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Preliminary Assessment of Shrimp in Denmark Strait in 1997

by

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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 5 000 in 1994 and finally to 3 400 tons in 1996. In 1997 the provisional figure is about 3 700 tons. A new fishery started in 1993 in two areas found further south where some 1 200 to 6 200 tons were taken in the southern area in the years 1993 to 1996. In 1996 the catch is already about 2 400 tons in the 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 5 years. The new areas lie south of 65°N. The traditional northern fishing area extends from approximately 65°20'N to 67°30'N and between 26°W and 34°W. The southern area is between 60°30'N and 65°N and west of 35°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 of this area are kept separate from those of 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 (Skúladóttir, 1997 a). 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 stablee to 1983. Catches increased steadily from 1983 to 1988 to 12 500 tons and then decreased to 3 400 tons in 1996 in the northern area. The catch in the northern area has increased again in 1997 to 3 700 tons (provisional). The overall catch in north and south was 9 600 in 1996 (Fig. 1, Table 1).

Total effort values in the northern area showed the same pattern as catch. Between 1980 and 1989, effort increased from about 35 000 hours to more than 100 000 hours in 1989, declining thereafter gradually to about 32 000 in 1994 and was at that level till 1996. 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 the effort is again excerted in the first half of the year. In the southern area the effort was between 7 900 and 20 300 hours in 1993-96 (Skúladóttir, 1997 a).

2.1.2 Trends in catch rates

Abundance indices were calculated from the unstandardized catch rate series of the years 1980 to 1997 using all countries. In the paper on catch statistics the catch and effort for all countries are combined (Skúladóttir, 1997 a). The calculations leading up to the annual CPUE can be followed in tables 2-4 of the present paper in the northern and the whole area respectively. The unstandardized CPUE in the north area has been 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 decreased to about 5 000 tons on the average in the fishery north of 65°N. The CPUE of 1996 appears lower than expected, but the 1997 value is as expected. The unstandarized catch rates for the northern area are presented in Fig. 4. and for both northern and southern in Fig. 5). In the northern area there is a declining trend from 1980 to 1989. Catch rates were similar in the period from 1989 to 1993, where the 1989-93 level was about 50% of the level seen during the period of relative stability from the early 1980's. In year 1994 there was a a considerable rise in this catch rate, which subsequently declined in 1995-96 and increased in 1997 reaching a value above the lows recorded in 1989-93 and equivalent to the 1987 value. The unstandardized catch rate for the whole area rose from the 1993 value to a higher value in 1994 and remained stable after that.

2.1.3 Standardization of the catch rates

The catch and effort data from Greenland for the north area from 1987 to 1997 were analyzed using SAS multible 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 1993 and a considerable increase in 1994 and remained relatively constant thereafter.

2.2 Commercial Biological data

2.2.1 Icelandic fishery data

The Icelandic samples (Fig.7) taken in the spring of 1991, 1992 and 1993 showed that male shrimp dominated in all three years. After

that males were dominant in 1996 but 19994, 1995 and 1997 show about 50% occcurence of females again. The occurrence of a component of female shrimp with a mode at 25-26 mm in the Icelandic samples in 1990 suggested that sex change occurred earlier than normal. The samples in the 1991 through 1997 show a tiny proportion of small females but there was no noticeable component as seen in the 1990 data (Skúladóttir et al, 1994). Samples taken in 1994 on the eastern area and analysed electrophoretically show more affinity with samples taken in the offshore Icelandic waters than to samples taken west of the midline (Jónsdóttir, 1996). This could indicate occasional influxes from the Icelandic continental shelf. rather than a change in age/length at sex change.

2.2.2. Greenlandic fishery data

The samples from the Greenlandic fishery in 1991-1997 are shown on Fig. 8. There were no samples in 1996 and 1997 from the northern area. In 1997 males and females seemed to be in equal numbers in the south whereas in 1996 males were dominant in the south area (Hvingel *et al* 1997).

2.3 RESSEARCH SURVEY DATA

2.3.1 Abundance estimates

A two phase stratified random trawl survey (Spline method) was conducted by Greenland in the Denmark Strait in September-October, 1995 as was 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. Due to bad weather the second phase was never carried out, so only the abundance indices can be compared. The higher abundance estimate found in 1995 1996 as compared to 1990, 1992 and 1994 is the result of an increasing number of both male and female shrimp (Carlsson 1996).

