

SOME ASPECTS OF THE BIOLOGY OF THE BOGUE, *BOOPS BOOPS* (LINNAEUS, 1758) IN MONTENEGRIN WATERS (SOUTH ADRIATIC SEA)

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ABSTRACT

Some aspects of the biology of bogue, *Boops boops* (Linnaeus, 1758) in the Southern Adriatic Sea (Montenegrin shelf) were studied. Specimens of bogue were caught monthly from September 2009 to August 2010 on Montenegrin shelf, by various types of fishing gears. Total length of the sampled 861 fish ranged from 9.0 to 26.6cm with the mean length of 17.1cm. Sex ratio (M/F+M) was in favor of females (0.4). The LW relationship of females and males was: $W=0.0146TL^{2.8276}$ and $W=0.011TL^{2.889}$, respectively. According to MEDITS protocol, four different maturity stages were established for females and males. The highest GSI value was in February. The size at first maturity ($L_{50\%}$) estimated for both sexes combined was 13.0cm while the estimated sizes at maturity were 11.5cm for females and 11.9cm for males.

Key words: Bogue, *Boops boops*, biology aspects, South Adriatic Sea

INTRODUCTION

Boops boops, family Sparidae, is a demersal, as well as semi-pelagic species living on all types of bottom (sand, mud, rock, and seagrass beds) to 350 m, more abundant in the upper 100 m and sometimes in coastal waters (El-Haweet *et al.*, 2005). It moves in aggregations, ascending to the surface mainly at night (Bauchot, 1987). It is widely distributed throughout the Adriatic Sea (Jardas, 1996). According to the same author this species is most commonly found at about 50-150 m depth. Despite its commercial importance, the biology of this species is not well known for the Adriatic and there are no data about this species in Montenegrin waters.

So, the aim of this paper is to investigate some biological aspects of *B.boops* such as length-weight relationship, length frequency distribution, sex ratio, gonadosomatic index and size at first maturity in Montenegrin waters.

MATERIAL AND METHODS

A total of 861 individuals of *Boops boops* were collected from the commercial landings in three different ports (Bar, Budva and Herceg-Novi), but each month from the different port. Bogue was mainly caught by gill and seine netters, although significant quantities were caught by trawlers monthly from September 2009 to August 2010 on Montenegrin shelf (Fig. 1), in the framework of the AdriaMed Pilot Study. Hauls were performed during the day at depths ranging from 50 to 200 m. Immediately after capture, specimens were processed. Total length (TL) of fish was measured to the nearest 0.1 cm and body weight to the nearest 0.01 g. The sex ratio was expressed as a fraction of males over the total of males and females combined. According to MEDITS protocol, four different maturity stages were established for females and males, based on the macroscopic observations of gonads: immature (1), in maturation

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(2), spawning (3) and post-spawning (4). Length at first maturity was estimated by sexes and for the entire population, based on the length and maturity stage data.

