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Report of the Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys (PGNAPES)

24–27 August 2004
Murmansk, Russia

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Contents

Abstract

The report presents the results from the acoustic, hydrographic, plankton, and fish sampling during the international ICES coordinated surveys on Norwegian spring-spawning herring and blue whiting in the Norwegian Sea in May 2004 (Denmark, Faroes, Iceland, Norway and Russia), as well as the coordinated survey on the blue whiting spawning grounds west of the British Isles in March/April 2004 (Holland, Ireland, Norway, and Russia). The Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys (PGNAPES) met in Murmansk, 24–27 August 2004. The survey results include the distribution and stock estimates of Norwegian spring-spawning herring and blue whiting, and the environment (oceanographic conditions and biomass of zooplankton) of the Norwegian Sea and adjacent waters in spring and summer of 2004, and the biomass estimate of spawning blue whiting in March/April. The abundance estimates are used in the fish stock assessment of Norwegian spring spawning herring and blue whiting in ICES Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW). The collection of environmental data further improves the basis for ecosystem modelling of the Northeast Atlantic. Broad plans for the ICES coordinated surveys for 2005 are also outlined with descriptions of the relevant protocols, preliminary participants and suggested survey designs.

1 Introduction

1.1 Terms of Reference 2004

The terms of reference and sections of the report in which the answers are provided:

2D08 The **Planning Group on Surveys of Pelagic Fish in the Norwegian Sea** [PGSPFN] will be renamed the **Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys** [PGNAPES] (Chair: J. A. Jacobsen, Faroe Islands) and will meet in Murmansk, Russia, from 24–27 August 2004 to:

Item	ToR 2004	Section
a)	Evaluate the surveys carried out in 2004 and suggest whether changes could be made to further optimise these with regard to stock migrations and accuracy of stock estimates, and in relation to the stock – environment interactions	3 and 5
b)	combine the 2004 survey data and provide the following data for the Northern Pelagic and Blue Whiting Working Group:	
	i) stock indices of blue whiting and Norwegian spring-spawning herring	3.3, 3.5 and 4.4
	ii) zooplankton biomass for making short-term projection of herring growth	3.2 and 4.2
	iii) hydrographic and zooplankton conditions for ecological considerations	3.1 and 4.1
	vi) aerial distribution of such pelagic species as mackerel	3.7
c)	describe the migration pattern of the Norwegian spring-spawning herring and blue whiting stocks in 2004 on the basis of biological and environmental data	4.3
d)	plan and coordinate the surveys on the pelagic resources and the environment in the North East Atlantic in 2005 including the following:	
	i) the international acoustic survey covering the main spawning grounds of blue whiting in March-April 2005	5.2
	ii) the international coordinated survey on Norwegian spring-spawning herring, blue whiting and environmental data in May-June 2005	5.1
	iii) Russian investigations on pelagic fish and the environment in May-July 2005	3.3.1
	vi) Icelandic investigations on pelagic fish and the environment in June-July 2005	3.5.3
	v) Norwegian investigation on pelagic fish and the environment in August 2005	-
e)	develop protocols and criteria to ensure standardisation of all sampling tools, procedures and survey gears	6
f)	plan the implementation of the Group's database	7
g)	consider the 2003 report of the Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries with the objective of contributing to better quantification of salmon by-catch in pelagic fisheries	8

PGNAPES will report by 15 September 2004 for the attention of the Resource Management and the Living Resource Committees, as well as ACFM and ACE.

1.2 List of participants

Jørgen Dalskov	Denmark
Jan Arge Jacobsen (Chair)	Faroe Islands
Leon Smith	Faroe Islands
Súni Lamhauge (part time)	Faroe Islands
Marit Pedersen (part time)	Faroe Islands
Sveinn Sveinbjørnsson	Iceland
Maurice Clarke	Ireland
Esben Moland Olsen	Norway
Mikko Heino	Norway
Jens Christian Holst	Norway
Webjørn Melle	Norway
Øyvind Tangen	Norway

Alexander Krysov	Russia
Evgeniy Sentyabov	Russia
Evgeny Shamray (part time)	Russia
Irina Prokopchuk	Russia
Sergey Belikov (part time)	Russia
Mark Dickey-Collas	The Netherlands

A full address list for the participants is provided in Appendix 1.

1.3 Background and general introduction

The Norwegian spring spawning herring is a highly migratory and straddling stock carrying out extensive migrations in the NE Atlantic. After a major stock collapse in the late 1960s the stock has been rebuilt and varied from approximately 5 to 10 million tonnes of biomass during the 1990s. During this period the main spawning areas have been situated along the Norwegian coast from approximately 58°N to 69°N, with the main spawning occurring off the Møre coast from approximately 62°N – 64°N. After spawning in February – March the herring have migrated NW-wards towards the Norwegian Sea feeding grounds. In general, the main feeding has taken place along the polar front from the island of Jan Mayen and NE-wards towards Bear Island. During the latter half of the 1990s there has been a gradual shift of migration pattern with the herring migrations shifting north and eastwards. In 2002 and 2003 this development seems to have stopped and the herring had at more southerly distribution at the end of the feeding season than in 2001. After feeding, the herring have concentrated in August in the northern parts of the Norwegian Sea prior to the southern migration towards the Vestfjord wintering area (68°N, 15°E). During the winter 2002–2003 and 2003–2004 a certain fraction of the stock wintered in the Norwegian Sea off Lofoten. In January the herring start their southerly spawning migrations.

Besides herring, abundant stocks of blue whiting and mackerel exploit the Norwegian Sea as an important feeding area. Blue whiting is the fish species that currently is supporting the largest fishery of the Northeast Atlantic. The main spawning areas are located along the shelf edge and banks west of the British Isles. The eggs and larvae can drift both towards the south and towards the north, depending on location and oceanographic conditions. The northward drift spreads juvenile blue whiting to all warmer parts of the Norwegian Sea and adjacent areas from Iceland to the Barents Sea. Adult blue whiting carry out active feeding and spawning migrations in the same area. Blue whiting has consequently an important role in the pelagic ecosystems of the area, both by consuming zooplankton and small fish, and by providing a resource for larger fish and marine mammals.

Since 1995, the Faroes, Iceland, Norway, and Russia, and since 1997 (except 2002 and 2003) also the EU, have coordinated their survey effort on these and the other pelagic fish stocks in the Norwegian Sea. The coordination of the surveys has strongly enhanced the possibility to assess abundance and describe the distribution of the pelagic resources, and their general biology and behaviour in relation to the physical and biological environment (Table 1.4.1). Based on an ICES recommendation in 1948, similar surveys were conducted under the auspices of ICES from 1950 to the late 1970s. National surveys were continued after this time. At the 1996 Annual Science Conference, the Pelagic Committee recommended that the ICES cooperation on the planning and conducting of future surveys on herring and the environment in the Norwegian Sea should be reintroduced, resulting in a PGSPFN. In autumn 2003 participants from Denmark, Ireland and the Netherlands joined the PGSPFN and, in addition to the Faroes, Iceland, Norway, and Russia, one research vessel from Denmark (EU-coordinated) joined the international survey in the Norwegian Sea 2004.

The spawning areas of blue whiting west of the British Isles have most actively been surveyed by Norway and Russia. Some coordination of these survey activities took place over a number of years, until the Russian spawning stock survey was discontinued in 1996. Russia resumed the blue whiting spawning stock survey in 2001. There has, however, been no further coordination between Norwegian and Russian surveys. In 2003 ACFM recommended the following:

"Several surveys on blue whiting are presently going on. ICES recommends that a coordinated survey be organised covering the main spawning grounds of blue whiting. Other countries than those presently taking part in these surveys are invited to take part. It is furthermore suggested that the coordination of blue whiting surveys should be taken care of by an extended ICES Planning Group on Surveys of Pelagic Fish in the Norwegian Sea (PGSPFN)."

Albeit this suggestion was not made in time to enter the ToR's of PGSPFN in 2003, the coordination task has been taken up by PGSPFN by correspondence in 2003/2004, where, in addition to Norway and Russia, also vessels from Ireland and the Netherlands joined the survey in 2004.

Due to the inclusion of the international blue whiting survey on the spawning grounds west of the British Isles (see above) the PGSPFN decided to change its name to PGNAPES (Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys) to mark the broadening of its scope (ICES C.Res 2003/ 2D08). This inclusion is considered a major advance for the group.

In 2004 a series of surveys were carried out by vessels from Denmark (EU), Faroe Islands, Iceland, Norway, Ireland, the Netherlands, and Russia, co-ordinated by the PGNAPES (Table 2.4.1 –2), resulting in a relatively good coverage of the areas and relevant species. Unfortunately, in 2004, as in 2003, Russia was not able to execute its planned surveys on pelagic fishes in the Barents and the Norwegian seas by research vessels in May/July due to organizational restrictions. Only in July/August one Russian vessel carried out small-scale survey in the central

Norwegian Sea and Faroese EEZ. These research surveys have been conducted for many years and form the basis for continuation of existing time-series (Table 1.4.1). The planning group was very concerned by the loss of this information. This information is important for both the assessment of pelagic fish stocks and for ascertaining conditions of the environment of the Northeast Atlantic.

The surveys were grouped as follows:

May – the Faroese EEZ, Icelandic EEZ, and Norwegian Sea
June/July – Icelandic EEZ
July/August –central Norwegian Sea and Faroese EEZ
March/April – spawning grounds west of the British Isles

The main objectives of these surveys were to map the distribution and migrations of blue whiting and herring and other pelagic fish and to assess their biomass. Furthermore to monitor the hydrographic and plankton conditions on the blue whiting spawning grounds and in the Norwegian Sea and adjacent waters and describe how feeding and migration of blue whiting, herring and other pelagic fishes are influenced by this. The results are presented for the different periods and areas in the same sequence as in the list above. The decision to present the March/April blue whiting spawning survey as the last is due to its former presentation to the Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW) in late April 2004, both as a separate detailed survey report (Heino *et al*. 2004a) and in the WGNPBW report (ICES, 2004b). Therefore, due to its previous presentation only the surveyed area and the blue whiting biomass estimate from the spawning survey will be given in this report.

The results of the coordinated surveys in spring and summer 2004 were evaluated during a meeting in Murmansk in late August 2004 (Table 1.4.1) and are presented in this report. The purpose of the report is to provide a short summary of the surveys, their findings and planning next years surveys, however, there is a large potential for exploring the data further. Such effort is highly recommended by the group, but limited time resources have made this task difficult for the individual members of the group.

2 Material and methods

The surveyed area in May 2004 is shown in Figure 2.1. Four vessels participated, the Danish RV “Dana”, the Norwegian RV “G.O. Sars”, the Icelandic RV “Arni Fridriksson”, and the Faroese RV “Magnus Heinason”.

Unfortunately, in 2004, as in 2003, Russia was not able to execute its planned surveys on pelagic fishes in the Barents and the Norwegian seas by research vessels in May/July due to organizational restrictions. Only in July/August 2004 F/T “Persey-IV” carried out small-scale survey in the central Norwegian Sea and Faroese EEZ area (64 hydrographic stations, Figure 2.2).

The surveyed area in March/April 2004 is shown in Figure 2.3. Four vessels participated, the Dutch RV “Tridens”, the Irish RV “Celtic Explorer”, the Russian RV “Fritjof Nansen”, and the Norwegian RV “Johan Hjort”.

2.1 Hydrography

The hydrographic observations were made using Sea Bird CTD-Probes from 0–1000 m depth.

In spring and summer 2004 a total of about 400 hydrographic stations were made for description of the horizontal distribution of temperature and salinity for the period April-June and July-August (Table 2.4.1). In March/April 170 hydrographic stations were made (Table 2.4.2). The MATLAB program from Mathworks Inc. was used to check and prepare the data for plotting. The section plots (Svinøy and Gimsøy) of temperature and salinity were made with MATLAB while horizontal distributions of temperature were plotted with the SURFER program.

In addition surface (~4m) temperature (“Magnus Heinason”), and temperature and salinity (“Dana”) was recorded continuously along the complete track of the cruise using a ship-mounted device. On “Johan Hjort” temperature, salinity and fluorescence were recorded continuously using a ship-mounted thermosalinograph (SBE21).

2.2 Plankton

In spring and summer 2004 a total of 287 plankton hauls were made, which is 23 hauls less than in 2003 and about half of the number of hauls taken in 2002 (Table 2.4.1). There were no Russian plankton cruises in the Norwegian Sea during spring and summer this year. Neither was the Norwegian summer cruise conducted. During May, zooplankton was sampled in vertical hauls from 200–0 m by standard WP-2 nets with a 180 µm mesh (“Arni Fridrikson”, “Dana”, “G.O. Sars”, “Magnus Heinason”). The sampling depths on “Arni Fridrikson” were 50–0 m on the standard sections around Iceland during May, while both 50–0 m and 200–0 m were sampled on the oceanic stations. The Icelandic data from standard sections were scaled to biomasses in 200–0 m using a conversion factor of 1.98 established from simultaneous 50–0 m and 200–0 m net hauls on “Bjarni Saemundson” in 1998. As with the hydrographic data all zooplankton results were reported to the IMR in Bergen, Norway to produce a combined map of the zooplankton biomass in the surveys.

The zooplankton biomass estimated on the basis of the "Dana" cruise turned out to be about 30% lower than the biomass estimated from the "G.O. Sars" data. During both cruises the zooplankton was size fractionated, and the smallest size fraction did not differ between ships while the intermediate and especially the largest size fraction was much lower in the "Dana" data. Probably the difference between ships was due to problems with the hydrography winch on "Dana". Due to these problems the WP2 net on "Dana" was probably hauled with a speed lower than the recommended 0.5 m s^{-1}, causing increased avoidance by the largest zooplankton. For example no krill was caught during the "Dana" cruise. To be able to use the "Dana" data it was decided to transform the "Dana" data to the same mean as the "G.O. Sars" data.

2.3 Fish sampling

During the surveys trawling was carried out opportunistically for identification of the acoustic recordings and for representative biological sampling of the population (ranging from 1–6 times per day). In most cases fishing was carried out on fish traces identified on the echo-sounders. The fishery was conducted using medium-sized pelagic trawls (vertical openings of 20–70 m). With ordinary rigging, the trawls could be used to catch deep fish schools, in some cases down to depth of 400 meters. The trawls were also rigged to catch fish near or in the surface layer by removing the weights, extending the upper bridles and/or attaching buoys to each upper wing.

Each trawl catch was sorted and weighted for species composition. Samples of all species were taken for length measurements and samples or sub-samples of up to 100 specimens of herring and blue whiting were taken for further biological analyses. Length, weight, sex, maturity stage and in some cases stomach contents, parasite load and liver size index were recorded. Scales and/or otoliths were taken for age reading of herring and otoliths from blue whiting.

2.4 Acoustics and biomass estimation

During the surveys, continuous acoustic recordings of fish and plankton were collected using calibrated echo integration systems (38 kHz Simrad EK500 ["Magnus Heinason", "Johan Hjort"], EK60 ["Dana", "Tridens", "G.O. Sars"] or ER60 ["Celtic Explorer" and "Fridtjof Nansen"] working at a range of 10–500 m or 10–750 m). The recordings of area back scattering strength (s_A) per nautical mile were averaged over five nautical miles, and the allocation of area backscattering strengths to species was made by comparison of the appearance of the echo recordings to trawl catches. To record schools near the surface, a horizontal guided sonar was operated from some of the vessels. However, no counts of schools were provided.

The equipment of the research vessels was calibrated immediately prior or during the surveys against a standard calibration spheres. Vessel intercalibrations were performed during March-April blue whiting survey.
Acoustic estimate of herring and blue whiting abundance were obtained during the surveys. This was done by visual scrutiny of the echo recordings using post-processing systems (BEI/BI500-system ["Johan Hjort", "Dana", "G.O. Sars"], Echoview version 3.1 ["Magnus Heinason", "Tridens", "Celtic Explorer"] or FAMAS-Fisheries Acoustic Monitoring & Analysis ["Fridtjof Nansen"]). The allocation of s_A-values to herring, blue whiting and other acoustic targets was based on the composition of the trawl catches and the appearance of the echo recordings. To estimate the abundance, the allocated s_A-values were averaged for ICES-squares (1° latitude by 2° longitude). For each statistical square, the unit area density of fish (ρ_A) in number per square nautical mile ($N*nm^{-2}$) was calculated using standard equations (Foote, 1987, Toresen *et al*. 1998). For blue whiting a TS= 21.8 log(L) – 72.8 dB has been used while Foote (1987) recommended TS = 20 log(L) – 71.9 dB for physostom species, which has been used for herring.

To estimate the total abundance of fish, the unit area abundance for each statistical square was multiplied by the number of square nautical miles in each statistical square and then summed for all the statistical squares within defined subareas and for the total area. The biomass was calculated by multiplying abundance in numbers by the average weight of the fish in each statistical square and then sum all squares within defined subareas and the total area. The Norwegian BEAM software (Totland and Godø 2001) was used to make estimates of total biomass and numbers of individuals by age and length in the whole survey area and within different sub-areas.

The scrutinized acoustic data from the participating vessels were reported to the Marine Institute, Bergen, to produce combined assessments of the herring and blue whiting stocks surveyed.

2.5 Aerial surveys

In the period from 11 July to 1 August, in the Norwegian Sea, during feeding migrations of mackerel, Russia (PINRO) carried out annual comprehensive aerial surveys. The total area of the aerial surveys was between 62º45'–70ºN and 10ºE–12ºW and presented in details in Figure 2.4. Within the framework of aerial surveys, conducted were experimental and calibration works, as well as the surveys with the two Norwegian vessels ("Libas" and "Endre Dyrøy") executed trawl-acoustic survey for mackerel and the Russian vessel "Persey-4".

The results of above mentioned surveys will be presented in details and considered at the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy in September 2004 and the Planning Group on Aerial and Acoustic Surveys for Mackerel in 2005.

3 Results

3.1 Hydrography

General hydrographic features

Two main features of the circulation in the Norwegian Sea, where the herring and blue whiting stocks are grazing (see Section 3.3), are the Norwegian Atlantic Current (NWAC) and the East Icelandic Current (EIC). The NWAC with its offshoots forms the northern limb of the North Atlantic current system and carries relatively warm and salty water from the North Atlantic into the Nordic Seas. The EIC, on the other hand, carries Arctic waters south and eastwards. To a large extent this water derives from the East Greenland Current, but to a varying extent, some of its waters may also have been formed in the Iceland and Greenland Seas. The EIC flows into the south western Norwegian Sea where its waters subduct under the Atlantic waters to form an intermediate Arctic layer. While such a layer has long been known in the area north of the Faroes and in the Faroe-Shetland Channel, it is only in the last three decades that a similar layer has been observed all over the Norwegian Sea.

This circulation pattern creates a water mass structure with warm Atlantic Water in the eastern part of the area and more Arctic conditions in the western part. Due to the influence from the EIC, the NWAC is rather narrow in the southern Norwegian Sea, but when meeting the Vøring Plateau off Mid Norway it is deflected westward. The western branch reaches the area of Jan Mayen at about 71°N. Further northward in the Lofoten Basin the lateral extent of the Atlantic water gradually narrows again, apparently under topographic influence of the mid-ocean ridge.

It has been shown that atmospheric forcing largely controls the distribution of the water masses in the Nordic Seas. Hence, the lateral extent of the NWAC, and consequently the position of the Arctic Front in the Norwegian Basin, is correlated with the large scale distribution of the atmospheric sea level pressure. This is clearly indicated for example by the correlation with the winter index of the North Atlantic Oscillation (NAO). As a result, the Atlantic water now has a far more easterly distribution than it had during the 1950s. Current measurements south in the Norwegian Sea have also shown that high NAO index gives larger Atlantic inflow, along the shelf edge, in the eastern part of the Norwegian Sea. In winter 2004 the NAO index was close to the long term average and a little lower than compared to 2003 (see Figure 3.1.1).

May – the Faroese EEZ, Icelandic EEZ, and Norwegian Sea

Figure 3.1.2 shows the temperature in the Svinøy section for 3–5 May. The influence of the EIC is seen in the intermediate layer lying under the Atlantic layer. The intermediate water is of Arctic origin and is characterized by salinities below 34.90 and temperatures below 1°C. The temperatures were about normal (for the last 10 years) east in the section but above normal in the upper 50 meters west in the section. There the difference was about 1°C.

Figures 3.1.3–3.1.8 shows the horizontal temperature distributions at surface, 20, 50, 100, 200 and 400 m depth during May 2004. The distribution of the waters carried into the Norwegian Sea by the EIC is clearly indicated at all depths. A body of relatively cold and fresh water extends eastward from the Iceland Sea. These Arctic waters are separated from the Atlantic waters in the eastern part of the area by the Arctic Front which is indicated by closely spaced isotherms. In general, the influence of the EIC was somewhat larger in 2004 compared to 2003 but still much less compared to 2002. For example, at 200 m depth the 4°C isotherm in the southern Norwegian Sea, outside Svinøy (about 64°N), was displaced about 20 nm more eastward in 2004 than 2003.

In the central and northern Norwegian Sea (~72–73°N) there was significant warmer water on the western side compared to both 2003 and 2002. At 100 m depth at 72°N the 5°C isotherm reach further west than the 0° meridian while in 2003 it reached only to 4°E.

The surface water was warmer for 2004 compared to 2003. In the eastern side of the Norwegian Sea it was about 1°C warmer.

Figure 3.1.9 and 3.1.10 show the salinity and the temperature in an extended Gimsøy-NW section, running from Gimsøy (at Lofoten) and into the Greenland Sea for May/June 2003. The Mohns Ridge, separating the Norwegian and Greenland Sea can be seen as large peaks in bottom topography. The Arctic front that separates warm Atlantic waters and cold Arctic waters is topographically controlled. The front is placed over the Mohns Ridge and has sharp east-west gradient in both salinity and temperature. There is still not developed any warm surface layer in the section which was the case in 2002 (see Figure 3.1.11, ICES CM 2002/D:07).

3.1.1 July/August –central Norwegian Sea and Faroese EEZ

Figures 3.1.11–3.1.15 shows the horizontal temperature distribution at surface, 20, 50, 100 and 200 m depth during July-August 2004.

In July, in the central Norwegian Sea, the surface temperature varied from 8.5ºC in the west to 11.5°C in the east. In comparison with 2003, the temperature was 0.2–0.8ºC higher in the west, while it was 1.0–1.5°C lower in the east. At 50 m, the temperature was 0.2–1.5°C higher than last year. The largest difference was registered in the Western Branch of the NWAC (1ºW–1ºE 67–68ºN). There, the frontal zone was shifted 30–50 nm eastward compared to 2003, located at 0–1ºW. Compared to last year, the frontal zone was sharper, possibly, because of lower temperature in the EIC.

