PROSJEKTRAPPORT

ISSN 0071-5638

HAVFORSKNINGSINSTITUTTET
MILJØ - RESSURS - HAVBRUK

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Forskningsstasjonen	Austevoll	Matre
Flødevigen	havbruksstasjon	havbruksstasjon
4817 His	5392 Storebø	5984 Matredal
Tlf.: 37 05 90 00	Tlf.: 56 18 03 42	Tlf.: 56 36 60 40
Faks: 37 05 90 01	Faks: 56 18 03 98	Faks: 56 36 61 43

Distribusjon:
ÅPEN

HI-prosjektnr.:
9103.3

Oppdragsgiver(e):
Havforskningsinstituttet

Oppdragsgivers referanse:

Rapport:
FISKEN OG HAVET NR. 7 - 1999

Tittel:
REPORT ON DEMERSAL FISH SURVEYS IN THE BARENTS SEA AND SVALBARD AREA DURING SUMMER/AUTUMN 1996 AND 1997

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Senter:
Marine ressurser

Seksjon:
Bunnfisk

Antall sider, vedlegg inkl.:
39

Dato:
11.02.99

Sammendrag:

Et kombinert akustikk- og bunntråltokt med hovedvekt på torsk ble gjennomført med fire fartøy i Barentshavet og ved Vest-Spitsbergen sommeren 1996 og 1997. Mengdemål for torsk, blåkveite, hyse og uer ble sammenliknet med resultatet fra sommeren 1995. For å vurdere eventuelle forekomster nord for det valgte standardområdet, ble resultater tatt med fra en bunntråldekning rettet mot blåkveite nord og øst for Svalbard i august-september i 1996 og 1997. Av de nevnte arter var det bare blåkveite og små snabeluer det ble observert betydelige mengder av nord for standardområdet. Resultatene tyder på minkende torskebestand, men brukbar rekruttering fra årsklassene 1994 og 1995. Anslagene for hyse har også minket de siste årene, og de yngste årsklassene ser ut til å være svake. Både for vanlig uer og snabeluer var det betydelig mindre av den aller minste fisken i 1997 enn foregående år, mens for eldre fisk var endringene små. Resultatene for blåkveite innenfor standardområdet tyder på at 1995-årsklassen er noe sterkere enn de øvrige, mens nord for standardområdet ble det i tillegg registrert en del av 1993- og 1994-årsklassene. Russisk økonomisk sone ble ikke dekket i 1997. Dette medfører stor usikkerhet for totalresultatet, spesielt for torsk og hyse.

Emneord - norsk:
1. Bunnfisk
2. Bunntrål
3. Mengdemåling

Emneord - engelsk:
1. Demersal fish
2. Bottom trawl, acoustics
3. Abundance estimation

Asgeir Aglen
Prosjektleder

Seksjonsleder

HAVFORSKNINGSINSTITUTTET
SENTER FOR MARINE RESSURSER

Report on demersal fish surveys in the Barents Sea and Svalbard area during summer/autumn 1996 and 1997

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SUMMARY

A combined acoustic and bottom trawl survey focused on cod was made with four vessels in the Barents Sea and West-Spitsbergen area during summer 1996 and 1997. Abundance estimates of cod, Greenland halibut, haddock and redfish were compared with results from a summer survey in 1995. To evaluate the amount of fish outside the chosen standard area for the summer survey, results were also included from a bottom trawl survey aimed at Greenland halibut north and east of Svalbard during August-September 1996 and 1997. The cod results were also compared with results with annual bottom trawl surveys in the Barents Sea /West Spitsbergen area during 1990-1993. The Russian Economic Zone was not covered in 1997. This has led to uncertainties regarding the total results, particularly for cod and haddock.

The main conclusions are:

- Cod; Estimated biomass of 3 year and older cod has decreased by about 40% during the period 1995-1997. The year classes 1994 and 1995 were abundant both in 1996 and 1997. The year classes 1989 and 1990 were rather abundant in 1995 and 1996. They have, however, suffered a high mortality. Lengths and weights at age in 1997 were considerably below the values for the period 1990-1992, but have changed rather little since 1995. North of the standard area the observed amounts were low and mainly consisting of age groups 1-3.
- Haddock; The 1990 year class was abundant in 1995 and has shown a strong decrease since then. Younger year classes appear to be weak. Slightly more 1 year olds in 1997 compared to the two previous years. No haddock was observed north of the standard area.
- *Sebastes mentella*; Lower estimates in 1997 compared to the two previous years, much lower for fish less than 10 cm. For fish less than 15 cm the estimates outside the standard area were at the same order of magnitude as those inside the standard area. Low abundance of larger fish outside the standard area.
- *Sebastes marinus*; Lower estimates in 1997 compared to the two previous years for fish less than 30 cm, especially for fish less than 15 cm. Minor changes for fish above 30 cm. No *S. marinus* observed north of the standard area.
- Greenland halibut; Low estimates of young fish compared to old fish indicated that the standard area covered the young fish poorly. For fish younger than 6 years the abundance estimated north of the standard area was considerably larger than the estimate within the standard area. All the year classes 1993, 1994 and 1995 were abundant in the northern area, while only the 1995 year class appeared abundant inside the standard area.

SAMMENDRAG

Et kombinert akustikk –og bunntråltokt med hovedvekt på torsk ble gjennomført med fire fartøy i Barentshavet og ved Vest-Spitsbergen sommeren 1996 og 1997. Mengdemål for torsk, blåkveite, hyse og uer ble sammenliknet med resultater fra sommeren 1995. For å vurdere eventuelle forekomster nord for det valgte standardområdet, ble også resultater tatt med fra en bunntråldekning rettet mot blåkveite nord og øst for Svalbard i august-september i 1996 og 1997. Resultatene for torsk ble også sammenliknet med årlige bunntråldekninger i Barentshavet og ved Vest-Spitsbergen i perioden 1990-1993. Russisk økonomisk sone ble ikke dekket i 1997. Dette medfører stor usikkerhet for totalresultatet, spesielt for torsk og hyse.

Hovedkonklusjonene er:

- Torsk; Beregnet biomasse av 3 år og eldre torsk her minket med omlag 40% i perioden 1995-1997. Årsklassene 1994 og 1995 var tallrike både i 1996 og 1997. Årsklassene 1989 og 1990 var ganske tallrike i 1995 og 1996, men har hatt en høy dødelighet. Lengde og vekt ved alder var i 1997 betydelig lavere enn i perioden 1990-1992, men har endret seg lite siden 1995. Nord for standardområdet ble det funnet små mengder hovedsakelig av aldersgruppene 1-3.
- Hyse; 1990 årsklassen var tallrik i 1995, men har minket raskt. Yngre årsklasser ser ut til å være svake. Litt mer ettåringer i 1997 enn de to foregående år. Ingen forekomster observert nord for standardområdet
- *Sebastes mentella*; Lavere tall i 1997 enn de to foregående år, mye lavere for fisk mindre enn 10 cm. For fisk minre enn 15 cm var beregnet mengde nord for standardområdet av samme størrelsesorden som innenfor standardområdet. Små forekomster av større fisk nord for standardområdet.
- *Sebastes marinus*; Lavere tall i 1997 enn de to foregående år for fisk mindre enn 30 cm, spesielt for fisk mindre enn 15 cm. Små endringer for fisk større enn 30 cm. Ingen forekomster observert nord for standardområdet.
- Blåkveite; Lave tall for de yngste aldersgrupper sammenliknet med de eldre indikerer at standardområdet dekte den yngste fisken dårlig. For fisk yngre enn 6 år var mengden observert nord for standardområdet betydelig større enn innenfor standardområdet. Nord for standardområdet var det ganske høye tall for åsklassene 1993, 1994 og1995, mens innenfor standardområdet var det bare 1995 årsklassen som syntes å være tallrik.

INTRODUCTION

In 1995 a summer survey on demersal fish in the Barents Sea and West-Spitsbergen area was started, with the intention of covering all the important distribution area of the North-East Arctic cod (Aglen and Nakken, 1996). In 1996 an additional autumn survey covering the areas to the north and east of Spitsbergen was started to have a better coverage of the total distribution of Greenland halibut (Gundersen *et al.* 1997). Results from these northern areas are included in the present report for comparison with the results obtained within the standard area chosen for the summer surveys. Swept area estimates and acoustic estimates are presented for cod, haddock, *Sebastes mentella* and *Sebastes marinus*. In addition swept area estimates are given for Greenland halibut.

MATERIAL AND METHODS

Figure 1 shows the strata used for swept area estimation. Strata A,B,C,E and H each contains 3 depth strata; 100-300m, 300-500m and 500-1500m. Strata 1-5 and 6-10 are depth strata within the limits 0,100,200,300,400 and 800 m. Figures 2 and 3 show the position of the bottom trawl hauls used for swept area estimation. Here also the borders between Regions are indicated. Region 2b is nearly identical to the area covered in the "Svalbard-survey" prior to 1995 (Senneset, 1992). The border between Region 1nw and 2a/2b is about 1 degree further to the east compared to the borders between ICES Divisions I and II. The split between Region 1se and 1nw was made after the 1997 survey to obtain separate estimates from 1995 and 1996 for the areas not covered in 1997. The strata included in each Region are as follows (median line is the median line between Russia and Norway);

Region	Corr. ICES area	Strata
1se	I	12 (east of 39° E), 13, 16 (E of median line), 17
1nw	I	11, 12 (west of 39° E), 16 (W of median line)
2a	IIa	14,15
2b	IIb	1-10
3	IIb	A,B,C,E,H

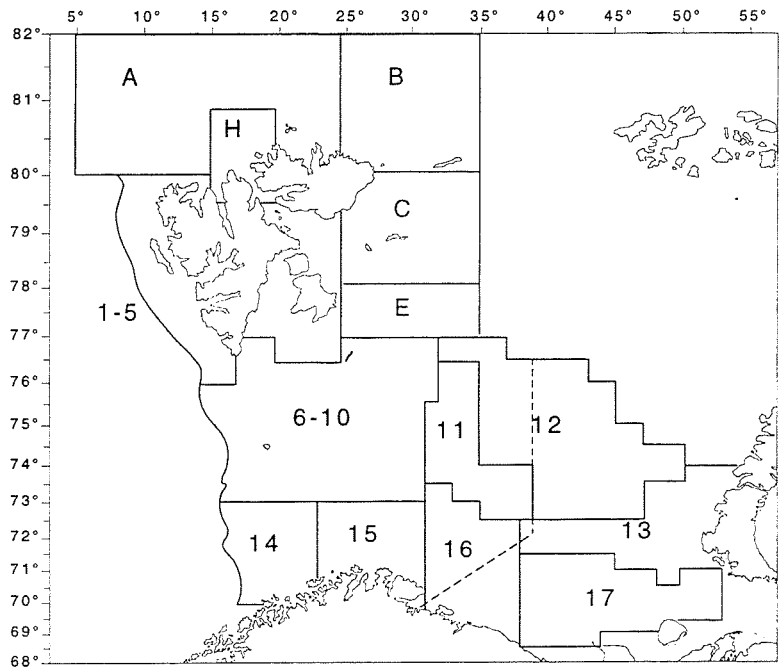

Figure 1. Strata system used for swept area calculations

Time, Region and fishing station reference number in the data base (at Institute of Marine Research) are listed for the participating vessels in the text table below;

Vessel	Time period	Region	Fishing station ref. No.
RV Johan Hjort	07.08.96-22.08.96	2a, 2b	81001-81073
RV Michael Sars	24.07.96-20.08.96	1se, 1nw, 2a	80801-80965
FV Varegg	01.08.96-23.08.96	1nw, 2a, 2b	81201-81335
FV Hopen	01.08.96-22.08.96	1nw, 2a, 2b	81401-81526
FV Hopen	23.08.96-17.09.96	2b, 3	81527-81690
RV Johan Hjort	18.07.97-04.08.97	1nw, 2a, 2b	81001-81114
RV Michael Sars	29.07.97-14.08.97	1nw, 2a, 2b	80801-80870
FV Varegg	25.07.97-28.08.97	2a, 2b	81201-81312
FV Hopen	25.07.97-21.08.97	2a, 2b	81401-81550
FV Tromsland	27.08.97-13.09.97	2b, 3	90001-90125

Not all the strata shown in Figure 1 were fully covered. Some areas were skipped due to very low density of the target species (associated with water temperatures below –0.5°C close to the bottom), and in some areas entrance of the vessels was not allowed. In Figures 2-19 the borders of the areas covered are indicated. For abundance estimation the strata area were adjusted according to the coverage.

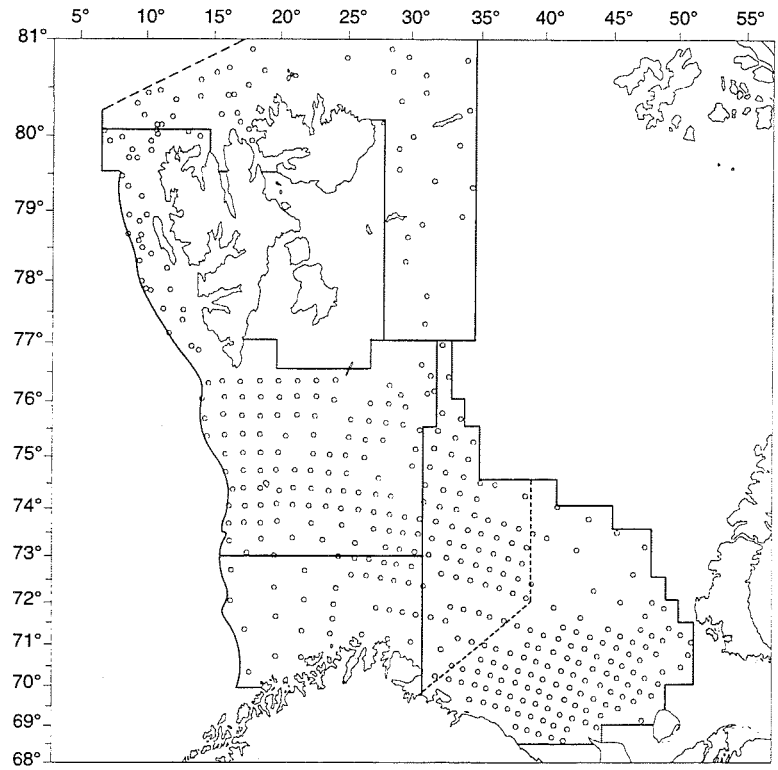

Figure 2 Bottom trawl stations used for swept area estimates 1996.

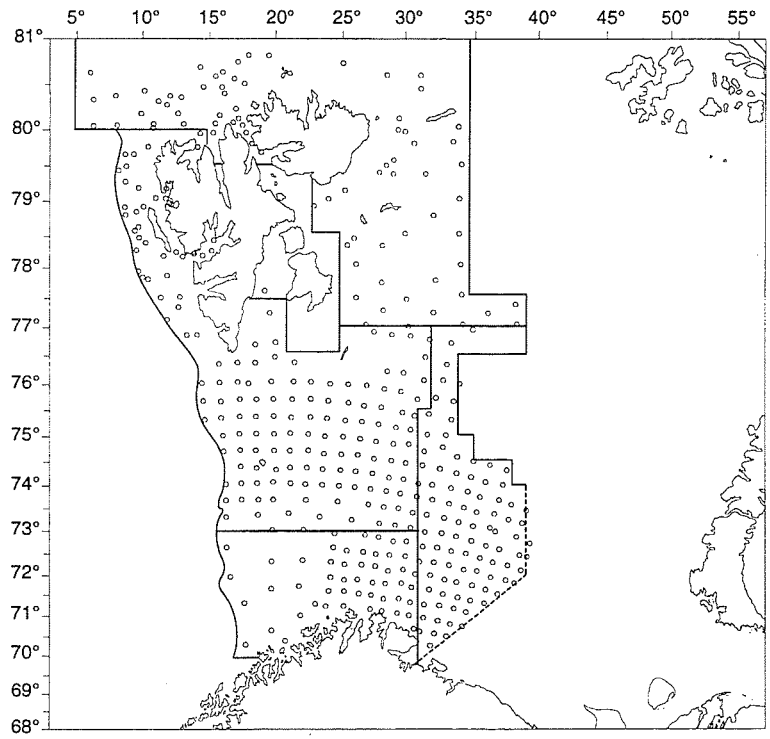

Figure 3 Bottom trawl stations used for swept area estimates 1997.

All vessels were equipped with a standard research bottom trawl, which is a Campelen, 1800 meshes shrimp trawl with 80 mm (stretched) meshes in the front and 22 mm (stretched) meshes in the cod end. It has a rockhopper groundgear and 40 m sweep wires. Technical details of the trawl are given by Engås and Godø (1989a and b). RV Michael Sars used Wacoo doors (6 m^2, 1400 kg), while the other vessels used Steinshamn W9 doors (V-shaped, 7.1 m^2, 2050 kg). All vessels used a 10 m long restriction rope between the warps 150 m in front of the doors to restrict the door spread to about 50 m, independent of the warp lengths used. Standard tow duration was 30 minutes at 3.0 knots.

All vessels, except those operating in Region 3, were equipped with a Simrad EK500, 38 kHz echo sounder, and a BEI (Knudsen 1990) post processing unit.

