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Assessment of Capelin Stocks from Results of USSR Investigations in Div. 2J+3K and 3LNO in 1986

by

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ABSTRACT

The results of capelin stock assessment from two echo surveys: summer survey for prespawning schools in Divs. 3LNO and autumn survey for feeding concentrations in Divs. 2J3K are presented in the paper. The abundance of the 1986 year class was estimated by the results of December trawl survey for capelin pre-recruits in Divs. 3LNO.

The surveys were noted to be carried out under unfavourable conditions, therefore, the biomass value about 1.5 mill. t obtained in each of surveys should be considered minimum. According to the tentative data the 1986 year class strength turned to be some times lower than that of abundant 1983 and just below the 1984 year class.

INTRODUCTION

The annual estimate of the stock size and its recruitment with fish species having a short lifetime and variable numbers such as Newfoundland capelin are - one of the main tasks in stock prediction and their rational fishery.

The hydroacoustic method is the most widespread of various known to fishery science procedures for assessing the capelin biomass and abundance. Its application became possible due to appearance in recent years of highly effective hydroacoustic and echo-integrating equipment, and also to improved methods of their utilization. In this case, the peculiarities of capelin biology and behaviour: the aggregated pelagic mode of life, concentration in some periods of a year in the limited area - are of no small importance.

The long-term studies showed that the hydroacoustic method permitted on the whole to control the state of capelin stocks and to obtain the quantitative estimate quite satisfactory for practical purposes.

However, the reliability of the stock quantitative estimate obtained by this method is influenced by many factors, the degree of efect of the latters is a very complicative and not sufficiently studied at present problem. One of the factors is the pattern of fish distribution relative to abiotic and biotic conditions of a given year which influence the object availability during the surveys, to the Soviet vessels in particular, as the part of fish migrate to the Canadian territorial waters.

The results of two echo surveys carried out in summer 1986 in the area of Grand Newfoundland Bank and in autumn in South Labrador and Notre-Dame Bay are presented in the paper. The conditions under which the surveys were conducted are described. The data on capelin pre-recruit assessment obtained in the area of Grand Bank in autumn 1986 are also compared with the results of earlier surveys.

METHODS

The echo survey for capelin was conducted by RV "Artemida" equipped with echo sounder EK-38 and echo integrator SIORS in Divs. 3LNO from 16 to 27 June 1986.

The capelin stocks in Divs. 2J3K were surveyed by MG-1364 "Vitebsk" from 30 October to 20 November 1986 with the use of a system of Soviet instruments Priboy-G - the echo sounder working at a frequency of 20 kHz, USOD - the receiver of echo signals with preset TVG function and SIORS - the digital echo integrator.

The known relationship between target strength TS and capelin length L applied for Norwegian echo sounders with 38 kHz were used in calculations of both surveys.

$$TS\ (L) = 19.1\ \lg L - 74.4$$

The correction for echo sounder "Priboy-G was calculated from the formula:

$$\Delta\ TS = 0.9\ \lg \frac{\lambda_1}{\lambda_2}\ ,$$

where λ_1 and λ_2 - wave lengths of echo sounders Priboy-G and EK-38 respectively.

The constant of echo integrating instruments was determined through calibration with a standard copper sphere 60 mm in diameter. As concerns the rest of survey methods, operating conditions of instruments and data processing, they are similar to those used earlier in the areas (Mamylov et al., 1984).

The trawl survey for capelin pre-recruits was carried out by MG-1330 "Klintsy" in Div. 3O from 30 November to 12 December 1986. The fishing gears, methods of data collection and treatment were the same as in previous surveys (Bakanev et al., 1984).

RESULTS AND DISCUSSION

The routes of echo surveys, position of test hauls and density of capelin schools are shown in Figs. 1 and 2.

In 1986 the capelin echo survey in Divs. 3LNO was delayed by nearly two weeks compared with usual terms due to technical reasons. Therefore, a considerable portion of mature fish migrating to Canadian shores for spawning was underestimated. The immature capelin which migrated by that time northward to the feeding grounds outside the Grand Bank were not surveyed either.

