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Age, growth and mortality of *Acanthobrama microlepis* (De Filippi, 1863) from Lake Çıldır, Turkey

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Abstract: This study was carried out in August-September 2014 and May 2015 in Lake Çıldır. A total of 229 specimens of *Acanthobrama microlepis* were used to determine some population parameters. The age of the specimens ranged from I to IV age groups and dominant age group was II. Total length varied from 7.6 to 24.2 cm with mean of 16.23±4.22 cm and total weight ranged from 3.68 to 123.46 g with mean of 42.70±33.24 g. The length-weight relationship were estimated as $W = 0.0058L^{3.1199}$. The von Bertalanffy growth parameters, growth performance index and Fulton's condition factor were calculates as L_∞ = 38.37 cm, k = 0.193 year^{-1}, t_o = -0.73 year, Φ = 2.45 and K = 0.75, respectively. Total mortality, natural mortality, fishing mortality and exploitation rates also estimated as Z = 0.50, M = 0.28, F = 0.22 and E = 0.44, respectively. In the light of these values it could not indicate any overfishing on population based on the exploitation rate.

Keywords: *Acanthobrama microlepis*, Blackbrow bleak, Caucasian bream, Lake Çıldır, Population parameters, Mortality rates.

Introduction

The genus *Acanthalburnus* belongs to Leuciscine Cyprinids and distributed in Southwest Asia. It is mentioned as the only endemic genus of the Kura-Aras River Basin (Bogutskaya, 1997). According to cytochrome *b* data, *Blicca-Abramis-Vimba* group, includes two genus of *Acanthobrama* and *Acanthalburnus* and interestingly the genera *Abramis* and *Acanthobrama* were paraphyletic (Durand et al., 2002). However, Perea et al. (2010) proposed *Acanthalburnus* synonymy of *Acanthobrama* using mitochondrial and nuclear DNA data. Additionally, morphological study conducted on validating this genus changing by Küçük et al. (2014).

Acanthobrama with about 13 species, among them, 4 species occur in inland waters of Turkey, including *A. marmid*, *A. centisquama, A. orontis* and *A. microlepis*, they found in Tigris-Euphrates, Orontes, Seyhan and Kura-Aras rivers basins, respectively (Küçük et al., 2014). *Acanthobrama microlepis* is endemic to the Kura-Aras basin inhabits both rivers and lakes where is restricted to the Kura River drainage including its tributary Aras, excluding the lower reaches of the Kura (Berg, 1964; Coad, 2015). Even though the species has not economic value, is used for human consumption by locally, however, it plays an important role because of it is an important prey item of many predator fish species while its main food items are plankton and some invertebrates (Geldiay and Balık, 2007). Lake Çıldır is the second largest freshwater lake after Lake Van in the eastern part of Turkey. The lake is located in northeastern part of Turkey at the elevation of about 1950 m, maximum surface area is about 123.5 km^2 with a maximum depth about 40 m (Akbulut and Yıldız, 2002). Surface of the lake is cover with about 40 cm ice thickness during winter season.

There are several paper dealing with the karyotype (Nur, 2006; Vasilyan, 2009), toxicity (Aksu, 2006; Gül et al., 2007; Aksu et al., 2008a, b) and some population parameters (Temelli, 1988; Türkmen et al., 2001) of *A. microlepis* in tributaries of Aras River. However, there has not been any study conducted on population dynamic parameters of the species inhabiting lentic ecosystem. Therefore, this study aimed to investigate population parameters including age, growth, mortality and

Table 1. Age, length and weight-frequency distribution of *Acanthobrama microlepis* from Lake Çıldır.

Age	n	%n	Total Length (cm)			Total Weight (g)	
			Mean	Range	Growth Rate (%)	Mean	Range
I	45	20.2	10.72±1.58	7.6-13.0		10.18±3.76	3.68-17.12
II	89	39.9	14.83±0.96	12.7-16.9	38.34	25.68±6.20	14.62-41.36
III	59	26.5	19.14±2.49	13.7-23.6	29.06	62.19±23.16	18.78-115.94
IV	30	13.4	22.91±0.70	22.0-24.2	16.41	103.65±9.92	98.10-123.46
Σ	223		16.23±4.22	7.6-24.2		42.70±33.24	3.68-123.46

exploitation rates of *A. microlepis* from Lake Çıldır.

Materials and Methods

This investigation was carried out in August 05, 2014, September 27, 2014 and May 30, 2015 in Lake Çıldır (43.132453˚-43.332953˚E/40.940109˚-41.107950˚N). A total of 229 specimens were caught using multi-mesh gillnet (5, 6.25, 8, 10, 12.5, 15.5, 19.5, 24, 29, 35, 43, and 55 mm, knot to knot). The collected specimens were fixed into 10% formalin, transferred to the laboratory and stored in 70% ethanol for further processing. The taxonomic key given by Berg (1964) was used to identify the samples. Five of the specimens were cataloged (NHVIC 201505010) in the Ichthyology Collections of Nevsehir Hacı Bektaş Veli University, Department of Biology, Nevşehir, Turkey.

