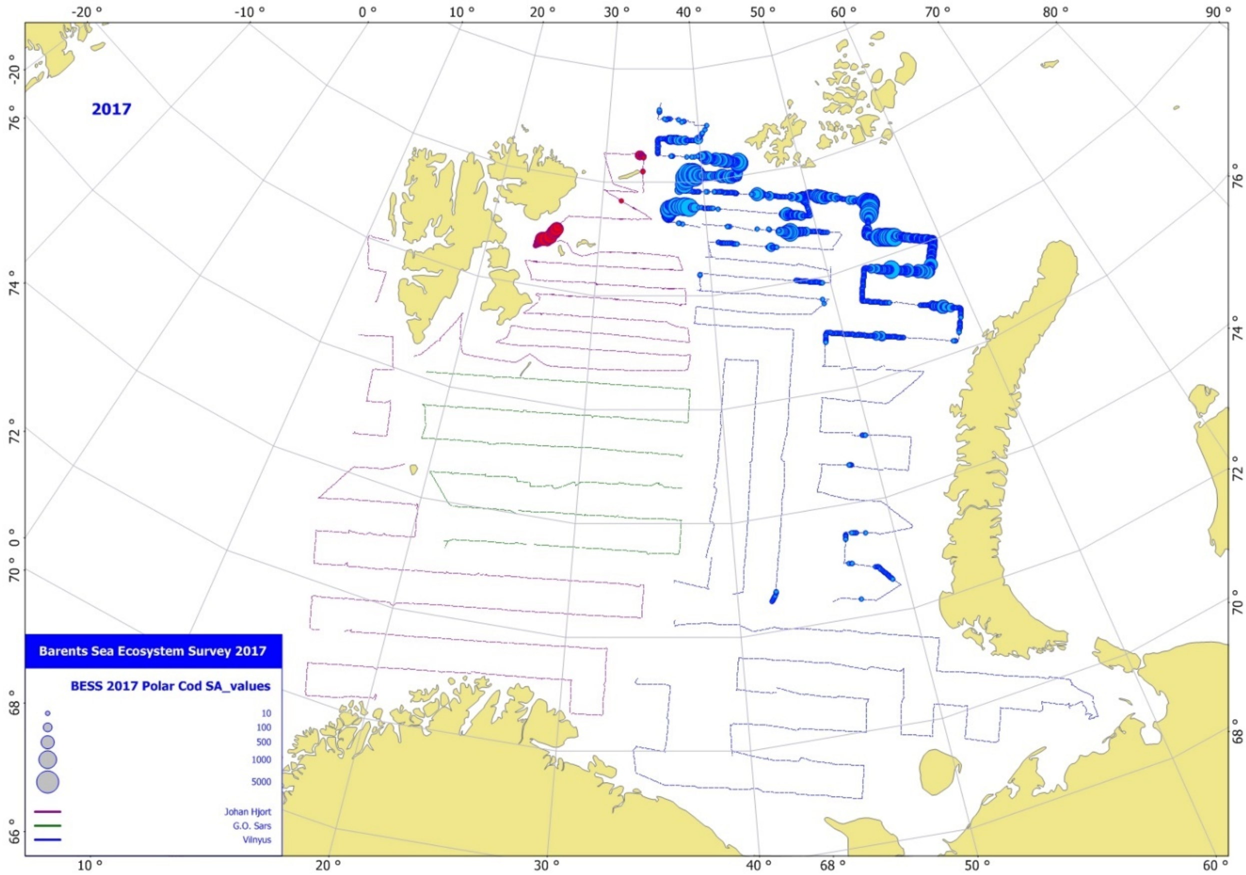

Figure 7.2.1.1 Estimated geographical distribution of polar cod in autumn 2017. Circle sizes correspond to S_A values per nautical mile.

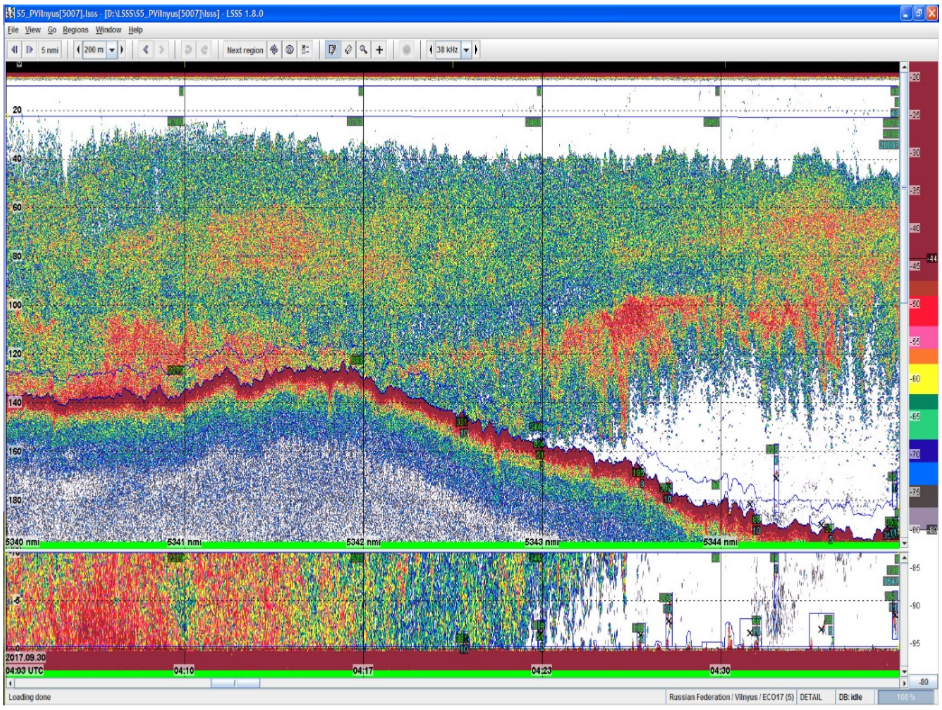

Figure 7.2.1.2 Echo recordings of polar cod in shallow waters near Victoria Island.

7.2.2 Abundance by size and age

A detailed overview of the stock estimate for 2017 is given in Table 7.2.2.1. and the time series of abundance estimates is summarized in Table 7.2.2.2. A comparison between the estimation results from 2017 and 2016 is given in the table 7.2.2.3. The 2016 estimate is shown on shaded background.

Compared to 2016, the 2017 estimated total numbers and biomass of polar cod in the Barents Sea had decreased significantly. Total stock biomass (TSB) was estimated to 357 thousand tonnes, which is only about 38 % of the 2016 estimate. Total stock numbers (TSN) was only at about 23% of the 2016 estimate. The 2015 year-class had decreased from an estimated 95 billion in 2016 to 8.27 billion individuals this year. Nevertheless, fish of the 2015 year-class contributed most to the stock biomass (56%). The estimate of the 2016 year-class was low (13.81 billion individuals).

Such significant fluctuations of the polar cod stock may be the consequence of variable mortality due to consumption by cod and other predators, but possibly also the proportion of the stock present within the survey area was different between the two years. The average weight of polar cod for all age groups was very similar to 2016. More detailed information about the polar cod stock development can be found in the ICES WGIBAR Report (2017, 2018 in prep).

Table 7.2.2.1 Barents Sea polar cod. Summary of results from the acoustic estimate in August-October 2017.

Length (cm)	Age group / year class				Sum	Biomass	Mean,
	1 2016	2 2015	3 2014	4+ 2013	(10^9)	(10^3 t)	weight (g)
7.0 - 7.9	0.065				0.065	0.17	2.62
8.0 - 8.9	0.467				0.467	2.03	4.34
9.0 - 9.9	2.745				2.745	15.59	5.68
10.0 - 10.9	4.076		0.002		4.078	31.64	7.76
11.0 - 11.9	4.065	0.147	0.002		4.214	41.89	9.94
12.0 - 12.9	2.008	0.660	0.004		2.672	33.77	12.64
13.0 - 13.9	0.297	1.297	0.235		1.828	29.76	16.28
14.0 - 14.9	0.087	2.172	0.153		2.413	49.41	20.48
15.0 - 15.9		1.689	0.174		1.863	47.80	25.66
16.0 - 16.9		1.240	0.153		1.393	43.54	31.27
17.0 - 17.9		0.701	0.130	0.001	0.832	31.22	37.53
18.0 - 18.9		0.253	0.144	0.002	0.399	17.31	43.38
19.0 - 19.9		0.069	0.077		0.147	7.93	54.14
20.0 - 20.9		0.041	0.026		0.067	3.72	55.3
21.0 - 21.9			0.000	+	0.000	0.03	66.82
22.0 - 22.9			0.012	+	0.012	1.29	105.0
23.0 - 23.9						0.00	
24.0 - 24.9			+		+	0.004	100.0
TSN (10^9)	13.81	8.269	1.112	0.0032	23.195		
TSB (10^3 t)	121.82	200.80	34.29	0.14		357.05	
Mean length	10.89	15.08	16.14	18.41	12.64		
Mean weight	8.82	24.28	30.83	44.21			15.40

Target strength estimation based on formula: TS = 21.8 log (L)- 72.7

Table 7.2.2.2 Barents Sea polar cod. Summary of acoustic estimates by age in August-October. TSN and TSB is total stock numbers (10^9) 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	24.038	169.6	6.263	104.3	1.058	31.5	0.082	3.4	31.441	308.8
1987	15.041	125.1	10.142	184.2	3.111	72.2	0.039	1.2	28.333	382.8
1988	4.314	37.1	1.469	27.1	0.727	20.1	0.052	1.7	6.562	86
1989	13.54	154.9	1.777	41.7	0.236	8.6	0.06	2.6	15.613	207.8
1990	3.834	39.3	2.221	56.8	0.65	25.3	0.094	6.9	6.799	127.3
1991	23.67	214.2	4.159	93.8	1.922	67	0.152	6.4	29.903	381.5
1992	22.902	194.4	13.992	376.5	0.832	20.9	0.064	2.9	37.79	594.9
1993	16.269	131.6	18.919	367.1	2.965	103.3	0.147	7.7	38.3	609.7
1994	27.466	189.7	9.297	161	5.044	154	0.79	35.8	42.597	540.5
1995	30.697	249.6	6.493	127.8	1.61	41	0.175	7.9	38.975	426.2
1996	19.438	144.9	10.056	230.6	3.287	103.1	0.212	8	33.012	487.4
1997	15.848	136.7	7.755	124.5	3.139	86.4	0.992	39.3	28.012	400.7
1998	89.947	505.5	7.634	174.5	3.965	119.3	0.598	23	102.435	839.5
1999	59.434	399.6	22.76	426	8.803	286.8	0.435	25.9	91.463	1141.9
2000	33.825	269.4	19.999	432.4	14.598	597.6	0.84	48.4	69.262	1347.8
2001	77.144	709	15.694	434.5	12.499	589.3	2.271	132.1	107.713	1869.6
2002	8.431	56.8	34.824	875.9	6.35	282.2	2.322	143.2	52.218	1377.2
2003*	32.804	242.7	3.255	59.9	15.374	481.2	1.739	87.6	53.172	871.4
2004	99.404	627.1	22.777	404.9	2.627	82.2	0.51	32.7	125.319	1143.8
2005	71.675	626.6	57.053	1028.2	3.703	120.2	0.407	28.3	132.859	1803.3
2006	16.19	180.8	45.063	1277.4	12.083	445.9	0.698	37.2	74.033	1941.2
2007	29.483	321.2	25.778	743.4	3.23	145.8	0.315	19.8	58.807	1230.1
2008	41.693	421.8	18.114	522	5.905	247.8	0.415	27.8	66.127	1219.4
2009	13.276	100.2	22.213	492.5	8.265	280	0.336	16.6	44.09	889.3
2010	27.285	234.2	18.257	543.1	12.982	594.6	1.253	58.6	59.777	1430.5
2011	34.46	282.3	14.455	304.4	4.728	237.1	0.514	36.7	54.158	860.5
2012	13.521	113.6	4.696	104.3	2.121	93	0.119	8	20.457	318.9
2013	2.216	18.1	4.317	102.2	5.243	210.3	0.18	9.9	11.956	340.5
2014	0.687	6.5	4.439	110	3.196	121	0.08	5.3	8.402	243.2
2015	10.866	97.1	1.995	45.1	0.167	5.3	0.008	0.5	13.036	148
2016	95.919	792.7	6.38	139.1	0.207	6.9	0.023	0.7	102.529	939.4
2017	13.81	121.82	8.269	200.8	1.112	34.29	0.0032	0.14	23.195	357.05
Average	30.91	247.32	14.08	322.38	4.74	178.57	0.50	27.07	50.26	777.07

*-values are based on VPA runs due to survey failure

Table 7.2.2.3 Summary of stock size estimates for polar cod in 2016-2017.

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2016	2015	1	13.81	95.9	8.8	8.3	121.8	792.7
2015	2014	2	8.27	6.4	24.3	21.8	200.8	139.1
2014	2013	3	1.11	0.2	30.8	33.5	34.3	6.9
2013	2012	4	0.003	0.02	44.21	47.7	0.14	0.1
Total stock in								
2017	2016	1-4	23.2	102.5	15.4	9.2	357.0	939.4

7.3 Herring (Clupea harengus)

7.3.1 Geographical distribution

Young Norwegian spring spawning herring (NSSH) were widely distributed in the southern Barents Sea in 2017 (Figure 7.3.1.1) from the west coast of Novaya Zemlya to the edge of the continental slope in the western Barents Sea. The highest concentrations were found off the shelf edge, but here mostly of herring age 4+, and north of the Kola Peninsula, predominantly age 1+ herring.

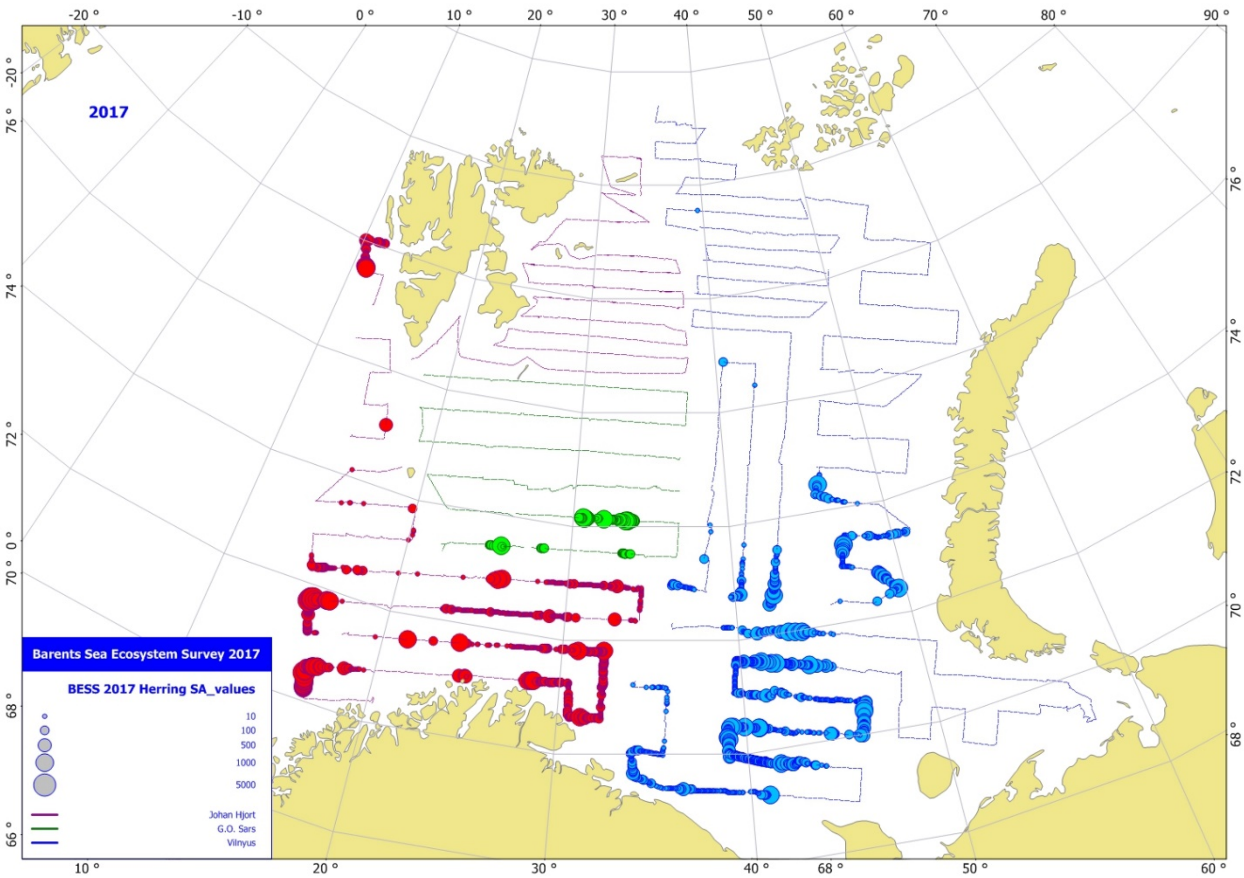

Figure 7.3.1.1 Estimated geographical distribution of herring in autumn 2017. Circle sizes correspond to S_A values per nautical mile. The westernmost recordings off the shelf edge were mostly of herring age 4+.

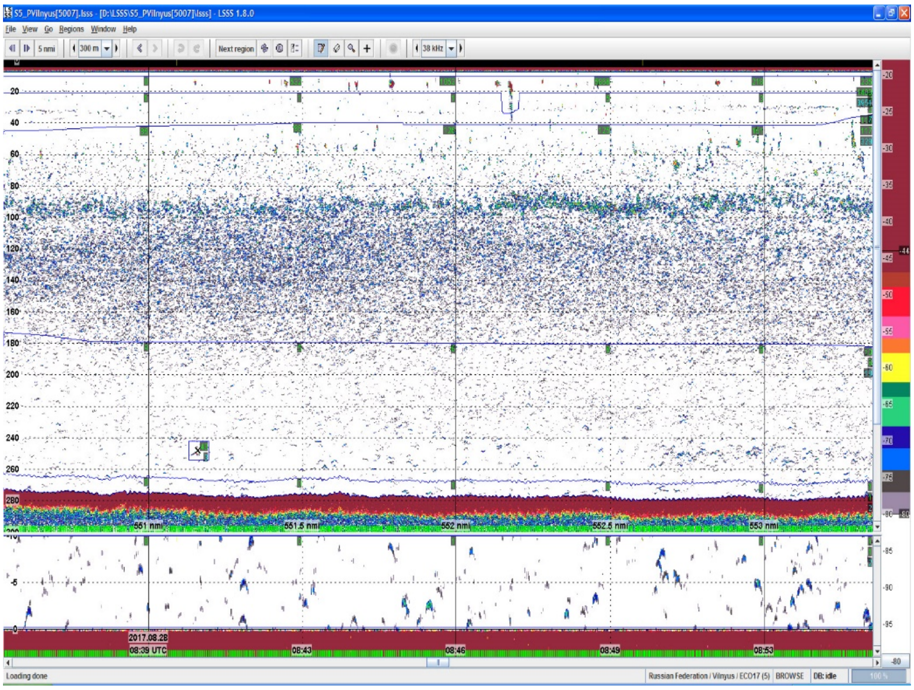

Figure. 7.3.1.2 Typical echo recordings of young herring in the southern part of Barents Sea.

