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Trawl Survey for the 1990 Year-class of Capelin Stock Assessment in Divisions 3LN0

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ABSTRACT

A trawl survey for the 0-group capelin stock assessment conducted in November-December 1990 in Divs 3LN0 revealed that an abundant year-class has appeared; its abundance index turned to be close to that for the 1983, 1988 and 1989 year-classes.

INTRODUCTION

An assessment of year-class strength at the 0-group stage has been carried out by Soviet research ships in Divs 3LN0 since 1983 according to the NAFO Scientific Council Working Group decision. An estimate of supposed recruitment made on the grounds of assessment of fishes with a short life-cycle (e.g. capelin) is important for yearly TAC correction.

MATERIALS AND METHODS

The 0-group capelin survey was conducted by R/V "Kokshaisk" from 22 to 25 November and from 1 to 11 December 1990. A special mid-water small-fish trawl with 20 x 20 m opening was used during this survey. A small-mesh knotless netting with 3.6 mm mesh size was inserted into the codend of that trawl. Hauling were done step by step at depths 40-60, 20-40 and 0-20 m. Duration of a hauling at speed 3.0 knots was 30 min, i.e. 10 min. per each layer. The distance between haulings was 30-40 miles. Standard (total) length of 200 specimens of fish larvae was measured with 1 mm accuracy.

The present paper gives an abundance index which for the first time was calculated by a method of stratified mean catches expressed in specimens per mile hauling and plotted on a logarithmic scale in the way it was done by Randa (1984) for the Arcto-Norwegian cod and haddock 0-group. That was done to avoid a considerable influence of large catches upon the final result, which are not representative for individual strata of individual area.

Besides, during the described survey some northern parts of the Grand Bank (strata 1-5) were excluded from the analysis because long-time investigations showed that in average only 6% of larvae were taken in this area covering 25% of the whole study area

(Bakanev, 1990). At the same time the correlation coefficient between the above indices and actual abundance of those year-classes at age 2 calculated for the southern part of the Grand Bank is higher ($r=0.89$) than that for the whole Grand Bank area ($r=0.78$). With this purpose the whole study area was subdivided into 11 strata (Fig.1) and the materials of previous investigations (1983-1989) were back calculated for that area.

To calculate a year-class strength index the following designations and formulae were used:

x_{ij}	- catch at station i in stratum j , specimens;
N_{ij}	- number of valid (with catch) haulings i in stratum j ;
N_j	- total number of haulings in stratum j ;
a_j	- stratum j area, sq.miles;
A	- total area, sq.miles;
K	- number of strata;
$\bar{x}_j = \frac{1}{N_{ij}} \sum_{i=1}^{N_{ij}} \ln(x_{ij})$	- mean arithmetic of the catch logarithm;
$\sigma_j^2 = \frac{1}{N_{ij}-1} \sum_{i=1}^{N_{ij}} [\ln(x_{ij}) - \bar{x}_j]^2$	- variance of the mean arithmetic;
$P_j = \frac{N_{ij}}{N_j}$	- proportion of valid haulings;
$\sigma_{P_j}^2 = \frac{1}{N_j-1} P_j(1-P_j)$	- variance of the proportion of valid haulings;
$R = \frac{1}{A} \sum_{j=1}^K a_j \bar{x}_j$	- stratified mean arithmetic of the catch logarithm per area;
$\sigma_R = \sqrt{\frac{1}{A^2} \sum_{j=1}^K \frac{a_j^2 \sigma_j^2}{N_j}}$	- standard deviation of catch logarithm mean arithmetic per area;
$Q = \frac{1}{A} \sum_{j=1}^K a_j P_j$	- weighed portion of valid haulings;
$\sigma_Q = \sqrt{\frac{1}{A^2} \sum_{j=1}^K a_j^2 \sigma_{P_j}^2}$	- standard deviation of the weighed portion of valid haulings;
$L = R \cdot Q$	- final logarithmic index of a year-class strength.

Confidence intervals for L were obtained in the following way: first confidence intervals for R and Q , i.e. $R - 2\sigma_R$
 $R < R < R + 2\sigma_R$ or $R' < R < R''$ and $Q - 2\sigma_Q$ $Q < Q < Q + 2\sigma_Q$ or $Q' < Q < Q''$ were calculated with 95% probability of faultless prediction ($tr=2$). Then confidence intervals for L will look like $R' - Q < RQ < R'' + Q''$ or $L' < L < L''$.