In the upper 200 meters, the temperature was only slightly higher than last year, except for the eastern areas of the Norwegian Sea. There the temperature was 0.3–0.4ºC lower than last year. Compared to the mean in 0–200 m layer, the temperature remained high. North of 66ºN, the Western Branch of the NWAC was 1.5ºC warmer than normal.

In August, to the east of the Faroese EEZ, the temperature and salinity of the NWAC Water exceeded the mean by 0.5ºC and 0.15, respectively. In the EIC, the temperature was 0.5–1.0ºC lower than the mean. The EIC was stronger, than last year. The cold waters with temperatures below 3–4ºC were observed to 62º30'N at 4ºW and to 64º30'N at 2ºW. That was an eastward shift of 1–2º compared to the mean situation. As a result, cold waters occupied layers deeper than 50 m in the north-eastern Faroese EEZ. On the eastern and southern boundary a sharp and considerably meandering frontal zone was formed with horizontal gradients reaching 0.25º/nm at 100 m depth and 0.33–0.50º/nm at 200 m depth.

3.2 Zooplankton

3.2.1 May – the Faroese EEZ, Icelandic EEZ, and Norwegian Sea

As usual the zooplankton biomass was highest in the cold water of the East Icelandic current (Figure 3.2.1). The sampling stations were fairly evenly spread over the area, but due to reduced ship time on the Norwegian vessel the north-western region was not sampled. The biomass in May 2004 was generally lower than in 2003. For the total area, the average biomass of zooplankton was much lower than the mean for the years 1997–2004 and close to value for the year 1997, the lowest biomass measured during the time series (Table 3.2.1). The zooplankton biomass in the two areas west and east of 2°W was also lower than the mean for the time series and only slightly higher than in 1997 (Table 3.2.1).

3.3 Norwegian spring spawning herring

3.3.1 May – the Faroese EEZ, Icelandic EEZ, and Norwegian Sea

May – Information from surveys

The international coordinated herring survey in May was carried out with four vessels, one from the Denmark (EU coordinated), one from Faroes, one from Iceland and one from Norway during 28 April–3 June 2004. The survey covered the central and eastern Norwegian Sea from 60°N to 73°20'N. In addition the Faroes EEZ and the eastern part of the Icelandic EEZ were surveyed. The cruise tracks are shown in Figure 2.1.

Herring were recorded over large areas in the Norwegian Sea as shown in Figure 3.3.1. The distribution in 2003 is included for comparison (Figure 3.3.2). As compared to 2003 the geographic extent of herring in May 2004 was restricted and the herring was more southerly distributed. While significant herring concentrations were observed in the Svalbard zone in May 2003 hardly any fish were present in May 2004. The southern displacement is reflected in a more south western centre of gravity in 2004 (Figure 3.3.3). The distribution in the Faroese and Icelandic zones resembled that observed in 2003. The western boundary in the Jan Mayen zone was more easterly in 2004 than in 2003.

The acoustic estimate from May 2004 is given in Table 3.3.1, and the length and age distributions are given in Figure 3.3.4. The estimate of about 8.9 million tonnes is of the same magnitude as the estimate in May 2003 (8.6 mill. tonnes, ICES, 2003).

Like in 2003 there was a clear size gradient of herring (Figure 3.3.5) through the surveyed area with the smallest fish appearing to the northeast and the largest to the southwest.

May 2004- Information from the fisheries

No coastal state agreement was obtained for 2004. As a consequence the fisheries could not follow the herring migrations as freely as in earlier years. This gives the interpretation of the fishing pattern limited value and is omitted for 2004.

3.3.2 June/July –Icelandic EEZ

An Icelandic survey (Section 3.5.2) was conducted in the northern part of the Icelandic EEZ in end of June/beginning of July, but no Norwegian spring spawning herring were recorded. The cruise tracks are shown in Figure 2.1.

3.4 Young herring

Like in 2003 parts of the 2002 year class was distributed in the areas off Lofoten Isles and north-eastwards into the Barents Sea. The eastern 0-line of this year class was not observed as its distribution stretch towards the eastern parts of the Barents Sea (Fig 3.4.1).

3.5 Blue whiting

Blue whiting data are available from the spawning areas west of the British Islands–southwest of the Faroes in March-April (also reported to the WGNPBW; ICES, 2004b), from Faroese EEZ and Norwegian Sea in May, and from Icelandic waters in July.

3.5.1 March-April – the spawning areas west of the British Islands

An international blue whiting spawning stock survey was carried out on the spawning grounds west of the British Isles in March-April 2004. Four research vessels participated in the survey: “Celtic Explorer”, “Fridtjof Nansen”, “Johan Hjort” and “Tridens”. This is the first international survey with such a broad international participation, which allowed for broad spatial coverage as well as a relatively dense net of trawl and hydrographic stations. The results from the international blue whiting spawning stock survey have been reviewed in WGNPBW report (ICES, 2004b) and described in detail in the joint cruise report (Heino *et al.* 2004a) as well as in reports from individual vessels (“Celtic Explorer”: O’Donnell *et al.* 2004; “F. Nansen”: Oganin *et al.* 2004; “J. Hjort”: Heino *et al.* 2004b; “Tridens”: Couperus *et al.* 2004). Below we reiterate some of the most important results.

The highest abundances of blue whiting were observed along the shelf edge from the northern Porcupine bank to the Hebrides, south/southwest of the Faroe Plateau and the adjacent banks, and west of Rockall. Limits of the oceanic distribution were found in south and southwest. The distribution of acoustic backscattering densities for blue whiting as recorded by the four vessels is shown in Figure 3.5.1.

Blue whiting spawning stock estimate based on the international survey is 10.9 million tonnes and 119 x 10^9 individuals. An age-disaggregated total stock estimate is presented in Table 3.5.1, showing that the stock was dominated by blue whiting of 4 years in age (year class 2000). Blue whiting of ages 3–5 years made up 78% of spawning stock biomass (Figure 3.5.2). There was some variability in the age structure between different areas with the highest mean age observed in the Hebrides area.

3.5.2 May – the Faroese EEZ, Icelandic EEZ, and Norwegian Sea

Four research vessels, “Dana”, “Magnus Heinason”, “Arni Fridriksson” and “G.O. Sars”, were active in May (Figure 2.1). The area covered in 2004 was similar to the coverage in 2003 but larger than in the earlier years, particularly in the Icelandic and Faroese waters. Dense blue whiting concentrations were found in the southwest part of the survey area, east of Iceland and in the Faroese-Shetland Channel, and near the Lofoten (Figure 3.5.3). Mean length of blue whiting increased from east to west, away from the Norwegian coast (Figure 3.5.4).

The most abundant year class in terms of biomass was that of year 2000, but in terms of numbers 2003 year class was the dominant one (Table 3.5.2). Estimated age and size distributions are shown in Figure 3.5.5. The total biomass estimate is 10.3 million tonnes, i.e., about 10% lower than in 2003.

3.5.3 June/July –Icelandic EEZ

Acoustic assessment surveys for blue whiting in the Icelandic area in July have been carried out since 1998. The survey in 2004 was conducted on the RV “Bjarni Sæmundsson” and began off the west coast of Iceland and continued southwards and eastwards along the shelf to the southeast coast. The area covered was not as extensive as in 2003 but more comparable to the coverage in the earlier years (Figure 2.1).

The distribution of blue whiting was extensive (Figure 3.5.6) and as in 2003 reached as far north as north of Iceland. Blue whiting was recorded in all the area surveyed, mostly at 250–400 m depth in southern and eastern part of the survey area but at 150–200 m further north and west. The densest recordings were observed in and off the shelf area at the southeast coast (Iceland-Faroe ridge). 0-group blue whiting were observed mostly as relatively dense schools at 50–150 m depth in an area off the shelf at southeast Iceland (Figure 3.5.6).

The total biomass estimate was 2.2 million tonnes and 27.8 x 10^9 individuals. The 2004 year class was most numerous (10.4 x 10^9 fish) followed by the year classes from 2000, 2001 and 2002 in that order. An age-disaggregated biomass estimate is given in Table 3.5.3.

3.6 Mackerel

No data.

3.7 Aerial surveys

In the second half of July 2004 in the international water of the Norwegian Sea SST varied from 8.5ºC on the 70ºN to 12.5 ºC on the southern part and to 15ºC in the Eastern Branch of the Norwegian Current in Norwegian EEZ. Spatial structure of the SST field in the eastern sea in the first half of July was homogeneous. In the west part of the international water of the Norwegian Sea and to the north of the Faroes horizontal heterogeneities as frontal zones and eddies were registered. In the late July, in the most part of research area, the surface temperature field was homogeneous. The pycnocline depth (by the data of aerial observations made by LIDAR and corroborated by the results from CTD observations) was equal to 20–30 m in the west of the aerial survey area and 10–15 m in the east.

Further results from investigations in summer 2004 will be presented to the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy (WGMHSA) in September 2004.

4 Discussion

4.1 Hydrography

In winter 2004 the NAO index was close to the long term average and a little lower than in 2003. The surface water in May was warmer in 2004 than in 2003. In the eastern side of the Norwegian Sea it was about 1^{o}C warmer. The surface temperature in the EIC area (western part of the sea) was 0.3–0.7^{o}C lower than in 2003. As a whole, the surface temperature was the highest measured during the time series starting in 1995. Compared to the "cold" 1995–1997 period the temperature in 2004 was more than 1.5–2.0^{o}C higher, and compared to the "warmer" 1998–2002 period the temperature was about 0.5–1.0^{o}C higher. Maximum difference was observed in the central Norwegian Sea. A tendency towards increased surface temperature of the Norwegian Sea from 2000 to 2004 was reflected in the May data. However in July surface temperature in the central and eastern part of the sea was 1.0–1.5^{o}C lower than last year.

In the central and northern Norwegian Sea (~72–73^{o}N) there was significantly warmer water on the western side compared to both 2003 and 2002. This may be a result of the wind forcing and the ocean-atmosphere heat fluxes.

The rather low NAO index in 2004 and 2003 may explain the modest influence of the EIC during these two years. On the southern and western part of the sea in the summer a sharp and considerably meandering frontal zone was formed with horizontal gradients reaching 0.25°/nm at 100 m depth and 0.33–0.50°/nm at 200 m depth.

4.2 Plankton

From 2003 to 2004 there was a decrease in zooplankton biomass in the Norwegian Sea in May. The overall distribution pattern of zooplankton biomass in 2004 was similar to that observed in 2003 (Figure 4.2.1), which is consistent with the similarity in atmospheric (NAO) and hydrographic conditions these years. After a high NAO and a high inflow of cold water in the south-western Norwegian Sea in 2002, NAO close to the long term mean coincided with reduced flow of cold water into the south-western Norwegian Sea in 2003 and 2004. At the same time warm Atlantic water spread westward occupying most of the southern Norwegian Sea gyre and the Lofoten Basin. Average zooplankton biomass in 2004 was lower than the mean for the time series from 1997 to 2004, and close to the lowest values observed in 1997. In 1997 the low biomass measured in May coincided with extremely poor feeding conditions for the herring, and in the wintering areas in December we measured a record low condition for the herring. We expect the feeding conditions for the herring during 2004 to be poor and herring condition in December to be low.

The reduced ship time for the Norwegian vessel, which resulted in fewer sampling stations, particularly in the north-western region where the herring feeds in June and July, weakens the reliability of our prediction of the herring condition. The sampling problems on "Dana" further increase the uncertainty of our predictions.

4.3 Herring migrations and the environment in 2004

As only one survey covering the adult herring distribution was conducted in 2004 and with little information from the fisheries it was decided not to draw up a suggested herring migration pattern for 2004. However, the general migration pattern is believed to resemble that of 2003 with the exception that the herring had a somewhat more southerly distribution in 2004.

<u>Oceanic herring in winter 2003/2004</u>
A new herring wintering area was observed in the areas northwest of Vesterålen during December 2002. The area was surveyed systematically for the first time in December 2003. Around 5.5 mill. tonnes of the herring stock (consisting practically only of the 1998 and 1999 year classes) were observed in the oceanic part of the northern Norwegian EEZ (Figure 4.3.1), while 1.5 mill. tonnes were observed in the Ofotfjord and Tysfjord, which, together with the Vestfjord, has been the traditional wintering area in recent time. The herring wintering in the fjords was mainly composed by old herring. There is presently an ongoing process in shaping the wintering area of the 1998 and 1999 year class of the Norwegian spring spawning herring. Based on similar situations observed earlier it is reasonable to assume that this shaping will be more or less finite after the coming winter (2004/2005).

<u>The 2002 year class</u>
Parts of the 2002 year class of herring was observed in the northern part of the Norwegian EEZ in spring and summer 2004. The largest component of this year class is expected to be situated in the Barents Sea but this component was not measured as planned in 2004. The Norwegian Sea component and the Barents Sea component has deviating growth

patterns, with the oceanic part growing faster, and they will mature asynchronously. Parts of the Norwegian Sea component will be close to maturity already the coming winter. The future development of the two components is not clear yet, but it is anticipated that the year class will contribute significantly to the spawning stock from 2006 and onwards.

4.4 Blue whiting

The results from the surveys in 2004 suggest either unchanged or slightly decreased abundance of blue whiting in comparison to year 2003. The results confirm that the blue whiting year class from 2000 has been very strong. Year classes 2001–2003 are weaker than the 2000 year class, but the surveys yield no clear signals on the relative strengths of these year classes.

Both total and spawning stock biomass estimates from the spawning areas in March–April are similar to those obtained in 2002 and 2003. The stock in 2004 is, however, composed of fewer and larger fish than in 2002 or 2003. To a large extent this reflects the ageing of year class 2000 that has numerically dominated the total stock estimate since 2002. In fact, this year class has broken the earlier record numbers each year in 2002–2004.

The coverage of the international survey in the Norwegian Sea–Faroese EEZ has been broader in 2003–2004 than in earlier years. For this reason, stock estimates have been also calculated for the survey area that has been covered in all years, that is, for the area north of 63°N and east of 8°W. These results are presented in Table 4.4.1. Stock-level statistics all show that the year 2004 is intermediate, both in terms of stock abundance and size of fish. At a finer level, year class 2000 appears as the strongest year class in record at all ages 1–4 years. Year class 2003 is now recorded for the first time in this survey, and has about the same abundance as that from 1999, which was a strong year class.

The coverage of the Icelandic survey in July was broader in 2003 than in other years. Stock numbers have therefore also been calculated for the survey area that has been covered in all years (Table 4.4.2). The total stock numbers are essentially unchanged from 2003. The biomass estimate from 2003 is not comparable with the estimate in 2004; in comparison to 1999–2002 the stock biomass is slightly higher.

As before, the abundance estimates reported here should be considered as relative rather than absolute estimates because of the uncertainty in the target strength (TS) relationship underlying the calculations. The estimates reported here are based on a TS relationship that is believed to give too low TS for blue whiting and, in consequence, too high biomass estimates (ICES, 2004b). Work to find a more adequate TS relationship will hopefully be commenced in 2005.

Apart from the Norwegian blue whiting spawning stock survey (which was a part of the international survey), none of the blue whiting surveys reported here were used in the final blue whiting stock assessment (ICES, 2004b). The Study Group on Assessment Methods Applicable to Assessment of Norwegian Spring-Spawning Herring and Blue Whiting Stocks (SGAMHBW) recommended considering the Icelandic survey to be used in tuning, whereas it did not recommend using the international May survey (ICES, 2004a). The latter recommendation reflects the fact that at the time of that study group the time series consisted of only four years. The Planning Group feels that the extended temporal range of the survey time series warrants considering the international May survey in the 2005 assessment working group (six years by that time).

5 Planning

5.1 Planned acoustic survey of pelagic fish and the environment in the Norwegian Sea and in the Barents Sea, spring/summer 2005

It is planned that five parties; Denmark (EU-coordinated), Faroe Islands, Iceland, Russia and Norway, will contribute to the survey of pelagic fish and the environment in the Norwegian Sea in May 2005. The participation and area coverage for the different parties are given in Figures 5.1.1 and 5.1.2. It is proposed that the Danish vessel start its survey in the end of April. The plan will be to calibrate the acoustic equipment of the vessel near Ålesund and then start surveying the area north of 62°N and east of 2°W with east-west cruise-lines.

The Norwegian vessel(s) will start at the end of April/beginning of May (the date(s) and name(s) of vessel(s) will be decided by mid October 2004) and start by conducting the Svinøy hydrographic section. After this it will start surveying the area north of 66°N.

It is however important that an acoustic intercalibration on herring recordings of the Norwegian vessel and the Danish vessel takes place. This intercalibration did not take place at the 2004 survey. Therefore, effort should be put into this task at the 2005 survey. Fishing would also be carried out during this intercalibration exercise and the trawl selectivity compared. The intention is further that the area north of 66°N can be surveyed with survey lines 30 nm apart and alternating cruise lines by the Norwegian and Danish vessel.

The Faroes will survey the area south of 62°N in the first half of the survey and the area north of 62°N in the second half. The Icelandic vessel has planned to conduct their survey in mid May.

The Russian vessel will start the survey at the middle of May from Barents Sea to the west direction and will continue in the Norwegian Sea in June-July. The Barents Sea part of the survey will cover young herring (1–3 years old) and it is the intention that the second Norwegian vessel will cover the western part of the immature herring (2002 year class). An acoustic intercalibration should also be carried out between these two vessels.

There are planned areas of overlap (Figures 5.1.1 and 5.1.2). If possible east-west cruise lines should be applied. The proposed programme is shown in the text table below.

Ship	Nation	Vessel time (days)	Active survey time (days)	Preliminary dates
G.O. Sars	Norway	35	28	1/5–4/6
Johan Hjort	Norway	15	10	?
Fridtjof Nansen	Russia	15	15	15/5–30/5
Dana	Denmark (EU)	30	22	27/4–25/5
Magnus Heinason	Faroes	18	14	27/4–25/5
Arni Fridriksson	Iceland	14	10	(22/5–3/6)
Fridtjof Nansen	Russia	61	56	June–July
Bjarni Sæmundsson	Iceland	18	14	(13/7–30/7)

? denotes no information at present and figures in brackets are preliminary information

The following investigations should be targeted:

- Norwegian spring-spawning herring
- Blue whiting
- Plankton
- Temperature and salinity

If possible the participating vessels should be rigged for surface trawling. For age-reading of the Norwegian spring-spawning herring scales should be utilized, and if possible the cod end of the trawls should be equipped with some device (cage or other) for reduction of scale losses.

Standardisation of sampling procedures

The PG participants agreed to conduct their acoustic surveys in May 2005 using the standardised sampling procedures given below.

Zooplankton

Zooplankton should be sampled using a WP2 sampler (diameter 56 cm and mesh size 180 µm) and vertical haul from 200 m depth to the surface with a speed of ½ m per second should be carried out.

It is recommended that the zooplankton samples are split into three size fractions (180, 1000 and 2000 µm) and from the largest size fraction krill, fish and shrimps are sorted out prior to drying and weighing. The use of size fractioning is a quick and cost effective method to obtain information on seasonal developmental status and species distribution in the samples. The dried zooplankton samples should be weighed in the laboratory on land.

In the Russian cruise zooplankton will be sampled by both Djedy and WP-2 nets. WP-2 will be used in order to get samples for dry weight of zooplankton. The zooplankton samples will be weighed in the laboratory PINRO. Zooplankton will be sampled in vertical hauls mainly from 50–0 m by Djedy with mesh size 180 µm. Samples by WP-2 net (180 µm mesh) will be taken in vertical hauls from 200 m to the surface in order to have suitable data for comparison.

Hydrography

The coordinated cruises in the Nordic Seas are producing an important time-series on hydrography. In the future, this time-series may be used to track general oceanographic and climatic changes, and to resolve water mass distribution. To enable this, the time-series should consist of high quality data, covering adequate depths. PGNAPES recommends that the sampling depth for CTD casts be standardised to 1000 m.

Acoustic sampling

PGNAPES recommends channel intervals to be selected so that data can be reported by 50 m channels from the surface to 400 m, and one channel from 400–500 m. However, if possible the acoustic data should be reported by 10 m channels from the surface to 500 m.

Biological samples of fish

PGNAPES recommends that a random full sample of at least 50, but preferably 100, fish is taken from every trawl catch. If there is only few fish in the catch these should also be analysed. The full sample should include the biological variables of length, weight, age (otolith, scales), maturity (1–8 scale herring, 1–7 scale blue whiting) and sex.

Special task (outside standard sampling programme)
If possible, stomachs of herring should be weighted during standard biological sampling. Stomach weight is recommended due to the uncertainty introduced by the subjective stomach fullness index. PGNAPES also recommends that the empty stomach and body weight of 500 herring be measured during next year's cruises to establish a relationship between stomach and body weight. The relationship will be used to estimate stomach content from total stomach weight and body weight.

5.2 Planned acoustic survey of the NE Atlantic blue whiting spawning grounds in 2005

In 2004, PGNAPES considered the optimum coverage that could be achieved for the spawning area blue whiting surveys. It was felt that the group should produce a plan that, if implemented, would achieve complete coverage of the spawning stock and form the basis of an international time series for tuning the blue whiting assessment. The group also recognised the need to maintain the integrity of the international survey, in the event of the non-participation of some countries.

It is probable that at least 4, and as many as 5 parties will contribute to the blue whiting survey in 2005. Norway and Russia (PINRO) as in previous years will survey the spawning area in late March and early April (Figure 5.2.1). In addition, the group considered that a 2-vessel EU contribution is the best means to achieve coverage of the Porcupine slope spawners and aggregations to the southwest, whilst avoiding double counting. Russia (AtlantNIRO) may participate, by surveying the area at and west of Rockall. It was also suggested that participation by Iceland and the Faroe Islands would be beneficial to overall international effort on spawning fish.

The group decided to maintain the integrity of the existing (Norwegian) tuning series, and to produce a second, more comprehensive international survey series. In order to handle the logistical complexities of such an approach, the group produced a priority list of target areas to be covered in the survey (Figure 5.2.1), as follows:

1) Core area spawning survey (March-April). Norway and Russia (PINRO)

2) a. Porcupine Bank and Seabight southwards (EU)
b. western Porcupine (EU and Russia)
c. western Rockall (EU and Russia)

3) South east Iceland and Faroes (non allocated as yet)

Every year the target areas will be allocated to ships, but the highest priority will always be target area 1. If preliminary transects show no blue whiting in areas 2b and 2c the survey will be adjusted accordingly. The preliminary sea programme is:

Ship	Nation	Vessel time (days)	Active survey time (days)	Preliminary dates
G.O. Sars	Norway	35	28	18/3–18/4
Smolensk	Russia	49	34	18/3–20/4
Celtic Explorer	Ireland (EU)	20	18	Late March
Tridens	Netherlands (EU)	18	14	Late March
Atlantniro	Russia	?	?	Early March?

