

Northwest Atlantic



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Assessment of Shrimp in the Denmark Strait

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1. INTRODCTION

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 tradional (northern area), to 6 500 in 1993 and finally to 4 900 tons in 1994. In 1995 the provisional figure is about 5 200 tons. At the same time there has been a new fishery starting in 1993 in two areas found further south (Fig. 1) where some 1 200 and 5 000 tons were taken in the middle and south area combined in 1993 and 1994 respectively. In 1995 the catch is already 1 700 tons in this so-called southern area.

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 three years. The new areas lie south of 65°N and are shown on Fig.1 along with the traditional north and east 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 southern area belong to the same stock, the catch and effort data are kept separate from those of the northern area. Throughout this paper unless otherwise stated there are data from the northern 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, Faroe Islands and Denmark since 1980 and from France for the years 1980 to 1991. Catches and corresponding effort were compiled by month and by fleet. CPUE was 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 catches increased rapidly from 1978 to 1980, decreased in 1981 and remained stable to 1983. Catches increased steadily from 1983 to 1988 to 10 500 tons and then decreased to 4 860 tons in 1994 (Fig. 2).

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 in and 1989, declining thereafter gradually to about 70 000 and 95,000 hours in 1993 and then further to 31 000 hours. In 1995 the effort will be similar. The fishery from July-December became more important at the end of the eighties, accounting for approximately 50% of the total annual effort. In the early nineties again the effort is again exerted in the first half of the year

2.1.2 Trends in catch rates

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. 3). From this figure it appears that some recovery has taken place as the annual removals of shrimp from the fishery decreased to about 6 000 tons on the average.

Abundance indices were calculated from the unstandardized catch rate series of the years 1980 to 1994 (Skuladottir, 1995), using 1995 as the reference point (Fig. 4). There is 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 1980's. But in year 1994 there is a considerable increase in CPUE and in 1995 there is a continued stability.

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 and again stability in 1995.

2.2 Commercial Biological data

2.2.1 Icelandic fishery data

The Icelandic samples (Fig.6) taken in the autumn of 1987 and 1988 show 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 show 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 show that male shrimp dominated in all three years. In 1994 the samples taken in spring show about 50% occurrence of males again. 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 show the occurrence of these small females but there was no noticeable component as seen in the 1990 data (Skúladóttir et al, 1994)

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 upto 20% of a year-class change 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. In 1995 however there appears to be just one peak in the immature females.

2.2.2. Greenlandic fishery data

The samples from the Greenlandic fishery in 1994 (Fig. 7) shown here is from the north area. The large female peaks that existed in 1991 and 1992 seem to have diminished a lot indicating a reduction in the mean age in the last 3 years. In 1995 there is a hint of the oldest females building up again (Hvingel et al 1995).

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, 1995 as was also done in 1994. The biomass estimate of 4 558 and 3 800 tons respectively, being much higher than that of either 1990 or 1992, which were only 1 860 and 1 044 tons respectively. In the first year 1989 the biomass was however highest, namely 4879 tonnes.

2.3.2 Demographic structure

Greenlandic survey samples from 1989, 1990, 1992, 1994 and 1995 (Fig. 8) showed an increase in the proportion of males over the period which is consistent with a trend from the 1985 to 1989 in Norwegian surveys. However overall abundance declined, especially for females. In 1995 the total number of females has increased (text table and Fig. 8).

	Percent males									
	1985	1986	1987	1988	1989	1990	1992	1994	1995	
Norway	43.8	41.4	53.5	58.5	58.0					
Greenland					63.1	62.5	78.3	74.5	74.2	

The higher biomass estimate found in 1995 compared to 1990, 1992 and 1994 is the result of an increasing number of both male and female shrimp (Carlsson and Kannevorf 1995).

	Males	Females	Total
1989	231.0	135.4	366.3
1990	142.6	86.7	228.3
1992	163.6	45.3	209.0
1994	264.4	90.4	354.8
1995	315.7	109.9	425.6

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 tonnes.

Steady increase from 1983 to 1988 to 12.500.

Decrease from 1988 to 1994 and 1995.

Trends in effort

General increase from 1979 to 1989.

General decrease from 1989 to 1994 and 1995.

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.

