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Investigations on demersal fish in the Barents Sea winter 2006 Detailed report

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PROSJEKTRAPPORT



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Sammendrag (norsk):

Et kombinert akustikk og bunntåltokt i januar-mars har vært gjennomført årlig siden 1981 for å framskaffe mengdeindekser for bunnfisk samt trål for lengde og vekt ved alder. Målantene er torsk og hyse, men mengdeindekser er også beregnet for uerartene siden 1986 og for blåkveite siden 1990. Før 1993 ble et fast standardområde dekket. Dette ble utvidet nordover og østover i 1993 for å få bedre dekning av de yngste aldergrupper av torsk. Siden 1997 har dekningen i russisk sone vært noe variabel. Dette medførte at et viktig område på Murmansk-kysten ikke ble dekket i 2006.

Summary (English):

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 abundance indices have also been worked out for the redfish species since 1986 and Greenland halibut since 1990. Prior to 1993 a fixed standard area (ABCD in Fig. 2.1) was covered, but in 1993 the survey area was 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 the years 2001-2005 a Russian research vessel covered the

areas where the Norwegian vessels did not have access. In 2006 no Russian vessel participated, and an area off the Murman coast could not be covered.

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PREFACE

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

The survey started in the mid 1970-ies, focused on acoustic measurements of cod and haddock. Since 1981 it has been designed to produce both acoustic and swept area estimates of fish abundance. Some development has taken place since then, both in area coverage and in methodology. The development is described in detail by Jacobsen et al. (1997). At present the survey provides the main data input for a number of projects at the 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-March 2006. The survey was performed with the Norwegian research vessels “G.O. Sars” and “Johan Hjort”. The total duration of the survey was from 1 February to 14 March.

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 abundance indices have also been worked out for the redfish species since 1986 and Greenland halibut since 1990. Prior to 1993 a fixed standard area (ABCD in Fig. 2.1) was covered, but in 1993 the survey area was 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 the years 2001-2005 a Russian research vessel covered the areas where the Norwegian vessels did not have access. In 2006 no Russian vessel participated, and an area off the Murman coast could not be covered.

The main results in 2006 were:

- The index for the 2005 year-class of **cod** was well below average. This year-class was distributed outside the covered area and is therefore underestimated. The abundance of the 2003 and 2001 year-classes are also well below average, while the 2004 year and the 2002 year-classes are somewhat below average.
- The abundance of older cod (6 years and older) has increased slightly compared to the results of the 2005 survey, and is now near average.
- For most age groups the lengths and weights at age have increased slightly compared to the previous years.
- the survey mortality calculated from the swept area results are higher than in the previous year.
- for **haddock** the indices are above average for the age groups 1,2,4 and 10+. The index for the 2005 year class is the highest in the time series.
- For age 2 and older lengths and weights at age and weight increments have increased compared to the previous year.
- the abundance indices of the ***S. marinus*** are among the lowest in the time series and there are no signs of improved recruitment
- Also for ***S. mentella*** in the length range 10-30 cm the indices are among the lowest in the time series, for larger fish the indices have been rather stable in the three latest years. For fish below 10 cm the index is the highest since 1996, but still well below the values in the years 1988-1991.
- For **Greenland halibut** above 30 cm there has been an increasing trend over last three years, for larger fish the indices have fluctuated without clear trend.

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 the 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 by length and age for cod, haddock and redfish
- Obtain swept area abundance indices by length (and age) for 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 and analyse stomach samples from cod, for estimating predation by cod

Data and results from the survey are used both in the ICES stock assessments and by several research projects at IMR and PINRO.

From 1981 to 1992 the survey area was fixed (ABCD in Fig. 2.1). Due to improved climate and increasing stock size in the early 1990-ies, the cod distribution area increased. In 1993 the survey area therefore was increased towards east and north, and since then the survey has been aiming at covering the whole cod distribution area outside the ice-border. Since 1997 Norwegian research vessels have had limited access to the Russian EEZ. In 1997 and 1998 the 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 the coverage has been satisfactory.

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 Simrad EK500 echo sounder and Bergen Echo Integrator (BEI, Knudsen 1990) have been used. The Simrad ER60 echo sounder has replaced the EK500; on the new R/V “G.O. Sars” since the 2004 survey and on R/V “Johan Hjort” since the 2005 survey.

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 in the close to surface layer.

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 $1/2^\circ$ 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:

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

$\bar{\rho}_A$ is average fish density (number of fish / square n.mile) by rectangle

\bar{s}_A is average acoustic density (square m / square n.mile) by rectangle

$\bar{\sigma}_A$ 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):

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

Indices for the period 1981-1992 have been recalculated (Aglen and Nakken 1997) 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).

Combining equations 1 and 2 gives:

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

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

As a basis for estimating \bar{L}^2 trawl catches considered to be representative for each rectangle and depth zone are selected. 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, while both pelagic and bottom trawl catches are applied to the pelagic zone. Length frequency distributions by 1cm 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). Length distributions from pelagic catches are applied unmodified. Since 2001 the post processing program BEAM has been used for working out the acoustic estimates. This program provides an automatic allocation of trawl samples to strata (rectangles). The automatic allocation is modified by the user when considered necessary.

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:

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

For each species the total density ($\bar{\rho}_A$) by rectangle and depth zone is now calculated by equation (3). This total density is then split on length groups according to the estimated length distribution. Next, these densities are converted to abundance by multiplying with the area of the rectangle. The abundance by rectangle is then summed for defined main areas (Figure

3.2). Estimates by length are converted to estimates by age using an age length key for each main area.

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. Prior to 1994 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 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 length dependent fishing efficiency and/or sweep width (Godø and Sunnanå 1992, Aglen and Nakken 1997). The sweep wire length is 40 m, plus 12 m wire for connection to the doors. Vaco doors (6m², 1500kg), which are considered to be the best compromise when doing both pelagic and bottom trawling, have been used as standard trawldoors on board the Norwegian research vessels. On the Russian vessels and hired vessels V-type doors (ca 7 m²) have been used. Since 2004, R/V "Johan Hjort" and R/V "G.O.Sars" also have used a V-type door ("Steinshamn W-9", 7.1m², 2050kg), the same type as used on the Russian research vessels. 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 is then in most hauls restricted to the range 48-52 m regardless of depth (Engås and Ona 1993, Engås 1995). Strapping was first attempted in the 1993 survey on board one vessel, in 1994 It was used on every third haul and in 1995-1997 on every second haul on all vessels. Since 1998 it has been used on all hauls when weather conditions permitted. Standard tow duration is 30 minutes (until 1985 the tow duration was 60 min.). Trawl performance is constantly monitored by Scanmar trawl sensors, i.e., distance between the doors, vertical opening of the trawl and bottom contact control. Since 2003 also trawl speed sensors have been used and since 2005 sensors monitoring the roll and pitch angle of the doors have been used.

The positions of the trawl stations are pre-defined. When the swept area investigations started in 1981 the survey area was divided into four main areas (A, B, C og D, Fig 3.2) and 35 strata. 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 where high and variable fish densities were expected to occur. During the 1990ies trawl stations have been spread out more evenly, yet the distance between stations in the most important cod strata is shorter (16 n.miles) compared to the less important strata (24 or 36 n.miles). During the 1990s considerable amounts of young cod were 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); 28 strata altogether. 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 need for a sufficient number of trawl stations in each stratum to get reliable estimates of density and variance.

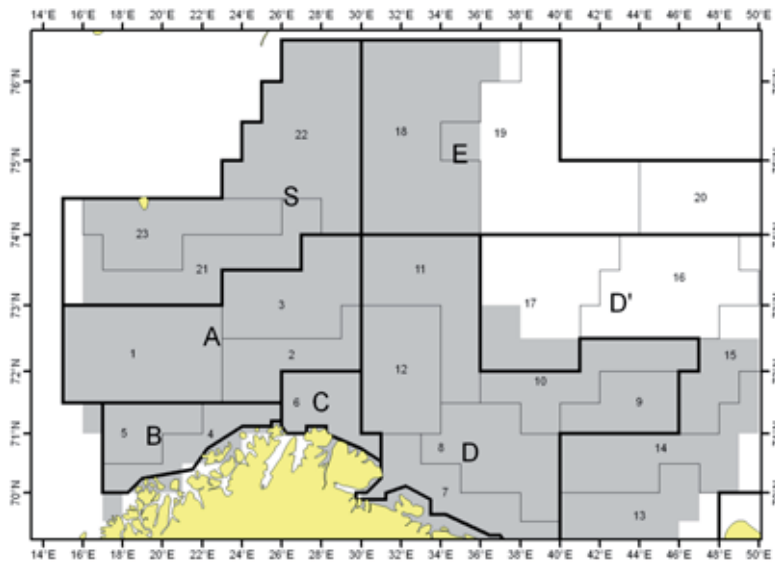


Figure 2.1 Strata (1-23) and Main Areas (A,B,C,D,D',E and S) used for swept area estimations. The Main Areas are also used for acoustic estimation. The grey shading indicates the area covered in 2006.

2.3 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:

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

$$EW_l = EW_{l_{\min}} = \alpha \cdot l_{\min}^\beta \text{ for } l \leq l_{\min}$$

$$EW_l = EW_{l_{\max}} = \alpha \cdot l_{\max}^\beta \text{ for } l \geq l_{\max}$$

The parameters are given in the text table below:

| Species | α | β | l_{\min} | l_{\max} |
|---------|----------|---------|------------|------------|
| Cod | 5.91 | 0.43 | 15 cm | 62 cm |
| Haddock | 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.

For each station, s , observations of fish density by length ($\rho_{s,l}$) is summed in 5 cm length-groups. 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 most northern and most eastern strata differs from year to year. The areas of these strata are therefore calculated according to the coverage each year. 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 the indices of 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 the values for 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 Mjanger *et al.* (2005). Since 1999 all data except age are recorded electronically by Scantrol Fishmeter measuring board, connected to stabilized scales. The whole catch or a representative sub sample of most species was length measured on each station.

At each trawl station age (otoliths) and stomach were sampled from one cod per 5 cm length-group. All cod above 80 cm were sampled. The stomach samples were frozen and analysed after the survey. Haddock otoliths were sampled from one specimen per 5 cm length-group. Regarding the redfish species, *Sebastes marinus* and *S. mentella*, otoliths for age determination were sampled from two fish in every 5 cm length-group on every station. 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.

An 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 2006 was conducted with R/V "G.O. Sars" 01.02-10.03 (IMR-BEI-survey no. 2006103, IMR-series no. 70251-70424), R/V "Johan Hjort" 01.02-14.03 (IMR-BEI-survey no. 2006203, IMR-series no. 70001-70182).

Figure 3.1 shows survey tracks and trawl stations, and Figure 3.2 shows the trawl stations used for swept area estimation.

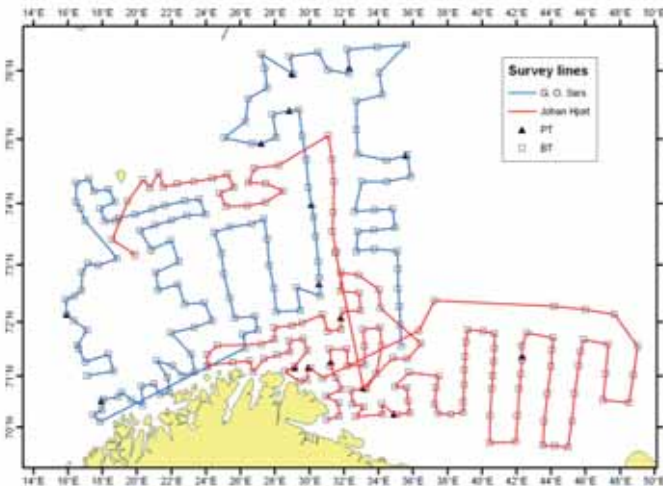


Figure 3.1. Survey tracks and trawl stations R/V "G.O. Sars" and R/V "Johan Hjort" 01.02-14.03.2006.

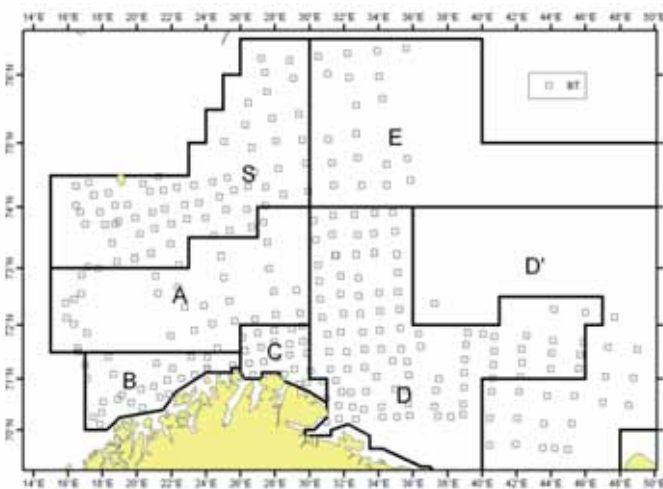


Figure 3.2. Bottom trawl stations used in the swept area estimation in 2006 and borders for the main areas.

Table 3.1 shows the area covered by the survey every year. In the 2006 survey 158 hydrographical (CTD) stations and 356 trawl stations were taken (Figure 3.1, Table 3.2). 10 of the trawl stations were pelagic trawl hauls 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 within the defined strata system were used. Those added up to 271 stations. Among the bottom trawl stations not used in the swept area calculation are; 58 stations taken for trawl comparisons, and 2 non-predefined hauls for identification of acoustic records. The remaining 8 were rejected due to damage or malfunction of the gear. Age sampling from these additional bottom trawl hauls and from pelagic hauls has been used in the calculations.

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.

