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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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Et kombinert akustikk og bunntråltokt i januar-mars har vært gjennomført årlig siden 1981 for å framskaffe mengdeindekser for bunnfisk samt trål for lengde og vekt ved alder. Målartene 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 blow 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° 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:

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

$\bar{\rho}_A$ 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):

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

Indicies 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 1and 2 gives:

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

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

As a basis for estimating $\overline{L^2}$ trawl catches considered to be representative for each rectangle and depth zone are selected. 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:

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

For each species the total density ($\overline{\rho}_A$) by rectangle and depth zone is 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 ($6m^2$, 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 m^2) 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", $7.1m^2$, 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.

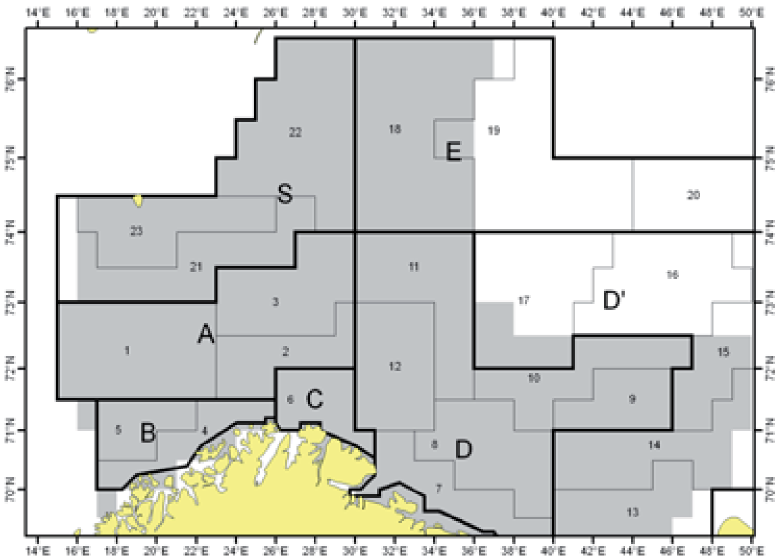

Figure 2.1 Strata (1-23) and Main Areas (A,B,C,D,D',E and S) used for swept area estimations. The Main Areas are also used for acoustic estimation. The grey shading indicates the area covered in 2006.

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:

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

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

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

The parameters are given in the text table below:

Species	α	β	l_{min}	l_{max}
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.

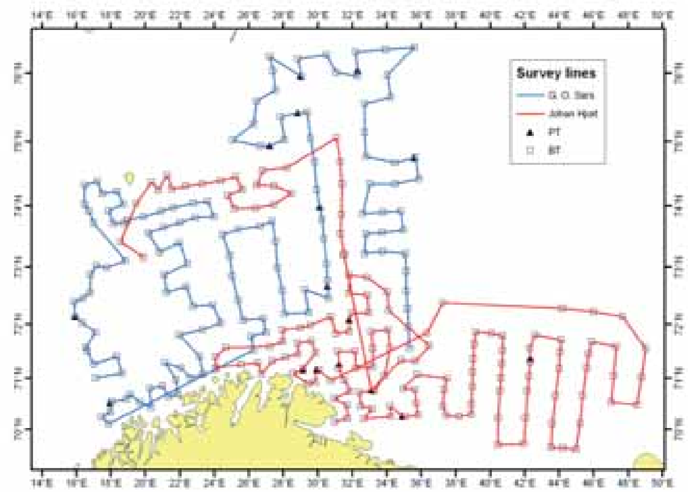

Figure 3.1. Survey tracks and trawl stations R/V "G.O. Sars" and R/V "Johan Hjort" 01.02-14.03.2006.

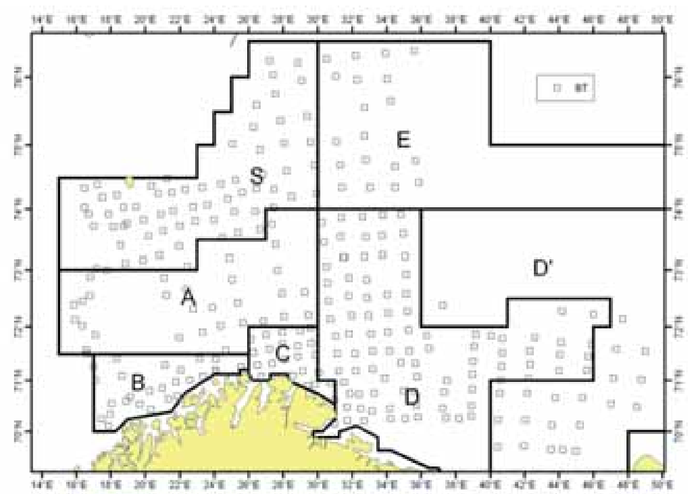

Figure 3.2. Bottom trawl stations used in the swept area estimation in 2006 and borders for the main areas.

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.miles^2) covered in the bottom trawl surveys in the Barents Sea winter 1981-2006.

	Main Area							Sum	
Year	A	B	C	D	D'	E	S	ABCD	Total
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		*S.marinus*		*S. mentella*		Greenland halibut	
			L	A	L	A	L	A	L	A	L	A
	B1	31	1102	278	3508	305	105		956		47	
A	B2	0	0	0	0	0	0		0		0	
	P	1	10	6	49	11	0		0		0	
	B1	26	935	231	2057	230	252		83		2	
B	B2	0	0	0	0	0	0		0		0	
	P	2	0	0	0	0	0		0		0	
	B1	22	860	215	2407	185	54		335		2	
C	B2	0	0	0	0	0	0		0		0	
	P	2	1	1	69	5	0		0		0	
	B1	93	8625	1023	10224	686	57		316		172	
D	B2	3	0	0	0	0	0		0		0	
	P	7	7	4	384	16	0		0		0	
	B1	19	969	91	597	44	0		0		0	
D'	B2	2	10	0	0	0	0		0		0	
	P	0	0	0	0	0	0		0		0	
	B1	16	1249	132	933	85	5		8		218	
E	B2	3	0	0	0	0	0		0		0	
	P	2	0	0	66	0	0		0		0	
	B1	64	5551	702	3005	326	255		1658		521	
S	B2	2	0	0	0	0	0		0		0	
	P	3	0	0	312	6	0		0		0	
	B1	271	19291	2672	22731	1861	728		3356		962	
Total	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.

