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Recruitment of Greenland Halibut at West Greenland

by

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Introduction.

Since 1988 the Greenland trawl survey has been conducted off West Greenland with commercial shrimp trawlers. The main purpose of the survey is to evaluate the biomass of Northern shrimp (*Pandalus borealis*) hence the gear used is a shrimp trawl. However the bycatches of fish has been used to get biomass and abundance indices for commercial important species. During the last years the sampling of fish has improved and the survey is considered as a combined groundfish/shrimp survey. Most effort is concentrated at the areas where the commercial shrimp trawling is placed, especially on the northern slopes of the grand bank Store Hellefiskebanke and in the inshore area Disko Bay, places also known to be nursery areas for Greenland halibut (Smidt,1969; Riget & Boje, 1988). This paper presents a recruitment index for the Greenland halibut based on the surveys in 1988 to 1994.

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). The survey area is divided into NAFO divisions, which is further divided into depth strata (0-200 m, 201-400 m, 401-600 m). The area surveyed has however changed throughout the years. From 1988 to 1990 the survey area included divisions 1AN to 1D. In 1991 the offshore survey area changed to include 1AS to 1D, and then the inshore area Disko Bay was included. In 1992 the survey area was extended to include divisions 1AN to 1F and Disko Bay, and this area is now annually surveyed.

The survey is designed as a stratified-random trawl survey (Doubleday, 1981) where hauls are allocated to the depth strata proportionally to the strata size. A minimum of two hauls per stratum is always planned.

Due to lack of information of the bottom topography division 1AN and Disko Bay are considered as two single strata.

The survey has been conducted with trawlers of the same size and class throughout the years, and since 1991 the 722 GRT stern trawler M/Tr 'Pâmiut' has been used. The trawl gear used is a Skjervoy 3000/20 trawl with bobbin gear and double bag . The mesh size in the codend was from 1988 to 1992 at 40 mm. In the 1993 survey the mesh size was changed to 20 mm. The change of the codend mesh size did not influence the catches of Greenland halibut significantly (Bech, 1994).The trawl doors in use are of the type 'Perfect', except for the 1989 survey where 'BMV' doors were used. The wing spread is estimated by use of Scanmar equipment.

The standard trawling time is 60 minutes at a mean towing speed of 2.5 knots. The trawling operations are only performed during day time.

The anually survey period off West Greenland is July to September .

The catch from each station is sorted by species and weighed. Catches of Greenland halibut are length measured to centimetre below. Biomass and abundance indices with standard deviations are calculated by the swept area method (Cochran, 1977), assuming a catchability factor of 1.0. Hauls taken outside Greenland economic zone are not included in the calculations.

Catch per unit effort (CPUE) is calculated as catch in numbers per centimetre group per standardized trawl hour (figs. 7 and 8). However due to insufficient sampling it is not possible to make these calculations for 1989 and 1990, and CPUE data are also given as kg/trawl hour (fig. 9).

Results.

The number of valid hauls taken annually in the offshore area varies between 78 and 190, and between 30 and 47 in Disko Bay . The trawl positions from the 1994 survey are given in fig. 1. The results from the former surveys have been reported earlier (Bech, 1994; Bech, 1993; Kanneworff & Pedersen, 1992; Pedersen & Nygård, 1992; Carlsson & Kanneworff, 1991)

The biomass estimates of Greenland halibut from the total offshore area showed a significant drop from 1988 (18,800 t) to 1989 (3,400 t), and after some fluctuation during 1990 and 1991 there seems to be an increasing trend up to 1994 (12,200 t) (table 1). The biomass in the nursery area seems to follow the same tendencies. The 1994 estimate (8,200) is at the same level as the 1988 estimate (table 1). In the period in between the biomass has been stable around 4,000 to 5,000 t.

The biomass indices of the inshore area Disko Bay are rather stable around 2-3,000 tons throughout the years (table 1).

The abundance indices (table 2) from the total offshore survey area shows a decrease from 1988 (251 mio.) to 1990 (83 mio.). Due to missing sampling there is no estimate in 1989. As for the biomass indices the 1991 abundance index showed the lowest value recorded, but increased in 1992 to the largest estimate (276 mio .). In 1993 the abundance decreased to 240 mio. and remained at that level in 1994. The same trend, with a large abundance estimate in 1992 and then estimates on a relatively stable level in the following years, is also seen in the nursery area (1AS-1B) and Disko Bay.

The relative length frequencies of the Greenland halibut catches have distinct modes at 11-12 cm and 18-20 cm (fig. 2-4) representing the year classes 1 and 2 respectively (Smidt, 1969). These year classes are almost exclusively restricted to the nursery areas (Bech, 1993 and 1994). In 1988 and 1990 the catches were composed of an equal number of 11-12 cm fish and 18-20 cm fish (fig. 2), but in the following years the catches became more dominated by 11-12 cm fish (fig. 2-3) in the offshore areas. In Disko Bay the catch composition variates from year to year (fig. 4).

The length frequencies from the divisions in the vicinity to the nursery areas (1AN and 1C) differs markedly from the length composition seen in the nursery area. In division 1AN the catches are dominated by larger fish (fig. 5), while there has been a change in the size composition in division 1C (fig. 6). In 1988 the catches in 1C were dominated by 30 cm fish, but throughout the following years the catches became more and more dominated by 12 to 15 cm fish.

