GENERAL BIOLOGY OF HORSE MACKEREL *TRACHURUS MEDITERRANEUS* (ALEEV, 1956) OFF THE BULGARIAN BLACK SEA COAST

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АБСТРАКТ

Настоящото изследване се основава на данните от анализа на 2000 броя сафрид *Trachurus mediterraneus* (Aleev, 1956), събиран пред българския бряг на Черно море.

Представена е динамиката на някои популационни параметри на вида като линейни размери, тегловно нарастване и съотношение между половете. От направения анализ за връзката между размер и тегло на вида се установи, че нарастването е изометрично през месеците май-юни и алометрично през останалите месеци. Гонадосоматичният индекс на сафрида показа най-високи стойности през месец юли.

Ключови думи: сафрид, *Trachurus mediterraneus*, българско черноморско крайбрежие.

INTRODUCTION

The species of genus *Trachurus*, horse mackerel, are zooplanktivorous fishes usually of economic importance [19]. Commonly accepted is the opinion that *T. mediterraneus* entered in the Black Sea waters at about 7000 years ago, i.e. after the last connection of the Black Sea with the Sea of Marmara and the Mediterranean Sea through the Bosporus strait and the Dardanelles[2].

The Black Sea horse mackerel (*Trachurus mediterraneus*) is a migratory species distributed in the whole Black Sea basin [1, 2, 5, 6, 7, 9, 11, 12]. The main prey of the species are small fishes and zooplankton. The latter group represents over 55% of the total index of different food sources relative importance [21].

The biological characteristics of horse mackerel in the Black Sea have been well described by many researchers. Recently, few studies have been conducted on the horse mackerel biology in the Bularian waters, e.g. Yankova and Raykov (2006), Raykov and Yankova (2008), and Yankova et al (2010). The biology of the species in the Romanian Black Sea waters was investigated by Cautis and Jonescu (1979), Ambroaz (1954), Radu et al (2006), and Radu et al (2007).

Winters the horse mackerel population is found mainly along the Crimean, Caucasian and Anatolian coasts of the Black Sea and in some parts of the Marmara Sea. The shoals spend the winter at depths ranging between 20 and 90 meters off Crimea and between 20 and 60 meters off the Caucasian coasts. During the spring season the Black Sea horse mackerel migrates in the north direction for reproduction and feeding. The appearance of the horse mackerel in front of Bulgarian coast is closely related to water heating up to 14 °C [6, 8]. In the summer this species is distributed preferably in the shelf waters above the seasonal thermocline. It migrates towards the withering grounds along the Anatolian and Caucasian coasts in autumn [7, 16].

This study aims at investigating the horse mackerel reproductive status during the spawning migration along the Bulgarian coast.

MATERIALS AND METHODS

For the purpose of the study, 2000 analyzed specimens were collected from the eastern part of the Black Sea waters (Fig. 1) during the period of May 2009 to December 2009. In the laboratory fish was immediately analyzed by length, weight, sex maturity stage and age. Total length was measured to the nearest 0.1cm and body weight to the nearest 0.1g. Gonad weights were measured with the accuracy of 0.01g. The gonads were examined to determine sex and reproductive state. The otoliths were used to determine fish age in the present study. Sex was determined considering shape, look of and gonad structure. The ovaries were fixed in 4% formaldehyde after measurment. The gonadosomatic index (GSI) was calculated as follows:
GSI =Gonad weight / Body weight - Gonad weight) x 100
The mathematical function suggested by Le Cren (1951) was used in estimating length –weight relationship.

$$W = aL^b$$

where W is total body weight (g), L the total length (cm), a and b are the coefficients of the functional regression between W and L.

The condition factor (c.f.*)* was computed by Fulton's index: $K = \frac{W}{L^3} * 100000$ where

W- average weight by size groups, L-average length by size groups.

RESULTS AND DISCUSSION

The monthly changes in the length and weight distribution of horse mackerel obtained during the study were shown in Table 1.
The average weight of the fish increased from 18.61 g in May to 27.16 g in July. The mean length also increased from 9.0 cm in June to 14.77 cm in July.
The length-weight relationship for horse mackerel collected during the investigations might be described by following equiation: $W = 0.0027\ L^{3.34067}$ and is presented at Figure 2.
The monthly length-weight relationship (Table 2) showed significant differences in the exponential component (b) of the equiation. It was higher than 3.0 in July (3.35) August (3.58), October (3.24), November (3.58), December (3.33) and represented lower values in May (2.92) and September (2.72).
The sex ratio fluctuation during months (Table 3) showed that the spawning migration started by a rush of males. The males were abundant during May and June.
The average GSI for females and males increased during July-August, and started to decrease in autumn.
The third age group was dominant in the population. The modal age of all fish was 3 years (22.96%), followed by 1 (21.84%), 4 (20.29%), 2(17.12%) and 0 years (16.45). Fish of 5 and 6 years old were poorly represented. The oldest ages (5 and 6 age groups) represented just about 1.40%. Data adequately describe the reproductive activity of horse mackerel.
Reproductive activity started in May and lasted till August with peak in July. The average GSI for females and males increased from July to August and decreased in October. Spawning season of horse mackerel takes place in the warmer part of the year [18], which is in accordance with our data.
Generally there was an increase of the mean length and weight toward the spawning season. The larger body weight is related to the gonad size increase closer to spawning season, which could be seen in higher GSI. The sex ratio dynamics established in this study assures that the spawning migrations of horse mackerel in front of Bulgarian Black Sea coast started with the high presence of males followed by a big

rush of females. During the spawning period the sex ratio was close to 1:1. The GSI and sex ratio dynamics indicated that the horse mackerel reproductive activity started in June and prolonged until August with peak in July.