Leveling off from 1992 to 1993

Increase in 1994 and stability in 1995.

Biomass estimate from research surveys

Biomass in 1995 the second highest of comparable surveys..

Demographic structure from research surveys

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 tonnes (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 tonnes 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 tonnes. The 1989 Norwegian survey showed that the stock was dispersed and the sexes well mixed. In 1991, the catch rate series for the Greenlandic fleet 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 tonnes. The depressed conditions were still evident in the 1991 data and in 1992 a further reduction to 5,000 tonnes 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 for all nations combined showed a declining trend from 1987 to 199, but a stabilization between 1991 and 1993 a rise in 1994 and 1995. The standardized catch rates of Greenland show also a decline from 1987 to 1992 and a stabilization between 1992 and 1993 followed by about the same increase in catch rate in 1994 and 1995 as for that of 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 lower according to Greenlandic and Icelandic commercial samples.

6. Prognosis

Given that it is not certain that the stock has recovered substantially catches should be xxx tons in 1995 in an attempt to keep the catch rate at the present level. This should apply to the whole area including the new areas.

7. References:

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- Lehmann, K. 1990. Report on a commercial trial fishery for shrimp (*Pandalus borealis*) off southwest, southeast and east Greenland. NAFO SCR Doc. 90/62, Ser. No. N1784. 6p.
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- Skúladóttir, U. 1995. The catch statistics of the shrimp fishery (*Pandalus borealis*) in the Denmark Strait, in the years 1980-1995. NAFO SCR Doc. 95/114, Ser. No N2653 18p.
1995. The Icelandic shrimp fishery (*Pandalus borealis* Kr.) in the Denmark Strait in 1994-1995 and some reflection on age groups in the years 1991-1995. NAFO SCR Doc. 95/108, Ser. No N2647. 7p.
- Skúladóttir, U., M. Andersen, D.M Carlsson, P. Kannevorff and H. Siegstad, 1994. Preliminary Assessment of shrimp in the Denmark Strait. NAFO SCR Doc. 94/96, Ser. No N2483 12p.

Table 2a. 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	*** 1996	*** 1998	
North area																					
Denmark	-	-	702	561	740	204	443	353	500	555	444	366	390	358	160	111	198	198	251		
Faroe Islands	-	-	4233	713	737	443	668	674	727	595	679	595	843	1007	1092	554	368	368	626		
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	4205	2012	1425	1056	1056	1879		
Iceland	363	485	759	125	0	43	742	1784	1150	1330	1431	1326	281	485	1750	2553	1514	1514	1151		
Norway	-	-	800	2461	1896	1727	2128	2051	2026	2041	2052	2098	2500	2504	2500	1860	1736	1736	1296		
Total	363	1285	8405	4792	4902	4175	6731	8110	10964	12178	12556	10742	10275	8657	7514	6503	4872	4872	5203		
Middle and south area																					
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	488	488	395		
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	777	777	129		
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	918	2868	2868	734		
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	817	817	446		
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1191	4950	4950	1704		
Σ eastern side	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1514	1514	1151		
Σ north area not eastern side	0	800	7646	4667	4902	4132	5989	6316	9814	10848	11125	9416	9894	8192	5764	3950	3358	3358	4052		
Σ middle and south area																1191	4950	4950	1704		
Σ western side	0	800	7646	4667	4902	4132	5989	6316	9814	10848	11125	9416	9994	8192	5764	5141	8308	8308	5756		
Σ Σ all areas	363	1285	8405	4792	4902	4175	6731	8110	10964	12178	12556	10742	10275	8657	7514	7694	9822	9822	6907		
Advised 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	9563	9563	9563		

* Advised for a few years as a precautionary measure.

