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The fishery for northern shrimp
(*Pandalus borealis*) off West Greenland, 1970-2000

by

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Abstract

Northern shrimp (*Pandalus borealis*) occurs off West Greenland in NAFO Divisions 0A and 1A–1F. The stock is assessed as a single population and managed by Total Allowable Catch (TAC). Greenland and Canada exploit the stock in Subarea 1 and Division 0A respectively.

After reaching a maximum in 1992 of 87000 tons catches have decreased somewhat to around 66000 tons in 1998 due to management measures. Catches increased again to 76500 tons in 1999. The projected catch of 2000 is at this level. During recent year more than 95% of the annual catches were taken by Greenland. The inshore fishery (vessels below 80 GRT) accounted for around 20% of the total landings. Discard of shrimp and fish has since 1987 been reported to about 0.3% and 2.5% of the total catch respectively. By-catch of *P. montagui* is registered in quantities below 1000 tons per year since 1995.

A standardized CPUE series showed an increasing trend since the early 1990's. The projected 2000 value marks the highest point of that period and the index may be considered back at the level of the 1976-1988 period. Standardized effort based on biomass indicated a decrease in harvest rate since 1992 by about 40%. However, when based on numbers only a 25% decrease was evident.

The mean size of shrimp caught has declined since 1991 at least partly due to changes in targeting strategy of the fishery. Male shrimp has comprised about 2/3 of the catches in the late 1990's compared to about 1/2 in the beginning of this decade. However, the year 2000 data indicates a large decrease of the male proportion in the catches and a resulting increase in individual mean weight from 6.3 to 7.5 g since last year.

The length-frequency distribution of the 2000 catches shows a large peak of females around 25 mm cpl. The male component is comparatively small, however, representing a broad selection of size groups.

Geographical changes in the distribution of fishing effort have taken place. 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. This may be due to the fishery tracking changes in shrimp distribution. The spatial distribution of the 2000 fishery is not expected to deviate significantly from that of 1999.

Introduction

Northern shrimp (*Pandalus borealis*) occurs off West Greenland in NAFO Divisions 0A and 1A–1F. The stock is continuously distributed from Cap Farewell to about 74°N in depths down to around 800 meters (Fig. 5). The highest concentrations occur from 150-600 m. There is no evidence of distinct sub-populations and since 1993 this stock is assessed as a single population (Anon., 1993).

The fishery for shrimp began in inshore areas in 1935. Since 1970 a multinational offshore fishery developed and landings increased from about 10000 tons to a level of around 75 000 tons in the 1990s. Since 1981 access to this stock was limited to Greenlandic vessels in Subarea 1 and Canadian vessels in Div. 0A. Catch restrictions were first imposed in 1977 and since then the stock has been managed by Total Allowable Catch (TAC).

Two Greenlandic fleet components exploit the stock in Subarea 1: an offshore fleet, which at present consists of 13 large factory trawlers (1500-3000 GRT) and a small vessel fleet composed of about 100 vessels below 80 GRT. The offshore fleet component is restricted to offshore areas and by quotas. With a few exceptions vessels below 80 GRT were unrestricted by areas and quotas until 1997 when catch regulation was introduced also for this fleet component. Since 1986 logbooks have been mandatory for vessels above 50 GRT. Since 1997 logbooks are available for all vessels. Internal Transferable Quotas (ITQ) were introduced as a management tool in 1991.

The Canadian fleet exploits the stock component in Div. 0A. 17 companies are currently licensed to fish in the area but in recent years only 6-7 vessels (2000-4000 GRT) have participated. Catches are restricted by quotas. Vessel logs are available since 1979.

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

Materials and Methods

Total catches were estimated from vessel logs and weekly reporting to Greenlandic authorities. 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. Unstandardized 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 standardized annual catch rate indices. One unified time series covering 1976-2000 was calculated based on the methods described in Hvingel *et al.* (in press). Unstandardized effort was calculated by dividing total catch with mean CPUE. Standardized effort was calculated by dividing total catch by the standardized CPUE-index.

Annual size compositions of shrimp catches were obtained from samples taken before processing by fisheries observers onboard offshore vessels. Onboard the vessel or later in the laboratory samples were sorted by sexual characteristics (McCrary, 1971) and measured to the nearest 0.1 mm (Greenland) and 0.5 mm (Canada) carapace length. In 1998 295 samples of 2-4 kg including 135000 individuals were measured. The preliminary 1999 figures are based 99 samples including 35000 individuals. The data were 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. Sex specific indices of abundance were calculated by dividing the numbers caught of each sex by the standardized effort.

Results and Discussion

Catch

Table 1 and Figure 1 show total catch, effort and CPUE in Subarea 1 and Div 0A. 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 more than 86 000 tons in 1992. Since then, government restrictions to reduce effort and fishing opportunities elsewhere for the Canadian fleet have somewhat reduced the landings which in 1999 amounted to about 76 000 tons. However, when measured in numbers caught the catch level of 1992 has been maintained. The projected catch of 2000 is expected to be close to the 1999 level.

Since the beginning of the 1970's catches in the inshore areas have been fluctuating between 10000-20000 tons. Limited access for vessels above 80 GRT has been the only restraint on inshore catch levels until 1997 when ITQ's were enforced also for the small vessel fleet. Subsequently catches decreased substantially while a major reorganisation of the fleet took place. During most of the nineties the inshore fishery had accounted for 20-25% of the total catches, but in 1998 only 14% were taken by the small vessel fleet. In 1999 catches were back up again amounting to 17000, which will also be the expected catch level of year 2000.

The Canadian catches in Div. 0A have fluctuated between 1700 and 5400 tons during 1979-1983 after which they increased from 2100 tons in 1984 to the highest recorded level of around 6-7000 tons in the late 1980's-early 1990's. Catches thereafter declined to around 1 000 tons in 1998 coincident with the increased fishing opportunities off Labrador. During the late 1990's catches in Div. 0A have accounted for less than 5% of the total catches off West Greenland. The 1999 catches are expected to be about 2500 tons (as of Oct. 29, it was 2036 tons).

Table 2 shows the catch in Subarea 1 by month since 1987. Fishery takes place in all months. In general the monthly amount of shrimp caught tracks a dome shaped curve over the year with a maximum in midsummer (June-July) of about 8000 tons. In some years (1991-1994) a second maximum occur in October. In Div. 0A the fishery usually begins in late June - early July and continues into late November. However, most of the catch and effort occurs in August-October (Parsons and Veitch, 1997).

Effort

Since 1975, when the offshore fishery was well established, until 1984 annual unstandardized effort showed a slightly increasing trend from about 75000 hr's to about 93000 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 250000 hr's in 1991-1992. Hereafter unstandardized effort has decreased as a result of management measures, reduced activity in Div. 0A and a general increased fishing efficiency of the participating vessels. The increase in unstandardized effort from 1996 to 1997 is caused by the addition of logbooks from vessels below 50 tons to the database (new logbook system). In 1999 about 170000 trawling hr's were registered and preliminary data suggest that the year 2000 figure will of the same magnitude size.

The standardized effort (Fig. 1B) may be considered a proxy for harvest rate. The course of the weight based standardized effort time series is in good agreement with the unstandardized (Fig. 1B). Since 1992, when it reached its highest value as yet, standardized effort has decreased by about 40%. A corresponding effort index based on number of individuals (Fig. 1B) showed a similar decreasing trend of the 1990's however the reduction was less i.e. about 25%.

Catch-per-unit-effort

The unified standardized CPUE index is given in Table 1 and Figure 1C and the individual fleet based indices in Table 4. All fleets included in the analysis mainly exploit shrimp greater than 16 mm cpl. The CPUE indices are therefore indicative of the older male and the female stock combined. The combined index may be interpreted as fluctuations of this stock component by a factor of 2 around a constant level between 1976 and 1987 followed by a drop to a lower level in the late 1980's. The marked spike in 1987 is likely the result of some very strong year classes produced in the early 1980's (Anon., 1991). During the 1990's the CPUE index has shown an increasing trend. The revised 1999 index value, using the complete set of data for the year, increased slightly compared to the preliminary value reported by

Hvingel (1999). The projected 2000 value marks the highest value of a continuously increasing trend since the early 1990's.

The standardisation method used 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 individual models suggests that this has minor influence on the use of the CPUE index as a biomass indicator. However, the standardized CPUE time series interpreted as a biomass index is expected to give a slightly optimistic view of the stock development (for further discussion of the CPUE index as a stock indicator see Hvingel *et al.*, 2000).

By-catch and discard

Table 5 shows reported discard of shrimp and fish and landed by-catch of *P. montagui* by Greenlandic trawlers during the years 1987-2000. The reported discard of shrimp has remained less than 1% of total catch throughout the period. The reported discard of fish has shown a slightly increasing trend from about 1 to 3% of total catch in the years 1987-1998. The introduction of observers on all offshore vessels in 1991 has most likely contributed to this development by the increasing incentive to report discard. An improved market for smaller shrimp may have offset the corresponding effect of observers on the reported discard of shrimp. A negligible quantity of fish discarded is registered for 1999 and 2000. No sorting grid is used in this fishery.

From 1995 to 1998 vessels have reported annual catches of *P. montagui* in the range of about 300 to 1000 tons. No catches of this species is reported for 1999 and 2000. Landings of *P. montagui* are allowed to include up to 70% *P. borealis*. As *P. montagui* can be landed outside the quota it has therefore been possible to "hide" catches of *P. borealis* within these landings. Hence, it is difficult to use the emergence and disappearance 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 indications 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 the vast majority of the annual fishing effort were allocated to Div. 1and 1B. Div. 1C and 0A received some attention but almost no effort was spent in 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 since the late 80's (Hvingel, 1996) is also indicated by the mean latitude of effort allocation shown in Figure 2. 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 was 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 in Subarea 1 by statistical units of 7.5' latitude and 15' longitude from 1987 to 2000 is shown in Figure 5. The fishery in Div. 0A occurs in a small area extending from about $67^{o}20'$ to $68^{o}45'$ and 58° to $59^{o}30'$ between the international boundary to the east and the 500 m depth contour to the west. For further detail on the geographical distribution in this area see Parsons and Veitch (1998). The preliminary data for 2000 do not suggest any significant changes in the distribution of the fishery in Subarea 1 and Div. 0A from 1999 to 2000.

Catch composition.

Figure 6 shows the overall annual Length-Frequency Distribution (LFD) resolved in LFD of males, primiparous and multiparous females of the total catch in Subarea 1 from 1991 to 2000.

The mean shrimp size caught has declined during the 1990's. In Subarea 1 it declined by 3.1 mm cpl. since 1991 corresponding to a mean individual weight reduction of about 25% (Figure 4). Mean shrimp size caught in the Canadian fishery in Div. 0A showed a corresponding declining trend since 1981. Part of this development may be due to better market prices for small shrimp along with a thorough restructuring of the Greenlandic offshore fleet during this time period leaving most vessels with enough quota to make high-grading less profitable. However, the preliminary data for year 2000 indicates a reversal of this trend. Data for Subarea 1 shows a decreasing proportion of males and a corresponding increase in the proportion of females in the catches (Table 6). The mean weight has thus increased from 6.3 to 7.5 g since last year.

This tendency is also reflected in the LFD of year 2000 (Fig. 6). The length distribution shows a large peak of female shrimp at around 25 mm cpl. The male component is comparatively small, however, with representation of all sizes normally present in the catches.

The standardized catch rates indicate a decrease in the abundance of males compared to 1999 (Figure 3) while abundance indices of females increase.

