Resource Management Committee

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REPORT OF THE

Planning Group on Surveys on Pelagic Fish in the Norwegian Sea

Tórshavn, Faroe Islands
27–29 August 2003

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

Abstract

The report present the results from the acoustic, hydrographic, plankton, and fish sampling during the ICES co-ordinated surveys in the Norwegian Sea in 2003 (Norway, Faroes, Iceland and Russia). The PGSPFN met in Tórshavn, 27-29. August 2003. 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 late winter, spring and summer of 2003. The abundance estimates are used in the fish stock assessment of Norwegian spring spawning herring and blue whiting in ICES (NPBWWG) and the collection of environmental data further improve the basis for ecosystem modelling of the Northeast Atlantic. Broad plans for the ICES coordinated surveys for 2004 are also outlined with descriptions of the relevant protocols and suggested survey designs.

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1 INTRODUCTION

1.1 Terms of Reference 2003

The **Planning Group on Surveys on Pelagic Fish in the Norwegian Sea** [PGSPFN] (Chair: J.A. Jacobsen, Faroe Islands) will meet in Tórshavn, Faroe Islands from 27-29 August 2003 to:

a) consider the migration pattern of the Norwegian spring-spawning herring stock in 2003;

b) consider major hydrographic and zooplanktonic developments since last year. Consider the significance of these developments in relation to the herring stock;

c) evaluate the survey transects carried out in 2003 and consider whether changes could be made to further optimise these with regard to the herring migration and the herring – environment interactions;

d) plan and co-ordinate the national surveys on the pelagic resources and the environment in the Norwegian Sea in 2004; together with the international co-ordinated survey on Norwegian spring-spawning herring in May-June 2004;

e) Evaluate the consequences of the withdrawal of EU countries from the survey in terms of decrease in spatial and temporal coverage and in terms of precision in stock estimates;

f) follow up the ongoing publishing process of the Group.

g) develop protocols and criteria to ensure standardisation of all sampling tools and survey gears.

PGSPFN will make its report available to WGNPBW and will report by 15 September 2003 for the attention of the Resource Management Committee and ACFM and ACE.

1.2 Special requests concerning blue whiting

In addition to the above ToRs, ACFM in May 2003 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)."

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

Item	ToR 2003	Section
a)	consider the migration pattern of the Norwegian spring-spawning herring stock in 2003	3.3
b)	consider major hydrographic and zooplanktonic developments since last year. Consider the significance of these developments in relation to the herring stock	3.1, 3.2, and 4.3
c)	evaluate the survey transects carried out in 2003 and consider whether changes could be made to further optimise these with regard to the herring migration and the herring – environment interactions	3 and 5.1
d)	plan and co-ordinate the national surveys on the pelagic resources and the environment in the Norwegian Sea in 2004; together with the international co-ordinated survey on Norwegian spring-spawning herring in May-June 2004	5.1
e)	Evaluate the consequences of the withdrawal of EU countries from the survey in terms of decrease in spatial and temporal coverage and in terms of precision in stock estimates	6
f)	follow up the ongoing publishing process of the Group	7
g)	op protocols and criteria to ensure standardisation of all sampling tools and survey gears	8
blue whiting (ACFM)	"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)."	5.2

1.3 List of participants

Maurice Clarke	Ireland
Jørgen Dalskov	Denmark
Mark Dickey-Collas	The Netherlands
Asta Gudmundsdottir	Iceland
Mikko Heino	Norway
Jan Arge Jacobsen (chair)	Faroe Islands
Alexander Krysov	Russia
Webjørn Melle	Norway
Ingolf Røttingen	Norway
Leon Smith	Faroe Islands
Sveinn Sveinbjørnsson	Iceland
Øyvind Tangen	Norway
Hjálmar Vilhjálmsson	Iceland

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

1.4 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 1960's the stock has been rebuilt and varied from approximately 5 to 10 million tonnes of biomass during the 1990's. 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 NE-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 1990's 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 an unknown fraction of the stock wintered in the Norwegian Sea off Lofoten. In January the herring start their southerly spawning migrations. In 2003, the catch of Norwegian spring spawning herring is expected to reach about 750 thousand tonnes, down from about 850 thousand tonnes in 2002.

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 south or towards 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 70's. 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. A planning meeting was held in Reykjavik in August 2001 for surveys to be carried out in the summer of 2002 (for methods cf. Holst *et al*., 1998 and the present report).

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, the coordination task has been taken up by PGSPFN. The coordination task is made even more crucial as, in addition to Norway and Russia, also EU plans to join the survey in 2004 with one vessel from Ireland and one from the Netherlands.

A series of surveys to be carried out by Faroese, Icelandic, Norwegian and Russian vessels in spring and summer 2003, were included in the coordinated programme (Table 1.4.2), resulting in a relatively good coverage of the areas and relevant species. Unfortunately in 2003, Russia could not execute its planned surveys on pelagic fishes in the Barents and the Norwegian seas in June/July due to financial and technical constraints. 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 planning group strongly hopes that the planned surveys for 2004, including all countries, will be successfully completed and the results integrated into next years report.

The surveys were grouped as follows:

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

June/July – Icelandic EEZ

July/August – northern Norwegian Sea and southern part of the Svalbard area

The main objectives of these surveys were to map the distribution and migrations of herring and other pelagic fish and to assess their biomass. Furthermore to monitor the hydrographic and plankton conditions of the Norwegian Sea and adjacent waters and describe how feeding and migration of 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 text table above.

In 2003 the EU was back in the planning group, after having withdrawn from the group in 2002, and will participate with one vessel in the coordinated cruises in May 2004 aimed at Norwegian spring spawning herring and blue whiting, and with two vessels in March/April 2004 in the planned coordinated survey on the blue whiting spawning grounds.

The results of the coordinated surveys in 2003 were evaluated during a meeting in Tórshavn in late August 2003 (Table 1.4.1) and are presented in this report. The purpose of the report is to provide a short summary of the surveys and their findings and 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

Data were sampled along transect lines of the hydro-acoustic surveys of the Faroe Islands (Magnus Heinason, 30.04-28.05.2003, Figure 2.1), Iceland (Arni Fridiriksson, 21.05.-29.05.2003, Figure 2.1), Norway (G.O. Sars, 25.04-10.06.2003, Figure 2.1), Iceland (Bjarni Saemundson, 23.06.-17.07.2003, Figure 2.2), and Norway (G.O. Sars, 25.07-15.08.2003, Figure 2.3 and 2.4). Details on the temporal and spatial coverage and sampling in 2003 are given in Table 1.4.2.

2.1 Hydrography

The hydrographic observations were made using CTD-probes. A total of 456 hydrographic stations were occupied for description of the horizontal distribution of temperature and salinity in the periods April-May and June-August (Table 1.4.2). 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.

2.2 Plankton

A total of 310 plankton hauls were made, which is about half the number of hauls taken in 2002 (Table 1.4.2). There were no Russian cruises to the Norwegian Sea during spring and summer this year. During May, zooplankton was sampled in vertical hauls from 200-0 m by standard WP-2 nets with a 180 µm mesh ("G.O. Sars", "Magnus Heinason", “Arni Fridrikson”). The sampling depths on "Arni Fridrikson" were 50-0 m on the standard sections around Iceland during late May, while in June both 50-0 m and 200-0 m were sampled on the oceanic stations. The Icelandic data from standard sections in May 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.

2.3 Fish sampling

Fish traces identified on the echosounder were sampled by pelagic trawls (vertical openings of 20 - 40 m). With ordinary rigging, the trawls could be used to catch deep fish schools. The trawls were also rigged to catch fish near the surface by removing the weights, extending the upper bridles and attaching buoys to each upper wing.

Subsamples of up to 100 specimens of herring and blue whiting were taken from the trawl catches. The length, weight, sex, maturity stage and stomach contents were recorded. Scales and/or otoliths were taken for age reading of herring and otoliths from blue whiting.

2.4 Acoustics

During the surveys, continuous acoustic recordings of fish and plankton were collected using calibrated echo integration systems (38 kHz Simrad EK500 or EK600 working at a range of 10 - 500 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.

Acoustic estimate of herring and blue whiting abundance were obtained during the surveys. This was done, either by visual scrutiny of the echo recordings directly from the echograms or by post-processing using the BEI/BI500-system. 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 echorecordings. To estimate the abundance, the allocated s_A-values were averaged for ICES-squares (0.5° latitude by 1° longitude). For each statistical square, the unit area density of fish (ψ_A) in number per square nautical mile ($N{*}nm^{-2}$) was calculated using standard equations (Foote, 1987). However, 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 physoclist species. For clupeoid species Foote (1987) recommended TS = 20 log(L) – 67.5 dB, 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 herring in each statistical square and then sum all squares within defined subareas and the total area. Furthermore, the average length, weight, area density and biomass of each year class were also estimated for each statistical square, for defined subareas and for the total area.

2.5 Aerial surveys

During July and August 2003, aerial surveys for makrel in the Norwegian Sea were carried out by Russia. One Russian plane was in the air. Four Russian vessels were available as search vessel to identify the recordings observed from the aircraft. The results from the investigations will be presented to the mackerel working group (WGMHSA) in September 2003.

2.6 Seabird counts

Seabird counts were made by one observer from the bridge during the Faroese survey (R/V "M. Heinason") covering the Faroese EEZ in May 2003. Counting was made during 21 days (107 hours). Bird was counted whenever the ship speed was above 4 knots and the weather permitted such.

2.7 Whale counting

Whales were counted by one observer from the bridge during the Faroese survey (R/V "M. Heinason") in May.

3 RESULTS

3.1 Hydrography

3.1.1 General hydrographic features

The two main features of the circulation in the Norwegian Sea, where the herring stock is grazing (see sec. 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 saline water from the North Atlantic into the Nordic Seas. The EIC, on the other hand, carries Arctic waters. 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-like 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. Farther north, in the Lofoten Basin, the lateral extent of the Atlantic water gradually narrows again, apparently under topographic influence by the mid-Atlantic 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 closely 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 in the southern 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 2003 the NAO index was close to the long-term average and a little lower compared to that of 2002 (see Figure 3.1.1).

<u>May – the Faroese EEZ, Icelandic EEZ, and Norwegian Sea</u>

Figures 3.1.2-3.1.3 show the salinity and the temperature along the Svinøy section for 27-30 April before the start of the seasonal warming. 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. Both temperature and salinity were above normal in the upper layers and close to the values observed in 2002.

Figures 3.1.4-3.1.9 show the horizontal temperature distributions at surface, 20, 50, 100, 200 and 400 m depth from the end of April to the end of May 2003. The distribution of the waters carried into the Norwegian Sea by the EIC is clearly indicated at all depths below the seasonal surface layer. 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. The EIC was weak in 2003 compared to 2002. For example, at 100 m depth the 5°C isotherm in the southern Norwegian Sea, outside Svinøy, was displaced about 150 nm more westward in 2003 than 2002. Consequently, the Arctic Front is located much farther west in 2003 compared to 2002. In the central Norwegian Sea, the 4°C isotherm (at 100m depth) extends as far West as to 7°W while in 2002 it extended to only 3°W.

In the central Norwegian Sea, the Lofoten Basin, volume of accumulated Atlantic water has increased during the last years. Since the CTD-stations were only taken to 500 m depth it is not possible to calculate this for 2003. However, instead we calculated the mean salinity from the surface to 500 m depth in the Lofoten Basin (not shown). The mean salinity in 2003 was the highest ever in this time-series (1995-2003). Thus, there has been an increased accumulation of Atlantic Water in the Lofoten Basin. There are still some uncertainties of this result because the 2003 observations only reached a maximum depth of 500 m.

Figure 3.1.10 and 3.1.11 show salinity and temperature along an extended Gimsøy-NW section, running from Gimsøy (at Lofoten) and into the Greenland Sea for May/June 2003. The Mohn Ridge, separating the Norwegian and Greenland Sea can be seen as large peaks in bottom topography. The Arctic front, which separates warm Atlantic waters and cold Arctic waters is topographically controlled. The front is located over the Mohn Ridge and has a sharp east-west gradient in both salinity and temperature. Contrary to the 2002 situation, a warm surface layer had not developed on this section as was the case in 2002 (see Figure 3.1.11 in the 2002 report, ICES 2002/D:07).

July/August – Svinøy section, northern Norwegian Sea and southern part of Svalbard area

Figures 3.1.12-3.1.13 show the temperature and salinity in the Svinøy section for 24-26 July 2003. Due to the seasonal warming a warm surface layer had developed. The surface layer was warmer than normal (about 2°C difference) and also compared with 2002 (about 1°C difference). In some areas temperatures were above 15°C. In the Atlantic layer, both the temperature and salinity were above normal. Figure 3.1.14 is a time-series of the area along the Svinøy section showing the portion occupied by Atlantic water and the averaged temperature of the Atlantic water for July/August from 1978 to 2003. The averaged temperature in 2003 was 8°C, which is the highest value ever recorded since the systematic observations started in 1978.

Figs. 3.1.15-3.1.20 show horizontal distribution of the temperature at the surface, 20, 50, 100, 200 and 400 m depth in the northern Norwegian Sea. A warm surface layer has developed and maximum sea surface temperature is 12°C. At 20 m depth a tongue with cold water (minimum temperature less than 1°C) is seen. In mid-June, drift ice was also observed on a cruise around Bear-Island. The coverage of CTD stations in 2002 was coarse for that area and it is difficult to compare the 2003 findings against those of 2002. Compared to 2001, the temperature at 20 m depth in 2003 was about 1°C higher for most of the area. In the deeper layers, the difference is less.

3.2 Zooplankton

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

Figure 3.2.1 shows the distribution of the zooplankton biomass (g dw m^{-2}) in 200-0 m in May 2002. The sampling stations were fairly evenly spread over the area, and the cold water in the west was also well sampled. The biomass in May 2003 was generally lower than in 2002. For the total area, the average biomass of zooplankton was close to the mean value for the years 1997-2003 (Table 3.2.1).

There was a decrease of biomass from 2002 to 2003 in the area to the east of 2°W. West of 2°W zooplankton biomass increased and was above the average for the time-series (Table 3.2.1).

3.2.2 June/July –Icelandic EEZ

No data.

3.2.3 July/August – northern Norwegian Sea and southern part of Svalbard area

The Norwegian survey of the Norwegian Sea in July –August 2003 was carried out with one vessel. The zooplankton biomass in the northern Norwegian Sea in July-August decreased from 2002 to 2003, and was below 5 g dw m^{-2} in large parts of the survey area (Figure 3.2.2).

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 was carried out with three vessels, one from Norway, one from Faroes and one from Iceland, during the time period 25 April –10 June 2003. The survey covered the central and eastern Norwegian Sea from 64°N to 74°30'N. In addition the Faroes EEZ and the western part of the Icelandic EEZ was surveyed. The cruise tracks are shown in Figure 2.1.

Herring were recorded over very large areas in the Norwegian sea as shown in Figure 3.3.1 The distribution in 2002 is included for comparison (Figure 3.3.2). The main changes compared to 2002 are:

1. The distribution of herring extends farther south and west in 2003 compared to 2002.

2. An important feature of the herring distribution in 2003 is the occurrence of immature herring (2002 year class) in the feeding areas in the northeastern Norwegian Sea.

3. In general, the herring was recorded in higher concentrations in the Norwegian Sea in 2003 compared to 2002.

1) The herring were distributed in the Icelandic and Faroese EEZs as far south as 63°N (Figure 3.3.1) The herring distributed in these southern areas had a mean length of approximately 35 cm and average weight of 350 g, thus representing the older part of the adult population. It is the first time since the mid-1990s that the herring have been distributed so far south as 2003.

In the Icelandic EEZ the conditions for surveying were not ideal. Around 65°N the herring was mixed with large blue whiting concentrations, and very difficult to catch. The judgement of classifying herring recordings was thus based primary on visual characteristics. In the upper 100 m the herring showed an obvious avoidance reaction to the approaching vessel.

In the southern part of the distribution area the highest concentrations of herring were located within the Faroese EEZ from 63°30'-66°00'N and 2°00'-8°30'W. The herring were large (average 35.5 cm and 355 g). These herring were spent with a condition factor around 0.8 actively feeding on *Calanus finmarchius* and *Meganyctiphanes norvegica*. In the northern part of the Faroese area (north of 64°30'N) the herring was observed as schools from 150-350 m depth, usually well separated from blue whiting found deeper in the water column (Figure 3.3.3). Further south (from 64°30'N south to 63°30'N) the schools were more loose and scattered, and in areas where they were mixed with blue whiting the herring schools usually were below or within the blue whiting layer at around 350 m depth. In addition herring was observed at the surface in the southern part of the area, as determined by surface trawling. Due to the shallow distribution these herring were difficult to record with the hull mounted acoustic equipment.

The western boundary of the herring distribution in 2003 was at approximately 8-10°W compared to 3-5°W in 2002.

Acoustic records from all vessels were scrutinized and integrator values allocated to the target species. Further trawl samples were used to convert integrator values to biomass at age. However, there were some discrepancies in the age readings from some of the areas. It was therefore decided to use the length distributions for the different areas combined with an overall length/age key to obtain the age structured abundance estimate. The estimate is given in Table 3.3.1, and the length and age distributions are given in Figure 3.3.4. The estimate of about 8.5 million tonnes should be regarded as preliminary. A quality check on otholits will be conducted and the result reported to the ICES WGNPBW in April-May 2004.

2) The immature herring distribution is discussed in section 3.4.

3) The main concentrations of herring were located west of the Lofoten Islands, in approximately the same area as the highest concentrations were located also in 2002. However, in 2003 the abundance, as represented by acoustic integrator values was higher in 2003 compared to 2002 in both the Norwegian EEZ, the Jan Mayen and Svalbard zones as well as in international waters (Figures 3.3.1 and 3.3.2).

<u>May 2003- Information from the fisheries</u>

The positions of the catches in the Icelandic fishery is shown in Figure 3.3.5. The Icelandic fishery started in the international area east of Jan Mayen in the beginning of the second week of May, where small catches of mixed small and large herring were taken between about 70°N and 72°N. The northern fishery continued during the second week of June, with most of the catch taken near 72°N, 04°E. However, some catches of generally larger herring were also taken in the Jan Mayen zone at about 72°N, 03°W.

Around 20 May, the Faroese survey recorded herring in the northern part of the Faroese EEZ, reaching into the southernmost part of the international area. A few days later the Icelandic survey also recorded herring concentrations in the southernmost part of the Jan Mayen zone as well as in the international area south of there. Those were large herring (on average about 35.5 cm; 350 g). Together, these findings resulted in a division of the fishery into three main areas, i.e. the international area at about 72°N, an area at the border of the Jan Mayen zone, southeast of the island, and near 04°W, on either side of the border between the Faroese EEZ and the international zone. In the last week of May the only Icelandic catches were taken near the border between the Jan Mayen EEZ and the international area. These were both few and small due to a mandatory fishermen's holiday over the fist weekend in June.

3.3.2 June/July –Icelandic EEZ

June/July 2003- Information from the surveys

Unfortunately in 2003, Russia could not execute its planned surveys on pelagic fishes in the Barents and the Norwegian seas so there are little survey information on herring distribution and migration from June/July 2003.

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 2.2.

June /July 2003-Information from the fisheries

In the first week of June all of the catch, with one exception, was taken in the international zone near 72°15'N, 08°E (Figure 3.3.5). In the second week, however, fishable concentrations were also located near the boundary between the EEZs of Iceland, Jan Mayen and the international area, which yielded good catches of large herring. The fishery in this westernmost location did not last and all of the catch in the third week of June was taken in the easternmost international area, between about 70°30'N and 74°N. In the last week of June the catch was taken in international waters east and northeast of Jan Mayen.

The Icelandic fishery ended in the first week of July in the Norwegian EEZ, at about 76°N, 12°E.

3.3.3 July/August – northern Norwegian Sea and southern part of Svalbard area

July/August 2003- Information from the surveys

During the period 25/7-15/8 R/V "G O Sars" surveyed the Norwegian Sea north of 70°N from the Norwegian coast to the Spitsbergen area, between 04°E and 18-20°E (Figure 2.3). The main concentrations of herring were found in the border area between the Norwegian EEZ and international waters at 71°N-72°N (Figure 3.3 6). The herring were mostly distributed in the upper 50 m of the water column. They could easily be recorded by sonar, and in still weather the schools could be seen on the sea surface. The biological samples were mostly collected by surface trawling. Immature herring (2002 year class) was recorded over a large part of the distribution area. In the south-eastern part of the distribution area some 0-group herring were also recorded, but the 0-group concentrations were much smaller than in 2002.

In 2003 the northern boundary was recorded at about 76°N, approximately the same latitude as in 2002, but further south than in 2001 when the northern boundary was 77°N.

The acoustic estimate of herring was carried out and gave a result of approximately 5 million tonnes (Table 3.3.2). As the southern border was not recorded, this cannot be regarded as an estimate of the entire stock. Figure 3.3.7 gives the length and age distribution of herring in the samples taken.

3.4 1-group herring (2002 year class)

In last year's report recordings of 0-group (2002 year class) herring in the Norwegian Sea were described. In May 2003 this year class was distributed north of 68°N in the Norwegian Sea (Figure 3.4.1). Thus, it seems that a component of this year class has wintered in 2002/2003 in the Norwegian Sea. The extent of such a wintering area is not known, but wintering in this area is a new element in the present migration pattern of Norwegian spring spawning herring.

The larvae and young herring have drifted northwards with the coastal current and have after metamorphosis been distributed in the Norwegian coast and fjord areas and in the Barents Sea. The latter area has been the most important nursery area since the rebuilding of this stock. The herring has stayed in this nursery area for 3-4 years before migrating to the Norwegian Sea and there adopted the migration pattern of the adult stock. However, the observations that a component of the 2002 year class utilizes the Norwegian Sea as a nursery area may indicate a new development in the migration pattern. At present it is not know how long ago the Norwegian Sea was part of the nursery area system. In 1950 large concentrations of 0-group were recorded in the Norwegian Sea, but it is not known if a part of this year class wintered in this area as immature herring.

3.5 Blue whiting

Blue whiting data are available from the Faroese EEZ and Norwegian Sea in May, from Icelandic waters in June-July, and from northern Norwegian Sea and southern part of Svalbard area in July/August. Because of technical and financial difficulties, no new Russian data are available.

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

Three research vessels, “Magnus Heinason”, R/V “Arni Fridriksson” and R/V “G.O. Sars”, were active in May (Figure 2.1). An estimate based on the Faroese results has been calculated. In addition, an estimate based on acoustic data from all three vessels, biological data from “Magnus Heinason” and R/V “G.O. Sars”, has been calculated.

The Faroese results. On the survey of R/V “Magnus Heinason”, the highest concentrations of post spawning blue whiting were recorded in May along the eastern edge of the Faroe bank and on the Monk ("Munkagrunnurin") (Figure 3.5.1). In the northern area inside the Faroese EEZ blue whiting was observed in most of the area Norwegian Sea except on the northernmost stations, where the influence of the cold East-Icelandic current had its influence. The length and weight distributions of blue whiting in the Faroese area is shown in Figure 3.5.2 and 3.5.3, respectively. In the southern area the 2002 and the 2000 year classes dominated, while the 2000 year class dominated in the northern part of the Faroese EEZ (Figure. 3.5.4). The total biomass estimate of blue whiting in the Faroese area in May 2003 was 4.8 million tonnes (Table 3.5.1), about equally divided between the southern (< 65°N) and northern areas.

Combined results. The area covered in 2003 was larger than previously, 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 south of the Faroes, and near the Lofoten (Figure 3.5.5). The most abundant year class was that of year 2000, both in terms of numbers and biomass (Table 3.5.2); the same year class dominates also the estimates made in 2001 and 2002. Year class 2002 was also observed in large numbers. Estimated age and size distributions are shown in Figure 3.5.6. The total biomass estimate is 11.8 mill. tonnes, i.e., about twice as high as in 2001-2002.

3.5.2 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 2003 was conducted on the R/V Bjarni Sæmundsson and began off the west coast of Iceland and continued northward along the shelf to the Dohrn Bank. The survey resumed off the eastern north coast of Iceland and the area between 66º40'N and 68º00'N and from 17ºW to the EEZ of Jan Mayen was surveyed. From there the area between the Icelandic shelf and the International zone and the Faroese EEZ was surveyed south to 62º30'N. Finally the shelf edge off southeast to southwest Iceland was surveyed. The coverage was larger in Icelandic waters than in the previous years (Figure 2.2).

The distribution of blue whiting was more extensive than observed before. Blue whiting was recorded in the whole surveyed area, mostly at 250–400 m depth in southern and eastern part of the survey area but at 150–200 m depth further north and west. The densest recordings were observed in and off the shelf area at the southeast coast, in the shelf area off the eastern north coast and in an area further offshore off the southern east coast of Iceland. 0-group Blue whiting was observed mostly as relatively dense schools at 50–120 m depth over and at the shelf in several locations off the southwest–southeast coast of Iceland. Figure 3.5.7 shows the distribution of acoustic density of blue whiting.

The total biomass estimate was about 3.1 million tonnes and 35 x 10^9 individuals. This represents an increase of about 50% as compared to year 2002, mostly because of higher abundance of blue whiting of ages 2-4 years. The most numerous were 1-year old fish (year class 2002), but 3-year old fish had the highest contribution to the total biomass. A preliminary age disaggregated biomass estimate is given in Table 3.5.3.