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

*** Provisional

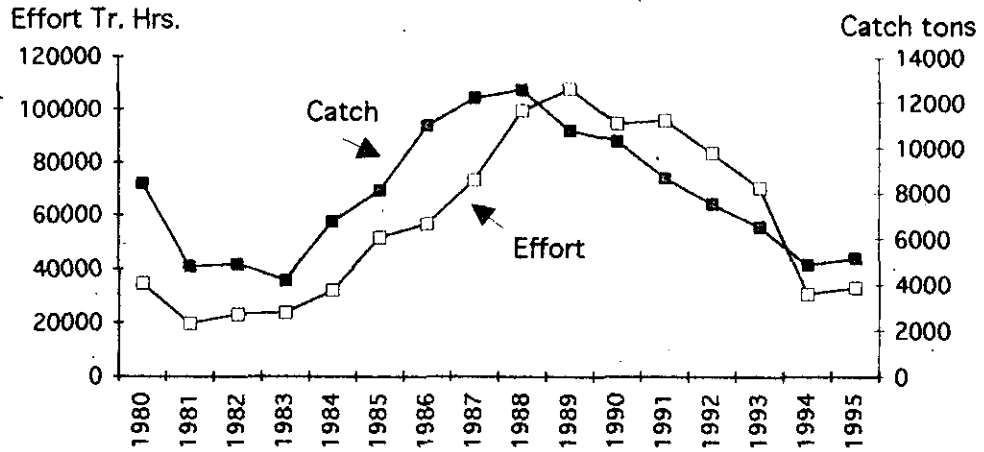


Fig. 2. Catch and effort from the logbooks weighted by nominal catches from the area north of 65° N.

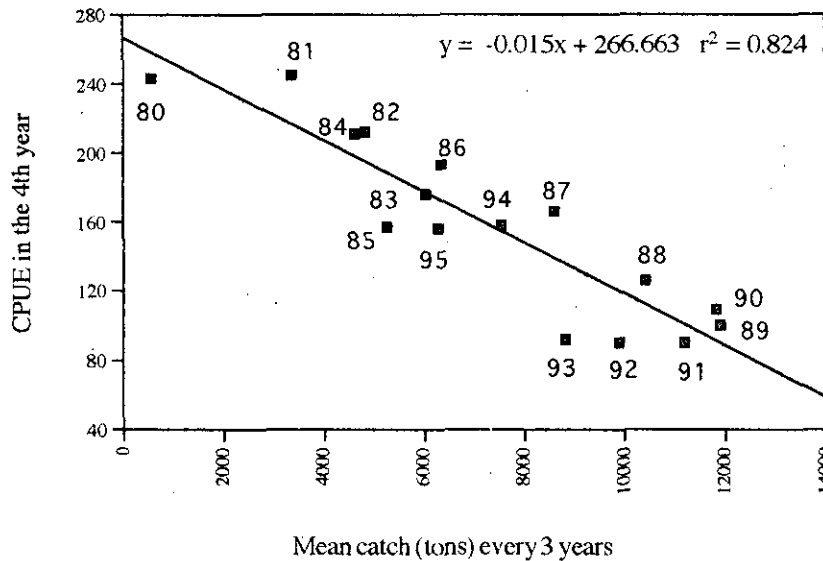


Fig. 3. The mean catch of every 3 years against unstandardized CPUE in the fourth year, denoted by that year, north of 65° N.

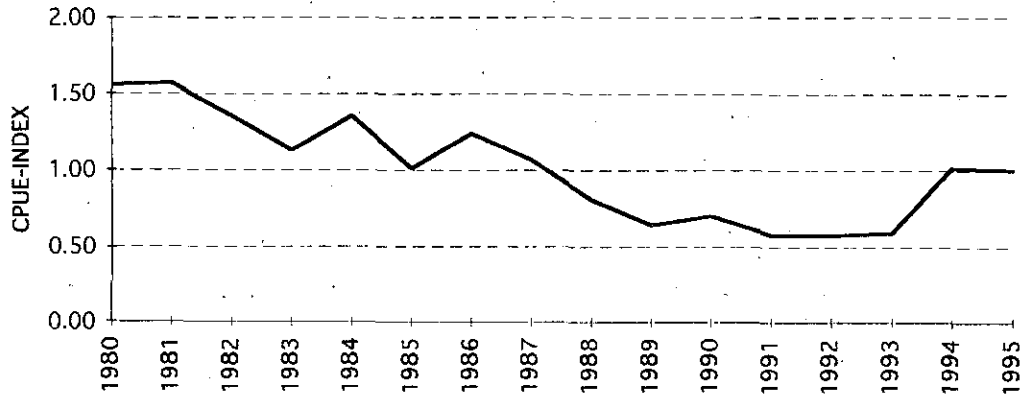


Fig. 4. The unstandardized catch rate indices of all countries combined, north of 65° N.

