

Northwest Atlantic



Fisheries Organization

Serial No. N1761

NAFO SCR Doc. 90/44

SCIENTIFIC COUNCIL MEETING - JUNE 1990

Greenland Fishery for Shrimp (Pandalus borealis)

at North West Greenland from 1985 to 1989

by

Henrik Lund

Greenland Fisheries Research Institute
Tagensvej 135, 1, DK-2200 Copenhagen N, Denmark

INTRODUCTION

Greenland fishery for shrimp (*Pandalus borealis*) in West Greenland offshore waters north of 70° 52, 5'N (outside the 3 nm limit) began in 1985. During 1985 and 1986 this fishery was regarded as a trial fishery, and reported catches of 4.349 tons in 1985 and 11.071 tons in 1986 were not considered part of the West Greenland TACs set for these years.

However, for 1987 Greenland authorities set a TAC of 11.580 tons for the area delimited by 71° N and 72° 52, 5'N; experimental fishery continued north of 71° N. Reported catches amounted to 10.579 tons.

In 1988 and 1989 TACs were 11.500 and 8.000 tons while reported catches were 6.683 and 2.530 tons, respectively.

Fishing intensity was high during 1986, 1987 and 1988, and the fishery had a pronounced effect on the shrimp stock as shown by data on catch rates, abundance of shrimp, and length distributions of shrimp.

This paper sums up the development of this fishery.

MATERIALS AND METHODS

Data on the commercial fishery were available from two sources: 1) Logbook data on effort and catches, and 2) weekly radio reports on total catches to Greenland authorities (Greenland Fishing License Control, GFLK) by all vessels participating in the fishery.

Logbook data from 1988 and 1989 cover the total catches reported by vessels to GFLK; for 1985, 1986, and 1987 data available cover about 59, 83 and 90% of total catches reported to GFLK.

In order to make total effort comparable between years, logbook data were weighted according to the total catches reported to GFLK. It was assumed that the distribution of effort on fishing grounds, as shown by logbook data, reflects the distribution of total effort.

For sake of comparison, catch rate indices shown in Figure 3 were obtained by simple division of total effort (hours) into total catch, as data did not allow the computation of standardized indices for all fishing grounds and years. However, standardized indices, based on analysis of variance (the General Linear Models procedure of SAS), were computed for Ground I (1987 and 1988) and Ground III (1986-1988). These indices show the same development and are of the same order of magnitude as the simple CPUE indices shown here.

For the analyses of variance the statistical squares (used in the Greenland reporting system) were chosen as the unit area. Statistical squares were included in the analyses if they were part of a fishing ground and if they had been visited by more than one trawler during a specified year. Trawlers were included only if they had performed at least 50 hours of fishing in the squares selected.

Shrimps were sampled by crews on board commercial trawlers (1986) and by the Greenland Fisheries Research Institute staff during surveys (1988 and 1989). Oblique carapace length of shrimp was measured to the nearest 0.1 mm; 0.1 mm groups were later combined in 0.5 mm groups.

Data on shrimp biomass in the offshore area delimited by 71° N and $72^{\circ} 52', 5''$ N (east of 59° W) were available from Greenland Fisheries Research Institute surveys.

RESULTS

Starting in 1985, Greenland trawlers conducted a trial fishery in the West Greenland sea territory north of $70^{\circ} 52', 5''$ N - an area estimated to cover roughly 80,000 km² of sea bottom within the depth range of commercial trawling (Figure 1, depths < 600 m).

The first two years of fishing resulted in the discovery of five fishing grounds (Figures 1 and 3): Three small (II, IV, V), covering less than 100 km² each, and two large (I, III), covering about 1500 and 2900 km², respectively.

Figure 2 shows the total annual shrimp catches during the period 1985 to 1989 as registered by GFLK; data are given in Table 1. Catches rose from about 4,000 tons in 1985 to more than 10,000 tons in 1986 and 1987. Catches subsequently declined and reached a level of less than 3,000 tons in 1989.

Figure 3 shows the distribution of fishing effort and shrimp catches in the five areas that may be considered fishing grounds. About 90% of the total effort spent north of 71° N from 1985 to 1989 were spent on the two largest fishing grounds, I and III, while most of the remaining 10% was spent on fishing grounds II, IV, and V. Only about 1% of the fishery took place outside these five areas. Figure 1 depicts the distribution of low effort areas.

In the first year of experimental fishery (1985) effort was concentrated on Ground III and Ground IV. There was little fishery north of these grounds and almost nil to the south. During 1986 the fishery spread to the north and to the south of Ground III. This was mainly a result of an obligation to place part of the fishing effort north of $72^{\circ} 52', 5''$ N imposed by Greenland authorities on

the main part of the fishing fleet.

Trawlers fished as far north as 75° 50' N, but shrimp densities were consistently low north of 74° N: At the western side of Kap York Isfjeldsbanke (Figure 1: 74° 52' N-75° 37' N, along 62° 30' W) few, but very large shrimp were found (Figure 7 d-e), while west of 63° W no shrimp were found.