	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
1996	527.3	124.0	651.3

2.3.2 Demographic structure

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 1996 the total number of females has increased (text table).

Percent males

	1985	1986	1987	1988	1989	1990	1992	1994	1995	1996
Norway	43.8	41.4	53.5	58.5	58.0					
Greenland					63.1	62.5	78.3	74.5	74.2	81.0

3. 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 firt 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 tons. 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 adviced for 1993 and several years thereafter in an attemt to protect the spawning biomass and rebuild the stock.

4. STATUS Of THE RESOURCE

Unstandardized catch rates in the northern area for all nations combined, showed a declining trend from 1987 to 1989, but a stabilization between 1989 and 1993 a rise in 1994 and fluctuations after that. Taking the whole area into acoount the catch rates are stable. The standarized catch rates of Greenland north of 65°N 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 and 1995 as for that of all fleets combinedfor the area north of 65°N. Moreover there was an increase in abundance index from the Greenlandic surveys,in 1994 and 1995 from the low abundance of the years 1990 and 1992. The abundance of the 1996 survey was the highest of all the Greenlandic surveys but can not be used as an indicator as the coverage was incomplete. Little is known about abundance of the males and females in 1997 as there was no survey and commercial samples were few in the northern area (only Icelandic commercial samples) as well as in the southern area.

5. PROGNOSIS

The changes in fishing pattern (changes in proportion of effort allocated to northern and southern areas), low levels of commercial sampling make assessment of this stock difficult.
Catch rates are increased in 1994 in the southern area and are stable thereafter. The 1996 survey indicates that abundance is being maintained in the northern area.

Despite the uncertainty of the present assessment, it seems that the stock has recently improved, however, it remains below the level of the mid-1980s.

6. REFERENCES

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Table 1 . Nominal catch (tons) 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	*** 1997	*** 1998
North area																					
Denmark	-	-	702	581	740	204	443	353	500	555	444	366	390	358	160	111	199	242	21		
Faroe Islands	-	-	4233	713	737	443	668	674	727	595	679	595	843	1007	1092	554	368	745	761	243	
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	1913	221	40	
Iceland	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1514	1151	566	2718	
Norway	-	800	2461	2016	1896	1727	2128	2051	2026	2041	2052	2098	2500	2504	2500	1758	1890	2058	1808	753	
Total	363	1285	8405	4792	4902	4175	6731	8110	10964	12178	12556	10742	10275	8657	7514	6401	5027	6109	3377	3754	
Middle and south area																					
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	488	585	935	301	
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	776	236	294	345	
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	918	2870	2135	4284	1315	
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	651	440	711	466	
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1247	4785	3396	6224	2427	
Σ eastern side	363	485	759	125	0	43	742	1794	1150	1330	1431	1326	281	465	1750	2553	1514	1151	566	2718	
Σ north area not eastern side	0	800	7646	4667	4902	4132	5989	6316	9814	10848	11125	9416	9994	8192	5764	3848	3513	4958	2811	1036	
Σ middle and south area																1247	4785	3396	6224	2427	
Σ western side	0	800	7646	4667	4902	4132	5989	6316	9814	10848	11125	9416	9994	8192	5764	5095	8298	8354	9035	3463	
ΣΣ all areas	363	1285	8405	4792	4902	4175	6731	8110	10964	12178	12556	10742	10275	8657	7514	7648	9812	9505	9601	6181	
Adviced TAC	-	-	-	-	4200	4200	4200	5000	-	-	-	10000*	10000*	10000*	8000	5000	5000	5000	5000	5000	
Effective TAC western side	-	-	-	8000	4500	5725	5245	6090	7525**	7725**	8725**	9025**	14100	14500	13000	9563	9563	9563	9563		

* Adviced for a few years as a precautionary measure.

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

*** Provisional

Table 2. North area. Catch rates (kg per hour trawling) and corresponding effort (hours trawling) and catch (tons) from the shrimp fishery in Denmark Strait north of 65° N, by years.