Modal analyses were not applied to the annual length frequency distributions. Different approaches to resolve the bulk catch in catch-at-age to produce abundance-at-age tables (Hvingel *et al*, 1997) have not been successful, i.e. the outputs from the analysis have been inconsistent and it has not been possible to trace the suggested year-classes over time.

Acknowledgement

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Table 1. Total Allowable Catch (TAC), catch, effort and Catch per Unit of Effort (CPUE) of the shrimp fishery in NAFO SA 1 and Div. 0A 1970-2000. Catch are in tons, effort in '000 hr's (unstandardized) or as an index (standardized). CPUE is given in kg/hr (unstandardized) or as an index (standardized).

| Year | TAC (t) | | | | | Catch (t) | | | | | Effort | | | | CPUE | | | |
| | Subarea 1 | | | Div. 0A | Total | Subarea 1 | | | Div. 0A | Total | SA 1 | Div. 0A | Total | Total | SA 1 | Div. 0A | Total | Total |
	Offshore	Inshore*	Total	Offshore		Offshore	Inshore	Total	Offshore		Unstd. ('000 hr's)			Std. (index)	Unstd. (kg/hr)			Std. (index)
1970	no	no	no	no	no	130	8429	8559	0	8559	-	-	-	-	-	-	-	-
1971	no	no	no	no	no	696	8741	9437	0	9437	-	-	-	-	-	-	-	-
1972	no	no	no	no	no	2314	7342	9656	0	9656	-	-	-	-	-	-	-	-
1973	no	no	no	no	no	4692	7950	12642	0	12642	-	-	-	-	-	-	-	-
1974	no	no	no	no	no	11945	10064	22009	0	22009	-	-	-	-	-	-	-	-
1975	no	no	no	no	no	29190	8700	37890	0	37890	74.2	-	74	-	511	-	511	-
1976	no	no	no	no	no	42374	7300	49674	392	50066	80.1	-	80	0.63	620	-	625	1.03
1977	-	no	-	-	36000	33843	7800	41643	457	42100	73.0	-	73	0.57	571	-	577	0.97
1978	-	no	-	-	41000	26747	7600	34347	122	34469	84.1	-	84	0.59	408	-	410	0.77
1979	-	no	-	-	31500	25958	7500	33458	1732	35190	72.4	7.3	80	0.66	462	236	441	0.69
1980	-	no	-	-	32000	35778	7500	43278	2726	46004	80.0	7.6	88	0.72	541	358	525	0.83
1981	35000	no	35000	5000	40000	32016	7500	39516	5284	44800	88.2	17.7	106	0.72	448	299	423	0.81
1982	34800	no	34800	5000	39800	35015	7500	42515	2064	44579	81.1	6.2	87	0.57	524	335	511	1.02
1983	34625	no	34625	5000	39625	33854	7500	41354	5413	46767	89.0	19.1	108	0.69	464	284	433	0.89
1984	34925	no	34925	5000	39925	33741	7500	41241	2142	43383	85.0	7.7	93	0.68	485	280	468	0.83
1985	42120	no	42120	6120	48240	43896	7500	51396	3069	54465	109.4	9.9	119	0.82	470	309	457	0.87
1986	42120	no	42120	6120	48240	52634	7500	60134	2995	63129	129.2	6.7	136	0.91	466	445	464	0.90
1987	40120	no	40120	6120	46240	50720	6921	57641	6095	63736	136.6	12.4	149	0.73	422	491	428	1.14
1988	40120	no	40120	6120	46240	44159	10233	54392	5881	60273	150.1	12.6	163	0.93	362	468	371	0.85
1989	45245	no	45245	7520	52765	45198	13224	58422	7235	65657	176.4	18.5	195	1.26	331	391	337	0.68
1990	45245	no	45245	7520	52765	49554	13630	63184	6177	69361	206.3	15.3	222	1.39	306	405	313	0.65
1991	46225	no	46225	8500	54725	52834	16258	69092	6788	75880	228.7	20.6	249	1.57	302	330	304	0.63
1992	44200	no	44200	8500	52700	58664	20594	79258	7493	86751	232.9	17.6	250	1.64	340	425	346	0.69
1993	40600	no	40600	8500	49100	52280	17843	70123	5491	75614	206.1	13.6	220	1.43	340	404	344	0.69
1994	42300	no	42300	8500	50800	53693	18118	71811	4766	76577	209.6	16.3	226	1.54	343	292	339	0.65
1995	39500	no	39500	8500	48000	51900	16429	68329	2361	70690	186.9	7.2	194	1.30	366	329	364	0.71
1996	37890	26032	63922	8500	72422	49251	17359	66610	2623	69233	168.6	8.6	177	1.22	395	303	391	0.74
1997**	38292	26308	64600	8500	73100	50483	13517	64000	517	64517	191.2	1.2	192	1.19	335	443	335	0.71
1998**	36000	24729	60729	7650	68379	55655	9515	65170	954	66124	159.2	3.2	162	1.09	409	300	407	0.79
1999**	40109	30891	71000	7650	78650	56968	17017	73985	2500	76485	170.1	7.1	177	1.18	435	354	432	0.84
2000***	40109	30891	71000	7650	78650	54000	20000	74000	2500	76500	139.7	2.1	142	1.00	530	800	540	1.00

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* The TAC are actually confined to vessels below 79 GRT. These vessels fish almost exclusively in inshore areas.
**Preliminary.
***Projected.
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Table 2. Total shrimp catch in Subarea 1 by month 1987-2000. 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	1268	995	3951	5132	6344	6592	8110	6343	5850	6539	4096	2422
1988	1884	2359	2905	5983	6003	6276	6423	6056	5962	4509	3847	2185
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	3518	3175	5336	6971	5990	5851	7564	6537	8010	8504	5833	4521
1995	4457	3044	4165	6053	8020	6471	6199	6567	6561	5996	6110	4685
1996	3659	5323	6451	7484	7255	7195	7131	6867	6151	4584	2314	2196
1997	3342	5270	5049	5298	6275	6699	7805	6605	6304	5935	3734	1682
1998*	7089	5254	4825	8167	8542	8597	8434	4088	3910	2794	2031	1439
1999*	4178	4622	6057	6655	7698	7022	9106	6801	5998	6267	5424	4157
2000*	3517	5173	5554	6815	7453	8478	6950	1795	0	0	0	0

*Preliminary.

Table 3. Annual catch, effort and CPUE of the shrimp fishery in Subarea 1 and Div. 0A 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)						
year	0A	1A	1B	1C	1D	1E	1F	0A	1A	1B	1C	1D	1E	1F	0A	1A	1B	1C	1D	1E	1F
1975	0.0	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	0.4	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	0.5	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	0.1	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	1.7	3.9	29.1	0.4	0.0	0.0	0.0	7.3	6.7	64.1	1.5	0.1	0.0	0.0	236	585	454	283	91	-	-
1980	2.7	11.9	28.4	2.7	0.2	0.0	0.0	7.6	21.2	53.3	4.9	0.5	0.0	0.0	358	562	533	547	485	0	-
1981	5.3	4.7	30.5	4.3	0.0	0.0	0.0	17.7	11.2	66.4	10.4	0.1	0.0	0.0	299	416	459	415	333	-	-
1982	2.1	0.7	35.2	6.6	0.0	0.0	0.0	6.2	1.7	65.7	13.5	0.1	0.0	0.0	335	384	535	492	316	-	-
1983	5.4	0.4	32.9	7.6	0.4	0.0	0.0	19.1	0.9	69.5	17.8	0.9	0.0	0.0	284	455	474	430	432	0	500
1984	2.1	0.9	24.8	13.8	1.7	0.0	0.0	7.7	2.7	51.1	28.4	2.7	0.0	0.1	280	351	484	487	639	0	38
1985	3.1	5.0	29.9	12.6	3.8	0.0	0.0	9.9	15.8	62.2	24.3	7.1	0.0	0.0	309	318	481	519	544	-	-
1986	3.0	22.0	25.7	7.5	4.9	0.0	0.0	6.7	55.6	50.6	13.7	9.1	0.1	0.1	445	395	509	545	544	-	-
1987	6.1	16.2	35.0	5.8	0.7	0.0	0.0	12.4	56.5	67.1	10.2	2.8	0.0	0.0	491	287	521	567	250	0	-
1988	5.9	10.0	38.2	5.7	0.4	0.0	0.1	12.6	41.2	92.1	14.0	1.8	0.0	1.0	468	242	415	403	226	0	124
1989	7.2	13.2	27.1	10.2	7.6	0.0	0.4	18.5	48.1	77.7	29.7	16.6	0.0	4.3	391	275	348	343	457	0	89
1990	6.2	9.9	24.6	18.4	9.9	0.0	0.4	15.3	42.3	77.9	54.4	28.9	0.0	2.8	405	234	316	339	341	0	134
1991	6.8	10.3	26.9	15.3	15.9	0.5	0.2	20.6	37.2	90.1	51.8	47.6	0.7	1.3	330	276	298	296	335	671	158
1992	7.5	13.2	26.7	16.1	18.8	4.0	0.5	17.6	49.4	76.2	47.8	50.7	7.4	1.3	425	267	350	337	370	538	398
1993	5.5	6.2	29.7	12.9	14.9	3.7	2.6	13.6	22.9	82.0	41.2	44.3	8.1	7.6	404	272	363	314	336	456	349
1994	4.8	5.9	27.4	13.0	16.2	5.9	3.4	16.3	23.4	83.8	40.7	42.6	10.0	9.2	292	254	327	318	381	593	369
1995	2.4	5.6	21.8	12.5	17.7	6.9	3.9	7.2	21.1	69.8	34.1	41.6	12.4	7.9	329	265	312	365	425	552	501
1996	2.6	4.4	18.3	13.9	19.0	6.7	4.3	8.6	18.7	52.0	35.9	40.8	12.0	9.1	303	238	351	387	465	555	474
1997*	0.5	6.1	16.8	9.3	18.6	6.9	6.3	1.2	44.1	55.7	24.8	42.1	11.8	12.7	443	138	302	377	441	579	498
1998*	1.0	3.7	18.5	11.1	17.3	7.1	7.4	3.2	20.1	50.6	27.2	36.6	11.2	13.5	300	185	366	407	473	635	548
1999*	2.5	7.5	23.2	12.0	15.6	6.8	8.9	7.1	34.4	59.4	24.3	29.1	9.9	13.0	354	216	391	492	536	692	687
2000**	2.5	11.1	22.3	13.4	13.6	3.9	9.6	2.1	25.8	46.8	23.0	25.1	5.5	13.6	800	432	478	580	543	717	709

*Preliminary.
**Projected.

Table 4. Time series of the four standardized CPUE indices included in the combined CPUE index for NAFO Subarea 1 + Div. 0A.

Year	1BCD	KGH	Small ves.	0A	Combined
1976	-	1.66	-	-	1.03
1977	-	1.56	-	-	0.97
1978	-	1.23	-	-	0.77
1979	-	1.11	-	-	0.69
1980	-	1.34	-	-	0.83
1981	-	1.27	-	1.13	0.81
1982	-	1.61	-	1.33	1.02
1983	-	1.42	-	1.06	0.89
1984	-	1.34	-	0.97	0.83
1985	-	1.43	-	0.85	0.87
1986	-	1.49	-	0.89	0.90
1987	1.85	1.79	-	1.38	1.14
1988	1.19	1.47	1.29	1.22	0.85
1989	1.04	1.09	1.03	0.90	0.68
1990	1.00	1.00	1.00	1.00	0.65
1991	0.98	-	0.88	0.88	0.63
1992	1.08	-	0.92	1.02	0.69
1993	1.05	-	1.02	0.96	0.69
1994	1.05	-	0.87	0.74	0.65
1995	1.17	-	0.87	0.81	0.71
1996	1.25	-	0.84	0.76	0.74
1997	1.21	-	0.85	0.59	0.71
1998	1.33	-	1.01	0.70	0.79
1999	1.42	-	0.99	0.89	0.84
2000*	1.55	-	1.49	-	1.00

*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 1987-2000.

