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The Greenlandic Fishery for Northern Shrimp (*Pandalus borealis*) off West Greenland, 1970-1998

by

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Introduction

The shrimp stock at West Greenland is confined to NAFO Subarea 1 and Div. 0A. In accordance with the recommendations by STACFIS in November 1993 (Anon., 1993), this stock is assessed as a single population.

Two Greenlandic fleet components exploit the stock in Subarea 1: the offshore fleet, which at present consists of 17 large factory trawlers and the small vessel fleet composed of about 100 vessels smaller than 80 GRT. The offshore fleet component is restricted to offshore areas and by quotas. With few exceptions vessels below 80 GRT were unrestricted by areas and quotas until 1997 when a catch regulation was introduced also for this fleet component. Since 1986 logbooks have been mandatory for vessels above 50 GRT fishing in Greenlandic waters. Since 1997 logbooks are available for all vessels. Internal Transferable Quotas (ITQ) were introduced as a management tool in 1991.

In 1997 Greenlandic shrimp trawlers reported a total catch in Subarea 1 of 64,000 tons including 13,500 tons taken in the inshore areas. This represents a decline of about 2,000 tons compared to the previous year. From Jan-August 1998 reported catches amounted to 33,500 tons of which 7,700 tons were taken inshore. The total 1998 catch is projected to be at the 1997 level.

The present paper updates time series of total catch and effort, catch composition, CPUE-indices and spatial distribution of the Greenlandic shrimp fishery off West Greenland.

Materials and Methods

Total catches were estimated from vessel logs and weekly reporting to Greenlandic authorities by vessels larger than 80 GRT. Catches from vessels smaller than 80 GRT were estimated and allocated to inshore/offshore areas, based on information from logbooks and sales slips. Logbook data were analysed to show the spatial distribution of the fishery and the overall distribution of catch, effort and catch rates by year, month and NAFO Division. Unstandardised CPUE was calculated using a factor 2 as a multiplier for recorded effort by vessels using twin-trawl.

CPUE data from Greenlandic vessels above 50 GRT fishing in Subarea 1 and Canadian vessels fishing in Div. 0A were used in multiplicative models to calculate standardised annual catch rate indices. One 1976-1995-time series was calculated by the model presented in Hvingel, Lassen and Parsons (1996a). The index value of the individual years 1996-98 were calculated from this model by applying the estimated effects of the model to the original data of these years (Hvingel, Siegstad and Folmer, 1996b, 1997). A revised version of this standardised CPUE time series based on data up and including 1997 was also calculated. The main differences to the former index is the use of total catch only instead of catch of large shrimp (<count 120/kg) in part of the CPUE data (the data accounting for Div. 1B+C+D since 1987). A comprehensive documentation and discussion of this index as an indicator of stock biomass is given in Hvingel *et al.* (1998). The 1998 value of this index was calculated by applying the estimated effects of the model to the original data of the year.

Unstandardised effort was calculated by dividing total catch in Subarea 1 with mean CPUE as calculated from logbooks. Standardised effort was calculated by dividing total catch in Subarea 0+1 with the revised standardised CPUE-index for Subarea 0+1.

Annual size compositions of shrimp catches were obtained from samples taken before processing by fisheries observers onboard offshore vessels. In the laboratory samples were sorted by sexual characteristics (McCrary, 1971) and measured to the nearest 0.1 mm carapace length. The data were then pooled in 0.5 mm length groups and adjusted by the weight of the catch to the number caught in the set. Numbers from all sets for the month were totalled and adjusted by weight to the monthly catch by NAFO Division. The numbers from all months and areas were totalled and adjusted by weight to the total or projected catch of the year.

The annual length frequency distributions of the total catch in Subarea 1 were converted to catch at age by modal analysis including use of the MIX application (McDonald & Pitcher, 1979). The data were analysed using fixed mean modal lengths. Four modes with mean lengths at 14, 18.5, 21 and 25 mm respectively were included in the analysis. The iterations were run with all coefficients of variations held a fixed value of 0.065.

A catch-at-age table was produced by multiplying proportions of the four modes by total number caught. Age specific indices of abundance were then calculated by dividing the numbers caught at age by the standardised effort.

Results and Discussion

Catch, effort and CPUE

Table 1 and Figure 1 show total catch, effort and CPUE by vessels in Subarea 1. Since 1973 most catches were taken offshore. In conjunction with the development of the offshore shrimp fishery total annual catch has increased from less than 10,000 tons in the early 1970's to a peak of almost 80,000 tons in 1992. Since then, government restrictions have gradually reduced the landings to about 64,000 tons in 1997. The projected catch of 1998 is at this level.

Since the beginning of the 1970's catches in the inshore areas have been fluctuating between 10,000-20,000 tons. Limited access for vessels above 80 GRT has been the only restraint on inshore catch levels until 1997 when quotas were enforced also for the small vessel fleet. During the nineties inshore fishery has accounted for about 25% of the total catch in Subarea 1.

Table 2 shows catch by month since 1987. In general the monthly amount of shrimp caught tracks a dome shaped curve over the year with a maximum in June-July of about 8000 tons. In some years (1991-1994) a second maximum occur in October.

Since 1975, when the offshore fishery was well established, until 1984 annual unstandardised effort showed a slightly increasing trend from about 75,000 hr's to about 85,000 hr's (Fig. 1B). In the subsequent years a considerable enlargement of the offshore fleet took place and effort went up by almost a factor three reaching 230,000 hr's in 1991-1992. Hereafter unstandardised effort has been decreasing due to enforced government policy to reduce catches and increased fleet efficiency. The apparent increase in unstandardised effort from 1996 to 1997 was caused by the addition of logbooks from vessels below 50 tons to the database (new logbook system). In 1997 the unstandardised effort was about 190,000 hr's and preliminary data suggest that the 1998 figure will be at around 170,000 hr's. The long time trend of the standardised effort is in good agreement with the unstandardised (Fig. 1B).

The standardised CPUE index based on the model presented in Hvingel *et al.* (1996a) is given in Table 1 and Figure 1C (std. A index). The preliminary index value of 1997 did not change appreciably by adding a complete data set of the year. The projected 1998 value is at the 1997 level.

The new revised CPUE index based on Hvingel *et al.* (1998) is given in Table 1+4 and Figure 1C (std. B index). Compared to the older version of this time series the main difference is in the trend of the 1990's. The older version is showing a slight downward trend while the revised is showing an upward trend of the 1990's. This discrepancy stems from the fact that the two indices largely represent two different parts of the stock for this time period. Since 1987 the catch data used in the old index version is a combination of total catch (the KGH index, the inshore index and the 0A index) and catch of shrimp larger than 8g (the 1B and 1CD indices), while the data in the new index is total catch only. The divergence of the two CPUE trajectories therefore suggests that the biomass or the availability of shrimp larger than 8g has been reduced throughout the 1990's. However, increased catch rates of smaller size classes have been able to compensate for this development. The reduction in mean shrimp size caught 1991-1998 (Table 6 and Figure 4) adds to this interpretation.

The standardisation method used in both indices accounts for the increase in efficiency from renewal of the fleet but does not account for the technological improvements, which results from the upgrading of older vessels. The lack of importance of the YEAR*VESSEL term in the models suggests that this has minor influence on the use of the CPUE index as a biomass indicator. However, the standardised CPUE time series interpreted as a biomass index is expected to give a slightly optimistic view of the stock development.

By-catch and discard

Table 5 shows reported discard of shrimp and fish and landed by-catch of *Pandalus montagui* during the years 1987-98. The reported discard of shrimp has been around 0.5% of total catch throughout the period. The discard of fish reported has shown a slightly increasing trend. The introduction of observers on all offshore vessels in 1991 has most likely contributed to this development. The corresponding effect of observers on the reported discard of shrimp may have been offset by an improved market for smaller shrimp.

Since 1995 vessels have reported annual catches of *P. montagui* in the range of about 300 to 800 tons. Landings of *P. montagui* are allowed to include up to 70% *P. borealis*. As *P. montagui* can be landed outside the quota it is therefore possible to "hide" catches of *P. borealis* within these landings. Hence, it is difficult to use the emergence of *P. montagui* in the catches to infer changes in targeting strategy of the fishery or as an indication of increased availability of this species. However there have been reportings of increased biomass of P. montagui during the mid 90's (Folmer, 1996)

Spatial distribution of the fishery

The allocation of catch and effort to NAFO Divisions and the resulting mean CPUE based on logbook information is given in Table 3. Incomplete logbook coverage of the small vessel component causes underestimation of the fishery in Div. 1A and 1F until 1997. Alternating quota restrictions in offshore areas of Div. 1A may also have biased data for this area.

However, a substantial change in the relative importance of the different areas is indicated. Since the mid 1970's until the early 1980's Div. 1A+1B have been the far most important areas of this shrimp fishery. Div. 1C received minor attention and almost no effort was allocated to Div. 1D,1E and 1F. Since then the fishery has gradually expanded southward to include also these three southern most Divisions in Subarea 1. The southward expansion/displacement of the offshore fishery during the late 80's - mid 90's (Hvingel, 1996) is also indicated in Figure 2 and 5. Indications of biomass distribution from the German groundfish survey (Rätz, 1997) and the Greenlandic trawl survey (Carlsson and Kanneworff, 1997) may suggest that the fishery is tracking a southward shift in shrimp biomass. However, development of improved trawling gear for accessing the more difficult trawling grounds in the southern areas may also be an important factor.

The spatial distribution of catches by statistical units of 7.5' latitude and 15' longitude from 1987 to 1998 is shown in Figure 5. The preliminary catch figures for 1998 do not suggest any significant changes in the distribution of the fishery from 1997 to 1998.

Catch composition.

Modal analyses were applied to the annual length frequency distributions. Figure 6 shows the overall annual length-frequency distribution and the estimated modal structure of the total catch in Subarea 1 from 1991 to 1998. The modes may be interpreted as age group 3-6+. However, the assignment of absolute age to the modes still needs further research. Table 7 gives an update of the underlying number of samples and the number of individuals measured as given in Hvingel *et al.* (1997). As samples may be unevenly distributed in time and space possible effects of pooling these temporal and spatial disaggregated samples by year were investigated. Analyses of data by NAFO Div. and quarter showed no serious bias of the annual parameter estimates as a result of the data pooling procedure.

The proportion of the 6+ group in the catches has shown a declining trend along with an increase in the proportion of small shrimp at age 3 and 4 during the 1990's (Table 6). This development was also reflected by the calculated mean shrimp size caught, which has declined by 2.7 mm cpl. since 1991 corresponding to a mean individual weight reduction of about 20% (Figure 4). Mean shrimp size caught in the Canadian fishery in Div. 0A showed a similar declining trend since 1981 except for the 1998 value, which however, is based on one sample only (Figure 4).