Table 3.1. Area (n.miles²) covered in the bottom trawl surveys in the Barents Sea winter 1981-2006.

| Year | Main Area | | | | | | | Sum | Total |
|---------|-----------|------|------|-------|-------|-------|-------|-------|--------|
| | A | B | C | D | D' | E | S | ABCD | |
| 1981-92 | 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 |
| 2003 | 26483 | 9701 | 5048 | 52805 | 23506 | 6185 | 22849 | 94038 | 146578 |
| 2004 | 27976 | 9845 | 5162 | 53567 | 42903 | 4782 | 20415 | 96549 | 164649 |
| 2005 | 27581 | 9701 | 5048 | 53932 | 38716 | 19720 | 24194 | 96263 | 178893 |
| 2006 | 27581 | 9701 | 5048 | 53932 | 34980 | 13687 | 24194 | 96263 | 169123 |

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 2006, B1=fixed bottom trawl, B2=other bottom trawl, P=pelagic trawl.

| Area | Trawltype | No. hauls | Cod | | Haddock | | <i>S. marinus</i> | | <i>S. mentella</i> | | Greenland halibut | |
|-------|-----------|-----------|-------|------|---------|------|-------------------|---|--------------------|---|-------------------|-----|
| | | | L | A | L | A | L | A | L | A | L | A |
| A | B1 | 31 | 1102 | 278 | 3508 | 305 | 105 | | 956 | | 47 | |
| | B2 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 1 | 10 | 6 | 49 | 11 | 0 | | 0 | | 0 | |
| B | B1 | 26 | 935 | 231 | 2057 | 230 | 252 | | 83 | | 2 | |
| | B2 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 2 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| C | B1 | 22 | 860 | 215 | 2407 | 185 | 54 | | 335 | | 2 | |
| | B2 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 2 | 1 | 1 | 69 | 5 | 0 | | 0 | | 0 | |
| D | B1 | 93 | 8625 | 1023 | 10224 | 686 | 57 | | 316 | | 172 | |
| | B2 | 3 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 7 | 7 | 4 | 384 | 16 | 0 | | 0 | | 0 | |
| D' | B1 | 19 | 969 | 91 | 597 | 44 | 0 | | 0 | | 0 | |
| | B2 | 2 | 10 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| E | B1 | 16 | 1249 | 132 | 933 | 85 | 5 | | 8 | | 218 | |
| | B2 | 3 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 2 | 0 | 0 | 66 | 0 | 0 | | 0 | | 0 | |
| S | B1 | 64 | 5551 | 702 | 3005 | 326 | 255 | | 1658 | | 521 | |
| | B2 | 2 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 3 | 0 | 0 | 312 | 6 | 0 | | 0 | | 0 | |
| Total | B1 | 271 | 19291 | 2672 | 22731 | 1861 | 728 | | 3356 | | 962 | |
| | B2 | 10 | 10 | 0 | 0 | 0 | 0 | | 0 | | 0 | |
| | P | 17 | 18 | 11 | 880 | 38 | 0 | | 0 | | 0 | |
| Sum | | 298 | 19319 | 2683 | 22561 | 1899 | 728 | | 3356 | | 962 | 867 |

4. HYDROGRAPHY

The standard hydrographical sections "Fugløya-Bjørnøya" and "Vardø-north" taken during the last days of the survey. Figure 4.1 shows the observed mean temperature at 50-200 m depth, compared to the period 1999-2006. The Sem Islands section has not been taken since 2001.

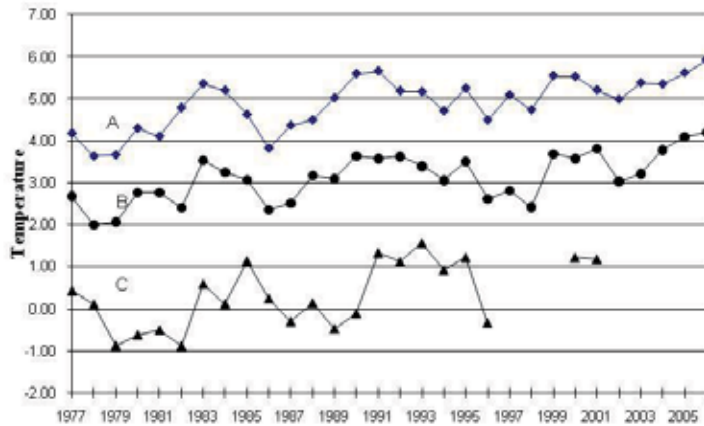


Figure 4.1. Mean temperatures in 50-200 m depth in 1977-2006. A) "Fugløya-Bjørnøya" in March, B) "Vardø-Nord" in March, C) Sem Islands in January-February.

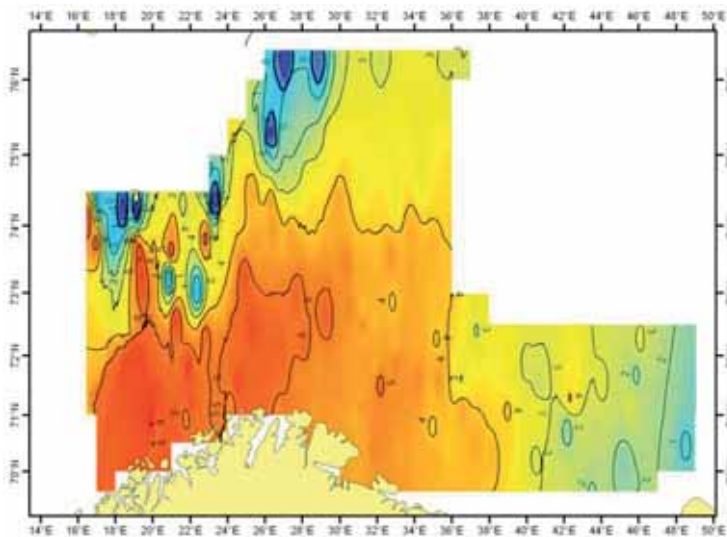


Figure 4.2. Temperatures at 10m depth during the 2006 survey.

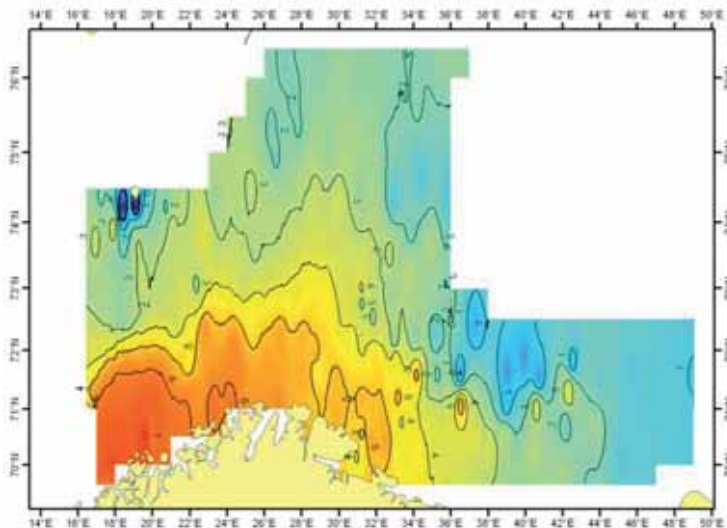


Figure 4.3. Temperatures at bottom during the 2006 survey.

5. TOTAL ECHO ABUNDANCE OF COD AND HADDOCK

Table 5.1 shows the echo abundance (echo density multiplied by area) distributed on main areas as well as on pelagic versus bottom channels, and table 5.2 presents the time series of total echo abundance of cod and haddock in the investigated areas. Since 1993 the acoustic values have been split between the two species. The 2006 value for cod is at a similar low level as in 2004 and 2005. The 2006 value for haddock is rather high and similar to the 2005 value. Only 4 years in the 14 year time series show higher values.

For cod the values are distributed among the main areas in the same pattern as in 2005. For haddock the contribution from the northern main areas (E and S) were higher than in any earlier years. Compared to most years in the series the fraction of the total echo abundance recorded in the bottom layer in 2005 was high (0.39) for cod and rather low (0.25) for haddock.

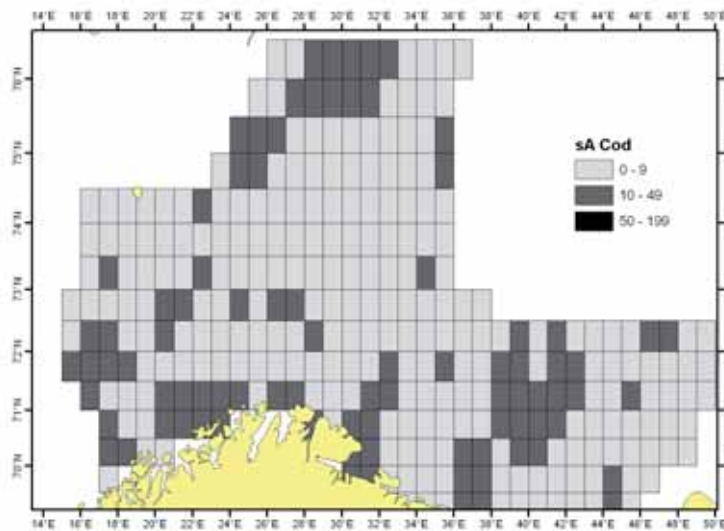


Figure 5.1. COD. Distribution of total echo abundance winter 2006. Unit is s_A per square nautical mile ($m^2/n.mile^2$).

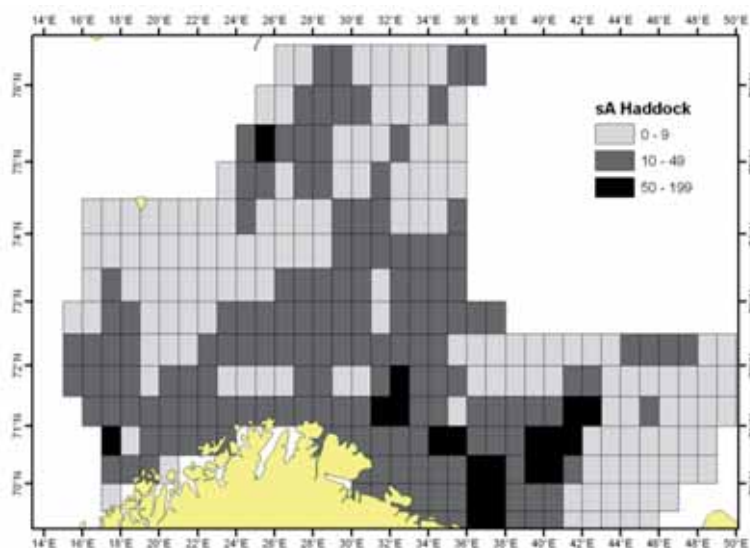


Figure 5.2. HADDOCK. Distribution of total echo abundance winter 2006. Unit is s_A per square nautical mile ($m^2/n.mile^2$).

Table 5.1. Echo abundance of cod and haddock in the pelagic layer (P) and in the 10 m layer above the bottom (B) in main areas of the Barents Sea winter 2006 (m^2 reflecting surface $\cdot 10^{-3}$).

| Area | Cod | | | Haddock | | |
|-------|-----|-----|-------|---------|-----|-------|
| | P | B | Total | P | B | Total |
| A | 120 | 47 | 167 | 248 | 94 | 342 |
| B | 69 | 64 | 133 | 105 | 68 | 173 |
| C | 22 | 12 | 34 | 68 | 24 | 92 |
| D | 280 | 193 | 473 | 1178 | 391 | 1569 |
| D' | 67 | 54 | 121 | 186 | 58 | 244 |
| E | 79 | 18 | 97 | 100 | 17 | 117 |
| S | 96 | 73 | 169 | 174 | 45 | 219 |
| Total | 733 | 462 | 1195 | 2058 | 697 | 2755 |

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 1981-2006 (m^2 reflecting surface $\cdot 10^{-3}$). 1981 - 1992 includes only mainly areas A, B, C and D.

| Year | Echo abundance | | | | | | | | |
|-------------------|----------------|------------|------|------|------|------|------|------|------|
| | Cod | Total 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 |
| 2003 | 3699 | 3398 | 7097 | 1248 | 753 | 2001 | 0.34 | 0.22 | 0.28 |
| 2004 | 1162 | 1985 | 3147 | 576 | 626 | 1202 | 0.50 | 0.32 | 0.38 |
| 2005 | 1299 | 2873 | 4172 | 457 | 940 | 1397 | 0.35 | 0.33 | 0.33 |
| 2006 | 1195 | 2755 | 3950 | 462 | 697 | 1159 | 0.39 | 0.25 | 0.29 |

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. There are indications that a higher proportion than earlier has spawned along the Finnmark coast in the recent three years. Thereby a higher proportion of the spawners might have been covered by the survey these years.

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 (1981-2006) is presented in table 6.3. The estimates have fluctuated largely in recent years and the high values observed in 2003 appear as overestimates compared to the results in the years before and after.

Table 6.1. COD. Abundance indices at length and age from the acoustic survey in the Barents Sea winter 2006 (numbers in millions).

| Length | Age (year-class) | | | | | | | | | | Sum | Biomass |
|---------|------------------|-------|------|------|------|------|------|------|------|-----|-------|---------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ | | |
| Cm | (05) | (04) | (03) | (02) | (01) | (00) | (99) | (98) | (97) | | | (000 t) |
| 5-9 | 9.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.3 | 0.1 |
| 10-15 | 503.9 | 6.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 510.2 | 6.5 |
| 15-20 | 31.1 | 91.9 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 123.3 | 4.8 |
| 20-25 | 0.3 | 102.8 | 5.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 108.4 | 9.3 |
| 25-30 | 0.0 | 15.0 | 26.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 41.2 | 6.9 |
| 30-35 | 0.0 | 0.6 | 33.9 | 3.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 38.2 | 11.0 |
| 35-40 | 0.0 | 0.0 | 11.4 | 16.6 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 28.8 | 13.1 |
| 40-45 | 0.0 | 0.0 | 2.5 | 20.3 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 23.4 | 15.2 |
| 45-50 | 0.0 | 0.0 | 0.2 | 14.0 | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15.9 | 14.5 |
| 50-55 | 0.0 | 0.0 | 0.0 | 3.3 | 5.1 | 1.9 | 0.4 | 0.0 | 0.0 | 0.0 | 10.8 | 13.7 |
| 55-60 | 0.0 | 0.0 | 0.0 | 0.8 | 4.5 | 7.0 | 0.8 | 0.0 | 0.0 | 0.0 | 13.2 | 21.9 |
| 60-65 | 0.0 | 0.0 | 0.0 | 0.4 | 1.9 | 9.5 | 1.3 | 0.0 | 0.0 | 0.0 | 13.1 | 27.5 |
| 65-70 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 5.6 | 2.3 | 0.3 | 0.0 | 0.0 | 9.2 | 23.8 |
| 70-75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 2.5 | 1.1 | 0.2 | 0.0 | 5.0 | 16.5 |
| 75-80 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.8 | 1.3 | 0.4 | 0.0 | 2.8 | 11.3 |
| 80-85 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.4 | 0.8 | 0.1 | 0.0 | 1.4 | 6.5 |
| 85-90 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.2 | 0.0 | 0.9 | 5.2 |
| >90 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.5 | 0.5 | 0.5 | 1.5 | 14.3 |
| sum | 544.6 | 216.6 | 79.8 | 59.1 | 15.5 | 25.6 | 8.8 | 4.5 | 1.4 | 0.5 | 956.5 | |
| Biomass | 7.7 | 15.2 | 21.7 | 40.8 | 22.6 | 54.2 | 25.7 | 20.3 | 8.1 | 6.0 | | 222.2 |

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 2006 (numbers in millions).

