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The Commercial Shrimp Fishery in Denmark Strait
in 1992 and Early 1993

by

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INTRODUCTION

In 1991 STACFIS recommended that the total allowable catch of shrimp in the Denmark Strait in 1992 should be reduced to 8,000 tons. In the Greenland zone the effective TAC was set to 13,000 tons, while the total catch reported from this area was 5,658 tons. Greenland vessels accounted for approximately 2,000 tons.

The fishery was carried out from January to May and from September to December, most effort being spent in the first period. Approximately 3,800 tons of shrimp were reported from the first period and approximately 1,800 tons from the second period. In 1993 from January through May a catch of about 4,500 tons has been reported.

Logbooks from all the 19 Greenland vessels and from one Danish and 10 Faroese vessels fishing at East Greenland in 1992 have been available to the Greenland Fisheries Research Institute. The logbooks cover about 52% of the total catches in the Greenland economic zone.

The present paper updates information given by Carlsson & Kannevorff (1992) on catches and analysis of commercial fishery data.

MATERIALS AND METHODS

Total catches and number of vessels fishing in the Greenland zone were compiled by nation and month based on the compulsory weekly reporting to Greenland authorities by all vessels above 75 GRT (smaller vessels are not fishing in this area).

Logbook data were analysed to show the overall distribution of catches by year and of effort and catch-rates by month. Monthly mean catch-rates from 1980 to early 1993 were calculated from available logbook data.

Based on logbook data from 27 Greenland trawlers a multiplicative model was run using the SAS multiple regression procedures to calculate standardized annual catch rate indices for the total catch, and for shrimp larger than 8.5 g to avoid the influence of unreported discard. The method is described in Carlsson and Lassen, 1991. Catch of large shrimp and total catch were aggregated by vessel, month and year. All cells with less than 10 hours of effort or with 10% or more of the catch not being sorted by shrimp size were excluded to avoid the influence of cells with few hauls and of non-sorted catch. Out of a possible 1944 cells this brought the number of cells down to 595, of which further 10 were removed as marked outliers. Although some improvement in r-square values could be obtained by including interactions in the model, the final runs were done with the simple model.

Shrimp samples from the commercial fishery in February 1992 were analysed for size composition of catches. The samples were taken by observers in a project to estimate discards in the commercial fishery (Siegstad, 1993).

RESULTS AND DISCUSSION

Reported catches in 1992 and 1993.

Tables 1a and 1b show reported catches in the Greenland zone by nation and month, and Tables 2a and 2b the corresponding total numbers of reporting vessels for the years 1992 and 1993 (January to April), respectively. The catch figures should be considered minimum figures due to unreported discard of shrimp (Siegstad, 1993).

The seasonal distribution of the fishery in 1992 was similar to previous years in that little or no fishing took place in the summer period (June to September). Highest catches were taken in January to March and in November and December. About 32% of the reported catches were taken in the second half of the year.

For January-May 1993 a total catch of approximately 4,500 tons has been reported (preliminary figure), which is less than in the same period in 1991 (approx. 6,000 tons), but more than in January to May 1992 (3,800 tons). In 1993, however, observers have been placed onboard most of the vessels fishing in Greenland zone in Denmark Strait, and hence the amount of unreported discard may have been significantly reduced. A total of 47 vessels participated in the spring fishery in 1993 (Table 2b).

To reduce the amount of unreported discard in the shrimp fishery Greenland authorities have in 1993 implemented an observers programme with two observers onboard each vessel (> 80 GRT). Also, a minimum mesh size of 55 mm (stretched) in the cod-end has been introduced from April 1, 1993.

Geographical distribution of the fishery.

Fig. 1 shows the distribution of total catches by Greenland vessels in 1992 and Fig. 2 the monthly distribution of CPUE and effort from January 1992 to April 1993 by statistical rectangle.

The geographical distribution of catches in 1992 (Fig. 1) was similar to that of 1990 and 1991 (Carlsson and Kannevorff, 1991, 1992). In previous years it changed substantially between years, depending primarily on variations in ice coverage and the distribution of shrimp over the area (Carlsson and Kannevorff, 1990), but in the last three years it concentrated in the same areas between 65°30' and 67°N and 30° and 32°W.

In 1990 the northern part of the so-called 'redfish-box' southwest of the traditionally most important shrimp fishing areas was opened to the shrimp fishery. The 'redfish-box' was originally pointed out in the early eighties by the ICES Redfish Working Group as an important nursery area for especially redfish and was as such closed for trawling. The area follows the east coast of Greenland from 63°30'N to 67°N. The opening in 1990 resulted in temporarily high catch rates of shrimp and at the same time very little by-catch of redfish. Since then, however, catches in the area have been small. The total 'redfish-box' was opened for the shrimp fishery by Greenland authorities in early 1993, and about 50 tons of shrimp was fished south of 65°N in January to March 1993.

The monthly distribution of the fishery in 1992 (Fig. 2) and in January to March 1993 (Fig. 3) was very similar to that of 1991 (Carlsson and Kannevorff 1992). In the spring period of 1992 and again in December 1992 to March 1993 the fishery concentrated in the central parts of the fishing grounds, while in October and November it was more widespread with low catch rates. Catch rates in 1993 in the former 'redfish-box' south of 65°N (Fig. 3) were generally low.

CPUE and effort.

Monthly and semi-annual mean catch rates in the Greenland fishery in the main fishing area in Denmark Strait are shown in Table 4. While catch rates are fluctuating between months, there is a evident declining trend in mean catch rates for the January to June period from 1988 to 1993. For the July-December period mean catch rates decrease from 1988 to 1989 and show a slight increasing trend from 1990 to 1992. Monthly and semi-annual mean catch rates in the Danish and the Faroese fishery in Denmark Strait (Tables 5 and 6) show a similar decreasing trend in the January-June period and stability in the July to December period over the last three to four years.

Figure 4 shows the monthly mean catch rates in the Greenland fishery from 1986 to April 1993. The high peak catch rates found in the winter-spring fishery in earlier years are not present since 1991, and catch rates appear more stable over the fishing periods.

Standardized CPUE-index.

The results of the multiple regression analysis to standardize catch rates of large shrimp (Table 9) show that the model explains 68% of the total variation with all three variables highly significant. T-values suggest that for all years from 1987 to 1991 catch rates were significantly higher than in 1992. Histogram, box- and probit plots of the residuals (Fig. 5) suggest that the residuals are normally distributed without marked outliers.

Results of the same model run for the total catch (not shown here) were similar to the results for large shrimp catch. Because of few cells/little effort spent in June, July and August (Tables 7 and 8) the model was run omitting these month, but this had no effect to the results.

Calculated annual cpue-indices for large shrimp and total catch based on results from the regression analysis are shown in Fig. 6. Except for 1989-1990 the indices show a significantly declining trend as indicated in raw catch rates (Fig. 4).

Biological samples.

Commercial shrimp samples from the fishery in 1992 were not sorted by sexual characteristics. Fig. 8 shows length frequency diagrams for pooled samples from February 1992 by statistical units used by Iceland (Fig. 7), and Table 10 gives the numbers of shrimp by length group in the samples. The samples show considerable variation in size composition between areas. In all samples a peak is found at 26 mm carapace length. As indicated by results from the trawl survey in 1992 (Carlsson and Kannevorff, 1993) this size group may consist of males and (at that time of the year) primiparous females. Smaller size groups of males are almost absent except for the southern areas (unit 580 and 581), where peaks are found at 22 and 24 mm carapace length. A variety of size groups with peaks between 28 and 34 mm is found in all samples. The catches presented by the samples (Table 10) suggest that the density of shrimp in February 1992 was highest in the southernmost areas (unit 580 and 581), with a dominating group of females at 30 mm carapace length.

CONCLUSIONS

Reported catches of shrimp in 1992 from the Greenland part of Denmark Strait totalled 5,658 tons, the lowest catch since 1983 in that area. 52 vessels participated in the fishery. The mean catch per vessel was about 110 tons in 1992, compared to 170 tons in 1991 and about 150 tons in 1989 and 1990. The fishery took place from January to May and from September to December. 68% of the catches were taken in the first half of the year.