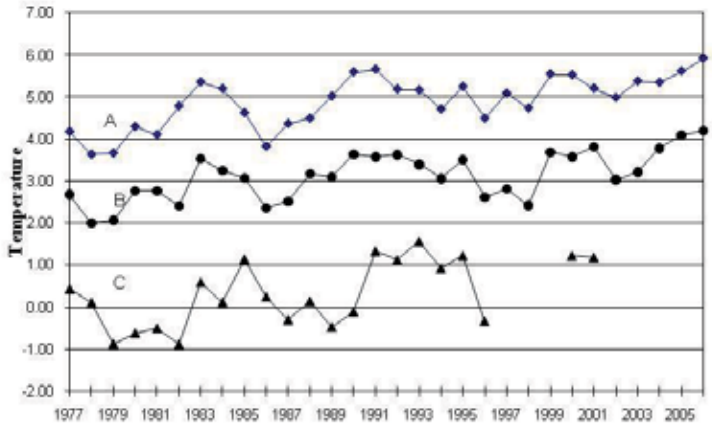

Figure 4.1. Mean temperatures in 50-200 m depth in 1977-2006. A) "Fugløya-Bjørnøya" in March, B) "Vardø-Nord" in March, C) Sem Islands in January-February.

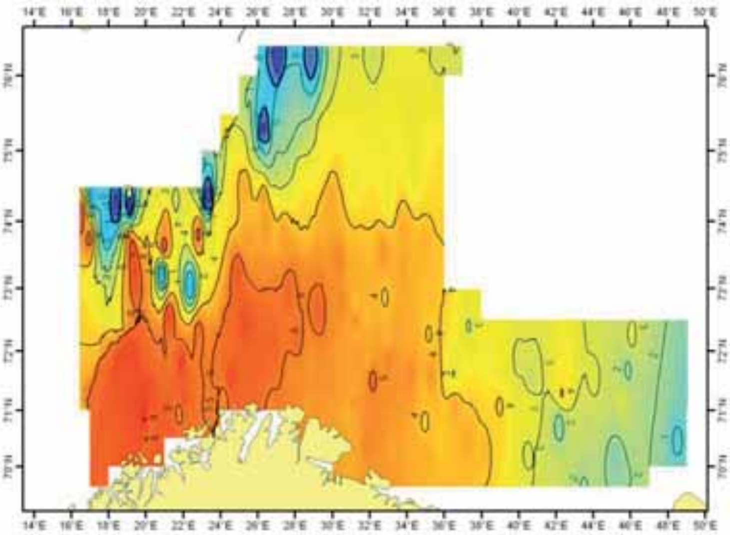

Figure 4.2. Temperatures at 10m depth during the 2006 survey.

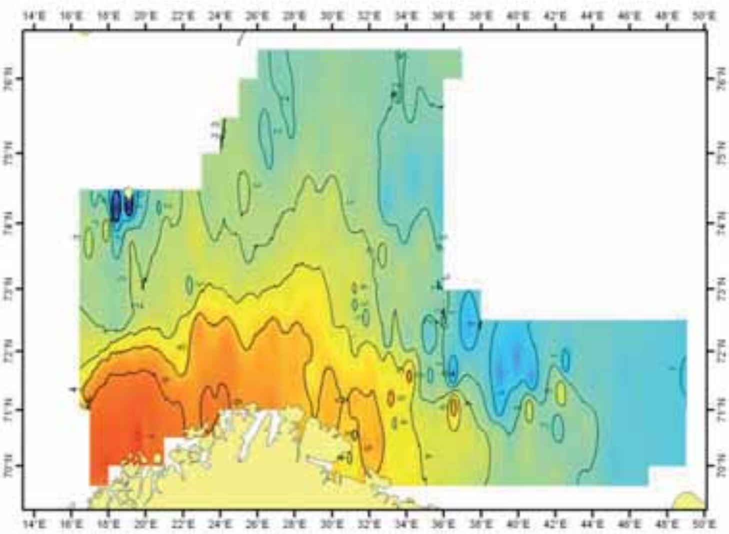

Figure 4.3. Temperatures at bottom during the 2006 survey.

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.

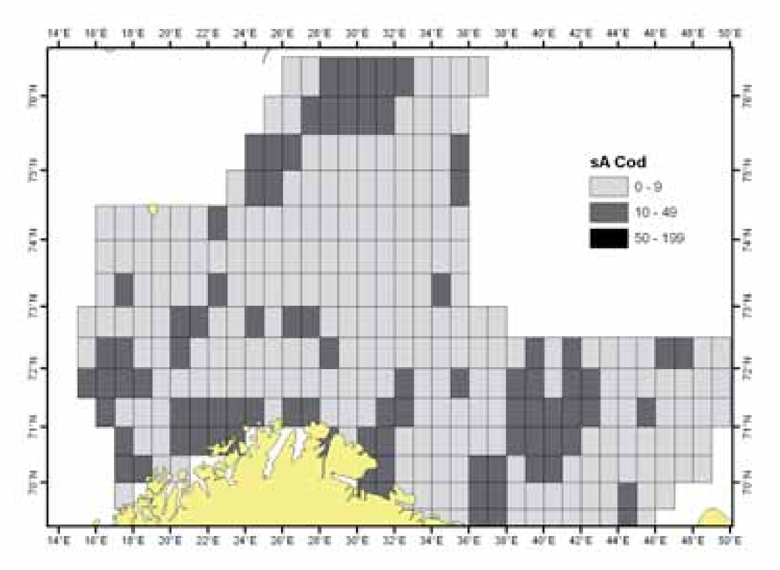

Figure 5.1. COD. Distribution of total echo abundance winter 2006. Unit is s_A per square nautical mile (m^2/n.mile^2).

