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INVESTIGATIONS ON DEMERSAL FISH IN THE SVALBARD AREA AUTUMN 2000 AND 2001, WITH SPECIAL ATTENTION ON JUVENILE GREENLAND HALIBUT

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PREFACE

In 1989 the ICES Advisory Committee on Fishery Management stated that actions should be taken to rebuild the spawning stock of the northeast Arctic Greenland halibut (ICES 1990). The following observations of the stock and fishery then led to actions taken in 1992 when strong regulations was enforced to reduce the total landings. Trawl catches were limited to by-catch only and the limited coastal fishery was restricted by seasonal closure.

During the end of the 1980s the year class abundance indices for Northeast Arctic Greenland halibut decreased. These indices were generated by the yearly 0-group and juvenile surveys in the Barents Sea, and it was uncertain if the decrease actually reflected the status of the stock or if there were changes in the distribution area of the young fish during this period. Russian investigations around Franz Josef Land in the period 1978-1980 (Borkin 1983) together with sporadic registrations by the Norwegian surveys early in the 1990s indicated that the area north of Spitsbergen and Franz Josef Land could be important nursery grounds. Based on these indications and a pilot survey in 1993, the Institute of Marine Research started in 1996 a program to investigate to what degree Greenland halibut's nursery grounds extended into the Arctic waters and to establish a time series of recruitment indices for these areas.

The Norwegian survey was conducted in August-September each year when the ice coverage in the area was assumed to be on its yearly minimum. The survey area has been increased several times and in 2000 it was determined to expand the survey further east into the Frans Josef area and make it a joint survey between Russian and Norwegian vessels.

This report presents the results from the surveys in 2000 and 2001, but we have also chosen to include the time series back to 1996 as illustration even if this is not really comparable due to lesser survey coverage and the fact that the years before 2000 was achieved only with one Norwegian vessel. The total duration of the surveys in 2000 and 2001 was from 28.08 – 17.09 and 28.08–24.09, respectively.

SUMMARY

Institute of Marine Research in Bergen started in 1996 a program to investigate to what degree Greenland halibut's nursery grounds extended to the north and east of Spitsbergen, and Norwegian vessels executed this survey until 1999 with coverage with some stations into the Russian EEZ in 1998 and 1999. The annual meeting between Russian and Norwegian scientists decided to extend this survey to a joint survey, and the first year with joint effort with a Russian and a Norwegian vessel was year 2000. The survey was conducted as a traditional bottom trawl survey with main focus on Greenland halibut, but also analyses were carried out for cod, redfish and long rough dab.

The main results in 2000 and 2001 were:

- signs of improved recruitment of Greenland halibut, the yearclasses 1999 and 2000 were the strongest in the time series
- mean length and mean weight were in accordance with previous years
- low abundance of cod in the survey area with no length groups which substantially dominate the estimates
- very low abundance of redfish in the survey area, both *S. mentella* and *S. marinus*
- long rough dab most abundant in the area with the widest distribution of the surveyed species
- the long rough dab estimates strongly dominated by fish smaller than 25 cm.

INTRODUCTION

Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) is distributed in the Arctic and boreal waters in the North Atlantic and in the North Pacific (Fedorov 1971; Godø & Haug 1989; Bowering & Brodie 1995; Bowering & Nedreaas 2000). In the northeastern Atlantic the distribution is more or less continuous along the continental slope from the Faeroe Islands and Shetland to north of Spitsbergen (Whitehead *et al.* 1986; Godø & Haug 1989), with the highest concentrations from 500 to 800 m depth between Norway and Bear Island, which is also regarded as the main spawning area (Godø & Haug 1987; Albert *et al.* 2001b). Peak of spawning occurs in December in the main spawning area, but also in nearby localities during summer (Albert *et al.* 2001b). Eggs and larvae drift northwards and the juveniles are distributed in the deeper parts of the Barents Sea and to the north and east of Spitsbergen, to the waters around Franz Josef Land (Borkin 1983; Godø & Haug 1987; Godø & Haug 1989; Albert *et al.* 2001a).

Tantsura (1958), (Loeng 1989) and (Strømberg 1989) have mapped the currents in the Barents Sea and the areas around Svalbard. Important currents in this area are the two main branches of warm water, the North Cape Current flowing into the Barents Sea and West Spitsbergen Current, which flows north along the slope of the continental shelf. A branch of the latter current swings eastwards north of Svalbard and this results in bottom temperatures between 1-2°C north of Svalbard and eastward towards Franz Josef Land. In the entire area the warm water is gradually mixed with cold water from the Polar basin. Ice covers the area north of Spitsbergen most of the year, but during the short summer the ice recedes towards the northeast. During some warm summers only ice drifts through the area transported by the southwestern Transpolar Current. The ice conditions change from year to year, but the period August/ September is usually the best for survey activity.

During the end of the 1980s the year class abundance indices for Northeast Arctic Greenland halibut decreased. These indices were generated by the Norwegian yearly 0-group surveys for juvenile fish in the Barents Sea, and it was uncertain if the decrease actually reflected the status of the stock or if there were changes in the distribution area of the young fish during this period. Russian investigations around Franz Josef Land in the period 1978-1980 (Borkin 1983) together with sporadic registrations by the Norwegian surveys early in the 1990s indicated that the area north of Spitsbergen and Franz Josef Land could be important nursery grounds. Based on these indications and a pilot survey in 1993, the IMR started in 1996 a program to investigate to what degree Greenland halibut's nursery grounds extended into the Arctic waters and to establish a time series of recruitment indices for these areas.

The main goal of the program was to establish a time series of recruitment indices for Greenland halibut, and also an additional goal was to look closely at the population structure (age, size, growth, survival, etc) in the different areas and depths. Further, information on other species, in particular to determine their distribution and abundance in relation to Greenland halibut, became an important task as well.

Norwegian vessels executed this survey until 1999 with coverage with some stations into the Russian EEZ in 1998 and 1999. The annual meeting between Russian and Norwegian scientists decided to extend this survey to a joint survey, and the first year with joint effort was year 2000. The result of this joint effort is a much better geographical coverage of the assumed distribution area of juvenile Greenland halibut.

METHODS

1.1 Sampling of catch

The catches were mainly sorted to species but in some cases it was difficult to determine the species, and for these cases only family was determined. The entire catch was sorted but for the most numerous species usually a representative sub-sample was taken. Greenland halibut was prioritised during sampling. Next in importance were polar cod, then cod, redfish, Long rough dab and lastly, capelin. Other species were counted and weighed.

Stratified age samples of Greenland halibut were taken in each area. Usually 10-15 otoliths per sex per 5 cm length group were selected and the smallest length group was commonly 10-14 cm. For each stratified sample, length, weight, sex and maturity status were recorded. Degree of maturation was determined according to the general scale for demersal fish given by (Fotland *et al.* 2000). In addition for female Greenland halibut, a special scale modified after (Nielsen & Boje 1995) was used.

1.2 Swept area analysis

Length based indices for each sub area was estimated using the method of (Jakobsen *et al.* 1997). For each trawl station and length, fish density was estimated by

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

where

$P_{s,l}$ is the number of fish/n.m.^{2} observed at station s (length l)

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

$a_{s,l}$ is swept area given by

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

d_s is towed distance (n.m.)

and

EW_l is the length dependent effective swept width.

For Greenland halibut, there is no available estimate of the length dependent effective swept width, so it was set to 25 m, independent of fish length and trawl depth.

Based on (Dickson 1993a; Dickson 1993b), length dependent effective fishing width for cod was included in the calculations where EW was:

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

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

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

The parameters used for cod were:

α:	5.91
β:	0.43
$l_{\min}$:	15 cm
$l_{\max}$:	62 cm

Point observations for fish density based on length (*l)* was summed up in 5 cm length groups denoted by $p_{s,l}$. Stratified abundance indices for each length group and strata were generated using

$$L_{p,l} = \frac{A_p}{S_p} * \sum P_{s,l}$$

where

$L_{p,l}$	is the index for stratum p, length group l
A_p	area (n.m.^{2}) of stratum p
S_p	is the number of stations in stratum p

For each sub area, the total number of fish in each 5cm length group was estimated by summing over all strata in the sub area, and the total number of fish in each age group in the area was estimated using an age/length key. Finally, the total index for each length and age class is the sum of the values for all sub areas.

For each year, an age/length key was estimated for each stratum. All age samples for a stratum were used. Age samples from a length group was weighted by the index of the number of fish in the 5 cm length group within a stratum divided by the number of age samples in the length group:

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

where $n_{p,l}$ is the number of age samples in stratum p and length group l.

The proportion of age a at length l was estimated using

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

where $P_a^{(l)}$ is the weighted proportion of age a in length group l in stratum p,

and $n_{p,a,l}$ is the number of age samples of age a in length group l.

The sum of the weighted factors in a sub area is the abundance index for the total number of fish in the sub area. The number of fish at age was estimated by

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

Average length and weight at age was estimated using (only shown for weight):

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

where $W_{p,a,l,j}$ is the weight for sample j in length group l in stratum p and age a.

SURVEY OPERATION

The survey area was divided into seven sub areas (Fig.3.1), and each of these sub areas was divided into three depth strata, 100-300m, 300-500m, and >500m (Table 3.1). Some trawl hauls were also taken outside this area, but these were excluded from the swept area analyses. The survey was conducted using the research vessel "Jan Mayen" in the period 28.August to 15.September 2001 and the Russian vessel R/V "Nerey" in the period 1.September to 19.September 2001. In the previous years (the years 1996-2000) the Norwegian survey was conducted using hired vessels in the period August/September (Table 3.2). From the Norwegian side the numbers of stations in each stratum in each year have been fairly constant, with exception of subarea D (Kvitøya) and E (Russian EEZ).

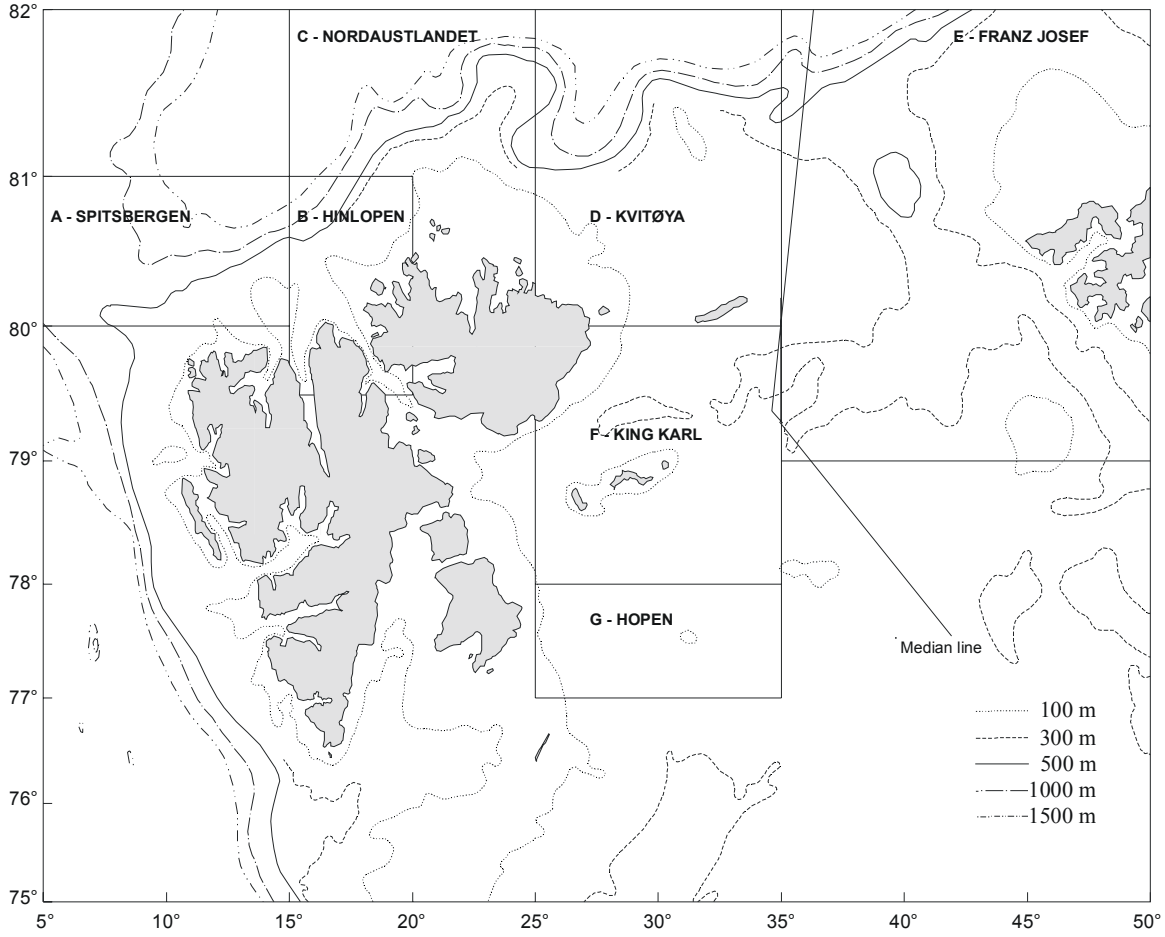


Figure 3.1. Map of the survey area with sub areas marked

The trawlers were equipped with the same type of trawl that is used by the IMR's research vessels in the Barents Sea, a Campelen 1800 standard shrimp trawl equipped with rockhopper gear with a trawl bag (22 mm stretched meshes; (Engås & Godø 1989)). The sweeps were 40 m and strapping was used to stabilize the opening of the trawl. Vaco trawl doors were employed ($6m^2$, 1500 kg) and the standard trawling time was 30 min at 3 knots. The trawls were equipped with ScanMar (Jan Mayen) or Simrad FS-900/FS-925 (Nerey) sensors, which measured the distance between the doors, the trawl's vertical opening and contact with the bottom. The trawls were also equipped with a calibrated temperature recorder from ScanMar. From 2000 the

Norwegian vessel also was equipped with a CTD-probe causing a better coverage of the hydrographical conditions in the survey area.

