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Stock Abundance Indices and Length Compositions of Demersal Redfish and
Other Finfish in NAFO Subarea 1 and Near Bottom Water Temperature
Derived from the German Bottom Trawl Survey 1982-2003

by

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Abstract

Survey abundance, biomass estimates and length compositions for golden and deep sea redfish ≥ 17 cm (*Sebastes marinus* and *S. mentella*), juvenile redfish < 17 cm, American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffish (*Anarhichas lupus* and *A. minor*) and thorny skate (*Raja radiata*) in Division 1F are presented. In general, stocks sizes have declined significantly until the early-1990s and remained at a low level since then. They are presently composed of small and mainly juvenile specimens. Near bottom water temperature continued to be high (since 1996) and was at its maximum of the time series in 2003.

Introduction

This paper presents estimates of stock abundance and biomass indices disaggregated by length as derived from annual German groundfish surveys for golden and deep sea redfish ≥ 17 cm (*Sebastes marinus* and *S. mentella*), juvenile redfish < 17 cm, American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffish (*Anarhichas lupus* and *A. minor*) and thorny skate (*Raja radiata*). The surveys commenced in 1982 and represent the longest time series of quantitative information from the traditional fishing grounds off West Greenland south of 67° northern latitude. Environmental conditions are reflected as trends in near bottom water temperatures. The information is presented as an update of continued analyses of the survey results (Rätz, 1999; Rätz and Stransky, 2003.)

Materials and Methods

Abundance, biomass estimates and length structures were derived from annual groundfish surveys covering shelf areas and the continental slope off West Greenland. Surveys commenced in 1982 and were primarily designed for the assessment of cod. Because of favourable weather and ice conditions and to avoid spawning concentrations, autumn was chosen for the time of the surveys. These were carried out by the research vessel (R/V) WALTHER HERWIG (II) throughout most of the time period. In 1984 R/V ANTON DOHRN was used and she was replaced by the new R/V WALTHER HERWIG III since 1994, respectively.

The fishing gear used was a standardized 140-foot bottom trawl, its net frame rigged with heavy ground gear because of the rough nature of the fishing grounds. A small mesh liner (10mm) was used inside the cod end. The horizontal distance between wing-ends was 25 m at 300 m depth, the vertical net opening being 4 m. In 1994, smaller Polyvalent doors (4.5 m², 1,500 kg) were used for the first time to reduce net damages due to overspread caused by bigger doors (6 m², 1,700 kg), which have been used earlier. All calculations of abundance and biomass

indices were based on the 'swept area' method using 22 m horizontal net opening as trawl parameter, i. e. the constructional width specified by the manufacturer. The towing time was normally 30 min. at a speed of 4.5 knots. Trawl parameters are listed in Table 1. Hauls, which received net damage or became hang-up after less than 15 minutes, were rejected. Some hauls of the 1987 and 1988 surveys were also included although their towing time had been intentionally reduced to 10 minutes because of the expected large cod catches as observed from echo sounder traces.

Fish were identified to species or lowest taxonomic level and the catch in number and weight was recorded. Total fish lengths were measured to cm below.

The surveys were primarily designed for the assessment of cod. In order to reduce the error of abundance estimates, the subdivision of shelf areas and the continental slope into different geographic and depth strata was required due to a pronounced heterogeneity of cod distribution. The survey area was thus split into four geographic strata. Each stratum was itself subdivided into two depth strata covering the 0-200 m and 201-400 m zones. Figure 1 and Table 2 indicate the names of the 8 strata, their geographic boundaries, depth ranges and areas in nautical square miles (nm²). All strata were limited at the 3 mile offshore line.

The applied strategy was to distribute the sampling effort according both to the stratum areas and to cod abundance. Consequently, fifty percent of the hauls were allocated proportionally to strata by stratum area while the other fifty percent were apportioned on the basis of a review of the historical mean cod abundance/nm², all hauls being randomly distributed within trawlable areas of the various strata. Non-trawlable areas were mainly located inshore. During 1982-2002, 1 697 successful sets were carried out, the numbers of valid sets by year and stratum being listed in Table 3. In 1995 and since 2001, the survey area off West Greenland was incompletely covered due to technical problems. Only 75 % of the strata of West Greenland were covered in 2003. Figure 1 shows the positions of hauls conducted during the most recent survey.

Stratified abundance estimates were calculated from catch-per-tow data using the stratum areas as weighting factor (Cochran, 1953; Saville, 1977). Strata with less than five valid sets were rejected from the calculation. The coefficient of catchability was set arbitrarily at 1.0, implying that estimates are merely indices of abundance and biomass. Respective confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

Near bottom water temperature was measured directly before or after a trawl haul by means of a CTD sonde. The annual stratified mean temperature was estimated in the same manner as applied for the fish abundance, i.e. through area weighting (Cochran, 1953; Saville, 1977).

Results

Figure 1 displays the coverage of the survey area by the geographical haul distribution in 2002. All abundance estimates in 1995 and since 2001 must be considered significantly underestimated as a result of the incomplete coverage of the survey area.

The abundance and biomass indices by stratum of *S. marinus* ≥ 17 cm is given in Table 3 and illustrated in Figure 2. The stock is indicated to be depleted since the early-1990s lacking any recovery signs. Recently, the stock is mainly composed of golden redfish varying among 25-35 cm in body length (Fig. 3 and Table 4).

Table 5 lists the abundance and biomass indices of *S. mentella* ≥ 17 cm by stratum, the values being presented in Fig. 4. Since 1996, the survey abundance is increased but the stock consists mainly about juvenile fish below 25 cm length (Fig. 5 and Table 6). It must be noted, that the survey design hardly covers the distribution area of deep sea redfish, and the survey results should be carefully interpreted.

The abundance of juvenile redfish < 17 cm *Sebastes spp.* has varied over a wide range since 1982. More recent indices since 2001 are among the lowest (Fig. 6 and Table 7). The length composition of the stock has reiterately revealed peaks at 6-7, 10-12 and 14-16 cm, an indication of sizes at ages 0, 1 and 2 in autumn (Fig. 7 and Table 8).

Abundance and biomass of American plaice *Hippoglossoides platessoides* has been significantly reduced since the late-1980s (Fig. 8 and Table 9). The stock is predominantly composed of small fish below 20 cm as illustrated in

Figure 9 and listed in Table 10. The catchability of flatfish by the survey gear is considered poor but the time series seems to represent the stock development.

Atlantic wolffish *Anarhichas lupus* does not show a decrease in survey abundance but in biomass estimates, which were significantly lower since the early-1990s (Fig. 10 and Table 11). That indicates that the stock is mainly composed of small fish with low body weights. This indication is confirmed by the length distributions given in Fig. 11 and Table 12 as fish below 35 cm are recently dominating the size composition of the stock.

In accordance with lots of other finfish stocks, the abundance and biomass of spotted wolffish *Anarhichas minor* decreased significantly since 1992 and remained low (Fig. 12 and Table 13). The size distribution is scattered as a result of low catch rates and high variation in body length (Fig. 13 and Table 14).

Both abundance and biomass indices of thorny skate *Raja radiata* are recently very low compared to the values estimated during the 1980s (Fig. 14 and Table 15). The size composition is dominated by small fish below 25 cm body length (Fig. 15 and Table 16).

Trends in near bottom temperature means by stratum and stratified mean temperature are listed in Table 17 and shown in Fig. 16. They reveal that the warm conditions off West Greenland continued since 1996 with a maximum stratified mean temperature in 2003. The stratum mean temperatures show a significant depth effect, with the colder temperatures measured in the shallow strata (<200 m). Deeper strata are generally warmer by about 1-2°C.

References

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Table 1. Trawl parameters of the German bottom trawl survey off West Greenland.

German survey	
Gear	140-feet bottom trawl
Horizontal net opening	22 m
Standard trawling speed	4.5 kn
Towing time	30 minutes
Variable to standard distance	
Coefficient of catchability	1.0

Table 2. Survey areas and effort (hauls) of the German bottom trawl survey off West Greenland by stratum, 1982-2003.

