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Assessment of Capelin Stocks in Divisions 3LNO in May-June 1979

by

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Abstract

The paper contains data on the methods of stock assessment, estimates of biomass and abundance, biological state of pre-spawning and immature capelin in Subarea 3LNO. The data were obtained in the cruise of R/V "Poisk".

Introduction

Assessment of biomass and abundance of Newfoundland capelin by means of instrumental methods has been made since 1975. To study the distribution and abundance of mature capelin during their migration to the spawning grounds R/V "Poisk" conducted researches in May/June 1979. Besides, for the first time assessment of abundance and biomass of immature capelin and sand eel was made.

Material and Methods

Echo sounding of capelin concentrations in Divs. 3L and 3NO in May/June 1979 was conducted with two echo sounders (EK-38 and EK-120). Single-channel echo integrator IS-I was connected to EK-38 and ISP-I, consisting of five-channel echo-integrating and echo-counting systems, to EK-120.

Absolute calibration of echo-integrating systems in ISP-I and IS-I was conducted in the following ways:

a) with the help of echo-counting system in ISP-I on scattered concentrations of capelin;

b) with the help of artificial models of capelin concentrations placed under the external transducer of EK-38.

First method

A set of echo-signals parameters consisting of echo-signals from single fish, groups of fish and total echo-intensity was measured on scattered capelin concentrations with the help of ISP-I connected to EK-120.

Based on the set measured there were determined angles of directional diagram of echo sounder EK-120, number of fish (ρ_s) per square mile and coefficient (C) of absolute calibration of echo-integrating system in ISP-I. The method was used earlier, in 1978 (Ermolchev, Kovalev, Seliverstov, 1978).

Alongside with measuring the acoustic parameters capelin were trawled at the same depths in order to determine a size-weight composition.

The measurements showed that,

$$\rho_{S1} = CI_{ISP} + d = 0{,}95 \cdot 10^5 I_{ISP} + 1{,}48 \cdot 10^6;\ R=0{,}88;\ \bar{L}=13{,}75 \text{ cm}$$

$$\rho_{S2} = 2{,}34 \cdot 10^5 I_{ISP} + 1{,}14 \cdot 10^6;\ R=0{,}97;\ \bar{L} = 7{,}45 \text{ cm} \quad (1)$$

where

I_{ISP} - echo-intensity from capelin concentrations in number of deflections of echo-integrating system in ISP-I;

R - correlation coefficient;

$\bar{L}$ - mean length of capelin, sm;

d - constant coefficient

Second method

An artificial model of concentration was made up of fish caught, which were with the help of nylon filament placed in a horizontal position and distributed evenly within a concentration volume. The external transducer was connected to EK-38

and placed above the concentration, echo-intensity was measured by means of ISP-I and IS-I with different number of fish in the shoal.

Coefficients of absolute calibration (C) of echo-integrating systems in ISP-I and IS-I were calculated (a transfer factor between the external transducer and that installed in the vessel bottom was taken into account).

For ISP-I

$$C_I = 3{,}04 \cdot 10^6 \text{ sp.(sq.m.) deflec.} \cdot I_{ISP};\ R=0{,}97\ (\bar{L} = 15{,}5 \text{ cm})$$
$$C_2 = 1{,}95 \cdot 10^6 \text{ sp.(sq.m.) deflec.} \cdot I_{ISP};\ R=0{,}97\ (\bar{L} = 16{,}5 \text{ cm}) \quad (2)$$

For IS-I

$$C_I = 3{,}2 \cdot 10^6 \text{sp. (sq.m.) deflec.} \cdot I_{IS};\ R=0{,}97\ (\bar{L} = 15{,}5 \text{ cm})$$
$$C_2 = 2{,}2 \cdot 10^6 \text{sp. (sq.m.) deflec.} \cdot I_{IS};\ R=0{,}97\ (\bar{L} = 16{,}5 \text{ cm}) \quad (3)$$

The analysis of instantaneous values of echo-intensities from the model showed that this method of calibration provided an accuracy of $\leqslant 10\%$.

