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The Fishery for Northern Shrimp (*Pandalus borealis*) off West Greenland, 1970-2001

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 Div. 0A respectively. Following a southward expansion during the late-1980s to late-1990s the spatial distribution of the fishery seems to have stabilised. The distribution of the 2001 fishery is not expected to deviate significantly from that of 2000.

After reaching a maximum in 1992 of 87 000 tons catches have decreased somewhat to around 66 000 tons in 1998 due to management measures. Since then catch quotas have been raised again and with that catches. The projected catch of 2001 is expected to be about 83 500 tons. The inshore fishery (vessels below 80 GRT) accounted for around 20% of the total landings. Reported discard and by-catch is low.

A standardized CPUE series indicate an increasing trend of stock biomass since the early -1990s. The estimated 2001 value shows a 13% decline compared to the value of the previous year. Standardized effort based on biomass indicated a decrease in harvest rate from 1992 to the late-1990s by about 40%. However, when based on numbers only a 25% decrease was evident. For 2001 the indices indicate an increase in harvest rate as compared to the most recent years.

The mean size of shrimp caught has declined since 1991. In spite of these changes, the proportions of female to male shrimp in the catches seem relatively stable since the mid-1990s. The length-frequency distribution of the 2001 catches shows a large peak of males around 20 mm cpl. The female component is less prominent, however, with representation of all sizes normally present.

**Introduction**

Northern shrimp (*Pandalus borealis*) occurs off West Greenland in NAFO Div. 0A and 1A–1F. The stock is continuously distributed from Cap Farewell to about 74°N in depths down to around 800 meters (Fig. 1). 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. In 1970 the development of a multinational offshore fishery began and within the following 20-years landings increased to the current level of 65-85 000 tons. Since 1981 access to the 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 a 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 70 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. Seventeen 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 catch and effort, catch composition, CPUE-indices and spatial distribution of 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 1.6 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 1976-2001, was calculated based on the methods described in Hvingel *et al.* (2000). 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 2000 102 samples of 2-4 kg including 44 000 individuals were measured. The preliminary 2001 figures are based on 31 samples including 14 000 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

In conjunction with the development of the offshore shrimp fishery total annual catch has increased from less than 10 000 tons in the early-1970s to more than 86 000 tons in 1992 (Fig. 2, Table 1). Since then, government restrictions to reduce effort and fishing opportunities elsewhere for the Canadian fleet have somewhat reduced the landings which in 1998 amounted to about 66 000 tons. However, when measured in numbers caught the catch level of 1992 was maintained. A raise of quotas in 1999 and again in 2001 has been followed by increased catches (Table 1). The projected catch of 2001 is expected to be about 83 500 tons (projected from Nov. to the end of the year).

Since the beginning of the 1970s catches in the inshore areas have been fluctuating between 10 000-20 000 tons (Table 1). Limited access for vessels above 80 GRT has been the only management related restraint on inshore catch levels until 1997 when ITQs were enforced also for the small vessel fleet. Subsequently catches decreased substantially while a major reorganization 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% (9 500 tons) were taken by the small vessel fleet. In 1999-2000 catches were back up again amounting to 20 000 tons in 2000, which will also be the expected catch level of year 2001.

The Canadian catches in Div. 0A have fluctuated between 1 700 and 5 400 tons during 1979-1983 after which they increased from 2 100 tons in 1984 to the highest recorded level of around 6-7 000 tons in the late-1980s to early-1990s (Table 1). Catches thereafter declined to around 1 000 tons in 1998 coincident with the increased fishing opportunities off Labrador. During the late-1990s catches in Div. 0A have accounted for less than 5% of the total catches off West Greenland. The 2001 catches are expected to be about 1 500 tons.

The fishery takes place in all months (Table 2). 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 8 000 tons. In some years (1991-94) a second maximum occur in October. In Div. 0A the fishery usually begins in late-June to early-July and continues into late November. However, most of the catch and effort occurs in August-October.

#### By-catch and discard

The reported discard of shrimp has remained less than 1% of total catch throughout the period 1987-2001 (Table 3). The discard of fish has shown a slightly increasing trend from about 1 to 3% of total catch in the years 1987-98. 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 2000 and 2001. Sorting grids are mandatory for stern trawlers.

From 1995 to 2001 vessels have reported annual catches of *P. montagui* in the range of about 300 to 1 000 tons (Table 3). 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-1990s (Folmer, 1996).

#### Effort

Since 1975, when the offshore fishery was well established, until 1984 annual unstandardized effort showed a slightly increasing trend from about 75 000 hr's to about 93 000 hr's (Fig. 2B). In the subsequent years a considerable enlargement of the offshore fleet took place and effort went up by almost a factor three reaching 250 000 hr's in 1991-1992. Hereafter unstandardized effort has decreased as a result of management measures, reduced activity in Div. 0A (Table 4) 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 2000 about 165 000 trawling hr's were registered and preliminary data suggest that the year 2001 figure will at or a little above this level.

The development of the weight based standardized effort time series agrees well with the unstandardized (Fig. 2B). Since 1992, when it reached its highest value, standardized effort has shown a continuous decrease until the late-1990s by a total of about 40%. A corresponding effort index based on number of individuals (Fig. 2B) showed a similar decreasing trend of the 1990s however the reduction was less, i.e. about 25%. In 2001 the indices indicate an increase of harvest rate as compared to the most recent years.

#### Catch-per-unit-effort

The unified standardized CPUE index consists of four individual indices (Table 5). 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 (Fig. 2C, Table 5) may be interpreted as fluctuations of this stock component by a factor of 2 around a higher level between 1976 and 1987 followed by a drop to a lower level in the late-1980s. The marked spike in 1987 is likely the result of some very strong year classes produced in the early-1980s (Anon., 1991). During the 1990s the CPUE index has shown an increasing trend. The revised 2000 index value, using the complete set of data for the year, decreased slightly compared to the preliminary value reported by Hvingel (2000). The estimated 2001 value shows a 13% decline compared to the value of the previous year.

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).

#### Spatial distribution of the fishery

The fishery has been conducted on the continental shelf of Greenland between 59° and 74°N, mainly between 200 and 600 m depth (Fig. 1). However, during the period of logbook recordings (since 1975) a substantial change in the relative importance of the different areas is indicated. Since the mid-1970s until the early-1980s the vast majority of the annual fishing effort were allocated to Div. 1 and 1B. Div. 1C and 0A received some attention but almost no effort was spent in Div. 1D, 1E and 1F (Table 4). Since then the fishery has gradually expanded southward to include also these three southern-most Divisions in Subarea 1. 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.

The southward expansion/displacement of the offshore fishery since the late-1980s (Hvingel, 1996) is summarized by a decreasing mean latitude of effort allocation as shown in Fig. 3 and may be observed in more detail in Fig. 4.

Indications of biomass distribution from the German groundfish survey (Rätz, 1997) and the Greenlandic trawl survey (Carlsson and Kannevorff, 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 preliminary data for 2001 do not suggest any significant changes in the distribution of the fishery in Subarea 1 and Div. 0A as compared to that of year 2000 (Fig. 4).

#### Catch composition.

The mean shrimp size caught has declined during the 1990s. In Subarea 1 it declined by 3.1 mm cpl. from 1991 to 1999 corresponding to a mean individual weight reduction of about 25% (Fig. 5). Mean shrimp size caught in the Canadian fishery in Div. 0A showed a corresponding declining trend since 1981 (Fig. 5). 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 decline of shrimp size in the catches stopped in year 2000 caused by the presence of a relative high proportion of female shrimp (Table 6). The length frequency distribution of year 2000 shows a large peak of female shrimp at around 25 mm cpl. (Fig. 6).

The preliminary data of 2001 does not indicate quite as good catch quality. Yet in Subarea 1 mean size it is still better than the three latest years of the 1990s (Table 6). The length frequency distribution shows a dominant peak of male shrimp at around 20 mm cpl. (Fig. 6). The female component is less prominent, however, with representation of all sizes normally present in the catches. Thus, the standardized catch rates indicate a decrease in the abundance of females compared to 2000 (Fig. 7) while abundance indices of males indicate an 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.

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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 1970-2001. 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	Total	Offshore	Inshore	Total	Offshore	Total	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	0.49	620	-	625	1.23
1977	-	no	-	-	36000	33843	7800	41643	457	42100	73.0	-	73	0.44	571	-	577	1.15
1978	-	no	-	-	41000	26747	7600	34347	122	34469	84.1	-	84	0.45	408	-	410	0.91
1979	-	no	-	-	31500	25958	7500	33458	1732	35190	72.4	6.9	79	0.51	462	253	444	0.83
1980	-	no	-	-	32000	35778	7500	43278	2726	46004	80.0	7.7	88	0.55	541	354	525	0.99
1981	35000	no	35000	5000	40000	32016	7500	39516	5284	44800	88.2	18.4	107	0.57	448	288	421	0.95
1982	34800	no	34800	5000	39800	35015	7500	42515	2064	44579	81.1	5.3	86	0.44	524	387	516	1.21
1983	34625	no	34625	5000	39625	33854	7500	41354	5413	46767	89.0	19.3	108	0.54	464	281	432	1.04
1984	34925	no	34925	5000	39925	33741	7500	41241	2142	43383	85.0	6.9	92	0.53	485	311	472	0.98
1985	42120	no	42120	6120	48240	43896	7500	51396	3069	54465	109.4	10.4	120	0.63	470	294	455	1.04
1986	42120	no	42120	6120	48240	52634	7500	60134	2995	63129	129.2	6.5	136	0.69	466	464	465	1.09
1987	40120	no	40120	6120	46240	50720	6921	57641	6095	63736	136.6	12.2	149	0.56	422	498	428	1.36
1988	40120	no	40120	6120	46240	44159	10233	54392	5881	60273	150.1	12.6	163	0.71	362	466	370	1.02
1989	45245	no	45245	7520	52765	45198	13224	58422	7235	65657	176.4	16.9	193	0.96	331	428	340	0.82
1990	45245	no	45245	7520	52765	49554	13630	63184	6177	69361	206.3	15.4	222	1.07	306	402	313	0.78
1991	46225	no	46225	8500	54725	52834	16258	69092	6788	75880	228.7	21.6	250	1.19	302	315	303	0.76
1992	44200	no	44200	8500	52700	58664	20594	79258	7493	86751	232.9	16.6	249	1.24	340	452	348	0.83
1993	40600	no	40600	8500	49100	52280	17843	70123	5491	75614	206.1	13.2	219	1.09	340	415	345	0.83
1994	42300	no	42300	8500	50800	53693	18118	71811	4766	76577	209.6	17.6	227	1.17	343	271	337	0.78
1995	39500	no	39500	8500	48000	51900	16429	68329	2361	70690	186.9	7.0	194	0.99	366	337	364	0.85
1996	37890	26032	63922	8500	72422	49251	17359	66610	2632	69242	168.6	9.2	178	0.94	395	285	389	0.89
1997	38292	26308	64600	10200	74800	50483	13517	64000	517	64517	191.2	1.1	192	0.90	335	476	335	0.86
1998**	36000	24729	60729	7650	68379	55655	9515	65170	933	66103	159.2	2.9	162	0.82	409	325	408	0.97
1999**	40109	30891	71000	9350	80350	56724	17261	73985	2046	76031	170.1	3.9	174	0.88	435	521	437	1.03
2000***	40109	30891	71000	9350	80350	57774	20563	78337	1590	79927	161.3	1.9	163	0.83	486	837	490	1.15
2001***	45609	36391	82000	9350	91350	62550	19450	82000	1500	83500	169.1	2.2	171	1.00	485	683	487	1.00

\* The TAC's are actually confined to vessels below 79 GRT. These vessels fish almost exclusively in inshore areas.

\*\* Preliminary.

\*\*\* Projected.

