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Preliminary Assessment of Shrimp (*Pandalus borealis*) in Davis Strait 1998 (Subareas 0+1)

by

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1. INTRODUCTION

The shrimp stock off West Greenland is distributed to NAFO Div.0A and Subarea 1 and the entire shrimp stock is assessed as a single population. The Greenland fishery exploits the stock in Subarea 1 (Div. 1A to 1F) in offshore and inshore areas (primarily Disko Bay). The Canadian fishery has been restricted to Div. 0A since 1981. The Scientific Council recommended at its 1997 November meeting that 1998 catches be not higher than 55.000 tons and that the TAC be reduced to this level.

Two offshore fleet components, one from Canada and one from Greenland participated in the fishery. The offshore fleet has been restricted by areas and quotas since 1977. An inshore small-vessel Greenlandic fleet was unrestricted by areas and quotas until January 1997, where quota regulation was imposed. The Canadian fishery in Div. 0A is regulated by a quota based on 17% of the advised TAC of the offshore area. Canada set the effective TAC for 1998 to 8.500 tons in Div. 0A and Greenland set the effective TAC to a total of 60.729 tons (36.000 tons to the offshore fleet and 24.729 to the small-vessel fleet).

The following presents the preliminary assessment of the shrimp resource in Davis Strait by summarising and interpreting data from the Greenland and the Canadian fishery and research vessel surveys.

2. COMMERCIAL FISHERY (SCR Doc. 98/111, 113, 123)

2.1. History of the Fishery

Over the last 17 years, the Canadian fishery has been restricted to Div. 0A, between the international boundary to the east and the 500 m depth contour to the west. The Canadian fishery usually takes place from July to November, whereas the Greenland fishery in Subarea 1 occurs in all months (Figure 1). Overall catches in the entire stock area increased until 1992 and decreased from 1993 to 1997 (Table 1, Figure 2). Catches in 1998 are projected to be slightly below the 1997 level.

The nominal catch of shrimp in the offshore areas of Subarea 1and the adjacent part of Subarea 0 (Div.0A) increased from less than 1 000 tons before 1972 to almost 43 000 tons in 1976. The catch fluctuated thereafter, stabilised around a level of 54 000 tons during 1985-88, then increased to 66 000 tons in 1992 and decreased thereafter to 51 000 tons in 1997. Total catch in the offshore area for 1998 is projected to be at the 1997 level. The Canadian fishery in Div.0A amounted to about 2 600 tons in 1996, decreased to 517 tons in 1997 and 875 tons has been reported up to October 1998.

Historically, the fishing grounds in Div. 1B have been the most important. Since 1989, a gradual southward movement in particular of the offshore fishery has taken place and since 1990, catches in Div. 1C+ 1D have exceeded those from Div. 1B. The preliminary catch figures for 1998 do not suggest any significant changes in the

distribution of the fishery from 1996 to 1998 (Fig. 3). At the end of the eighties, exploitation began in Div. 1E and 1F and catches from these areas now account for about 20% of the total catch. Indications of biomass distribution from the German groundfish survey (Rätz, 1997) and the Greenland trawl survey (Carlsson and Kanneworff, 1997) may suggest that the fishery is tracking a southward shift in shrimp biomass. However, development of improved trawling gear for accessing the more difficult trawling grounds in the southern areas may also be an important factor.

The West Greenland inshore shrimp fishery was elatively stable from 1972 to 1987 with estimated catches of 7 000-8 000 tons annually (except for 10 000 tons in 1974). Inshore catches in recent years have increased to over 20 500 tons in 1992, but decreased to 13 500 tons in 1997. Preliminary data for 1998 (January-October) indicate inshore catches at the same level as for the same period for 1997. During the nineties inshore catches have accounted for about 25% of the total catch in SA1.

2.2. Trends in fishing effort and CPUE

Catch and effort data from the shrimp fishery in 1997 and 1998 were available from fishing records from Canadian vessels in Div. 0A and from Greenland logbooks for Subarea 1.

Up to 1986, unstandardised and standardised effort showed a slight increasing trend. Effort more than doubled between 1987 and 1992, and decreased thereafter (Figure 2). The long time trend of the standardised effort is in good agreement with the unstandardised. Twin trawls introduced in 1995 on several Greenland trawlers have been accounted for in analyses of effort data.

Two standardised CPUE indexes were presented in Hvingel et al (1998) (Table 1 and Fig. 2). The standardised CPUE series including mainly female shrimp showed a declining trend in the 1990's (A-index). The preliminary index value presented in 1997 did not change appreciably by adding a complete data set of the year. The projected 1998 value is at the 1997 level. The other index represents the CPUE series of the total catch (B-index) and showed a slightly increasing trend of the 1990's. The projected 1998 value is the highest value in the 1990's.

This discrepancy in the two CPUE series stems from the fact they largely represent two different parts of the stock for this time period. Since 1987 the catch data used in the old index version is a mix of total catch and catch of shrimp larger than 8g, while the data in the new index is total catch only. The divergence of the two CPUE trajectories therefore suggests that the biomass or the availability of shrimp larger than 8g have been reduced throughout the 1990's.

2.3. By-catch and discard

Logbook from the Greenland fleet reports on landed by-catch of *Pandalus montagui*, discards of shrimp and fish during the years 1987-98 (Table 2). Since 1995 Greenland vessels have reported annual catches of *P. montagui* in the range of about 300 to 800 tons. The reported discard of shrimp has been around 0.5% of total catch throughout the period. The recorded discard of fish showed a slightly increasing trend.

2.4. Biological Data

Length frequency distributions obtained by observers were available from the commercial fishery in Div. 0A during the 1996-1998 period (Fig. 7), and in Subarea 1 from 1991 to 1998 (Table 3, Fig. 6).

The proportion of older males and female in the catches in the 1990's has shown a declining trend along with an increase in the proportion of small male shrimp (Table 3). Calculated mean shrimp size caught has declined since 1991 corresponding to a mean individual reduction in weight (g) of about 30% (Fig. 5).

The standardised catch rates for most year classes indicate increasing abundance up to age 6+, as they pass trough the fishery (Table 3, Fig. 4). Expect for the 1993-yearclass, which appeared in large numbers in the fishery at age 4, but in reduces number at age 5 the following year. This suggests an increased mortality on the 1993-yearclass and when it is supposed to appear in the fishery as female in 1999 the abundance could be seriously reduced.

Overall sample data indicate good recruitment, but a gradual decline in the mean carapace length of shrimp taken in this fishery.

3. RESEARCH SURVEY DATA (SCR Doc 98/115, 118)

3.1. Biomass Estimate

Stratified-random trawl surveys have been conducted from 1988 in offshore areas (Subarea 1 + Div. 0A) and from 1991 in inshore Subarea 1 (Fig. 8). Since 1992, the survey extended further to the south in Div. 1F compared to the survey coverage in 1988 to 1991. From 1994 - 1997, the survey has been carried out as a two-phase survey allocating extra trawl hauls to strata with high shrimp densities. The survey in 1998 was carried out in one step only. Compared to earlier years more trawl hauls per day have been obtained and thus a better coverage of the areas: 490 km2 per haul in 1998 compared to 650 km2 per haul at average for the period 1988-1997.

The biomass estimate in Div. 1F has exhibited very large variations between hauls and was thus determined with a very high degree of uncertainty.

The overall biomass estimate from the survey has shown good stability in both the inshore and offshore areas. The offshore estimate varies from 160 to 220 thousand tons, apart from somewhat lower value in 1991 and 1997 (Table 4, Fig. 9). Inshore in Disko Bay is an increase in total biomass indicated for the period 1993-1998 (Table 4, Fig. 10). Large variations from year to year both geographically and over depth zones are observed and may suggest that the stock is highly migratory (Fig. 11).

3.2. Demographic structure offshore

Overall length distribution and results from modal analysis of shrimp in the 1998-survey area show occurrence of a very abundant year-class of large males at 20 mm CL (Fig. 12a, 12b). Also abundance of the female stock component appears high. Because the biomass estimate in the offshore area is not comparable between 1998 and 1994-97 abundance-at-age is not reported.

