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# Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the Greenland Shrimp Survey, 1988-2002.

by

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## 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 spices 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 2002 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 (Fig. 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 40mm 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 15-30 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 day time 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 caches 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, 1977). 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. In recent years the principles for the allocation of trawl hauls in the survey has been changed in order to reduce the variance in the estimation of abundance and biomass of shrimp. In order to reduce the effect of this, the estimation of CPUE (recruitment of year one), has been recalculated including only halus >250 m in the calculations. That means that the index values generally have become higher, but the over all trends have not changed.

The available age and maturity data on American place, Atlantic wolfish, spotted wolfish 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 2002 the biomass and abundance was estimated to 303 million individuals and 23663 tons (Tables 3 and 5). Distribution of survey catches in kg pr. hour and number pr. hour are shown in Fig. 1 and Fig. 2 for 2002. High abundance is 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 11000-14000 tons. In 1996 the abundance increased to 603 mill. individuals, witch is the largest figure in the time series. Since the abundance has declined somewhat but increased again in 2001. The biomass in 2002 is just below the average for the survey period.

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

The CPUE (number per age per hour of age 1 (2001 year class) was estimated as 431.0 specimens in the offshore nursery area (Div. 1AS, 1BN and 1BS), which is about average for the time series (Fig. 4). In the Disko Bay the CPUE was estimated at 912.5 specimens per hour, which is a little above average for time series (Fig. 4). The abundance of 2-year olds is 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. The very god 2000 year class in Disko Bay, was however also relatively god as age 2.

Redfish (*Sebastes sp.*).

Redfish was found in all the survey areas, but was most common in Div. 1B and 1C. Distribution of survey catches in kg pr. hour and number pr. hour are shown in Fig. 5 and Fig. 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 12000-31000 tons. In recent years the abundance and biomass has decreased from 2.4 billion individuals and 22000 tons in 1996 to 277 millions individuals and 12500 tons in 2002 (Tables 5 and 6). This decrease is particular 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 resent 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 2002 the biomass and abundance was estimated to 57 million individuals and 2675tons (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 614 and 1968 tons. In 2002 the highest abundance and biomass estimate for the survey period have been registered, with a biomass estimate of 2896 tons and an abundance of 59 millions individuals. The length distribution ranged between 5 and 37 cm, with larger individuals than seen in earlier years (Fig. 8). A clear mode was found at 15-17 cm a somewhat weaker mode was found at 7 cm and at 10-12 cm in 2002 .

Spotted wolffish (*Anarhichas minor*)

Spotted wolffish is evenly distributed, in respect to biomass, in the survey area. In the three southern divisions 1D 1E and 1F only 7% of the individuals were found but 30% of the biomass, this could indicate a drift of adult fish from north to the south. In 2002 the biomass and abundance was estimated to 1,6 million individuals and 1363 tons (Tables 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 (283000). 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 (Tables 11 and 12). In 2002 the abundance and biomass was estimated to 5 million individuals and 835 tons the second highest value in the survey series and a more northern distribution was detected this year.

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 2002 the length ranged between 5 and 60 cm (Fig. 9). The analysis of the length distribution reveals the dominance of small fish < 35cm with modes at 5-9 cm, 12-17, 19-23, 30-34 and 42-44 cm.

Cod (*Gadus morhua*)

Cod was captured in all areas except 1AN and 1AS during the 2002 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 217 tons and 547,000 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 2002 were estimated to 5,2 million individuals, which is the highest estimate in the abundance time series. In 1999 to 2002 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 Nuuk area (1D). Figure 10 gives the length distribution of cod in the survey during the years. In the 2002 survey the lengths range between 20 and 60 cm with distinct modes at 22-27, 28-33 cm and 34-42 cm in which category the main part of cod were in and 54-56 cm.

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 2000-3000 tons in 1994-2000. Last year a decreased in abundance and biomass was registered, but in 2002 an increase was observed again (Tables 15 and 16). In 2002 the abundance was estimated to be 10 millions individuals with a biomass close to 2000 tons. 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 variance in the catches of shrimp is large, especially on the northern slopes of the grand bank Store Hellefiskebanke (67°50N 55°00W) 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 biomasses 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 although this year's abundance increased some. The abundance is still only 10% of the in the record high year in 1994. There seems to be a continued recruitment of Greenland halibut both in the Disko Bay area and the off shore area. The survey shows, 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 Rätz, 1998b; 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 5500 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 22mm sorting grids shows a nearly complete protection to finfish larger than about 20 cm, but poor protection of the smallest fish (Engelstoft *et al*., 2001). ). 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 certain limits.

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

| Stratum | | | | | depth | area |
|---|---|---|---|---|---|---|
| | south | north | east | west | (m) | (km2) |
| 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-1AX | 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 | * | * | 102 | 149 |
| 1992 | 32 | 16 | 44 | 42 | 8 | 18 | 20 | 11 | 17 | 163 | 207 |
| 1993 | 23 | 13 | 32 | 44 | 10 | 21 | 16 | 14 | 14 | 155 | 187 |
| 1994 | 28 | 19 | 30 | 52 | 10 | 24 | 10 | 10 | 9 | 162 | 192 |
| 1995 | 29 | 17 | 37 | 53 | 13 | 29 | 15 | 14 | 11 | 181 | 218 |
| 1996 | 22 | 12 | 36 | 52 | 11 | 29 | 12 | 9 | 11 | 158 | 194 |
| 1997 | 29 | 17 | 37 | 110 | 9 | 32 | 13 | 12 | 19 | 241 | 278 |
| 1998 | 20 | 20 | 36 | 68 | 14 | 27 | 19 | 14 | 15 | 197 | 233 |
| 1999 | 20 | 26 | 37 | 64 | 18 | 33 | 16 | 14 | 17 | 208 | 245 |
| 2000 | 18 | 13 | 23 | 59 | 17 | 37 | 23 | 14 | 28 | 209 | 232 |
| 2001 | 18 | 16 | 23 | 63 | 16 | 36 | 24 | 13 | 26 | 211 | 234 |
| 2002 | 12 | 13 | 24 | 69 | 12 | 32 | 18 | 20 | 25 | 201 | 225 |

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-1AX | 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 | * | * | (65320) | (91300) | 25 |
| 1992 | 31920 | 4100 | 68690 | 235900 | 1599 | 1230 | 568 | 594 | 0 | 275866 | 344556 | 27 |
| 1993 | 28170 | 14290 | 35240 | 174100 | 10230 | 4295 | 3910 | 3517 | 427 | 238921 | 274161 | 32 |
| 1994 | 21780 | 24490 | 43760 | 170500 | 12050 | 20720 | 133 | 397 | 559 | 252884 | 296644 | 27 |
| 1995 | 18900 | 11320 | 83220 | 111100 | 22830 | 14320 | 5651 | 201 | 339 | 184655 | 267875 | 21 |
| 1996 | 118100 | 2049 | 111500 | 326500 | 13530 | 18700 | 11790 | 129 | 355 | 491232 | 602732 | 22 |
| 1997 | 32430 | 3019 | 126500 | 61590 | 2615 | 14520 | 783 | 57 | 273 | 115251 | 241751 | 20 |
| 1998 | 54490 | 5898 | 181500 | 71840 | 28370 | 8360 | 4109 | 1323 | 658 | 175100 | 356600 | 22 |
| 1999 | 63010 | 7854 | 94400 | 106800 | 6426 | 5617 | 7602 | 1043 | 983 | 199300 | 293700 | 18 |
| 2000 | 50570 | 10440 | 160100 | 109800 | 4728 | 5415 | 8059 | 187 | 589 | 189800 | 349900 | 23 |
| 2001 | 79940 | 89150 | 201100 | 147500 | 1838 | 6099 | 2910 | 597 | 1673 | 329700 | 530800 | 21 |
| 2002 | 75450 | 59270 | 94800 | 52660 | 3438 | 8029 | 7180 | 556 | 1287 | 207873 | 302673 | 25 |

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-1AX | 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 | 8620 | 12422 | 19 |
| 1993 | 2558 | 252 | 2364 | 3617 | 757 | 587 | 449 | 121 | 44 | 8285 | 10649 | 23 |
| 1994 | 2069 | 849 | 2488 | 4407 | 1799 | 1786 | 99 | 11 | 27 | 11046 | 13534 | 26 |
| 1995 | 1627 | 168 | 5053 | 2305 | 949 | 1178 | 459 | 6 | 46 | 6738 | 11791 | 19 |
| 1996 | 4363 | 41 | 8047 | 7204 | 508 | 1575 | 959 | 8 | 114 | 14772 | 22819 | 21 |
| 1997 | 3195 | 284 | 7723 | 3450 | 495 | 1941 | 164 | 14 | 89 | 9631 | 17354 | 19 |
| 1998 | 4824 | 417 | 12500 | 4121 | 1940 | 1089 | 300 | 105 | 317 | 13111 | 25611 | 20 |
| 1999 | 6006 | 376 | 8117 | 6437 | 704 | 879 | 245 | 35 | 339 | 15020 | 23137 | 20 |
| 2000 | 1815 | 320 | 9608 | 4142 | 536 | 783 | 619 | 24 | 287 | 8525 | 18133 | 18 |
| 2001 | 5942 | 1494 | 10552 | 5064 | 318 | 1444 | 315 | 18 | 460 | 15339 | 25891 | 22 |
| 2002 | 5769 | 1746 | 8838 | 4145 | 956 | 928 | 837 | 37 | 407 | 14825 | 23663 | 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.-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 7647 | 45740 | 6227 | 1032000 | 205200 | 55770 | 29050 | 5386 | 6528 | 1387698 | 1393925 | 33 |
| 1993 | 9222 | 28290 | 5838 | 408100 | 22430 | 173300 | 189900 | 660000 | 248500 | 1139996 | 1145834 | 29 |
| 1994 | 48530 | 89130 | 12470 | 1747000 | 357800 | 291200 | 102300 | 12740 | 118900 | 2768037 | 2780507 | 26 |
| 1995 | 56920 | 23260 | 10430 | 604800 | 55970 | 216300 | 95150 | 4592 | 5163 | 1062191 | 1072621 | 22 |
| 1996 | 2452 | 3956 | 5493 | 1980000 | 66080 | 118500 | 67390 | 10740 | 63060 | 2442661 | 2448154 | 29 |
| 1997 | 11890 | 16250 | 4573 | 395000 | 71740 | 176300 | 48740 | 23159 | 15640 | 758727 | 763300 | 25 |
| 1998 | 8401 | 7169 | 14540 | 241500 | 17640 | 91510 | 80820 | 7202 | 36360 | 490560 | 505100 | 20 |
| 1999 | 39880 | 13750 | 6950 | 209900 | 6195 | 118600 | 48420 | 3028 | 18180 | 457950 | 464900 | 18 |
| 2000 | 2580 | 11190 | 1836 | 65580 | 31470 | 30470 | 8450 | 15170 | 17510 | 182364 | 184200 | 23 |
| 2001 | 8041 | 9413 | 1313 | 24900 | 14900 | 21550 | 19910 | 960 | 21320 | 120987 | 122300 | 24 |
| 2002 | 773 | 4854 | 763 | 56240 | 111800 | 45470 | 46190 | 1422 | 9869 | 276637 | 277400 | 30 |

