Northwest Atlantic Fisheries Organization

Serial No. N2806 NAFO SCR Doc. 96/109

SCIENTIFIC COUNCIL MEETING - NOVEMBER 1996

The Greenland Fishery for Northern Shrimp (*Pandalus borealis*) in Davis Strait in 1995 and January-October 1996

by

C. Hvingel, H. Siegstad and O. Folmer

Greenland Institute of Natural Resources
Box 570, DK-3900 Nuuk, Greenland

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, this stock is assessed as a single population.

In Subarea 1 two Greenlandic fleet components, named the offshore- and the small-vessel fleet exploit the stock. The distinction is based on vessel size. Vessels above 75 GRT belong, by definition, to the offshore fleet and are restricted to offshore areas and by quotas. An exception from the "offshore-only" rule applies to eight 79 GRT vessels, which also have a small quota in inshore areas. Vessels below 75 GRT belong to the "small-vessel fleet" which are unrestricted by areas and quotas.

Since 1986 logbooks have been mandatory for all vessels above 50 GRT fishing in Greenland waters. Catch from vessels below 50 GRT can only be estimated from sales slips. Logbooks from the small-vessel fleet component between 50- and 75 GRT are considered incomplete until 1990.

Trawlers above 75 GRT in 1995 reported a total catch in Subarea 1 of 42,919 tons including 2,173 tons taken in the inshore areas. Catches of smaller vessels in 1995 are estimated to 25,362 tons, of which about 14,256 tons were taken in the inshore area. This brought the total catch by Greenland vessels in 1995 up to 68,329 tons in Subarea 1, a decline of about 3,000 tons compared to the year before.

The reported catches by the offshore fleet in 1996 until October totalled 37,009 tons, of which 2,210 tons were taken inshore. Catches by the small-vessel fleet until September amounted to 15,992 tons, of which 8,323 tons were taken inshore. This sums to a preliminary total catch in 1996 of 52,999 tons which is at the same level as the 1995 catch at the same time of the year.

The present paper updates information on reported catch and effort of the two fleet components and the allocation of the inshore/offshore catch for the years 1990-1996. Geographical distribution, standardized and unstandardized catch rates and size composition of the commercial catches are also compared and presented.

Materials and methods

Based on compulsory weekly reporting to Greenland authorities by vessels above 75 GRT, total catch and number of vessels in the shrimp fishery in NAFO Subarea 1 in 1995 and the first three quarters of 1996 were compiled by nation and month.

Logbook data were analysed to show the spatial distribution of the fishery and the overall distribution of catches by year, and of catch, effort and catch rates by month.

Total landings from vessels below 75 GRT were allocated to inshore/offshore areas, based on information from logbooks and sales slips.

CPUE data from Greenland vessels above 50GRT were used in multiplicative models to calculate standardized annual catch rate indices.

Four time series of standardized CPUE indices exist including both the offshore and small vessel component. The derivation of the models along with the resulting time series up to and including 1995 are described in Hvingel, Lassen and Parsons (1996). All models include a Vessel, Month, Area and Year effect.

The current year's indices (1996) were estimated by the models presented by Hvingel *et al.* (1996) using their estimated mean effects in a back calculation procedure. Thus, the index values were fixed at the 1995 level. The calculated 1996 indices were then combined and added to the integrated SA 0+1 index series as also described in Hvingel *et al.* (1996). Standardized effort was calculated by dividing total nominal catches with CPUE's as estimated by the combined index using 1995 as a reference year.

Annual size composition of shrimp catches were generated from samples from the commercial fishery (offshore fleet). Before processing samples taken by observers 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 reported in vessel logs. The numbers from all months and areas were totalled and adjusted by weight to the total catch of the year.

The annual length frequency distributions of total catches in Subarea 1 were analysed by modal analysis (McDonald & Pitcher, 1979) to isolate year classes and determine their proportions.

The number of age components in the catch and initial estimates of their mean lengths were based on the findings of Savard *et al.* (1994). The iterations were run with all coefficients of variations held a fixed value of 0.048 (Parsons & Veitch, 1991). A catch-at-age table was produced by multiplying proportions and total number caught. Age specific indices of abundance were then calculated by dividing the numbers caught at age by the standardized effort.

Results and Discussion

Geographical distribution the fishery 1995-October 1996.

Figures 1 and 2 show the geographical distribution of the Greenland catches by statistical units of 7.5' latitude and 15' longitude in 1995 and 1996 respectively as recorded in vessel logs.

Like previous years the fishery in 1995-96 was widespread over the fishing grounds. Most catch was taken in Div. 1B, C and D (>75%). The preliminary catch figures for 1996 do not suggest any significant changes in the distribution of the fishery from 1995 to 1996. However, the north-western corner of Div. 1B, north of 68° and west of 56°, has received much less attention in 1996 than in the previous years. Furthermore a continuation of earlier years southwards displacement of the fishery is indicated (see Hvingel, 1996).

Figure 3 shows the monthly distribution of catches in 1995 and 1996. In 1996, apart from other years, areas north of 67°N could still be accessed in January due to a mild winter. Otherwise, as in previous years, ice prevented access to the northern fishing areas in the beginning of the year. The fishing grounds north of 67°N were as in 1994 and 1995 accessed in April - a month earlier than in 1993.

Reported catch, effort and CPUE

Table 1 and fig. 4 show the nominal catches and standardized effort by Greenland in Subarea 1. Catches have been almost steadily increasing from about 20,000 tons in 1974 to a peak of nearly 80,000 tons in 1992. Since then, government restrictions have reduced the landings to about 68,000 tons in 1995. The preliminary statistics of 1996 suggests landings a little below the 1995 level.

Until 1987 effort has been fluctuating around 75,000 hr's showing a slowly increasing trend. In the subsequent five years effort went up by almost a factor three. In 1995 effort decreased from this new high level of about 200,000 hr's and the preliminary data for 1996 suggest that this trend will continue. As the preliminary figures of 1996 are about 12,000 hours short of the corresponding figures in 1995 (fig. 4).

Most catches are taken offshore. The allocation of catches to the inshore areas has varied from 12%-46% over the years since 1974. However, in the nineties the inshore fishery has accounted for about 25% of the total catches.
Vessels above 75GRT take the major part of the catches. Since 1990 when the small vessel logbooks became reliable vessels below 75GRT have been calculated to account for about 35% of the total catches.

Table 2 shows the catch and effort as reported in logbooks from vessels below 75GRT in inshore and offshore areas 1990-1996.

Very little effort is spent in the inshore areas in February-April. Then main effort is allocated to the offshore areas. In late autumn the situation is reversed as the fishery moves inshore.

The catches in inshore areas were relatively stable during 1990-1996 and no displacement of effort in favour of offshore areas, as previously suggested in Anon. (1994) and by Andersen (1994), is registered. About 60% of the catches by this fleet component (<75GRT) was taken inshore.

The catch rates fluctuated during the seasons in both offshore and inshore fishery. High catch rates are seen every year in May in the inshore fishery, probably a reflection of areas which have been inaccessible due to ice until this month. The overall catch rates seem stable in both the inshore and offshore areas.

Table 3-4 show catches and the number of reporting vessels in NAFO Subarea 1 by month and division in 1995 and 1996 as reported to Greenland authorities.

Total reported catch in 1995 was 42,919 tons, a decline from the 44,448 tons reported in 1994. The preliminary catch figures for 1996 are at the same level as at the corresponding figures in 1995, i.e. 37,009 tons. More than 75% of the catches were confined to Div. 1B, C and D.

A total of 32 vessels participated in the fishery in 1995 (table 4) and until October 1996 26 vessels have been registered.

Annual catch, effort and mean catch rates based on logbook data from vessels above 50 GRT are given in table 5.
In the nineties the annual unstandardized fishing effort spent in Subarea 1 has been relative stable fluctuating around 165,000 hours. A decrease, however, is noted in 1995. The effort in 1996 will probably end up below the 1995 level.

Unstandardized catch rates showed an up going trend in the nineties, presumably partly reflecting technological improvements of vessel fishing power. Especially the introduction of twin trawling in 1995 may have contributed to this development.

Standardized CPUE from Greenland Vessel Logs

The time series of the four Greenlandic, the Canadian and the combined Subarea 0+1 CPUE indices as calculated by Hvingel et al. (1996) are tabulated in table 7 including the estimated index values of 1996. Table 6 shows the results of the 1996 calculations.

All three indices (1B, 1CD and Small vessel) show a concurrent increasing trend from 1995-1996. The small vessel index with about 7% and the 1B and 1CD index both with 11%. Although hauls with twin trawls were excluded from the calculations, part of this increase in the CPUE indices might be caused by vessel increase in fishing power. The contribution of this effect is however not quantified. The Small vessel index including vessels <80GRT is believed to be less biased in that respect, as this fleet component has been technological more or less constant in the last 10 years.

Looking at the long time trend in the combined index (fig. 6), 1996 continues the improvement of 1995. The index is however recovering from the lowest value ever in 1994 and is still about 20% lower than the average level of the time series.

Taken as a weighted average (linear or exponential regression) the stock seems to have decreased with about 3% per year in the last 20 years. This means that the total reduction of the stock since 1976 is about 60%.

Another way of looking at the combined index series may be to see it as two levels of stock abundance: One higher level from 1976 to 1989 and a new lower level of the nineties. Subtracting the average index value of these two time periods shows a reduction of about 46% from the 1976-1989 level to the 1990-1996 level.

No matter how the trend of the combined index time series is interpreted it must be kept in mind that the curve is biased upwards by individual vessel increase in fishing power. This effect is most influential in the last years of a time series as technological improvement events tend to be averaged out in the models as years go by.

Overlaying the general trend of abundance is the year to year variations in stock size. Stock abundance fluctuates with about a factor two and in that context 1987 in particular is conspicuous. However, the 1987 spike is most probably amplified by the introduction of high opening trawls, KEVLAR netting and trawl positioning systems in 1985-1986 (Carlsson, 1987). Also, the peak in 1982 may be correlated to the introduction of more efficient gears around 1980. The magnitude of the year to year fluctuations of stock abundance may therefore be overestimated in the time series.

Thus, besides showing a decreasing trend the combined index can also be interpreted as showing a stable stock in the sense that the strength of the year classes does not vary much, i.e. the recruitment to the fishery is comparatively stable.

Length Distributions

Modal analyses were applied to the annual length frequency distributions from 1991 to 1996 of the catches in Subarea 1 (figure 8). Table 8 shows the underlying number of samples taken and the number of individuals measured.

Estimated mean lengths at age (table 9) proved consistency over the years and agreed well with the findings in a previous ageing study by Savard *et al.* (1994).

The standardized catch rates for all year classes indicate increasing abundance up to about age 7, as they pass through the fishery (see also fig. 6). This means that the shrimp are only partly recruited to the fishery at least up to age 7. This agrees with the findings of Savard, McQuinn and Parsons (1991) who concluded that the shrimp probably are not fully recruited until age 8.

As also noticed in Siegstad *et al.* (1995) the 1990 and 1991 year classes still come out stronger than the rest of the year classes in the time series. Also, the 1993 and 1994 year classes looks promising in the 1996 data with index values above average for age 3 and 2 respectively. The 1995 year class is about three times larger than previous ones, but this estimate may be encumbered with great uncertainty.

The strength of the incoming year classes is also reflected in the catch rates of male shrimp, which after a minor decrease from 1991 to 1993, have increased to a maximum in 1996. The female catch rate peaks in 1993 and after a decline until 1995 increases to the next highest level in 1996 probably as a response to the increasing male abundance in the years before (fig. 7).

It is possible, however, that changes in the fishing pattern targeting smaller shrimp might mimic good incoming recruitment, but no signals suggesting this were left within our data on geographical distribution of the fishery. Furthermore, the 1996 Greenlandic survey results also indicate good year classes coming in (Folmer *et al.*, 1996).

The conclusions or suggestions above should be viewed in the context that the annual length frequency distributions, although based on a huge amount of measured individuals, do not represent a complete coverage of the fishery in time and space.

Conclusion

In broad outline the geographical distribution of the fishery in Subarea 1 in 1995 was maintained in 1996. However, the North-Western corner of Div. 1B, about north of 68° and west of 56°, have received much less attention in 1996 than in the previous years, which further adds to the general trend of a more southerly distribution if the fishery.

Landings of shrimp by vessels below 75 GRT were estimated to about 25,000 tons in 1995 and are expected to reach the same level in 1996. Stability in size of catches by the offshore fleet from 1995 to 1996 is also suggested, i.e. about 43,000 tons. This sums to a total catch by Greenland vessels of around 68,000 tons in 1995 and an expectation of total catches at the same level or a little below in 1996.

In the nineties the annual standardized fishing effort spent in Subarea 1 has been relative stable around 175,000 hours. The 1996-level will be of the same order of magnitude. However, the declining trend from 1994-1995 is expected to be continued in 1996 (fig. 4).

The catches of vessels below 75 GRT in inshore areas were relatively stable during 1990-1996 and there is no shift in effort to offshore areas as previously suggested (Andersen, 1994). The unstandardized catch rates of the small-vessel fleet show stability in both the inshore and offshore areas.

The introduction of twin trawling in 1995 pushed unstandardized CPUE for the vessels above 50 GRT upwards, but even without these sets in the calculation the unstandardized CPUE went up from 1994 to 1995 and again from 1995 to 1996 to the highest level since 1989.

All three Greenlandic indices (1B, 1CD and Small vessel) show a concurrent increasing shrimp abundance from 1995-1996 of about 7%-11%. Integrated in the combined index along with the Canadian index for Div. 0A, 1996 continues the improvement of 1995 (fig. 5). The index is however recovering from the lowest value ever in 1994 and is still about 20% lower than the average level of the time series.

According to the combined CPUE index the West Greenland shrimp stock has been reduced by about 46-60% through the last 20 years and this should be seen as the most optimistic estimate.

Increase in male shrimp abundance seems to be the main cause of the improved catch rates in both 1995 and 1996. In 1996, however, female abundance is increasing, too (fig. 7). Especially the 1990 and 1991 year classes seem more abundant than average and are driving the male abundance up. However, also the 1993 and 1994 year classes look promising in the 1996 data. The 1995 year class comes out about three times larger than previous ones in the calculations, but this estimate may be encumbered with great uncertainty.

The increase in female abundance may be explained by the 1989 year class, but contributions from the adjacent 1988 and 1990 year classes may also be involved.

The 1997 shrimp catches will depend on the strengths of the 1989-1992 year classes. As these year classes include two good year classes and two on an average level, a continuing increase in standardized catch rates may be anticipated. Signs of good recruitment for the years further ahead are indicated from the estimated size of the 1993 and 1994 year classes and maybe also the 1995 year class.

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Table 1. Nominal catches and standardized effort by Greenland in NAFO Subarea 1, 1974 to 1996. The distribution of catches in an inshore/offshore component and when possible for vessels >75 GRT and vessels < 75 GRT is shown. (* Preliminary figures. **preliminary figures only including catches from Jan-Oct.).

	Inshore		Offshore		Total nominal catches			Total std.
Year	>75GRT	<75GRT	>75GRT	<75GRT	Inshore	Offshore	Total	effort
1974	-	-	-	-	10064	11945	22009	-
1975	-	-	-	-	8700	29190	37890	-
1976	-	-	-	-	7300	42374	49674	71966
1977	-	-	-	-	7800	33843	41643	64535
1978	-	-	-	-	7600	26747	34347	69499
1979	-	-	-	-	7500	25958	33458	78704
1980	-	-	-	-	7500	35778	43278	85737
1981	-	-	-	-	7500	32016	39516	77352
1982	-	-	-	-	7500	35015	42515	67401
1983	-	-	-	-	7500	33854	41354	76459
1984	-	-	-	-	7500	33741	41241	80148
1985	-	-	-	-	7500	43896	51396	95229
1986	-	-	-	-	7500	52634	60134	106898
1987	-	-	-	-	6921	50720	57641	75051
1988	-	-	-	-	10233	44159	54392	93370
1989	-	-	-	-	13224	45198	58422	135826
1990	0	13787	42915	6639	13787	49554	63341	152205
1991	0	16677	45568	7266	16677	52834	69511	193723
1992	2012	18550	51425	7239	20562	58664	79226	211712
1993	1770	15764	41393	10887	17534	52280	69814	173761
1994*	1712	16406	42740	10953	18118	53693	71811	214726
1995*	2173	14256	40794	11106	16429	51900	68329	191935
1996**	2210	8323	34797	7669	10533	42466	52999	137243

Table 2. Catch (tons), and unstandardized effort (hr's) and CPUE (kg/hr) from the small-vessel fleet (<75GRT) logbooks. The data is shown by year and month divided in inshore/offshore area (*1996 incomplete).

