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Capelin Stock Assessment in NAFO Divisions 3NO Based on Data from Trawl Surveys

by

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Abstract

The purpose of this work is to assess the current state of capelin stock in Divisions 3NO. Indices of capelin trawl biomass obtained in Canadian random-stratified bottom trawl surveys are the only available at the present time indicators of capelin stock dynamics. In 2005, trawl biomass of capelin in Divisions 3NO was 3.9 thousand tons that corresponded to the lowest level of the stock since 1996, in 2006 trawl biomass slightly increase and was 9.6 thousand tons, at the average value for this period 24 thousand tons. The average catch in 2005-2006 per 1 km^2 was 0.06 t and 0.20 t, correspondingly, at the average value of 0.33 t. The estimate in 2006 corresponds to the low level of the stock. Fishery was conducted in the years when this value was equal or higher than 2 t/km^2. Capelin stock in Divisions 3NO remains at the very low level.

Introduction

Estimation of capelin stock (*Mallotus villosus*) in Divisions 3NO was based on the results of Russian and Canadian acoustic surveys conducted before 1993. In all subsequent years, data on capelin by-catch in Canadian trawl surveys of demersal fish has been the only source of data on state of capelin stock. Before 1995, Yankee 41-5 trawl and Engel 145 Hi-Lift trawl were used. Since autumn 1995, Campelen 1800 shrimp trawl has been applied as standard sampling gear. After taking in use a new trawl, by-catches of capelin increased greatly and this made it even more difficult to interpret the obtained results.

Since capelin is a pelagic fish species, a bottom trawl cannot be used as adequate sampling gear for quantitative estimation of the stock. Therefore, relationship between biomass indices from bottom trawl survey and stock size remains unclear. As analytical methods could not be applied, the purpose of this work was to estimate current state of capelin stock in the Divisions 3NO according to the available indirect data.

Fishery and management

Fishery for capelin started in 1971 and total catch was maximal in mid-1970s with the highest catch of 132 000 tons in 1975. The fishing was closed in 1979-1986 and then reopened in 1987-1992. Annual catches in this period did not exceed 25 000 tons. In subsequent years due to abrupt decline of the stock size, the target fishery for capelin was banned. Highest historical catches were taken by Russia (former USSR), Norway, Iceland and Japan (Table 1).

TAC of capelin was set for the first time in 1974 and in 1977-1978 it reached 200 000 tons, then TAC was reduced to 30 000 tons in 1990-1992. Considering that the catch did not exceed TAC in the whole regulation period, the decline of stock size observed since early 1990s could hardly be caused by overexploitation of the stock. A similar idea about capelin stock in NAFO Subareas 2 and Divisions 3KL was expressed by J. Carscadden (DFO, 2000).

Because of dramatic decline of the capelin stock size since 1993, the ban on target fishery for capelin was imposed as a regulation measure.

Research surveys

1) Acoustic surveys of capelin stock in Divisions 3NO were conducted by the USSR/Russia in 1975-1994 and Canada in 1981-1992.
2) Spring and autumn bottom trawl surveys of Canada in 1995-2006.

Biological characteristics

Compared to the previous survey, when one modal class of 15 cm was expressed in the length composition of capelin, in 2006 two peaks at 10 and 15 cm are distinctly seen (Fig. 1). Similar to the last year, proportion of males and females remained the same. A number of juveniles increased 5 times compared to the previous year and constituted about 10 % (Fig. 2). Dependences between capelin length and weight (Fig. 3), as well as length and age (Fig. 4), obtained with the use of GLM procedure remained similar to those of last year.

Stock assessment

Stock assessment based on data of acoustic surveys

Acoustic surveys of capelin stock in Divisions 3NO were conducted by the USSR/Russia in 1975-1994 and Canada in 1981-1992. Now, it is difficult to compare the results of these surveys since some Russian assessments were merged for Divisions 3LNO. However, both surveys showed that maximum stock size was registered in 1988 and then an abrupt decline was observed after 1990 (Table 2). Despite the collapse of the stock registered in surveys conducted in Divisions 3 LNO, TAC remained at the same level of 30 000 tons in 2 years.

In recent years, STACFIS several times has advised to conduct investigations of capelin stock in Division 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this advice was not followed.

