LENGTH-WEIGHT RELATIONSHIP AND GROWTH OF LAKE SHKODRA BLEAK (*Alburnusscoranza)*

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ABSTRACT

Shkodra Lake bleak (*Alburnusscoranza,* Bonaparte, 1845) is one of the most commercially important species of Shkodra Lake. It is native in Ohrid and Shkodra basins. In recent years the bleak catches has fallen considerably. This study is an attempt to evaluate the condition of the bleak population through estimation of the length-weight relationship, growth parameters and condition factor to provide a database for the estimation of stock structure and forecast the Shkodra lake bleak biomass in the future. For the study year, 2017, bleak population in Shkodra Lake showed a negative allometric growth expressed by the equation $W=0.000088 \cdot L^{2.57}$. Growth parameters are estimated as: $L_\infty = 19.43$ cm; $K=0.70$ yr^{-1} and $t_0=0.18$ yr . Length at first maturity is $L_m=13.28$ cm and the growth performance index of bleak population is estimated as $\emptyset'=2.42$.

Keywords: Bleak, length-weight relationship, growth parameters.

INTRODUCTION

Shkodra Lake bleak (*Alburnusscoranza,* Bonaparte, 1845) is one of the most commercially important species of Shkodra Lake. It is native in Ohrid and Shkodra basins (Albania, the Former Yugoslav Republic of Macedonia and Montenegro.

Bleak was initially described by Bonaparte (1841), who named it *Alburnusarborella.* Currently, in the ichthyologic literature this species is known with several synonyms: *Alburnusalborella* De Filippi (1844), *Leuciscusalbidus* Costa (1838), *Aspiusalburnus* Bonaparte (1838-1841), *Alburnusscoranza* Bonaparte (1845), *Alburnusscoranza* Heckel&Kner (1858), *Alburnusalburnusscoranza*Karaman (1924), *Alburnusalborella*Heckel and Kner (1957). These synonyms belong to individuals sampled in Lake Verbano and Lario (Italy) as well as in Shkodra Lake and used by different authors who have studied the morphological and ecological features of this species (Šorić, 2006).

Bleak has a long, stretched body and pressed laterally. The maximum total length (TL, mm) range 160-180 mm, but rarely reaches 200 mm. A dark gray color stripe is extended along the body. The mouth lies slightly above the horizontal plane with the maxillar bone margin reaching the upper level of the eye (Rakaj&Flloko, 1995; Šorić, 2006).

It is gregarious forming large schools and lives up to five years. Spawn for the first time at one year (FishBase, 2017). In Lake Shkodra spawns in the time period March-July, peaking in May at 18-23°C water temperature (Rakaj&Flloko, 1995). The eggs are deposited on sand and gravel bottom at about 0.3 m and rarely at 0.15 m depth (Ivanovic, 1968). The eggs of Shkodra Lake Bleak have a diameter of about 5.4 mm and are sticky. The incubation lasts about 106 hours in water temperatures from 18^0C to 22^0C. The larvae phase lasts until the

end of the second month after the egg fertilization, when the total length ranges from 15 mm to 19 mm (Ivanovic, 1968). The adults feed mainly on *Cladocera* and *Copepoda* (FishBase, 2017).

The morphometric characteristics of bleak, inhabiting different habitats of Ohrid-Drin-Shkoder basin appears with a noticeable variability (Dimovski&Grupče, 1971; Šorić, 2006). The differences in morphometric ratios are higher among the populations that inhabit Shkodra and Ohrid Lake, and smaller, but still present, among the bleak population inhabiting Shkodra Lake and White Drin River (Dimovski&Grupče, 1971; Šorić, 2006).

Since 1947 the technological development of fishing effort made by the fishermen of Shkodra Lake was accompanied with the great increase of the catches (Högman, 1973). The bleak fishery in the Lake fluctuated around the 1950s and decreased from 1972 to 1976. The production decrease was a direct result of the increased long –term fishery and not of the habitat changes.

With the collapse of the dictatorial regime and starting the political and economic transition period (1991-2004) of the country, like all other production sectors of the Albanian economy, also fishery declined year after year.

