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The Commercial Shrimp Fishery in Denmark Strait
in 1993 and January-October 1994

by

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INTRODUCTION

In November 1993 STACFIS recommended that the total allowable catch of shrimp in the Denmark Strait in 1994 should be 5,000 tons. In 1993 and again in 1994 the effective TAC in the Greenland zone was set to 9,563 tons, of which 3,888 tons each year was allocated to Greenland. Reported catches by Greenland vessels in 1993 totalled 2,343 tons and the total catch amounted to 5,086 tons. By the end of October 1994 total catch reported from this area was 6,213 tons, of which Greenland vessels accounted for approximately 3,200 tons. Greenland, Denmark, the Faroe Islands and Norway participated in the fishery in the Greenland zone in 1993 and 1994.

In 1993 the fishery was carried out from January to May and from September to December, most effort being spent in the spring. Approximately 4,550 tons of shrimp were reported from the first period and 500 tons from the second period. In 1994 the fishery was carried out in all months until October except for June. Reported catches from the spring period (January-May) in 1994 amounted to 5,056 tons of a total of 6,213 tons.

Logbooks from 18 Greenland, two Danish and ten Faroese vessels fishing in East Greenland in 1993 and 1994 have been available.

In the last two years the geographical distribution of the Greenland shrimp fishery has extended south of 65°N into areas which previously were not fished or fished only occasionally. In 1994 two thirds of the Greenland catches have been taken in the area south of the traditional fishing zone.

The present paper updates information given by Carlsson et al. (1993). Catch and effort data, geographical distribution of the fishery and size composition of catches are compared to previous years.

MATERIALS AND METHODS

Based on compulsory weekly reporting to Greenland authorities by vessels above 75 GRT, total catch and number of vessels fishing in the Greenland zone were compiled by nation and month.

Logbook data were analyzed to show the overall distribution of catches by year, and of catch, effort and catch-rates by month. Monthly mean catch-rates from 1989 to October 1994 were calculated from available logbook data.

Logbook data from 32 Greenland trawlers were used in a multiplicative model (SAS multiple regression procedures) to calculate standardized annual catch rate indices for the years 1987-1994 in the traditional fishing area north of 65°N. Indices were calculated for total catch, and - to avoid the influence of unreported discard of smaller shrimp - for shrimp larger than 8.5 g (Carlsson and Lassen, 1991). Catch of large shrimp and total catch were aggregated by vessel, month and year.

All cells in the matrix 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. From 2784 possible cells this brought the number of cells down to 704, of which further 13 marked outliers were removed. 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 January to April 1994 were analyzed. Shrimp were measured to nearest .1 mm carapace length and pooled in .5 mm length groups by fishing area and month.

RESULTS AND DISCUSSION

Reported catches in 1993 and 1994

Table 1a and 1b show reported catches in the Greenland zone in 1993 and in January to October 1994 by nation and month. Table 2a and 2b show the corresponding numbers of reporting vessels.

Total reported catch in 1993 was 5,086 tons, a decrease from the 1992 reported catch of 5,658 tons. The reported catches in 1994 (January-October) increased to 6,213 tons.

The seasonal distribution of the fishery in 1993 was similar to previous years in that little or no fishing took place in the summer period (June to September). Fishing activities in 1994 are reported from all months except June. In January to May 1993 a total catch of 4,557 tons has been reported, in 1994 total catch for the same period has increased to 5,056 tons.

A total of 49 vessels participated in the fishery in 1993 (Table 2a), and until October 1994 a total of 45 vessels have reported in 1994 (Table 2b).

Geographical distribution of the Greenland fishery

The fishing pattern in the Denmark Strait has changed during the last two years. The fishery activities were extended south of 65°N into several areas which previously were not fished or fished only occasionally. Three areas are recognized: the traditional main fishing area between 65° and 67°N, the area between 65°N and 63°30'N, and the area south of 63°30'N.

An area along the east coast of Greenland from 63°30'N to 67°N (the 'redfish-box', Figure 1 and 2) has since the early eighties been considered as an important nursery area for redfish and has been closed for trawling. In 1990 a minor part of the area neighbouring the shrimp grounds on the Dohrn Bank was opened to the shrimp fishery. In 1993 and 1994 the total 'redfish-box' was opened to the shrimp fishery in January-May. In 1993 new fishing grounds south of 63°30'N were found and from then a substantial part of fishing efforts has been conducted in that area.

Tables 3-5 show the catches by month from January 1990 to October 1994 in the three fishing areas, as reported in available logbooks from the Greenland fleet. Annual catch in the traditional fishing area has decreased from approx. 6,000 tons in 1990 to approx. 1,000 tons in 1994 (through October). Until 1993 the fishery in the two southern areas was at a low level, but it has increased substantially since then. Catches increased to 1,743 tons in January to October 1994 in the fishing area south of 63°30'N. Figure 1 shows the total Greenland catch in East Greenland waters from 1990 to October 1994 and the catch in the three fishing areas in the same period.

Figure 2 and 3 show the distribution of total catches by Greenland vessels in 1993 and January-October 1994 respectively by statistical unit of 7.5' latitude and 15' longitude. Figure 4 shows the monthly distribution of CPUE and effort from December 1993 and Figure 5 shows the same information from January to October, 1994 by statistical unit.

From January to March 1994 the distribution of effort north of 65°N was more concentrated in the central part of the traditional fishing grounds than it was in 1993 (Carlsson et al. 1993). The catch rates in the central part were higher in 1994 in the same area and period than in 1993 and 1992. The catch rates in the western part of the traditional fishing area were low compared to both 1992 and 1993. The fishery south of 65°N shows high catch rates both 1993 and in January to May 1994.

CPUE and effort

Monthly and semi-annual mean catch rates based on logbooks from the Greenland fishery in the traditional fishing area (north of 65°N) in Denmark Strait are shown in Table 6. Catch rates fluctuated between months, but the January-June period generally showed higher catch rates than the July-December period. For the January-June period mean catch rates decreased from 1989 to 1993, but increased in 1994. For the July-December period mean catch rates decreased from 1989 to 1990 and show an increasing trend from 1991 to 1993. Only little effort was spent in the area in autumn 1993.

In the area between 63°30'N and 65°N (Table 7) catch rates in 1993 and 1994 fluctuated from January to June, very little effort was spent in the July-December period. The area south of 63°30'N (Table 8) showed high catch rates in both 1993 and 1994, fluctuating only slightly between months. The spring mean catch rate in the area was more than twice the mean catch rate in the north.

Monthly and semi-annual mean catch rates in the Danish and the Faroese fishery in the traditional area north of 65°N (Table 9 and 11) show a decreasing trend from 1988 to 1993 - but increased in 1994 to more than double the catch rates from previous years. South of 65°N (Table 10 and 12) the catch rates fluctuated in 1993 and 1994. In 1994 catch rates in this area were high.

In general, catch rates may be biased by changes in the amount of unreported discard, depending on quota restrictions, market prices, and size composition of the stock. Since 1993, catch rates may be affected upwards due to the introduction of an observer system, aimed at reducing unreported discards in the fishery.

Standardized CPUE-index

Results of the multiple regression analysis to standardize catch rates of large shrimp (Table 13) show that the model explains 67% of the total variation with all three variables highly significant. T-values suggest that from 1987 to 1989 catch rates were significantly higher and in 1992 and 1993 significantly lower than in 1994. Histogram, box- and probit plots of the residuals are shown in Fig. 7.

Results of the same model run for the total catch showed significantly higher catch rates in 1987 and 1988, and significantly lower catch rates from 1991 to 1993 when compared to 1994.

Calculated annual cpue-indices for large shrimp and total catch based on results from the regression analysis are shown in Fig. 6. The indices show a significantly declining trend from 1987 to 1992, stability between 1992 and 1993, and an increase from 1993 to 1994.

Biological samples

Shrimp samples from the commercial fishery are available from January-April 1994. The samples from January and February were sorted only in males and females. Samples from March-April were sorted by sexual characteristics.

Figure 8 show the sample sites and Figure 9a and 9b show length frequency diagrams for the samples, pooled by the three fishing areas and month. Table 14a and 14b gives the numbers of shrimp by length group in the samples by area and month.

Samples from the traditional fishing grounds north of 65°N (Figure 9a) are available from February 1994. The distribution show peaks occurring at 23, 25, and 28.5 mm CL, with 25 mm being the most dominant. Samples from the same area and month in 1993 (Carlsson et al. 1993) show almost the same distribution, but the peak at 28.5 mm CL in the 1994 samples is more dominant indicating a more dominant female component.

Samples from the 'redfish-box' area between 64°-65°N from March (Figure 9a) and April (Figure 9b) show a distribution with a number of size groups indicated. The female component decreased from March to April.

Samples from around 62°N are from January, February and April. Dominant peaks occur at 23-24 mm CL and 28-29 mm CL. The abundance of the female component in April is lower than in samples from January and February. Samples from the same area in 1993 in March and April, were dominated by a peak at 22-24 mm CL, and the abundance of larger shrimp was low. The relative abundance of the female component in the area is larger in 1994 compared to 1993.

In 1994 females up to 35 mm carapace length occur in all three areas.

CONCLUSIONS

Reported catches of shrimp from the Greenland part of Denmark Strait in 1993 totalled 5,086 tons. The reported catches in 1994 (January-October) amounted 6,213 tons. The seasonal distribution of the fishery in 1993 was similar to previous years in that little or no fishing took place in the summer period (June to September). Fishing activities in 1994 (January-October) are reported from all month except June. A total of 49 vessels participated in the fishery in 1993, and so far 45 vessels have reported in 1994.

The geographical distribution of the Greenland shrimp fishery has the last two years extended south of 65°N into areas previously not fished or fished only occasionally. In 1994 two-third of the catches has been taken in the area south of the traditional fishing area.

Similar to 1990-1992 the fishery in the traditional fishing area north of 65°N took place in the area between 65°30' and 67°N and 30° and 32°W, in 1993 and 1994 it was, however, more concentrated than in previous years.

Semiannual mean catch rates in the traditional fishing area for Greenland, Danish, and Faroese vessels show a declining trend in the January-June period from 1989 to 1992 and stability between 1992 and 1993. In the July-December period catch rates were stable from 1989 to 1992. In both 1993 and 1994 very little effort was spent in the July-December period in the traditional fishing area. In 1994 the catch rates increased in all area.

Standardized catch rate indices for catch of large shrimp and total catch of 32 Greenland trawlers in the traditional fishing area show a declining trend from 1987 to 1992, stability between 1992 and 1993, and a significant increase from 1993 to 1994.

The introduction in 1993 of an observer program to minimize unreported discard in the shrimp fishery may affect catches and catch rates upwards when compared to earlier years.

Biological samples from the commercial fishery in January-April indicate that the female component is more dominant in 1994 than in 1993 in the traditional fishing area. Samples taken south of 65°N show a decrease in the relative abundance of the female component from March to April.

REFERENCES

- Carlsson, D.M. & H. Lassen, 1991. A Catch-rate Index for Large Shrimp in the Greenland Shrimp Fishery in NAFO Division 1B. NAFO SCR Doc. 91/57. Ser. No. N1941.
- Carlsson, D.M. & P. Kannevorf & H. Slegstad, 1993. The Commercial Shrimp Fishery in Denmark Strait January to October 1993. NAFO SCR Doc. 93/131. Ser. No. N2343.

Table 1a. Catches of shrimp (t) in Denmark Strait in 1993 by nation and month as reported to the Greenland authorities (including discards).

YEAR 1993

AREA	NATION	MONTH									TOTAL
		JAN	FEB	MAR	APR	MAJ	SEP	OCT	NOV	DEC	
14B	DENMARK	31	25	27	28	21	1	13	.	12	158
	FAROE ISL.	220	180	191	111	5	1	.	1	71	780
	GREENLAND	559	490	445	445	296	.	.	.	108	2343
	NORWAY	236	359	381	335	171	48	117	96	62	1804
TOTAL		1046	1054	1043	919	494	50	129	97	253	5086

Table 1b. Catches of shrimp (t) in Denmark Strait in January-October 1994 (October incomplete) by nation and month as reported to the Greenland authorities (including discards).

YEAR 1994

AREA	NATION	MONTH									TOTAL
		JAN	FEB	MAR	APR	MAJ	JUL	AUG	SEP	OCT	
14B	DENMARK	18	8	29	49	14	.	150	43	104	414
	FAROE ISL.	284	188	73	127	69	.	.	.	3	744
	GREENLAND	1049	888	488	229	96	9	447	3	8	3217
	NORWAY	135	269	336	510	196	.	124	189	77	1837
TOTAL		1486	1353	926	916	375	9	721	234	193	6213

Table 2a. No. of vessels in the shrimp fishery in Denmark Strait in 1993 by nation and month as reported to the Greenland authorities.

YEAR 1993

AREA	NATION	MONTH									TOTAL
		JAN	FEB	MAR	APR	MAJ	SEP	OCT	NOV	DEC	
14B	DENMARK	2	2	2	2	1	1	1	.	1	2
	FAROE ISL.	10	10	8	6	1	1	.	1	1	10
	GREENLAND	18	17	15	11	3	.	.	.	2	18
	NORWAY	14	15	16	16	11	5	8	11	5	19
	TOTAL	44	44	41	35	16	7	9	12	9	49

Table 2b. No. of vessels in the shrimp fishery in Denmark Strait in January-October 1994 (October incomplete) by nation and month as reported to the Greenland authorities.

YEAR 1994

AREA	NATION	MONTH									TOTAL
		JAN	FEB	MAR	APR	MAJ	JUL	AUG	SEP	OCT	
14B	DENMARK	1	1	1	1	1	.	2	1	2	2
	FAROE ISL.	4	5	2	4	6	.	.	.	1	9
	GREENLAND	15	16	11	5	3	1	4	1	1	18
	NORWAY	4	4	9	12	10	.	7	8	7	16
	TOTAL	24	26	23	22	20	1	13	10	11	45

Table 3. Monthly catches by year and month from January 1990 to October 1994 in the traditional fishing area north of 65°N in Denmark Strait, as reported in available logbooks from the Greenland fleet.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	1197	1533	1187	496.9	971.5	5.2	7.7	20.6	45.2	101.7	138.7	408.5	6 112.8
1991	956.9	919.1	643.8	982.2	430.8	33.9	0	0	29.6	24.1	45.8	93.8	4 160.0
1992	344.3	429.1	660.8	264.7	126.5	0	0	0	0	4.7	29.8	173.8	2 033.7
1993	527.2	468.1	280.6	33.1	0.4	0	0	0	0	0	0	16.7	1 326.1
1994	182.1	519.9	337.0	2.8	0	0	0	0	0	0	-	-	1 041.8

Table 4. Monthly catches by year and month from January 1990 to October 1994 in the 'middel' fishing area north of 63°30'N. and south of 65°N in Denmark Strait, as reported in available logbooks from the Greenland fleet.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	0	0	2.8	0	0	0	0	0	0	0	0	0	2.8
1991	0	0	0	0	0.2	0	0	0	0	0	0	0	0.2
1992	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1993	10.2	24.4	64.3	396.5	295	0	0	0	0	0	0	0.9	791.3
1994	72.5	57.0	107.0	160.8	31.2	0	0	11.5	0	0	-	-	440.0

Table 5. Monthly catches by year and month from January 1990 to October 1994 in the fishing area south of 63°30'N in Denmark Strait, as reported in available logbooks from the Greenland fleet.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1991	0	0	0	0.8	0	0	0	0	0	0	0	0	0.8
1992	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1993	1.0	0	65.3	39.2	8.0	0	0	0	0	0	0	90.1	203.6
1994	806.2	302.1	14.1	78.8	86.3	0	8.8	402.7	34.7	0	-	-	1 733.7

Table 6. Monthly and semi-annual mean catch rates, efforts and catches from 1989 to October 1994, based on logbooks from the Greenland fleet. Data from 1993 and 1994 are from the traditional fishing area north of 65°N only.

