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Original Article

Age, growth and some biological characteristics of Silver bream (*Blicca bjoerkna* L., 1758) (Cyprinidae) from Aras Dam Lake in Northwest of Iran

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Abstract: We collected Silver bream *Blicca bjoerkna* from March to July 2013 from Aras Dam Lake (North-west of Iran) and investigated its age, size, and some biological characteristics. The maximum age was 5^+ years. The total length and weight of specimens ranged 137-278 mm and 26-247 g for male and 134-282 mm and 26-289 g for female, respectively. Length-weight relationship was estimated as $W = 1E\text{-}06TL^{3.44}$ for females, $W = 1E\text{-}06TL^{3.45}$ for males and $W = 1E\text{-}06TL^{3.44}$ for the sexes combined. Sex ratio was 1:1.42 in favor of males. The growth model was positive allometric for males, females and sexes combined. The calculated maximum condition factor was 0.34 in male and 0.37 in female. The most frequent age classes in the samples were 2^+ years for males and females.

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Introduction

Silver bream, *Blicca bjoerkna*, is a cyprinid fish species and widespread in stagnant waters of lakes and reservoirs, calm rivers and canals throughout central and northern Europe, from the east of England to the Caspian Sea basin (Spillmann, 1961; Wheeler, 1969; Lelek, 1980; Kottelat, 1997). This species has been reported from the southern Caspian Sea basin, including Aras, Atrak, Gorgan, Tajan, Babol, Haraz, Sardab, Tonekabon and Safidrud Rivers as well as the Anzali and the Boojagh Wetlands (Derzhavin, 1934; Holčík and Oláh, 1992; Nejatsanatee, 1994; Kiabi et al., 1999; Abdoli, 2000; Abdoli and Naderi, 2009; Khara et al., 2011). Silver bream is strictly a phytophilous species (Balon, 1975, 1984; Philippart and Vranken, 1983) reproducing from May to July (Kottelat and Freyhof, 2007). Since, this species spawns at shallow depths, it is highly sensitive to changes in water level; in the bays of the Kakhovka reservoir, Spivak (1987) observed that this fish lays eggs along the shoreline at depths to 40 cm on willow roots, floating residues of the previous year's plants and stems of growing reed. Males of this species become partially mature in the 2nd year and females in the 3rd-5th year. Silver bream can live up to 16 years (Pecl, 1990). Despite being an abundant species, Silver bream is of little importance as its meat is of poor quality. Nevertheless, this species is an important component in the diet of predatory fishes (Okgerman et al., 2012).

In Iran, studies on the biology and ecology of *B. bjoerkna* is rare, but out of Iran several works on its feeding strategy and growth (Specziár et al.,1997), growth and reproduction aspects (Balık et al., 1999; Hamalosmanoğlu, 2003), maturity and fecundity (Gürsoy, 2001) and length-weight relationship (Tarkan et al., 2006;Yılmaz et al., 2012) have been published.

Although there is no economic value of Silver bream in general, this species caught for consumption in Aras Dam Lake due to the decrease of commercial

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Table 1. Average total length (mm) and weight (g)-at-age of *B. bjoerkna* in Aras Dam Lake

Age group	Total length ± SD	Min–Max	Total weight ± SD	Min–Max	N
Male					
1^+	185.8 ± 26.17	154-226	79.6 ± 45.49	33-149	17
2^+	203.8 ± 34.6	137-262	112.7 ± 56.4	26-216	131
3^+	207.1 ± 33.1	138-278	114.2 ± 55.7	27-248	63
4^+	221.1 ± 13.5	200-247	131.7 ± 39.4	89-248	18
5^+	270	270	230.9	230.9	1
Female					
1^+	170.7 ± 22.2	146-206	58.7 ± 32.3	31-130	12
2^+	201.4 ± 38.4	134-266	112.2 ± 63.7	26-223	91
3^+	211.8 ± 34.2	143-276	126.1 ± 67.2	27-289	48
4^+	234.9 ± 21.87	209-282	157.9 ± 45.3	98-241	9
5^+	236.5 ± 13.4	227-246	161.7 ± 12.6	152-171	2

fish as a result of overfishing. Aras River is one of the largest rivers of the Caspian Sea basin. Aras dam with max capacity of 1350 × 106 m^3, max area of 153 km^2, mean depth of 20 m and height of 36 m, was constructed in 1972 on this river.

