IMR / PINRO
JOINT REPORT SERIES
6
2002

INVESTIGATIONS ON DEMERSAL FISH IN THE BARENTS SEA WINTER 2002

Detailed report

Institute of Marine Research - IMR

Polar Research Institute of Marine Fisheries and Oceanography - PINRO

This report should be cited as:
Anon. 2002. Investigations on demersal fish in the Barents Sea winter 2002.
IMR/PINRO Joint Report Series, No. 6/2002. ISSN 1502-8828. 63 pp.

Joint IMR-PINRO report

Investigations on demersal fish in the Barents Sea winter 2002

Detailed report

Asgeir Aglen[1], John Alvsvåg[1], Konstantin Drevetnyak [2], Åge Høines[1],
Knut Korsbrekke[1], Sigbjørn Mehl[1], and Konstantin Sokolov[2]

[1] Institute of Marine Research
P.O. Box 1870 Nordnes
N-5024 Bergen
NORWAY

[2] PINRO
6 Knipovich Street
183763 Murmansk
RUSSIA

CONTENTS

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 this 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-ies, 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 2002. This year the Russian research vessel “Persey 3” participated in addition to the Norwegian research vessels “G.O. Sars” and “Johan Hjort”. The total duration of the survey was from 28 January to 04 March. One scientist from PINRO, Murmansk, participated onboard ”Johan Hjort”.

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 Norwegian vessels had full access to the Russian EEZ. In 2001 and 2002 a Russian research vessel covered most of the areas where the Norwegian vessels did not have access, and a sufficient coverage was obtained.

The main results in 2002 were:

- the 2001 year class of **cod** is very weak and the 2000 year class is indicated to be somewhat below average. The 1999 and 1998 year classes is slightly higher than expected from last years survey
- the abundance indices of 5-8 year old cod (1997-1994 year classes) are as expected from the last years survey
- the numbers of 9 year and older cod are very low
- lengths and weights at age and weight increments are similar to those observed in 2001, while some increase was observed from 2000 to 2001.
- the mortality rate has been reduced compared with the previous years for age group 6 and younger, while it has remained high for older age groups
- for **haddock** all the year classes 1998, 1999, 2000 and 2001 are indicated to be at or above average. The 1996 year class is below average, but considerably larger than the year classes 1992-1995, which are very weak.
- length and weight at age and weight increment seem to have stabilized, after a period of increase over the years 1998-2000.
- the abundance indices of the **redfish** species are among the lowest in the time series and there are no signs of improved recruitment
- compared to the 2001-results the abundance indices of **Greenland halibut** in the size range 15 to 44 cm have decreased, while they have increased for the other size groups.

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 and PINRO.

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. Since 2000 Russian research vessels have participated in the survey and the coverage have been far better then in the years 1997-1999.

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 been continuously 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 allocating 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 appearance of the echo recordings
- inspection of target 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) 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:

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

$\overline{\rho}_A$ 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):

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

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

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

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:

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

$\overline{L^2}$ 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 an age 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, plus 10 m wire for connection to the doors. 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. On hired vessels V-type doors (ca 7 m^2) have been used. In 2001, R/V "Johan Hjort" and R/V "G.O.Sars" used Vaco doors (6m^2, 1500kg), while R/V "Persey 4" used a V-type door ("Steinshamn W-9", 7.1m^2, 2050kg). In order to achieve constant sampling width of a trawl haul independent of e.g. depth and wire length, a 10 m rope "locks" the distance

between the trawl wires 150-180 m in front of the trawl doors. This is called “strapping”. The distance between the trawl doors then become almost constant of 48-52 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 is 50-60 m and increasing with increasing wire length, and thereby with increasing depth. 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 tow duration is 30 minutes (until 1985 the tow duration was 60 min.). On all trawl stations the trawl performance is constantly monitored 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 n.miles) compared to the more marginal areas (30 n.miles). In 2001 the strata close to the Finnmark coast was covered by a 15 n.mile grid. 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 Table 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 a revised strata system with 23 strata has been used (Figure 2.1). The main reason for reducing the number of strata was the neccessity to get a sufficient number of trawl stations in each stratum to get reliable estimates of density and variance.

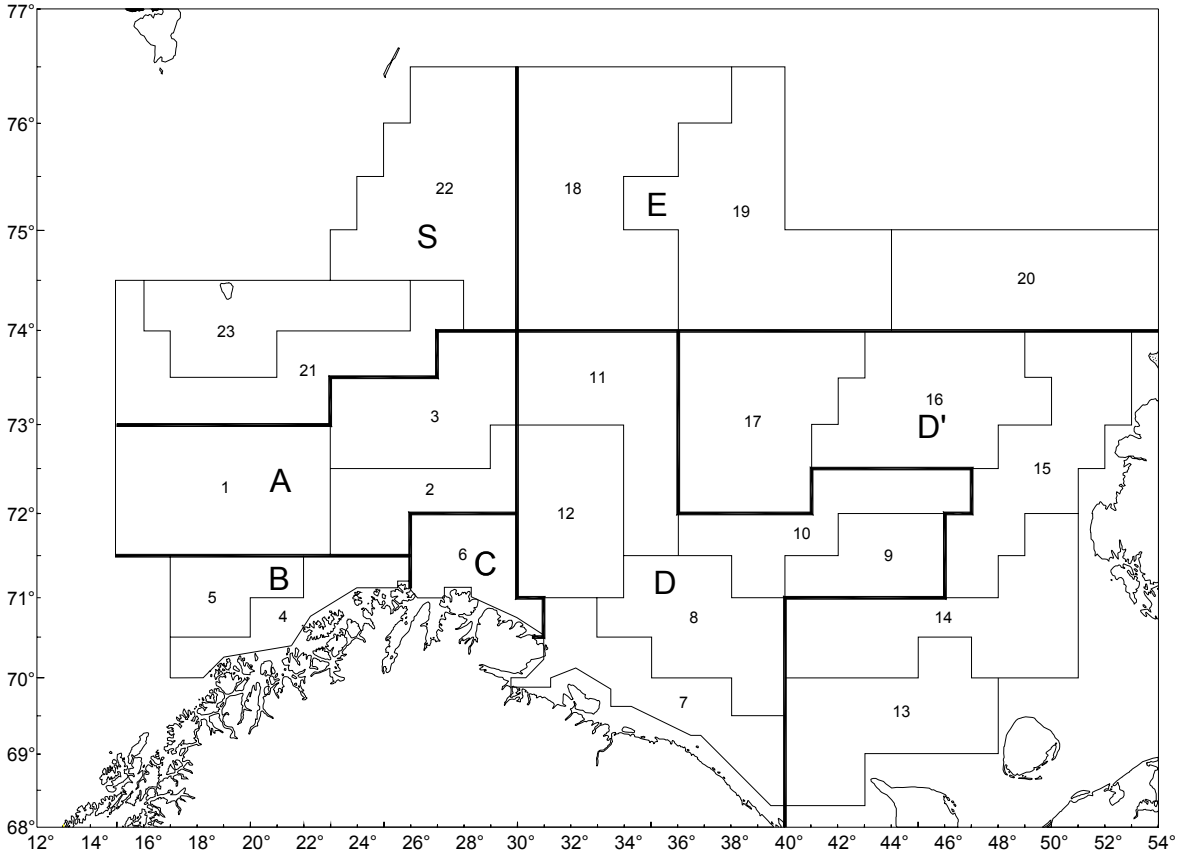

Figure 2.1 Strata (1-23) and Main Areas (A,B,C,D,D',E and S) used for swept area estimations. The Main Areas are also used for the acoustic estimation.

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.mile)

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, a measuring board connected to stabilized scales. The whole catch or a representative sub sample 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. The stomach samples were frozen and analysed after the survey. From haddock 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 2 fish in every 5 cm length-group on every station. This regular sampling was supplemented 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 for each 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

Fractions 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 fraction 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 2002 was conducted with R/V "G.O. Sars" 30.01-04.03 (IMR-BEI-survey no. 2002002, IMR-series no. 80001-80167 and 80853 and 8860), R/V "Johan Hjort" 29.01-03.03 (IMR-BEI-survey no. 2002202, IMR-series no. 80201-80365), and R/V "Persey 3" from PINRO 31.01-25.02. The catch data and biological samples from R/V "Persey3" were converted to the IMR-format "Regfisk" (IMR-series no. 80401-80529). The acoustic data from R/V "Persey 3" was reported to IMR as allocated values by species at 5 n.mile intervals, split on a bottom layer (<10m from bottom) and a pelagic layer (>10m above bottom).

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). Table 3.1 shows the area in square n.miles of each main area covered by the survey every year. In the 2002 survey 254 hydrographical (CTD) stations and 463 trawl stations were taken (fig. 3.1, table 3.2). 19 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**.** For the calculation of swept area indices, only the successful pre-defined bottom trawl stations were used. Those added up to 399 stations. There were 45 additional stations, not used in the swept area calculation; 14 unsuccessful hauls (either damage or malfunction of the gear), 2 non-predefined hauls for identification of acoustic records, 12 outside the strata system defined in Figure 2.1 (1 NE of Bear Island and 11 close to the Murman coast), and 17 taken for a special study in the "Grey Zone". Age sampling from these additional bottom trawl hauls and from pelagic hauls has been used in the calculations, as long as they were taken within the defined strata system.

Table 3.2 gives an account of the sampled length- and age material from pre-defined bottom trawl hauls, other bottom hauls and pelagic hauls.

One scientist from PINRO, Murmansk, participated onboard ”Johan Hjort” as long as the vessels were working in Russian EEZ.

Table 3.1. Area (n.miles^2) covered in the bottom trawl surveys in the Barents Sea winter 1981-2002.

	Main Area							Sum	
Year	A	B	C	D	D'	E	S	ABCD	Total
1981-1992	23299	8372	5348	51116	-	-	-	88135	88135
1993	23929	8372	5348	51186	23152	8965	16690	88835	137642
1994	27131	8372	5348	51186	24975	12576	14252	92037	143840
1995	27131	8372	5348	51186	56822	14859	22836	92037	186554
1996	25935	9701	5048	53932	53247	5818	11600	94616	165281
1997	27581	9701	5048	23592	2684	1954	16989	65922	87549
1998	27581	9701	5048	23592	5886	3819	23587	65922	99214
1999	27581	9701	5048	43786	7961	5772	18470	86116	118319
2000	27054	9701	5048	52836	28963	14148	24685	94639	162435
2001	26469	9701	5048	53932	29376	15717	23857	95150	164100
2002	26483	9701	5048	53932	21766	15611	24118	95165	156659

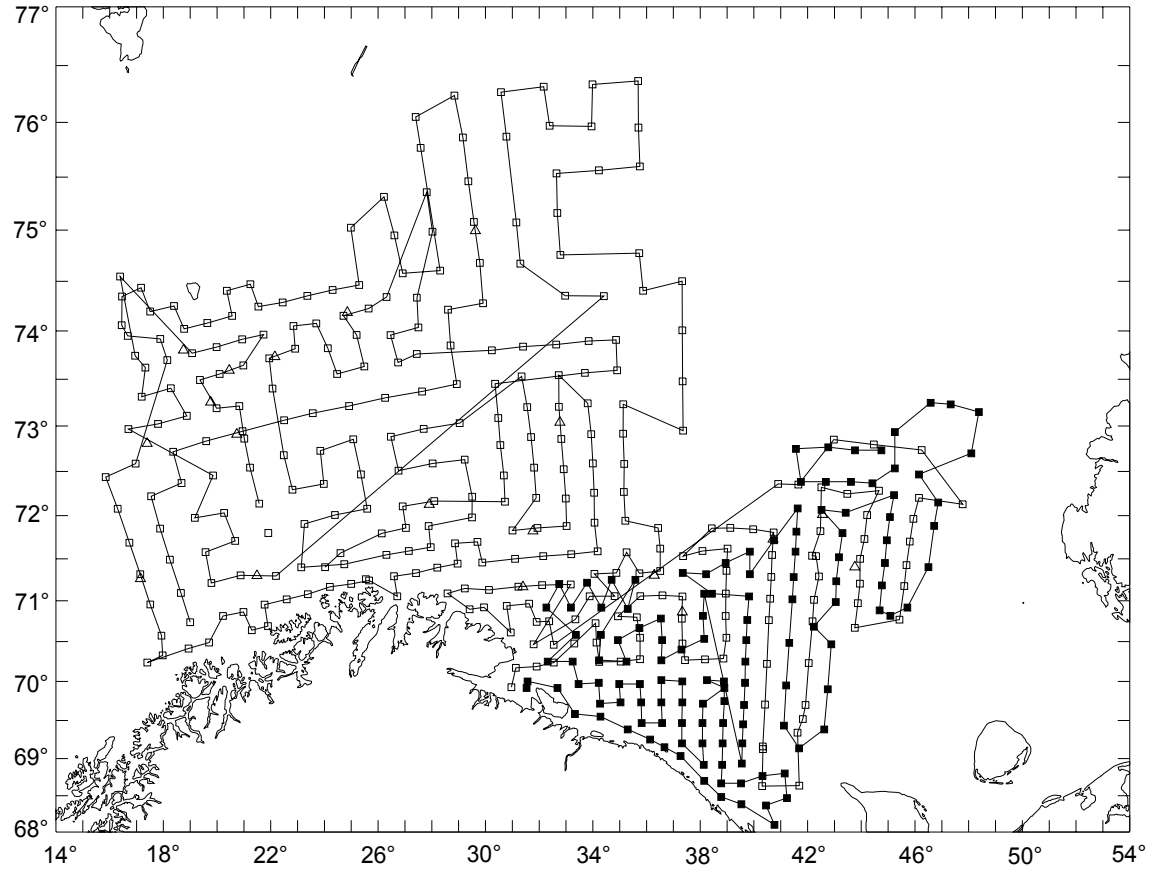

Figure 3.1. Survey tracks and trawl stations; R/V "G.O. Sars" and R/V "Johan Hjort" (open symbols) and R/V ”Persey 3” (filled symbols) 29.1-6.3.2002.

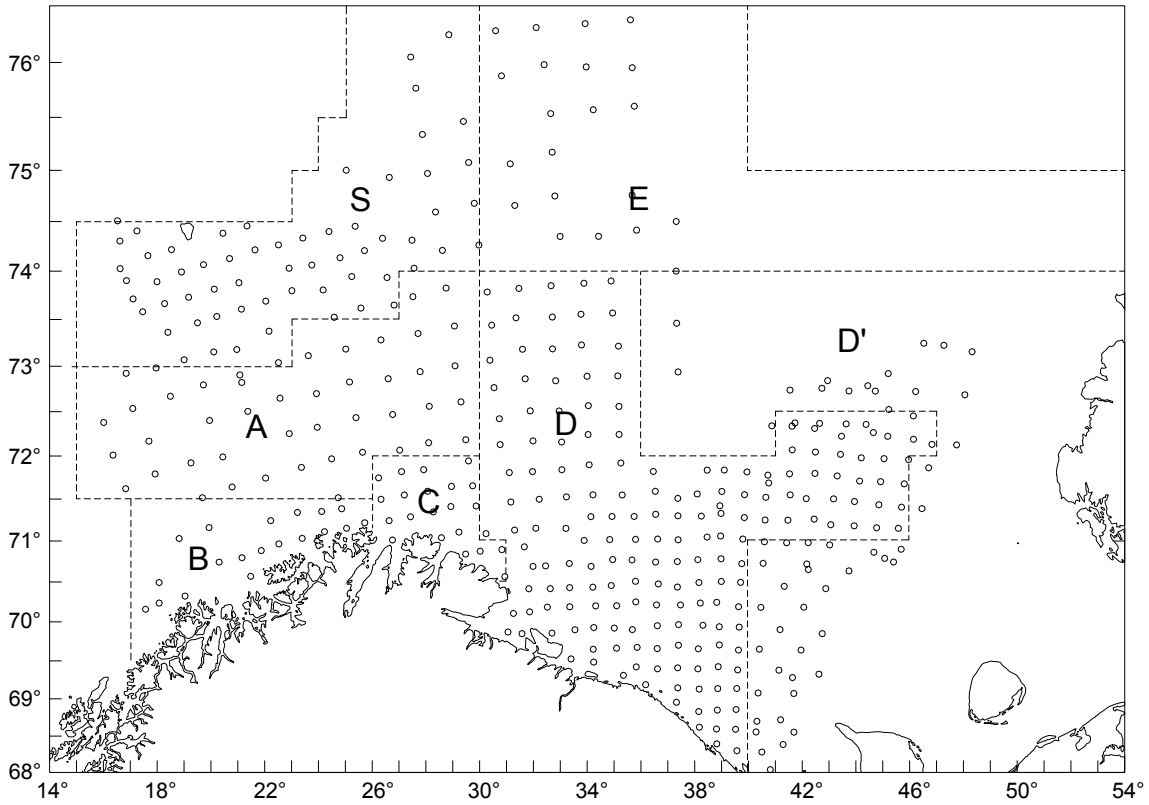

Figure 3.2. Bottom trawl stations used in the swept area estimation in 2002 and borders for the main areas.

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 2002. B1=fixed bottom trawl, B2=other bottom trawl, P=pelagic trawl.