The CPUE data from the offshore nursery area confirms the change in the catch composition as mentioned above (fig 7). In 1988 the catches had an almost equal amount of 10 to 12 cm and 16 to 20 cm fish (1 and 2 year old fish respectively). In 1991 there is a general decrease in the CPUE and the lowest values are recorded. However, the survey in 1992 showed a relatively strong 1991 year class, 135 11 cm fish caught per hour, the highest number recorded. In 1993 these fish are seen as a relatively large appearance of year class 2 fish (17 cm), but not as large as year class 2 in 1988. In 1993 and 1994 CPUE values for 1 year old fish are stable, but the mode for 1 year old fish has moved from 11 to 12 cm in 1994.

In Disko Bay the catches generally consists of larger fish, however the strong 1991 year class is also recognized in 1992, together with a large amount of 2 year old fish (fig. 8). These fish are seen in 1993 as modes around 19 and 24 cm respectively. In 1994 the strong 1991 year class is seen as a mode around 24 cm.

Because of insufficient length sampling in 1989 and 1990 CPUE values were calculated from catch weights as kg/trawl hour for all years (fig. 9). In the offshore nursery area the largest CPUE value was recorded in 1988 (28 kg/h). However the lowest value was recorded in 1989 (4 kg/h) and in the following years there is a generel increasing tendency up to 14 kg/hour in 1994. The largest CPUE values are seen inshore in Disko Bay, indicating that an increasing amount of larger fish is caught in the inshore waters. The inshore CPUE values have a mode in 1992 (40 kg/h), where the strong 1991 year class was recorded, while in 1991, 1993 and 1994 the values for Disko Bay were constant around 25 kg/hour.

Discussion.

The total biomass of Greenland halibut decreased from 1988 to 1990, but since 1991 there has been an increase up to 1994 (table 1). Considering the nursery

areas seperately, this increase in biomass has also been recorded, and is followed by an increase in kg/h CPUE-values (fig. 9). The abundance estimates are not increasing at the same time, and in the length frequencies there is no sign of a strong yearclass in 1994 (fig. 7). Thus the growth in the biomass may be due to an increasing amount of 2 and 3 year old fish (1992 and 1991 year classes respectively) because no strong year classes are seen since 1991.

Outside the nursery area the largest biomass is normally found in division 1AN (Bech, 1993 and 1994). In 1988 the biomass in this area constituted 50% of the total offshore biomass, but the catches in 1AN are dominated by year class 2 (fig. 5). In 1994 the biomass was 17 % (2000 t) of the total biomass. In 1994 an unusual large proportion of the biomass, 15% (1800 tons), was found in 1C. This estimate is significantly larger than the previously largest estimate on 1000 tons in 1988. The biomass was mainly found in depth stratum 401 to 600 m and the catches consisted of Greenland halibut in length range 30 to 40 cm, which is consistent with earlier investigations (Jørgensen, 1994). The 1988 catches were dominated by larger fish (fig. 6) but in recent years large numbers of year class 1 have been observed in the area mainly in depth stratum 201 to 400 m. This indicates that the extension of the nursery area is variating between years.

Generally the recruitment to the Greenland halibut stock, from the nursery areas West and South-West of Disko Island, seems to be at a stable level.

In Disko Bay, which can be considered as a nursery area for the inshore stock at Ilulissat, the strong 1991 yearclass is clearly seen (fig. 8), and can be followed as a mode at 19 cm in 1993 and 24 cm in 1994. No indications of a strong 1993 yearclass are found, but the recruitment seems at a stable level.

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Table 1. Biomass estimates (tons) from the nursery area (1AS-1B), the inshore area Disko Bay (Disko) and the total offshore estimate (W. Grl.) with C.V. values.

area/year	1988	1989	1990	1991	1992	1993	1994
1AS-1B	8383	1743	4929	2587	5294	5728	8224
Disko	-[4]	-[4]	-[4]	2147	3927	2364	3194
W. Grl.	18810[1]	3418[1]	7918[1]	2943[2]	8643[3]	9598[3]	12222[3]
C.V.(%)	25	18	19	31	25	31	31

[1] Indicates the survey area 1AN-1D
[2] Indicates the survey area 1AS-1D
[3] Indicates the survey area 1AN-1F
[4] Indicates no inshore survey

Table 2. Abundance estimates (millions), from the nursery area (1AS-1B), the inshore area Disko Bay (Disko) and the total offshore estimate (W. Grl.) with C.V. values.

area/year	1988	1989[5]	1990	1991	1992	1993	1994
1AS-1B	145	-	60	62	242	199	207
Disko	-[4]	-[4]	-[4]	26	69	35	44
W.Grl.	251[1]	-	83[1]	65[2]	276[3]	239[3]	253[3]
C.V.(%)	26	-	24	34	33	36	31

[1] Indicates the survey area 1AN-1D
[2] Indicates the survey area 1AS-1D
[3] Indicates the survey area 1AN-1F
[4] Indicates no inshore survey
[5] No abundance estimates available

