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The Southeast Shoal (Div. 3NO) Capelin Stock

by

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Introduction

During the late 1970's, the capelin stock spawning on the Southeast Shoal (Div. 3N) declined and since 1979 has been closed to fishing. During its June 1985 assessment, "STACFIS considered, but could not evaluate, the possibility that this stock has reached equilibrium levels lower than those estimated during the mid 1970's" and recommended a review of this capelin stock for the 1986 meeting. This paper presents information relevant to this recommendation.

Stock Discrimination

Capelin spawning on the Southeast Shoal (Div. 3N) have been considered to be a separate stock based on distribution and spawning times, meristics and morphometrics. During the peak of the offshore fishery during the 1970's, fishing started during March or April each year in NAFO Div. 3L. The fleet (mostly USSR trawlers) took maturing fish that were migrating to spawn either inshore on Newfoundland beaches or on the Southeast Shoal. This latter group of fish was fished during its spawning migration from Div. 3L, through Div. 3O to the spawning grounds in Div. 3N and during the spawning period. This pattern of fishing and the observation that capelin spawned on the Southeast Shoal at the same time (June and July) as capelin were spawning inshore prompted the suggestion that this capelin stock was discrete (Campbell and Winters 1973, Winters 1974).

Recently meristic and morphometric (Misra and Carscadden 1984, 1986) studies have supported this observation.

Management and Catches

The stocks occurring in Div. 3LNOPs were originally managed as a stock complex because of the mixing of these stocks during the prespawning portion of their life history. National allocations were provided for Div. 3L, 3Ps, and 3NO but because of the migration routes of capelin and the pattern of fishing, countries with specific allocations could add to their 3NO allocations any part of their Div. 3Ps and Div. 3L allocations not taken in the latter two areas (see eg. p. 15, 1975 ICNAF Redbook).

All capelin stocks declined during the late 1970's but it appeared that the Div. 3NO capelin stock had declined at a faster rate (p. 37, 1979 ICNAF Redbook). While STACRES recommended lower catches of capelin from other stocks during 1979, closure was recommended for Div. 3NO. Capelin fishing has not been allowed in this area beginning in 1979.

Nominal catches by country and by month are given in Tables 1 and 2. From an initial low catch in 1971, catches rose rapidly and exceeded 100,000 t from 1973 to 1976, then fell rapidly. USSR and Norway recorded the highest catches. Peak catches usually occurred in June.

Biomass Estimates

Acoustic surveys have been conducted by Norway, USSR and Canada in the Div. 3NO area since 1972 (Table 3) but for various reasons, the time series is not complete. The three biomass estimates from USSR surveys during 1975-77 are the highest in the series and on average are about four times higher than the average of all of the other estimates. During the 1978 surveys, USSR and Canadian researchers had problems locating concentrations of mature

capelin and STACRES concluded that the small catch in that year (5,000 t) represented the bulk of the spawning stock (p. 33, 1979 ICNAF Redbook). In both 1979 and 1980, USSR researchers failed to find mature capelin on the traditional spawning grounds. Canadian researchers did find some concentrations of mature capelin but due to technical difficulties (Stevens et al. 1985), biomass estimates are not considered reliable. However, it seems reasonable to conclude that during 1978, 1979, and 1980 the Div. 3NO spawning stock was at a very low level. Canadian biomass estimates have been revised (Miller 1986) and this and the original references are provided in Table 3.

Catch Rates

Catch rates for USSR trawlers and Norwegian purse seiners are given in Tables 4 and 5. For USSR trawlers there is some annual variation during the years when catches were high but there is a large drop in 1978. The variation in these catch rates is mostly the result of catches from May and July and if only June, 3N catch rates are considered (reflecting the bulk of catches) the variation is not as dramatic between 1972 and 1977.

For Norwegian purse seiners, the 1978 catch rate did not show a dramatic drop. This may be a classic example of a purse seine fleet maintaining good catch rates even though the fish stock being fished has declined dramatically (p. 34, 1979 ICNAF Redbook).

