Northwest Atlantic Fisheries Organization

Serial No. N830

NAFO SCR Doc. 84/VI/45

SCIENTIFIC COUNCIL MEETING - JUNE 1984

On Time and Areas of Spawning for *Notoscopelus elongatus kroeyeri*

by

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ABSTRACT

Ovaries and testes of the myctophid fish Notoscopelus elongatus kroeyeri from the Flemish Cap and Grand Newfoundland Bank were the object of investigations. These fish were reported to become mature at their third year of life, body length being 95-105 mm. Trophic substances accumulate in ripening egg cells within 5 months - from September till February; post-spawning recovery lasts for about the same time - from April till August. Basing on the obtained data, it was concluded that in the Northwest Atlantic an independent spawning population of Notoscopelus elongatus kroeyeri exists. Eastern slopes of the Flemish Cap seem to be the spawning areas. A portion of spawned-out fish may be transported by the Gulf Stream into the Northwest Atlantic.

INTRODUCTION

As is known, myctophid fish are the major prey of such important commercial fishes of the North Atlantic as redfishes, grenadiers, Greenland halibut, cod, skates (Konstantinov, 1977). Besides, owing to a wide range of distribution and high abundance, lanternfishes attract still greater attention as potential object of fisheries. Notoscopelus elongatus kroeyeri is one of the commonest species of myctophids in the North Atlantic. They are found in a vast area from 37°N to 60°N in the western part of the ocean and at 65°N in its eastern part. Gjøsaeter (Gjøsaeter, 1981), while studying this species off the British Isles, came to conclusion that the population

under study is an emigrant, because all fish examined lacked the signs of maturation or past spawning. While analysing the state of reproductive system of Notoscopelus elongatus from the Reykjanes Ridge, banks of the Mid-Atlantic Ridge, the relation of these fish to reproductive part of the population was proved, though their spawning areas remain unknown (Mazhirina, 1983).

The data on age composition, length and weight growth rates, feeding are presented, problems of gonad maturation in Notoscopelus elongatus of the Flemish Cap and Grand Newfoundland Bank are discussed in order to determine the areas and time of spawning.

MATERIAL AND METHODS

Ovaries and testes of myctophid fish Notoscopelus elongatus kroeyeri from different areas of the Flemish Cap and Grand Newfoundland Bank were the object of investigations. The material was collected in January, February, April and September and was processed according to the accepted methods: treated with spirits of growing concentration, paraffin-xylene and, lastly, paraffined. Sections 5 - 6 μm thick were stained with iron haematoxyline. The age was determined, length and weight growth rates were estimated. The feeding intensity was judged of by the degree of stomach fullness determined visually by 5-point scale. The condition factor was calculated by Fulton's formula $K = \frac{Q \times 100}{L}$ where Q - fish round weight in g, L - standard length (from the tip of the upper jaw to the base of medium rays of caudal fins in cm).

RESULTS AND DISCUSSION

Most data were obtained in autumn-winter. Age composition of fish on the Flemish Cap is shown in Table 1. Two-year-olds were most plentiful in catches with males prevailing, while females were predominant in other age groups. The highest age for males was 5 years, that for females - 7 years (Table 2).

Out of 8 samples taken in the Northwest Atlantic three

were of immature fish. The first two samples were taken south and north-east of the Flemish Cap, the third one - on the south-eastern slope of the Grand Newfoundland Bank.

The smallest specimens (40-60 mm long) had testes visually similar to ovaries. The outside of transparent chordae of gonads situated in the upper caudal part of the abdominal cavity is covered by a thin peritoneal film. The weight of testes was 1.5 - 3 mg, that of ovaries - 2 - 15 mg. Single oogonia dispersed in somatic tissue were seen on histological preparations.

Specimens longer than 60 mm have the initial signs of sexual dimorphism, namely, a supracaudal light gland in the shape of a narrow dark band on the upper side of the caudal peduncle of males. Testes look like flat bands. Sex cells reproduce in the anterior part making up the two thirds of the length; the caudal part continues the excretory duct on the caudal side of glands. Germinative tissue had, besides primary spermatogonia, cysts with egg cells of the last orders.

In the rest of the samples fish were mature. Three samples from the western, north-western and eastern areas of the Flemish Cap were taken in January and February. Fish were 98-153 mm long. Males had a well-developed supracaudal light gonad composed of 8-9 scale-like segments. The state of gonads was about similar: gaps in excretory ducts, tubules as well as in ampullae adjoining to excretory tubules were filled with formed spermatozoa. Epithelial lining was swollen, its surface uneven - the sign of the start of testes running.