Table 3.1. Area and depth intervals for each strata

Strata nr.	Area	Depth	Area (nm^2)
1	A	100-300 m	848
2	A	300-500 m	304
3	A	> 500 m	4373
4	B	100-300 m	915
5	B	300-500 m	324
6	B	> 500 m	299
7	C	100-300 m	438
8	C	300-500 m	818
9	C	> 500 m	1444
10	D	100-300 m	5560
11	D	300-500 m	707
12	D	> 500 m	1600
13	E	100-300 m	11577
14	E	300-500 m	8006
15	E	> 500 m	1058
16	F	100-300 m	10204
17	F	300-500 m	1485
18	F	> 500 m	-
19	G	100-300 m	7373
20	G	300-500 m	-
21	G	> 500 m	-

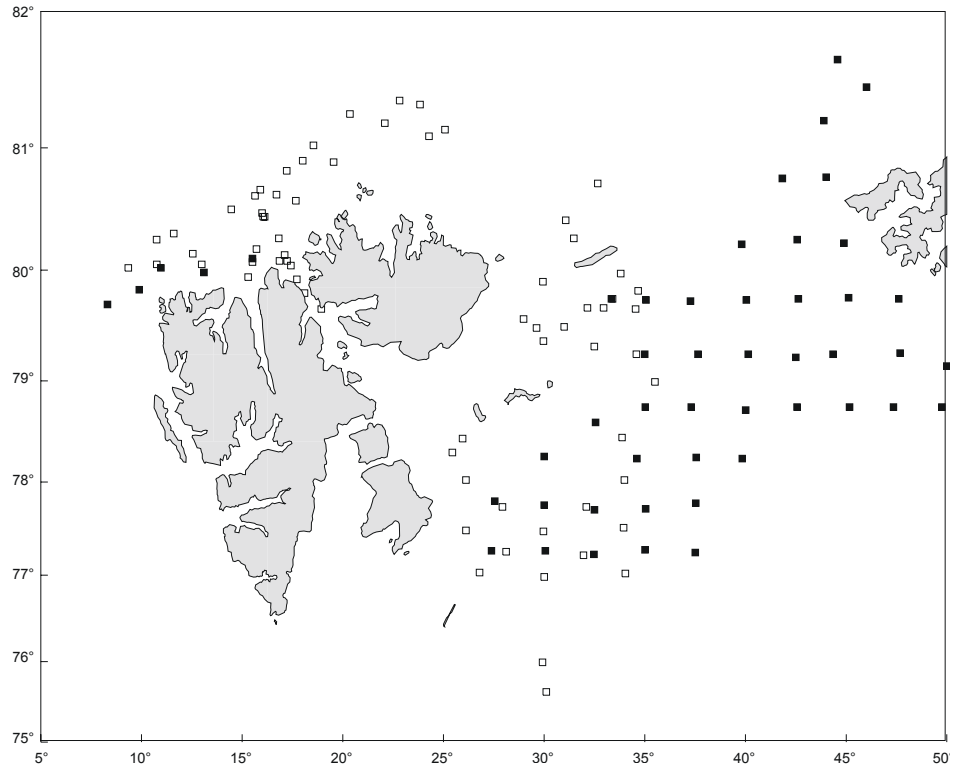


Figure 3.2. Trawl stations in the bottom trawl survey in 2000. Filled symbols are stations carried out by Persey IV and open symbols are carried out by Jan Mayen

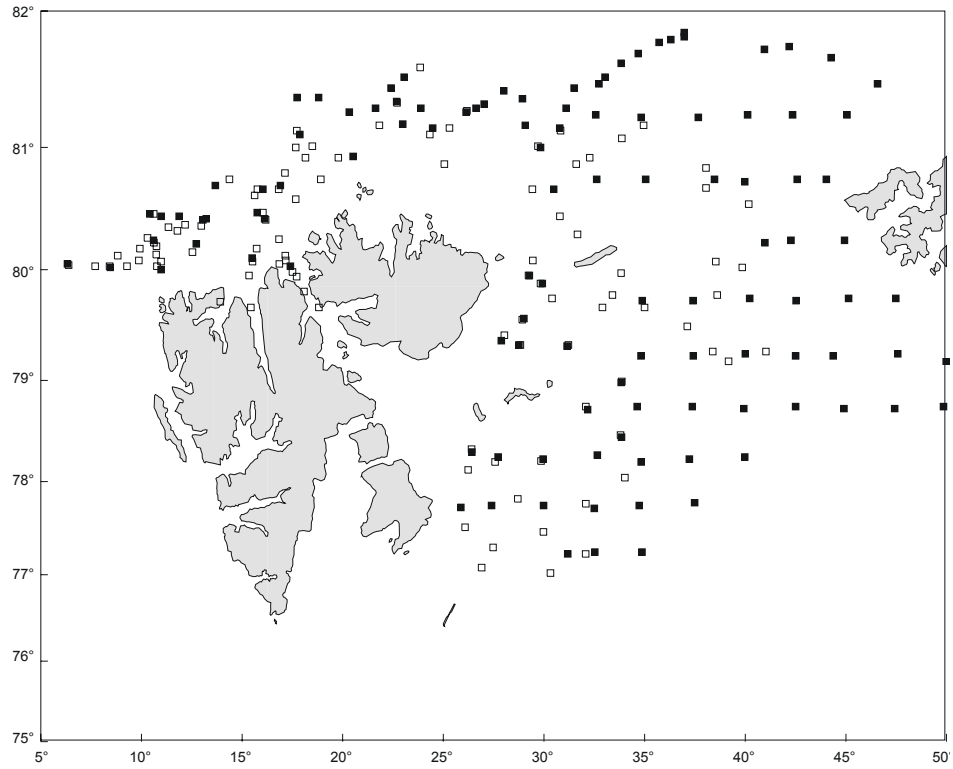


Figure 3.3. Trawl stations in the bottom trawl survey in 2001. Filled symbols are stations carried out by Nerey and open symbols are carried out by Jan Mayen

In 2000 when the vessel "Persey IV" conducted the Russian part of the joint survey, their coverage was mainly in the Russian EEZ, only a few stations were carried out in the other areas (Tab. 3.3, Fig. 3.2). In 2001 the vessels had better coverage of the total area, however, the vessels involved slightly different areas with Russian responsibility most pronounced in the northern and eastern parts (Fig. 3.3).

Table 3.2. Vessel and time period for each Norwegian survey and the number of approved trawl hauls (used in the estimates) for each stratum and year

Vessel	Time period	Number of hauls in each sub area and stratum																		
		A			B			C			D			E			F		G	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Ftr Hopen	23/8-17/9-96	4	2	4	8	4	1	2		4	9	6					7	3		2		
Mtr Tromsland	27/8-13/9-97	5	3	7	11	8		4	1	3	4	3					13	11		9		
Mtr Comet	31/8-19/9-98	5	4	8	12	9	1	4	1	1	12	3		8	4		18	7		9		
Mtr Comet	31/8-15/9-99	6	5	5	10	9		4	4	1	9	2		6	4		13	7		9		
RV Jan Mayen	28/8-17/9-00	4	3		11	10		4	1	1	4						10	8		9		
RV Jan Mayen	28/8-15/9-01	3	7	8	12	10		3	1	1	10	3		6	4		11	9		8		

Table 3.3. Vessel and time period for each Russian survey and the number of approved trawl hauls (used in the estimates) for each stratum and year

Vessel	Time period	Number of hauls in each sub area and stratum																		
		A			B			C			D			E			F		G	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
RV Persey IV	2/9-14/9 -00	1			1									10	10	2	3			6		
RV Nerey	1/9-24/9 -01	2	3	5	3	3		4	3	5	8	4	6	12	16	3	9	8		8		

HYDROGRAPHY

Measurements of temperature and salinity were recorded for the whole water column on all fixed stations on the Norwegian vessel. Figures 4.1 and 4.2 shows the temperature distributions close to surface and at bottom in 2001.

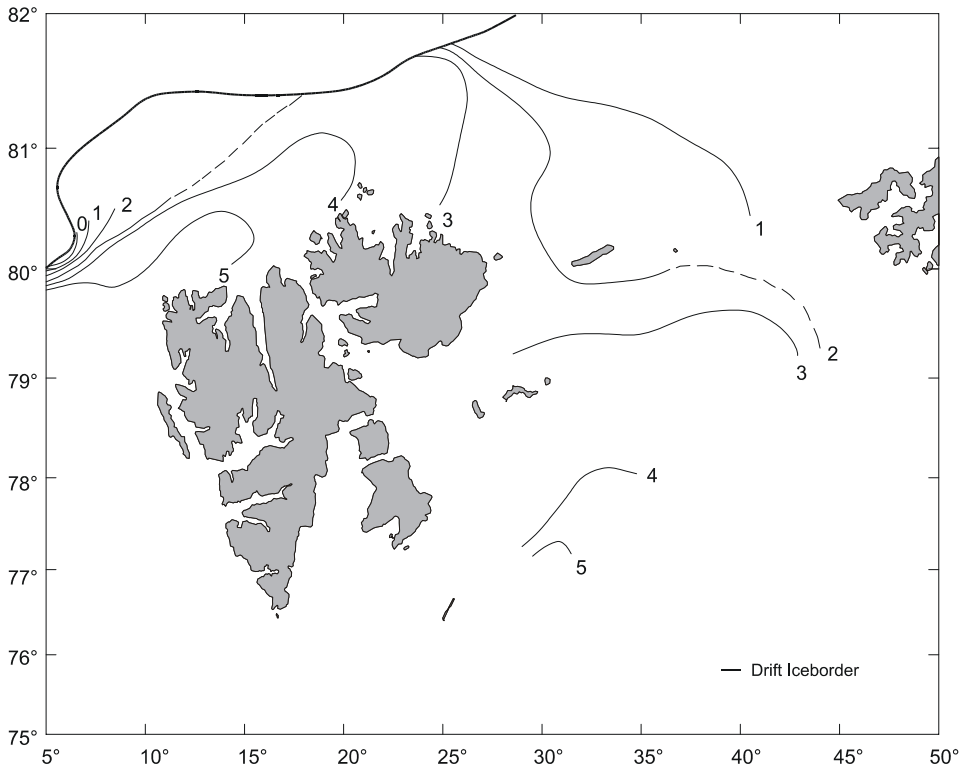


Figure 4.1. Temperature distribution at 5 m below surface in August-September 2001

The drift ice border was far to the north and east in comparison with earlier years, which resulted in good survey coverage and no problems in executing the planned stations. The bottom temperature was slightly higher in most of the sub areas in 2001 than in the previous years (Table 4.1), and the 1°C isotherm at surface extended as far east as to the waters of Franz Josef Land (Fig. 4.1).

The bottom temperature showed similar trend, but the cold, below zero water, followed the bottom topography and extended into the deeper channels southwards into Hinlopen and between Spitsbergen and Kvitøya (Fig. 4.2). In the eastern part the 1°C isotherm also at bottom extended to the waters around Franz Josef Land.

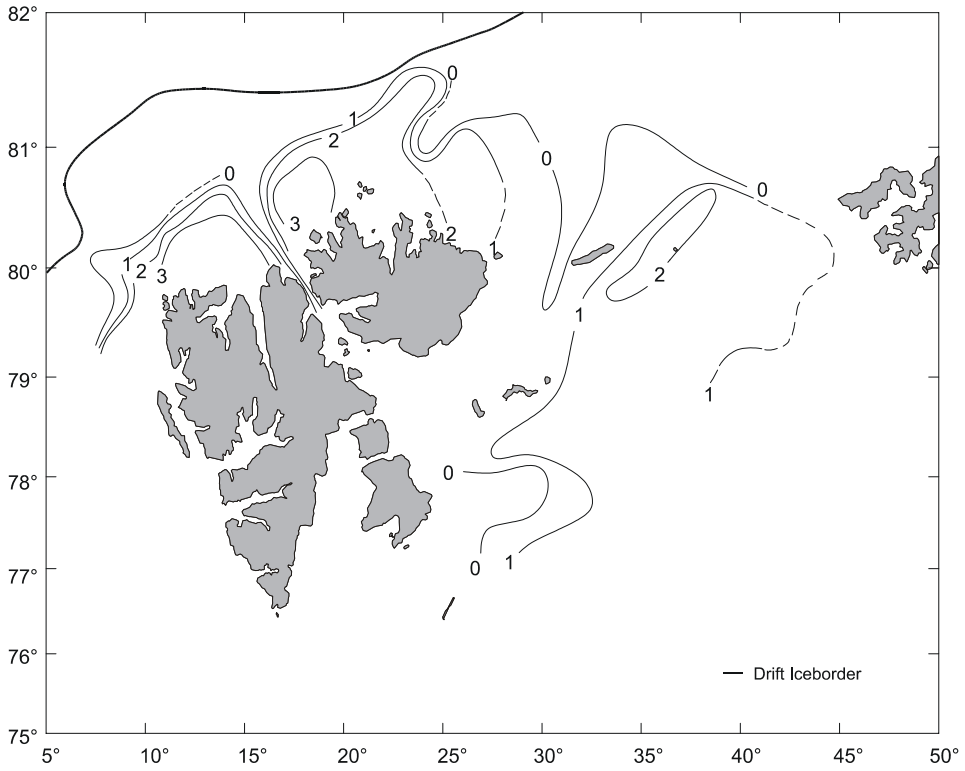


Figure 4.2. Temperature distribution at bottom in August-September 2001

Table 4.1 Mean bottom temperature (°C) in different sub areas in the period 1997-2001. Values are calculated based on mean values in strata (1-3) from Norwegian vessels where measurements are done each year

	A	B	C	D	E	F	G
1997	1.74	2.06	0.02	0.53	-	1.02	0.14
1998	1.67	1.96	-	0.32	0.65	0.70	-0.29
1999	1.38	2.62	1.58	0.55	0.27	0.24	-0.09
2000	2.65	2.09	1.84	0.33	-	0.76	0.17
2001	1.79	2.46	2.21	0.55	1.33	0.93	0.30

DISTRIBUTION AND ABUNDANCE OF GREENLAND HALIBUT

1.3 Swept area

The geographic distribution based on bottom trawl catch rates (number of fish per 3 nautical miles, corresponding to 1 hour towing) of Greenland halibut for 2000 and 2001 are shown in Figures 5.1 – 5.4. Greenland halibut showed mainly the same distribution in both years, more or less linked with the 1°C isotherm, but also well into subzero water in the north-eastern area. The smallest fish (< 15 cm) seemed to have a more northerly distribution than larger fish.

