Original Article

Some biological properties of Kura goby, *Ponticola cyrius* (Kessler, 1874) (Gobiiformes, Gobiidae) from Kura River, Turkey

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Abstract: This work presents some biological properties, including length-frequency, length-weight relationships, Fulton's condition factor, growth parameter, and growth performance and mortality indices of Kura goby, *Ponticola cyrius*. A total of 73 specimens were collected from the Çot Creek a tributary of Kura River, from May to September 2015. Age of *P. cyrius* varied from 0 to III age with age group I as the most frequent (56.16%). The total length and weight ranged 4.3-16.4 cm, and 1.10-50.10 g, respectively. The length-weight relationship was $W=0.0145L^{2.9795}$ with *b*-value indicating isometric growth pattern. The estimated von Bertalanffy growth parameters are $L_\infty = 26.36$ cm, $k = 0.187$ year^{-1} and $t_o = -1.33$ year. Growth performance index (Φ') and mean Fulton's condition factor were estimated as 2.115 and 1.43, respectively. Instantaneous rate of total, natural and fishing mortalities were 0.588, 0.371 and 0.217 year^{-1}, respectively and the exploitation rate was calculated as 0.369.

Introduction

The genus *Ponticola* Iljin, 1927 consists 14 valid species inhabiting the Black and Caspian Sea basins (van der Laan, 2019) that 8 of them viz. *P. constructor, P. cyrius, P. eurycephalus, P. kessleri, P. rattan, P. rizensis, P. syrman* and *P. turani* are found in Turkey (Çiçek et al., 2015). Among them, Kura goby, *P. cyrius* (Kessler, 1874) is endemic to the Kura River drainage (Kuru, 1975; Çiçek et al., 2016) and its absence in the lower Kura River could have been prevented by prior penetration of *P. gorlap* (Vasil'eva and Vasilev, 1995).

The Kura goby prefers slow current and muddy bottoms. This species reaches a maximum total length of about 13.0 cm (Coad, 2019). Few population dynamic parameters of the Kura goby have been provided by Zamani Faradonbeh et al. (2015) and Asadi et al. (2017) from the southern Caspian Sea basin. Recently Vasileva et al. (2015) described *P. iranicus* from of Sefid river drainage including Shahre Bijar, Totkabon and Gisum rivers, Guilan Province which probably is those previously reported

P. cyrius in Iranian part of the Caspian Sea basin, that need to be confirmed (Nikmehr et al., 2018, 2019).

The growth is the determination of the body size as a function of age and the stock assessment methods work essentially with age composition data (Sparre and Venema, 1998; Hawk and Allen, 2014). Hence, age and growth information are crucial for management of the exploited fish stocks, and in this regard, the determination of the biological characteristics of a species is of great importance. Therefore, this study aimed to provide some population parameters of *P. cyrius* inhabiting Kura River part of Turkey.

Materials and Methods

A total of 73 specimens were collected from the Çot Creek (41.17566121N, 42.94917989E), a tributary of the Kura River, eastern Anatolia Region, Turkey using an electrofishing device in May-September 2015 (Fig. 1). The specimens were collected in slow flowing creek over rock-stony and muddy substrates. During sampling, stream width was 16 m, mean water depth

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Figure 1. General body shape of *Ponticola cyrius*. (A) Pelvic disc fraenum with angular lobes, and (B) ctenoid and (C) cycloid scales.

24 cm, water temperature 21°C and flow rate of 0.67 m/s. The specimens were fixed into 10% formalin, after anesthesia, transferred to the laboratory and then stored in 70% ethanol.

Measurements were taken using a digital calipers and data recorded to the nearest 0.1 mm. Meristic characteristics were counted using a stereo-microscope. The taxonomic key given by Berg (1949), Kuru (1975) and Coad (2018) were used to identify the samples. The total length and total weight were measured and weighed to the nearest 1 mm and 0.01 g, respectively. The scale samples were removed from the nape area (cycloid) and the left side of the body ventral to the dorsal fin (cteniod) for the age determination. 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 stereomicroscope. 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-frequency data were plotted with 1 cm length intervals. The length-weight relationships were determined according to the equation of $W = a*L^b$, (Sparre and Venema, 1998), where W is total weight, a and b are regression constants and L is total length. Growth in length and weight were expressed in terms of the von Bertalanffy equation of $L_t = L∞[1-e^{-k(t-to)}]$. The growth parameters $L∞$, k and t_o were estimated using the least squares method (Sparre and Venema, 1998). Correspondence between empirical data and an expected distribution was tested by Khi^2 test. The b value was tested by t-test to verify that it was significantly different from the isometric growth ($b = 3$).

