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Catch, Effort and Biological Characteristics of Shrimp (*Pandalus borealis*)
in the French Fishery off West Greenland, 1980

by

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I - Introduction.

The French fishery for shrimp (*Pandalus borealis*) off West Greenland was again conducted in 1980 by the freezer trawler Finlande III (OTB 2-6) from 16 July to 9 September. As in previous years, the same trawl with 40 mm stretched mesh in the codend was used.

From 16 July to 5 August, the biological characteristics of the shrimp caught were observed and data on effort, yield, discards and by-catches were collected on board the trawler by the first author. For the last part of the trip (7 August to 9 September), the fishing logbooks were provided by the captain and analysed at the laboratory.

II - Material and methods.

1) Collection of biological data.

In order to avoid the bias consecutive to the diurnal variation in the shrimp availability, the biological sampling was made at sea uniformly throughout the day during six periods of 4 hours each.

Two types of samples were collected, one on the total catch, before sorting, and another one on shrimp discarded by the sorting machine. For the first type, 65 samples were collected on 164 hauls, representing a total of 6,825 individuals. For the second type, 21 samples were collected, representing a total of 2,218 individuals.

Each sample, composed of about 100 individuals, was divided according to the sexual stages (immatures and males, transitionals, females) and then for females according to the maturity stages (no roe, head roe, berried, lost or newly hatched roe).

Each of these six groups was then weighted. On each individual, the cephalothorax length (from the hiatus of the eye to the middle of the posterior edge) was measured to the millimeter below, using a calliper-square.

2) Collection of catch and effort data.

The fishing logbooks including information on date, position, depth and time (GMT-2) at start and end, catches of shrimp and other species were analysed for each of the 436 hauls carried out during the trip.

III - Results.

A - Biological characteristics of shrimp.

1. Length composition and sexual stages.

The size distribution of shrimp taken by the trawl, extended from 8 to 32 mm (carapace length), with the bulk ranging from 20 to 27 mm (Fig.1).

The mean length of the individuals in the catch, before sorting was 24.9 mm, and the individual mean weight of 8.8 g (Table 1).

No significant differences were observed in the composition by sexual and maturity stages (Table 2) during the period of sampling (16 July to 5 August). Males represented 23 % of the catch, transitionals 16 % and females 61 %. Most of females (98 %) were mature (head roe) but no spawning was observed. The spawning period probably occurred between mid-August and mid-October, as noted by HORSTED (1978), for shrimp of the offshore grounds at West Greenland.

Likewise, the composition by sexual and maturity stages was not modified along the day (Table 3). However, a slight decrease in the proportion of males and transitionals was noted during the night (0 h 00 to 4 h 00 period), with consecutive increase in the percentage of females head roe. It may indicate a minor tendency of the mature females for vertical migration off the bottom at night.

The percentages in weight and the total removal (in tons), of shrimp caught during the sampling period, were estimated from the mean individual weight (Table 1) and from the proportion (Table 2) of each sexual group :

	Males	Transitionals	Females				Total
			NR	HR	KR	BR	
% Weight	14.4	13.6	1.1	70.8	0.1	0.0	100
Removal (Tons)	17.28	16.32	1.32	84.96	0.12	0.0	120

2. Modal groups and age groups.

The length distribution (Fig.1) reveals four modes. As indicated in Fig.2, the first and second modes are composed of males, the third of transitionals and the last one of females. In addition, a little group of small individuals (non apparent in Fig. 1 and 2) was observed in the samples and corresponds to immature shrimp ranging from 8 to 9 mm Lc.

Characteristics of modes (median and standard deviation) were calculated using the CASSIE's method (1954) to the length distribution by sex.

However, the selectivity ogive estimated by THOMASSEN and ULLTANG (1975) for Pandalus borealis indicates a 50 % retention length close to 20 mm Lc for codends with 40 mm stretched mesh. Accordingly, only the last two modes (transitionals and females) can be defined without bias (Fig.2).

	Immatures	1st group Males	2nd group Males	Transitionals	Females
Median (mm)	8.7	14.1	19.7	22.6	25.8
S.D.	-	1.4	1.7	1.6	1.5
Age group	0	1	2	3	4 ⁺

For the second mode of males (ranging from 15 to 25 mm Lc), we used the mean of medians and standard deviations calculated both, in the frequency distribution of total catch (Fig.2) which gives overestimated values, and in the frequency distribution of discards (Fig.3) which provides underestimated values.

For the first mode of males (ranging from 10 to 18 mm Lc), we only use the discard distribution (Fig.3) where this mode is well represented.

For the immature group (8 and 9 mm Lc), the number sampled is not sufficient to obtain accurate values. We can suppose that the median (8.7 mm) is overestimated, due to the size of the mesh of the gear, inadequate to catch smallest individuals.

Referring to the life-cycle of Pandalus borealis described by HORSTED (1978) for the grounds off West Greenland, the immature group should result from the spawning occurred in autumn 1979 and hatched in spring 1980 and so representing the group 0. Then, the two modes of males are respectively the groups 1 and 2; the transitionals, the group 3 and the last mode represents an accumulation of several year-classes of females (mainly groups 4 and 5).

B - Observations on catch, effort and CPUE.

1) Catches.

During this trip of Finlande III in the Davis Strait, from 16 July to 9 September, 248 metric tons of shrimp were caught : 78 tons in July, 132 tons in August and 38 tons in September (Table 4).

The fishing grounds were again this year located from 67°15 N to 68°00 N on the Northwestern part of the Store Hellefiske Bank, on both sides of the midline between Subareas 0 and 1.

On the 436 hauls carried out during this trip, most of them (270) were made at depth ranging from 250 to 300 meters, other catches being mainly obtained in deeper waters between 300 and 400 meters.

2) Discards.

After each tow, the catches of shrimp were sorted. Two types of sorting are to be distinguished.

The first one was operated by an automatic sorting machine which systematically discarded small individuals between 8 and 16 millimeters Lc but also a part of those ranging from 16 to 26 millimeters Lc (Fig.1). An estimate obtained from sampling on 21 hauls, provides a discard of 5.6 % of the weight of the total catch of shrimp.

In addition to this sorting based on the size of shrimp, another one was operated by hand on individuals with soft and/or damaged shell. The quantity discarded by this second sorting was estimated at 2.4 % of the total weight caught.

So, the total discard of shrimp during this trip was calculated to be at a level of 8 % of the total catches, which is approximatively the same observed in the Norwegian commercial fishery at West Greenland (ULLTANG and ØYNES, 1978).

3) By-catches.

