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Estimation of Growth Parameters of Bleak (*Alburnus alburnus alborella*) in Shkodra and Ulza Lake through Length at Age Relationship[#]

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Abstract: Growth varies considerably amongst the individuals in a population and between individuals in different populations of the same species, especially when these populations are found in environments with different characteristics. This study is an attempt to estimate the age of bleak (*Alburnus alburnus alborella*, de Filippi, 1844) using length frequency analysis and the growth parameters through length at age relationship. A Ford Walford plot is used to estimate the von Bertalanffy growth parameters. Growth curves of the bleak populations in both lakes are built using the parameters estimated by non-linear least squares as $K=0.52\ yr^{-1}$; $L_\infty=20\ cm$ and $K=0.45\ yr^{-1}$; $L_\infty=19\ cm$ respectively for Shkodra and Ulza Lake. The growth curves of the bleak populations of two lakes were different with K and L_∞ being higher for Shkodra Lake.

***Key words**: Alburnus alburnus alborella, length frequency analysis, length at age analysis.*

Introduction

The bleak (*Alburnus alburnus alborella*, de Filippi, 1844) is one of the most traditional species of fishing in Albanian fresh and brackish waters. It inhabits both – running and stagnant waters and it is found in large numbers where there is an inflow of food from pumping stations or behind weirs. According to the study of Marku and Nuro (2005) on the concentration profile of the chlorinated compounds in fish samples of Shkodra Lake, the bleak display higher sensitivity to pollution then other cyprinids. Bleak catch in Shkodra Lake in 2005 was 53 ton that makes 10% of the total fish cached in the lake (MoEFWA, 2007). There is no official evidences on bleak fishing in Ulza Lake, however, based on our monitoring it shows some economic interest for the local community living around the reservoir. Despite the work on biology and systematic of bleak (Rakaj, 1995; Kristo, 2001; Dhora, 2005; Dhora, *et al*., 2008) there is no published work available on fish growth in Shkodra and Ulza Lake. In order to achieve a sustainable use of fish resources of Shkodra and Ulza Lake, management plans have to be prepared, and these based on reliable data on fish stock and its variations. For stock assessment knowledge on how the fish in the given population grows is essential. This study is an attempt to estimate the age and growth parameters of *A. alburnus alborella* in two habitats (Shkodra and Ulza Lake) using length frequency analysis and length at age relationship. The method using analysis of length-frequency data have found wider application than skeletal and tagging studies, at least in the case of the relatively small fishes. The reason is that length frequency analyses are easier and cheaper, since less equipment is required.

Materials and Methods

Shkodra Lake is situated in the western part of the Balkan, in the border between Albania and Montenegro and has a surface of 5179 km^2, of which 1027 km^2 are within the Albanian territory. The average altitude of the watershed area is 770 m above the sea level.

The area where is situated Ulza Lake represents the central part of Mati River Valley, near the village Ulza and the city of Burrel. Mati River basin has an area of 2,441 km^2. The area consist a depression which altitude gently decreases to the Mati River Valley from about 500 m to about 80-120 m above the sea level. Relieve is very fragmentized by many small and deep streams which flow to Mati River.

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The fish were cached using trawl nets with mesh sizes of the inner wall 18, 20 and 22 mm and outer walls 36, 40 and 44 mm. In Shkodra Lake the bleak is cached at two sites in near shore shallow waters and at two sites in more offshore waters, whilst in Ulza Lake the samples were collected in two sites offshore. The samplings were made by catch from the local commercial fishery. The samples were collected between October – November 2007 and the bleak length data for each lake were composed together as a singe time collection. Given the short duration of the sampling period, no allowance was made for fish growth during this period.

The lengths (TL) of *A. alburnus alborella* were grouped into 1 cm size classes and graphed as a length-frequency diagram. It is assumed that the sample shown in the diagram is representative of the bleak population - that is, the gear used to collect the sample was totally unselective. The bleak growth curve was estimated from the relative position of the modes in a single length frequency sample (Pauly and David, 1980). The assumption is that the modes have resulted from spawning events that were 12 months apart. The length-frequency data were used for estimating the von Bertalanffy growth parameters. The bleak growth parameters were analyzed using both the traditional graphical method (a Ford-Walford plot) and the non-linear least squares method, that involve a direct search of the values of K, L_∞ and t_0, that best fit a curve through the length at age data (FiSAT II, 2005).

