Some Growth Parameters of *Capoeta umbla* (Heckel, 1843) Population Living In The Pülümür River

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Abstract

In this study, some growth parameters have been investigated like sex distribution, length and weight relationship, age determination, von Bertalanffy growth parameters and condition factor of *Capoeta umbla* (Heckel, 1843) (644 female, 743 male) captured from Pülümür River between 2017 and 2019. Females varied from 7.1 to 38.8 cm in total length and 3.4 to 514.2 g in weight. Males varied from 7.3 to 38.3 cm in total length and 3.5 to 450.4 g in weight. The sex ratio (females/males) for *C. umbla* was 1:1.154. The age groups for *C. umbla* was 0-11. The von Bertalanffy growth parameters were determined as $L_t=49.25[1-e^{-0.128(t+1.68)}]$; $W_t=666.91[1-e^{-0.128(t+1.68)}]^{2.973}$ for female, $L_t=44.42[1-e^{-0.155(t+1.37)}]$; $W_t=735.19[1-e^{-0.155(t+1.37)}]^{2.954}$ for male and $L_t=45.29[1-e^{-0.146(t+1.42)}]$; $W_t=772.56[1-e^{-0.146(t+1.42)}]^{2.963}$ for all individuals. The growth performance index (Φ') value was determined as 2.476. The length and weight relations of *C. umbla* were found as $W=0.0096*L^{2.973}$, $R^2=0.97$ (*95 % CI of b*=2.773-3.139) for females; $W=0.0103*L^{2.954}$, $R^2=0.98$ (*95 %CI of b*=2.797-3.092) for males and $W=0.0100*L^{2.963}$, $R^2=0.98$ (*95 %CI of b*=2.773-3.139) for all individuals. The growth type of *C. umbla* was isometric for all individuals ($R=0.99$, $R^2=0.97$, $F_{1,1385}=51700.4$, $P<0.001$). The highest condition factor was observed as 2nd age (0.931), while the lowest was observed 11nd age (0.796).

Keywords: Age, *Capoeta umbla*, Pülümür River, von Bertalanffy growth parameters

Pülümür Nehri'nde Yaşayan *Capoeta umbla* (Heckel, 1843) Populasyonunun Bazı Büyüme Parametreleri

Öz

Bu çalışmada; 2017 ve 2019 tarihleri arasında Pülümür Nehri'nden yakalanan *Capoeta umbla*'nın (Heckel, 1843) (644 dişi, 743 erkek) cinsiyet dağılımı, boy ve ağırlık ilişkisi, yaş tayini, von Bertalanffy büyüme parametreleri ve kondisyon faktörü gibi bazı büyüme parametreleri araştırılmıştır. Dişilerde total boy 7.1-38.8 cm ve ağırlık 3.4-514.2 g arasında değişmektedir. Erkeklerde total boy 7,3-38,3 cm ve ağırlık 3,5-450,4 g arasında değişmektedir. *C. umbla* için cinsiyet oranı (dişi/erkek) 1:1.154 olarak hesaplanmıştır. *C. umbla* için yaş grupları 0-11 yaş olduğu tespit edilmiştir. von Bertalanffy büyüme parametreleri dişiler için $L_t=49.25[1-e^{-0.128(t+1.68)}]$; $W_t=666.91[1-e^{-0.128(t+1.68)}]^{2.973}$, erkekler için $L_t=44.42[1-e^{-0.155(t+1.37)}]$; $W_t=735.19[1-e^{-0.155(t+1.37)}]^{2.954}$ ve tüm bireyler için $L_t=45.29[1-e^{-0.146(t+1.42)}]$; $W_t=772.56[1-e^{-0.146(t+1.42)}]^{2.963}$ olarak belirlendi. Büyüme performans endeksi (Φ') değeri 2.476 olarak belirlendi. *C. umbla*'nın boy-ağırlık ilişkileri dişiler için $W=0.0096*L^{2.973}$, $R^2=0.97$ (*95 % CI of b*=2.773-3.139), erkekler için $W=0.0103*L^{2.954}$, $R^2=0.98$ (*95 %CI of b*=2.797-3.092) ve tüm bireyler için $W=0.0100*L^{2.963}$, $R^2=0.98$ (*95 %CI of b*=2.773-3.139) olarak bulundu. *C. umbla*'nın büyüme tipi tüm bireyler için izometrikti ($R=0.99$, $R^2=0.97$, $F_{1.1385}=51700.4$, $P<0,001$). En düşük kondisyon faktörü 11 yaş (0.796), en yüksek kondisyon faktörü 2 yaş (0.931) olarak görülmüştür.