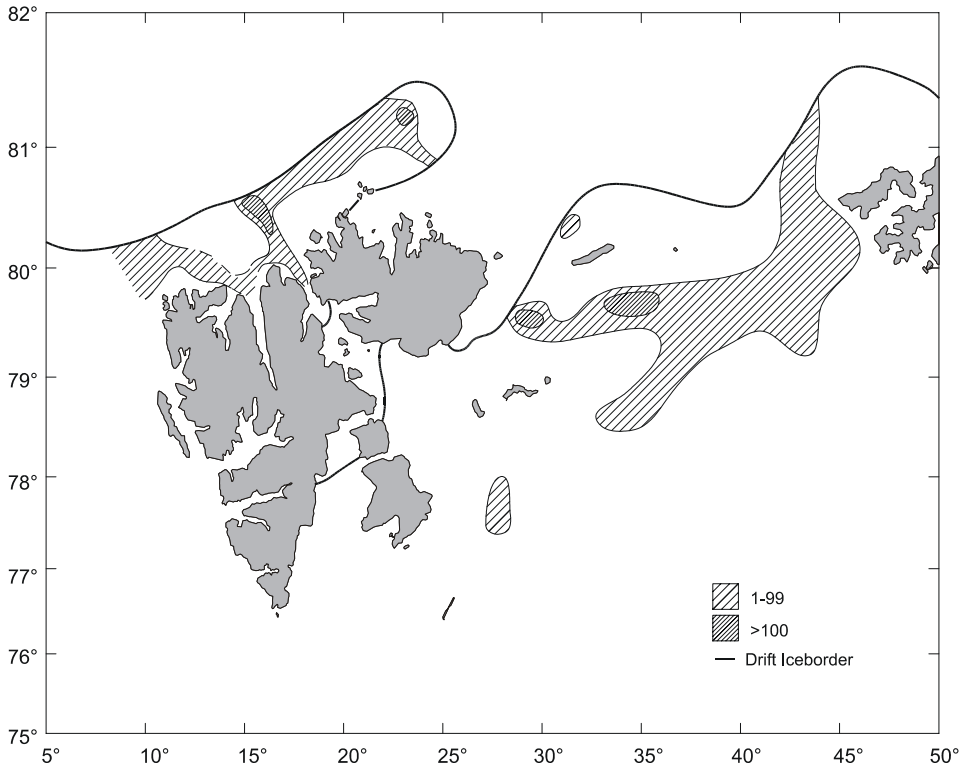


Figure 5.1. GREENLAND HALIBUT < 15 CM. Distribution in trawl catches in August – September 2000 (number per hour trawling)

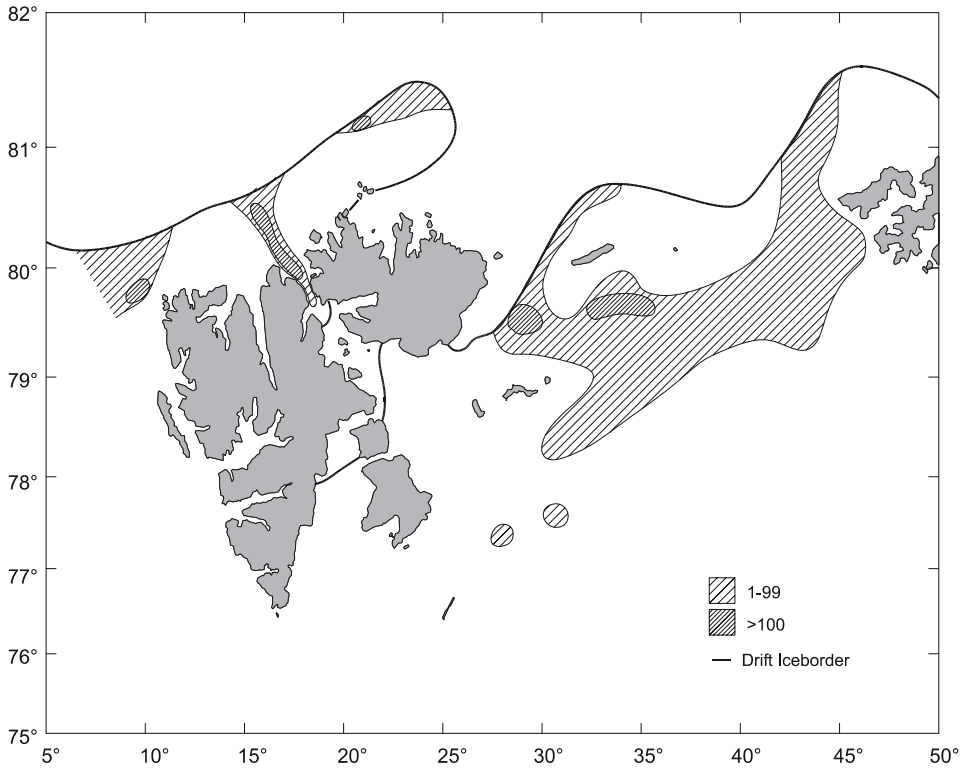
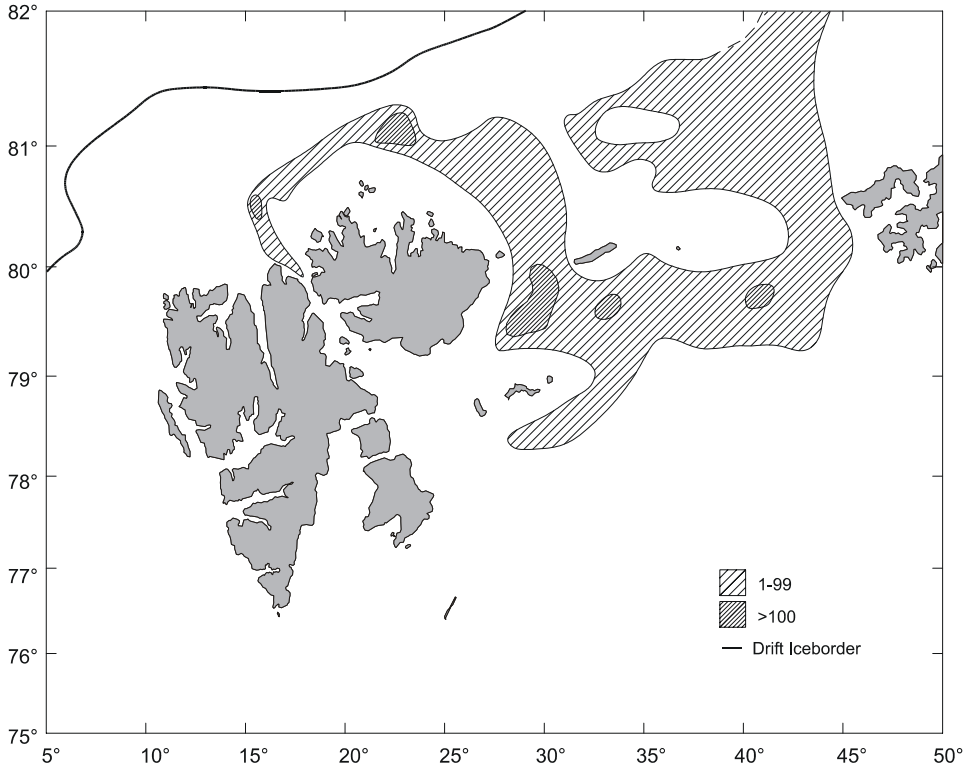


Figure 5.2. GREENLAND HALIBUT > 15 CM. Distribution in trawl catches in August – September 2000 (number per hour trawling)



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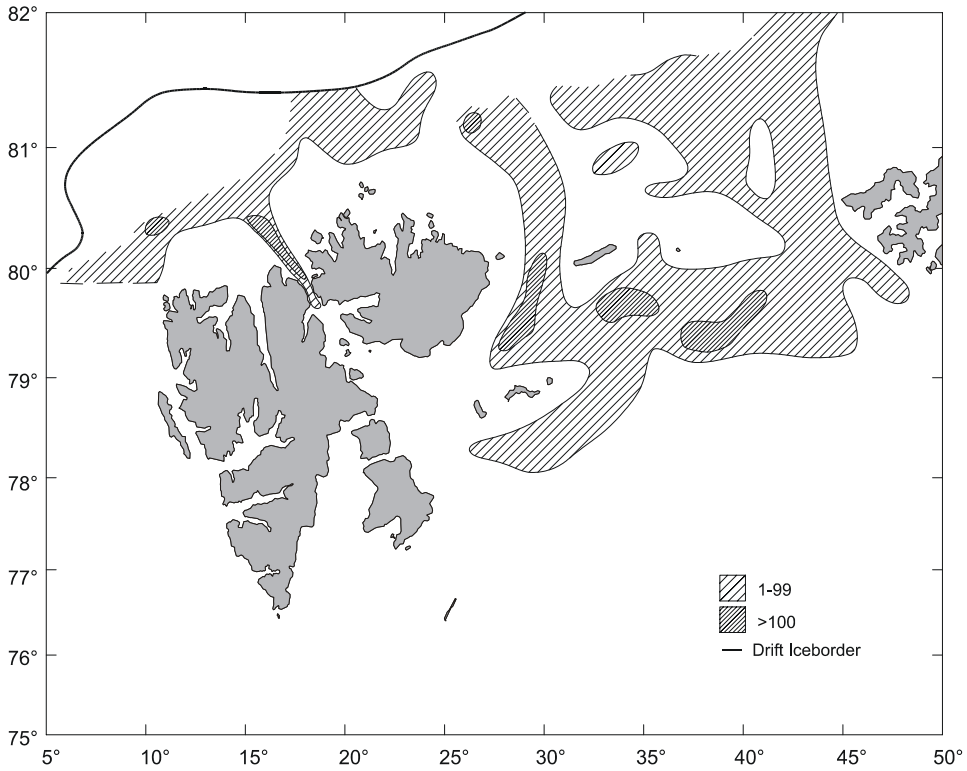

Figure 5.4. GREENLAND HALIBUT > 15 CM. Distribution in trawl catches in August – September 2001 (number per hour trawling)

Table 5.1 presents the abundance indices by length for each sub area. Standard error and coefficient of variation (CV) are also given. For the size groups between 10 and 50 cm the CVs are less than 30 %. Table 5.2 shows the abundance indices by age- and length groups, and Table 5.3 presents the indices for each age group by sub areas. Fish smaller than 25 cm dominated the estimates and the highest abundance were observed in sub area F and E.

Time series (1996 – 2001) is presented in Table 5.4. The indices are very variable throughout the time series due to differences in area coverage and changes in survey operation. From 1996 to 1999 the survey was conducted by one Norwegian vessel only, and in the years 1996 and 1997 there were also no coverage in the Russian EEZ (Sub area E).

However, the total indices in 2001 are the second highest in the time series, with the highest recorded estimate of 1-group fish and the second highest estimate of 2-group fish. Also in 2000 the estimate of 1-group was high, the second highest in the time series.