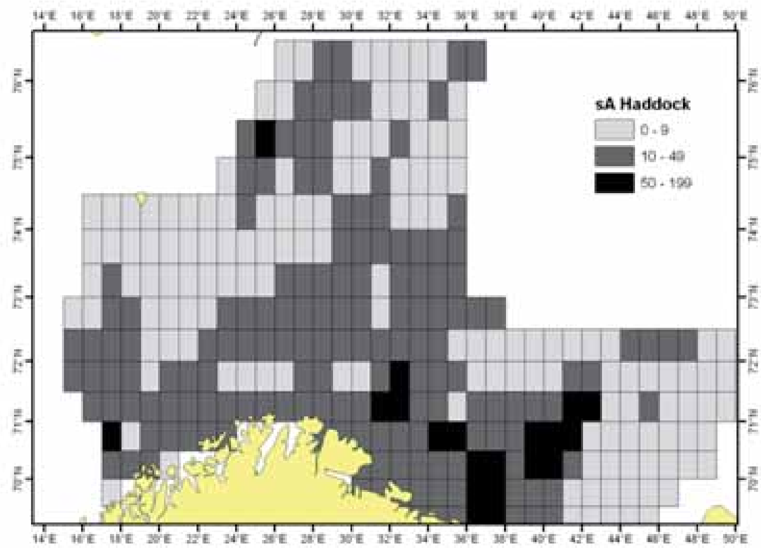

Figure 5.2. HADDOCK. Distribution of total echo abundance winter 2006. Unit is s_A per square nautical mile (m^2/n.mile^2).

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 · 10^{-3}).

	Cod			Haddock		
Area	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 · 10^{-3}). 1981 - 1992 includes only mainly areas A, B, C and D.

	Echo abundance								
	Total			Bottom			bottom/total		
Year	Cod	Had.	Sum	Cod	Had.	Sum	Cod	Had.	Sum
1981			2097			799			0.38
1982			686			311			0.45
1983			597			169			0.28
1984			2284			604			0.26
1985			5187			736			0.14
1986			5990			820			0.14
1987			2676			608			0.23
1988			1696			579			0.34
1989			914			308			0.34
1990			1355			536			0.40
1991			2706			803			0.30
1992			4128			951			0.23
1993	3905	2854	6759	1011	548	1559	0.26	0.19	0.23
1994	5076	3650	8726	1201	609	1810	0.24	0.17	0.21
1995	4125	3051	7176	1525	651	2176	0.37	0.21	0.30
1996	2729	1556	4285	1004	626	1630	0.37	0.40	0.38
1997[1]	1354	995	2349	530	258	788	0.39	0.26	0.34
1998[1]	2406	581	2987	632	143	775	0.26	0.29	0.26
1999	1364	704	2068	389	145	534	0.29	0.21	0.26
2000	2596	1487	4083	610	343	953	0.23	0.23	0.23
2001	2085	1440	3525	698	615	1313	0.34	0.43	0.37
2002	1943	2329	4272	627	477	1104	0.32	0.20	0.26
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).

	Age (year-class)											
Length	1	2	3	4	5	6	7	8	9	10+	Sum	Biomass
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).

		Age (year-class)										
		1	2	3	4	5	6	7	8	9	10+	Biomass
Area	Layer	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(98)	(97)		('000 t)
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.

	Age											Biomass
Year	1	2	3	4	5	6	7	8	9	10+	Total	('000 t)
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.

