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Assessment of Shrimp in Davis Strait (Subareas 0+1)

by

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1. INTRODUCTION

The shrimp fishery off West Greenland occurs in three main areas: the offshore area north of 71° N; the inshore area (primarily Disko Bay); and the offshore area south of 71° N. STACFIS has provided advice on TAC (since 1977) for only the last area which includes the fishery off West Greenland in Subarea 1 (Divisions 1A to 1F) and the Canadian fishery in Div. 0A. No TACs have been advised for the northern area or the inshore fishery but a cautious approach to exploitation has been advised in recent years for the former. Although treated separately for management purposes, sampling data suggest that the shrimp resources in these areas are parts of a single stock or stock complex.

This paper presents the assessment of the status of the shrimp resource throughout the area by summarizing data from the various fisheries and research vessel surveys.

2. COMMERCIAL FISHERY (SCR Doc. 93/128, 93/130)

2.1 History of the Fishery

The nominal catch in the offshore area south of 71°N increased from less than 1,000 tons before 1972 to almost 43,000 tons in 1976. Catches fluctuated in subsequent years but stabilized at a level about 44,000 tons from 1985 to 1988 and have since increased further to about 63,000 tons in 1992. Preliminary data for the first three quarters of 1993 indicate a total catch somewhat lower than in 1992 (Table 1, Fig. 1).

The Canadian fishery in Div. 0A usually takes place from July to November whereas the Subarea 1 fishery occurs in all months. The location of fishing activity in the latter area is affected in the early part of the year by the presence of ice, confining the fleet to the southern grounds in Div. 1C, 1D, 1E and 1F. Exceptional ice coverage in 1993 hampered access to some fishing grounds till the end of August. Catches in Div. 1A, 1B and 0A (Fig. 2) have been relatively stable since 1987 (except for a high catch in Div. 1B in 1988). Since 1987, catches have increased in Div. 1C and 1D and, for the 1990-1993 period, combined catch from these two divisions have exceeded those from Div. 1B. The catch from Div. 1E and 1F increased from less than 1,000 tons in 1988-91 to about 3,200 tons in 1992 and to more than 3,500 in the first three quarters of 1993. Effort values show the same trends as the catch data.

The fishery in the offshore area north of 71°N, which is outside the area for which TAC's are advised, began in 1985 with a catch of about 4,300 tons. Catches increased to about 11,000 tons in both 1986 and 1987 but subsequently declined to 1,100 tons in 1991. In 1992 catches increased to 2,647 tons, but preliminary data indicate a decline to less than 1,500 tons in 1993 (641 tons were taken by the end of October 1993). The fishery in this area usually occurs from June to November.

The West Greenland inshore fishery was relatively stable from 1972 to 1986 with estimated catches of 7,500 tons annually (except for 10,000 tons in 1974). Catches in recent years have increased from about 7,000 tons in 1987 to over 21,000 tons in 1992. Preliminary data indicate a decrease in 1993 (10,500 tons taken by the end of September 1993 compared to about 14,700 tons in the same period 1992), reflecting a shift from inshore to offshore areas of the small vessel fishery.

An overall decrease in the effort offshore reflects the long lasting ice cover in 1993 as well as a shift of effort to the new fishing grounds at Flemish Cap in the spring/early summer.

2.2 Trends in Catch Rates

Three catch rate indices are available for different offshore areas south of 71°N - the standardized catch rates of large (>8.5 g) shrimp for 27 Greenland trawlers from 1987 to 1993 in Div. 1B, a similar index for Div. 1CD, and standardized catch rates for the Canadian fishery in Div. 0A from 1981 to 1993 (Fig. 3). The large shrimp index for the Greenland trawlers in Div. 1B showed a decrease from 1987 to 1989, followed by stability from 1989 to 1992 and an increase in 1993. Catch rates in Div. 1CD increased from 1987 to 1988, decreased to 1991, and has remained stable thereafter. The Canadian series showed two periods of stable catch rates at similar levels: 1983 to 1986 and 1989 to 1993. These periods were separated by significantly higher catch in both 1987 and 1988. All three indices showed the same stability from 1989 to 1993 except for the small increase in Div. 1B in 1993.

2.3 Biological Data

Length frequency distributions obtained by observers were available from the commercial fishery in Div. 0A in 1993 and in Subarea 1 from 1990 to 1993.