STRATUM	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Sum
AREA nm ²	6805	1881	2350	1018	1938	742	2568	971	18273
1982	20	11	16	7	9	6	13	2	84
1983	26	11	25	11	17	5	18	4	117
1984	25	13	26	8	18	6	21	4	121
1985	10	8	26	10	17	5	21	4	101
1986	27	9	21	9	16	7	18	3	110
1987	25	11	21	4	18	3	21	3	106
1988	34	21	28	5	18	5	18	2	131
1989	26	14	30	9	8	3	25	3	118
1990	19	7	23	8	16	3	21	6	103
1991	19	11	23	7	12	6	14	5	97
1992	6	6	6	5	6	6	7	5	47
1993	9	6	9	6	10	8	7	0	55
1994	16	13	13	8	10	6	7	5	78
1995	0	0	3	0	10	7	10	5	35
1996	5	5	8	5	12	5	10	5	55
1997	5	6	5	5	6	5	8	5	45
1998	9	5	10	7	11	6	10	5	63
1999	8	6	14	8	13	6	9	3	67
2000	13	6	14	7	14	5	9	5	73
2001	0	0	15	7	15	5	11	6	59
2002	0	0	7	2	5	6	8	4	32
2003	0	0	7	6	7	7	6	5	38

Table 3. *S. marinus* \geq 17cm, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	7016	6341	88792	5511	5736	14876	4088		132360	55
1983	4022	3186	3356	6523	4043	5886	1697		28713	53
1984	1327	3438	461	1209	10671	2776	4214		24096	65
1985	4661	10451	6157	1569	3221	14442	4974		45475	52
1986	6329	4324	2077	3483	21504	2883	2717		43317	53
1987	905	653	1328		9611		660		13157	39
1988	830	2238	343	2255	5938	1954	732		14290	54
1989	422	421	776	690	6490		362		9161	60
1990	122	433	280	710	1037		146	2270	4998	75
1991	225	256	96	691	236	528	21	1671	3724	51
1992	129	105	73	190	194	476	193	836	2196	151
1993	170	482	59	267	79	132	0		1189	93
1994	109	325	155	167	66	46	152	247	1267	41
1995					50	68	39	146	303	97
1996	150	267	21	243	380	383	28	298	1770	47
1997	252	609	16	175	120	311	36	552	2071	40
1998	116	141	45	142	19	106	126	254	949	160
1999	225	293	132	219	72	213	10		1164	70
2000	197	621	63	571	83	200	10	836	2581	59
2001			106	304	72	456	8	1557	2503	124
2002			101		333	536	13		983	93
2003			251	375	186	516	0	1998	3326	50

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	1797	1354	34439	2557	3205	9794	2532		55678	54
1983	844	944	1572	3043	1874	4816	1084		14177	61
1984	306	893	197	518	4934	2284	2088		11220	55
1985	1021	1819	2968	472	1426	9210	2720		19636	34
1986	1279	1215	752	1230	10122	1705	1762		18065	38
1987	252	246	660		4954		439		6551	38
1988	143	404	118	942	2570	1342	383		5902	60
1989	184	137	273	249	2620		208		3671	47
1990	41	149	75	275	479		80	1343	2442	45
1991	41	83	24	226	120	272	3	1007	1776	98
1992	20	36	21	61	52	241	69	447	947	130
1993	48	111	19	114	39	55	0		386	68
1994	34	147	47	64	27	36	41	80	476	38
1995					19	19	21	43	102	38
1996	61	102	2	60	128	118	8	132	611	40
1997	41	261	5	61	35	188	10	246	847	58
1998	20	43	12	42	14	54	56	117	358	102
1999	54	71	35	68	17	82	8		335	61
2000	68	173	31	215	21	76	3	388	975	96
2001			24	113	54	228	3	776	1198	67
2002			24		157	230	13		424	82
2003			96	174	83	284	0	966	1603	85

Table 5. *S. mentella* \geq 17cm, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	0	389	16	348	0	2360	0		3113	65
1983	41	1010	71	2528	0	5236	0		8886	42
1984	41	2966	7	1276	0	1115	0		5405	93
1985	0	369	31	26	56	327	0		809	47
1986	2144	414	38	292	4	444	0		3336	36
1987	987	13679	42		56		0		14764	45
1988	150	3186	26	777	60	4620	0		8819	58
1989	0	186	9	102	0		8		305	60
1990	0	9	5	704	50		0	3881	4649	43
1991	0	0	0	0	0	652	0	1773	2425	81
1992	0	36	0	15	0	106	0	0	157	165
1993	0	23	0	159	8	0	0		190	86
1994	0	271	21	96	95	162	0	36	681	168
1995					29	234	95	1468	1826	55
1996	1524	619	0	236	0	1921	28	7135	11463	64
1997	252	1759	0	381	37	3204	144	30742	36519	62
1998	0	324	0	212	151	828	10	2543	4068	67
1999	34	235	7	281	39	1735	95		2426	43
2000	0	94	7	768	31	1422	0	21187	23509	65
2001			24	636	116	5419	0	13939	20134	66
2002			0		0	1351	23		1374	95
2003			0	571	114	1554	0	9365	11604	116

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	0	96	7	114	0	893	0		1110	68
1983	14	213	26	1158	0	2857	0		4268	47
1984	7	798	5	491	0	472	0		1773	97
1985	0	96	14	11	27	110	0		258	35
1986	225	38	19	110	4	180	0		576	36
1987	82	1183	9		31		0		1305	46
1988	20	425	21	159	45	1878	0		2548	56
1989	0	23	7	15	0		0		45	63
1990	0	6	2	87	8		0	542	645	44
1991	0	0	0	0	0	153	0	445	598	80
1992	0	2	0	1	0	28	0	0	31	160
1993	0	4	0	22	2	0	0		28	61
1994	0	32	2	10	12	24	0	3	83	128
1995					6	24	10	159	199	52
1996	7	55	0	19	0	235	3	689	1008	59
1997	20	141	0	38	2	320	18	2973	3512	59
1998	0	26	0	17	17	88	3	326	477	73
1999	7	21	5	36	6	188	21		284	52
2000	0	9	0	65	2	122	0	1915	2113	57
2001			2	66	10	469	0	1468	2015	74
2002			0		0	145	3		148	102
2003			0	66	12	223	0	1557	1858	120

Table 7. *Sebastes. spp.* < 17cm, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	1055	357	120	27	8	42	23		1632	44
1983	3954	506	14	138	8	16	21		4657	56
1984	5022	3713	21	219	141	27	13		9156	67
1985	4886	9616	54	2712	47	67	54		17436	164
1986	10738	237636	113	1811	54	218	39		250609	168
1987	12453	113990	5		19		18		126485	87
1988	19680	42481	0	107	19	139	0		62426	41
1989	7717	13159	3071	5370	17		69		29403	35
1990	11255	35933	15416	1538	72		6199	848	71261	52
1991	51936	59846	34872	22668	13692	2508	891	1540	187953	38
1992	25716	19083	12690	17276	17463	13973	41	13718	119960	54
1993	5458	39035	665	11331	355	2773	13		59630	111
1994	3403	12003	9828	4014	1190	1730	10842	9867	52877	95
1995					399	10236	855	34695	46185	106
1996	456	14356	5210	9377	26961	11571	2488	107236	177655	98
1997	6519	47117	0	15852	43421	20194	444	68931	202478	62
1998	1558	25350	50177	30834	55983	13090	37049	13318	227359	100
1999	3886	54143	1067	8617	1105	7643	758		77219	48
2000	1293	9958	63	3052	393	8195	0	33103	56057	62
2001			1318	3559	110	2432	8	1484	8911	24
2002			1255		145	1523	23		2946	85
2003			390	7090	114	1674	15	1054	10337	79

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	34	13	7	1	0	1	0		56	41
1983	102	21	0	6	0	1	0		130	52
1984	88	105	0	5	6	1	0		205	73
1985	82	367	2	58	2	3	0		514	142
1986	456	6646	2	77	2	6	0		7189	168
1987	265	5020	0		0		0		5285	93
1988	218	1492	0	3	0	5	0		1718	56
1989	109	271	21	49	0		0		450	42
1990	102	369	63	20	0		10	2	566	58
1991	197	798	73	242	29	24	3	15	1381	46
1992	150	386	49	111	74	220	0	64	1054	54
1993	75	512	16	265	6	76	0		950	90
1994	27	216	54	57	29	64	141	277	865	132
1995					6	330	10	348	694	97
1996	7	284	14	117	91	297	18	3300	4128	96
1997	61	344	0	214	163	544	15	2437	3778	81
1998	20	433	165	322	221	351	141	531	2184	120
1999	54	941	14	190	17	272	18		1506	47
2000	27	252	2	106	14	284	0	1414	2099	61
2001			7	65	6	90	0	71	239	29
2002			12		2	29	0		43	83
2003			9	138	2	40	0	26	215	53

Table 9. *Hippoglossoides platessoides*, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	31582	5092	29598	5735	2843	2133	1043		78026	30
1983	46601	6482	55493	2871	2725	461	811		115444	49
1984	18251	6258	53766	4366	2928	2244	1792		89605	43
1985	21388	5974	22819	6185	2632	239	3161		62398	23
1986	22035	11393	58741	9556	2936	2388	4463		111512	39
1987	23321	3314	26226		2357		1030		56248	26
1988	10963	3476	8025	5698	3566	800	1035		33563	18
1989	9370	4454	11362	3775	8764		1446		39171	28
1990	8615	6465	8227	2614	1083		1492	606	29102	25
1991	7826	4537	5168	1899	1517	639	1248	952	23786	17
1992	8527	4996	3020	2704	1233	1707	1744	175	24106	28
1993	5859	3284	1201	1212	632	694	398		13280	17
1994	2212	3525	1488	1514	624	282	1661	189	11495	21
1995					891	1189	1019	785	3884	18
1996	3716	1337	956	1424	1946	772	1566	472	12189	17
1997	8656	3262	2585	3543	2973	1288	2427	109	24843	21
1998	6254	3956	5654	2873	1767	865	2296	204	23869	17
1999	5410	2675	5013	2904	1835	389	1356		19582	20
2000	2273	3929	1953	3302	1016	361	1197	36	14067	18
2001			11195	3831	1275	394	3616	182	20493	23
2002			6820		1203	2138	1718		11879	23
2003			20675	9700	1140	2170	1633	15	35333	34

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	6050	946	7797	1151	919	376	157		17396	32
1983	7451	1155	11771	607	1008	88	167		22247	41
1984	1701	762	8662	807	607	387	365		13291	45
1985	1939	600	3861	1062	519	49	321		8351	22
1986	2150	1147	8429	1385	703	452	460		14726	30
1987	3130	339	5471		645		229		9814	30
1988	919	293	1699	807	814	137	236		4905	19
1989	517	297	1476	371	2120		288		5069	40
1990	395	397	1220	314	213		288	221	3048	22
1991	347	399	486	260	266	125	187	173	2243	18
1992	578	419	228	183	151	250	152	25	1986	26
1993	327	222	82	102	66	70	26		895	17
1994	143	416	134	143	64	34	108	28	1070	25
1995					70	154	123	58	405	20
1996	211	100	66	164	159	78	149	38	965	22
1997	490	265	209	343	353	168	185	7	2020	27
1998	306	252	355	244	186	122	185	19	1669	20
1999	245	160	331	268	180	35	85		1304	26
2000	122	331	136	309	105	38	49	6	1096	22
2001			637	297	109	45	149	12	1249	22
2002			390		122	200	113		825	22
2003			1462	922	124	258	126	3	2895	35

Table 10. *Hippoglossoides platessoides*. Length composition by year (1 000), 1982-2003.