From January to May 1993 a catch of about 4,500 tons has been reported, taken by 47 vessels.

As in 1990 and 1991 the fishery in 1992 was concentrated in the area between 65°30 and 67°N and 30° and 32°W, different from previous years, when the fishery was more widespread. In 1993, after the opening of an area hitherto closed for the fishery, some fishing occurred southwest of the traditional area.

Semiannual mean catch rates for Greenland, Danish, and Faroese vessels show a declining trend in the January-June period from 1988 to 1993 and stability in the July-December period in the last three to four years.

Standardized catch rate indices for catch of large shrimp and total catch of 27 Greenland trawlers show a declining trend from 1987 to 1992, except for stability between 1989 and 1990.

Biological samples from the commercial fishery in February 1992 show a variety of modes, smaller males however being absent except for the southern part of the fishing area, where density of shrimp was highest, and a female component at 30 mm carapace length dominated the samples.

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Table 1a. Catches of shrimp (tons) in Denmark Strait in 1992 by nation and month as reported to the Greenland authorities (including discards).

	JAN	FEB	MAR	APR	MAJ	JUN	JUL	AUG	SEP	OKT	NOV	DEC	TOTAL
DANMARK	4	52	71	4							5	24	160
FAROE ISL.	179	98	160	16	55					10	216	358	1093
GREENLAND	363	425	693	237	104					4	31	166	2022
NORWAY	253	277	437	231	156				68	215	405	340	2393
TOTAL	798	852	1360	488	316				68	229	658	889	5658

Table 1b. Catches of shrimp (tons) in Denmark Strait in January-April 1993 (April incomplete) by nation and months as reported to the Greenland authorities (including discards).

	JAN	FEB	MAR	APR	TOTAL
DENMARK	31	25	27	16	99
FAROE ISL.	219	181	191	63	654
GREENLAND	558	490	444	229	1721
NORWAY	235	360	381	99	1075
TOTAL	1044	1055	1042	407	3549

Table 2a. No. of vessels in the shrimp fishery in Denmark Strait in 1992 by nation and month as reported to the Greenland authorities.

	JAN	FEB	MAR	APR	MAJ	JUN	JUL	AUG	SEP	OKT	NOV	DEC	TOTAL
DANMARK	1	1	2	1							1	2	3
FAROE ISL.	6	5	5	4	3					3	8	10	12
GREENLAND	11	16	15	9	5					2	2	6	19
NORWAY	11	15	16	15	10				5	15	15	15	18
TOTAL	29	37	38	29	18				5	20	26	33	52

Table 2b. No. of vessels in the shrimp fishery in Denmark Strait in January-April 1993 (April incomplete) in 1993 as reported to the Greenland authorities.

	JAN	FEB	MAR	APR	TOTAL
DENMARK	2	2	2	2	2
FAROE ISL.	10	10	8	6	10
GREENLAND	18	17	15	11	18
NORWAY	14	15	16	16	17
TOTAL	44	44	41	35	47

Table 3. Number of hours trawled by year and month from January 1986 to April 1993 (1993 incomplete) in the main fishing area in Denmark Strait as reported in available logbooks from the Greenland fishery.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug.	Sep	Oct	Nov	Dec	Total
1986	1565	2593	2413	1032	602	-	-	-	-	77	686	1160	10128
1987	3608	4471	2965	951	406	-	-	81	400	753	1915	4067	19617
1988	6951	7950	6408	1121	550	-	-	1019	1487	2586	3207	4662	35941
1989	6602	6361	3905	3505	2322	137	15	713	2290	2600	7031	7107	42588
1990	8602	8289	8299	1050	2133	116	82	352	710	1734	2121	5160	38648
1991	6793	7192	6393	7681	5045	471	38	-	404	371	505	892	35785
1992	3691	3780	5395	3658	1257	-	-	-	-	139	340	1669	19929
1993	5959	4288	1394	70	-	-	-	-	-	-	-	-	11711

Table 4. Monthly and semi-annual mean catch rates, efforts and catches from 1988 to April 1993, based on logbooks from the Greenland fishery. Semi-annual efforts are calculated from total catches and CPUES.

Year		Cpue	Effort	Catch	Cpue	Effort	Catch	
1988	Jan	301	6951	2089.8	Aug	117	1019	119.6
	Feb	226	7950	1793.2	Sep	121	1487	179.4
	Mar	152	6408	975.1	Oct	105	2586	270.5
	Apr	104	1121	116.0	Nov	157	3207	503.3
	May	114	550	62.9	Dec	205	4662	957.7
	Subtotal	219	22980	5037.0	157	12961	2030.5	
Total	219	24111	5285.0	157	13820	2165.0		
1989	Jan	249	6602	1646.6	Jul	27	15	0.4
	Feb	214	6361	1361.0	Aug	44	713	31.3
	Mar	131	3905	512.1	Sep	59	2290	135.3
	Apr	197	3505	690.6	Oct	96	2600	248.7
	May	68	2322	157.5	Nov	67	7031	474.1
	Jun	39	137	5.4	Dec	84	7107	598.9
Subtotal	192	22832	4373.2	75	19756	1488.7		
Total	192	23343	4471.0	75	20039	1510.0		
1990	Jan	139	8602	1196.8	Jul	94	82	7.7
	Feb	185	8289	1533.1	Aug	59	352	20.6
	Mar	143	8299	1186.1	Sep	64	710	45.2
	Apr	473	1050	496.9	Oct	58	1734	101.4
	May	455	2133	971.5	Nov	65	2121	138.7
	Jun	45	116	5.2	Dec	79	5160	408.5
Subtotal	189	28489	5389.6	71	10159	722.1		
Total	189	28956	5478.0	71	10298	732.0		
1991	Jan	141	6793	956.9	Jul	0	38	0.0
	Feb	128	7192	919.1	Aug	-	-	-
	Mar	101	6393	643.8	Sep	73	404	29.6
	Apr	128	7681	982.3	Oct	64	371	23.8
	May	85	5045	430.8	Nov	91	505	45.8
	Jun	72	471	33.9	Dec	105	892	93.8
Subtotal	118	33575	3966.8	87	2210	193.0		
Total	118	33991	4016.0	87	2256	197.0		
1992	Jan	93	3691	344.3	Jul	-	-	-
	Feb	114	3780	429.1	Aug	-	-	-
	Mar	123	5395	661.0	Sep	-	-	-
	Apr	72	3658	264.7	Oct	34	139	4.7
	May	101	1257	126.5	Nov	88	340	29.8
	Jun	-	-	-	Dec	104	1669	173.8
Subtotal	103	17781	1825.6	97	2148	208.3		
Total	103	17269	1773.0	97	2001	194.0		
1993	Jan	85	5959	506.8	-	-	-	
	Feb	89	4288	380.5	-	-	-	
	Mar	97	1394	135.8	-	-	-	
	Apr	88	70	6.1	-	-	-	
Subtotal	88	11711	1029.2	-	-	-		
Total	88	18411	1618.0	-	-	-		

Table 5. Monthly and semi-annual mean catch rates, efforts and catches from 1985 to April 1992, based on logbooks from the Danish fishery. Semi-annual efforts are calculated from total catches and CPUEs.