The applied procedures for biological sampling, scrutinizing of acoustic data, and abundance estimation were as described by Jakobsen *et al.* (1997). Mean acoustic values (s_A , m^2 acoustic back scattering per square nautical mile) allocated to a given species were converted to fish density (ρ_l) by length group (l) according to the formula:

$$\rho_l = f_l * (s_A / \overline{\sigma})$$

where f_l is the fraction by number of the particular length group.
$\overline{\sigma} = \Sigma f_l * \sigma_l$ is the average back scattering cross section for the actual length distribution.

Both for cod, haddock and redfish the following target strength function was applied;

$$TS = 10 * \log(\sigma_l / 4\pi) = 20 * \log l - 68 \Rightarrow \sigma_l = 1{,}99 * 10^{-6} * l^2$$

Instead of basing the acoustic estimate on a separate length distribution within each rectangle (1/2 degree Latitude, 1 degree Longitude, as described by Jakobsen *et al.*1997), the acoustic estimates in the present report are based on the length distribution of the total swept area estimate within each Region.

Swept area fish density estimates (ρ_{sl}) by species (s) and length (l) were estimated for each bottom trawl haul by the equation;

$$\rho_{sl} = c_{sl} / (d * w_{sl}),$$

where d is the towed distance, w_{sl} is the effective fishing width and c_{sl} is the catch of species s and length group l. As described for the standard surveys in the Barents Sea (Jakobsen *et al.* 1997), a length dependent fishing width was applied for cod and haddock. The following functions were used:

$$w_{sl} = \alpha * l_{min}^{\beta} \text{ for } l \leq l_{min}$$

$w_{sl} = \alpha * l^{\beta}$ for $l_{min} < l < l_{max}$

$w_{sl} = \alpha * l_{max}^{\beta}$ for $l \geq l_{max}$

The symbols involved are defined in the text table below:

	α	β	L_{min}	L_{max}
Cod	5.91	0.43	15 cm	62 cm
Haddock	2.08	0.75	15 cm	48 cm

For redfish a fishing width of 25 m was applied, independent of the fish length.

Table 1 shows the amount of biological sampling by Region

Table 1. Number of bottom trawl hauls used for swept area estimates (B1), pelagic hauls (P), and other fishing stations (B2) by Region, and number of fish sampled for length (L) and age (A) within categories in 1996 and 1997.

Year/		#	Cod		Haddock		*S. marinus*		*S. mentella*		Gr. halibut	
Region	Type	Hauls	L	A	L	A	L	A	L	A	L	A
1996												
1	B1	191	25440	1730	5455	426	773	18	250	10	85	31
	B2	2	9	0	0	0	0	0	0	0	0	0
	P	13	656	13	8	0	0	0	0	0	0	0
2a	B1	33	3657	279	1635	137	721	22	1569	78	16	10
	B2	11	10	0	0	0	0	0	0	0	0	0
	P	2	5	0	11	0	0	0	0	0	0	0
2b	B1	147	17502	758	479	46	409	50	5959	178	554	329
	B2	191	16669	146	2832	82	128	28	25	0	1044	86
	P	12	749	46	52	14	0	0	1	0	0	0
3	B1	57	1593	0	0	0	0	0	140	0	1110	319
	B2	11	0	0	0	0	0	0	0	0	61	57
	P	6	18	0	0	0	0	0	0	0	2	0
1997												
1	B1	90	12042	881	906	110	365	103	903	164	136	124
	B2	3	476	16	140	17	0	0	0	0	0	0
	P	14	832	48	129	0	0	0	0	0	0	0
2a	B1	54	4588	518	3156	263	493	82	3428	265	32	30
	B2	24	1754	67	712	38	17	10	1060	60	22	21
	P	2	3	0	27	7	0	0	0	0	0	0
2b	B1	168	12305	744	369	25	766	29	4136	149	633	364
	B2	114	11906	822	927	57	391	34	7	1	33	33
	P	3	104	27	0	0	0	0	0	0	0	0
3	B1	82	765	15	0	0	13	0	776	0	1952	394
	B2	6	0	0	0	0	0	0	0	0	0	0
	P	0	0	0	0	0	0	0	0	0	0	0

RESULTS

Total echo abundance

Total echo abundance (s_A times area) allocated to cod, haddock and redfish are shown in Table 2. Pelagic values (more than 10 m above the bottom) and bottom values (less than 10 m above bottom) are shown separately.

For cod the total values showed a minimum in 1996, while the bottom values have decreased considerably over the whole three year period. The pelagic values represented 55% of the total in 1995, 59% in 1996 and 78% in 1997. Total values of haddock also showed a minimum in 1996, and the percentage pelagic was between 60 and 70 all three years. Total values of redfish had a maximum in 1996.

Table 2. Echo abundance ('000 m^2 acoustic back scattering) by Region, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Cod			Haddock			Redfish		
Year	Bottom	Pelagic	Total	Bottom	Pelagic	Total	Bottom	Pelagic	Total
1 se									
1995	899	440	1339	249	614	863	23	1	24
1996	913	840	1752	184	214	398	3	1	4
1 nw									
1995	450	1377	1827	24	27	51	25	34	59
1996	141	591	732	6	88	94	12	27	39
1997	133	863	996	55	109	164	10	28	38
2 a									
1995	79	88	167	97	101	198	146	229	375
1996	87	220	307	43	244	286	146	654	800
1997	123	135	259	183	262	445	127	338	465
2 b									
1995	1445	1563	3008	53	32	85	107	331	438
1996	705	1048	1753	29	60	89	88	444	532
1997	441	1484	1925	17	27	44	61	441	502
1nw+2a+2b									
1995	1974	3028	5002	174	160	334	278	594	872
1996	934	1859	2792	78	392	469	246	1125	1371
1997	698	2481	3179	255	397	652	198	807	1005
1se+1nw+2a+2b									
1995	2873	3468	6341	423	774	1197	301	595	896
1996	1846	2698	4545	262	606	868	249	1126	1375
*1997	1136	4039	5175	472	735	1206	199	809	1008
Ratio 95	1,46	1,15	1,27	2,43	4,84	3,58	1,08	1,00	1,03
Ratio 96	1,98	1,45	1,63	3,38	1,55	1,85	1,01	1,00	1,00

*scaled by the ratio observed for total values in 1996

Tables 3-6 give a more detailed description of the vertical distribution of echo abundance. Here the values for Region 1 are not adjusted for reduced coverage in 1997. For cod (Table 3) it is seen that close to bottom the values decreased from 1996 to 1997. This was also the case at intermediate heights within the bottom depth intervals 150-200 and 200-250, while at other bottom depth intervals the values at intermediate heights had remained much the same. At heights above 200 m there was an increase from 1996 to 1997. This was caused by recordings of cod mixed with capelin in the upper part of the water column to the east and north east of Bear Island.

Table 3. Cod. Vertical distribution of echo abundance ('000 m^2 back scattering) within bottom depth intervals and Regions. Note the different extension of the height intervals.

1996

Bottom depth (m)	Height above bottom (m)										
	0-10	10-20	20-30	30-50	50-100	100-150	150-200	200-250	250-300	>300	Total
0-50	10	0	0	0	*	*	*	*	*	*	10
50-100	560	31	7	25	16	*	*	*	*	*	639
100-150	477	67	32	29	35	17	*	*	*	*	658
150-200	389	169	108	141	105	58	17	*	*	*	987
200-250	158	60	58	107	159	115	26	9	*	*	693
250-300	122	53	45	81	100	40	23	6	0	*	470
300-350	84	29	23	48	127	96	50	10	0	0	469
>350	47	24	22	42	82	162	148	74	13	6	619
Sum	1846	434	296	474	624	490	264	99	13	6	4545
1se+1nw	1054	223	156	277	364	214	148	46	3	1	2485
2a	87	17	11	34	56	79	20	3	0	0	307
2b	705	194	129	163	204	196	96	50	10	5	1753

1997

Bottom depth (m)	Height above bottom (m)										
	0-10	10-20	20-30	30-50	50-100	100-150	150-200	200-250	250-300	>300	Total
0-50	34	0	0	0	*	*	*	*	*	*	34
50-100	29	11	5	5	3	*	*	*	*	*	53
100-150	212	73	41	35	17	5	*	*	*	*	382
150-200	78	40	19	19	31	13	3	*	*	*	203
200-250	128	60	50	78	179	92	6	0	*	*	593
250-300	83	75	64	85	147	151	61	9	2	*	676
300-350	94	59	49	54	52	73	47	17	5	3	455
>350	39	19	17	34	73	69	69	79	135	249	783
Sum	697	337	245	311	502	402	187	105	142	253	3179
1nw	133	113	86	120	251	191	74	16	7	3	996
2a	123	24	19	26	34	16	5	5	6	1	258
2b	441	200	140	165	217	195	107	83	129	249	1925

For haddock (Table 4) the total values close to bottom were about the same in 1996 and 1997, in spite of the reduced coverage. High values at 30 to 200 m height in 1996 mainly originated from Region 1se which was not covered in 1997. Values observed at more than 300 m height in 1997 are caused by recordings of large haddock close to surface at the East Finnmark coast.

Table 4. Haddock. Vertical distribution of echo abundance ('000 m^2 back scattering) within bottom depth intervals and Regions. Note the different extension of the height intervals.

1996

Bottom depth (m)	Height above bottom (m) 0-10	10-20	20-30	30-50	50-100	100-150	150-200	200-250	250-300	>300	Total
0-50	1	0	0	0	*	*	*	*	*	*	1
50-100	121	12	5	6	5	*	*	*	*	*	148
100-150	77	15	16	10	94	37	*	*	*	*	250
150-200	43	25	19	37	23	64	56	*	*	*	266
200-250	11	6	7	21	51	32	12	4	*	*	146
250-300	11	4	3	6	8	3	2	0	0	*	38
300-350	6	4	3	5	9	5	7	1	0	0	39
>350	2	1	1	2	2	1	1	1	0	0	11
Sum	272	67	55	87	192	142	77	6	0	0	899
1se+1nw	200	50	42	69	77	46	39	0	0	0	523
2a	43	8	5	12	102	74	36	5	0	0	287
2b	29	9	7	7	13	22	2	0	0	0	89

1997

Bottom depth (m)	Height above bottom (m) 0-10	10-20	20-30	30-50	50-100	100-150	150-200	200-250	250-300	>300	Total
0-50	9	2	0	0	*	*	*	*	*	*	11
50-100	30	8	6	12	6	*	*	*	*	*	63
100-150	87	21	16	28	77	21	*	*	*	*	250
150-200	41	8	4	9	22	21	2	*	*	*	107
200-250	44	11	6	5	5	3	2	0	*	*	77
250-300	28	11	7	5	4	3	3	1	0	*	62
300-350	9	3	2	5	6	2	1	1	1	0	31
>350	6	2	2	4	9	6	4	2	2	15	52
Sum	255	65	44	69	130	56	12	4	3	16	653
1nw	55	19	12	17	26	12	5	2	2	14	164
2a	183	38	28	47	100	42	4	2	0	1	445
2b	17	8	5	4	4	3	2	0	0	0	44

For redfish (Table 5) there was a clear pattern of increasing echo abundance and an extension upward in the water column at increasing bottom depth. In Regions 1 and 2b neither the values nor the vertical distribution differed much between the years. In Region 2a the values at heights above 30m were considerably higher in 1996 compared to 1997. These values mainly originated from western part of 2a, where the species identification through pelagic trawling was poor both years. There are indications that blue whiting was abundant in that area, and the difference between years might be mainly caused by species allocation errors.

Table 5. Redfish. Vertical distribution of echo abundance ('000 m^2 back scattering) within bottom depth intervals and Regions. Note the different extension of the height intervals.

1996

Bottom depth (m)	Height above bottom (m) 0-10	10-20	20-30	30-50	50-100	100-150	150-200	200-250	250-300	>300	Total
0-50	0	0	0	0	*	*	*	*	*	*	0
50-100	1	0	0	0	0	*	*	*	*	*	1
100-150	12	0	0	0	0	0	*	*	*	*	13
150-200	36	12	5	3	3	1	0	*	*	*	60
200-250	30	18	8	7	5	0	0	0	*	*	69
250-300	29	15	14	27	22	2	1	0	0	*	110
300-350	45	25	23	41	63	11	2	1	0	0	211
>350	96	96	113	192	209	70	54	40	14	26	911
Sum	249	167	164	270	303	84	57	41	14	26	1375
1se+1nw	15	6	5	8	7	2	0	0	0	0	43
2a	146	93	84	148	184	51	45	36	10	2	800
2b	88	68	75	114	112	31	11	5	4	23	532

1997

Bottom depth (m)	Height above bottom (m) 0-10	10-20	20-30	30-50	50-100	100-150	150-200	200-250	250-300	>300	Total
0-50	0	0	0	0	*	*	*	*	*	*	0
50-100	1	0	0	0	0	*	*	*	*	*	1
100-150	6	0	0	0	1	0	*	*	*	*	8
150-200	30	3	1	0	0	0	0	*	*	*	34
200-250	12	3	1	1	1	1	0	0	*	*	19
250-300	19	19	14	11	4	1	1	0	0	*	68
300-350	60	30	23	34	27	6	1	1	0	0	183
>350	70	72	76	138	223	78	26	7	2	1	691
Sum	198	127	115	185	257	85	28	8	2	1	1005
1nw	10	4	4	6	8	4	1	0	0	0	38
2a	127	67	56	86	104	17	5	1	1	0	465
2b	61	55	55	93	145	64	22	6	1	0	502

Horizontal fish distribution

The horizontal distribution of acoustic values and bottom trawl catch rates are shown in Figures 4 to 7 for cod and Figures 8 to11 for haddock. The distribution of acoustic values of redfish (both species combined) is shown in Figures 12 and 13. Bottom trawl catch rates for *Sebastes mentella* are shown in Figures 14 and 15, for *Sebastes marinus* in Figures 16 and 17, and for Greenland halibut in Figures 18 and 19.

On the maps the borders of the investigated area are indicated. The vessel covering the most northern areas (Region 3) did not collect acoustic data. Therefore the borders of investigation are not equal for the maps showing acoustic results and the maps showing bottom trawl results. It should be noticed that the map projection over-emphasis the northern areas compared to the southern areas. As can be observed in Tables 6, 16 and 22 the fish abundance in Region 3, relative to other Regions, is not as high as it might appear on the maps.

For cod the horizontal distributions in 1996 and 1997 were rather similar, and the acoustic values (Figure 4 and 5) and the catch rates (Figure 6 and 7) show more or less the same distribution.

For haddock the areas with moderate to high density decreased from 1996 to 1997. Some high acoustic values close to the Finnmark coast (Figure 8 and 9) are not reflected in the catch rates (Figures 10 and 11). In these coastal areas most of the large haddock was distributed too far from bottom (in the upper 70 m of the water column) to be caught by the bottom trawl.

In 1996 there were some high catches of *S. mentella* between 73 and 74 degree north (Figure 14). These concentrations were missing in 1997 (Figure 15). The maps of catch rates of *S. marinus* also indicate a decrease from 1996 to 1997 (Figures 16 and 17).

The maps of acoustic values of redfish (both species combined, Figures 12 and 13) resemble the catch distributions of *S. mentella* much more than those for *S. marinus*. Both years the map of acoustic values of redfish shows a concentration at the western boarder of Region 2a. The bottom trawl catch rates do not fully reflect this. This is not unreasonable, since a large proportion of these acoustic recordings were too high in the water column to be caught by bottom trawl (Table 5). It should, however, be noticed that in this area the species allocation of the pelagic recordings was rather uncertain due to poor pelagic trawl sampling. Young age groups of blue whiting were rather abundant in the bottom trawl in this area both years, and the ratio between redfish and blue whiting in the pelagic recordings was not known.

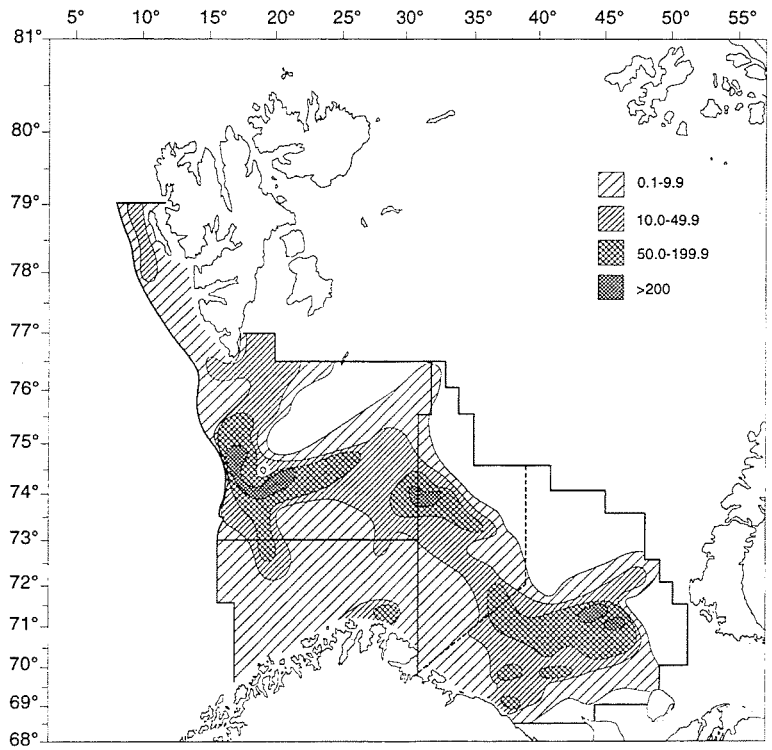

Figure 4. Acoustic densities (m^2 / $n.mile^2$) allocated to cod, 1996.