Indices of trawl biomass according to the data from Canadian spring surveys

Indices of capelin biomass obtained in Canadian random-stratified bottom surveys are the only available at the present time indicators of capelin stock dynamics. Since autumn 1995, Campelen 1800 shrimp trawl has been used as a standard sampling gear instead of Engel 145 Hi-Lift trawl and the catch rate of Campelen trawl for capelin appeared to be much higher (Lilly and Simpson, 2000).

The applicability of biomass indices obtained by Campelen trawl for assessment of capelin stock was investigated by identification of relationship between values of trawl and acoustic biomasses of capelin in Division 3L obtained in 1999-2004 (Gorchinsky and Golovanov, 2005).

In 1996-2005, trawl biomass of capelin in Divisions 3NO varied greatly from 3.9 to 58.1 thousand tons (Fig. 5). In 2006, trawl biomass slightly increase and was 9.6 thousand tons. An indirect sign of a slight growth of capelin stock can be the increased estimation by data of the autumn survey of 2006, since trends of biomass indices by data of spring and autumn surveys were similar, excluding 1998 and 2002 (Fig. 6).

Based on the results of classification of average catches per 1 km^2 in 1990-2004, the estimate in 2005 corresponds to the lowest level of the stock observed in the period since 1996. In 2006, the average catch per 1km^2 obtained by bootstrapping of values of actual catches, increased insufficiently and constituted 0.20 t/km^2 (Fig. 7). Fishing was conducted in the years when this parameter exceeded or was approximately close to 2 t/km^2.

The results of assessment show that capelin stock in Division 3NO remains in depressive state (Shibanov et al. 2002; Gorchinsky 2003, 2004; Gorchinsky and Golovanov, 2005; Golovanov and Gorchinsky, 2006). Results of analysis of capelin stock status in 2006 give ground to prolong advice of the Scientific Council about the ban on target fishery for capelin in 2008-2009. A more precise estimation of the stock will be possible if trawl-acoustic surveys are resumed.

In today situation when the target fishing is banned and no acoustic surveys of capelin in Divisions 3NO are conducted on a regular basis, it is impossible to calculate LRPs.

Distribution of capelin stock

In 8 cases during last 10 years capelin stock distributed mostly in Division 3O or approximately in even proportions between the Divisions. The characteristic pattern of the distribution was that in odd years main aggregations as a rule occurred on the slopes of the bank and in even years fish mostly concentrated in the central shallow part of the bank. In 2005, the distribution was to some extent different from that in previous year and the highest catches were registered in the central shallow part of the bank. In 2006, survey was covered only shallow part of Divisions 3NO and number of trawl stations were in 3 times less, compared to previous years (Fig. 8).

Acknowledgments

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TABLE 1. Nominal catch and TAC of capelin in NAFO Divisions 3NO (tons)

Year	BGR	CAN	CUB	DDR	ISL	IRL	JPN	NOR	POL	E/PRT	ROM	E/ESP	RUS	**Total**	TAC
1970														**0**	
1971													750	**750**	
1972	166												20598	**20764**	
1973		1658						41293	203				83721	**126875**	
1974		3698						43682		500		4016	48855	**100751**	148000
1975					15814		2734	37477	4306			3748	67704	**131783**	180000
1976	311	5233			8839	230	5007	23178	3778				63610	**110186**	180000
1977		36	700		2994		3746	21499	401				17322	**46698**	200000
1978				56	116		665	4237	7		7		119	**5207**	200000
1979														**0**	0
1980														**0**	0
1981														**0**	0
1982														**0**	0
1983														**0**	0
1984														**0**	0
1985			3											**3**	0
1986														**0**	0
1987							793						14	**807**	10000
1988							1395	1094					4738	**7227**	15000
1989							2222	4085					3189	**9496**	28000
1990			85				2054	8415					14076	**24630**	30000
1991			118											**118**	30000
1992			65											**65**	30000
1993			3											**3**	0
1994														**0**	0
1995														**0**	0
1996														**0**	0
1997														**0**	0
1998														**0**	0
1999														**0**	0
2000														**0**	0
2001														**0**	0
2002														**0**	0
2003														**0**	0
2004														**0**	0
2005														**0**	0
2006														**0**	0
Total	**477**	**10625**	**1059**	**56**	**27763**	**230**	**20670**	**193375**	**8695**	**500**	**7**	**7764**	**338772**	**609993**	

Note: TACs in 1974-1978 are merged for NAFO Div. 3LNO.

