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RESEARCH PAPER

Morphological Comparison of Six Coastal Stream Populations of Crimean Barbel (*Barbus tauricus Kessler*, 1877) from the Southern Black Sea Basin

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Abstract

In this study we investigated possible morphological and biological differences among some populations of the Crimean Barbel *Barbus tauricus* Kessler, 1877 inhabiting Black Sea Region. The intraspecific variation of crimean barbel, on the basis of morphometric characters, was investigated. Samples caugth from six different coastal streams (streams Akçay, Terme, Engiz, Karadere, Solaklı and Değirmenağzı) between April 2015 and December 2016. A total of 311 samples were used in analysis. Length-weight (LWR) and morphological measurements-total length relationships, coefficient of variance were estimated according to localities. LWR show that *B.tauricus* has isometric growth most of the localities (b=3). Principle Component and Discriminant Function Analysis were used to calculate variations in populations. All relationships of the 29 morphological measurements were found significant in ANOVA results (P<0.001). According to DFA results fifteen morphometric measurements were used for clasification of populations with 92.3%. PCA analysis showed that six (PostDD, DPV, LCAUF, PrePD, DDC and PostPD) of the morphometric measurements are important for the populations.

Introduction

The crimean barbel, *Barbus tauricus* Kessler, 1877, is a member of genus *Barbus* which has 34 species all around world. There are 10 *Barbus* species in Turkey included endemics (with valid names) (Froese & Pouly, 2018). *Barbus* genus has a wide distribution all over the world in cyprinid species and *B. tauricus* widely distributed in Black Sea watersheds. Crimean barbel inhabits generally in streams, though it also occurs in lakes. *B. tauricus* prefers mountain streams with strong current to brackish estuaries and river stretches at 100-600 m above sea level (Kottelat & Freyhof, 2007). The phenotypic variation can be best observed in fish species such as *B. tauricus* because of the varieties in the habitat.

In terms of fisheries management and biology, it is important to determine the phenotypic variation caused by environmental factors. Generally, it is quite difficult to explain the causes of morphological variations between populations (Cadrin, 2000). However, these differences might be associated with phenotypic plasticity in response to different environmental factors in each locality (Murta, 2000). Among all stock identification methods, the study of morphological characters and morphometric variation is one of the most frequently prefered and cost-effective methods. Studies suggest that the environment significantly influences morphological variability of populations in different locations (Chen, Tzeng, Shih, Chu, & Lee, 2015; Porrini, Iriarte, Iudica, & Abud, 2015; Allaya *et al*., 2017; Freire, Bentes, Fontes,

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& da Silva, 2017).

Morphometrics is the study of the geometrical form of organisms, which combines themes from biology, geometry and statistics. The study of morphological characteristics of fish species has been considered significant in recent years for stock identification (Mir, Saxena, Patiyal, & Sahoo, 2015; Verma & Serajuddin, 2016; Geladakis, Nikolioudakis, Koumoundouros, & Somarakis, 2017).

There are some studies about age (Vilizzi & Coop, 2013), ecology (Briton & Pegg, 2011), otolith morphometry (Kontaş & Bostancı, 2015), molecular (Tsigenopoulos, Rab, Naran, & Berrebi, 2002; Ren & Mayden, 2016), phylogeny (Antal *et al*., 2016) and morphometry (Verep, Turan, & Kováč, 2006; Osuka & Mleva, 2011; Motamedi, Madjdzadeh, Teimori, Esmaeli, & Mohsenzadeh, 2014) of some *Barbus* species.

Aim of this study is to examine morphological variations and determine the intraspecies variation in populations of *B.tauricus,* one of the primary freshwater fishes in the Cyprinidae, sampled from six different localities in the Black Sea Region by using morphometric methods.

