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SHORT COMMUNICATION **KISA ARAŞTIRMA**

Length-weight and length-length relationships of *Capoeta umbla* in Karasu River (East Anatolia, Turkey)

Karasu Nehri'ndeki (Doğu Anadolu, Türkiye) *Capoeta umbla*'nın boy-ağırlık ve boy-boy ilişkileri

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Abstract: In this study, the length-weight relationships and length-length relationships were determined for shiraz barb (*Capoeta umbla* (Heckel, 1843)) captured in the 15 different site of Karasu River (Tributary of Fırat River). A total of 407 specimens were catched by electroshocker, gill nets, trammel nets between October 2014 to September 2015. The total length-weight relationships were determined $W=0.0113L^{2.99}$ for females, $W=0.0117L^{2.84}$ for males and $W=0.0115L^{2.93}$ for all individuals. The types of growth for all individuals were negative allometric for *C. umbla*. Length-length relationships were determined as TL=0.734+1.084FL, FL=2.883+1.070SL and SL=-2.840+0.858TL.

Keywords: *Capoeta umbla, length-weight relationship, length-length relationships, Karasu River, Turkey*

Öz: Bu çalışmada, Karasu Nehri'nin (Fırat Nehri kolu, Türkiye) 15 farklı istasyonundan yakalanan siraz balığının (Capoeta umbla (Heckel, 1843))'nın boy-ağırlık ve boy-boy ilişkileri belirlendi. Ekim 2014-Eylül 2015 tarihleri arasında fanyalı ağları, uzatma ağları ve elektroşoker ile toplam 407 örnek yakalandı. Total boy-ağırlık ilişkileri dişilerde $W=0,0113L^{2.99}$, erkeklerde $W=0,0117L^{2.84}$ ve tüm bireylerde $W=0,0115L^{2.93}$olarak tespit edildi. *C. umbla*'nın tüm bireylerinde negatif allometrik büyüme bulundu. Tüm bireylerde boy-boy ilişkisi TL=0.734+1.084FL, FL=2.883+1.070SL ve SL=-2.840+0.858TL olarak bulundu.

Anahtar kelimeler: *Capoeta umbla, boy-ağırlık ilişkisi, boy-boy ilişkileri, Karasu Nehri, Türkiye*

INTRODUCTION

Cyprinidae is the largest of fish family in Turkey. They are distributed widely in fresh water of Turkey. In fisheries biology and population dynamics, length parameters plays a major role (Sivashanthini, 2008). Length–weight relationships (LWRs) for fish have been used extensively to provide information on the condition of fish, their isometric or allometric growth, in the analysis of ontogenic changes, to compare life histories of fish species between regions, age structure, reproduction history (Binohlan and Pauly, 1998; Can et al., 2002; Moutopoulos and Stergiou, 2002; Başusta and Çiçek, 2006). Many studies have been done about growth properties of this species (Şen and Aydın, 2000; Türkmen et al., 2002; Güneş, 2007; Çoban and Şen, 2011; Gündüz et al., 2015).

Length-length relationships (LLRs) are significant for comparative growth resourches in fisheries management (Başusta et al., 2013). Aim of this study is to determine sex ratio, length-weight and length-length relationships of *C. umbla* from Karasu River.

MATERIAL AND METHODS

The study area, which is in the tributary of Karasu River (Yeşildere, Köşk, Ağasuyu, Sincan, Poik, Çiğdemli, Han, Karahasan, Taşağıl, Karataş, Büyükgöze, Deli, Eriç, Kırık, Karnı streams) in the East Anatolia region of Turkey. Specimens (407 individuals) were collected during October 2014 to September 2015 by electroshocker, gill nets, trammel nets from Karasu River (Figure 1). The samples were immediately preserved with ice and fixed with 5% formaldehid on arrival in the laboratory. All individuals were measured for total length (TL, in cm), fork length (FL, in cm), standard length (SL, in cm) to the nearest mm and weighted (W, total weight in g) to the nearest 0.01 g in situ. Standard length was measured from the anterior tip of the upper jaw to the tip of the hypural bone.