Length	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5	0	0	0	0	0	10	0	0	0	0	0	0	0	0	11	73	0	6	0	0	0	0
4.5	0	0	0	0	0	10	7	0	5	10	0	0	7	0	0	108	14	87	5	44	17	0
5.5	0	0	0	127	19	0	22	0	0	27	0	0	0	0	0	0	0	43	0	6	0	0
6.5	0	0	0	9	19	41	33	10	0	87	14	0	0	0	0	0	0	51	94	71	0	13
7.5	13	0	10	74	9	58	52	19	32	251	68	0	14	0	21	20	506	546	182	134	52	0
8.5	7	20	36	57	43	84	103	43	44	170	123	7	93	0	29	20	353	336	146	196	50	0
9.5	20	14	53	142	64	90	181	36	161	253	163	136	34	9	39	71	194	435	146	234	99	107
10.5	20	29	86	403	154	359	235	212	370	273	505	251	57	27	318	155	139	635	177	525	200	151
11.5	59	46	148	364	333	367	473	514	569	620	618	430	74	19	115	189	278	1059	413	757	198	233
12.5	150	228	368	381	751	540	749	813	1060	1087	846	913	353	88	181	842	406	1226	602	979	290	315
13.5	302	404	940	610	1187	668	873	1275	1875	1106	731	904	576	34	362	1238	757	798	919	1585	571	1352
14.5	420	978	1283	1067	2197	1142	1060	1742	2629	1291	1024	654	835	31	606	1692	1163	1055	997	2027	768	1804
15.5	793	1976	2023	1674	3597	1177	1130	2215	2556	1399	1627	977	1276	142	981	2604	2321	1275	1260	2161	1059	3389
16.5	814	2232	2567	2443	6220	1047	1365	2093	2259	1863	1663	1110	1204	241	1481	2180	2527	1169	1205	2061	1394	4056
17.5	1340	3336	3768	3631	7906	1625	1159	2007	1883	1771	1901	1109	882	287	996	1789	3035	1076	945	1690	1363	3488
18.5	1661	3934	4833	4281	8122	2132	1715	1778	1658	1593	1788	1079	634	338	1078	1663	2205	1178	812	1647	1113	2658
19.5	2054	5257	4170	3890	8619	2716	1658	1905	1407	1320	1851	705	488	360	715	1556	1794	1141	601	1042	867	2898
20.5	2839	8731	5896	4259	9066	3088	1984	2012	1414	1317	1254	827	587	379	580	1572	1286	1250	636	1161	723	1867
21.5	2737	8334	5740	3752	9715	3140	1802	1866	1008	1218	1292	593	463	308	712	1043	966	1329	488	878	607	2047
22.5	3541	7697	5159	3992	9279	3253	1803	1537	937	942	1342	476	439	217	649	1112	798	783	541	416	284	1440
23.5	2976	7502	7171	3398	7120	3593	1654	1685	900	1052	1217	442	428	290	654	932	692	643	625	423	330	1534
24.5	3802	6773	4220	3281	6310	3085	1431	1878	807	934	857	409	415	110	451	1091	741	707	528	331	302	1301
25.5	4532	6553	4913	3029	4428	2976	1711	2005	811	919	1086	481	566	119	434	785	665	429	562	209	360	1445
26.5	4872	8563	4609	2408	3495	2580	1722	1886	889	735	1050	335	430	198	485	826	754	419	386	404	209	1060
27.5	5366	7078	5200	2450	3485	3308	1233	2129	1035	687	552	324	367	117	217	668	526	538	353	347	163	1121
28.5	5300	6700	6410	2546	2934	2547	1189	1386	914	600	671	335	247	70	394	770	521	367	365	380	86	648
29.5	5035	4102	4824	2949	3145	2868	1342	1866	1238	454	597	206	259	119	221	502	348	232	198	257	143	926
30.5	5532	5194	4645	2974	3235	3332	1687	1644	967	484	427	199	237	73	184	510	330	271	249	211	180	511
31.5	4302	3381	2769	2243	2910	2714	1369	1251	479	365	215	113	231	106	83	379	206	132	177	114	91	401
32.5	3799	3120	2114	1580	2173	2298	1306	1042	285	312	337	141	133	87	34	156	118	152	223	118	100	241
33.5	2655	2328	2099	1669	1803	1993	841	770	447	182	119	9	60	44	97	116	58	50	81	77	78	141
34.5	2421	2278	1176	1093	1307	1158	592	628	202	167	67	77	60	19	31	65	44	49	76	50	77	61
35.5	2516	2012	749	552	781	851	410	325	121	144	86	17	32	31	20	23	10	40	25	22	32	34
36.5	2043	1818	500	355	358	637	318	200	67	57	21	12	11	11	12	47	24	30	39	0	32	73
37.5	1655	1352	375	244	264	351	198	195	32	19	0	12	5	7	0	0	27	9	24	0	5	8
38.5	1143	1051	291	135	184	135	67	77	37	31	5	0	5	4	0	51	5	0	0	0	5	13
39.5	915	512	210	128	101	132	61	46	5	18	0	0	0	0	0	0	10	0	0	5	13	0
40.5	940	754	84	79	55	73	4	49	4	5	0	0	0	4	0	0	0	0	5	0	0	0

Table 11. *Anarhichas lupus*, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	11113	2955	3457	2313	1822	458	945		23063	23
1983	7567	3186	1720	485	1471	211	786		15426	24
1984	5777	1277	1542	185	1382	111	750		11024	26
1985	5369	2718	1419	370	955	999	907		12737	19
1986	4961	1704	1967	635	1500	511	811		12089	19
1987	5328	1644	888		1023		691		9574	15
1988	4927	1834	895	449	1136	555	758		10554	21
1989	3675	673	1669	516	2901		1130		10564	21
1990	3511	1076	1981	295	1899		1066	612	10440	17
1991	2838	1010	968	756	2593	639	562	494	9860	21
1992	3015	376	1509	937	3360	916	948	2107	13168	26
1993	4723	1712	703	426	574	326	385		8849	28
1994	1545	1196	1725	567	1225	153	4515	1047	11973	48
1995					1349	563	529	705	3146	26
1996	715	942	254	381	2574	622	799	1075	7362	21
1997	3001	1279	1126	335	3771	1149	1538	2863	15062	30
1998	3083	957	783	653	1990	620	1009	1047	10142	21
1999	4457	1138	1941	653	6287	1337	801		16614	29
2000	1980	1725	402	413	2072	1116	480	2652	10840	21
2001			973	1110	3800	1160	724	1774	9541	28
2002			3001		3351	403	552		7307	22
2003			1307	1714	7345	511	575	1468	12920	27

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	9908	2974	5203	3926	2273	475	1240		25999	31
1983	3661	3442	2084	471	1769	271	1086		12784	31
1984	3089	673	1283	189	820	71	871		6996	24
1985	1837	1134	1020	200	581	557	632		5961	16
1986	1783	912	1441	434	973	458	768		6769	16
1987	2191	521	573		1048		616		4949	16
1988	1102	384	797	298	882	341	696		4500	16
1989	687	222	620	246	1750		1037		4562	19
1990	708	177	496	111	655		660	320	3127	16
1991	456	166	160	161	674	148	249	214	2228	20
1992	436	79	322	237	831	200	231	630	2966	27
1993	646	314	101	80	130	67	108		1446	22
1994	218	209	376	97	285	26	865	171	2247	42
1995					248	68	131	114	561	25
1996	61	261	42	68	486	114	169	238	1439	19
1997	306	239	89	77	665	164	352	372	2264	24
1998	361	194	125	146	287	97	175	266	1651	16
1999	327	273	322	146	1039	230	136		2473	23
2000	231	297	63	88	349	168	172	560	1928	22
2001			209	263	1006	218	185	579	2460	25
2002			578		859	91	146		1674	21
2003			486	438	2475	141	200	646	4386	26

