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Preliminary Assessment of Shrimp in the Denmark Strait

by

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Shrimp in Denmark Strait

a) Introduction

The fishery was initiated in 1978 with a catch of about 360 tons and subsequently increased rapidly to about 12,500 tons in 1988. In 1989 and 1990 the nominal catch decreased to less than 11,000 tons and in 1991 and 1992 declined further to 8,600 and 7,500 tons, respectively. The annual catches have continued to fall in the traditional north area, to 6,600 in 1993, and finally to 4,500 in 1994. At the same time there has been a new fishery starting in 1993 in two areas found further south (Fig. 1) where some 1,100 tons and 1,900 tons were taken in the middle area in 1993 and 1994 respectively. In the south area the catch was 200 tons in 1993 and some 1,700 in 1994.

The fishery takes place primarily in the area of Strede Bank and Dohrn Bank as well as on the slopes of Storfjord Deep. Two new areas were discovered in 1989 by Greenland (Lehmann, 1990), but not found profitable at the time, have now been fished for two years. The new areas lie south of 65°N and are shown on Fig.1 along with the traditional area. The traditional fishing area extends from approximately 65°20'N to 67°30'N and between 26°W and 34°W. For the sake of comparison and because of the uncertainty of whether the shrimp of the new areas belong to the same stock, the catch and effort data are kept separate from those of the traditional area.

2. Input Data

2.1 Commercial fishery data

2.1.1. Trends in catch and effort. Catch and effort data from logbooks were available from Greenland, Norway, Iceland, France, Faroe Islands and Denmark since 1980. Catches and corresponding effort were compiled by month and by fleet. CPUEs were calculated by month and the mean weighted CPUE of two periods of the year(January to June, and July to December) was then applied to the total catch of the period to estimate the total effort.

Total effort values showed the same pattern as catch. Between 1980 and 1989, effort increased from about 35,000 hours to more than 100,000 hours, declining thereafter to about 92,000 and 95,000 hours in 1990 and 1991, respectively. The fishery from July-December became more important at the end of the eighties, accounting for approximately 50% of the total annual effort.

Total catches increased rapidly from 1978 to 1980, decreased in 1981 and remained stable to 1983. Catches increased steadily from 1983 to 1988 and then decreased to 1992 (Fig. 2). Total effort values show about the same pattern as catch. between 1980 and 1989, effort increased from about 35,000 hours to 108,000 hours, declining thereafter to about 70,000 hours in 1993 and further to 30,000 hours in 1994 in the northern area (north of 65°N)

2.1.2. Trends in catch rates

Abundance indices were calculated from the unstandardized catch-rate series of the years 1980 to 1994 (Skuladottir, 1994), using 1994 as the reference point (Fig. 3). There was a declining trend from 1980 to 1991. Within the general trend, however, a period of fluctuating (unstandardized) catch rates can be seen from 1981 to 1987, followed by an obvious decline from 1987 to 1989. Catch rates were similar in the period from 1989 to 1993, where the 1989-94 level was about 50% of the level seen during the period of relative stability from the mid-1980s. But in 1994 there was a considerable increase in CPUE. The unstandardized overall CPUE has been calculated for all countries and set against removals as catch from the stock in every 3 previous years (Fig. 4). From this figure it appears that some recovery has taken place as the annual removals of shrimp from the fishery decrease.

2.1.3. Standardization of the catch rates

The catch and effort data from Greenland from 1987 to 1994 were analyzed using SAS multiple regression procedures to account for the vessel size and seasonality (months) of the fishery both the total catch and the proportion of shrimp >8.5 g of weight (Fig. 5). The results for both showed a continuous decline till 1992, stability in 1993, and a considerable increase in 1994.

2.2 Commercial Biological data

2.2.1. Icelandic fishery data

The Icelandic samples (Fig.6) taken in the autumn of 1987 and 1988 showed that the catches east of the midline were comprised mainly of female shrimp with a distinct mode at 31 mm CL. The 1990 fall samples showed the increased importance of the male component (about 50% compared to 32 and 26% in 1987 and 1988). In 1991, 1992 and 1993 samples taken in spring showed that the male shrimp dominated in all three years. In 1994 the samples taken in spring showed about 50% occurrence again of males. The occurrence of a component of female shrimp with a mode at 25-26 mm in the Icelandic samples suggested that sex change occurred earlier than normal. The 1991 and 1992 samples showed the occurrence of these small females but there was no noticeable component as seen in the 1990 data.