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	1269	996	3948	5137	6348	6873	8841	7676	7335	8794	4097	2421
1988	1884	2357	2906	5982	6004	6277	7414	7463	7793	5866	4124	2204
1989	2036	2455	3520	6274	5241	8414	11406	8014	5767	6465	3459	2606
1990	3331	3493	4027	6841	7224	7141	7363	7493	6251	5662	6766	3768
1991	3258	2917	3300	3120	5220	7895	9419	8989	7487	8420	9069	6785
1992	3749	2786	4886	5442	6851	9062	10014	9225	9942	10835	8120	5837
1993	2158	2594	3561	4870	6282	6530	7031	8056	8255	11196	9412	5669
1994	3519	3176	5337	6972	5991	5851	8058	7732	9072	9841	6507	4521
1995	3105	4247	6175	8179	6600	6406	7065	7694	6782	6332	4907	3196
1996	3659	5324	6452	7484	7255	7195	7241	7629	7111	4881	2815	2196
1997	3342	5267	5051	5301	6277	6700	7806	6618	6305	5935	4236	1680
1998	7076	5258	4828	8168	8539	8598	8434	4096	4137	3086	2443	1440
1999*	4180	4627	6063	6659	7698	7027	9342	8075	6495	6287	5422	4157
2000*	3726	5413	6248	7507	7987	9354	9626	7051	6296	5483	6635	4600
2001*	3217	4248	4471	3565	3255	857	509	41				

\* Preliminary.

Table 3. Annual discard of shrimp and fish in tons and percent of total shrimp catch, and landed by-catch of *P. montagui* (tons) as reported in vessel logs from Subarea 1 1987-2001.

Year	<i>P. borealis</i>		Fish		<i>P. montagui</i> landed (tons)
	discard (tons)	discard (%)	discard (tons)	discard (%)	
1987	150	0.3	693	1.2	0
1988	169	0.3	865	1.6	0
1989	166	0.3	1072	1.8	0
1990	218	0.3	1030	1.6	0
1991	333	0.5	1686	2.4	0
1992	265	0.3	1771	2.2	0
1993	205	0.3	1566	2.2	0
1994	271	0.4	2179	3.0	4
1995	390	0.6	2167	3.2	471
1996	268	0.4	2213	3.3	634
1997	254	0.4	1919	3.0	336
1998*	257	0.4	1788	2.7	1026
1999*	161	0.2	1174	1.6	530
2000*	221	0.3	542	0.7	239
2001**	174	0.2	660	0.8	948

\* Preliminary

\*\* Projected

Table 4. 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 year	Catch ('000 tons)							Effort ('000 hr's)							CPUE (kg/hr)						
	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	6.9	6.7	64.1	1.5	0.1	0.0	0.0	253	585	454	283	91	-	-
1980	2.7	11.9	28.4	2.7	0.2	0.0	0.0	7.7	21.2	53.3	4.9	0.5	0.0	0.0	354	562	533	547	485	0	-
1981	5.3	4.7	30.5	4.3	0.0	0.0	0.0	18.4	11.2	66.4	10.4	0.1	0.0	0.0	288	416	459	415	333	-	-
1982	2.1	0.7	35.2	6.6	0.0	0.0	0.0	5.3	1.7	65.7	13.5	0.1	0.0	0.0	387	384	535	492	316	-	-
1983	5.4	0.4	32.9	7.6	0.4	0.0	0.0	19.3	0.9	69.5	17.8	0.9	0.0	0.0	281	455	474	430	432	0	500
1984	2.1	0.9	24.8	13.8	1.7	0.0	0.0	6.9	2.7	51.1	28.4	2.7	0.0	0.1	311	351	484	487	639	0	38
1985	3.1	5.0	29.9	12.6	3.8	0.0	0.0	10.4	15.8	62.2	24.3	7.1	0.0	0.0	294	318	481	519	544	-	-
1986	3.0	22.0	25.7	7.5	4.9	0.0	0.0	6.5	55.6	50.6	13.7	9.1	0.1	0.1	464	395	509	545	544	-	-
1987	6.1	16.2	35.0	5.8	0.7	0.0	0.0	12.2	56.5	67.1	10.2	2.8	0.0	0.0	498	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	466	242	415	403	226	0	124
1989	7.2	13.2	27.1	10.2	7.6	0.0	0.4	16.9	48.1	77.7	29.7	16.6	0.0	4.3	428	275	348	343	457	0	89
1990	6.2	9.9	24.6	18.4	9.9	0.0	0.4	15.4	42.3	77.9	54.4	28.9	0.0	2.8	402	234	316	339	341	0	134
1991	6.8	10.3	26.9	15.3	15.9	0.5	0.2	21.6	37.2	90.1	51.8	47.6	0.7	1.3	315	276	298	296	335	671	158
1992	7.5	13.2	26.7	16.1	18.8	4.0	0.5	16.6	49.4	76.2	47.8	50.7	7.4	1.3	452	267	350	337	370	538	398
1993	5.5	6.2	29.7	12.9	14.9	3.7	2.6	13.2	22.9	82.0	41.2	44.3	8.1	7.6	415	272	363	314	336	456	349
1994	4.8	5.9	27.4	13.0	16.2	5.9	3.4	17.6	23.4	83.8	40.7	42.6	10.0	9.2	271	254	327	318	381	593	369
1995	2.4	5.6	21.8	12.5	17.7	6.9	3.9	7.0	21.1	69.8	34.1	41.6	12.4	7.9	337	265	312	365	425	552	501
1996	2.6	4.4	18.3	13.9	19.0	6.7	4.3	9.2	18.7	52.0	35.9	40.8	12.0	9.1	285	238	351	387	465	555	474
1997	0.5	6.1	16.8	9.3	18.6	6.9	6.3	1.1	44.1	55.7	24.8	42.1	11.8	12.7	476	138	302	377	441	579	498
1998*	0.9	3.7	18.5	11.1	17.3	7.1	7.4	2.9	20.1	50.6	27.2	36.6	11.2	13.5	325	185	366	407	473	635	548
1999*	2.0	7.5	23.2	12.0	15.6	6.8	8.9	3.9	34.4	59.4	24.3	29.1	9.9	13.0	521	216	391	492	536	692	687
2000*	1.6	11.9	23.4	12.7	15.7	5.5	9.1	1.9	35.4	51.9	23.0	29.2	8.0	13.9	837	337	451	551	537	692	659
2001**	1.5	8.0	25.9	13.7	16.2	4.7	13.5	2.2	23.8	68.5	23.0	30.2	6.5	17.2	683	337	379	597	536	716	782

\* Preliminary.

\*\* Projected.

Table 5. Time series of the four standardized CPUE indices included in the combined CPUE index for NAFO Subarea 1 + Div. 0A. Estimates based on data until July 2001.

Year	1BCD		KGH		Small ves.		0A		Combined	
	mean	se	mean	se	mean	se	mean	se	mean	se
1976	-	-	1.66	0.15	-	-	-	-	1.23	-
1977	-	-	1.56	0.09	-	-	-	-	1.15	-
1978	-	-	1.23	0.07	-	-	-	-	0.91	-
1979	-	-	1.11	0.07	-	-	-	-	0.83	-
1980	-	-	1.34	0.08	-	-	-	-	0.99	-
1981	-	-	1.27	0.07	-	-	1.06	0.11	0.95	-
1982	-	-	1.61	0.10	-	-	1.39	0.17	1.21	-
1983	-	-	1.42	0.09	-	-	1.01	0.10	1.04	-
1984	-	-	1.34	0.08	-	-	0.97	0.13	0.98	-
1985	-	-	1.43	0.08	-	-	0.91	0.17	1.04	-
1986	-	-	1.49	0.09	-	-	1.04	0.13	1.09	-
1987	1.85	0.06	1.79	0.11	-	-	1.41	0.11	1.36	-
1988	1.19	0.03	1.47	0.09	1.29	0.06	1.27	0.12	1.02	-
1989	1.03	0.02	1.09	0.07	1.03	0.04	0.97	0.07	0.82	-
1990	1.00	-	1.00	-	1.00	-	1.00	-	0.78	-
1991	0.98	0.02	-	-	0.88	0.03	0.93	0.07	0.76	-
1992	1.08	0.02	-	-	0.92	0.03	1.08	0.07	0.83	-
1993	1.05	0.02	-	-	1.02	0.03	1.02	0.07	0.83	-
1994	1.05	0.02	-	-	0.87	0.02	0.73	0.05	0.78	-
1995	1.17	0.02	-	-	0.87	0.03	0.81	0.08	0.85	-
1996	1.25	0.03	-	-	0.84	0.03	0.75	0.06	0.89	-
1997	1.21	0.03	-	-	0.85	0.03	0.63	0.12	0.86	-
1998	1.33	0.04	-	-	1.01	0.04	0.93	0.15	0.97	-
1999	1.42	0.04	-	-	1.00	0.03	1.09	0.11	1.03	-
2000	1.52	0.05	-	-	1.32	0.04	1.22	0.14	1.15	-
2001	1.29	0.08	-	-	1.19	0.06	1.12	0.18	1.00	-

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.

<b>Mean size</b>											
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Cpl (mm)	23.5	23.5	22.9	22.3	21.8	21.9	21.2	21.2	21.1	21.6	21.3
Weight (g)	8.4	8.5	8.4	7.8	7.6	7.2	6.5	6.6	6.2	7.4	6.5
Count (no/kg)	119	118	119	128	132	140	154	151	160	134	154
<b>Proportion of total catch</b>											
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Males	46%	33%	51%	56%	64%	64%	64%	66%	64%	54%	62%
Primi	9%	3%	1%	11%	15%	9%	12%	8%	12%	15%	7%
Multi	45%	63%	48%	33%	21%	27%	24%	26%	24%	30%	31%
Females total	54%	67%	49%	44%	36%	36%	36%	34%	36%	46%	38%
<b>Number caught (millions)</b>											
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Males	4188	3388	4560	5502	5971	6243	6368	6583	7809	5801	8039
Primi	825	350	96	1067	1384	824	1197	835	1438	1648	896
Multi	4031	6493	4370	3217	1962	2614	2363	2583	2891	3248	3943
Females Total	4856	6843	4466	4284	3347	3438	3560	3418	4329	4895	4839
Total	9044	10231	9026	9786	9317	9681	9928	10001	12138	10696	12877
<b>Abundance index</b>											
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Males	1.0	0.8	1.2	1.3	1.7	1.9	2.0	2.3	2.5	2.0	2.3
Primi	1.0	0.4	0.1	1.3	2.0	1.3	1.9	1.5	2.4	2.9	1.3
Multi	1.0	1.5	1.2	0.8	0.6	0.8	0.8	0.9	1.0	1.2	1.2
Females total	1.0	1.3	1.0	0.9	0.8	0.9	1.0	1.0	1.2	1.5	1.2

