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The Shrimp Fishery in NAFO Subarea 1 in 1988

by

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#### INTRODUCTION

The scientific advice for the offshore catch of shrimp in NAFO Subareas 0 and 1 (not including Subarea 1 north of 71°N) was 36,000 tons for 1987, and due to lack of information that might change the advised level, the same advice was given for 1988. The effective TAC for offshore Subarea 1 in the area considered by STACFIS was for 1988 set by the Greenland Home Rule Authorities at 34,000 tons, including a Greenland allocation of 32,225 tons. Trawlers above 80 GRT reported a total catch in the Subarea of 40,643 tons, including 6,660 tons taken north of the area considered by STACFIS. Catches of smaller vessels including inshore catches are estimated to about 18,500 tons.

Until 1986 in general only logbooks from the fishery of nine trawlers owned by the Greenland Home Rule Administration were available to the Greenland Fisheries Research Institute (GF). From 1986 compulsory logbooks have been introduced for all vessels above 50 GRT. For 1988 logbooks available to GF cover about 114,000 hours of trawling and a total catch of more than 41,000 tons of shrimp.

Although the data base has not yet been fully adjusted for errors, it has been used to introduce attempts to standardize effort in catch rate calculations. The present paper also updates earlier information on the geographical distribution, catch rates and by-catches in the offshore Subarea 1 shrimp fishery. Also, results from an analysis of samples from the commercial shrimp fishery is presented.

#### MATERIAL AND METHODS

Based on the compulsory weekly reportings to Greenland authorities by all vessels above 80 GRT total catches and numbers of vessels in the shrimp fishery in NAFO Subarea 1 in 1988 were compiled by nation and month.

Logbook data were analysed to show the yearly and monthly distribution of fishing effort and mean catch-rates. Mean catch rate indices for seven trawlers owned by the Greenland Trawler Company (GTC) for the July-September period have been used since 1976 to reflect the state of the shrimp stock in Div 1B.

During the later years a large fleet of vessels of different sizes have been introduced to this fishery. As available logbook data now cover a greater part of the total fishery, a new way of estimating mean catch rate indices seems reasonable.

By using information on the geographical distribution of the fishery by the different vessels together with catches and hours fished in each trawl operation an analysis has been carried out to produce a mean standardized effort for each year comparable to the mean effort figures earlier given for the GTC-trawlers.

A linear regression model was applied to the data as follows:

$$\ln(\text{CATCH PER HOUR}) = I + a \times \text{VESSEL} + b \times \text{YEAR} + c \times \text{VESSEL} \times \text{YEAR}$$

For a comparison between the CPUE-indices used by STACFIS for the period 1976-88 (July-September weighted means), the above model was applied to the same material including the seven trawlers owned by GTC.

Due to the short range of years for which the logbook database from the private vessels is useful, the interaction between vessel and year in the above formula has been removed in runs including these vessels. Also, these calculations only include vessels with high activity in the area of interest (Div. 1B). In total 35 vessels were included in the analysis for the period 1985-88.

A series of shrimp samples from the commercial shrimp fishery in Division 1B was sorted by stages of sexual development, and shrimps were measured to nearest 0.1 mm carapace length. Length-frequencies were analysed to evaluate the occurrence of sexual stages.

## RESULTS AND DISCUSSION

### Reported catches in 1987.

Table 1 shows catches by division, nation and month in offshore Subarea 1 in 1988 as reported by vessels above 80 GRT, and Table 2 shows the corresponding numbers of reporting vessels. The figures for Greenland include catches in the offshore fishery north of 71°N, and although these catches have declined compared to 1986 and 1987 (Lund, 1989), they still constitute a substantial part of the total shrimp fishery by Greenland vessels in Subarea 1 in August, September and October.

The shrimp landings from Subarea 1 in 1988 by smaller Greenland vessels (below 80 GRT) are about 18,500 tons (preliminary figure), of which about 7,500 tons are estimated to be inshore catches.

The preliminary total nominal shrimp catch in Subarea 1 was about 60,000 tons in 1987, which is about the same as in 1986 and 1987.

### Geographical distribution of the offshore fishery.

Figure 1 shows the distribution of fishing effort (in numbers of hours trawled) in 1988 as recorded in the logbook data base (the map does not include the fishing grounds north of 72°N - see Lund, 1989). As in earlier years the fishery concentrated in the Holsteinsborg Deep, on the northern and western slopes of the Store Hellefiske Bank and in the southernmost grounds in the Northwest Greenland area.

Figure 2 shows the distribution of total catches over the year and elucidates the importance of certain areas to the fishery.

Figure 3 shows the monthly distribution of mean catch-rates and effort (numbers of hours trawled) from January 1988 through December 1988. As has been the case in several years (1983, 84 and 87) ice hampered the access to the fishing grounds west and north of the Store Hellefiske Bank area in the beginning of the year (from February to April).

Trends in catch rates.

Figure 4 shows the variation in mean catch rates by month from January, 1981 through December 1988 in NAFO Division 1B based on logbook information of seven state-owned trawlers (721-1000 GRT) - Table 3 shows the corresponding numbers of hours trawled. A spring peak in catch rate found in May 1988 is followed by the typical decline throughout the year as has been the case in most years since the fishery started. As mentioned the spring fishery was hampered by ice, but the catch rates may as in 1986 reflect that there was access to spring concentrations of berried females.

Table 4 shows the mean catch rates based on logbook recordings by division and month in a north to south 7.5' latitude grid in 1988, and Table 5 shows the corresponding numbers of hours trawled. Similar to previous years there is a northward shift in the fishery throughout the first half of the year.

Comparison of catch rates between years in the Davis Strait fishery has been based on mean catch rate indices of the state-owned trawlers (using the 1976 mean catch rate as reference point) for the period July-September in Division 1B. CPUE indices for seven Greenland trawlers (721-1000 GRT) from 1976 to 1988 are shown in Figure 5, based on the following figures:

	1976	1977	1978	1979	1980	1981
Hours						
trawled	1,005	2,966	3,446	3,588	1,872	5,285
kg/hour	743	549	501	379	468	438
Index	1.00	0.74	0.67	0.51	0.63	0.59

	1982	1983	1984	1985	1986	1987	1988
Hours							
trawled	3,543	3,967	2,784	3,817	2,967	3,644	4,979
kg/hour	550	490	495	563	620	777	561
Index	0.74	0.66	0.67	0.76	0.84	1.05	0.76

As mentioned by Carlsson and Kannevorff (1987) CPUE indices since 1980 may not be directly comparable to those from earlier years due to the introduction of more efficient gears around 1980 and in the following years.

The attempt to standardize the catch-rates of the state-owned trawlers by a log-normal model did not have any effect on the trend in the catch-rate index. The results of the analyses, i.e. mean weighted catch rates, are shown in Fig. 5. The trends in the catch rates follow very clearly the traditionally calculated catch rates, but the figures should be treated very cautiously, this analysis being only preliminary. A more complete analysis including a.o. vessel size and trawltype used would possibly produce indices with much higher precision.

Introducing 35 vessels in a similar analysis for the years 1985 to 1988 resulted in index-values 1.02, 1.04, 1.05, and 0.79 (using the same index-value in both analysis in 1987). These indices do not show the same increase from 1985 to 1987 as found for the GTC-trawlers, but all data show a significant decrease in mean catch-rate from 1987 to 1988.

### By-catches in the shrimp fishery.

Table 6 shows by-catches as reported in the logbook data in 1988 compared to earlier years. The reported by-catch level in 1988 in relation to the corresponding shrimp catch is similar to 1987. As before redfish is the most dominant species except in Division 1A, where polar cod and Greenland halibut dominate.

Due to the condition during the handling of the shrimp catches it is not possible for skippers to estimate the amount of by-catch properly, thus by-catches are known to be underreported (Pedersen and Lehmann, 1989).

### Biological samples.

Length-frequencies of shrimp samples from the Greenland commercial fishery in Division 1B are shown in Fig. 6-19. All samples are from the main fishing area north of Store Hellefiske Bank, from May (Fig. 6-9), July (Fig. 10-16) and November (Fig. 17-19). All samples show a fair amount of smaller shrimp (males and juveniles), occurring in a number of size-groups. Larger shrimp (primiparous and multiparous females) are scarce in May and July, but more numerous in November.

### Conclusions

The nominal offshore catch of shrimp in NAFO Subarea 1 is estimated to be about 51,500 tons in 1988, at the same level as in 1986 and 1987. The figure includes about 6,660 tons taken in the Northwest Greenland area. Inshore catches are estimated to be around 7,500 tons.

As in 1987 ice hampered the access to the main fishing grounds early in the year, but catch-rates indicate access to concentrations of berried females from the beginning of the year. The northward shift in the fishery as seen in earlier years occurred again in 1988.

Mean catch rates of Greenland trawlers in Division 1B in the July-September period declined from 1987 to 1988, the 1988-figure being at the same level as in 1985. An attempt to standardize the effort resulted in similar trends in cpue-figures. Standardized data from a larger number of selected vessels in the years from 1985 to 1988 did not show the increase found in the GTC-data from 1985 to 1987, but did reflect the decrease from 1987 to 1988. These data however included fishery in all Divisions in Subarea 1, and variances in the model are still very high.

Reported by-catches showed a low level as in 1987, but are not considered to be realistic.

Biological samples from the commercial fishery in Division 1B in April, July and November showed occurrence of several size-groups of males and juveniles. Females were scarce in April and July-samples but more frequent in November.

### References

- Carlsson, D.M., Kanneworff, P., 1987. The shrimp fishery in NAFO Subarea 1 in 1985 and 1986. NAFO SCR Doc. 87/08, Ser.No. N1276.
- Lund, H., 1989. Greenland fishery for shrimp (Pandalus borealis Kr.) in NAFO Division 1A, (Greenland management areas NV1 and NV2) in 1988. NAFO SCR Doc. 89/38. Ser.No. N1615.
- Pedersen, S.A., Lehmann, K., 1989. By-catch of redfish and Greenland halibut in the shrimp fishery off West Greenland, 1988. NAFO SCR Doc. 89/41. Ser.No. N1618.

Table 1. Offshore catches of shrimp (tons) by division, nation and month in NAFO Subarea 1 by trawlers above 80 GRT as reported to Greenland authorities in 1988.

NAFO DIVISION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1A NORTH	GREENLAND	-	-	-	-	3	275	692	1461	1589	1820	702	118	6660
	TOTAL	-	-	-	-	3	275	692	1461	1589	1820	702	118	6660
1A SOUTH	GREENLAND	-	-	-	-	-	-	-	-	-	1	-	-	1
	TOTAL	-	-	-	-	-	-	-	-	-	1	-	-	1
1B	DENMARK	-	-	-	-	50	17	-	23	109	-	-	-	199
	FAROE ISL-	-	-	-	-	31	30	-	8	-	25	178	22	294
	FRANCE	-	-	-	-	-	-	88	333	-	-	-	-	421
	GREENLAND	1246	744	2525	2359	4963	4271	2866	3026	1637	1120	2226	805	27788
	NORWAY	-	-	-	-	-	31	-	-	-	-	-	-	31
TOTAL	1246	744	2525	2359	5044	4349	2954	3390	1746	1145	2404	827	28733	
1C	DENMARK	-	-	-	70	11	-	-	-	-	-	-	-	81
	FAROE ISL-	-	-	-	-	8	6	45	25	-	12	3	9	108
	GREENLAND	43	1041	182	2087	305	88	84	70	-	-	70	235	4205
	NORWAY	-	-	-	-	-	67	159	71	-	-	-	-	297
	TOTAL	43	1041	182	2157	324	161	288	166	-	12	73	244	4691
1D	DENMARK	-	-	-	-	33	-	-	-	-	-	-	-	33
	FAROE ISL-	-	-	-	1	7	-	-	-	-	-	11	3	22
	GREENLAND	219	-	6	24	107	1	-	-	-	1	8	7	373
	NORWAY	-	-	-	-	5	81	43	1	-	-	-	-	130
	TOTAL	219	-	6	25	152	82	43	1	-	1	19	10	558
TOTAL	DENMARK	-	-	-	70	94	17	-	23	109	-	-	-	313
	FAROE ISL-	-	-	-	1	46	36	45	33	-	37	192	34	424
	FRANCE	-	-	-	-	-	-	88	333	-	-	-	-	421
	GREENLAND	1508	1785	2713	4470	5378	4635	3642	4557	3226	2942	3006	1165	39027
	NORWAY	-	-	-	-	5	179	202	72	-	-	-	-	458
TOTAL	1508	1785	2713	4541	5523	4867	3977	5018	3335	2979	3198	1199	40643	

Table 2. No. of vessels above 80 GRT by division, nation and month in the shrimp fishery in NAFO Subarea 1 as reported to Greenland authorities in 1988.