Results and Discussion

The length frequency data in Figure 1 show the number of Shkodra bleaks in each 1 cm class and modes are evident at 8, 13, 15 and 17 cm (arrowed). Fig.2 shows the number of Ulza bleaks in each 1 cm class and the modes are at 7, 11 and 15 cm. In both cases as growth slows down and modal group get closer with age, there may be several year classes bunched together in the "group" with the mode at 15 and 17 cm for Shkodra bleak and at 15 cm for Ulza bleak. The low catch gear ensuing small size bleak sample, especially from Ulza Lake, as well as the use of particular fishing gears has resulted in samples in which some size classes are not well represented in the length frequency data.

In the Figures 3 and 4 the Ford-Walford plot is used to analyze the growth parameters respectively for the bleak of Shkodra and Ulza Lake. The derivation of Ford-Walford plot is based on the von Bertalanffy equation:

$$L_t = L_\infty(1-\exp[-K\ (t - t_0)])$$

with $t_0 = 0$.

A Ford-Walford plot of L_{t+1} against L_t has the equation of the straight line and has for the bleak population of Shkodra a slope of 0.551 and an intercept of 8.471 (Fig.3) and for the bleak population of Ulza a slope of 0.594 and an intercept of 7.479 (Fig.4). Based on these values the growth coefficient (K) and the theoretical maximum length (L_∞) for the bleak population of Shkodra Lake resulted respectively 0,60 yr^{-1} and 18.86 cm. The growth parameters of the bleak population of Ulza Lake were: K=0.52 yr^{-1} and L_∞=18.42 cm.

The theoretical age at 0 length (t_0) is not estimated with the graphical method, since in this study the direct estimation of fish age were not undertaken and the data available on the length at a particular age of bleak populations of both lakes are not reliable.

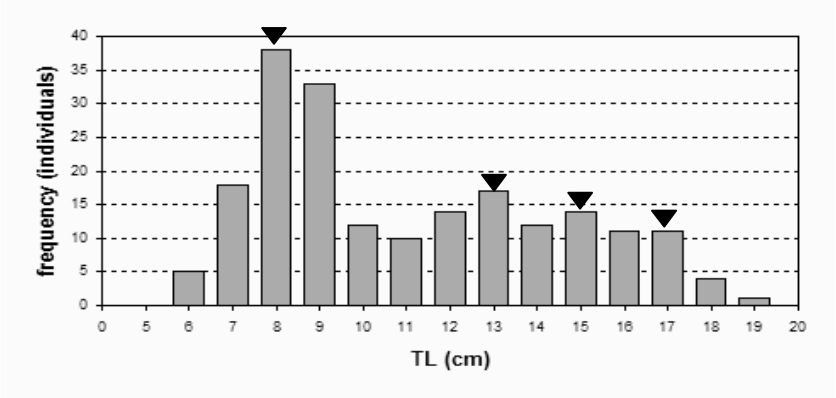

Figure 1. Length-frequency distribution of the bleak of Shkodra Lake in each 1 cm class (n=200). The length modes are showed with arrows.

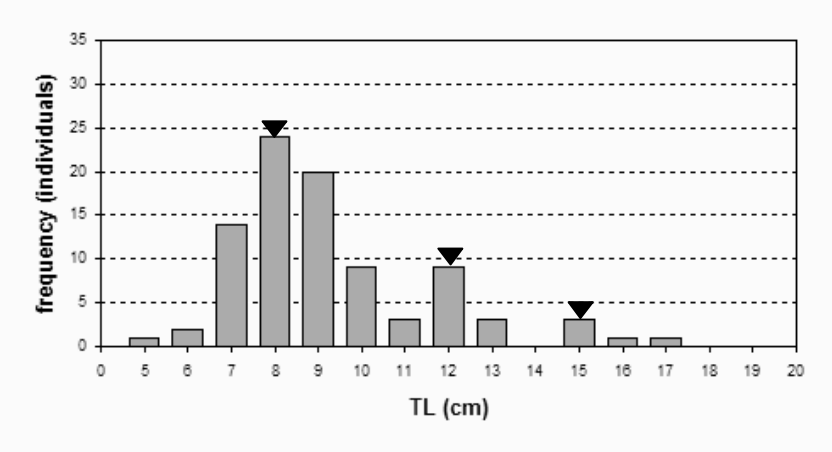

Figure 2. Length-frequency distribution of the bleak of Ulza Lake in each 1 cm class (n=90). The length modes are showed with arrows.

