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Size of a spawning capelin stock on the Grand Newfoundland Bank (Div. 3N) in 1976 (South-Western stock)

by

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Synopsis

The paper discusses the data on the size - age structure of a capelin stock which spawns in the ppen waters in southeast shoal of the Grand Newfoundland Bank (div.3 N) as well as an estimate of this stock done in June 1976.It was found that the biomass of the capelin present on the spawning grounds between June 16 - 17 was 687 000 tons and the abundance 35561.8 x 10^6.

Introduction

In 1975 the first estimate of the biomass and abundance of capelin on the spawning grounds was done June 9 - 14.The biomass estimate was found to be 1.05 million tons and the abundance estimate 29829.2 x 10^6.

On the spawning grounds in division 3 N prevailed the fish at the age of 3 - 4 years (74.5%) from the 1971 - 1972 year - classes (Seliverstov,Kovalev 1976).In June 1976 the assessment of capelin biomass and abundance in div.3 N was carried out June 16 - 17 from a research vessel " Odissey ".

Material and methods

The hardware used to estimate the abundance and biomass of the spawning fish were sounder " Simrad EK - 38 " and integrator " Simrad QM ".Due to peculiarities in the behaviour of the fish much difficulty was encountered in the use of underwater cameras " Triton ".The capelin kept in very small dense shoals which did not disperse during the night - time.The shoals were fast moving ones and we failed to obtain enough photoes to carry out a standard calibration of acoustic instruments.The situation being like this,we used another standard calibration method based on earlier stereophotogrammetric investigations and visual underwater observations.These investigations showed a definite relationship between an average density of a moving shoal and an average length of fishes (Serebrov 1976):

$$\rho = \frac{1}{(K\ell)^3} \qquad (1)$$

where ρ - density of a shoal

ℓ - average length of a fish

K - coefficient

For the capelin, the coefficient is equal to 2.72.Therefore:

$$\rho = \frac{1}{(2.72)^3} \qquad (2)$$

Dense shoals which follow this relationship can be identified on the scunder recordings by relatively small dimensions (height up to 15 m) and by a sharp increase in the integrated echo intensity.

To carry out the calibration we determined the integrated echo intensity of a shoal (J_{sh}) in millimetres and a volume of a shoal within a sounder beam:

$$V_{sh} = (L - Z)\,Dh \qquad (3)$$

where L - horizontal extention of a shoal

Z - beam width alongships

D - beam width athwartships

h - height of a shoal

An average length of capelin at the time of calibration was 148.6 mm.From formula (2) an average density of active shoals is

$$\rho_{av} = 15\ m^{-3}$$

Then was determined a number of fishes within the sounder beam $N = \rho_{av} \cdot V_{sh}$ and this number was compared with integrated echo intensity J_{sh}.The result of a standard calibration is a correlation function $J = A\,N$.

Coefficient A determined by the method of least squares was found to be equal to :

$$A = \frac{J\,N}{N\,2} = 39 \cdot 10^{6}\ mm/spec$$

The average weight of a capelin on the spawning grounds was 19.4 gr.Hence A= 2mm/ton

The echo integrator calibration equation is:

$$J = 39 \cdot 10^{-6} \qquad (4)$$

or

$$J = 2\,W \qquad (5)$$

where N- number of fishes in a sounder beam

W- biomass of fish

J- integrated echo intensity in mm for 30 minutes

A correlation coefficient between J and N (or W) was found to be $r = 0.91 \pm 0.02$ which supports the assumption about relatively small deviations of shoal densities from the average density calculated from formula (2).

The value of the coefficient in equation (4) can change following changes in the length composition of the shoals but equation (5) remains unchanged (Serebrov 1976).

Therefore equation (5) was used.

During the assessment of capelin spawning concentrations the echo integrator was continuously operating in the following mode:gain 20 dB,signal threshold 4,paper speed 1mm/min, integration range from 10 m to the bottom.It integrated not only the signals reflected from the capelin shoals but also a background signal from a scattering layer. which was uniformly distributed over the observed area.Integrator recordings from a scattering layer were 7mm for 30 minutes.This was established by echointegrating a scattering layer in the areas where there was no capelin.The absence of the capelin was checked by trawlings.