Catch

	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
1990	Inshore	230	121	140	208	236	535	409	201	448	476	317	199	3520
	Offshore	183	137	225	276	423	487	430	515	200	68	119	90	3153
1991	Inshore	227	89	76	55	382	459	460	580	630	706	721	467	4852
	Offshore	154	306	361	509	445	452	622	235	80	44	184	130	3522
1992	Inshore	474	5	28	136	552	861	434	670	675	919	389	360	5503
	Offshore	161	260	565	517	389	394	535	167	153	142	133	271	3687
1993	Inshore	117	86	10	25	514	896	654	598	942	1038	924	488	6292
	Offshore	332	413	343	739	891	625	832	420	151	178	125	233	5282
1994	Inshore	386	167	126	558	617	649	701	786	849	904	613	396	6752
	Offshore	424	468	417	515	588	480	673	350	485	366	311	138	5215
1995	Inshore	308	190	169	597	786	574	660	488	666	823	544	559	6364
	Offshore	284	405	609	437	222	423	476	590	182	154	95	32	3909
1996*	Inshore	349	178	151	454	660	794	573	491	353	0	0	0	4003
	Offshore	109	664	516	326	545	504	700	304	35	0	0	0	3703

Effort

	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
1990	Inshore	713	569	623	677	659	1609	1582	751	1471	1674	1376	623	12327
	Offshore	615	509	734	837	1331	1725	1477	1750	730	308	466	274	10756
1991	Inshore	914	438	425	202	852	1693	1924	2208	2462	2739	2801	1599	18257
	Offshore	757	1394	1624	1845	1731	1429	2144	1070	382	192	595	423	13586
1992	Inshore	1588	33	142	311	1671	2486	1722	2425	2418	3489	3052	1308	20645
	Offshore	654	1535	1898	1698	1260	1228	1905	752	655	477	495	993	13550
1993	Inshore	262	276	58	150	1408	2617	1822	2165	3068	3724	3345	1860	20755
	Offshore	1597	1473	1061	2031	3152	1964	2569	1350	553	628	419	912	17709
1994	Inshore	1611	768	567	1187	1845	2461	2434	2659	2751	3426	2922	1951	24582
	Offshore	1706	1980	1870	1520	2094	1622	2173	1011	1807	1491	1167	627	19068
1995	Inshore	1513	991	952	1082	2849	2361	2236	1653	2383	2917	2501	1891	23329
	Offshore	1230	1550	1686	1084	783	1217	1494	1512	833	535	401	101	12426
1996*	Inshore	1290	422	445	959	1792	3072	2195	1890	1307	0	0	0	13372
	Offshore	330	1123	1177	660	1279	1365	2098	979	155	0	0	0	9166

CPUE

	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
1990	Inshore	323	213	225	307	358	332	258	268	305	284	230	319	286
	Offshore	296	268	307	330	318	282	291	295	275	220	256	327	293
1991	Inshore	248	202	179	271	449	271	239	263	256	258	257	292	266
	Offshore	204	219	222	276	257	316	290	219	210	226	310	307	259
1992	Inshore	299	153	199	438	330	346	252	276	279	263	275	275	267
	Offshore	246	170	298	304	308	321	281	222	233	297	268	273	272
1993	Inshore	445	312	176	168	365	245	359	276	307	279	276	262	303
	Offshore	208	280	323	364	283	318	324	311	272	284	298	255	298
1994	Inshore	239	218	222	470	334	264	288	295	309	264	210	203	275
	Offshore	249	237	223	339	281	296	310	346	268	246	266	220	273
1995	Inshore	204	192	178	552	276	243	295	295	279	283	218	295	273
	Offshore	231	262	361	403	283	347	318	390	218	287	237	317	315
1996*	Inshore	271	421	339	474	368	259	261	260	270	0	0	0	299
	Offshore	330	591	439	494	426	369	334	311	224	0	0	0	404

Table 3. Catches of shrimp (tons) by division and month in NAFO Subarea 1 in 1995 and 1996 until October, as reported to the Greenland authorities by vessels above 75GRT.

Year 1995

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1AN	0	0	0	0	1	0	0	200	36	39	0	0	276
1AS	0	0	0	0	0	0	3	79	105	375	310	70	942
1B	393	460	634	1681	712	1075	752	2347	1244	2019	856	395	12568
1C	428	717	1182	1763	1310	576	1171	526	478	305	347	379	9182
1D	972	1229	1054	1442	1709	1387	1295	637	1171	955	777	199	12827
1E	102	452	775	497	796	261	553	385	518	472	111	264	5186
1F	227	122	236	18	122	1	83	414	167	151	227	170	1938
Total	2122	2980	3881	5401	4650	3300	3857	4588	3719	4316	2628	1477	42919

Year 1996

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1AN	0	0	0	0	0	0	105	101	157	0	-	-	363
1AS	0	0	0	0	1	0	0	261	430	2	-	-	694
1B	170	234	964	1580	966	852	298	928	1205	210	-	-	7407
1C	753	823	958	2120	1106	1477	1117	631	242	67	-	-	9294
1D	897	1425	1557	1093	1756	1169	1874	1604	1333	208	-	-	12916
1E	423	550	246	743	241	344	814	464	621	102	-	-	4548
1F	228	285	264	156	55	200	200	158	226	15	-	-	1787
Total	2471	3317	3989	5692	4125	4042	4408	4147	4214	604	-	-	37009

Table 4. Number of vessels in the shrimp fishery by division and month in NAFO Subarea 1 in 1995 and 1996 until October, as reported to the Greenland authorities by vessels above 75GRT. Only Greenland vessels participated in the fishery.

Year 1995

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1AN	0	0	0	0	1	0	1	3	2	1	0	0	5
1AS	0	0	0	0	0	0	2	5	3	7	6	4	13
1B	10	12	15	29	21	19	11	19	20	18	14	12	32
1C	13	18	21	24	22	16	19	10	15	11	12	8	31
1D	15	18	24	23	22	18	16	9	19	15	12	6	30
1E	4	13	13	13	11	8	8	7	7	5	4	5	23
1F	6	5	8	2	3	1	2	10	6	5	7	8	15
													32

Year 1996

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1AN	0	0	0	0	0	0	2	3	3	0	-	-	5
1AS	0	0	0	0	1	0	0	7	12	1	-	-	16
1B	8	6	19	23	20	17	6	18	17	8	-	-	26
1C	12	17	21	22	15	16	15	18	14	8	-	-	26
1D	16	19	20	19	17	14	17	20	15	9	-	-	25
1E	5	8	9	9	5	6	11	9	8	7	-	-	16
1F	10	8	7	5	1	3	3	6	4	1	-	-	18
													26

Table 5. Annual catch (tons) and unstandardized effort (hr's) and CPUE (kg/hr) based on information from Greenland vessel logs 1990 to October 1996.

Catch

	1990		1991		1992		1993		1994		1995		1996	
Area	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
1A	7838	16	7871	15	9471	17	4889	9	4712	8	4396	8	1609	5
1B	19369	39	20485	39	19090	34	23382	42	21705	38	17198	32	9718	27
1C	14570	29	11723	22	11618	20	10184	18	10293	18	9865	18	8570	24
1D	7765	16	12175	23	13493	24	11727	21	12881	23	14007	26	10168	29
1E	0	0	380	1	2859	5	2905	5	4702	8	5435	10	3322	9
1F	298	1	150	0	365	1	2078	4	2679	5	3104	6	2204	6
Total	49840	100	52784	100	56896	100	55165	100	56972	100	54005	100	35591	100

Effort

	1990		1991		1992		1993		1994		1995		1996	
Area	Hours	%	Hours	%	Hours	%	Hours	%	Hours	%	Hours	%	Hours	%
1A	33472	21	28248	16	35410	21	17998	11	18458	11	16553	11	6079	7
1B	61383	38	68514	39	54619	33	64386	40	66202	40	54914	37	25518	30
1C	42939	26	39385	23	34391	21	32347	20	32268	19	26908	18	22251	26
1D	22762	14	36170	21	36526	22	34787	21	33708	20	32701	22	22317	26
1E	0	0	564	0	5344	3	6360	4	7869	5	9790	7	5651	7
1F	2223	1	962	1	924	1	5958	4	7304	4	6182	4	4493	5
Total	162779	100	173843	100	167214	100	161836	100	165809	100	147048	100	86309	100

CPUE

	1990		1991		1992		1993		1994		1995		1996	
Area	kg/hr	%	kg/hr	%	kg/hr	%	kg/hr	%	kg/hr	%	kg/hr	%	kg/hr	%
1A	234	76	279	92	267	79	272	80	255	74	266	72	265	64
1B	316	103	299	98	350	103	363	107	328	95	313	85	381	92
1C	339	111	298	98	338	99	315	92	319	93	367	100	385	93
1D	341	111	337	111	369	109	337	99	382	111	428	117	456	110
1E	0	0	674	222	535	157	457	134	598	174	555	151	588	143
1F	134	44	156	51	395	116	349	102	367	107	502	137	491	119
Total	306		304		340		341		344		367		412	

Table 6. The 1996 standardized CPUE index values for the Greenlandic 1B, 1CD and Small vessel indices (Hvingel et al., 1996). N is the number of cells included in the calculations i.e. number of year*month*area*vessel combinations available in the data set. Mean is the 1996 index value and SE is standard error of this estimate. Max. is the maximum value observed and Min. is the minimum value observed. (All figures in logarithmic scale).

	1B index	1CD index	Small vessel index
N	71	230	112
Mean	0.105	0.100	0.067
SE	0.056	0.026	0.030
Max.	1.604	1.232	1.120
Min.	-2.394	-2.007	-1.164

Table 7. Time series of the five standardized CPUE indices used in the assessment of the West Greenland shrimp stock including the Greenlandic 1B, KGH, 1CD and Small vessel index and the Canadian 0A index (Hvingel et al. 1996 and Parsons et al. 1996). The weighting factors used in combining the indices are also shown (Hvingel at al., 1996). (Note the index values are not standardized to the same level).

	1B		KGH		1CD		Small Vessel		0A		Combined
Year	Index	Weight	Index	Weight	Index	Weight	Index	Weight	Index	Weight	index
1976	-	-	1.72	1.00	-	-	-	-	-	-	1.72
1977	-	-	1.60	1.00	-	-	-	-	-	-	1.60
1978	-	-	1.23	1.00	-	-	-	-	-	-	1.23
1979	-	-	1.06	1.00	-	-	-	-	-	-	1.06
1980	-	-	1.25	1.00	-	-	-	-	-	-	1.25
1981	-	-	1.24	0.87	-	-	-	-	1.48	0.13	1.27
1982	-	-	1.55	0.87	-	-	-	-	1.74	0.13	1.57
1983	-	-	1.35	0.87	-	-	-	-	1.36	0.13	1.34
1984	-	-	1.28	0.87	-	-	-	-	1.27	0.13	1.28
1985	-	-	1.38	0.87	-	-	-	-	1.09	0.13	1.34
1986	-	-	1.44	0.87	-	-	-	-	1.12	0.13	1.40
1987	2.25	0.37	1.85	0.49	-	-	-	-	1.71	0.13	1.91
1988	1.64	0.21	1.47	0.28	1.76	0.30	1.53	0.14	1.53	0.09	1.45
1989	1.07	0.21	1.09	0.28	1.36	0.30	1.22	0.14	1.12	0.09	1.07
1990	1.04	0.21	1.00	0.28	1.32	0.30	1.17	0.14	1.27	0.09	1.03
1991	0.94	0.41	-	-	1.07	0.30	1.03	0.21	1.10	0.09	0.89
1992	0.93	0.41	-	-	1.17	0.30	1.06	0.21	1.26	0.09	0.93
1993	1.07	0.41	-	-	1.14	0.30	1.22	0.21	1.19	0.09	1.00
1994	0.91	0.41	-	-	0.93	0.30	1.02	0.21	0.93	0.09	0.83
1995	1.00	0.41	-	-	1.00	0.30	1.00	0.21	1.00	0.09	0.88
1996	1.11	0.41	-	-	1.11	0.30	1.07	0.21	0.90	0.09	0.96

Table 8. Number of biological samples taken in the commercial shrimp by year month and NAFO Division to examine size composition of the catches. Absolute number of individuals measured, sample weight and the size of the catch from which the samples were taken are tabulated.

Year	Month	Division	Number of samples	Number measured	Sample weight (kg)	Catch total (kg)
91	6	1C	4	1558	15.6	5693
91	6	1D	20	10623	86	45992
91	9	1A	42	33306	303.4	104689
91	9	1B	51	41872	348.9	79741
91	11	1B	9	3631	28.5	12595
91	12	1B	12	3346	29.5	23310
91	12	1C	11	3881	31.7	8646
91	12	1D	11	2759	26.3	16068
92	1	1A	1	448	4.3	860
92	5	1C	6	2010	21.4	2728
92	5	1D	38	16754	138.5	57553
92	5	1E	1	375	3.5	1843
92	8	1C	11	3958	37.9	18769
92	8	1D	40	16354	125	102657
92	8	1E	4	1680	13.5	5894
92	11	1A	44	13799	124.8	42425

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Table 8. Continued..

Year	Month	Division	Number of samples	Number measured	Sample weight (kg)	Catch total (kg)
93	2	1B	11	4513	40.1	20628
93	2	1C	34	12425	118.3	35114
93	3	1C	1	614	4.4	237
93	3	1D	22	14552	109.5	29175
93	3	1E	17	7782	83	28586
93	8	1C	12	4175	39.02	15676
93	9	1B	15	8165	69.7	23068
93	9	1D	13	7043	53.62	28759
93	9	1E	2	1043	7.86	4828
93	10	1B	16	7776	67.85	21871
94	1	1D	19	12473	87.35	17928
94	2	1C	12	7409	53.14	11834
94	2	1D	5	2669	20.26	5834
94	3	1B	2	1672	11	4384
94	3	1C	10	4715	47.99	17975
94	4	1B	7	4709	32.14	7505
94	4	1C	22	8144	90.04	41482
94	5	1C	1	348	3.8	100
94	5	1D	10	5844	38.73	16997
94	5	1E	14	4871	46.11	15844
94	6	1B	17	8165	61.51	18417
94	6	1C	15	5345	46.42	22561
94	6	1D	17	6985	54.46	20964
94	7	1C	18	7401	64.49	39231
94	7	1D	9	6341	39.9	12431
94	7	1E	1	414	4.2	372
94	9	1B	18	11151	86.16	43322
94	9	1C	5	3040	24.22	4697
94	10	1B	10	5121	43.4	15433
94	12	1B	26	13806	105.12	28470
95	1	1C	8	3781	28	5259
95	3	1B	30	18090	119	61804
95	3	1C	57	28504	237.1	77685
95	3	1D	45	23942	163.36	73167
95	3	1E	13	6272	57.58	38644
95	3	1F	1	390	4.6	2064
95	4	1D	5	2898	21.6	3872
95	6	1B	18	10983	78.7	23058
95	6	1C	1	645	4.5	2748
95	7	1D	6	3404	22.72	10080
95	7	1E	1	336	4.06	1074
95	7	1F	2	885	8	15863
96	1	1D	1	821	4	3129
96	2	1C	5	2480	20	12313
96	2	1D	1	381	4	1000
96	3	1C	2	442	8	2512
96	5	1B	1	622	4	1238
96	5	1C	12	6525	48	27627
96	5	1D	6	2777	24	8371
96	6	1C	7	6005	28	15113
96	6	1D	17	9966	68	38933
96	7	1D	13	7533	52	42595
96	7	1E	2	782	8	3709
96	8	1C	3	974	12	4356
96	8	1D	15	10054	60	38602
96	8	1E	10	4540	40	15293
96	8	1F	6	2655	24	7652
96	9	1D	4	2465	16	4458

Table 9. Mean length at age, catch at age in proportions and absolute numbers and standardized catch rates at age as determined from commercial length frequency distributions in NAFO Subarea 1.

