

Length-Weight, Length-Length Relationships and Condition Factors of Some Fish Species in Yalıköy Stream (Ordu-Turkey)

Derya BOSTANCI^{1*}, Serdar YEDİER¹, Seda KONTAŞ², Gülşah KURUCU¹, Nazmi POLAT³

¹Ordu University, Department of Molecular Biology and Genetics, Ordu, TURKEY.

²Ordu University, Department of Fisheries Technology Engineering, Ordu, TURKEY.

³Ondokuz Mayıs University, Department of Biology, Samsun, TURKEY.

*Corresponding Author Tel.: +90 452 234 50 10 / 1658

E-mail: deryabostanci@gmail.com

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Abstract

The aim of the present study is to determine the length-weight, length-length relationships and condition factors of some fish species in Yalıköy Stream (Ordu-Turkey). All specimens were collected by fishing nets, fishing cast nets with different mesh sizes, fishing tackle, and electro shocker between June 2013 and June 2014 in the Yalıköy stream. In present study, 8 species (*Alburnus chalcoides*, *Barbus tauricus*, *Capoeta banarescui*, *Neogobius melanostomus*, *Neogobius fluviatilis*, *Salaria fluviatilis*, *Salmo labrax*, *Squalius cephalus*) belonging to 4 families (Blennidae, Cyprinidae, Gobiidae, Salmonidae) were examined. Total length (TL), fork length (FL) and standard length (SL) of the fish samples were measured to the nearest 0.1 cm, the weight (W) of fish was recorded to the nearest the 0.1 g in there. The length-weight relationships, TL vs SL and TL vs FL relationships and condition factors were calculated for each species which caught from Yalıköy Stream. All statistical analyses were evaluated at P<0.05 significance level. The highest length-length correlation coefficient was 0.99 (*B. tauricus*, *C. banarescui* and *S. cephalus*) while the lowest coefficient was 0.96 (*A. chalcoides*). The highest length-weight correlation coefficient was 0.97 (*S. cephalus*) while the lowest coefficient was 0.84 (*A. chalcoides*). The mean condition factors were calculated as 0.716±0.093 for *A. chalcoides*, 0.967±0.113 for *B. tauricus*, 1.069±0.113 for *C. banarescui*, 1.021±0.080 for *N. fluviatilis* and 1.197±0.095 for *S. cephalus*, respectively. In this study, determination of the length-weight, length-length relationships and condition factor were investigated for the first time in eight fish species from Yalıköy stream and these values were determined for the first time for five species living in this habitat.

Keywords: Growth, Length-weight relationship, Length-length relationship, Condition factor, Yalıköy stream.

Öz

Yalıköy Deresi (Ordu, Türkiye)'ndeki Bazı Balık Türlerinin Boy-Ağırlık ve Boy-Boy İlişkileri ile Kondisyon Faktörleri

Bu çalışmanın amacı Yalıköy Deresi (Ordu-Turkey)'ndeki bazı balık türlerinin boy-ağırlık, boy-boy ilişkileri ve kondisyon faktörlerini belirlemektir. Balık örnekleri, Haziran 2013 ve Haziran 2014 tarihleri arasında farklı göz açıklıklarına sahip ağlar, serpm ağlar, olta takımı ve elektroşok cihazı yardımıyla yakalanmıştır. Bu çalışmada, 4 familyaya (Blennidae, Cyprinidae, Gobiidae, Salmonidae) ait 8 tür (*Alburnus chalcoides*, *Barbus tauricus*, *Capoeta banarescui*, *Neogobius fluviatilis*, *Neogobius melanostomus*, *Squalius cephalus*, *Salaria fluviatilis*, *Salmo labrax*) örneklenmiştir. Balık örneklerinin total boy (TL), çatal boy (FL) ve standart boyları (SB) 0.1 cm hassasiyetle, balık ağırlığı (A) ise 0.1 g hassasiyetle ölçümleri yapılmıştır. Boy-ağırlık ilişkileri, TB-SB ve TB-ÇB ilişkileri ve kondisyon faktörleri Yalıköy Deresi'nden yakalan her tür için ayrı ayrı hesaplanmıştır. Tüm istatistiksel analizler, P<0.05 anlamlılık düzeyinde değerlendirilmiştir. En yüksek boy-boy ilişki katsayısı 0.99 (*B. tauricus*, *C. banarescui* ve *S. Cephalus*) iken en

