



Length-Weight, Length-Length Relationships and Condition Factor of *Squalius cephalus* (Linnaeus, 1758) in the Munzur River

Ebru İfakat ÖZCAN* Osman SERDAR
Munzur University, Faculty of Fisheries, Tunceli, Turkey

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*ID: <https://orcid.org/0000-0003-2017-6647>
ID: <https://orcid.org/0000-0003-1744-8883>

*Corresponding author:
Ebru İfakat ÖZCAN
Munzur University, Faculty of Fisheries,
Tunceli, Türkiye
✉: ebruozzer@munzur.edu.tr

Abstract: In this study; some features were investigated such as length-weight, length-length relationships and condition factor of *Squalius cephalus* (Linnaeus, 1758) were obtained between 2019-2021 from Munzur River. 49 of the *S. cephalus* samples were female and 59 were male; female/male ratio was found 1/1.20. Total length and weight ranged between 8.2-24.1 cm and 6.8-148.6 g for female; 8.9-24.3 cm and 7.3-156.8 g for male. The length-weight relationship of *S. cephalus* was found as $W = 0.0079L^{3.1229}$ ($R^2 = 0.965$) in females, $W = 0.0074L^{3.1536}$ ($R^2 = 0.971$) in males and $W = 0.0076L^{3.1407}$ ($R^2 = 0.969$) in all individuals. It was determined that the b value was statistically different from 3 in female, male and all individuals (t-test; $p < 0.05$). The growth of *S. cephalus* was determined positive allometric ($b > 3$) in the Munzur River. The relationship between total, fork and standard lengths was determined for female, male and all individuals were quite strong ($P < 0.001$; $R^2 > 0.927$). Condition factor of *S. cephalus* varies between 0.827-1.438 in females and 0.826-1.517 in males from Munzur River.

Keywords: Length-weight relationship, length-length relationship, condition factor, *Squalius cephalus*, munzur river.

Munzur Nehri'ndeki *Squalius cephalus*'un (Linnaeus, 1758) Boy-Ağırlık, Boy-Boy İlişkileri ve Kondisyon Faktörü

Öz: (Linnaeus, 1758) boy-ağırlık, boy-boy ilişkileri ve kondisyon faktörü gibi bazı özellikleri incelenmiştir. *S. cephalus* örneklerinin 49'u dişi ve 59'u erkek; dişi/erkek oranı 1/1,20 olarak bulunmuştur. Dişilerde toplam boy ve ağırlık 8,2-24,1 cm ile 6,8-148,6 gr; erkeklerde 8,9-24,3 cm ve 7,3-156,8 gr arasında değişmektedir. *S. cephalus*'un boy-ağırlık ilişkisi dişilerde $W = 0,0079L^{3,1229}$ ($R^2 = 0,965$), erkeklerde $W = 0,0074L^{3,1536}$ ($R^2 = 0,971$) ve tüm bireylerde $W = 0,0076L^{3,1407}$ ($R^2 = 0,969$) olarak bulunmuştur. b değerinin dişi, erkek ve tüm bireylerde istatistiksel olarak 3'ten farklı olduğu belirlenmiştir (t-testi; $p < 0,05$). Munzur Nehri'nde *S. cephalus*'un büyümesinin pozitif allometrik ($b > 3$) olduğu belirlenmiştir. Dişi, erkek ve tüm bireyler için total, çatal ve standart boylar arasındaki ilişki oldukça güçlü bulunmuştur ($P < 0,001$; $R^2 > 0,927$). Munzur Nehri'nde *S. cephalus*'un kondisyon faktörü dişilerde 0,827-1,438 ve erkeklerde 0,826-1,517 arasında değişmektedir.

*Sorumlu yazar:
Ebru İfakat ÖZCAN
Munzur Üniversitesi, Su Ürünleri Fakültesi,
Tunceli, Türkiye
✉: ebruozzer@munzur.edu.tr

Anahtar kelimeler: Boy-ağırlık ilişkisi, boy-boy ilişkisi, kondisyon faktörü, *Squalius cephalus*, munzur nehri.

