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Acoustic Estimation of Capelin Abundance and Biomass
in NAFO Div. 2J+3K in 1985

by

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ABSTRACT

The paper presents the results of the echo survey for
capelin performed by the RV "Poisk" in autumn 1985.

A remarkable stock growth is stated to have taken place
due to a very rich 1983 year class which will form the basis
of commercial stock for the two forthcoming years (1986-1987).

INTRODUCTION

Echo surveys for capelin stock assessment in Divs.2J3K
have been carried out by PINRO since 1974.

Canada has performed similar investigations since 1977,
but in the last years they were only restricted to spring-
summer echo surveys in Divs. 3LNO. The results of acoustic
assessment obtained by the two countries are used for the
total stock estimation and serve as a basis for determining
the quota.

MATERIAL AND METHODS

The survey was performed from 21 October to 7 November 1985.
The routes are shown in Fig. 1. The applied methods, instru-
ments and regime of their operation were similar to those used
before in the same surveys (Mamylov and Bakanev, MS 1985).

Readings of the echo integrator were taken every 5 miles,

the distance between tacks being chosen according to the
density of concentrations.

Test hauls were made regularly and the data on length and
age composition of capelin were collected. Besides, for this
purpose the results of six hauls of the RV "N.Kononov" having
operated alongside with the RV "Poisk" for 2 days were utilized.

On the basis of test hauls and the distribution pattern
of capelin the region of Divs. 2J3K was split into 3 subdi-
visions (Fig. 2), biological characteristics and echo intensities
along tacks being averaged for each of them. Prior to this
subdivisions were divided into 16 strata. These were chosen
so that to provide regular sampling of echo intensities per
area of each stratum.

The final expression for estimation of capelin abundance
by length groups in each subdivision was as follows:

$$N_i = \frac{C_I \cdot p_i}{\sum\limits_i p_i \, \sigma_i} \cdot \bar{M} \cdot S = 4.4 \cdot 10^6 \frac{p_i}{\sum\limits_i p_i L_i^{1.91}} \cdot \bar{M} \cdot S \quad ,$$

where N_i – abundance of capelin from the i-th length group;

p_i – portion of fish from the i-th length group (%);

$\bar{M}$ and S – mean echo intensity and area (sq. miles) for each
subdivision;

C_I – instrument constant of the echo integrating system
equal to $1.89 \cdot 10^3$ cm^2/sq. mile;

σ_i – average acoustic backscattering cross section of
capelin in situ equal to $4.3 \cdot 10^{-4} \cdot L_i^{1.91}$ (cm^2);

L_i – fork length of fish, cm.

Then the numbers of males and females by ages were deter-
mined for each subdivision through length-age keys. The total
biomass of capelin was estimated from the mean weight of each
length group.

RESULTS

During the echo survey capelin were distributed over
an extensive area from 51° to 55°N between 53°40' and 56°00'W.
The densest concentrations were found in the central part of
the surveyed area (Subdivision II), where, as final calculations

showed, there were nearly 70% of the estimated stock. Here test
hauls comprised mainly fish 12-14 cm long of the 1983 year
class (83.2%, Fig. 3).

The largest fish were distributed in the north of the
surveyed area (Subdivision III), though, as before, three-year-
olds of the 1983 year class prevailed (67.7%), while the portion
of four-year-olds of the 1982 year class came up to 27.6%.

The total abundance and biomass of capelin in Divs. 2J3K
amounted to 103 bil. spec. and 1.5 mil. t, respectively. Besides,
in the north of Div. 3L in the second half of November a small
concentration of capelin was found including fish from the 1983
year class (60.9%) and the 1984 year class (39.1%), thus consti-
tuting 4.4% in number against the estimated stock. The total
results of capelin abundance and biomass estimation in Divs. 2J3K
are given in Table 1. The distribution of water temperature
during the survey is shown in Fig. 4.

DISCUSSION

The analysis of the long term abundance dynamics of capelin
shows that the fish total amount depends greatly on the strength
of each year class.

The data on commercial withdrawal of each year class in
mil. spec. (Table 2) are indicative of variations in abundance
of capelin year classes. Thus, in the period 1972 to 1978 there
were two very abundant year classes - those of 1969 and 1973 -
which at ages 3 to 5 made up the basis of capelin yearly catch.