Only one very small fishing ground (V), covering an area of less than 100 km², was discovered north of 73° N. More than 90% of the fishery north of 73° N, corresponding to 16% of the total effort in 1986, took place on Ground V (Fig. 3). However, mean catch rates were low (150-200 kg/hour) and only about 7% (=700 tons) of the total reported catch were taken on this ground. In 1987, fishing on this ground accounted for less than 2% of the total effort, and it was more or less abandoned in the following years. Catches on Ground V made up 2.5% of the total catches reported since 1985.

Grounds I and II were discovered in 1986. Ground II is comparable in size to Grounds IV and V, but mean catches obtained on the former in 1986 and 1987 were about twice as high as those on the latter two grounds (IV and V); even though the total fishing effort spent on Ground II was about 20% lower than on Ground V, catches on Ground II made up 6% of the total catch, or 2.5 times more than catches on Ground V. During 1988 and 1989, total fishing effort on Ground II was down to less than 100 hours (Table 1, Figure 3).

The southernmost fishing ground (I) was discovered in the last month before the end of season in 1986, when very high catch rates (about 1000 kg/hour and above) were obtained. About 37% of that year's total catch was taken on Ground I.

Approximately 80% of the total catch reported in 1986 was taken on Grounds I and III.

Starting in 1987, Greenland Home Rule set a TAC of 11,580 tons for the area between 71° N and 72° 52, 5' N. The obligation to fish north of 72° 52, 5' N was discontinued and fishing effort was concentrated on the large southern grounds and on the small grounds in the vicinity of Grounds I and III.

This stayed the picture from 1987 to 1989. The proportion of the total fishing effort that was spent on the large grounds (I and III) rose from 73% in 1986 to 92% in 1987 and 99% in 1988 and 1989. The same figures apply to the proportion of the total catches taken on these grounds.

The distribution of effort shifted towards deeper water in the eastern parts of the fishing grounds. During the period from 1985 to 1986 there was no fishing activity in the northeastern part of Ground III. In 1987 30% of the fishery on Ground III took place in this area; in 1988 and 1989, this fraction of the fishery increased to 40% and 65% respectively. 50% of the effort spent on Ground I in 1988 was spent in the eastern fourth of the area, while in 1989 more than 70% was spent here.

Concomitantly with the concentration of effort on the large grounds the significance of the small grounds (II and IV) diminished, so that in 1989 the effort on these grounds was about 0.5% of the total effort expended north of 71° N.

Catch rates

Due to heterogeneous sets of data for fishery on Grounds II, IV and V it was not

possible to calculate standardized CPUE indices for these areas.

Simple CPUE indices show that Grounds IV and V were areas of comparatively low yield, but the limited data available do not allow any conclusions to be drawn as concerns the development of catch rates.

The limitations imposed by few data also apply to Ground II. However, the combination of a marked decline of CPUE from 1986/1987 to 1988/1989 (Figure 3) and the restricted area of this ground indicates that the low mean CPUE values of the later years are reliable.

Mean catches per hour obtained on Ground III diminished by about 50% over a three year period (1986-1988), as shown by the index based on simple means (Figure 3). The standardized CPUE index, based on 1272 hauls made by 7 trawlers, shows that the decline was even steeper than indicated by the simple index.

A standardized index was not calculated for 1989, but the composition of the fishing fleet did not change noticeably from 1988 to 1989, so the simple index may be representative of mean catch rates. The simple index indicates a slight rise of CPUE.

Catch rates obtained on Ground I from 1986 to 1988 (Figure 3) show the same development as described above. However, initial catch rates on this ground were about twice as high as those on Ground III and, despite a high fishing intensity, mean catch rates stayed comparatively high (Figure 3).

Shrimp samples

Shrimp samples from the middle part of Ground I indicate that mean length of shrimp decreased from 1986 to 1989. Samples from 1986 show a negatively skewed distribution (Figure 4 a-b) while samples from 1989 show positively skewed distribution (Figure 4 e-f).

Samples from Ground II (1988 and 1989; Figure 5 a-c) show that the mean length of shrimp is small. The largest fraction of the individuals are found in the length groups around 15, 18, and 22 mm, and individuals larger than 28 mm are absent. There are no samples available from 1987 and 1986, but fishermen state that the mean length of shrimp was small from the start of the fishery in 1986.

1986-samples from Ground III show a stock composed of a broad range of shrimp sizes (Figure 6 a-d). Length distributions of shrimp in samples from 1989 show distinct modes around 22 1/2-23 mm and 25 mm cpl (Figure 7 a-c) and a decrease of shrimp sizes above 27-28 mm.

DISCUSSION AND CONCLUSION

The small fishing grounds at North West Greenland have proved to be of transient significance. Owing to the fishery legislation of 1986 fishing intensity was very high on Ground V in 1986, but due to low catch rates and the remote location of this ground effort was low in 1987. No catches were reported after 1987.

Ground IV is characterized by rough bottom and low catch rates; the extremely high catch rate of 1989 (Table 1) is not characteristic of this ground and is likely due to a single haul that must be regarded as an isolated instance. The proximity of Ground IV and Ground III may be part of the reason why trawlers have visited this area every year since 1985.

Mean catch rates were high on Ground II during 1986 and 1987, and effort was high considering that the ground covers a restricted area. However, the very low effort of 1988 and 1989 indicates that the area is no longer attractive to the fishing fleet. Mean catch rates of about and less than 100 kg/hour obtained are probably part of the reason for this, but the small mean size of shrimp (Figure 5) may also be an incentive to fish elsewhere.