This study aimed to describe the age structure, growth pattern, condition factor (*K*A) and length-weight relationship (LWR) of *B. bjoerkna* inhabiting Aras Dam Lake (Western-Azerbaijan Province, Iran). These biological data of fishes are imperative for both fishery biology and taxonomic studies and give information on the condition and growth patterns of fish that are necessary for proper management and conservation of the wild population (Oscoz et al., 2005).

Materials and Methods

A total of 392 specimens were caught using gillnets (20 m × 2 m) of various mesh sizes (16, 18, 20, 22, 24, 28, 32, 36, 40, 45, 50, and 55 mm, knot to knot) monthly during March to July 2013 (in the last week of each month) from Aras Dam Lake (46°54'52.05"E, 39°09'42.11"N).

In the field, all specimens were anaesthetized by 1% clove solution and then preserved in 10% formaldehyde solution. In the laboratory, all specimens were measured for total length (TL) and total body weight (TW) to the nearest 0.01 mm (using a digital caliper) and 0.01 g (using a digital balance), respectively. Age was determined from both left and right opercula based on banding patterns, being reviewed three times (each time by a different person) using a 20-40X binocular microscope under reflected light.

The relationship between TL and TW was determined using the equation: $TW = a\,TL^b$; where a is the intercept and b is the slope (coefficient of allometry) (Pauly, 1984). Sex was determined by visual examination of the gonadal tissue. Condition factor (*K*A) was calculated using the equation $K\text{A} = W/L^b$ (Ricker, 1975), where W is the body weight (BW) in g; L is the total length (TL) in cm; b is the parameters of the TL-BW relationship. According to Froese (2006), the factor 100 is used to bring *K*A close to unity.

Analysis of co-variance (ANCOVA) was performed to test for significant differences in weight-length relationships between sexes. Any significant difference in the overall sex ratio was assessed using the chi-square test (Zar, 1984). All statistical analyses were performed with a significance level of $P<0.05$ using the SPSS 21 software package.

Results

The total length and weight of males range 137-278 mm and 26-247 g, respectively, while those of females range from 134-282 mm and 26-289 g, respectively. The majority of specimens were belonged to age group 2^+, with 5^+ being the oldest age recorded for both sexes. The observed length-at-

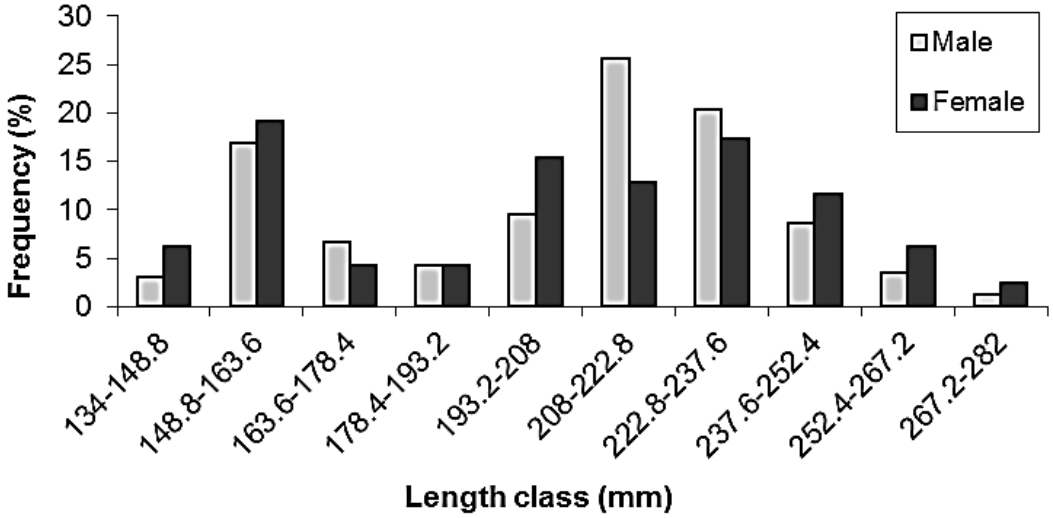

Figure 1. Total length (mm) frequency of male and female *B. bjoerkna* in Aras Dam Lake.

