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The Commercial Shrimp Fishery in Denmark Strait January to October 1993

by

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INTRODUCTION

At the June meeting in 1992 STACFIS recommended that the total allowable catch of shrimp in the Denmark Strait in 1993 should be reduced to 5,000 tons. In the Greenland zone the effective TAC was set to 9,563 tons. By the end of October 1993 total catch reported from this area was 4,734 tons, of which Greenland vessels accounted for approximately 2,200 tons.

The fishery was carried out from January to May and started again in September. Approximately 4,550 tons of shrimp were reported from the spring period.

Logbooks from 18 Greenland, two Danish and ten Faroese vessels fishing at East Greenland in 1993 have been available to the Greenland Fisheries Research Institute. The logbooks cover about 63% of the total catches in the Greenland economic zone.

The present paper updates information given by Carlsson & Kanneworff (1993) 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 analyzed to show the overall distribution of catches by year and of effort and catch-rates by month. Monthly mean catch-rates from 1980 to 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 of smaller shrimp. 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. From 2052 possible cells this brought the number of cells down to 641, of which further 11 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, March and April 1993 were analyzed for size composition of catches.

RESULTS AND DISCUSSION

Reported catches in 1993

Table 1 show reported catches in the Greenland zone from January to October by nation and month, and Table 2 the corresponding numbers of reporting vessels.

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). In January-May a total catch of approximately 4,550 tons has been reported, which is at the same level as in the same period in 1992 (approx. 4,500 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, pushing the reported catch figures upward.

So far a total of 48 vessels have participated in the fishery in 1993 (Table 2).

From April to July 1993 a minimum mesh size of 55 mm (stretched) in the cod-end was compulsory. The effect of this regulation on the catch data from East Greenland is considered negligible.

Geographical distribution of the fishery

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

The geographical distribution of catches in 1993 (Fig. 1) in the traditional main fishing area north of 65°N was similar to that of 1990, 1991, and 1992 (Carlsson and Kanneworff, 1991, 1992, 1993).

An area along the east coast of Greenland from 63°30'N to 67°N (the 'redfish-box', Fig. 1) has since the early eighties been considered as an important nursery area for especially redfish and has been closed for trawling. Trial fishery for shrimp in 1989 indicated that shrimp abundance in the area was too low to be of commercial interest (Lehmann, 1989 and 1990). In 1990 a minor part of the area neighbouring the shrimp grounds on the Dohrn Bank was opened to the shrimp fishery (Fig. 1), resulting in temporarily high catch rates of shrimp. In 1991 and 1992 catches in this area were small. In 1993 the total 'redfish-box' was opened to the shrimp fishery, and catches in the spring period along the East Greenland coast south of 65°N amounted to almost 1,000 tons of shrimp. This fishery was, however, taking place on shrimp concentrations in areas of restricted size.

The monthly distribution of the fishery in spring 1993 is shown in Fig. 2. In January to March the distribution north of 65°N was very similar to that of 1992 (Carlsson and Kanneworff, 1993), concentrating in the central and western parts of the traditional fishing grounds. In January and February some fishing took place south of 65°N, but generally with low catch rates. In March catch rates increased, and in April and May most fishing effort was spent here, while very little fishing took place north of 65°N. Monthly effort from 1985 to October 1993 in the Greenland fishery north and south of 65°N is given in Table 3 and 4, respectively.

CPUE and effort

Monthly and semi-annual mean catch rates in the Greenland fishery in the main fishing area (north of 65°N) in Denmark Strait are shown in Table 5. 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 1992 and stability between 1992 and 1993. For the July-December period mean catch rates decrease from 1988 to 1989 and show a slight increasing trend from 1990 to 1992. South of 65°N (Table 6) catch rates in 1993 decrease from January to February and the increase to the highest figure in May, even though most effort is spent in April and May. The spring mean catch rate in the south is 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 fishing area north of 65°N (Tables 7 and 8) show a similar decreasing trend in the January to June period until 1992 and stability between 1992 and 1993. In the July to December period catch rates show stability over the last three to four years.

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. In 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

The results of the multiple regression analysis to standardize catch rates of large shrimp (Table 9) show that the model explains 67% 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 1993. Histogram, box- and probit plots of the residuals (Fig. 3) 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.

Calculated annual cpue-indices for large shrimp and total catch based on results from the regression analysis are shown in Fig. 4. The indices show a significantly declining trend from 1987 to 1992 and stability between 1992 and 1993.

Also standardized cpue-indices may be affected upwards in 1993 by the new observer system in the Greenland zone, aimed to minimize unreported discard.

Biological samples

Shrimp samples from the commercial fishery are available from February, March, and April 1993. The samples were not sorted by sexual characteristics. Fig. 6, 7, and 8 show length frequency diagrams for the samples pooled by statistical units used by Iceland (Fig. 5), and Table 10 gives the numbers of shrimp by length group in the samples. The samples show considerable variation in size composition between areas.

Samples from the traditional fishing grounds north of 65°N in February (Fig. 6) show peaks occurring at 23, 26, and 29 mm CL, with 26 mm being the most dominant. In the central and northern areas (unit 630 and 680) females up to 36 mm CL occur, while the largest females are absent in the southern and western areas (unit 580 and 631). In commercial samples from 1992 a size group at 29 mm CL dominated in several units (Carlsson and Kanneworff 1993); in the 1993 samples the same size group can be identified, but it is not dominating in any of the units, indicating that mean size of shrimp in the traditional fishing areas has decreased.

Samples from March and April are all from the area south of 65°N. Samples from around 62°N (units 191, 240, 241, and 290 - Fig. 7) are by far dominated by a peak at 22 - 24 mm CL; smaller and larger size groups are indicated, but larger shrimp are much less abundant than to the north. Samples from areas just south of 65°N (units 486 and 487) in April (Fig. 8) show a wider distribution with a number of size groups indicated. Only in one of these units is the size group at 29 mm CL dominating the catch.

CONCLUSIONS

Reported catches of shrimp from January through October 1993 from the Greenland part of Denmark Strait totalled 4,734 tons, about 600 tons more than in the same period in 1992. However, in 1993 almost 1,000 tons were taken south of 65°N, mainly in an area hitherto closed to the fishery. So far 48 vessels participated in the fishery. The fishery took place in spring from January to May and started again in September in the autumn.

Similar to 1990-1992 the fishery in the traditional fishing area north of 65°N was concentrated in the area between 65°30 and 67°N and 30° and 32°W in 1993, different from previous years, when the fishery was more widespread. In 1993, after the opening of the closed area south of 65°N, a considerable effort was spend here, especially in March, April and May.

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 1988 to 1992 and stability between 1992 and 1993. In the July-December period catch rates were stable over the last three to four years.

Standardized catch rate indices for catch of large shrimp and total catch of 27 Greenland trawlers in the traditional fishing area show a declining trend from 1987 to 1992, and stability between 1992 and 1993.

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 February, March and April 1993 show that the mean size of shrimp in the traditional fishing area north of 65°N has decreased between 1992 and 1993. In the new fishery in the southern areas catches were dominated by a single size group at 22 to 24 mm CL.

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Table 1. Catches of shrimp (tons) in Denmark Strait in January-October 1993 by nation and month, as reported to the Greenland authorities.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
DENMARK	31	25	27	28	21	-	-	-	1	12	145
FAROE ISL.	220	180	191	111	5	-	-	-	1	-	709
GREENLAND	559	490	445	445	296	-	-	-	-	-	2235
NORWAY	236	359	381	335	171	-	-	-	48	116	1644
TOTAL	1046	1054	1043	919	494	-	-	-	50	128	4734

Table 2. Number of vessels in the shrimp fishery in Denmark Strait in January-October 1993 by nation and month, as reported to the Greenland authorities.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	Total
DENMARK	2	2	2	2	1	-	-	-	1	1	2
FAROE ISL.	10	10	8	6	1	-	-	-	1	-	10
GREENLAND	18	17	15	11	3	-	-	-	-	-	18
NORWAY	14	15	16	16	11	-	-	-	5	8	18
TOTAL	44	44	41	35	16	-	-	-	7	9	48

Table 3. Number of hours trawled by year and month from January 1985 to October 1993 in the main fishing area north of 65°N 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
1985	647	610	570	625	-	-	-	-	-	51	360	643	3506
1986	1565	2593	2413	1032	602	4	-	-	-	77	686	1160	10132
1987	3608	4471	2968	951	408	-	25	81	400	755	1915	4067	19649
1988	6951	7950	6408	1121	550	-	-	1019	1487	2597	3211	4662	35956
1989	6602	6363	3905	3505	2322	137	19	713	2304	2600	7031	7121	42622
1990	8602	8289	8299	1050	2133	116	82	369	712	1736	2121	5164	38673
1991	6793	7192	6401	7681	5051	471	38	-	404	371	505	897	35804
1992	3691	3780	5395	3675	1257	-	-	-	-	139	340	1669	19946
1993	6192	5050	2327	385	23	-	-	-	-	-			13977

Table 4. Number of hours trawled by year and month from January 1985 to October 1993 in the fishing area south of 65°N 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
1985	-	-	128	-	-	-	-	-	-	-	-	3	131
1986	-	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	35	-	-	-	-	-	-	-	35
1988	-	-	6	-	-	-	-	-	-	-	-	8	14
1989	-	-	-	1	-	-	-	-	-	-	-	4	5
1990	-	-	3	-	2	-	-	-	9	-	-	-	14
1991	-	-	4	5	7	-	-	-	-	4	-	-	20
1992	-	-	-	-	-	-	-	-	-	-	-	-	-
1993	71	342	802	2424	924	-	-	-	-	-			4563

Table 5. Monthly and semi-annual mean catch rates, efforts and catches from 1988 to October 1993, based on logbooks from the Greenland fishery. Semi-annual efforts are calculated from total catches and CPUEs. Data from 1993 are from the main fishing area north of 65°N only.