7.3.2 Abundance by size and age

A detailed summary of the 2017 NSSH stock estimate is given in Table 7.3.2.1. and the time series of abundance estimates is summarized in Table 7.3.2.2. The comparison between the 2017 and 2016 estimates is given in the table 7.3.2.3. The 2016 estimate is shown on a shaded background.

Total numbers of young herring in 2017 was estimated at 41.5 billion individuals and biomass at about 1.5 million tonnes. The abundance of herring was 3.3 times higher than in 2016, but it should be noted that a part of the NSSH distribution area was not well covered in the 2016 survey. The total number of young herring exceeded the long-term annual average for autumn survey observations.

The increased abundance of young herring was mainly due to the 2016 year-class, which comprises 84 % of the TSN. The proportion of fish older than 4 years was negligible. Mean weight of the main age group 1+ was higher than in 2016 (Table 7.3.2.3), but mean weight of the other groups was lower.

A more detailed analysis of the stock dynamics of juvenile herring in the Barents Sea can be found in the AFWG WGWIDE Report.

Table 7.3.2.1 Norwegian spring spawning herring. Summary of results from the acoustic estimate in the Barents Sea in August-October 2017

	Age group / year class						Sum	Biomass	Mean
	1	2	3	4	5	6			
Length (cm)	2016	2015	2014	2013	2012	2011	(10^9)	(10^3 t)	weight (g)
12-13	0.274						0.274	3.861	14.1
13-14	3.211						3.211	52.386	16.3
14-15	5.852	0.004					5.856	115.371	19.7
15-16	14.231	0.000					14.231	322.220	22.6
16-17	9.137	0.014					9.152	247.522	27.1
17-18	1.919	0.182					2.101	71.566	34.1
18-19	0.316						0.316	13.754	43.5
19-20		0.325					0.325	17.333	53.4
20-21	0.009	0.590					0.599	37.220	62.1
21-22		0.510	0.021				0.531	37.395	70.5
22-23		0.267	0.012				0.280	22.736	81.3
23-24		0.213	0.028				0.241	21.242	88.3
24-25		0.018	0.435				0.453	48.064	106.2
25-26		0.015	2.690	0.005			2.710	319.639	117.9
26-27			0.183	0.019			0.201	28.546	141.8
27-28			0.056	0.056			0.112	18.830	167.9
28-29			0.040	0.297			0.337	64.591	191.5
29-30				0.320	0.029		0.349	76.159	218.2
30-31				0.058	0.000	0.005	0.063	15.223	243.1
31-32				0.153	0.037		0.191	49.004	256.9
32-33				0.001	0.001	0.001	0.002	0.595	282.3
33-34									
35-36						0.001	0.001	0.195	322
TSN (10^9)	34.95	2.138	3.465	0.908	0.067	0.007	41.534		
TSB (10^3 t)	819.75	140.68	412.19	192.29	16.86	1.678		1583.4491	
Mean length (cm)	15.3	20.66	25.04	29.17	30.38	30.85			17.0
Mean weight (g)	23.46	65.81	118.96	211.67	251.19	263.5			38.12

Target strength estimation based on formula: TS = 20.0 log (L) - 71.9 dB

Table 7.3.2.2 Norwegian spring spawning herring. Summary of acoustic estimates by age in autumn 1999-2017. TSN and TSB are total stock numbers (10^9) and total stock biomass (10^3 t) respectively.

Age	1		2		3		4+		Sum	
Year	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
1999	48.759	716	0.986	31	0.051	2	0	0	49.795	749
2000	14.731	383	11.499	560	0	0	0	0	26.230	943
2001	0.525	12	10.544	604	1.714	160	0	0	12.783	776
2002	**No data**	–	–	–	–	–	–	–	–	–
2003	99.786	3090	4.336	220	2.476	326	0	0	106.597	3636
2004	14.265	406	36.495	2725	0.901	107	0	0	51.717	3252
2005	46.38	984	16.167	1055	6.973	795	0	0	69.520	2833
2006	1.618	34	5.535	398	1.620	211	0	0	8.773	643
2007	3.941	148	2.595	218	6.378	810	0.25	46	13.164	1221
2008	0.03	1	1.626	77	3.987**	287**	3.223**	373**	8.866**	738**
2009	0.002	48	0.433	52	1.807	287	1.686	393	5.577	815
2010	1.047	35	0.215	34	0.234	37	0.428	104	2.025	207
2011	0.095	3	1.504	106	0.006	1	0	0	1.605	109
2012	2.031	36	1.078	66	1.285	195	0	0	4.394	296
2013	7.657	202	5.029	322	0.092	13	0.057	9	12.835	546
2014	4.188	62	1.822	126	6.825	842	0.162	25	13.011	1058
2015	1.183	6	9.023	530	3.214	285	0.149	24	13.569	845
2016	7.760	131	1.573	126	3.089	389	0.029	6	12.452	652
2017	34.95	820	2.138	141	3.465	412	0.982	210	41.537	1583
Average	16.053	395	6.255	411	2.451	287	0.387	66	25.247	1161

** including several Kanin herring (mix concentration in south-east area)

Table 7.3.2.3 Summary of stock size estimates for NSS herring in 2016-2017.

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2016	2015	1	34.95	7.76	23.46	16.9	820	131
2015	2014	2	2.138	4.573	65.81	80.2	141	126
2014	2013	3	3.465	3.089	118.96	126.1	412	389
2013	2012	4+	0.982	0.29	213.8	223.7	210	6
Total stock in								
2017	2016	1-4	41.537	12.452	38.12	52.4	1583	652

7.4 Blue whiting (Micromesistius poutassou)

7.4.1 Geographical distribution

Blue whiting is an important component of the Barents Sea ecosystem, and changes in the stock of blue whiting in the Norwegian Sea are also observed in the Barents Sea.

As in previous years, blue whiting was observed in the western part of the Barents Sea, in particular along the continental shelf slope (Figure 7.4.1.1).

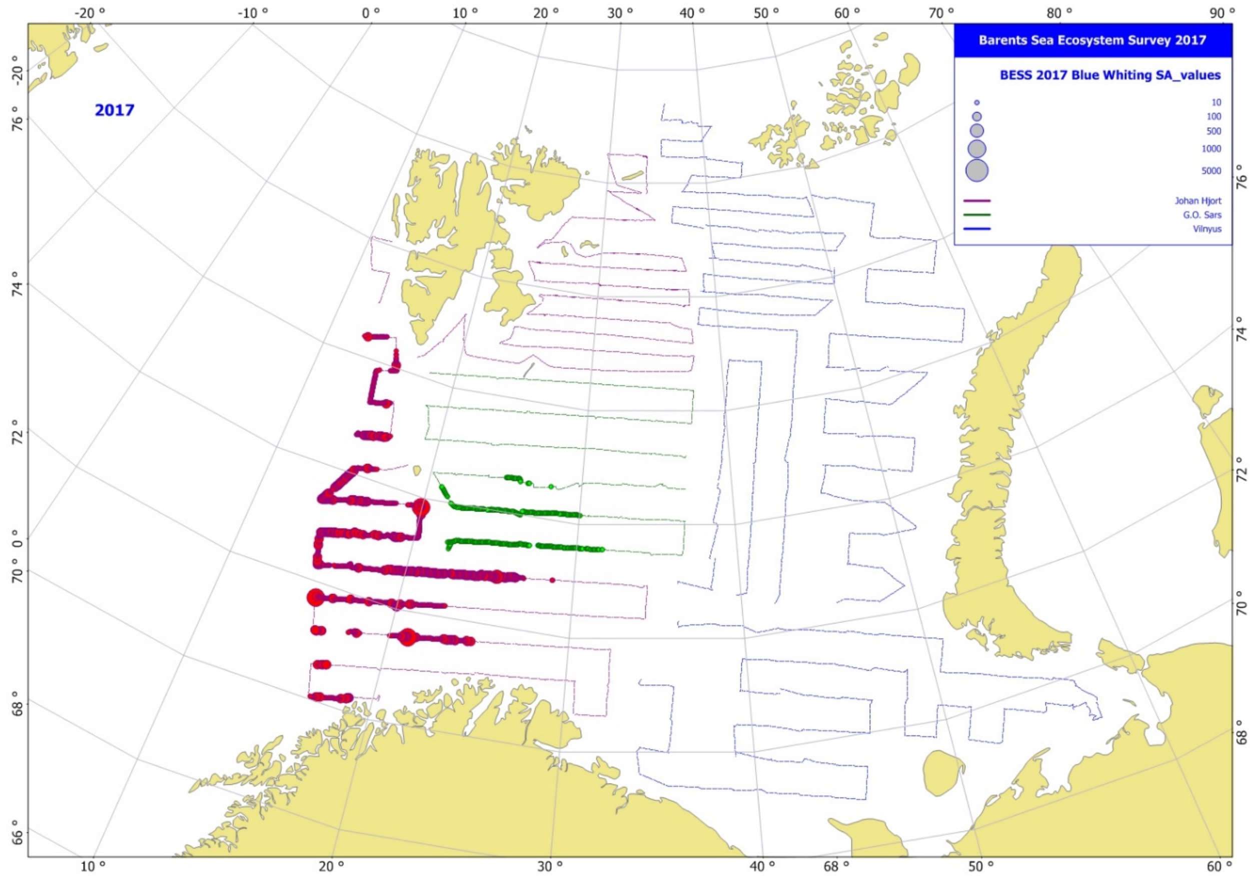

Figure 7.4.1.1. Estimated geographical distribution of blue whiting in autumn 2017. Circle sizes correspond to S_A values per nautical mile.

7.4.2 Abundance by size and age

In previous BESS biomass estimates of blue whiting in the Barents Sea, the conversion from acoustic backscatter to biomass has been through the equation TS = 21.8 log (L) - 72.8 dB based on measurements of juvenile cod (Nakken and Olsen, 1977).

The formula was revised based on target strength measurements (Pedersen et al., 2011) and incorporated in the blue whiting assessment (ICES CM 2012/SSGESST:01). The new equation is TS=20 log (L) - 65.2.

Prior to the present BESS report, the Barents Sea time series of blue whiting was recalculated using the StoX software and the new TS-formula. As part of the recalculation, the coverage area was also standardised, and the western border was defined along the 500 m depth contour on the shelf edge. This was done to avoid annual variability due to differences in survey coverage from year to year. This method of using standardised area may require further discussion, and the results from the recalculation must therefore be considered preliminary. This new blue whiting time series is not directly comparable with the old one.

From 2004-2007 estimated biomass of blue whiting in the Barents Sea was between 200 000 and 350 000 tons (Table 7.4.2.1). In 2008 the estimated biomass dropped abruptly to only about 18% of the estimated biomass in the previous year, and it stayed low until 2012. From 2012 onwards it has been variable, and this year the biomass was slightly below the long-term average, a decrease from last year.

The 3-year olds (2014 year class) dominated in terms of both number and biomass as expected based on the high abundance of 2-year-olds last year and 1-year-olds the year before (Table 7.4.2.1).

Table 7.4.2.1 Blue whiting. Acoustic estimate in the Barents Sea in August-October 2017.

length (cm)	Age group/year-class													Sum (10^6)	Biomass (10^3 t)	Mean Weight (g)
	1 2016	2 2015	3 2014	4 2013	5 2012	6 2011	7 2010	8 2009	9 2008	10 2007	11 2006	12 2005	15 2002			
18.5-19.0	1.7													1.7	0.1	35.9
19.0-19.5																
19.5-20.0	6.7													6.7	0.3	39.5
20.0-20.5	19.3													19.3	0.8	42
20.5-21.0	23													23	1	44.9
21.0-21.5	12.2													12.2	0.6	48.8
21.5-22.0	20.3													20.3	1.1	52.8
22.0-22.5	22.3													22.3	1.3	56.6
22.5-23.0	2.8	27.5												30.3	1.9	62.3
23.0-23.5	13.5	27.3	7.3											48.2	3.3	68.3
23.5-24.0		20.2	45.2											65.4	5	76
24.0-24.5			81.8											81.8	6.5	80
24.5-25.0		35.5	86.4											121.9	10.6	86.6
25.0-25.5		24.6	70.4											95	8.7	92
25.5-26.0		104.8	7.2											112	11	98.3
26.0-26.5			58.3	36.2										94.6	9.8	104.1
26.5-27.0			84.5											84.5	9.5	112.1
27.0-27.5			16.6	62.1										78.8	9.4	119.7
27.5-28.0			19.9	41.7										61.5	7.7	125.7
28.0-28.5			27.4	16.7										44	5.8	132.5
28.5-29.0				22.7										22.7	3.2	140.9
29.0-29.5			7.7	17.2										24.9	3.6	145.6
29.5-30.0				12.6										12.6	1.9	154.1
30.0-30.5				6.5	6.2									12.7	2.1	165.5
30.5-31.0				5.3	3.2	2.8								11.3	2	174.6
31.0-31.5					4.8	2.8								7.6	1.4	185
31.5-32.0				2.3	2		0.3							4.5	0.9	192.5
32.0-32.5				1.9		1.9								3.8	0.8	197.1
32.5-33.0						0.4								0.4	0.1	253
33.0-33.5					0.8					1.3				2	0.4	203.6
33.5-34.0						0.8				1.8				2.5	0.6	222.1
34.0-34.5					1.9	0.4								2.4	0.6	234.3
34.5-35.0					1.5									1.5	0.4	259
35.0-35.5								1						1	0.3	242.7
35.5-36.0																
36.0-36.5								0.5			0.7			1.2	0.3	258.7
36.5-37.0												0.8		0.8	0.2	210
37.0-37.5									1.1	1.6			0.5	3.2	0.9	293.3
37.5-38.0										1		0.6		1.5	0.3	173.4
38.0-38.5													0.4	0.4	0.1	333
38.5-39.0																
39.0-39.5								1.2						1.2	0.4	334.2
40.0-40.5										637			0.6	1.3	0.4	352.5
TSN (10^6)	121.8	239.9	512.8	225	20.3	9.1	0.3	2.7	1.1	6.2	0.7	1.3	1.5	1143		
TSB (10^3 t)	2.4	20.7	50.1	29.1	3.9	1.7	0.1	0.8	0.3	1.5	0.2	0.3	0.3		115.2	
Mean lenght (cm)	21.4	24.5	25.4	27.7	31.3	31.5	31.5	36.9	37	35.6	36	36.9	38.5			
Mean weight, (g)	50.9	86.3	97.6	129.2	189.6	190.5	209	285.5	289.5	238	258.5	214.3	327.7			100.8

Target strength estimation based on formula: TS=20 log (L) - 65.2

Table 7.4.2.2 Blue whiting. Acoustic estimates by age in autumn 2004-2017. TSN and TSB are total stock numbers (10^6) and total stock biomass (10^3 tons)

Age	1		2		3		4+		Sum	
Year	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
2004	669	26	439	33	1056	98	1211	159	3575	327
2005	649	20	523	36	1051	86	809	102	3039	244
2006	47	2	478	34	730	70	922	129	2177	235
2007	0	0	116	11	892	92	743	107	1757	210
2008	0	0	0	0	10	1	238	36	247	37
2009	1	0	0	0	6	1	359	637	366	65
2010	0	0	2	0	5	1	155	31	163	33
2011	2	0	2	0	13	2	93	22	109	25
2012	583	27	64	8	58	9	321	77	1025	121
2013	1	0	349	28	135	13	175	42	664	84
2014	111	5	19	2	185	20	127	28	443	55
2015	1768	71	340	29	134	15	286	44	2529	159
2016	277	13	1224	82	588	48	216	36	2351	188
2017	43	2	253	22	503	49	269	38	1143	115
Average	297	12	272	20	383	36	423	106	1399	136

Target strength estimation based on formula: TS = 20 log (L) - 65.2 (Recalculation by Åge Høines, IMR 2017)

Table 7.4.2.3 Summary of stock size estimates for Blue whiting in 2016-2017.

Year class		Age	Number (10^6)		Mean weight (g)		Biomass (10^3 t)	
2016	2015	1	43	277	50.9	45.8	2	13
2015	2014	2	253	1224	86.3	66.7	22	82
2014	2013	3	503	588	97.6	81.9	49	48
2013-	2012-	4+	269	224	142.2	163.5	38	37
Total stock in								
2017	2016	1-4	1143	2351	100.8	79.6	115	188

8. COMMERCIAL DEMERSAL FISH

Text by B. Bogstad, E.H. Hallfredsson, H. Höffle, D.V. Prozorkevitch

Figures by P.Krivosheya

This section provides data on the distribution and BESS stock indices for the main commercial demersal fish species. Stock indices were calculated by swept area method (Jakobsen, 1997) which are described in the Survey manual: http://www.imr.no/tokt/okosystemtokt_i_barentshavet/nb-no and in AFWG 2014 (WD02).

In 2017 the area covered increased significantly compared to 2016, and only a few small areas were not covered by bottom trawling.

Estimates of the abundance and biomass of demersal fish were made at the end of the survey and presented in Table 8.1. Estimates by age/length group for cod, haddock, redfish, and Greenland halibut will be presented in the ICES AFWG report in 2018.

In 2017, the abundance and biomass of bottom fish generally increased compared to 2016. It should be noted that in 2016 the survey area was not completely covered. The combined biomass of all commercial demersal fish species in 2017 was very close to that found in 2014-2015.

As seen in Table 8.1, numbers and biomass of demersal fish species varies annually. These changes are significant for some species, and negligible for others. However, abundance indices allow for investigations of total fish abundance dynamics in the Barents Sea. Fluctuation in abundance estimates for different fish species indicates not only stock changes, but also changes in ecosystem conditions.

8.1 Cod (Gadus morhua)

At the time of survey cod usually reaches the northern and eastern limits of its feeding area. In 2017 the zero-line for cod distribution was not found in the north-eastern Barents Sea. In general, the cod was distributed almost over the entire survey area (Fig. 8.1.1), and the distribution pattern was similar to last year. The abundance of cod in 2017 was slightly higher than in 2016, while the biomass was higher than in 2016 and close to the 2015 level.

