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INVESTIGATIONS ON DEMERSAL FISH IN THE BARENTS SEA WINTER 2000

Detailed report

BOTNFISKUNDERSØKINGAR I BARENTSHAVET VINTEREN 2000

Detaljert rapport

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Investigations on demersal fish in the Barents Sea winter 2000

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Botnfiskundersøkingar i Barentshavet vinteren 2000

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PREFACE

Annual catch quotas and other regulations of the Barents Sea fisheries are set through negotiations between Norway and Russia. Assessment of the state of the stocks and quota advices are given by the International Council for the Exploration of the Sea (ICES). Their work is based on survey results and the international landings statistics. The results from the Norwegian demersal fish winter survey in the Barents Sea are an important source of information for the annual stock assessment.

These surveys started in the mid 1970-ties, focused on acoustic measurements of cod and haddock. Since 1981 the survey has been designed to give both acoustic and swept area estimates of fish abundance. Some development has taken place since then, both in terms of area coverage and in terms of methodology. The development is described in more detail by Jacobsen et al. (1997). At present this survey provides the main data input for a number of projects at Institute of Marine Research, Bergen:

- monitoring abundance of the Barents Sea demersal stocks
- mapping fish distribution in relation to climate and prey abundance
- monitoring food consumption and growth
- estimating predation mortality caused by cod

This report presents the results from the survey in February 2000. This year the Russian research vessel “Persey III” participated in addition to the Norwegian research vessels “G.O. Sars” and “Johan Hjort” and the hired factory trawler “Varegg”. The total duration of the survey was from 27 January to 29 February. The total scientific crew on the Norwegian vessels was 28 (see Chapter 11). One scientist from PINRO, Murmansk, participated onboard ”Johan Hjort”, and a Russian observer participated on both ”G.O. Sars” and ”Johan Hjort”. Both vessels visited Murmansk for inspection at 3 February.

SAMANDRAG

Eit kombinert akustikk- og botntråltokt med sikte på å framskaffa indeksar for talet på fisk og data for individuell lengde og vekt av kvar aldersgruppe av viktige botnfiskartar er gjennomført kvar vinter (4-6 veker i januar - mars) sidan 1981 i Barentshavet. Hovudinnsatsen er retta mot ungfiskbestandane av torsk og hyse, men i seinare år er slike indeksar også utarbeidde for uerartane og blåkveite. Sidan 1993 er undersøkingsområdet utvida mot nord og aust for å få ei fullstendig dekking av den isfrie delen av utbreiingsområdet til dei yngste årsklassane av torsk. Vinteren 1997 vart berre den norske delen av Barentshavet samt ein mindre del av Svalbard-området dekka, medan ein i 1998 fekk tilgang til ein liten del av russisk sone. I 1999 og 2000 hadde ein full tilgang til russisk sone.

Resultata for 2000 viser:

- 1998-årsklassen av torsk er svak og 1999-årsklassen er svært svak
- indeksane for 3-6 år gamal torsk (1997-1994 årsklassane) er omlag som venta ut frå siste bestandsvurdering og på nivå med gjennomsnittet for 1993-1999
- det er lite att av 7 år gamal og eldre torsk
- dødsraten har gått noko ned i høve til dei fire siste år for dei fleste aldersgrupper av torsk
- lengde, vekt og individuell tilvekst for torsk er omlag som i 1999
- 1998 -årsklassen av hyse er godt over middels, medan 1999-årsklassen er omlag middels. 1996-årsklassen viser seg som middels sterk i dei akustiske målingane, men godt under middels i botntrål estimatet.
- indeksane for eldre hyse er reduserte til under halvparten av middels nivå og er til dels svært svake
- lengde, vekt og individuell tilvekst for hyse er omlag som i 1999
- total dødsrate for hyse har gått ned i høve til tidlegare år
- indeksane for uerartane er mellom dei lågaste i tidsserien og det er ingen teikn på nyrekruttering
- for snabeluer er det ei svak auke for fisk over 25-30 cm p.g.a. dei siste gode årsklassane (1989-1990) i bestanden
- for blåkveite mellom 25 og 40 cm er indeksen over det den var på heile 1990-talet, men for dei andre lengdegrupper omlag på gjennomsnittet for 1990-talet

SUMMARY

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January- March) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea and a small part of the Svalbard area was covered, while in 1998 also a small part of the Russian EEZ was covered. In 1999 and 2000 the vessels had full access to the Russian EEZ.

The main results in 2000 were:

- the 1998 year class of **cod** is weak and the 1999 year class is very weak
- the abundance indices of 3-6 year old cod (1997-1994 year classes) are as expected from the last cod stock assessment and at the 1993-1999 average
- the numbers of 7 year and older cod are very low
- length and weight at age and weight increment are low but improving
- the mortality rate has been reduced compared with the previous four years for most of the cod age groups
- the 1998 year class of **haddock** is well above average and the 1999 year class is about average. The 1996 year class turns out as an average one from the acoustic estimation, but well below average in the swept area estimate.
- the abundance indices of older haddock are below average and partly very poor
- length and weight at age and weight increment are improving slowly, most clearly seen for ages 1 and 2.
- the abundance indices of the **redfish** species are among the lowest in the time series and there are no signs of improved recruitment
- the index of *S .mentella* larger than 25-30 cm shows an increase due to the last good year classes (1989-1990) in the stock
- the abundance index of **Greenland halibut** between 25 and 40 cm is greater than in the 1990-ies, while for the other length groups the indices are about the average 1990-ies level.

1. INTRODUCTION

The Institute of Marine Research (IMR), Bergen, has performed acoustic measurements of demersal fish in the Barents Sea since 1976. Since 1981 a bottom trawl survey has been combined with this acoustic survey. The survey area was extended in 1993. Since then the typical effort of the combined survey has been 10-14 vessel-weeks, and about 350 bottom trawl hauls have been made each year. Most years 3 vessels have participated from about 1 February to 1 March.

The purpose of the investigations is:

- Obtain acoustic abundance indices of cod, haddock and redfish
- Obtain swept area abundance indices by length (and age) groups of cod haddock, redfish and Greenland halibut.
- Map the geographical distribution of those fish stocks
- Estimate length, weight and maturity at age for those stocks
- Collect stomach samples from cod as a basis for estimating predation by cod

The results and the collected data are used both in the ICES stock assessments and by several research projects at IMR.

In the early 1990-ies the cod distribution area increased both due to improved climate and increasing stock size. In 1993 the survey area therefore was increased, and since then the survey has been aimed towards covering the whole cod distribution area outside the ice-border. In 1997 and 1998 the Norwegian research vessels were not allowed to cover the Russian EEZ, and in 1999 the coverage was partly limited by a rather unusually wide ice-extension. Adjustments, associated with large uncertainties, are applied to the estimates in 1997 and 1998 to compensate for the lack of coverage. The results for those years may therefore not be comparable to the results for other years. The coverage in 2000 was far better then in the three previous years.

2. METHODS

2.1 Acoustic measurements

The method is explained by Dalen and Smedstad (1979, 1983), Dalen and Nakken (1983), MacLennan and Simmonds (1991) and Jakobsen *et al*. (1997). The acoustic equipment has be continously improved. Since the early 1990-ies a Simrad EK500 echo sounder and Bergen Echo Integrator (BEI, Knudsen 1990) has been used. In the mid 1990-ies the echo sounder transducers were moved from the hull to a protrudable centreboard. This latter change has largely reduced the signal loss due to air bubbles close to the ship's hull.

Acoustic backscattering values (s_A) are stored at high resolution in the BEI-system. After scrutinizing and allocting the values to species or species groups, the values are stored with 10m vertical resolution and 1 nautical mile horizontal resolution. The procedure for allocation by species is based on:

- composition in trawl catches (pelagic and demersal hauls)
- the appearence of the echo recordings
- inspection of targeth strength distributions

For each trawl catch the relative s_A-contribution from each species is calculated (Korsbrekke 1996) and used as a guideline for the allocation. In these calculations the fish length dependent catching efficiency of cod and haddock in the bottom trawl (Aglen and Nakken 1997, see below) is taken into account. If the trawl catch gives the true composition of the species contributing to the observed s_A value, those catch-based s_A -proportions could be used directly for the allocation. In the scrutinizing process the scientists have to evaluate to what extent these catch-based s_A -proportions are reasonable, or if they should be modified on the basis of knowledge about the fish behaviour and the catching performance of the gear.

Estimation procedures

The area is divided into rectangles of 1/2° latitude and 1° longitude. For each rectangle and each species an arithmetic mean s_A is calculated for the demersal zone (less than 10m above bottom) and the pelagic zone (more than 10m above bottom). Each of those acoustic densities by rectangle are then converted to fish densities by the equation:

$$\overline{\rho}_A = \frac{\overline{s}_A}{\overline{\sigma}_A} \qquad (1)$$

$\overline{\rho}_A$ is average fish density (number of fish / square n.mile) by rectangle
$\overline{s}_A$ is average acoustic density (square m / square n.mile) by rectangle
$\overline{\sigma}_A$ is average backscattering cross-section (square m) by rectangle

For cod, haddock and redfish the backscattering cross-section (σ), target strength (TS) and fish length (L cm) is related by the equation (Foote, 1987):

$$\mathrm{TS} = 10 \cdot \log\left(\frac{\sigma}{4\pi}\right) = 20 \cdot \log(L) - 68 \qquad (2)$$

From 1992 onward the following target strength function has been applied for cod, haddock and redfish:

$$\mathrm{TS} = 21.8 \cdot \log(L) - 74.9 \qquad (3)$$

The data for the period 1981-1992 has been recalculated (Aglen and Nakken 1997) for taking account of:
-changed target strength function
-changed bottom trawl gear (Godø and Sunnanå 1992)
-size dependant catching efficiency for cod and haddock (Dickson 1993a,b).

In 1999 some errors in the time series were discovered and corrected (Bogstad *et al.* 1999). Those errors related to cod for the years 1983-1998 and for haddock for the years 1985-1998.

Combining equations 1,2 and 3 gives:

$$\overline{\rho}_A = 5.021 \cdot 10^5 \cdot \overline{s}_A \,/\, \overline{L^2} \qquad (3)$$

$\overline{L^2}$ is average squared fish length by rectangle and by depth channels (i.e., pelagic and bottom)

As a basis for estimating $\overline{L^2}$ trawl catches considered to be representative for each rectangle and depth zone are selected. (Anon. 1998). This is a partly subjective process, and in some cases catches from neighbouring rectangles are used. Only bottom trawl catches are used for the demersal zone. Obtaining a sufficient number of useful pelagic catches requires huge effort, and uncertainties concerning the fish behaviour relative to the pelagic trawl often lead to doubts about the representativity of the pelagic catches. Therefore, both pelagic and bottom trawl catches are applied to the pelagic zone. Length frequency by 5cm length groups form the basis for calculating mean squared length. The bottom trawl catches are normalised to 1 nautical mile

towing distance and adjusted for length dependant fishing efficiency (Aglen and Nakken 1997, see below). Pelagic catches are applied unmodified.

Let f_i be the (adjusted) catch by length group *i* and let L_i be the midpoint (cm) of the length interval *i*. Then:

$$\overline{L}^2 = \frac{\sum_{i=i_{\min}}^{i_{\max}} f_i \cdot L_i^2}{\sum_{i=i_{\min}}^{i_{\max}} f_i} \qquad (4)$$

For each species the total density ($\overline{\rho}_A$) by rectangle and depth zone is calculated by equation (3). This total density is then split on length groups according to the estimated length distributions. These densities are further converted to abundance by multiplying with the area of the rectangle. The estimated abundance by rectangle is then added for defined main areas (Figure 3.2). Estimates by length are converted to estimates by age by using age an length key for each main area derived from the age sampling during the survey.

2.2 Swept area measurements

All vessels were equipped with the standard research bottom trawl Campelen 1800 shrimp trawl with 80 mm (stretched) mesh size in the front. Until and including 1993 a cod-end with 35-40 mm (stretched) mesh size and a cover net with 70 mm mesh size were used. Since this mesh size may lead to considerable escapement of 1 year old cod, the cod ends were in 1994 replaced by cod-ends with 22 mm mesh size. At present a cover net with 116 mm meshes is mostly used. The ground gear has also been changed during the time series. The trawl is now equipped with a rockhopper ground gear. Until and including 1988 a bobbins gear was used, and the cod and haddock indices from the time period 1981-1988 have since been recalculated to 'rockhopper indices' and adjusted for fish length dependent fishing or sweep width (Godø and Sunnanå 1992, Aglen and Nakken 1997). The sweep wire length is 40 m. Vaco doors ($6m^2$, 1500kg), which are considered to be the best compromise when doing both pelagic and bottom trawling, have earlier been used as standard trawldoors on board the research vessels, except on R/V "Jan Mayen" where Steinshamn W-9 doors ($7.1m^2$, 2050kg) are used. In 2000, R/V "Johan Hjort" and R/V "G.O.Sars" used Vaco doors ($6m^2$, 1500kg), while R/V "Persey III" and the hired commercial trawler F/Tr "Varegg" used Steinshamn W-9 doors ($7.1m^2$, 2050kg). In order to achieve constant sampling width of a trawl haul independent of e.g. depth

and wirelength, a 10 m rope "locks" the distance between the trawl wires 150 m in front of the trawl doors. This is called "strapping". The distance between the trawl doors then become almost constant of 48-50 m (Engås and Ona 1993, Engås 1995). The trawl's catchability of different species and length groups then becomes independent of bottom depth. Without strapping, the distance between the doors was 50-60 m and increasing with increasing depth assuming a constant relationship between wirelength and trawldepth. In 1993 strapping was used on board the research vessels, in 1994 on every third haul, in 1995-1997 on every second haul on all vessels, and since 1998 on all hauls when weather conditions allow for it. Standard towing time is 30 minutes (until 1985 the towing time was 60 min.). On all trawl stations the trawl performance is constantly followed by Scanmar trawl sensors, i.e., distance between the doors, vertical opening of the trawl and bottom contact control.

The geographical position of the trawl stations are pre-defined and kept fixed from year to year. When the swept area investigations started in 1981 the investigated area was divided into four main areas (A, B, C og D) and 35 strata (smaller and, by experience, more uniform biotops). During the first years the number of trawl stations in each stratum was set based on expected fish distribution in order to reduce the variance, i.e., more hauls in strata with high and variable fish density. In recent years the trawl stations have been spread out more evenly, although the distance between stations in the central cod distribution area is shorter (20 naut.miles) compared to the more marginal areas (30 naut.miles). Considerable amounts of young cod were during the 1990-ies distributed outside the initial four main areas, and in 1993 the investigated area was therefore enlarged by areas D', E, and the ice-free part of Svalbard (S) (Fig. 3.2 and Tabell 3.1), altogether 28 new strata. In the 1993- and 1994 survey reports, the Svalbard area was included in A' and the western (west of 30°E) part of area E. Since 1996 the number of strata has been 23, and the fixed trawl stations have been spread out with either 20 or 30 naut. miles distance to each other based on the fish distribution in recent previous years. The main reason for reducing the number of strata was the necessity to get sufficient trawl stations in each stratum to get reliable estimates of density and variance.

Swept area fish density estimation

Swept area fish density estimates ($\rho_{s,l}$) by species (s) and length (l) were estimated for each bottom trawl haul by the equation:

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

$\rho_{s,l}$ number of fish of length l per n.m.^{2} observed on trawl station s

$f_{s,l}$ estimated frequency of length l

$a_{s,l}$ swept area:

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

d_s towed distance (n.m.)

EW_l length dependent effective fishing width:

$$EW_l = \alpha \cdot l^{\beta} \text{ for } l_{\min} < l < l_{\max}$$
$$EW_l = EW_{l_{\min}} = \alpha \cdot l_{\min}^{\beta} \text{ for } l \le l_{\min}$$
$$EW_l = EW_{l_{\max}} = \alpha \cdot l_{\max}^{\beta} \text{ for } l \ge l_{\max}$$

The parameters are given in the text table below:

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

The fishing width was previously fixed to 25 m = 0.0135 nm. Based on Dickson (1993a,b), length dependent effective fishing width for cod and haddock was included in the calculations in 1995 (Korsbrekke *et al*., 1995). Aglen and Nakken (1997) have adjusted both the acoustic and swept area time series back to 1981 for this length dependency based on mean-length-at-age information. In 1999, the swept area 1983-1995 time series was recalculated for cod and haddock using the new area and strata divisions (Bogstad *et al.* 1999).

For redfish, Greenland halibut and other species, a fishing width of 25 m was applied, independent of fish length.

Observations of fish density by length are summed together in 5 cm length-groups $\rho_{s,l}$ where l is the length-group. Stratified indices by length-group and stratum will then be:

$$L_{p,l} = \frac{A_p}{S_p} \cdot \sum_{s \text{ in stratum } p} \rho_{s,l}$$

$L_{p,l}$ index, stratum *p,* length-group l

A_p area (n.m.^{2}) of stratum p (or the part of the stratum covered by the survey)
S_p number of trawl stations in stratum p

The coverage of the northern- and easternmost strata differs from year to year. The strata area is therefore recalculated when necessary by multiplying the total stratum area by the ratio of trawl stations taken. Indices are estimated for each stratum within the main areas A, B, C, D, D', E and S. Total number of fish in each 5 cm length group in each main area is estimated by adding all strata within the area. Total number of fish at age is estimated by using an age-length key constructed for each main area. Total indices on length and age are estimated adding all main areas.

2.3 Sampling of catch and age-length keys.

Sorting, weighing, measuring and sampling of the catch are done according to instructions given in Fotland *et al*. (1997). Since 1999 all data except age are recorded electronically by Scantrol Fishmeter (**ref ?**), a measuring board connected to stabilized Marel scales. The whole catch or a representative subsample of most species was length measured on each station.

On each bottom and pelagic trawl station age (otoliths) and stomach were sampled from 1 cod per 5 cm length-group. All cod above 90 cm were sampled. Most of the stomachs were analysed on board according to the simplyfied procedure given in Fotland *et al*. (1997). From haddock only age was sampled from 1 specimen per 5 cm length-group. Regarding the redfish species, *Sebastes marinus* and *S. mentella*, otoliths for age determination were sampled from 5 fish in every 5 cm length-group on every second station with more than 10 specimens in the catch. This regular sampling was supplied with extra samples from hauls with big redfish catches. Greenland halibut were sorted by sex before length measurement and age (otolith) sampling. From this species otoliths were collected from 5 fish per 5 cm length group per sex on all stations. Table 3.2 gives an account of the sampled material.

One age-length key is constructed for each main area. All age samples are included and weighted according to:

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

$w_{p,l}$ - weighting factor
$L_{p,l}$ - swept area index of number fish in length-group l in stratum p

$n_{p,l}$ - number of age samples in length-group l and stratum p

Portions are estimated according to:

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

$p_a^{(l)}$ - weighted portion of age a in length-group l and stratum p
$n_{p,a,l}$ - number of age samples of age a in length-group l and stratum p

Number of fish by age is then estimated following the equation:

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

Mean length and –weight by age is then estimated according to (only shown for weight):

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

$W_{a,p,l,j}$ - weight of sample j in length-group l, stratum p and age a

3. SURVEY OPERATION

The survey in 2000 was conducted with R/V "G.O. Sars" 29.01-24.02 (BEI-survey no. 2000002, series no. 80001-80200), R/V "Johan Hjort" 01.02-29.02 (BEI-survey no. 2000202, series no. 80201-80400), F/Tr ”Varegg” 27.01-06.02 (BEI-survey no. 2000805, series no. 80201-80400), and R/V “Persey III” from PINRO 07.02-17.02 (series no. 80351-80366) . Fig. 3.1 shows survey tracks and trawl stations, and fig. 3.2 shows the survey area with the main areas A, B, C, D, D', E and S (part of the Svalbard area). Tabell 3.1 shows the area in square n.miles of each main area covered by the survey every year. Altogether 250 hydrographical (CTD) stations and 265 trawl stations were taken; of these were 246 fixed, pre-defined, bottom trawl stations. 226 of the fixed bottom trawl stations are included in the calculation of swept area indices (fig. 3.2). 10 of the trawl stations were pelagic trawl hauls using Åkrahamn pelagic trawl (3200 mm mesh size in front and 20 mm in the cod end; see Valdemarsen and Misund 1995) in order to get more samples and information to improve the echo scrutinizing by species and fish length**.** This was the first year that a Russian research vessel participated in the survey. “Persey III” used the same trawl gear (Campelen 1800 purchased at NOFI, Tromsø) as the Norwegian vessels. Sixteen comparative trawl hauls between “Persey III” and “Johan Hjort” were conducted (see chapter 10, page 64) and the results from 12 trawl hauls taken by the Russian vessel were added to the swept area abundance estimation. “Persey III” also conducted a survey in the Russian EEZ according to a national program.

Before starting the survey in the Russian Federation’s Exclusive Economic Zone (Russian EEZ), both ”G.O. Sars” and ”Johan Hjort” had to go to Murmansk for inspection at 3 February. One scientist from PINRO, Murmansk, participated onboard ”Johan Hjort”, and a Russian observer participated on both "Johan Hjort" and “G.O.Sars” as long as the vessels were working in Russian EEZ. The ice border was further to the east this year compared with 1999 leading to a wider and better coverage of the fish distribution. Some ice-free parts of the Hopen Deep and the Sentralbanken were not covered completely.
Logg-, catch- and temperature data were regularly sent by telex via Inmarsat C to the head vessel ”Johan Hjort” from the other vessels. The cruise leader on board the head vessel led the survey. Here all data were edited and prepared for abundance estimation and presentation.
Table 3.2 gives an account of sampled length- and age material from fixed and free (set out on echo registration) bottom trawl stations as well as pelagic trawl stations.

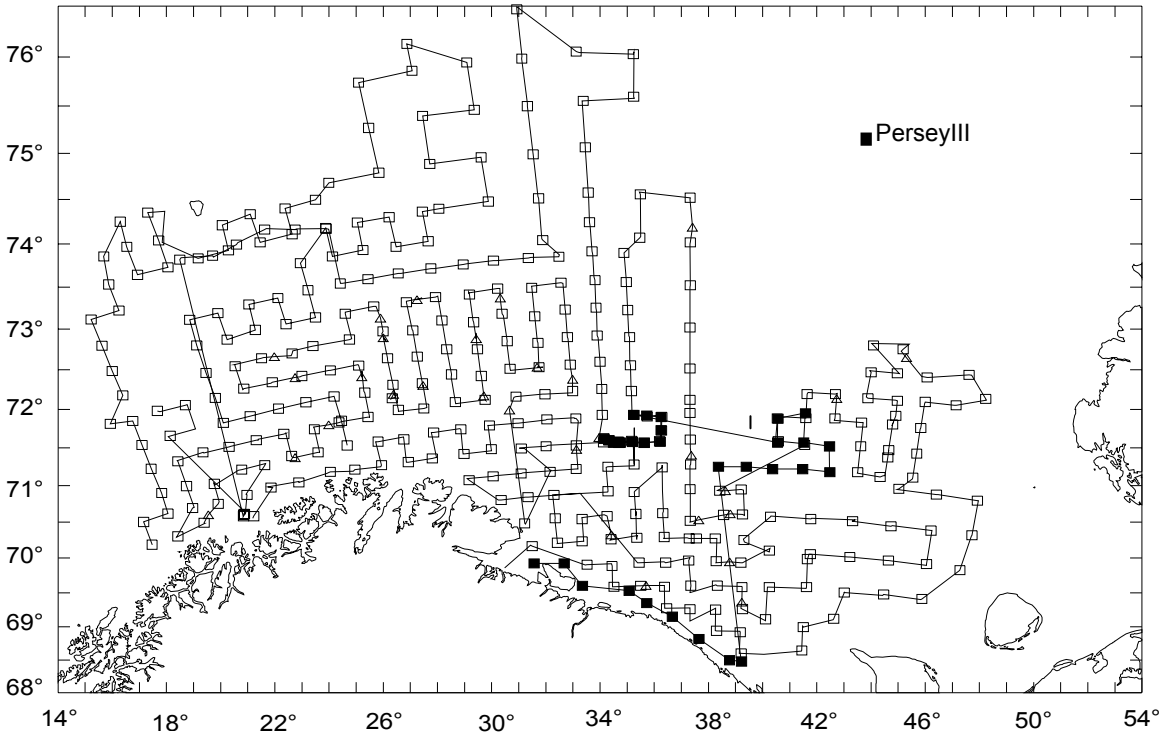

Figure 3.1. Survey tracks and trawl stations; R/V "G.O. Sars" 29.1-24.2, R/V "Johan Hjort" 1.2-29.2, F/F "Varegg" 27.1-6.2. and F/F "Persey III" 7.2-17.2.2000.
Kurslinjer og trålstasjonar; F/F "G.O. Sars" 29.1-24.2, F/F "Johan Hjort" 1.2-29.2, F/F "Varegg" 27.1-6.2. og F/F "Persey III" 7.2-17.2.2000.

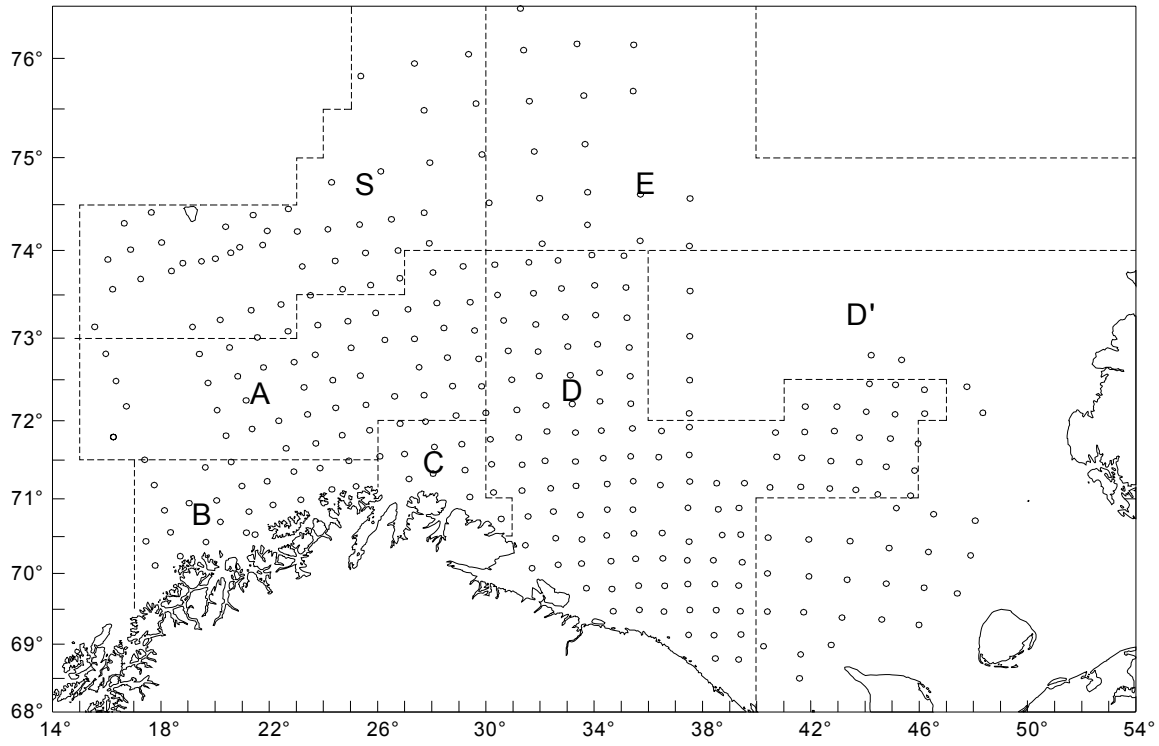

Figure 3.2. The survey area with main areas A, B, C and D, additional areas D', E and S and stations taken in the swept area survey (bottom trawl) 27.1-29.2.2000.
Undersøkingsområdet med hovudområde A, B, C og D, tilleggsområde D', E og S og trålstasjonar teke i botntrålundersøkinga 27.1-29.2.2000.