Year	P. borealis		Fish		P. montagui
	discard (tons)	discard (%)	discard (tons)	discard (%)	landed
1987	150	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	2175	3.0	4
1995	389	0.6	2162	3.2	470
1996	267	0.4	2207	3.3	632
1997	254	0.4	1918	3.0	336
1998*	257	0.4	1787	2.7	1026
1999*	161	0.2	1172	1.6	530
2000**	168	0.2	1306	1.8	756

*Preliminary

Table 6. Composition of shrimp catches in NAFO SA 1 as derived from sub samples weighted up to the total catch. Numbers caught were divided by standardized effort to produce abundance indices.

Mean size

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cpl (mm)	23.5	23.5	22.9	22.3	21.8	21.9	21.2	21.2	21.1	22.3
Weight (g)	8.4	8.5	8.4	7.8	7.6	7.2	6.5	6.6	6.3	7.5
Count (no/kg)	119	118	119	128	132	140	154	151	160	133

Proportion of total catch

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males	46%	33%	51%	56%	64%	64%	64%	66%	64%	45%
Primi	9%	3%	1%	11%	15%	9%	12%	8%	12%	2%
Multi	45%	63%	48%	33%	21%	27%	24%	26%	24%	53%
Females total	54%	67%	49%	44%	36%	36%	36%	34%	36%	55%

Number caught (millions)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males	4188	3388	4560	5502	5971	6243	6368	6583	7584	4232
Primi	825	350	96	1067	1384	824	1197	835	1391	188
Multi	4031	6493	4370	3217	1962	2614	2363	2583	2840	4989
Females Total	4856	6843	4466	4284	3347	3438	3560	3418	4230	5177
Total	9044	10231	9026	9786	9317	9681	9928	10001	11814	9409

Abundance index

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males	2.8	2.2	3.3	3.7	4.6	5.1	5.2	5.9	6.4	4.2
Primi	0.6	0.2	0.1	0.7	1.1	0.7	1.0	0.8	1.2	0.2
Multi	2.7	4.2	3.2	2.2	1.5	2.1	1.9	2.3	2.4	5.0
Females total	3.3	4.4	3.3	2.9	2.6	2.8	2.9	3.1	3.6	5.2
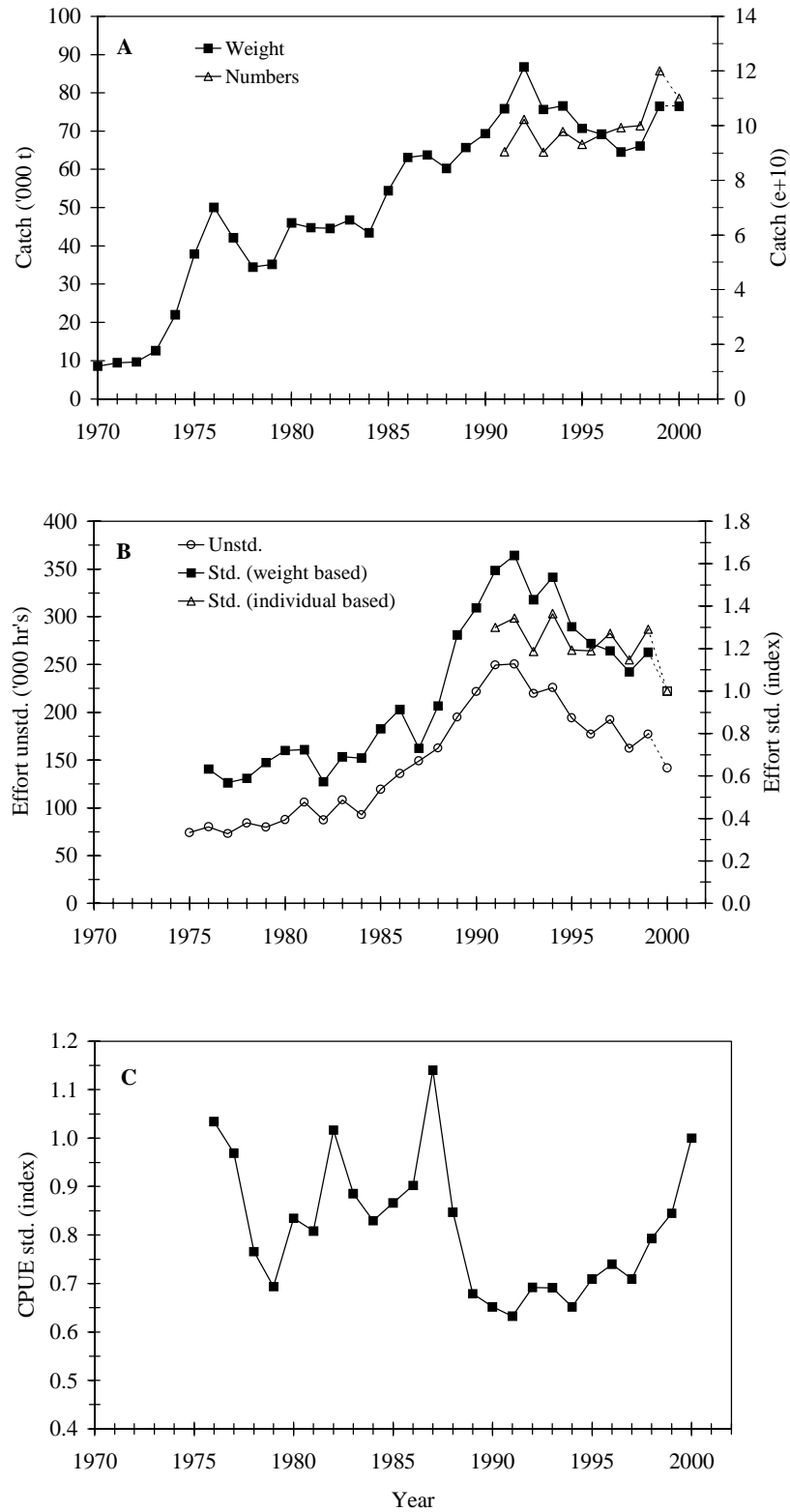
Figure 1. Total catch (panel A), effort standardized and unstandardized (Panel B) and standardized CPUE indices (panel C) of the shrimp fishery in NAFO SA 1 + Div. 0A. Data for 2000 are projected values.
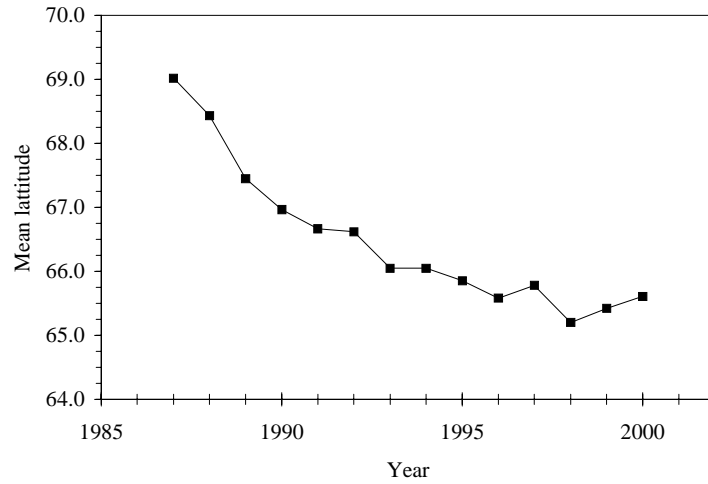
Figure 2. Mean latitude (°N) of allocated effort by vessels fishing offshore in Subarea 1, 1987-2000.
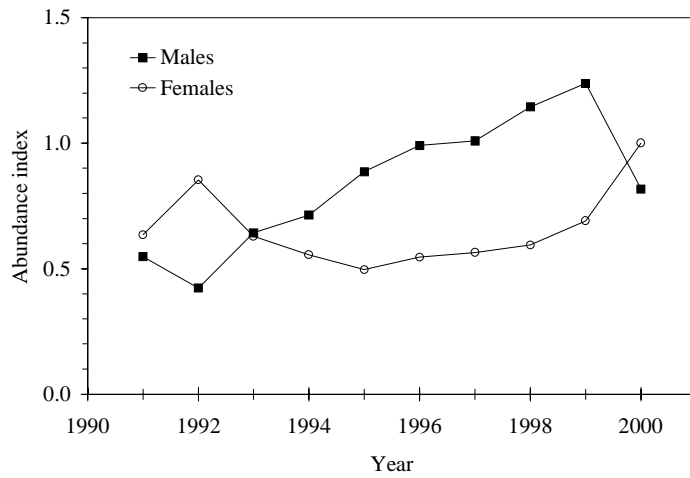
Figure 3. Standardized CPUE indices of the male and female component of the West Greenland shrimp stock 1991-2000 (data from Table 6).
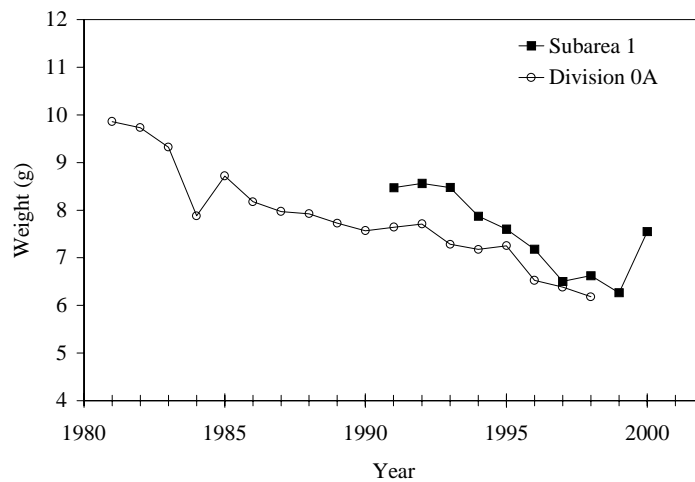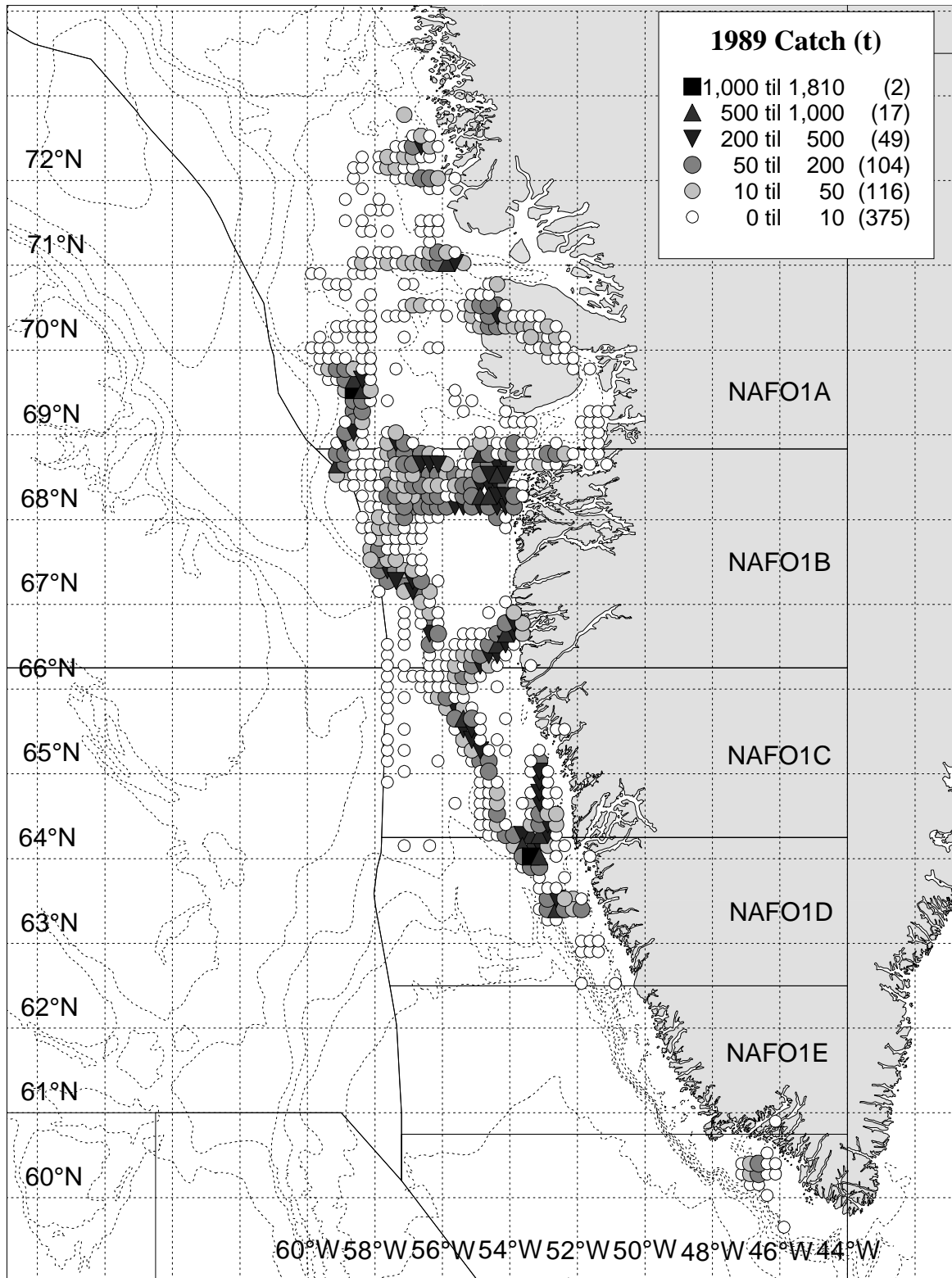

