Northwest Atlantic Fisheries Organization

Serial No. N1785

NAFO SCR Doc. 90/63

SCIENTIFIC COUNCIL MEETING - JUNE 1990

Fecundity of Shrimp (*Pandalus borealis*) Sampled on Fishing Grounds at North West Greenland and West Greenland

by

Henrik Lund

Greenland Fisheries Research Institute, Tagensvej 135, 1
DK-2000 Copenhagen N, Denmark

INTRODUCTION

From 1985 to 1989, Greenland fishery for shrimp removed about 35,000 tons of shrimp from fishing grounds at North West Greenland 9 north of 71°N). Decreasing mean catch rates experienced during this period show that this level of exploitation may be too high.

The northerly location of these populations and the observation that environmental conditions may be less favourable than those found at West Greenland made it desirable to investigate if the level of reproduction of these populations is below that of more southern populations.

This paper presents a comparison of fecundity of shrimp sampled on fishing grounds at North West Greenland with samples from West Greenland.

MATERIALS AND METHODS

Berried shrimp were collected immediately after spawning (August, 1989) on fishing Grounds I (71°N) and III (72°N) at North West Greenland (Figure 1), and in Holsteinsborg Deep (66°N) at West Greenland. Samples were stored at -20°C until examination.

In the laboratory undamaged shrimp with intact egg masses were selected and measured (oblique carapace length). Shrimp measuring between 22 and 26 mm were included in the study. Pleopods and the attached egg mass were removed together by cutting the pleopods at the bases. The mass was then transferred to a Petri dish and the pleopods were removed.

In order to facilitate counting of eggs it was attempted to separate the eggs from the cementing material by which they are attached to the pleopods.

However, it proved almost impossible to separate the eggs and the cementing material - in part because the eggs were very sensitive to handling and many burst during the process.

It was then attempted to accomplish the separation through enzymatic degradation of the cementing material. Whole lumps of eggs were incubated at 32°C to 37°C in a solution of a neutral protease [0.5 mg Dispase/ml 0.9% Nacl (w/v) in demineralized water; specific activity of Dispase > 0.5 U/mg].

The method proved useless because the eggs decomposed while the cementing material was left intact! Enzyme solutions of lower concentrations gave the same result.

It was finally decided to count untreated egg masses. Because a large (variable) part of the eggs burst, leaving the empty shells, it was necessary to count the shells and add this number to the number of whole eggs in order to get the initial ("true") number of eggs. Three persons performed the counting.

Water temperature on shrimp grounds was measured during trawling by means of a probe attached to the trawl. No information was available concerning the accuracy of this device. Therefore the temperature values given below must be regarded as relative values.

RESULTS

Table 1 shows observations made by three different persons, while Figures 2 to 4 show the number of eggs per clutch as a function of carapace length of the female. The three persons who carried out the counting showed significantly different ability to detect the hyaline shells. However, as each person treated shrimp from two different areas a comparison of areas was possible.

Mean numbers of eggs carried by shrimp from the same sampling site and in the same length group differed by 15-18%, depending on the person counting.

An analysis of variance was applied to shrimp in length groups 23-24 mm and 24-25 mm. The analysis showed that berried shrimp sampled on Ground I carried significantly less eggs than did berried shrimp sampled in Holsteinsborg Deep ($p<0.01$; $r^2=0.5$). The difference was about 40%; this applied to both length groups.

Data also indicated significant differences between Holsteinsborg Deep and Ground III, and between Ground I and Ground III regarding females in the 24-25mm group. However, the differences were less pronounced than in the case mentioned above.

Data on temperature indicate a difference of 1-2°C between Holsteinsborg Deep (t=3-5°C) and the northern grounds (t=1-3°C). There are no indications of a difference in temperature between the northern grounds.

DISCUSSION AND CONCLUSION

Berried shrimp sampled on fishing grounds at North West Greenland north of 71° N carry significantly less (20-40%) eggs per clutch than do berried shrimp sampled at West Greenland (66°N). For reasons that are not evident at present the mean number of eggs per berried shrimp is lower at 71°N than at 72°N (taking size of shrimp into account).

Compared to northern stocks outside Greenland waters the fecundity of shrimp sampled in this study may be considered low. Fecundity studies of *Pandalus borealis* populations in the Barents Sea (Berenboim & Sheveleva, 1989; Teigsmark, 1983), at norway (Thomassen, 1977; Figure 5), and in the Gulf of Alaska (Nunes, 1984) generally show a higher mean number of eggs per berried shrimp in the length group 23-25 mm.