Age Composition

Parallelism in year-class strengths of capelin in the Northwest Atlantic has been observed although the data are scattered throughout numerous research reports and therefore the phenomenon has never been well documented. Based on studies of beach spawning capelin Leggett et al. (1984) suggested that large-scale meteorological and hydrologic factors in the Northwest Atlantic are important in influencing year-class strengths in all stocks in the area. If parallelism in abundance of year-class strengths is an ongoing phenomenon then knowledge of recruitment in one capelin stock may provide insight about recruitment in another. This could be particularly useful for the Div. 3NO capelin stock since in the advice given by STACFIS in recent years, it has been noted that there are no estimates of recruitment available for the Div. 3NO stock.

In earlier research reports for this stock, the 1969 and 1973 year-classes were observed to have contributed strongly to the mature portion of the stock (see eg. Kovalev et al. 1977, Klochkov and Seliverstov 1978). Sampling data for other stocks and sequential capelin abundance models (Carscadden and Miller 1981, Carscadden et al. 1981) also indicated that these year-clases were strong. Bakanev and Mamylov (1986) also suggest that the 1969 and 1973 year-classes were strong in all areas.

Age-composition data are available for Div. 3NO capelin from research vessel surveys and these data can be compared to age-compositions from the inshore commercial fisheries in Div. 3L and 3K (Table 6). Differential annual maturity rates will affect the relative age-compositions therefore the presence of a year-class in the stock at age 5 as well as ages 3 and 4 may be a reasonable (although somewhat subjective) criterion to adopt to identify a relatively strong year-class. The data from Div. 3L and 3K would indicate that both the 1979 and 1980 year-classes have been "good". In Div. 3N, the 1979 year-class also appears to have been good but this does not appear to be the case for the 1980 year-class. The estimates of biomass (Table 3) and numbers-at-age (Table 7) agree with the presence of a strong 1979 year-class. In both Div. 3L and 3N (Table 6), the 1983 year-class, which now appears to be strong (see results at this meeting), appeared in significant proportions at age 2.

Although the absolute values differ somewhat, the presence of dominant year-classes in the Soviet data agree with that reported from the Canadian data. In 1981 and 1984 (Bakanev and Ermolchev 1982, Mamylov and Bakanev 1985), three-year-olds dominated while in 1983 (Mamylov and Bakanev 1984) the 1979 year-class was dominant at age 4.

Discussion

While the foregoing is by no means a thorough review of the biological data a number of points can be made.

1. The biomass estimates indicate that in recent years, the spawning stock has been lower than the biomass estimated during the mid 1970's and more comparable to the first estimate provided by Norwegian scientists for 1972. Two year-classes, the 1969 and 1973 year-classes, have been identified (Bakanev and Mamylov 1986) as being very abundant year-classes. Based on these observations, peak biomasses would have been expected to occur in 1972 and 1973 (from the 1969 year-class) and 1976 and 1977 (from the 1973 year-class). High biomasses were reported for 1976 and 1977 but the 1975 biomass was the highest on record and the estimate for 1972 is well below the biomasses of 1975-77.

2. During the 1979 assessment of this stock, STACRES concluded that "because the capelin

occurring in Div. 3N are composed of dense spawning schools, the catchability coefficient would probably increase as the stock declined and the catch per unit effort would remain high. Under these conditions, catch per unit effort would not likely be indicative of the trend in stock abundance until the stock had declined to an extremely low level". Based on the data presented here, this is especially true for purse seines. Catch rates for trawlers did show a dramatic decline in 1978 and may have reflected the decline in stock abundance. Ulltang (1980) notes that gears other than purse seines may provide better indices of abundance but that aimed trawling may have the same biases as purse seines. Thus, if another fishery were allowed on the Southeast Shoal spawning stock of capelin, catch rates would probably not be useful as indicators of stock status and research vessel surveys to the area should be continued to provide an independent index of abundance.