| Area | Layer | Age (year-class) | | | | | | | | | | Biomass (‘000 t) |
|-------|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|---------------------|
| | | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) | 9 (97) | 10+ | |
| A | P | 10.2 | 1.9 | 2.2 | 4.0 | 1.9 | 6.4 | 1.8 | 0.8 | 0.2 | 0.0 | 30.3 |
| | B | 5.6 | 1.0 | 0.9 | 1.6 | 0.7 | 2.4 | 0.7 | 0.3 | 0.1 | 0.0 | 11.7 |
| B | P | 0.9 | 0.1 | 0.6 | 1.4 | 1.0 | 2.4 | 1.4 | 1.0 | 0.3 | 0.1 | 21.9 |
| | B | 0.8 | 0.1 | 0.5 | 1.3 | 1.0 | 2.2 | 1.3 | 0.9 | 0.3 | 0.1 | 20.5 |
| C | P | 6.5 | 2.7 | 0.4 | 1.1 | 0.3 | 0.5 | 0.3 | 0.1 | 0.1 | 0.0 | 5.2 |
| | B | 2.8 | 0.9 | 0.3 | 0.7 | 0.2 | 0.3 | 0.2 | 0.1 | 0.0 | 0.0 | 3.1 |
| D | P | 111.0 | 44.3 | 29.9 | 21.1 | 4.5 | 3.4 | 1.3 | 0.5 | 0.1 | 0.0 | 47.1 |
| | B | 86.7 | 30.7 | 20.7 | 14.0 | 2.9 | 2.2 | 0.9 | 0.4 | 0.1 | 0.0 | 32.6 |
| D' | P | 76.0 | 13.3 | 4.3 | 2.7 | 0.8 | 1.0 | 0.1 | 0.1 | 0.0 | 0.0 | 9.1 |
| | B | 60.9 | 9.9 | 3.0 | 1.8 | 0.6 | 0.9 | 0.2 | 0.1 | 0.0 | 0.0 | 7.8 |
| E | P | 75.3 | 39.2 | 7.8 | 1.7 | 0.4 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 8.2 |
| | B | 15.7 | 9.6 | 1.8 | 0.4 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 |
| S | P | 50.0 | 38.2 | 4.4 | 4.1 | 0.7 | 1.9 | 0.3 | 0.1 | 0.0 | 0.0 | 12.8 |
| | B | 42.3 | 24.5 | 3.0 | 3.2 | 0.6 | 1.7 | 0.3 | 0.1 | 0.0 | 0.0 | 10.0 |
| ABCD | P | 128.5 | 49.0 | 33.1 | 27.6 | 7.7 | 12.7 | 4.8 | 2.5 | 0.7 | 0.3 | 104.5 |
| | B | 95.9 | 32.8 | 22.4 | 17.5 | 4.7 | 7.1 | 3.1 | 1.7 | 0.5 | 0.2 | 67.9 |
| Total | P | 329.7 | 139.8 | 49.6 | 36.1 | 9.5 | 15.9 | 5.3 | 2.6 | 0.8 | 0.3 | 134.6 |
| | B | 214.8 | 76.8 | 30.2 | 22.9 | 6.1 | 9.8 | 3.6 | 1.9 | 0.6 | 0.2 | 87.6 |
| | sum | 544.5 | 216.6 | 79.8 | 59.1 | 15.5 | 25.6 | 8.8 | 4.5 | 1.4 | 0.5 | 222.2 |

Table 6.3. COD. Abundance indices from acoustic surveys in the Barents Sea winter 1981-2006 (numbers in millions). 1981-1992 includes only main areas A, B C and D.

| Year | Age | | | | | | | | | | Total | Biomass (‘000 t) |
|------|--------|-------|-------|-------|-------|-------|------|------|-----|-----|--------|---------------------|
| | 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 | 595 |
| 1982 | 4.0 | 5.0 | 49.0 | 43.0 | 40.0 | 26.0 | 28.0 | 2.0 | 0.0 | 0.0 | 197.0 | 303 |
| 1983 | 60.5 | 2.8 | 5.3 | 14.3 | 17.4 | 11.1 | 5.6 | 3.0 | 0.5 | 0.1 | 120.5 | 111 |
| 1984 | 745.4 | 146.1 | 39.1 | 13.6 | 11.3 | 7.4 | 2.8 | 0.2 | 0.0 | 0.0 | 966.0 | 134 |
| 1985 | 69.1 | 446.3 | 153.0 | 141.6 | 19.7 | 7.6 | 3.3 | 0.2 | 0.1 | 0.0 | 840.9 | 392 |
| 1986 | 353.6 | 243.9 | 499.6 | 134.3 | 65.9 | 8.3 | 2.2 | 0.4 | 0.1 | 0.0 | 1308.2 | 503 |
| 1987 | 1.6 | 34.1 | 62.8 | 204.9 | 41.4 | 10.4 | 1.2 | 0.2 | 0.7 | 0.0 | 357.3 | 207 |
| 1988 | 2.0 | 26.3 | 50.4 | 35.5 | 56.2 | 6.5 | 1.4 | 0.2 | 0.0 | 0.0 | 178.4 | 99 |
| 1989 | 7.5 | 8.0 | 17.0 | 34.4 | 21.4 | 53.8 | 6.9 | 1.0 | 0.1 | 0.1 | 150.1 | 155 |
| 1990 | 81.1 | 24.9 | 14.8 | 20.6 | 26.1 | 24.3 | 39.8 | 2.4 | 0.1 | 0.0 | 234.1 | 246 |
| 1991 | 181.0 | 219.5 | 50.2 | 34.6 | 29.3 | 28.9 | 16.9 | 17.3 | 0.9 | 0.0 | 578.7 | 418 |
| 1992 | 241.4 | 562.1 | 176.5 | 65.8 | 18.8 | 13.2 | 7.6 | 4.5 | 2.8 | 0.2 | 1092.9 | 405 |
| 1993 | 1074.0 | 494.7 | 357.2 | 191.1 | 108.2 | 20.8 | 8.1 | 5.0 | 2.3 | 2.5 | 2264.0 | 753 |
| 1994 | 858.3 | 577.2 | 349.8 | 404.5 | 193.7 | 63.6 | 12.1 | 3.7 | 1.7 | 0.9 | 2465.4 | 950 |
| 1995 | 2619.2 | 292.9 | 166.2 | 159.8 | 210.1 | 68.8 | 16.7 | 2.1 | 0.7 | 1.0 | 3537.4 | 713 |
| 1996 | 2396.0 | 339.8 | 92.9 | 70.5 | 85.8 | 74.7 | 20.6 | 2.8 | 0.3 | 0.4 | 3083.8 | 450 |
| 1997 | 1623.5 | 430.5 | 188.3 | 51.7 | 49.3 | 37.2 | 22.3 | 4.0 | 0.7 | 0.1 | 2407.5 | 322 |
| 1998 | 3401.3 | 632.9 | 427.7 | 182.6 | 42.3 | 33.5 | 26.9 | 13.6 | 1.7 | 0.3 | 4762.8 | 506 |
| 1999 | 358.3 | 304.3 | 150.0 | 96.4 | 45.1 | 10.3 | 6.4 | 4.1 | 0.8 | 0.3 | 976.0 | 224 |
| 2000 | 154.1 | 221.4 | 245.2 | 158.9 | 142.1 | 45.4 | 9.6 | 4.7 | 3.0 | 1.1 | 985.4 | 481 |
| 2001 | 629.9 | 63.9 | 138.2 | 171.6 | 77.3 | 39.7 | 11.8 | 1.4 | 0.5 | 0.2 | 1134.7 | 408 |
| 2002 | 18.2 | 215.5 | 69.3 | 112.2 | 102.0 | 47.0 | 18.0 | 3.0 | 0.4 | 0.3 | 585.9 | 416 |
| 2003 | 1693.9 | 61.5 | 303.4 | 114.4 | 129.0 | 114.9 | 34.3 | 7.7 | 1.9 | 0.5 | 2461.5 | 731 |
| 2004 | 157.6 | 105.2 | 33.6 | 92.8 | 30.7 | 27.6 | 17.0 | 5.9 | 1.2 | 0.2 | 471.8 | 241 |
| 2005 | 465.3 | 119.6 | 123.9 | 33.7 | 62.8 | 16.9 | 14.5 | 4.2 | 1.0 | 0.4 | 842.4 | 249 |
| 2006 | 544.6 | 216.6 | 79.8 | 59.1 | 15.5 | 25.6 | 8.8 | 4.5 | 1.4 | 0.5 | 956.5 | 222 |

6.2 Swept area estimation

Figures 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 (less than 35 cm) were found in the eastern part of the survey area within the Russian EEZ. In addition there were some concentrations near the northern borders of the area covered, indicating that these size groups might have been underestimated.

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. Age-length distribution of the total swept area index as well as the distribution of the index by main area and age is given in tables 6.5 and 6.6, respectively. The swept area indices are somewhat higher than the acoustic indices (Table 6.3) for all age groups.

The time series (1981-2006) is shown in table 6.7. In the period 2000-2004 the abundance of 7 year and older fish has increased gradually, but decreased again in 2005 and 2006. The latest survey confirms that the 2001 year-class is poor, and the 2003 year-class is also indicated to be low.

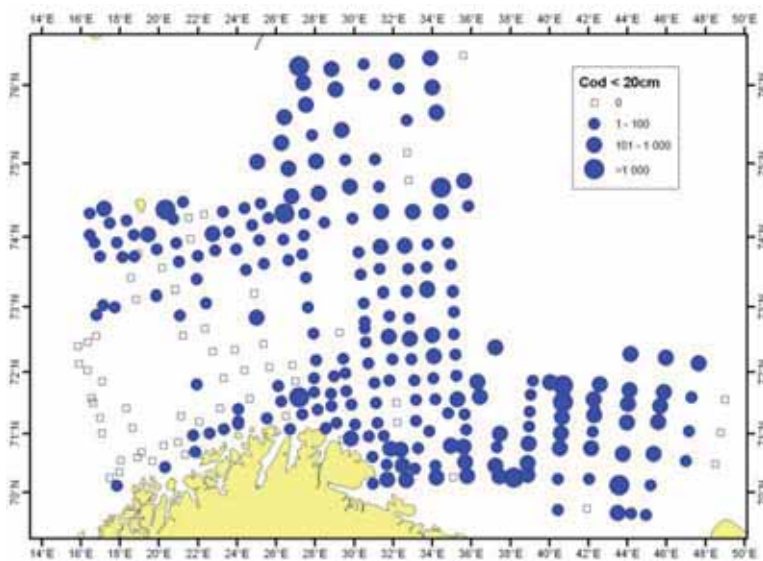


Figure 6.1. COD < 20 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

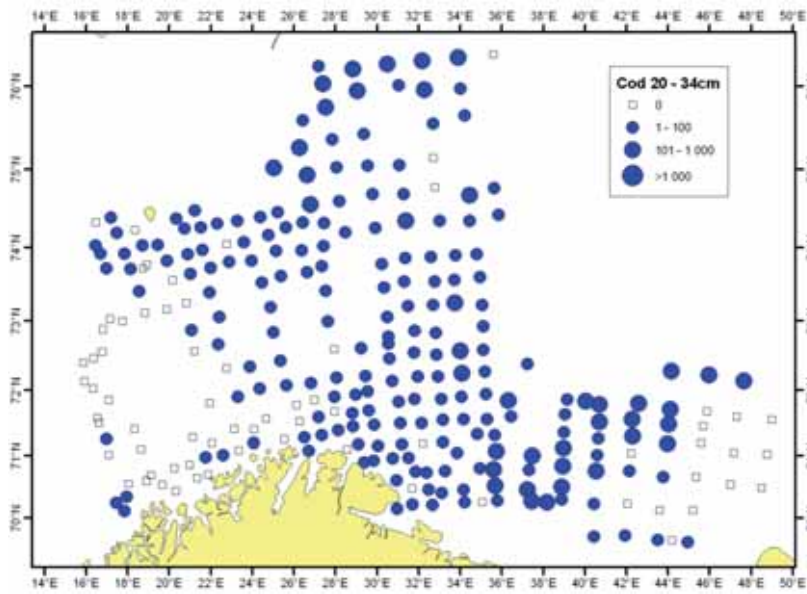


Figure 6.2. COD 20-34 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

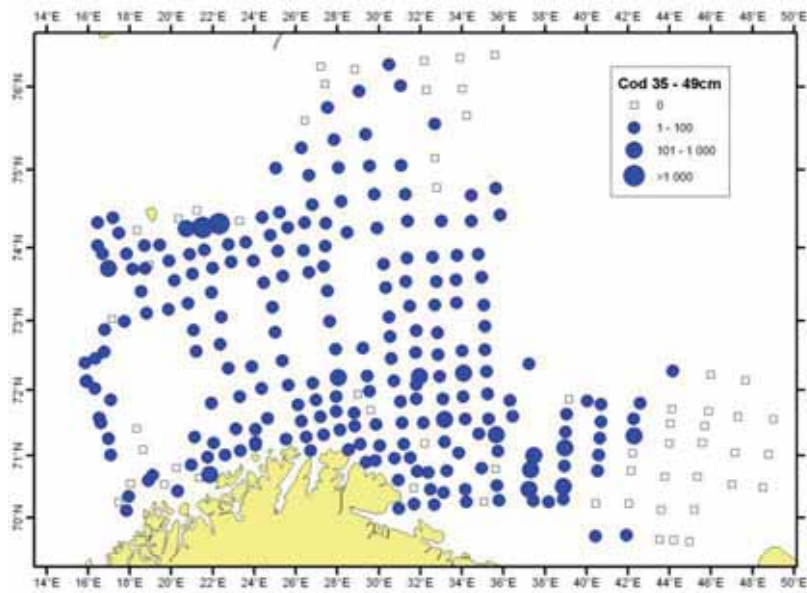


Figure 6.3. COD 35-49 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

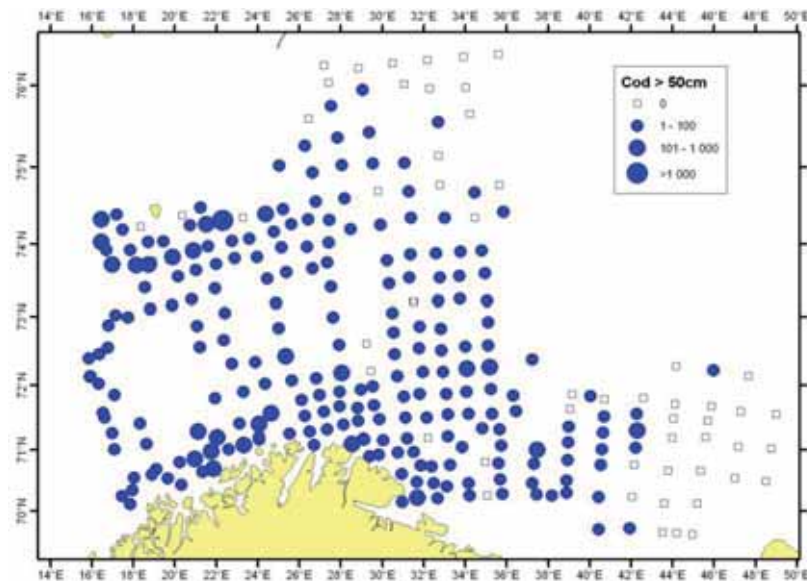


Figure 6.4. COD > 50 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

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 2006 (no. in millions).