NAFO DIVISION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1A NORTH	GREENLAND	-	-	-	-	2	5	16	15	16	15	11	6	30
	TOTAL	-	-	-	-	2	5	16	15	16	15	11	6	30
1A SOUTH	GREENLAND	-	-	-	-	-	-	-	-	-	1	-	-	1
	TOTAL	-	-	-	-	-	-	-	-	-	1	-	-	1
1B	DENMARK	-	-	-	-	2	1	-	1	1	-	-	-	2
	FAROE ISL-	-	-	-	-	1	1	-	1	-	2	3	3	4
	FRANCE	-	-	-	-	-	-	1	1	-	-	-	-	1
	GREENLAND	11	10	16	20	21	18	15	15	15	14	16	14	46
	NORWAY	-	-	-	-	-	1	-	-	-	-	-	-	1
TOTAL	11	10	16	20	24	21	16	18	16	16	19	17	54	
1C	DENMARK	-	-	-	1	1	-	-	-	-	-	-	-	2
	FAROE ISL-	-	-	-	1	1	1	2	-	-	1	1	1	3
	GREENLAND	4	10	11	20	15	5	5	5	-	-	6	8	38
	NORWAY	-	-	-	-	-	3	3	3	-	-	-	-	3
	TOTAL	4	10	11	21	17	9	9	10	-	1	7	9	46
1D	DENMARK	-	-	-	-	1	-	-	-	-	-	-	-	1
	FAROE ISL-	-	-	-	1	1	-	-	-	-	-	1	1	3
	GREENLAND	6	-	2	3	9	1	-	-	-	1	1	1	21
	NORWAY	-	-	-	-	1	1	2	1	-	-	-	-	3
	TOTAL	6	-	2	4	12	2	2	1	-	1	2	2	28
TOTAL	DENMARK	-	-	-	1	2	1	-	1	1	-	-	-	2
	FAROE ISL-	-	-	-	1	1	1	1	2	-	2	3	3	5
	FRANCE	-	-	-	-	-	-	1	1	-	-	-	-	1
	GREENLAND	12	11	16	20	21	18	19	18	17	18	17	14	46
	NORWAY	-	-	-	-	1	4	3	4	-	-	-	-	4
TOTAL	12	11	16	22	25	24	24	26	18	20	20	17	58	





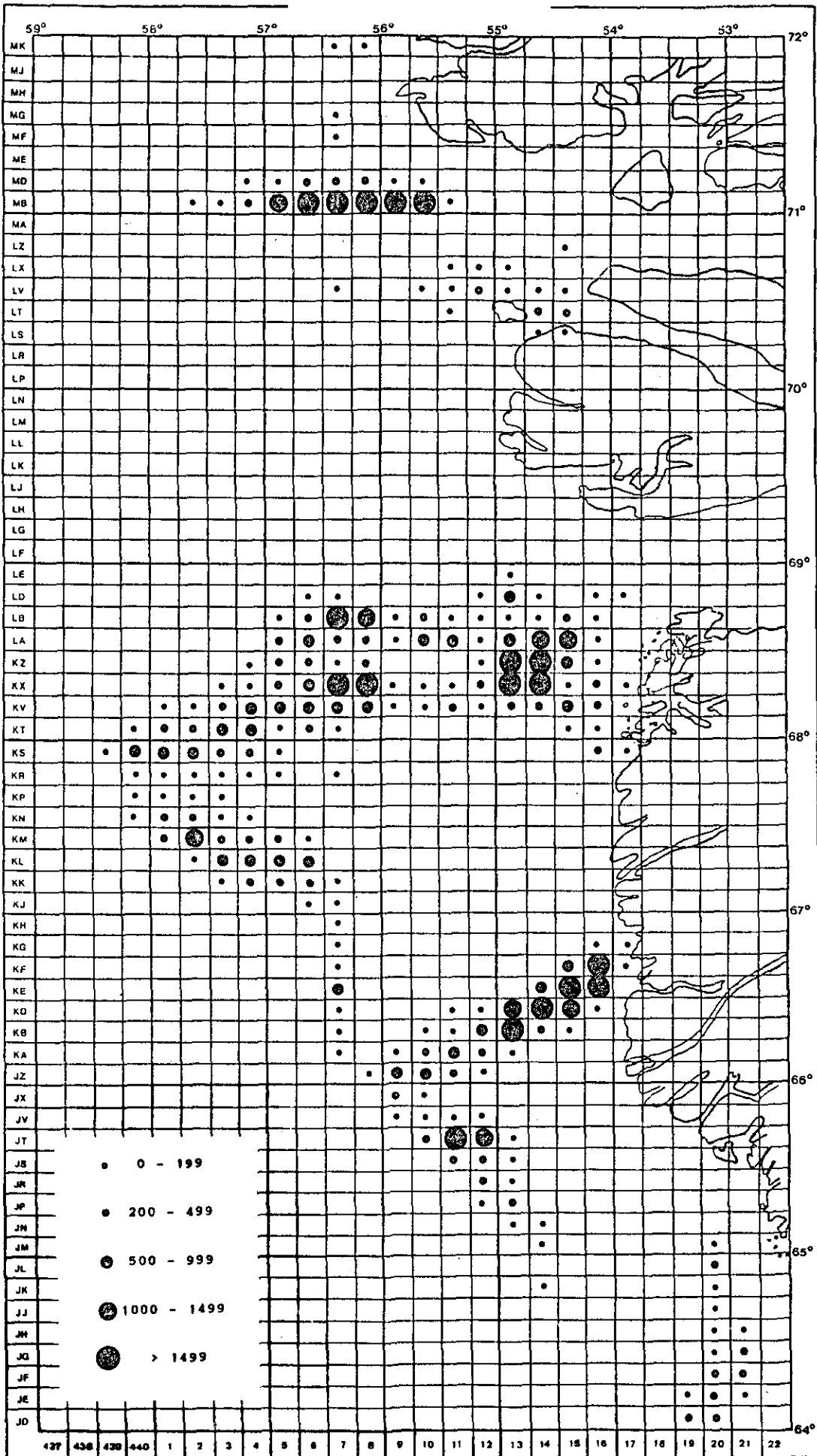


Figure 1. Distribution of effort (in no.s of hauls trawled) in 1988 in the shrimp fishery in NAFO Subarea 1 between 64°N and 72°N, based on logbooks from



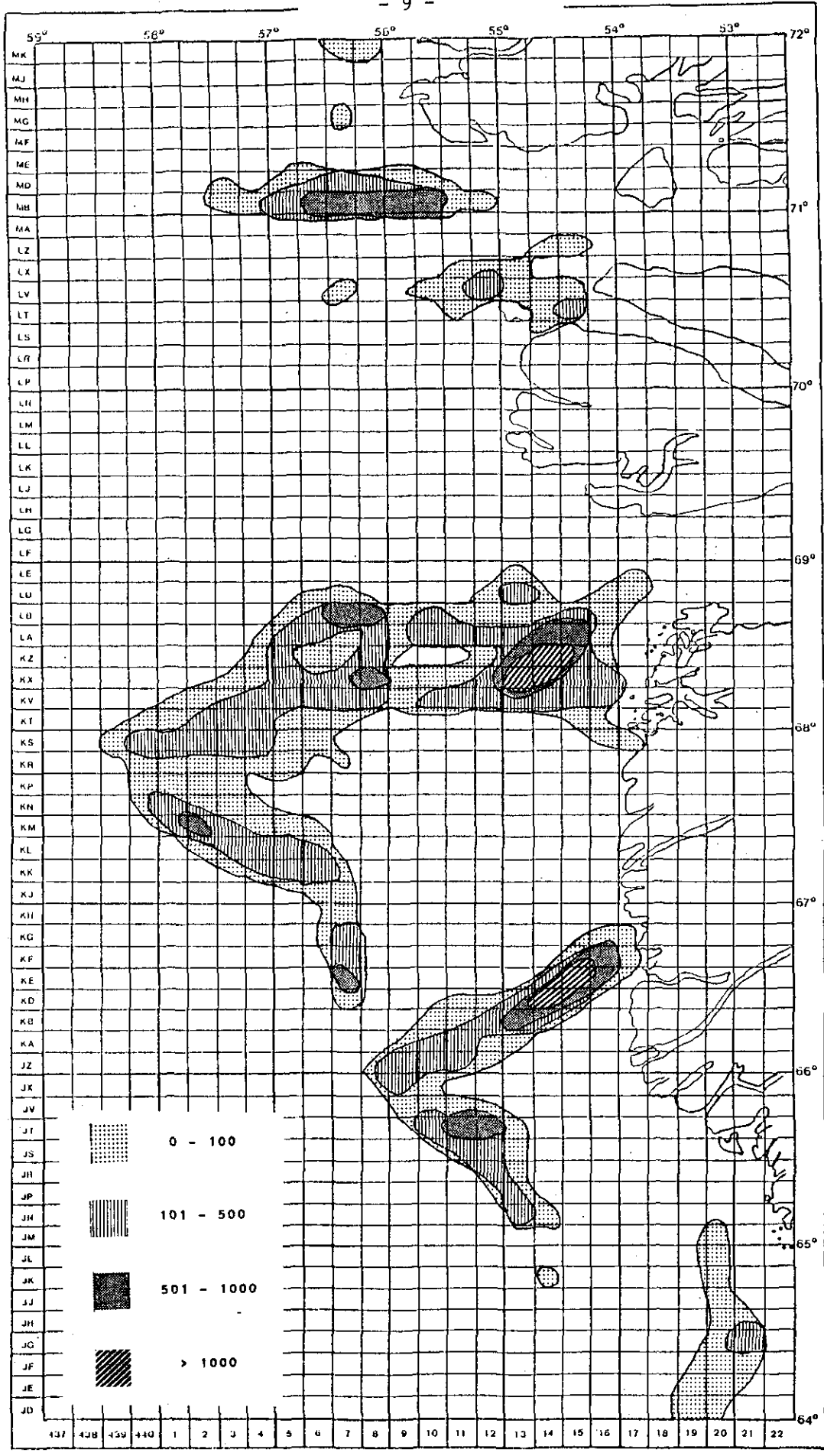


Figure 2. Distribution of total catches in 1988 in the shrimp fishery in NAFO Subarea 1 between 64°N and 72°N, based on logbooks from Greenland trawlers.

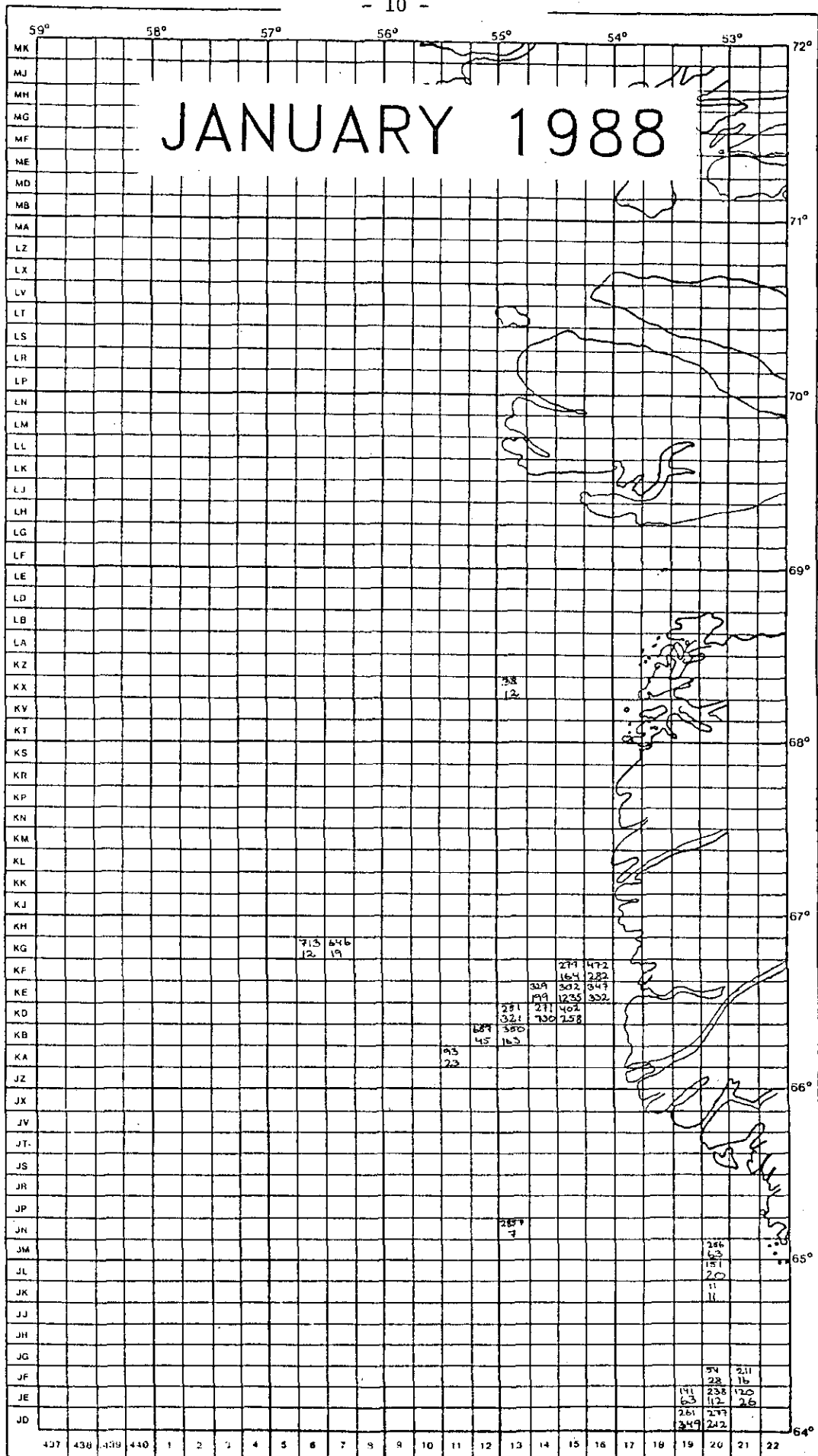


Figure 3. Distribution of mean catch of shrimp and effort in January 1988 in the shrimp fishery in NAFO Subarea 1 (from 64° to 72°N), based on available logbooks from Greenland trawlers. Upper figure in each statistical unit is mean catch rate (kg/hour). Lower figure, no. of hours trawled.



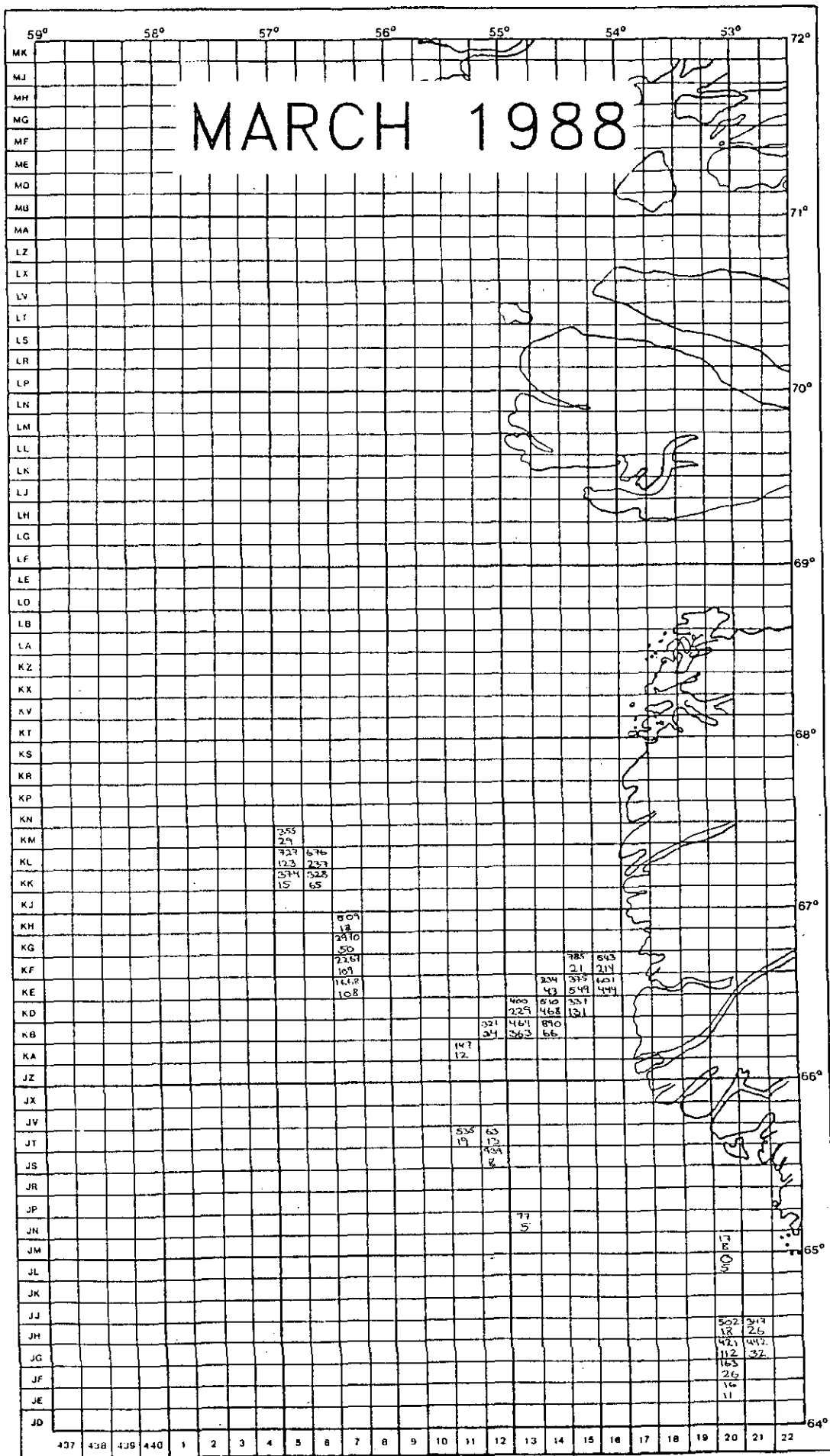


Figure 3. Continued. March 1988.