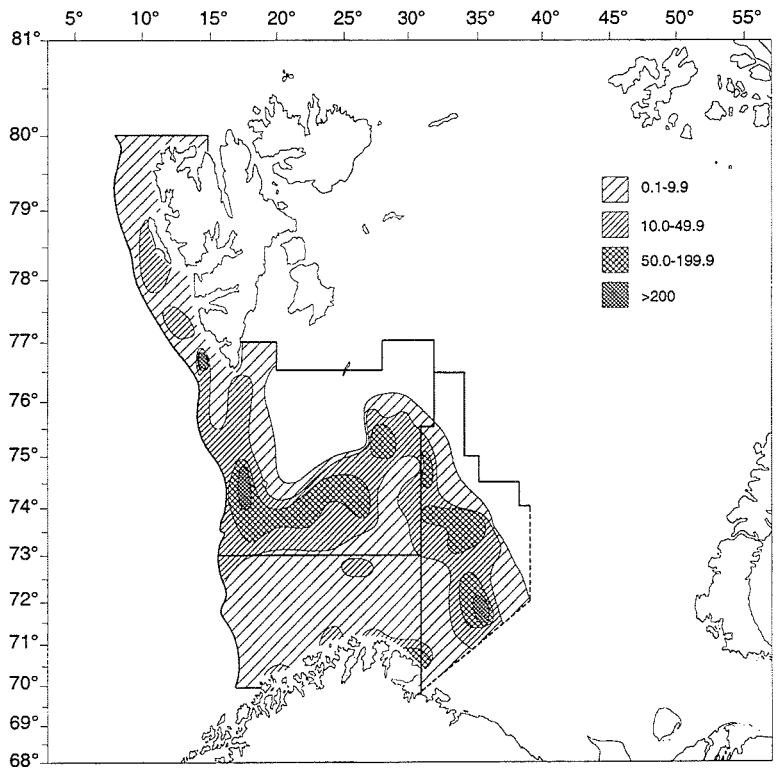

Figure 5. Acoustic densities (m^2 / $n.mile^2$) allocated to cod, 1997.

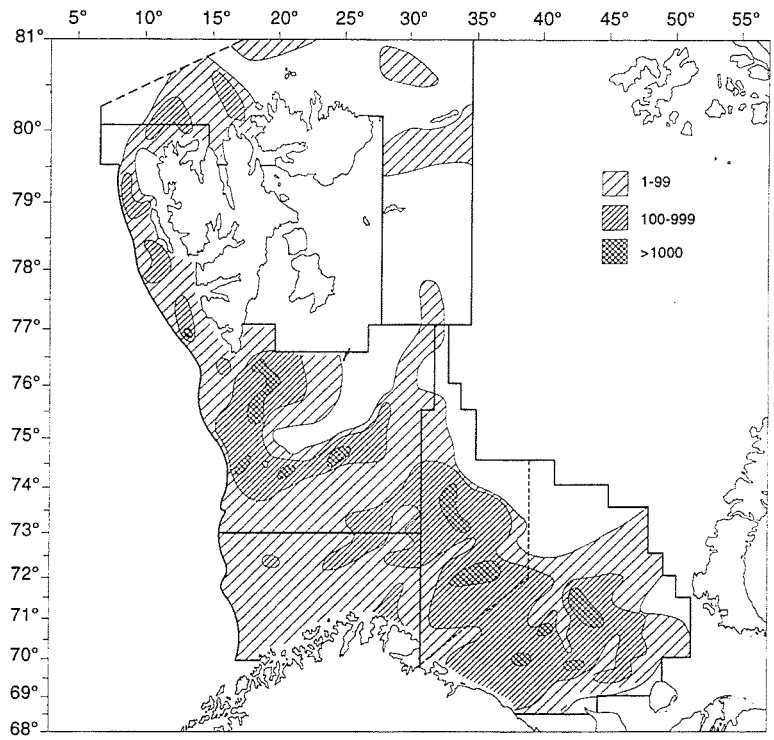

Figure 6. Catch rates (number/ 3 nautical mile) of cod >19cm, 1996.

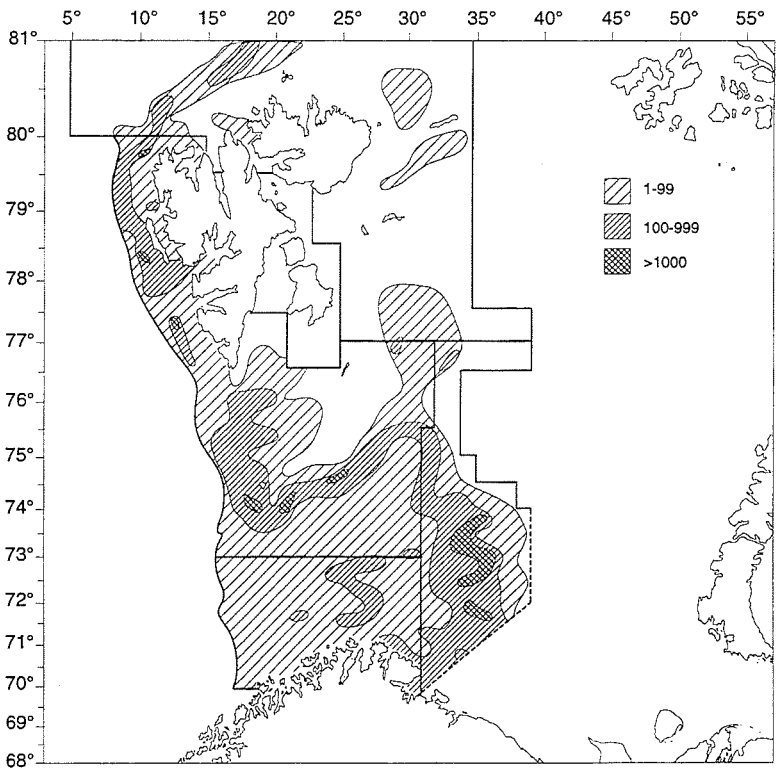

Figure 7. Catch rates (number/ 3 nautical mile) of cod >19cm, 1997.

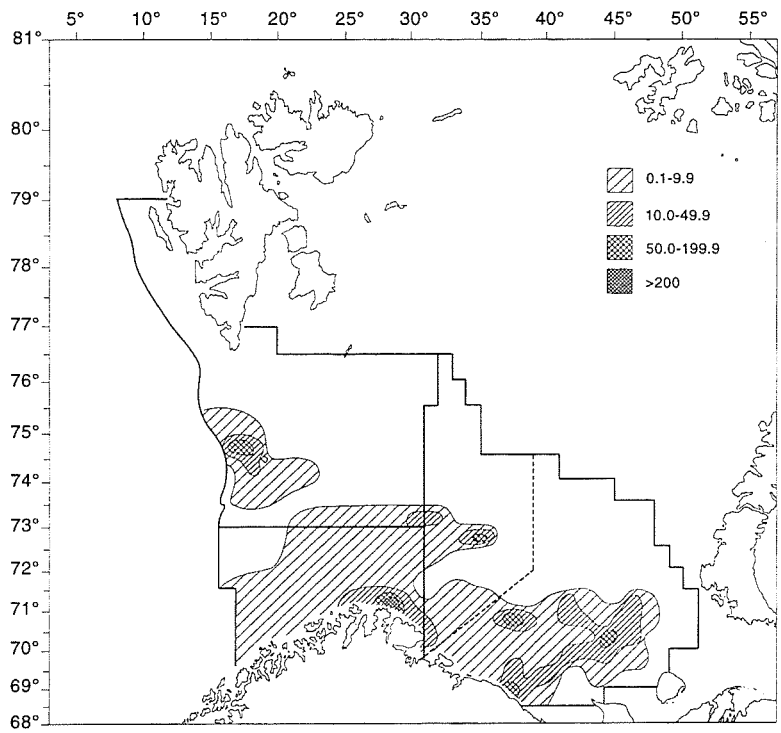

Figure 8. Acoustic densities (m^2 / $n.mile^2$) allocated to haddock, 1996.

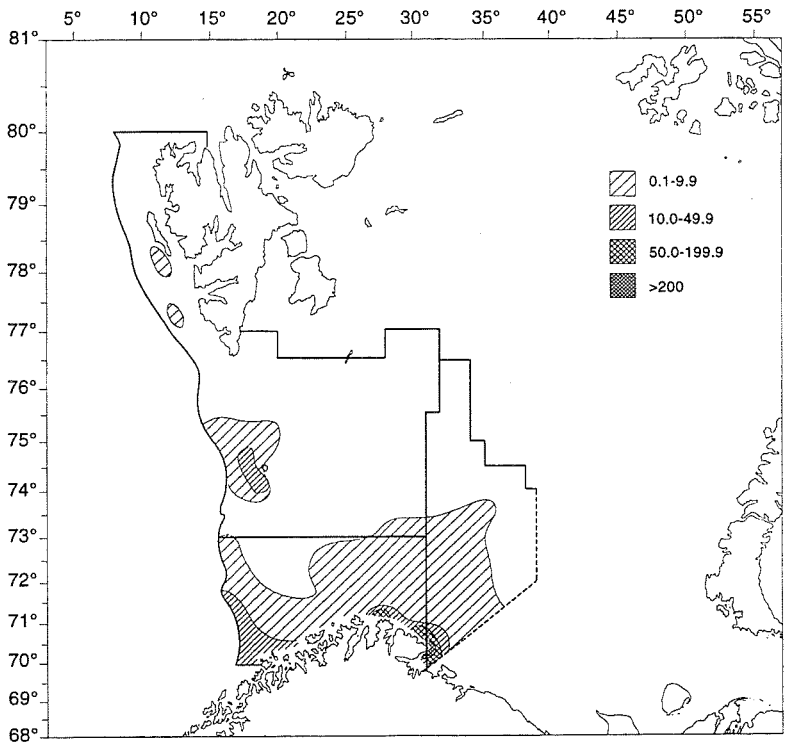

Figure 9. Acoustic densities (m^2 / $n.mile^2$) allocated to haddock, 1997.