No significant by-catches of fish were recorded during the trip of Finlande III. However, from mid-August to the beginning of September, catches of small redfish occurred, representing a total of about 26 tons i.e. 11 % of the catches of shrimp.

4) Fishing effort.

Efforts calculated in adding all tow durations give a value of 976 hours fished during the trip, with 273 hours in July, 541 hours in August and 162 hours in September (Table 4).

The monthly distributions of the French fishing effort (in hours) are reported in Fig. 4, 5 and 6, using the rectangular units (7,5' latitude x 15' longitude) proposed by the Danish scientists. These figures indicate that, again this year, the effort was concentrated in a rather small area of the offshore grounds with a westwards shift from July to September.

5) Catch-per-unit-effort.

Data on CPUE of shrimp (kg/hour) by month are indicated in Table 4. The resulting figures were calculated from all reported catches including nil ones and without adjustments in relation to the fishing time (night or different periods of the day).

Results indicate a slight monthly decrease in CPUE from July (285 kg/h) to August (243 kg/h) and to September (237 kg/h). However, these values as well as the average one for the whole trip (254 kg/h) are significantly higher than those obtained last year at the same period during the first trip of Finlande III (MINET, 1979).

The monthly distributions of the French CPUE (kg/hour) are reported in Fig. 7, 8 and 9, using again the rectangular unit areas. These figures show that the best catch-rates were obtained mainly in August just below the 68° N parallel.

6) Diurnal variation of CPUE.

In addition to the seasonal variation of the CPUE observed again this year, a diurnal variation in the commercial catch-rates was noted. In order to illustrate this variation, the totality of the 436 CPUE were grouped according to the time periods when the hauls took place (Fig. 10).

In spite of the large variability in the catch-rates, this figure shows clearly that the minimum CPUE are obtained during the night period (111 kg/hour), the maximum being observed in the middle of the daylight period (317 and 313 kg/hour from 08:00 to 16:00 GMT-2).

These observations lead to establish conversion factors to the catches as follows :

Time Periods (GMT-2)	00:00 04:00	04:00 08:00	08:00 12:00	12:00 16:00	16:00 20:00	20:00 24:00
Conversion Factors	2.86	1.20	1.00	1.01	1.07	1.53

The diurnal variations observed in 1980 in the French fishery are in the same order of magnitude than those noted in the same area by SMIDT (1978) in 1976 (1.88 in July, 2.80 in August and 3.28 in September).

IV - Conclusions.

From the biological data collected on shrimp in the French fishery on the offshore grounds of West Greenland in 1980, it appears that the demographic structure of the exploited stock is very similar to that of previous years. The same age groups are present in constant proportion and strength indicating that the status of this stock is relatively stable. Also, from data on maturity stages of females, it appears that most of them were ripe (98 % head roe) and ready to spawn indicating a possible good recruitment in the stock next year.

From data on the French commercial fishery, it appears, as in previous years, a seasonal decrease in catch-rates during the same fishing period (July to September). However, the catch-rates obtained this year are significantly higher (20 %) than those observed in 1979.

References

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- HORSTED, Sv.Aa. 1978.- The Life Cycle of Shrimp, Pandalus borealis Kr., in Greenland Waters in Relation to the Potential Yield. ICNAF Sel. Pap., 4 : 51-60.
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THOMASSEN, T., and Ø. ULLTANG MS 1975.- Report from mesh selection experiments on Pandalus borealis in Norwegian waters. ICES C.M. 1975, Doc. No. K : 51.

ULLTANG, Ø., and P. ØYNES 1978.- Norwegian Investigations on the Deep Sea Shrimp, Pandalus borealis, in West Greenland Waters. ICNAF Sel. Pap., 4 : 35-42.

Table 1.- Mean length and weight of the different sexual stages of Pandalus borealis in the non-sorted catches of Finlande III off West Greenland (16 July-5 August 1980).

For females : NR = no roe ; HR = head roe ; BR = berried ; KR = lost or newly hatched roe.

	Males	Transitionals	Females				Total
			NR	HR	BR	KR	
\bar{L}_c (mm)	20.9	23.6	26.4	26.8	-	27.5	24.9
S.D.	2.7	1.2	1.9	1.3	-	2.0	3.0
\bar{W} (g)	5.4	7.5	9.0	10.6	-	11.2	8.8

Table 2.- Percentages in number of each sexual stage of shrimp, during four weeks of observation, in the non-sorted catches of Finlande III off West Greenland in 1980.

For legend of Females, see Table 1.

Weeks	Number examined	Males	Transitionals	Females			
				NR	HR	BR	KR
14-20 July	1726	19.2	17.0	1.2	62.3	0	0.2
21-27 July	2283	26.1	15.6	1.0	57.2	0	0.1
28 July-3 August	2196	25.5	16.4	0.8	57.3	0	0
4-10 August	620	16.1	13.5	2.3	68.1	0	0
TOTAL	6825	23.3	16.0	1.1	59.5	0	0.1

Table 3.- Percentages in number of each sexual stage of shrimp in relation to the period of the day (GMT-2) in the non-sorted catches of Finlande III off West Greenland in 1980.

For legend of Females, see Table 1.

Time periods	Number examined	Males	Transitionals	Females			
				NR	HR	BR	KR
00:00 - 04:00	1150	18.5	13.2	1.0	67.0	0	0.3
04:00 - 08:00	1053	24.8	16.6	1.3	57.2	0	0.1
08:00 - 12:00	1160	24.8	15.3	0.9	59.1	0	0
12:00 - 16:00	1059	25.5	16.0	0.9	57.6	0	0
16:00 - 20:00	1038	20.7	17.1	1.3	60.8	0	0.1
20:00 - 24:00	1365	25.0	17.9	1.2	55.9	0	0
TOTAL	6825	23.3	16.0	1.1	59.5	0	0.1

Table 4.- Catch and effort data by month for the trip of Finlande III at West Greenland in 1980.

