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Preliminary Assessment of Shrimp (*Pandalus borealis*) in Davis Strait 1999 (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 1998 November meeting that catches in 1997 and projected catches in 1998 average about 65 000 tons. Given the uncertainty of the absolute size of incoming recruitment, Scientific Council recommended that catches of shrimp in 1999 should not exceed above this average.

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 Greenland 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 1999 to 7.650 tons in Div. 0A and Greenland set the effective TAC to a total of 71.000 tons (40.109 tons to the offshore fleet and 30.891 tons 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. 99/107)

2.1. History of the Fishery

After reaching a maximum in 1992 of 87000 tons catches have gradually decreased to around 66000 tons in 1998. However, measured in numbers caught the high catch level of 1992 has been maintained (Table 1). The projected catch of 1999 is at the 1998 level. During the late 1990's more than 95% of the annual catches were taken by Greenland. The inshore fishery (vessels below 80 GRT) accounted for around 20% of the total landings. Discard of shrimp and fish has in recent years been reported to about 0.5% and 3% of the total catch respectively. By-catch of *P. montagui* is registered in amounts below 1000 tons per year since 1995.

Since the beginning of the 1970's catches in the inshore areas have been fluctuating between 10,000-20,000 tons. Limited access for vessels above 80 GRT has been the only restraint on inshore catch levels until 1997 when quotas were enforced also for the small vessel fleet. During most of the nineties inshore fishery has accounted for 20-25% of the total catches. This fleet component consists of relatively old and inefficient vessels and is currently facing a major reorganisation. For 1999 the catches in inshore areas are expected to remain at the relative low level of around 9000 tons seen in 1998.

The Canadian catches in Div. 0A have fluctuated between 1700 and 5400 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 1980's-early 1990's. Catches thereafter declined to around 1 000 tons in 1998 coincident with the increased fishing opportunities off Labrador. During the late 1990's catches in Div. 0A have accounted for less than 5% of the total catches off West Greenland. The 1999 catches are expected to be about 2 500 tons (as of Oct. 29, it was 2036 tons).

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

2.2. Trends in fishing effort and CPUE

Catch and effort data from the shrimp fishery in 1998 and 1999 were available from fishing records from Canadian vessels in Div. 0A and from Greenland logbooks for Subarea 1. Twin trawls introduced in 1995 on several Greenland trawlers have been accounted for in analyses of effort data using a factor 2 as a multiplier for recorded effort by vessels using twin trawl.

Up to 1986, unstandardized and standardized effort showed a slight increasing trend. Effort more than doubled between 1987 and 1992, and decreased thereafter (Fig. 2B). The long time trend of the weight based standardized effort is in good agreement with the unstandardized. Since 1992, when it reached its highest value, standardized effort has decreased by about 1/3. However, a standardized effort index based on number of individuals (Fig. 2B) only show a minor decrease during the same period.

CPUE data from Greenland 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 1976-1999 was calculated by the methods described in Hvingel *et al.* (in press). The unified standardized CPUE index is given in Table 1 and Fig. 2C and the individual fleet based indices in Table 2. All fleets included in the analysis mainly exploit shrimp greater than 16 mm cpl. The CPUE indices are therefore indicative of the older male and the female stock combined. The combined index may be interpreted as fluctuations of this stock component by a factor of 2 around a constant level between 1976 and 1987 followed by a drop to a lower level in the late 1980's. The marked spike in 1987 is likely the result of some very strong year classes produced in the early 1980's. During the 1990's the CPUE index has shown an increasing trend. The revised 1998 index value, using the complete set of data for the year, did not change appreciably from the preliminary value reported by Hvingel and Folmer (1998). The projected 1999 value is at the level of the previous year, which was the highest on record in 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 1987-99 (Table 3). Since 1995 Greenland vessels have reported annual catches of *P. montagui* in the range of about 300 to 1000 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. Spatial distribution of the fishery

A substantial change in the relative importance of the different areas is indicated in Subarea 1. Since mid 1970's until the early 1980's Div. 1A+1B have been the far most important areas of this shrimp fishery. Div. 1C and 0A received some attention but almost no effort was allocated to Div. 1D, 1E and 1F. Since then the fishery has gradually expanded southward to include also these three southern most Divisions in Subarea 1. The southward expansion/displacement of the offshore fishery since the late 80's is also indicated by the mean latitude of effort allocation shown in Fig. 3. The preliminary data for 1999 do not suggest any significant changes in the distribution of the fishery in Subarea 1 and Div. 0A from 1998 to 1999.

2.4. Biological Data

Length frequency distributions obtained by observers were available from the commercial fishery in Subarea 1 and Div. 0A during the 1991-1999 period (Fig. 6, Table 4).

The male proportion of the catch in numbers has increased during the 1990's. (Table 4). This development was also reflected by the calculated mean shrimp size caught, which in Subarea 1 has declined by 3.1 mm cpl. since 1991 corresponding to a mean individual weight reduction of about 20% (Fig. 5). Mean shrimp size caught in the Canadian fishery in Div. 0A showed a corresponding declining trend since 1981. Part of this development may be due to better market prices for small shrimp along with a thorough restructuring of the Greenland offshore fleet during this time period leaving most vessels with enough quota to make high-grading less profitable.

The standardized catch rates indicate increasing abundance of males (Fig. 4) while abundance indices of females have stayed more or less at the same level throughout the 1990's. However, these results may be bias by the change in targeting strategy.

Like the previous years catches the LFD of 1999 shows good representation of all sizes. Good recruitment is indicated by relative large modes around 12 mm Cpl.. These shrimp may be expected to reach the female stage within the next 4-5 years.

3. RESEARCH SURVEY DATA (SCR Doc 99/109)

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. 7). 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 and 1999 was carried out in one step only. In 1999 a new method of choosing stations for the survey was introduced using a minimum distance between stations (a buffer zone), however still keeping the randomness in placing stations (Kingsley et al., 1999).

From 1988 through 1998 stations have been selected at random by re-placing sampling sites for each year. The authors (D. M. Carlsson et al, 1999 a) wished to study the stability of the stock distribution and assess the performance of a fixed-station design relative to that of resampling. Therefore about 50 % of the stations from the survey in 1998, randomly chosen, were repeated as fixed stations in the 1999 survey. The remainder of the stations was re-selected, using the above-mentioned buffer zone method, and using the fixed stations as already chosen stations.

The database for the survey period 1988-99 has been revised, and all shrimp samples have been checked with length-weight keys and corrected for possible errors. Various adjustments for earlier inclusions of other species (a.o. *Pandalus montagui*) have been applied. These revisions caused major changes of the biomass estimates in some strata, but overall trends through the period have not changed significantly. The revised total estimates indicate less variation than the earlier given figures. The estimates for 1991 and 1997 are, however still considerably lower than other years estimates.

The overall biomass estimate from the survey has shown good stability in both the inshore and offshore areas. Large variations from year to year both geographically and over depth zones are observed and may suggest that the stock is highly migratory. Some areas account for a large proportion of the variances of the estimated biomasses.

3.2. Demographic Structure

Estimated total number of shrimp in the survey area (including both inshore and offshore areas, but excluding region S) from 1988 to 1999 are given in Table 7. Total number of shrimp was at the same high level as in 1996 and 1998, higher than all other years. However, number of female shrimp decreased by 25% since 1998, to below the average number for the years 1991 to 1999, while number of male shrimp only went down by 4% (Table 7 and Fig. 9).

Overall length distributions for the offshore survey area from 1988-99 are shown in Fig. 9a and 9b, and for the inshore survey area from 1991-99 in Fig. 10a and 10b. Total number of shrimp in 1999 was at the same high level as in 1996 and 1998. While the number of female shrimp was below average, number of males was at the highest level recorded, and recruitment to the female group appears to be assured for the coming years.

Inspection of overall length-frequencies the deviation method and a preliminary modal analysis of offshore and inshore length distributions indicate a change between 1997 and 1998 to faster growth. At the same time age at sex reversal appears to have changed from six years to five years.