Grounds I and III have shown to be of major significance, primarily owing to the greater extension of these grounds. Fishery on these grounds has contributed 90% to the total catch obtained in the whole area since 1985. Mean catch rates declined by about 50% during the period from 1986 to 1988 as shown by simple and standardized CPUE indices (Figure 3-III, 3-I). However, as of 1989 the decline of CPUE was seemingly replaced by a stabilization or even a slight rise of catch rates. This may be a result of less effort being spent in 1989 compared to the previous years (Table 1) and a displacement of the fishery toward deeper water, rather than a recovery of the shrimp stock.

On the basis of data collected at a stratified random survey in 1988 (Carlsson & Kannevorff, 1989) shrimp biomass was estimated to about 16,000 tons in the offshore area delimited by 71° N and 72° 52', 5' N (east of 59° W). At a similar survey in 1989 the biomass was estimated to roughly half the 1988 figure (Carlsson et al. 1990).

Shrimp samples indicate that the fishery has affected the shrimp stocks on both grounds. The broad range of shrimp sizes that made up the virgin stock on Ground III at the beginning of the exploitation, now seems to be replaced by fewer dominating size classes. In at least one area of Ground I the shrimp stock has experienced a marked displacement of mean size towards the low end of the scale.

Data on shrimp biomass, mean catch rates, and size composition of the shrimp stock suggest that the stock on the large grounds was reduced by about 50% from 1985 to 1988, and that the size composition of the stock has changed during this period. In the light of these observations it is likely that the displacement of the fishery towards deeper water was the main reason why a further decline of mean catch rates was not experienced in 1989.

As reported elsewhere (Lund, 1990) the level of reproduction in the North West Greenland shrimp stock may be low compared to more southern stocks. The combination of a low level of reproduction and a decrease of the frequency of large sized shrimp, i.e. female shrimp, as was experienced on Ground I, may prove fatal to the regeneration of the North West Greenland shrimp stock. It is therefore suggested that the level of exploitation does not exceed the level of 1989.

REFERENCES

- Carlsson, D.M., and P. Kannevorff. 1989. Report on a Stratified-random Trawl Survey Shrimp (Pandalus borealis) in NAFO Subarea 0+1 in July 1988. NAFO SCR Doc. 89/40, Serial No. N1617.
- Carlsson, D.M., P. Kannevorff, and K. M. Lehmann. 1990. Report on a Stratified-random Trawl Survey for Shrimp (Pandalus borealis) in NAFO Subarea 0+1 in July-August 1989. NAFO SCR Doc. 90/46, Serial No. N1763.
- Lund, H. 1990. Fecundity of shrimp (Pandalus borealis) sampled on fishing grounds at North West Greenland and West Greenland. NAFO SCR Doc. 90/63, Serial No. N1785.