Area	Trawl type	No. hauls	Cod		Haddock		S.marinus		S. mentella		Greenland halibut	
			L	A	L	A	L	A	L	A	L	A
A	B1	44	1960	409	3949	315	227	79	2089	300	42	23
	B2	5	0	0	0	0	0	0	0	0	0	0
	P	3	12	4	99	12	0	0	0	0	0	0
B	B1	20	615	163	1738	188	148	68	107	12	0	0
	B2	4	0	0	0	0	0	0	0	0	0	0
	P	2	2	0	7	4	0	0	0	0	0	0
C	B1	21	1210	232	2105	198	27	14	619	105	1	1
	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	182	29261	1846	38566	967	336	96	1275	218	208	125
	B2	29	2540	130	7570	75	151	0	45	0	2	0
	P	8	178	44	747	50	0	0	0	0	0	0
D'	B1	47	3471	143	403	30	11	6	0	0	18	12
	B2	4	126	13	3	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0
E	B1	21	1471	178	404	33	5	5	32	12	97	94
	B2	0	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0
S	B1	64	4551	566	2825	183	238	74	2491	380	320	236
	B2	3	0	0	0	0	0	0	0	0	0	0
	P	6	2	2	48	2	0	0	2	0	0	0
Total	B1	399	42539	3537	49990	1914	992	342	6613	1027	686	491
	B2	45	2666	143	7573	75	151	0	45	0	2	0
	P	19	194	50	901	68	0	0	2	0	0	0
Sum		463	45399	3730	58464	2057	1143	342	6660	1027	688	491

4. HYDROGRAPHY

Measurements of temperature and salinity where recorded for the whole water column on most of the pre-defined trawl stations.

Fig. 4.2 shows the drift ice border and temperature distribution close to surface, at 100 m depth and at the bottom. The Barents Sea was slightly colder in 2002 compared to the year before.

The standard hydrographical sections ”Fugløya-Bjørnøya” and “Vardø-north” taken at a Norwegian survey one or two weeks after the fish survey, showed moderate changes in mean temperature at 50-200 m depth, compared to the period 1999-2001. The Sem Islands section was only partly covered in 2002. This section was not covered in the 1997-1999.

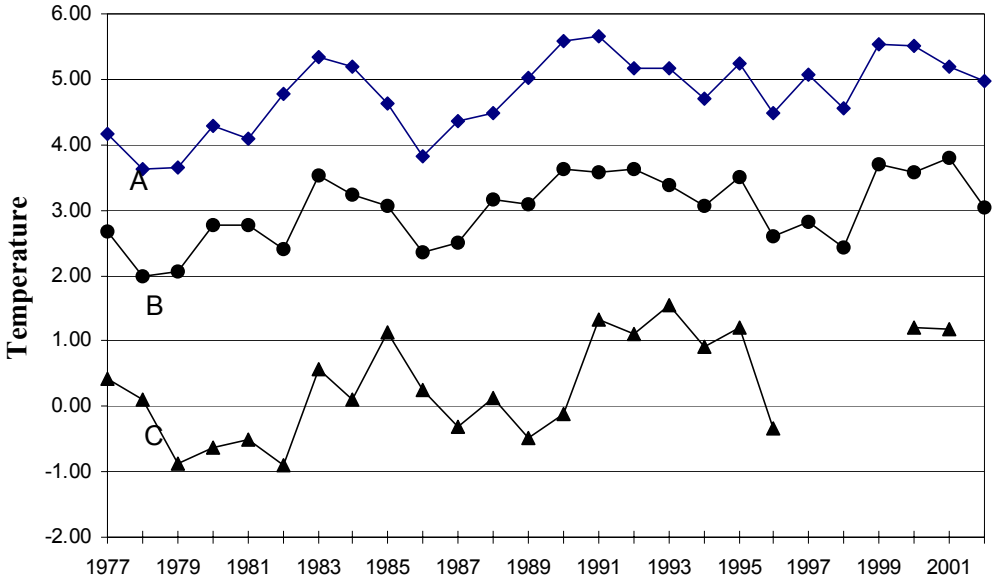

Fig.4.1. Mean temperatures in 50-200 m depth in 1977-2002. A) "Fugløya-Bjørnøya" in March, B) "Vardø-Nord" in March, C) Sem Islands in January-February.

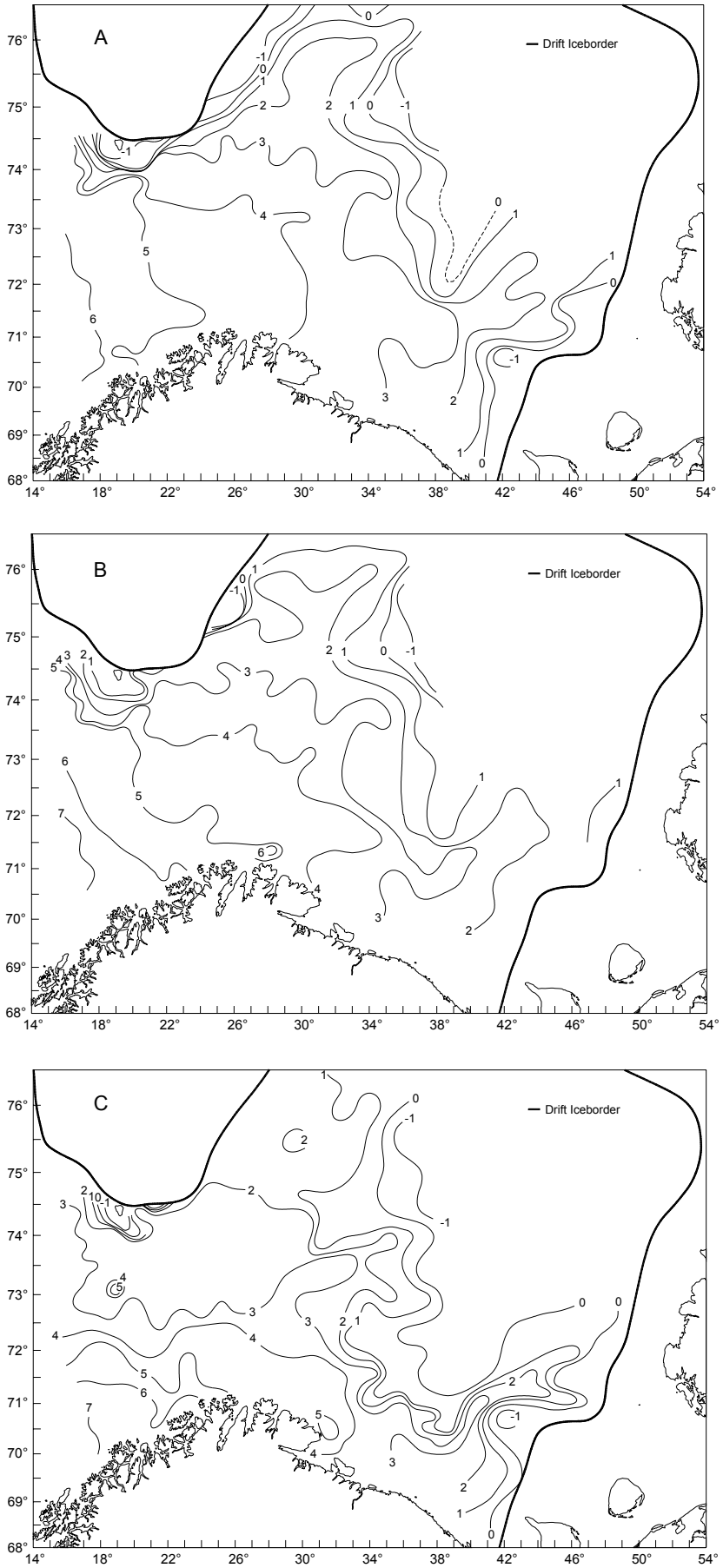

Figure 4.2. Temperature distribution February 2002. A) surface, B) 100 m depth, C) bottom.

5. TOTAL ECHO ABUNDANCE OF COD AND HADDOCK

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 distribution of cod was similar to the previous year. Very scattered recordings of cod were observed over most of the area covered by the survey, while the areas with dense recordings were quite limited.

Haddock had a wider distribution to the north than usual. The densest recordings were observed from Skolpen Bank to the Murman coast and east of Fugløy Bank.

Table 5.1 shows the echo abundance (echo density multiplied by area) distributed on main areas as well as on pelagic versus bottom channels. Compared to the 2001 survey (Aglen et al. 2002) the echo abundance of cod was rather similar in all main areas. The total value for cod has decreased by 7%. For haddock there was an increase in all main areas, except D', and the total value increased by 62%. For redfish there was a decrease in all areas, and the total value decreased by 60%.

Table 5.2 presents the time series of total echo abundance of cod and haddock in the investigated areas. The 2002 value for cod is above those from 1997 and 1999, but considerably below the values observed in the mid 90-ies. The value for haddock is the fourth highest among the ten latest years. The relative echo abundance for cod in the bottom channel (0-10 m above bottom) was 32%, which is close to the year before, but somewhat higher than in the years 1998-2000. The percentage of haddock in the bottom zone was 20, which is much less than in 2001 (43%), but not far from the average for the last ten years.

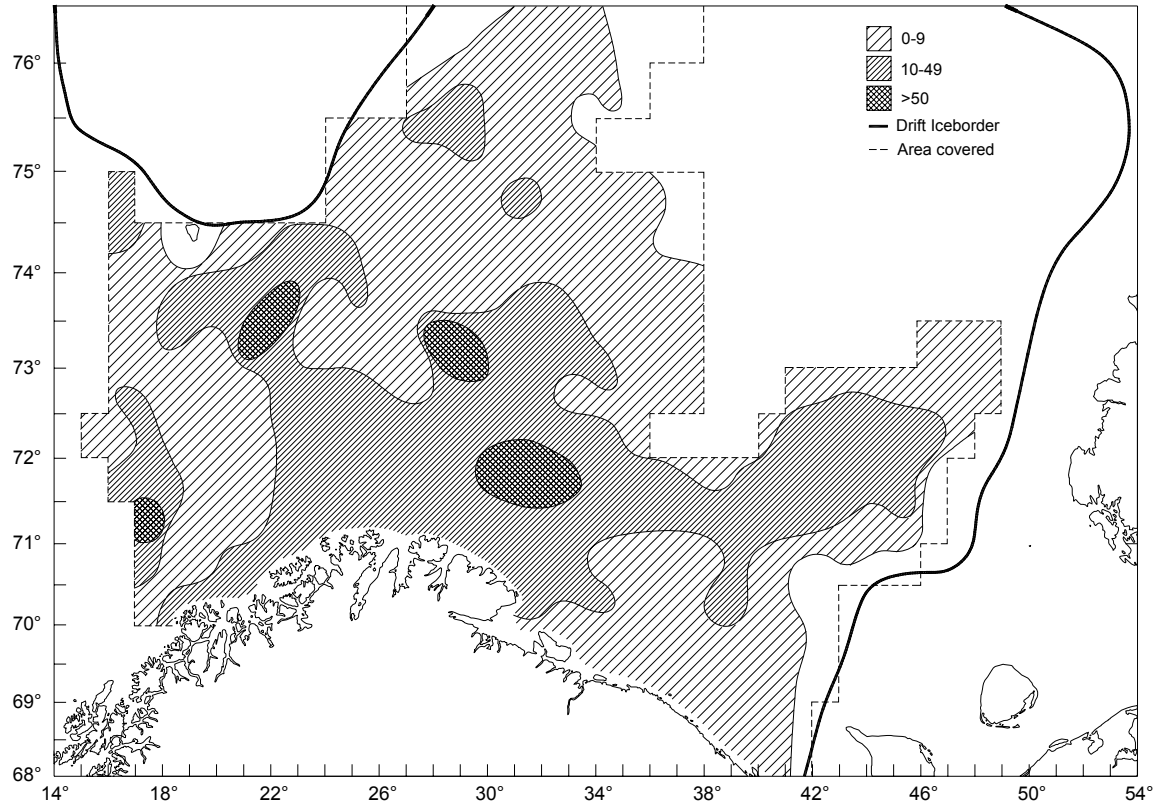

Figure 5.1. COD. Distribution of total echo abundance winter 2002. Unit is area back scattering surface (s_A) per square nautical mile (m^2/n.mile^2).

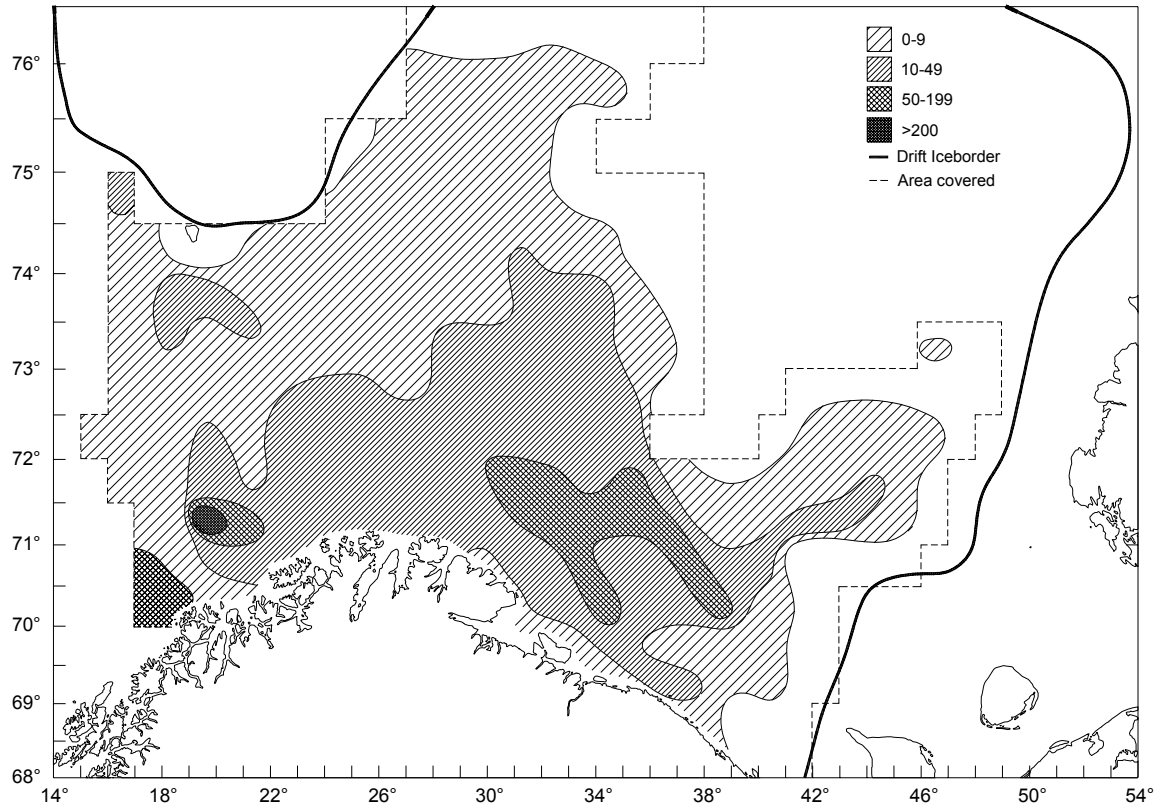

Figure 5.2. HADDOCK. Distribution of total echo abundance winter 2002. Unit is area back scattering surface (s_A) per square nautical mile (m^2/n.mile^2).

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 2002 (m^2 reflecting surface · 10^{-3}).

	Cod			Haddock			Redfish		
Area	P	B	Total	P	B	Total	P	B	Total
A	276	115	391	294	60	354	75	54	129
B	66	86	152	180	127	306	24	24	48
C	82	47	128	81	34	115	12	10	22
D	663	260	923	1191	214	1405	14	11	25
D'	39	24	63	11	15	25	+	0	+
E	17	28	45	18	7	25	+	+	1
S	173	66	239	77	21	98	65	26	91
Total	1316	627	1943	1851	477	2329	191	125	316

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 1981-2002 (m^2 reflecting surface · 10^{-3}). 1981 - 1992 includes mainly areas A, B, C and D.

	Echo abundance								
	Total			bottom			bottom/total		
Year	Cod	Had.	Sum	Cod	Had.	Sum	Cod	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
2001	2085	1440	3525	698	615	1313	0.34	0.43	0.37
2002	1943	2329	4272	627	477	1104	0.32	0.20	0.26

[1)] Norwegian EEZ and part of the Svalbard area

6. DISTRIBUTION AND ABUNDANCE OF COD

6.1 Acoustic estimation

Surveys in the Barents Sea at this time of the year mainly cover the immature part of the cod stock. Most of the mature cod (age 7 and older) have started on its spawning migration southwards out of the investigated area, and is therefore to a lesser extent covered.

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 (1981-2002) 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 ratios 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 ages 1 and 3 are the lowest estimated since the survey area was extended in 1993. For age 2 the index is 58% of the 1993-2001 average, and for age 4 it is 68% of that average. For ages 5-7 the indices are close to the 1993-2001 average.

Table 6.1. COD. Abundance indices at length and age from the acoustic survey in the Barents Sea winter 2002 (numbers in millions).

Length cm	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Sum
5-9	1.9										1.9
10-14	15.7	4.6									20.3
15-19	0.6	108.5									109.1
20-24		80.7	14.5								95.2
25-29		21.1	19.4	0.1							40.5
30-34		0.6	19.9	5.2	+						25.7
35-39			12.1	19.6	1.1						32.8
40-44			3.3	35.4	4.1						42.8
45-49				37.4	21.5	0.4					59.3
50-54				12.4	42.6	2.2					57.2
55-59				2.2	24.8	13.3	0.3	0.2			40.8
60-64				+	6.7	14.9	3.1	0.5			25.3
65-69					1.1	11.4	3.7	0.1			16.2
70-74					0.1	3.8	5.3	0.5			9.7
75-79						0.9	3.7	0.3	+		4.9
80-84						0.1	1.4	0.5	+	0.1	2.2
85-89						+	0.4	0.4	+	+	0.9
>90						+	0.1	0.4	0.3	0.2	1.0
Sum	18.2	215.5	69.3	112.2	102.0	47.0	18.0	3.0	0.4	0.2	585.9

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 2002 (numbers in millions).

