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An overview of Norwegian investigations of the shrimp stock off East Greenland in 1982-1986.

by

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Introduction

Northern shrimp (*Pandalus borealis*) occurs off East Greenland from Cape Farewell to about 70°N on both sides of the territorial midline between Greenland and Iceland. The stock is distributed in depths down to around 800 meters, with the highest concentrations from 150-600m (Hvingel 1999).

The catches in the Greenland zone account for around 70-90% of the total. In the Greenland zone the stock is managed by a total allowable catch (TAC), while there are no restrictions on the fishery in the Icelandic zone (Hvingel 1999). The main area for shrimp fishing is in the Denmark Strait (65-68°N 36-26°W) (Fig. 1).

Norway carried out scientific investigations on shrimp in waters off East Greenland from 1982 until 1986, due to little knowledge about the stock in this area when the shrimp fishery started in the late 1970's (Smedstad 1987). This report gives an overview of the Norwegian investigations and the resulting data.

Norwegian cruises were also conducted off the West Greenland coast. The target species was mainly shrimp (Ulltang 1978), (Ulltang and Øynes 1978), (Ulltang and Øynes 1980), (Pedersen and Lehmann 1989), (Pedersen and Kannevorff 1995), (Carlsson and Kannevorff 1994), Carlsson et al. 2000) but also silver hake (Rikhter 1989), (Sigaev 1990). These results are not presented in this report.

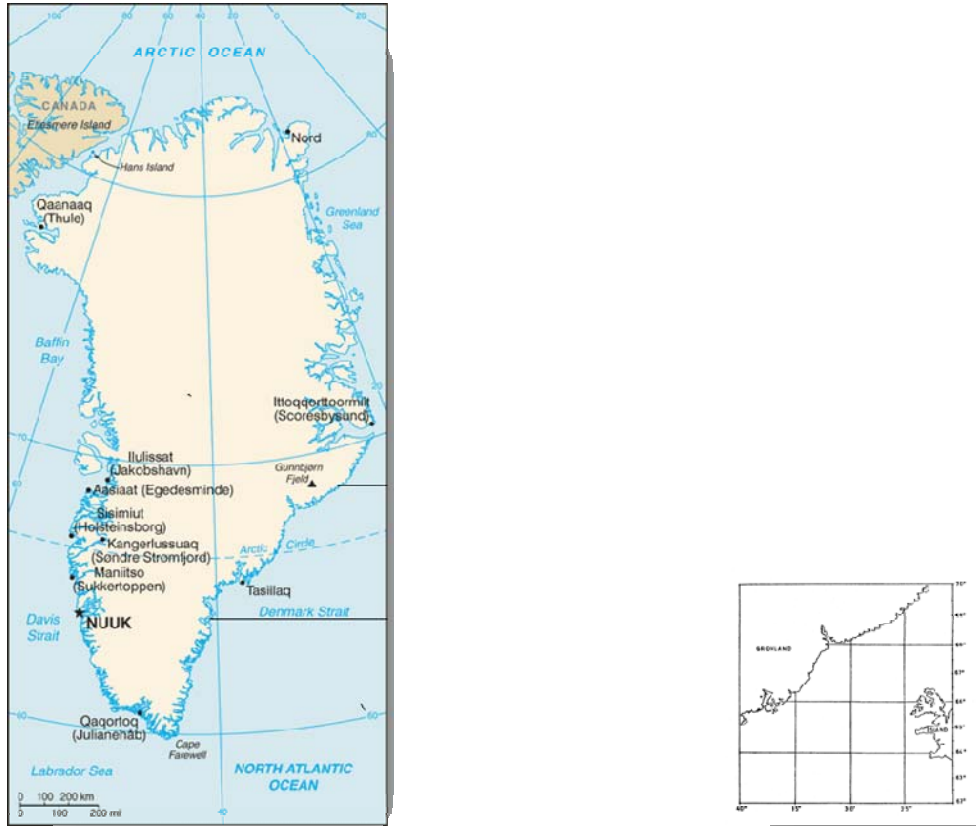


Figure 1: An overview map of Greenland and the Denmark Strait (shown in the little picture), which is the most important area for shrimp fishery off East Greenland.