Year		Cpue	Effort	Catch(t)		Cpue	Effort	Catch(t)
1989	Jan	249	6 602	1 646.6	Jul	27	15	0.4
	Feb	214	6 361	1 361.0	Aug	44	713	31.3
	Mar	131	3 905	512.1	Sep	59	2 290	135.3
	Apr	197	3 505	690.9	Oct	96	2 600	248.7
	May	68	2 322	157.5	Nov	67	7 031	474.1
	Jun	39	137	5.4	Dec	84	7 107	598.9
		192	22 832	4 373.5		75	19 756	1 488.7
1990	Jan	139	8 629	1 196.8	Jul	94	82	7.7
	Feb	184	8 314	1 533.1	Aug	56	366	20.6
	Mar	142	8 371	1 186.9	Sep	63	712	45.2
	Apr	473	1 050	496.9	Oct	59	1 736	101.7
	May	453	2 143	971.5	Nov	65	2 125	138.7
	Jun	45	116	5.2	Dec	79	5 196	408.5
		188	28 623	5 390.4		71	10 217	722.4
1991	Jan	140	6 812	956.9	Jul	0	38	0.0
	Feb	128	7 205	919.1	Aug	0	0	0.0
	Mar	101	6 403	643.8	Sep	73	404	29.6
	Apr	128	7 700	982.2	Oct	64	375	24.1
	May	85	5 084	430.8	Nov	91	505	45.8
	Jun	72	471	33.9	Dec	105	892	93.8
		118	33 675	3 966.7		87	2 214	193.3
1992	Jan	93	3 698	344.3	Jul	0	0	0.0
	Feb	113	3 802	429.1	Aug	0	0	0.0
	Mar	122	5 423	660.8	Sep	0	0	0.0
	Apr	72	3 664	284.7	Oct	33	143	4.7
	May	100	1 260	126.5	Nov	83	358	29.8
	Jun	0	0	0.0	Dec	104	1 669	173.8
		102	17 847	1 825.4		96	2 170	208.3
1993	Jan	85	6 216	527.2	Jul	0	0	0.0
	Feb	92	5 066	468.1	Aug	0	0	0.0
	Mar	120	2 347	280.6	Sep	0	0	0.0
	Apr	85	390	33.1	Oct	0	0	0.0
	May	13	26	0.4	Nov	0	0	0.0
	Jun	0	0	0.0	Dec	175	95	16.7
		93	14 045	1 309.4		176	95	16.7
1994	Jan	216	844	182.1	Jul	0	0	0.0
	Feb	171	3 037	519.9	Aug	0	0	0.0
	Mar	154	2 194	337.0	Sep	0	0	0.0
	Apr	37	76	2.8	Oct	0	0	0.0
	May	0	2	0.0	Nov			
	Jun	0	0	0.0	Dec			
		169	6 153	1 041.8			0	0.0

Table 7. Monthly and semi-annual mean catch rates, efforts and catches from 1993 to October 1994, based on logbooks from the Greenland fleet. Data are from the fishing area north of 63°30'N and south of 65°N.

Year		Cpue	Effort	Catch(t)		Cpue	Effort	Catch(t)
1993	Jan	142	72	10.2	Jul	0	0	0.0
	Feb	70	350	24.4	Aug	0	0	0.0
	Mar	105	613	64.3	Sep	0	0	0.0
	Apr	173	2 298	396.5	Oct	0	0	0.0
	May	336	878	295.0	Nov	0	0	0.0
	Jun	0	0	0.0	Dec	112	8	0.9
		188	4 211	790.4		113	8	0.9
1994	Jan	179	405	72.5	Jul	0	0	0.0
	Feb	190	300	57.0	Aug	807	14	11.5
	Mar	178	600	107.0	Sep	0	0	0.0
	Apr	270	595	160.8	Oct	0	0	0.0
	May	126	247	31.2	Nov			
	Jun	0	0	0.0	Dec			
		200	2 147	428.5		821	14	11.5

Table 8. Monthly and semi-annual mean catch rates, efforts and catches from 1993 to October 1994, based on logbooks from the Greenland fleet. Data are from the fishing area south of 63°30'N.

Year		Cpue	Effort	Catch(t)		Cpue	Effort	Catch(t)
1993	Jan	506	2	1.0	Jul	0	0	0.0
	Feb	0	0	0.0	Aug	0	0	0.0
	Mar	346	189	65.3	Sep	0	0	0.0
	Apr	317	124	39.2	Oct	0	0	0.0
	May	179	44	8.0	Nov	0	0	0.0
	Jun	0	0	0.0	Dec	1248	72	90.1
		316	359	113.5		1251	72	90.1
1994	Jan	501	1 609	806.2	Jul	477	19	8.8
	Feb	367	823	302.1	Aug	453	890	402.7
	Mar	338	42	14.1	Sep	379	92	34.7
	Apr	329	239	78.8	Oct			
	May	352	246	86.3	Nov			
	Jun	0	0	0.0	Dec			
		435	2 959	1 287.5		446	1001	446.2

Table 9. Monthly and semi-annual mean catch rates, effort and catches from 1986 to May 1994, based on logbooks from the Faroese shrimp fishery in Denmark Strait north of 65°N.

Year	January - June				July - December			
	Mth.	Cpue	Effort	Catch	Mth.	Cpue	Effort	Catch
1986	Feb	0	4	0.0				
	Mar	98	413	40.4				
	Apr	76	84	6.3	Dec	416	164	68.2
	Subtotal	93	501	46.7		416	164	68.2
	Total	93	5428	506.0		416	531	221.0
1987	Jan	361	208	74.9				
	Feb	228	825	188.0	Nov	91	231	21.0
	Mar	175	449	78.8	Dec	115	440	50.4
	Subtotal	231	1482	341.7		106	671	71.4
	Total	231	1626	375.0		106	2068	220.0
1988	Jan	204	863	175.8				
	Feb	196	1271	248.4				
	Mar	129	647	83.6				
	Apr	76	468	35.7				
	May	104	70	7.3				
Subtotal		166	3319	550.8				
Total		166	4031	669.0				
1989	Jan	157	867	136.2				
	Feb	122	781	95.1				
	Mar	108	781	84.3	Nov	51	430	22.0
	Apr	297	230	68.3	Dec	108	1202	130.3
	Subtotal	144	2659	383.9		93	1632	152.3
Total		144	3041	439.0		93	1672	156.0
1990	Jan	93	1205	112.5				
	Feb	109	1307	142.2				
	Mar	85	957	81.2				
	Apr	24	113	2.6	Nov	45	307	13.9
	May	268	663	177.5	Dec	90	1357	122.7
Subtotal		122	4245	516.0		82	1664	136.6
Total		122	5635	685.0		82	1925	158.0
1991	Jan	112	1980	221.6	Sep	83	262	21.7
	Feb	91	2922	266.7	Oct	48	274	13.2
	Mar	68	1790	122.5	Nov	60	1335	79.7
	Apr	128	330	42.2	Dec	88	2759	244.1
	Subtotal	93	7022	653.0		77	4630	358.7
Total		93	8614	801.0		77	2659	206.0
1992	Jan	69	2040	140.0				
	Feb	66	1536	101.2				
	Mar	96	1135	108.6	Oct	31	290	9.1
	Apr	52	356	18.4	Nov	81	2120	171.6
	May	50	1234	61.7	Dec	112	3131	350.2
Subtotal		68	6301	429.9		96	5541	530.9
Total		68	7446	508.0		96	6095	584.0
1993	Jan	66	2773	182.1				
	Feb	69	2394	165.7				
	Mar	62	1674	103.8				
	Apr	57	703	40.2				
	May	59	23	1.4				
Subtotal		65	7567	493.2				
Total		65	10847	707.0				
1994	Jan	397	133	52.6				
	Feb	178	596	106.1				
	Mar	168	293	49.3				
	Apr	65	235	15.3				
	May	108	98	10.5				
Subtotal		173	1355	233.8				
Total		173	1658	286.1				

Table 10. Monthly and semi-annual mean catch rates, effort and catches from 1986 to May 1994, based on logbooks from the Faroese shrimp fishery in Denmark Strait south of 65°N.

Year	January - June				July - December			
	Mth.	Cpue	Effort	Catch	Mth.	Cpue	Effort	Catch
1993	Feb	39	153	6.0				
	Mar	73	875	64				
	Apr	65	1332	86.2				
	May	32	180	5.7	Dec	1894	38	71
	Subtotal	64	2540	161.9		1868	38	71.0
Total		64	2399	152.9		1868	38	70.8
1994	Jan	321	500	160.4				
	Feb	197	495	97.5				
	Mar	167	161	26.9				
	Apr	230	376	86.5				
	May	124	247	30.6				
Subtotal		226	1779	401.9				
Total		226	3280	740.9				

Table 11. Monthly and semi-annual mean catch rates, effort and catches from 1986 to May 1994, based on logbooks from the Danish shrimp fishery in Denmark Strait north of 65°N.

Year	January - June				July - December			
	Mth.	Cpue	Effort	Catch	Mth.	Cpue	Effort	Catch
1986	Jan	225	229	51.6				
	Mar	564	106	59.8				
	Apr	158	135	21.3	Nov	226	119	26.9
	May	157	388	61.0				
	Subtotal	226	858	193.7		226	119	26.9
	Total	226	1962	443.0		226	252	57.0
1987	Mar	310	33	10.1	Oct	105	268	28.2
	Apr	150	422	63.1	Nov	84	234	19.7
	May	109	221	24.0	Dec	107	252	26.9
	Subtotal	144	676	97.2		99	754	74.8
	Total	144	2997	431.0		99	1250	124.0
1988	Feb	91	360	32.9	Sep	84	203	17.1
	Mar	104	188	19.6	Oct	83	445	37.1
	Apr	78	41	3.2	Nov	87	375	32.5
					Dec	155	242	37.4
	Subtotal	95	589	55.7		98	1265	124.1
	Total	95	3479	329.0		98	1172	115.0
1989	Jan	231	346	80.1	Aug	52	112	5.8
	Feb	277	474	131.4	Sep	51	418	21.4
	Mar	169	415	70.0	Oct	68	305	20.7
					Nov	48	337	16.3
	Jun	13	105	1.4	Dec	72	264	19.0
	Subtotal	211	1340	282.9		58	1436	83.2
1990	Jan	100	243	24.3	Jul	46	316	14.5
	Feb	73	140	10.3	Aug	43	454	19.3
	Mar	93	338	31.3	Sep	38	373	14.2
					Oct	47	414	19.5
					Nov	46	406	18.7
	Subtotal	91	721	65.9	Dec	17	186	3.1
1991	Jan	100	243	24.3	Jul	46	316	14.5
	Feb	73	140	10.3	Aug	43	454	19.3
	Mar	93	338	31.3	Sep	38	373	14.2
					Oct	47	414	19.5
					Nov	46	406	18.7
	Subtotal	91	721	65.9	Dec	17	186	3.1
1992	Jan	60	70	4.1	Jul	46	316	14.5
	Mar	41	293	11.9	Aug	43	454	19.3
	Apr	42	212	9.0	Sep	38	373	14.2
	May				Oct	47	414	19.5
	Jun				Nov	46	406	18.7
	Subtotal	43	575	25.0	Dec	17	186	3.1
1993	Jan	34	451	15.5	Jul	46	316	14.5
	Feb	46	566	25.9	Aug	43	454	19.3
	Mar	44	477	21.2	Sep	38	373	14.2
	Apr	33	222	7.3	Oct	47	414	19.5
	Subtotal	41	1716	69.9	Nov	46	406	18.7
	Total	41	2093	85.3	Dec	17	186	3.1
1994	Jan	146	147	21.5	Jul	46	316	14.5
	Feb	72	65	4.7	Aug	43	454	19.3
	Mar	102	283	28.8	Sep	38	373	14.2
	Apr	51	110	5.6	Oct	47	414	19.5
	Subtotal	100	605	60.6	Nov	46	406	18.7
	Total	100	645	64.6	Dec	17	186	3.1

Table 12. Monthly and semi-annual mean catch rates, effort and catches from 1986 to May 1994, based on logbooks from the Danish shrimp fishery in Denmark Strait south of 65°N.

Year	January - June				July - December			
	Mth.	Cpue	Effort	Catch	Mth.	Cpue	Effort	Catch
1993	Apr	65	361	23.4				
	May	120	183	21.9				
	Subtotal	83	544	45.3				
Total		83	571	47.6				
1994	Jan	156	10	1.0				
	Feb	0	8	0				
	Apr	156	303	47.1				
	May	95	114	10.8				
	Subtotal	135	435	58.9				
Total		135	872	118.1				
					Aug	329	236	77.7
					Sep	216	79	17.1
					Subtotal	301	315	94.8
Total						301	942	283.6

Table 13. Standardization of CPUE for large shrimp (> 8.5 g):
Anova table and parameter estimates.