The occurrence of a component of female shrimp with a mode at 25-26 mm as noted in the 1990 samples is here again present but not very distinct, and the preliminary age assessment of Icelandic samples of the years 1990 to 1994 indicate that up to 20% of a year-class changed sex one year earlier than the rest. This

could indicate a response to fishing pressure, as indicated by declining catch rates of the past years, or there could have been a migration of shrimp from Icelandic waters where males change sex at a smaller size.

2.2.2. Greenlandic fishery data

The samples from the Greenlandic fishery in 1994 (Fig. 7 A and B) came from all 3 areas. The occurrence of males in the north area was very low or only 26.5% in February. In the middle area the occurrence of males was from 37% in March to 46% in April. In the south area the occurrence of males is 34% in January, 29% in February and 58% in April. Those proportions of males resembled more the conditions of the population in the north area in the eighties. There appeared to be a peak in the female component at 29 mm CL in January and February but at 26 mm in April in the south area. In the middle area there was also a female peak at around 30 mm CL.

2.3. Research Survey Data

2.3.1. Biomass estimates

A two phase stratified random trawl survey was conducted by Greenland in the Denmark Strait in September-October, 1994. The biomass estimate of 3,800 tons was much higher than that of either 1990 or 1992, which were 1,860 and 1,044 tons, respectively. In the beginning the biomass was, however highest, namely 4,879 tons.

2.3.2. Demographic structure

Greenlandic survey samples from 1989, 1990, 1992 and 1994 (Fig. 8) showed an increase in the proportion of males over the period which was consistent with a trend from the 1985 to 1989 Norwegian surveys. However overall abundance declined, especially for females.

	Percent males									
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Norway	43.8	41.4	53.5	58.5	58.0					
Greenland					63.1	62.5	-	78.3	- -	74.5

3. Summary of all Indices

Trends in catches

Increase from 1978 to 1980.
Decrease in 1981 and stabilization in '82 and '83 at around 4,700 tons.
Steady increase from 1983 to 1988 to 12,500.
Decrease from 1988 to 1994.

Trends in effort

General increase from 1979 to 1989.
General decrease from 1989 to 1994.

Trends in catch rates

Overall declining trend in the unstandardized catch rate from 1980 to 1991.
Considerable increase from 1993 to 1994.
A steady decrease for the standardized catch rate for both large shrimp and all shrimp from 1987 to 1992 for Greenland.
Levelling off from 1992 to 1993
Increase in 1994.

Biomass estimate from research surveys

Biomass in 1994 the second highest of comparable surveys..

Demographic structure from research surveys

After 1988, increasing proportions of male shrimp (<28 mm CL) in Icelandic samples
In 1994 decrease in proportions of male shrimp in Icelandic samples.
Increase in proportions of males since 1989 in Greenlandic surveys

4. Summary of Advice From Previous Years

The interpretation of the effects of fishing on the stock in the Denmark Strait north of 65°N has changed since the first assessment was conducted in 1980. In 1981, it was thought that the decrease observed in the spring catch rates were due to heavy exploitation. Also it was considered that the stock was at the northern limit of the species distribution range, and as such, could be more sensitive to exploitation. Therefore, a cautious approach for the exploitation was recommended, and a TAC of 5,000 tons (average catch 1981-1984) was advised.

No TAC advice was provided for 1986, 1987 or 1988 because the catch rates could not be interpreted as an index of stock abundance. In 1988, it was observed that increased catches over the previous several years had no apparent effect on the resource and catch levels at around 10,000 tons were recommended as an exploratory level for several years.

Catch rates declined in 1987 and 1988, however catch composition and biomass estimates from 1985 to 1989 suggested that the stock was stable and in 1990 it was recommended that the TAC remain at 10,000 tons. The 1989 Norwegian survey showed that the stock was dispersed and the sexes well mixed. In 1991, the catch rate series was standardized to account for changes in seasonality and fleet composition and it was interpreted that the stock in 1989-90 was substantially lower than in the period of stabilized catch rates. Also more males appeared in the catches and there were indications of earlier sex change. These concerns resulted in an arbitrary reduction of the TAC from 10,000 to 8,000 tons. The depressed conditions were still evident in the 1991 data and in 1992 a further reduction to 5,000 tons was advised for 1993 and several years thereafter in an attempt to protect the spawning biomass and rebuild the stock.

5. Status of the Resource

Unstandardized catch rates showed a declining trend from 1987 to 1991 but a stabilization between 1991 and 1993 a rise in 1994. The standardized catch rates of Greenland show also a decline from 1987 to 1992 and a stabilization between 1992 an 1993 followed by about the same increase in catch rate in 1994 as that for all fleets combined. Moreover there was an increase in biomass index from low biomass of the years 1990 and 1992. As such this could be an indication of improvement of the resource. On the other hand the proportion of males to females is high according to Greenlandic survey but about half according to the Icelandic samples, and low according to the Greenlandic samples.