The relative importance of the 1985 year-class in Div. 0A was evident in 1990 as it recruited to the fishery and in 1991 when it clearly dominated the catches (Parsons and Veitch, 1993). This year-class was expected to change sex to females in 1992, but data from the 1992 and 1993 fishery showed that the sex inversion took place over two years. In 1993 this year-class still accounted for a substantial part of the catches (Fig. 4).

Length frequency distributions obtained from the commercial fishery in Subarea 1 in 1990, 1991, 1992, and 1993 pooled by division and quarter or month, also showed the importance of the 1985 year-class (Fig. 5). In 1990 this year-class was dominating in the male group at 21.5 mm CL in samples from the second quarter in Div. 1B and from the third quarter in Div. 1A. In 1991 it generally dominated all available samples. In 1992 a part of this year-class changed sex and appeared in the size group of smallest females, but a significant part remained as males and changed sex in 1993, when it contributed further to the female group in the catches.

3. RESEARCH SURVEY DATA (SCR Doc. 93/129, 93/132)

3.1 Biomass Estimates

In July-August 1993, a stratified random trawl survey was carried out in the main area of shrimp distribution in Div. 1A-1F and the adjacent part of Subarea 0. The area surveyed was extended beyond (south of) the areas covered in 1992 with the inclusion of Div. 1F.

The estimate of biomass for the area surveyed in all years south of 69°30'N was about 215,000 tons compared to 158,000 tons in 1992. The increase in biomass is due to an increase in both the northern and southern parts of this area, while a decrease was observed in the western parts. Biomass in the area north of 69°30'N decreased from 21,000 tons in 1992 to 9,000 tons in 1993, similar to the level before 1992 (Table 2).

In August 1993 a stratified-random trawl survey was conducted in the inshore areas in Disko Bay and Vaigat. Biomass was estimated at 32,000 ions, lower than the estimates around 47,000 tons in 1991 and 1992.

The introduction of a small mesh cod-end in the survey does not appear to have a significant influence on the overall length frequencies, except for the youngest year-classes. These year-classes do not contribute considerably to the biomass estimate, which is thus comparable to those of previous surveys. Data from 30 sets of hauls with alternating cod-ends showed no significant changes in catch rates between the two mesh sizes.

3.2 Demographic Structure

The abundance of male shrimp increased significantly in 1989, when the 1985 year-class entered the fishable stock, decreased in 1990 and 1991, increased again in 1992 to the level of 1988 and in 1993 to the 1989 level. The recent increase is due to recruitment, especially of the 1987 year-class, but also the 1988 and 1989 year-class contribute significantly to the male group. The number of female shrimp decreased from 1988 to 1989, increased in 1990, decreased in 1991 to the lowest number observed, increased in 1992 (to the 1989 level), and again in 1993 (to the 1990 level)(Fig. 6 and 7).

The overall size composition of shrimp from the inshore survey in 1991 was similar to that for the offshore in relation to the occurrence of modes. In the inshore area, however, there was a higher proportion of younger male shrimp with a modal length of about 17 mm, likely representing the 1987 year-class. In 1992, this group was found at 18.5 mm CL. Overall abundance of shrimp was similar in 1991 and 1992, but there was an evident shift between areas. In 1992 abundance of shrimp decreased in the southern parts of the Disko Bay and increased in the central areas and to the north in the Vaigat. The observed decrease in biomass in 1993 compared to the previous years is due to a decrease in number of male shrimp, while the number of females remains stable over the three years. The overall size distribution, however, still shows the presence of a wide range of male year-classes in the population.

SUMMARY OF ALL INDICES

overall variations in catches:

- increase from 1981 to 1992, decrease in 1993

local variations in catches:

- catches north of 71°N decreased since 1987, increased slightly in 1992, decreased in 1993
- catches in the inshore area increased since 1987, preliminary statistics indicate a decrease in 1993
- catches offshore increased since 1988 (TAC exceeded), preliminary statistics indicate a decrease in 1993
- catches in division 0A have ranged between 6,000 and 7,500 tons from 1987 to 1992, expected to decrease to less than 5,000 tons in 1993.

variations in effort:

- overall increase in effort from 1987 to 1991, decrease in 1992 and 1993
- effort fluctuated in Div. 1A and 1B, decreasing in 1B since 1991
- effort increased in Div. 0A till 1992, decreased in 1993
- effort increased in Div. 1C to 1990 and decreased thereafter
- effort increased in Div. 1D to 1992
- new fishing activity in Div. 1E in 1991-1993
- decreasing effort in Div. 1F from 1989 to 1992, increase in 1993

trends in recent catch rates:

variations in division 0A:

- catch rates from 1989 to 1993 stable but lower than 1987-88

variations in division 1B:

- decrease from 1987 to 1989 followed by stability from 1989 to 1992, and slight increase in 1993

variations in 1CD:

- variable from 1987 to 1991, stable since then

composition of catches:

from division 0A:

- in general, years of high catch rates are associated with a dominance of females in the catches
- catch rates for females reflected the same trend as the overall commercial CPUE index while those for males increased to 1987 and have since stabilized

throughout West Greenland offshore area:

- the 1985 year-class contributed to the female group in both 1992 and 1993, as sex change occurred over two years. New year-classes were evident in the fishery data in both 1992 and 1993

discarding:

- levels of discarding in SA1 were estimated at approximately 11,000 tons in 1990, 9,000 tons in 1991, and 7,000 tons in 1992
- expected decrease in discarding rates in 1993 due to introduction of a new observer system

biomass estimates from research surveys:

- biomass in the area North of 69°30'N decreased from 1988 (22,000 tons) to 1991 (6,000 tons), increased to 21,000 tons in 1992, but decreased again in 1993 (to 9,000 tons)
- biomass South of 69°30'N was stable at roughly 160,000 tons from 1988 to 1990 but decreased in 1991 to 113,000 tons, increased again in 1992 to 158,000 tons, and further in 1993 to 216,000 tons
- total offshore biomass fluctuated around 180,000 tons from 1988 to 1993 (except for the low 1991 value of 120,000 tons). 1993 value the highest observed (225,000 tons)
- estimates of biomass of about 47,000 tons for 1991 and 1992 in the inshore area, decreased to 32,000 tons in 1993

demographic structure:

- males: estimated number of males was highest in 1989 and 1993 and lowest in 1991
- females: estimated number of females decreased from 1990 to 1991, increased in 1992, and again in 1993 (to 1990 level)

- the 85 year-class dominated in 1989, 1990 and 1991 and the spatial distribution reflects the migration into deeper water of the year-class as it grows. In 1992 the 1987 year-class began recruiting to the survey and the commercial fishery, especially to the south, and so did the 1988 year-class in 1993
- the size at age composition of shrimp from the inshore survey is similar in the occurrence of modes to the offshore
- same modes of males occur in inshore and offshore areas
- decrease in inshore biomass in 1993 reflects a decrease in males, number of females stable.

STATUS OF THE RESOURCE

Indices from the commercial fishery show that the abundance in 1989-93 was stable but lower than the high 1987-88 level. This high level can be explained by the recruitment to the female component of at least two strong year-classes. The decrease from the 87-88 level can be explained by mortality (fishing and natural) of these year-classes. The stability since 1989 was maintained by the strong 1985 year-class, but new year-classes recruited to the fishery in 1992 and 1993.

The research survey index from 1988 to 1993 showed relative stability around a mean of approximately 180,000 tons. The low 1991 estimate might have been due to a decreased availability of shrimp to the research gear and/or survey area in that year.

The strong 1985 year-class recruited to the fishery in 1990. It maintained catch rates in 1991, 1992, and 1993. Data from both the 1992 and 1993 surveys and from commercial fishery in Div. 0A showed that the 1985 year-class changed sex over two years (1992 and 1993).

The combined inputs to the assessment indicate a stable stock that, in 1994, 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, 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.

References

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Table 1. Nominal catches (tons) in NAFO SA0 and SA1 from 1983 to October 1993, and advised and effective TAC for SA0+1 in 1983-94.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0+1 offshore catch	39267	35883	42187	44584	46160	43646	49911	52601	57104	63357	46622
Inshore	7500	7500	7500	7500	6921	10233	13224	15386	17891	21148	10490
N of 71°N	0	0	4349	11045	10700	6660	2522	2121	1077	2647	641
Total catch	46767	43383	54036	63129	63781	60539	65657	70108	76072	87152	57753
0+1 advised TAC	29500	29500	36000	36000	36000	36000	44000	50000	50000	50000	50000
0+1 effective TAC	34625	34925	42120	40420	40120	40120	45245	45245	46225	44200	40600

Table 2. Shrimp biomass estimates (thousand tons), obtained from stratified-random trawl surveys in Davis Strait 1988-93.