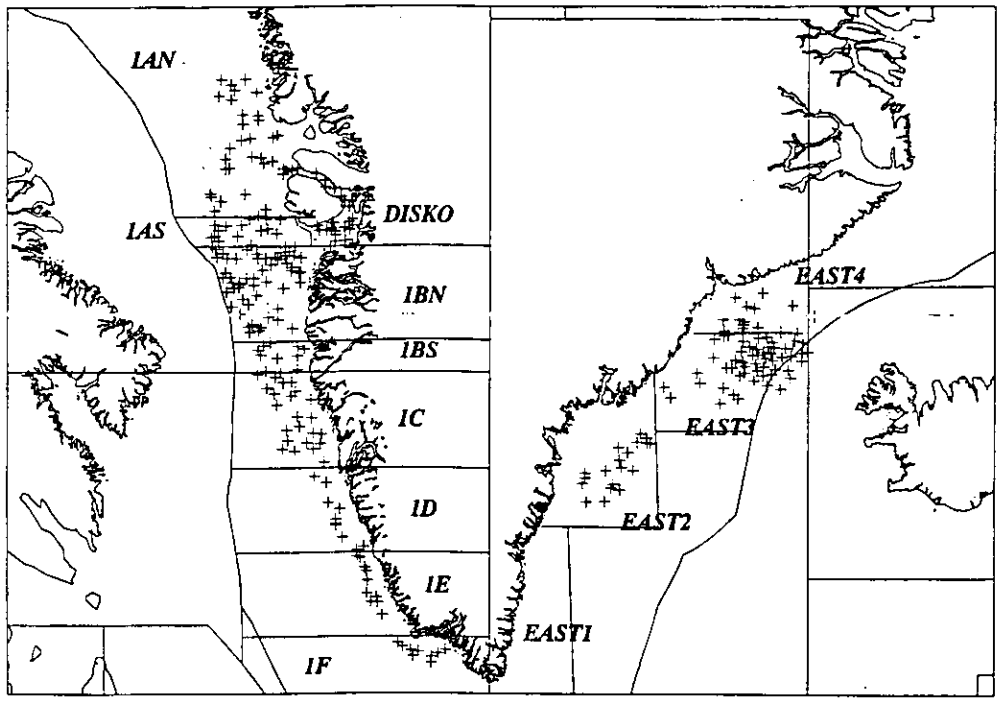

Fig. 1. Survey area and haul location (+) in the 1994 trawl survey.

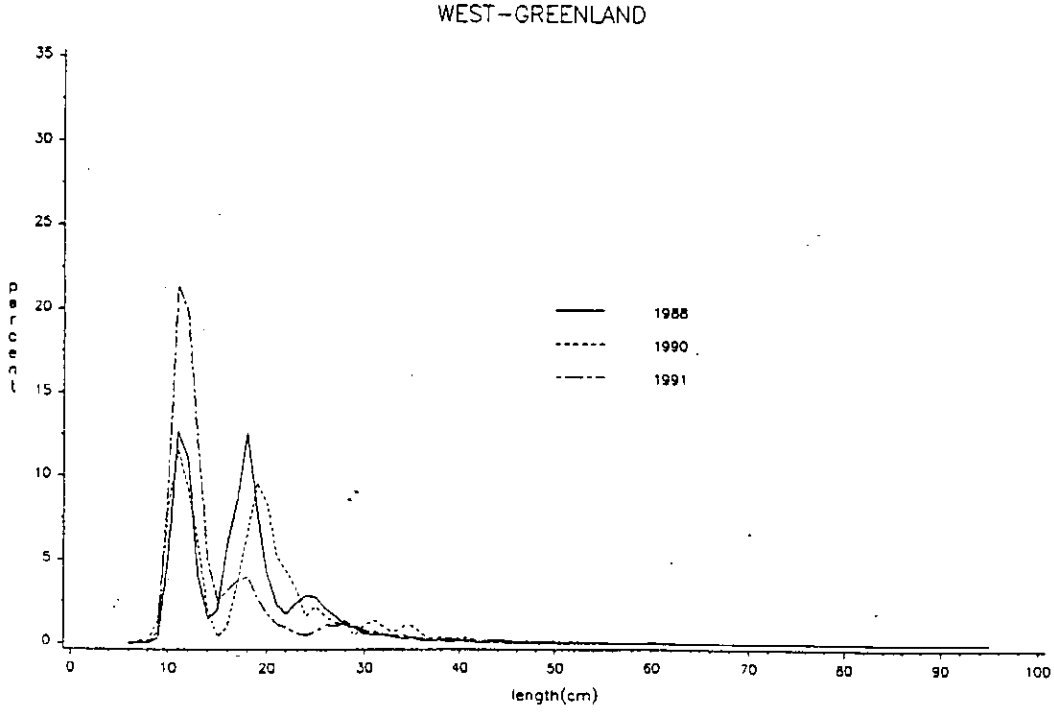

Fig. 2. Relative length frequencies (1 cm) from the offshore catches taken in 1988, 1990 and 1991 surveys.