Mean Cpl. length (mm)

Year/Year class	1991	1992	1993	1994	1995	1996
1	-	-	9.8	10.2	9.3	11.2
2	13.4	12.1	13.2	12.4	12.6	13.5
3	16.2	15.3	15.0	14.3	15.3	15.4
4	18.1	17.9	17.5	17.1	17.3	17.5
5	20.9	20.5	19.5	19.3	19.3	19.8
6	22.5	22.8	21.6	21.6	21.2	21.6
7	24.7	25.4	24.9	24.8	24.2	24.9
8+	27.2	27.9	27.3	26.6	26.4	26.9

Proportion of total catch

Year/Year class	1991	1992	1993	1994	1995	1996
1	0.000	0.000	0.002	0.002	0.002	0.005
2	0.004	0.003	0.012	0.023	0.006	0.018
3	0.012	0.017	0.032	0.024	0.030	0.040
4	0.049	0.077	0.066	0.095	0.122	0.077
5	0.197	0.209	0.123	0.156	0.218	0.212
6	0.303	0.229	0.201	0.259	0.253	0.248
7	0.295	0.415	0.497	0.318	0.222	0.307
8+	0.141	0.050	0.067	0.122	0.146	0.092

Number caught (millions)

Year/Year class	1991	1992	1993	1994	1995	1996
1	0	0	17	18	18	39
2	33	28	99	210	54	139
3	98	157	265	219	270	308
4	401	713	546	867	1098	593
5	1610	1935	1017	1423	1962	1633
6	2477	2121	1663	2362	2277	1910
7	2412	3843	4111	2901	1998	2364
8+	1153	463	554	1113	1314	708
Total	8175	9260	8272	9121	9001	7701

Number caught per hour (standardized)

Year/Year class	1991	1992	1993	1994	1995	1996
1	-	-	95	85	94	281
2	169	131	571	977	281	1010
3	506	744	1523	1020	1407	2244
4	2068	3368	3142	4036	5721	4321
5	8313	9142	5856	6627	10223	11895
6	12786	10016	9569	11002	11865	13915
7	12449	18152	23661	13508	10411	17226
8+	5950	2187	3190	5182	6847	5162
Total	42199	43740	47607	42479	46895	56110

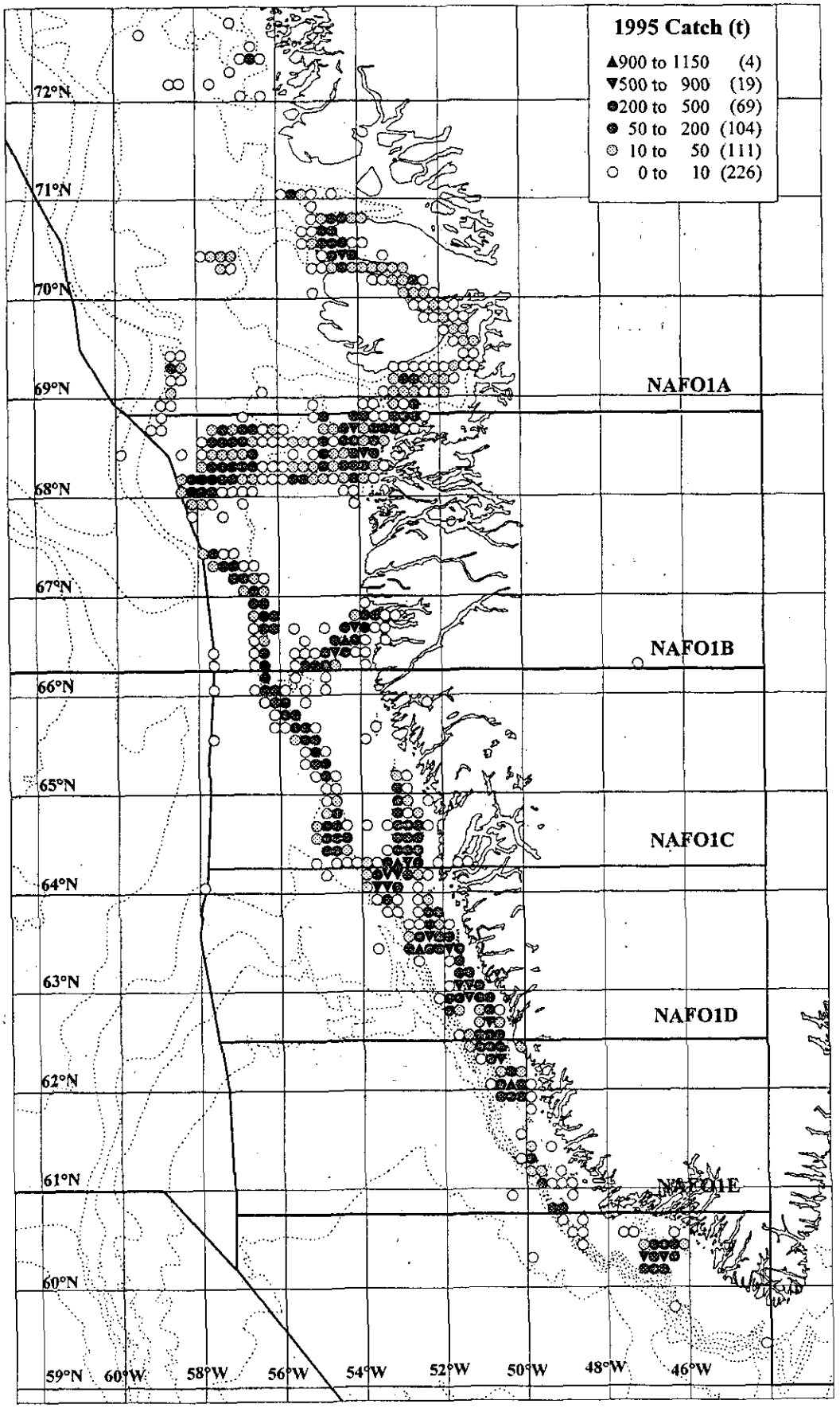


Figure 1. The geographical distribution of the Greenland catches in 1995 by vessels larger than 50GRT.

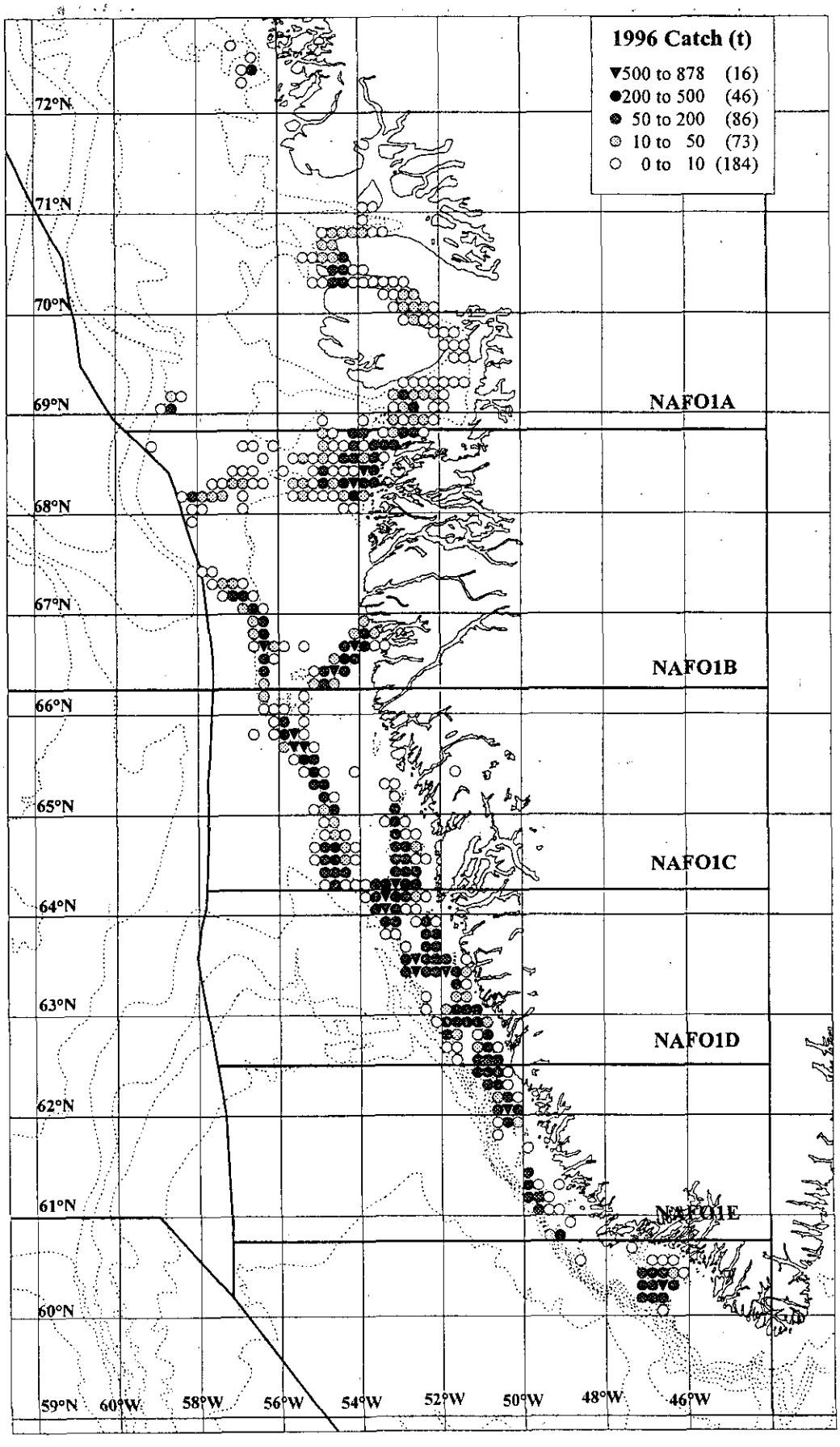
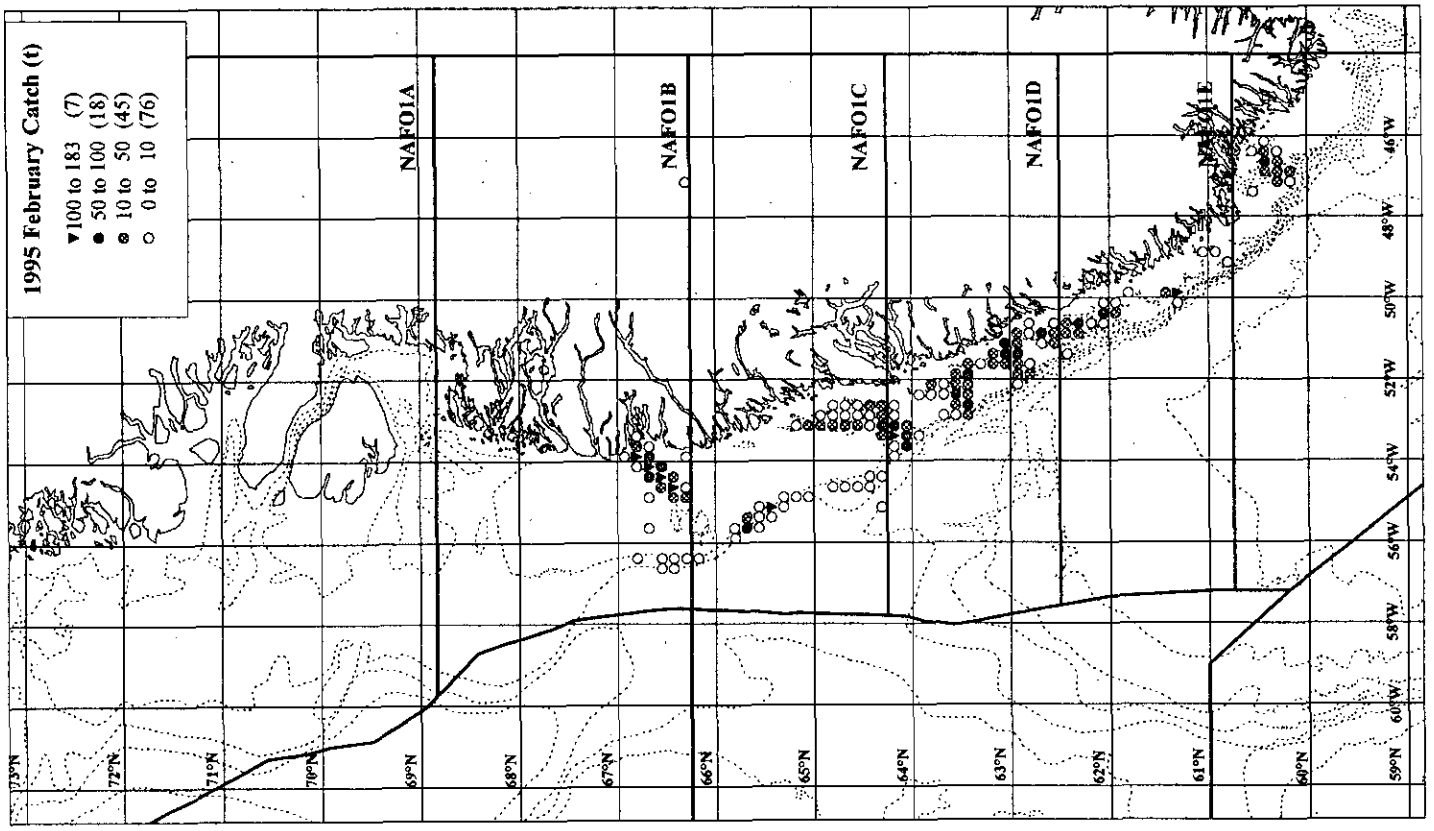


Figure 2. The geographical distribution of the Greenland catches in 1996 by vessels larger than 50GRT.