Table 3.1. Area (n.miles^2) covered in the bottom trawl surveys in the Barents Sea winter 1981-2000.
Areal (n.mil^2) dekka i botntrålundersøkingane i Barentshavet vinteren 1981-2000.

Område *(Area)*	År *(Year)*								
	1981-1992	1993	1994	1995	1996	1997[1]	1998[1]	1999	2000
A	23299	23929	27131	27131	25935	27581	27581	27581	27054
B	8372	8372	8372	8372	9701	9701	9701	9701	9701
C	5348	5348	5348	5348	5048	5048	5048	5048	5048
D	51116	51186	51186	51186	53932	23592	23592	43786	52836
D'	-	23152	24975	56822	53247	2684	5886	7961	28963
E	-	8965	12576	14859	5818	1954	3819	5772	14148
Svalbard		16690	14252	22836	11600	16989	23587	18470	24685
ABCD	88835	88835	92037	92037	94016	65922	65922	86116	94639
Total	88835	137642	143840	186554	165281	87549	99214	118320	162435

1) Norwegian EEZ and part of the Svalbard area
Norsk sone og del av Svalbardområdet

Table 3.2. Number of trawl stations, fish measured for length (L) and age (A) for main areas and trawl types in the Barents Sea winter 2000. B1=fixed bottom trawl, B2=other bottom trawl, P=pelagic trawl.
Tal for trålstasjonar, lengdemålt (L) og aldersbestemt (A) fisk for kvart hovudområde og stasjonstype i Barentshavet vinteren 2000. B1=fast botntrål, B2=annan botntrål, P=pelagisk trål.

Område *(Area)*	Trål type *(Trawl type)*	Tal hal *(No. hauls)*	Torsk *(Cod)*		Hyse *(Haddock)*		Vanleg uer *(S.marinus)*		Snabeluer *(S. mentella)*		Blåkveite *(Greenland halibut)*	
			L	A	L	A	L	A	L	A	L	A
A	B1	54	3181	591	4919	311	265	4	4258	20	55	31
	B2	7	91	0	136	0	5	0	1	0	0	0
	P	14	154	41	705	66	2	0	56	0	0	0
B	B1	22	625	191	2416	199	200	33	329	16	4	2
	B2	5	155	0	716	0	10	0	0	0	0	0
	P	0	1	0	0	0	0	0	0	0	0	0
C	B1	11	899	134	896	97	58	26	467	98	7	5
	B2	0	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0
D	B1	128	14297	1143	12072	621	335	106	1481	125	110	100
	B2	15	2920	33	1803	10	37	0	5	0	12	3
	P	14	500	46	694	41	0	0	0	0	0	0
D'	B1	33	1497	75	528	22	1	0	0	0	0	0
	B2	1	38	0	1	0	0	0	0	0	0	0
	P	1	13	0	0	0	0	0	0	0	0	0
E	B1	17	1350	144	437	21	11	0	41	5	213	168
	B2	0	0	0	0	0	0	0	0	0	0	0
	P	1	0	0	0	0	0	0	0	0	0	0
S	B1	50	5800	473	558	38	237	20	2101	42	145	45
	B2	6	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0
Total	B1	317	27671	2751	21826	1309	1107	189	8677	306	534	351
	B2	34	3204	33	2656	10	52	0	6	0	12	3
	P	30	668	87	1399	107	2	0	56	0	0	0
Sum		381	31543	2871	25881	1426	1161	189	8739	306	546	354

4. HYDROGRAPHY

Measurements of temperature and salinity where recorded for the whole water column on all fixed trawl stations. In addition, the standard hydrographical section ”Semøyene – north” was taken by ”Johan Hjort” (fig. 4.1).

Fig. 4.2 shows the drift ice border and temperature distribution close to surface, at 100 m depth and at the bottom. The ice border in 2000 was far to the east and north and hampered only to a minor extent the survey coverage. The Barents Sea was slightly warmer in 2000 compared to the year before. This was especially noticeable by the extension of the 2º C isotherm at bottom, which extended far to the northeast and southeast.

The standard hydrographical sections ”Fugløya-Bjørnøya” and “Vardø-north” which were taken one week before the fish survey, showed almost the same mean temperatures at 50-200 m depth as in 1999 and in the beginning of the 90’s. The Sem Islands section, which was not taken in 1997-1999, also showed a similar high temperature as in the early 90’s. In average the temperatures in the Barents Sea are 0,5-1,0°C above the long term mean.

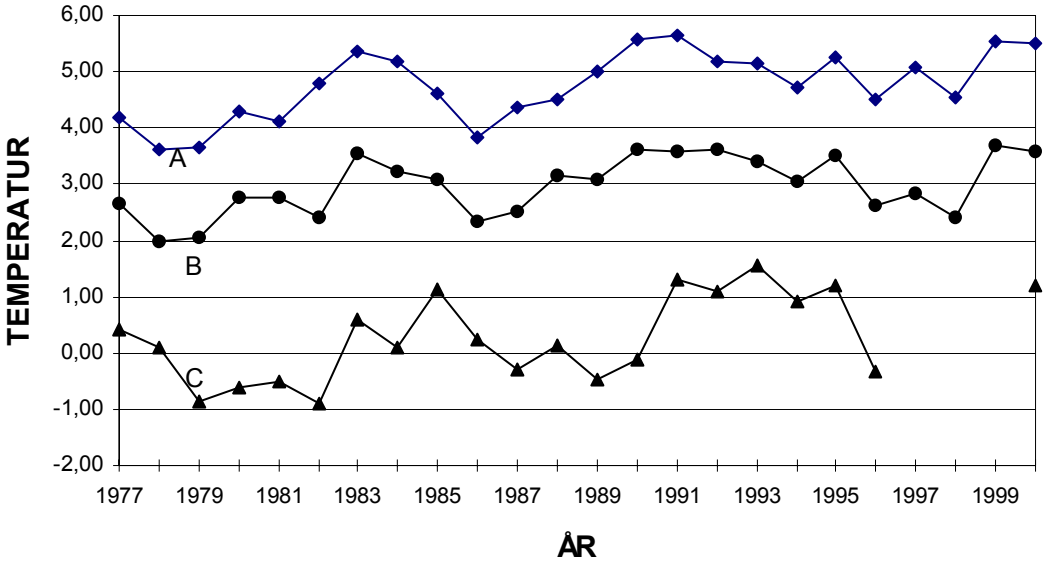

Figure 4.1. Mean temperatures in 50-200 m depth in 1977-2000. A) "Fugløya-Bjørnøya" in March, B) "Vardø-Nord" in March, C) Sem Islands in January-February.
Gjennomsnittleg temperatur i 50-200 m djup i 1977 – . A) Fugløya-Bjørnøya i mars, B) Vardø-Nord (B) mars, C) Semøyene-nord i januar-februar.

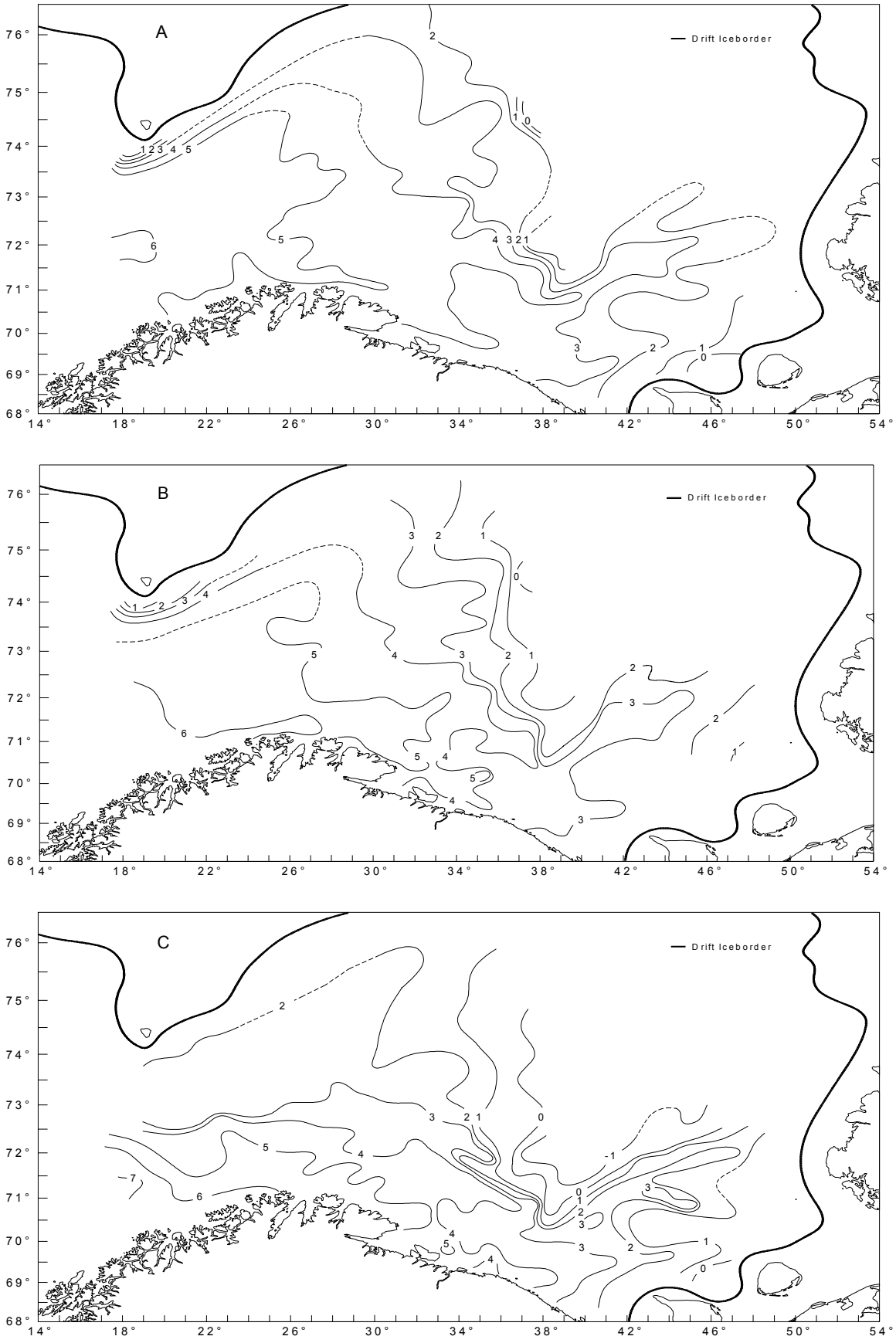

Figure 4.2. Temperature distribution February 2000. A) surface, B) 100 m depth, C) bottom.
Temperaturfordeling februar 2000. A) ved overflata, B) i 100 m djup, C) ved botnen.

5. TOTAL ECHO ABUNDANCE OF COD AND HADDOCK

5.1 Horizontal distribution

The geographical distributions of total echo abundance of cod and haddock are shown in fig. 5.1 and 5.2, respectively, where also the drift ice border is drawn. The densest registrations of cod were made in the southern part of the Barents Sea outside the Norwegian coast and at Bear Island. Also in 2000 cod were registered over most of the area covered by the survey. The figure also shows that the area of distribution was not completely covered northwest of Bear Island and north of the Central Bank.

The haddock registrations do not extend as far north as for cod (usually not beyond the 2°C isotherm). The densest registrations were found around the Norwegian-Russian border in the southern part of the Barents Sea east and northeast of Vardø.

Table 5.1 shows the echo abundance (echo density multiplied with area) distributed on main areas as well as on pelagic versus bottom channels. In 1999 the echo abundance of cod was reduced by nearly 50% compared with the year before. In 2000 the echo abundance of cod increased by 90% compared with 1999. The increase was especially noticeable in the pelagic channel, and was observed in all main areas. The echo abundance of haddock showed a similar increase compared with 1999, a more than 100% increase was detected in both the pelagic and bottom channels. Also the total echo abundance of redfish increased in all main areas, especially in the pelagic channel.

Table 5.2 presents the time series of total echo abundance of cod and haddock in the investigated areas. Despite the increase compared to the year before, the total echo abundance for cod and haddock are 75% and 63%, respectively, of the average values for the 1990-ies. The relative echo abundance for cod in the bottom channel (0-10 m above bottom) decreased from 29% in 1999 to 23% in 2000, while for haddock it increased from 21% to 23%.

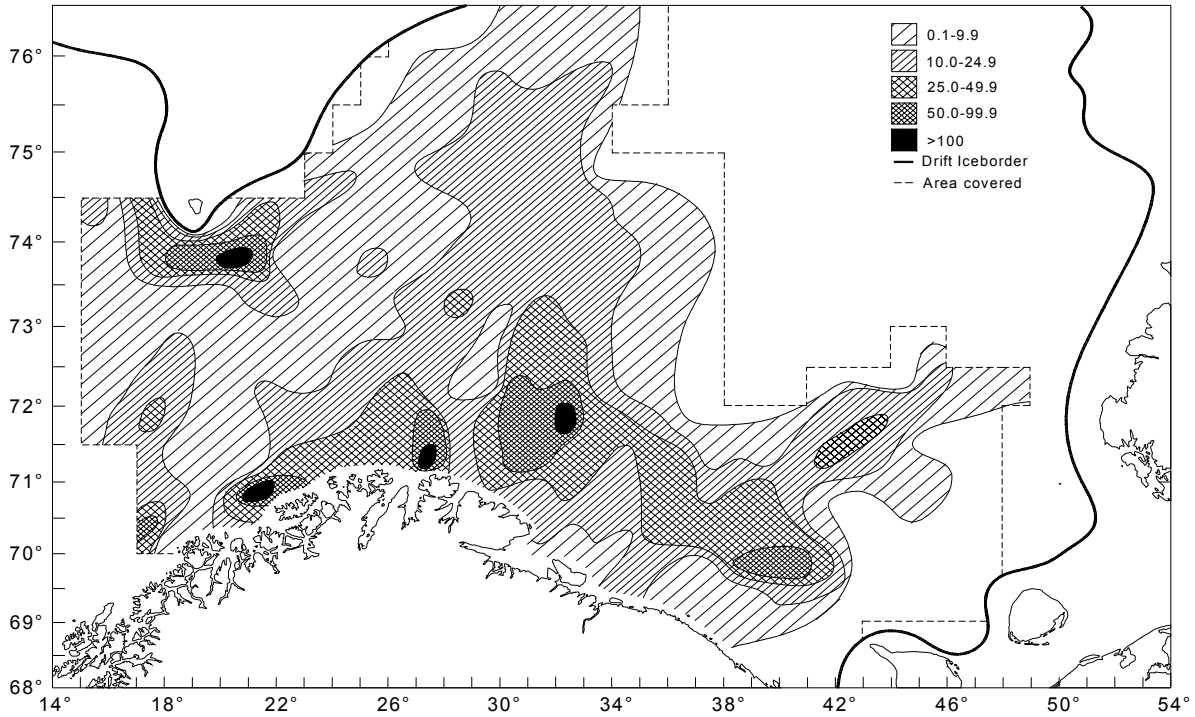

Figure 5.1. COD. Distribution of total echo abundance winter 2000. Unit is integrated back scattering surface per square nautical mile (m^2/nm^2).
TORSK. Fordeling av total ekkotettleik vinteren 2000. Eining er integrert reflekterande overflate pr. kvadrat nautisk mil (m^2/nm^2).

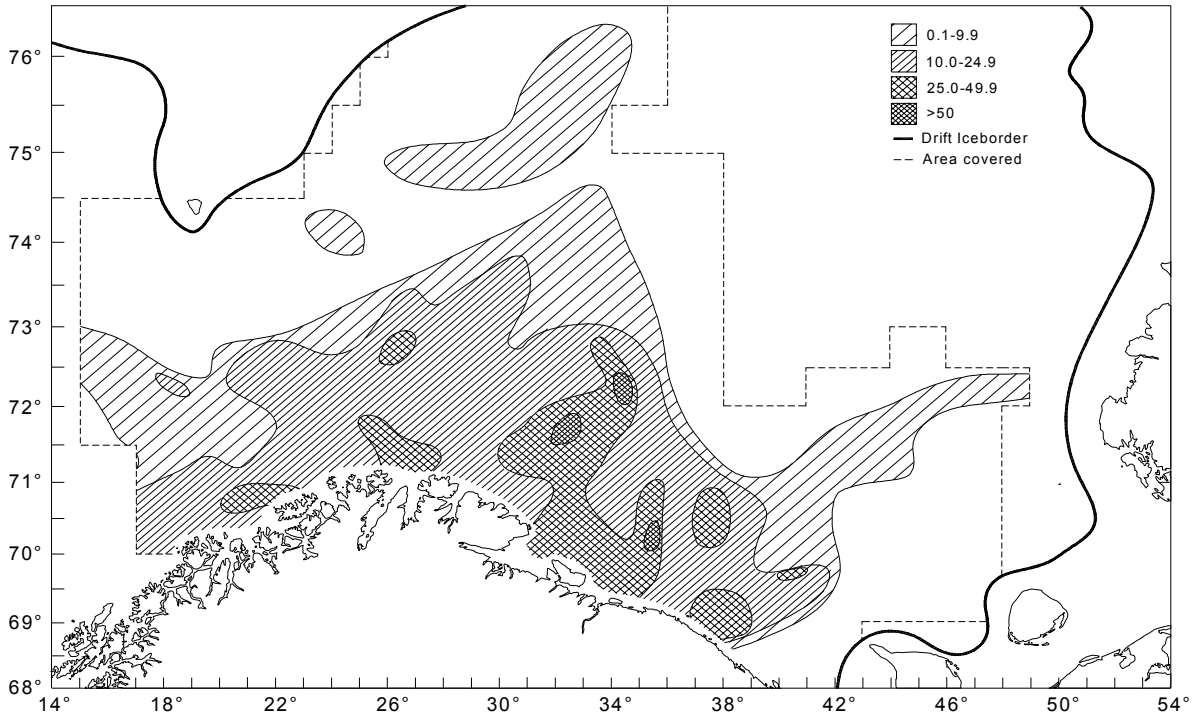

Figure 5.2. HADDOCK. Distribution of total echo abundance winter 2000. Unit is integrated back scattering surface per square nautical mile (m^2/nm^2).
HYSE. Fordeling av total ekkotettleik vinteren 2000. Eining er integrert reflekterande overflate pr. kvadrat nautisk mil (m^2/nm^2).

Table 5.1. Echo abundance of cod, haddock and redfish in the pelagic layer (P) and in the 10 m layer above the bottom (B) in main areas of the Barents Sea winter 2000 (m^2 reflecting surface · 10^{-3}).
Ekkomengde av torsk, hyse og uer i det pelagiske sjiktet (P) og i 10 m sjiktet over botn (B) i kvart hovudområde av Barentshavet vinteren 2000 (m^2 reflekterande overflate · 10^{-3}).

Område *(Area)*	Torsk *(Cod)*			Hyse *(Haddock)*			Uer *(Redfish)*		
	P	B	Total	P	B	Total	P	B	Total
A	235	74	309	248	47	295	310	68	378
B	193	63	256	101	64	165	76	31	107
C	177	19	196	93	9	108	37	4	41
D	948	278	1226	660	202	862	60	8	68
D'	90	46	136	27	16	42	-	-	-
E	64	39	103	8	4	12	2	-	2
S	280	92	372	7	+	7	95	9	104
Total	1986	610	2596	1144	343	1487	580	121	701

Table 5.2. Cod and haddock. Total echo abundance and echo abundance in the 10 m layer above the bottom from acoustic surveys in the Barents Sea winter 1981-2000 (m^2 reflecting surface · 10^{-3}). 1981 - 1992 includes mainly areas A, B, C and D.
Torsk og hyse. Total ekkomengde og ekkomengde i 10 m sjiktet over botn frå akustisk undersøkingar i Barentshavet vinteren 1981-2000 (m^2 reflekterande overflate · 10^{-3}). 1981-1992 inkluderer i hovudsak områda A, B, C og D.

År *(Year)*	Ekkomengde *(Echo abundance)*								
	Total			Botn *(bottom)*			Botn/total *(bottom/total)*		
	Torsk *(Cod)*	Hyse *(Had.)*	Sum	Torsk *(Cod)*	Hyse *(Had.)*	Sum	Torsk *(Cod)*	Hyse *(Had.)*	Sum
1981			2097			799			0.38
1982			686			311			0.45
1983			597			169			0.28
1984			2284			604			0.26
1985			5187			736			0.14
1986			5990			820			0.14
1987			2676			608			0.23
1988			1696			579			0.34
1989			914			308			0.34
1990			1355			536			0.40
1991			2706			803			0.30
1992			4128			951			0.23
1993	3905	2854	6759	1011	548	1559	0.26	0.19	0.23
1994	5076	3650	8726	1201	609	1810	0.24	0.17	0.21
1995	4125	3051	7176	1525	651	2176	0.37	0.21	0.30
1996	2729	1556	4285	1004	626	1630	0.37	0.40	0.38
1997[1]	1354	995	2349	530	258	788	0.39	0.26	0.34
1998[1]	2406	581	2987	632	143	775	0.26	0.29	0.26
1999	1364	704	2068	389	145	534	0.29	0.21	0.26
2000	2596	1487	4083	610	343	953	0.23	0.23	0.23

[1)] Norwegian EEZ and part of the Svalbard area
Norsk sone og del av Svalbardområdet

5.2 Vertical distribution

Table 5.3 shows the vertical distribution of **cod** echo density per meter depth.
It should be noticed that the values are direct averages off all observations, which means that areas with high sampling intensity are over-represented compared to areas with low sampling intensity.

All main areas combined shows that the highest echo densities for cod were observed 0-10 m above bottom on 150-200 m bottom depth. About 61% of the cod were registered closer to bottom than 50 m. This is less than in 1999 (74%). An increase in cod abundance closer to bottom than 50 m may make the cod less exposed to acoustic detection and more available for bottom trawl. Among the main areas, B and D showed the highest densities.

Table 5.3. Average acoustic backscattering volume density (s_A per meter depth x 1000) allocated to cod by height intervals above bottom and by bottom depth intervals winter 2000. The total average corresponds to the average by bottom depth intervals weighted by the number of observations (Naut. miles).
Gjennomsnittleg ekkotettleik (s_A pr. meter djup x 1000) av torsk i aukande avstand frå botn for ulike botndjup for Barentshavet, samt totalen for kvart hovudområde vinteren 2000.

	Bottom	Height above bottom (intervals in m)										Naut.
Region	depth (m)	0- 10	10-20	20- 30	30- 50	50-100	100-150	150-200	200-250	250-300	300 -->	Miles
All	000-050	10	0	0	0							12
All	050-100	26	7	5	3	5						485
All	100-150	314	99	37	20	6	1					557
All	150-200	850	555	296	144	46	7	2				1089
All	200-250	657	286	207	181	109	33	2	0			1441
All	250-300	393	241	222	205	143	52	10	2	0		1938
All	300-350	311	184	157	147	135	67	25	9	0	0	1000
All	>350	143	95	83	68	57	47	23	7	3	1	1396
All	Total	421	235	170	135	89	36	10	3	1	0	7918
A	Total	261	156	126	103	53	21	8	2	0	0	1337
B	Total	640	267	208	170	128	62	13	3	3	1	635
C	Total	393	288	334	367	235	126	44	9	1	0	268
D	Total	545	346	235	174	120	53	12	3	0	0	2933
D’	Total	165	82	53	38	24	4	0	0	0	0	932
E	Total	242	59	34	27	20	12	4	1	0	0	473
S	Total	452	204	148	126	78	18	10	3	1	0	1340

Table 5.4 shows the vertical distribution of **haddock** echo density per meter depth. As for cod, the highest echo densities for haddock were observed 0-10 m above bottom on 150-200 m bottom depth. As in 1999 the highest densities were observed in main area B. About 63% of the haddock were observed closer to bottom than 50 m. This is slightly more than was found in 1999 (57%), 1998 (60%) and 1997 (53%).

Table 5.4. Average acoustic backscattering volume density (s_A per meter depth x 1000) allocated to haddock by height intervals above bottom and by bottom depth intervals. The total average corresponds to the average by bottom depth intervals weighted by the number of observations (Naut. miles).

	Bottom	Height above bottom (intervals in m)										Naut.
Region	depth (m)	0- 10	10-20	20- 30	30- 50	50-100	100-150	150-200	200-250	250-300	300 -->	Miles
All	000-050	8	2	9	8							12
All	050-100	7	1	0	0	0						485
All	100-150	460	152	53	19	3	0					557
All	150-200	657	426	229	124	34	5	0				1089
All	200-250	309	185	156	132	67	14	1	0			1441
All	250-300	189	150	157	141	90	39	10	3	0		1938
All	300-350	142	98	83	76	65	32	10	3	0	0	1000
All	>350	28	29	31	34	37	28	11	3	1	0	1396
All	Total	248	157	118	92	54	22	6	2	0	0	7918
A	Total	177	136	130	118	68	25	9	3	0	0	1337
B	Total	670	230	147	95	56	28	4	1	0	0	635
C	Total	203	142	177	187	121	87	25	4	0	0	268
D	Total	400	282	202	153	89	32	8	2	0	0	2933
D’	Total	71	35	22	14	7	1	0	0	0	0	932
E	Total	21	9	7	4	2	1	0	0	0	0	473
S	Total	1	4	3	2	1	0	0	0	0	0	1340

Table 5.5 shows the vertical distribution of **redfish** echo density per meter depth. The highest echo densities for redfish were observed 0-10 m above bottom deeper than 350 m bottom depth. The highest densities were observed in main area B and A. About 54% of the redfish were registered closer to bottom than 50 m.

Table 5.5. Average acoustic backscattering volume density (s_A per meter depth x 1000) allocated to redfish by height intervals above bottom and by bottom depth intervals winter 2000. The total average corresponds to the average by bottom depth intervals weighted by the number of observations (Naut. miles).
Gjennomsnittleg ekkotettleik (s_A pr. meter djup x 1000) av uer i aukande avstand frå botn for ulike botndjup for Barentshavet, samt totalen for kvart hovudområde vinteren 2000.

	Bottom	Height above bottom (intervals in m)										Naut.
Region	depth (m)	0- 10	10-20	20- 30	30- 50	50-100	100-150	150-200	200-250	250-300	300 -->	Miles
All	000-050	1	0	0	0							12
All	050-100	1	0	0	0	0						485
All	100-150	21	4	1	1	0	0					557
All	150-200	45	10	5	2	0	0	0				1089
All	200-250	54	24	16	12	6	1	0	0			1441
All	250-300	64	39	30	26	17	7	1	0	0		1938
All	300-350	119	100	81	60	41	19	5	1	0	0	1000
All	>350	155	134	124	92	64	37	23	8	4	1	1396
All	Total	76	52	43	33	22	11	5	2	1	0	7918
A	Total	205	158	130	90	50	25	15	4	2	1	1337
B	Total	285	117	83	64	48	19	2	1	0	0	635
C	Total	90	60	60	69	55	28	9	2	0	0	268
D	Total	19	13	12	12	10	5	1	0	0	0	2933
D’	Total	0	0	0	0	0	0	0	0	0	0	932
E	Total	0	0	0	0	0	0	0	0	0	0	473
S	Total	47	53	48	34	23	11	8	3	1	0	1340

6. DISTRIBUTION AND ABUNDANCE OF COD

6.1 Acoustic estimation

Figs. 6.1 - 6.6 show the distribution of the different age groups. The maps are based on average acoustic density ($\bar{s}_A$, square m / square n.mile) by rectangle, and the resolution is therefore less than for the total echo abundance maps (Fig. 5.1). As previous investigations have shown, the youngest age groups of cod tend to have a more easterly distribution than the older ones. The maps show fewer areas with dense concentrations of 1- and 2-year old cod, while some increase in abundance is seen for age groups 3-6 compared to 1999. Most of the mature cod (age 6 and older) have already started on its spawning migration southwards out of the investigated area, and are therefore to a lesser extent covered by the present investigation.