6. Prognosis

Given that it is not certain that the stock has recovered substantially catches should be 5,000 tons in 1995 in an attempt to increase the catch rate further and rebuild the stock. This should apply to the whole area including the new areas.

Table 4. Nominal catch (tonnes) of shrimp in the Denmark Strait.

Nation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994 ***	1995
North area																		
Denmark	-	-	702	581	740	204	443	353	500	555	444	366	390	358	160	97	65	
Faroe Islands	-	-	4233	713	737	443	668	674	727	595	679	595	843	1007	1092	707	286	
France	-	-	50	353	414	291	500	642	780	1030	494	381	51	118				
Greenland	-	-	200	1004	1115	1467	2250	2596	5781	6627	7456	5976	6210	4213	2034	1339	1108	
Iceland	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1417	
Norway	-	800	2461	2016	1896	1727	2128	2051	2026	2041	2052	2098	2500	2504	2500	1860	1581	
Total	363	1285	8405	4792	4902	4175	6731	8110	10964	12178	12556	10742	10275	8665	7536	6556	4457	
Middle area																		
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	402	
Faroe Islands																233	741	
Greenland																799	440	
Norway																	354	
Total	-	-	-													1080	1937	
South area	-	-	-															
Greenland	-	-	-													205	1734	
Σ eastern side	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1417	
Σ north area not eastern side	0	800	7646	4667	4902	4132	5989	6316	9814	10848	11125	9416	9994	8200	5786	4003	3040	
Σ middle area																1080	1937	
Σ south area																205	1734	
Σ western side	0	800	7646	4667	4902	4132	5989	6316	9814	10848	11125	9416	9994	8200	5786	5288	6711	
ΣΣ all areas	363	1285	8405	4792	4902	4175	6731	8110	10964	12178	12556	10742	10275	8665	7536	7841	8128	
Adviced TAC	-	-	-	-	4200	4200	4200	5000	-	-	-	10000*	10000*	10000*	8000	5000	5000	5000
Effective TAC western side	-	-	-	8000	4500	5725	5245	6090	7525**	7725**	8725**	9025**	14100	14500	13000	9563		

* Adviced for a few years as a precautionary measure.