After 1973 five poor year classes appeared successively.
Table 3 shows that in 1981 the stock of capelin was recruited
by a strong year class born in 1979, a high abundance of
which became apparent already at an age 1 (Bakanev, MS 1980).

Later on the 1982 year class which was much richer than
the 1979 year class became highly important for the stock.
But the 1983 year class is the most abundant on being at the
level of the 1969 and 1973 year classes and averaging nearly
80% of the total stock during the 1985 surveys.

REFERENCES

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of capelin stocks in Divisions 2J+3K and trawl survey of
capelin prerecruits in Divisions 3KLNO in November 1984 -
January 1985. NAFO SCR Doc. 85/52.

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Table 1. Abundance and biomass of capelin in Divs. 2J3K from
the echo survey results for October-November 1985

Subdivision	Area, sq. miles	Mean echo intensities	Stock	Age						Total
				1+	2+	3+	4+	5+		
I	1402	175	mil. spec.	546	8685	222				9453
			tons	2720	78356	3704				84780
II	5519	429	mil. spec.	278	58307	12201	1745	155		72686
			tons	1399	734767	270472	51720	5264		1063622
III	6003	123	mil. spec.	16	13939	5677	894	68		20594
			tons	82	203797	131949	27213	2302		365343
Total	12924	259	mil. spec.	840	80931	18100	2639	223		102733
			tons	4201	1016920	406125	78933	7566		1513745

Table 2. Catches of capelin by year classes for 1971-1980

Year of fishery	Catches by year classes, %													Total catch	
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	mil.sp.	mil. t
1971-72	0.1	3.5	53.7	40.0	2.7									989	25.2
1972-73		1.2	15.9	70.6	9.6	2.7								7112	177.7
1973-74			3.3	34.2	30.8	30.5	1.1							10874	297.1
1974-75				9.8	13.2	42.6	27.4	7.0						11021	294.4
1975-76					1.5	6.2	25.1	64.6	2.6					15538	342.6
1976-77						1.2	7.3	76.9	13.8	0.8				12029	294.2
1977-78							5.4	57.4	32.5	3.8	0.8			6406	182.5
1978-79								6.0	41.4	32.0	20.5	0.1		2541	67.4
1979-80									7.1	27.1	43.1	21.9	0.8	872	24.1
Catches by year classes, mil. spec.	1	122	2018	4821	5744	9330	8277	23876	5261	1394	2339	192	7	63382	1705.2

Note: the data are given for a biological year, i.e. the autumn catch in Divs. 2J3K is pooled with the spring-summer catch of the following year in Divs. 3LNO.

Table 3. Results of acoustic estimation of capelin stock
abundance made by PINRO vessels in 1980-1985

Year	Area	Stock abundance by ages, mil. spec.							Biomass, thou. tons
		1, 1+	2, 2+	3, 3+	4, 4+	5, 5+	6, 6+	Total	
1980	2J3K		0.1	0.4	0.2	+		0.7	20
1981	3LNO	0.7	7.6	3.5	0.4	0.3		52.5	530
1982	3LNO	0.1	11.6	19.1	4.7	0.8	0.1	36.4	610
1983	3LNO	110.0	0.7	4.3	6.4	1.9		123.3	346
	2J3K	2.1	20.5	16.2	2.5			41.4	852
1984	3LNO	360.0	123.6	50.2	16.2	1.7		551.7	2655
	2J3K	41.3	19.3	3.8	1.4	0.2		66.0	480
1985	3LNO		230.7	53.3	4.4	0.9	+	289.3	2200
	2J3K	2.7	83.8	18.1	2.6	0.2		107.4	1540