**Figure 4.** Mean shrimp size (g) in catches in Subarea 1 and Division 0A, 1998-2000.

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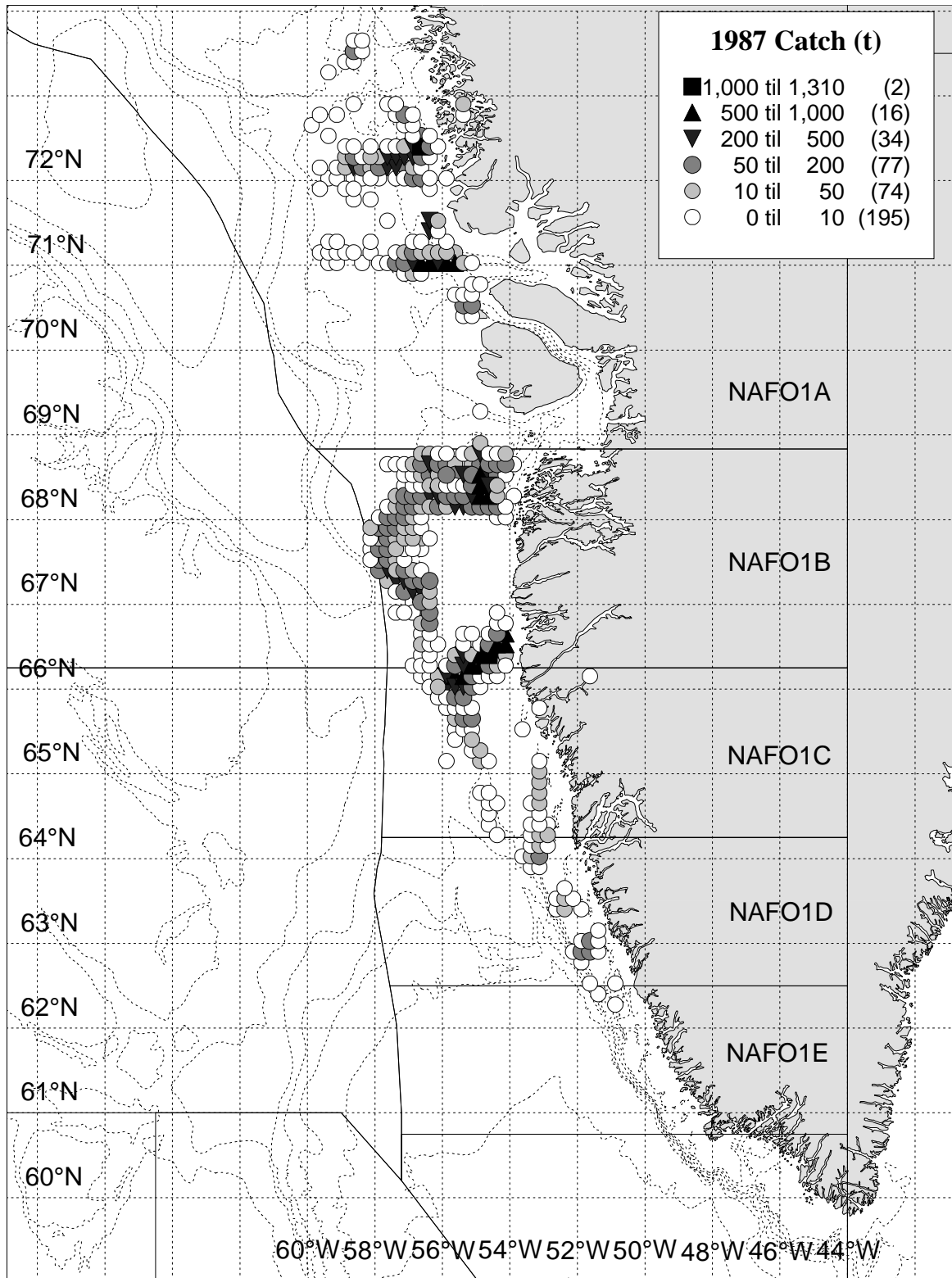
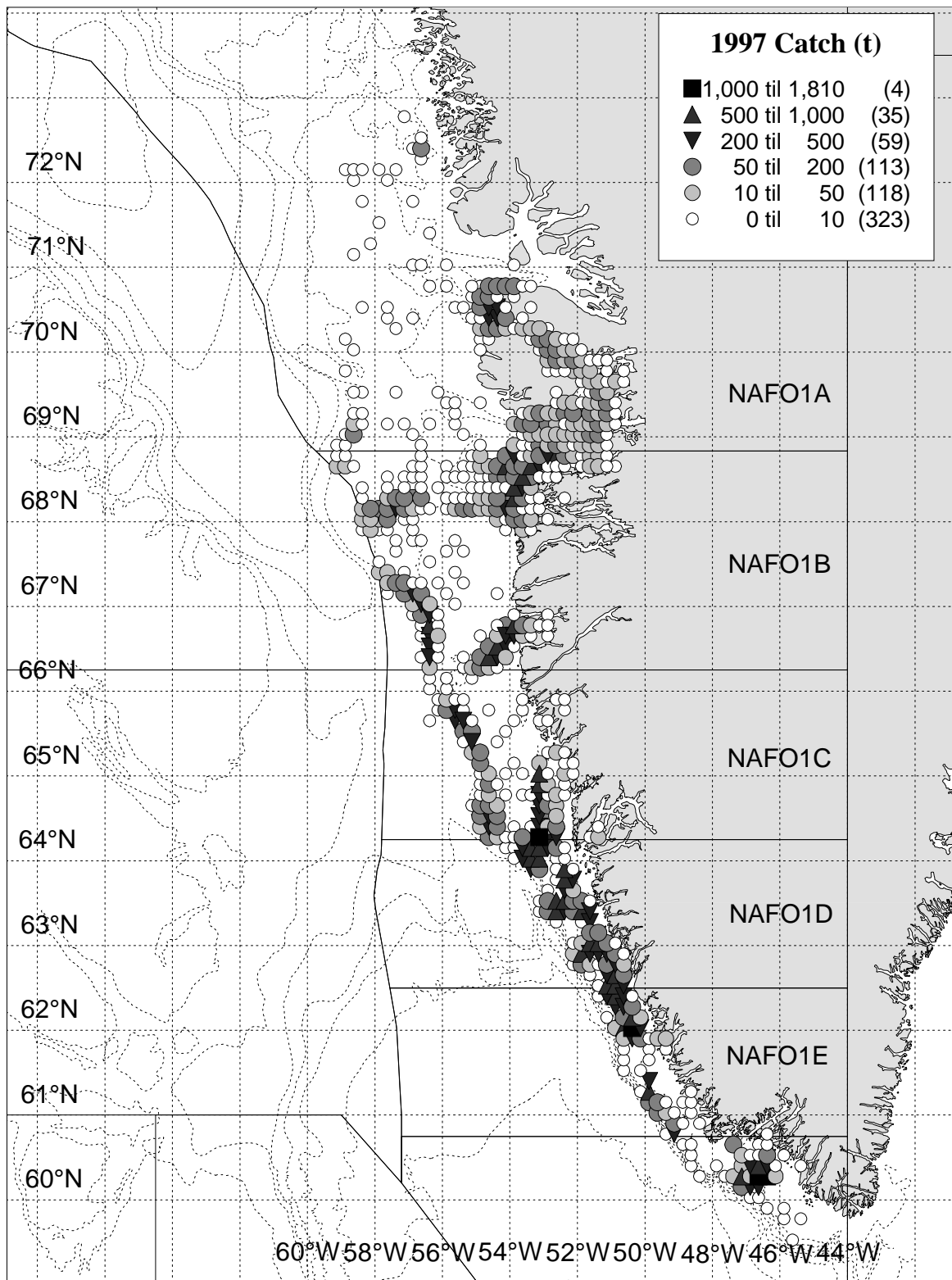**Figure 5A.** Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1987.
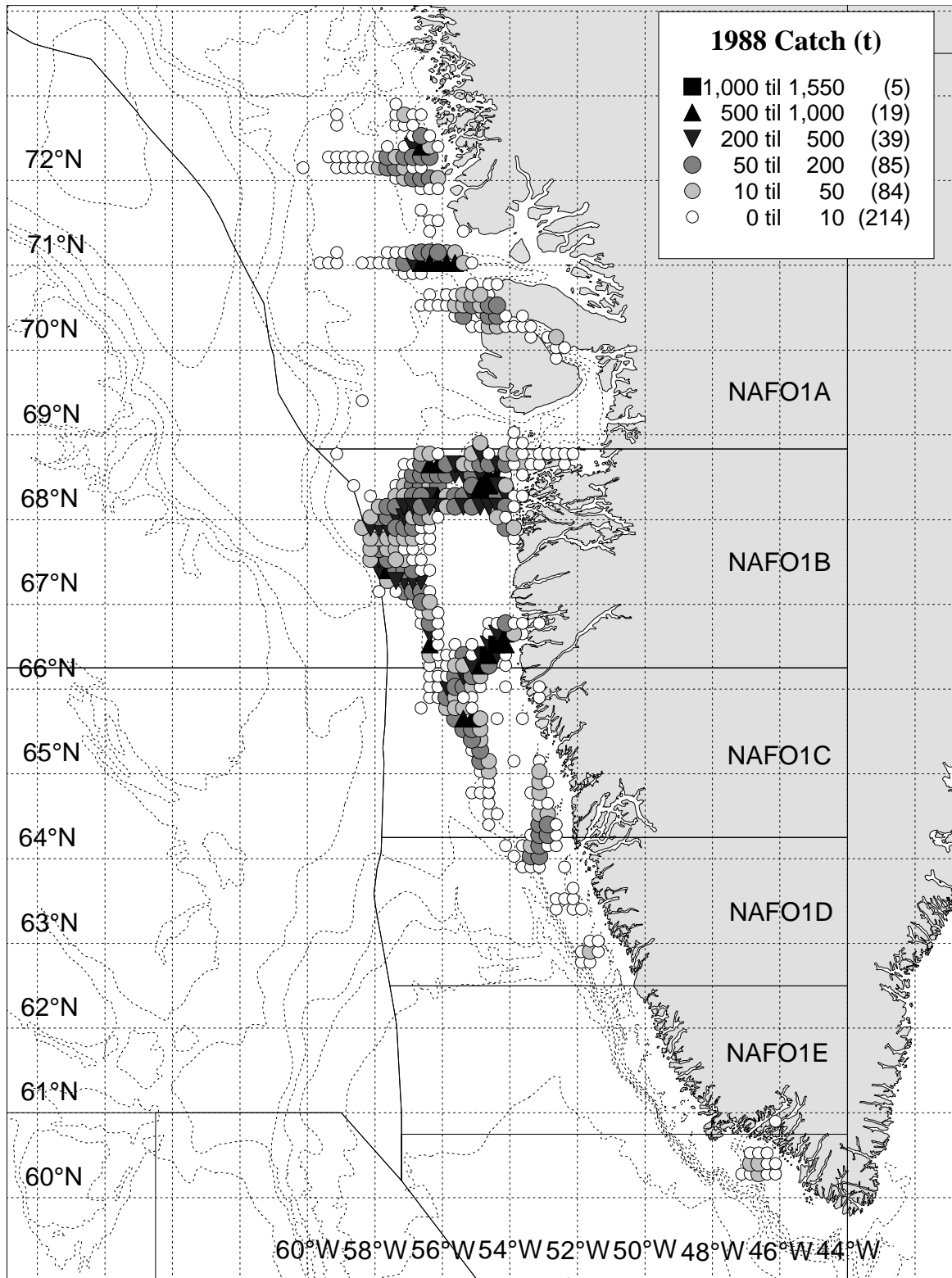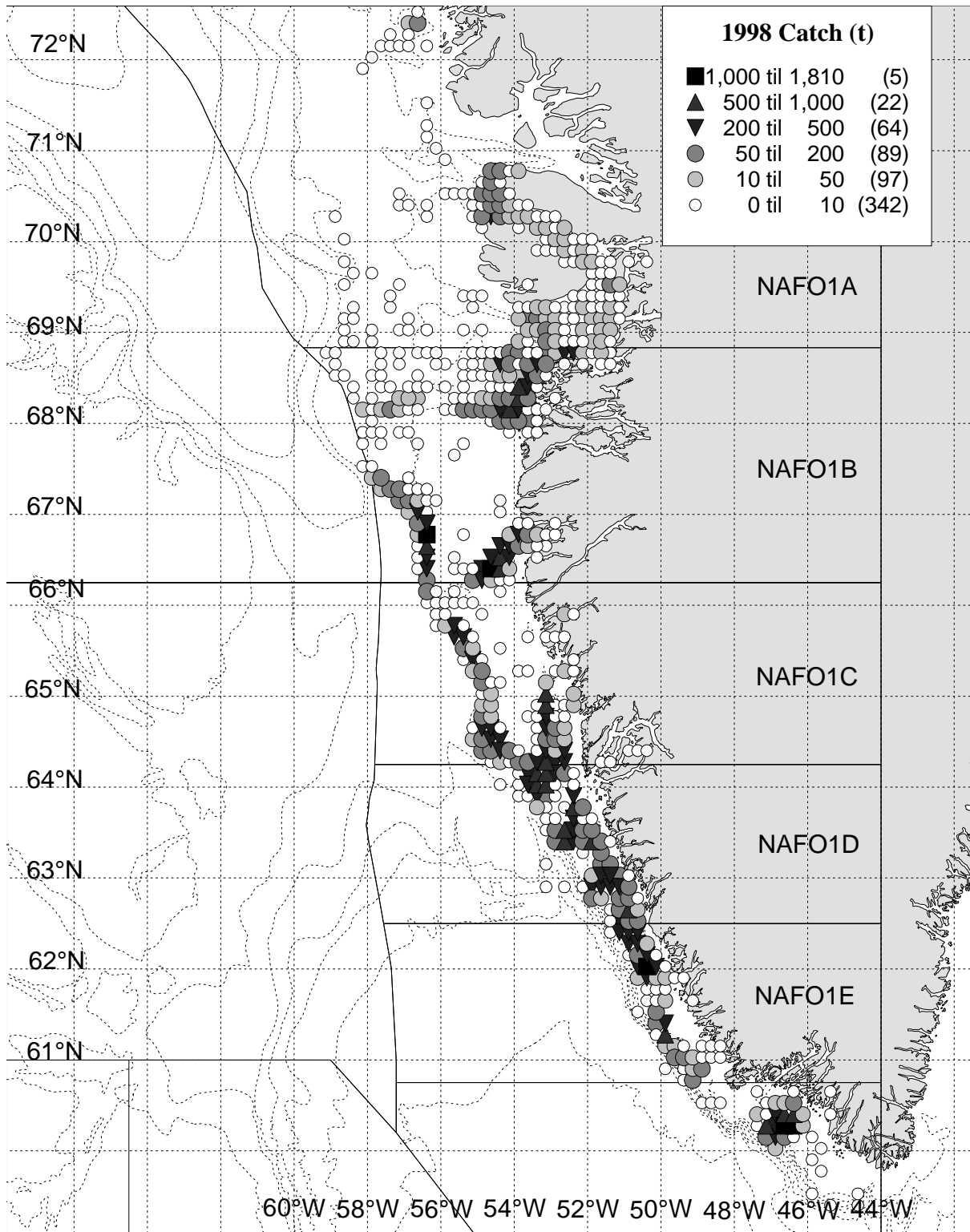
Figure 5B. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1988.