** not including Greenland fishery north of 66°30'N.

*** Provisional

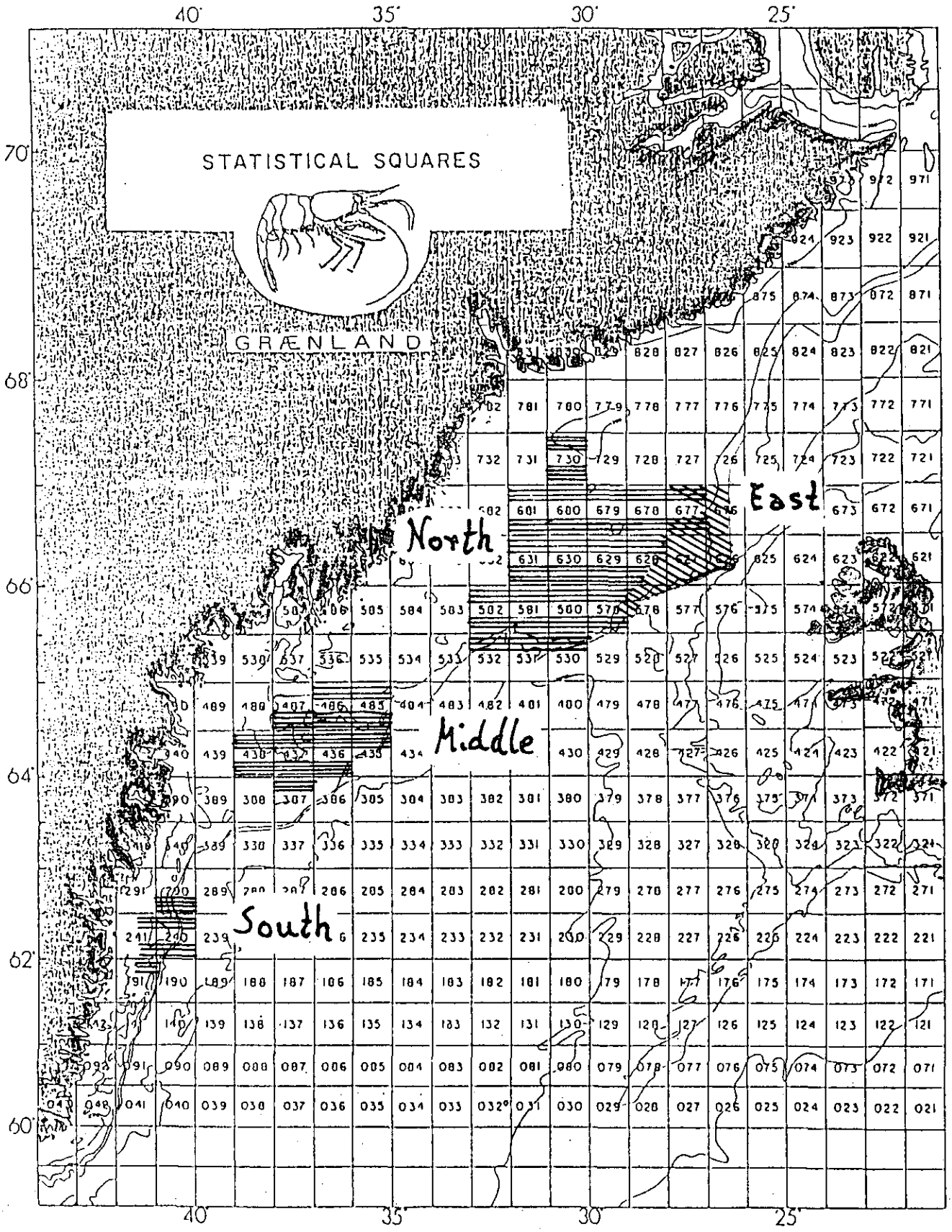

Fig. 1. The strata numbers in the Denmark Strait.

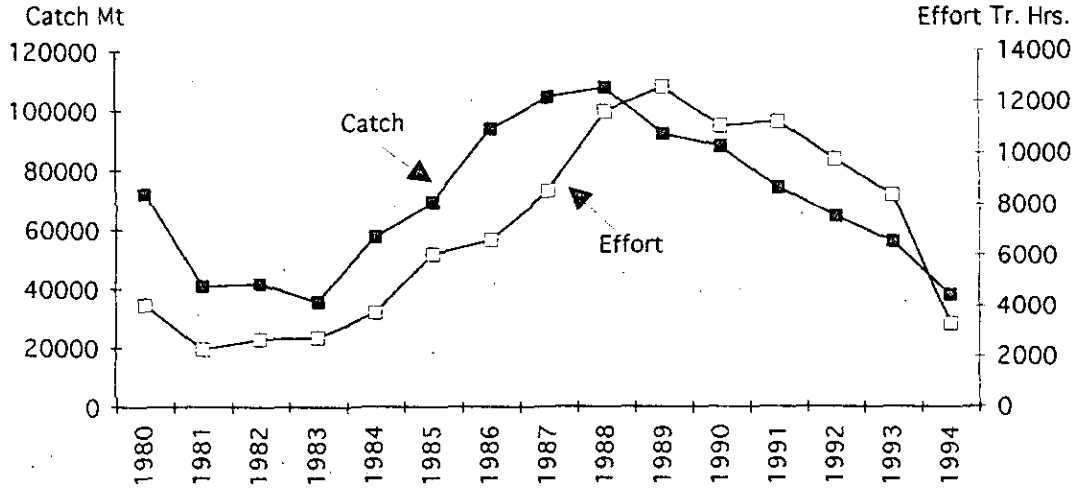

Fig. 2. Catch and effort from the logbooks weighted by nominal catches from the area north of 65°N.