Fishing Periods	Catch (kg)	Effort (h)	CPUE (kg/h)
15-31 July	77,818	273	285
1-31 August	131,556	541	243
1-9 September	38,455	162	237
TOTAL	247,829	976	254

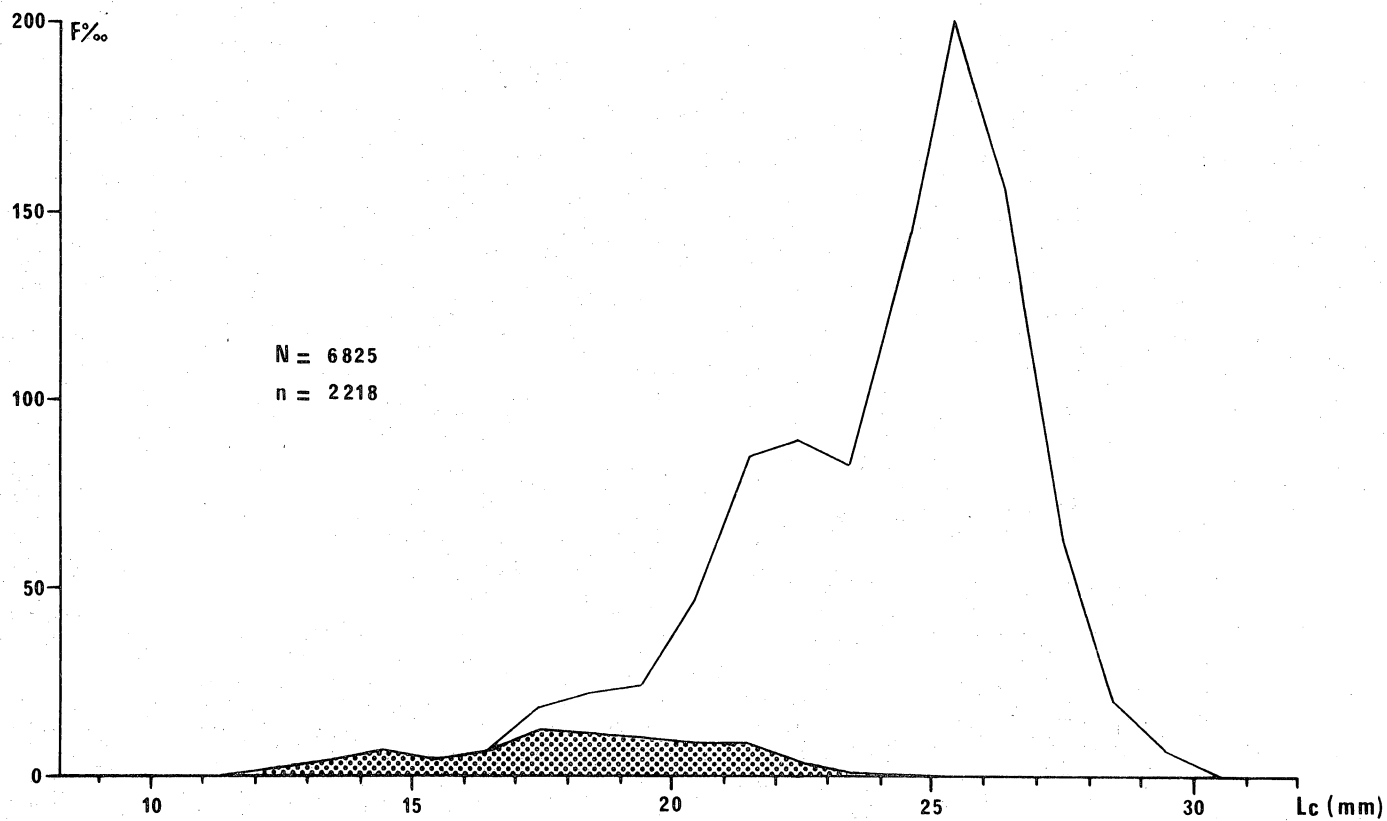


Fig.1 - Length distribution of shrimp caught by Finlande III at West Greenland (16 July-5 August 1980) and discarded by the sorting machine (dotted area).

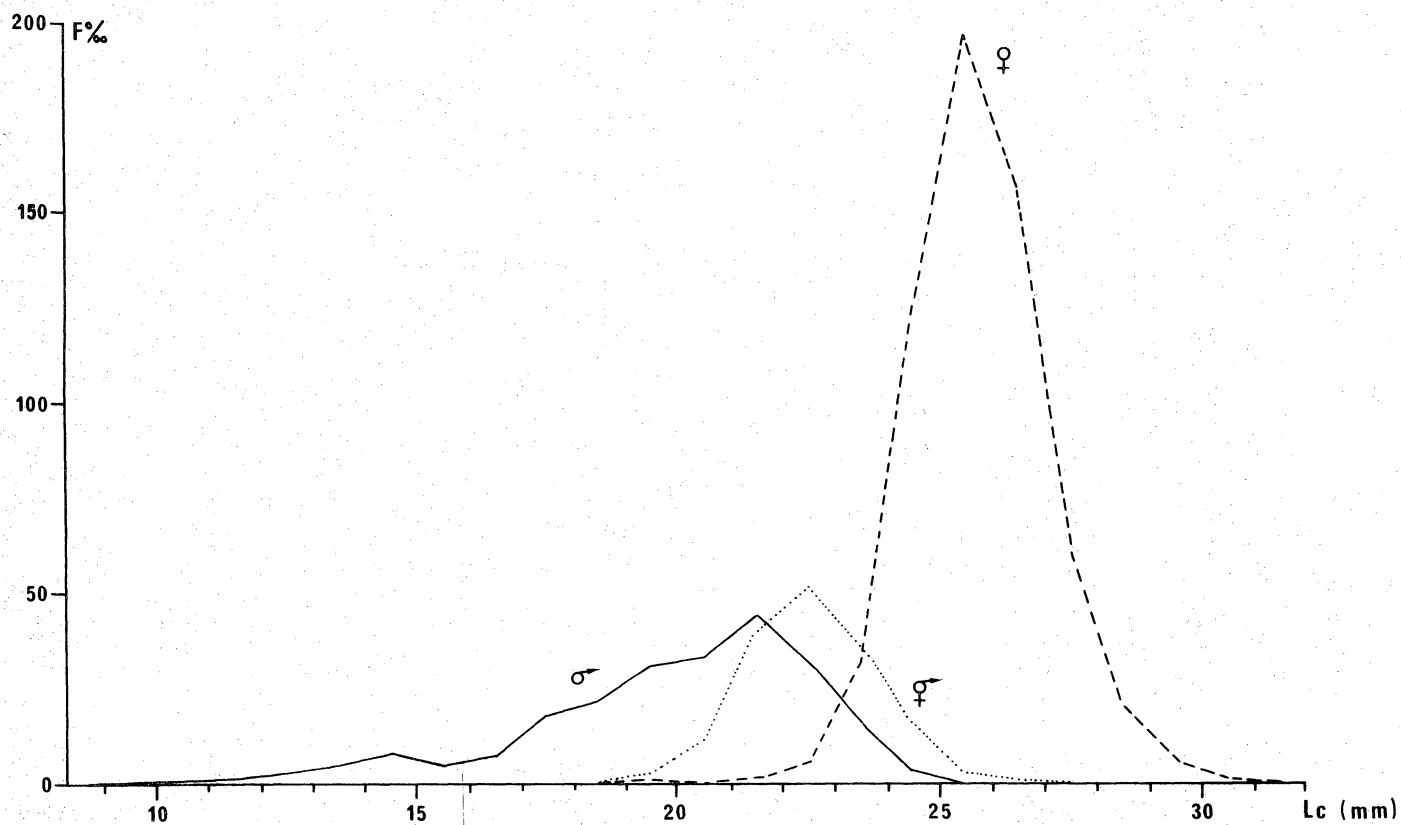


Fig.2 - Length distribution of male, transitional and female shrimp in the catches of Finlande III at West Greenland (16 July-5 August 1980).