3.5.3 July/August – northern Norwegian Sea and southern part of Svalbard area

This survey was partially run as a part of the combined joint Norwegian-Russian 0-group survey. The survey coverage in 2003 was similar to than in 2002, but much less than in the earlier years. Thus, the results in 2002-2003 are not comparable with the earlier results.

Blue whiting was most abundant in the southern part of the survey area (Figure 3.5.8). No blue whiting were recorded north of about 76-77°N. The total biomass in 2003 was slightly less than in the previous year. Blue whiting in the survey area were numerically dominated by the 2000 year class, which also contributed to almost 50% of biomass (Table 3.5.4). The 2001 cohort, which was dominant in 2002, appeared in much reduced numbers in the survey area in 2003.

3.6 Mackerel

No data.

3.7 Aerial surveys

The results from the investigations in summer 2003 will be presented to the mackerel working group (WGMHSA) in September 2003.

3.8 Seabird counts

The weather condition during the Faroese survey (R/V "M. Heinason") were not ideal for bird counting, mainly due to much wind. The amount of The amount of guillemot, puffin, kittiwake, and gannet was about the same as in previous years, however, with less density over the depths compared to the Faroe shelf. The preliminary counts of sea gulls indicated slightly less abundance in 2003.

3.9 Whale counts

The weather condition during the Faroese survey (R/V "M. Heinason") were rather poor for whale counting, mainly due to much wind. In total 14 whale observations were made, mainly sperm whale, finhvale, and seiwhale, and is not considered a representative estimate.

4 DISCUSSION

4.1 Hydrography

The winter NAO index was about average in 2003 (0.2) and lower than in 2002 (0.76). In May, Atlantic Water had a more western extension as compared to 2002. In the Svinøy section the Atlantic layer was at a record high and the surface layer was also warmer than in 2002.

4.2 Plankton

From 2002 to 2003 there was an increase in zooplankton biomass in the western Norwegian Sea in May. This coincided with an extensive warming of the western Norwegian Sea due to a reduced influx of cold water, following a reduction of southerly winds as indicated by the lowered NAO winter index for 2003. In the eastern Norwegian Sea there was large decrease in zooplankton biomass. In Icelandic waters the situation had not changed much since 2002, except for a northward shift of the high biomass waters usually found in the cold water of the East Icelandic current. An area of enhanced biomass that was observed southeast of Iceland was based on high biomass measurements on only one station at the end of the transect.

4.3 Herring migrations and the environment in 2003

The wintering area in 2002/2003 was different compared to previous years. The major part of the recruiting year classes 1998 and 1999 did not join the migration of the older year classes into Vestfjorden, but wintered instead west of the Lofoten Islands. The exact extent of the wintering area is not known.

The spawning areas in 2003 were located along the Norwegian coast from Møre (62°N) in the south to Lofoten (70°N) in the north. High larval concentrations indicated substantial spawning in the northern part of the spawning area. There was no survey to cover the spawning areas and the start of the feeding migration.

The first survey in 2003 was the joint Norwegian/Faroese/Icelandic herring survey in May (Figure 3.3.1). At this time, the herring were spread over an extensive area, stretching approximately from off the Norwegian coast, west to about 10ºW, and from approximately 62°00'N and north to 74°30'N (Figure 3.3.1). In the period 1995-2001 there was a pronounced stepwise northward shift in the feeding migration patterns. However, this development seems to have stopped, and the distribution at the end of the feeding season in August 2002 and 2003 does not seem to reach so far north as that observed in 2001 (Figs 3.3.1 and 4.3.1). Furthermore, herring distribution in May extended farther west in 2003 (to approximately 10°W) as compared to 05°W in 2002 (Figure 4.3.2). The centre of gravity of the herring distribution in May 2003 seems to be similar to that of 2002 (Figure 4.3.1).

It has often proved difficult to find rational explanations for changes of migration routes and behaviour patterns of dynamic pelagic stocks like the Norwegian spring spawning herring. In the present case, however, environmental variability must be the prime suspect. Thus, a comparison of zooplankton abundance in 2002 and 2003 (Figure 4.3.5 and Table 3.2.1) shows a radical change from the 2002 situation and strongly indicates that this year the herring had to migrate much farther west to obtain satisfactory feeding conditions than was necessary in May 2002. The older herring, recorded in the southern- and westernmost areas had experienced contacts with high plankton concentrations shortly after leaving Norwegian coastal waters in 2002. However, does not seem to apply to the younger year classes in the adult population, which were distributed west of Lofoten and in the international area in 2003 where low plankton concentrations were recorded

Furthermore, the temperature data (Figures 4.3.3 and 4.3.4) clearly show that the water temperatures along the migration routes in May 2003 were much higher as compared to 2002. This may also have promoted a more westerly herring distribution.

Due to the unfortunate circumstances resulting in an absence of the regular Russian surveys, there is relatively little information on herring migrations in June-July 2003. However, the general northward migration seems to have commenced in June. Thus, the Icelandic fleet caught herring at 68°N, 8°W (at the borderline between the Icelandic EEZ, the international area and the Jan Mayen zone) around mid-June, but by the end of June no herring were recorded in the Icelandic survey of the Icelandic EEZ and all fishing had shifted to latitudes north of 70°N.

Suggested migration patterns of Norwegian spring spawning herring during April-June 2003 (Figure 4.3.6).

The survey in August recorded the northern distribution border at 76°N, which is approximately at the same latitude as in 2002, but farther south than in 2001. The plankton abundance in the northern area in August 2003 was lower than in 2002. During the August survey, relatively large concentrations of herring were recorded as far south as 71°N.

As we do not know where the 1998 and 1999 year classes will winter this year, it was decided not to indicate any migration routs (arrows) on the map of the July-August 2003 distribution (Figure 3.3.6).

In summary, the large changes of the physical and biological ocean climate as compared to recent years seem to be the most likely causes of the extended westward migration observed in 2003. High temperatures and high plankton biomasses in the western are may have promoted the western distribution. Why did the herring not appear on the traditional feeding grounds of North- Iceland? There is perhaps no obvious answer to this , but we note, however, that very large numbers of blue whiting were recorded west of 9-10°W in the area east of Iceland in late May 2003 as well as further north off the Icelandic east coast and northeast of Iceland during the Icelandic blue whiting/herring survey in July. Since these two species may to some degree be competitors for the same or similar food supply it is possible that the blue whiting concentrations had influence in determining the western border of the herring migration. It should also be kept in mind that the herring which migrated furthest to the west only represented a small part of the total biomass of the stock and experience gained during earlier surveys in the series has shown that under such circumstances it can be very difficult to identify herring schools among those of blue whiting.

4.4 Blue whiting

The surveys summarized in this report, taken together, cover large parts of the distribution of blue whiting in the feeding areas north of 60 ºN, but were not designed to provide a synoptic estimate of blue whiting in the northern areas.

Year class 2000 appears as a very strong one in all survey areas covered here. The surveys also suggest that year class 2002 is strong, whereas year class 2001 is weaker, at least in comparison to the 2000 and 2002 year classes. Older blue whiting represent only relatively small contributions to stock numbers and biomass, except in Icelandic waters where the age distribution was rather broad. This is also the only survey where 0-group blue whiting have been regularly observed in large numbers in later years.

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 2003/ACFM:23). As an indication of the magnitude of this problem, the Faroese estimate (Table 3.5.1), if based on an alternative TS relationship [TS=20 log(L)-65 instead of TS=21.8 log(L)-72.8], is reduced from 4.8 mill. tonnes to 1.4 mill. tonnes. Work to find a more adequate TS relationship is ongoing, but until this work has been concluded and the results made available, there is no firm factual basis for choosing a specific TS relationship (probably being somewhere in between the two extremes described above).

Quantitative interpretation of the changes in biomass is confounded by changes in survey coverage. Only the survey in the northern Norwegian Sea and southern Svalbard area in July-August had a similar coverage both in 2002 and in 2003. This survey suggests a marginal decrease (about 13%) in blue whiting biomass. The surveys in Icelandic waters and in the Faroese EEZ and Norwegian Sea had a significantly larger coverage in 2003 as compared to earlier years. The biomass estimates from these surveys are also much larger. The interpretations of the results from these two surveys are discussed below.

For the first time, the May survey covered the eastern part of the Icelandic EEZ. In this area strong registrations of blue whiting were made. Furthermore, the southern part of the Faroese zone, which also had a strong concentration of blue whiting, was not covered in 2002 (the area has been covered in the earlier years and has typically contained relatively strong blue whiting registrations). Thus, the two areas that contained the highest registrations were not covered in 2002. Therefore, the question whether there is more blue whiting in the Norwegian Sea and adjacent waters as compared to, e.g., 2002 remains unresolved.

The survey of the Icelandic waters covered areas northeast and west of Iceland that had not been covered earlier. At the same time, the observed distribution of blue whiting extended further north in 2003 than in 2002. Thus, the increase in the survey estimate probably reflects not only the extended coverage but also an increase of blue whiting in Icelandic waters as compared to previous years.

The surveys reported by PGSPFN could provide valuable tuning data for quantitative stock assessments of blue whiting (WGNPBW already used data from the Icelandic EEZ cruise for exploratory purposes in 2003). Both the May survey in the Faroese/Icelandic EEZ and Norwegian Sea and the survey of the Icelandic EEZ in June-July, however, highlight the fact that if these survey time-series are to be used for stock assessment purposes, there is a need to account for the changes in survey coverage which have taken place over the time period.

5 PLANNING

5.1 Planned acoustic survey of pelagic fish and the environment in the Norwegian Sea, spring/summer 2004

It is planned that 4 parties, EU, Faroe Islands, Iceland and Norway, will contribute to the survey of pelagic fish and the environment in the Norwegian Sea in May 2004. The participation and area coverage for the different parties are given in Figure 5.1.1 and Table 5.1.1. It is proposed that the EU vessel (R/V "Dana") leaves Denmark at the end of April. The plan will be to calibrate the acoustic equipment of the vessel near Bergen and then start surveying the area north of 62°N and east of 2°W with east-west cruise-lines.

The Norwegian vessel will start at the end of April/beginning of May (the date and name of vessel will be decided medio October 2003) 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 R/V Dana can take place as early as possible during the 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 EU vessel.

The Faroes will their survey the area south of 62°N in the period 01.05-15.05 and the area north of 62°N in the period 15.05- 30.05. The Icelandic vessel has planned to conduct their survey in the period 06.05-20.05.

There are planned areas of overlap (Figure 5.1.1). If possible east-west cruise lines should be applied.

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.

A second coordinated survey in June/July with Russia and Iceland participating is planned in the Norwegian Sea 2004 (Figure 5.1.2 and Table 5.1.1).

Standardisation of sampling procedures

The PG participants agreed to conduct their acoustic surveys in May 2004 using the standardised sampling procedures given below.

Zooplankton

It is recommended that the zooplankton samples are split into three size fractions 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. Weighing at sea is effective because results can be obtained and interpreted during the cruise. Still, this method may introduce bias to the data due to the difficulties involved in weighing small quantities when the ship is moving. The PGSPFN recommends that an experiment is performed by weighing the zooplankton samples both at sea and on land, to investigate the possible bias introduced by both methods.

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. The PGSPFN recommends that the sampling depth for CTD casts be standardised to 1000 m.

Acoustic sampling

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

Biological samples of fish

The PGSPFN recommends that a random full sample of at least 50, but preferably 100, fish is taken from every trawl catch. 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. The PGSPFN 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 2004

It is probable that at least 4 nations will contribute to the blue whiting survey in 2004. Norway and Russia as in previous years will survey the spawning area in late March and early April. It is intended that The Netherlands and Ireland will also join the survey (Table 5.2.1). With this in mind, the planning group proposed a joint survey design, with the objective of synoptically mapping the entire spawning population of blue whiting and maintaining the time-series used for the blue whiting assessment.

It is proposed that the continental shelf from the Celtic Sea to the Faroe Islands be surveyed, with each nation concentrating on a particular area. The Norwegian survey and a Russian survey will form the core of the shelf edge survey, and a second Russian survey will take place on the spawning aggregations further west. This will ensure that the stability of the time-series is maintained (Figure 5.2.1). In addition to these three surveys, the Dutch will survey from 54° to 48°N along the Porcupine Bank and the Celtic Sea shelf edge. This survey will overlap with a survey carried out by Ireland from 52° to 56°N along the shelf edge, which will also partly overlap with the Norwegian survey. This spatial overlapping of the surveys was designed to counteract any unforeseen problems that may prevent the completion of a survey sector. It is intended to survey the entire area in a 4 week period.

An intercalibration exercise is planned for the 21st and 22nd March 2004, in the region of the continental slopes north of the Porcupine Bank. 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 e 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. This is needed to ensure that the survey results are available for the ICES NPBWWG which meets in Copenhagen (beginning on the 27th April, 3 weeks after the cruises finish). The results of the cruises will be collated at a meeting in Bergen, directly after the cruises, which will coincide with the docking of the Russian research vessel in Bergen.

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 is still unclear as different institutes used different systems.

6 TOR (E)

ToR e) evaluate the consequences of the withdrawal of EU countries from the survey in terms of decrease in spatial and temporal coverage and in terms of precision in stock estimates.

Three members from EU countries attended the planning group and advised the group of the intention to join the survey of herring in the Norwegian Sea and the survey of blue whiting on their spawning grounds. With this information, it was clearly not necessary to evaluate the consequences of the withdrawal of EU countries from the survey. In fact the planning group had to spend time integrating the proposed collaboration into the existing time-series of surveys.

7 PUBLICATION AND OTHER MATTERS, TOR (F)

To the present time the PGSPFN publishing effort has been concentrated in and limited to the annual report.

The annual report describes the procedures for the acoustic, hydrographic, plankton, and fish sampling during the ICES co-ordinated surveys in the Norwegian Sea (Norway, Faroes, Iceland, EU and Russia). The results of the surveys are presented, including the distribution and stock estimates of Norwegian spring-spawning herring, blue whiting and other pelagic fish, and the environment of the Norwegian Sea and adjacent waters in late winter, spring and summer. The abundance estimates are used in fish stock assessments within ICES (NPBWWG) and the collection of environmental data further improves the basis for ecosystem modelling of the Northeast Atlantic.

The PGSPFN publishing activity is limited to the annual report for some obvious reasons. The group gathers once a year for 3 days, which are used to prepare the annual report and to plan the next year's surveys. To expect additional publications from the group as a whole, based on the data the group has collected, is not possible until the following demands have been met:

1) The technical implementation of the PGSPFN database is mandatory.

2) An additional workshop is needed to gather and organize existing data.

3) Agreement on data access, how data is used and publicised must be established.

As for item 3, a possibility could be to use the setup as used for survey data in other areas. A suggestion is given below.

If a scientist is interested to use the collected data for scientific purposes, a request including a description of purpose of using the data, should be sent to the survey database manager. Each country must have appointed a survey data contact person. The data manager contacts all the contact persons in order to get permission to distribute the data.

If permission to use the data is given the data will be provided on the understanding that:

1. They will be used only for the scientific purpose as described above;
2. They will not be used in any project that is carried out for remuneration (unless specifically stated otherwise);
3. They will not be made available to other persons;
4. The source of the data, names of the data providers (Research institute names) is included in all tables, figures, reports, publications, etc., that make use of the data;
5. Full acknowledgement is made to the data providers.

Time-series and data collected are definitely strong enough for publishing purposes. The implementation of the PGSPFN database was agreed at the Bergen meeting 2000 (Appendix 2). A draft database was constructed with tables, constraints and formats. An agreement was made, that a database available to all members over the internet, should be located in Bergen. However, this goal has not been achieved yet.

An example of such a database was given by Jørgen Dalskov (Denmark) during the Tórshavn 2003 meeting. JD demonstrated the online HERSUR database (International Acoustic Survey Database for the North Sea) with all essential documentation of the database structure (Tables, constraints and formats) and contacts. The practical implementation of the PGSPFN database could ideally be based on the experiences of techniques and administration of the database made by the people behind the HERSUR project.

It is recommended that a PGSPFN database, including all available data from the surveys, should be implemented. It is not possible to achieve this during the ordinary annual meeting of the PGSPFN group. A separate workshop is needed to initiate this task, as well as to follow up on the implementation progress.

8 STANDARDISATION, TOR (G)

A sampling manual (Manual for herring acoustic surveys in ICES Divisions III, IV and VIa) was presented to the group, and it was agreed to use it as a template for a sampling protocol for the PGSPFN. It is suggested that a first version should be finalised before the surveys starts in May 2004. The Faroese Fisheries Laboratory will coordinate this work.

The Planning Group made a set of standard spreadsheets in 1997 to be used in the pelagic surveys (ICES 1997/H:3). The procedures have been followed, however with some modifications along (indicated in the various reports from the group). As part of a coordinated acoustic survey the participating vessels plan to carry out acoustic intercalibration as early as possible in the survey at a convenient place at sea to ensure comparable readings from the acoustic equipment. The manual scrutinising or allocation of the acoustic reading to species groups is the main source of bias. The task to standardise the trawl and associated equipment to ensure that all participating vessels obtain similar species and length distribution from samples of fish observed with the acoustic equipment is considerable, and for practical purposes almost impossible to achieve. There are many factors to consider in a pelagic survey, including different sizes of vessels (horsepower), type and size of trawls doors and trawls. However, with the recent addition to cover blue whiting on the spawning areas and the participation of several parties in the coming years warrant a proper survey manual covering all aspects of the surveys.

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Table 1.4.1 Organisational frame of the coordinated herring investigations in the Norwegian Sea, 1995-2003.

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 1997/H:3)	Reykjavík (Vilhjálmsson, 1997/Y:4)
1998	Faroe Islands, Iceland Norway, Russia, EU	11	Reykjavík (ICES 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 2002/D:07)
2003	Faroe Islands, Iceland Norway, Russia, EU	5	Bergen (ICES 2002/D:07) + correspondence	Tórshavn (this report)

Table 1.4.2 Surveys conducted in spring and summer 2003 by Faroese, Icelandic and Norwegian 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 sec. 1.4).

Platform	Country	Survey area	Period	Herring samples	Blue whiting samples	Mackerel samples	Plankton samples	CTD stations
G.O. Sars	NO	62°N-75°N, 8°W-20°E	25/4-10/6	55	28		109	158
Magnus Heinason	FA	60°N-66°30'N, 14°W-1°E	30/4-28/5	19	25	2	112	125
Arni Fridriksson	IS	64°50'N-68°45'N, 18°50'W-2°W	21/5-29/5	1	3		56	54
Bjarni Saemundson	IS	62°30'N-68°N, 30°W-5°50'W	23/6-17/7		35			86
G.O. Sars	NO	70°N-77°N, 4°E-20°E	25/7-15/8	61	3		33	33

Table 3.2.1 Average zooplankton biomass [g dry weight m^{-2}]. The 1998 and 2001 data on the Faroese shelf were omitted to allow comparison with the other years.

Year	1997	1998	1999	2000	2001	2002	2003	Mean
Total area	8.2	13.4	10.6	14.2	11.6	13.1	12.4	11.9
Region W of 2°W	9.1	13.4	13.5	15.7	11.4	13.7	14.6	13.1
Region E of 2°W	7.5	14.4	10.2	11.8	8.7	13.6	9.0	10.7

Table 3.3.1 Acoustic estimate of herring in the Norwegian Sea, May 2003.

Length	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Numbers	Biomass	Weight
15	11218	863														12081	310.7	25.7
16	17218	1324	265													18807	560.3	29.8
17	3333	2333														5666	214.1	37.8
18	304	1976														2280	102.0	44.7
19		773	386													1159	64.9	56.0
20		488	542													1030	67.4	65.4
21		91	272													363	27.9	77.0
22		178	689													867	74.5	86.0
23		38	1562	38												1638	162.2	99.0
24		51	1269	25												1345	148.8	110.6
25			745	174												919	116.0	126.2
26			380	527	21											928	132.0	142.3
27			230	1589	96											1915	303.0	158.3
28			177	3182	530											3889	671.0	172.5
29			22	2684	2041											4747	899.7	189.5
30			22	1315	2782	22										4141	861.2	208.0
31			0	358	2921	60	30									3369	752.1	223.3
32			0	66	1228	531	166									1991	480.0	241.1
33			0	27	247	275	192		27	55						823	210.7	255.5
34					52	568	258	103	103	723	310	310				2427	697.3	287.5
35					43	43	86	43	43	475	1079	604				2416	748.7	309.7
36										448	806	448				1702	555.4	326.5
37									55	164	164	273				656	221.3	337.3
38												134			45	179	67.1	374.6
39														287		287	113.7	397.0
40																0		
41																0		
42																0		
43																0		
44																0		
45																0		
Numbers (10^6)	32073	8115	6561	9985	9961	1499	732	146	228	1865	2359	1769		287	45	75625		
Biomass (10^3 t)	941.0	345.1	663.8	1789.3	2114.7	392.6	196.7	43.0	68.5	570.3	741.7	564.9		113.7	16.8		8562.1	
Length (cm)	16.3	18.0	23.5	28.8	30.8	33.5	33.8	34.8	35.3	35.5	35.8	36.1		39.5	38.5			22.9
Weight (g)	29.3	42.5	101.2	179.2	212.3	262.1	268.6	294.0	299.7	306.0	314.5	319.3		397.0	374.6			113.2

Table 3.3.2. Acoustic estimate Norwegian spring-spawning herring July – August 2003.

Length	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Numbers	Biomass	Weight
15																0	21.6	34.1
16	632															632	81	40.4
17	2008															2008	91.6	49.2
18	1861															1861	55.9	58.6
19	953															953	24.9	67.5
20	277	92														369	10.1	81.1
21	15	108														123	17	89.1
22		191														191	54.5	108.9
23		319	182													501	88.8	119
24		213	533													746	124.5	135.5
25		131	787													918	241.1	150.9
26		28	1514	56												1598	215.2	168.7
27		27	1194	54												1275	239.7	190.4
28			382	858	19											1259	679.3	213.5
29			168	2489	524											3181	784.2	233.9
30			20	1745	1588											3353	680.5	258.9
31				897	1685	46										2628	441.3	283.8
32				167	1237	100	50									1554	249.4	316.3
33				18	348	275	128									769	255.5	336.7
34					48	48	178	16	48	97	258	65				758	516.1	361.1
35					19		74	19	56	260	613	353	37			1431	263.6	384.5
36								18	54	90	307	199	18			686	80	403.9
37									50		50	50		50		200	36.2	401.8
38											45	27		18		90	0.1	526.3
39																0	0.2	568.3
40																		
41																		
42																		
43																		
44																		
45																		
Numbers (10^6)	5746	1109	4780	6284	5468	469	430	53	208	447	1273	694	55	68		27084		
Biomass (10^3 t)	270	118.7	732.9	1406	1407.6	143.8	141.4	19.1	77.2	161.1	464.2	256.3	26.1	27.4			5251.9	
Length (cm)	18.2	23.5	26.5	30	31.4	33.2	34.1	35.5	36	35.5	35.7	36	35.2	37.8				27.6
Weight (g)	47	106.9	153.4	223.7	257.4	305.8	328.7	361.6	371.7	360.5	364.9	370.2	355.6	404.2				193.8

Table 3.5.1 Age stratified abundance estimates of post-spawning blue whiting in the Faroes area during May 2003. Data from R/V “Magnus Heinason”. Biomass in thousand tonnes, numbers in millions, L= mean total length (cm), and W= mean weight (g). Target strength used for blue whiting, TS= 21.8 log(L)-72.8 dB.

Faroese area	Age							
May 2003	1	2	3	4	5	6	7	Total
Northern area								
Biomass	62	314	1,030	479	165	68	7	2,125
Numbers	1,085	3,415	9,587	3,449	1,040	368	27	18,971
Length (cm)	20.4	24.0	25.6	28.1	29.6	31.0	34.5	25.8
Weight (g)	58	92	107	139	159	183	266	112
Southern area								
Biomass	786	477	1,159	204	19	7	0	2,652
Numbers	19,821	6,917	14,824	1,974	138	51	0	43,725
Length (cm)	19.2	23.4	25	27.7	30.3	29	0	22.2
Weight (g)	40	69	78	103	134	132	0	61
Total area								
Biomass	848	791	2,189	683	184	75	7	4,777
Numbers	20,906	10,332	24,411	5,423	1,178	419	27	62,696
Length (cm)	19.2	23.6	25.2	28.0	29.7	30.8	34.5	23.4
Weight (g)	41	77	90	126	156	177	266	77.3

Table 3.5.2 Age and length stratified abundance estimate of blue whiting in the Faroese EEZ and Norwegian Sea in May 2003. Based on the acoustic results and length data from R/V "Magnus Heinason", R/V "Arni Fridriksson", and R/V "G.O. Sars", and biological data from R/V "Magnus Heinason" and R/V "G.O. Sars". Target strength used for blue whiting: TS = 21.8 log L – 72.8 dB.