düşük katsayı ise 0.96 (*A. chalcoides*) olarak belirlenmiştir. En yüksek boy-ağırlık ilişki katsayısı ise 0.97 (*S. cephalus*) iken en düşük katsayı 0.84 (*A. chalcoides*) olarak belirlenmiştir. Ortalama kondisyonfaktörlerisıraıyla *A. chalcoides* için 0.716 ± 0.093 , *B. tauricus* için 0.967 ± 0.113 , *C. banarescui* için 1.069 ± 0.113 , *N. fluviatilis* için 1.021 ± 0.080 ve *S. cephalus* için 1.197 ± 0.095 olarak hesaplanmıştır. Bu çalışmada, Yalıköy Deresi'nden sekiz balık türünde ilk kez boy-ağırlık, boy-boy ilişkileri ve kondisyon faktörleri araştırılmış ve bu habitatta yaşayan beş tür için bu değerler ilk kez belirlenmiştir.

Anahtar Kelimeler: Büyüme, Boy-ağırlık ilişkisi, Boy-boy ilişkisi, Kondisyon faktörü, Yalıköy Deresi.

Introduction

Length-weight and length-length relationships are given information on the condition and growth patterns of fish species in many fisheries study (Bagenaland Tesch, 1978). They are useful tools in fishery assessment (Yılmaz et al., 2010; Tsagarakis et al., 2015; Yazıcıoğlu et al., 2013; Yazıcıoğlu and Yazıcı, 2016). The relationship between the length (L) and weight (W) of a fish is usually expressed by the equation $W=aL^b$. Values of the exponent b provide information on fish growth. When $b=3$, increase in weight is isometric. When the value of b is other than 3, weight increase is allometric (positive if $b>3$, negative if $b<3$) (Froese, 2006).

These relationships permit for the calculation of condition indexes of the fish species and they also provide significant contributions to the researcher by providing sex, species and region-based comparisons (Froese, 2006). Another important role is related to the conservation of fish species (Kamaruddin et al., 2011). Fulton's condition factor (K) is widely utilized in fisheries research (Froese, 2006). Condition value of a fish differs in many studies, which may have different causes such as age of the species, abundance of food in their habitats, sex and sexual maturity (Birecikligil et al., 2016). The condition factor is frequently used in the analysis of onto genetic changes (Safran, 1992) and for between-regions life-history comparisons (Petrakis and Stergiou, 1995).

Although length-weight and length-

length conversion factors are of fundamental importance in fisheries, Turkish freshwater fishes are quite lacking in terms of these properties (Birecikligil et al., 2016). There are no investigations on the length-weight, length-length relationship and condition factor of the species in Yalıköy Stream (Ordu-Turkey). Therefore, this study is the first study to be carried out in the length-weight, length-length relationship and condition factor in this stream.

The aim of the current study is to determine the, length-length length-weight relationships and condition factor of eight fish species, including *Alburnus chalcoides*, (Güldenstädt, 1772); *Barbus tauricus*, Kessler, 1877; *Capoeta banarescui*, Turan, Kottelat, Ekmekçi and Imamoglu, 2006; *Neogobius melanostomus* (Pallas, 1814); *Neogobius fluviatilis*, (Pallas, 1814); *Salaria fluviatilis*, (Asso, 1801); *Salmo labrax*, Pallas, 1814 and *Squalius cephalus* (Linnaeus, 1758) in Yalıköy Stream (Ordu, Turkey).