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	17746	1822.0		97	2073	201.0
1993	Jan	85	6192	527.2				
	Feb	93	5051	468.2				
	Mar	121	2317	280.4				
	Apr	86	384	33.1				
	May	17	21	0.4				
	Jun							
Subtotal		94	13965	1309.3				
Total		94	14098	1321.8				

Table 6. Monthly and semi-annual mean catch rates, efforts and catches from January to October 1993 south of 65°N, based on logbooks from the Greenland fishery. Semi-annual efforts are calculated from total catches and CPUEs.

Year		Cpue	Effort	Catch		Cpue	Effort	Catch
1993	Jan	157	71	11.2				
	Feb	71	342	24.4				
	Mar	162	802	129.7				
	Apr	180	2424	436.0				
	May	328	924	302.9				
Subtotal		198	4563	904.2				
Total		198	4608	913.2				

Table 7. Monthly and semi-annual mean catch rates, efforts and catches from 1985 to June 1993, 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	Aug			
	Feb				Sep			
	Mar	564	106	59.8	Oct			
	Apr	158	135	21.3	Nov	226	119	26.9
	May	157	388	61.0	Dec			
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
	May				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	Jul			
	Feb	277	474	131.4	Aug	52	112	5.8
	Mar	169	415	70.0	Sep	51	418	21.4
	Apr				Oct	68	305	20.7
	May				Nov	48	337	16.3
	Jun	13	105	1.4	Dec	72	264	19.0
Subtotal		211	1340	282.9		58	1436	83.2
Total		211	1336	282.0		58	1450	84.0
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
	Apr				Oct	47	414	19.4
	May				Nov	46	406	18.7
	Jun				Dec	17	186	3.1
Subtotal		91	721	65.9		42	2149	89.2
Total		91	3304	302.0		42	2120	88.0
1991	Mar	52	349	18.2	Sep	45	230	10.3
	Apr	81	424	34.4	Oct	68	521	35.7
	May	78	328	25.6	Nov	0	3	0.0
	Jun	0	0	0.0	Dec	52	294	15.2
Subtotal		71	1101	78.2		58	1048	61.2
Total		71	3295	234.0		58	2123	124.0
1992	Jan	60	70	4.1	Jul			
	Feb				Aug			
	Mar	41	293	11.9	Sep			
	Apr	42	212	9.0	Oct			
	May				Nov	37	115	4.3
	Jun				Dec	53	217	11.4
Subtotal		43	575	25.0		47	332	15.7
Total		43	3013	131.0		47	613	29.0
1993	Jan	35	447	15.5				
	Feb	46	566	25.9				
	Mar	44	477	21.2				
	Apr	32	227	7.3				
Subtotal		41	1717	69.9				
Total		41	3242	132.0				

Table 8. Monthly and semi-annual mean catch rates, efforts and catches from 1985 to June 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				
	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	226	821	185.2	Nov	91	231	21.0
	Mar	175	449	78.8	Dec	115	440	50.4
Subtotal		229	1478	338.9		106	671	71.4
Total		229	1635	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	158	862	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		145	2654	383.9		93	1632	152.3
Total		145	3035	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	269	660	177.5	Dec	90	1357	122.7
Subtotal		122	4242	516.0		82	1664	136.6
Total		122	5631	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	1333	79.6
	Apr	128	330	42.2	Dec	88	2759	244.1
Subtotal		93	7022	653.0		77	4628	358.6
Total		93	8614	801.0		77	2659	206.0
1992	Jan	64	1808	115.5				
	Feb	66	1536	101.2				
	Mar	96	1136	108.6	Oct	25	290	7.3
	Apr	52	356	18.4	Nov	69	2120	145.7
	May	59	1472	86.2	Dec	106	2536	267.6
Subtotal		68	6308	429.9		85	4946	420.6
Total		68	7454	508.0		85	6867	584.0
1993	Jan	66	2773	182.1				
	Feb	70	2366	165.6				
	Mar	62	1675	103.8				
	Apr	57	696	39.7				
Subtotal		65	7510	491.2				
Total		65	10809	707.0				

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

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LNCPUE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F
MODEL	43	168.68276682	3.92285504	27.69	0.0
ERROR	586	83.01360161	0.14166144		
CORRECTED TOTAL	629	251.69636843			

R-SQUARE	C.V.	ROOT MSE	LNCPUE MEAN
0.670184	7.9667	0.37637938	4.72441030

SOURCE	DF	TYPE I SS	F VALUE	PR > F
VESS	26	36.03197030	9.78	0.0001
YR	6	52.22233051	61.44	0.0001
MO	11	80.42846601	51.61	0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
VESS	26	41.09542858	11.16	0.0001
YR	6	82.43586321	96.99	0.0
MO	11	80.42846601	51.61	0.0001

PARAMETER		ESTIMATE	T FOR HO: PARAMETER=0	PR > !T!	STD ERROR OF ESTIMATE
INTERCEPT		3.61582778 B	37.45	0.0	0.09655309
VESS	OUIN	0.04638769 B	0.41	0.6849	0.11424308
	OUIQ	0.30142656 B	2.50	0.0126	0.12050627
	OUOQ	0.07699837 B	0.81	0.4158	0.09455481
	OUPJ	0.20776697 B	2.23	0.0259	0.09301594
	OUTM	-0.33065033 B	-3.05	0.0024	0.10856685
	OUWH	0.17231779 B	1.81	0.0711	0.09529195
	OUYM	-0.48565074 B	-3.08	0.0021	0.15747556
	OWDV	-0.27673243 B	-1.85	0.0644	0.14933246
	OWLQ	-0.31045840 B	-3.00	0.0028	0.10338780
	OWQU	0.55248679 B	5.60	0.0001	0.09874062
	OWSH	-0.14219693 B	-1.38	0.1690	0.10324989
	OWUD	-0.31171541 B	-1.13	0.2584	0.27556093
	OWUJ	-0.42350584 B	-2.11	0.0351	0.20048201
	OWVM	-0.25036815 B	-2.47	0.0138	0.10138554
	OWWP	0.30415750 B	3.21	0.0014	0.09487286
	OYBZ	0.28950216 B	3.06	0.0023	0.09471339
	OYCK	0.16772567 B	1.55	0.1210	0.10802281
	OYFF	0.12286077 B	0.96	0.3356	0.12750046
	OYHO	0.51587446 B	6.38	0.0001	0.08083652
	OYKK	-0.13883630 B	-1.56	0.1203	0.08923390
	OYNR	0.03858537 B	0.41	0.6844	0.09488882
	OYNS	-0.12446477 B	-1.30	0.1927	0.09544021
	OYRK	0.16375215 B	1.46	0.1453	0.11228295
	OYRT	0.16172530 B	1.76	0.0787	0.09182392
	OYXT	0.35048188 B	3.65	0.0003	0.09598259
	OZKQ	0.41368123 B	4.24	0.0001	0.09747974
	ZZZZ	0.00000000 B	.	.	.
YR	87	1.25664031 B	15.80	0.0001	0.07952303
	88	1.23705504 B	17.43	0.0001	0.07096922
	89	0.82415109 B	12.26	0.0001	0.06721596
	90	0.74638269 B	10.92	0.0001	0.06837924
	91	0.41062406 B	5.90	0.0001	0.06962050
	92	0.06022350 B	0.80	0.4253	0.07548712
	93	0.00000000 B	.	.	.
MO	1	0.65149323 B	11.36	0.0001	0.05736325
	2	0.63072289 B	11.18	0.0001	0.05643282
	3	0.37035461 B	6.39	0.0001	0.05794047
	4	0.33164304 B	4.67	0.0001	0.07102665
	5	0.08984625 B	1.18	0.2372	0.07592737
	6	-0.49314752 B	-3.02	0.0026	0.16309170
	7	-0.38152277 B	-1.68	0.0931	0.22680176
	8	-0.50303520 B	-4.06	0.0001	0.12395967
	9	-0.48382354 B	-4.52	0.0001	0.10694650
	10	-0.32391516 B	-3.80	0.0002	0.08517117
	11	-0.44448054 B	-6.22	0.0001	0.07149865
	12	0.00000000 B	.	.	.

Table 10. No. of shrimp per length group in commercial samples from 1993, pooled by month and Iceland area units (see Fig. 5.). The entry 'catch' is the total catch from which samples were taken.