3.3. Demographic structure inshore

Survey samples from the Disko area from 1995 to 1998 were reanalysed by modal analysis, and a new age-at-length structure has been derived. The new interpretation indicated occurrence of only five year-classes of males or one year-class less than in the former interpretation.

Using the new interpretation the stock composition data from the 1998 survey indicate occurrence of a dominating size group of males at 17 mm in 1997 and at 20 mm in 1998 (Fig. 13). The female component is larger than in 1997 and of the same magnitude as in 1995 and 1996.

4. OTHER INFORMATION

Evaluations of trawl survey (SCR Doc 98/114). A study group was formed in 1998 to evaluate the design and efficiency of the survey. The group assessed the precision of the survey estimates, the effectiveness of the present stratification, the allocation of effort within the survey area, the appropriate tow duration and the suitability of two-stage sampling. The study group also recommended on future survey design and analysis. Following these recommendations the 1998 survey has reduced the tow duration to 30 minutes from the formerly used 60 minutes in about 25 % of the offshore hauls in depths between 200 and 400 meters and the two-phase survey design used from 1994 to 1997 was disconnected.

An experimental survey (SCR Doc. 98/119). An experimental bottom-trawl survey for shrimp was carried out in 1997 to examine small-scale spatial structure of shrimp and fish population densities. This study showed that day-to-day variation was small, and there was a good correlation between days for all species, both overall and within transects. There was no serial correlation in catches along isobathic transects.

Production model (SCR Doc. 98/116). A logistic model of biomass dynamics was fitted to data on catch, standardised CPUE, and research survey biomass. The reliability of the conclusions was investigated by standard jackknife, omitting one year at a time from all the series of raw data. For most of the jackknife results F_{MSY} was estimated consistently, both MSY and B_{MSY} both ranged over a factor of about 170%. STACFIC concluded that further investigation of the behaviour of the model is required.

5. SUMMARY OF ALL INDICES

overall variations in catches:

- overall increase from 1981 to 1992, thereafter decreased from 1992 to 1997. Catches in 1998 are expected to be at the 1997 level.

local variation in catches:

- catches in the inshore area increased till 1992, since then inshore catches have accounted for about 25% of the total catch in SA1
- catches offshore increased from 1988-1992, decreased since
- catches in division 0A have ranged between 6,000 and 7,500 tons from 1987 to 1992, from 1993 catches has decreased

variations in effort:

- overall increase in effort from 1987 to 1992, has decreased since
- effort increased in Div. 0A till 1992, decreased thereafter
- in Div. 1E and Div. 1F increasing effort since 1991 and amount to almost 25% in 1997
- minor shift in effort allocation in inshore/offshore – the inshore fleet optimise the catch for large female after the introduction of the quota

a shift in the fishery:

- from 1987 to 1996 a southward movement of the Greenland fishery has occurred, hereafter it stabilised

trends in recent catch rates:

- standardised CPUE series for female shrimp showed a declining trend in the 1990's
- standardised CPUE series for all shrimp (male + female) showed a slightly increasing trend in the 1990's

composition of catches:

- overall sample data indicate good recruitment, but a gradual decline in the mean carapace length of shrimp taken in this fishery

discard of shrimp:

- level of discarding in 0Adeclined in recent years from a high of 6.5% in 1991 to 1% in 1998
- discard of shrimp has been reported to about 0,5% of total catch throughout the period 1987-98

biomass estimates from research surveys:

- overall stability in both offshore and inshore area
- total offshore biomass show a good stability ranging from 160 to 220 thousand tons, apart from the lower values in 1991 and 1997
- the large increase in offshore estimated biomass from 1997 to 1998 has mainly taken place in areas W3 and W4 in depths between 200 and 400 meter
- the inshore estimated biomass for 1998 amounted to about 65,000 tons and is the highest in the time series
- in Div.0A the estimated biomass has fluctuated between 3,000 to 17,000 tons over the previous years. The estimate for 0A in 1997 and 1998 is the lowest in the time series

demographic structure:

- offshore and inshore males: abundant yearclass of 20 mm CL – probably the 94 yearclass
- offshore and inshore females: estimated number of females was highest

- overall length distribution show a relative strong 1994 year class and recruitment of several year classes of smaller shrimp
- a very abundance yearclass of large males of 20 mm CL is the hole survey area
- also abundance of the female stock component appears high and there is no concern for the spawning potential
- prospects of recruitment to the female group are fair in 1999 and good in 2000

6. STATUS OF THE RESOURCE

Indices from the commercial fishery show that the abundance of shrimp in 1989-98 was stable but lower than the high 1976-88 level. The observed decrease of shrimp abundance from 1987 to 1989 was coincident with a substantial increase in effort. Indices show that the abundance of female shrimp declined in the 1990's, however indices of total (male and female) abundance of shrimp showed a slightly increasing trend in the 1990's. The projected 1998 value for total shrimp abundance is the highest value in the 1990's. Overall commercial sample data indicate good recruitment, but a gradual decline in the abundance of the female component over time.

The observed southward movement of the Greenland fishery from 1987 to 1996 has stabilised. The southward displacement of the fishery may be due to the fleet tracking the southward shift in the distribution of the stock.

The overall biomass estimate from the survey has shown good stability in both the inshore and offshore areas. The offshore estimate varies from 160 to 220 thousand tons, apart from somewhat lower value in 1991 and 1997. Inshore in Disko Bay is an increase in total biomass indicated for the period 1993-1998. Large variations from year to year both geographically and over depth zones are observed and may suggest that the stock is highly migratory.

The combined inputs to the assessment indicate a stable stock that, in 1999, will be able to sustain a fishery similar to that of the latest years. The fishery in 1998 will depend on the relatively strong year class of large male and as it recruit to the female component it will maintain or improve the catch rate. The presence of several year classes, recruiting to the fishable stock in coming years, further suggest that the stock will stay at a level not lower than the present for a number of years, depending on exploitation levels and environmental changes. The stability of shrimp biomass from surveys also indicates a stable stock.

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Table 1. Total catch, unstandardised and standardised effort and CPUE in Subarea 1 and Div. 0A. from 1970-1998.

Year	Catch					Effort unstandardised			CPUE unstandardised		CPUE standardised		Effort standardised	Effort standardised
	Greenland Inshore	Greenland Offshore	Greenland SA1 In+Offshore	Canada Div.0A	Total Subarea 0+1	SA1 Greenland	Div.0A Canada	Total Subarea 0+1	SA1 Greenland	Div.0A Canada	Std. A Index	Std. B Index	Std. A Index	Std. B Index
1970	8.429	130	8.559		8.559									
1971	8.741	696	9.437		9.437									
1972	7.342	2.314	9.656		9.656									
1973	7.950	4.692	12.642		12.642									
1974	10.064	11.945	22.009		22.009									
1975	8.700	29.190	37.890		37.890	74.154		74.154	511					
1976	7.300	42.374	49.674	392	50.066	80.131		80.131	620		1,72	1,51	2,92	3,33
1977	7.800	33.843	41.643	457	42.100	72.980		72.980	571		1,60	1,40	2,62	3,00
1978	7.600	26.747	34.347	122	34.469	84.134		84.134	408		1,23	1,08	2,81	3,20
1979	7.500	25.958	33.458	1.732	35.190	72.408	7.339	79.747	462	236	1,06	0,96	3,33	3,66
1980	7.500	35.778	43.278	2.726	46.004	79.955	7.615	87.570	541	358	1,25	1,12	3,67	4,13
1981	7.500	32.016	39.516	5.284	44.800	88.164	17.672	105.836	448	299	1,27	1,11	3,53	4,02
1982	7.500	35.015	42.515	2.064	44.579	81.064	6.161	87.225	524	335	1,57	1,37	2,84	3,26
1983	7.500	33.854	41.354	5.413	46.767	89.036	19.060	108.096	464	284	1,34	1,19	3,48	3,94
1984	7.500	33.741	41.241	2.142	43.383	84.980	7.650	92.630	485	280	1,28	1,14	3,39	3,80
1985	7.500	43.896	51.396	3.069	54.465	109.369	9.932	119.301	470	309	1,34	1,21	4,06	4,50
1986	7.500	52.634	60.134	2.995	63.129	129.178	6.730	135.908	466	445	1,40	1,28	4,51	4,92
1987	6.921	50.720	57.641	6.095	63.736	136.624	12.413	149.037	422	491	1,91	1,66	3,34	3,85
1988	10.233	44.159	54.392	5.881	60.273	150.061	12.566	162.627	362	468	1,45	1,21	4,16	5,00
1989	13.224	45.198	58.422	7.235	65.657	176.413	18.504	194.916	331	391	1,07	0,97	6,14	6,74
1990	13.630	49.554	63.184	6.177	69.361	206.337	15.252	221.589	306	405	1,03	0,93	6,70	7,46
1991	16.258	52.834	69.092	6.788	75.880	228.721	20.570	249.291	302	330	0,89	0,91	8,51	8,34
1992	20.594	58.664	79.258	7.493	86.751	232.856	17.631	250.486	340	425	0,93	0,99	9,33	8,74
1993	17.916	52.420	70.336	5.451	75.787	206.680	13.493	220.173	340	404	1,00	0,99	7,59	7,65
1994	18.118	53.693	71.811	4.766	76.577	209.650	16.322	225.972	343	292	0,83	0,95	9,21	8,09
1995	16.429	51.900	68.329	2.361	70.690	186.939	7.176	194.115	366	329	0,88	1,03	7,99	6,86
1996	17.359	49.251	66.610	2.623	69.233	168.640	8.600	177.240	395	305	0,92	1,09	7,55	6,34
1997**	13.504	50.496	64.000	517	64.517	191.250	1.534	192.784	335	337	0,77	1,04	8,37	6,18
1998**	15.040	48.960	64.000	875	64.875	172.085	2.522	174.606	372	347	0,77	1,15	8,42	6,00