Year	Periods	CPUE	Effort	Catch	Year	Periods	CPUE	Effort	Catch
1980	Jan-Jun	393	15775	6198.3	1989	Jan-Jun	155	45428	7034.6
	Jul-Dec	117	18815	2206.4		Jul-Dec	59	62475	3712.5
	Mean/Total	243	34590	8404.7		Mean/Total	100	107903	10747.1
1981	Jan-Jun	260	18072	4698.0	1990	Jan-Jun	150	52697	7880.9
	Jul-Dec	62	1516	93.9		Jul-Dec	57	42003	2394.1
	Mean/Total	245	19588	4791.9		Mean/Total	109	94700	10275.0
1982	Jan-Jun	212	23072	4900.0	1991	Jan-Jun	99	72144	7153.6
	Jul-Dec	-	-	-		Jul-Dec	63	23960	1502.7
	Mean/Total	212	23072	4900.0		Mean/Total	90	96104	8656.3
1983	Jan-Jun	203	17332	3524.1	1992	Jan-Jun	95	60241	5697.3
	Jul-Dec	103	6338	651.3		Jul-Dec	78	23412	1817.1
	Mean/Total	176	23670	4175.4		Mean/Total	90	83653	7514.4
1984	Jan-Jun	247	23900	5899.2	1993	Jan-Jun	96	62447	6016.5
	Jul-Dec	103	8074	831.6		Jul-Dec	42	9104	384.4
	Mean/Total	211	31974	6730.8		Mean/Total	89	71551	6400.9
1985	Jan-Jun	181	28959	5249.0	1994	Jan-Jun	179	22839	4094.6
	Jul-Dec	126	22779	2861.0		Jul-Dec	98	9523	932.0
	Mean/Total	157	51738	8110.0		Mean/Total	155	32362	5026.6
1986	Jan-Jun	189	41140	7755.0	1995*	Jan-Jun	166	28115	4678.2
	Jul-Dec	205	15668	3209.0		Jul-Dec	69	20746	1431.0
	Mean/Total	193	56808	10964.0		Mean/Total	125	48861	6109.2
1987	Jan-Jun	235	36251	8512.0	1996*	Jan-Jun	112	20543	2299.4
	Jul-Dec	99	37004	3666.0		Jul-Dec	94	11407	1076.5
	Mean/Total	166	73255	12178.0		Mean/Total	106	31950	3375.9
1988	Jan-Jun	158	51842	8190.5	1997*	Jan-Jun	208	16042	3329.7
	Jul-Dec	91	47717	4352.5		Jul-Dec	60	7014	423.0
	Mean/Total	126	99559	12543.0		Mean/Total	163	23056	3752.7

Table 3. North and south area. Catch rates (kg per hour trawling) and corresponding effort (hours trawling) and catch (tons) from the shrimp fishery by all nations combined in two periods of the year.

		January-June			July - December		
Year	Country	CPUE	Effort	Catch	CPUE	Effort	Catch
1993	North	96	62447	6016.5	42	9104	384.4
	South	158	7874	1247.0	953	182	173.5
	Total	103	70321	7263.5	60	9286	557.9
1994	North	179	22839	4094.6	98	9523	932.0
	South	279	8958	2503.5	290	7879	2281.1
	Total	208	31797	6598.1	185	17402	3213.1
1995*	North	166	28115	4678.2	69	20746	1431.0
	South	222	3178	705.5	302	8914	2690.5
	Total	172	31293	5383.7	139	29660	4121.5
1996*	North	112	20543	2299.4	94	11407	1076.5
	South	319	9064	2894.0	297	11195	3329.7
	Total	175	29607	5193.4	195	22602	4406.2
1997*	North	208	16042	3329.7	60	7014	423.0
	South	293	7573	2217.9	298	701	208.7
	Total	235	23615	5547.6	82	7715	631.7

Table 4. North and south area combined to the whole year as regards effort, catch and CPUE.