Materials and Methods

Yalıköy stream located between $41^{\circ} 2'17.46'' - 41^{\circ} 3'11.61''$ N latitudes and $37^{\circ} 38'15.60'' - 37^{\circ} 36'45.38''$ E longitudes (Figure 1). A total of 309 specimens were collected by fishing nets, fishing cast nets with different mesh sizes, fishing tackle, and electro shocker between June 2013 and June 2014 in Yalıköy stream (Ordu, Turkey).

All samples were transported to the hydrobiology laboratory at Ordu University and total length (TL), fork length (FL) and standard length (SL) of the fish samples were measured to the nearest 0.1 cm, the weight (W) of fish was recorded to the nearest the 0.1 g in there. The relationships were not calculated for the low number of fish samples. While the length-weight relationships were calculated using the $W=aL^b$ equation, TL vs SL and TL vs FL relationships were calculated by linear regressions.

The length-length (L-L) relationships were calculated by the simple linear regression a: $x = by + \alpha$ where x and y are variables, α and b

are regression constants. Fulton's Condition Factor was estimated using following equation: $K=100(W/L^3)$. The condition factor is computed for each species from Yalıköy stream. All graphics were powered by Microsoft Excel 2016 and all statistical analyses were evaluated at $P < 0.05$ significance level by Minitab 17.0.

Results

In present study, 8 species (*Alburnus chalcoides*, *Barbus tauricus*, *Capoeta banarescui*, *Neogobius melanostomus*, *Neogobius fluviatilis*, *Salaria fluviatilis*, *Salmo labrax* and *Squalius cephalus*) belonging to 4 families (Blenni-