Acoustic indices by length and age are given in table 6.1. Table 6.2 shows the acoustic indices for each age group by main areas, in the pelagic layer (P) and in the 10 m layer above the bottom (B).

The time series (1981-2000) is presented in table 6.3. The indices for 1997 and 1998 are raised to also represent the Russian EEZ. Indices for the Russian EEZ in 1997 and 1998 were calculated by interpolation of the ratio found in the Russian EEZ in 1996 and 1999, age group by age group. Since the coverage of the Svalbard area (S) varies from year to year due to ice, this area has been excluded in the extrapolation of fish abundance in the Russian EEZ in 1997-1998, and just added to the total index afterwards.

The indices for 1 and 2 year old cod are the lowest estimated since the survey area was extended in 1993. The indices for 3-6 year olds show an increase compared to the year before, but these age groups are still only at the average 1993-1999 level. For 7 year old fish the acoustic abundance index is 60% of the 1993-1999 average. For older fish, the estimates of this Barents Sea survey are considered uncertain due to the spawning migration out of the area, which may vary from year to year.

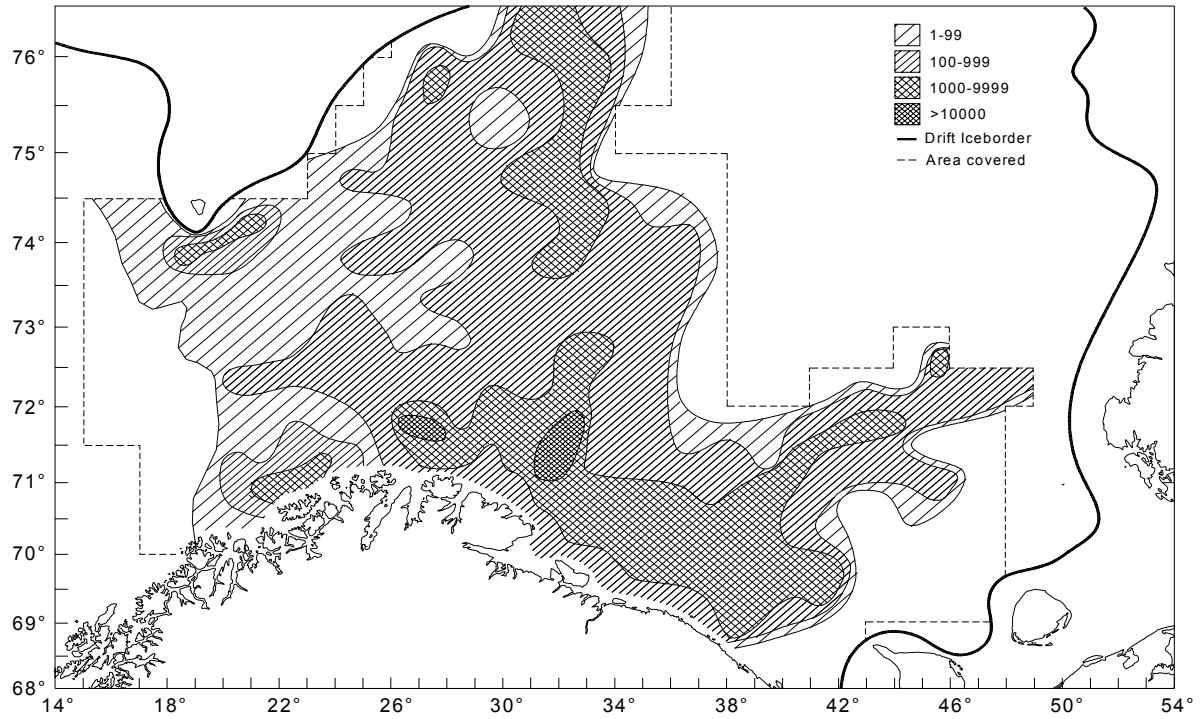

Figure 6.1. 1-GROUP COD. Distribution winter 2000 (echo recordings, no. of fish per square nautical mile).
1-GRUPPE TORSK. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

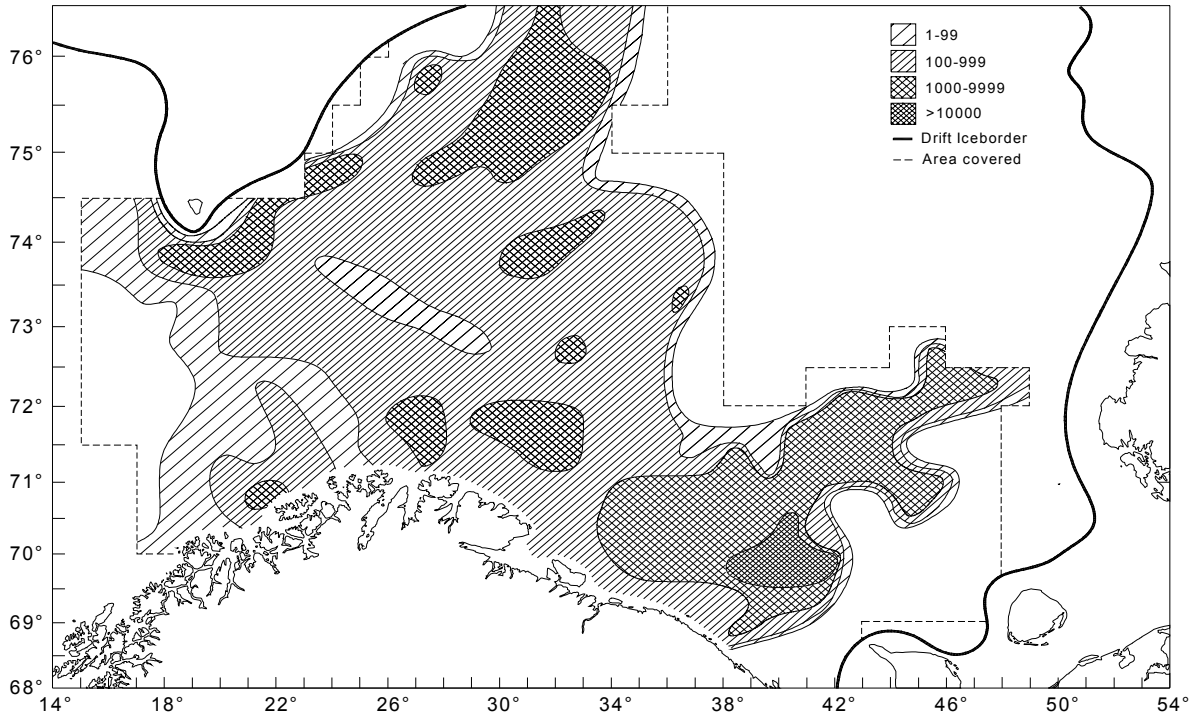

Figure 6.2. 2-GROUP COD. Distribution winter 2000 (echo recordings, no. of fish per square nautical mile).
2-GRUPPE TORSK. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

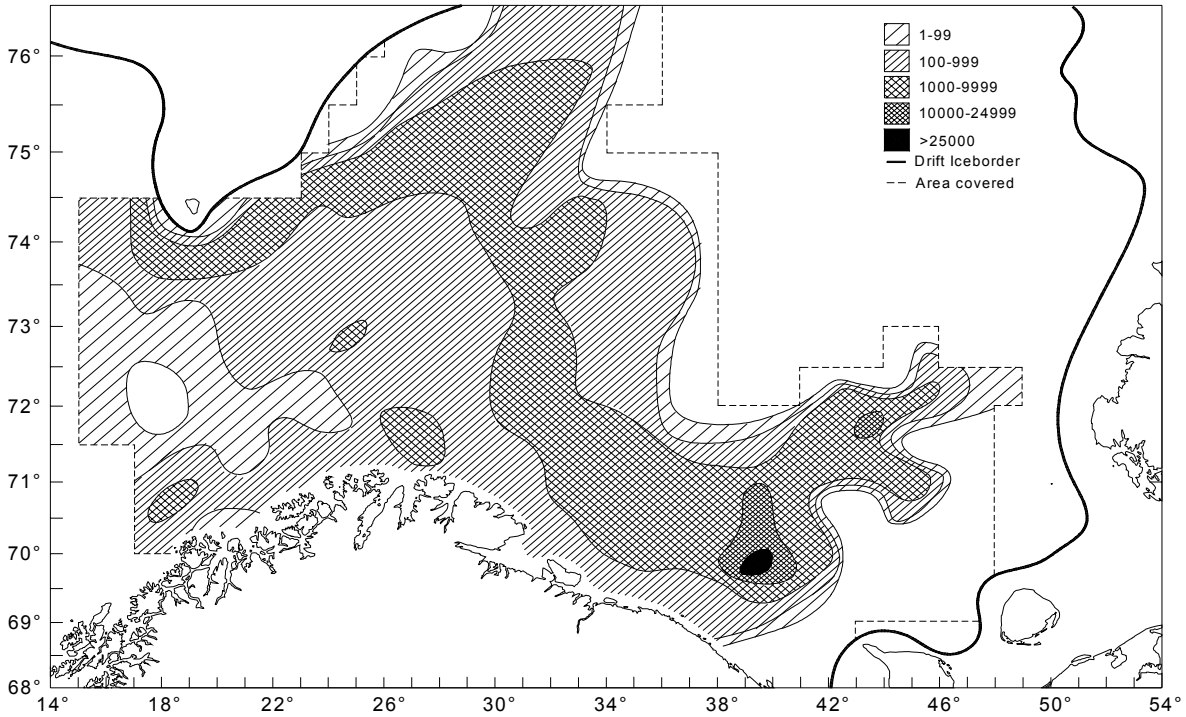

Figure 6.3. 3-GROUP COD. Distribution winter 2000 (echo recordings, no. of fish per square nautical mile).
3-GRUPPE TORSK. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

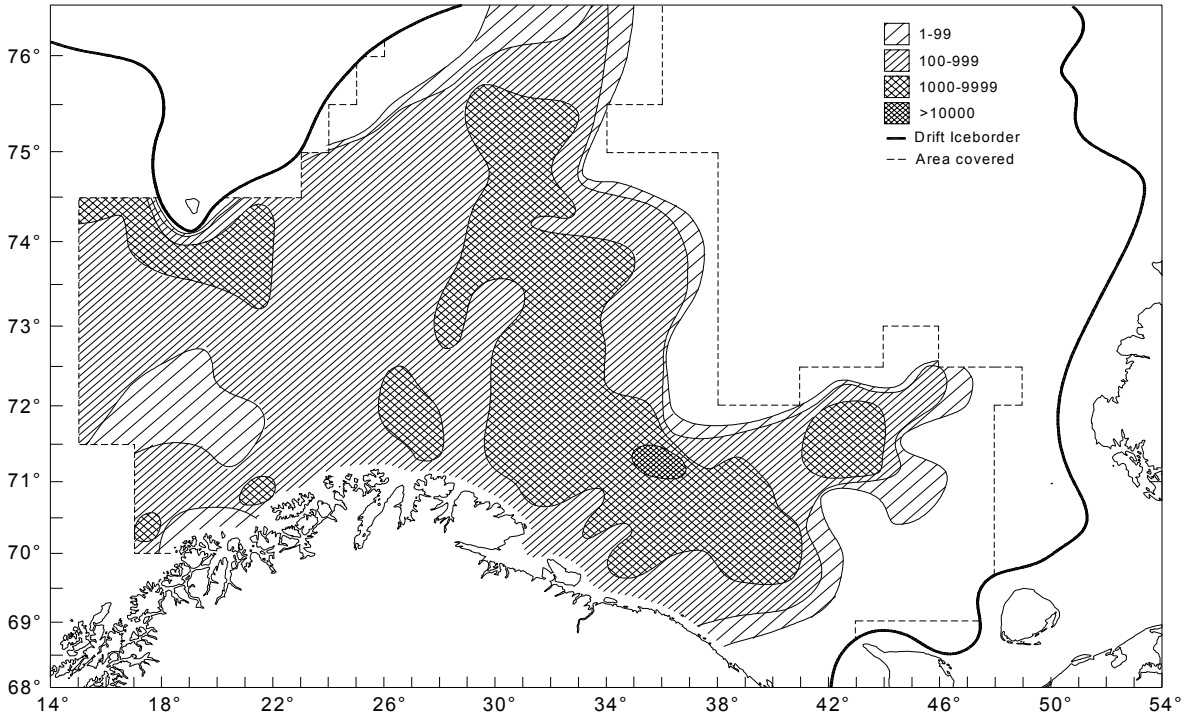

Figure 6.4. 4-GROUP COD. Distribution winter 2000 (echo recordings, no. of fish per square nautical mile).
4-GRUPPE TORSK. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

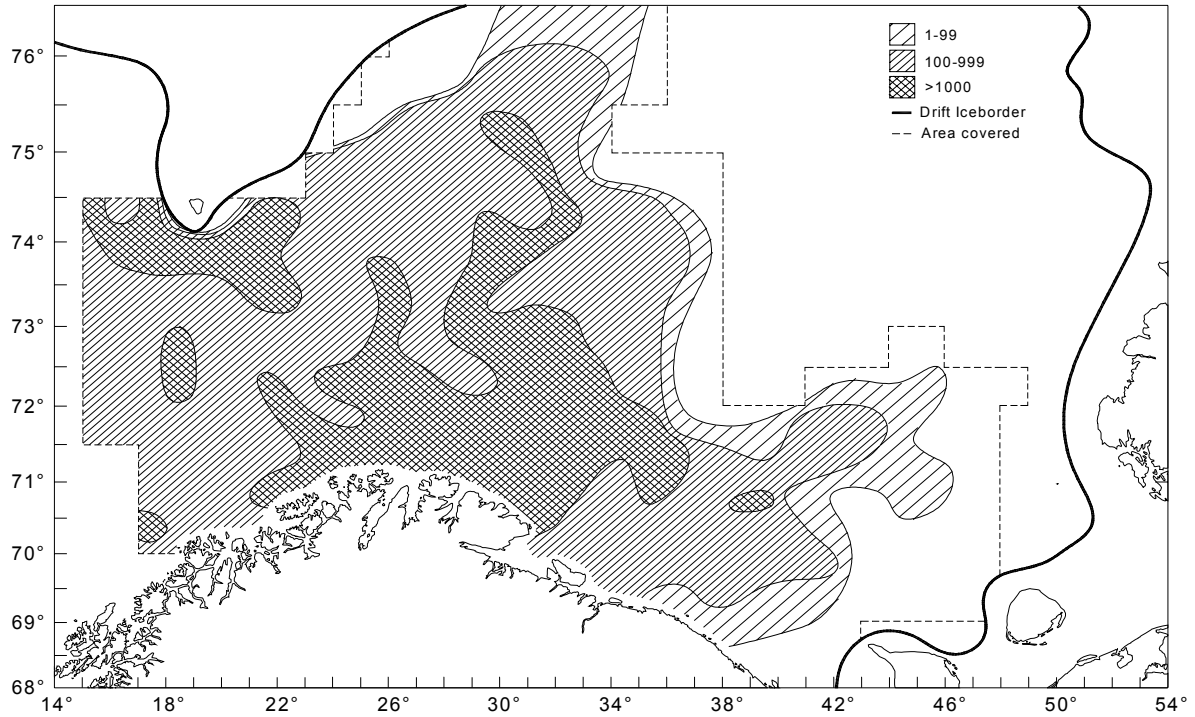

Figure 6.5. 5-GROUP COD. Distribution winter 2000 (echo recordings, no. of fish per square nautical mile).
5-GRUPPE TORSK. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

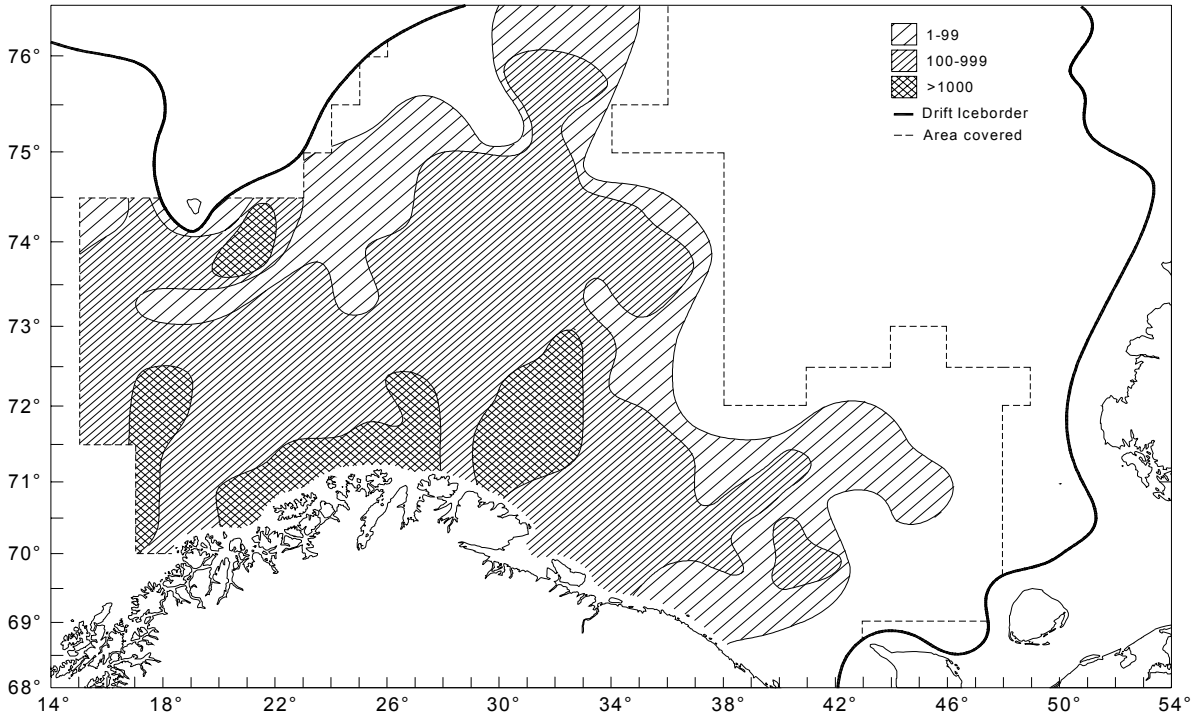

Figure 6.6. 6-GROUP AND OLDER COD. Distribution winter 2000 (echo recordings, no. of fish per square nautical mile).
6-GRUPPE OG ELDRE TORSK. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

Table 6.1. COD. Abundance indices at length and age from the acoustic survey in the Barents Sea winter 2000 (numbers in millions).
TORSK. Mengdeindeksar for lengde- og aldersgrupper frå den akustiske undersøkinga i Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)* cm	Alder (årsklasse) / *Age (year-class)*										Sum
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	
5-9	2.2										2.2
10-14	132.7	2.1									134.8
15-19	19.2	75.9	0.5								95.6
20-24		118.4	33.3								151.6
25-29		24.9	102.5	2.1							129.6
30-34		0.1	85.6	13.5							99.3
35-39			20.7	57.1	1.0						78.9
40-44			2.4	58.0	7.2						67.6
45-49			0.1	23.1	32.6	0.3	0.1				56.1
50-54				3.9	55.1	2.8					61.8
55-59				0.8	34.5	10.7	0.5	0.3		0.2	47.0
60-64				0.4	9.5	17.1	0.3	0.2			27.5
65-69					1.7	11.3	3.5	0.3			16.8
70-74					0.4	2.6	3.2	0.6	+		6.8
75-79						0.6	1.4	1.2	0.3		3.5
80-84						+	0.6	1.2	1.0		2.9
85-89							0.1	0.5	0.9	+	1.5
>90								0.2	0.7	0.9	1.8
Sum	154.1	221.4	245.2	158.9	142.1	45.4	9.6	4.7	3.0	1.1	985.4

Table 6.2. COD. Acoustic abundance indices in the pelagic layer (P) and in the 10 m layer above the bottom (B) for the main areas of the Barents Sea winter 2000 (numbers in millions).
TORSK. Akustiske mengdeindeksar i det pelagiske sjiktet (P) og i 10 m sjiktet over botn (B) for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Omr. *(Area)*	Sjikt *(Layer)*	Alder (årsklasse) / *Age (year-class)*										Total
		1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	
A	P	2.4	2.8	3.7	8.4	18.9	8.1	1.0	0.4	0.2	0.1	46.1
	B	2.3	1.6	1.7	2.2	5.0	2.8	0.4	0.2	0.2	+	16.2
B	P	2.8	1.5	2.5	2.6	7.3	6.0	3.0	1.5	1.1	0.3	28.6
	B	0.9	0.4	1.1	0.7	2.1	2.0	1.1	0.5	0.3	0.1	9.3
C	P	17.8	8.2	4.6	4.1	13.3	4.5	1.0	0.4	0.3	0.1	54.3
	B	1.8	0.9	0.5	0.4	1.4	0.5	0.1	+	+	-	5.6
D	P	71.2	76.9	110.0	78.6	46.2	12.5	2.2	1.1	0.6	0.4	399.6
	B	26.0	35.3	43.9	22.3	10.6	2.7	0.5	0.2	0.1	0.1	141.7
D'	P	3.4	39.1	19.7	1.9	0.4	0.4	+	-	-	-	65.0
	B	5.6	22.1	8.8	0.9	0.3	0.2	+	-	-	-	38.0
E	P	6.3	7.2	8.7	4.5	3.0	1.0	0.1	0.1	-	-	30.8
	B	5.4	5.8	5.8	2.3	1.6	0.6	+	+	-	-	21.6
S	P	4.9	14.6	26.0	22.2	24.1	3.1	0.2	0.2	0.1	0.0	95.5
	B	3.3	5.0	8.3	7.7	7.9	1.0	0.1	+	+	0.0	33.2
ABCD	P	94.2	89.2	120.8	93.7	85.6	31.1	7.1	3.4	2.2	0.9	528.6
	B	31.0	38.1	47.1	25.6	19.1	8.0	2.0	1.0	0.6	0.2	172.8
Total	P	108.8	150.4	175.2	122.4	113.2	35.6	7.4	3.6	2.4	0.9	719.8
	B	45.3	71.0	69.9	36.5	28.9	9.8	2.1	1.0	0.6	0.2	265.5
	Sum	154.1	221.4	245.1	158.9	142.1	45.4	9.6	4.7	3.0	1.1	985.4

Table 6.3. COD. Abundance indices from acoustic surveys in the Barents Sea winter 1981-2000 (numbers in millions). 1981-1992 includes mainly areas A, B C and D.
TORSK. Mengdeindeksar frå akustiske undersøkingar i Barentshavet vinteren 1981-2000 (talet på fisk i millionar). 1981-1992 inkluderer i hovudsak områda A, B, C og D.

År	Alder (*Age)*										
(Year)	1	2	3	4	5	6	7	8	9	10+	Total
1981	8.0	82.0	40.0	63.0	106.0	103.0	16.0	3.0	1.0	1.0	423.0
1982	4.0	5.0	49.0	43.0	40.0	26.0	28.0	2.0	+	0.0	197.0
1983	60.5	2.8	5.3	14.3	17.4	11.1	5.6	3.0	0.5	0.1	120.5
1984	745.4	146.1	39.1	13.6	11.3	7.4	2.8	0.2	0.0	0.0	966.0
1985	69.1	446.3	153.0	141.6	19.7	7.6	3.3	0.2	0.1	0.0	840.9
1986	353.6	243.9	499.6	134.3	65.9	8.3	2.2	0.4	0.1	0.0	1308.2
1987	1.6	34.1	62.8	204.9	41.4	10.4	1.2	0.2	0.7	0.0	357.3
1988	2.0	26.3	50.4	35.5	56.2	6.5	1.4	0.2	0.0	0.0	178.4
1989	7.5	8.0	17.0	34.4	21.4	53.8	6.9	1.0	0.1	0.1	150.1
1990	81.1	24.9	14.8	20.6	26.1	24.3	39.8	2.4	0.1	0.0	234.1
1991	181.0	219.5	50.2	34.6	29.3	28.9	16.9	17.3	0.9	0.0	578.7
1992	241.4	562.1	176.5	65.8	18.8	13.2	7.6	4.5	2.8	0.2	1092.9
1993	1074.0	494.7	357.2	191.1	108.2	20.8	8.1	5.0	2.3	2.5	2264.0
1994	858.3	577.2	349.8	404.5	193.7	63.6	12.1	3.7	1.7	0.9	2465.4
1995	2619.2	292.9	166.2	159.8	210.1	68.8	16.7	2.1	0.7	1.0	3537.4
1996	2396.0	339.8	92.9	70.5	85.8	74.7	20.6	2.8	0.3	0.4	3083.8
1997[1]	1623.5	430.5	188.3	51.7	49.3	37.2	22.3	4.0	0.7	0.1	2407.5
1998[1]	3401.3	632.9	427.7	182.6	42.3	33.5	26.9	13.6	1.7	0.3	4762.8
1999	358.3	304.3	150.0	96.4	45.1	10.3	6.4	4.1	0.8	0.3	976.0
2000	154.1	221.4	245.2	158.9	142.1	45.4	9.6	4.7	3.0	1.1	985.4

1) Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

6.2 Swept area estimation

Figs. 6.7-6.10 show the geographic distribution of cod < 20 cm, 20-34 cm, 35-49 cm and > 50 cm (number of fish per 3 mile) from the swept area investigation. As in 1999 and previous years the greatest concentrations of the smallest cod were found in the eastern part of the survey area within the Russian EEZ.

Also the biggest catches of 20-34 cm cod were done in this eastern area, whereas the highest catch rates of 35-49 cm cod were done in the northwestern part of the area around Bear Island. Bigger cod were only caught in small numbers with no dense registrations. South of Bear Island and close to the coast of northern Norway were the most important fields for these cod sizes.

Table 6.4 presents the abundance indices by length groups for each main area. Standard error and coefficient of variation (CV) are also given. Age-length distribution of the total swept area index as well as the distribution of the index by main area and age is given in tables 6.5 and 6.6, respectively.

The time series (1981-2000) is shown in table 6.7. The indices for 1997 and 1998 are adjusted the same way as the acoustic indices to also represent the Russian EEZ. The results on 1- and 2-year olds confirm the acoustic results, and show that the abundance of these age groups is the lowest observed since the survey area was extended in 1993, 4% (!) and 41% of the 1993-1999 average, respectively. The indices for age groups 3-6 are just below the 1993-1999 average, while for ages 7 and older the indices are the lowest observed since 1990.