The standardised catch rates of most year classes indicate increasing abundance up to age 6+, as they pass through the fishery (Figure 3). This suggest that the shrimp are only partly recruited to the fishery at least until their first year as females as also noted by Savard *et al.* (1991). However, the increase in abundance of the1993 year class was reversed at age 4. This may indicate increased mortality for this particular year class compared to the others in the time series.

The prediction made in 1997 of weak recruitment to the female group in 1998 seems to have been fulfilled (Hvingel *et al.*, 1997). As also noted in 1997 a consequence of the relative weak 1992 year class, the 1993 year class may be subjected to increased fishing mortality to maintain catch rates. In 1998 the 1993 year class has been reduced to the level of the weak 1992 year class at age 5. As the 6+ group in 1999 will be dominated by the relative weak 1992 year class and the diminished 1993 year class, female abundance is expected to be proportionally low.

The 1994 year class seems to be at the former level of the 1993 year class. However, due to the current relatively low abundance of females, the 1994 year class will most likely parallell the development of the 1993 and therefore be reduced substantially when it reaches age five in 1999.

Conclusion

Catches reached a maximum in 1992 at 80,000 tons. Since then catches have constantly been reduced due to government restrictions. The projected catch of 1998 is at the 1997 level of about 64,000 tons. During the 1990 approximately 25% of the catches were taken inshore.

Traditionally Div. 1A and 1B have included the most important fishing grounds. Since the late 1980's the fishery has gradually expanded southward while the effort allocated to Div. 1A and 1B has been reduced. There are indications that the southward displacement/expansion fishing effort from the late 80's to the mid 90's to some extent was due to the fishery tracking changes in shrimp distribution. In broad outline the geographical distribution of the fishery in Subarea 1 in 1994-1997 was maintained in 1998.

A standardised CPUE series including mainly female shrimp showed a declining trend of the 1990's. The projected 1998 value is at the level of 1997 index, which was the lowest on record. A standardised CPUE series based on total catches only showed a slightly increasing trend of the 1990's. The projected 1998 value is the highest of the 1990's. The 1998 values of both indices may be estimated with some uncertainty due to reduced amount of available logbook data for the current year.

Fewer large and more small shrimp in the catches has made the mean size of shrimp caught decline by about 2.7 mm cpl. since 1991 corresponding to a mean individual weight reduction of about 20%.

Increased mortality has reduced the strength of the 1993 year class and the abundance of the female component in 1999 may therefore be reduced. The 1994 year class appears relatively strong and may be abundant in 1999 at 21 mm cpl. However, the current and expected weakness of the 6+ component in 1999 will probably increase exploitation rate of the younger year classes. Thus the strength of the 1994 year class may have weakened considerably when it reaches the female stage in 2000-2001.

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Table 1. Total catch, unstandardised effort and unstandardised CPUE of the shrimp fishery in NAFO SA 1 and the standardised effort and CPUE of the fishery in SA 1+Div. 0A 1970-1998. The A and B indices are based on the models presented in Hvingel *et al.* (1996a) and in Hvingel *et al.* (1998) respectively.

*Preliminary. **Projected.

Year	Catch (t)			Effort (hr's)			CPUE (kg/hr)		
	Total	Inshore	Offshore	Unstd.	Std. A (index)	Std. B (index)	Unstd.	Std. A (index)	Std. B (index)
1970	8559	8429	130	-	-	-	-	-	-
1971	9437	8741	696	-	-	-	-	-	-
1972	9656	7342	2314	-	-	-	-	-	-
1973	12642	7950	4692	-	-	-	-	-	-
1974	22009	10064	11945	-	-	-	-	-	-
1975	37890	8700	29190	74154	-	-	511	-	-
1976	49674	7300	42374	80131	2.92	3.33	620	1.72	1.51
1977	41643	7800	33843	72980	2.62	3.00	571	1.60	1.40
1978	34347	7600	26747	84134	2.81	3.20	408	1.23	1.08
1979	33458	7500	25958	72408	3.33	3.66	462	1.06	0.96
1980	43278	7500	35778	79955	3.67	4.13	541	1.25	1.12
1981	39516	7500	32016	88164	3.53	4.02	448	1.27	1.11
1982	42515	7500	35015	81064	2.84	3.26	524	1.57	1.37
1983	41354	7500	33854	89036	3.48	3.94	464	1.34	1.19
1984	41241	7500	33741	84980	3.39	3.80	485	1.28	1.14
1985	51396	7500	43896	109369	4.06	4.50	470	1.34	1.21
1986	60134	7500	52634	129178	4.51	4.92	466	1.40	1.28
1987	57641	6921	50720	136624	3.34	3.85	422	1.91	1.66
1988	54392	10233	44159	150061	4.16	5.00	362	1.45	1.21
1989	58422	13224	45198	176413	6.14	6.74	331	1.07	0.97
1990	63184	13630	49554	206337	6.70	7.46	306	1.03	0.93
1991	69092	16258	52834	228721	8.51	8.34	302	0.89	0.91
1992	79258	20594	58664	232856	9.33	8.74	340	0.93	0.99
1993	70123	17843	52280	206054	7.57	7.64	340	1.00	0.99
1994	71811	18118	53693	209650	9.21	8.09	343	0.83	0.95
1995	68329	16429	51900	186939	7.95	6.83	366	0.88	1.03
1996	66610	17359	49251	168640	7.55	6.34	395	0.92	1.09
1997*	64000	13504	50496	191250	8.37	6.18	335	0.77	1.04
1998**	64000	15040	48960	172085	8.29	5.55	372	0.77	1.15

Table 2. Total shrimp catch in Subarea 1 by month 1987-1998. Numbers are summed from vessel logs and weighted up to total catch.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987	1269	996	3949	5137	6348	6583	8116	6348	5842	6538	4093	2422
1988	1884	2358	2906	5982	6004	6276	6424	6056	5959	4510	3847	2186
1989	2036	2455	3520	6274	5240	7890	8723	6949	4994	4817	2917	2606
1990	3332	3493	4027	6841	7224	7141	6312	5886	5303	4404	5454	3768
1991	3258	2918	3300	3119	5220	7895	8463	6614	6146	7046	8327	6785
1992	3748	2785	4886	5442	6851	9062	8915	7487	6729	9707	7808	5837
1993	2158	2594	3560	4869	6282	6530	6909	6775	7145	9248	8383	5669
1994	3519	3175	5337	6971	5991	5851	7564	6538	8008	8505	5831	4521
1995	4458	3045	4166	6055	8021	6472	6199	6570	6560	5998	6104	4681
1996	3659	5323	6451	7484	7255	7195	7131	6867	6151	4584	2314	2196
1997*	3343	5269	5053	5302	6278	6700	7808	6609	6306	5936	3732	1665
1998*	5508	4079	3661	5024	5671	4905	4041	686	0	0	0	0

*Preliminary.

Table 3. Annual catch, effort and CPUE of the shrimp fishery in Subarea 1 by NAFO Divisions. Data was derived from vessel logs and weighted up to total catch of the year.

Year	Catch ('000 tons)						Effort ('000 hr's)						CPUE (kg/hr)					
	1A	1B	1C	1D	1E	1F	1A	1B	1C	1D	1E	1F	1A	1B	1C	1D	1E	1F
1975	0.0	36.3	1.6	0.0	0.0	0.0	0.0	70.5	3.6	0.0	0.0	0.0	-	514	448	-	-	-
1976	0.0	44.5	5.1	0.0	0.0	0.0	0.1	70.1	8.0	0.1	0.8	1.1	0	635	639	0	0	32
1977	0.1	38.8	2.5	0.2	0.0	0.0	0.5	67.6	4.4	0.5	0.0	0.0	290	574	567	365	-	-
1978	0.4	33.3	0.4	0.2	0.0	0.0	1.4	80.7	1.3	0.8	0.0	0.0	311	413	339	211	-	-
1979	3.9	29.1	0.4	0.0	0.0	0.0	6.7	64.1	1.5	0.1	0.0	0.0	585	454	283	91	-	-
1980	11.9	28.4	2.7	0.2	0.0	0.0	21.2	53.3	4.9	0.5	0.0	0.0	562	533	547	485	0	-
1981	4.7	30.5	4.3	0.0	0.0	0.0	11.2	66.4	10.4	0.1	0.0	0.0	416	459	415	333	-	-
1982	0.7	35.2	6.6	0.0	0.0	0.0	1.7	65.7	13.5	0.1	0.0	0.0	384	535	492	316	-	-
1983	0.4	32.9	7.6	0.4	0.0	0.0	0.9	69.5	17.8	0.9	0.0	0.0	455	474	430	432	0	500
1984	0.9	24.8	13.8	1.7	0.0	0.0	2.7	51.1	28.4	2.7	0.0	0.1	351	484	487	639	0	38
1985	5.0	29.9	12.6	3.8	0.0	0.0	15.8	62.2	24.3	7.1	0.0	0.0	318	481	519	544	-	-
1986	22.0	25.7	7.5	4.9	0.0	0.0	55.6	50.6	13.7	9.1	0.1	0.1	395	509	545	544	-	-
1987	16.2	35.0	5.8	0.7	0.0	0.0	56.5	67.1	10.2	2.8	0.0	0.0	287	521	567	250	0	-
1988	10.0	38.2	5.7	0.4	0.0	0.1	41.2	92.1	14.0	1.8	0.0	1.0	242	415	403	226	0	124
1989	13.2	27.1	10.2	7.6	0.0	0.4	48.1	77.7	29.7	16.6	0.0	4.3	275	348	343	457	0	89
1990	9.9	24.6	18.4	9.9	0.0	0.4	42.3	77.9	54.4	28.9	0.0	2.8	234	316	339	341	0	134
1991	10.3	26.9	15.3	15.9	0.5	0.2	37.2	90.1	51.8	47.6	0.7	1.3	276	298	296	335	671	158
1992	13.2	26.7	16.1	18.8	4.0	0.5	49.4	76.2	47.8	50.7	7.4	1.3	267	350	337	370	538	398
1993	6.2	29.7	12.9	14.9	3.7	2.6	22.9	82.0	41.2	44.3	8.1	7.6	272	363	314	336	456	349
1994	5.9	27.4	13.0	16.2	5.9	3.4	23.4	83.8	40.7	42.6	10.0	9.2	254	327	318	381	593	369
1995	5.6	21.8	12.5	17.7	6.9	3.9	21.1	69.8	34.1	41.6	12.4	7.9	265	312	365	425	552	501
1996	4.4	18.3	13.9	19.0	6.7	4.3	18.7	52.0	35.9	40.8	12.0	9.1	238	351	387	465	555	474
1997*	6.1	16.8	9.3	18.6	6.9	6.3	44.1	55.7	24.8	42.1	11.8	12.7	138	302	377	441	579	498
1998**	5.5	20.0	8.5	13.7	5.1	10.2	30.1	59.6	21.8	30.1	8.5	19.3	183	335	388	456	599	530

*Preliminary. **Projected.