Material and methods

Norwegian data come from three sources: scientific cruises, observers on board commercial shrimp vessels, and Norwegian landings statistics and logbook data from this fishery. Norwegian cruises were, according to our information, carried out in 1983-1986. Observations on board shrimp vessels took place the same years. Logbook and landings data are presented for the years 1982-1986.

Cruises

In November 1983 the scientific cruise was conducted with R/V Eldjarn, a rebuilt purse seiner/blue whiting trawler. The trawl gear used was a bottom-trawl with 30 m headline and 19 m groundrope. The sweep wires were 40 m long (Smedstad and Torheim 1984). The following three cruises (1984-86) were conducted with the commercial fresh fish trawler, M/T Masi, using a trawl called "Campelen Super 1800 mesh" shrimp trawl with 35 mm meshes in the codend and an inner net with 4 mm meshes. Fifty extra floats were added along the sides and about twenty extra floats along the fishline (Smedstad 1985), (Smedstad and Torheim 1986), (Smedstad 1986), (Smedstad 1987). For all cruises towing speed was 2.5-3 knots, while towing distance was 1 nm. On bad bottom conditions towing distance was reduced to 0.5 nm or less. The survey area of the cruises was divided into 31 different strata (Fig. 2).

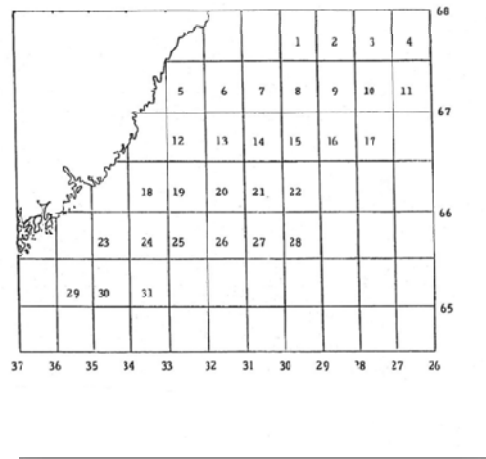


Figure 2: Survey area with strata (Smedstad 1986).

A typical survey track is shown in Fig. 3 (Smedstad 1987). The number of stations differed on the different cruises, but the cruises in 1985 (Smedstad 1986) and 1986 (Smedstad 1987) both had 68 stations.

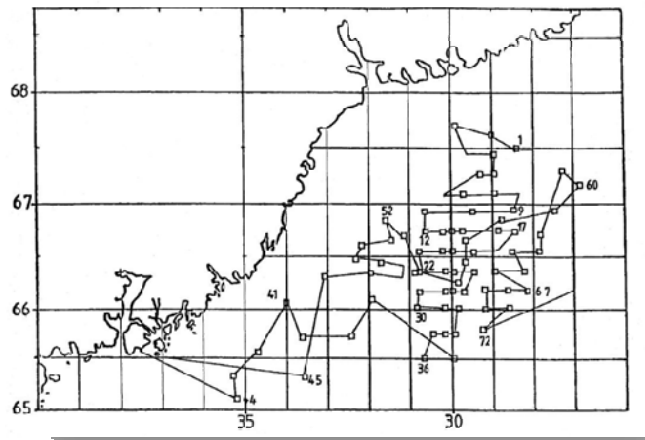


Figure 3: Survey tracks and trawl stations taken by M/T Masi in September 1986 (Smedstad 1987).

Details on the Norwegian cruises are shown in Table 1.

Table 1: An overview of the Norwegian scientific cruises off East Greenland from 1983-1986: year, date of the cruise, area covered, biomass index, vessel, number of stations and reference.