Year	CPue Effort	Catch	CPue Effort	Catch
1985	Dec	137	304	41.7
Subtotal		137	304	41.7
Total		137	1480	203.0
1986	Jan	225	229	51.6
Feb	564	106	0.0	0.0
Mar	564	106	59.8	26.9
Apr	189	133	21.3	26.9
May	386	386	191.7	26.9
Subtotal	226	1828	443.0	57.0
Total				
1987	Mar	310	33	10.1
Apr	150	422	63.1	26.8
May	109	221	24.0	19.7
Subtotal	144	676	97.2	74.8
Total				
1988	Jan	91	0	0.0
Feb	360	32.9	80.1	17.1
Mar	104	188	19.6	37.1
Apr	78	41	3.2	32.5
May	0	0	0.0	37.4
Subtotal	95	589	55.7	124.1
Total				
1989	Jan	231	346	80.1
Feb	277	474	131.4	0
Mar	169	415	70.0	5.8
Apr	0	0	0.0	21.4
May	0	0	0.0	20.7
Jun	13	105	1.4	16.3
Subtotal	211	1340	282.9	19.0
Total				
1990	Jan	100	243	24.3
Feb	73	140	10.3	46
Mar	93	338	31.3	33
Apr	0	0	0.0	373
May	0	0	0.0	47
Jun	91	721	65.8	18.7
Subtotal	91	721	65.8	83.2
Total				
1991	Jan	0	0	0.0
Feb	52	349	18.2	0
Mar	81	424	34.4	0
Apr	78	328	25.6	330
May	0	0	0.0	521
Jun	71	1101	78.2	3
Subtotal	71	3295	234.0	15.2
Total				
1992	Jan	60	70	14.1
Feb	0	0	0.0	0
Mar	41	293	11.9	0
Apr	42	212	9.0	0
May	0	0	0.0	115
Jun	0	0	0.0	35
Subtotal	61	575	35.0	10.9
Total				

Table 6. Monthly and semi-annual mean catch rates, efforts and catches from 1986 to January 1993, based on logbooks from the Faroese fishery. Semi-annual efforts are calculated from total catches and CPUEs.

Year	CPue Effort	Catch	CPue Effort	Catch
1986	Feb	0	4	0.0
Mar	98	413	40.4	0.0
Apr	76	84	6.3	Dec
Subtotal	94	497	46.7	416
Total				
1987	Jan	361	208	74.9
Feb	226	821	185.2	Nov
Mar	175	449	78.0	Dec
Subtotal	229	1478	338.1	115
Total				
1988	Jan	204	863	176.8
Feb	196	1227	287.8	83.6
Mar	129	647	283.6	35.7
Apr	176	468	35.7	7.3
May	104	70	7.3	550.8
Subtotal	166	3319	669.0	106
Total				
1989	Jan	158	862	136.2
Feb	111	626	69.3	Nov
Mar	108	781	84.3	Dec
Apr	297	230	68.3	108
Subtotal	143	2499	358.1	93
Total				
1990	Jan	93	1205	112.5
Feb	109	1307	142.2	Nov
Mar	85	957	81.2	Dec
Apr	24	113	2.6	45
May	269	660	177.5	307
Subtotal	122	4242	516.0	90
Total				
1991	Jan	112	1980	221.6
Feb	91	2322	286.7	Sep
Mar	68	1790	122.5	Oct
Apr	123	330	42.2	Nov
Subtotal	33	7022	853.0	60
Total				
1992	Jan	64	1808	115.5
Feb	66	1538	104.2	Oct
Mar	96	1132	104.2	Nov
Apr	52	356	18.4	Dec
May	59	1472	86.2	25
Subtotal	68	6308	429.9	230
Total				
1993	Jan	57	404	23.2
Subtotal	57	10814	621.0	145.7
Total				

Table 7. Total effort (hours) by month and year as reported in logbooks for 27 Greenland trawlers in Denmark Strait 1987-92 as used in the multiplicative model.

MONTH	YEAR					
	87	88	89	90	91	92
1	3225	6185	6035	8142	6632	3268
2	3776	6366	5879	8119	7017	3310
3	1873	4735	3664	7793	6094	4813
4	824	512	3410	830	7516	2955
5	387	498	2161	1320	4897	1214
6			130	78	457	
7			15	82		
8	70	967	669	296		
9	398	951	2162	655	385	
10	484	2185	2328	1189	350	119
11	1395	2860	6636	1635	489	339
12	3460	4493	6300	4791	851	1616

Table 8. Number of cells with data by month and year used in the multiplicative model (Re. Table 7).

MONTH	YEAR					
	87	88	89	90	91	92
1	10	18	21	24	17	10
2	12	18	24	23	19	15
3	7	18	21	22	19	12
4	3	2	12	5	19	7
5	1	2	11	8	14	5
6			2	2	2	
7			1	2		
8	1	3	4	3		
9	1	4	7	3	1	
10	2	8	10	5	1	2
11	7	11	19	7	1	1
12	13	15	23	14	4	6

Table 9. Anova table and parameter estimates with calculated standard errors (shrimp >8.5 g).

GENERAL LINEAR MODEL PROCEDURE									
DEPENDENT VARIABLE: LNCRUF									
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.		
MODEL	43	162.05658059	3.76899006	27.18	0.0	0.678439	7.9263		
ERROR	541	76.81037707	0.14197857				LNCRUF MEAN		
CORRECTED TOTAL	583	238.86695980				0.37680037	4.75378019		
SOURCE	DF	TYPE III SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F	
VESS	26	34.78453150	9.40	0.0001	26	38.78154086	10.51	0.0001	
YR	5	45.01876285	63.40	0.0001	5	63.24630582	89.09	0.0001	
MO	11	82.25328804	52.67	0.0001	11	82.25328804	52.67	0.0001	
PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > T	STD ERROR OF ESTIMATE					
INTERCEPT	3.69222016	41.05	0.0	0.08993650					
VESS	0.03388894	0.29	0.7701	0.11591918					
YR	0.28335941	2.32	0.0207	0.12310285					
MO	0.04812550	0.48	0.6286	0.0965085					
QUTN	0.12546309	1.88	0.0617	0.0666699					
QULQ	-0.02120385	-2.86	0.0044	0.0740532					
QUUQ	0.15073022	1.50	0.1340	0.10047460					
QUPJ	-0.58003877	-3.15	0.0017	0.18881435					
QUJH	-0.28888105	-1.92	0.0558	0.15073253					
QUYM	-0.32088552	-3.05	0.0024	0.10516247					
QUWV	0.57944972	5.55	0.0001	0.10468945					
QUWQ	-0.15443855	-1.47	0.1427	0.10507164					
QUWU	-0.33117128	-1.22	0.2220	0.27657667					
QUWY	-0.43591330	-2.16	0.0311	0.20162538					
QUWZ	-0.27238367	-2.56	0.0106	0.10621144					
QUXW	0.29232023	3.02	0.0026	0.09676470					
OYBZ	0.26021364	2.61	0.0093	0.09973237					
OYCK	0.15901272	1.37	0.1722	0.11634015					
OYFF	0.10762053	0.83	0.4046	0.12802168					
OYHO	0.50811276	6.00	0.0001	0.08430284					
OYKK	-0.14131073	-1.53	0.1277	0.09262992					
OYNR	0.03643167	0.36	0.7156	0.09944550					
OYNS	0.13353934	1.34	0.1809	0.09466919					
OYRK	0.14819440	1.30	0.1951	0.11392726					
OYRT	0.12535144	1.30	0.1941	0.09634103					
OYXT	0.54281949	3.35	0.0009	0.10235613					
OZKQ	0.38694462	3.76	0.0002	0.10304430					
ZZZZ	0.00000000	0							
YR	87	1.19126376	16.11	0.0001	0.07396372				
	88	1.17414204	17.83	0.0001	0.06586907				
	89	0.78098019	12.45	0.0001	0.06114243				
	90	0.68450837	10.93	0.0001	0.06264505				
	91	0.35012845	5.49	0.0001	0.06330675				
	92	0.00000000	0						
MO	1	0.67666201	11.56	0.0001	0.05895113				
	2	0.64537684	11.24	0.0001	0.05747850				
	3	0.32595938	5.53	0.0001	0.05897045				
	4	0.32521798	4.47	0.0001	0.07291560				
	5	0.02637815	1.13	0.2872	0.07610304				
	6	-0.58019832	-3.06	0.0023	0.16354522				
	7	-0.38672980	-1.70	0.0893	0.22723034				
	8	-0.50448143	-4.06	0.0001	0.12424528				
	9	-0.48532272	-4.53	0.0001	0.10722388				
	10	-0.30233503	-3.80	0.0002	0.08536008				
	11	-0.44877326	-6.22	0.0001	0.07162724				
	12	0.00000000	0						

Table 10. No. of shrimp per length group in commercial samples from 1992, pooled by month and area (Iceland area units, see Fig. 4). The entry 'Corresponding catch' is the catch represented by the samples.