The total capelin biomass constituted about 1.5 mill. t (Table 1) which was nearly 2.5 times less (3.7 mill. t) than the biomass obtained by Canadian scientists during the analogous echo survey in May 1986 (Miller, 1986). Mature specimens accounted for about 60% of the stock abundance, the half of them was distributed in Divs. 3NO.

The autumn survey was carried out in Divs. 2J3K under unfavourable conditions especially in the north of the area surveyed where the stormy weather prevented from executing the required number of test hauls. Naturally, such weather conditions could not but influence the quantitative estimate of stocks both through the factor of fish behaviour (it is known that part of fish is scattered in stormy weather) and wind wave which caused a considerable noise field intensity and sound attenuation in the near-surface water layer.

The total capelin biomass in Divs. 2J3K turned to be at the level of summer survey (1.5 mill. t) though its abundance

decreased nearly by 30%. The stock in both surveys consisted, mainly, of specimens of abundant 1983 and, to a lesser degree, of 1984 and 1982 year classes (Fig.3). The absence of younger (1985) and older (1980, 1981) age groups in summer survey resulted, first of all, from the insufficient number of samples collected in this area and also from poor abundance of aforementioned year classes in the given area.

The position of trawl stations and catch of fingerlings (the 1986 year class) per trawling mile are presented in Fig. 4. During the survey a small catch (about 50 spec.) of 2-year-olds (the 1985 year class) was taken on two stations in the north of Div. 3L.

The highest number of fingerlings was found in Div. 3N, and Div. 3O in particular. Their length composition by areas is given in Fig.5.

To calculate the capelin fingerling numbers the methods were used which the Soviet and Norwegian scientists applied for assessment of the Barents Sea capelin fry (Anon., 1974). The total area of scattered schools (with density less than 1050 spec. per trawling mile) was 20.1 thou. sq. miles and that of dense schools - 2.5 thou. sq. miles. Substituting these data in the formula for the numbers calculation we shall derive:

$$T = A_s + KA\mathcal{A} = 20.1 + 10 \cdot 2.5 = 45.1,$$

where K - coefficient of density relation equal to 10.

The obtained numbers of capelin fingerlings of the 1986 year class turned to be lower than those of the 1984 and 1983 year classes by a factor of 1.5 and about 6 respectively (Table 3).

Though a short series of observations did not allow at present to assess reliably the year class strength by the above methods, nevertheless, the preliminary comparison of the numbers of fingerlings of the 1983 and 1984 year classes and their absolute values obtained by the hydroacoustic method at the age of 2 showed a close relation between these indices. So, the ratio of the numbers of the 1984 year class to that of the 1983 year class equalled 0.26 (Table 2), and ratios between the numbers of these year classes at the age of 2 were 0.17 and 0.23 according to the data of Canadian (63.7/367.4 bill. spec.; Miller, 1986; Table 4) and Soviet (19/81 bill. spec., Divs. 2J3K, Table 3) echo surveys respectively.

Thus, the results of investigations show that the rich 1983 year class composing the major part of biomass and abundance in recent two years will prevail in the spawning stock as well in summer 1987 after which a certain decrease of stocks will be observed in the nearest future since the strength of the three successive year classes (1984–1986) were assessed according to tentative data to be lower than the numbers of the 1983 year class.

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Table 1. Results of capelin echo surveys in Divs. 3LNO and 2J3K in 1986.

Division	Area, sq. miles	Stock index, N – bill. spec., W – thou. t	Year class I985	I984	I983	I982	I98I	I980	Total	Mature included
3L	20626	N	–	I7,0	47,0	2,7	–	–	66,7	3I,5
		W	–	I66,7	704,0	62,I	–	–	932,8	432,4
3N 0	I0966	N	–	I,4	23,9	3,2	–	–	28,5	27,0
		W	–	23,8	460,3	74,6	–	–	558,7	496,4
3LN 0	3I592	N	–	I8,4	70,9	5,9	–	–	95,2	58,5
		W	–	I90,5	II64,3	I36,7	–	–	I49I,5	928,8
2J 3K	II050	N	0,5	I9,0	44,6	3,6	0,I	0,I	67,9	
		W	2,4	299,7	III3,3	III,0	4,0	4,9	I535,3	

Table 2. Results of trawl surveys for capelin fingerlings (0+) in 1983, 1984 and 1986.