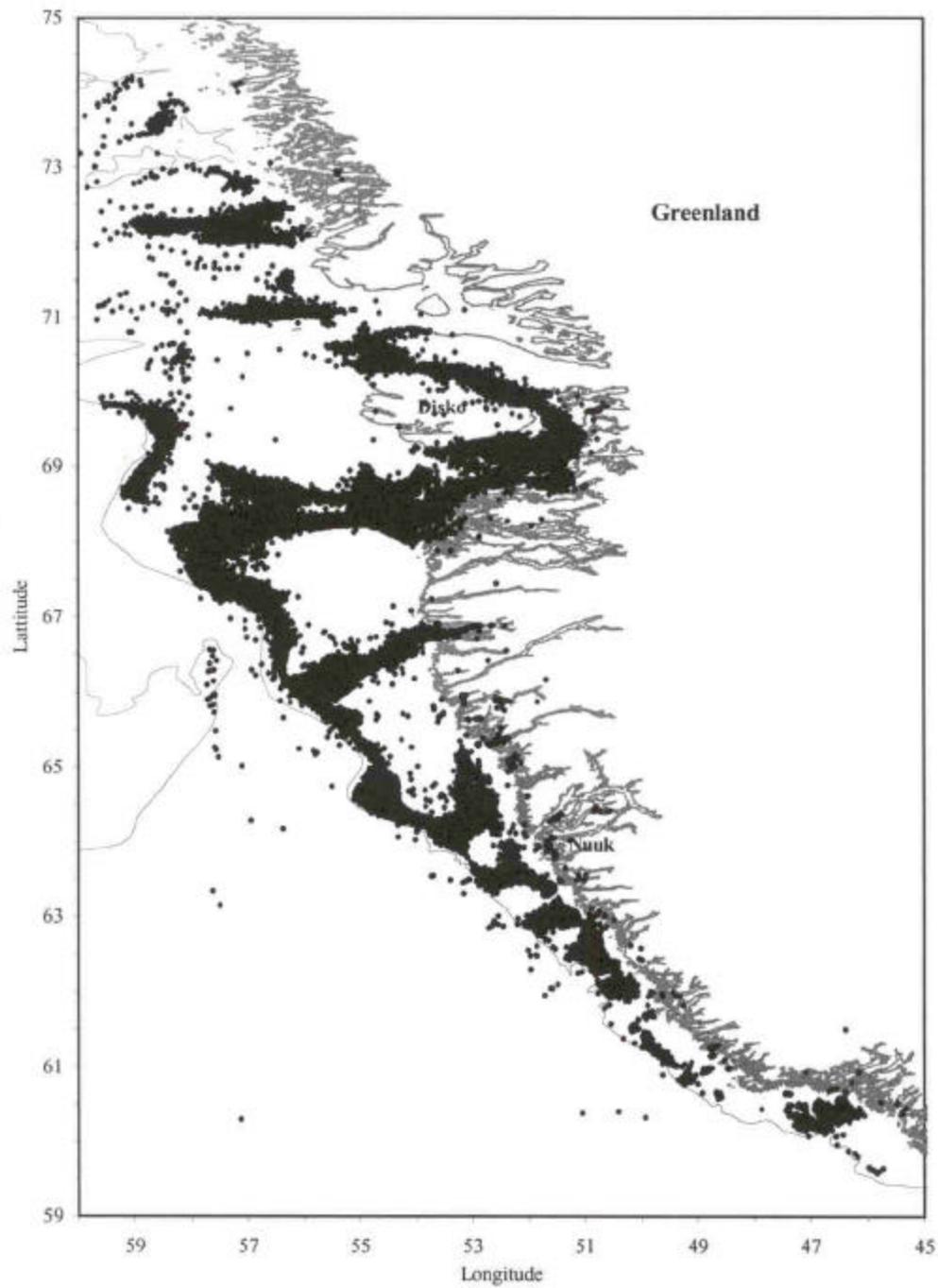


Fig. 1. Distribution of hauls by Greenlandic shrimp trawlers fishing off West Greenland, based on available logbooks 1975-2001. The fishery by Canadian vessels occurs in a small area extending from about  $67^{\circ}20'$  to  $68^{\circ}45'$  and  $58^{\circ}$  to  $59^{\circ}30'$  between the international boundary to the east and the 500 m depth contour to the west (Parsons and Veitch, 1998). 600 m depth contour is shown as the bold line.

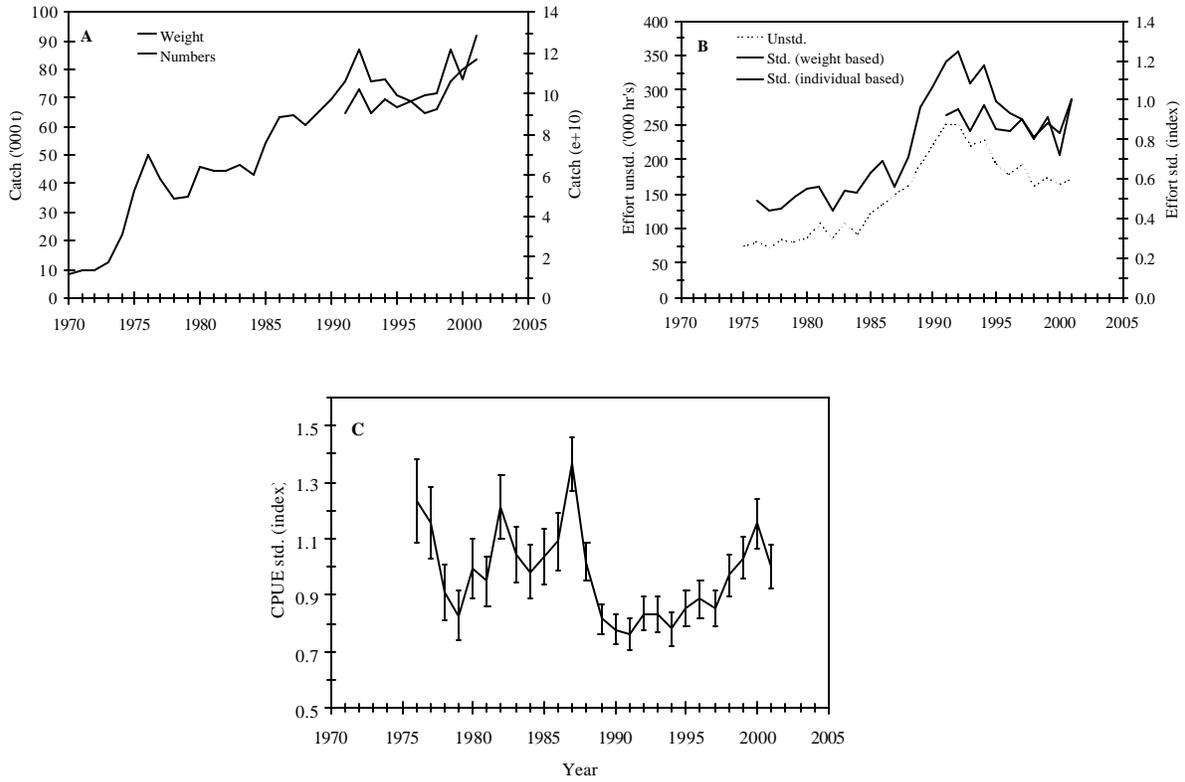


Fig. 2. Total catch (A), standardized and unstandardized effort (B) and standardized CPUE indices (C) of the shrimp fishery in NAFO SA 1 + Div. 0A. Catch for 2001 are projected from November to the end of the year. Estimates of effort and CPUE are based on data series until July 2001.

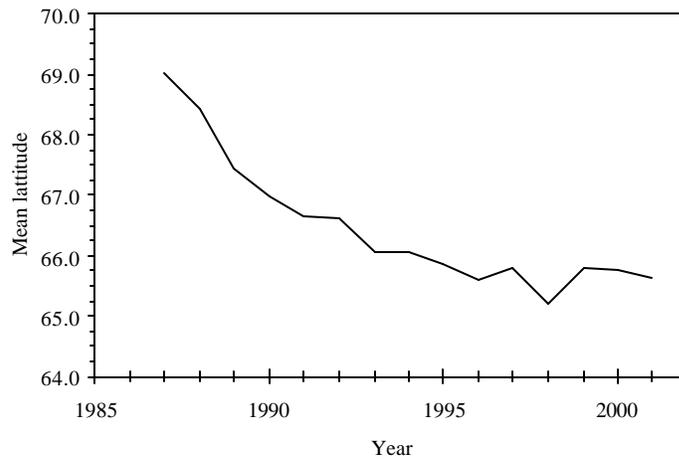


Fig. 3. Mean latitude (°N) of allocated effort by vessels fishing offshore in Subarea 1, 1987-2001.

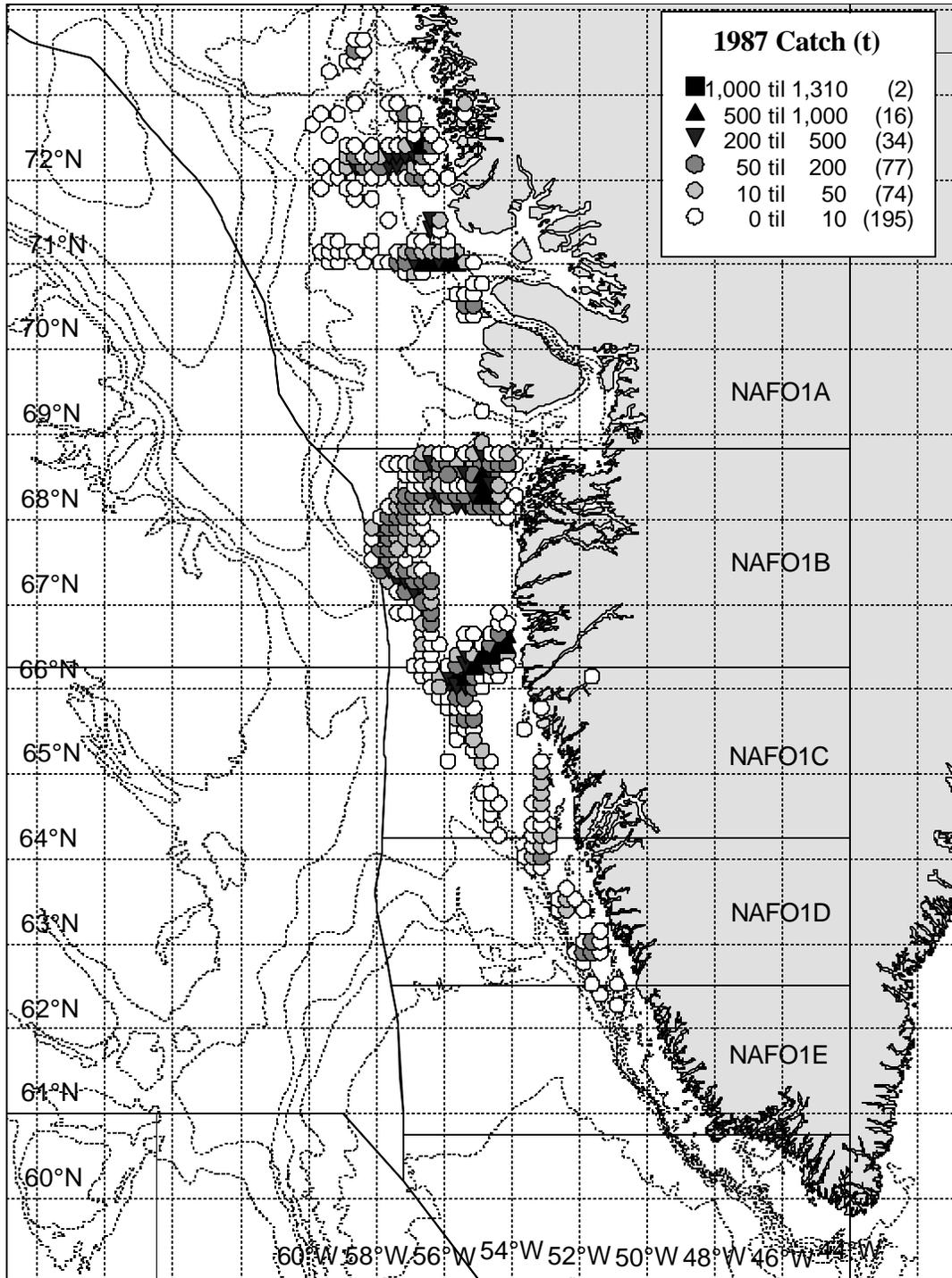


Fig. 4A. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1987.