Table 5.1 GREENLAND HALIBUT. Abundance indices (I) at length with standard error of the mean (S) from bottom trawl hauls for main areas north and east of Spitsbergen in August-September 2001 (numbers in thousands). Area G removed from the table since no Greenland halibut were caught in this area

Length (cm)	Area												Total		
	A		B		C		D		E		F				
	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV(%)
5 - 9			24	19			20	16	69	41	30	26	143	54	38.1
10 - 14	17	17	216	140	2 592	1 539	937	429	3 736	1 435	3 862	1 515	11 359	2 632	23.2
15 - 19			42	25	1 043	784	1 063	400	3 758	1 093	6 208	2 143	12 115	2 562	21.1
20 - 24			90	39	572	376	750	248	8 411	3 323	8 816	3 522	18 639	4 863	26.1
25 - 29	67	36	158	61	193	67	516	146	2 658	967	1 589	452	5 179	1 081	20.9
30 - 34	89	54	191	53	344	192	551	167	1 515	494	1 123	257	3 813	617	16.2
35 - 39	187	61	122	45	222	139	529	248	603	184	428	112	2 089	364	17.4
40 - 44	199	54	66	27	71	49	236	100	255	89	176	65	1 003	168	16.7
45 - 49	150	50	11	4	83	47	31	17	92	47	30	26	395	89	22.4
50 - 54	85	39	0		12	12							97	41	42.3
55 - 59	91	55	1	1	48	30							140	62	44.4
60 - 64	50	26			12	12							62	29	46.7
65 - 69					12	12							12	12	100
70 - 74															
75 - 79															
80 - 84	25	25											25	25	100
>85															
Sum	958		920		5 204		4 632		21 096		22 259		55 069		

Table 5.2 GREENLAND HALIBUT. Abundance indices at length and age from bottom trawl survey north and east of Spitsbergen in August-September 2001 (numbers in thousands)

Length (cm)	Age (year-class)						Sum
	1 (00)	2 (99)	3 (98)	4 (97)	5 (96)	6+	
5 - 9	143						143
10 - 14	11 359						11 359
15 - 19	11 988	127					12 115
20 - 24	1 129	17 504	6				18 639
25 - 29		1 654	3 525				5 179
30 - 34			1 894	1 919			3 813
35 - 39			19	1 459	612		2 090
40 - 44				120	824	60	1 004
45 - 49					4	391	395
50 - 54						96	96
55 - 59						140	140
60 - 64						62	62
65 - 69						12	12
70 - 74						+	0
75 - 79						+	0
80 - 84						25	25
>85							0
Sum	24 619	19 285	5 444	3 498	1 440	786	55 072

Table 5.3 GREENLAND HALIBUT. Abundance indices from bottom trawl hauls for main areas north and east of Spitsbergen in August-September 2001 (numbers in thousands). n = number of valid hauls in each sub area

Sub area	Age (year-class)						Total	n
	1 (00)	2 (99)	3 (98)	4 (97)	5 (96)	6+		
A	0	17	69	213	204	455	958	28
B	294	84	278	182	74	8	920	28
C	3 635	620	489	231	60	170	5 205	17
D	1 893	948	689	571	500	31	4 632	31
E	7 563	9 700	1 864	1 605	273	92	21 097	41
F	11 218	7 933	2 055	695	329	30	22 260	37
G	0	0	0	0	0	0	0	16
Total	24 603	19 302	5 444	3 497	1 440	786	55 072	198

Table 5.4 GREENLAND HALIBUT. Abundance indices from bottom trawl surveys north and east of Spitsbergen in August-September 1996-2001 (numbers in thousands). Indices in 1996-1999 based on Norwegian surveys only

Year	Age						Total
	1	2	3	4	5	6+	
1996*	15 655	14 510	10 025	3 487	1 593	3 349	48 619
1997*	3 415	15 271	14 140	2 803	403	434	36 466
1998	10 210	28 020	17 186	6 380	1 551	932	64 279
1999	7 514	16 159	8 045	3 067	2 401	954	38 140
2000	17 087	10 320	7 460	5 855	1 629	476	42 827
2001	24 603	19 302	5 444	3 497	1 440	786	55 072

*No coverage in Russian EEZ.

1.4 Growth

Table 5.5 presents the time series for mean length (A) and mean weight (B) by age for the entire investigated area. The mean length is in accordance with previous years. Both mean length and mean weight of the Greenland halibut has been relatively stable throughout the time period the survey has been carried out, but in 1997 all age groups with exception of 1-group had somewhat elevated mean values in comparison with the other years. There is no clear explanation for this.

Table 5.5. GREENLAND HALIBUT. Mean length (A) and mean weight (B) of Greenland halibut, all areas and strata pooled. Standard deviation of length in brackets.

A	Age							
	1	2	3	4	5	6	7	N
1996	14.7 (1.80)	22.3 (1.96)	27.3 (2.48)	34.6 (1.90)	41.6 (3.16)	47.1 (2.27)	50.6 (2.26)	300
1997	13.0 (1.34)	23.9 (2.81)	32.9 (3.25)	39.6 (2.68)	45.7 (3.39)	51.4 (2.24)	54.0 (-)	376
1998	14.7 (0.65)	21.3 (1.78)	30.7 (2.42)	36.5 (2.62)	42.3 (2.07)	47.8 (2.25)	52.6 (2.28)	366
1999	13.9 (1.53)	22.3 (1.90)	28.9 (2.36)	36.1 (2.74)	40.1 (3.32)	46.0 (1.48)	50.5 (4.42)	491
2000	15.6 (2.59)*	23.2 (1.36)	29.2 (2.20)	34.5 (2.87)	42.2 (2.40)	46.8 (1.80)	53.9 (0.38)	615
2001	15.6 (2.59)	22.6 (1.51)	28.5 (2.06)	34.1 (2.79)	40.2 (2.10)	45.7 (2.14)	52.7 (1.88)	564
B	Age							
	1	2	3	4	5	6	7	N
1996	24	91	183	386	684	946	1 239	300
1997	18	113	305	581	935	1 142	1 480	376
1998	18	71	243	431	692	973	1 348	366
1999	49	88	208	458	585	891	1 336	491
2000	28*	94	201	346	690	943	1 582	615
2001	28	92	199	369	631	841	1 330	564

*No samples of 1-group in 2000, used mean length and mean weight as in 2001.

The annual growth increment is shown in Table 5.6 and for all the age groups in the surveys the annual growth has been low from 1997 – 1998. This is probably an effect of the odd elevation of mean lengths and mean weights in 1997. From 1999 – 2000 the growth for the youngest age groups has been the lowest in the period, but the older age groups seem not to be affected of the reduced growth in this period. The growth between 2000 and 2001 was higher than the year before, but the II-group in 2000 showed the same reduced growth as the year before.

Table 5.6. GREENLAND HALIBUT. Annual growth increment (g) from the surveys north and east of Spitsbergen in the period 1996–2001

Year	Age				
	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6
1996 – 1997	89	214	398	549	458
1997 – 1998	53	130	126	111	38
1998 – 1999	70	137	215	154	199
1999 – 2000	45	113	138	232	358
2000 – 2001	64	105	168	285	151

1.5 Considerations and conclusions

When using the abundance indices for stock assessment it is important to be aware of all the technical changes introduced during the time series. The Norwegian survey, which was started in 1996, has undergone changes during the whole period with respect to area coverage and also in using different vessels. After 2000 when this survey became a joint survey between Russian

and Norwegian vessels and the area coverage again changed. The survey area was extended further to the east and the area around Franz Josef Land was included in the geographical coverage. The analyses are also influenced by using data from two different vessels combined into one estimate. The between vessel factors was looked into in chapter 9, and for future use of this time series it is probably most correct to only use data after 2000.

It is important to have in mind the catchability of the smallest length groups of Greenland halibut when looking at the abundance estimates. There are no investigations known to the authors, which have looked in detail into length dependent catchability of Greenland halibut, but recent analyses using video in the opening of Campelen trawl indicates that the smallest individuals easily is overrun by the rockhopper ground gear (Høines, according to unpublished data from experiments done in August 2002). This implies that the smallest length groups and then the youngest fish is underrepresented in the catches. This is probably most pronounced for 1-group fish, i.e. fish smaller than 10-15 cm.

DISTRIBUTION AND ABUNDANCE OF COD

1.6 Swept area

The geographic distribution based on bottom trawl catch rates (number of fish per 3 nautical miles, corresponding to 1 hour towing) of cod for 2000 and 2001 are shown in Figures 6.1 – 6.4. The survey area is in the outer boundary of the natural distribution for cod and the figures reflect this. There are a few pockets where cod are distributed and this is in the warmer water (>1^{o}C) to the north of Spitsbergen else cod is distributed in the southernmost parts of the survey area (sub-area G and F).

Cod smaller than 20 cm showed equal distribution as larger cod north of Spitsbergen, but was not distributed to the north in the same extent as the larger fish in the eastern part of the survey area. The results both from 2000 and 2001 showed the same general trend in geographical distribution of cod in the Spitsbergen area.

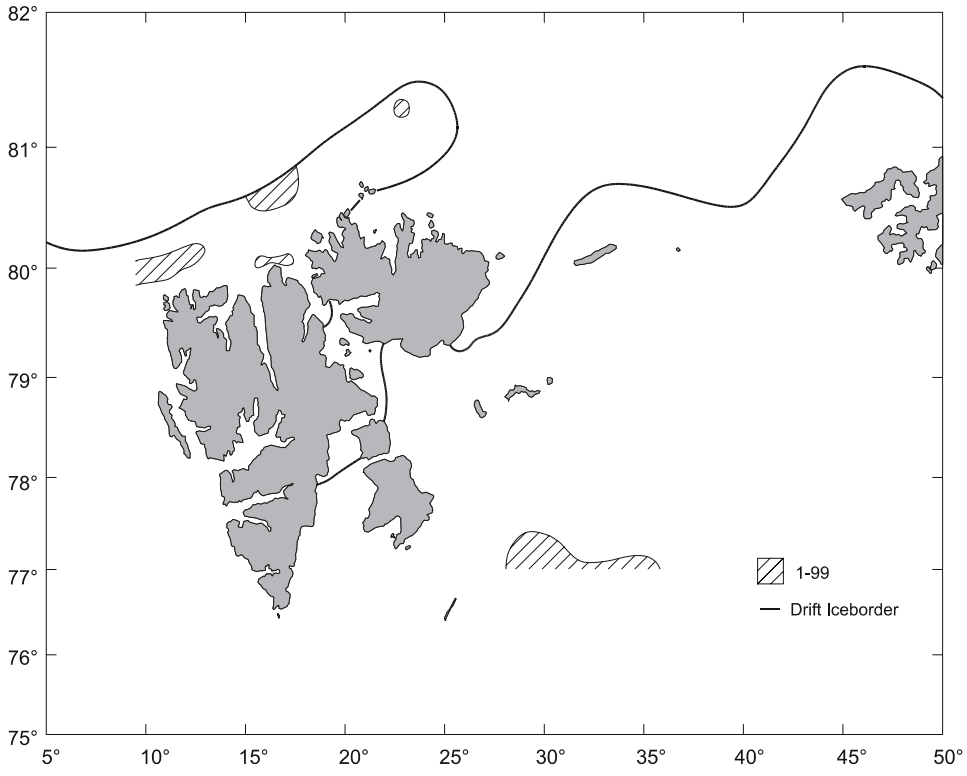

Figure 6.1. COD < 20 CM. Distribution in trawl catches in August – September 2000 (number per hour trawling)

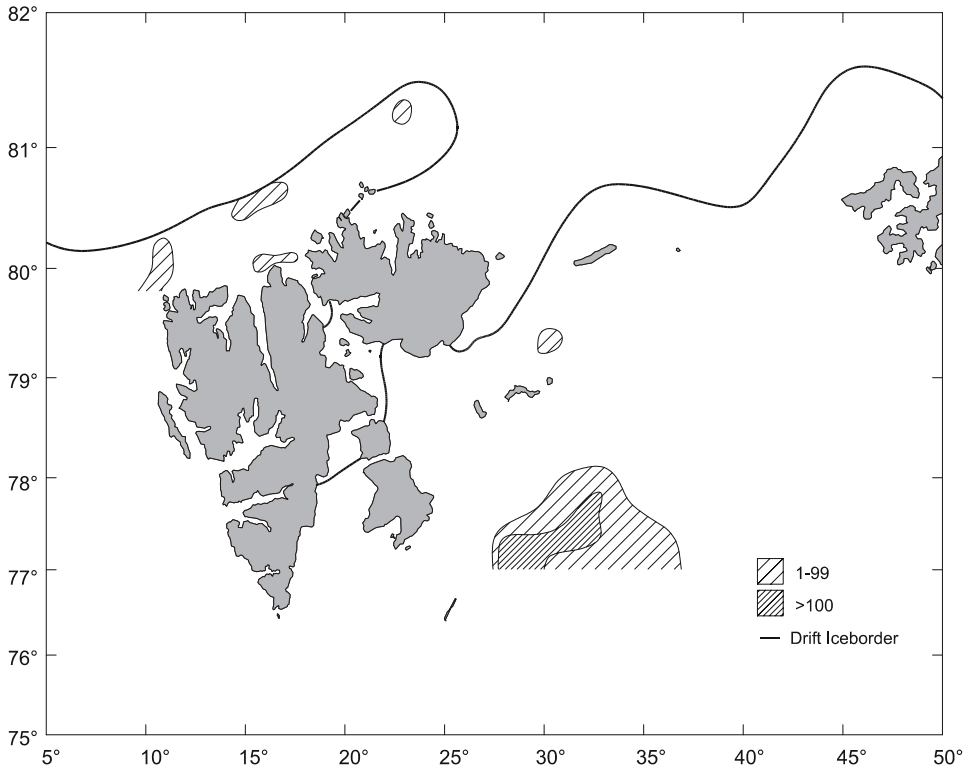

Figure 6.2. COD > 20 CM. Distribution in trawl catches in August – September 2000 (number per hour trawling)