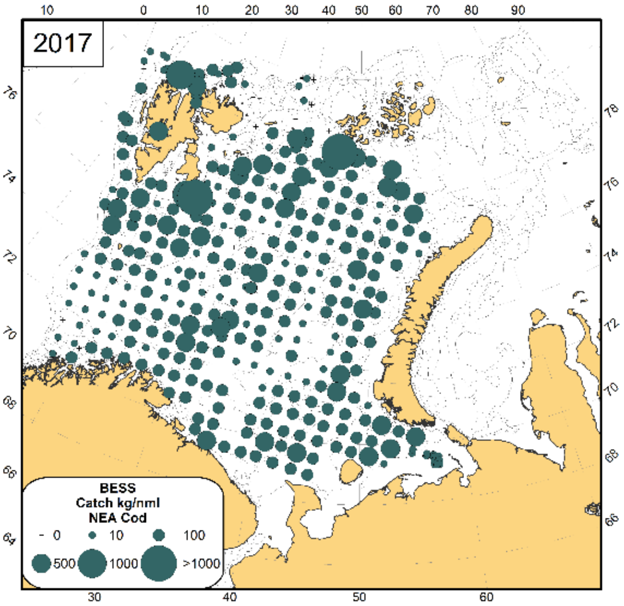

Figure 8.1.1 Distribution of cod (*Gadus morhua*), August-October 2017.

8.2 Haddock (Melanogrammus aeglefinus)

As in 2016, haddock was in 2017 widely distributed in the southeastern and western parts of the Barents Sea (Fig. 8.2.1). However, the very large catches reported in some hauls in 2016 were not seen in 2017. The abundance of haddock decreased from 2016 to 2017, and the biomass in 2017 was the lowest observed in the time series.

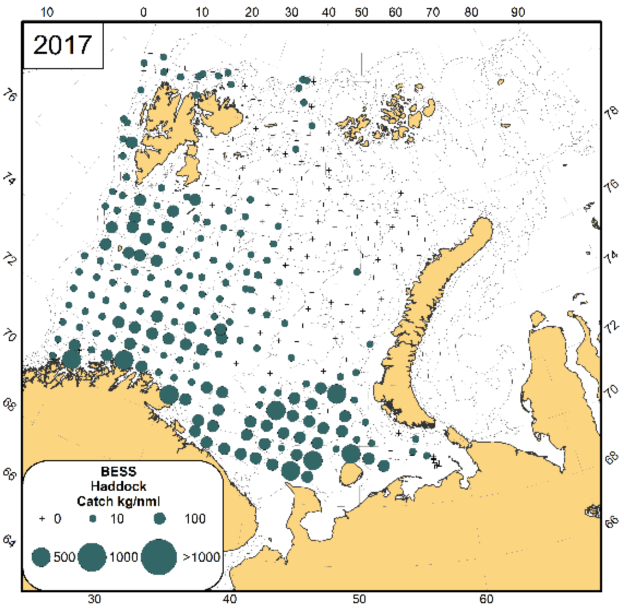

Figure 8.2.1 Distribution of haddock (*Melanogrammus aeglefinus*), August-October 2017.

8.3 Saithe (Pollachius virens)

This survey covers only a minor part of the saithe stock distribution. As in previous years, the main concentrations of saithe were distributed along the Norwegian coast. The abundance and biomass of saithe observed in 2017 was the highest in the time series, surpassing the previous high from 2015 (Table 8.1). According to the AFWG assessment, the saithe stock has increased since 2011.

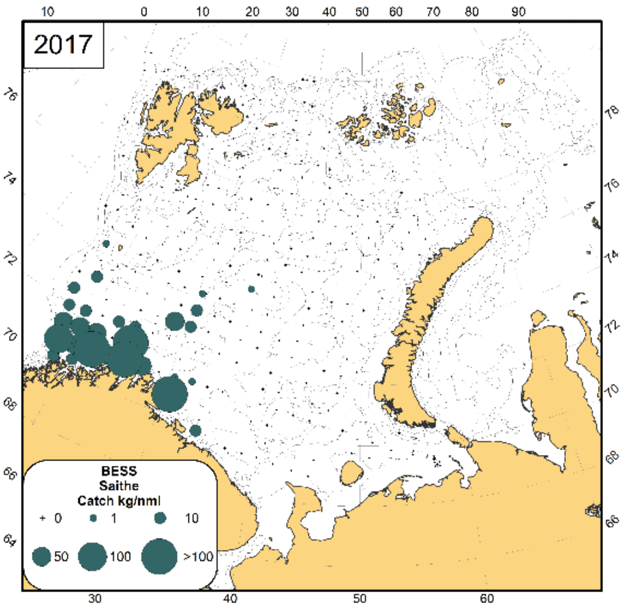

Figure 8.3.1 Distribution of saithe (*Pollachius virens*), August-October 2017.

8.4 Greenland halibut (Reinhardtius hippoglossoides)

BESS covers mainly the area where young Greenland halibut is found, including the nursery area in the northernmost part. However, in recent years larger Greenland halibut has increasingly been registered in the deep-water central parts of Barents Sea. This affects the stock indices when expressed in biomass.

In comparison with the last three years, both abundance and biomass indices for G. halibut increased in 2017, but did not reach the 2006-2013 level. (Table 8.1).

G. halibut indices that are used in the assessment in ICES AFWG are calculated differently from this survey report. The BESS registrations are divided into northern (nursery) area and southern part. Thus, two indices are estimated, each of them additionally divided by sex, based on BESS. Moreover, two trawl indices from surveys that cover deeper waters than BESS, at the continental slope, are also used in the assessment.

Estimates of abundance and biomass of G. halibut based on BESS are uncertain. It strongly depends on the area covered by each annual survey.

As in previous years, the Greenland halibut was observed in almost all catches in the deep areas of the Barents Sea (Fig. 8.4.1). Compared with last year the distribution pattern has not changed, but the catches increased, particularly in the northern part of the survey area.

The main concentrations of G. halibut were observed around Svalbard (Spitsbergen) and to the west of Franz Josef Land.

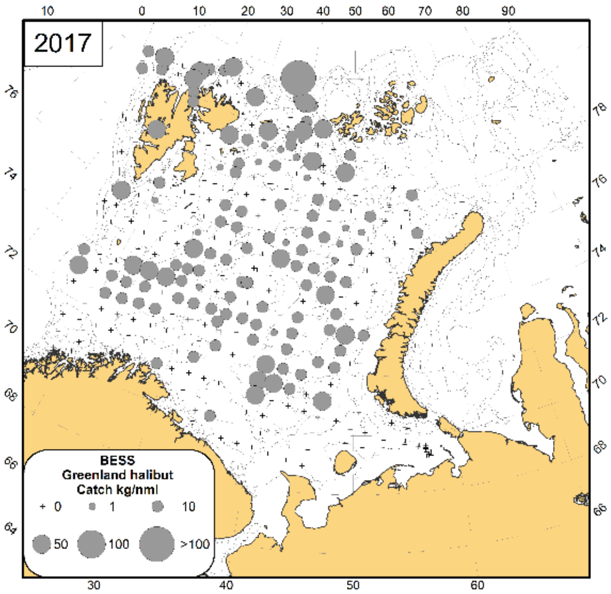

Figure 8.4.1 Distribution of Greenland halibut (*Reinhardtius hippoglossoides*), August-October 2017.

8.5 Golden redfish (*Sebastes norvegicus*)

In 2017, as in 2016, golden redfish was observed along the Norwegian coast and west of Bear Island. However, golden redfish was in 2017 also observed along the Murman coast, where it was practically absent in 2016 (Fig. 8.5.1). In 2017 the maximum catch of golden redfish (283 kg) was observed quite far to the east (Fig. 8.5.2). The number of golden redfish remained at the same level as in 2016, whilst the biomass decreased slightly (Table 8.1).

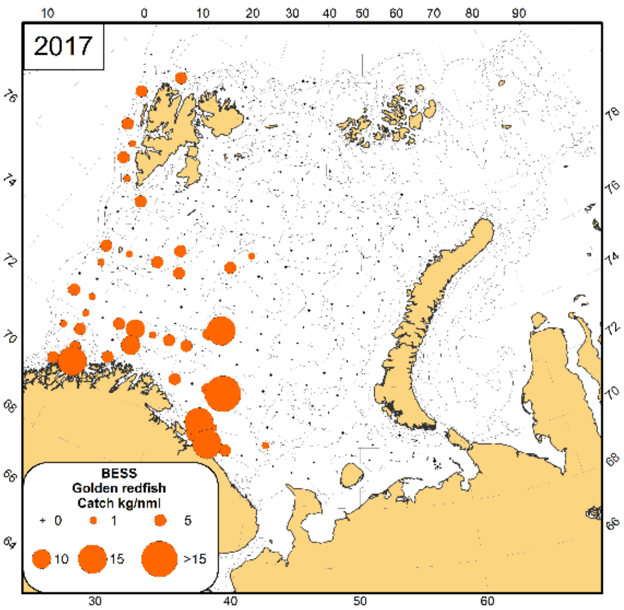

Figure 8.5.1 Distribution of golden redfish (*Sebastes norvegicus*), August-October 2017.

Figure 8.5.2 Catch of golden redfish at 71°14N 35° 42°E.

8.6 Deep-water redfish (*Sebastes mentella*)

Deep-water redfish was widely distributed in almost the entire survey area, except for the south-eastern and eastern parts of the Barents Sea (Fig. 8.6.1). As in 2016, mostly juvenile redfish were observed in the Russian zone (eastern and northern areas). Highest catches of redfish were found in the western part of Barents Sea to the south and east of Bear Island. The biomass of deep-water redfish has been relatively stable since 2012, while the number observed in 2017 was the highest in the time series.

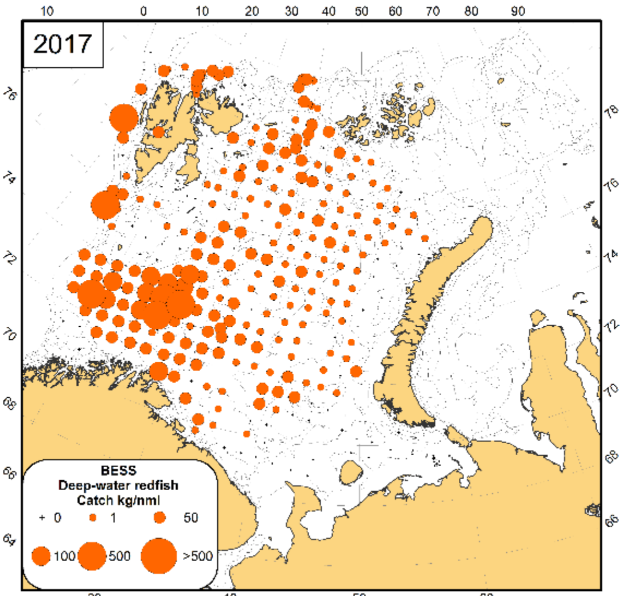

Figure 8.6.1 Distribution of deep-water redfish (*Sebastes mentella*), August-October 2017.

8.7 Long rough dab (Hippoglossoides platessoides)

As usual, long rough dab were found in the entire survey area (Fig. 8.7.1). Relatively low catches were observed only in south-western areas of Barents Sea and close to the northern limit of the survey area. Main concentrations of long rough dab were typically found in the north and central parts of Barents Sea and to the south and west of the coast of Novaya Zemlya. The abundance and biomass of long rough dab has been relatively stable through the entire survey period. In 2017, the total numbers amounted to 4.6 billion individuals and 538 thousand tons, respectively (Table 8.1). Long rough dab is still the most numerous bottom fish species in this survey.

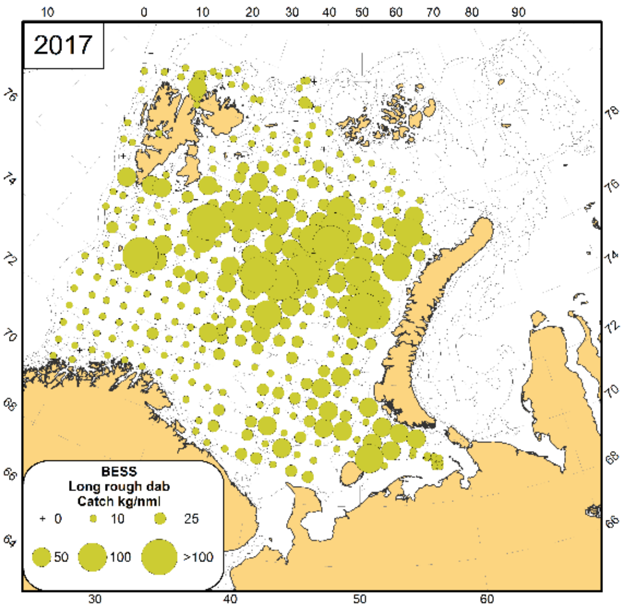

Figure 8.7.1 Distribution of long rough dab (*Hippoglossoides platessoides*), August-October 2017.

8.8 Atlantic wolffish (*Anarhichas lupus*)

Atlantic wolffish is the most numerous of the three species of wolffishes inhabiting the Barents Sea, while it has the lowest biomass of the three species.

Distribution of Atlantic wolffish was generally similar to last year. In 2017, Atlantic wolffish were not found along the Murman and Varanger coasts. At the same time, some catches were found to the west of Franz Josef Land. The biomass and abundance of Atlantic wolffish has been stable in 2015-2017 (Table 8.1).

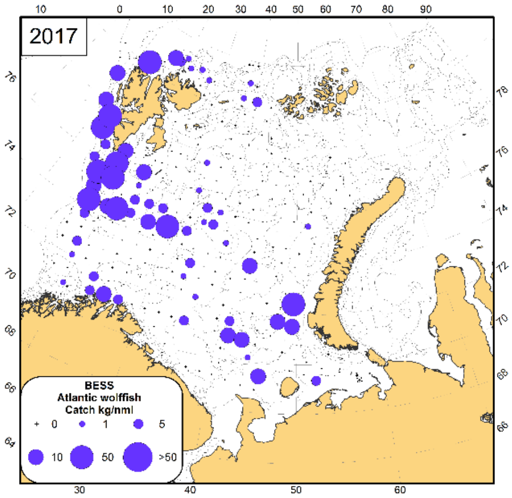

Figure 8.8.1 Distribution of Atlantic wolffish (*Anarhichas lupus*), August-October 2017.

8.9 Spotted wolffish (*Anarhichas minor*)

Spotted wolffish is the most valuable commercial wolffish species in the Barents Sea. In 2017 the distribution of spotted wolffish was almost the same as in previous years (Fig. 8.9.1). Spotted wolffish catches increased slightly in the southern part of the Barents Sea and decreased to the north of Svalbard (Spitsbergen). The distribution of spotted wolffish probably depends on the time when the survey area is covered.

In 2017, the number of spotted wolffish was estimated to 14 million individuals and biomass is 63 thousand tons (Table 8.1). During the observation period from 2006 the abundance and biomass of spotted wolffish has been very stable and the inter-annual fluctuations are insignificant (Table 8.1).

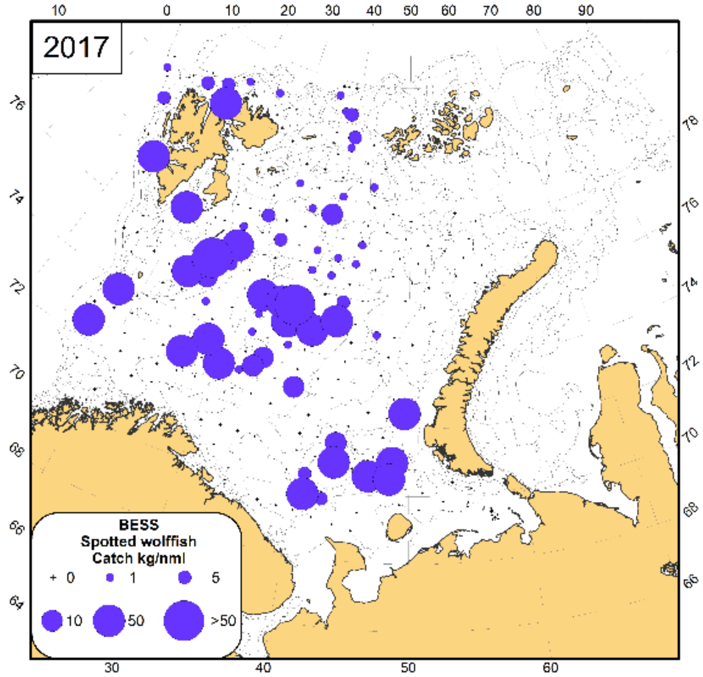

Figure 8.9.1 Distribution of spotted wolffish (*Anarhichas minor*), August-October 2017.

8.10 Northern wolffish (*Anarhichas denticulatus*)

In 2017 distribution of Northern wolffish was wider than in 2016 (Fig. 8.10.1). Northern wolffish was observed in the northern and western parts of the Barents Sea and along the coast of Novaya Zemlya north to 72° N.

During the last 7 years, the stock of northern wolffish in the Barents Sea has been relatively stable with abundances around 8 million individuals and biomass around 50 thousand tons.

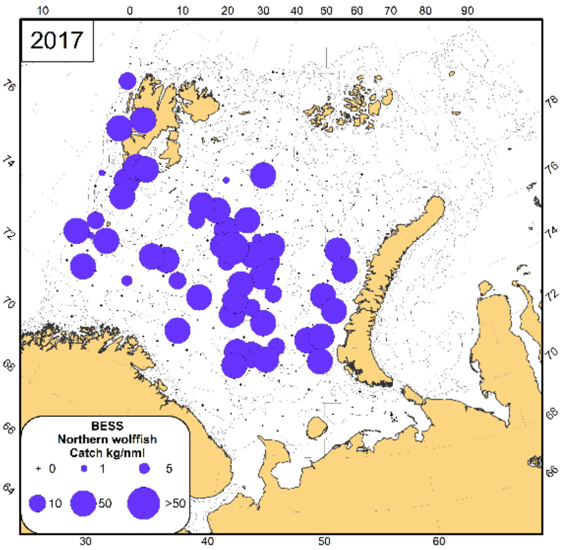

Figure 8.10.1 Distribution of northern wolffish (*Anarhichas denticulatus*), August-October 2017.

8.11 Plaice (*Pleuronectes platessa*)

In 2017 plaice was mainly found in the southeastern Barents Sea between 43° and 56°E (Fig. 8.11.1). Several individuals were caught near the Norwegian coast, along the Varanger peninsula. From 2014 a negative trend in the plaice stock index has been observed. It is possible that some part of the plaice stock is distributed outside the survey coverage area, particularely in areas where trawling is impossible due to crab traps. In any case, the catches in the standard survey area was reduced. Thus, in 2017 the indices of abundance and biomass continued to decrease (Table 8.1).