Year	Reported catches (in tonnes)	Date	Area	Index (in tons)	Vessel	No of stations	Reference
1983	not reported	nov.83 07/09-28/09	north of 66°N * 65-70° 01-56'N	not reported	R/V Eldjarn		Smedstad and Torheim 1984
1984	not reported	1984 26/08-26/09	19-32° 00-59'W 65-68°N 26-	not reported	M/T Masi	28	Smedstad 1985
1985	2,23	1985 08/09-06/10	35°W 65-68°N 26-	31 082	Masi	68	Smedstad 1986
1986	not reported	1986	36°W	48 900	M/T Masi	68	Smedstad 1987

* shrimp was only caught in any amount north of 66°N, but the total area is not reported.

The data collected on the scientific cruises are: horizontal distribution of stages, length distributions (carapace length to the nearest mm) and biomass index (for some years).

Observers onboard commercial vessel

Shrimp catches were sorted into "landings" or "discard", this job was done after the separation of fish in the catch. Random samples of shrimp catches were taken for length measurements (carapace length to the nearest mm). Details on the observer trips in the East Greenland waters are given in Table 2.

Table 2: Observer trips in the Denmark Strait off East Greenland: reported catch, date of the fishing trip, area of fishing, towing time, vessel, percentage of discarded shrimp, and reference. The reported catches are the value from the time the observer was on board.

Year	Reported catches (in tonnes)	Date	Area	Towing time (hrs)	Vessel	Discard	Reference
1982	23,4	10/04- 27/04-1982	65-66° 06-64'N, 29-30° 01-59'W	2,00-4,50	M/V Lyshaug	3,7 %	Jakobsen and Torheim 1983
1983	7,3	20/04- 06/05-1983	65°37-50'N 29°00-59'W	1,00-4,25	M/V Lyshaug	0,8 %	Smedstad & Torheim 1984
1984	16,7	12/04- 19/04-1984	66° 03-49'N 29° 56-58 30° 00- 49'W	1,50-4,00	M/V Kap Farvel	3,4 %	Smedstad & Torheim 1985
1985							Smedstad & Torheim 1986*
1986	7,9	28/02-10/03 1986	65° 35-53'N 30° 06-30'W	3,00-4,25	M/V Lyshaug	0,9 %	Smedstad & Torheim 1987

* There was also one cruise in 1985, but we have not been able to find the report.

Results

The ice-conditions had some impact on the shrimp fishery and catches of shrimp in some years. In 1983 the vessels had to leave the fish grounds because of ice-problems in the beginning of May (Smedstad and Torheim 1984). In both 1984 and 1985 there were no problems with ice (Smedstad and Torheim 1985), (Smedstad 1986), but in 1986 bad weather and ice conditions hampered the shrimp fishery during the winter (Smedstad and Torheim 1987), whilst in the autumn there were no problems (Smedstad 1987).

Cruises

On the cruise in November 1983 with R/V Eldjarn, shrimp were only caught in any significant amount north of 66°N. The greatest catch was 243 kg per hour trawling. However, the coverage of this area was poor because of ice conditions (Smedstad and Torheim 1984).

The horizontal distribution of the sexes seems to vary very little from year to year (Smedstad 1986), (Smedstad 1987). The pattern is that the greatest amount of males and transitionals was found in the western (strata 18, 19, 24, and 25) and northern areas (strata 1, 7, 15, 16, and 17). Transitionals were, however, scarce. Males were found in smallest numbers around Dohrn Bank (strata 21, 22, 27, and 28) (Smedstad 1986).

For the total investigated area 42.6% of the shrimp in numbers (in 1985) were males (Smedstad 1986) and 41.4% in 1986 (Smedstad 1987). Samples taken in strata 1, 15, and 22, representing a transect from north to south, show that the shrimp increase in length southwards (Smedstad 1986), (Smedstad 1987). Stratum 18 represents the western area. Compared with stratum 22 the same pattern is seen: An increase in length from west towards the Dohrn Bank area, and greater frequencies of males smaller than 25 mm in the western area (Smedstad 1986).