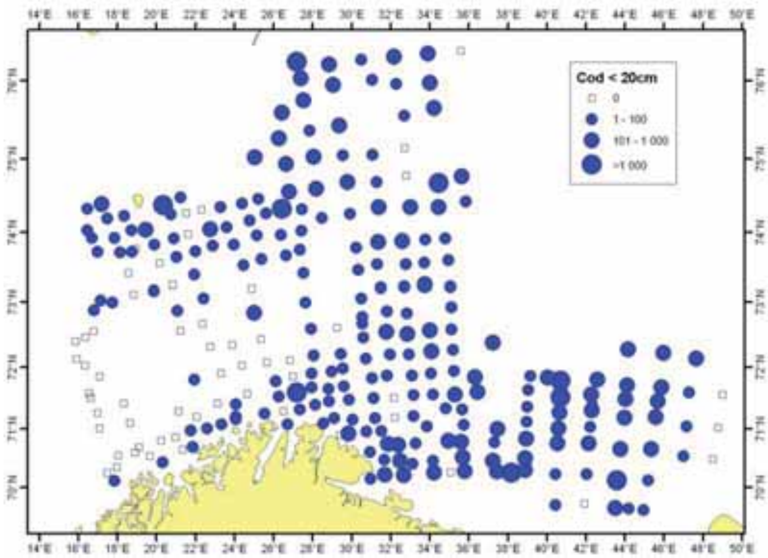

Figure 6.1. COD < 20 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

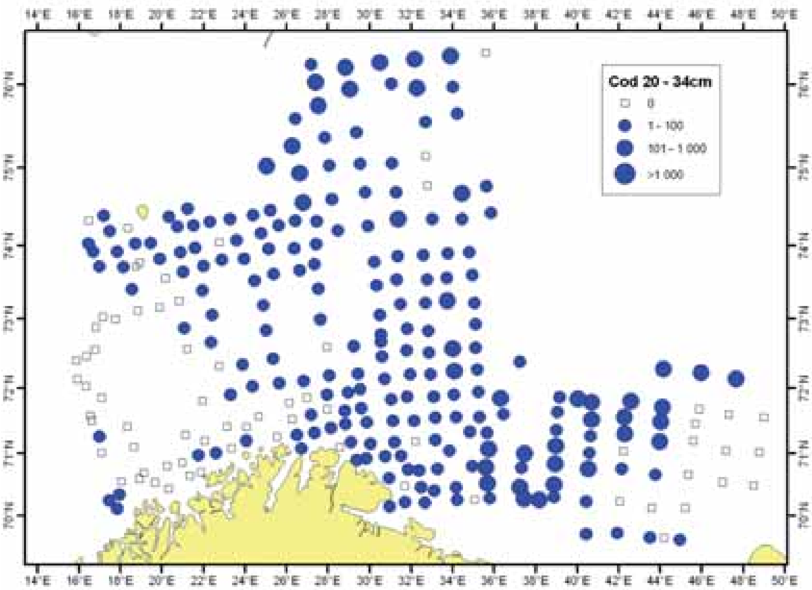

Figure 6.2. COD 20-34 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

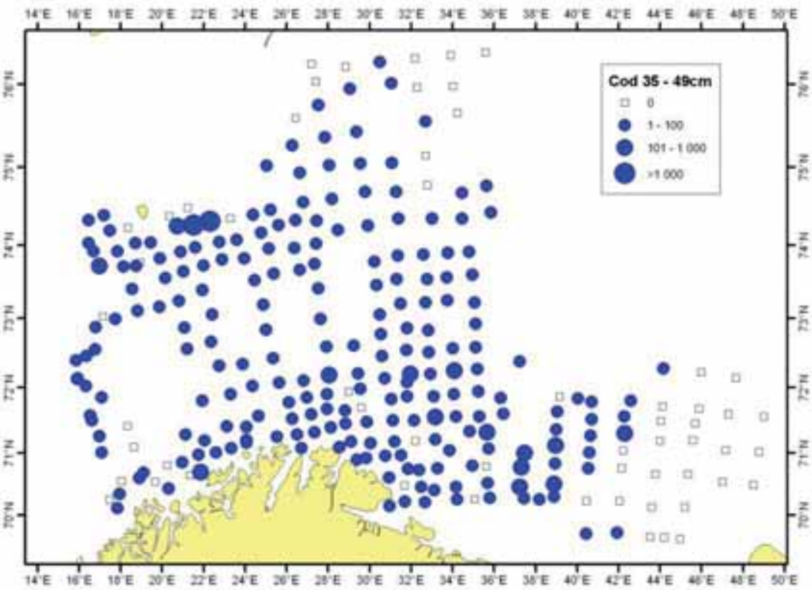

Figure 6.3. COD 35-49 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

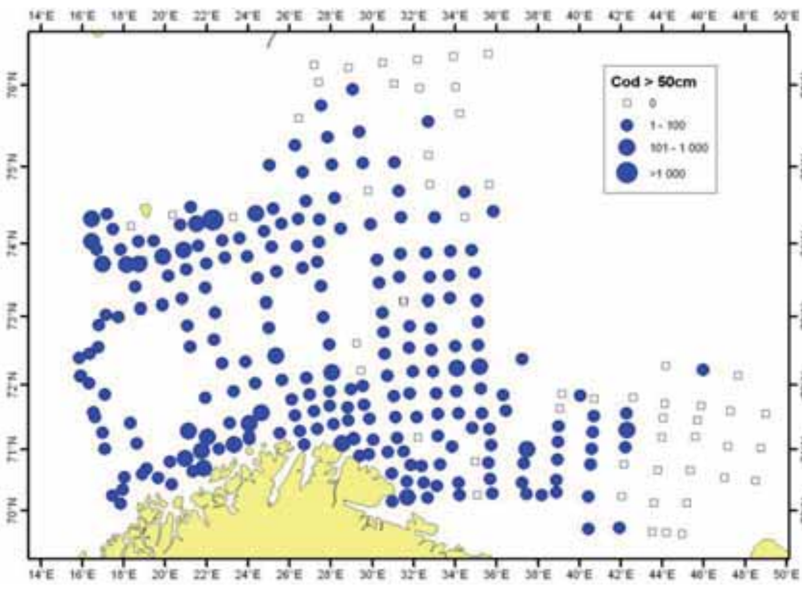

Figure 6.4. COD > 50 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

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).

	Area																
Length	A		B		C		D		D'		E		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	1.6	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).

	Age (year-class)											
Length	1	2	3	4	5	6	7	8	9	10+	Sum	Biomass
cm	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(98)	(97)			('000 t)
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.)

	Age (year-class)										
	1	2	3	4	5	6	7	8	9	10+	Biomass
Area	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(98)	(97)		'000 t
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.

	Age											Biomass
Year	1	2	3	4	5	6	7	8	9	10+	Total	('000 t)
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.

	Age (year-class)							
	1	2	3	4	5	6	7	8
Area	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(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.

	Age							
Year	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.

	Age						
Year	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 are 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

	Age							
Year	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).

	Age (year-class)											
Length	1	2	3	4	5	6	7	8	9	10+	Sum	Biomass
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).

		Age (year-class)										
		1	2	3	4	5	6	7	8	9	10+	Biomass
Area	Layer	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(98)	(97)		('000 t)
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.

	Age											Biomass
Year	1	2	3	4	5	6	7	8	9	10+	Total	('000 t)
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.