As far as nearly all year classes (both rich and poor) are
the main contributors to the commercial stock at ages 3+ and 4
years (Table 1), i.e. at an age of mass maturation, and also
considering a low abundance of the 1984 year class (Bakanev and
Gorchinsky, MS 1985), it may be concluded that the 1983 year class
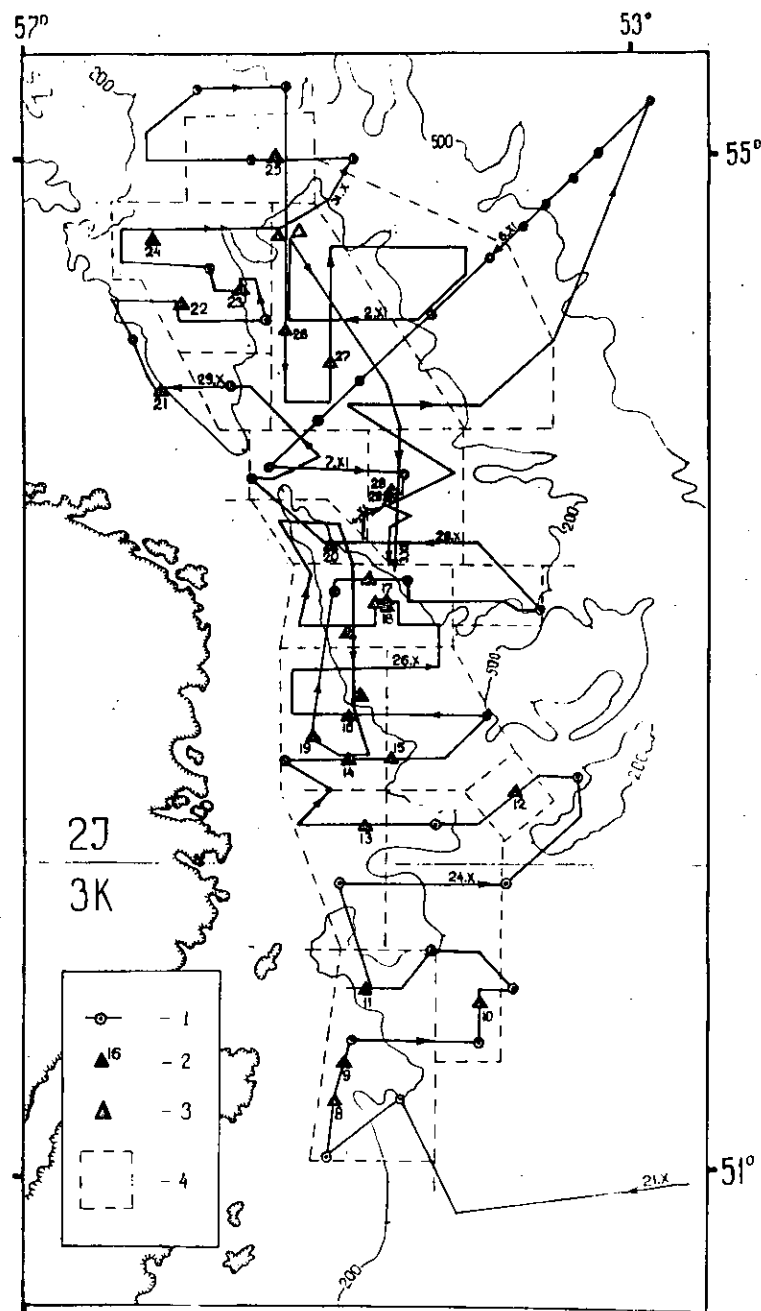will serve as a basis for the commercial stock in 1986-1987.