* The small vessel's kvota was introduced in 1996 but not effective.
** Premiliary

Table 2. Annual discard of shrimp and fish in tons and % of total shrimp catch and catch of *P. montagui* as reported in vessel logs from Subarea 1 1987-98.

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

Table 3. Composition of shrimp catches in NAFO SA 1 as derived from sub samples weighted up to the total catch and analysed by modal analysis to produce catch at age table. Numbers caught were divided by standardised effort to produce abundance at age indices.

Mean size

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

Proportion of total catch

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

Number caught (millions)

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

Numbers caugth (millions)

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

Abundance index

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

Abundance index

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

Table 4. Biomass estimates 1988-98 (thousand tons) in combined areas from north to south.

Area	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
N1-N9	21.9	11.3	11.7	6.0	21.2	9.1	8.5	9.8	9.1	7.1	7.8
W1-W2	57.7	56.6	78.4	38.8	55.6	103.2	81.1	42.6	54.5	37.9	43.7
W3-W4	65.9	81.5	48.3	41.1	37.8	41.5	45.2	43.5	30.3	15.6	112.3
C1+C3	9.3	3.8	11.4	4.7	16.8	3.6	7.0	5.1	1.7	0.3	0.5
W5-W7	16.8	38.4	24.7	28.6	47.7	67.3	36.2	57.4	90.8	52.5	53.3
S1-S2	-	-	-	-	-	-	23.7	1.8	3.8	26.1	23.1
Total	171.5	191.7	174.6	119.1	179.1	224.6	201.7	160.1	190.2	139.5	240.5

Table 5. Estimated trawlable biomass in offshore and inshore areas from 1988 to 1998

Areas	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
N1-N4	12,816	8,120	9,568	3,961	14,459	8,161	3,285	3,130	7,494	4,100	5,918
N5-N9	6,797	5,150	2,387	1,363	4,368	319	5,187	6,658	1,614	3,000	1,842
W1	34,893	22,970	32,833	22,459	31,785	56,559	38,625	22,277	25,713	11,487	9,943
W2	22,764	33,601	45,577	16,290	37,279	46,597	42,427	22,655	28,818	26,425	33,713
W3	42,706	51,805	35,694	26,655	27,738	21,871	34,822	30,486	26,574	14,838	33,800
W4	23,209	29,726	12,556	14,451	11,006	18,965	10,327	12,829	3,689	737	78,515
W5	16,758	38,421	17,149	15,467	35,384	24,655	27,836	25,877	47,853	43,726	16,262
W6			7,593	13,083	12,788	34,569	7,861	11,350	32,405	1,246	22,757
W7						7,246	316	4,695	10,599	7,584	14,232
S1+S2					483	19,872	22,053	1,784	3,806	26,100	23,106
Disko				48,614	45,053	32,169	41,289	47,080	54,744	48,880	64,167
C1+C3	9,305	3,870	11,398	4,776	16,763	3,609	7,037	5,138	1,740	255	460
Total SA0+1 inshore+	169,247	193,662	174,755	167,120	237,105	274,594	241,064	193,957	245,048	188,378	304,715

Table 6. Length- and percents-at-age of males, and abundance-at age of all shrimp based on modal analysis of total length distributions from the survey area (N+C+W), 1988-98 (old length-at-age interpretation).

Males, lengths-at-age

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Mean
1						9.3	8.5	8.5	8.5	8.6	8.9	8.7
2	12.3	12.6	12.0	12.7	13.2	11.9	11.9	10.9	11.6	11.8	11.0	12.0
3	14.7	15.4	14.0	15.8	15.1	14.1	14.3	13.7	13.8	14.3	14.2	14.5
4	17.4	17.3	16.8	17.3	17.2	16.9	16.8	17.1	16.8	17.5	16.5	17.1
5	19.9	19.5	19.2	19.8	19.3	19.3	19.5	19.7	19.2	20.3	19.7	19.6
6	22.3	22.1	21.2	21.5	22.0	21.8	22.0	22.3	21.4	22.0	21.7	21.8

Males, percents-at-age

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Mean
1						1.6	1.0	2.9	2.2	4.5	1.1	2.2
2	2.3	1.4	3.8	1.3	3.4	6.8	5.3	2.7	5.8	4.9	1.9	3.8
3	4.7	14.5	4.8	5.2	11.8	10.7	9.6	6.3	24.2	10.3	8.7	10.2
4	19.0	50.1	14.4	14.1	15.1	22.5	26.4	20.0	21.3	38.4	19.4	24.1
5	39.2	21.9	53.4	18.1	27.1	32.1	27.9	42.1	18.2	19.5	58.9	30.0
6	34.8	12.1	23.6	61.3	42.7	26.3	29.8	26.0	28.3	22.3	10.1	30.7
Total	100.0	100.0	100.0	100.0	100.1	100.0	100.0	100.0	100.0	99.9	100.1	101.0

Abundance-at-age, all shrimp (billions)

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Mean
1						0.5	0.3	0.5	0.7	0.7	0.4	0.5
2	0.4	0.4	0.8	0.2	0.7	2.2	1.3	0.5	1.9	0.8	0.6	0.9
3	0.9	4.6	1.1	0.6	2.5	3.4	2.4	1.1	8.0	1.6	2.9	2.6
4	3.4	16.0	3.2	1.7	3.2	7.2	6.6	3.6	7.0	6.1	6.4	5.8
5	7.1	7.0	11.7	2.2	5.7	10.2	7.0	7.6	6.0	3.1	19.4	7.9
6	6.3	3.9	5.2	7.5	8.9	8.4	7.5	4.7	9.3	3.5	3.3	6.2
7+	7.7	6.0	8.0	4.4	5.5	7.9	6.4	5.1	5.6	4.4	7.7	6.2
Total	25.8	37.9	29.9	16.6	26.4	39.7	31.4	23.1	38.5	20.2	40.6	30.2