Table 4. Time series of the four standardised CPUE indices based on total catch. The indices were included in the combined CPUE index for NAFO Subarea 1 + Division 0A as described in Hvingel *et al.* (1998).

Year	1BCD	KGH	Small Vessel	0A	Combined
1976	-	1.68	-	-	1.51
1977	-	1.57	-	-	1.40
1978	-	1.21	-	-	1.08
1979	-	1.07	-	-	0.96
1980	-	1.25	-	-	1.12
1981	-	1.22	-	1.15	1.11
1982	-	1.51	-	1.35	1.37
1983	-	1.32	-	1.07	1.19
1984	-	1.28	-	0.99	1.14
1985	-	1.38	-	0.86	1.21
1986	-	1.46	-	0.88	1.28
1987	1.86	1.81	-	1.38	1.66
1988	1.19	1.44	1.29	1.22	1.21
1989	1.04	1.09	1.02	0.90	0.97
1990	1.00	1.00	1.00	1.00	0.93
1991	0.98	-	0.87	0.88	0.91
1992	1.08	-	0.91	1.01	0.99
1993	1.05	-	1.02	0.96	0.99
1994	1.05	-	0.86	0.74	0.95
1995	1.16	-	0.85	0.82	1.03
1996	1.26	-	0.84	0.76	1.09
1997	1.21	-	0.84	0.60	1.04
1998*	1.30	-	1.00	0.63	1.15

*Projected.

Table 5. Annual discard of shrimp and fish in tons and % of total shrimp catch and catch of *P. montagui* as reported in vessel logs from Subarea 1 1987-98.

	Shrimp		Fish		P. montagui
Year	discard (tons)	discard (%)	discard (tons)	discard (%)	landed (tons)
1987	149	0.3	693	1.2	0
1988	169	0.3	864	1.6	0
1989	166	0.3	1070	1.8	0
1990	218	0.3	1028	1.6	0
1991	332	0.5	1680	2.4	0
1992	264	0.3	1765	2.2	0
1993	204	0.3	1562	2.2	0
1994	270	0.4	2174	3.0	4
1995	389	0.6	2162	3.2	470
1996	267	0.4	2207	3.3	632
1997	254	0.4	1919	3.0	336
1998	171	0.3	1337	2.1	758

Table 6. Composition of shrimp catches in NAFO SA 1 as derived from sub samples weighted up to the total catch and analysed by modal analysis to produce catch at age table. Numbers caught were divided by standardised effort to produce abundance at age indices.

Mean size

Year	1991	1992	1993	1994	1995	1996	1997	1998
Cpl (mm)	23.4	23.4	23.0	22.3	21.7	22.0	20.7	20.7
Weight (g)	8.5	8.6	8.5	7.9	7.6	7.2	6.5	6.7
Count (no/kg)	118	117	118	127	132	139	155	149

Proportion of total catch

Year/Year class	1991	1992	1993	1994	1995	1996	1997	1998
3	1%	1%	4%	6%	3%	7%	6%	5%
4	4%	10%	14%	19%	30%	18%	35%	39%
5	39%	28%	22%	27%	31%	34%	25%	22%
6+	56%	60%	60%	48%	36%	41%	34%	34%

Number caught (millions)

Year/Year class	1991	1992	1993	1994	1995	1996	1997	1998
3	54	119	343	502	236	676	595	469
4	351	968	1120	1729	2710	1643	3470	3661
5	3212	2573	1811	2480	2796	3126	2478	2065
6+	4551	5599	4998	4408	3258	3794	3370	3191
Total	8174	9260	8272	9121	9001	9239	9913	9386

Numbers caugth (millions)

Year	1991	1992	1993	1994	1995	1996	1997	1998
Unidentified	8178	8170	2144	15	44	33	76	79
Males	0	0	2897	5089	5767	5907	6352	5970
Females	0	1091	3231	4018	3190	3299	3673	3375

Abundance index

Year	1991	1992	1993	1994	1995	1996	1997	1998
Unidentified	980	934	281	2	6	5	12	14
Males	0	0	379	629	845	939	1027	1076
Females	0	125	423	497	467	525	594	608

Abundance index

Year/Year class	1991	1992	1993	1994	1995	1996	1997	1998
3	6	14	45	62	35	108	96	85
4	42	111	147	214	397	261	561	660
5	385	294	237	306	410	497	401	372
6+	546	640	655	545	477	603	545	575
Total	979	1059	1083	1127	1319	1469	1603	1691

Table 7. Catch samples taken in Subarea 1 1997-98 summed by month and NAFO Division. (These data updates table 5 in Hvingel *et al.* 1997.

1997

Month	Division	Number of samples	Sample weight (kg)	Numbers measured	Catch (kg)
1	1B	7	22.21	7822	4213
1	1C	3	10.42	525	1113
1	1D	3	9.45	4398	1320
1	1E	14	47.21	27686	6884
2	1C	1	2.79	608	563
2	1D	2	5.45	5403	917
2	1E	7	25.66	16508	3934
3	1B	3	14.95	14167	1220
3	1C	7	25.63	25161	3341
3	1D	3	6.29	3587	1300
3	1E	9	22.73	11105	2655
4	1C	10	31.9	19327	3960
4	1D	25	78.02	57749	12057
4	1E	6	21.28	13552	2707
5	1C	13	31.12	11142	3852
5	1D	9	33.82	24416	4972
5	1E	13	46.78	27312	5904
6	1D	23	69.75	85352	10911
6	1E	6	16.97	13148	2511
7	1F	12	45.24	60635	5770
8	1C	1	2	4156	370
8	1D	29	103.85	86553	15710
8	1E	10	40.91	21221	5854
9	1D	24	85.5	40799	13924
9	1E	9	26.12	19892	4403
11	1A	1	2.75	421	419
11	1D	10	25.59	17362	3856
11	1F	5	17.98	12915	2280
	Total	265	872.37	632922	126920

1998

Month	Division	Number of samples	Sample weight (kg)	Numbers measured	Catch (kg)
1	1B	14	50.37	34367	8836
1	1D	15	49.97	17675	8782
2	1D	15	51.14	50700	8557
2	1E	7	31.92	7572	5110
4	1B	17	61.23	62340	8306
4	1C	11	40.39	12617	4811
4	1D	5	15.98	14484	2462
4	1E	6	17.46	13820	2846
4	1F	1	2.26	2500	407
5	1B	4	12.05	8849	1127
5	1C	8	24.92	10419	2745
5	1D	8	26.97	16040	3907
5	1E	11	32.44	21732	4206
6	1C	2	5.58	3643	655
6	1D	10	28.27	40488	4764
	Total	134	450.95	317246	67521

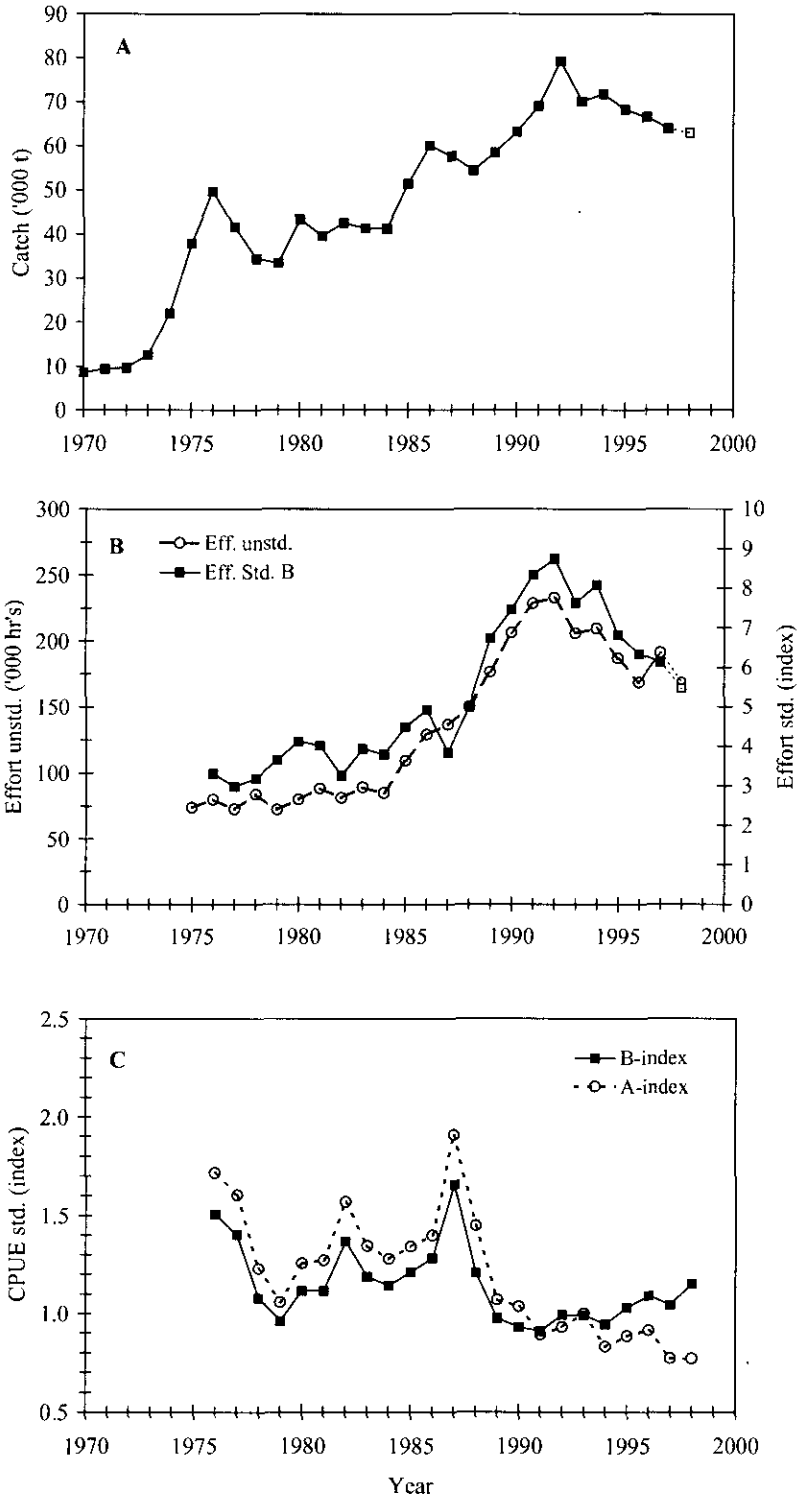

Figure 1. Total catch and effort of the Greenland shrimp fishery in NAFO SA 1 (panel A, B) and standardised effort and CPUE indices of the shrimp fishery in NAFO SA 1 and Div. 0A by Canada and Greenland (panel B and C). Effort is calculated as total catch/CPUE. CPUE is weight/hr' towed as calculated from vessel logs. Data for 1998 are projected values.

