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Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated
from the Greenland Shrimp Survey, 1988-2001.

by

Jens Jacob Engelstoft
Greenland Institute of Natural Resources, Box 570, 3900 Nuuk, Greenland

and

Ole A. Jørgensen
Danish Institute for Fisheries Research, Charlottenlund Slot, 2920 Charlottenlund, Denmark

Abstract

Since 1988 Greenland Institute of Natural Resources annually has conducted a bottom trawl survey off West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of Northern shrimp (*Pandalus borealis*), but data on most fish species have been recorded. This paper presents biomass and abundance estimates together with length frequencies of cod, Greenland halibut, redfish, wolffishes, American plaice and starry skate from the 2001 survey. Further, a recruitment index for Greenland halibut is presented.

Materials and Methods

The survey covers the offshore areas at West Greenland between 59°00'N and 72°30'N from the 3-mile limit to the 600 m depth contour line and the inshore area Disko Bay (Figure 1 and Table 1). The survey area is divided into NAFO Divisions, which were further subdivided into three depth strata (0-200, 201-400 and 401-600 m) on basis of depth contour lines. The area surveyed has, however, changed throughout the years. From 1988 to 1990 the survey area included Div. 1AN to 1D. In 1991 the Div. 1AN was not covered. In 1992 the survey area was extended to include Div. 1AN to 1F and Disko Bay (Div. 1AX), and this area is now surveyed annually. The survey was originally designed as a shrimp survey and sampling of fish data was not complete in the period 1988-1991. Since 1992 the sampling of fish has improved and the survey is now considered as a combined groundfish/shrimp survey. The survey period was July to September.

The survey is designed as a stratified-random trawl survey. A minimum of two hauls per stratum is always planned. Due to lack of information of the bottom topography Div. 1AN and Disko Bay are considered as two single strata. The number of valid hauls by year and stratum is listed in Table 2.

The surveys have been conducted with trawlers of the same size throughout the years. Since 1991 the 722 GRT stern trawler M/Tr 'Pâmiut' has been used. The trawl is a Skjervoy 3000/20 with bobbin gear and double bag. The mesh size in the codend was 40 mm from 1988 to 1992. From 1993 the mesh size in the codend has been 20 mm. The changes of mesh size did not influence the catchability of fish except for redfish. Abundance estimates for redfish before 1993 are therefore adjusted in according to Bech, 1994. The trawl doors in use are of the type 'Perfect', except for the 1989 survey where 'BMV' doors were used. Wing spread is set as 19.0 m. The standard trawling time offshore is 15-60 minutes at a mean towing speed of 2.5 knots. In Disko Bay (1AX) the trawling time is 30 min. The trawling operations are performed during

daytime only. After each haul the catch was sorted by species or lowest taxonomic level and weighed to 0.1 kg and the number recorded. Fish was measured as total length to 1 cm below. The catches of redfish consisted almost exclusively of specimens <20 cm. Due to difficulties in identification of species all redfish were classified as *Sebastes sp.*

Stratified abundance and biomass estimates were calculated from catch-per-tow data using the stratum areas as weighting factor (Cochran, 1953). The coefficient of catchability was set at 1.0, implying that estimates are merely indices of abundance and biomass. Confidence intervals (CI) were set at the 95% level of significance of the stratified mean.

Catch per unit effort (CPUE) for Greenland halibut was calculated in numbers per year class per hour. Separation of ages was based on the Petersen method.

The available age and maturity data on American plaice, Atlantic wolffish, spotted wolffish and thorny skate were considered to be insufficient for a reliable calculation of spawning biomasses as recommended by STACFIS in 2001.

Results

Greenland halibut (*Reinhardtius hippoglossoides*).

Greenland halibut was found in all divisions, but it was most common in Div. 1AN-1BN. In 2001 the biomass and abundance was estimated to 531 million individuals and 25891 tons (Table 5 and 4). Distribution of survey catches in kg pr. hour and number pr. hour are shown in Figure 1 and Figure 2 for 2001. High abundance are especially found in Div. 1AX (Disko Bay). The abundance and biomass estimates in the period 1992-1995 have been relatively stable with 270-345 mill individuals and 11,000-14,000 tons. In 1996 the abundance increased to 603 mill. individuals, which is the largest figure in the time series. Since the abundance has declined somewhat but increased again in recent years to the present level. The biomass shows a slight increasing trend during the time series.

The length distribution ranged between 6 and 42 cm with two clear modes around 13 cm and 23 cm (Figure 3). In 1998-2000 modes were found around 15 cm and 25 cm.

The CPUE (number per age per hour of age 1 (2000 year-class) was estimated to 443.6 specimens in the offshore nursery area (Div. 1AS, 1BN and 1BS), which is the second largest in the time series. In the Disko Bay the CPUE was estimated at 1,597.4 specimens per hour, which is the largest in the time series. The abundance of 2-year olds are generally lower in the offshore area in comparison to the Disko Bay. But there is generally a steep decline in the CPUE of fish age one and fish age two the following year in both areas.

Redfish (*Sebastes sp.*).

Redfish was found in all the survey areas, but was most common in Div. 1BN and 1C. Distribution of survey catches in kg pr. hour and number pr. hour are shown in Figure 5 and Figure 6.

Tables 5 and 6 list abundance and biomass indices by stratum. The abundance and biomass estimated in the period 1992-1996 have fluctuated without a clear trend between 1.1-2.8 billion individuals and 12,000-31,000 tons. In recent years the abundance and biomass has decreased from 4.7 billion individuals and 60,497 tons in 1997 to 122 millions individuals and 12,060 tons in 2001 (Table 5 and 6). This decrease is particularly distinct for Div. 1BN.

During the years catches has comprised almost exclusively of specimens less than 20 cm. Annual growth increments of 4 cm were indicated by repeatedly pronounced peaks in length compositions at 7-8 cm and 12 cm probably corresponding to age 1 and 2 (Nederaas, 1990). Figure 7 shows the abundance estimate as a function of the length distribution. There is a low consistency in year class strength indicating a high mortality. The recent four survey estimates revealed only small peaks at 7-8 cm and 12 cm, leaving no sign of prominent future recruitment.

American plaice (*Hippoglossoides platessoides*).

American plaice is mainly found in Div. 1A-1D. In 2001 the biomass and abundance was estimated to 30 million

individuals and 1476 tons (Tables 7 and 8). The abundance and biomass estimates for American plaice has varied without any significant trend between 9 and 48 millions individuals and 656 and 1,951 tons. In 2001 the length ranged between 5 and 35 cm (Figure 8). A clear mode at 10-12 and somewhat weaker modes at 15-20, 23-25 and 30-32 cm is found in 2001 as well as in previous years.

Spotted wolffish (*Anarhichas minor*)

Spotted wolffish is evenly distributed in the survey area. In 2001 the biomass and abundance was estimated to 1,6 million individuals and 625 tons (Table 9 and 10). The abundance and biomass has varied through the time series without any significant trend with highest estimates in 2000 (1,6 million individuals) and lowest in 1993 (283,000). Too few spotted wolffish were caught in the survey during the years to reveal meaningful length distributions.

Atlantic wolffish (*Anarhichas lupus*)

Atlantic wolffish is mainly caught south of 68°00'N (Table 11 and 12). In 2001 the abundance and biomass was estimated to 1.5 million individuals and 140 tons.

The abundance and biomass has varied through the time series without any significant trend with highest estimates in 1994 (6.7 million individuals and 977 tons) and lowest in 1993 (1.0 million individuals and 228 tons). In 2001 the length ranged between 5 and 50 cm (Figure 9). The analysis of the length distribution reveals the dominance of small fish < 35cm with clear modes at 8-12 cm and 25-30 cm.

Cod (*Gadus morhua*)

Cod was captured in all areas except 1AN and 1AS during the 2001 survey. Tables 13 and 14 list abundance and biomass indices of cod by stratum. The biomass-indices for cod were estimated to 4,000-7,000 tons in 1988-1990. In 1992 the biomass decreased with over 95% to only 250 tons and 528,000 individuals and remained at this low until recent years. There are indications of a slight improvement in the abundance of small cod. Abundance indices in 2001 were estimated to 1.6 million individuals, which is the highest estimate in the abundance time series. In 1999 to 2001 a significant amount of cod was captured in area 1AS and 1BN for the first time since 1990. A significant amount was also taken in the Disko Bay area (1AX). Figure gives the length distribution of cod in the survey during the years. The lengths range between 15 and 60 cm with distinct modes at 23-27 and 34-38 in the 2001 survey.

Starry skate (*Raja radiata*)

The biomass is mainly distributed in Div. 1A-1D. The abundance and biomass of starry skate have increased from a level about 6-10 million individuals and 7-12,000 tons in 1991-1993 to a level of 13-16 million individuals and 2,000-3,000 tons in 1994-2000. In 2001 the abundance and biomass decreased to 9.1 mill. individuals and 1224 tons (Table 15 and 16). During the years the abundance and biomass varies without any significant trend. No length data are available for this species.

