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FECUNDITY AND EGG SIZE OF SPRING SPAWNING BARENTS SEA CAPELIN

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ABSTRACT

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Fecundity of Barents Sea capelin was studied in 1971 and 1972. No differences were found between these two years. The regression line

$$\log F = 3.4871 \cdot \log L - 0.2049$$

was fitted to the whole material. This is in good accordance with studies on Barents Sea capelin carried out by others and shows much lower fecundity than capelin from New Foundland waters.

Diameters, measured on artifically fertilized eggs, ranged between 1.10 and 1.23 mm, mean 1.165 mm, and diameters of eggs from spawning beds measured between 1.10 and 1.20, mm mean 1.184 mm. Canadian and Icelandic measurements show smaller and similar sizes respectively.

INTRODUCTION

Spring spawning capelin, *Mallotus villosus* (Müller), from the Barents Sea mature at an age of 3 and 4 years and spawn from February to April along the coasts of northern Norway and Murman. Capelin are believed to be one time spawners, but parts of the stock probably survive and spawn one year later for a second time (PROKHOROV 1965). Earlier work on fecundity of the Barents Sea capelin has been reviewed by PROKHOROV (1965). Fecundity of capelin in Newfoundland waters has been studied by TEMPLEMAN (1948) and WINTERS (1971). An extensive difference in egg numbers seems to occur between these two stocks of the North-Atlantic capelin. Diameters of fertilized eggs of Newfoundland capelin have been measured by TEMPLEMAN (1948) and of Icelandic capelin by FREDRIKSSON & TIMMERMANN (1951). No comparable data is found for Barents Sea capelin, although POZDNYAKOV (1967) has measured some ripe interovarial eggs.

This paper gives data on fecundity and egg size of Barents Sea spring spawning capelin for the years 1971 and 1972. The results of the present study are compared with data from Canada, U.S.S.R. and Iceland.

METHODS

Prespawning capelin were collected by pelagic trawl off Finnmark in February 1971 and 1972. Total length of the fish, i.e. the length between the anterior end of the mandible to the posterior end of the ventral lob of the caudal fin in natural position, was measured in 1971 on fresh material and in 1972 on frozen. To make the measurements comparable, shrinking due to freezing and thawing was adjusted for by using the equation

$$L_{fresh} = 1.01\ L_{frozen} + 0.273$$

developed by MONSTAD (1971). Length measurements made by POZDNYAKOV (1957) were converted from fork length to total length by adding 8% (TEMPLEMAN 1968). The age of the fish was determined from the otoliths.

In 1971 the gonads were removed from the fresh fish and placed in 10% formalin. In 1972 the fish were frozen, and after about one week the gonads were removed and transferred to formalin. As it turned out to be quite easy to separate the eggs of capelin gonads kept in formalin, Gilson's fluid was not used.

After separating the eggs from each other, a whirling vessel (WIBORG 1951) was used to fraction the samples, and one sample of 1/10 of both gonads combined was counted from each fish. A study of egg size was carried out in 1971. Eggs were artificially fertilized and kept in glass jars with sea water at 5°C for about 12 hours. Diameters of a hundred eggs or more from each fish were measured using a Watson eyepiece micrometer. Length and age of these fish were recorded.

Diameters were also measured on live eggs from natural spawning beds situated along the Finnmark coast.

RESULTS

FECUNDITY

In 1971 eggs were counted in 48 specimens ranging between 14.1 and 18.2 cm in length. Fecundity ranged between 5800 and 19090 eggs per female (Fig. 1). The following logaritmic regression of fecundity (F) on length (L in cm) was found:

$$\log F = 3.6473 \cdot \log L - 0.4074$$

In 1972 egg counts were made from 34 capelin ranging between 14.2—18.6 cm. Fecundity ranged from 5250 to 19070 eggs per female. Accordingly the regression line

$$\log F = 3.2508 \cdot \log L + 0.0924$$

was found.