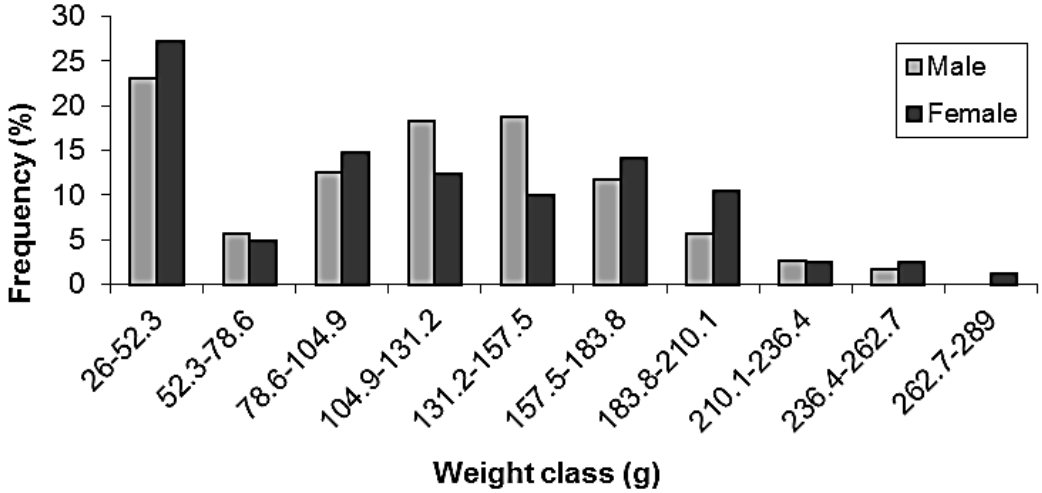

Figure 2. Total weight (g) frequency of male and female *B. bjoerkna* in Aras Dam Lake.

age in the population was different between sexes, females being longer and heavier than males (Table 1). Length and weight frequency distribution of the fish (Figs. 1 and 2)indicate that the most frequent size classes in the samples were 208-222.8 mm and 26-52.3 g for males and148.8-163.6 mm and 26-52.3 g for females, respectively. Females were rare in length classes greater than 267.2-282 mm.

The growth model was positive allometric for males, females and sexes combined because the *b* value was significantly different from 3 (Pauly's Test, t_{male} = 9.5, t_{male} = 9.49, $t_{sexes\ combined}$ = 12.6, t_{pooled} = 1.96, P>0.05).

The overall ratio of females to males was 1: 1.42 and Chi-square analysis indicated a significant difference from an expected ratio of 1: 1 (χ^2 = 113.27, P<0.05). An unequal sex ratio was observed among length classes (Fig. 1).

The total length-weight relationships were evaluated for males, females and sexes combined. A significant relationship with the high regression coefficient (r>0.98) was found between the length and weight of the Silver bream. The length-weight relationships were found as $W = 1E\text{-}06TL^{3.45}$ for males, $W = 1E\text{-}06TL^{3.44}$ for females, and $W = 1E\text{-}06TL^{3.44}$ for sexes combined (Fig. 3).

The calculated condition factor (*K*A) values are shown in Figure 4. There was no significant difference in mean *K*A between sexes (t-test, P>0.05). The calculated minimum and maximum