Area	Layer	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Total
A	P	0.8	4.5	3.9	15.3	12.5	10.5	3.2	0.3	+	+	51.0
	B	0.3	1.6	1.3	5.8	5.1	4.5	1.5	0.2	+	+	20.4
B	P	0.7	0.3	0.4	0.8	1.9	2.3	2.1	0.4	+	0.1	9.0
	B	0.3	0.3	0.5	1.1	2.4	3.0	2.8	0.5	0.1	0.1	11.1
C	P	0.7	0.6	0.9	2.2	4.6	3.0	1.0	0.3		+	13.3
	B	0.4	0.3	0.4	1.1	2.6	1.8	0.6	0.2		+	7.4
D	P	5.5	92.2	33.2	43.5	38.0	13.0	3.4	0.6	0.1	+	229.5
	B	2.4	41.2	14.5	18.2	14.2	4.6	1.2	0.2	0.1	+	96.6
D'	P	0.9	25.7	3.1	1.7	0.5	0.1	+	+			32.1
	B	1.0	16.3	1.2	1.0	0.5	0.2	+	+			20.2
E	P	0.4	5.2	0.8	0.8	0.8	0.3	0.1	+	+	+	8.3
	B	0.7	8.3	1.2	1.3	1.2	0.5	0.2	+	+	+	13.4
S	P	2.3	11.0	5.5	13.9	13.0	2.5	1.4	0.1		+	49.7
	B	1.7	8.1	2.5	5.4	4.7	0.8	0.4	+			23.6
ABCD	P	7.7	97.6	38.4	61.8	57.0	28.8	9.7	1.6	0.2	0.1	302.9
	B	3.4	43.4	16.7	26.2	24.3	13.9	6.1	1.1	0.2	0.1	135.5
Total	P	11.4	139.5	47.7	78.2	71.2	31.7	11.3	1.8	0.2	0.1	393.2
	B	6.8	76.0	21.5	34.0	30.8	15.3	6.7	1.2	0.2	0.1	192.7
	Sum	18.2	215.5	69.3	112.2	102.0	47.0	18.0	3.0	0.4	0.3	585.9

Table 6.3. COD. Abundance indices from acoustic surveys in the Barents Sea winter 1981-2002 (numbers in millions). 1981-1992 includes mainly areas A, B C and D.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
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
2001	629.9	63.9	138.2	171.6	77.3	39.7	11.8	1.4	0.5	0.2	1134.7
2002	18.2	215.5	69.3	112.2	102.0	47.0	18.0	3.0	0.4	0.3	585.9

1) Indices raised to also represent the Russian EEZ.

6.2 Swept area estimation

Figs. 6.1-6.4 show the geographic distribution of bottom trawl catch rates (number of fish per 3 naut.mile, corresponding to 1 hours towing) for cod for each of the size groups < 20 cm, 20-34 cm, 35-49 cm and > 50 cm. As in previous years the greatest concentrations of the smallest cod (<20 cm) were found in the eastern part of the survey area within the Russian EEZ. Also the size groups 20-34 cm and 35-49 cm show highest densities in this eastern area. For cod larger than 50 cm the areas with catch rates above 100 per hour have increased slightly compared to the results from the 2001 survey. This is most pronounced in the eastern areas.

Table 6.4 presents the abundance indices by 5 cm length groups for each main area. Standard error and coefficient of variation (CV) are also given. The CV is lowest (7-9%) in the size range 30-79 cm and is below 17% for all size groups above 20 cm. 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. For age 4 and older the total indices are similar to the acoustic

observations (Table 6.3), while for ages 1-3 the swept area indices are higher than the acoustic indices.

The time series (1981-2002) 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 2002 results for ages 1 and 3 are the lowest observed since the survey area was extended in 1993. The result for age 2 and ages 4-7 are reasonably close to (77-109%) the 1993-2001 average.

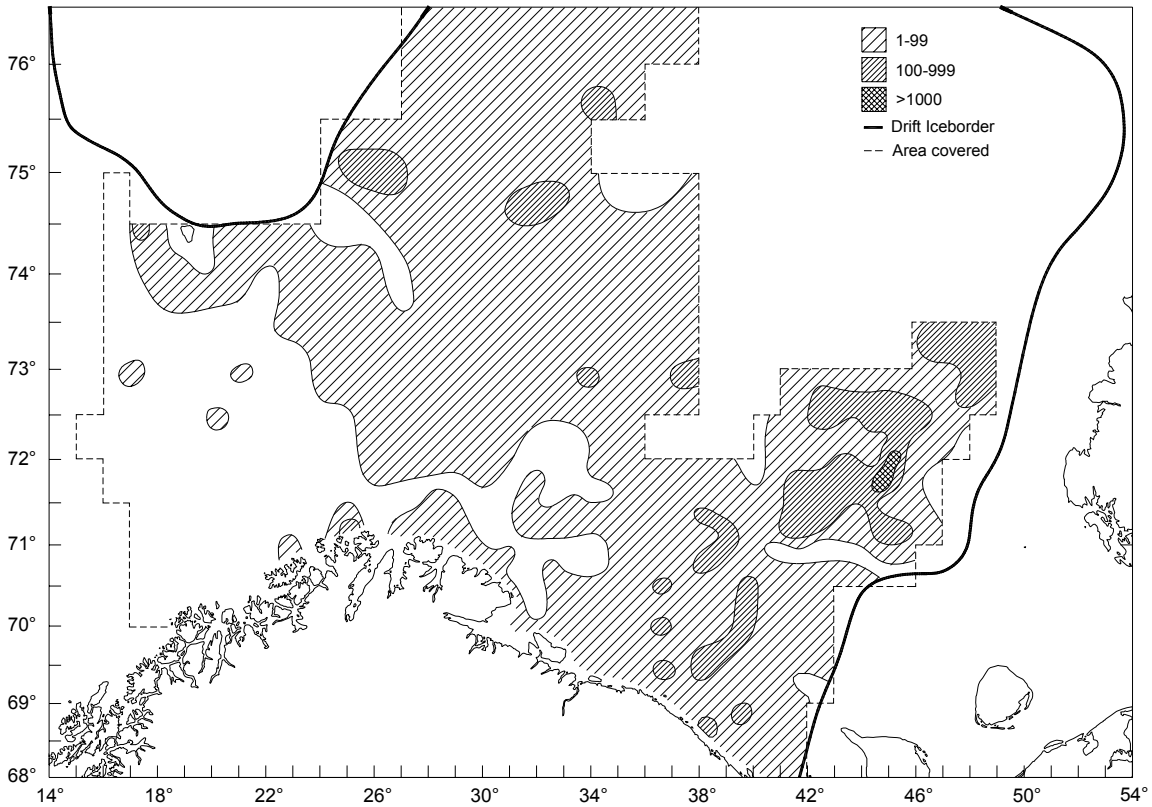

Figure 6.1. COD < 20 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

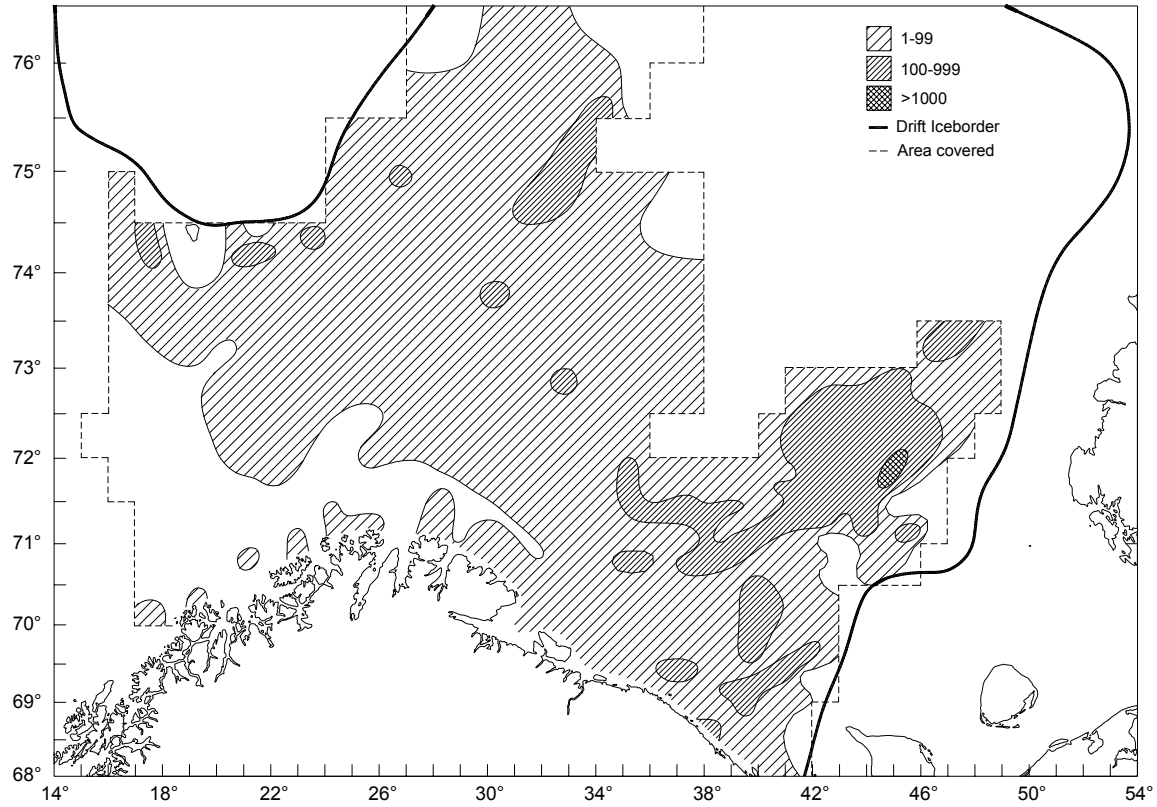

Figure 6.2. COD 20-34 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

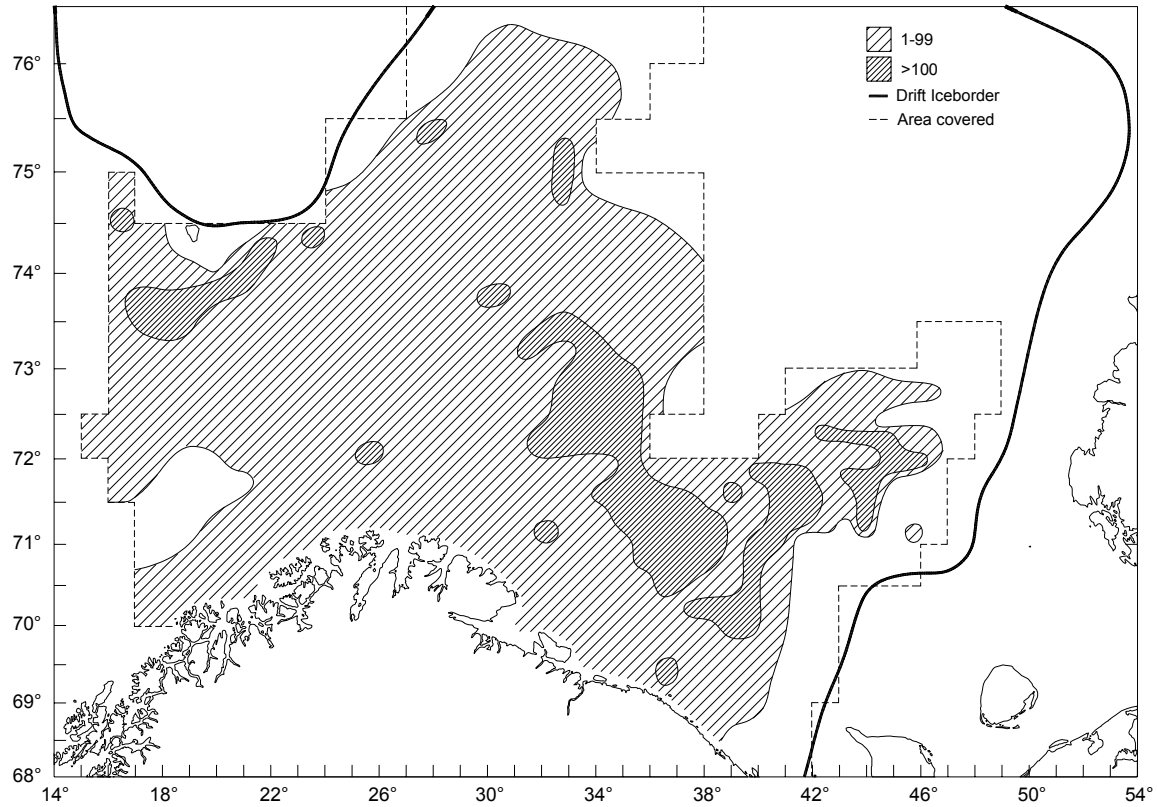

Figure 6.3. COD 35-49 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

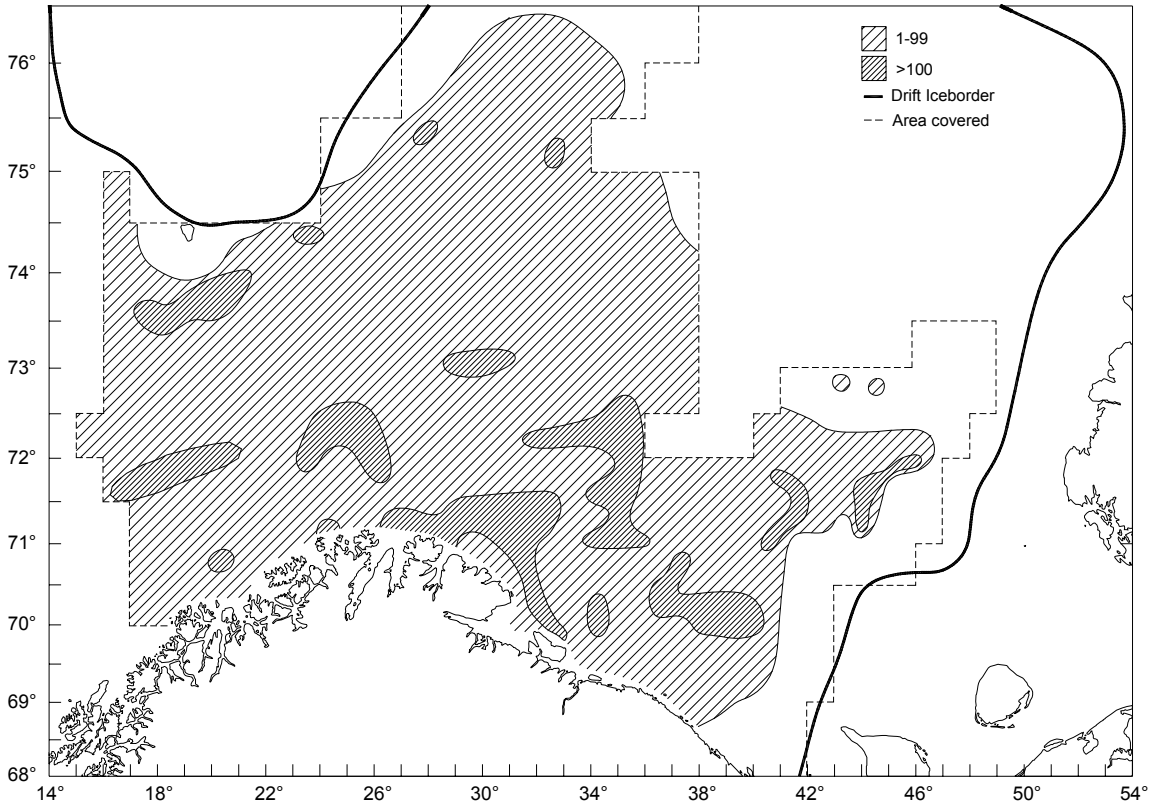

Figure 6.4. COD > 50 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

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 2002 (no. in millions).

Length	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	-	-	0.5	0.5	0.1	0.1	0.5	0.1	0.5	0.2	-	-	1.2	0.5	2.7	0.9	33.1
10-14	0.5	0.2	0.6	0.4	0.5	0.2	15.8	1.4	8.5	2.2	9.8	3.2	6.0	2.5	41.6	4.8	11.6
15-19	1.7	0.4	0.2	0.1	0.2	0.1	151.9	79.1	43.0	10.7	15.7	5.5	16.5	5.3	229.2	80.2	35.0
20-24	1.7	0.4	+	+	0.2	0.1	119.0	25.7	35.7	7.4	11.8	3.6	13.5	3.2	181.8	27.2	15.0
25-29	1.1	0.3	0.1	0.1	0.1	+	46.9	8.9	7.1	2.5	4.0	1.4	6.3	1.5	65.5	9.5	14.5
30-34	1.6	0.6	0.2	+	0.1	0.1	24.4	2.9	2.5	0.9	2.3	1.0	5.1	1.0	36.3	3.4	9.5
35-39	2.8	0.6	0.1	0.1	0.3	0.1	28.9	2.5	0.7	0.4	2.1	0.9	6.8	1.3	41.7	3.0	7.3
40-44	5.4	0.9	0.4	0.2	0.5	0.1	31.0	2.7	0.5	0.2	2.9	1.2	12.0	2.7	52.6	4.0	7.7
45-49	9.2	1.7	0.5	0.2	0.9	0.2	41.3	3.3	0.6	0.3	2.8	0.9	13.9	3.4	69.2	5.1	7.4
50-54	11.3	1.7	0.7	0.3	2.1	0.3	34.7	3.2	0.6	0.4	2.9	1.0	10.0	2.9	62.2	4.7	7.6
55-59	10.2	2.0	1.0	0.2	1.9	0.3	21.4	2.4	0.3	0.2	1.6	0.5	4.7	1.2	41.0	3.4	8.3
60-64	7.6	1.7	1.1	0.3	1.4	0.2	10.4	1.2	0.1	0.1	1.5	0.5	2.2	0.4	24.3	2.2	9.1
65-69	4.3	0.9	1.1	0.3	1.1	0.2	5.6	0.6	0.1	+	1.1	0.3	1.1	0.2	14.3	1.2	8.7
70-74	2.6	0.5	1.1	0.3	0.2	0.1	2.5	0.3	-	-	0.6	0.2	0.4	0.1	7.9	0.7	8.4
75-79	1.1	0.3	0.5	0.2	0.4	0.1	1.4	0.2	0.1	+	0.3	0.1	0.3	0.1	4.1	0.4	9.6
80-84	0.6	0.2	0.1	0.1	0.2	+	0.6	0.1	+	+	0.1	0.1	0.1	0.1	1.8	0.3	13.8
85-89	0.1	+	0.2	0.1	0.1	+	0.3	0.1	+	+	0.1	0.1	0.1	+	0.8	0.1	16.5
>90	0.1	0.1	0.2	0.2	0.1	+	0.3	0.2	-	-	+	+	+	+	0.7	0.1	16.8
Sum	61.8	4.0	8.5	0.9	10.8	0.6	536.8	84.0	100.2	13.5	59.5	7.9	100.0	8.9	877.6	86.0	9.8

Table 6.5. COD. Abundance indices at length and age from the bottom trawl survey in the Barents Sea winter 2001 (numbers in millions).