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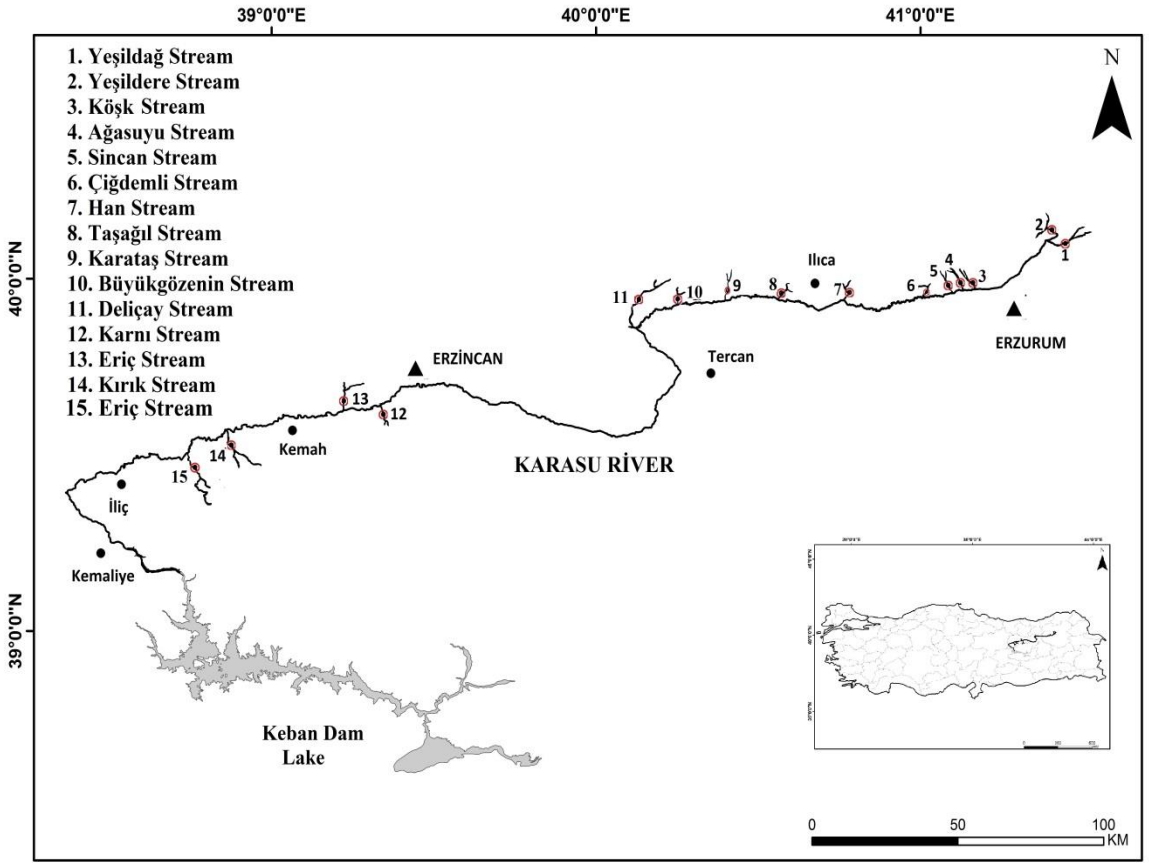

Figure 1. Sampling sites on the Karasu River

The length-weight relationship was calculated using the expression: $W= a L^b$ (Sparre and Venema, 1998), where the W is the body weight (g), L the total length (cm), "a" the intercept of the regression and "b" is the regression coefficient. Student t-test was used the determine whether the difference between length and weight are significant. In the length weight equation a and b are intercept and the slope (exponent) of the length weight curve, respectively (Türker-Çakır et al., 2008; Başusta et al., 2012). The student's t-test used to test whether the slope (b) was importantly different from 3, indicate the growth type: isometric (b = 3), positive allometric (b > 3) or negative allometric (b < 3). Additionally, standard error of the parameter b and the statistical significance level of r^2 were estimated.

Length-length relationships were calculated using linear regression analysis. LLRs were measured as FL=a+bSL, SL=a+bTL and TL=a+bFL equations in all individuals.

RESULTS AND DISCUSSION

The total of 407 samples caught for the study, 190 (46.68%) were females, 201 (49.38%) were males and 16 (3.93%) were undetermined. The total lengths and weights of investigated specimens varied from 2.5 to 32.9 cm and from 0.3 to 330.0 g, respectively (Table 1). Length-weight relationships for females, males and all individuals were determined as $W=0.0113L^{2.99}$, $W=0.0117L^{2.84}$, $W=0.0115L^{2.93}$ respectively (Table 1).

Table 1. Total length-weight relationships of *C. umbla* in Karasu River

Sex		Total Length (cm)		Weight (g)		Parameters of LWR		
	n	Min	Max	Min	Max	*a*	*b±(SE)*	r^2
Female	190	9.4	32.3	8.4	324	0.0113	2.99±0.0016	0.97
Male	201	10.1	32.9	13	330	0.0117	2.84±0.0014	0.94
Undetermined	16	2.5	9.7	0.3	7.4	0.0114	2.86±0.0011	0.98
All	407	2.5	32.9	0.3	330	0.0115	2.93±0.0013	0.96

There have been different studies on the length-weight relationships of *C. umbla* inland waters and the b values declared in these studies are presented in Table 2.