Material and Methods

Study Material and Sampling

B. tauricus has laterally compressed body covered with middle-sized cyloid scales, lower mouth and two pairs of barbels and some spots on upper parts of body. Maxilla is longer than mandible. The mandible has a well-developed lobe from the mouth. The authors distinguished this species from other *Barbus* species by its 53–65 lateral line scales, 3 simple and 5-6 branched anal fin rays, 1 simple and 15-17 branched pektoral fin rays, 4 simple and 7-8 branched dorsal fin rays. Transversal scales (counted as scale rows above lateral line (between lateral line and dorsal-fin origin) and scales rows below lateral line (between lateral line and anal-fin origin) separately) of *B. tauricus* was 11-15/7-10. The conservation status of crimean barbel is "VU" according to IUCN (Kottelat & Freyhof, 2008).

A total of 311 *B.tauricus* specimens were collected with electroshocker from six streams of Turkish Black Sea coast (Figure 1). The coordinates of sampling localities were given in Table 1. The samples were captured from the parts of the rivers which are defined as the "Barbel Zone". This zone have sandy, rocky floor and a fast-flowing stream, where the barbs are dominant in rivers. It inhabits mainly streams, though it also occurs in lakes. It prefers well oxygenated sections with gravel bottom and high current velocity. Karadere, Akçay and Terme Streams are large streams. Solaklı, Değirmenağzı and Engiz are small streams with a high current. The floor of the all streams were rocky. There are hydroelectric dams on Karadere, Solaklı and Engiz Streams.

Biometric and meristic investigations on the sample were done by the same person. The sex was determined by macroscopic examination of the gonads.

Biological Study

The Kolmogorov-Smirnov test was applied for

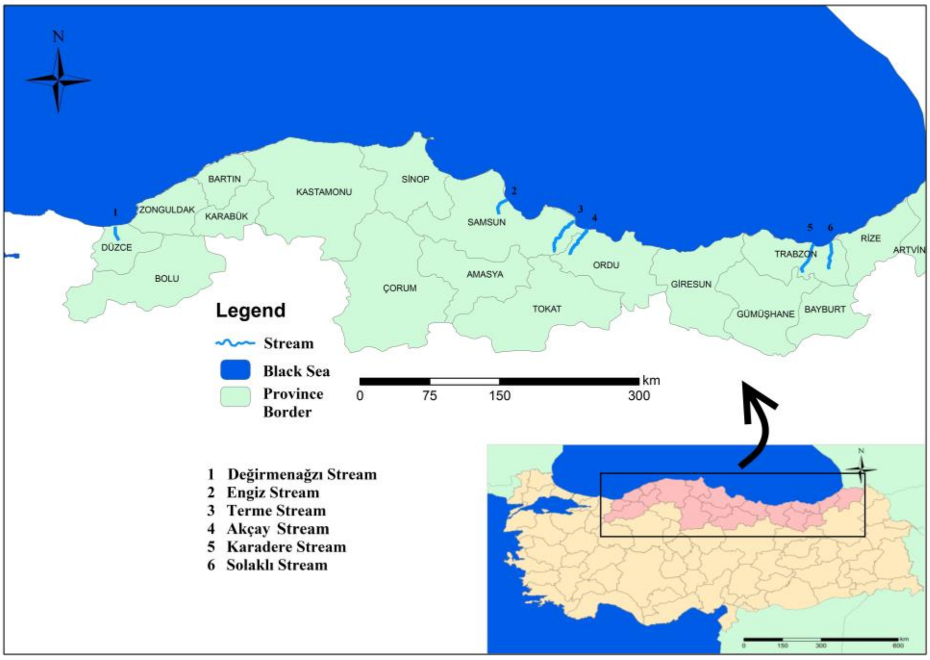

Figure 1. The map of sampling area.

determine differences between male and female individuals. Length–weight relations were calculated using the equation W = aL^b (Bagenal & Tesch, 1978). The t-test employed to test whether the slopes (b) were significantly different from 3, indicating the growth type: isometric (b=3), positive allometric (b>3) or negative allometric (b<3). Analysis of variance (ANOVA) was used to test differences of the b values of length-weight relationship between sexes (Zar, 1999).