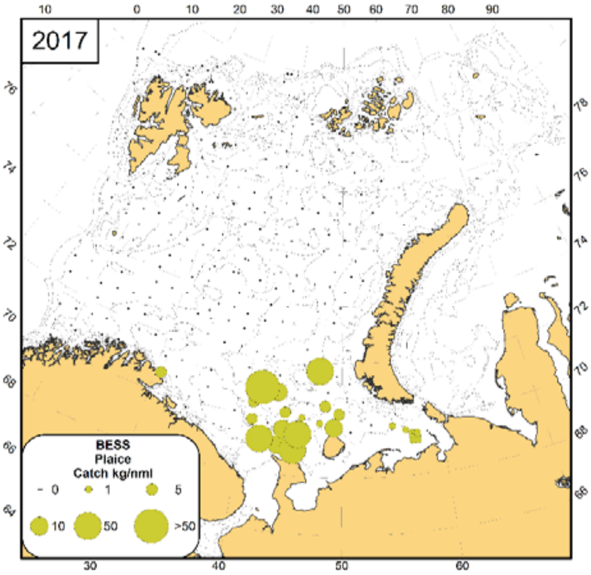

Figure 8.11.1 Distribution of plaice (*Pleuronectes platessa*), August-October 2017.

Table 8.1. Abundance (N, million individuals) and biomass (B, thousand tons) of the main demersal fish species in the Barents Sea (not including 0-group).

Species		Year											
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	2017
Atlantic wolffish	N	26	42	25	20	17	20	22	27	12	33	40	↓30
	B	11	11	14	8	17	13	9	30	12	37	24	↑29
Spotted wolffish	N	12	12	13	9	7	9	13	13	8	12	13	↑14
	B	46	42	51	47	37	47	83	84	51	86	40	↑63
Northern wolffish	N	2	3	3	3	3	6	8	12	6	9	8	=8
	B	19	25	22	31	25	42	45	52	34	63	51	↑63
Long rough dab	N	3705	5327	3942	2600	2520	2507	4563	4932	3046	3624	3369	↑4604
	B	378	505	477	299	356	322	584	565	413	438	402	↑538
Plaice	N	36	120	57	21	34	36	21	36	170	107	37	↓17
	B	19	55	29	13	21	26	13	29	121	79	29	↓19
Golden redfish	N	16	20	42	12	22	14	32	75	45	9	34	=34
	B	16	11	17	11	4	5	8	20	13	5	24	↓18
Deep-water redfish	N	526	796	864	1003	1076	1271	1587	1608	927	894	1527	↑1705
	B	219	183	96	213	112	105	196	256	208	214	319	↓212
Greenland halibut	N	430	296	153	191	186	175	209	160	43	79	82	↑134
	B	77	86	76	90	150	88	86	94	53	52	40	↑74
Haddock	N	3518	4307	3263	1883	2222	1068	1193	734	1110	1135	1604	↓1321
	B	659	1156	1246	1075	1457	890	697	570	630	505	836	↓303
Saithe	N	28	70	3	33	5	9	14	18	3	105	58	↑282
	B	49	98	7	29	9	10	13	33	6	153	54	↑193
Cod	N	1539	1724	1857	1593	1651	1658	2576	2379	1373	1694	1767	↑1880
	B	810	882	1536	1345	2801	2205	1837	2132	1146	1425	1087	↑1397

*survey coverage was incomplete in the central part of the Barents Sea.

9 FISH BIODIVERSITY

9.1 Fish biodiversity in the pelagic component

By T. Prokhorova, E. Eriksen, and A. Dolgov
Figures by D. Prozorkevich

Since 2012 abundance and biomass of pelagic juveniles of fish species from the families Agonidae, Ammodytidae, Cottidae, Liparidae, Myctophidae and Stichaeidae (called "small fishes" here) were calculated and presented in the survey report from BESS. Only standard pelagic stations are taken into account in this analysis.

In 2017, the total biomass of 3.8 thousand tonnes for all small fishes was 1.8 times less than in 2016 and slightly less than the long-term mean (4.2 thousand tonnes, Table 9.1.1). Biomass of 0-group fish of the most abundant commercial species (capelin, cod, haddock, herring, redfish and polar cod) was 1.9 million tonnes in 2017, so the biomass of small fishes in 2017 were 495 times lower than the most abundant 0-group fish.

Table 9.1.1 Abundance indices (in millions) and biomass (in tonnes) of pelagically distributed juveniles from main fish families.

Year	Agonidae		Ammodytidae		Cottidae		Liparidae		Myctophidae		Stichaeidae		Total biomass
	Abundance index	Biomass	Abundance index	Biomass	Abundance index	Biomass	Abundance index	Biomass	Abundance index	Biomass	Abundance index	Biomass	
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
2014	40	12	2059	1029	15	4	18	6	141	64	1480	740	1855
2015	59	18	2903	1452	216	65	439	154	107	48	4050	2025	3761
2016	113	34	9346	4673	185	56	2081	728	687	309	2440	1220	7020
2017	32	10	2810	1405	8	2	911	319	1	1	4212	2106	3843
Mean	**182**	**55**	**5728**	**2864**	**671**	**201**	**622**	**218**	**185**	**83**	**1644**	**822**	**4243**

Agonidae were represented by *Leptagonus decagonus*. *L. decagonus* was mostly distributed in the northern area (Figure 9.1.1). Agonidae were distributed westwards in 2017 compared to in 2016. The estimated indices in 2017 showed that abundance (32 million individuals) and biomass (10 tonnes) was the lowest since 2014 and 5 times lower than the long-term mean (abundance of 182 million and biomass of 55 tonnes (Table 9.1.1).

Ammodytidae were represented by *Ammodytes marinus* and in 2017 it was observed in the same area as in previous years - in the western and south-eastern areas (Figure 9.1.1). In 2017, estimated abundance and biomass was half that of the long-term mean, 2.8 billion individuals and 1.4 thousand tonnes, respectively.

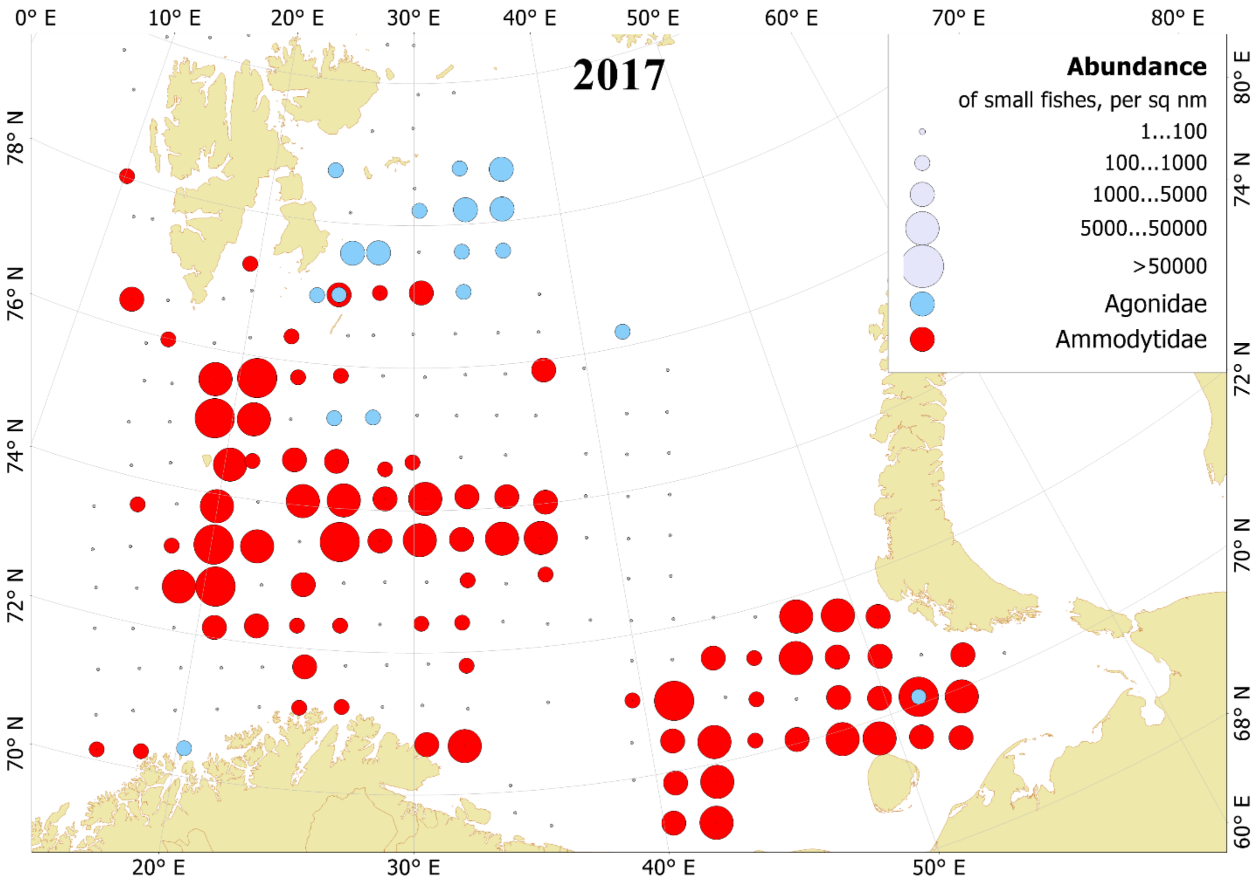

Figure 9.1.1. Distribution of Agonidae and Ammodytidae, August- October 2017.

Stichaeidae includes *Lumpenus lampraetaeformis*, *Leptoclinus maculatus* and *Anisarchus medius* (Figure 9.1.2). In 2017, like in 2016, Stichaeidae were observed in the north-western and south-eastern areas. However, in 2017 Stichaeidae was distributed more northwards in the north-eastern area, compared to in 2016. In 2017, abundance (4.2 billion individuals) and biomass (2.1 thousand tonnes) of Stichaeidae was the highest since 2012 and was higher than the long-term means of 1.6 billion individuals (abundance) and 0.8 thousand tonnes (biomass) (Table 9.1.1).

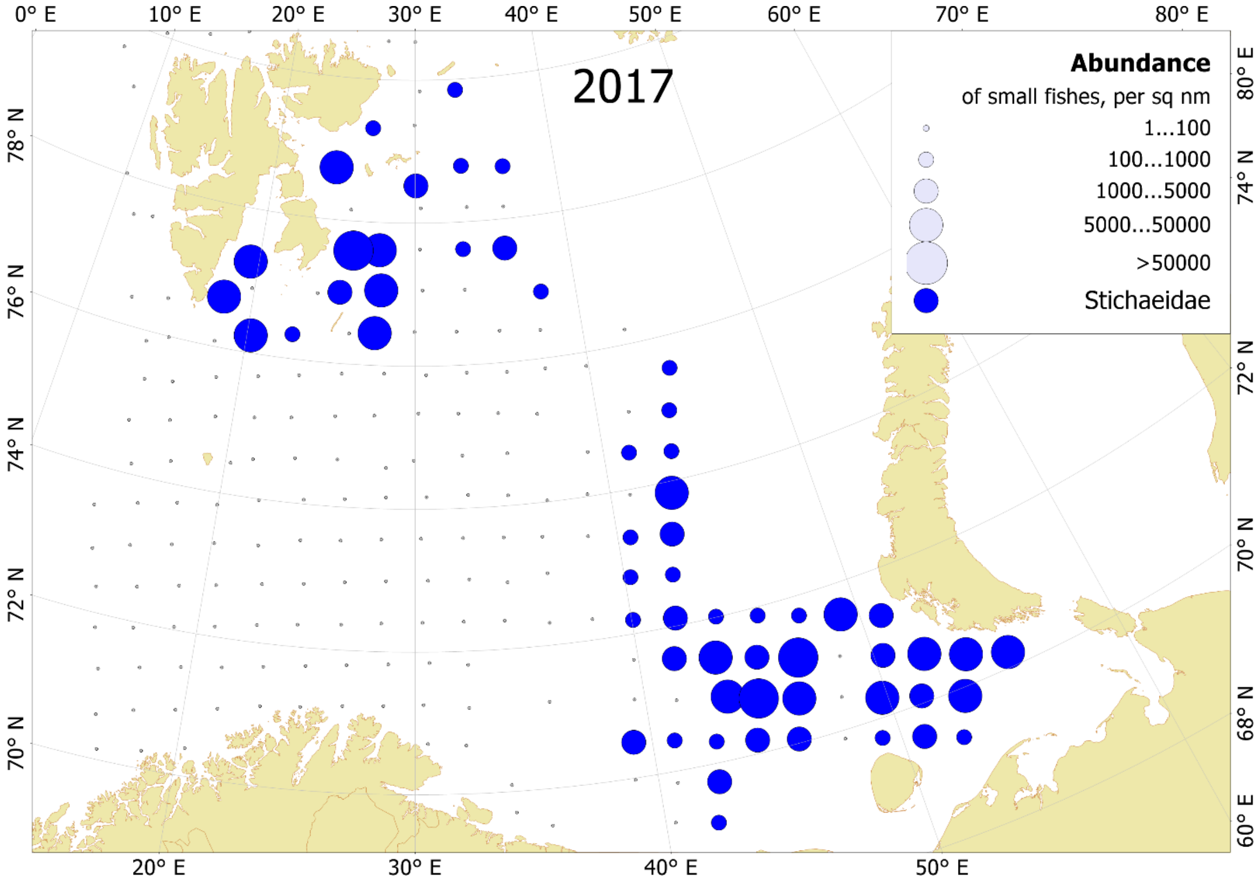

Figure 9.1.2. Distribution of Stichaeidae, August-October 2017.

Cottidae were mostly represented by *Myoxocephalus scorpius, Triglops nybelini, Triglops pingelii* and *Triglops murrayi*. In 2017, Cottidae were found only in the north-western part and their distribution was reduced compared to 2016 (Figure 9.1.3). Abundance (8 million individuals) and biomass (2 tonnes) was very low, and almost 100 times lower than the long-term means of 671 million individuals (abundance) and 201 tonnes (biomass) (Table 9.1.1).

Liparidae were represented by *Liparis fabricii* and *Liparis bathyarcticus.* In 2017, Liparidae was found distributed east of Svalbard/Spitsbergen archepelago, but also further northwards compared in 2016 (Figure 9.1.3). During the 2017 BESS abundance and biomass was 911 million individuals and 319 tonnes, respectively. That is a reduction compared to 2016 (2.8 billion individuals and 728 tonnes) but higher than the long-term mean (622 million individuals and 218 tonnes, Table 9.1.1).

Myctophidae are mostly represented by *Benthosema glaciale*, and was observed between 72 °N-75°30' N and 18°-36° E (Figure 9.1.3). Myctophidae was absent in the eastern part of the Barents Sea in 2017. Biomass (43 tonnes) and abundance (95 million individuals) of pelagically distributed myctophids in 2017 is the lowest since 2012 and half of the long-term means (189 million individuals and 85 tonnes, respectively, Table 9.1.1). However, it should be taken into account that myctophids have a high tendency for trawl avoidance.

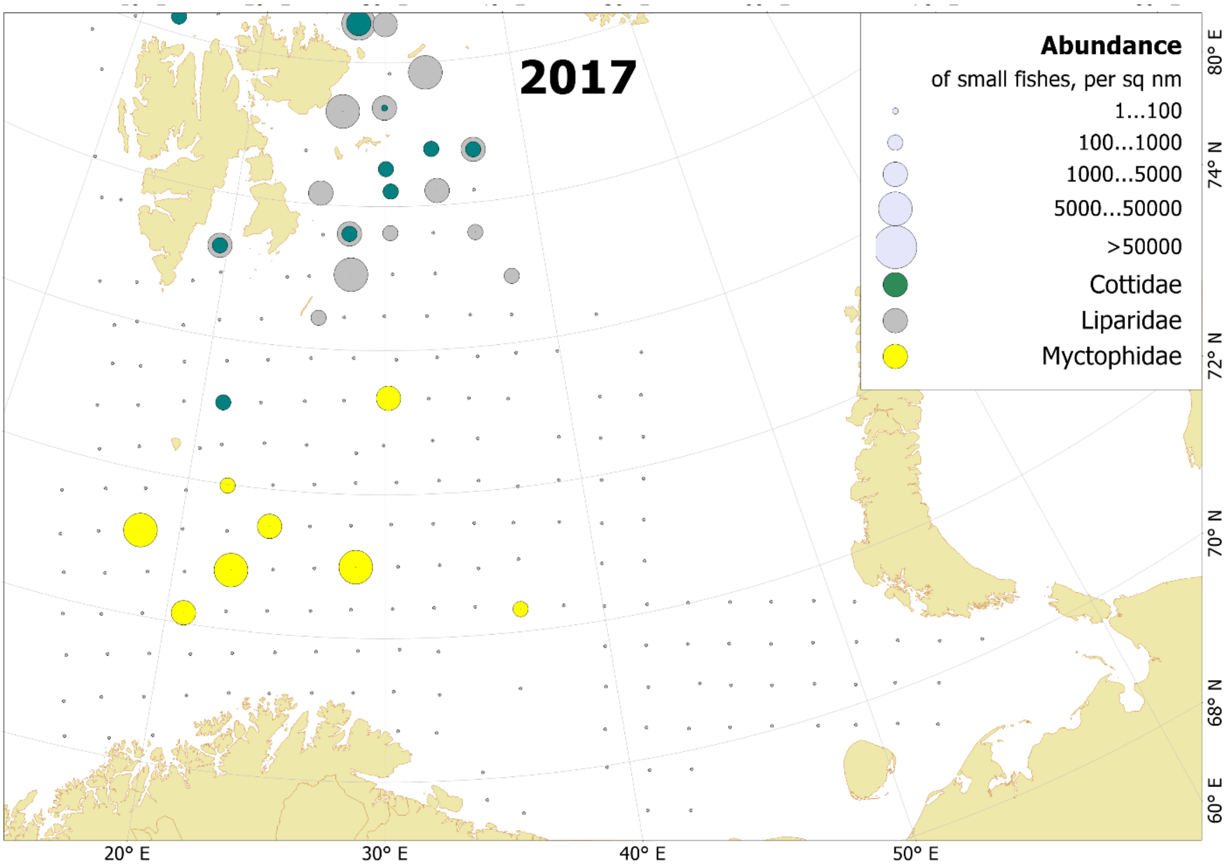

Figure 9.3.3. Distribution of Cottidae, Liparidae and Myctophidae, August- October 2017.