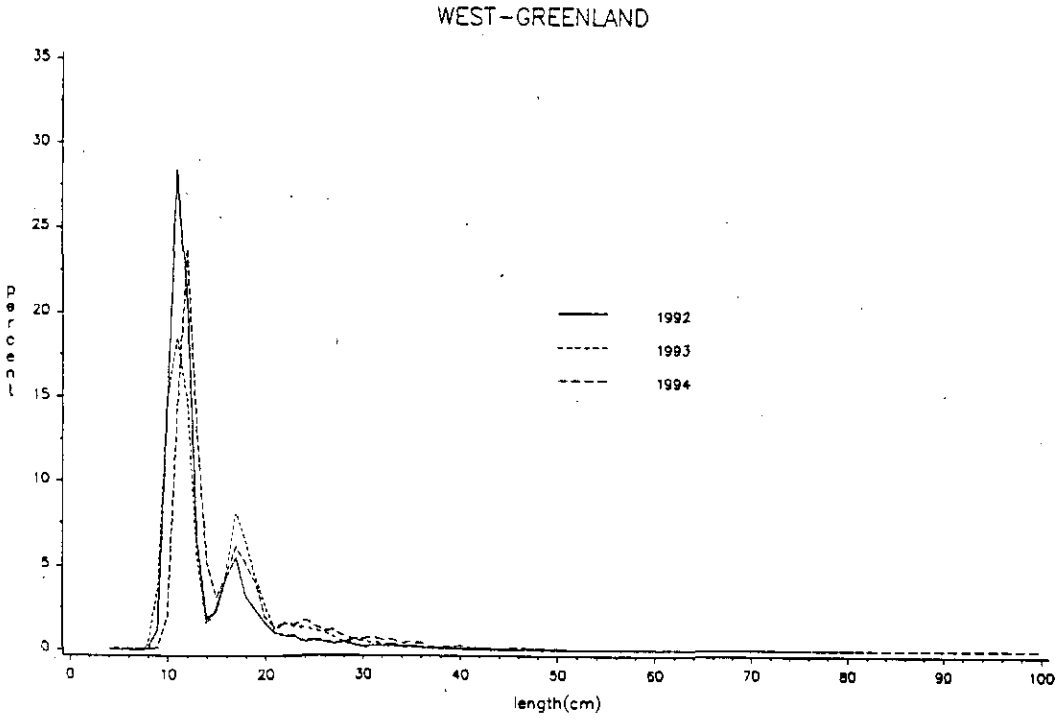

Fig. 3. Relative length frequencies (1 cm) from offshore catches taken in 1992 to 1994 surveys.

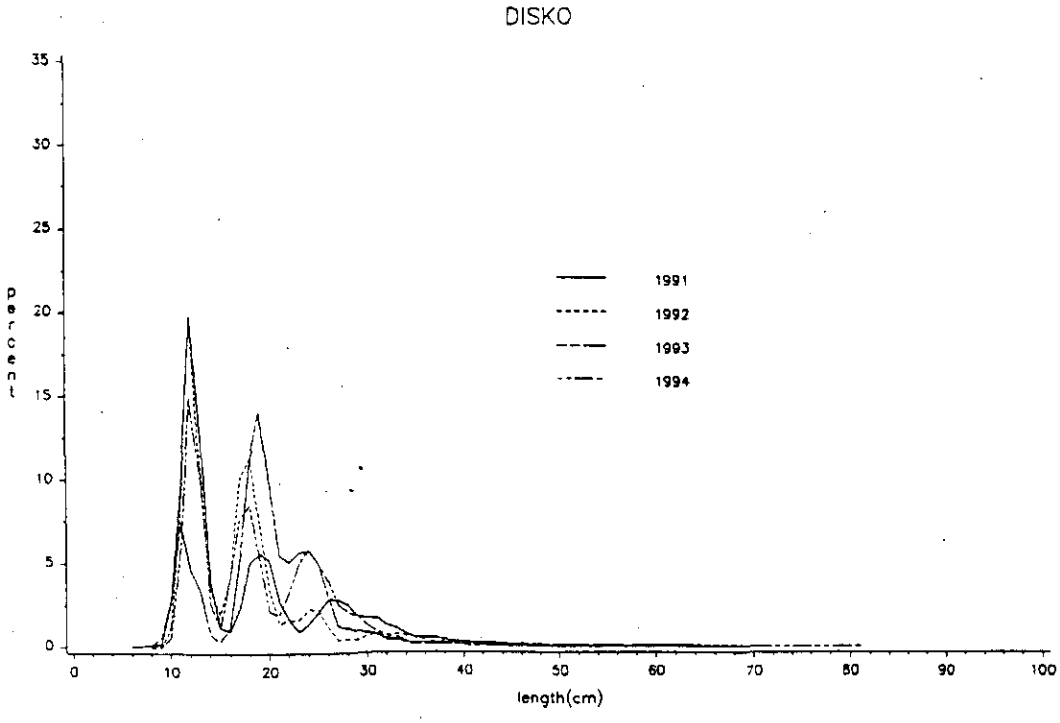

Fig. 4. Relative length frequencies (1 cm) from inshore catches taken in 1991 to 1994 surveys.