Cl mm	Year-month and statistical unit				
	9202 580	9202 501	9202 630	9202 680	9202 681
13.5	0	1	0	0	0
14.0	0	0	0	0	0
14.5	1	1	0	0	0
15.0	1	0	0	0	0
15.5	0	0	0	0	0
16.0	0	1	0	0	0
16.5	2	2	0	0	0
17.0	6	4	0	0	0
17.5	8	11	0	0	0
18.0	11	11	0	1	0
18.5	15	14	0	1	2
19.0	26	15	0	2	0
19.5	21	21	0	4	0
20.0	34	27	2	11	2
20.5	34	46	3	7	3
21.0	49	49	3	13	0
21.5	67	61	3	9	5
22.0	69	61	2	13	8
22.5	77	56	4	21	13
23.0	56	52	7	14	6
23.5	76	57	8	31	6
24.0	97	58	10	37	14
24.5	62	65	10	46	23
25.0	75	46	12	52	22
25.5	77	38	15	56	29
26.0	75	50	18	48	25
26.5	45	46	10	31	25
27.0	48	34	8	21	19
27.5	55	36	5	39	13
28.0	57	51	8	44	14
28.5	70	60	11	35	17
29.0	83	67	20	39	12
29.5	105	59	14	32	20
30.0	136	76	9	29	7
30.5	153	73	8	35	9
31.0	120	55	15	30	12
31.5	107	37	5	19	7
32.0	69	36	7	16	4
32.5	37	19	6	13	4
33.0	25	17	1	8	2
33.5	9	8	3	9	0
34.0	9	3	1	3	1
34.5	4	3	1	1	0
35.0	1	1	0	0	0
35.5	0	1	0	0	0
All	2072	1429	229	771	333
No. of samples	9	6	1	3	1
Σ sample weight	27.3	18.9	3.2	10.0	4.1
Corresp. catch	4660	3409	171	673	615

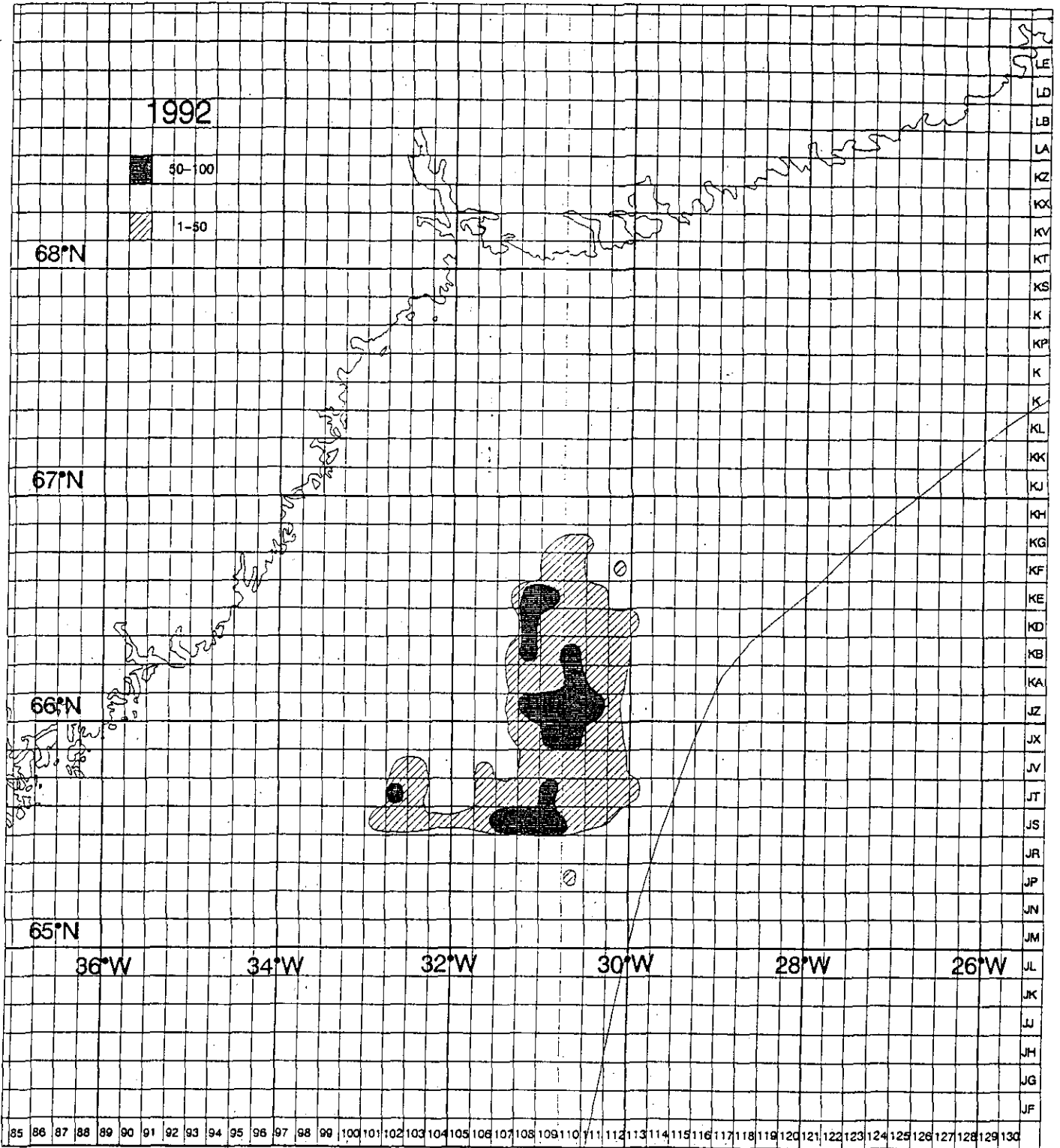


Figure 1. Distribution of catches of shrimp (tons per statistical unit) in the fishery in Denmark Strait in 1992, based on logbooks from the Greenland fishery.