DEPENDENT VARIABLE: LNCPUE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE
MODEL	49	168.94506287	3.44785843	25.92
ERROR	641	85.27669566	0.13303697	PR > F
CORRECTED TOTAL	690	254.22175853		0.0

R-SQUARE	C.V.	ROOT MSE	LNCPUE MEAN
0.664558	7.7190	0.36474233	4.72525013

SOURCE	DF	TYPE I SS	F VALUE	PR > F
VESS	31	34.77553011	8.43	0.0001
YR	7	53.85375526	57.83	0.0001
MO	11	80.31577751	54.88	0.0

SOURCE	DF	TYPE III SS	F VALUE	PR > F
VESS	31	41.59966420	10.09	0.0001
YR	7	81.47875538	87.49	0.0
MO	11	80.31577751	54.88	0.0

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > T	STD ERROR OF ESTIMATE
INTERCEPT	4.18270743 B	42.37	0.0	0.09872576
VESS				
OUIN	0.05873543 B	0.54	0.5903	0.10905066
OUIQ	0.31497358 B	2.73	0.0065	0.11532481
OUKV	0.53546816 B	2.75	0.0062	0.19489753
OUOQ	0.08941883 B	1.00	0.3191	0.08967434
OUPJ	0.21705127 B	2.53	0.0115	0.08568569
OUTM	-0.28088074 B	-2.81	0.0050	0.09981002
OUWH	0.17458105 B	1.97	0.0490	0.08850645
OUYM	-0.47265896 B	-3.12	0.0019	0.15145310
OWDV	-0.26714079 B	-1.86	0.0631	0.14348992
OWCG	0.38358629 B	2.52	0.0121	0.15244353
OWLQ	-0.29752901 B	-3.02	0.0026	0.09840750
OWQU	0.51929035 B	5.55	0.0001	0.09360492
OWSH	-0.12935940 B	-1.32	0.1886	0.09829171
OWUD	-0.29698966 B	-1.12	0.2652	0.26633384
OWUJ	-0.41170753 B	-2.13	0.0336	0.19337729
OWVM	-0.23857056 B	-2.47	0.0136	0.09645713
OWWP	0.30159616 B	3.39	0.0008	0.08908599
OWZR	-0.41586103 B	-2.71	0.0070	0.15367089
OXSY	-0.25096269 B	-1.64	0.1011	0.15284248
OYAO	-0.28605191 B	-1.76	0.0793	0.16273690
OYBZ	0.28734929 B	3.30	0.0010	0.08716898
OYCK	0.14719728 B	1.50	0.1328	0.09780884
OYFF	0.13766123 B	1.13	0.2604	0.12219903
OYHO	0.48116230 B	6.39	0.0001	0.07533817
OYKK	-0.10399218 B	-1.26	0.2082	0.08253924
OYNR	0.04639470 B	0.52	0.6066	0.09005055
OYNS	-0.09392153 B	-1.06	0.2899	0.08866609
OYRK	0.17258399 B	1.61	0.1081	0.10727231
OYRT	0.18817092 B	2.20	0.0279	0.08540532
OYXT	0.33955237 B	3.85	0.0001	0.08814555
OZKQ	0.42238982 B	4.56	0.0001	0.09256914
ZZZZ	0.00000000 B			
YR				
87	0.69424961 B	8.08	0.0001	0.08596331
88	0.65834807 B	8.29	0.0001	0.07937569
89	0.25632772 B	3.33	0.0009	0.07690286
90	0.15277727 B	1.96	0.0500	0.07780571
91	-0.14307548 B	-1.80	0.0722	0.07943741
92	-0.49540786 B	-5.93	0.0001	0.08349951
93	-0.57008266 B	-6.70	0.0001	0.08514228
94	0.00000000 B			
MO				
1	0.64971123 B	12.02	0.0001	0.05403380
2	0.61283194 B	11.50	0.0001	0.05328946
3	0.37239126 B	6.82	0.0001	0.05459029
4	0.28876622 B	4.31	0.0001	0.06702052
5	0.06316198 B	0.86	0.3894	0.07334148
6	-0.48659708 B	-3.08	0.0021	0.15776953
7	-0.36925626 B	-1.68	0.0932	0.21965552
8	-0.49560412 B	-4.13	0.0001	0.11989368
9	-0.45823975 B	-4.54	0.0001	0.10097285
10	-0.31935630 B	-3.88	0.0001	0.08225620
11	-0.43084202 B	-6.29	0.0001	0.06848205
12	0.00000000 B			

Tabel 14a. No. of shrimp per length group in commercial samples from 1994, pooled by month and fishing area (see figure 8). The entry 'catch' is the total catch from which samples were taken.

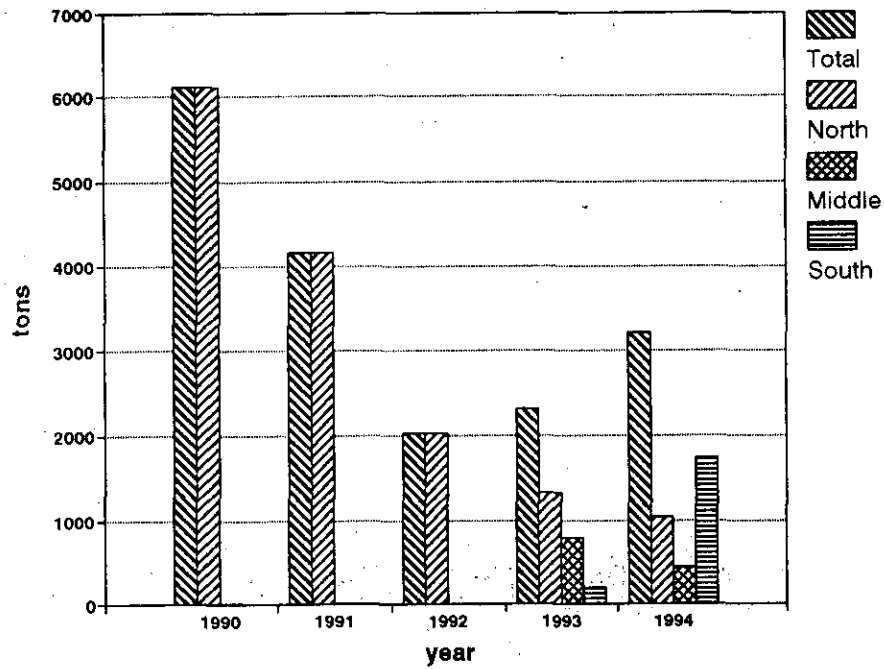
East-green land	month							
	1							
	area							
	61°N				62°N			
	sample w				sample w			
	190.45				8730.8			
	catch				catch			
	0				4010630			
	No. of samples				No. of samples			
	1				30			
MM	male	primi	fema-le	all	male	primi	fema-le	all
5	0	0	0	0	0	0	0	0
5.5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
6.5	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
11.5	0	0	0	0	1	0	0	1
12	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0
13	0	0	0	0	1	0	0	1
13.5	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
14.5	0	0	0	0	2	0	0	2
15	0	0	0	0	3	0	0	3
15.5	0	0	0	0	9	0	0	9
16	0	0	0	0	14	0	0	14
16.5	0	0	0	0	14	0	0	14
17	0	0	0	0	27	0	0	27
17.5	1	0	0	1	35	0	0	36
18	0	0	0	0	41	0	0	41
18.5	2	0	0	2	54	0	0	54
19	1	0	0	1	73	0	0	73
19.5	4	0	0	4	108	0	0	108
20	11	0	0	11	124	0	0	124
20.5	8	0	0	8	146	0	0	146
21	22	0	0	22	167	0	0	167
21.5	36	0	0	36	208	1	0	209
22	37	0	0	37	228	8	0	236
22.5	35	0	0	35	263	12	0	275
23	38	0	0	38	296	28	0	324
23.5	35	0	0	35	281	42	0	323
24	27	0	0	27	264	87	0	351
24.5	25	0	1	26	232	108	0	340
25	20	0	2	22	205	168	0	373
25.5	2	0	5	7	166	231	0	397
26	5	0	3	8	145	314	0	459
26.5	2	0	8	10	108	391	0	500
27	1	0	6	7	82	454	0	536
27.5	0	0	6	6	47	536	0	583
28	1	0	2	3	33	533	0	566
28.5	0	0	0	0	11	585	0	596
29	0	0	2	2	6	561	0	567
29.5	0	0	1	1	0	510	0	510
30	0	0	0	0	0	440	0	440
30.5	0	0	0	0	0	462	0	462
31	0	0	0	0	0	366	0	366
31.5	0	0	0	0	0	314	0	314
32	0	0	0	0	0	207	0	207
32.5	0	0	0	0	0	113	0	113
33	0	0	0	0	0	54	0	54
33.5	0	0	0	0	0	23	0	23
34	0	0	0	0	0	7	0	7
34.5	0	0	0	0	0	5	0	5
35	0	0	0	0	0	1	0	1
35.5	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
36.5	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
TOTAL	313	0	36	349	3394	0	6561	9957

East-green land	month							
	2							
	area							
	62°N				66°N			
	sample w				sample w			
	2663.7				5194.8			
	catch				catch			
	658905				911625			
	No. of samples				No. of samples			
	8				19			
MM	male	primi	fema-le	all	male	primi	fema-le	all
5	0	0	0	0	0	0	0	0
5.5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
6.5	0	0	0	0	0	0	1	1
7	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
11.5	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
13.5	0	0	0	0	0	0	0	0
14	0	0	0	0	1	0	0	1
14.5	0	0	0	0	1	0	0	1
15	1	0	0	1	1	0	0	1
15.5	1	0	0	1	5	0	0	5
16	1	0	0	1	1	0	0	1
16.5	1	0	0	1	3	0	0	3
17	5	0	0	5	2	0	0	2
17.5	2	0	0	2	2	0	0	2
18	6	0	0	6	11	0	0	11
18.5	6	0	0	6	12	0	0	12
19	6	0	0	6	20	0	0	20
19.5	11	0	0	11	29	0	0	29
20	15	0	0	15	54	0	0	54
20.5	10	0	0	10	72	0	1	73
21	18	0	0	18	123	0	2	125
21.5	23	0	0	23	136	0	8	144
22	26	0	0	26	170	0	24	194
22.5	46	0	0	46	218	0	56	274
23	45	0	1	46	248	0	80	328
23.5	59	0	4	63	249	0	139	388
24	84	0	7	91	172	0	215	387
24.5	69	0	14	83	127	0	314	441
25	83	0	18	101	70	0	379	449
25.5	74	0	33	107	32	0	412	444
26	55	0	67	122	10	0	379	389
26.5	49	0	107	156	2	0	339	341
27	40	0	107	147	0	0	334	334
27.5	20	0	171	191	0	0	328	328
28	18	0	150	168	0	0	318	318
28.5	12	0	164	176	0	0	325	325
29	3	0	145	148	0	0	255	255
29.5	1	0	163	164	0	0	203	203
30	1	0	153	154	0	0	174	174
30.5	0	0	165	165	0	0	148	148
31	0	0	159	159	0	0	119	119
31.5	0	0	122	122	0	0	98	98
32	0	0	92	92	0	0	83	83
32.5	0	0	52	52	0	0	66	66
33	0	0	14	14	0	0	45	45
33.5	0	0	12	12	0	0	29	29
34	0	0	1	1	0	0	21	21
34.5	0	0	0	0	0	0	8	8
35	0	0	0	0	0	0	3	3
35.5	0	0	0	0	0	0	2	2
36	0	0	0	0	0	0	0	0
36.5	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
TOTAL	791	0	1921	2712	1771	0	4910	6681

Tabel 14b. No. og shrimp per length group in commercial samples from 1994; pooled by month and fishing area (see figur 8). The entry 'catch' is the total catch from which samples were taken.

East-green land	month			
	3			
	area			
	64°-65°N			
	sample w			
	3426.8			
	catch			
	538720			
	No. of samples			
	14			
	male	primi	fema-le	all
MM				
5	0	0	0	0
5.5	0	0	0	0
6	0	0	0	0
6.5	0	0	0	0
7	0	0	0	0
7.5	0	0	0	0
8	0	0	0	0
8.5	0	0	0	0
9	0	0	0	0
9.5	0	0	0	0
10	0	0	0	0
10.5	0	0	0	0
11	0	0	0	0
11.5	0	0	0	0
12	0	0	0	0
12.5	0	0	0	0
13	0	0	0	0
13.5	0	0	0	0
14	0	0	0	0
14.5	0	0	0	0
15	0	0	0	0
15.5	0	0	0	0
16	0	0	0	0
16.5	0	0	0	0
17	1	0	0	1
17.5	3	0	0	3
18	4	0	0	4
18.5	6	0	0	6
19	14	0	0	14
19.5	23	0	0	23
20	37	0	0	37
20.5	32	0	0	32
21	39	0	0	39
21.5	58	0	0	58
22	81	0	0	81
22.5	109	2	0	111
23	155	0	0	155
23.5	177	9	1	187
24	173	12	0	185
24.5	182	33	5	220
25	140	48	11	199
25.5	91	89	31	211
26	81	108	37	227
26.5	34	141	59	234
27	11	134	58	203
27.5	8	143	75	226
28	1	117	89	207
28.5	0	94	113	207
29	2	67	134	203
29.5	1	29	126	157
30	0	26	134	160
30.5	0	12	107	119
31	0	5	122	128
31.5	0	0	101	101
32	0	1	63	64
32.5	0	0	57	57
33	0	0	30	30
33.5	0	0	15	15
34	0	0	10	10
34.5	0	0	1	1
35	0	0	1	1
35.5	0	0	0	0
36	0	0	0	0
36.5	0	0	0	0
37	0	0	0	0
TOTAL	1463	1070	1380	3916

East-green land	month							
	4							
	area							
	62°N				64°-65°N			
	sample w				sample w			
	1903.85				2126.8			
	catch				catch			
	691340				259155			
	No. of samples				No. of samples			
	6				5			
	male	primi	fema-le	all	male	primi	fema-le	all
MM								
5	0	0	0	0	0	0	0	0
5.5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
6.5	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
11.5	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
12.5	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
13.5	1	0	0	1	0	0	0	0
14	1	0	0	1	0	0	0	0
14.5	1	0	0	1	0	0	0	0
15	1	0	0	1	0	0	0	0
15.5	3	0	0	3	1	0	0	1
16	7	0	0	7	0	0	0	0
16.5	4	0	0	4	0	0	0	0
17	6	0	0	6	0	0	0	0
17.5	10	0	0	10	4	0	0	4
18	25	0	0	25	3	0	0	3
18.5	32	0	0	32	18	0	0	18
19	44	0	0	44	16	0	0	16
19.5	65	0	0	65	29	0	0	29
20	71	0	0	71	27	0	0	27
20.5	86	0	0	86	29	0	0	29
21	104	0	0	104	38	0	0	38
21.5	94	0	0	94	42	1	0	43
22	138	0	1	139	52	0	0	52
22.5	134	0	0	134	60	1	0	61
23	159	5	0	164	76	0	0	76
23.5	168	9	4	183	109	1	0	112
24	149	26	8	183	116	10	0	126
24.5	106	41	7	155	122	12	1	135
25	89	65	19	175	144	27	9	180
25.5	36	71	27	135	87	42	15	144
26	17	81	39	137	84	70	19	173
26.5	10	86	53	150	43	94	21	158
27	1	55	57	115	19	94	28	141
27.5	0	50	60	111	5	91	47	143
28	0	23	51	74	2	88	41	131
28.5	0	9	57	66	0	83	46	129
29	0	5	44	49	0	62	54	116
29.5	0	2	26	28	0	43	53	96
30	0	1	29	30	0	21	61	82
30.5	0	0	31	31	0	9	40	49
31	0	0	22	22	0	3	36	39
31.5	0	0	16	17	0	3	31	34
32	0	0	8	8	0	1	14	15
32.5	0	0	4	4	0	0	20	20
33	0	0	6	6	0	0	9	9
33.5	0	0	1	1	0	0	6	6
34	0	0	1	1	0	0	4	4
34.5	0	0	1	1	0	0	0	0
35	0	0	0	0	0	0	1	1
35.5	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
36.5	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
TOTAL	1562	529	572	2674	1127	756	557	2441



Figur 1. Total catches and catches in the tree fishing area from 1990 to 1994.