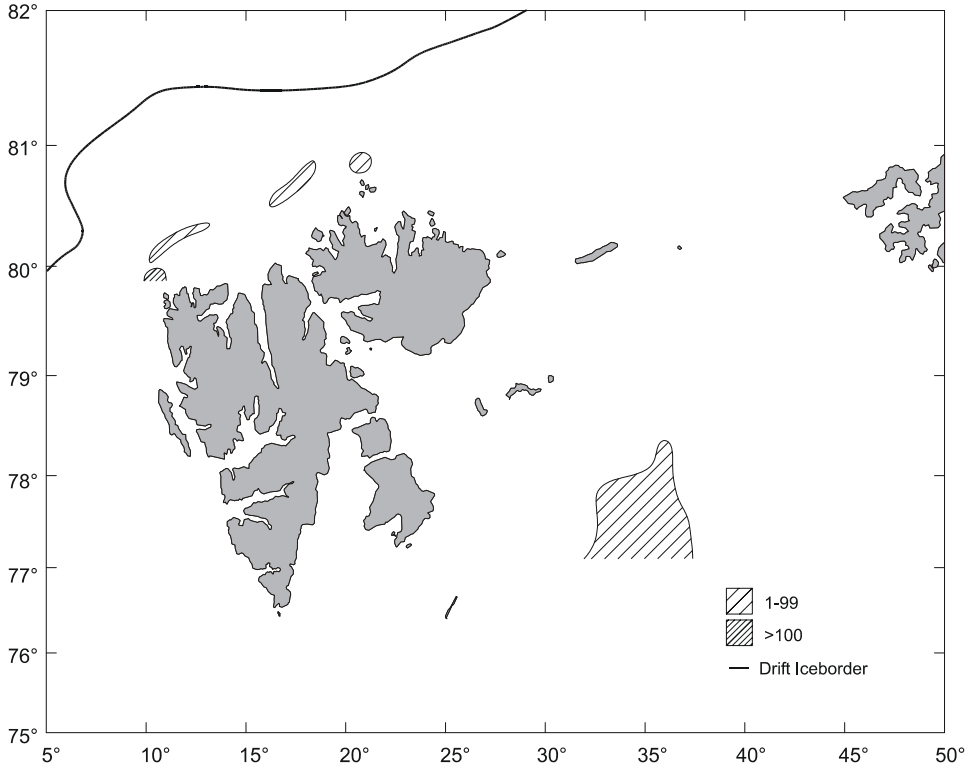

Figure 6.3. COD < 20 CM. Distribution in trawl catches in August – September 2001 (number per hour trawling)

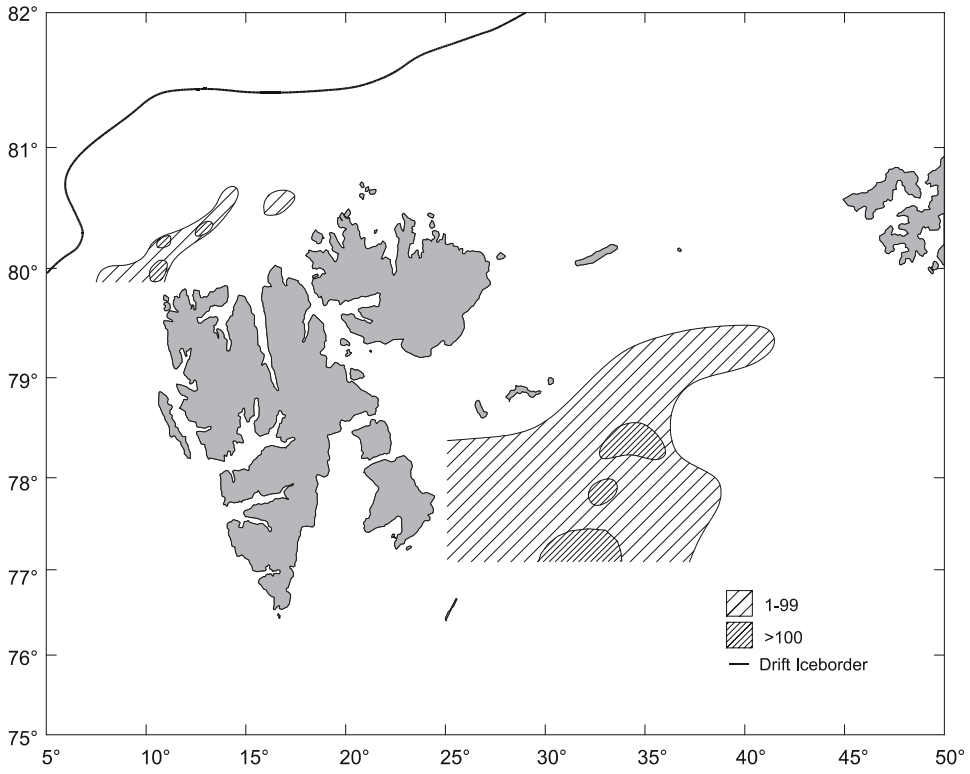

Figure 6.4. COD > 20 CM. Distribution in trawl catches in August – September 2001 (number per hour trawling)

Table 6.1 COD. Abundance indices (I) at length with standard error of the mean (S) from bottom trawl hauls for main areas north and east of Spitsbergen in August-September 2001 (numbers in thousands)

	Area														Total		
	A		B		C		D		E		F		G				
Length (cm)	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV(%)
5 - 9															0		
10 - 14			12	6							33	33	90	65	135	74	54.4
15 - 19	45	42	23	17	8	8					157	157	640	353	873	389	44.5
20 - 24	585	377	10	7							88	48	259	125	942	400	42.4
25 - 29	785	356	5	3							27	27	345	166	1 161	394	33.9
30 - 34	98	45									314	264	1 014	535	1 427	599	42.0
35 - 39	36	17									779	422	1 080	479	1 895	638	33.7
40 - 44	5	2									720	403	644	230	1 369	464	33.9
45 - 49	1	1							25	25	744	331	739	235	1 509	407	27.0
50 - 54	21	20									969	371	1 102	404	2 093	549	26.2
55 - 59									72	53	1 241	530	1 080	428	2 393	683	28.5
60 - 64	1	1							64	38	865	393	690	252	1 620	469	28.9
65 - 69									109	48	903	362	740	292	1 751	468	26.7
70 - 74	3	2							27	27	582	197	722	252	1 333	321	24.1
75 - 79	1	1							27	27	170	63	286	89	483	112	23.2
80 - 84											24	19	127	57	151	60	40.0
85 – 89											58	29	15	15	73	33	44.7
90 - 94													47	34	47	34	71.8
>95											3	3			3	3	100.0
Sum	1580		50		8		0		322		7 678		9 621		19 259		

Table 6.2 COD. Abundance indices from bottom trawl surveys north and east of Spitsbergen in August-September 1996 - 2001 (numbers in thousands)

	Length group (cm)																			
Year	5-9	10-14	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	80-84	85-89	90-94	>95	Total
1996*	1 490	3 002	35 732	6 927	2 107	2 386	2 525	1 257	274	6	0	0	1 300	520	781	0	130	0	0	58 437
1997*	51	517	2 673	3 344	2 751	527	219	429	89	60	0	88	87	116	60	116	0	29	0	11 156
1998	36	1 099	722	516	391	215	167	211	132	22	117	131	109	168	133	106	17	0	0	4 291
1999	6	353	2 324	2 288	3 685	3 732	2 281	1 397	1 478	1 995	1 395	860	685	442	490	304	151	114	42	24 022
2000	103	78	600	443	1 801	2 078	2 780	1 555	948	1 146	2 184	2 337	1 110	849	392	229	82	33	0	18 747
2001	0	135	873	942	1 161	1 427	1 895	1 369	1 509	2 093	2 393	1 620	1 751	1 333	483	151	73	47	3	19 259

*No coverage in Russian EEZ.

Table 6.1 presents the abundance indices by length in 2001, for each sub area with standard error in addition to the coefficient of variation for the total. The CV's were relatively high for most of the length groups and only the estimate for fish in length group 45-79 cm showed a CV less than 30 %. The length groups 50-59 cm were most abundant, but they were not much richer than the other. None of the length groups contributed more than 13% of the total estimate.

Time series (1996-2001) is presented in Table 6.2. The highest index was estimated in 1996 when the length group 15-19 cm contributed with 61% of the total estimate. The lowest estimate in the time series was in 1998 with only 4 mill individuals and this is also the year with the lowest observed mean bottom temperature in sub area G (Table 4.1). Since 1999 the total estimate has fluctuated around 20 mill individuals with relatively low numbers of fish smaller than 25 cm.

1.7 Considerations and conclusions

The cod estimate is very dependent of the bottom temperature conditions in this area, and since the polar front is variable from year to year in the survey area it is expected that also this will influence the total estimate. If the polar front extends far south the distribution of cod will be limited in the survey area and the estimate will be reduced. Variation in the cod estimate will then not necessarily reflect variation in cod abundance, but variation in suitable living conditions for cod. It is not possible to make conclusions about stock status on cod based on this survey alone, but the results are important as supplement to other investigations done every year for mapping the cod stock.

DISTRIBUTION AND ABUNDANCE OF REDFISH

1.8 Swept area

1.8.1 Sebastes marinus

Figures 7.1 and 7.2 show the horizontal distribution of *Sebastes marinus* during the swept area investigations in 2000 and 2001. The general picture was that the abundance of *S. marinus* was very low in the survey area in both years and the distribution was also very limited. Only small pockets with low catches were registered in the area, mainly to the north of Spitsbergen and a few catches to the east in 2001 linked to the warmer water (not below 1°C).

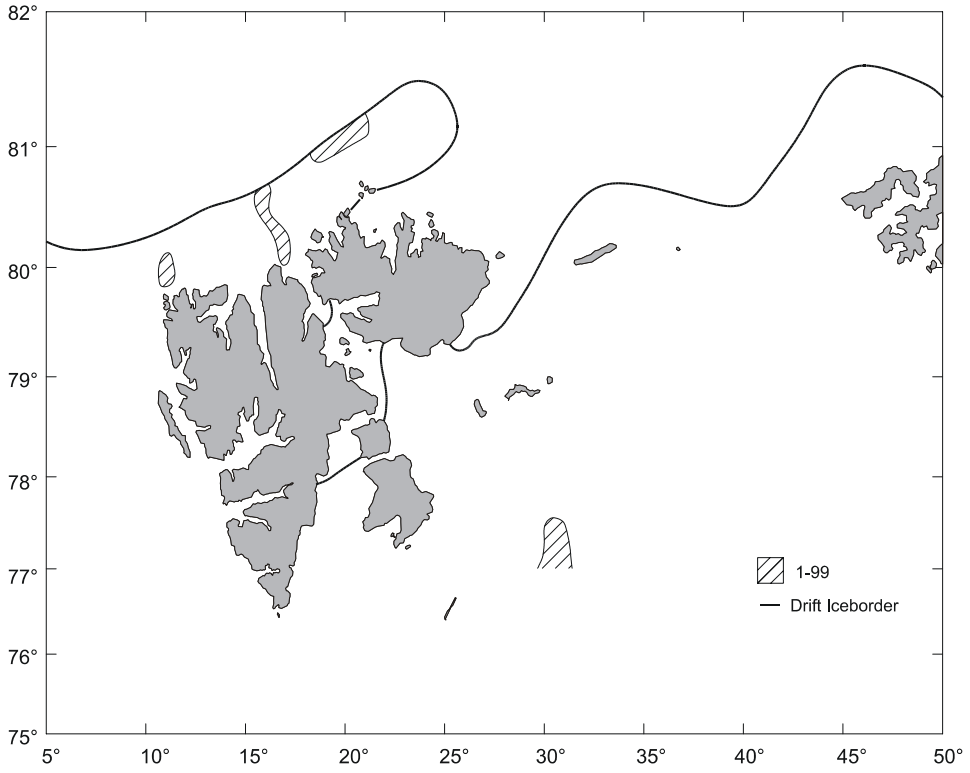

Figure 7.1. ***SEBASTES MARINUS*. Distribution in trawl catches in August – September 2000 (number per hour trawling)**

Table 7.1 presents the abundance indices by length in 2001, for each sub area with standard error in addition to the coefficient of variation for the total. The CV's were high for all the length groups and only the estimate for fish in length group 25-29 cm showed a CV less than 50 %. In 2001 this was the most abundant length group in the catches with an estimate of 1/3 of the total estimate.