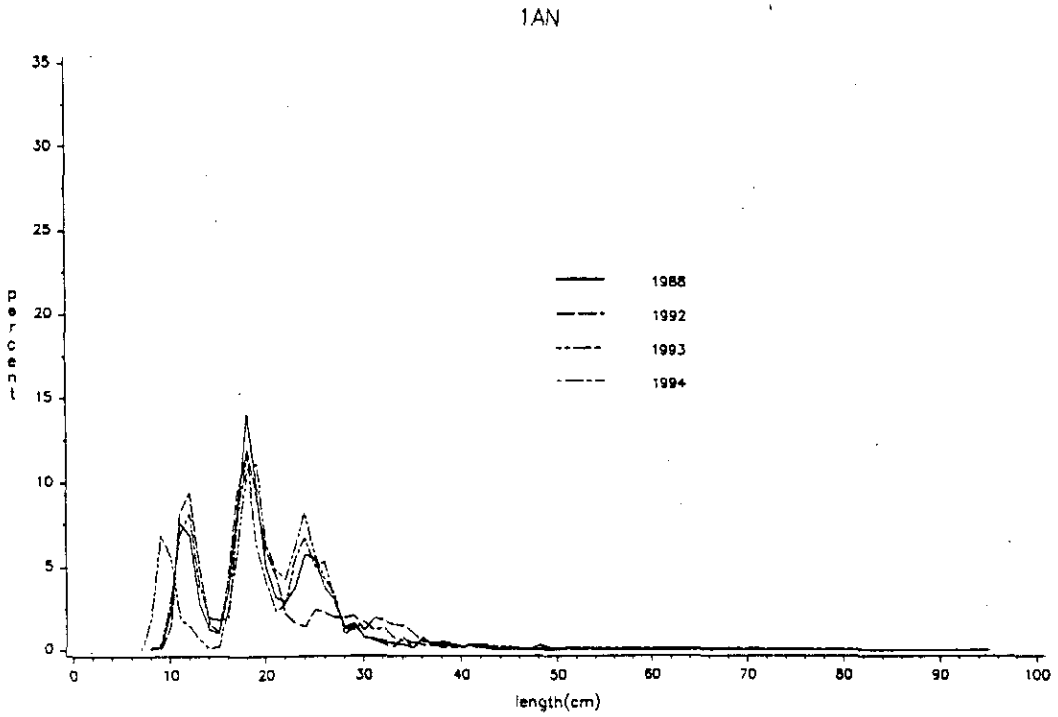

Fig. 5. Relative length frequencies (1 cm) from catches taken in division 1AN in 1988 and 1992 to 1994 surveys.

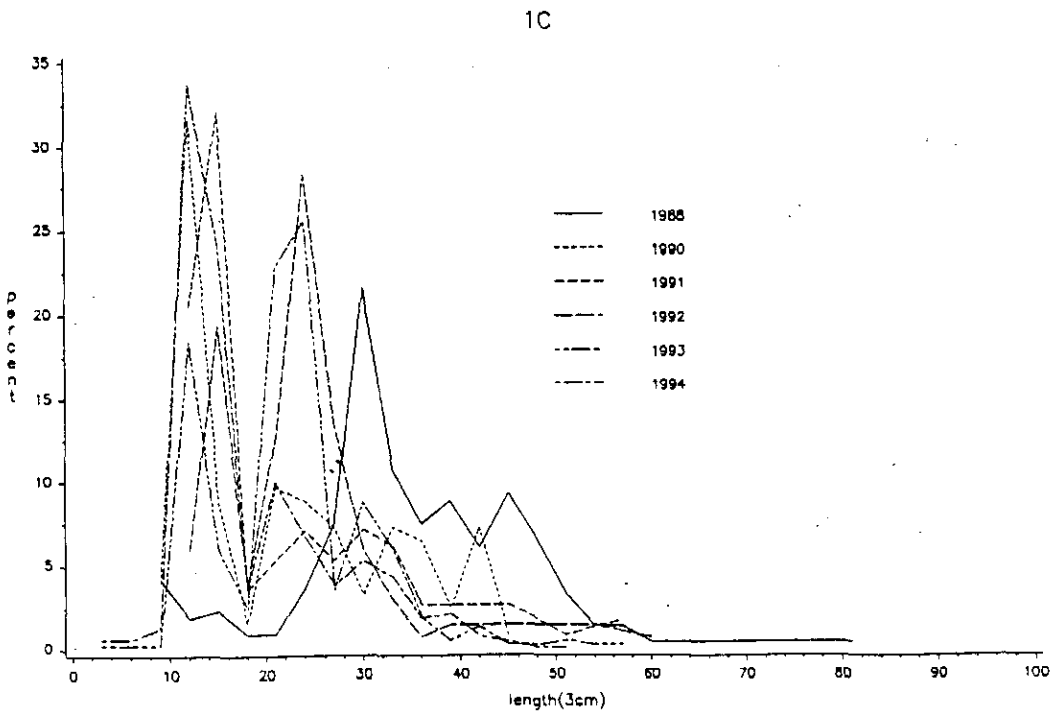

Fig. 6. Relative length frequencies (3 cm) from catches taken in division 1C during 1988 and 1990 to 1994 surveys.