In females large gonads occupied the whole abdominal cavity. The weight ranged from 250 to 950 mg. Ovaries were light yellow. Oocytes of different size were seen through the stretched membrane. In the maturest ovaries three generations of sex cells were ripening: in the phase of intensive yolk accumulation, initial yolk and fat accumulation and in the vacuolization phase. The diameter of older oocytes was 220-320 μm.

Ovaries with such complex of ripening oocytes should be assigned to the 3rd stage of development. The maturity coefficient for females was 2.2 - 5.0%.

In late April post-spawning fish were found on the south-eastern slope of the Grand Newfoundland Bank. Testes were half-transparent, residual sperm was seen in excretory ducts. The gaps - the results of partial spending - were available on histological sections of gonads between spermatozoa and walls of ducts. Among spermatozoa large phagocytes showing the start of phagocytosis were found.

Whitish ovaries had a half-reduced membrane. On the section the cavity was seen with single unspent eggs. The ripening oocytes were dispersed with a great number of residual follicles among them, as well as not fully developed oocytes subsequently undergoing resorption. The maturity coefficient for females is 1.20 - 1.88%.

Some feeding specimens of N.e. kroeyeri were found in the north-western part of the Flemish Cap in September. Mature fish had weak traces of past spawning or lacked them at all.

Gaps in ducts and tubules were, on the main, free of residual sperm. A new wavw of spermatogenesis started in germinative tissue. Pale pink ovaries were half-transparent. In older egg cells of mature fish vaciolization of cytoplasm was observed. The maturity coefficient for females did not exceed 1%.

Notoscopelus elongatus kroeyeri become mature at the third year of life, body length being 95-105 mm. Trophic substances accumulate in ripening egg cells within 5 months, from September to February, and both ovaries and testes recover after spawning for the same period of time, from April to August. All the processes mentioned are reflected in variations of condition factor and feeding intensity (Table 3). In autumn and winter a high condition factor of fish and low feeding intensity are observed; in spring fish feed actively, but have a low condition factor. A sharp decrease of condition factor in spring is accounted for by the fact that in March and April post-spawning specimens were analysed.

Basing on the data obtained it was concluded that an independent population of Notoscopelus elongatus kroeyeri exists in the Northwest Atlantic and is limited by a gyre of anticyclonic nature produced by mixing of the Flemish Cap branches of the Labrador and North Atlantic Currents (Borovkov, Boytsov, Kudlo, 1978). Fish spawn, apparently, on the eastern slopes of the Flemish Cap. Feeding migrations are directed to the north and north-west.

Apparently, a portion of spawned fish are transported by the Gulf Stream into the North Atlantic, resulting in the appearance of specimens with traces of past spawning in the areas of the banks in the Mid-Atlantic Ridge and Reykjanes Ridge.

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Table 1. Age composition of N.e.kroeyeri from the Flemish Cap, %

Month	Sex	Age, years						
		I	2	3	4	5	6	7
September - November	juv	I9,9	-	-	-	-	-	-
	males	-	27,5	I0,2	7,5	I,3	-	-
	females	-	I9,I	4,0	I0,2	-	0,4	-
January - March	juv	-	-	-	-	-	-	-
	males	-	27,3	9,0	2,3	I,2	-	-
	females	-	I6,8	30,4	6,6	2,3	2,3	I,8

Table 2. Length and weight growth rates of N.e.kroeyeri

Age, years	Sex	Average length, mm	Average weight, mg	n
I	juv	57,6	I700	45
2	males	89,8	7400	I32
	females	90,I	7600	86
3	males	I06,5	I4700	46
	females	I08,0	I4800	87
4	males	II5,3	I8000	23
	females	II9,I	I9600	40
5	males	I27,9	22600	6
	females	I3I,5	26300	6
6	males	-	-	-
	females	I37,7	33900	7
7	males	-	-	-
	females	I4I,7	34900	3

Table 3: Seasonal fluctuations of condition factor and feeding intensity of *N.e.kroeyeri* from the Flemish Cap

Month	Fulton's condition factor			Average length of fish, mm	Mean degree of stomach fullness	n
	juv	males	females			
January	I,I6	I,I6	I,I6	II6,2	0,83	99
February	I,I6	I,I4	I,I6	I09,I	I,I4	I00
March	0,9I	0,95	0,87	I04,2	I,I6	50
April	0,88	0,93	0,84	I25,8	I,65	250
May	-	-	-	-	2,07	I00
September	-	-	-	-	0,76	50
October	I,I6	I,I6	I,I5	I08,5	0,69	I00
November	I,09	I,II	I,08	93,4	0,86	50