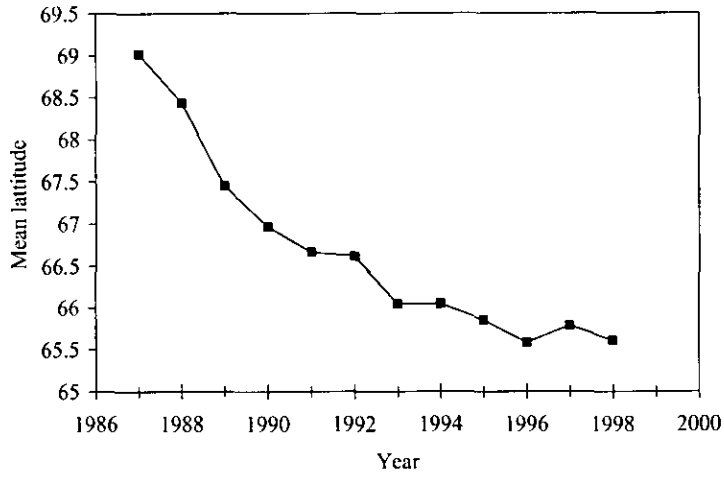

Figure 2. Mean latitude (°N) of allocated effort by the Greenlandic offshore fleet 1987-98.

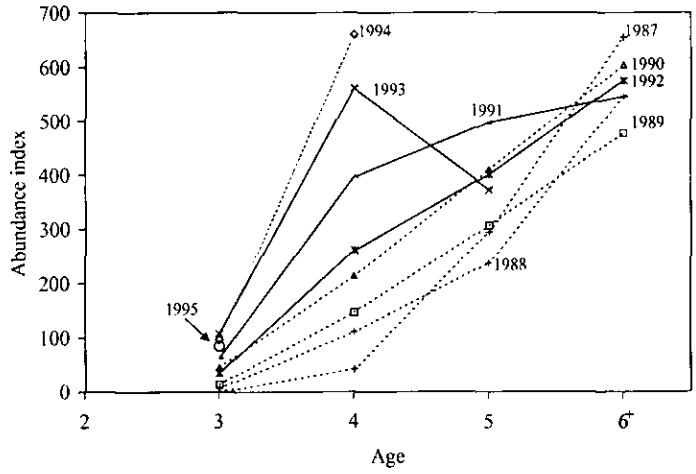

Figure 3. Standardised CPUE indices of the year classes 1987-95 as they appeared in the offshore fishery 1991-98 (data from Table 6).

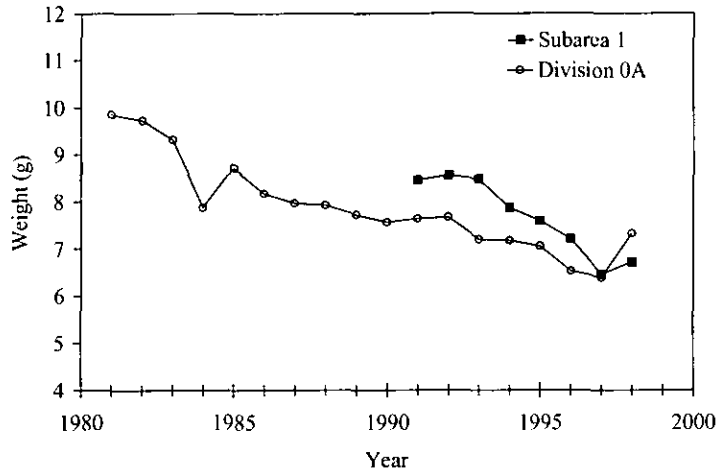

Figure 4. Mean shrimp size (g) in catches in Subarea 1 and Division 0A. (Data on Div. 0A from Parsons, 1997 and persn. comm.)

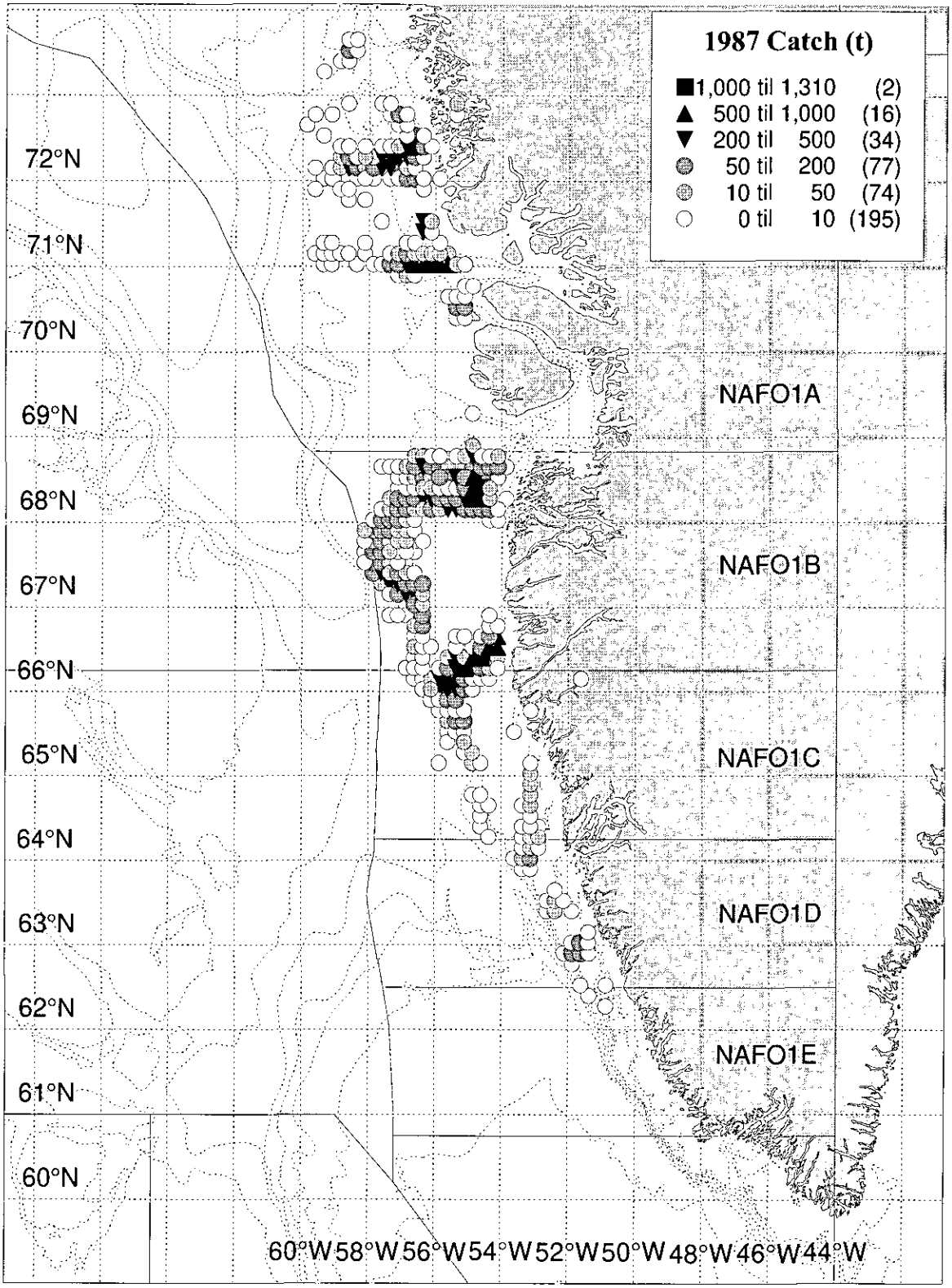

Figure 5A. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1987.

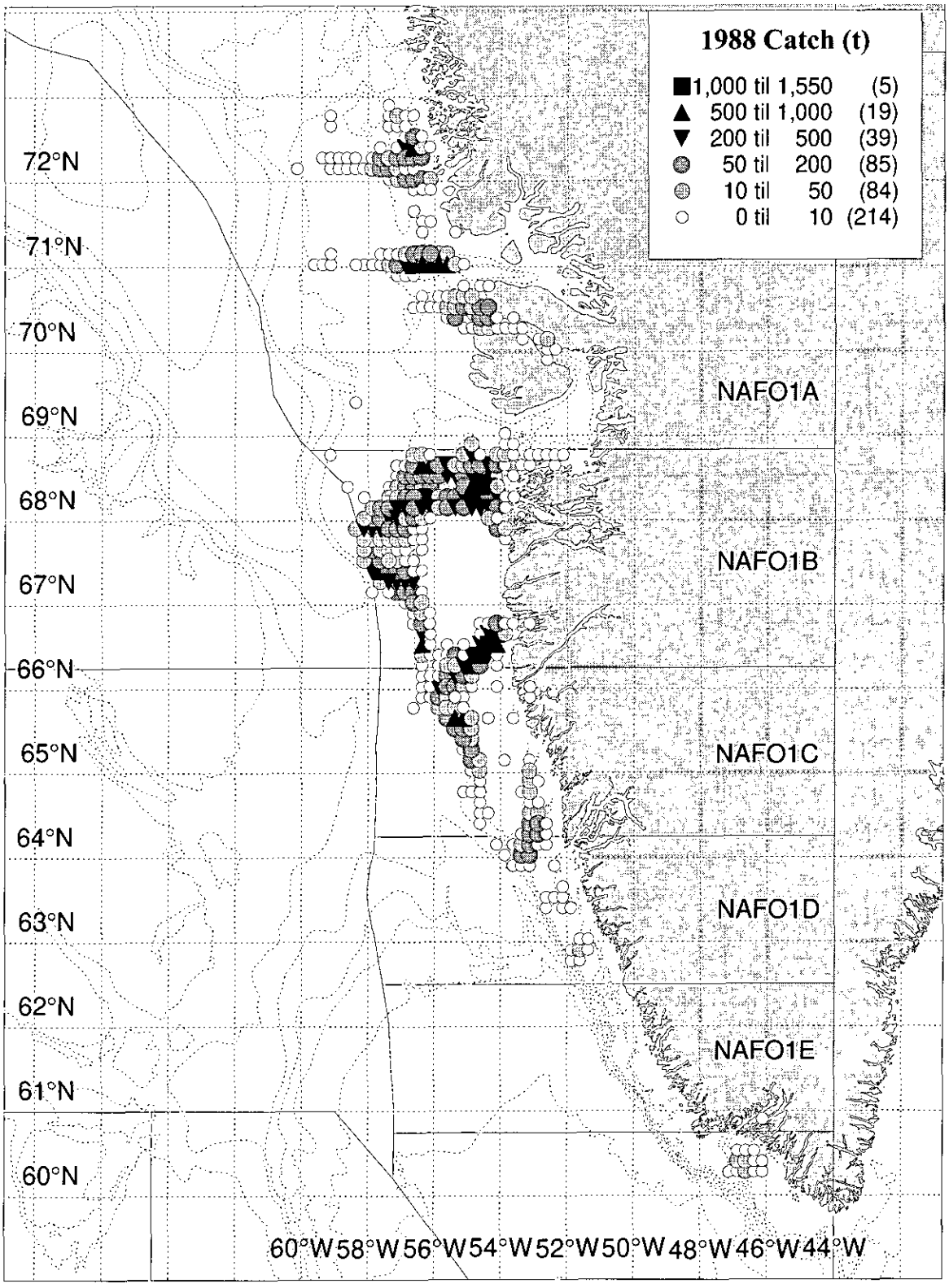

Figure 5B. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1988.