EAST GREENLAND	month										
	2				3		4				
	area				area		area				
	580	630	631	680	240	241	191	240	290	486	487
	sample w	sample w	sample w	sample w	sample w	sample w	sample w	sample w	sample w	sample w	sample w
	11.3	129.1	22.9	43.5	42.4	16.4	4.3	30	10.2	7.5	309.3
	catch	catch	catch	catch	catch	catch	catch	catch	catch	catch	catch
	1002	11731	2653	6828	6429	1598	5	2811	344	2008	78550
	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples	No. of samples
	3	36	6	11	7	3	1	5	2	1	29
	CL MM	CL MM	CL MM	CL MM	CL MM	CL MM	CL MM	CL MM	CL MM	CL MM	CL MM
MM											
5	0	0	0	0	0	0	0	0	0	0	0
5.5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
6.5	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
7.5	0	0	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0	0	1
8.5	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
9.5	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
10.5	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	1
11.5	0	0	0	0	0	0	0	0	0	0	1
12	0	0	0	0	0	0	0	0	0	0	4
12.5	0	0	0	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	0	0	0	16
13.5	0	0	0	0	0	0	0	0	0	0	23
14	0	0	0	0	0	1	0	0	0	0	40
14.5	0	1	0	0	0	0	1	0	0	0	26
15	0	1	0	1	0	1	0	0	0	0	32
15.5	0	1	0	0	0	0	0	0	0	0	30
16	0	2	1	0	0	1	0	0	0	0	17
16.5	1	1	0	0	1	2	1	1	1	0	31
17	1	2	1	1	3	2	0	0	2	1	24
17.5	0	8	0	1	8	4	4	2	4	0	52
18	2	8	0	5	10	4	5	4	6	3	72
18.5	2	21	1	4	17	7	5	15	8	3	125
19	0	19	2	8	42	13	14	25	9	12	211
19.5	1	22	3	15	59	15	23	37	21	8	268
20	7	44	8	10	101	40	37	77	26	11	355
20.5	4	80	8	24	135	54	48	97	49	17	449
21	13	111	15	50	248	66	68	169	90	19	499
21.5	17	176	14	57	294	74	79	274	116	16	524
22	24	251	21	111	349	72	76	312	153	29	543
22.5	28	326	36	129	392	109	55	306	134	35	581
23	20	393	43	161	431	132	51	355	141	30	685
23.5	31	400	39	152	420	141	39	339	103	31	740
24	24	449	47	179	432	140	20	306	88	39	778
24.5	36	522	56	181	363	118	17	222	63	26	718
25	47	582	95	199	329	119	9	216	47	24	848
25.5	39	645	100	229	300	94	7	161	39	34	872
26	68	684	115	247	238	82	7	146	35	40	949
26.5	65	690	123	221	171	72	2	124	31	22	933
27	59	568	103	211	111	70	5	99	21	29	914
27.5	49	610	116	206	83	47	1	82	13	25	1009
28	49	482	105	167	76	36	1	60	8	11	961
28.5	57	485	81	157	54	23	0	41	5	26	1015
29	47	435	77	116	73	21	0	23	5	20	996
29.5	46	429	92	147	42	17	0	26	1	18	1102
30	37	355	78	123	33	17	0	15	1	19	1068
30.5	30	343	74	113	59	9	0	15	0	17	994
31	25	273	48	85	28	6	0	6	0	9	983
31.5	19	263	60	88	13	3	0	8	2	11	868
32	11	202	41	63	9	5	0	4	0	6	646
32.5	15	150	38	49	3	5	0	2	0	7	442
33	5	116	23	25	5	2	0	0	1	1	276
33.5	8	75	15	30	2	0	0	0	0	1	137
34	7	49	13	8	1	0	0	1	0	0	67
34.5	0	32	8	6	0	0	0	0	0	0	11
35	0	19	2	2	0	0	0	0	0	0	10
35.5	0	19	1	2	1	0	0	0	0	0	2
36	0	2	1	0	0	0	0	0	0	0	2
36.5	0	0	1	0	0	0	0	0	0	0	1
37	0	0	0	0	0	0	0	0	0	0	0
TOTAL	894	10346	1705	3583	4936	1624	575	3570	1223	600	21965

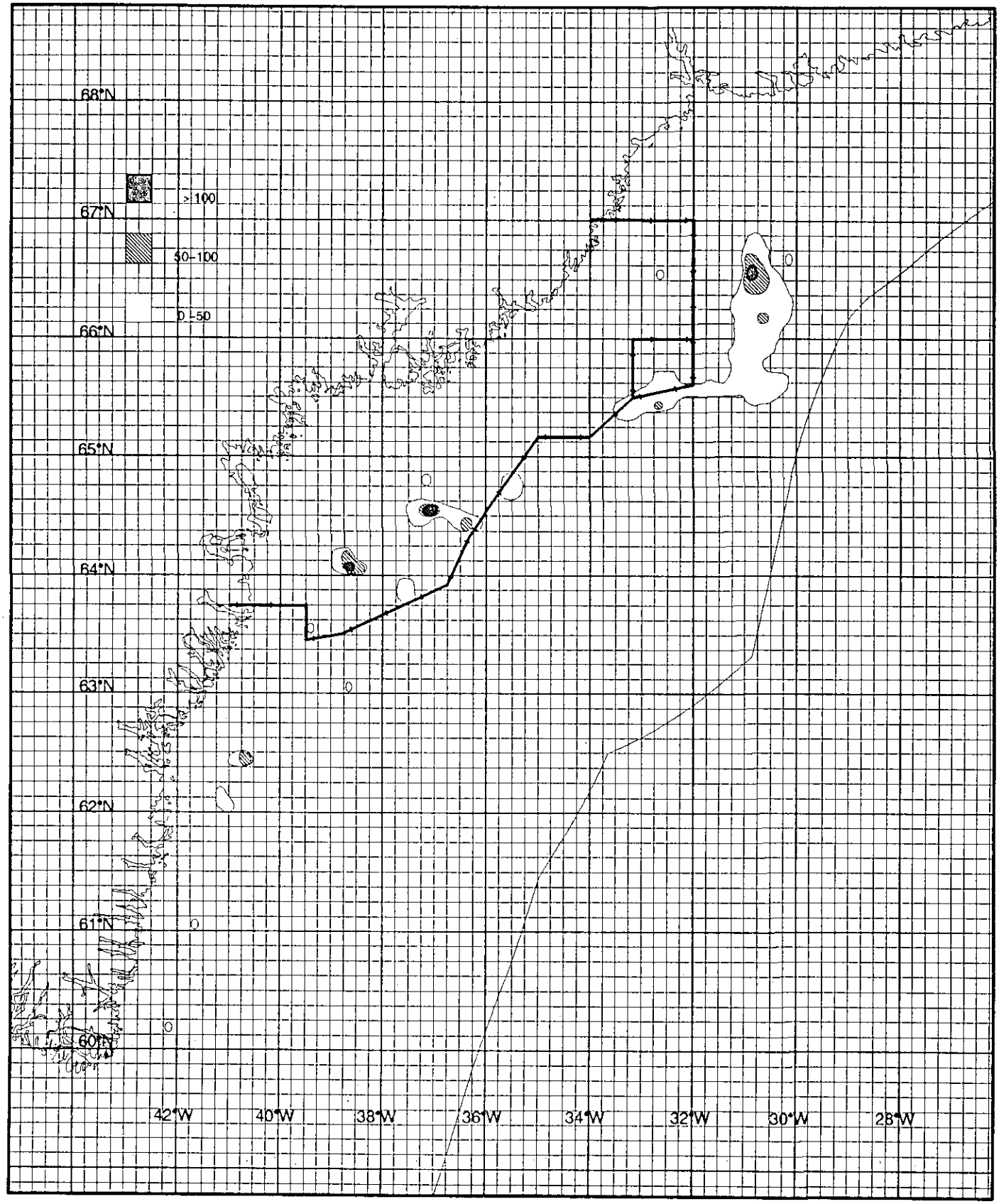


Figure 1. Distribution of catches of shrimp (tons per statistical unit) in the fishery in Denmark Strait in January-October 1993, based on logbooks from the Greenland fishery. The area delimited by a dotted line is the 'redfish' box (see text) opened to the fishery in 1993. The small area south of 66°N was opened from 1990.

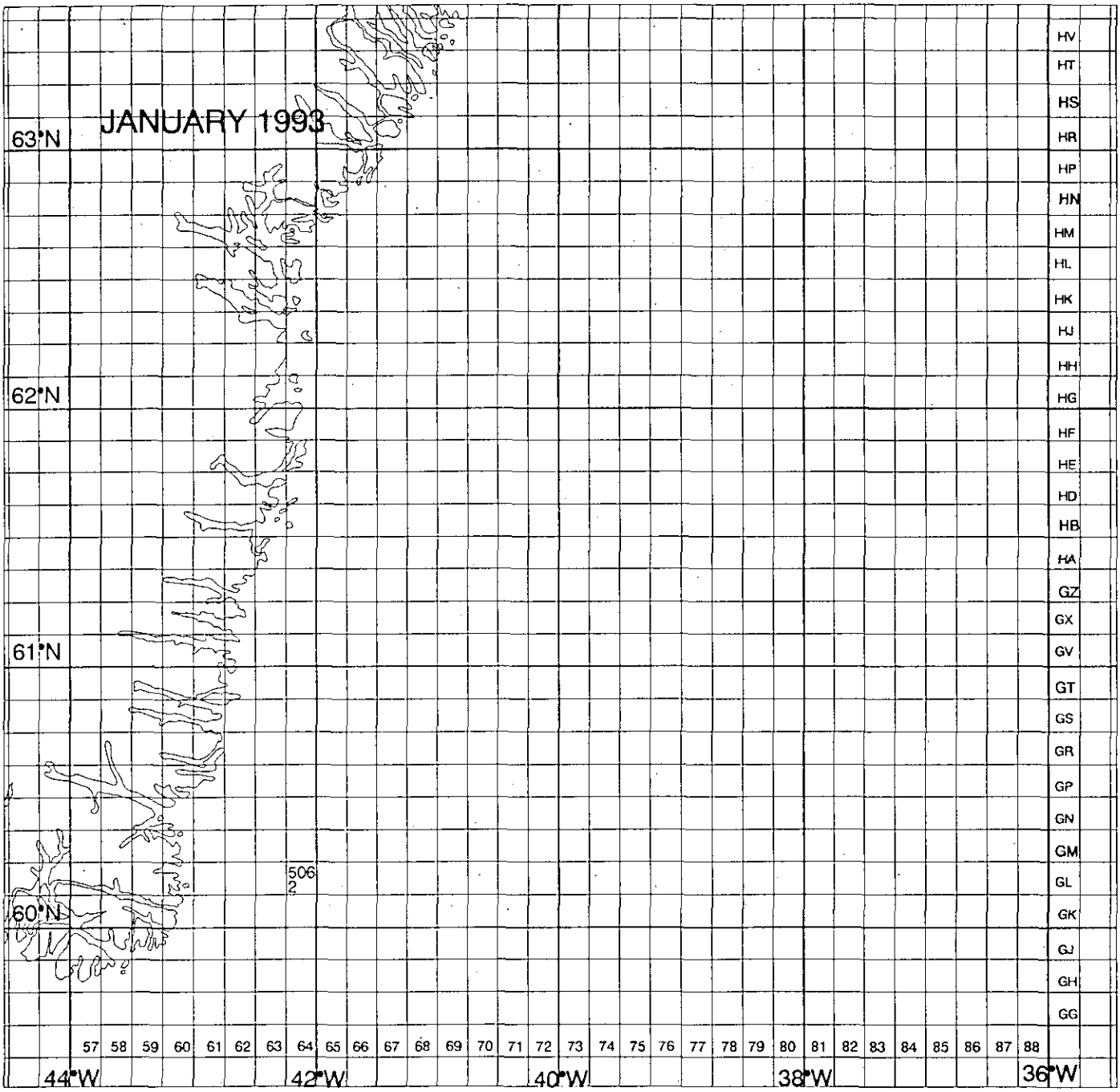


Figure 2a. Distribution of mean catch of shrimp (kg/hour) and effort (hours) in the shrimp fishery in Denmark Strait south of 63°30'N in January 1993, based on logbook information from the Greenland fishery.