For the years 2011 and 2012 the average bleak catches compared to total Lake catch were respectively 21.88% and 26.58%, while the catches ranged from 200 to 250 ton/year. According to the census conducted by Shkodra Lake Fishing Management Organization in 2013 the annual catch of bleak was 102.9 tons or 25.9% of total catch. The bleak catches in 2014 were reduced to 82.7 ton that made up 15.6% of total catches of the Albanian part of the Lake (Dervishi et al., 2015). In 2015, the bleak has been fished only in two months, providing a total amount of fish caught of only 30 ton or 3.75% of the Lake's total catch. These figures are far from the bleak production in the period 2009-2013.

Reduced fishery production in Lake Shkodra requires urgent intervention. Hence, drafting plans for effective management of fish stocks requires continuously monitoring of stocks dynamics and their abundance. This study is an attempt to evaluate the condition of the bleak population through estimation of the length-weight relationship, condition factor and growth performance and to provide the reliable database for the estimation of stock structure and forecast the Shkodra lake bleak biomass in the future based on the information of growth and mortality.

MATERIAL AND METHODS

The study was carried out during the year 2017. The sampling of bleak were made in landing catches by commercial fisheries in the Albanian part of the Lake Shkodra, in the areas of Koplik, Shiroka and Zogaj that are the main areas of local commercial fishery. The data collected by commercial fishing can be successfully used for assessing population parameters. The main advantage of sampling the fish landed on the shore is that the sampling is much cheaper and can be carried out much more often than with a boat or research vessel. The main obstacles are that the sampling should be random and not reflecting commercial categorization of the fish, as well as the fishing zone and the fishing vessel and effort. These obstacles were exceeded by increasing the number and the frequency of sampling.

The fish samples were obtained by monthly samples caught with nets of (the mesh screen step and the size of the net) mesh sizes. The length-weight relationship for both species were determined according to allometric equation $W=a \cdot L^b$ given by (Ricker, 1975).

The total length (TL) of each specimen was measured to the nearest 0.1 cm and the total weight to the nearest 0.01 g for bleak. The fishes were grouped into 1 cm size classes.

The Fish Stock Assessment Tool (FiSATII , 2015) was used to analyze the monthly length frequency data. The estimation of growth parameters from the time series of the length frequency data was performed using the Electronic Length Frequency Analysis (ELEFAN I) package. L_∞ (theoretical maximum length) and K (growth rate) were calculated by ELEFAN I (after Pauly& David, 1980), whereas t_0 (age at length 0) was calculated based on formula:

$$ln(-t_0) = -0.3922 - 0.2752 \cdot ln(L_\infty) - 1.038\, ln(K) \qquad \text{(Pauly, 1979)}$$

Empirical relationship (Froese &Binohlan, 2000) was used to predict length at first maturity from theoretical maximal length (L_∞).

$$ln(L_m) = 0.8979 \cdot ln(L_\infty) - 0.0782$$

The growth parameters were used to fit the von Bertalanffy growth function (VBGF) and growth performance index in terms of length $Ø' = logK + 2logL_\infty$ (Pauly& Munro, 1984) that was used to study the overall growth performance of fish populations.

RESULTS AND DISCUSSION

The minimum, maximum and the mean length and weights, as well as the estimated parameters of the length-weight relationship are presented in Table 1.

Table 1 , Minimum, maximum and the mean length and weights, the estimated parameters of the length-weight relationship of the bleak population in Shkodra Lake (n=190)

Population	n	Total Length (TL, cm)			Total Weight (W, kg)			Length-weight relationship		
		Min.	Max.	Mean	Min.	Max.	Mean	a	b	R^2
A. scoranza	190	9.4	16.0	12.8	0.033	0.122	0.075	0.000088	2.57	0.797

The shortest length of fish caught and sampled by commercial fishery was 9.4 cm, that lies under the minimum allowed length for bleak fishing in Albania (10 cm). The lowest weight, 0.033 kg, corresponds to the shorter fish, whereas the heaviest fish sampled, 0.122 kg, correspond to the larger one 16 cm. The maximum length and weight reported for Shkodra bleak by Milisevic and Mrdak (2016) are 17.9 cm (TL) and 0.474 kg.