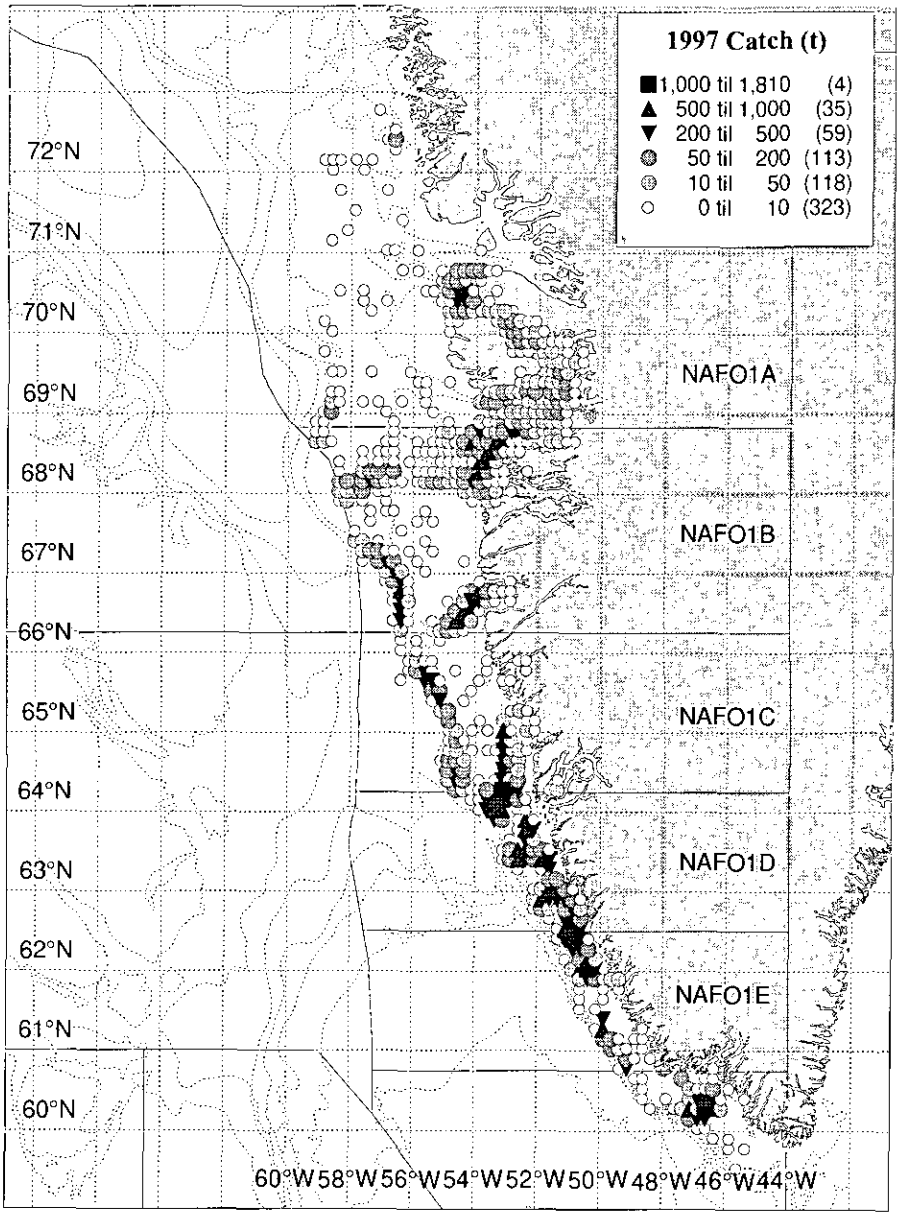

Figure 1. The geographical distribution of the catches in Subarea 1 in 1997.

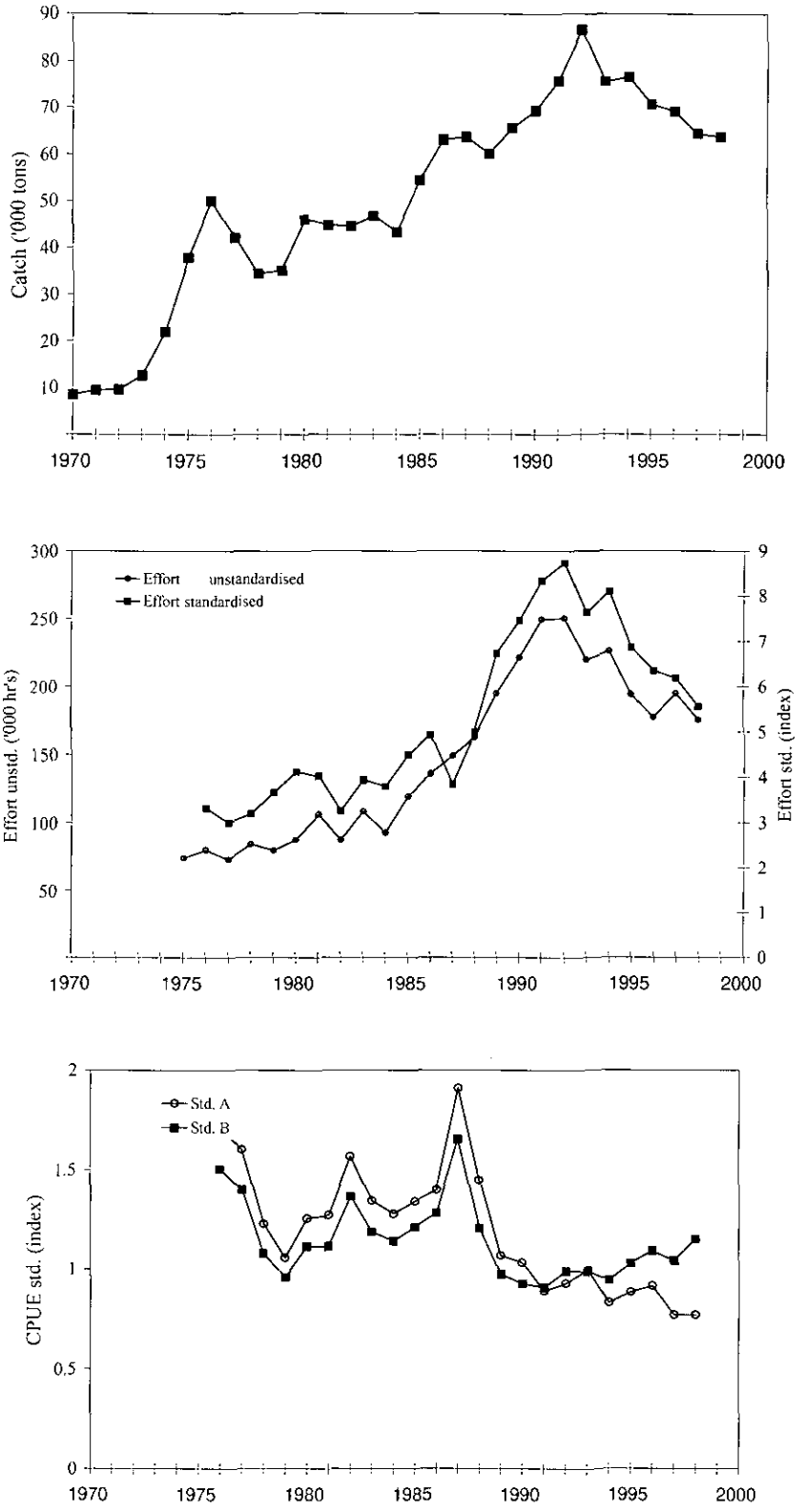

Figure 2. Total catch (panel A) and effort of the shrimp fishery by Canada and Greenland in NAFO SA 1 and Div. 0A and standardised effort and CPUE indices of the shrimp fishery in NAFO SA 1 and Div. 0A (panel B and C). Effort is calculated as total catch/CPUE. CPUE is weight/hr' towed as calculated from vessel logs. Data for 1998 are projected values.

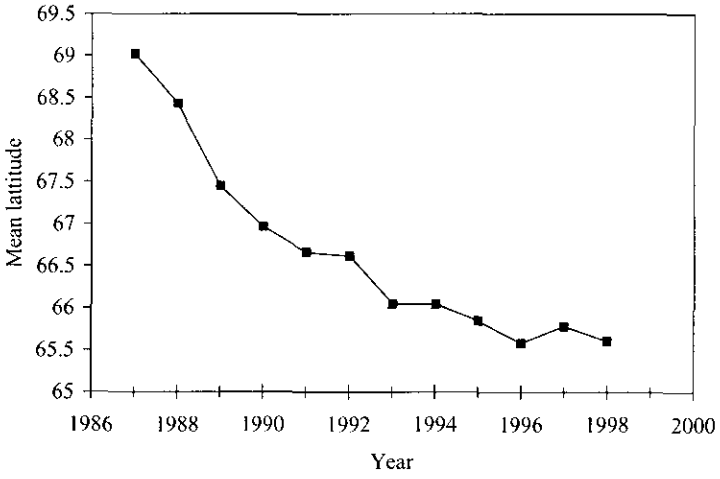

Figure 3. Mean latitude (°N) of allocated effort by the Greenlandic offshore fleet 1987-98.