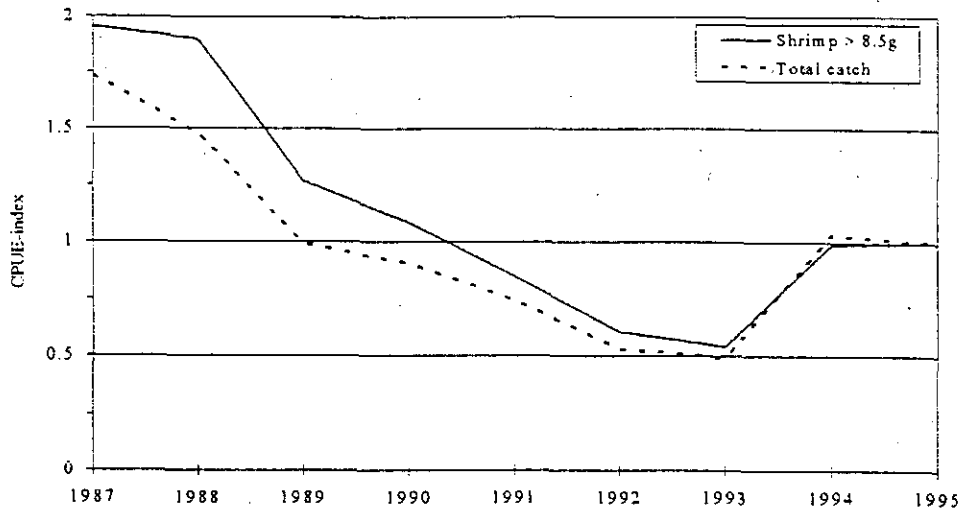
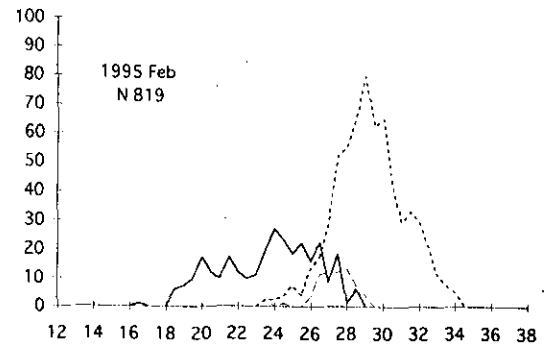
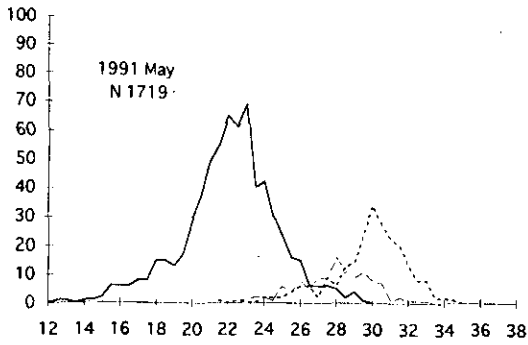
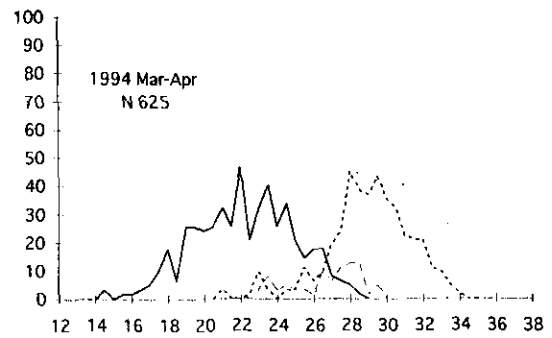
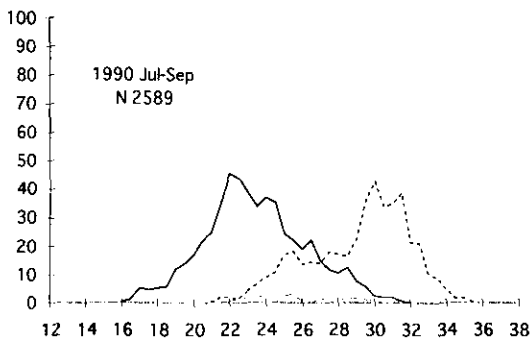