Table 13. *Anarhichas minor*, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	381	154	353	153	130	14	326		1511	29
1983	184	38	148	3	89	39	367		868	32
1984	184	60	176	14	89	23	241		787	30
1985	204	115	106	4	29	61	110		629	33
1986	483	203	108	38	68	16	118		1034	22
1987	306	211	63		130		239		949	28
1988	231	150	45	15	145	33	316		935	25
1989	245	130	49	25	281		110		840	34
1990	109	201	38	19	99		152	6	624	27
1991	333	141	26	33	54	4	74	50	715	27
1992	41	47	14	107	37	23	13	29	311	63
1993	82	222	49	51	37	17	69		527	35
1994	61	109	61	62	21	9	28	7	358	79
1995					14	4	18	0	36	73
1996	0	56	54	38	17	11	0	7	183	45
1997	102	58	16	38	60	16	49	73	412	46
1998	116	28	26	11	27	23	39	44	314	55
1999	34	83	56	38	50	19	21		301	56
2000	218	164	26	88	37	11	44	44	632	28
2001			47	27	87	5	44	12	222	49
2002			101		72	23	0		196	32
2003			63	32	31	8	15	7	156	52

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	2198	470	1896	827	531	42	1988		7952	43
1983	1674	256	656	5	562	183	2357		5693	37
1984	851	196	1036	15	448	55	1358		3959	34
1985	14	119	569	0	134	307	681		1824	44
1986	1157	307	566	63	370	36	1004		3503	27
1987	653	126	334		1029		2034		4176	29
1988	136	85	195	87	1141	101	3010		4755	38
1989	374	32	167	40	1382		847		2842	36
1990	82	83	200	7	667		1217	3	2259	31
1991	27	30	2	9	252	5	724	179	1228	41
1992	7	6	0	7	29	4	36	35	124	104
1993	68	40	16	33	35	16	211		419	42
1994	27	24	75	25	10	1	141	3	306	76
1995					66	40	218	0	324	64
1996	0	137	33	42	39	7	0	10	268	68
1997	75	9	26	38	37	2	23	57	267	69
1998	20	2	103	26	118	3	252	49	573	61
1999	34	43	141	30	109	13	113		483	61
2000	218	96	108	167	225	86	198	177	1275	38
2001			157	65	516	38	229	56	1061	42
2002			197		535	99	0		831	55
2003			247	73	91	53	56	113	633	45

Table 14. *Anarhichas minor*. Length composition by year (1 000), 1982-2003.

Length	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
10.5	0	0	0	0	0	13	22	0	5	32	0	0	0	0	11	0	0	0	12	0	0	0
11.5	0	0	0	26	9	0	3	4	0	0	0	15	0	0	0	0	0	6	0	0	0	0
12.5	0	0	0	33	0	0	0	0	10	28	0	0	0	0	0	0	0	0	20	0	0	0
13.5	0	0	0	29	0	10	22	0	24	61	0	57	5	0	0	0	0	0	52	0	0	0
14.5	0	0	10	66	19	0	7	12	0	82	14	23	20	0	0	0	43	0	69	0	0	0
15.5	0	0	0	21	54	10	15	0	10	67	8	17	37	0	0	0	0	12	20	0	0	0
16.5	0	0	0	0	19	10	7	33	0	6	20	32	12	0	0	19	0	0	12	0	0	0
17.5	0	0	0	40	4	16	14	3	0	19	27	36	12	0	11	26	0	0	27	0	5	0
18.5	0	0	10	26	0	6	14	9	18	33	20	28	0	0	0	0	0	6	0	0	0	0
19.5	0	0	0	0	0	0	7	0	10	4	0	12	12	0	0	12	5	6	0	0	0	0
20.5	0	0	0	26	17	6	7	0	10	0	5	15	7	0	0	24	11	0	0	0	0	0
21.5	0	0	0	0	0	13	15	13	24	14	0	12	11	0	0	0	7	5	0	0	13	0
22.5	19	0	0	40	19	13	14	23	40	20	12	35	5	0	0	0	0	0	0	0	0	0
23.5	0	0	5	4	27	6	10	4	0	6	0	25	26	0	0	7	5	0	6	0	0	6
24.5	0	0	4	0	40	6	3	33	4	6	49	12	26	0	14	5	12	0	0	9	0	0
25.5	0	0	0	0	44	6	22	0	0	20	0	0	5	0	0	5	7	0	35	0	0	0
26.5	6	0	0	0	73	0	7	13	0	0	27	6	0	0	0	7	0	0	11	5	13	0
27.5	0	0	0	7	28	10	0	0	5	4	8	12	0	0	0	5	0	0	6	0	0	8
28.5	0	0	0	4	37	16	3	3	0	26	13	0	0	0	0	0	14	12	35	0	0	0
29.5	0	0	0	7	0	19	0	0	0	13	0	3	0	0	0	0	0	12	0	0	0	0
30.5	0	0	0	0	27	0	7	10	14	0	24	6	0	0	0	0	5	0	0	6	0	0
31.5	0	0	5	0	20	13	25	13	10	0	0	23	16	0	0	12	0	12	0	0	0	0
32.5	0	0	0	0	33	26	10	0	0	6	0	6	7	0	0	0	0	5	6	0	13	0
33.5	0	0	10	0	0	16	10	0	0	0	0	0	0	0	8	0	0	11	0	0	0	0
34.5	6	0	10	0	8	6	3	0	0	20	0	0	0	0	0	12	0	0	0	0	0	0
35.5	19	0	0	0	0	0	17	9	0	6	7	0	15	0	0	54	0	5	0	0	0	0
36.5	0	0	5	0	0	6	3	9	10	13	19	0	0	0	0	27	0	0	0	0	13	0
37.5	0	0	5	0	0	0	22	0	6	6	0	0	7	0	0	0	0	5	0	0	0	0
38.5	0	0	0	0	5	16	17	0	0	6	8	0	5	0	0	21	0	0	0	0	0	0
39.5	6	0	21	0	0	13	7	0	0	0	0	0	0	0	0	0	0	5	6	0	0	0
40.5	0	0	0	7	19	10	9	24	0	14	0	5	0	0	6	0	0	6	7	0	0	0
41.5	0	1	0	0	4	6	0	0	0	0	0	0	0	0	19	12	0	12	0	0	0	0
42.5	25	0	0	0	0	3	0	10	0	0	0	12	0	11	0	15	0	0	5	13	0	0
43.5	13	0	14	0	17	10	10	0	0	0	0	19	0	0	22	29	0	6	0	0	0	0
44.5	6	0	10	4	13	0	0	4	10	0	0	0	7	0	0	0	0	0	6	0	6	6
45.5	25	0	0	7	0	0	0	29	0	0	0	24	0	14	64	0	0	0	0	0	6	6
46.5	0	0	11	7	0	20	0	0	5	0	8	0	0	0	0	29	0	12	0	0	0	0
47.5	17	1	20	4	0	0	0	15	0	0	0	0	0	0	0	0	0	6	0	0	0	0
48.5	0	0	0	0	0	7	41	10	0	3	0	0	0	25	0	0	12	0	0	0	0	0
49.5	19	0	5	0	16	20	0	29	0	4	0	9	5	7	0	0	0	45	0	0	0	13
50.5	0	0	5	0	12	0	3	0	4	0	25	0	10	0	0	0	0	12	0	13	0	0
51.5	10	10	0	7	12	0	3	10	0	6	0	0	0	0	11	0	0	5	0	0	0	0
52.5	21	0	4	31	4	0	7	20	14	0	0	0	0	0	7	0	0	0	0	0	0	0
53.5	18	0	0	4	0	4	4	0	0	0	10	0	0	0	0	0	0	5	0	0	0	10
54.5	16	7	4	0	0	0	3	9	0	7	0	12	0	0	8	28	0	0	0	0	0	0
55.5	28	1	13	0	16	4	14	18	5	0	0	15	0	0	0	0	0	21	0	0	0	0
56.5	10	1	0	4	12	0	0	0	0	0	0	0	0	0	0	9	12	6	0	0	0	0
57.5	11	0	19	10	8	0	11	9	4	0	0	0	0	0	0	0	0	5	6	0	0	10
58.5	44	3	12	4	0	0	0	0	0	0	0	0	0	0	8	0	5	0	5	0	0	0
59.5	19	25	0	0	0	10	0	0	0	0	30	0	0	0	15	10	6	0	12	0	0	0
60.5	19	6	8	0	13	4	10	36	0	0	0	0	0	0	8	0	7	0	12	0	0	0
61.5	22	25	20	6	16	24	0	3	0	0	0	0	0	0	0	15	0	0	0	0	0	0
62.5	30	17	16	4	4	20	4	3	5	7	0	6	0	0	0	0	7	5	6	0	0	13
63.5	13	1	15	4	4	20	14	4	0	0	0	0	0	0	0	0	0	6	0	0	0	0
64.5	29	21	4	0	4	0	14	9	27	0	0	0	0	0	0	0	0	0	0	0	0	0
65.5	59	26	13	8	0	4	0	20	9	0	0	0	0	0	14	0	9	0	6	0	0	0
66.5	35	12	23	4	4	6	0	4	9	0	0	0	0	0	0	0	0	12	0	6	0	13
67.5	14	5	12	0	0	6	0	3	0	12	0	0	0	0	0	0	0	5	0	0	0	0
68.5	40	25	14	0	8	5	4	0	15	6	0	0	0	0	0	0	0	6	0	11	0	0
69.5	18	21	13	4	5	0	11	0	10	0	13	0	0	0	0	0	10	0	12	6	14	0
70.5	21	8	22	10	4	24	3	13	5	0	7	14	0	0	0	0	0	12	12	0	0	0

Table 15. *Raja radiata*, abundance (1 000) and biomass (tons) for West Greenland by stratum and total, 1982-2003. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance.