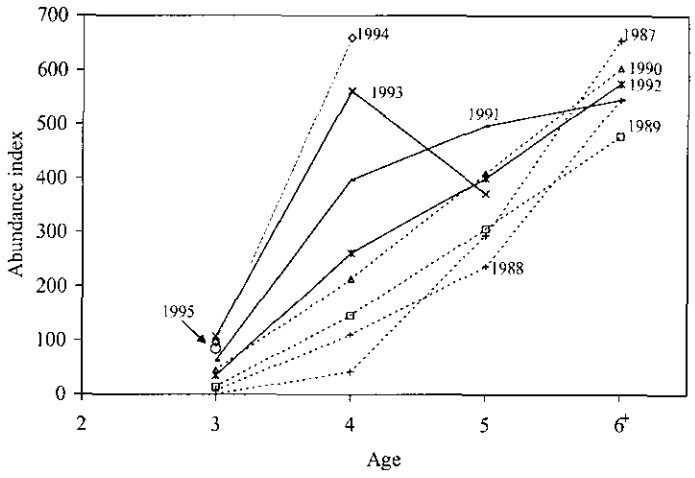

Figure 4. Standardised CPUE indices of the year classes 1987-95 as they appeared in the offshore fishery 1991-98 (data from Table 6).

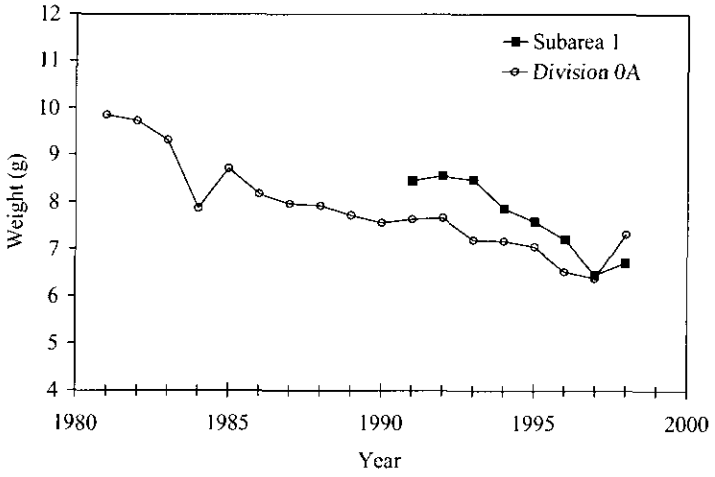

Figure 5. Mean shrimp size (g) in catches in Subarea 1 and Division 0A. (Data on Div. 0A from Parsons pers. Comm.)

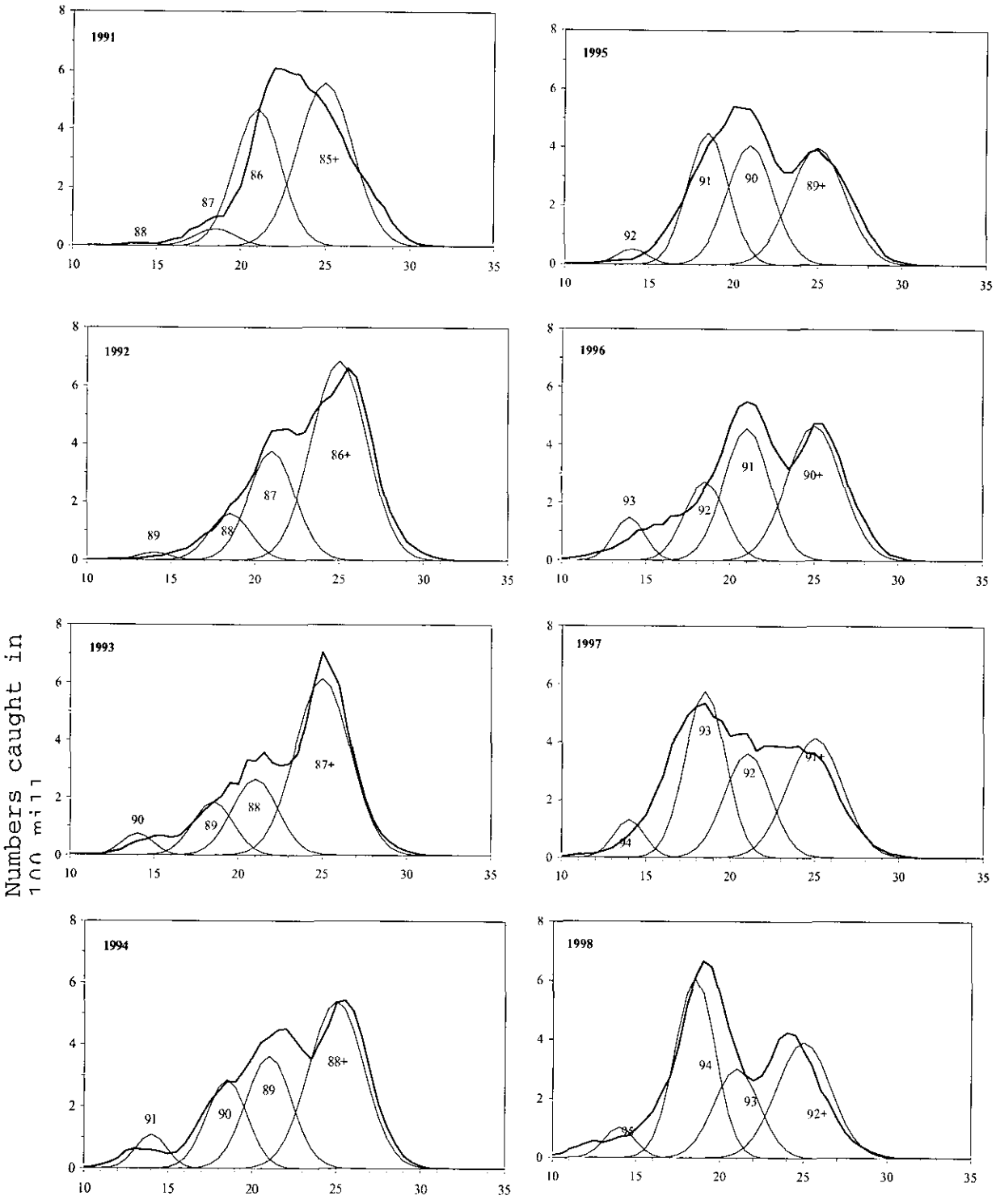

Figure 6. Length frequency distributions of commercial shrimp catches in Subarea 1 1991 – 1998 and the estimated modes of year classes 3 to 5 and the 6+ group.