The growth performance index ($Φ'$) was calculated

Table 1. Age, length and weight-frequency distribution of *Ponticola cyrius* from Kura River drainage.

Age	n	%n	Mean Length (cm)	Range	Growth Rate %	Mean Weight (g)	Range
0	9	12.33	5.54±0.91	4.3-7.3		2.50±1.28	1.10-5.34
I	41	56.16	9.45±0.82	8.2-11.6	70.56	12.12±3.26	7.48-19.41
II	21	28.77	11.25±0.81	9.7-12.7	19.05	20.05±4.73	11.48-30.91
III	2	2.73	14.75±2.33	13.1-16.4	31.11	39.31±15.27	28.51-50.10
Overall	73		9.63±2.08	4.3-16.4		13.96±7.91	1.10-50.10
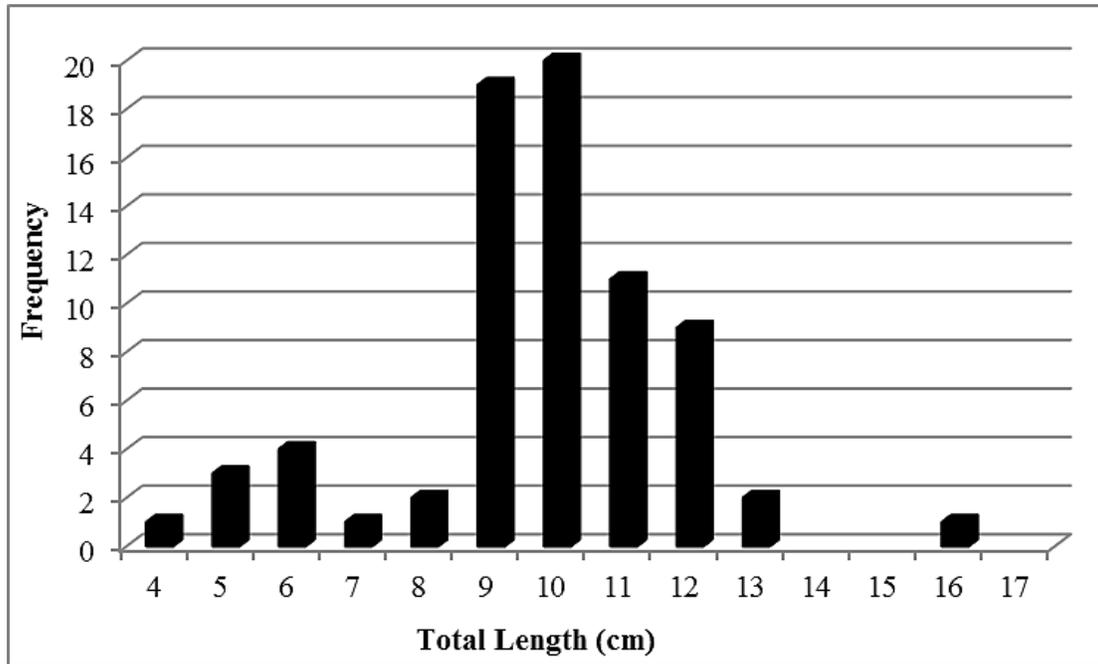
Figure 2. Length distribution of *Ponticola cyrius* from Kura River drainage.

using the formula (Pauly and Munro 1984) of $\Phi' = \log k + 2\log L_\infty$ and Fulton's condition factor (K) by equations of $K = 100\frac{W}{L^b}$ where; W = total weight, L = total length and b = regression constant (Sparre and Venema, 1998). The instantaneous rate of total mortality coefficient Z was estimated using Beverton and Holt (1956)'s Z Equation using the formula of $Z = k\frac{(L_\infty - \bar{L})}{(\bar{L} - L')}$, where $\bar{L}$ is the mean length of the entire catch, and L' = 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 9.3°C. $\text{Log}10M = -0.0152 - 0.279\log10L_\infty + 0.6543\text{Log}10k + 0.463\text{Log}10T$. Fishing mortality rate (F) was calculated as the difference between Z and M ($Z = F + M$). The value of the average annual exploitation rate (E) was obtained by $E = F/Z$ (Sparre and Venema, 1998).

