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Size composition, growth, mortality rate and condition of shortfin squid (*Illex illecebrosus*) stocks in the west Atlantic

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ABSTRACT

In the present paper the size-composition, growth, mortality rate and the state of the stock of Illex illecebrosus are considered and some hypothesis on life duration suggested. The growth parameters for winter spawning, natural instantaneous mortality rate, as well, as the squid biomass were determined.

INTRODUCTION

The squid, Illex illecebrosus, belongs to one of the less studied fishery objects in the West Atlantic. There is little literature on this species, all the information being of descriptive character which leaves uncertain such problems as migrations, spawning grounds, abundance and many others. It is clear that only the availability of detailed data can support fishery and proper allocation of quotas. Preliminary assessment of the squid stock is indicative of their high abundance, though the quotas established currently are too low. It should be remembered that squids are much in demand with the consumers due to their high tasts qualities, which together with all the

above-said suggest the necessary of more detailed studies of this species.

This paper is presented in order to consider some aspects of biology and abundance of the squid, Illex illecebrosus, from the West Atlantic.

MATERIAL AND METHODS

This paper is based on size-composition data obtained during the research cruises in 1974. To determine the abundance indices, the material of the joint trawling surveys made in 1971-1973 by the USSR and USA, as well as the material of ecological cruise conducted in June on board the RV ARGUS were utilized. Besides, the data of Squires (Squires, 1957, 1967) were also used. The assessment of growth parameters of the squid for the period of May-November was made by Bertalanfy equation according to Hoendorf, (1966); total instantaneous mortality rate was calculated by an integral method of Beverton and Holf (Beverton and Holf, 1957).

RESULTS

The West Atlantic is a part of feeding area of the squid, which stretches from the northern end of Labrador Peninsula to Florida at the depth of 100-250 m (Squires, 1957). In the Nova Scotia shelf area the size of squids from the catches ranged from 9 to 21 cm with the mode of 10-12 cm in spring from 11 to 25 cm with the mode of 16-20 cm in summer and from 15 to 28 cm with the mode of 19-22 cm in fall. On the Georges Bank the size-composition of the squid ranged from 10 to 24 cm with the mode of 15-18 cm in spring and from 6 to 25 cm with the mode of 15-19 cm in summer (table 1). From a hypothesis suggested by Squires (Squires, 1967) who studied the squids of the northern Great Newfoundland Bank region it follows that the life cycle of the squid lasts one year and two years. The analyses of size-composition of the squid showed that the life cycle of the squid from the Nova Scotia shelf and Georges Bank regions may last one year. In

TABLE 1. SIZE-COMPOSITION OF I. ILLECEBROSUS ON THE NOVA SCOTIA SHELF AND GEORGES BANK, 1974

TABLE 1

Month	Region ICNAF	LENGTH 6	7	8	9	10	11	12	13	14	15	FREQUENCY 16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL	No sp.	Mean length (cm)	Mean weight (g)
March	4				6,5	34,5	43,5	11,0	3,5	-	-	-	0,5	-	-	-	0,5								100,0	200	10,83	28,3
April					0,7	10,2	45,3	40,6	1,6	1,6															-"-	128	11,4	33,2
June									1,0	3,5	21,0	29,5	25,0	13,5	3,0	3,0	0,5								-"-	200	16,5	85,0
July								0,1	0,3	1,9	2,6	8,2	13,9	21,9	24,3	17,1	6,5	2,2	0,6	0,3	0,1				-"-	12455	18,5	102,0
August						+	0,1	0,8	2,2	4,3	6,9	4,1	12,8	15,5	18,3	17,9	7,6	2,7	1,1	0,5	0,2	+	+		-"-	7197	18,1	110,0
September												1,5	3,8	9,9	20,4	30,5	21,9	6,6	2,5	2,1	0,7	-	-	0,1	-"-	1642	20,0	153,0
October											0,2	0,7	0,8	3,1	4,2	8,1	15,5	24,7	21,7	9,1	7,6	3,0	1,1	0,2	-"-	831	22,1	223,3
April						0,4	1,2	4,1	4,6	12,3	18,8	19,9	21,8	11,8	3,6	1,2	0,2	0,1							-"-	1900	15,8	72,0
May							0,2	1,7	6,7	10,1	13,1	16,9	14,8	13,5	10,2	5,8	4,2	1,7	1,0	0,1					-"-	1800	16,7	89,5
June					+	0,3	0,4	0,3	1,1	2,8	6,5	12,1	23,8	24,5	15,5	8,1	2,9	1,0	0,5	0,1	0,1				-"-	4000	17,6	93,1
July		0,1	0,4	0,4	0,7	1,1	0,7	0,1	0,2	0,8	2,6	6,4	16,6	28,1	20,6	14,3	4,6	1,8	0,4	0,1					-"-	28933	18,0	118,0
August								0,4	0,9	3,6	14,6	28,1	23,2	10,6	7,9	7,6	1,9	0,7	0,3	0,1	0,1				-"-	3232	16,9	86,4