? denotes no information at present

Transects should be carried out with a general distance of at most 60 nm apart by each vessel. In areas with coverage by two ships, such as target area 1, this should result in transect at most 30 nm apart. The spatial overlapping of the surveys is designed to counteract any unforeseen problems that may prevent the completion of a survey sector.

The survey will take place from 18 March to 18 April each year, to coincide with the spawning aggregations. These dates have been confirmed for the 2005 survey. Real time coordination of the survey will be carried out by the lead scientist on the Norwegian vessel.

An intercalibration exercise is planned, in the region of the continental slope. A suitable aggregation of blue whiting will be located and parallel tracks completed by the participating vessels. Fishing would also be carried out during this intercalibration exercise and the trawl selectivity compared.

Where ever possible survey transects should be consistent with good survey design. At present due to the preliminary state of the internationally coordinated survey, either zigzag or parallel transects will be carried out. It is envisaged that staff be exchanged between the participating vessels, in order to share expertise and to reinforce the adoption of the existing standard operating procedures by the newly participating countries.

Scrutiny of acoustic profiles will take place at sea and most vessels will determine the age of sampled blue whiting from otoliths at sea as well. The results of the cruises will be collated at a meeting in Bergen, after the cruises.

The acoustic data should be collated and analysed in the same format for all countries, to facilitate the rapid incorporation of the results to the WG. This format should be as s_A values per nautical mile of transect. The format for the biological data should in the *.csv format (comma-separated-values) with tables arranged as described by the PGNAPES database format.

5.3 The EU contribution

Plans for the contribution by the EU to the ICES coordinated Norwegian Sea and Blue whiting spawning aggregation surveys were discussed. Both surveys are now designated as priority 1 surveys for the EU under the Data Directive (fisheries data collection programme). This means they receive financial assistance from the European Commission and the EU must take part in them every year. Additional resources of the surveys should be shared proportionately across EU nations with quota shares greater than 5% of the EU quota for each respective species.

In acoustic surveys the vessel, gear and interpretation of data can effect the resulting biomass estimates (see previous report and PGHERS 2003) but the combining effect of multi-vessel coordinated surveys can counteract these differences (e.g. PGHERS). This planning group acknowledged that in both the Norwegian Sea and the blue whiting spawning aggregation surveys the need for scientific constancy is crucial. As the spatial and temporal coverage of these pelagic fish is so large, the more vessels regularly involved in the surveys, the better. It is also important to share the responsibility for the execution of the surveys within the EU to maintain an expert and logistic base across the participatory institutes.

In 2004, “Dana”, “Celtic Explorer” and the “Tridens” took part in surveys under the auspices of PGNAPES for the EU. All three vessels are available for the surveys in 2005. Denmark has submitted plans for “Dana” to join the ICES Norwegian Sea survey in 2005 to the European Commission, and has provisional agreement from Sweden, Ireland, Germany and the UK on sharing the costs. Ireland has submitted plans for 2005 for the “Celtic Explorer” to the European Commission but has yet no agreements on the share of costs with other nations. The proposal to the European Commission by the Netherlands for “Tridens” in 2005 is on hold pending the agreement on the EU contribution to the PGNAPES programme for 2005.

6 Standardisation, TOR (e)

In order to secure more uniform running of the surveys and consequently better data collection of results, there is a need of developing common survey protocols and criteria to ensure this standardization.

Surveys on blue whiting and Norwegian spring spawning herring have been carried out by a number of different research vessels. These vessels have been equipped with different acoustic equipment, used different gears and different survey strategies have been used. These differences may have a negative impact on the collation of results.

Some of the present problems are:

- Differences between vessels.
- Different acoustic equipment is used.
- Differences in running the survey – survey strategy - when to stop echo integration due to the weather conditions - where to fish - when and how.
- Differences in the scrutinization of the echo integrations.
- Differences in age-readings.

Problems, such as vessel effect differences, can not be solved, but can be minimized by the regular use of a restricted number of different vessels when running the surveys.

Concerning the acoustic equipment, adequate maintenance standard should be maintained and the equipment should be calibrated in connection with the survey and preferably just before the survey starts and ends.

One of the best ways of promoting standardization of running surveys is staff exchange between the vessels. An example of this has been the RV Dana 2004 survey in the Norwegian Sea. The survey was conducted as a joined EU survey and the scientific staff was manned by scientist from Denmark, Germany, Ireland, the Netherlands, Sweden and in order to secure continuation of the Norwegian way of running the survey in the area, one scientist from IMR in Norway joined the RV Dana survey. This method proved successful and will be used in the future.

As an example of the problems of scrutinization of the echo-recordings, experiences during the RV Dana 2004 survey can be given. Due to bad weather and bubble noise, it was impossible to scrutinize the upper 50 m in some areas and periods. A comparison of the herring distribution versus the wind speed suggested that many schools in the upper 50 m may have been lost due to this problem. Furthermore, in the two northernmost transects of the Danas survey it appeared not to be possible to make a clear distinction between herring and blue whiting schools. Experience from previous years has shown that herring is found mainly in the upper 50 meters of the water column in small school amidst a more or less dense plankton layer. Blue whiting was found in a lower layer (150–400 m) in less dense schools mixed with mesopelagic fish species and zooplankton. This year, in the northern part of the area covered by RV Dana, trawl information revealed some herring in this mesopelagic layer as well. There was no clear way of distinguishing the schools of blue whiting and herring by their properties in the echograms. The trawl hauls targeted at schools in this layer, were very small (tens of kg) and contained mixtures of blue whiting and herring. Only on one occasion the information from the echo-sounders suggested that the trawl actually caught part of these schools. Based on reports from the Faroese and Norwegian research vessels, reports from fishermen and the sparse trawl information, schools in the upper boundary of this layer with comparatively high s_A values were assigned to herring, whereas the remaining recordings in the same layer were assigned to blue whiting and mesopelagic fish.

However, in the one occasion mentioned above when the trawl information was thought to reflect the school composition, the schools were dense and high up (app.150 m), the catch consisted of blue whiting. This caused considerable confusion amongst the scrutinizers. The targeted schools were in close vicinity of a CTD station, which showed that the temperature at 150m, where the schools were found, was approximately 2º Celsius. Hydrographic data from the ships inlet, showed a sudden drop of the temperature in western direction, right before encountering the schools. At the same time the plankton density seen on the echogram decreased markedly. On the basis of this trawl information and the two trawl hauls thereafter, which contained no herring, in the remaining transect (72º35'N, in western direction), any schools deeper than 50 m were assigned to blue whiting. This is in harmony with previous surveys for Norwegian spring spawners in May, when no herring was found in water of less than 2º Celsius.

Problems as the above mentioned needs to be dealt with and more effort have to be put into common standards for scrutinization of the information from the echo-sounders.

By running otolith- and scale exchange programmes differences between age-readers can be minimized. During the RV Dana survey herring scales were read by one of the Danish age-reading experts and subsequently read by experts from Norway. There was a general consensus in the age readings. Much more work on ageing standardization is required in the future.

The Planning group agreed to develop a manual for conducting surveys on blue whiting and Norwegian spring spawning herring in the north east Atlantic area. This work was agreed to be carried out intersessionally.

Following members of the PG has been assigned to following tasks:

Coordinator	Jørgen Dalskov, Denmark
Hydrographical data	Kjeld Arne Mork, Norway
Plankton data	Webjørn Melle, Norway
Acoustic data	Jens Chr. Holst, Norway
Biological data	Øyvind Tangen, Norway
Data exchange	Leon Smith, Faroe Islands

7 PGNAPES database, TOR (f)

At the PGSPFN meeting in Bergen 2001 the group agreed to set up a common database for the data collected in Norwegian Sea since 1996 by the different nations. This was due to the fact that the data handling was becoming more and more difficult, as the amount of data collected is huge. Already then a draft database design was made.

At the Nordic blue whiting network meeting (with strong PGNAPES participation) in Copenhagen 2004 the Faroese Fisheries Laboratory agreed to set up a test database. Format of tables where finally discussed, and an agreement on table design was reached. It was agreed that all nations should submit all the data from the May surveys conducted in Norwegian Sea in 2003. Nevertheless only few nations have yet committed data.

The database structure was tested onboard RV "Magnus Heinason" during the May-survey in the Norwegian sea 2004, where all data collected where stored in the database, and the survey results extracted from there. A demonstration of the database was given by LS at the meeting. The conclusion is that the base is performing well, making it easy to account for records, and importantly, easy to extract results. Some minor changes in table format has been made. The final description of the base along with a copy of the database with data collected up till now was submitted to the participants of the meeting.

It is recommended that the participants use the database in their work with the data from the Norwegian Sea, to get familiar with the base, and to exploit its possibilities. Further, agreements on a data-exchange format were reached. Data files should be interchanged between the vessels in the *.csv format (comma-separated-values) with tables arranged as described by the PGNAPES database format.

8 By-catch

PGNAPES considered the Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries (SGBYSAL) report (ICES, 2004c) with the objective of contributing to better quantification of salmon by-catch in pelagic fisheries. All trawl catches handled within the framework of PGNAPES are properly screened and salmon catches in the scientific catches are available to the SGBYSAL group. It seems difficult to increase the scientific sampling of salmon within the present frames of PGNAPES. The way towards a better quantification of salmon by-catch seems well described in the recommendations of SGBYSAL.

In general, by-catch has been relatively rare occurrence, but associated with rather wide confidence limits. In Iceland there has been made systematic sampling in 2003, and preliminary results indicated that saithe and silver smelt were recorded as by-catch. Spatial distributions indicate that saithe and silver smelt were primarily caught in Faroese waters, while also cod and lumpfish were caught in Icelandic waters. In terms of the effect of the by-catch on non-targeted fish stocks, concerns are mainly raised with respect to saithe and lumpfish. In 2004 extensive areas within the Icelandic EEZ off south-east Iceland have been closed to the blue whiting fishery due to of large by-catches of mainly saithe and some cod.

During the Icelandic blue whiting survey in July 2004 by-catches of mainly saithe, were more prominent than in previous years but as no environmental studies were done during the cruise it is difficult to explain in terms of changes in environment.

In the Faroes, there has not been any systematic sampling in the past years, however, it seems like there is a wide confidence limit of the by-catch when samples are taken, and the present high level of blue whiting catches is likely to remain for the next few years. Therefore, it seems advisable to systematically monitor the by-catch of all species including the mesopelagic species to improve the information on the possibilities of by-catch of non-targeted species in the fishery. EU countries are now required to collect data on by-catch in pelagic fisheries, and results of these investigations should be made available to this group and SGBYSAL in 2005.

9 References

Anon. (Monstad *et al.*), 1982. Report of the International acoustic survey on blue whiting in the Norwegian Sea, July/August 1982. ICES CM 1982/H:5.

Couperus, B., Ybema, S. and Dickey-Collas, M. 2004. Report of Dutch blue whiting survey west of Ireland. Unpublished Report.

Dalskov, J., Slotte, A. and Lundgren, B. The international acoustic survey in the Norwegian Sea, RV Dana. Unpublished Report.

Commission of the European Communities. Framework for the collection of data in the fisheries sector. Commission Regulation EC 1639/2001.

Heino, M. , Søiland, H., Nygaard, J. E., Oleynik, A., Alvarez, J., Tangen, Ø., O'Donnell, C. Mullins, E., Monstad, T., Macualay, G., Power, G., Ullgren, J., Oganin, I., Ratushnyy, S., Astakhov, A., Guzenko, V., Couperus, B., Ybema, S., Bol, R. and Dickey-Collas, M. 2004a. International blue whiting spawning stock survey spring 2004. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 27 April–4 May 2004. Also available through Web as Toktrapport/Havforskningsinstituttet/ISSN 1503–6294/Nr. 27 – 2003 (sic)

Heino, M., Søiland, H., Nygaard, J. E., Alvarez, J., de Lange, J., Eriksen, K. B., Kristiansen, J., Meland, E., Tangen, Ø., Oleynik, A., Varne, R. and Wienerroither, R. 2004b. Blue whiting survey during spring 2004. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 27 April–4 May 2004. Also available through Web as Toktrapport/Havforskningsinstituttet/ISSN 1503–6294/Nr. 26 – 2003 (sic)

ICES. 2002. Report of the Planning Group on Surveys on Pelagic Fish in the Norwegian Sea 2002. Bergen, Norway, 28–30 August 2002. ICES CM 2002/D:06, 68 pp.

ICES. 2003. Report of the Planning Group on Surveys on Pelagic Fish in the Norwegian Sea 2003. Tórshavn, Faroe Islands, 27–29 August 2003. ICES CM 2003/D:10, 62 pp.

ICES. 2004a. Report of the Study Group on Assessment Methods Applicable to Assessment of Norwegian Spring-Spawning Herring and Blue Whiting Stocks [SGAMHBW]. IPIMAR, Lisboa, Portugal. 19–22 February, 2004. ICES CM 2004/ACFM:23.

ICES. 2004b. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. ICES Headquarters, 27. April – 4. May 2004. ICES CM 2004/ACFM:24. 294 pp.

ICES. 2004c. Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries. Institute of Marine Research, Bergen, Norway, 9–12 March 2004. ICES CM 2004/I:01. 65 p.

Monstad, T., 1986. Report of the Norwegian survey on blue whiting during spring 1986. ICES CM 1986/H53.

O'Donnell, C., Mullins, E., Monstad, T., Macualay, G., Power, G. and Ullgren, J. 2004 .Blue Whiting Acoustic Survey Cruise Report. Marine Institute, Ireland.

Oganin, I., Ratushnyy, S., Astakhov, A. and Guzenko, V. 2004. Blue whiting survey during spring 2004. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 27 April–4 May 2004.

Toresen, R., Gjøsæter, H. and Barros de, P. 1998. The acoustic method as used in the abundance estimation of capelin (*Mallotus villosus* Müller) and herring (*Clupea harengus* Linné) in the Barents Sea. Fisheries Research, 34: 27–37.

Totland, A. and Godø, O.R. 2001. BEAM – an interactive GIS application for acoustic abundance estimation. In T. Nishida, P.R. Kailola and C.E. Hollingworth (Eds): Proceedings of the First Symposium on Geographic Information System (GIS) in Fisheries Science. Fishery GIS Research Group. Saitama, Japan.

Table 1.4.1. Organisational frame of the coordinated herring investigations in the Norwegian Sea, 1995–2004.

Year	Participants	Surveys	Planning meeting	Evaluation meeting
1995	Faroe Islands, Iceland Norway, Russia	11	Bergen (Anon., 1995a)	Reykjavík (Anon., 1995b)
1996	Faroe Islands, Iceland Norway, Russia	13	Tórshavn (Anon., 1996a)	Reykjavík (Anon., 1996b)
1997	Faroe Islands, Iceland Norway, Russia, EU	11	Bergen (ICES CM 1997/H:3)	Reykjavík (Vilhjálmsson, 1997/Y:4)
1998	Faroe Islands, Iceland Norway, Russia, EU	11	Reykjavík (ICES CM 1997/Assess:14)	Lysekil (Holst *et al.*, 1998/D:3)
1999	Faroe Islands, Iceland Norway, Russia, EU	10	Lysekil (Holst *et al.*, 1998/D:3)	Hamburg (Holst *et al.*, 1999/D:3)
2000	Faroe Islands, Iceland Norway, Russia, EU	8	Hamburg (no printed planning report)	Tórshavn (Holst *et al.*, 2000/D:03)
2001	Faroe Islands, Iceland Norway, Russia, EU	11	Tórshavn (no printed planning report)	Reykjavik (Holst *et al.*, 2001/D:07)
2002	Faroe Islands, Iceland Norway, Russia	8	Reykjavik (no printed planning report)	Bergen (ICES CM 2002/D:07)
2003	Faroe Islands, Iceland Norway, Russia, EU	5	Bergen (ICES CM 2002/D:07) + correspondence	Tórshavn (ICES CM 2003/D:10)
2004	Faroe Islands, Iceland Norway, Russia, EU	5	Tórshavn (ICES CM 2003/D:10) + correspondence	Murmansk (this report)

Table 2.4.1. Surveys conducted in spring and summer 2004 by Faroese, Icelandic, Norwegian, Russian and Danish vessels in the North Atlantic, which are related to the Norwegian spring-spawning herring and blue whiting. No Russian surveys were conducted in this time period (see Section 1.4).

Platform	Country	Survey area	Period	Herring samples	Blue whiting samples	Mackerel samples	Plankton samples	CTD stations
Dana	DK	62°N–72°30'N, 2°W–15°E	27/4–26/5	24	25	–	43	43
Magnus Heinason	FA	60°N–66°30'N, 14°W–0°W	28/4–26/5	10	31	5	103	122
G.O. Sars	NO	62°N–73°30'N, 6°W–18E°W	2/5–27/5	19	18	–	42	46
Arni Fridriksson	IS	68°40΄N–62°50'N, 16°W–3°W	22/5–3/6				56	56
Mosby	NO	62°45´N– 67°36´N 5°20'W–1°20'E	10/6–30/6	14	–	–	43	67
Persey–IV	RU	62°30'N–68°30'N, 5°20'W–1°20'E	4/7–18/8	7	8	5	–	64
Bjarni Sæmundsson	IS	62°45´N– 67°36´N 5°20'W–1°20'E	13/7–30/7					–

Table 2.4.2. Surveys conducted in March-April 2004 by Norwegian, Russian and EU (Ireland and Holland) vessels in the North Atlantic, targeting blue whiting on the spawning grounds west of the British Isles.

Platform	Country	Survey area	Period	Blue whiting samples	Mackerel samples	Plankton samples	CTD stations
Celtic Explorer	IR	50°20'N–56°N, 16°W–9°W	25/3–4/4	10	3	-	18
Tridens	NL	49°N–55°20'N, 18°W–10°W	17/3–27/3	5	0	-	6
Johan Hjort	NO	53°30'N–62°00'N, 17°W–1°30'W	19/3–18/4	36	-	43	103
Fridtjof Nansen	RU	53°15'N–60°15'N, 18°W–8°W	23/3–15/4	?	?	?	67

Table 3.2.1. Average zooplankton biomass [g dry weight m^{-2}]. The 1998 and 2004 data on the Faroese shelf were omitted to allow comparison with the other years.

Year	1997	1998	1999	2000	2001	2002	2003	2004	Mean
Total area	8.2	13.4	10.6	14.2	11.6	13.1	12.4	9.2	11.6
Region W of 2°W	9.1	13.4	13.5	15.7	11.4	13.7	14.6	9.8	12.7
Region E of 2°W	7.5	14.4	10.2	11.8	8.7	13.6	9.0	8.0	10.4

Table 3.3.1. Age- and length-stratified abundance estimate of Norwegian spring-spawning herring in May-June 2004. Data from RVs "G.O. Sars", "Dana", "Magnus Heinason" and "Arni Fridriksson", May-June 2004. Target strength used for herring: 20 log(L) – 71.9.

Length	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Numbers	Biomass	Weight
15		200														200	5	24
16		784														784	23	29
17		2750														2750	98	36
18		2087														2087	85	41
19		1883	37													1920	92	48
20		1570	77													1647	95	58
21		1106														1106	80	73
22		1335	213	34												1582	135	85
23		1162	177	29	7											1375	130	94
24		549	280													829	89	107
25		266	333													599	72	120
26		33	277	79												389	55	141
27		0	73	556	17	85										731	116	159
28		0	18	1083	75	14										1190	210	176
29		10	1	1846	794	326										2977	571	192
30			57	1194	4200	1409	105	14								6979	1445	207
31				314	4810	3373	84									8581	1925	224
32				92	2241	3367	106	19					6			5831	1413	242
33					246	1785	427	68				6				2532	684	270
34					181	340	231	156	16	4	5	6	78			1017	297	293
35							76	270	60	220	166	637	144			1573	523	333
36						11	46	53		89	191	528	466	8	85	1477	520	352
37												108	325	2	3	438	163	371
38													92			92	36	396
39												9	9			18	8	408
40																		
41																		
42																		
43																		
44																		
45																		
Numbers (10^6)	0	13735	1543	5227	12571	10710	1075	580	76	313	362	1294	1120	10	88	48,704		
Biomass (10^3 t)		792	177	989.5	2779.9	2528.2	290.6	179.9	24.7	105.9	124.6	445.2	396.7	3.7	31.1		8,869	
Length (cm)		20	24.8	29.4	31.3	32	33.4	34.9	35.3	35.8	35.9	36.1	36.7	36.7	36.5			28.2
Weight (g)		57.7	114.6	189.3	221.1	236	270.4	310.4	324.2	337.6	340.1	343.6	354.1	356.1	352.3			181.7

Table 3.5.1. Age- and length-stratified abundance estimate of blue whiting in the spawning area, west of the British Isles. Data from RVs "Celtic Explorer", "Fridtjof Nansen", "Johan Hjort" and "Tridens", March–April 2004. Target strength used for blue whiting: TS = 21.8 log L – 72.8 dB.