TABLE 2. Estimate of capelin stock according to the data of Russian and Canadian acoustic survey in 1975-1994 (thousand tons)

Year	USSR 3LNO	Canada 3NO	Year	USSR 3LNO	Canada 3NO
1975	1050*		1985	2200	212
1976	685*		1986	1491	494
1977	1000*		1987	2161	229
1978	310		1988	3900	561
1979	483		1989	2455	28
1980	0		1990	3752	
1981	109	223	1991	118	
1982		419	1992		4
1983	346	219	1993	315	
1984	2880	85	1994	83	

* biomass of mature capelin in Divisions 3NO.

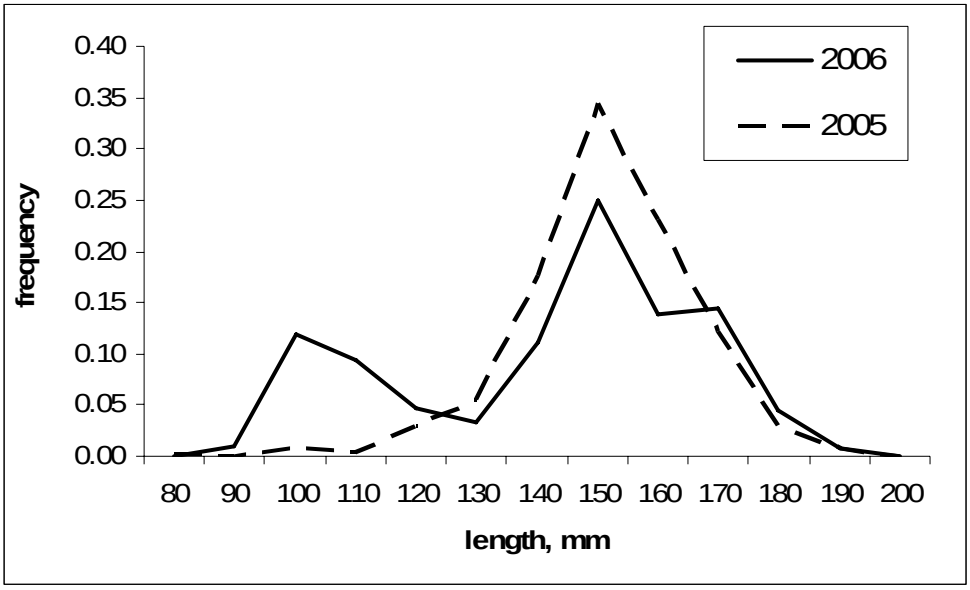

Fig. 1. 3NO capelin length series from spring surveys in 2005-2006.

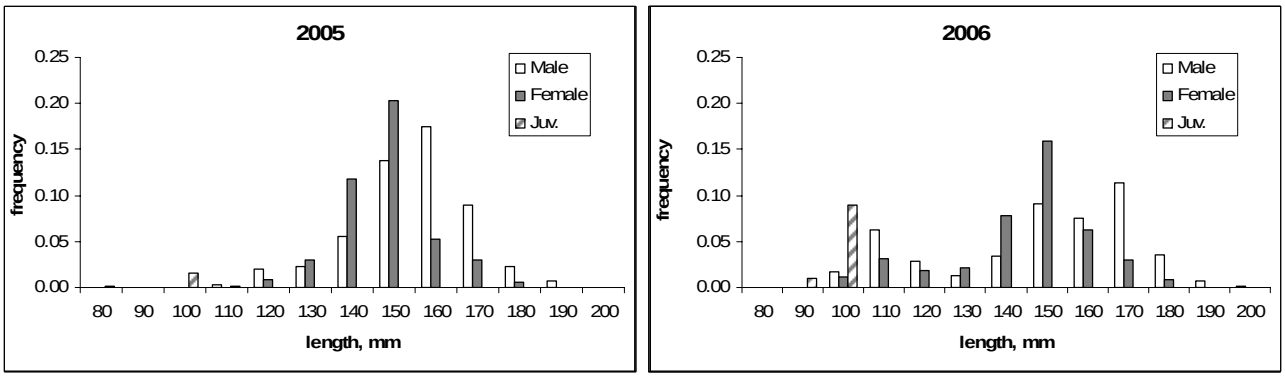

Fig. 2. Length composition of capelin on the spring survey data in 2005-2006.

