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Using Trawlable Biomass Data from Canadian Bottom Trawl Survey in Spring 2002 to estimate Capelin State of the Stock on the Grand Bank

by

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Abstract

Data from Canadian spring trawl survey of demersal fish were used to calculate biomass of capelin on the Grand Bank in 2002. Data for different trawl types were correlated with a conversion factor of 49. The biomass of capelin on the Grand Bank in the recent years has remained at a steadily low level.

Introduction

Trawl acoustic surveys of capelin on the Grand Bank previously conducted by Russia and Canada on a regular basis have not been undertaken since 1995. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random bottom trawl surveys. In the course of spring surveys in 1990-2002 two trawl types were used and the data were not directly comparable. In autumn 1995, a new research trawl Campelen 1800 was introduced, which led to an increase in absolute values of capelin by-catch by several tens of times (Fig. 1). Aiming to make new data since 1996 more consistent with previous ones, Campelen's indices were decreased using a conversion factor of 49. An assessment of the biomass as well as distribution of capelin on the Grand Bank in 2002 are presented in this paper.

Materials and Methods

Capelin by-catch data (trawl positions, depths, catch in numbers and by weight) available by courtesy of our Canadian colleagues were used. These data were obtained during Canadian spring surveys with bottom trawls Engel 145 (1990-1995) and Campelen 1800 (1996-2002).

Trawlable biomass of capelin in Div. 3LNO and 3NO for 1977-2002 was converted into absolute values on the basis of the relationship between trawl (Lilly and Simpson, 2000) and acoustic (Bakanev and Sergeeva, 1994) estimates of capelin stock in Div. 3LNO in spring 1977-1994.

Based on the assumption about similar catch rates for same sized cod and capelin of 14 cm length (mean length of capelin by Russian acoustic survey data) caught by the Campelen trawl, data on capelin by-catch were made compatible with the Engel trawl data. Transformation coefficient **K** for cod of 14 cm length has been accepted equal 49.

Similarly to the last year, total biomass ($Y=W_{regr}$) in 2002 was calculated by 4 different regressions, using data from trawl surveys in Div. 3LNO ($X=W_{tr}$) converted in terms of Engel's catch rate. Regression analysis of trawl and

acoustic estimates for Div. 3NO indicated a very weak relationship (R^2<0.1) and these results were not further used for biomass calculations.

By the combined Russian-Canadian acoustic data:

$Y = 125.0 * X^{1.212}$ ($R^2 = 0.20$) and
$Y = 188.8 * X - 14.9$ ($R^2 = 0.11$);

By the Canadian acoustic data:

$Y = 542.3 * X^{0.773}$ ($R^2 = 0.36$) and
$Y = 231.1 * X + 754.6$ ($R^2 = 0.17$).

Distribution of capelin by-catch (indiv./haul and kg/km^2) in the near-bottom layer of Div. 3NO was mapped by the isoline method. To remove certain differences in survey techniques (regarding speed, tow duration and wing spread), capelin by-catches were standardized as per 1 km^2.

The methods used were submitted in detail earlier (Shibanov *et al*., 2002).

Results and Discussion

Due to the absence of trawl-acoustic surveys in Div. 3NO since 1995 there were no reliable data regarding capelin state of the stock in 2002. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random bottom trawl surveys. The directed fishery for capelin was closed in 1992 and this closure has continued through 2003.

In our opinion, data on by-catches of capelin in bottom trawls reflect only the availability of its aggregations in the 5 m near-bottom layer for research trawls rather than actual capelin biomass in all layers. Therefore the suitability of trawl data for capelin biomass assessment remains to be unclear. Besides, interannual catch size changes indicate that capelin shoals can migrate from year to year within the Grand Bank and therefore stock distribution is subject to considerable variations.

Biomass estimates for 1977-2002 recalculated on the basis of the above regressions and the acoustic survey data for 1977-1994 are presented in Table 1 and in Fig. 2.

The correlation between biomass estimates derived by the acoustic and the trawl methods was relatively weak with the maximal $R^2 = 0.36$. Nevertheless assuming the existence of a certain relationship, it can be concluded that up to the middle of the 1990s total biomass of capelin on Grand Bank varied within a wide range. Since 1995 it has remained at a steadily low level. In 2002 capelin stock was estimated in Div. 3LNO as maximum as 0.988 million t.

By-catches of capelin in bottom trawls indicate that in 2002 major capelin aggregations in Div. 3NO were mainly distributed in the margins of the Grand Bank close to 200 m isobath (Fig. 3). Estimates of capelin trawlable biomass indices in Div. 3NO received by isoline and stratified-random methods suggests some increase of the stock in this area, accompanied with widening of capelin distribution (Table 2, Fig. 4).