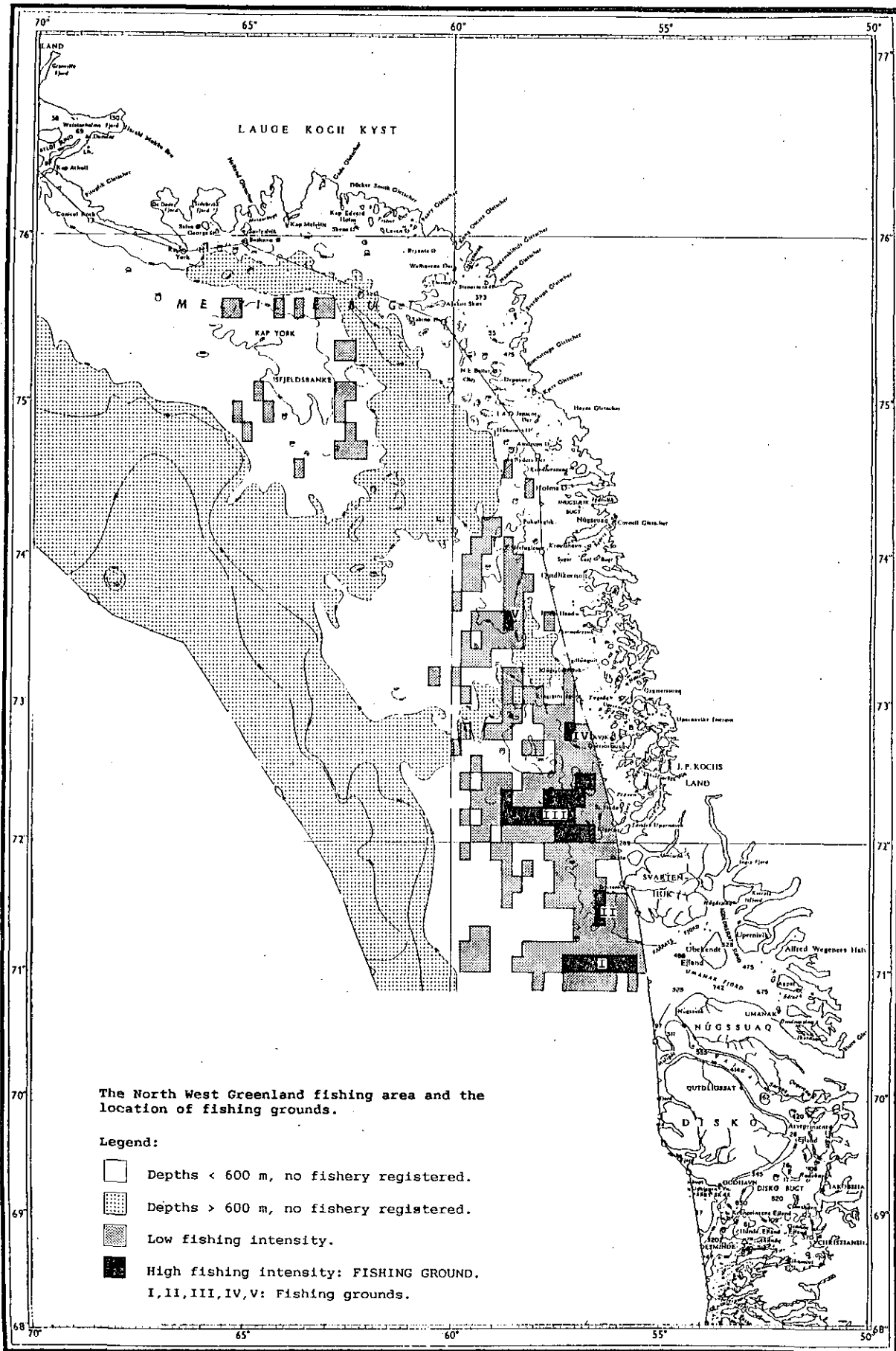


Figure 1.

**CATCH AND EFFORT DATA ON GREENLAND SHRIMP FISHERY
AT NORTH WEST GREENLAND FROM 1985 TO 1989.**

	1985	1986	1987	1988	1989
GROUND V					
EFFORT (hours)		4,482	684		
CATCH (tons)		738	103		
CPUE-index		0.49	0.45		
GROUND IV					
EFFORT (hours)	1,463	472	510	227	11
CATCH (tons)	330	154	97	50	12
CPUE-index	0.67	0.98	0.57	0.66	-
GROUND III					
EFFORT (hours)	11,973	13,418	18,533	12,636	4,238
CATCH (tons)	3,969	4,479	5,045	2,344	960
CPUE-index	0.99	1.00	0.81	0.56	0.68
GROUND II					
EFFORT (hours)		2,470	1,493	61	32
CATCH (tons)		1,369	690	3	4
CPUE-index		1.66	1.38	0.15	0.37
GROUND I					
EFFORT (hours)		6,434	14,070	14,863	4,612
CATCH (tons)		4,037	4,240	3,938	1,506
CPUE-index		1.88	0.90	0.79	0.98
Total Allow. Catch			11,580	11,500	8,000
Tons reg. by GFLK	4,349	11,071	10,579	6,683	2,530
Tons reg. by GF	2,572	9,212	9,446		
% reg. by GF	59 %	83 %	90 %	100 %	100 %
Weighting factor	1.69	1.20	1.12	1.00	1.00

Catch figures registered by Greenland Fisheries Research Institute (GF) refer to fishing grounds only, while catch figures registered by Greenland authorities (GFLK) refer to the total off shore area at North West Greenland..

Table 1.

Percentages = % of GFLK-catch registered by GF.
Weighting factor = ratio of 'Tons registered by GFLK' to 'Tons registered by GF'.

CPUE indices are based on a mean CPUE value of 334 kg/hour (=1) obtained on ground III in 1986.