Morphometric Study

Twenty-nine traditional morphometric characters were measured using a digital callipers in this study with an accuracy of 0.01 mm. Measurements and abbreviations follow Holcik (1999), Kottelat and Freyhof (2007) and Motamedi *et al* (2014) (Table 2). Measurements were made by the same person. Measurements of the morphometric characters were

Table 1. Sex distributions, total length and weight values according to localities

Locality	Coordinates	N	Sex (F/M)	Total length (cm) Min-Max	Weight (g) Min-Max
Karadere Stream	40°51'54.43"N 40° 1'10.06"E	50	22/28	10.80-26.10	15.10-154.30
Solaklı Stream	40°52'2.23"N 40°16'42.66"E	50	28/22	13.10-19.20	19.78-73.29
Değirmenağzı Stream	41°05ˈ07.21" N 31°06ˈ 06.50" E	50	23/27	7.1-22.1	3.20-97.56
Akçay Stream	41°05ˈ30.99 "N 37°07ˈ20.89" E	51	22/29	6.6-18.7	3.31-73.95
Terme Stream	41°09ˈ34.03 "N 36°53ˈ28.48" E	55	17/38	7.50-24.20	3.86-122.08
Engiz Stream	41°28'55.48"N 36°02'49.58"E	55	25/30	5.70-21.0	1.81-89.30

N: Sample size, M: Male, F: Female, Min: Minimun, Max: Maximum

Table 2. Characters and the abbreviations of morphometric measurements

Character No.	Abbreviation	Characters
1.	TL	Total length
2.	HL	Head length
3.	HW	Head width
4.	PreDD	Predorsal distance
5.	PostDD	Postdorsal distance
6.	PrePD	Prepectoral distance
7.	PostPD	Postpectoral distance
8.	LDF	Length of dorsal fin
9.	DDF	Depth of dorsal fin
10.	LAF	Length of anal fin
11.	LPF	Length of pectoral fin
12.	LVF	Length of ventral fin
13.	LCAUF	Length of upper lobe of caudal fin
14.	HCAUF	Distance between upper and lower lobes of caudal fin
15.	ED	Eye diameter
16.	InorD	Interorbital distance
17.	PreorD	Preorbital distance
18.	PostorD	Postorbital distance
19.	InNM	Internasal distance
20.	ABL	Anterior barbel length
21.	PBL	Posterior barbel length
22.	NL	Nose length
23.	PreOPD	Preopercular distance
24.	DDC	Distance between dorsal and caudal fins
25.	DPV	Distance between pectoral and ventral fins
26.	DVA	Distance between ventral and anal fins
27.	Lcaup	Length of caudal pedancule
28.	Dcaup	Depth of caudal pedancle
29.	MaxBD	Maximum body depth

standardized in order to eliminate any size effect (Elliot, Haskard & Koslow, 1995):

$$M_{adj} = M\ (L_S/L_0)^b$$

Coefficient of variance were calculated with the following formula.

$$VC\% = SD/\bar{X} \times 100,$$

Before the evaluation of samples from different localities, all data were tested for Kolmogorov-Smirnov to determine whether normal distribution. In addition, the difference between female and male subjects was determined by two sample t-tests. Regression equations and correlation coefficients of morphometric characters of *B. tauricus* with total length were calculated separately for each locality.

Principal Component Analysis (PCA) and Discriminant Analysis (DFA) have been performed in evaluating the data. PCA helps in morphometric data reduction in decreasing the redundancy among the variables and in extracting a number of independent variables for population differentiation (Verma & Serajuddin, 2016) and DFA is used to separate taxa and estimate their differences. All the calculations were done with help of MINITAB 15.0, PAST 3.0 (Hammer, Harper, & Ryan, 2001) and SPSS 21.0 software.

Abbrevations

W is the total weight of the fish (g),

L is the total length (cm),

a and b are the parameters of the equation

M is original measurement,

M_{adj} is the size adjusted measurement,

L_0 is the total length of the fish,

L_S is the overall mean of total length for all fish from all samples in each analysis,

b was estimated for each character from the observed data as the slope of the regression of log M on log L_0 using all fish from both the groups.

VC is Coefficient of a variance,

SD is Standard Deviation

$\bar{X}$ is Arithmetic avarage of morphological measurement.