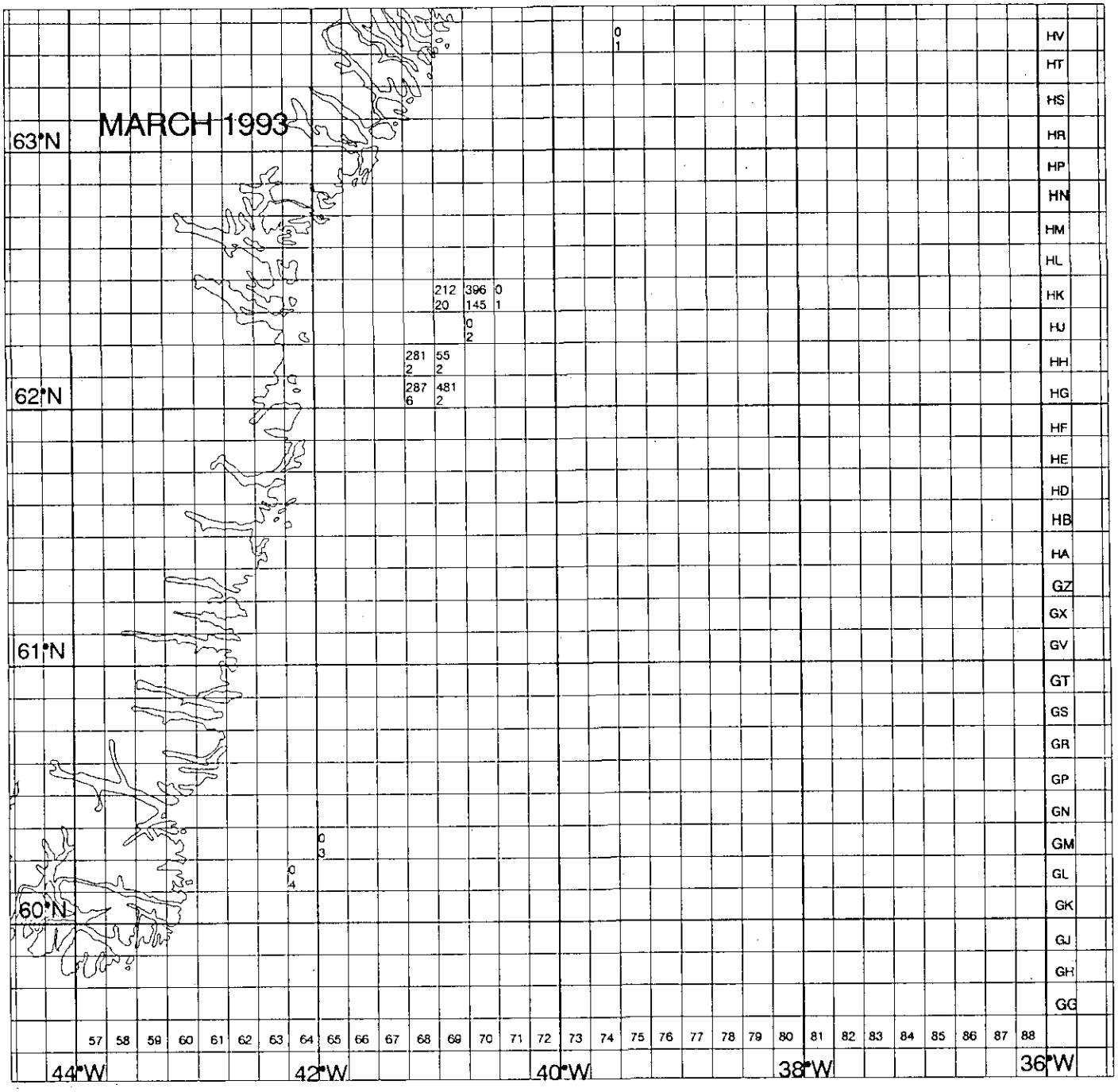


Figure 2a continued. Data from March 1993.

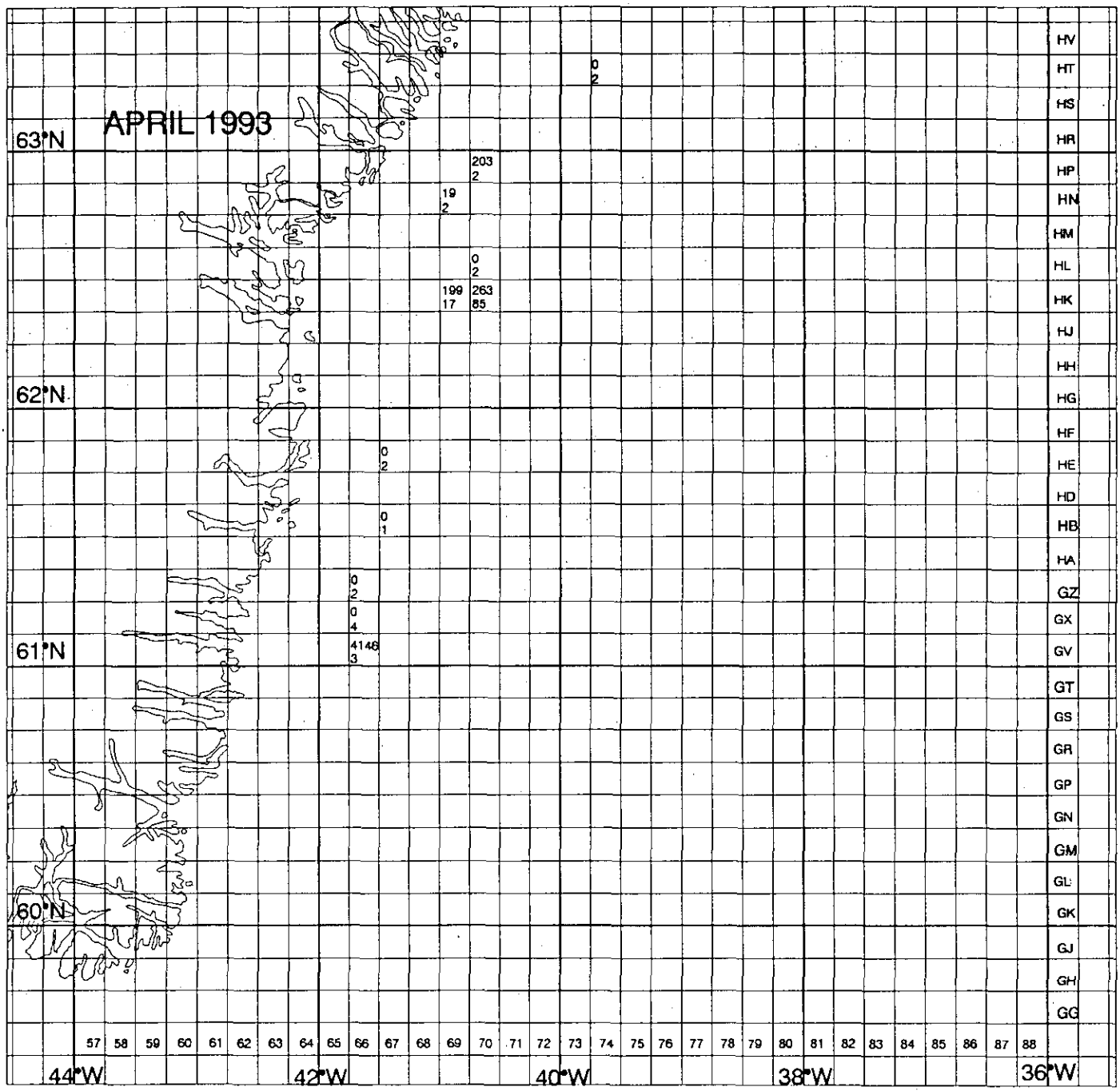


Figure 2a continued. Data from April 1993.