	Age									Numbers	Weight	Mean wt
Length	1	2	3	4	5	6	7	8	9	(10^6)	(10^3 t)	(g)
15												
16	449									449	11	24.2
17	3278	137								3414	95	27.9
18	9903	157								10060	320	31.8
19	14342	148	148							14638	546	37.3
20	13428	463	154							14046	610	43.4
21	6203	1348	539	135						8225	429	52.2
22	1570	6019	3533							11121	688	61.9
23	493	9171	10058	197						19920	1402	70.4
24	275	8155	15944	92						24465	1958	80.0
25		2944	15238	1126						19308	1745	90.4
26		341	7841	2250	68					10500	1099	105
27			4785	4554	386					9725	1139	117
28	54		1130	3176	807	161				5329	682	128
29			71	2061	782	640				3553	519	146
30				436	934	187				1557	245	157
31				262	197	328				786	139	177
32					55	276				331	65	196
33					32	32		32		96	21	219
34				79			79			158	40	256
35												
Numbers (10^6)	49995	28882	59442	14366	3261	1623	79	32		157680		
Biomass (10^3 t)	2019	2077	5156	1741	469	262	20.2	7.0			11752	
Length (cm)	19.8	23.6	25.0	27.8	29.4	30.5	34.5	33.5				23.5
Weight (g)	40.4	71.9	86.7	121	144	162	256	219				74.5

Table 3.5.3 Age stratified abundance estimate of blue whiting in the Icelandic waters. Data from R/V "Bjarni Sæmundsson", 23.6-16.5.2003. Target strength used for blue whiting: TS = 21.8 log L – 72.8 dB.

	Age										
June-July2003	0	1	2	3	4	5	6	7	8	9	Total
Numbers (10^6)	5011	9363	6054	7429	3888	1350	852	581	91.4	33.2	34652
Biomass (10^3 t)	68.0	555	600	852	503	200	146	101	19.4	8.5	3054
Length (cm)	13.2	21.3	25.1	26.4	27.9	29.2	31.0	31.1	33.9	31.0	23.4
Weight (g)	13.6	59.3	99.1	115	129	148	172	175	212	257	88.1
% of total ind.	14.5	27.0	17.5	21.4	11.2	3.9	2.5	1.7	0.3	0.1	100

Table 3.5.4 Age stratified abundance estimate of blue whiting in the northern Norwegian Sea and southern Svalbard area in July-August 2003. Data from R/V "G.O. Sars", 25.7-16.8.2003. Target strength used for blue whiting: TS = 21.8 log L – 72.8 dB.

	Age							
July-Aug. 2003	1	2	3	4	5	6	7	Total
Numbers (10^6)	4434	2393	5269	848	162	25	0	13131
Biomass (10^3 t)	183	188	487	98.4	27.0	4.7		97.5
Length (cm)	20.6	24.3	25.5	27.4	30.8	32.5		23.8
Weight (g)	41.2	78.5	92.4	116	166	185		75.2

Table 5.1.1 Planned participation in the coordinated spring/summer 2004 survey in the Norwegian Sea.

Country	Research vessel	Total time interval	Coverage
EU	Dana	From 27.04(?) and 30 days of surveying	North of 62ºN and east of 2ºW
Faroe Islands	Magnus Heinason	01.05-30.05	Mainly Faroe EEZ
Iceland	Arni Fridriksson	06.05-25.05	Western part of the herring distribution between 65 and 70ºN
Norway	One vessel to be decided	May	Norwegian Sea north of 66ºN
Russia	Fridtjof Nansen	15.05-30.05	Young herring investigations in the Barents Sea.
Iceland	Bjarni Sæmundsson	20.06-15.06	Figure 5.1.2.
Russia	Fridtjof Nansen	June/July	Figure 5.1.2.
Norway	Vessel to be decided	August	Northern Norw. Sea

Table 5.2.1 Expected survey effort on the spawning grounds of blue whiting in spring 2004. The timings refer to the total survey time from port to port, unless otherwise stated.

Country	Expected timing	Expected coverage	Time-series
Norway	18/3 - 20/4	Shelf edge and banks from 54ºN northwards	1972-2003 (some gaps)
Russia (PINRO)	18/3 - 20/4[1]	Shelf edge and banks from 54ºN northwards	1981-1996, 2002-2003
The Netherlands	15/3 - 4/4	Shelf edge from 54ºN to about 48ºN	New
Ireland	20/3 - 5/4	Shelf edge from 52ºN to about 58ºN	New
Russia (AtlantNIRO)	5/3 - 25/4	International waters from about 53ºN northwards	2001-2003

[1]Estimated time of arrival to the survey area-arrival to Bergen

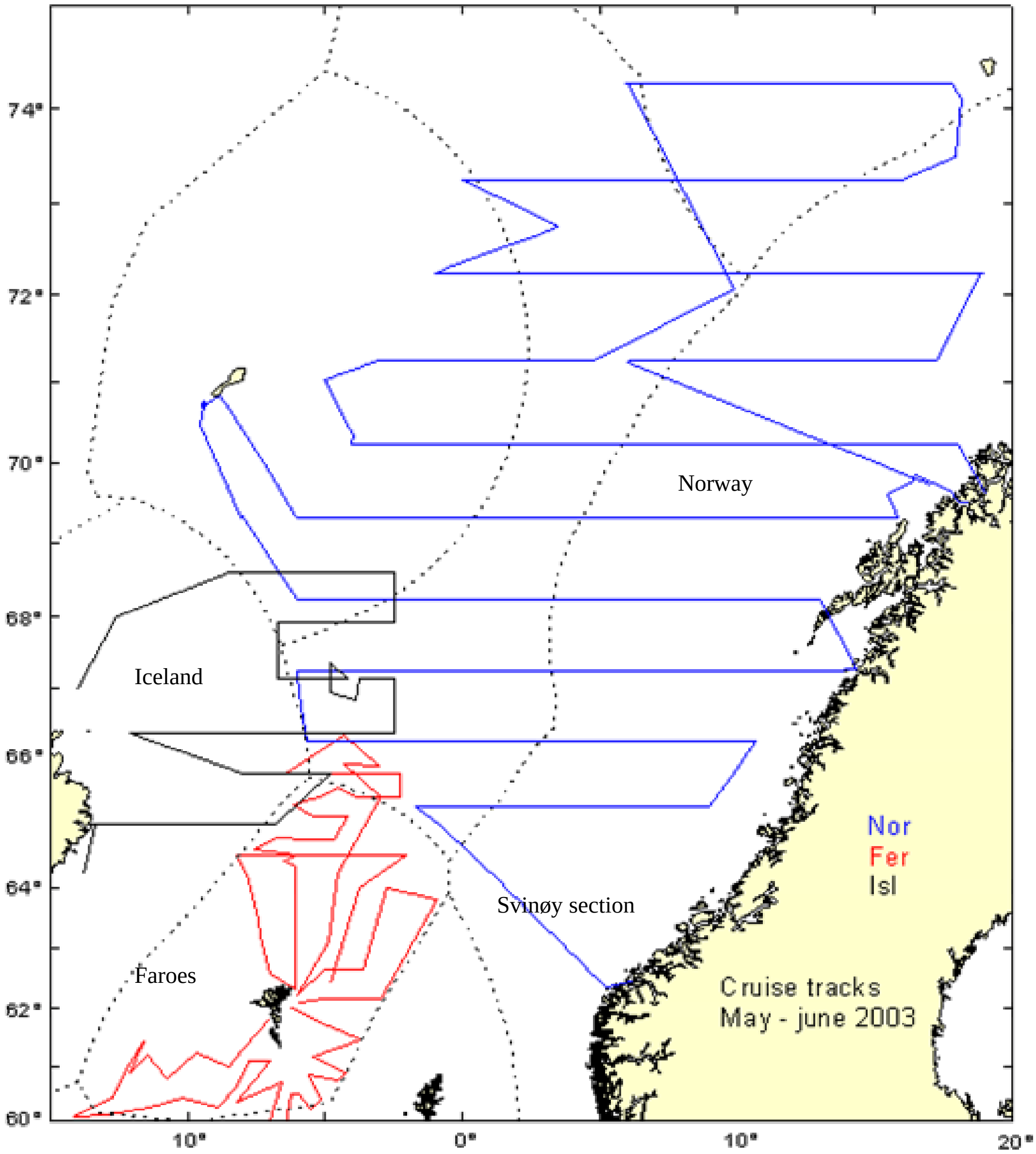

Figure 2.1 Cruise tracks for the Faroese R/V "Magnus Heinason", the Icelandic R/V "Arni Fridriksson", and the Norwegian R/V "G.O. Sars" in the Norwegian Sea in late April and May 2003.

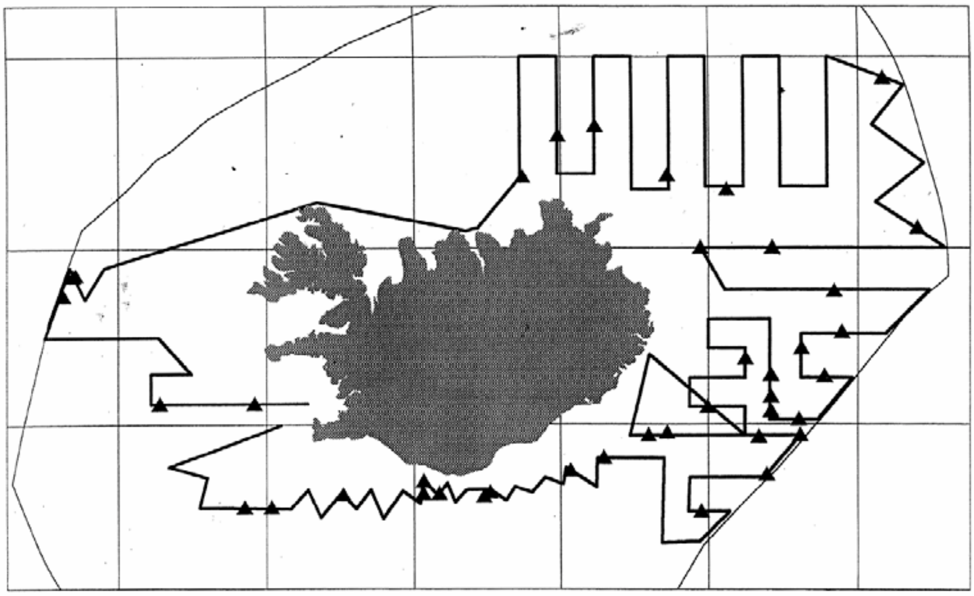

Figure 2.2 Survey transects of the R/V "Bjarni Saemundsson" June/July 2003.

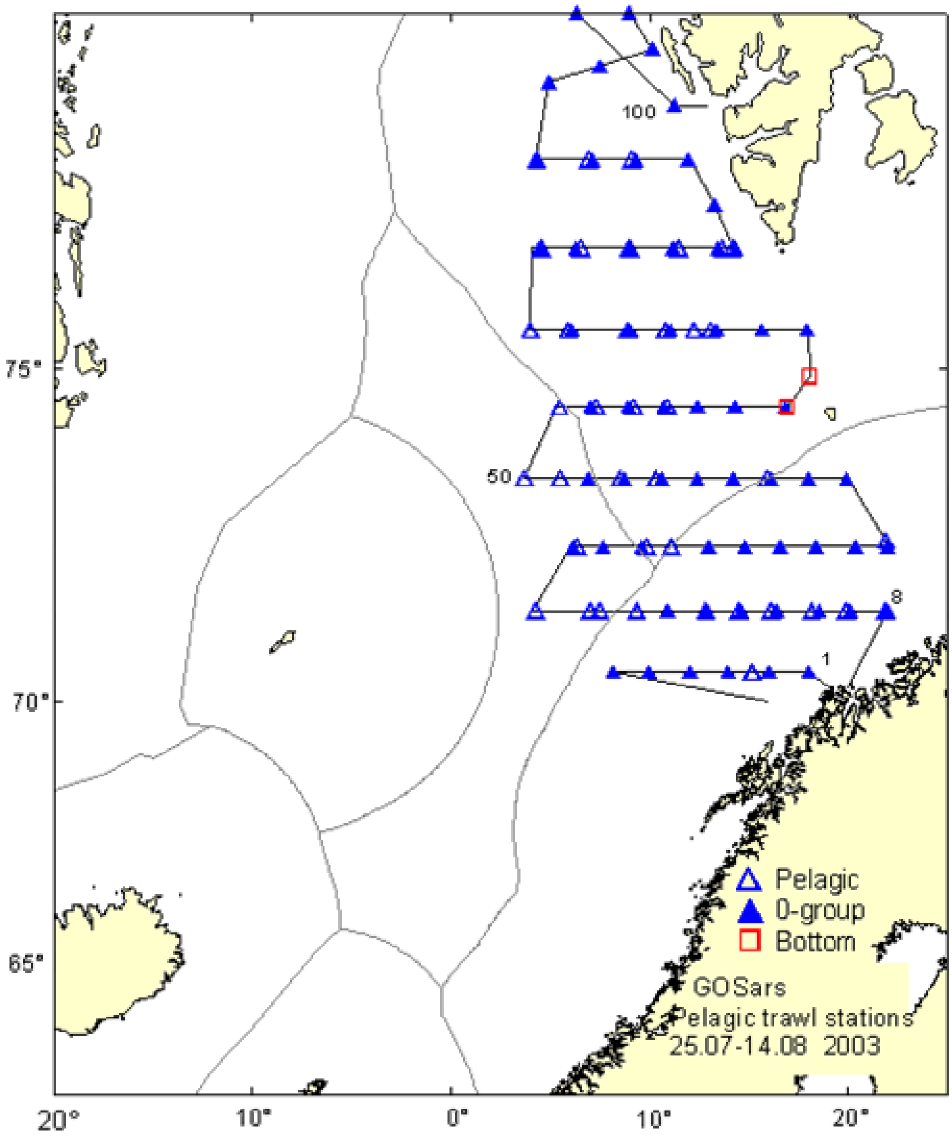

Figure 2.3 Cruise tracks and trawl stations for R/V "G.O. Sars" 25.07-15.08. 2003.

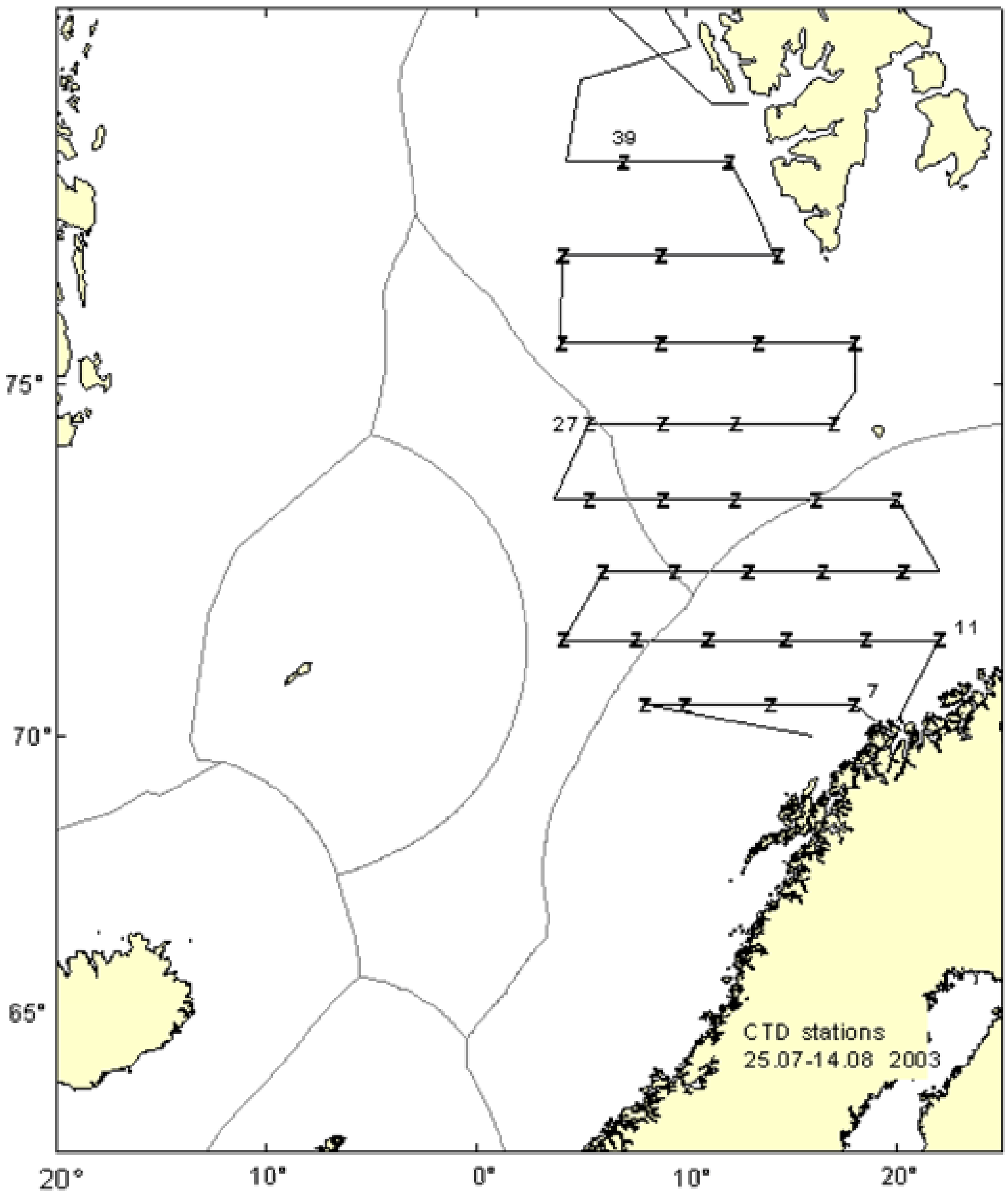

Figure 2.4 Cruise tracks and CTD stations for R/V "G.O. Sars" 25.07-15.08. 2003.

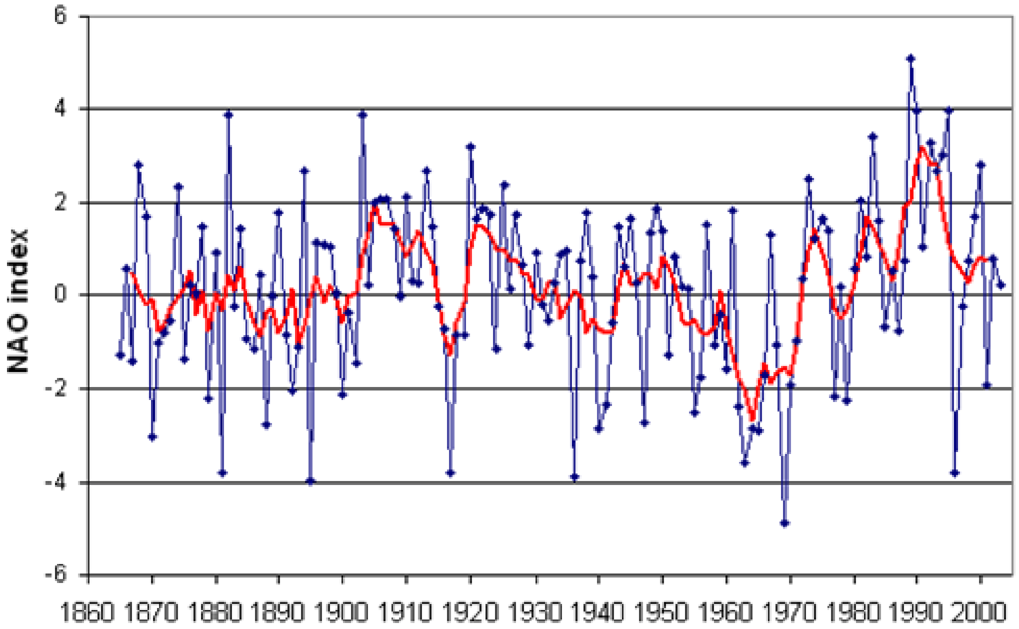

Figure 3.1.1 Winter NAO index, from 1865 to 2003. Red line is 5 years moving averages.

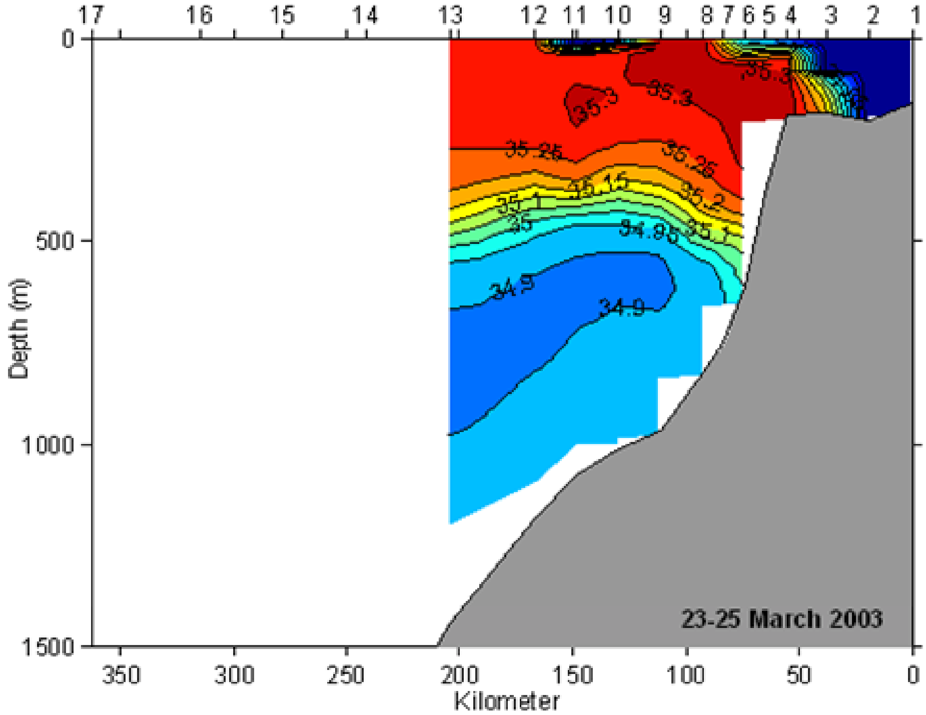

Figure 3.1.2 Salinity in the Svinøy section , March 2003.

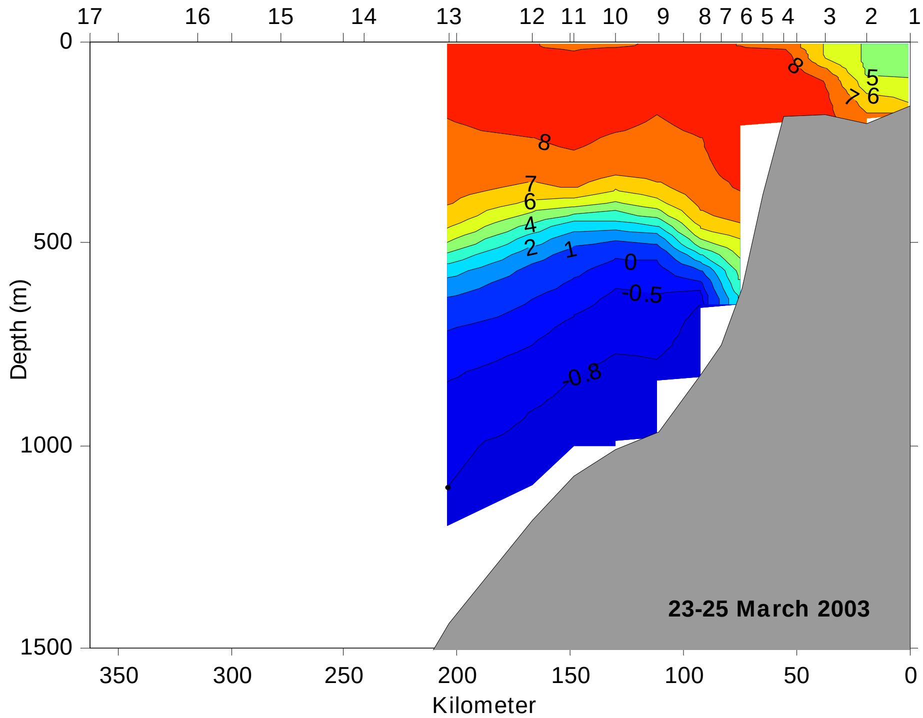

Figure 3.1.3 Potential temperature in the Svinøy section, March 2003.