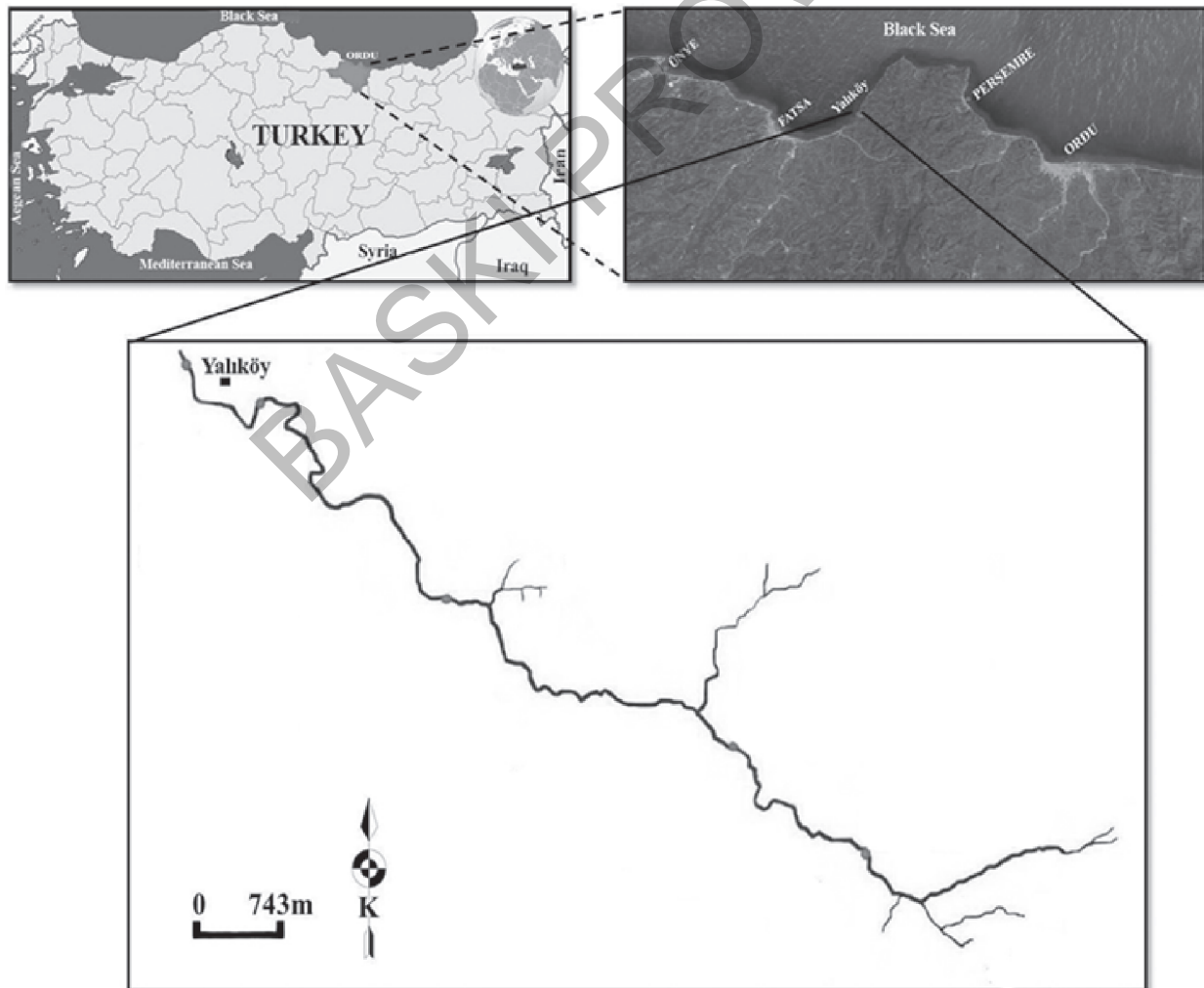


Figure 1. Map of the study area.

dae, Cyprinidae, Gobiidae, Salmonidae) were examined. Length-length, length-weight relationships (LWRs) and mean condition factor were calculated for five species because of the low number of *N.melanostomus* and *S. fluviatilis* and *S. labrax* species.

The length-length relationships (LLRs) between total length, fork length, and standard length and also the estimated parameters of the length-length relationship and the coefficient of determination R^2 of *A. chalcoides*, *B. tauricus*, *C. banarescui*, *N. Fluviatilis* and *S. Cephalus* species are shown in Table 1. All LLRs were highly significant with $R^2 > 0.96$ and they

are illustrated in Figure 2.

Characteristics of parameters 'a' and 'b' of the LWR relationship, growth types, 95% confidence limit of 'b', and coefficient of determination R^2 of five species are presented in the Table 2 and LWRs are illustrated in Figure 3. LWR indicated positive allometric growth for *A. chalcoides*, *C. banarescui* and *S. cephalus* ($W=0.0064TL^{3.0425}$, $W=0.0055TL^{3.2726}$, $W=0.0106TL^{3.0447}$ respectively), while *B. tauricus* and *N. fluviatilis* exhibited negative allometric growth ($W=0.0212TL^{2.6707}$, $W=0.0155TL^{2.8111}$, respectively).

Table 1. Length-length relation ship parameters for five fish species (♂ + ♀) from the Yalıköy stream, Ordu (Turkey)

Species	n	TL Mean± SE (cm)	TL-FL Regression equations and coefficient	TL-SL Regression equations and coefficient
<i>A. chalcoides</i>	58	11.42±0.149	TL=1.0626FL+0.3552 (R ² =0.97)	TL=1.1195SL+0.8525 (R ² =0.96)
<i>B. tauricus</i>	22	11.20±0.366	TL=1.0486FL+0.4278 (R ² =0.99)	TL=1.1384SL+0.5560 (R ² =0.99)
<i>C. banarescui</i>	67	11.55±0.197	TL=1.0326FL+0.5849 (R ² =0.99)	TL=1.004SL+0.9079 (R ² =0.99)
<i>N. fluviatilis</i>	23	9.21±0.188	-	TL=1.2447SL-0.5940 (R ² =0.97)
<i>S. cephalus</i>	118	13.43±0.248	TL=1.0357FL+0.5102 (R ² =0.99)	TL=1.1101SL+0.9713 (R ² =0.99)

TL: total length; FL: fork length; SL: standard length; SE: standard error; R²: coefficient of determination; n: sample size.