| Length cm | Area | | | | | | | | | | | | | | | | CV (%) |
|--------------|------|-----|------|-----|------|-----|-------|------|-------|------|-------|------|-------|-------|--------|-------|--------|
| | A | | B | | C | | D | | D' | | E | | S | | Total | | |
| | I | S | I | S | I | S | I | S | I | S | I | S | I | S | I | S | |
| 5-9 | 1.6 | 1.6 | 0.3 | 0.2 | 0.0 | 0.0 | 4.1 | 1.1 | 1.9 | 0.8 | 4.1 | 4.1 | 0.5 | 0.3 | 12.5 | 4.6 | 36.8 |
| 10-14 | 6.9 | 1.6 | 0.5 | 0.2 | 4.8 | 1.8 | 281.4 | 40.6 | 142.4 | 46.8 | 104.0 | 43.6 | 288.9 | 193.9 | 829.0 | 208.2 | 25.1 |
| 15-19 | 5.4 | 3.9 | 0.0 | 0.0 | 8.3 | 8.0 | 45.6 | 6.8 | 38.6 | 26.0 | 26.2 | 6.7 | 33.4 | 11.3 | 157.6 | 31.2 | 19.8 |
| 20-24 | 1.0 | 0.4 | 0.0 | 0.0 | 0.1 | 0.0 | 59.0 | 12.6 | 29.6 | 25.6 | 21.2 | 3.8 | 32.5 | 9.4 | 143.5 | 30.2 | 21.1 |
| 25-29 | 0.5 | 0.2 | 0.0 | 0.0 | 0.2 | 0.1 | 34.6 | 5.9 | 3.9 | 2.3 | 6.4 | 1.1 | 6.7 | 1.2 | 52.2 | 6.5 | 12.5 |
| 30-34 | 1.2 | 0.3 | 0.1 | 0.0 | 0.4 | 0.1 | 38.7 | 7.1 | 3.1 | 1.8 | 3.5 | 1.2 | 5.1 | 0.9 | 52.0 | 7.4 | 14.3 |
| 35-39 | 2.3 | 0.5 | 0.3 | 0.1 | 0.5 | 0.2 | 29.3 | 5.4 | 1.8 | 0.7 | 2.8 | 1.0 | 11.2 | 6.0 | 48.2 | 8.2 | 17.0 |
| 40-44 | 3.8 | 0.8 | 0.8 | 0.3 | 0.6 | 0.2 | 20.8 | 3.8 | 0.8 | 0.5 | 1.0 | 0.4 | 25.6 | 16.8 | 53.4 | 17.3 | 32.4 |
| 45-49 | 3.1 | 0.7 | 1.2 | 0.5 | 0.8 | 0.2 | 13.1 | 2.7 | 0.5 | 0.3 | 0.4 | 0.2 | 12.4 | 6.4 | 31.4 | 7.0 | 22.2 |
| 50-54 | 2.6 | 0.6 | 1.3 | 0.6 | 0.6 | 0.2 | 6.7 | 1.1 | 1.1 | 0.3 | 0.4 | 0.2 | 9.6 | 4.3 | 22.3 | 4.5 | 20.2 |
| 55-59 | 4.2 | 0.7 | 1.6 | 0.5 | 0.7 | 0.2 | 6.3 | 1.0 | 1.0 | 0.3 | 0.3 | 0.2 | 9.8 | 3.1 | 23.9 | 3.4 | 14.3 |
| 60-64 | 4.1 | 0.8 | 2.1 | 0.5 | 0.4 | 0.1 | 4.8 | 0.8 | 1.1 | 0.6 | 0.2 | 0.1 | 6.1 | 1.2 | 18.8 | 1.8 | 9.7 |
| 65-69 | 2.6 | 0.6 | 1.6 | 0.3 | 0.4 | 0.1 | 3.3 | 0.7 | 1.7 | 0.7 | 0.1 | 0.0 | 2.7 | 0.5 | 12.3 | 1.3 | 10.4 |
| 70-74 | 1.4 | 0.4 | 1.0 | 0.2 | 0.2 | 0.0 | 1.9 | 0.5 | 0.4 | 0.2 | 0.0 | 0.0 | 1.1 | 0.3 | 6.1 | 0.8 | 12.5 |
| 75-79 | 1.0 | 0.2 | 0.7 | 0.2 | 0.2 | 0.1 | 0.5 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.7 | 0.2 | 3.3 | 0.4 | 11.6 |
| 80-84 | 0.4 | 0.1 | 0.3 | 0.1 | 0.1 | 0.0 | 0.6 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.2 | 0.1 | 1.7 | 0.3 | 15.8 |
| 85-89 | 0.3 | 0.1 | 0.2 | 0.1 | 0.1 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.9 | 0.2 | 17.9 |
| >90 | 0.2 | 0.1 | 0.3 | 0.1 | 0.1 | 0.0 | 0.4 | 0.1 | 0.2 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 1.3 | 0.2 | 16.7 |
| Sum | 42.6 | 4.9 | 12.3 | 1.2 | 18.5 | 8.2 | 551.4 | 44.6 | 228.5 | 59.4 | 170.5 | 44.5 | 446.6 | 195.5 | 1470.3 | 214.0 | 14.6 |

Table 6.5. COD. Abundance indices at length and age from the bottom trawl survey in the Barents Sea winter 2006 (numbers in millions).

| Length cm | Age (year-class) | | | | | | | | | | Sum | Biomass ('000 t) |
|--------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|--------|---------------------|
| | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) | 9 (97) | 10+ | | |
| 5-9 | 12.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.5 | 0.0 |
| 10-15 | 813.2 | 15.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 829.0 | 13.7 |
| 15-20 | 35.4 | 121.4 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 157.6 | 7.1 |
| 20-25 | 1.6 | 130.8 | 11.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 143.5 | 13.8 |
| 25-30 | 0.0 | 19.8 | 32.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 52.2 | 9.2 |
| 30-35 | 0.0 | 0.6 | 44.2 | 7.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 52.0 | 15.1 |
| 35-40 | 0.0 | 0.0 | 23.8 | 23.3 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 48.3 | 21.5 |
| 40-45 | 0.0 | 0.0 | 5.6 | 46.4 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 53.4 | 34.6 |
| 45-50 | 0.0 | 0.0 | 0.3 | 26.9 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 31.4 | 28.5 |
| 50-55 | 0.0 | 0.0 | 0.0 | 6.5 | 9.8 | 5.7 | 0.3 | 0.0 | 0.0 | 0.0 | 22.3 | 27.3 |
| 55-60 | 0.0 | 0.0 | 0.0 | 1.0 | 8.0 | 14.1 | 0.8 | 0.0 | 0.0 | 0.0 | 23.9 | 38.5 |
| 60-65 | 0.0 | 0.0 | 0.0 | 0.2 | 2.8 | 14.3 | 1.3 | 0.4 | 0.0 | 0.0 | 18.8 | 38.9 |
| 65-70 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 7.1 | 3.0 | 0.2 | 0.2 | 0.2 | 12.3 | 31.9 |
| 70-75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 3.0 | 1.1 | 0.2 | 0.0 | 6.1 | 19.6 |
| 75-80 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.9 | 1.5 | 0.3 | 0.1 | 3.3 | 12.9 |
| 80-85 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.6 | 0.8 | 0.1 | 0.0 | 1.7 | 8.1 |
| 85-90 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.2 | 0.0 | 0.9 | 5.1 |
| >90 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.4 | 0.5 | 0.3 | 1.3 | 8.9 |
| sum | 862.7 | 288.4 | 118.1 | 111.5 | 28.7 | 43.7 | 10.2 | 4.9 | 1.4 | 0.6 | 1470.4 | 334.6 |
| Biomass | 12.9 | 20.5 | 34.0 | 76.1 | 39.3 | 87.0 | 30.2 | 21.4 | 8.3 | 5.0 | | 334.6 |

Table 6.6. COD. Abundance indices from bottom trawl hauls for main areas of the Barents Sea winter 2006 (numbers in millions.)

| Area | Age (year-class) | | | | | | | | | | Biomass '000 t |
|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|-------------------|
| | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) | 9 (97) | 10+ | |
| A | 12.0 | 3.4 | 3.3 | 7.7 | 3.1 | 8.9 | 2.6 | 1.3 | 0.4 | 0.1 | 45.6 |
| B | 0.8 | 0.1 | 1.0 | 1.7 | 1.8 | 3.5 | 1.9 | 1.0 | 0.3 | 0.1 | 27.4 |
| C | 7.6 | 5.7 | 0.9 | 1.9 | 0.7 | 0.9 | 0.5 | 0.2 | 0.1 | 0.0 | 9.0 |
| D | 286.2 | 110.3 | 74.7 | 54.2 | 12.3 | 9.0 | 2.8 | 1.4 | 0.4 | 0.3 | 120.7 |
| D' | 152.3 | 60.5 | 7.1 | 3.2 | 1.9 | 2.9 | 0.3 | 0.3 | 0.0 | 0.0 | 23.2 |
| E | 108.0 | 46.2 | 12.3 | 3.0 | 0.6 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 11.4 |
| S | 295.9 | 62.3 | 18.8 | 39.9 | 8.4 | 18.1 | 2.2 | 0.7 | 0.3 | 0.1 | 97.2 |
| ABCD | 306.6 | 119.4 | 79.9 | 65.5 | 17.9 | 22.3 | 7.7 | 3.9 | 1.2 | 0.5 | 202.8 |
| Total | 862.7 | 288.4 | 118.1 | 111.5 | 28.7 | 43.7 | 10.2 | 4.9 | 1.4 | 0.6 | 334.5 |

Table 6.7. COD. Abundance indices from bottom trawl surveys in the Barents Sea winter 1981-2006 (numbers in millions). 1981-1992 includes only main areas A, B, C and D.

| Year | Age | | | | | | | | | | Total | Biomass ('000 t) |
|-------|--------|--------|-------|-------|-------|-------|------|------|-----|-----|--------|----------------------|
| | 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 | 163.1 | 203 |
| 1982 | 0.8 | 2.9 | 28.3 | 27.7 | 23.6 | 15.5 | 16.0 | 1.4 | 0.2 | 0 | 116.4 | 174 |
| 1983 | 152.9 | 13.4 | 25.0 | 52.3 | 43.3 | 17.0 | 5.8 | 3.2 | 1.0 | 0.1 | 314.0 | 220 |
| 1984 | 2755.0 | 379.1 | 97.5 | 28.3 | 21.4 | 11.7 | 4.1 | 0.4 | 0.1 | 0.1 | 3297.7 | 310 |
| 1985 | 49.5 | 660.0 | 166.8 | 126.0 | 19.9 | 7.7 | 3.3 | 0.2 | 0.1 | 0.1 | 1033.6 | 421 |
| 1986 | 665.8 | 399.6 | 805.0 | 143.9 | 64.1 | 8.3 | 1.9 | 0.3 | 0 | 0 | 2088.9 | 639 |
| 1987 | 30.7 | 445.0 | 240.4 | 391.1 | 54.3 | 15.7 | 2.0 | 0.5 | 0 | 0 | 1179.7 | 398 |
| 1988 | 3.2 | 72.8 | 148.0 | 80.5 | 173.3 | 20.5 | 3.6 | 0.5 | 0 | 0 | 502.4 | 285 |
| 1989 | 8.2 | 15.6 | 46.4 | 75.9 | 37.8 | 90.2 | 9.8 | 0.9 | 0.1 | 0.1 | 285.0 | 271 |
| 1990 | 207.2 | 56.7 | 28.4 | 34.9 | 34.6 | 20.6 | 27.2 | 1.6 | 0.4 | 0 | 411.6 | 246 |
| 1991 | 460.5 | 220.1 | 45.9 | 33.7 | 25.7 | 21.5 | 12.2 | 12.7 | 0.6 | 0 | 832.9 | 352 |
| 1992 | 126.6 | 570.9 | 158.3 | 57.7 | 17.8 | 12.8 | 7.7 | 4.3 | 2.7 | 0.2 | 959.0 | 383 |
| 1993 | 534.5 | 420.4 | 273.9 | 140.1 | 72.5 | 15.8 | 6.2 | 3.9 | 2.2 | 2.4 | 1471.9 | 565 |
| 1994 | 1035.9 | 535.8 | 296.5 | 310.2 | 147.4 | 50.6 | 9.3 | 2.4 | 1.6 | 1.3 | 2391.0 | 761 |
| 1995 | 5253.1 | 541.5 | 274.6 | 241.4 | 255.9 | 76.7 | 18.5 | 2.4 | 0.8 | 1.1 | 6666.0 | 943 |
| 1996 | 5768.5 | 707.6 | 170.0 | 115.4 | 137.2 | 106.1 | 24.0 | 2.9 | 0.4 | 0.5 | 7032.6 | 701 |
| 1997* | 4815.5 | 1045.1 | 238.0 | 64.0 | 70.4 | 52.7 | 28.3 | 5.7 | 0.9 | 0.5 | 6321.1 | 495 |
| 1998* | 2418.5 | 643.7 | 396.0 | 181.3 | 36.5 | 25.9 | 17.8 | 8.6 | 1.0 | 0.5 | 3729.8 | 429 |
| 1999 | 484.6 | 340.1 | 211.8 | 173.2 | 58.1 | 13.4 | 6.5 | 5.1 | 1.2 | 0.4 | 1294.4 | 318 |
| 2000 | 128.8 | 248.3 | 235.2 | 132.1 | 108.3 | 26.9 | 4.3 | 2.0 | 1.2 | 0.4 | 887.5 | 356 |
| 2001 | 657.9 | 76.6 | 191.1 | 182.8 | 83.4 | 38.2 | 8.9 | 1.1 | 0.4 | 0.2 | 1240.6 | 428 |
| 2002 | 35.3 | 443.9 | 88.3 | 135.0 | 109.6 | 42.5 | 15.1 | 2.4 | 0.3 | 0.2 | 872.6 | 441 |
| 2003 | 2991.7 | 79.1 | 377.0 | 129.7 | 91.1 | 67.3 | 18.3 | 4.9 | 1.0 | 0.2 | 3760.3 | 546 |
| 2004 | 328.5 | 235.4 | 76.6 | 172.5 | 56.9 | 44.7 | 27.3 | 7.6 | 1.7 | 0.4 | 951.6 | 413 |
| 2005 | 824.3 | 224.6 | 246.9 | 62.1 | 98.1 | 24.7 | 15.5 | 4.5 | 1.1 | 0.4 | 1502.3 | 355 |
| 2006 | 862.7 | 288.4 | 118.1 | 111.5 | 28.7 | 43.7 | 10.2 | 4.9 | 1.4 | 0.6 | 1470.4 | 335 |

* 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). For age 8 there are few observations in main areas 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 (1978-2006) and mean weight (1983-2006) at age for the entire investigated area. Weights and lengths at age were fairly low in the period 1995-2000, but increased somewhat in 2001. Since then there has been moderate fluctuations. The same pattern is reflected in the tabulated annual weight increments (Table 6.12).