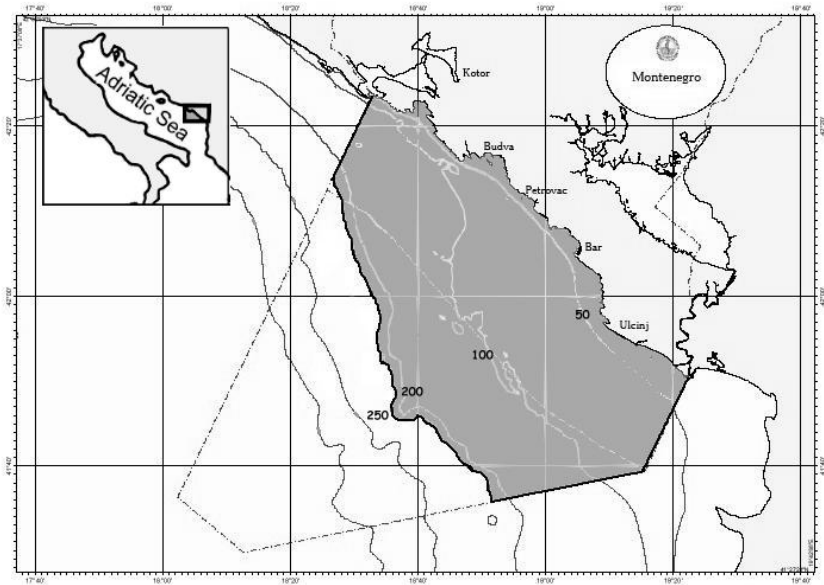


Figure 1. Map of the investigated area

Maturity stages 2, 3 and 4 were included in the mature category while maturity stage 1 was included in the immature category. Gonads of all specimens were dissected and weighed to the nearest 0.01 g to calculate the GSI index ($GSI = \text{weight of gonads} / \text{weight of fish} \times 100$). The relationship between total length and weight was determined using the expression: $W = aL^b$ (Ricker, 1975), where W is the total body weight (in g) and L is the total length (in cm), a is coefficient related to the body form and b is the coefficient of allometry.

RESULTS AND DISCUSSION

During the time of investigation, 861 specimens of Bogue were analyzed. Total length of the sampled fish ranged from 9.0 to 26.6 cm TL with

the mean length of 17.1 cm TL. Almost the same value of the mean observed length (17.26 cm) was obtained Hassan (1990) who studied this species in the Egyptian waters. Allam (2003), in his study of this species in the same area determined lower mean length (16.02 cm), which he explained by disappearing of larger fish from the catch (from 22 to 25 cm). Length frequency distribution of males reveal that the size range extends from 10.0 to 26.6 cm with size groups 16.5 to 18.0 cm dominating in the catch while the length frequency distribution of females reveal that the size range extends from 10.3 to 22.4 cm with size groups 17.5 to 18.5 cm dominating in the catch (Figure 2). Females showed almost equal median length with males (17.24 versus 17.29 mm). The LFD of the whole sample (pooled data) showed that the majority of catch consists of individuals ranging in length from 16.5 to 18.5 cm TL (Figure 3).

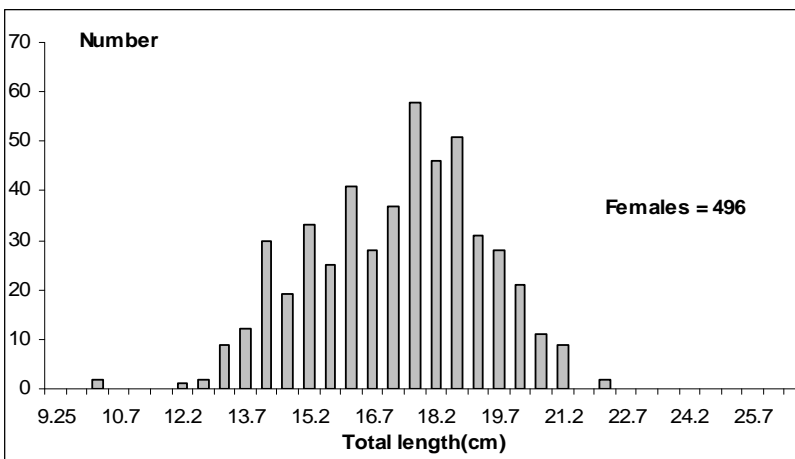


Figure 2. Length frequency distribution by sex of *Boops boops* caught in national waters of Montenegro during the 2009-2010 sampling period. N = number of specimens.