Year	Country	CPUE	Effort	Catch
1993	Jan-Jun	103	70321	7263.5
	Jul- Dec	60	9286	557.9
	Total	98	79607	7821.4
1994	North	208	31797	6598.1
	South	185	17402	3213.1
	Total	199	49199	9811.2
1995*	North	172	31293	5383.7
	South	139	29660	4121.5
	Total	156	60953	9505.2
1996*	North	175	29607	5193.4
	South	195	22602	4406.2
	Total	184	52209	9599.6
1997*	North	235	23615	5547.6
	South	82	7715	631.7
	Total	197	31330	6179.3

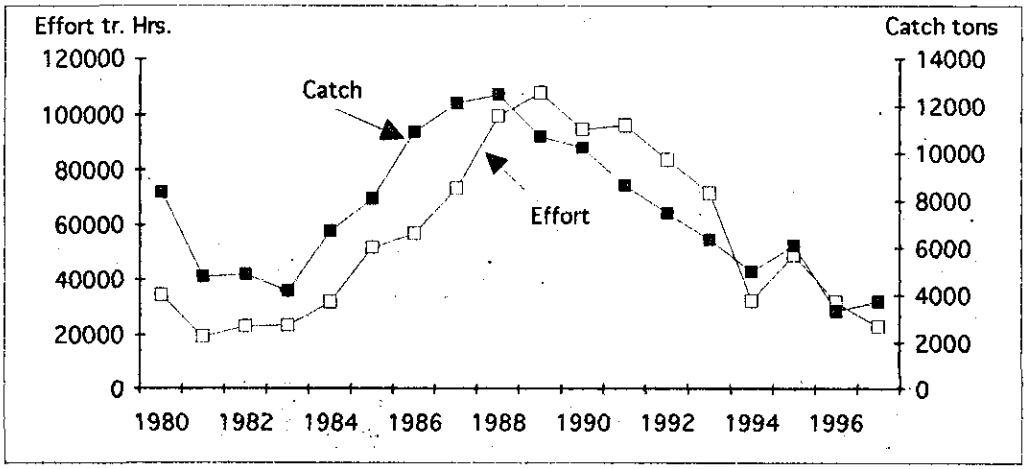

Fig. 1. Catch and effort from the logbooks weighted by nominal catches from the area north of 65°N.

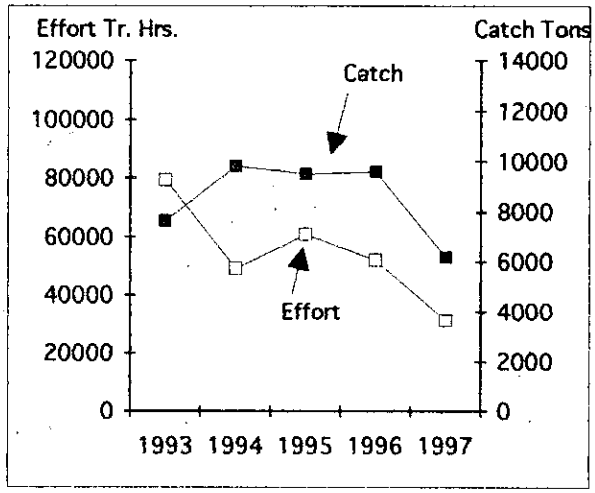

Fig. 2. Catch and effort in north and south combined.