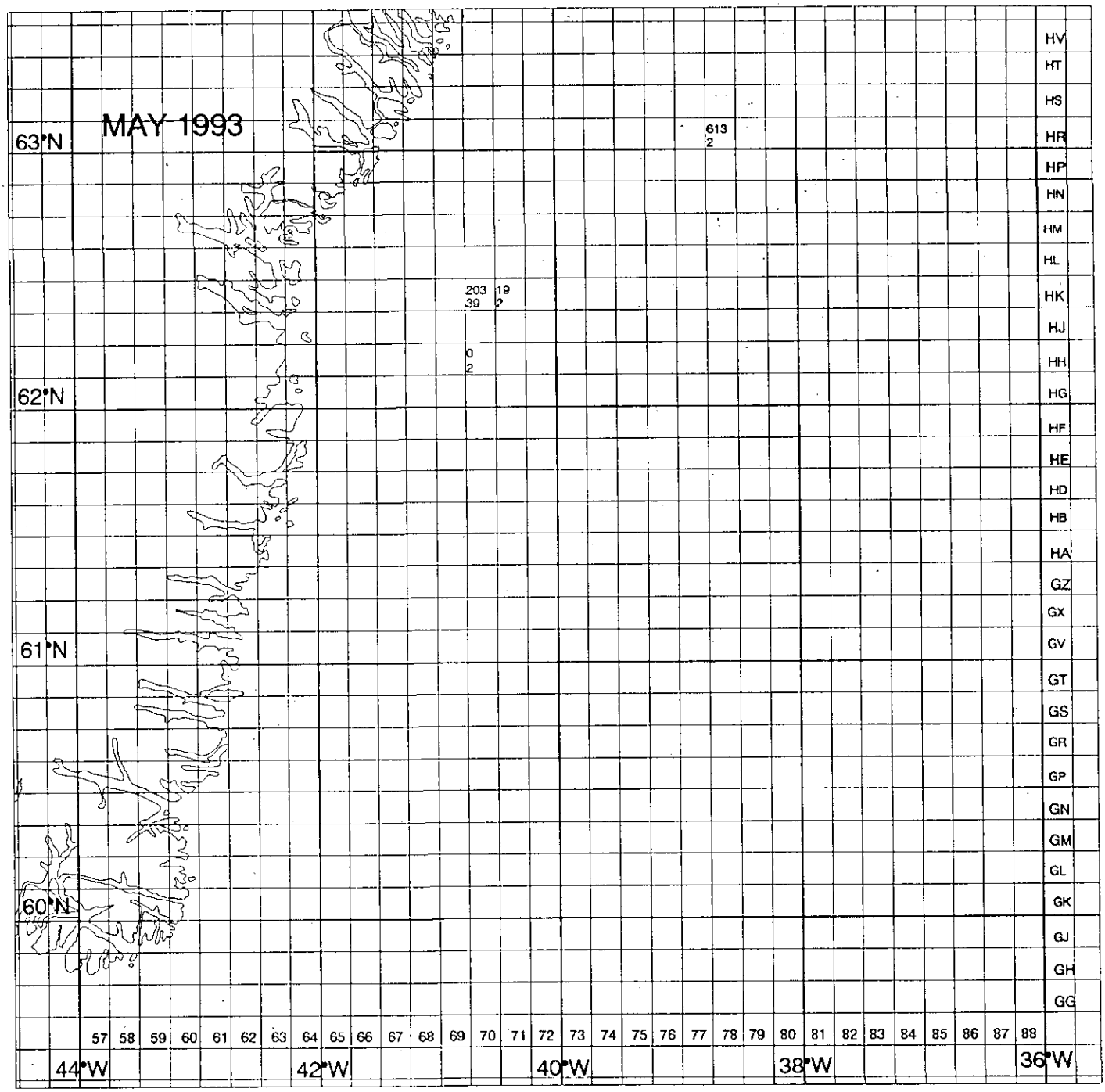


Figure 2a continued. Data from May 1993.

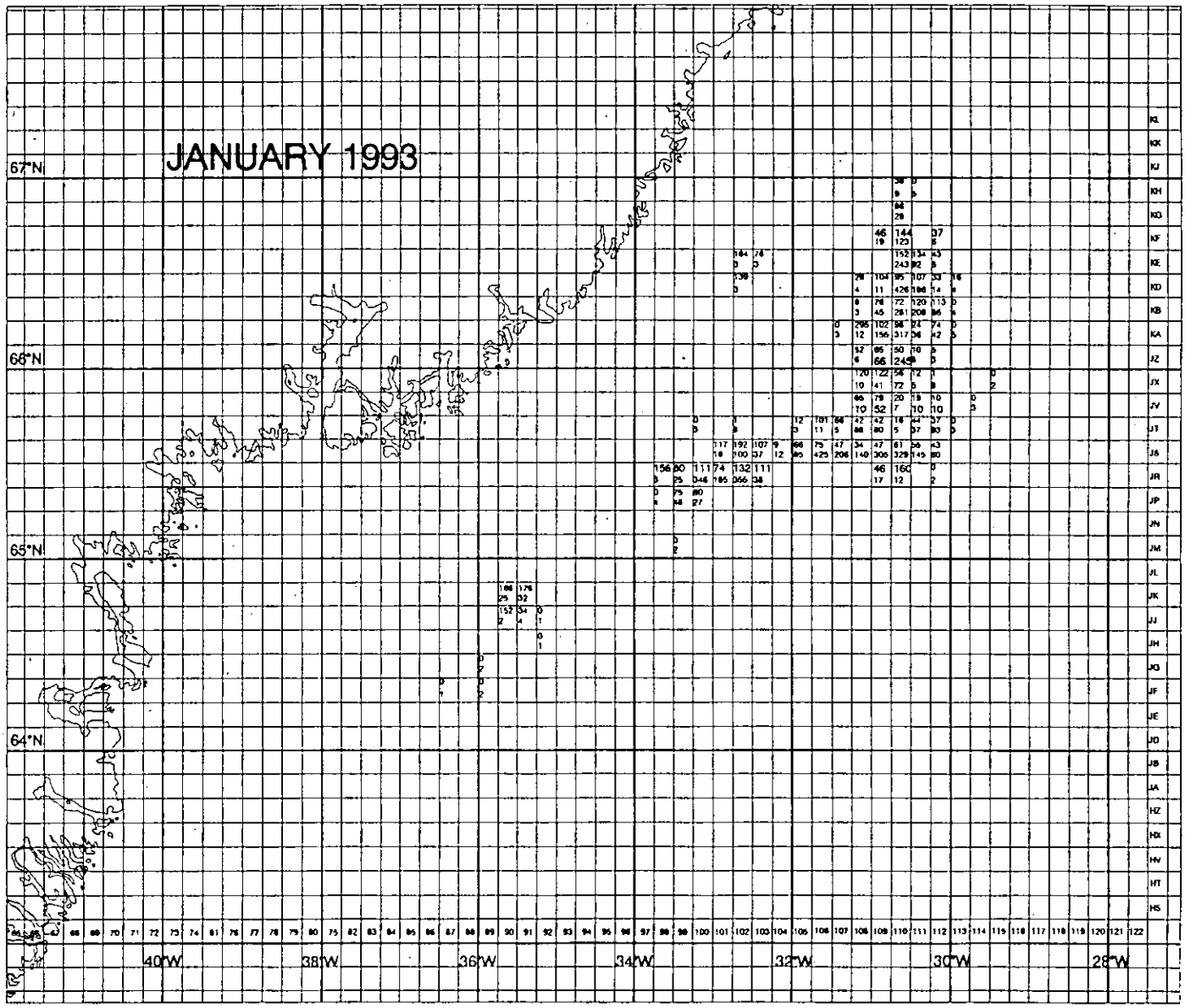


Figure 2b. Distribution of mean catch of shrimp (kg/hour) and effort (hours) in the shrimp fishery in Denmark Strait north of 63°30'N in January 1993, based on logbook information from the Greenland fishery.

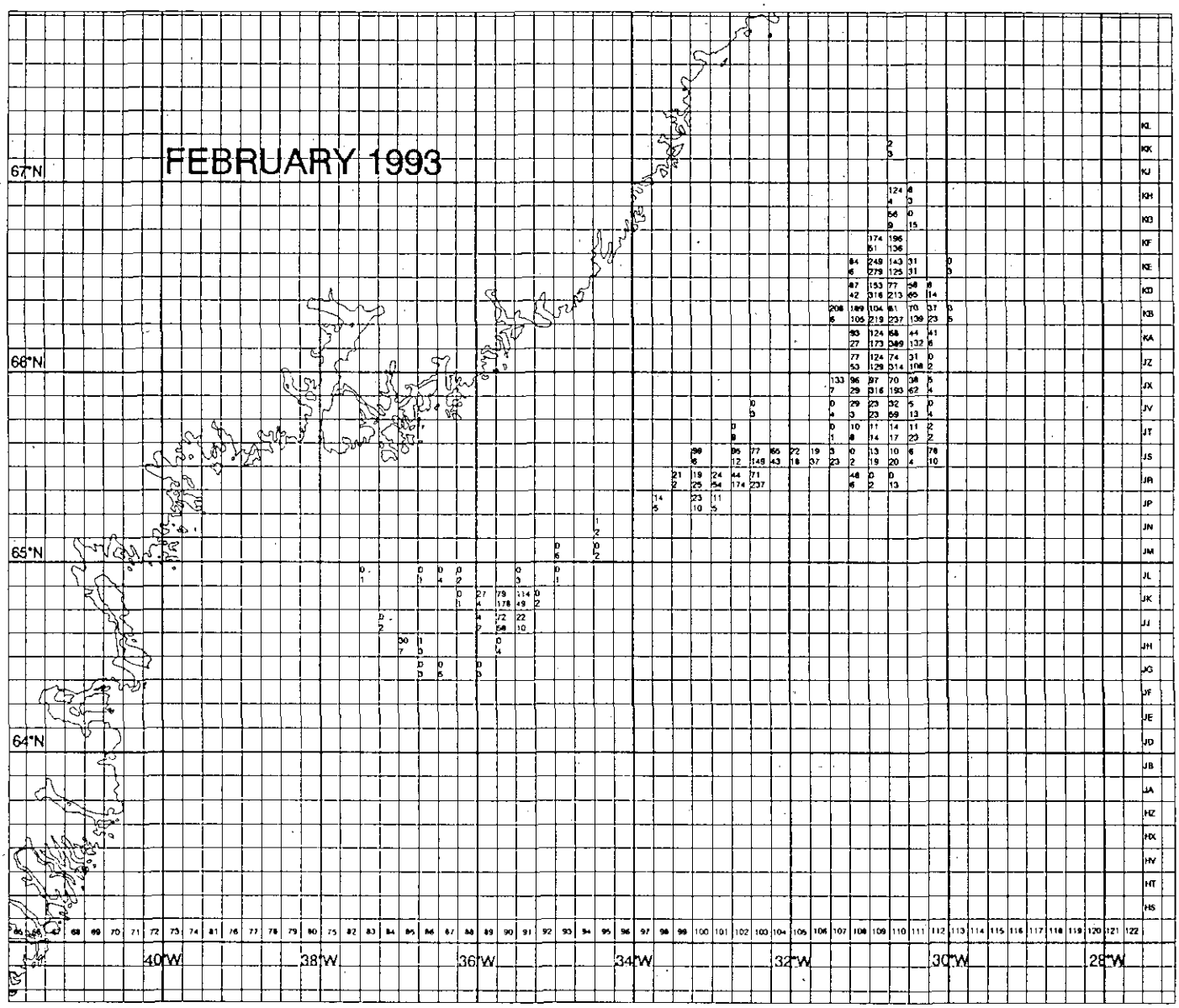


Figure 2b continued. Data from February 1993.