4. OTHER INFORMATION

Modifications of the design of the trawl survey for *Pandalus borealis* in West Greenland Water (SCR Doc 99/105). A stratified random sample survey based on one-hour trawl stations has been carried out since 1988 as a component of the assessment of the stock of northern shrimp *Pandalus borealis* in offshore West Greenland waters. Survey procedures were reviewed in early 1998 and again in 1999, and the 1998 and 1999 survey practices were consequently modified. The 1999 West Greenland trawl survey for northern shrimp mixed 15-minute, 30-minute and one-hour tows and also had 40% of stations fixed from the previous year. The station positions were chosen by buffered sampling, which was also an innovation. Analyses of this mixed design showed that there was high short-range spatial autocorrelation, so that short tows appeared to collect about as much information on local density as long ones. However, medium-range spatial autocorrelation appeared to be low, so that buffered random sampling offered little or no more precision than independent sampling. Within strata, catches at fixed stations appeared well correlated between years, and a stratified analysis of the year-to-year differences by station doubled the sensitivity of detecting changes in biomass.

Bottom Temperatures and Possible Effect on Growth and Size at sex Reversal of Northern Shrimp in West Greenland (SCR Doc. 99/110). Temperature data and shrimp samples collected during the stratified-random trawl surveys 1990-99 are analysed. The trends and changes in mean temperatures and mean size at sex change of the shrimp are compared and discussed in this paper.

By-catches of fish in the West Greenland shrimp survey: an initial analysis (SCR Doc 99/111). Fish by-catch in the Greenland shrimp survey at West Greenland is counted and weighed, and for some species measured. A multivariate analysis of the most abundant by-catch species was carried out using factor analysis and canonical correlation. Strongly associated groups of fish species were not detected, although there were some weak associations among species that apparently prefer deeper water. Although there has been a strong change in average bottom temperature over the data period, there was little sign of any general response in the fish by-catch, and no abundance among fish by-catch appeared to be related to temperature change.

5. SUMMARY OF ALL INDICES

overall variations in catches:

- overall increase from 1981 to 1992, thereafter decreased from 1992 to 1997 and increased slightly again in 1998
- catches in 1999 are expected to be at the 1998 level.

a shift in the fishery:

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

variation in catch-rates indices and in effort indices:

- a standardized CPUE series showed a slightly increasing trend in the 1990's
- the projected CPUE -value for 1999 equals that of 1998, which was the highest on record during the 1990's
- standardized effort showed a decreased since 1992 by about 1/3 based on biomass
- standardized effort when based on numbers showed only a minor decrease in the 1990's

trends in recent catch-rates on the males and females component:

- standardized CPUE series for female shrimp showed stability in the 1990's
- standardized CPUE series for male showed an 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
- males comprise about 2/3 of the catches in 1998 and 1999 compared to about 1/2 in the early 1990's

biomass estimates from research surveys:

- overall stability in both offshore and inshore area
- total offshore biomass show a good stability ranging from 170 to 290 thousand tons, apart from somewhat lower values in 1991 and 1997
- large variations from year to year both geographically and over depth zones are observed and may suggest that the stock is highly migratory

demographic structure:

- total number of shrimp in 1999 was at the same high level as in 1996 and 1998
- the number of female shrimp was below average
- number of males was at the highest level recorded
- recruitment to the female group appears to be assured for the coming years
- overall length-frequencies of offshore and inshore length distributions indicate a change between 1997 and 1998 to faster growth
- at the same time age at sex reversal appears to have changed from six years to five years

6. STATUS OF THE RESOURCE

Indices from the commercial fishery show that the abundance of shrimp in 1989-99 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 1998 value for total shrimp abundance is the highest value in the 1990's and the projected value for 1999 is at the same level as 1998. Overall commercial sample data indicate good recruitment.

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 show a good stability ranging from 170 to 290 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 1993-1999. 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 2000, will be able to sustain a fishery similar to that of the latest years. The presence of several year classes, recruiting to the fishable stock in coming years 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.

7. References

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M.C.S. Kingsley, P. Kanneworff and D. M. Carlsson' 1999. By-catches of fish in the West Greenland shrimp survey: an initial analysis. NAFO SCR Doc.99/111 Serial No. 4191.

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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 1970-1999. 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	SA 1	Div. 0A	Total	
	Offshore	Inshore*	Total	Offshore	Offshore	Inshore	Total	Offshore	Offshore	Total	Unstd. ('000 hr's)	Std. (index)	Total	Unstd. (kg/hr)	Std. (index)	Total	
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	3.40	620	-	625
1977	-	no	-	-	36000	33843	7800	41643	457	42100	73.0	-	73	3.05	571	-	577
1978	-	no	-	-	41000	26747	7600	34347	122	34469	84.1	-	84	3.16	408	-	410
1979	-	no	-	-	31500	25958	7500	33458	1732	35190	72.4	7.3	80	3.56	462	236	441
1980	-	no	-	-	32000	35778	7500	43278	2726	46004	80.0	7.6	88	3.87	541	358	525
1981	35000	no	35000	5000	40000	32016	7500	39516	5284	44800	88.2	17.7	106	3.92	448	299	423
1982	34800	no	34800	5000	39800	35015	7500	42515	2064	44579	81.1	6.2	87	3.09	524	335	511
1983	34625	no	34625	5000	39625	33854	7500	41354	5413	46767	89.0	19.1	108	3.70	464	284	433
1984	34925	no	34925	5000	39925	33741	7500	41241	2142	43383	85.0	7.7	93	3.65	485	280	468
1985	42120	no	42120	6120	48240	43896	7500	51396	3069	54465	109.4	9.9	119	4.35	470	309	457
1986	42120	no	42120	6120	48240	52634	7500	60134	2995	63129	129.2	6.7	136	4.85	466	445	464
1987	40120	no	40120	6120	46240	50720	6921	57641	6095	63736	136.6	12.4	149	3.89	422	491	428
1988	40120	no	40120	6120	46240	44159	10233	54392	5881	60273	150.1	12.6	163	4.99	362	468	371
1989	45245	no	45245	7520	52765	45198	13224	58422	7235	65657	176.4	18.5	195	6.77	331	391	337
1990	45245	no	45245	7520	52765	49554	13630	63184	6177	69361	206.3	15.3	222	7.50	306	405	313
1991	46225	no	46225	8500	54725	52834	16258	69092	6788	75880	228.7	20.6	249	8.36	302	330	304
1992	44200	no	44200	8500	52700	58664	20594	79258	7493	86751	232.9	17.6	250	8.75	340	425	346
1993	40600	no	40600	8500	49100	52280	17843	70123	5491	75614	206.1	13.6	220	7.65	340	404	344
1994	42300	no	42300	8500	50800	53693	18118	71811	4766	76577	209.6	16.3	226	8.10	343	292	339
1995	39500	no	39500	8500	48000	51900	16429	68329	2361	70690	186.9	7.2	194	6.84	366	329	364
1996	37890	26032	63922	8500	72422	49251	17359	66610	2623	69233	168.6	8.6	177	6.37	395	304	391
1997**	38292	26308	64600	8500	73100	50496	13517	64000	517	64517	191.2	1.5	193	6.18	335	337	335
1998**	36000	24729	60729	7650	68379	49855	9489	65170	954	66124	159.2	3.2	162	5.69	409	302	407
1999**	40109	30891	71000	7650	78650	49725	9750	65000	2500	67500	133.5	5.4	139	5.83	487	465	486

Table 2. Time series of the four standardized CPUE indices included in the combined CPUE index for NAFO Subarea 1 + Div. 0A.

Year	1BCD	KGH	Small Vessel	0A	Combined
1976	-	1.66	-	-	1.47
1977	-	1.56	-	-	1.38
1978	-	1.23	-	-	1.09
1979	-	1.11	-	-	0.99
1980	-	1.34	-	-	1.19
1981	-	1.27	-	1.15	1.14
1982	-	1.61	-	1.35	1.44
1983	-	1.42	-	1.07	1.27
1984	-	1.34	-	0.99	1.19
1985	-	1.43	-	0.86	1.25
1986	-	1.49	-	0.88	1.30
1987	1.85	1.79	-	1.38	1.64
1988	1.19	1.47	1.29	1.22	1.21
1989	1.04	1.09	1.03	0.90	0.97
1990	1.00	1.00	1.00	1.00	0.93
1991	0.98	-	0.88	0.88	0.91
1992	1.08	-	0.92	1.01	0.99
1993	1.05	-	1.03	0.96	0.99
1994	1.05	-	0.87	0.74	0.95
1995	1.17	-	0.87	0.82	1.03
1996	1.25	-	0.85	0.76	1.09
1997	1.21	-	0.85	0.60	1.04
1998	1.32	-	1.02	0.68	1.16
1999*	1.30	-	0.99	-	1.16

*Projected.