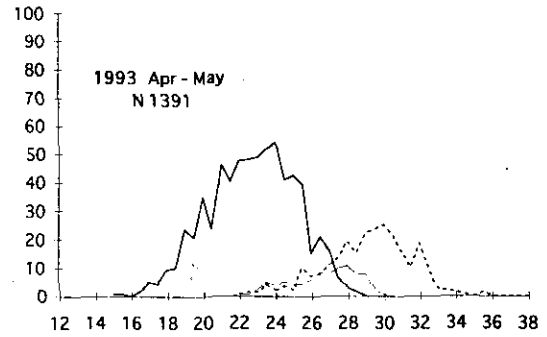
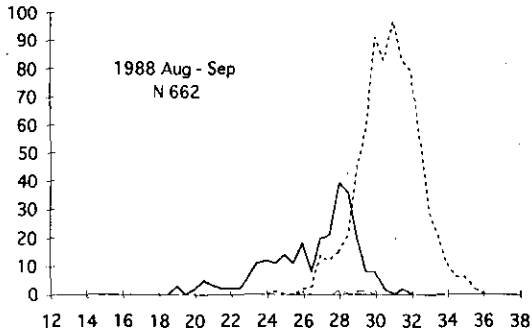
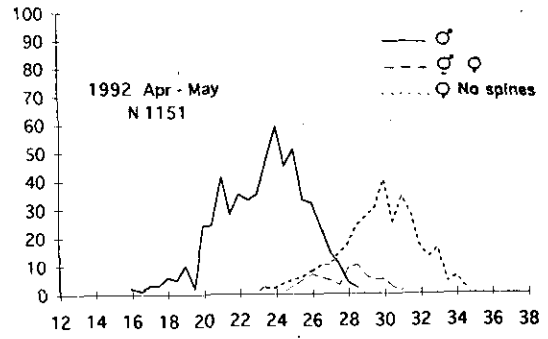
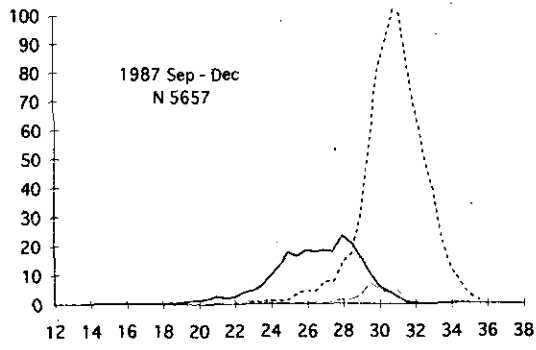