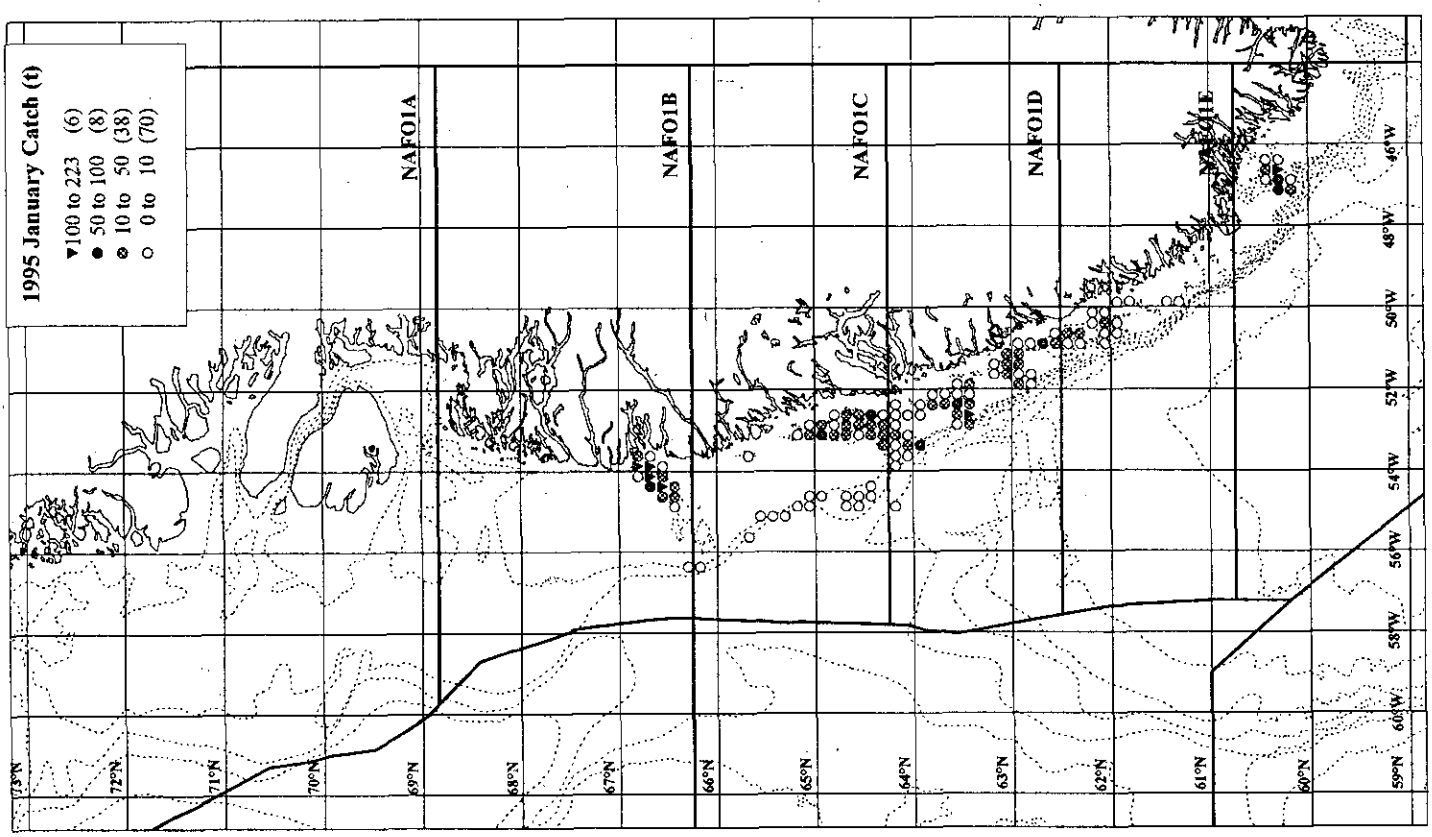
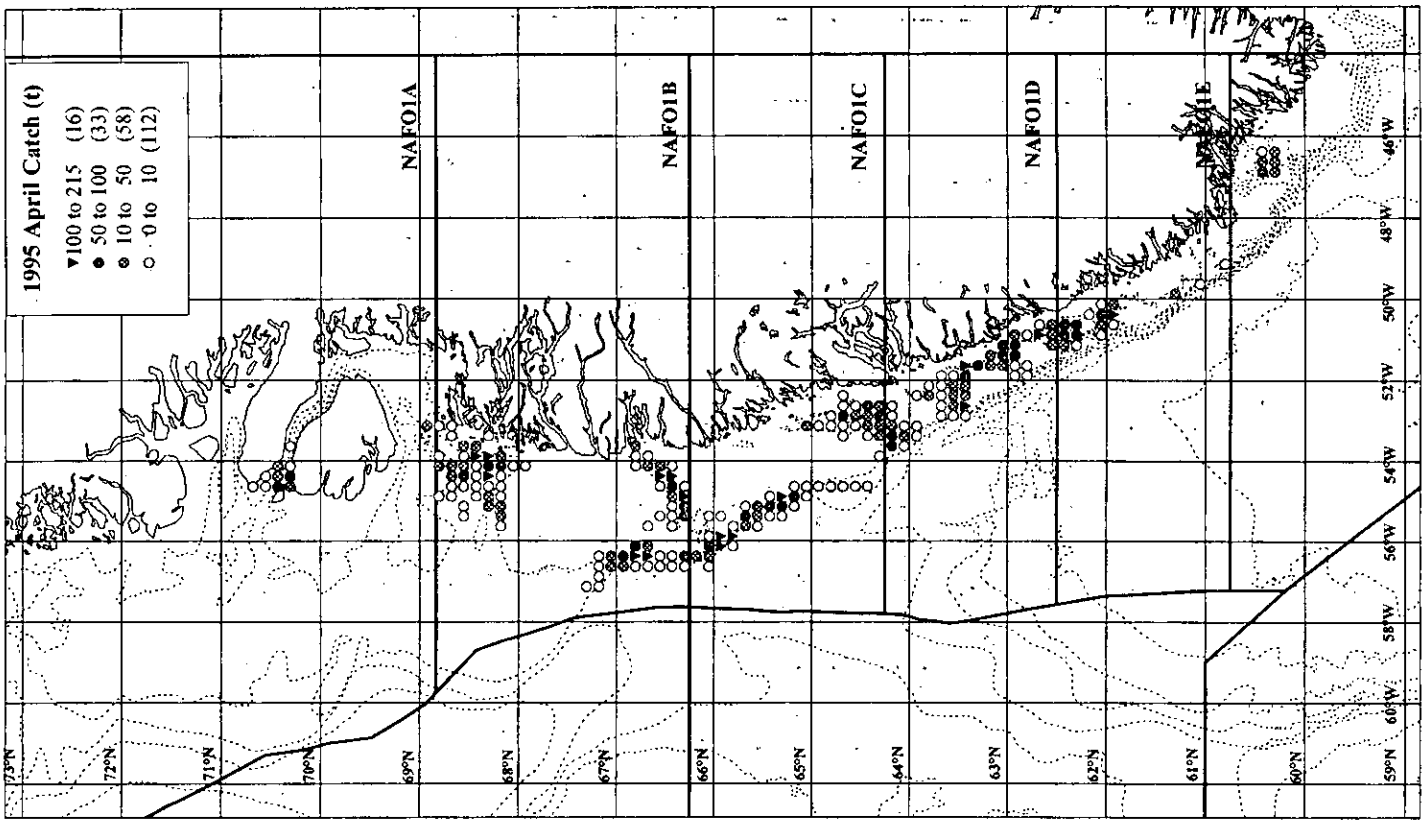
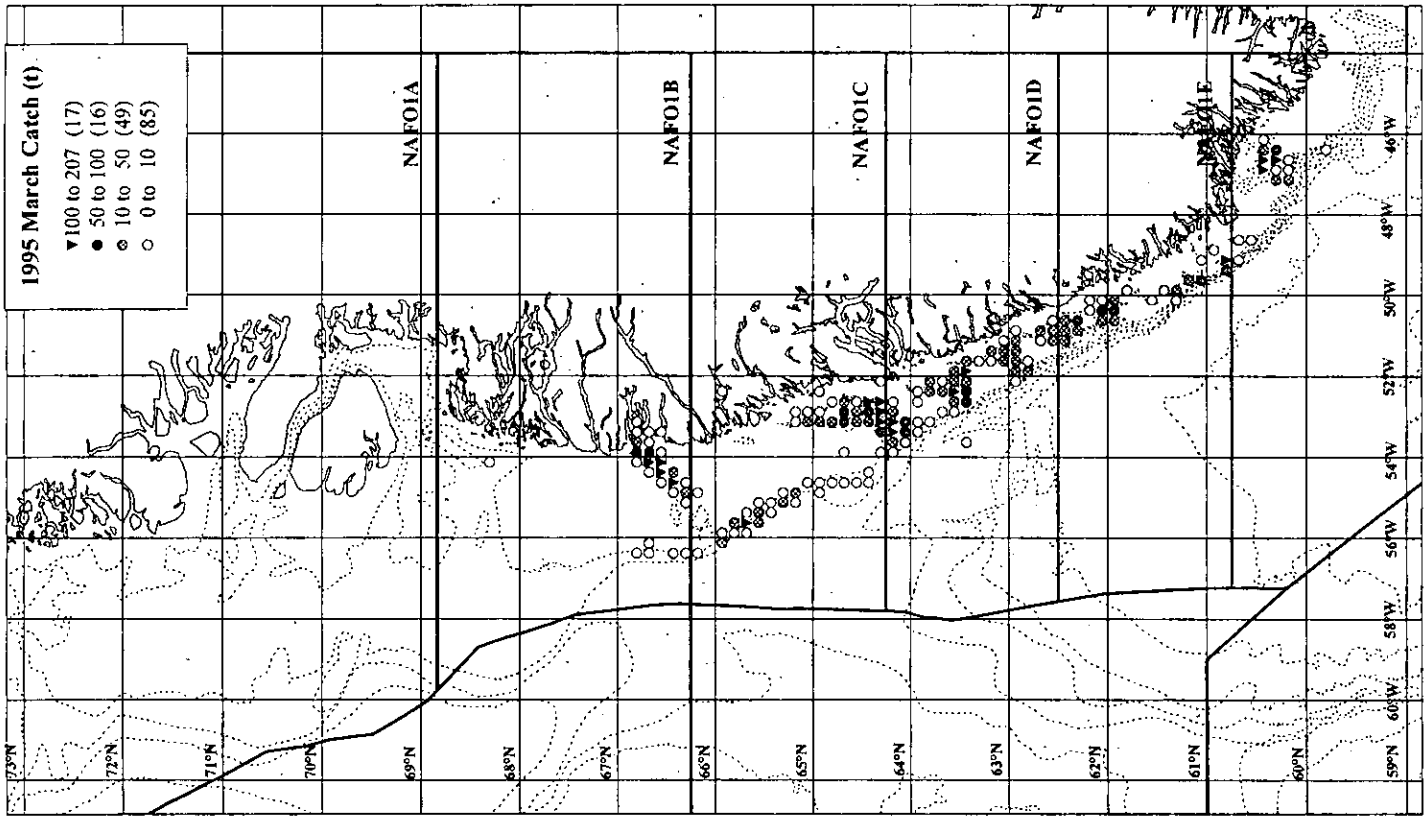


Figure 3. The geographical distribution of chatches by Greenland vessels larger than 50GRT by month from January 1995 to September 1996. (Note, the figure continues on the following pages).





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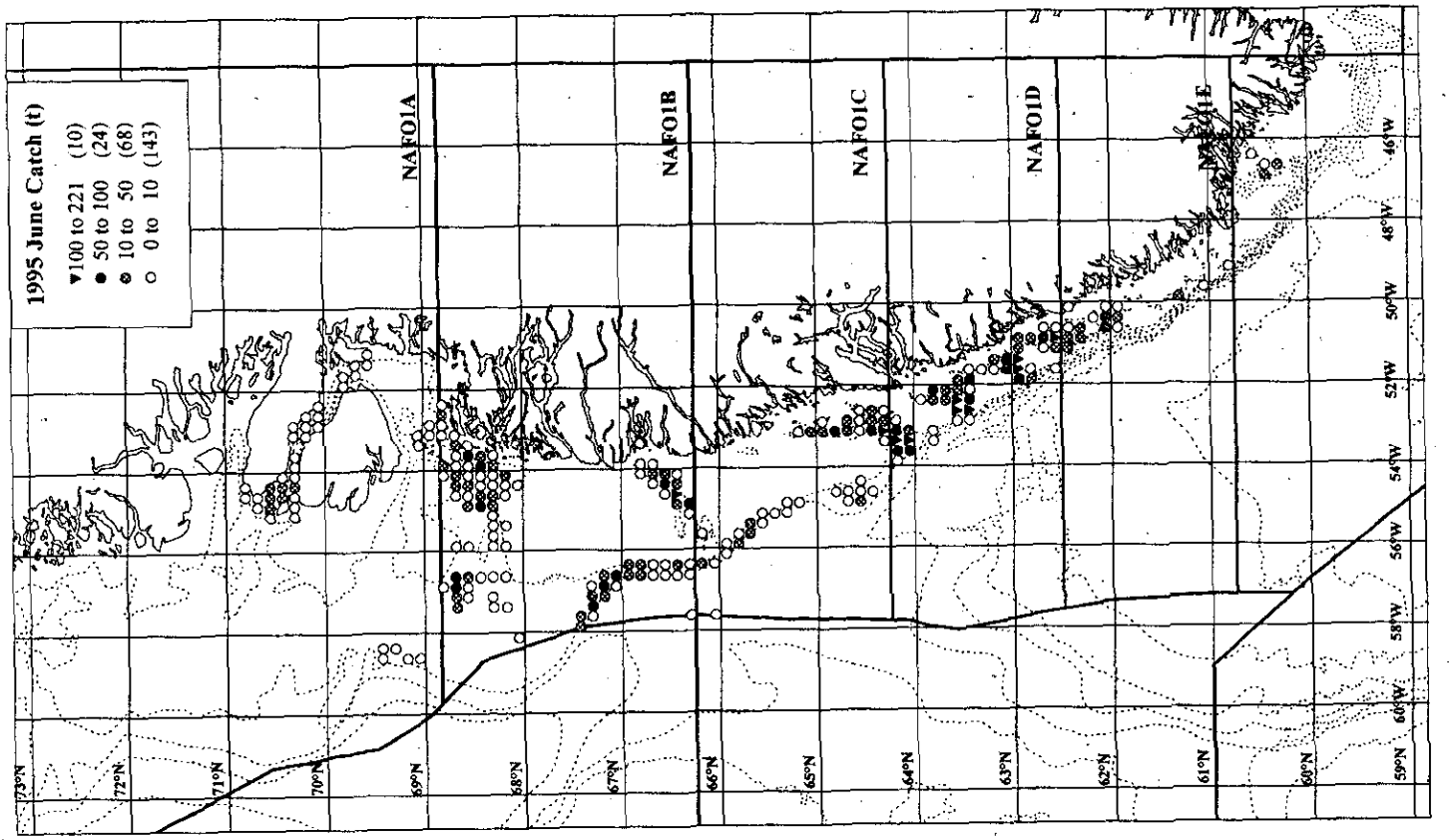

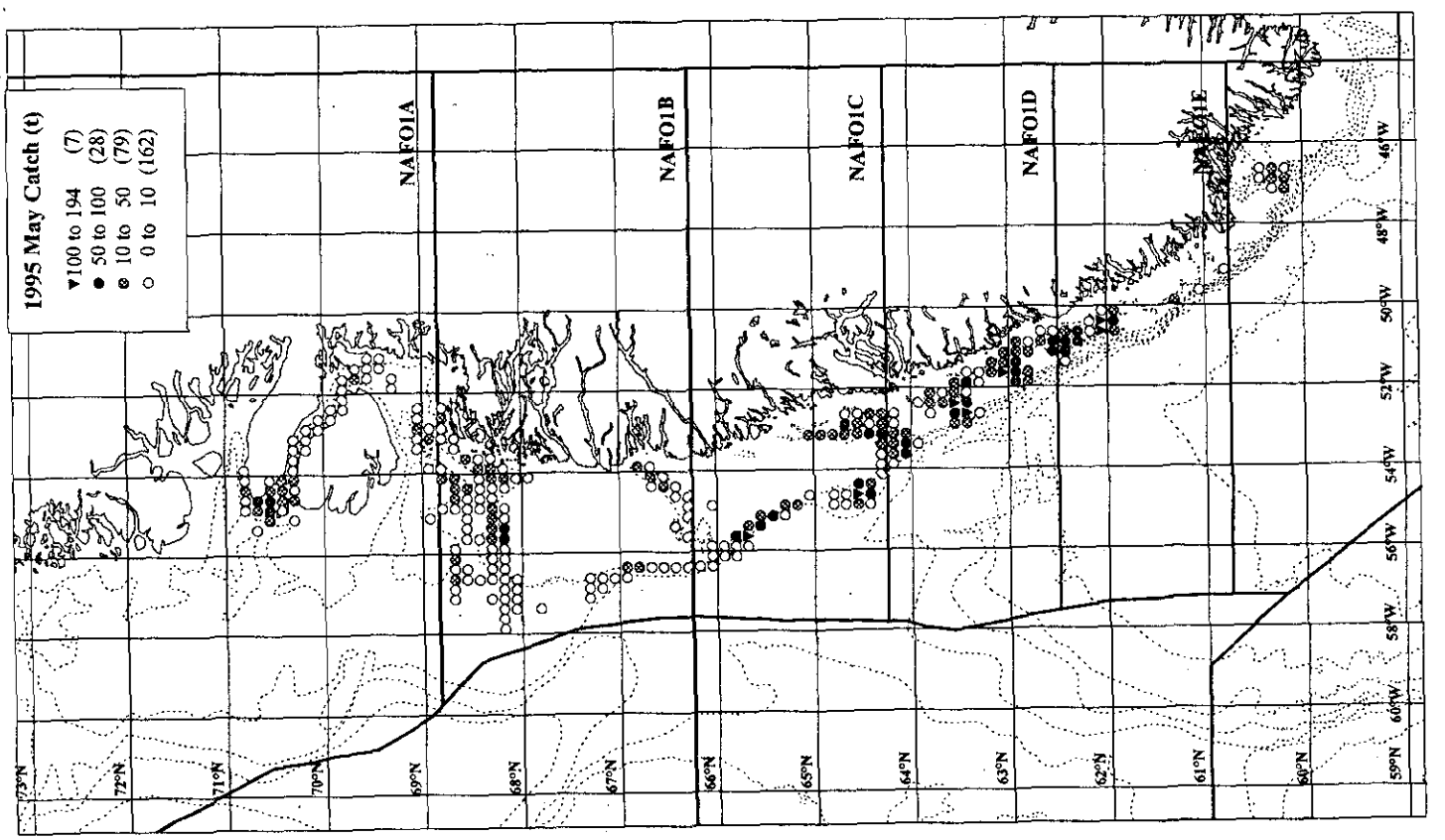

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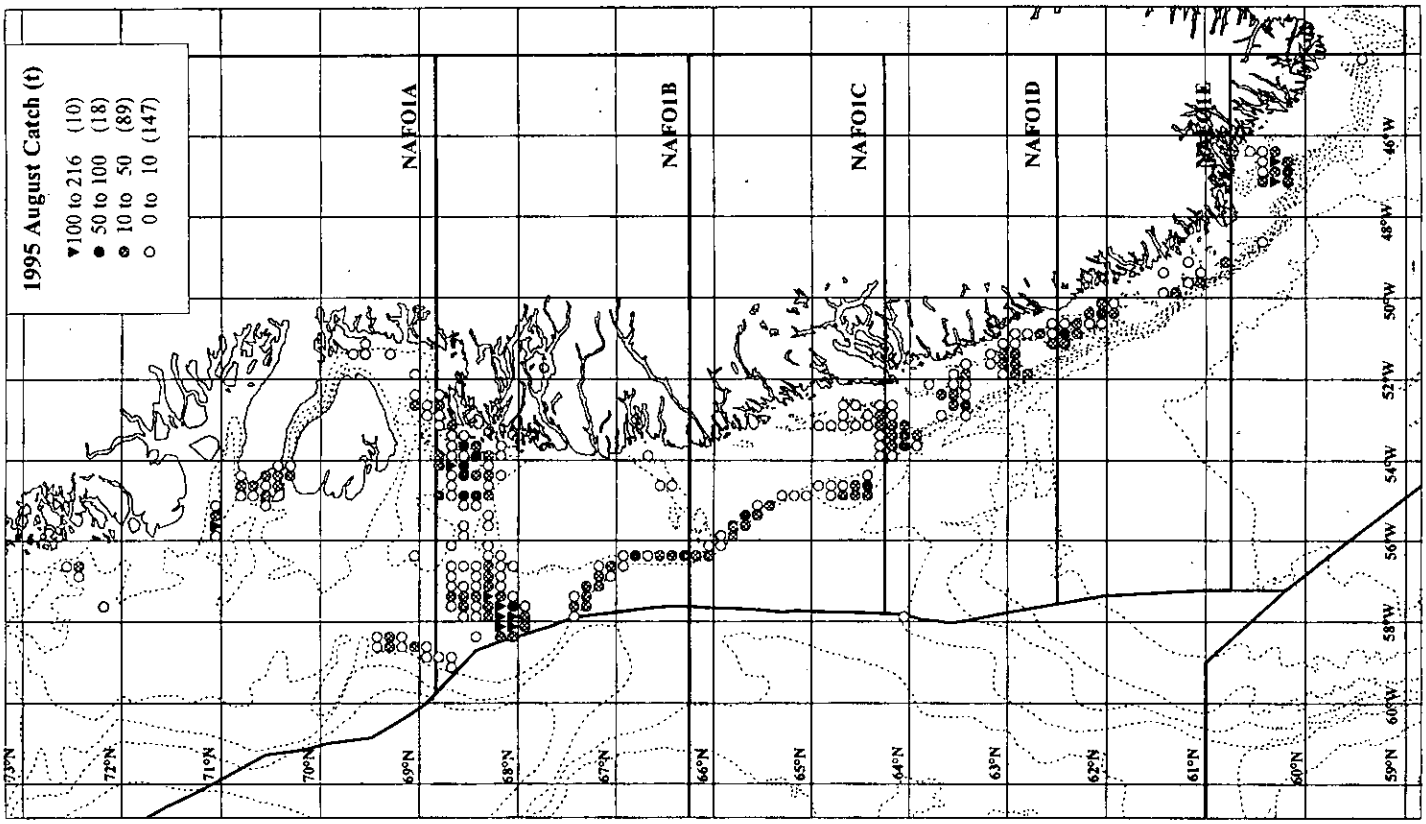