Abundance

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	5383	1625	1412	473	556	83	162		9694	38
1983	4798	589	815	360	349	27	59		6997	87
1984	2742	1672	653	505	149	482	116		6319	42
1985	2239	2393	1847	689	397	56	257		7878	44
1986	2178	2806	766	326	295	131	203		6705	46
1987	1790	538	653		291		64		3336	30
1988	3879	1046	996	770	335	39	85		7150	39
1989	11963	2141	3859	694	607		149		19413	38
1990	7145	1981	2489	548	271		550	345	13329	51
1991	1967	480	1220	262	610	130	95	65	4829	26
1992	4457	598	2844	1531	496	523	205	58	10712	50
1993	2266	352	684	279	188	263	95		4127	39
1994	2531	378	872	272	233	79	398	15	4778	43
1995					182	301	116	15	614	59
1996	1273	126	428	76	114	111	56	29	2213	29
1997	4886	493	879	46	120	122	180	0	6726	41
1998	1694	534	439	202	258	46	49	15	3237	31
1999	2164	235	684	195	297	194	213		3982	36
2000	721	188	503	870	248	134	234	15	2913	37
2001			435	88	116	134	629	30	1432	41
2002			642		116	194	121		1073	35
2003			428	292	62	286	208	0	1276	40

Biomass

Year	Str1.1	Str1.2	Str2.1	Str2.2	Str3.1	Str3.2	Str4.1	Str4.2	Total	CI
1982	2994	811	1328	340	409	59	154		6095	36
1983	966	192	703	132	331	27	56		2407	34
1984	728	333	404	96	136	126	95		1918	31
1985	497	427	804	181	159	46	56		2170	22
1986	517	527	421	83	122	65	39		1774	28
1987	415	149	306		184		13		1067	29
1988	653	122	503	238	174	19	33		1742	28
1989	2076	429	980	107	314		90		3996	31
1990	980	263	526	56	91		113	201	2230	45
1991	279	81	181	36	246	42	10	33	908	28
1992	327	94	139	134	221	89	23	27	1054	49
1993	340	88	82	31	29	24	3		597	28
1994	231	71	143	30	91	14	54	11	645	61
1995					70	37	41	0	148	75
1996	95	23	38	23	21	16	8	13	237	44
1997	354	96	181	6	16	29	33	0	715	35
1998	143	90	89	47	56	13	8	15	461	33
1999	150	68	143	65	68	26	54		574	56
2000	116	47	141	298	103	12	28	13	758	42
2001			75	30	58	24	131	18	336	49
2002			136		21	32	15		204	35
2003			73	55	25	51	90	0	294	45

Table 17. Stratum means of near bottom temperature (°C) and stratified mean, 1982-2003.

YEAR	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	Mean
1982	2.540	3.627	1.953	3.100	3.256	3.633	2.623							4.600	3.139
1983	2.028	3.713	1.420	3.819	2.139	4.808	2.160			4.117		4.000		2.943	3.012
1984	1.365	2.790	1.617	3.886	2.462		2.519					4.129			2.698
1985	4.190	5.154	3.116	4.612	2.614	4.336	4.444		5.040	5.190	4.421	4.300		3.300	4.181
1986	3.669	4.393	4.014	5.073	4.203	5.066	4.102			4.796	4.042	4.516		3.347	4.136
1987	3.086	4.890	3.393		3.504		3.530			4.467		4.400		3.300	3.783
1988	2.548	4.328	3.034	4.956	4.228	5.234	4.332		4.479	4.559	4.298	4.578		3.792	3.959
1989	2.323	3.953	2.718	4.525			2.579		3.392	3.743	3.648	4.064		3.146	3.295
1990	2.497	3.922	3.000	4.809	3.421		2.516		4.395	4.570	3.252	4.019		3.025	3.461
1991	3.533	4.726	3.477	4.204	3.016		2.997								3.558
1992	3.900	4.418	2.911	4.457	2.985	4.691	1.938							3.472	3.489
1993	3.007	4.003	2.360	3.360	4.711	4.959	2.773		3.771	4.056	4.327	4.394		2.820	3.597
1994	2.914	4.436	3.747	4.641	3.847	5.109	3.773								3.620
1995					4.229	4.614	3.469	4.242	2.601	3.623	3.683	4.318		3.834	3.862
1996	4.614	5.506	4.414	5.688	5.610	5.700	5.057	5.732	4.505	5.129	5.320	4.903		2.848	4.709
1997	3.304	4.938	4.022	5.180	4.570	5.478	4.606	5.540	4.578	4.742		4.266		3.464	4.189
1998	4.059	5.336	4.686	5.840	6.400	6.382	5.359	5.978	6.021	5.820	5.583	5.346		4.641	5.181
1999	4.941	5.051	4.429	5.729	4.834	5.773	4.104		5.225	5.315	4.777	4.087		2.435	4.435
2000	3.085	4.583	4.377	5.033	4.645										3.860
2001			5.007	5.350	5.133	5.992	4.429		5.620						5.128
2002			4.503		5.832	5.961	4.906		4.820	5.298		4.924		4.278	4.904
2003			6.948	6.515	6.529	6.633	5.406	6.539	6.124	5.821	4.970	5.093		4.021	5.500

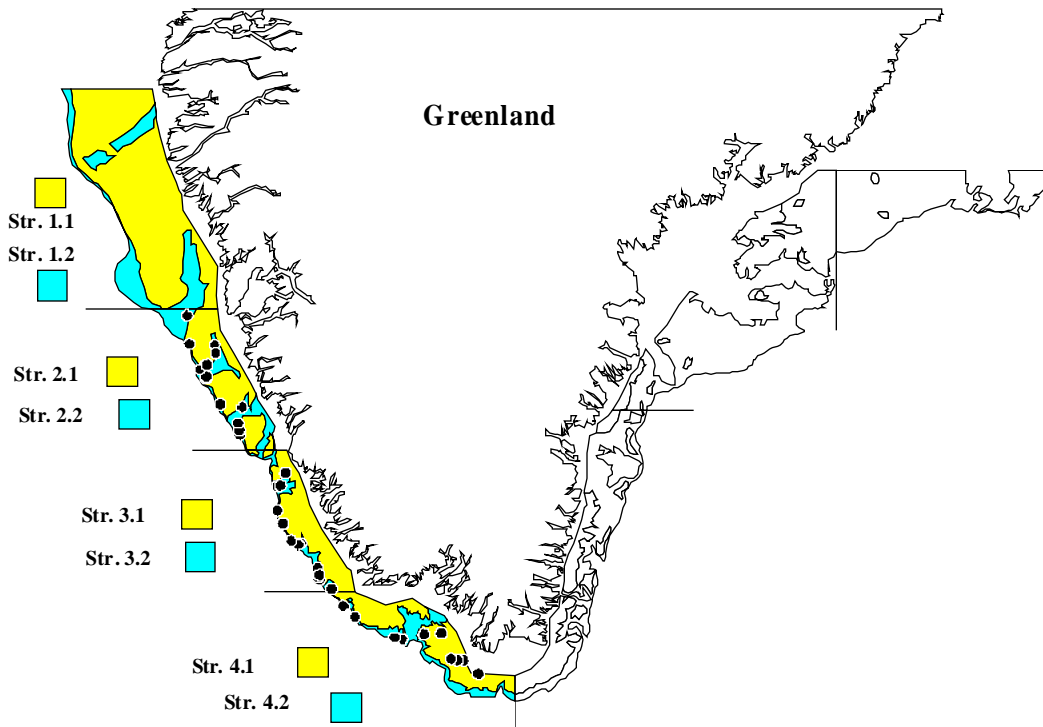


Fig. 1. Stratification of the survey area as specified in Table 2, positions of hauls carried out in 2003.

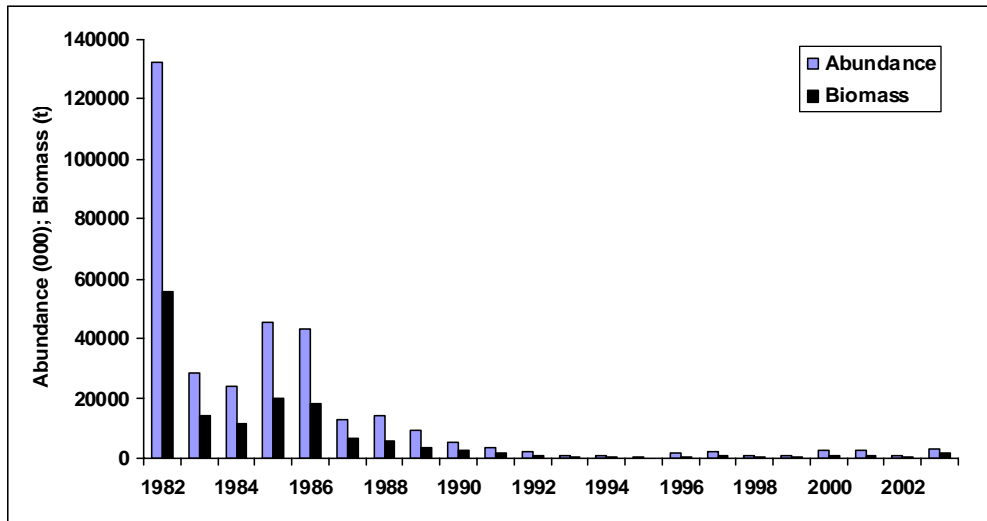


Fig. 2. Abundance and biomass indices for *S. marinus* ≥ 17 cm off West Greenland, 1982-2003. Respective values are listed in Table 3.