Figure 5C. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1989.
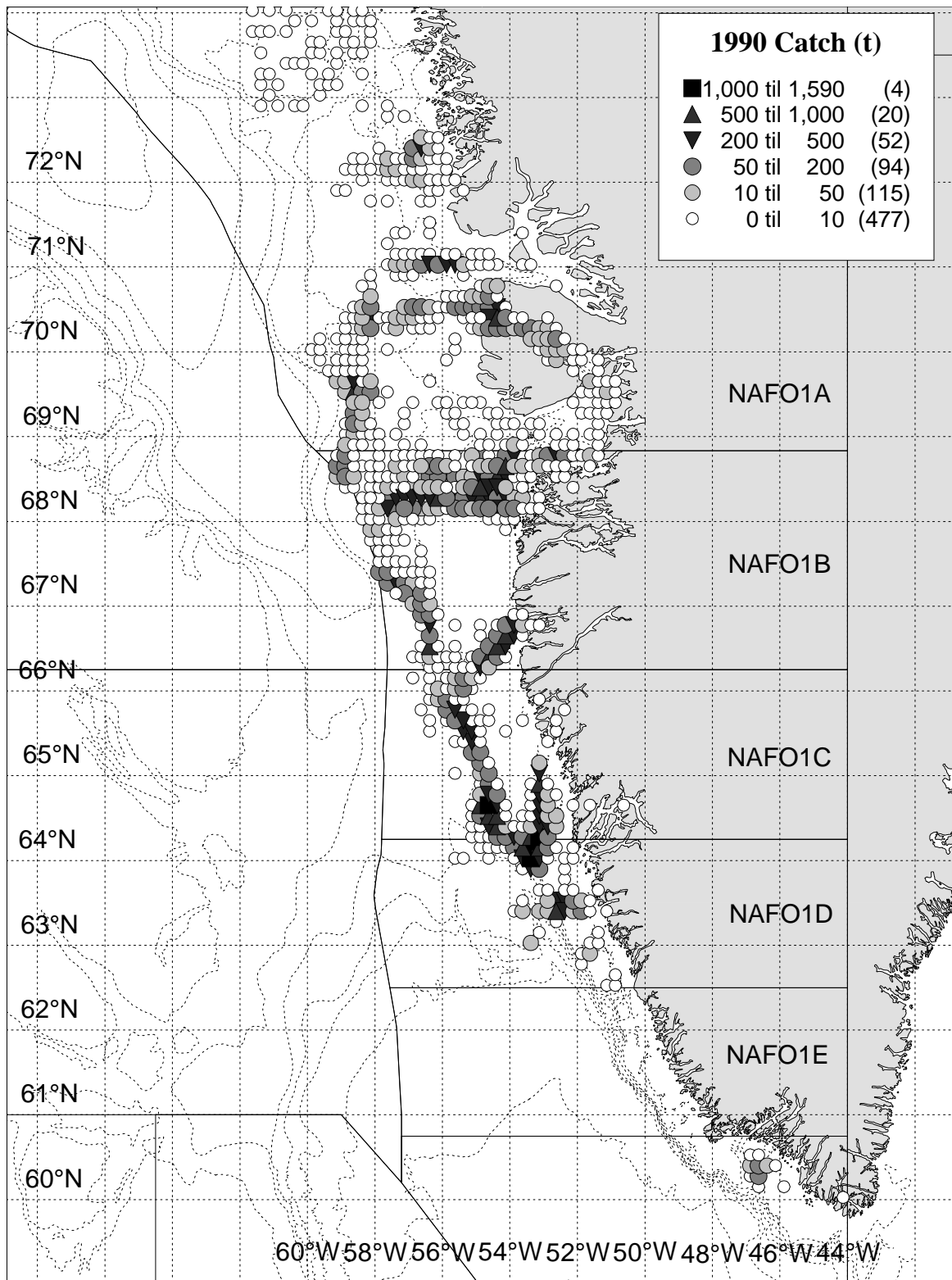
Figure 5D. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1990.
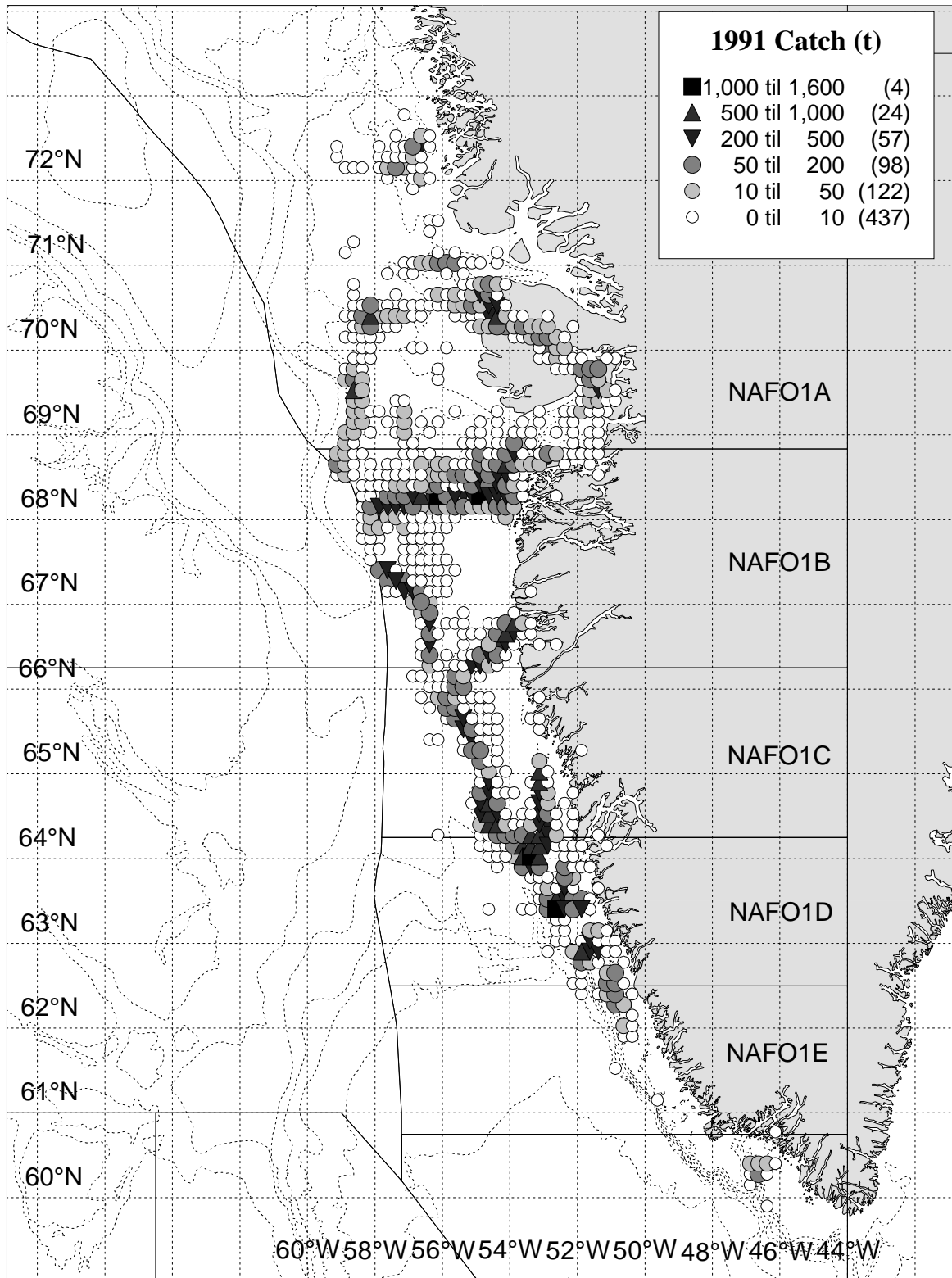
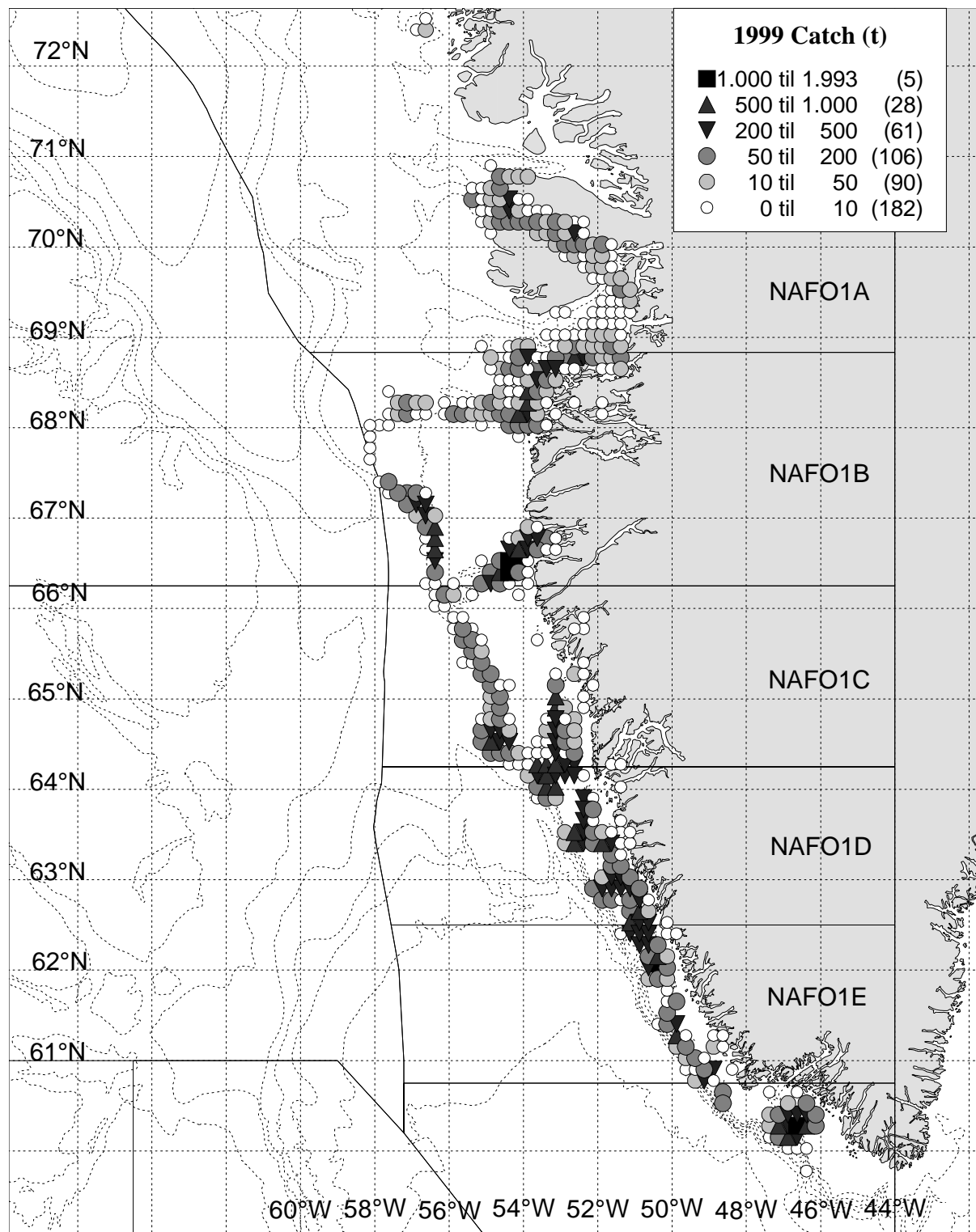**Figure 5E.**   Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1991.
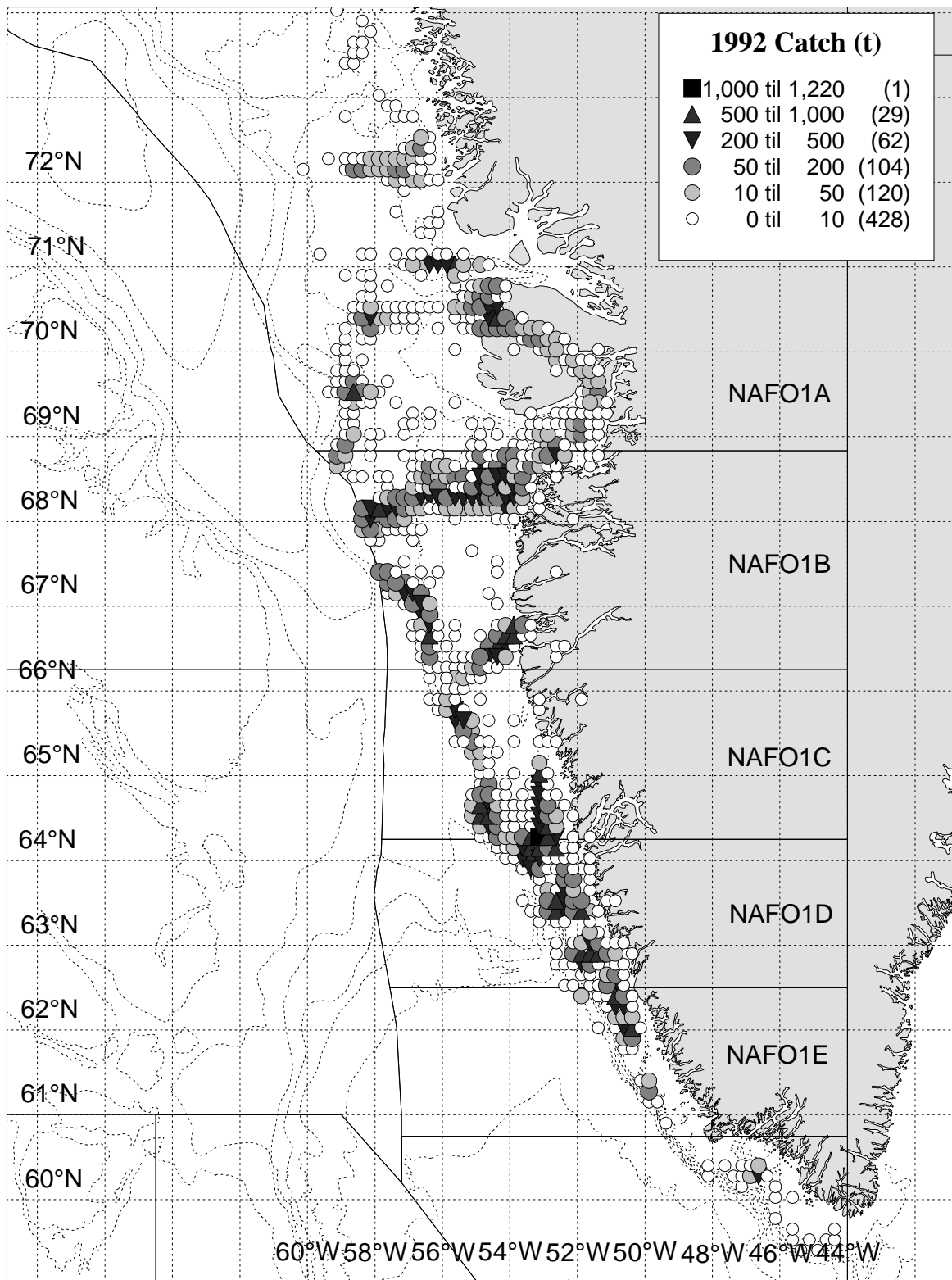
Figure 5F. Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1992.