Length	Age in years (year class)										Num-Bers	Bio-mass	Mean weight	Prop. mature
	1	2	3	4	5	6	7	8	9	10				
(cm)	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	(10^6)	(10^6 kg)	(g)	(%)
14.0 – 15.0	117										117	2	12.6	0
15.0 – 16.0	475										475	8	17.2	0
16.0 – 17.0	792										792	16	20.6	0
17.0 – 18.0	1006										1006	25	24.7	0
18.0 – 19.0	1181										1181	34	29.1	0
19.0 – 20.0	756	549									1305	44	33.9	28
20.0 – 21.0	339	1408									1746	70	40.2	48
21.0 – 22.0	90	1839	42	3							1974	94	47.5	57
22.0 – 23.0	18	2429	1100	272	7						3826	215	56.3	67
23.0 – 24.0	102	4851	2697	1150	18						8817	545	61.8	83
24.0 – 25.0	11	3667	7002	5717	634	103					17134	1167	68.1	93
25.0 – 26.0		1538	9795	9150	1190	35	43				21751	1616	74.3	97
26.0 – 27.0		837	6311	9981	2601	80		80			19891	1611	81.0	99
27.0 – 28.0		141	3696	8956	2410	842	49	101	53		16249	1459	89.8	99
28.0 – 29.0		225	2266	4382	3319	520	222	579	94		11608	1187	102	100
29.0 – 30.0		58	514	2852	2400	982	553	133	58		7551	833	110	100
30.0 – 31.0		59	383	1207	1672	943	677	195			5136	631	123	100
31.0 – 32.0			125	448	1381	787	544	180			3465	476	137	100
32.0 – 33.0			6	278	473	437	456	238			1888	291	154	100
33.0 – 34.0			97		254	89	243	146	537		1367	226	166	100
34.0 – 35.0			315		52	52	153	153			725	122	168	100
35.0 – 36.0					36	518	23	22	114		714	146	205	100
36.0 – 37.0					157	94	16	94	9		370	85	229	100
37.0 – 38.0							87		132	87	307	80	262	100
38.0 – 39.0					170	13	13	13	13	13	233	53	229	100
39.0 – 40.0						13	17	13	107	13	163	44	272	100
40.0 – 41.0						7	7	7	7	7	35	12	333	100
41.0 – 42.0						3	3	4	4	4	18	5	299	100
TSN (10^6)	4886	17603	34350	44397	16775	5521	3111	1962	1131	127	129900			
TSB (10^6 kg)	138	1092	2697	3762	1775	713	427	262	205	34	11100			
Mean length (cm)	18.1	23.5	25.9	26.7	28.7	30.5	31.4	30.9	34.0	38.2	26.4			
Mean weight (g)	28.3	62.0	78.5	84.7	106	129	137	133	181	263	85.5			
Condition	4.8	4.8	4.5	4.4	4.5	4.6	4.4	4.5	4.6	4.7	4.6			
% mature	3	76	96	99	100	100	100	100	100	100	91.5			
% of SSB	+	8	25	36	17	7	4	3	2	+				

Table 3.5.2. Age- and length-stratified abundance estimate of blue whiting in the Norwegian Sea–Faroese EEZ in May 2004. Data from RVs "Dana", "Magnus Heinason", "Arni Fridriksson" and "G. O. Sars". Target strength used for blue whiting: TS = 21.8 log L – 72.8 dB.

Length (cm)	Age in years (year class) 1 2003	2 2002	3 2001	4 2000	5 1999	6 1998	7 1997	8 1996	9 1995	10 1994	Numbers (10^6)	Biomass (10^6 kg)	Mean weight (g)
15.0 – 16.0	166										166	3	17
16.0 – 17.0	2267										2267	51	22
17.0 – 18.0	12566	113									12679	334	26
18.0 – 19.0	18681	269									18950	610	32
19.0 – 20.0	14379	322									14701	544	37
20.0 – 21.0	5915	1852									7767	354	46
21.0 – 22.0	524	7255	521								8300	484	58
22.0 – 23.0	246	12774	1759	410							15189	999	66
23.0 – 24.0	163	8665	6673	447							15948	1175	74
24.0 – 25.0	156	2469	7938	2438	18						13019	1075	83
25.0 – 26.0	64	286	6278	5604	123						12355	1132	92
26.0 – 27.0	23	140	3108	6940	417	60	51				10739	1085	101
27.0 – 28.0	4	13	716	5513	1213	9	9				7477	820	110
28.0 – 29.0	1	3	37	2435	2291	28	1	1			4797	577	120
29.0 – 30.0		1	12	577	2309	348	2	2			3251	438	135
30.0 – 31.0				74	284	1757					2115	310	146
31.0 – 32.0				8	32	979	30	5			1054	166	158
32.0 – 33.0				1	17	302	296				616	105	170
33.0 – 34.0				20		41	143	20			224	44	195
34.0 – 35.0						212	31				243	47	192
35.0 – 36.0						73					73	16	227
36.0 – 37.0							2				2	1	246
37.0 – 38.0								9			9	2	258
TSN (10^6)	55155	34162	27042	24467	6704	3809	565	37	0	0	151941		
TSB (10^6 kg)	1869	2256	2267	2468	824	585	96	8			10373		
Mean length (cm)	18.7	22.5	24.6	26.5	28.6	31.1	32.2	33.9			22.7		
Mean weight (g)	33.9	66.0	83.8	101	123	154	170	202			68.3		
Condition	5.2	5.8	5.6	5.4	5.3	5.1	5.1	5.2			5.8		

Table 3.5.3. Age stratified abundance estimate of blue whiting in the Icelandic waters. Data from RV “Bjarni Sæmundsson”, 13.7–30.7.2004. Target strength used for blue whiting: TS = 21.8 log L – 72.8 dB.

	Age										
	0	1	2	3	4	5	6	7	8	9	Total
Number (10^6)	10440	989	3970	3983	4854	2048	817	507	157	33	27800
Biomass (10^6 kg)	169	59	354	429	620	305	153	100	33	8	2229
Mean weight (g)	16.2	59.4	89.1	107.7	128	149	188	197	208	242	95.0
Mean length (cm)	13.5	21.4	24.7	26.4	27.8	29.4	31.8	32.4	33.3	35.0	23.3
% of TSN	37.5	3.6	14.3	14.3	17.5	7.4	2.9	1.8	0.6	0.1	100

Table 4.4.1. Blue whiting, results of the international survey in the Norwegian Sea–Faroese EEZ in May 2000–2004 for the standardised survey area (the southern and western borders set to respectively 63° N and 8° W).

	Age										
	1	2	3	4	5	6	7	8	9	10	Total
Numbers (10^6)											
2000	48927	3133	3580	1668	201	5					57514
2001	85772	25110	7533	3020	2066						123501
2002	15251	46656	14672	4357	513	445		15		6	81915
2003	35688	21487	35372	4354	639	201	43	3			97787
2004	49254	22086	13292	8290	1495	533	83	39			95072
Biomass (10^6 kg)											
2000	1795	260	335	193	25	1					2608
2001	2735	1776	763	418	322						6014
2002	651	2640	1289	526	76	64		3		2	5250
2003	1475	1539	2897	497	88	31	11	1			6538
2004	1643	1437	1188	886	193	77	13	6			5442
Length (cm)											
2000	19.2	24.7	25.6	27.3	27.7	33.2					20.2
2001	18.2	23.4	26.3	28.8	29.8						20.2
2002	20.1	21.9	25.1	27.9	30.1	30.2		34.5		37.5	22.5
2003	20.1	23.5	24.5	27.0	28.9	29.9	34.5	33.5			22.8
2004	18.7	22.5	24.8	26.5	28.6	30.1	31.4	30.9			21.4
Weight (g)											
2000	36.7	83.0	93.5	116	122	225					45.3
2001	31.9	70.7	101	138	156						48.7
2002	42.7	56.6	87.8	121	147	145		210		269	64.1
2003	41.3	71.6	81.9	114	138	153	256	219			66.9
2004	33.4	65.0	89.4	107	129	144	162	160			57.2

Table 4.4.2. Blue whiting, results of the Icelandic acoustic summer survey in 1998–2004 with only the regular survey area included in the estimate for 2003.

	Age										
	0	1	2	3	4	5	6	7	8	9+	Total
Numbers (10^6)											
1998	4293										13186
1999	14869	2100	1357	1772	5790	1344	316	50	15	42	27655
2000	10683	8594	934	523	1218	468	106	25	1	1	22533
2001	27305	4090	5215	1657	1614	398	132	37	2	2	40456
2002	3815	10785	3107	1436	1724	1430	727	178	5	5	23254
2003	5011	9158	4899	4645	1918	646	218	227	91	6	26819
2004	10437	989	3970	3983	4854	2048	817	507	157	33	27795

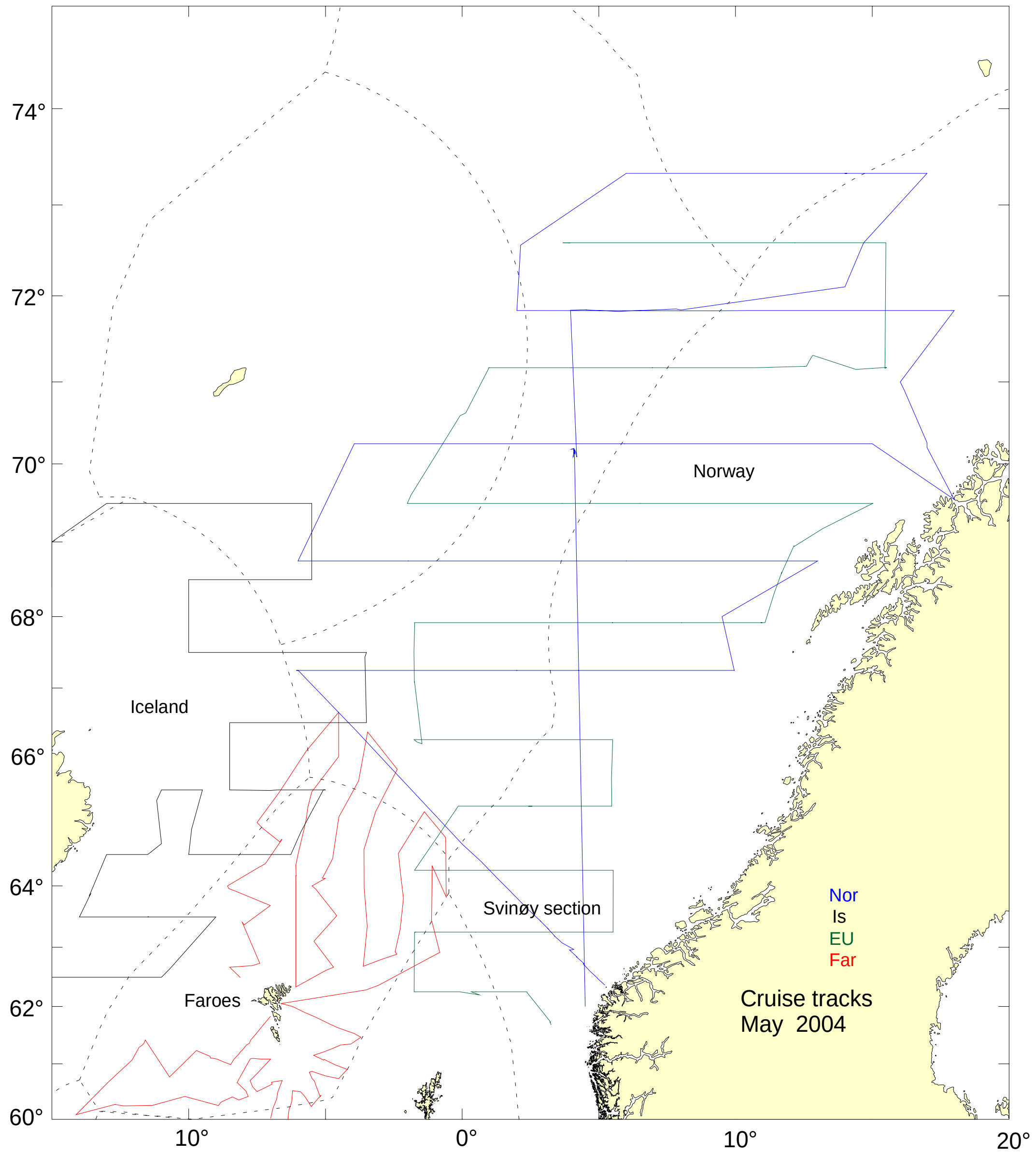

Figure 2.1. May 2004 cruise tracks.

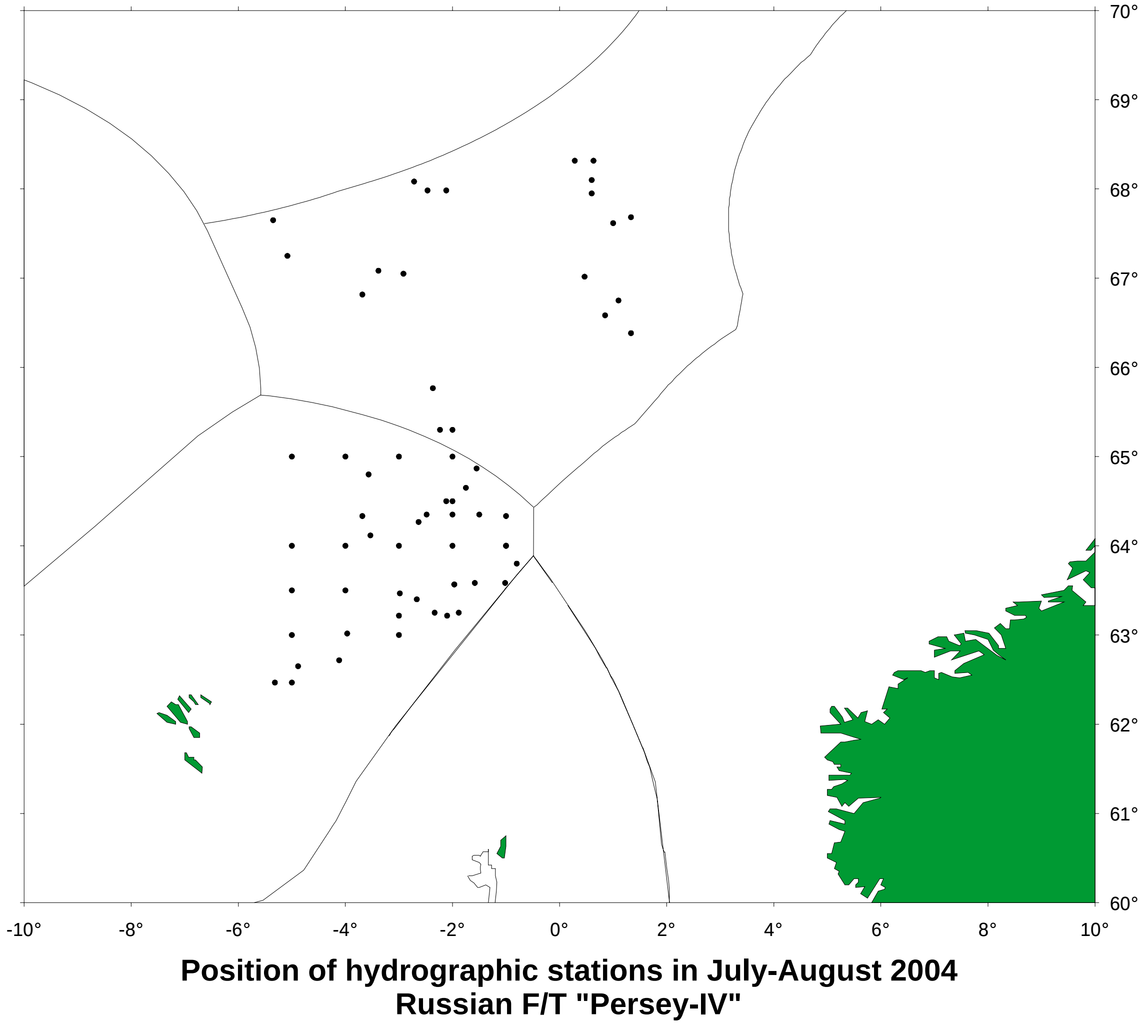

Figure 2.2. Positions of hydrographic station in July/August by F/T "Persey-IV" in the central Norwegian Sea and Faroese EEZ area.

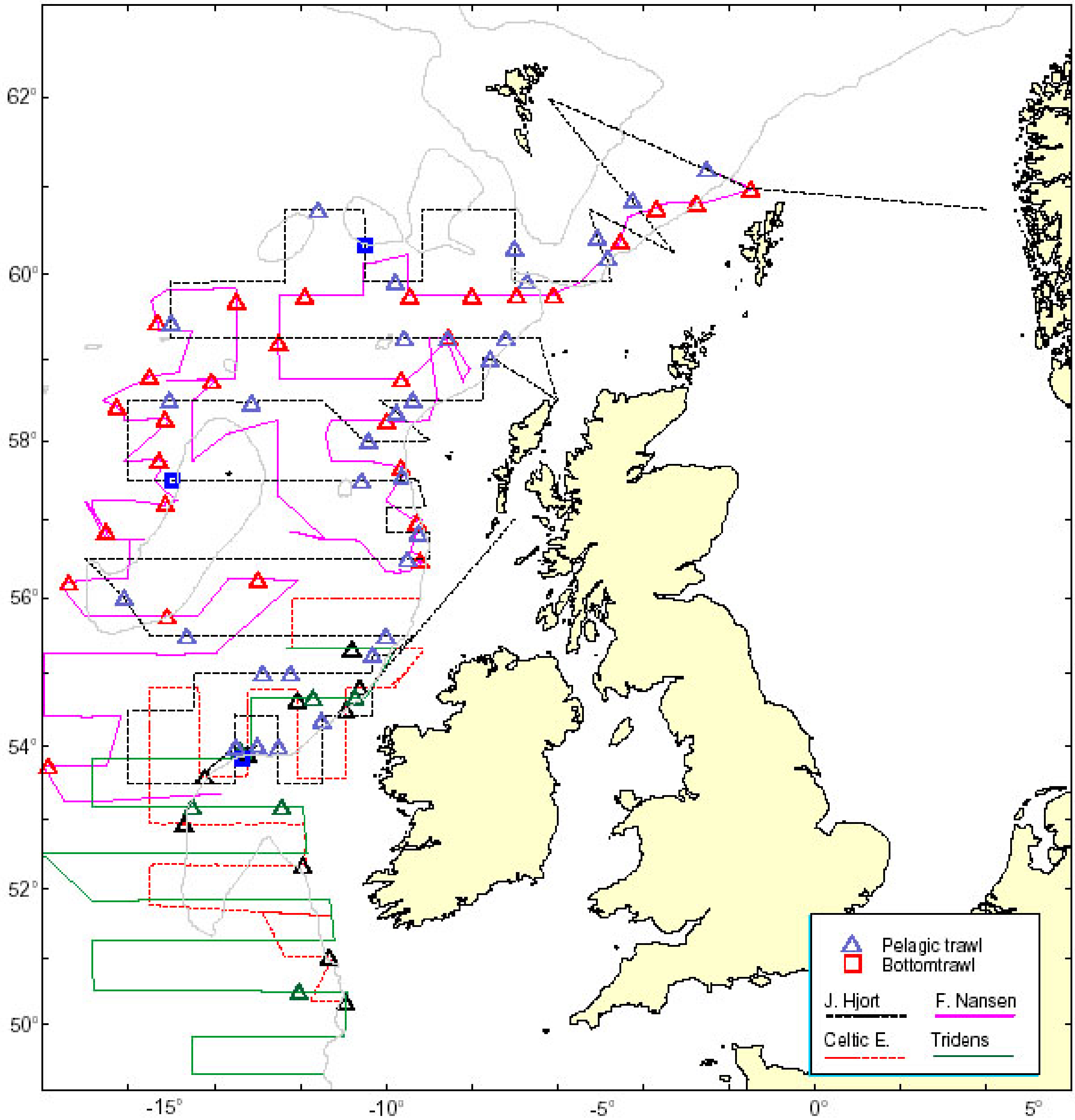

Figure 2.3. March/April 2004 cruise tracks with trawl stations (triangles).

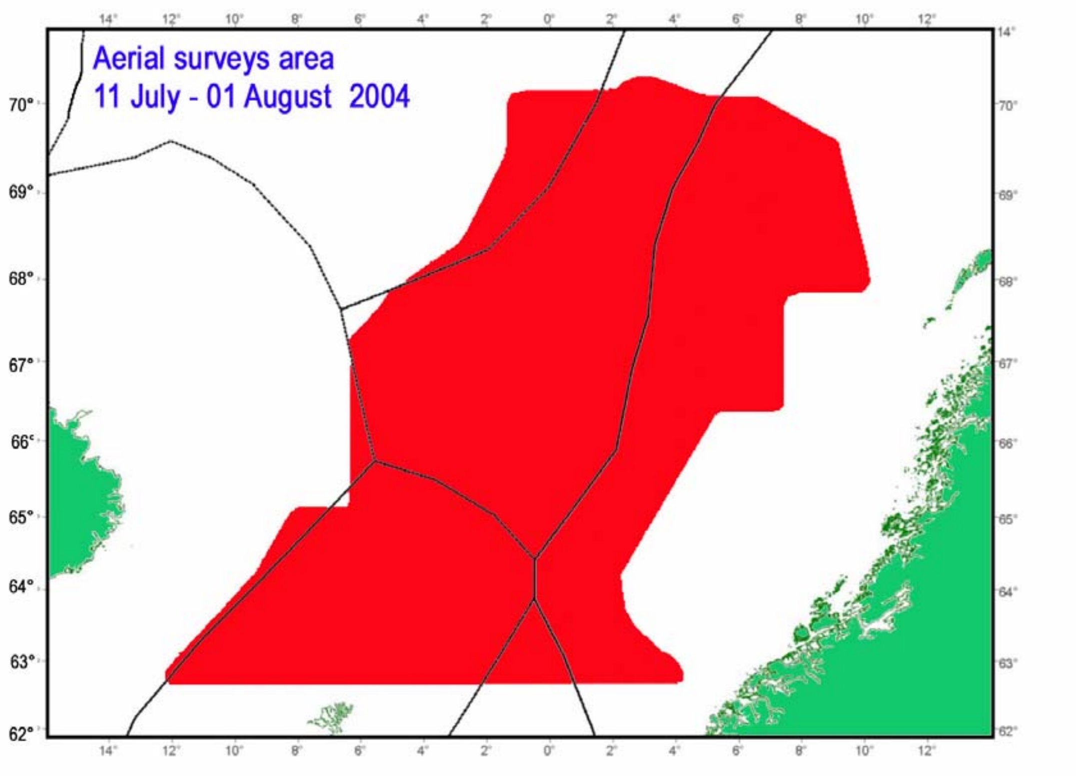

Figure 2.4. Russian coverage in the aerial survey in the Norwegian Sea in summer 2004.

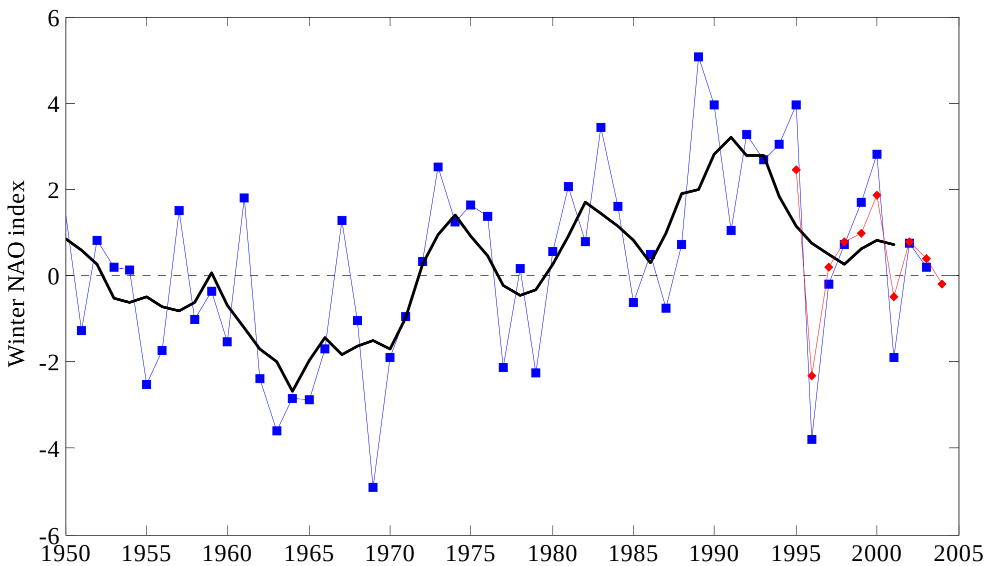

Figure 3.1.1. Hurrell's winter NAO index, from 1950 to 2003 (blue line), and Osborn's winter NAO index from 1995 to 2004 (red line). Black line is 5 years moving averages.