RESULTS AND DISCUSSION

Trawl stations location and grades of larvae distribution densities obtained for a historical period are presented in Fig.2. In 1990, like in previous years, the majority of larvae was registered in the southern part of the Grand Bank. The maximum amount of larvae per mile hauling was registered in stratum 7 (46.6 thousand specimens). The highest logarithmic index also fits this stratum (Table 1). The minimum amount of larvae was taken in the north of Div. 3L and in the west of Div. 30.

High concentrations of the O-group capelin were registered in gradient zones with water temperatures 3-7°C (Figs 3-4).

Table 2 gives total indices of the O-group capelin and their confidence intervals for the period 1983-1990. The 1990 O-group index was 6.21 which is somewhat lower than those indices for the strong 1988-1989 year-classes (6.88 and 6.87, respectively), but higher than that for the rich 1983 year-class (5.85).

Thus, during the nearest 3-4 years we may expect a good recruitment to the capelin stock due to rich 1988-1990 year-classes.

The O-group length composition by Divisions is given in Table 3. The largest larvae were registered in the southern Grand Bank (3N), their mean length was 49 mm. In Divs 3L and 3O mean lengths of larvae were equal (45 mm), but in 3L the length composition range was wider (from 23 to 76 mm) than that in 3O.

REFERENCES

- BAKANEV V.S. 1990. Estimate of the Newfoundland capelin (*Mallotus vilosus*) year-classes abundance by method of ichthyoplankton survey. Reports of the Soviet - Canadian symposium (In press).
- RANDA K. 1984. Abundance and distribution of O-group Arcto - Norwegian cod and haddock 1965-1982. Reproduction and recruitment of Arctic cod: Doc. of the Soviet - Norwegian Symp. - Bergen: Inst.Mar.Research, p.192-212.

Table 1. Results of trawl survey of the 1990 year-class of capelin at the 0-group stage (November - December 1990)

Div.	No. of stratum, j	Area, sq. miles	Trawl No.	Catch X_{ij} spec./sq. mi	Mean length, mm	Mean weight, g	$\ln x_{ij}$	$\ln \bar{x}_{ij}$	2	
3L	1	3600	1	369	38	0.14	5.91	4.93	3.52	
			2	5	52	0.26	1.61			
			3	43	45	0.22	3.76			
			4	485	49	0.25	6.18			
			5	517	48	0.21	6.25			
			6	367	46	0.20	5.90			
	2	3600	1	375	48	0.24	5.93	6.08	0.10	
			2	628	41	0.14	6.44			
			3	359	41	0.15	5.88			
	3	6000	1	457	41	0.13	6.12	4.96	1.69	
			2	531	44	0.17	6.27			
			3	43	58	0.42	3.76			
			4	291	48	0.27	5.67			
			5	123	48	0.24	4.81			
			6	23	50	0.23	3.14			
	$R - 2\sigma_R < R < R + 2\sigma_R = 3.68 < 5.26 < 6.48$									
	3N	4	2800	1	1001	50	0.27	6.91	6.75	7.18
				2	1671	52	0.26	7.42		
3				19873	51	0.29	9.90			
4				768	42	0.16	7.05			
5				12	50	0.20	2.48			
5		3600	1	211	43	0.16	5.35	7.01	2.16	
			2	1343	50	0.30	7.20			
			3	735	44	0.17	6.60			
			4	7228	50	0.24	8.89			
6		4800	1	9822	48	0.21	9.19	6.01	3.88	
			2	2210	53	0.31	7.70			
			3	163	48	0.28	5.09			
			4	171	51	0.27	5.14			
			5	96	41	0.13	4.56			
			6	78	47	0.22	4.36			
7		5000	1	5258	47	0.25	8.57	8.21	5.80	
			2	9107	51	0.26	9.12			
			3	46581	52	0.29	10.75			
	4		7037	48	0.20	8.86				
	5		4155	49	0.19	8.33				
	6		37	46	0.17	3.61				
$R - 2\sigma_R < R < R + 2\sigma_R = 5.02 < 7.04 < 9.06$										
3O	8	4800	1	8150	45	0.21	9.01	6.94	2.84	
			2	1287	49	0.23	7.16			
			3	69	46	0.18	4.23			
			4	7160	42	0.15	8.88			
			5	464	42	0.15	6.14			
			6	397	46	0.20	5.98			
			7	1306	44	0.17	7.17			
	9	3600	1	798	43	0.16	6.68	7.09	0.13	
			2	1168	46	0.21	7.06			
			3	1187	48	0.24	7.08			
			4	1900	46	0.19	7.55			
	10	4800	1	2	47	0.19	0.69	4.66	4.48	
			2	109	42	0.16	4.69			
			3	562	46	0.19	6.33			
			4	1015	46	0.18	6.92			
	11	2800	1	85	45	0.18	4.44	6.09	2.29	
			2	157	45	0.19	5.06			
			3	2534	46	0.20	7.84			
4			1844	48	0.23	7.52				
5			268	40	0.11	5.59				
$R - 2\sigma_R < R < R + 2\sigma_R = 4.10 < 6.14 < 8.16$										
3LNO		45400	56	2750						
$L < L < L^* = 5.05 < 6.21 < 7.37$										