Table 3. 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 1987-99.

Year	<i>P. borealis</i>		Fish		<i>P. montagui</i>
	discard (tons)	discard (%)	discard (tons)	discard (%)	landed
1987	150	0.3	693	1.2	0
1988	169	0.3	864	1.6	0
1989	166	0.3	1070	1.8	0
1990	218	0.3	1028	1.6	0
1991	332	0.5	1680	2.4	0
1992	264	0.3	1765	2.2	0
1993	204	0.3	1562	2.2	0
1994	270	0.4	2175	3.0	4
1995	389	0.6	2162	3.2	470
1996	267	0.4	2207	3.3	632
1997	254	0.4	1918	3.0	336
1998*	257	0.4	1787	2.7	1026
1999*	0	0.0	8	0.0	0

*Preliminary

Table 4. 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 standardized effort to produce abundance at age indices.

Mean size									
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
Cpl (mm)	23.5	23.5	22.9	22.3	21.8	21.9	21.2	20.4	21.2
Weight (g)	8.4	8.5	8.4	7.8	7.6	7.2	6.5	6.6	6.4
Count (no/kg)	119	118	119	128	132	140	154	151	157

Proportion of total catch									
Year/Year class	1991	1992	1993	1994	1995	1996	1997	1998	1999
Males	46%	33%	51%	56%	64%	64%	64%	66%	67%
Primi	9%	3%	1%	11%	15%	9%	12%	8%	11%
Multi	45%	63%	48%	33%	21%	27%	24%	26%	22%
Females total	54%	67%	49%	44%	36%	36%	36%	34%	33%

Number caught (millions)									
Year/Year class	1991	1992	1993	1994	1995	1996	1997	1998	1999
Males	4188	3388	4560	5502	5971	6243	6368	6583	7060
Primi	825	350	96	1067	1384	824	1197	835	1194
Multi	4031	6493	4370	3217	1962	2614	2363	2583	2333
Females Total	4856	6843	4466	4284	3347	3438	3560	3418	3527
Total	9044	10231	9026	9786	9317	9681	9928	10001	10587

Abundance index									
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
Males	5.0	3.9	6.0	6.8	8.7	9.8	10.3	11.6	12.1
Primi	1.0	0.4	0.1	1.3	2.0	1.3	1.9	1.5	2.0
Multi	4.8	7.4	5.7	4.0	2.9	4.1	3.8	4.5	4.0
Females total	5.8	7.8	5.8	5.3	4.9	5.4	5.8	6.0	6.1

Table 5. Biomass estimates 1988-99 (thousand tons) in combined areas from north to south.

Area	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
D1-D9	-	-	-	50.6	47.4	33.6	40.0	47.3	54.3	52.3	61.9	61.2
N1-N9	21.7	11.3	11.1	5.8	20.6	8.0	8.0	8.2	10.0	7.2	8.3	14.4
W1-W2	58.6	48.2	82.1	30.9	52.0	103.1	107.7	43.7	53.8	40.1	42.2	54.2
W3-W4	74.4	79.6	54.2	52.4	35.0	41.3	49.7	58.6	34.9	15.1	107.1	26.1
C1+C3	9.6	3.9	11.1	4.8	24.1	3.4	6.8	4.4	1.7	0.2	0.4	11.9
W5-W7	19.0	38.6	23.3	28.1	46.1	67.5	37.7	53.0	90.5	66.5	50.9	55.9
S1-S2	-	-	-	-	-	-	20.7	1.7	3.7	24.9	22.3	63.7
Total	183.3	181.5	181.8	172.6	225.1	256.8	270.6	217.1	248.9	206.2	293.3	287.4

Table 6. Estimated trawlable biomass in offshore and inshore areas from 1988 to 1999.

Areas	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N1-N4	13.172	8.106	9.326	3.891	14.797	7.320	3.162	3.025	7.197	3.948	5.634	9.239
N5-N9	8.556	3.182	1.755	1.929	5.824	0.651	4.874	5.186	2.848	3.232	2.628	5.203
Inshore				50.575	47.382	33.605	39.973	47.306	54.316	52.272	61.915	61.183
W1-W2	58.625	48.188	82.054	30.861	51.969	103.080	107.681	43.748	53.775	40.072	42.238	54.185
C1+C3	9.595	3.852	11.127	4.789	24.075	3.381	6.799	4.419	1.690	0.245	0.443	11.901
W3	51.234	49.910	51.826	31.834	24.687	21.452	39.765	37.166	31.389	14.369	40.552	19.760
W4	23.167	29.684	2.404	20.587	10.267	19.808	9.978	21.455	3.536	0.686	66.596	6.326
W5	18.950	38.622	12.262	15.625	33.934	26.651	27.872	38.002	49.452	52.996	15.732	29.577
W6	-	-	11.079	12.520	12.214	33.479	9.843	14.392	30.824	1.201	21.615	26.340
W7	-	-	-	-	-	7.362	0.001	0.650	10.195	12.334	13.601	0.005
N1-N9	21.729	11.288	11.080	5.819	20.621	7.971	8.037	8.212	10.045	7.180	8.262	14.442
W1+W2+W3+C	119.453	101.949	145.007	67.484	100.731	127.913	154.244	85.334	86.853	54.686	83.233	85.845
W4-W7	42.117	68.306	25.745	48.732	56.414	87.301	47.693	74.500	94.007	67.217	117.544	62.247
Total offshore	183.299	181.543	181.832	122.035	177.765	223.185	209.974	168.045	190.905	129.082	209.038	162.535

Table 7. Numbers (billions) of male and female Northern shrimp in over-all length distributions from the total survey area (excluding region S).

Year	males	females	total	males, %	females, %
1988	18.7	8.1	26.8	69.8	30.2
1989	29.4	5.7	35.2	83.7	16.3
1990	23.0	8.2	31.1	73.8	26.2
1991	17.4	6.2	23.6	73.8	26.2
1992	29.7	7.3	36.9	80.3	19.7
1993	35.6	9.9	45.4	78.3	21.7
1994	32.2	9.9	42.1	76.5	23.5
1995	28.9	7.9	36.8	78.6	21.4
1996	40.9	8.0	48.9	83.7	16.3
1997	26.8	6.7	33.5	79.9	20.1
1998	41.5	10.1	51.6	80.4	19.6
1999	39.8	7.6	47.4	83.9	16.1
Average¹	32.5	8.2	40.7	79.5	20.5