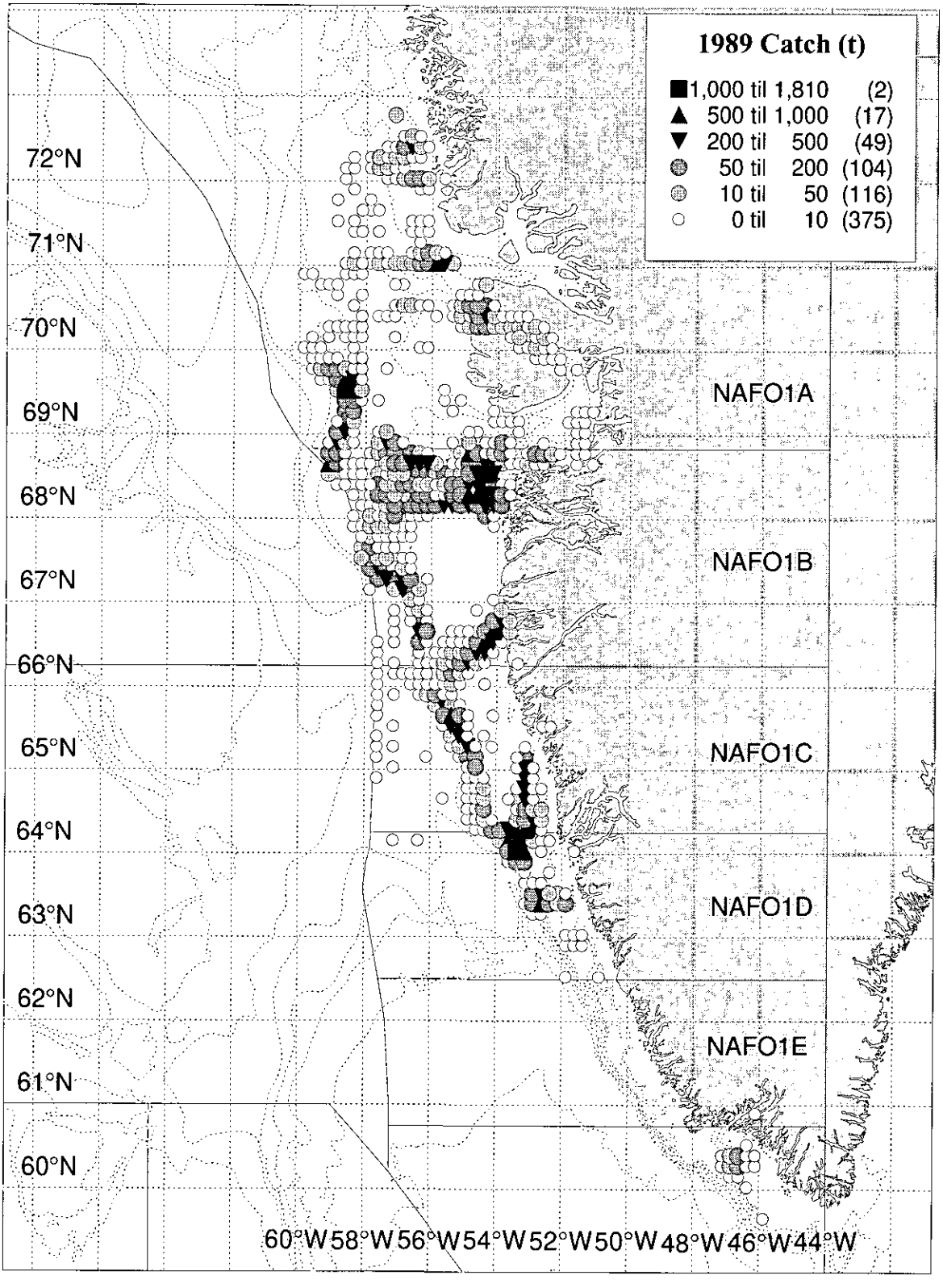

Figure 5C. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1989.

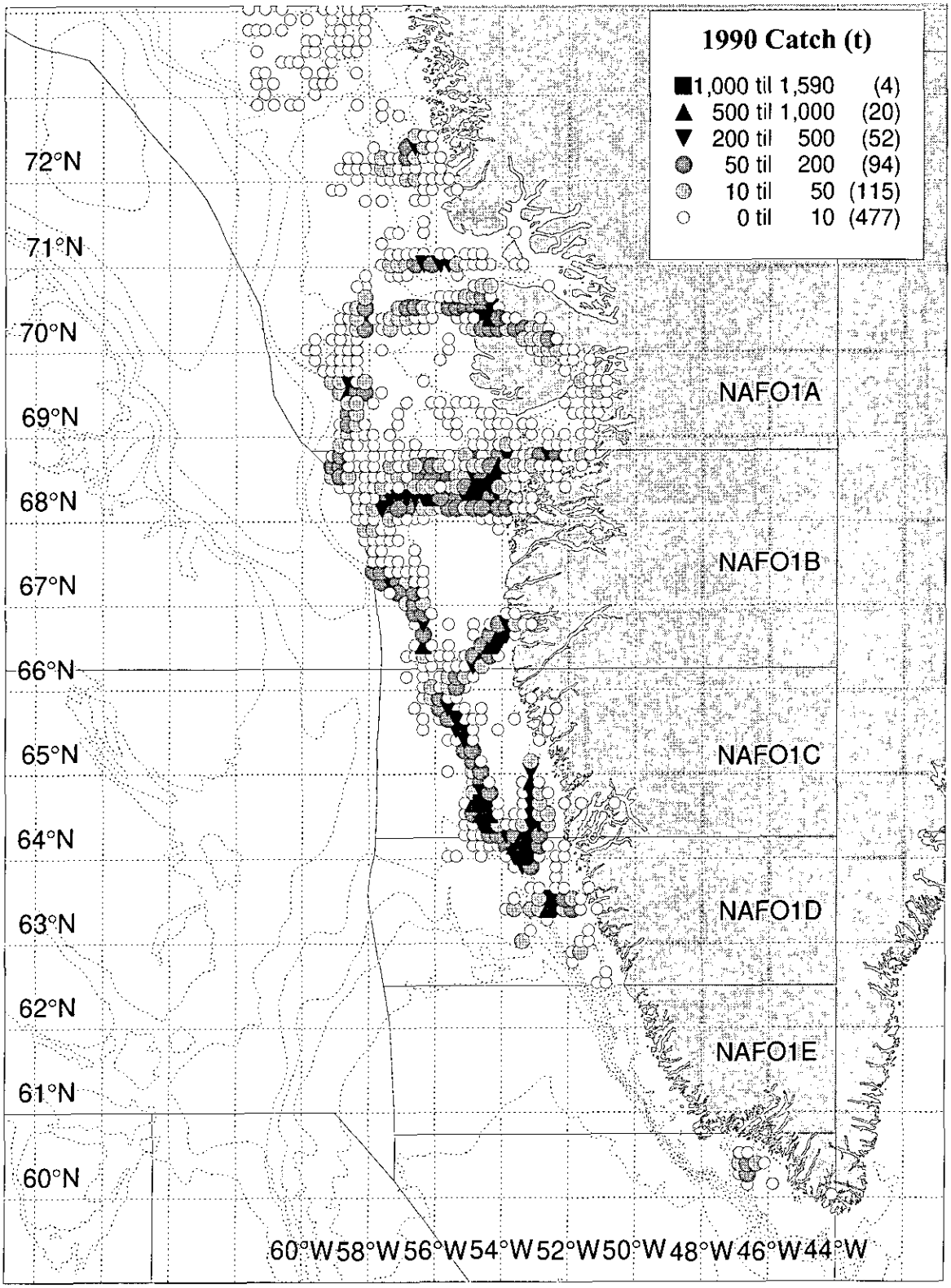

Figure 5D. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1990.

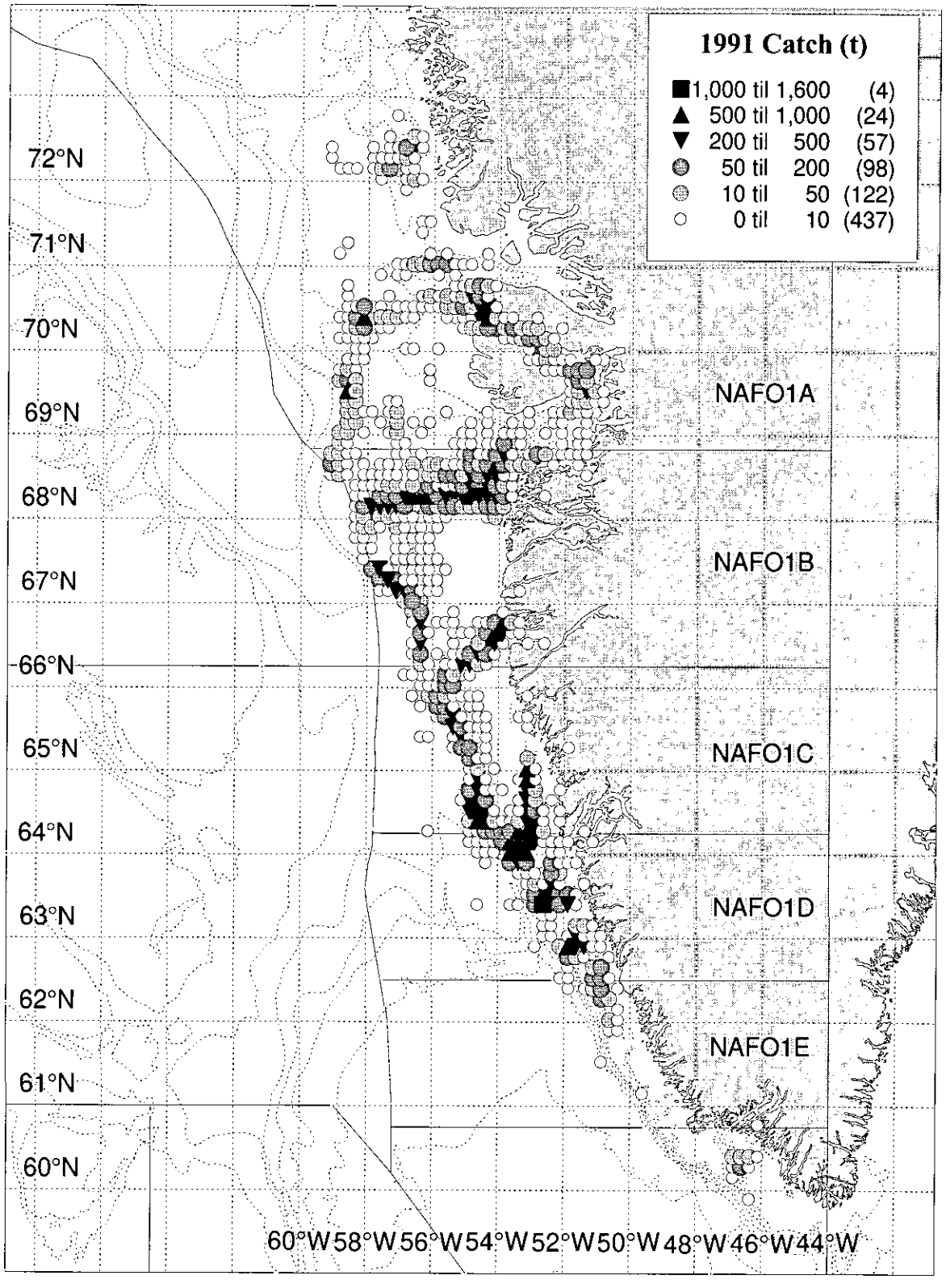

Figure 5E. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1991.