Date	No. of stations	Area (sq. miles) occupied by schools with catches (spec.) per 1 trawling mile		Abundance index	Index relative to 1983
		> 1050	< 1050		
06.II - 20.II.1983	48	38,2	21,6	254,2	1
11.12 - 15.12.1984 30.12.1984 - 14.01.1985	38	36,3	3,3	66,5	0,26
30.11 - 12.12.1986	33	20,1	2,5	45,1	0,18 ∞

Table 3. Capelin abundance and biomass according to data of echo surveys in Divs. 3LNO and 2J3K in 1984–86.

Year of survey	Area	Age						Total
		1	2	3	4	5	6	
Abundance, bill.spec.								
1984	3 LNO	360,0	123,6	50,2	16,2	1,7	-	551,7
	2 J3K	41,3	19,3	3,8	1,4	0,2	-	66,0
1985	3 LNO	-	230,7	53,3	4,4	0,9	+	289,3
	2 J3K	0,8	81,0	18,1	2,6	0,2	-	102,7
1986	3 LNO	-	18,4	70,9	5,9	-	-	95,2
	2 J3K	0,5	19,0	44,6	3,6	0,1	0,1	67,9
Biomass, thou.t								
1984	3 LNO	375,0	808,3	977,6	439,3	55,1	-	2655,3
	2 J3K	67,7	125,3	45,0	22,0	3,2	-	263,2
1985	3 LNO	-	1281,1	755,3	130,5	31,7	1,2	2199,8
	2 J3K	4,2	1016,9	406,1	78,9	7,6	-	1513,7
1986	3 LNO	-	190,5	1164,3	136,7	-	-	1491,5
	2 J3K	2,4	299,7	1113,3	111,0	4,0	4,9	1535,3