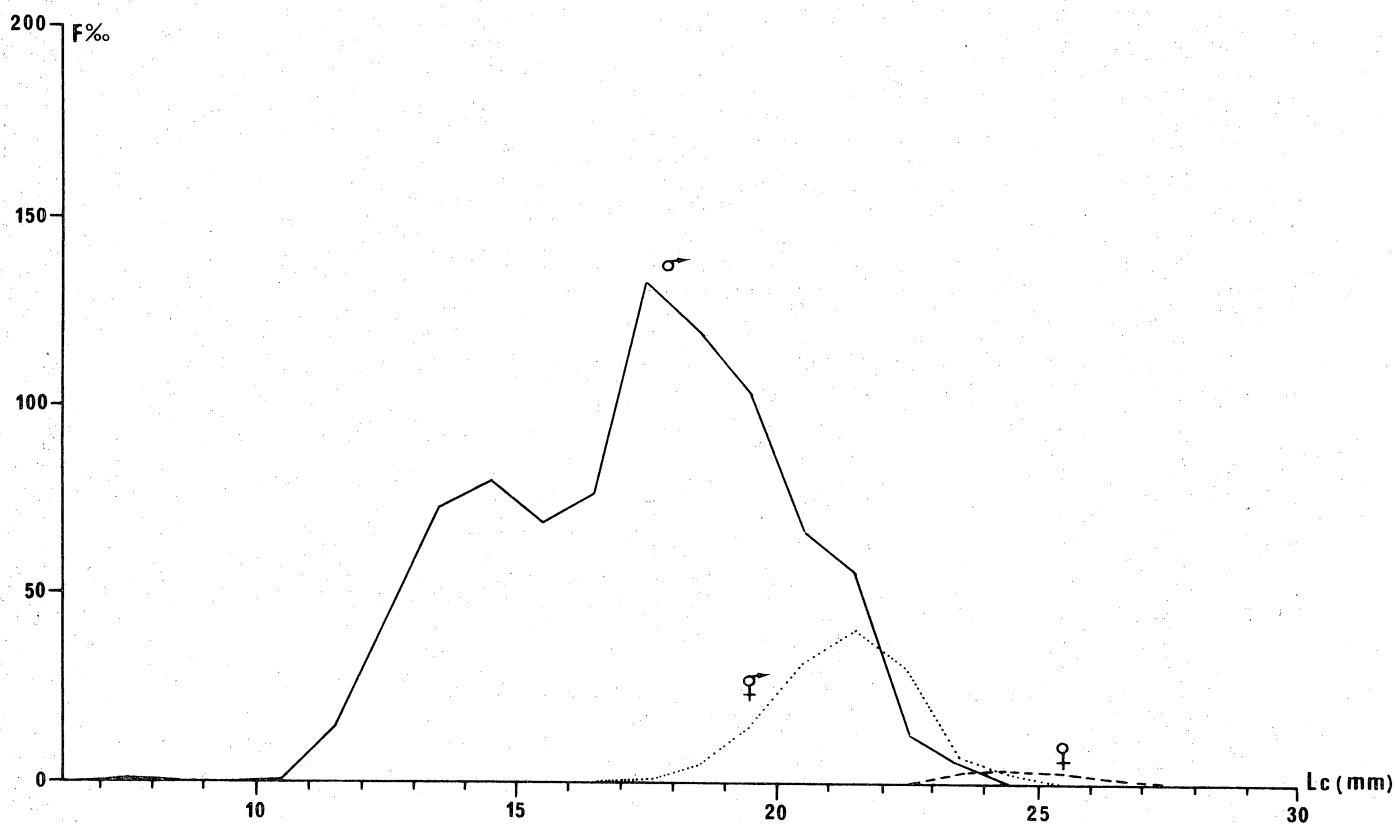


Fig.3 - Length distribution of shrimp discarded by the sorting machine from the catches of Finlande III at West Greenland (16 July-5 August 1980).