Results and Discussions

Age and growth: Age was determined by comparing the growth increment readings on scales by two readers. It was observed that the number of annuli counted for each specimen was similar for the two readers and there was a high harmony (89.05%) between the age estimations. Age of *P. cyrius* varied from 0 to III age groups and group I was the most frequent groups containing 56.16%, whereas the age group III was the least i.e. 2.74%. Indeed, life span of this species reported up to 3 years (Coad, 2018).

The total length ranged 4.3-16.4 cm with a mean (±SD) of 9.63±2.08 cm. In the previous studies, range of total length reported as 4.9-11.0 cm (8.1±2.1) by

Table 1. Length-weight relationship and von Bertalanffy estimated growth parameters for *Ponticola cyrius* from Kura River drainage.

b	95% CI of b	a	r^2	L_∞ (cm)	K (year^{-1})	L_∞ (g)	t_0 (year)	Φ'	K	Type of growth	Author
2.9795	2.919-3.041	0.0145	0.993	26.36	0.187	248.20	-1.33	2.115	1.43	I	This study
2.938		0.00001	0.983						1.11	-A	Asadi et al. (2017)
3.214		0.0006	0.861							+A	Zamani Faradonbeh et al. (2015)
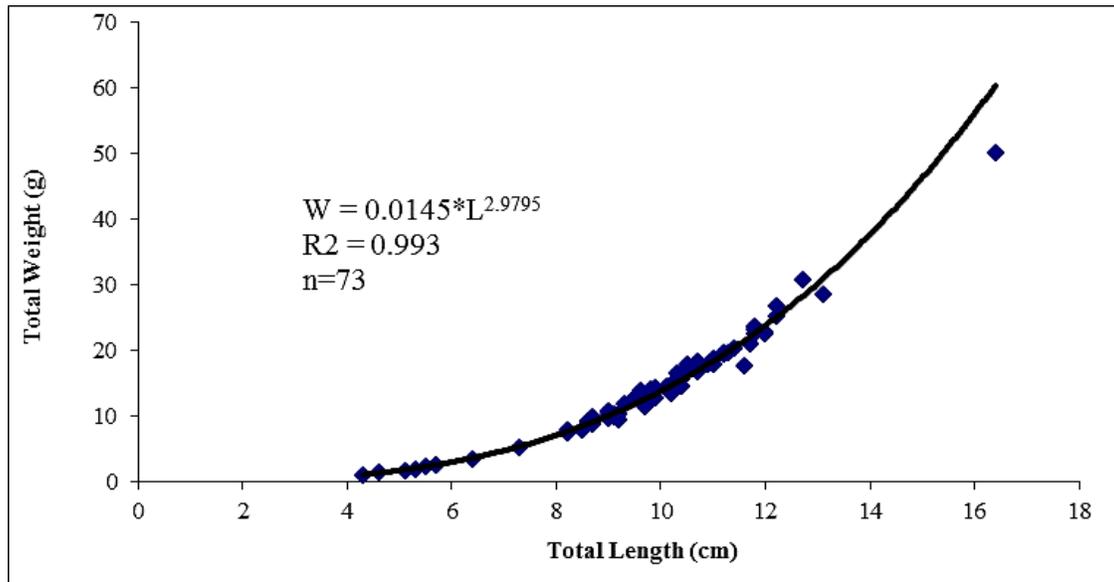
Figure 3. Length-weight relationship for *Ponticola cyrius* from Kura River drainage.

Zamani Faradonbeh et al. (2015) and 2.3-11.9 cm (7.5±2.4) by Asadi et al. (2017). The longest observed specimen in this study was 16.4 cm. Total weight varied between 1.10-50.10 g with a mean of 13.96±7.91 g. Based on the results, *P. cyrius* grows rapidly in their first year, and then this rate declines (Table 1).

According to Vasil'eva and Vasil'ev (2003) maturity of *P. cyrius* is attained in the second or third year. Based on our examination, II year's old specimens had eggs. The total length-frequency distribution of Kura goby is given in Figure 2. The distribution was unimodal and the highest frequency (27.4%) was observed in the 10 cm length class followed by the 9 cm length class (26.0%).

Length-weight relationship: The length-weight relationship for *P. cyrius* is presented in Figure 3. The correlation (r^2) for regression analysis indicated strong relationship between the variables. The total length-weight relationship was as $W=0.0145L^{2.9795}$ with the b-value was not significantly different from 3.0

($P<0.001$) indicating isometric growth of *P. gorlap.* In the previous studies, length-weight relationships of *Ponticola* c.f. *cyrius* were reported as $W=0.00001*L^{2.938}$ and $W=0.0006*L^{3.214}$ by Asadi et al. (2017) and Zamani Faradonbeh et al. (2015), recpectively. However, the confidance intervals of the b-value were not estimated in both of these studies. The length-weight relationship may be influenced by sex, maturity, geographical location and environmental conditions given year (Balon, 1984).