Length (cm)	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Sum
5-9	2.7										2.7
10-14	31.2	10.5									41.6
15-19	4.3	224.8									229.2
20-24		162.4	19.4								181.8
25-29		34.4	30.8	0.3							65.5
30-34		0.7	29.6	5.8	0.1						36.3
35-39			17.6	23.3	0.8						41.7
40-44			4.8	42.8	5.0						52.6
45-49				44.5	24.3	0.4					69.2
50-54				13.5	45.1	3.6					62.2
55-59				2.0	26.7	12.1	0.1	0.1			41.0
60-64				0.1	6.5	15.5	2.1	0.1			24.3
65-69					0.9	9.6	3.7	0.1			14.3
70-74					0.2	2.8	4.6	0.4			7.9
75-79						0.7	3.1	0.3	+		4.1
80-84						0.1	1.1	0.6	+	0.1	1.8
85-89						+	0.3	0.4	0.1	+	0.8
>90						+	0.1	0.3	0.2	0.1	0.7
Sum	38.2	432.8	102.2	132.2	109.6	44.7	15.0	2.4	0.3	0.2	877.6

Table 6.6. COD. Abundance indices from bottom trawl hauls for main areas of the Barents Sea winter 2002 (numbers in millions.)

Area	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Total
A	0.4	4.0	4.1	17.5	18.2	12.1	5.1	0.4	0.1	+	61.8
B	0.9	0.5	0.5	0.9	1.7	1.9	1.8	0.3	+	0.1	8.5
C	0.6	0.4	0.4	1.7	4.0	2.3	1.1	0.3	-	+	10.8
D	14.4	278.3	76.0	83.2	58.0	21.4	4.4	0.9	0.2	+	536.8
D'	8.4	82.5	6.5	1.7	0.7	0.3	0.1	+	-	-	100.2
E	6.4	33.8	4.9	4.7	5.8	2.8	0.9	0.2	0.1	+	59.5
S	7.1	33.3	9.9	22.6	21.1	4.0	1.7	0.2	-	-	100.0
ABCD	16.3	283.2	81.0	103.3	81.9	37.7	12.4	2.0	0.2	0.2	616.5
Total	38.2	432.8	102.2	132.2	109.6	44.7	15.0	2.4	0.3	0.2	877.6

Table 6.7. COD. Abundance indices from bottom trawl surveys in the Barents Sea winter 1981-2002 (numbers in millions). 1981-1992 includes only main areas A, B, C and D).

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
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
2001	657.9	76.6	191.1	182.8	83.4	38.2	8.9	1.1	0.4	0.2	1240.6
2002	38.2	432.8	102.2	132.2	109.6	44.7	15.0	2.4	0.3	0.2	877.6

1) Indices raised to also represent the Russian EEZ.

6.3 Growth

Table 6.8 and 6.10 show length and weight by age for each main area. In most years the largest fish at age has been observed in the south-western main areas (A, B and C). This pattern has been less evident in the two latest surveys. For age 8 there are few observations in some main area D' and E, and those mean lengths and weights are therefore more uncertain.

Tables 6.9 and 6.11 present the time series for mean length (1978-2002) and mean weight (1983-2002) at age for the entire investigated area. Weights at age were fairly low in the period 1995-2000, but increased somewhat in 2001. Mean length and weight for ages 2 and 3 showed a considerable increase from 2000 to 2001 and some decrease from 2001 to 2002. For these ages the 2002 weights are about 30% below the 1983-2001 average. For older fish the 2002 weights are about 10% below the 1983-2001 average. The annual weight increments observed over the last year are above those observed for the period 1994-2000, but still below those observed in the period 1990-1993 (Table 6.12).

Table 6.8. COD. Length (cm) at age in main areas of the Barents Sea winter 2002.

Area	Age (year-class)							
	1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)
A	11.6	20.2	34.1	46.3	54.1	62.2	71.5	78.4
B	10.8	18.9	37.4	48.6	56.7	65.2	72.2	79.9
C	10.9	20.5	36.3	47.3	55.5	64.5	73.7	70.6
D	12.4	20.0	29.5	43.2	52.2	61.0	71.9	80.6
D'	12.6	19.8	28.9	42.6	52.4	58.5	81.8	82.0
E	12.0	19.0	32.3	44.0	51.2	63.4	73.1	82.8
S	11.9	20.0	32.3	42.5	50.1	60.1	68.3	83.9
Total	12.2	19.9	30.1	43.6	52.2	61.7	71.6	79.1

Table 6.9. COD. Length (cm) at age in the Barents Sea from the investigations winter 1978 - 2002.

Year	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
2001	12.0	22.5	33.1	41.6	52.2	63.1	71.2	79.2
2002	12.2	19.9	30.1	43.6	52.2	61.7	71.6	79.1

1) *Adjusted lengths*

Table 6.10. COD. Weight (g) at age in main areas of the Barents Sea winter 2002.

Area	Age (year-class)							
	1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)
A	12	69	363	853	1333	1974	3092	3895
B	12	71	459	1083	1634	2433	3370	5079
C	11	78	441	909	1467	2299	3492	3232
D	15	68	244	740	1242	1991	3260	4751
D'	15	67	207	748	1265	1887	4286	6095
E	14	63	317	776	1217	2299	3554	5285
S	16	69	288	661	1056	1824	2682	5221
Total	15	68	256	747	1234	2024	3190	4511

Table 6.11. COD. Weight (g) at age in the Barents Sea from the investigations winter 1983-2002.

Year	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
2001	14	103	338	664	1257	2186	3145	4463
2002	15	68	256	747	1234	2024	3190	4511

[1)] Estimated weights
[2)] Adjusted weights

Table 6.12. COD. Yearly weightincrement (g) from the investigations in the Barents Sea winter 1983 - 2002.

Year	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
2000-01	86	261	454	698	997	1167	1474
2001-02	54	153	409	570	767	1004	1366

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 (the time series is adjusted for this) did also lead to more small fish relative to larger fish.

Table 6.13 gives the time series of survey based mortalities (log ratios between survey indices of the same year class in two successive years) since 1993. These mortalities are influenced both by natural and fishing mortality, as well as the true catchability at age for the survey. In the period 1993-1999 there was an increasing trend in the survey mortalities. The trend appears most consistent for the age groups 3-7 in the swept area estimates. The two latest surveys indicate that since 1999 the mortalities have decreased, at least for ages 1-4. Presumably the mortality of the youngest age groups (ages 1-3) is mainly caused by predation, while for the older age groups it is mainly caused by the fishery. Before 2001 the survey mortalities for age 4 and older were well above the mortalites estimated in the ICES assessment. Decreasing survey catchability at increasing age could be one reason for this. Another possible reason could be that the assessment does not include all sources of mortality, like discards, unreported catches, or poorly quantified predation. The 2002 survey indicates some reduced mortality also for ages 5 and 6.

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 1993-2001.

Year	Age							
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
	Acoustic investigations							
1993-94	0.62	0.35	-0.12	-0.01	0.53	0.54	0.78	1.08
1994-95	1.08	1.24	0.78	0.66	1.04	1.34	1.75	1.67
1995-96	2.04	1.15	0.86	0.62	1.03	1.21	1.79	1.95
1996-97	1.72	0.59	0.59	0.36	0.84	1.21	1.64	1.39
1997-98	0.94	0.01	0.03	0.20	0.39	0.32	0.49	0.86
1998-99	2.41	1.44	1.49	1.40	1.41	1.66	1.88	2.83
1999-00	0.48	0.22	-0.06	-0.39	-0.01	0.07	0.31	0.31
2000-01	0.88	0.47	0.36	0.72	1.28	1.35	1.93	2.24
2001-02	1.07	-0.08	0.21	0.52	0.50	0.79	1.37	1.36
	Bottomtrawl investigations							
1993-94	0.00	0.35	-0.12	-0.05	0.36	0.53	0.95	0.89
1994-95	0.65	0.67	0.21	0.19	0.65	1.01	1.35	1.10
1995-96	2.00	1.16	0.87	0.57	0.88	1.16	1.85	1.79
1996-97	1.71	1.09	0.98	0.49	0.96	1.32	1.44	1.17
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	1.38	1.25	1.97
1999-00	0.67	0.37	0.47	0.47	0.77	1.14	1.18	1.45
2000-01	0.52	0.26	0.25	0.46	1.04	1.11	1.36	1.61
2001-02	0.42	-0.29	0.37	0.51	0.62	0.93	1.31	1.30

7. DISTRIBUTION AND ABUNDANCE OF HADDOCK

7.1 Acoustic estimation

As for cod it is expected that the survey best covers the immature part of the stock. At this time of the year a large proportion of the mature haddock (age 6 and older) are on its spawning migration southwestwards out of the investigated area. There are indications that the distribution of age groups 1 and 2 in some years are concentrated in coastal areas not well covered by the survey. This year small haddock was widely distributed, and was found unusually far to the north. This might be caused by rather favourably hydrographic conditions far to the north (Figure 4.2).

Table 7.1 shows the acoustic abundance indices by length and age, and table 7.2 presents the indices by age within the main areas for the pelagic layer and the bottom layer. As in most of the previous years the highest abundance was observed in main area D. The time series (1981-2002), with adjusted indices for 1997 and 1998, is presented in table 7.3. The indices for ages 1, 2 and 3 are well above the 1993-2001 average, while the indices are well below this average for age 6 and older. The indices for ages 4 and 5 are closer to that average (117 and 74%, respectively).

Table 7.1. HADDOCK. Abundance indices at length and age from the acoustic survey in the Barents Sea winter 2001 (numbers in millions).

Length (cm)	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Sum
5-9	+										+
10-14	691.7										691.7
15-19	1369.1	35.0									1404.1
20-24	0.9	205.9	27.1								233.9
25-29		40.9	86.8	0.6							128.7
30-34		0.2	81.5	14.0	0.1						95.9
35-39			18.4	40.9	0.9	0.2					60.5
40-44			1.8	64.7	2.5	0.2					69.2
45-49			0.1	26.4	7.3	1.3					35.2
50-54				2.6	2.0	5.8	0.3	+		+	10.8
55-59				0.2	0.6	3.6	0.4			0.1	4.9
60-64						0.3	0.2	0.1	+	0.1	0.8
65-69						0.2	0.1	+	+	0.4	0.7
70-74							+			+	0.1
75-79											
80-84											
85-89											
>90											
Sum	2062.1	282.0	215.7	149.5	13.5	11.7	1.0	0.2	+	0.7	2736.5

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 2002 (numbers in millions).

Area	Layer	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Total
A	P	345.7	17.8	8.9	15.0	3.6	2.4	0.3	0.1	+	0.1	393.9
	B	69.8	3.5	1.8	3.1	0.8	0.6	0.1	+	+	+	79.6
B	P	193.0	11.0	4.6	8.7	1.4	3.4	0.1	-	-	0.2	222.4
	B	139.9	9.2	3.5	5.6	0.9	2.2	+	-	-	0.2	161.6
C	P	70.6	4.4	1.8	7.6	0.9	0.8	0.2	+	-	+	86.3
	B	30.0	1.8	0.6	3.2	0.4	0.4	0.1	+	-	+	36.4
D	P	874.4	179.3	158.7	85.3	4.5	1.6	0.2	+	+	0.1	1304.2
	B	148.5	30.9	29.0	16.6	0.8	0.3	+	+	+	+	226.2
D'	P	1.5	4.6	1.3	0.6	0.1	+					8.0
	B	2.8	6.4	1.6	0.7	0.1	+					11.6
E	P	32.8	1.1	0.5	0.2	+	+	+				34.7
	B	11.2	0.5	0.3	0.1	+	+					12.1
S	P	112.8	9.3	2.3	2.1		0.1	+			+	126.6
	B	29.1	2.4	0.8	0.7		+	+			+	33.0
ABCD	P	1483.7	212.4	174.0	116.6	10.5	8.2	0.7	0.2	+	0.4	2006.8
	B	388.3	45.4	34.9	28.4	2.9	3.4	0.2	+	+	0.2	503.8
Total	P	1630.8	227.4	178.1	119.5	10.6	8.2	0.8	0.2	+	0.5	2176.0
	B	431.4	54.6	37.6	30.0	3.0	3.4	0.2	+	+	0.2	560.5
	Sum	2062.2	282.0	215.7	149.5	13.5	11.7	1.0	0.2	+	0.7	2736.5

Table 7.3. HADDOCK. Abundance indices from acoustic surveys in the Barents Sea winter 1981-2002 (numbers in millions). 1981-1992 includes mainly areas A, B, C and D.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
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
2001	976	316	210	23	22	1	1	+	+	1	1549
2002	2062	282	216	149	14	12	1	+	+	1	2737

1) Indices raised to also represent the Russian EEZ.

7.2 Swept area estimation

Figs. 7.1 - 7.4 show the geographic distribution of bottom trawl catch rates (number of fish per 3 naut.mile, corresponding to 1 hours towing) for haddock for each of the size groups < 20 cm, 20-34 cm, 35-49 cm and > 50 cm. As in 2001, the distribution extends further than usual to the north, especially for the size groups <20 cm and 20-34 cm.

Table 7.4 presents the abundance indices by 5 cm length groups for each main area. Standard error and coefficient of variation (CV) are also given. The CVs for haddock are generally higher than those for cod. Within the size range 10-59 cm the CVs are between 8 and 15%.

Table 7.5 shows 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 (1981-2001) is shown in table 7.7. The indices for 1997 and 1998 are adjusted the same way as for cod to also represent the Russian EEZ.

Relative to the 1993-2001 average age 4 appears more abundant and age 5 less abundant in the swept area results compared to the acoustic results (table 7.3).