¹1991-1999

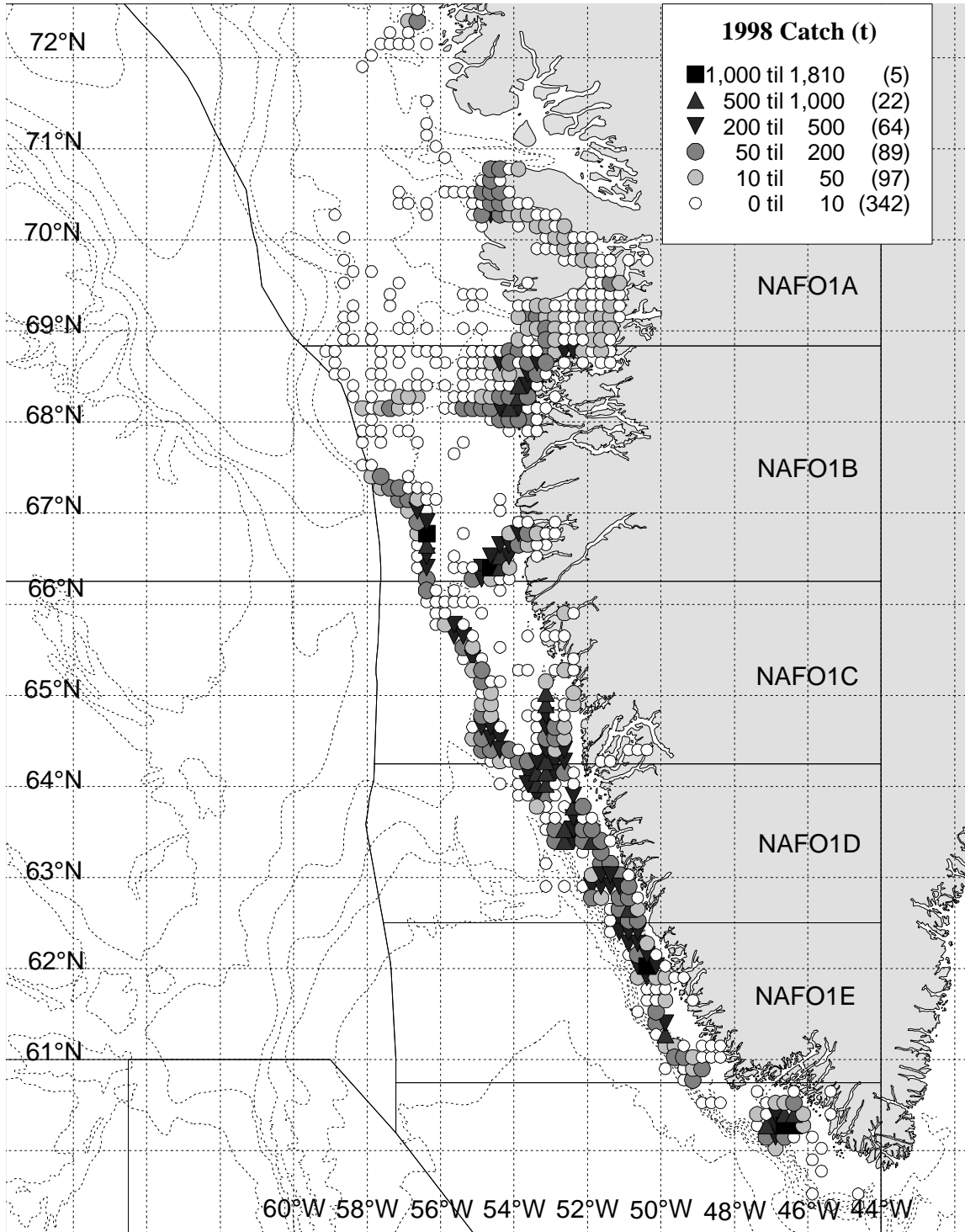


Figure 1. The geographical distribution of the catches in Subarea 1 in 1998.

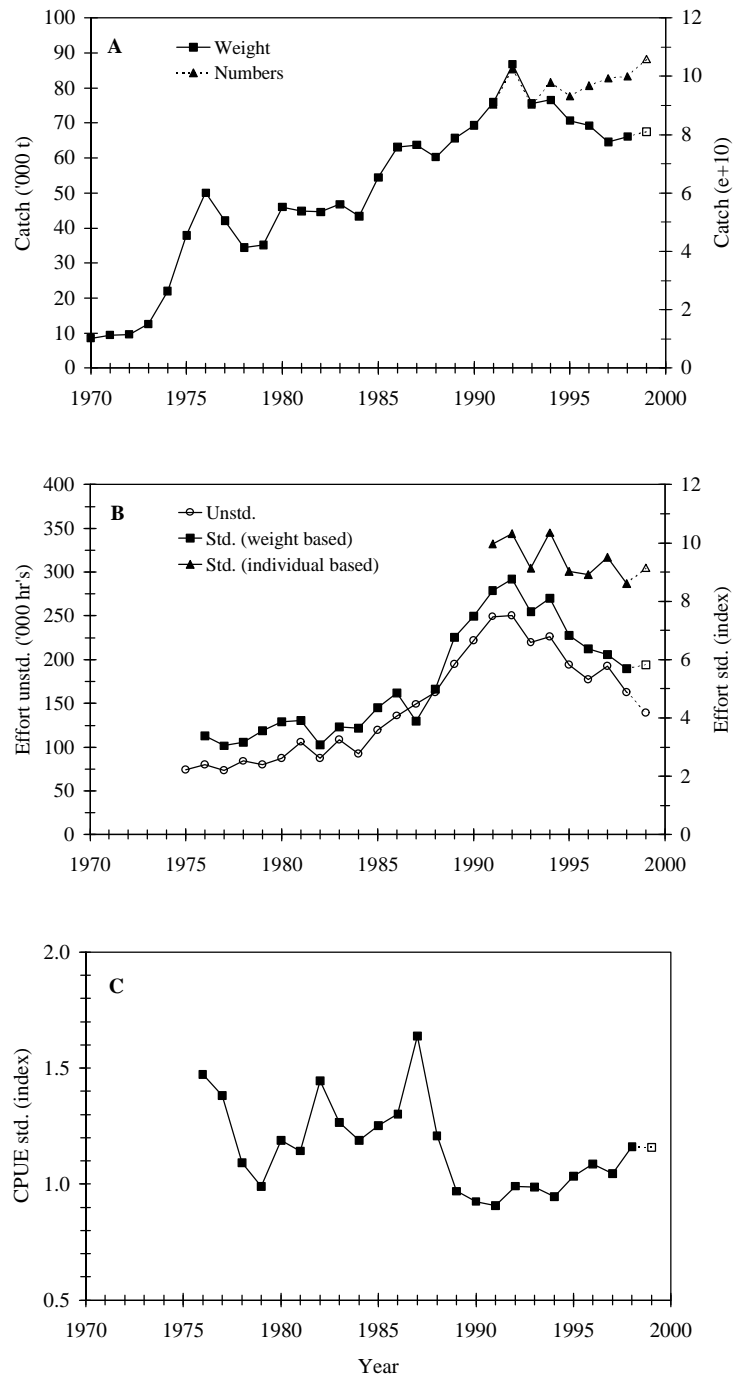


Figure 2. Total catch (panel A), effort standardized and unstandardized (Panel B) and standardized CPUE indices (panel C) of the shrimp fishery in NAFO SA 1 + Div. 0A. Data for 1999 are projected values.

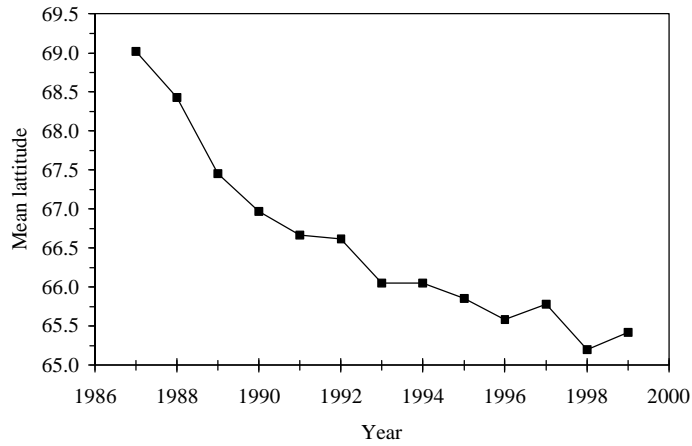


Figure 3. Mean latitude (°N) of allocated effort by the Greenlandic offshore fleet 1987-99.

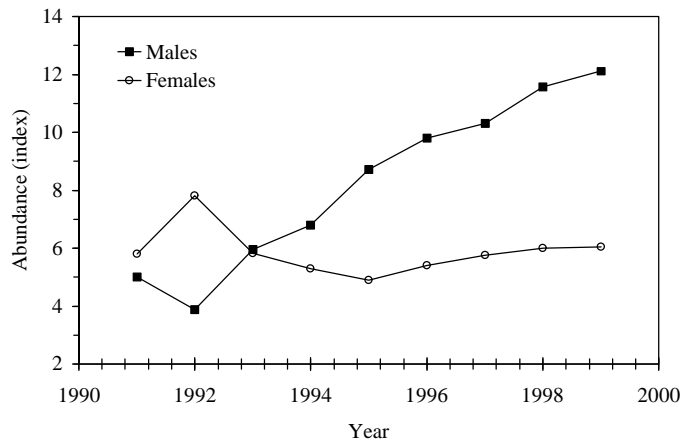


Figure 4. Standardized CPUE indices of the male and female component of the West Greenland shrimp stock 1991-1999.