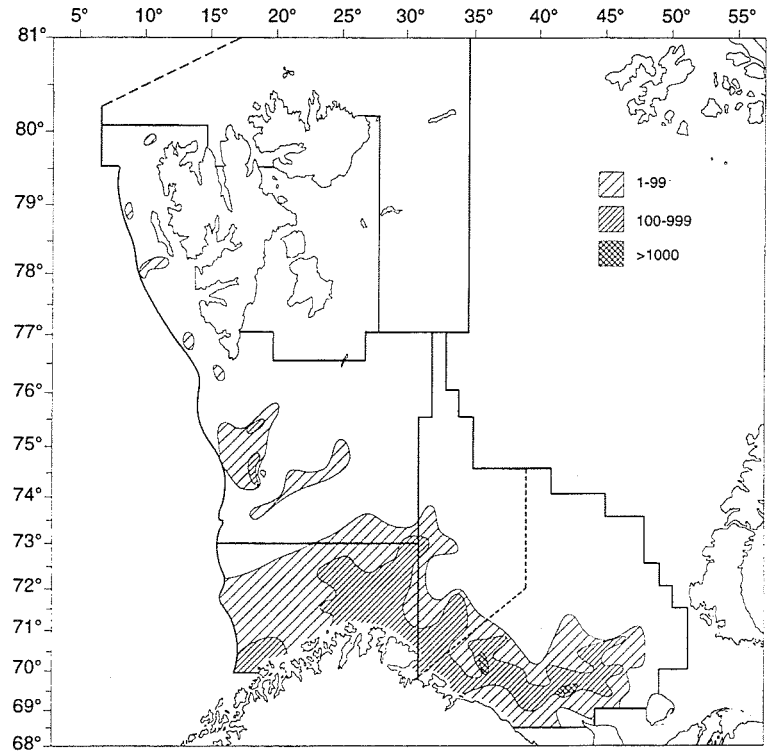

Figure 10. Catch rates (number/ 3 nautical mile) of haddock >19cm, 1996

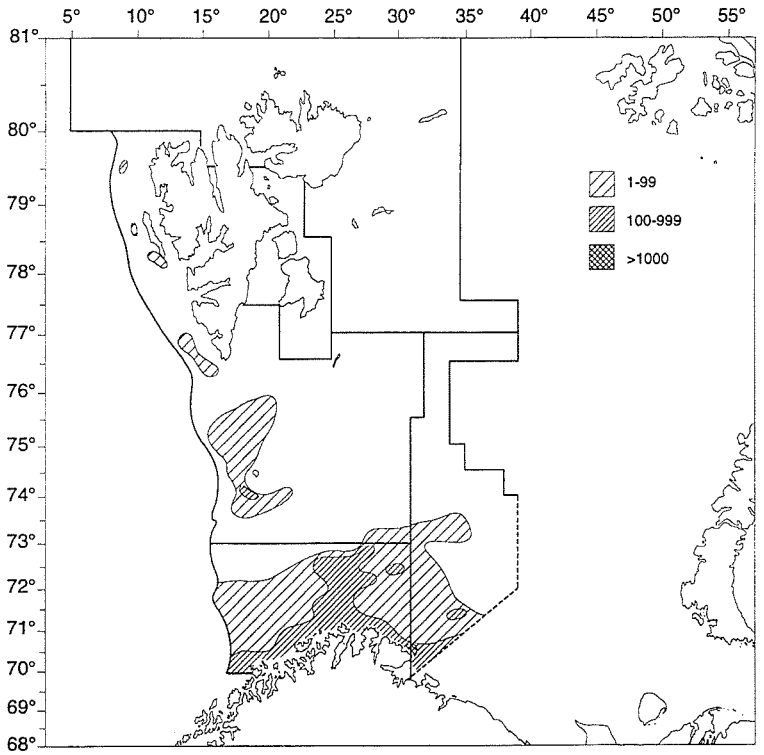

Figure 11. Catch rates (number/ 3 nautical mile) of haddock >19cm, 1997

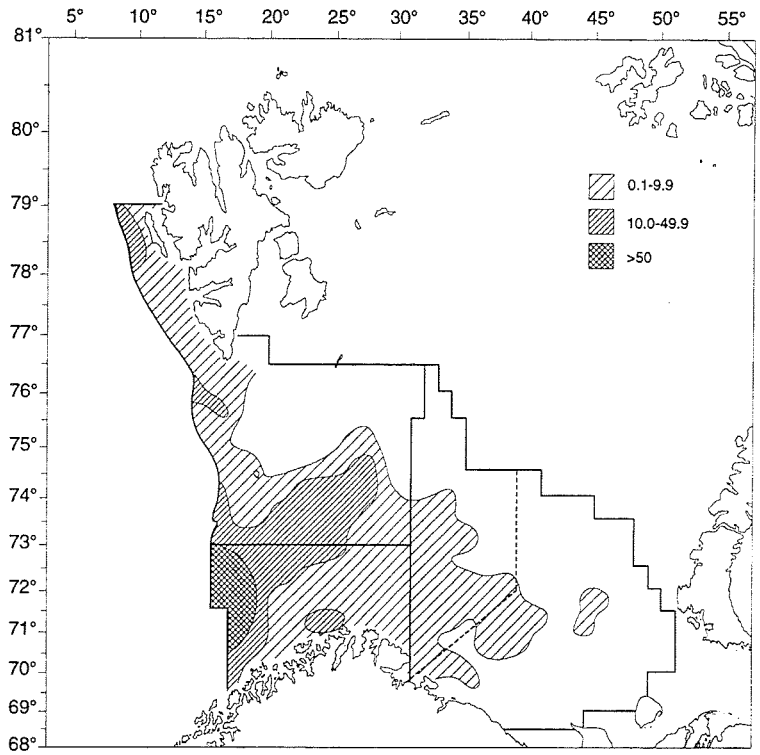

Figure 12. Acoustic densities (m^2 / $n.mile^2$) allocated to redfish, 1996

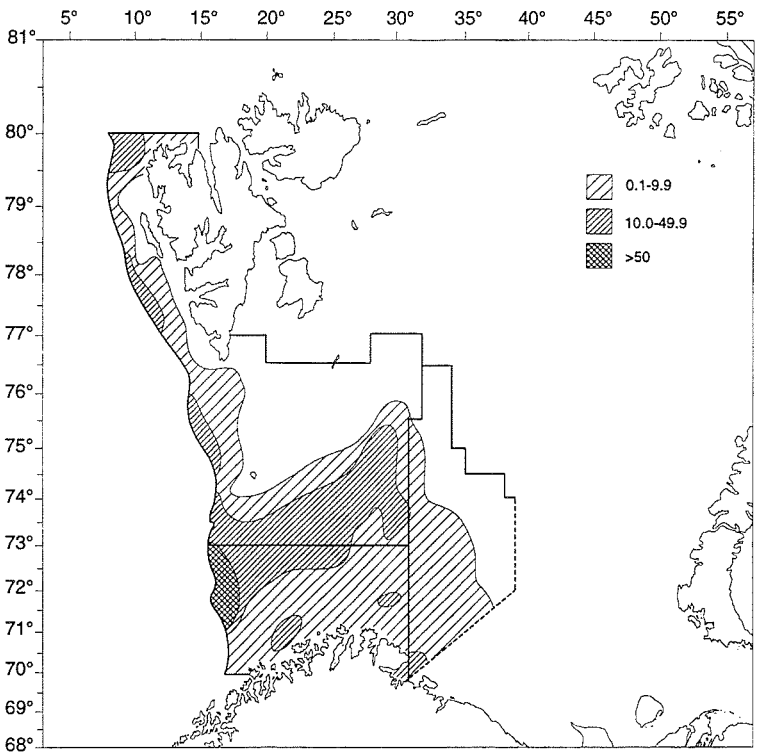

Figure 13. Acoustic densities (m^2 / $n.mile^2$) allocated to redfish, 1997

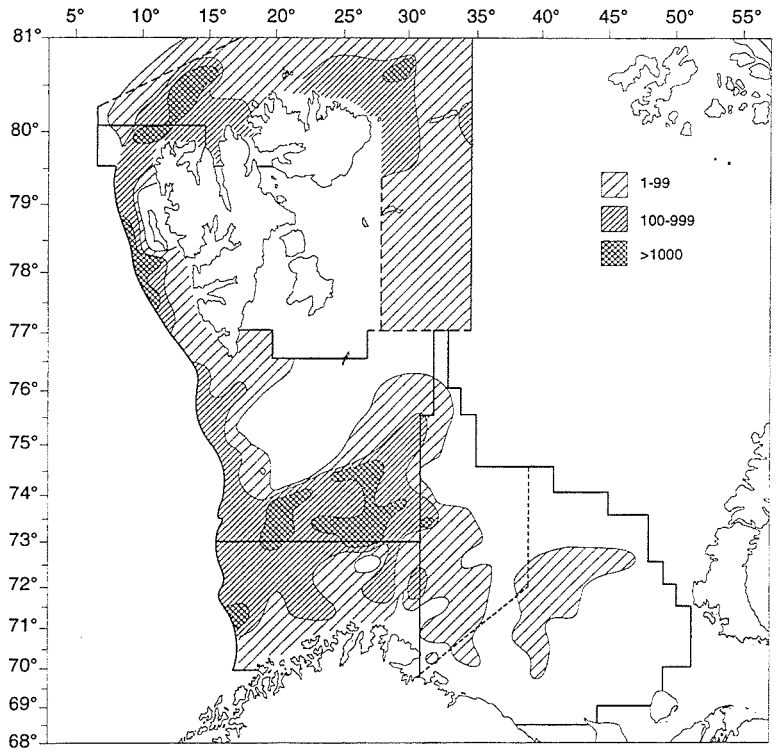

Figure 14. Catch rates (number/ 3 nautical mile) of *S. mentella*, 1996

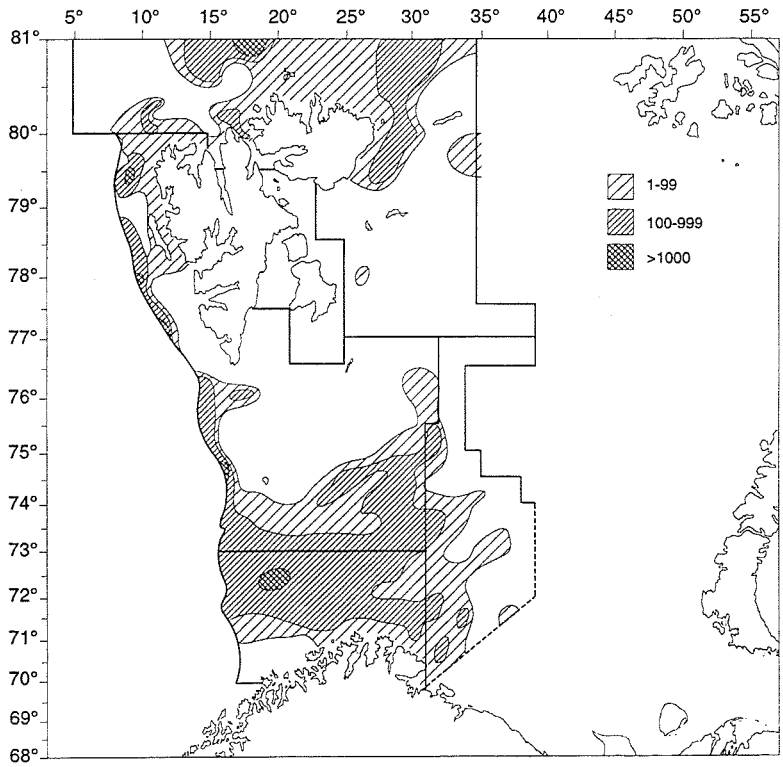

Figure 15. Catch rates (number/ 3 nautical mile) of *S. mentella*, 1997

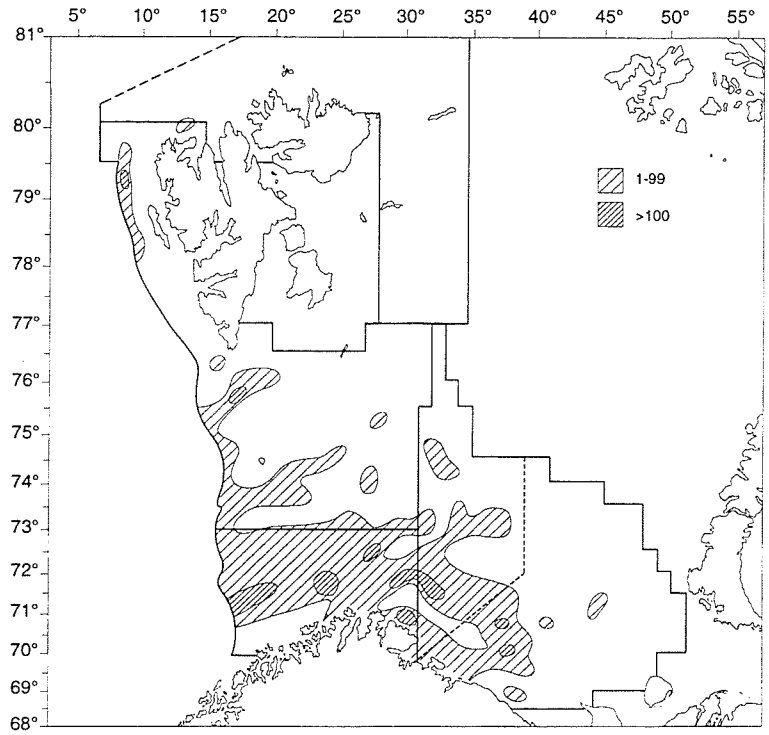

Figure 16. Catch rates (number/ 3 nautical mile) of *S. marinus*, 1996

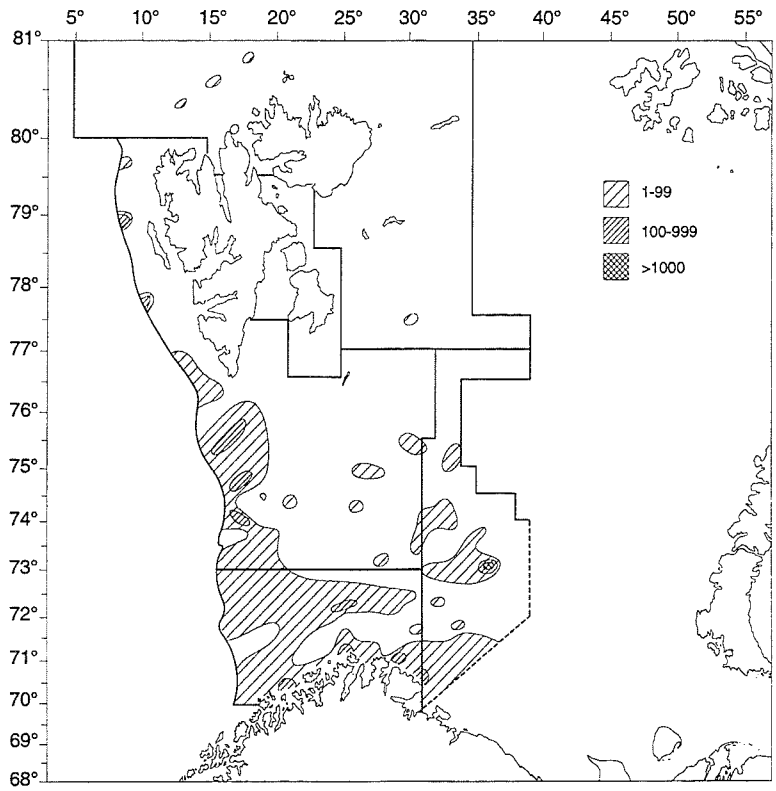

Figure 17. Catch rates (number/ 3 nautical mile) of *S. marinus*, 1997

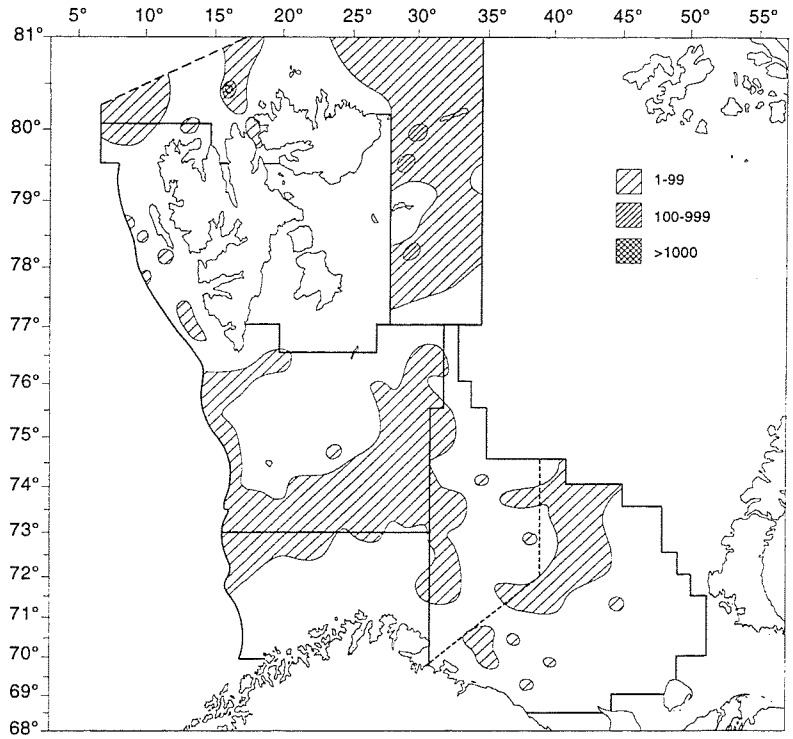

Figure 18. Catch rates (number/ 3 nautical mile) of Greenland halibut, 1996

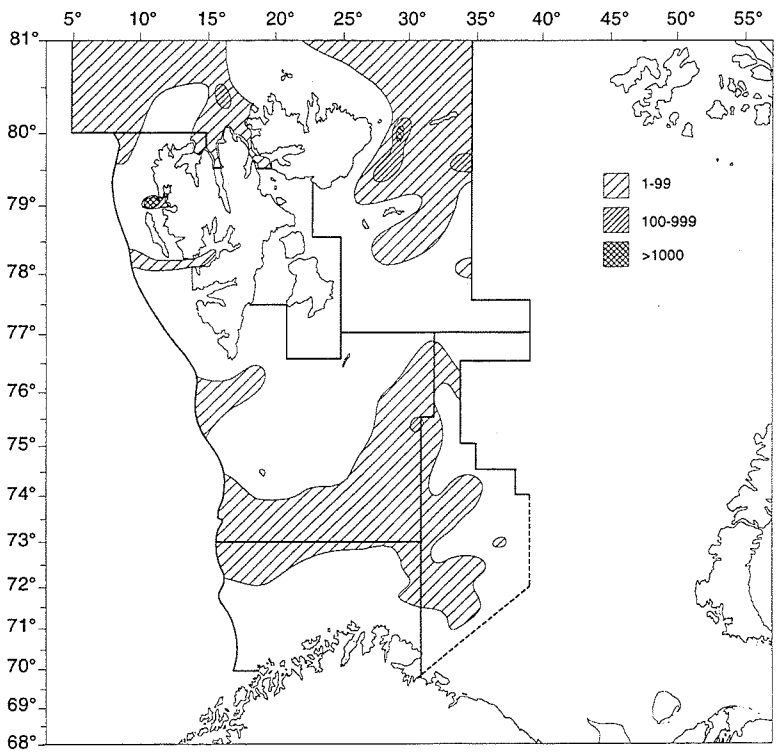

Figure 19. Catch rates (number/ 3 nautical mile) of Greenland halibut, 1997

Abundance estimates

For cod, haddock, *Sebastes mentella, S. marinus* and Greenland halibut swept area estimates by length and their coefficient of variation are given in Appendix 1-5.

Cod

Swept area estimates by age are shown in Table 6, total acoustic estimates by age in Table 7 and the combined swept area + pelagic (more than 10m above the bottom) acoustics in Table 8. The acoustic estimates were somewhat higher than the swept area estimates both in 1995 and 1997. In all the three years the combined estimates were higher than the total acoustic estimates, which means that the acoustic estimate in the lower 10 m above bottom was lower than the swept area estimate in all years.

Table 6. Cod. Swept area estimates (millions) by Region and year and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Age											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1se												
1995	317.54	102.54	72.94	113.78	79.56	23.83	7.75	1.20	0.46	0.17	0.13	0.17
1996	631.46	303.56	64.63	76.89	71.09	33.10	12.84	1.92	0.36	0.14	-	-
1nw												
1995	177.35	59.42	47.89	84.36	25.12	7.53	2.45	0.38	0.14	0.06	0.04	0.06
1996	666.03	197.94	30.73	27.28	21.01	10.91	6.08	1.56	0.33	-	0.10	0.10
1997	426.47	298.48	93.80	17.37	13.31	14.59	11.13	5.02	0.64	0.11	0.06	0.13
2a												
1995	85.75	15.67	5.48	9.53	12.31	4.04	0.93	0.47	0.03	-	-	-
1996	221.77	31.52	9.31	16.11	17.13	6.12	2.38	0.48	0.03	0.03	-	-
1997	102.53	40.70	19.07	4.04	4.47	5.46	2.56	0.56	0.41	0.09	0.12	0.06
2b												
1995	448.07	67.06	108.56	82.99	69.25	33.73	11.46	2.75	0.59	0.40	0.02	0.28
1996	548.16	192.49	60.02	38.06	35.11	31.93	17.65	2.29	0.38	0.09	0.15	0.20
1997	245.91	206.35	54.99	18.18	10.34	10.24	6.92	2.03	0.31	0.00	0.01	0.07
3												
1996	36.85	13.23	5.15	1.75	0.11	-	-	-	-	-	-	-
1997	1.99	7.50	1.67	0.47	0.12	0.15	0.23	0.10	0.01	-	-	-
1nw+2a+2b												
1995	711.17	142.15	161.93	176.88	106.68	45.30	14.84	3.60	0.76	0.46	0.06	0.34
1996	1435.96	421.95	100.06	81.45	73.25	48.96	26.11	4.33	0.74	0.12	0.25	0.30
1997	774.91	545.53	167.86	39.59	28.12	30.29	20.61	7.61	1.36	0.20	0.19	0.26
1se+1nw+2a+2b												
1995	1028.71	244.69	234.87	290.66	186.24	69.13	22.59	4.80	1.22	0.63	0.19	0.51
1996	2067.42	725.52	164.69	158.33	144.34	82.06	38.95	6.25	1.10	0.26	0.25	0.30
*1997	1115.68	938.00	276.28	76.96	55.41	50.77	30.75	10.97	2.01	0.44	0.19	0.26
Ratio 95	1.45	1.72	1.45	1.64	1.75	1.53	1.52	1.33	1.60	1.38	3.13	1.52
Ratio 96	1.44	1.72	1.65	1.94	1.97	1.68	1.49	1.44	1.48	2.20	1.00	1.00

*scaled by the ratios observed in 1996

Table 7. Cod. Acoustic estimates (millions) by Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Age											
/ Year	1	2	3	4	5	6	7	8	9	10	11	12+
1se												
1995	259.83	83.91	59.69	93.10	65.10	19.50	6.34	0.98	0.37	0.14	0.11	0.14
1996	605.27	290.97	61.95	73.70	68.14	31.73	12.31	1.84	0.34	0.14	-	-
1nw												
1995	403.32	135.13	108.91	191.86	57.13	17.11	5.57	0.86	0.33	0.13	0.09	0.13
1996	511.42	151.99	23.60	20.94	16.13	8.38	4.67	1.20	0.26	-	0.08	0.08
1997	382.53	267.73	84.14	15.58	11.94	13.09	9.98	4.50	0.57	0.10	0.05	0.12
2a												
1995	63.71	11.64	4.07	7.08	9.15	3.00	0.69	0.35	0.02	-	-	-
1996	169.61	24.11	7.12	12.32	13.10	4.68	1.82	0.37	0.02	0.02	-	-
1997	97.84	38.84	18.20	3.86	4.27	5.21	2.44	0.53	0.39	0.09	0.11	0.06
2b												
1995	728.33	109.00	176.46	134.90	112.56	54.83	18.63	4.47	0.96	0.65	0.03	0.46
1996	631.68	221.82	69.16	43.86	40.46	36.79	20.34	2.64	0.44	0.10	0.17	0.23
1997	623.79	523.44	139.49	46.12	26.23	25.98	17.55	5.15	0.79	0.00	0.03	0.18
1nw+2a+2b												
1995	1195.36	255.78	289.44	333.84	178.84	74.94	24.89	5.68	1.31	0.78	0.13	0.58
1996	1312.70	397.92	99.88	77.12	69.69	49.85	26.83	4.21	0.72	0.13	0.25	0.31
1997	1104.16	830.01	241.82	65.55	42.43	44.27	29.98	10.19	1.75	0.18	0.19	0.35
1se+1nw+2a+2b												
1995	1455.19	339.68	349.13	426.94	243.94	94.45	31.23	6.66	1.68	0.92	0.23	0.72
1996	1917.98	688.89	161.83	150.82	137.83	81.58	39.14	6.04	1.06	0.26	0.25	0.31
*1997	1613.28	1436.94	391.81	128.19	83.93	72.45	43.74	14.63	2.58	0.39	0.19	0.35
Ratio 95	1.22	1.33	1.21	1.28	1.36	1.26	1.25	1.17	1.29	1.18	1.84	1.25
Ratio 96	1.46	1.73	1.62	1.96	1.98	1.64	1.46	1.44	1.48	2.09	1.00	1.00

*scaled by the ratios observed in 1996

Table 8. Cod. Combined swept area + pelagic acoustic estimates (millions) by Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Age											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1nw+2a+2b												
1995	1427.17	306.77	337.85	395.31	213.05	88.26	29.08	6.76	1.52	0.89	0.15	0.67
1996	2347.79	694.49	165.55	133.39	119.83	81.07	43.34	7.14	1.23	0.20	0.42	0.50
1997	1638.14	1201.15	357.75	90.64	60.91	64.37	44.06	15.76	2.67	0.33	0.32	0.53
1se+1nw+2a+2b												
1995	1830.09	436.88	430.40	539.68	314.00	118.51	38.91	8.28	2.10	1.11	0.31	0.89
1996	3269.25	1137.47	259.86	245.58	223.57	129.37	62.08	9.94	1.75	0.41	0.42	0.50
*1997	2281.08	1967.30	561.56	166.89	113.63	102.72	63.12	21.92	3.79	0.68	0.32	0.53
Ratio 95	1.28	1.42	1.27	1.37	1.47	1.34	1.34	1.23	1.38	1.25	2.11	1.33
Ratio 96	1.39	1.64	1.57	1.84	1.87	1.60	1.43	1.39	1.42	2.06	1.00	1.00

*scaled by the ratios observed in 1996

Swept area estimates from autumn surveys in Region 2b since 1983 and in the Barents Sea since 1990 are listed in Table 9. The table indicates that all year classes since the 1994 year class have been quite abundant at age 1 and 2. It also indicates high mortality for most age groups in later years.