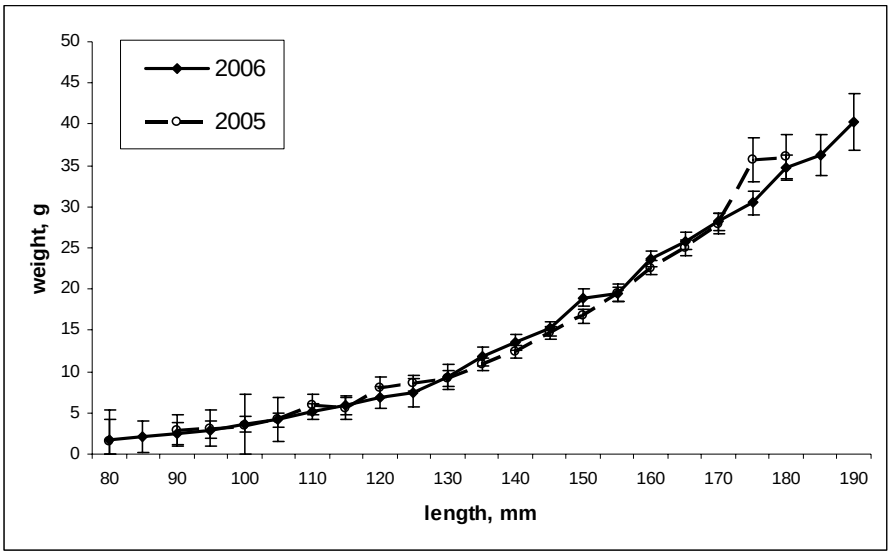

Fig. 3. 3NO capelin length-weight relationship in 2005-2006.

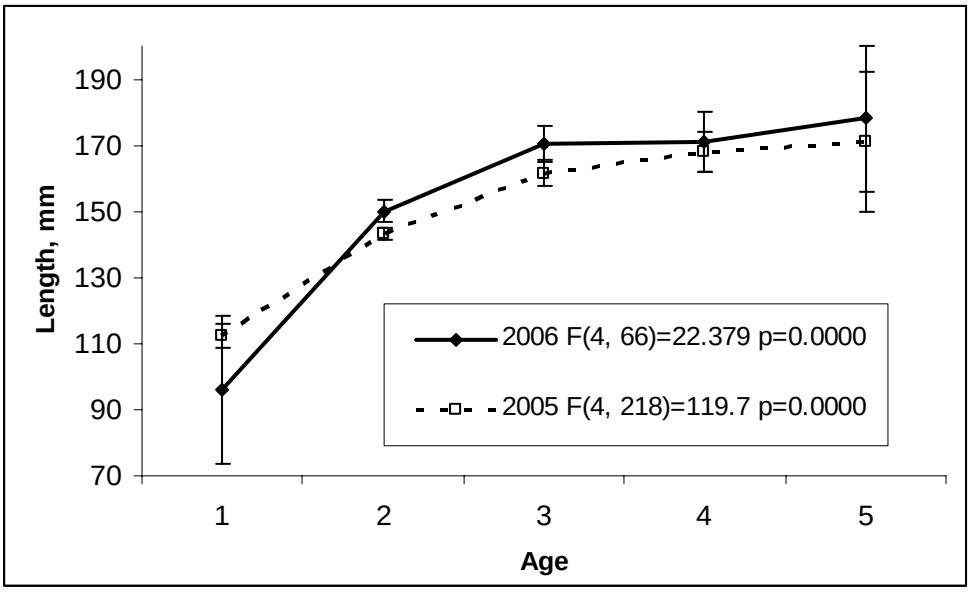

Fig. 4. 3NO capelin age-length relationship in 2005-2006.