Table 6.8. COD. Length (cm) at age in main areas of the Barents Sea winter 2006.

| Area | Age (year-class) | | | | | | | |
|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) |
| A | 13.3 | 20.7 | 36.2 | 44.0 | 54.6 | 61.2 | 69.2 | 77.9 |
| B | 10.8 | 29.2 | 41.9 | 48.0 | 56.0 | 63.2 | 68.0 | 78.0 |
| C | 13.4 | 17.1 | 34.3 | 46.0 | 54.5 | 60.0 | 70.8 | 80.5 |
| D | 12.0 | 20.3 | 30.8 | 41.0 | 51.9 | 61.8 | 69.5 | 75.7 |
| D' | 11.7 | 19.6 | 27.8 | 40.0 | 61.0 | 63.3 | 75.3 | 83.5 |
| E | 12.5 | 19.5 | 29.1 | 39.9 | 54.8 | 58.8 | 0.0 | 0.0 |
| S | 12.5 | 20.2 | 34.4 | 43.2 | 53.2 | 59.3 | 66.9 | 77.4 |
| Total | 12.2 | 19.9 | 31.3 | 42.1 | 53.5 | 60.8 | 68.9 | 77.7 |

Table 6.9. COD. Length (cm) at age in the Barents Sea from the investigations winter 1978 - 2006.

| 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 |

Table 6.9. Continued.

| Year | Age | | | | | | | |
|-------------------|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 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 |
| 2003 | 12.0 | 21.2 | 29.1 | 39.2 | 53.3 | 61.6 | 70.3 | 80.7 |
| 2004 | 11.0 | 18.9 | 32.0 | 40.9 | 52.0 | 61.8 | 69.0 | 79.0 |
| 2005 | 11.5 | 18.6 | 29.3 | 43.0 | 51.1 | 60.3 | 71.1 | 78.4 |
| 2006 | 12.2 | 19.9 | 31.3 | 42.1 | 53.5 | 60.8 | 68.9 | 77.7 |

¹⁾ Adjusted lengths

Table 6.10. COD. Weight (g) at age in main areas of the Barents Sea winter 2006.

| Area | Age (year-class) | | | | | | | |
|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) |
| A | 16 | 72 | 364 | 692 | 1274 | 1812 | 2520 | 4030 |
| B | 11 | 233 | 690 | 1080 | 1611 | 2279 | 2923 | 4634 |
| C | 20 | 39 | 379 | 898 | 1432 | 2001 | 3330 | 4773 |
| D | 13 | 74 | 275 | 646 | 1299 | 2082 | 3242 | 4334 |
| D' | 13 | 67 | 199 | 674 | 1974 | 2483 | 3505 | 4935 |
| E | 16 | 69 | 232 | 592 | 1482 | 1830 | | |
| S | 16 | 72 | 364 | 692 | 1274 | 1812 | 2520 | 4030 |
| Total | 15 | 71 | 288 | 682 | 1366 | 1991 | 2959 | 4354 |

Table 6.11. COD. Weight (g) at age in the Barents Sea from the investigations winter 1983-2006.

| 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 | 2188 | 3145 | 4463 |
| 2002 | 15 | 68 | 256 | 747 | 1234 | 2024 | 3190 | 4511 |
| 2003 | 14 | 82 | 228 | 569 | 1302 | 1980 | 2975 | 4666 |
| 2004 | 11 | 58 | 294 | 600 | 1167 | 1934 | 2657 | 4025 |
| 2005 | 13 | 57 | 230 | 705 | 1135 | 1817 | 2948 | 4081 |
| 2006 | 15 | 71 | 288 | 682 | 1366 | 1991 | 2959 | 4354 |

¹⁾ Estimated weights

²⁾ Adjusted weights

Table 6.12. COD. Yearly weight increment (g) from the investigations in the Barents Sea winter 1983 - 2006.

| 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 | 999 | 1167 | 1474 |
| 2001-02 | 54 | 153 | 409 | 570 | 767 | 1002 | 1366 |
| 2002-03 | 67 | 160 | 313 | 555 | 746 | 951 | 1476 |
| 2003-04 | 44 | 212 | 372 | 598 | 632 | 677 | 1050 |
| 2004-05 | 46 | 172 | 411 | 535 | 650 | 1014 | 1424 |
| 2005-06 | 58 | 231 | 452 | 661 | 856 | 1142 | 1406 |

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. Over the past 8-10 years the acoustic and swept area indices of cod have been in reasonable agreement and indicated a similar development. Over the most recent 5 year period the acoustic indices have fluctuated more than the swept area indices.

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 by natural and fishing mortality, age reading errors, and the 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 later surveys show lower mortalities, but the 2004 and later surveys indicate a new increase. 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 mortalities 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 observed mortality rates in the acoustic investigations have been more variable. This might be caused by changes in fish behaviour and how available the fish is for acoustic registration. The negative mortalities observed from 2002 to 2003 are possibly caused by sampling errors; over-representation of dense near-shore concentrations in 2003.

Table 6.13. Total mortality observed for cod during the winter survey in the Barents Sea in 1993-2006

| 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 | 1.25 |
| 2002-03 | -1.22 | -0.34 | -0.50 | -0.14 | -0.12 | 0.32 | 0.85 | 0.46 |
| 2003-04 | 2.78 | 0.60 | 1.18 | 1.32 | 1.54 | 1.91 | 1.76 | 1.86 |
| 2004-05 | 0.28 | -0.16 | 0.00 | 0.39 | 0.60 | 0.64 | 1.40 | 1.77 |
| 2005-6 | 0.76 | 0.40 | 0.74 | 0.78 | 0.90 | 0.65 | 1.17 | 1.10 |
| | Bottom trawl 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 | 0.39 | -0.14 | 0.35 | 0.51 | 0.67 | 0.93 | 1.31 | 1.30 |
| 2002-03 | -0.81 | 0.16 | -0.38 | 0.39 | 0.49 | 0.84 | 1.13 | 0.88 |
| 2003-04 | 2.54 | 0.03 | 0.78 | 0.82 | 0.71 | 0.90 | 0.89 | 1.05 |
| 2004-05 | 0.38 | -0.05 | 0.21 | 0.56 | 0.83 | 1.06 | 1.80 | 1.94 |
| 2005-06 | 1.05 | 0.64 | 0.79 | 0.77 | 0.81 | 0.89 | 1.15 | 1.14 |

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 south-westwards out of the investigated area. In 2004 and 2005 concentrations of mature haddock have been observed pelagic rather far above bottom along the shelf edge. These concentrations are poorly covered by the bottom trawl sampling.

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 occurred in the late 90s. In the four latest surveys small haddock has been widely distributed, and haddock has been found unusually far to the north. This might be caused by rather favourably hydrographic conditions.

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 (1981-2006) is presented in table 7.3. The index of age 1 is the highest in the 26 year time series.

Table 7.1. HADDOCK. Abundance indices at length and age from the acoustic survey in the Barents Sea winter 2006 (numbers in millions).

| Length | Age (year-class) | | | | | | | | | | Sum | Biomass |
|---------|------------------|-------|------|------|------|------|------|------|------|------|--------|----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ | | |
| cm | (05) | (04) | (03) | (02) | (01) | (00) | (99) | (98) | (97) | | | ('000 t) |
| 10-15 | 1564.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1564.2 | 30.0 |
| 15-20 | 1201.4 | 39.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1240.7 | 39.7 |
| 20-25 | 1.6 | 515.8 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 519.6 | 52.0 |
| 25-30 | 0.0 | 244.2 | 9.6 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 255.1 | 39.7 |
| 30-35 | 0.0 | 4.3 | 29.4 | 11.9 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 46.5 | 15.6 |
| 35-40 | 0.0 | 0.0 | 13.0 | 42.0 | 4.1 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 59.2 | 29.5 |
| 40-45 | 0.0 | 0.0 | 0.0 | 24.1 | 13.7 | 2.7 | 0.1 | 0.0 | 0.0 | 0.0 | 40.5 | 28.6 |
| 45-50 | 0.0 | 0.0 | 0.0 | 6.2 | 8.5 | 5.1 | 3.5 | 0.0 | 0.0 | 0.0 | 23.2 | 23.1 |
| 50-55 | 0.0 | 0.0 | 0.0 | 0.8 | 2.9 | 2.7 | 4.0 | 0.6 | 0.0 | 0.0 | 11.0 | 14.9 |
| 55-60 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.9 | 1.2 | 1.1 | 0.04 | 0.01 | 3.4 | 6.0 |
| 60-65 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.4 | 0.04 | 0.12 | 0.9 | 2.2 |
| 65-70 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.04 | 0.06 | 0.01 | 0.0 | 0.11 | 0.3 |
| 70-75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.0 | 0.0 | 0.04 | 0.06 | 0.2 |
| >75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.05 | 0.04 | 0.2 |
| sum | 2767.1 | 803.6 | 54.2 | 86.2 | 30.2 | 11.6 | 9.0 | 2.2 | 0.09 | 0.21 | 3764.4 | |
| Biomass | 68.5 | 92.3 | 18.1 | 49.6 | 24.6 | 12.6 | 11.7 | 3.9 | 0.2 | 0.7 | | 282.2 |

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 2006 (numbers in millions).

| Area | Layer | Age (year-class) | | | | | | | | | | Biomass (‘000 t) |
|-------|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|---------------------|
| | | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) | 9 (97) | 10+ | |
| A | P | 296.0 | 34.7 | 3.8 | 4.4 | 3.8 | 2.4 | 3.5 | 0.5 | 0.0 | 0.0 | 27.8 |
| | B | 119.6 | 12.6 | 1.3 | 1.6 | 1.3 | 0.8 | 1.2 | 0.2 | 0.0 | 0.0 | 10.0 |
| B | P | 92.0 | 23.1 | 2.4 | 4.7 | 1.2 | 0.4 | 0.4 | 0.7 | 0.0 | 0.1 | 13.5 |
| | B | 57.8 | 16.1 | 1.6 | 3.0 | 0.7 | 0.3 | 0.3 | 0.5 | 0.0 | 0.1 | 8.7 |
| C | P | 78.5 | 3.5 | 0.2 | 2.1 | 2.9 | 0.8 | 0.5 | 0.1 | 0.0 | 0.0 | 7.9 |
| | B | 27.6 | 1.4 | 0.1 | 0.7 | 1.0 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 2.7 |
| D | P | 1026.8 | 403.6 | 25.0 | 38.6 | 12.9 | 5.1 | 2.1 | 0.1 | 0.0 | 0.0 | 119.1 |
| | B | 370.1 | 139.6 | 7.3 | 10.5 | 3.3 | 1.3 | 0.5 | 0.0 | 0.0 | 0.0 | 37.5 |
| D' | P | 128.7 | 71.9 | 7.0 | 13.1 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21.0 |
| | B | 57.7 | 19.4 | 1.6 | 3.1 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.9 |
| E | P | 153.5 | 24.4 | 0.8 | 1.2 | 1.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 8.1 |
| | B | 26.3 | 4.3 | 0.1 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 |
| S | P | 275.0 | 37.1 | 2.3 | 2.2 | 0.3 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 14.6 |
| | B | 57.5 | 12.0 | 0.7 | 0.8 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 4.0 |
| ABCD | P | 1493.3 | 464.9 | 31.3 | 49.7 | 20.7 | 8.8 | 6.4 | 1.4 | 0.1 | 0.1 | 168.3 |
| | B | 575.1 | 169.7 | 10.3 | 15.8 | 6.4 | 2.7 | 2.1 | 0.7 | 0.0 | 0.1 | 58.9 |
| Total | P | 2050.6 | 598.2 | 41.4 | 66.3 | 23.2 | 8.9 | 6.8 | 1.5 | 0.1 | 0.1 | 212.0 |
| | B | 716.6 | 205.4 | 12.8 | 19.9 | 7.0 | 2.7 | 2.2 | 0.7 | 0.0 | 0.1 | 70.2 |
| | sum | 2767.1 | 803.6 | 54.2 | 86.2 | 30.2 | 11.6 | 9.0 | 2.2 | 0.1 | 0.2 | 282.2 |

Table 7.3. HADDOCK. Abundance indices from acoustic surveys in the Barents Sea winter 1981-2006 (numbers in millions). 1981-1992 includes mainly areas A, B, C and D.