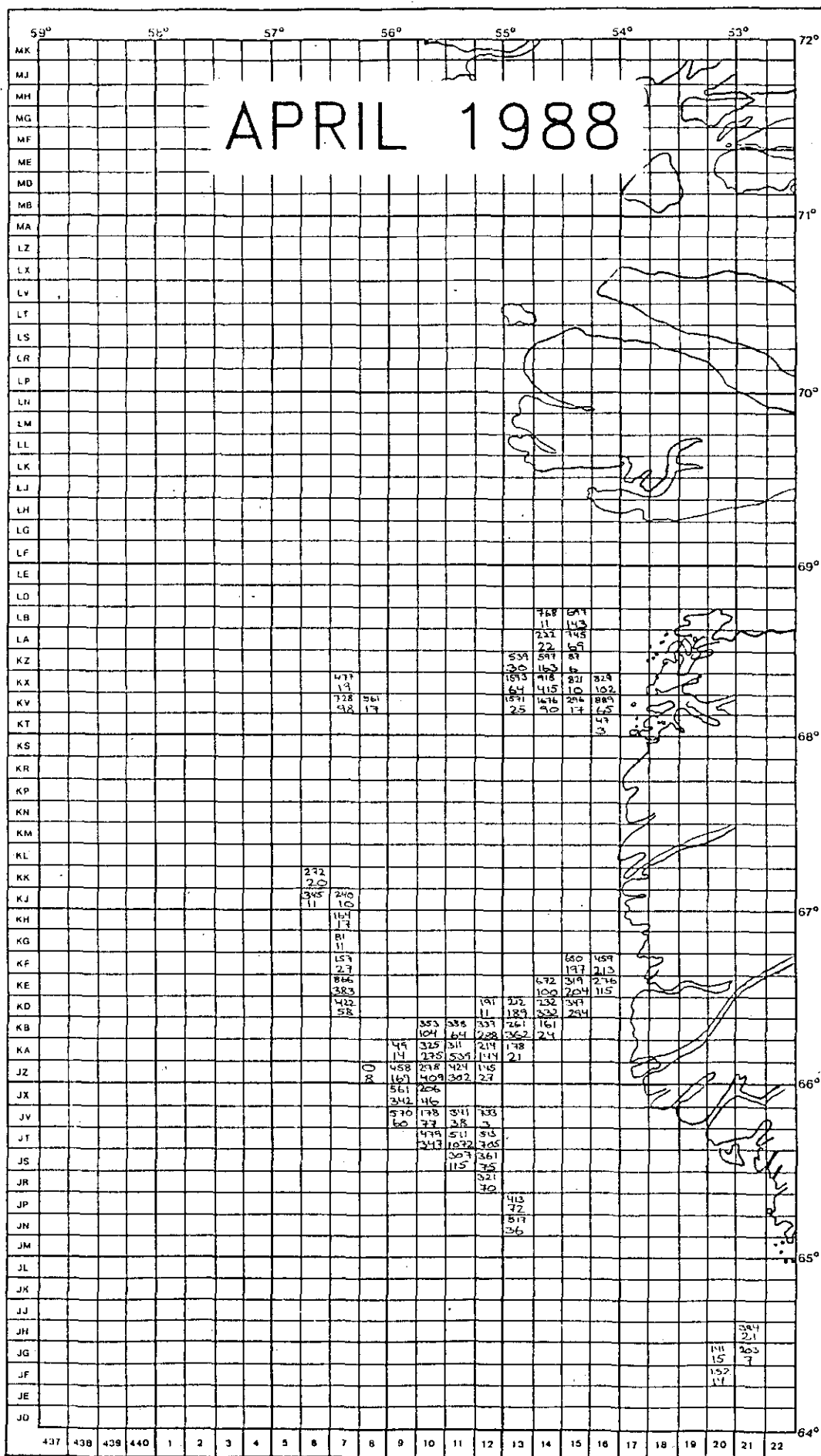


Figure 3. Continued. April 1988.

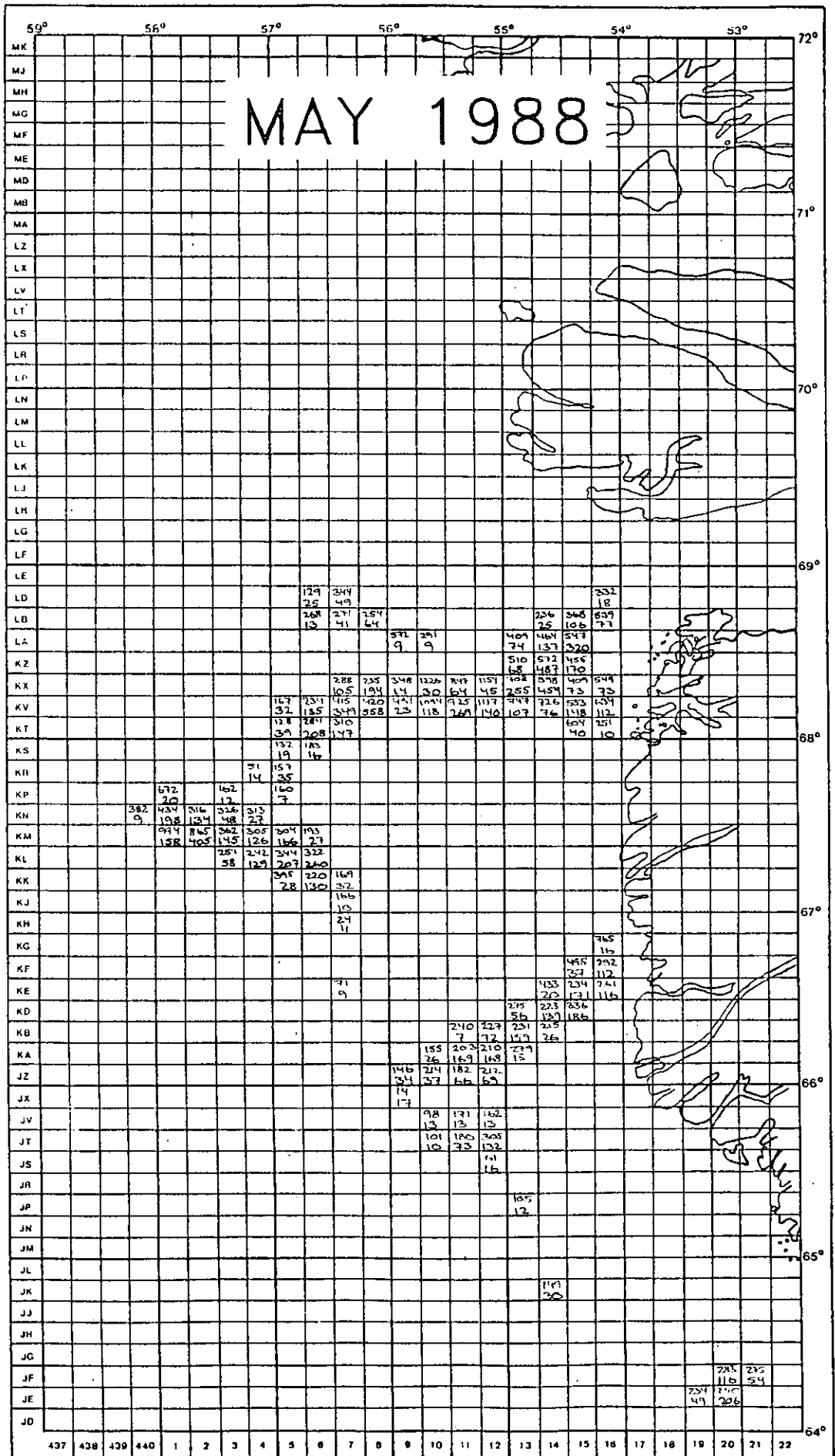


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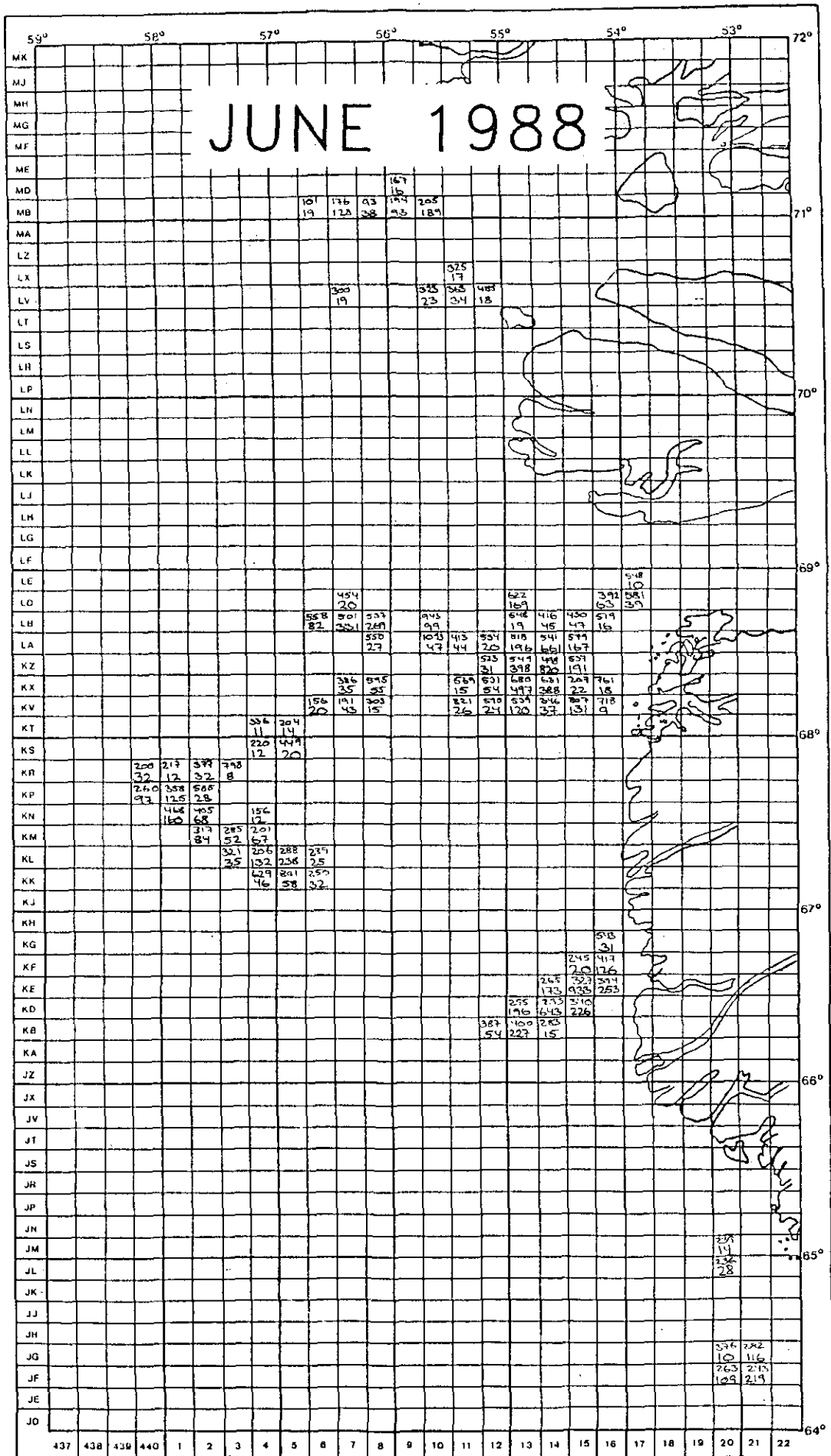


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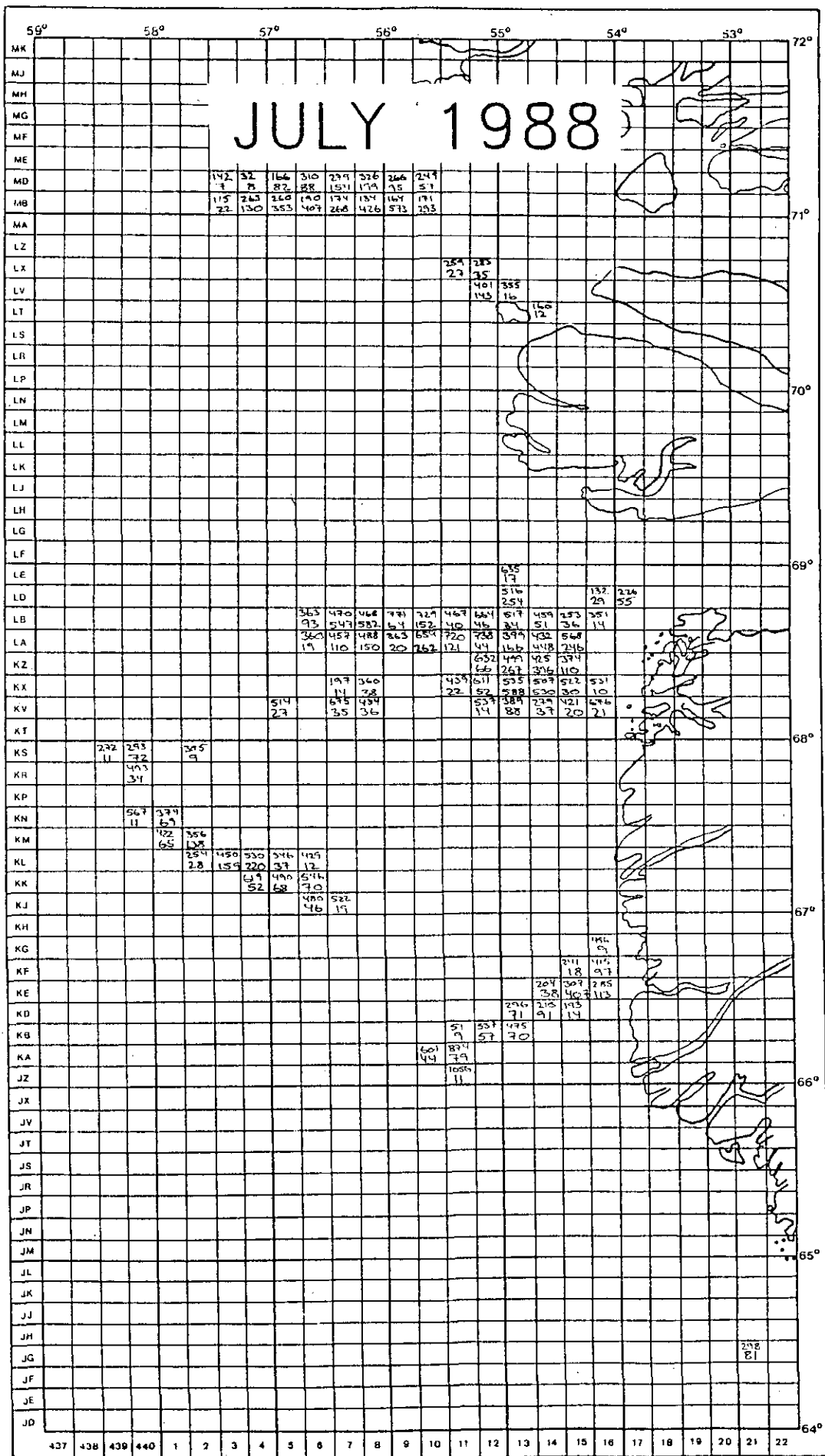