Table 2. Length-weight relationship parameters for five fish species (♂ + ♀) from the Yalıköy stream, Ordu (Turkey)

Species	TL range (cm)	W range (g)	TL-W Regression equations and coefficient	95% C.I. of b	Growth Type
<i>A. chalcoides</i>	8.9-14.7	5.8-22.8	$W=0.0064TL^{3.0425}$ (R ² =0.84)	3.0290-3.0573	+A
<i>B. tauricus</i>	8.5-15.0	6.0-27.4	$W=0.0212TL^{2.6707}$ (R ² =0.93)	2.6517-2.6904	-A
<i>C. banarescui</i>	7.8-16.0	4.4-47.8	$W=0.0055TL^{3.2726}$ (R ² =0.95)	3.2605-3.2803	+A
<i>N. fluviatilis</i>	7.8-12.1	4.4-16.0	$W=0.0155TL^{2.8111}$ (R ² =0.91)	2.7952-2.8255	-A
<i>S. cephalus</i>	9.8-25.3	11.0-221.8	$W=0.0106TL^{3.0447}$ (R ² =0.97)	3.0406-3.0515	+A

W: fish weight; TL: total length; R²: coefficient of determination; +A: positive allometric, -A: negative allometric.

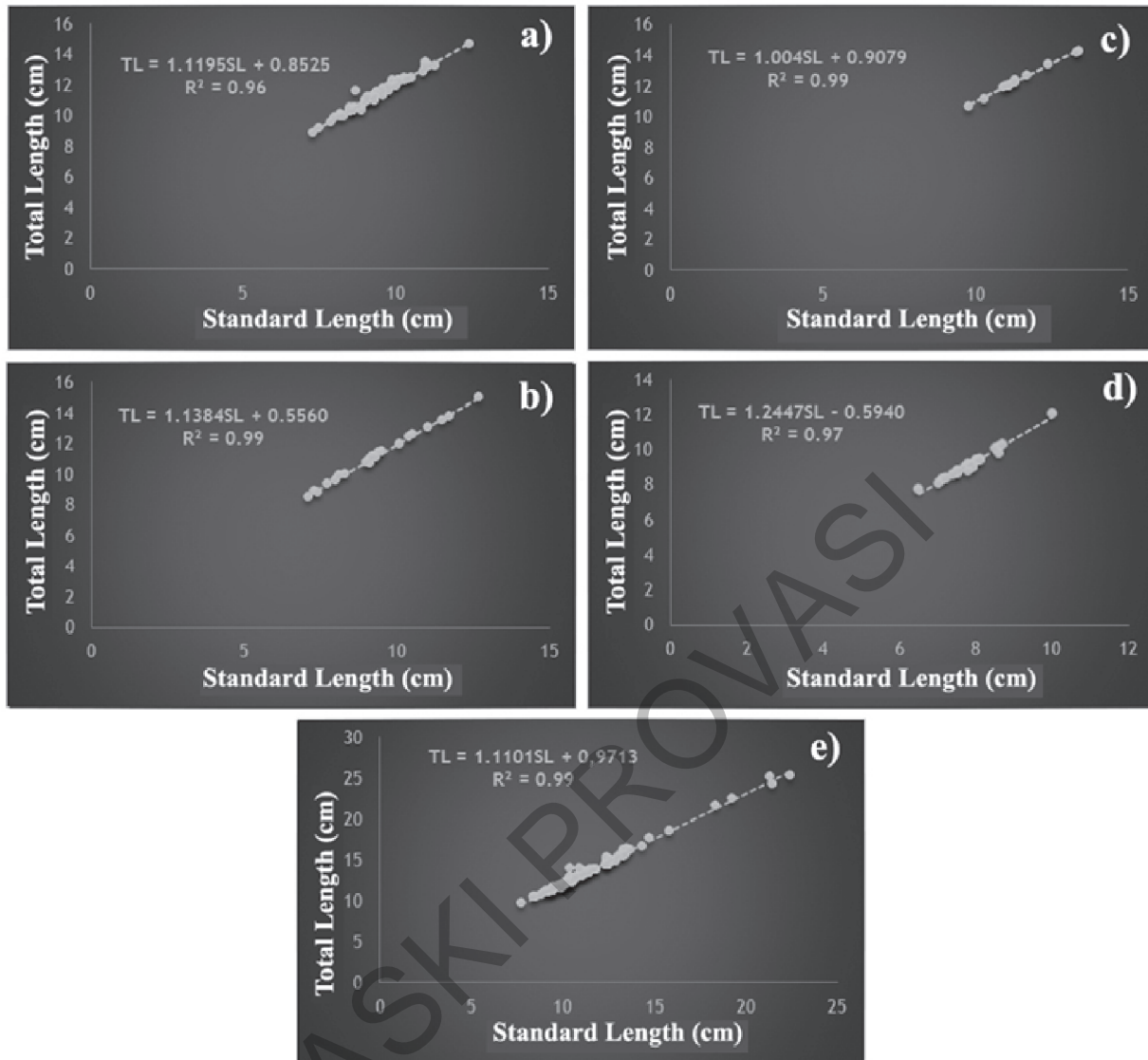


Figure 2. Total length-standard length relationships of five fish species (a) *A. chalcoides*, b) *B. tauricus*, c) *C. banarescui*, d) *N. fluviatilis* and e) *S. cephalus*) collected from the Yalıköy stream, Ordu (Turkey).

Calculation of condition factors were summarized in Table 3. Fulton's Condition Factor (K) values were ranged between 0.538 and 0.956 with an average of 0.716 ± 0.093 for *A. chalcoides*, between 0.811 and 1.210 with an average of 0.967 ± 0.113 for *B. tauricus*, between 0.827 and 1.307 with an average of 1.069 ± 0.113 for *C. banarescui*, between 0.860 and 1.155 with an average of 1.021 ± 0.080 for *N. Fluviatilis* and between 0.934 and 1.535 with an average of 1.197 ± 0.095 for *S. cephalus*.

Discussion

The b value in the fish length-weight equation shows the fish shape according to the habitat conditions in which the fish lives and it is known that the value of B changes between 2.5 and 3.5 (Erkoyuncu, 1995). In this study, the b values were determined between 2.67-3.26 for five fish Species (Table 4). When the growth was evaluated in terms of length, it was found that the growth for *A. chalcoides*, *C. banarescui*, and