| Year | Age | | | | | | | | | | Total | Biomass (‘000 t) |
|------|--------|-------|-------|-------|-------|------|-----|-----|------|------|--------|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ | | |
| 1981 | 7 | 14 | 5 | 21 | 60 | 18 | 1 | + | + | + | 126 | 166 |
| 1982 | 9 | 2 | 3 | 4 | 4 | 10 | 6 | + | + | + | 38 | 50 |
| 1983 | 0 | 5 | 2 | 3 | 1 | 1 | 4 | 2 | + | + | 18 | 25 |
| 1984 | 1685 | 173 | 6 | 2 | 1 | + | + | + | + | + | 1867 | 101 |
| 1985 | 1530 | 776 | 215 | 5 | + | + | + | + | + | + | 2526 | 259 |
| 1986 | 556 | 266 | 452 | 189 | + | + | + | + | + | + | 1463 | 333 |
| 1987 | 85 | 17 | 49 | 171 | 50 | + | + | + | 0 | + | 372 | 157 |
| 1988 | 18 | 4 | 8 | 23 | 46 | 7 | + | 0 | 0 | + | 106 | 56 |
| 1989 | 52 | 5 | 6 | 11 | 20 | 21 | 2 | 0 | 0 | 0 | 117 | 49 |
| 1990 | 270 | 35 | 3 | 3 | 4 | 7 | 11 | 2 | + | + | 335 | 51 |
| 1991 | 1890 | 252 | 45 | 8 | 3 | 3 | 3 | 6 | + | 0 | 2210 | 166 |
| 1992 | 1135 | 868 | 134 | 23 | 2 | + | + | 1 | 2 | + | 2165 | 239 |
| 1993 | 947 | 626 | 563 | 130 | 13 | + | + | + | + | 3 | 2282 | 385 |
| 1994 | 562 | 193 | 255 | 631 | 111 | 12 | + | + | + | + | 1764 | 573 |
| 1995 | 1379 | 285 | 36 | 111 | 387 | 42 | 2 | + | + | + | 2242 | 466 |
| 1996 | 249 | 229 | 44 | 31 | 76 | 151 | 8 | + | 0 | + | 788 | 280 |
| 1997 | 693 | 24 | 51 | 17 | 12 | 43 | 43 | 2 | + | + | 885 | 155 |
| 1998 | 220 | 122 | 20 | 28 | 12 | 5 | 13 | 16 | 1 | + | 437 | 92 |
| 1999 | 855.8 | 45.5 | 57.3 | 13.1 | 13.9 | 3.6 | 1.4 | 1.9 | 1.6 | 0.03 | 994.0 | 81 |
| 2000 | 1024.4 | 508.9 | 32.2 | 64.9 | 18.5 | 10.5 | 1.6 | 0.5 | 1.8 | 0.4 | 1663.8 | 185 |
| 2001 | 976.5 | 315.6 | 209.6 | 23.1 | 21.6 | 1.3 | 0.9 | 0.1 | 0.04 | 0.5 | 1549.1 | 175 |
| 2002 | 2062.1 | 282.0 | 215.7 | 149.5 | 13.5 | 11.7 | 1.0 | 0.2 | 0.03 | 0.7 | 2736.5 | 264 |
| 2003 | 2394.5 | 278.6 | 145.2 | 197.6 | 168.8 | 17.2 | 5.0 | 0.2 | 0.1 | 1.1 | 3208.3 | 455 |
| 2004 | 751.8 | 474.3 | 126.7 | 75.9 | 76.0 | 65.9 | 6.6 | 2.0 | 0.1 | 0.3 | 1579.5 | 287 |
| 2005 | 3363.6 | 209.2 | 218.9 | 101.9 | 36.5 | 40.1 | 9.0 | 0.1 | 0.1 | 0.0 | 3979.3 | 302 |
| 2006 | 2767.1 | 803.6 | 54.2 | 86.2 | 30.2 | 11.6 | 9.0 | 2.2 | 0.09 | 0.21 | 3764.4 | 282 |

7.2 Swept area estimation

Figures 7.1 - 7.4 show the geographic distribution of bottom trawl catch rates (number of fish per 3 n.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 the three previous years, the distribution extends further to the north than usual, especially for the size groups <20 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.

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 (1981-2006) is shown in table 7.7. The indices for the ages 1, 2, 4 and 7+ are well above the 1993-2005 average. The swept area index of ages 1 is the highest in the 26 year time series.

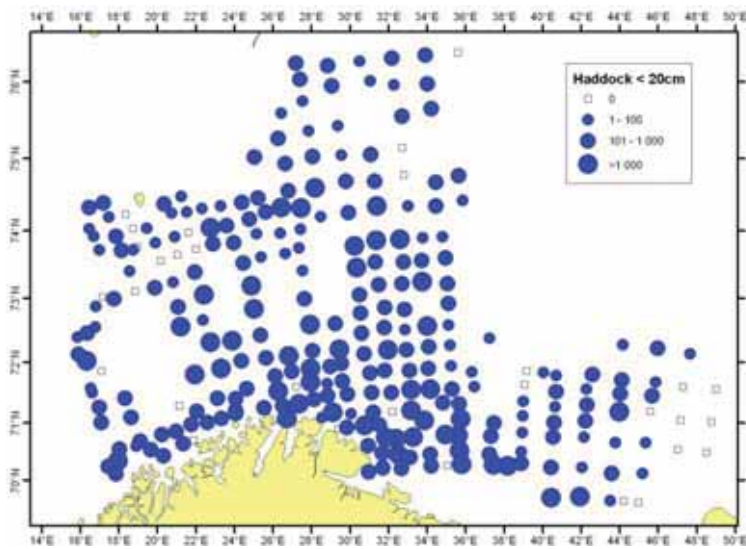


Figure 7.1. HADDOCK < 20 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

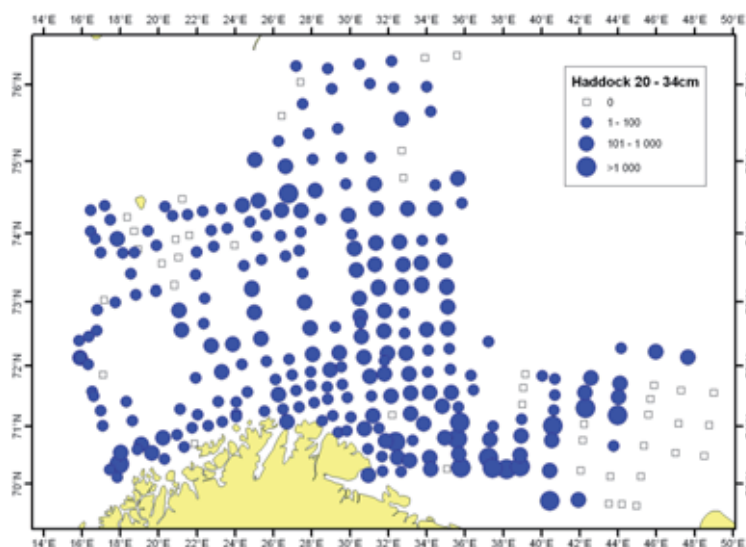


Figure 7.2. HADDOCK 20-34 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

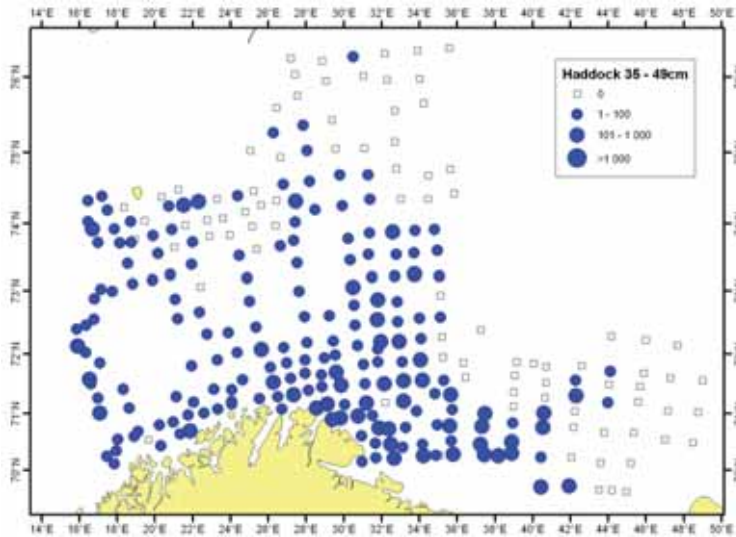


Figure 7.3. HADDOCK 35-49 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

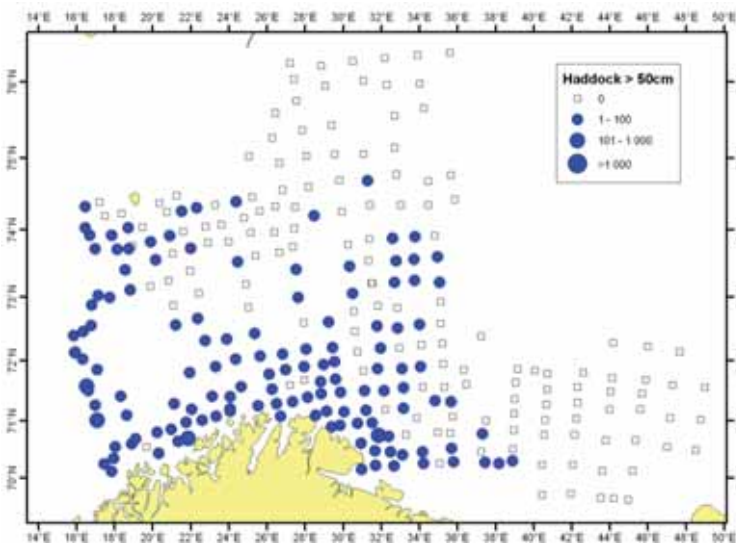


Figure 7.4. HADDOCK > 50 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

7.3 Growth

Mean length and weight at age for each main area in 2006 are shown in table 7.8 and 7.10. The time series (1983-2006) is shown in tables 7.9 and 7.11. Both lengths and weights showed a decreasing in the period 2003-2005. Some increase in growth is observed in the 2006 survey.

Table 7.4. HADDOCK. Length (cm) at age in main areas of the Barents Sea winter 2006.

| Area | Age (year-class) | | | | | | | |
|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) |
| A | 15.3 | 20.3 | 26.8 | 39.3 | 45.8 | 49.3 | 51.8 | 58.5 |
| B | 15.6 | 21.1 | 30.2 | 43.8 | 46.4 | 50.8 | 52.0 | 55.5 |
| C | 15.4 | 21.0 | 33.6 | 39.8 | 44.9 | 46.7 | 48.6 | 55.3 |
| D | 14.7 | 23.2 | 32.6 | 36.6 | 42.2 | 46.9 | 49.8 | 56.9 |
| D' | 13.4 | 23.8 | 31.2 | 38.1 | 41.0 | | | |
| E | 14.3 | 21.7 | 28.5 | 36.7 | 40.3 | | 52.0 | |
| S | 15.0 | 22.9 | 31.2 | 40.8 | 47.5 | 51.6 | 52.3 | 59.2 |
| Total | 14.7 | 22.6 | 31.3 | 37.8 | 43.2 | 48.0 | 50.8 | 57.0 |

Table 7.5. HADDOCK. Length (cm) at age in the Barents Sea from the investigations winter 1983 – 2006.

| 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 | 16.1 | 27.7 | 27.7 | 35.4 | 39.7 | 47.5 | 50.1 |
| 1998 | 14.4 | 29.2 | 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 | 22.2 | 22.2 | 32.2 | 37.8 | 47.2 | 51.2 | 58.7 |
| 2002 | 21.1 | 21.1 | 29.6 | 40.2 | 44.2 | 50.9 | 58.4 |
| 2003 | 16.5 | 24.1 | 28.0 | 37.2 | 46.5 | 49.6 | 54.7 |
| 2004 | 14.2 | 22.3 | 30.6 | 36.3 | 43.4 | 49.8 | 51.4 |
| 2005 | 15.1 | 20.8 | 30.0 | 36.6 | 41.5 | 47.9 | 51.9 |
| 2006 | 14.7 | 22.6 | 31.3 | 37.8 | 43.2 | 48.0 | 50.8 |

¹⁾ Adjusted lengths

Table 7.6. HADDOCK. Weight (g) at age in main areas of the Barents Sea winter 2006.

| Area | Age (year-class) | | | | | | | |
|-------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 1 (05) | 2 (04) | 3 (03) | 4 (02) | 5 (01) | 6 (00) | 7 (99) | 8 (98) |
| A | 29 | 78 | 195 | 616 | 961 | 1202 | 1436 | 2002 |
| B | 30 | 90 | 278 | 833 | 991 | 1372 | 1411 | 1734 |
| C | 28 | 85 | 359 | 621 | 902 | 1042 | 1165 | 1780 |
| D | 25 | 114 | 336 | 488 | 775 | 1020 | 1228 | 1688 |
| D' | 21 | 116 | 295 | 523 | 626 | | | |
| E | 25 | 99 | 225 | 521 | 736 | | 1317 | |
| S | 28 | 115 | 311 | 705 | 1108 | 1382 | 1469 | 2058 |
| Total | 26 | 107 | 303 | 540 | 821 | 1111 | 1332 | 1846 |

Table 7.7. HADDOCK. Weight (g) at age in the Barents Sea from the investigations winter 1983 - 2006.

| Year | Age | | | | | | |
|------|-----|-----|-----|------|------|------|------|
| | 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 | 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 | 35 | 88 | 200 | 429 | 625 | 1063 | 1286 |
| 1998 | 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 | 556 | 1100 | 1429 | 2085 |
| 2002 | 30 | 84 | 144 | 623 | 848 | 1341 | 2032 |
| 2003 | 38 | 127 | 202 | 493 | 981 | 1189 | 1613 |
| 2004 | 23 | 98 | 266 | 459 | 780 | 1167 | 1328 |
| 2005 | 29 | 84 | 253 | 469 | 699 | 1054 | 1378 |
| 2006 | 26 | 107 | 303 | 540 | 821 | 1111 | 1332 |

Table 7.8. HADDOCK. Yearly weight increment (g) from the investigations in the Barents Sea winter

| Year | Age | | | | | |
|---------|-----|-----|-----|------|-----|-----|
| | 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 | -21 |
| 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 | 317 | 544 | 278 |
| 1998-99 | 60 | 221 | 373 | 477 | 748 | 447 |
| 1999-00 | 81 | 184 | 387 | 454 | 394 | -64 |
| 2000-01 | 74 | 229 | 287 | 380 | 361 | 744 |
| 2001-02 | 56 | 38 | 286 | 292 | 241 | 603 |
| 2002-03 | 97 | 118 | 349 | 358 | 341 | 272 |
| 2003-04 | 60 | 139 | 257 | 287 | 186 | 139 |
| 2004-05 | 61 | 155 | 203 | 240 | 274 | 211 |
| 2005-06 | 78 | 219 | 287 | 352 | 412 | 278 |

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. Both the swept area indices and the acoustic indices in 2006 indicates increased mortality compared to the period 1998-2005 (table 7.13).

Table 7.9. Total mortality observed for haddock during the winter survey in the Barents Sea for the period 1993-2006.

| 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 | 1.56 | 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 |
| 2002-03 | 2.00 | 0.66 | 0.09 | -0.12 | -0.24 | 0.85 | 1.63 |
| 2003-04 | 1.62 | 0.79 | 0.65 | 0.96 | 0.94 | 0.96 | 0.92 |
| 2004-05 | 1.28 | 0.77 | 0.22 | 0.73 | 0.64 | 1.99 | 4.19 |
| 2005-06 | 1.43 | 1.35 | 0.93 | 1.22 | 1.15 | 1.49 | 1.41 |
| 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 | -0.07 | 0.34 | 1.60 | 1.49 | 2.08 |
| 2001-02 | 0.83 | 0.38 | 0.47 | 0.51 | 1.12 | 0.75 | 1.10 |
| 2002-03 | 1.19 | 0.52 | 0.55 | 0.92 | 1.16 | 1.27 | 1.39 |
| 2003-04 | 1.54 | 1.00 | 1.13 | 0.82 | 0.47 | -0.07 | 0.74 |
| 2004-05 | 0.53 | 0.72 | 0.34 | 0.43 | 0.43 | 1.33 | 2.37 |
| 2005-06 | 1.26 | 1.69 | 0.90 | 1.02 | 1.23 | 1.24 | 1.37 |

8. DISTRIBUTION AND ABUNDANCE OF REDFISH

8.1 Acoustic estimation

Earlier reports from this survey has presented distribution maps and abundance indices based on acoustic observations of redfish. In recent years blue whiting has dominated the acoustic records in some of the main redfish areas. Due to incomplete pelagic trawl sampling the splitting of acoustic records between blue whiting and redfish has been very uncertain. The uncertainty relates mainly to the redfish, since it only make up a very minor proportion of the total value. This has been the case since 2003 survey, and the acoustic results for redfish are therefore not included in the report.