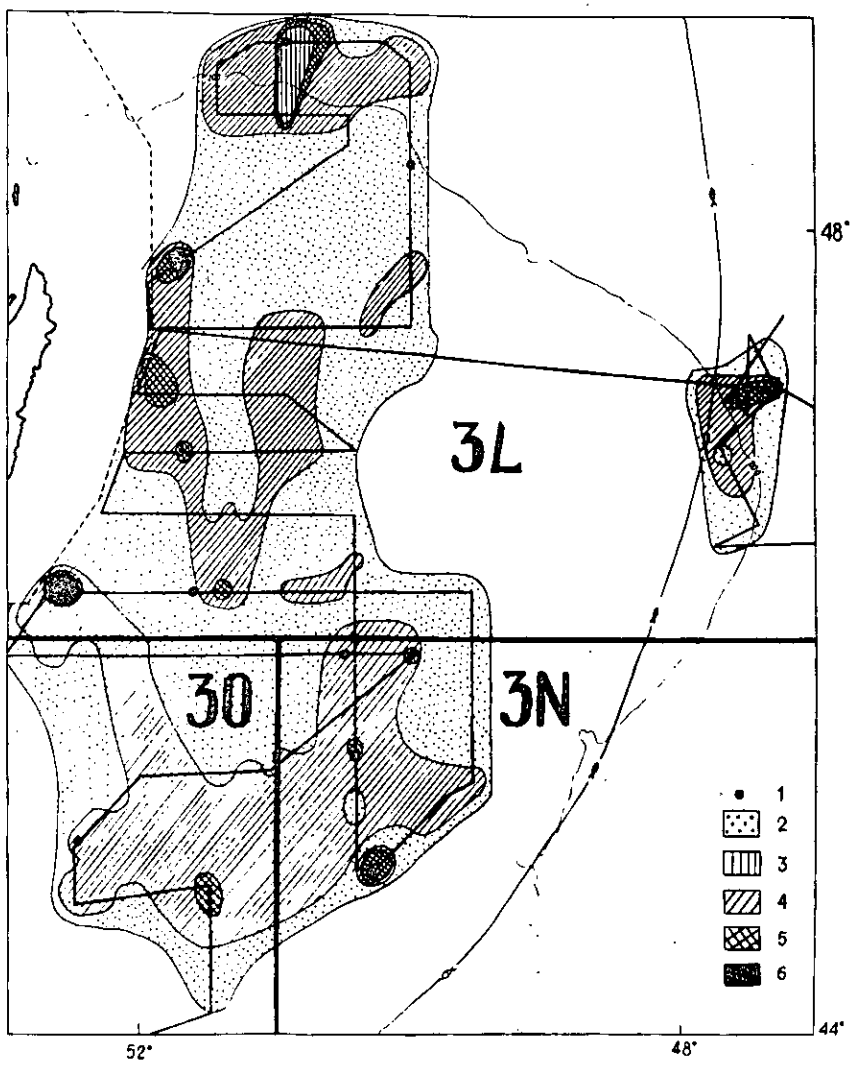

Fig.1 Survey route and density (echo intensity units M) of capelin concentrations in Divs. 3LNO

1 - test hauls, 2 - M < 10, 3 - M=10-50,

4 - M=50-100, 5 - M=100-1000, 6 - M > 1000

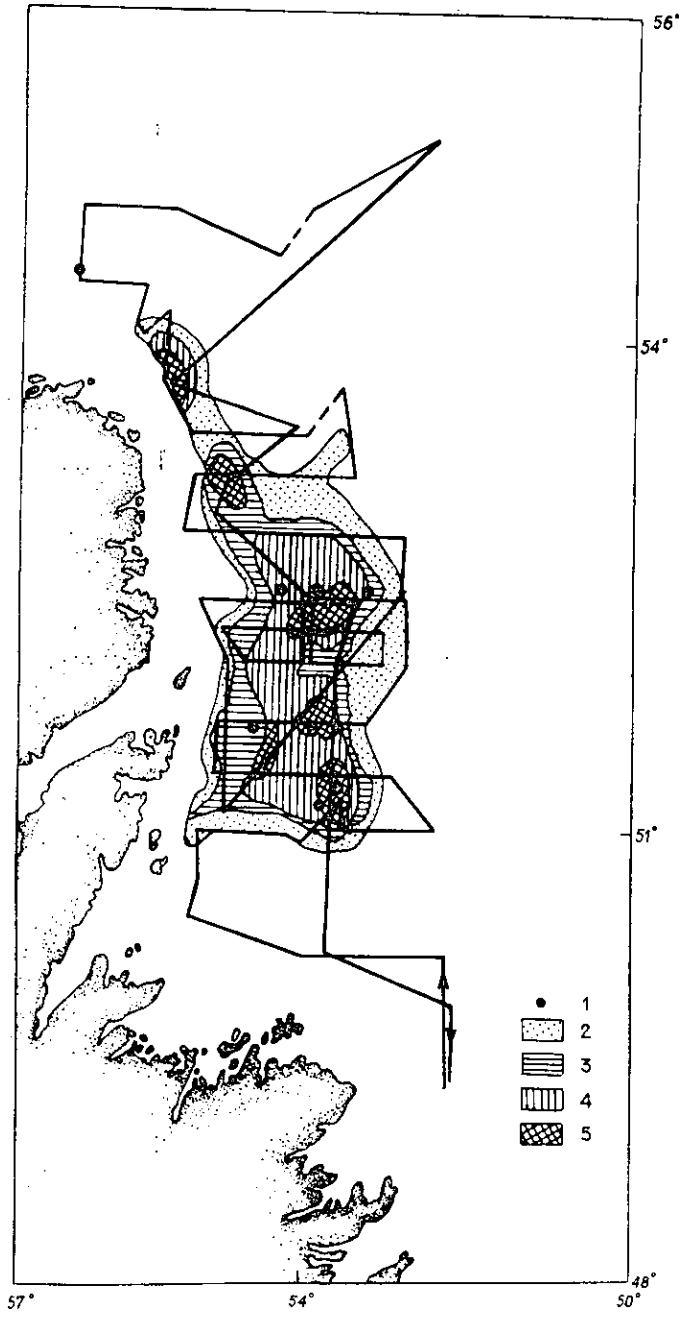

Fig.2 Survey route and density (echo intensity units M) of capelin concentrations in Divs. 2J3K