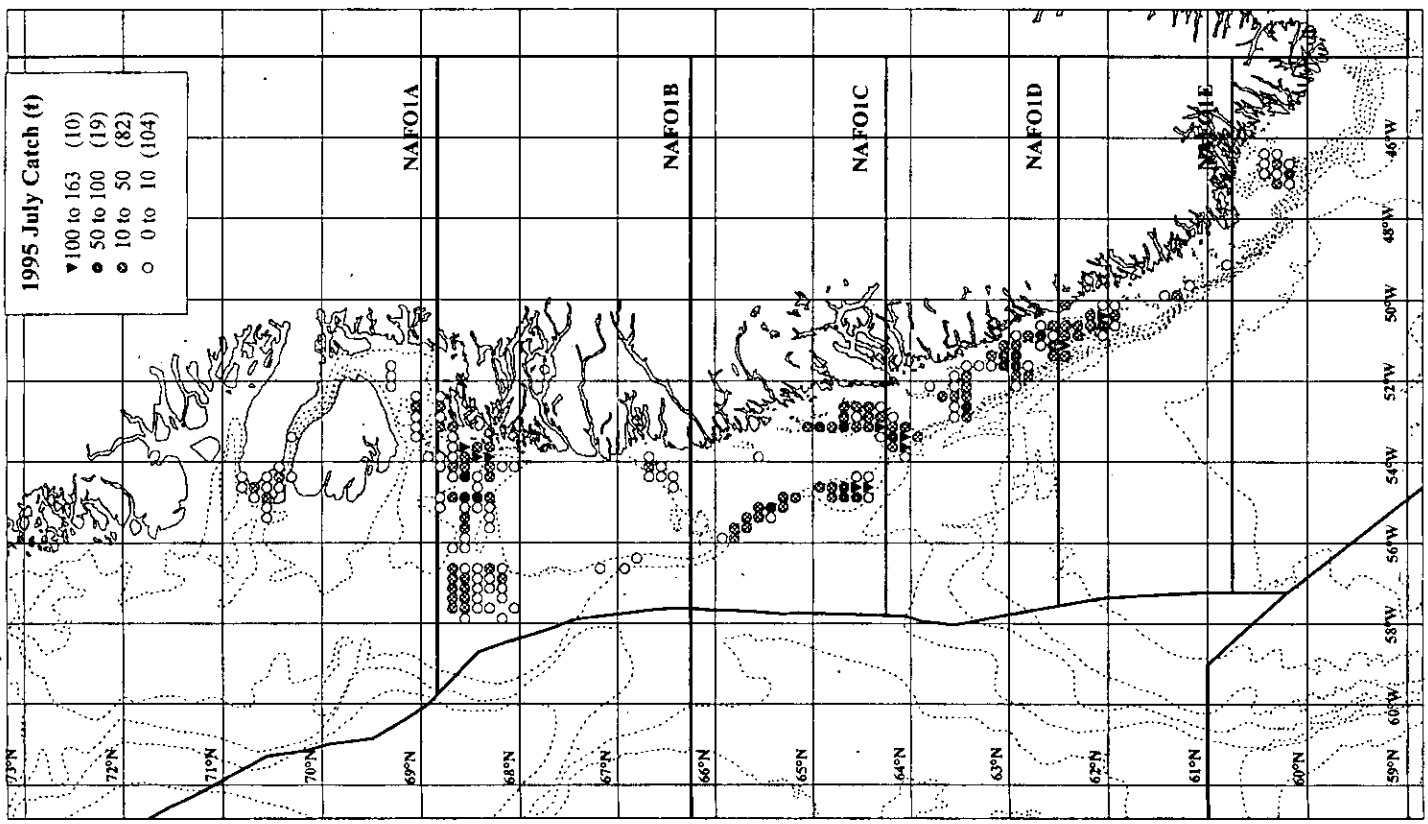

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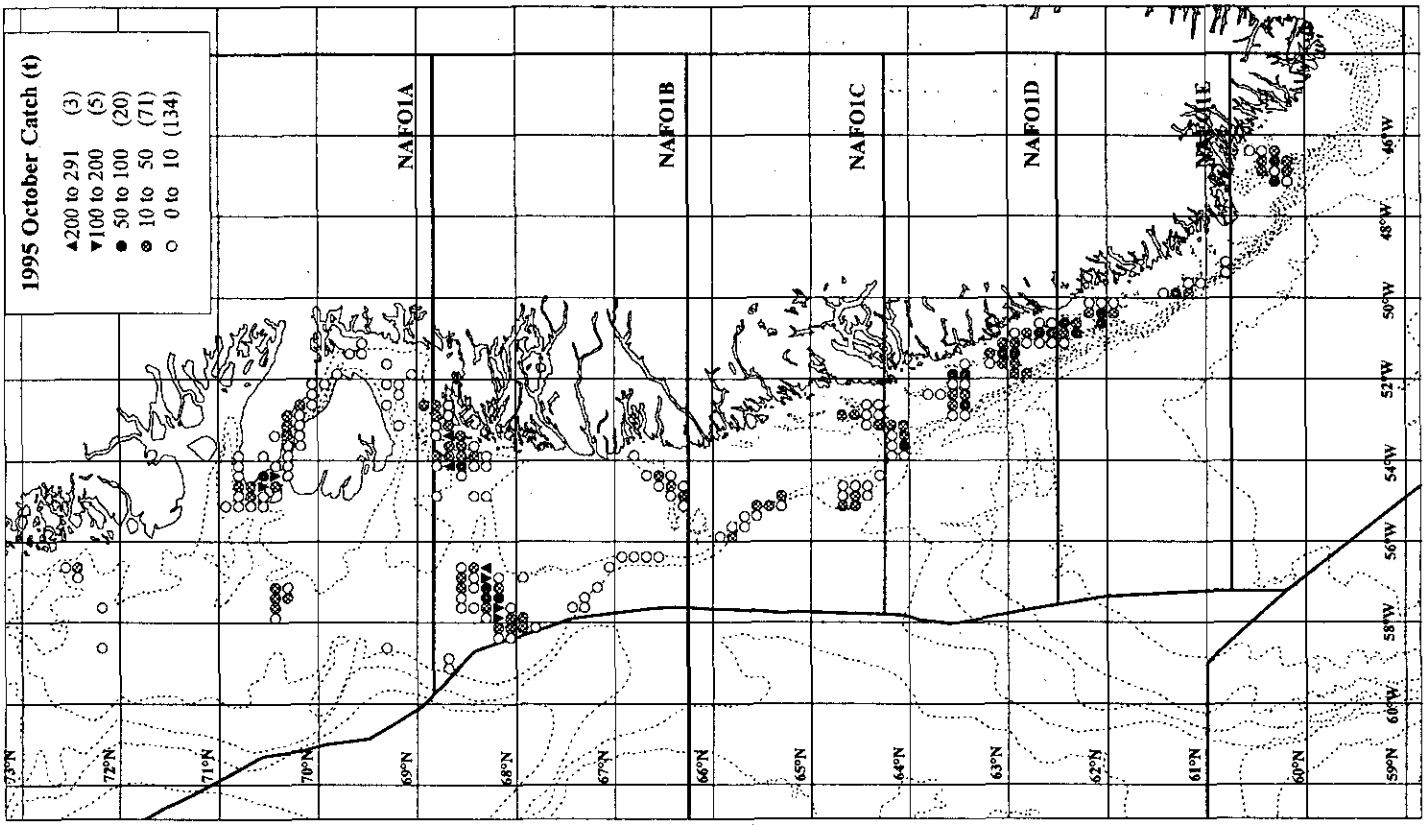

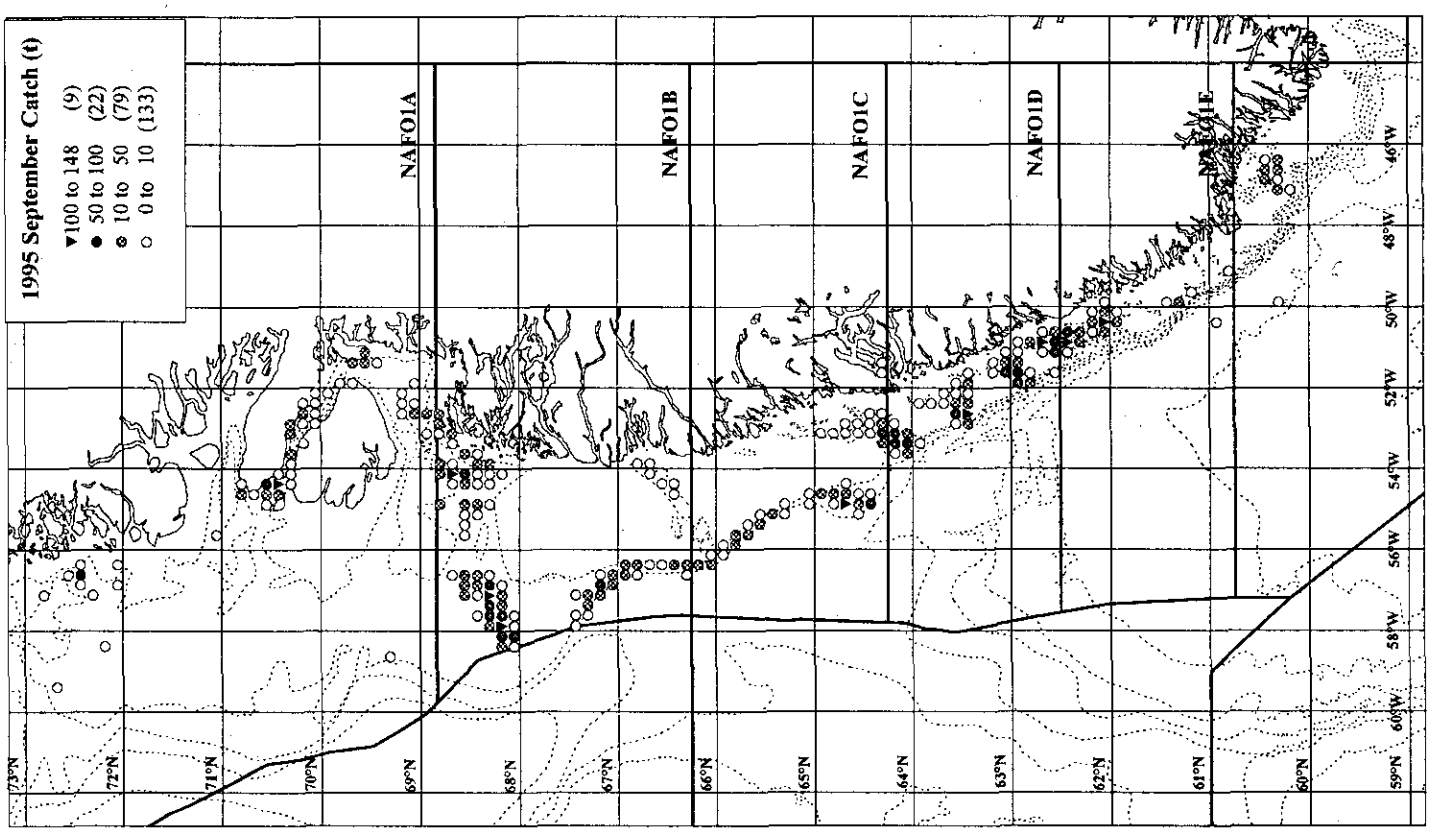

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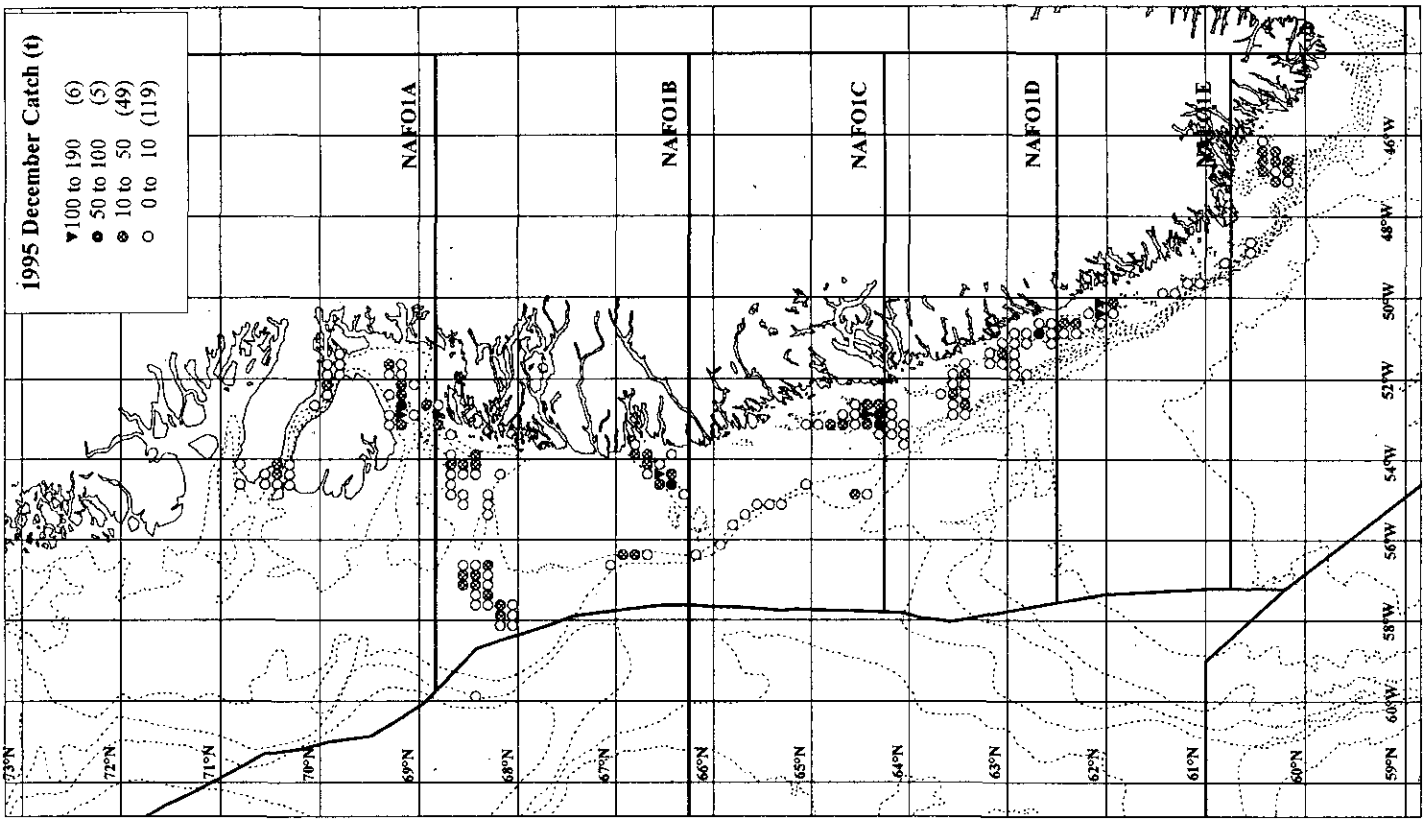