Table 9. The time series of swept area estimates (based on length dependent fishing width).

Region	Age								
Year	1	2	3	4	5	6	7	8	9+
Svalbard (2b)									
1983	173.7	25.4	9.3	7.4	1.7	1.4	0.7	0.9	0.2
1984	598.4	106.8	6.3	3.3	3.4	1.3	0.3	0.3	0.3
1985	280.6	447.7	81.1	21.5	9.8	3.9	0.7	0.3	0.2
1986	49.8	182.3	260.6	32.5	11.0	1.9	0.7	0.2	0.1
1987	48.7	112.3	128.0	103.5	12.5	3.9	0.4	0.1	0.1
1988	3.6	16.8	31.0	27.5	29.2	6.8	0.4	0.4	0.6
1989	4.5	2.6	13.5	10.7	9.3	13.9	2.3	0.3	0.1
1990	80.9	8.9	7.3	11.5	17.4	11.8	14.3	1.4	0.2
1991	134.2	92.1	20.6	6.3	9.9	11.5	9.7	13.6	1.1
1992	112.9	125.1	85.9	42.6	11.5	5.2	4.1	2.4	6.4
1993	178.1	135.6	126.5	48.8	21.0	2.4	2.8	1.6	3.9
1994	88.4	174.5	90.7	43.8	38.9	18.6	4.2	1.6	3.3
1995	448.1	67.1	108.6	83.0	69.3	33.7	11.5	2.8	1.3
1996	548.2	192.5	60.0	38.1	35.1	31.9	17.7	2.3	0.8
1997	245.9	206.4	55.0	18.2	10.3	10.2	6.9	2.0	0.4
Barents Sea (1se+1nw+2a)									
1990	117.0	18.5	24.9	13.8	20.7	19.5	43.7	4.0	0.6
1991	257.2	121.6	84.9	24.7	10.3	10.8	11.0	17.6	2.7
1992	337.2	324.4	154.3	127.1	21.4	12.6	5.9	4.3	5.8
1993	275.6	406.5	322.4	74.5	43.5	10.8	4.4	0.8	6.0
1994									
1995	580.6	177.6	126.3	207.7	117.0	35.4	11.1	2.1	1.3
1996	1519.3	533.0	104.7	120.3	109.2	50.1	21.3	4.0	1.1
*1997	869.8	731.7	221.3	58.8	45.1	40.5	23.8	8.9	2.5
Total (1se+1nw+2a+2b)									
1990	197.9	27.4	32.1	25.3	38.1	31.3	58.1	5.5	0.9
1991	391.4	213.6	105.6	31.0	20.2	22.3	20.7	31.3	3.8
1992	450.1	449.5	240.2	169.7	33.0	17.8	10.0	6.7	12.2
1993	453.7	542.1	448.9	123.2	64.6	13.2	7.2	2.4	9.8
1994									
1995	1028.7	244.7	234.9	290.7	186.2	69.1	22.6	4.8	2.6
1996	2067.5	725.5	164.7	158.3	144.3	82.1	39.0	6.3	1.9
*1997	1115.7	938.0	276.3	77.0	55.4	50.8	30.8	11.0	2.9

*scaled for uncovered areas

Table 10 shows survey mortality ($Z_{a,y}$) for age group a in year y, calculated as; $Z_{a,y} = -\ln(N_{a,y}/ N_{a-1,y-1})$, where $N_{a,y}$ is the survey estimate of age group a in year y. For the age groups 5-10 the arithmetic mean of the age specific mortalities is given. Due to missing values in 1994, annual mortality in 1994 and 1995 are given as half the mortality between the 1993 and 1995 surveys.

The swept area method show a considerable increased mortality for the age groups 2, 3 and 4 in 1997, while the older fish showed increased mortality in 1996, remaining high in 1997. The acoustic method and the combined method gave mortalities at the same general level, but showed a reduction from 1996 to 1997.

The biomass estimates for 3+ (fish at age 3 and older) and for 7+ (age 7 and older) are also listed in Table 10. For the later three years the swept area method showed a considerable decrease for 3+, and the 1997 estimate is 57% of the highest value in the time series (the 1995 value). The swept area estimate for 7+ in 1997 is 64% of the highest value in the time series (the 1991 value). The other methods give a less pessimistic trend over the last three years, particularly for 7+.

Table 10. Cod. Survey mortality rates for age groups 2, 3, 4 and 5-10 calculated from survey results, and biomass ('000 tonnes) for age group 3 and older (3+) and age group 7 and older (7+).

Method	Survey mortality				Biomass	
Year	2	3	4	5-10	3+	7+
Swept area						
1990	-	-	-	-	493	270
1991	-0.08	-1.35	0.04	0.47	557	276
1992	-0.14	-0.12	-0.47	0.69	726	149
1993	-0.19	0.00	0.67	0.92	791	104
1994	0.33	0.31	0.44	0.73	-	-
1995	-	0.33	0.31	0.63	894	126
1996	0.35	0.40	0.39	1.06	707	177
1997	0.79	0.97	0.76	1.07	513	176
Acoustics						
1995	-	-	-	-	1227	164
1996	0.75	0.74	0.84	1.41	685	170
1997	0.29	0.56	0.23	0.78	735	234
Swept area + Pelagic Acoustics						
1995	-	-	-	-	1551	204
1996	0.48	0.52	0.56	1.16	1101	273
1997	0.51	0.71	0.44	0.87	1036	342

Length at age (Table 11) and weight at age (Table 12) do not show clear trends over the last three years, but they are considerably lower than in the period 1990-1993.

Table 11. Cod. Mean length (cm) at age.

	Age											
	1	2	3	4	5	6	7	8	9	10	11	12
Svalbard (2b)												
1990	20.5	32.3	42.3	49.9	56.9	64.6	73.1	83.4				
1991	20.4	35.5	45.9	56.6	62.3	70.5	76.5	84.2				
1992	17.7	31.3	45.7	54.1	63.2	72.0	80.1	83.7				
1993	15.5	26.7	42.5	57.4	65.4	74.3	77.9	85.7	86.5	94.7	103.3	109.4
1994	16.2	22.7	33.0	48.5	60.7	69.7	75.8	85.3	94.8	95.6		
1995	16.2	24.6	33.3	45.7	57.8	66.9	75.9	79.6	90.7	94.5	106.1	101.1
1996	16.1	24.8	35.5	44.1	54.6	64.5	72.3	84.4	93.8	91.5	100.0	
1997	13.6	22.3	33.0	44.1	53.2	62.3	73.2	85.0	89.6	99.9	96.7	91.5
Barents Sea (1se+1nw+2a)												
1990	21.1	32.0	43.3	50.7	62.2	68.2	75.6	84.5				
1991	18.1	34.9	44.1	58.0	66.9	72.9	79.1	79.8				
1992	16.6	29.3	43.8	53.5	63.6	70.7	78.4	85.8				
1993	14.2	24.8	40.4	54.8	64.7	72.8	79.9	85.0	88.1	93.3	87.9	82.2
1994												
1995	15.0	20.8	33.1	42.6	55.9	66.2	78.6	84.4	86.2	103.9	98.7	104.2
1996	14.8	22.4	33.5	43.0	52.3	64.4	73.5	86.6	93.5	104.1	110.4	116.0
1997	13.9	22.5	34.4	44.9	51.9	62.6	65.5	82.1	93.3	98.0	102.0	
Total (1se+1nw+2a+2b)												
1990	20.9	32.1	43.1	50.3	59.8	66.8	75.0	84.2				
1991	18.9	35.2	44.5	57.7	64.6	71.7	77.9	81.7				
1992	16.9	29.9	44.5	53.7	63.5	71.1	79.1	85.1				
1993	14.7	25.3	41.0	55.9	65.0	73.1	79.1	85.5	87.5			
1994												
1995	15.5	21.8	33.2	43.5	56.6	66.5	77.2	81.7	88.5			
1996	15.1	23.0	34.2	43.3	52.9	64.4	73.0	85.8	93.6			
1997	13.8	22.4	34.0	44.6	52.3	62.5	68.4	82.9	92.7			

Table 12. Cod. Mean weight (grams) at age.

	Age											
	1	2	3	4	5	6	7	8	9	10	11	12
Svalbard (2b)												
1990	79	408	756	1237	1782	2483	3605	5653				
1991	81	439	1010	1842	2299	3424	4235	5795				
1992	49	277	914	1467	2277	3392	4823	5360				
1993	31	179	757	1756	2513	3605	4302	5553	5822	7641	10279	11335
1994	34	108	315	1063	1943	2834	3657	5152	7278	7787		
1995	36	133	352	859	1753	2663	3654	4214	5985	7191	12156	9247
1996	34	132	405	788	1439	2285	3172	5152	7915	7260	9221	
1997	28	99	358	827	1317	2265	2845	4772	6550	9080	10525	
Barents Sea (1se+1nw+2a)												
1990	88	303	773	1435	2228	2941	4165	5710				
1991	49	399	831	1945	2827	3630	4516	4889				
1992	38	223	797	1394	2348	3267	4541	5492				
1993	20	125	590	1478	2448	3350	4728	5683	5992	7425	6233	4925
1994												
1995	27	81	324	690	1495	2478	4171	5432	5865	9046	8002	10051
1996	25	95	318	622	1196	2261	3410	5704	7186	9755	11626	
1997	20	99	323	784	1335	2097	3376	5329	7460	7795	9718	7015
Total (1se+1nw+2a+2b)												
1990	84	337	769	1345	2024	2768	4027	5695				
1991	60	416	866	1924	2567	3524	4384	5284				
1992	41	238	839	1412	2323	3304	4657	5445				
1993	24	139	637	1588	2469	3397	4564	5595	5925			
1994												
1995	31	95	337	738	1591	2568	3909	4734	5926			
1996	27	105	350	662	1255	2270	3302	5502	7504			
1997	22	99	334	803	1329	2156	3179	5176	7302			

Haddock

Swept area estimates are shown in Table 13, acoustic estimates in Table 14 and combined swept area + pelagic acoustics in Table 15.

Table 13. Haddock. Swept area estimates (millions) by Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Age											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1se												
1995	133.72	67.11	12.33	46.41	75.38	4.51	0.32	-	-	-	0.12	0.08
1996	72.14	60.95	14.82	15.95	31.95	20.87	1.38	0.09	-	-	0.03	0.25
1nw												
1995	60.02	11.72	1.81	5.55	18.45	1.10	0.08	-	-	-	0.03	0.02
1996	51.57	40.36	7.70	3.51	3.08	1.44	0.10	0.01	-	-	0.01	0.03
1997	29.46	3.33	5.57	0.56	0.18	0.29	0.26	0.01	-	-	-	-
2a												
1995	323.34	117.23	16.75	10.41	14.25	2.59	-	-	0.05	-	-	0.07
1996	26.36	46.64	15.83	4.18	4.63	3.73	0.96	0.11	0.05	-	-	-
1997	324.80	36.11	39.99	13.85	2.12	2.18	7.40	0.70	0.03	0.00	0.36	0.12
2b												
1995	12.40	2.40	0.51	1.95	7.67	2.92	1.31	-	-	-	-	-
1996	3.06	1.97	0.49	0.38	1.12	1.13	0.08	0.05	-	-	0.01	-
1997	3.62	-	0.48	0.16	0.30	0.53	1.34	0.35	0.11	0.02	-	0.01
1nw+2a+2b												
1995	395.76	131.35	19.07	17.91	40.37	6.61	1.39	-	0.05	-	0.03	0.09
1996	80.99	88.97	24.02	8.07	8.83	6.30	1.14	0.17	0.05	-	0.02	0.03
1997	357.88	39.44	46.04	14.57	2.60	3.00	9.00	1.06	0.14	0.02	0.36	0.13
1se+1nw+2a+2b												
1995	529.48	198.46	31.40	64.32	115.75	11.12	1.71	-	0.05	-	0.15	0.17
1996	153.13	149.92	38.84	24.03	40.78	27.17	2.52	0.26	0.05	-	0.04	0.28
*1997	676.63	66.46	74.44	43.35	12.01	12.94	19.93	1.63	0.14	0.02	0.96	1.17
Ratio95	1.34	1.51	1.65	3.59	2.87	1.68	1.23	1.00	1.00	1.00	5.09	1.90
Ratio96	1.89	1.69	1.62	2.98	4.62	4.31	2.21	1.53	1.00	1.00	2.67	9.02

*scaled by the ratios observed in 1996

Table 14. Haddock. Acoustic estimates (millions) by Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Age											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1se												
1995	187.76	94.23	17.32	65.17	105.84	6.33	0.45	-	-	-	0.17	0.11
1996	63.07	53.29	12.96	13.95	27.94	18.25	1.21	0.08	-	-	0.02	0.22
1nw												
1995	20.79	4.06	0.63	1.92	6.39	0.38	0.03	-	-	-	0.01	0.01
1996	38.71	30.29	5.78	2.64	2.31	1.08	0.07	0.01	-	-	0.00	0.02
1997	122.63	13.86	23.19	2.33	0.75	1.21	1.08	0.04	-	-	-	-
2a												
1995	136.34	49.43	7.06	4.39	6.01	1.09	-	-	0.02	-	-	0.03
1996	50.55	89.43	30.35	8.02	8.88	7.15	1.84	0.21	0.10	-	-	-
1997	321.17	35.71	39.54	13.70	2.10	2.16	7.32	0.69	0.03	-	0.36	0.12
2b												
1995	12.20	2.36	0.50	1.92	7.54	2.87	1.29	-	-	-	-	-
1996	13.44	8.65	2.15	1.67	4.92	4.96	0.35	0.22	-	-	0.04	-
1997	7.45	-	0.99	0.33	0.62	1.09	2.76	0.72	0.23	0.04	-	0.02
1nw+2a+2b												
1995	169.32	55.85	8.19	8.23	19.94	4.35	1.32	-	0.02	-	0.01	0.04
1996	102.70	128.38	38.29	12.32	16.11	13.20	2.26	0.44	0.10	-	0.05	0.02
1997	451.25	49.57	63.72	16.36	3.46	4.45	11.16	1.45	0.26	0.04	0.36	0.14
1se+1nw+2a+2b												
1995	357.08	150.08	25.51	73.40	125.78	10.67	1.77	-	0.02	-	0.18	0.15
1996	165.77	181.67	51.25	26.27	44.04	31.45	3.47	0.51	0.10	-	0.07	0.24
*1997	728.35	70.14	85.28	34.87	9.47	10.61	17.10	1.71	0.26	0.04	0.52	1.44
Ratio95	2.11	2.69	3.11	8.92	6.31	2.46	1.34	1.00	1.00	1.00	1.00	4.11
Ratio96	1.61	1.42	1.34	2.13	2.73	2.38	1.53	1.18	1.00	1.00	1.46	10.3

*scaled by the ratios observed in 1996

Table 15. Haddock. Combined swept area + pelagic acoustic estimates (millions) by Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Age											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1nw+2a+2b												
1995	480.90	159.60	23.19	21.89	49.66	8.45	1.89	-	0.06	-	0.03	0.11
1996	169.44	199.41	56.75	18.50	21.86	16.74	3.01	0.50	0.13	-	0.05	0.05
1997	632.84	69.65	85.29	24.38	4.71	5.74	15.72	1.94	0.30	0.05	0.57	0.21
1se+1nw+2a+2b												
1995	748.21	293.75	47.84	114.66	200.34	17.46	2.53	-	0.06	-	0.28	0.27
1996	275.45	288.99	78.53	41.94	68.82	47.41	5.04	0.63	0.13	-	0.08	0.42
*1997	1028.78	100.94	118.02	55.28	14.83	16.25	26.32	2.45	0.30	0.05	1.01	1.68
Ratio95	1.56	1.84	2.06	5.24	4.03	2.07	1.34	1.00	1.00	1.00	7.90	2.48
Ratio96	1.63	1.45	1.38	2.27	3.15	2.83	1.67	1.26	1.00	1.00	1.77	7.91

*scaled by the ratios observed in 1996

Sebastes mentella

Estimates by age are given in Appendix 6. The age sampling has been incomplete for several length groups in some Regions. In addition there also seem to be some inconsistencies in the age readings. Therefore abundance estimates by length groups are considered to be more reliable (Tables 16-18). The abundance of fish less than 10 cm decreased considerably in 1997. For this size group the swept area estimates (Table 16) in Region 3 were larger than in the other areas combined. Size group 10-14 was also relatively abundant in Region 3 both years, while larger fish were rather scarce in this Region.