Results

Biological Analysis

There is no significantly differences in morphometric data between female and male (P>0.05). For this reason, statistical analyzes were according to population not for only male or female. Female to male ratio were evaluated as 0.79/1.00 (Table 1).

Length-weight relationships (LWR) were calculated for all localities (Table 3). The value of 'b' of LWR was found to be significantly different from 3.0 in *B.tauricus* for some localities. According to results, the type of growth for crimean barbel is isometric for localities except Terme and Karadere streams.

Morphometric Analysis

Twenty-nine morphometric measurement were taken with a digital calliper. In this study, twenty-nine morphometric characteristics for six localities were distributed according to normal distribution (Kolmogorov-Simirnov test, P>0.05). Descriptive statistics of the morphometric characters according to localities are shown in Table 4. All of the morphometric measurement have significant correlation with the total length after M transformation indicating that allometric formula was effective in removing size effect from the data (P<0.001).

The VC% values of each morphometric measurement were calculated separately according to each locality. The highest variation were calculated PostDD (37.99) and InNM (30.16) for Karadere Stream; InorD (36.56), PreorD (33.17), InNM (37.51), PBL (33.65) for Terme Stream; LAF (32.72), InNM (35.80), NL (33.7144) for Akçay Stream; ABL (25,701) ve NL (21,13) for Solaklı; PreDD (29.69), PrePD (30.69) for Engiz Stream; LAF (28.92), LCAUF (31.75783), InorD (33.87), InNM (41.45) for Değirmenağzı Stream.

According to DFA, fifteen morphometric measurements (HL, PreDD, PostDD, PrePD, PostPD, LAF, LPF, HCAUF, ED, InorD, ABL, NL, DDC, DVA and Lcaup) were found to be highly significant for separating the populations (P<0.001) and classification of localities were calculated as 92.3% (Figure 2). Especially, Engiz Stream population is very important because of measurement which taken from head (ED,

Table 3. LWR and growth types for *B. tauricus* according to localities

Locality	a	b	r^2	95% CI	Growth Type
Akçay Stream	0.0098	3.040	0.988	2.943-3.137	Isometric
Engiz Stream	0.0106	2.987	0.992	2.918-3.056	Isometric
Terme Stream	0.0119	2.901	0.990	2.820-2.982	(-) Allometry
Karadere Stream	0.0278	2.621	0.959	2.466-2.777	(-) Allometry
Solaklı Stream	0.0155	2.822	0.949	2.635-3.002	Isometric
Değirmenağzı Stream	0.0092	3.030	0.983	2.916-3.144	Isometric

InNM, ABL, PBL). This population is quite different from the other five populations. Wilks' Lambda tests results were shown in Table 5. The explanation of the total variation of morphological characteristics taken on a fish sample could be explained by fewer variables than the whole of them. PCA analysis showed that six (PostDD, DPV, LCAUF, PrePD, DDC and PostPD) of the morphometric measurements used to separate the