Areas	1988	1989	1990	1991	1992	1993
N1-N4	12.762	8.137	8.847	4.083	14.196	8.075
N5-N7	9.139	3.206	2.886	1.948	6.968	0.982
Inshore				47.578	45.167	32.169
W1-W2	57.658	56.571	78.407	38.750	55.601	103.157
C1+C3	9.305	3.836	11.425	4.668	16.764	3.609
W3	42.706	51.806	35.693	26.655	27.738	21.892
W4	23.210	29.726	12.557	14.451	10.098	19.641
W5	16.758	38.422	17.149	15.467	36.301	24.655
W6	-	-	7.595	13.083	11.419	34.672
W7	-	-	-	-	-	7.950
N1-N7	21.901	11.343	11.733	6.031	21.164	9.057
W1+W2+W3+C	109.669	112.213	125.525	70.073	100.103	128.658
W4-W7	39.968	68.148	37.301	43.001	57.818	86.918
Total offshore	171.538	191.704	174.559	119.105	179.085	224.633

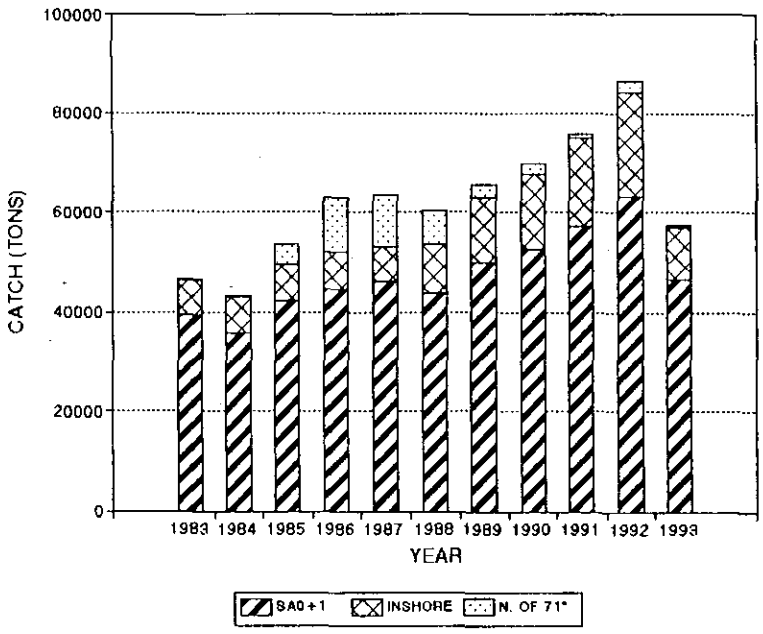


Fig. 1. Nominal catches of shrimp (tons) in Davis Strait 1983-93 (1993 only includes Jan-Sep).