Females were also found in greatest numbers in west (strata 18, 19, and 20) and in north (strata 8, and 15). Most of the females were ovigerous, very few had head roe, and 21% and 26% (Smedstad 1987) of the females had no roe (Smedstad 1986).

Because of the higher amount of ovigerous females in the area of Dohrn Bank, this seems to be a spawning area for the shrimp (Smedstad 1986). Further, the length frequencies and the horizontal distribution of males indicate that the nursery areas are north and west of the Dohrn Bank area (Fig. 4). One aspect worth considering is that it is very difficult to find specimens smaller than 20 mm (Smedstad 1986).

A study done in a bigger area (65-70° 01-56'N 19-32° 00-59'W) shows that almost no shrimp were caught east of 28°W. The best catches were taken around 30°W. The males were dominating in the outer parts of the area while the share of females is increasing towards the Dohrn Bank. There the female accounts for more than 90% of the catches (Smedstad 1985). These results indicate possible drift- and migration routes for shrimp in the area (Smedstad 1987) (Fig. 4).

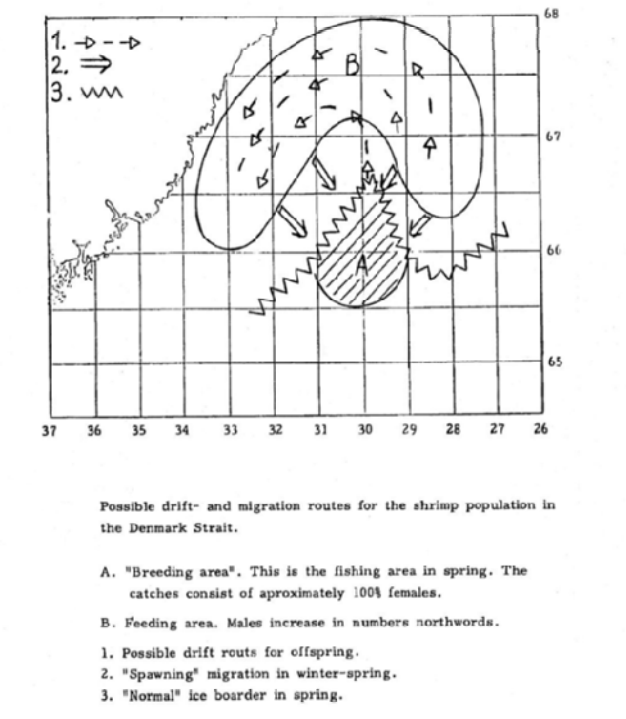


Figure 4: Possible drift- and migration routes for the shrimp population in the Denmark Strait, Greenland (Smedstad 1987).

Big mature females always dominated the catches during the years the Norwegian vessels fished in the area around the Dohrn Bank. It is therefore difficult to explain the good recruitment to the fishing area without taking into account an active migration into the area (Smedstad 1985). If the above theory is correct it means that parts of the nursing areas are protected from fishery because of rough bottom. In addition the whole nursery area is covered by ice a large part of the year (Smedstad 1985).

Fig. 5 shows the calculated total biomass by stratum of shrimp on the scientific cruise in the Denmark Strait in 1985 (Smedstad 1986). These results are quite similar to results found on the cruise in 1986 (Smedstad 1987).