Anahtar Kelimeler: Yaş, *Capoeta umbla*, Pülümür Nehri, von Bertalanffy büyüme parametreleri

INTRODUCTION

Capoeta genus, denotes distributed geographically central Asia, southern China, northern India, Afghanistan, Turkmenistan, Georgia, Armenia, Azerbaijan, Uzbekistan (Aral), the Middle East and in Anatolia, live 5 species and 6 subspecies in Turkey. Species and subspecies all have economic importance in human feeding (Geldiay and Balık, 1999; Çicek et al., 2016). *Capoeta umbla* is a cyprinid species known as Tigris scraper and reach a length of 40 cm (Froese and Pauly, 2006). This species is common in the

Tigris River, and has been recorded from Iran, Iraq, Syria and Turkey (Turkey-in-Asia) and listed it in the Least Concern (LC) category (Freyhof, 2014).

The body of the *C. umbla*, which is more or less cylindrical, is slightly pressed from the sides and covered with small scales. The nose is blunt, the mouth is large and the shape of a transverse slit. The lips are covered with a hard skin that has a horn-like structure. There is a pair of small mustaches at the corners of the mouth. The last bone beam of the dorsal fin is underdeveloped and has small denticles on the posterior margin. The color is dark brown on the back, brown-yellow on the sides, and often off-white in the abdomen. They spread in the upper basins of the Euphrates and Tigris River systems (Geldiay and Balık, 2007).

Fish in an environment determination of population growth characteristics is one of the basic biology subjects. Determining the rates of fish in the population of individuals of different age groups, life span, calculation of growth rates, growth rates, mortality rates, determination of sexual maturation and spawning periods bring the need for age information (Polat, 2000).

C. umbla has economic importance in Turkey eastern region, so there are many studies about this species (Girgin et al., 1997; Aydın and Şen, 2002; Türkmen et al., 2002; Güneş, 2007; Ceyhun and Erdoğan, 2008; Saler et al., 2010; Çoban et al., 2013; Gündüz et al., 2015; Serdar and Özcan., 2016; Eroğlu et al., 2018; Pala et al., 2018). The aim of our study is the biological characteristics of the *Capoeta umbla* population captured from Pülümür River and creating a data source on the management and conservation of the species. Thus, the research results contribute to the stock management of the species we have studied. It will also shed light on future biological studies.

MATERIAL AND METHODS
Study area/Sampling/Data collection

The Pülümür River (Tunceli), located in eastern Turkey, approximately 70 km long (Gültekin et al., 2017). Pülümür River rises from the foothills of Avcı Mountains and flows from Pülümür to 20 km north of Tunceli with the joining of streams and in Tunceli city center borders with Munzur water (Saler and Bulut, 2011). It is present in various studies previously conducted in this region (Saler and Bulut, 2011; Saler et al., 2014; Özcan, 2019; Özcan, 2020).

Fish samples were caught Pülümür River (Tunceli) by electroshockers between 2017 and 2019 (1. station: 39° 40' 09.72 "N, 39° 82' 85.67" E 2. station: 39° 39' 63.38 "N, 39° 82' 77.50" E) (Figure 1). Fish samples were transported to the laboratory of Fisheries Faculty of Munzur University. All individuals, the total length (TL), the weight (W) were measured to the nearest 0.1 cm and 0.01 g. After dissection of fish, sex detection determined with macroscopic examination of gonads. Whether the sex ratio (females/males) in the sample is statistically different from the expected 1:1 ratio was determined by applying the chi-square ($\chi 2$) test (Zar 1999).