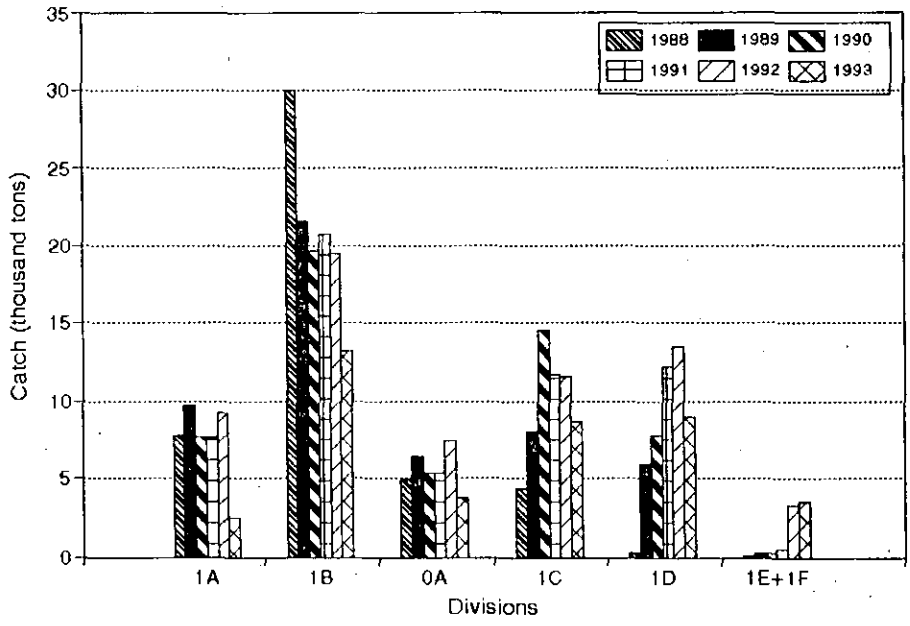
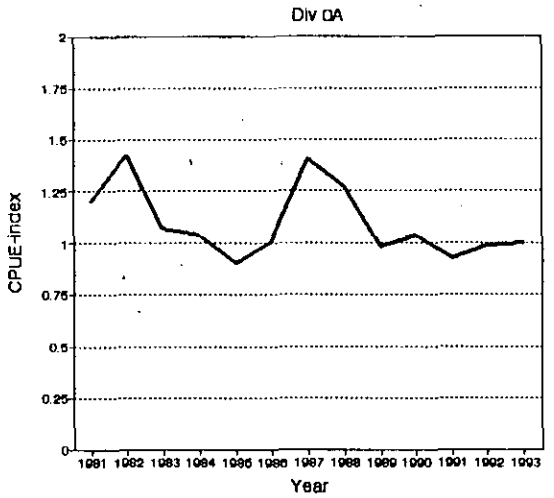
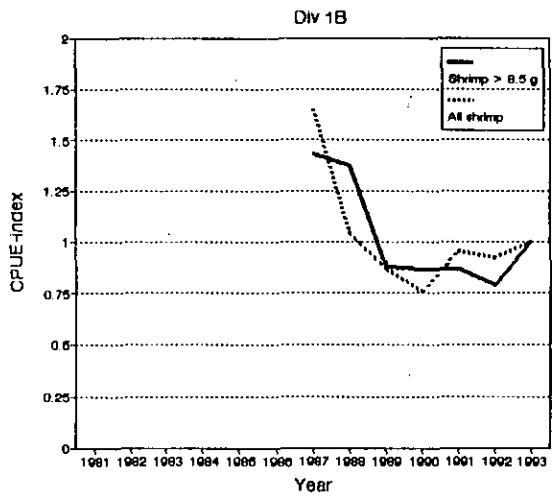


Fig. 2. Logbook catches of shrimp by Division in 1988-93 (1993 only includes Jan-Oct).





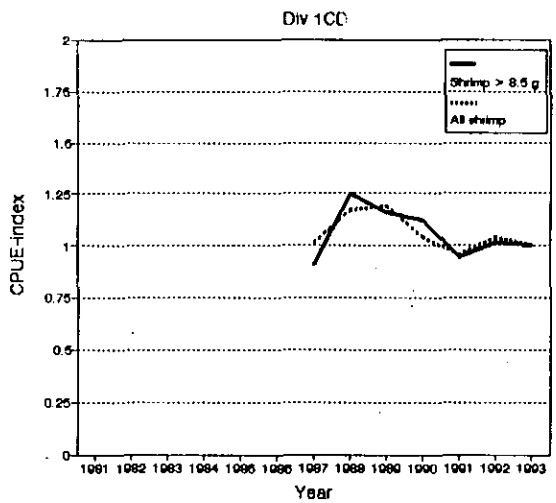


Fig. 3. Catch rate indices for shrimp in Davis Strait.

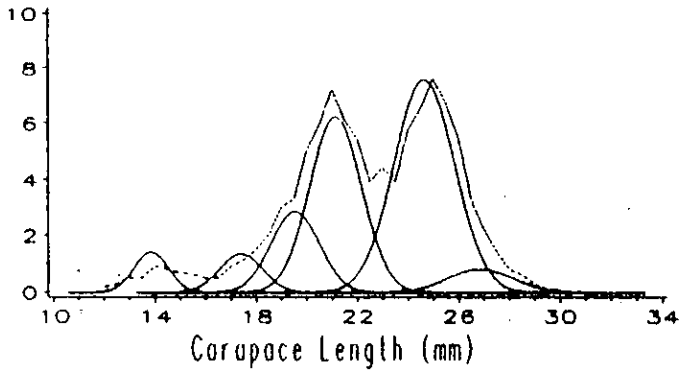


Fig. 4. Separation of ages from commercial length frequency data (broken line = commercial frequency), NAFO Div. 0A, 1993.