Fig. 1. Routes of capelin echo survey in Divs. 2J3K (21 Oct – 7 Nov 1985).
1 – hydrological stations; 2 – test hauls of RV "Poisk"; 3 – test hauls of RV "N. Kononov"; 4 – limits of strata for averaging echo intensities.
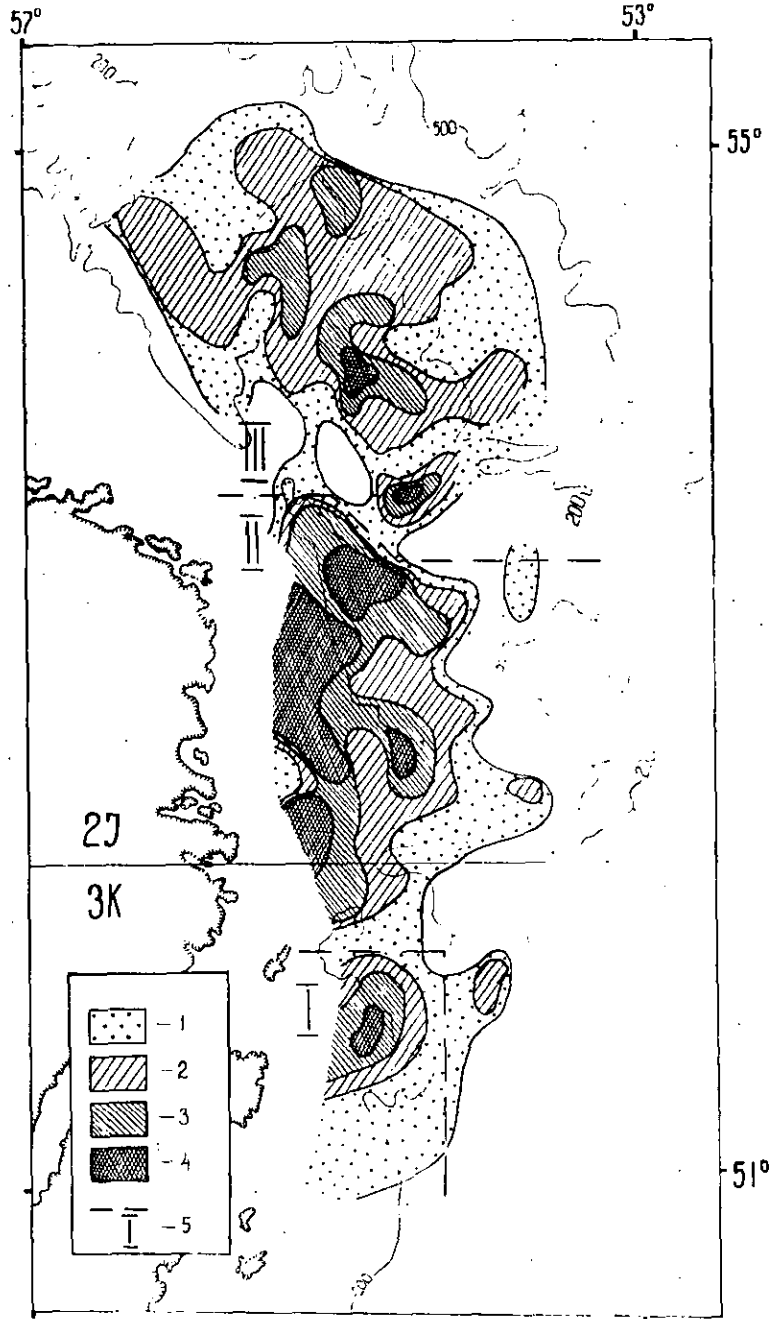
Fig. 2. Distribution of capelin in Divs. 2J3K from the echo
survey results: 1-4 - density of distribution in umits
of echo intensity M:
1 - M = 1-50; 2 - M = 50-250; 3 - M = 250-1000;
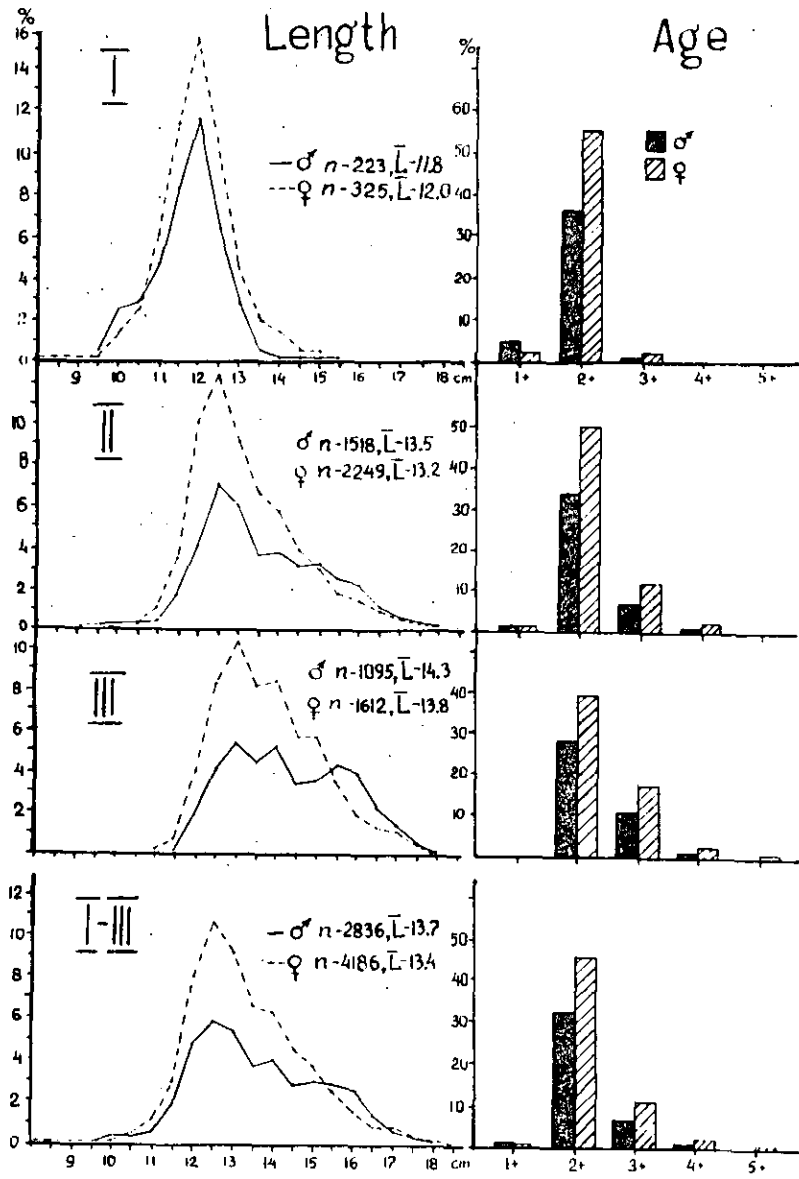4 - 1000-5000; 5 - boundaries of subdivisions.