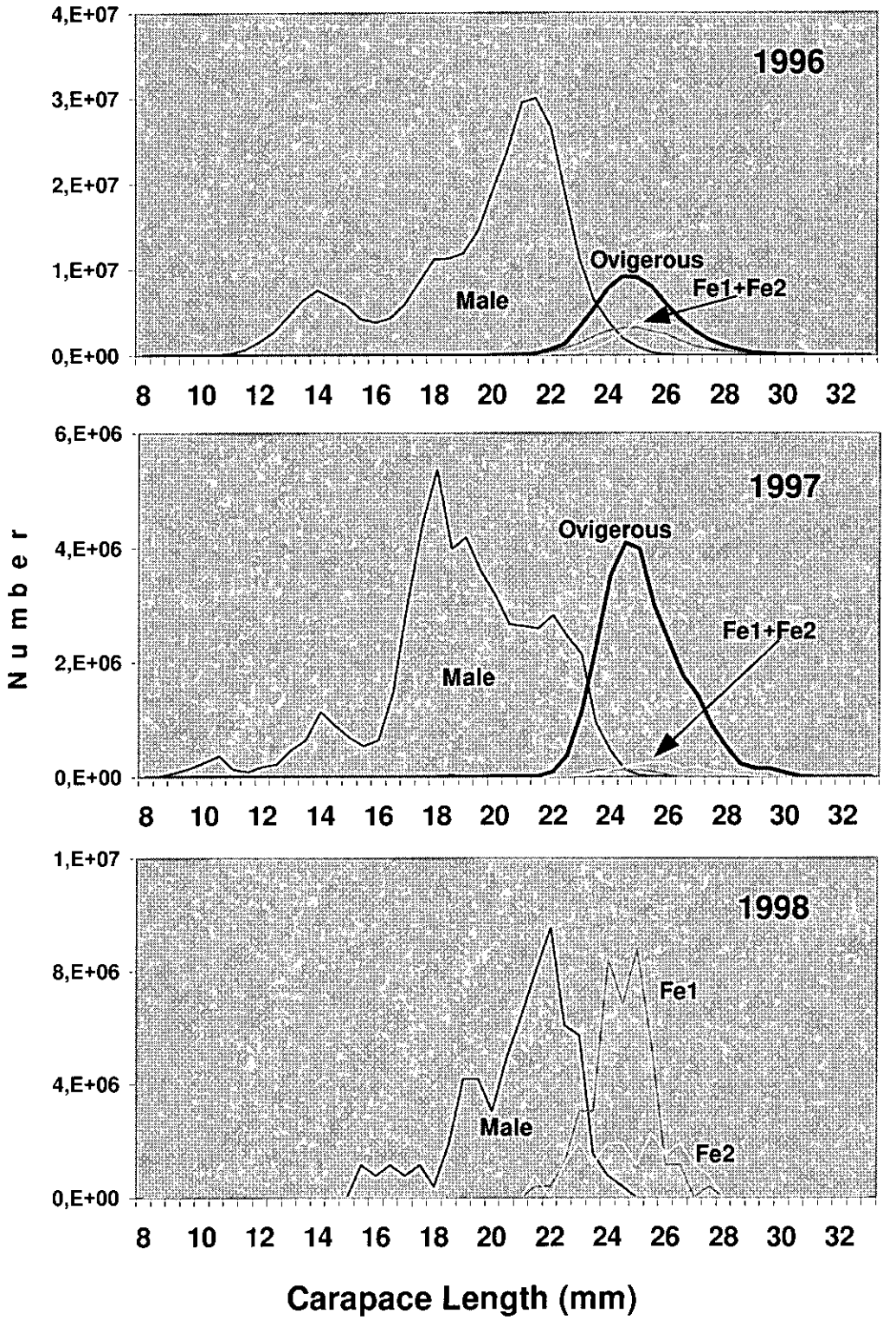

Figure 7. Length frequency distributions for shrimp from the Canadian fishery in Div.0A, 1996-1998.

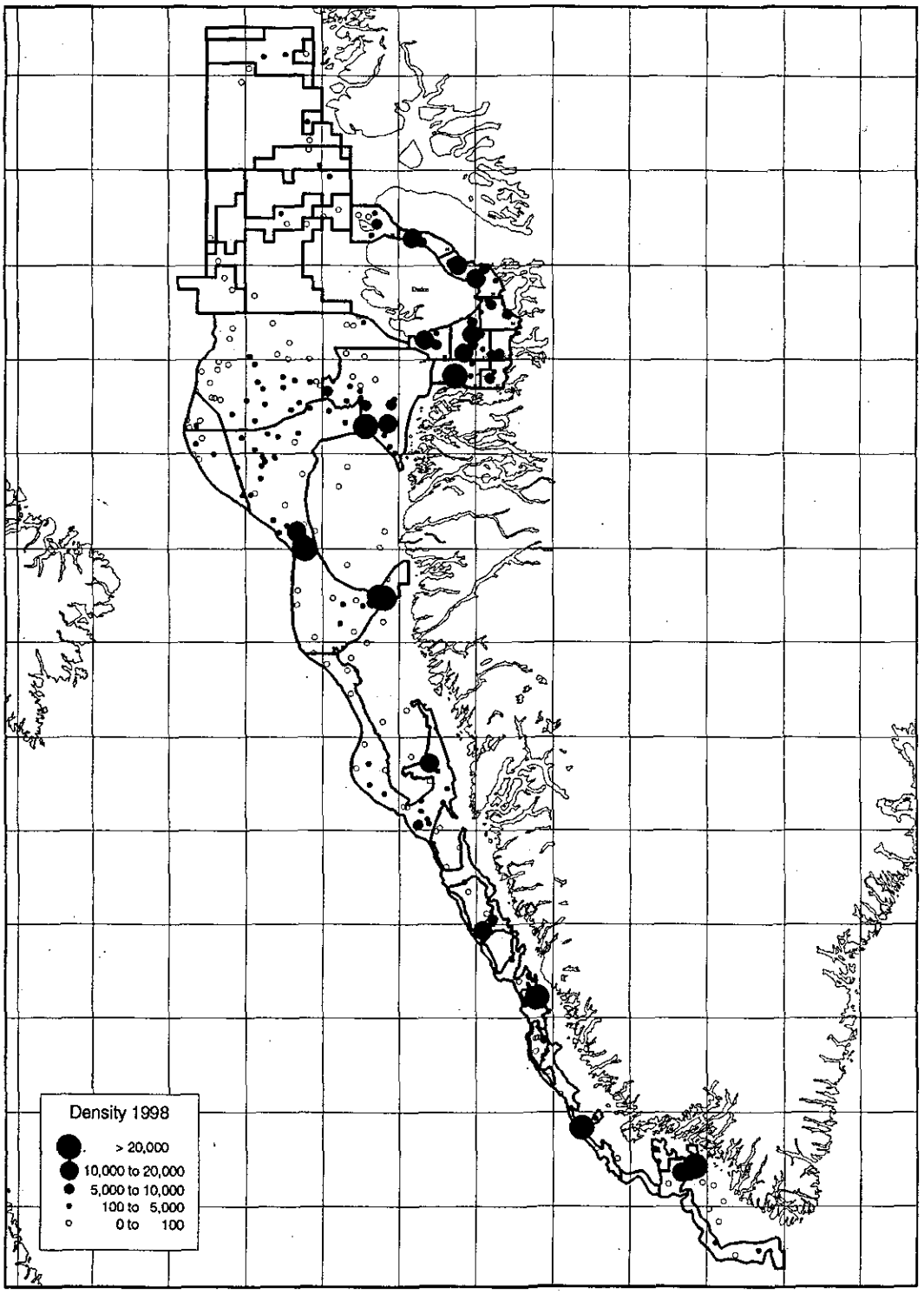

Figure 8. Sampling sites and shrimp densities (kg per km2 swept area) in the trawl survey in 1998.

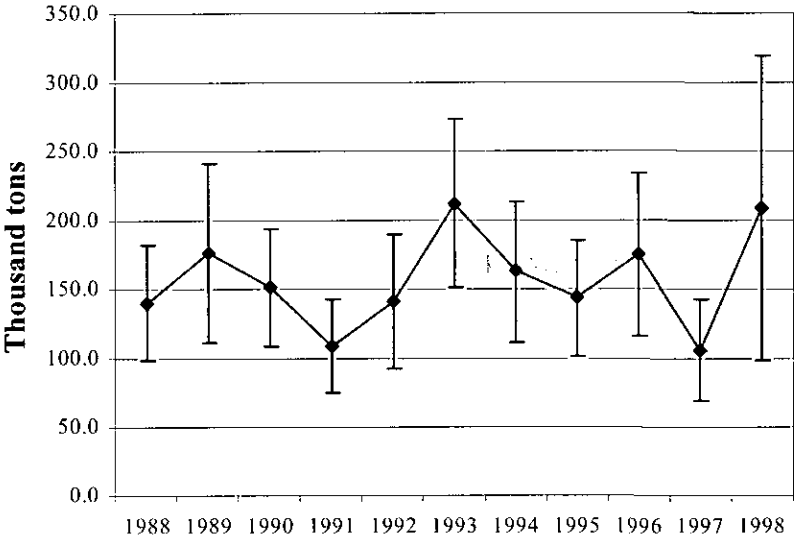

Figure 9. Estimated yearly biomass 1988-98 for region W with 95 % confidence limits.