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.-1AX | 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 | * | * | 10195 | (10437) | 23 |
| 1992 | 279 | 490 | 330 | 13970 | 2928 | 1419 | 837 | 76 | 279 | 20279 | 20609 | 28 |
| 1993 | 309 | 701 | 270 | 6904 | 330 | 1327 | 2232 | 652 | 1119 | 13573 | 13843 | 31 |
| 1994 | 1604 | 2138 | 451 | 17303 | 2912 | 4063 | 883 | 200 | 1519 | 30172 | 30623 | 45 |
| 1995 | 1225 | 231 | 569 | 4178 | 1012 | 2618 | 1982 | 256 | 68 | 11570 | 12139 | 22 |
| 1996 | 40 | 61 | 495 | 14879 | 1727 | 3015 | 2161 | 284 | 1964 | 21613 | 22108 | 27 |
| 1997 | 618 | 515 | 278 | 6069 | 1879 | 7457 | 1708 | 737 | 677 | 19659 | 19937 | 32 |
| 1998 | 428 | 443 | 622 | 9290 | 2554 | 3561 | 2189 | 392 | 1336 | 20192 | 20814 | 20 |
| 1999 | 1121 | 624 | 467 | 5878 | 188 | 1928 | 1586 | 123 | 752 | 12201 | 12668 | 20 |
| 2000 | 80 | 427 | 98 | 2005 | 2074 | 2500 | 307 | 1609 | 934 | 9935 | 10033 | 30 |
| 2001 | 441 | 647 | 247 | 2408 | 1706 | 3102 | 1060 | 60 | 2388 | 11813 | 12060 | 28 |
| 2002 | 55 | 330 | 214 | 3216 | 2895 | 1787 | 2728 | 218 | 989 | 12218 | 12432 | 27 |

Table 7. American plaice (*Hipplogossoides 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.-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | * | 460 | 535 | 3630 | 506 | 3659 | 3412 | * | * | 11669 | (12204) | 43 |
| 1992 | 1297 | 421 | 1569 | 1618 | 629 | 1820 | 1267 | 683 | 112 | 7846 | 9415 | 25 |
| 1993 | 1577 | 315 | 1071 | 3477 | 964 | 2147 | 1817 | 497 | 725 | 11518 | 12589 | 23 |
| 1994 | 3272 | 1493 | 3181 | 20950 | 7001 | 10420 | 819 | 441 | 694 | 45088 | 48269 | 27 |
| 1995 | 1068 | 283 | 1733 | 6365 | 1193 | 2812 | 3863 | 589 | 572 | 16745 | 18478 | 23 |
| 1996 | 2174 | 607 | 8072 | 5776 | 2602 | 4599 | 4732 | 251 | 751 | 21492 | 29564 | 21 |
| 1997 | 5818 | 776 | 2489 | 9452 | 1137 | 12330 | 2831 | 466 | 858 | 33666 | 36155 | 21 |
| 1998 | 1414 | 818 | 2064 | 4671 | 1992 | 1864 | 8382 | 787 | 2122 | 22056 | 24120 | 21 |
| 1999 | 569 | 856 | 1633 | 8968 | 1818 | 5925 | 2128 | 722 | 689 | 21677 | 23310 | 16 |
| 2000 | 1222 | 4003 | 5067 | 17390 | 2007 | 4110 | 5803 | 391 | 565 | 35483 | 40550 | 22 |
| 2001 | 1268 | 1187 | 1320 | 14180 | 1871 | 5140 | 3741 | 524 | 609 | 28480 | 29800 | 26 |
| 2002 | 230 | 3597 | 2839 | 10150 | 2372 | 7246 | 29410 | 1562 | 1933 | 56501 | 59340 | 27 |

Table 8. American plaice (*Hipplogossoides platessoides*). Biomass indices (tonss) 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.-1AX | 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 | * | * | 105 | (194) | 64 |
| 1992 | 52 | 11 | 126 | 84 | 53 | 140 | 118 | 65 | 7 | 530 | 656 | 26 |
| 1993 | 68 | 25 | 71 | 97 | 36 | 101 | 137 | 47 | 32 | 543 | 614 | 28 |
| 1994 | 140 | 96 | 285 | 599 | 343 | 316 | 66 | 32 | 74 | 1666 | 1951 | 23 |
| 1995 | 82 | 17 | 264 | 211 | 61 | 97 | 167 | 35 | 17 | 687 | 951 | 20 |
| 1996 | 158 | 48 | 715 | 264 | 95 | 158 | 161 | 12 | 30 | 927 | 1642 | 20 |
| 1997 | 331 | 29 | 315 | 227 | 99 | 420 | 146 | 37 | 29 | 1318 | 1633 | 17 |
| 1998 | 142 | 33 | 347 | 241 | 74 | 100 | 468 | 83 | 102 | 1243 | 1590 | 18 |
| 1999 | 80 | 36 | 159 | 361 | 72 | 230 | 156 | 45 | 54 | 1034 | 1193 | 23 |
| 2000 | 103 | 196 | 373 | 588 | 79 | 208 | 315 | 64 | 43 | 1595 | 1968 | 16 |
| 2001 | 155 | 55 | 114 | 482 | 81 | 295 | 227 | 27 | 47 | 1362 | 1476 | 15 |
| 2002 | 115 | 122 | 221 | 461 | 207 | 347 | 1260 | 93 | 69 | 2675 | 2896 | 22 |

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.-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 49 | 31 | 9 | 49 | 28 | 50 | 28 | 39 | 60 | 334 | 343 | 22 |
| 1993 | 61 | 21 | 14 | 47 | 41 | 41 | 29 | 32 | 33 | 273 | 287 | 23 |
| 1994 | 113 | 193 | 16 | 318 | 57 | 427 | 35 | 13 | 80 | 1237 | 1253 | 23 |
| 1995 | 176 | 38 | 7 | 60 | 52 | 46 | 34 | 47 | 35 | 488 | 495 | 19 |
| 1996 | 177 | 23 | 6 | 145 | 52 | 34 | 34 | 0 | 41 | 506 | 512 | 22 |
| 1997 | 299 | 18 | 26 | 101 | 0 | 39 | 51 | 0 | 5 | 513 | 539 | 33 |
| 1998 | 449 | 687 | 0 | 286 | 36 | 26 | 45 | 17 | 5 | 923 | 923 | 28 |
| 1999 | 558 | 124 | 57 | 766 | 110 | 18 | 4 | 0 | 0 | 1582 | 1639 | 26 |
| 2000 | 368 | 508 | 31 | 506 | 144 | 30 | 5 | 53 | 0 | 1615 | 1646 | 25 |
| 2001 | 683 | 171 | 36 | 295 | 42 | 46 | 0 | 0 | 6 | 1244 | 1280 | 28 |
| 2002 | 326 | 108 | 14 | 576 | 333 | 124 | 71 | 10 | 26 | 1573 | 1587 | 46 |

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.-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 11 | 65 | 35 | 85 | 9 | 37 | 26 | 11 | 273 | 517 | 552 | 35 |
| 1993 | 40 | 8 | 67 | 45 | 18 | 44 | 4 | <1 | 187 | 346 | 413 | 58 |
| 1994 | 213 | 105 | 15 | 81 | 55 | 164 | 56 | 12 | 4 | 690 | 705 | 20 |
| 1995 | 65 | 20 | 14 | 51 | 19 | 29 | 20 | 20 | 196 | 419 | 433 | 32 |
| 1996 | 267 | <1 | 9 | 255 | 25 | 7 | 34 | 0 | 60 | 648 | 657 | 23 |
| 1997 | 291 | 17 | 38 | 33 | 0 | 19 | 111 | 0 | 3 | 475 | 513 | 24 |
| 1998 | 148 | 9 | 0 | 280 | 21 | 7 | 161 | 53 | 7 | 686 | 686 | 23 |
| 1999 | 197 | 51 | 18 | 40 | 62 | 14 | 2 | 0 | 0 | 368 | 386 | 38 |
| 2000 | 37 | 55 | 30 | 104 | 35 | 20 | 1 | 342 | 0 | 595 | 625 | 53 |
| 2001 | 313 | 13 | 22 | 306 | 84 | 5 | 0 | 0 | 12 | 733 | 755 | 30 |
| 2002 | 131 | 135 | 3 | 274 | 258 | 145 | 236 | 70 | 112 | 1360 | 1363 | 38 |