Discussion

The survey was originally designed as a shrimp survey. The fish data are incomplete and the survey did not cover the same area in the period 1988-1991. Direct comparison was hence only possible for the period 1992-2001. The main purpose of the survey is to evaluate the biomass of northern shrimp and most effort is concentrated in the areas and depths where the commercial shrimp trawling taking place, especially on the northern slopes of the grand bank Store Hellefiskebanke (67°50'N 55°00'W) and in the inshore area Disko Bay. As Store Hellefiskebanke and Disko Bay are important nursery areas for Greenland halibut and redfish as well as other important species (Smidt, 1969; Tåning, 1949) it is likely, that the abundance and biomass estimates of the survey reflects the juvenile stock situation of these species, however the short time series and the high variability on estimates calls for some reservations. Three successive years of low recruitment to the redfish stock might indicate a general decreasing trend. The seems to be a continued recruitment of Greenland halibut both in the Disko Bay area and the off shore area. The survey showed, however, a drastic decline in abundance between age one and age two for both Greenland halibut and redfish. This could be caused by high mortality, migration out of the survey area, or a change in catchability by age. One year old Greenland halibut is known to be much

more pelagic compared to older age classes (Jørgensen, 1997), and is hence caught more easily by a 20 m high shrimp trawl, than older age classes, while older age classes probably are able to escape under the trawl, that is attached to the ground gear with 75 cm long straps.

According to a number of investigations the fishable part of all ground fish stocks off West Greenland has been severely depleted during the last decade (Rätz, 1998a, b; Ogawa *et al.*, 1994; Yokawa *et al.*, 1995). The low biomass and abundance of cod, American plaice, wolffish and starry skate presented in this paper supports this general picture. Apart from an annually fishery of about 5,500 tons Greenland halibut, no fishing effort has in recent years been directed towards ground fish off West Greenland, but an extensive shrimp fishing on traditional fishing grounds is suspected to have had a negative effect on the survival rates of recruits during the years. In order to reduce the bycatch in the shrimp fishery Greenland introduced the 1. October 2000 mandatory use of 22-mm sorting grids into the full geographic range of the Greenland shrimp fishery. Results of experimental fishing with 22 mm sorting grids shows a nearly complete protection to finfish larger than about 20 cm, but poor protection of the smallest fish (Engelstoft *et al.*, 2000). Besides the introducing of sorting grids Greenland shrimp trawling regulations require ships to change grounds by at least 5 miles as soon as bycatch exceeds limits.

References

- Bech, G. 1994. Biomass and Abundance of Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes* sp.) from a bottom Trawl Survey in NAFO Subarea 1 in 1993. NAFO SCR Doc. 94/9, Serial No. N2367, 12p
- Cochran, W. G. 1977: Sampling Techniques, Third edition, Wiley & Sons.
- Engelstoft, J. J, Isaksen, B., Larsen, R. B., Rosing, M., Zachariassen, K 2001. Studies of technical methods for secure shrimp fishery in the Redfish Box, East Greenland. Project Report for the Nordic Strategy for the Environment and Fisheries.
- Jørgensen O. A. 1997. Pelagic Occurrence of Greenland Halibut, *Reinhardtius hippoglossoides* (Walbaum), in West Greenland Waters. *J. Northw. Atl. Fish. Sci.*, Vol 21:39-50.
- Nedreaas, K. 1980: Age determination of Northeast Atlantic *Sebastes* species. *J. Cons. int. Mer.* 47: 47: 208-230.
- Ogawa, M., K. Yokawa and O. Jørgensen 1994. Results of a Stratified Random Trawl Survey off West Greenland in 1993. NAFO SCR Doc. 94/31, Ser. No N2399:1-12.
- Rätz, H.J., 1998a: Structures and Changes of the Demersal Fish Assemblage off Greenland and Trends in Near Bottom Temperature, 1982-97. NAFO SCR Doc. 98/21, Ser. No. N3005
- Rätz, H.J., 1998b: Assessment of Other Finfish in NAFO Subarea 1. NAFO SCR Doc. 98/45 Serial No. N3036
- Smidt, E.L.B., 1969: The Greenland Halibut *Reinhardtius hippoglossoides* (Walb.), Biology and Exploitation in the Greenland Waters. *Meddelelser fra Danmarks Fiskeri- og Havundersøgelser*, N.S.,6: 79-148.
- Tåning, Å.V., 1949. On the breeding places and abundance of the redfish (*Sebastes*) in the North Atlantic. *Ibid.* Journ. Cons. Vol.16 No.1: 85-96.
- Yokawa, K., H. Shimizu, O. Jørgensen and H. Yamada 1995. Results of a stratified-random bottom trawl survey off West Greenland in 1994. NAFO SCR Doc. 95/23, Ser. No. N2531:1-12

Table 1. Specification of strata. 1AX=Disko Bay.

Stratum					depth	area
	south	north	east	west	(m)	(km ²)
1AN*	6930'N	7300'N	5000'W	6300'W	1-600	41129
1AS	6850'N	6930'N	5000'W	5700'W	1-200	4681
-	6850'N	6930'N	5000'W	5700'W	200-400	7474
-	6850'N	6930'N	5000'W	5700'W	400-600	640
1AX*	6850'N	7030'N	5000'W	5300'W	1-600	9364
1BN	6700'N	6850'N	5000'W	5700'W	1-200	16093
-	6700'N	6850'N	5000'W	5700'W	200-400	17370
-	6700'N	6850'N	5000'W	5700'W	400-600	4133
1BS	6615'N	6700'N	5000'W	5700'W	1-200	7722
-	6615'N	6700'N	5000'W	5700'W	200-400	1682
-	6615'N	6700'N	5000'W	5700'W	400-600	1243
1C	6415'N	6615'N	5000'W	5700'W	1-200	17916
-	6415'N	6615'N	5000'W	5700'W	200-400	5314
-	6415'N	6615'N	5000'W	5700'W	400-600	3366
1D	6230'N	6415'N	5000'W	5500'W	1-200	8921
-	6230'N	6415'N	5000'W	5500'W	200-400	3562
-	6230'N	6415'N	5000'W	5500'W	400-600	903
1E	6045'N	6230'N	4800'W	5300'W	1-200	7871
-	6230'N	6415'N	5000'W	5500'W	400-600	903
1E	6045'N	6230'N	4800'W	5300'W	1-200	7871
-	6045'N	6230'N	4800'W	5300'W	200-400	2000
-	6045'N	6230'N	4800'W	5300'W	400-600	329
1F	5900'N	6045'N	4400'W	5000'W	1-200	8808
-	5900'N	6045'N	4400'W	5000'W	200-400	3330
-	5900'N	6045'N	4400'W	5000'W	400-600	1211
Total West Greenland					165698	

* No depth stratification in Div. 1AN and Disko Bay

Table 2. Numbers of valid hauls, 1988-1998. 1AX=Disko Bay.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Total
1988	23	14	*	25	5	7	4	*	*	78
1989	37	11	*	60	13	21	2	*	*	144
1990	28	20	*	69	17	35	21	*	*	190
1991	*	11	47	54	17	11	9	*	*	149
1992	32	16	44	42	8	18	20	11	17	207
1993	23	13	32	44	10	21	16	14	14	187
1994	28	19	30	52	10	24	10	10	9	192
1995	17	11	37	53	13	29	15	14	11	200
1996	22	12	36	52	11	29	12	9	11	194
1997	29	17	37	110	9	32	13	12	19	278
1998	20	20	36	68	14	27	19	14	15	233
1999	20	26	37	64	18	33	16	14	17	245
2000	18	13	23	59	17	37	23	14	28	232
2001	18	16	23	63	16	36	24	13	26	234

Table 3. Greenland halibut (*Reinhardtius hippoglossoides*). Abundance indices (x1000) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1988	103500	2697		110900	7572	2140	194	*	*	(251263)	26
1989	*	*	*	*	*	*	*	*	*	*	*
1990	21730	1290	*	58310	4920	950	297			(83070)	24
1991	*	508	25980	58710	2972	1308	1821	*	*	(91300)	25
1992	31920	4100	68690	235900	1599	1230	568	594	0	344556	27
1993	28170	14290	35240	174100	10230	4295	3910	3517	427	274161	32
1994	21780	24490	43760	170500	12050	20720	133	397	559	296644	27
1995	18900	11320	83220	111100	22830	14320	5651	201	339	267875	21
1996	118100	2049	111500	326500	13530	18700	11790	129	355	602732	22
1997	32430	3019	126500	61590	2615	14520	783	57	273	241751	20
1998	54490	5898	181500	71840	28370	8360	4109	1323	658	356600	22
1999	63010	7854	94400	106800	6426	5617	7602	1043	983	293700	18
2000	50570	10440	160100	109800	4728	5415	8059	187	589	349900	23
2001	79940	89150	201100	147500	1838	6099	2910	597	1673	530800	21

Table 4. Greenland halibut (*Reinhardtius hippoglossoides*). Biomass indices (tons) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1988	9334	1012	*	5955	1416	1009	85	*	*	(18810)	25
1989	1342	294	*	1364	85	333	*	*	*	*	*
1990	2543	251	*	4384	278	271	174	*	*	(7901)	19
1991	*	5	2147	1705	88	286	70	*	*	(4301)	19
1992	2980	161	3802	4715	377	270	70	46	0	12422	19
1993	2558	252	2364	3617	757	587	449	121	44	10649	23
1994	2069	849	2488	4407	1799	1786	99	11	27	13534	26
1995	1627	168	5053	2305	949	1178	459	6	46	11791	19
1996	4363	41	8047	7204	508	1575	959	8	114	22819	21
1997	3195	284	7723	3450	495	1941	164	14	89	17354	19
1998	4824	417	12500	4121	1940	1089	300	105	317	25611	20
1999	6006	376	8117	6437	704	879	245	35	339	23137	20
2000	1815	320	9608	4142	536	783	619	24	287	18133	18
2001	5942	1494	10552	5064	318	1444	315	18	460	25891	22