Table 4. Descriptive statistics of morphological characters

Morphometric characteristics (mm)	LOCALITIES					
	Akçay (Mean±SD)	Terme (Mean±SD)	Engiz (Mean±SD)	Karadere (Mean±SD)	Solaklı (Mean±SD)	Değirmenağzı (Mean±SD)
HL	14.21±1.12	13.89±1.60	13.85±1.57	14.54±1.29	13.57±1.16	13.89±1.09
HW	26.73±1.05	26.79±1.34	25.00±0.32	26.99±1.24	26.92±1.18	26.30±1.63
PreDD	53.28±1.73	52.45±1.45	53.67±0.58	54.25±1.85	54.94±0.92	53.40±2.97
PostDD	32.51±1.88	39.12±2.64	34.91±3.02	35.07±2.15	36.52±1.16	34.69±3.17
PrePD	27.82±1.51	27.20±2.29	30.03±2.14	28.16±1.32	29.48±1.45	27.22±1.65
PostPD	49.06±5.41	57.39±3.79	52.06±3.54	54.25±5.13	55.45±4.28	50.01±4.16
LDF	17.17±1.08	17.23±1.34	17.89±1.24	17.56±1.24	17.83±2.48	17.17±1.21
DDF	13.45±0.85	13.40±0.87	13.61±1.21	13.46±0.90	13.58±0.78	13.38±1.16
LAF	8.31±1.08	8.49±0.71	8.85±0.95	8.87±0.95	8.36±1.02	8.77±0.88
LPF	18.24±0.95	17.61±1.26	18.99±1.22	19.22±0.98	19.56±0.78	18.184±1.12
LVF	16.07±1.02	16.21±1.25	17.36±1.19	16.48±1.05	17.59±1.05	16.31±1.12
LCAUF	22.63±2.19	22.91±1.53	21.67±2.66	23.53±2.11	24.15±2.52	22.08±2.44
HCAUF	28.99±2.15	27.19±1.39	31.06±2.30	29.51±2.38	30.65±2.19	31.07±4.13
ED	5.39±0.48	5.25±0.42	5.13±0.04	5.46±0.29	5.96±0.25	5.24±0.41
InorD	6.30±0.57	6.12±0.50	5.65±0.05	6.84±0.95	6.75±0.54	6.19±0.92
PreorD	11.86±0.99	11.73±1.93	12.70±1.18	11.64±0.82	12.33±1.78	11.41±1.30
PostorD	16.93±0.86	17.06±1.28	16.93±1.13	16.54±0.91	16.94±1.53	16.64±1.19
InNM	2.94±0.63	2.74±0.55	2.69±0.29	3.12±0.37	3.45±0.45	2.93±0.64
ABL	4.79±0.75	4.68±0.83	4.64±0.43	4.56±0.46	4.86±0.68	4.98±0.51
PBL	8.37±0.69	8.33±1.43	9.19±0.70	8.39±0.65	8.61±0.56	8.37±0.82
NL	6.33±0.77	6.11±0.50	7.71±0.69	5.94±0.57	6.45±0.85	6.90±0.76
PreOPD	20.11±1.15	20.33±1.58	19.53±1.61	20.00±1.10	20.72±1.18	19.39±1.29
DDC	57.07±2.17	47.70±2.08	46.37±3.16	49.97±3.69	48.94±3.45	45.98±4.56
DPV	29.96±1.69	30.31±2.31	28.27±1.94	31.76±1.96	31.99±1.86	29.16±81.99
DVA	21.95±1.45	22.44±1.56	22.12±1.41	22.07±1.62	22.46±1.50	22.28±1.57
Lcaup	12.24±1.23	11.79±1.63	12.33±0.92	12.98±0.71	12.82±0.58	12.19±1.01
Dcaup	10.65±0.60	10.31±0.54	11.32±0.78	11.42±0.77	11.93±0.71	10.99±0.62
MaxBD	22.59±2.53	23.01±1.64	22.71±1.46	24.24±1.16	24.46±1.05	22.84±1.83

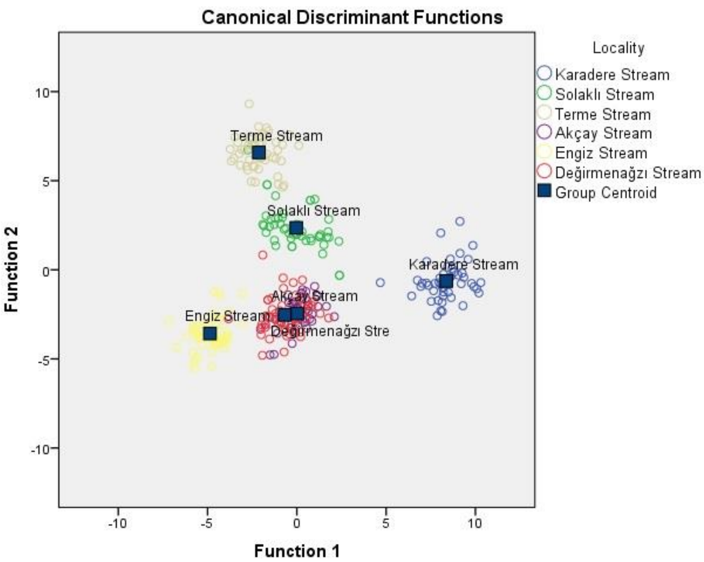

Figure 2. Graphical representation of Discriminant Function Analysis (DFA) for the classification of *B.tauricus* according to mophometric measurements.

populations were significantly more important than the others (Figure 3). The relationships between morphometric characters and total length were shown in Table 6. According to morphological characters which used in this study, six population could be separated from each other. Phenotypic variations could be seen in *B. tauricus* populations.