spring and summer seasons the squid from the catches was of smaller size increasing gradually towards the fall: in the following spring large specimens of squids were not observed in the catches (table 1). This question cannot be solved until the spawning grounds of the squid are found and the tagging experiment conducted. The analyses of the size-composition revealed also the fact that the young appeared on the shelf slope twice: in spring (March-May) and in summer (July-August) (table 1). This may lead to a conclusion that the spawning of the squid occurs two times a year - one part of the population spawns in January-February while another one in June.

Having used the monthly data on the mean size of the Squid spawned in January-February and having adopted a hypothesis that the life cycle lasted one year, we calculated the parameters of growth equation by Bertalanfy.

$$L_t = L_\infty (1-e^{-k\,(t-t_o)}),$$

where

L_∞ is the mean theoretical maximum length (cm),

e - is the base of natural logarithm,

K - is the coefficient expressing growth rate,

t_o is the age at zero length of organism.

After substitution of the parameters obtained the growth equation would be written as:

$$L_t = 33.4\ (1-e^{-0.14\ (t+2.9)})$$

It should be mentioned that calculated maximum size of the squid ($L_\infty = 33.4$) is close to theoretical, since in the catches this species of 31 cm in length occurred. From the comparison of calculated values and the observed data a good correspondence between them was revealed

$$SD = \pm\sqrt{\frac{\sum_{i=1}^{n} (D_t\,\%)^2}{n-2}} = 2,9\ \%$$

where

D_t - is a difference between the observed and calculated data (%)

$n-2$ - is the number of freedom degrees.

The value of the mean theoretical maximum length (L_∞=33.4), (K=0.14) and that of the mean length ($\bar{l}$) made it possible toassess total instantaneous mortality rate during the highest occurrence of the squid (August) in 1971 by integral method:

$$Z = \frac{K (L_\infty - \bar{l})}{\bar{l} - l'}$$

where

K is the coefficient expressing growth rate,

L_∞ is the mean theoretical maximum length,

$\bar{l}$ is mean length calculated for the lengths from l' and greater,

l' is the smallest fish length fully represented in samples.

The calculated total instantaneous mortality rate relates to May-November period. The analyses of the fishery stations showed that the yield of the both squid species (shortfin and longfin) from the West Atlantic(Subareas 4,5,6) in 1971 constituted only 31.1 thous. tons (ICNAF Stat Bull). It is evident that the fishing effort is too low for such abundante species, therefore, the value of natural instantaneous mortality rate may be equated with total instantaneous mortality rate, i.e. M would approximately be 0.6 with a 45% loss for the whole period of calculation. $Y = 1 - e^{-Z}$

where

e - is the base of natural logarithm,

z - is a total instantaneous mortality

True annual loss may reach 100%.

The results of trawling survey made in 1971 on board the RV ARGUS showed the mimimum biomass of I. illecebrosus to be 110 thous. tons in the southern part of the Nova Scotia shelf and on Georges Bank. We call this value minimum for two reasons: (1) the squid belongs to nekton species dispersed in water

column at night and occupying mainly pre-bottom layers in the day-time, which allows it to escape the trawl; (2) the catchability factor of the trawl is 0.2. Therefore we expect that the true biomass of the squid in the southern Nova Scotia Shelf and Georges Bank should be 5 times the calculated minimum biomass.

The trawling surveys conducted by ALBATROSS-IV did not show any considerable changes on Georges Bank at present (table 2), so high value of natural instantaneous mortality rate allows to intensively exploit the squid stock.

TABLE 2. The indices of the squid abundance on Georges Bank per 30 min hauling, Yankee trawl 36

Abundance indices	GEORGES BANK		
	1971	1972	1973
Specimen number	1.74	1.05	1.63
Weight	0.45	0.22	0.306

It may be assumed that the size of squid catches would be equal to minimum biomass which constitutes 100-110 thous. toms for the southern Nova Scotia Shelf and Georges Bank.

CONCLUSIONS

1. The squid sizes range from 6 to 28 cm, mode of 12-17 cm, on Georges Bank and Nova Scotia Shelf.
2. The young squid appears on the shelf slopes twice a year; in spring (March-May) and Summer (July-August) time.
3. The growth parameters for the winter spawning squid are $K=0.14$; $L_\infty=33.4$; $t_o=2.9$ for the period from May to November.
4. The value of natural instantaneous mortality rate is $M=0.60$ for the period from May to November.

5. In the southern Nova Scotia Shelf area and Georges Bank a total allowable catch pf 100-110 thous. tons may be taken.

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