Size composition of 228 individuals was analysed in 2002. Length groups of 14-16 cm predominated in capelin by-catches (Fig. 5).

Conclusions

Since 1995 the biomass of capelin on the Grand Bank has remained at a steadily low level. In 2002 this index constituted 0.988 million tons.

It can be recommended to resume trawl-acoustic surveys in Div. 3NO on a regular basis to obtain reliable data on the status of capelin stock.

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TABLE 1. Calculated capelin biomass (W * 10^3 t) in Divs. 3LNO by the data from trawl and acoustic surveys conducted in spring 1977-2002 (1996-2002 for the Engel trawl).

YEAR	$W_{tr.}$	$W_{ac.}$	$W_{(lin.\ reg.)}$	$W_{(pow.\ reg.)}$	$W_{(lin.\ reg.)}$	$W_{(pow.\ reg.)}$
	Can. data	Rus/Can. data	Rus/Can. data		Can. data	
1977	20.84	8369*	3920	4959	5571	5672
1978	0.54	310	87	59	879	337
1979	17.48	483	3285	4007	4794	4951
1980	0.54	2*	87	59	879	337
1981	12.24	655	2296	2602	3583	3759
1982	7.60	885	1420	1460	2511	2601
1983	-	330	-	-	-	-
1984	0.13	1453	10	11	785	112
1985	3.90	2920	721	651	1656	1553
1986	34.02	2842	6408	8982	8617	8285
1987	19.50	2493	3667	4575	5261	5388
1988	4.24	4350	786	720	1734	1657
1989	7.26	3156	1356	1382	2432	2510
1990	16.67	5850	3132	3784	4607	4773
1991	3.23	160	595	518	1501	1342
1992	1.01	-	176	127	988	546
1993	12.64	315	2372	2705	3676	3854
1994	0.67	278*	112	77	909	398
1995	1.88	-	340	269	1189	883
1996	2.51	-	459	381	1335	1105
1997	0.74	-	125	87	926	430
1998	2.60	-	476	398	1355	1135
1999	1.79	-	323	253	1168	851
2000	1.84	-	332	262	1180	869
2001	2.34	-	427	350	1295	1046
2002	1.01	-	176	127	988	546

* - very approximate data, excluded from the analysis

TABLE 2. Calculation of trawlable biomass by the isoline and stratified-random methods (thousand tons) and the area of capelin aggregations (thousand km^2) in Div. 3NO in 1990-2002.

Method	Year												
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Random stratification	0.87	1.88	0.67	9.08	0.20	0.54	0.57	0.34	1.18	0.15	0.83	0.22	0.59
Isolines	1.06	1.03	0.39	6.82	0.20	0.51	0.51	0.39	1.29	0.15	0.79	0.22	0.37
Deviation, %	17.9	-45.2	-41.8	-24.9	0.0	-5.6	-10.5	12.8	8.5	0.0	-4.8	-0.7	-37.3
Area	26.23	18.60	30.88	46.37	23.47	19.46	41.42	54.50	62.79	28.18	38.93	26.35	28.10

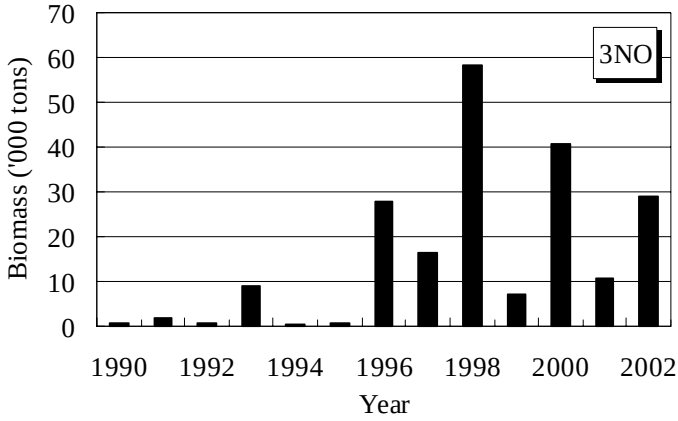

Fig. 1. Not counted Capelin biomass indices by results of bottom trawls spring survey conducted with Engel (1990-1995) and Campelen (1996-2002).