To determine coefficients of absolute calibration for caplin of different lengths relationships obtained by norwegian specialists when using echo sounders with 38 kHz and 120 kHz frequencies were applied(Dalen, Bakness, Rottingen, 1976).

$$C = C_n L^{-1{,}91}(38 \text{ kHz}),\quad C = C_n L^{-1{,}84}(120 \text{ kHz}) \quad (4)$$

After the echo-integrating systems had been calibrated the abundance of capelin was estimated through trawl-acoustic method. Echo-intensities and distribution of fish according to length composition from control trawlings were plotted on the charts. These methods were formulated and tested when assessing capelin stocks in the Barents Sea (Nakken, Dommasnes,1975).

$$\rho_{ai} = \frac{K_{ai}}{\sum_{a=1}^{p} \sum_{i=1}^{n} \frac{K_{ai}}{C_{ai}}} \quad (5)$$

where K_a - percentage of fish of length group i and species a in a catch;

P - number of species in a catch; a=1,2,3, ... P

n - number of length groups; i=1,2,3, ... n

C - coefficient of absolute calibration of echo-integrating system for length i species a.

Species and length-weight compositions of catches were compared with regard to echo sounders recordings, depth of the sea and water temperature at different depths. During the surveys mature pre-spawning capelin in Div.3L were at daytime observed mainly near the bottom. Shoals of immature capelin inhabited pelagic waters.

When mature and immature capelin formed mixed concentrations a division was made according to formula 5.

During the surveys sand eel were often found in catches from the near bottom layer (sometimes nearly to 90%). But sand eel were observed at the depth less than 100-110 m, isotherm 0° coinsiding with isobath 100 m was the boundary of their distribution.

The analysis of data permitted to construct separate charts of distribution of mature and immature capelin, sand eel and to provide separate estimates of their biomasses.

Three trawl-acoustic surveys were conducted in May/June 1979, the first one - on May 10-13 in Div.3L; the second - on May 16-19 in the same Division; the third - on May 25/June 5 in Div.3L and in the north of Divs. 3NO. From June 5 to 23 a careful search for pre-spawning and spawning concentrations of capelin was undertaken in Divs. 3NO; their biomasses were estimated.

Discussion and conclusions

During the first survey pre-spawning mature capelin made up dense concentrations in the south-west of Div. 3L. During the second survey no dense concentrations of mature capelin were discovered, and their abundance turned out to be 4 times as less as that in the first survey. During the third survey in Div. 3L

rather dense concentrations of mature capelin were found again, their abundance was 2 times as high as that in the second survey (Table 1,Fig.1).

The distribution of immature capelin in Div. 3L in May/June 1979 was relatively constant. From survey to survey the fish migrated eastwards, their abundance in Div. 3L gradually decreased.From June 5 to 23 all in all 11 shoals of spawning capelin were detected in Divs. 3NO. Geometric parameters of shoals were determined according to echo sounder records, capelin abundance and biomass in each shoal were caculated using ISP-I and IS-I connected to EK-38 (Table 1).

3-4 year old capelin(1975 and 1976 year classes) made up the bulk of spawning stock. Specimens of the rich 1973 year class constituted no more than 4% (Table 2).

The nature of capelin distribution in Div. 3L and observation of their migrations permit to suppose that during the first and third surveys separated by almost a month the abundance and biomass of different "waves" of migrating mature capelin were determined. The analysis of gonads maturity (Table 3) and sharp reduction in abundance of mature capelin during the second survey in Div. 3L (Table 1) prove this.

Comparison of capelin abundance and biomass in Subarea 3LNO for 1975-1979 indicates that the lowest values were observed in 1978 (Table 4). Since 1979 the biomass of mature capelin has been increasing. But this refers only to Div. 3L, no fish were detected on spawning grounds in Div. 3N.

In 1979 for the first time the biomass of immature capelin in Div. 3L was estimated. It was nearly equal to a half biomass of mature stock, as for the abundance, immature fish were more numerous than mature ones (Table 1).To restore the spawning stock in Div. 3N it is necessary to keep Subarea 3NO closed for fisheries in 1980.

References

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Table 1. Capelin abundance and biomass in May/June 1979.