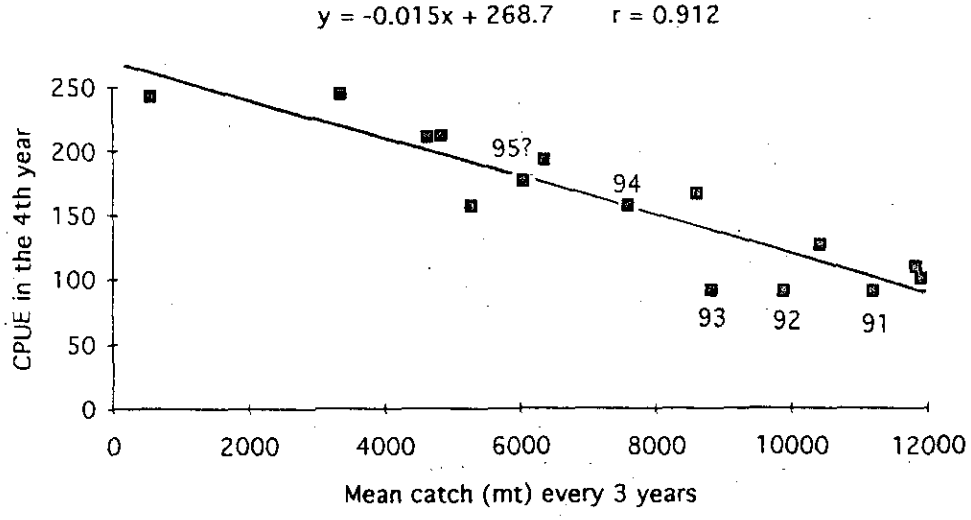

Fig. 3. The mean catch of shrimp every 3 years against unstandardized CPUE in the fourth year, denoted by that year, north of 65°N.

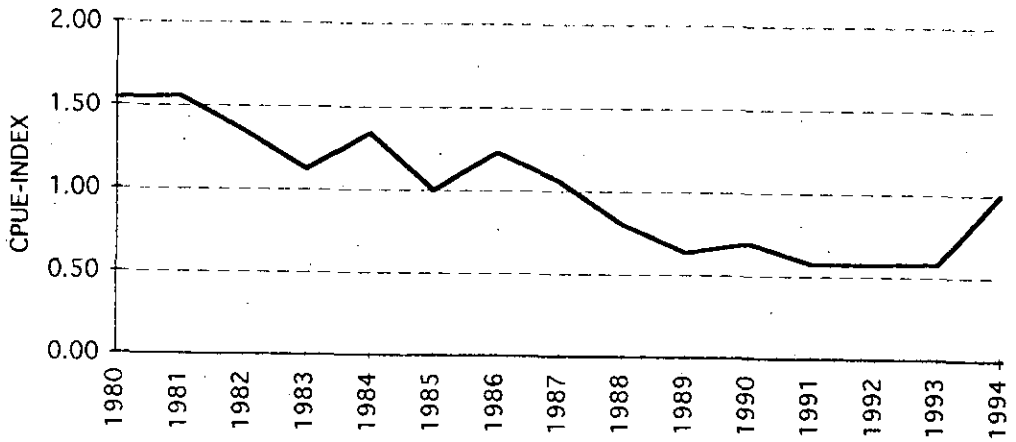

Fig. 4. The unstandardized catch rate indices of all countries combined.

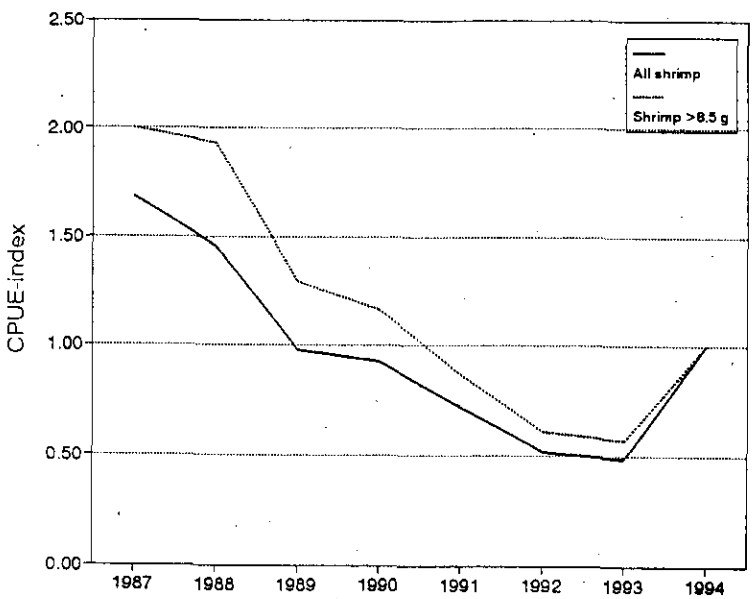

Fig. 5. Annual CPUE-indices calculated for shrimp >8.5 g and for total catch by 32 Greenland trawlers in Denmark Strait from 1987 to 1994.