Fig. 5. Annual standardized CPUE-indices calculated for shrimp > 8.5 g and for total catch by 32 trawlers in the area north of 65° N from 1987 to 1995.

Per mille



CL mm

CL mm

Fig. 6. The Icelandic commercial samples in the years 1987 to 1995 in the eastern part of the Denmark Strait area, i.e. north of 65° N.

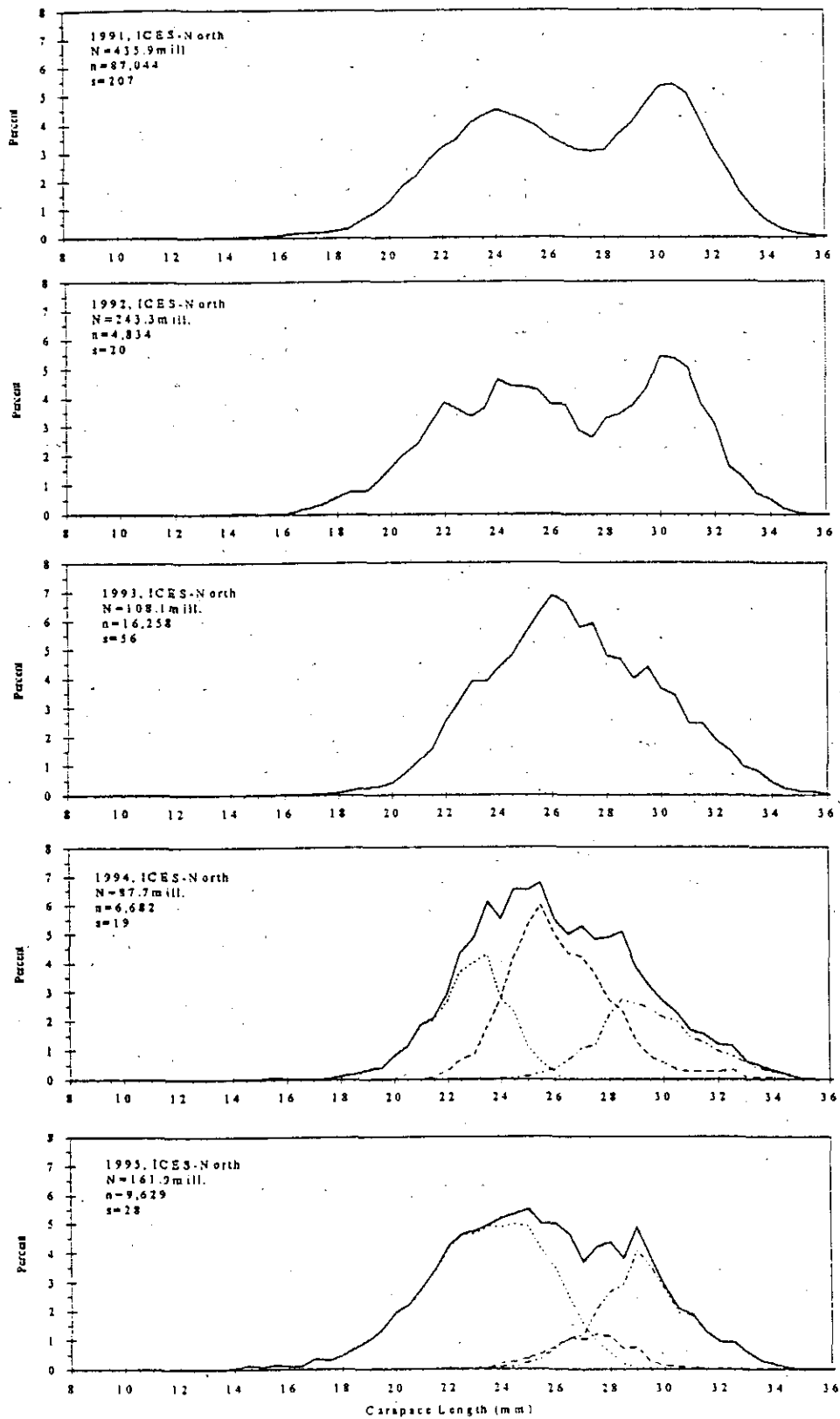


Fig. 7. The Greenlandic commercial samples in the years 1991 to 1995 in the north area north of 65° N.