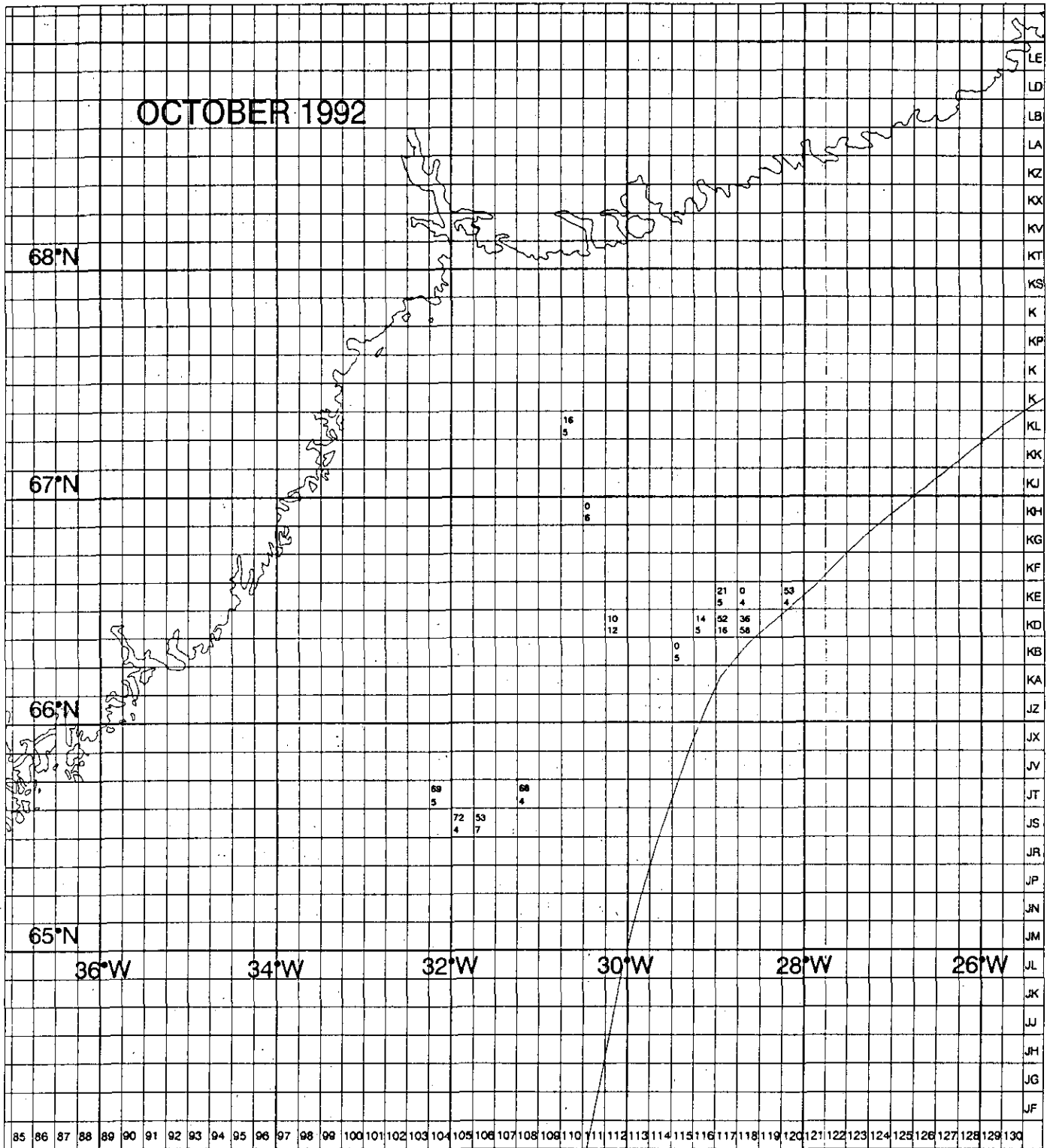


Figure 2 continued. Data from October 1992.

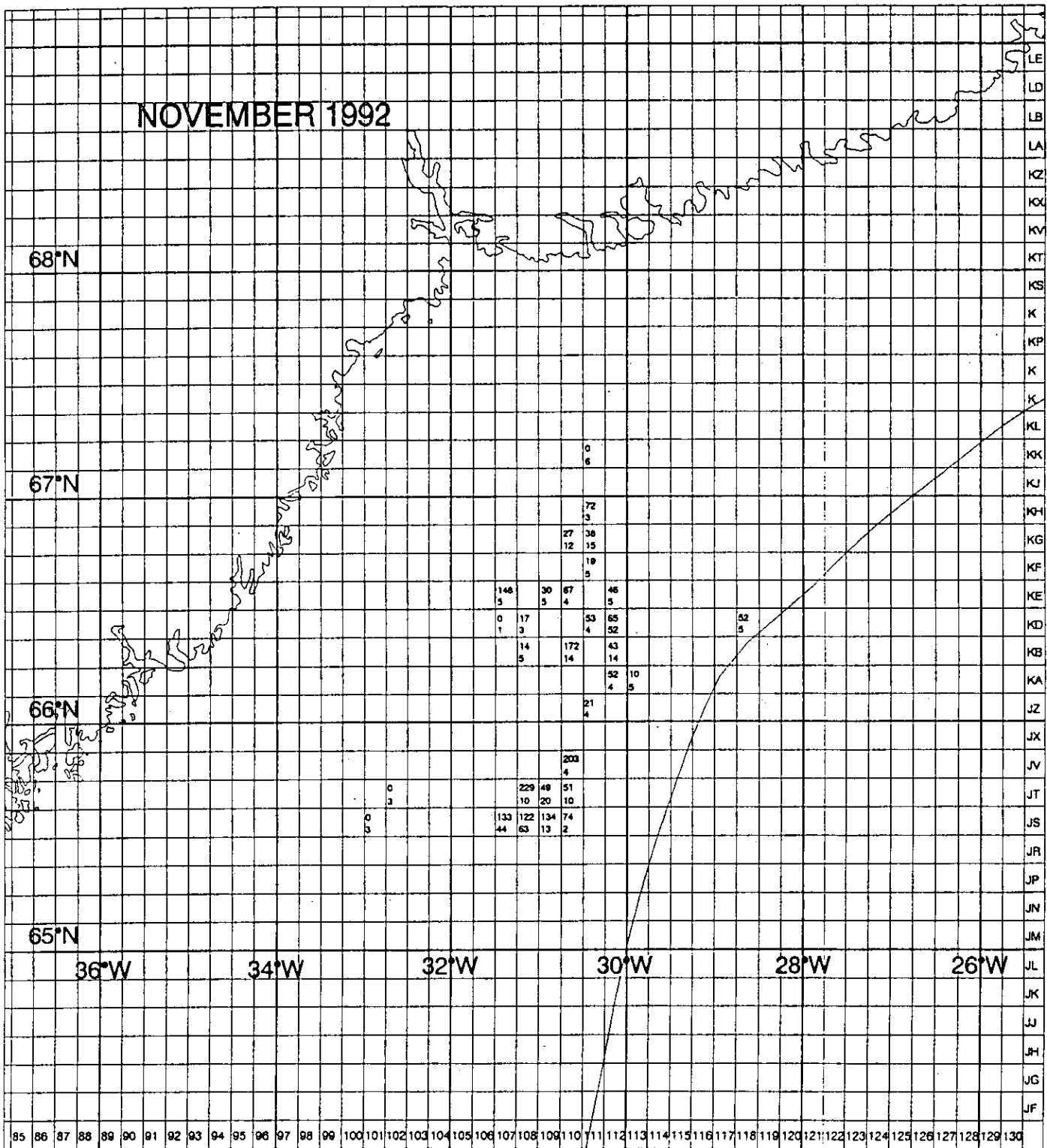


Figure 2 continued. Data from November 1992.