INTRODUCTION

The genus *Squalius*, called *Leuciscus*, is a large group represented by 45 species in the family Cyprinidae and has been revised as *Squalius* since 2011. The freshwater mullet *S. cephalus* has commercial value and wide

distribution in all of Europe, Black Sea, Caspian Sea and Azov Sea Basins, Caucasus and Anatolia (Kottelat & Freyhof, 2007). There are various studies on this species in different water resources in our country (Ünver & Erk'akan, 2012; Demiroğlu et al., 2016; Benzer & Gül, 2017; Özcan et

al., 2017; Özpiçak et al., 2018; Çelik, 2019; Özcan & Serdar, 2019).

Length and weight values of fish are used determining growth rates. However, length value is most commonly used in the expression of growth because it is easier to measure and shows less variation (Çetinkaya, 1989). The "b" value in the length-weight relationship is an indicator of the body shape of the fish and directly affected by the characteristics of the habitat in which the fish live (Ricker, 1975).

In fisheries biology, length-weight and length-length relationships of fish species are frequently used for different purposes such as estimating fish weight from fish length or estimating the total length from the standard length of a damaged fish, as well as useful in comparing the stocks of the same species in different habitats. In addition, a and b values, which are the length-weight relationship parameters, allow the morphology of and life processes compared of fish species distributed in different habitats (Yılmaz et al., 2010).

Condition factor in fish is one of the most important parameters related to body shape of the fish. This parameter can give information about the development of the related fish species in its habitat. This may allow researchers to make inter-habitat comparisons by comparing the condition factors of fish populations of the same species living in different environments. In addition, it provides information to researchers on issues such as condition factor, population density, nutritional status and effect of climate change on growth (Froese, 2006).

With this study, it was aimed to determine for the first time some population characteristics such as length-weight, length-length and condition factor of *S. cephalus* in Munzur River, and it will allow comparison with future studies on this species.

MATERIAL AND METHOD

The Munzur River starts in many branches from the southern slopes of the hills in the middle part of the Munzur Mountains. These branches unite in the Ovacık depression area, which is the largest plain of the province. Munzur River joins the Pülümür River in the borders of Tunceli city center (Saler & Haykır 2011). Uzunçayır Dam Lake is located, which was established to generate energy on the Munzur River (Saler et al., 2014; Bulut et al., 2021).

In this study, non-living 108 *S. cephalus* specimens were obtained from local fishermen in the Munzur River between 2019-2021 (Figure 1). The obtained fish were brought to the laboratory immediately and their total length was measured on a measuring board with ± 1 mm; the weights were recorded by measuring with an electronic balance with ± 1 g. The sexes of the fish were determined by opening their bellies and examining their gonads. Those with milky white and smooth surface gonads were evaluated as

male, those with greenish yellow and granular surface gonads as female (Lagler et al., 1977).



Figure 1. Munzur River (URL-1 2023).

Average length and weight values for each sex were calculated. In our study, the formula $W=aL^b$ (Bagenal & Tesch, 1978) was used to calculate the length-weight relationships. In this formula, W= fish weight (g), L= fish total length (cm), a and b represent the relationship constants. For this species, the 95% confidence interval (95%CI) of the b value was also calculated (Zar, 1999).

The relations between total length-standard length, total length-fork length, fork length-standard length, values were calculated with the linear relationship equation $y=ax+b$ and correlation coefficients were determined.

Condition factor, which is an indicator of the nutritive capacity of the environment was calculated with the following formula:

$$\text{Condition factor} = (W/L^3) * 100 \quad (\text{Le Cren, 1951}).$$

RESULT AND DISCUSSION

Total length and weight of female individuals of *S. cephalus* ranged between 8.2-24.1 cm and 6.8-148.6 g, the mean length was found 14.88 ± 0.47 cm in Munzur River, respectively. In males of *S. cephalus*, the total length and weight ranged between 8.9-24.3 cm and 7.3-156.8 g, the mean length was found 15.37 ± 0.41 cm, respectively. It was observed that the most dominant length group was 14.0-16.0 cm length group (Figure 2). Female and male individuals the difference between length and weight values was found to be statistically significant ($P > 0.05$). For this purpose, the length-weight relationship was evaluated separately for females, males and all individuals. In previous studies on *S. cephalus*; Bostancı & Polat (2009), 18.5-35.3 cm fork length and 124.4-667.6 g weight in Çamlıdere Dam Lake; İnnal (2010), 8.0-38.4 cm fork length and 8.3-845.0 g weight in Çamkoru Pond; Gaygusuz (2012), 1.9-34.7 cm total length and 0.04-509.50 g weight in streams flowing into Darlık Dam Lake; Çoban et al., (2013), 15.8-22.9 cm standard length in Uzunçayır Dam Lake; Kaptan (2014), 2.6-30.1 cm total length and 0.14-357.50 g weight in the Istranca Stream;

Aydın et al., (2015), 16.5-42.4 cm total length and 62.7-1365.2 g weight in Keban Dam Lake; Demirool et al., (2016) total length values were 13.00-36.20 cm for males and 13.60-33.80 cm for females; weight values of 25.82-616.00 g for males and 22.10-494.00 g for females in Uzunçayır Dam Lake; Özcan et al., (2017) found as 6.0-26.0 cm total length and 4.8-212.0 g weight in the Karasu River (Erzincan-Erzurum). Differences in length and weight values in studies conducted with the same species may be caused by sampling location and time, sampling method, fork length or total length values used in the study and many ecological factors (Suiçmez et al., 2011; Gündüz, 2014).

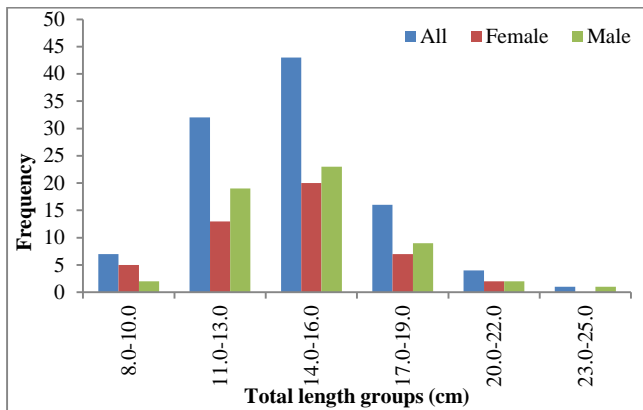


Figure 2. Distribution of total length groups-frequency of *S. cephalus* in Munzur River.

49 were female and 59 were male of the *S. cephalus* obtained from the Munzur River; female/male ratio was found to be 1/1.20. Sex composition; Bostancı & Polat (2009), 71.3% female and 28.7% male in Çamlıdere Dam Lake; İnnal (2010), stated 61.2% female, 30.6% male and 8.14% unidentified individuals and the female/male ratio was 1.0/0.5 in Çamkoru Pond. Gaygusuz (2012), stated 7.62% unidentified, 33.71% females and 58.67% males and the female/male ratio was 1/1.74% in the streams flowing

into Darlık Dam. Kaptan (2014), found the female/male ratio of *S. cephalus* 1/1.74 in the Istranca Creek. It is seen female/male ratios are generally different in each examined studies. In this regard, it can be considered normal that there are differences between different populations of the same species.

The length-weight relationship of *S. cephalus* was found as $W = 0.0079L^{3.1229}$ ($R^2 = 0.965$) in females, $W = 0.0074L^{3.1536}$ ($R^2 = 0.971$) in males and $W = 0.0076L^{3.1407}$ ($R^2 = 0.969$) in all individuals. The 95% confidence interval of the b value calculated as 3.035-3.252 for all individuals. In addition, it was determined that the b value was statistically different from 3 in female, male and all individuals (t-test; $p < 0.05$). The growth of the *S. cephalus* was determined positive allometric ($b > 3$) in the Munzur River. The high R^2 value showed a very strong relationship between length and weight in female, male and all individuals (Figure 3, 4, 5, Table 2). The b values obtained from the length-weight relationship of *S. cephalus* in previous studies are as follows; Bostancı & Polat (2009), 3.03 for all individuals in Çamlıdere Dam Lake; İnnal (2010), 3.01 for all individuals in Çamkoru Pond; Gaygusuz (2012), 3.14 for all individuals in Darlık Dam Lake; Kaptan (2014), 3.1494 for all individuals in the Istranca Stream; Aydın et al., (2015), 3.1484 for all individuals in Keban Dam Lake; Demirool et al., (2016), 3.1357 for all individuals in Uzunçayır Dam Lake; Özcan et al., (2017), 3.24 for all individuals in Karasu River (Erzincan-Erzurum); Özpiçak et al., (2018), 3.224; 3.285; 3.298; 3.210 for Abdal, Akçay, Terme and Yedikır in the Central Black Sea Region, respectively. These growth parameters in fish may differ from species to species, as well as between individuals of the same species living in different habitats. In addition to these, it is known that seasonal changes can be seen depending on the amount of food and reproduction in the environment (Yakut, 2019).