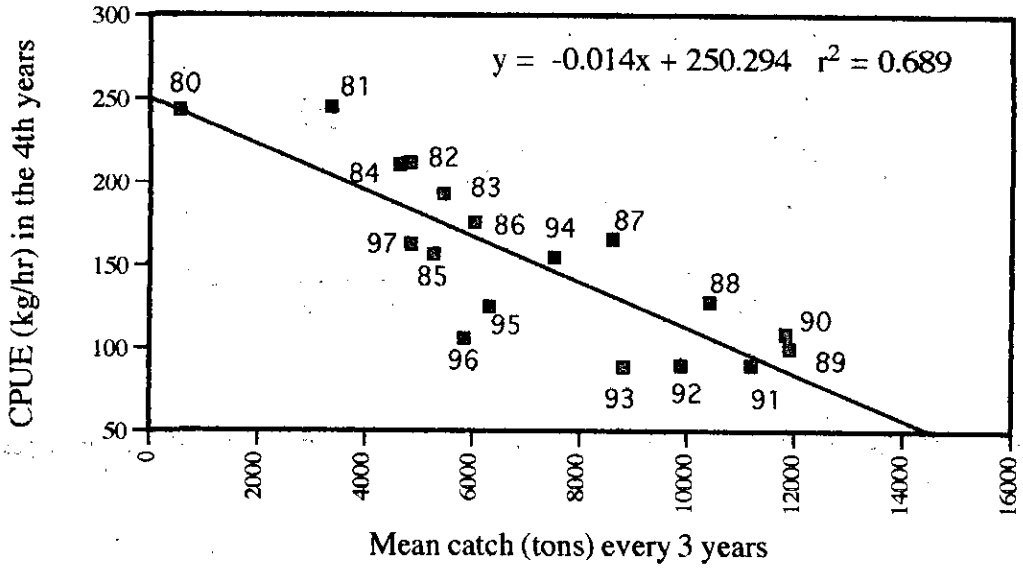

Fig. 3. North area. The mean catch of every 3 years against unstandardizrd CPUE in the 4th year, denoted by that year.

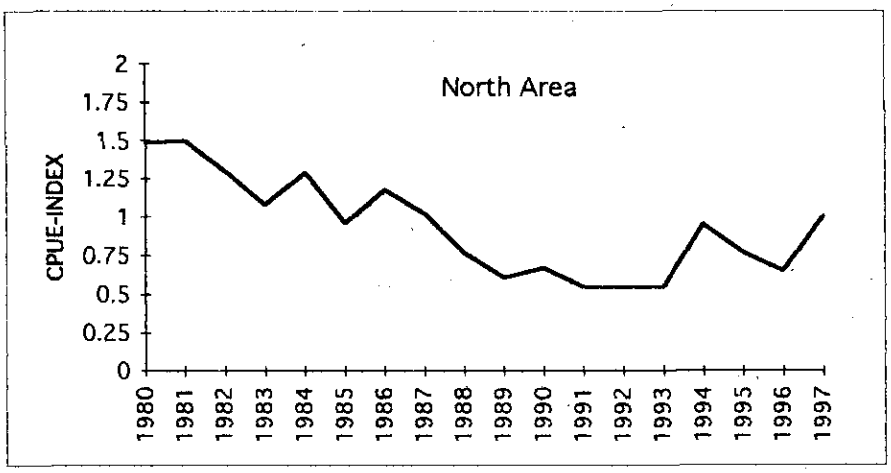

Fig. 4. The unstandarized catch rate indices, north of 65°N, of all countries combined.

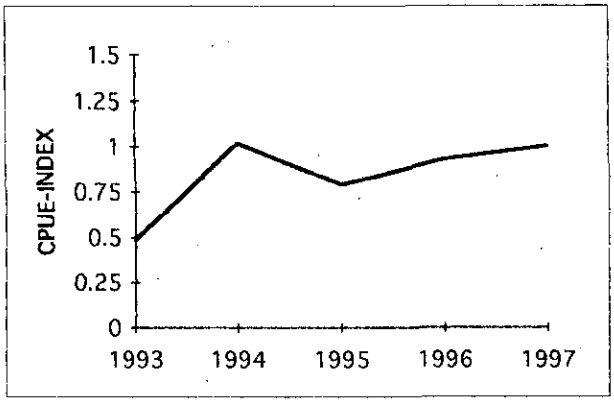

Fig. 5. The unstandardized catch rate indices for both north and south areas combined.

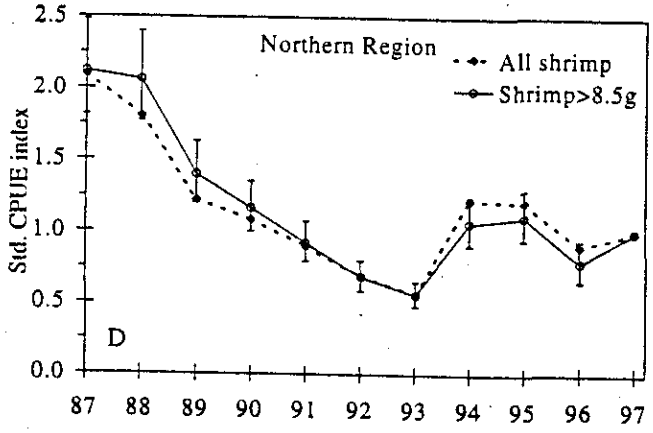

Fig. 6. Annual standardized CPUE-indices calculated for shrimp > 8.5 g and for total catch of Greelandic vessels in the area north of 65°N.