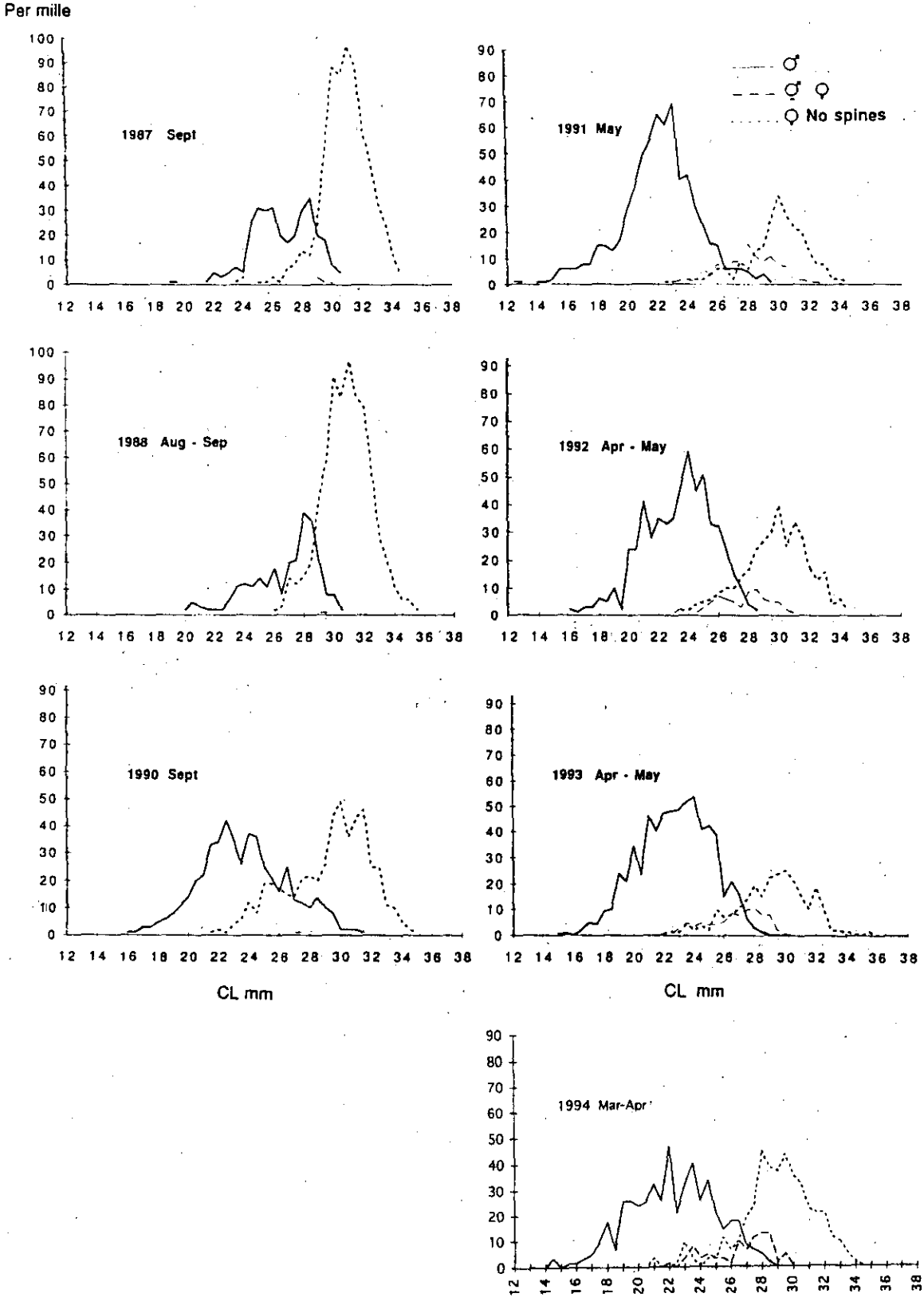

Fig. 6. The Icelandic samples in the years 1987, 1990 to 1994 in the eastern part of the area.