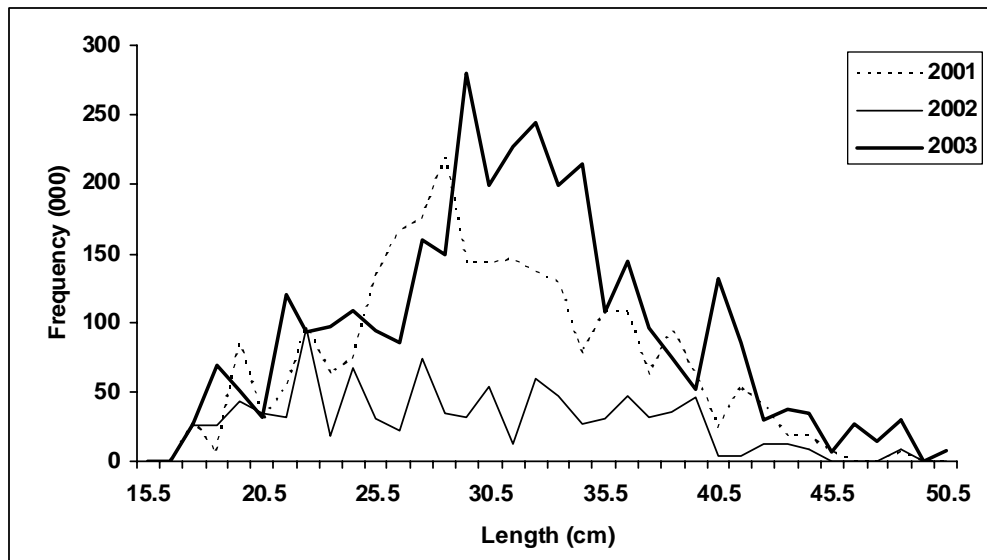


Fig. 3. Length disaggregated abundance indices for *S. marinus* ≥ 17 cm off West Greenland, 2001-2003. Respective values are listed in Table 4.

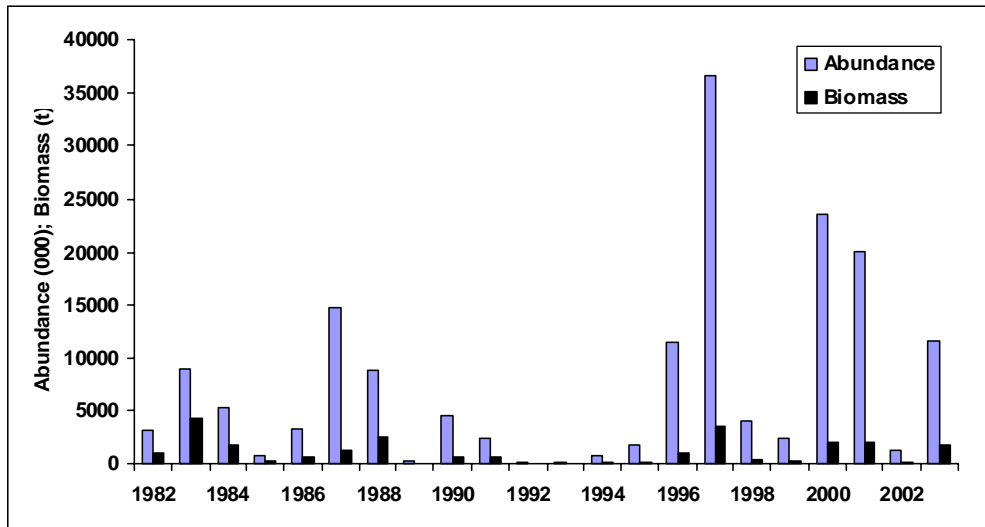


Fig. 4. Abundance and biomass indices for *S. mentella* ≥ 17 cm off West Greenland, 1982-2003. Respective values are listed in Table 5.

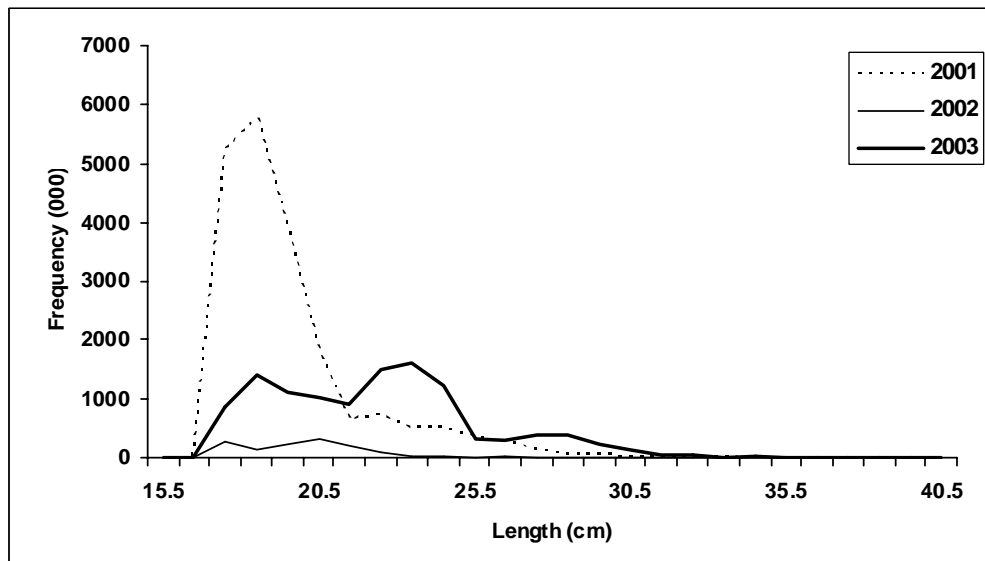


Fig. 5. Length disaggregated abundance indices for *S. mentella* ≥ 17 cm off West Greenland, 2001-2003. Respective values are listed in Table 6.

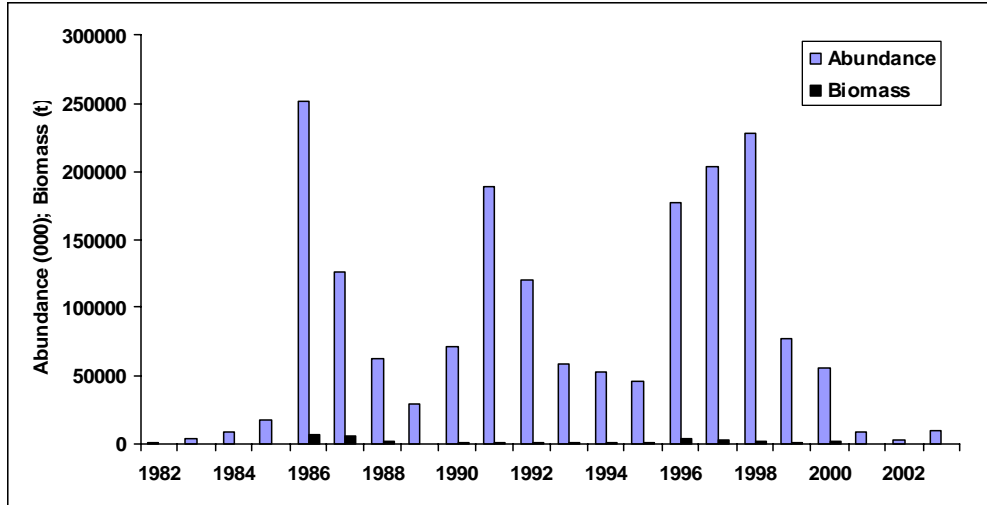


Fig. 6. Abundance and biomass indices for *Sebastes* spp. <17 cm off West Greenland, 1982-2003. Respective values are listed in Table 7.

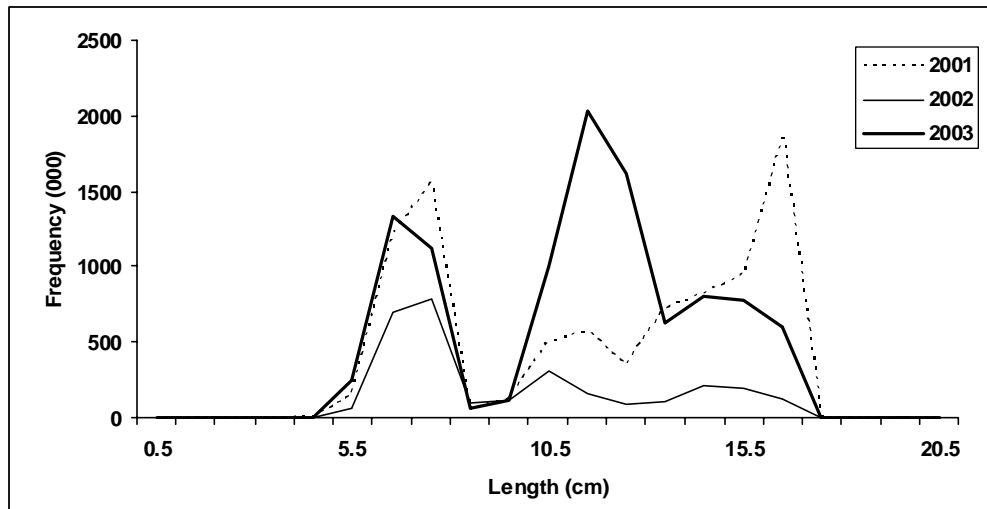


Fig. 7. Length disaggregated abundance indices for *Sebastes* spp. <17 cm off West Greenland, 2001-2003. Respective values are listed in Table 8.