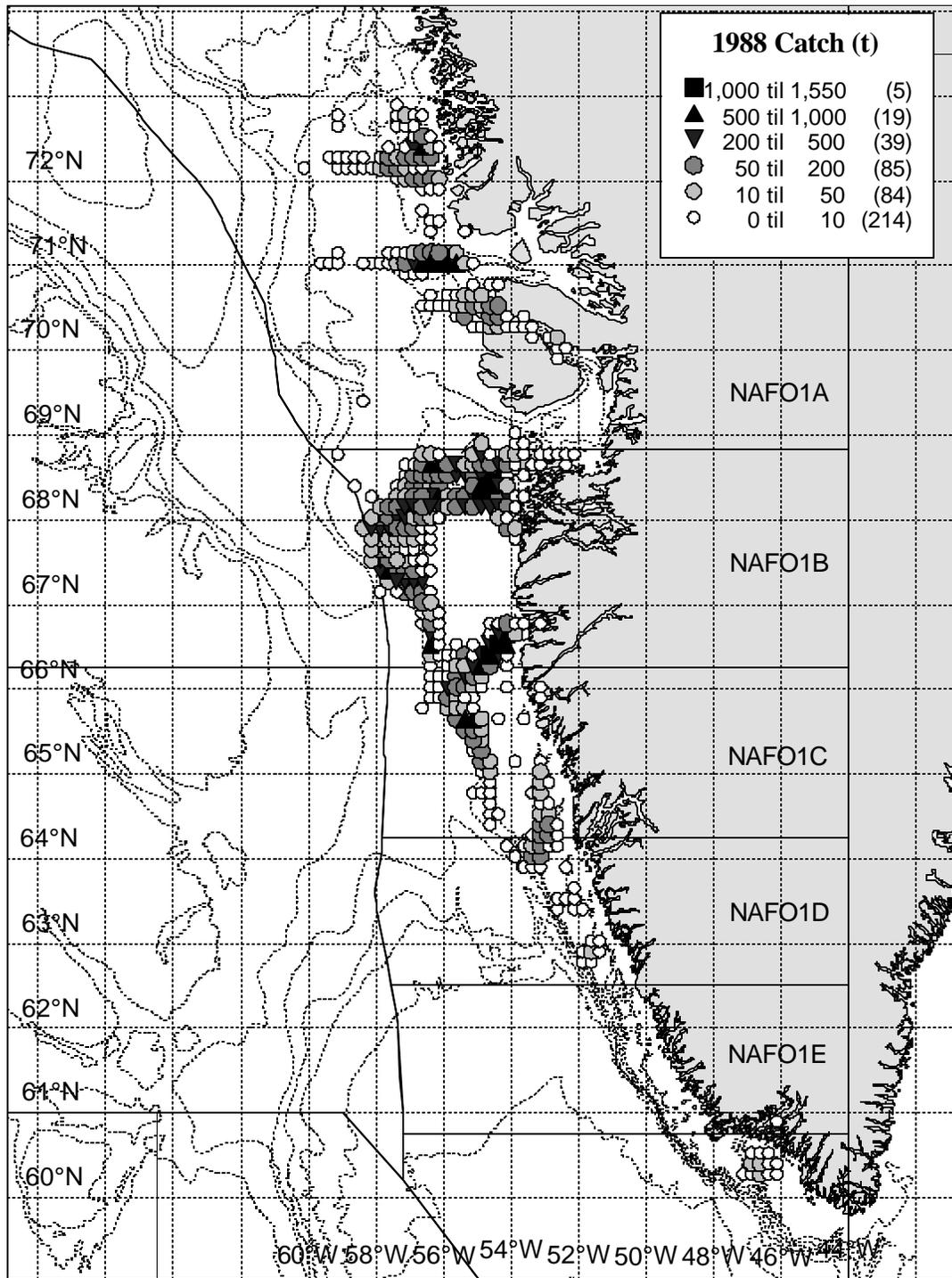


Fig. 4B. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1988.

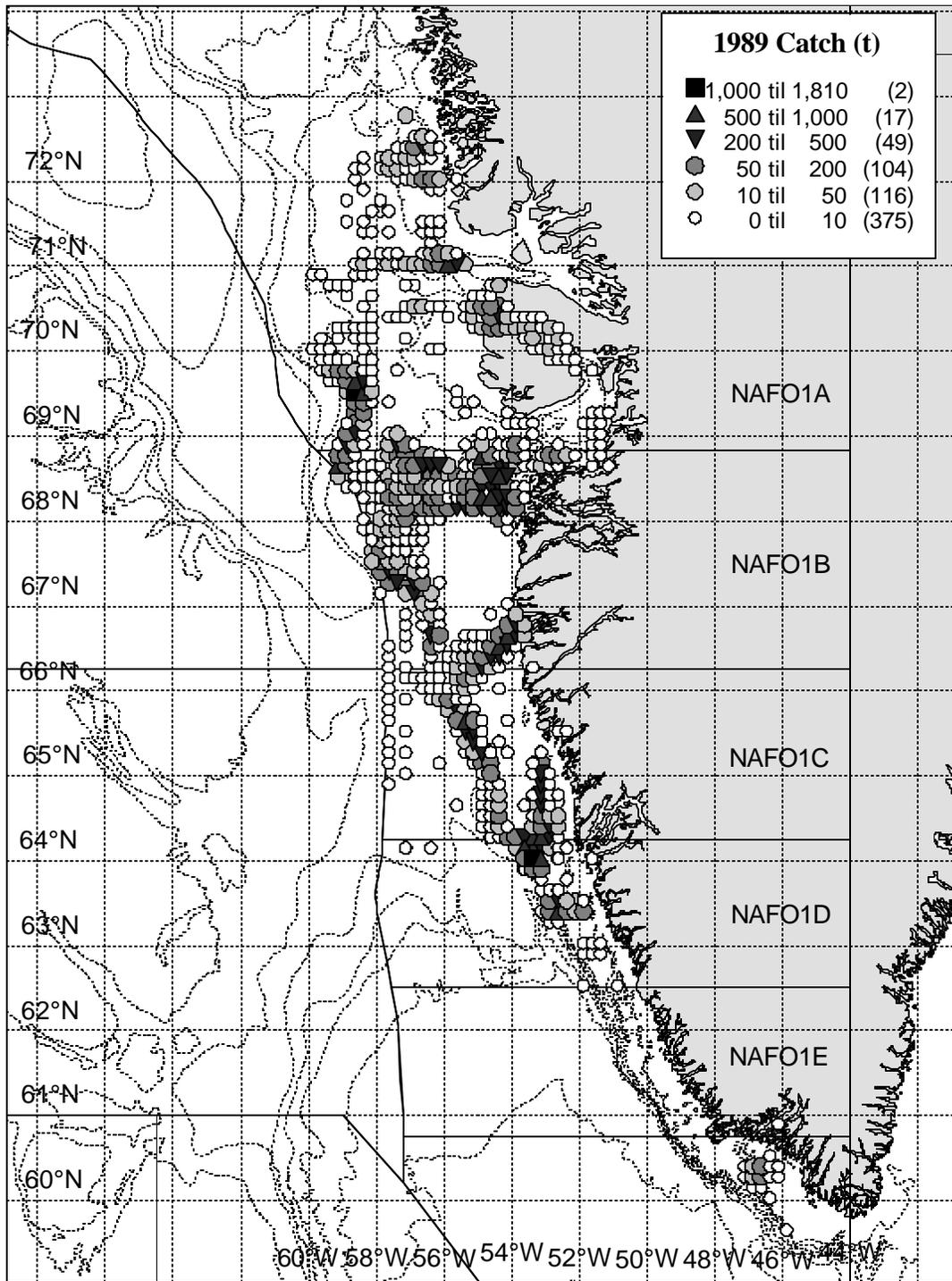


Fig. 6C. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1989.

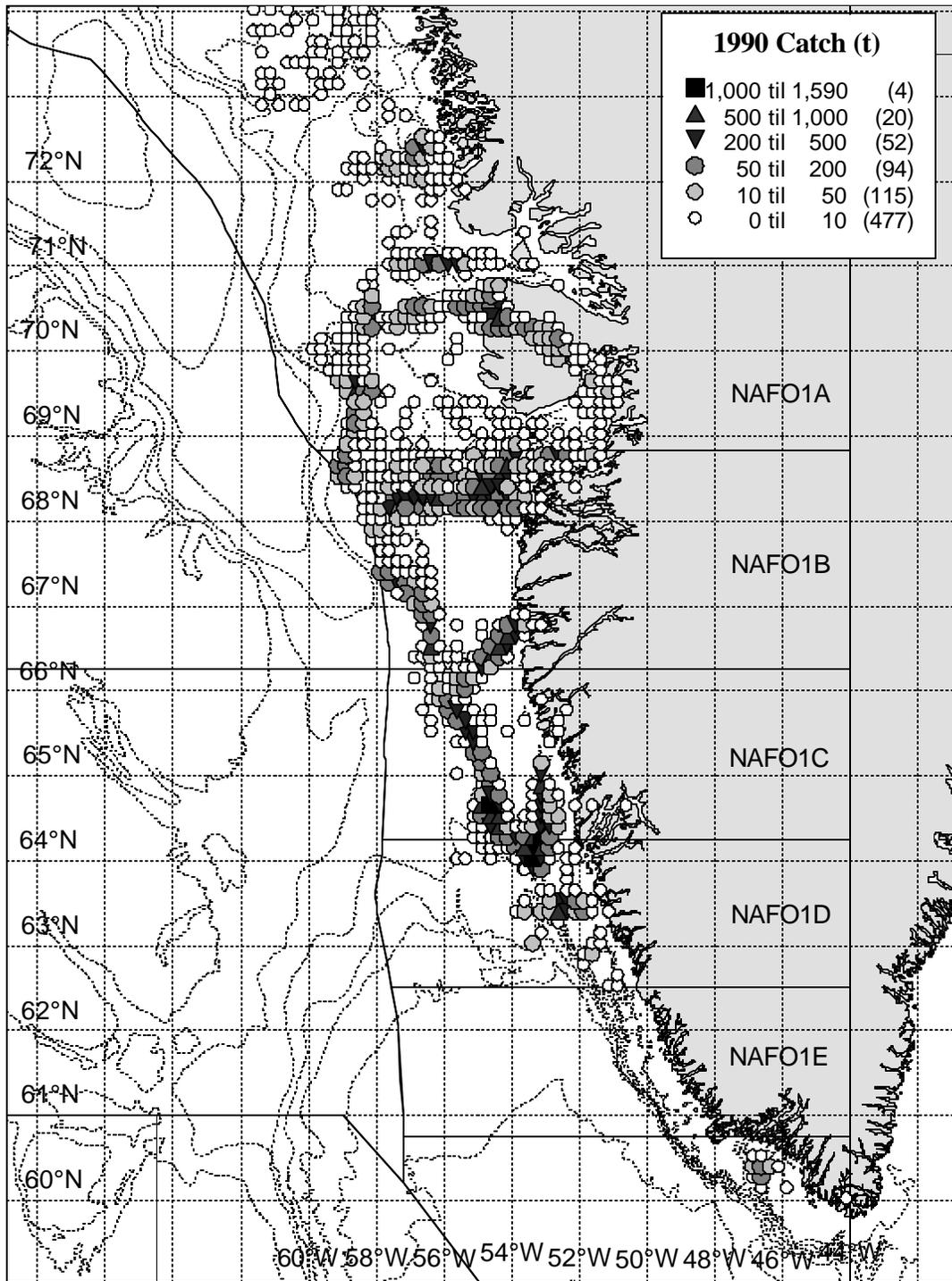


Fig. 4D. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1990.