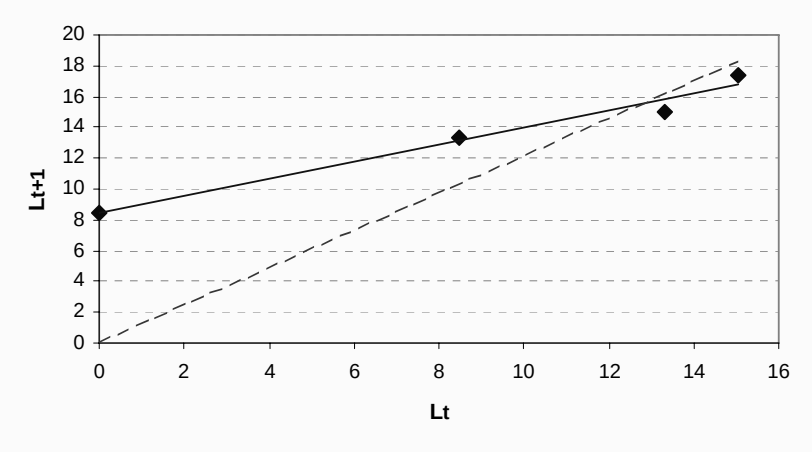

Figure 3. A linear growth curve (continuous line) estimated based on the modal values (diamond spots) of the length-frequency data of bleak population of Shkodra Lake and the Ford-Walford plot for t_0=0 (intermitted line).

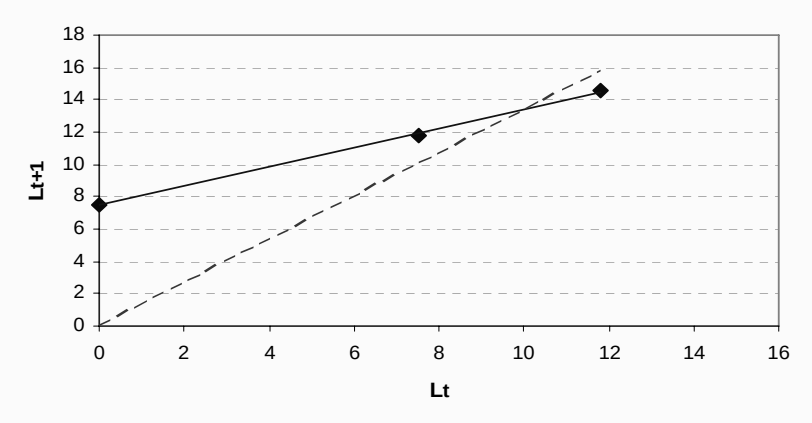

Figure 4. A linear growth curve (continuous line) estimated based on the modal values (diamond spots) of the length-frequency data of bleak population of Ulza Lake and the Ford-Walford plot for t_0=0 (intermitted line).

The growth parameters, besides the graphical method were estimated more directly by the non-linear least squares that involve the estimation of the optimal values of the parameters that result in the model fitting the observed data. Fig.5 shows a growth curve of the bleak population of Shkodra Lake

using the parameters estimated by non-linear least squares as K=0.52 yr^{-1}, L_∞=20.0 cm and t_0=-0.03 yr with a minimum sum of squared residuals (SSR) of 0.92. The growth curve of bleak population of Ulza Lake as K=0.45 yr^{-1}, L_∞=19.0 cm and t_0=-0.09 yr and the SSR=0.74 is shown in Figure 6.