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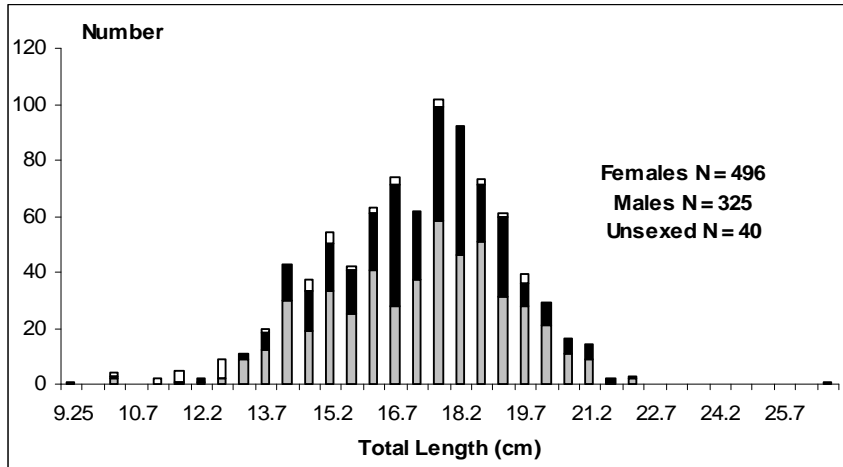


Figure 3. Length frequency distribution for the whole sample of *Boops boops* during the 2009-2010 sampling period. N = number of specimens; gray bars = females; black bars = males; white bars = unsexed.

The sample was composed of 496 females (57.6%), 325 males (37.7%) and 40 unsexed individuals (4.7%), (Figure 4). The overall sex ratio during the period of investigation was in favour of females (0.4). The sex ratio by size showed female predominance in almost all length classes (Figure 5). Mature specimens of *B. boops* were found at a wide size range, TL varying between 13.3 and 26.6 cm in males and between 12.7 and 22.4 cm in females (Table 1).

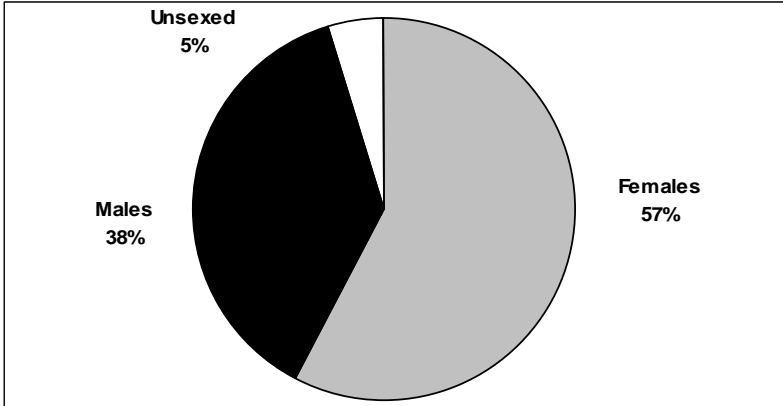


Figure 4. Sex ratio of the whole catch of *Boops boops* during the 2009-2010 sampling period. Gray = females; black = males; white = unsexed.

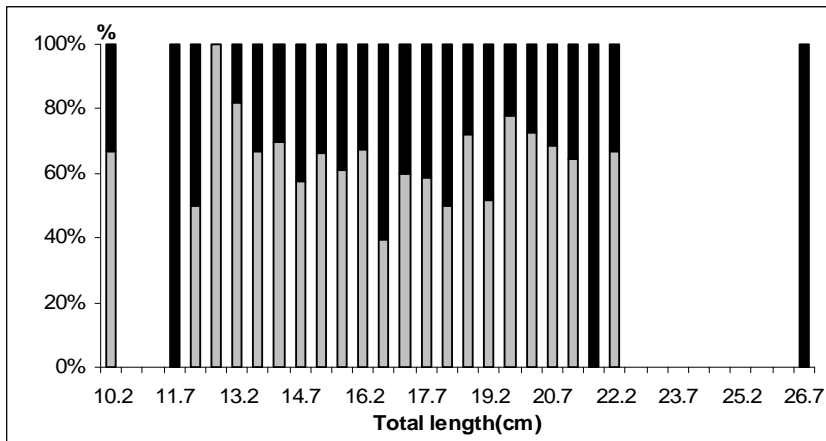


Figure 5. Sex ratio variations according to size classes of *Boops boops* during the 2009-2010 sampling period. Gray bars = females; black bars = males.