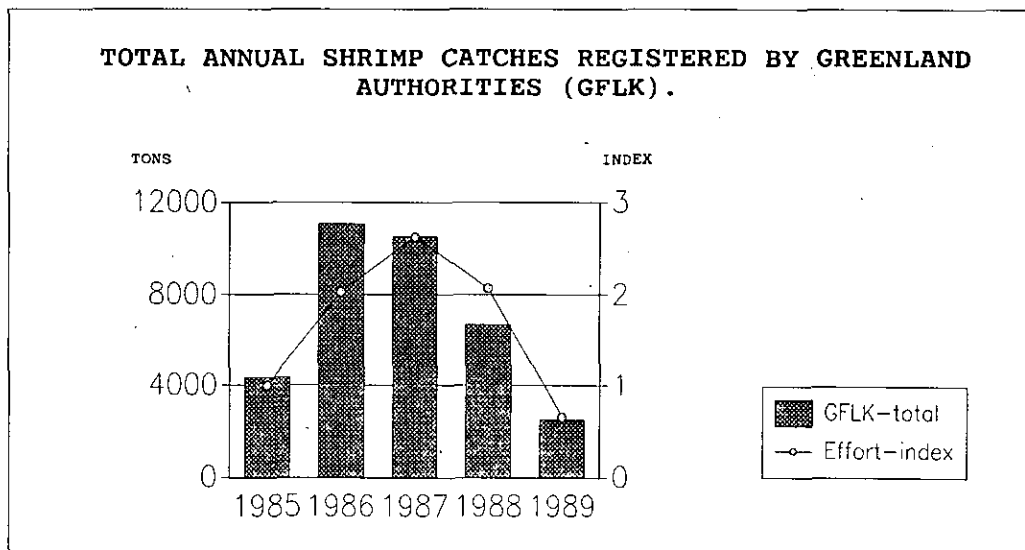
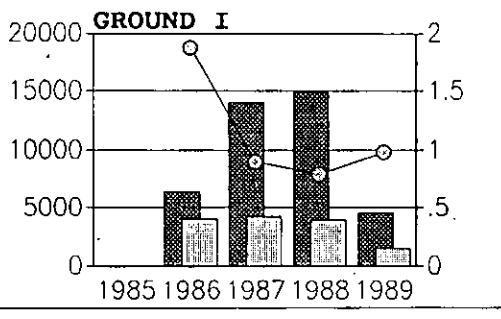
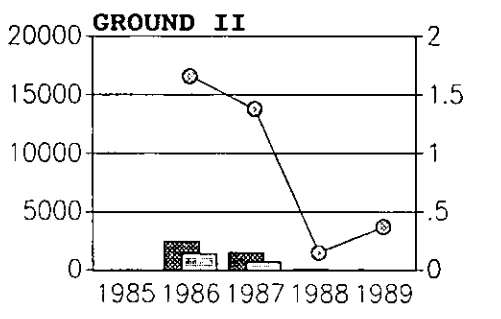
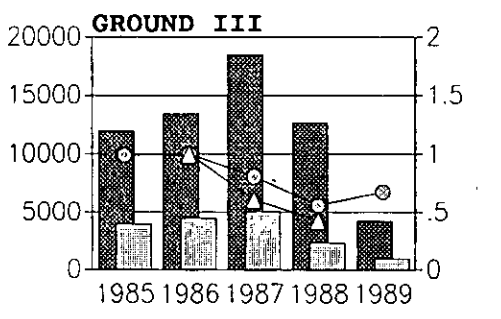
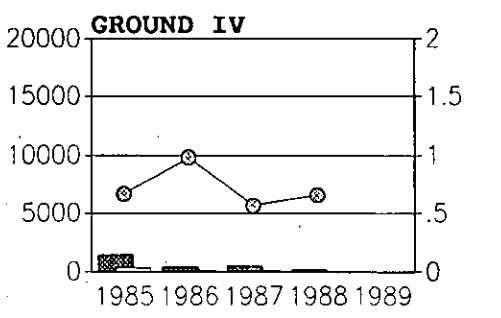
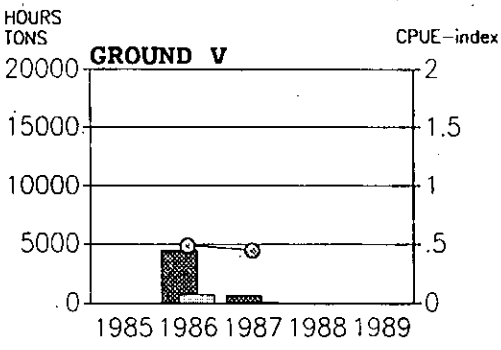
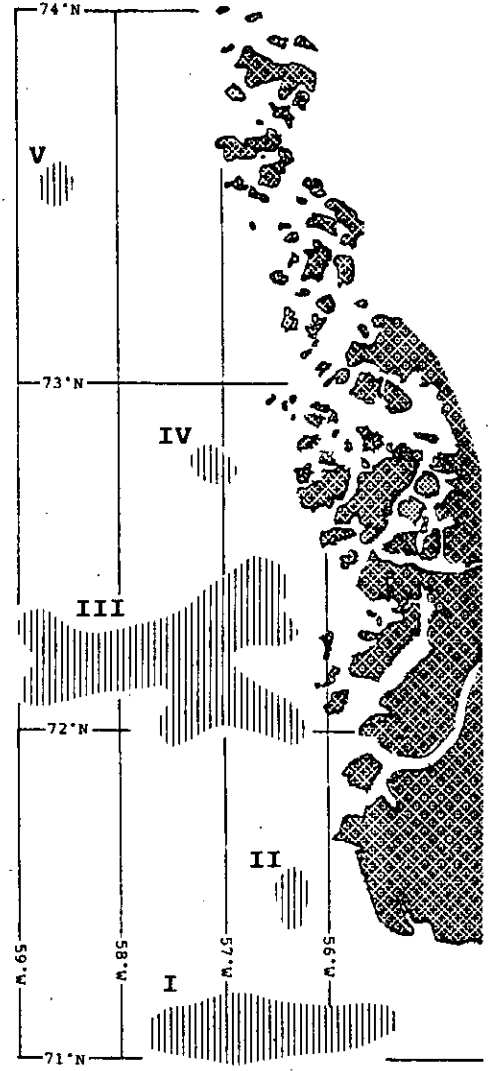


Figure 2.

TOTAL ANNUAL FISHING EFFORT, CATCHES AND CPUE INDICES ON NORTH WEST GREENLAND FISHING GROUNDS FROM 1985 TO 1989.



HOURS
 TONS
 CPUE-index
 stand. index



CPUE index = simple index.
 (1=334 kg/hour = ground III 1986)
 Stand. index = standardized index.
 HOURS = weighted number of fishing hours registered in log books.
 TONS = weighted number of total catches registered in log books.

Exact figures are given in table 1.

Figure 3.