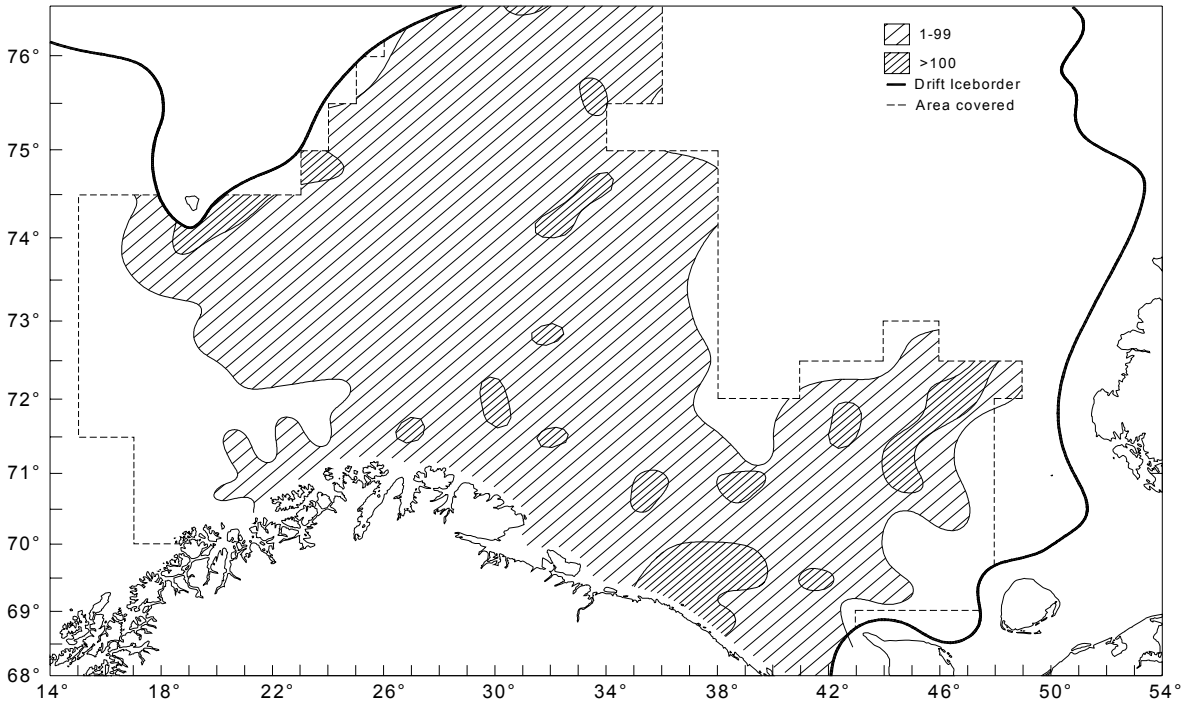

Figure 6.7. COD < 20 cm. Distribution in the trawl catches winter 2000(number per hour trawling).
TORSK < 20 cm. Fordeling i trålfangstane vinteren 2000(talet på fisk pr. tråltime).

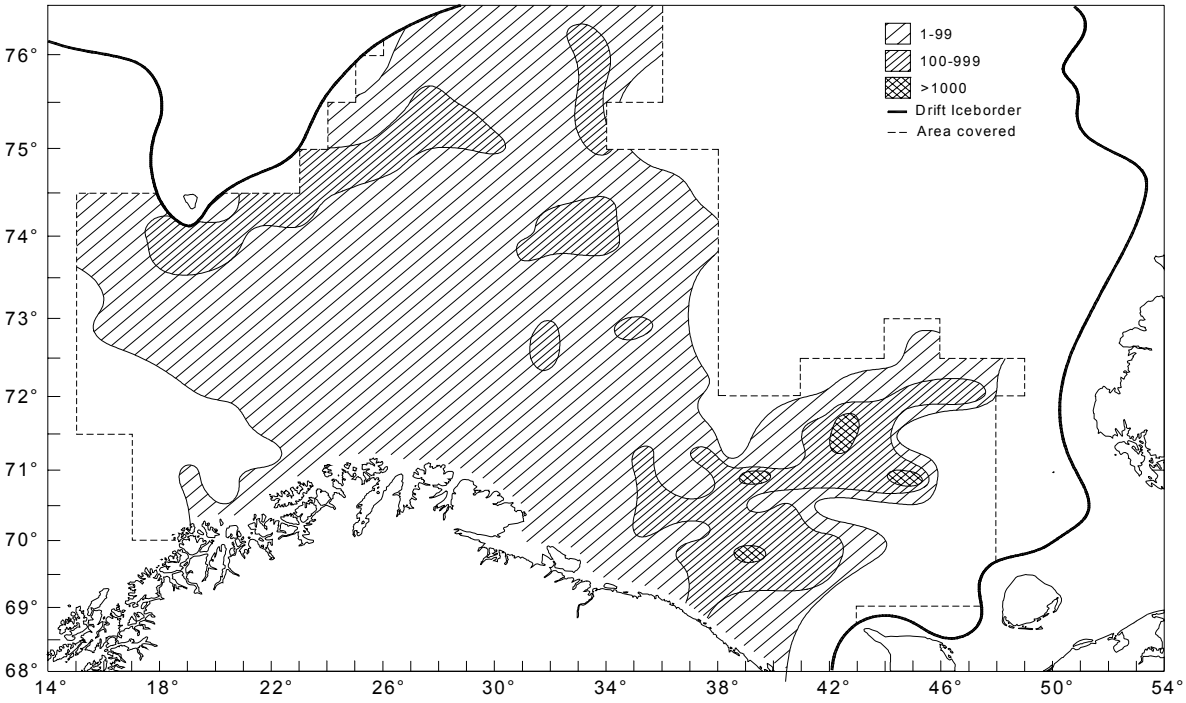

Figure 6.8. COD 20-34 cm. Distribution in the trawl catches winter 2000(number per hour trawling).
TORSK 20-34 cm. Fordeling i trålfangstane vinteren 2000(talet på fisk pr. tråltime).

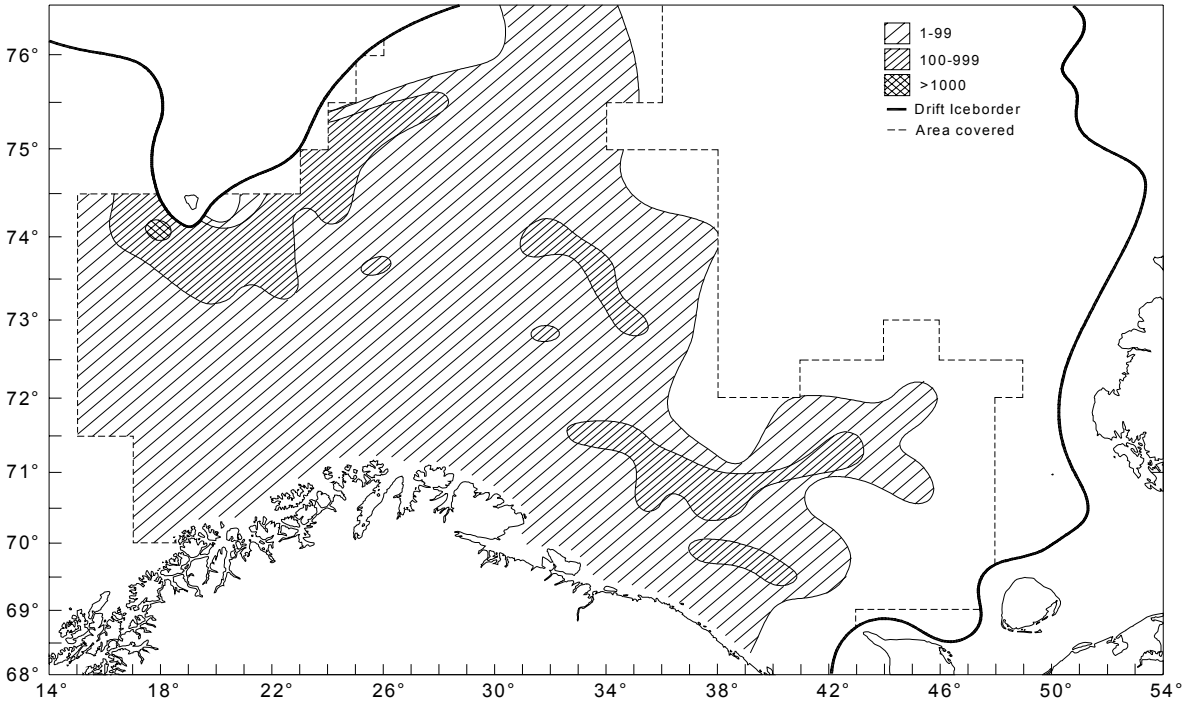

Figure 6.9. COD 35-49 cm. Distribution in the trawl catches winter 2000(number per hour trawling).
TORSK 35-49 cm. Fordeling i trålfangstane vinteren 2000(talet på fisk pr. tråltime).

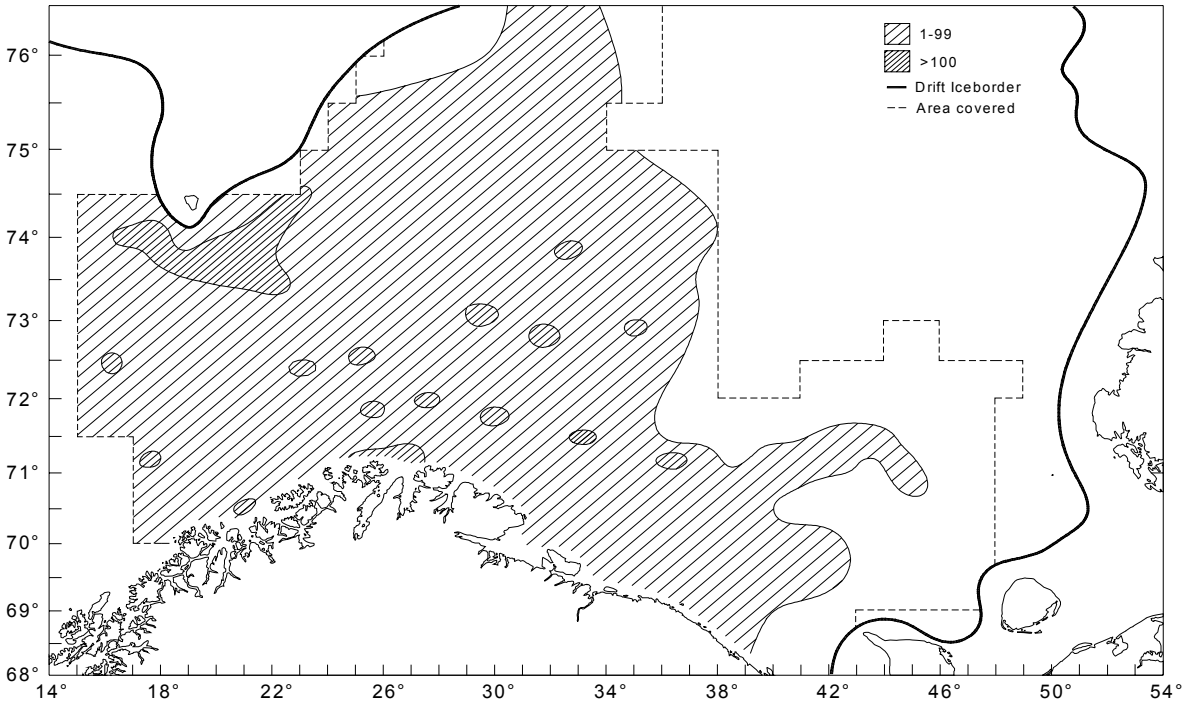

Figure 6.10. COD > 50 cm. Distribution in the trawl catches winter 2000(number per hour trawling).
TORSK > 50 cm. Fordeling i trålfangstane vinteren 2000(talet på fisk pr. tråltime).

Table 6.4. COD. Abundance indices (I) at length with standard error of mean (S) from bottom trawl hauls for main areas of the Barents Sea winter 2000 (no. in millions).
TORSK. Mengdeindeksar (I) for lengdegrupper med standard feil (S) frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet fisk i millionar)

Lengde *(Length)*	Område *(Area)*																
	A		B		C		D		D'		E		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	+	+	0.1	+	+	+	1.1	0.4	0.6	0.3	0.1	0.1	1.6	1.2	3.5	1.3	38.5
10-14	9.4	3.1	0.8	0.3	5.2	2.5	54.9	5.5	6.2	1.5	17.3	6.4	15.1	6.8	109.0	11.6	10.7
15-19	3.8	0.7	0.2	0.1	2.5	1.2	38.7	5.0	26.3	11.4	11.4	4.4	15.2	4.7	98.2	14.1	14.3
20-24	4.3	0.7	0.1	0.1	1.3	0.6	66.7	11.4	64.8	27.3	12.3	3.2	32.6	8.9	182.0	31.1	17.1
25-29	2.7	0.5	0.1	0.1	0.7	0.3	64.1	12.4	26.0	12.1	10.1	2.7	28.0	6.5	131.7	18.7	14.2
30-34	3.1	0.5	0.3	0.1	0.6	0.2	46.8	8.8	11.1	7.6	5.2	1.5	18.6	3.0	85.7	12.1	14.1
35-39	3.9	0.6	0.3	0.1	0.7	0.3	33.8	5.9	4.3	2.9	3.4	1.1	21.6	4.3	67.9	8.0	11.7
40-44	4.0	0.5	0.3	0.1	0.8	0.3	25.5	3.8	1.2	0.6	2.2	0.7	21.2	4.3	55.2	5.8	10.6
45-49	6.2	0.8	0.3	0.1	1.1	0.3	16.0	2.0	0.8	0.4	1.9	0.7	19.8	4.0	46.2	4.6	9.9
50-54	9.3	1.0	1.2	0.2	1.8	0.4	11.5	1.2	0.4	0.2	2.0	0.6	20.1	3.7	46.2	4.1	8.9
55-59	7.8	0.8	1.7	0.4	2.1	0.4	7.4	0.8	0.3	0.1	1.7	0.6	10.0	2.2	31.1	2.6	8.2
60-64	4.2	0.4	1.5	0.4	1.5	0.5	4.0	0.4	0.1	0.1	0.7	0.2	4.0	0.9	15.9	1.2	7.6
65-69	2.4	0.3	1.6	0.4	0.7	0.2	1.8	0.2	0.1	0.1	0.3	0.1	1.0	0.3	7.8	0.7	8.4
70-74	1.1	0.2	0.7	0.2	0.3	0.1	0.6	0.1	0.1	0.1	0.2	0.1	0.4	0.1	3.3	0.4	11.3
75-79	0.4	0.1	0.6	0.2	0.2	0.1	0.4	0.1	+	+	+	+	0.1	0.1	1.7	0.3	14.7
80-84	0.3	0.1	0.4	0.1	0.1	0.1	0.2	0.1	+	+	+	+	0.2	0.1	1.1	0.2	18.4
85-89	0.2	0.1	0.3	0.1	+	+	0.1	+	+	+	+	+	+	+	0.6	0.1	20.5
>90	0.1	0.1	0.1	0.1	0.1	+	0.2	0.1	+	+	+	+	0.1	0.1	0.6	0.2	41.4
Sum	63.3	3.7	10.4	0.9	19.5	3.0	373.7	21.7	142.4	33.1	68.8	9.1	209.4	16.5	887.5	44.1	5.0

Table 6.5. COD. Abundance indices at length and age from the bottom trawl survey in the Barents Sea winter 2000 (numbers in millions).
TORSK. Mengdeindeksar for lengde- og aldersgrupper frå botntrålundersøkinga i Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)* (cm)	Alder (årsklasse) / *Age (year-class)*										Sum
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	
5-9	3.5										3.5
10-14	106.9	2.0									109.0
15-19	18.4	78.9	0.9								98.2
20-24		143.9	38.2								182.0
25-29		23.4	105.3	3.0							131.7
30-34		+	72.9	12.7							85.7
35-39			16.7	50.1	1.2						67.9
40-44			1.2	47.1	6.8						55.2
45-49			+	16.5	29.4	0.3	+				46.2
50-54				2.0	42.7	1.5					46.2
55-59				0.7	22.5	7.6	0.2	0.1		0.1	31.1
60-64				0.1	4.9	10.6	0.1	0.1			15.9
65-69					0.7	5.3	1.5	0.3			7.8
70-74					0.1	1.3	1.6	0.3	+		3.3
75-79						0.3	0.7	0.6	0.2		1.7
80-84						+	0.2	0.4	0.5		1.1
85-89							+	0.2	0.3	0.1	0.6
>90								0.1	0.2	0.3	0.6
Sum	128.8	248.3	235.2	132.1	108.3	26.9	4.3	2.0	1.2	0.4	887.5

Table 6.6. *COD. Abundance indices from bottom trawl hauls for main areas of the Barents Sea winter 2000 (numbers in millions.)*
TORSK. Mengdeindeksar frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Omr. *(Area)*	Alder (årsklasse) / *Age (year-class)*										
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	Total
A	10.1	6.8	7.3	10.1	19.2	7.7	1.1	0.5	0.3	0.1	63.3
B	0.9	0.4	0.9	1.0	2.8	2.3	1.2	0.6	0.4	0.1	10.4
C	6.1	2.9	1.6	1.5	5.3	1.7	0.3	0.1	0.1	+	19.5
D	62.8	92.5	117.3	64.4	28.1	6.7	1.2	0.4	0.2	0.1	373.7
D'	9.9	94.6	34.5	2.1	0.6	0.6	0.1	-	-	-	142.4
E	22.6	17.5	16.3	6.2	4.3	1.6	0.1	0.1	-	-	68.8
S	16.4	33.5	57.3	46.9	48.0	6.4	0.4	0.3	+	+	209.4
ABCD	79.9	102.6	127.1	77.0	55.4	18.4	3.8	1.6	1.0	0.3	466.6
Total	128.8	248.3	235.2	132.1	108.3	26.9	4.3	2.0	0.4	0.4	887.5

Table 6.7. COD. Abundance indices from bottom trawl surveys in the Barents Sea winter 1981-2000 (numbers in millions). 1981-1992 includes only main areas A, B, C and D).
TORSK. Mengdeindeksar frå botntrålundersøkingar i Barentshavet vinteren 1981-2000 (talet på fisk i millionar). 1981-1992 inkluderer berre hovudområda A, B, C og D.

År	Alder (*Age)*										
(Year)	1	2	3	4	5	6	7	8	9	10+	Total
1981	4.6	34.3	16.4	23.3	40.0	38.4	4.8	1.0	0.3	0.0	163.1
1982	0.8	2.9	28.3	27.7	23.6	15.5	16.0	1.4	0.2	0.0	116.4
1983	152.9	13.4	25.0	52.3	43.3	17.0	5.8	3.2	1.0	0.1	313.9
1984	2755.0	379.1	97.5	28.3	21.4	11.7	4.1	0.4	0.1	0.1	3297.7
1985	49.5	660.0	166.8	126.0	19.9	7.7	3.3	0.2	0.1	0.1	1033.6
1986	665.8	399.6	805.0	143.9	64.1	8.3	1.9	0.3	0.0	0.0	2089.1
1987	30.7	445.0	240.4	391.1	54.3	15.7	2.0	0.5	0.0	0.0	1179.8
1988	3.2	72.8	148.0	80.5	173.3	20.5	3.6	0.5	0.0	0.0	502.5
1989	8.2	15.6	46.4	75.9	37.8	90.2	9.8	0.9	0.1	0.1	285.0
1990	207.2	56.7	28.4	34.9	34.6	20.6	27.2	1.6	0.4	0.0	411.5
1991	460.5	220.1	45.9	33.7	25.7	21.5	12.2	12.7	0.6	0.0	832.7
1992	126.6	570.9	158.3	57.7	17.8	12.8	7.7	4.3	2.7	0.2	959.0
1993	534.5	420.4	273.9	140.1	72.5	15.8	6.2	3.9	2.2	2.4	1471.9
1994	1035.9	535.8	296.5	310.2	147.4	50.6	9.3	2.4	1.6	1.3	2391.0
1995	5253.1	541.5	274.6	241.4	255.9	76.7	18.5	2.4	0.8	1.1	6666.2
1996	5768.5	707.6	170.0	115.4	137.2	106.1	24.0	2.9	0.4	0.5	7032.5
1997[1]	4815.5	1045.1	238.0	64.0	70.4	52.7	28.3	5.7	0.9	0.5	6321.1
1998[1]	2418.5	643.7	396.0	181.3	36.5	25.9	17.8	8.6	1.0	0.5	3729.8
1999	484.6	340.1	211.8	173.2	58.1	13.4	6.5	5.1	1.2	0.4	1294.4
2000	128.8	248.3	235.2	132.1	108.3	26.9	4.3	2.0	1.2	0.4	887.5

[1)] Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

6.3 Growth

Table 6.8 and 6.10 show length and weight by age for each main area. For ages 3 and older, the smallest and lightest fish are observed furthest to the north and east (area D, D', E and S), while for ages 1 and 2 the picture is nearly the opposite. In some areas and for the oldest fish there are few observations and the values are therefore more uncertain.

Tables 6.9 and 6.11 present the time series for mean length (1978-2000) and weight at age (1983-2000) for the entire investigated area. Since the smallest and lightest cod usually are found in the eastern part of the distribution area, the values for 1997 and 1998, when this part was not covered, were adjusted using factors for each age group achieved by interpolating between "1996-total-value/1996-Norwegian EEZ-value" and "1999-total-value/ 1999-Norwegian EEZ-value". Mean length and weight at age 1 and 2 are the highest since 1992,

while for the other age groups the values are still low. Except for the oldest age groups, yearly weight increments were simila to previous year (table 6.12).

Table 6.8. COD. Length (cm) at age in main areas of the Barents Sea winter 2000.
TORSK. Lengde (cm) ved alder i kvart hovudområde av Barentshavet vinteren 2000.

Område *(Area)*	Alder (årsklasse / *Age (year-class)*							
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)
A	12.9	20.0	30.1	42.6	53.0	62.1	71.4	75.3
B	12.6	19.9	35.9	51.5	57.4	64.5	71.0	78.1
C	13.1	19.9	30.7	41.5	55.2	63.5	72.4	77.5
D	12.8	21.0	28.9	39.6	51.2	61.2	68.9	73.6
D'	13.4	21.5	29.2	42.1	52.8	55.3	72.3	-
E	13.5	21.1	28.0	39.5	51.7	61.1	71.2	88.3
S	12.6	19.7	27.8	38.9	50.4	60.7	70.3	71.8
Total	13.0	21.0	28.7	39.7	51.5	61.6	70.5	75.7

Table 6.9. COD. Length (cm) at age in the Barents Sea from the investigations winter 1978 - 2000.
TORSK. Lengde (cm) ved alder i Barentshavet frå undersøkingane vinteren 1978 -2000.

År *(Year)*	Alder (*Age)*							
	1	2	3	4	5	6	7	8
1978	14.2	23.1	32.1	45.9	54.2	64.6	67.6	76.9
1979	12.8	22.9	33.1	40.0	52.3	64.4	74.7	83.0
1980	17.6	24.8	34.2	40.5	52.5	63.5	73.6	83.6
1981	17.0	26.1	35.5	44.7	52.0	61.3	69.6	77.9
1982	14.8	25.8	37.6	46.3	54.7	63.1	70.8	82.9
1983	12.8	27.6	34.8	45.9	54.5	62.7	73.1	78.6
1984	14.2	28.4	35.8	48.6	56.6	66.2	74.1	79.7
1985	16.5	23.7	40.3	48.7	61.3	71.1	81.2	85.7
1986	11.9	21.6	34.4	49.9	59.8	69.4	80.3	93.8
1987	13.9	21.0	31.8	41.3	56.3	66.3	77.6	87.9
1988	15.3	23.3	29.7	38.7	47.6	56.8	71.7	79.4
1989	12.5	25.4	34.7	39.9	46.8	56.2	67.0	83.3
1990	14.4	27.9	39.4	47.1	53.8	60.6	68.2	79.2
1991	13.6	27.2	41.6	51.7	59.5	67.1	72.3	77.6
1992	13.2	23.9	41.3	49.9	60.2	68.4	76.1	82.8
1993	11.3	20.3	35.9	50.8	59.0	68.2	76.8	85.8
1994	12.0	18.3	30.5	44.7	55.4	64.3	73.5	82.4
1995	12.7	18.7	29.9	42.0	54.1	64.1	74.8	80.6
1996	12.6	19.6	28.1	41.0	49.3	61.4	72.2	85.3
1997[1]	11.4	18.8	28.0	40.4	49.9	59.3	69.1	80.6
1998[1]	10.9	17.4	28.7	40.0	50.5	58.9	67.5	76.3
1999	12.1	18.8	29.0	40.6	50.6	59.9	70.3	78.0
2000	13.0	21.0	28.7	39.7	51.5	61.6	70.5	75.7

1) *Adjusted lengths*
Justerte lengder

Table 6.10. COD. Weight (g) at age in main areas of the Barents Sea winter 2000.
TORSK. Vekt (g) ved alder i kvart hovudområde av Barentshavet vinteren 2000.

Område *(Area)*	Alder (årsklasse) / *Age (year-class)*							
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)
A	14	62	237	671	1260	2011	3039	3582
B	15	69	415	1202	1750	2378	3192	4279
C	16	60	245	594	1353	1927	3134	3959
D	16	77	219	557	1176	1944	2755	3504
D'	16	80	212	668	1234	1523	3189	-
E	21	86	206	599	1230	1977	2869	4773
S	15	67	183	513	1113	1882	2787	3261
Total	17	77	210	559	1189	1978	2989	3797

Table 6.11. COD. Weight (g) at age in the Barents Sea from the investigations winter 1983-2000.
TORSK. Vekt (g) ved alder i Barentshavet frå undersøkingane vinteren 1983-2000.

År *(Year)*	Alder *(Age)*							
	1	2	3	4	5	6	7	8
1983	-	190	372	923	1597	2442	3821	4758
1984	23	219	421	1155	1806	2793	3777	4566
1985	-	171	576	1003	2019	3353	5015	6154
1986	-	119	377	997	1623	2926	3838	7385
1987[1]	21	65	230	490	1380	2300	3970	-
1988	24	114	241	492	892	1635	3040	4373
1989	16	158	374	604	947	1535	2582	4906
1990	26	217	580	1009	1435	1977	2829	4435
1991	18	196	805	1364	2067	2806	3557	4502
1992	20	136	619	1118	1912	2792	3933	5127
1993	9	71	415	1179	1743	2742	3977	5758
1994	13	55	259	788	1468	2233	3355	4908
1995	16	54	248	654	1335	2221	3483	4713
1996	15	62	210	636	1063	1999	3344	5514
1997[2]	12	54	213	606	1112	1790	2851	4761
1998[2]	10	47	231	579	1145	1732	2589	3930
1999	13	55	219	604	1161	1865	2981	3991
2000	17	77	210	559	1189	1978	2989	3797

[1] Estimated weights *(Estimerte vekter)*
[2] Adjusted weights *(*Justerte vekter*)*

Table 6.12. COD. Yearly weight increment (g) from the investigations in the Barents Sea winter 1983 - 2000.
TORSK. Årleg tilvekst (g) frå undersøkingane i Barentshavet vinteren 1983 - 2000.

År *(Year)*	Alder *(Age)*						
	1-2	2-3	3-4	4-5	5-6	6-7	7-8
1983-84	-	231	783	883	1196	1335	745
1984-85	148	357	582	864	1547	2222	2377
1985-86	-	206	421	620	907	485	2370
1986-87	-	111	113	383	677	1044	-
1987-88	93	176	262	402	255	740	403
1988-89	134	260	363	455	643	947	1866
1989-90	201	422	635	831	1030	1294	1853
1990-91	170	588	784	1058	1371	1580	1673
1991-92	118	423	313	548	725	1127	1570
1992-93	51	279	560	625	830	1185	1825
1993-94	46	188	373	289	490	613	931
1994-95	41	193	395	547	753	1250	1358
1995-96	46	156	388	409	664	1123	2031
1996-97	39	151	396	476	727	852	1417
1997-98	35	177	366	539	621	799	1079
1998-99	45	172	373	582	720	1249	1402
1999-00	64	155	340	585	817	1124	816

6.4 Considerations and conclusion

When using the abundance indices for stock assessment it is important to be aware of all the technical changes introduced during the time series. Better acoustic equipment after 1990 has increased the quality of the indices for all age groups. The survey area was enlarged in 1993. This led to higher indices, especially for the youngest age groups, and the indices also became more accurate all over. The introduction of more fine meshed cod-ends in 1994 and fish length dependent fishing width of the trawl in the calculations (the time series is adjusted for this) did also lead to (relative) more small fish.