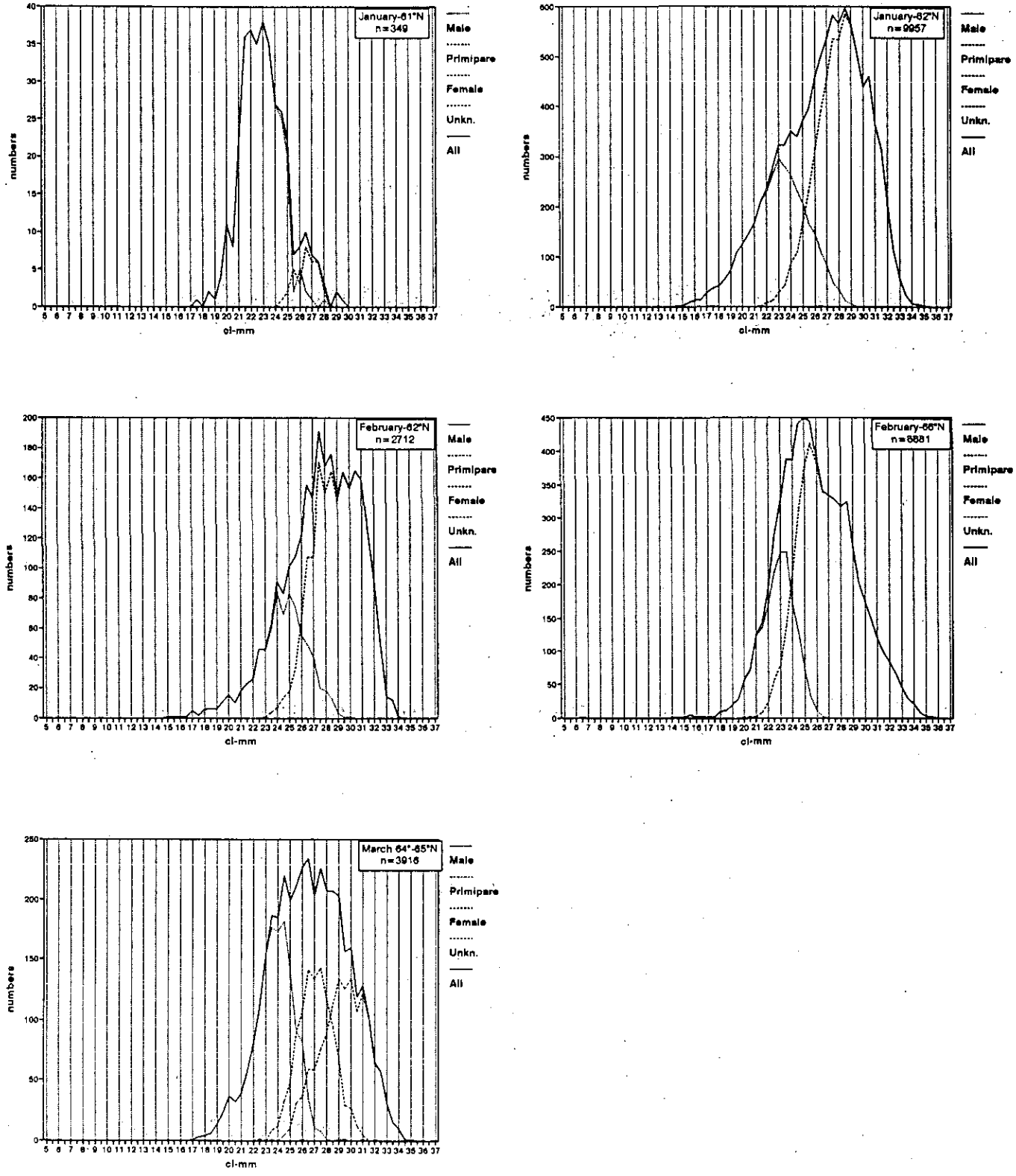

Fig. 7A. Pooled shrimp samples from January-March 1994 sampled in various fishing areas.

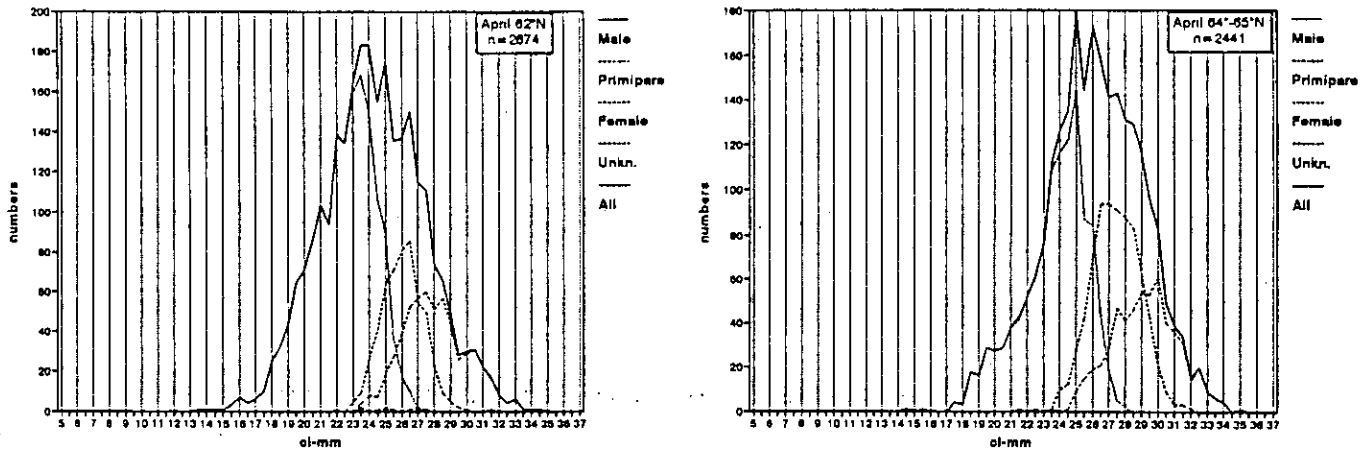

Fig. 7B. Pooled shrimp samples from April 1994 sampled in various fishing areas.