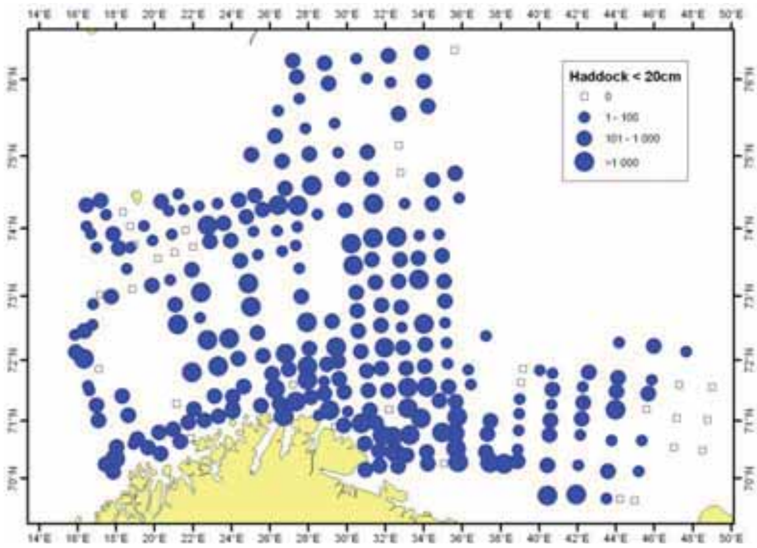

Figure 7.1. HADDOCK < 20 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

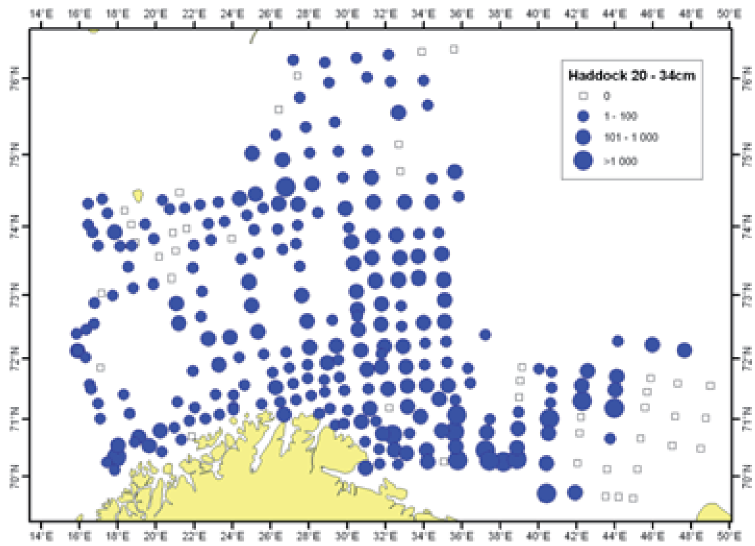

Figure 7.2. HADDOCK 20-34 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

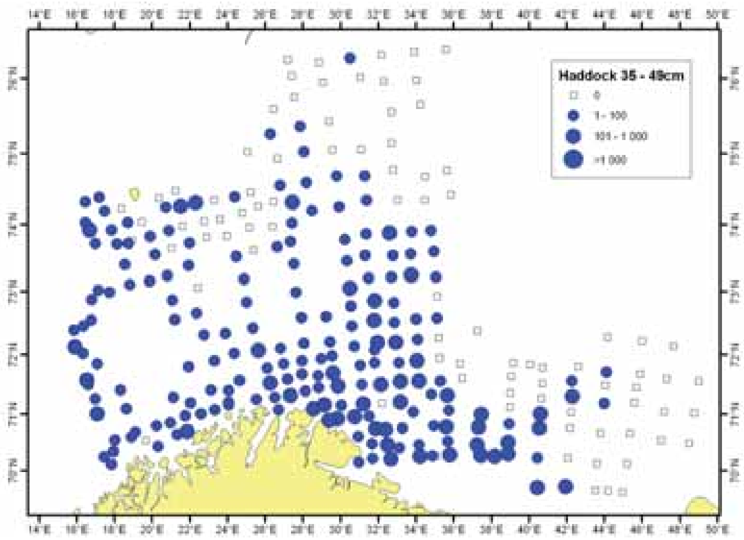

Figure 7.3. HADDOCK 35-49 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

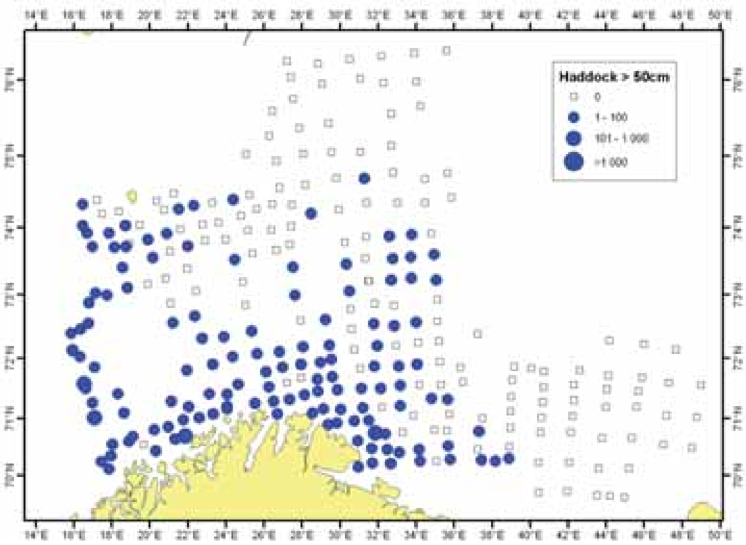

Figure 7.4. HADDOCK > 50 cm. Distribution in the trawl catches winter 2006 (number per hour trawling).

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	2	3	4	5	6	7	8
	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(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	2	3	4	5	6	7	8
	(05)	(04)	(03)	(02)	(01)	(00)	(99)	(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.