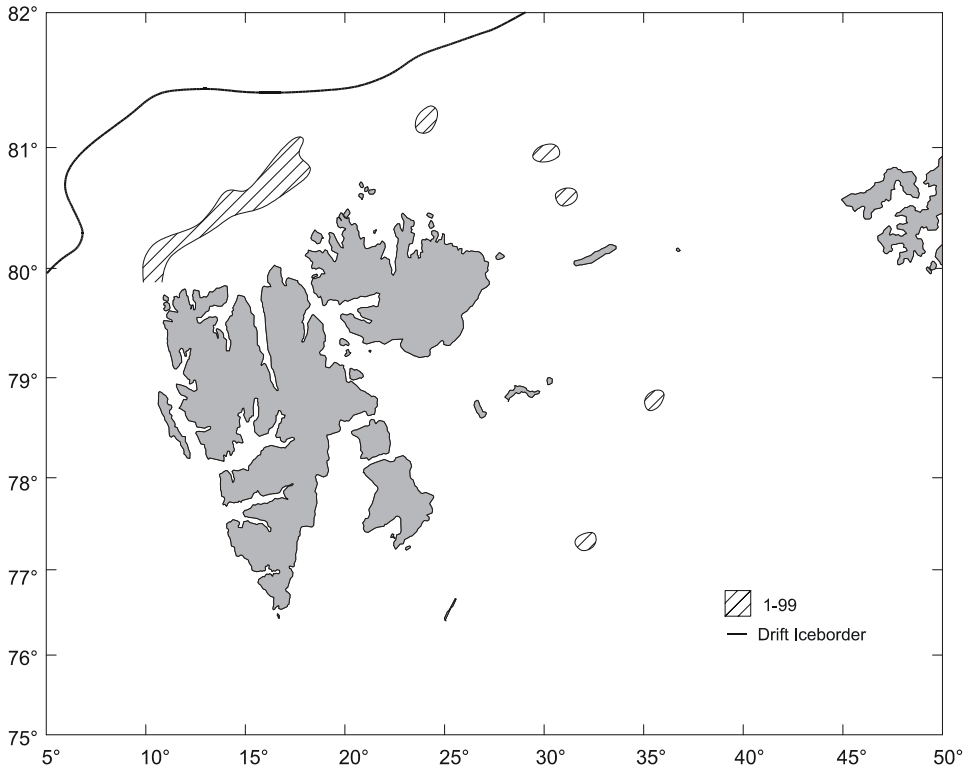

Figure 7.2. ***SEBASTES MARINUS*. Distribution in trawl catches in August – September 2001 (number per hour trawling)**

Time series (1997-2001) is presented in Table 7.2. In 1996 the redfish was not separated in the two species and the indices for *S. marinus* is included in the result for *S. mentella*. The indices were generally low with exception of 1999 when the length groups between 10 and 19 cm were good represented. In 2000 and 2001 these length groups were again very low or absent from the survey area. It is important to notify that the estimate for 1999 is not due to one or two very rich catches, but it is caused by several moderate catches. Since 1999 the indices has decreased and in 2001 the estimate was the second lowest observed in the time series.

Table 7.1 ***SEBASTES MARINUS*. Abundance indices (I) at length with standard error of the mean (S) from bottom trawl hauls for main areas north and east of Spitsbergen in August-September 2001 (numbers in thousands)**

	Area														Total		
	A		B		C		D		E		F		G				
Length (cm)	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV(%)
5 - 9																	
10 - 14																	
15 - 19	52	50	1	1											53	50	95.3
20 - 24	13	13	13	7							4	4			30	15	50.1
25 - 29	66	38	12	7	15	12	14	14			4	4			110	43	38.6
30 - 34	25	25	7	4	12	12									44	28	63.8
35 - 39	1	1			24	24							23	23	48	33	68.7
40 - 44	14	13													14	13	90.0
45 - 49																	
50 - 54							15	15							15	15	100.0
55 - 59																	
> 60																	
Sum	170		33		51		29				9		23		314		

Table 7.2 ***SEBASTES MARINUS*. Abundance indices from bottom trawl surveys north and east of Spitsbergen in August-September 1996 – 2001 (numbers in thousands)**

	Length group (cm)												
Year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	> 60	Total
1996*	All redfish determined only to family – included in the chapter of *S. mentella*												
1997*	0	0	54	154	123	0	0	5	0	0	0	0	336
1998	0	0	0	0	5	5	29	0	0	0	0	0	39
1999	26	2 027	4 219	447	72	32	10	15	0	0	0	0	6 848
2000	0	0	4	41	181	179	23	86	0	2	0	0	515
2001	0	0	53	30	110	44	48	14	0	15	0	0	314

*No coverage in Russian EEZ.

1.8.2 Sebastes mentella

Figure 7.3 and 7.4 shows the horizontal distribution of *Sebastes mentella* during the swept area investigations in 2000 and 2001. The general picture was that the abundance of *S. mentellas* was low, but higher than *S. marinus,* and the distribution area extended further to the north and east in comparison with *S. marinus*. The distribution of *S. mentella* is comparable with the distribution of Greenland halibut, however less pronounced into the subzero water. Only a few catches were larger than 100 individuals per trawl hour.

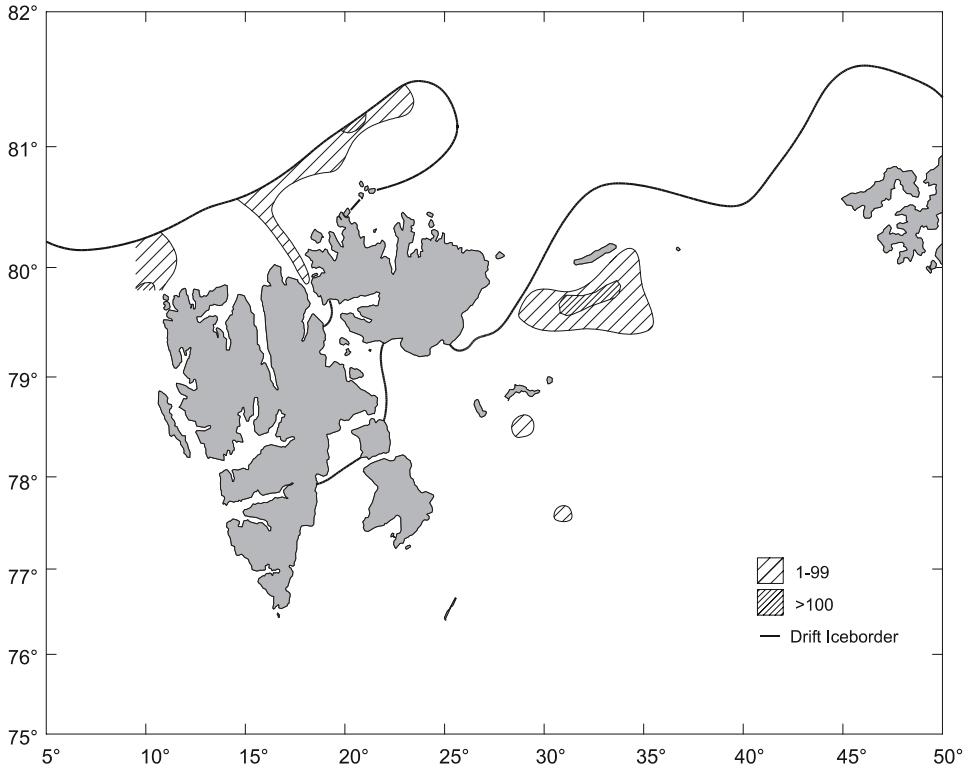

Figure 7.3. *SEBASTES MENTELLA*. Distribution in trawl catches in August – September 2000 (number per hour trawling)

Table 7.3 presents the abundance indices by length in 2001, for each sub area with standard error in addition to the coefficient of variation for the total. The CV's were generally lower than for *S.marinus* and all length groups smaller than 30 cm showed a CV less than 50 %. In 2001 the most abundant length group in the catches was the smallest one, 5-9 cm, which is almost 2/3 of the total estimate.

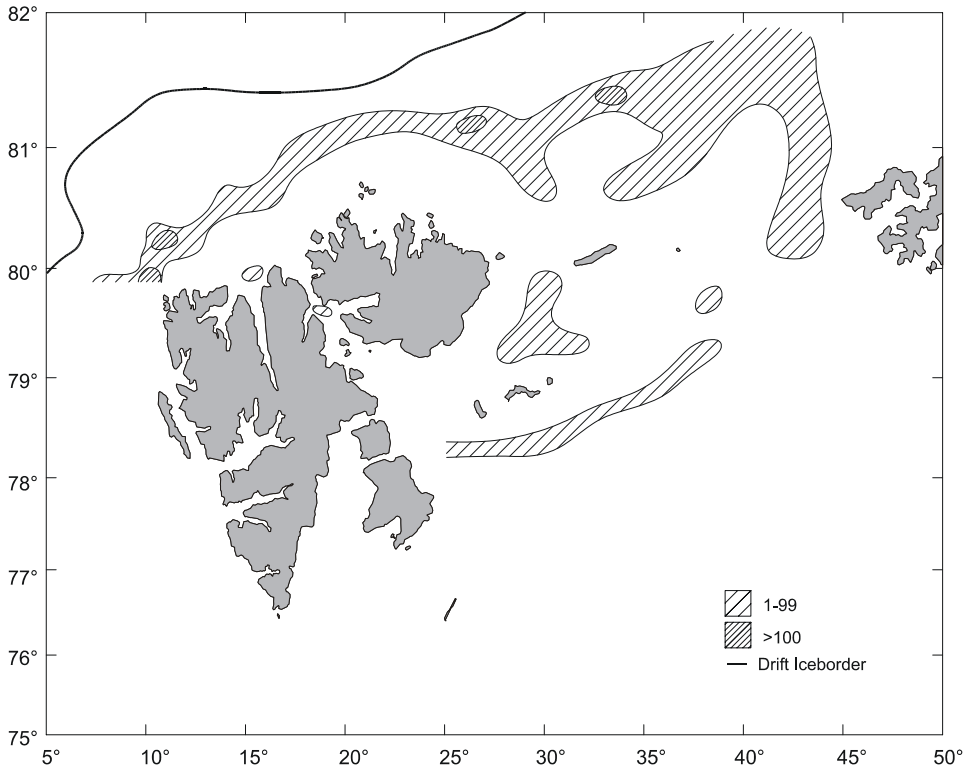

Figure 7.4. ***SEBASTES MENTELLA*. Distribution in trawl catches in August – September 2001 (number per hour trawling)**

Time series (1996-2001) is presented in Table 7.4. In 1996 the redfish was not separated in the two species and the indices for *S. marinus* is included in the result for *S. mentella*. The indices showed a decreasing trend until 1999 with signs of stabilising or even a very weak recovery in 2000 and 2001. As mentioned before the richest length group in 2001 is the smallest one, which indicated a sign of somewhat improved recruitment.

1.9 Considerations and conclusions

Both *S. marinus* and *S. mentella* showed very low abundance and horizontal distribution in the survey area, which is not very surprising taking into account the very low total stock numbers estimated for these species in the North-eastern Atlantic area in later years. Also for these species the survey area is more or less in the border region of their natural distribution, which implies variable abundance estimates.

Table 7.3 ***SEBASTES MENTELLA*. Abundance indices (I) at length with standard error of the mean (S) from bottom trawl hauls for main areas north and east of Spitsbergen in August-September 2001 (numbers in thousands)**

	Area														Total		
	A		B		C		D		E		F		G				
Length (cm)	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV(%)
5 - 9	8	8	548	307	216	216	697	431	4 195	2 212	1 660	1 021			7 325	2 503	34.2
10 - 14	166	98	3	3	134	121	35	24	52	37					390	162	41.6
15 - 19	539	169	47	36	526	328	857	355	77	47	68	36			2 113	517	24.5
20 - 24	398	152	6	4	348	179	551	406	79	36	9	6			1 392	471	33.8
25 - 29	60	43	4	3	45	33	93	70			17	17			220	90	41.0
30 - 34							5	5			4	4			9	7	70.9
35 - 39					71	71	5	5			25	25			102	76	74.7
40 - 44					12	12	5	5							17	13	76.4
45 - 49					12	12					4	4			16	13	78.1
50 - 54																	
55 - 59																	
>60																	
Sum	1 172		609		1 365		2 248		4 402		1 788				11 583		

Table 7.4 ***SEBASTES MENTELLA*. Abundance indices from bottom trawl surveys north and east of Spitsbergen in August-September 1996 - 2001 (numbers in thousands)**

	Length group (cm)												
Year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	> 60	Total
1996*	258 032	76 682	16 267	7 666	368	443	43	23	0	0	0	0	359 523
1997*	13 483	53 681	10 670	7 408	4 216	567	0	0	0	0	0	0	90 025
1998	26	58 210	9 038	2 848	663	101	29	0	29	0	0	0	70 943
1999	0	2 040	3 077	500	37	8	0	0	0	0	0	0	5 662
2000	88	552	6 141	986	145	153	2	0	0	0	2	0	8 068
2001	7 325	390	2 113	1 392	220	9	102	17	16	0	0	0	11 583

*No coverage in Russian EEZ, 1996 also includes *Sebastes marinus.*

DISTRIBUTION AND ABUNDANCE OF LONG ROUGH DAB

1.10 Swept area

Figure 8.1 and 8.2 shows the horizontal distribution of Long rough dab during the swept area investigations in 2000 and 2001. Long rough dab showed the widest distribution of the species included in this report, and were distributed all over the survey area where the bottom temperature was above 0°C. In both years the richest catches were found in the southern part of sub-area G (Hopen) with catch rates of more than 1000 individuals per 3 nautical miles. In general mean catch rate, in areas where Long rough dab was distributed, were between 50 and 100 individuals per 3 nautical miles.