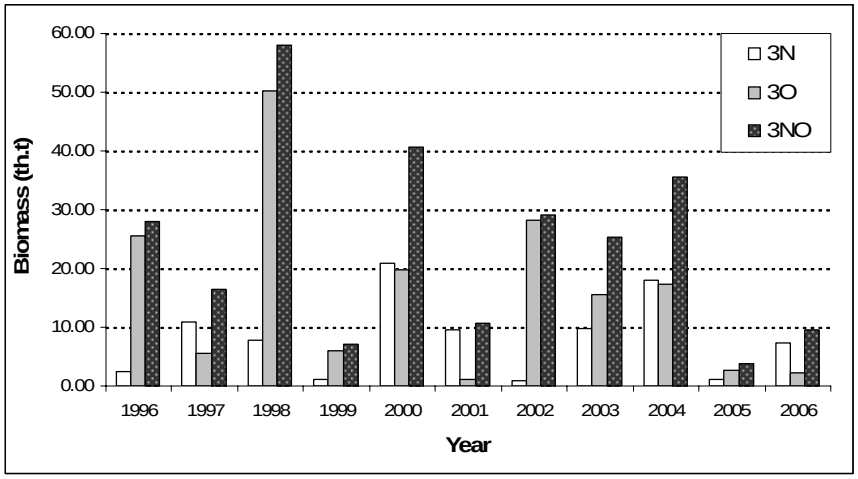

Fig. 5. Estimates of trawl biomass of capelin in Div. 3NO according to the data of Canadian spring surveys conducted in 1996-2006.

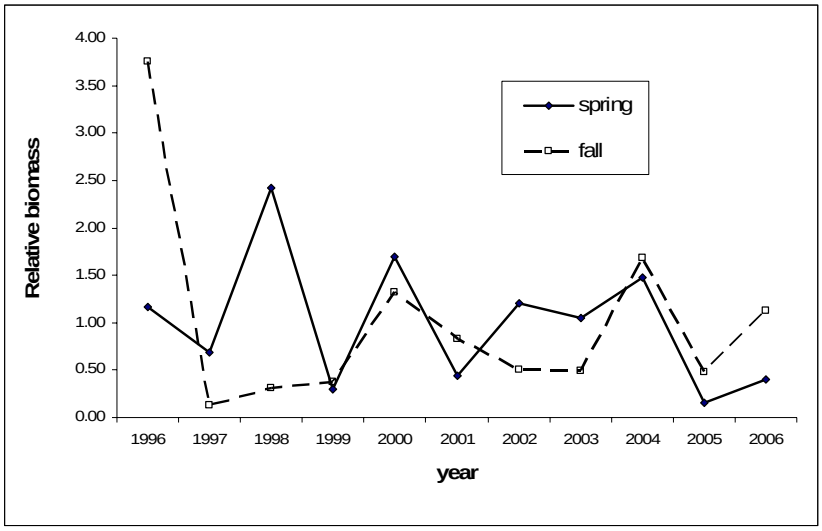

Fig. 6. Relative spring and fall survey biomass in 1996-2006.