	Age						
Year	1	2	3	4	5	6	7
1983	52	133	480	1043	1641	2081	2592
1984	36	196	289	964	1810	2506	2240
1985	35	138	432	731	1970	2517	-
1986	47	100	310	734	-	-	-
1987	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

	Age					
Year	1-2	2-3	3-4	4-5	5-6	6-7
1983-84	144	156	484	767	865	159
1984-85	102	236	442	1006	707	-
1985-86	65	172	302	-	-	-
1986-87	44	173	232	200	-	-
1987-88	115	141	169	201	259	-
1988-89	102	170	252	289	269	206
1989-90	105	221	545	502	564	514
1990-91	104	309	534	685	740	513
1991-92	95	254	492	587	521	548
1992-93	61	181	374	369	338	106
1993-94	60	157	228	275	251	-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.

	Age						
Year	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.

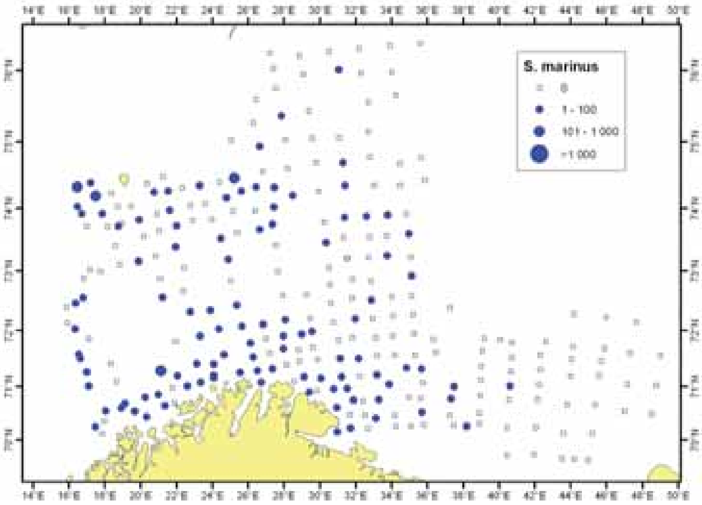

Figure 8.1. *Sebastes marinus*. Distribution in the trawl catches winter 2006 (no. per hour trawling).

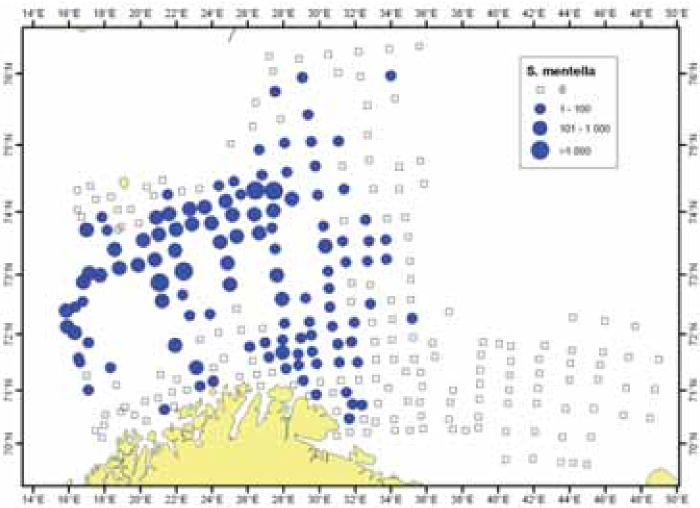

Figure 8.2. *Sebastes mentella*. Distribution in the trawl catches winter 2006 (no. per hour trawling).

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.

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

	Length group (cm)								
Year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	> 45	Total
1986	81.3	151.9	205.4	87.7	169.2	129.8	87.5	23.6	13.8	951
1987	71.8	25.1	227.4	56.1	34.6	11.4	5.3	1.1	0.1	433
1988	587.0	25.2	132.6	182.1	39.6	50.1	47.9	3.6	0.1	1070
1989	622.9	55.0	28.4	177.1	58.0	9.4	8.0	1.9	0.3	962
1990	323.6	304.5	36.4	55.9	80.2	12.9	12.5	1.5	0.2	830
1991	395.2	448.8	86.2	38.9	95.6	34.8	24.3	2.5	0.2	1123
1992	139.0	366.5	227.1	34.6	55.2	34.4	7.5	1.8	0.5	867
1993	30.8	592.7	320.2	116.3	24.2	25.0	6.3	1.0	+	1117
1994	6.9	258.6	289.4	284.3	51.4	69.8	19.9	1.4	0.1	979
1995	263.7	71.4	637.8	505.8	90.8	68.8	31.3	3.9	0.5	1674
1996	213.1	100.2	191.2	337.6	134.3	41.9	16.6	1.4	0.3	1037
1997**	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.

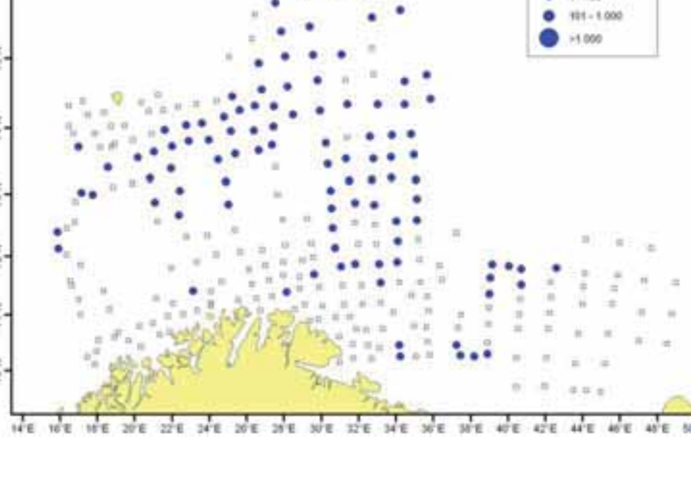

Figure 8.2. GREENLAND HALIBUT. Distribution in the trawl catches winter 2006 (no. per hour trawling).

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	A		B		C		D		D'		E		S		Total		
cm	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV (%)
5-9	0	0	0	0	0	0	0	0	0	0	0	0	0	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.