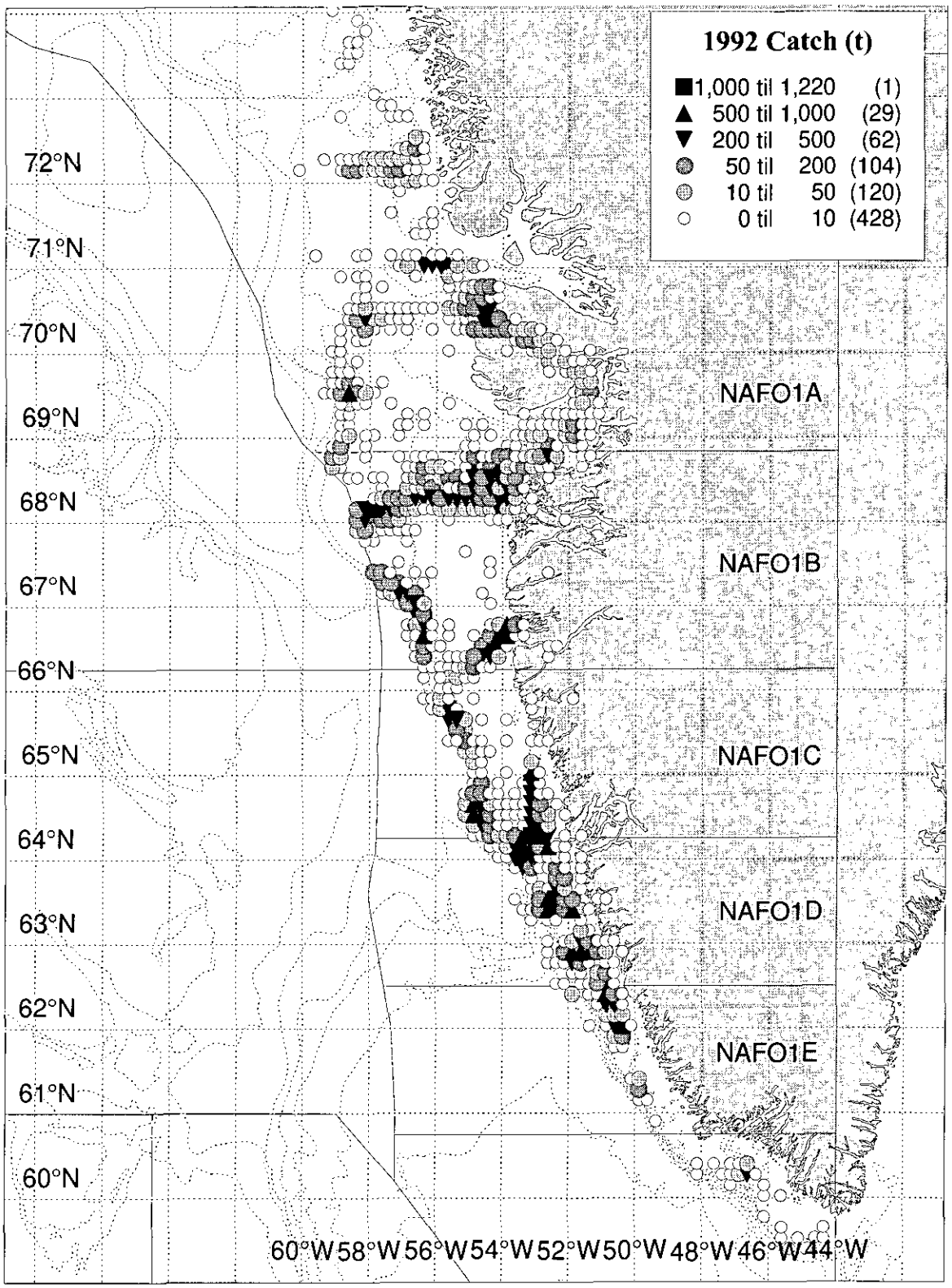

Figure 5F. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1992.

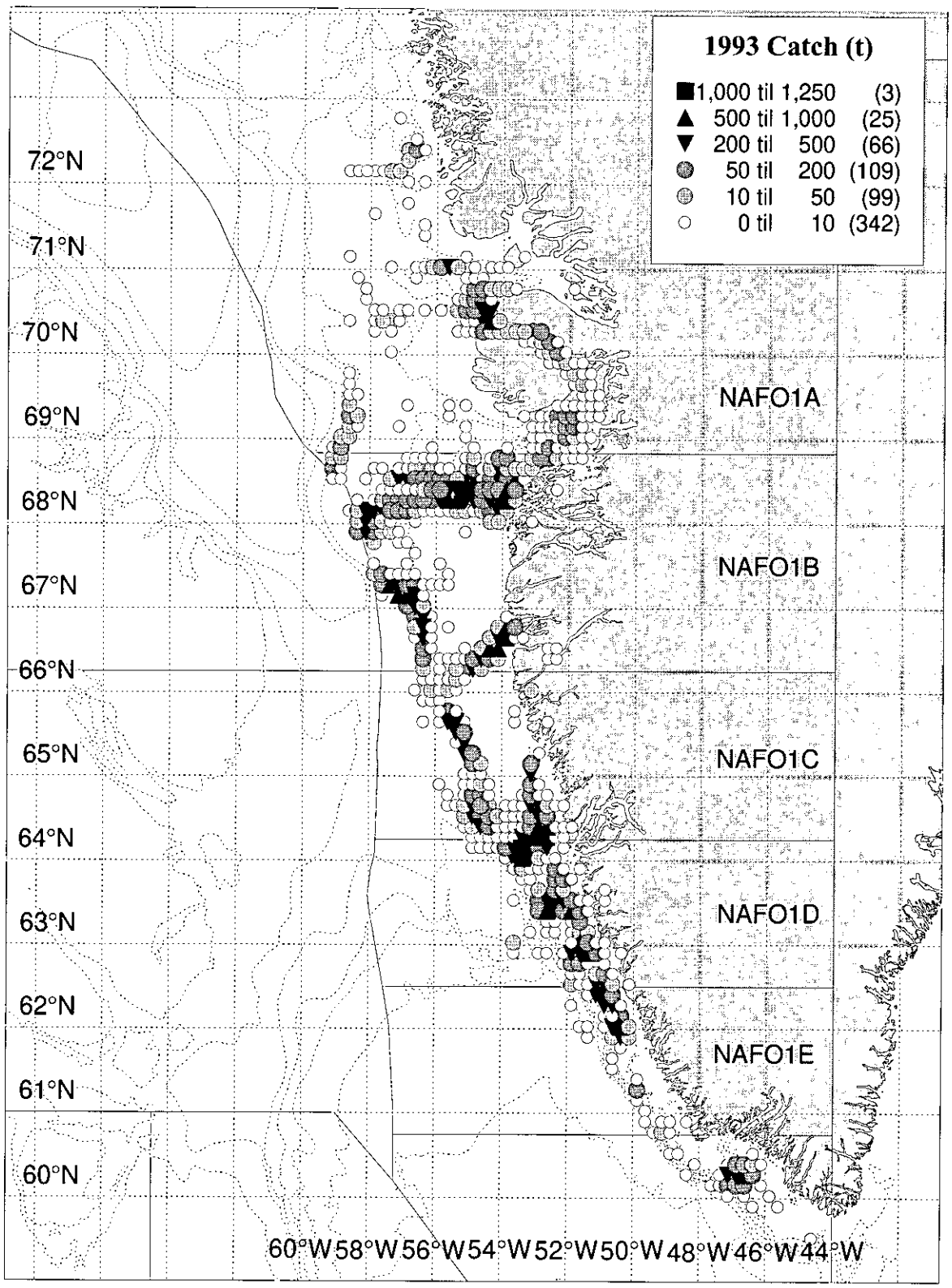

Figure 5G. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1993.