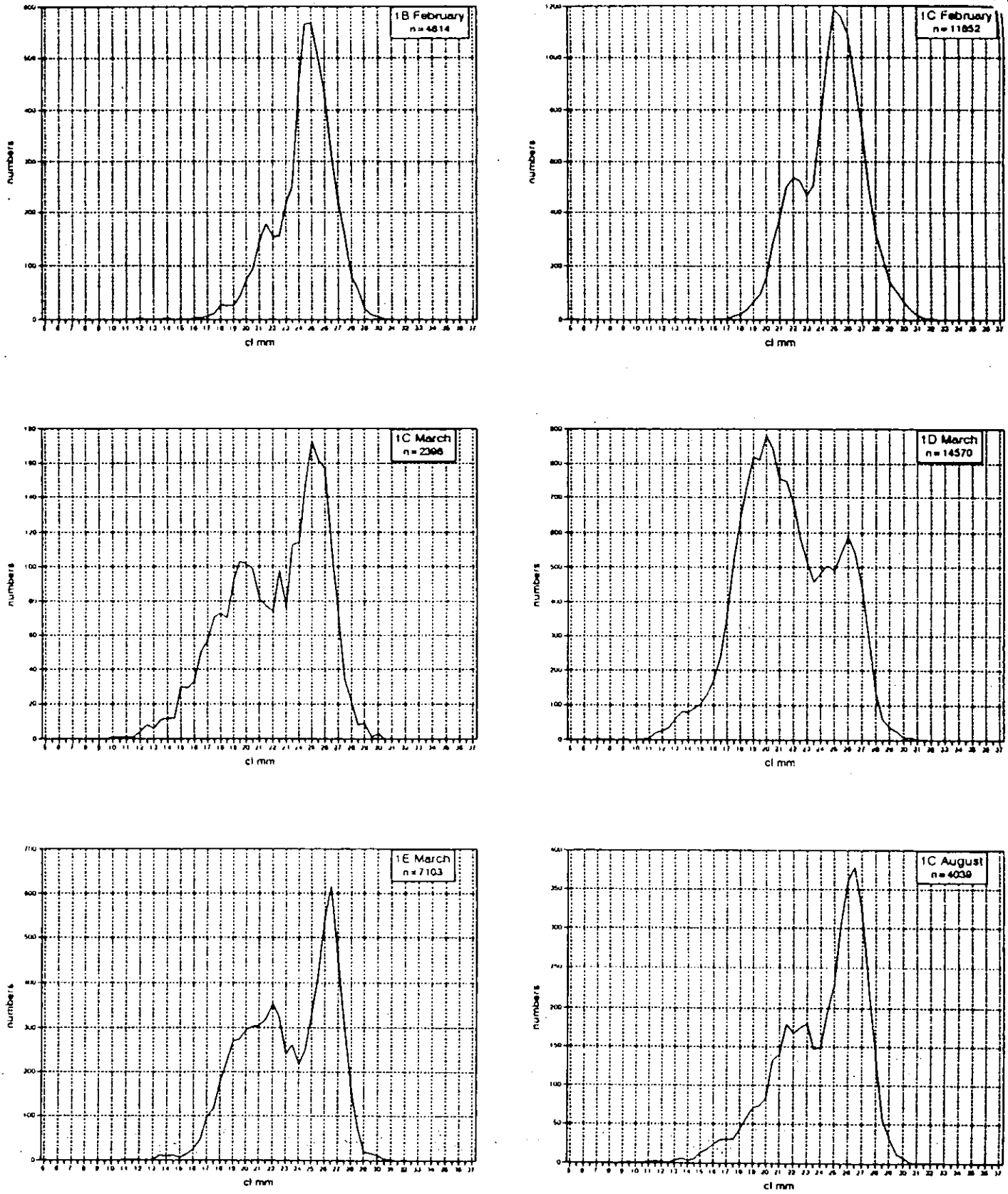
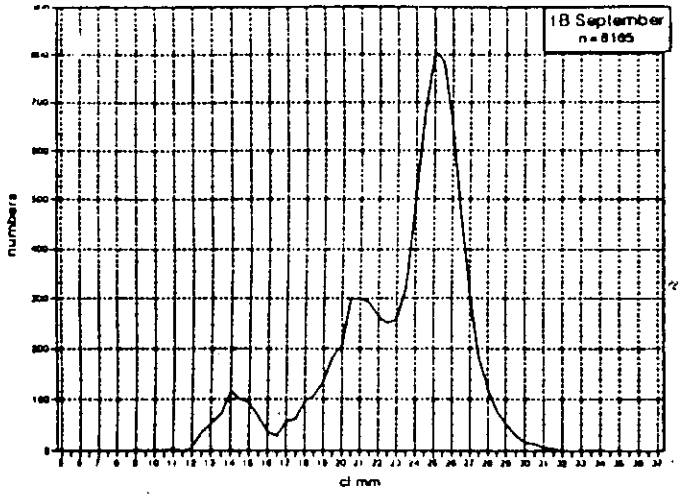
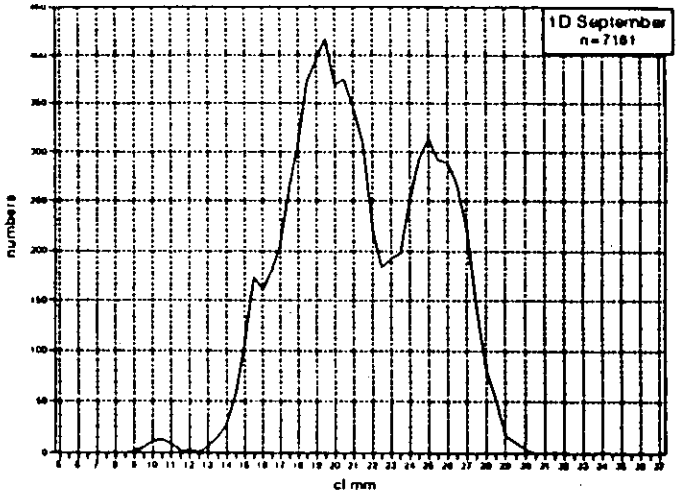