	Length group (cm)															
Year	<14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	> 80	Total
1990	21	199	777	785	1205	1657	1829	2043	1349	479	159	160	40	40	0	10800
1991	0	42	262	618	655	868	954	1320	1875	1577	847	165	34	34	0	9270
1992	14	35	64	149	509	843	1096	1072	1029	827	633	108	31	31	26	6500
1993	0	0	17	67	265	959	2310	4004	3374	1911	1247	482	139	139	34	14840
1994	0	0	16	99	142	1191	2625	3866	2885	1796	753	440	25	25	0	13838
1995	42	0	0	0	83	149	3228	9240	7438	2811	2336	909	468	468	0	26761
1996	3149	0	0	0	61	124	1163	3969	4425	1824	1041	593	346	73	12	16781
1997	0	65	0	0	173	227	858	4344	5500	2725	1545	632	282	66	22	16439
1998	80	217	1006	444	532	403	1064	3888	6331	2977	1725	633	337	76	43	19765
1999	41	82	261	427	576	264	757	1706	3069	1640	1077	483	109	74	28	10594
2000	122	184	322	859	1753	3841	2190	1599	2143	1715	1163	564	242	75	0	16769
2001	68	49	129	178	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.

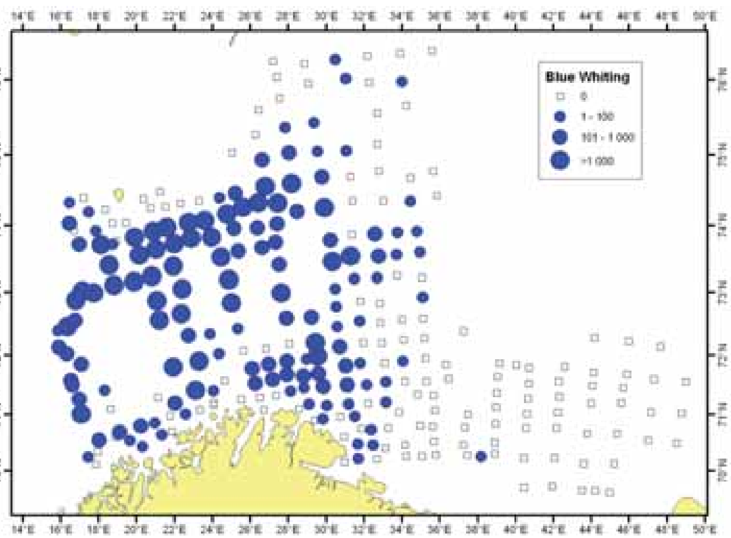

Figure 9.2. BLUE WHITING. Distribution in the trawl catches winter 2006 (no. per hour trawling).

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

Year	Length group (cm)							
	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Total
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 experimantal bottom trawl tows. The reasons for these experimental hauls was intercalibration and gear development. The results will be given in a separate report.