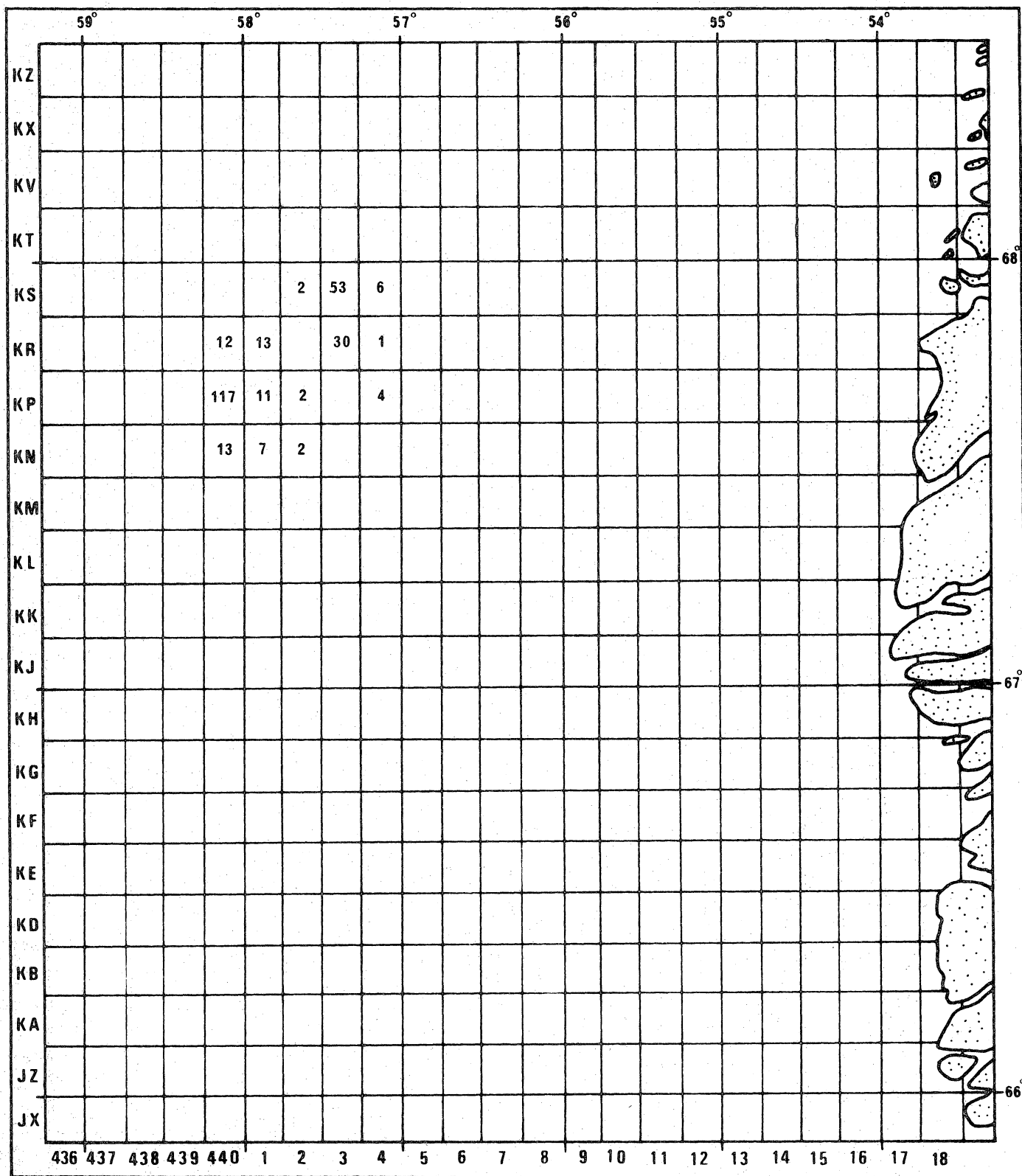


Fig.4 - Distribution of the fishing effort (hours) of Finlande III
at West Greenland, in July 1980.

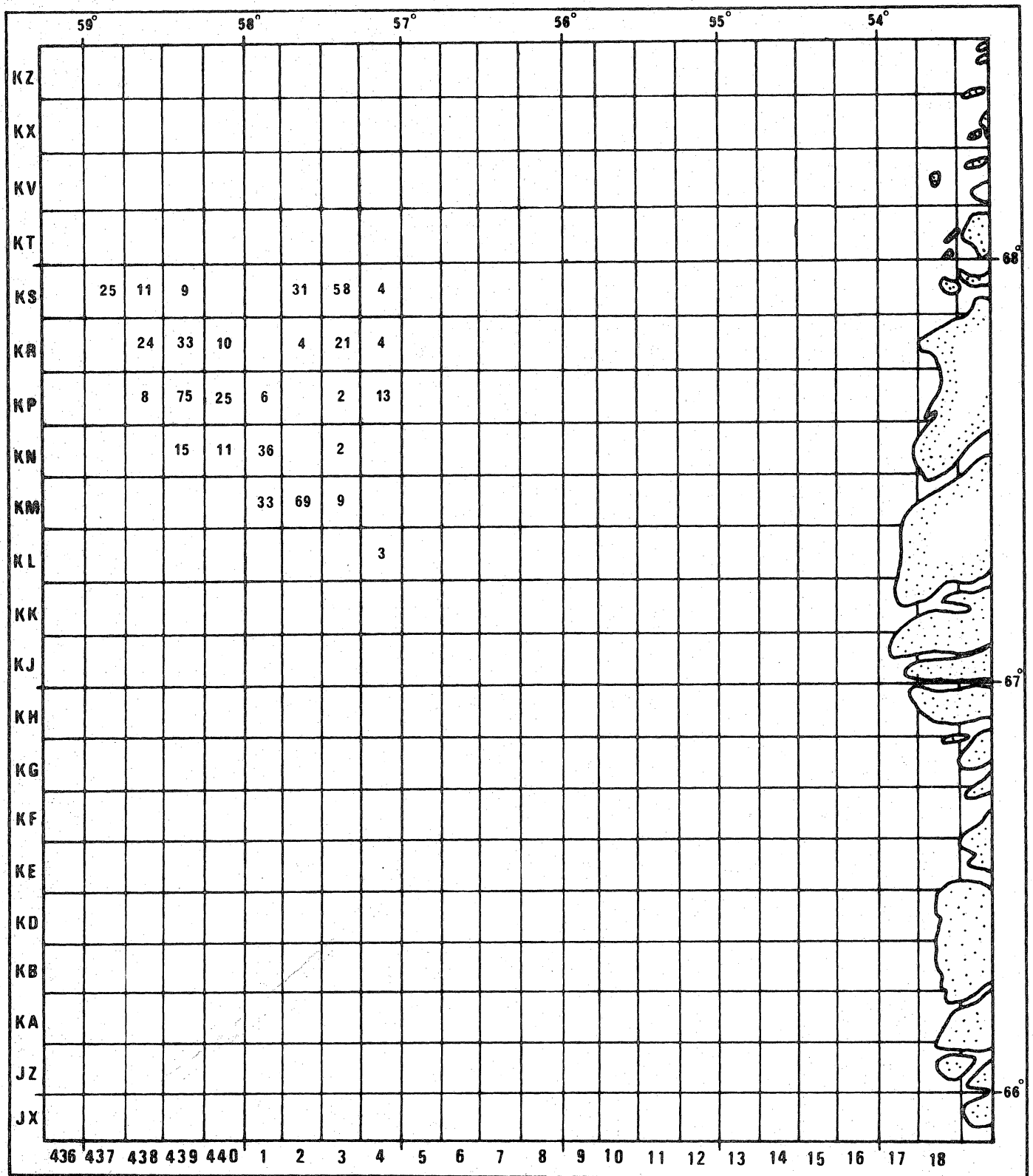


Fig.5 - Distribution of the fishing effort (hours) of Finlande III at West Greenland, in August 1980.