1 - test hauls, 2 - M < 10, 3 - M=10-100,

4 - M=100-1000, 5 - M > 1000

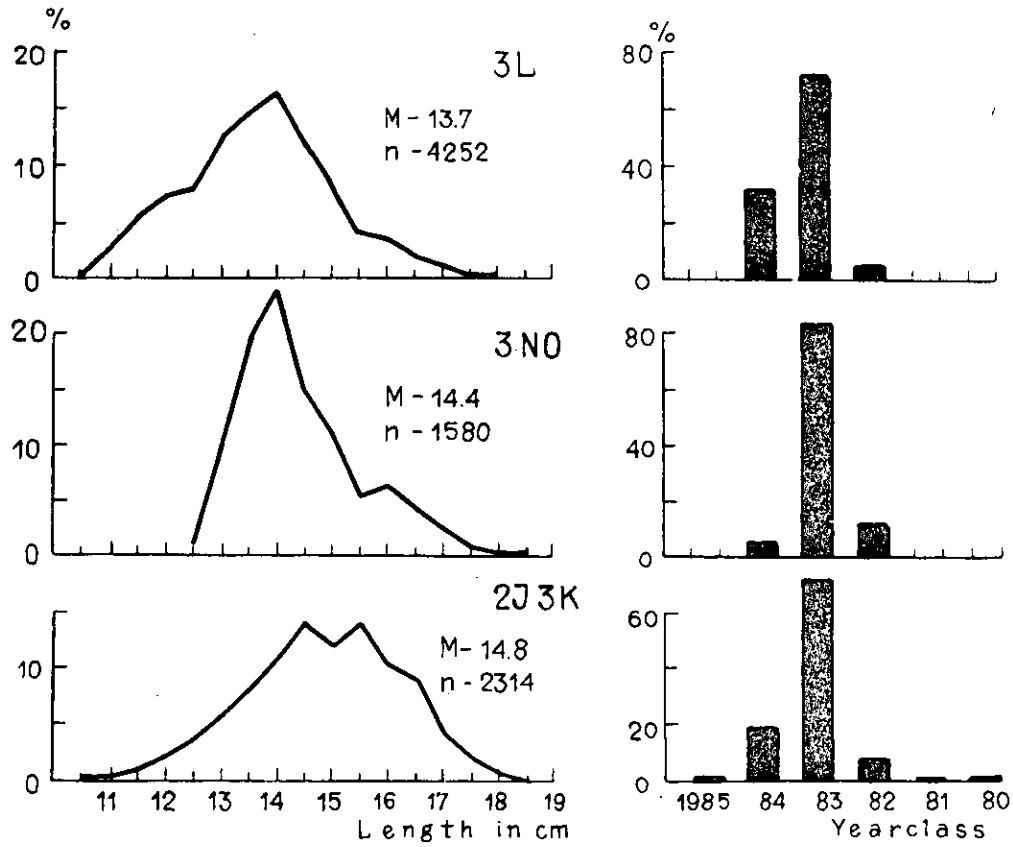

Fig.3 Length-age composition of capelin catches by areas.