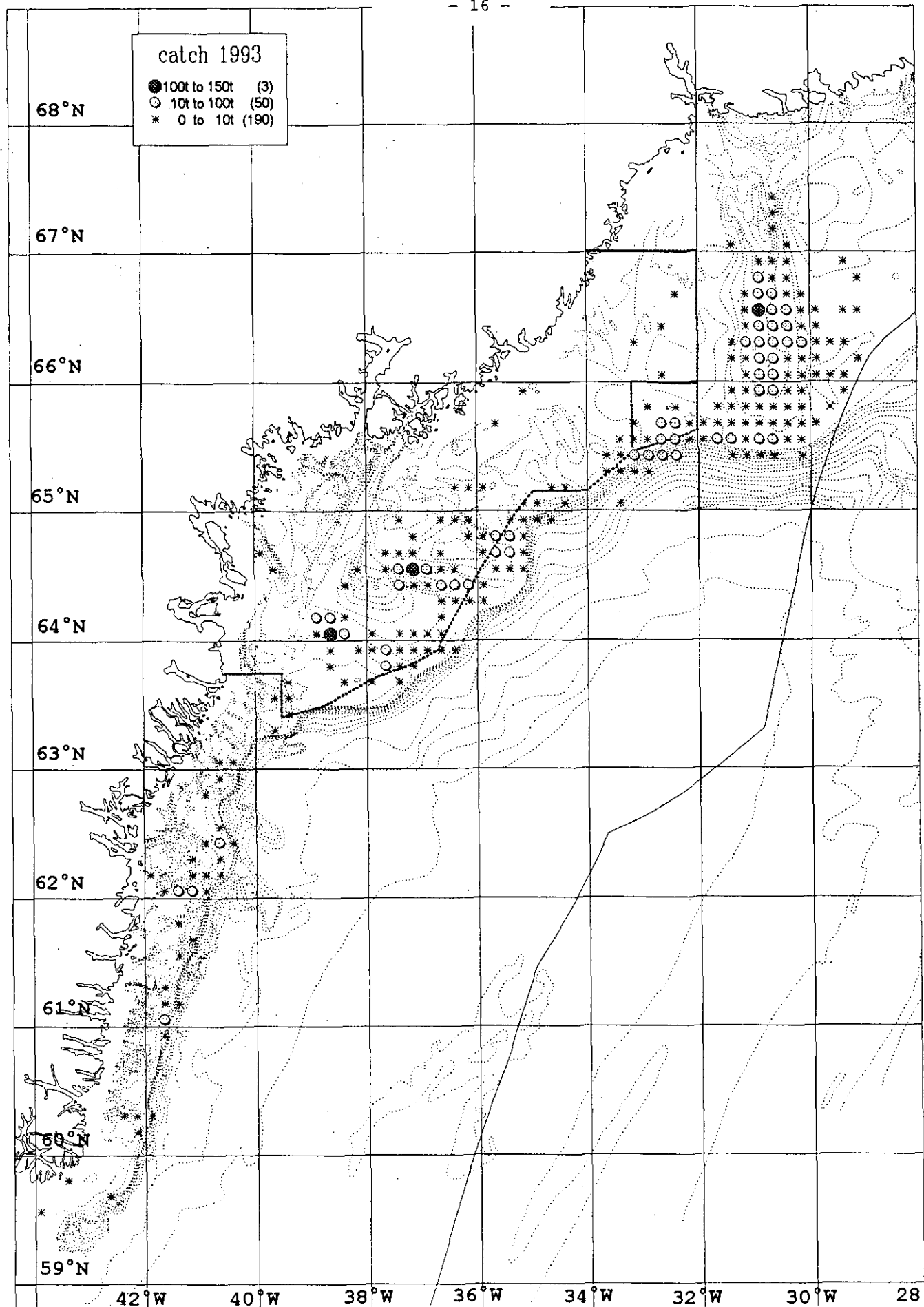


Figure 2. Distribution of catches of shrimp (tons per statistical unit) in the fishery in 1993, based on logbooks from the Greenland fishery. The area delimited by dotted line is the 'redfish' box opened to the fishery in 1993.

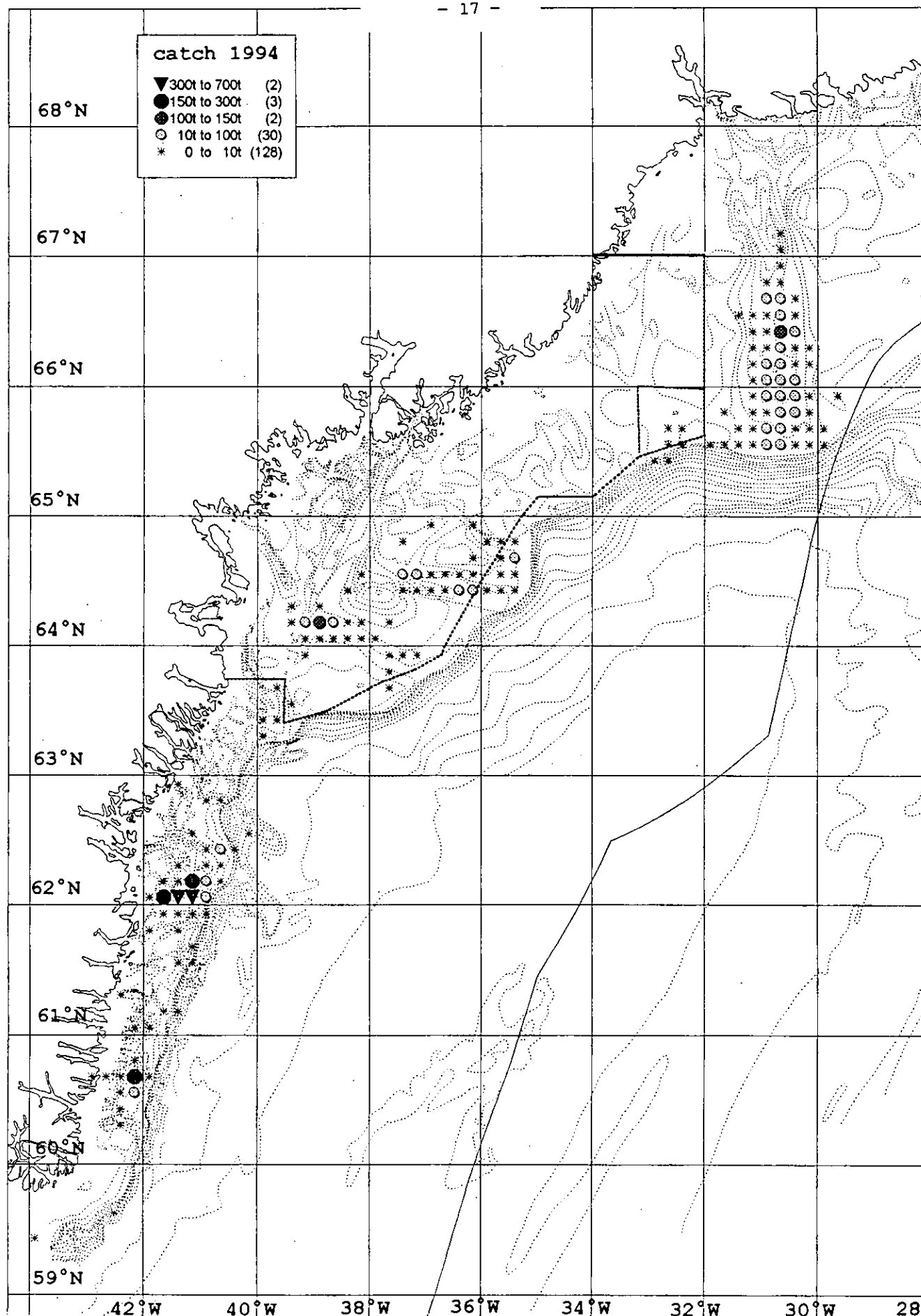


Figure 3. Distribution of catches of shrimp (tons per statistical unit) in the fishery in January-October 1994, based on logbooks from the Greenland fishery. The area delimited by dotted line is the 'redfish' box opened to the fishery in 1993.

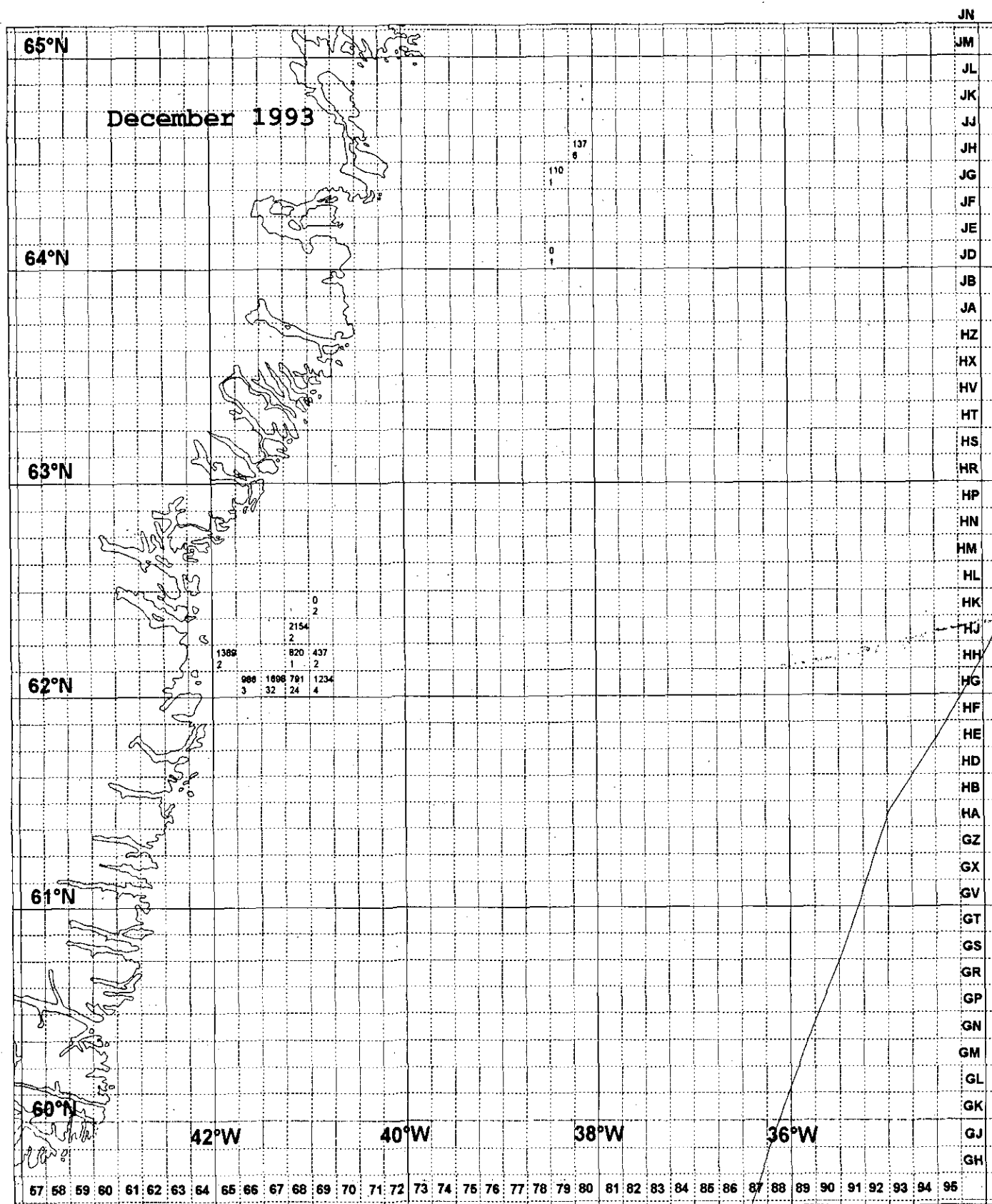


Figure 4a Distribution of mean catch of shrimp (kg/hour) and effort (hours) in the shrimp fishery in Denmark Strait south of 65°N in December 1993, based on logbooks from the Greenland fishery.