The total length and weight were determined to the nearest 1 mm and 0.01 g, respectively. The scale samples were removed from the left side of specimens, from the ventral to the dorsal fin for the age determination. The length-frequency data were plotted with 1 cm length intervals. Scales were soaked in water and examined independently twice with no reference to the previous readings and without any knowledge of the length or weight of the fish under the stereo binocular microscope. The precision was measured by the percentage of agreement between the two readings (Chang, 1982). The assessment of age was based on the determination of the number of annuli on each scale.

The length-weight relationships were determined according to the power equation given by Sparre and Venema (1998):

$$W=\alpha * L^{b}.$$

In this equation, W is total weight, α and b are regression constants and L is total length. The length-length (total length: TL, fork length: FL, and Standard Length: SL) relationships were calculated linear regression.

The von Bertalanffy parameters, L_∞, k and t_o, were estimated using the Least Squares Method recommended by Sparre and Venema (1998). Growth in length and weight were expressed in terms of the von Bertalanffy equation $L_t = L_\infty[1\text{-}e^{-k(t\text{-}to)}]$. Correspondence between empirical data and an expected distribution was tested by Khi^2 test. The b value was tested by t-test to verify whether it was significantly different from the isometric growth ($b = 3$).

The growth performance index (Φ') was calculated using the formula (Pauly and Munro, 1984):

$$\Phi' = \log k + 2\log L_\infty$$

Fulton's condition factor (K) were calculated by following equations:

$$K = 100\frac{W}{L^b}$$

Where, W is total weight, L is total length and b is regression constant (Sparre and Venema, 1998). The instantaneous rate of total mortality coefficient Z was estimated using Beverton and Holt's Z Equation (1956):

$$Z = k\frac{(L_\infty - \bar{L})}{(\bar{L} - L')},$$

Where, $\bar{L}$ is the mean length of the entire catch and L' is the lower limit of corresponding length intervals (Sparre and Venema, 1998). The natural mortality coefficient (M) was estimated following Pauly's empirical formula (Pauly, 1980), linking the natural mortality with the von Bertalanffy parameters, L_∞ (cm), k and mean annual temperature (T, °C) of water in habitat (in this case 6.0°C):

$$\log_{10} M = -0.0152 - 0.279\log_{10} L_\infty + 0.6543\log_{10} k + 0.463\log_{10} T.$$

Fishing mortality rates (F) was calculated as the difference between Z and M ($F = Z\text{-}M$). The value of the average annual exploitation rate (E) was obtained by $E = F/Z$ (Sparre and Venema, 1998).

Results

A concentric pattern of translucent and opaque zones was readily distinguishable in the scales, and easily

Table 2. Length-weight relationship and von Bertalanffy growth parameters for *Acanthobrama microlepis* from Lake Çıldır.

n	*b*	*a*	L_∞ (cm)	*k* (year^{-1})	t_0 (year)	Φ'	*K*	References
	3.0016	0.0077	30.8	0.07	-3.28		1.32	Temelli, 1988
	3.052-3.098	0.001-0.012	29.9	0.10	-1.92	1.97	1.201	Türkmen et al., 2001
	2.429	0.0000005					0.73	Faradonbeh et al., 2015
229	3.1199	0.0058	38.4	0.19	-0.73	2.54	0.75	This study

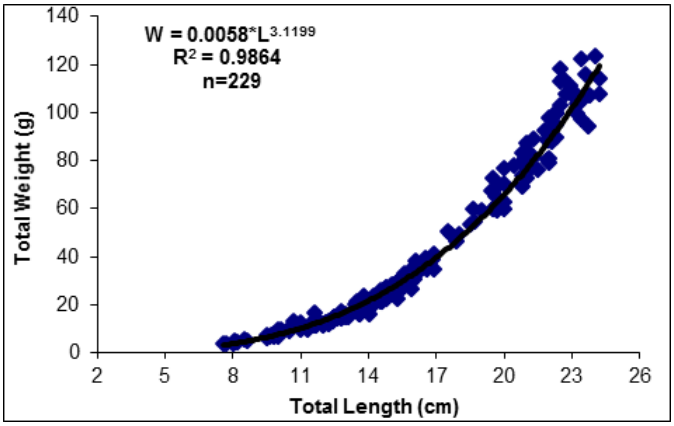

Figure 1. Length-weight relationship of *Acanthobrama microlepis* from Lake Çıldır.

interpreted. Of the 229 examined specimens, six (2.6%) were considered unreadable and therefore no age estimates were obtained from them. Of the remaining 223 scales, the readings were coincident by two readers in 206 (92.4%). The value of the index of average percent error was only 4.7%. Age-frequency distributions in total length and weight of *A. microlepis* were represented in Table 1. Age of varied from I to IV age groups and most frequent groups was II (39.9%) followed by III (26.5%), I (20.2%) and IV (13.4) age groups, respectively. The total length ranged between 7.6 and 24.2 cm with a mean of 16.23±4.22 cm. The total weight of studied varied from 3.68 to 123.46 g, and mean weight 42.70±33.24 g. It was evident that *A. microlepis* grew rapidly in their first year after which growth rate declined year by year (Table 1).