The length-weight relationship for the Shkodra Lake bleak population is expressed by the equation W $W=0.000088 \cdot L^{2.57}$. The graphic presentation of this function is shown if Figure 1. The "R^2" value indicates a good correlation between length and weight values. The variation of weight for a certain length for the lengths over 13 cm might be the reason of the slightly lower value of correlation coefficient. The calculated "b" coefficient has the value of 2.57, that shows the growth is allometric. In this study, the factors that affect the condition of the fish, such as habitat and season, health and condition of the fish and the length ranges of the sampled individuals (Tesch, 1971), were not tested. The coefficient value "a" relates to the condition of the fish, therefore it is used as an indicator of the condition. The fact that the a-

values in the length-weight relationship of the bleak population has a low value, suggests a poor condition of individuals of the population. Length-weight relationship coefficients calculated from the data gained from 1007 individuals of Shkodra Lake Bleak during 2010-2014 are a = 0.009 and b = 2.936 and R^2 = 0.965 (Milisevic and Mrdak, 2016) and as indicated the growth is almost isometric.
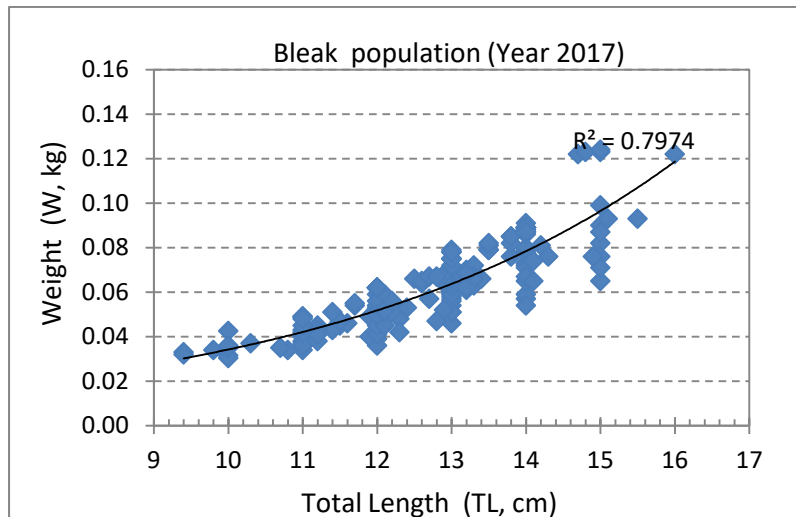

Figure 1 Length-weight relationship of Shkodra Lake bleak population (n=190 individuals sampled)

The analysis of growth parameters of bleak population during the year 2017 was based on 472 individuals sampled from the local commercial fishermen of Shkodra Lake in the months March, June, July August, September and October. During the winter time the bleak is almost not caught in the Albanian part of the lake, because it migrates to wintering in the Northern part of the Lake (Montenegrin part of the lake).

The growth parameters of bleak population, obtained from the time series of the length frequency distribution data using non-linear least squares method. L_∞ was estimated first using the Powell-Watherall Plot and its value was used to calculate growth rate (K) using K-Scan routine. The plot of Rn (goodness of fit index) versus K (growth coefficient) with K ranging from 0.10 to 10 yr^{-1} is shown in Figure 2. A clear peak can be distinguished at K=0.7 yr^{-1}.

The growth parameters calculated using ELEFAN I procedure were: Asymtotic length: L_∞= 19.43 cm; VBGF growth constant: K=0.70 yr^{-1} and age at length 0: t_0=0.18 yr (calculated based on Pauly, 1979 formula). The VBGF curves for bleak population are shown in Figure 3.

The obtained results show a satisfactory growth rate for the bleak population in Lake Shkodra. The calculated growth coefficient of K= 0.70 yr^{-1} is greater than that reported for the same species in the same Lake by Dervishi et al. 2017, Kolaneci et al. 2014 and Memia, 1987 with respectively 0.62 yr^{-1}, 0.42 yr^{-1} and 0.32 yr^{-1}.

Theoretical maximum length (L_∞) of 19.43 cm obtained from this study, is close to the values L_∞=20.0 cm and L_∞=19.42 cm reported by Kolaneciet al.(2010, 2014) respectively for the years 2007 and 2012 and higher than 17.33 cm reported by Dervishi et al. (2017) for the Lake's bleak of the year 2015.

The observed and predicted extreme length (L_{max}) for bleak was found to be respectively 16.50 cm and 16.92 cm. (Figure 4). The range at 95% confidence interval for extreme length was calculated as 15.54 – 18.31 cm.