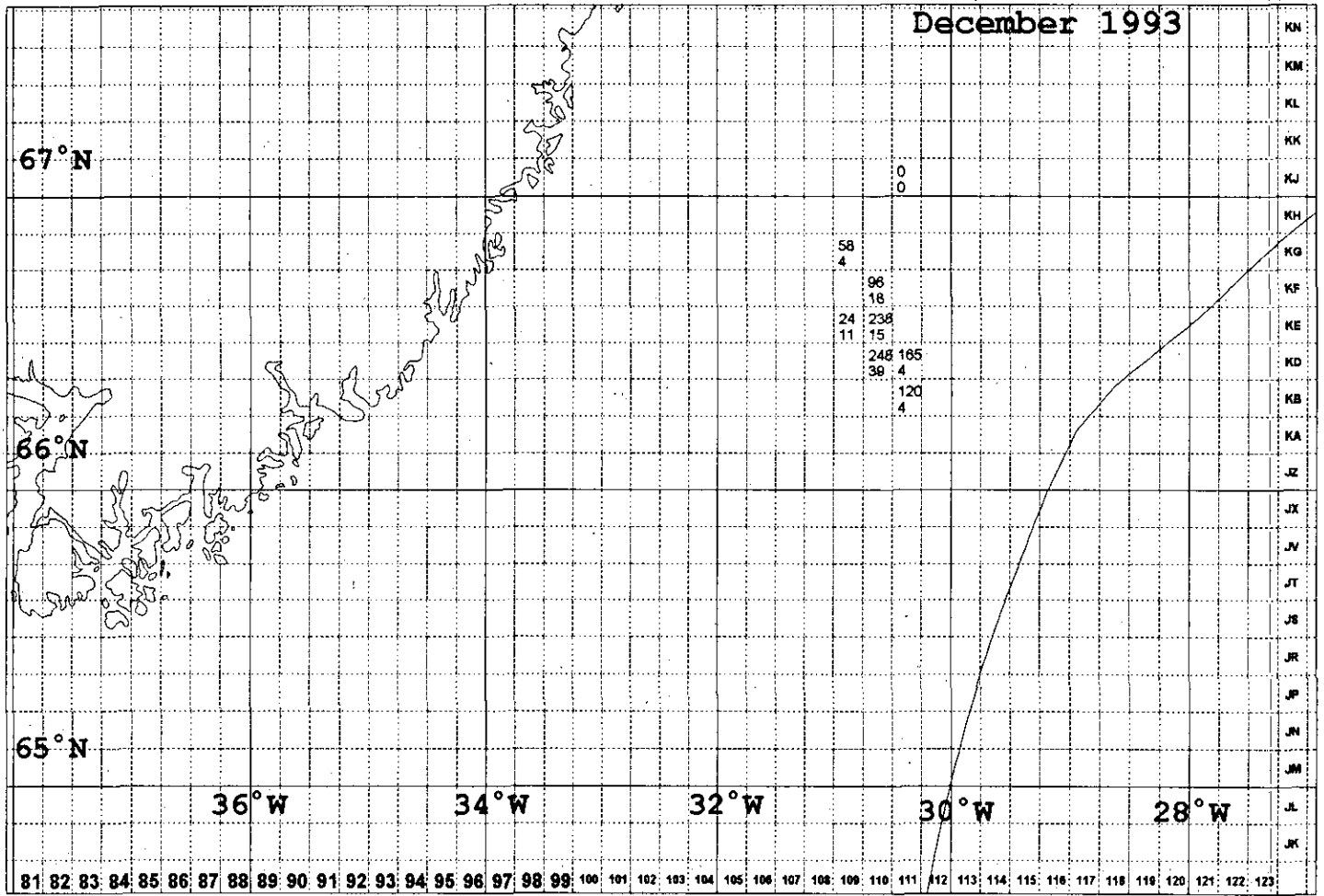


Figure 4b. Distribution of mean catch of shrimp (kg/hour) and effort (hours) in the shrimp fishery in Denmark Strait north of 65°N in December 1993, based on logbooks from the Greenland fishery.

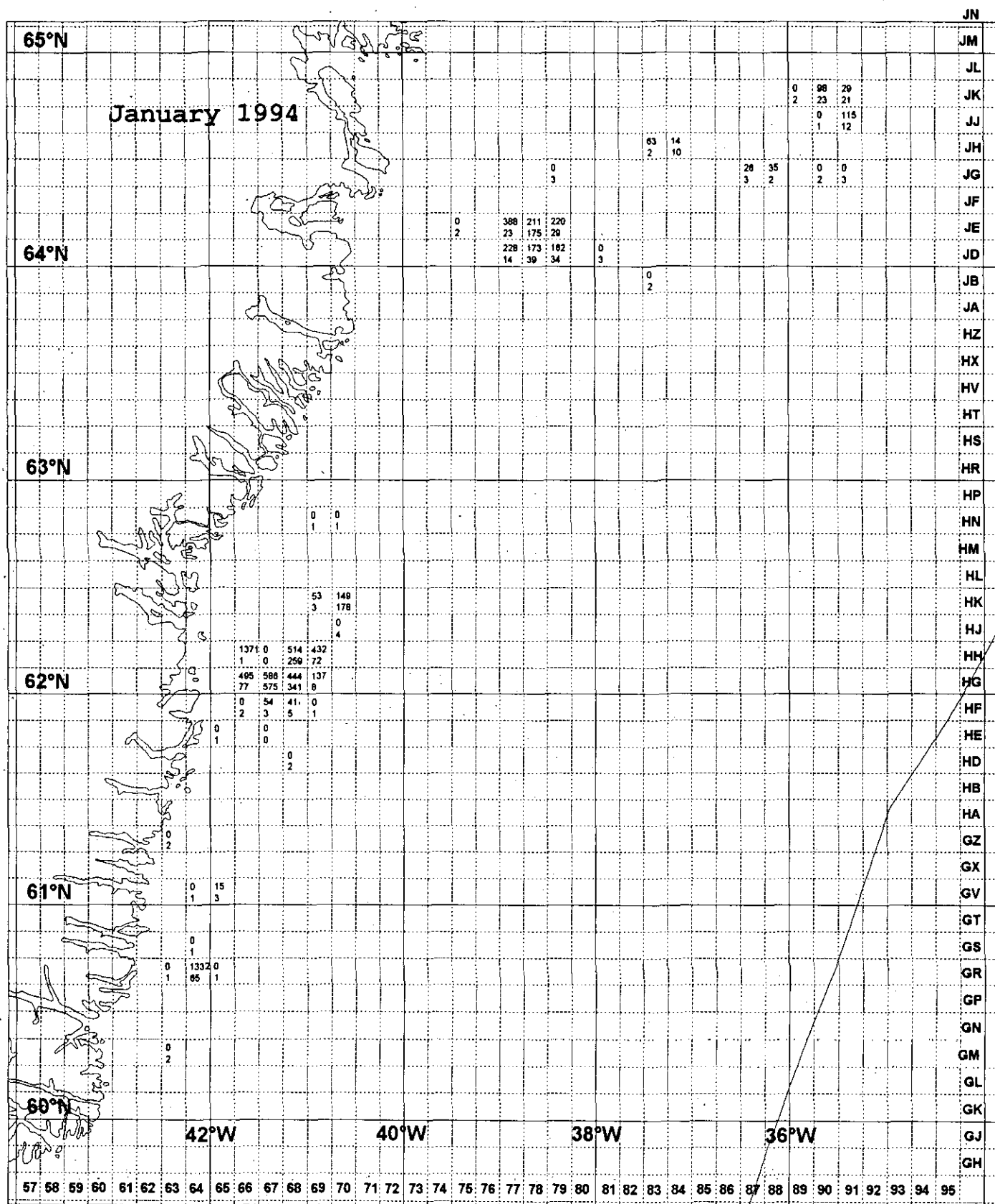


Figure 5a. Distribution of mean catch of shrimp (kg/hour) and effort (hours) in the shrimp fishery in Denmark Strait south of 65°N in January 1994, based on logbooks from the Greenland fishery.

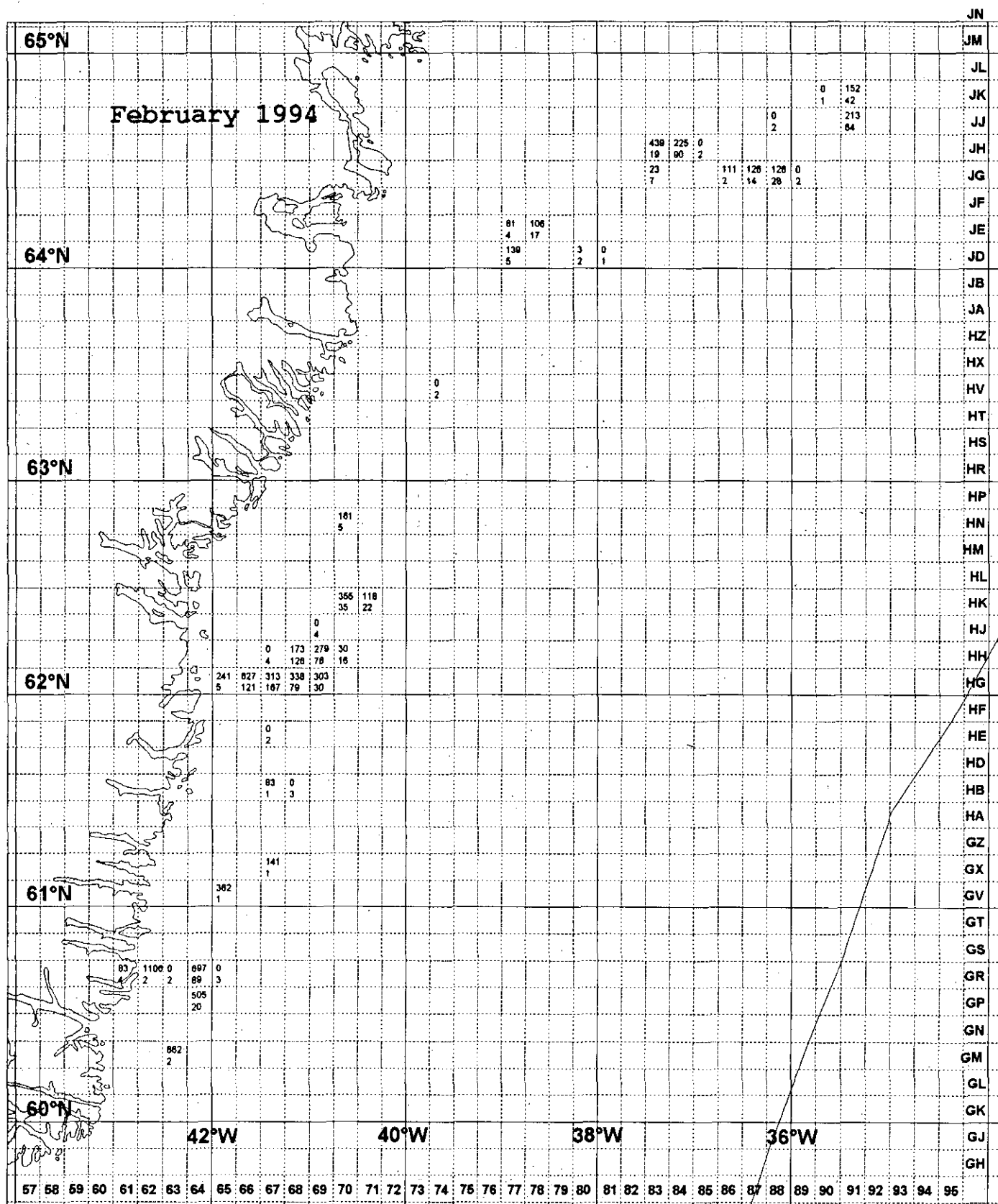


Figure 5a cont. Data from February 1994.

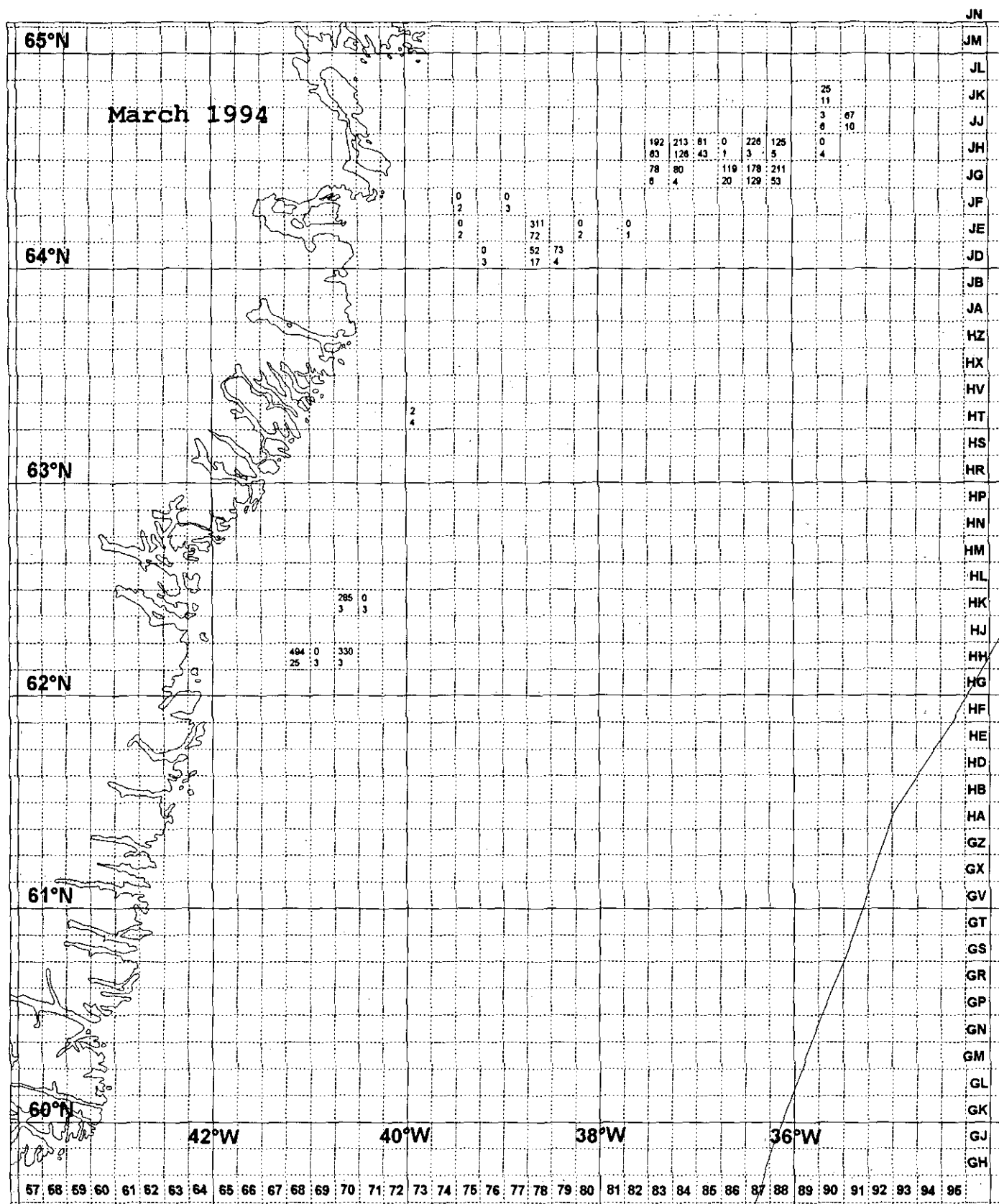


Figure 5a cont. Data from March 1994.