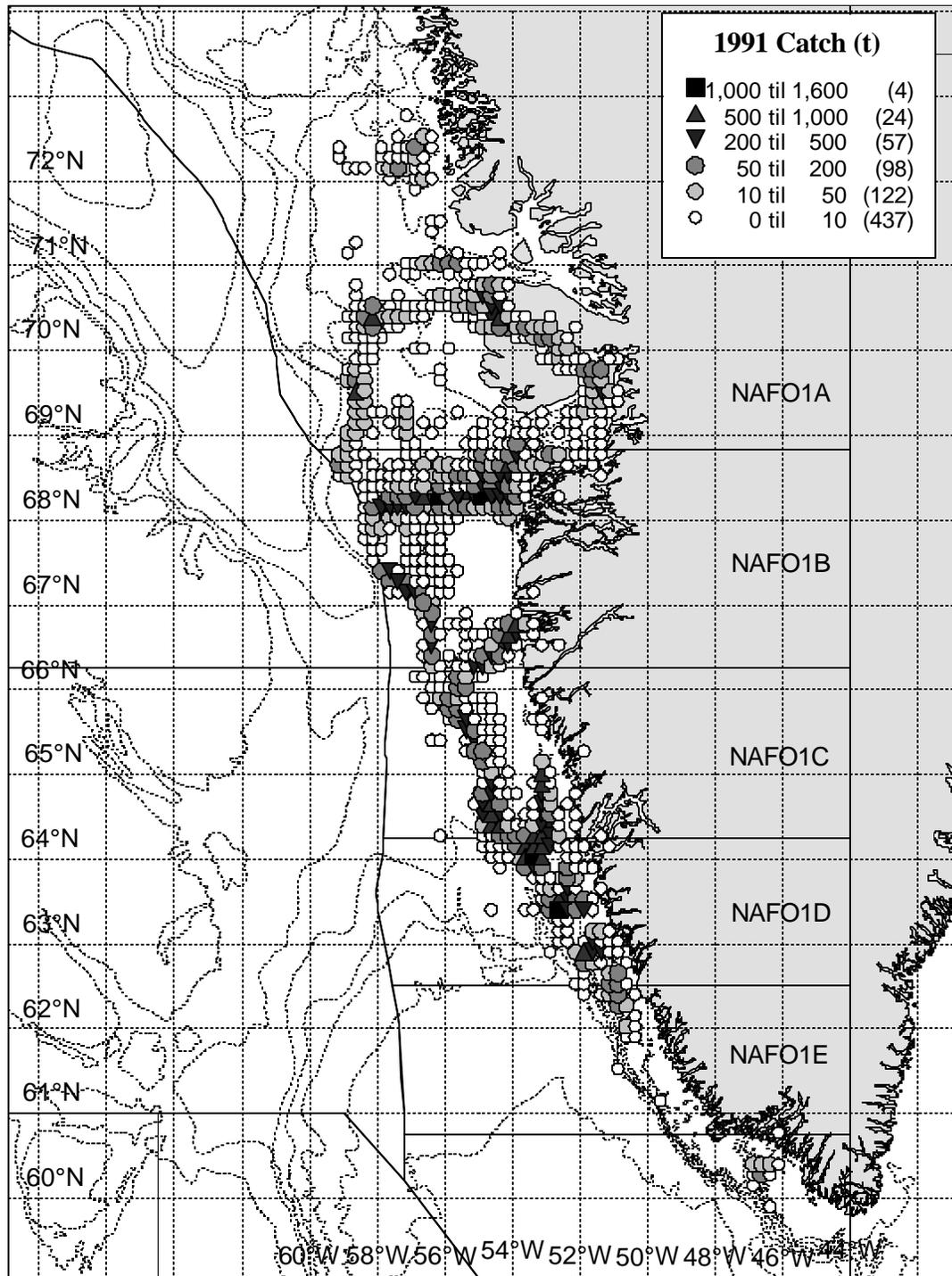


Fig. 4E. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1991.

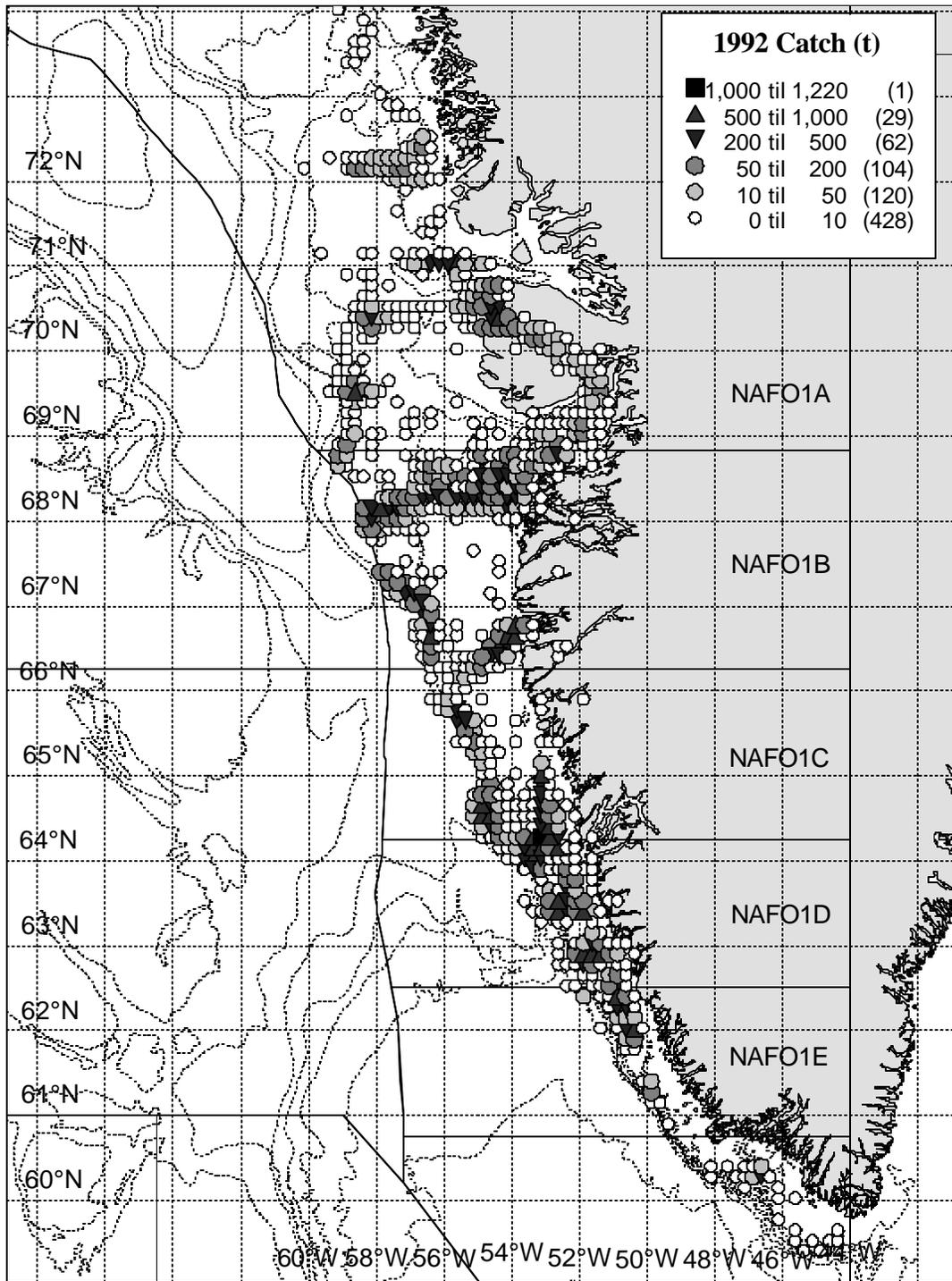


Fig. 4F. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1992.

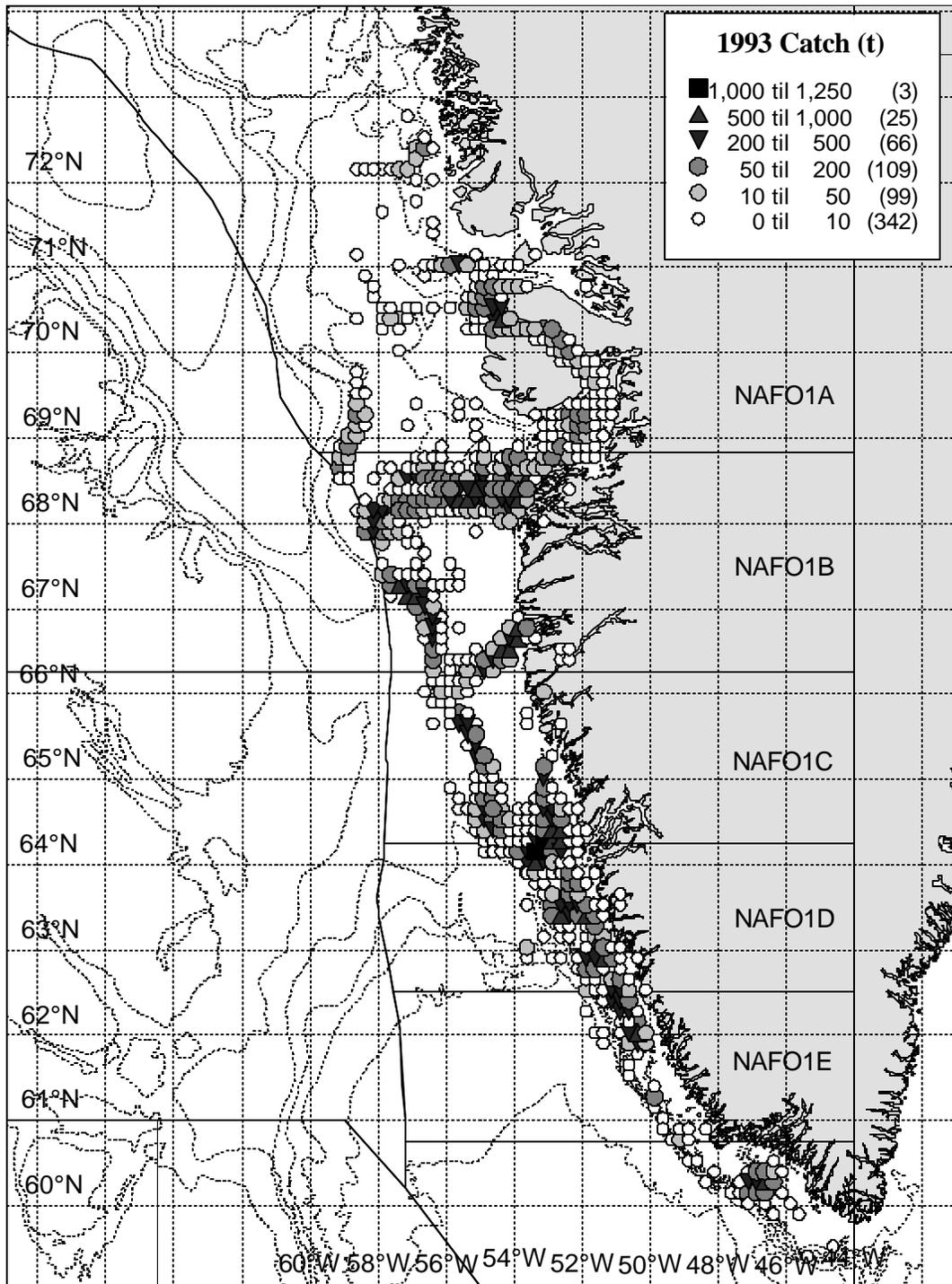


Fig. 4G. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1993.