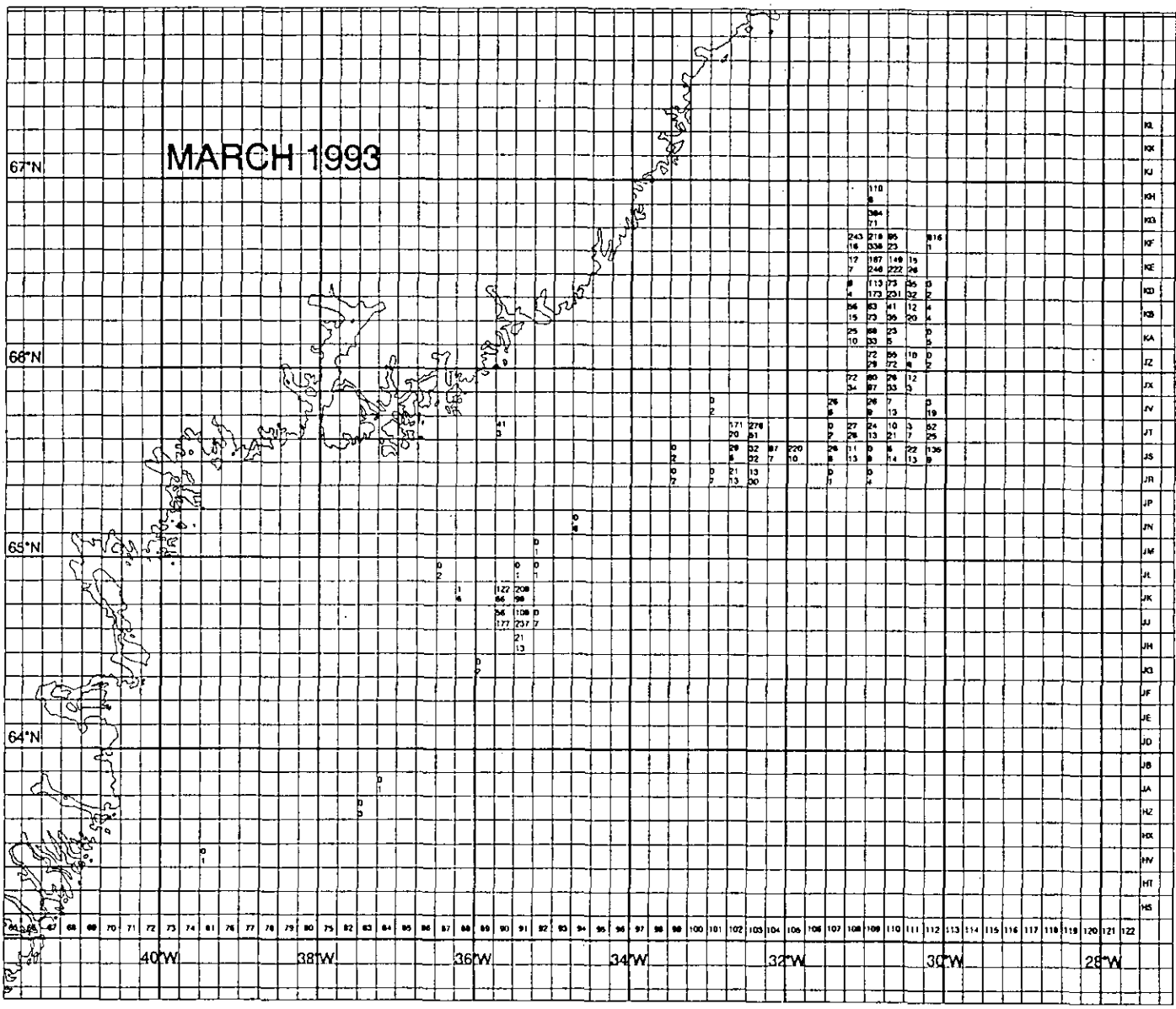


Figure 2b continued. Data from March 1993.

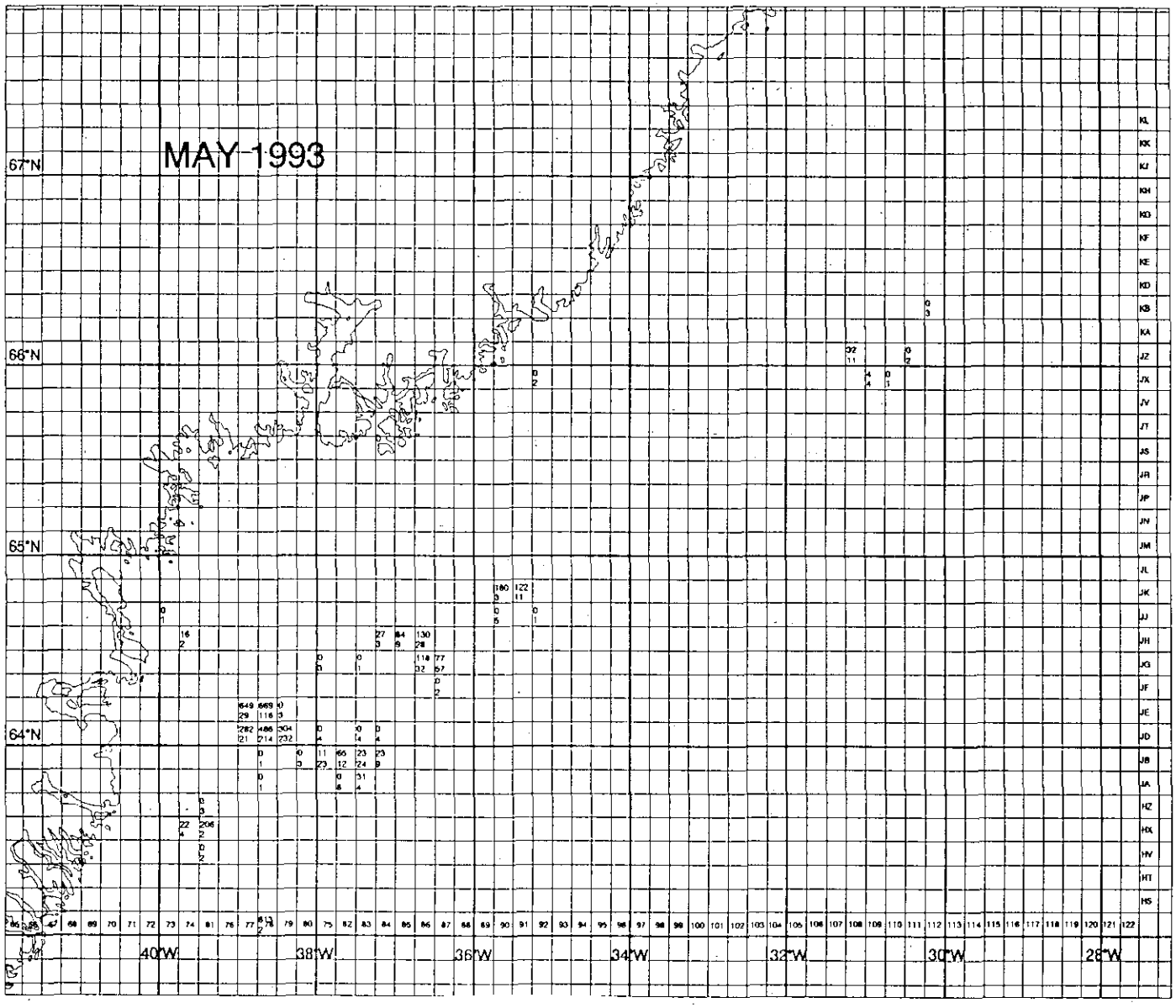


Figure 2b continued. Data from May 1993.

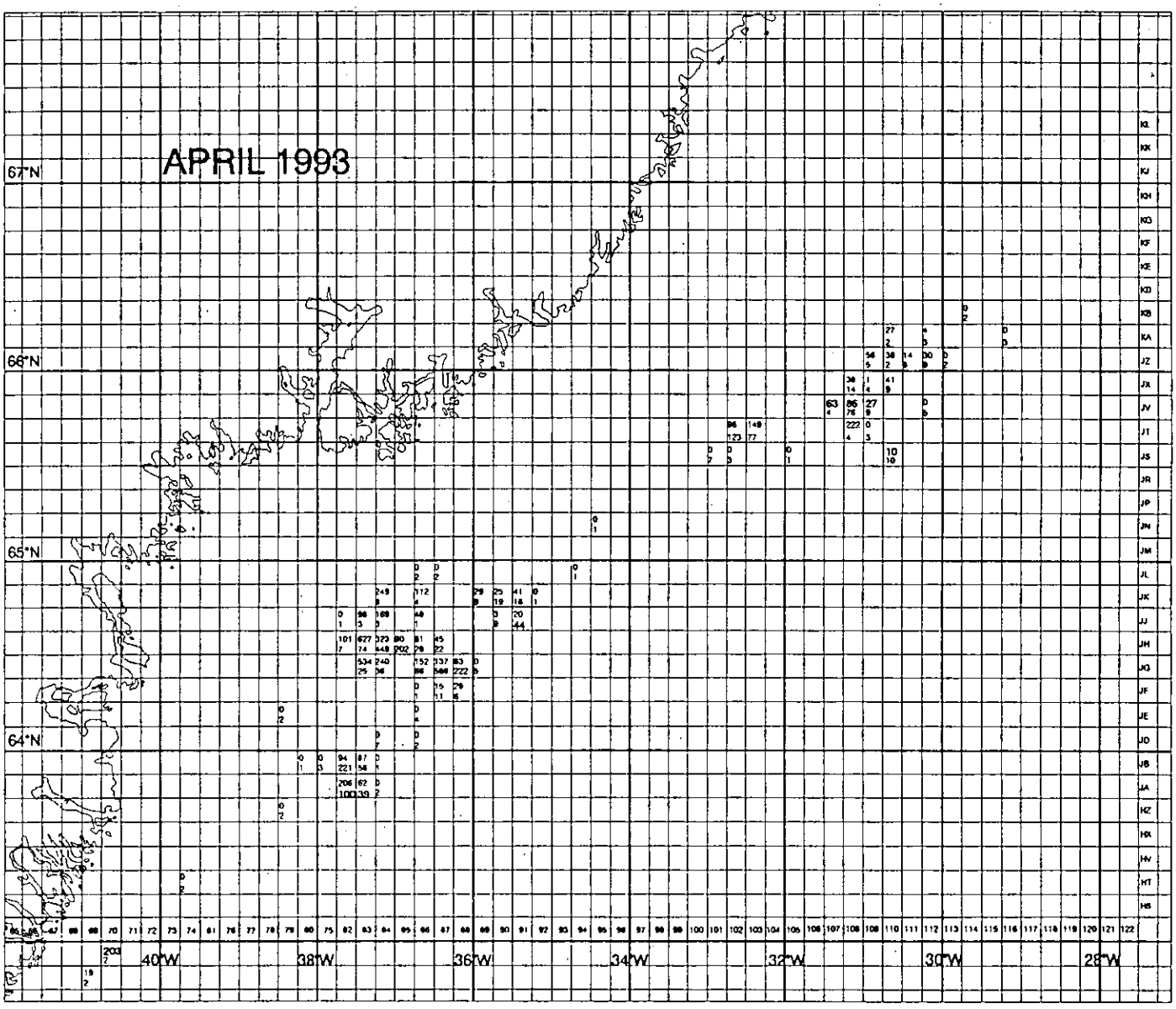
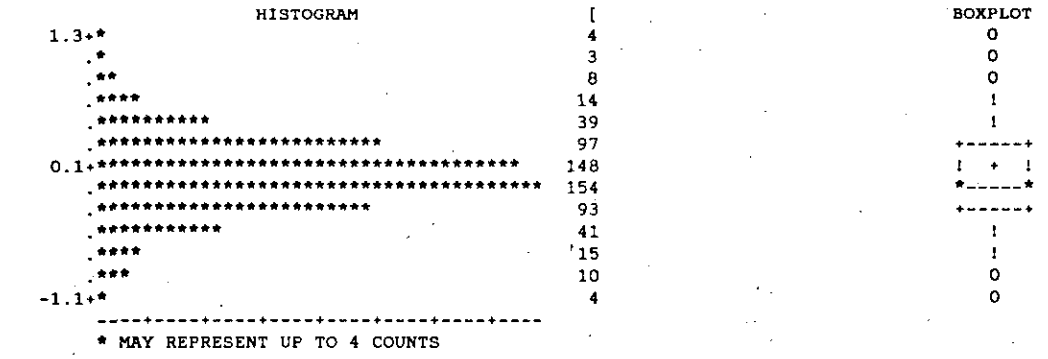