Table 5. Redfish (*Sebastes sp.*). Abundance indices (1000) for West Greenland with 95% confidence limits in percent of the stratified mean.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1992	7647	45740	6227	1032000	205200	55770	29050	5386	6528	1393925	33
1993	9222	28290	5838	408100	22430	173300	189900	660000	248500	1145834	29
1994	48530	89130	12470	1747000	357800	291200	102300	12740	118900	2780507	26
1995	56920	23260	10430	604800	55970	216300	95150	4592	5163	1072621	22
1996	2452	3956	5493	1980000	66080	118500	67390	10740	63060	2448154	29
1997	11910	16250	4641	4347000	71740	176300	48740	23200	19980	4719847	20
1998	8401	7169	14540	241500	17640	91510	80820	7202	36360	505100	20
1999	39880	13750	6950	209900	6195	118600	48420	3028	18180	464900	18
000	2580	11190	1836	65580	31470	30470	8450	15170	17510	184200	23
2001	8041	9413	1313	24900	14900	21550	19910	960	21320	122300	24

Table 6. Redfish (*Sebastes sp.*). Biomass indices (tons) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1989	554	164	*	5110	2381	2307	2180	*	*	(12690)	30
1990	882	1908	*	7373	471	1753	710	*	*	(13077)	19
1991	*	13	242	7261	408	1091	1421	*	*	(10437)	23
1992	279	490	330	13970	2928	1419	837	76	279	20609	28
1993	309	701	270	6904	330	1327	2232	652	1119	13843	31
1994	1604	2138	451	17303	2912	4063	883	200	1519	30623	45
1995	1225	231	569	4178	1012	2618	1982	256	68	12139	22
1996	40	61	495	14879	1727	3015	2161	284	1964	22108	27
1997	629	515	285	45933	1879	7457	1708	742	1349	60497	18
1998	428	443	622	9290	2554	3561	2189	392	1336	20814	20
1999	1121	624	467	5878	188	1928	1586	123	752	12668	20
2000	80	427	98	2005	2074	2500	307	1609	934	10033	30
2001	441	647	247	2408	1706	3102	1060	60	2388	12060	28

Table 7. American plaice (*Hipploglossoides platessoides*). Abundance indices (1000) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1991	*	460	535	3630	506	3659	3412	*	*	(12204)	43
1992	1297	421	1569	1618	629	1820	1267	683	112	9415	25
1993	1577	315	1071	3477	964	2147	1817	497	725	12589	23
1994	3272	1493	3181	20950	7001	10420	819	441	694	48269	27
1995	1068	283	1733	6365	1193	2812	3863	589	572	18478	23
1996	2174	607	8072	5776	2602	4599	4732	251	751	29564	21
1997	5818	776	2489	9452	1137	12330	2831	466	858	36155	21
1998	1414	818	2064	4671	1992	1864	8382	787	2122	24120	21
1999	569	856	1633	8968	1818	5925	2128	722	689	23310	16
2000	1222	4003	5067	17390	2007	4110	5803	391	565	40550	22
2001	1268	1187	1320	14180	1871	5140	3741	524	609	29800	26

Table 8. American plaice (*Hipploglossoides platessoides*). Biomass indices (tons) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1989	38	53	*	151	111	392	64	*	*	(810)	29
1990	0	0	*	120	48	145	364	*	*	(677)	40
1991	*	5	89	118	58	160	380	*	*	(194)	64
1992	52	11	126	84	53	140	118	65	7	656	26
1993	68	25	71	97	36	101	137	47	32	614	28
1994	140	96	285	599	343	316	66	32	74	1951	23
1995	82	17	264	211	61	97	167	35	17	951	20
1996	158	48	715	264	95	158	161	12	30	1642	20
1997	331	29	315	227	99	420	146	37	29	1633	17
1998	142	33	347	241	74	100	468	83	102	1590	18
1999	80	36	159	361	72	230	156	45	54	1193	23
2000	103	196	373	588	79	208	315	64	43	1968	16
2001	155	55	114	482	81	295	227	27	47	1476	15

Table 9. Spotted wolffish (*Anarhichas minor*). Abundance indices (1000) for West Greenland with 95% confidence limits in percent of the stratified mean.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1992	49	31	9	49	28	50	28	39	60	343	22
1993	61	21	14	47	41	41	29	32	33	287	23
1994	113	193	16	318	57	427	35	13	80	1253	23
1995	176	38	7	60	52	46	34	47	35	495	19
1996	177	23	6	145	52	34	34	0	41	512	22
1997	299	18	26	101	0	39	51	0	5	539	33
1998	449	687	0	286	36	26	45	17	5	923	28
1999	558	124	57	766	110	18	4	0	0	1639	26
2000	368	508	31	506	144	30	5	53	0	1646	25
2001	683	171	36	295	42	46	0	0	6	1280	28

Table 10. Spotted wolffish (*Anarhichas minor*). Biomass indices (tons) for West Greenland with 95% confidence limits in percent of the stratified mean.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1992	11	65	35	85	9	37	26	11	273	552	35
1993	40	8	67	45	18	44	4	<1	187	413	58
1994	213	105	15	81	55	164	56	12	4	705	20
1995	65	20	14	51	19	29	20	20	196	433	32
1996	267	<1	9	255	25	7	34	0	60	657	23
1997	291	17	38	33	0	19	111	0	3	513	24
1998	148	9	0	280	21	7	161	53	7	686	23
1999	197	51	18	40	62	14	2	0	0	386	38
2000	37	55	30	104	35	20	1	342	0	625	53
2001	313	13	22	306	84	5	0	0	12	755	30

Table 11. Atlantic wolffish (*Anarhichas lupus*). Abundance indices (1000) for West Greenland with 95% confidence limits in percent of the stratified mean.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1992	0	17	4	39	2	203	107	291	213	1133	37
1993	17	12	6	33	43	233	240	231	205	1020	28
1994	17	35	16	512	263	2129	518	598	2628	6717	38
1995	15	0	0	120	120	365	123	626	261	1630	31
1996	0	41	6	119	134	391	361	430	725	2207	30
1997	32	10	0	103	30	1063	321	442	152	2153	28
1998	147	67	17	322	157	825	469	450	780	3232	27
1999	0	112	65	210	276	349	254	344	236	1847	41
2000	0	409	59	310	486	314	488	1054	49	3170	47
2001	0	96	52	518	74	221	284	234	72	1543	27

Table 12. Atlantic wolffish (*Anarhichas lupus*). Biomass indices (tons) for West Greenland with 95% confidence limits in percent of the stratified mean.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1992	0	5	<1	9	51	34	24	62	71	257	34
1993	7	1	1	3	3	31	45	21	116	228	36
1994	<1	9	6	77	59	237	45	107	436	977	41
1995	<1	0	0	33	10	35	36	153	40	307	35
1996	0	<1	4	21	52	46	56	76	120	375	29
1997	5	-	0	21	1	173	17	92	19	328	28
1998	-	1	4	12	14	74	38	79	137	359	33
1999	0	27	-	24	25	8	11	165	41	302	24
2000	0	22	-	56	41	67	41	239	17	483	39
2001	0	2	1	24	-	20	26	40	26	140	26

Table 13. Cod (*Gadus morhua*). Abundance indices (1000) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1991	*	0	11	7	32	429	78	*	*	(528)	73
1992	0	0	4	16	33	242	242	0	9	547	45
1993	0	0	0	0	0	54	36	205	12	308	67
1994	9	0	0	0	54	98	0	7	0	167	43
1995	0	0	0	33	17	504	42	20	46	662	58
1996	0	0	0	0	0	47	78	66	108	298	40
1997	0	0	0	2	8	35	0	0	0	45	64
1998	0	0	0	5	0	0	25	28	4	62	44
1999	0	10	18	141	52	17	18	8	0	261	41
2000	0	188	273	311	201	86	47	9	205	1321	19
2001	0	0	15	248	86	140	498	210	373	1570	23

Table 14. Cod (*Gadus morhua*). Biomass indices (tons) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1988	0	0	*	35	0	1230	2613	*	*	(3879)	81
1989	44	0	*	73	0	41	1002	*	*	(1217)	51
1990	4	13	*	7	7	118	6825	*	*	(7004)	45
1991	*	0	7	1	2	188	53	*	*	(250)	58
1992	0	0	3	22	31	74	85	0	2	217	44
1993	0	0	0	0	0	24	8	87	4	122	69
1994	0	3	0	0	12	41	0	1	0	58	43
1995	0	0	0	3	2	158	22	2	5	190	67
1996	0	0	0	0	0	16	26	21	49	112	41
1997	0	0	0	2	2	60	0	0	0	64	65
1998	0	0	0	<1	0	0	55	57	4	117	43
1999	0	1	4	38	5	<1	13	1	0	64	31
2000	0	63	65	80	60	27	6	2	56	360	20
2001	0	0	9	133	38	72	186	67	110	615	26

Table 15. Starry skate (*Raja radiata*). Abundance indices (1000) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.
1991	*	176	22	4028	890	876	1140	*	*	(7133)
1992	2600	387	710	3082	626	713	1404	177	21	9720
1993	1022	125	552	1872	608	1162	484	401	192	6419
1994	2406	636	1131	5065	2367	3279	621	308	72	15885
1995	3245	170	802	3147	1243	560	3181	804	89	13240
1996	5586	429	1842	4640	513	748	747	21	607	15134
1997	4060	389	826	3133	249	3278	732	137	48	12850
1998	4446	712	2421	3751	561	656	1096	397	269	14310
1999	3651	513	879	3963	410	1110	784	193	188	11690
2000	1888	1190	2689	4304	583	718	631	121	583	12710
2001	3646	298	521	2829	336	579	486	119	260	9073

Table 16. Starry skate (*Raja radiata*). Biomass (tons) for West Greenland with 95% confidence limits in percent of the stratified mean. () incomplete coverage of survey area.