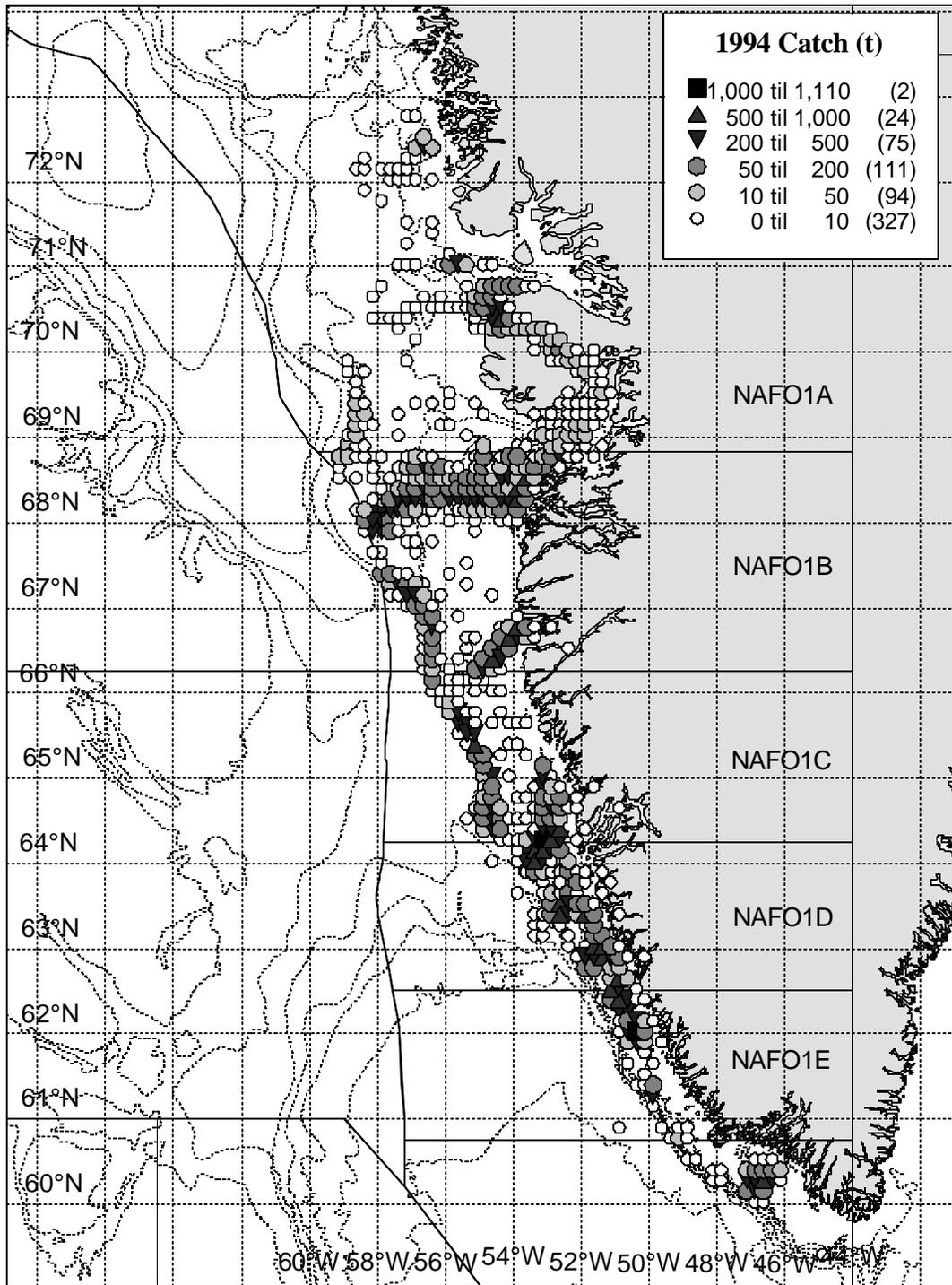


Fig. 4H. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1994.

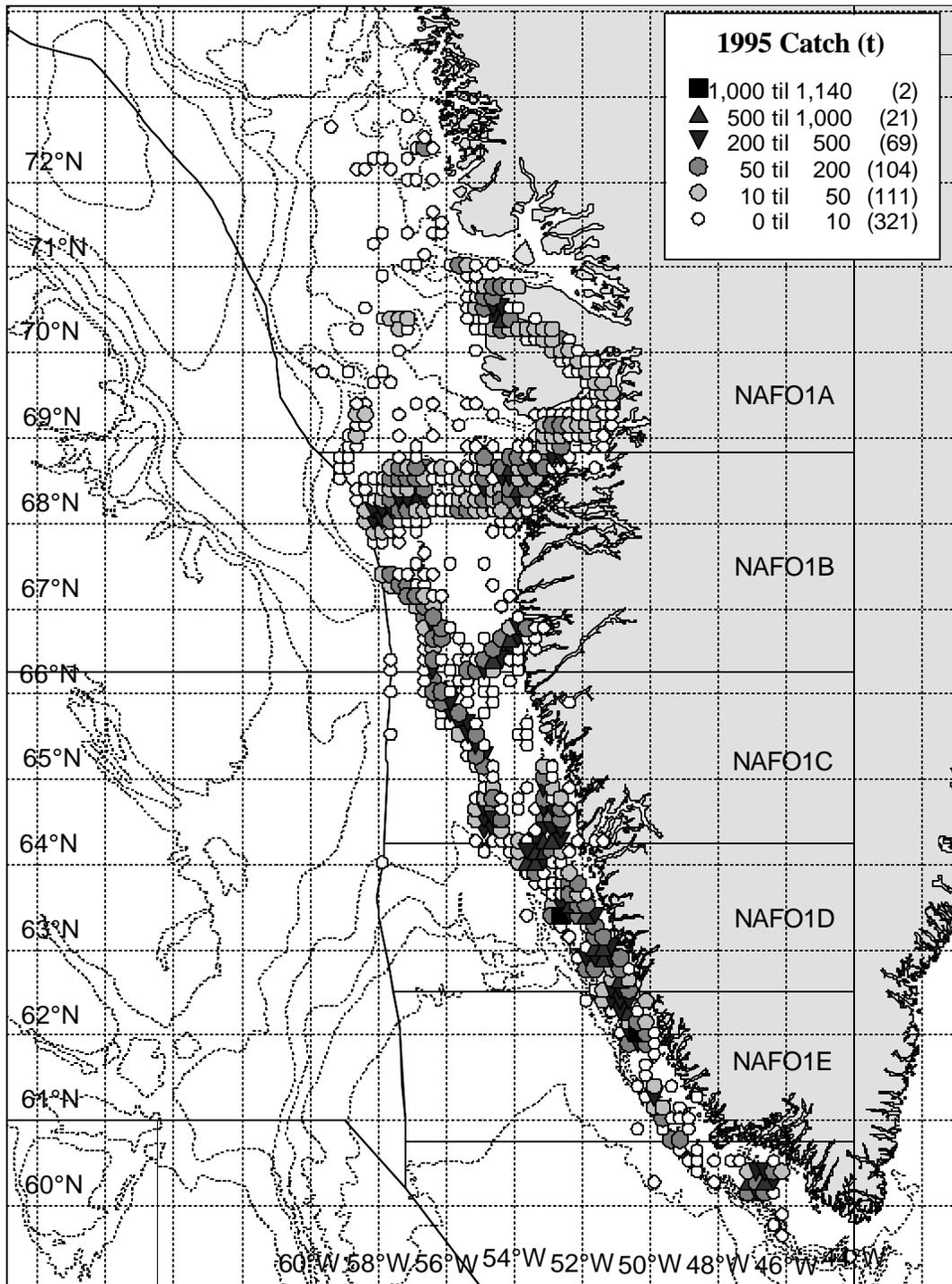


Fig. 4I. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1995.

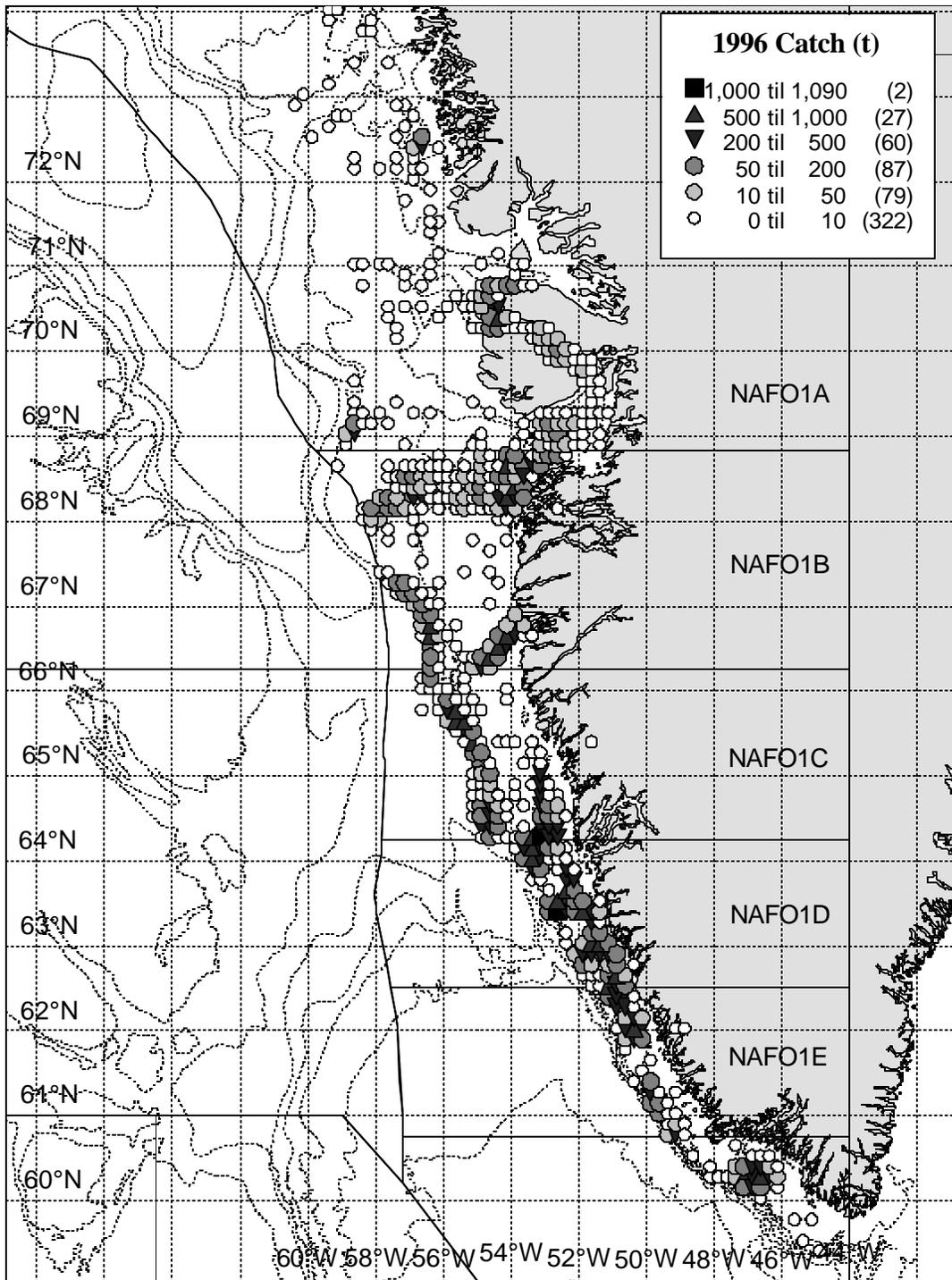


Fig. 4J. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1996.