The von Bertalanffy growth parameters estimated as follows $L_\infty = 26.36$ cm, $k= 0.187$ year^{-1} and $t_o = -1.33$ year (Table 2). Growth performance index (Φ') and mean Fulton's condition factor were estimated 2.115 and 1.43, respectively. The back-calculated lengths were determined using von Bertalanffy growth parameters and the observed and calculated growth in total length is presented in Figure 4. The growth curves were not significantly different between the observed and calculated length ($P<0.05$).

Mortality: Instantaneous total (Z), natural (M) and
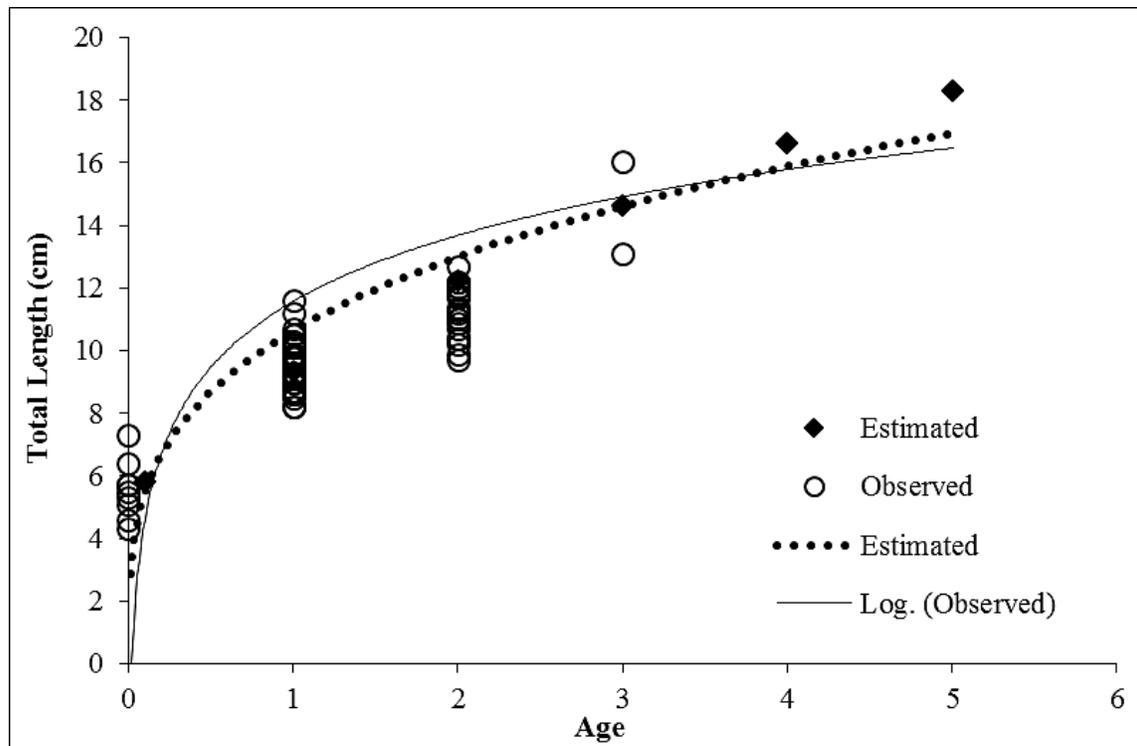
Figure 4. Von Bertalanffy length-at-age growth curve for *Ponticola cyrius* from Kura River drainage.

fishing (*F*) mortalities were estimated as 0.588, 0.371 and 0.217 year^{-1}, respectively. The exploitation rate (*E*) was calculated as 0.369 using estimated mortality rates.

There is no published estimation of the natural and total mortality for *P. cyrius* for comparison. Instantaneous natural mortality was estimated higher than fishing mortality. The species is fished only as by-catch, since has no commercial value. Therefore, it is not fishing pressure on the species, however, the exploitation rate was calculated as 0.369. In addition, Freyhof (2014) reported that *P. cyrius* is widespread occurring in more than 10 independent populations. Hence, its IUCN category assessed as LC (Freyhof, 2014). Indeed, no treat observed don the population during the sampling period.

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