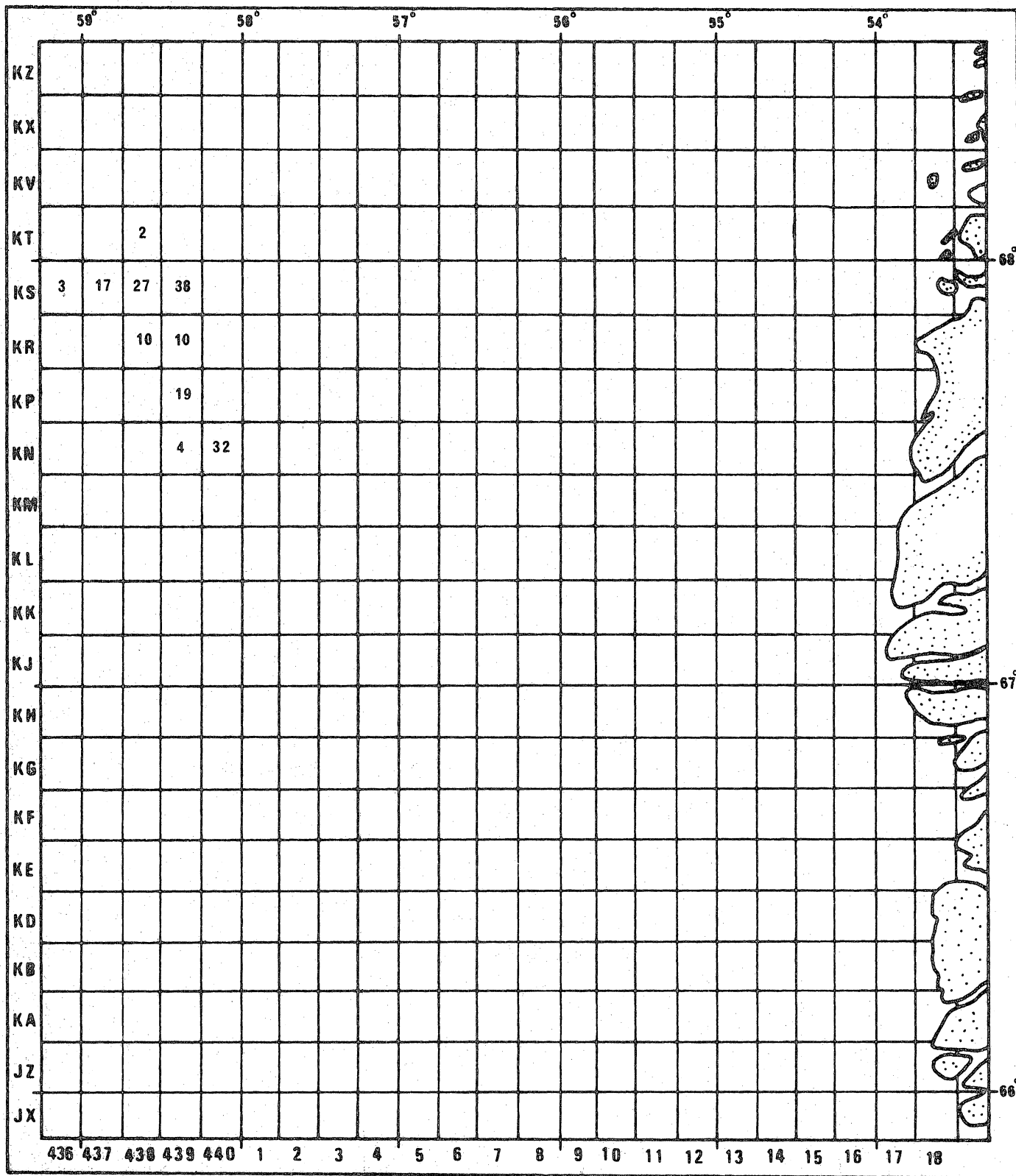


Fig.6 - Distribution of the fishing effort (hours) of Finlande III
at West Greenland, in September 1980.