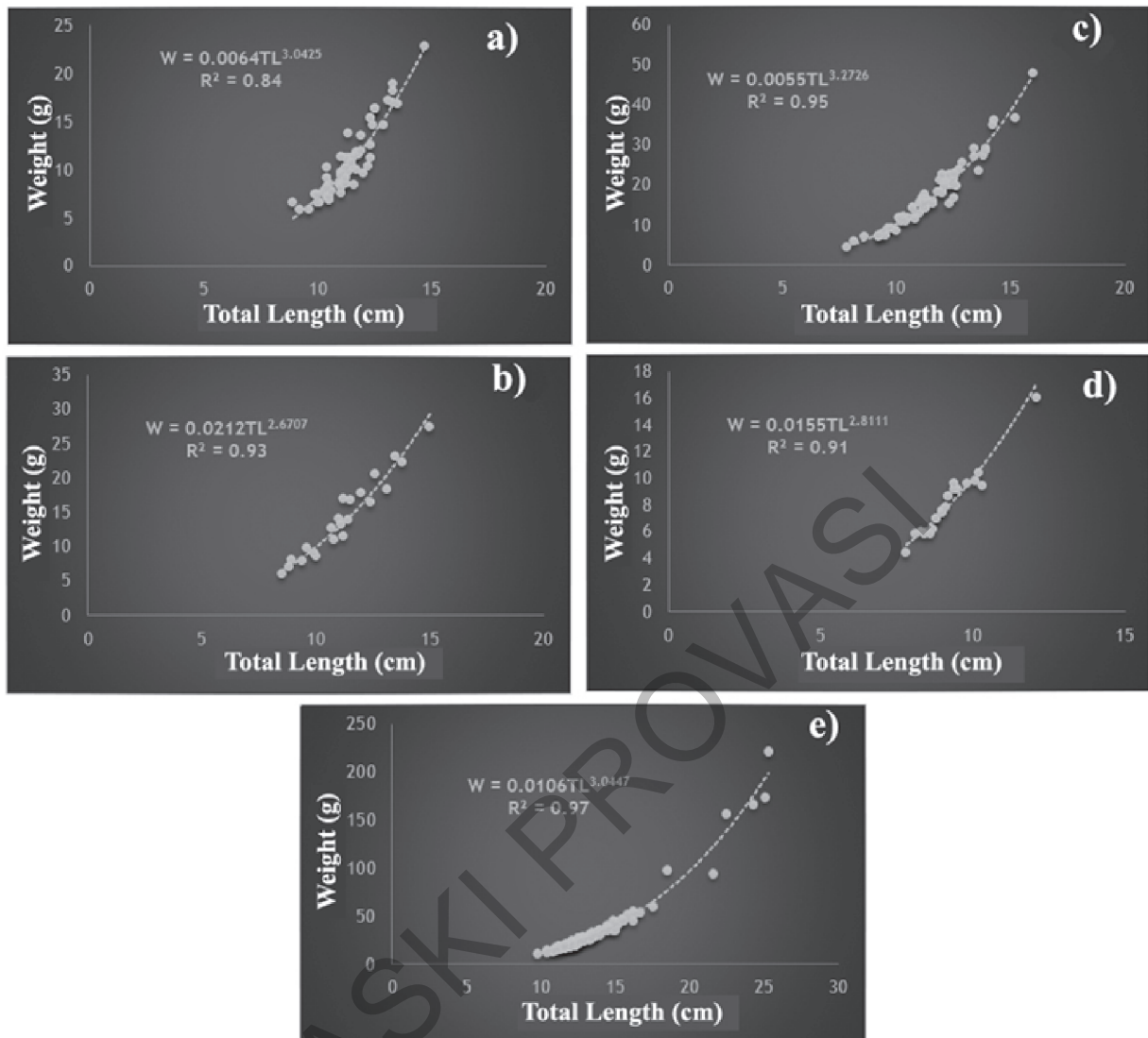


Figure 3. Length-weight relationships of five fish species (a) *A. chalcoides*, b) *B. tauricus*, c) *C. banarescui*, d) *N. fluviatilis* and e) *S. cephalus*) collected from the Yalıköy stream, Ordu (Turkey)

Table 3. Condition factor of five fish species in the Yalıköy stream, Ordu (Turkey).

	<i>A. chalcoides</i>	<i>B. tauricus</i>	<i>C. banarescui</i>	<i>N. fluviatilis</i>	<i>S. cephalus</i>
Min-Max	0.538-0.956	0.811-1.210	0.827-1.307	0.860-1.155	0.934-1.535
K values					
Mean± SE	0.716±0.093	0.967±0.113	1.069±0.113	1.021±0.080	1.197±0.095
K values					

K: Fulton's Condition Factor; SE: standard error.

S. cephalus were positive allometric ($b > 3$, $P < 0.05$), *B. tauricus* and *N. fluviatilis* were negative allometric ($b < 3$, $P < 0.05$). Other studies

have conducted research on the LWRs of identical species in different habitats (Table 4).

The functional regression b value in fish

Table 4. Parameters of the length–weight relationship of the five fish species (♂ + ♀) in different habitats