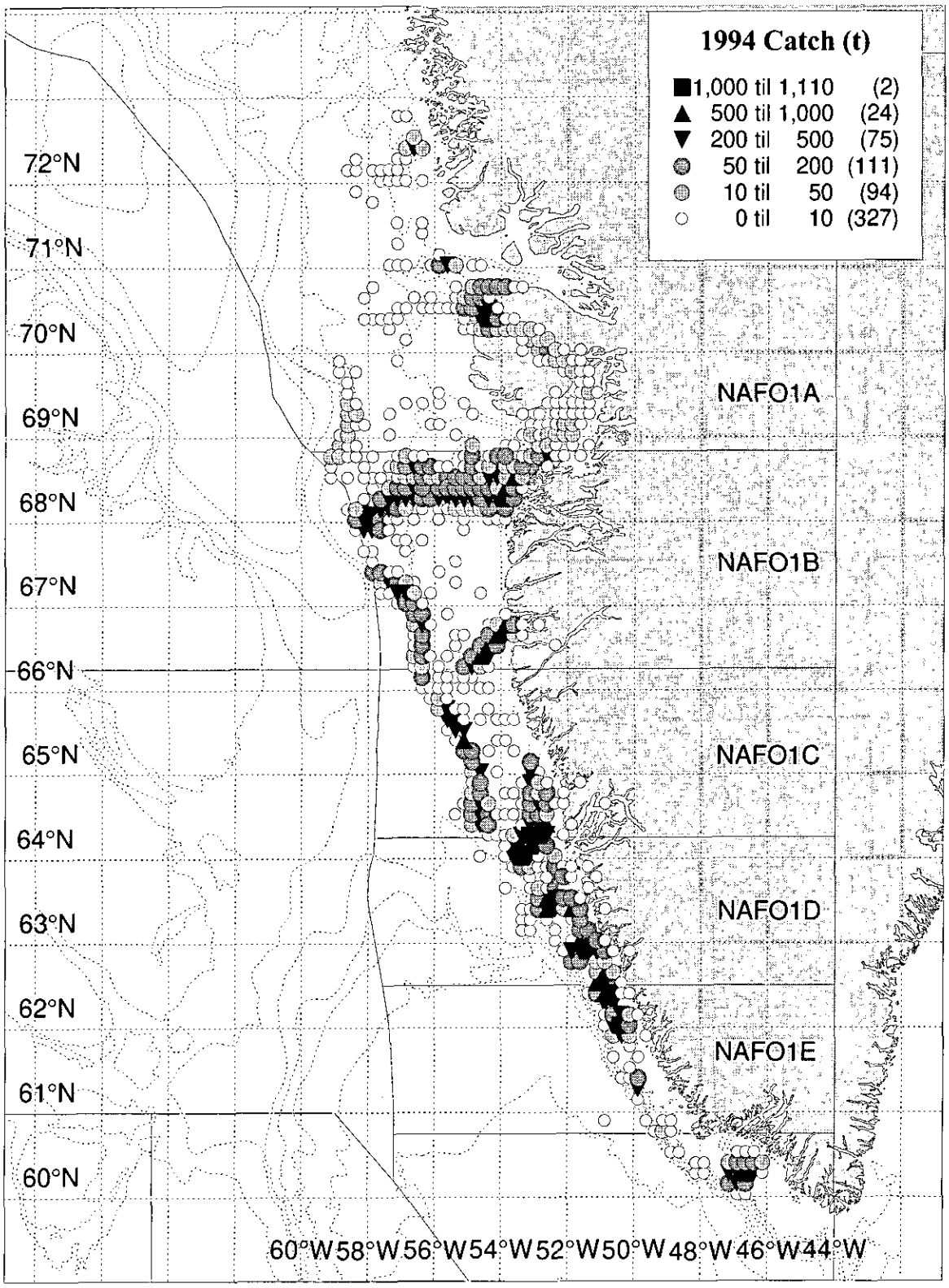

Figure 5H. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1994.

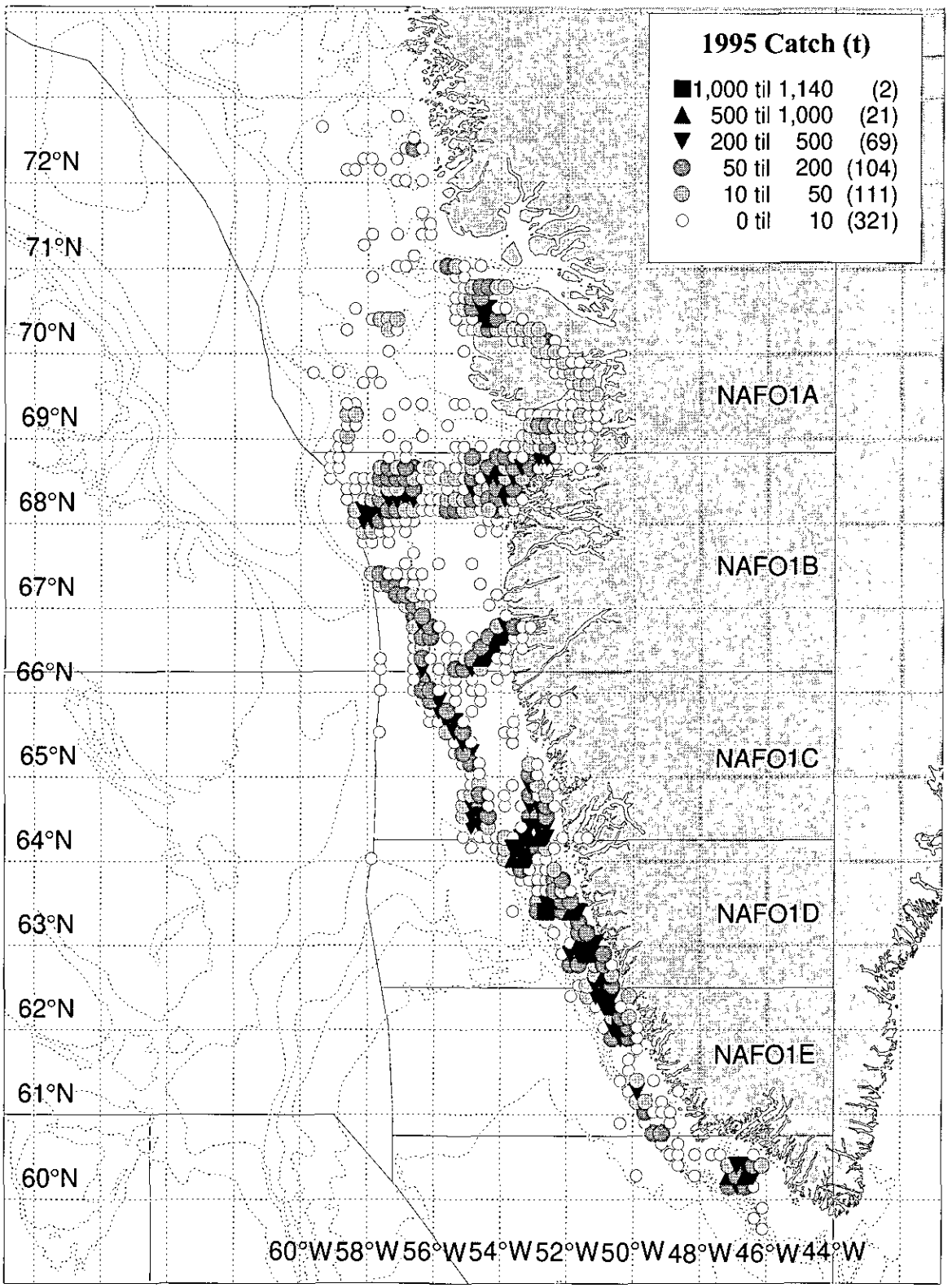

Figure 5I. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1995.

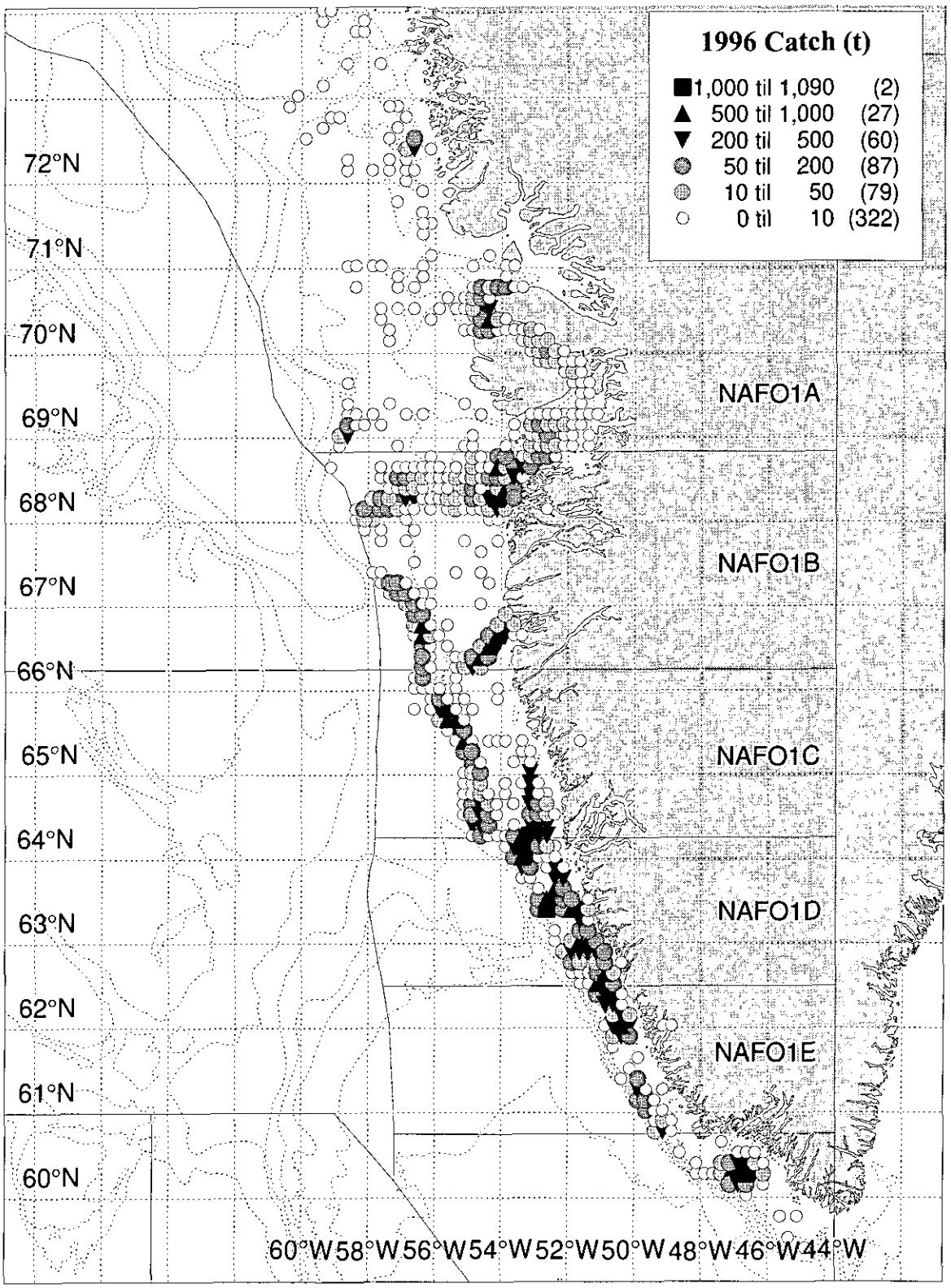

Figure 5J. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1996.