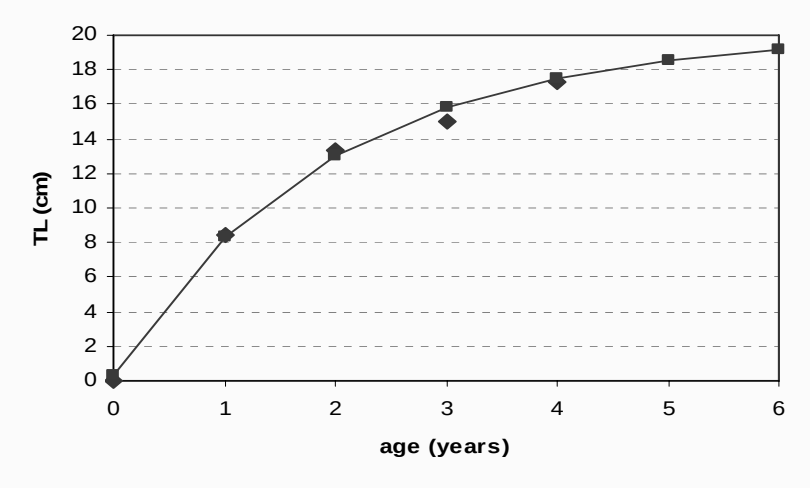

Figure 5. The Von Bertalanffy's growth curve of bleak population of Shkodra Lake estimated by non-linear least squares. Diamond spots show the observed length, whereas the quadrate spots show the estimated length at different ages.

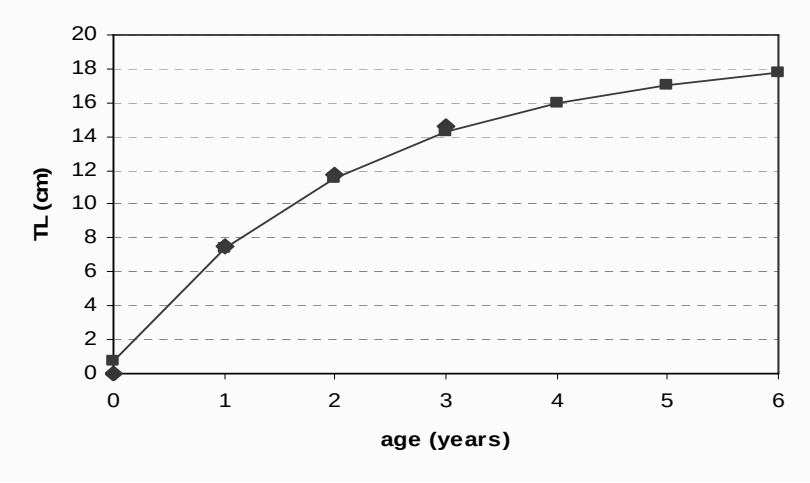

Figure 6. The Von Bertalanffy's growths curve of bleak population of Ulza Lake estimated by non-linear least squares. Diamond spots show the observed length, whereas the quadrate spots show the estimated length at different ages.

The growth coefficients (K) estimated by the non-linear least squares for bleak populations of both lakes are of lower value comparing with the coefficients estimated by the graphical method. The L_∞ calculated by the non-linear least squares were respectively 1.1 and 0.6 cm longer for the bleak population of Shkodra and Ulza Lake compared with the same parameter estimated by the graphical method. L_∞ value of Ulza's bleak is still lower when comparing with the length of some exemplars reported by Rakaj (1995). The best growth of bleak was expressed in Shkodra Lake (K=0.52), although it can be concluded that the fish has a stabile growth in length in spite of different habitats it inhabits, particularly during the first two years of its life. This confirms the considerations of Rakaj (1995). Population growth of bleak over years is difficult to interpret since data for comparison are lacking. The explanation of the lower rate of growth of Ulza bleak compared with Shkodra bleak needs further studies on water quality of Ulza Lake, since there are not measurements on the microcomponents concentration like heavy metals. It should be of particular interest to measure the concentration of cupper and chrome in Ulza Lake because of the existence of some cupper and chrome

mines that are situated in the watershed of Uraka river (a tributary of Mati River) and in upper part of Mati River.

The use of sequential length-frequency samples collected at different times would have provided more reliable fish growth data. Beside this, further studies are needed on the population characteristics of plankton and predators in the lakes that will provide the needed information for the explanation of the differences in growth characteristics of bleak populations.

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