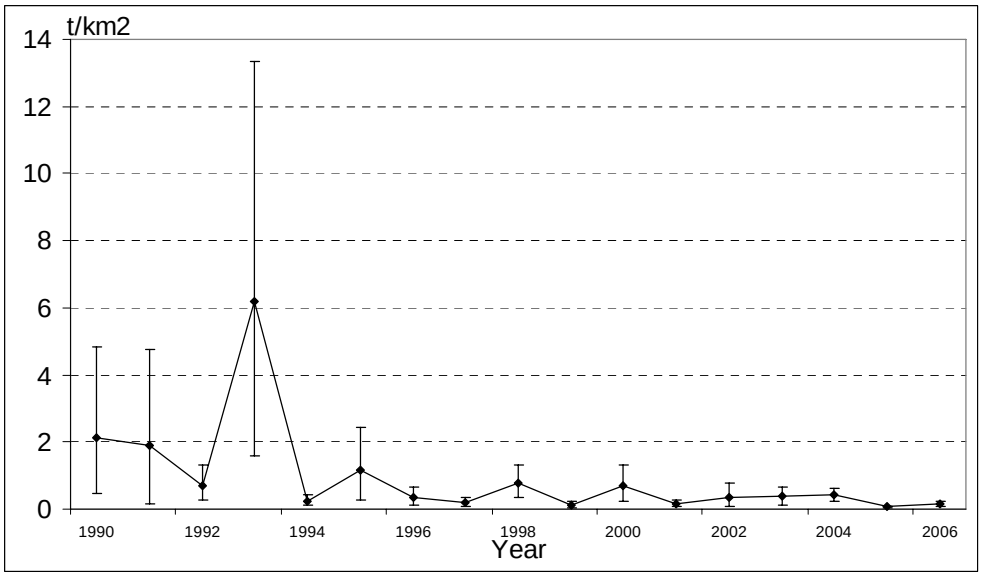

Fig. 7. Average catch (t/km^2) according to the data of Canadian spring surveys in Div. 3NO.

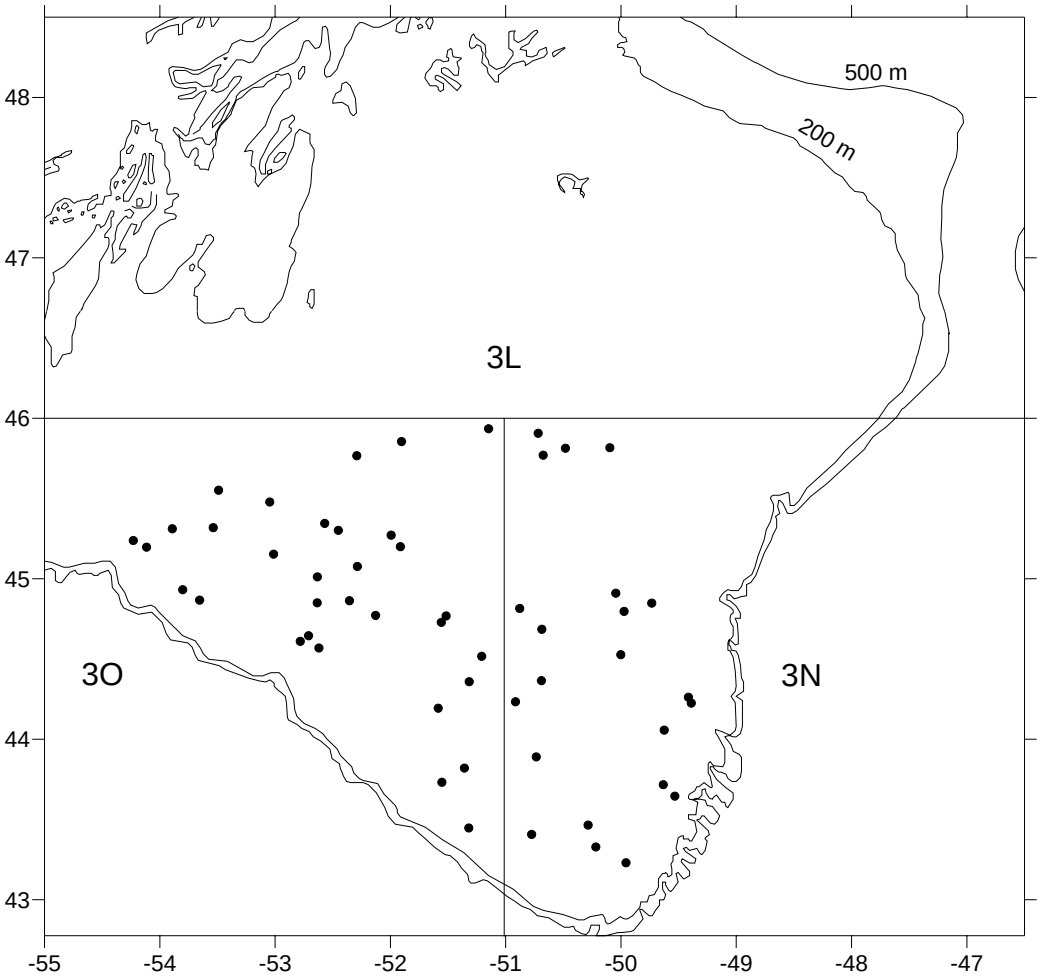

Fig. 8. Distribution of valid tows in spring, 2006.