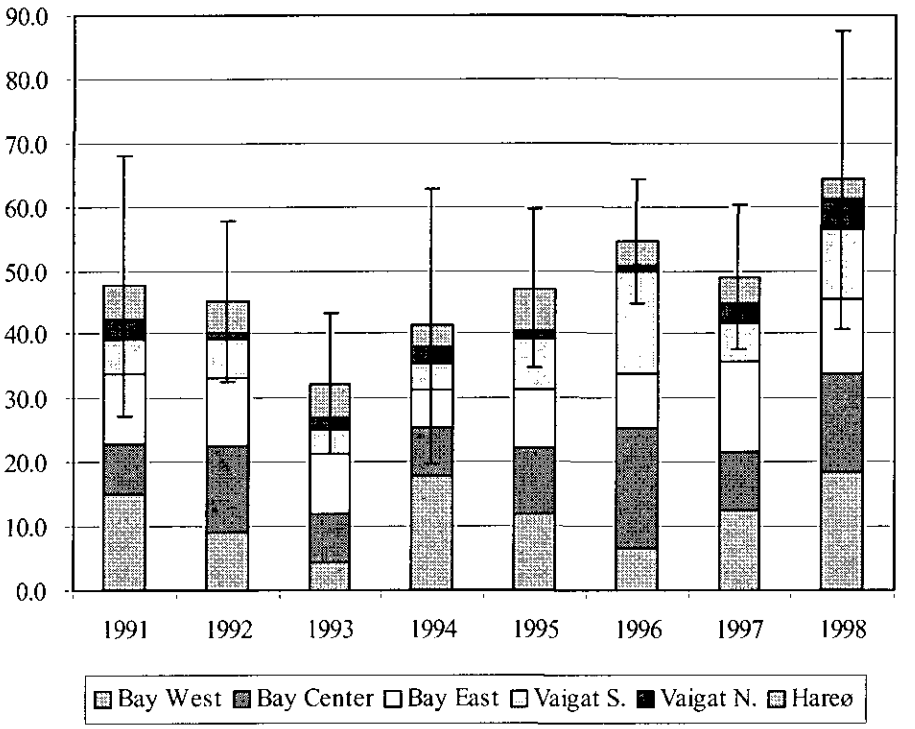

Figure 10. Estimated biomass 1991-98 in different parts of the Disko Bay – Vaigat area. Approximate confidence limits (95 %) for the total biomass estimates are also indicated.

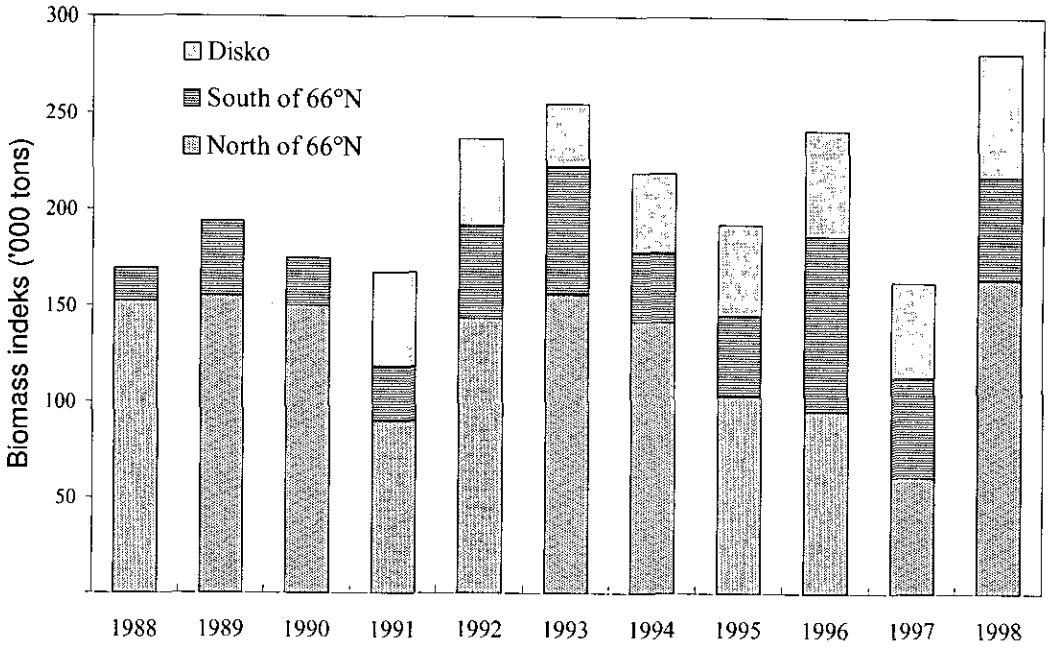

Figure 11. Estimated biomass 1988-98 in Disko Bay and North and South of 66 N offshore in West Greenland.

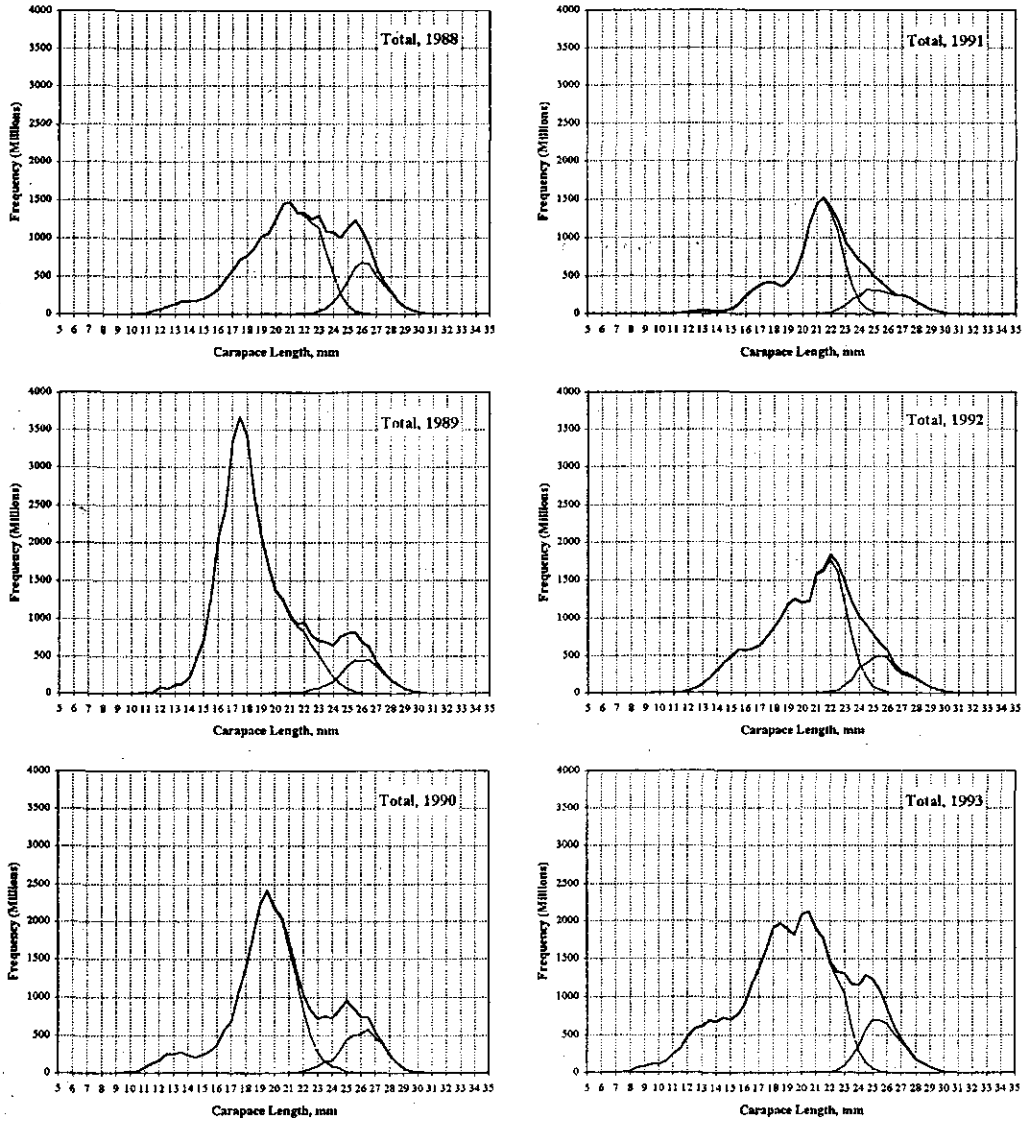

Figure 12a. Numbers of shrimp by length group (CL) in offshore survey area (excluding region S) in 1988-93.