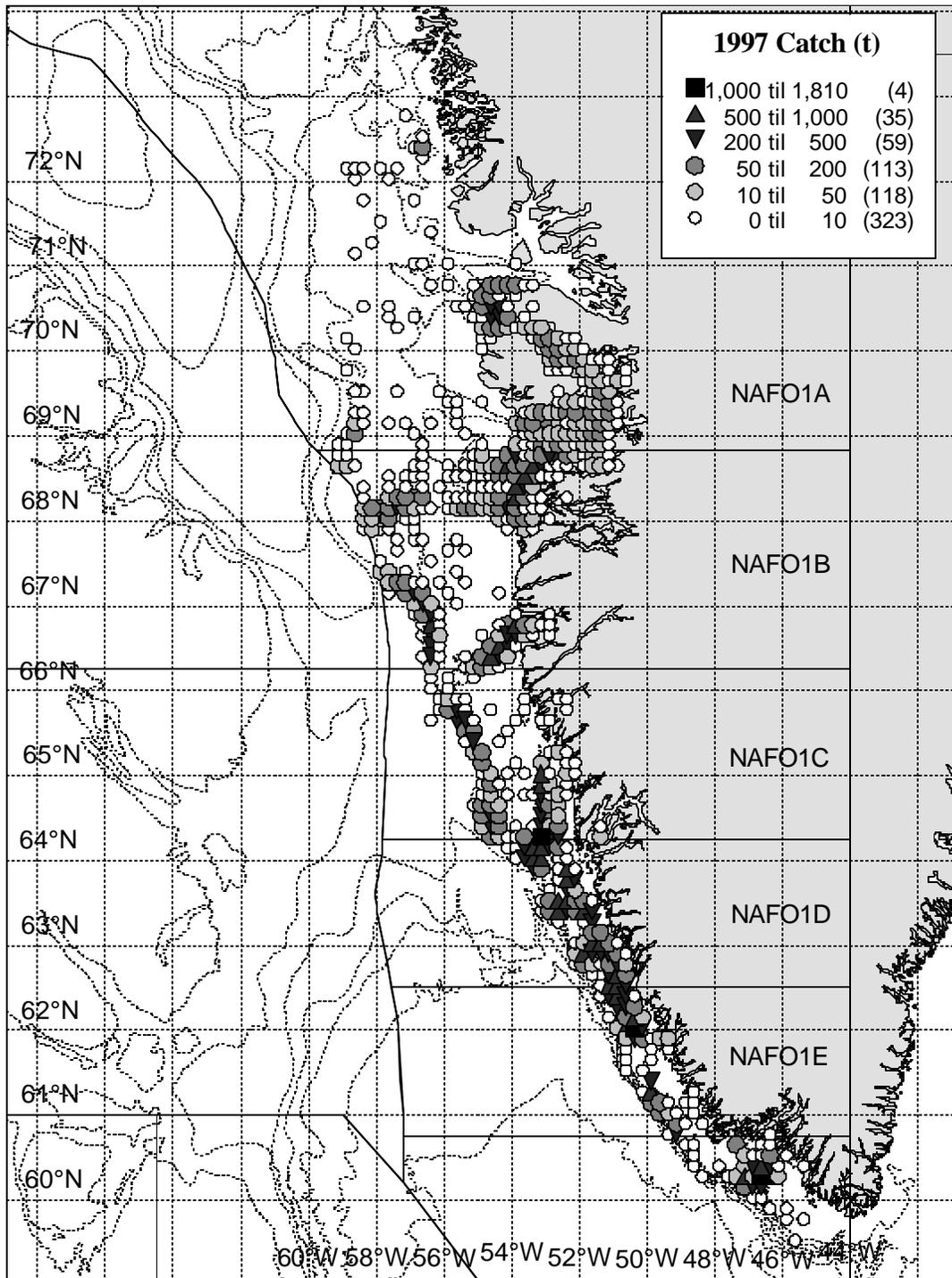


Fig. 4K. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1997.

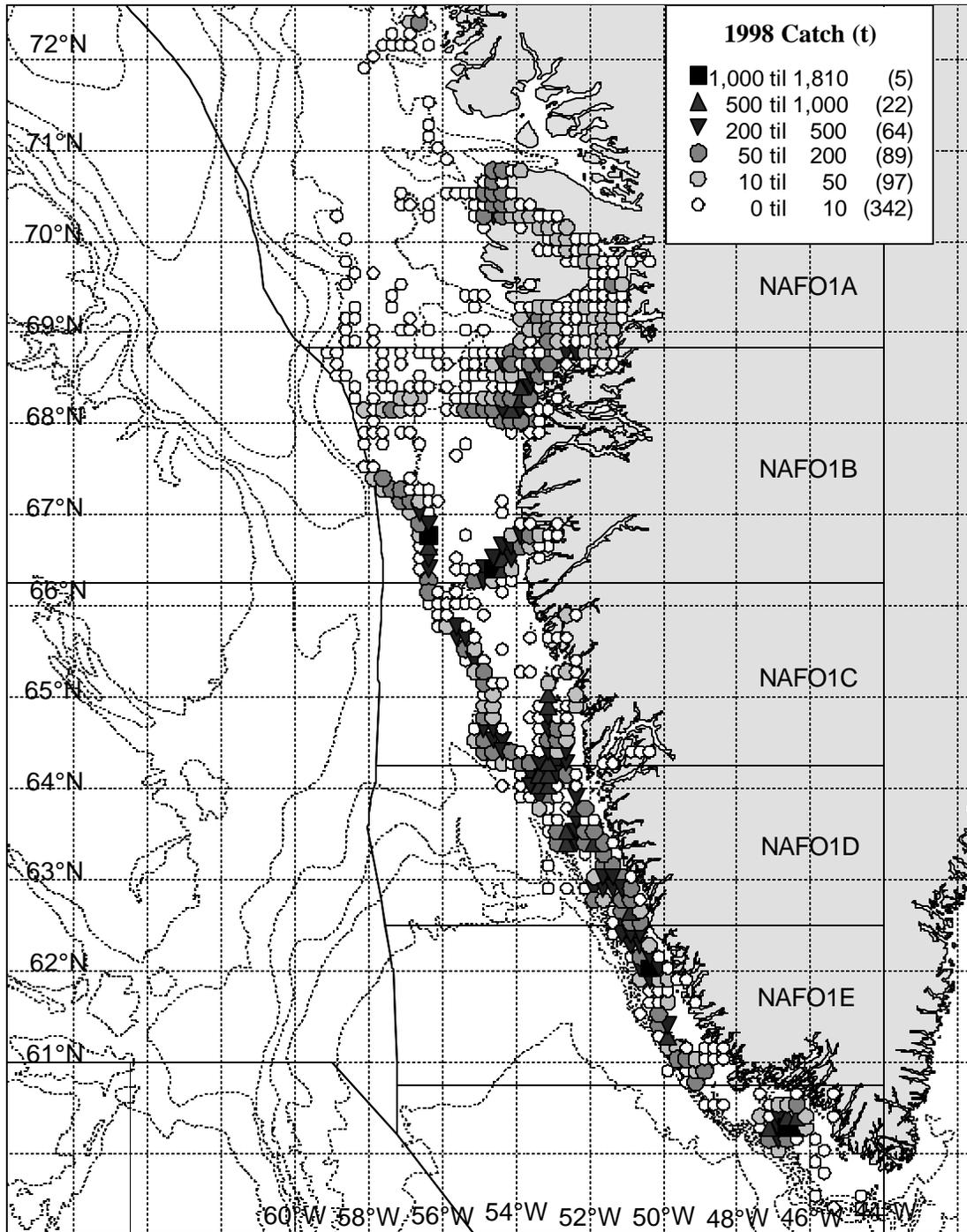


Fig. 4L. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1998.

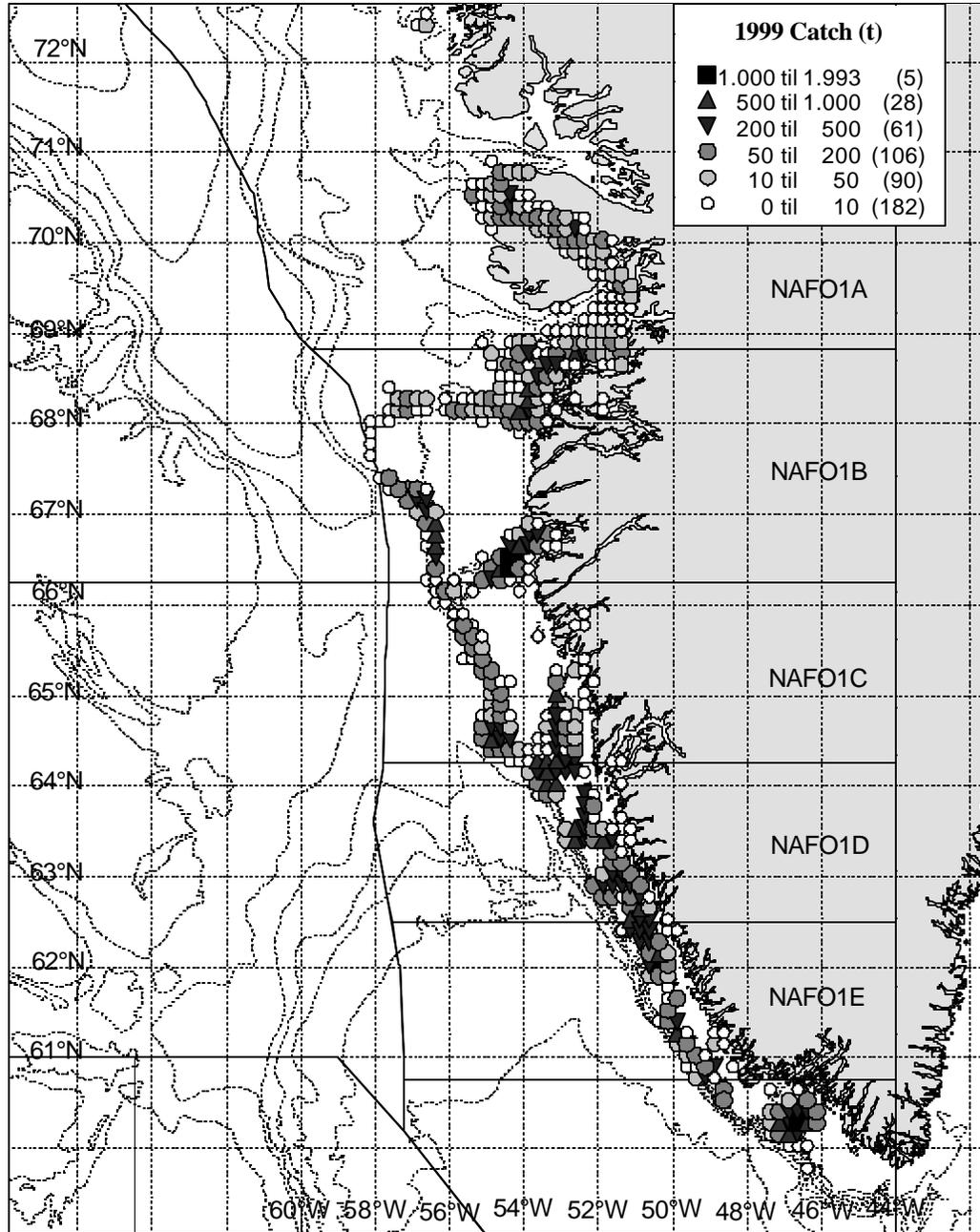


Fig. 4M. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 1999.