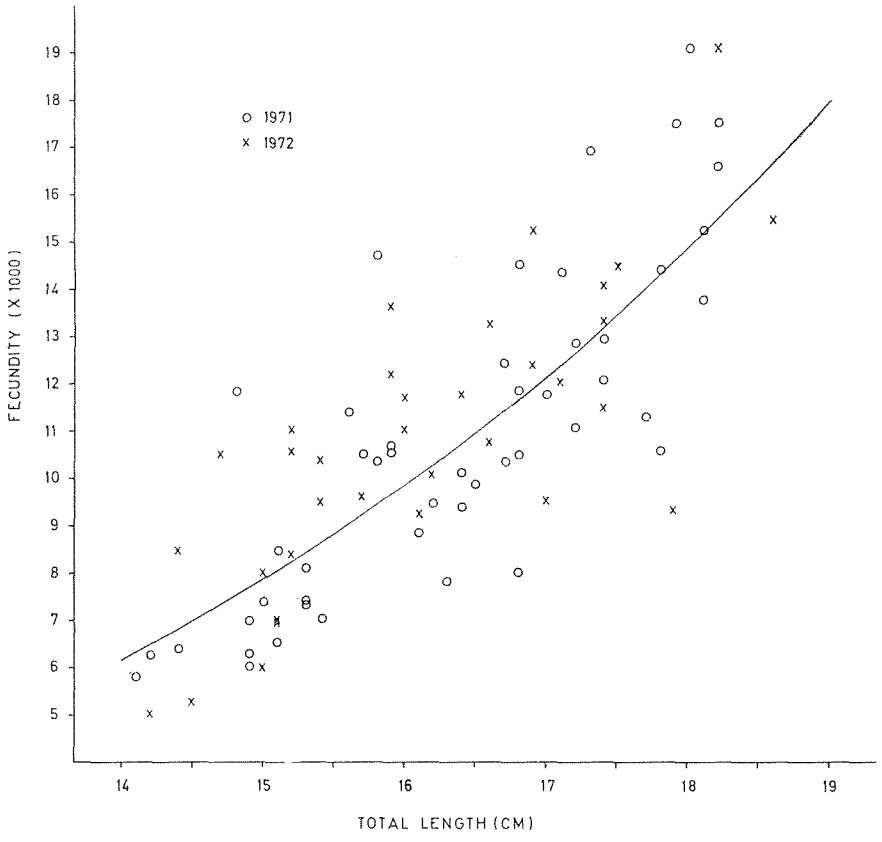

Fig. 1. Fecundity of Barents Sea capelin from 1971 and 1972 with the regression line $F = 0.3913 \cdot L^{3.4871}$

Correlation coefficients, r, variances of estimate, $S^2_{\log F \log L}$, regression coefficients, b, with confidence intervals, and intercepts, a, with confidence intervals are listed in Table 1. Both correlations are highly significant.

Values of t between the regression coefficients, b, and between the intercepts, a, for the years 1971 and 1972 are 0.358 and 0.040 respectively. This shows that there is no significant difference in fecundity-length relationship between the two years. Therefore the material from the two years were combined, and the regression line

$$\log F = 3.4871 \cdot \log L - 0.2049$$

was found. Some parameters for this regression are also listed in Table 1.