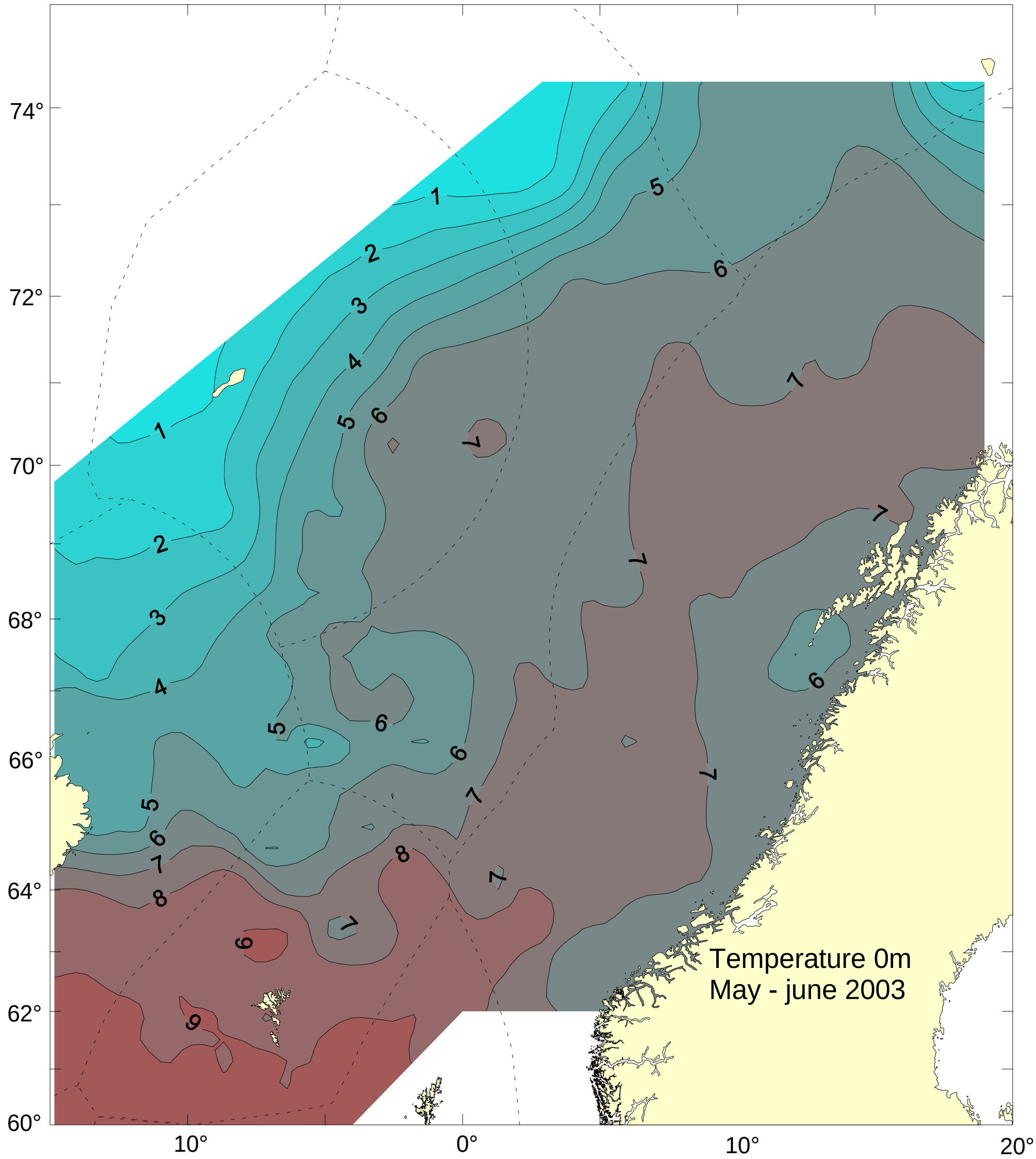

Figure 3.1.4 Temperature at surface in May 2003.

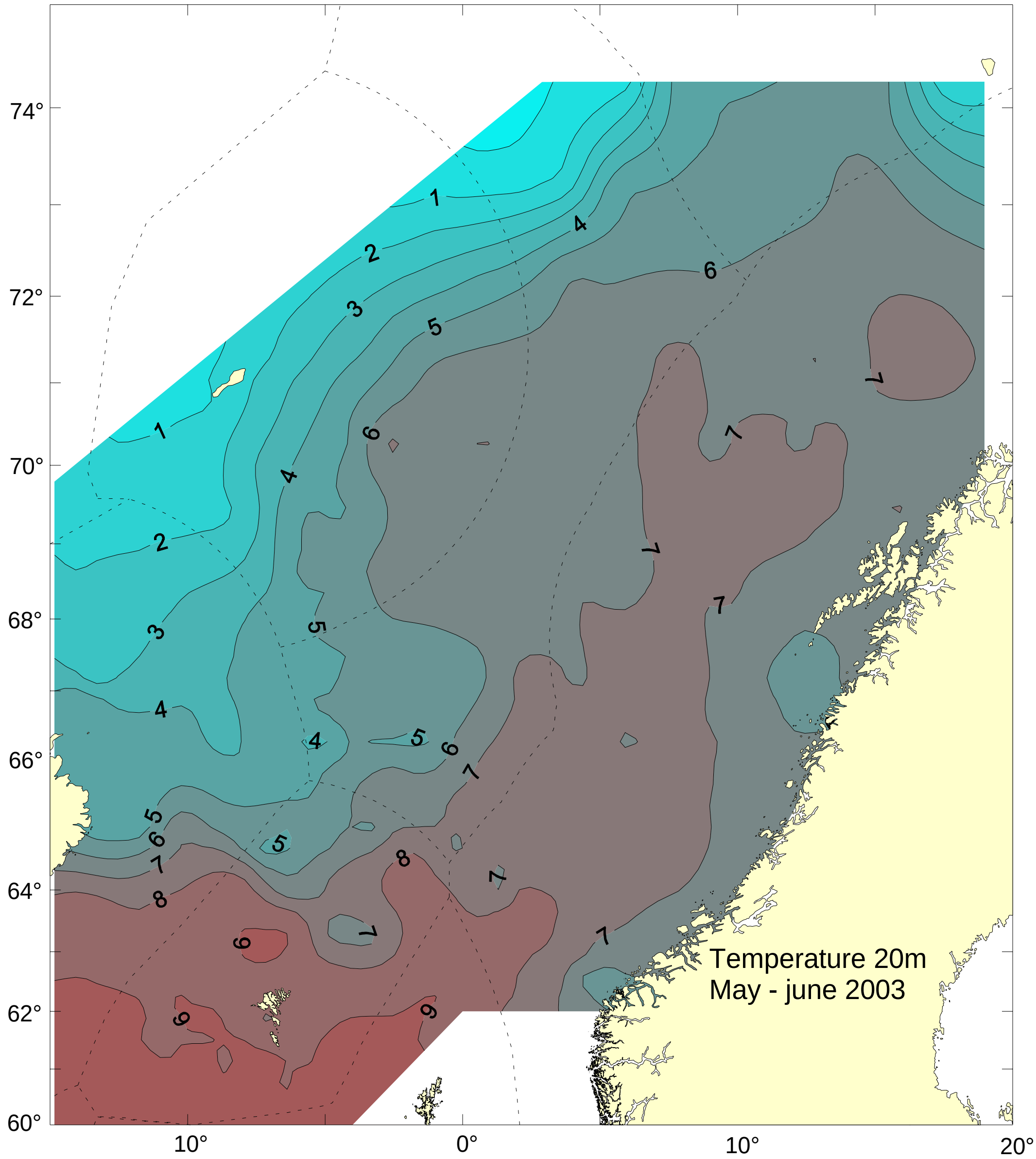

Figure 3.1.5 Temperature at 20 m depth in May 2003.

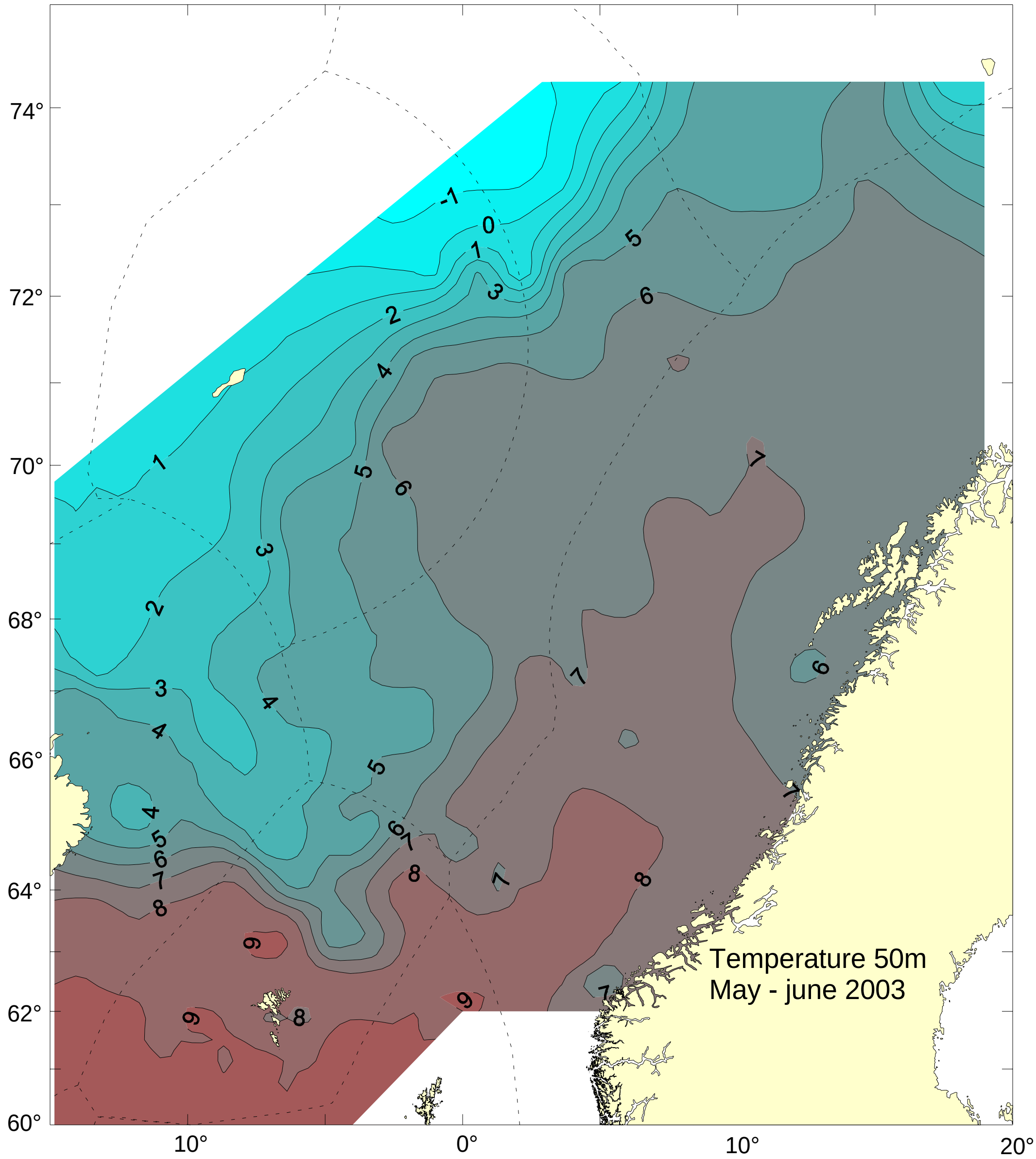

Figure 3.1.6 Temperature at 50 m depth in May 2003.

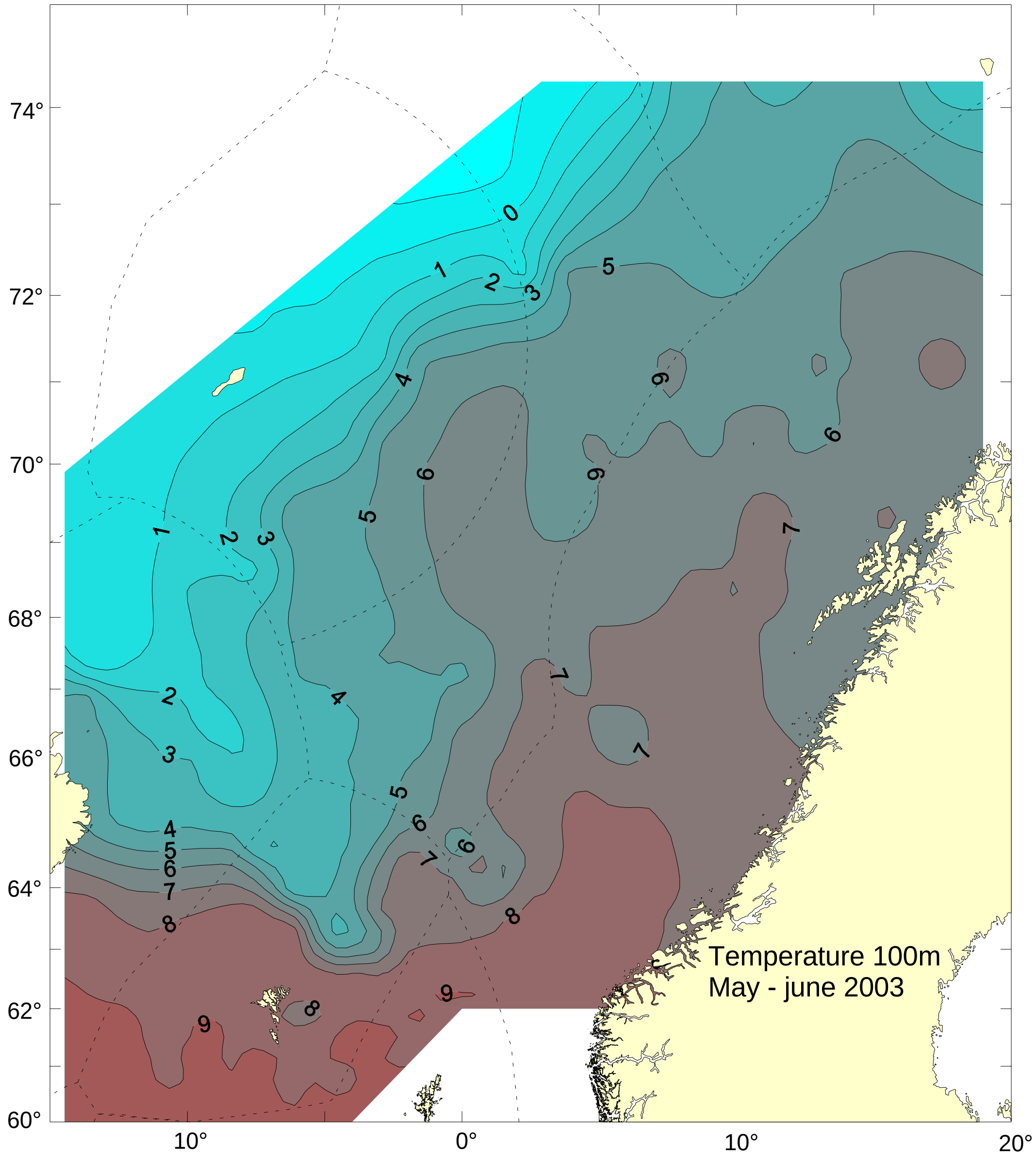

Figure 3.1.7 Temperature at 100 m depth in May 2003.

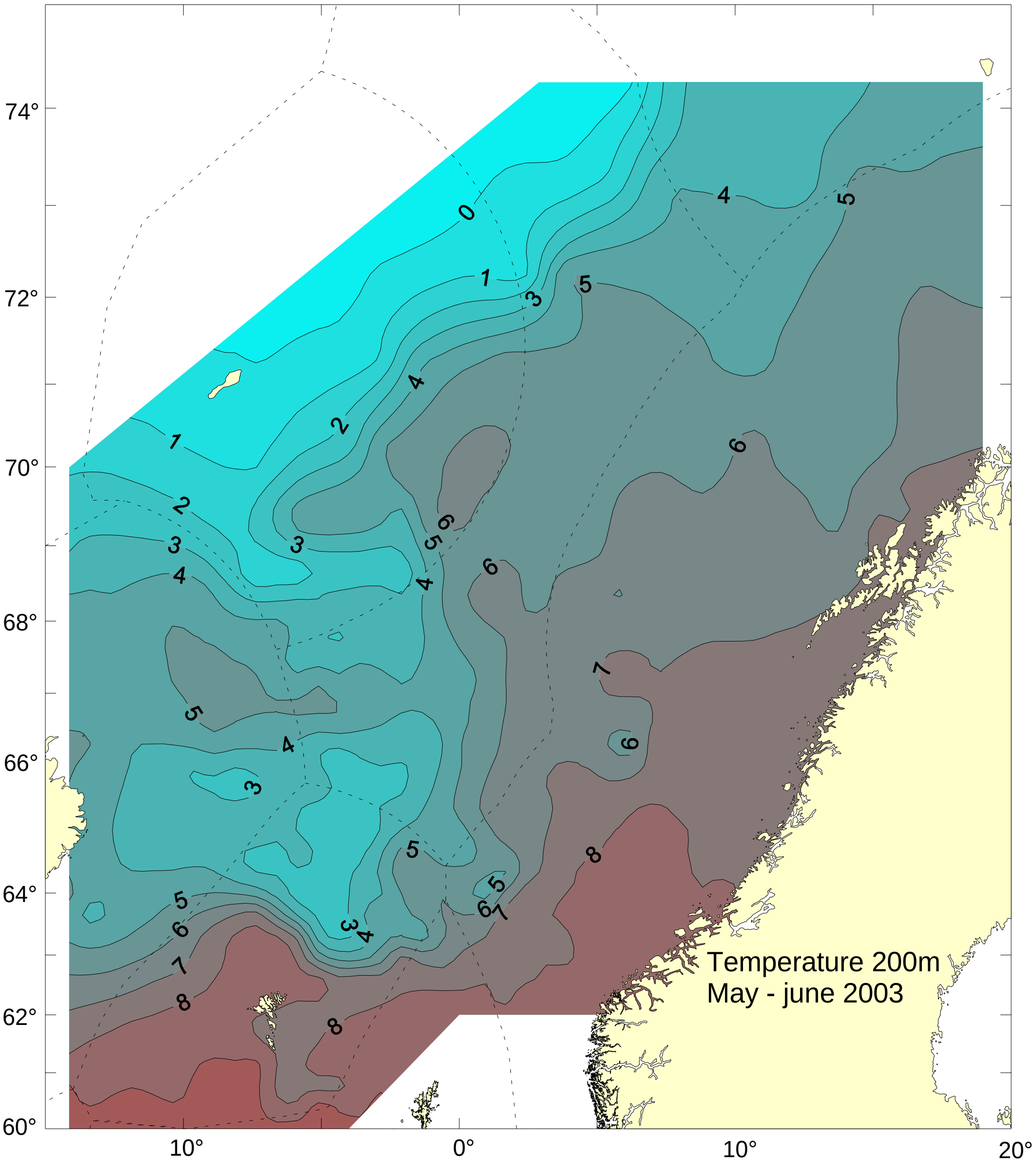

Figure 3.1.8 Temperature at 200 m depth in May 2003.

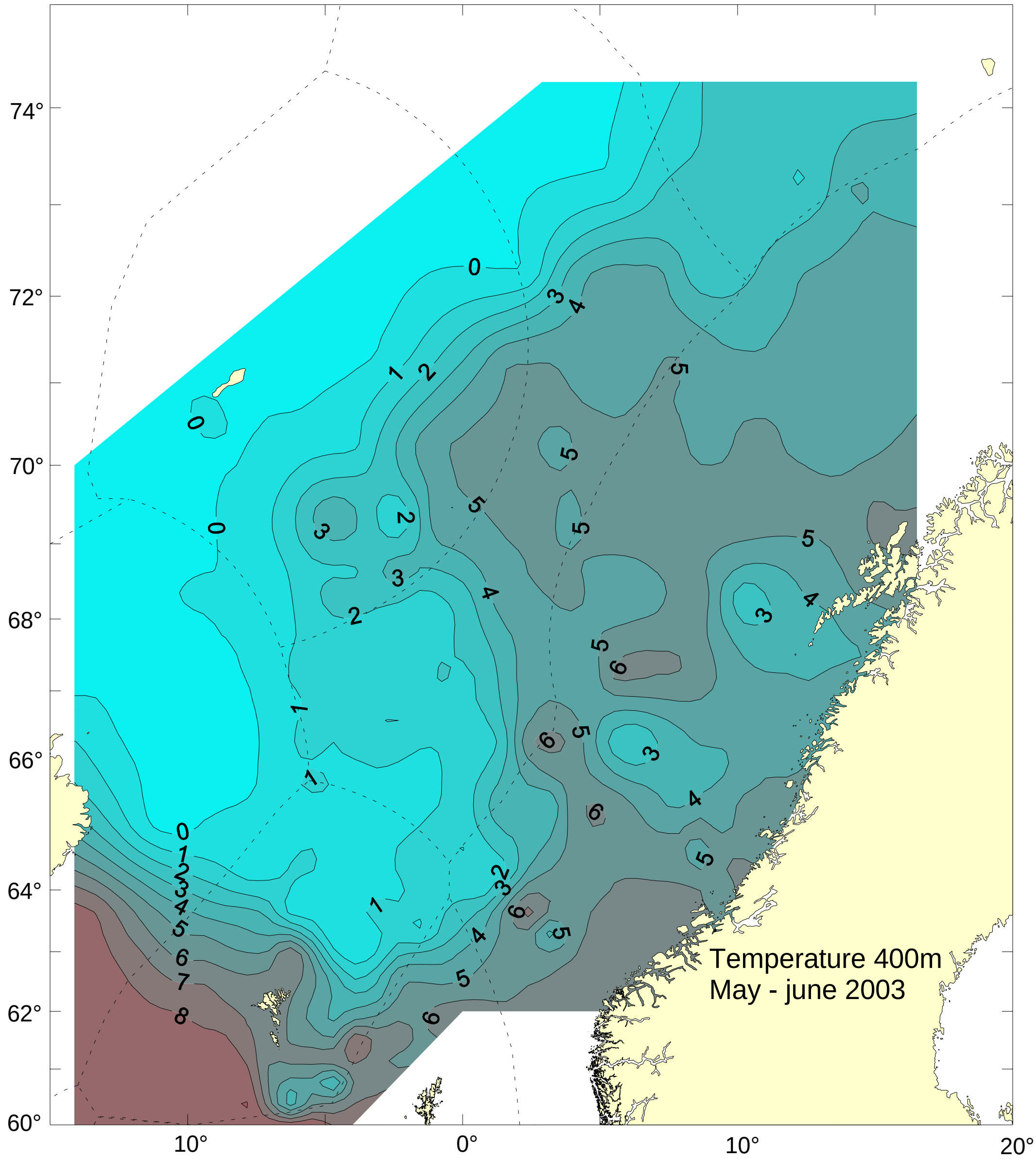

Figure 3.1.9 Temperature at 400 m depth in May 2003.

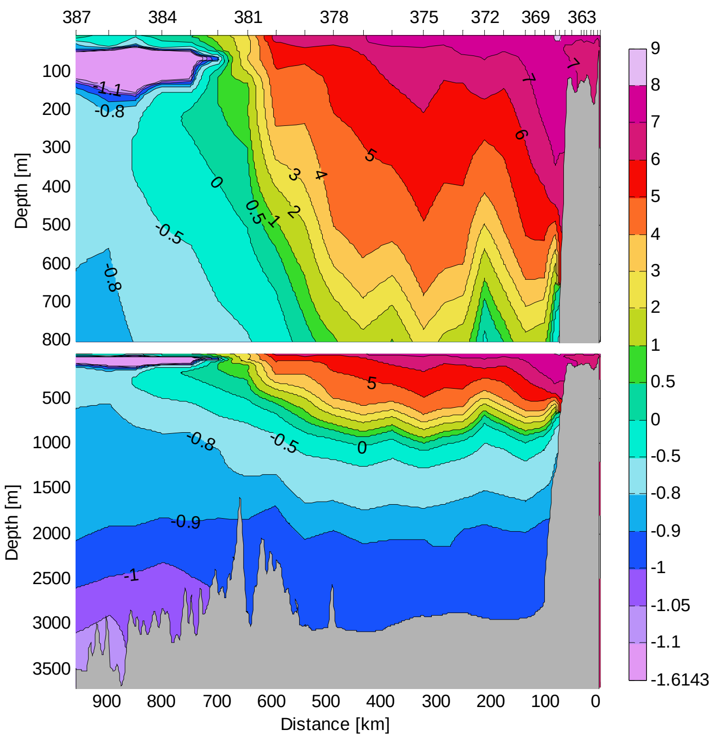

Figure 3.1.10 Potential temperature in the extended Gimsøy-NW section during May/June 2003. Norwegian coast (Gimsøy) is on the right.

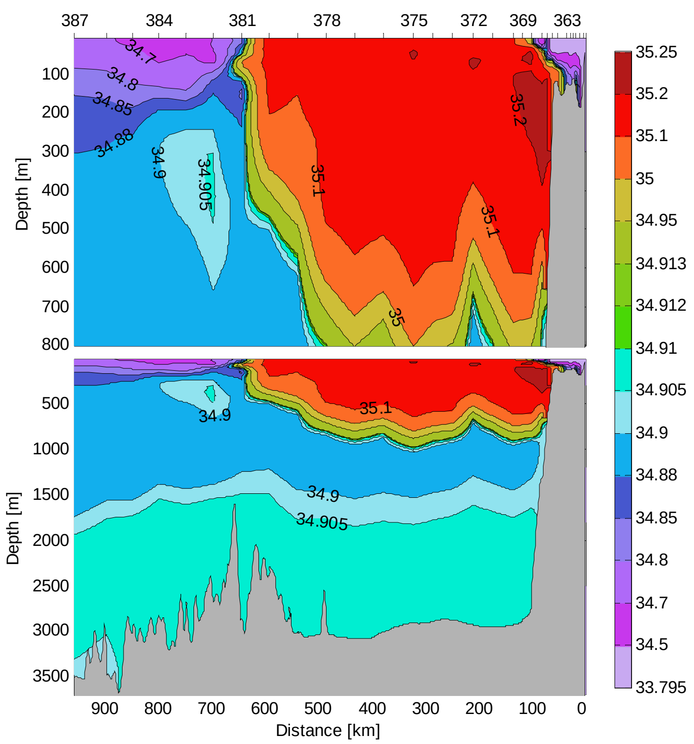

Figure 3.1.11 Salinity in the extended Gimsøy-NW section during May/June 2003. Norwegian coast (Gimsøy) is on the right.