Table 1. Total length, weight and condition factor values of *S. cephalus* in Munzur River

Sex	n	Total Length (cm)		Weight (g)		Condition Factor	
		Ort±S.E	Min-Max	Ort±S.E	Min-Max	Ort±S.E	Min-Max
Female	49	14.88±0.47	8.2-24.1	42.12±4.74	6.8-148.6	1.109±0.02	0.827-1.438
Male	59	15.37±0.41	8.9-24.3	47.93±4.14	7.3-156.8	1.123±0.02	0.826-1.517
All	108	15.15±0.32	8.2-24.3	45.29±3.20	6.8-156.8	1.117±0.01	0.826-1.517

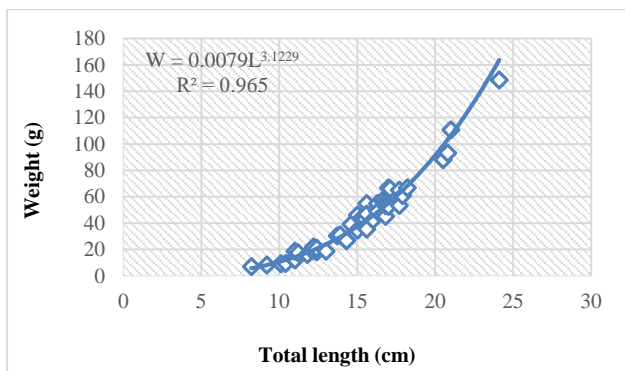


Figure 3. Length-weight relationship in females of *S. cephalus* from Munzur River.

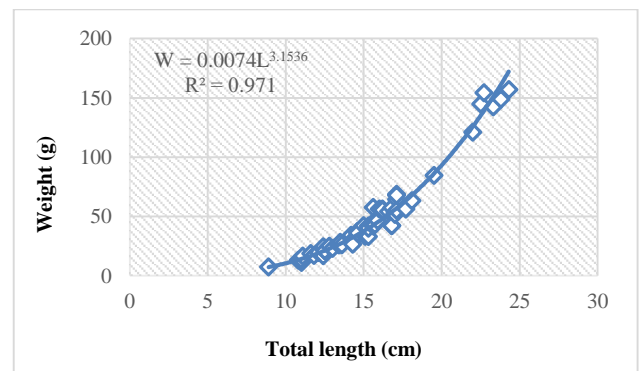


Figure 4. Length-weight relationship in males of *S. cephalus* from Munzur River.

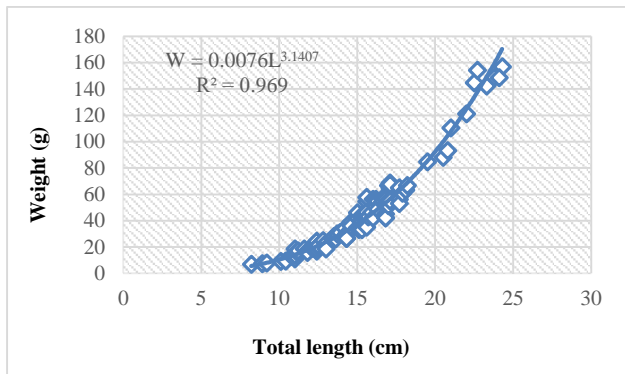


Figure 5. Length-weight relationship all individuals of *S. cephalus* from Munzur River.