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.-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 0 | 17 | 4 | 39 | 2 | 203 | 107 | 291 | 213 | 872 | 876 | 37 |
| 1993 | 17 | 12 | 6 | 33 | 43 | 233 | 240 | 231 | 205 | 1014 | 1020 | 28 |
| 1994 | 17 | 35 | 16 | 512 | 263 | 2129 | 518 | 598 | 2628 | 6701 | 6717 | 38 |
| 1995 | 15 | 0 | 0 | 120 | 120 | 365 | 123 | 626 | 261 | 1630 | 1630 | 31 |
| 1996 | 0 | 41 | 6 | 119 | 134 | 391 | 361 | 430 | 725 | 2230 | 2207 | 30 |
| 1997 | 32 | 10 | 0 | 103 | 30 | 1063 | 321 | 442 | 152 | 2153 | 2153 | 28 |
| 1998 | 147 | 67 | 17 | 322 | 157 | 825 | 469 | 450 | 780 | 3215 | 3232 | 27 |
| 1999 | 0 | 112 | 65 | 210 | 276 | 349 | 254 | 344 | 236 | 1782 | 1847 | 41 |
| 2000 | 0 | 409 | 59 | 310 | 486 | 314 | 488 | 1054 | 49 | 3111 | 3170 | 47 |
| 2001 | 0 | 96 | 52 | 518 | 74 | 221 | 282 | 234 | 77 | 1491 | 1543 | 27 |
| 2002 | 230 | 291 | 27 | 816 | 15 | 98 | 64 | 138 | 64 | 4992 | 5019 | 30 |

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.-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 0 | 5 | <1 | 9 | 51 | 34 | 24 | 62 | 71 | 257 | 257 | 34 |
| 1993 | 7 | 1 | 1 | 3 | 3 | 31 | 45 | 21 | 116 | 227 | 228 | 36 |
| 1994 | <1 | 9 | 6 | 77 | 59 | 237 | 45 | 107 | 436 | 971 | 977 | 41 |
| 1995 | <1 | 0 | 0 | 33 | 10 | 35 | 36 | 153 | 40 | 307 | 307 | 35 |
| 1996 | 0 | <1 | 4 | 21 | 52 | 46 | 56 | 76 | 120 | 371 | 375 | 29 |
| 1997 | 5 | - | 0 | 21 | 1 | 173 | 17 | 92 | 19 | 328 | 328 | 28 |
| 1998 | - | 1 | 4 | 12 | 14 | 74 | 38 | 79 | 137 | 355 | 359 | 33 |
| 1999 | 0 | 27 | - | 24 | 25 | 8 | 11 | 165 | 41 | 302 | 302 | 24 |
| 2000 | 0 | 22 | - | 56 | 41 | 67 | 41 | 239 | 17 | 483 | 483 | 39 |
| 2001 | 0 | 2 | 1 | 24 | - | 20 | 26 | 40 | 26 | 139 | 140 | 26 |
| 2002 | 11 | 7 | 1 | 143 | 6 | 138 | 110 | 281 | 138 | 834 | 835 | 33 |

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-1AX | Westgr. | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | * | 0 | 11 | 7 | 32 | 429 | 78 | * | * | 546 | (557) | 73 |
| 1992 | 0 | 0 | 4 | 16 | 33 | 242 | 242 | 0 | 9 | 543 | 547 | 45 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 54 | 36 | 205 | 12 | 308 | 308 | 67 |
| 1994 | 0 | 9 | 0 | 0 | 54 | 98 | 0 | 7 | 0 | 167 | 167 | 43 |
| 1995 | 0 | 0 | 0 | 33 | 17 | 504 | 42 | 20 | 46 | 662 | 662 | 58 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 47 | 78 | 66 | 108 | 298 | 298 | 40 |
| 1997 | 0 | 0 | 0 | 2 | 8 | 35 | 0 | 0 | 0 | 45 | 45 | 64 |
| 1998 | 0 | 0 | 0 | 5 | 0 | 0 | 25 | 28 | 4 | 62 | 62 | 44 |
| 1999 | 0 | 10 | 18 | 141 | 52 | 17 | 18 | 6 | 0 | 243 | 261 | 41 |
| 2000 | 0 | 188 | 273 | 311 | 201 | 86 | 48 | 9 | 205 | 1048 | 1321 | 19 |
| 2001 | 0 | 0 | 15 | 248 | 86 | 140 | 498 | 210 | 373 | 1555 | 1570 | 23 |
| 2002 | 0 | 0 | 9 | 75 | 172 | 99 | 3595 | 102 | 202 | 5245 | 5254 | 52 |

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.-1AX | 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 | * | * | 243 | (250) | 58 |
| 1992 | 0 | 0 | 3 | 22 | 31 | 74 | 85 | 0 | 2 | 214 | 217 | 44 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 24 | 8 | 87 | 4 | 122 | 122 | 69 |
| 1994 | 0 | 3 | 0 | 0 | 12 | 41 | 0 | 1 | 0 | 58 | 58 | 43 |
| 1995 | 0 | 0 | 0 | 3 | 2 | 158 | 22 | 2 | 5 | 192 | 192 | 67 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 16 | 26 | 21 | 49 | 112 | 112 | 41 |
| 1997 | 0 | 0 | 0 | 2 | 2 | 60 | 0 | 0 | 0 | 64 | 64 | 65 |
| 1998 | 0 | 0 | 0 | <1 | 0 | 0 | 55 | 57 | 4 | 117 | 117 | 43 |
| 1999 | 0 | 1 | 4 | 38 | 5 | <1 | 13 | 1 | 0 | 60 | 64 | 31 |
| 2000 | 0 | 63 | 65 | 80 | 60 | 27 | 6 | 2 | 56 | 295 | 360 | 20 |
| 2001 | 0 | 0 | 9 | 133 | 38 | 72 | 186 | 67 | 110 | 606 | 615 | 26 |
| 2002 | 0 | 0 | 9 | 59 | 96 | 52 | 1629 | 38 | 87 | 1959 | 1968 | 48 |

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.-1AX | Westgr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | * | 176 | 22 | 4028 | 890 | 877 | 1140 | * | * | (7111) | (7133) |
| 1992 | 2600 | 387 | 710 | 3082 | 626 | 713 | 1404 | 177 | 21 | 9010 | 9720 |
| 1993 | 1022 | 125 | 552 | 1872 | 608 | 1162 | 484 | 401 | 192 | 5867 | 6419 |
| 1994 | 2406 | 636 | 1131 | 5065 | 2367 | 3279 | 621 | 308 | 72 | 14754 | 15885 |
| 1995 | 3245 | 170 | 802 | 3147 | 1243 | 560 | 3181 | 804 | 89 | 12438 | 13240 |
| 1996 | 5586 | 429 | 1842 | 4640 | 513 | 748 | 747 | 22 | 607 | 13292 | 15134 |
| 1997 | 4060 | 389 | 826 | 3131 | 249 | 3278 | 732 | 137 | 48 | 12024 | 12850 |
| 1998 | 4446 | 712 | 2421 | 3751 | 561 | 656 | 1096 | 397 | 269 | 11889 | 14310 |
| 1999 | 3651 | 513 | 879 | 3963 | 410 | 1110 | 784 | 193 | 188 | 10811 | 11690 |
| 2000 | 1888 | 1190 | 2689 | 4716 | 583 | 718 | 631 | 121 | 583 | 10021 | 12710 |
| 2001 | 3646 | 298 | 521 | 2829 | 336 | 579 | 486 | 119 | 260 | 8552 | 9073 |
| 2002 | 772 | 749 | 626 | 3148 | 503 | 1866 | 2827 | 226 | 524 | 10616 | 11242 |

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.-1AX | 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 | * | * | 718 | (739) | 32 |
| 1992 | 404 | 106 | 115 | 310 | 100 | 57 | 152 | 43 | 5 | 1177 | 1292 | 20 |
| 1993 | 83 | 19 | 147 | 276 | 89 | 147 | 123 | 27 | 17 | 780 | 927 | 28 |
| 1994 | 501 | 88 | 194 | 560 | 341 | 355 | 89 | 122 | 11 | 2066 | 2260 | 26 |
| 1995 | 397 | 16 | 299 | 483 | 401 | 138 | 335 | 138 | 25 | 1933 | 2232 | 22 |
| 1996 | 806 | 46 | 691 | 632 | 69 | 120 | 81 | 199 | 54 | 1955 | 2646 | 27 |
| 1997 | 731 | 68 | 403 | 324 | 69 | 200 | 185 | 24 | 7 | 1608 | 2011 | 19 |
| 1998 | 541 | 81 | 663 | 593 | 126 | 44 | 129 | 83 | 74 | 1671 | 2334 | 19 |
| 1999 | 633 | 54 | 308 | 299 | 67 | 101 | 103 | 45 | 50 | 1352 | 1660 | 22 |
| 2000 | 335 | 369 | 683 | 533 | 146 | 100 | 148 | 3 | 197 | 1800 | 2483 | 18 |
| 2001 | 326 | 91 | 219 | 289 | 61 | 65 | 88 | 6 | 79 | 1005 | 1224 | 17 |
| 2002 | 33 | 148 | 203 | 407 | 131 | 118 | 692 | 67 | 189 | 1785 | 1988 | 20 |