Year	1AN	1AS	1AX	1BN	1BS	1C	1D	1E	1F	Westgr.	CI
1989	220	38	*	257	110	202	44	*	*	(870)	24
1990	10	1	*	272	27	224	703	*	*	(1237)	48
1991	*	12	21	252	94	101	259	*	*	(739)	32
1992	404	106	115	310	100	57	152	43	5	1292	20
1993	83	19	147	276	89	147	123	27	17	927	28
1994	501	88	194	560	341	355	89	122	11	2260	26
1995	397	16	299	483	401	138	335	138	25	2232	22
1996	806	46	691	632	69	120	81	199	54	2646	27
1997	731	68	403	324	69	200	185	24	7	2011	19
1998	541	81	663	593	126	44	129	83	74	2334	19
1999	633	54	308	299	67	101	103	45	50	1660	22
2000	335	369	683	503	146	100	148	3	197	2483	18
2001	326	91	219	289	61	85	88	6	79	1224	17

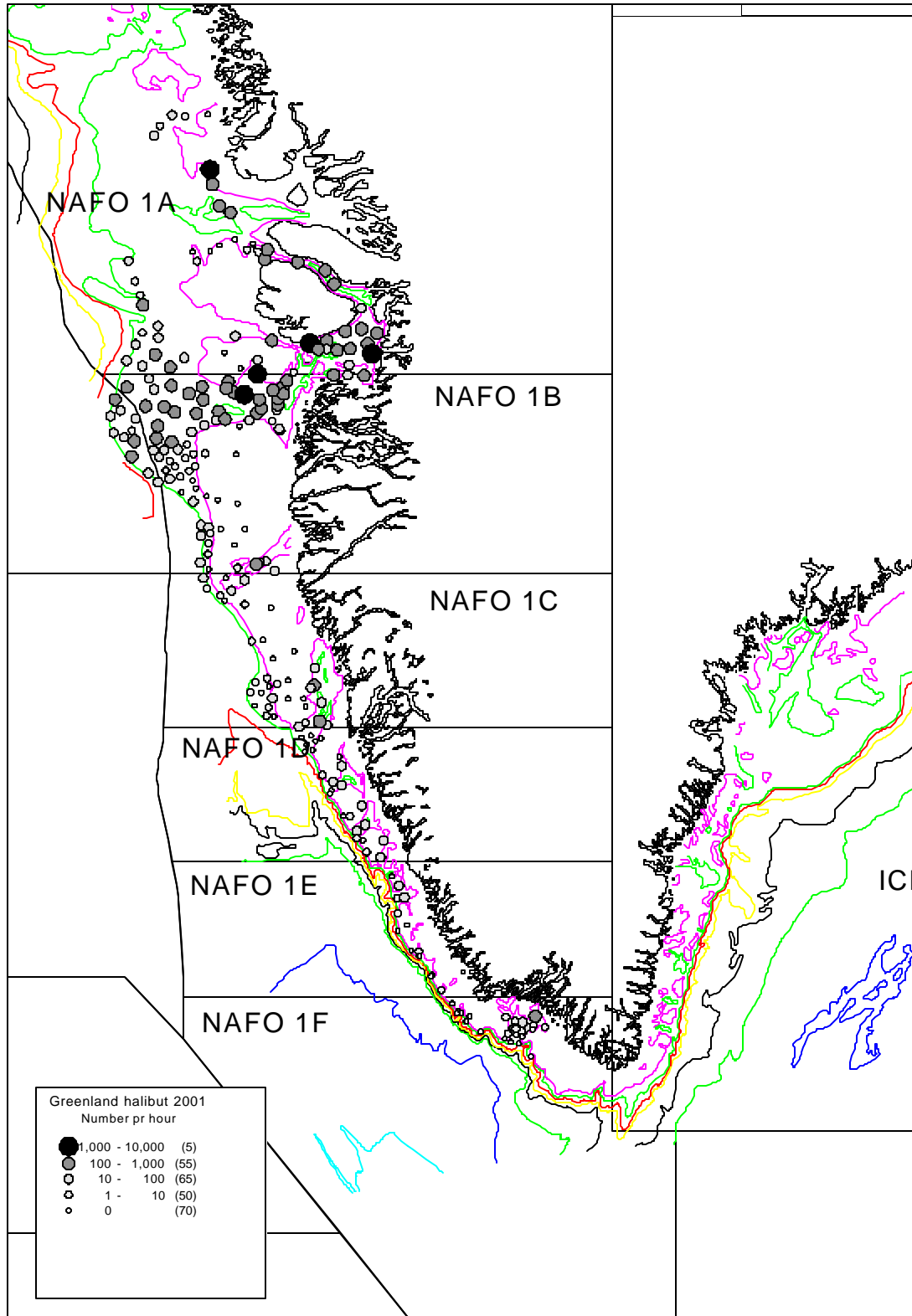


Fig. 1. Distribution of 2001-survey catches (number/hour) of Greenland halibut (all hauls). The midline against Canada and 200, 400 and 600 m depth contour lines are shown.

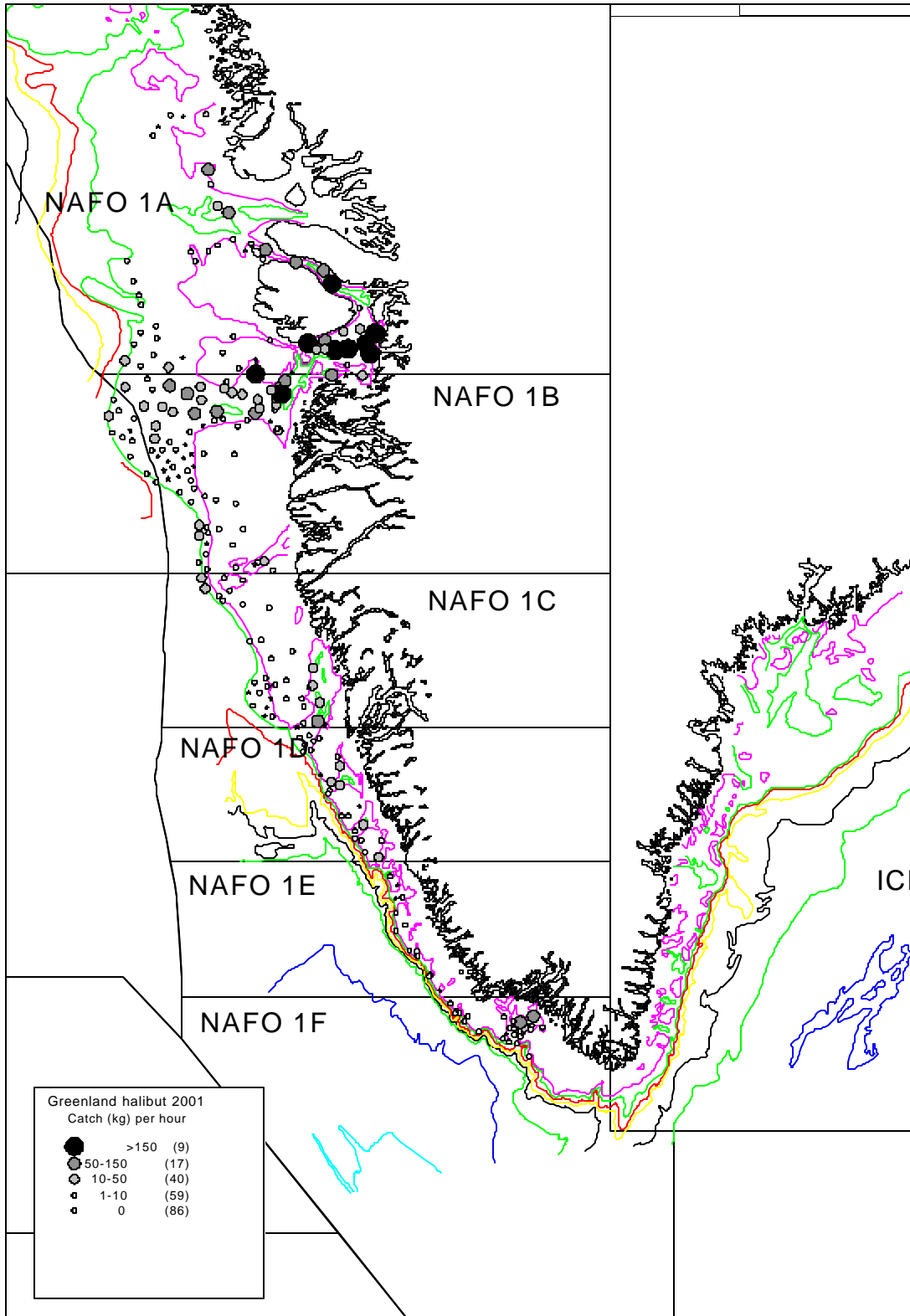


Fig. 2. Distribution of 2001-survey catches (kg/hour) of Greenland halibut (all hauls). The midline against Canada and the 200, 400 and 600 m depth contour lines are shown