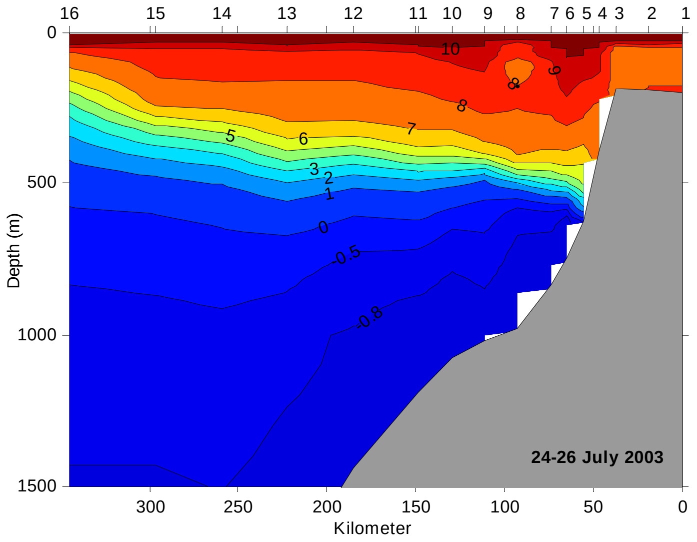

Figure 3.1.12 Potential temperature in the Svinøy section, 24-26 July.

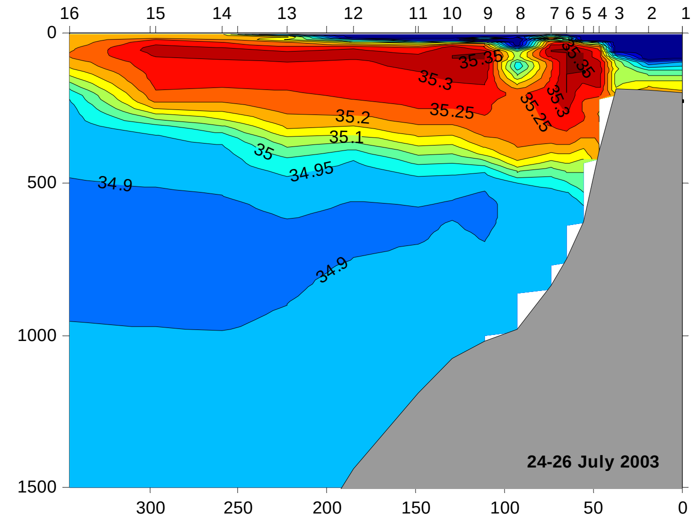

Figure 3.1.13 Salinity in the Svinøy section, 24-26 July.

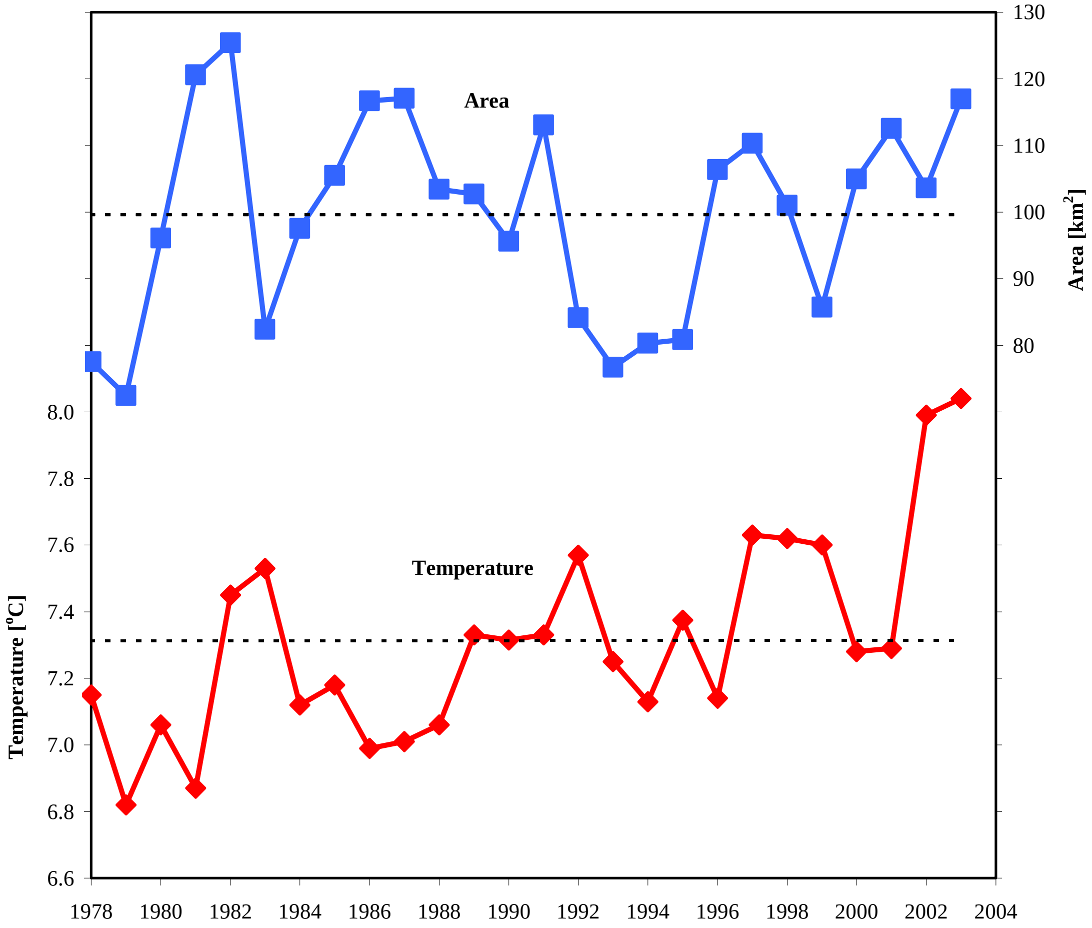

Figure 3.1.14 Time-series of area occupied by Atlantic Water and its averaged temperature in the Svinøy section for July/August.

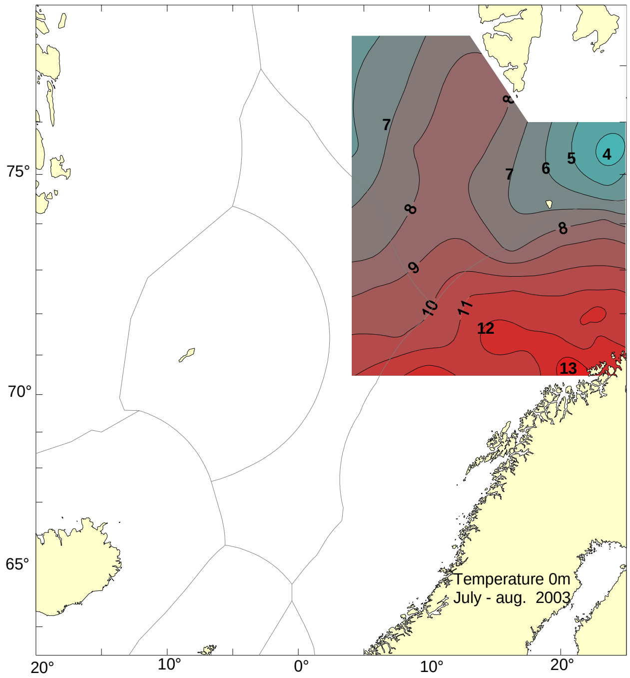

Figure 3.1.15 Surface temperature in July/August 2003.

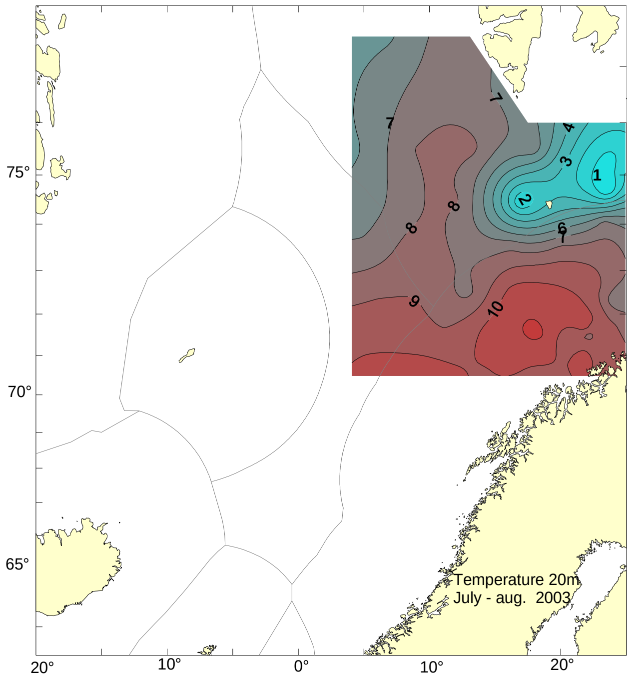

Figure 3.1.16 Temperature at 20 m depth in July/August 2003.

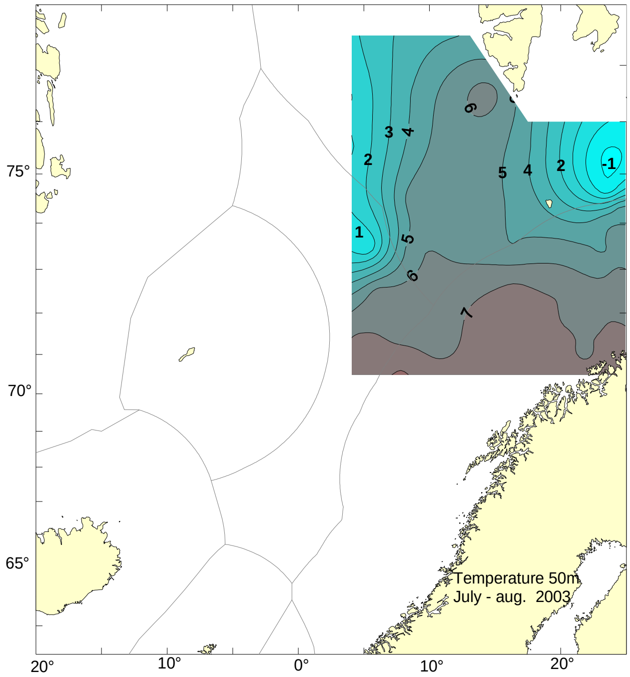

Figure 3.1.17 Temperature at 50 m depth in July/August 2003.

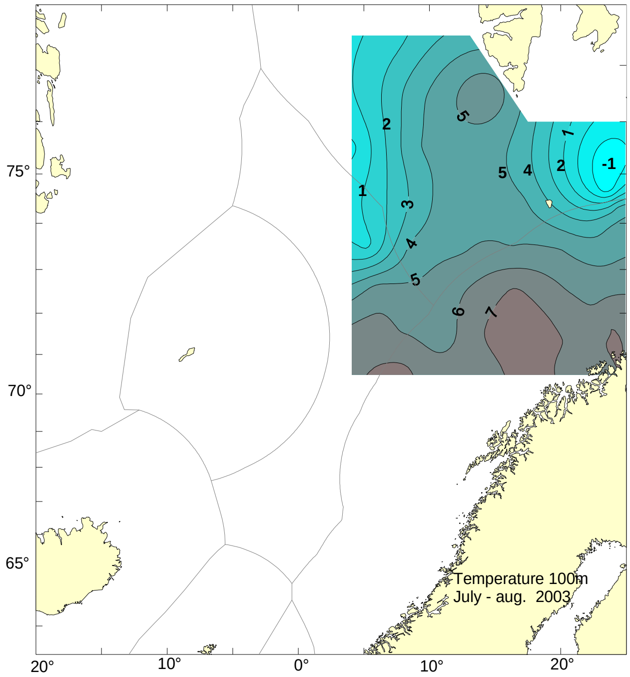

Figure 3.1.18 Temperature at 100 m depth in July/August 2003.

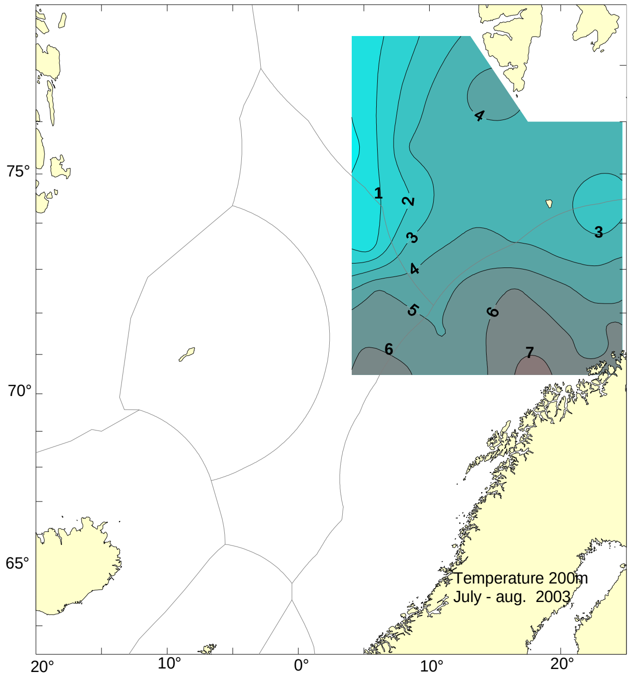

Figure 3.1.19 Temperature at 200 m depth in July/August 2003.

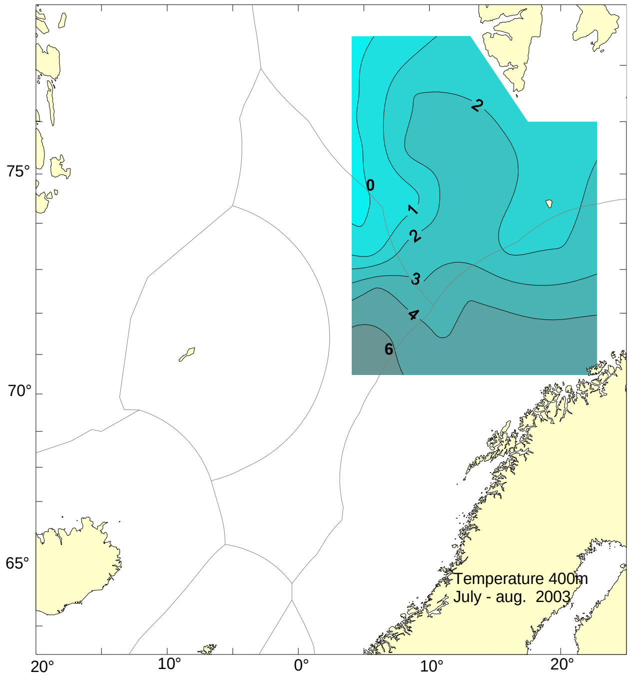

Figure 3.1.20 Temperature at 400 m depth in July/August 2003.

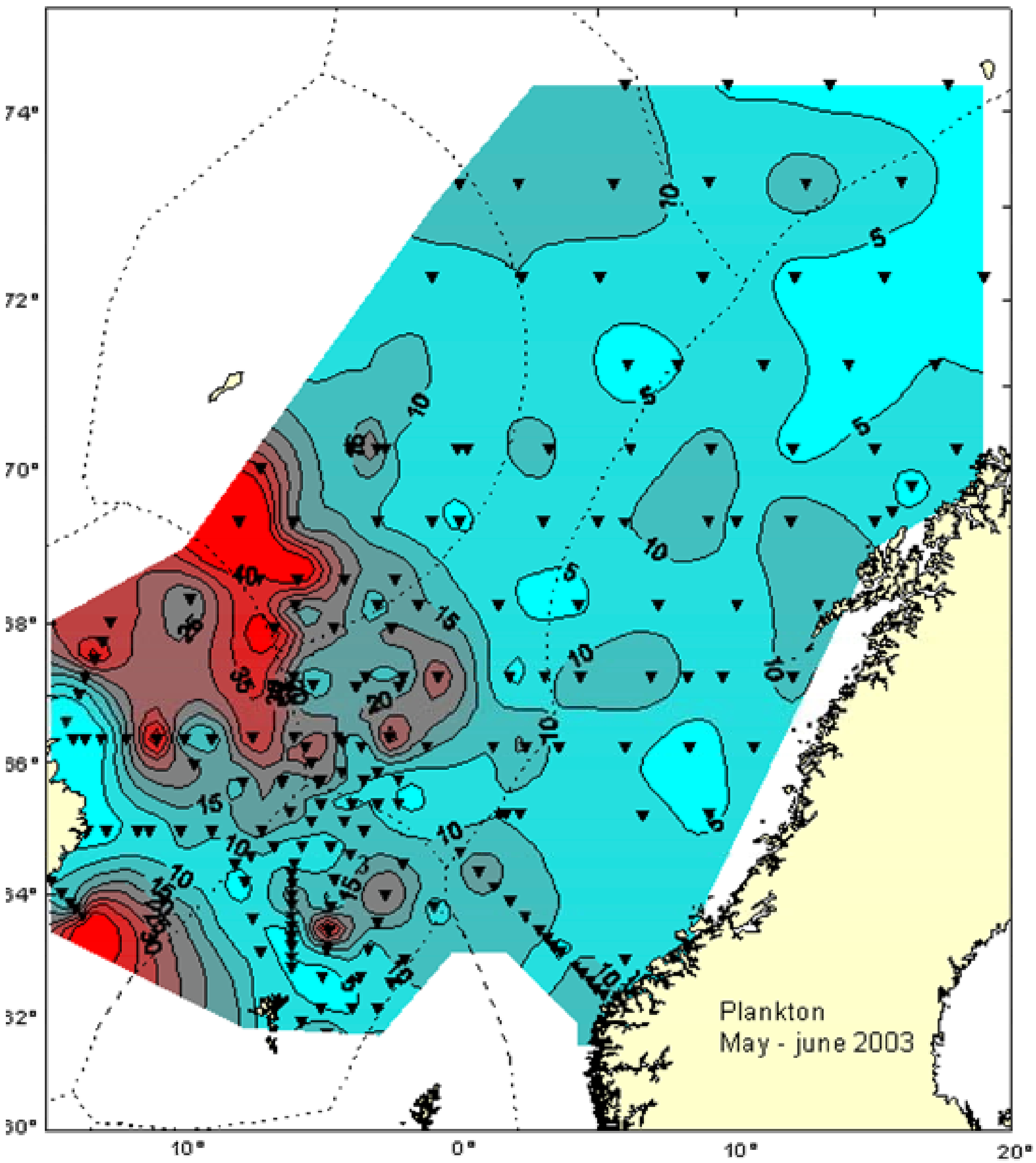

Figure 3.2.1 Zooplankton biomass (g dw m^{-2}) (200-0m) (50-0 m in Icelandic standard sections) in May 2003.

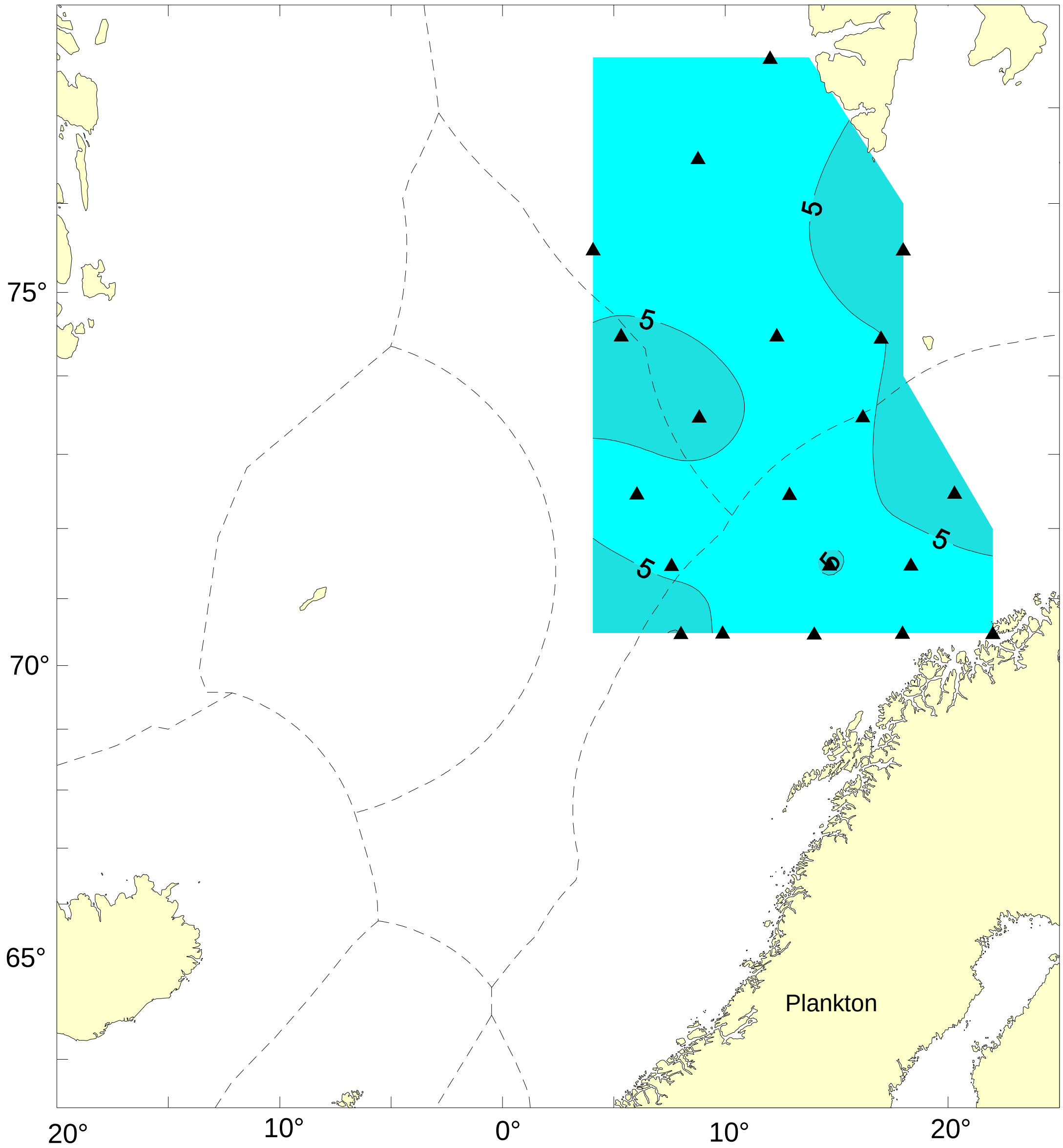

Figure 3.2.2 Zooplankton biomass (g dw m^{-2}) (200-0m) in July to August 2003.

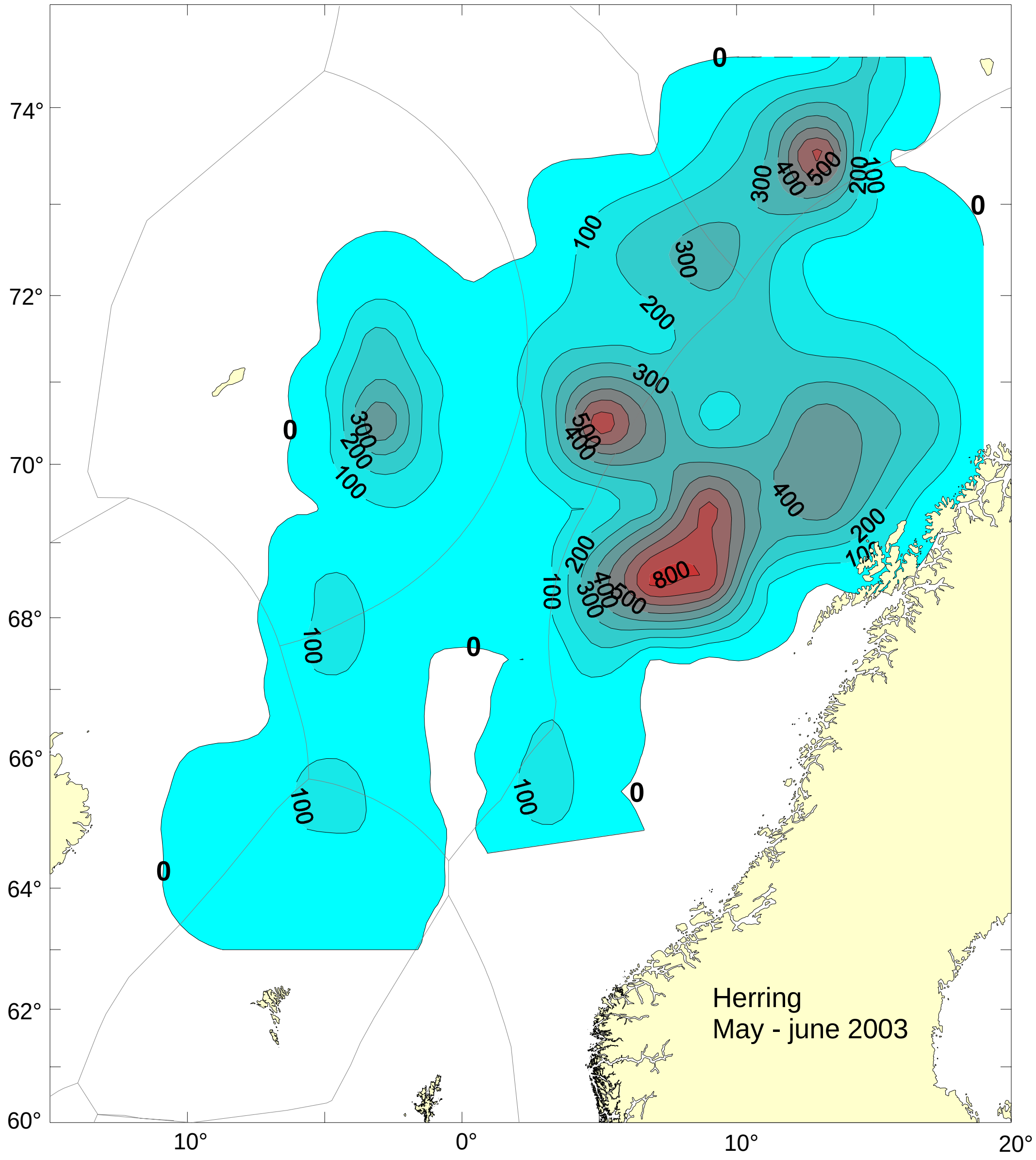

Figure 3.3.1 Distribution of Norwegian spring spawning herring in May-June 2003.