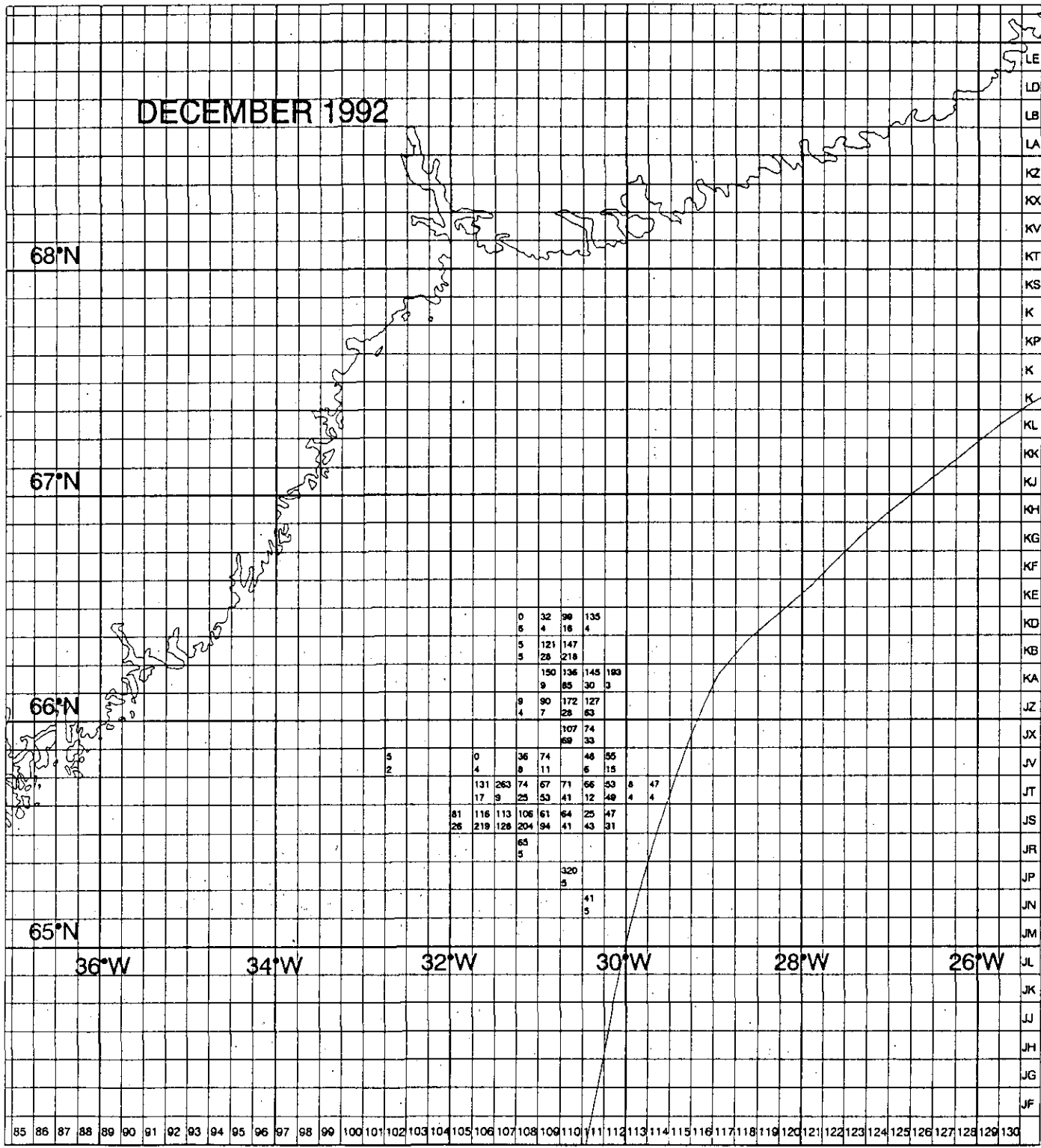


Figure 2 continued. Data from December 1992.

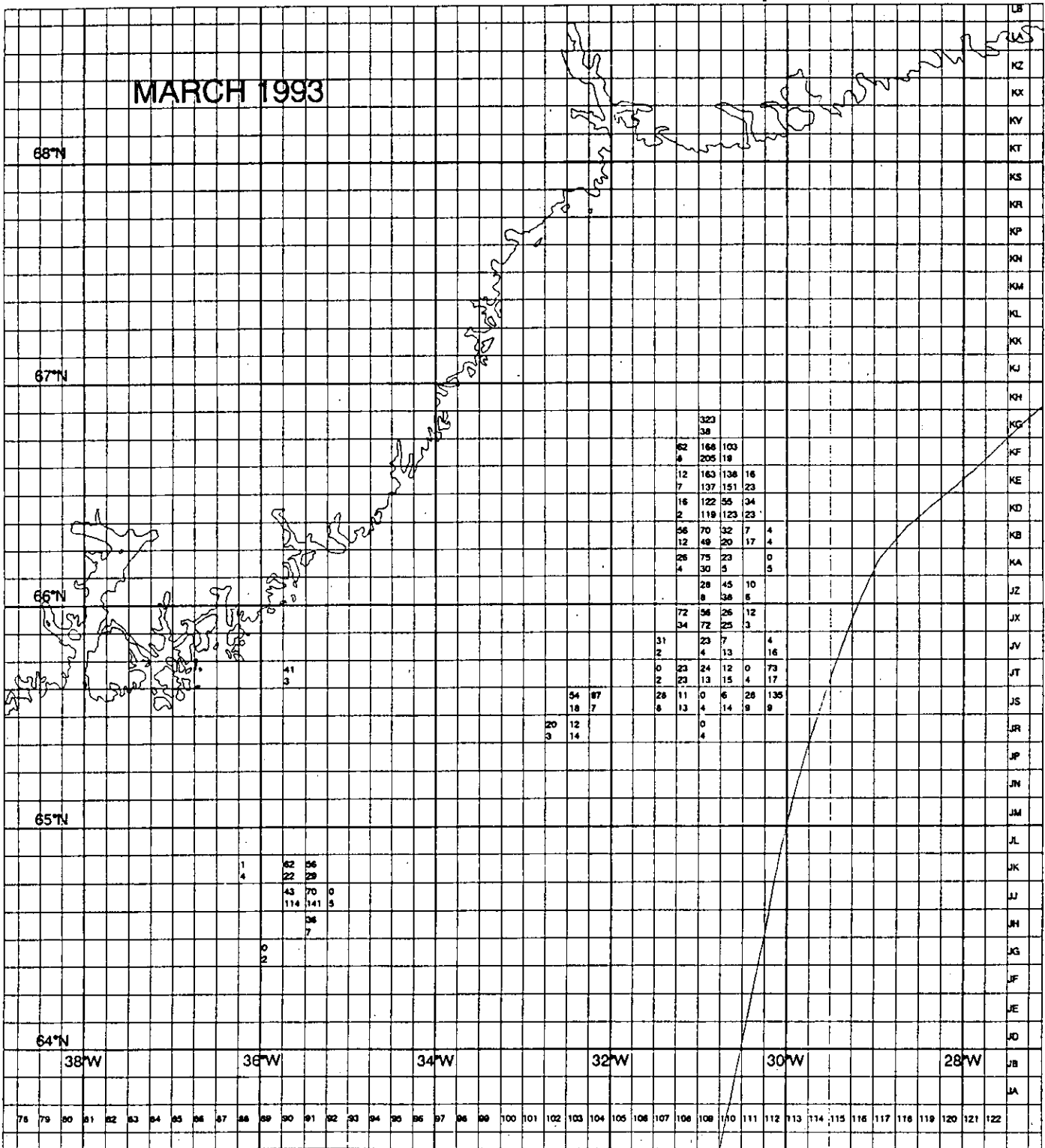


Figure 3 continued. Data from March 1993.