Table 2. 0-group capelin indices and their confidence intervals for the period 1983-1990

Year-class	Logarithmic index	Confidence intervals
I983	5.85	4.56 - 7.26
I984	2.98	2.52 - 3.46
I986	3.48	2.28 - 4.91
I987	5.58	4.60 - 6.54
I988	6.88	4.04 - 8.28
I989	6.87	5.27 - 8.68
I990	6.21	5.05 - 7.37

Table 3. 0-group capelin age composition in Divs 3LNO in November-December 1990, per cent

Length, mm	Division		
	L	O	N
23-25	0.1	-	-
26-28	0.1	-	-
29-31	1.6	0.1	+
32-34	3.7	0.9	0.5
35-37	9.5	4.1	4.0
38-40	13.2	13.1	7.7
41-43	14.3	22.1	10.0
44-46	16.0	22.1	14.6
47-49	14.5	17.6	16.8
50-52	12.1	11.1	17.9
53-55	7.3	5.5	13.2
56-58	4.4	2.2	8.9
59-61	2.3	0.9	4.3
62-64	0.6	0.3	1.6
65-67	0.1	-	0.5
68-70	-	+	+
71-73	0.1	-	-
74-76	0.1	-	+
n	2242	3594	3701
L mm	45	45	49
%	100	100	100