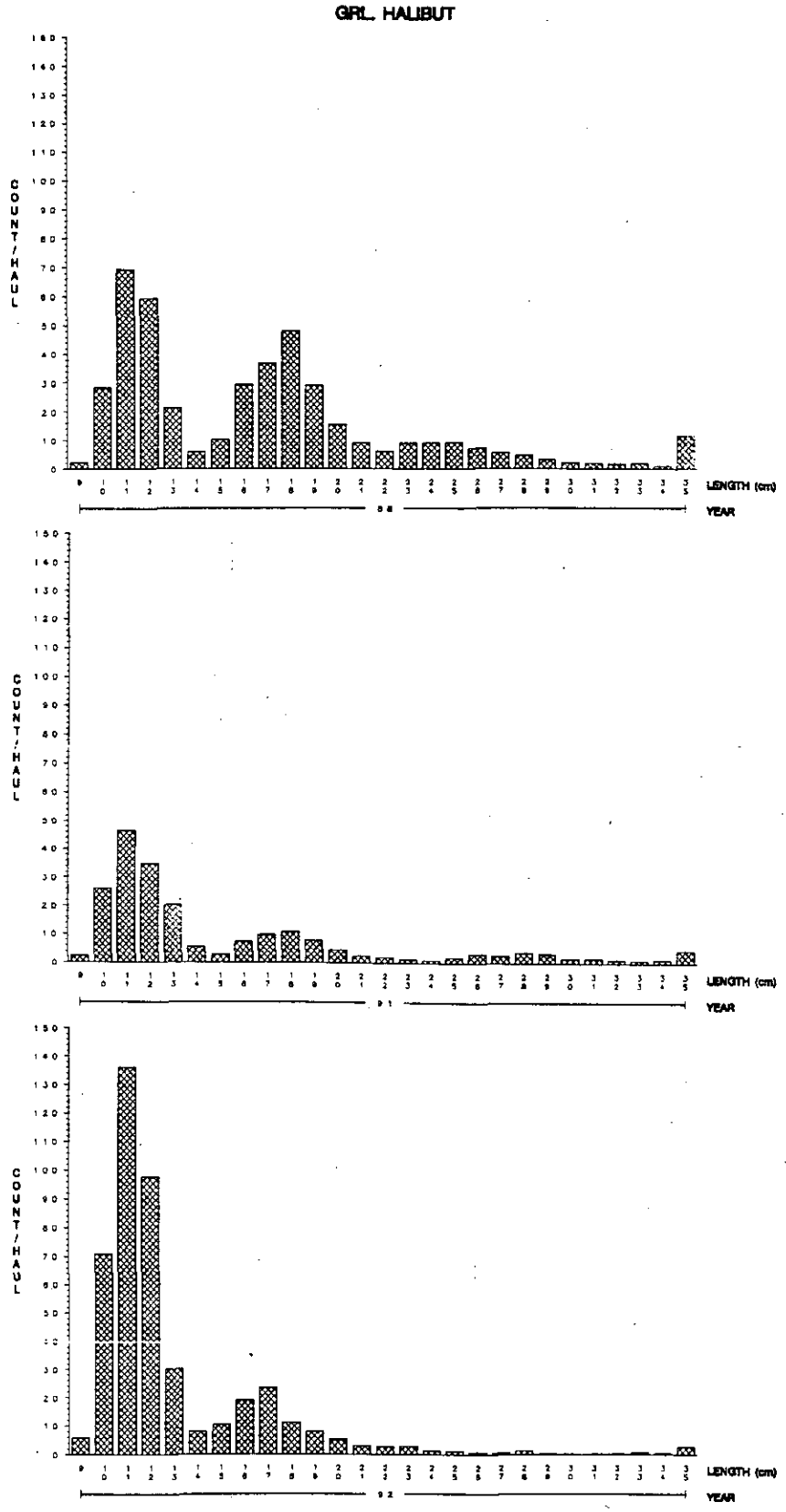

Fig. 7. CPUE values (numbers/cm/trawl hour) from the offshore nursery area (1AS-1B) for the 1988 and 1991, 1992 surveys. Continues.