Table 16. *S. mentella*. Swept area estimates (millions) by length groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	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
1se											
1995	0.95	0.22	4.33	2.38	0.19	0.01	0.01	-	-	-	-
1996	1.55	4.39	5.20	6.75	0.18	0.07	0.05	-	-	-	-
1nw											
1995	37.32	8.76	169.34	92.92	7.45	0.43	0.37	0.04	-	-	-
1996	2.07	4.06	6.03	7.55	0.28	0.07	0.05	-	-	-	-
1997	0.28	9.93	4.30	10.90	3.97	0.44	0.05	0.02	-	-	-
2a											
1995	71.55	23.53	63.08	214.03	151.11	33.59	9.44	0.29	0.23	-	-
1996	91.24	44.51	8.42	107.60	83.60	24.40	12.27	2.29	0.14	0.14	0.10
1997	3.88	83.15	27.98	53.93	111.10	25.43	9.59	1.24	0.11	-	-
2b											
1995	32.53	33.38	416.81	349.33	77.15	17.85	5.08	0.69	0.06	-	-
1996	55.98	68.85	138.83	310.14	97.24	8.05	4.37	0.93	0.39	0.05	-
1997	3.37	43.50	12.64	64.78	57.33	9.03	4.50	0.15	0.12	-	-
3											
1996	276.97	87.59	24.65	14.95	0.52	0.79	0.07	0.08	-	-	-
1997	8.05	39.45	8.31	5.81	2.66	0.40	-	-	-	-	-
1nw+2a+2b											
1995	141.40	65.67	649.23	656.28	235.71	51.87	14.89	1.02	0.29	-	-
1996	149.29	117.42	153.28	425.29	181.12	32.52	16.69	3.22	0.53	0.19	0.10
1997	7.53	136.58	44.92	129.61	172.40	34.90	14.14	1.41	0.23	-	-
1se+1nw+2a+2b											
1995	142.35	65.89	653.56	658.66	235.90	51.88	14.90	1.02	0.29	-	-
1996	150.84	121.80	158.47	432.04	181.29	32.59	16.73	3.22	0.53	0.19	0.10
*1997	7.61	141.68	46.44	131.67	172.57	34.98	14.18	1.41	0.23	-	-
Ratio95	1.01	1.00	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ratio96	1.01	1.04	1.03	1.02	1.00	1.00	1.00	1.00	1.00	1.00	1.00

*scaled by the ratios observed in 1996

The acoustic estimates are shown in Table 17 and the combined bottom trawl and pelagic acoustics (more than 10m above bottom) are shown in Table 18.

Table 17. *S. mentella.* Acoustic estimates (millions) by length groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	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
1se											
1995	0.45	0.11	2.06	1.13	0.09	0.01	0.00	-	-	-	-
1996	0.21	0.59	0.69	0.90	0.02	0.01	0.01	-	-	-	-
1nw											
1995	8.57	2.01	38.90	21.35	1.71	0.10	0.09	0.01	-	-	-
1996	2.63	5.14	7.64	9.58	0.35	0.09	0.06	-	-	-	-
1997	0.12	4.10	1.78	4.50	1.64	0.18	0.02	0.01	-	-	-
2a											
1995	41.91	13.78	36.95	125.37	88.51	19.68	5.53	0.17	0.13	-	-
1996	153.46	74.86	14.16	180.98	140.61	41.04	20.64	3.85	0.24	0.24	0.17
1997	4.36	93.44	31.44	60.60	124.85	28.58	10.78	1.39	0.12	-	-
2b											
1995	17.32	17.78	221.98	186.04	41.09	9.51	2.71	0.37	0.03	-	-
1996	48.09	59.15	119.27	266.44	83.54	6.92	3.75	0.80	0.34	0.04	-
1997	7.33	94.57	27.48	140.83	124.63	19.63	9.78	0.33	0.26	-	-
1nw+2a+2b											
1995	67.81	33.57	297.83	332.76	131.31	29.28	8.32	0.55	0.17	-	-
1996	204.18	139.16	141.07	457.00	224.50	48.04	24.45	4.65	0.57	0.28	0.17
1997	11.80	192.11	60.70	205.93	251.12	48.39	20.58	1.73	0.38	-	-
1se+1nw+2a+2b											
1995	68.26	33.68	299.89	333.89	131.40	29.29	8.32	0.55	0.17	-	-
1996	204.39	139.74	141.77	457.90	224.52	48.05	24.45	4.65	0.57	0.28	0.17
*1997	11.81	192.91	61.00	206.34	251.14	48.40	20.59	1.73	0.38	-	-
Ratio95	1.01	1.00	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ratio96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

*scaled by the ratios observed in 1996

Table 18. *S. mentella.* Combined swept area + pelagic Acoustic estimates (millions) by length groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	Length groups (cm)										
Year	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
1nw+2a+2b											
1995	185.02	88.68	861.96	885.74	321.80	71.13	20.36	1.41	0.40	-	-
1996	316.70	231.54	269.68	802.24	366.03	71.90	36.73	7.04	1.00	0.42	0.24
1997	17.22	290.60	93.22	300.69	373.84	73.05	30.58	2.72	0.55	-	-
1se+1nw+2a+2b											
1995	185.99	88.90	866.38	888.16	321.99	71.14	20.37	1.41	0.40	-	-
1996	318.30	236.07	275.05	809.21	366.21	71.98	36.78	7.04	1.00	0.42	0.24
*1997	17.31	296.28	95.08	303.31	374.03	73.12	30.62	2.72	0.55	-	-
ratio95	1.01	1.00	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ratio96	1.01	1.02	1.02	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Sebastes marinus

Esimates by age are given in Appendix 7. The age sampling has been incomplete for several length groups in some Regions. In addition there also seem to be some inconsistencies in the age readings. Therefore abundance estimates by length groups are considered to be more reliable. The swept area estimates are shown in Table 19, acoustic estimates in Table 20 and combined swept area + pelagic acoustics in Table 21. Also for this species the estimates of fish less than 10 cm were low in 1997.

Table 19. *S. marinus*. Swept area estimates (millions) by length groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region	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
1se												
1995	0.06	3.03	2.36	3.00	2.78	2.00	3.30	3.28	2.13	0.10	0.01	-
1996	0.60	1.53	1.80	5.64	2.89	1.33	0.69	0.17	0.15	0.03	0.02	-
1nw												
1995	0.06	2.67	2.07	2.64	2.44	1.76	2.91	2.89	1.87	0.08	0.01	-
1996	0.45	1.46	1.81	5.46	2.78	1.22	0.68	0.17	0.15	0.03	0.02	-
1997	-	0.11	0.21	1.15	1.72	2.54	5.62	8.49	2.70	0.04	0.04	-
2a												
1995	-	0.71	1.85	5.02	5.48	2.01	3.64	2.79	0.87	0.08	0.05	-
1996	2.49	3.17	5.03	12.18	11.78	4.29	4.98	7.50	4.69	1.59	0.08	0.18
1997	0.02	0.05	0.16	0.39	1.23	6.55	8.73	3.51	1.13	0.42	0.33	0.08
2b												
1995	0.47	2.00	9.10	5.07	3.06	2.40	1.04	0.92	0.44	0.24	0.05	0.05
1996	0.08	0.13	1.26	2.48	1.03	0.48	0.55	0.99	0.19	0.09	0.08	0.04
1997	0.04	0.81	1.98	5.47	5.56	2.34	0.59	0.19	0.22	0.17	0.04	0.02
1nw+2a+2b												
1995	0.53	5.38	13.02	12.73	10.98	6.17	7.59	6.60	3.18	0.40	0.11	0.05
1996	3.02	4.76	8.10	20.12	15.59	5.99	6.21	8.66	5.03	1.71	0.18	0.22
1997	0.06	0.97	2.35	7.01	8.51	11.43	14.94	12.19	4.05	0.63	0.41	0.10
1se+1nw+2a+2b												
1995	0.59	8.41	15.38	15.73	13.76	8.17	10.89	9.88	5.31	0.50	0.12	0.05
1996	3.62	6.29	9.90	25.76	18.48	7.31	6.89	8.83	5.17	1.74	0.19	0.22
*1997	0.07	1.28	2.87	8.98	10.09	13.96	16.59	12.43	4.17	0.63	0.45	0.10
ratio95	1.12	1.56	1.18	1.24	1.25	1.32	1.44	1.00	1.67	1.00	1.10	1.00
ratio96	1.20	1.32	1.22	1.28	1.19	1.22	1.11	1.02	1.03	1.00	1.09	1.00

*scaled by the ratios observed in 1996

Table 20. *S. marinus*. Acoustic estimates (millions) by length groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region		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
1se													
	1995	0.03	1.44	1.12	1.42	1.32	0.95	1.57	1.56	1.01	0.05	0.01	-
	1996	0.08	0.20	0.24	0.75	0.39	0.18	0.09	0.02	0.02	0.00	0.00	-
1nw													
	1995	0.01	0.61	0.48	0.61	0.56	0.40	0.67	0.66	0.43	0.02	0.00	-
	1996	0.57	1.85	2.30	6.93	3.53	1.54	0.86	0.22	0.18	0.04	0.02	-
	1997	-	0.05	0.09	0.47	0.71	1.05	2.32	3.51	1.12	0.02	0.02	-
2a													
	1995	-	0.42	1.08	2.94	3.21	1.18	2.13	1.63	0.51	0.05	0.03	-
	1996	4.19	5.33	8.46	20.49	19.81	7.22	8.38	12.61	7.89	2.67	0.13	0.30
	1997	0.02	0.06	0.18	0.44	1.38	7.36	9.81	3.94	1.27	0.47	0.37	0.09
2b													
	1995	0.25	1.07	4.85	2.70	1.63	1.28	0.55	0.49	0.23	0.13	0.03	0.03
	1996	0.07	0.11	1.08	2.13	0.88	0.41	0.47	0.85	0.16	0.08	0.07	0.03
	1997	0.09	1.76	4.30	11.89	12.09	5.09	1.28	0.41	0.48	0.37	0.09	0.04
1nw+2a+2b													
	1995	0.26	2.09	6.41	6.25	5.40	2.86	3.35	2.79	1.17	0.19	0.06	0.03
	1996	4.83	7.30	11.84	29.54	24.22	9.17	9.70	13.68	8.24	2.79	0.22	0.34
	1997	0.11	1.86	4.57	12.80	14.18	13.50	13.41	7.86	2.86	0.86	0.47	0.13
1se+1nw+2a+2b													
	1995	0.29	3.53	7.52	7.67	6.72	3.81	4.92	4.35	2.18	0.24	0.06	0.03
	1996	4.91	7.50	12.08	30.30	24.61	9.35	9.80	13.70	8.25	2.79	0.22	0.34
	*1997	0.11	1.91	4.66	13.13	14.41	13.76	13.54	7.88	2.87	0.86	0.48	0.13
ratio95		1.12	1.69	1.17	1.23	1.24	1.33	1.47	1.56	1.86	1.23	1.09	1.00
ratio96		1.02	1.03	1.02	1.03	1.02	1.02	1.01	1.00	1.00	1.00	1.01	1.00

*scaled by the ratios observed in 1996

Table 21. *S. marinus*. Combined swept area + pelagic Acoustic estimates (millions) by length groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region		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
1nw+2a+2b													
	1995	0.72	6.79	17.62	16.92	14.50	8.09	9.69	8.35	3.92	0.54	0.15	0.07
	1996	6.90	10.49	17.51	43.44	34.97	13.29	14.04	19.83	11.74	3.99	0.36	0.50
	1997	0.15	2.59	6.33	18.12	20.66	22.02	24.91	18.00	6.21	1.31	0.77	0.20
1se+1nw+2a+2b													
	1995	0.79	9.88	20.03	19.98	17.33	10.13	13.06	11.70	6.09	0.64	0.16	0.07
	1996	7.52	12.08	19.37	49.27	37.95	14.66	14.75	20.01	11.89	4.02	0.37	0.50
	1997	0.17	2.98	7.00	20.56	22.42	24.29	26.16	18.16	6.29	1.32	0.80	0.20
ratio95		1.09	1.45	1.14	1.18	1.20	1.25	1.35	1.40	1.55	1.18	1.07	1.00
ratio96		1.09	1.15	1.11	1.13	1.09	1.10	1.05	1.01	1.01	1.01	1.04	1.00

*scaled by the ratios observed in 1996

Greenland halibut

Swept area estimates by age are shown in Table 22.

Table 22. Greenland halibut. Swept area estimates (millions) by age groups, Region and year, and ratios between (1se+1nw+2a+2b) and (1nw+2a+2b).

Region							Age					
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1se												
1995	0.01	-	0.08	0.22	0.30	0.47	0.48	0.28	0.00	0.04	0.04	-
1996	2.09	-	0.02	0.01	0.01	0.15	0.30	0.35	0.04	0.08	0.02	-
1nw												
1995	0.01	-	0.10	0.29	0.39	0.63	0.64	0.38	0.00	0.05	0.05	-
1996	3.52	0.02	0.02		0.01	0.15	0.28	0.30	0.03	0.05	0.02	-
1997	0.11	0.47	0.02	0.11	0.19	0.53	0.88	0.26	0.02	0.02	-	-
2a												
1995	-	-	-	0.13	0.33	-	0.53	0.38	-	0.10	0.10	-
1996	-	-	-	-	0.04	0.13	0.10	0.22	0.29	-	-	-
1997	-	-	-	-	0.08	0.10	0.30	0.23	0.20	-	-	-
2b												
1995	0.07	-	0.10	0.37	1.14	1.75	2.79	0.62	0.14	0.29	0.18	0.11
1996	3.38	0.40	0.09	0.31	1.20	2.76	3.59	1.25	0.29	0.55	0.03	0.13
1997	0.65	2.77	0.50	0.09	0.63	3.09	3.04	0.49	0.33	0.04	-	-
3												
1996	15.69	14.62	10.03	3.73	2.35	2.03	2.50	0.58	0.10	0.21	0.05	-
1997	3.34	8.29	16.28	6.37	2.00	0.49	0.50	0.04	-	-	-	-
1nw+2a+2b												
1995	0.08	-	0.20	0.79	1.86	2.38	3.96	1.38	0.14	0.44	0.33	0.11
1996	6.90	0.42	0.11	0.31	1.25	3.04	3.97	1.77	0.61	0.60	0.05	0.13
1997	0.76	3.24	0.52	0.20	0.90	3.72	4.22	0.98	0.55	0.06	-	-
1se+1nw+2a+2b												
1995	0.09	-	0.28	1.01	2.16	2.85	4.44	1.66	0.14	0.48	0.37	0.11
1996	8.99	0.42	0.13	0.32	1.27	3.20	4.27	2.13	0.65	0.68	0.06	0.13
*1997	0.99	3.24	0.64	0.20	0.91	3.91	4.54	1.18	0.59	0.06	-	-
ratio95	1.11	1.00	1.38	1.28	1.16	1.20	1.12	1.00	1.00	1.00	1.12	1.00
ratio96	1.30	1.00	1.22	1.02	1.01	1.05	1.08	1.20	1.07	1.00	1.33	1.00

*scaled by the ratios observed in 1996

DISCUSSION

The 1997 abundance estimates depend on the scaling factors used for taking account of the uncovered Region 1se. The ratios calculated from the 1996 survey were applied as scaling factors for 1997, mainly because they were closest in time. In 1995 and 1996 Region 1se contained a rather low proportion of the total amount of redfish and Greenland halibut, and it is reasonable to assume that this would also have been the case in 1997. This means that the lack of coverage might have caused rather minor errors for those species. For haddock the scaling factors derived from the 1995 and the 1996 surveys were quite high and rather different between the years, and the errors caused by lack of coverage are likely to be quite serious. For cod the scaling factors were also rather high (but less variable between years compared to the factors for haddock), and the errors caused by lack of coverage could be quite high.

Applying the 1995 scaling factor for cod in 1997 would give 20-25 % lower swept area estimates for ages 4 and 5 and moderate changes for the other age groups, while the acoustic estimates of cod would be reduced by 20-35% for all the age groups 2-6.