Table 6.13 shows that during the time series 1993 – 1999 there was a clear increase in the total mortality rate (natural + fishing mortality) for all age groups that were covered by the swept area investigations (ages 1-6). For the youngest age groups (ages 1-3) this was caused by increased cannibalism, while for the other age groups it is caused by increased fishing pressure. The total mortality rate for these age groups are well above the mortality estimated in the ICES assessment. The reason for this may be found in the assessment models, changes within the index series, unreported commercial catches and/or discards.

The mortality rates estimated from the 2000 survey results show a decrease in total mortality for all age groups to the lowest level since 1994-1995.

The observed mortality rates in the acoustic investigations have been more variable. This is explained by changes in fish behaviour and how available the fish is for acoustic registration. During the winter survey 1998 the relative abundance of cod in the bottom channel was lower than the years before, and hence the fish were more available for acoustic registration. This led to lower mortality rates of all year classes from 1997 to 1998 in the acoustic series compared with the swept area series. A similar situation is observed in 2000 compared with 1999.

Table 6.13. Total mortality observed for cod during the winter survey in the Barents Sea in 1993-2000.
Total dødsrate for torsk observert under vintertoktet i Barentshavet i perioden 1993-2000.

År *(Year)*	Alder (*Age)*							
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
	Akustiske undersøkingar *(Acoustic investigations)*							
1993-94	0.62	0.35	-0.12	-0.01	0.53	0.55	0.78	1.06
1994-95	1.08	1.24	0.78	0.66	1.03	1.34	1.77	1.65
1995-96	2.04	1.15	0.86	0.62	1.03	1.21	1.80	2.10
1996-97	1.72	0.59	0.59	0.36	0.83	1.21	1.65	1.39
1997-98	0.94	0.01	0.03	0.20	0.39	0.33	0.49	0.85
1998-99	2.41	1.44	1.49	1.40	1.41	1.65	1.88	2.86
1999-00	0.48	0.22	-0.06	-0,39	0.00	0.07	0.33	0.31
	Botntrål-undersøkingar *(Bottomtrawl investigations)*							
1993-94	0.00	0.35	-0.12	-0.05	0.36	0.54	0.94	0.88
1994-95	0.65	0.67	0.21	0.19	0.65	1.00	1.35	1.12
1995-96	2.00	1.16	0.87	0.57	0.88	1.16	1.87	1.84
1996-97	1.71	1.09	0.98	0.49	0.96	1.32	1.44	1.14
1997-98	2.01	0.97	0.27	0.56	1.00	1.09	1.19	1.74
1998-99	1.96	1.11	0.83	1.14	1.00	1.39	1.25	2.00
1999-00	0.70	0.34	0.51	0.46	0.65	1.01	1.18	1.63

7. DISTRIBUTION AND ABUNDANCE OF HADDOCK

7.1 Acoustic estimation

Figs. 7.1 - 7.6 show the distribution of different haddock age groups. As for cod, the echo density map (fig. 5.2) gives a better resolution.
The distribution of the different age groups in 2000 was very similar to the year before. Minor differences are likely to be explained by differences in year class strength (e.g., 1 year olds in 1999 distributed around Bear Island). The 2000 distributions of 1 and 2, 3 and 4, 5 and 6-year-old haddock are pair wise very similar.

Also most of the mature haddock (age 7 and older) are on its spawning migration southwestwards out of the investigated area. The distribution of 1- and 2 year olds showing some dense concentrations and a more northward extension compared with the previous recent years reflects the strength of these year classes and the hydrographical conditions expressed by a tongue of 2°C seawater protruding northwards. The survey managed this year to cover all age groups satisfactorily in north and east.

Table 7.1 shows the acoustic abundance indices by length and age, and table 7.2 presents the indices by age for each channel (pelagic and bottom) within the main areas. More than 90% of the haddock were less than 30 cm. Almost 60% of the haddock were registered in main area D, and this was similar to the year before.

The time series (1981-2000), with adjusted indices for 1997 and 1998, is presented in table 7.3. The indices for 1- and 2 year olds are among the best observed since the strong 1990-year class. If we exclude the strong 1990-year class from the average, the abundance indices in 2000 for older haddock, except 4 year olds, are low and less than 50% of the 1993-1999 average. The age 4 index (1996 year class), however, is slightly above this average.

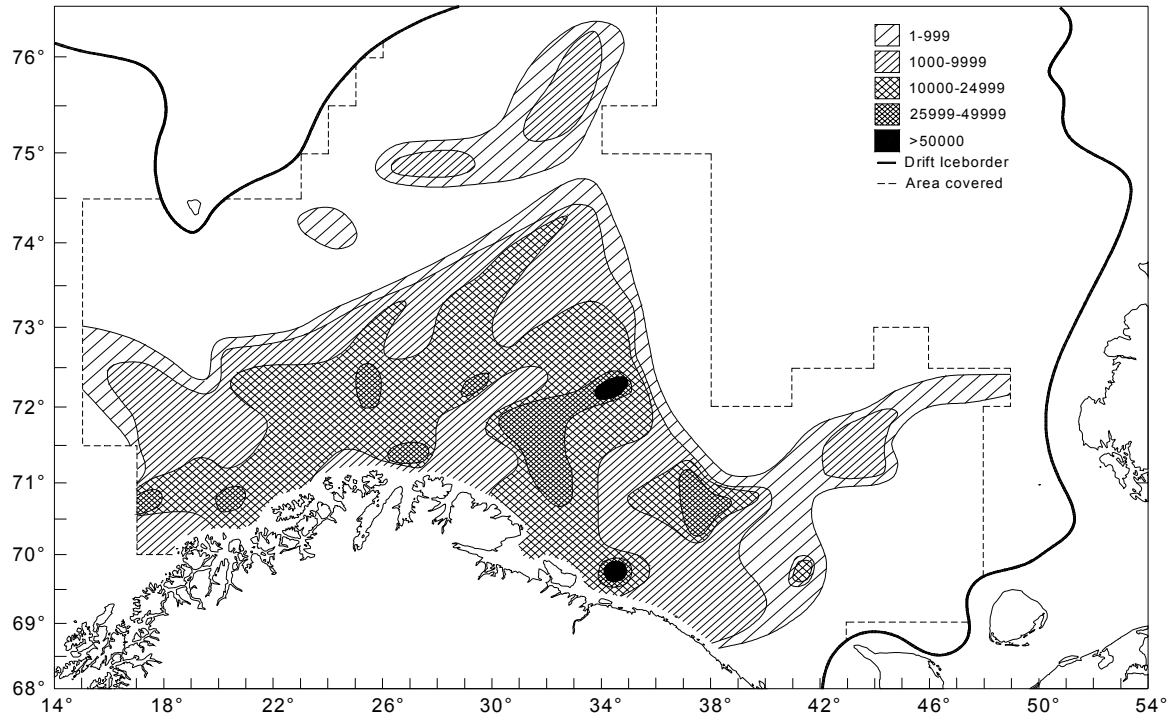

Figure 7.1. 1-GROUP HADDOCK. Distribution winter 2000 (echo recordings, number of fish per square nautical mile).
1-GRUPPE HYSE. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

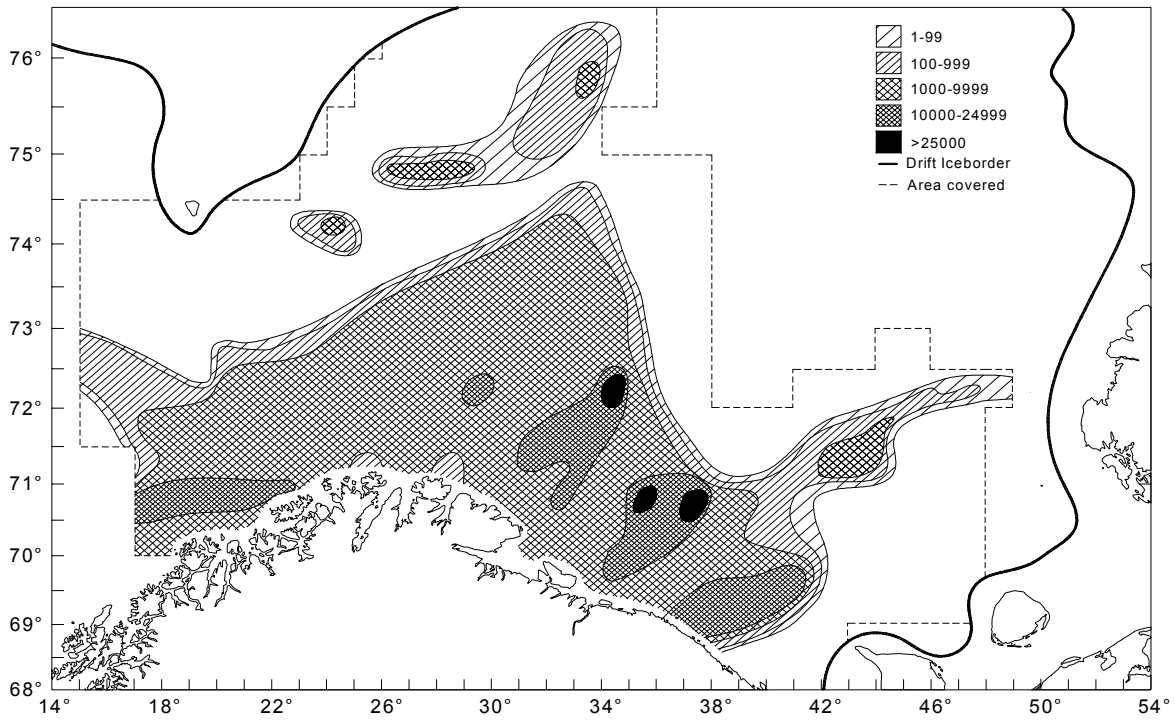

Figure 7.2. 2-GROUP HADDOCK. Distribution winter 2000 (echo recordings, number of fish per square nautical mile).
2-GRUPPE HYSE. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

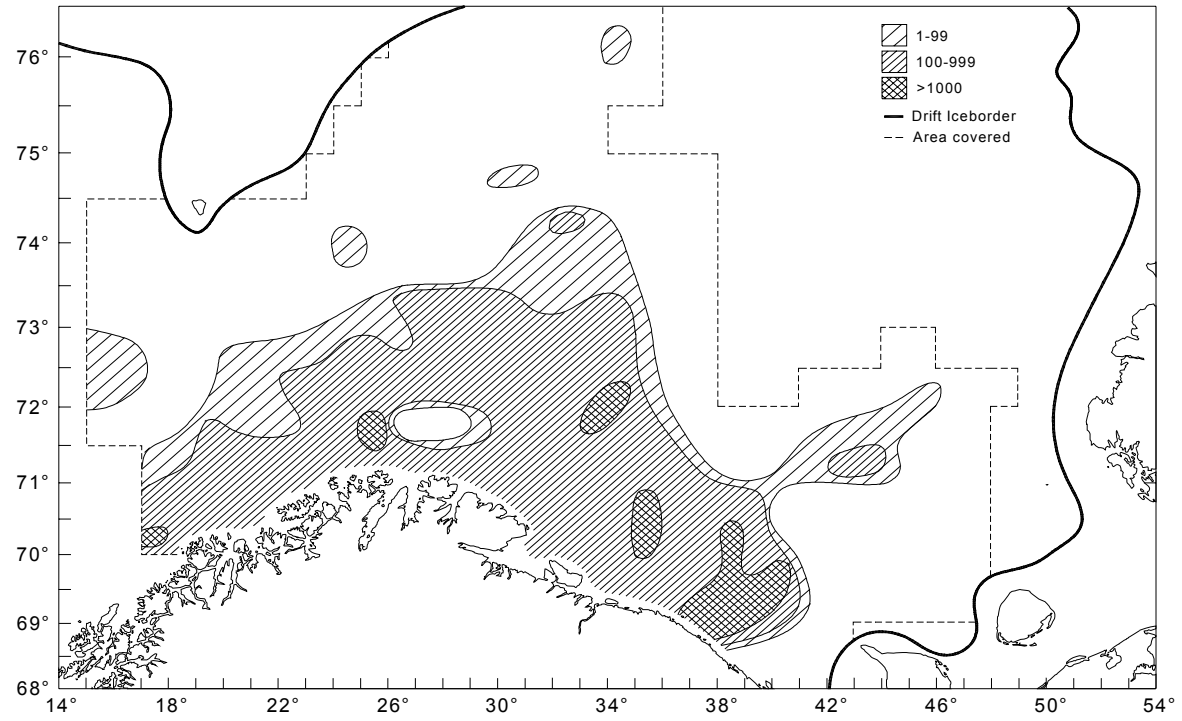

Figure 7.3. 3-GROUP HADDOCK. Distribution winter 2000 (echo recordings, number of fish per square nautical mile).
3-GRUPPE HYSE. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

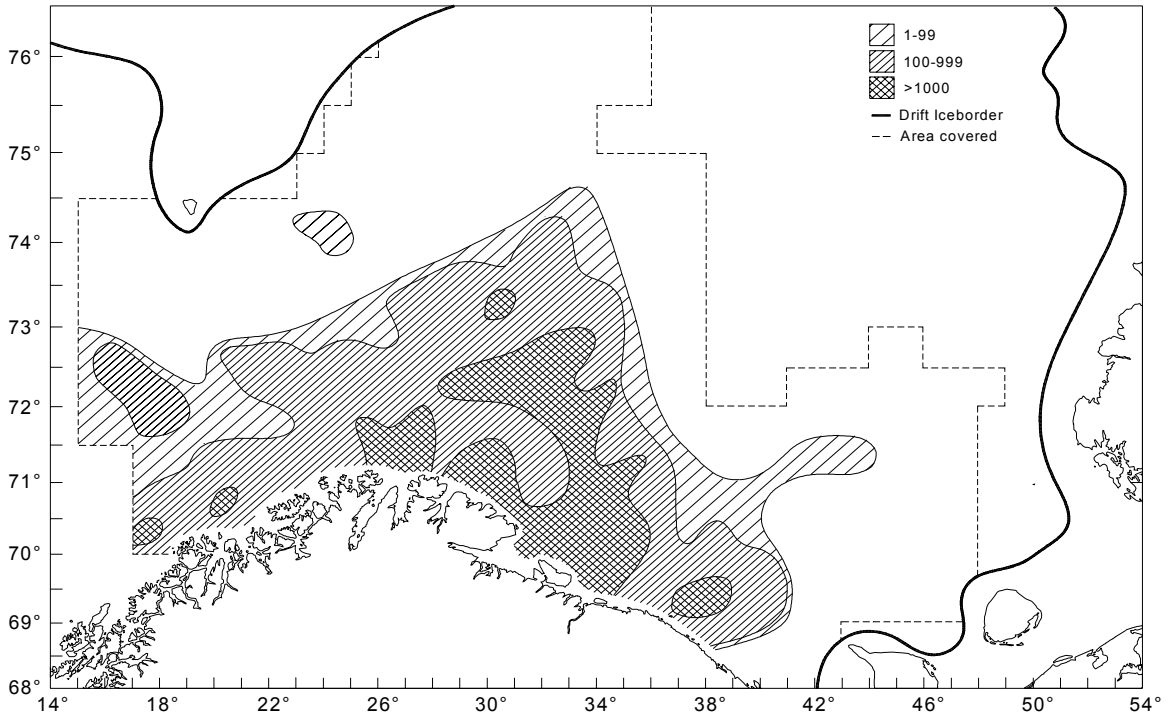

Figure 7.4. 4-GROUP HADDOCK. Distribution winter 2000 (echo recordings, number of fish per square nautical mile).
4-GRUPPE HYSE. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

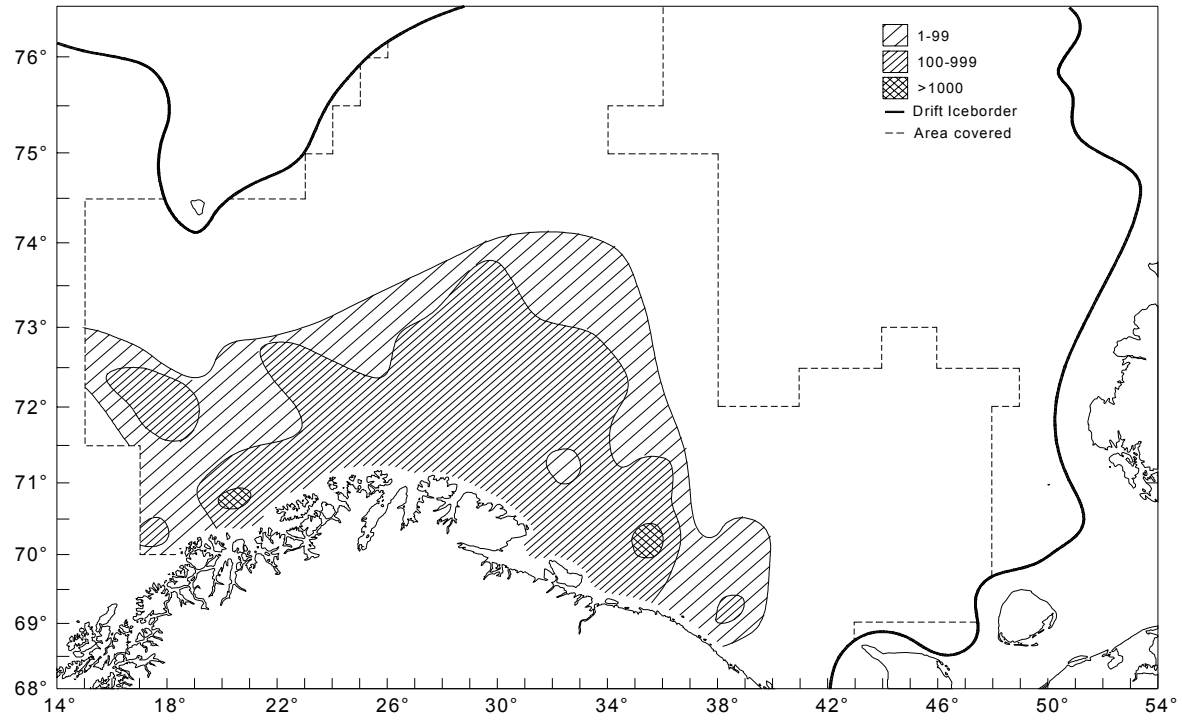

Figure 7.5. *5-GROUP HADDOCK. Distribution winter 2000 (echo recordings, number of fish per square nautical mile).*
5-GRUPPE HYSE. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

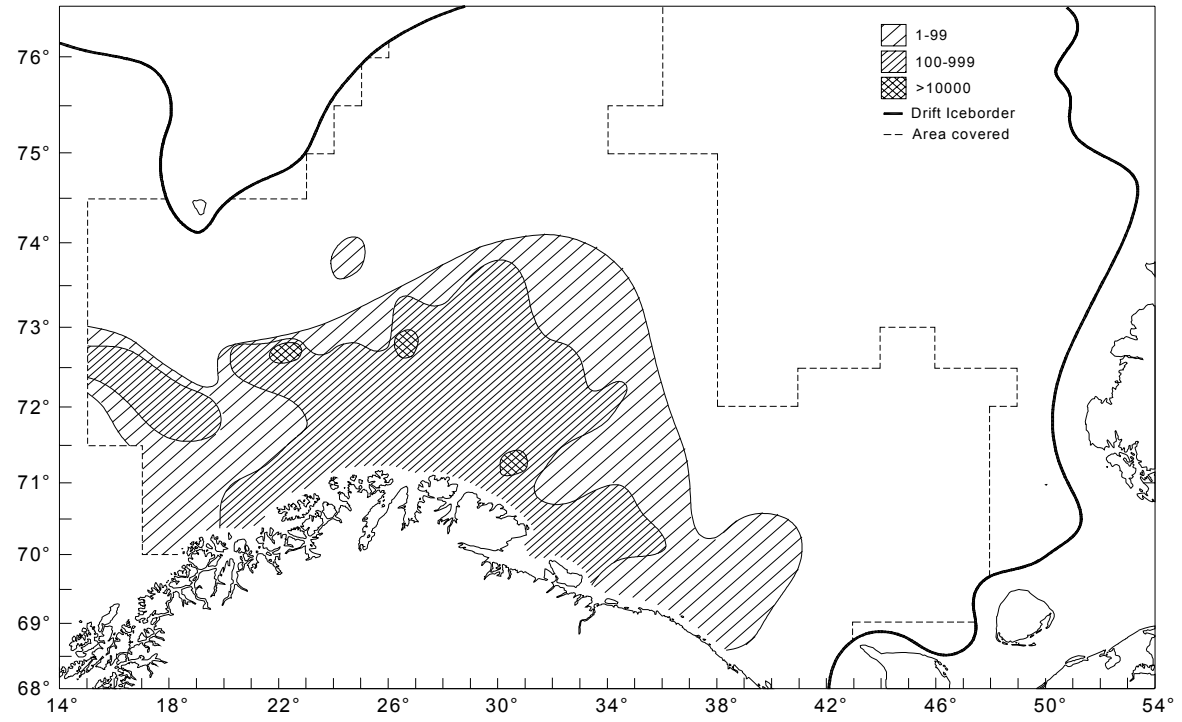

Figure 7.6. 6-GROUP AND OLDER HADDOCK. Distribution winter 2000 (echo recordings, number of fish per square nautical mile).
6-GRUPPE OG ELDRE HYSE. Fordeling vinteren 2000 (ekkoregistreringar, talet på fisk pr. kvadratnautisk mil).

Table 7.1. HADDOCK. Abundance indices at length and age from the acoustic survey in the Barents Sea winter 2000 (numbers in millions).
HYSE. Mengdeindeksar for lengde- og aldersgrupper frå den akustiske undersøkinga i Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)* (cm)	Alder (årsklasse) / *Age (year-class)*										Sum
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	
5-9	0.1										0.1
10-14	242.5										242.5
15-19	780.3	160.0									940.3
20-24	1.6	229.3									230.9
25-29		118.8	14.3	0.2							133.3
30-34		0.8	13.4	2.6							16.8
35-39			4.2	12.7	0.1						17.1
40-44			0.2	31.9	2.2	1.1	0.7	0.1			36.3
45-49				14.7	10.4	2.5					27.6
50-54				2.8	5.0	5.0	0.1		0.2	0.1	13.2
55-59					0.8	1.6	0.5	0.2	0.7	+	3.9
60-64						0.2	0.2	0.2	0.3	0.1	0.9
65-69							+		0.6		0.6
70-74										0.1	0.1
75-79										+	+
80-84											
85-89											
>90											
Sum	1024.4	508.9	32.2	64.9	18.5	10.5	1.6	0.5	1.8	0.4	1663.8

Table 7.2. *HADDOCK. Acoustic abundance indices in the pelagic layer (P) and in the 10 m layer above the bottom (B) for the main areas of the Barents Sea winter 2000 (numbers in millions).*
HYSE. Akustiske mengdeindeksar i det pelagiske sjiktet (P) og i 10 m sjiktet over botn (B) for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Omr. *(Area)*	Sjikt *(Layer)*	Alder (årsklasse) / *Age (year-class)*										Total
		1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	
A	P	152.3	64.1	4.9	13.7	4.8	4.6	0.3	0.1	1.2	0.1	246.3
	B	45.2	15.7	0.7	0.9	0.5	0.5	+	+	0.3	+	63.9
B	P	75.1	43.3	2.7	3.5	1.4	0.3	0.3	0.1	0.1	+	126.8
	B	50.3	26.6	1.2	2.4	1.0	0.2	0.1	0.1	+	0.0	81.8
C	P	67.3	9.7	0.9	4.6	2.8	1.6	0.1	0.2	0.0	0.0	87.3
	B	5.9	1.0	0.1	0.5	0.3	0.2	0.0	0.0	0.0	+	8.0
D	P	489.8	232.0	13.6	29.3	6.1	2.4	0.6	0.0	0.0	0.2	774.0
	B	101.0	85.3	6.3	9.1	1.6	0.5	0.2	0.0	0.0	0.0	204.1
D'	P	6.6	14.1	1.2	0.5	0.0	0.1	0.0	0.0	0.0	0.0	22.5
	B	6.7	8.5	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	16.0
E	P	10.9	2.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	13.3
	B	5.0	1.0	+	+	0.0	0.0	0.0	0.0	0.0	0.0	6.1
S	P	8.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3
	B	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
ABCD	P	784.5	349.1	22.0	51.1	15.1	9.0	1.2	0.4	1.5	0.3	1234.3
	B	202.4	128.5	8.2	12.9	3.4	1.4	0.3	0.1	0.3	+	357.7
Total	P	810.0	370.6	23.3	51.8	15.1	9.0	1.2	0.4	1.5	0.3	1283.4
	B	214.4	138.2	8.8	13.1	3.4	1.4	0.3	0.1	0.3	+	380.3
	Sum	1024.4	508.9	32.1	64.8	18.5	10.4	1.6	0.5	1.8	0.3	1663.7

Table 7.3. HADDOCK. Abundance indices from acoustic surveys in the Barents Sea winter 1981-2000 (numbers in millions). 1981-1992 includes mainly areas A, B, C and D.
HYSE. Mengdeindeksar frå akustiske undersøkingar i Barentshavet vinteren 1981-2000 (talet på fisk i mllionar). 1981-1992 inkluderer i hovudsak områda A, B, C og D.

År	Alder (*Age)*										
(Year)	1	2	3	4	5	6	7	8	9	10+	Total
1981	7	14	5	21	60	18	1	+	+	+	126
1982	9	2	3	4	4	10	6	+	+	+	38
1983	0	5	2	3	1	1	4	2	+	+	18
1984	1685	173	6	2	1	+	+	+	+	+	1867
1985	1530	776	215	5	+	+	+	+	+	+	2526
1986	556	266	452	189	+	+	+	+	+	+	1463
1987	85	17	49	171	50	+	+	+	0	+	372
1988	18	4	8	23	46	7	+	0	0	+	106
1989	52	5	6	11	20	21	2	0	0	0	117
1990	270	35	3	3	4	7	11	2	+	+	335
1991	1890	252	45	8	3	3	3	6	+	0	2210
1992	1135	868	134	23	2	+	+	1	2	+	2165
1993	947	626	563	130	13	+	+	+	+	3	2282
1994	562	193	255	631	111	12	+	+	+	+	1764
1995	1379	285	36	111	387	42	2	+	+	+	2242
1996	249	229	44	31	76	151	8	+	0	+	788
1997[1]	693	24	51	17	12	43	43	2	+	+	885
1998[1]	220	122	20	28	12	5	13	16	1	+	437
1999	856	46	57	13	14	4	1	2	2	+	994
2000	1024	509	32	65	19	11	2	1	2	+	1664

1) Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

7.2 Swept area estimation

Figs. 7.5 - 7.8 show the horizontal distribution of haddock < 20 cm, 20-34 cm, 35-49 cm and > 50 cm (number of haddock per 3 naut. mile) from the swept area investigations. The distribution patterns for the different length groups were very similar to previous years, but with 20-34 cm haddock distributed somewhat further to the north than the year before.