There have been some other studies of *C. umbla* other localites (Şen and Aydın, 2000; Türkmen et al., 2002; Güneş, 2007; Çoban and Şen, 2011; Gündüz et al., 2015) and min-max total length value reported in these studies are presented in Table 2. The previous studies of *C. umbla* found that minimum total length by Şen and Aydın 15.00 cm, Güneş 11.62 cm, Çoban and Şen 18.62 cm, Gündüz et al., 13.20 cm. But in these studies minimum total length value of *C. umbla* reported as 2.50 cm.

Table 2. Some study results of length-weight relationship for *C. umbla* in different areas

Habitats	Sex	n	TL(min-max)	*a*	*b*	r^2	Authors
Hazar Lake (Elazığ)	Female	180	18.70-47.20	0.0000083	3.186	0.96	Şen and Aydın, (2000)
	Male	164	19.50-46.00	0.0000050	3.097	0.96	
	All	344	15.00-47.20	0.0000029	3.006	0.94	
Karasu River (Aşkale)	Female	504	-	0.00117	2.99	0.99	Türkmen *et al*., (2002)
	Male	664		0.00139	2.94	0.99	
	All	1168		-	2.86	-	
Tercan Dam Lake (Erzurum)	Female	165	11.62-31.84	0.000500	2.32	0.98	Güneş, (2007)
	Male	158	12.35-31.06	0.000192	2.48	0.98	
	All	323	12.00-31.65	0.000677	2.67	0.98	
Tuzla Stream (Erzurum)	Female	146	12.11-32.67	0.000290	2.40	0.98	Güneş, (2007)
	Male	161	12.67-31.00	0.000141	2.53	0.99	
	All	307	12.42-32.34	0.000208	2.45	0.98	
Hazar Lake (Elazığ)	Female	96	18.62-38.30	0.0205	2.746	0.96	Çoban and Şen, (2011)
	Male	132	19.21-32.05	0.0255	2.690	0.94	
	All	228	19.00-34.13	0.0241	2.703	0.95	
Keban Dam Lake (Elazığ)	Female	109	26.68-37.06	0.0229	2.772	0.89	Çoban and Şen, (2011)
	Male	123	25.48-37.10	0.0315	2.678	0.92	
	All	232	25.98-37.06	0.0267	2.727	0.91	
Uzunçayır Dam Lake (Tunceli)	Female	158	15.33-43.05	0.011200	2.93	0.96	Gündüz *et al*., (2015)
	Male	288	13.20-42.70	0.011100	2.93	0.95	
	All	446	14.17-42.70	0.011000	2.93	0.95	
Karasu River	Female	190	9.40-32.30	0.011300	2.99	0.97	This Study
	Male	201	10.1-32.90	0.011700	2.84	0.94	
	Undetermined	16	2.50-9.70	0.011400	2.86	0.98	
	All	407	2.50-32.90	0.011500	2.93	0.96	

In this study, the LWRs were highly significant; all individuals of *C. umbla* were determined between length and weight very strong positive relationship in Karasu River (r^2=0.96). The high values of r^2 indicate that the length relationships are linear observed range of values. The equations for derivation of the lengths measurements presented may enable researchers to gain useful information about length conversions. The b values were determined as 2.99 for females, 2.84 for males and 2.93 for all individuals in Karasu River. The growth of all individuals was negative allometry (b<3; P<0.05) in Karasu River (Table 2). No significant differences were found between total length-weight of males and females (P< 0.05).

Şen and Aydın, (2000); Gündüz et al., (2015); Türkmen et al., (2002); Güneş, (2007); Çoban and Şen, (2011) were calculated a and b values for this species and this values were similar with this study (Table 2). The length–weight relationship in fishes can be affected by a number of factors, including season, habitat, gonad maturity, sex, diet and stomach

fullness, health and preservation techniques, and differences in the observed length ranges of the specimen caught (Tesch 1971; Wootton 1998), which were not accounted for in the present study. Thus, differences in length-weight relationships between this and other studies could potentially be attributed to the combination of one or more of the factors given above.

Length-length relationships and the coefficient of determination of *C. umbla* are presented in Table 3. LLRs were significant (P<0.001) for all specimens with all r^2 values greater than 0.99. There are no data available on LLRs of *C. umbla*. Thus, this study provides first information LLRs which are useful for fishery biologist.

This study provided the basic information on the length-weight and length-length relationships of *C. umbla* from the Karasu River that will be useful for the management of fishery resources.

Table 3. Length-length relationships of *C. umbla* in Karasu River (n=407)

Sex	Equation	*a*	*b*	r^2
Female	TL= a + bFL	0.230	1.088	0.998
	FL= a + bSL	2.618	1.073	0.997
	SL= a + bTL	-2.236	0.853	0.997
Male	TL= a + bFL	1.174	1.080	0.998
	FL= a + bSL	3.097	1.068	0.997
	SL= a + bTL	-3.339	0.862	0.996
All	TL= a + bFL	0.734	1.084	0.998
	FL= a + bSL	2.883	1.070	0.997
	SL= a + bTL	-2.840	0.858	0.997

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