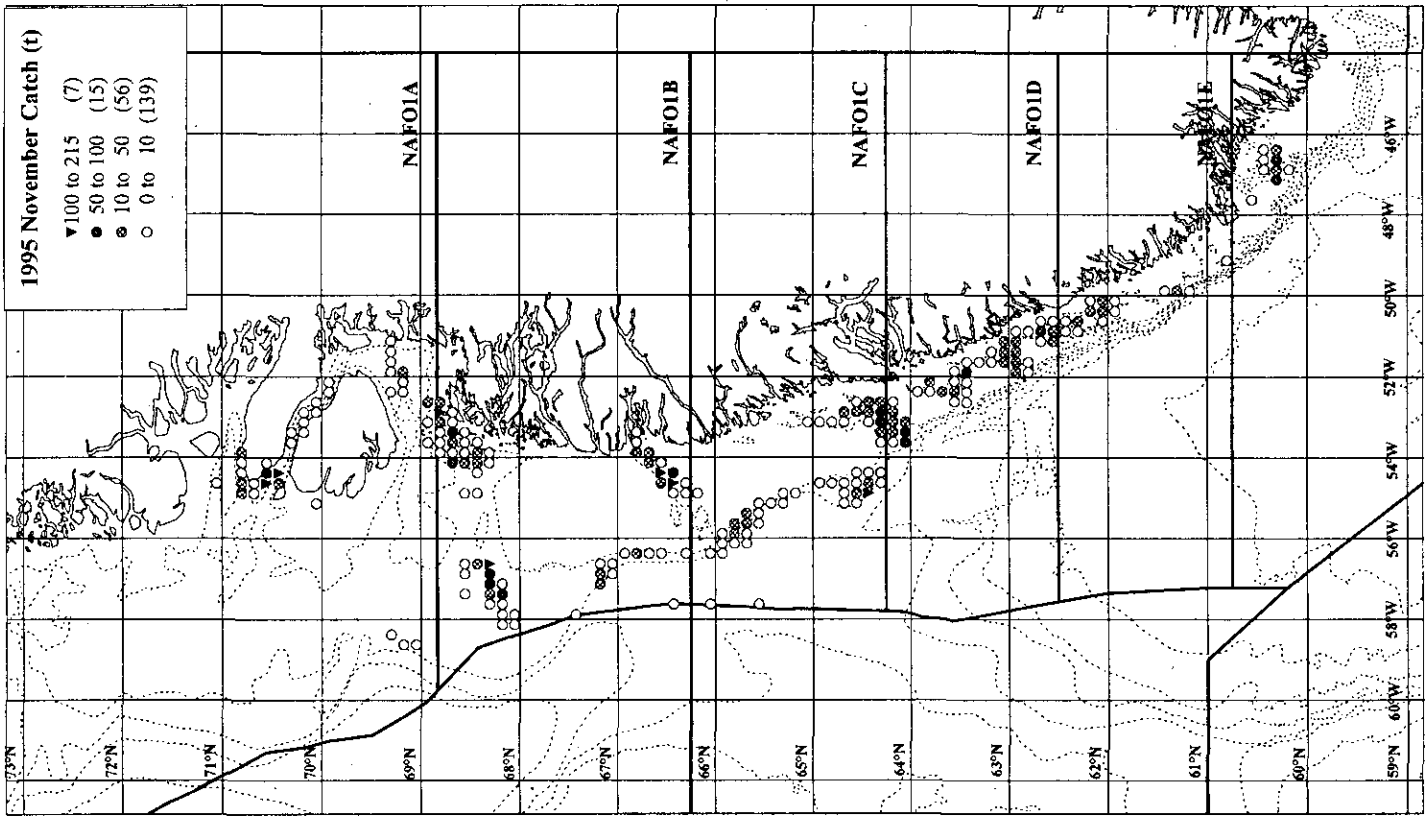

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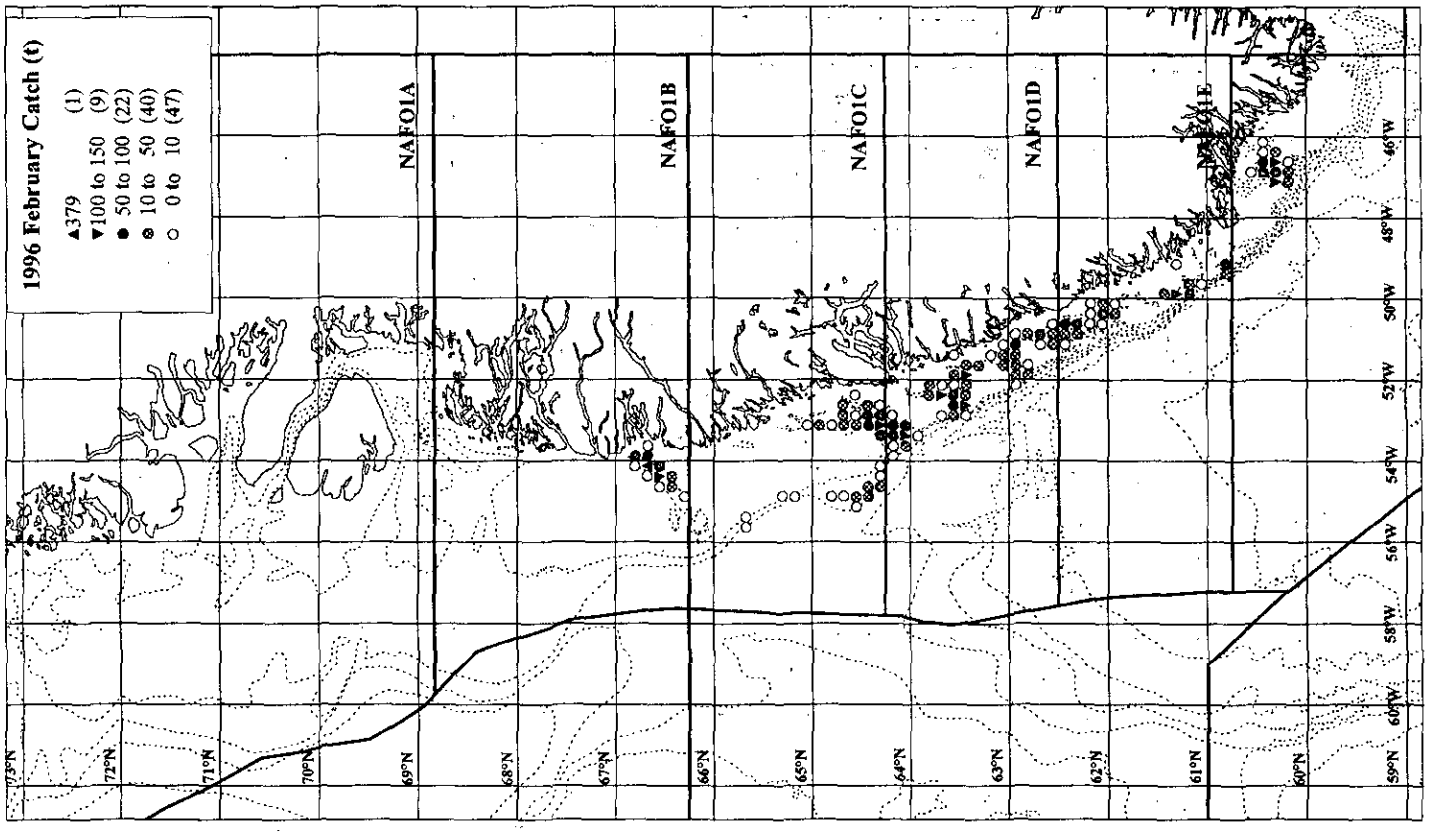

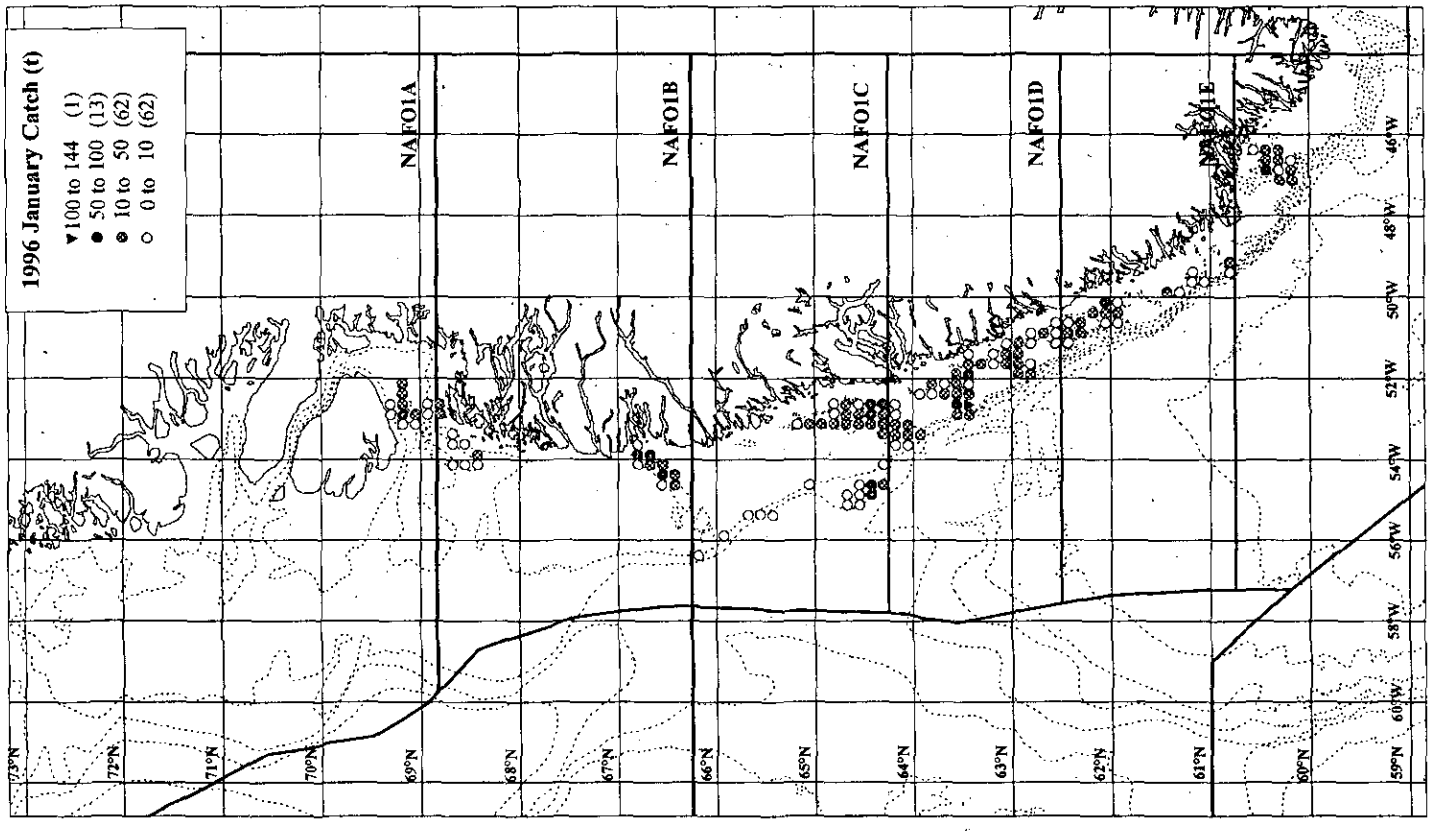

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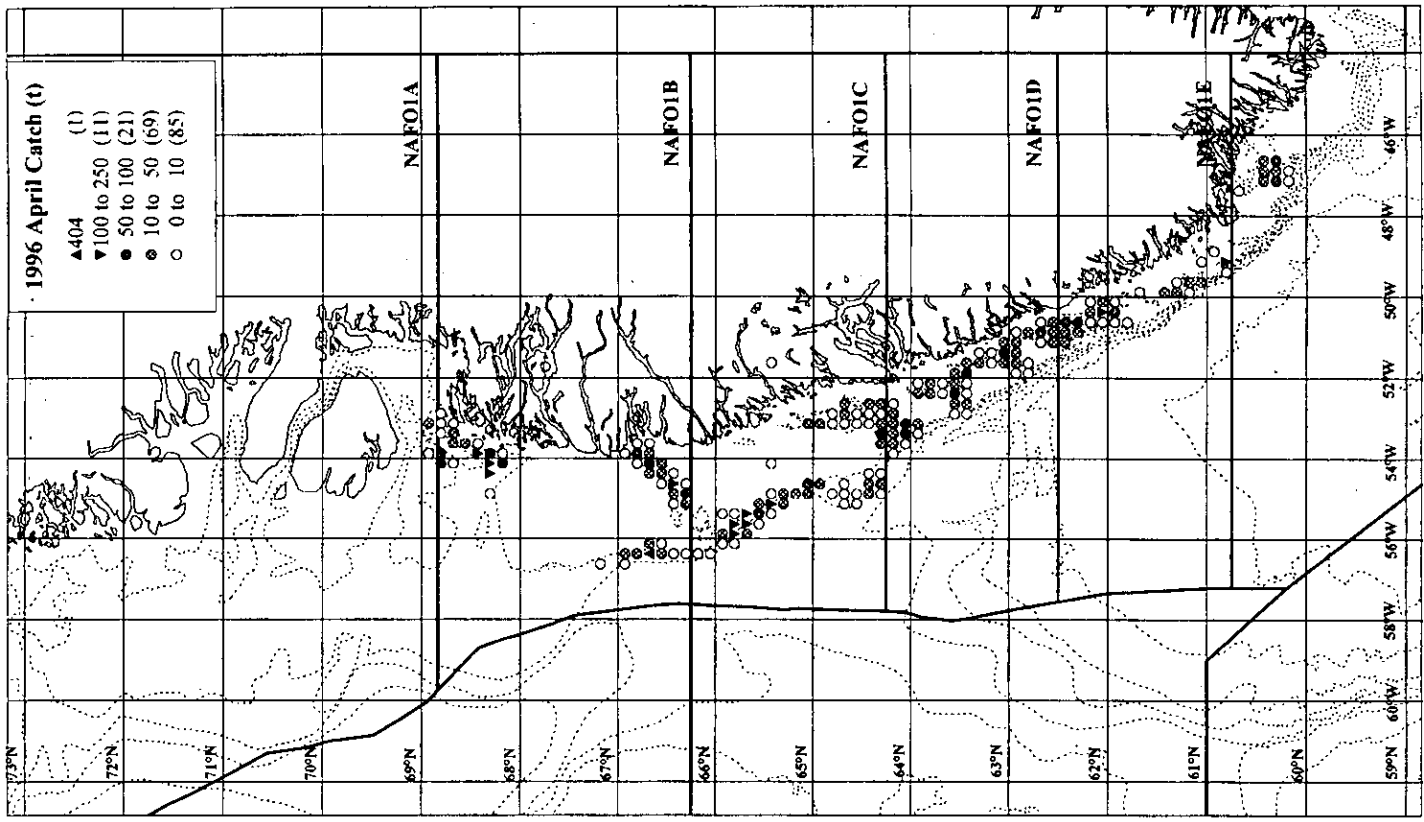