Length at first maturity is L_m=13.28 cm, that appears higher than minimal allowable length in catch for the bleak.

The growth performance index of bleak population is estimated as Ø'=2.42.
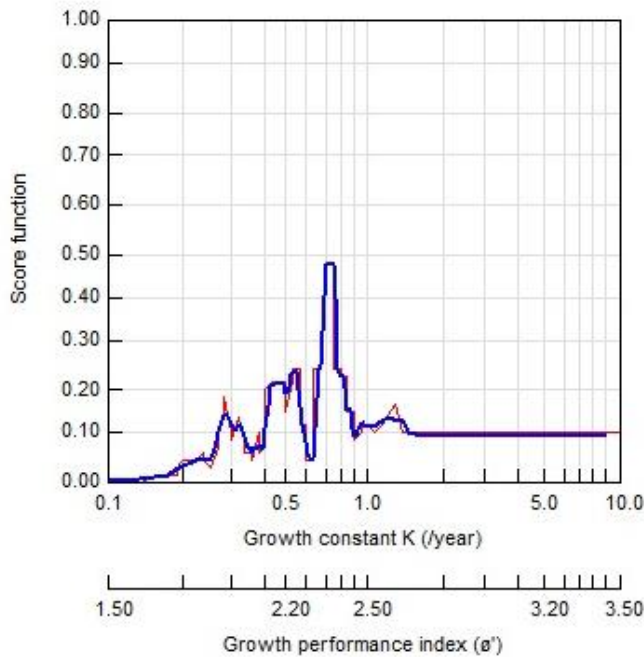

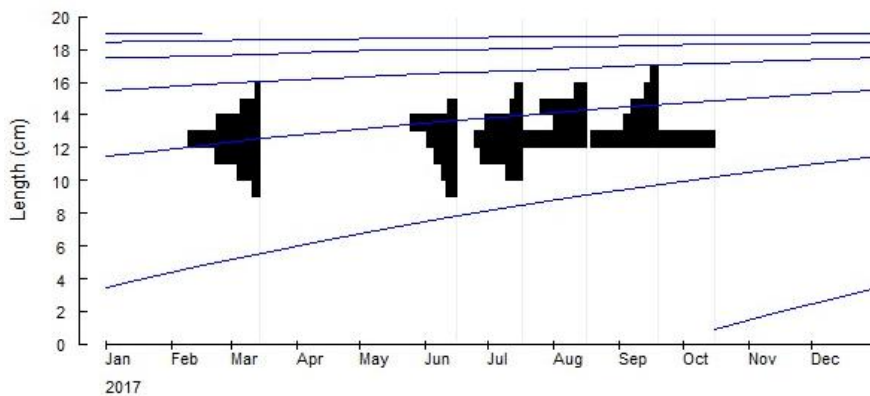Figure 2 K-Scan of length frequency data of Shkodra Lake bleak.

Figure 3   Length frequency data of Shkodra Lake bleak population with superimposed Von Bertalanffy growth curve as output by FISAT.
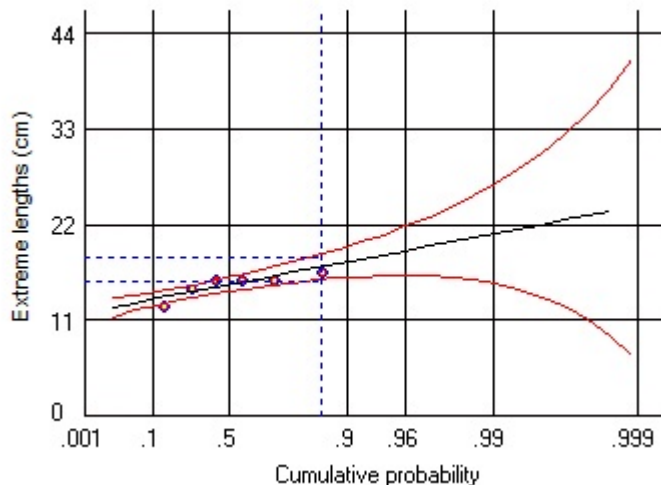
Figure 4   Facsimile representation of results of the analysis of extreme values (from 6 observed extreme length values).

The information on growth, length-weight relationship and performance of Shkodra Lake bleak presented in this paper, is a good bases for evaluation of the bleak populations' dynamics and its abundance.

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