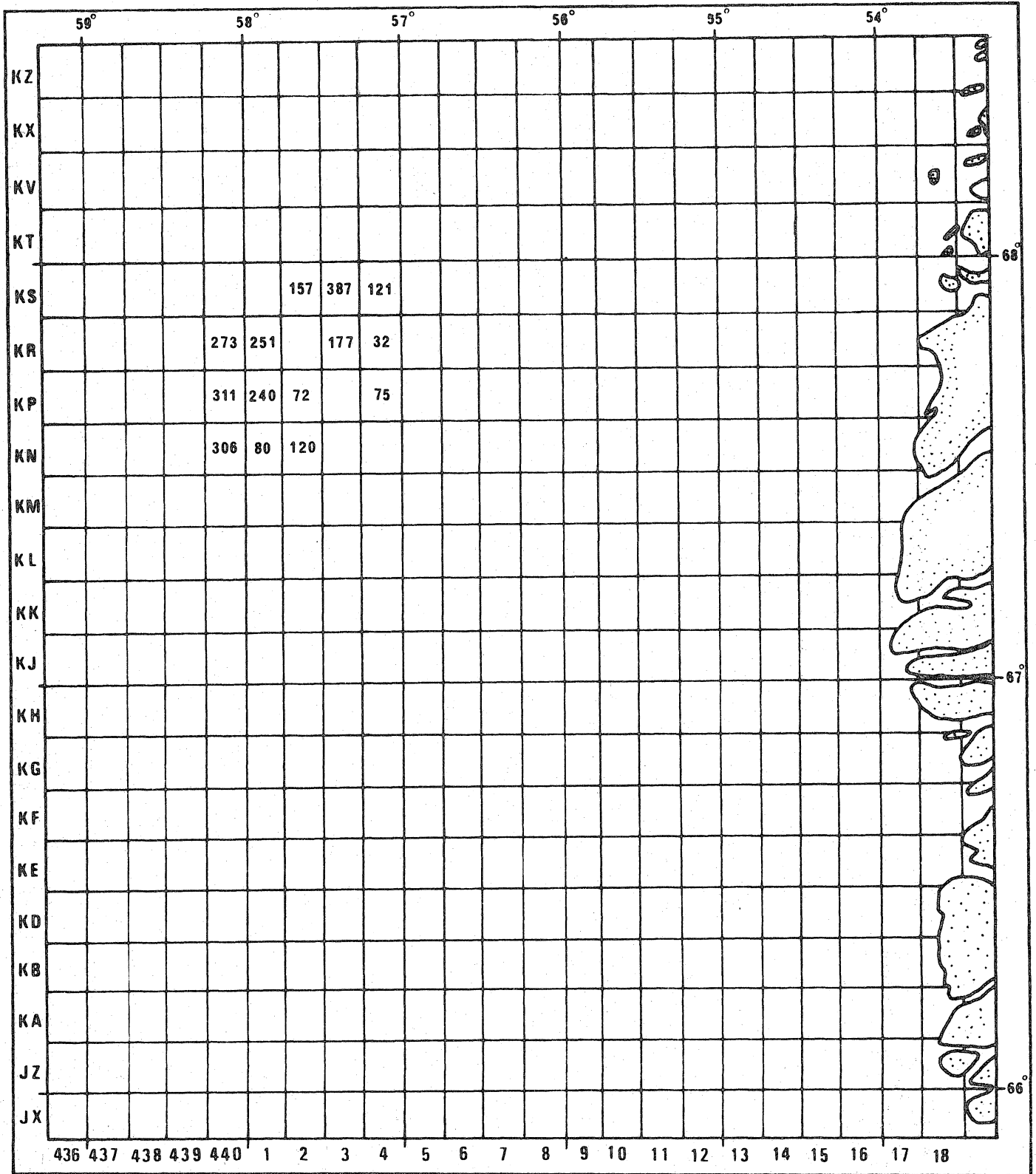
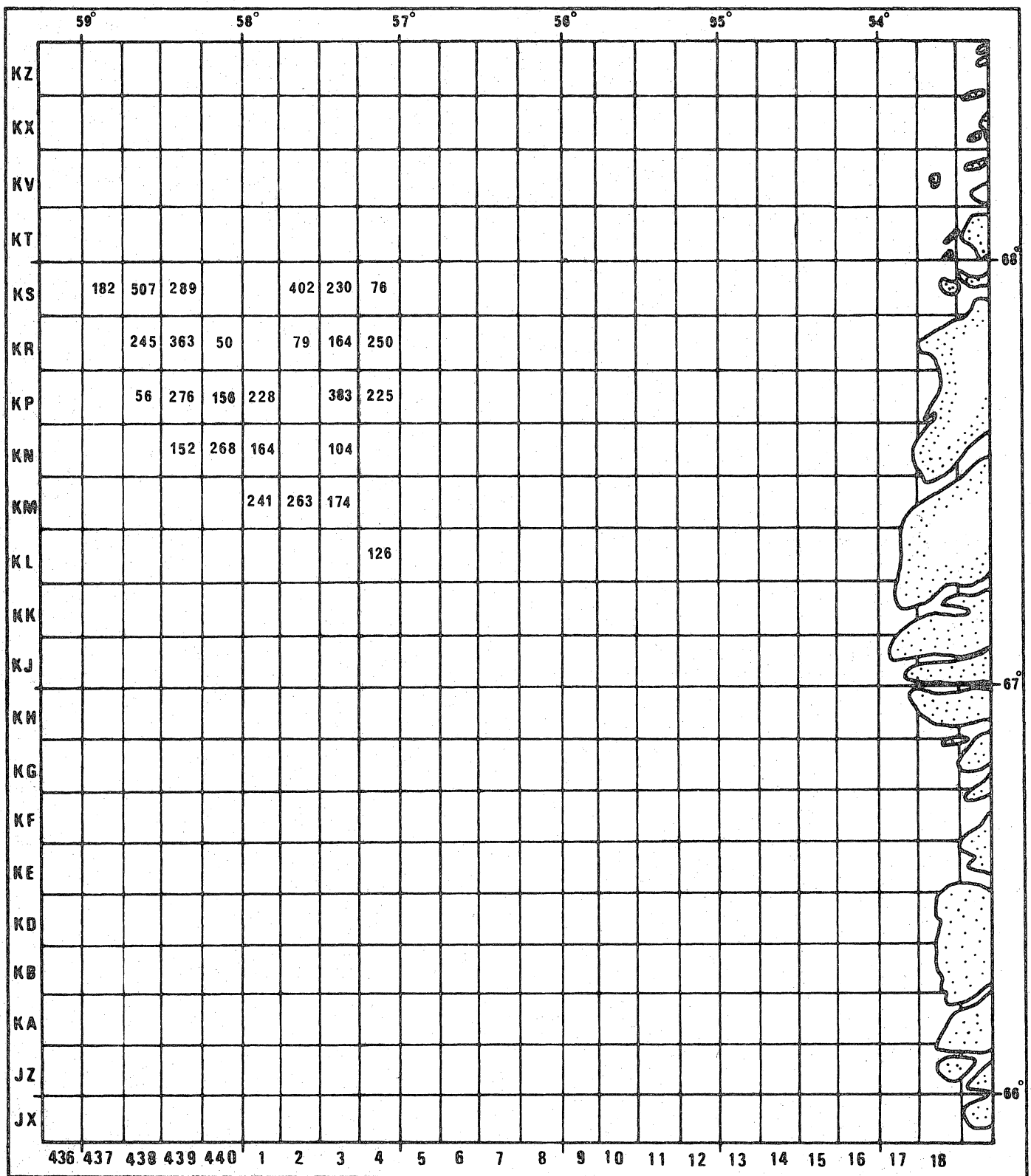


Fig.7 - Distribution of the CPUE (Kg/hour) of Pinlande III at West Greenland, in July 1980.