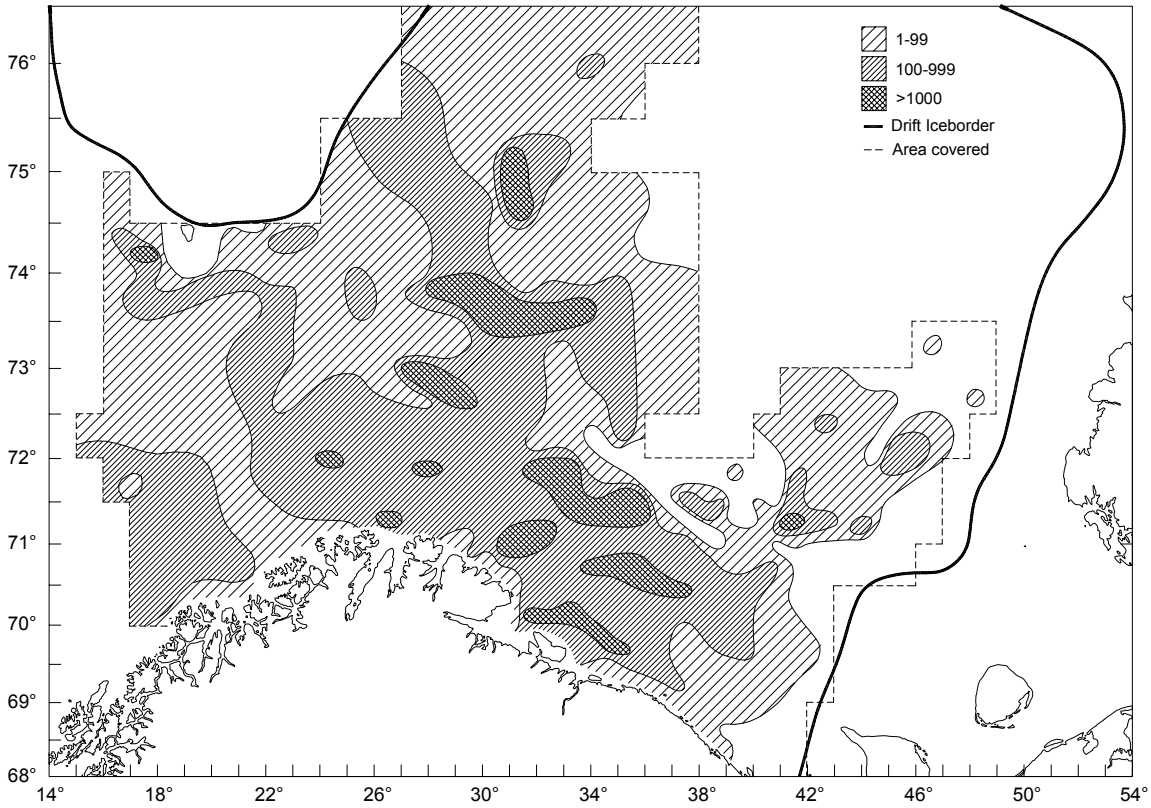

Figure 7.1. HADDOCK < 20 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

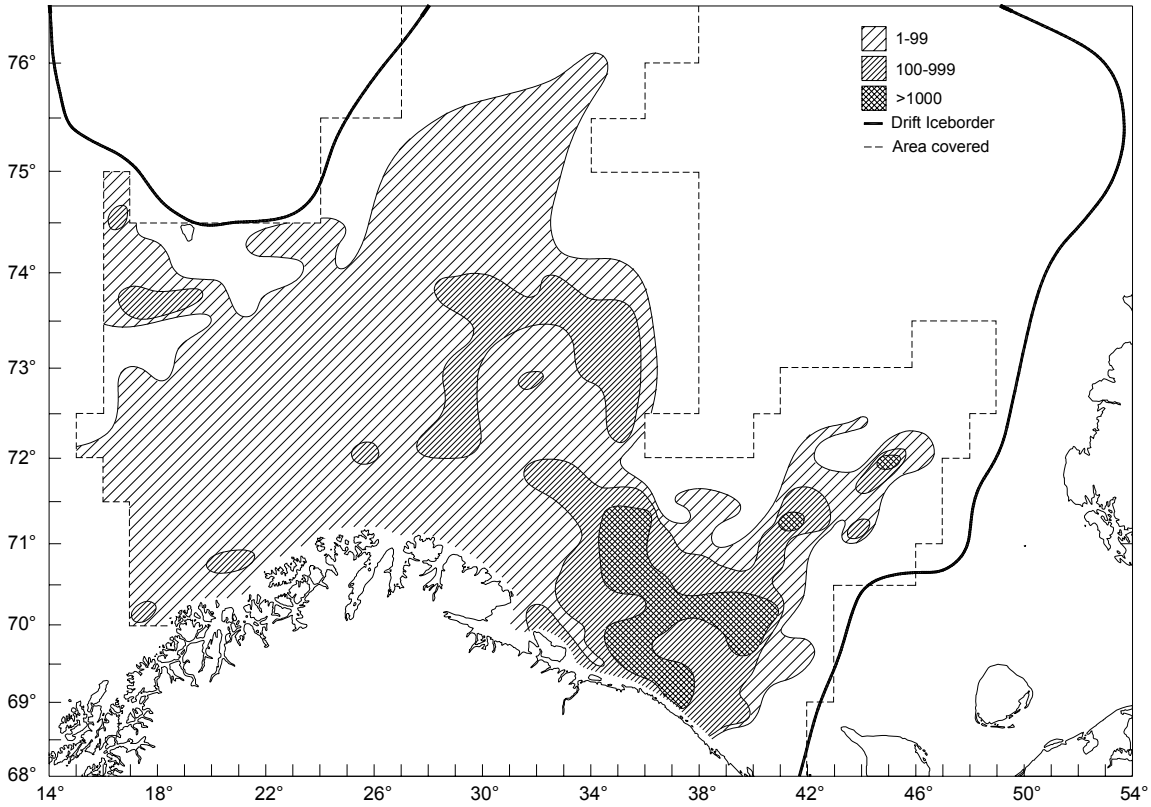

Figure 7.2. HADDOCK 20-34 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

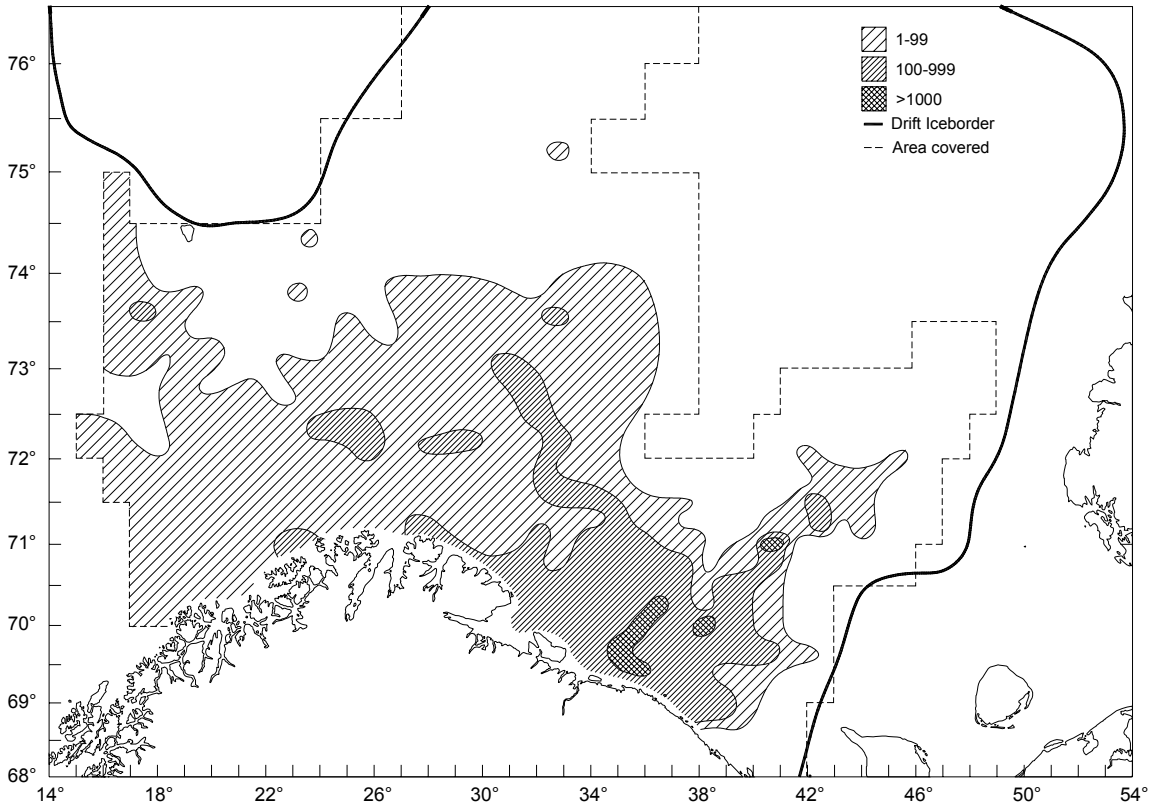

Figure 7.3. HADDOCK 35-49 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

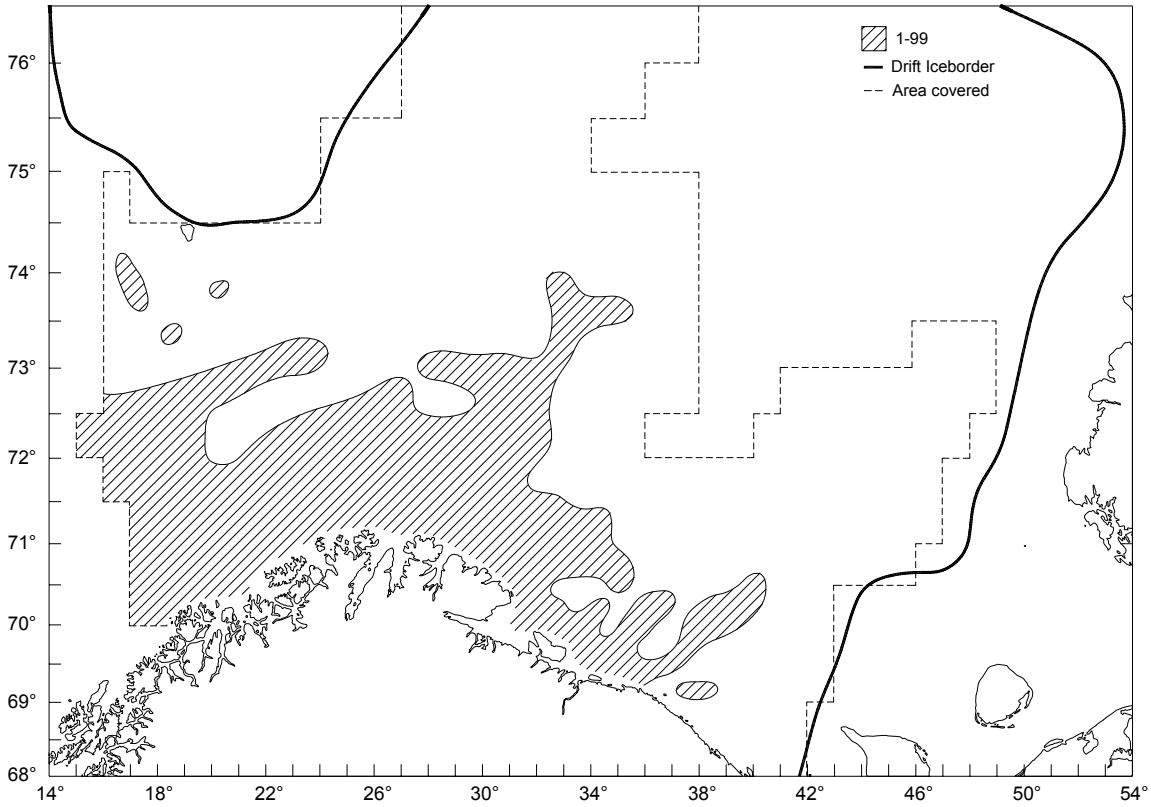

Figure 7.4. HADDOCK > 50 cm. Distribution in the trawl catches winter 2002 (number per hour trawling).

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 2002 (no. in mill).*

Length	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	0.1	0.1	0.1	100.0
10-14	139.7	38.5	22.7	6.0	25.2	7.7	330.8	50.8	3.0	1.2	45.3	23.0	53.9	9.1	620.5	69.0	11.1
15-19	248.7	37.5	54.4	10.5	55.0	19.2	748.4	92.1	6.2	2.6	48.6	25.3	81.4	15.4	1242.8	106.0	8.5
20-24	17.0	2.5	6.6	2.1	2.1	0.6	275.0	32.7	16.7	14.6	1.8	1.0	5.4	1.3	324.6	36.0	11.1
25-29	9.6	1.5	1.4	0.5	0.7	0.2	158.1	17.3	13.4	12.7	0.6	0.4	3.2	1.1	186.9	21.6	11.5
30-34	5.4	1.0	1.0	0.3	0.5	0.1	135.4	16.5	5.2	3.5	0.1	0.1	1.8	0.6	149.4	16.9	11.3
35-39	5.2	1.3	0.5	0.2	1.2	0.3	77.8	8.9	2.0	1.2	+	+	1.0	0.4	87.6	9.1	10.3
40-44	8.9	2.2	1.5	0.5	2.9	0.7	72.0	8.9	1.5	0.9			1.0	0.4	87.7	9.3	10.5
45-49	6.8	2.1	2.9	1.6	2.6	0.7	19.0	2.5	0.4	0.3			0.4	0.2	32.1	3.7	11.7
50-54	2.3	0.6	1.3	0.5	0.8	0.3	1.9	0.4					+	+	6.4	0.9	14.2
55-59	1.3	0.4	0.6	0.2	0.4	0.1	0.6	0.2					0.1	0.1	2.9	0.4	14.6
60-64	0.3	0.1	+	+	0.1	0.1	0.3	0.1					+	+	0.8	0.2	22.0
65-69	0.1	0.1	0.1	0.1	+	+	0.1	0.1							0.3	0.1	36.5
70-74					+	+	0.1	+							0.1	+	56.6
75-79																	
80-84																	
85-89																	
>90																	
Sum	445.3	53.9	93.0	12.4	91.6	20.7	1819.5	113.4	48.3	19.9	96.3	34.2	158.1	18.0	2742.2	135.0	4.9

Table 7.5. HADDOCK. Abundance indices at length and age from the bottom trawl survey in the Barents Sea winter 2001 (numbers in millions).

Length (cm)	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Sum
5-9	0.1										0.2
10-14	620.5										619.0
15-19	1056.7	186.1									1242.7
20-24	1.5	295.5	27.6								325.5
25-29	1.5	53.1	131.9	0.5							187.4
30-34		0.1	128.8	18.8	1.8						150.1
35-39			25.4	58.6	2.6	1.0					88.7
40-44			0.8	83.5	3.3	0.1					88.4
45-49			0.2	22.3	7.6	2.0					32.5
50-54				1.5	1.8	2.8	0.2	0.1		+	6.4
55-59				0.1	0.5	2.0	0.3			+	2.9
60-64						0.3	0.2	0.1	+	0.1	0.8
65-69						0.1	0.1	+	+	0.1	0.3
70-74							+			+	0.1
75-79											
Sum	1680.3	534.7	314.7	185.3	17.6	8.2	0.8	0.3	+	0.3	2742.2

Table 7.6 HADDOCK. Abundance indices from bottom trawl hauls for main areas of the Barents Sea winter 2002 (numbers in millions).

.

Area	Age (year-class) 1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)	9 (93)	10+	Total
A	381.0	28.0	11.5	18.0	3.5	2.5	0.4	0.2	+	0.1	445.3
B	77.1	5.4	3.1	4.7	1.0	1.6	+	-	-	0.1	93.0
C	75.0	7.5	1.4	5.7	1.0	0.9	0.2	+	-	+	91.6
D	919.0	444.2	289.1	152.0	11.7	3.2	0.2	0.1	+	0.1	1819.5
D'	7.4	31.9	6.0	2.7	0.4						48.3
E	89.8	6.0	0.6	+							96.3
S	131.1	11.8	3.0	2.1		0.1	+			+	148.1
ABCD	1459.5	517.0	311.1	183.1	17.6	8.2	0.8	0.3	0.0	0.3	2497.7
Total	1680.3	534.7	314.7	185.3	17.6	8.2	0.8	0.3	+	0.3	2742.2

Table 7.7. HADDOCK. Abundance indices from bottom trawl surveys in the Barents Sea winter 1981-2001 (numbers in millions). 1981-1992 includes only main areas A, B, C and D.

Year	Age										
	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
2001	1216.5	460.4	297.0	29.4	25.4	1.7	0.9	0.1	0.1	0.3	2031.7
2002	1680.3	534.7	314.7	185.3	17.6	8.2	0.8	0.3	+	0.3	2742.2

1) Indices raised to also represent the Russian EEZ.

7.3 Growth

Mean length and weight at age for each main area are shown in table 7.8 and 7.10. For some age groups mean length and weight at age are greatest in the east. This was also observed in 2001, but has been rather uncommon in earlier years.

The time series (1983-2002, tables 7.9 and 7.11) shows that the slightly increasing trend over the years 1997-2000 has stopped, and for several age groups a decrease was observed in 2001 and 2002.

Table 7.8. HADDOCK. Length (cm) at age in main areas of the Barents Sea winter 2002.

Area	Age (year-class)							
	1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)
A	15.7	22.0	29.7	41.6	47.4	53.8	57.9	58.4
B	15.8	22.3	27.4	42.5	47.1	52.1	55.0	-
C	15.6	19.9	31.7	43.0	47.0	52.8	55.5	68.0
D	15.4	20.9	29.5	39.8	42.8	47.4	61.8	62.0
D'	15.0	23.8	31.8	40.3	40.0	-	-	-
E	14.8	20.1	27.7	36.0	-	-	-	-
S	15.1	21.8	31.2	40.7	-	55.0	61.0	-
Total	15.5	21.1	29.6	40.2	44.2	50.9	58.4	59.4

Table 7.9. HADDOCK. Length (cm) at age in the Barents Sea from the investigations winter 1983 – 2001.

Year	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	51.1
2001	14.6	22.2	32.2	37.8	47.2	51.3	58.6
2002	15.5	21.1	29.6	40.2	44.2	50.9	58.4

[1)] Adjusted lengths

Table 7.10. HADDOCK. Weight (g) at age in main areas of the Barents Sea winter 2002.

Area	Age (year-class)							
	1 (01)	2 (00)	3 (99)	4 (98)	5 (97)	6 (96)	7 (95)	8 (94)
A	32	94	243	686	987	1492	1943	1818
B	32	96	209	802	1031	1463	1355	-
C	32	71	310	765	993	1498	1548	3315
D	30	81	243	605	786	1114	2383	2634
D'	31	116	286	616	586	-	-	-
E	25	69	192	355	-	-	-	-
S	30	97	295	652	-	1575	1920	-
Total	30	84	244	623	848	1341	1938	2032

Table 7.11. *HADDOCK. Weight (g) at age in the Barents Sea from the investigations winter 1983 - 2001.*

	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
2001	28	106	337	557	1100	1439	2073
2002	30	84	244	623	848	1341	2032

1) Estimated weights
2) Adjusted weights

Table 7.12. HADDOCK. Yearly weight increment (g) from the investigations in the Barents Sea winter 1983 - 2001.

	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
2000-01	74	229	288	380	371	732
2001-02	56	138	286	291	241	499

7.4 Conclusion

Survey mortalities based on the acoustic indices (tables 7.13) have varied between years, and for most age groups there is no obvious trend. Mortalities based on the swept area indices show a decreasing trend since 1998 (table 7.13).

Concerning the abundance indices it can be concluded that the recruitment to the stock is improving. All the year classes 1998-2001 are above average. The indices for the oldest age groups are, however, rather low. Mean lengths and weights at age are close to previous year's values.

Table 7.13. Total mortality observed for haddock during the winter survey in the Barents Sea for the period 1993-2001.