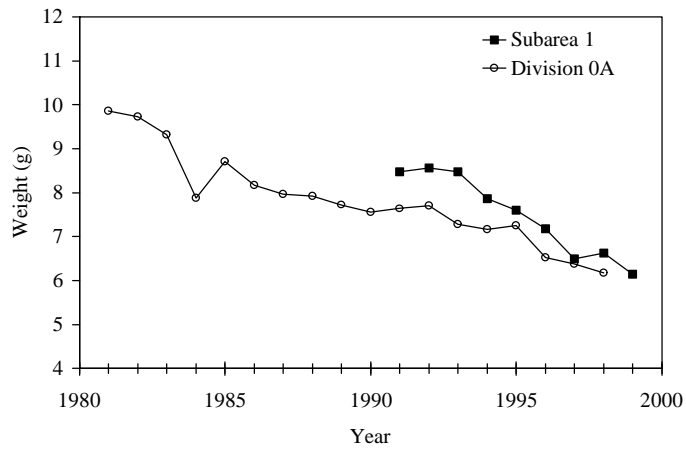


Figure 5. Mean shrimp size (g) in catches in Subarea 1 and Division 0A, 1998-1999.

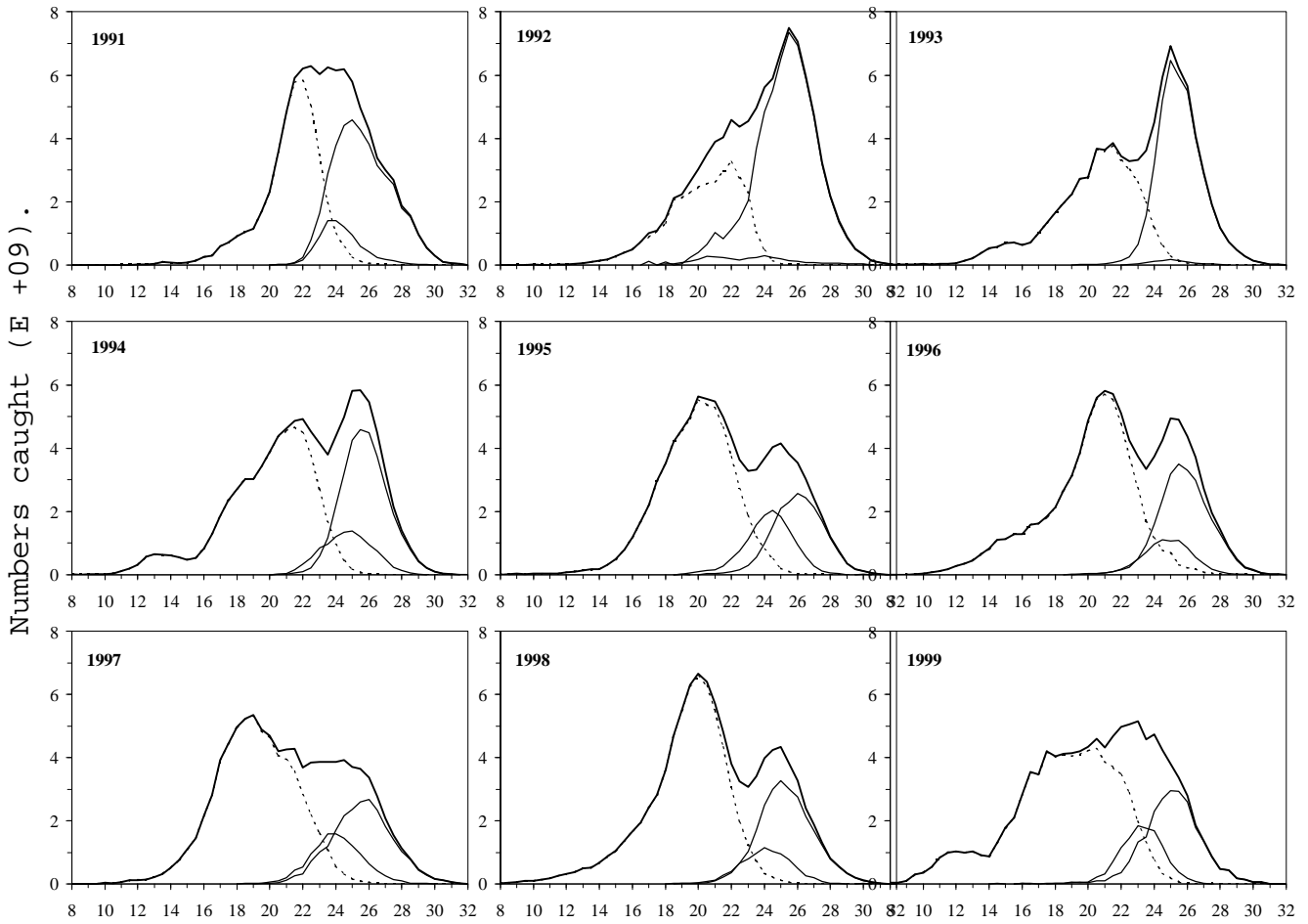


Figure 6. Length frequency distributions of commercial shrimp catches in Subarea 1 + Div. 0A, 1991 - 1999. The distribution of male shrimp is shown by the dotted line, primiparous and multiparous as the thin line (Primi. is recognized as the smallest component of the two) and total distribution as the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

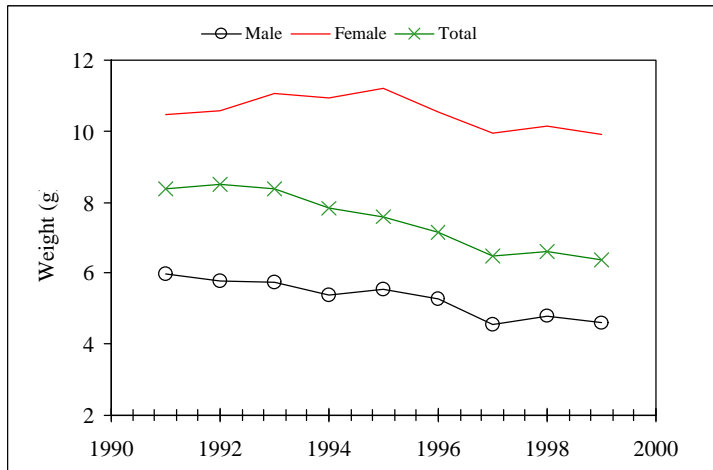


Figure 7. Mean shrimp size (g) for male, female and total in catches in Subarea 1 and Division 0A from 1991-1999.