This equation can be converted to

$$F = 0.3913 \cdot L^{3.4871}$$

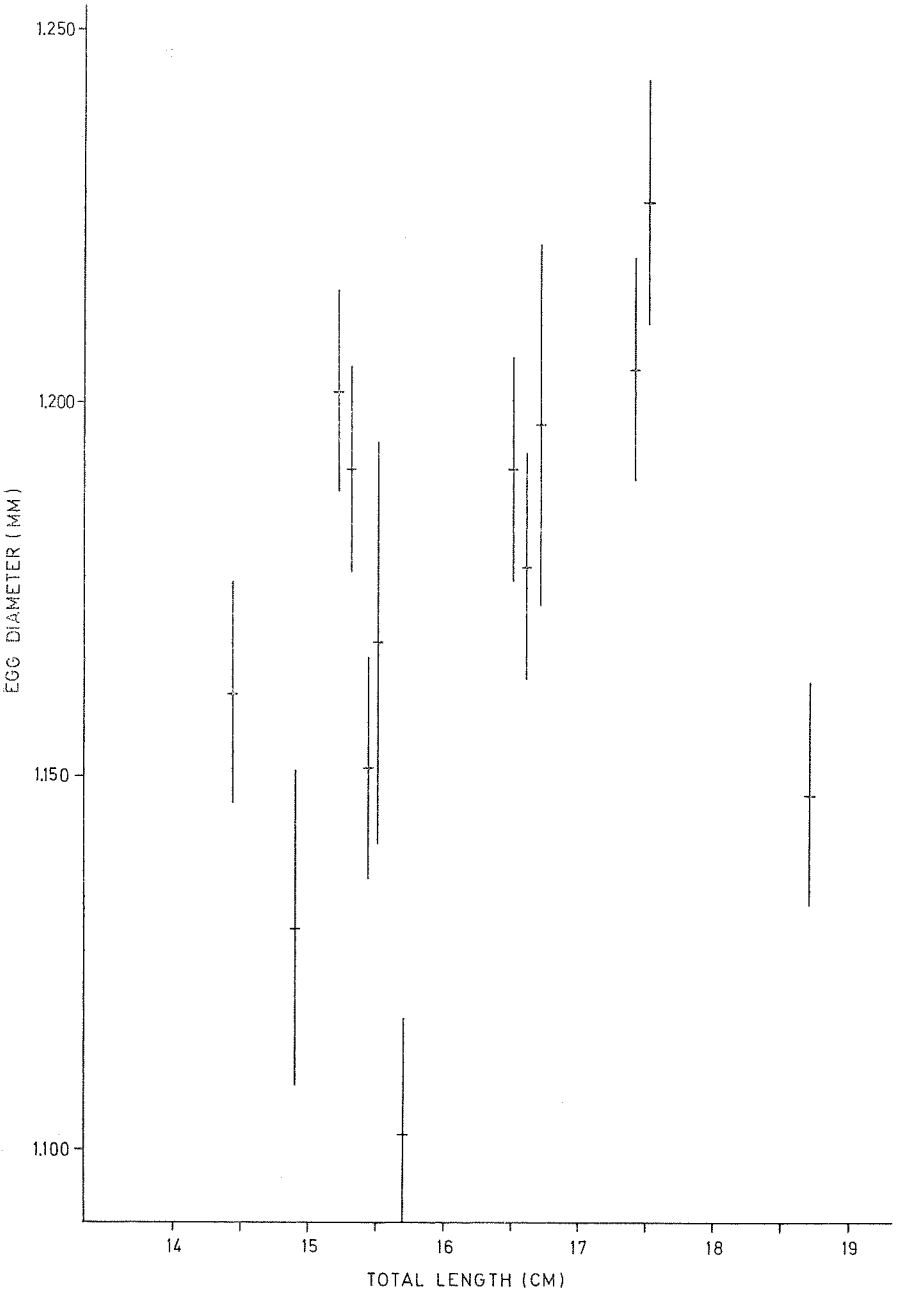

Fig. 2. Diameters of artificially fertilized eggs of Barents Sea capelin from 1971. The range of the vertical bars show two standard deviations.

Table 1. Parameters of the regression line $\log F = b \log L + a_n$ used for fecundity (F) and length (L) on Barents Sea capelin.