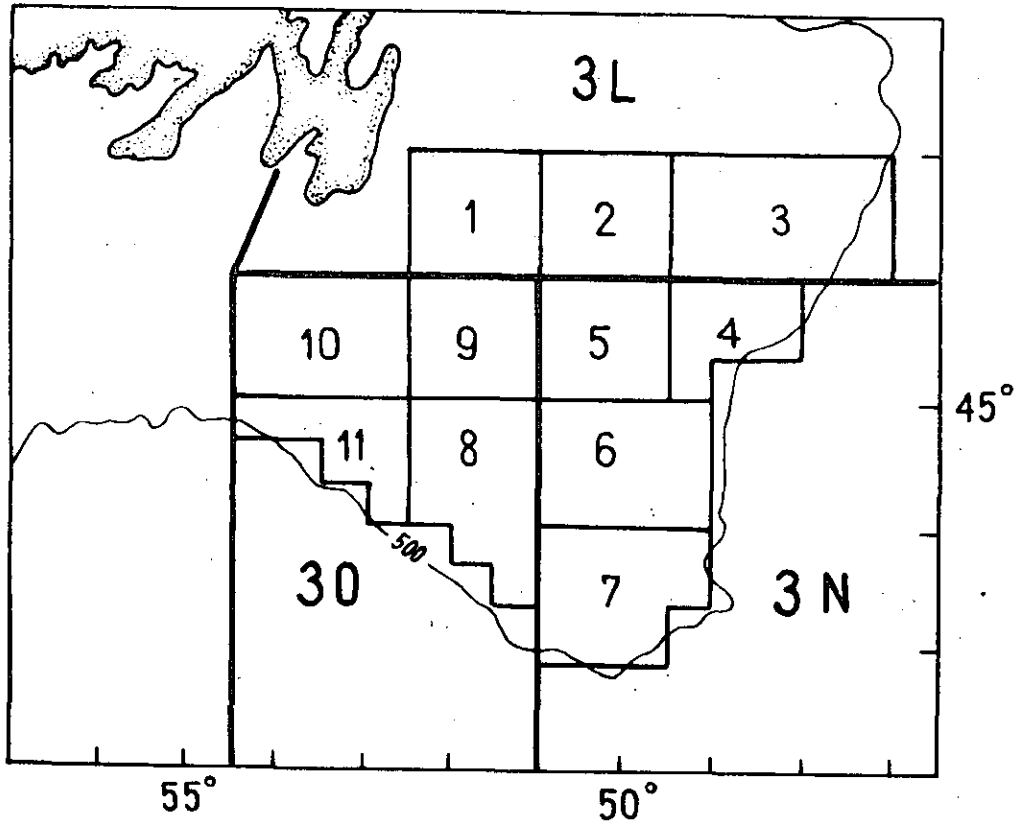


Fig. 1. Strata used for capelin O-group index calculation

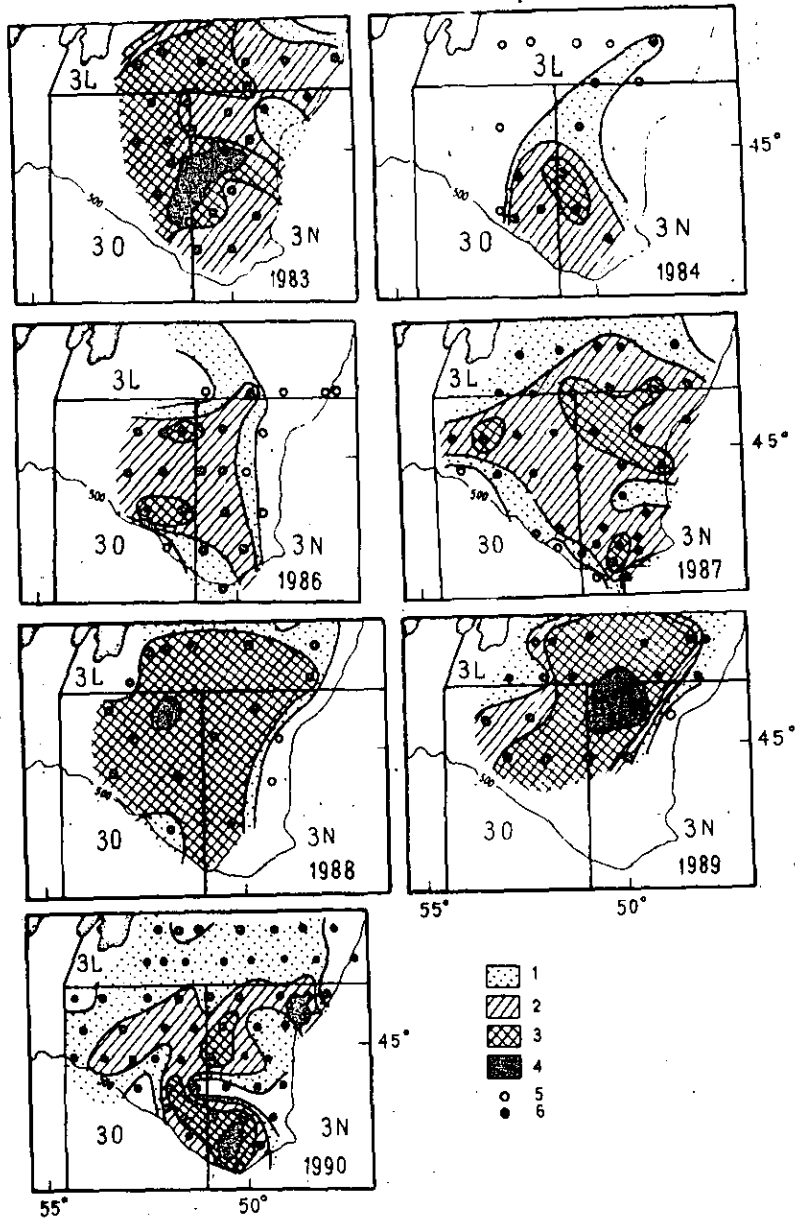


Fig. 2. Distribution of 0-group capelin from the trawl survey data for the period 1983-1990.

Catch per mile hauling (specimens): 1 - 1-100; 2 - 101-1000; 3 - 1001-10 000; 4 - 10 000; 5 - trawl stations without catch; 6 - trawl stations with catch.