Figure 2b continued. Data from April 1993.



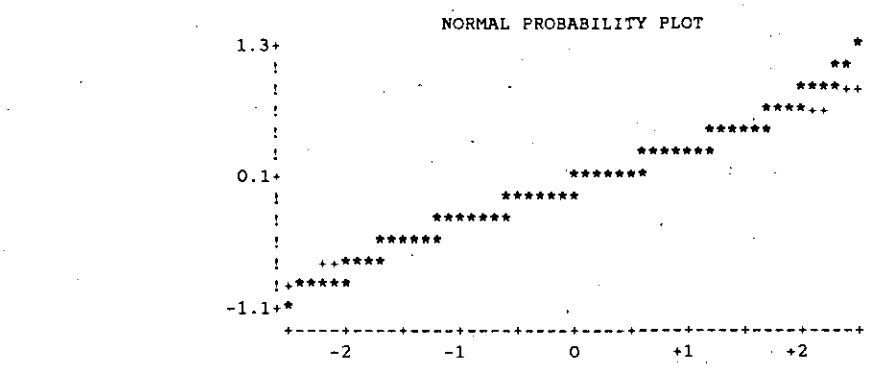


Figure 3. Histogram, box- and probit plot of the residuals from the multiplicative analysis in Table 9 (shrimp >8.5 g).

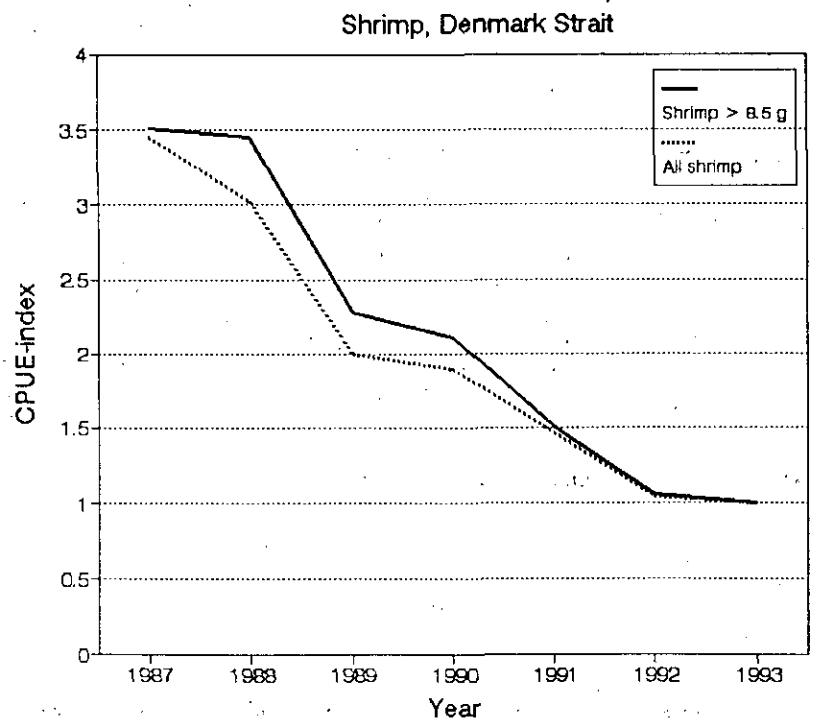


Figure 4. Annual CPUE-indices calculated for shrimp >8.5 g and for total catch by 27 Greenland trawlers in Denmark Strait from 1987 to 1993.

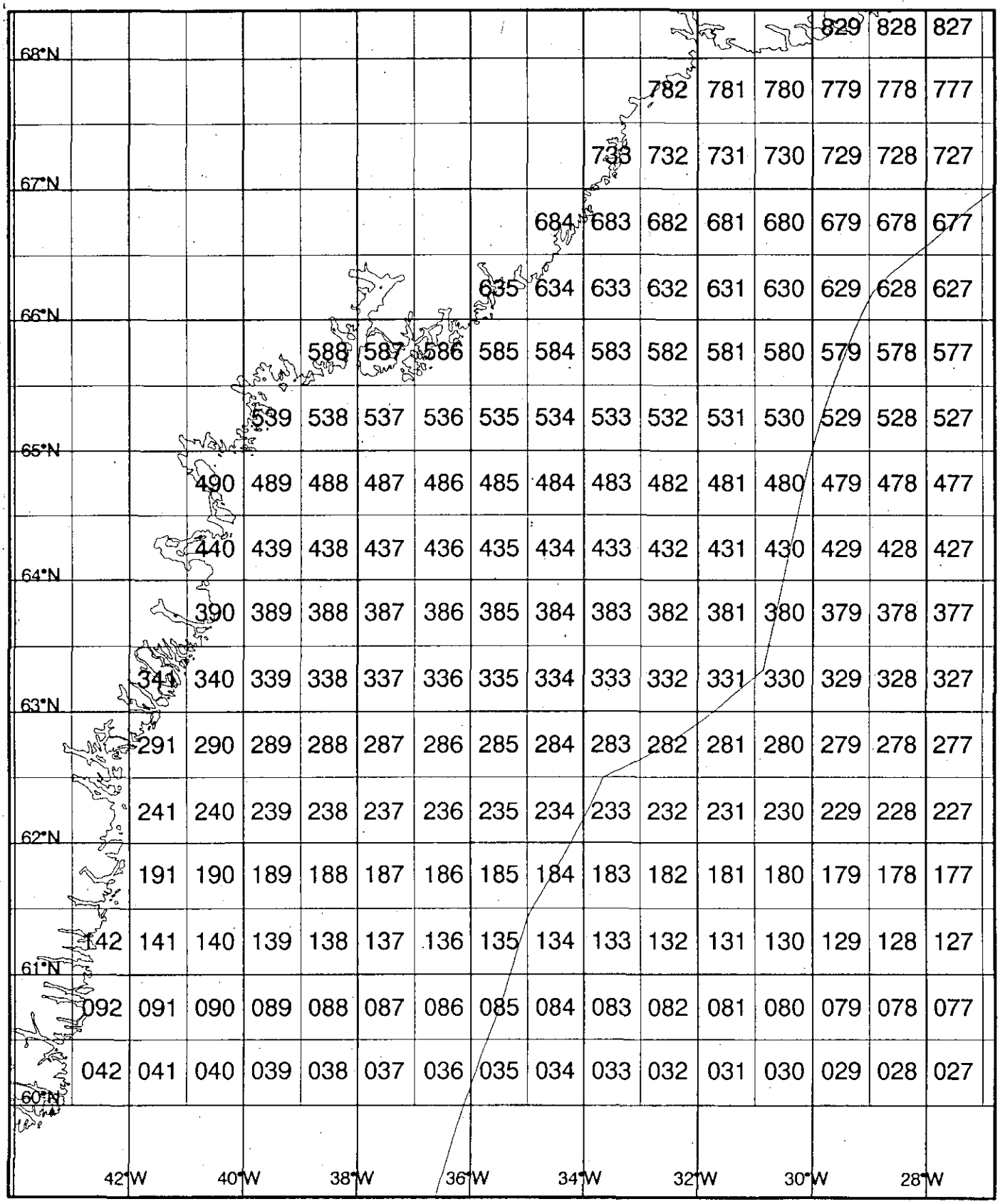
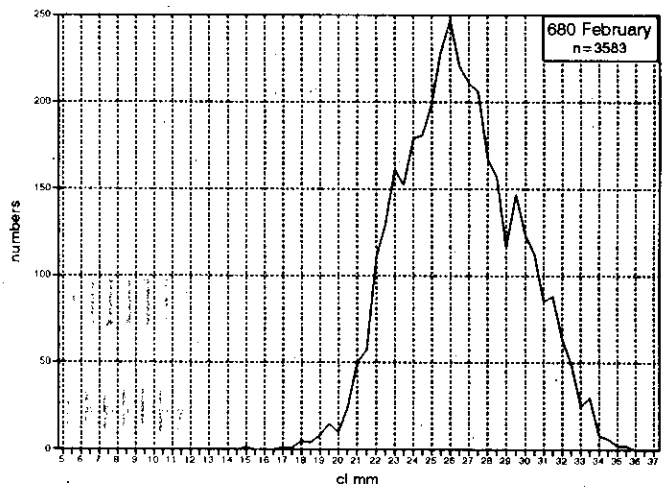
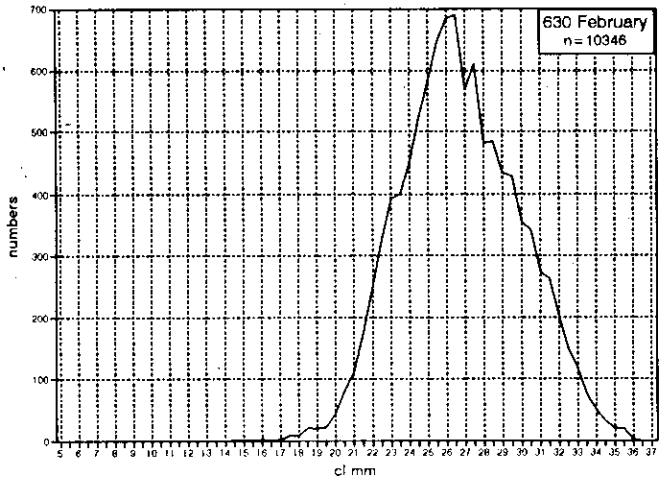
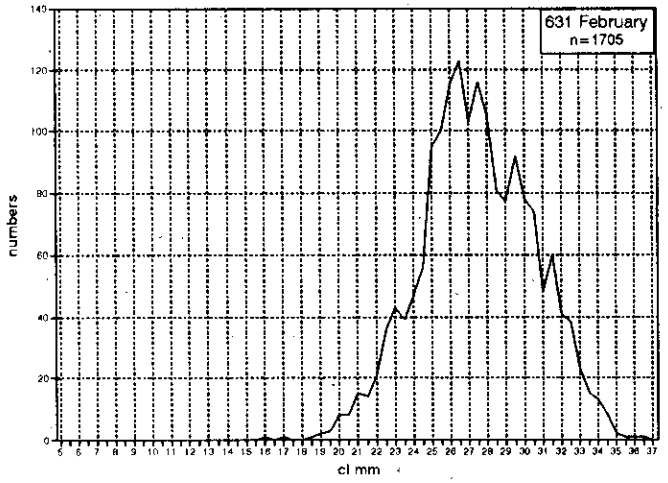