9.2 Fish biodiversity in the demersal compartment

by T. Prokhorova, E. Johannesen, A. Dolgov and R. Wienerroither
Figures by D. Prozorkevich

Norway pout (*Trisopterus esmarkii*). The distribution of Norway pout was similar to last year, except for the catches in Atlantic Water circulation in the south-eastern part in 2017 (Fig. 9.2.1). Main concentrations were found in the southwestern part of the Barents Sea along the Norwegian coast. The maximum catch of Norway pout was 142.7 kg/nautical mile with an average of 1.3 kg/nautical mile. Biomass of Norway pout in 2017 (21600 tonnes) was little less than in 2016, but abundance (1260.6 million individuals) was higher than in 2016 (Table 9.2.1).

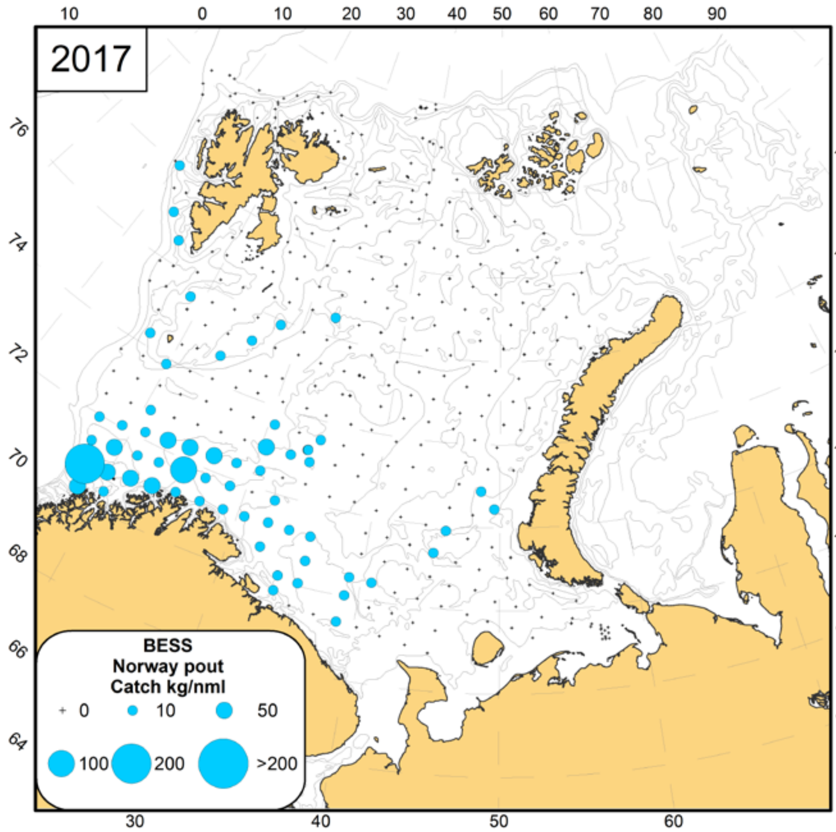

Figure 9.2.1 Distribution of Norway pout (*Trisopterus esmarkii*), August-October 2017

Norway redfish (*Sebastes viviparus*). In 2017 Norway redfish were mainly observed in the western areas of the survey along the Norwegian coast, similar to 2016 (Fig. 9.2.2). Several redfish individuals were caught in the south-eastern part and to the northwest off Svalbard (Spitsbergen). The recordings along Svalbard should be verified by voucher specimens since the species is new to this area. The maximum catch of Norway redfish in 2017 was 156.5 kg/nautical mile with average of 0.7 kg/nautical mile. Abundance and biomass indices in 2017 (133.7 million individuals and 14300 tonnes) were little higher than in 2016 (Table 9.2.1).

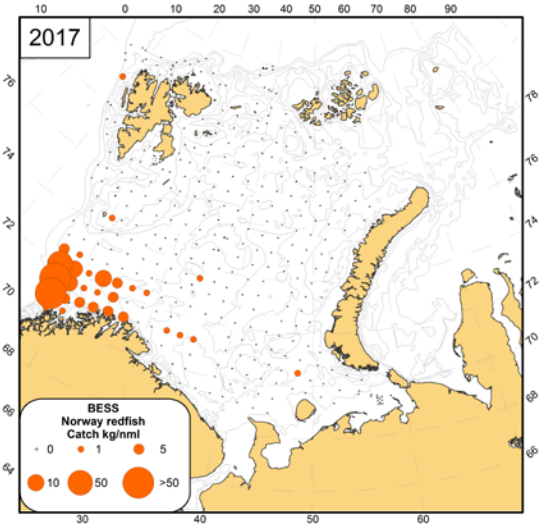

Figure 9.2.2 Distribution of Norway redfish (*Sebastes viviparus*), August-October 2017

Table 9.2.1 Abundance (N, million individuals) and biomass (B, thousand tonnes) of Norway pout and Norway redfish in the Barents Sea in August-October 2017 (not including 0-group).

Year	Species			
	Norway pout		Norway redfish	
	N	B	N	B
2006	1838	32	219	19
2007	2065	61	64	10
2008	3579	97	24	4
2009	3841	131	17	2
2010	3530	103	26	2
2011	5976	68	83	9
2012	3089	105	114	12
2013	2267	40	233	25
2014	1254	37	105	6
2015	943	33	168	20
2016	797	28	125	13
2017	1260.6 ↑	21.6 ↓	133.7 ↑	14.3 ↑

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

Thorny skate was distributed in the wide area from the southwest to the northwest where warm Atlantic and Coastal Waters dominate (Figure 9.2.3). It was found roughly in the same area as in 2016, and observed in 46.4 % of the bottom stations. Thorny skate was distributed within a depth of 36-1044 m, and the highest biomass was at depth 50-300 m (74.8 % of total biomass). The mean catch, estimated total biomass and abundance were higher than in 2014-2016 (Table 9.2.2). The mean weight in 2017 was the same as in 2014, but less than in 2015-2016 (Table 9.2.2).

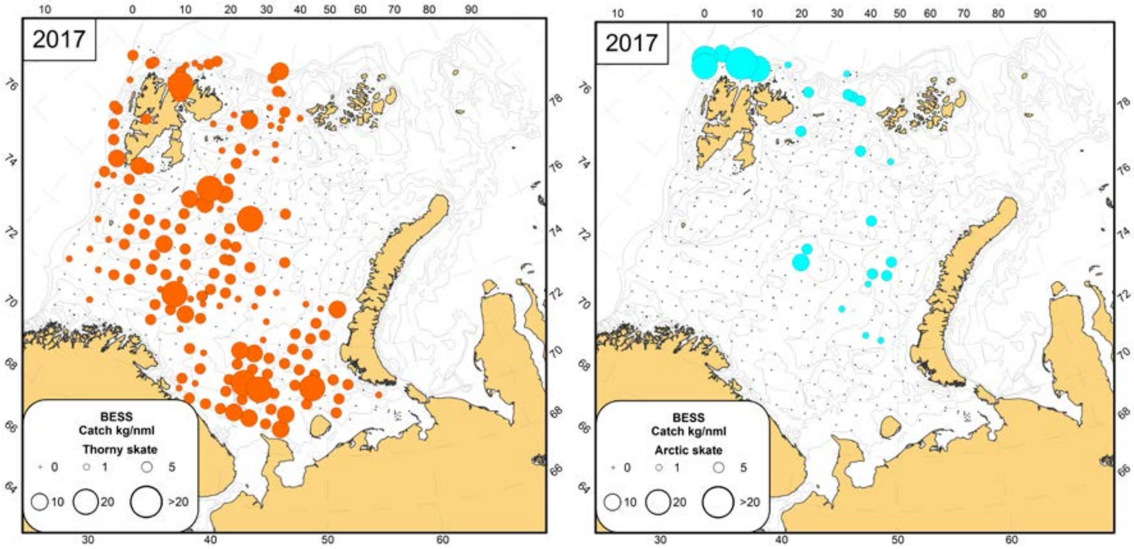

Figure 9.2.3 Distribution of thorny skate (*Amblyraja radiata*) and Arctic skate (*Amblyraja hyperborea*), August-October 2017

Table 9.2.2 Mean abundance (N, individuals per nautical mile) and biomass (B, kg per nautical mile), total abundance (N, million individuals) and biomass (B, thousand tonnes), and mean weight (kg) of thorny skate during BESS 2014-2017.

	2014		2015		2016		2017	
	N	B	N	B	N	B	N	B
Mean catch	1.4	1.2	1.1	1.0	1.0	0.9	1.8 ↑	1.3 ↑
Total	34.4	30.0	31.8	30.5	30.7	28.2	52.0 ↑	39.7 ↑
Mean weight		0.82		0.97		0.97		0.82 ↓

Arctic skate was mainly found in the deep trenches in the northwest and central Barents Sea (Figure 9.2.3), but not in the southwestern Barents Sea, as in 2016. Arctic skate was found in 7.5 % of the bottom stations, it was distributed within a depth of 150-1044 m, and the highest biomass was observed at 900-1044 m (61.8 %). The mean biomass in 2017 was higher than in 2015-2016, but the same as in 2014 (Table 9.2.3). The mean abundance in 2017 was higher than in 2014-2016 (Table 9.2.3). The estimated total biomass of Arctic skate in 2017 was higher than in 2015-2016, but less than in 2014. The total abundance in 2016 was higher than in 2014-2015, but less than in 2016 (Table 9.2.3). Mean weight of this species in 2017 was higher than in 2016, but less than in 2014-2015 (Table 9.2.3).

Table 9.2.3 Mean abundance (N, individuals per nautical mile) and biomass (B, kg per nautical mile), total abundance (N, million individuals) and biomass (B, thousand tonnes) and mean weight (kg) of Arctic skate during BESS 2014-2017.

	2014		2015		2016		2017	
	N	B	N	B	N	B	N	B
Mean catch	0.2	0.3	0.07	0.1	0.2	0.2	0.3 ↑	0.3 ↑
Total	3.7	6.7	1.6	1.9	8.6	4.0	4.9 ↓	4.4 ↑
Mean weight		1.66		1.44		0.47		1.08↑
								1.09

9.3 Uncommon or rare species

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

Uncommon or rare species are either species that are not caught in the Barents Sea ecosystem survey every year, or caught most years but in low numbers and with limited occurrence. Most of these species usually occur in adjacent areas of the Barents Sea and were therefore found mainly along the border of the surveyed area.

Some uncommon species were observed in the Barents Sea during the ecosystem survey in 2017 (Figure 9.3.1). E.g. Atlantic salmon *Salmo salar* is anadromous and sporadically found in the sea. Black seasnail *Paraliparis bathybius* and Adolf's eelpout *Lycodes adolfi* are distributed in the Arctic polar basin. Hooknose *Agonus cataphractus* and nine-spined stickleback *Pungitius pungitius* were caught in the southeast of the survey area. Boa dragonfish *Stomias boa* was caught for the first time since the beginning of the BESS in 2004 at 79°54'N, 5°41'E.

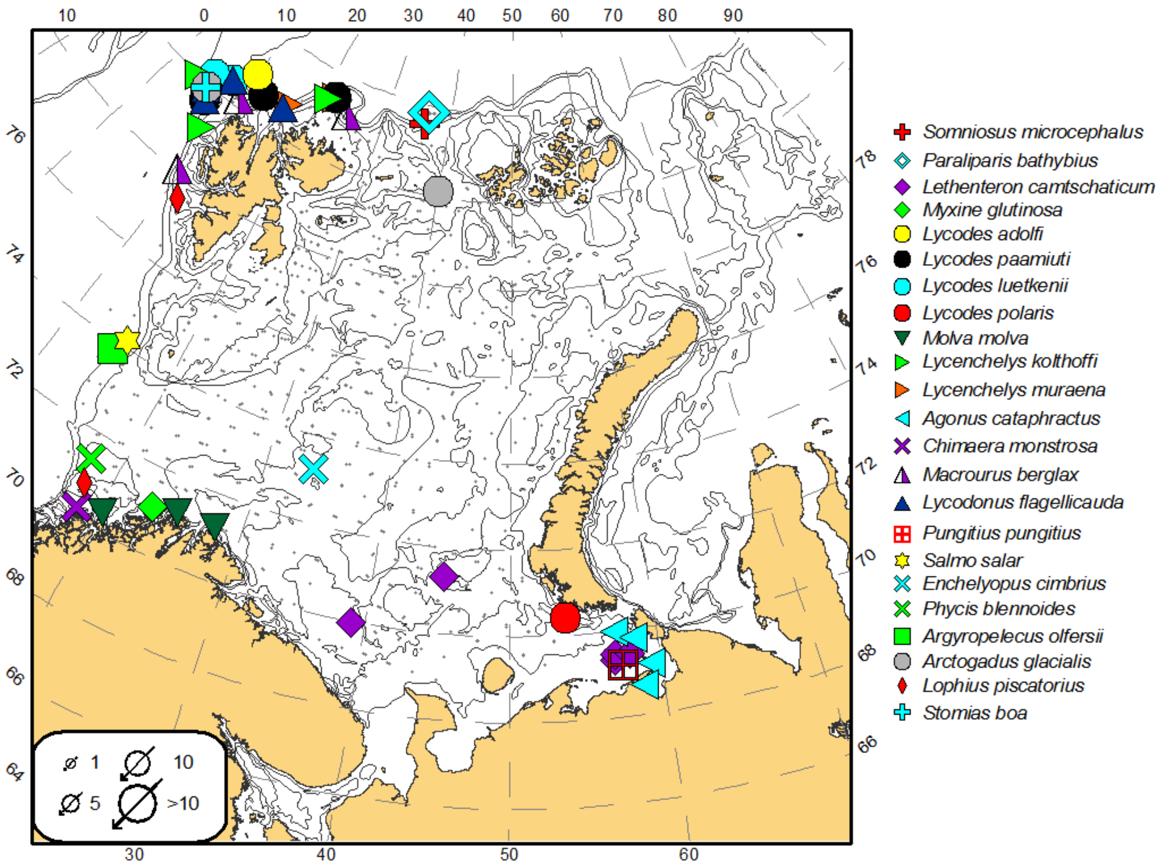

Figure 9.3.1 Distribution of species which are rare in the Barents Sea and which were found in the survey area in 2017. Size of symbol corresponds to abundance (individuals per nautical mile, both bottom and pelagic trawls were used)

9.4 Zoogeographic groups

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

During the 2017 ecosystem survey 101 fish species from 32 families were recorded in the catches, and some taxa were only recorded at genus or family level (Appendix 2). All recorded species belonged to the 7 zoogeographic groups: **widely distributed**, **south boreal, boreal**, **mainly boreal**, **Arctic-boreal**, **mainly Arctic** and **Arctic** as defined by Andriashev and Chernova (1994). Mecklenburg et al. (2018) in the recent "Marine Fishes of the Arctic Region" reclassified some of the species and geographical categorisation comprises six groups: **widely distributed, boreal, mainly boreal, Arctic-boreal, mainly Arctic and Arctic**. We use Andriashev and Chernova classification here due to the lack of comparative studies of the old and new classification applied to the Barents Sea. Table 9.4.1 represents median and maximum catches of species from different zoogeographic groups in the survey. While only bottom trawl data were used, and only non-commercial species were included into the analysis, both demersal (including bentho-pelagic) and pelagic (neritopelagic, epipelagic, bathypelagic) species were included (Andriashev and Chernova, 1994, Parin, 1968, 1988).

Widely distributed (only ribbon barracudina *Arctozenus risso* and silver hatchet-fish *Argyropelecus olfersi* represents this group), **south boreal** (e.g. grey gurnard *Eutrigla gurnardus*, silvery pout *Gadiculus argenteus*, angler *Lophius piscatorius*) and **boreal** (e.g. lemon sole *Mycrostomus kitt*, round skate *Rajella fyllae*, Sars' wolf eel *Lycenchelys sarsii*) species were mostly found over the south-western and western part of the survey area where warm Atlantic and Coastal Water dominates (Figure 9.4.1). In 2017, the median and maximum catches of widely distributed species were lower than in 2016, while the median and maximum catches of south boreal species were higher. The median catch of boreal species in 2016 was lower than in 2016, but the maximum catch was approximately the same (Table 9.4.1).

Mainly boreal species (e.g. lesser sandeel *Ammodytes marinus*, tusk *Brosme brosme*, Greater eelpout *Lycodes esmarkii*) were widely found on the south-western and south-eastern part of the Barents Sea and to the west and south off Svalbard/Spitsbergen Archipelago (Figure 4.2.1). The median and maximum catches of mainly boreal species in 2017 was approximately the same as in 2016 (Table 9.4.1).

Arctic-boreal species (e.g. Atlantic poacher *Leptagonus decagonus*, ribbed sculpin *Triglops pingelii*) were widely found throughout the survey area (Figure 9.4.1). The median and maximum catch of arctic-boreal species in 2017 were higher than in 2016 (Table 9.4.1).

Mainly Arctic (e.g. twohorn sculpin *Icelus bicornis*, Atlantic spiny lumpsucker *Eumicrotremus spinosus*, variegated snailfish *Liparis bathyarcticus*) and **Arctic** (e.g. Gelatinous snailfish *Liparis fabricii*, pale eelpout *Lycodes pallidus*, leatherfin lumpsucker *Eumicrotremus derjugini*) species were widely found on the northern, eastern and south-eastern part of the Barents Sea (Figure 9.4.1). Species of these groups mostly occur in areas influenced by cold Arctic Water, Spitsbergen Bank Water, Novaya Zemlya Coastal Water and Pechora Coastal Water. Median and maximum catches of mainly arctic and Arctic species in 2017 were much higher than in 2016 (Table 9.4.1), likely due to that the survey direction was from south to north in 2017 and from north to south in 2016. In the northern area the survey was conducted in September in 2017, but in August (one month earlier) in 2016 (south in August in 2017 and in September in 2016). Water masses temperature differs between August and September, and since species distribution may shift with water masses distribution, this might explain the difference between 2016 and 2017.