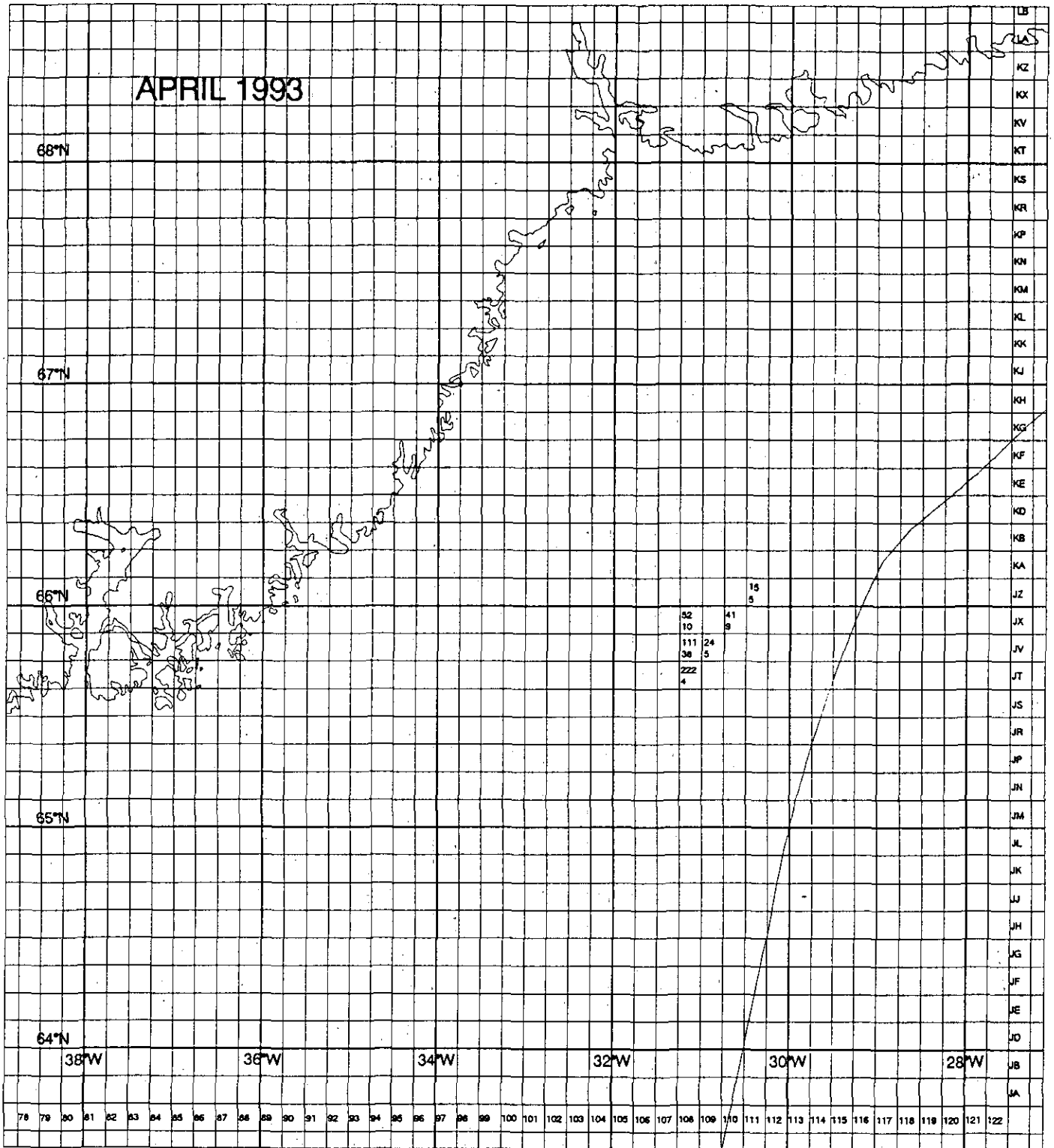


Figure 3 continued. Data from April 1993.

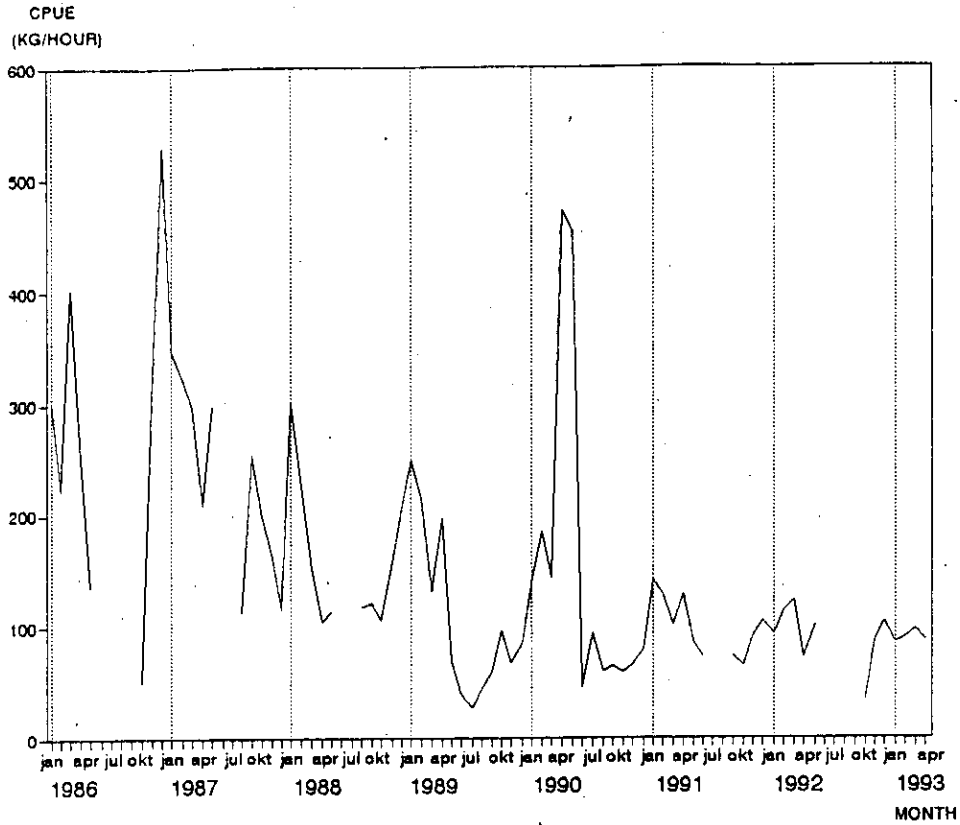


Figure 4. Monthly mean catch rates of shrimp (kg/hour) in the main fishing area in Denmark Strait from January 1986 to April 1993, based on logbook information from the Greenland fishery.

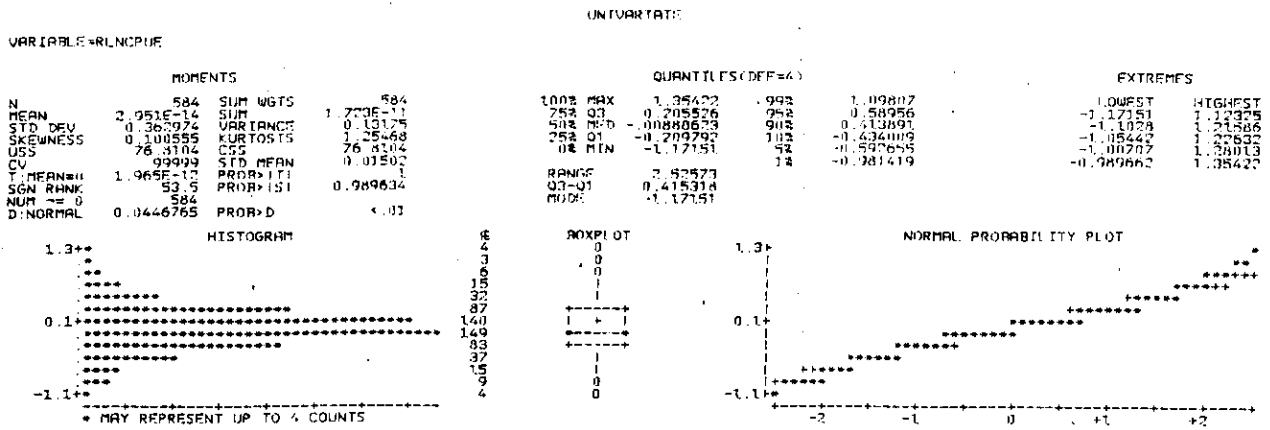


Figure 5. Histogram, Box- and Probit plot of the residuals from the multiplicative analysis in Table 9 (shrimp >8.5 g).

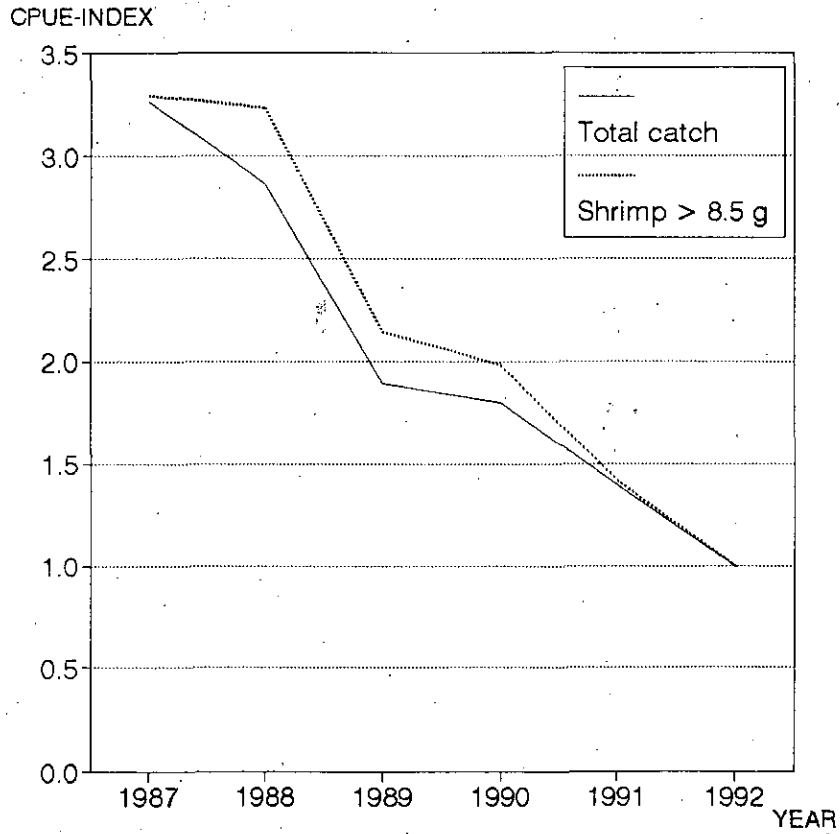


Figure 6. Annual CPUE-indices calculated for catch of shrimp >8.5 g and for total catch by 27 Greenland trawlers in Denmark Strait from 1987 to 1992.