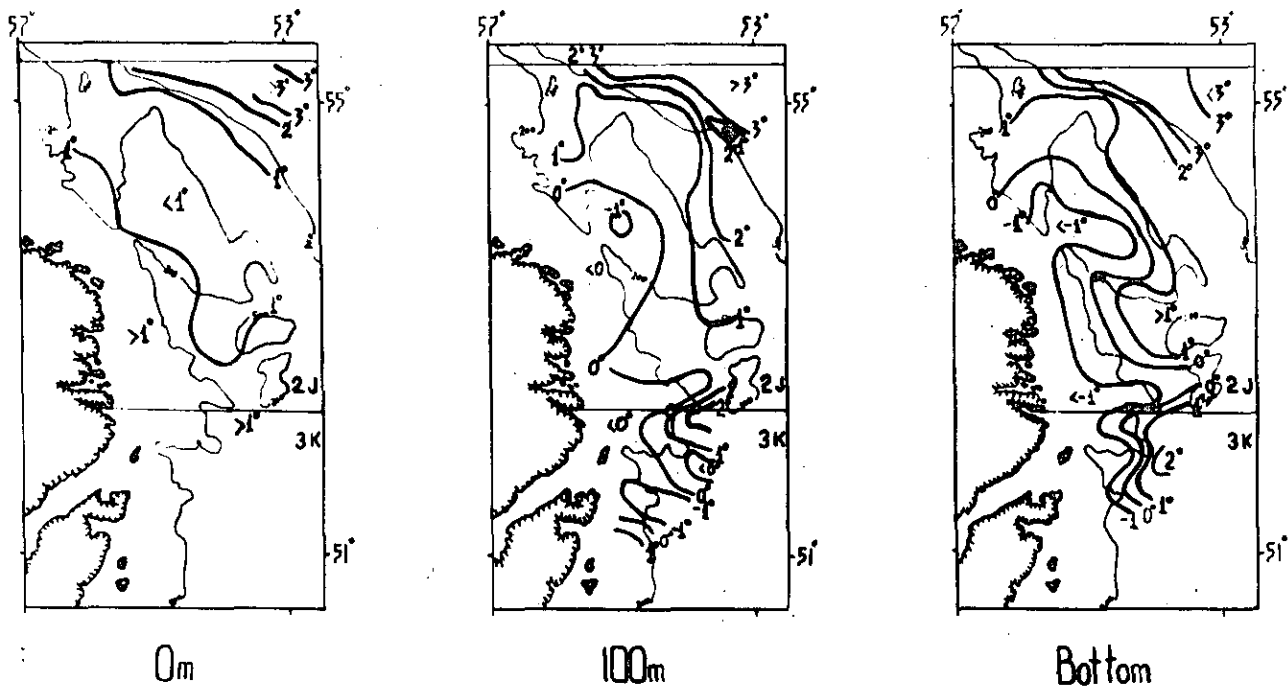Fig. 3. Length-age composition of capelin in Divs. 2J3K
(Subdivisions I-III)

Fig. 4. Water temperature distribution in Divs. 2J3K
during the capelin survey