Discussion

Biological Analysis

Growth of fishes is an indeterminate plastic process that can change considerably in response to environmental factors such as temparature, physical and chemical parameters of biotope etc (Weatherley & Gill 1987). The results presented in this study show a negative allometric growth for *B. tauricus* in Terme (Samsun) and Karadere (Trabzon) Streams but isometric growth in Akçay (Samsun), Değirmenağzı Streams (Düzce), Engiz (Samsun) and Solaklı Streams. There is no study which reported *B. tauricus* growth pattern but there are lots of study about genus *Barbus* (Herrera, Hernando, Fernandez-Delgade, & Bellido, 1988; Yıldırım, Erdoğan, & Türkmen, 2001; Oliveira, Ferreira, & Ferreira, 2002; Oscoz, Campos, & Escala,

Table 5. Results of Wilks' Lambda test according to DFA analysis

Functions	Wilks' Lambda	Chi-square	df	P
1-5	0.002	2380.639	80	0.000
2-5	0.006	1522.288	60	0.000
3-5	0.087	729.963	42	0.000
4-5	0.464	229.638	26	0.000
5	0.766	79.668	12	0.000

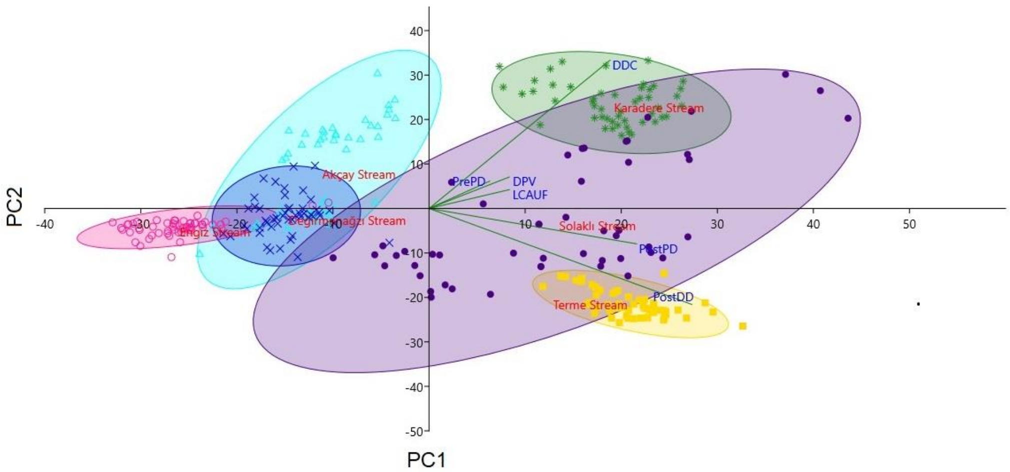

Figure 3. Principle Component Analysis (PCA) based on morphometric measurements of the six population.

Table 6. Morphological characters and Total length relationships of *B. tauricus* from six localities