For age determination of fish samples by ligne-lateral line and operculum and anterior side of dorsal fin 10-15 scales were taken from among. Scales usually leave no mark on and packed in non-adhesive paper envelopes. Scales that are dirty washed in warm water. Drop a few drops of glycerin and placed face up. Age readings were done (OLYMPUS BX53 brand microscope). Each sample prepared during age readings was read by different people at least 2 times.

von Bertalanffy growth function (VBGF)

The von Bertalanffy growth equation is as follows (von Bertalanffy, 1938) :

$$TL_t = TL_\infty [1-e^{-k(t-to)}]$$
$$W_t = W_\infty [1-e^{-k(t-to)}]^b \tag{1}$$

Accuracy of the growth parameters was tested using von Bertalanffy growth performance (Gayanilo and Pauly, 1997):

$$\emptyset = log_{10}(k) + 2log_{10}(L_\infty) \tag{2}$$

Length-weight relations (LWRs)

Total length-weight relation was determined with the equation (King, 1995) :

$$W = a L^b \tag{3}$$

Condition factor

The condition factor (CF) values of fish are acquire with this equation (Le Cren, 1951) :

$$CF = (W / TL^b).100 \tag{4}$$

Also statistical analysis of the data obtained was made using Microsoft Office Excel 2013 and SPSS 24.0 package programs.

Figure 1. Sampling area (Pülümür River) (URL-1, 2021).

RESULTS AND DISCUSSION

A total of 1387 individuals of *C. umbla* (644 female, 743 male) were collected during the study. Females varied from 7.1 to 38.8 cm (19.69±0.18) in TL and 3.4 to 514.2 g (79.79±2.28) in W. Males varied from 7.3 to 38.3 cm (19.69±0.17) in TL and 3.5 to 450.4 g (79.82±2.12) in W (Table 1). The sex composition was 46.43% females and 53.57% males. The sex ratio (females/males) for *C. umbla* was 1:1.154, chi-square ($\chi 2$) test showed that significantly different from the theroretical 1:1 ratio (*P*<0.05). The age of captured specimens of *C. umbla* is ranged from 0 to 11 years for all individuals and the 2nd group was dominant (658 samples) in the population. Age-frequency distribution by sex is given in Figure 2.

In this study, male of *C. umbla* were caught more in the field sample. Age composition of *C. umbla* in the present study was determined as 0-11 years. The age composition was determined by several studies (Table 3). The age distribution and sex ratios obtained from this study and the findings in Table 3 are different from each other. In the previous studies, the largest *C. umbla* was reported as 13 age (years) and 47.20 cm (Şen and Aydın, 2000). It can be assumed that this difference is due to different population structures in different regions, min-max lengths and catching method used to collect samples. Nikolsky (1963) reported that sex ratios in different populations of the same species may be different.

The parameters of von Bertalanffy growth estimated as L_t=49.25[1-e$^{-0.128(t+1.68)}$]; W_t=666.91[1-e$^{-0.128(t+1.68)}$]$^{2.973}$ for female, L_t=44.42[1-e$^{-0.155(t+1.37)}$]; W_t=735.19[1-e$^{-0.155(t+1.37)}$]$^{2.954}$ for male and L_t=45.29[1-e$^{-0.146(t+1.42)}$]; W_t=772.56[1-e$^{-0.146(t+1.42)}$]$^{2.963}$ for all individuals. The maximum length at age was determined as 38.8 cm at 11 years (Figure 3).

The growth performance index (Φ') value was calculated as 2.476 for *C. umbla* (all individuals) (Table 2).

The value of L_∞ of females (49.25) was higher than that of males (44.42). Türkmen et al., (2002), Güneş (2007), Ceyhun and Erdoğan (2008), Gündüz et al., (2015) and Eroğlu et al., (2018) achieved similar results. The reason for this may be that females grow faster than males and live longer (Weatherley, 1972; Türkmen et al., 2002). This can be due to in growth differences between females and males, according to Froese and Binohlan (2000). The values of *k* were found to be in female, male and all individuals 0.128, 0.155, 0.146, respectively. Fish with high k values are short-lived (Sparre and Venema, 1998).While k values were found to be very bigger from the findings of Şen and Aydın (2000), Türkmen et al., (2002), Güneş (2007) (Tuzla stream), Ceyhun and Erdoğan (2008), Gündüz et al., (2015) and Eroğlu et al., (2008); were found to be very smaller from findings of Güneş (2007) (Tercan Dam Lake) and Çoban et al., (2013) (Table 3). These differences may be due to the largest individuals. Using the von Bertalanffy growth parameters (*k* and L_∞), the "growth performance index" (Φ') was calculated. The values of Φ' were very close in the other studies (Table 3).