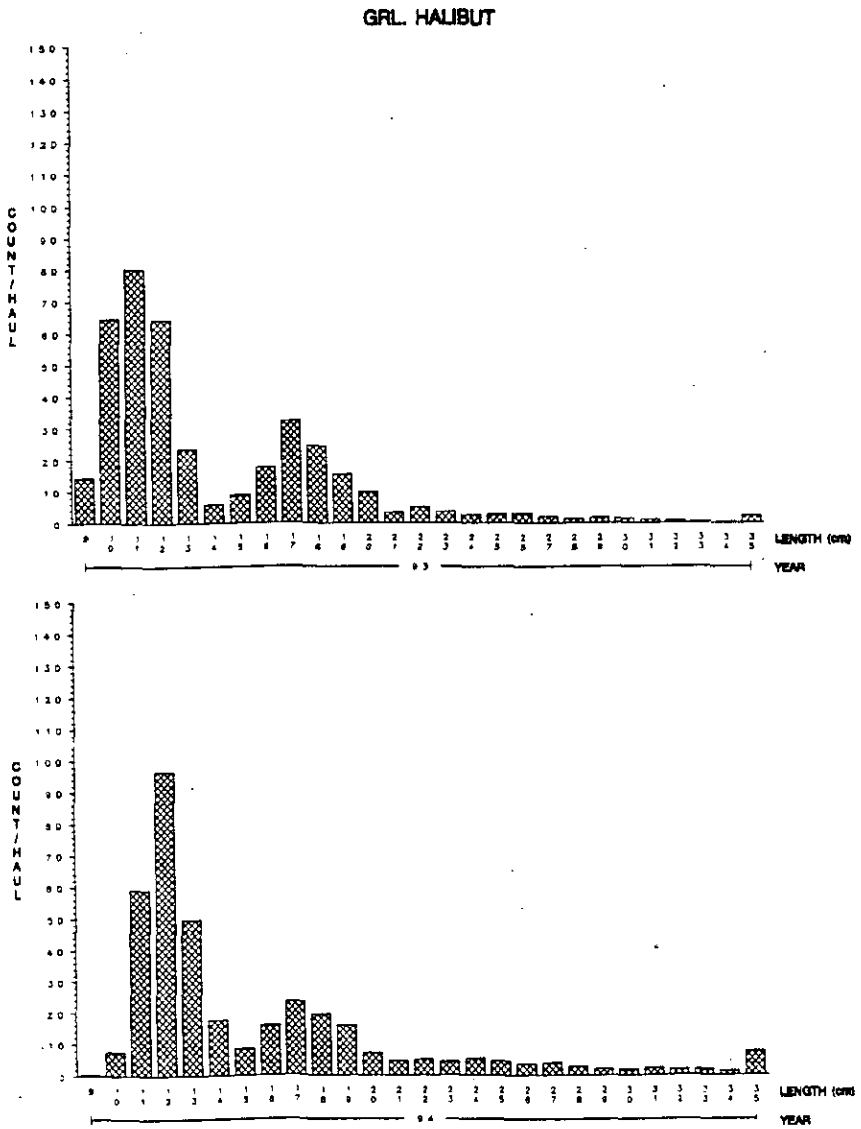

Fig. 7. Continued. CPUE values (numbers/cm/trawl hour) from the offshore nursery area (1AS-1B) for the 1993 and 1994 surveys.

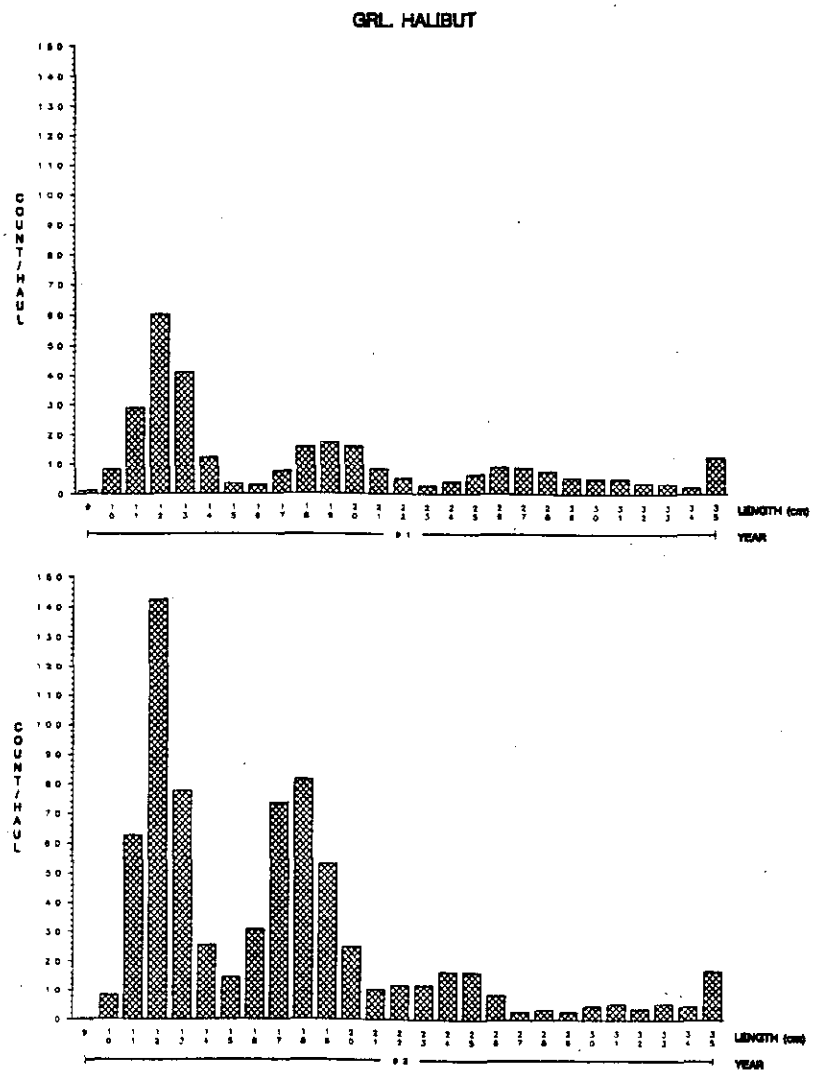

Fig. 8. CPUE values (numbers/cm/trawl hour) from the inshore nursery area Disko Bay from 1991 and 1992 surveys. Continues.