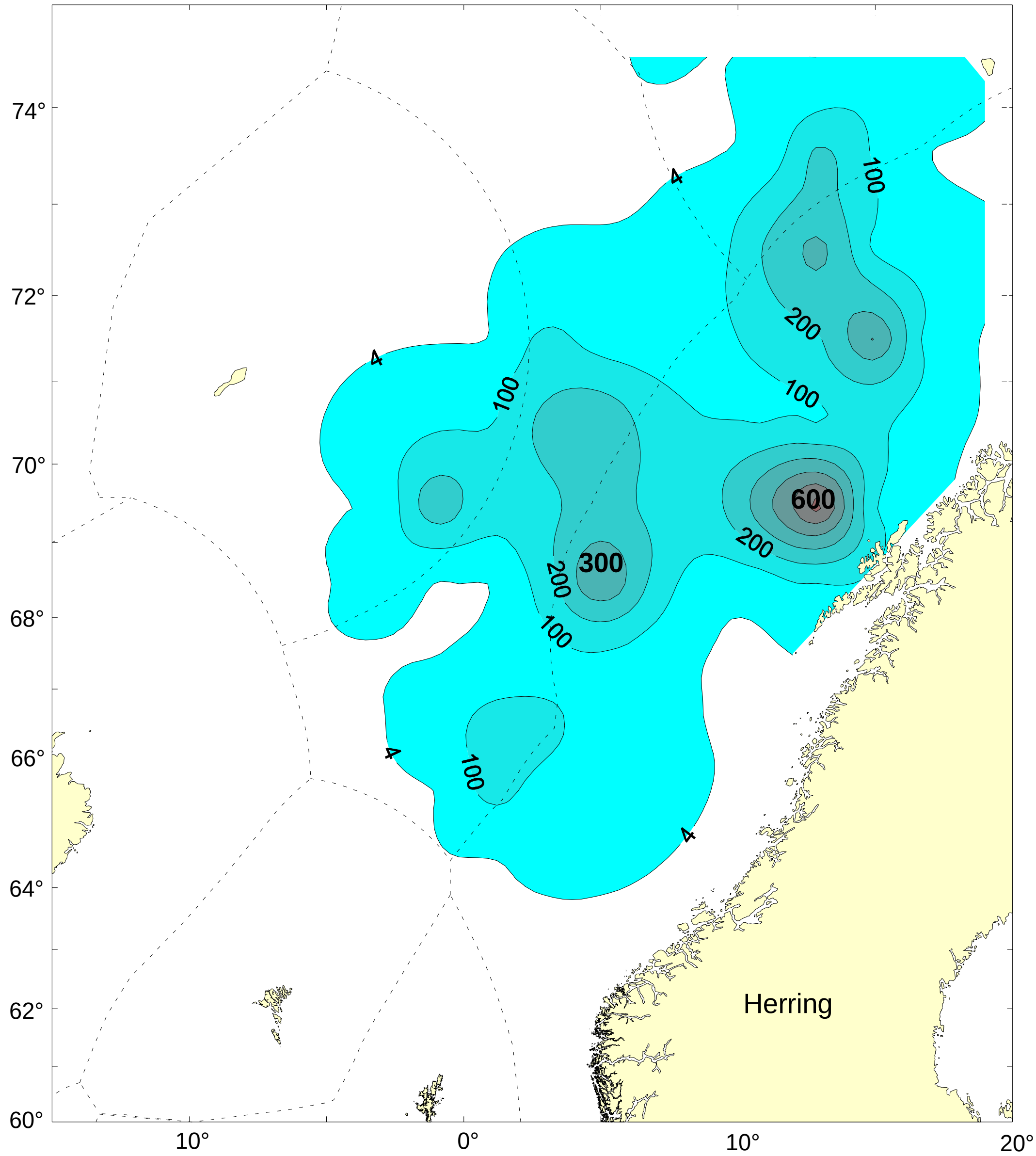

Figure 3.3.2 Distribution of Norwegian spring spawning herring in May 2002 (ICES 2002/D:07).

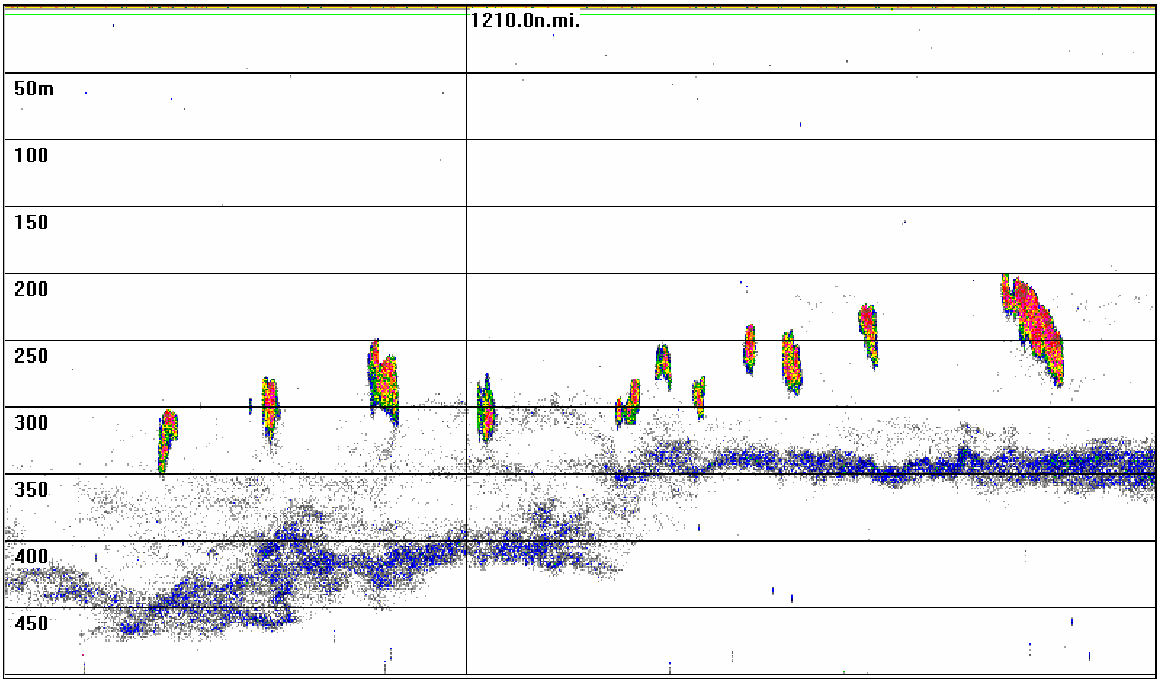

Figure 3.3.3 Echogram showing schools of Norwegian spring spawning herring observed by R/V *Magnus Heinason* in the northern part of the Faroese EEZ in late May 2003.

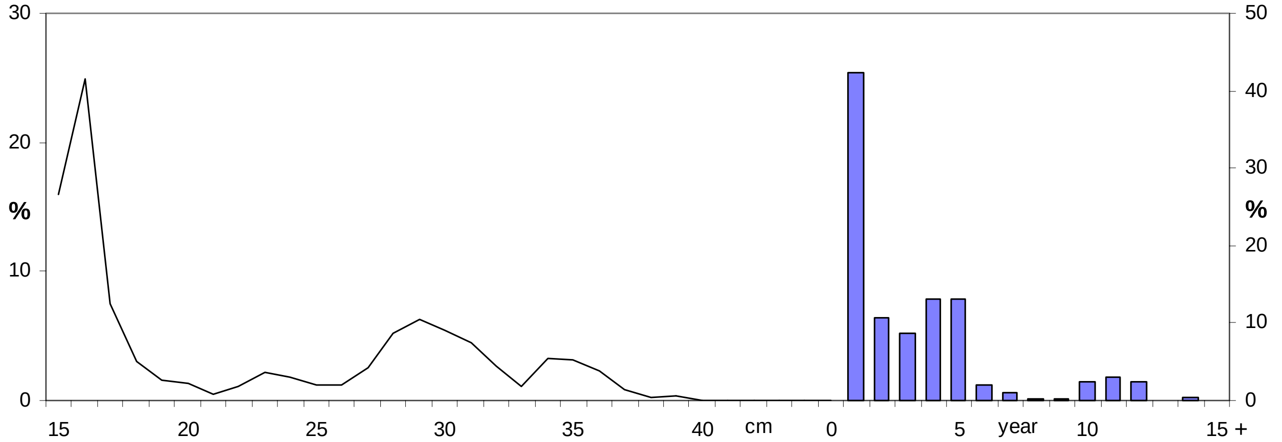

Figure 3.3.4 Preliminary length and age distribution of Norwegian spring spawning herring in May .June 2003. Based in the acoustic results from R/V "Magnus Heinason", R/V "Arni Fridriksson", and R/V "G.O. Sars", and age-length key from R/V "G.O. Sars".

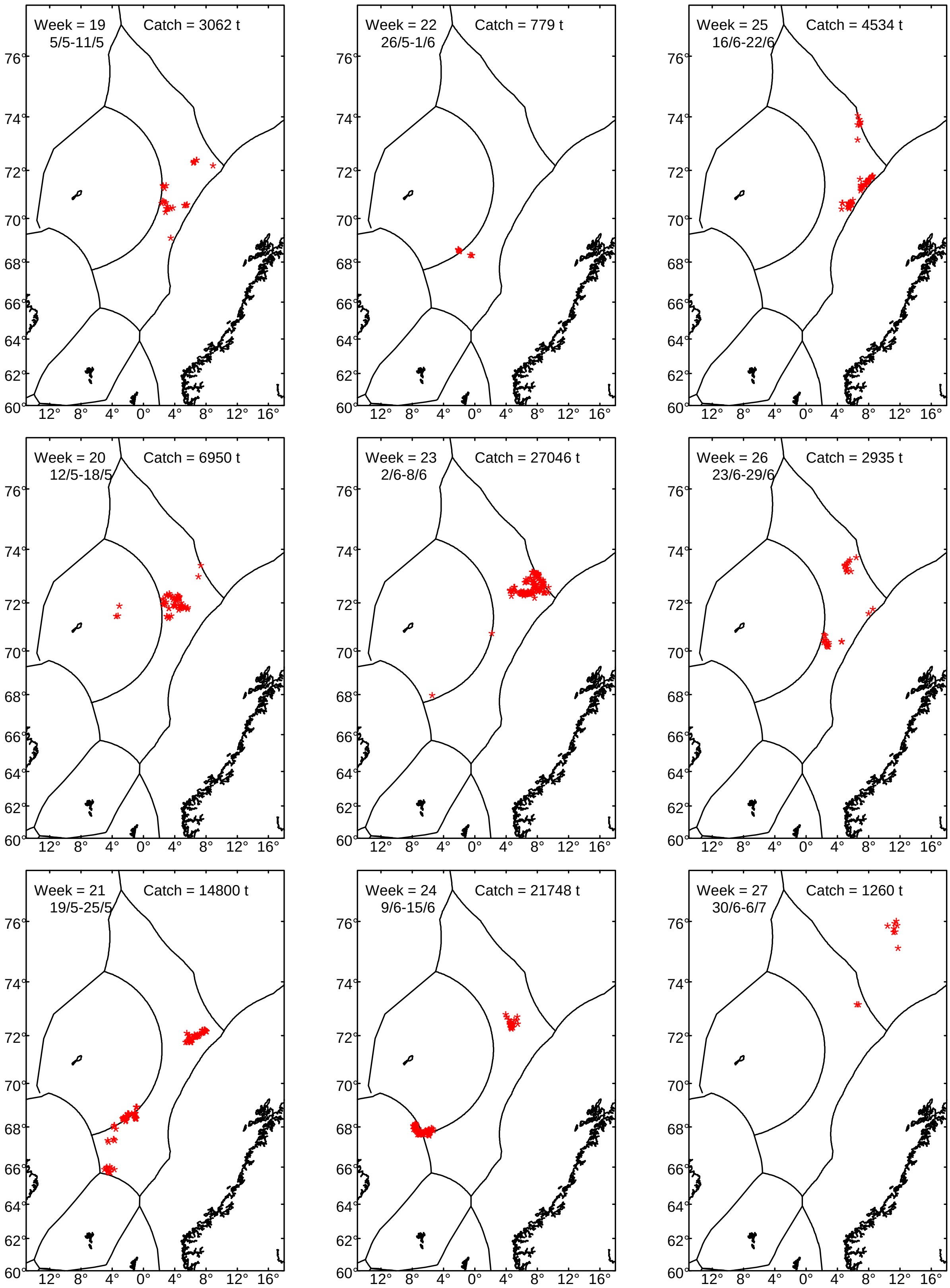

Figure 3.3.5 Position of the Icelandic commercial fishery by weeks in 2003, according to logbooks.

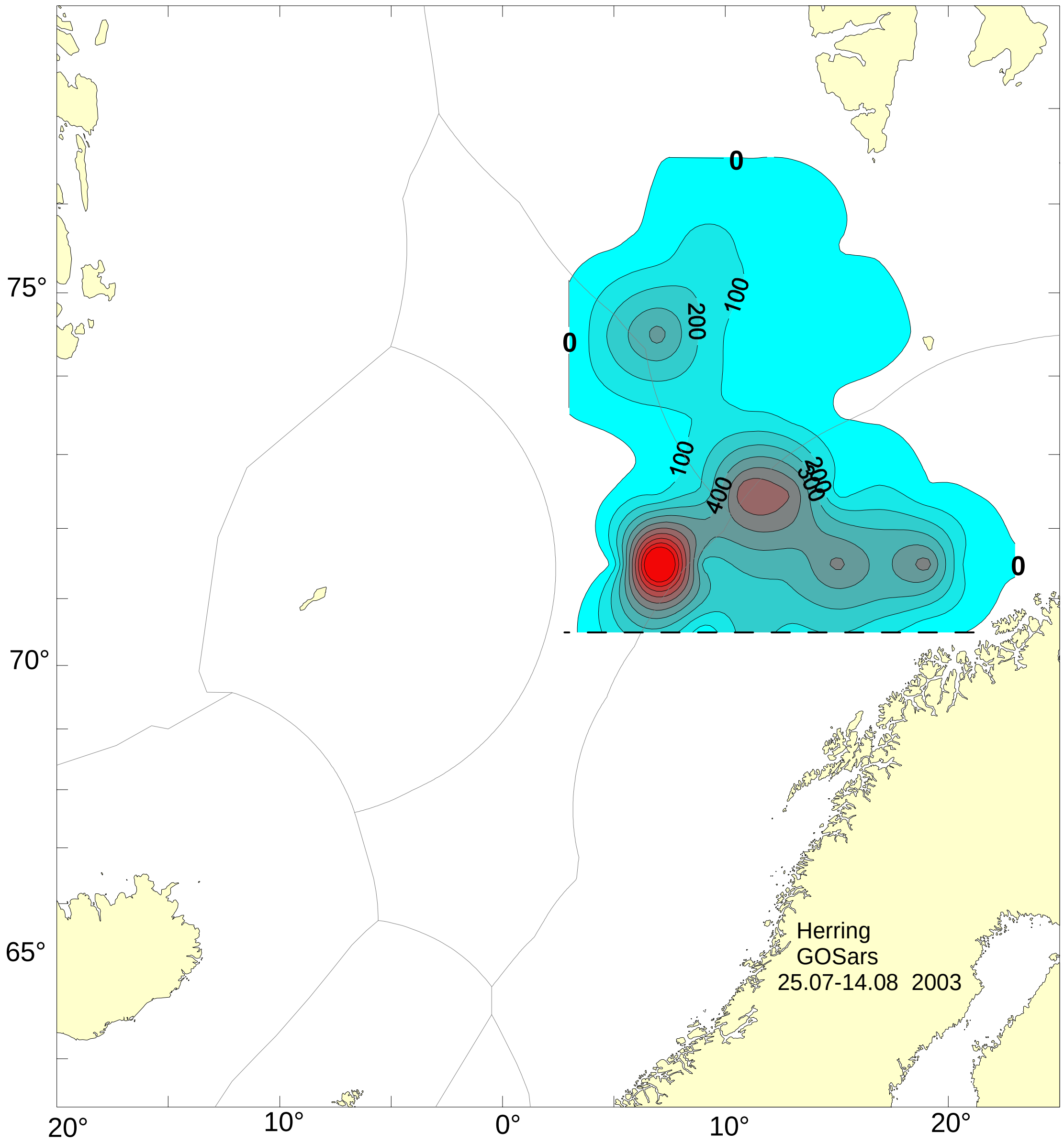

Figure 3.3.6 Distribution of Norwegian spring spawning herring in July-August 2003.

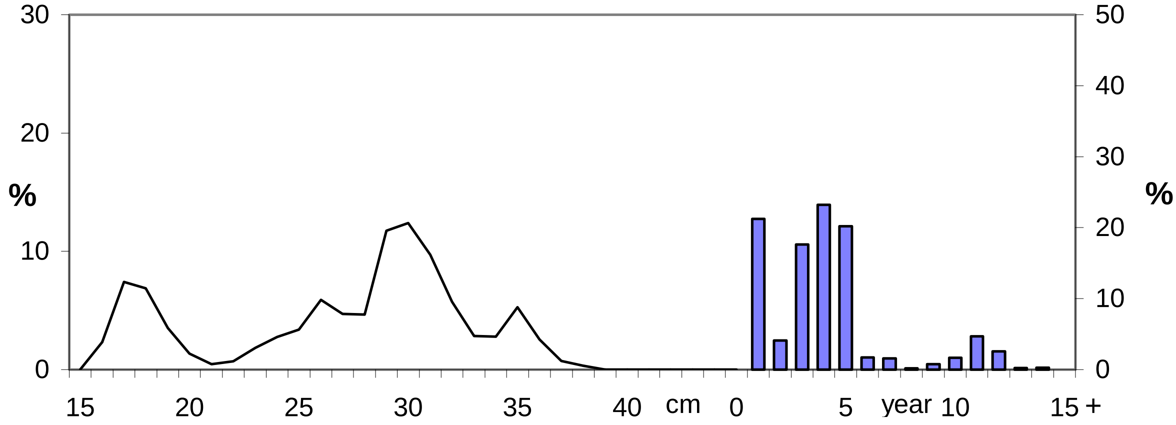

Figure 3.3.7 Length and age distribution, Norwegian spring spawning herring north of 70°N in July- August 2003.

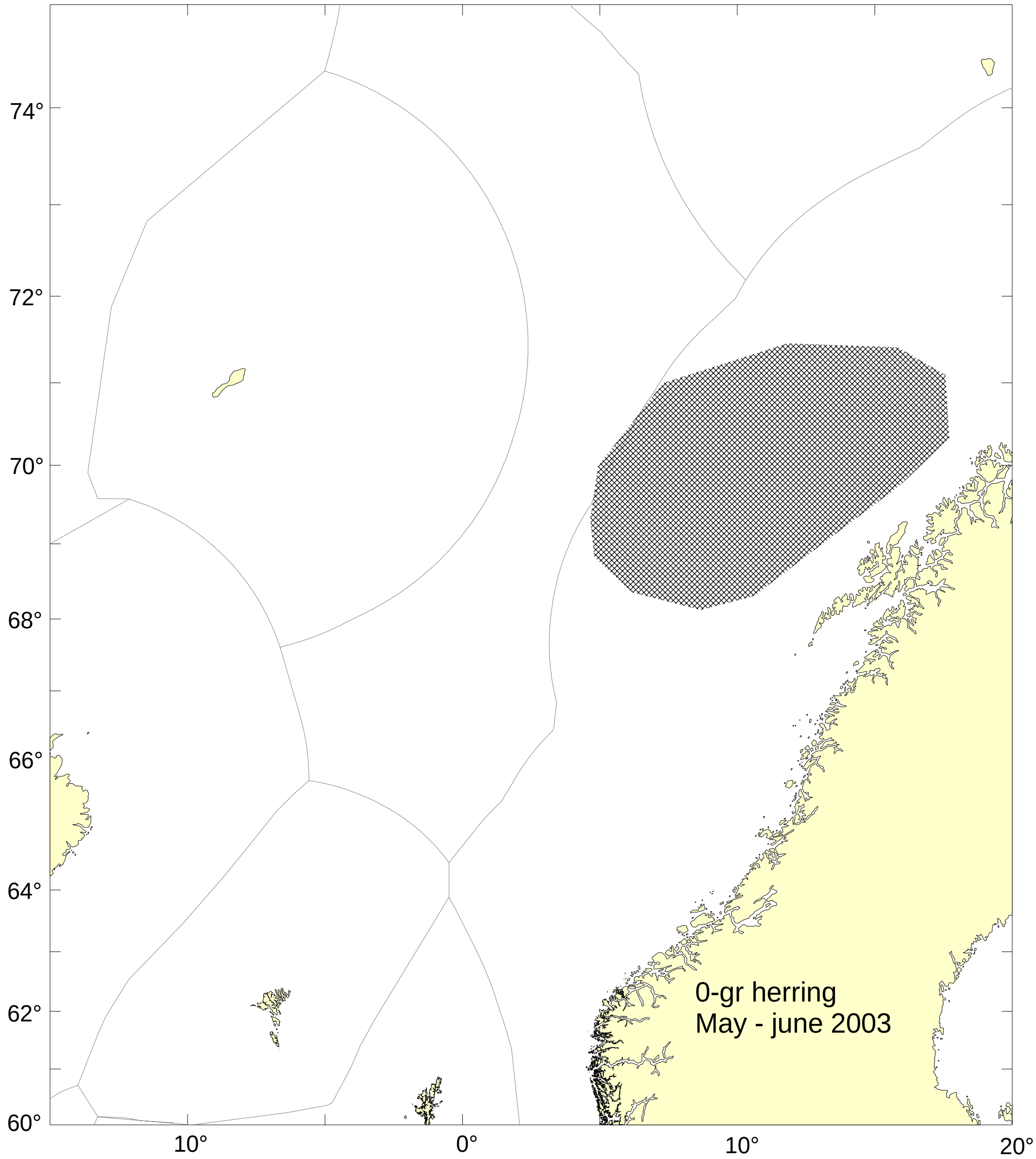

Figure 3.4.1 Distribution of I-group herring (2002 year class) in May-June 2003.

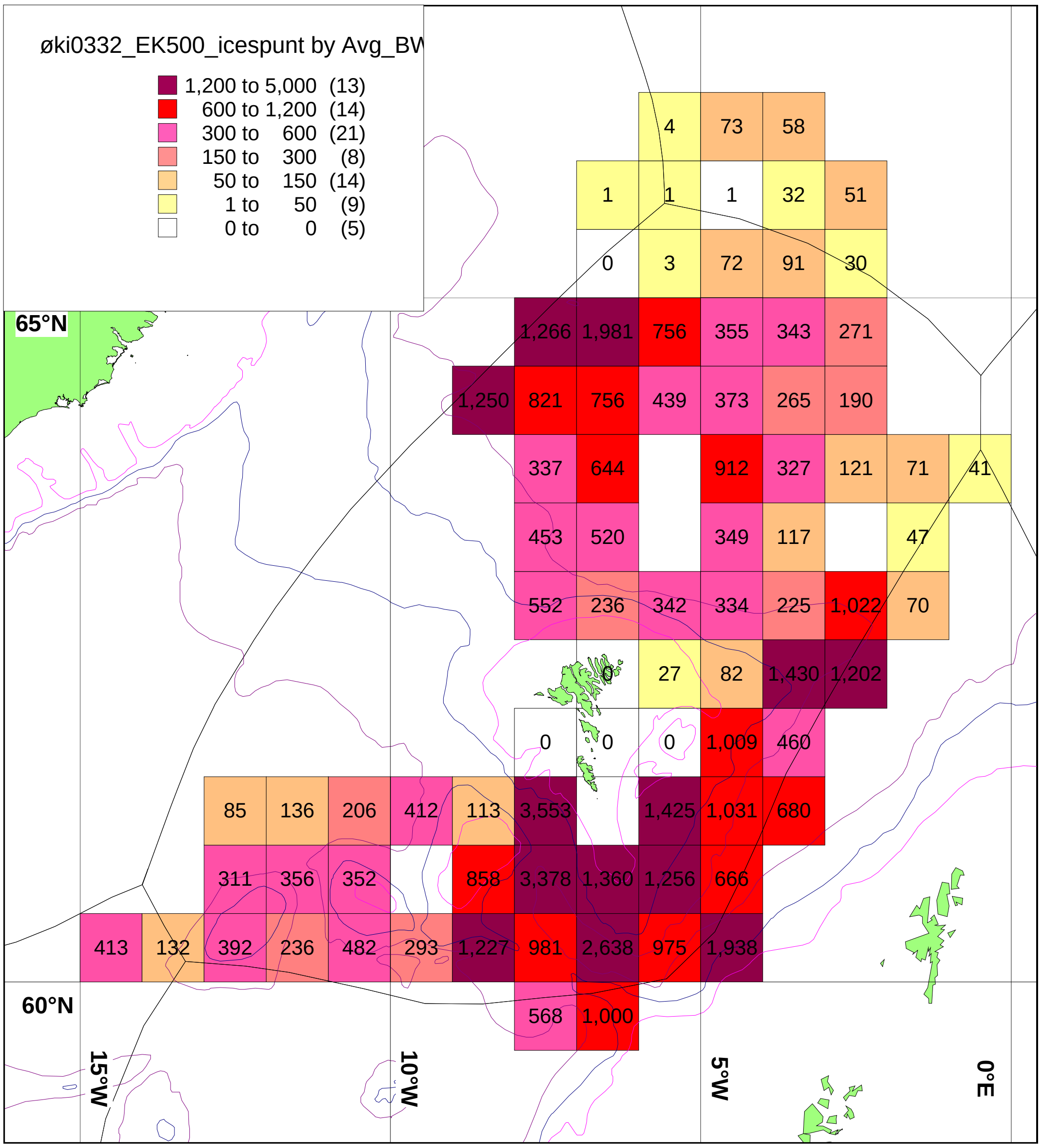

Figure 3.5.1 Mean integration values (s_A, m^2/nm^2) of blue whiting by statistical square, May 2003. Data from R/V *Magnus Heinason*.