CONCLUSIONS

An increase in the mean length and weight toward the spawning season was observed. The monthly length-weight relationships showed significant differences in the exponential component (b) of the equation. The average GSI for females and males increased from July to August and decreased in October, as the reproductive activity started in May and lasted till August with peak in July.

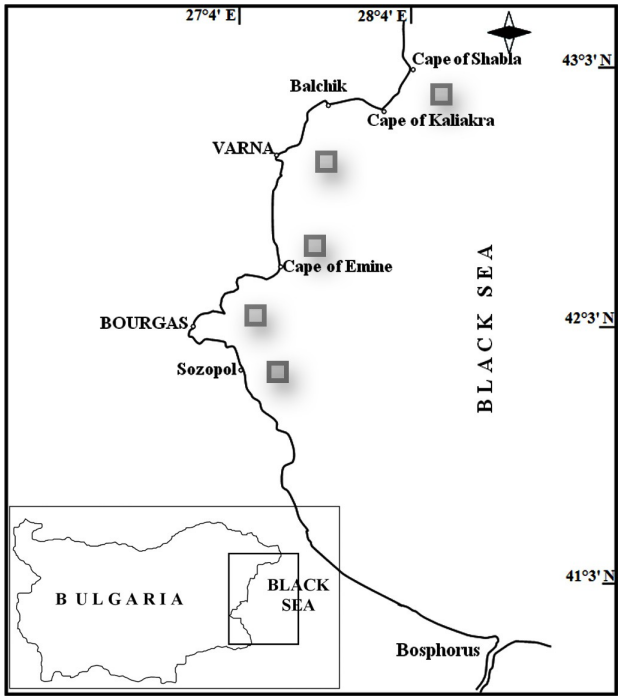

Fig.1.

Figure 1. The collection *site* in the Black Sea

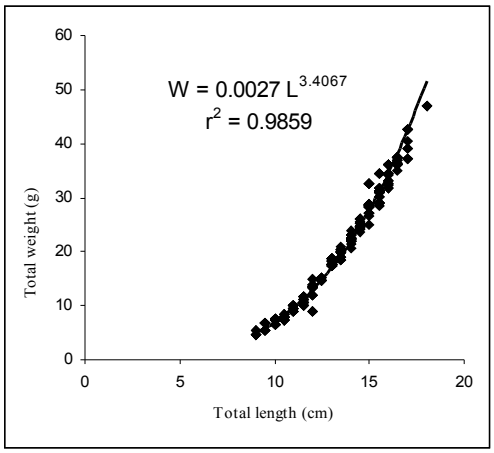

Figure 2. Length - weight relationship of horse mackerel from the Bulgarian Black Sea Coast (W- Weight, L- Length).

Table 1

. Length and weight distribution of horse mackerel

		Length(cm)		Weight (g)	
Months	**N**	**Range**	**Average±SE**	**Range**	**Average±SE**
May	34	11.5-17.00	13.39 ± 0.30	10.0-37.2	18.61±1.54
June	40	12.15-0.33	9.0-15.5	5.5-34.5	16.34±1.54
July	37	12-18.00	14.77±0.31	12.0-47.1	27.16±1.86
August	59	9-17.00	12.42±0.34	4.64-39.1	17.03±1.52
September	36	13-16.5	14.62±0.21	18.82-36	26.22±1.04
October	36	10.5-16	13.12±0.31	8.0-33.0	18.84±1.38
November	52	10.0-16	12.78±0.29	7.2-36.2	18.01±1.43
December	51	11.5-16.5	14.25±0.22	11.-37.6	24.60±1.17

Table 2.

Monthly changes in the length-weight relationship parameters, factor of determination (R^2) and mean Relative Condition Factor (KN).

Months	a	b	R^2	KN
May	0.0094	2.92	0.99	0.610±0.029
June	0.0065	3.08	0.99	0.712±0.117
July	0.0031	3.35	0.99	0.742±0.067
August	0.0017	3.58	0.99	0.768±0.009
September	0.0017	2.72	0.99	0.542±0.221
October	0.0042	3.24	0.99	0.845±0.030
November	0.0017	3.58	0.97	0.835±0.042
December	0.0034	3.33	0.99	0.800 ±0.006

Table 3.

Sex ratio of horse mackerel during months.

Months	Sex ratio F:M
V	1:4.22
VI	1:2.10
VII	1:0.89
VIII	1:1.12

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