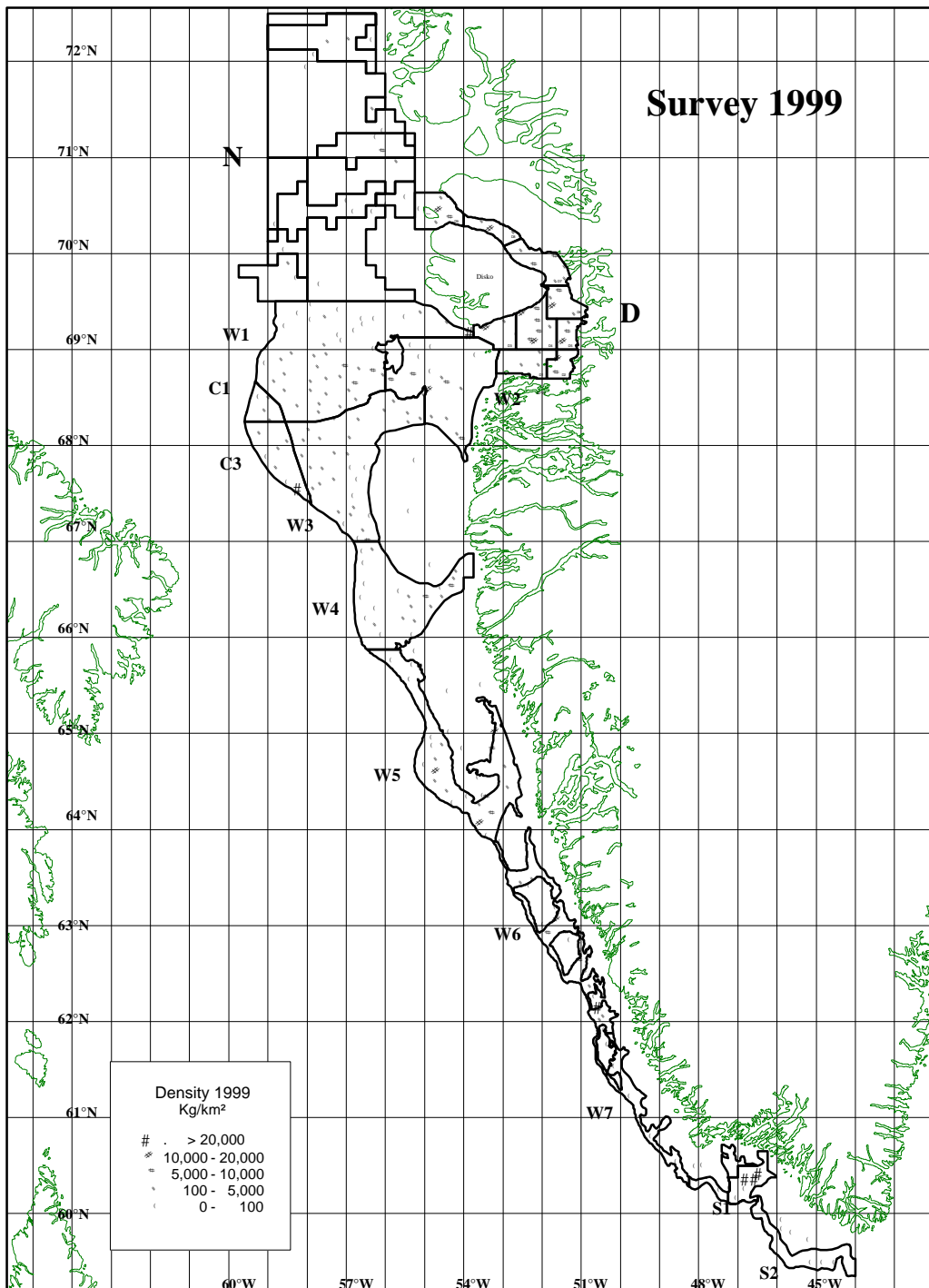


Figure 8. Sampling sites and shrimp densities (kg per km² swept area) in the trawl survey in 1999.

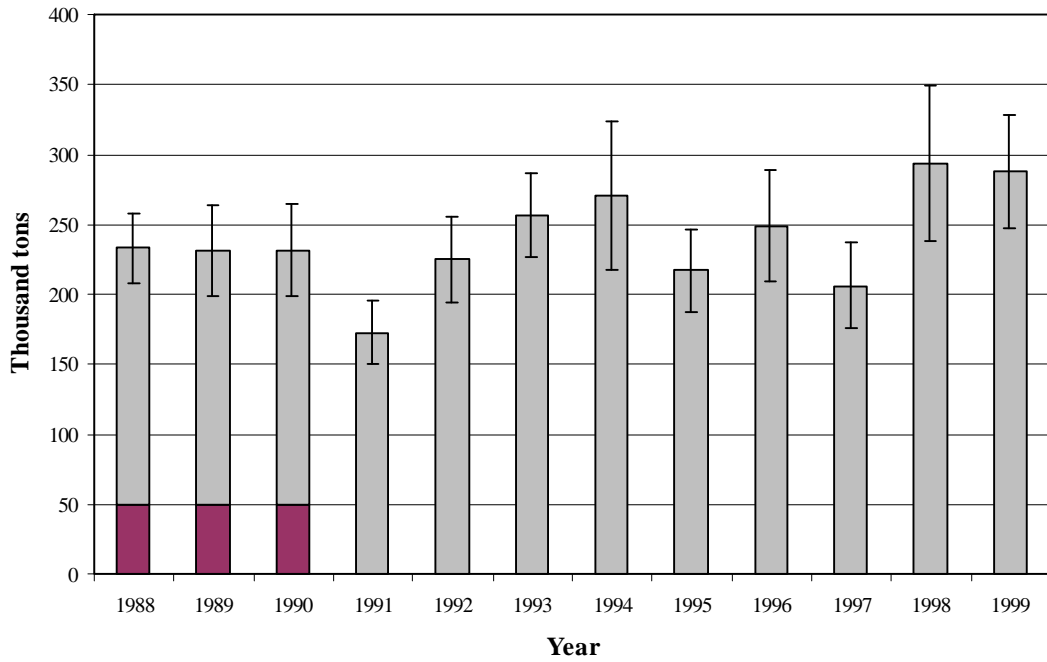


Figure 9. Estimated yearly biomass 1988-99 with standard errors. Estimates for 1988-1990 do not include inshore areas (Disko-Vaigat), but estimated average biomass for those areas 1991-1999 is inserted to facilitate between-year comparisons.

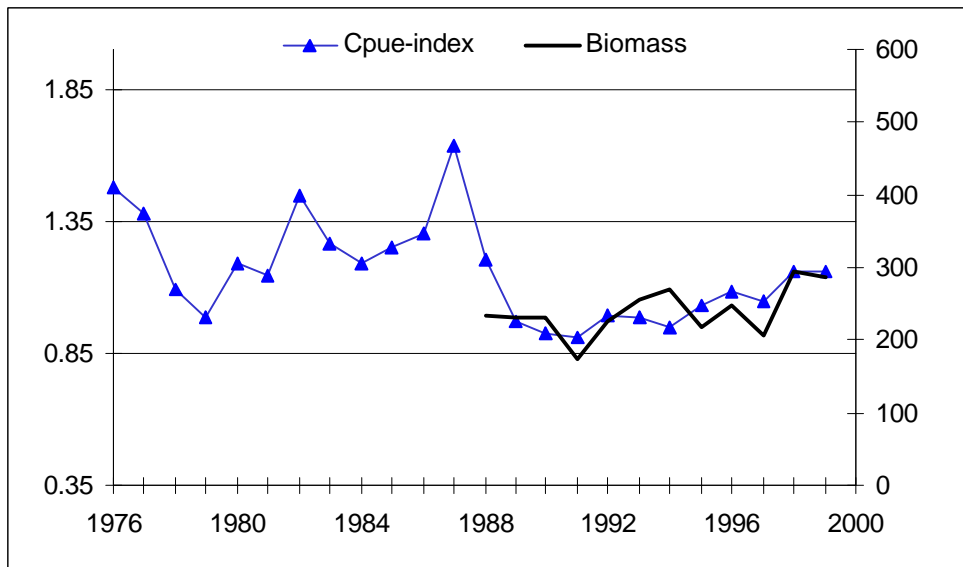


Figure 10. Indices of biomass from survey (1988-1999) and CPUE (1976-1999).