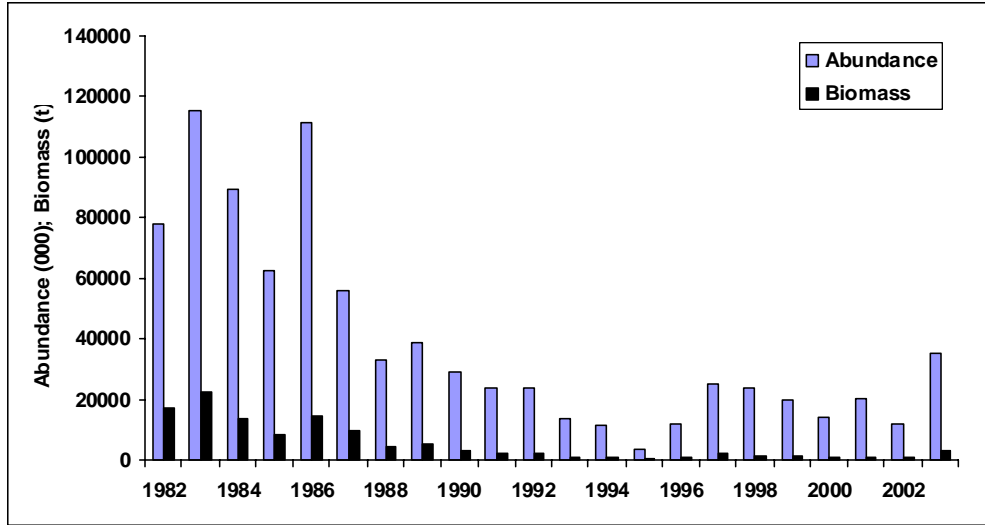


Fig. 8. Abundance and biomass indices for *Hippoglossoides platessoides* off West Greenland, 1982-2003. Respective values are listed in Table 9.

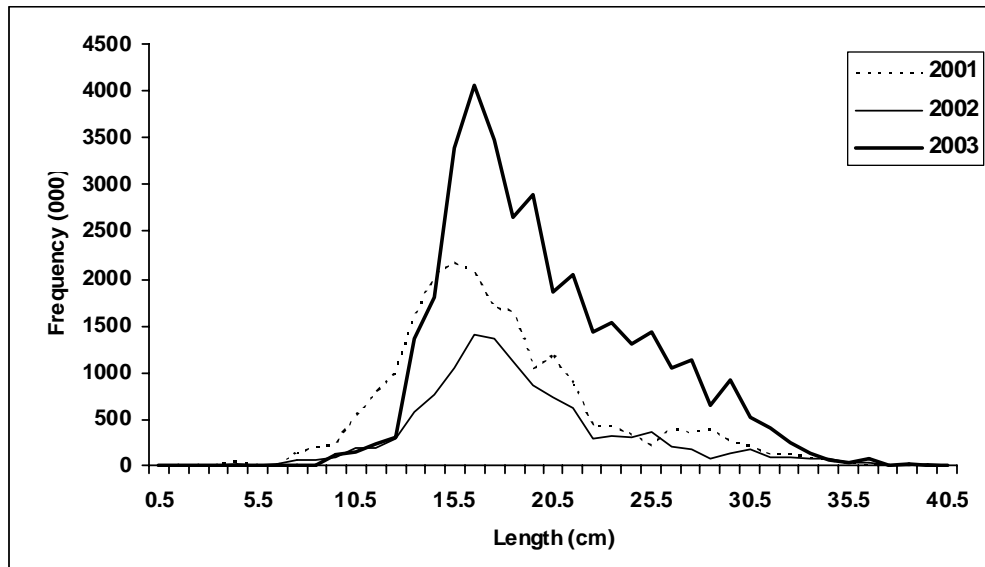


Fig. 9. Length disaggregated abundance indices for *Hippoglossoides platessoides* off West Greenland, 2001-2003. Respective values are listed in Table 10.

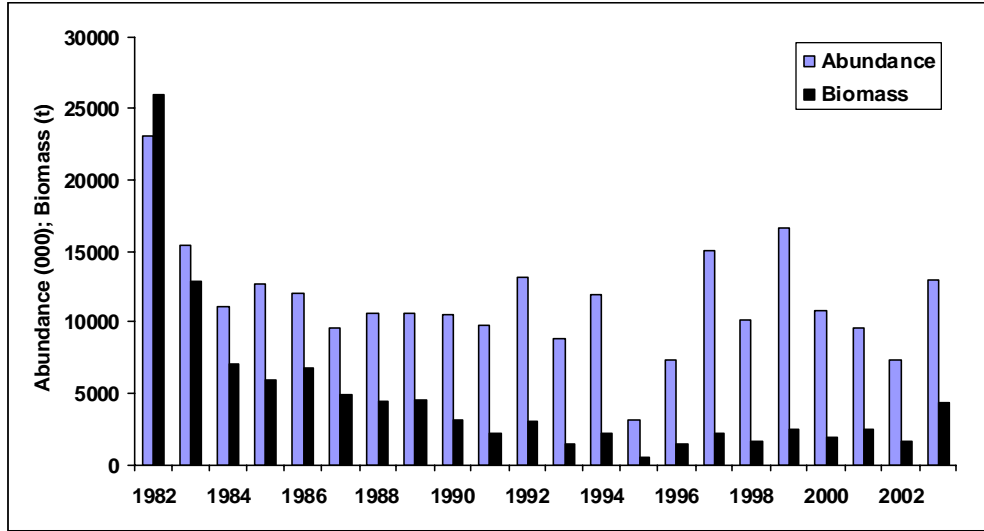


Fig. 10. Abundance and biomass indices for *Anarhichas lupus* off West Greenland, 1982-2003. Respective values are listed in Table 11.

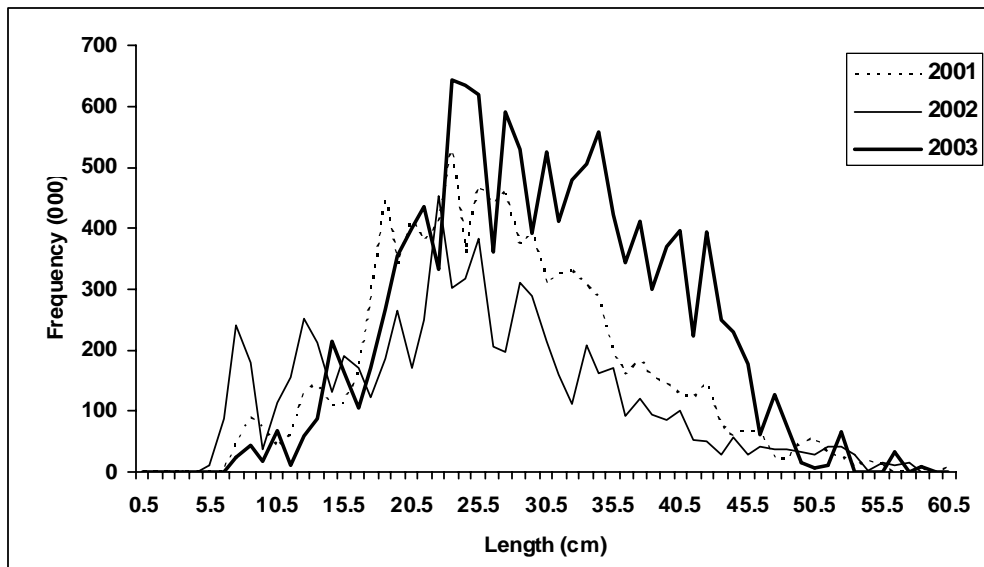


Fig. 11. Length disaggregated abundance indices for *Anarhichas lupus* off West Greenland, 2001-2003. Respective values are listed in Table 12.