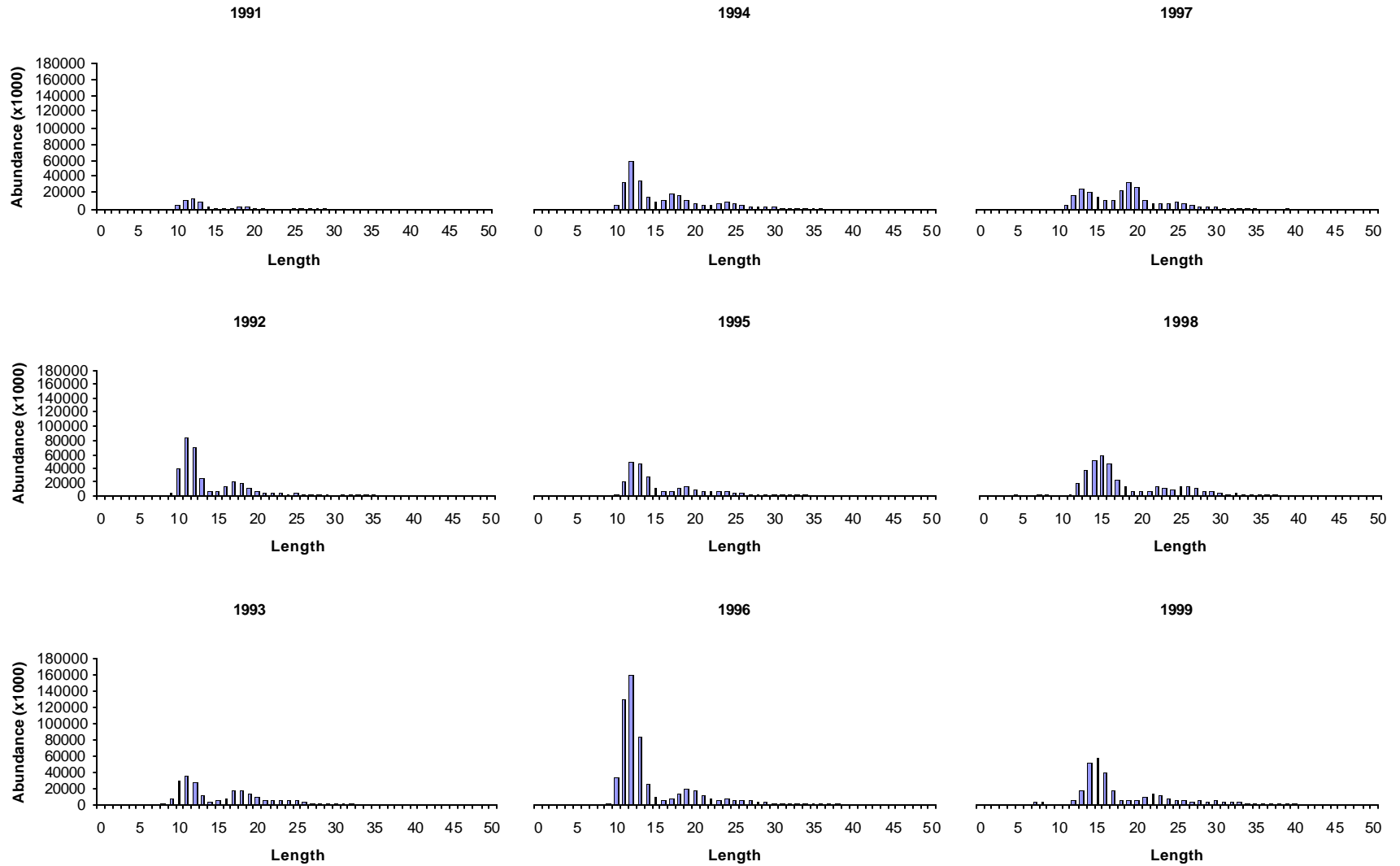
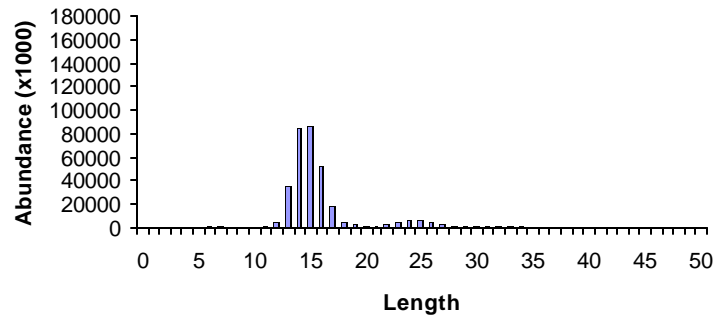


Fig. 3. Greenland halibut (*Reinhardtius hippoglossoides*). Length frequencies for West Greenland, 1991-1999.

2000



2001

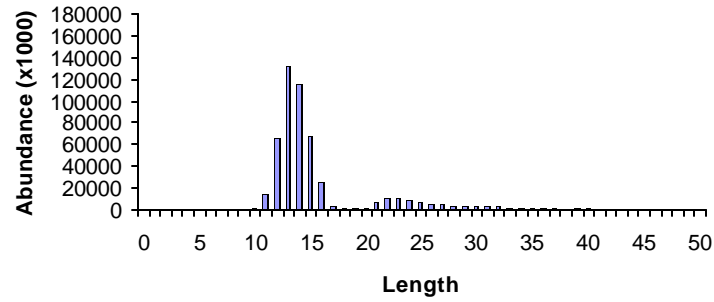


Fig. 3 cont. Greenland halibut (*Reinhardtius hippoglossoides*). Length frequencies for West Greenland, 2000-2001.

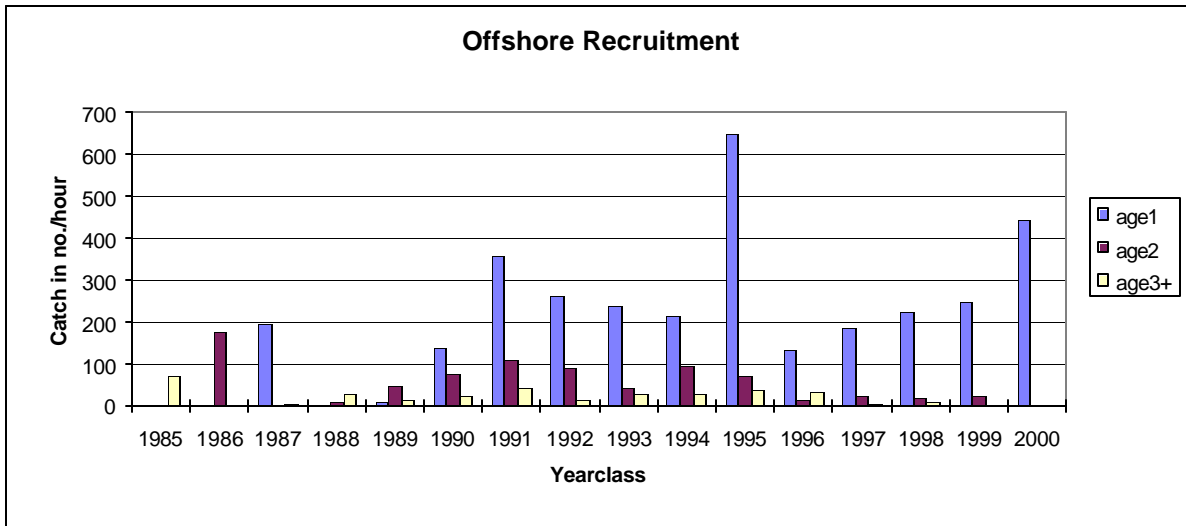


Fig. 4. Catch in number per hour of Greenland halibut at age 1, 2 and 3+ in the offshore nursery area (1AS-1B).

