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An Acoustic Assessment of Capelin Stocks in NAFO Div. 3LNO and 2J3K in 1983

by

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ABSTRACT

The paper presents methods and results of acoustic surveys to estimate capelin abundance and biomass which were conducted by RV "Poisk" in Divs. 3LNO in June 1983 and 2J3K in November 1983.

Results obtained evidenced that the stock had notably recovered due to highly abundant 1979-1981 year classes having recruited it. The total capelin stock was estimated to be 346 thou.t in Divs. 3LNO in summer and 850 thou.t in Divs. 2J3K in autumn.

INTRODUCTION

Surveys undertaken have continued annual hydroacoustic researches carried out by PINRO since 1974 which are aimed at assessing the stocks of Newfoundland capelin. Since 1977 similar annual surveys have been independently conducted by Canada.

Results obtained in Soviet and Canadian acoustic surveys are used to evaluate the stock status and to estimate catch quotas.

METHODS

RV "Poisk" made an acoustic survey in Divs. 3LNO between 7 and 20 June and in Divs. 2J3K from 12 to 19 November. SIMRAD EK-38A echo sounder and Soviet 5-channel digital echo integrator SIORS-I were used. Echo integration system was adjusted so that a dynamic range of treatment of echoes was not less than 40 dB relative to an average level of noise at the output of the echo sounder.

Signals were integrated using three depth channels within the range of 5-300 m simultaneously, one channel being used to integrate echoes from the near-bottom layer, 0.5-1 m off the bottom. Values from the integration system were reported for every 2.5-mile inter-

val over the survey track. Further, echo intensities were normalized with regard for the number of transmissions of the echo sounder and a conversion factor for the echo integration system. Recordings were then corrected which was necessary due to the difference between the actual TVG-function of the echo sounder and the TVG  $20 \lg + 2LR$  and because of "blanks" in the performance of the echo sounder caused by unfavourable weather conditions. To correct the TVG-function of the echo sounder absorption coefficient was assumed to be equal to  $L = 0.009$  dB/m. Density of fish concentration was estimated from a calibration equation for the echo integration system:

$$\rho_{SN} = \frac{C_I}{\sigma_{bs}} M$$

where  $\rho_{SN}$  - specific abundance (individuals per sq.mile);

$C_I$  - echo integration system constant;

$\sigma_{bs}$  - effective back scattering cross section of fish  
"in situ" ( $\text{cm}^2$ );

$M$  - normalized and corrected values from the echo  
integrator.

The value of  $C_I$  was determined through calibration of the echo integration system with a standard copper sphere (TS=-33.6 dB at 38 KHz). The value of  $\sigma_{bs}$  was assumed similar to that used in Soviet-Norwegian survey of capelin in the Barents Sea:

$$\rho_{SN} = 3.64 \cdot 10^{-4} L^{1.91}$$

Below are given calibration equations used to estimate the abundance of:

mature capelin in Divs. 3LNO:

$$\rho_{SN} = 2.5 \cdot 10^6 L^{-1.91} M$$

capelin fingerlings in Divs. 3LNO:

$$\rho_{SN} = 4.3 \cdot 10^6 L^{-1.91} M$$

capelin in divs. 2J3K:

$$\rho_{SN} = 3.5 \cdot 10^6 L^{-1.91} M$$

The abundance of immature capelin in the areas where they occurred was estimated from control fishing sets. Survey track was

selected based on preliminary data on capelin distribution with regard for hydrometeorological conditions (direction of wind and wave). To calculate the total abundance the area surveyed was stratified into subareas with relatively identical biological parameters, distribution of fish and thickness of tacks. Divs. 3LNO were subdivided into 30 strata, Divs. 2J3K - into 4. Mean echo intensity, specific density and then abundance and biomass of capelin were estimated for each stratum.

Isolines of capelin distribution density in Divs. 2J3K were plotted separately for time periods: 12-16 November and 16-19 November so that to demonstrate a migration pattern of fish. However, the abundance and biomass were estimated based on values M averaged by strata for the whole survey period.

## RESULTS and DISCUSSION

### Divisions 3LNO

Fig. 1 shows the track of the acoustic survey in Divs. 3LNO.

Densest capelin concentrations were recorded on spawning grounds at the south-eastern slope of the Grand Newfoundland Bank (3N), 44°00'-44°40'N 49°30'-50°00'W (Fig.2). Some prespawning capelin were distributed outside the 200-mile fishing zone of Canada and fished by Portuguese ships using twin trawls. In some places the density of fish reached 950 t per sq.mile.