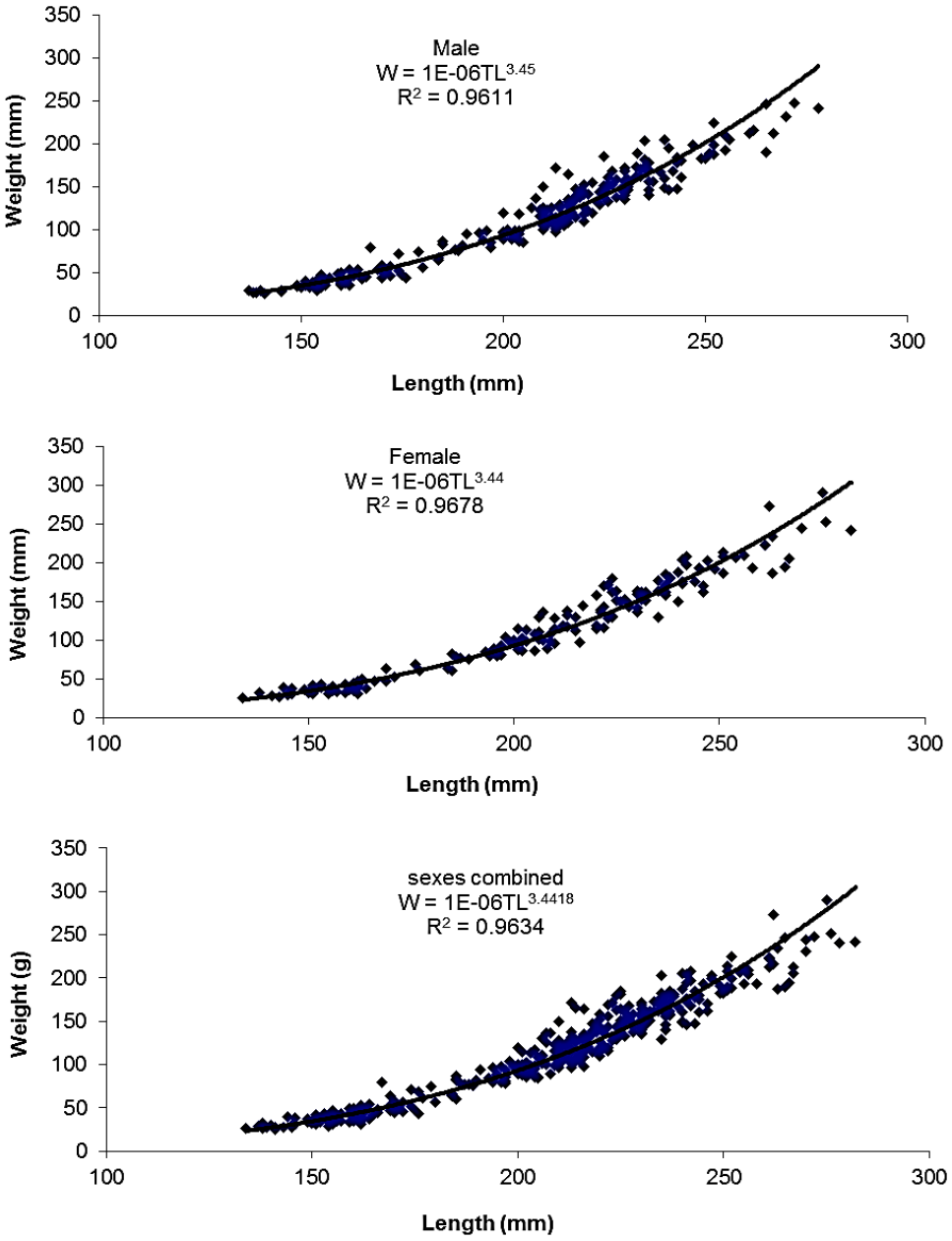

Figure 3. Relative growth curves (total length versus total weight) for males, females, and sexes combined of *B. bjoerkna* in Aras Dam Lake.

*K*A was 0.27 and 0.34 for 5^+ and 2^+ in male and 0.30 and 0.37 for 5^+ and 2^+ in female, respectively. Age frequency distribution of the fish (Fig. 5) indicated that the most frequent age classes in the samples were 2 year for males and females.

Discussion

The total lengths and weights of examined Silver bream specimens ranged 13.4-28.2 cm and 26-289 g, respectively. The standard lengths of this species ranged from 3.8 to 32.9 cm in Lake Balaton (Specziár et al., 1997). Balık et al. (1999) reported that distributions of the fork lengths and weights of Kuş Lake population of Silver bream were 3.5-17.2 cm and 0.5-134.6 g, respectively. These ranges were determined as 9.6-49.2 cm and 11-269 g for the Silver bream of the lake Sapanca (Hamalosmanoğlu, 2003). Tarkan et al. (2006) studied with Silver bream specimens were 12-21.2 cm of total lengths. Differences of weight and length distributions can be attributed to sampling time and method, type of length measured, population density and ecological

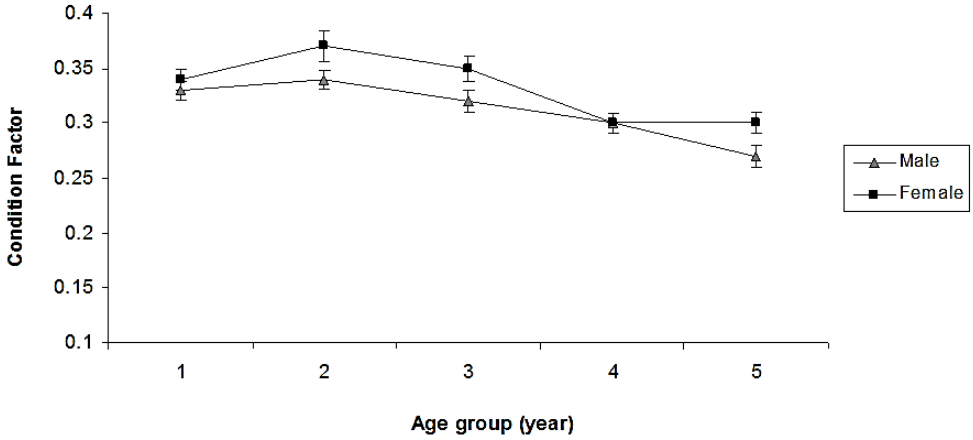

Figure 4. Condition factor of male and female *B. bjoerkna* in Aras Dam Lake.