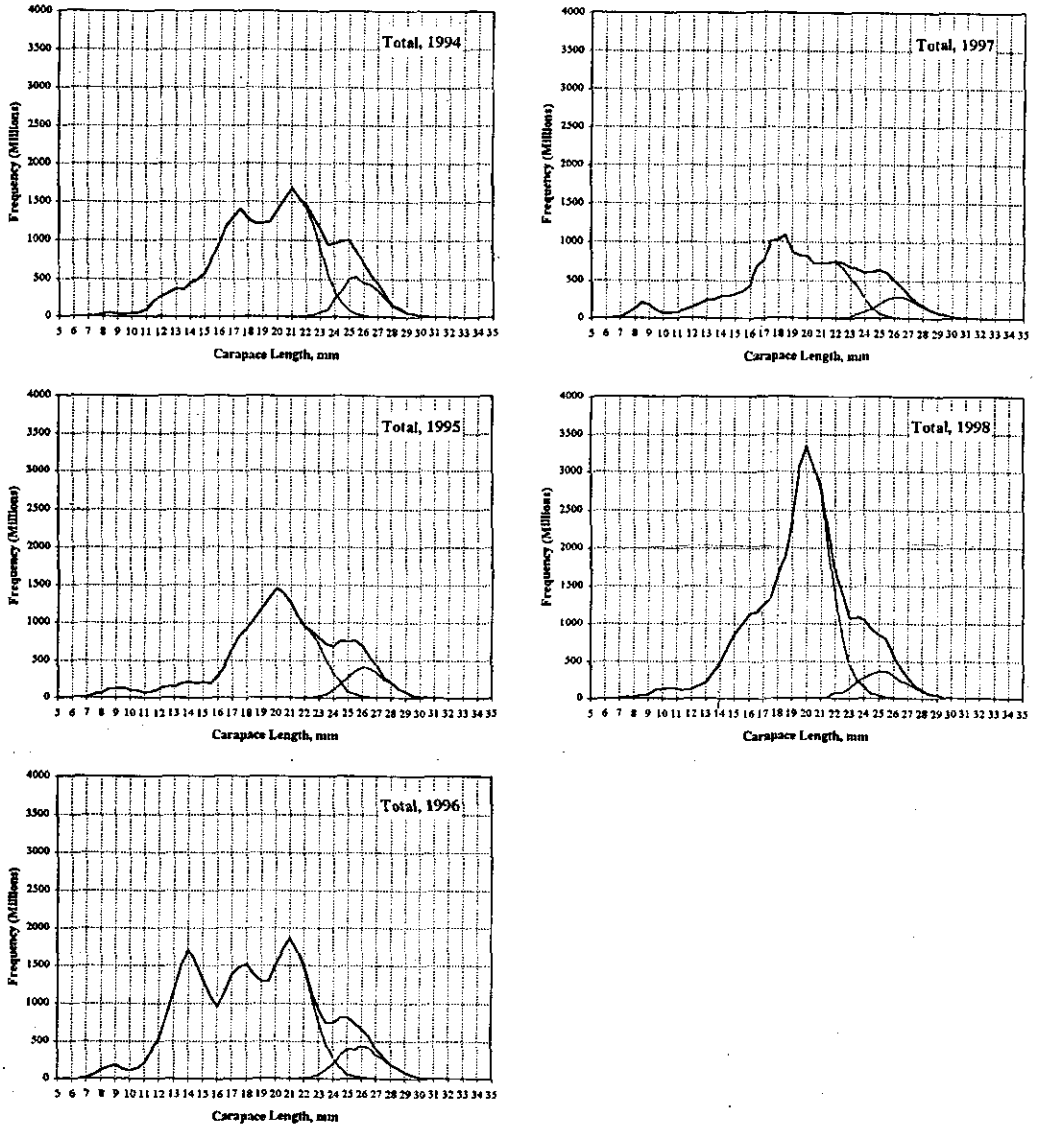

Figure 12b. Numbers of shrimp by length group (CL) in offshore survey area (excluding region S) in 1988-93.

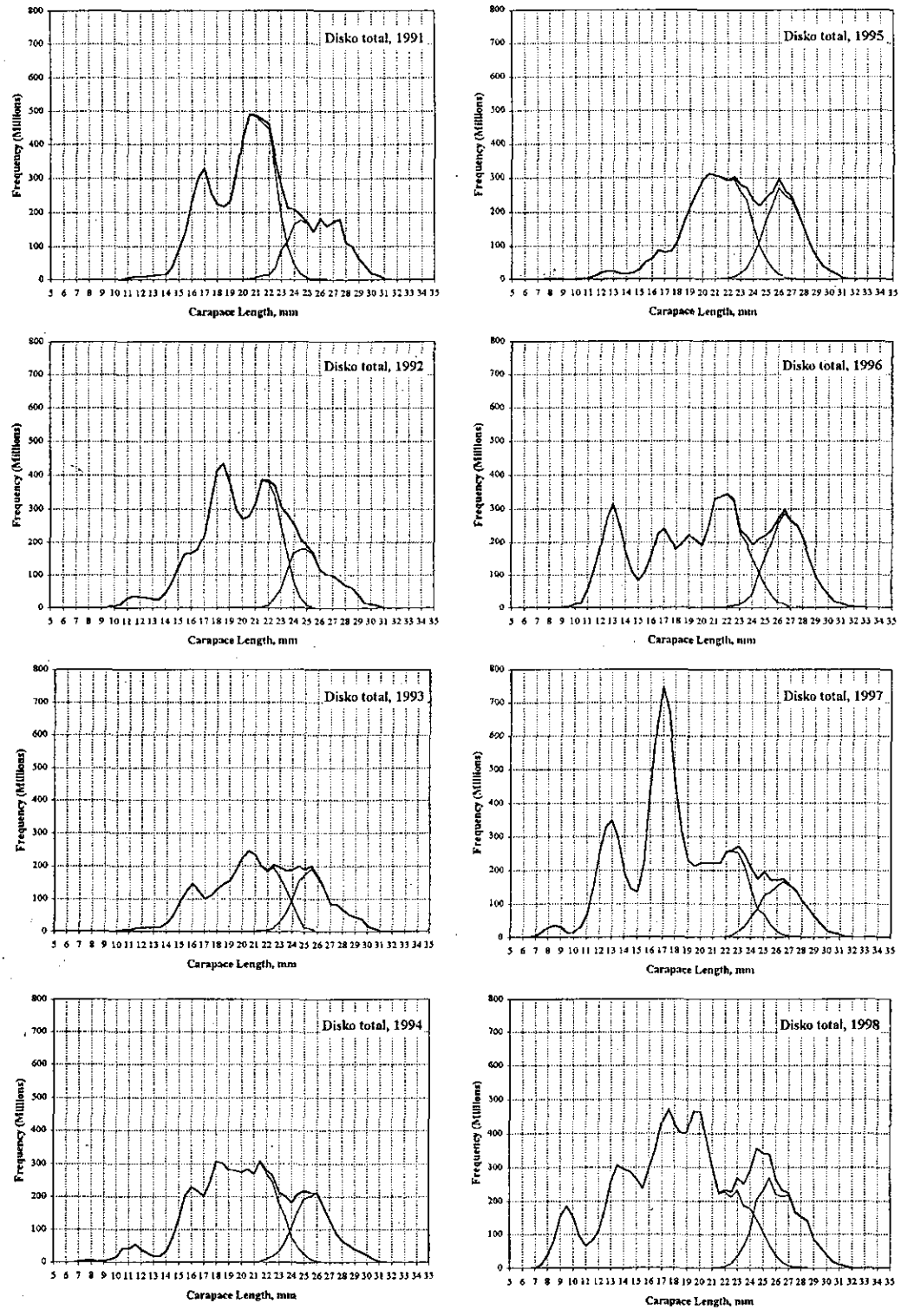

Figure 13. Numbers of shrimp by length group (CL) in inshore survey area (Disko Bay and Vaigat) in 1991-98.