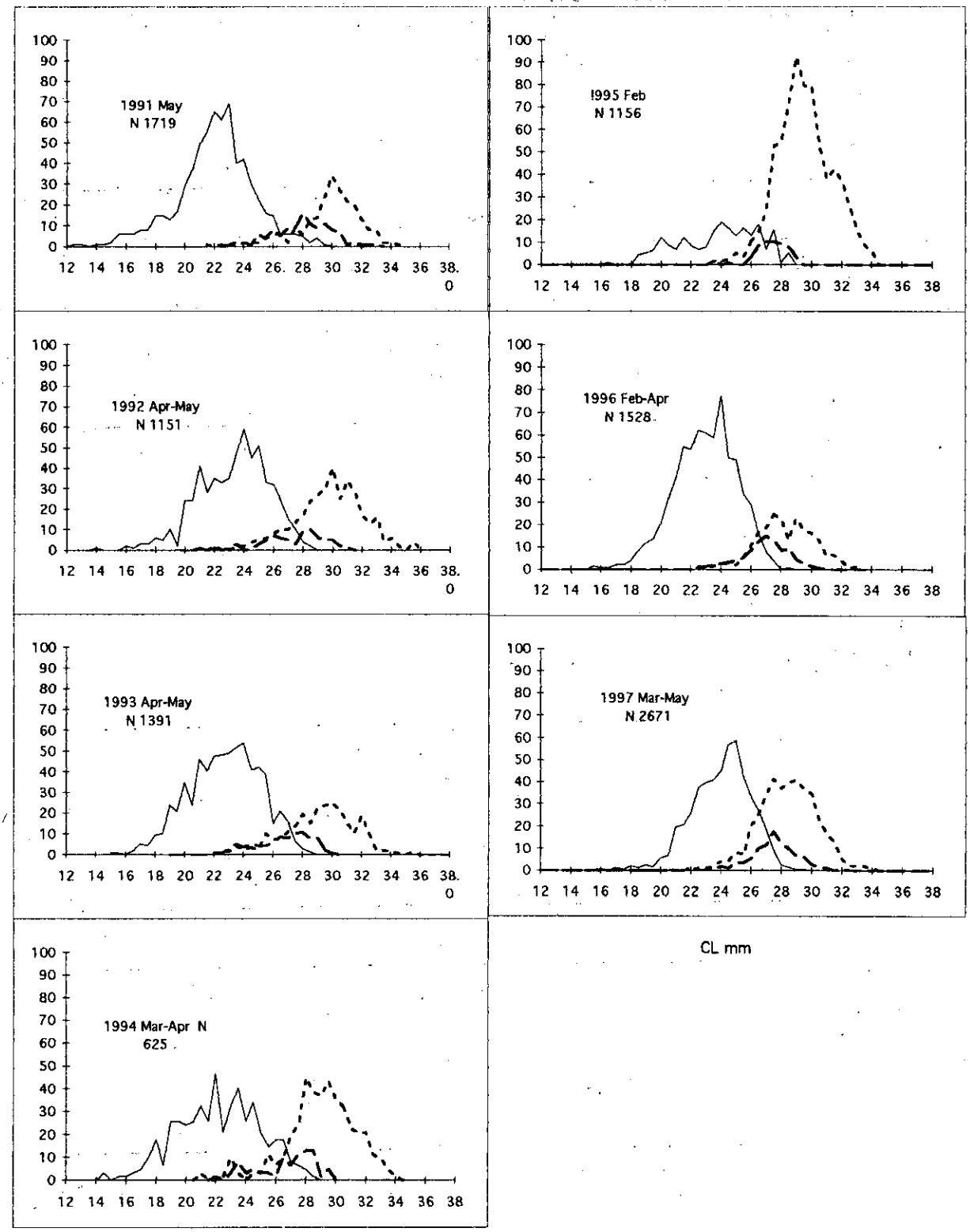

Fig. 7. The Icelandic commercial samples in the years 1991 to 1997 in the eastern part of the Denmark Strait area i.e. north of 65°N.