Figure 5. Map showing numbering of the Iceland statistical area units.







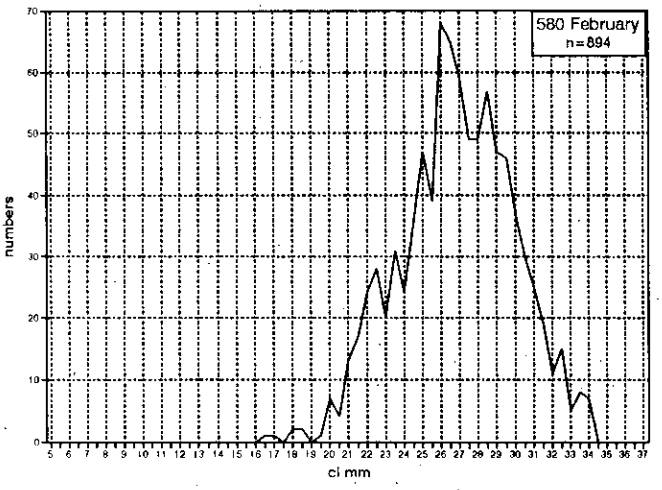


Figure 6. Pooled shrimp samples from February 1993 sampled in various statistical units (see Fig. 5).

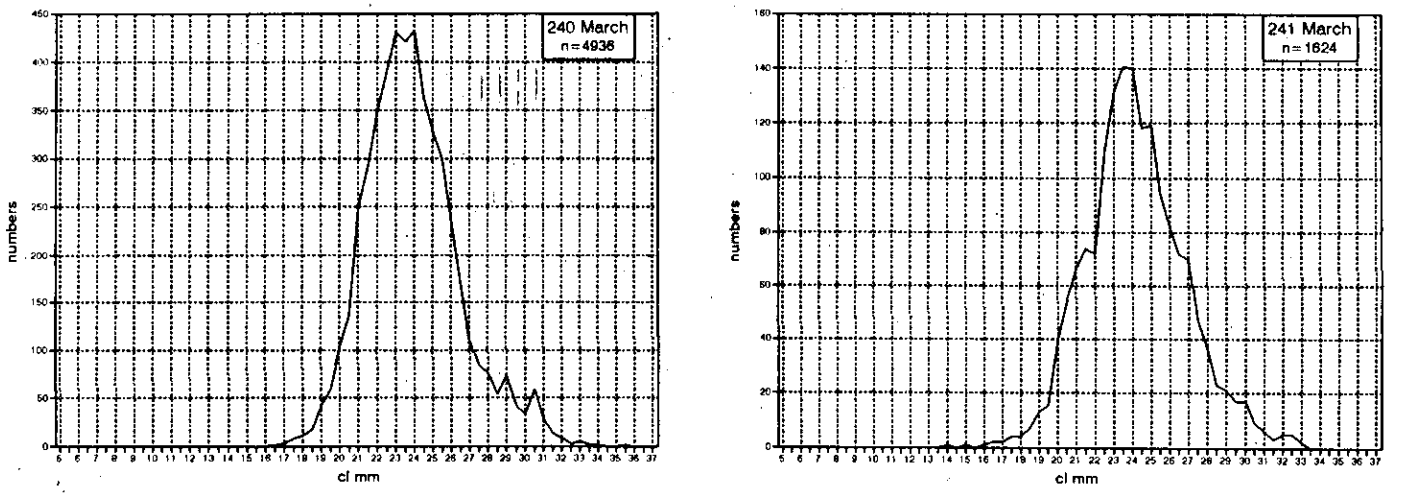


Figure 7. Pooled shrimp samples from March 1993 sampled in various statistical units (see Fig. 5).

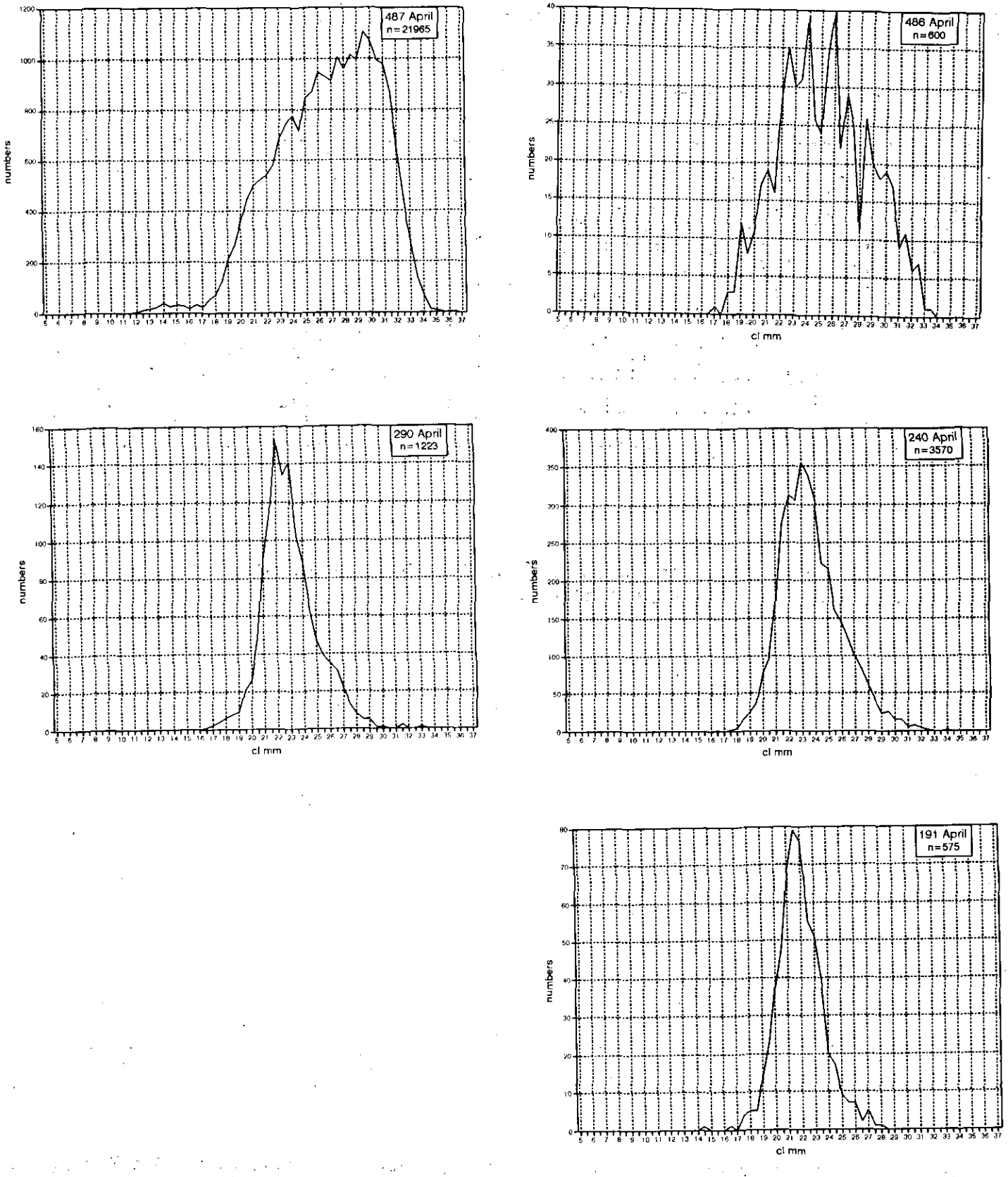


Figure 8. Pooled shrimp samples from April 1993 sampled in various statistical units (see Fig. 5).