Table 7.4 presents the abundance indices by length groups for each main area. Standard error and coefficient of variation (CV) are also given.

Table 7.5 show the abundance indices by age- and length groups, and table 7.6 presents the indices for each age group by main areas. The time series (1981-2000) is shown in table 7.7. The indices for 1997 and 1998 are adjusted the same way as for cod (as the acoustic indices) to also represent the Russian EEZ.

Also the swept area index show relative high abundance of 1- and 2-year olds, 1 year olds about the 1993-1999 average while the index for 2 year olds (1998 year class) is about twice the average. The 1996 year class which at present contributes most to the coastal fisheries shows only up as 50% of the 1993-1999 average, even if the strong 1990 year class is removed from this average. In the time series this year class therefore turns out relatively stronger when measured acoustically then by the swept area method. The other year classes are weak, estimated to less than 30% of the 1993-1999 average (excl. the 1990 year class).

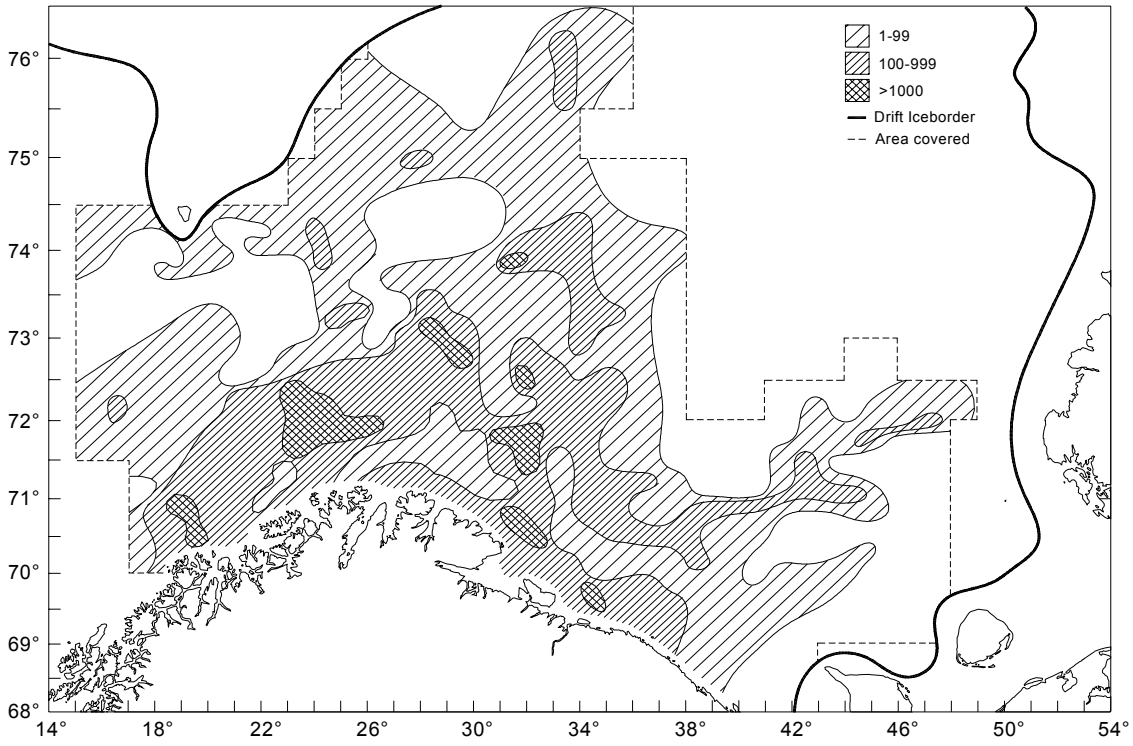

Figure 7.7. HADDOCK < 20 cm. Distribution in the trawl catches winter 2000 (number per hour trawling).
HYSE < 20 cm. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

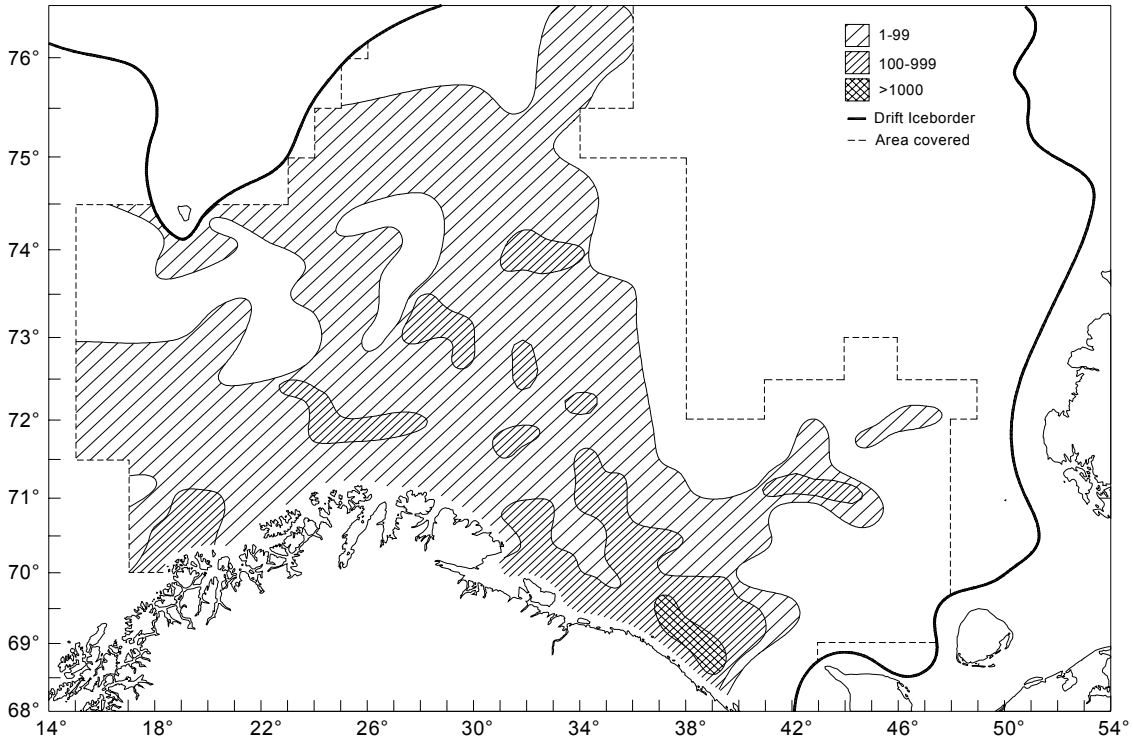

Figure 7.8. HADDOCK 20-34 cm. Distribution in the trawl catches winter 2000 (number per hour trawling).
HYSE 20-34 cm. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

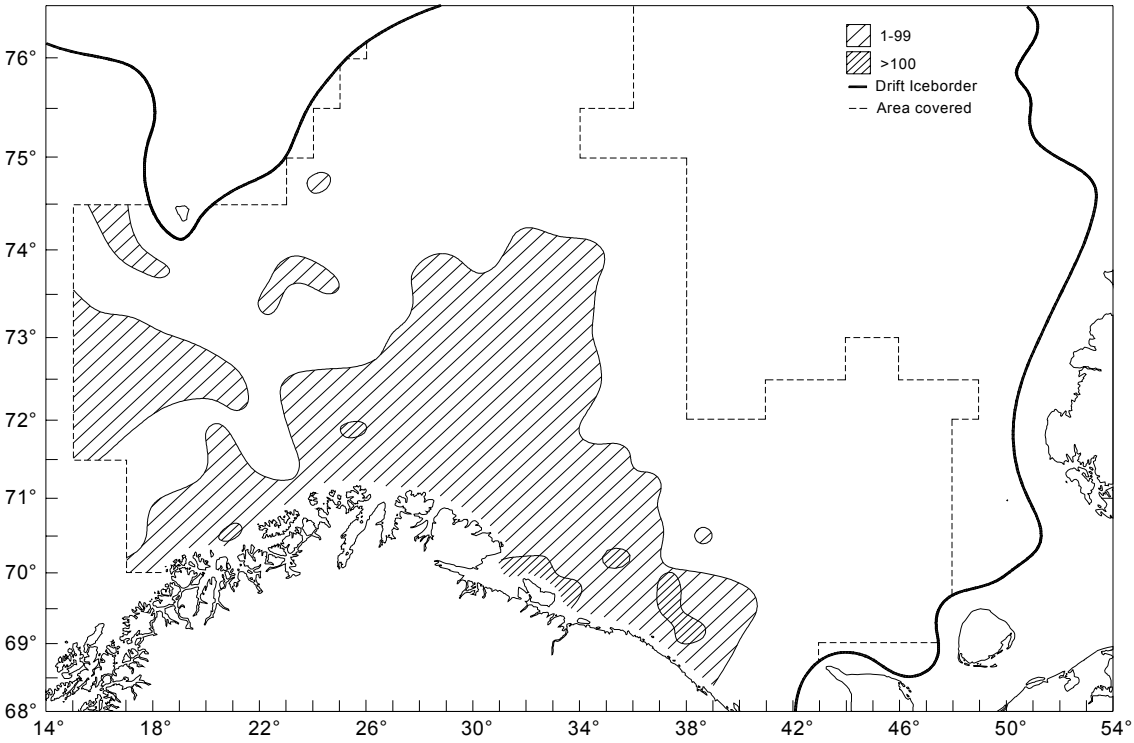

Figure 7.9. *HADDOCK 35-49 cm. Distribution in the trawl catches winter 2000 (number per hour trawling).*
HYSE 35-49 cm. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

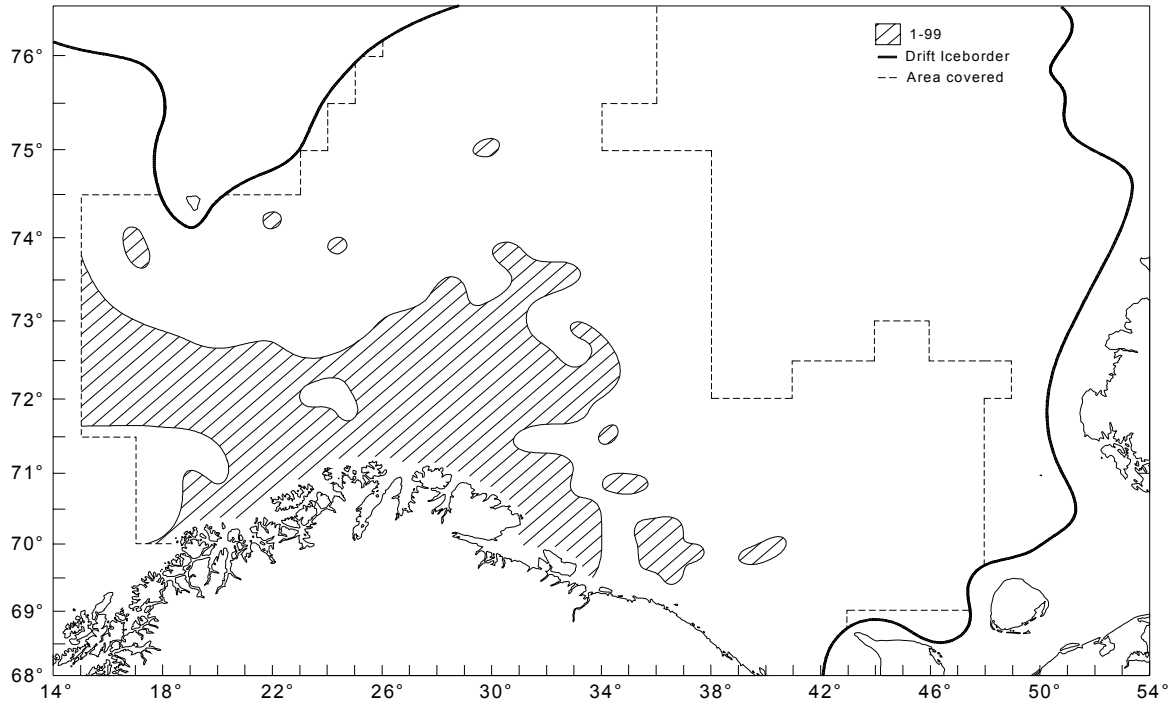

Figure 7.10. HADDOCK > 50 cm. Distribution in the trawl catches winter 2000 (number per hour trawling).
HYSE > 50 cm. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

Table 7.4. *HADDOCK. Abundance indices (I) at length with standard error of mean (S) from bottom trawl hauls for main areas of the Barents Sea winter 2000 (no. in mill). HYSE. Mengdeindeksar (I) for lengdegrupper med standard feil (S) frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet fisk i millionar).*

Lengde *(Length)*	Område *(Area)*																
	A		B		C		D		D'		E		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	0	0	+	+	0	0	0	0	0	0	0	0	0	0	+	+	0
10-14	59.7	13.3	18.5	4.2	6.3	2.6	101.7	14.1	3.1	1.2	8.4	4.5	5.1	2.4	202.9	20.7	100.0
15-19	230.1	39.5	105.8	26.6	35.6	15.0	366.1	49.2	5.9	2.9	26.3	11.4	16.1	5.8	785.9	71.3	10.2
20-24	26.9	4.5	19.7	4.4	4.2	1.4	113.3	15.3	6.8	3.9	5.5	2.8	5.2	1.2	181.5	17.3	9.1
25-29	4.9	1.3	2.0	0.6	0.9	0.3	108.3	18.6	24.8	18.0	0.7	0.5	0.3	0.1	141.9	25.9	9.5
30-34	1.5	0.3	1.8	0.5	0.2	0.1	8.4	2.1	2.0	1.4	0	0	+	+	13.9	2.6	18.3
35-39	1.4	0.3	1.0	0.2	0.3	0.1	7.5	1.1	0.3	0.3	0.1	0.1	+	+	10.6	1.2	18.7
40-44	1.7	0.3	1.0	0.3	0.7	0.2	14.9	2.5	0.2	0.2	0.3	0.3	+	+	18.9	2.6	11.4
45-49	2.4	0.5	1.6	0.5	1.1	0.3	8.5	1.2	+	+	0	0	0.1	0.1	13.7	1.5	13.7
50-54	1.7	0.4	0.8	0.3	0.9	0.2	1.2	0.2	0	0	0	0	0.1	+	4.6	0.6	10.5
55-59	0.9	0.3	0.5	0.1	0.3	0.1	0.2	0.1	+	+	0	0	+	0	1.8	0.3	12.4
60-64	0.4	0.1	0.2	0.1	0.1	0.1	0.1	+	0	0	0	0	0	+	0.7	0.1	16.9
65-69	0.1	+	+	+	+	+	0	0	0	0	0	0	+	0	0.1	+	20.6
70-74	+	+	+	+	0	0	0	0	0	0	0	0	0	0	0.1	+	35.4
75-79	+	+	0	0	0	0	0	0	0	0	0	0	0	0	+	+	79.9
80-84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.0
85-89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	331.6	42.0	152.9	27.3	50.6	15.3	730.1	56.7	43.1	18.7	41.3	12.5	27.0	6.4	1376.5	80.6	5.9

Table 7.5. HADDOCK. Abundance indices at length and age from the bottom trawl survey in the Barents Sea winter 2000 (numbers in millions).
HYSE. Mengdeindeksar for lengde- og aldersgrupper frå botntrålundersøkinga i Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)* (cm)	Alder (årsklasse) / *Age (year-class)*										Sum
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	
5-9	+										+
10-14	202.9										202.9
15-19	643.1	142.9									785.9
20-24	1.2	180.4									181.5
25-29		128.4	13.3	0.1							141.9
30-34		0.6	11.1	2.1							13.9
35-39			2.6	7.9	0.1						10.6
40-44			0.2	16.6	1.2	0.4	0.4	+			18.9
45-49				7.7	4.9	1.1					13.7
50-54				0.9	1.9	1.7	0.1		0.1		4.6
55-59					0.4	0.7	0.3	0.1	0.3	+	1.8
60-64						0.1	0.1	0.1	0.3	+	0.7
65-69							+		0.1	0.1	0.1
70-74										0.1	0.1
75-79										+	+
Sum	847.2	452.2	27.2	35.4	8.4	4.0	0.8	0.3	0.7	0.2	1376.6

Table 7.6 HADDOCK. Abundance indices from bottom trawl hauls for main areas of the Barents Sea winter 2000 (numbers in millions).
. *HYSE. Mengdeindeksar frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).*

Omr. *(Area)*	Alder (årsklasse) / *Age (year-class)*										
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)	9 (91)	10+	Total
A	237.7	81.5	3.8	4.3	1.7	1.7	0.1	0.1	0.6	0.1	331.7
B	91.4	53.4	2.7	3.3	1.4	0.3	0.2	0.1	+	+	152.9
C	42.0	5.1	0.3	1.5	0.9	0.6	+	0.1	0	0	50.6
D	418.8	261.6	18.1	25.3	4.5	1.3	0.4	0	0.1	0.1	730.2
D'	9.0	31.6	2.0	0.5	0	0	0	0	0	0	43.1
E	34.7	6.0	0.2	0.4	0	0	0	0	0	0	41.3
S	13.5	13.1	0.1	0.1	0	0.1	0	0	0	0	26.9
ABCD	790.0	401.5	24.9	34.4	8.4	3.9	0.8	0.3	0.7	0.2	1265.3
Total	847.2	452.2	27.2	35.4	8.4	4.0	0.8	0.3	0.7	0.2	1376.6

Table 7.7. HADDOCK. Abundance indices from bottom trawl surveys in the Barents Sea winter 1981-2000 (numbers in millions). 1981-1992 includes only main areas A, B, C and D.
HYSE. Mengdeindeksar frå botntrålundersøkingar i Barentshavet vinteren 1981-2000 (talet på fisk i millionar). 1981-1992 inkluderer berre hovudområda A, B, C og D.

År	Alder (*Age*)										
(Year)	1	2	3	4	5	6	7	8	9	10+	Total
1981	3.1	7.3	2.3	7.8	1.8	5.3	0.5	0.2	0.0	0.0	163.1
1982	3.9	1.5	1.7	1.8	1.9	4.8	2.4	0.2	0.0	0.0	116.4
1983	2919.3	4.8	3.1	2.4	0.9	1.9	2.5	0.7	0.0	0.0	2935.5
1984	3832.6	514.6	18.9	1.5	0.8	0.2	0.1	0.4	0.1	0.0	4369.2
1985	1901.1	1593.8	475.9	14.7	0.5	0.5	0.1	0.1	0.4	0.3	3987.4
1986	665.0	370.3	384.6	110.8	0.6	0.2	0.1	0.1	0.1	0.1	1531.9
1987	163.8	79.9	154.4	290.2	52.9	0.0	0.0	0.0	0.0	0.3	741.6
1988	35.4	15.3	25.3	68.9	116.4	13.8	0.1	0.0	0.0	0.0	275.0
1989	81.2	9.5	14.1	21.6	34.0	32.7	3.4	0.1	0.0	0.0	196.5
1990	644.1	54.6	4.5	3.4	5.0	9.2	11.8	1.8	0.0	0.0	734.5
1991	2006.0	300.3	33.4	5.1	4.2	2.7	1.7	4.2	0.0	0.0	2357.7
1992	1659.4	1375.5	150.5	24.4	2.1	0.6	0.7	1.6	2.3	0.0	3217.0
1993	727.9	599.0	507.7	105.6	10.5	0.6	0.4	0.3	0.4	1.1	1953.4
1994	603.2	228.0	339.5	436.6	49.7	3.4	0.2	0.1	0.2	0.6	1661.5
1995	1463.6	179.3	53.6	171.1	339.5	34.5	2.8	0.0	0.1	0.0	2244.6
1996	309.5	263.6	52.5	48.1	148.6	252.8	11.6	0.9	0.0	0.1	1087.6
1997[1]	1268.0	67.9	86.1	28.0	19.4	46.7	62.2	3.5	0.1	0.0	1581.8
1998[1]	212.9	137.9	22.7	33.2	13.2	3.4	8.0	8.1	0.7	0.1	440.0
1999	1244.9	57.6	59.8	12.2	10.2	2.8	1.0	1.7	1.1	0.0	1391.4
2000	847.2	452.2	27.2	35.4	8.4	4.0	0.8	0.3	0.7	0.2	1376.6

1) Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

7.3 Growth

Mean length and weight at age for each main area are shown in table 7.8 and 7.10. Few samples from the main areas D', E and S make these results less precise. There is no clear trend towards better growth in the southwestern areas, and for some age groups (e.g., age 2) mean length and weight at age are greatest in the east.

The time series (1983-2000, tables 7.9 and 7.11), with adjusted values for 1997 and 1998, shows an increase in mean length and weight for ages 1 and 2 compared with the year before. For all ages the mean lengths in 2000 are about the long term mean 1983-1999, whereas the mean weights are slightly less. The weight increment for a year class from 1999 to 2000 was for age groups 1-5 similar or slightly greater than the 1983-1999 average (table 7.12).

Table 7.8. HADDOCK. Length (cm) at age in main areas of the Barents Sea winter 2000.
HYSE. Lengde (cm) ved alder i kvart hovudområde av Barentshavet vinteren 2000.

Område *(Area)*	Alder (årsklasse) / *Age (year-class)*							
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)
A	16.0	20.0	28.7	42.4	48.2	51.4	56.3	59.5
B	16.4	20.0	31.2	40.8	50.2	55.0	58.5	48.3
C	16.5	22.6	33.9	45.6	48.8	52.3	62.0	60.4
D	15.6	23.5	30.3	41.4	46.5	48.5	44.1	-
D'	14.8	26.0	32.0	41.1	-	-	-	-
E	15.5	21.0	28.0	40.6	-	-	-	-
S	15.4	20.4	29.2	38.4	-	53.0	-	-
Total	15.8	22.5	30.3	41.6	47.7	50.8	51.1	56.5

Table 7.9. HADDOCK. Length (cm) at age in the Barents Sea from the investigations winter 1983 – 2000.
HYSE. Lengde (cm) ved alder i Barentshavet frå undersøkingane vinteren 1983 – 2000.

År *(Year)*	Alder (*Age)*						
	1	2	3	4	5	6	7
1983	16.8	25.2	34.9	44.7	52.5	58.0	62.4
1984	16.6	27.5	32.7	-	56.6	62.4	61.8
1985	15.7	23.9	35.6	41.9	58.5	61.9	63.9
1986	15.1	22.4	31.5	43.0	54.6	-	-
1987	15.4	22.4	29.2	37.3	46.5	-	-
1988	13.5	24.0	28.7	34.7	41.5	47.9	54.6
1989	16.0	23.2	31.1	36.5	41.7	46.4	52.9
1990	15.7	24.7	32.7	43.4	46.1	50.1	52.4
1991	16.8	24.0	35.7	44.4	52.4	54.8	55.6
1992	15.1	23.9	33.9	45.5	53.1	59.2	60.6
1993	14.5	21.4	31.8	42.4	50.6	56.1	59.4
1994	14.7	21.0	29.7	38.5	47.8	54.2	56.9
1995	15.4	20.1	28.7	34.2	42.8	51.2	55.8
1996	15.4	21.6	28.6	37.8	42.0	46.7	55.3
1997[1]	16.1	21.1	27.7	35.4	39.7	47.5	50.1
1998[1]	14.4	22.9	29.2	35.8	41.3	48.4	50.9
1999	14.7	20.8	32.3	39.4	45.5	52.3	54.6
2000	15.8	22.5	30.3	41.6	47.7	50.8	56.5

[1)] Adjusted lengths
Justerte lengder

Table 7.10. HADDOCK. Weight (g) at age in main areas of the Barents Sea winter 2000.
HYSE. Vekt (g) ved alder i kvart hovudområde av Barentshavet vinteren 2000.

Område *(Area)*	Alder (årsklasse) / *Age (year-class)*							
	1 (99)	2 (98)	3 (97)	4 (96)	5 (95)	6 (94)	7 (93)	8 (92)
A	34	70	220	786	1150	1400	1754	2162
B	34	74	287	724	1250	1684	1930	1320
C	32	94	351	865	1121	1399	2412	2156
D	31	121	273	701	972	1164	949	-
D'	28	169	303	698	-	-	-	-
E	34	88	195	690	-	-	-	-
S	29	79	239	515	-	1600	-	-
Total	32	108	269	720	1068	1341	1430	1910

Table 7.11. *HADDOCK. Weight (g) at age in the Barents Sea from the investigations winter 1983 - 2000.*
HYSE. Vekt (g) ved alder i Barentshavet frå undersøkingane vinteren 1983 - 2000.

År	Alder (*Age*)						
(Year)	1	2	3	4	5	6	7
1983	52	133	480	1043	1641	2081	2592
1984	36	196	289	964	1810	2506	2240
1985	35	138	432	731	1970	2517	-
1986	47	100	310	734	-	-	-
1987[1]	24	91	273	542	934	-	-
1988	23	139	232	442	743	1193	1569
1989	43	125	309	484	731	1012	1399
1990	34	148	346	854	986	1295	1526
1991	41	138	457	880	1539	1726	1808
1992	32	136	392	949	1467	2060	2274
1993	26	93	317	766	1318	1805	2166
1994	25	86	250	545	1041	1569	1784
1995	30	71	224	386	765	1286	1644
1996	30	93	220	551	741	1016	1782
1997[2]	35	88	200	429	625	1063	1286
1998[2]	25	112	241	470	746	1169	1341
1999	27	85	333	614	947	1494	1616
2000	32	108	269	720	1068	1341	1430

[1)] Estimated weights (*Estimerte vekter*)
[2)] Adjusted weights (*Justerte vekter*)

Table 7.12. HADDOCK. Yearly weight increment (g) from the investigations in the Barents Sea winter 1983 - 2000.
HYSE. Årleg tilvekst (g) frå undersøkingane i Barentshavet vinteren 1983 - 2000.

År	Alder (*Age*)					
(Year)	1-2	2-3	3-4	4-5	5-6	6-7
1983-84	144	156	484	767	865	159
1984-85	102	236	442	1006	707	-
1985-86	65	172	302	-	-	-
1986-87	44	173	232	200	-	-
1987-88	115	141	169	201	259	-
1988-89	102	170	252	289	269	206
1989-90	105	221	545	502	564	514
1990-91	104	309	534	685	740	513
1991-92	95	254	492	587	521	548
1992-93	61	181	374	369	338	106
1993-94	60	157	228	275	251	-
1994-95	46	138	136	220	245	75
1995-96	63	149	327	355	251	496
1996-97	58	107	209	74	322	270
1997-98	77	153	270	316	544	277
1998-99	60	221	373	477	748	447
1999-00	81	184	387	464	394	-64

7.4 Conclusion

Both the acoustic and swept area indices (tables 7.3 and 7.7) show a reduction in total mortality for all ages from 1999 to 2000 compared with previous years (table 7.13).

Concerning the abundance indices it can be concluded that the recruitment to the stock is improving. The index for the 1998 year class as 2 year old is among the highest in the time series, and the 1999 year class, measured as 1 year olds, is above average. The indices for the older age groups are, however, very low, with the exception of the 1996 year class which is about 50% of the average. Length- and weight at age, and the growth from 1999 to 2000, are for all ages about the long-term mean 1983-1999.

Table 7.13. Total mortality observed for haddock during the winter survey in the Barents Sea for the period 1993-2000.
Total dødsrate for hyse observert under vintertoktet i Barentshavet for perioden 1993-2000.