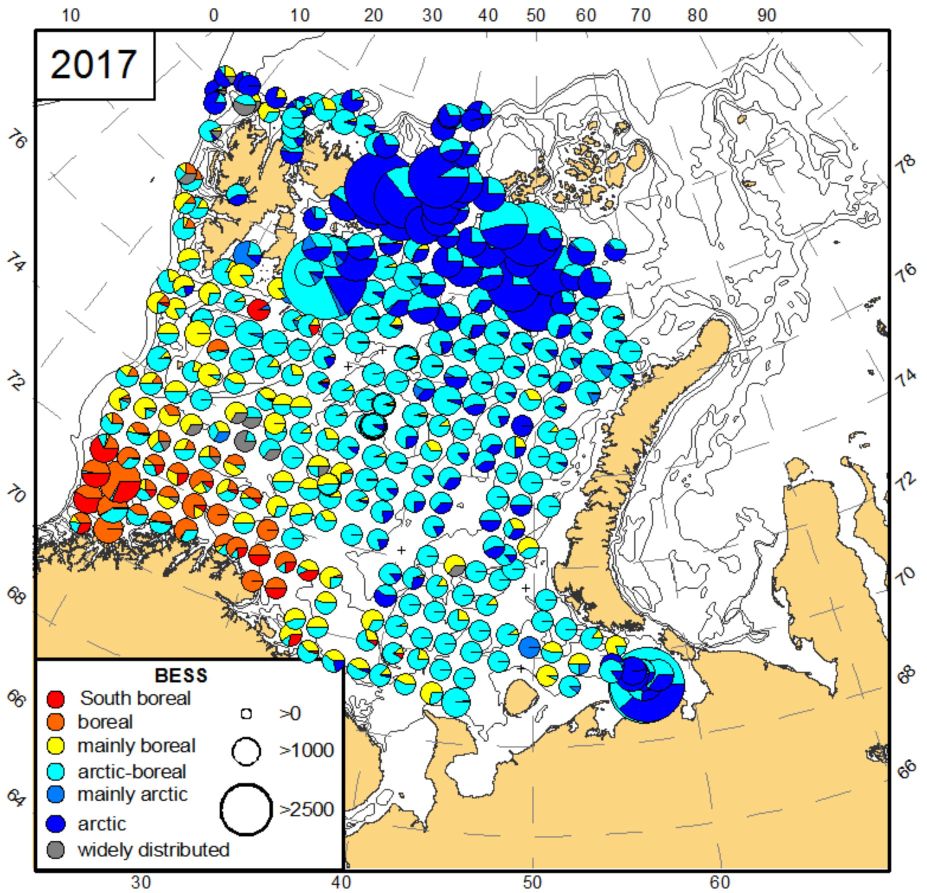

Figure 9.4.1 Distribution of non-commercial fish species from different zoogeographic groups during the ecosystem survey 2017. Size of circle corresponds to abundance (individuals per nautical mile, only bottom trawl stations were used, both pelagic and demersal species are included)

Table 9.4.1 Median and maximum catch (individuals per nautical mile) of non-commercial fish from different zoogeographic groups

Zoogeographic group	Median catch					Maximum catch				
	2013	2014[1]	2015	2016[2]	2017	2013	2014[1]	2015	2016[2]	2017
Widely distributed	0.2	0.1	0.09	0.5	0.2 ↓	17.1	14.3	10.0	36.7	7.5 ↓
South boreal	0.8	0.9	1.2	1.4	3.2 ↑	171.4	105.7	216.3	135	372.9 ↑
Boreal	7.1	8.7	8.7	18.3	15.0 ↓	230.0	478.6	660.0	743.8	792.9 ↑
Mainly boreal	48.9	36.4	71.4	55.3	53.7 ↓	982.5	3841.4	1587.1	2962.5	2945.0 ↓
Arctic-boreal	25.4	8.6	14.0	8.8	19.3 ↑	3326.9	371.6	1502.4	283.8	571.3 ↑
Mainly Arctic	10.2	1.7	1.9	3.3	4.9 ↑	656.3	60.9	53.8	123.2	282.5 ↑
Arctic	70.8	7.4	31.5	29.1	78.5 ↑	3013.8	386.4	832.2	808.6	2731.1 ↑

note:
Only bottom trawl data were used, both pelagic and demersal species are included
1 – Coverage in the northern part of Barents Sea was highly restricted
2 – The survey started from the north

10 COMMERCIAL SHELLFISH

10.1 Northern shrimp (*Pandalus borealis*)

Text by D. Zakharov, T. H. Thangstad
Figures by D. Zakharov, T. H. Thangstad

During the survey in 2017 376 trawls were made. Northern shrimp was found in the catches of 281 trawls. The biomass of shrimp varied from several grams to 439.8 kg per nautical mile with an average catch of 13.8±1.7* kg/n.ml. The densest concentrations of the shrimp were registered in central part of the Barents Sea, around Svalbard (Spitsbergen)(Spitsbergen) and in the Franz Victoria Trough (Figure 10.1.1). In 2017, the calculated index of the biomass (method of squares) of the Northern shrimp was 314.2 thousand tons, which is 1.5 % higher than 2016, and 8 % lower than the average index.

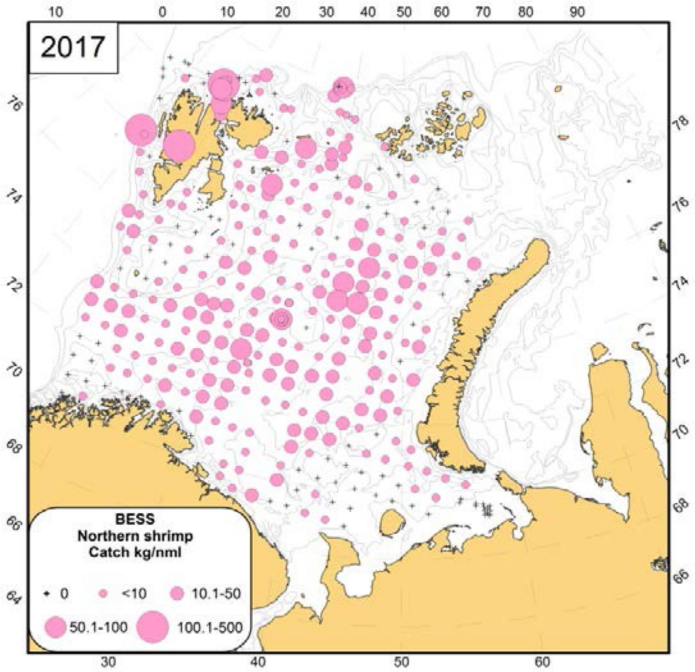

Figure 10.1.1. Distribution of the Northern shrimp (*Pandalus borealis*) in the Barents Sea, August-October 2017

Biological analysis of the northern shrimp was conducted in 2017 on Russian vessel in the eastern part of the survey area. Likewise, in the previous year the bulk of population of the Barents Sea shrimp was made up of individuals of smaller age groups – males with carapace length of 12-27 mm and females with carapace length of 17-30 mm (Figure 10.1.2).

In the western survey area, as in the eastern part of the Barents Sea, the smaller male shrimps (carapace lengths 11-23 mm, compared to females 18-28 mm) were most frequent, making up 64% of the catches (Figure 10.1.3).

* In the section 10 the average values are reported with standard error

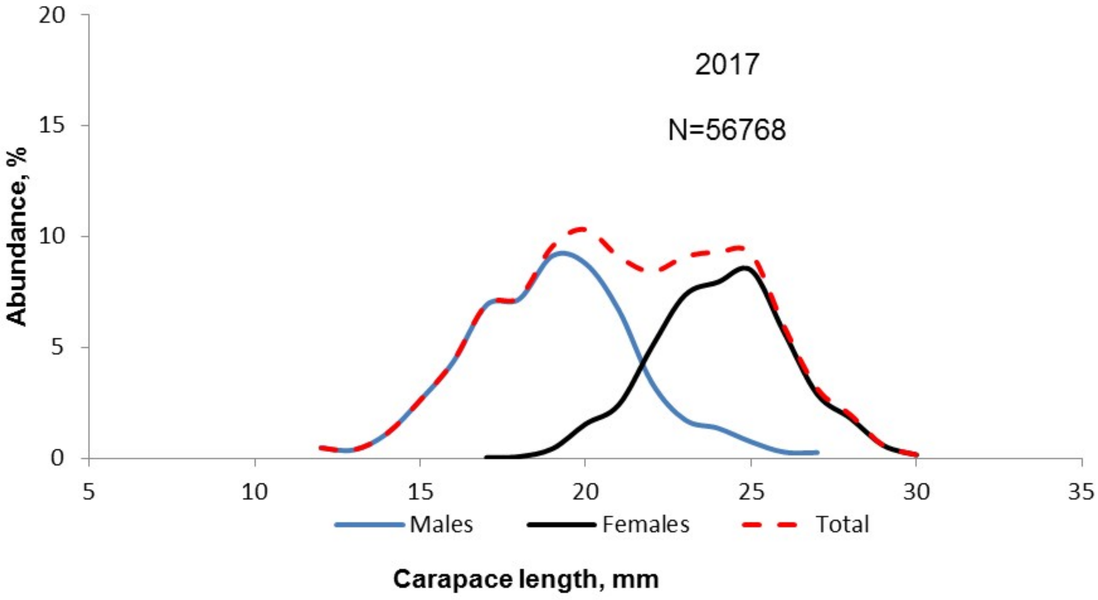

Figure 10.1.2. Size and sex structure of catches of the Northern shrimp (*Pandalus borealis*) in the eastern Barents Sea, August-October 2017

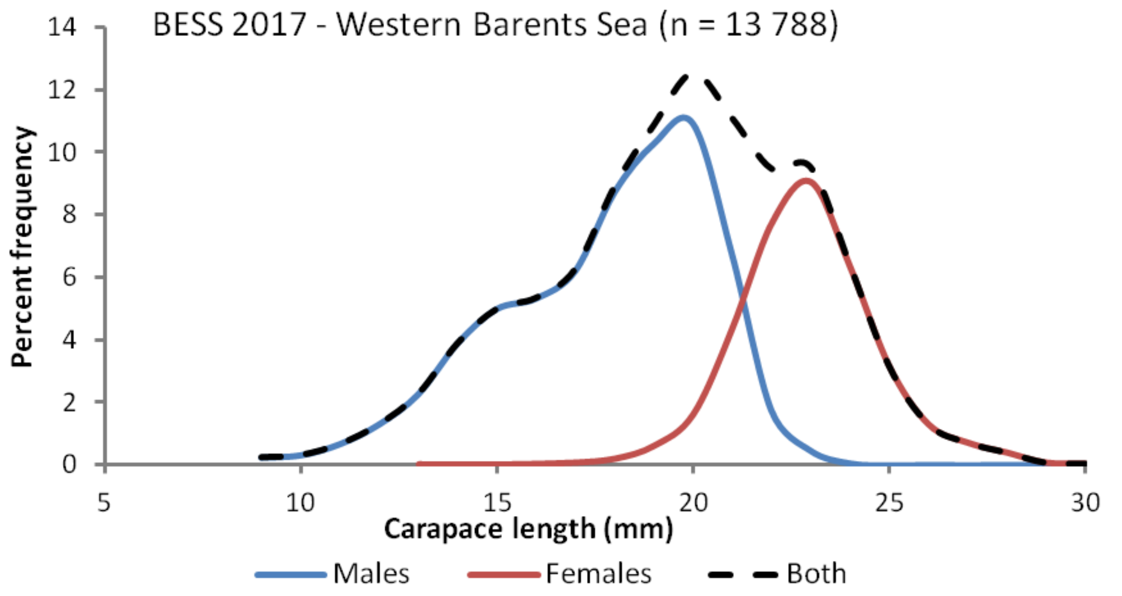

Figure 10.1.3. Size and sex structure of catches of the Northern shrimp (Pandalus borealis) in the western Barents Sea, August-October 2017

10.2 Red king crab (Paralithodes camtschaticus)

Text by N. Strelkova and J. Sundet Figures by D. Zakharov and N. Strelkova

The red king crab was recorded in 13 of 376 trawl catches (all catches in REZ). Unlike the previous year, the crab was not registered in the Norwegian coastal waters. The most northern catch was recorded on 70.6° N. The most eastern catch was made at south of the archipelago Novaya Zemlya near the Kara Strait (Karskie Vorota) on the 70.16° N and 55.63° E (Figure 10.2.1). It was adult commercial male with a carapace width 172 mm and weight of 3.04 kg. This is the second recordings of the red king crab so far to the east from its main distributional area since the BESS started. The first recording was made in 2015 in the south-eastern part of the Barents Sea at 69.47° N and 57.02° E (mature female with a clutch on the pleopods with carapace width of 145 mm and weight of 1.505 kg.).

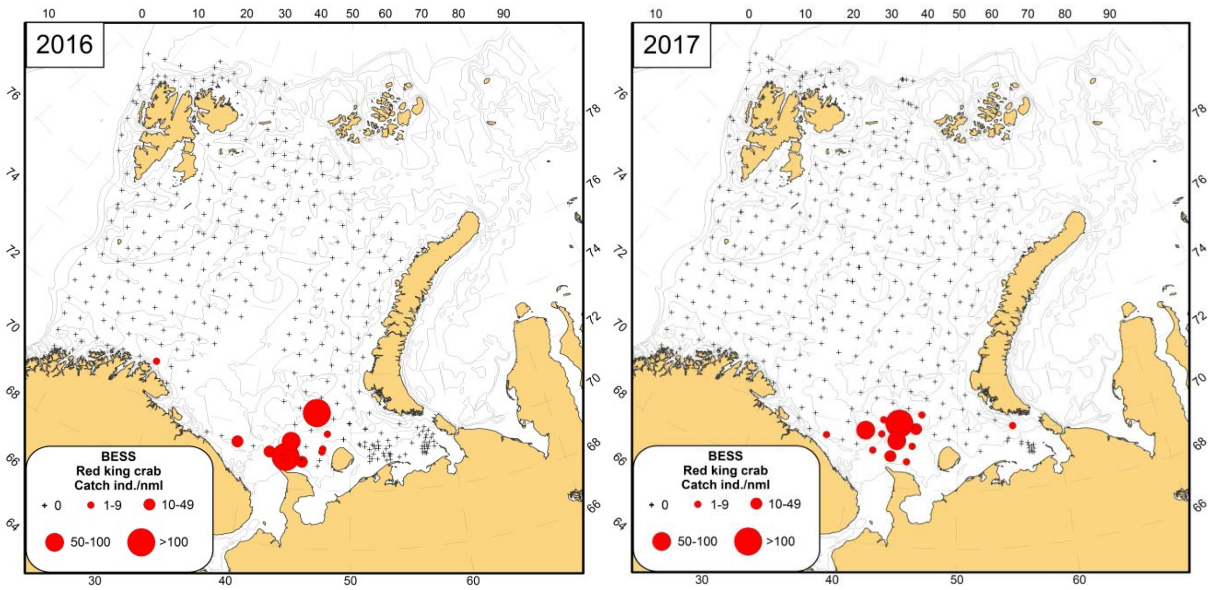

Figure 10.2.1 – Distribution of the red king crab (*Paralithodes camtschaticus*) in the Barents Sea, August-October 2016 and 2017

The average bottom temperature at the stations where the red king crab was recorded is 2.44±0.26 °C (within the range from 0.06 to 3.83 °C).

The biomass of red king crab varied from 0.78 to 324.29 kg/haul (0.30-397.91 kg/n.ml). The average biomass was 52.82±25.44 kg/haul (64.64±31.27 kg/n.ml). The abundance of crab ranged from 1 to 109 ind./haul (0.09-133.7 ind./n.ml) given an average crab abundance of 23.00±10.01 ind./haul (28.26±12.37 ind./n.ml). Compared with 2016, the average biomass increases only with 1.3 % and the abundance with 21.6 %. This could be an indicator of rejuvenation of the crab population.

As in the previous year the main concentrations of red king crabs are located to north of the Kanin Nos cape in the Kanin Bank (Figure 10.2.1)

The total catch of red king crabs in 2017, compared with the previous year, increased with 48 % in terms of abundance and with 24 % in terms of biomass (Table 10.2.1).

Table 10.2. 1. The total catch of the red king crab during BESS 2004-2017.

Year	Total numbers, ind.	Total biomass, kg
2004	385	1293
2005	106	309
2006	1243	3350
2007	1521	3869
2008	127	93
2009	15	25
2010	12	25
2011	40	22
2012	126	308
2013	272	437
2014	168	403
2015	255	517
2016	202	552
2017	299	687

The most abundant size groups of the red king crab population were the individuals with a carapace width of 120-139 mm (Figure 10.2.2).

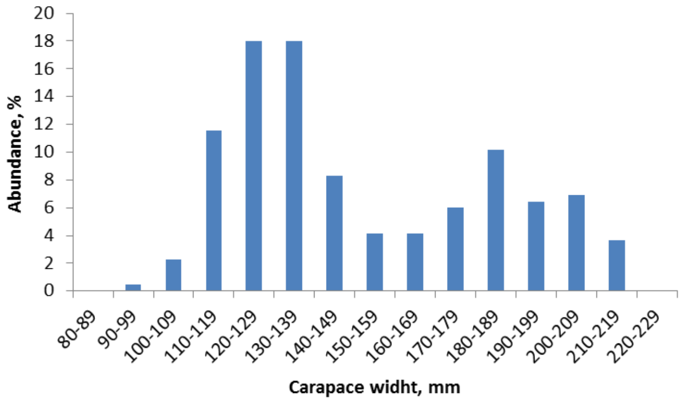

Figure 10.2.2. Size structure of the red king crab in the BESS survey area, August-October 2017

10.3 Snow crab (Chionoecetes opilio)

Text by N. Strelkova, A. M. Hjelsted
Figures by D. Zakharov

In 2017 the snow crabs were recorded in 159 out of 376 trawl catches and are now distributed further to the west compared to previous years. In 2017 the snow crab was for the first time recorded in the water of Svalbard (Spitsbergen). One recording was made in the Storfjord at 163 m depth (two immature males with carapace wide 47 and 48 mm) and the other recorded northwest of the Svalbard (Spitsbergen) archipelago at 506 m depth (one juvenile male with carapace wide 14 mm) (Figure 10.3.1).

The densest aggregation of the snow crabs (more than 1000 ind./n.ml) was recorded in central part of the Barents Sea (in the Loop Hole area), in the north part of the Pechora Sea and on the banks to west of the North Island of the Novaya Zemlya archipelago (Figure 10.3.1).