Young capelin 6-10 cm long of the 1982 year class were distributed primarily in Div. 3L above 90-100 m. Distribution patterns of adult fish and the young in the day-time were different: dense concentrations of mature fish were recorded near the bottom, young capelin were found in much less dense concentrations than adult fish and were usually distributed in shoals in open water. At night both adult and young capelin moved up to the surface getting mixed with sand eel and zooplankton and were recorded in a tape-shaped shoal in the surface layer which impeded the identification of capelin and other organisms, especially in Divs. 3LN.

Catches from control fishing sets contained mainly mature fish 13-18 cm long of the 1979 and 1980 year classes (Fig.3). Immature capelin primarily 1981 year class were distributed in the nor-

thern part of Div.3K and were not assessed by the survey because of shortage of time due to vessel waiting for a long time for a licence to work within the fishing zone of Canada.

Table 1 shows results of the survey. The total abundance of capelin was estimated to be 13.3 thou.mill.individuals and biomass 346 thou.t. As for the abundance and biomass of juvenile capelin of the 1982 year class preliminary estimates were 90-130 thou.mill.individuals and 150-250 thou.t respectively.

#### Divisions 2J3K

Fig.4 shows the track of capelin survey in Divs.2J3K and boundaries of strata used to estimate abundance and biomass.

In autumn major concentrations of capelin were recorded in the South Labrador (2J). Densest concentrations were found south of the Hamilton Bank (Fig.5), where Soviet large refrigerator trawlers fishing capelin successfully were concentrated in that period. Surely some fish were distributed north of 54°N, but they were not covered by the survey because of hard weather conditions. In the day-time fish were concentrated in shoals with a vertical distribution from 30 m to 150 m primarily in 100-250 m depth interval. At night fish were distributed in a path-shaped shoal at the depth 30-150 m. Some concentrations were very dense. For example, on 18 November in the area of about 5 sq.miles with positions 53°35'N 54°50'W the density of fish was recorded to be on average 6 thou.t per sq.mile. Capelin were observed to migrate southwards, south-eastwards and to leave coastal territorial waters located out of range of the survey.

The results of the survey evidenced that the total abundance of capelin was 41.5 thou.mill.individuals and biomass - about 852 thou.t (Table 2). Catches taken in control fishing sets were composed mainly of fish 13-16 cm long of the 1981 and 1980 year classes (Fig. 3).

Thus, the age composition of fish indicated that the spawning stock of capelin in Divs. 3LNO in summer 1983 contained individuals of the highly abundant 1979 year class and of less abundant compared to the former 1980 year class. In feeding areas in autumn fish prevailed of the 1981 year class which is expected to be as

abundant as the 1979 year class and to make a significant contribution to capelin spawning stock in summers of 1984 and 1985. This year class is likely to constitute the bulk of capelin feeding stock by biomass in autumn 1984.

Table 1. Abundance and biomass of capelin in Divs. 3LNO in June 1983.

Division	Area, sq.miles	Average		Abundance $\cdot 10^9$ ind.	Biomass, thou.t
		Length, cm	Weight, g		
3	13080	14,7	20,7	3,1	64,6
3	9190	15,1	20,6	0,6	12,8
30	14870	15,0-16,1	22,6-29,4	2,5	67,6
3	14190	15,3-16,3	24,2-31,0	7,1	201,2
3 0	51330			13,3	346,2

Table 2. Abundance and biomass of capelin in Div. 2J in November 1983.

Subarea	Area, sq.miles	Abundance, $10^9$ individ.	Biomass, thou.t
A	512	2,5	52
B	686	19,3	395,0
C	1429	19,1	393,0
D	592	0,6	12,0
Total	3219	41,5	852,0

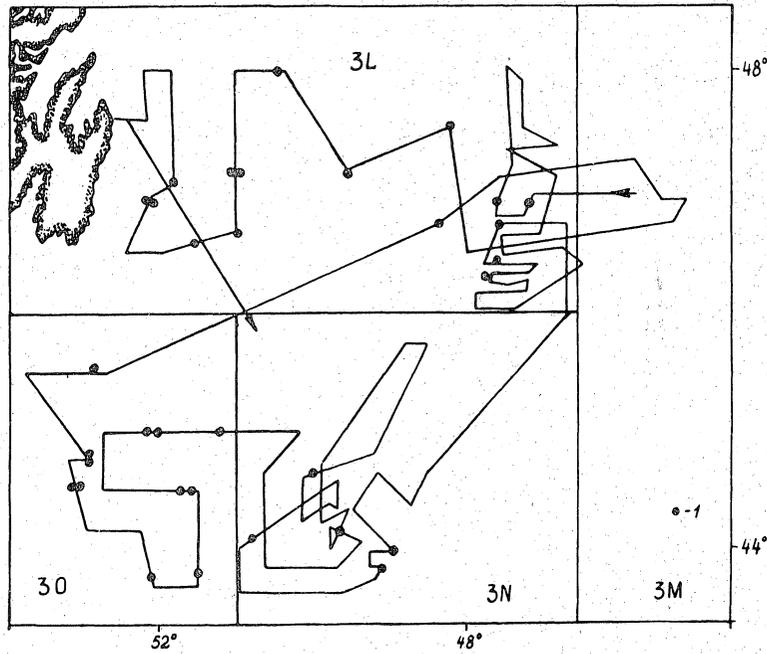


Fig. 1 Track of acoustic capelin survey in Divs. 3LNO

I - control fishing sets.