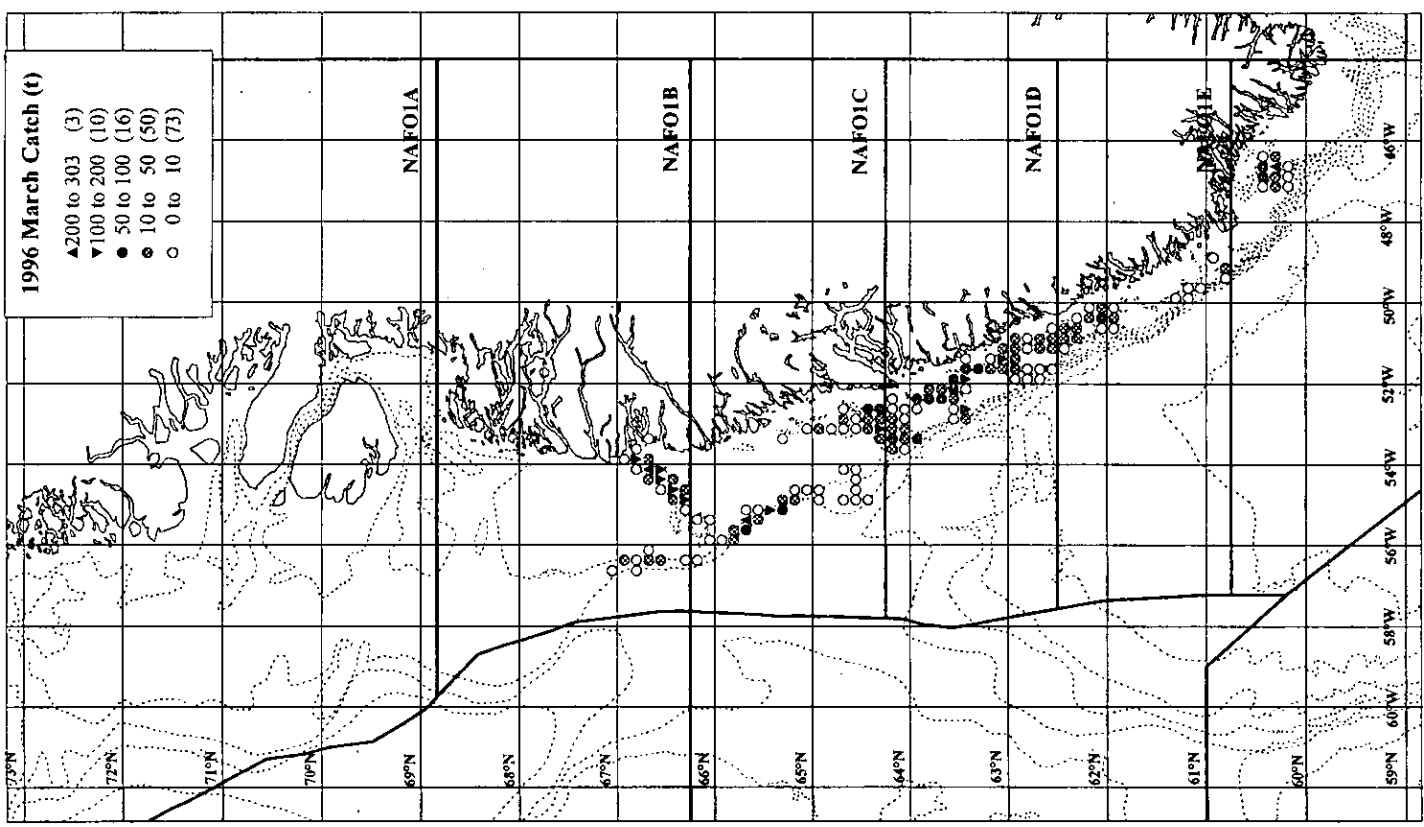

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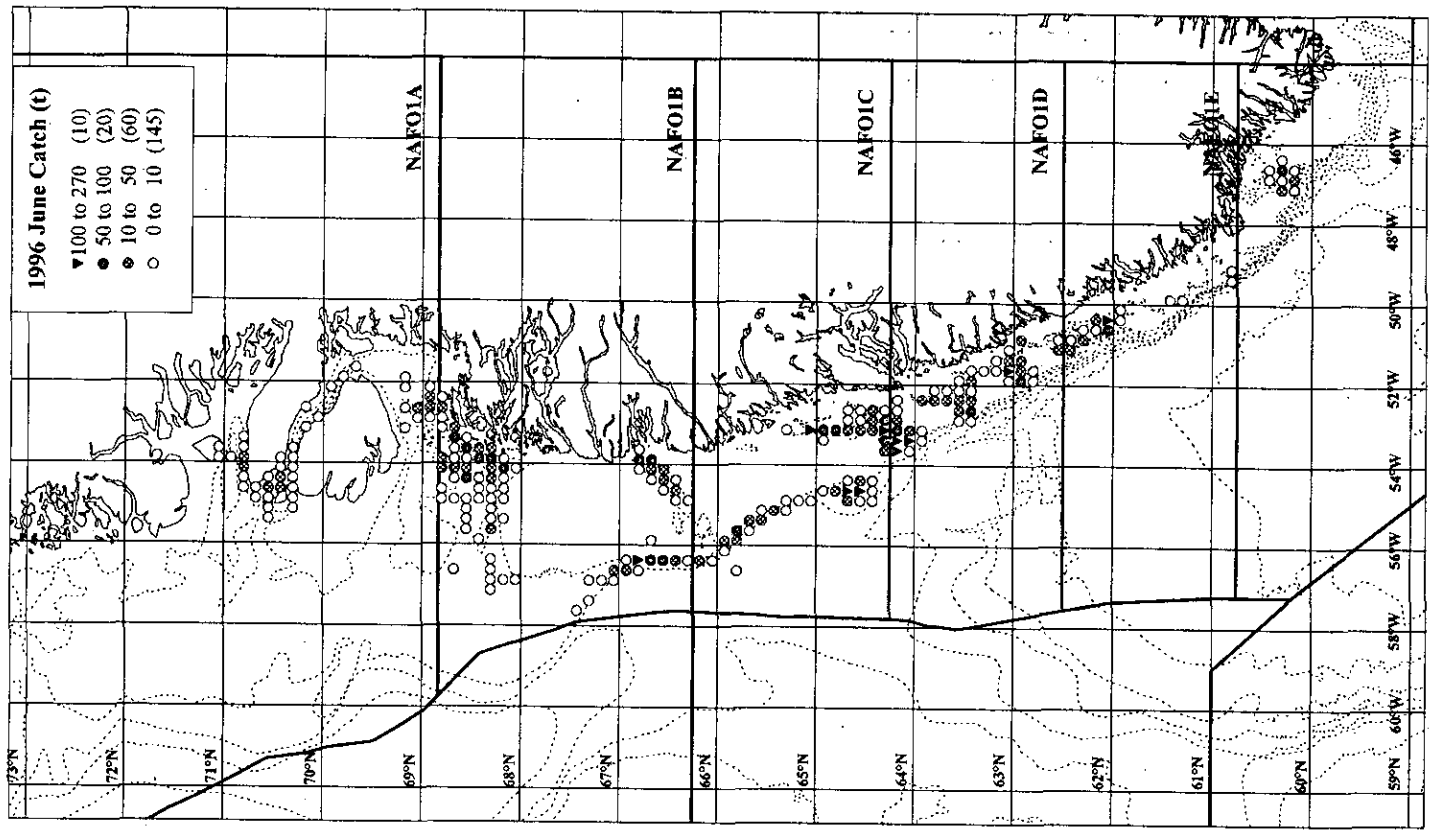

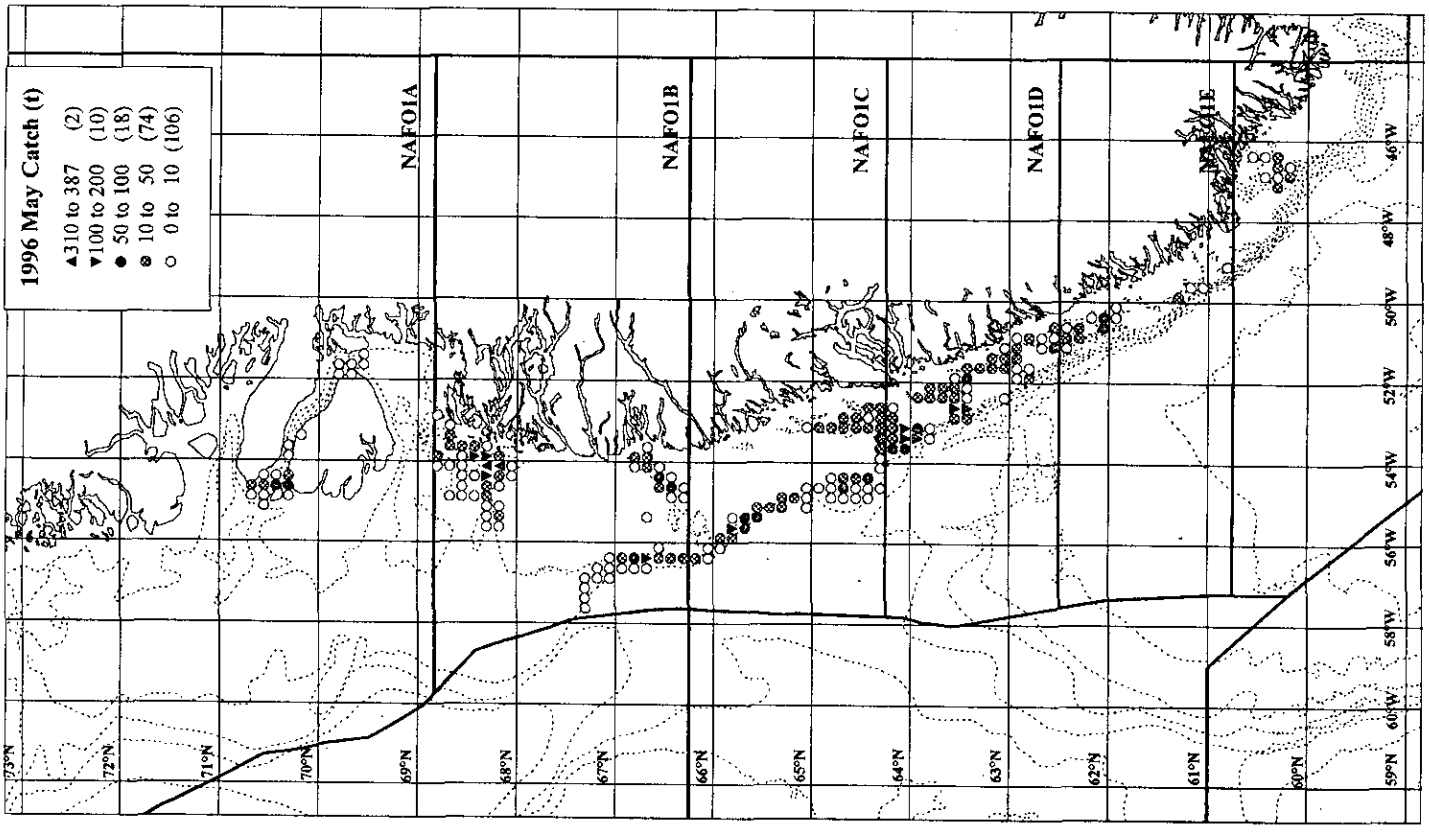

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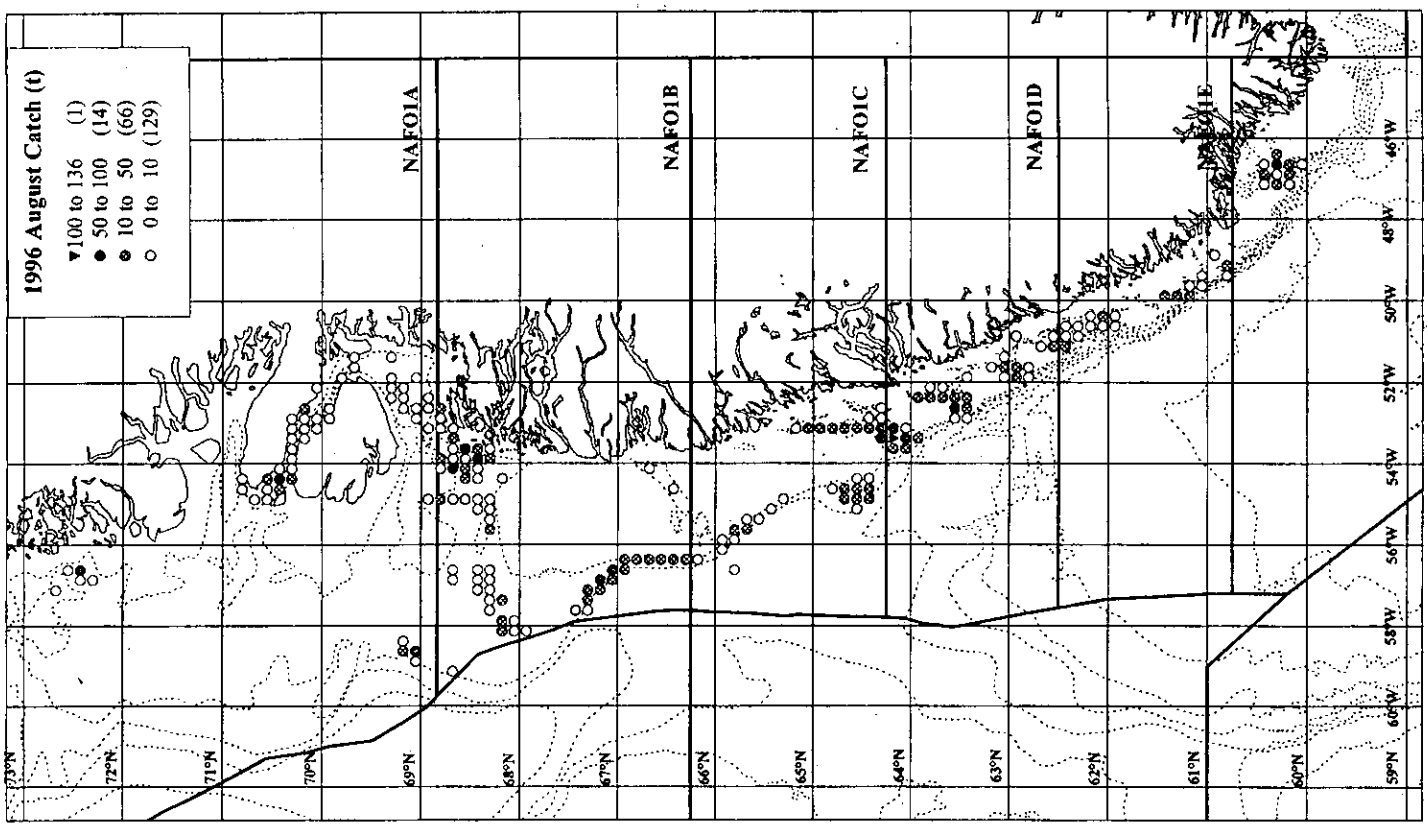

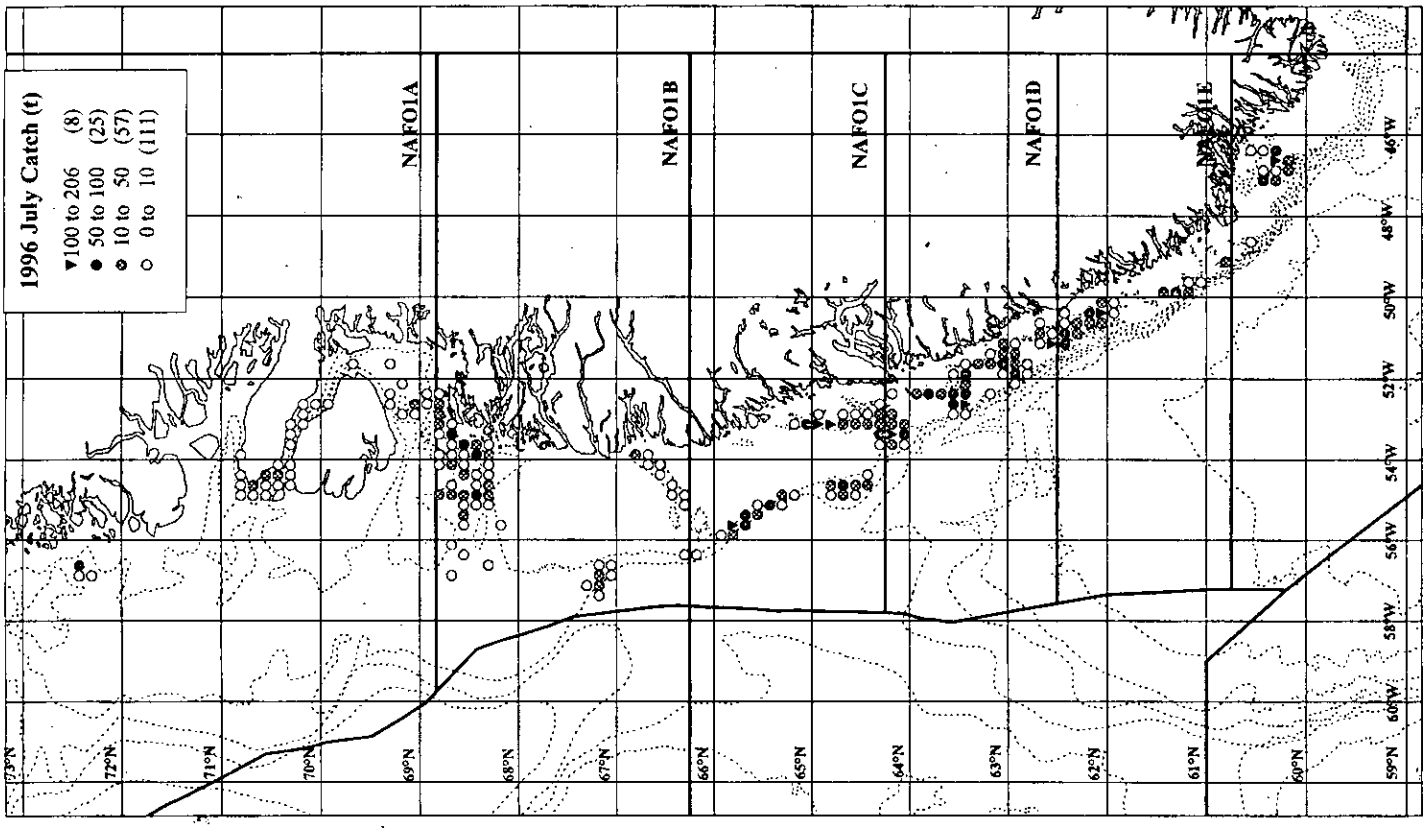

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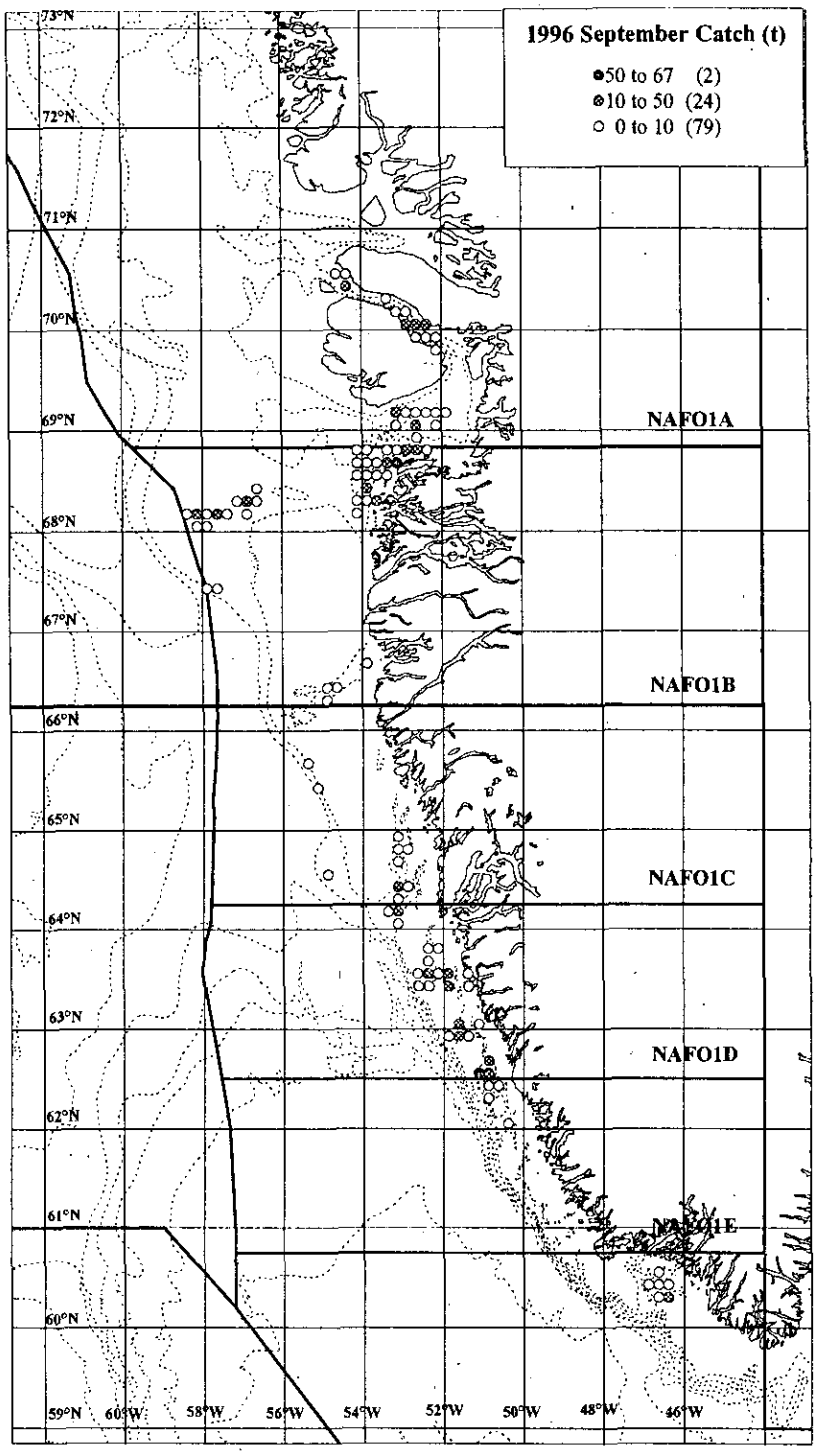