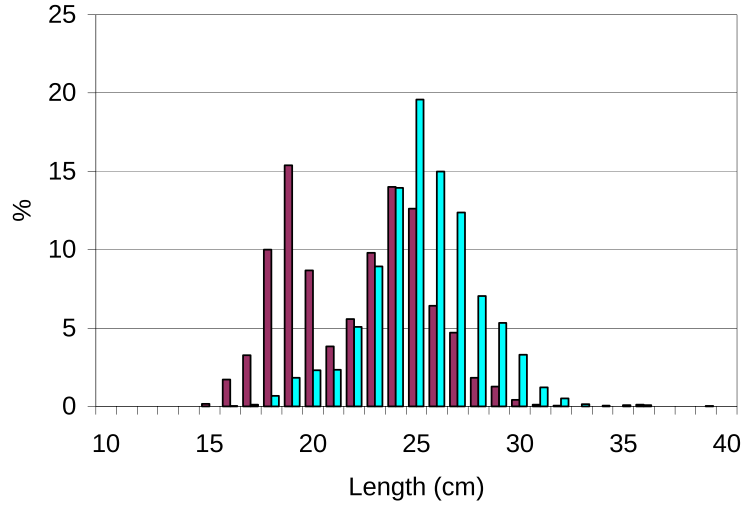

Figure 3.5.2 Length distribution of blue whiting in the southern part (< 62°N, dark bars) and in the northern part of the Faroese area sampled from R/V *Magnus Heinason*, May 2003.

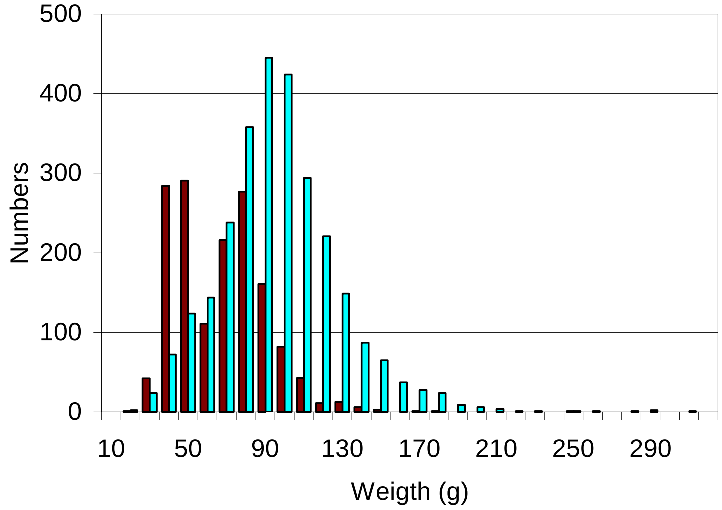

Figure 3.5.3 Weight distribution of blue whiting in the southern part (< 62°N, dark bars) and in the northern part of the Faroese area sampled from R/V *Magnus Heinason*, May 2003.

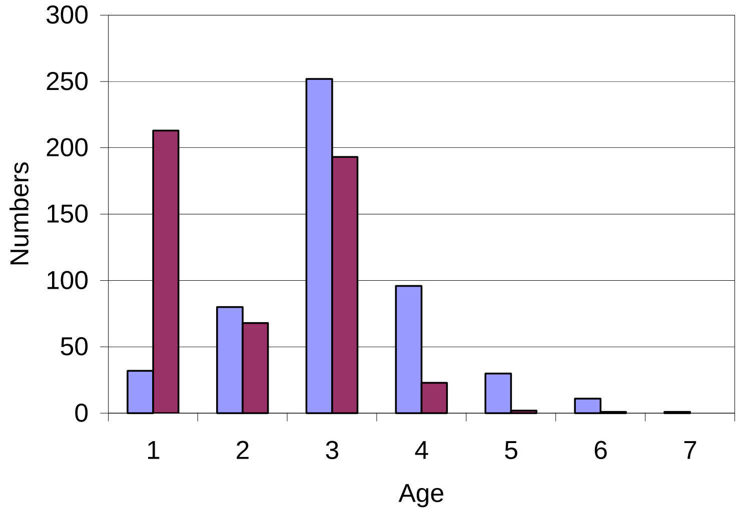

Figure 3.5.4 Age distribution of blue whiting in the southern part (< 62°N, dark bars) and in the northern part of the Faroese area sampled from R/V *Magnus Heinason*, May 2003.

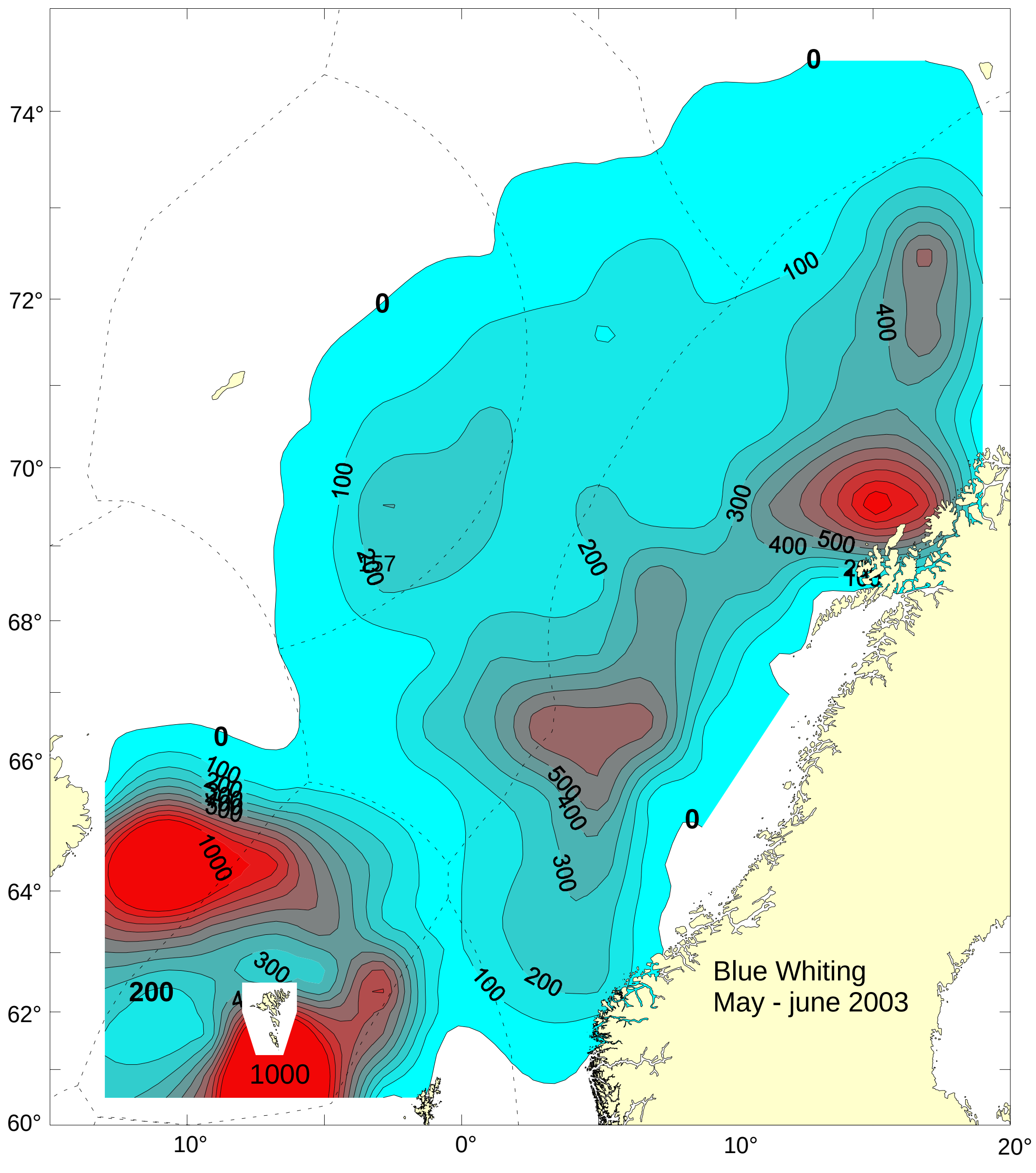

Figure 3.5.5 Distribution of blue whiting (s_A-values) in May-June 2003. Data from R/V "Magnus Heinason", R/V "Arni Fridriksson", and R/V "G.O. Sars".

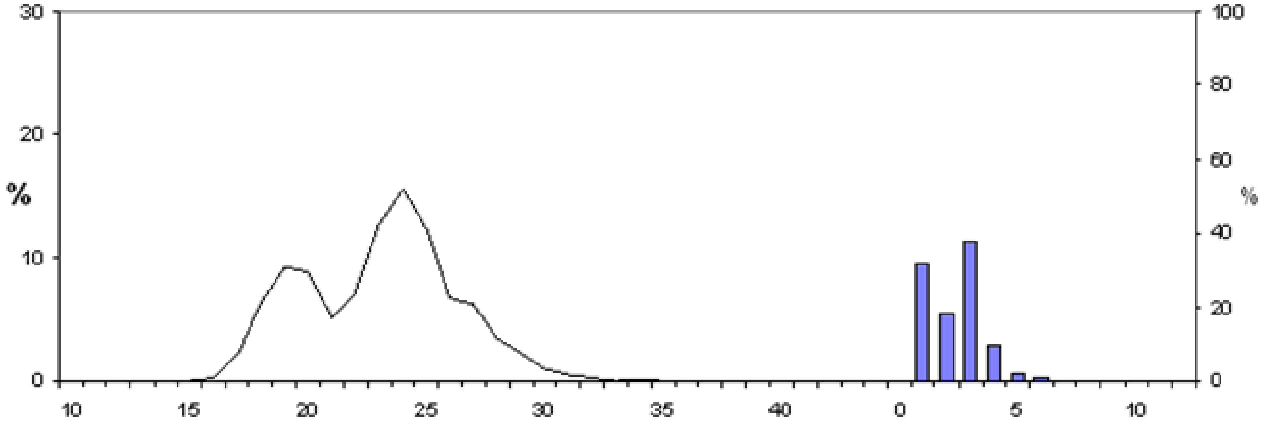

Figure 3.5.6 Length (cm) and age (years) distribution of blue whiting in the Faroese EEZ and Norwegian Sea in May 2003. Based in the acoustic results from R/V "Magnus Heinason", R/V "Arni Fridriksson", and R/V "G.O. Sars", and biological data from R/V "Magnus Heinason" and R/V "G.O. Sars".

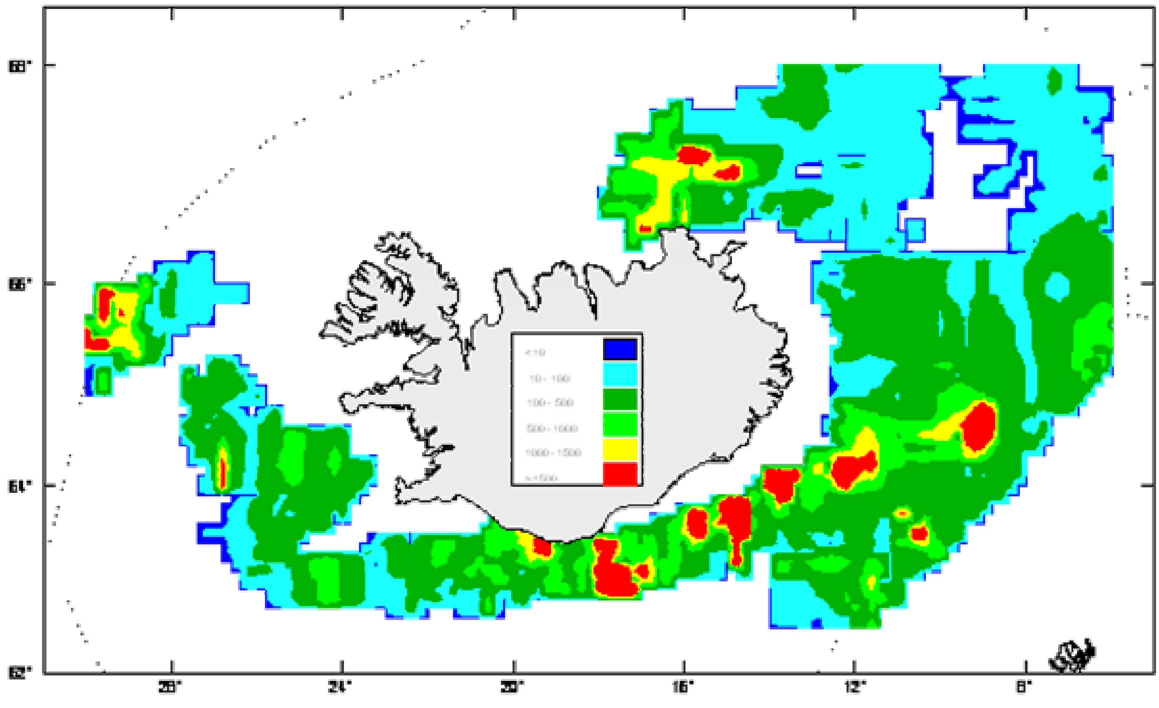

Figure 3.5.7 Distribution of blue whiting (s_A-values) in the Icelandic waters. Data from R/V "Bjarni Sæmundsson", 23.6-16.5.2003.

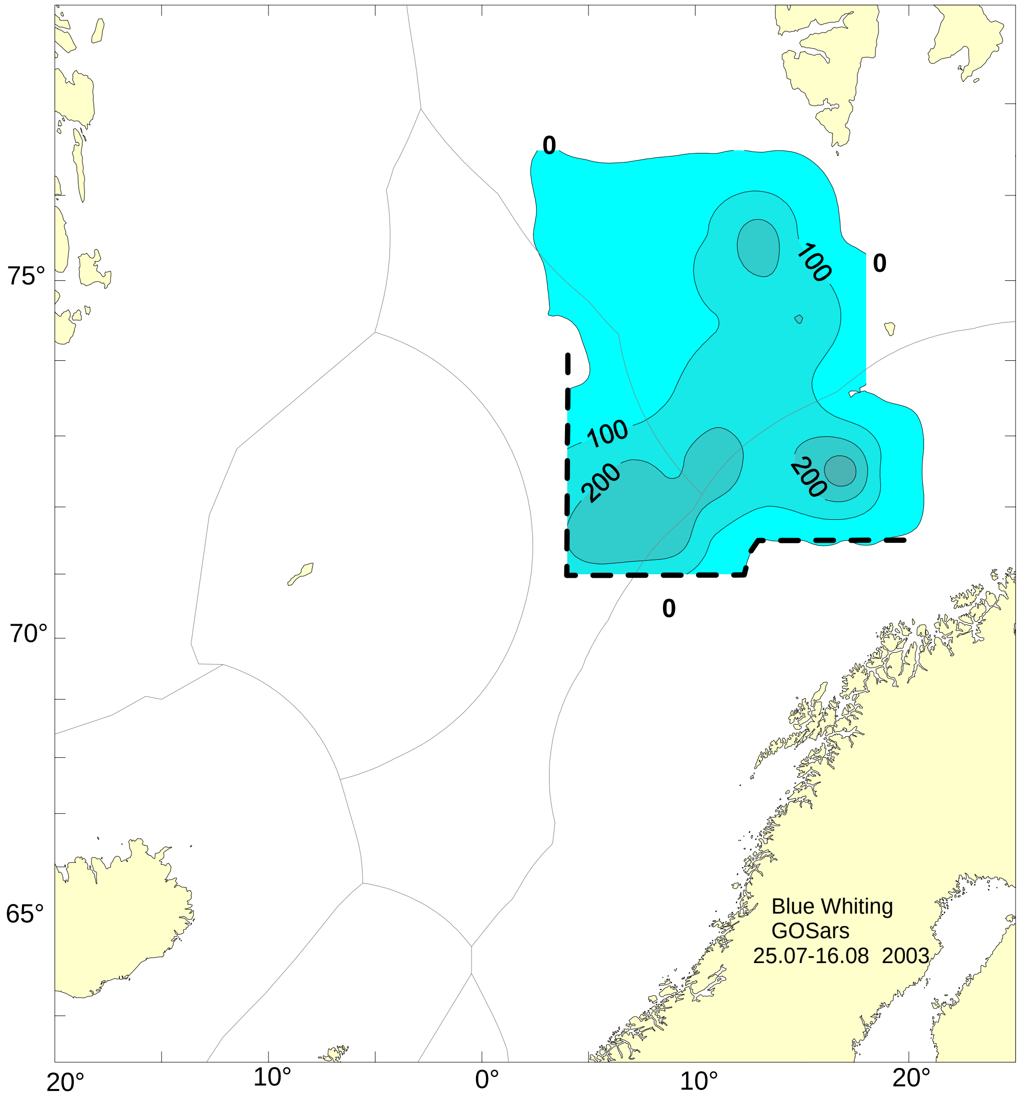

Figure 3.5.8 Distribution of blue whiting (s_A-values) in the northern Norwegian Sea and southern Svalbard area in July-August 2003. Data from R/V "G.O. Sars", 25.7-16.8.2003.

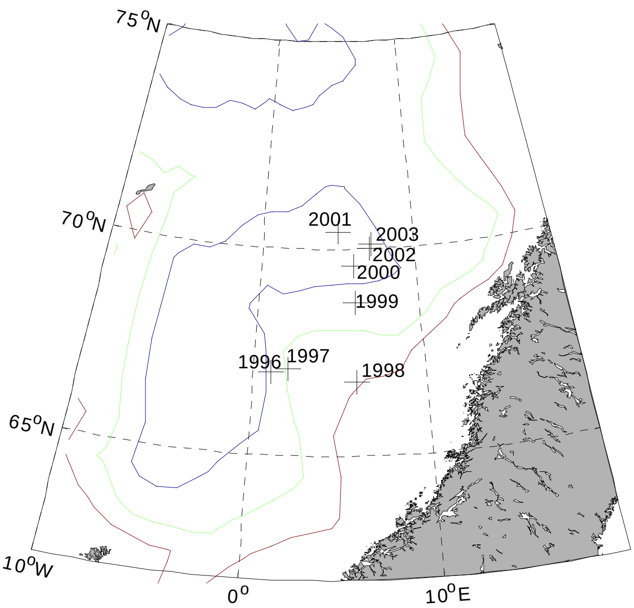

Figure 4.3.1 Centre of gravity of the measured distribution (acoustic integrator values) of Norwegian spring spawning herring during May in the years 1996 to 2003.

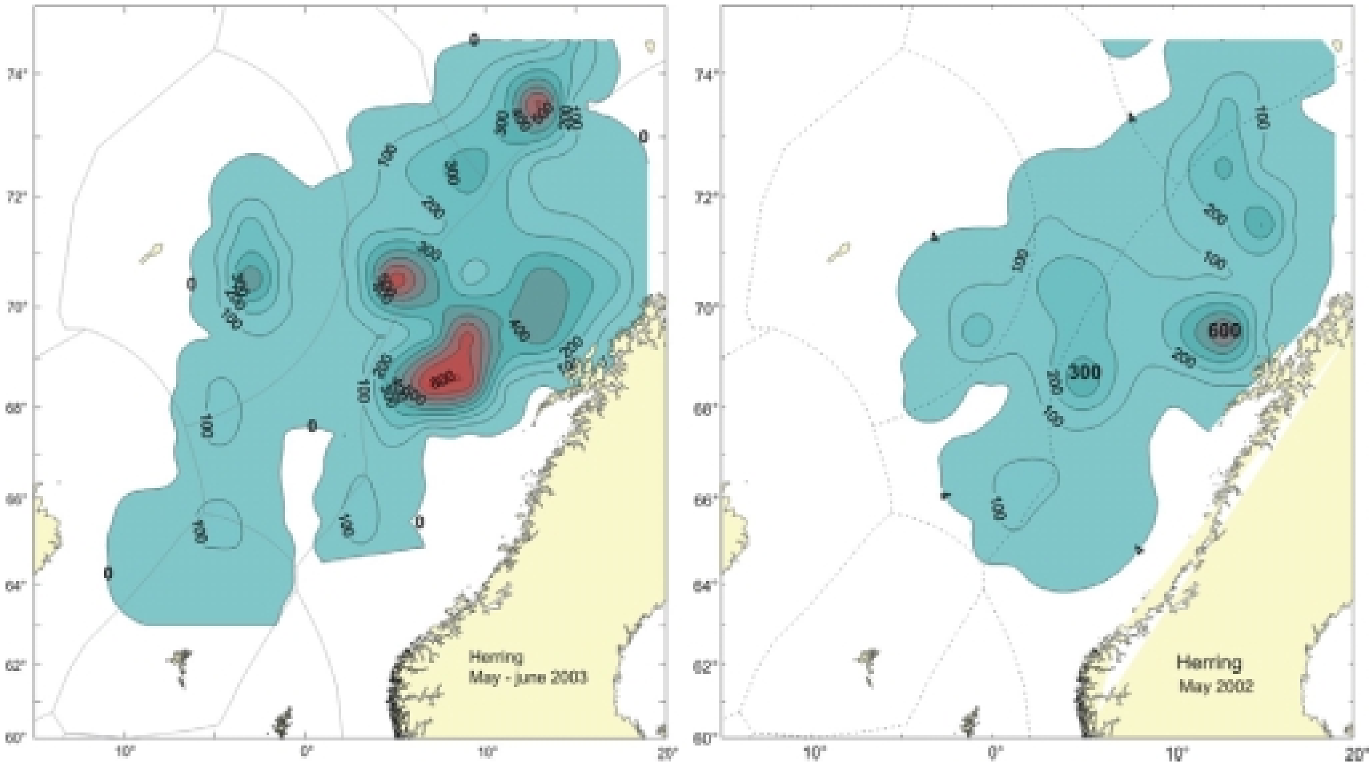

Figure 4.3.2 Comparison of the distribution of Norwegian spring spawning herring in May 2003 (left) and 2002 (right).

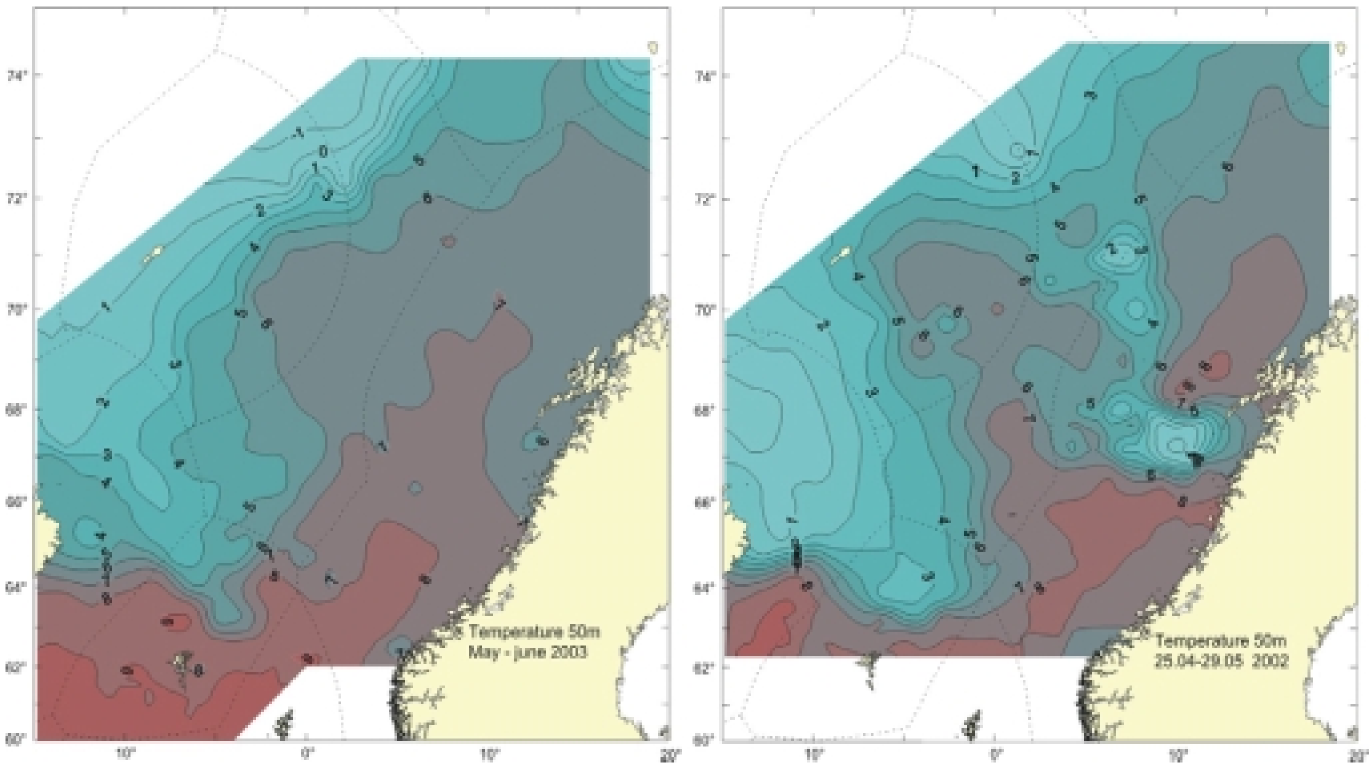

Figure 4.3.3 Temperature in 50 m in the Norwegian Sea in May 2003 (left) and 2002 (right).