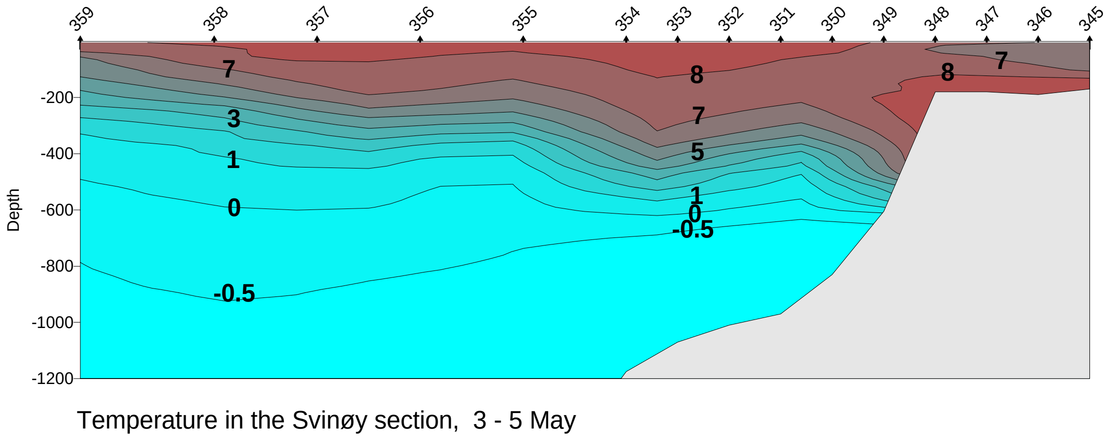

Figure 3.1.2. Temperature in the Svinøy section, 3–5 May 2004.

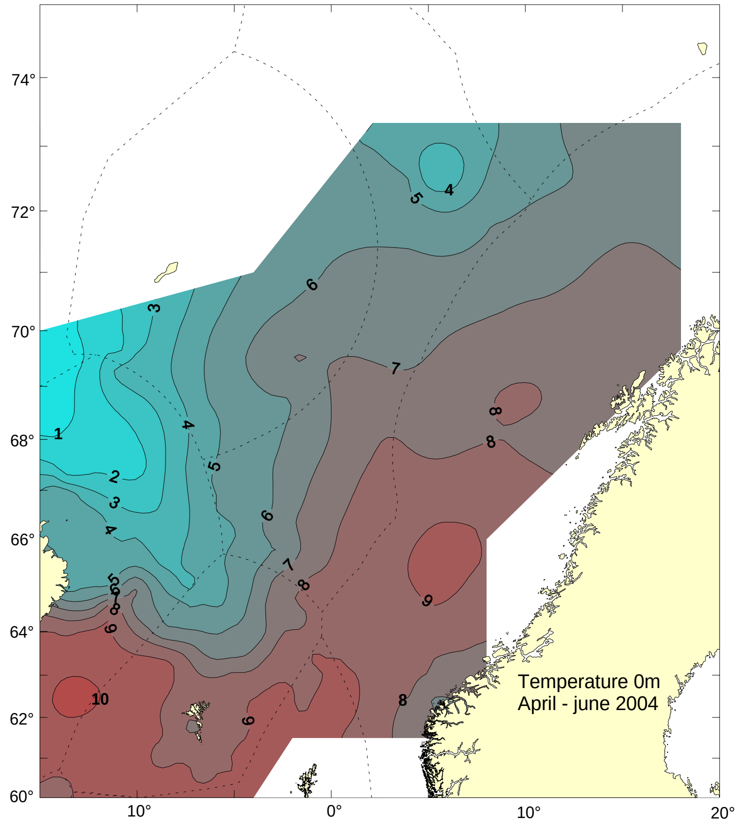

Figure 3.1.3. Temperature at surface in May 2004.

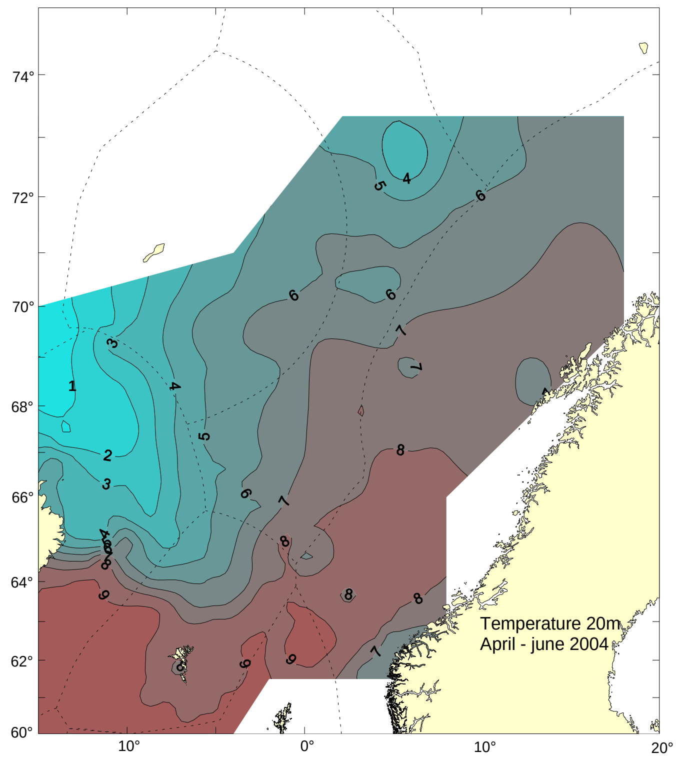

Figure 3.1.4. Temperature at 20 m depth in May 2004.

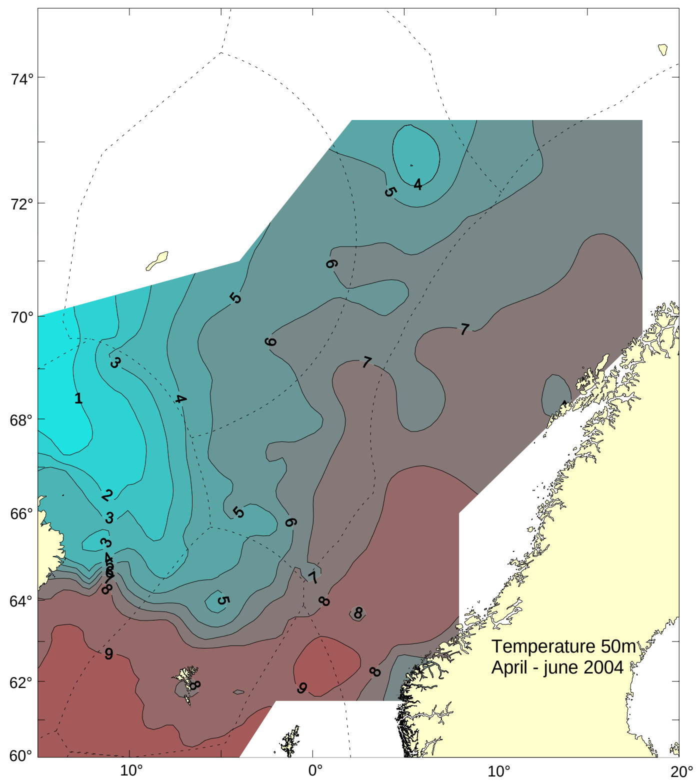

Figure 3.1.5. Temperature at 50 m depth in May 2004.

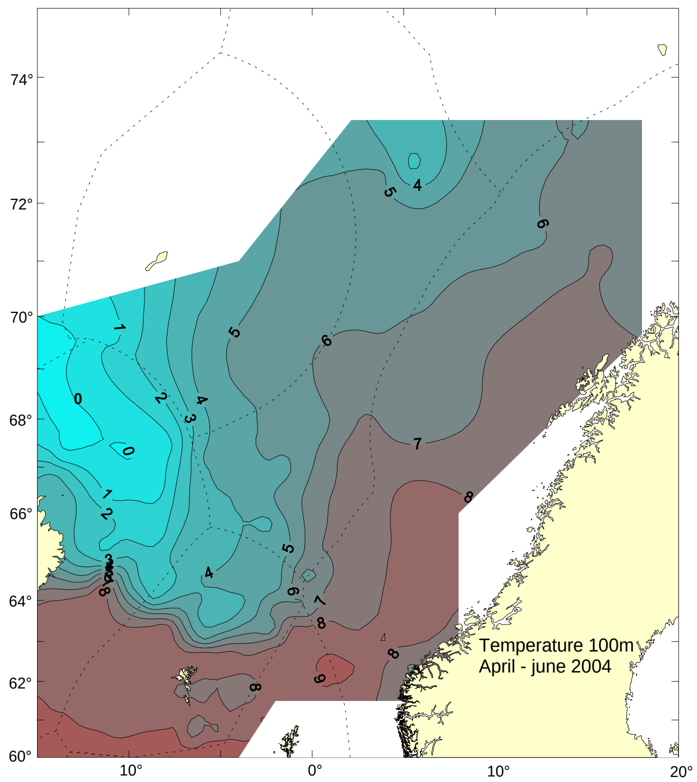

Figure 3.1.6. Temperature at 100 m depth in May 2004.

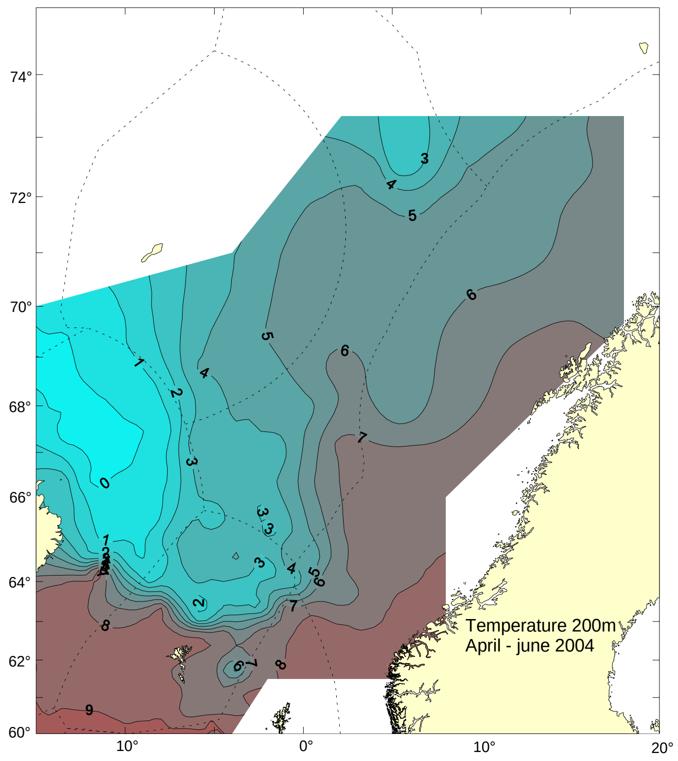

Figure 3.1.7. Temperature at 200 m depth in May 2004.

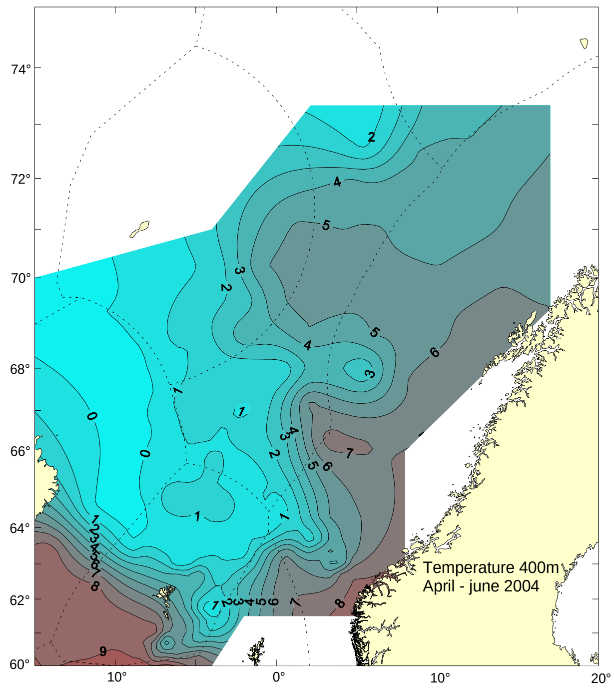

Figure 3.1.8. Temperature at 400 m depth in May 2004.

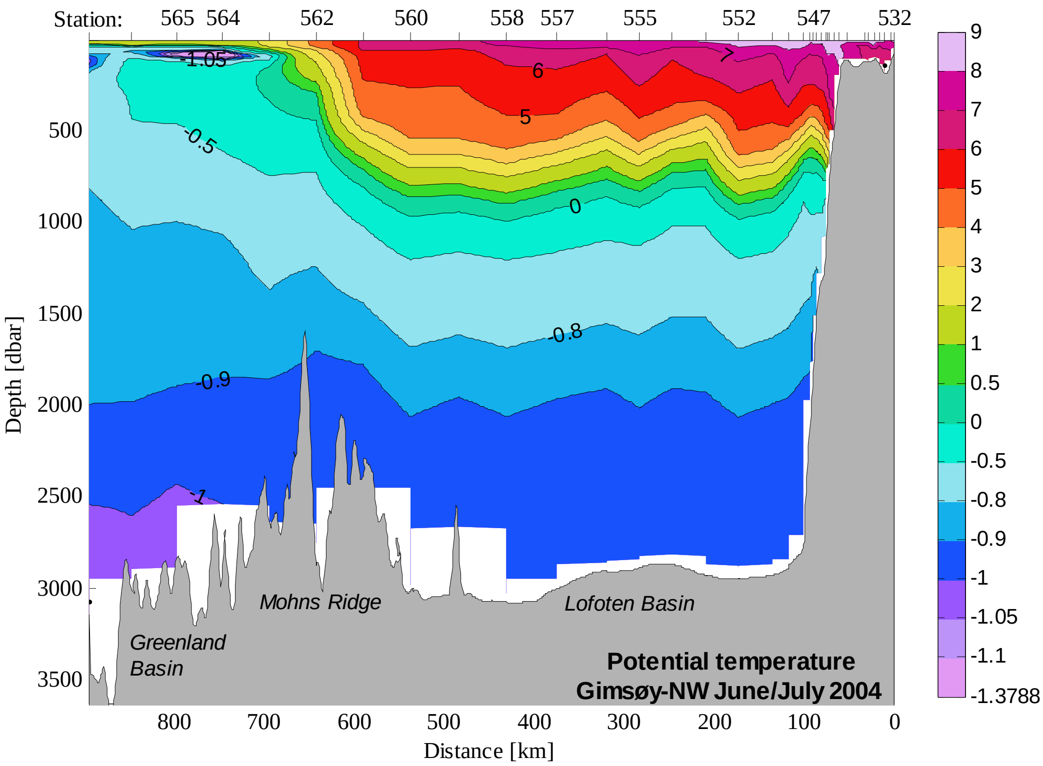

Figure 3.1.9. Potential temperature in the extended Gimsøy-NW section during June 2004. Norwegian coast (Gimsøy) is on the right.

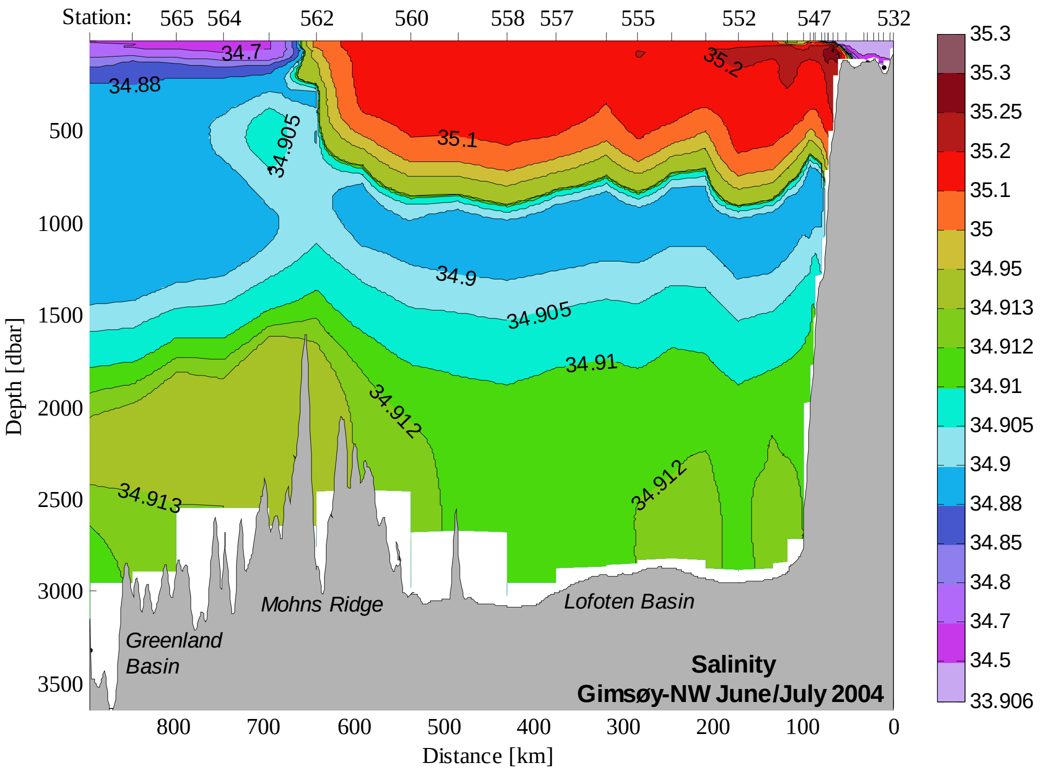

Figure 3.1.10. Salinity in the extended Gimsøy-NW section during June 2004. Norwegian coast (Gimsøy) is on the right.

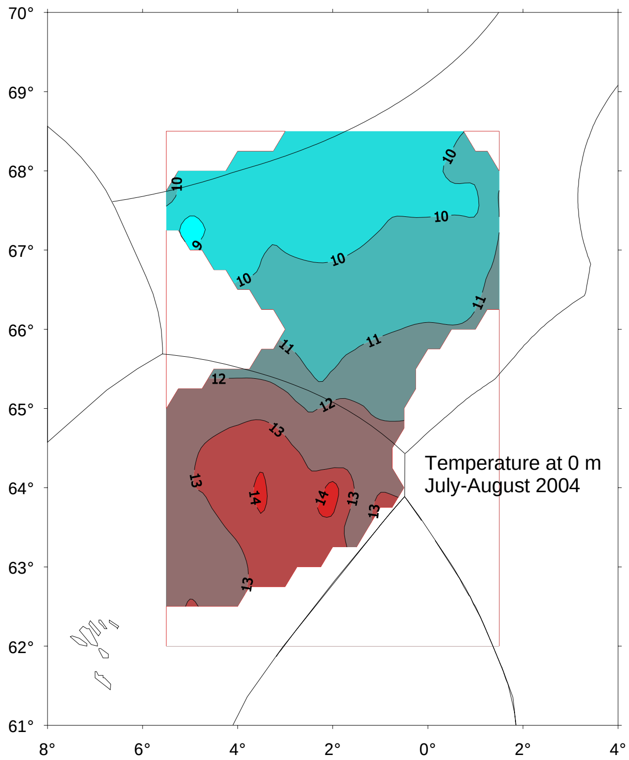

Figure 3.1.11. Temperature at surface in July-August 2004.

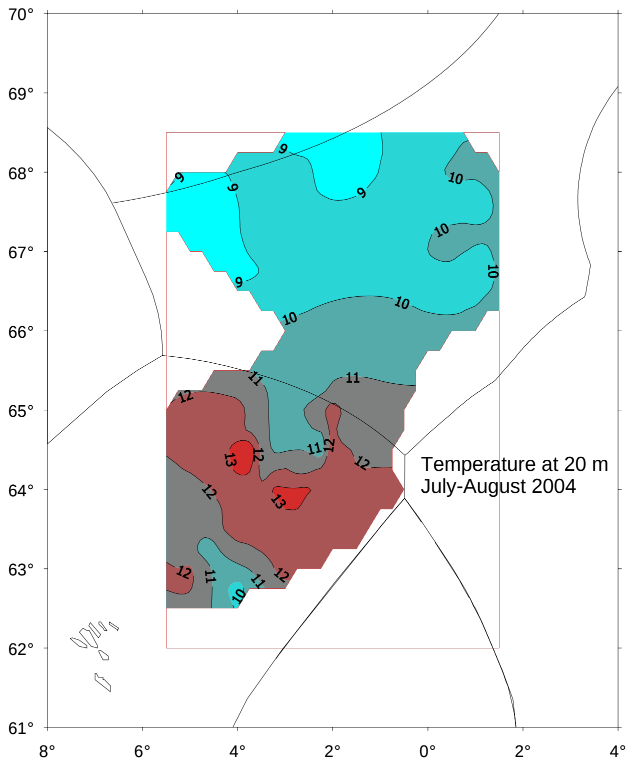

Figure 3.1.12. Temperature at 20 m in July-August 2004.