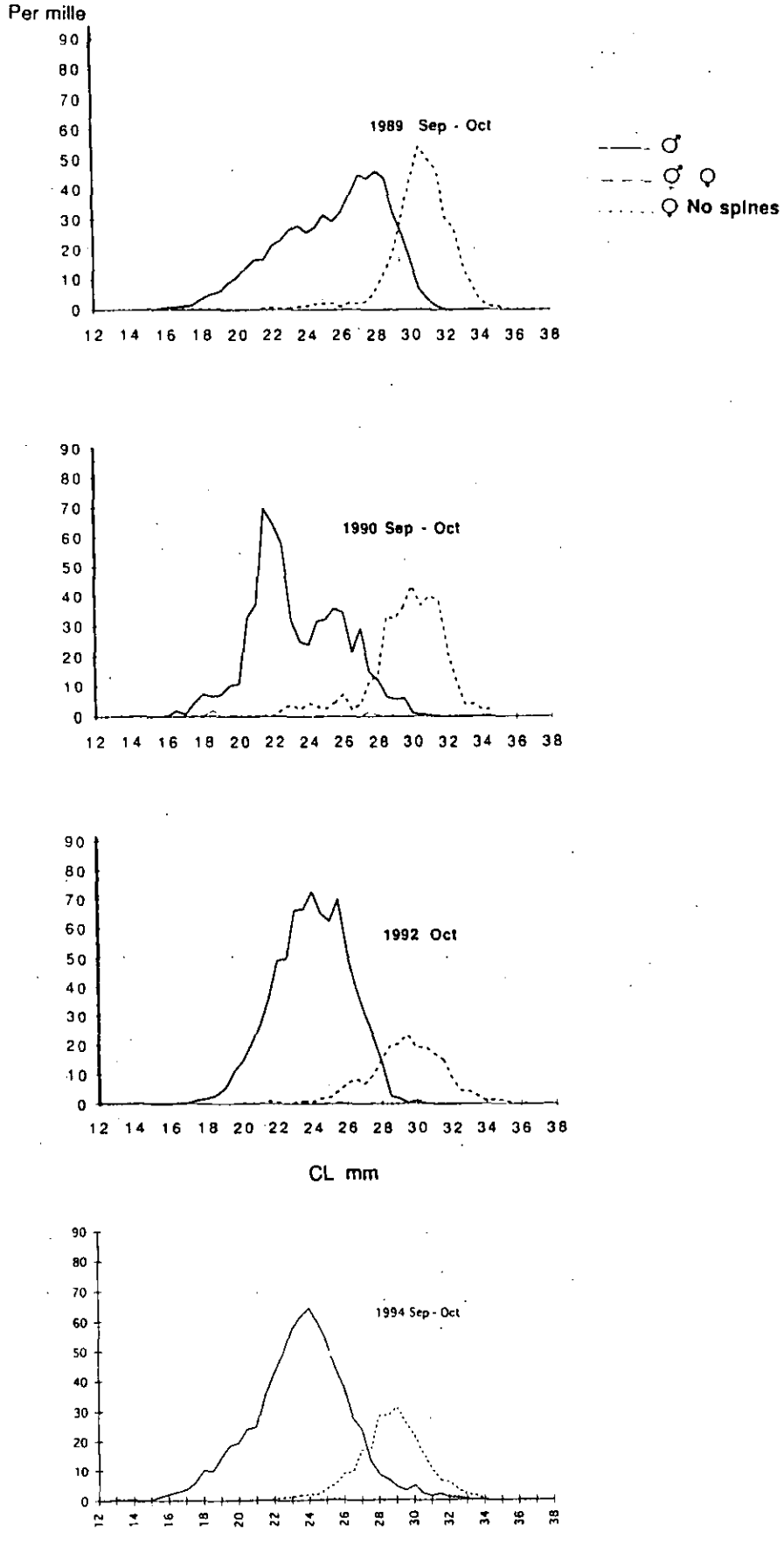

Fig. 8. The Greenlandic survey samples in the years 1989, 1990 and 1992 in the Denmark Strait area. In pooling the samples were weighted by catch and stratum area.