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Table 1. Gonad maturity stages by sex of *Boops boops* during the 2009-2010 sampling period. F = female; M = male; TL = total length in cm; 1-4 = gonad maturity stages.

Boops boops	M				F			
Maturity stage	No	%	TL		No	%	TL	
			min	max			min	max
1	40	12.31	10.0	18.3	28	5.65	10.3	18.6
2	165	50.77	13.3	26.6	350	70.56	12.7	22.2
3	117	36.00	14.0	21.8	113	22.78	15.0	22.4
4	3	0.92	15.2	20.0	5	1.01	17.5	20.5
Total	325	100.00			496	100.00		

During the whole sampling period very small number of post-spawning specimens (in maturity stage 4) was found. The greatest number of individuals, both males and females, were in maturity stage 2 (Figure 6). The largest fraction of spawning specimens (maturity stage 3) was found during the sampling in January-February period.

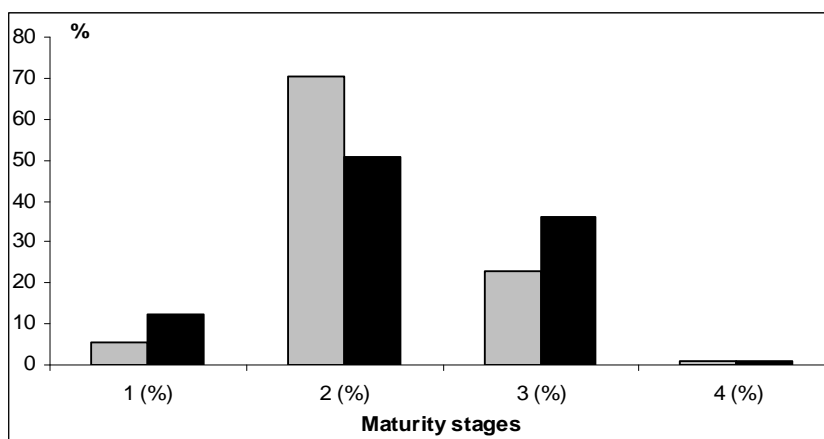


Figure 6. Gonad maturity stages proportion by sex of *Boops boops* during the 2009-2010 sampling period. Gray bars = females; black bars = males.

The size at first maturity ($TL_{50\%}$) was 13.02 cm for the two sexes combined (Figure 7). The estimated mean size at which 50% of females were mature was 11.49 cm, whereas the estimated mean size at which 50% of males were mature was 11.90 cm. Our results are not in agreement with Alegria-Hernández (1990) who was reported that the minimum length at onset of the first maturity is 12.45 cm for males and 14.25 cm for females. Gordo (1995) found, regarding the length at first maturity, very similar values (between 13 and 15 cm) for the bogue from the Portuguese coast and those living in the western and eastern Mediterranean.