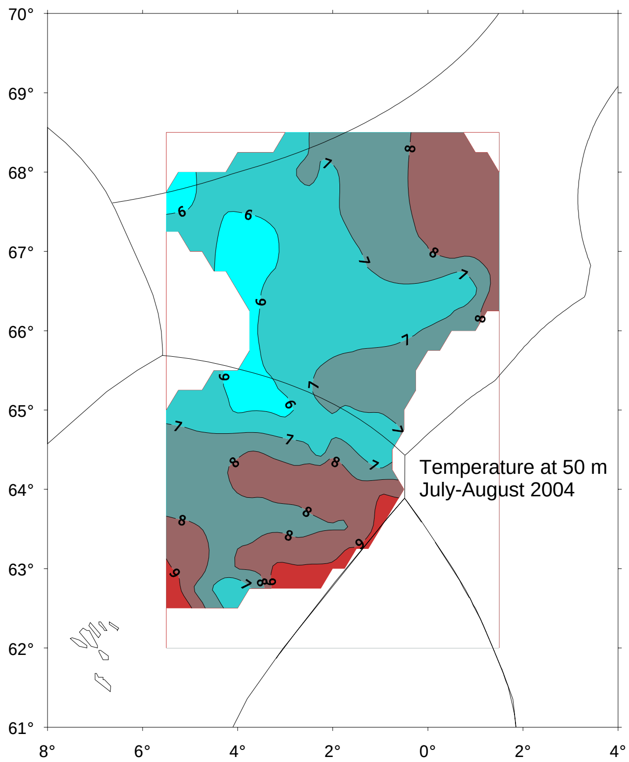

Figure 3.1.13. Temperature at 50 m in July-August 2004.

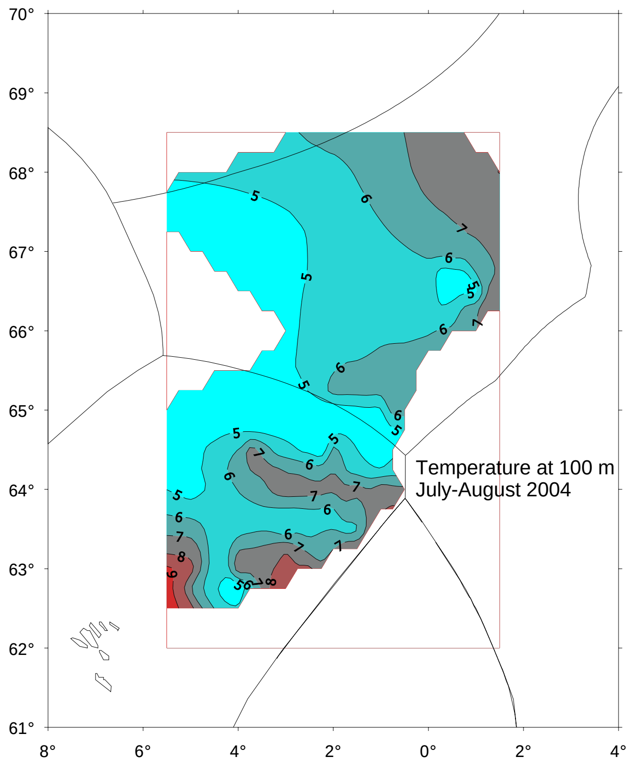

Figure 3.1.14. Temperature at 100 m in July-August 2004.

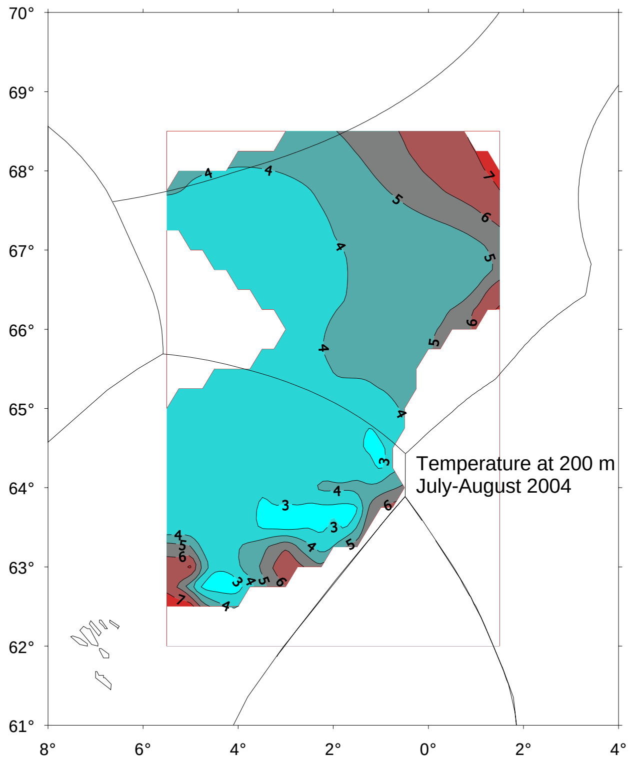

Figure 3.1.15. Temperature at 200 m in July-August 2004 .

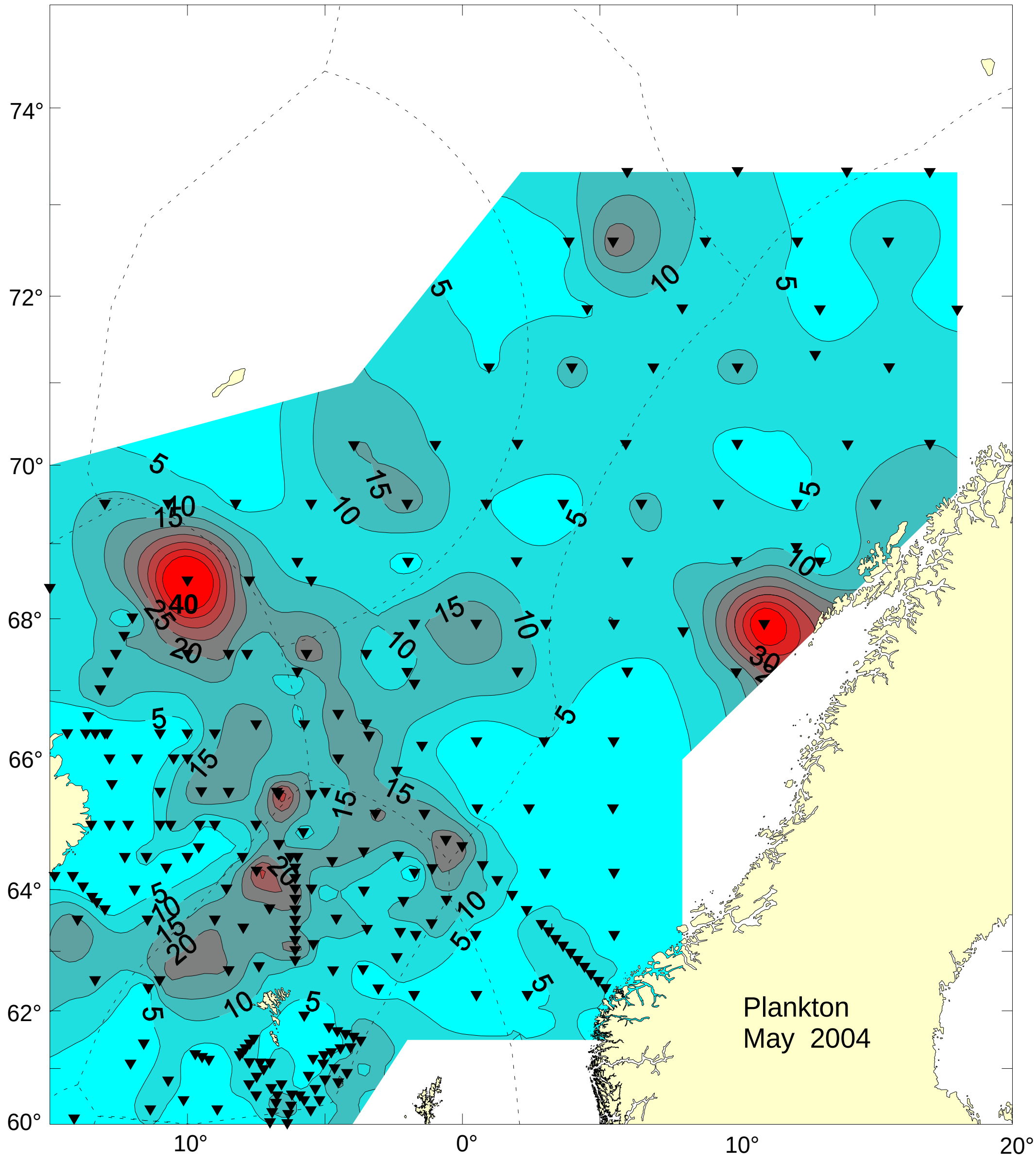

Figure 3.2.1. Zooplankton biomass (g dw m^{-2}) (200–0 m) (50–0 m in Icelandic standard sections) in May 2004.

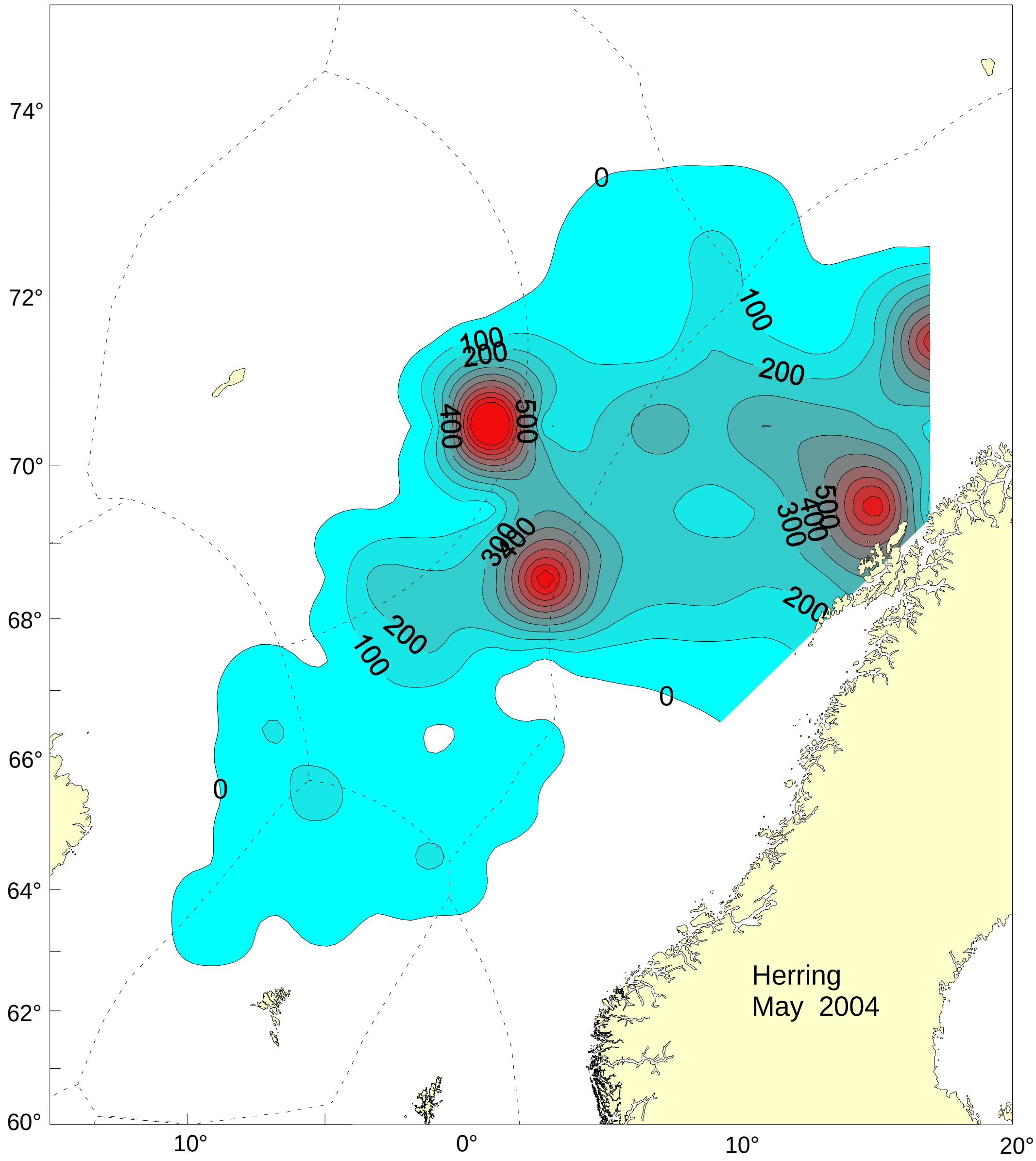

Figure 3.3.1. Distribution of Norwegian spring spawning herring in May 2004.

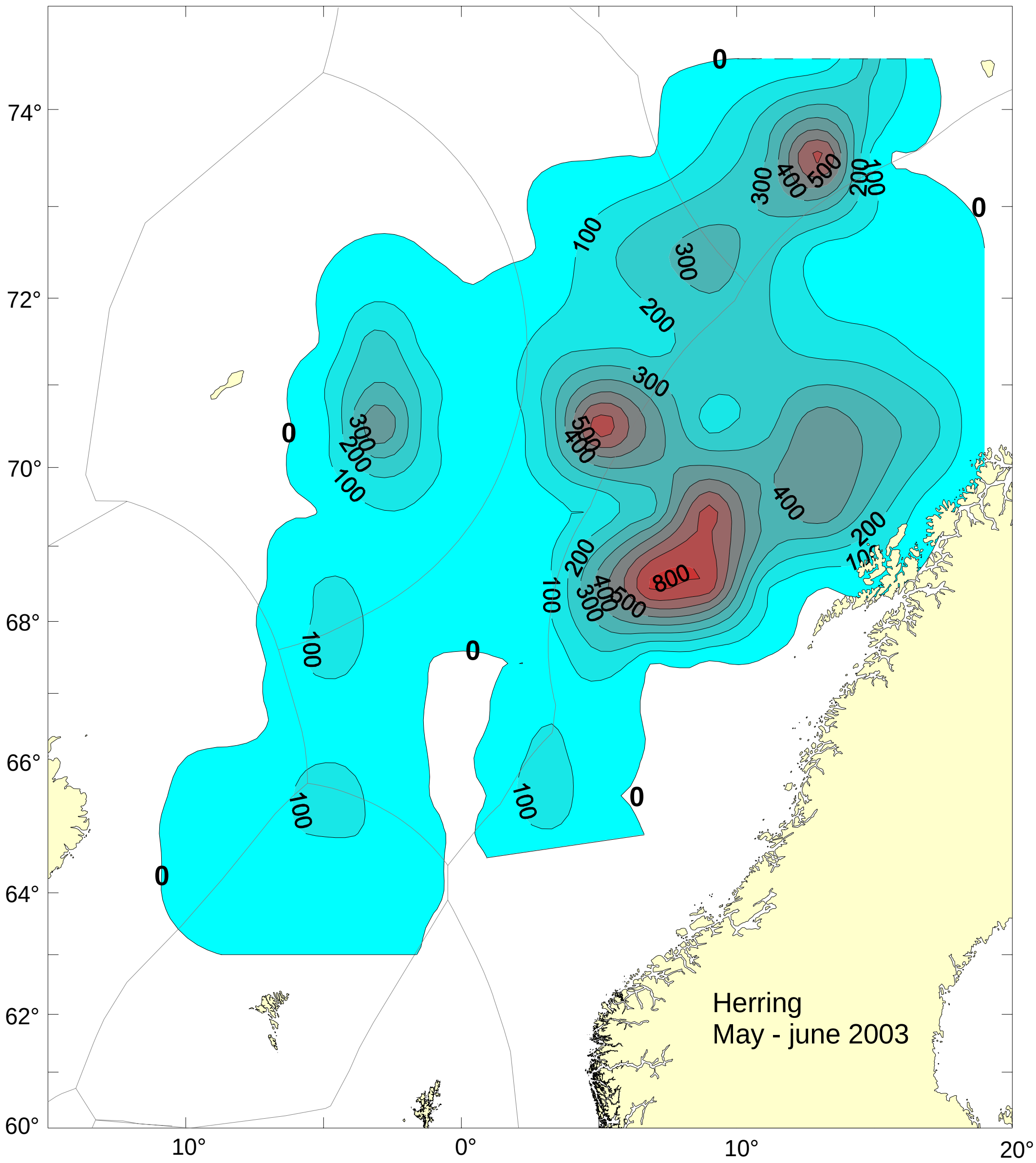

Figure 3.3.2. Distribution of Norwegian spring spawning herring in May 2003 (ICES CM 2003/D:10).

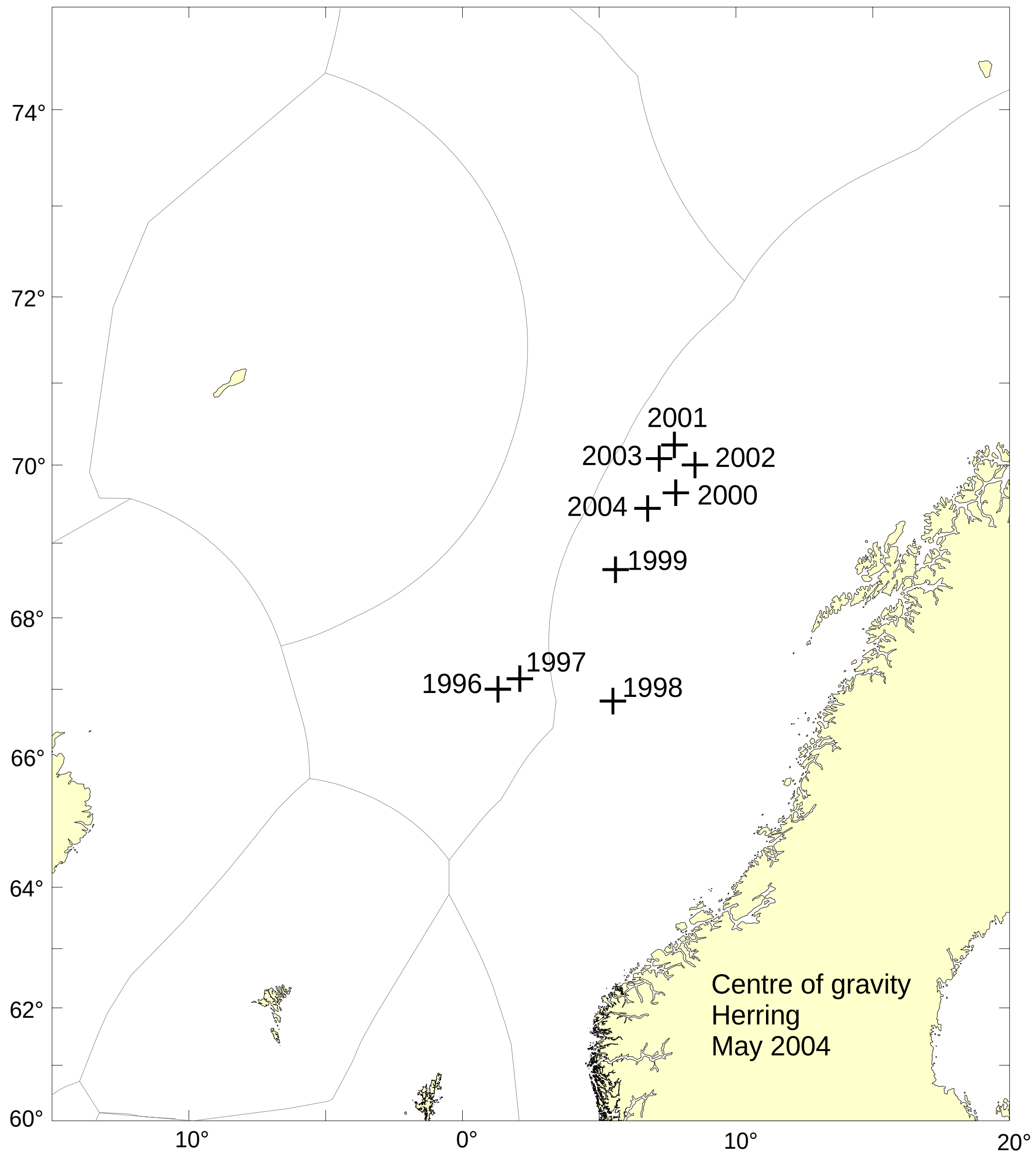

Figure 3.3.3. Centre of gravity of herring during the period 1996–2004 derived from acoustic value.

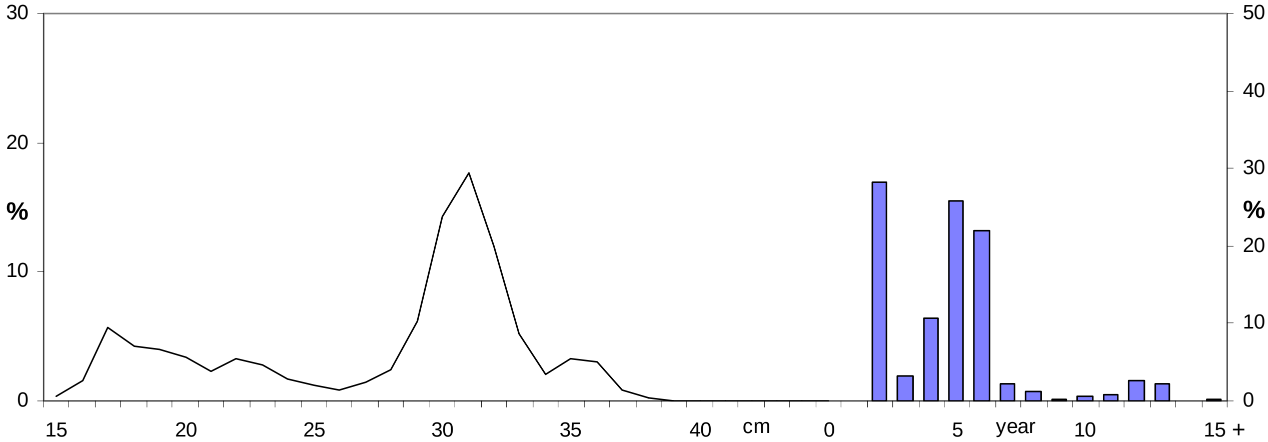

Figure 3.3.4. Length and age distribution of Norwegian spring spawning herring in May 2004.