Low numbers of eggs, comparable to the numbers found on Ground I, were found in the eastern and central parts of the Barents Sea (Teigsmark, 1983). Teigsmark assumed that these "low production populations" were associated with water masses of low temperature (i.e. 0°-1°C; Figure 5: Barents Sea C.).

Temperature is regarded as exerting major influences on growth and reproductive characteristics of populations of *Pandalus borealis*. Thus Nunes (1984) showed a significantly larger clutch size in laboratory populations held at 3°C compared to populations held at 6°C and 9°C. Berenboim (1982) showed that temperatures below 2°C lowered fecundity of shrimp in the Barents Sea. These findings indicate that optimum conditions for egg production are attained in a relatively narrow range of temperatures.

As indicated by temperature data shrimp populations at North West Greenland and at West Greenland are influenced by different water masses. The relatively warm Irminger Current component of the West Greenland CUrrent affects the fishing grounds at West Greenland while the North West Greenland grounds are more influenced by cold polar water from northern Canada. These differences may be the underlying cause of differences of fecundity.

Bearing in mind that data cover a very short span of time and space the observations on fecundity made in this study do suggest that the level of fecundity in parts of the North West Greenland shrimp stock is low compared to the West Greenland shrimp stock. It is therefore likely that reproduction rate of the North West Greenland shrimp stock is relatively low. If this stock is considered as a self-sustaining one, the fraction of the stock that can be removed annually by fishing (on any given strategy for balancing stock) is smaller than the comparable fraction at West Greenland.

REFERENCES

Berenboim, B.I. 1982. Reproduction of the Shrimp *Pandalus borealis* in the Barents Sea. Oceanology, 22(1): 85-89.

Berenboim, B.I., and G. K. Sheveleva. 1989. Data on the Deepwater Shrimp (*Pandalus borealis* Kroyer) Fecundity in the Barents Sea. ICES C.M. 1989/K:16.

Nunes, P. 1984. Reproductive and Larval Biology of Northern Shrimp, *Pandalus borealis* Kroyer, in Relation to Temperature. Doctoral Dissertation, Fairbanks, Alaska.

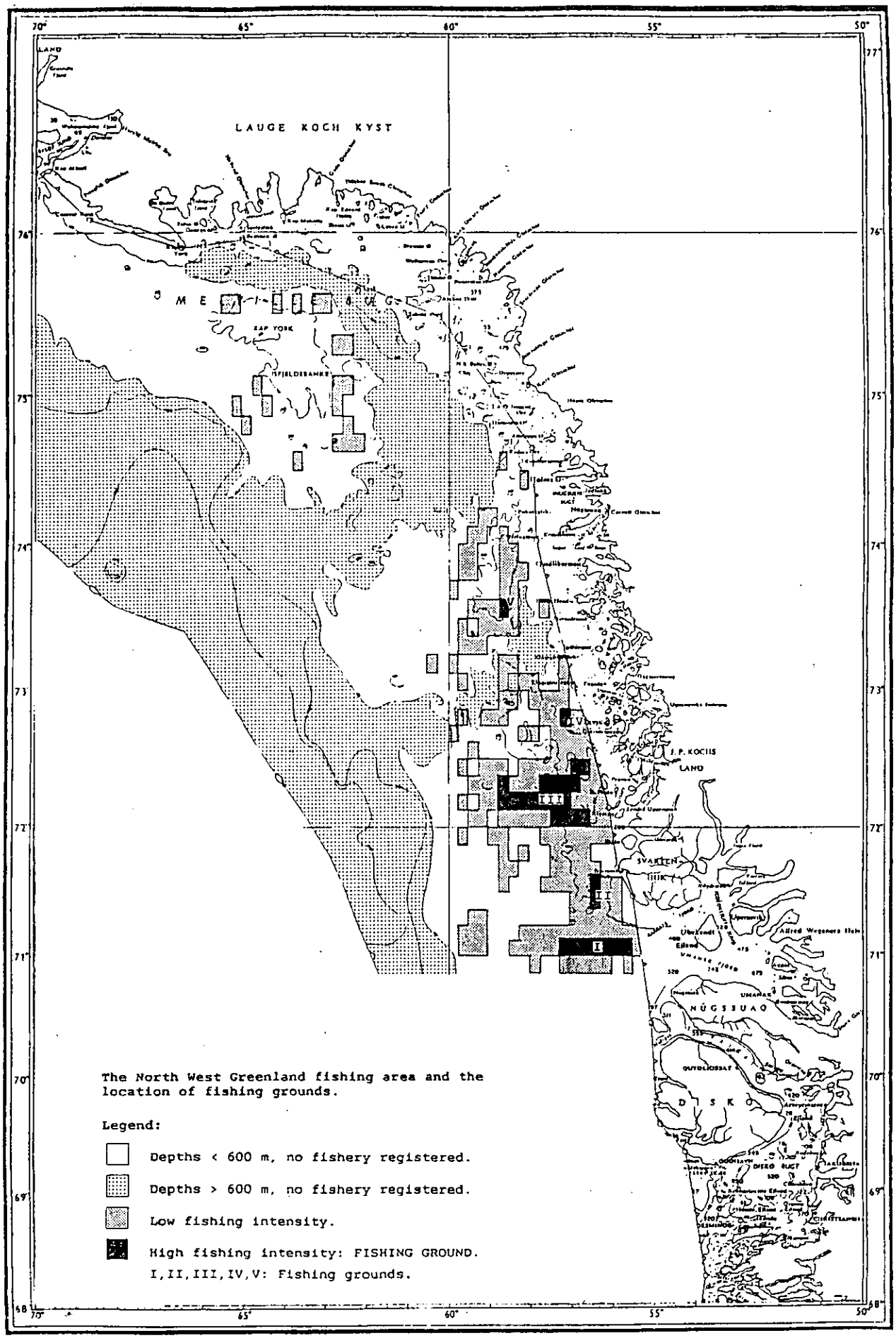
Teigsmark, G. 1983. Populations of the Deep-Sea Shrimp (*Pandalus borealis* Kroyer) in the Barents Sea. Fisk Dir. Skr. Ser. HavUnders., 17:377-430 (1983).