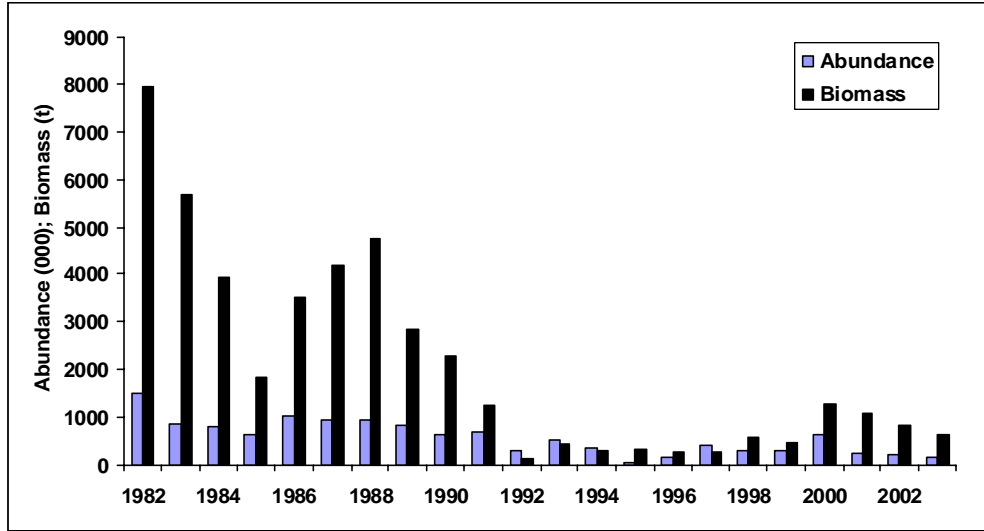


Fig. 12. Abundance and biomass indices for *Anarhichas minor* off West Greenland, 1982-2003. Respective values are listed in Table 13.

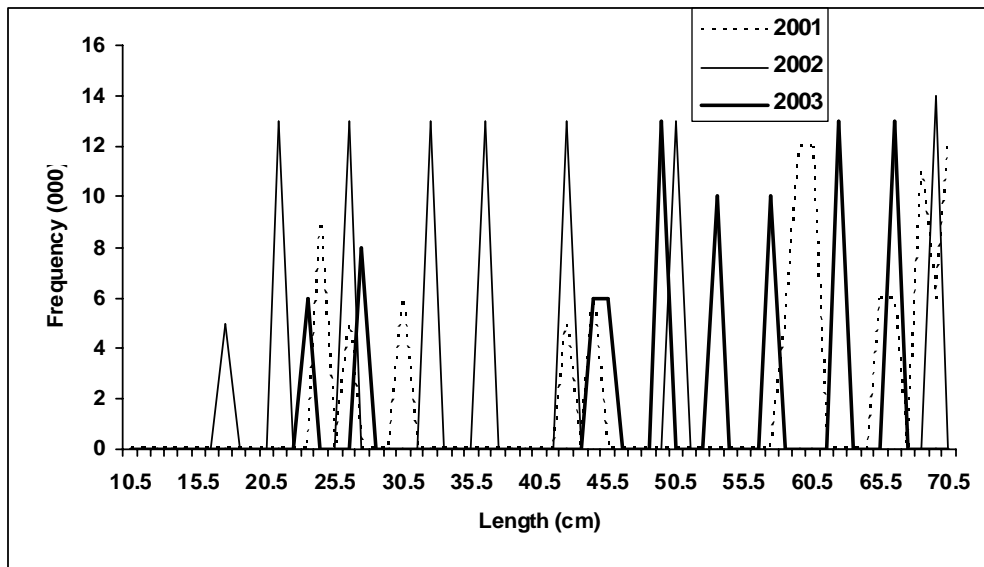


Fig. 13. Length disaggregated abundance indices for *Anarhichas minor* off West Greenland, 2001-2003. Respective values are listed in Table 14.

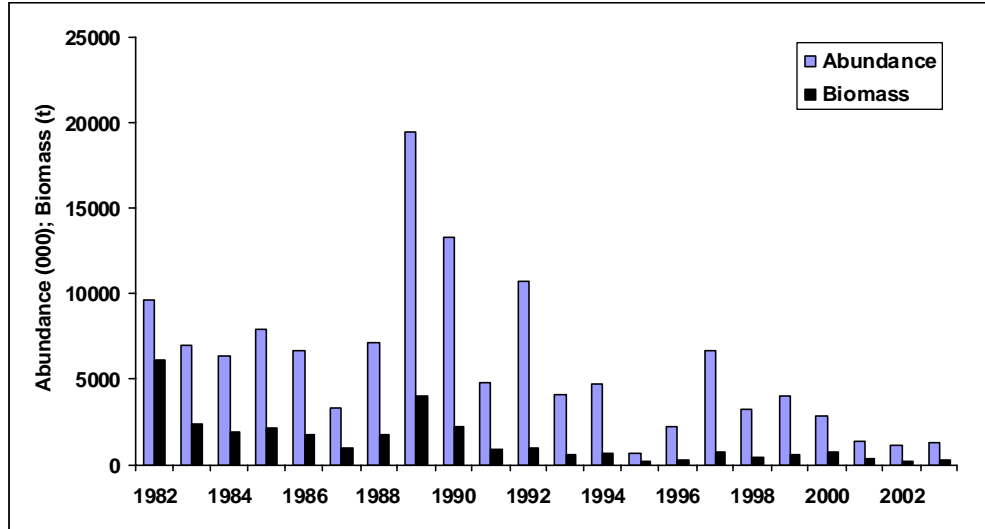


Fig. 14. Abundance and biomass indices for *Raja radiata* off West Greenland, 1982-2003. Respective values are listed in Table 15.

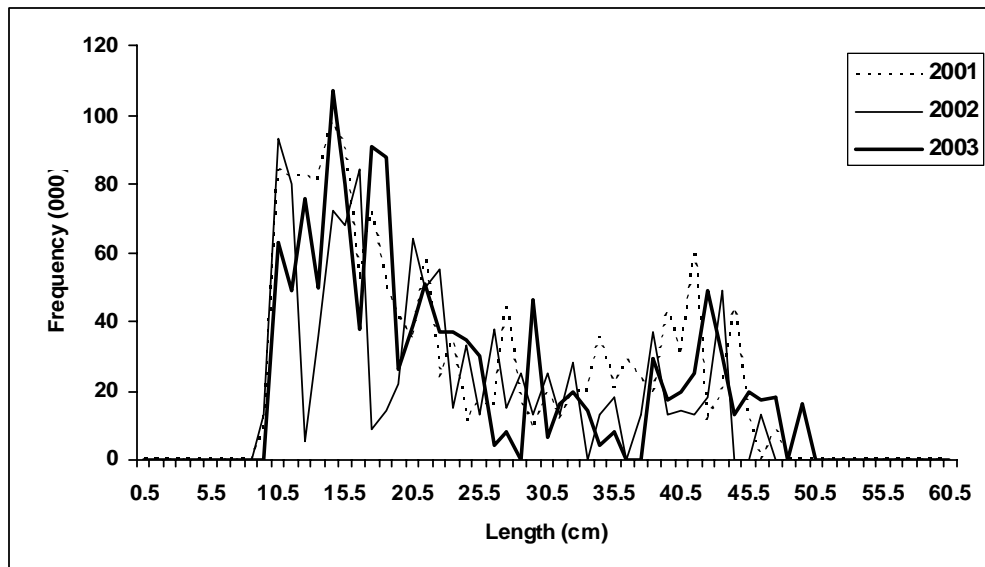


Fig. 15. Length disaggregated abundance indices for *Raja radiata* off West Greenland, 2001-2003. Respective values are listed in Table 16.

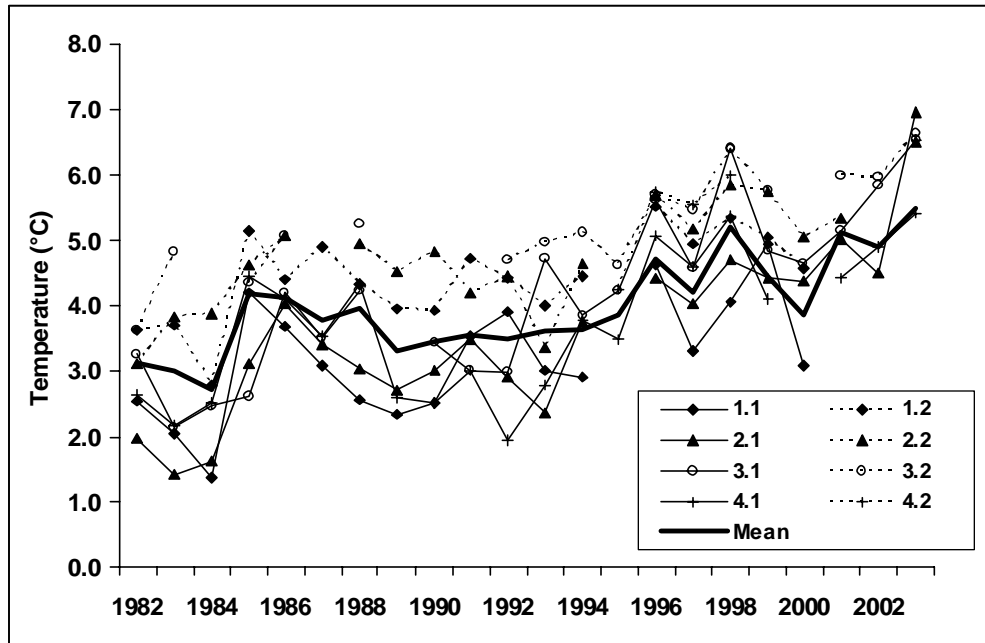


Fig. 16. Stratum means of near bottom temperature ($^{\circ}\text{C}$) and stratified mean, 1982-2003. Respective values are listed in Table 17. Solid lines display trends in shallow strata (<200 m), dashed lines display trends in deep strata (>200 m),