The LWRs of *C. umbla* were calculated as W=0.0096*L$^{2.973}$ (R^2=0.97, SE of b=0.0018 and 95 % confidence intervals of b=2.773-3.139, *t*-test *P*>0.05) for females, W=0.0103*L$^{2.954}$ (R^2=0.98 SE of b=0.0017 and 95 % confidence intervals of b=2.797-3.092, *t*-test *P*>0.05) for males and W=0.0100*L$^{2.963}$ (R^2=0.98 SE of b=0.0012 and 95 % confidence intervals of b=2.773-3.139, *t*-test *P*>0.05) for all individuals (Figure 4). Our data suggested that the growth type of *C. umbla* showed was isometric for all individuals (R=0.99, R^2=0.97, $F_{1,1385}$=51700.4, P <0.001; *t-test*=227.376, P<0.01). Also, the t-test results are when analyzed in terms of importance (P <0.01); fish size data can be used with high accuracy to estimate fish weight was found (Başusta et al., 2017; Serdar and Özcan, 2018).

The slope value (*b*) of the length-weight relation was determined as 2.973 for females, 2.954 for males and 2.963 for all individuals. According to 95% confidence limits of *b* (2.773-3.139 for female, 2.797-3.092 for male and 2.773-3.139 for all individuals); because of the *b* value close to 3, the growth of female, male and all individuals was isometric. The

values of *b* in Table 3 ranged from 2.310 to 3.186 but, our results are between the differ ranges. The values of *b* were within the limits of 2.5-3.5 commonly reported (Froese, 2006). While the values of *b* were close to those found by Türkmen et al., (2002) and Gündüz et al., (2015); were different from those found by Şen and Aydın (2000), Güneş (2007), Ceyhun and Erdoğan (2008), Çoban et al., (2013) and Eroğlu et al., (2018). Pauly (1984) reported that the value of *b* may vary according to ecological factors, food level, age, sex, sexual maturity and species. The differences in the value of *b* can be due to these factors in the other studies. The coefficient of determination (R^2) was found to be >0.97 highly significant value of the result.

When the *t*-test results was used for the significance condition of the regression coefficients, it was identified that length data could be used in highly reliable to estimate weight (Özcan and Başusta, 2018).