Year	n	b ± 95% conf.lim.	a ± 95% conf.lim.	r	$S^2 \log F \log L$
1971	48	3.6473 ± 1.4186	— 0.4074 ± 1.7174	0.82	0.023
1972	34	3.2508 ± 1.6283	+ 0.0924 ± 1.9626	0.75	0.021
Total	82	3.4871 ± 1.0420	— 0.2049 ± 1.0243	0.79	0.015

MONSTAD (1971) has shown that the length-weight relationship for maturing female Barents Sea capelin taken during late winter has the form

$$W = 0.00036 \cdot L^{3.89}$$

(W = weight in g, L = length in cm).

The conclusion, therefore, is that fecundity is changing nearly linearly with weight.

In the material analysed 72 specimens were 4 years old and only 8 and 2 were 3 and 5 years respectively. It is therefore impossible to analyse the effect of age on fecundity.

The results of the egg diameter measurements are shown in Fig. 2. The size of eggs varied between 1.10 and 1.23 mm, mean 1.165 mm. The regression line

$$D = 0.081 \cdot L + 1.040$$

of mean diameter of eggs, D (mm), on fish length, L (cm), was found. The results suggest that the diameter is increasing with fish length (Fig. 2), but the correlation coefficient $r = 0.2684$ shows that the correlation is not significant ($P > 0.05$).

In addition to artificially fertilized eggs, 467 live eggs from 3 spawning areas were measured. The following mean diameters were found: West-Finnmark, 1.177 mm (N = 147); Mid-Finnmark, 1.174 mm (N = 223); East-Finnmark, 1.218 mm (N = 97). Mean for the whole area was 1.184 mm.

DISCUSSION

Fecundity of Barents Sea capelin has been studied by POZDNYAKOV (1957), who counted eggs from 128 specimens. Fecundity ranged from 4518 to 22021 with a mean of 10764 eggs, and the corresponding lengths were between 12.5 and 19.0 cm, mean 16.1 cm. No regression line was fitted but he suggested an almost linear relation between weight and fecundity.

Table 2. Mean lengths and fecundity from POZDNYAKOV (1957) compared to fecundity at same lengths from the regression line log F = 3.487 · log L — 0.2049.

Length (cm)	Fecundity	
	Pozdnyakov	Authors
13,7	6 319	—
14,8	7 455	7 525
15,8	9 695	9 441
16,1	10 764	10 070
16,9	12 362	11 930
17,7	15 334	14 030
18,8	17 285	17 310

His data shows a slight, but insignificant higher fecundity than the present study (Table 2).

For Atlantic capelin in Canadian waters fecundity has been studied by TEMPLEMAN (1948) and also by WINTERS (1971) who found the regression line

$$\log F = 2.94 \log L - 4.8473$$

indicating a higher fecundity than in the Barents Sea.

In capelin from the area off British Colombia, ranging in total length between 10.7 and 12.2 cm, HART & MCHUGH (1944) found a fecundity range of 3020—6670 eggs, mean 4590.

Because of the small size at maturity, a comparison of this data to ours is very difficult.

Diameters of fertilized eggs of Atlantic capelin from Canada have been measured by TEMPLEMAN (1948). He found a mean diameter of 0.965 mm and the range from 0.901 to 1.037. His material was preserved in 10% formalin, but the developmental stage is not reported. The mean diameter of eggs from Barents Sea capelin were approximately 23% higher than this. Shrinkage of eggs in 4% formalin is about 7% (HIEMSTRA 1962) and cannot acount for the total difference. It can therefore be concluded that Barents Sea capelin have bigger eggs than Atlantic Canadian capelin. This is also to be expected from the differences in fecundity-length relationship between the two stocks.

In Icelandic capelin FREDRIKSSON & TIMMERMANN (1951) found diameters ranging between 0.98 and 1.27 mm with the mean 1.12 mm in fertilized eggs taken from a spawning bed. Preservation and developmental stages are not reported. Comparison is therefore difficult, but the eggs of Icelandic capelin seems to be of similar size as eggs from Barents Sea capelin.

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