Thomassen, T. 1977. Comparison of Growth, Fecundity, and Mortality between Two Populations of *Pandalus borealis* in Northern Norway. ICES C.M. Doc. 1977/K:38, 16 p.

TABLE 1.

	CPL	A				B				C			
		N	mean	std	cv	N	mean	std	cv	N	mean	std	cv
GROUND III	23-24 mm												
	24-25 mm					17	880	210	24	22	721	233	32
GROUND I	23-24 mm	36	517	165	32								
	24-25 mm	23	577	203	35								
HOLSTEINSBORG DEEP	23-24 mm	14	962	229	24								
	24-25 mm	12	1001	205	21	12	1115	148	13	17	947	298	31

A,B,C, = sets of observations made by the persons A, B, and C
CPL = oblique carapace length
std = standard deviation
cv = coefficient of variation



The North West Greenland fishing area and the location of fishing grounds.

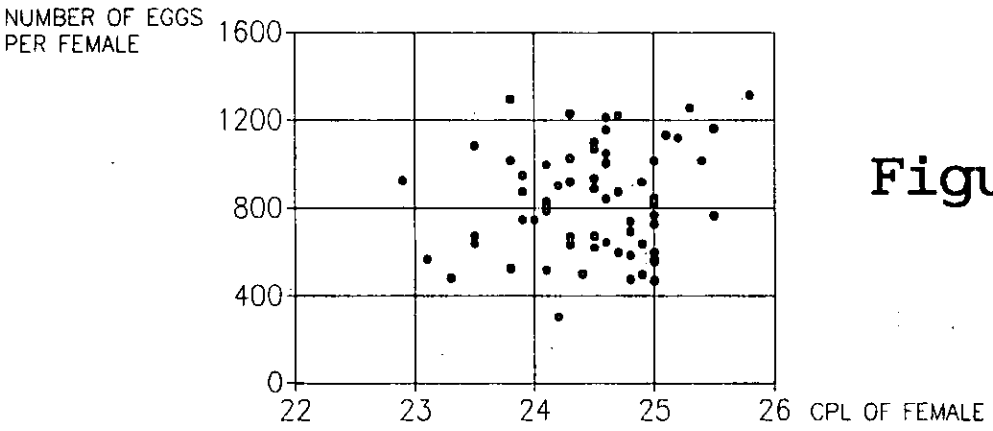
Legend:

- Depths < 600 m, no fishery registered.
- Depths > 600 m, no fishery registered.
- Low fishing intensity.
- High fishing intensity: FISHING GROUND.