Table 1. *Total length and weight values of C. umbla in Pülümür River*

Sex	*n*	Total Length (cm)		Weight (g)	
		Mean±S.E	Min-Max	Mean±S.E	Min-Max
♀	644	19.69±0.18	7.1-38.8	79.79±2.28	3.4-514.2
♂	743	19.69±0.17	7.3-38.3	79.82±2.12	3.5-450.4
♀+♂	1387	19.69±0.12	7.1-38.8	79.79±1.55	3.4-514.2
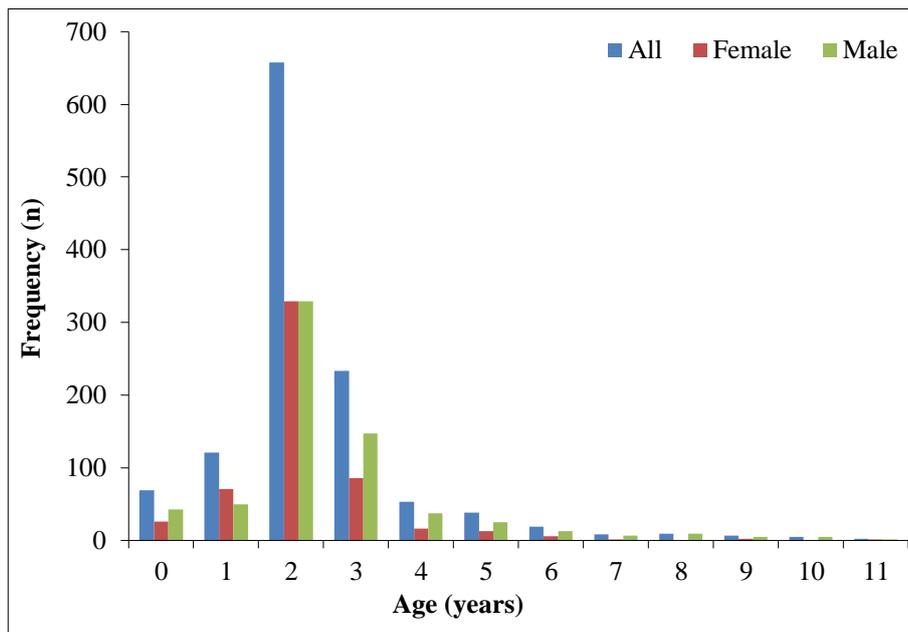
Figure 2. Age-frequency distribution of *C. umbla* from Pülümür River
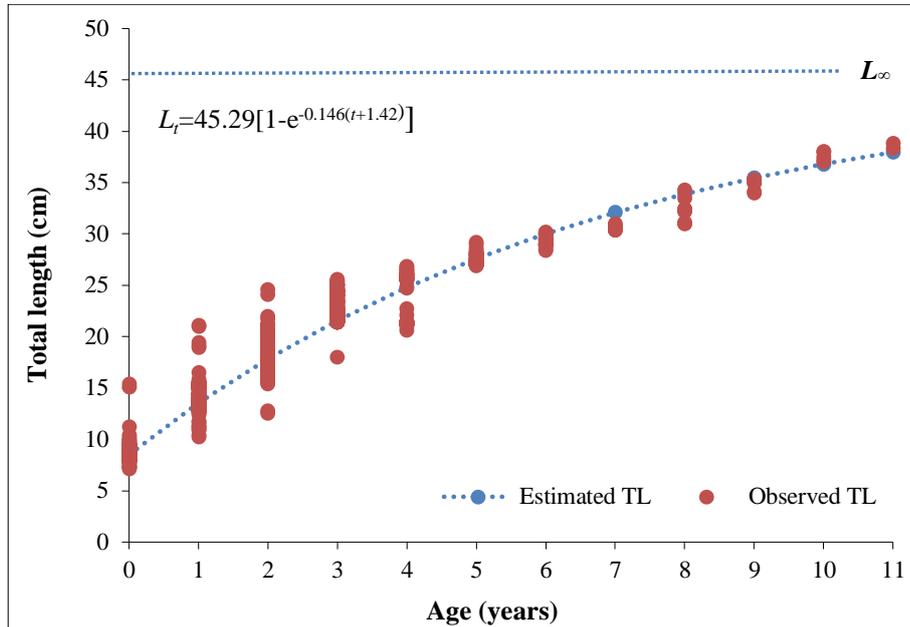
Figure 3. According to lengths at age (observed TL) and VBGF (estimated TL), age-total length distribution all individuals of *C. umbla* from Pülümür River

Table 2. *The parameters of the growth and age-length for C. umbla from Pülümür River*

Sex	n	a	b	95% CI of b	R^2	L_∞ (cm)	W_∞ (g)	k (year^{-1})	t_0 (year)	Φ'	CF
♀	644	0.0096	2.973	2.773-3.139	0.97	49.25	666.91	0.128	-1.68	2.492	0.809
♂	743	0.0103	2.954	2.797-3.092	0.98	44.42	735.19	0.155	-1.37	2.485	0.877
♀+♂	1387	0.0100	2.963	2.773-3.139	0.98	45.29	772.56	0.146	-1.42	2.476	0.876