Figure 3. Continued. July 1988



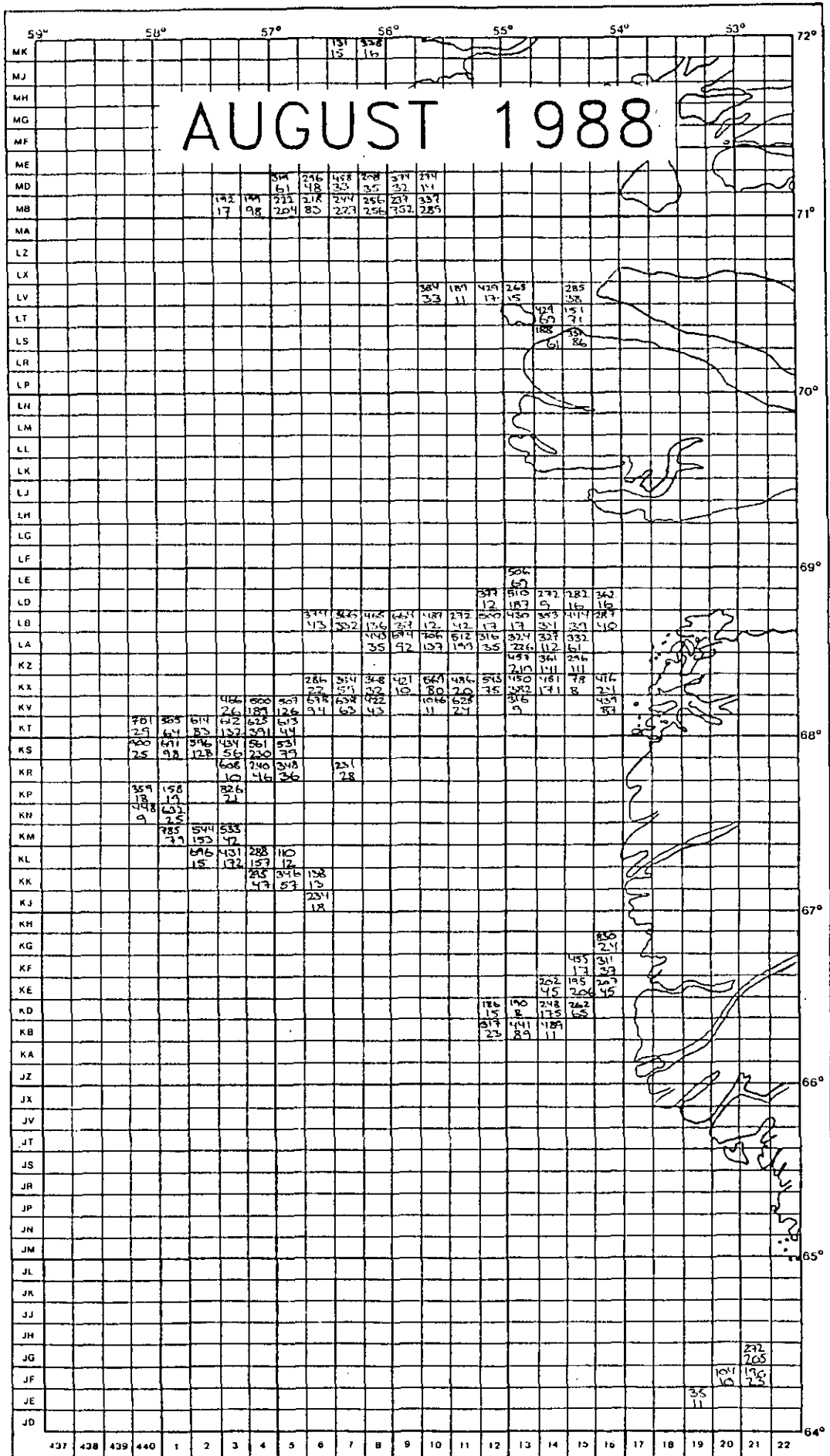


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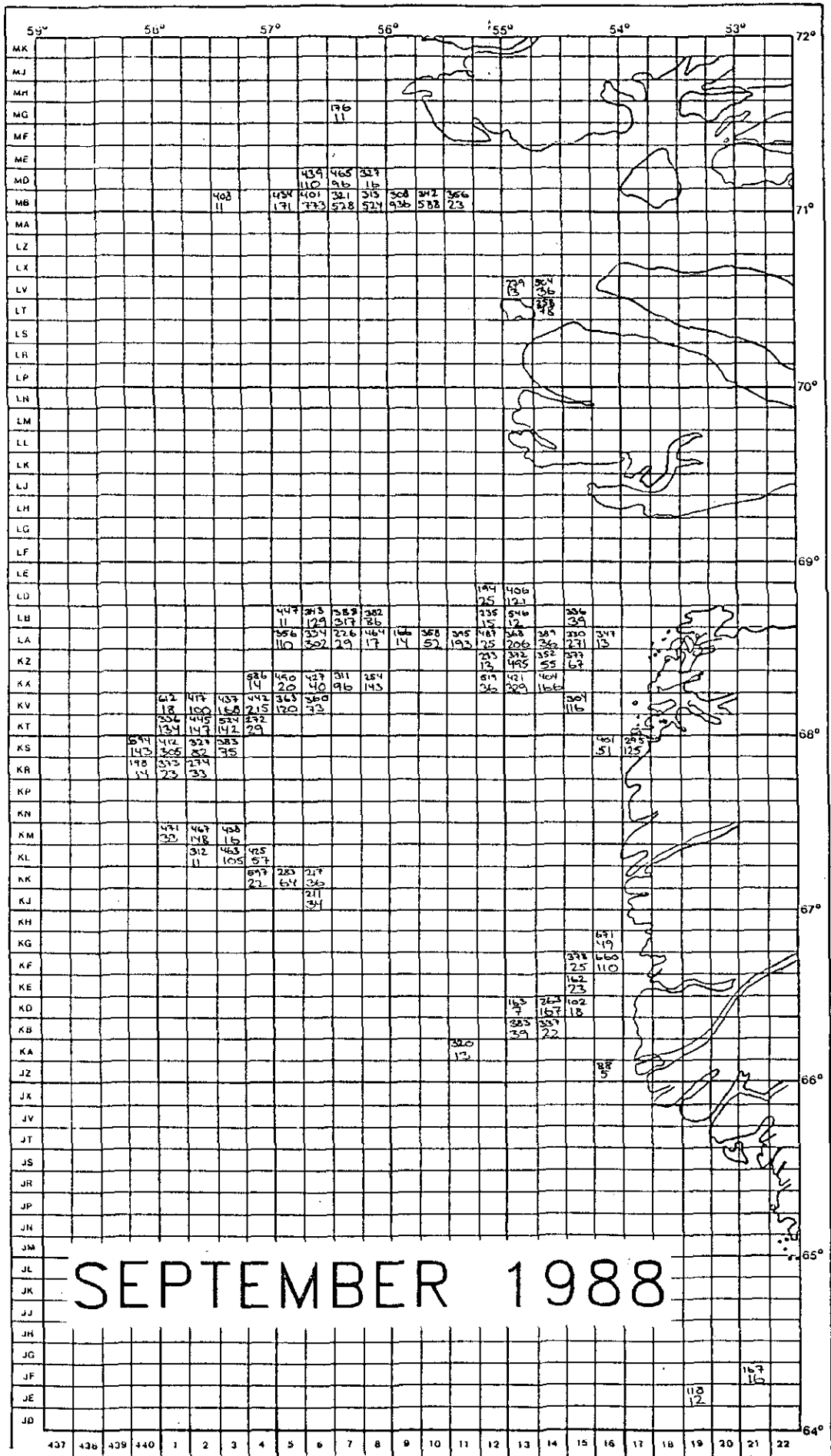


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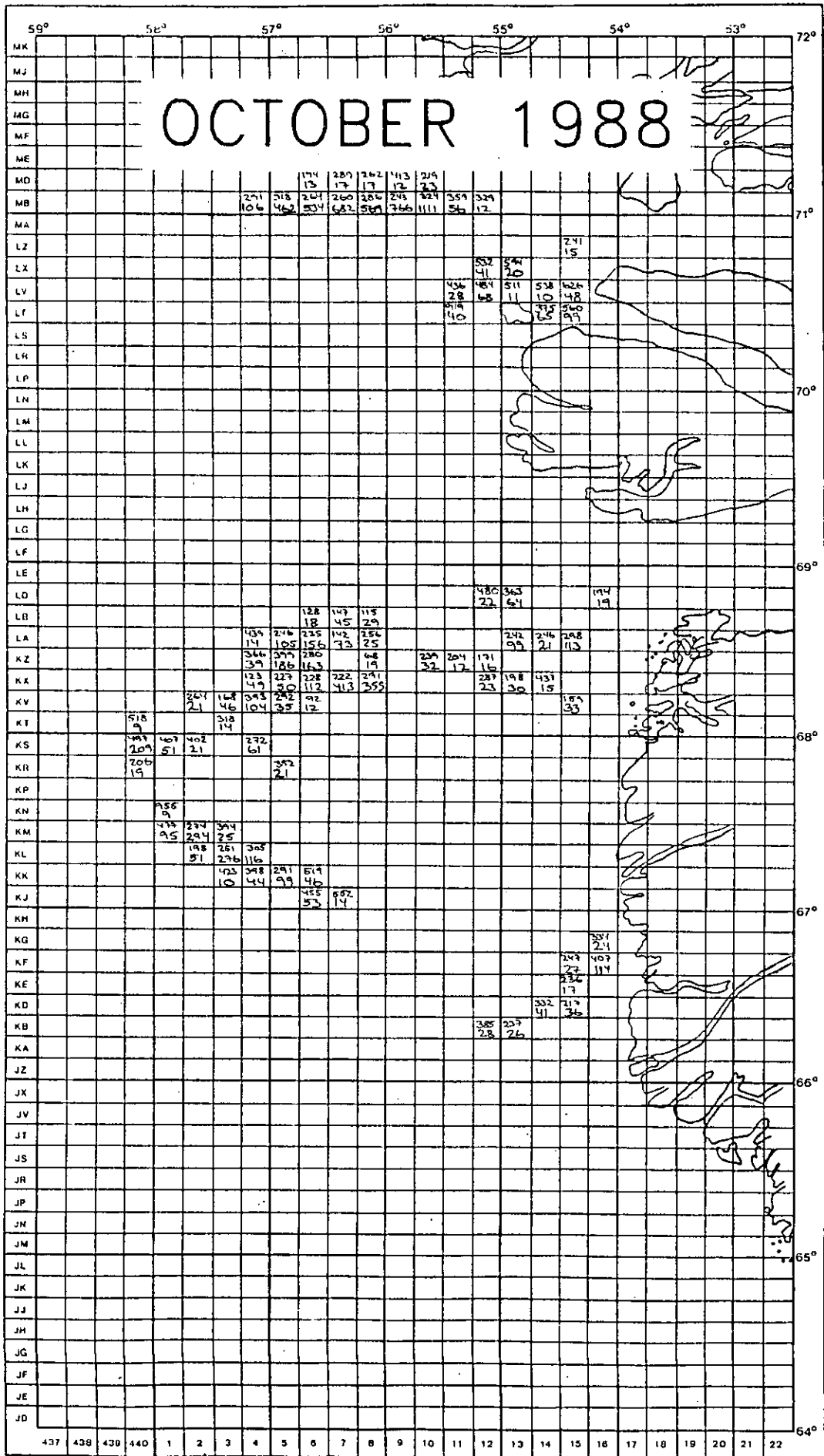