In the course of the acoustic survey a background storage was deducted from the recordings stored by the echo integrator for 30 minutes:

$$J=J_o - J_b = J_O - 7mm \qquad (6)$$

From formula (5) was determined the biomass in the beam (W) and then a specific biomass in tons per square mile:

$$q_W = \frac{W}{S} \qquad (7)$$

The area investigated for 30 minutes (S) was determined using the width of the sounder beam athwartships and the speed of the vessel:

$$S= 0.5 \cdot 1852vD = 926vD\ m^2$$

By drawing through the obtained points q_W isolines corresponding to 300 and 1 000 tons of capelin per square mile we had 3 density zones for which were calculated average specific biomasses,areas of the zones and the biomass of fish (Fig.1).

The results of the calculations are in table 1.

Organization of the acoustic - photogrammetrical survey and the techniques used to collect and process the biological material were the same as used in the previous years (Serebrov, Bakanev a.Kovalev 1975 ;Seliverstov,Kovalev 1976;Bakanev, Seliverstov,Serebrov 1976).

Discussion of results

In June 1976 the first scattered capelin concentrations appeared on the spawning grounds (div.3N) on June 6.A massive arrival of the fish on southeast shoal of the Grand Bank was observed on June 14.

The bulk of the capelin spawning stock consisted of recruits at the age of 3 years from the 1973 abundant year - class.

The recruits of the 1973 year - class appeared in great numbers in div.2J and 3K (South Labrador and Northern Newfoundland Bank) as early as the fall of 1975 and already at that time this massive appearance brought about some decrease in the stock biomass and a concurrent increase in its abundance (Bakanev,Seliverstov,Serebrov 1976).

The same picture was observed in June 1976 on a spawning ground in div.3N (Fig.2).

In 1976 the spawning started between June 18 - 22.Proceeding from the rate of capelin sexual maturation (Fig.3) we may assume that a stock assessment of June 16 - 17 covers only a part of the Bank capelin spawning stock.At the end of June the spent fish accounted for not more than 6%.In some samples before June 25 the spent capelin made up 80%.From this it follows that after the completion of the assessment new pre-spawning capelin shoals were still arriving on the spawning grounds.

The obtained results indicate a good status of the stocks and the recruitment to them of the 1973 abundant year - class. This permits to think that the 1975 - 1976 catch quotas were not excessive.

References

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Table 1

Biomass of capelin concentrations

Density gradations, tons/mile^2	Area of concentrations in square miles	Specific biomass tons/mile^2	Biomass in thousands tons
I000	I45,3	I490,7	248,2
800-999,9	467,3	554,1	258,9
299,9	II97,2	I50,2	I79,8
	I809,8		686,9