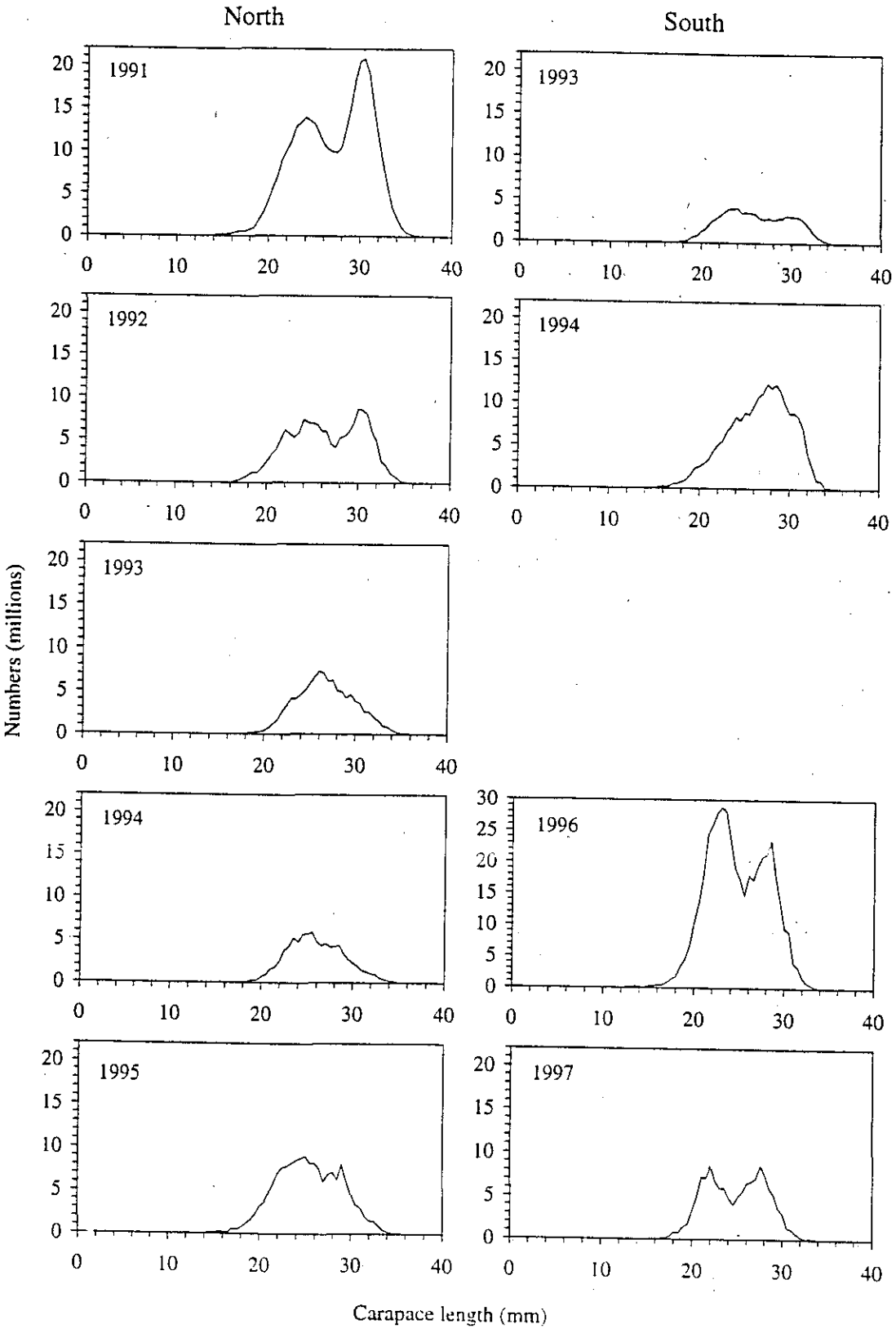

Fig. 8. The Greenlandic commercial samples from the north and south area.