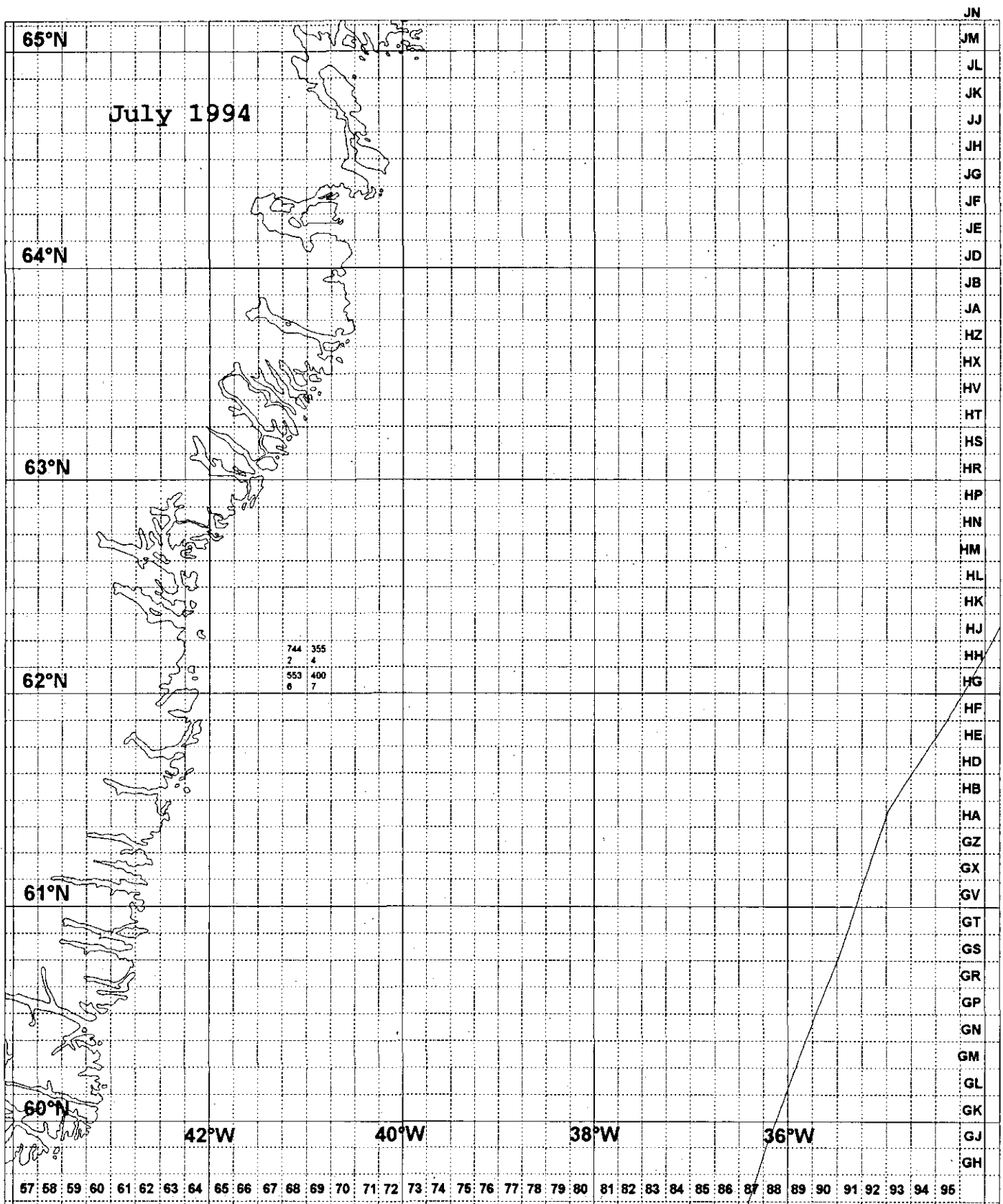


Figure 5a cont. Data from July 1994.

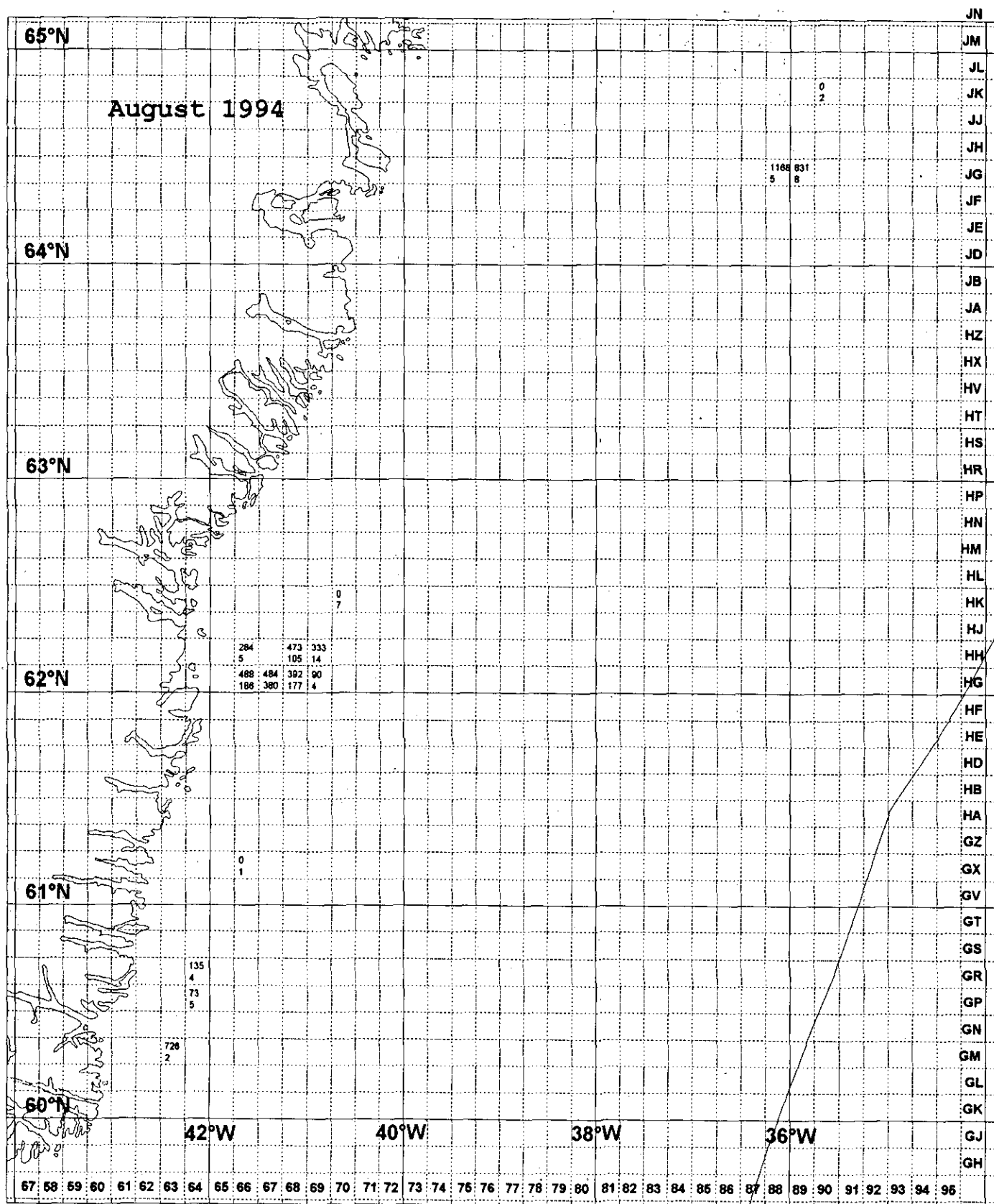


Figure 5a cont. Data from August 1994.

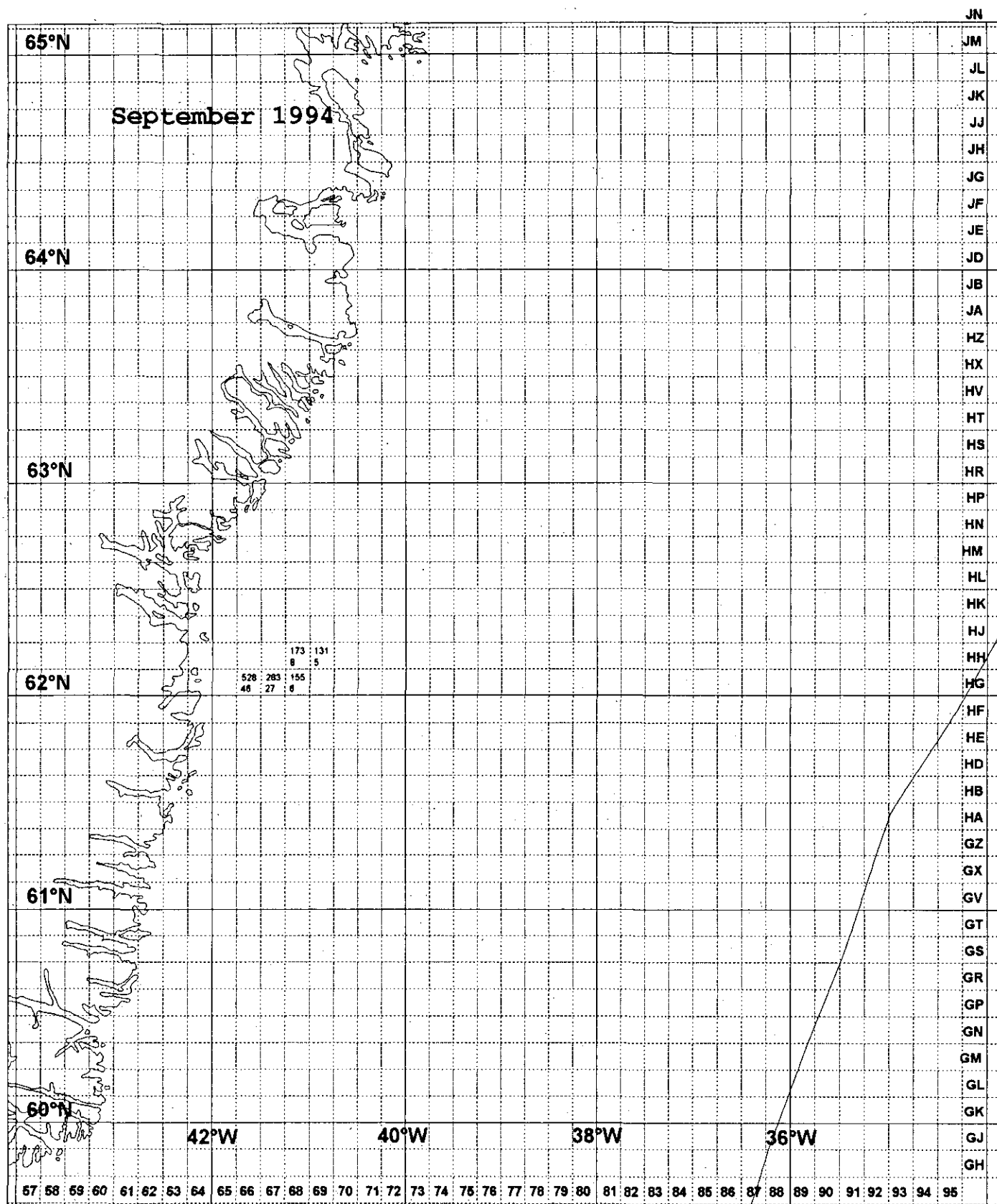


Figure 5a cont. Data from September 1994.

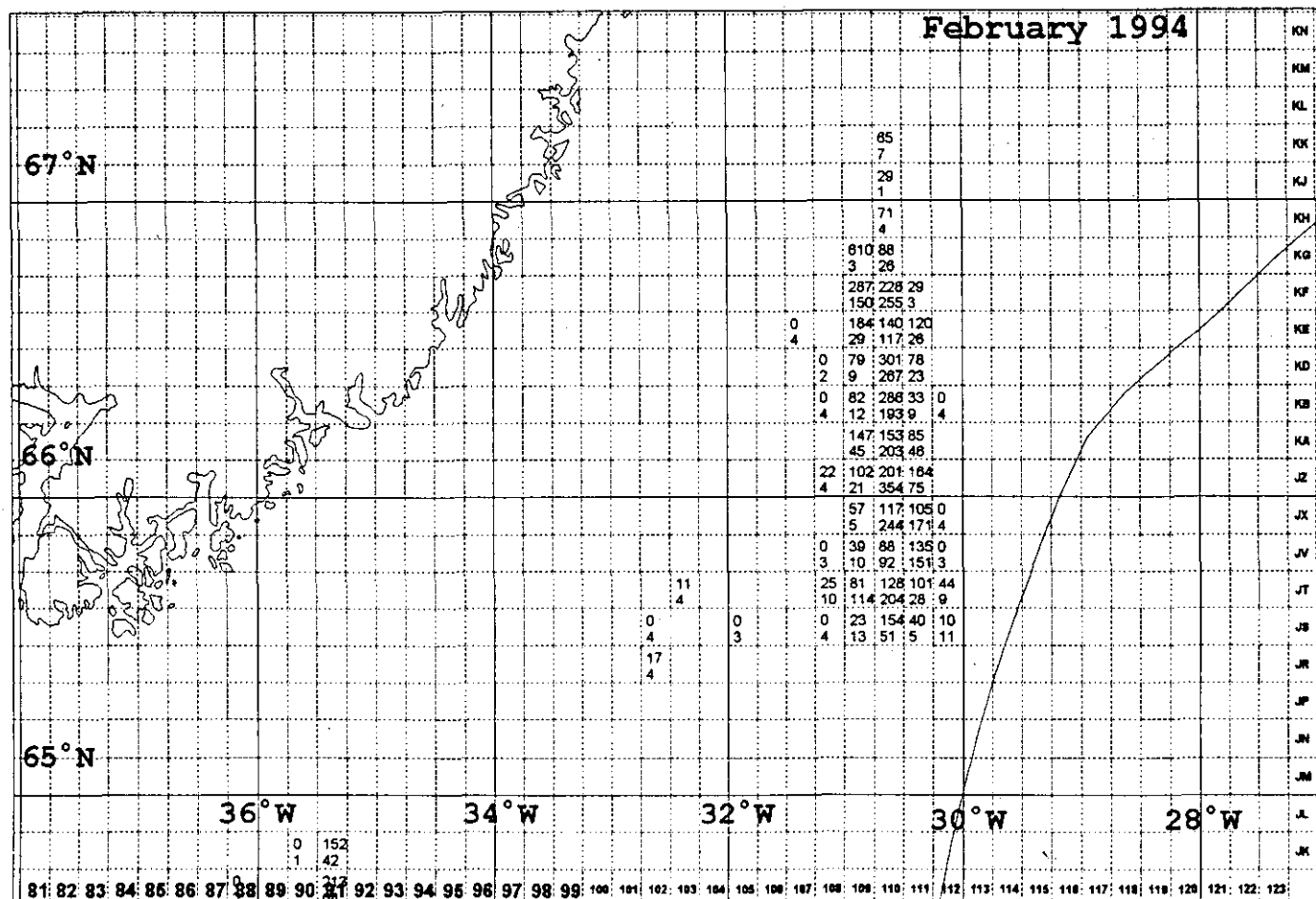
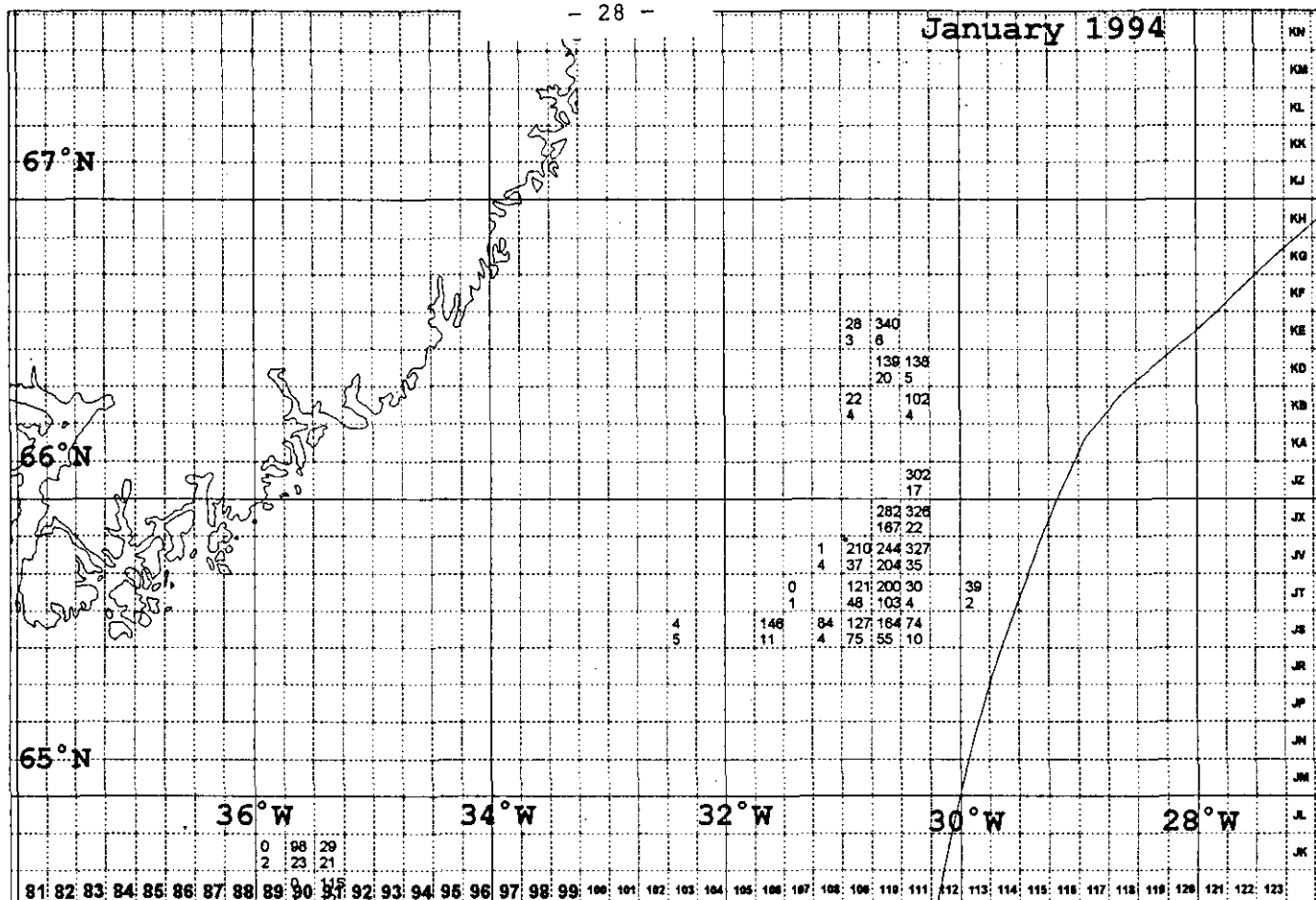