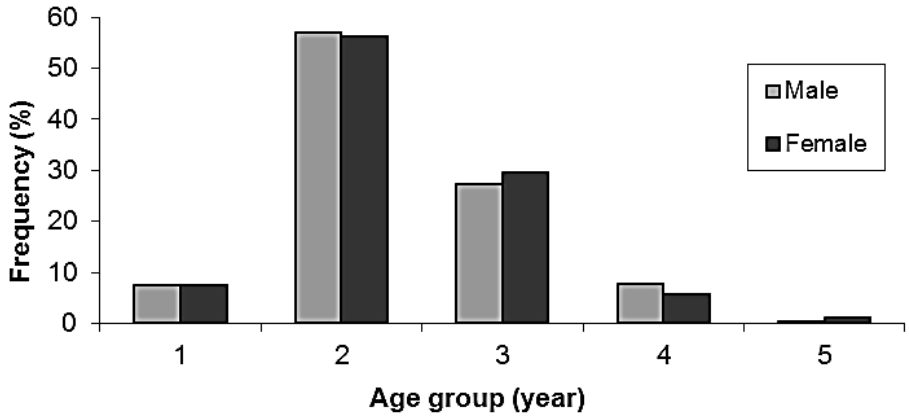

Figure 5. Age (year) frequency of male and female *B. bjoerkna* in Aras Dam Lake.

features of studied lakes (Yılmaz et al., 2012).

The growth model was positive allometric for males, females and sexes combined. Specziár et al. (1997) reported that growth of Silver bream population in Balaton Lake, Hungary, was positive allometric with *b* value of 3.267. In Turkey, *b* values of LWR for females, males and total individuals of *B. bjoerkna* inhabiting Lake Kuş were 3.24, 3.27 and 3.31, respectively (Balık et al., 1999). These parameters were determined as 3.09 for females, 2.96 for males and 3.04 for entire population of *B. bjoerkna* in Lake Sapanca by Hamalosmanoğlu (2003), and 3.18 for all specimens in the same lake by Tarkan et al. (2006). Our results were in accordance with the previous works. The variation in the *b* exponent which is interpreted as variation in fish condition or fitness could be attributed to the different environmental conditions that vary between rivers and between years in a river, and act as a local selective pressure on the fish. Therefore, variation in the *b* exponent can be attributable to a species response to different habitat conditions (Weatherley, 1972).

The sex ratio (female: male) was 1:1.42 in favor of males. This ratio was estimated 1:0.35 in Lake Kuş population of *B. bjoerkna* (Balık et al.,1999), 1:1.07 and 1:0.53 in Sapanca Lake (Gürsoy, 2001; Hamalosmanoğlu, 2003) and 1:0.98 in Lake Ladik (Turkey) (Yılmaz et al., 2012) populations of *B. bjoerkna*. Nikolsky (1980) reported that sex ratio varied considerably from species to species; however, in the majority of species, it is close to one. However, subsequent changes in this ratio may be explained by a number of hypotheses, including differences in habitat preference according to the season or sex, sampling errors and selective mortality (Fernandez and Rossomanno, 1997).

The maximum age of Silver bream in this study was

5^+ years that is less than that of reported by Okgerman et al.(2012) in Sapanca Lake (9^+ years), Kirilyuk (1991) in Kremenchug Reservoir (11^+ years) and Sasi and Berber (2012) in Uluabat Lake (7^+ years).

The calculated maximum *K*A was 0.34 in male and 0.37 in female for 2^+ years of Silver bream. There is no published information about the condition factor of Silver bream to compare with the present results. *K*A reflects, through its variations, information on the physiological state of the fish in relation to its welfare. From nutritional and reproductive points of view, higher *K*A values show the accumulation of fat and gonadal development (LeCren, 1951; Angelescu et al., 1958). *K*A also gives information when comparing two populations living in certain feeding, density, climate, and other conditions in terms of the period of gonad maturation and degree of feeding activity of a species to verify whether it is making good use of its feeding source (Weatherley, 1972).

The length, weight and age characteristics of Silver bream from the western Iran basin indicate a short life span (5^+ years in both sexes), and a moderate body weight (weight-length relationship: $b>3$). These findings provide important new data with respect to the biology of this species. It is suggested assessment of the potential impacts of habitat degradation on populations of this species.

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