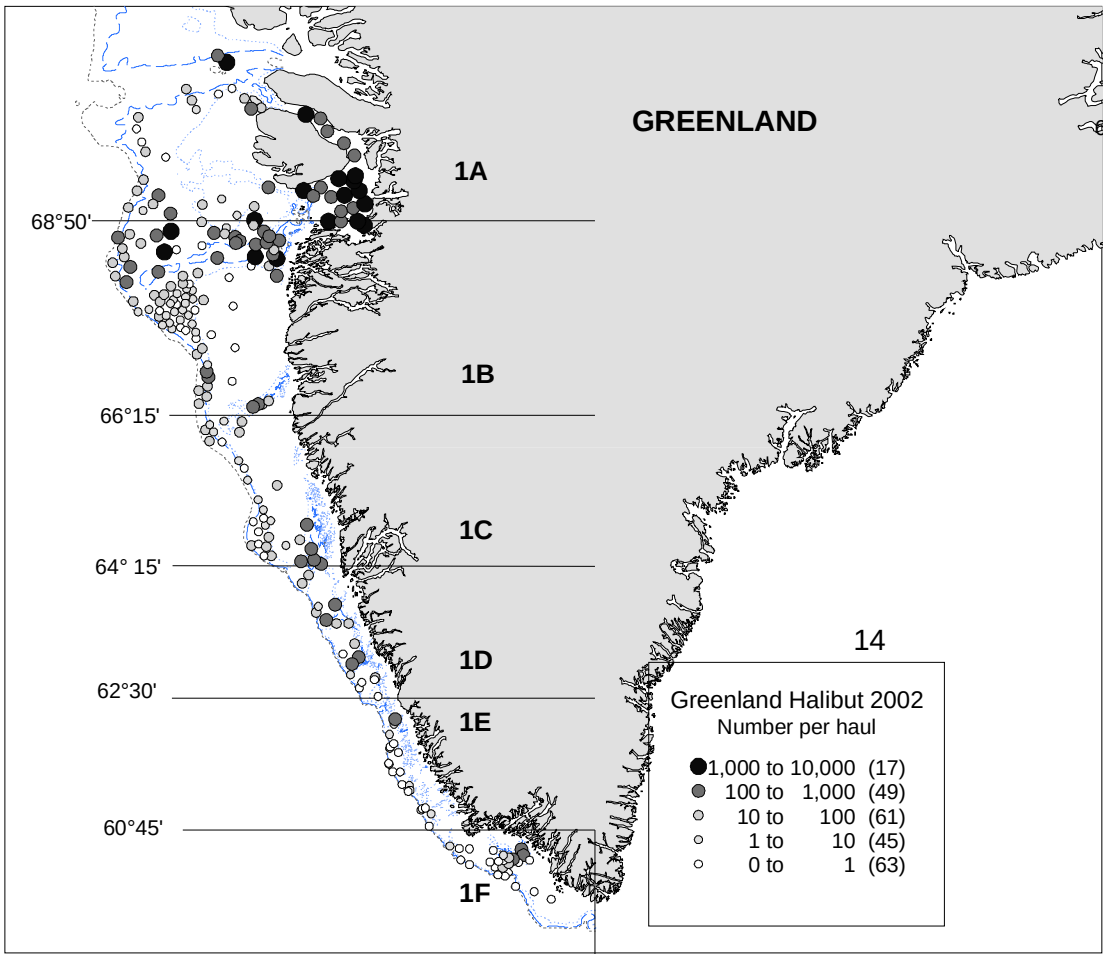


Fig. 1. Distribution of 2002-survey catches (number/hour) of Greenland halibut (all hauls). The midline against Canada and 200, 400 and 600 m depth contour lines are shown.

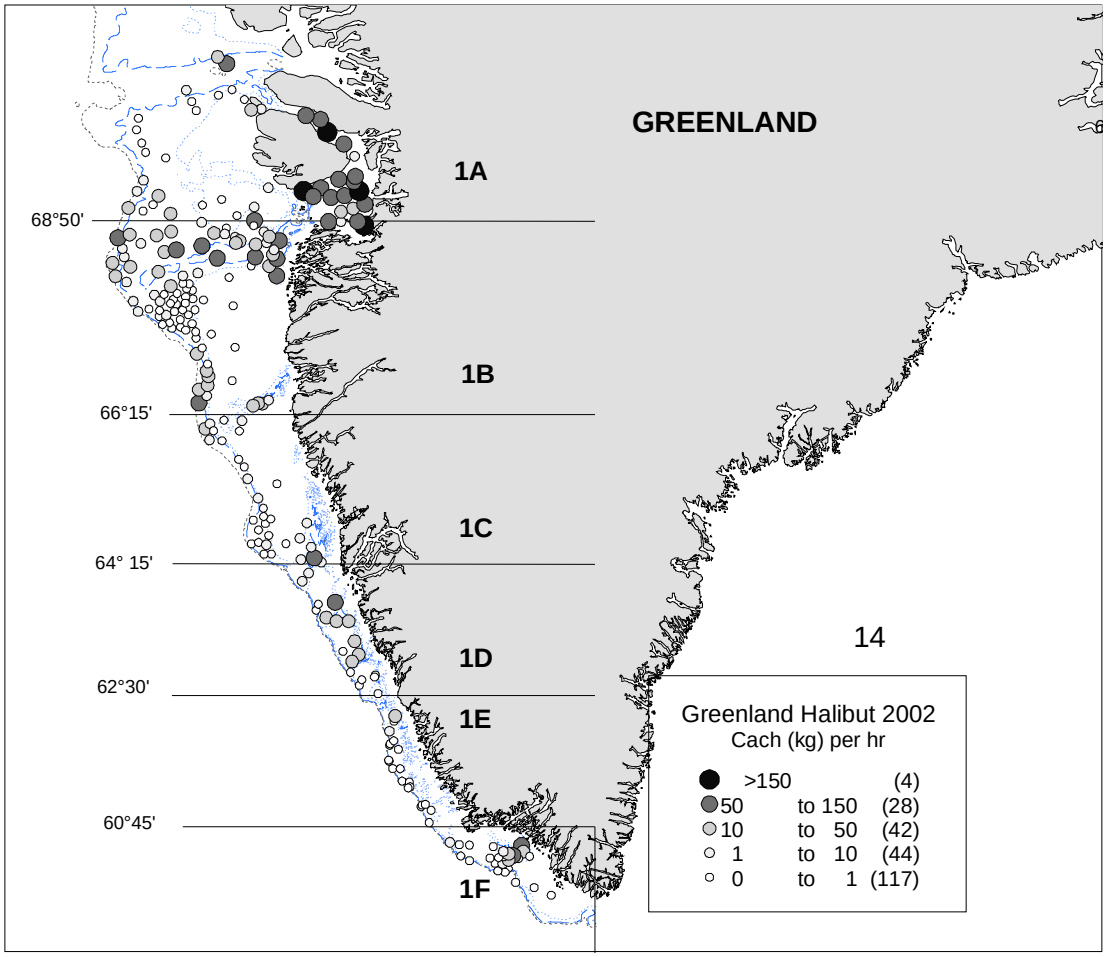


Fig. 2. Distribution of 2002-survey catches (kg/hour) of Greenland halibut (all hauls). The midline against Canada and the 200, 400 and 600 m depth contour lines are shown

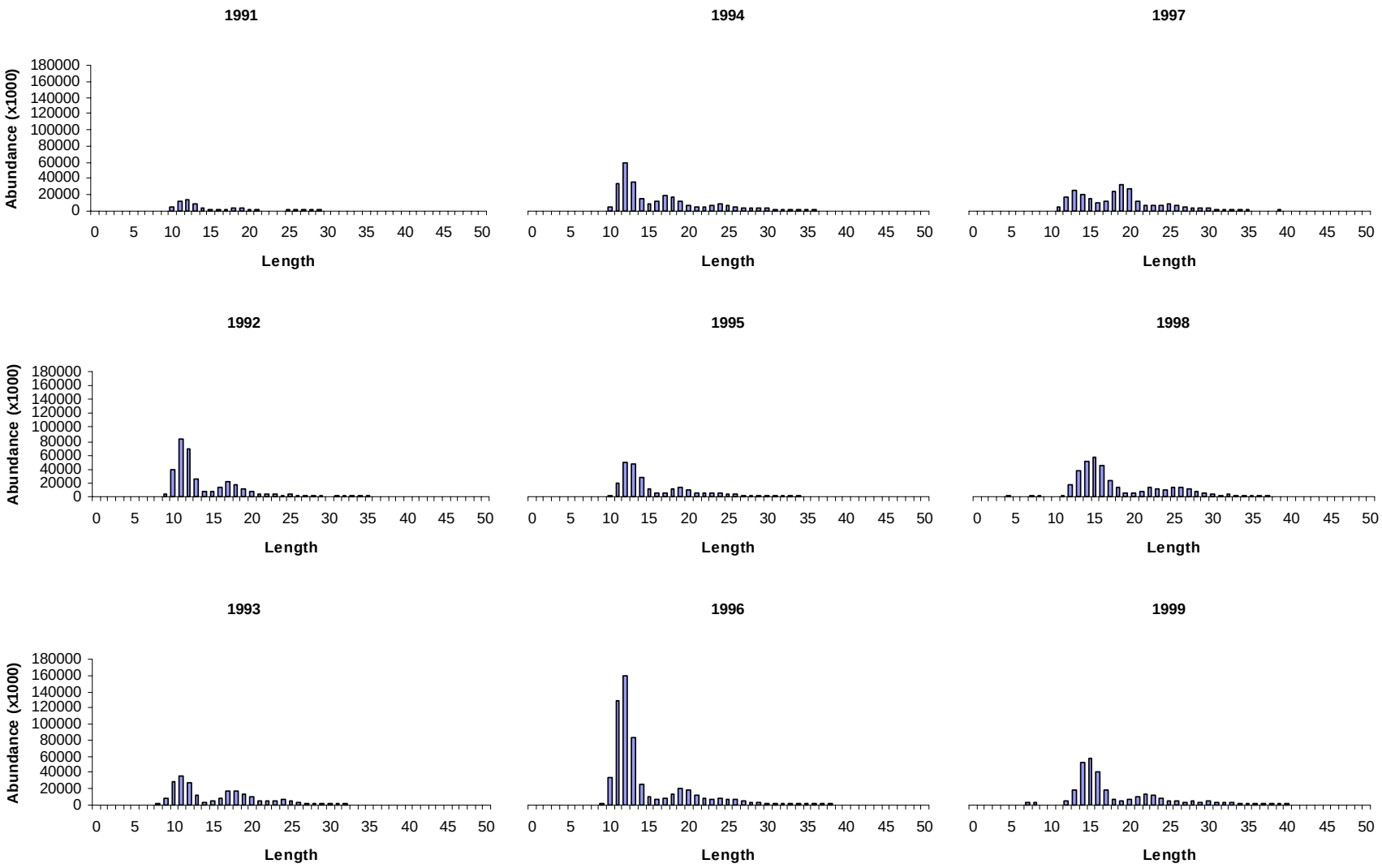


Fig. 3. Greenland halibut (*Reinhardtius hippoglossoides*). Length frequencies for West Greenland, 1991-1999.