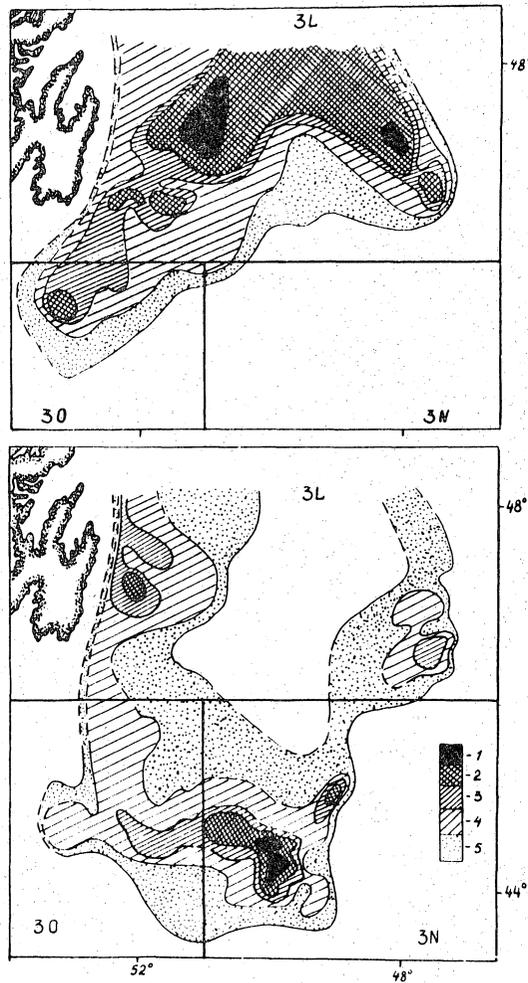


Fig. 2 Distributions of juvenile (top) and mature (bottom) capelin in the June 1983 survey. Distribution density is given in units of integrator M: 1 - 0-10; 2 - 10-50; 3 - 50-100; 4 - 100-500; 5 - 500.

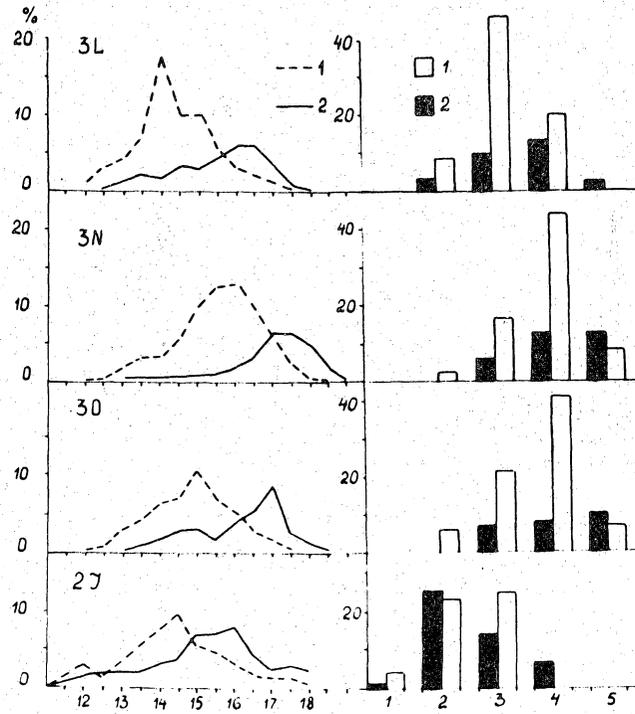


Fig.3 Length and age composition of capelin in Divs.3NL02J  
1 - females, 2 - males.