Table 2. Length-weight relationship parameters of *S. cephalus* in Munzur River.

Sex	Length-weight parameters			
	a	b	%95 Confidence Interval	R ²
Female	0.0079	3.1229	3.036-3.252	0.965
Male	0.0074	3.1536	3.035-3.252	0.971
All	0.0076	3.1407	3.035-3.252	0.969

The relationship between total, fork and standard lengths of *S. cephalus* in Munzur River is given in Table 3. It was determined that the length-length relations for female, male and all individuals were quite strong ($P < 0.001$; $R^2 > 0.927$). It provides convenience in comparison with other studies using different length measurements with LLRs. Özcan et al., (2017) investigated LLRs of *S. cephalus* from Karasu River and found highly significant relationships ($R^2 > 0.95$, $P < 0.001$). Özpiçak et al., (2018) determined LLRs were significantly important ($P < 0.001$) and coefficient of determination (R^2) ranged from 0.916 to 0.999 for inhabiting a few inland waters of Middle Black Sea Region of Turkey.

Table 3. Length-length relationships of *S. cephalus* in the Munzur River.

Sex	Equation	a	b	R ²
Female	TL=a+bFL	1.4676	0.9544	0.927
	FL=a+bSL	0.1875	1.0792	0.988
	SL=a+bTL	0.6527	0.9064	0.952
Male	TL=a+bFL	0.5285	1.0236	0.974
	FL=a+bSL	0.0893	1.0906	0.990
	SL=a+bTL	0.1178	0.8653	0.966
All	TL=a+bFL	0.9734	0.9904	0.952
	FL=a+bSL	0.1497	1.0840	0.989
	SL=a+bTL	0.3741	0.8853	0.959

Condition factor of *S. cephalus* varies between 0.827-1.438 in females and 0.826-1.517 in males from Munzur River. Aydın et al., (2015) stated that the condition factor values of *S. cephalus* male individuals showed a distribution between 0.9325-1.7282, while female individuals showed a distribution between 1.001- 1.8484 in Keban Dam Lake. Demirolo et al., (2016) stated that the condition factor values of *S. cephalus* varied between 1.041-1.233 for males and 0.890-1.298 for females in Uzunçayır Dam Lake.

In conclusion; length-weight, length-length relationships and condition factor are very important in

fisheries management. Due to the diversity and abundance of water resources in our country, it provides the opportunity for fish species with different characteristics to live. The population characteristics of the fish living in these environments should be compared, management plans should be established and the fish populations should be hunted and the sustainability of the fish stocks should be ensured.

REFERENCES

- Aydın, R., Yüce, S., Şen, D., Çoban, M.Z., Birici, N., Uslu, A.A. & Küçükylmaz, M. (2015). Keban Baraj Gölü'nde Yaşayan Tatlısu Kefali (*Squalius cephalus*, L., 1758)'nin Büyüme Özellikleri. *Yunus Araştırma Bülteni*, 2, 59-69.
- Bagenal, T.B. & Tesch, F.W. (1978). *Age and growth. In: Methods for assessment of fish production in freshwaters*. 3rd edn. T. Bagenal (Ed.). IBP Handbook No. 3. Blackwell Scientific Publications, Oxford, UK, pp. 101-136.
- Benzer, S. & Gül, A. (2017). Population structure and some growth properties of chub *Squalius cephalus* (Linnaeus, 1758) in Devres Stream of Kızılırmak River, Turkey. *Journal of Fisheries*, 5(3), 513-518. DOI: 10.17017/jfish.v5i3.2017.247
- Bostancı, D. & Polat, N. (2009). Age Determination and Some Population Characteristics of Chub (*Squalius cephalus* L., 1758) in the Çamlıdere Dam Lake (Ankara, Turkey). *Turkish Journal of Science and Technology*, 4(1), 25-30.
- Bulut, H., Sesli, A. & Tepe, R. (2021). Uzunçayır Baraj Gölü Güncel Zooplanktonunun Bazı Su Kalite Parametreleri ile Değerlendirilmesi. *International Journal of Pure and Applied Sciences*, 7(3), 429-441. DOI: 10.29132/ijpas.938647
- Çelik, Ç. (2019). Length, Weight and Age Characteristics of Chub [*Squalius cephalus* (Linnaeus, 1758)] in the Istanca Brook (İstanbul). *Turkish Journal of Bioscience and Collections*, 3(1), 11-18. DOI: 10.26650/tjbc.20190003
- Çetinkaya, O. (1989). *Balıkçılık Biyolojisi ve Populasyon Dinamiği* (Ders Notları). Akdeniz Üniv. Eğirdir Su Ürünleri YO, Eğirdir, 65s.
- Çoban, M.Z., Gündüz, F., Yüksel, F., Demirolo, F., Yıldırım, T. & Kurtoğlu, M. (2013). Uzunçayır Baraj Gölü (Tunceli) Balık Faunası. *Yunus Araştırma Bülteni*, 2, 35-44. DOI: 10.17693/yunus.00196
- Demirolo, F., Gündüz, F., Yıldız, N., Kurtoğlu, M., Çoban, M.Z. & Yüksel, F. (2016). Uzunçayır Baraj Gölü (Tunceli-Türkiye)'nde yaşayan tatlısu kefali (*Squalius cephalus*)'nin bazı büyüme parametreleri. *Journal of Limnology and Freshwater Fisheries Research*, 2(2), 67-76.
- Froese, R. (2006). Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22, 241-253.