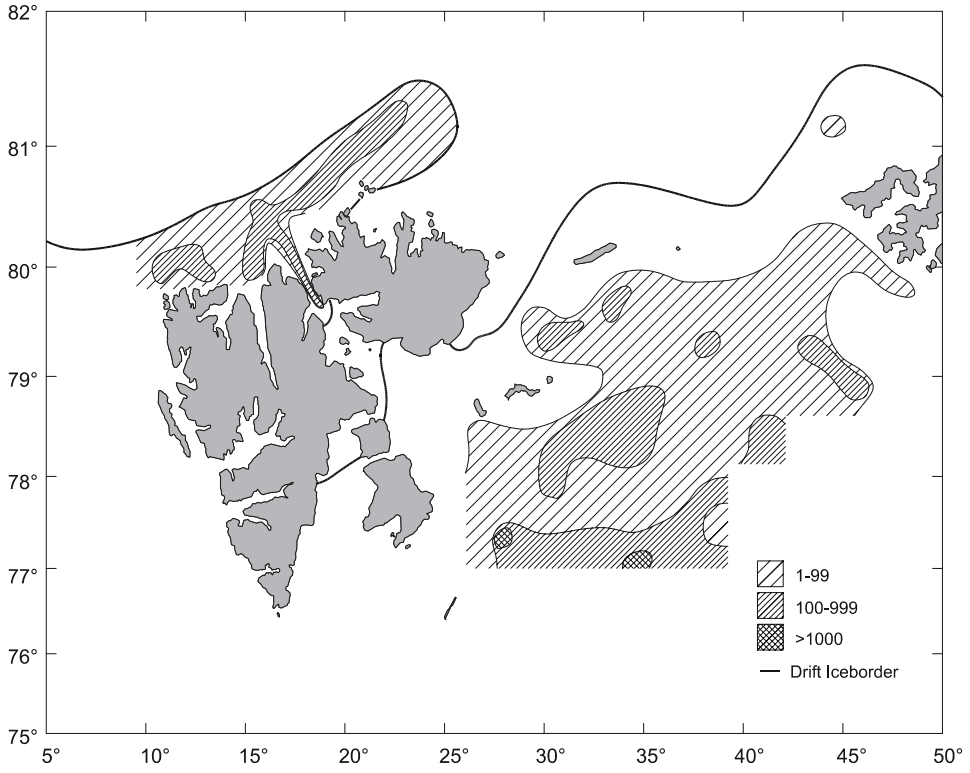

Figure 8.1. LONG ROUGH DAB. Distribution in trawl catches in August – September 2000 (number per hour trawling)

Table 8.1 presents the abundance indices by length in 2001, for each sub area with standard error in addition to the coefficient of variation for the total. For the length groups between 15 and 40 cm the CV's were less than 30%. Long rough dab smaller than 25 cm was most abundant in 2001, with the length group 10-14 cm as most abundant. This length group contributed with ca. 30 % of the total estimate.

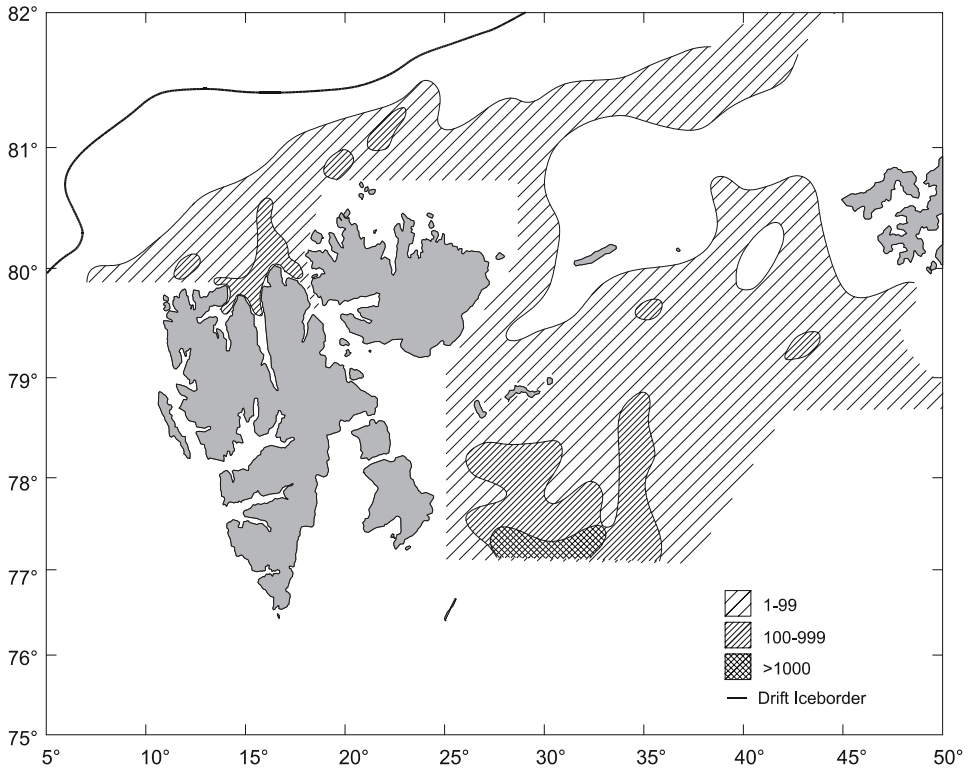

Figure 8.2. LONG ROUGH DAB. Distribution in trawl catches in August – September 2001 (number per hour trawling)

Time series (1996-2001) is presented in Table 8.2. The indices showed a relatively stable situation around 110 mill individuals, but with a low in 1997 and 1998 with values of 75 and 78 mill individuals, respectively, and a high in 2000 when the index was 138 mill individuals. Most of the years the length group 10-14 cm was most abundant, although the length group 15-19 cm dominated the catches in 1996 and 2000. However, in 2000 the three length groups smaller than 20 cm were almost equal in abundance.

1.11 Considerations and conclusions

The distribution of long rough dab covered more or less the whole survey area and this species was only absent from the areas with the coldest bottom water. This is reflected in the abundance estimates showing total values with smaller variability from year to year than the other species included in this report. However, the highest catch rates were found in the warmer water in the southern part where slight changes in the bottom temperature probably can force the higher concentrations of long rough dab out of the survey area. Consequently, it is important to see this abundance index in comparison with other surveys in the Barents Sea to make conclusions about the stock status of long rough dab.

Table 8.1 LONG ROUGH DAB. Abundance indices (I) at length with standard error of the mean (S) from bottom trawl hauls for main areas north and east of Spitsbergen in August-September 2001 (numbers in thousands)

	Area																
	A		B		C		D		E		F		G		Total		
Length (cm)	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S	CV(%)
5 - 9	150	146	761	307	93	61	156	72	71	42	1 933	1 152	13 687	6 736	16 850	6 843	40.6
10 - 14	426	332	1 400	472	648	337	297	127	936	422	7 624	3 214	21 527	10 459	32 857	10 971	33.4
15 - 19	462	191	560	205	20	20	180	98	1 303	799	5 393	2 109	8 578	3 361	16 496	4 059	24.6
20 - 24	196	80	432	133	657	338	177	58	1 626	634	7 622	2 237	15 402	6 631	26 113	7 037	26.9
25 - 29	288	91	174	46	756	273	373	93	916	307	3 303	908	2 934	1 335	8 744	1 672	19.1
30 - 34	164	62	172	57	502	237	334	74	532	166	1 514	499	844	383	4 061	701	17.3
35 - 39	49	28	34	16	66	41	128	58	114	40	483	210	2 776	959	3 648	986	27.0
40 - 44	2	2	2	2					20	20	83	45	1 072	743	1 179	745	63.2
45 - 49													106	106	106	106	100.0
50 - 54																	
55 - 59																	
>60																	
Sum	1 736		3 534		2 742		1 644		5 518		27 955		66 926		110 054		

Table 8.2 LONG ROUGH DAB. Abundance indices from bottom trawl surveys north and east of Spitsbergen in August-September 1996 - 20010 (numbers in thousands)

	Length group (cm)												Total
Year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	>60	
1996*	7 695	21 965	43 042	26 560	9 542	2 690	1 144	242	0	0	0	0	112 881
1997*	16 205	25 709	11 944	11 186	4 888	1 783	2 235	1 080	404	0	0	0	75 434
1998	2 794	31 989	13 476	13 513	9 175	4 768	2 069	735	0	0	0	0	78 517
1999	3 859	58 512	18 041	10 819	2 084	4 934	7 267	1 533	0	0	0	0	107 050
2000	35 010	33 342	38 986	13 728	7 674	4 238	4 134	1 125	68	0	0	0	138 304
2001	16 850	32 857	16 496	26 113	8 744	4 061	3 648	1 179	106	0	0	0	110 054

* No coverage in Russian EEZ.

COMPARISONS BETWEEN RESEARCH VESSELS

To compare efficiency of fishing equipment and to estimate possibility of pooling the obtained data, 10 pair calibration hauls with a 30-minute duration at the speed being 3.0 knots were performed by the R/Vs "Jan Mayen" and "Nerey" in the area of White Island on 8-9 September 2001. Hauls were done in parallel courses with a distance between the vessels being 4-5 kbt. Shooting of trawls (dropping of doors) was done simultaneously. Length of wires was agreed. The comparisons were done only with regard to catches of Greenland halibut and not to the other species or of catch composition.

Position, depth, courses of hauls and catches taken are given in Table 10.1. As can be seen in the Table and Fig.10.1, the amount of young Greenland halibut caught by the Norwegian and Russian research vessels was similar in most pair hauls. An exception was for the pairs 4, 8 and 9, where the catches taken by "Jan Mayen" were much higher (by 1.5-3.1 times) than those taken by "Nerey". As for the pairs 8 and 9, the discrepancies noted can be partially explained by different courses and depths of trawling. Large amount of clay found in a trawl could have an adverse impact on the results obtained by "Nerey" in pair 4.

On the whole, high variability in catches related to an irregular distribution of Greenland halibut (Table 10.2) was typical of both vessels. In spite of this, the analysis has indicated a reliably significant correlation of catches taken by "Jan Mayen" and "Nerey". If the results for the pairs 4, 8 and 9 are excluded, then a closeness of interrelation will increase even more (Table 10.3).

As for the length composition of catches, it is on the whole also similar (Fig.10.2).
However, fairly large differences were noted in specific catches (Fig.10.3). The major reason for that is probably that not all the catches were fully measured, that could falsify a real length frequency. Of 10 catches taken by "Nerey" 8 were fully measured, and only 3 were fully measured onboard "Jan Mayen". The closest results were obtained in pair 9 where a sufficiently large amount of fish was fully measured onboard both vessels.

In general the comparative results do not give strong reasons to suspect any considerable difference between vessels. However, the catches of Greenland halibut on RV “Jan Mayen” seemed to be somewhat higher in most of the hauls. Only the pairs 3 and 5 showed RV “Nerey” the highest catch.

Table 10.1. Some information on parallel hauls fulfilled in September 2001

Pair #	Vessel	Latitude N	Longitude E	Depth (m)	Course (°)	Catch (n)*	Measured (n)*
1	Jan Mayen	79°27	33°54	273	270	26	26
	Nerey	79°27	33°52	280	270	24	24
2	Jan Mayen	79°28	33°37	271	270	7	7
	Nerey	79°27	33°35	270	270	6	6
3	Jan Mayen	79°35	32°56	323	270	175	121
	Nerey	79°34	32°57	330	273	195	195
4	Jan Mayen	79°35	32°38	331	270	604	143
	Nerey	79°34	32°38	333	270	388	388
5	Jan Mayen	79°36	32°20	348	270	423	183
	Nerey	79°35	32°17	349	270	435	180
6	Jan Mayen	79°37	32°15	355	70	402	251
	Nerey	79°37	32°20	350	70	325	325
7	Jan Mayen	79°39	32°43	357	90	461	233
	Nerey	79°38	32°36	360	90	428	255
8	Jan Mayen	79°38	32°58	350	90	309	160
	Nerey	79°37	32°56	340	98	99	99
9	Jan Mayen	79°38	33°00	342	270	157	157
	Nerey	79°37	33°01	340	276	107	107
10	Jan Mayen	79°38	32°40	361	270	337	259
	Nerey	79°37	32°40	355	270	334	334

*Only Greenland halibut included.

Table 10.2. Statistical analysis of the parallel hauls results (all trawling pairs included)

Parameters	Descriptive statistics		Correlation test	T-test
	Jan Mayen	Nerey		
Valid N	10	10		
Mean	290.1	234.1		
Min	7	6		
Max	604	435		
SD	194.7	167.3		
SE	61.6	52.9		
CV(%)	67.1	71.5		
R			0.89	
R^2			0.80	
t_R			5.62	
t-value				0.69
P			0.001	0.499

Table 10.3. Statistical analysis of the parallel hauls results (with the exception of pairs # 4, 8, 9)

Parameters	Descriptive statistics		Correlation test	T-test
	Jan Mayen	Nerey		
Valid N	7	7		
Mean	261.6	249.6		
Min	7	6		
Max	461	435		
SD	191.1	179.0		
SE	72.2	67.7		
CV(%)	73.0	71.7		
R			0.99	
R^2			0.97	
t_R			13.28	
t-value				0.12
P			0.00004	0.90549