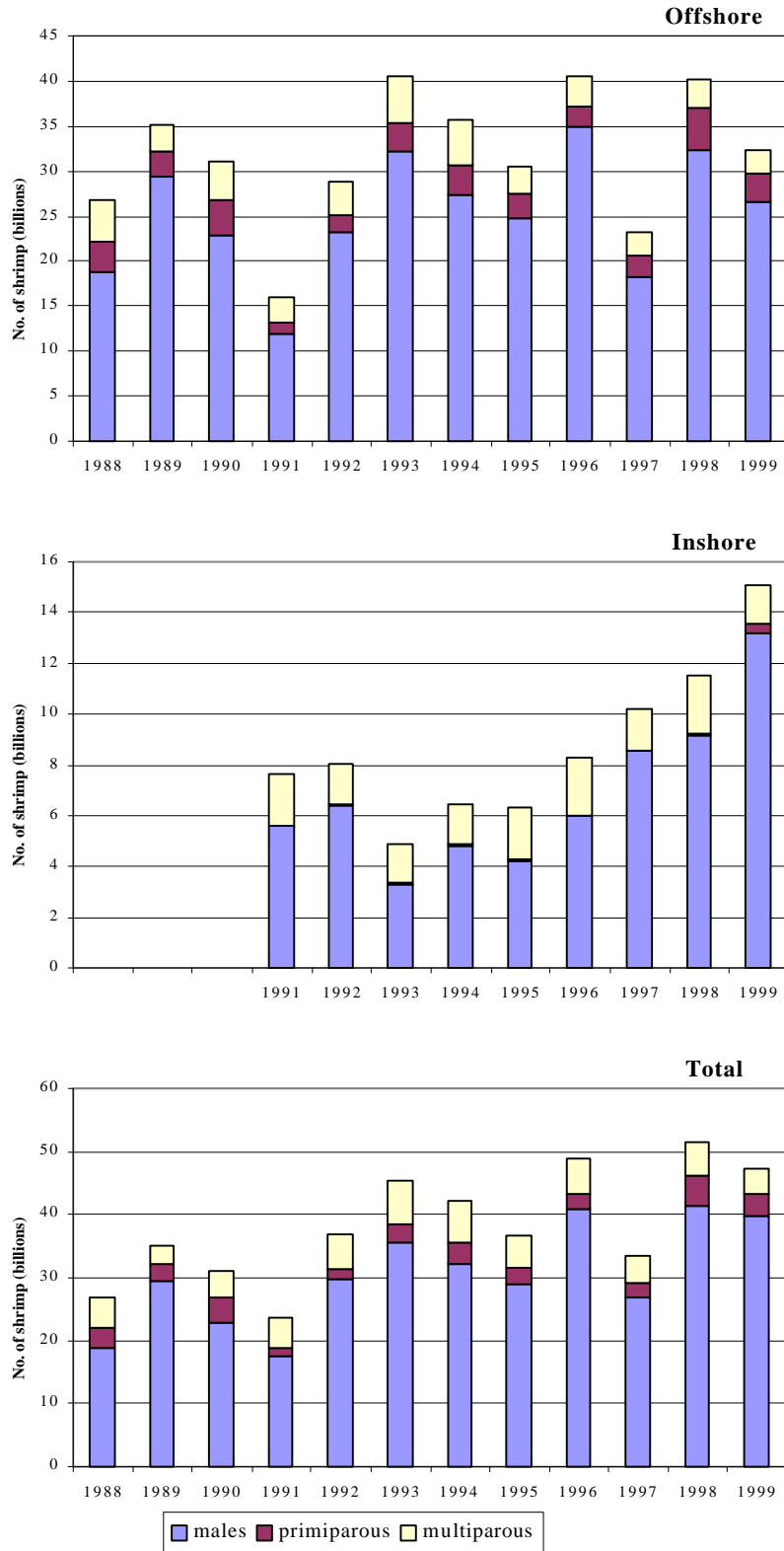


Figure 11. Estimated total number of Northern shrimp in offshore, inshore and total survey area by sexual stage.

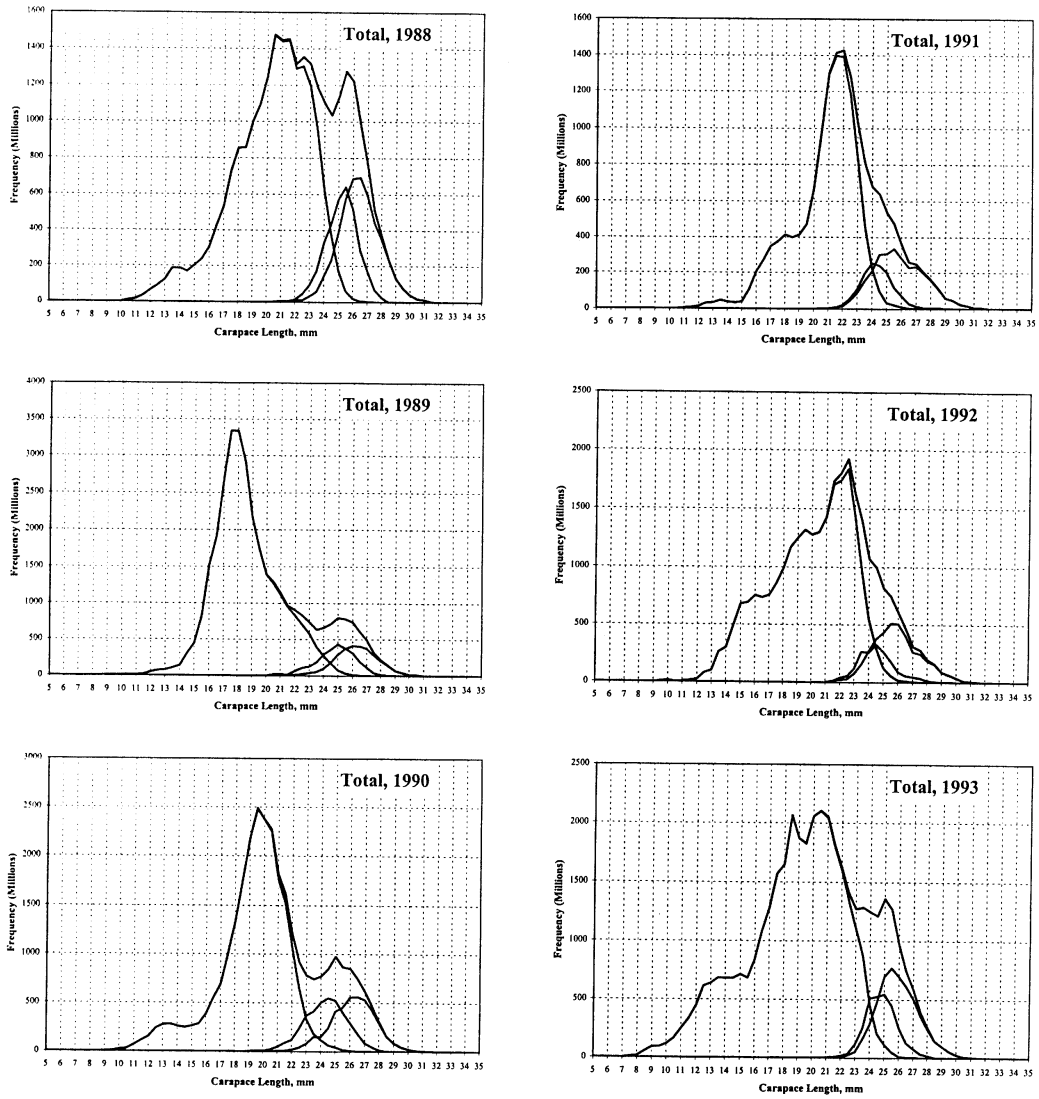


Figure 12a. Numbers of shrimp by length group (CL) in total offshore survey area (excluding region S) in 1988-93.