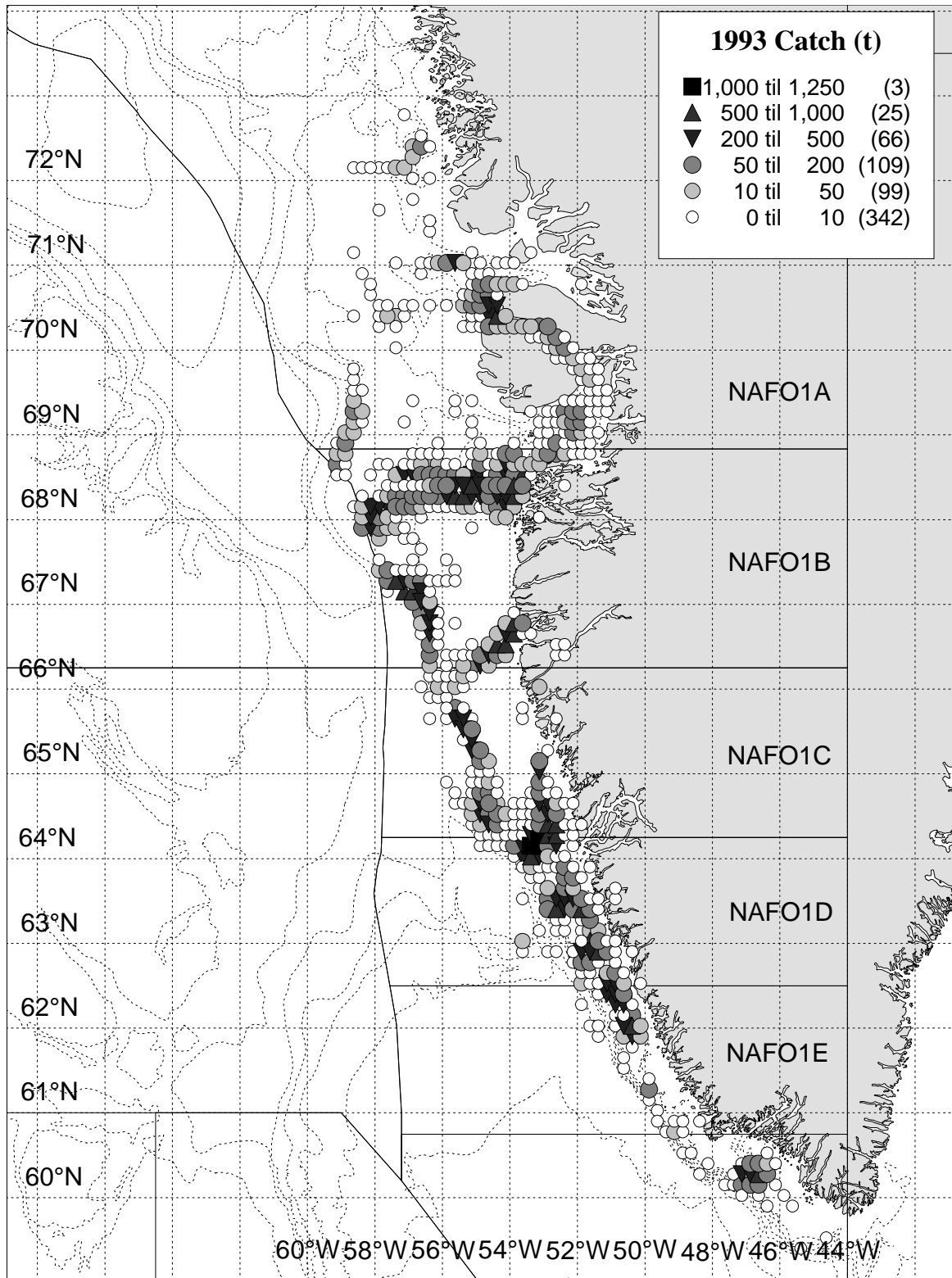
Figure 5G.   Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1993.
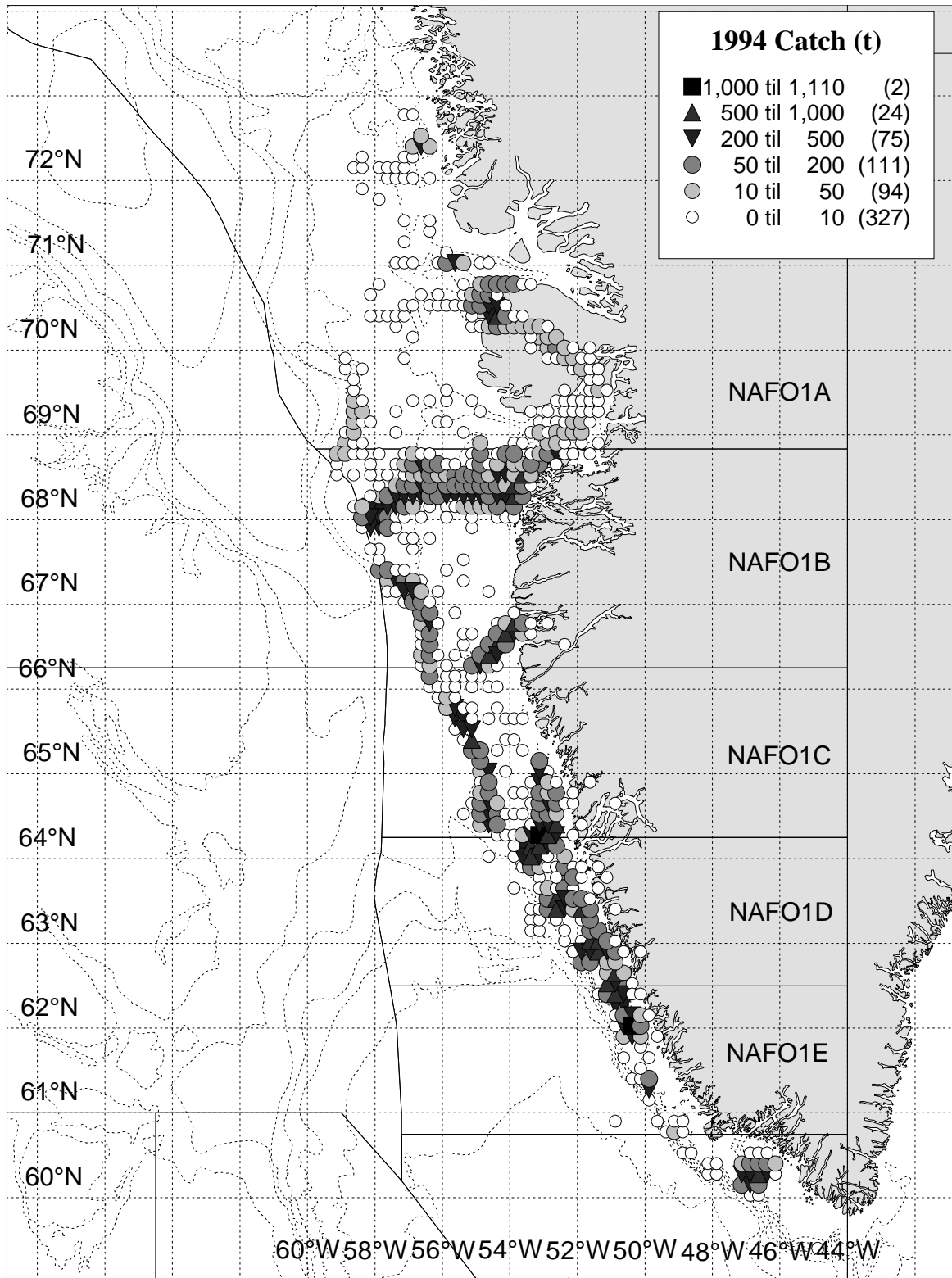
Figure 5H.   Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1994.
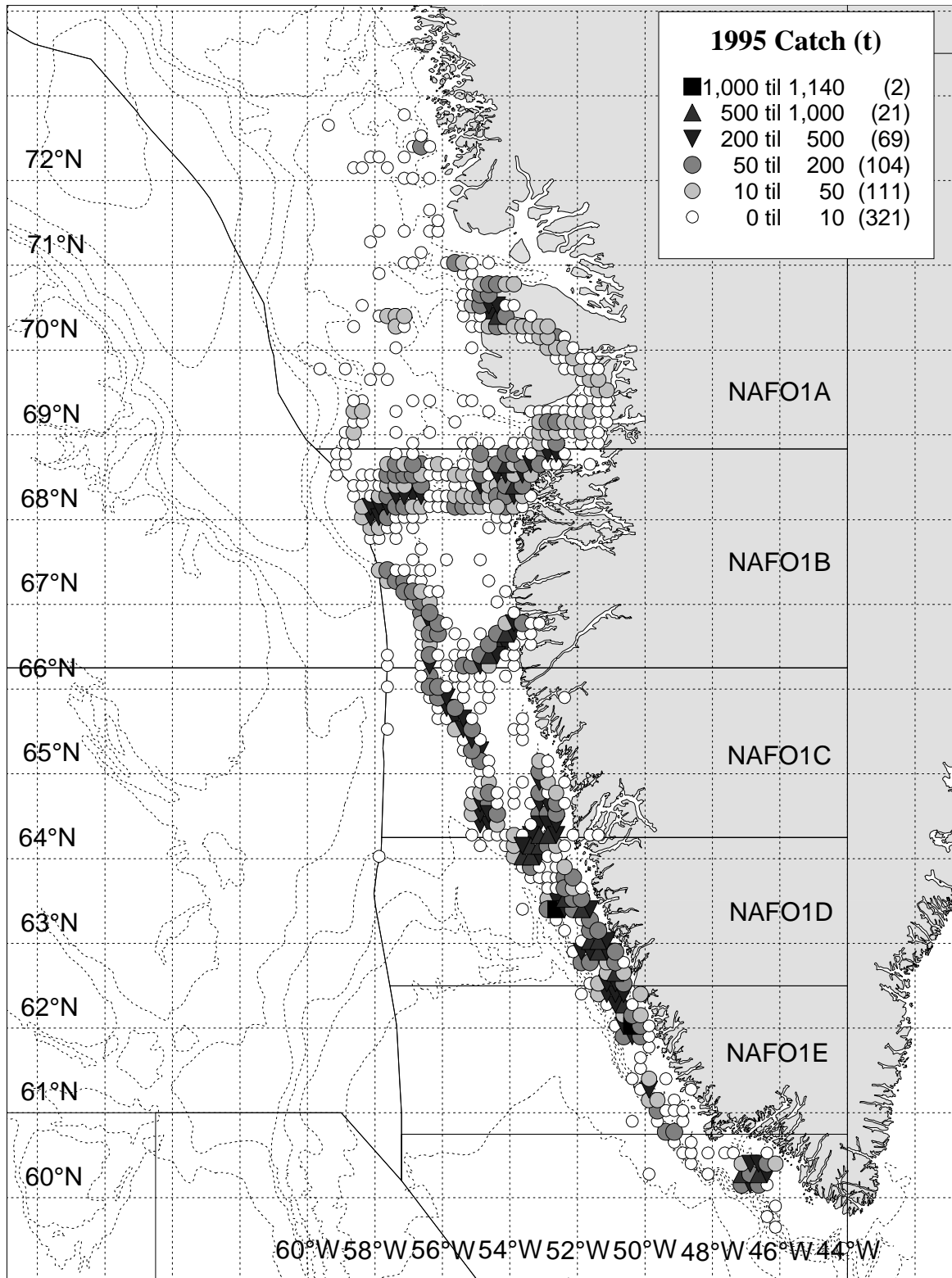
Figure 5I.   Spatial distribution of the Greenlandic shrimp catches in Subarea 1 1995.
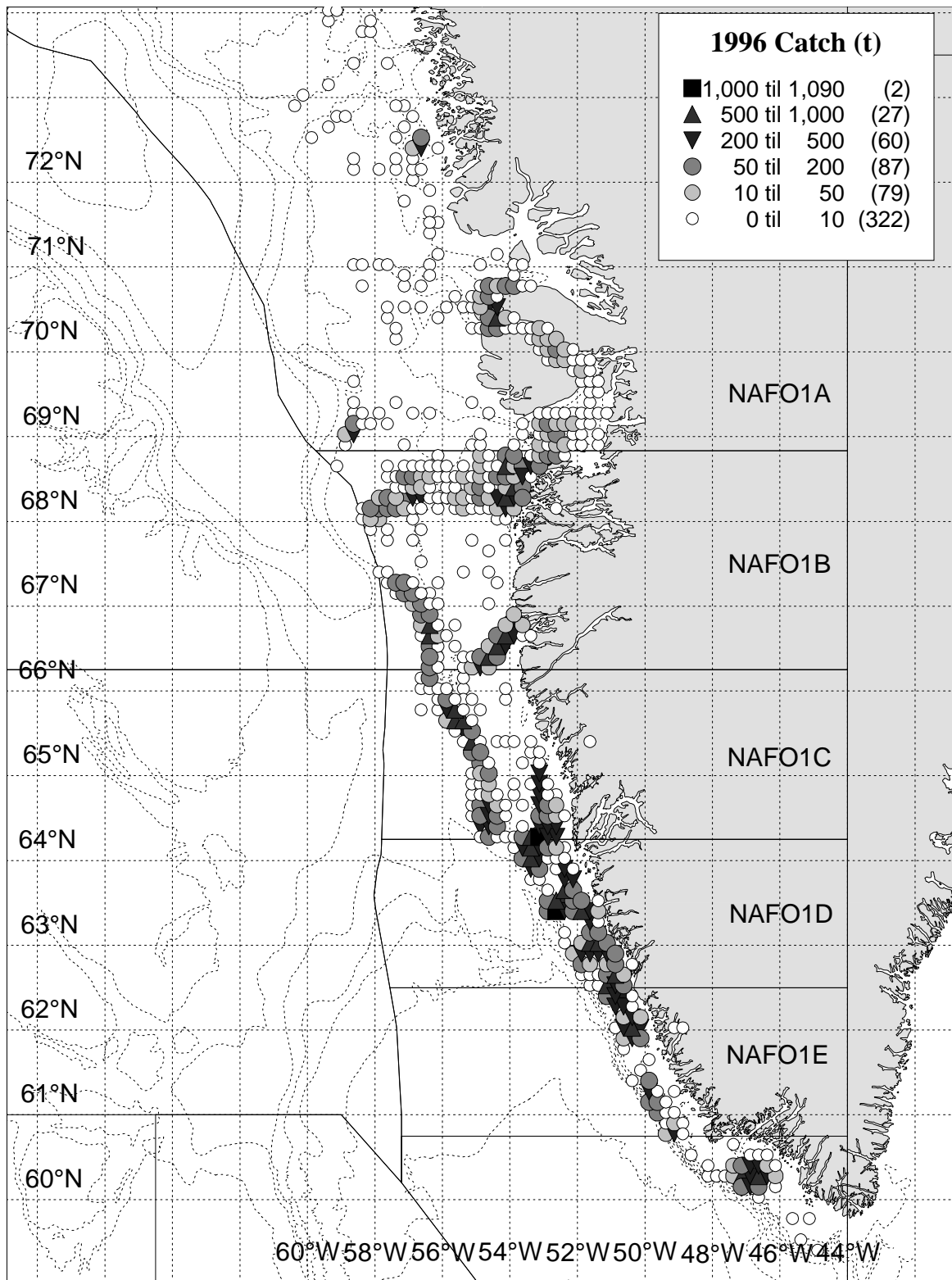
Figure 5J. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1996.