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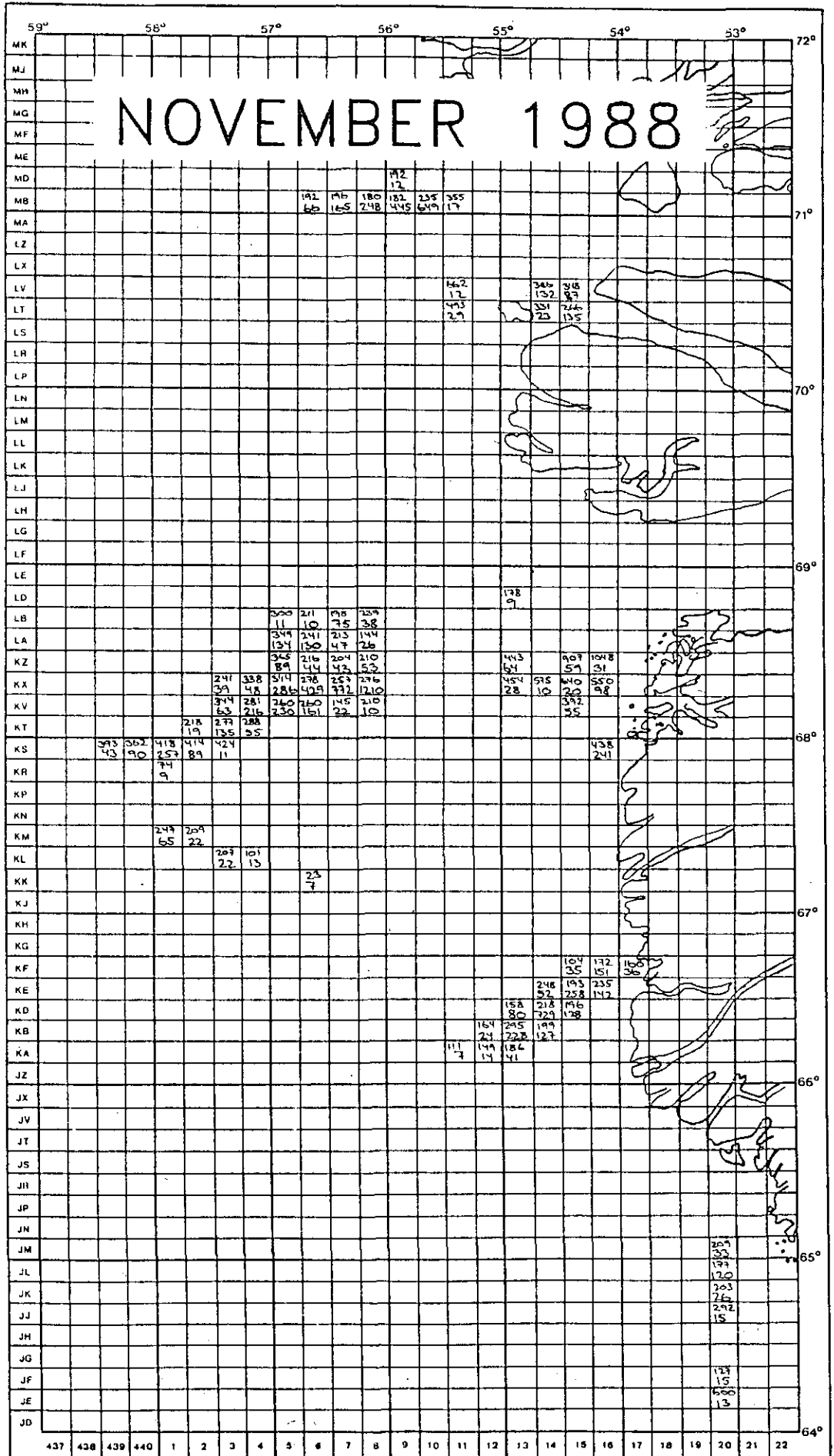


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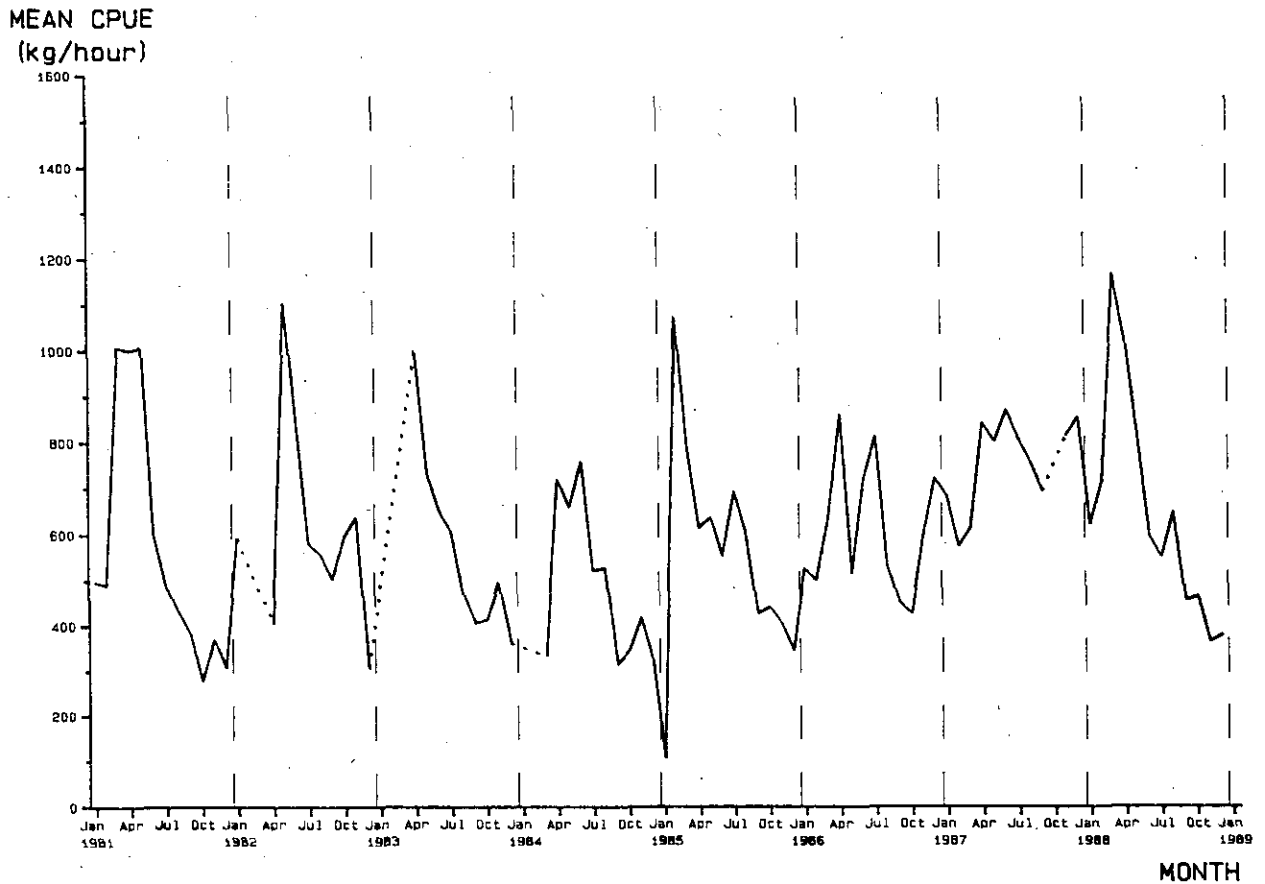


Figure 4. Monthly mean catch rate of shrimp (kg/hour) in NAFO Division 1B from January 1981 to December 1988 based on available logbook information from seven trawlers of the Greenland Home Rule Administration (corresponding no. of hours trawled are given in Table 3).

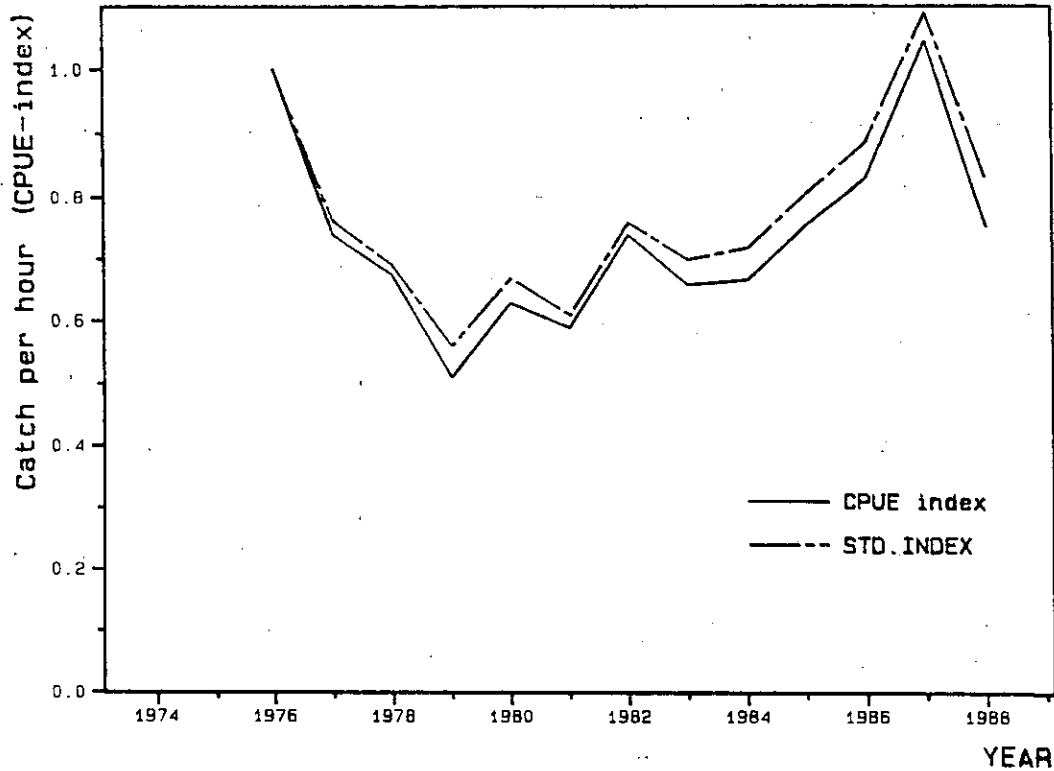


Figure 5. Indices of mean catch rates for the period July-September by year in NAFO Division 1B from 1976 to 1988, based on logbook information and landings of seven trawlers owned by the Greenland Home Rule Administration. Standardized indices for the same vessels are also given, see text. Indices are calculated relative to the mean catch rate for the period in 1976.

88SI0170508TR03 880508 SU-KX015 W. GREENLAND  
KX015 1340 GMT MEAN DEPTH: 392 M.  
2522 KG/HOUR SAMPLE WEIGHT 3.0 KG N= 474

88SI0170509TR04 880509 SU-KZ015 W. GREENLAND  
KZ015 1515 GMT MEAN DEPTH: 408 M.  
31579 KG/HOUR SAMPLE WEIGHT 2.3 KG N= 287

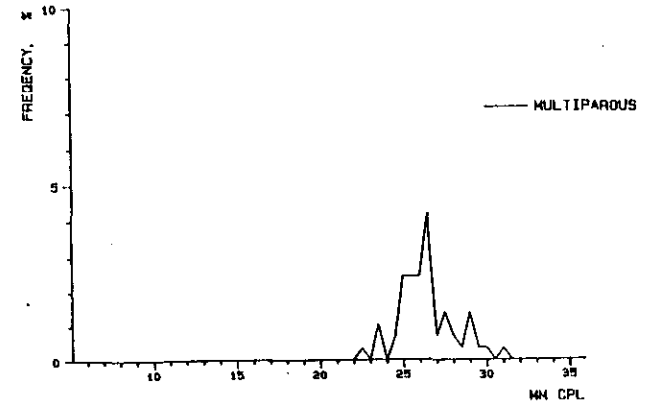
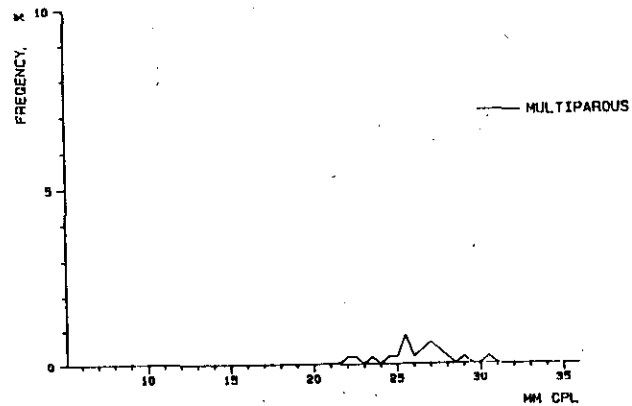
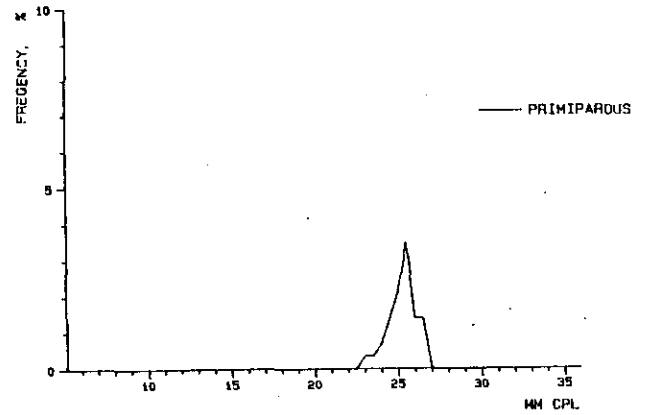
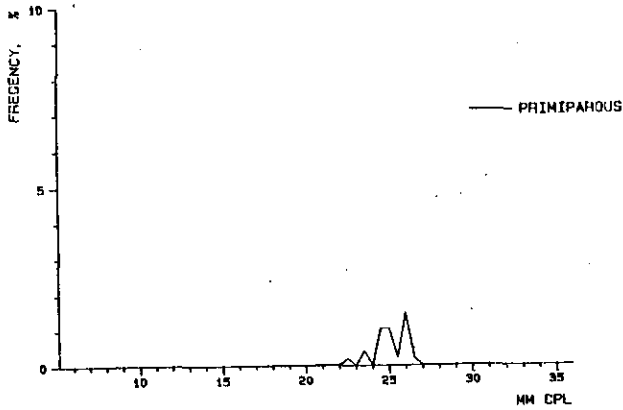
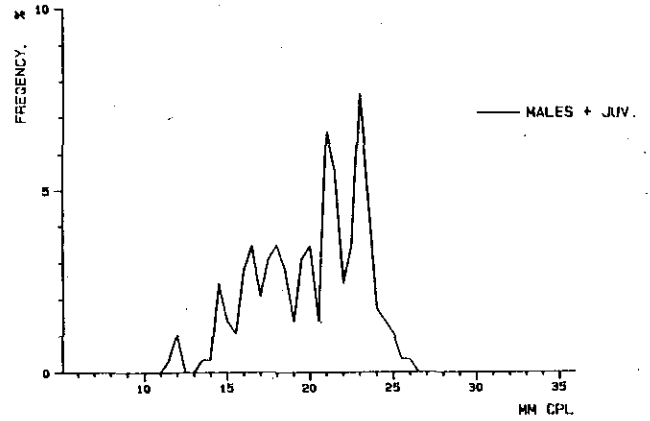
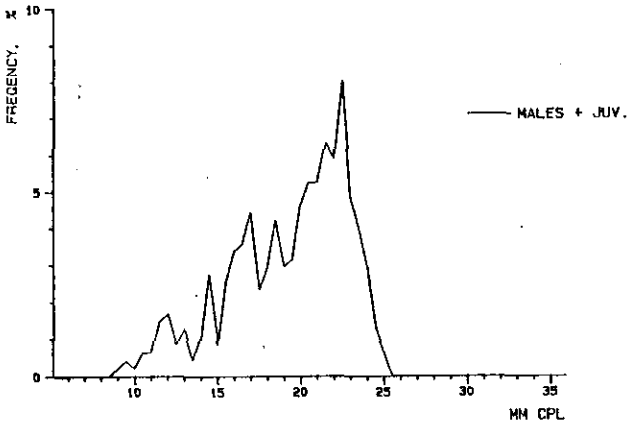
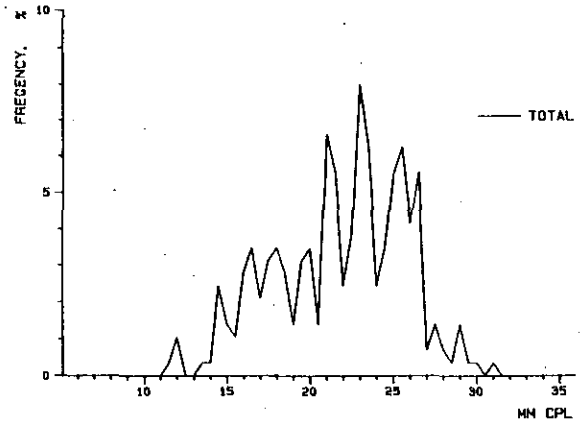
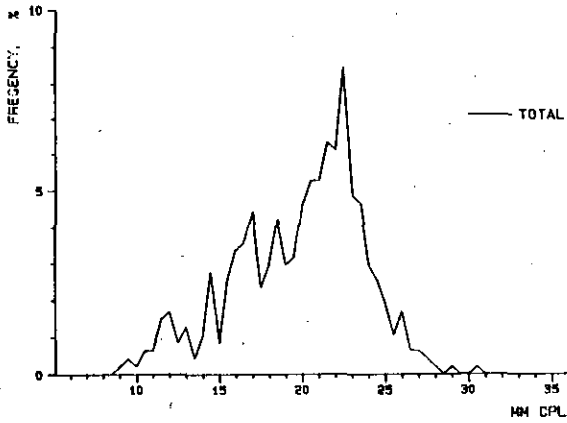


Fig. 6. Length-frequency diagrams for commercial shrimp samples from Div. 1B in May 1988.