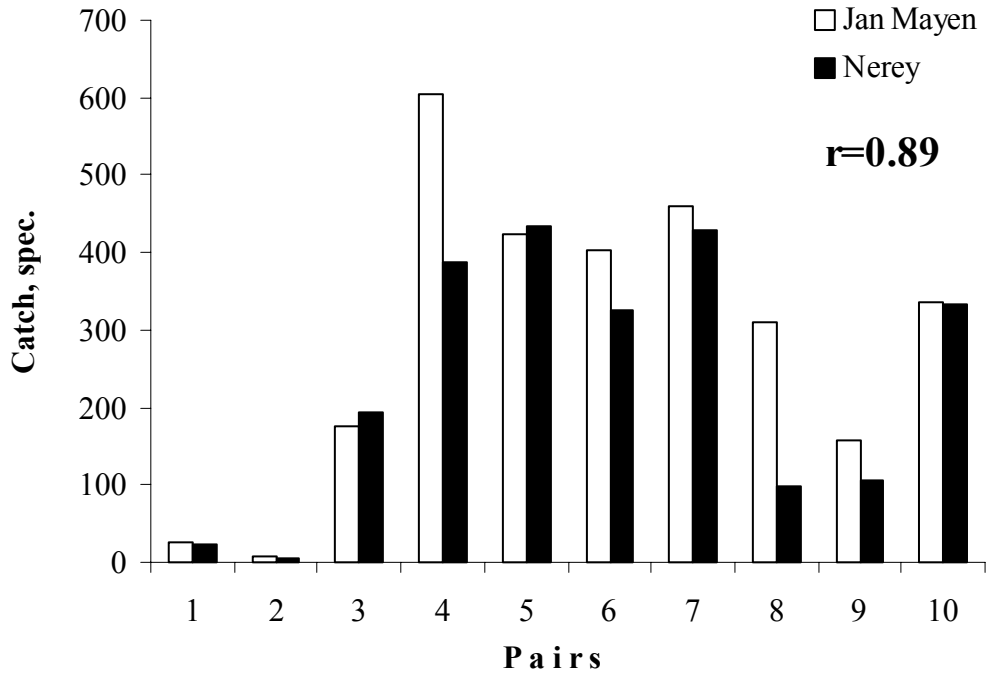

Fig. 10.1. Catches of Greenland halibut by vessels

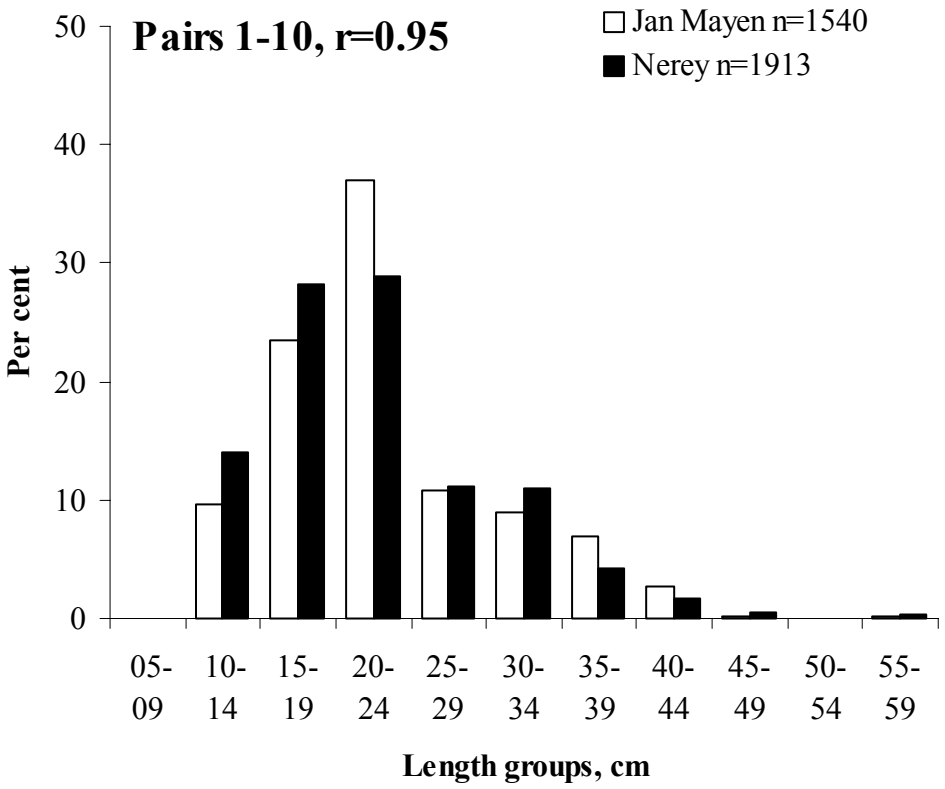

Fig. 10.2. Average length distribution of Greenland halibut (pairs 1-10 combined)

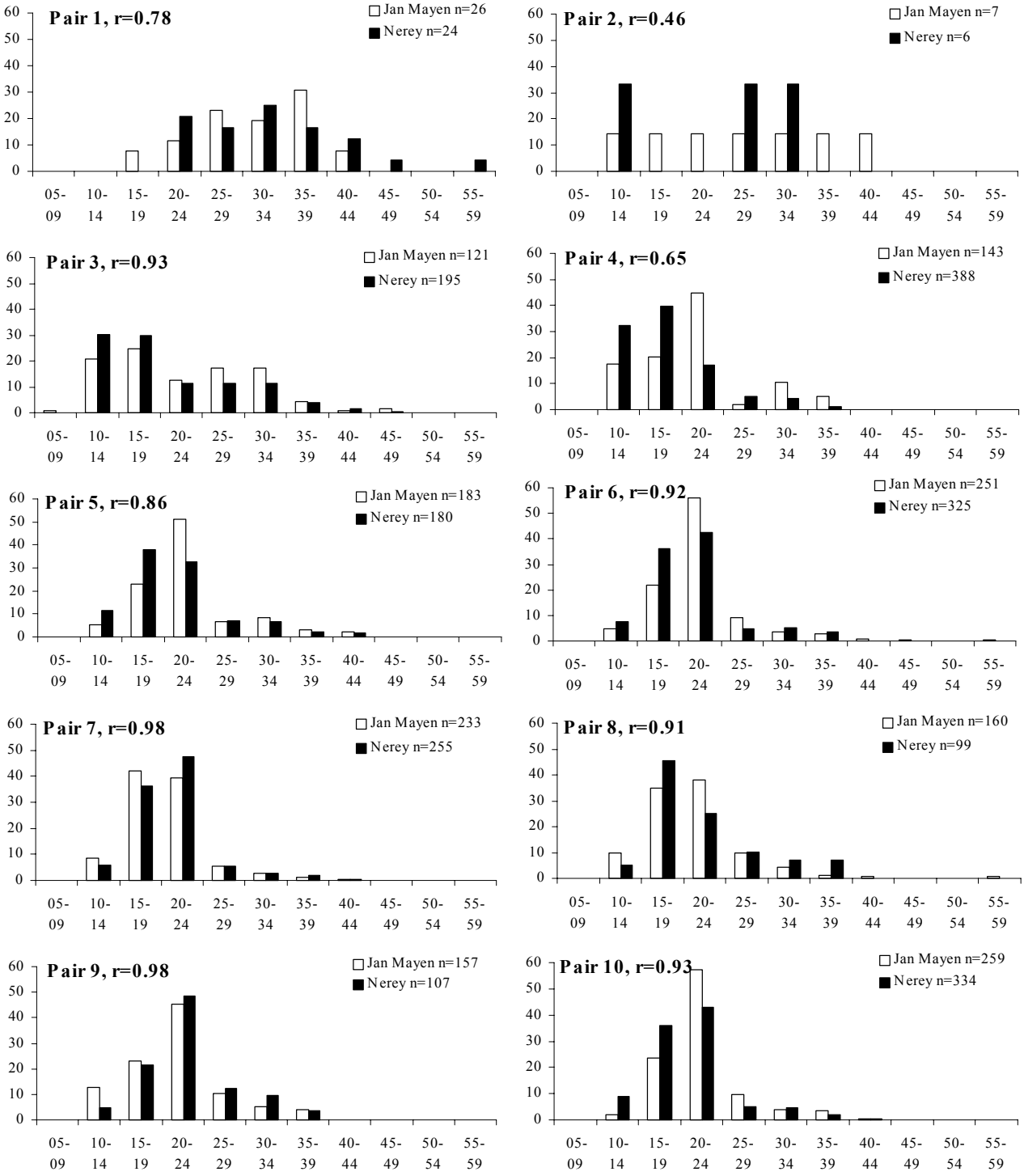

Fig. 10.3. Length distribution of Greenland halibut in the each trawling pair (%)

Considering the three strata were the overlap between the Russian and Norwegian vessels were relatively equal with respect to geographic coverage and number of stations a further comparison was done. The three strata used were strata 10, 11 and 16, which represents an overlapping area of 16 471 square nautical miles within sub-area D and F. For comparison these estimates were based on a fishing width of 25 m, independent of the fish length. The results are shown by length groups in Figure 10.4 and Table 10.4.

Differences were observed, but there were no consistent trend in the result and the differences could be due to separation in timing. The vessels did not cover these areas to the same time and also the location of the stations differed slightly. With respect to the length distribution in the catches the estimates were relatively similar and the results gave no reason to conclude that there were considerable differences between the vessels.

Table 10.4. Swept area estimates (in thousands) referring to 25 m fishing width, independent of fish length for Greenland halibut from Russian vessel Nerey and Norwegian vessel Jan Mayen in the overlapping strata of coverage

	Stratum 10		Stratum 11		Stratum 16	
Length	Nerey	Jan Mayen	Nerey	Jan Mayen	Nerey	Jan Mayen
5-9	0	28	9	0	56	0
10-14	1167	241	253	111	2464	2938
15-19	549	82	367	515	3080	1550
20-24	446	55	218	679	2296	1271
25-29	0	55	201	403	224	363
30-34	137	0	131	324	392	377
35-39	0	0	52	58	56	132
40-44	0	0	35	12	168	46
45-49	0	0	0	11	0	46
50-54	0	0	0	0	0	0
55-59	0	0	0	0	0	0
>60	0	0	0	0	0	0
Sum	2300	460	1266	2113	8735	6721

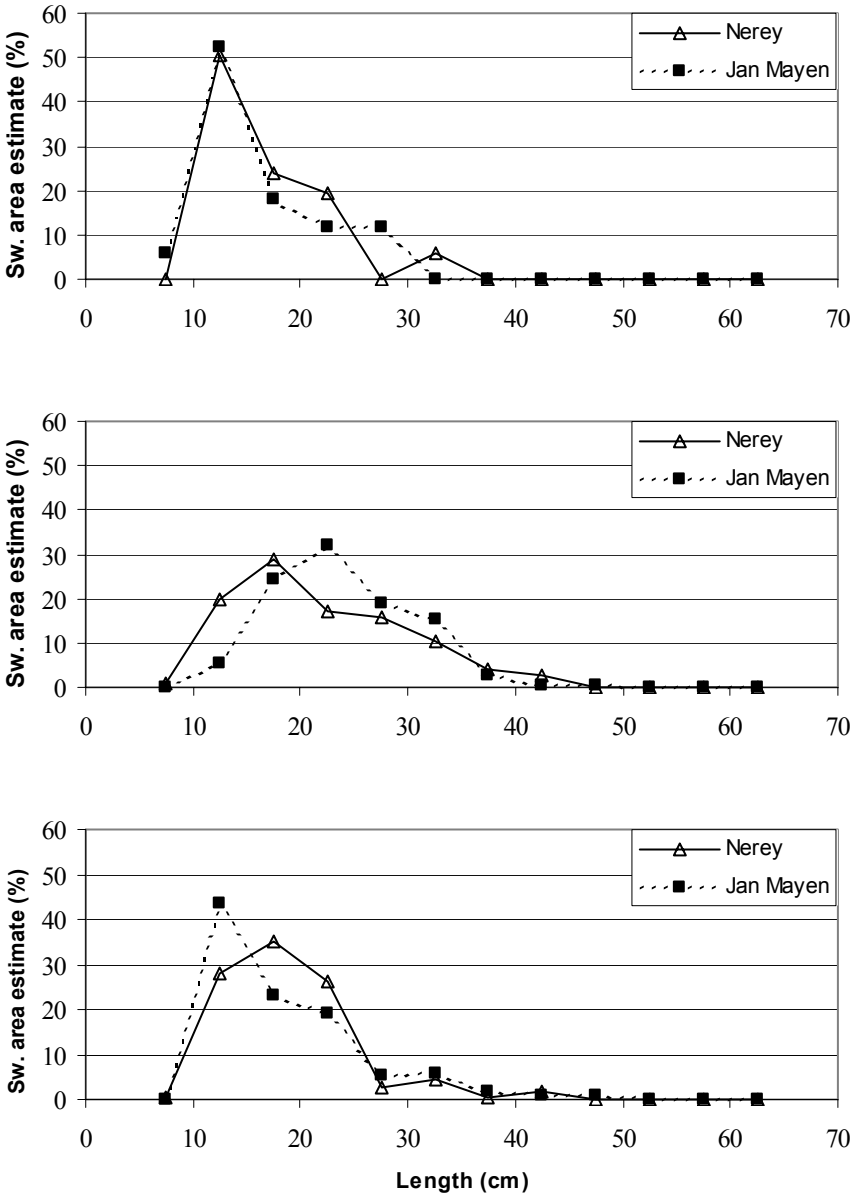

Fig. 10.4. **Swept area estimates (referring to 25 m fishing width, independent of fish length) for Greenland halibut by Russian vessel Nerey and Norwegian vessel Jan Mayen in the overlapping area of coverage. The figures represents stratum 10, 11 and 16 from top to bottom**

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LIST OF PARTICIPANTS

2000

Vessel:	F/F Jan Mayen	R/V Persey IV
Departure:	Longyearbyen, 28.08.00	Murmansk, 27.08.00
Arrival:	Longyearbyen, 15.09.00	Murmansk, 26.09.00
Personnel:	H. Larsen (cruise leader) S. Lemvig E. Eriksen T. Wenneck K. Lydersen	O.Smirnov (cruise leader) Ya. Lukmanov A. Karsakov O. Sazhenkov

2001

Vessel:	F/F Jan Mayen	R/V Nerey
Departure:	Longyearbyen, 28.08.01	Murmansk, 29.08.01
Arrival:	Longyearbyen, 15.09.01	Murmansk, 26.09.01
Personnel:	H. Larsen (cruise leader) K. LydersenA. Kluikov E. EriksenA. Klein T. Wenneck W. Richardsen A. Leithe	O. Smirnov (cruise leader)

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