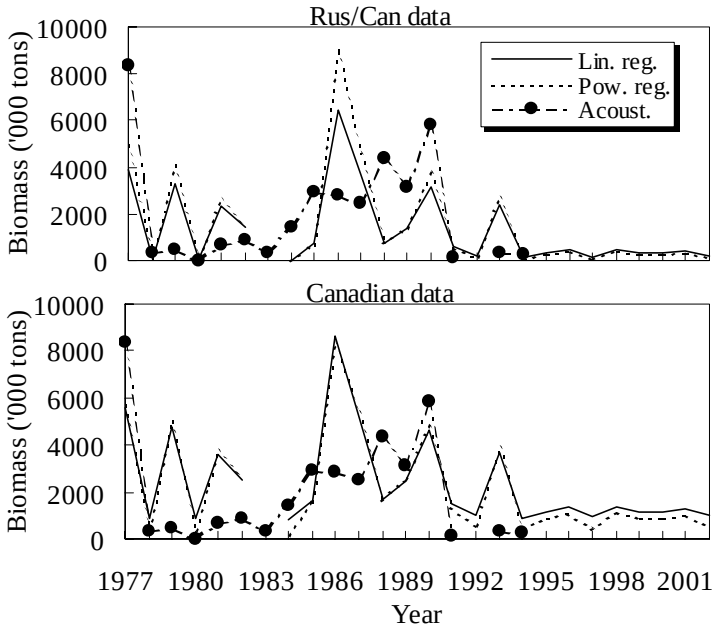

Fig. 2. Dynamics of capelin stock in Div. 3LNO in 1977-2002 by calculated biomass

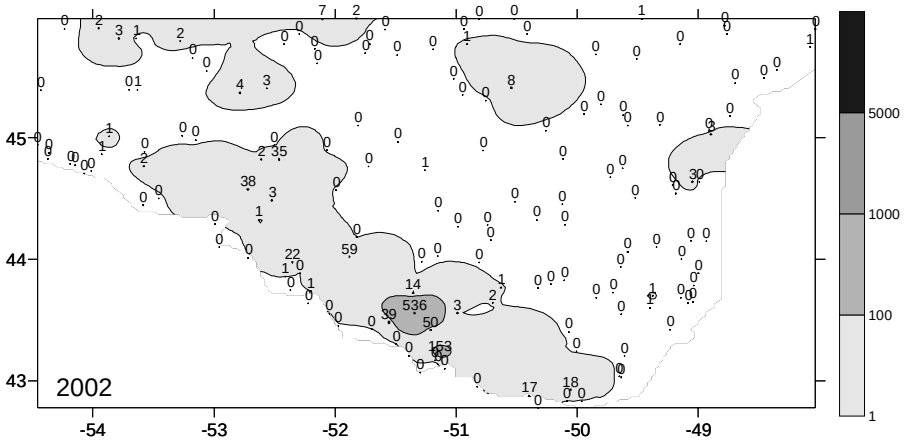

Fig. 3. Distribution of capelin catches (specimens/tow) in Div. 3NO in 2002.

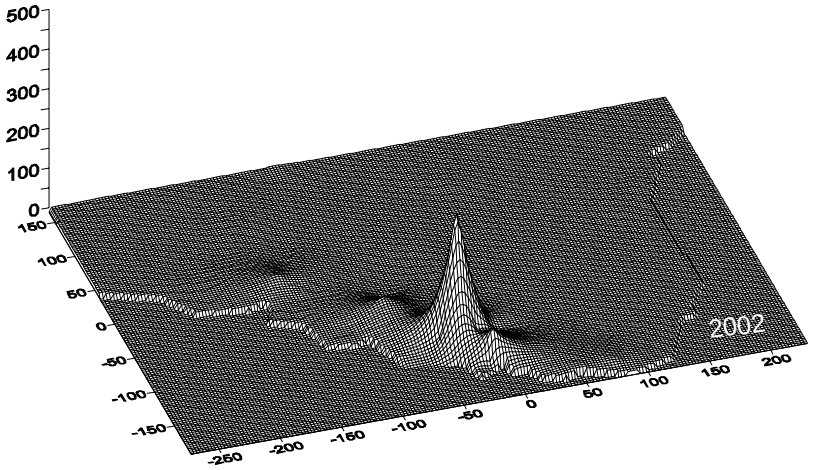

Fig. 4. Distribution of capelin biomass (kg/km^2) in Div. 3NO, spring 2002.

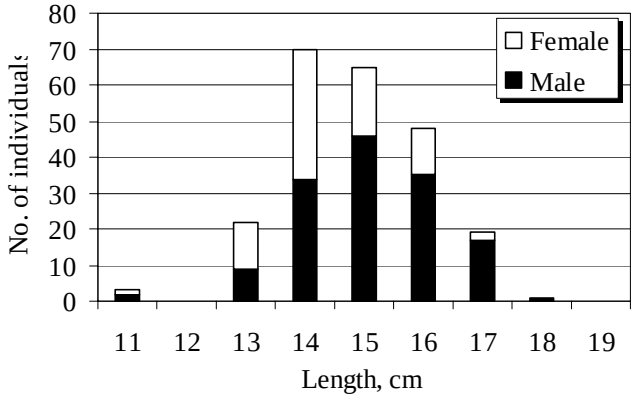

Fig. 5. Number at length of capelin in Div. 3NO, spring 2002.