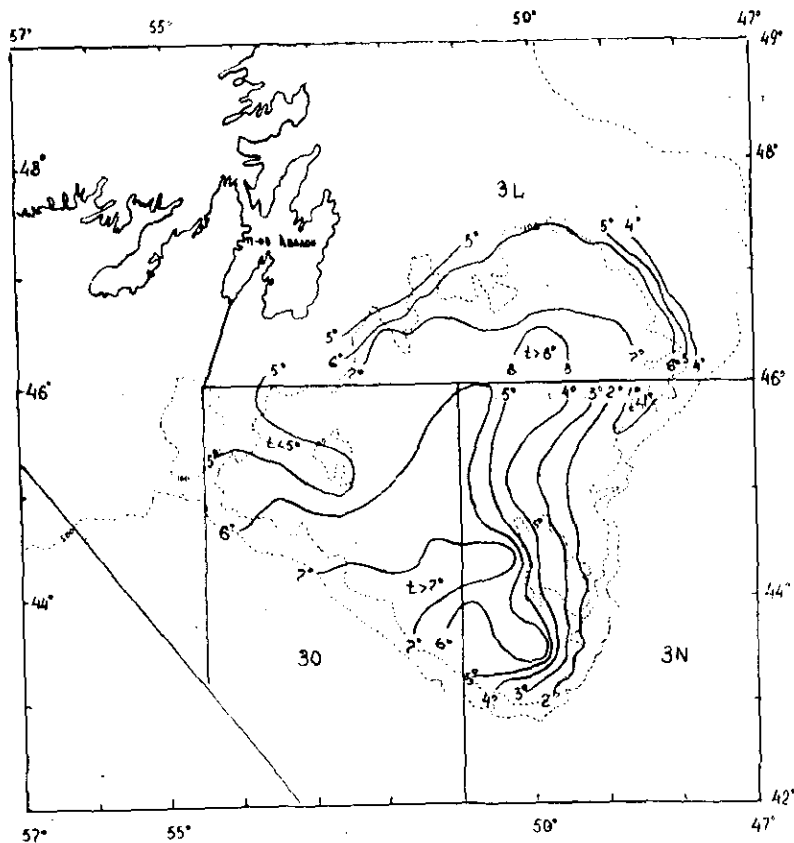


Fig. 3. Surface water temperature during the O-group capelin trawl survey in November - December 1990

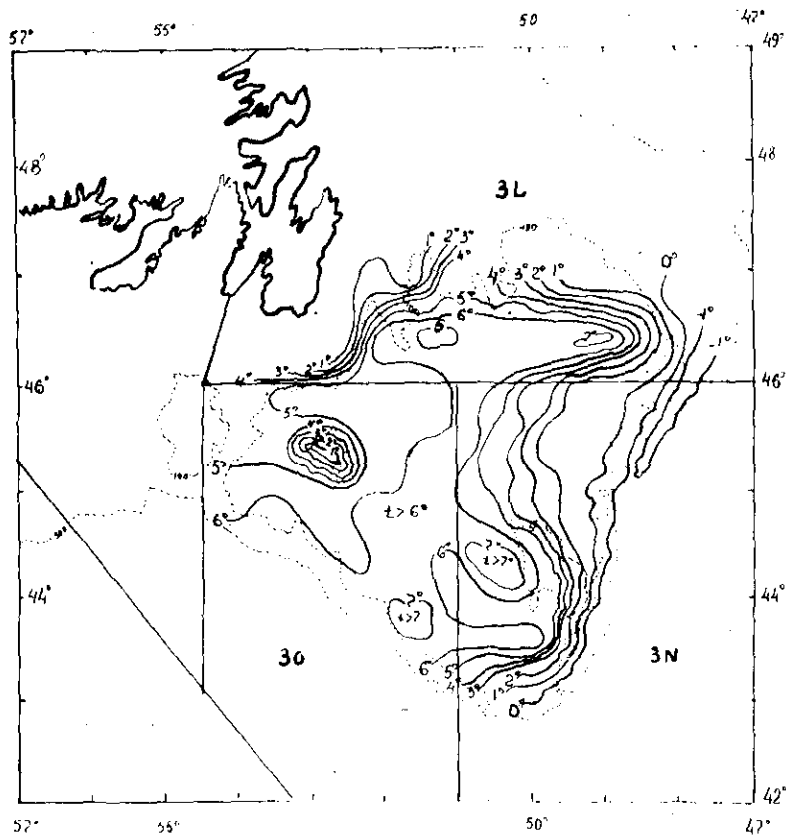


Fig. 4. Water temperature in the 0-50 m layer during the trawl survey in November - December 1990