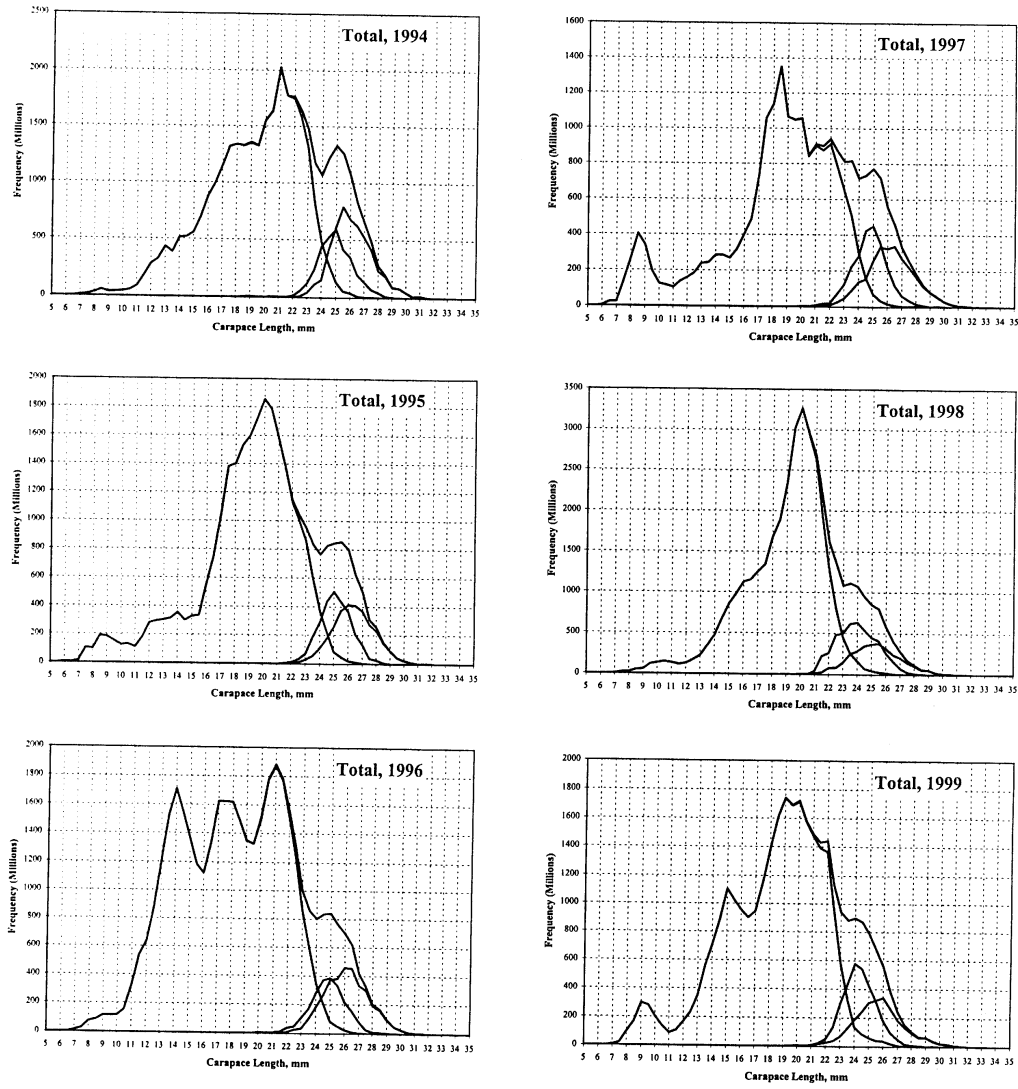


Figure 12b. Numbers of shrimp by length group (CL) in total offshore survey area (excluding region S) in 1994-99

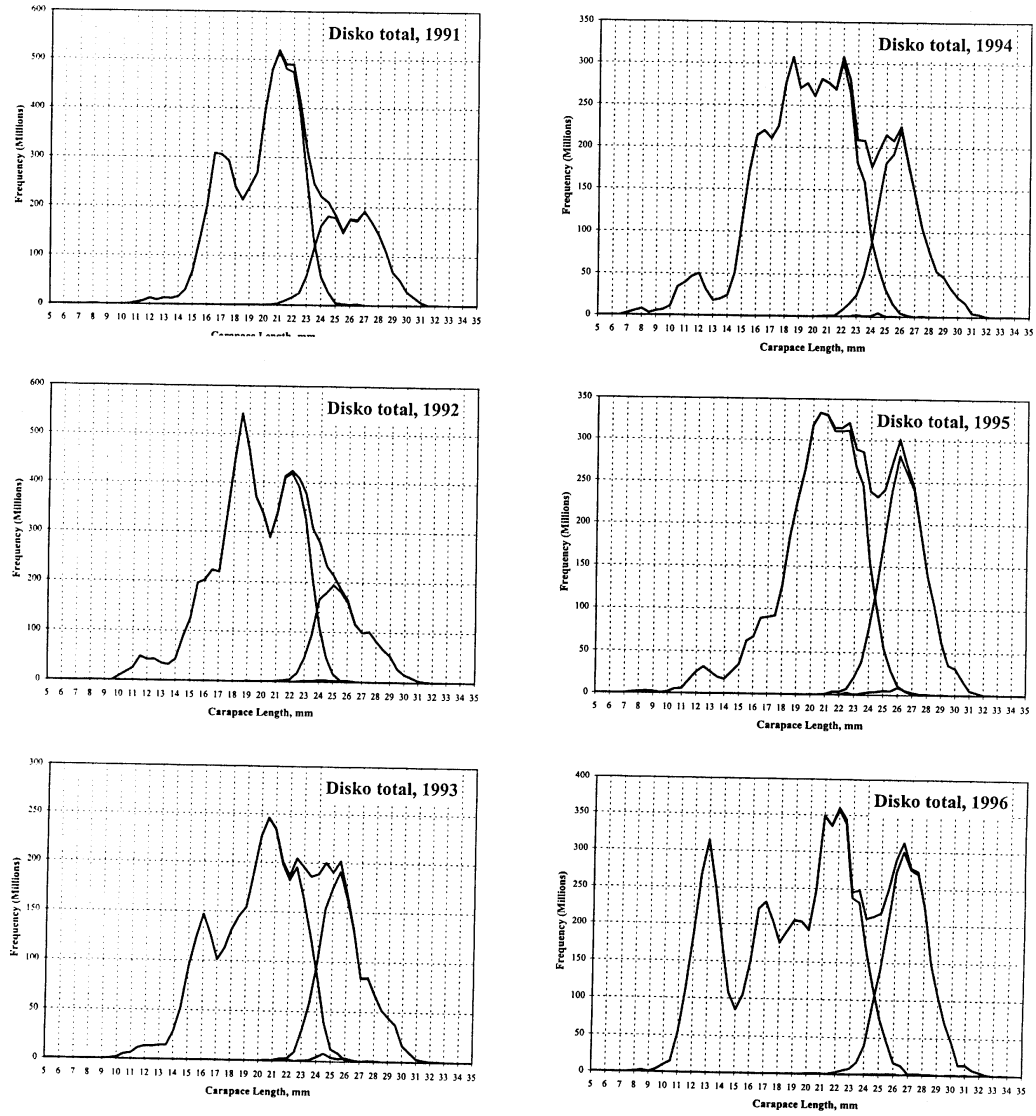


Figure 13a. Numbers of shrimp by length group (CL) in total inshore survey area in 1991-96.

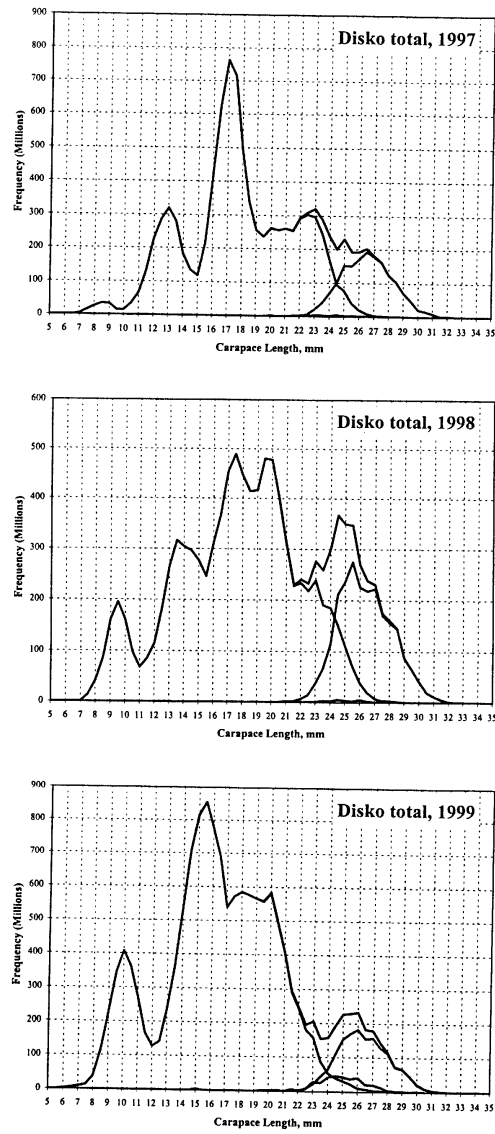


Figure 13b. Numbers of shrimp by length group (CL) in total inshore survey area in 1997-99.