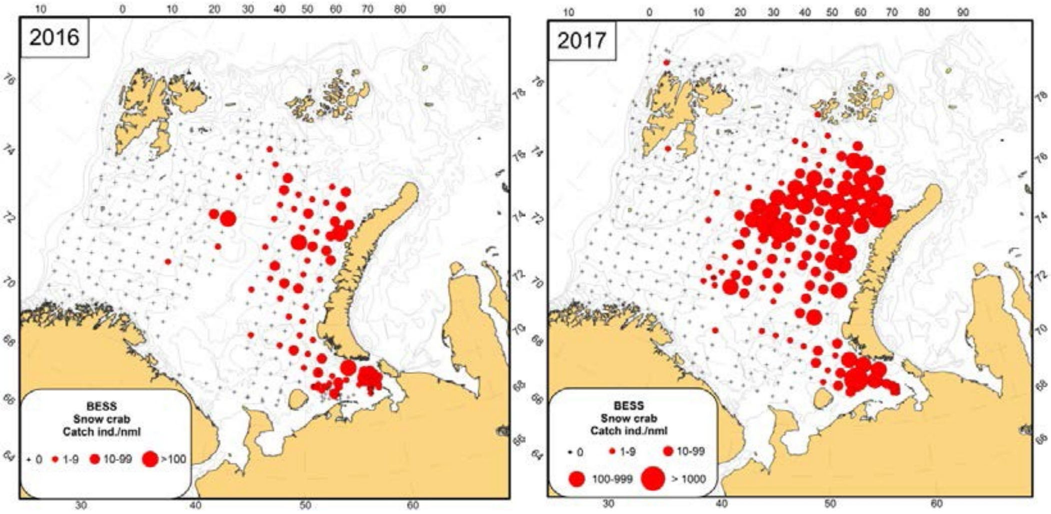

Figure 10.3.1. Distribution of the snow crab (*Chionoecetes opilio*) in the Barents Sea, August-October 2016 and 2017

The biomass of snow crab in 2017 varied from 1 g to 123.3 kg/haul (0.001-142.1 kg/n.ml) with an average of 8.94±1.62 kg/haul (9.95±1.76 kg/n.ml). The abundance ranged from 1 to 6707 ind./haul (0.6-3734 ind./n.ml) and with an average of 162.74±48.84 ind./haul (147.17±31.33 ind./n.ml). Compared with the previous year the average biomass noticeably increased by 284 % (3.8 times) whiles the average abundance by 436 % (5.4 times).

Compared with previous year, the total number of snow crabs had increase with more than a tenfold in 2017, and the biomass are now at the highest value recorded for the whole period of ecosystem surveys (Table 10.3.1).

Table 10.3.1 The total catch of snow crab during ecosystem surveys of 2005-2017

Year	Total number of station	Number of station with snow crab	Total numbers, ind.	Total biomass, kg
2005	649	10	14	2.5
2006	550	28	68	11
2007	608	55	133	18
2008	452	76	668	69
2009	387	61	276	36
2010	331	56	437	22
2011	401	78	6219	154
2012	455	116	37072	1169
2013	493	131	20357	1205
2014	304	78	12871	658
2015	335	89	4245	378
2016	317	84	2156	137
2017	376	159	25878	1422

The most abundant size groups of the snow crab population were the 2-3-year old juveniles with a mean carapace width of 20-30 mm and adult male with carapace width of 70-90 mm (Figure 10.3.2)

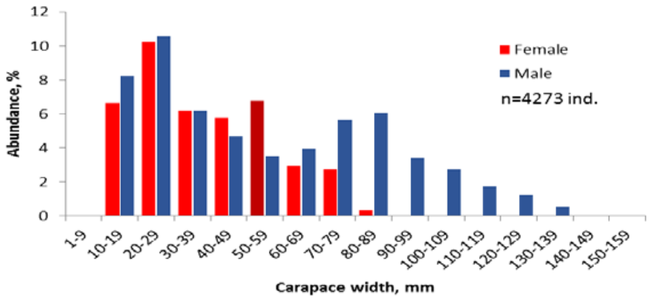

Figure 10.3.2 Size structure of the snow crab population in the Barents Sea in 2017

10.4 Iceland scallop (*Chlamys islandica*)

Text by N. Strelkova, I. Manushin, L. Lindal Jørgensen
Figures by D. Zakharov

In 2017 the Iceland scallop was recorded in 122 of 376 trawl catches. The survey showed a wide distribution of scallops in the Barents Sea. The deepest record in 2017 was at 1007 m north of the Svalbard (Spitsbergen), but the most abundant catches were recorded in the shallow banks and elevations of the bottom: Spitsbergen Bank, Central Bank, Great Bank, Novaya Zemlya Bank, North Kanin Bank, Goose Bank, Moller Rise (Figure 10.4.1).

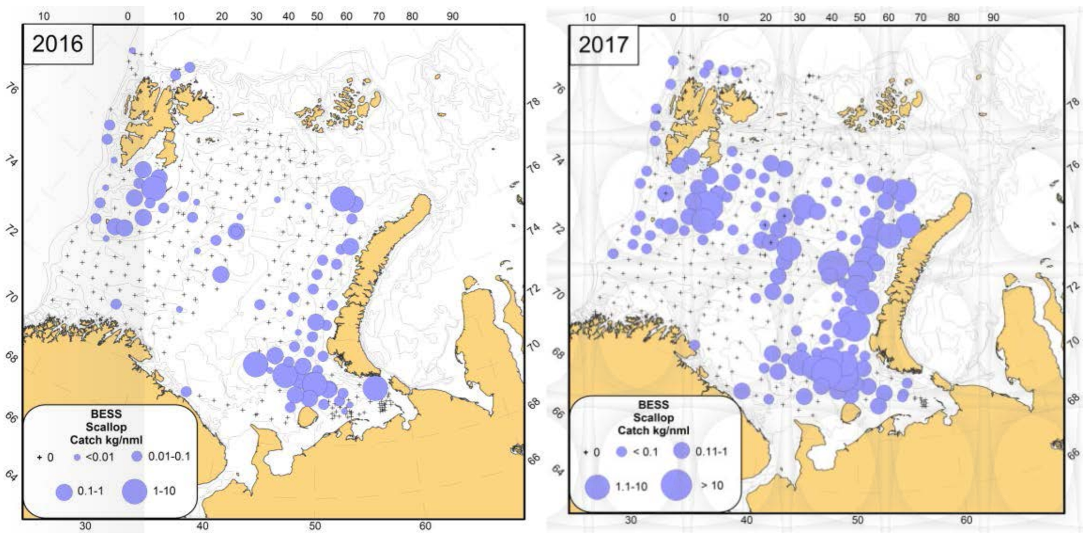

Figure 10.4.1. Distribution of Iceland scallop (*Chlamys islandica*) in the Barents Sea, August-October 2016 and 2017

The biomass of scallops in 2017 varied from 2 g to 29.4 kg/haul (0.002-35.4 kg/n.ml). The average biomass is 1216±394 g/haul (1486±479 g/n.ml). The abundance ranged from 1 to 2557 ind./haul (0.2-3081 ind./n.ml). The average abundance of scallops is 66.7±25.4 ind./haul (81.9±30.7 ind./n.ml).

The quantitative values obtain in 2017 greatly exceed the data of 2016 and included a 5.5 times larger average biomass and 4.5 times larger average abundance.

11 BENTHIC INVERTEBRATE COMMUNITY

Text by N. Strelkova, L. Lindal Jørgensen, D. Zakharov
Figures by D. Zakharov

In 2017, bycatch records of megabenthos was made from 339 of 376 bottom trawl hauls across all four research vessels of the BESS. The megabenthos was processed to closest possible taxon with abundance and biomass recorded. This was done by three Russian and five Norwegian experts and the number of species identified from the caught invertebrates is presented in table 11.1.

Table 11.1 Statistics of megabenthos bycatch processing and assessment of the quality of taxonomic processing of invertebrates in the BESS 2017

Research vessels	"G.O. Sars"		"Helmer Hanssen"	"Johan Hjort"		"Vilnus"		**Total**
Experts	Beck I. M.	Sveistrup A.K.	Jørgensen L. L.	Voronkov A. Ju. & Gabrielsen H.	Zakharov D.V.	Benzik A.N.	Nosova T.B.	
Number of processed hauls	25	24	28	30	58	83	93	**339**
Phyllum	11	11	12	12	13	12	11	**13**
Class	20	21	25	25	23	22	21	**28**
Order	47	56	61	68	58	60	56	**91**
Family	83	94	121	148	131	108	106	**216**
Species	**78**	**93**	**137**	**169**	**174**	**153**	**158**	**332**
Total number of taxa	149	163	213	259	227	206	195	**516**
Percentage of species identification*	52	57	64	65	76	74	81	**78**

* calculated as quotient from division of total number of identifications till species to total number of identifications, %

11.1 Species diversity, abundance and biomass

A total of 516 invertebrate taxa (332 identified to species level) have been recorded in 2017 (Table 11.1)

The most diversity groups in the trawl catches were Mollusca (129 taxa), Artropoda (95 taxa) and Echinodermata (75 taxa) (Figure 11.1.1). Among mollusks, 60% of taxa belong to the Gastropoda, 26 % – to the Bivalvia and the remaining 14 % are distributed among Cephalopoda, Polyplacophora and Caudofoveata groups. The taxa of Artropoda phylum in the main were presented by crustaceans (82 % of the taxa), and Echinodermata taxa – by sea stars (41% of taxa) and brittle stars (27 % of taxa).

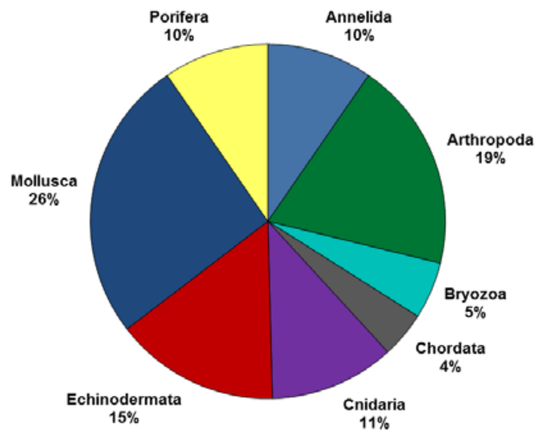

Figure 11.1.1. The number of main taxa per invertebrate groups (%) in the Barents Sea, August-October 2017

The species density in the terms of the number of taxa in trawl catches ranged from 2 to 90 with average of 29.4±0.8* taxon per trawl-catch. The hot-spot of taxonomic diversity was observed east of the Svalbard (Spitsbergen). As a total, the reduction of the taxonomic diversity occurred in a south direction, and the lowest values (less 20-10 taxa/trawl) were recorded in the southeast of the Barents Sea, especially near the North Kanin Bank, Goose Bank (Figure 11.1.2).

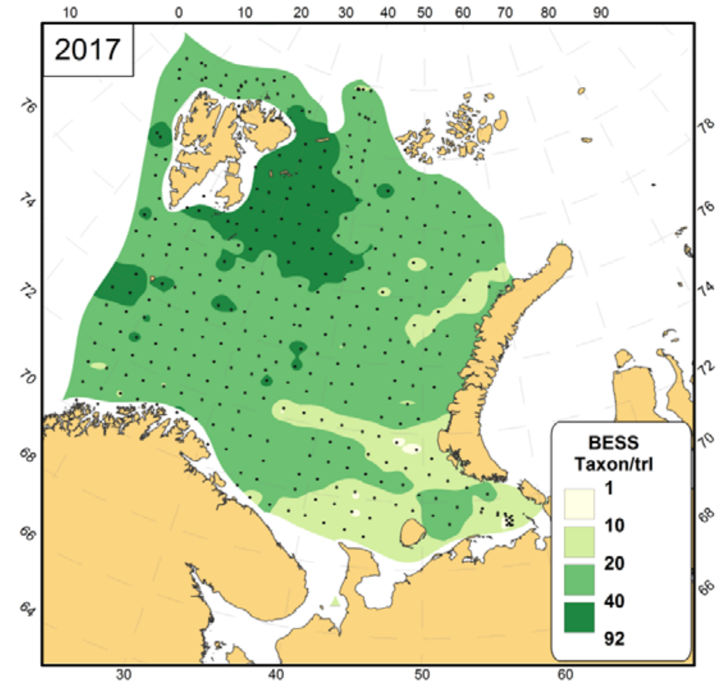

Figure 11.1.2. The number of megabenthic taxa per trawl-catch in the Barents Sea, August-October 2017

Compared with 2016, the total number of recorded species and the species density increase by 20 % and 44% respectively.

* In section 11 the average values are reported with standard error

The ten most common species in the catches were the following: *Ctenodiscus crispatus* (recorded at 63 % of the stations), *Sabinea septemcarinata* (53 %), *Pontaster tenuispinus* (50 %), *Ophiura sarsi* (44 %), *Chionoecetes opilio* (42 %), *Ophiopholis aculeata* (42 %), *Henricia* spp. (40 %), *Urasterias linckii* (39 %), *Molpadia borealis* (38 %), and *Hormathia digitata* (37 %).

Abundance (number of individuals)

The number of individuals in the trawl catches (excluding the pelagobenthic species *Pandalus borealis*) varied from 3 to 32241 (4-37785 ind./n.ml) with an average of 3167±291 ind. per catch (3787±333 ind./n.ml). In comparison with 2016, the average abundance decreases on 11 %.

The most abundant catches (more than 10 thousand ind./n.ml) were recorded in the northern and in the southeastern parts of the Barents Sea (Figure 11.1.3). In the northern part the most abundant catches consisted of echinoderms (brittle stars *Ophiacantha bidentata*, *Ophiopholis aculeata*, sea lilies *Heliometra glacialis*, sea urchin *Strongylocentrotus pallidus*), in the southeastern part of the Barents Sea (along the Novaya Zemlya Trough) was observed high abundance of sea star *Ctenodiscus crispatus* and the crustaceans *Sabinea septemcarinata* and *Chionoecetes opilio.*

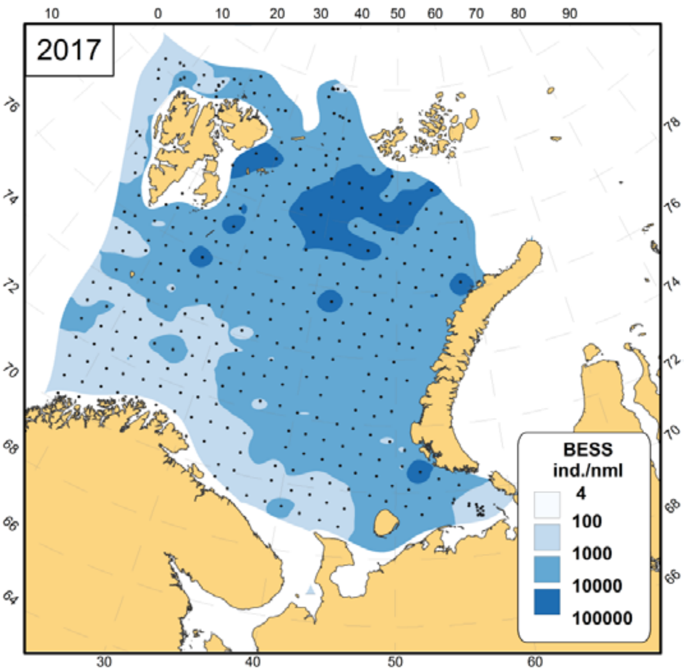

Figure 11.1.3. The extrapolated number of individuals of megabenthos (excluding *Pandalus borealis*) in the Barents Sea, August-October 2017

The ten most dominant species (by numbers) were observed in trawl catches: *Ophiacantha bidentata* (20,7 % of the total abundance), *Ctenodiscus crispatus* (16,6 %), *Ophiopleura borealis* (7,6 %), *Strongylocentrotus pallidus* (5,6 %), *Sabinea septemcarinata* (3,5 %), *Heliometra glacialis* (3,2 %), *Bathyarca glacialis* (2,8 %), *Pontaster tenuispinus* (2,6 %), *Ophioscolex glacialis* (2,5 %) and *Ophiopholis aculeata* (2,1 %).

Biomass

The biggest part of the total biomass of the by-catches (93 %) was made up by Echinoderms, Sponges and Crustaceans (Figure 11.1.4).

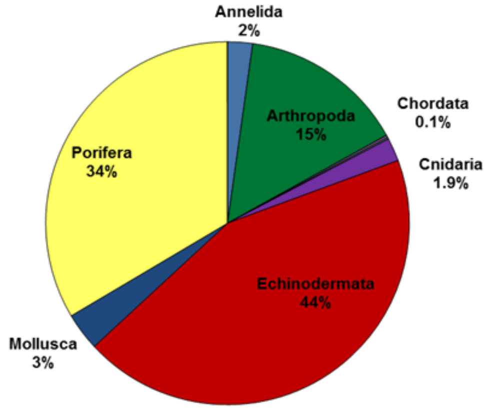

Figure 11.1.4. Distribution of biomass (excluding *Pandalus borealis*) across the main invertebrate groups (%) in the Barents Sea, August-October 2017

The invertebrate's biomass taken by the trawl (excluding pelagobenthic species *Pandalus borealis*) ranged from 8 g to 1018 kg (0.010-1272 kg/n.ml) with an average of 47.98±5.72 kg per trawl-catch (58.70±7.15 kg/n.ml). The maximum bycatch of megabenthos was observed in the southwestern part of the Barents Sea (329 m depth) in the area where the *Geodia* sponges dominates (Figure 11.1.5). Compared with 2016 the average biomass increases on 11 %.

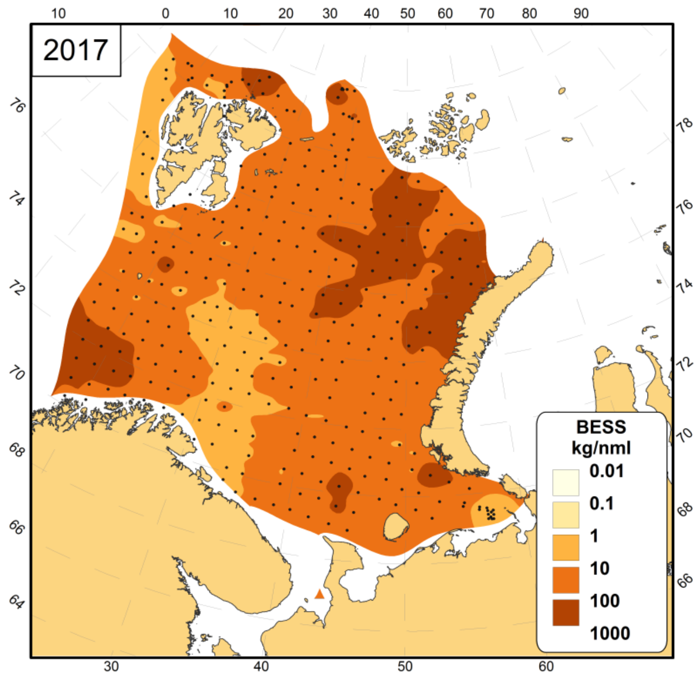

Figure 11.1.5. Biomass distribution of megabenthos (excluding *Pandalus borealis*) in the Barents Sea, August-October 2017

As in previous years, the distribution of the main taxonomic groups (Figure 11.1.6) shows an increase area where Echinodermata predominate from southwest to northeast. Around the of Novaya Zemlya archipelago and Kola Peninsula there has been registered a significant dominance of crustaceans caused by the distribution of *Chionoecetes opilio* (snow crab) and *Paralithodes camtschaticus* (red king crab). Large colonies of *Geodia* sponges in the southwestern part of Barents Sea around continental slope has been recorded all years. Mollusks dominated the shallow areas in the southeastern part of the Barents Sea and on the Spitsbergen Bank. Abundant catches of Cnidaria (mostly Actiniaria) were registered in south and western part of the Barents Sea, in the area with high fishing intensity.