Fig. 7. Length-frequency diagrams for commercial shrimp samples from Div 1B in May 1988.



BBS10170508TR01 880508 SU-KX015 W. GREENLAND  
KX015 0300 GMT MEAN DEPTH: 351 M.  
475 KG/HOUR SAMPLE WEIGHT 2.2 KG N= 309

BBS10170508TR02 880508 SU-KX015 W. GREENLAND  
KX015 0813 GMT MEAN DEPTH: 356 M.  
1463 KG/HOUR SAMPLE WEIGHT 3.6 KG N= 459

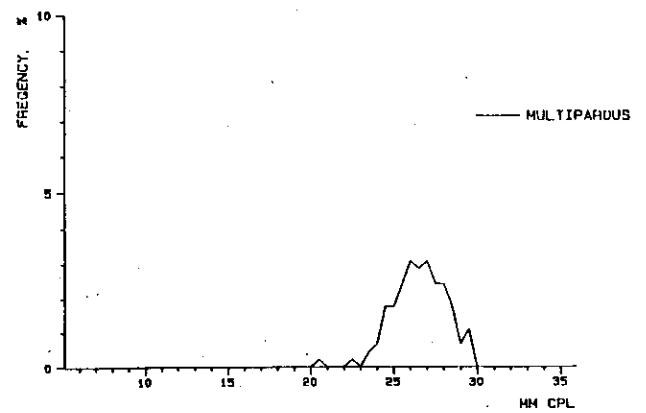
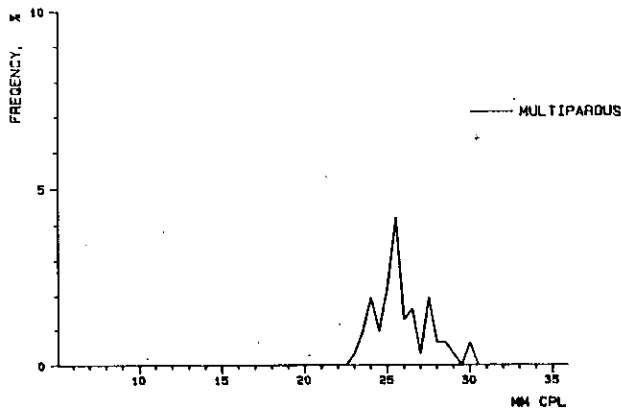
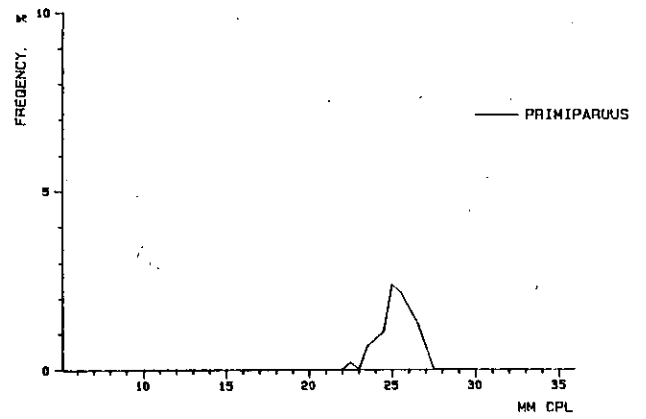
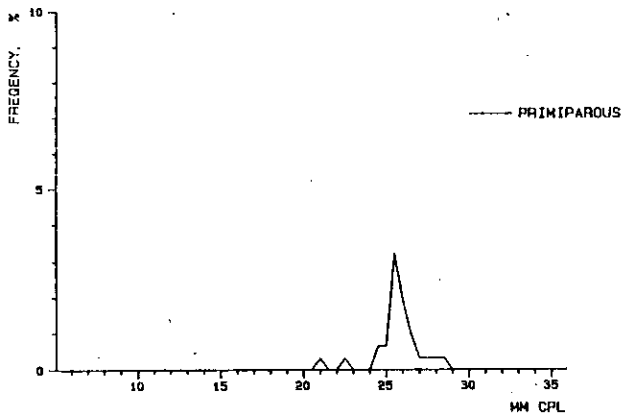
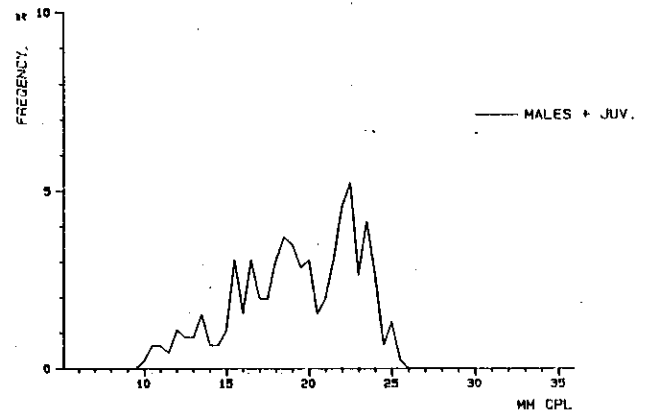
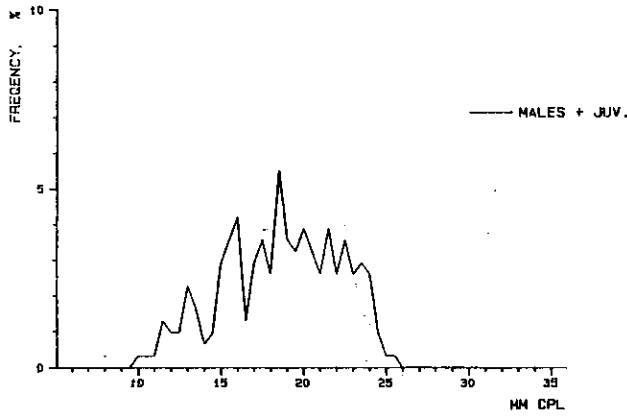
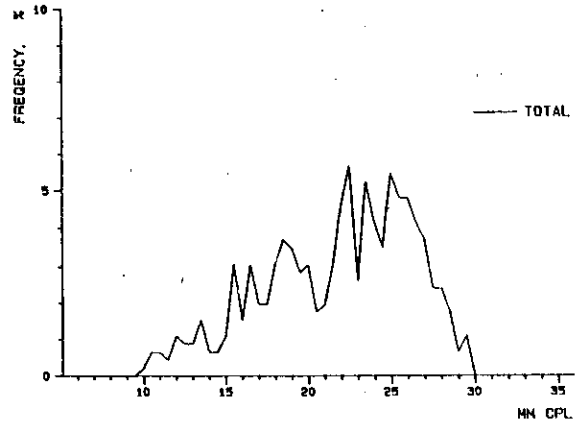
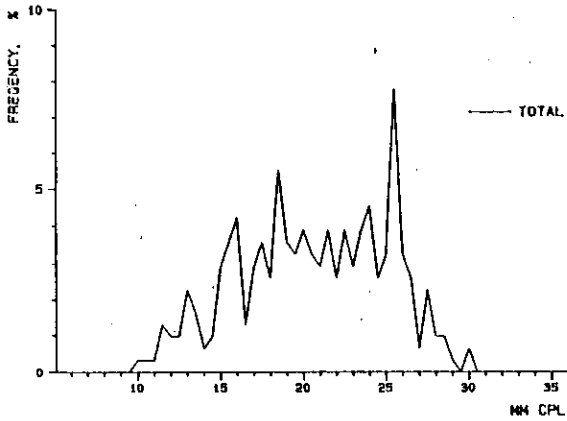


Fig. 8. Length-frequency diagrams for commercial shrimp samples from Div. 1B in May 1988.

Fig. 9. Length-frequency diagrams for commercial shrimp samples from Div 1B in May 1988.

88EK014005TR01 880728 SU-KV010 W.GREENLAND  
 KV010 1255 GMT MEAN DEPTH: 285 M.  
 1723 KG/HOUR SAMPLE WEIGHT 5.2 KG N= 757

88EK014006TR01 880728 SU-KV010 W.GREENLAND  
 KV010 1727 GMT MEAN DEPTH: 291 M.  
 1032 KG/HOUR SAMPLE WEIGHT 5.4 KG N= 904

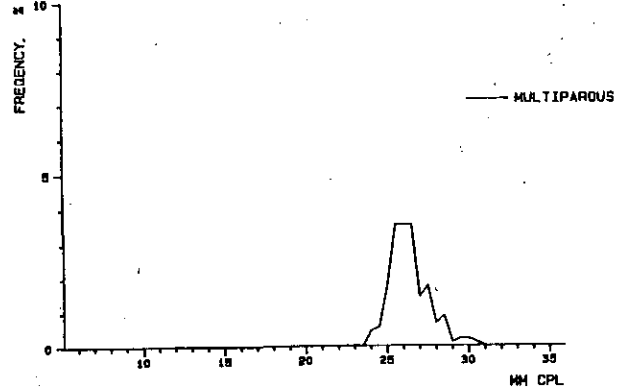
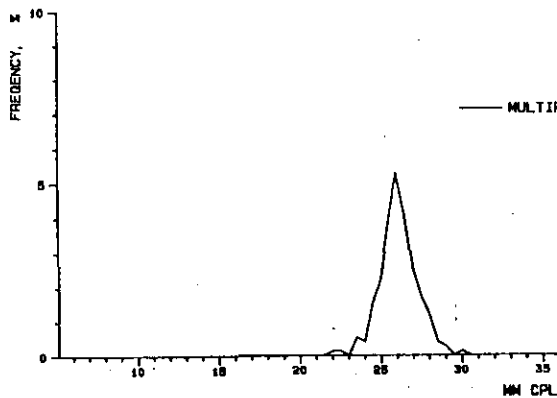
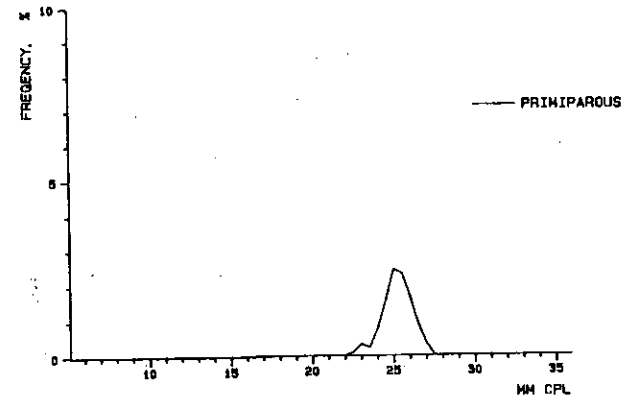
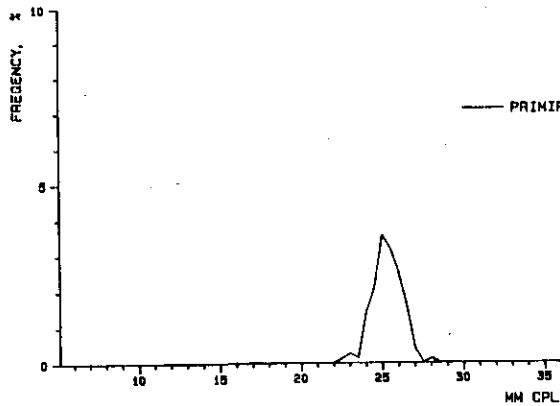
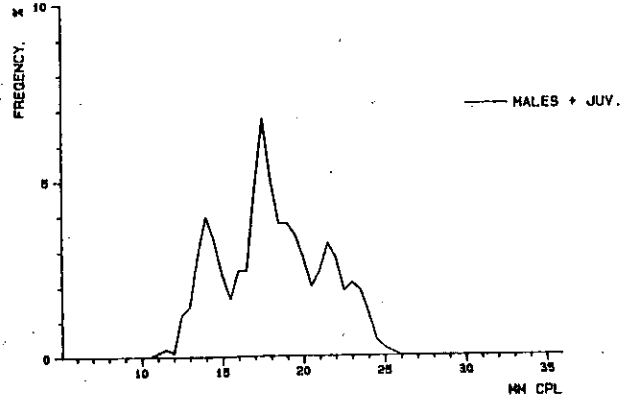
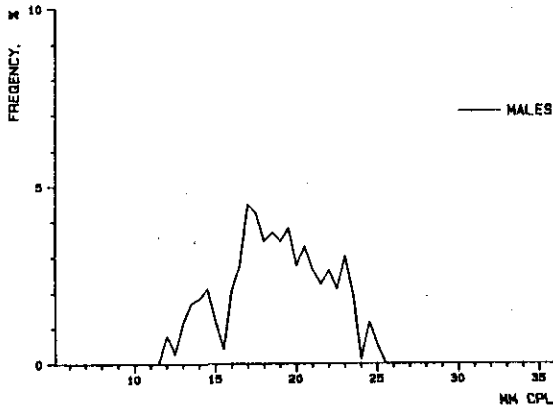
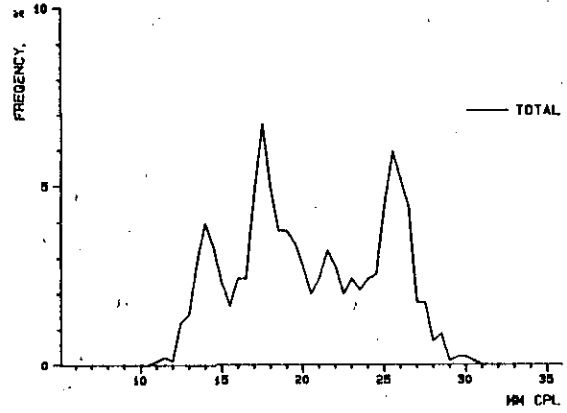
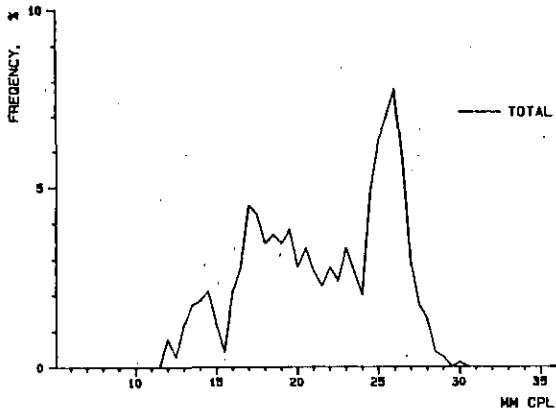


Fig. 10. Length-frequency diagrams for commercial shrimp samples from Div. 1B in July 1988.