Fig. 5. Commercial shrimp samples from Subarea 1 in 1993, pooled by Division and month.





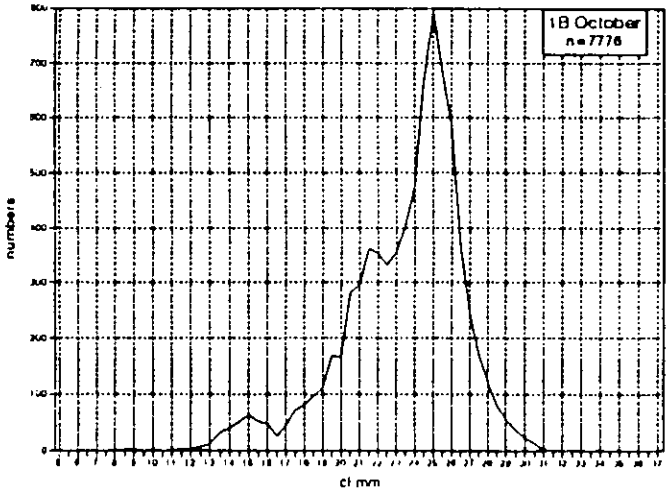


Fig. 5. (continued)

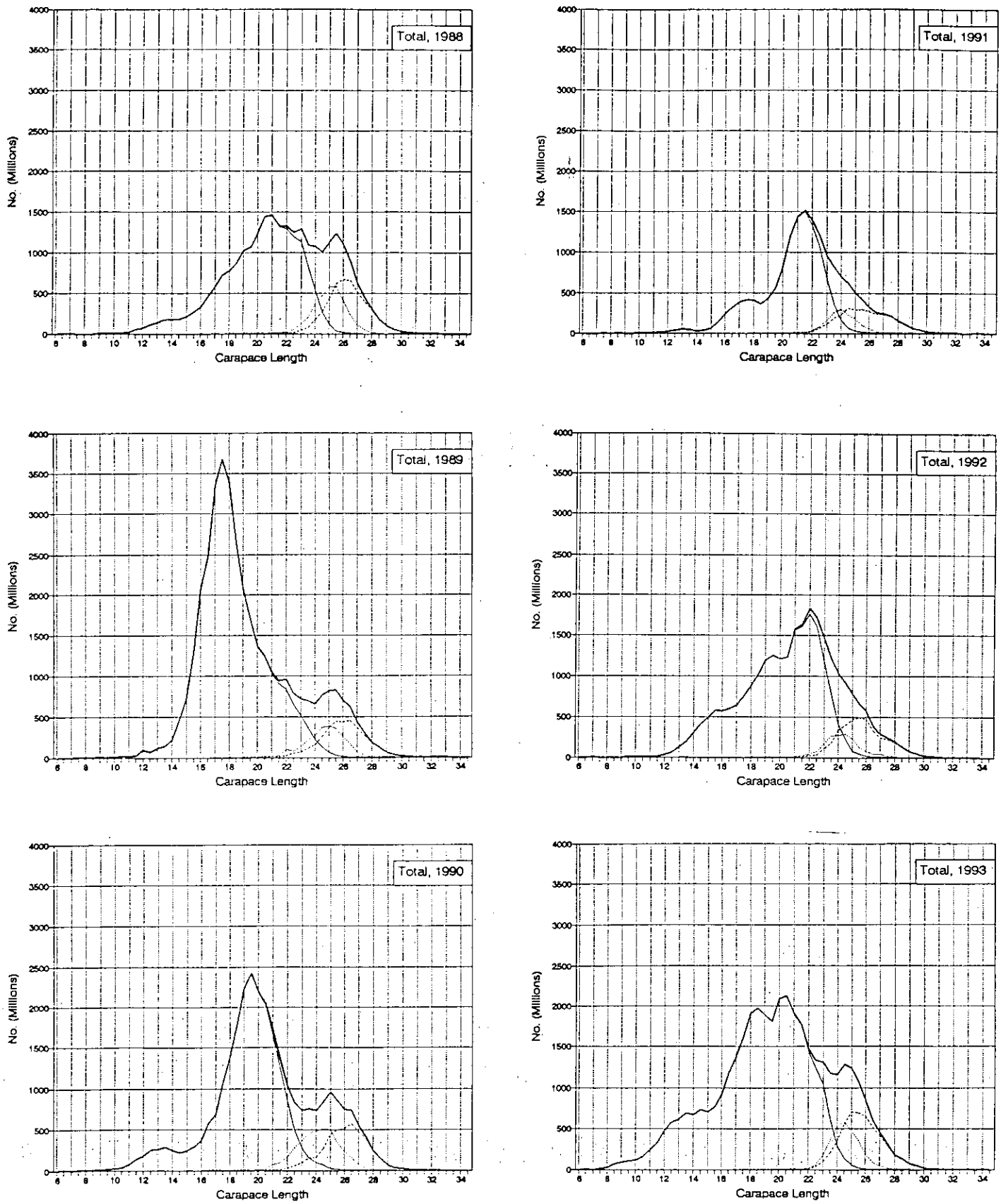