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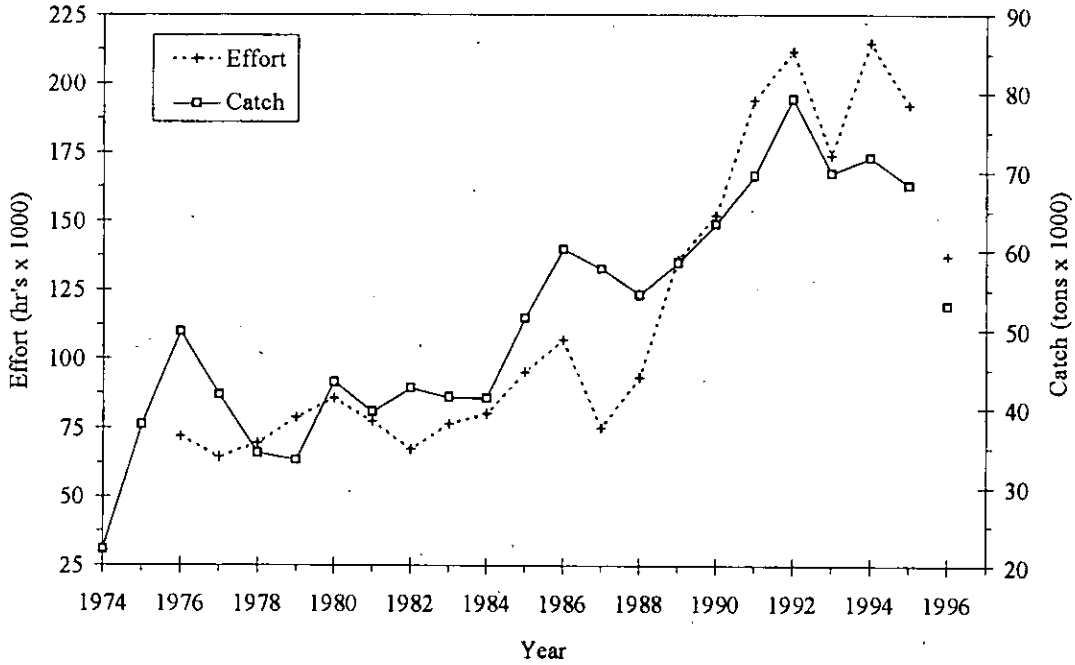

Figure 4. Nominal catch (tons) and standardized effort (hr's) by Greeland vessels in NAFO Subarea 1.

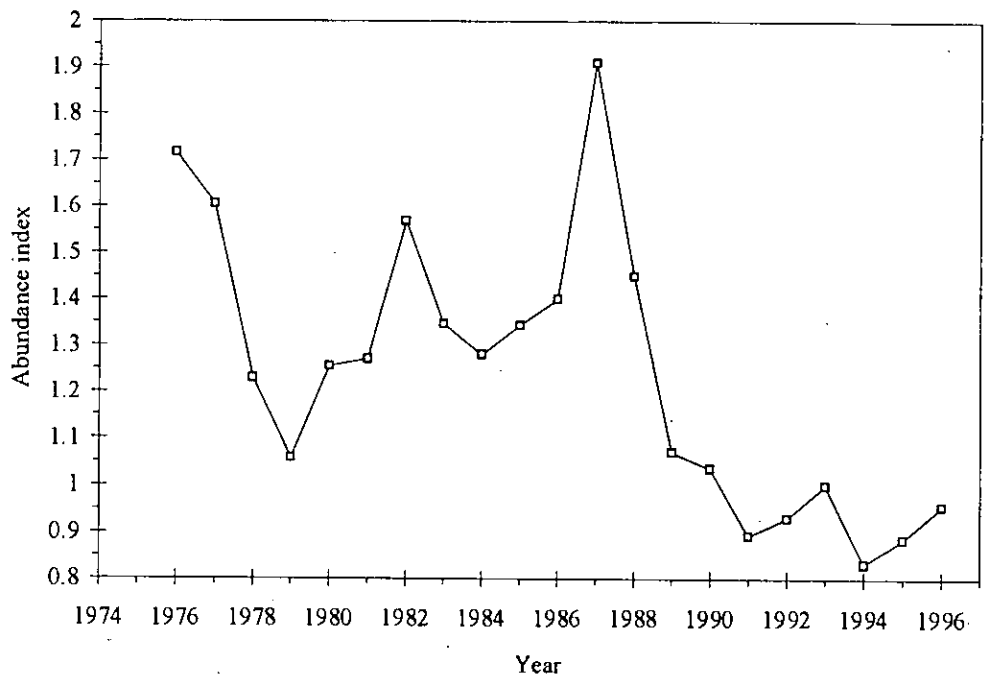

Figure 5. Time series of the combined CPUE index as described in Hvingel et al. (1996) with the 1996 value added.

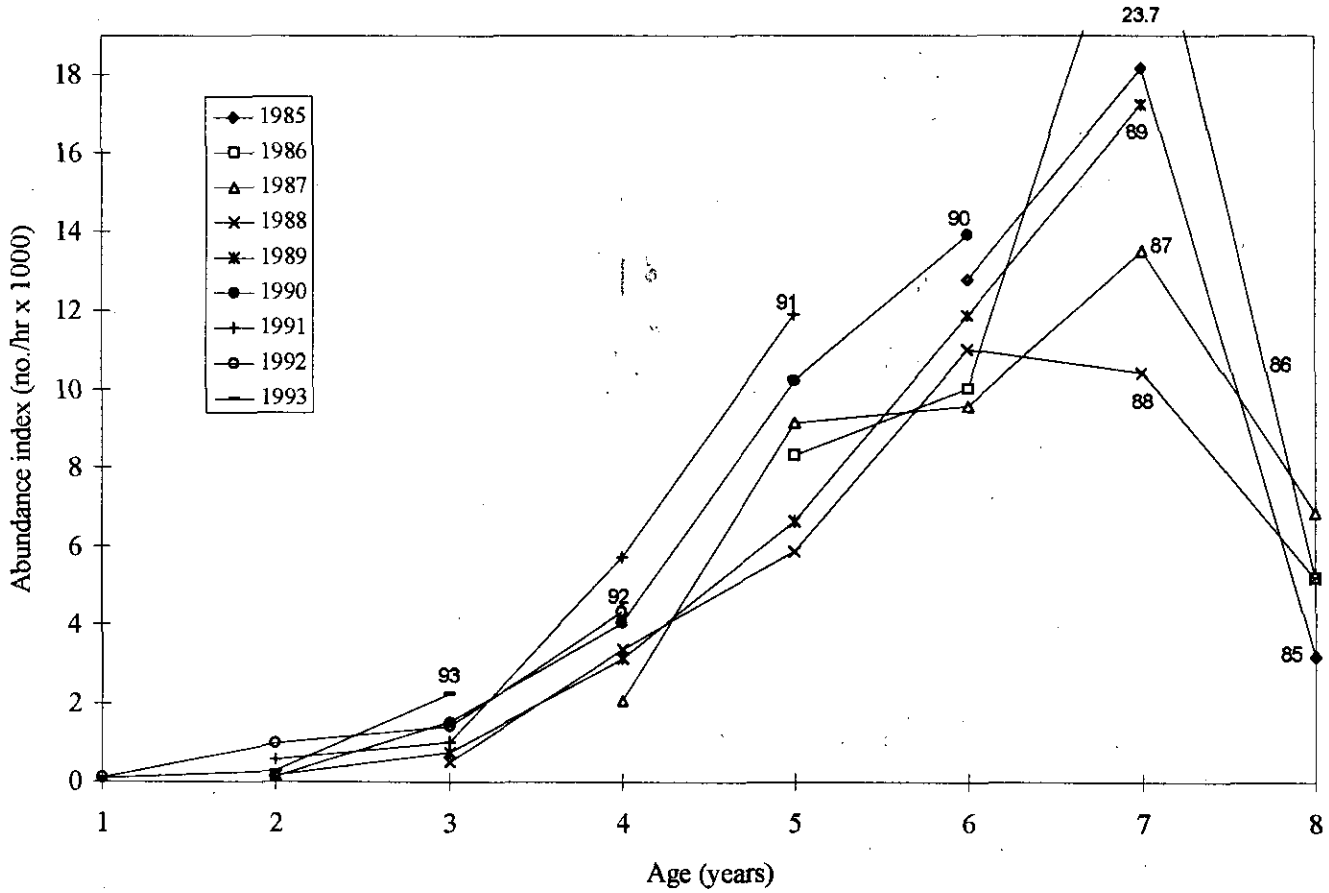

Figure 6. Standardized CPUE index (numbers /hr x 1000) for the year classes 1985-1993 as they appear in the commercial fishery in 1991-1996.

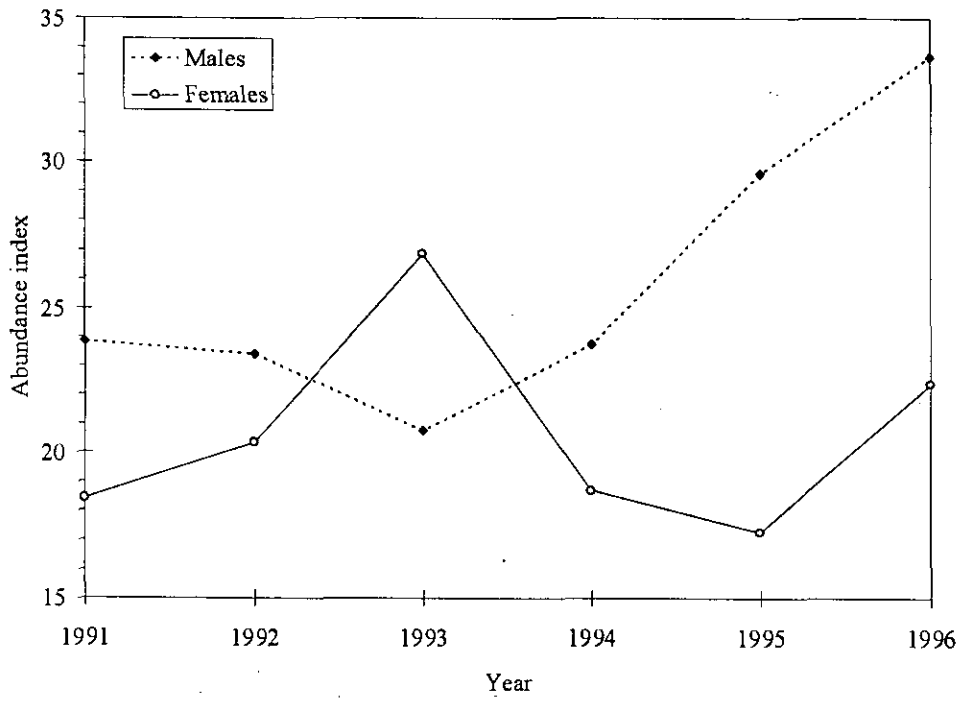

Fig. 7. Standardized catch rates (numbers/hr) of male shrimp (age 1 to 6) and female shrimp (age 7 and 8+) as seen in the commercial fishery 1991-1996.

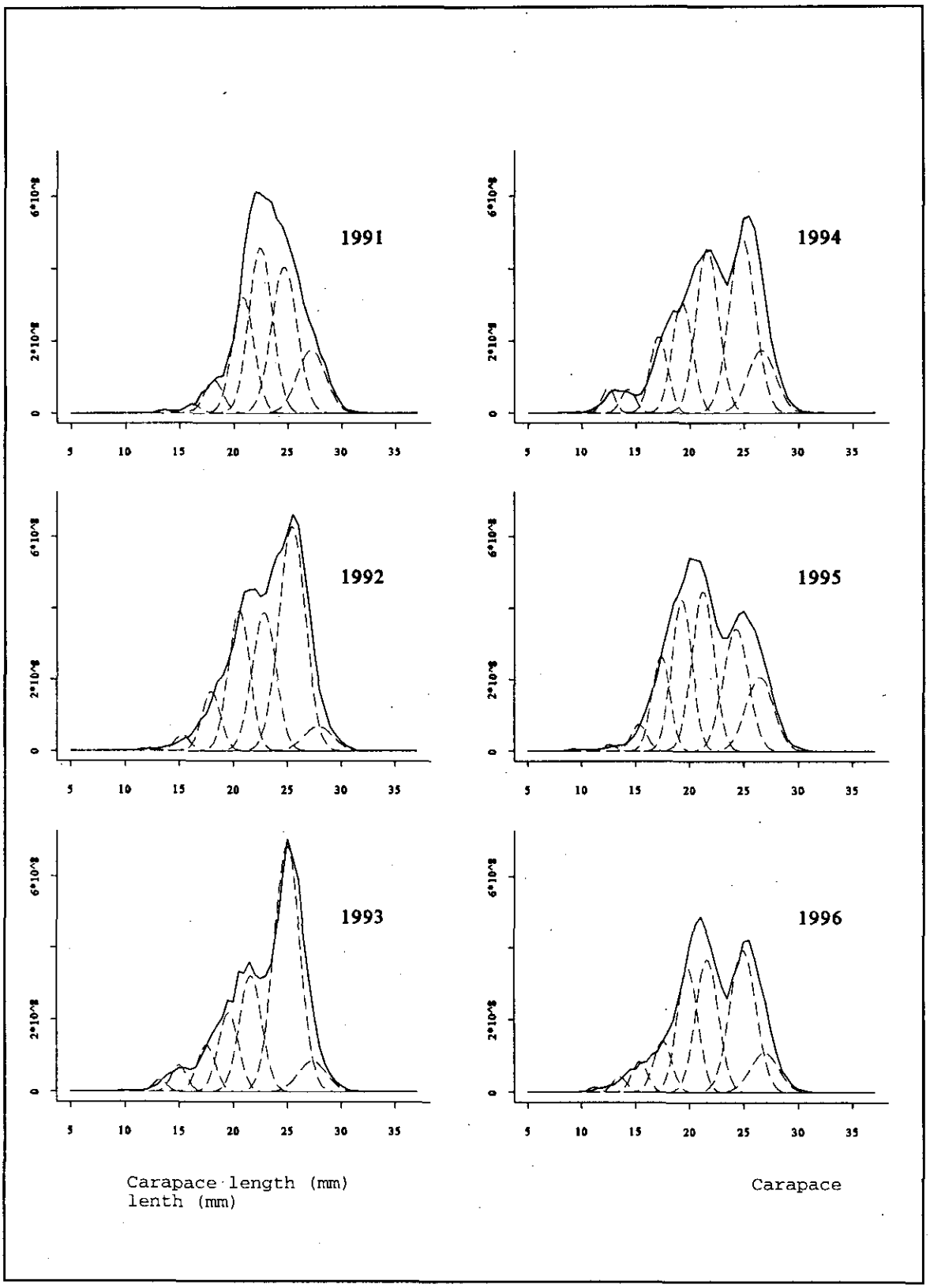

Figure 8. Length frequencies of shrimp caught in the commercial fishery at west Greeland 1991-1996 (solid line). The dotted lines are the distributions of year class 1 to 8+ as calculated by modal analysis (Macdonald and Pitcher, 1979).