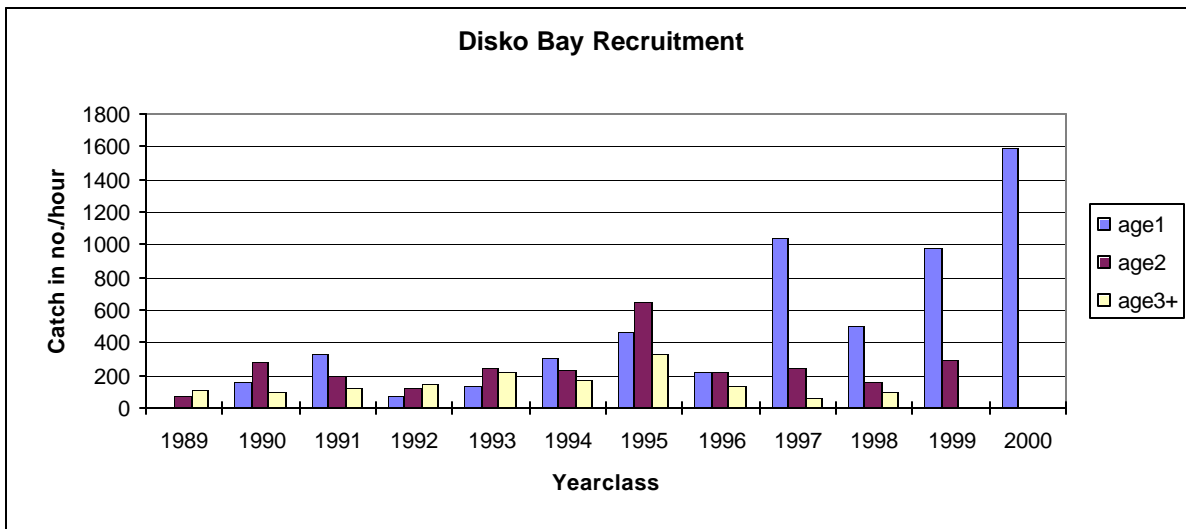


Fig. 4 cont. Catch in number per hour of Greenland halibut at age 1, 2 and 3+ in the in the inshore Disko Bay.

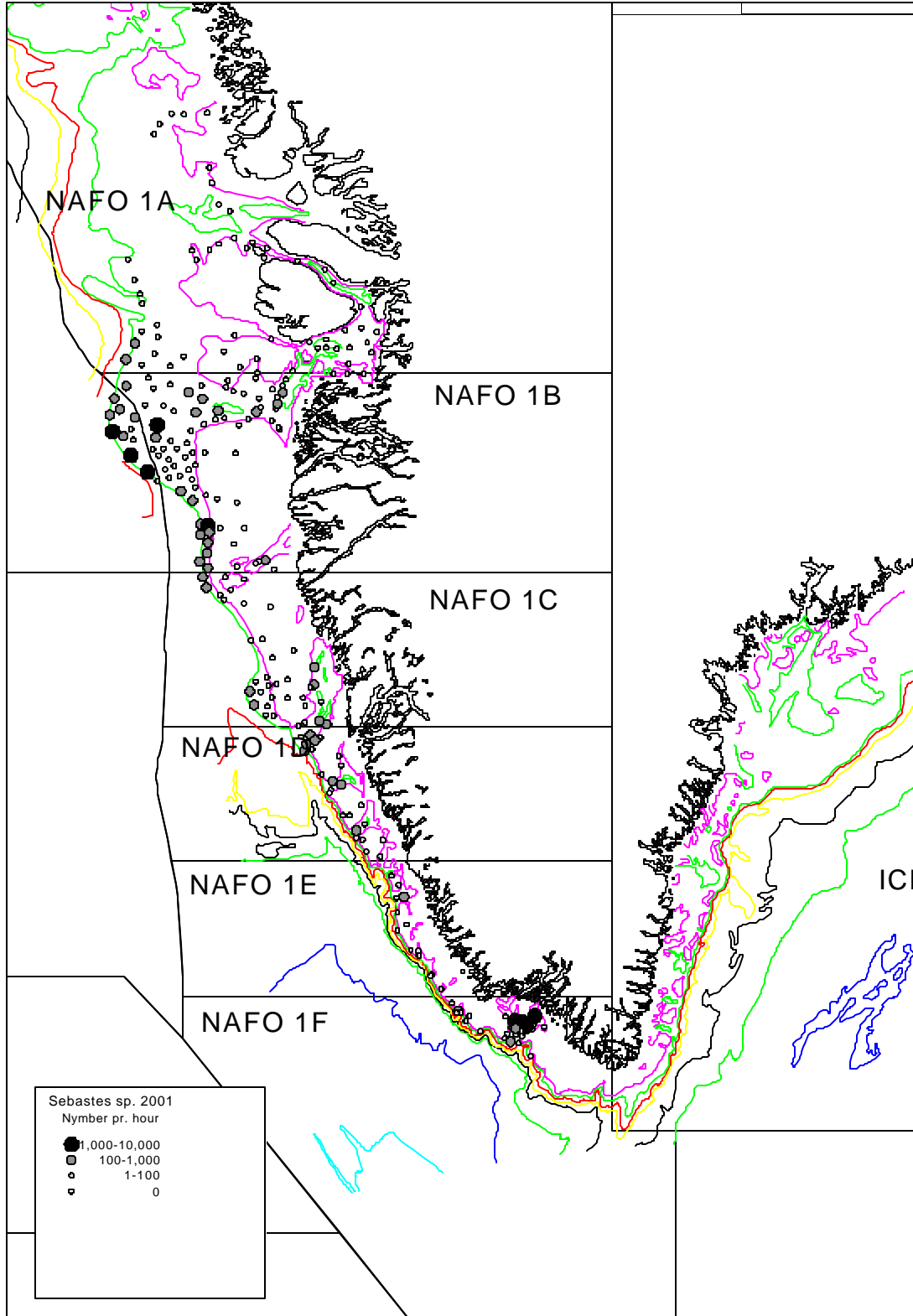


Fig. 5. Distribution of 2001-survey catches (number/hour) of redfish sp. (all hauls). The midline against Canada and the 200, 400 and 600 m depth contour lines are shown.

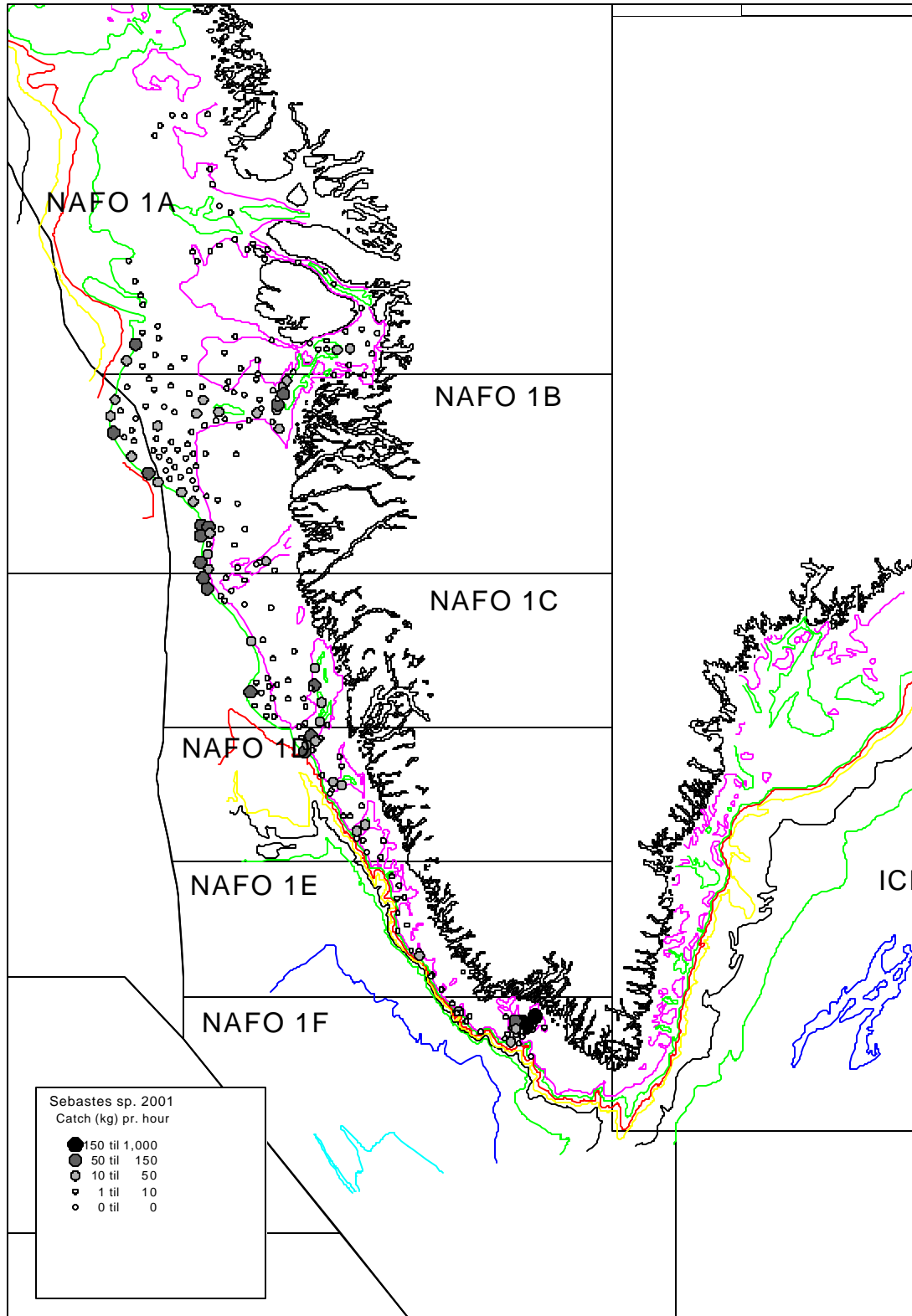


Fig. 6. Distribution of 2001-survey catches (kg/hour) of redfish sp. (all hauls). The midline against Canada and the 200, 400 and 600 m depth contour lines are shown.