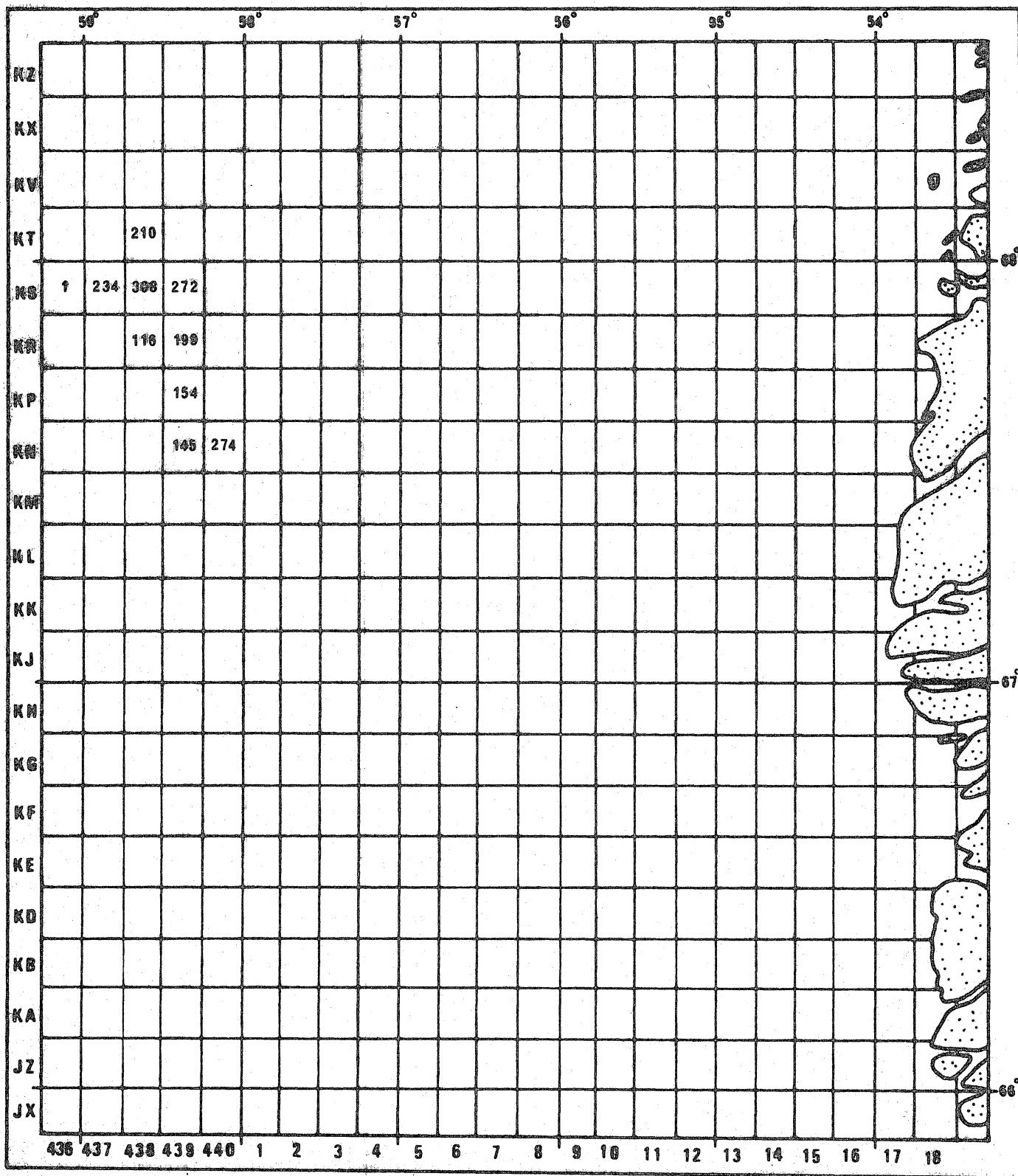


Fig.9 - Distribution of the CPUE (kg/hour) of Finlande III at West Greenland, in September 1980.

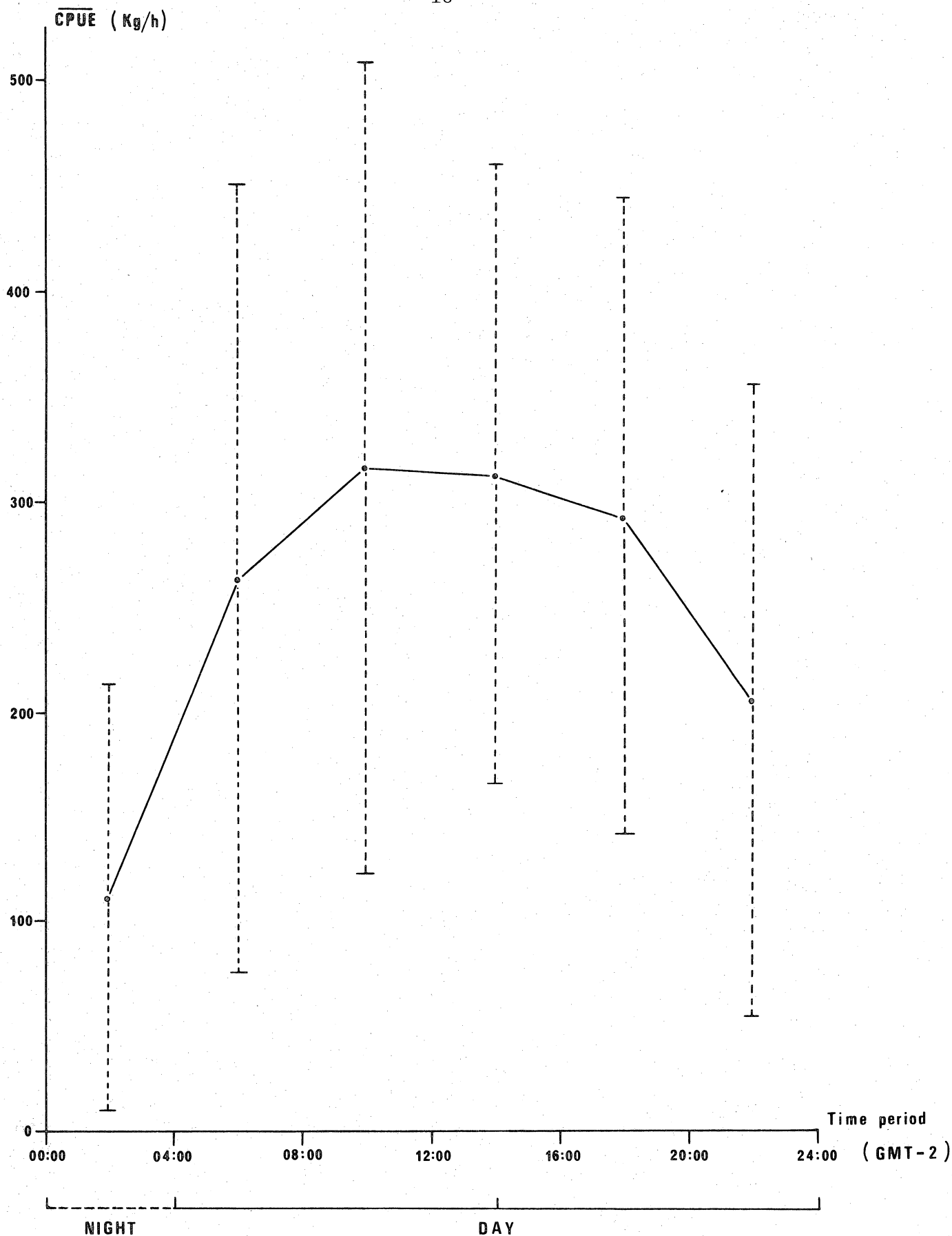


Fig.10- Diurnal variation of shrimp catch-rates (kg/h) of Finlande III at West Greenland (16 July-9 September 1980).

Each dot represents the mean for each time period and standard deviations are indicated by vertical lines.