Fig. 11. Length-frequency diagrams for commercial shrimp samples from Div 1B in July 1988.

8BEK0140001TR01 880727 SU-KV011 W.GREENLAND  
KV011 2113 GMT MEAN DEPTH: 304 M.  
2211 KG/HOUR SAMPLE WEIGHT 5.4 KG N= 843

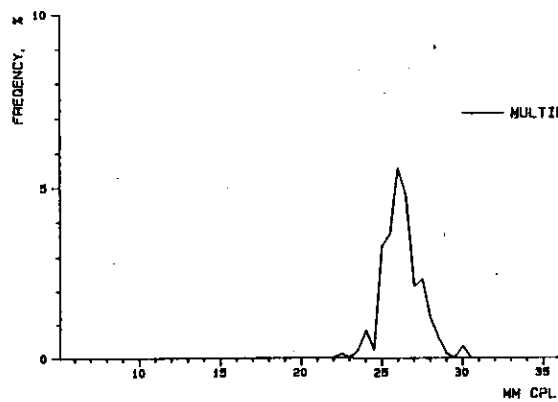
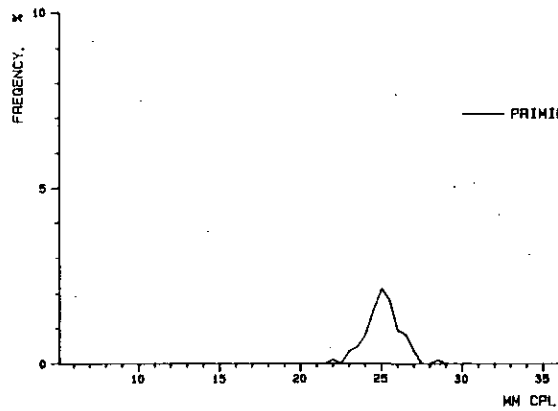
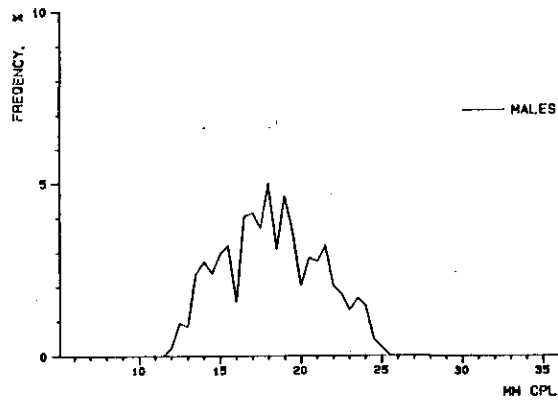
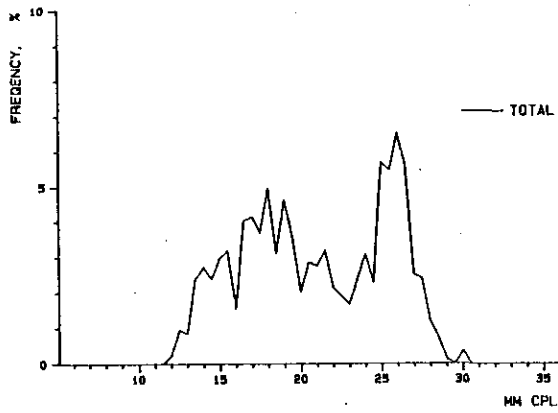


Fig. 12. Length-frequency diagrams for commercial shrimp samples from Div. 1B in July 1988.

8BEK0140002TR01 880727 SU-KV012 W.GREENLAND  
KV012 0056 GMT MEAN DEPTH: 292 M.  
1167 KG/HOUR SAMPLE WEIGHT 4.9 KG N= 852

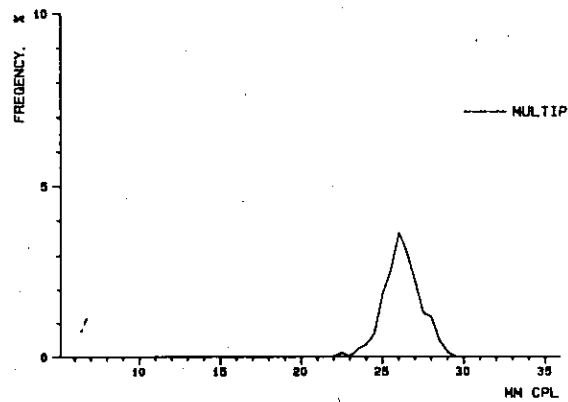
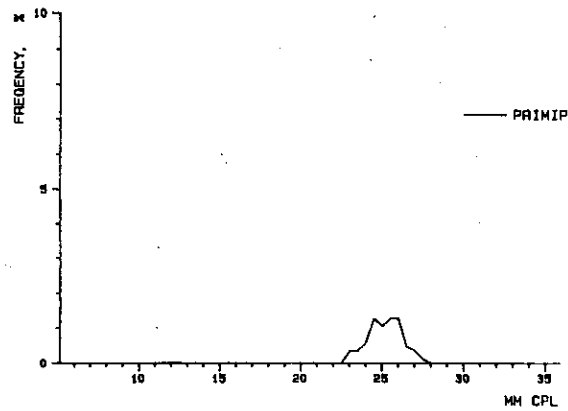
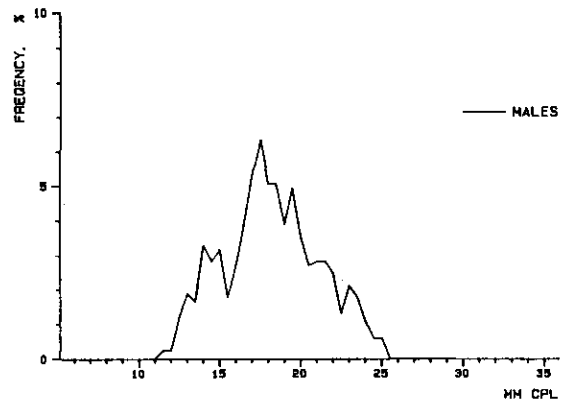
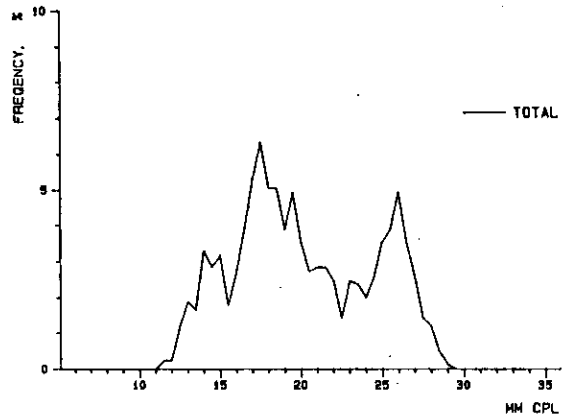


Fig. 13. Length-frequency diagrams for commercial shrimp samples from Div 1B in July 1988.

BBEK0140003TR01 880728 SU-KV011 W. GREENLAND  
KV011 0456 GMT MEAN DEPTH: 293 M.  
503 KG/HOUR SAMPLE WEIGHT 4.6 KG N= 901

BBEK0140004TR01 880728 SU-KV010 W. GREENLAND  
KV010 0903 GMT MEAN DEPTH: 289 M.  
503 KG/HOUR SAMPLE WEIGHT 6.7 KG N=1101

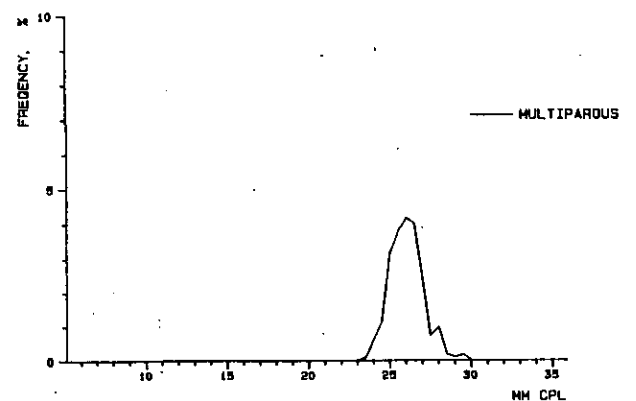
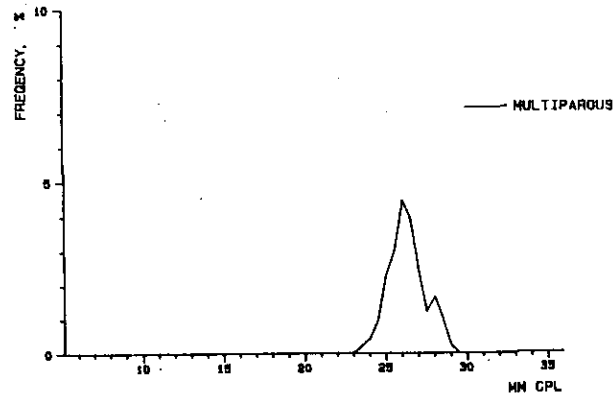
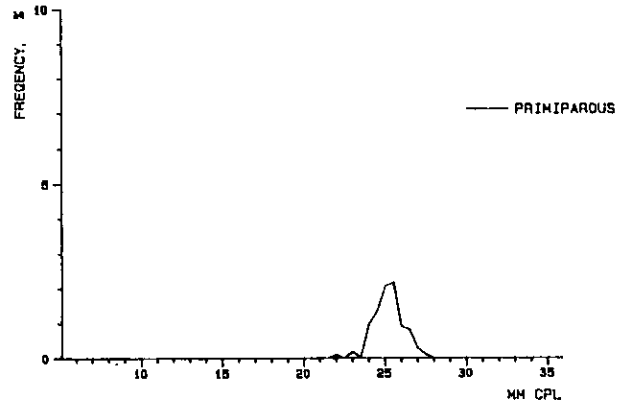
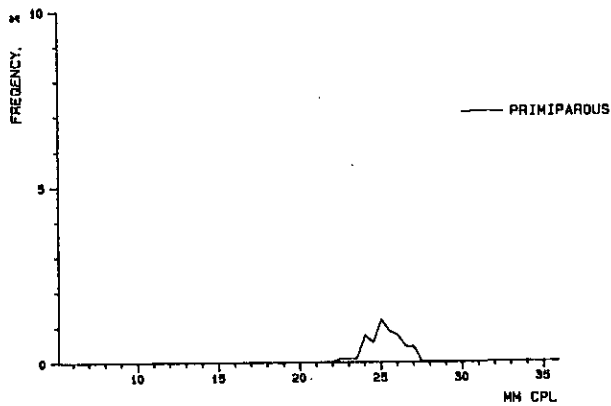
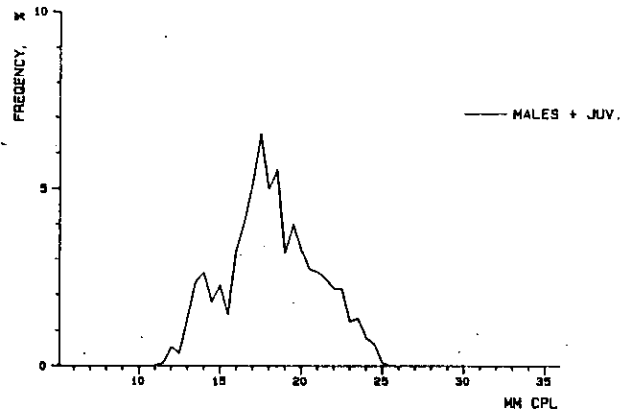
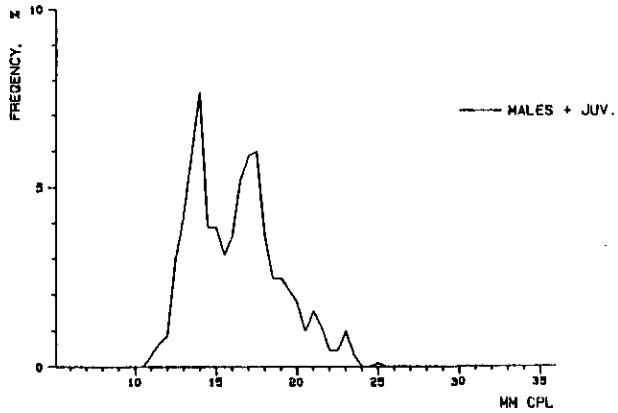
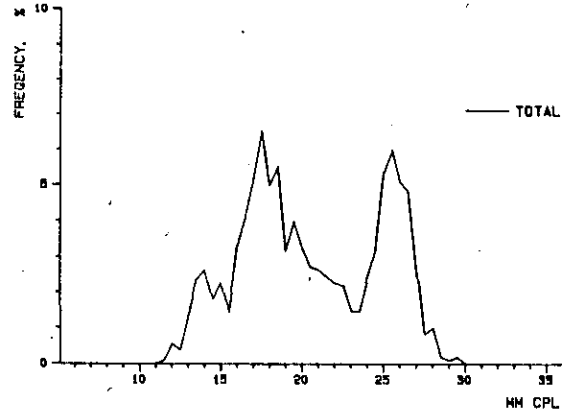
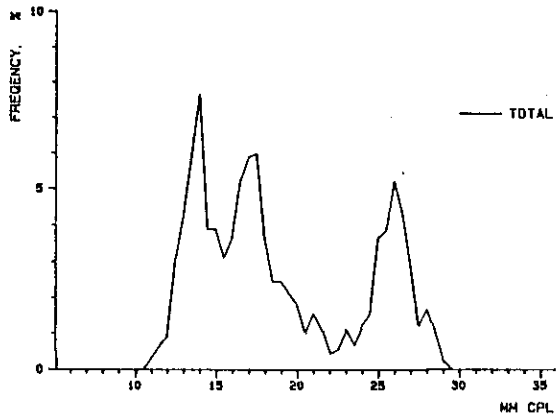


Fig. 14. Length-frequency diagrams for commercial shrimp samples from Div. 1B in July 1988.