I, II, III, IV, V: Fishing grounds.

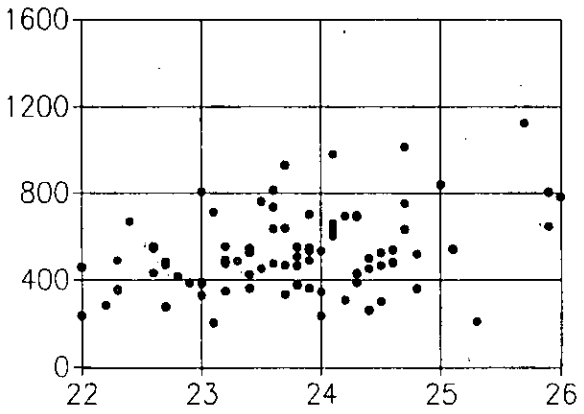
Figure 1.

FECUNDITY OF GREENLAND SHRIMP STOCKS.



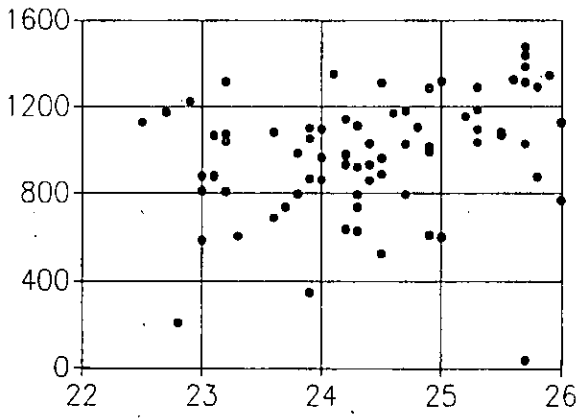
GROUND III, AUG. 1989

Figure 2.



GROUND I, AUG. 1989

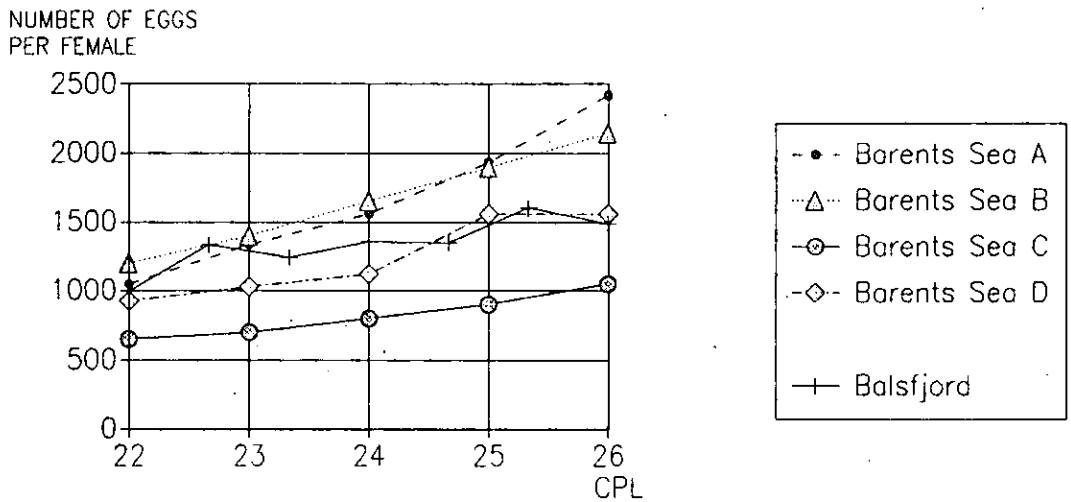
Figure 3.



HOLSTEINSBORG DEEP
AUGUST 1989

Figure 4.

FECUNDITY OF SHRIMP STOCKS IN THE BARENTS SEA AND AT NORWAY.



Barents Sea A: Central Barents Sea (Berenboim 1989)
Barents Sea B: Coastal population (Teigsmark 1983)
Barents Sea C: Eastern/central part (Teigsmark 1983)
Barents Sea D: Eastern part (Berenboim 1989)

Balsfjord: Fiord population in northern Norway (Thomassen 1977)

Figure 5.