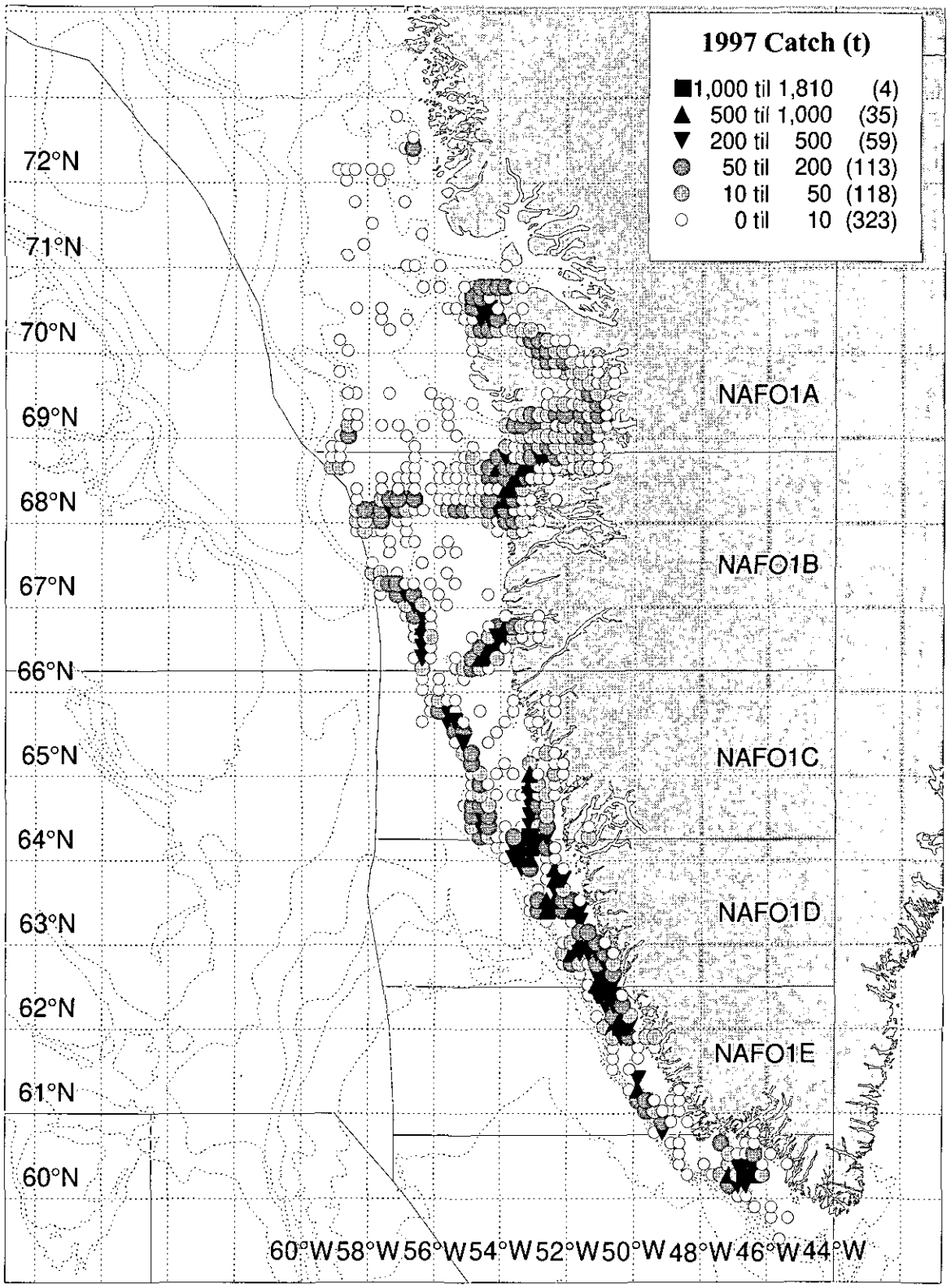

Figure 5K. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1997.

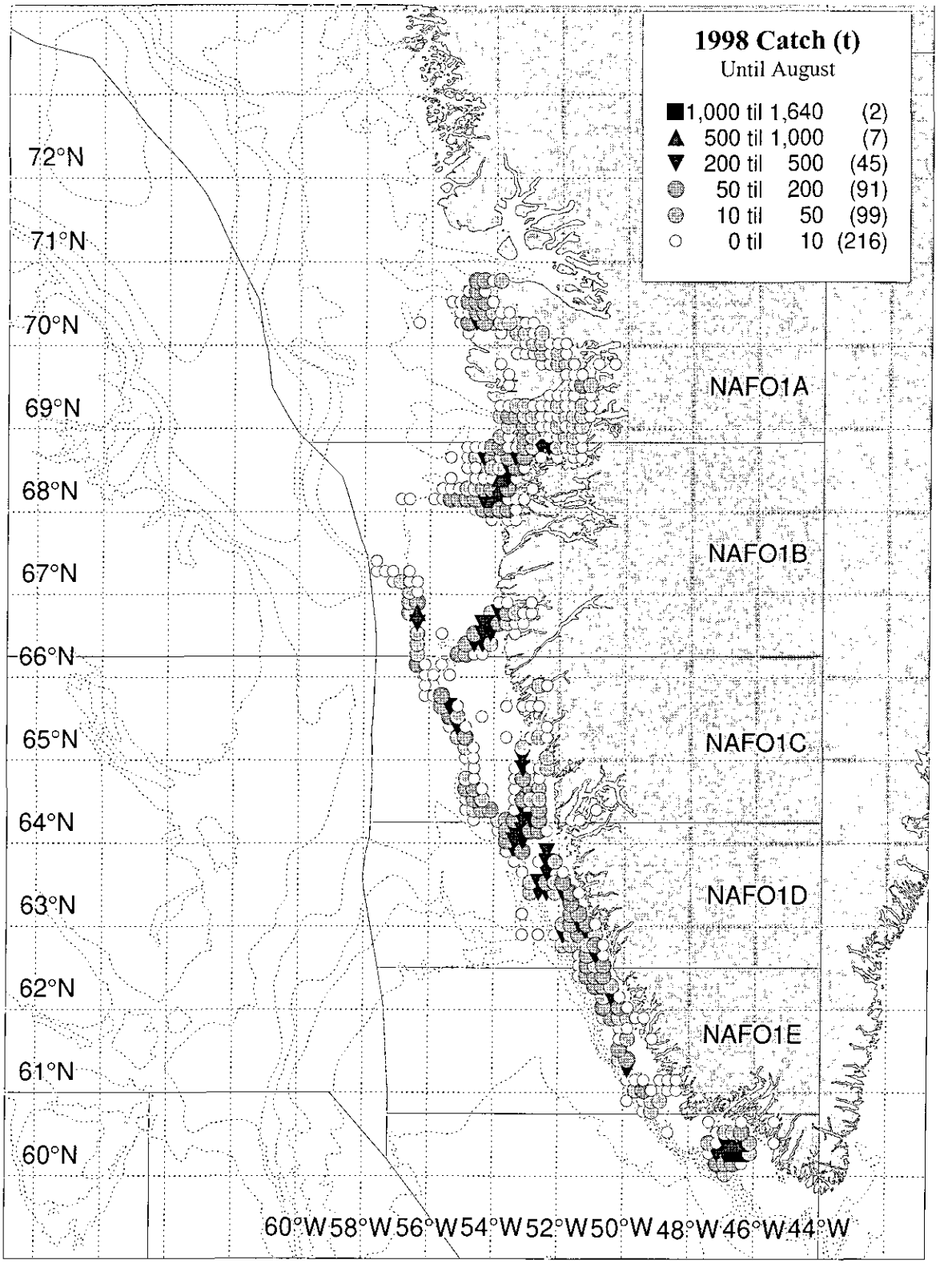

Figure 5L. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1998 until August.

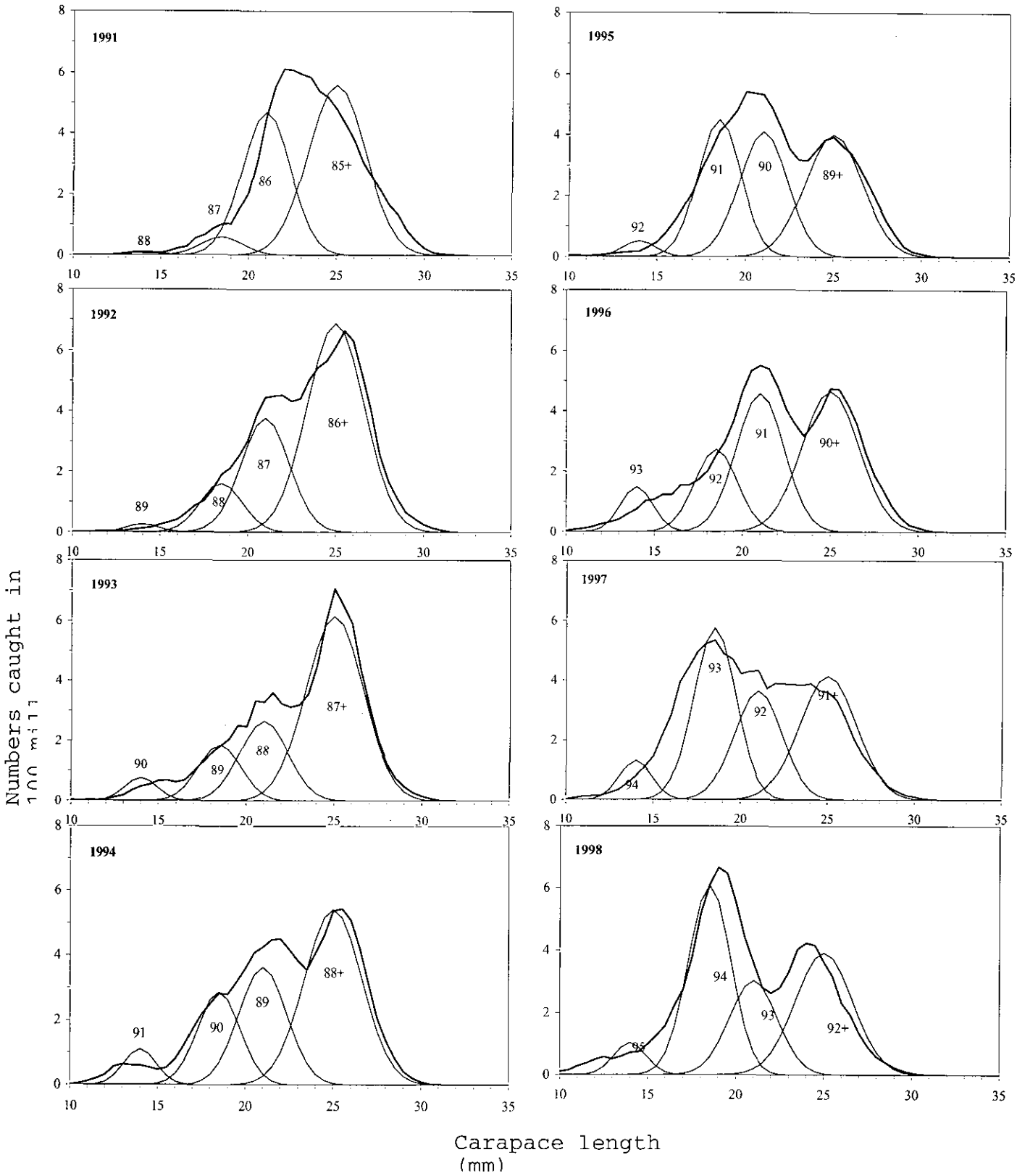

Figure 6. Length frequency distributions of commercial shrimp catches in Subarea 1 1991 – 1998 and the estimated modes of year classes 3 to 5 and the 6+ group.