Fig. 15. Length-frequency diagrams for commercial shrimp samples from Div 1B in July 1988.

BBEK0140007TR01 880728 SU-KV013 W.GREENLAND  
KV013 2230 GMT MEAN DEPTH: 298 M.  
954 KG/HOUR SAMPLE WEIGHT 4.9 KG N=1341

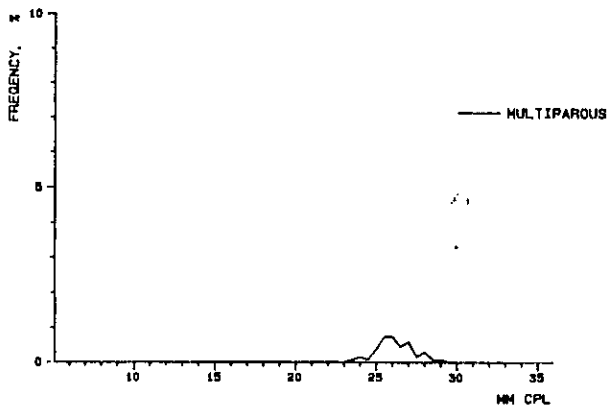
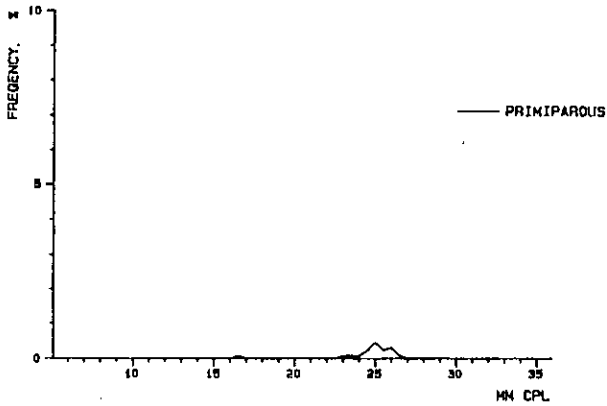
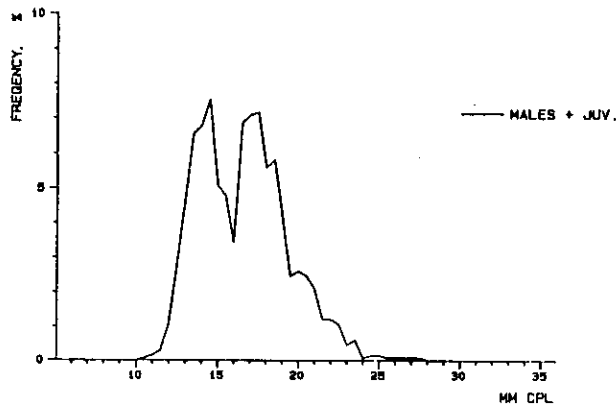
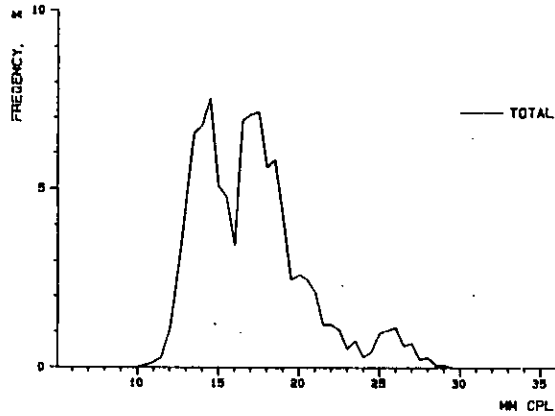


Fig. 16. Length-frequency diagrams for commercial shrimp samples from Div. 1B in July 1988.

BBSI0421116TR02 881116 SU-LA005 W.GREENLAND  
LA005 1045 GMT MEAN DEPTH: 351 M.  
489 KG/HOUR SAMPLE WEIGHT 2.7 KG N= 337

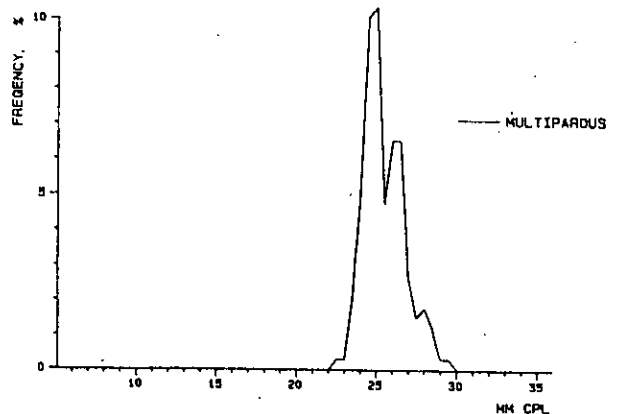
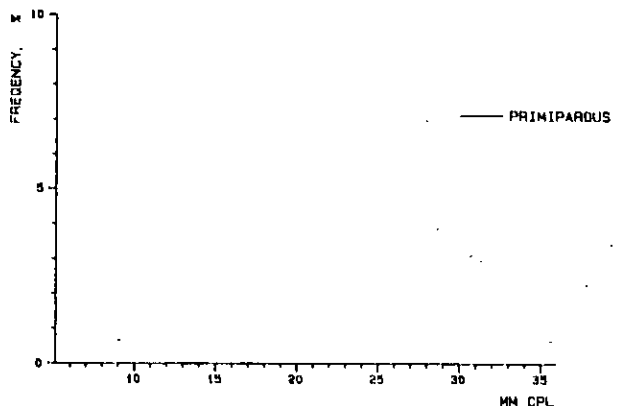
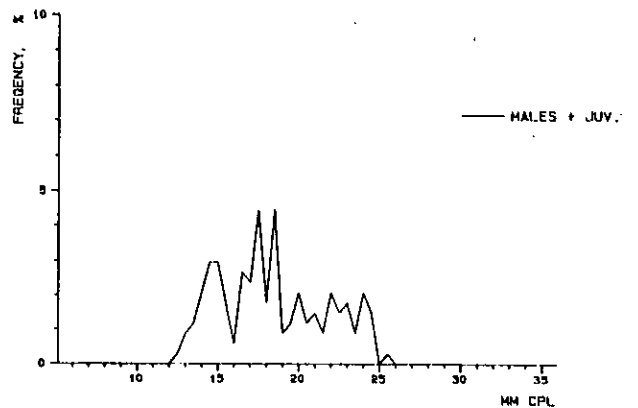
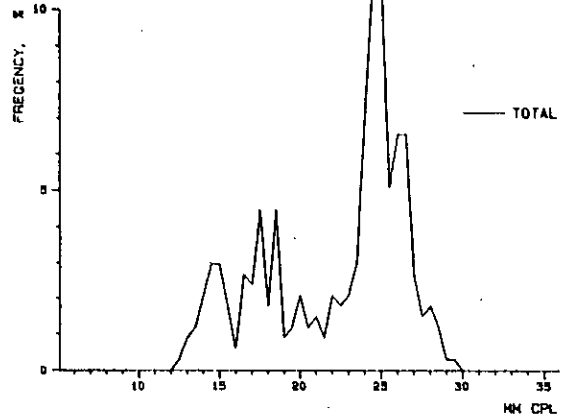


Fig. 17. Length-frequency diagrams for commercial shrimp samples from Div 1B in November 1988.

88SI0421111TR02 881111 SU-KX008 W.GREENLAND  
KX008 1458 GMT MEAN DEPTH: 505 M.  
346 KG/HOUR SAMPLE WEIGHT 3.3 KG N= 417

88SI0421111TR03 881111 SU-KX007 W.GREENLAND  
KX007 1920 GMT MEAN DEPTH: 496 M.  
415 KG/HOUR SAMPLE WEIGHT 3.0 KG N= 509

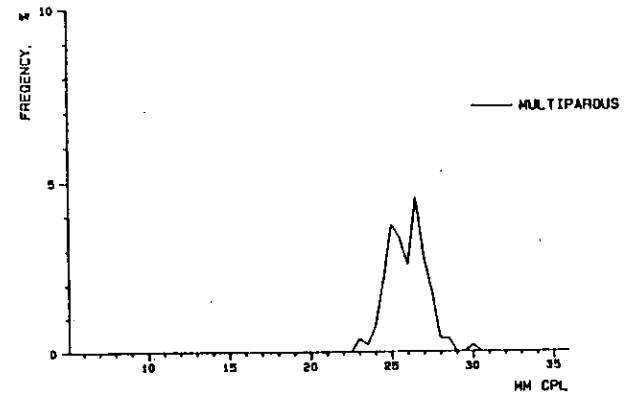
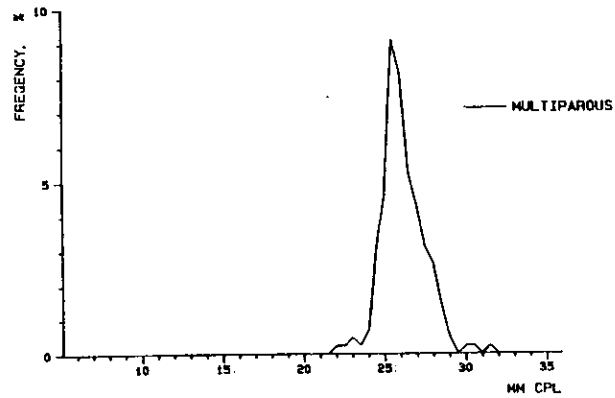
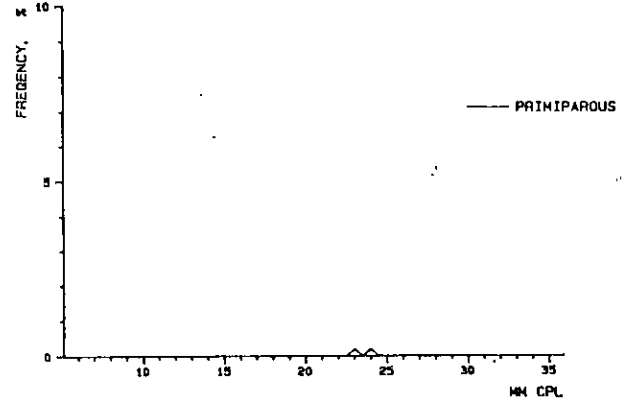
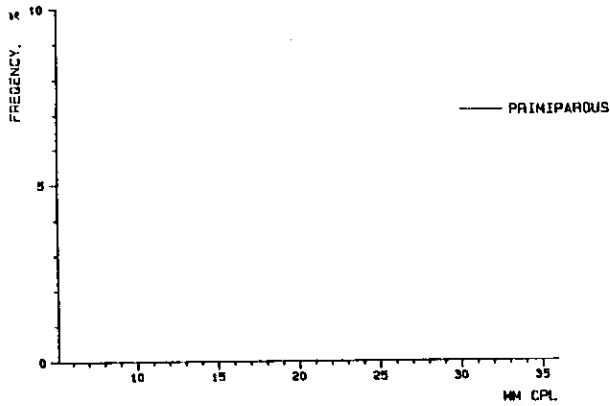
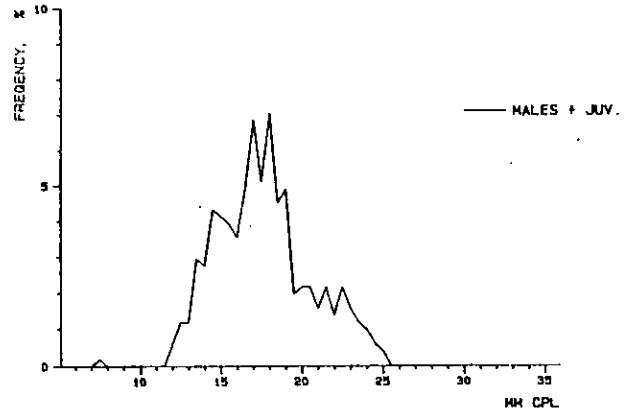
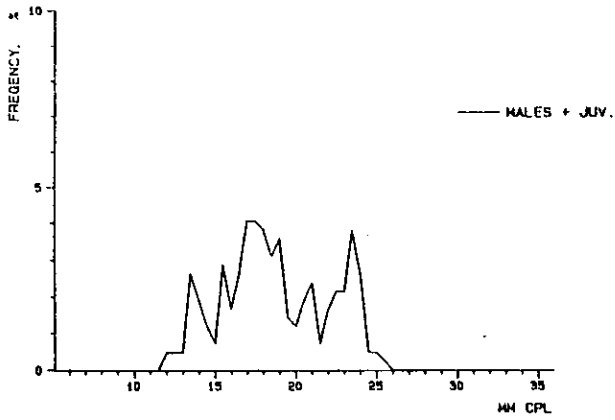
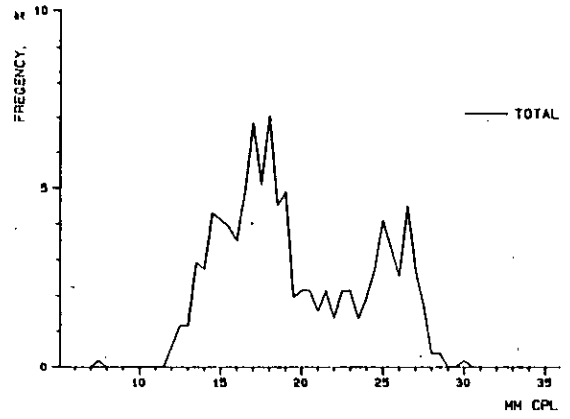
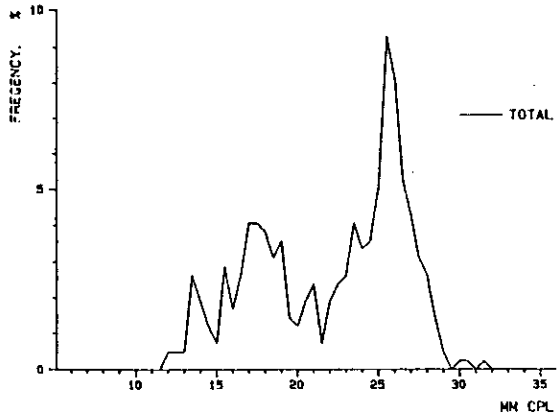


Fig. 18. Length-frequency diagrams for commercial shrimp samples from Div. 1B in November 1988.

Fig. 19. Length-frequency diagrams for commercial shrimp samples from Div 1B in November 1988.