Figure 5b. Distribution of mean catch of shrimp (kg/hour) and effort (hours) in the shrimp fishery in Denmark Strait south of 65°N in January and February 1994, based on logbooks from the Greenland fishery.

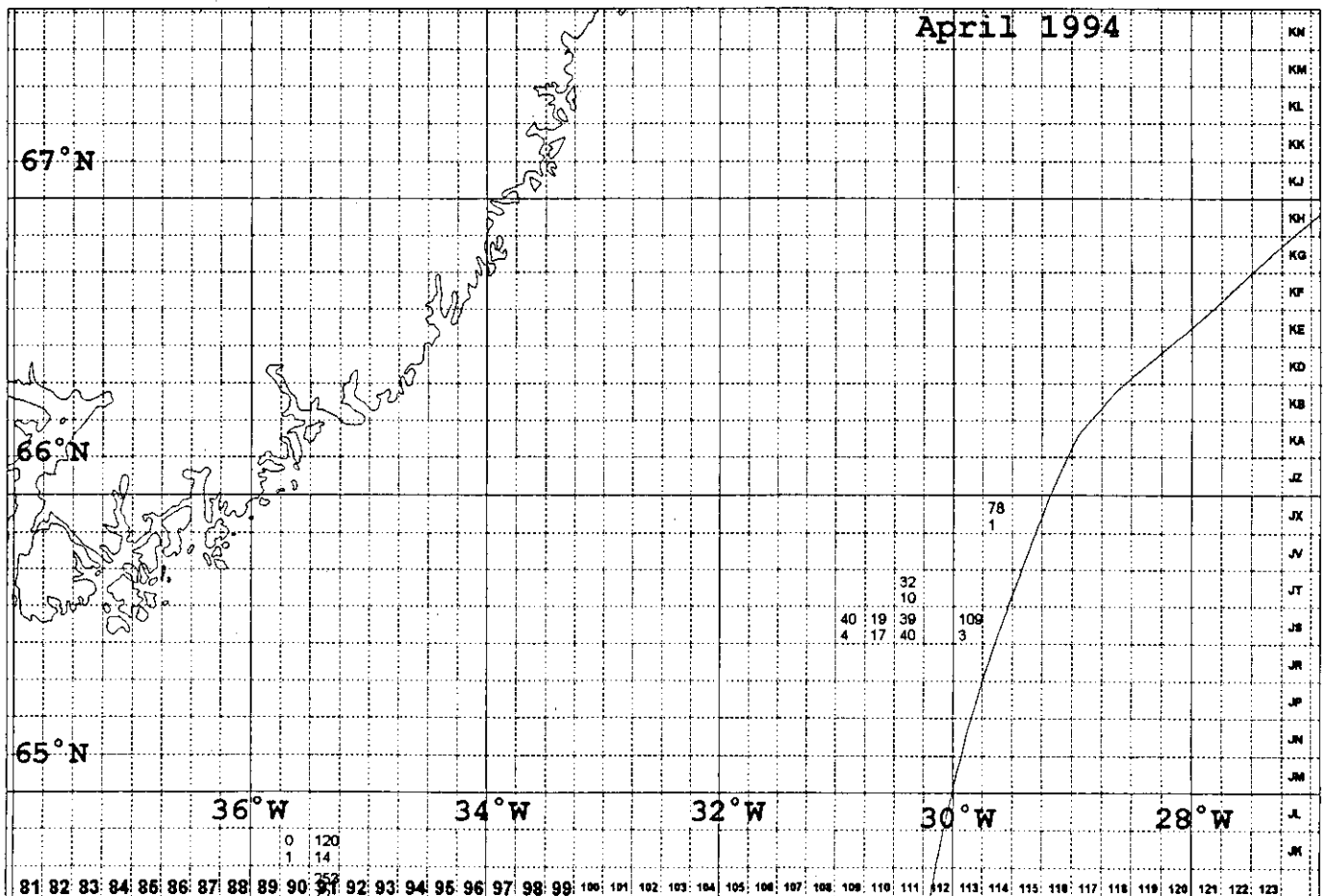
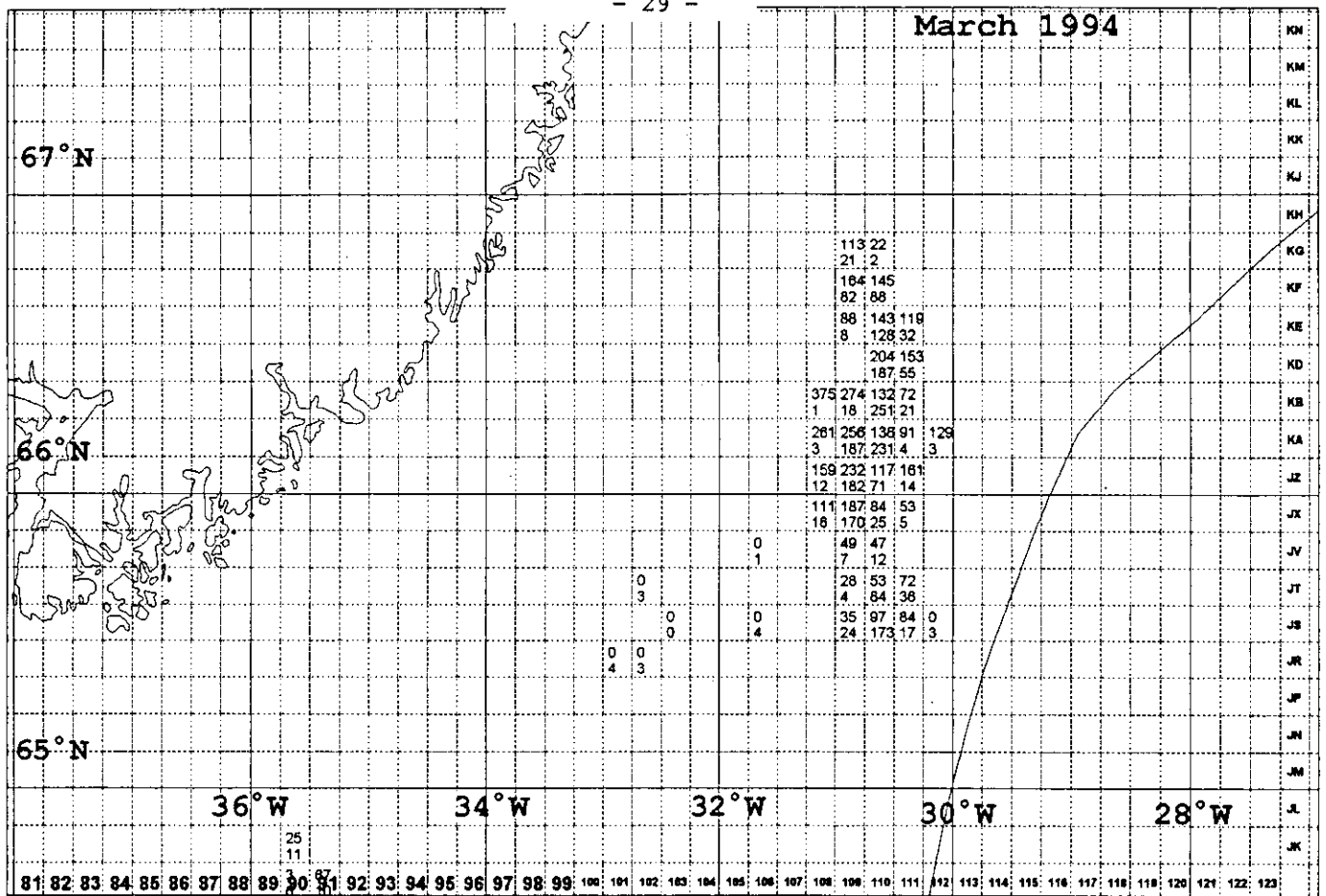


Figure 5b cont. Data from March and April 1994.

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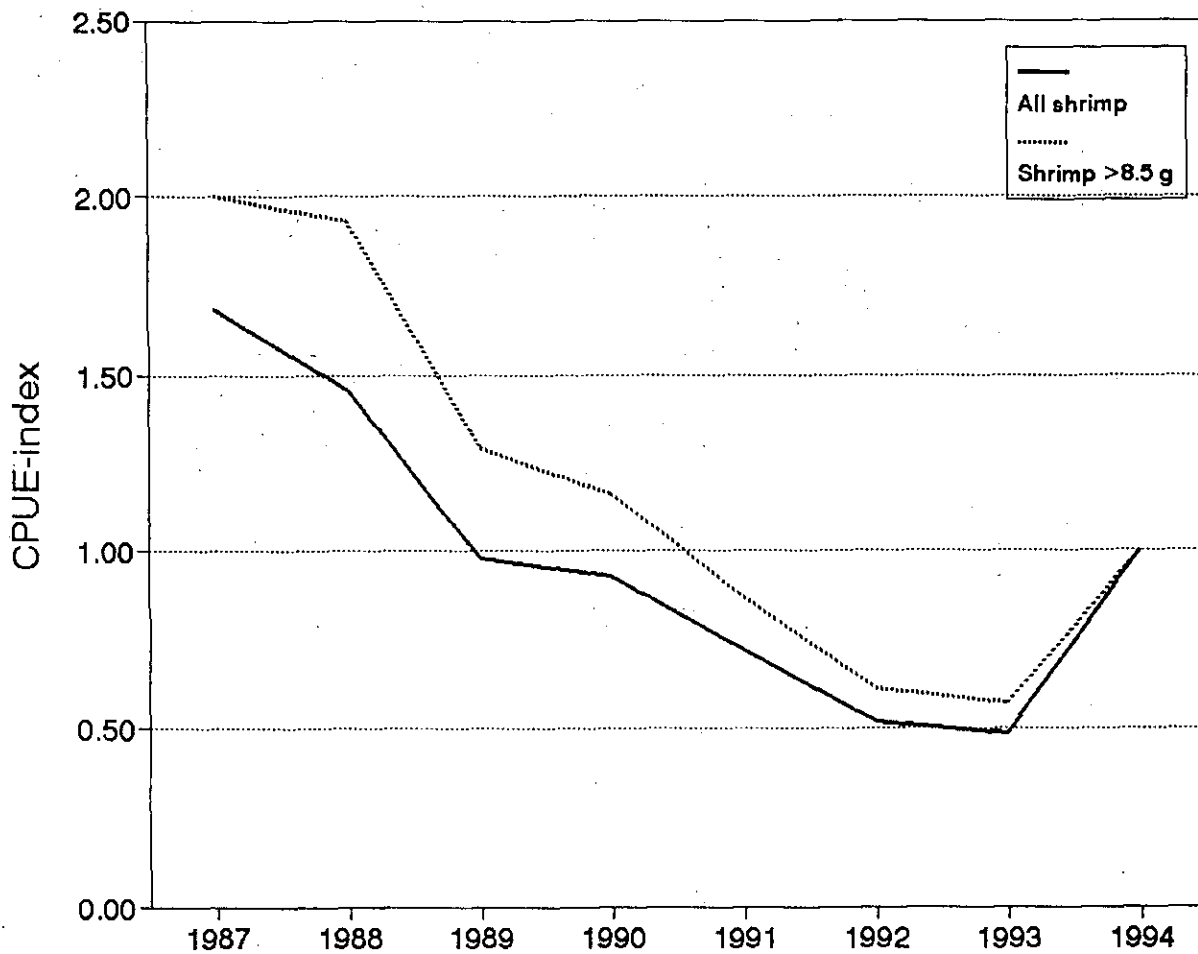
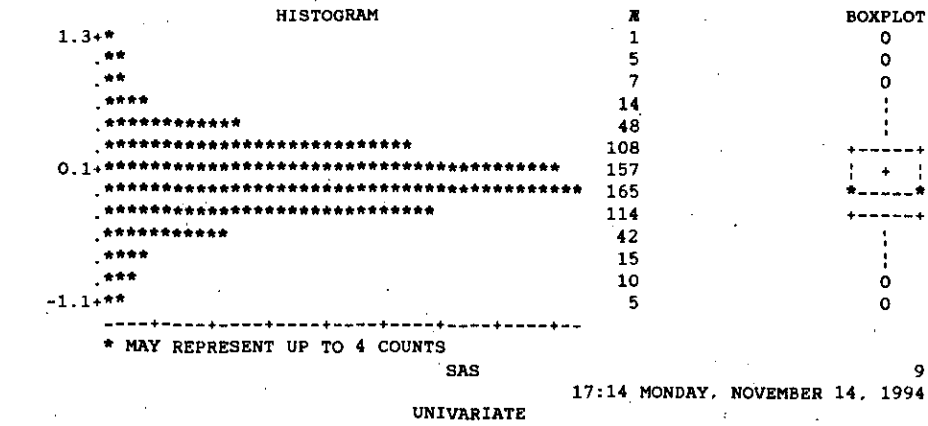


Figure 6. Annual CPUE-indices calculated for shrimp > 8.5 g and for total catch by 32 Greenland trawlers in Denmark Strait from 1987 to 1994.