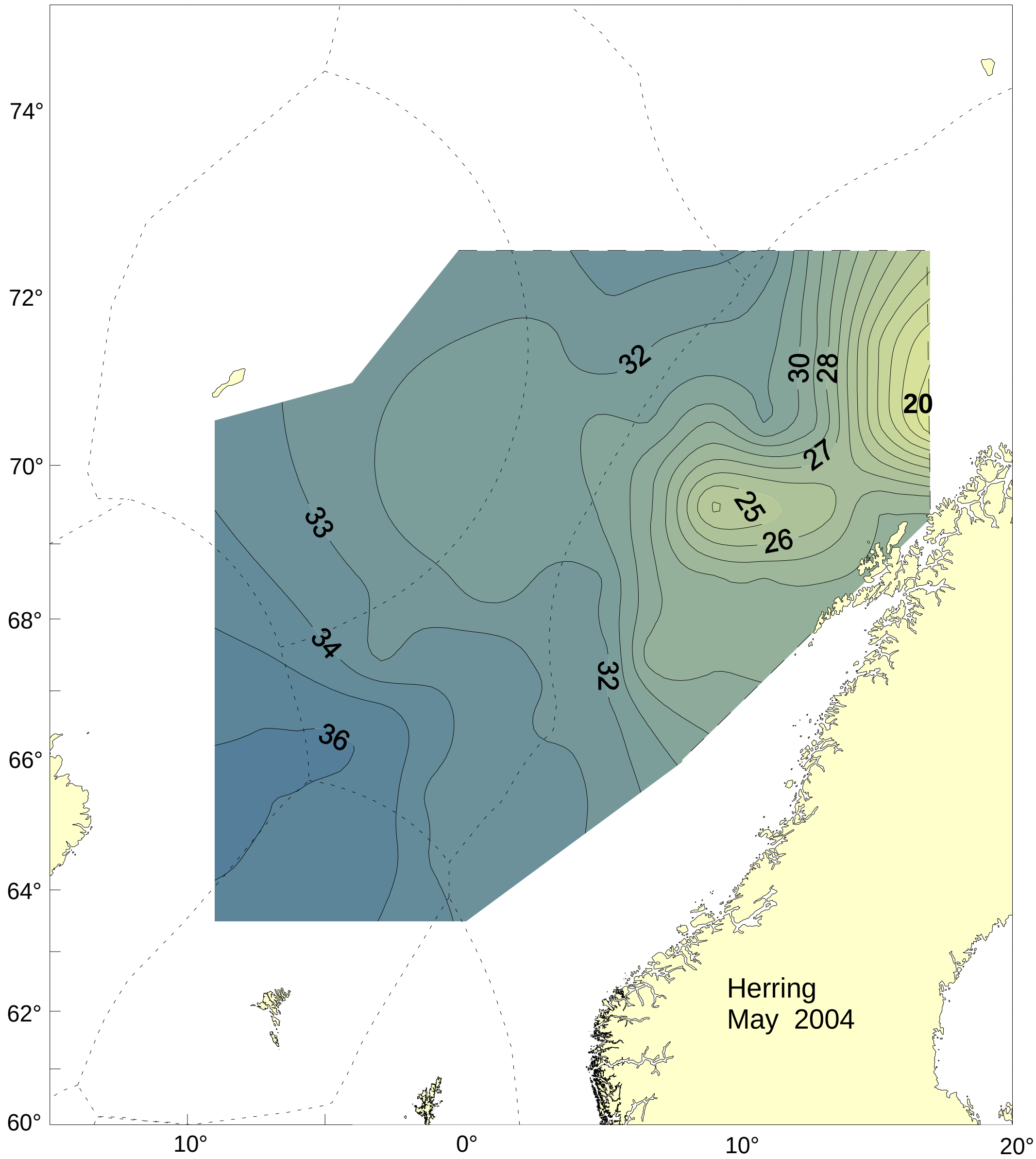

Figure 3.3.5. Mean lengths by area of herring derived from trawl samples.

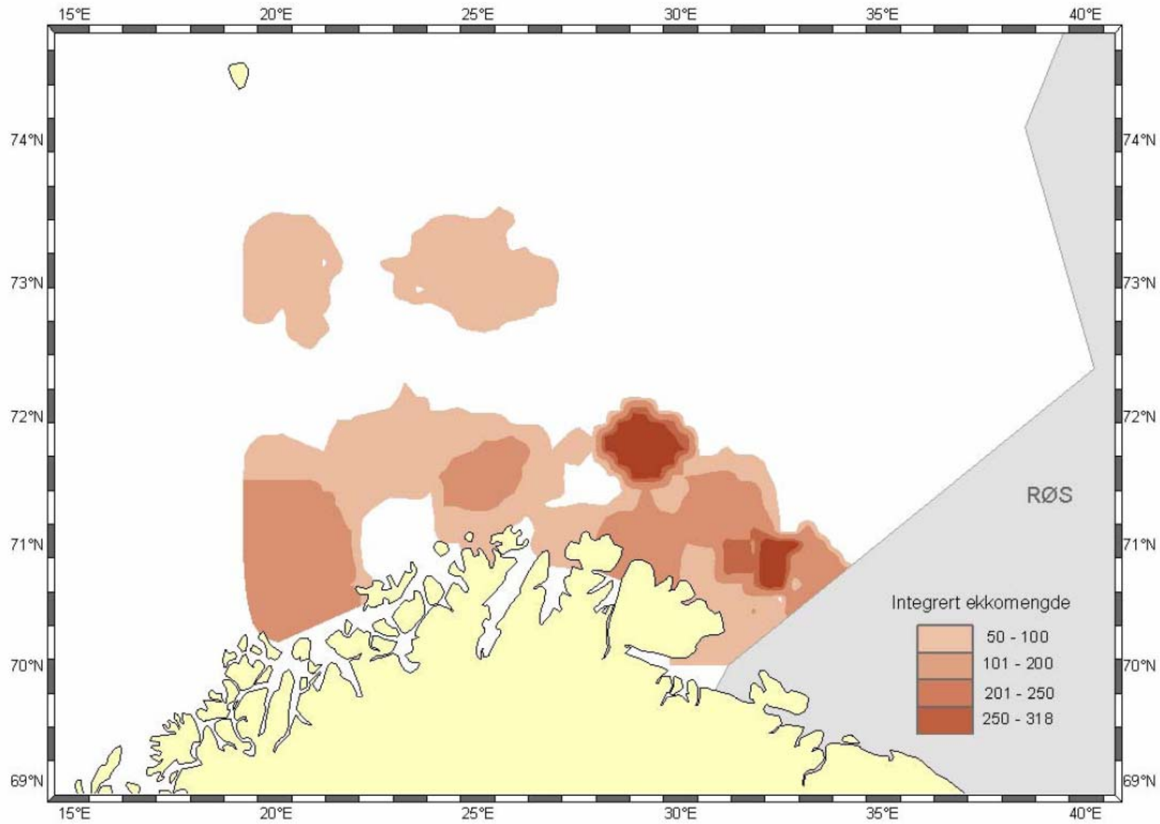

Figure 3.4.1. Distribution of young herring in the Barents Sea as measured by RV "Håkon Mosby" during the period 10–30 July 2004.

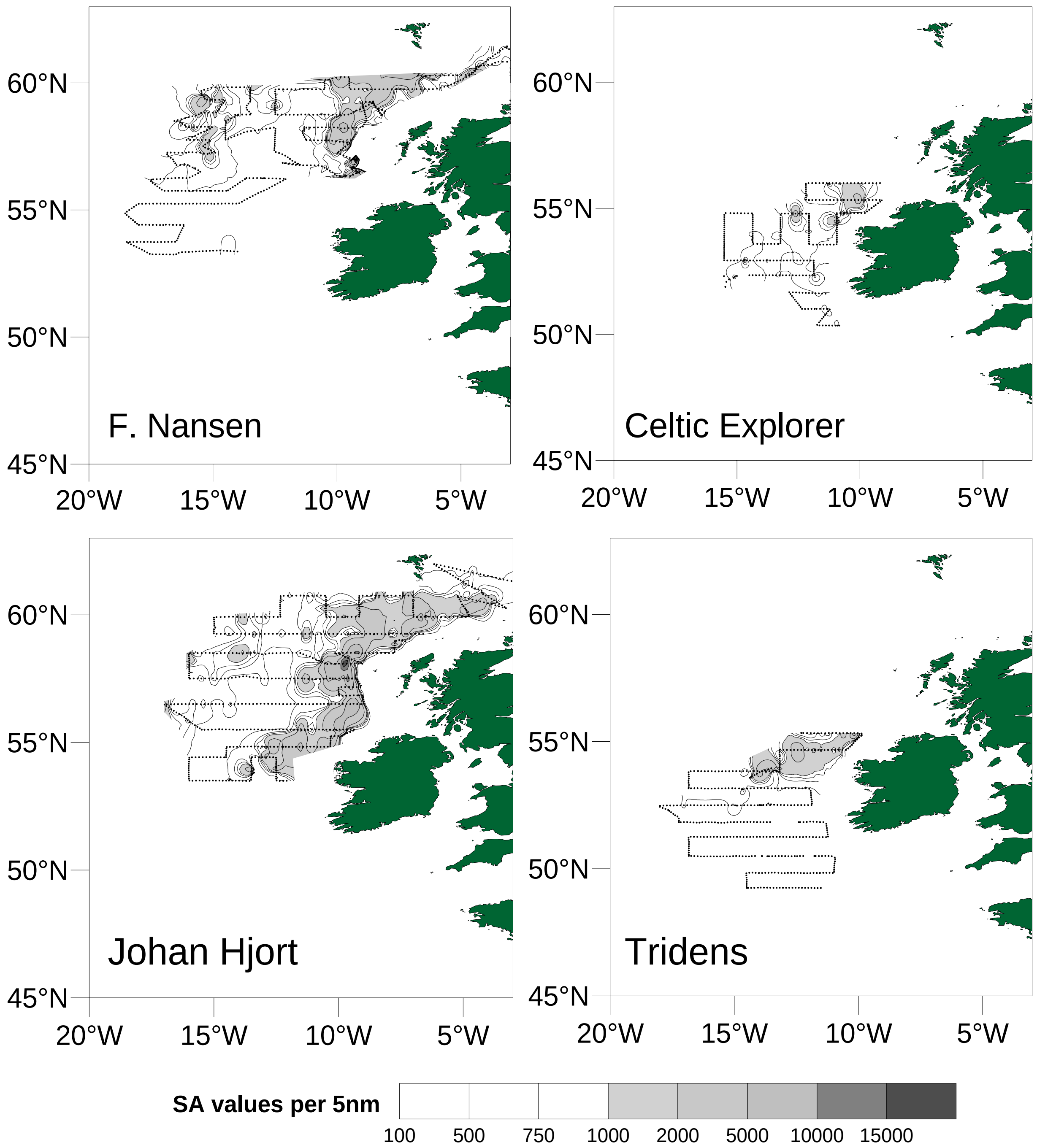

Figure 3.5.1. Density of blue whiting in terms of s_A-values ($m^2/n.mile^2$) based on 5 nm values reported by each of the four research vessels during the international blue whiting spawning stock survey in March-April 2004.

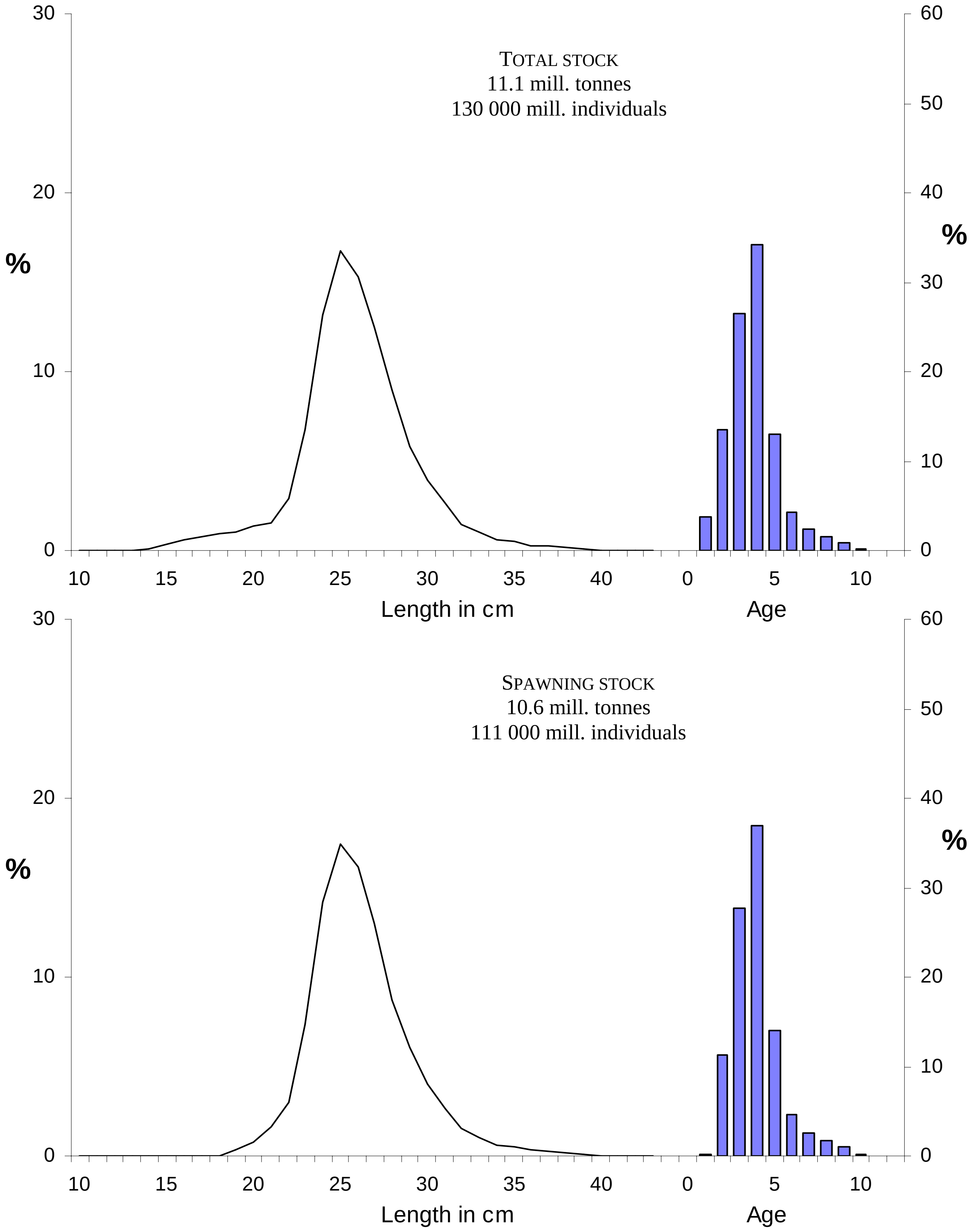

Figure 3.5.2. Length and age distribution of blue whiting estimated from the international blue whiting spawning stock survey by research vessels “Celtic Explorer”, “Fridtjof Nansen”, “Johan Hjort” and “Tridens” in March-April 2004.

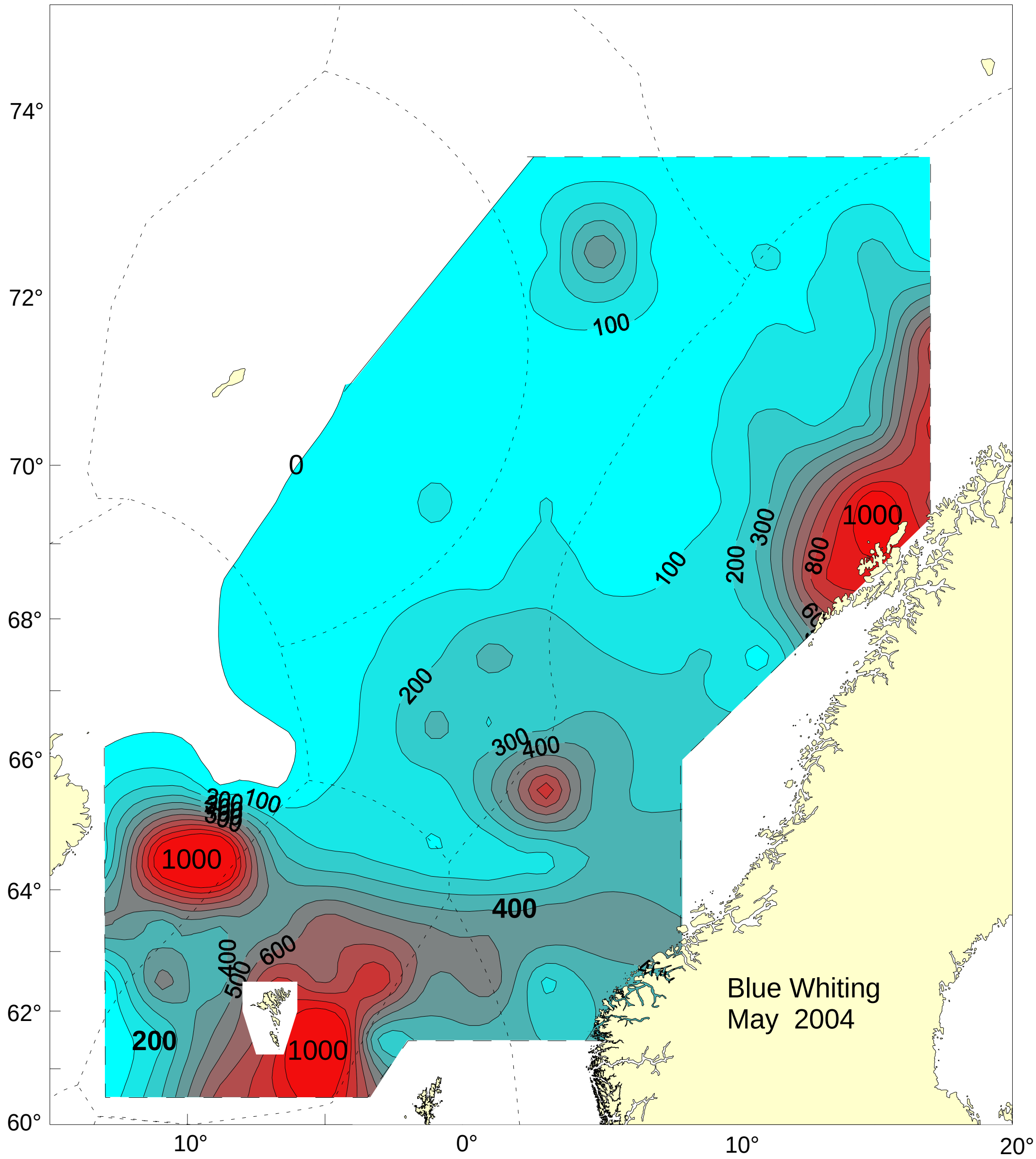

Figure 3.5.3. Density of blue whiting in terms of s_A-values ($m^2/n.mile^2$) based on 5 nm values reported by each of the research vessels "Dana", "Magnus Heinason", "Arni Fridriksson" and "G. O. Sars" in the Norwegian Sea–Faroese EEZ in May 2004.

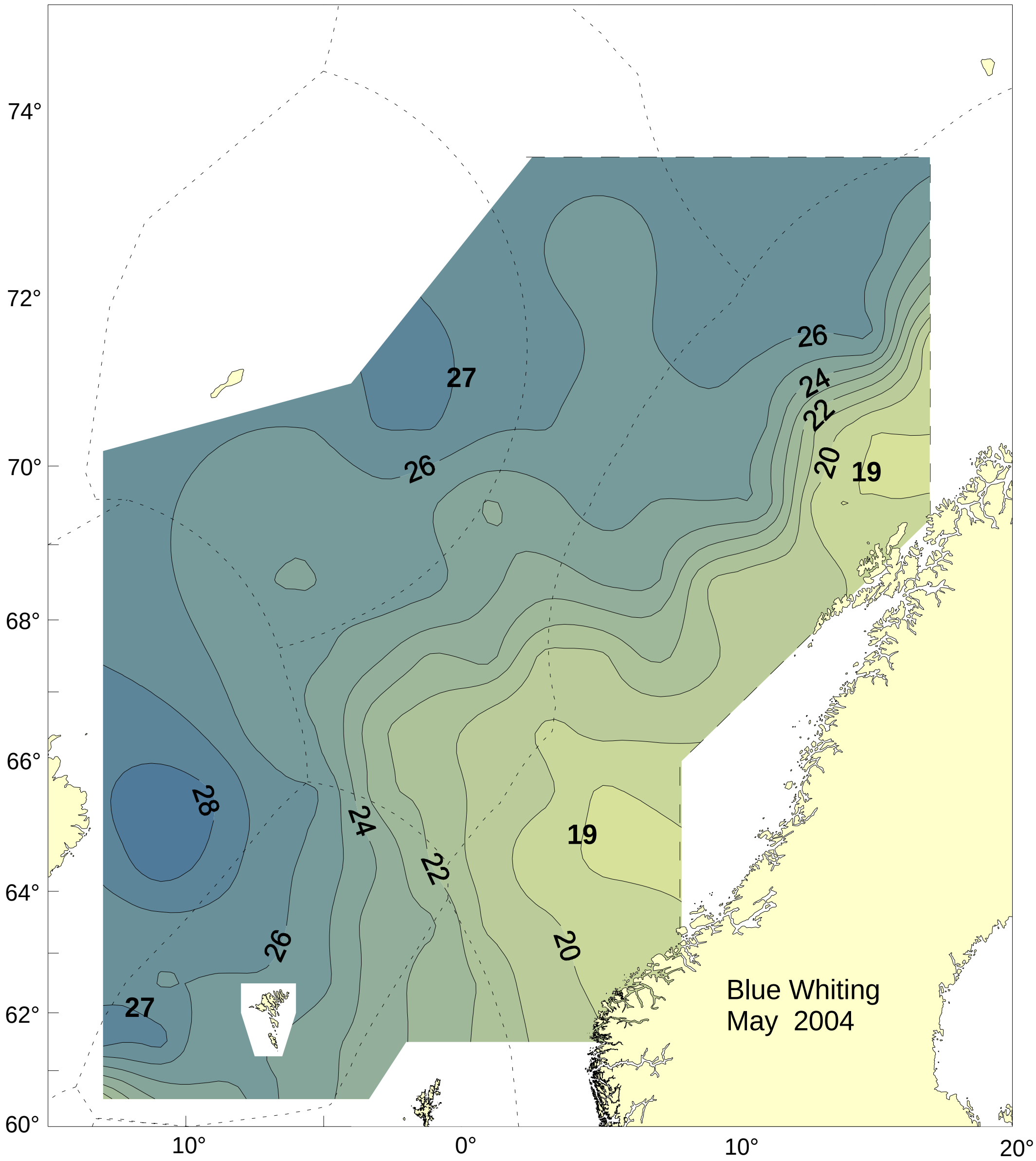

Figure 3.5.4. Mean length (cm) of blue whiting in the Norwegian Sea–Faroese EEZ in May 2004. Data from RVs "Dana", "Magnus Heinason", "Arni Fridriksson" and "G. O. Sars".