År *(Year)*	Alder *(Age)*						
	1-2	2-3	3-4	4-5	5-6	6-7	7-8
	Akustiske undersøkingar *(Acoustic investigations)*						
1993-94	1.59	0.90	-0.11	0.16	0.08	-	-
1994-95	0.68	1.68	0.83	0.49	0.97	1.79	-
1995-96	1.80	1.87	0.15	0.38	0.94	1.66	-
1996-97	2.34	1.50	0.95	0.95	0.57	1.26	1.39
1997-98	1.74	0.18	0.60	0.35	0.88	1.20	0.99
1998-99	1.59	0.76	0.43	0.69	1.39	1.61	2.56
1999-00	0.52	0.35	-0.12	-0.35	0.29	0.81	1.03
	Botntrål-undersøkingar *(Bottom trawl investigations)*						
1993-94	1.16	0.57	0.15	0.75	1.12	1.10	1.25
1994-95	1.21	1.45	0.69	0.25	0.36	0.21	2.30
1995-96	1.71	1.23	0.11	0.14	0.29	1.10	1.13
1996-97	1.52	1.12	0.63	0.91	1.16	1.40	1.19
1997-98	2.22	1.10	0.95	0.75	1.76	1.77	2.04
1998-99	1.31	0.84	0.62	1.18	1.55	1.17	1.56
1999-00	1.01	0.75	0.52	0.37	0.94	1.25	1.20

8. DISTRIBUTION AND ABUNDANCE OF REDFISH

8.1 Acoustic estimation

Fig. 8.1 shows the geographic distribution of total echo abundance of the three redfish species golden redfish (*Sebastes marinus*), deep-sea redfish (*S. mentella*) and smaller redfish (*S. viviparus*). The distribution pattern was similar to recent previous years, and some more dense registrations in the western area towards the continental slope has to do with better survey coverage in 2000.

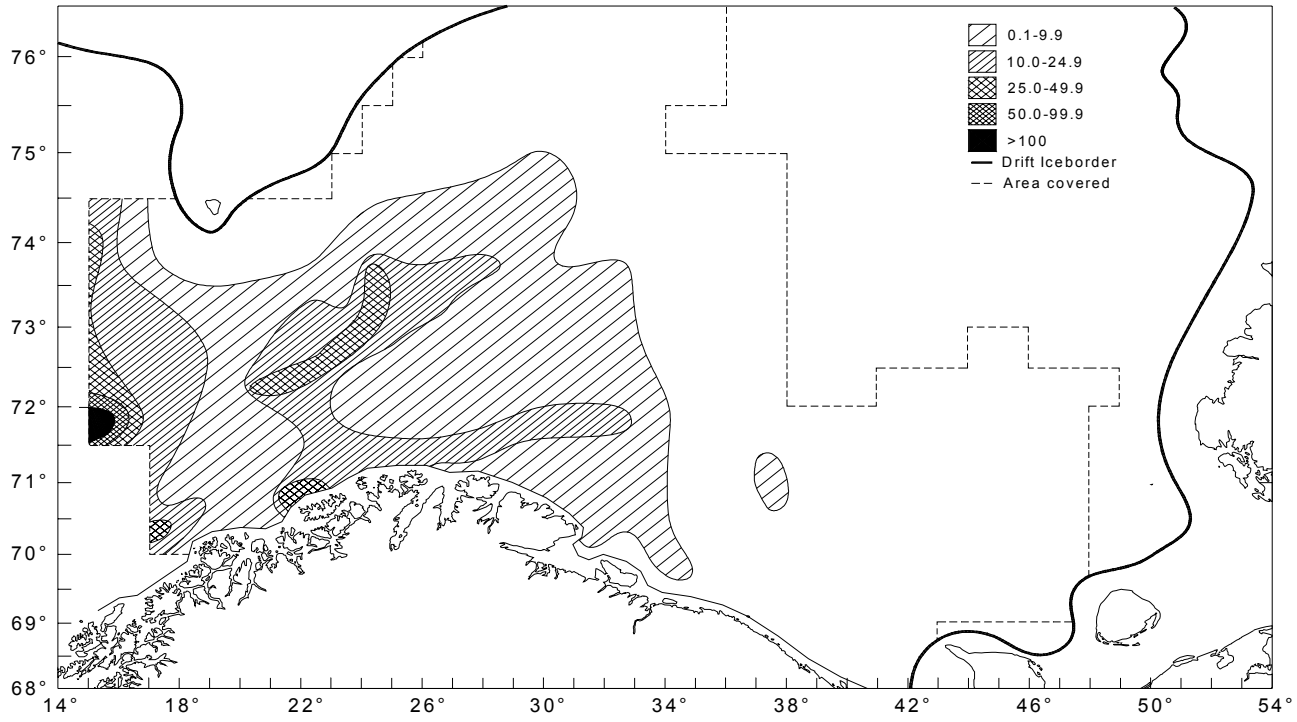

Figure8.1. REDFISH (Sebastes spp.). Distribution of total echo abundance winter 2000. Unit is integrated backscattering surface per square nautical mile (m^2/nm^2).
UER (Sebastes spp.). Fordeling av total ekkotettleik vinteren 2000. Eining er integrert reflekterande overflate pr. kvadrat nautisk mil (m^2/nm^2).

Table 8.1 shows the acoustic values for ***S. marinus*** by length-groups and main areas. More than 94% of the fish were observed in area ABCD. In the time series (table 8.2), the indices for 1997 and 1998 are adjusted based on data from 1996 and 1999 to take account of the Russian EEZ, but unlike cod and haddock the Svalbard area (S) was included in these calculations. In recent years it has been observed few *S. marinus* in the eastern Barents Sea, and in 1996 and 1999 the Norwegian EEZ accounted for about 90% of the total *S. marinus* acoustic value. The adjusted indices for 1997 and 1998 are therefore probably more precise than for cod and haddock. The total index is still low, only 57% of the 1993-1999 average, and there are no signs of improved recruitment.

Table 8.1. SEBASTES MARINUS. Acoustic abundance indices for main areas of the Barents Sea winter 2000 (numbers in millions).
VANLEG UER. Akustiske mengdeindeksar for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Område *(Area)*	Lengdegruppe (cm) / *Length group (cm)*								Total
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	>45	
A	+	+	+	1.0	3.0	1.0	0.4	0.6	6.3
B	1.4	2.2	2.8	1.4	2.9	2.8	2.4	0.7	16.7
C	0.3	0.1	0.1	0.4	1.5	1.1	0.4	0.4	4.4
D	0.7	0.4	1.2	0.9	1.1	0.9	0.2	0.2	5.6
D'	-	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-	-
S	-	-	0.1	0.8	1.0	0.1	+	+	2.0
ABCD	2.5	2.7	4.1	3.8	8.5	5.9	3.4	1.9	33.0
Total	2.5	2.7	4.2	4.6	9.5	6.0	3.4	2.0	35.0

Table 8.2. SEBASTES MARINUS. Abundance indices from acoustic surveys in the Barents Sea winter 1986-2000 (numbers in millions). 1986-1992 includes only the area covered in 1986.
VANLEG UER. Mengdeindeksar frå akustiske undersøkingar i Barentshavet vinteren 1986-2000 (talet på fisk i millionar). 1986-1992 inkluderer berre området som vart dekka i 1986.

År *(Year)*	Lengdegruppe (cm) / *Length group (cm)*								Total
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	>45	
1986	4	7	7	8	5	1	+	6	38
1987	6	17	13	8	3	3	2	3	55
1988	1	1	5	4	2	1	1	+	15
1989	4	3	7	9	6	4	2	1	36
1990	2	2	6	9	9	6	5	4	43
1991	21	10	15	20	21	14	7	7	115
1992	2	4	9	11	13	11	5	3	58
1993	3	6	9	11	24	18	8	7	86
1994	5	11	5	5	7	5	2	1	41
1995	5	11	15	13	14	16	10	6	90
1996	1	4	9	13	15	22	10	4	77
1997[1]	0	2	9	11	12	12	6	3	56
1998[1]	8	3	9	11	11	9	6	4	61
1999	1	+	2	4	6	4	2	1	20
2000	2	3	4	5	10	6	3	2	35

[1)] Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

About 80% of ***S. mentella*** (table 8.3) were observed in area ABCD. In 1996 and 1999, nearly 100 % and 96%, respectively, of the total index was registered in the Norwegian EEZ and at Svalbard (S). Accordingly, only minor adjustments were therefore necessary to take account for the Russian EEZ in 1997 and 1998 (table 8.4). The acoustic index in 2000 is for most of the length-groups higher than the very low indices in 1999. For 25 cm and larger fish the acoustic abundance indices for 2000 are at or above the 1993-1999 average, while the indices for smaller fish are the lowest observed.

Table 8.3. SEBASTES MENTELLA.[1] Acoustic abundance indices for main areas of the Barents Sea winter 2000 (numbers in millions).
SNABELUER.[1] Akustiske mengdeindeksar for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Område *(Area)*	Lengdegruppe (cm) / *Length group (cm)*								Total
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	>45	
A	2.4	15.4	35.7	69.0	54.5	15.3	5.3	1.1	198.8
B	0.2	0.2	1.5	2.2	5.1	5.1	0.6	+	13.9
C	2.0	0.3	4.0	3.3	7.5	1.2	0.4	0.1	18.8
D	12.6	7.7	22.9	7.9	6.2	1.0	+	-	58.4
D'	-	-	-	-	-	-	-	-	-
E	0.6	1.3	0.4	0.1	+	-	-	-	2.4
S	0.1	5.7	7.7	27.3	13.9	5.4	0.8	-	61.0
ABCD	17.3	23.6	64.3	82.4	63.4	22.6	6.4	1.3	291.2
Total	18.0	30.6	72.4	109.8	87.3	28.0	7.2	1.3	354.6

1) Includes unidentified Sebastes specimens, mostly less than 15 cm.
Inkluderer uidentifiserte Sebastes individer, for det meste mindre enn 15 cm.

Table 8.4. SEBASTES MENTELLA.[1] Abundance indices from acoustic surveys in the Barents Sea winter 1988-2000 (numbers in millions).) 1986-1992 includes only the area covered in 1986.
SNABELUER.[1] Mengdeindeksar frå akustiske undersøkingar i Barentshavet vinteren 1986-2000 (talet på fisk i millionar). 1986-1992 inkluderer berre området som vart dekka i 1986.

År *(Year)*	Lengdegruppe (cm) / *Length group (cm)*								Total
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	>45	
1986	83	54	11	22	19	9	2	1	201
1987	17	178	86	34	10	3	1	+	329
1988	13	46	75	15	13	8	1	+	171
1989	35	12	89	36	6	10	2	+	190
1990	77	12	33	73	23	40	3	1	262
1991	549	88	31	75	38	33	3	+	817
1992	386	207	24	23	23	8	1	+	672
1993	1560	599	188	48	47	18	4	+	2464
1994	687	299	111	18	13	4	1	+	1133
1995	80	565	414	108	78	34	3	1	1283
1996	147	183	283	128	44	15	4	+	723
1997[2]	167	41	229	165	44	25	2	0	672
1998[2]	133	79	98	213	68	50	5	1	646
1999	4	35	18	44	19	7	1	+	130
2000	18	31	72	110	87	28	7	1	355

1) Includes unidentified Sebastes specimens, mostly less than 15 cm.
Inkluderer uidentifiserte Sebastes individer, for det meste mindre enn 15 cm.

2) Indices raised to also represent the the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

As in previous years, most of the ***S. viviparus*** are observed in area AB (table 8.5). The survey covers only the northern margin of this species' geographical distribution. Large variation in the indices from year to year is therefore likely due to variable area coverage in the south-western part of the survey area in addition to a very patchy distribution.

Table 8.5. SEBASTES VIVIPARUS. Acoustic abundance indices for main areas of the Barents Sea winter 2000 (numbers in millions).
LUSUER. Akustiske mengdeindeksar for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Område *(Area)*	Lengdegruppe (cm) / *Length group (cm)*					
	10-14	15-19	20-24	25-29	>30	Total
A	+	19.7	14.0	2.0	+	35.8
B	7.9	24.9	17.6	3.3	0.5	54.3
C	-	+	0.1	0.1	-	0.2
D	+	0.1	+	+	-	0.1
D'	-	-	-	-	-	-
E	-	-	-	-	-	-
S	-	+	0.1	+	-	0.1
ABCD	8.0	44.9	31.7	5.4	0.5	90.5
Total	8.0	44.9	31.8	5.4	0.5	90.6

Table 8.6. SEBASTES VIVIPARUS. Abundance indices from acoustic surveys in the Barents Sea winter 1986-2000 (numbers in millions). 1986-1992 includes only the area covered in 1986.
LUSUER. Mengdeindeksar frå akustiske undersøkingar i Barentshavet vinteren 1986-2000 (talet på fisk i millionar). 1986-1992 inkluderer berre området som vart dekka i 1986.

År *(Year)*	Lengdegruppe (cm) / *Length group (cm)*					
	10-14	15-19	20-24	25-29	> 30	Total
1986	1	1	+	+	+	4
1987	+	+	+	+	+	2
1988	2	3	3	1	+	10
1989	3	5	5	1	0	14
1990	6	11	16	4	+	37
1991	17	29	23	4	+	73
1992	17	10	7	3	1	38
1993	45	15	11	4	0	75
1994	40	14	8	1	+	63
1995	304	64	30	2	+	400
1996	70	30	27	4	+	132
1997	19	21	16	4	-	61
1998	16	42	10	1	+	71
1999	4	8	2	1	+	15
2000	8	45	32	5	1	91

8.2 Swept area estimation

The swept area time series for redfish (tables 8.9, 8.10 and 8.12) are based on catch data from trawls with bobbins gear until 1988 inclusive, and rockhopper gear since 1989. The time series has not been adjusted for this change.

Fig. 8.2 shows the horizontal distribution of bottom trawl catch rates of ***S. marinus*** during the swept area investigation. The distribution is very similar to 1999. Table 8.7 presents swept area indices with standard error for each main area in addition to the coefficient of variation for the total.

The time series for 1986-2000 (table 8.9), with adjusted indices for 1997 and 1998, shows historic low indices for most of the length-groups, and the lowest total index ever observed. There are no signs of improved recruitment.

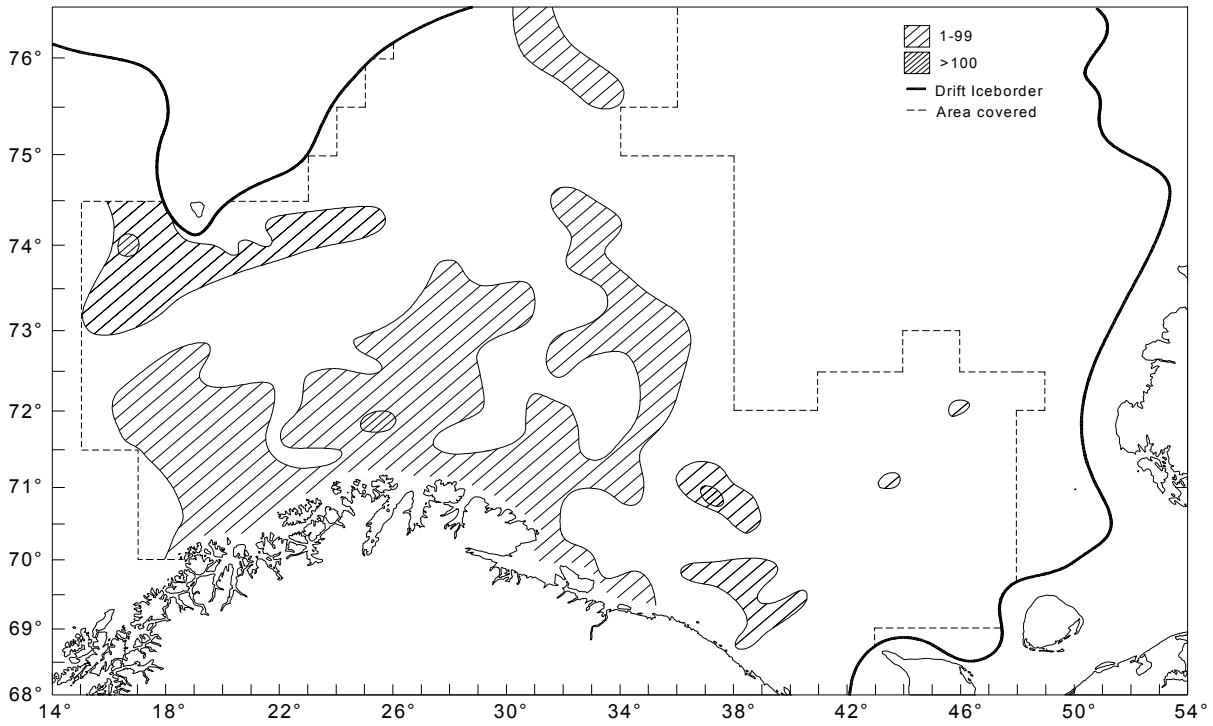

Figure 8.2. SEBASTES MARINUS. Distribution in the trawl catches winter 2000 (no. per hour trawling).
VANLEG UER. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

The mapping of the distribution of ***S. mentella*** is not complete in the north-western part of the surveyed area due to this species' extensive distribution further north in the Svalbard area, west and north of Spitsbergen. The 2000 coverage was nevertheless more complete than before (fig. 8.3), and the low abundance is therefore another confirmation of the poor stock condition.

Table 8.8 presents the swept area indices with corresponding standard errors for each main area in addition to the coefficient of variation of the total.

Table 8.7. SEBASTES MARINUS. Abundance indices (I) at length with standard error of mean (S) from bottom trawl hauls for main areas of the Barents Sea winter 2000 (numbers in millions).
VANLEG UER. Mengdeindeksar (I) for lengdegrupper med standard feil (S) frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)*	Område *(Area)*																
	A		B		C		D		D'		E		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	+	0	0	0	0	0	0.4	0.2	0	0	0.1	0.1	0	0	0.5	0.2	36.8
10-14	0.1	+	0.4	0.3	0.1	0.1	0.6	0.2	0	0	0	0	+	+	1.1	0.3	30.4
15-19	+	0.1	0.6	0.2	+	+	0.6	0.2	0	0	+	+	0.1	0.1	1.5	0.3	20.4
20-24	0.2	+	1.1	0.5	0	0	2.0	0.8	0.1	0.1	0.2	0.1	0.7	0.2	4.2	1.0	23.3
25-29	0.5	0.1	0.5	0.1	0.1	0.1	1.6	0.5	0	0	0.1	0.1	1.9	0.8	4.7	1.0	21.8
30-34	1.4	0.3	0.7	0.2	0.5	0.3	1.1	0.4	0	0	0	0	1.4	0.8	5.0	1.4	27.9
35-39	1.6	1.0	0.9	0.4	0.4	0.2	0.3	0.1	0	0	+	+	0.2	0.1	3.5	1.1	30.8
40-44	0.9	1.0	0.6	0.2	0.1	0.1	0.2	0.1	0	0	0	0	0.1	+	1.8	0.5	28.8
> 45	0.7	0.8	0.1	+	0.1	0.1	0.1	0.1	0	0	0	0	+	+	1.2	0.3	25.0
Sum	5.5	1.6	4.9	0.8	1.3	0.4	6.9	1.1	0.1	0.1	0.5	0.2	4.5	1.2	23.5	2.4	10.2

Table 8.8. SEBASTES MENTELLA.[1] Abundance indices (I) at length with standard error of mean (S) from bottom trawl hauls for main areas of the Barents Sea winter 2000 (numbers in millions).
SNABELUER.[1] Mengdeindeksar (I) for lengdegrupper med standard feil (S) frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)*	Område *(Area)*																
	A		B		C		D		D'		E		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	3.2	0.8	0.1	0.1	0.2	0.1	3.1	0.6	0	0	0.9	0.6	1.6	0.8	9.0	1.4	15.7
10-14	4.8	1.2	0.2	0.1	1.1	0.5	5.3	0.8	0	0	0.9	0.4	0.5	0.3	12.7	1.6	12.7
15-19	21.4	5.2	0.2	0.2	0.2	0.1	4.7	1.2	0	0	1.2	0.8	11.6	2.9	39.4	6.1	15.5
20-24	46.2	9.7	1.1	1.0	3.3	1.8	11.8	2.8	0	0	0.2	0.2	14.2	3.0	76.8	10.8	14.0
25-29	93.7	20.4	1.6	1.0	2.3	1.1	4.5	1.7	0	0	0	0	39.7	11.2	141.9	23.4	16.5
30-34	66.3	20.4	3.2	2.1	5.0	1.9	3.0	1.8	0	0	0.1	0.1	19.5	6.8	97.1	21.8	22.4
35-39	16.8	8.0	2.7	2.5	0.8	0.3	0.4	0.2	0	0	0	0	5.9	2.3	26.6	8.7	32.6
40-44	5.9	4.9	0.3	0.2	0.3	0.1	0	0	0	0	0	0	0.4	0.2	6.9	5.0	71.8
> 45	1.2	1.1	+	+	0.1	+	0	0	0	0	0	0	0.3	0.3	1.5	1.3	86.5
Sum	259.4	32.3	9.4	3.5	13.3	2.9	32.8	4.1	0	0	3.2	1.1	93.8	13.9	411.8	35.7	8.7

[1)] Includes unidentified Sebastes specimens, mostly less than 15 cm.
Inkluderer uidentifiserte Sebastes individer, for det meste mindre enn 15 cm.

Table 8.9. SEBASTES MARINUS. Abundance indices from bottom trawl surveys in the Barents Sea winter 1986-2000 (numbers in millions). 1986-1992 includes only main areas A, B, C and D.
VANLEG UER. Mengdeindeksar frå botntrålundersøkingar i Barentshavet vinteren 1986-2000 (talet på fisk i millionar). 1986-1992 inkluderer berre hovudområda A, B, C og D.

År	Lengdegruppe (cm) / *Length group (cm)*									
(Year)	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	> 45	Total
1986	3.0	11.7	26.4	34.3	17.7	21.0	12.8	4.4	2.6	134
1987	7.7	12.7	32.8	7.7	6.4	3.4	3.8	3.8	4.2	83
1988	1.0	5.6	5.5	14.2	12.6	7.3	5.2	4.1	3.7	59
1989	48.7	4.9	4.3	11.8	15.9	12.2	6.6	4.8	3.0	114
1990	9.2	5.3	6.5	9.4	15.5	14.0	8.0	4.0	3.4	75
1991	4.2	13.6	8.4	19.4	18.0	16.1	14.8	6.0	4.0	105
1992	1.8	3.9	7.7	20.6	19.7	13.7	10.5	6.6	5.8	92
1993	0.1	1.2	3.5	6.9	10.3	14.5	12.5	8.6	6.3	64
1994	0.7	6.5	9.3	11.7	11.5	19.4	9.1	4.4	2.8	75
1995	0.6	5.0	13.1	11.5	9.1	15.9	17.2	10.9	4.7	88
1996	+	0.7	3.5	6.4	9.4	11.7	16.6	7.9	3.9	60
1997[1]	-	0.5	1.5	3.2	6.6	21.4	28.0	8.4	3.3	73
1998[1]	0.2	6.0	2.5	10.5	49.5	25.2	13.1	6.9	2.3	116
1999	0.2	0.9	2.1	4.0	4.6	6.4	6.0	5.3	3.3	33
2000	0.5	1.1	1.5	4.2	4.7	5.0	3.5	1.8	1.2	24

1) Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

The time series for 1986-2000, with adjusted indices for 1997 and 1998, is presented in table 8.10. Similar to the acoustic abundance indices, the swept area indices for 2000 show that the abundance of 25 cm and larger *S. mentella* are at or above the 1993-1999 average, while the indices for smaller fish are the lowest observed. The smaller the fish the less abundant it is. The index for *S. mentella* smaller than 15 cm is only about 10% (!) of the 1993-1999 average. The future of the *S. mentella* stock is relying on the survival of the last good year classes born in 1989-1990 before the recruitment collapse in 1991. These year classes, at present about 30 cm, compose the bulk of the stock, and should be protected as much as possible if we want to improve the recruitment to maintain a fishery on this resource in the future.

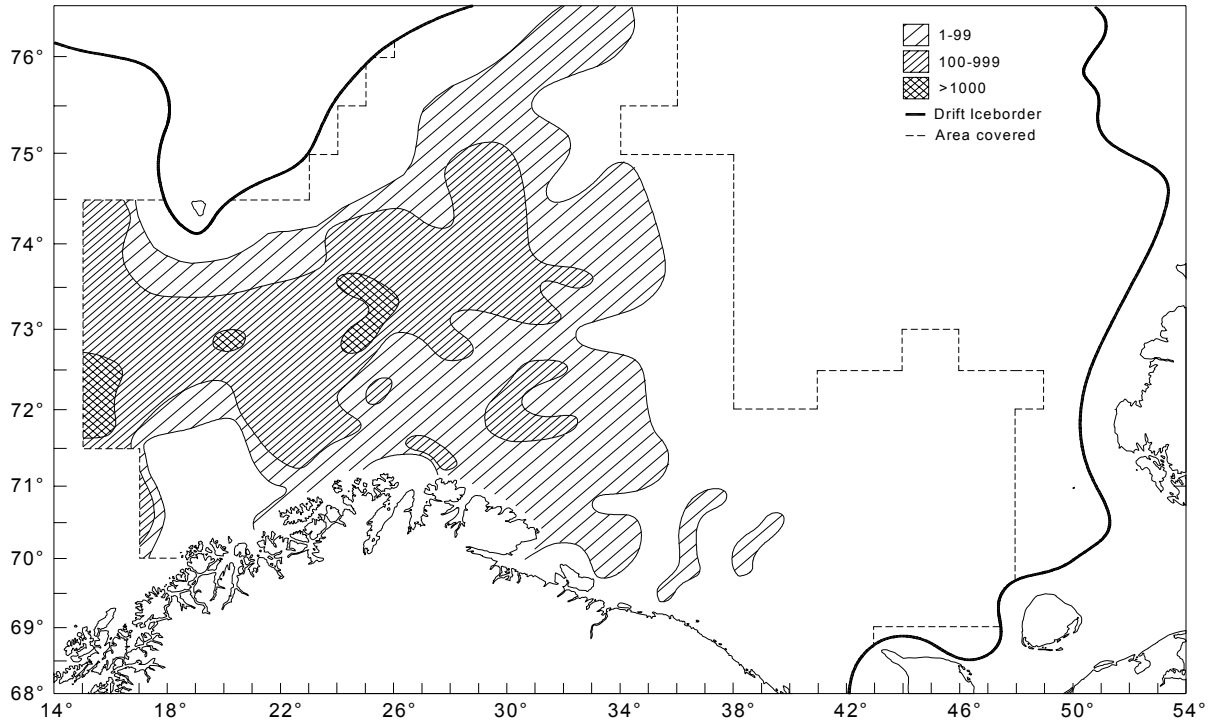

Figure 8.3. SEBASTES MENTELLA. Distribution in the trawl catches winter 2000 (no. per hour trawling).
SNABELUER. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

Table 8.10. SEBASTES MENTELLA.[1] Abundance indices from bottom trawl surveys in the Barents Sea winter 1986-2000 (numbers in millions). 1986-1992 includes only main areas A, B, C and D.
SNABELUER.[1] Mengdeindeksar frå botntrålundersøkingar i Barentshavet vinteren 1986-2000 (talet på fisk i millionar). 1986-1992 inkluderer berre hovudområde A, B, C og D.