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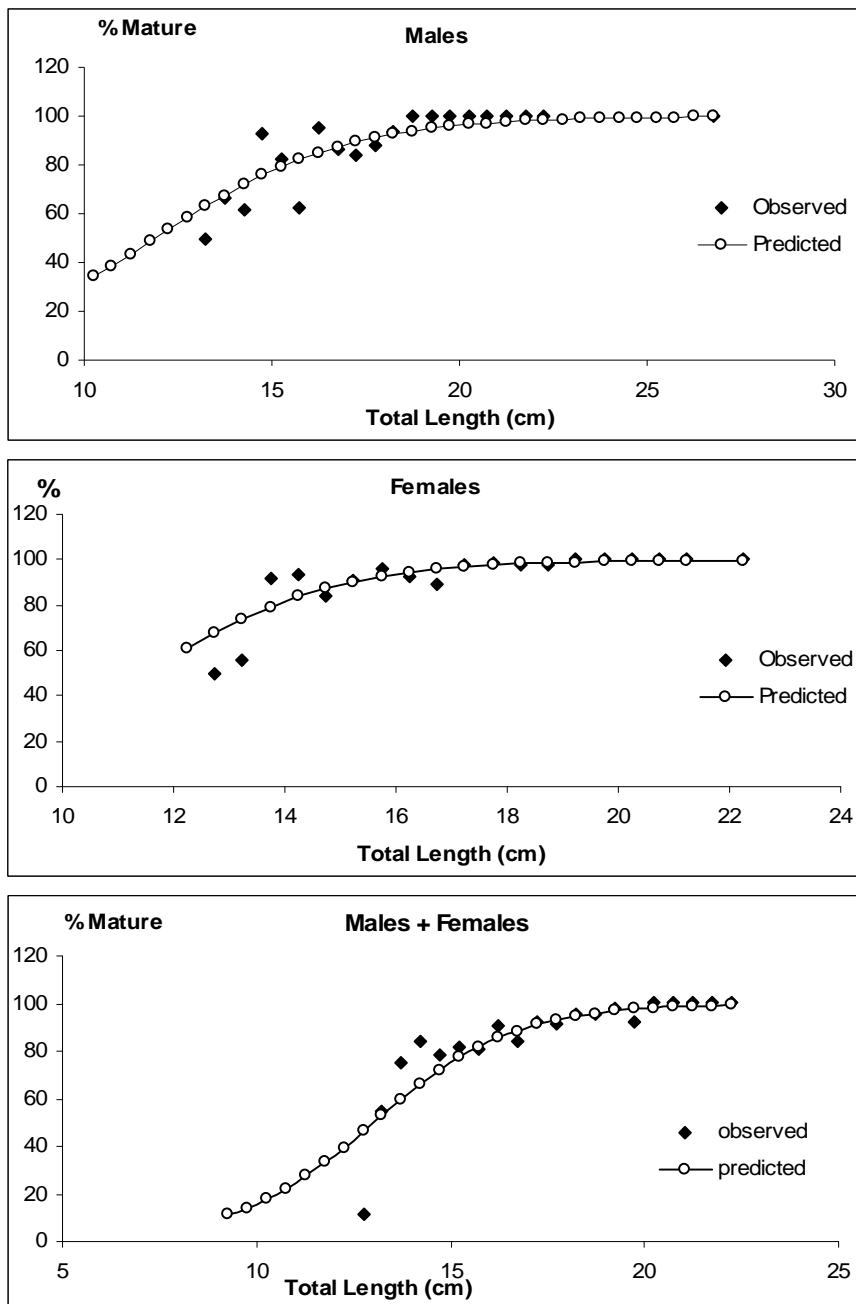


Figure 7. Size at first maturity (50%) for both sexes, and for males and for females of *Boops boops* during the 2009-2010 sampling period.

Spawning period was determined by evaluating the gonadosomatic index (GSI). Amongst females, the highest GSI value was 4.58 during February, while the lowest GSI value was 0.26 in August. Amongst males, the highest GSI value was 4.62 during February and the lowest GSI value was 0.11 in July. As we can see from the Fig. 8, the peak value of GSI was attained in February for both sexes, which is in agreement with El-Agamy *et al.*, (2004) who investigated the reproductive biology of bogue from Alexandria coast. Alegria-Hernández (1990) found that the peak of spawning of bogue from the mid-Adriatic Dalmatian channels occurs in May, while in June almost the entire population is spent. The present work showed that in the Montenegrin waters spawning season occurred between January and March which coincides with spawning season of bogue from the eastern Mediterranean. The spawning season lasts from February to April in the eastern Mediterranean and from March to June in the western Mediterranean, including the Portuguese coast (Gordo, 1995).