VARIABLE=RLNCPUE

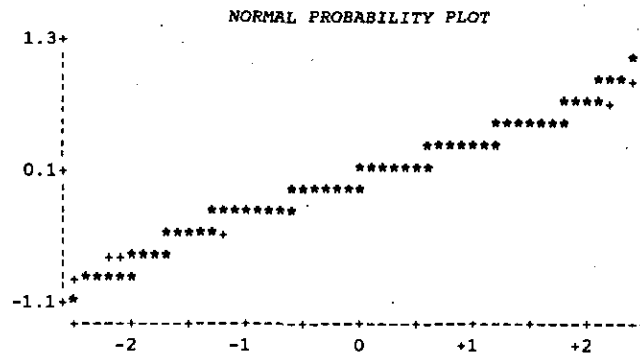


Figure 7. Histogram, box and probit plot of the residuals from the multiplicative analysis in Table 9 (shrimp > 8.5 g).

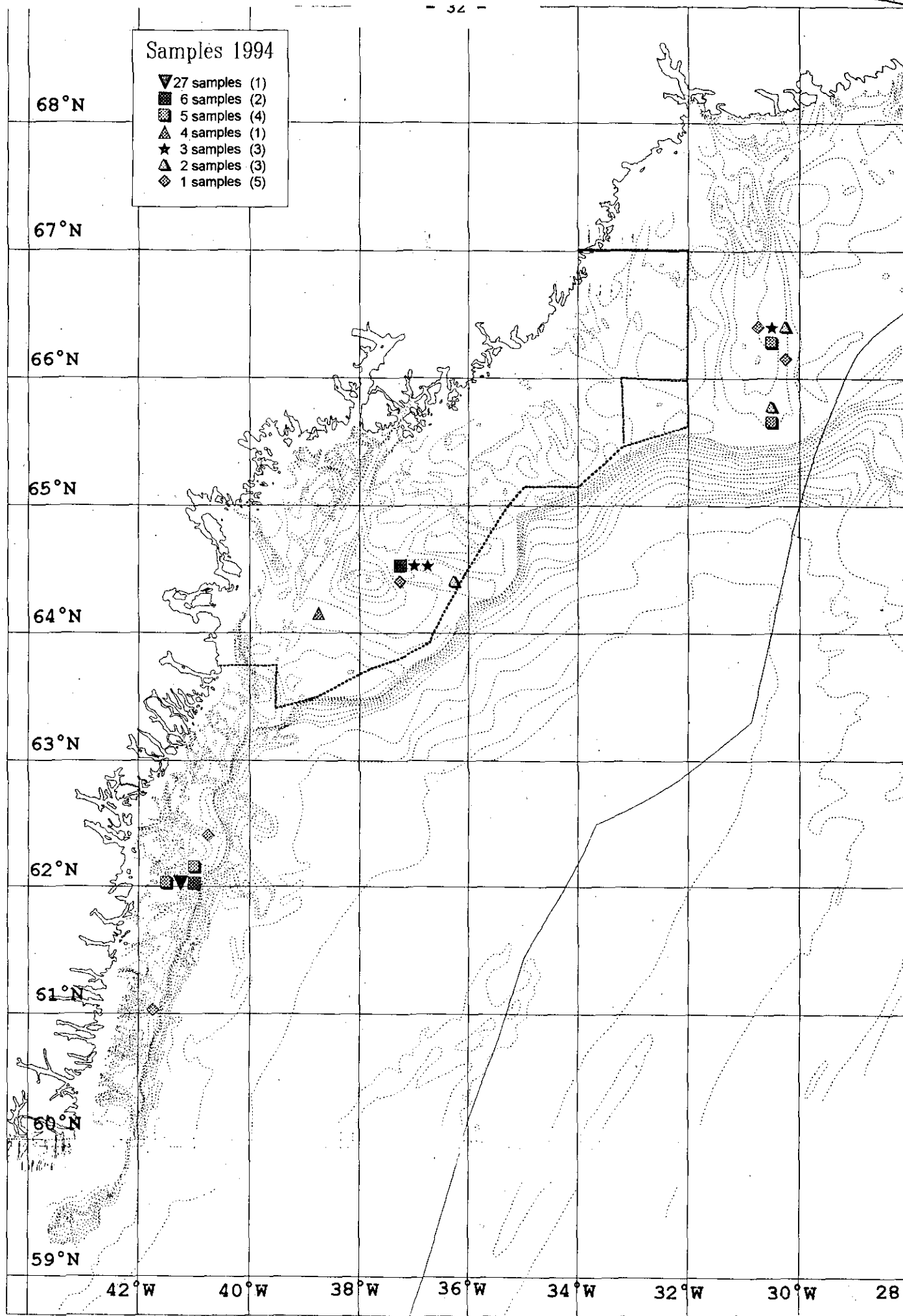


Figure 8. Map showing the sites for shrimp samples in 1994

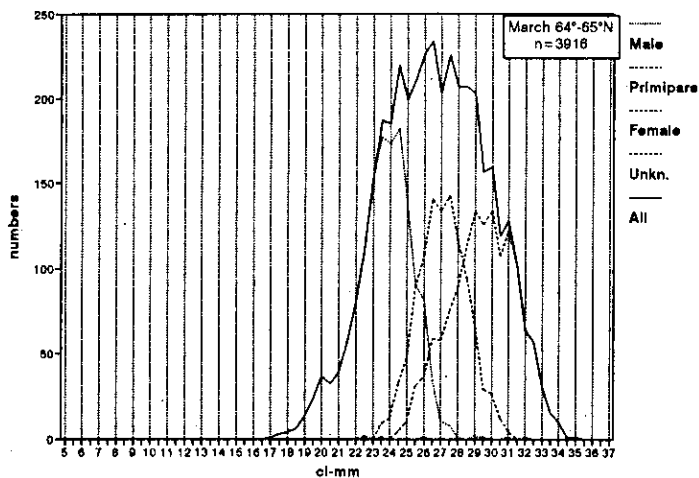
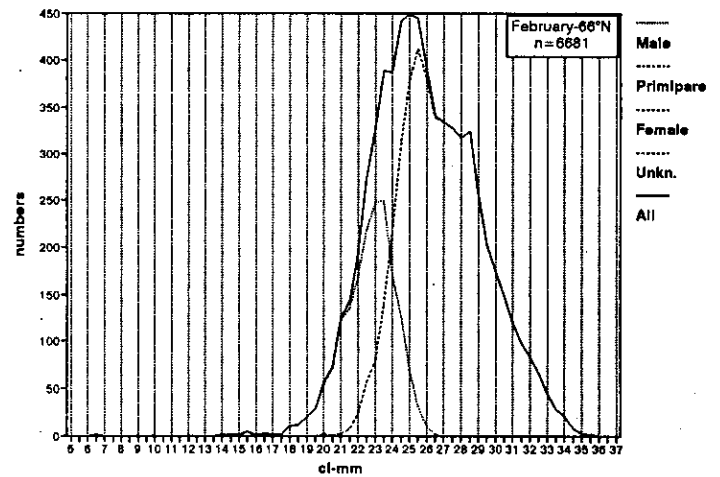
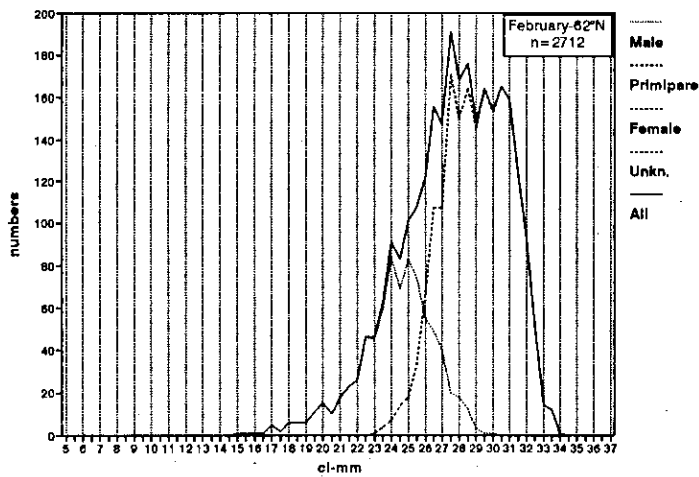
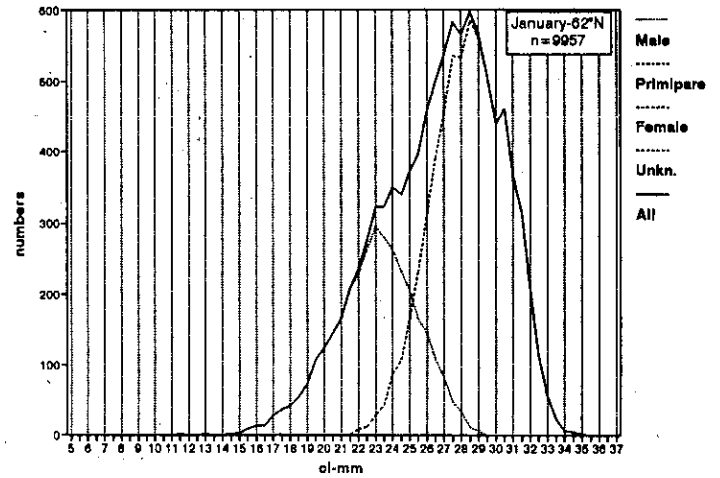
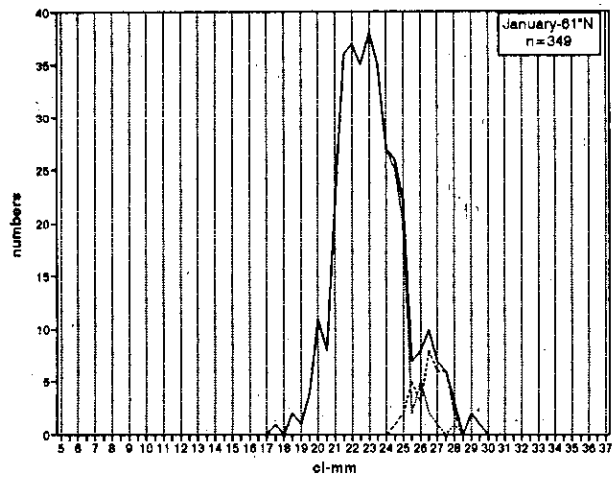


Figure 9a. Pooled shrimp samples from January-March 1994 sampled in various fishing areas.

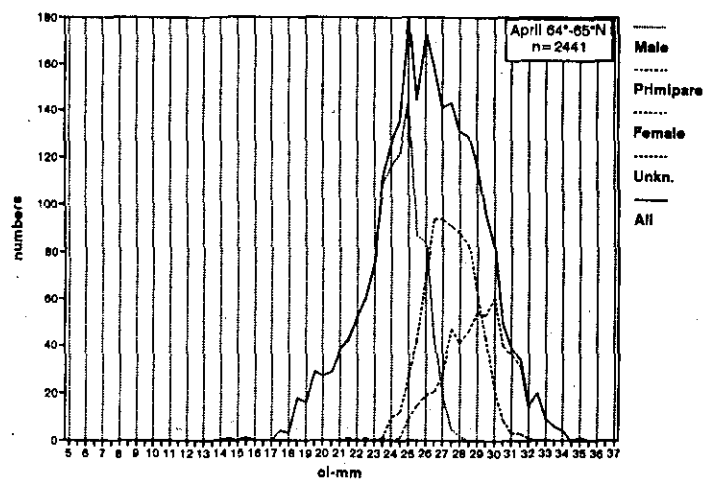
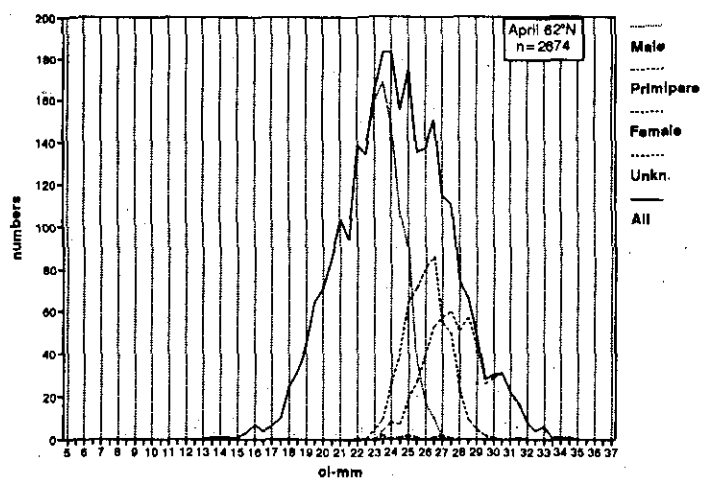


Figure 9b. Pooled shrimp samples from April 1994 sampled in various fishing areas.