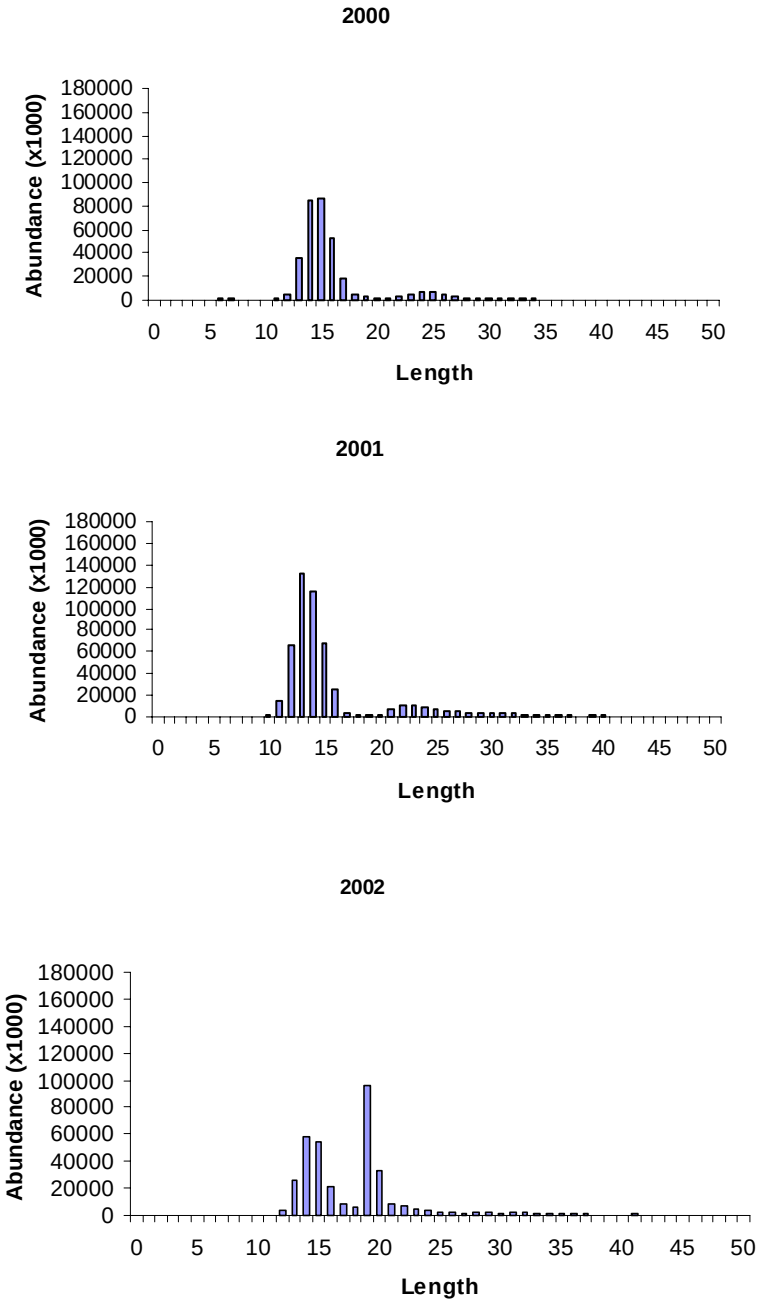


Fig. 3 cont. Greenland halibut (*Reinhardtius hippoglossoides).* Length frequencies for West Greenland, 2000-2002.

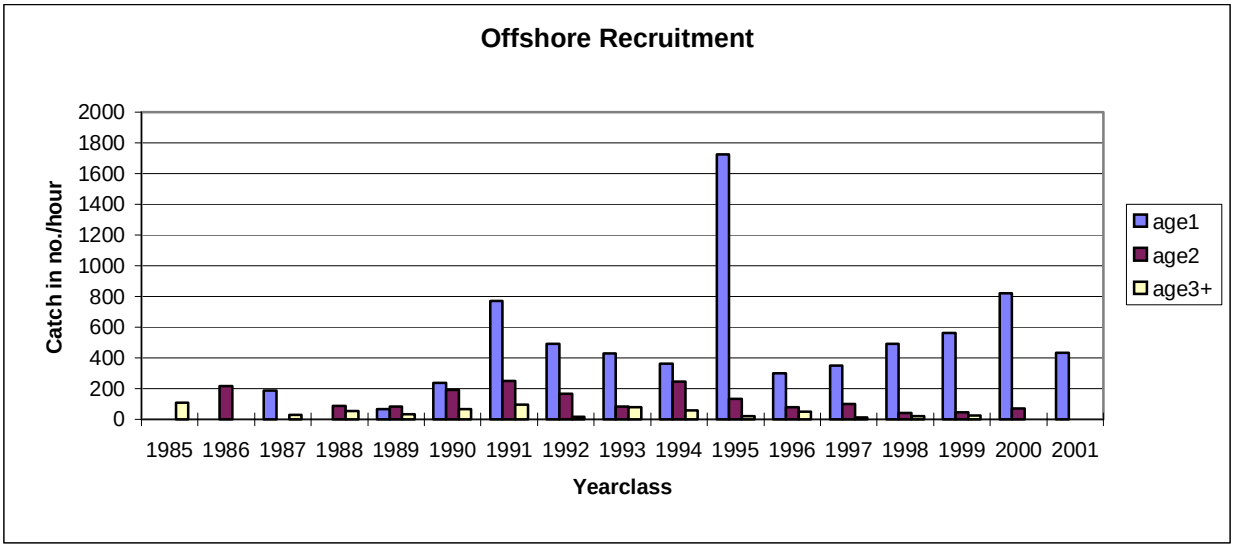


Fig. 4. Catch in number per hour of Greenland halibut at age 1, 2 and 3+ in the offshore nursery area (1AS-1B).

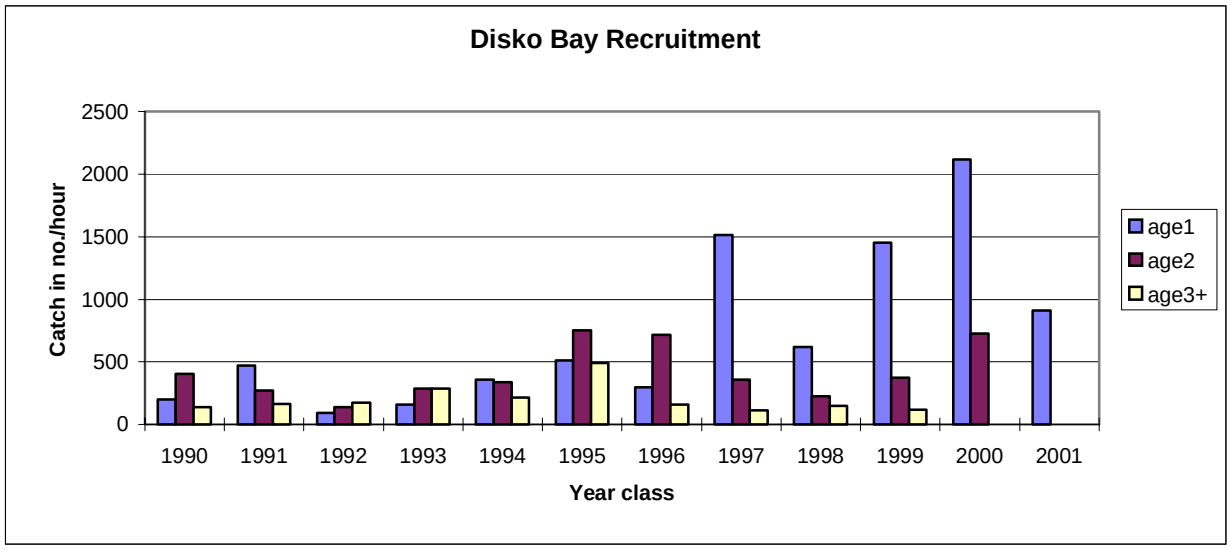


Fig. 4 cont. Catch in number per hour of Greenland halibut at age 1, 2 and 3+ in the in the inshore Disko Bay.