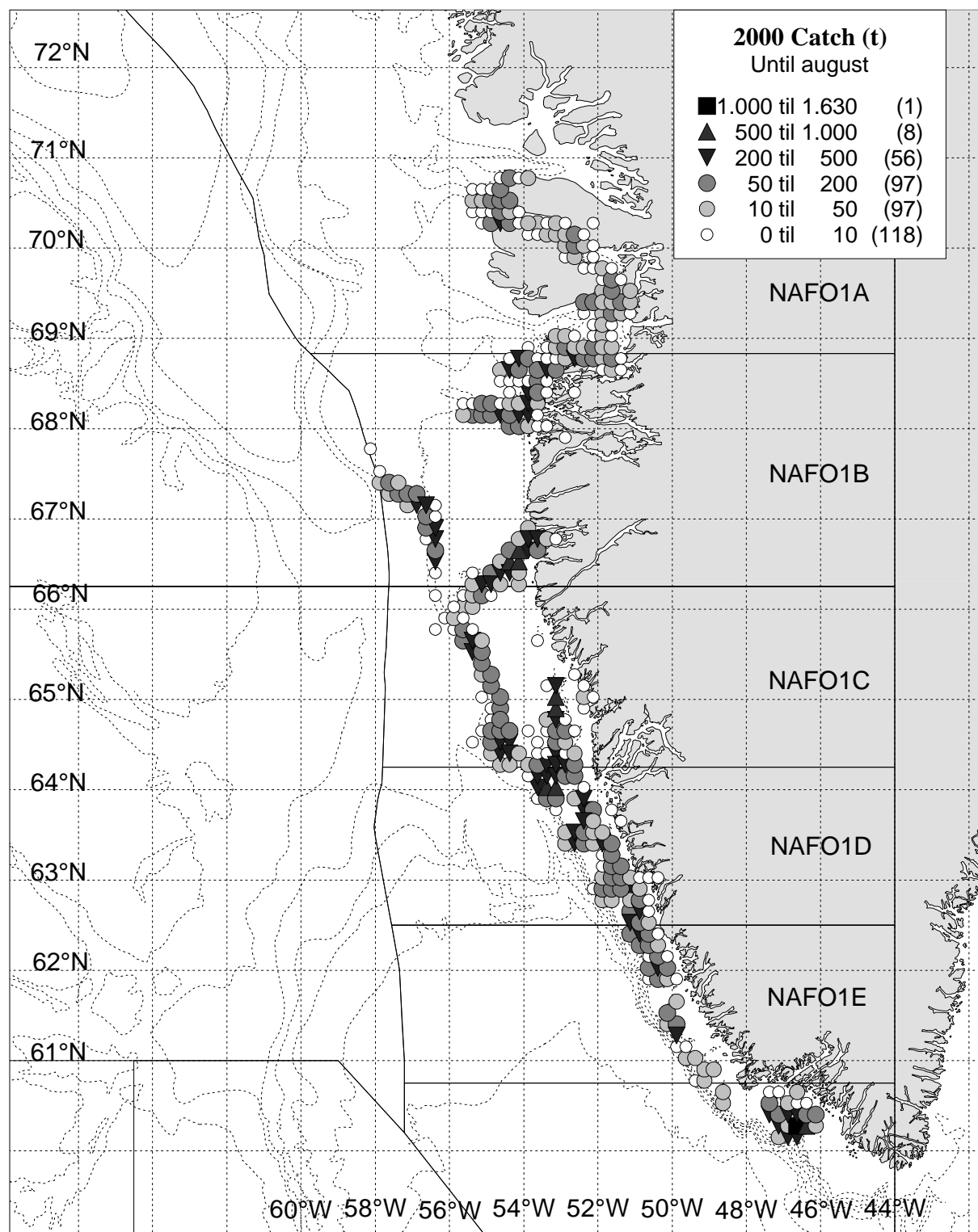**Figure 5K.**   Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1997.