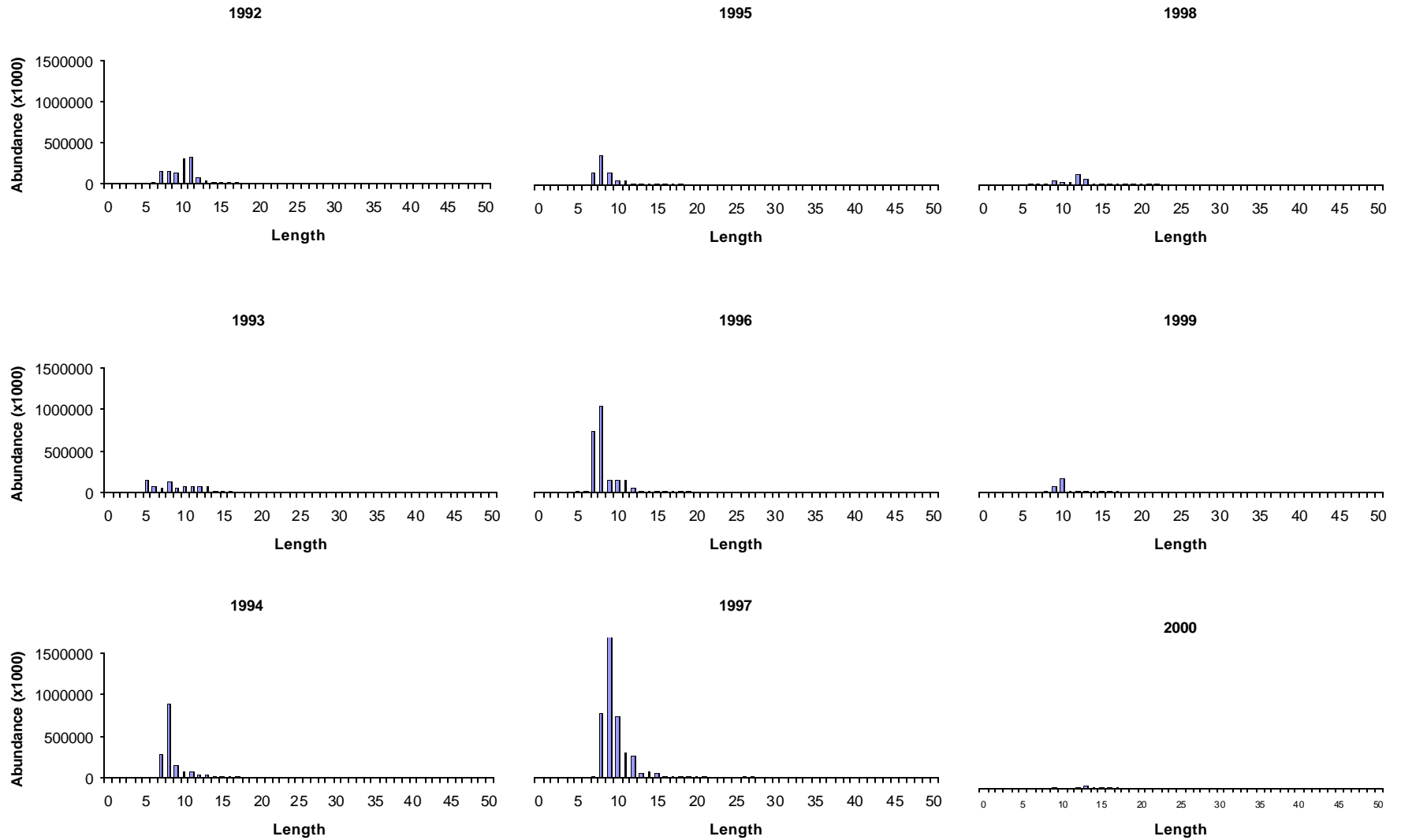


Fig. 7. Redfish (*Sebastes sp.*). Length frequencies for West Greenland, 1992-2000.

2001

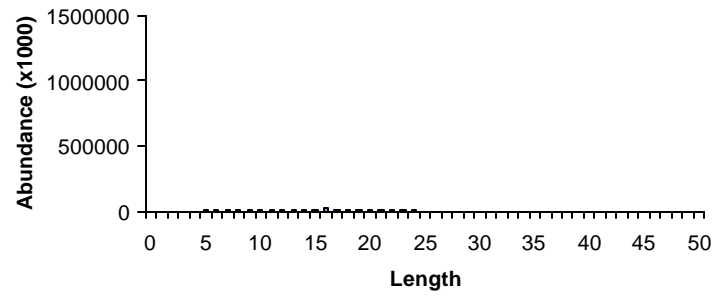


Fig. 7 cont. Redfish (*Sebastes sp.*). Length frequencies for West Greenland, 2001.

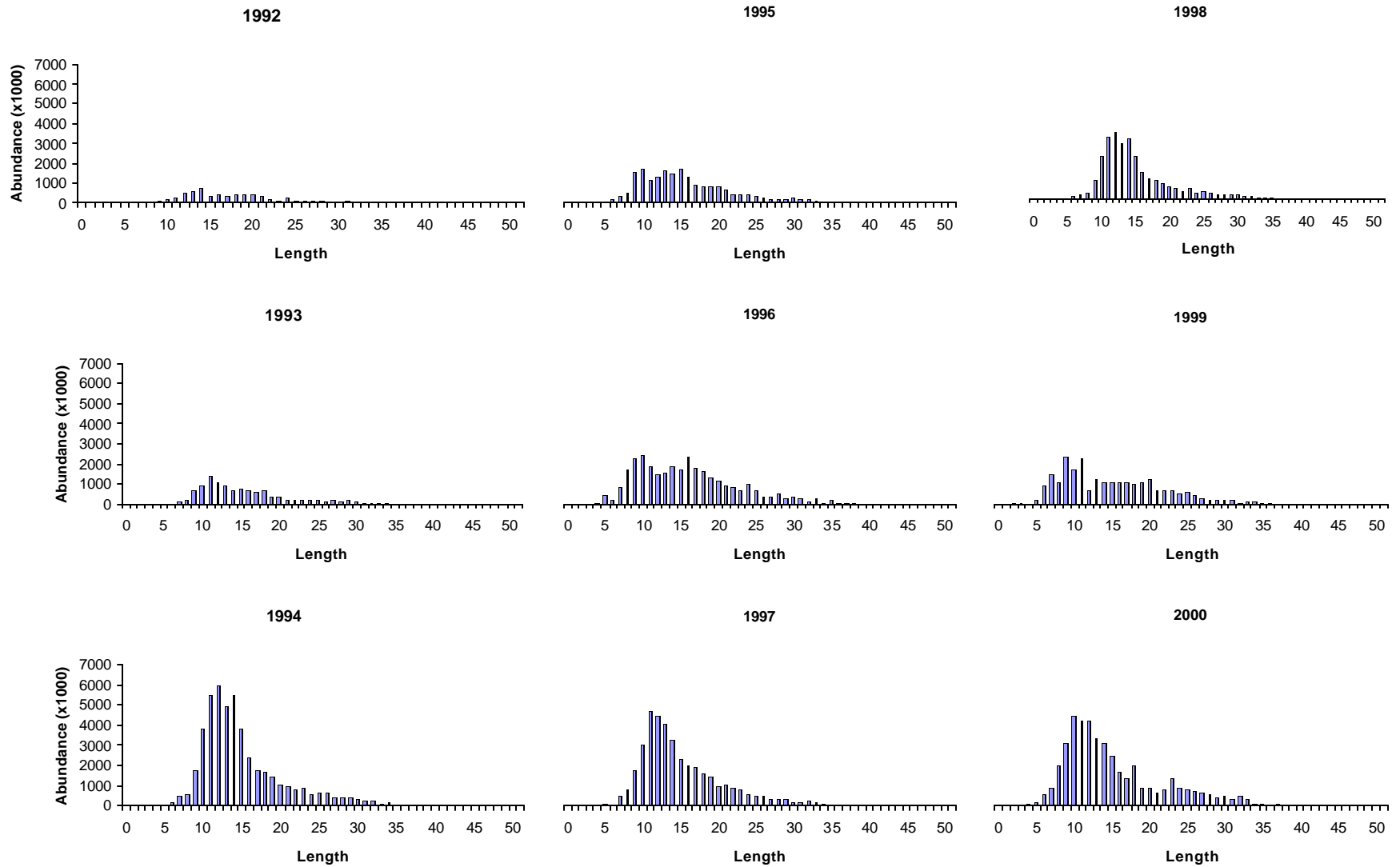


Fig. 8. American plaice (*Hippoglossoides platessoides*). Length frequencies, 1992-2000.

2001

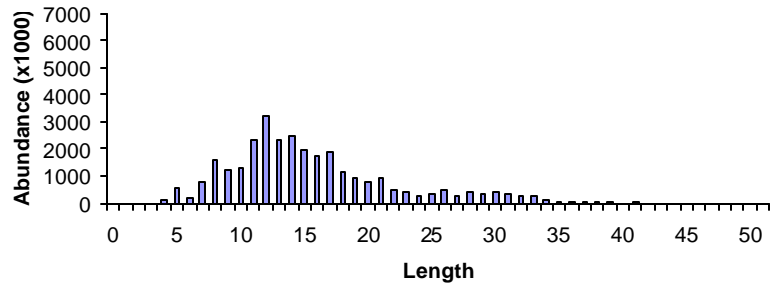


Fig. 8 cont. American plaice (*Hippoglossoides platessoides*). Length frequencies, 2001.