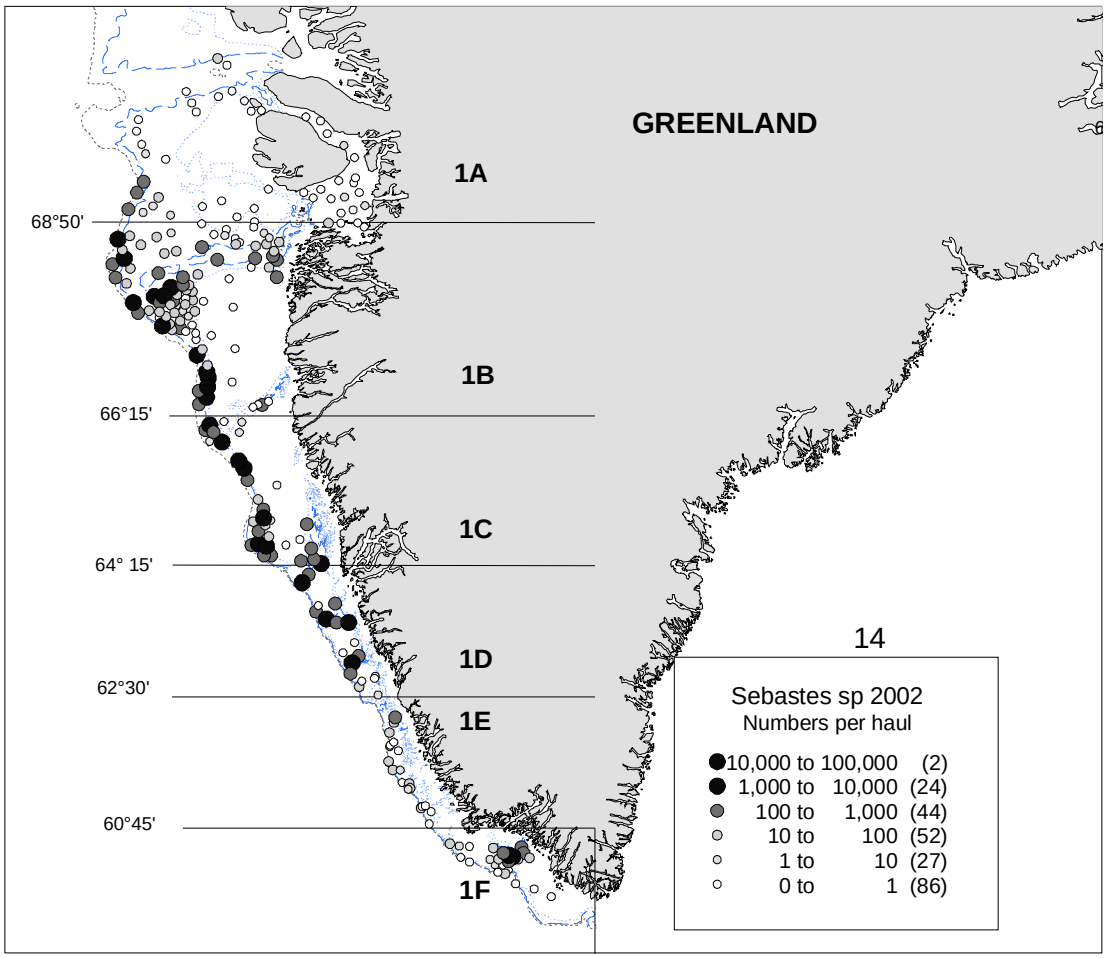


Fig. 5. Distribution of 2002-survey catches (number/hour) of redfish sp. (all hauls). The midline against Canada and the 200, 400 and 600 m depth contour lines are shown.

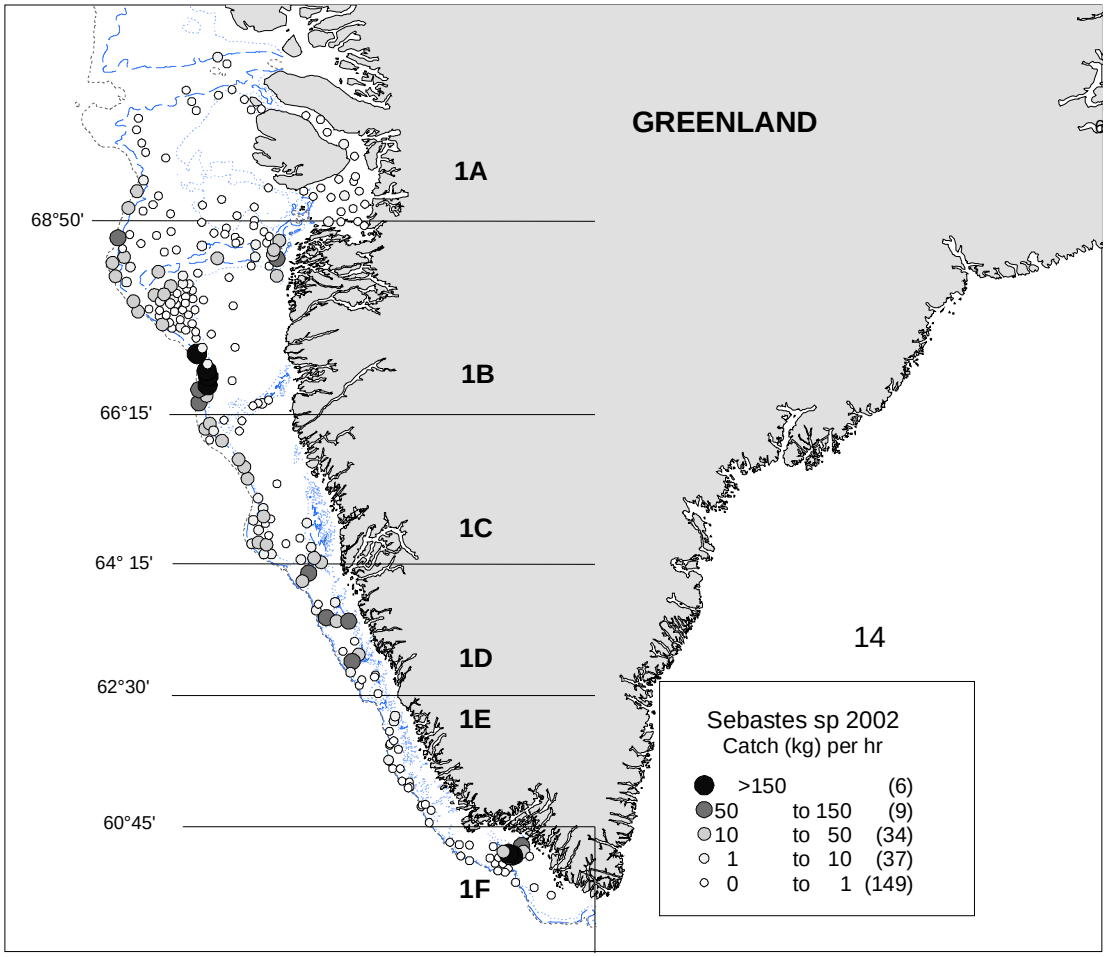


Fig. 6. Distribution of 2002-survey catches (kg/hour) of redfish sp. (all hauls). The midline against Canada and the 200, 400 and 600 m depth contour lines are shown.

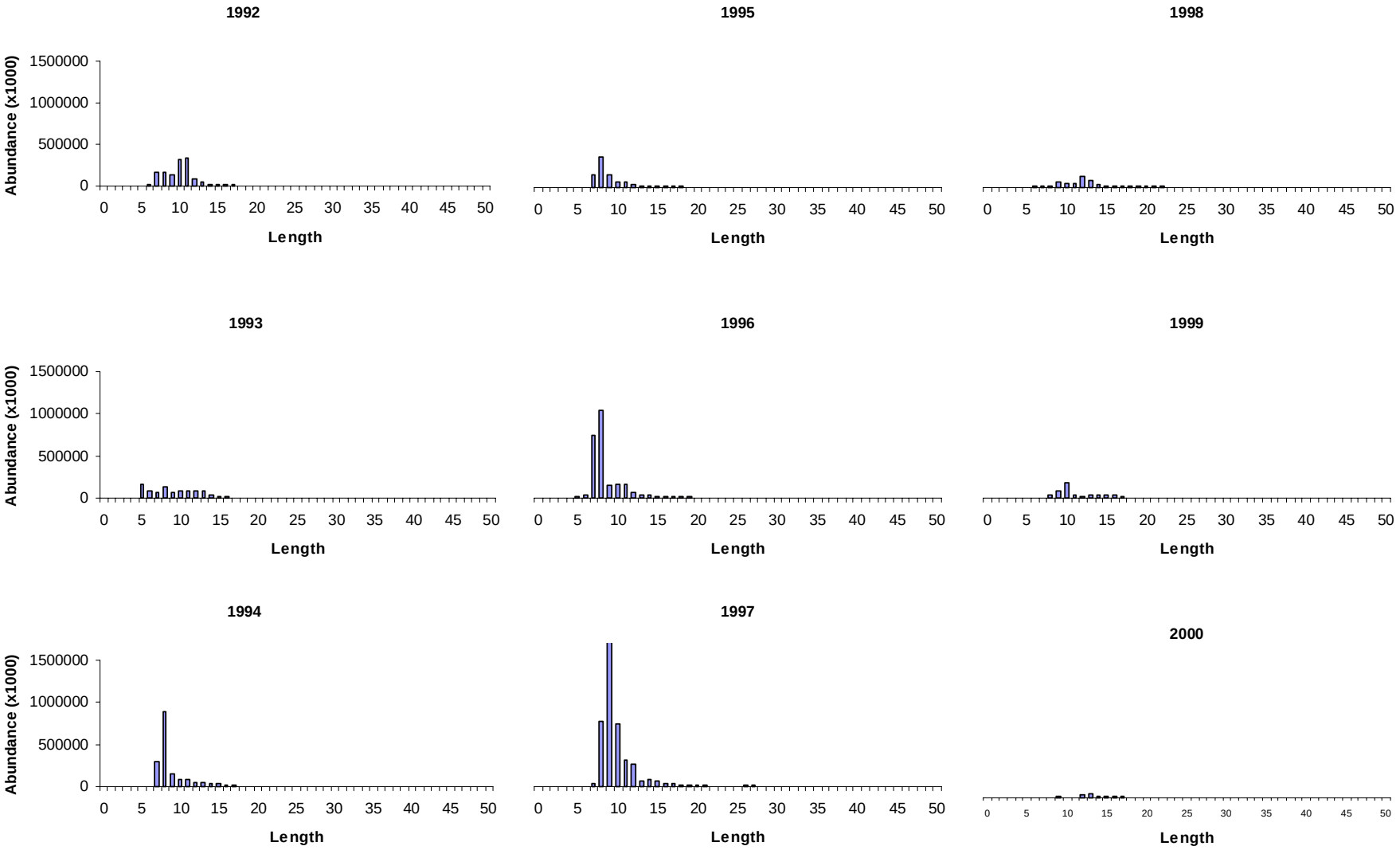


Fig. 7. Redfish (*Sebastes sp.*). Length frequencies for West Greenland, 1992-2000.