(**n**: sample size; **a**: intercept, **b**: slope, **CI**: confidence limits, **R^2**: coefficient of determination L_∞: asymptotic length; **W_∞**: asymptotic weight; **t_0**: theoretical age; **k**: body growth coefficient; **Ø**: growth performance index; **CF**: condition factor)
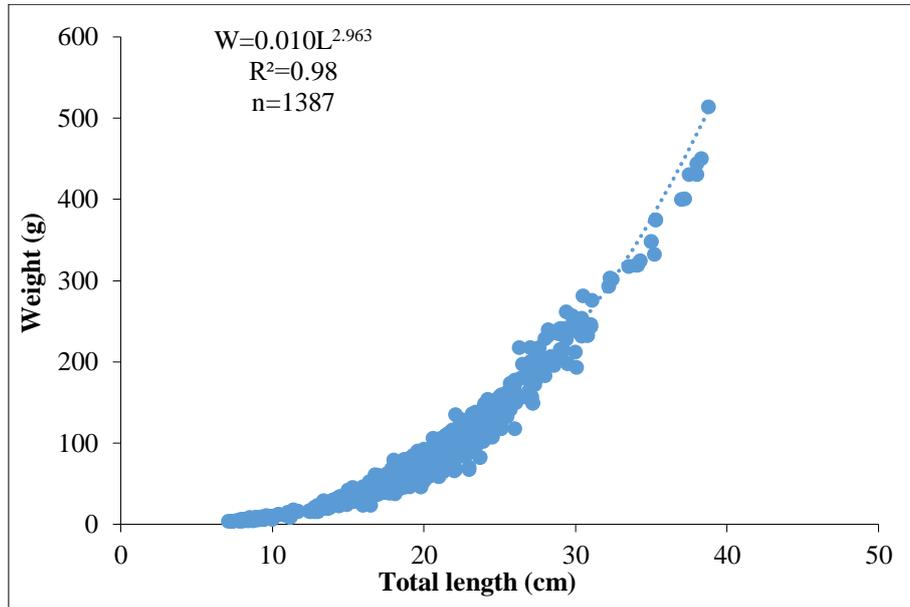
Figure 4. Length-weight relationships of *C. umbla* for all individuals from Pülümür River

Table 3. *Some parameters age, growth, length-weight relationships of C. umbla from different habitats*

Habitat	Sex	*n*	Age	*a*	*b*	*R²*	*L∞*	*k*	*t₀*	*Φ'*	*Author*
Hazar Lake	♀	180	2-13	0.0000083	3.006	0.96	68.61	0.07	-2.04	2.517	Şen and Aydın, 2000
	♂	164	2-13	0.0000050	3.097	0.96	71.49	0.06	-2.63	2.486	
	♀+♂	346	1-13	0.0000029	3.186	0.94	68.62	0.07	-2.20	2.517	
Karasu River	♀	506	1-10	0.0117	2.991	0.99	45.70	0.14	-0.83	2.465	Türkmen et al., 2002
	♂	665	1-12	0.0139	2.936	0.99	42.30	0.14	-0.98	2.398	
Tercan Dam Lake	♀	165	1-6	0.000500	2.321	0.98	41.64	0.19	-0.69	2.517	
	♂	158	1-6	0.000192	2.485	0.98	40.60	0.22	-0.29	2.559	
	♀+♂	323	1-6	0.000677	2.674	0.98	41.11	0.20	-0.54	2.528	Güneş, 2007
Tuzla stream	♀	161	1-6	0.000290	2.400	0.98	54.17	0.12	-1.54	2.546	
	♂	146	1-6	0.000141	2.532	0.99	46.08	0.15	-1.34	2.503	
	♀+♂	307	1-6	0.000208	2.458	0.98	52.15	0.14	-1.35	2.580	
Kilis stream	♀	103	1-5	0.069	2.31	0.86	57.20	0.09	-1.23	2.470	Ceyhun and Erdoğan, 2008
	♂	91	1-5	0.058	2.38	0.86	48.90	0.11	-1.07	2.420	
	♀+♂	194	1-5	0.064	2.34	0.86	53.00	0.09	-1.16	2.400	
Hazar Lake	♀	237	1-10	0.056	2.466	0.95	49.22	0.20	-1.88	2.685	Çoban et al., 2013
	♂	127	1-10	0.104	2.262	0.93	56.17	0.13	-1.62	2.612	
	♀+♂	364	1-10	0.070	2.390	0.95	53.77	0.16	-1.84	2.665	
Uzunçayır Dam Lake	♀	158	1-11	0.0112	2.927	0.96	47.01	0.16	-1.58	2.550	Gündüz et al., 2015
	♂	288	1-12	0.0111	2.930	0.95	44.91	0.14	-1.82	2.450	
	♀+♂	446	1-12	0.0110	2.932	0.96	46.85	0.14	-1.95	2.490	