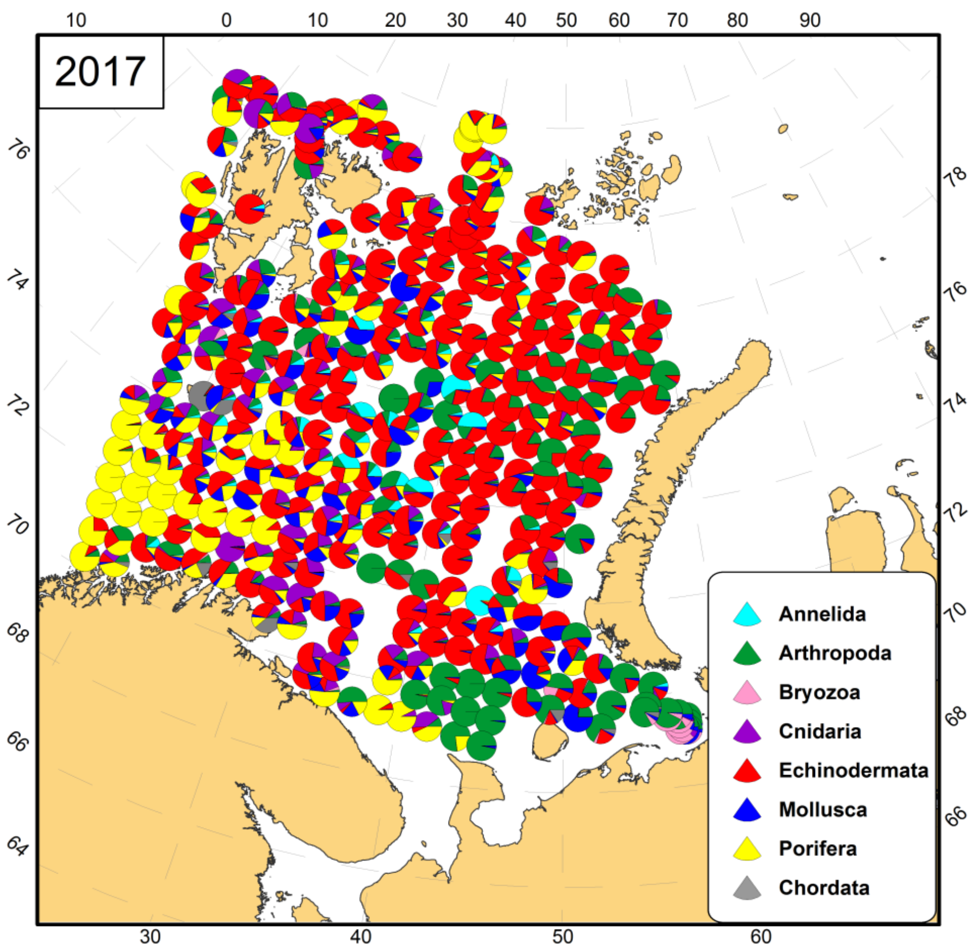

Figure 11.1.6. Biomass distribution of main taxonomic groups per station in the Barents Sea (excluding *Pandalus borealis*), August-October 2017

The ten most dominant species (by biomass) were observed in the trawl catches: *Geodia* spp. (26.3 % of the total biomass), *Gorgonocephalus* spp. (more than 8.6%) *Chionoecetes opilio* (7.9 %), *Strongylocentrotus pallidus* (7.1 %), *Paralithodes camtschaticus* (4.2 %), *Urasterias lincki* (3.8 %), *Ophiopleura borealis* (3.7 %), *Ctenodiscus crispatus* (3.7 %), *Molpadia borealis* (3.1 %), *Heliometra glacialis* (2.6 %).

12 MARINE MAMMALS AND SEA BIRDS

12.1 Marine mammals

Text by R. Klepikovskiy and N. Øien
Figures by R. Klepikovskiy

In total, 1518 individuals of 9 species of marine mammals in August-October 2017 were observed and 46 individuals (in total) were not identified to the species level. The results of observations are presented in Table 12.1.1 and Fig. 12.1.1-12.1.2.

As in previous years, white-beaked dolphin (*Lagenorhynchus albirostris*) were most common (more than 50% of all registrations). This species was widely distributed in research area. The most records of white-beaked dolphin overlapped with capelin and cod in the central area and herring in the coastal area The largest groups of white-beaked dolphin included up to 20-40 individuals.

Table 12.1.1. Number of marine mammal individuals observed from the RV "Johan Hjort", "G.O. Sars", "Vilnyus" during the ecosystem survey in 2017.

Order/ suborder	Name of species (english)	G.O.Sars	J. Hjort	Vilnyus	Total	%
Cetacea/ Baleen whales	Fin whale	22	148	4	174	11.5
	Humpback whale	11	159	7	177	11.7
	Minke whale	21	205	22	248	16.3
	Unidentified whale	3	37	-	40	2.6
Cetacea/ Toothed whales	White-beaked dolphin	280	354	220	854	56.2
	Harbour porpoise	-	-	5	5	0.3
	Killer whale	-	4	-	4	0.3
	Sperm whale	-	7	-	7	0.5
	Unidentified dolphin	5	-	-	5	0.3
	Unidentified cetacean	-	1	-	1	0.1
Pinnipedia	Harp seal	-	2	-	2	0.1
	Bearded seal	-	1	-	1	0.1
Total sum		342	918	258	1518	100

Besides white-beaked dolphin also toothed whales sperm whales (*Physeter macrocephalus*), harbour porpoises (*Phocoena phocoena*), and killer whales (*Orcinus orca*) were observed. Sperm whales were observed at deeper waters along the continental slope in the western part of research area. The harbor porpoise was mainly observed in the south-eastern area between 70º and 73º13'N. Harbor porpoise overlapped with the herring aggregations. Killer whale was observed only in the west part of research area this year.

Baleen whales like minke (*Balaenoptera acutorostrata*), humpback (*Megaptera novaeangliae*) and fin (*Balaenoptera physalus*) whales were also abundant in the Barents Sea, constituting for 39% of all observations. Minke whales were widely distributed in the research area. The densest concentrations of minke whale in north-western areas overlapped with capelin aggregations. In southern part of the Barents Sea, minke whales overlapped with herring and juveniles cod aggregations. In 2017 the numbers of minke whales increased in comparison with the period 2012-2015.

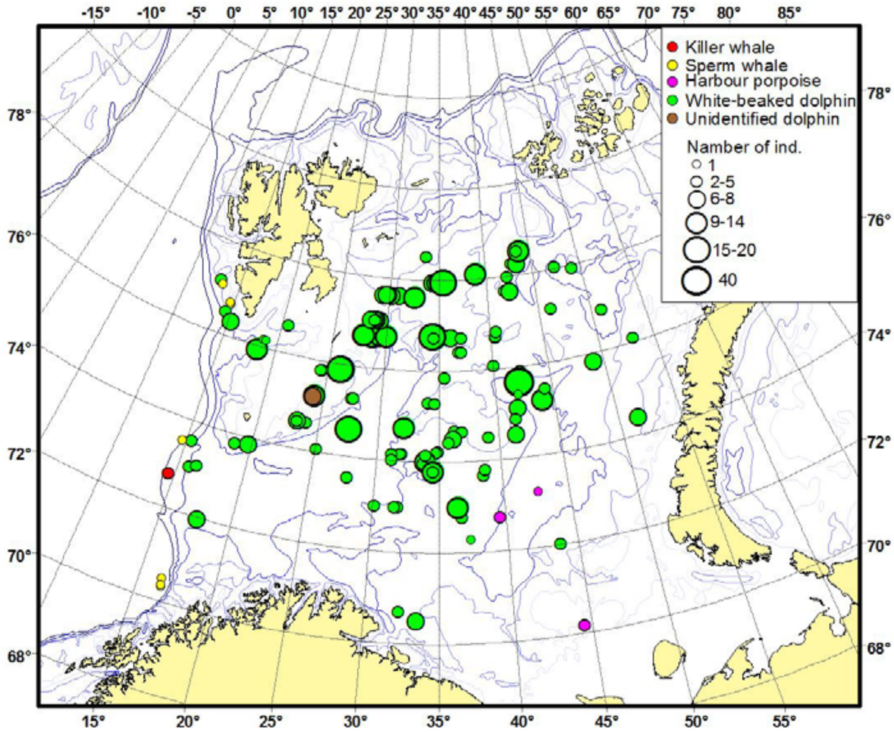

Figure 12.1.1. Distribution of toothed whales in August-October 2017

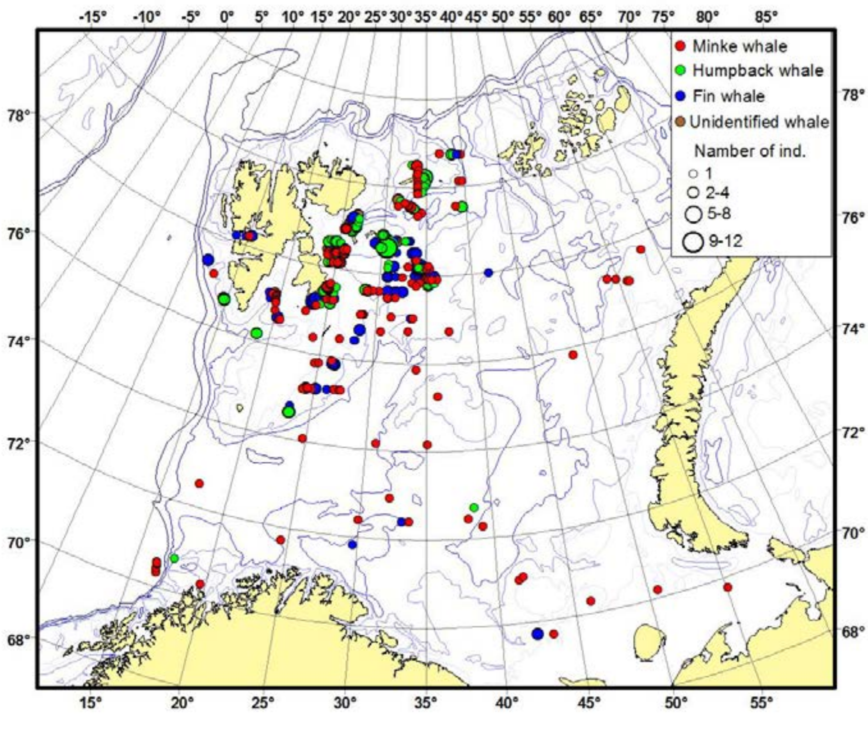

Figure 12.1.2. Distribution of baleen whales in August-October 2017

In 2017, fewer number humpback whale were observed than in 2013 and 2015. Most records of humpback whales (groups up of 12 individuals, as well as single specimens) were observed in the Great Bank and the White Island and overlapped with dense concentrations of capelin. In the same area, also minke whales and fin whales were recorded.

In 2017, more fin whales were observed during the survey. Most observations were recorded in the capelin area east of the Svalbard Archipelago and the Great Bank.

In 2017, the only pinnipeds observed were harp seals (*Phoca groenlandica*) and bearded seals (*Erignathus barbatus*). Harp seals were recorded in the Great Bank, while bearded seals were observed northward of the White Island. Polar bears (*Ursus maritimus*) were not observed during the survey, most likely due lack of the ice in the surveyed area.

12.2 Seabird observations

Text by P. Fauchald and R. Klepikovsky

Figures by P. Fauchald

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. On *Vilnyus*, ship-followers were counted continuously along the transects, and by a point observation at the start of each transect. The ship-followers are attracted to the ship from surrounding areas and individual birds are likely to be counted several times. The numbers of ship-followers are therefore probably grossly over-estimated.

Total transect length covered by the Norwegian research vessels; *Helmer Hanssen*, *G.O. Sars* and *Johan Hjort*, was 6632 km. Total transect length covered by the Russian research vessel *Vilnyus* was 4235 km. A total of 96 176 birds belonging to 34 different species were counted (Table 12.2.1). 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*) (Fig. 12.2.1).

Broadly, the distribution of the different species was similar to the distribution in the 2016 survey (Fig. 12.2.1). Alcids were observed throughout the study area but the abundance and species distribution varied geographically. Little auks (*Alle alle*) were found north of Svalbard (Spitsbergen), Brünnich’s guillemots were found in the western and northern area, Atlantic puffins (*Fratercula arctica*) were found in the southwest and common guillemots (*Uria aalge*) were found in the south. 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 the southeastern area, kittiwakes were found in high density in the eastern and northern area, while Northern fulmars were encountered in high numbers throughout the study area.

Table 12.2.1 List of species encountered during the survey in 2017.

English name	Scientific name	Norwegian vessels	Russian vessel
Razorbill	*Alca torda*	20	0
Little Auk	*Alle alle*	2598	744
Bean goose	*Anser fabalis*	0	56
Unident pipit	*Anthus sp.*	0	2
Ruddy turnstone	*Arenaria interpres*	3	0
Purple sandpiper	*Calidris maritima*	2	2
Black guillemot	*Cepphus grylle*	66	9
Ortolan bunting	*Emberiza hortulana*	1	0
Atlantic puffin	*Fratercula arctica*	762	17
*Northern fulmar	*Fulmarus glacialis*	57897	4889
Black-throated loon	*Gavia arctica*	0	3
Great northern loon	*Gavia immer*	5	0
White-tailed eagle	*Haliaeetus albicilla*	1	0
*Herring gull	*Larus argentatus*	301	101
Mew gull	*Larus canus*	6	0
Lesser black-backed gull	*Larus fuscus*	6	0
Heuglin's gull	*Larus heuglini*	0	27
*Glaucous gull	*Larus hyperboreus*	1061	216
*Great black-backed gull	*Larus marinus*	558	52
Common nightingale	*Luscinia megarhynchos*	1	0
Northern gannet	*Morus bassanus*	34	5
Ivory gull	*Pagophila eburnea*	108	1
Great cormorant	*Phalacrocorax carbo*	3	0
Snow bunting	*Plectrophenax nivalis*	62	5
Sooty shearwater	*Puffinus griseus*	13	1
Ross's gull	*Rhodostethia rosea*	1	0
*Kittiwake	*Rissa tridactyla*	6394	4870
Unident. shorebird	*Scolopacidae sp.*	5	0
Common eider	*Somateria mollissima*	5	11
Long-tailed skua	*Stercorarius longicaudus*	3	0
Arctic skua	*Stercorarius parasiticus*	72	44
Pomarine skua	*Stercorarius pomarinus*	173	260
Great skua	*Stercorarius skua*	32	1
Unident. Skua	*Stercorarius sp.*	6	0
Arctic tern	*Sterna paradisaea*	373	5
Common guillemot	*Uria aalge*	160	22
Brünnich's guillemot	*Uria lomvia*	6708	7376
Unspec. guillemot	*Uria sp.*	15	2
Total		77455	18721

**Ship-followers. Note: that ship-followers were counted differently on the Norwegian and Russian vessels.*

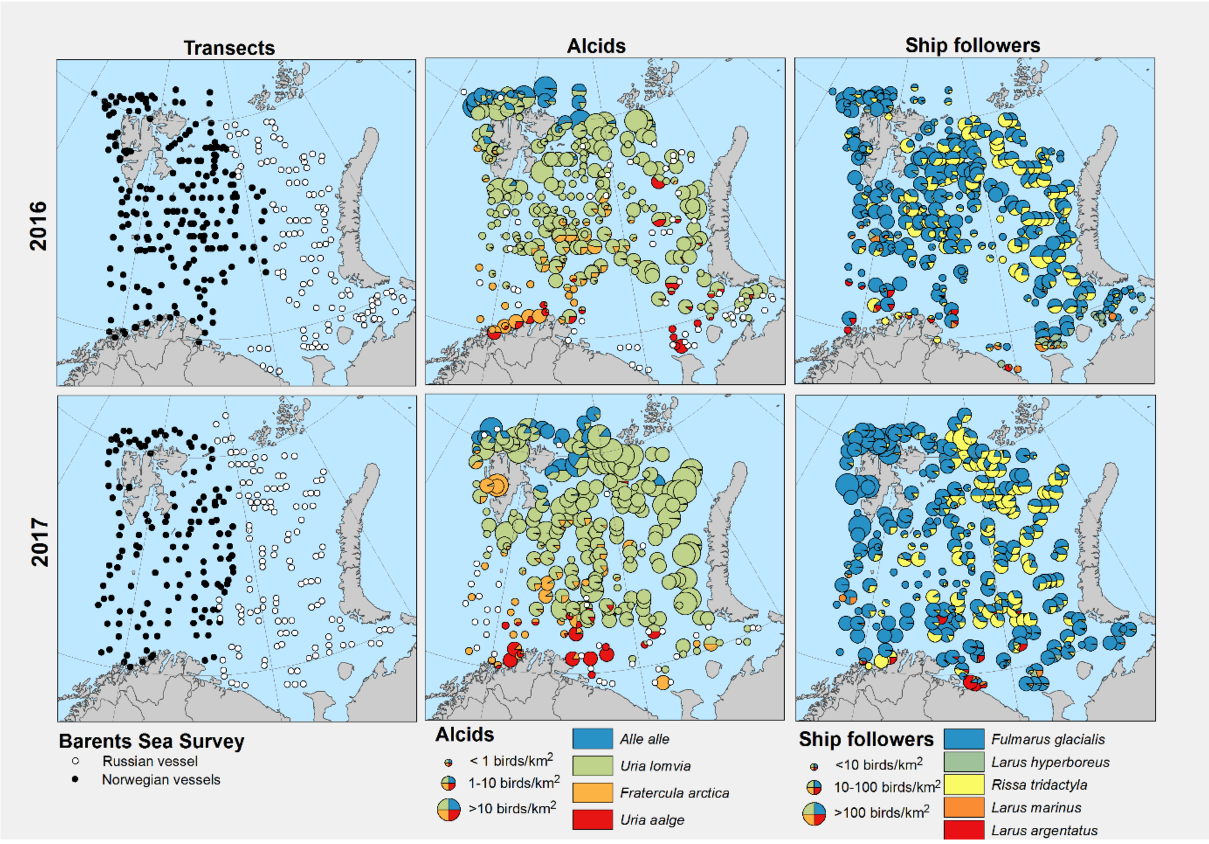

Figure 12.2.1 Seabird observations in 2016 (top) and 2017 (bottom). Left panel; positions of transects, middle panel; distribution of auks, right panel; distribution of ship-followers (gulls and fulmar).

JOINT REPORT

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