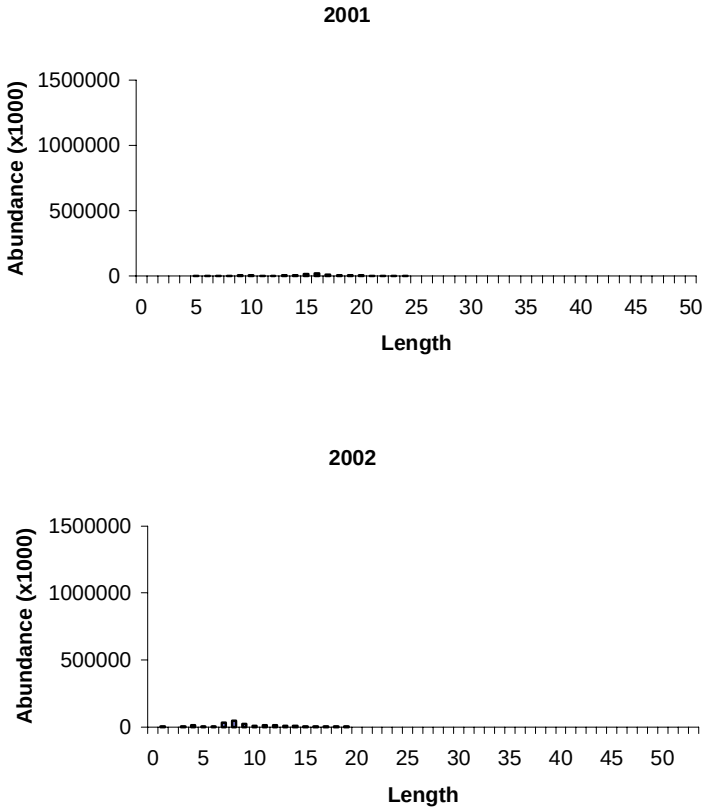


Fig. 7 cont. Redfish (*Sebastes sp.*). Length frequencies for West Greenland, 2001-2002.

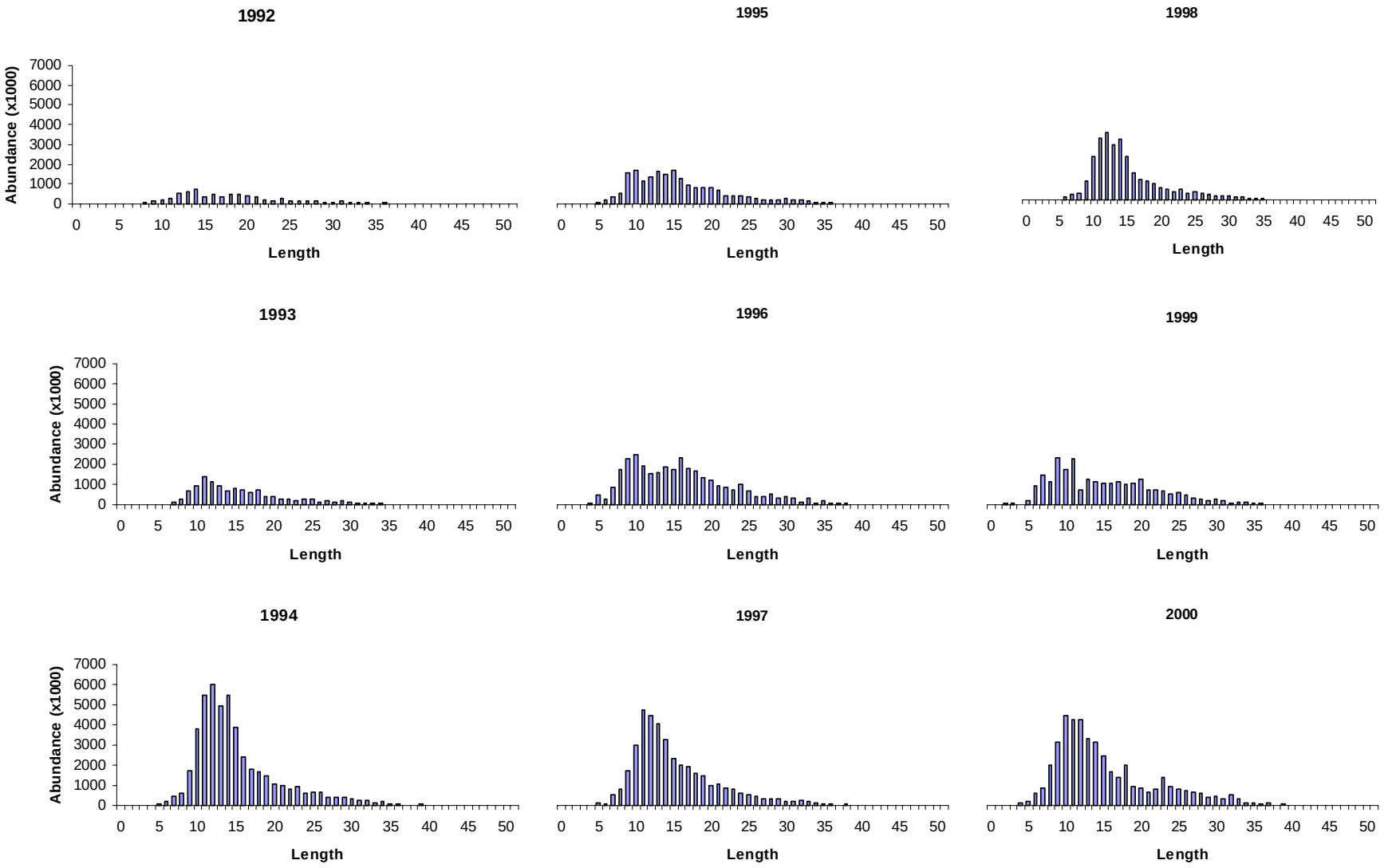


Fig. 8. American place (*Hippoglossoides platessoides*). Length frequencies, 1992-2000.

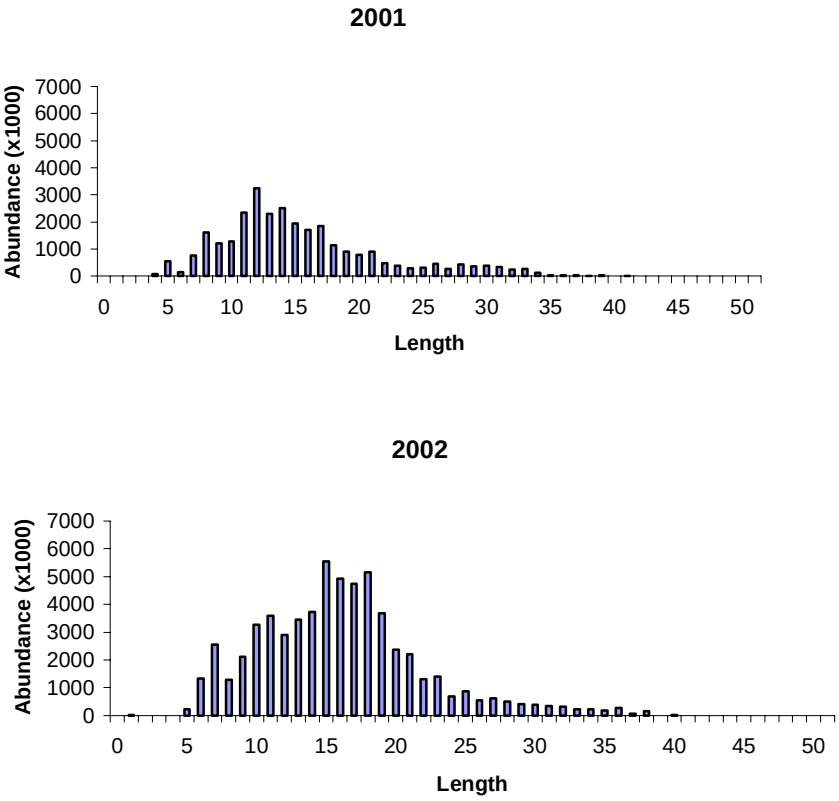


Fig. 8 cont. American place (*Hippoglossoides platessoides*). Length frequencies, 2001-2002.