År	Lengdegruppe (cm) / *Length group (cm)*									
(Year)	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	> 45	Total
1986	81.3	151.9	205.4	87.7	169.2	129.8	87.5	23.6	13.8	951
1987	71.8	25.1	227.4	56.1	34.6	11.4	5.3	1.1	0.1	433
1988	587.0	25.2	132.6	182.1	39.6	50.1	47.9	3.6	0.1	1070
1989	622.9	55.0	28.4	177.1	58.0	9.4	8.0	1.9	0.3	962
1990	323.6	304.5	36.4	55.9	80.2	12.9	12.5	1.5	0.2	830
1991	395.2	448.8	86.2	38.9	95.6	34.8	24.3	2.5	0.2	1123
1992	139.0	366.5	227.1	34.6	55.2	34.4	7.5	1.8	0.5	867
1993	30.8	592.7	320.2	116.3	24.2	25.0	6.3	1.0	+	1117
1994	6.9	258.6	289.4	284.3	51.4	69.8	19.9	1.4	0.1	979
1995	263.7	71.4	637.8	505.8	90.8	68.8	31.3	3.9	0.5	1674
1996	213.1	100.2	191.2	337.6	134.3	41.9	16.6	1.4	0.3	1037
1997[2]	63.2	120.9	24.8	278.2	271.8	70.9	39.8	5.2	0.1	875
1998[2]	1.3	88.2	62.5	101.0	203.2	40.4	12.9	1.1	0.2	511
1999	2.2	6.8	68.2	36.8	167.4	71.3	21.0	3.1	0.1	374
2000	9.0	12.7	39.4	76.8	141.9	97.1	26.6	6.9	1.5	412

1) Includes unidentified Sebastes specimens, mostly less than 15 cm.
Inkluderer uidentifiserte Sebastes individer, for det meste mindre enn 15 cm.

2) Indices raised to also represent the Russian EEZ.
Indeksar oppjusterte til også å omfatta russisk sone.

Nearly all ***S. viviparus*** were observed in area ABCD (table 8.11), and mostly in area B. The time series 1986-2000 of the swept area indices for the different length-groups is shown in Table 8.12.

Table 8.11. SEBASTES VIVIPARUS. Abundance indices (I) at length with standard error of mean (S) from bottom trawl hauls for main areas of the Barents Sea winter 2000 (numbers in millions).
LUSUER. Mengdeindeksar (I) for lengdegrupper med standard feil (S) frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (talet på fisk i millionar).

Lengde *(Length)*	Område *(Area)*												
	A		B		C		D		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	-	-	0.9	0.5	-	-	0.1	0.1	-	-	0.9	0.5	54.7
10-14	0.1	0.0	4.6	1.7	-	-	0.2	0.1	-	-	4.8	1.7	34.3
15-19	3.2	2.3	33.0	17.8	0.0	0.0	0.2	0.1	0.1	0.1	36.5	17.9	49.0
20-24	4.0	2.3	17.5	10.0	0.0	0.0	0.1	0.0	0.1	0.1	21.7	10.2	47.2
25-29	0.2	0.1	1.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.9	42.4
30-34	0.0	0.0	0.1	0.1	-	-	-	-	-	-	0.1	0.1	53.9
Sum	7.5	3.3	57.9	20.4	0.1	0.0	0.5	0.0	0.3	0.0	66.2	20.7	31.3

Table 8.12. SEBASTES VIVIPARUS. Abundance indices from bottom trawl surveys in the Barents Sea winter 1996-2000 (numbers in millions). 1986-1992 includes only the area covered in 1986.
LUSUER. Mengdeindeksar frå botntrålundersøkingar i Barentshavet vinteren 1986-2000 (talet på fisk i millionar). 1986-1992 inkluderer berre området som vart dekka i 1986.

Område	Lengdegruppe (cm) / *Length group (cm)*						
(Area)	5-9	10-14	15-19	20-24	25-29	> 30	Total
1986	1.0	2.3	4.8	6.4	1.3	+	16
1987	+	0.5	4.4	8.0	1.9	0.2	15
1988	6.9	6.2	6.4	10.0	3.6	0.3	33
1989	3.7	7.8	6.3	4.3	0.9	0.0	23
1990	0.3	12.7	11.7	9.9	3.3	0.2	38
1991	3.7	13.6	16.1	16.8	4.2	0.4	55
1992	15.1	32.1	27.4	16.9	5.1	0.3	97
1993	18.6	23.7	7.7	3.5	1.0	+	55
1994	48.0	64.0	15.0	12.3	1.2	0.2	141
1995	7.6	53.2	21.9	7.9	2.4	0.3	93
1996	0.5	45.0	42.5	35.4	5.5	0.1	129
1997	0.9	23.8	28.5	18.5	4.3	-	76
1998	0.7	9.3	41.7	20.6	2.9	0.1	75
1999	1.6	10.0	11.5	2.9	0.7	+	27
2000	0.9	4.8	36.5	21.7	2.1	0.1	66

9. DISTRIBUTION AND ABUNDANCE OF GREENLAND HALIBUT

Fig. 9.1 shows the horizontal distribution of Greenland halibut in the swept area investigations. Important parts of this species' distribution, e.g., northern part of Svalbard and the continental slope, are not covered by the survey. The distribution pattern was otherwise similar to the years before, i.e., mainly in the Bear Island channel towards the Hopen Deep.

Table 9.1 presents the swept area indices with corresponding standard errors for each main area in addition to the coefficient of variation of the total.

The time series for 1990-2000, with indices adjusted for 1997 and 1998 the same way as for redfish (i.e., the Svalbard area (S) included when extrapolating for the Russian EEZ), is presented in table 9.2. About **75 %** of the Greenland halibut survey catches are taken in the Norwegian EEZ and at Svalbard.

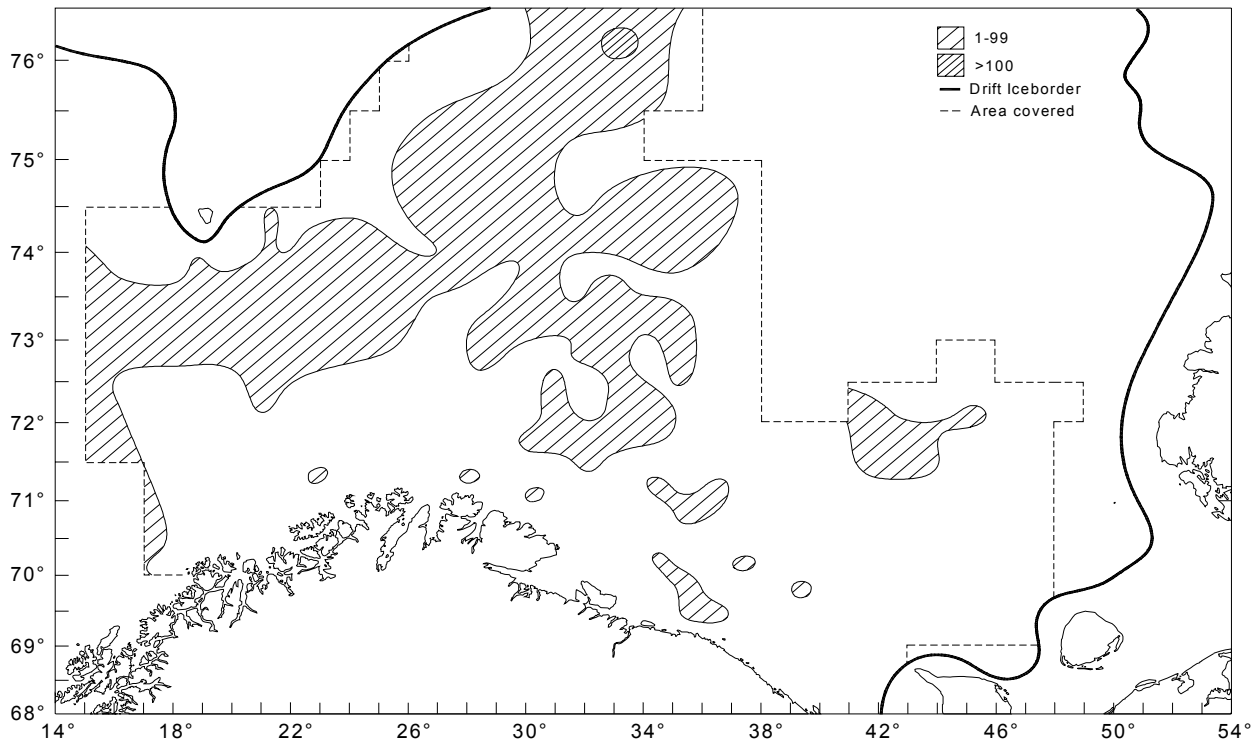

Figure 9.1. GREENLAND HALIBUT. Distribution in the trawl catches winter 2000 (no. per hour trawling).
BLÅKVEITE. Fordeling i trålfangstane vinteren 2000 (talet på fisk pr. tråltime).

Table 9.1. GREENLAND HALIBUT. Abundance indices (I) at length with standard error of mean (S) from bottom trawl hauls for main areas of the Barents Sea winter 2000 (numbers in thousands).
BLÅKVEITE. Mengdeindeksar (I) for lengdegrupper med standard feil (S) frå botntrålhal for kvart hovudområde av Barentshavet vinteren 2000 (i tusen).

Lengde *(Length)*	Område *(Area)*																	
	A		B		C		D		D'		E		S		ABCD	Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	I	S	CV(%)
5-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	122	88	72
15-19	-	-	-	-	-	-	41	28	-	-	122	88	21	21	41	184	127	69
20-24	-	-	-	-	-	-	20	20	-	-	122	122	18	18	20	322	245	76
25-29	-	-	-	-	-	-	148	82	-	-	284	244	21	21	148	859	695	81
30-34	-	-	-	-	-	-	557	183	-	-	690	690	61	61	557	1753	947	54
35-39	23	23	-	-	-	-	179	62	-	-	1136	927	273	101	202	3841	2337	61
40-44	79	46	-	-	-	-	163	67	-	-	3366	2333	239	103	242	2190	908	41
45-49	302	110	-	-	-	-	328	91	-	-	1710	898	563	158	630	1599	256	16
50-54	402	178	-	-	45	45	297	85	-	-	406	141	1115	413	744	2143	481	23
55-59	334	129	57	41	91	70	283	84	-	-	284	144	708	328	765	1715	398	23
60-64	295	118	19	19	23	23	229	72	-	-	243	143	393	147	566	1163	226	19
65-69	89	51	-	-	-	-	88	44	-	-	203	97	387	181	177	564	192	34
70-74	46	46	-	-	-	-	-	-	-	-	-	-	155	86	46	242	106	44
75-79	33	33	-	-	-	-	42	30	-	-	41	41	-	-	75	75	44	59
> 80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sum	1601	287	76	45	159	86	2373	283	-	-	8604	2782	3956	625	4209	16769	2882	17

Table 9.2. GREENLAND HALIBUT. Abundance indices from the bottom trawl surveys in the Barents Sea winter 1990-2000 (numbers in thousands). 1990-1992 includes only main areas A, B, C and D. Indices for 1997 and 1998 are raised to also represent the Russian EEZ.
BLÅKVEITE. Mengdeindeksar frå botntrålundersøkingar i Barentshavet vinteren 1990-2000 (talet på fisk i tusen). 1990-1992 inkluderer berre hovudområda A, B, C og D. Indeksane for 1997 og 1998 er oppjusterte til også å omfatta russisk sone.

År *(Year)*	Lengdegruppe (cm) / *Length group (cm)*															
	<14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	> 80	Total
1990	21	199	777	785	1205	1657	1829	2043	1349	479	159	160	40	40	0	10800
1991	0	42	262	618	655	868	954	1320	1875	1577	847	165	34	34	0	9270
1992	14	35	64	149	509	843	1096	1072	1029	827	633	108	31	31	26	6500
1993	0	0	17	67	265	959	2310	4004	3374	1911	1247	482	139	139	34	14840
1994	0	0	16	99	142	1191	2625	3866	2885	1796	753	440	25	25	0	13838
1995	42	0	0	0	83	149	3228	9240	7438	2811	2336	909	468	468	0	26761
1996	3149	0	0	0	61	124	1163	3969	4425	1824	1041	593	346	73	12	16781
1997	0	65	0	0	173	227	858	4344	5500	2725	1545	632	282	66	22	16439
1998	80	217	1006	444	532	403	1064	3888	6331	2977	1725	633	337	76	43	19765
1999	41	82	261	427	576	264	757	1706	3069	1640	1077	483	109	74	28	10594
2000	122	184	322	859	1753	3841	2190	1599	2143	1715	1163	564	242	75	0	16769

10. COMPARISONS BETWEEN RESEARCH VESSELS

The vessels “Persey3” and “Johan Hjort” made 16 parallel tows, most of them in the area between N 71º30 and 72º00 and E 34º and 37º. Figures 10.1 and 10.2 show the pair-wise observations for various categories, and some statistics are summarized in Table 10.1.

Table 10.1. Summarized results of the comparative trawling with “Persey3” and “Johan Hjort” (16 stations)
Oppsummerte resultat fra samtrålingen mellom “Persey3” og “Johan Hjort” (16 stasjoner).

	y=ax Slope a	correlation r
Cod kg	1.20	0.983
Haddock kg	1.01	0.990
Cod > 20 cm	1.16	0.983
Haddock > 20 cm	1.22	0.980
Cod < 20 cm	0.43	0.541
Haddock < 20 cm	0.43	0.938
Long rough dab kg	1.04	0.718
Total fish kg	1.12	0.985
Shrimp kg	0.80	0.947
Fish + shrimp, kg	1.10	0.975

In general these comparative results do not give strong reasons to suspect any considerable difference between the vessels. For small fish the catches in numbers were highly variable, and the number of observations are too few to detect moderate differences between the vessels.

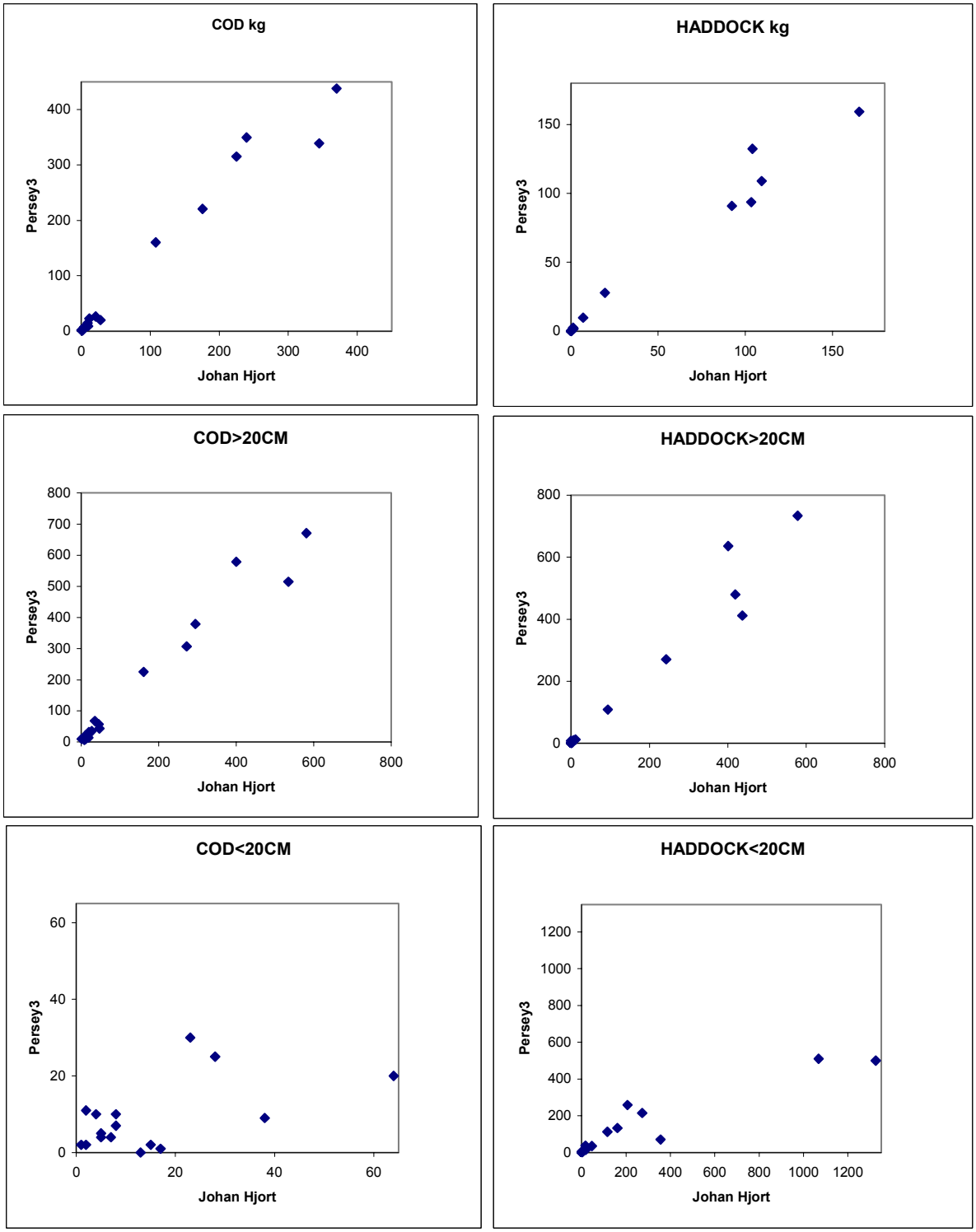

Figure 10.2. Comparison of catches of cod and haddock at parallel hauls. The two upper panels show catch in weight, the remaining show catch in numbers.
Resultat av samtråling. De to øverste figurene viser fangst i vekt, de øvrige viser fangst i antall.

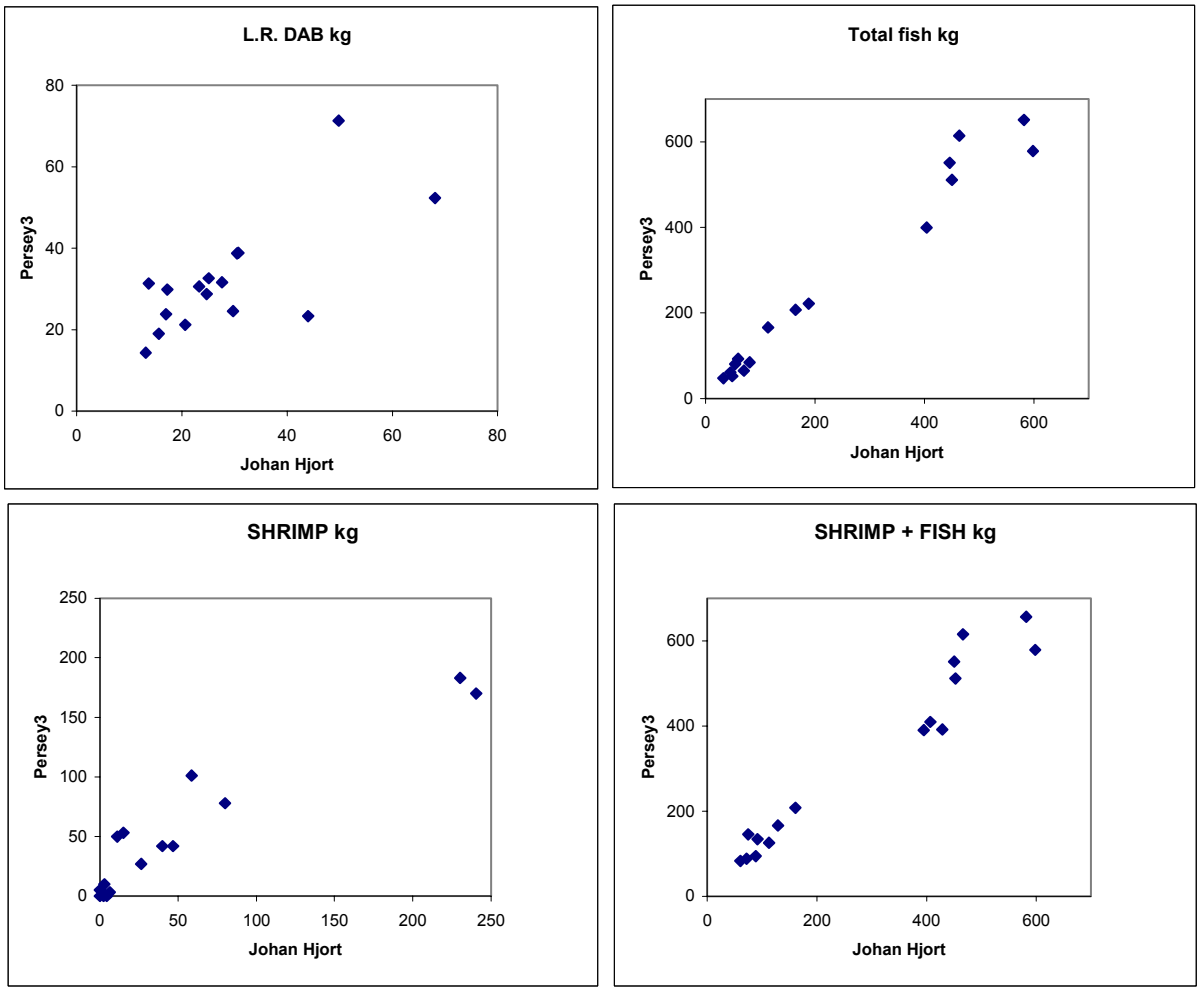

Figure 10.1. Comparison of catches (weight) at parallel hauls.
Sammenlikning av fangster (i vekt) under samtråling.

A further comparison was made by considering the total area of overlap between the Russian and the two Norwegian vessels during the survey. This overlapping area represents 28423 square nautical miles (within Main area D). In this area the Norwegian vessels had 54 bottom trawl hauls and the Russian vessel had 81. For comparison these estimates were based on a fishing width of 25m, independent of the fish length. The results for cod and haddock are shown by length groups and age in Figure 10.3 and Table 10.2. For cod the estimates by length are very similar, while the age distribution differs somewhat. For small haddock (less than about 30 cm) the Norwegian estimates are somewhat lower than the Russian. Close to the Russian coast the Norwegian vessels had fewer stations than the Russian vessel. This could explain some of the observed differences.

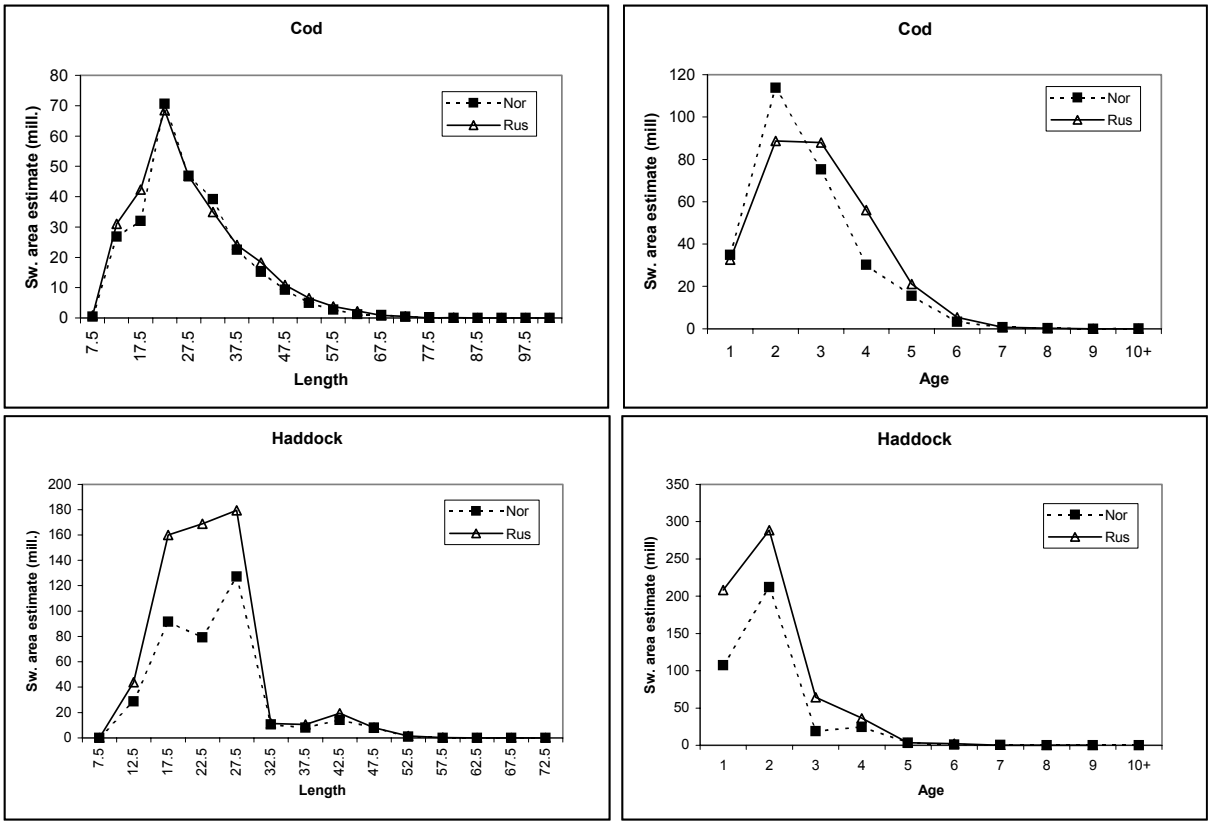

Figure 10.3. Swept area estimates (referring to 25m fishing width, independent of fish length) for cod and haddock by Russian (Rus) and Norwegian (Nor) vessels in the overlapping area of coverage.
Bunntrål-estimat (basert på 25m fiskebredde, uavhengig avfiskens lengde) for torsk og hyse for russisk (Rus) og norske (Nor) forskningsfartøy i felles deknings-område.

Table 10.2. Swept area estimates in millions (referring to 25m fishing width, independent of fish length) for cod and haddock from Russian (Rus) and Norwegian (Nor) vessels in the overlapping area of coverage.
Bunntrålestimat i millioner (basert på 25m fiskebredde, uavhengig av fiskens lengde) for torsk og hyse for russisk (Rus) og norske (Nor) forskningsfartøy i felles dekningsområde.

L-interval midpoint	Cod Nor	Cod Rus	Haddock Nor	Haddock Rus
7.5	0.45	0.93	0.00	0.04
12.5	26.82	31.07	28.72	43.68
17.5	32.00	42.36	91.53	159.98
22.5	70.63	68.54	79.20	168.81
27.5	46.84	46.78	127.23	179.41
32.5	39.20	34.98	10.37	11.25
37.5	22.46	24.08	7.83	10.43
42.5	15.25	18.34	14.13	19.51
47.5	9.31	10.89	7.98	7.86
52.5	4.97	6.62	0.82	1.27
57.5	2.77	3.84	0.07	0.17
62.5	1.28	2.33	0.02	0.04
67.5	1.00	0.82	0.00	0.00
72.5	0.40	0.55	0.00	0.02
77.5	0.21	0.08		
82.5	0.06	0.13		
87.5	0.02	0.02		
92.5	0.10	0.00		
97.5	0.02	0.00		
102.5	0.03	0.02		
Total	273.79	292.39	367.90	602.49

Age	Cod Nor	Cod Rus	Haddock Nor	Haddock Rus
1	34.96	32.58	107.31	208.14
2	113.77	88.60	212.35	288.64
3	75.11	87.88	18.81	64.15
4	30.13	56.00	24.62	36.11
5	15.57	21.09	3.37	3.24
6	3.19	5.28	0.99	2.11
7	0.66	0.75	0.42	0.00
8	0.29	0.17	0.00	0.00
9	0.03	0.02	0.00	0.09
10+	0.09	0.02	0.02	
Total	273.79	292.39	367.90	602.48

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