Species	a	b	TL Range (cm)	R ²	n	Locality	References
<i>Alburnus chalcoides</i>	0.0035	3.357	11.9-28.8	0.976	34	Porto-Lagos, Greece	Kleanthidis et al., 1999
	0.0029	3.410	12.9-21.5	0.960	67	Lake Volvi, Greece	Koutrakis and Tsikliras, 2003
	0.0192	2.730	10.1-19.3	0.910	21	Büyükçekmece Dam, Turkey	Tarkan et al., 2006
	0.0017	3.560	16.8-27.6	0.942	57	Lake Sapanca, Turkey	Tarkan et al., 2006
	0.0042	3.270	8.5-22.6	0.998	11	Terkos Dam, Turkey	Tarkan et al., 2006
	0.0038	3.320	8.8-28.4	0.995	108	Ömerli Dam, Turkey	Tarkan et al., 2006
	0.0089	3.012	4.1-16.6	0.987	574	Biga Peninsula, Turkey	Ilhan et al., 2012
	0.0079	3.051	11.8-17.8	0.945	26	Curi stream, Ordu, Turkey	Tsagarakis et al., 2015
	0.0064	3.042	8.9-14.7	0.840	58	Yalıköy stream, Ordu, Turkey	This study
<i>Barbus tauricus</i>	0.0070	3.060	6.8-40.0	0.972	123	Western Anatolia, Turkey	Gaygusuz et al., 2013
	0.0212	2.670	8.5-15.0	0.930	22	Yalıköy stream, Ordu, Turkey	This study
<i>Capoeta banarensis</i>	0.0088	3.072	8.1-21.0	0.960	247	Melet River, Turkey	Kurucu, 2013
	0.0107	3.035	6.9-28.6	0.988	101	Çoruh River, Turkey	Mazlum et al., 2015
	0.0055	3.272	7.8-16.0	0.950	67	Yalıköy stream, Ordu, Turkey	This study
<i>Neogobius fluviatilis</i>	0.0159	3.069	1.7-13.0	0.997	124	Kuban river, Russia	Troitsky and Tsunikova, 1983
	0.0057	3.290	3.5-13.0	0.978	515	Gomishan and Miankale, Iran	Abdoli et al., 2009
	0.0092	3.127	6.5-10.5	0.967	16	Biga Peninsula, Turkey	Ilhan et al., 2012
	0.0155	2.811	7.8-12.1	0.910	23	Yalıköy stream, Ordu, Turkey	This study
	0.0083	3.064	1.5-21.9	0.978	1161	Rihios estuary, Greece	Koutrakis and Tsikliras, 2003
	0.0027	3.444	12.5-32.4	0.977	27	River Neretva estuary, Croatia	Dulčić and Glamuzina, 2006
	0.0115	3.020	19.3-33.0	0.968	33	Lake Iznik, Marmara, Turkey	Tarkan et al., 2006
	0.0074	3.180	8.9-30.5	0.984	46	Ömerli Dam, Turkey	Tarkan et al., 2006
	<i>Squalius cephalus</i>	0.0090	3.057	3.4-30.0	0.994	45	Anyet River, Gerona, Spain
0.0066		3.112	8.0-22.9	0.994	6	Huesa Province, Spain	Leunda et al., 2006
0.0060		3.190	18.2-26.0	0.951	27	Seyhan Dam, Turkey	Erguden and Goksu, 2009
0.0076		3.117	4.0-38.7	0.990	2181	Flanders, Belgium	Verreycken et al., 2011
0.0080		3.170	8.4-11.6	0.997	16	Caspian Sea, Iran	Esmaili et al., 2014
	0.0106	3.044	9.8-25.3	0.970	118	Yalıköy stream, Ordu, Turkey	This study

TL: total length; n: sample size; a: intercept; b: slope; R²: coefficient of determination.

biology gives a variety of information about the body form and life of the fish. LWR parameters are directly related to the fish weight and it affected by ecological factors such as season, food supply, temperature, and spawning conditions and other factors such as gonad maturity sex, stomach fullness age, health fishing time diet, area, preservation techniques and fishing vessels (Ricker, 1973; Bagenal and Tesch, 1978; Froese, 2006).

In this study, determination of the length-weight, length-length relationships and condition factor were investigated for the first time in five fish species from Yalıköy stream (Ordu, Turkey). Difference in b values can be attributed to the combination of one or more factors such as general fish condition, seasonal effects, gonadal maturity, preservation technique, habitat, sex, stomach fullness and health (Froese,

2006). The results of the current study would be beneficial for fishery biologists, fishery management and also conservation of biodiversity for these ecosystems.

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BASKI PROVASI