Year	Age						
	1-2	2-3	3-4	4-5	5-6	6-7	7-8
	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	1.10	1.61	1.87
1999-00	0.52	0.36	-0.13	-0.38	0.24	0.69	0.00
2000-01	1.18	0.89	0.33	1.10	2.68	2.50	2.96
2001-02	1.24	0.38	0.34	0.54	0.61	0.24	1.57
	Bottom trawl investigations						
1993-94	1.16	0.57	0.15	0.75	1.13	1.10	1.39
1994-95	1.21	1.45	0.69	0.25	0.37	0.19	-
1995-96	1.71	1.23	0.11	0.14	0.29	1.09	1.13
1996-97	1.52	1.12	0.63	0.91	1.16	1.40	1.20
1997-98	2.22	1.10	0.95	0.75	1.74	1.76	2.04
1998-99	1.31	0.84	0.62	1.18	1.55	1.22	1.55
1999-00	1.01	0.75	0.52	0.37	0.94	1.25	1.20
2000-01	0.61	0.42	-0.08	0.33	1.60	1.49	2.08
2001-02	0.82	0.38	0.47	0.51	1.13	0.75	1.10

8. DISTRIBUTION AND ABUNDANCE OF REDFISH

8.1 Acoustic estimation

The geographical distribution of echo abundance is shown in figure 8.1 for the golden redfish (*Sebastes marinus*), and in figure 8.2 for the deep-sea redfish (*S. mentella*). The maps indicate reduced densities of redfish compared to the combined map for the 2001 survey (Aglen *et al*. 2002)

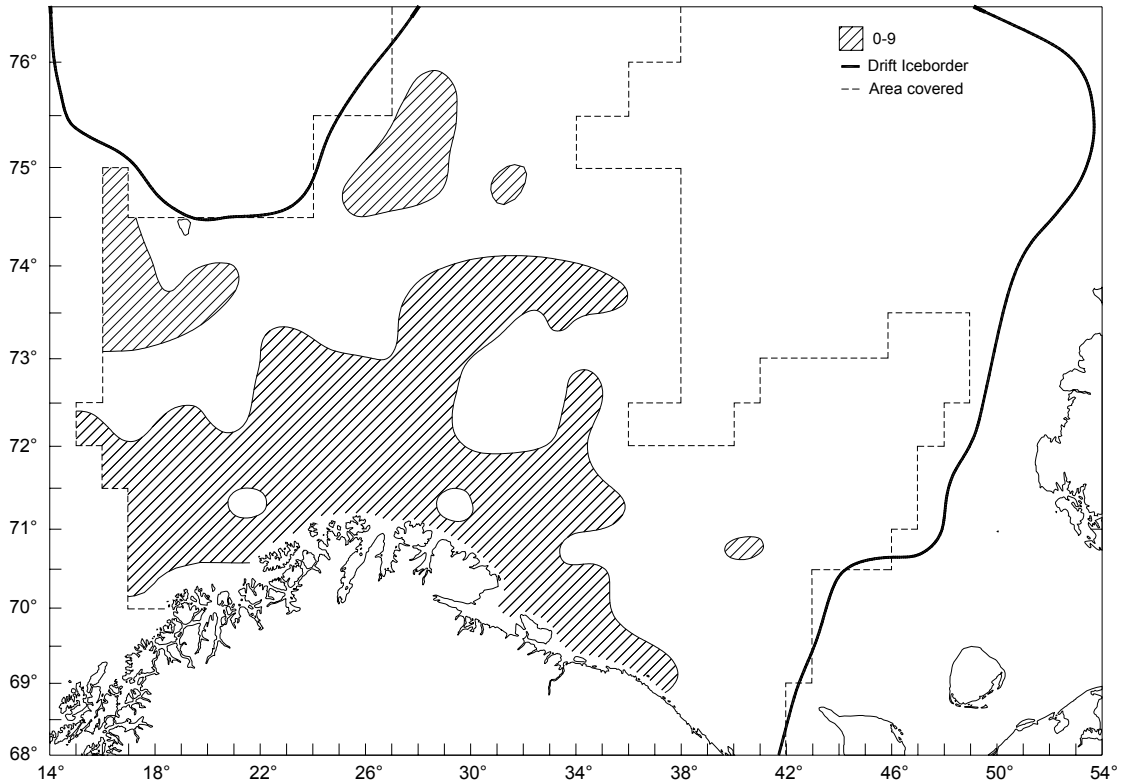

Figure 8.1. *Sebastes marinus*. Distribution of total echo abundance winter 2002. Unit is area back scattering surface (s_A) per square nautical mile (m^2/n.mile^2).

Table 8.1 shows the acoustic indices for ***S. marinus*** by length-groups and main areas. 91% of the fish were recorded 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. 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 adjustments of the indices for 1997 and 1998 are therefore more precise for *S. marinus* than for cod and haddock. The total index is very low, only 27% of the 1993-1996 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 2002 (numbers in millions).

Area	Length group (cm)								Total
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	>45	
A	0.1	0.2	0.1	0.2	0.6	1.1	2.0	1.4	5.6
B	0.1	0.4	0.3	0.7	0.8	0.8	1.2	0.5	4.7
C	+	+	+	+	+	0.1	0.1	0.1	0.5
D	0.2	0.3	0.4	0.7	1.1	0.8	0.3	0.2	3.9
D'	-	+	0.1	+	+	-	-	-	0.1
E	-	+	+	+	-	+	-	+	+
S	+	0.1	0.1	0.4	0.3	0.2	0.1	0.1	1.3
ABCD	0.4	0.8	0.8	1.6	2.6	2.7	3.6	2.2	14.8
Total	0.4	0.9	1.1	2.1	2.9	2.9	3.7	2.3	16.2

Table 8.2. SEBASTES MARINUS. Abundance indices from acoustic surveys in the Barents Sea winter 1986-2002 (numbers in millions). 1986-1992 includes only the area covered in 1986.

Year	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
2001	+	1	3	6	7	7	6	3	32
2002	+	1	1	2	3	3	4	2	16

[1)] Indices raised to also represent the Russian EEZ.

The acoustic index for ***S. mentella*** by main area (table 8.3) show that main area A and S contributed most to the total value. Main area S represented 48% of the total estimate and the value is considerably higher compared to two previous years. In 1996 and 1999, 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 of the lack of coverage in the Russian EEZ in 1997 and 1998 (table 8.4). For the length groups between 20 and 34 cm the acoustic index is considerably reduced compared to 2001. The index for 10-14 cm is the lowest observed.

Table 8.3. SEBASTES MENTELLA.[1] Acoustic abundance indices for main areas of the Barents Sea winter 2002 (numbers in millions).

Area	Length group (cm)								Total
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	>45	
A	0.7	2.4	10.7	25.5	22.3	3.4	0.2	-	65.3
B	0.1	0.1	1.1	5.2	3.3	0.9	+	-	10.6
C	0.1	0.9	0.3	5.5	3.5	1.3	0.1	+	11.8
D	0.8	4.1	1.1	4.4	2.1	0.7	+	-	13.2
D'	+	+	+	+	-	+	-	-	+
E	0.1	0.2	0.1	0.1	+	+	+	-	0.5
S	2.4	4.2	17.5	34.0	28.9	5.9	0.3	+	93.1
ABCD	1.7	7.5	13.1	40.6	31.2	6.3	0.4	+	100.9
Total	4.1	11.8	30.8	74.7	60.1	12.2	0.8	+	194.5

1) Includes unidentified Sebastes specimens, mostly less than 15 cm.

Table 8.4. SEBASTES MENTELLA.[1] Abundance indices from acoustic surveys in the Barents Sea winter 1988-2002 (numbers in millions).) 1986-1992 includes only the area covered in 1986.

Year	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
2001	20	11	106	146	134	16	1	+	435
2002	4	12	31	75	60	12	1	+	195

1) Includes unidentified Sebastes specimens, mostly less than 15 cm.

2) Indices raised to also represent the the Russian EEZ.

As in previous years, most of the ***S. viviparus*** are recorded in main areas A and B (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 and due to a very patchy distribution. The total index in 2002 is the lowest observed since 1989 (table 8.6).

Table 8.5. SEBASTES VIVIPARUS. Acoustic abundance indices for main areas of the

Barents Sea winter 2002(numbers in millions).

Area	Length group (cm)					
	10-14	15-19	20-24	25-29	>30	Total
A	0.6	1.6	1.9	0.2	-	4.4
B	3.7	11.0	8.2	0.6	0.1	23.7
C	+	+	+	+	-	+
D	+	0.1	+	-	+	0.1
D'	-	-	-	-	-	-
E	-	+	-	-	-	+
S	+	0.1	0.1	+	+	0.2
ABCD	4.5	12.7	10.2	0.8	0.1	28.2
Total	4.5	12.8	10.2	0.8	0.1	28.4

Table 8.6. SEBASTES VIVIPARUS. Abundance indices from acoustic surveys in the Barents Sea winter 1986-2002 (numbers in millions). 1986-1992 includes only the area covered in 1986.

Year	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
2001	3	20	23	3	+	50
2002	4	13	10	1	+	28

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. 8.3 shows the horizontal distribution of ***S. marinus*** during the swept area investigation. The distribution is very similar to 2001. Table 8.7 presents indices by 5 cm length groups with standard error for each main area in addition to the coefficient of variation for the total area.

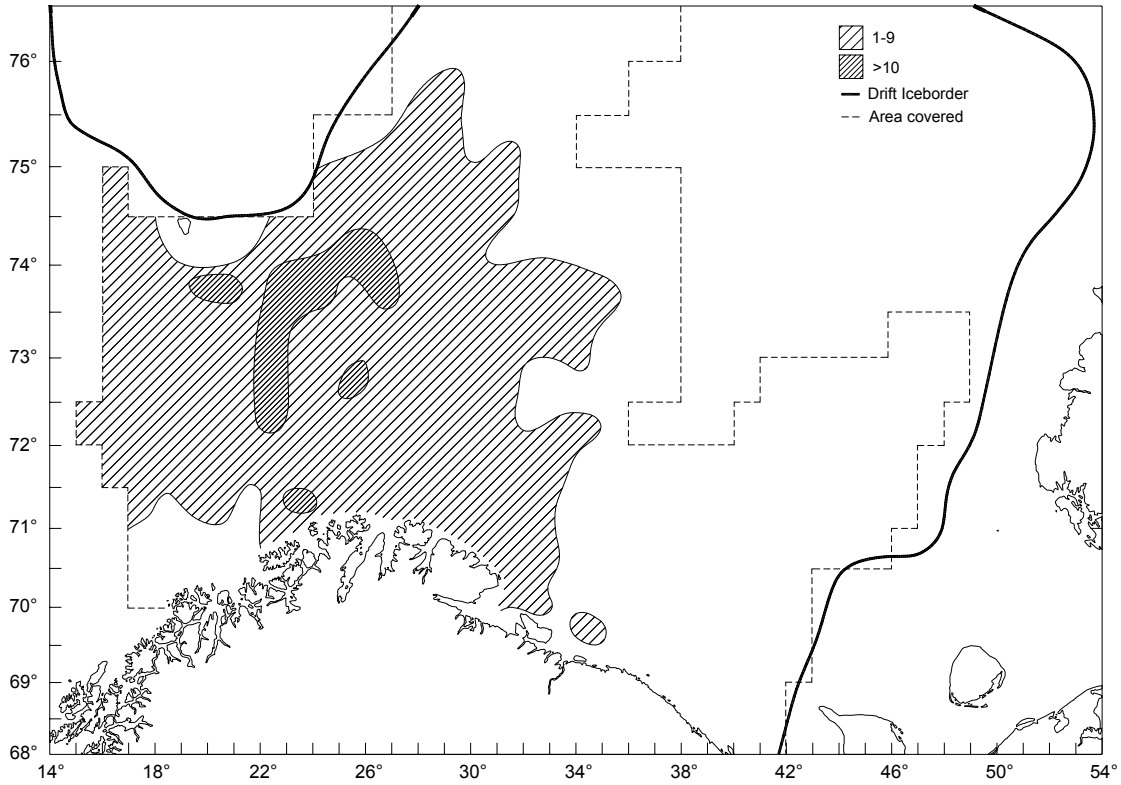

Figure 8.2. *Sebastes mentella*. Distribution of total echo abundance winter 2002. Unit is area back scattering surface (s_A) per square nautical (m^2/n.mile^2).

The time series for 1986-2001 (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.

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 2001 (numbers in millions).

Length	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	0.1							0.1	0.1	57.7
10-14	0.2	0.1	+	+	+	+	0.8	0.7					+	+	1.0	0.7	64.5
15-19	0.1	0.1	0.2	0.1	+	+	1.4	1.1			+	+	0.2	0.2	2.0	1.1	55.2
20-24	0.4	0.3	0.1	0.1	+	+	0.8	0.2	0.1	0.1	0.1	0.1	0.4	0.2	1.8	0.4	24.0
25-29	0.9	0.8	0.2	0.1			1.4	0.4	0.1	0.1	+	+	1.3	0.6	3.8	1.1	27.7
30-34	1.1	0.7	0.2	0.1	+	+	1.5	0.4	0.1	0.1			1.2	0.5	4.1	0.9	21.2
35-39	1.7	0.8	0.4	0.1	0.1	+	0.7	0.2			+	+	0.5	0.3	3.3	0.8	25.7
40-44	2.1	1.2	1.0	0.4	0.1	+	0.2	0.1					0.2	0.1	3.6	1.3	35.3
> 45	1.6	0.7	0.4	0.1	0.1	+	0.2	0.1					0.2	0.1	2.5	0.7	28.0
Sum	7.9	1.9	2.5	0.5	0.4	0.1	7.0	1.4	0.2	0.1	0.2	0.1	4.1	0.9	22.3	2.6	11.5

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).

Length	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	1.2	0.4	+	+	0.4	0.2	11.1	9.2			1.0	0.5	2.5	0.7	16.1	9.3	57.6
10-14	0.7	0.2	+	+	0.1	0.1	2.2	0.5			0.3	0.2	3.9	0.8	7.2	1.0	13.6
15-19	2.7	0.6	+	+	0.8	0.5	9.6	2.2			0.3	0.2	5.7	1.2	19.1	2.6	13.6
20-24	16.6	6.6	0.2	0.2	0.3	0.2	2.3	0.7			0.2	0.2	22.1	6.3	41.7	9.2	22.0
25-29	48.9	12.7	2.0	2.0	5.6	2.1	7.4	2.4			0.1	0.1	39.9	13.0	103.9	18.5	17.8
30-34	64.4	19.7	1.4	1.4	3.1	0.9	3.6	1.4					41.2	10.5	113.7	22.5	19.8
35-39	8.4	2.4	0.4	0.4	1.0	0.5	1.3	0.7			0.1	0.1	11.9	3.1	22.9	4.1	17.7
40-44	0.8	0.3			0.1	0.1	0.1	+					0.4	0.2	1.4	0.4	26.6
> 45					+	+							+	+	+	+	71.0
Sum	143.7	24.5	4.0	2.5	11.3	2.4	37.5	10.0			2.0	0.6	127.7	18.2	326.1	32.3	9.9

[1] Includes unidentified Sebastes specimens, mostly less than 15 cm.

Table 8.9. SEBASTES MARINUS. Abundance indices from bottom trawl surveys in the Barents Sea winter 1986-2002 (numbers in millions). 1986-1992 includes only main areas A, B, C and D.

	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
2001	0.1	0.4	0.4	2.4	5.8	5.5	4.5	3.2	1.6	24
2002	0.1	1.0	2.0	1.8	3.8	4.1	3.3	3.6	2.5	22

1) Indices raised to also represent the Russian EEZ.

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 2002 coverage was nevertheless more complete than before (fig. 8.4).

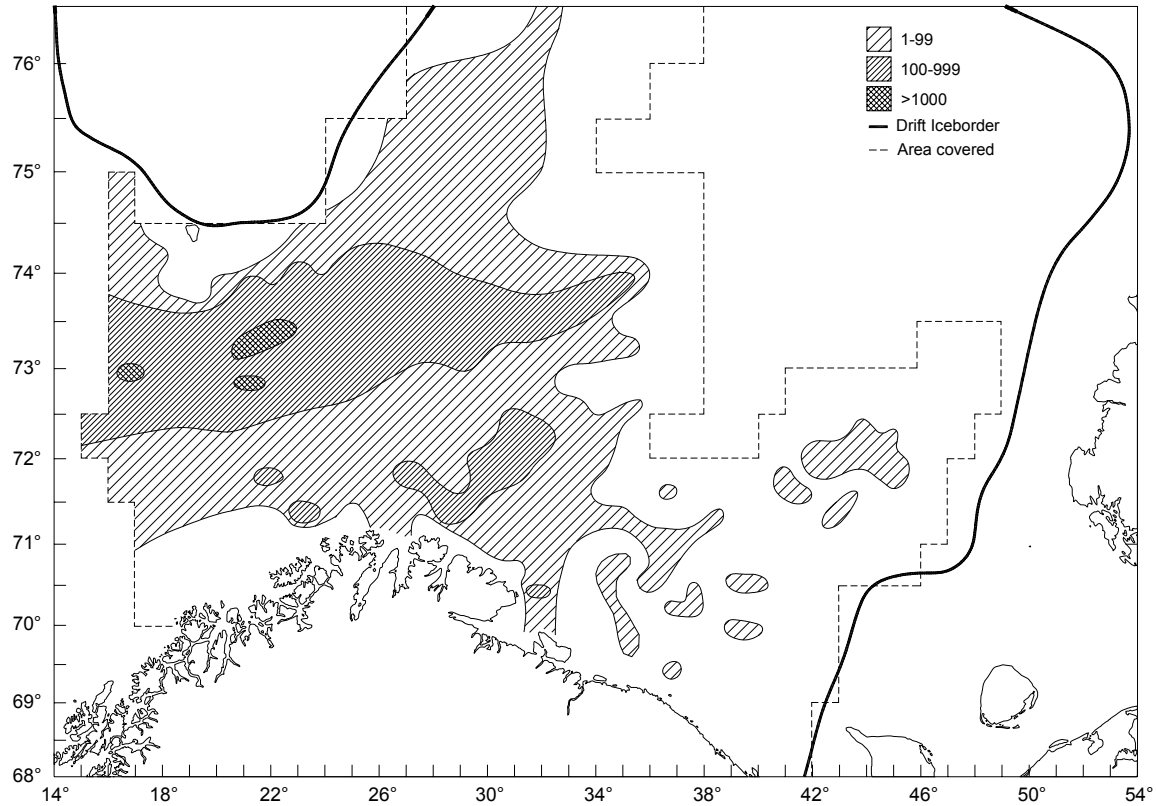

Figure 8.4. *Sebastes mentella* SEBASTES MENTELLA. Distribution in the trawl catches winter 2002 (no. per hour trawling).