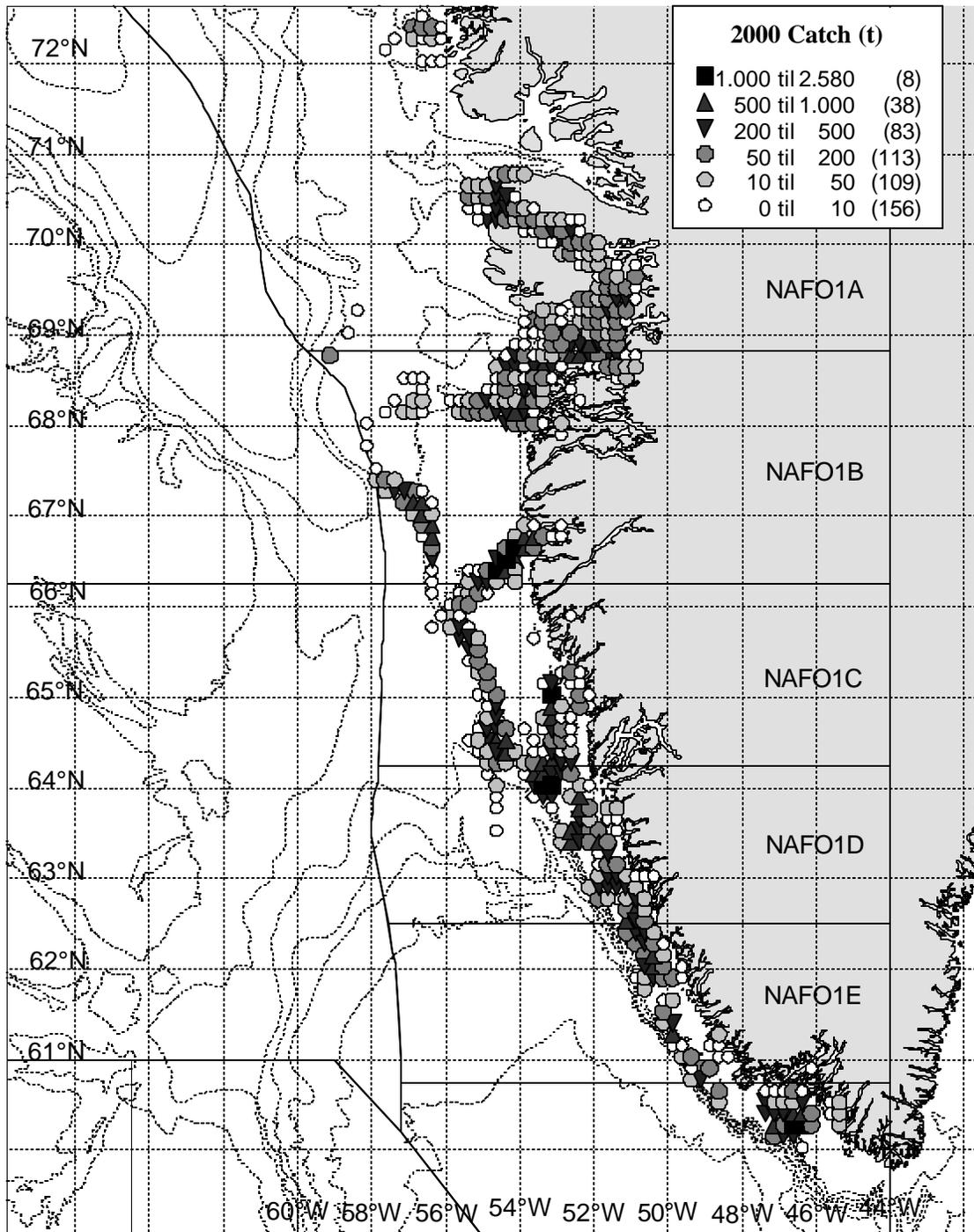


Fig. 4N. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 2000.

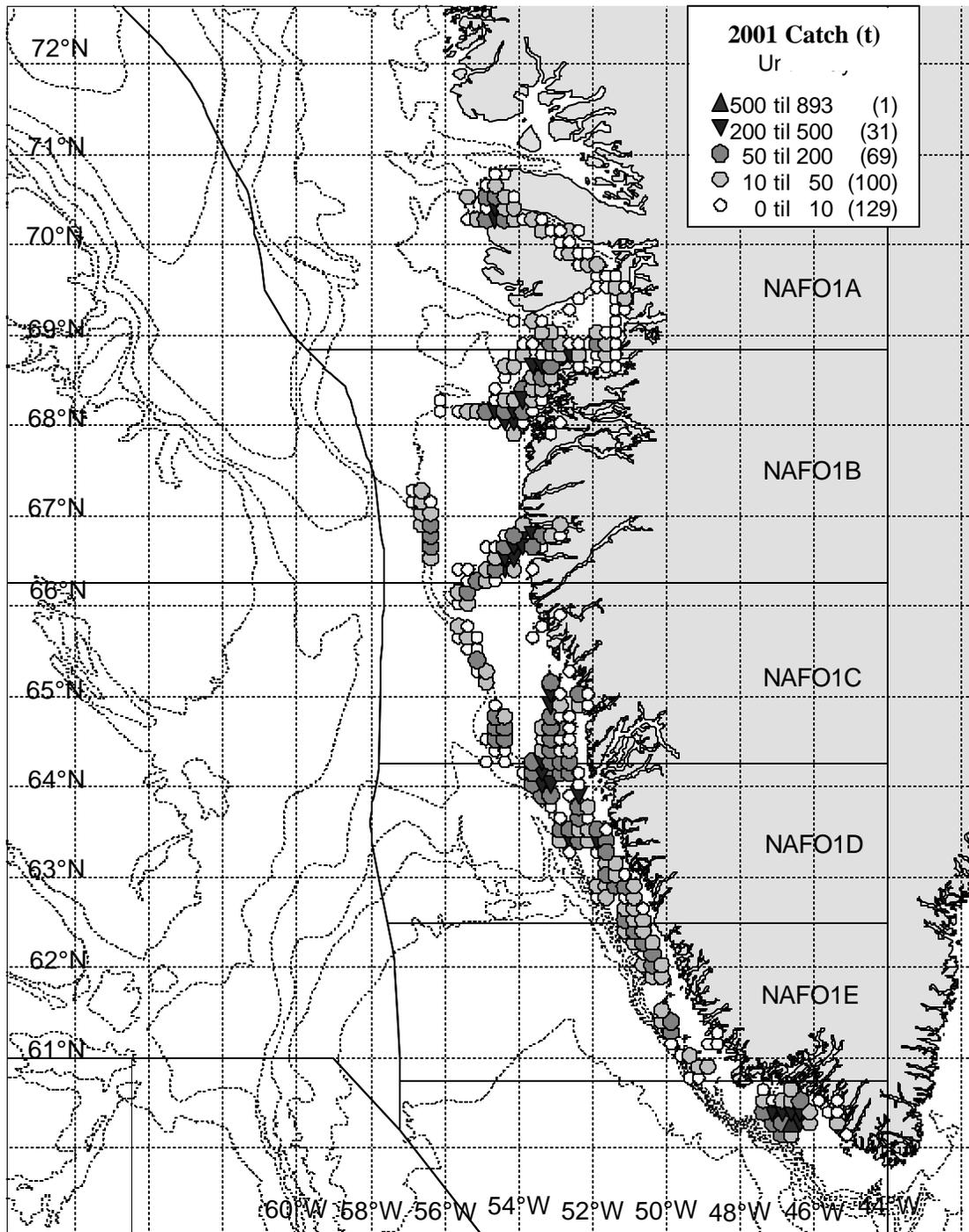


Fig. 40. Spatial distribution of the Greenlandic shrimp catches in Subarea 1, 2001 until July.

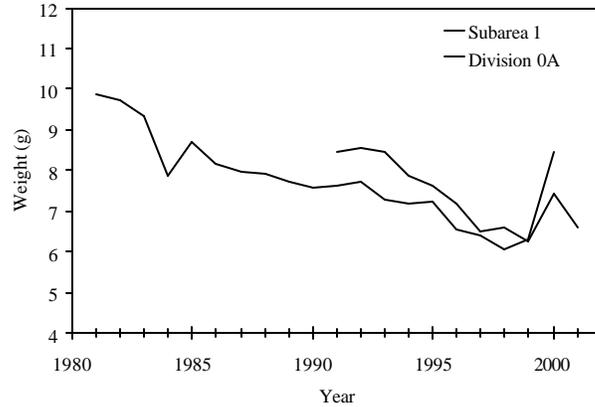


Fig. 5. Mean shrimp size (g) in catches in Subarea 1, 1991-2001, and Division 0A, 1981-2000.

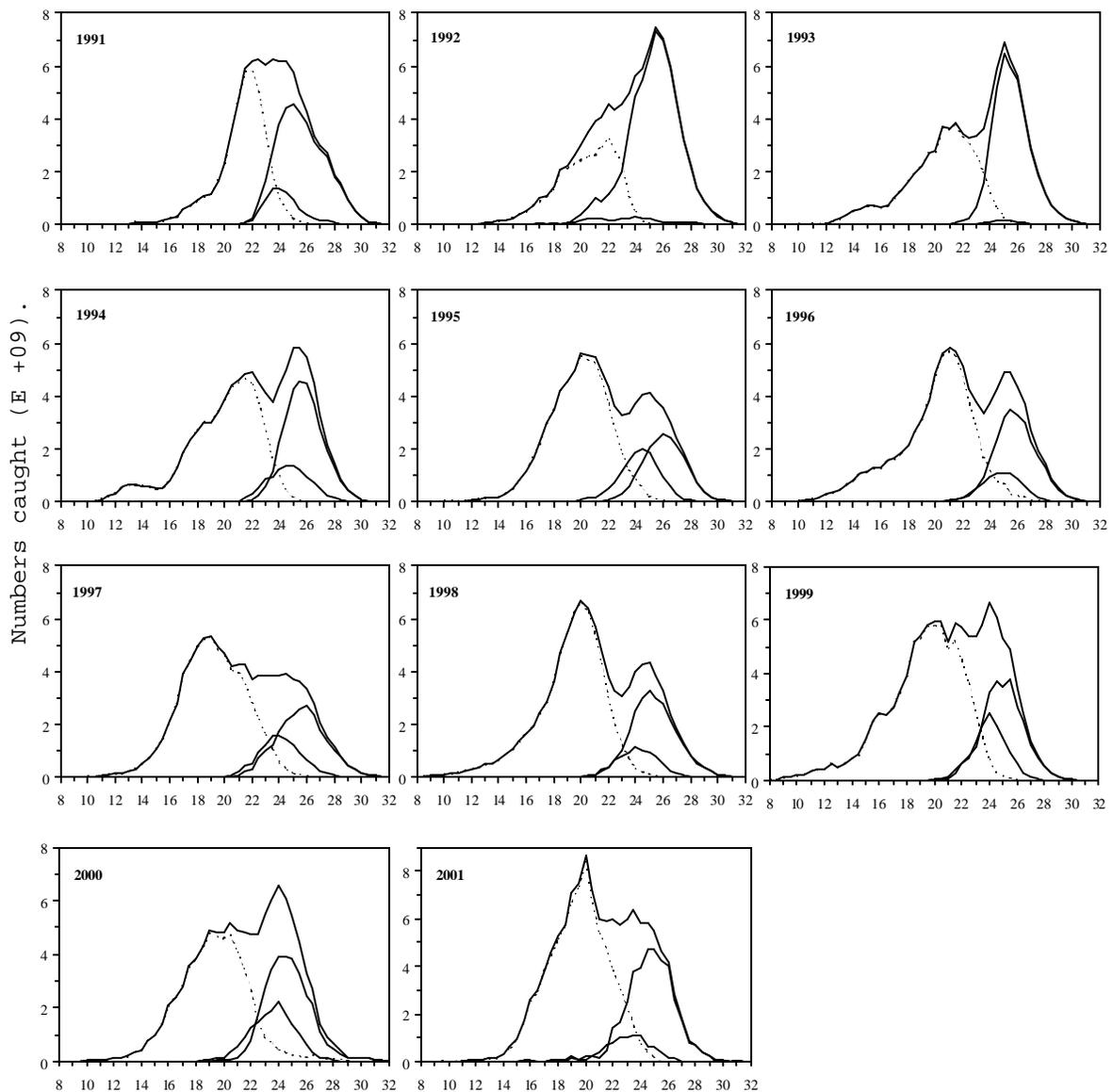


Fig. 6. Length frequency distributions of commercial shrimp catches in Subarea 1 and Div. 0A, 1991-2001. The distribution of male shrimp is shown by a dotted line, primiparous and multiparous each as a thin line where the primiparous is distinguished as the smallest component of the two. The sum, i.e. the total distribution, is shown by a bold line.

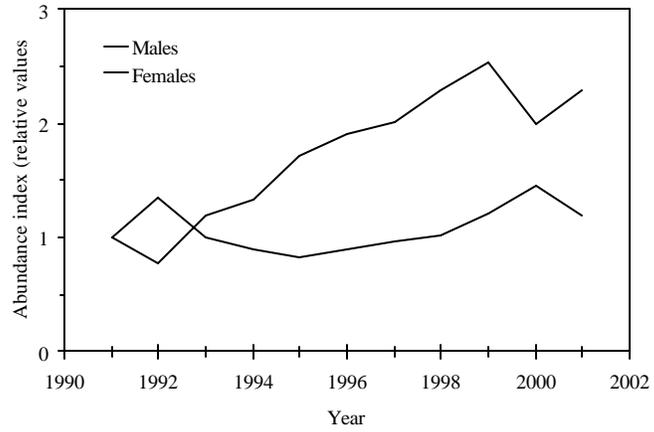


Fig. 7. Standardized CPUE indices of the male and female component of the West Greenland shrimp stock 1991-2001, both standardized to their value in 1991 (data from Table 6).