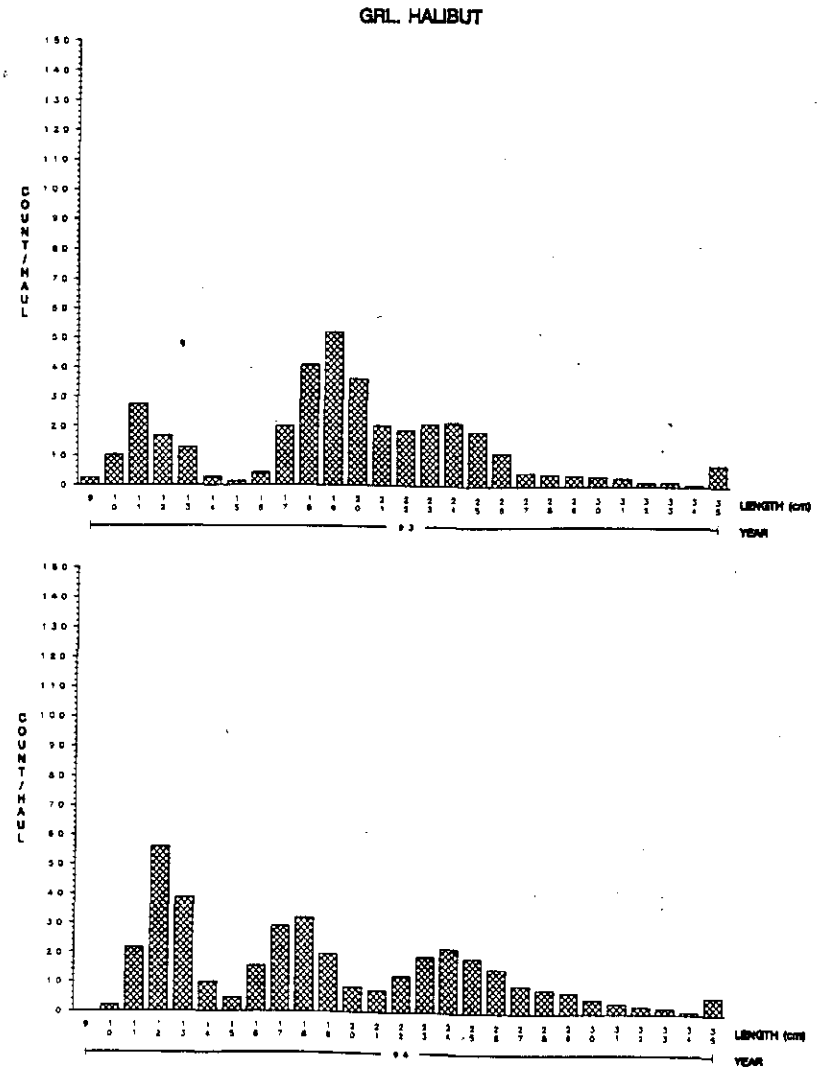

Fig. 8. Continued. CPUE values (numbers/cm/trawl hour) from the inshore nursery area Disko Bay from 1993 and 1994 surveys.

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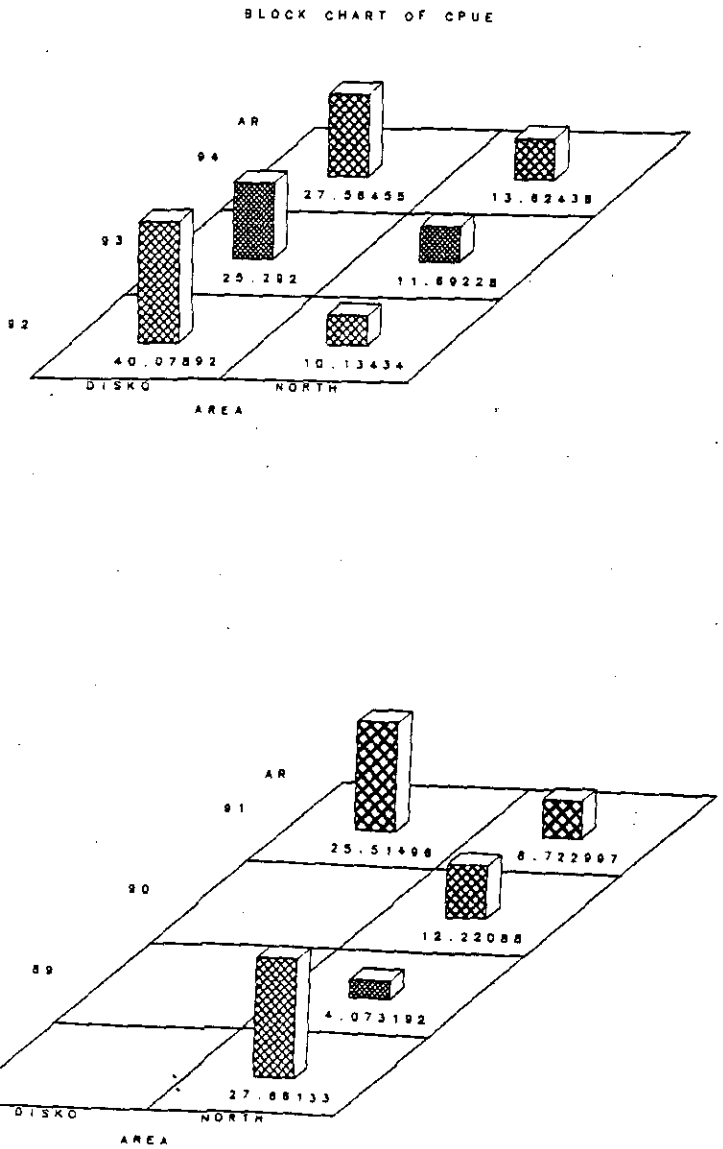

Fig. 9. CPUE values (kg/trawl hour) from the offshore nursery area (North) and the inshore nursery area Disko Bay (Disko), from the surveys in 1988 to 1994 (AR).