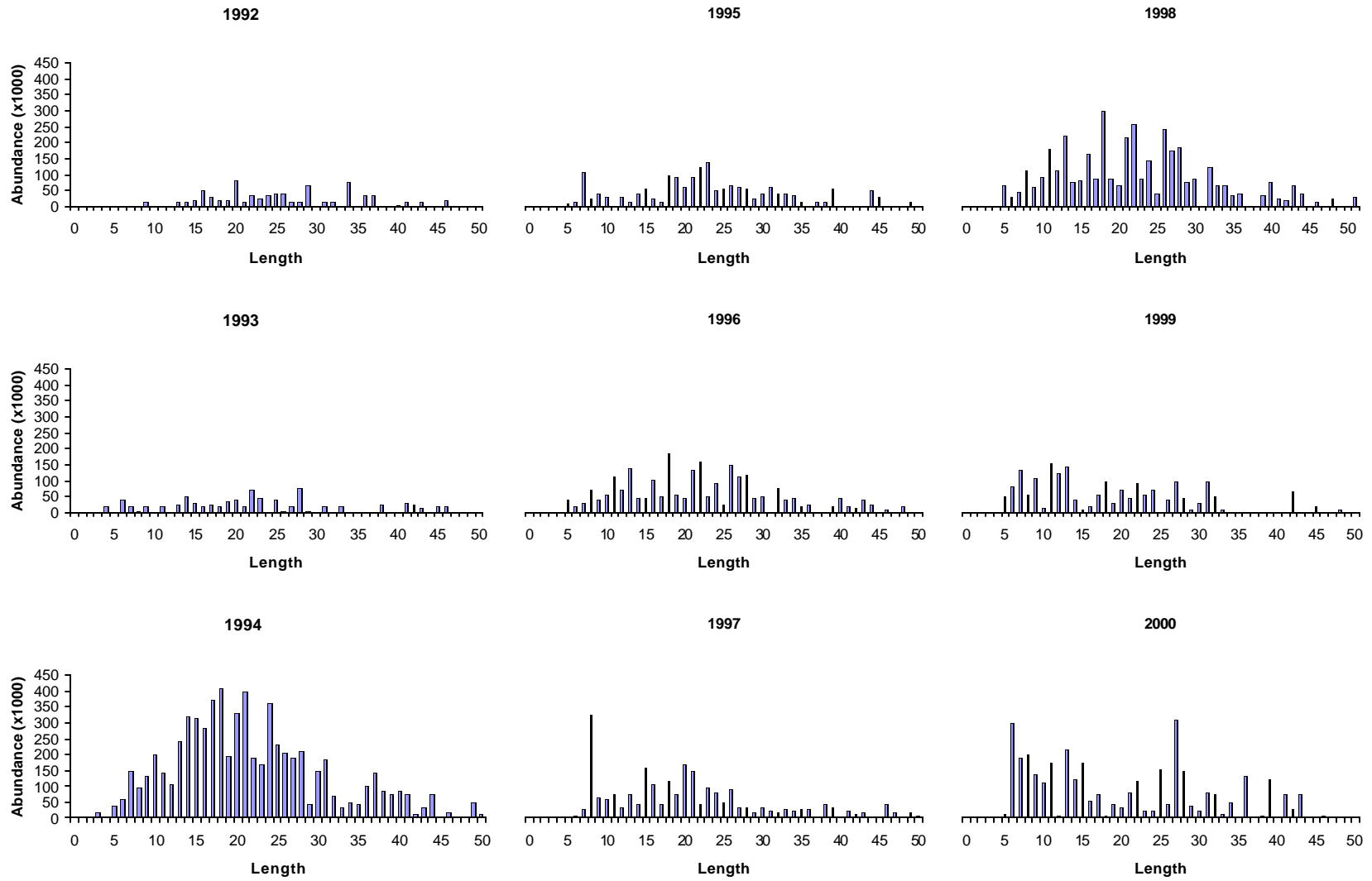


Fig. 9. Atlantic wolffish (*Anarhichas lupus*). Length frequencies for West Greenland 1992-2000.

2001

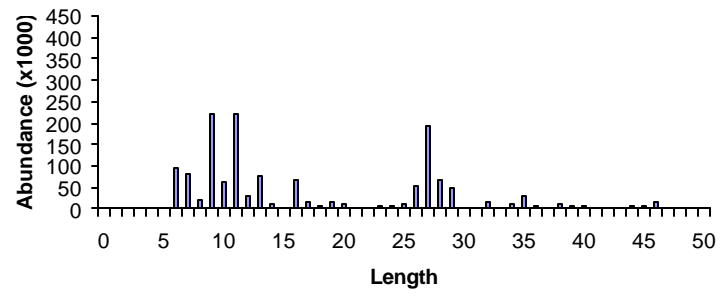


Fig. 9 cont. Atlantic wolffish (*Anarhichas lupus*). Length frequencies for West Greenland 2001.

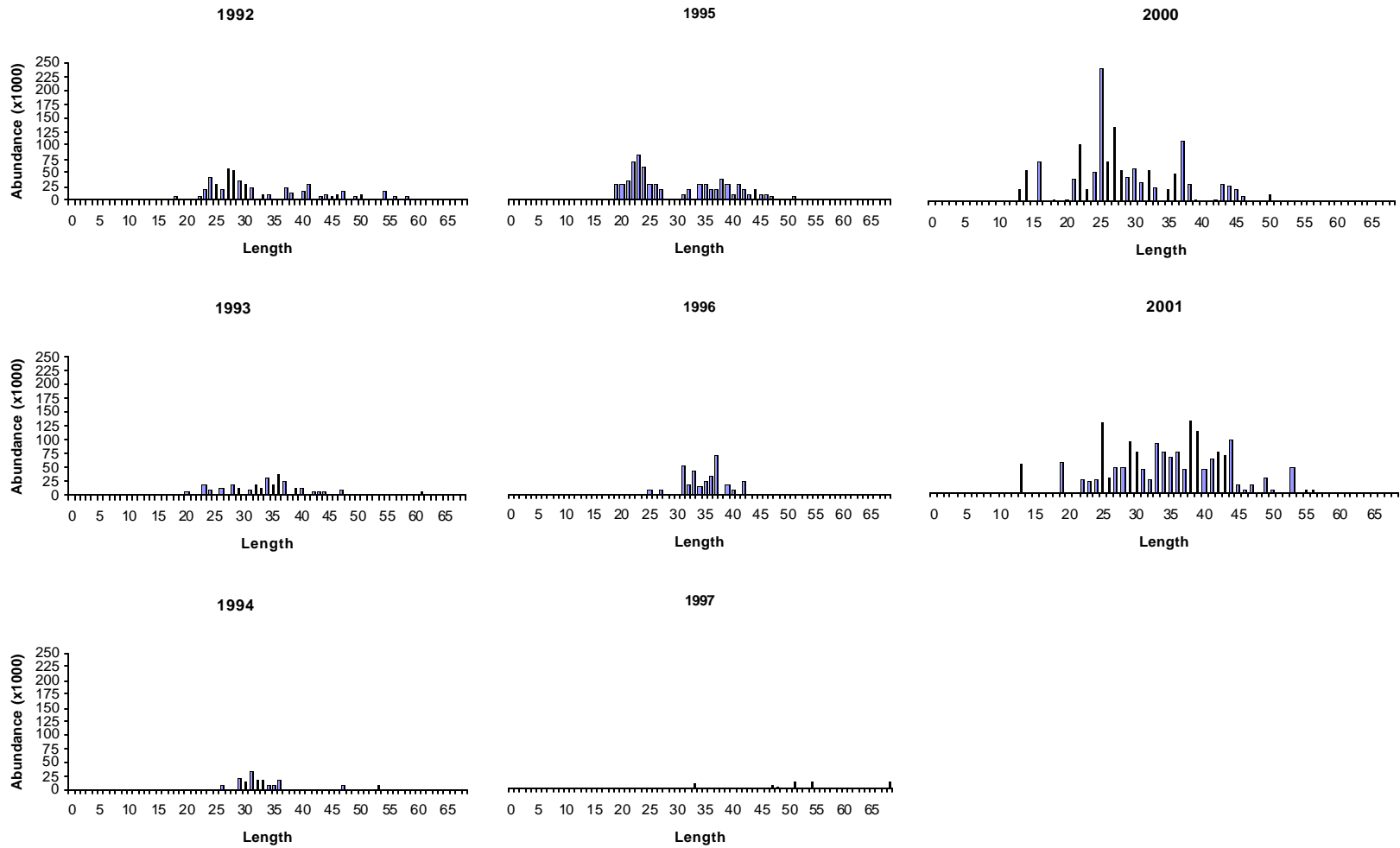


Fig. 10. Atlantic cod (*Gadus morhua*). Length frequencies for West Greenland 1992-2001. 1998 and is 1999 excluded due to very few observations.