3. Based on the present somewhat cursory examination of age-composition data it would appear that strong year-classes (1969, 1973 and 1979) occurred in three (Div. 2J3K, 3L and 3NO) capelin stocks in the NAFO area. The 1980 year-class which appeared to be strong in the Div. 3L and Div. 2J3K stocks did not appear to be strong in Div. 3NO. This may be the result of different environmental factors influencing relative year-class strengths of stocks from the inshore and offshore areas before they mix on the nursery areas on the northern Grand Banks. It may also reflect sampling in Div. 3NO. The observation that the 1969 and 1973 year-classes were strong in all stocks came from commercial samples (Bakanev and Mamylov 1986) when the fishery took large catches over longer time periods. The sampling in Div. 3NO in the 1980's has occurred during relatively short acoustic surveys (~10-15 days) and depending on annual differences in spawning times, the data may not always reflect the age composition of the entire spawning stock. Canadian surveys are planned to occur during the latter part of June and early July, that is, when the peak of spawning is thought to occur. However, capelin have been reported to arrive at the Southeast Shoal spawning grounds during June and July (Seliverstov and Kovalev 1976) and therefore, a survey to estimate the whole stock would have to occur during the entire spawning period.

   Without strong, unequivocal evidence of parallelism in year-class strengths caution should be exercised in providing advice on catch levels in Div. 3NO based on any extrapolation of observed year-class strengths in Div. 3L and 2J3K to Div. 3NO. This illustrates the need for recruitment information on the Div. 3NO stock and quantitative information on the possible mixing of capelin stocks in Div. 3L. Currently, estimates of abundance of juveniles in Div. 3L are treated as estimates for the Div. 3L stock only. However, based on observations during the early years of the offshore fishery, the northern Grand Banks (Div. 3L) is a mixing area for prespawning capelin and it is probable that capelin from both Div. 3L and Div. 3NO stocks mix there as juveniles. Thus, acoustic estimates of juvenile capelin in Div. 3L may be estimates of these mixed stocks.

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Table 1. Nominal catches (t) of capelin in Div. 3NO, 1970-79 (from NAFO SCS Doc. 86/2).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
BGR	0		166				311			0
CAN	0			1658	3698		5233	36		0
CUB	0							700		0
DDR	0								56	0
ESP	0				4016	3748				0
ISL	0					15814	8839	2994	116	0
JPN	0					2734	5007	3746	665	0
NOR	0		(261)*	41293	43682**	37477	23178	21499	4237	0
POL				203		4306	3778	401	7	0
PRT	0				500					0
ROM	0								7	0
SUN	0	750	20598	83721	48855	67704	63610	17322	119	0
E/IRL	0						230			0
Total	0	750	21025	126875	100751	131783	110186	46698	5207	0

* Nominal catches were not reported by divisions; these have been allocated on the basis of the catches by other countries which reported by division

** Differs from NOR total in Stat. Bull. by 149 t

Table 2. Monthly nominal catches (t) of capelin in Div. 3NO, 1972-78.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	NK
1972				239	2,661	17,839							
1973					5,697	79,074	39,539	2,258	2	142	60	103	
1974			844	10,803	26,700	37,269	15,969	726					8589
1975			10,000	12,750	21,080	60,667	25,625	688	512	113		348	
1976				62	22,660	67,716	19,382	351				15	
1977				12	1,534	42,702	2,334	107					
1978					31	5,158	13						

Table 3. Biomass estimates (000's t) of mature capelin in Div. 3NO, 1972-85.

1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
125-170			1,050	687	1,000	*	**	**	109	-	269	***	
(1)			(2)	(3)	(4)	(5,6)	(7,8)	(9,10)	(11)		(14)	(17)	
									223	419	219	85	168
									(12,19)	(13,19)	(15,19)	(16,19)	(18,19)

1 Dragesund and Monstad (1973)
2 Seliverstov and Kovalev (1976)
3 Kovalev et al. (1977)
4 Klochkov and Seliverstov (1978)
5 Ermolchev et al. (1979)
6 Carscadden and Miller (1979)
7 Ermolchev et al. (1980)
8 Miller and Carscadden (1980)
9 Bakanev (1981)
10 Miller and Carscadden (1981)
11 Bakanev and Ermolchev (1982)
12 Miller et al. (1982)
13 Miller and Carscadden (1983)
14 Mamylov and Bakanev (1984)
15 Miller (1984)
16 Miller (1985a)
17 Mamylov and Bakanev (1985)
18 Miller (1985b)
19 Miller (1986)