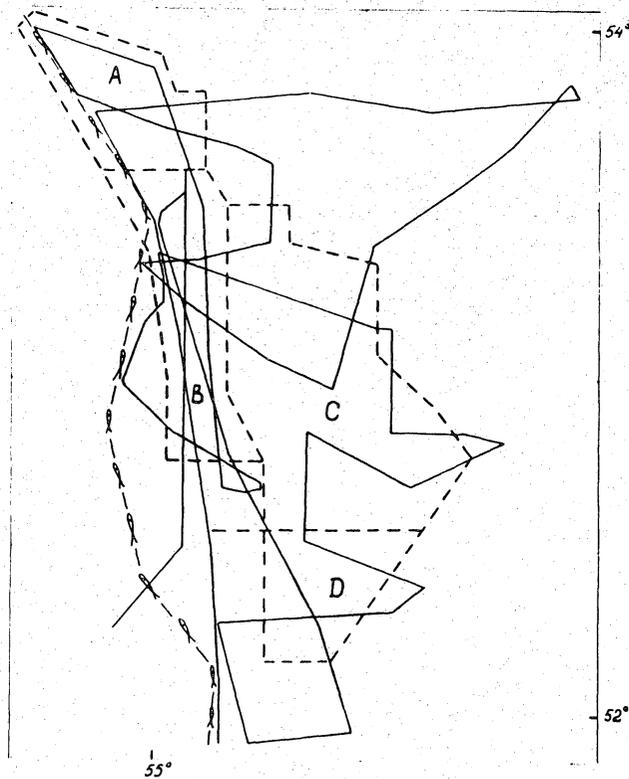


Fig. 4 Track of capelin acoustic survey in Divs.2J3K  
and boundaries of strata A, B, C, D.

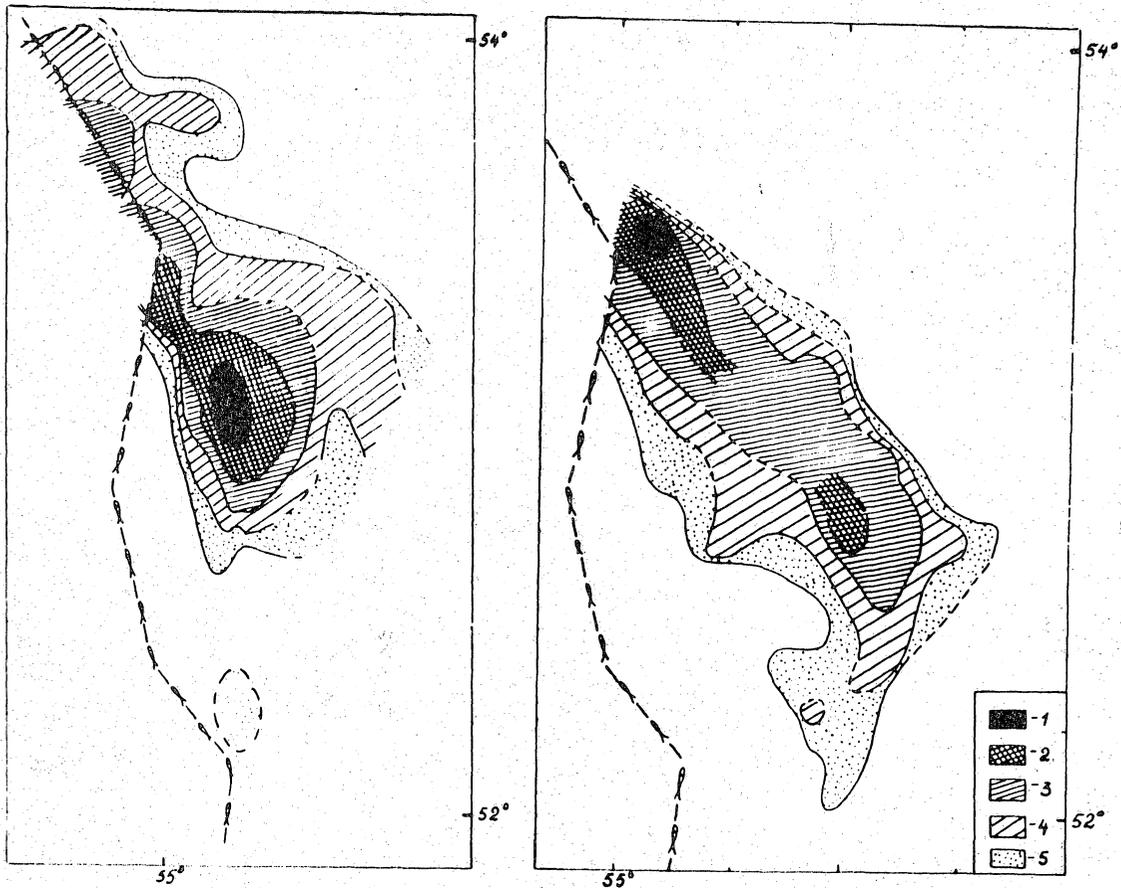


Fig. 5 Capelin distribution in Divs. 2J3K on 13-16 November (left) and 16-19 November (right) 1983. Distribution density of fish in units of the echo integrator M I-5000; 2-2000-5000; 3 - 500-2000; 4 - 50-500; 5 - 1-50.