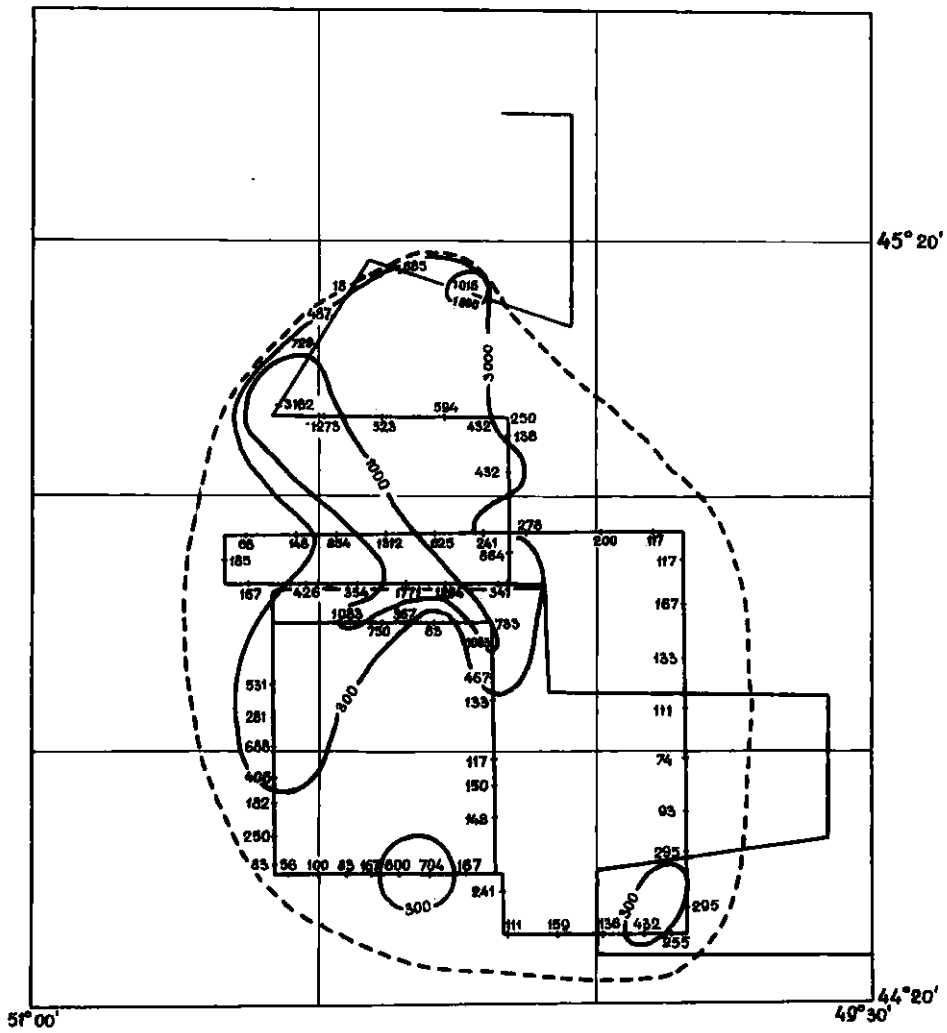

Fig.1.Echo survey of the Bank capelin biomass (3 N) on 16 - 17 June 1976

Biomass gradations :10 000 - 1 000 tons /mile^2

3 000 - 300 tons /mile^2

Dash line - boundary of concentrations

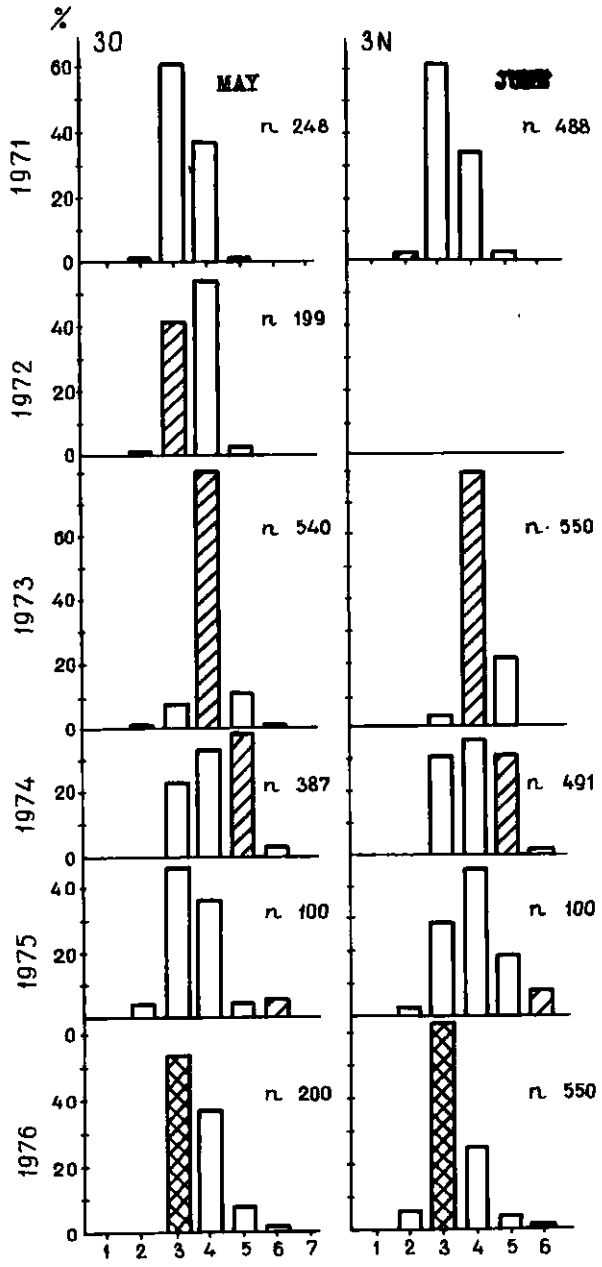