Table 8.8 presents the swept area indices by 5 cm length groups with corresponding standard errors for each main area in addition to the coefficient of variation for the total area.

The time series for 1986-2001, with adjusted indices for 1997 and 1998, is presented in table 8.10.

Similar to the acoustic abundance indices, the swept area indices for *S. mentella* in 2001 show for most size groups a decrease compared to last year. The indices for fish below 25 cm are among the lowest observed. The index for *S. mentella* below 15 cm is less than 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.

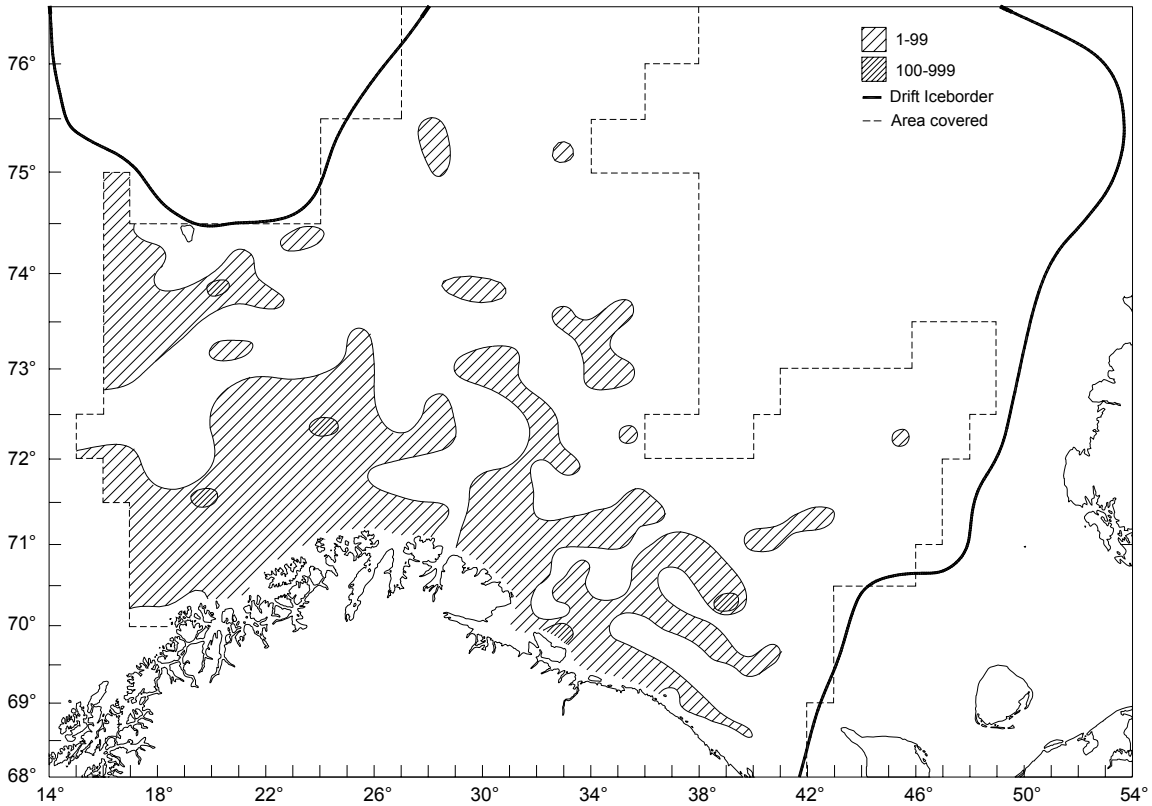

Figure 8.3. *Sebastes marinus*. Distribution in the trawl catches winter 2002 (no. per hour trawling).

Table 8.10. SEBASTES MENTELLA.[1] Abundance indices from bottom trawl surveys in the Barents Sea winter 1986-2002 (numbers in millions). 1986-1992 includes only main areas A. B. C and D.

	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
2001	9.3	22.5	7.0	54.9	77.4	73.2	9.4	0.6	0.1	254
2002	16.1	7.2	19.1	41.7	103.9	113.7	22.9	1.4	+	326

1) Includes unidentified Sebastes specimens, mostly less than 15 cm.

2) Indices raised to also represent the Russian EEZ.

S. viviparus was mainly observed in main area B. The time series 1986-2001 of the swept area indices are shown in (table 8.12). The 2002 value is the second lowest since 1989.

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 2001 (numbers in millions).

	Area												
Length	A		B		C		D		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9			0.3	0.2							0.3	0.2	65.8
10-14	0.2	0.2	2.8	1.2			+	+	+	+	3.1	1.2	40.2
15-19	3.5	2.2	12.7	3.1	+	+	0.1	0.1	0.6	0.6	17.0	3.8	22.5
20-24	6.5	3.3	7.5	1.2	+	+	+	+	0.4	0.3	14.5	3.6	24.7
25-29	0.8	0.5	0.4	0.1					+	+	1.2	0.5	41.4
30-34			0.1	0.1					+	+	0.1	0.1	70.2
Sum	11.1	4.0	23.7	3.6	+	+	0.1	0.1	1.1	0.7	36.1	5.4	14.9

Table 8.12. SEBASTES VIVIPARUS. Abundance indices from bottom trawl surveys in the Barents Sea winter 1996-2002 (numbers in millions). 1986-1992 includes only the area covered in 1986.

	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
2001	0.3	2.2	29.5	33.7	3.7	0.1	70
2002	0.3	3.1	17.0	14.5	1.2	0.1	36

9. DISTRIBUTION AND ABUNDANCE OF OTHER SPECIES

9.1 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 observed distribution pattern was similar to those observed in previous years' surveys, i.e., mainly in the Bear Island channel towards the Hopen Deep.

Table 9.1 presents the swept area indices by 5 cm length groups with corresponding standard errors for each main area in addition to the coefficient of variation for the total area. Most of the Greenland halibut was found in the northern main areas (D, E and S). For most length groups the coefficient of variation is higher than for cod and haddock. For each of the length groups between 40 and 64 cm the CVs are below 18%.

The time series for 1990-2002, with indices adjusted for 1997 and 1998, is presented in table 9.2. Compared to the 2001 values the indices for fish less than 45 cm are lower, while for fish larger than 45 cm the indices are at or above the 2001 values.

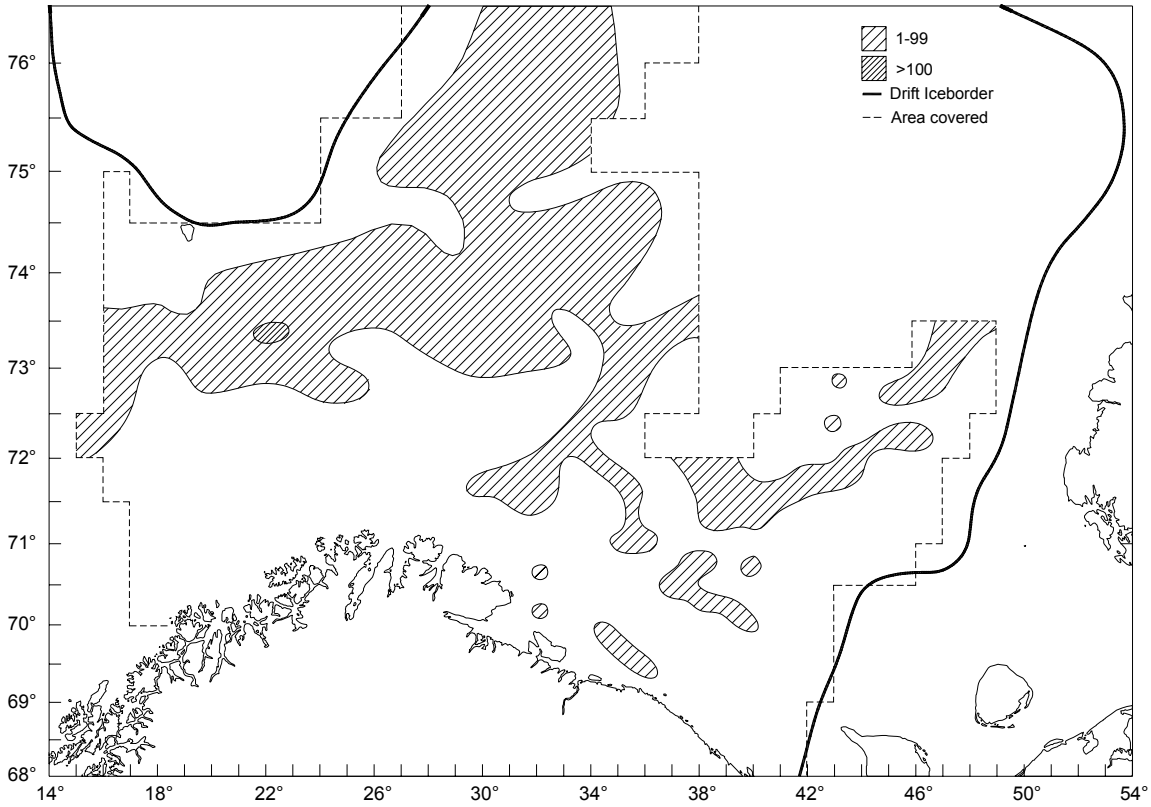

Figure 9.1. GREENLAND HALIBUT. Distribution in the trawl catches winter 2002 (no. per hour trawling).

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 2002 (numbers in thousands).

Length	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											233	233				233	233	100.0
10-14									35	24						35	24	69.9
15-19																		
20-24											71	48				71	48	68.7
25-29											33	33				33	33	100.0
30-34	29	29					78	38	22	22	135	105	144	59	97	408	131	32.2
35-39	30	30					365	154	123	111	271	103	207	146	395	996	262	26.3
40-44	108	60					713	257	42	28	510	144	553	153	821	1927	338	17.6
45-49	182	68					1096	284	185	166	1012	266	1227	250	1278	3702	496	13.4
50-54	449	172					649	152	165	165	468	138	1458	436	1098	3188	538	16.9
55-59	273	120					320	94	110	110	394	161	1113	293	593	2210	384	17.4
60-64	121	59					275	94			208	88	506	115	396	1110	182	16.4
65-69	202	169					112	52	55	55	139	81	467	142	314	975	248	25.4
70-74							42	26					188	63	42	230	68	29.7
75-79	57	39					52	30					48	27	109	157	56	35.6
> 80					12	12							96	56	12	96	69	57.9
Sum	1452	296			12	12	3700	466	736	290	3474	480	6008	655	5164	15383	1023	6.7

Table 9.2. GREENLAND HALIBUT. Abundance indices from the bottom trawl surveys in the Barents Sea winter 1990-2002 (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.

	Length group (cm)															
Year	<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
2001	68	49	129	178	680	1504	3708	3258	2263	1990	1081	522	204	48	40	15720
2002	268	0	71	33	408	996	1927	3702	3188	2210	1110	975	230	157	96	15383

9.2 Blue whiting

Since 2000 the blue whiting has shown a wider distribution than usual, and the echo recordings in 2001 and 2002 also indicated unusual high abundance in the Barents sea. Figure 9.2 shows the geographical distribution of the bottom trawl catch rates of blue whiting in 2002. Compared to the 2001 results, the distribution of catch rates in 2002 extended slightly further to the east and north, while the areas with highest catch rates have decreased. Since the fish was mainly found pelagic the bottom trawl do not reflect the real density distribution, but gives some indication of the distribution limits. Acoustic observations would better reflect the relative density distribution. Figure 9.3 shows the geographical distribution of acoustic values allocated to blue whiting in 2002. The general pattern is similar to the distribution of catch rates, but the densest concentrations are shifted somewhat to the north in the acoustic observations.

The catches of blue whiting was dominated by small fish (15-20 cm in 2001, 15-25 cm in 2002), mainly the 2000 year class.

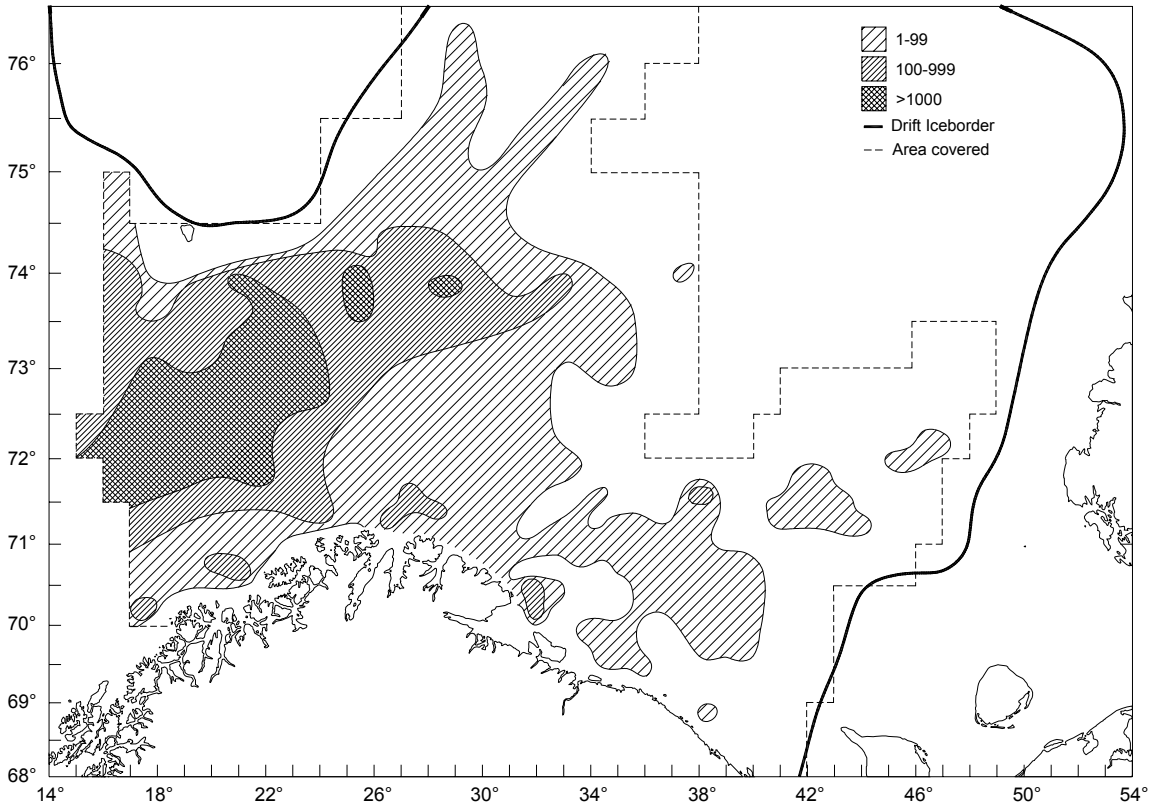

Figure 9.2. BLUE WHITING. Distribution in the trawl catches winter 2002 (no. per hour trawling).

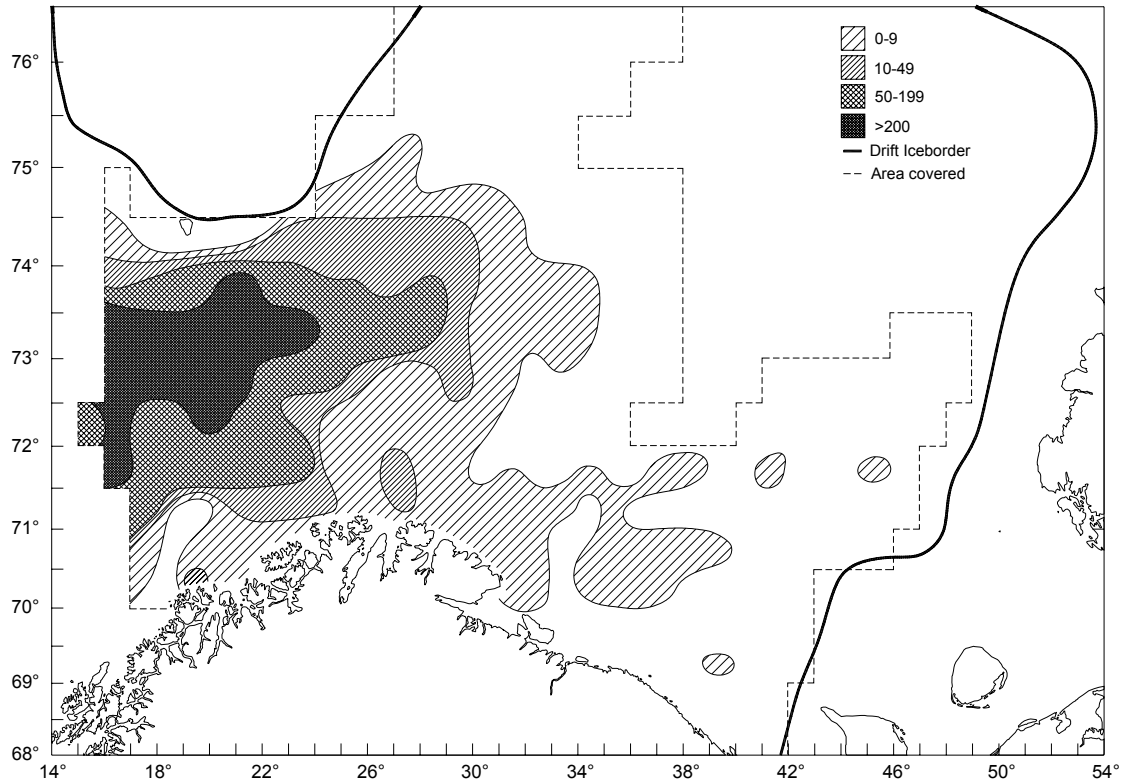

Figure 9.3. BLUE WHITING. Distribution of total echo abundance winter 2002. Unit is area back scattering surface (s_A) per square nautical (m^2/n.mile^2).