	Akçay		Terme		Engiz		Karadere		Solaklı		Değirmenağzı	
No	Equations	r^2	Equations	r^2	Equations	r^2	Equations	r^2	Equations	r^2	Equations	r^2
2=	1.23TL-0.61	0.918	1.43TL-3.59	0.889	0.83TL+3.41	0.806	1.16TL-0.43	0.803	0.98TL+1.97	0.770	1.01TL+1.50	0.891
4=	4.57TL-1.66	0.985	4.32TL-0.91	0.987	4.94TL-5.96	0.949	4.48TL-2.06	0.965	4.43TL-0.94	0.964	4.50TL-1.30	0.967
5=	2.69TL+0.15	0.958	4.86TL+6.24	0.900	2.58TL+2.27	0.907	2.70TL+1.14	0.880	5.43TL-3.17	0.865	2.96TL-1.21	0.910
6=	2.43TL-1.30	0.968	2.53TL-3.87	0.943	2.75TL-3.97	0.935	2.74TL-3.01	0.943	2.08TL+1.90	0.865	2.17TL+0.76	0.949
7=	2.69TL+0.15	0.958	4.86TL+6.24	0.900	2.58TL+2.74	0.907	2.70TL+1.14	0.880	5.43TL-13.1	0.757	2.96TL-1.21	0.910
10=	0.83TL-1.52	0.892	0.71TL-0.29	0.984	0.63TL+0.76	0.837	0.63TL+0.94	0.716	0.52TL+2.63	0.805	0.74TL-0.27	0.901
11=	1.40TL+1.36	0.950	1.40TL+0.32	0.913	1.34TL+2.19	0.919	1.45TL+0.99	0.907	1.32TL+2.00	0.898	1.54TL-0.50	0.956
14=	2.25TL+1.96	0.911	2.02TL+2.24	0.942	2.10TL+7.96	0.817	1.99TL+4.67	0.890	2.51TL-0.73	0.817	2.08TL-3.09	0.911
15=	1.63TL+3.02	0.848	1.79TL+0.79	0.928	1.47TL+3.25	0.719	1.69TL+2.86	0.732	1.79TL+0.52	0.873	2.08TL-3.07	0.911
16=	2.25TL+1.96	0.911	2.02TL+2.24	0.942	2.10TL+7.96	0.817	1.99TL+4.57	0.781	2.51TL-0.73	0.817	2.40TL+1.85	0.812
20=	0.45TL-0.52	0.829	0.47TL-1.05	0.815	0.27TL+1.26	0.832	0.45TL-1.21	0.846	0.41TL-0.84	0.819	0.38TL+0.38	0.870
22=	0.46TL-0.52	0.829	0.47TL-1.05	0.815	0.27TL+1.26	0.794	0.45TL-1.22	0.815	0.73TL-0.88	0.812	0.51TL+2.10	0.840
24=	0.77TL-0.84	0.942	0.89TL-2.53	0.819	0.56TL+2.12	0.863	0.87TL-2.57	0.888	4.63TL+11.8	0.882	2.03TL+20.1	0.914
26=	6.54TL+16.3	0.950	3.80TL+0.78	0.968	2.89TL+9.63	0.920	4.63TL+11.8	0.882	2.43TL+0.55	0.941	2.54TL-1.62	0.954
27=	2.72TL-2.57	0.966	2.43TL+0.26	0.899	2.07TL+2.13	0.915	2.67TL+3.22	0.867	0.92TL+0.89	0.900	0.91TL+1.03	0.951

2005; Şen & Kara, 2016). The differences between growth can be explained by ecological parameters. Different fish species could show the same or different growth type. Environmental conditions have an important influence on ecology of fishes and are considered to be the principal factors in intraspecific growth differences (Lobòn-Cerviá, Montanes, & De Sostoa, 1991; Oliveira *et al*., 2002).

Morphological Analysis

Morphometry is one of the multidisciplinary methods used to identify stocks (Ihssen *et al*., 1981). In fishes, morphological characteristics represent one of the main points for determining their growth variability, systematics, ontogenetic trajectories (Kováč, Copp & Francis, 1999). Some researchers suggest that the phenotypic variation is a dynamic and flexible concept that affects the structure of the population within a short period of time because it is influenced by environmental conditions (Tudela, 1999). Explaining the morphological differences between fish populations is partly difficult. Genetic, environment and interactions between them can be used for explanation of morphological characteristics (Pinheiro, Teixeira, Rego, Marques, & Cabral, 2005).

The barbel is a complex polyphyletic group of Old World Cyprinidae that provides a good model for studying evolutionary phenomena in freshwater fish (Berrebi, 1995). Among these species included in this genus, *B. tauricus* is one of the species that distributed Black Sea watersheds. The systematic position of this species has some problems and still disputable. There are some synonims and subspecies of crimean barbel in Turkey.