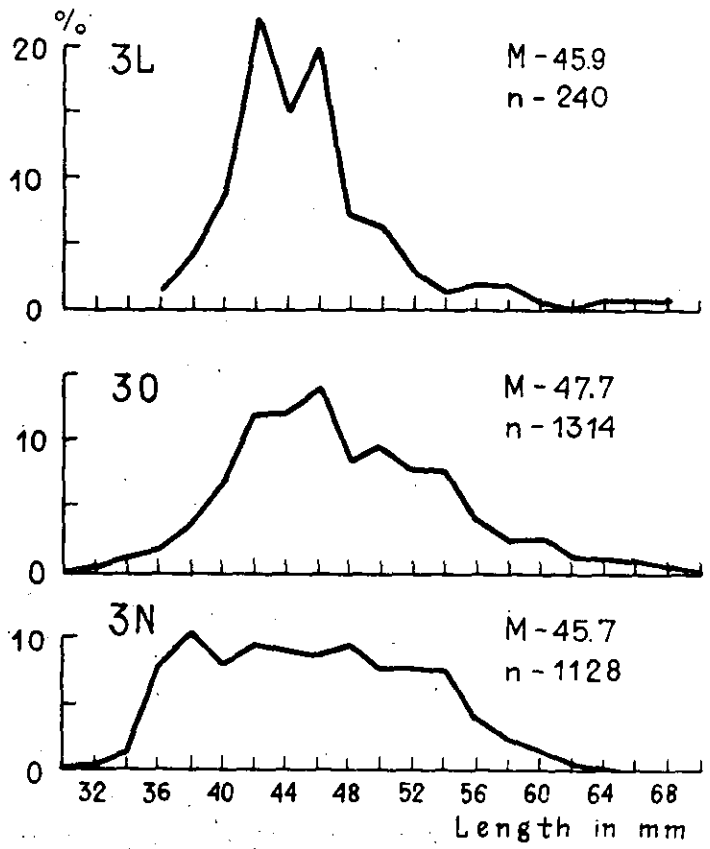

Fig.4 Position of trawl stations and number of capelin fingerlings per trawling mile.

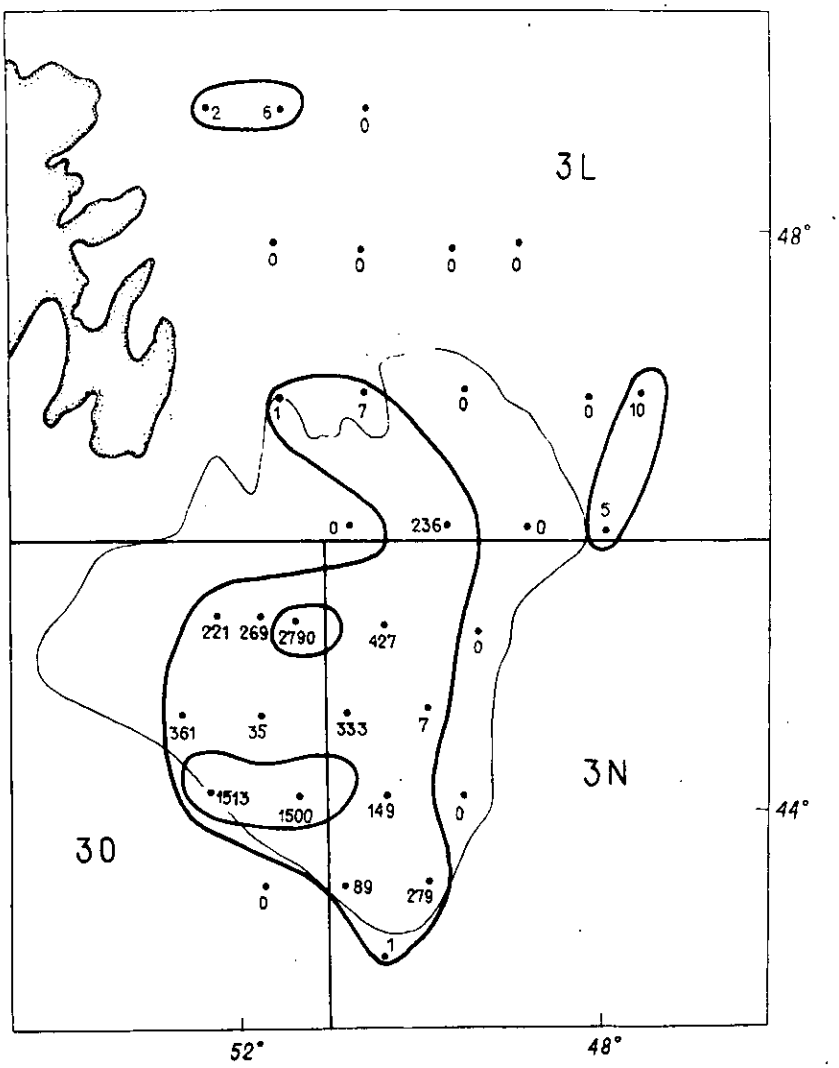

Fig.5 Length composition of capelin fingerlings.