Fig.2.Age composition of pre - spawning (3 O) and spawning (3 N) Bank capelin concentrations

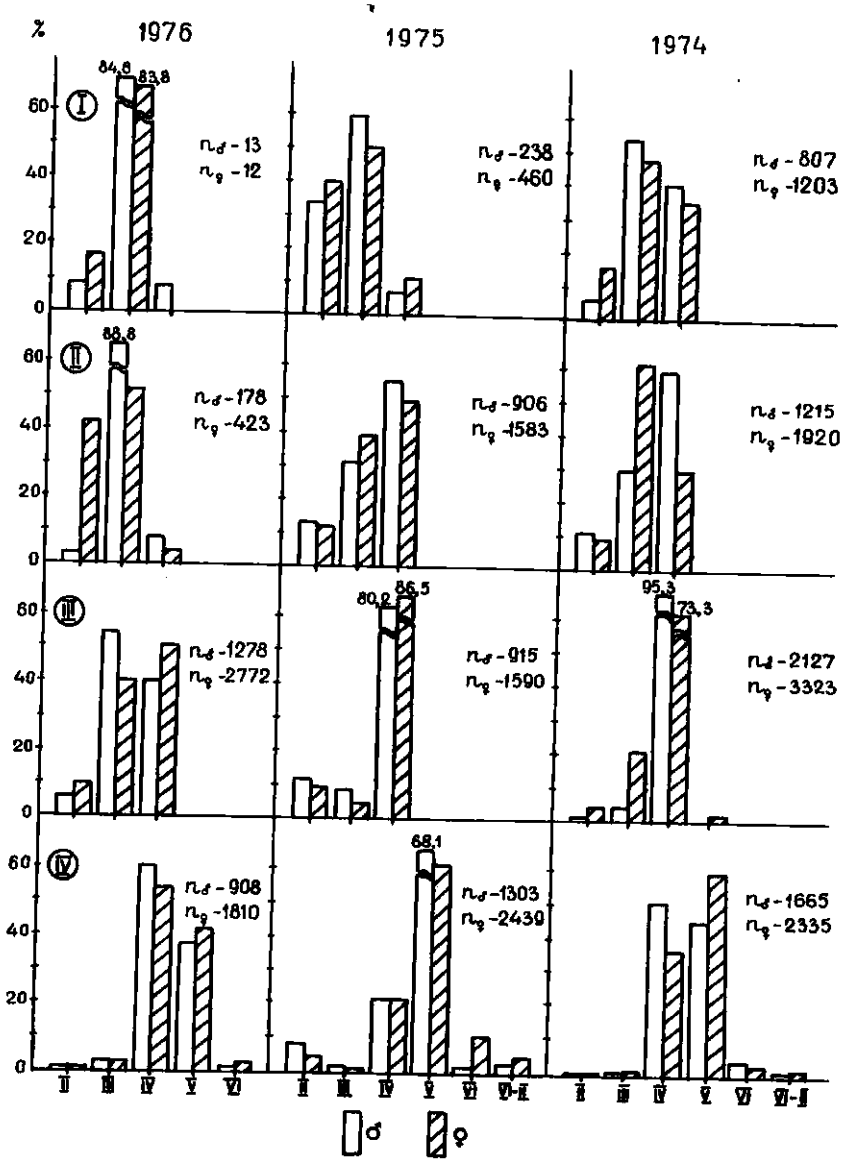

Fig.3.Capelin maturation by months in 1974 - 1976.

I - March; II - April ; III - May; IV - June; VI stage - running sexual products