10. COMPARISONS BETWEEN RESEARCH VESSELS

In most of the Russian economic Zone the vessels “Persey3” and “Johan Hjort” worked parallel transects 16 n. miles apart, using the same gear and similar sampling procedures. Tables 10.1 (cod) and 10.2 (haddock) compares the age distribution within 5 cm length groups for the fish sampled and aged onboard each vessel. Within the size range 20-34.9 cm, both for cod and haddock, there is a tendency that the Norwegian team observed a lower percentage at age 3, with corresponding higher percentage for age 2 (in the lower part of that size range) and age 4 (in the higher part). This should be further examined through the ongoing PINRO/IMR otolith exchange programme. In the other size groups there were no indications of any discrepancy. At lengths above 50 cm too few fishes are sampled to detect moderate discrepancies.

Table 10.1. Cod, winter survey 2002. Comparison of age distribution (%) whithin 5 cm length groups, sampled onboard Persey 3 and (P3) Johan Hjort (JH)

		Percent by age																#
	Length group	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	aged
P3	5.0- 9.9 cm	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
JH	5.0- 9.9 cm	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
P3	10.0- 14.9 cm	0	80	20	0	0	0	0	0	0	0	0	0	0	0	0	0	36
JH	10.0- 14.9 cm	0	72	28	0	0	0	0	0	0	0	0	0	0	0	0	0	51
P3	15.0- 19.9 cm	0	1	99	0	0	0	0	0	0	0	0	0	0	0	0	0	80
JH	15.0- 19.9 cm	0	1	99	0	0	0	0	0	0	0	0	0	0	0	0	0	64
P3	20.0- 24.9 cm	0	0	76	24	0	0	0	0	0	0	0	0	0	0	0	0	89
JH	20.0- 24.9 cm	0	0	94	6	0	0	0	0	0	0	0	0	0	0	0	0	62
P3	25.0- 29.9 cm	0	0	35	65	0	0	0	0	0	0	0	0	0	0	0	0	84
JH	25.0- 29.9 cm	0	0	51	48	1	0	0	0	0	0	0	0	0	0	0	0	62
P3	30.0- 34.9 cm	0	0	0	68	32	0	0	0	0	0	0	0	0	0	0	0	57
JH	30.0- 34.9 cm	0	0	1	82	15	1	0	0	0	0	0	0	0	0	0	0	59
P3	35.0- 39.9 cm	0	0	0	37	62	2	0	0	0	0	0	0	0	0	0	0	66
JH	35.0- 39.9 cm	0	0	0	35	65	0	0	0	0	0	0	0	0	0	0	0	57
P3	40.0- 44.9 cm	0	0	0	8	80	12	0	0	0	0	0	0	0	0	0	0	62
JH	40.0- 44.9 cm	0	0	0	7	76	17	0	0	0	0	0	0	0	0	0	0	58
P3	45.0- 49.9 cm	0	0	0	0	61	39	0	0	0	0	0	0	0	0	0	0	66
JH	45.0- 49.9 cm	0	0	0	0	72	26	2	0	0	0	0	0	0	0	0	0	57
P3	50.0- 54.9 cm	0	0	0	0	18	64	18	0	0	0	0	0	0	0	0	0	67
JH	50.0- 54.9 cm	0	0	0	0	32	66	2	0	0	0	0	0	0	0	0	0	57
P3	55.0- 59.9 cm	0	0	0	0	3	59	38	0	0	0	0	0	0	0	0	0	54
JH	55.0- 59.9 cm	0	0	0	0	4	77	19	0	0	0	0	0	0	0	0	0	51
P3	60.0- 64.9 cm	0	0	0	0	1	24	60	15	0	0	0	0	0	0	0	0	47
JH	60.0- 64.9 cm	0	0	0	0	0	36	55	10	0	0	0	0	0	0	0	0	44
P3	65.0- 69.9 cm	0	0	0	0	0	6	78	16	0	0	0	0	0	0	0	0	37
JH	65.0- 69.9 cm	0	0	0	0	0	5	60	29	7	0	0	0	0	0	0	0	31
P3	70.0- 74.9 cm	0	0	0	0	0	0	38	59	3	0	0	0	0	0	0	0	25
JH	70.0- 74.9 cm	0	0	0	0	0	0	60	29	11	0	0	0	0	0	0	0	19
P3	75.0- 79.9 cm	0	0	0	0	0	0	35	54	11	0	0	0	0	0	0	0	19
JH	75.0- 79.9 cm	0	0	0	0	0	0	8	88	0	3	0	0	0	0	0	0	11
P3	80.0- 84.9 cm	0	0	0	0	0	0	0	89	11	0	0	0	0	0	0	0	13
JH	80.0- 84.9 cm	0	0	0	0	0	0	0	54	30	16	0	0	0	0	0	0	16
P3	85.0- 89.9 cm	0	0	0	0	0	0	0	15	85	0	0	0	0	0	0	0	9
JH	85.0- 89.9 cm	0	0	0	0	0	0	42	58	0	0	0	0	0	0	0	0	3
P3	90.0- 94.9 cm	0	0	0	0	0	0	0	22	78	0	0	0	0	0	0	0	4
JH	90.0- 94.9 cm	0	0	0	0	0	0	0	0	71	0	29	0	0	0	0	0	3
P3	95.0- 99.9 cm	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	1
JH	95.0- 99.9 cm	0	0	0	0	0	0	0	0	22	78	0	0	0	0	0	0	4
P3	100.0-104.9 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JH	100.0-104.9 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P3	105.0-109.9 cm	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	1
JH	105.0-109.9 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.2. Haddock, winter survey 2002. Comparison of age distribution (%) whithin 5 cm length groups, sampled onboard Persey 3 and (P3) Johan Hjort (JH)

		Percent by age																#
	Length group	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	aged
P3	10.0- 14.9 cm	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
JH	10.0- 14.9 cm	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
P3	15.0- 19.9 cm	0	59	41	0	0	0	0	0	0	0	0	0	0	0	0	0	42
JH	15.0- 19.9 cm	0	70	30	0	0	0	0	0	0	0	0	0	0	0	0	0	46
P3	20.0- 24.9 cm	0	0	84	16	0	0	0	0	0	0	0	0	0	0	0	0	63
JH	20.0- 24.9 cm	0	0	96	4	0	0	0	0	0	0	0	0	0	0	0	0	45
P3	25.0- 29.9 cm	0	2	11	87	0	0	0	0	0	0	0	0	0	0	0	0	59
JH	25.0- 29.9 cm	0	0	36	64	0	0	0	0	0	0	0	0	0	0	0	0	43
P3	30.0- 34.9 cm	0	0	0	87	10	2	0	0	0	0	0	0	0	0	0	0	56
JH	30.0- 34.9 cm	0	0	0	94	6	0	0	0	0	0	0	0	0	0	0	0	38
P3	35.0- 39.9 cm	0	0	0	27	68	5	0	0	0	0	0	0	0	0	0	0	49
JH	35.0- 39.9 cm	0	0	0	30	63	3	4	0	0	0	0	0	0	0	0	0	37
P3	40.0- 44.9 cm	0	0	0	2	98	0	0	0	0	0	0	0	0	0	0	0	47
JH	40.0- 44.9 cm	0	0	0	0	93	7	0	0	0	0	0	0	0	0	0	0	32
P3	45.0- 49.9 cm	0	0	0	0	81	15	4	0	0	0	0	0	0	0	0	0	34
JH	45.0- 49.9 cm	0	0	0	0	62	38	0	0	0	0	0	0	0	0	0	0	27
P3	50.0- 54.9 cm	0	0	0	0	25	30	45	0	0	0	0	0	0	0	0	0	15
JH	50.0- 54.9 cm	0	0	0	0	0	48	52	0	0	0	0	0	0	0	0	0	7
P3	55.0- 59.9 cm	0	0	0	0	0	29	56	15	0	0	0	0	0	0	0	0	7
JH	55.0- 59.9 cm	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	3
P3	60.0- 64.9 cm	0	0	0	0	0	0	47	47	0	7	0	0	0	0	0	0	3
JH	60.0- 64.9 cm	0	0	0	0	0	0	42	0	29	0	0	29	0	0	0	0	4
P3	65.0- 69.9 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JH	65.0- 69.9 cm	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	1
P3	70.0- 74.9 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	1
JH	70.0- 74.9 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

It should be noticed that these tables are worked out by running the survey programme with Norwegian and Russian data separately. This means that each aged fish have been given weight according to the swept area estimate for that particular length group for that particular strata. This should be kept in mind when interpreting the results.

11. LITERATURE

Anon. 1998. Manual for bunnfiskundersøkelser i Barentshavet. Versjon 14.01.98. Seksjon Bunnfisk, Senter for Marine Ressurser, Havforskningsinstituttet. 7s. (upubl.).

Aglen, A., Alvsvåg, J., Lepesevich, Y., Korsbrekke, K., Mehl, S., Nedreaas, K.H., Sokolov, K., and Ågotnes, P. 2002. Investigations on demersal fish in the Barents Sea winter 2001. Detailed report. IMR/PINRO Joint report series no 2, 2002. 66pp.

Aglen, A. and Nakken, O. 1997. Improving time series of abundance indices applying new knowledge. Fisheries Research, 30: 17-26.

Bogstad, B., Fotland, Å. and Mehl, S. 1999. A revision of the abundance indices for cod and haddock from the Norwegian winter survey in the Barents Sea, 1983-1999. Working Document, ICES Arctic Fisheries Working Group, 23 August - 1 September 1999.

Dalen, J. and Nakken, O. 1983. On the application of the echo integration method. ICES CM 1983/B: 19, 30 pp.

Dalen, J. and Smedstad, O. 1979. Acoustic method for estimating absolute abundance of young cod and haddock in the Barents Sea. ICES CM 1979/G:51, 24pp.

Dalen, J. and Smedstad, O. 1983. Abundance estimation of demersal fish in the Barents Sea by an extended acoustic method. *In* Nakken, O. and S.C. Venema (eds.), Symposium on fisheries acoustics. Selected papers of the ICES/FAO Symposium on fisheries acoustics. Bergen, Norway, 21-24 June 1982. FAO Fish Rep., (300): 232-239.

Dickson, W. 1993a. Estimation of the capture efficiency of trawl gear. I: Development of a theoretical model. Fisheries Research 16: 239-253.

Dickson, W. 1993b. Estimation of the capture efficiency of trawl gear. II: Testing a theoretical model. Fisheries Research 16: 255-272.

Engås, A. 1995. Trålmanual Campelen 1800. Versjon 1, 17. januar 1995, Havforskningsinstituttet, Bergen. 16 s. (upubl.).

Engås, A. and Ona, E. 1993. Experiences using the constraint technique on bottom trawl doors. ICES CM 1993/B:18, 10pp.

Foote, K.G. 1987. Fish target strengths for use in echo integrator surveys. Journal of the Acoustical Society of America, 82: 981-987.

Fotland, Å., Borge, A., Gjøsæter, H., og Mjanger, H. 1997. Håndbok for prøvetaking av fisk og krepsdyr. Versjon 3.14 januar 1997. Havforskningsinstituttet, Bergen. 145s.

Godø, O.R. and Sunnanå, K. 1992. Size selection during trawl sampling of cod and haddock and its effect on abundance indices at age. Fisheries Research, 13: 293-310.

Jakobsen, T., Korsbrekke, K., Mehl, S. and Nakken, O. 1997. Norwegian combined acoustic and bottom trawl surveys for demersal fish in the Barents Sea during winter. ICES CM 1997/Y: 17, 26 pp.

Korsbrekke, K. 1996. Brukerveiledning for TOKT312 versjon 6.3. Intern program dok., Havforskningsinstituttet, september 1996. 20s. (upubl.).

Korsbrekke, K., Mehl, S., Nakken, O. og Sunnanå, K. 1995. Bunnfiskundersøkelser i Barentshavet vinteren 1995. Fisken og Havet nr. 13 - 1995, Havforskningsinstituttet, 86 s.

Knudsen, H.P. 1990. The Bergen Echo Integrator: an introduction. - Journal du Conseil International pour l'Exploration de la Mer, 47: 167-174.

MacLennan, D.N. and Simmonds, E.J. 1991. Fisheries Acoustics. Chapman Hall, London, England. 336pp.

Valdemarsen, J.W. and Misund, O. 1995. Trawl design and techniques used by norwegian research vessels to sample fish in the pelagic zone. Pp. 135-144 in Hylen, A. (ed.): Precision and relevance of pre-recruit studies for fishery management related to fish stocks in the Barents Sea and adjacent waters. Proceedings of the sixth IMR-PINRO symposium, Bergen, 14-17 June 1994. Institute of Marine Research, Bergen, Norway. ISBN 82-7461-039-3.

12. LIST OF SCIENTIFIC PARTICIPANTS

VESSEL	**"G. O. Sars"**	**"Johan Hjort"**	**"Persey-III"**
DEPARTURE	Tromsø 29.01.02	Vadsø 29.01.02	Murmansk 28.01.02
VISIT	Tromsø 11.02.02	Vadsø 14.02.02	
	Hammerfest 22.02.02	Hammerfest 25.02.02	
ARRIVAL	Tromsø 06.03.02	Tromsø 04.03.02	Murmansk 28.02.02
SCIENTIFIC STAFF	S.Mehl 29.01-11.02	A.Aglen 29.01-14.02	A.A.Grekov
	A.Leithe 29.01-11.02	S.Aanes 29.01-14.02	V.A.Ignashkin
	B.Grønevik 11.02-22.02	H.Græsdal 29.01-14.02	A.G.Klein
	F.Midtøy 29.01-22.02	E.Holm 29.01-04.03	A.I.Kljuev
	H.Myran 29.01-22.02	T.I.Halland 29.01-04.03	A.E.Kljuykov
	Ø.Nævdal 29.01-22.02	V.Anthonypillai29.01-04.03	R.A.Linnikov
	B.Røttingen 29.01-06.03	Å.Høines 14.02-04.03	S.M.Rusjaev
	J.Alvsvåg 11.02-22.02	A.Borge 14.02-04.03	K.M.Sokolov
	K.Korsbrekke 22.06-06.03	A.Storaker 14.02-04.03	F.A.Shevchenko
	B.Bergflødt 22.02-06.03	M.Dahl 29.01-04.03	N.S.Vovchuk
	V.Hjelvik 22.06-06.03	M.Mjanger 29.01-04.03	V.I.Zubov
	S.Lemvig 22.02-06.03	L.Drivenes 29.01-14.02	
	S.Kleven29.01-06.03		
	T.Haugland 29.01-06.03		
	R.Johannesen 29.01-22.02		
	E.H.Osland 22.02-06.03		
GUESTS		K.Drevetnyak 29.01-14.02	
		Y.Tang 14.02-04.03	

IMR/PINRO Joint Report Series

2001

No. 6

Shevelev, M., and Lisovsky, S. 2001. Technical regulations and by-catch criteria in the Barents Sea fisheries. Proceedings of the 9th PINRO-IMR Symposium, Murmansk, 14-15 August 2001. IMR/PINRO Joint Report Series, No. 6/2001. ISSN 1502-8828, ISBN 5-86349-099-3.

No. 7

Anon 2001. Survey report from the joint Norwegian/Russian acoustic survey of pelagic fish in the Barents Sea, September – October 2001. IMR/PINRO Joint Report Series, No. 7/2001.ISSN 1502-8828. 30 pp.

No. 8

Anon. 2001. Report of the international 0-group fish survey in the Barents Sea and adjacent waters in August – September 2001. IMR/PINRO Joint Report Series, No. 8/2001. ISSN 1502-8828. 26 pp.

2002

No.1

Anon. 2002. Report of joint Russian/Norwegian aerial surveys in the Barents sea in September 2001. IMR/PINRO Joint Report Series,
No. 1/2002. ISSN 1502-8828. 11pp.

No.2

Anon. 2002. Investigations оп demersal fish in the Barents Sea winter 2001. Detailed report. IMR/PINRO Joint Report Series, No.1 /2002.
ISSN 1502-8828. 11 pp.

No.3

Anon. 2002. Report of the international O-group fish survey in the Barents Sea and adjacent waters in August-September 2002. IMR/PINRO Joint Report Series, No. 3/2002.ISSN 1502-8828. 28 pp.

No.4

Anon. 2002. Report from the joint Norwegian/Russian acoustic survey of pelagic fish in the Barents Sea, September-October 2002. IMR/PINRO Joint Report Series, No. 4/2002. ISSN 1502-8828.

No.5

Jakobsen, T. (ed) 2002. Management strategies for the fish stocks in the Barents Sea. Proceedings of the 8th Norwegian-Russian Symposium, Bergen, 15-16 June 1999. IMR/PINRO Joint Report Series, No. 5/2002. ISSN 1502-8828,
ISBN 82-7461-057-1.

JOINT

Institute of Marine Research
Nordnesgaten 50,
5817 Bergen
Norway

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

REPORT