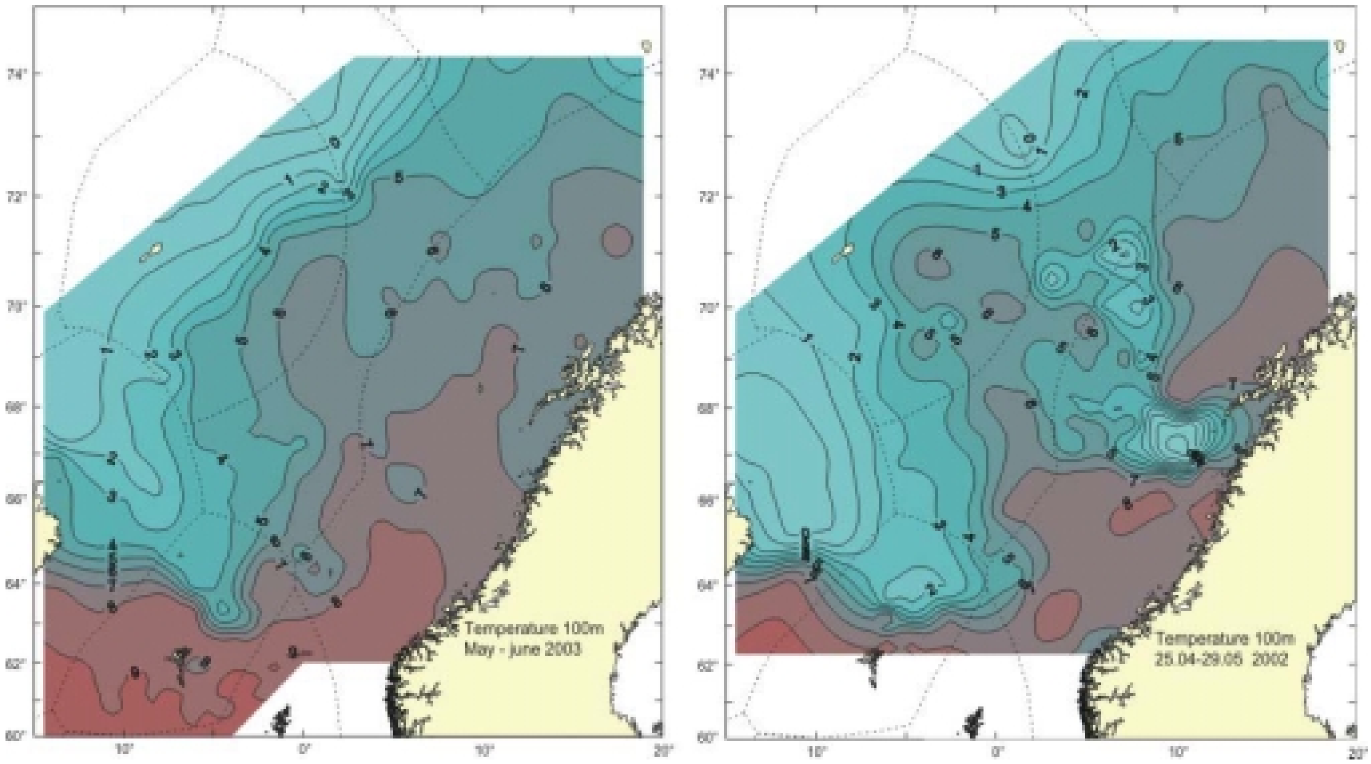

Figure 4.3.4 Temperature in 100 m in the Norwegian Sea in May 2003 (left) and 2002.

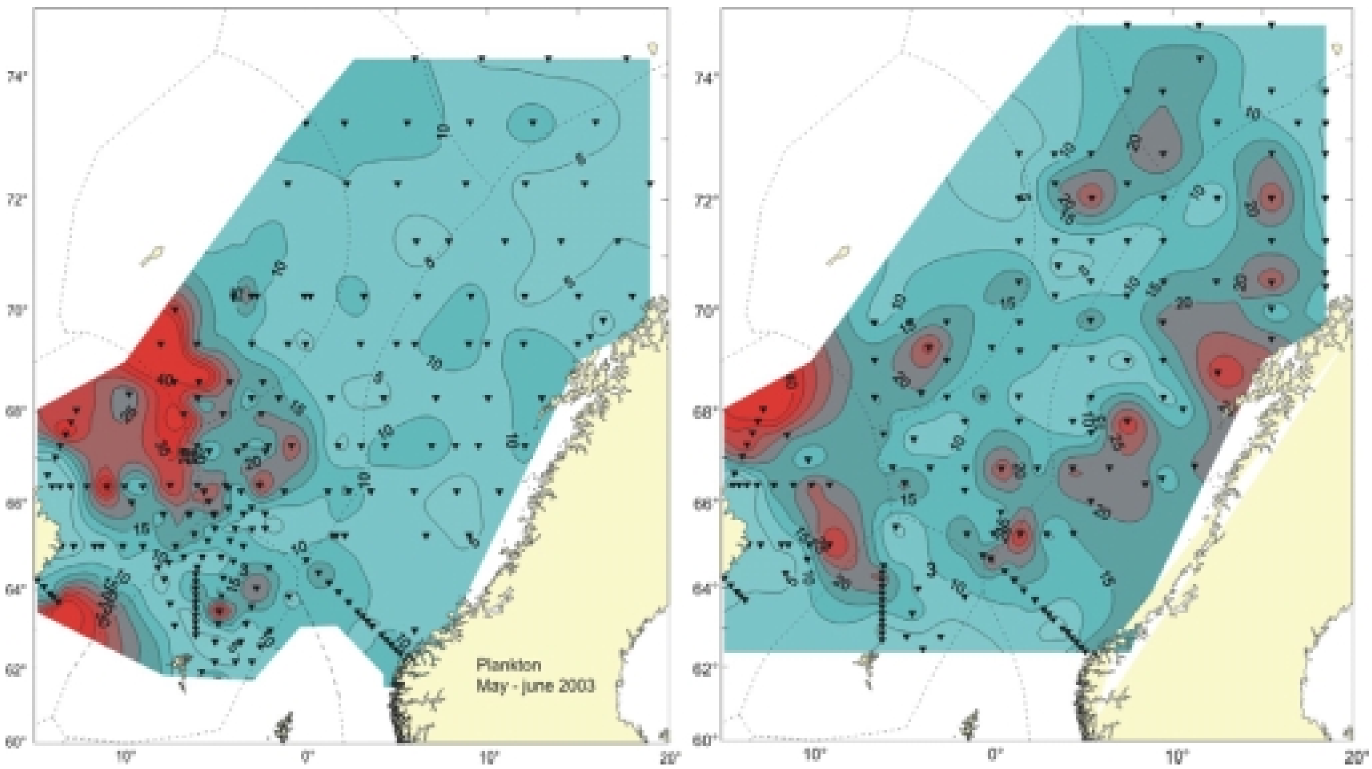

Figure 4.3.5 Comparison of the plankton distribution in the Norwegian Sea in May 2003 (left) and 2002 (right).

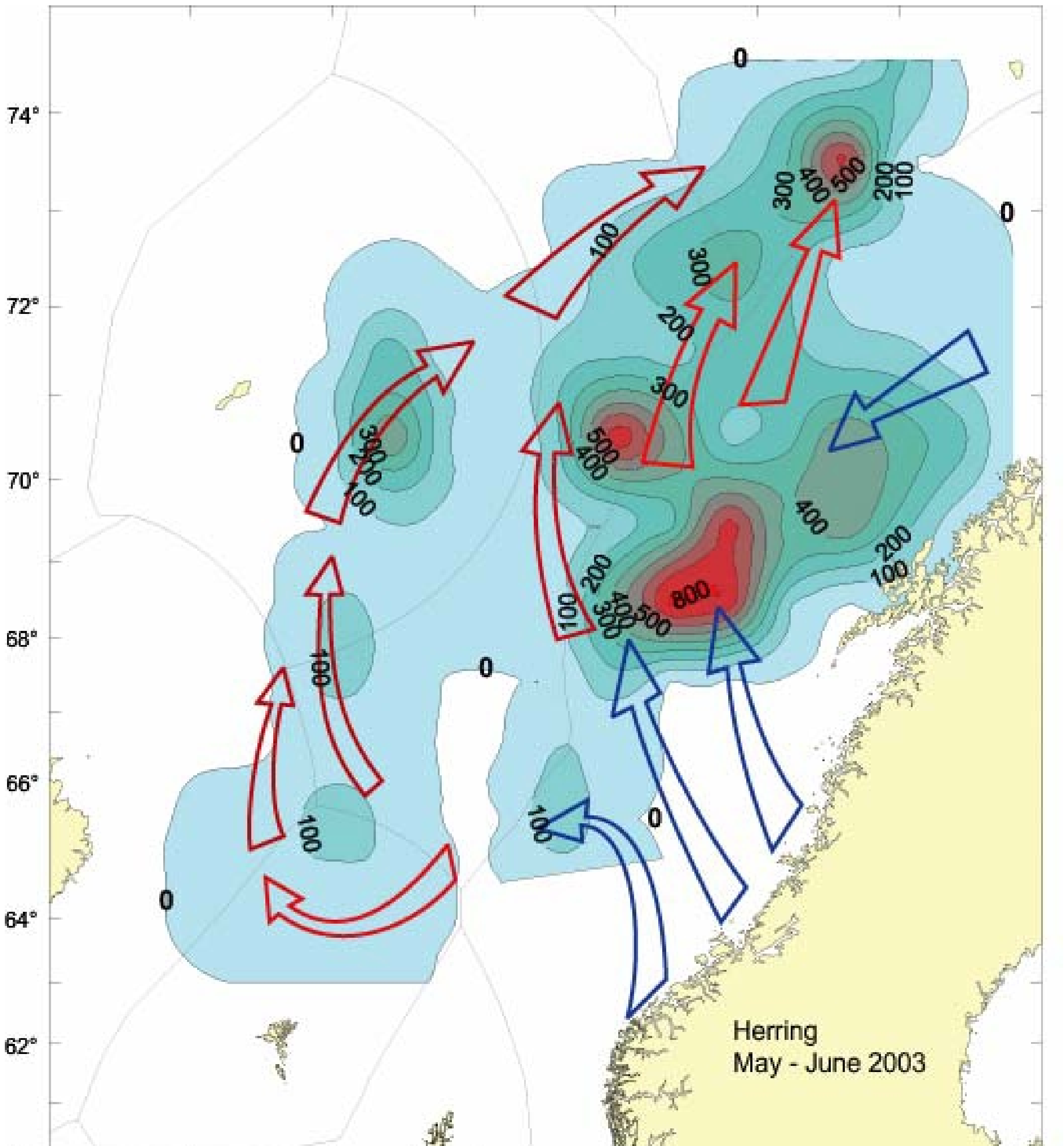

Figure 4.3.6 Distribution of Norwegian spring spawning herring in May 2003. Arrows indicate general migration pattern in spring (blue arrows, near the coast) and early summer (red arrows, oceanic) based on acoustic surveys and the movement of the fishing fleet.

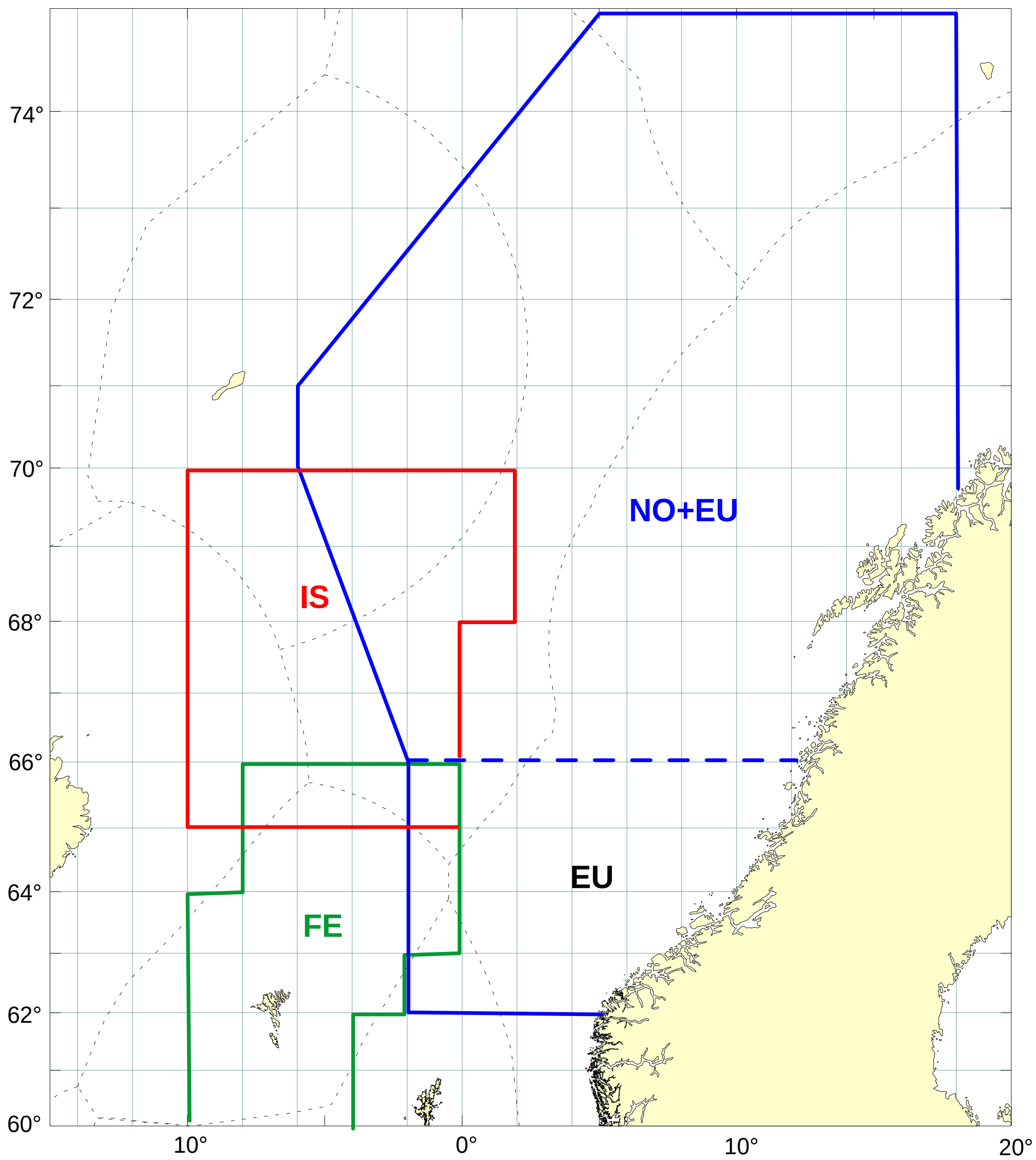

Figure 5.1.1 Survey area allocation for the May 2004 PGSPFN survey in the Norwegian Sea (Iceland, Faroes, Norway, and EU).

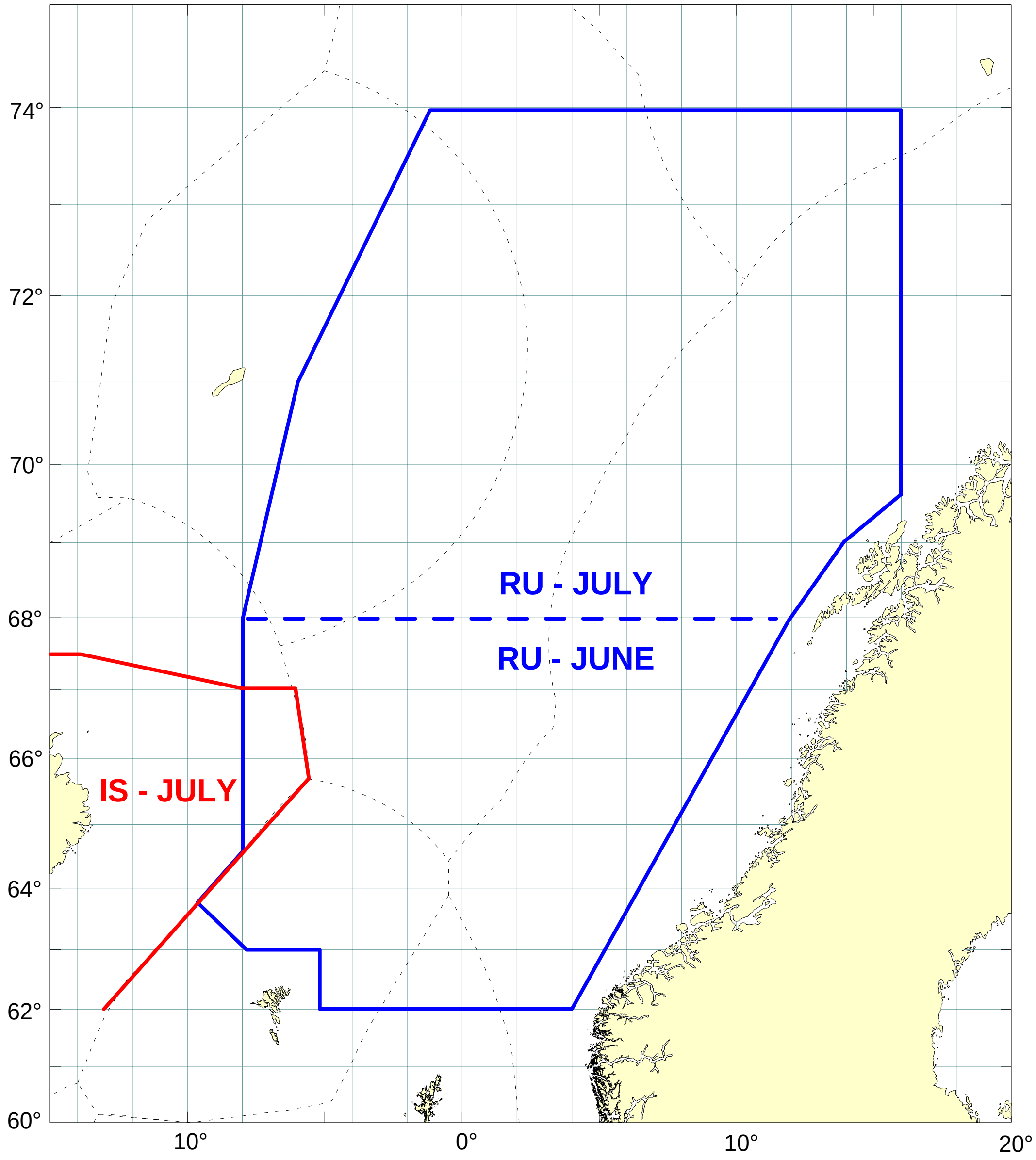

Figure 5.1.2 Planned survey areas for Russian R/V "Fridtjof Nansen" and Icelandic R/V "Bjarni Sæmundsson" in June/July 2004.

Figure 5.2.1 Planned coverage of blue whiting during the spawning season 2004, including Norwegian, Russian (2 vessels), Dutch and Irish vessels.

10 APPENDIX 1

List of participants, Planning Group on Surveys on Pelagic Fish in the Norwegian Sea, Tórshavn, Faroes Island, 27 – 29 August 2003.

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11 APPENDIX 2

New database worksheets. Parameters in bold indicate key variables, and used together they form a unique key from the logbook to the other sheets, except to the acoustic table. The acoustic table can be linked to the logbook by the cruise identifier together with country, vessel, year and month.

HEADING	DESCRIPTION

Logbook:

Country	Country code = post code, 2 digits
Vessel	Call sign, 2 or 6 digits
Cruise	Cruise identifier
Station	National station number
StType	Geartype/activity: one line per activity at the same station: CTD, Trawl, WP2, BTL, XBT
Year	YYYY (4 digits)
Month	MM
Day	DD
Hour	HH, time GMT 0-24
Min	MM
Lat	Decimal degrees, negative latitude south 0°
Lon	Decimal degrees, negative longitude west of 0°
BottDepth	Bottom depth (m)
WinDir	Compass degrees
WinSpeed	m/s
TowTime	minutes
WireLength	m
Herring	Catch (kg): always start with herring (HER)
Blue whiting	Catch (kg): blue whiting (BLU) is second in the list
Capelin	
Mackerel	
Horse mackerel	
Salmon	
Lumpsucker	
Mesopelagic fish	
Cod	
Haddock	
Saithe	
Redfish	

Acoustic:

Country	Country code = post code, 2 digits
Vessel	Call sign, 2 or 6 digits
Cruise	Cruise identifier
Log	Min 4 digits
Year	YYYY (4 digits)
Month	MM
Day	DD
Hour	HH, time GMT 0-24
Min	MM
Lat	Decimal degrees, negative latitude south 0°
Lon	Decimal degrees, negative longitude west of 0°
Species	Species code: HER, BLU,…
ChUppDepth	Upper channel depth (m)
ChLowDepth	Lower channel depth (m)
SA	Acoustic readings (m^2/nm^2)

Hydrography:

Country	Country code = post code, 2 digits
Vessel	Call sign, 2 or 6 digits
Station	National station numbers
StType	Geartype/activity: one line per activity at the same station: CTD, BTL, XBT
Year	YYYY (4 digits)
Month	MM
Day	DD
Hour	HH, time GMT 0-24
Min	MM
Lat	Decimal degrees, negative latitude south 0°
Lon	Decimal degrees, negative longitude west of 0°
BottDepth	Bottom depth (m)
StType	Geartype/activity: one line per activity at the same station
Depth	Depth of measurement (m)
Temp	°C (at least 2 decimals)
Sal	Salinity (psu, at least 3 decimals)
QF	Quality of salinity data: 0-5 (IGOSS quality flags)

Plankton:

Country	Country code = post code, 2 digits
Vessel	Call sign, 2 or 6 digits
Station	National station numbers
StType	Geartype/activity: one line per activity at the same station: WP2, MIK, Mocness
Year	YYYY (4 digits)
Month	MM
Day	DD
Hour	HH, time GMT 0-24
Min	MM
Lat	Decimal degrees, negative latitude south 0°
Lon	Decimal degrees, negative longitude west of 0°
BottDepth	Bottom depth (m)
StType	Geartype/activity: one line per activity at the same station
UppStatDepth	Upper station depth (m)
LowStatDepth	Lower station depth (m), if only one depth then same as upper
SumDryWt	Plankton mg dry weigth/m^2 in each interval
Frac2000	Size graded values, 2000 my sieve
Frac1000	1000 my sieve
Frac180	180 my sieve
Krill	From 2000 my sieve
Fish	-"-
Shrimp	-"-

Biology:

Country	Country code = post code, 2 digits
Vessel	Call sign, 2 or 6 digits
Station	National station numbers
StType	Geartype/activity: one line per activity at the same station: Trawl
Year	YYYY (4 digits)
Month	MM
Day	DD
Hour	HH, time GMT 0-24
Min	MM
Lat	Decimal degrees, negative latitude south 0°
Lon	Decimal degrees, negative longitude west of 0°
BottDepth	Bottom depth (m)
StType	Geartype/activity: one line per activity at the same station
Species	Species - see other worksheets

Length	cm with one decimal (dot as decimal sign)
Weight	g
AgeScale	From scale readings
AgeOtholit	From otholit
Sex	Empty means not sexed, 1= Female, 2= Male, 0= not possible to determine sex
Maturation	Maturation scale: Herring 1-8, Blue whiting 1-7
StomFullness	Stomach fullness, visual scale 1-5 (ICES)
StomachWt	Weight of stomach with content (g)

Country codes:

Country	**Postal code**
Faroe Islands	FO
Germany	DE
Netherlands	NL
Norway	NO
Iceland	IS
Russia	RU
Sweden	SE

ICES vessel codes:

Vessel name	**Call sign**
Argos	?
Arni Fridriksson (old)	TFJA
Arni Fridriksson (new)	TFNA
Bjarni Sæmundsson	TFEA
Dana	?
G.O. Sars (old)	LLZG
G.O. Sars (new)	LMEL
Johan Hjort	LDGJ
Magnus Heinason	OW2252
Michael Sars	LHUW
Walter Herwig III	DBFR
Tridens	?

Salinity quality flags according to IGOSS:

Quality flag	Interpretation
0	no control
1	Correct
2	inconsistent
3	doubtful
4	erroneous
5	corrected

Species codes:

PseciesID	Species name
BLU	Blue whiting
CAP	Capelin
COD	Cod
HAD	Haddock
HER	Herring
HOR	Horse mackerel
LUM	Lumpsucker
MAC	Mackerel
MES	Mesopelagic fish
RED	Redfish
SAI	Saithe
SAL	Salmon