Species	Division 3 L										Division 3 O	
	May 10 - 18				16 - 19 May		May 25 - 4 June				15 June EK-38	
	EK-38+IS-I		EK-120+ISP-I		EK-38+IS-I		EK-38+IS-I		EK-120+ISP-I		ISP-I	IS-I
	N .10^{10}	W .10^{6}_{T}	N .10^{10}	W .10^{6}_{T}	N .10^{10}	W .10^{6}_{T}	N.10^{10}	W.10^{6}_{T}	N .10^{10}	W.10^{6}_{T}	W .10^{4}_{T}	W .10^{4}_{T}
Mature capelin	2,33	0,483	1,35	0,358	0,64	0,104	1,3	0,234	1,05	0,186		
Immature capelin	3,0	0,246	1,85	0,182	1,92	0,146	1,3	0,10	1,01	0,079		
Juvenile capelin							5,06	0,7				
Sand eel									0,27	0,068		
Spawning capelin											0,186	0,273

Table 2. Age composition of capelin in May/June 1979.

Month	Div.	Sex	Age, %							n
			I	2	3	4	5	6	7	
May	3L	♂	-	-	8,7	II,3	I2,0	2,0	0,2	I54
		♀	-	0,2	2I,2	I3,3	I0,0	2,4	-	2I2
		juv	-	0,4	I5,6	2,7	-	-	-	84
June	3 L	♂	-	-	8,0	I5,0	I9,0	4,0	-	46
		♀	-	-	I6,0	I5,0	20,0	2,0	-	53
		JUV	-	-	I,0	-	-	-	-	I
	3N	♂	-	-	8,7	I0,4	I7,0	5,9	-	92
		♀	-	0,9	I9,6	I2,2	II,7	I,7	-	I06
		juv	-	I3,9	-	-	-	-	-	32

Table 3. Capelin maturity stages in Div. 3N.

Date	Males							Females							n
	I/II	II	II/III	III	III/IV	IV		I/II	II	II/III	III	III/IV	IV		
I0-I3.05	3,4	6,8	8,5	7I,I	I0,2	-	59	8,3	3,5	-	67,4	20,8	-		I47
I6-I9.05	-	I3,0	2,2	I9,6	65,2	-	46	-	2,9	-	I4,6	76,7	5,8		I7
25.05-4.05	-	-	-	I,7	44,8	53,5	58	-	I,0	2,I	35,0	6I,9	-		97

Table 4. Capelin abundance and biomass in 1975-1979.

Year	Abundance, sp. $\cdot 10^6$	Biomass, mill.t
1975	29829,2	1,05
1976	35561,8	0,685
1977	38614,5	1,00
1978	13433,0	0,31 x)
1979	23300,0	0,48 x)

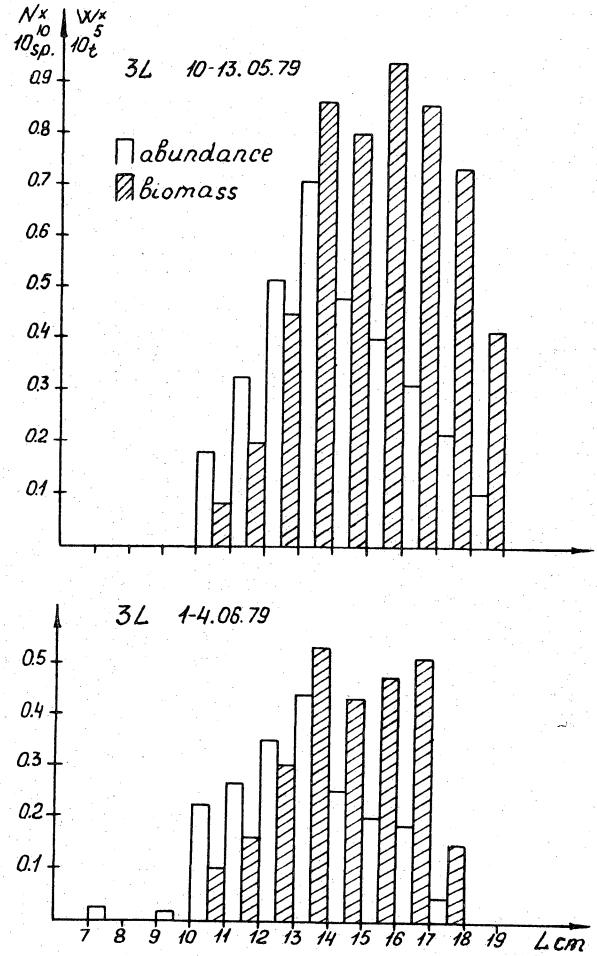

Fig. 1 Dynamics of changes in capelin abundance and biomass in Div. 3L in May/early June 1979.