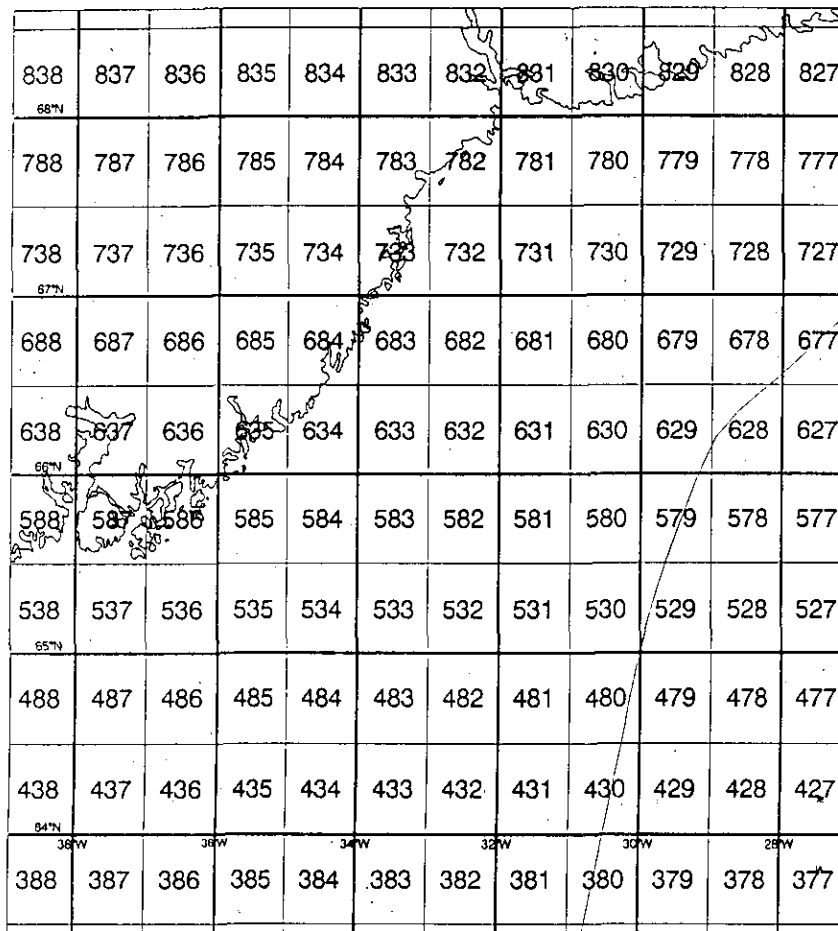


Figure 7. Map showing numbering of statistical units (Iceland system).

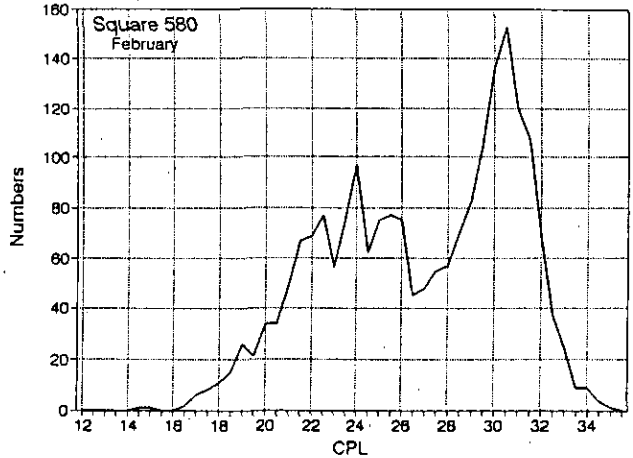
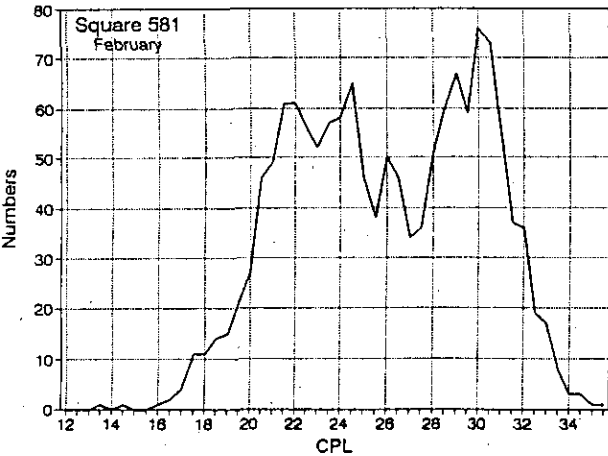
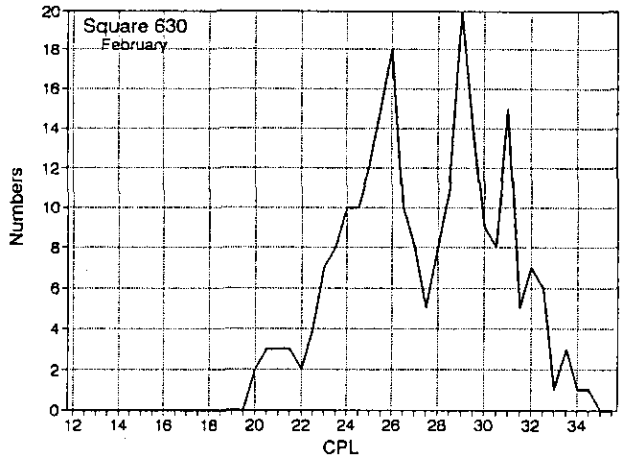
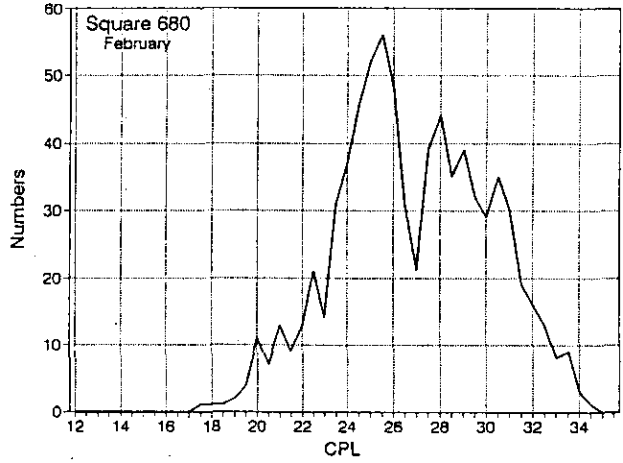
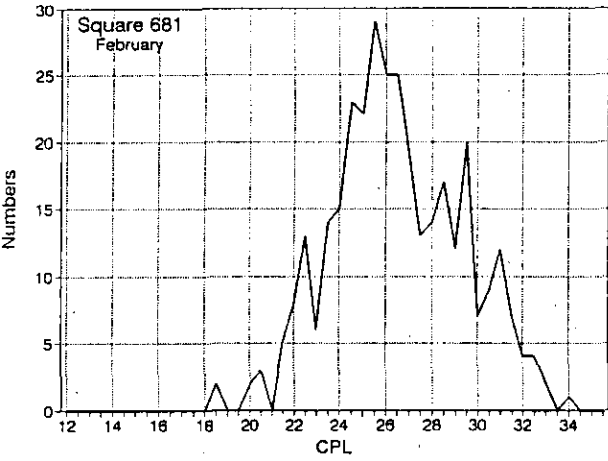


Figure 8. Pooled shrimp samples from February 1992 sampled in different statistical units (see Fig. 7).