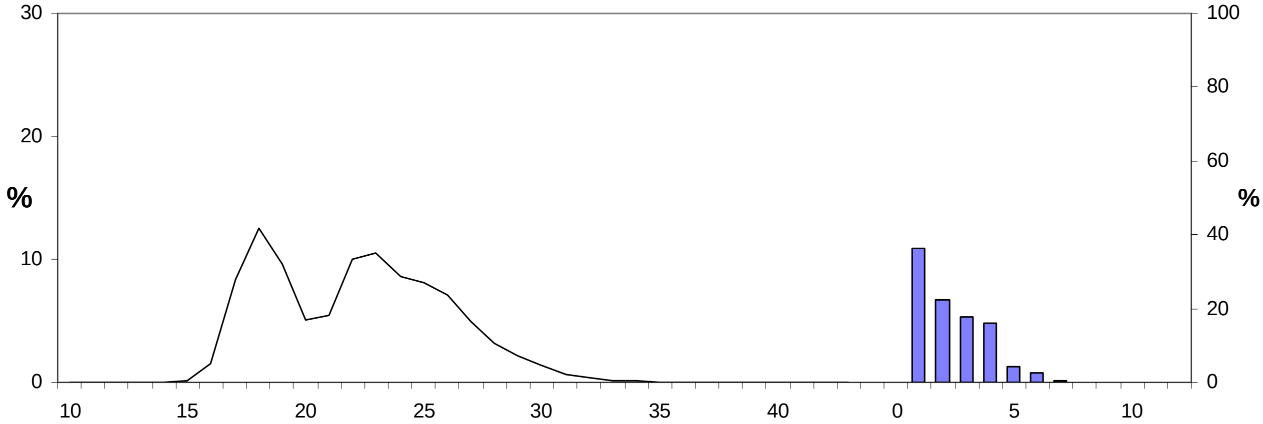

Figure 3.5.5. Length (cm) and age (yr) distribution of blue whiting in the Norwegian Sea–Faroese EEZ in May 2004. Data from RVs “Dana”, “Magnus Heinason”, “Arni Fridriksson” and “G. O. Sars”.

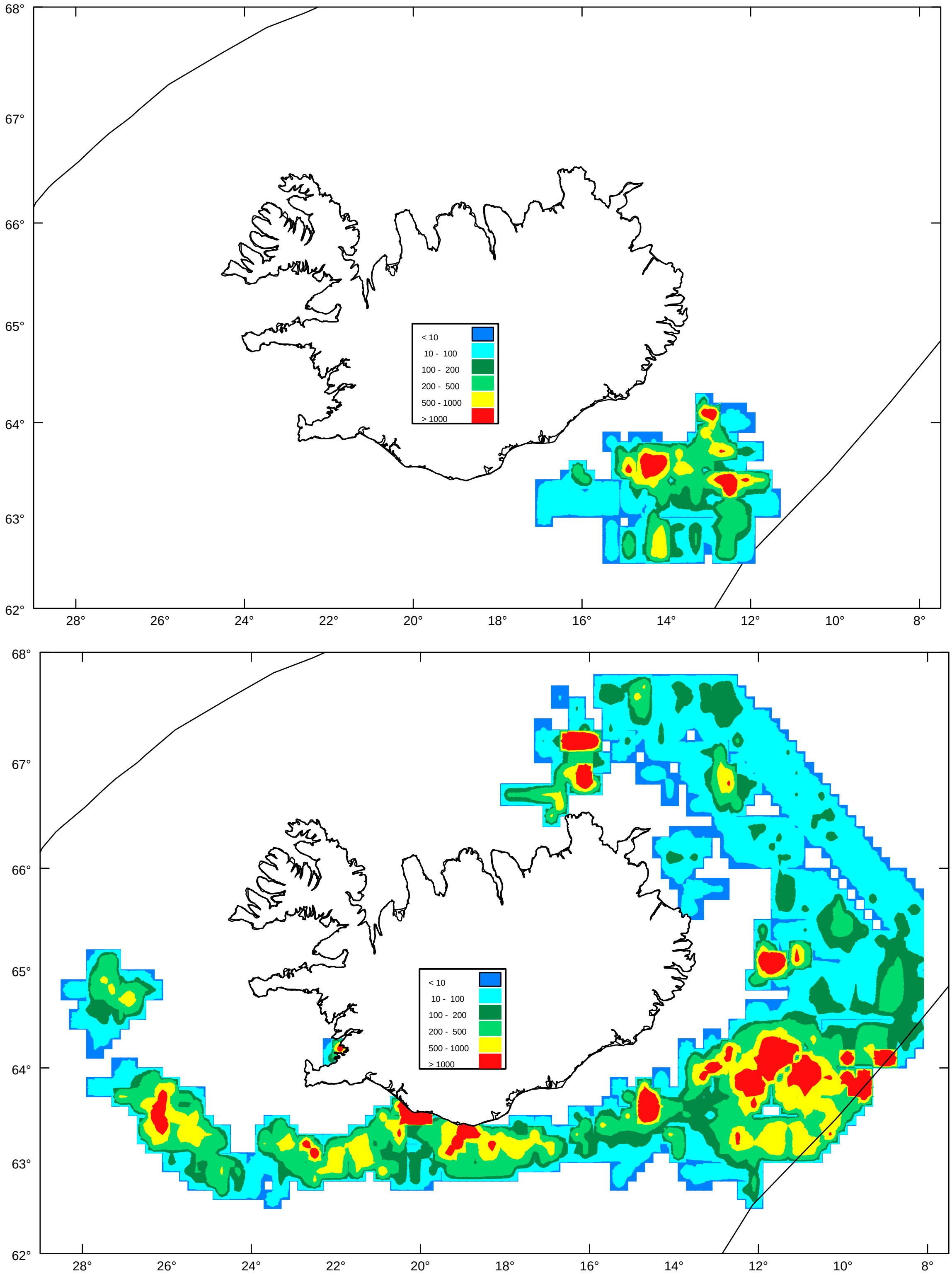

Figure 3.5.6. Density of blue whiting in terms of sA-values (m2/n.mile2) in the Icelandic waters in July 2004. Upper panel: 0- group blue whiting, lower panel: 1-group and older blue whiting.

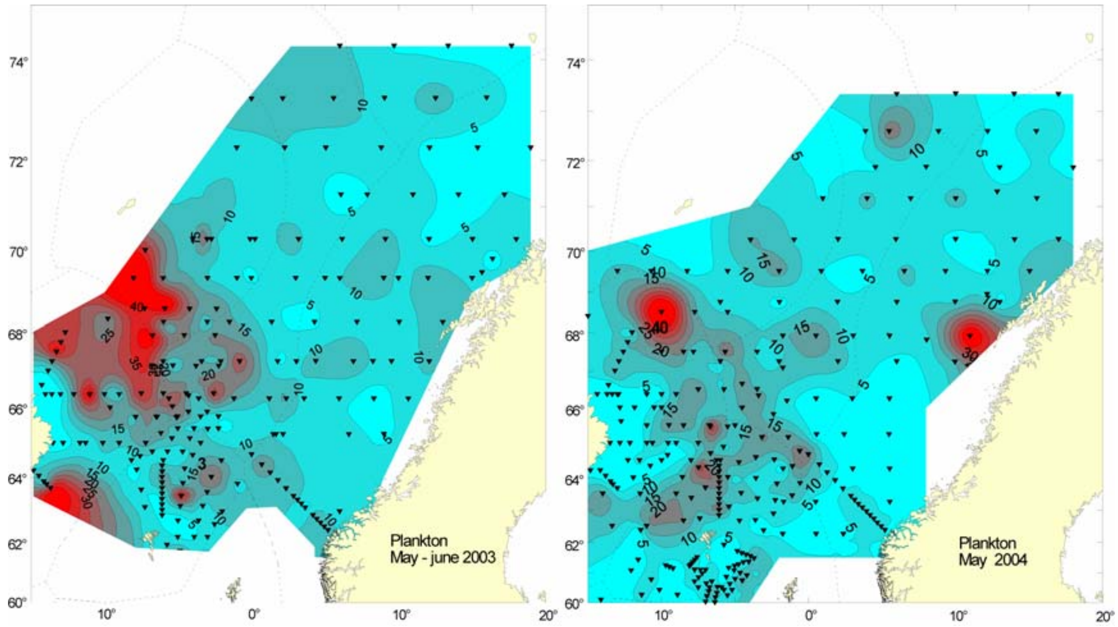

Figure 4.2.1. Comparison of the plankton distribution in the Norwegian Sea in May 2003 (left) and 2004 (right).

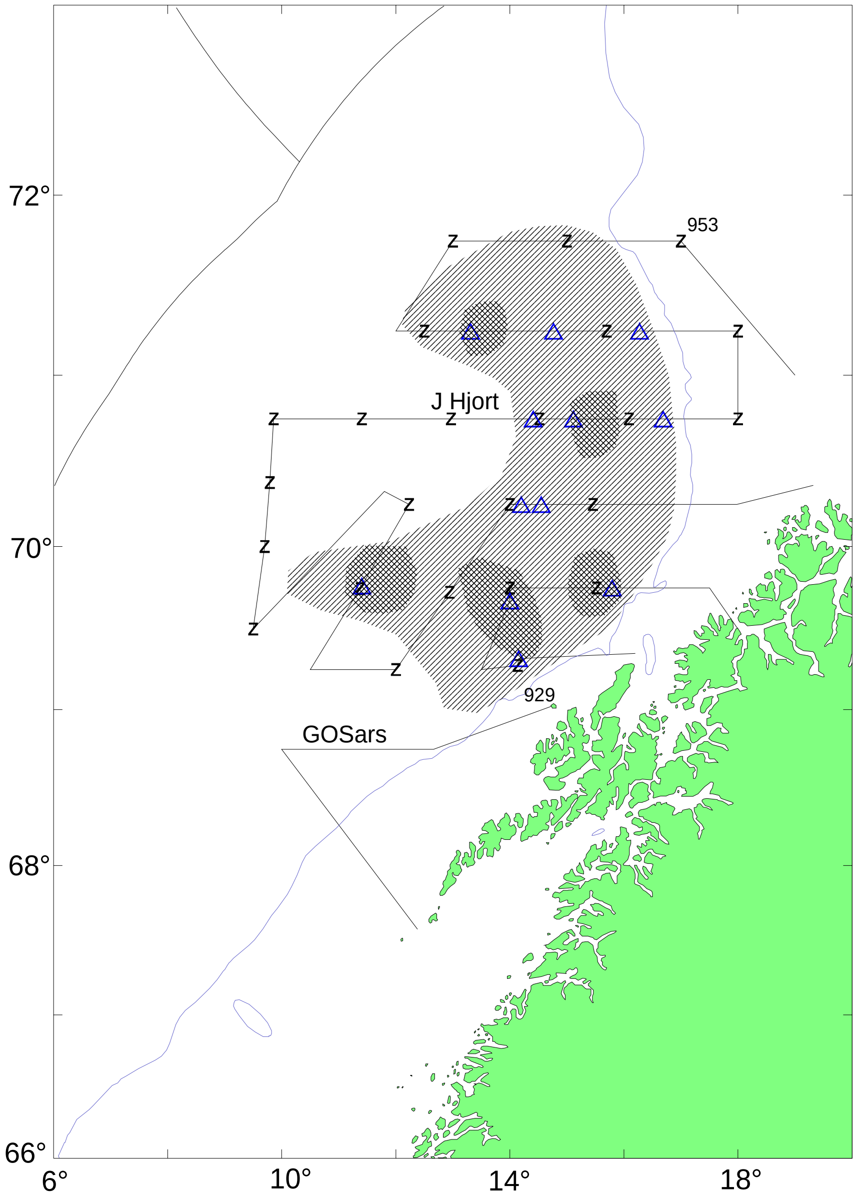

Figure 4.3.1. Oceanic herring distribution in December 2003 (5.5 million tonnes). In addition an estimated 1.5 million tonnes wintered in the Ofotfjord and Tysfjord.

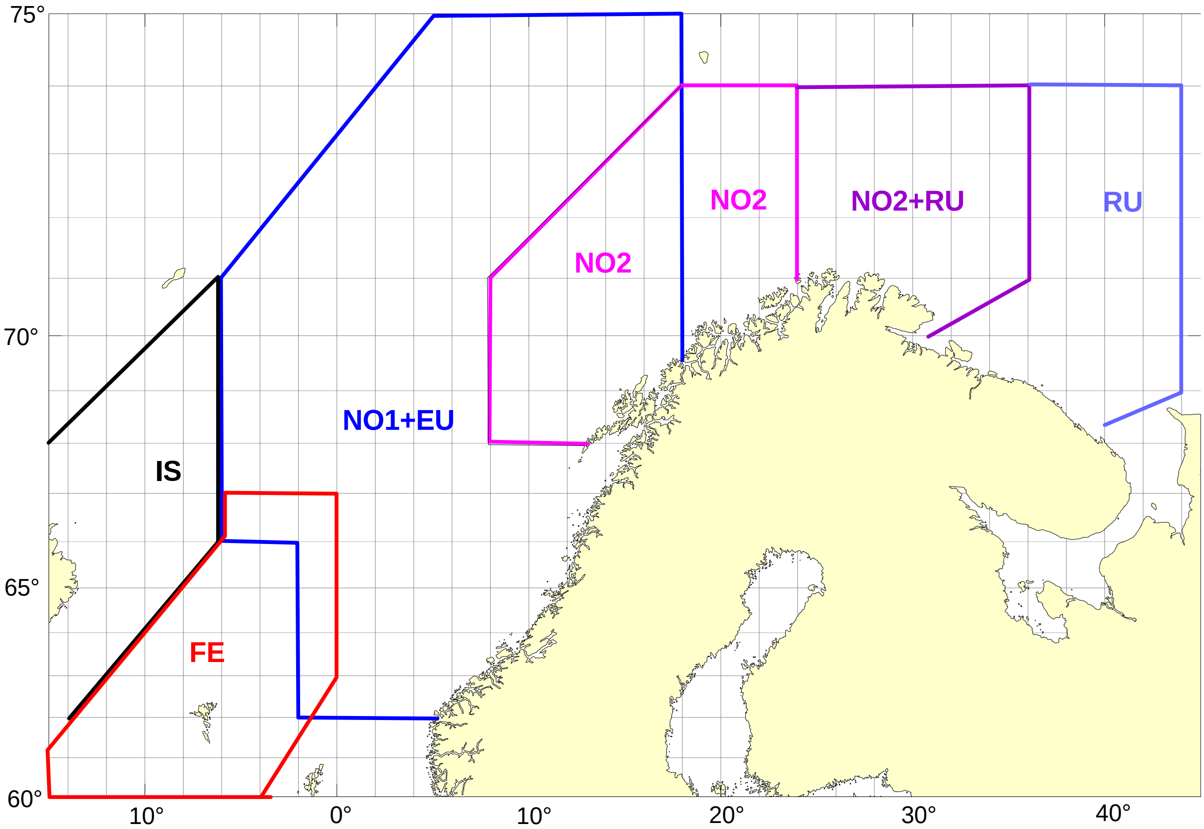

Figure 5.1.1. Planned survey area for surveys in the Norwegian Sea and Barents Sea in May 2005.

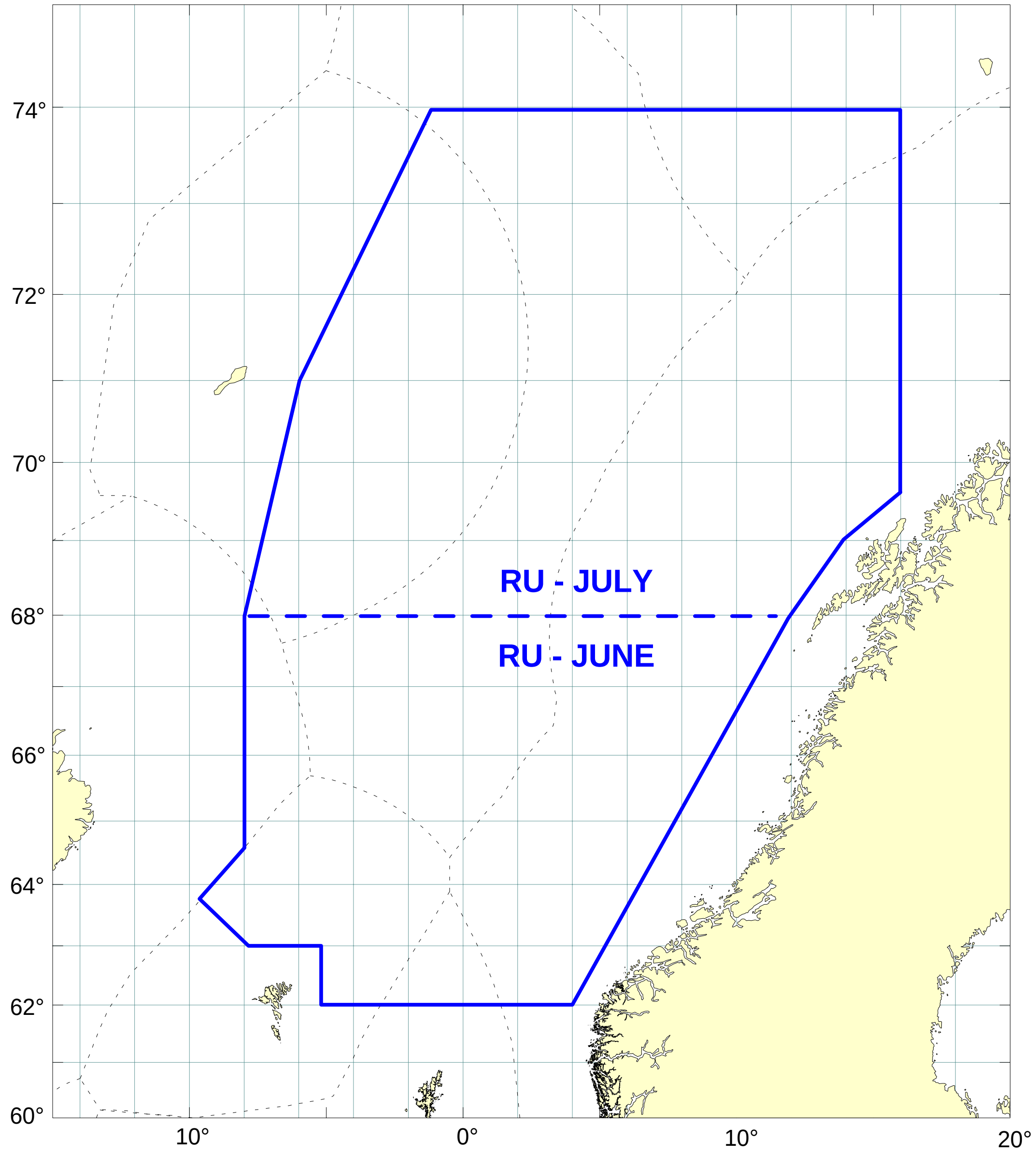

Figure 5.1.2. Planned survey area for the Russian survey in the Norwegian Sea in June-July 2005.

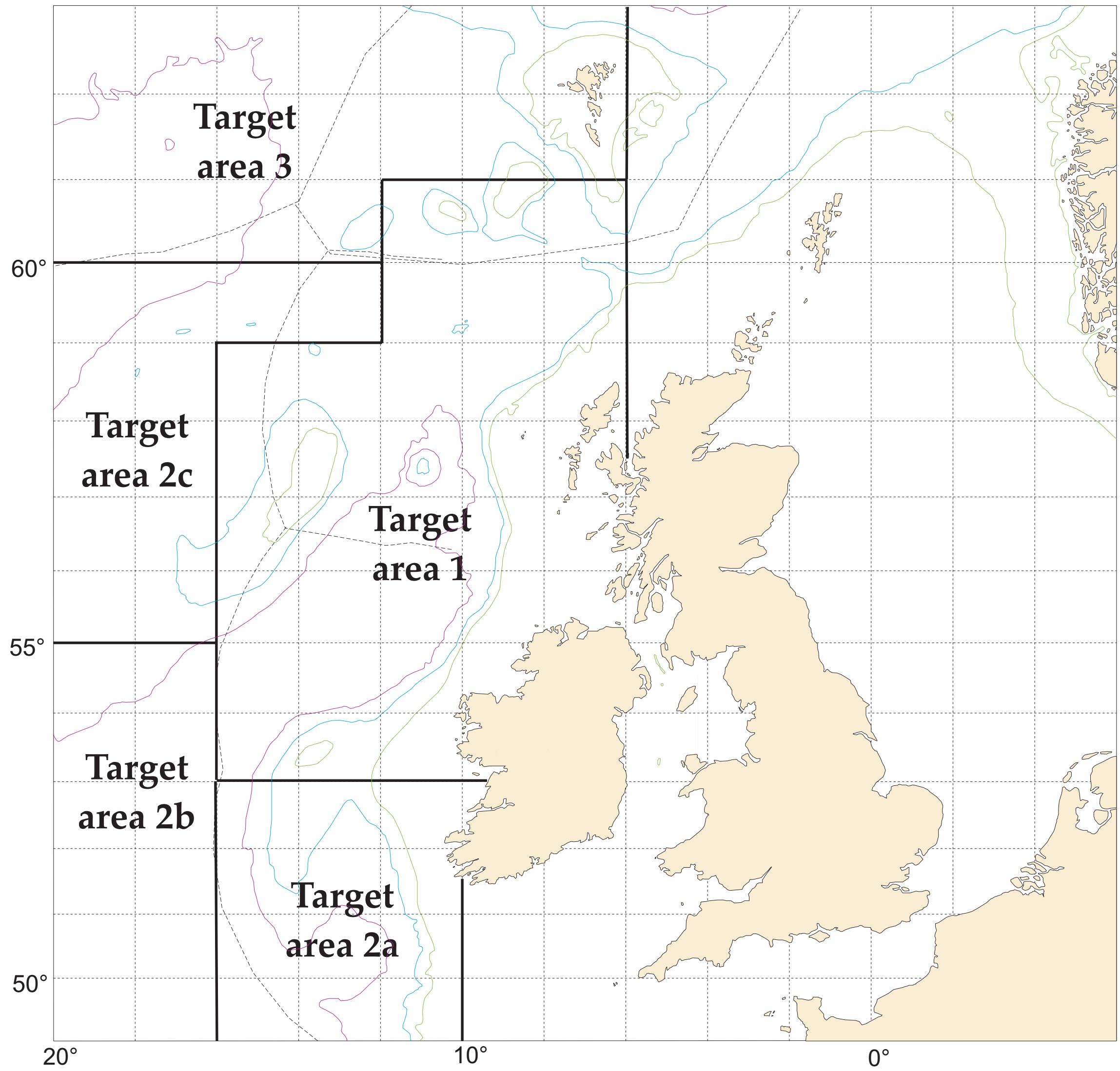

Figure 5.2.1. Planned survey area for the blue whiting spawning survey in March-April 2005.

Appendix

Appendix 1: List of participants, Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys, Murmansk, Russia, 24 – 27 August 2004.

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