Figure 5L. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1998.
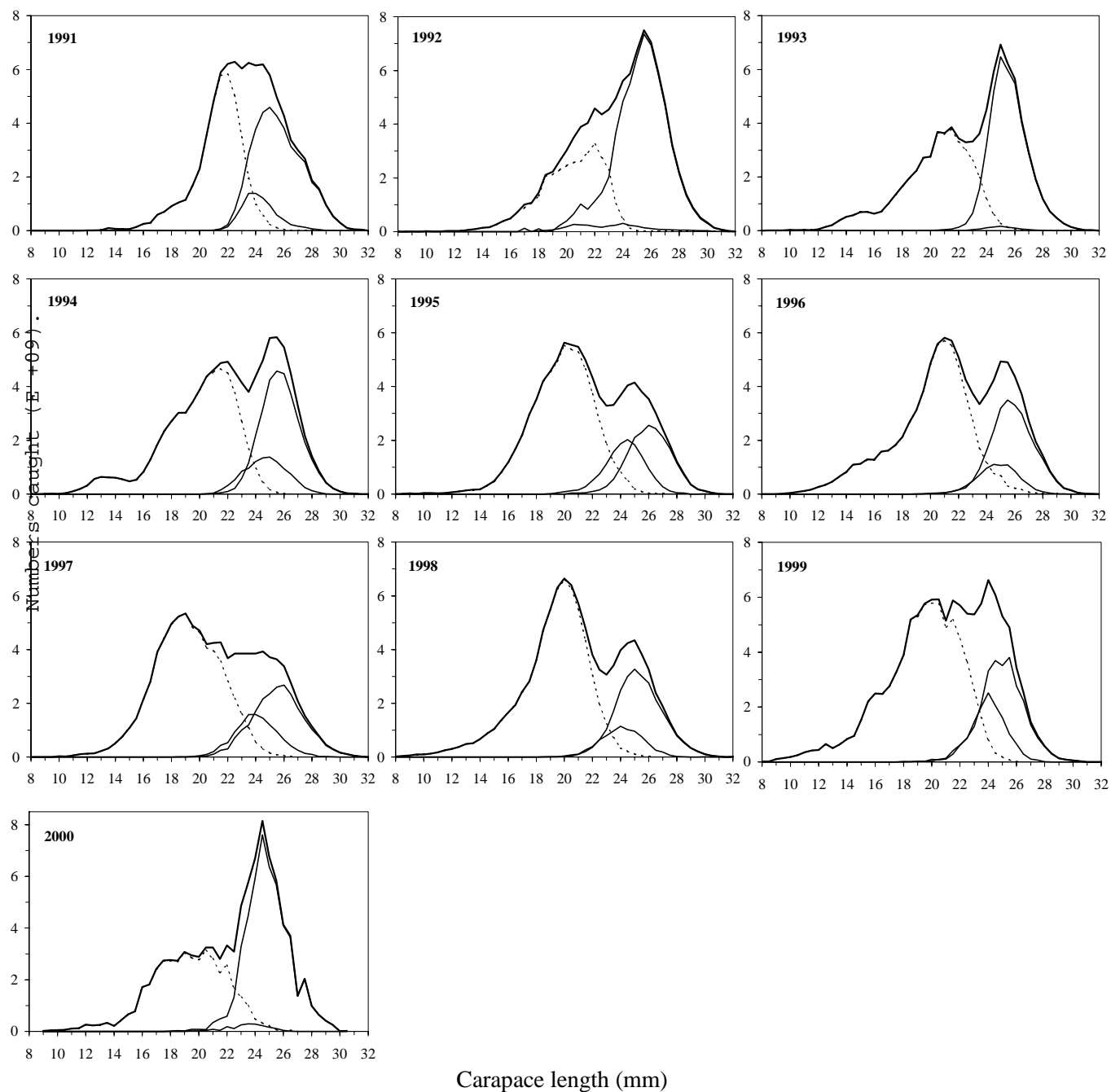
Figure 5M. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1999.

Figure 5N. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 2000 until August.

Figure 6. Length frequency distributions of commercial shrimp catches in Subarea 1 + Div. 0A, 1991-2000 (1999 and 2000 values were based on data from Subarea 1 only). The distribution of male shrimp is shown by the dotted line, primiparous and multiparous as the thin line (Primi. is recognized as the smallest component of the two) and total distribution as the bold line.