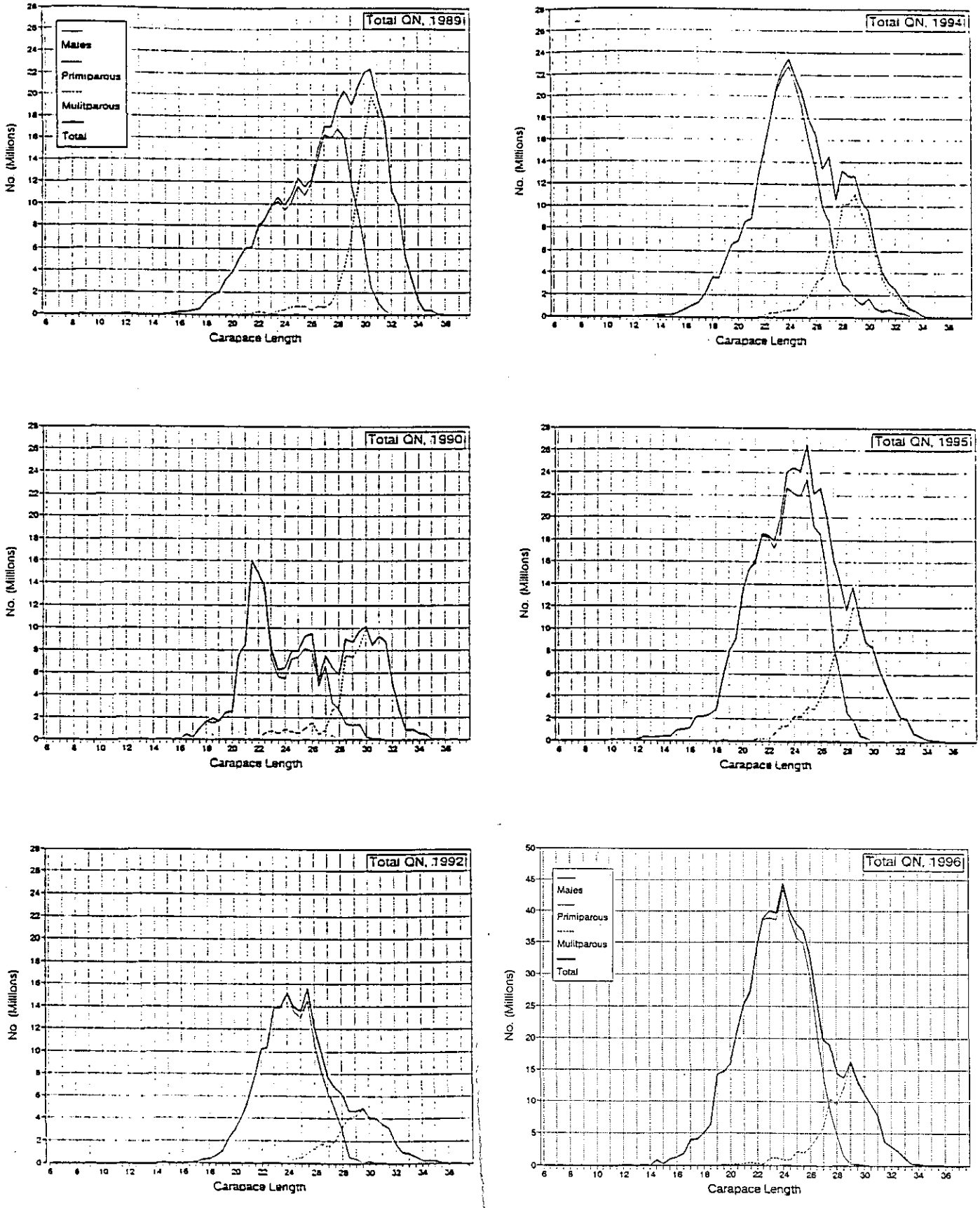

Fig. 9. The Greenlandic survey samples in the years 1989 to 1996 in the Denmark Strait area north of 65° N. In pooling, the samples were weighted by catch and stratum area.