8.2 Swept area estimation

The swept area time series for redfish (tables 8.1 and 8.2) 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. 8.1 shows the geographical distribution of *S. marinus* based on the catch rates in bottom trawl. The distribution in 2006 is very similar to those observed in the two previous years. Table 8.1 presents the time series (1986-2006) of swept area indices by 5 cm length groups. The indices have remained low since 1999. For fish below 25 cm the indices in 2006 are the lowest observed. This indicates that the latest year classes are very weak.

The mapping of the distribution of *S. mentella* (fig. 8.2) 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. Table 8.2 presents the time series (1986-2005) of swept area indices for *S. mentella* by 5 cm length groups.

The indices for fish above 15 cm are similar to those in 2005. The index for fish below 10 cm is the highest since 1996, but is still well below those observed in the period 1988-1991. 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 above 30 cm, compose the bulk of the stock, and should be protected as much as possible to improve the future recruitment.

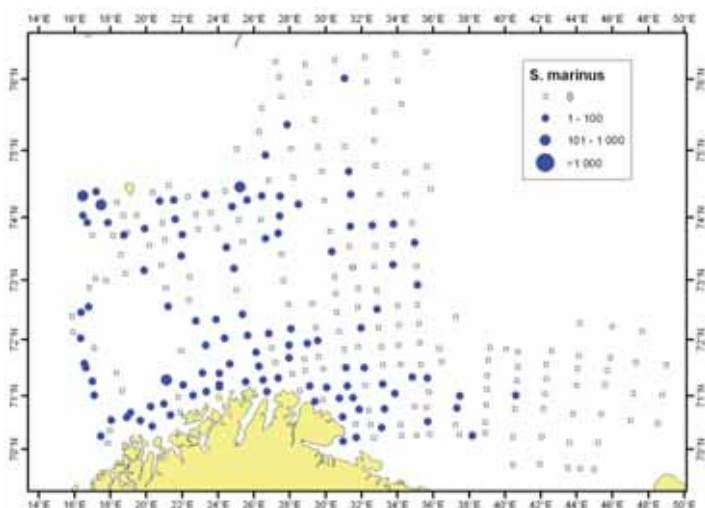


Figure 8.1. *Sebastes marinus*. Distribution in the trawl catches winter 2006 (no. per hour trawling).

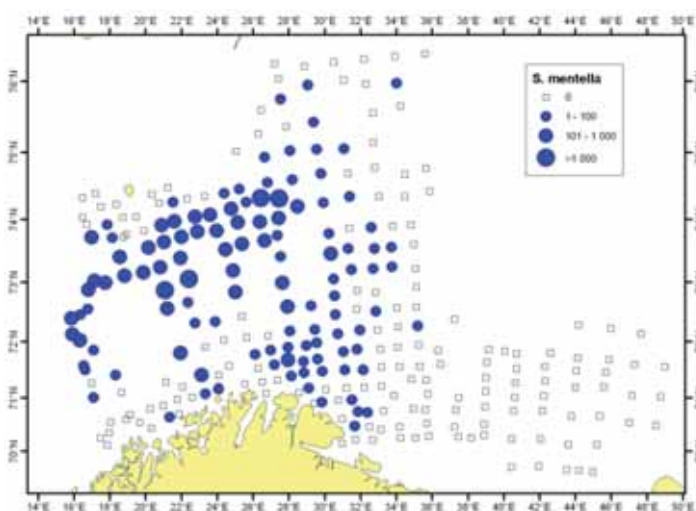


Figure 8.2. *Sebastes mentella*. Distribution in the trawl catches winter 2006 (no. per hour trawling).

Table 8.1. SEBASTES MARINUS. Abundance indices from bottom trawl surveys in the Barents Sea winter 1986-2006 (numbers in millions). 1986-1992 includes only main areas A, B, C and D.

| Year | Length group (cm) | | | | | | | | | Total |
|-------|-------------------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | > 45 | |
| 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* | - | 0.5 | 1.5 | 3.2 | 6.6 | 21.4 | 28.0 | 8.4 | 3.3 | 73 |
| 1998* | 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 | 5.7 | 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 |
| 2003 | - | 0.5 | 1.2 | 1.5 | 4.3 | 3.8 | 2.7 | 3.3 | 2.9 | 20 |
| 2004 | 0.7 | 0.2 | 0.4 | 1.0 | 2.9 | 4.4 | 5.5 | 4.0 | 3.2 | 22 |
| 2005 | - | 0.1 | 0.2 | 0.4 | 1.1 | 2.0 | 3.8 | 4.6 | 4.4 | 17 |
| 2006 | - | - | - | 0.2 | 2.5 | 5.4 | 6.1 | 4.1 | 4.2 | 23 |

Table 8.2. SEBASTES MENTELLA. Abundance indices from bottom trawl surveys in the Barents Sea winter 1986-2006 (numbers in millions). 1986-1992 includes only main areas A. B. C and D.

| Year | Length group (cm) | | | | | | | | | Total |
|--------|-------------------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | > 45 | |
| 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** | 63.2 | 120.9 | 24.8 | 278.2 | 271.8 | 70.9 | 39.8 | 5.2 | 0.1 | 875 |
| 1998** | 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 |
| 2003 | 3.9 | 3.9 | 10.0 | 12.4 | 70.8 | 199.8 | 46.9 | 6.0 | 0.3 | 354 |
| 2004 | 2.2 | 3.0 | 6.9 | 18.5 | 32.9 | 86.7 | 31.8 | 2.0 | 0.1 | 184 |
| 2005 | - | 6.2 | 7.3 | 10.7 | 28.4 | 153.4 | 86.6 | 3.9 | 0.2 | 297 |
| 2006 | 98.8 | 1.9 | 9.8 | 14.6 | 22.7 | 102.8 | 81.9 | 2.7 | 0.7 | 336 |

* Includes unidentified Sebastes specimens, mostly less than 15 cm.

** Indices raised to also represent the Russian EEZ.

9. DISTRIBUTION AND ABUNDANCE OF OTHER SPECIES

Appendix gives a total list of all fish species caught in the survey. For bottom trawl hauls the occurrence, mean length and catch weight per nautical mile is listed.

For Greenland halibut and blue whiting distribution maps are shown and described below.

9.1 Greenland halibut

Figure 9.1 shows the distribution of bottom trawl catch rates of Greenland halibut. The most important distribution areas for the adult fish (depths between 500 and 1000 m along the western 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 main areas S and E. For most length groups the coefficient of variation is higher than for cod and haddock. The time series for 1990-2006 is presented in Table 9.2. The 2006 values are rather similar to those in 2005.

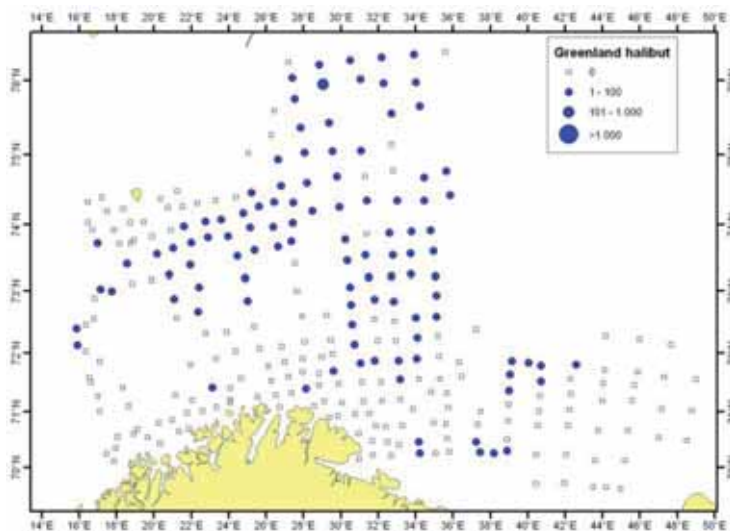


Figure 8.2. GREENLAND HALIBUT. Distribution in the trawl catches winter 2006 (no. per hour trawling).

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 2006 (numbers in thousands).

| Length cm | A | | B | | C | | D | | D' | | E | | S | | Total | | CV (%) |
|--------------|------|-----|----|----|----|----|------|-----|----|---|------|------|-------|-----|-------|------|-----------|
| | I | S | I | S | I | S | I | S | I | S | I | S | I | S | I | S | |
| 5-9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10-14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15-19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 | 53 | 72 | 53 | 73 |
| 20-24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 75 | 18 | 18 | 93 | 77 | 83 |
| 25-29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 367 | 275 | 41 | 31 | 408 | 277 | 68 |
| 30-34 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 54 | 0 | 0 | 1210 | 625 | 618 | 192 | 1949 | 656 | 34 |
| 35-39 | 225 | 132 | 0 | 0 | 0 | 0 | 523 | 169 | 0 | 0 | 2303 | 706 | 2045 | 515 | 5096 | 899 | 18 |
| 40-44 | 182 | 81 | 0 | 0 | 0 | 0 | 609 | 194 | 0 | 0 | 2153 | 731 | 1621 | 365 | 4565 | 844 | 19 |
| 45-49 | 668 | 389 | 0 | 0 | 0 | 0 | 1182 | 222 | 0 | 0 | 1990 | 519 | 1857 | 369 | 5696 | 779 | 14 |
| 50-54 | 749 | 429 | 0 | 0 | 0 | 0 | 668 | 246 | 0 | 0 | 708 | 213 | 2125 | 390 | 4250 | 665 | 16 |
| 55-59 | 275 | 150 | 12 | 12 | 0 | 0 | 539 | 174 | 0 | 0 | 268 | 125 | 1010 | 242 | 2103 | 356 | 17 |
| 60-64 | 84 | 57 | 0 | 0 | 11 | 11 | 269 | 89 | 0 | 0 | 240 | 121 | 277 | 81 | 880 | 181 | 21 |
| 65-69 | 97 | 71 | 0 | 0 | 0 | 0 | 131 | 47 | 0 | 0 | 40 | 40 | 175 | 70 | 442 | 117 | 26 |
| 70-74 | 0 | 0 | 12 | 12 | 10 | 10 | 17 | 17 | 0 | 0 | 0 | 0 | 212 | 72 | 252 | 76 | 30 |
| 75-79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 24 | 34 | 24 | 69 |
| >80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 18 | 18 | 18 | 100 |
| Sum | 2280 | 625 | 24 | 17 | 21 | 15 | 4059 | 469 | 0 | 0 | 9354 | 1361 | 10123 | 897 | 25858 | 1807 | 7 |

Table 9.2. GREENLAND HALIBUT. Abundance indices from the bottom trawl surveys in the Barents Sea winter 1990-2006 (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.

| Year | Length group (cm) | | | | | | | | | | | | | | | Total |
|------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| | <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 | |
| 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 |
| | 0 | 65 | 0 | 0 | 173 | 227 | 858 | 4344 | 5500 | 2725 | 1545 | 632 | 282 | 66 | 22 | 16439 |
| 1997 | 80 | 217 | 1006 | 444 | 532 | 403 | 1064 | 3888 | 6331 | 2977 | 1725 | 633 | 337 | 76 | 43 | 19765 |
| 1998 | | | | | | | | | | | | | | | | |
| 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 | 663 | 1470 | 3674 | 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 |
| 2003 | 50 | 0 | 71 | 17 | 295 | 674 | 1793 | 2916 | 4647 | 2186 | 708 | 609 | 231 | 125 | 0 | 14322 |
| 2004 | 67 | 103 | 15 | 0 | 316 | 1238 | 1224 | 1714 | 2278 | 1227 | 791 | 298 | 146 | 95 | 26 | 9537 |
| 2005 | 259 | 69 | 157 | 1125 | 2194 | 2695 | 4173 | 3687 | 3817 | 1992 | 935 | 583 | 330 | 116 | 0 | 22132 |
| 2006 | 0 | 72 | 93 | 408 | 1949 | 5096 | 4565 | 5696 | 4250 | 2103 | 880 | 442 | 252 | 34 | 18 | 25859 |

9.2 Blue whiting

Since 2000 the blue whiting has shown a wider distribution than usual. The echo recordings in 2001 and 2002 indicated unusual high abundance in the Barents Sea, while in 2003 it had decreased considerably. In the 2004 survey the echo abundance increased again and has later remained high. Figure 9.2 shows the geographical distribution of the bottom trawl catch rates of blue whiting in 2006. This distribution is similar to the one observed in 2005. 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.

Table 9.3 shows the bottom trawl swept area estimates for the years 2001-2006. In 2006 there is a shift towards larger fish compared to 2005. This is caused by reduced amounts of 1 year olds in 2006 and by growth of the older fish. It seems that the 2004 year class has grown from the 10-19 cm intervals into the 10-29 cm intervals.

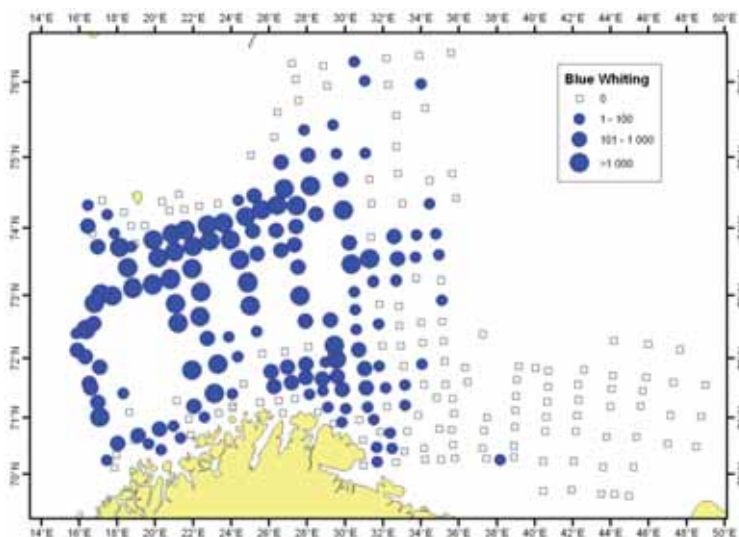


Figure 9.2. BLUE WHITING. Distribution in the trawl catches winter 2006 (no. per hour trawling).