The length-weight relationship for *A. microlepis* is presented in Figure 1. The relationship is determined as $W = 0.0058L^{3.1199}$ (95% CI of *b:* 3.072-3.168). The *b* value was significantly bigger than 3.0 ($P<0.001$), which indicates positive allometric growth of *A. microlepis.* The length-length relationships were expressed as FL = (0.9266*TL)-0.406 and SL = (0.8788*TL)-0.8072.

The von Bertalanffy growth parameters, growth performance index and Fulton's condition factor were calculates as $L_\infty = 38.37$ cm, $k = 0.193$ year^{-1}, $t_o = -0.73$ year, $\Phi = 2.45$ and $K = 0.75$, respectively. Instantaneous total (Z), natural (M) and fishing (F) mortalities were estimated 0.50, 0.28 and 0.22 years^{-1}, respectively. The exploitation rate (E) was calculated as 0.44.

Discussion

The age groups in the sample ranged from I to IV year in Lake Çıldır. In the previous studies, Temelli (1988) reported that age of *A. microlepis* varied from I to VI and the oldest age was reported as VII age by Türkmen et al. (2001). Total length of 229 analyzed specimens of *A. microlepis* collected during the survey ranged from 7.6 to 24.2 cm, most frequently from 11 to 15 cm (mean 16.23±4.22 cm). The mean fork lengths for age group I and VII were calculated as 7.78±0.08 cm and 18.12±0.92 cm, respectively by Türkmen et al. (2001). While the highest age was reported by Türkmen et al. (2001), the highest total length observed in Lake Çıldır.

Some population parameters were reported for *A. microlepis* in the previous studies given in Table 2. As can be seen the table, the length-weight relationship constant of *A. microlepis* in Lake Çıldır are very similar to those obtained by Temelli (1988) and Türkmen et al. (2001) from tributaries of Aras River. All estimated *b* values were above 3 reported from Turkey however lowest the *b* value was reported from Iran (Faradonbeh et al. 2015).

While the highest *b* value (3.1199) was estimated in this study, there is striking similarity among estimated length-weight relationship constant in Aras River basin, Turkey. However there is a significant difference found between Lake Çıldır and Totkabon River (Iran) populations (Faradonbeh et al., 2015). The length-weight relationship may be influenced by sex, maturity, geographical location and environmental conditions given year (Weatherley and Gill, 1987). Additionally, sampling bias due to the collection method could influence the size frequency distribution and finally the estimation of parameters. Sample size is only 22 specimens and length

ranged only between 3.1 and 8.3 cm with a mean 5.1±0.2 cm in the study carried out in Totkabon River (Faradonbeh et al. 2015).

The longest L_∞ value estimated in this study is 38.4 cm vs 29.9 cm given by Türkmen et al. (2001) and 30.8 cm given by Temelli (1988). For a long time, the influence of environmental factors on fish has been studied in respect to their effects on fish growth. Because of fish are an ectotherms, growth of fish is highly dependent on temperature. But other factors are also involved in the control of physiological functions (Boeuf and Le Bail, 1999). Consequently, all of these factors have an impact on population parameters.

The growth performance index obtained for *A. microlepis* of the Lake Çıldır ($\Phi' = 2.54$) is bigger than given from stream population by Türkmen (2001). Certain environmental factors such as water temperature, food supply, poor water quality, physical disturbance and biology of fish such as maturity and hormones have an obvious and major influence on growth rate (Kapoor and Khanna, 2004). Therefore the difference among studies linked with these factors.

The lowest K value was observed in this study compared to previous studies (Temelli, 1988; Türkmen et al., 2001). The condition factor is an index reflecting interactions between biotic and abiotic factors in the physiological condition of fishes (Le-Cren, 1951). K values vary over the season because of spawning activities with the lowest K value found during the spawning season. This indicates that during this period the fish often does not feed, but uses lipid reserves necessary for spawning (Craig et al., 2000). Indeed, the most of the analyzed specimens in this study caught during spawning season in May 2015.

Mortality and exploitation rates were estimated not estimated for *A. microlepis* previously. Exploitation rate was estimated as 0.44 in this study. This value is below the optimum level of exploitation to point out there is no overfishing pressure on the Lake Çıldır population. Indeed, *A. microlepis* is not commercially fished in Lake Çıldır.

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