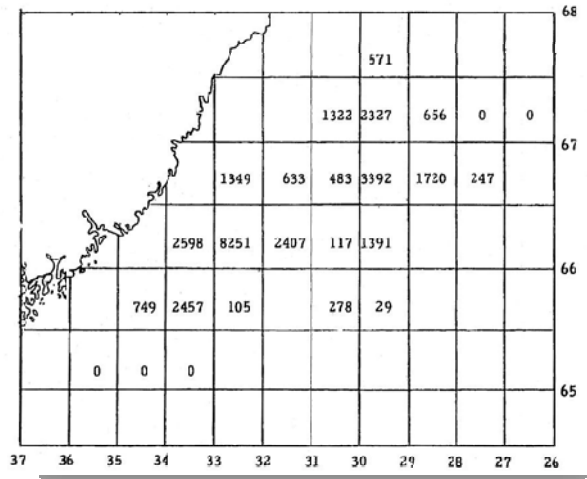


Figure 5: Calculated total biomass of shrimp in tons from the Norwegian scientific cruise in 1985 (Smedstad 1986).

Observer trips

The main by-catches of fish in the trawl hauls consisted of cod, Greenland halibut and redfish, but there were also smaller amounts of skates, plaice and catfish (Smedstad and Torheim 1984). The numbers of fish per kg shrimp from all the observer trips are shown in Table 3 (Smedstad and Torheim 1987).

Table 3: Average shrimp catches and by-catches of fish in the trawl hauls of "Lyshaug" and "Kap Farvel" in 1982-1986. (Smedstad and Torheim 1987).

	Mean number per tow				
	1982	1983	1984	1985	1986
No of hauls observed	37	21	19	40	19
Mean shrimp catch (kg)	608	346	880	732	410
Nos of fish per kg shrimp	0.16	0.18	0.24	0.13	0.26

Carapace length distribution (%) from random samples taken onboard commercial vessels in 1982-1986 shows that in the catches the largest amount of shrimp had a carapace length between 28-31 mm (Jakobsen and Torheim 1983), (Smedstad and Torheim 1984), (Smedstad and Torheim 1985), (Smedstad and Torheim 1987) (Fig. 6).

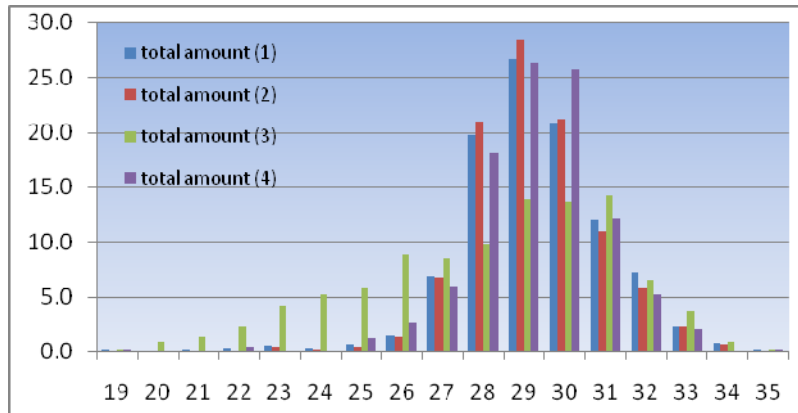


Figure 6: Percentage carapace length (mm) distribution of random samples from catches at four different observer trips: M/V "Lyshaug" in April 1982 (1) (Jakobsen and Torheim 1983), M/V "Lyshaug" in April-May 1983 (2) (Smedstad and Torheim 1984), M/V "Kap Farvel" in April 1984 (3) (Smedstad and Torheim 1985) and M/V "Lyshaug" in March 1986 (4) (Smedstad and Torheim 1987).

Fig. 7 show the weighted mean length distribution of shrimp from the same cruise as no 2 in Fig. 4, but here the discarded shrimp are shown in the same figure. The discarded shrimp has smaller carapace length than the total landed catch (Smedstad and Torheim 1984). The amount of discarded shrimps were 3.7% in 1982 (Jakobsen and Torheim 1983), 0.8% in 1983 (Smedstad and Torheim 1984), 3.4% in 1984 (Smedstad and Torheim 1985) and 0.9% in 1986 (Smedstad and Torheim 1987).