Table 9.3. Swept area estimates (millions) of blue whiting.

| Year | Length group (cm) | | | | | | | | Total |
|------|-------------------|-------|--------|--------|-------|-------|-------|-------|-------|
| | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | |
| 2001 | 0.1 | 306.6 | 1391.3 | 616.0 | 44.6 | 5.3 | 1.5 | 0.1 | 2365 |
| 2002 | 0.0 | 0.8 | 434.7 | 658.1 | 80.9 | 18.3 | 3.1 | 0.1 | 1196 |
| 2003 | 0.0 | 3.2 | 192.0 | 488.8 | 81.8 | 29.7 | 6.3 | 1.0 | 803 |
| 2004 | 0.0 | 7.2 | 723.0 | 816.8 | 274.1 | 38.4 | 1.1 | 0.2 | 1861 |
| 2005 | 0.0 | 125.5 | 715.4 | 980.1 | 222.7 | 31.5 | 0.1 | 0.2 | 2076 |
| 2006 | 0.0 | 0.0 | 162.9 | 1486.8 | 591.2 | 68.3 | 2.0 | 0.06 | 2311 |

10. COMPARISONS BETWEEN RESEARCH VESSELS

In total “G.O.Sars” and “Johan Hjort” worked 58 experimental bottom trawl tows. The reasons for these experimental hauls was intercalibration and gear development. The results will be given in a separate report.

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Appendix 1. Fish species caught at the winter survey 2006.

The table is sorted according to taxonomic groups. WCPUE is calculated from bottom trawl hauls only (n=281) and is given in kg per nautical mile towed. Occurrence is the number of bottom hauls with the species caught. The mean length estimates are weighted with the catch of the species in the haul and is based on catches in the bottom trawls only. The table is continued on the next page. Fish classified to genus or family is boldfaced.

| Family | Latin name (www.fishbase.org) | Norwegian name | English name (www.fishbase.org) | Occ. | Mean length (cm) | Mean WCPUE (kg/nm) |
|---------------------------|-------------------------------------|--------------------------|------------------------------------|-----------|------------------------|--------------------------|
| <i>Squalidae</i> | <i>Etmopterus spinax</i> | Svarthå | Velvet belly lantern shark | 2 | 27.4 | 0.0038 |
| <i>Squalidae</i> | <i>Somniosus microcephalus</i> | Håkjerring | Greenland shark | 1 | **** | **** |
| <i>Rajidae</i> | <i>Amblyraja hyperborea</i> | Isskate | Arctic skate | 5 | 35.6 | 0.0258 |
| <i>Rajidae</i> | <i>Amblyraja radiata</i> | Kloskate | Thorny skate | 214 | 39 | 2.7432 |
| <i>Rajidae</i> | <i>Bathyraja spinicauda</i> | Gråskate | Spinetail ray | 17 | 56.3 | 0.1623 |
| <i>Rajidae</i> | <i>Dipturus batis</i> | Storskate | Blue skate | 9 | 131.2 | 0.4182 |
| <i>Rajidae</i> | <i>Rajealla fyllae</i> | Rundskate | Round ray | 31 | 35 | 0.0709 |
| <i>Chimaeridae</i> | <i>Chimaera monstrosa</i> | Havmus | Rabbit fish | 8 | 35.8 | 0.165 |
| <i>Clupeidae</i> | <i>Clupea harengus</i> | Sild* | Atlantic herring (NSS*) | 75 | 22.3 | 0.2925 |
| <i>Clupeidae</i> | <i>Clupea harengus</i> | Sild** | Atlantic herring (WS**) | 22 | 21.7 | 0.0994 |
| <i>Osmeridae</i> | <i>Mallotus villosus</i> | Lodde | Capelin | 193 | 18.5 | 3.6824 |
| <i>Argentinidae</i> | <i>Argentina silus</i> | Vassild | Greater argentine | 49 | 23.2 | 0.9663 |
| <i>Argentinidae</i> | <i>Argentina sphyraena</i> | Strømsild | Argentine | 2 | 14 | 0.0002 |
| <i>Sternoptychidae</i> | <i>Arctozenus risso</i> | Liten laksetobis | Ribbon barracudina | 10 | 20 | 0.0009 |
| <i>Sternoptychidae</i> | <i>Maurolicus mueller</i> | Laksesild | Pearlside | *** | *** | *** |
| <i>Myctophidae</i> | <i>Myctophidae sp.</i> | Lysprikkfisk | Laternfish | 39 | 18 | 0.3071 |
| <i>Gadidae</i> | <i>Gadus morhua</i> | Torsk | Atlantic cod | 271 | 29.5 | 43.0362 |
| <i>Gadidae</i> | <i>Boreogadus saida</i> | Polartorsk | Polar cod | 12 | 14.7 | 1.1033 |
| <i>Gadidae</i> | <i>Pollachius virens</i> | Sei | Saithe | 47 | 43.1 | 5.5381 |
| <i>Gadidae</i> | <i>Merlangius merlangius</i> | Hvitting | Whiting | 25 | 19.7 | 0.0379 |
| <i>Gadidae</i> | <i>Melanogrammus aeglefinus</i> | Hyse | Haddock | 260 | 24.1 | 34.6496 |
| <i>Gadidae</i> | <i>Micromesistius poutassou</i> | Kolmule | Blue whiting | 140 | 27.5 | 16.9442 |
| <i>Gadidae</i> | <i>Gadiculus argenteus</i> | Sølvorsk | Silvery pout | 35 | 11.5 | 0.0306 |
| <i>Gadidae</i> | <i>Trisopterus esmarkii</i> | Øyepål | Norway pout | 153 | 13 | 2.7023 |
| <i>Gadidae</i> | <i>Brosme brosme</i> | Bromse | Cusk | 32 | 37 | 0.1662 |
| <i>Gadidae</i> | <i>Molva molva</i> | Lange | Ling | 10 | 69.7 | 0.0611 |
| <i>Gadidae</i> | <i>Gaidropsarus vulgaris</i> | Tretrådet tangbrosme | Three-bearded rockling | 3 | 8.4 | 0.0007 |
| <i>Gadidae</i> | <i>Enchelyopus cimbrius</i> | Firetrådet tangbrosme | Fourbeard rockling | 12 | 20.6 | 0.0042 |
| <i>Macrouridae</i> | <i>Macrourus berglax</i> | Isgalt | Rough rattail | 6 | 17.1 | 0.0143 |
| <i>Lophiidae</i> | <i>Lophius piscatorius</i> | Breiflabb | Anglerfish | 1 | 75.5 | 0.0255 |
| <i>Syngnathidae</i> | <i>Entelurus aequoreus</i> | Stor havnål | Snake pipefish | 13 | 31.1 | 0.0002 |
| <i>Gasterosteidae</i> | <i>Gasterosteus aculeatus</i> | Trepigget stingsild | Three-spined stickleback | 27 | 6.3 | 0.0018 |

*Norwegian spring spawning herring,

** White sea herring,

*** caught in pelagic trawl only,

**** wrong/missing weights and lengths

Appendix 1 cont.

| Family | Latin name (www.fishbase.org) | Norwegian name | English name (www.fishbase.org) | Occ. | Mean length (cm) | Mean WCPUE (kg/nm) |
|----------------------|----------------------------------|--------------------------|------------------------------------|------------|------------------------|--------------------------|
| Scorpaenidae | Sebastes sp. | Uerfamilien | Redfishes | 118 | 6.7 | 0.0331 |
| Scorpaenidae | <i>Sebastes mentella</i> | Snabeluer | Deepwater redfish | 115 | 32 | 10.0388 |
| Scorpaenidae | <i>Sebastes marinus</i> | Vanlig uer | Golden redfish | 107 | 37.1 | 2.0395 |
| Scorpaenidae | <i>Sebastes viviparus</i> | Lusuer | Norway redfish | 10 | 33.4 | 0.0274 |
| Trigidae | <i>Eutrigla gurnardus</i> | Knurr | Grey gurnard | 1 | 34 | 0.0007 |
| Cottidae | Triglops sp. | Knurrulkeslekten | | 10 | 8 | 0.0033 |
| Cottidae | <i>Triglops murrayi</i> | Nordlig knurrulke | Moustache sculpin | 62 | 8.9 | 0.066 |
| Cottidae | <i>Triglops nybelini</i> | Grønlandsknurrulke | Bigeye sculpin | 5 | 8.8 | 0.0015 |
| Cottidae | <i>Triglops pingeli</i> | Arktisk knurrulke | Ribbed sculpin | 2 | 8.4 | 0.0005 |
| Cottidae | <i>Icelus bicornis</i> | Tornulke | Twohorn sculpin | 6 | 15.9 | 0.0017 |
| Cottidae | <i>Myoxocephalus scorpius</i> | Vanlig ulke | Shorthorn sculpin | 1 | 11.9 | 0.0021 |
| Cottidae | <i>Arteidiellus atlanticus</i> | Krokulke | Atlantic hookear sculpin | 123 | 7.7 | 0.1443 |
| Cottunculidae | <i>Cottunculus microps</i> | Paddeulke | Polar sculpin | 39 | 12.1 | 0.0177 |
| Agonidae | <i>Ulcina olrikii</i> | Arktisk panserulke | Arctic alligatorfish | 2 | 6.8 | 0.0001 |
| Agonidae | <i>Leptagonus decagonus</i> | Tiskjegg | Atlantic poacher | 67 | 13.8 | 0.055 |
| Cyclopteridae | <i>Cyclopterus lumpus</i> | Rognkjeks | Lumpsucker | 113 | 37.1 | 1.5791 |
| Cyclopteridae | <i>Eumicrotremus derjugini</i> | Svartkjeks | Leatherfin lumpsucker | 1 | 9 | 0.0001 |
| Cyclopteridae | <i>Eumicrotremus spinosus</i> | Vortekjeks | Atlantic spiny lumpsucker | 11 | 7 | 0.0103 |
| Cyclopteridae | <i>Careproctus reinhardii</i> | Nordlig ringbuk | Sea tadpole | 53 | 10.1 | 0.0231 |
| Cyclopteridae | <i>Liparis fabricii</i> | Polarringbuk | Gelatinous snailfish | 1 | 13 | 0.0002 |
| Cyclopteridae | <i>Liparis gibbus</i> | Pukkelringbuk | Variagated snailfish | 6 | 8.3 | 0.0011 |
| Cyclopteridae | <i>Liparis liparis</i> | Vanlig ringbuk | Striped sea snail | 13 | 7 | 0.0058 |
| Anarhichadidae | <i>Anarhichas denticulatus</i> | Blåsteinbit | Northern wolffish | 49 | 85.4 | 1.0923 |
| Anarhichadidae | <i>Anarhichas lupus</i> | Gråsteinbit | Atlantic wolffish | 50 | 26.8 | 0.3901 |
| Anarhichadidae | <i>Anarhichas minor</i> | Flekksteinbit | Spotted wolffish | 64 | 61.9 | 1.1328 |
| Zoarcidae | Zoarcidae sp. | Ålebrosmefamilien | Eelpouts | 1 | 16 | < 1 g/nm |
| Zoarcidae | <i>Lycodes squamiventer</i> | Skjellålebrosm | Scalebelly eelpout | 1 | 30 | 0.0003 |
| Zoarcidae | <i>L. seminudus</i> | Storhodet ålebrosm | Longear eelpout | 13 | 14.6 | 0.016 |
| Zoarcidae | <i>L. rossi</i> | Nordlig ålebrosm | Threespot eelpout | 28 | 16.3 | 0.0199 |
| Zoarcidae | <i>L. reticulatus</i> | Nettålebrosm | Arctic eelpout | 11 | 16.9 | 0.0157 |
| Zoarcidae | <i>L. pallidus</i> | Blek ålebrosm | Pale eelpout | 5 | 12.7 | 0.0012 |
| Zoarcidae | <i>L. gracilis</i> | Vanlig ålebrosm | Vahl's eelpout | 121 | 19.4 | 0.12 |
| Zoarcidae | <i>L. eudipleurostictus</i> | Båndålebrosm | Double line eelpout | 8 | 23 | 0.0145 |
| Zoarcidae | <i>L.s esmarkii</i> | Ulvefisk | Esmark's eelpout | 8 | 53.9 | 0.0287 |
| Zoarcidae | <i>Lycenchelys kolthoffi</i> | Marmorert ålebrosm | | 1 | 5 | < 1 g/nm |
| Zoarcidae | <i>Gymnelis viridis</i> | Grønlandsålebrosm | Fish doctor | 1 | 8 | 0.001 |
| Lumpenidae | <i>Anisarchus medius</i> | Rundhalet langebarn | Stout eelblenny | 2 | 12.4 | 0.0031 |
| Lumpenidae | <i>Leptoclinus maculatus</i> | Tverrhalet langebarn | Daubed shanny | 50 | 11.3 | 0.0126 |
| Lumpenidae | <i>Lumpenus lampret aeformis</i> | Langhalet langebarn | Snake blenny | 37 | 22.6 | 0.0325 |
| Callionymidae | Callionymidae sp. | Floyfiskfamilien | Dragonets | 1 | 10 | < 1 g/nm |

Appendix 1 cont.

| Family | Latin name (www.fishbase.org) | Norwegian name | English name (www.fishbase.org) | Occ. | Mean length (cm) | Mean WCPUE (kg/nm) |
|-----------------------|---|-------------------|------------------------------------|------|------------------------|--------------------------|
| <i>Bothidae</i> | <i>Lepidorhombus whiffiagonis</i> | Glassvar | Megrim | 2 | 45 | 0.0033 |
| <i>Pleuronectidae</i> | <i>Limanda limanda</i> | Sandflyndre | Dab | 2 | 22.9 | 0.0007 |
| <i>Pleuronectidae</i> | <i>Pleuronectes platessa</i> | Rødspette | European plaice | 26 | 40 | 0.616 |
| <i>Pleuronectidae</i> | <i>Reinhardtius hippoglossoides</i> | Blåkveite | Greenland halibut | 106 | 46.2 | 2.3089 |
| <i>Pleuronectidae</i> | <i>Glyptocephalus cynoglossus</i> | Smørflyndre | Witch | 13 | 42.1 | 0.0418 |
| <i>Pleuronectidae</i> | <i>Hippoglossoides platessoides</i> | Gapeflyndre | Long rough dab | 268 | 23.5 | 15.0402 |
| <i>Pleuronectidae</i> | <i>Hippoglossus hipposglossus</i> | Kveite | Halibut | 13 | 53.6 | 0.1038 |

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