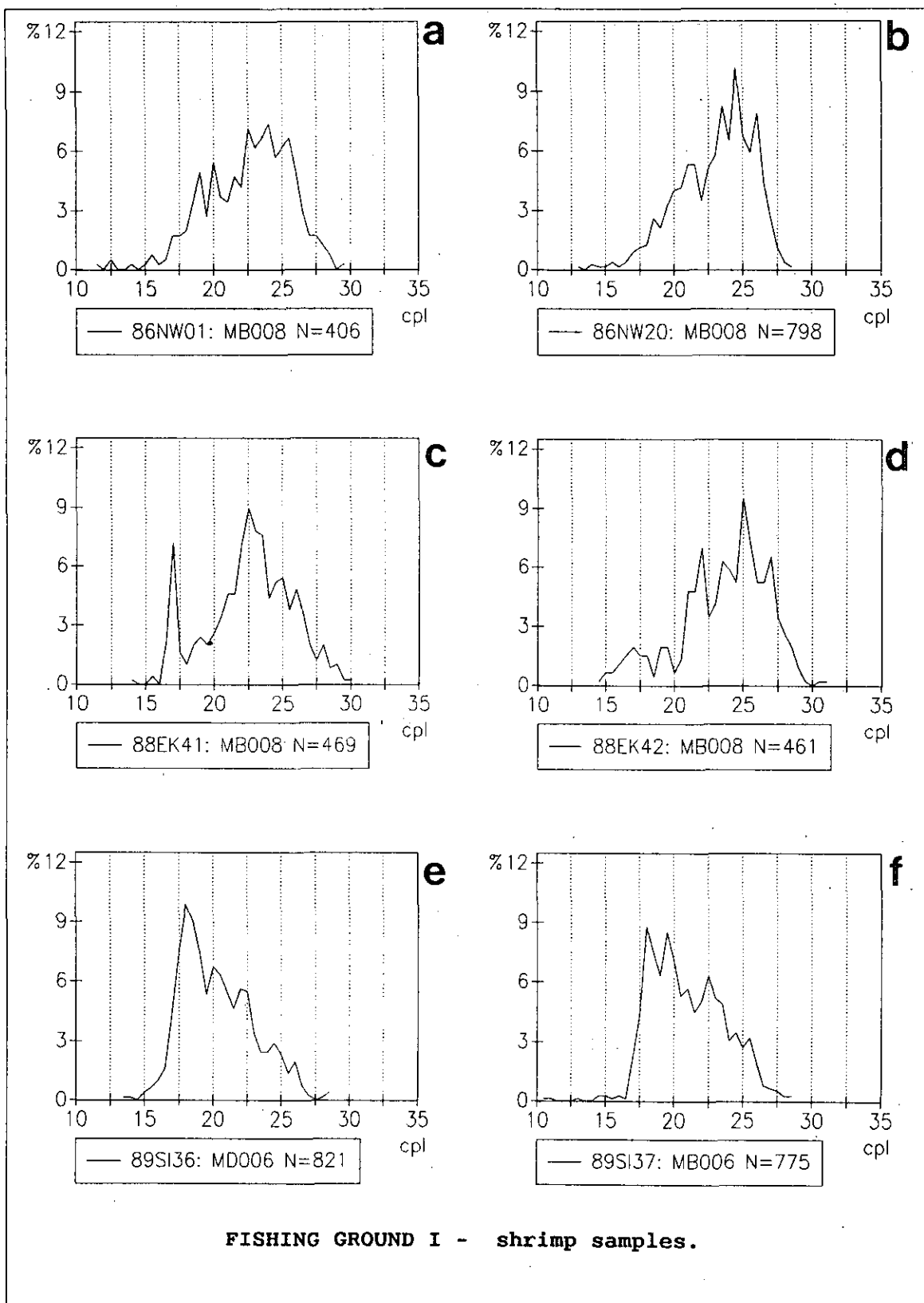
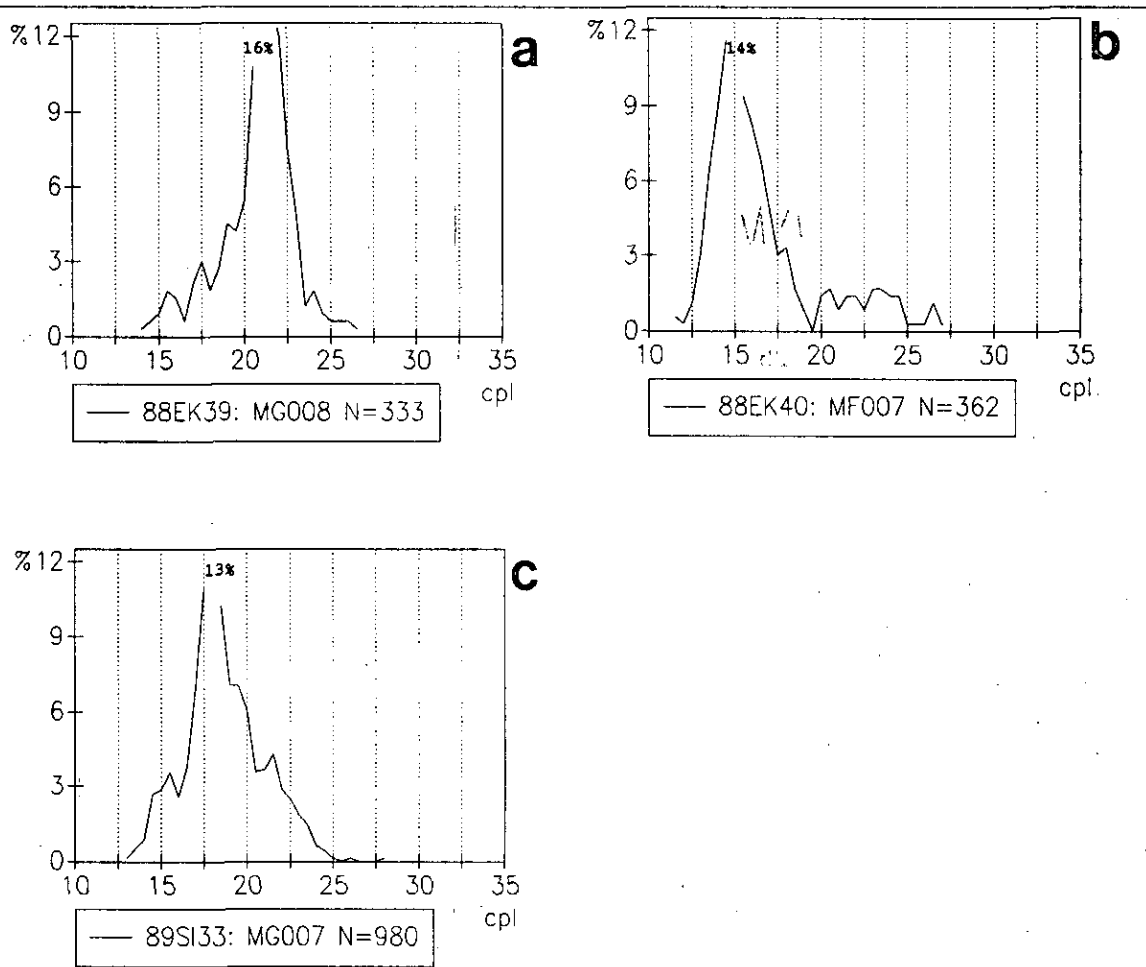