The allocation of acoustic values to species is based on the trawl catch compositions and the patterns seen on the echograms. Proper pelagic sampling has shown to be difficult. The species involved tend to dive when approached by the trawl, and particularly fish distributed far above bottom have been difficult to catch. When towing somewhat deeper than the echo recordings observed on the hull mounted sounder, some fish were usually caught, but it was often difficult to judge which part of the echo recordings which actually had been sampled. Therefore, both the species and size composition of the fish recorded in the pelagic zone are rather uncertain. For cod there was indications of a pattern that the 1 and 2 year olds were missing in the pelagic catches. The acoustic estimates presented here are entirely based on length distributions from bottom trawl catches. For cod, therefore, both the acoustic estimates and the combined swept area plus pelagic acoustics might overestimate the youngest age groups and underestimate the older fish. Ongoing studies on the relationship between the size distribution in pelagic catches and bottom trawl catches may form a basis for improving the acoustic estimates.

The coefficient of variation for the swept area estimates of the dominating length groups (Appendix 1-6) indicates that the precision in 1997 (compared to the two previous years) was reduced for cod and haddock, improved for Greenland halibut and was fairly unchanged for *Sebastes mentella* and *S. marinus*. Reduced precision seems to be linked to the reduced coverage in Region 1. For redfish and Greenland halibut the area uncovered in 1997 mainly represented zero catches in previous years, thus having minor impact on the precision. The improvement for Greenland halibut seems to be linked to the additional sampling in Region 3.

REFERENCES

Aglen, A. and Nakken, O. 1996. Bunnfiskundersøkelser i Barentshavet sommeren 1995. (Investigations on demersal fish in the Barents Sea summer 1995). Fisken og Havet nr 30- 1996. 33p. (in Norwegian with English summary, table headings and figure captions).

Engås, A. and Godø, O.R. 1989a. Escape of fish under the fishing line of a Norwegian sampling trawl and its influence on survey results. Journal du Conseil International pour l'Exploration de la Mer, 45:269-276.

Engås, A. and Godø, O.R. 1989b. Swept area variation with depth and its influence on abundance indices of groundfish from trawl surveys. J. Northw. Atl. Fish. Sci., Vol 9:133-139.

Gundersen, A.C., Nedreaas, K.H., Smirnov, O.V., Albert, O.T. and Nilssen, E. 1997. Extension of recruitment and nursery areas of Greenland halibut *(Reinhardtius hippoglossoides)* into the Arctic. Poster. ICES Symposium on "Recruitment Dynamics of Exploited Marine Populations: Physical-Biological Interactions": Baltimore, Maryland, USA, 22-24 September 1997. (Proceedings to be published in ICES Journal of Marine Science).

Jakobsen, T., Korsbrekke, K., Mehl, S. and Nakken, O. 1997. Norwegian combined acoustic and bottom trawl surveys for demersal fish in the Barents Sea during winter. ICES CM 1997/Y:18, 26p.

Knudsen, H.P. 1990. The Bergen Echo Integrator: an introduction. J.Cons. int Explor. Mer, 47:167-174.

Senneset, H. 1992. Intern toktrapport, F/T "Anny Kræmer", 7. august - 14. september 1991. Interne toktrapporter, Havforskningsinstituttet, Nr 2-1992 (IT XIV-92). (In Norwegian).

PARTICIPANTS

1996

VESSEL	Johan Hjort	Michael Sars	Varegg	Hopen	Hopen
DEPARTURE	Tromsø 07.08.1996	Tromsø 24.07.1996	Tromsø 01.08.1996	Tromsø 01.08.1996	Tromsø 23.08.1996
PORT OF CALL		Kirkenes 07.08.1996	Longyearbyen 10.08.1996		Longyearbyen 30.08.1996
ARRIVAL	Hammerfest 22.08.1996	Hammerfest 20.08.1996	Tromsø 23.08.1996	Tromsø 22.08.1996	Tromsø 17.09.1996
PARTICIPANTS	O. R. Godø	O. Nakken	B.K. Berentsen	A.Aglen	A. Gundersen
	M. Møgster	K. Michalsen	S. Lemvig	J. Birkeland	I. Smedstad
	A. Leithe	H. Larsen	E. Johnsen	A. Salthaug	O. Rasmussen
	A. Storaker	L. Solbakken	Kaare Hansen	J. Kristiansen	O. Smirnov*
	K. Kvalsvik	A. Sæverud			
	A. Romslo	P. Pahr			
	A. Totland	Ø. Nævdal			
	Y. Lepesevich*	K. Bolstad			
	C. Wilson*	R. Pedersen			

* Visiting scientist

1997

VESSEL	Johan Hjort	Michael Sars	Varegg	Hopen	Tromsland
DEPARTURE	Tromsø 18.07.1997	Tromsø 29.07.1997	Tromsø 25.07.1997	Tromsø 25.07.1997	Longyearbyen 27.08.1997
PORT OF CALL			Tromsø 06.08.1997	Tromsø 05.08.1997	
ARRIVAL	Honningsvåg 04.08.1997	Kirkenes 14.08.1997	Tromsø 28.08.1997	Tromsø 21.08.1997	Tromsø 13.09.1997
PARTICIPANTS	O. R. Godø	A.Aglen	H. Larsen	P. Ågotnes	A. Gundersen
	K.Korsbrekke	Å. Høines	K. Kvalsvik	S. Lemvig	T.I. Halland
	P. Pahr	A. Storaker	E. Johnsen	A. Salthaug	O. Bjelland
	A. Leithe	L. Brungot	Kaare Hansen	J.A. Vågenes	
	H. Fitje	K. Tønnesen			
	S. Furnes	M. Mjanger			
	Ø. Nævdal	K. Bolstad			
	V. Askeland				
	A. Romslo				
	E. Molvær				

Appendix 1. COD. Swept area abundance estimate (N), coefficient of variation (CV) and standard error (se) by 5 cm length groups.

1995

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
0	0,03	100	3,71	93					3,74	92	3,44
5	7,39	45	108,16	44	26,20	47			141,75	35	49,60
10	239,69	20	29,36	26	87,50	17			356,55	14	50,21
15	335,30	21	66,98	22	341,95	19			744,23	13	95,29
20	51,97	19	2,85	29	43,09	17			97,91	12	12,17
25	47,52	10	3,57	27	48,63	19			99,72	10	10,31
30	57,68	12	2,54	24	40,22	28			100,44	13	13,00
35	84,01	16	2,75	18	40,07	23			126,83	13	15,98
40	91,40	16	3,71	17	40,24	22			135,35	12	16,78
45	53,17	11	4,44	19	35,51	34			93,12	15	13,63
50	46,67	13	5,38	18	26,63	28			78,68	12	9,59
55	44,91	15	5,32	20	31,86	25			82,09	13	10,29
60	29,75	15	3,81	17	28,98	25			62,54	14	8,66
65	14,17	18	1,75	21	16,91	27			32,83	16	5,29
70	7,69	15	0,79	28	10,94	24			19,42	15	2,90
75	5,39	14	0,34	34	8,29	26			14,02	16	2,28
80	4,05	15	0,26	58	3,06	21			7,37	12	0,91
85	2,10	15	0,17	50	1,11	24			3,38	12	0,41
90	0,78	19	0,04	100	0,73	25			1,55	15	0,24
95	0,67	19	0,09	82	0,63	26			1,39	16	0,22
100	0,28	28	0,02	100	0,25	35			0,55	22	0,12
105	0,21	43			0,09	45			0,30	33	0,10
110	0,05	73			0,02	75			0,07	57	0,04
115	0,02	100	0,02	100					0,04	71	0,03
120	0,02	100	0,03	100					0,05	72	0,04

1996

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
0	0,54	81	1,29	59	0,10	71			1,93	46	0,88
5	6,34	44	16,88	32	22,45	28	1,53	55	47,20	19	8,86
10	690,26	11	76,98	20	139,72	18	3,00	51	909,96	9	79,45
15	759,18	10	151,17	18	421,20	15	36,97	35	1368,52	7	100,68
20	231,10	12	15,36	22	81,49	14	7,97	21	335,92	9	30,99
25	128,41	13	8,76	26	95,56	49	3,72	27	236,45	21	49,59
30	56,44	15	4,12	24	35,02	49	3,18	26	98,76	19	19,17
35	47,20	12	5,70	37	26,98	45	2,61	40	82,49	16	13,57
40	51,43	12	7,85	37	18,62	31	1,31	46	79,21	11	8,92
45	53,68	13	9,61	37	18,36	27	0,29	51	81,94	11	9,23
50	44,20	14	9,58	30	19,49	24	0,02	100	73,29	11	8,36
55	30,44	14	6,39	25	17,81	22			54,64	11	5,91
60	20,85	14	3,71	25	16,01	20			40,57	11	4,33
65	19,01	13	2,47	27	16,07	19			37,55	11	3,96
70	12,27	14	1,62	30	10,61	21			24,50	11	2,78
75	6,02	13	0,80	27	5,04	21			11,86	11	1,35
80	3,19	13	0,22	46	2,41	16			5,82	10	0,58
85	1,75	16	0,19	45	1,27	22			3,21	13	0,41
90	1,34	16	0,15	49	0,36	32			1,85	14	0,25
95	0,74	23	0,09	55	0,11	49			0,94	20	0,19
100	0,23	30	0,06	69	0,21	33			0,50	21	0,11
105	0,15	43			0,16	41			0,31	29	0,09
110	0,08	50	0,03	100	0,01	100			0,12	42	0,05
115	0,05	58	0,03	100					0,08	52	0,04
120											

1997

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
0			4,22	57					4,22	57	2,42
5	3,31	23	20,76	29	0,54	48	0,05	96	24,66	25	6,16
10	365,95	17	60,20	16	164,41	24	0,53	51	591,09	13	73,90
15	146,82	21	50,44	22	144,28	17	2,56	41	344,10	12	41,69
20	148,99	39	16,51	20	90,42	15	3,53	36	259,45	23	60,23
25	76,71	45	13,32	20	60,26	19	3,29	31	153,58	24	36,23
30	47,57	33	10,66	25	25,97	19	0,75	31	84,95	20	16,57
35	26,16	26	8,02	21	20,26	26	0,34	45	54,78	16	8,78
40	14,48	27	4,28	15	11,50	36	0,55	79	30,81	19	5,73
45	8,45	26	2,42	30	8,18	48	0,10	49	19,15	24	4,55
50	6,28	21	2,54	35	6,14	34	0,08	62	15,04	17	2,62
55	7,10	28	3,03	27	5,30	35			15,43	19	2,87
60	7,14	40	3,40	19	5,52	40	0,09	100,0	16,15	23	3,67
65	6,26	43	2,02	29	4,98	35	0,09	100,0	13,35	24	3,24
70	5,21	39	1,53	30	2,88	29	0,12	100,0	9,74	23	2,25
75	4,14	42	0,38	31	2,74	26	0,06	66,2	7,32	26	1,88
80	3,19	43	0,38	44	1,38	27	0,12	100,0	5,07	28	1,43
85	1,39	31	0,20	78	0,56	30			2,15	23	0,49
90	0,78	33	0,37	63	0,37	31	0,03	100,0	1,55	24	0,37
95	0,47	32	0,10	46	0,11	40			0,68	24	0,16
100	0,50	34	0,15	61	0,05	52			0,70	28	0,20
105	0,11	44	0,13	61	0,01	100			0,25	37	0,09
110	0,07	44			0,02	100			0,09	41	0,04
115	0,03	71			0,02	100			0,05	58	0,03
120	0,01	100							0,01	100	0,01

Appendix 2. HADDOCK. Swept area abundance estimate (N), coefficient of variation (CV) and standard error (se) by 5 cm length groups.

1995

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5											
10	0,55	42	0,09	100	0,28	72			0,92	35	0,32
15	171,80	19	2,52	57	0,14	50			174,46	18	31,82
20	87,81	22	279,88	19	8,81	42			376,50	15	55,23
25	25,54	23	127,45	21	3,45	38			156,44	17	27,16
30	36,13	26	40,71	20	1,51	45			78,35	16	12,39
35	32,34	20	12,72	27	1,40	51			46,46	16	7,45
40	37,70	12	6,53	27	1,95	50			46,18	11	5,06
45	28,68	11	5,08	31	3,07	50			36,83	10	3,82
50	12,89	13	4,77	30	3,70	59			21,36	14	3,05
55	3,79	15	2,93	42	2,75	48			9,47	20	1,88
60	1,04	19	1,57	49	1,51	52			4,12	27	1,12
65	0,37	29	0,43	52	0,64	56			1,44	30	0,44
70	0,07	49	0,07	78	0,21	56			0,35	38	0,13
75	0,05	100	0,05	56	0,03	71			0,13	47	0,06
80											

1996

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5			1,25	70	0,52	48			1,77	52	0,91
10	2,44	52	1,45	80	1,79	89			5,68	41	2,35
15	124,77	35	28,64	46	1,00	37			154,41	29	45,40
20	55,62	26	33,87	19	0,97	66			90,46	18	15,95
25	56,12	33	16,72	18	0,89	49			73,73	25	18,72
30	12,21	25	7,44	30	0,59	71			20,24	19	3,79
35	8,98	22	4,10	33	0,39	73			13,47	18	2,39
40	14,53	22	3,58	28	0,39	36			18,50	18	3,39
45	22,49	25	3,43	26	0,73	38			26,65	21	5,72
50	18,10	25	1,70	26	0,86	44			20,66	22	4,53
55	8,46	31	1,06	28	0,47	50			9,99	26	2,63
60	1,71	26	0,53	46	0,17	52			2,41	21	0,51
65	0,49	32	0,11	63	0,05	78			0,65	27	0,18
70	0,18	33							0,18	33	0,06
75	0,07	59	0,05	69					0,12	45	0,05
80	0,03	70							0,03	70	0,02

1997

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5			0,30	100					0,30	100	0,30
10	0,13	79	3,45	48					3,58	46	1,65
15	21,75	41	244,20	36	2,27	31			268,22	33	87,87
20	9,37	46	107,12	20	1,35	35			117,84	18	21,33
25	4,93	39	25,76	34	0,14	52			30,83	29	8,91
30	2,07	30	20,75	47	0,21	53			23,03	42	9,73
35	0,77	32	10,73	53	0,13	64			11,63	49	5,66
40	0,22	36	3,49	36	0,11	63			3,82	33	1,25
45	0,19	35	3,32	45	0,30	59			3,81	39	1,49
50	0,14	41	4,47	57	0,87	61			5,48	48	2,62
55	0,09	48	3,23	59	0,85	74			4,17	48	1,99
60	0,01	100	0,66	46	0,43	58			1,10	36	0,39
65			0,36	49	0,18	60			0,54	38	0,21
70			0,07	67	0,03	58			0,10	50	0,05
75			0,05	100	0,03	73			0,08	68	0,05
80											

Appendix 3. GREENLAND HALIBUT. Swept area abundance estimate (N), coefficient of variation (CV) and standard error (se) by 5 cm length groups.

1995

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	0,02	100			0,02	100			0,04	71	0,03
10	0,02	100			0,01	100			0,03	75	0,02
15					0,04	73			0,04	73	0,03
20											
25	0,09	100							0,09	100	0,09
30	0,18	100			0,10	100			0,28	74	0,21
35	0,02	100			0,28	57			0,30	54	0,16
40	1,04	41	0,26	82	0,89	36			2,19	26	0,57
45	1,48	35	0,41	57	2,66	25			4,55	19	0,87
50	0,88	35	0,33	63	2,32	25			3,53	19	0,69
55	0,66	40	0,38	67	0,66	24			1,70	23	0,40
60	0,09	61	0,10	100	0,30	36			0,49	32	0,16
65	0,09	70	0,10	100	0,18	51			0,37	40	0,15
70											
75					0,11	60			0,11	60	0,07

1996

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5					0,01	100			0,01	100	0,01
10	5,30	41			2,86	42	4,94	65	13,10	31	4,07
15	0,33	95			0,55	55	9,22	68	10,10	62	6,27
20					0,36	79	11,82	92	12,18	90	10,90
25					0,06	52	5,53	75	5,59	74	4,13
30	0,05	71			0,03	82	2,37	66	2,45	63	1,55
35					0,31	41	0,49	29	0,80	24	0,19
40	0,03	100	0,04	100	1,04	19	0,86	32	1,97	17	0,34
45	0,43	35	0,13	74	3,86	15	1,13	28	5,55	12	0,67
50	0,75	24	0,28	78	2,73	16	0,50	23	4,26	12	0,53
55	0,44	42	0,04	100	1,37	20	0,17	43	2,02	17	0,33
60	0,12	49	0,13	76	0,52	27	0,08	38	0,85	22	0,18
65	0,03	100	0,04	100	0,12	42	0,05	100	0,24	36	0,09
70			0,13	74	0,08	55	0,05	100	0,26	45	0,12
75					0,07	73			0,07	73	0,05

1997

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	0,02	100			0,02	72	0,02	68	0,06	47	0,03
10	0,09	71			0,49	43	3,00	58	3,58	49	1,75
15	0,27	42			0,76	33	1,52	38	2,55	25	0,63
20	0,23	60			1,97	36	8,18	41	10,38	33	3,46
25					0,38	44	7,04	37	7,42	35	2,59
30	0,02	100			0,25	44	9,44	38	9,71	37	3,58
35	0,04	70			0,22	36	4,50	35	4,76	33	1,59
40	0,20	37	0,07	100	0,67	28	2,35	35	3,29	26	0,86
45	0,66	28	0,09	59	2,24	18	0,47	33	3,46	14	0,48
50	0,52	22	0,23	65	2,67	13	0,72	27	4,14	11	0,44
55	0,37	28	0,26	67	1,28	17	0,04	100,0	1,95	15	0,30
60	0,14	33	0,07	73	0,41	22	0,04	100,0	0,66	18	0,12
65	0,05	57	0,21	55	0,21	37			0,47	30	0,14
70					0,01	100			0,01	100	0,01
75					0,03	100			0,03	100	0,03

Appendix 4. *Sebastes mentella*. Swept area abundance estimate (N), coefficient of variation (CV) and standard error (se) by 5 cm length groups.