Fig. 6. Numbers of shrimp by length group (CL) in the total survey area in 1988-93, based on pooling of samples weighted by catch and stratum area.

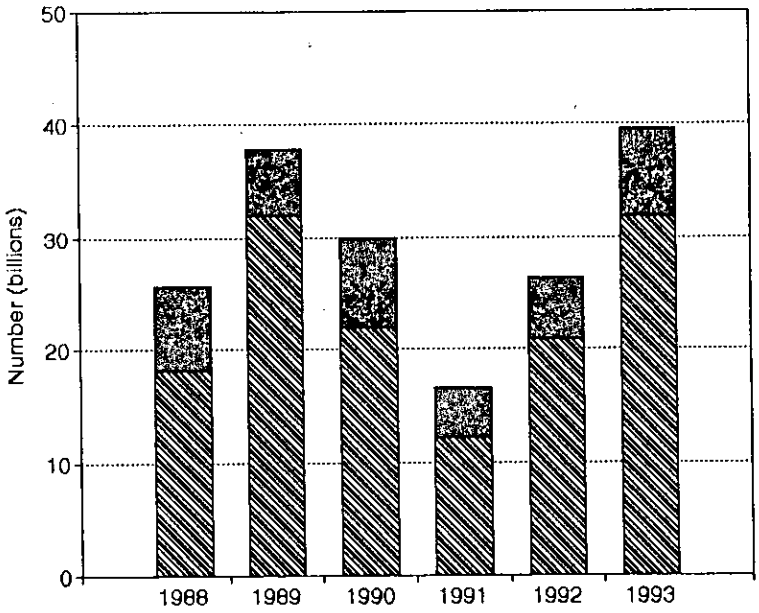


Fig. 7. Number of males and females shrimp in survey area.