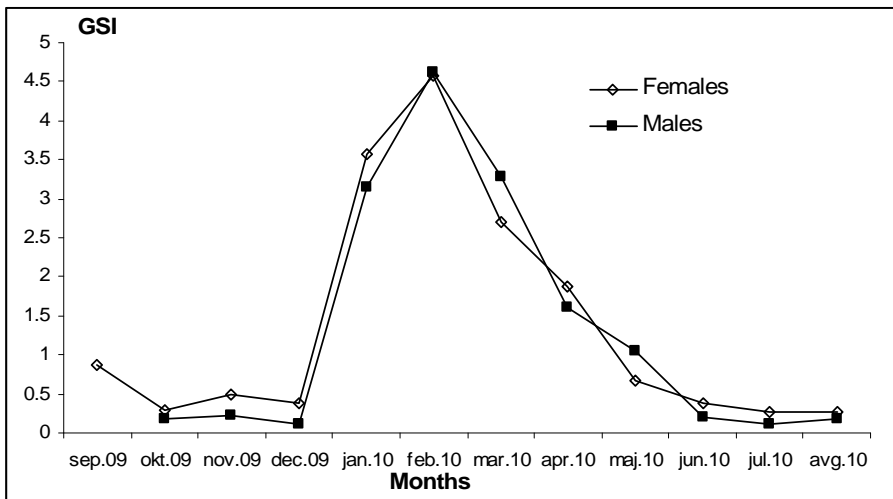


Figure 8. Mean monthly gonadosomatic index for males and females of *Boops boops* during the 2009-2010 sampling period.

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The length-weight relationships of bogue in Montenegrin waters for females, males and the total sampled population were determined as $W=0.0072*L^{2.8276}$, $W=0.0119*L^{2.889}$, $W=0.0146*L^{2.8219}$, respectively (Fig. 9). The LWR of this species indicates negative deviation from ideal allometric growth ($b<3$). The similar growth was observed for *B. boops* in Egyptian (Hassan, 1990) and Tunisian waters (Anato and Ktari, 1986). The parameters of the fish LWRs are affected by a series of factors including season, habitat, gonad maturity, sex, diet, stomach fullness, health and preservation techniques (Bagenal and Tesch, 1978).

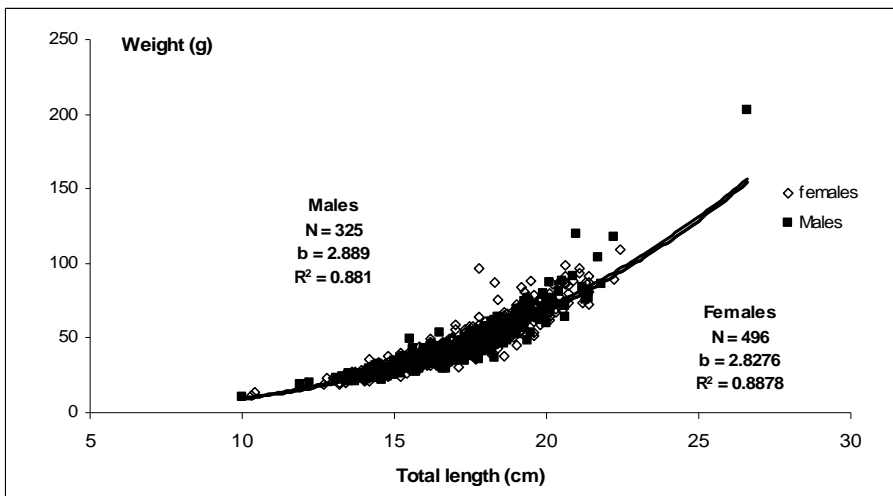


Figure 9. Length-weight relationship for males and females, and their respective estimated slope (b) for *Boops boops* caught in Montenegrin national waters during the 2009-2010 sampling period. N = number of specimens.

CONCLUSIONS

Some biological aspects of *B. boops* has been studied for the first time in the Montenegrin coast (South Adriatic Sea). These results will provide the basis for future stock assessment and management studies on this species.

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