Figure 4.



FISHING GROUND II - shrimp samples.

LEGEND: Applies to all shrimp sample figures

— 86NW17: MM001 N=408

-86NW17 : Year (86) and sample identifier (NW17),

MM001: Statistical square

N: Number of shrimp in sample

%: Frequency of individuals in CPL groups.

cpl: Oblique carapace length.

Figure 5.

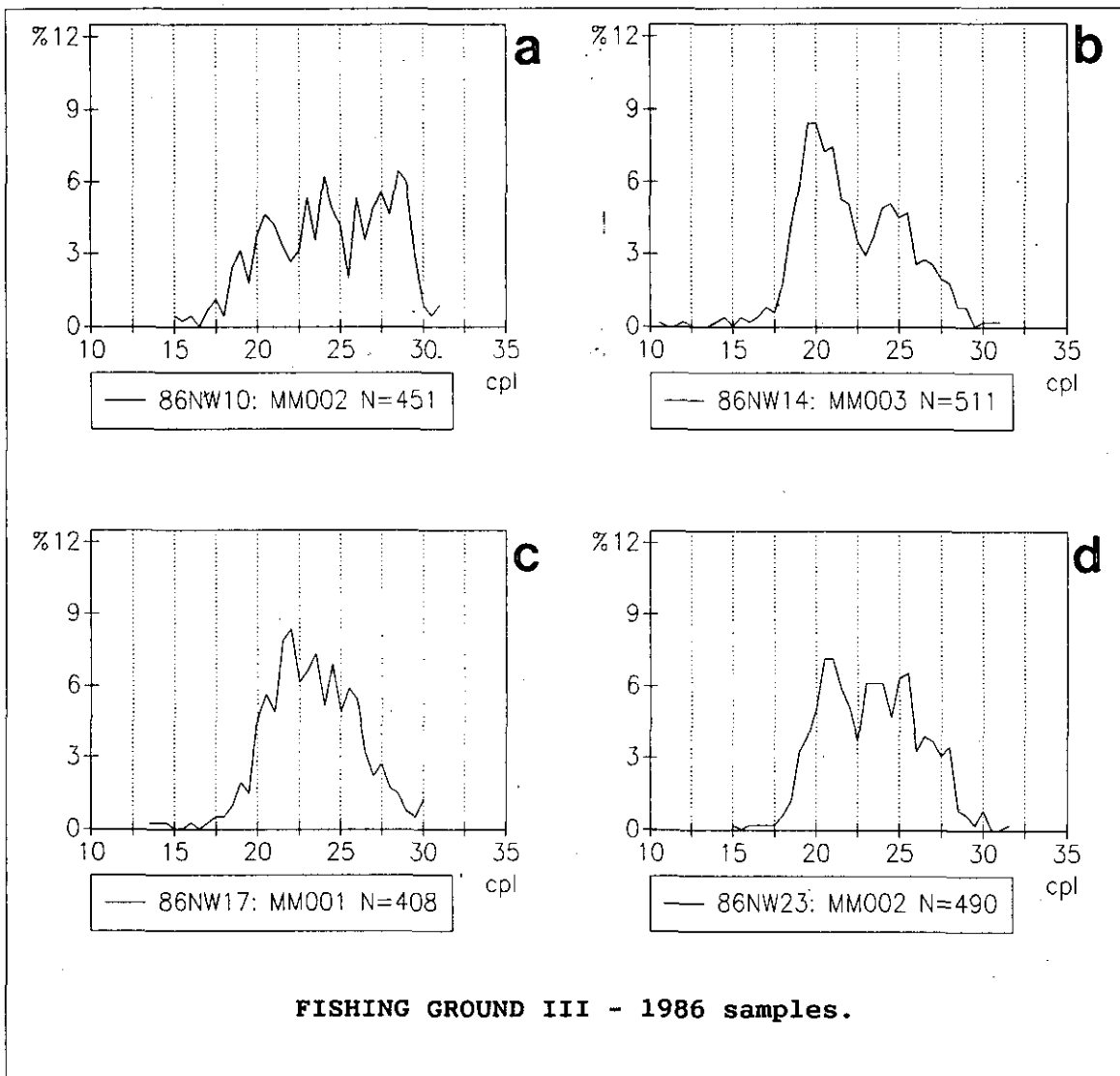


Figure 6.

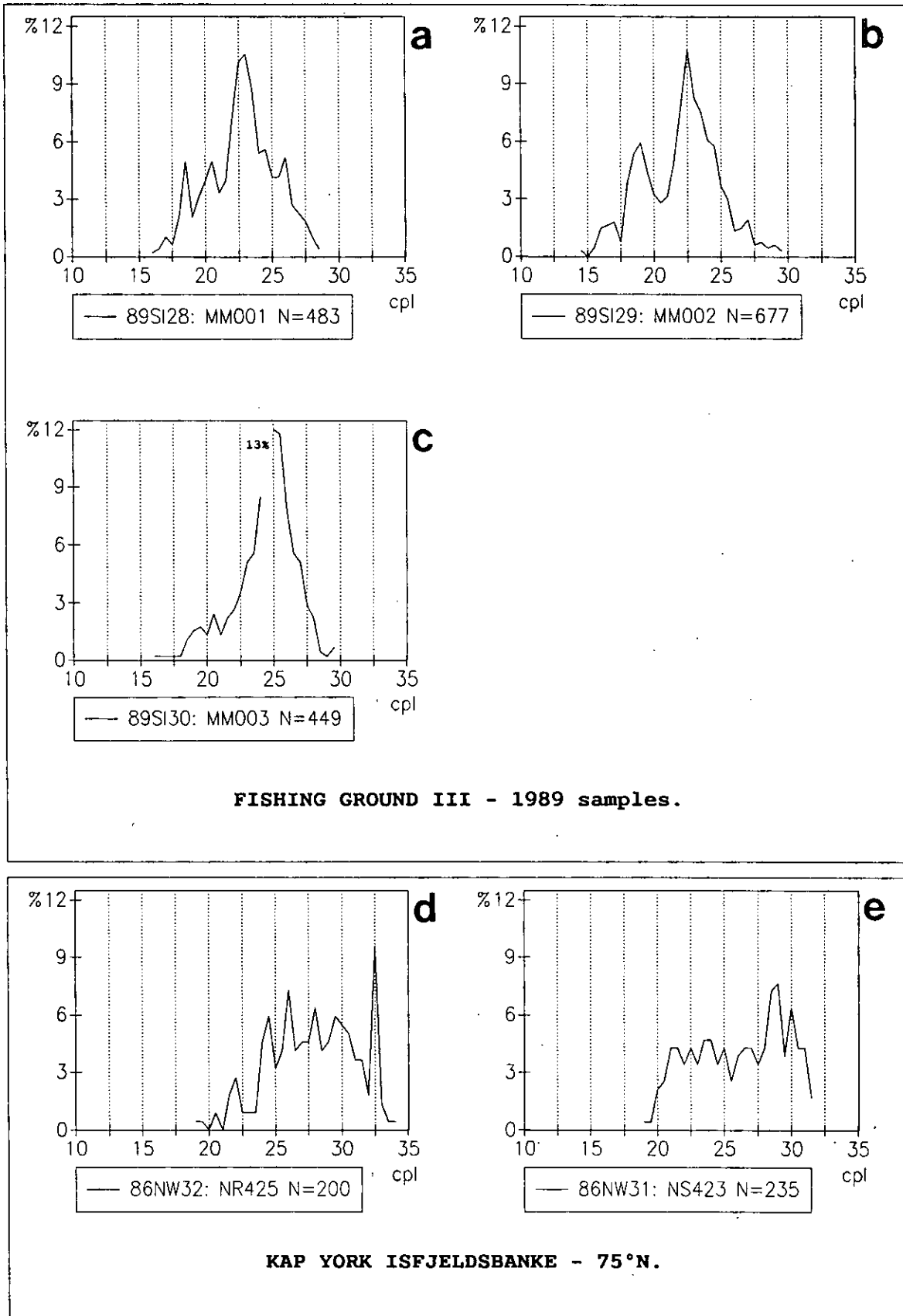


Figure 7.