11. LITERATURE

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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)
Squalidae	*Etmopterus spinax*	Svarthå	Velvet belly lantern shark	2	27.4	0.0038
Squalidae	*Somniosus microcephalus*	Håkjerring	Greenland shark	1	****	****
Rajidae	*Amblyraja hyperborea*	Isskate	Arctic skate	5	35.6	0.0258
Rajidae	*Amblyraja radiata*	Kloskate	Thorny skate	214	39	2.7432
Rajidae	*Bathyraja spinicauda*	Gråskate	Spinetail ray	17	56.3	0.1623
Rajidae	*Dipturus batis*	Storskate	Blue skate	9	131.2	0.4182
Rajidae	*Rajealla fyllae*	Rundskate	Round ray	31	35	0.0709
Chimaeridae	*Chimaera monstrosa*	Havmus	Rabbit fish	8	35.8	0.165
Clupeidae	*Clupea harengus*	Sild*	Atlantic herring (NSS*)	75	22.3	0.2925
Clupeidae	*Clupea harengus*	Sild**	Atlantic herring (WS**)	22	21.7	0.0994
Osmeridae	*Mallotus villosus*	Lodde	Capelin	193	18.5	3.6824
Argentinidae	*Argentina silus*	Vassild	Greater argentine	49	23.2	0.9663
Argentinidae	*Argentina sphyraena*	Strømsild	Argentine	2	14	0.0002
Sternoptychidae	*Arctozenus risso*	Liten laksetobis	Ribbon barracudina	10	20	0.0009
Sternoptychidae	*Maurolicus mueller*	Laksesild	Pearlside	***	***	***
Myctophidae	***Myctophidae sp.***	**Lysprikkfisk**	**Laternfish**	**39**	**18**	**0.3071**
Gadidae	*Gadus morhua*	Torsk	Atlantic cod	271	29.5	43.0362
Gadidae	*Boreogadus saida*	Polartorsk	Polar cod	12	14.7	1.1033
Gadidae	*Pollachius virens*	Sei	Saithe	47	43.1	5.5381
Gadidae	*Merlangius merlangius*	Hvitting	Whiting	25	19.7	0.0379
Gadidae	*Melanogrammus aeglefinus*	Hyse	Haddock	260	24.1	34.6496
Gadidae	*Micromesistius poutassou*	Kolmule	Blue whiting	140	27.5	16.9442
Gadidae	*Gadiculus argenteus*	Sølvtorsk	Silvery pout	35	11.5	0.0306
Gadidae	*Trisopterus esmarkii*	Øyepål	Norway pout	153	13	2.7023
Gadidae	*Brosme brosme*	Bromse	Cusk	32	37	0.1662
Gadidae	*Molva molva*	Lange	Ling	10	69.7	0.0611
Gadidae	*Gaidropsarus vulgaris*	Tretrådet tangbrosme	Three-bearded rockling	3	8.4	0.0007
Gadidae	*Enchelyopus cimbrius*	Firetrådet tangbrosme	Fourbeard rockling	12	20.6	0.0042
Macrouridae	*Macrourus berglax*	Isgalt	Rough rattail	6	17.1	0.0143
Lophiidae	*Lophius piscatorius*	Breiflabb	Anglerfish	1	75.5	0.0255
Syngnathidae	*Entelurus aequoreus*	Stor havnål	Snake pipefish	13	31.1	0.0002
Gasterosteidae	*Gasterosteus aculeatus*	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	*Sebastes mentella*	Snabeluer	Deepwater redfish	115	32	10.0388
Scorpaenidae	*Sebastes marinus*	Vanlig uer	Golden redfish	107	37.1	2.0395
Scorpaenidae	*Sebastes viviparus*	Lusuer	Norway redfish	10	33.4	0.0274
Trigidae	*Eutrigla gurnardus*	Knurr	Grey gurnard	1	34	0.0007
Cottidae	***Triglops sp.***	**Knurrulkeslekten**		**10**	**8**	**0.0033**
Cottidae	*Triglops murrayi*	Nordlig knurrulke	Moustache sculpin	62	8.9	0.066
Cottidae	*Triglops nybelini*	Grønlandsknurrulke	Bigeye sculpin	5	8.8	0.0015
Cottidae	*Triglops pingeli*	Arktisk knurrulke	Ribbed sculpin	2	8.4	0.0005
Cottidae	*Icelus bicornis*	Tornulke	Twohorn sculpin	6	15.9	0.0017
Cottidae	*Myoxocephalus scorpius*	Vanlig ulke	Shorthhorn sculpin	1	11.9	0.0021
Cottidae	*Artediellus atlanticus*	Krokulke	Atlantic hookear sculpin	123	7.7	0.1443
Cottunculidae	*Cottunculus microps*	Paddeulke	Polar sculpin	39	12.1	0.0177
Agonidae	*Ulcina olrikii*	Arktisk panserulke	Arctic alligatorfish	2	6.8	0.0001
Agonidae	*Leptagonus decagonus*	Tiskjegg	Atlantic poacher	67	13.8	0.055
Cyclopteridae	*Cyclopterus lumpus*	Rognkjeks	Lumpsucker	113	37.1	1.5791
Cyclopteridae	*Eumicrotremus derjugini*	Svartkjeks	Leatherfin lumpsucker	1	9	0.0001
Cyclopteridae	*Eumicrotremus spinosus*	Vortekjeks	Atlantic spiny lumpsucker	11	7	0.0103
Cyclopteridae	*Careproctus reinhardii*	Nordlig ringbuk	Sea tadpole	53	10.1	0.0231
Cyclopteridae	*Liparis fabricii*	Polarringbuk	Gelatinous snailfish	1	13	0.0002
Cyclopteridae	*Liparis gibbus*	Pukkelringbuk	Variagated snailfish	6	8.3	0.0011
Cyclopteridae	*Liparis liparis*	Vanlig ringbuk	Striped sea snail	13	7	0.0058
Anarhichadidae	*Anarhichas denticulatus*	Blåsteinbit	Northern wolffish	49	85.4	1.0923
Anarhichadidae	*Anarhichas lupus*	Gråsteinbit	Atlantic wolffish	50	26.8	0.3901
Anarhichadidae	*Anarhichas minor*	Flekksteinbit	Spotted wolffish	64	61.9	1.1328
Zoarcidae	***Zoarcidae sp.***	**Ålebrosmefamilien**	**Eelpouts**	**1**	**16**	**< 1 g/nm**
Zoarcidae	*Lycodes squamiventer*	Skjellålebrosme	Scalebelly eelpout	1	30	0.0003
Zoarcidae	*L. seminudus*	Storhodet ålebrosme	Longear eelpout	13	14.6	0.016
Zoarcidae	*L. rossi*	Nordlig ålebrosme	Threespot eelpout	28	16.3	0.0199
Zoarcidae	*L. reticulatus*	Nettålebrosme	Arctic eelpout	11	16.9	0.0157
Zoarcidae	*L. pallidus*	Blek ålebrosme	Pale eelpout	5	12.7	0.0012
Zoarcidae	*L. gracilis*	Vanlig ålebrosme	Vahl's eelpout	121	19.4	0.12
Zoarcidae	*L. eudipleurostictus*	Båndålebrosme	Double line eelpout	8	23	0.0145
Zoarcidae	*L.s esmarkii*	Ulvefisk	Esmark's eelpout	8	53.9	0.0287
Zoarcidae	*Lycenchelys kolthoffi*	Marmorert ålebrosme		1	5	< 1 g/nm
Zoarcidae	*Gymnelis viridis*	Grønlandsålebrosme	Fish doctor	1	8	0.001
Lumpenidae	*Anisarchus medius*	Rundhalet langebarn	Stout eelblenny	2	12.4	0.0031
Lumpenidae	*Leptoclinus maculatus*	Tverrhalet langebarn	Daubed shanny	50	11.3	0.0126
Lumpenidae	*Lumpenus lampret aeformis*	Langhalet langebarn	Snake blenny	37	22.6	0.0325
Callionymidae	**Callionymidae sp.**	**Fløyfiskfamilien**	**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)
Bothidae	*Lepidorhombus whiffiagonis*	Glassvar	Megrim	2	45	0.0033
Pleuronectidae	*Limanda limanda*	Sandflyndre	Dab	2	22.9	0.0007
Pleuronectidae	*Pleuronectes platessa*	Rødspette	Europeian plaice	26	40	0.616
Pleuronectidae	*Reinhardtius hippoglossoides*	Blåkveite	Greenland halibut	106	46.2	2.3089
Pleuronectidae	*Glyptocephalus cynoglossus*	Smørflyndre	Witch	13	42.1	0.0418
Pleuronectidae	*Hippoglossoides platessoides*	Gapeflyndre	Long rough dab	268	23.5	15.0402
Pleuronectidae	*Hippoglossus hipposglossus*	Kveite	Halibut	13	53.6	0.1038

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