The statistical analyzes performed, revealed that the morphometric data are much more sensitive to environmental variables than the meristic data (Turan, Kottelat, Kirankaya & Engin, 2006). It is necessary to determine whether there is a differences between female and male individuals in the morphometry studies carried out. In this study, it was determined that sex is not important both in population and between populations (P>0.05). There are a lot of studies that show that sex is not important between female and male individuals and evaluations have been carried out whole populations (Pinheiro *et al*., 2005; Zengin, Polat, & Saygın, 2015; Doung, Nguyeni, & Pham, 2017).

In this study, for each locality, the length and weight values of the samples were recorded, and the CV% values of the morphometric measurements were determined separately. In addition, equations of the relationships between significant morphometric measurement value and total length were determined (Table 6). The study of length-length (LLR), length-weight (LWR) and total length-mophometric measurements relationships is considered to be important to get different kinds of information of fish in fish biology such as growth rate, discrimination of stocks and population dynamic studies. The relationship between LLR, LWR transformations and morphometric measurements with TL are the important equations used in back calculation. These equations were used in many studies (Hossain, 2010; Yılmaz, Polat & Yazıcıoğlu, 2010; Kashyap *et al*., 2014; Özdemir, 2015; Tsagarakis *et al*., 2015; Singh, & Serajuddin, 2017).

There are some sudies that examined morphological characteristics of *Barbus* species. Verep, Turan, & Kovác (2006) were studied morphometric characteristics of *Barbus tauricus* sampled from Rize and Artvin Province. They measured ED, HL, PreorD, InterorD, PostDD and PreDD. The results of that study were smilar with this study. Radkhah, Hadi, Soheil, & Manoochehr (2016) were studied with *Barbus lacerta* from Zarrineh River for determining body shape of fishes were influenced by environmental parameters and the habitat condition or not. Graaf, Dejen, Sibbing, & Osse (2000) were described a new *Barbus* species "*Barbus tanapelagius*" with morphometric measurement. The majority of morphometric studies shape factor affects 80% or more of the variations between variables (Junquerra & Perez-Gandaras, 1993). Also, multivariate analysis (PCA and DFA) were used to distinguish populations from each other and to determine which morphometric characters better reflect these distinctions. Turan, Oral, Öztürk & Düzgüneş (2006), Mohaddasi, Shabanipour, & Abdolmaleki (2013), Vatandoust, Abdoli, Anvarifar, & Mousavi-Samet (2014), Özdemir (2015), Hedayati, Farsani, Gerami, & Fricke (2016) were used multivariant approach for distinguishing populations of *Pomatomus saltatrix*, *Alburnus chalcoides, Salmo trutta fario, Capoeta* sp*., Alburnus zagrosensis* populations from different sites, respectively. Also in this study the multivariate analysis were used. Fifteen morphometric measurements were found important according to localities. The formula which performed by Elliott *et al.* (1995) were used for standardising the data. There are lots of study used this formula (Motamedi *et al.,* 2014; Vatandoust, Abdoli, Anvarifar, & Mousavi-Samet, 2014; Mir *et al.,* 2015).

Motamedi *et al.* (2014) find out morphological and molecular perspective on geographical differentiation of *Barbus* populations within Iranian freshwater drainages and they found no significant differences between the males and females with regard to the morphometric and meristic characters like this study. According to DFA analysis, classification success among three *Barbu*s species from three drainages were 97.5% (Motamedi *et al*., 2014). In this study, classification success were found as 92.3%.

Morphometric characters are known to have a very high flexibility depending on the habitat conditions (Wimberger, 1994). In addition, the morphological characteristics of fish are determined by the environment, genetics and interactions between them (Poulet *et al.,* 2004; Tzeng 2004; Motamedi *et al*., 2014; Kashyap, Awasthi, & Serajuddin, 2016).

The present study provides a baseline for biological information for *B. tauricus* and indicates that different populations could have variations in morphological characteristics. These differences could be used for fisheries management and conservation. This is the first study that investigated some biological and morhological characteristics of *B. tauricus* populations from Black Sea Region.

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