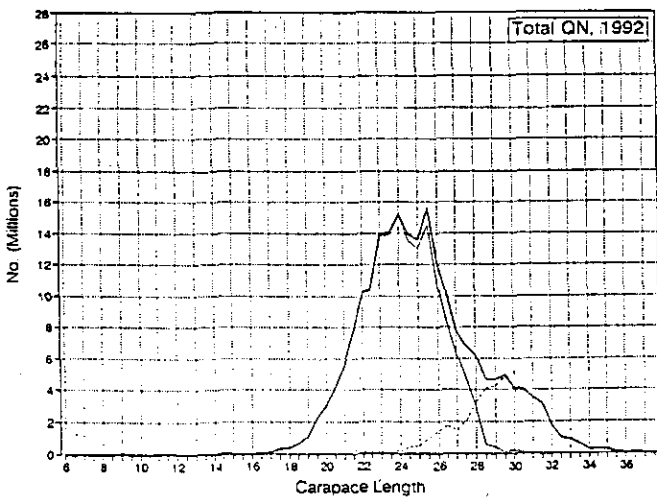
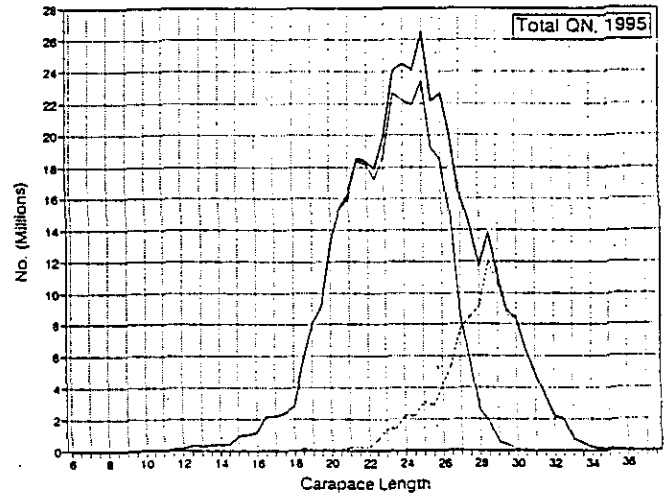
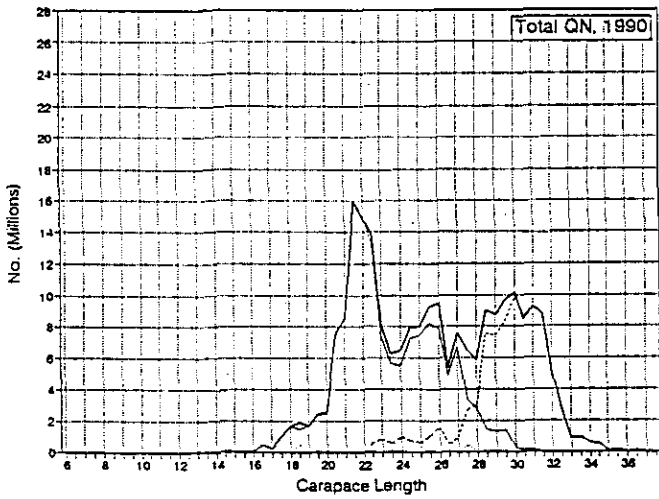
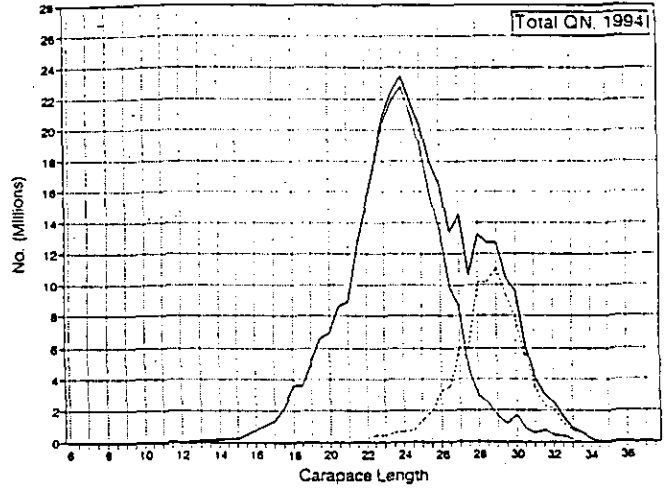
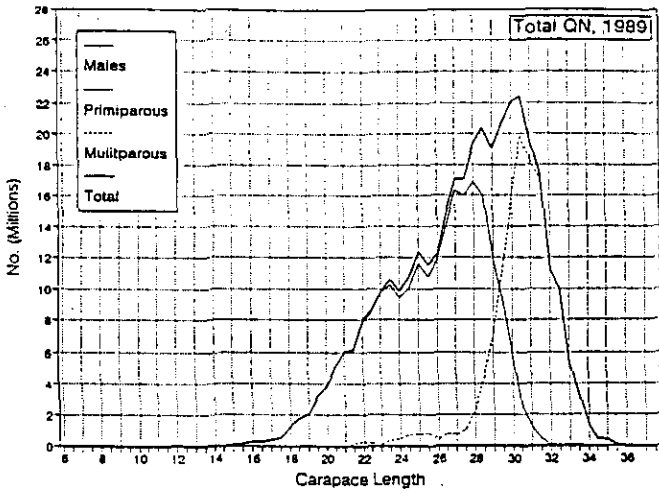


Fig. 8. The Greenlandic survey samples in the years 1989 to 1995 in the Denmark Strait area north of 65°N. In pooling the samples were veighted by catch and stratum area.