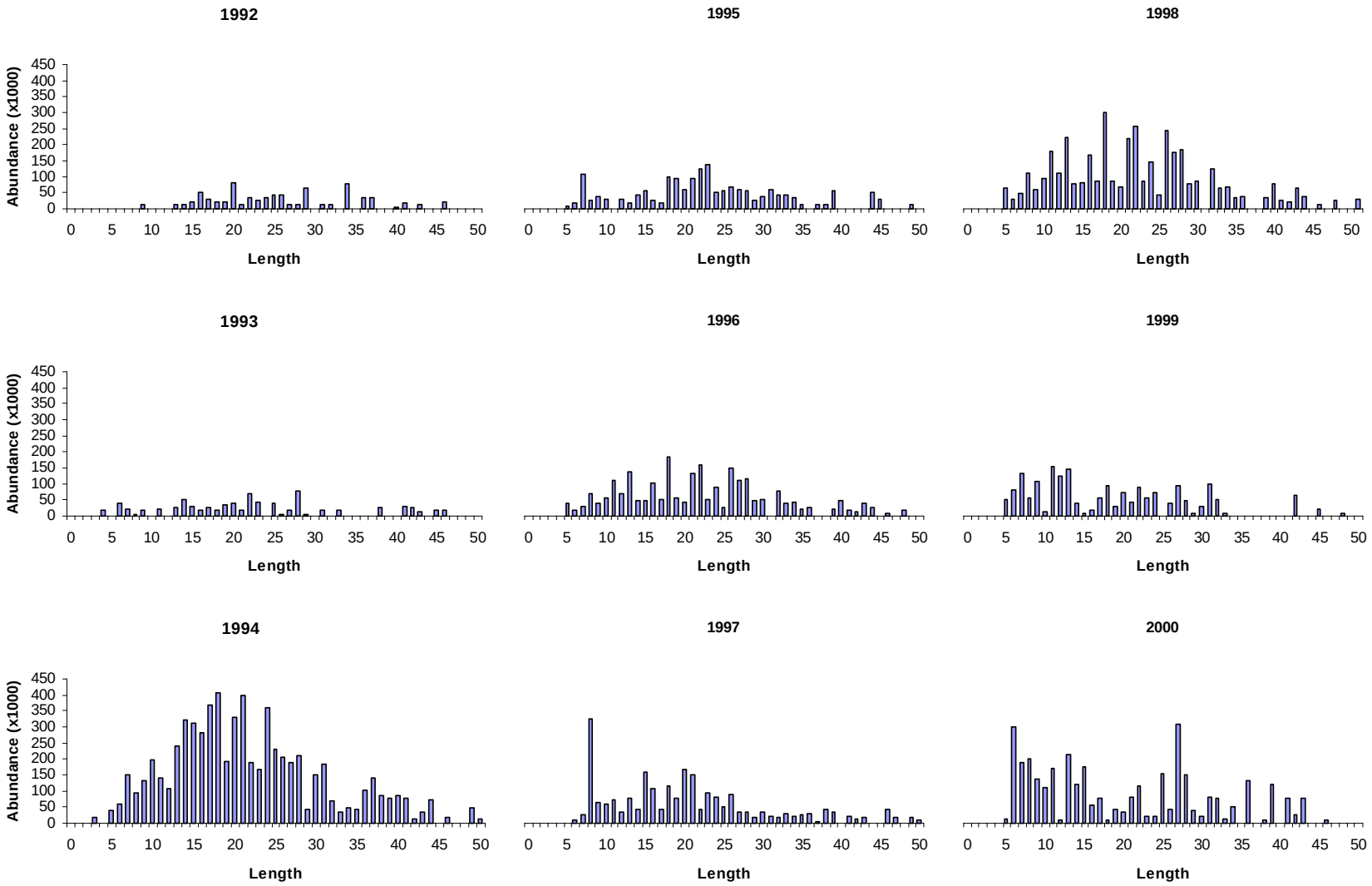


Fig. 9. Atlantic wolfish (*Anarhichas lupus*). Length frequencies for West Greenland 1992-2000.

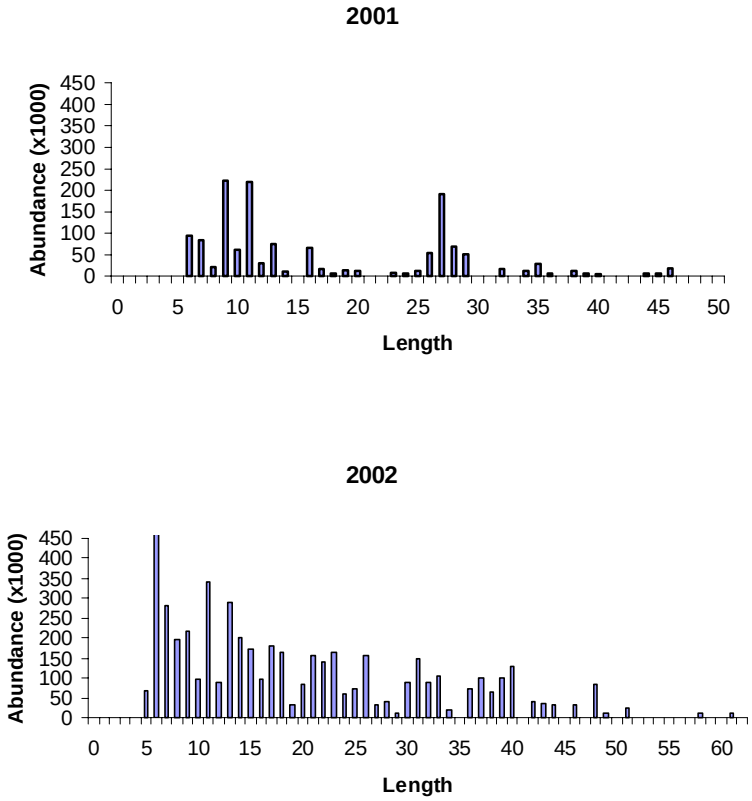


Fig. 9 cont. Atlantic wolfish (*Anarhichas lupus*). Length frequencies for West Greenland 2001-2002.

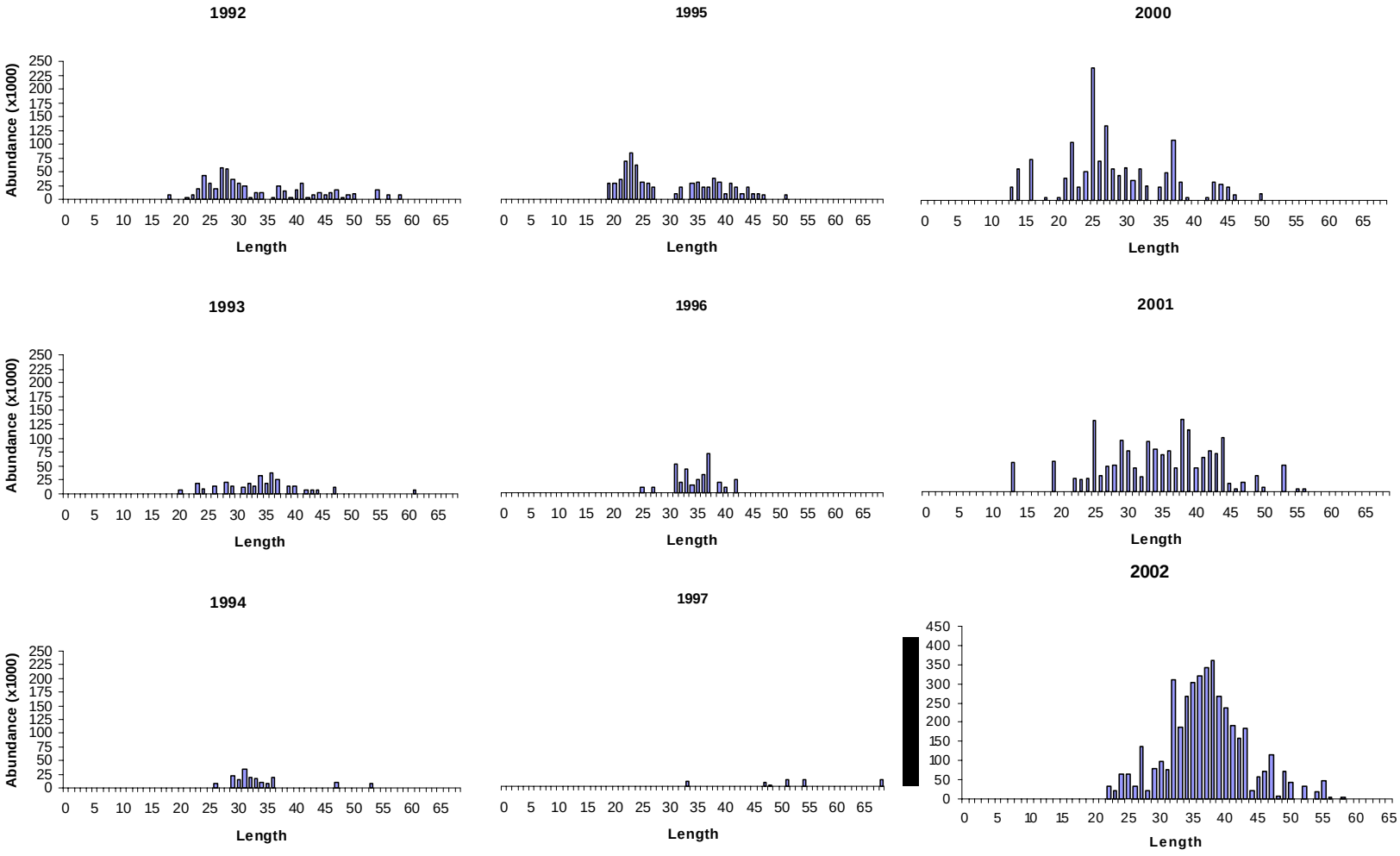


Fig. 10. Atlantic cod (*Gadus morhua*). Length frequencies for West Greenland 1992-2001. 1998 and is 1999 excluded due to very few observations.