* No mature capelin found by USSR and Canadian surveys
** No mature capelin found by USSR; mature capelin found in Canadian survey but biomass estimates considered unreliable
*** Biomass estimate for Div. 3NO could not be separated from total Div. 3LNO estimate

Table 4. Catch rates of USSR trawlers (OTSN-7, 1972-74 and OTM2-7, 1975-78) for capelin in Div. 3NO.

	1972	1973	1974	1975	1976	1977	1978
Catch (t)/day							
Div. 3N							
May		64.0	30.3	52.5	31.7	19.3	
June	49.4	47.4	50.1	42.3	44.5	40.6	9.0
May-June		47.6	35.9	47.5	42.5	40.4	
Div. 3O							
May		35.9	41.0	55.3	40.0	28.4	
June			42.3	52.3	44.2	25.2	
May-June			41.5	53.7	41.3	26.6	
Div. 3NO							
May-June			37.8	52.0	41.9	36.7	
Catch (t)/hr							
Div. 3N							
May		4.7	2.8	5.4	3.0	2.1	
June	4.8	5.4	5.6	4.4	4.7	4.7	0.7
May-June		5.4	3.5	4.9	4.4	4.7	
Div. 3O							
May		3.0	3.2	4.6	3.5	1.9	
June			3.1	4.5	3.9	2.5	
May-June			3.1	4.6	3.7	2.2	
Div. 3NO							
May-June			3.4	4.7	4.0	3.8	

Table 5. Catch rates of Norwegian purse seiners (PS-5) in Div. 3N, 1974-78.

		1974	1975	1976	1977	1978
Catch (t)/day						
Div. 3N	June	53.1	472.1	209.6	248.0	209.1
	July	48.1	475.1	266.3	-	-
Catch (t)/set						
Div. 3N	June	53.1	136.9	68.3	85.0	80.4
	July	48.1	180.5	86.0	-	-

Table 6. Age compositions of capelin from Div. 3N Canadian acoustic surveys Div. 3L and Div. 3K inshore fisheries. Values in brackets are recalculated not including the one-year-olds.

Division	Year	Age 1	2	3	4	5	6
3N	1981	<0.1	5.7	78.3	13.2	2.8	<0.1
	1982	0	0.6	94.9	4.0	0.6	<0.1
	1983	0	2.5	44.4	46.9	6.2	<0.1
	1984	27.6	5.2	48.3	15.5	3.4	<0.1
			(7.1)	(66.7)	(21.4)	(4.8)	(<0.1)
	1985	1.5	45.0	49.6	3.8	<0.1	
3L (inshore)	1981	7.4	3.2	42.7	28.7	17.2	0.9
	1982	0.1	1.4	83.1	11.4	3.2	0.7
	1983	-	4.6	60.7	32.9	1.7	0.1
	1984	-	1.7	39.6	53.7	4.8	0.2
	1985	-	12.6	61.0	20.2	5.8	0.4
3K (offshore)	1982	0	0.9	84.1	9.7	4.3	1.0
	1983	0	0.1	62.4	37.1	0.4	0
	1984	0	0.6	33.4	62.6	3.1	0.1
	1985	0	1.4	57.4	29.3	11.5	0.4

Table 7. Estimates of year-class abundance (No. x 10^9) of capelin in Div. 3NO from Canadian acoustic surveys. (From Miller, 1986)

Year	Age 1	2	3	4	5	6
1981	<0.1	0.6	8.3	1.4	0.3	<0.1
1982	0	0.1	16.6	0.7	0.1	<0.1
1983	0	0.2	3.6	3.8	0.5	<0.1
1984	1.6	0.3	2.8	0.9	0.2	<0.1
1985	0.2	5.9	6.5	0.5	<0.1	0