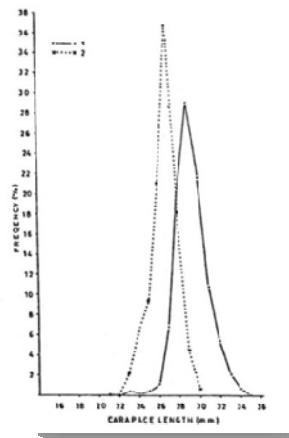


Figure 7: Weighted mean length distribution of shrimp from samples taken off East Greenland in April – May 1983: 1) Landed shrimp, 2) Discarded shrimp (Smedstad and Torheim 1984).

Log books

Table 4 shows catch and catch per unit effort (CPUE) by month in division XIV B for the Norwegian fishery off East Greenland in 1982-1986 (Smedstad and Torheim 1987). CPUE is calculated as total catch/total effort. In April the CPUE is lower in 1983 than in 1982. This relates to the ice conditions that were worse in 1983 than in 1982 (Smedstad and Torheim 1987). The scarce CPUE data make it difficult to draw any firm conclusions about the state of the stock in the years 1982-1986 (Fig. 8).

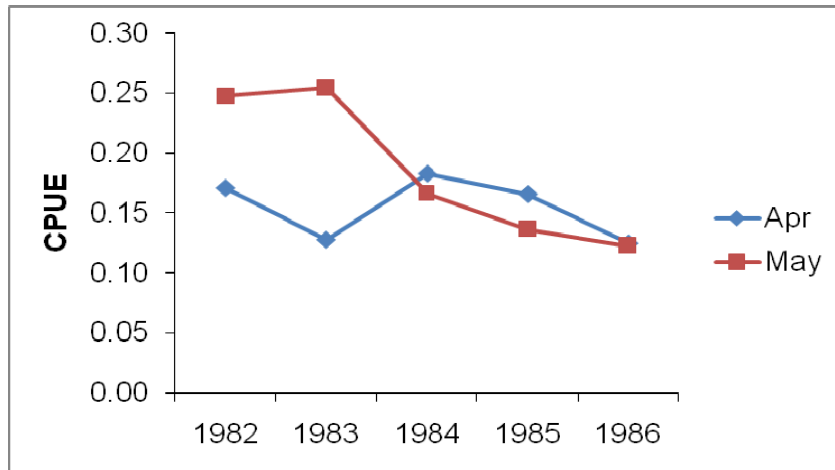


Figure 8: CPUE (tons/hr) in April and May from the Norwegian shrimp fishery in Denmark Strait in 1982-1986.

Table 4: Catch (tons) and catch per hour trawling in division XIV B from 1982 to 1986 (Smedstad and Torheim 1987).

Month	1982		1983 ¹		1984		1985		1986 ²	
	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
Jan.	-	-	-	-	-	-	-	-	31	0.112
Feb.	-	-	-	-	79	0.232	-	-	208	0.141
Mar.	305	0.197	-	-	622	0.224	760	0.184	618	0.145
Apr.	761	0.171	350	0.128	732	0.183	995	0.166	502	0.125
May	828	0.248	367	0.255	500	0.167	269	0.137	268	0.123
Jun.	-	-	257	0.143	-	-	-	-	-	-
Jul.	-	-	6	0.133	-	-	-	-	2	0.071
Aug.	-	-	61	0.098	-	-	-	-	105	0.131
Sep.	-	-	-	-	-	-	-	-	18	0.114
TOTAL	1896	0.203	1041	0.157	1933	0.191	2024	0.166	1752	0.133

1) 60 % of total landings
2) 85 % of total landings

Conclusions

The data from the Norwegian scientific cruises in the 1980's suggest that there exist drift- and migration routes in the shrimp stock in the Denmark Strait (Fig. 4). The data from the commercial fishery support the theory of an active migration towards the Dohrn Bank.

The scarce CPUE data make it difficult to draw any firm conclusions about the state of the stock in the years 1982-1986.

Landings of shrimp from the Norwegian fishery were dominated by big female shrimp, and the amount of discards was very small.

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