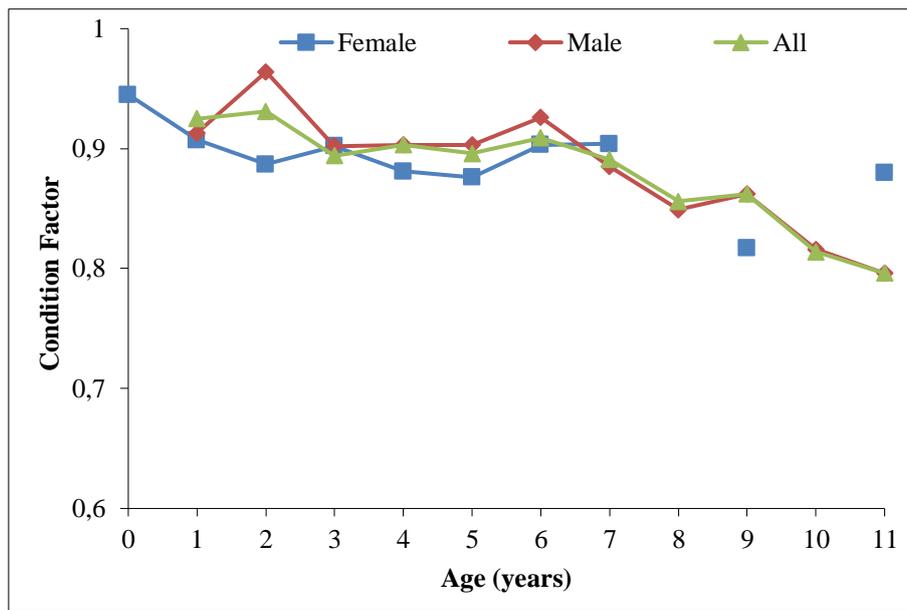|											
Özlüce	♀	223	1-12	0.0072	3.064	0.89	50.59	0.14	-1.99	2.550	Eroğlu et
Dam Lake	♂	153	1-11	0.0066	3.092	0.95	47.12	0.12	-2.78	2.430	al., 2018
	♀+♂	376	1-12	0.0071	3.070	0.94	49.83	0.13	-2.13	2.510	
Pülümür	♀	644	0-11	0.0096	2.973	0.97	49.25	0.128	-1.68	2.492	This study
River	♂	743	0-11	0.0103	2.954	0.98	44.42	0.155	-1.37	2.485	
	♀+♂	1387	0-11	0.0100	2.963	0.98	45.29	0.146	-1.42	2.476	

Figure 5. According to age-condition factor for *C. umbla* from Pülümür River

Condition factor was calculated for sexes (Table 2) and all age-groups. The difference between sexes by age groups was not significant (*p*>0.05). The highest condition factor was observed as 2nd age (0.931), while the lowest was observed 11nd age (0.796) (Figure 5).

In this study, mean condition factor values were determined between 0.525-1.351 for female and 0.577-1.270 for male. During the later age (years), the condition factor value has decreased. Şen and Aydın (2000) found that the condition factor of *Capoeta umbla* in Hazar Lake is between 0.52-1.45 and they found the average condition factor in at least 1 age groups and at most 10 age groups. In addition, it has been reported that the condition factor value of fish may vary depending on factors such as age (Korkut et al., 2007).

The average condition factor values were ranged from 0.85-0.95 for male and 0.76-0.98 for female in Uzunçayır Dam Lake (Gündüz et al., 2015). Eroğlu et al., (2018) condition factor values were ranged from 0.78-1.15 for female and 0.81-0.96 for male living in Özlüce Dam Lake. The differences in the condition factor show the biological conditions such as the adaptation of the environment and nutrient status (Le Cren, 1951).

CONCLUSION

As a result, biological characteristics of *C. umbla* species from Pülümür River found to be similar to findings obtained in other previous studies. Growth parameters may vary from species to species, as well as in different populations of the same species. At the same time, the growth of different year classes in a stock; changes can also be seen due to changes in habitat sharing, ecological conditions and eating

habits. Apart from these, significant growth differences can also be seen between genders in a population (Çetinkaya et al., 2005). So, the present study is on the some growth parameters of *Capoeta umbla* population living in Pülümür River. The findings of this study will be an important reference for the similar studies in the future for this species.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in this study.

RESEARCH AND PUBLICATION ETHICS STATEMENT

The author declares that the research and publication ethics are complied with in the study.

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