1995

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	38,27	22	71,57	28	32,53	18			142,37	16	22,72
10	8,98	33	23,53	49	33,38	24			65,89	22	14,47
15	173,67	75	63,08	55	416,81	20			653,56	24	158,34
20	95,30	62	214,04	50	349,33	16			658,67	20	134,23
25	7,64	53	151,12	29	77,14	35			235,90	22	51,42
30	0,44	52	33,61	31	17,86	52			51,91	27	13,98
35	0,38	71	9,44	36	5,09	56			14,91	30	4,43
40	0,04	100	0,29	56	0,69	50			1,02	38	0,39
45			0,23	72	0,06	71			0,29	59	0,17
50											
55											

1996

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	3,63	24	91,24	46	55,98	17	276,97	37	427,82	26	109,98
10	8,44	48	44,51	42	68,85	30	87,59	23	209,39	16	34,47
15	11,23	43	8,42	44	138,83	15	24,65	36	183,13	13	23,81
20	14,30	72	107,60	38	310,14	14	14,95	59	446,99	14	61,33
25	0,45	60	83,60	26	97,24	23	0,52	51	181,81	17	30,90
30	0,14	81	24,40	43	8,05	28	0,79	64	33,38	32	10,62
35	0,09	73	12,27	56	4,37	35	0,07	71	16,80	42	7,00
40			2,29	66	0,93	35	0,08	100	3,30	47	1,56
45			0,14	100	0,39	47			0,53	43	0,23
50			0,14	100	0,05	100			0,19	78	0,15
55			0,10	100					0,10	100	0,10

1997

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	0,28	49	3,88	62	3,37	33	8,05	37	15,58	26	3,98
10	9,93	28	83,15	39	43,50	23	39,45	38	176,03	21	37,14
15	4,30	27	27,98	38	12,64	16	8,31	38	53,23	21	11,36
20	10,90	58	53,93	60	64,78	16	5,81	41	135,42	26	34,74
25	3,97	35	111,10	52	57,33	25	2,66	65	175,06	34	59,35
30	0,44	62	25,43	39	9,03	29	0,40	62	35,30	29	10,37
35	0,05	75	9,59	67	4,50	30			14,14	47	6,60
40	0,02	100	1,24	57	0,15	54			1,41	50	0,71
45			0,11	82	0,12	76			0,23	56	0,13
50											
55											

Appendix 5. *Sebastes marinus*. Swept area abundance estimate (N), coefficient of variation (CV) and standard error (se) by 5 cm length groups.

1995

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	0,12	100			0,47	66			0,59	57	0,33
10	5,70	61	0,71	85	2,00	37			8,41	43	3,61
15	4,43	27	1,85	58	9,10	33			15,38	22	3,42
20	5,64	35	5,02	59	5,07	41			15,73	26	4,12
25	5,22	37	5,48	77	3,06	32			13,76	34	4,71
30	3,76	36	2,01	42	2,40	35			8,17	22	1,81
35	6,21	68	3,64	44	1,04	28			10,89	42	4,52
40	6,17	88	2,79	48	0,92	34			9,88	57	5,60
45	4,00	86	0,87	44	0,44	58			5,31	65	3,45
50	0,18	46	0,08	56	0,24	53			0,50	32	0,16
55	0,02	100	0,05	70	0,05	100			0,12	53	0,06
60					0,05	100			0,05	100	0,05
65											

1996

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5	1,06	52	2,49	100	0,08	100			3,63	70	2,55
10	2,99	43	3,17	67	0,13	64			6,29	40	2,49
15	3,61	29	5,03	92	1,26	41			9,90	48	4,78
20	11,10	41	12,18	49	2,48	51			25,76	30	7,61
25	5,68	37	11,78	39	1,03	51			18,49	27	5,02
30	2,54	36	4,29	44	0,48	40			7,31	29	2,12
35	1,36	36	4,98	55	0,55	60			6,89	41	2,82
40	0,34	46	7,50	61	0,99	55			8,83	52	4,62
45	0,29	63	4,69	71	0,19	53			5,17	64	3,32
50	0,06	70	1,59	63	0,09	47			1,74	58	1,00
55	0,03	100	0,08	69	0,08	58			0,19	41	0,08
60			0,04	100	0,04	100			0,08	71	0,06
65			0,14	100					0,14	100	0,14

1997

Length	Region 1		Region 2a		Region 2b		Region 3		Total		
(lower lim.)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	N (mill.)	CV (%)	se(mill)
5			0,02	100	0,04	71			0,06	58	0,03
10	0,11	100	0,05	70	0,81	37			0,97	33	0,32
15	0,21	66	0,16	85	1,98	40			2,35	35	0,82
20	1,15	44	0,39	55	5,47	34			7,01	28	1,95
25	1,72	40	1,23	41	5,56	60			8,51	40	3,44
30	2,54	67	6,55	57	2,34	56			11,43	38	4,32
35	5,62	90	8,73	62	0,59	40			14,94	49	7,39
40	8,49	97	3,51	47	0,19	34			12,19	69	8,39
45	2,70	98	1,13	28	0,22	33			4,05	65	2,65
50	0,04	70	0,42	54	0,17	44			0,63	38	0,24
55	0,04	100	0,33	58	0,04	72			0,41	48	0,20
60			0,07	100	0,02	100			0,09	81	0,07
65			0,08	100					0,08	100	0,08

Appendix 6. *Sebastes mentella*. Abundance estimates (millions) by age.

Swept area

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1se																
1995	0,94	0,04	0,46	3,76	1,68	0,71	0,34	0,06	0,09	0,01	0,00	0,00	0,01	0,00	0,00	0,00
1996	0,00	2,22	3,93	0,00	0,56	5,77	2,42	2,38	0,32	0,03	0,29	0,01	0,04	0,15	0,02	0,02
1nw																
1995	36,71	1,52	17,87	147,01	65,73	27,84	13,42	2,21	3,64	0,26	0,01	0,07	0,24	0,00	0,00	0,11
1996	0,00	2,69	3,68	0,00	0,63	6,67	2,71	2,67	0,38	0,04	0,32	0,02	0,05	0,18	0,02	0,02
1997		4,63	7,83	1,07	2,97	6,95	2,90	1,91	1,37	0,11	0,02	0,00	0,07	0,00	0,00	0,07
2a																
1995	70,39	3,63	16,74	60,34	141,08	139,01	58,47	30,76	15,56	20,09	0,52	1,79	6,14	0,00	0,00	2,33
1996		99,28	37,26	0,00	10,20	29,81	32,96	56,35	32,60	13,25	14,41	5,87	15,25	12,06	5,56	9,83
1997	19,70	36,69	53,49	5,51	11,12	24,46	32,61	48,11	54,96	10,14	12,82	0,19	0,08	0,17	0,08	6,27
2b																
1995	32,00	4,03	49,88	365,16	236,53	132,12	60,86	18,48	16,88	10,67	0,28	0,96	3,30	0,00	0,00	1,72
1996	55,98	22,91	47,21	15,06	37,33	105,14	143,66	83,96	16,70	51,47	31,58	33,75	9,46	20,55	1,66	8,41
1997		7,87	42,90	5,72	6,41	39,81	20,27	29,86	25,18	6,73	2,82	0,56	2,26	1,75	0,71	2,55
3																
1996	276,97	29,15	46,09	15,25	5,85	15,12	8,53	3,14	0,35	2,14	0,57	0,90	0,17	0,81	0,08	0,49
1997	0,00	12,13	37,67	4,02	1,70	4,00	1,54	1,88	1,17	0,31	0,13	0,03	0,09	0,03	0,00	0,00
1nw+2a+2b																
1995	139,10	9,19	84,49	572,50	443,35	298,96	132,74	51,45	36,08	31,02	0,80	2,82	9,68	0,00	0,00	4,16
1996	55,98	124,88	88,15	15,06	48,16	141,62	179,33	142,98	49,68	64,76	46,31	39,64	24,76	32,79	7,24	18,26
1997	19,70	49,19	104,22	12,30	20,50	71,22	55,78	79,88	81,51	16,98	15,66	0,75	2,41	1,92	0,79	8,89
1se+1nw+2a+2b																
1995	140,04	9,23	84,95	576,26	445,03	299,68	133,09	51,51	36,17	31,02	0,80	2,82	9,69	0,00	0,00	4,17
1996	55,98	127,09	92,08	15,06	48,73	147,40	181,74	145,36	50,00	64,79	46,60	39,65	24,80	32,94	7,25	18,29
*1997	19,70	50,06	108,86	12,30	20,74	74,12	56,53	81,21	82,03	16,98	15,76	0,75	2,41	1,93	0,79	8,90

Total acoustics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1se																
1995	0,5	0,0	0,2	1,8	0,8	0,3	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1996	0,0	0,3	0,6	0,0	0,1	0,9	0,4	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1nw																
1995	8,6	0,4	4,2	34,4	15,4	6,5	3,1	0,5	0,9	0,1	0,0	0,0	0,1	0,0	0,0	0,0
1996	0,0	3,7	5,1	0,0	0,9	9,3	3,8	3,7	0,5	0,1	0,4	0,0	0,1	0,2	0,0	0,0
1997	0,0	2,1	3,5	0,5	1,3	3,1	1,3	0,9	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2a																
1995	42,6	2,2	10,1	36,5	85,3	84,0	35,4	18,6	9,4	12,1	0,3	1,1	3,7	0,0	0,0	1,4
1996	0,0	170,9	64,1	0,0	17,6	51,3	56,7	97,0	56,1	22,8	24,8	10,1	26,3	20,8	9,6	16,9
1997	22,7	42,3	61,7	6,4	12,8	28,2	37,6	55,5	63,3	11,7	14,8	0,2	0,1	0,2	0,1	7,2
2b																
1995	17,1	2,2	26,6	194,9	126,3	70,5	32,5	9,9	9,0	5,7	0,1	0,5	1,8	0,0	0,0	0,9
1996	49,5	20,3	41,8	13,3	33,0	93,0	127,1	74,3	14,8	45,5	27,9	29,9	8,4	18,2	1,5	7,4
1997	0,0	17,8	97,3	13,0	14,5	90,3	46,0	67,7	57,1	15,3	6,4	1,3	5,1	4,0	1,6	5,8
1nw+2a+2b																
1995	68,2	4,7	40,9	265,8	226,9	161,1	71,0	29,0	19,3	17,9	0,5	1,6	5,5	0,0	0,0	2,4
1996	49,5	194,9	111,0	13,3	51,5	153,6	187,6	175,0	71,4	68,4	53,2	40,0	34,7	39,2	11,1	24,4
1997	22,7	62,2	162,4	19,8	28,7	121,6	84,9	124,0	121,1	27,0	21,2	1,5	5,2	4,2	1,7	13,0
1se+1nw+2a+2b																
1995	68,7	4,7	41,1	267,6	227,8	161,4	71,1	29,0	19,3	17,9	0,5	1,6	5,5	0,0	0,0	2,4
1996	49,5	195,2	111,6	13,3	51,6	154,5	188,0	175,4	71,5	68,4	53,2	40,0	34,7	39,2	11,1	24,4
*1997	22,7	62,3	163,3	19,8	28,7	122,3	85,0	124,3	121,1	27,0	21,2	1,5	5,2	4,2	1,7	13,0

* scaled by the ratios observed in 1996

Appendix 7. *Sebastes marinus*. Abundance estimates (millions) by age.

Swept area

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1se																
1995	0,01	0,91	1,81	2,49	1,80	1,20	1,63	1,53	0,85	1,04	0,84	1,98	1,15	1,44	1,24	2,05
1996	0,60	0,77	0,77	0,68	0,90	0,23	5,64	0,58	1,73	0,43	1,33	0,663	0,415	0,00	0,00	0,12
1nw																
1995	0,01	0,80	1,59	2,20	1,59	1,06	1,44	1,35	0,75	0,92	0,74	1,74	1,02	1,27	1,09	1,81
1996	0,45	0,73	0,73	0,68	0,91	0,23	5,46	0,56	1,67	0,42	1,22	0,641	0,41	0,00	0,00	0,12
1997	0,00	0,11	0,00	0,03	0,07	0,31	0,50	1,00	1,11	1,22	1,17	2,90	2,75	0,81	3,01	7,63
2a																
1995	0,00	0,21	0,49	2,44	2,16	2,15	2,94	2,53	1,10	1,21	0,88	1,89	1,16	1,08	0,93	1,32
1996	0,00	1,20	1,20	0,00	1,59	4,10	2,52	20,22	0,00	0,53	0,00	4,71	0,00	2,28	2,03	17,50
1997	0,02	0,00	0,05	0,08	0,08	0,16	0,39	4,43	0,26	1,11	5,24	3,83	1,55	1,53	1,24	2,71
2b																
1995	0,47	0,60	1,60	6,42	5,14	1,76	2,20	1,78	0,73	0,73	0,41	0,74	0,52	0,38	0,50	0,86
1996	0,08	0,04	0,12	0,00	0,56	1,05	0,94	0,93	0,40	1,05	0,28	0,32	0,59	0,16	0,07	0,80
1997	0,04	0,32	0,49	0,00	0,48	1,50	6,95	2,72	1,68	0,80	1,31	0,55	0,03	0,00	0,12	0,44
1nw+2a+2b																
1995	0,48	1,61	3,69	11,06	8,89	4,97	6,58	5,66	2,58	2,86	2,03	4,37	2,70	2,73	2,53	3,99
1996	0,53	1,97	2,05	0,68	3,06	5,38	8,92	21,71	2,07	2,00	1,50	5,67	1,00	2,44	2,10	18,42
1997	0,06	0,43	0,54	0,11	0,63	1,97	7,84	8,15	3,05	3,13	7,72	7,28	4,33	2,34	4,37	10,78
1se+1nw+2a+2b																
1995	0,49	2,52	5,49	13,55	10,68	6,17	8,21	7,19	3,43	3,90	2,87	6,35	3,85	4,17	3,77	6,05
1996	1,13	2,74	2,82	1,35	3,96	5,60	14,56	22,28	3,80	2,43	2,82	6,33	1,42	2,44	2,10	18,54
*1997	0,13	0,60	0,74	0,22	0,82	2,05	12,80	8,37	5,61	3,13	14,56	8,13	6,13	2,34	4,37	10,85

Total acoustics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1se																
1995	0,01	0,44	0,87	1,21	0,87	0,58	0,79	0,74	0,41	0,50	0,41	0,96	0,56	0,70	0,60	0,99
1996	0,09	0,11	0,11	0,10	0,13	0,03	0,83	0,09	0,26	0,06	0,20	0,10	0,06	0,00	0,00	0,02
1nw																
1995	0,00	0,19	0,37	0,51	0,37	0,25	0,34	0,32	0,18	0,21	0,17	0,41	0,24	0,30	0,26	0,42
1996	0,62	1,01	1,01	0,94	1,26	0,31	7,57	0,77	2,31	0,59	1,69	0,89	0,57	0,00	0,00	0,16
1997	0,00	0,05	0,00	0,01	0,03	0,14	0,22	0,45	0,50	0,55	0,53	1,30	1,24	0,36	1,35	3,43
2a																
1995	0,00	0,13	0,30	1,48	1,31	1,30	1,78	1,53	0,66	0,73	0,53	1,14	0,70	0,65	0,56	0,80
1996	0,00	2,07	2,07	0,00	2,74	7,06	4,34	34,81	0,00	0,91	0,00	8,11	0,00	3,93	3,49	30,13
1997	0,02	0,00	0,06	0,09	0,09	0,18	0,45	5,11	0,30	1,28	6,04	4,41	1,79	1,76	1,43	3,12
2b																
1995	0,25	0,32	0,86	3,43	2,74	0,94	1,17	0,95	0,39	0,39	0,22	0,39	0,28	0,20	0,27	0,46
1996	0,07	0,04	0,11	0,00	0,50	0,93	0,83	0,82	0,35	0,93	0,25	0,28	0,52	0,14	0,06	0,71
1997	0,09	0,73	1,11	0,00	1,09	3,40	15,76	6,17	3,81	1,81	2,97	1,25	0,07	0,00	0,27	1,00
1nw+2a+2b																
1995	0,25	0,64	1,53	5,42	4,42	2,49	3,29	2,79	1,23	1,34	0,92	1,95	1,22	1,15	1,09	1,68
1996	0,70	3,11	3,18	0,94	4,49	8,30	12,74	36,40	2,67	2,43	1,93	9,28	1,09	4,07	3,56	31,00
1997	0,11	0,78	1,17	0,11	1,21	3,72	16,43	11,72	4,61	3,64	9,54	6,97	3,09	2,13	3,05	7,55
1se+1nw+2a+2b																
1995	0,26	1,08	2,40	6,62	5,29	3,07	4,08	3,54	1,64	1,84	1,33	2,90	1,78	1,85	1,69	2,68
1996	0,78	3,23	3,30	1,04	4,62	8,33	13,57	36,49	2,92	2,49	2,13	9,38	1,15	4,07	3,56	31,01
*1997	0,13	0,80	1,21	0,12	1,25	3,74	17,50	11,75	5,05	3,74	10,50	7,04	3,26	2,13	3,05	7,56

* scaled by the ratios observed in 1996