- Gaygusuz, Ö. (2012).** *Darlık Barajına Akan Bazı Derelerde Cyprinidae Familyasına Ait İki Türün Biyokolojik Özellikleri.* Doktora Tezi, İstanbul Üniversitesi Fen Bilimleri Enstitüsü.
- Gündüz, F. (2014).** *Determination of biological characteristics of *Acanthobrama marmid* Heckel, 1843 population in the Uzunçayır dam lake (Tunceli).* Yüksek Lisans Tezi. Kahramanmaraş Sütçü İmam Üniversitesi/Fen Bilimleri Enstitüsü/Su Ürünleri Anabilim Dalı, 61s.
- İnnal, D. (2010).** Population Structures and Some Growth Properties of Three Cyprinid Species [*Squalius cephalus* (Linnaeus, 1758); *Tinca tinca* (Linnaeus, 1758) and *Alburnus escherichii* Steindachner, 1897] Living in Camkoru Pond (Ankara, Turkey), *Kafkas Üniversitesi Veterinerlik Fakültesi Dergisi*, **16-B**, 297-304.
- Kaptan, Ç. (2014).** *Istranca Deresi'ndeki Tatlı Su Kefalinin [*Squalius cephalus* (Linnaeus, 1758)] Büyüme, Beslenme Ve Üreme Biyolojisi.* Yüksek Lisans Tezi, İstanbul Üniversitesi Fen Bilimleri Enstitüsü.
- Kottelat, M. & Freyhof, J. (2007).** Handbook of European Freshwater Fishes. The World Conservation Union (IUCN), Switzerland, 646 p.
- Lagler, K.F., Bardach, J.E., Miller, R.R. & Passino, D.R.M. (1977).** *Ichthyology.* John Wiley and Sons, Newyork, 506 p.
- Le Cren, E.D. (1951).** The length-weight relationships and seasonal cycle in gonad weight and condition in Perch (*Perca fluviatilis*). *Journal of Animal Ecology*, **20**, 210-219. DOI: 10.2307/1540
- Özcan, E.İ., Serdar, O. & Aydın, R. (2017).** Karasu Nehri'ndeki (Erzincan-Erzurum) *Squalius cephalus*'un (L., 1758) Boy-ağırlık ve Boy-Boy ilişkisi. *Yunus Araştırma Bülteni*, **1**, 109-114.
- Özcan, E.İ. & Serdar, O. (2019).** Age and some growth parameters of *Squalius cephalus* (Linnaeus, 1758) inhabiting Karasu River (East Anatolia, Turkey). *Ege Journal of Fisheries and Aquatic Sciences*, **36**(1), 25-30. DOI: 10.12714/egejfas.2019.36.1.03
- Özpiçak, M., Saygın, S., Hançer, E., Aydın, A., Yılmaz, S. & Polat, N. (2018).** Length-weight and length-length relationships of chub (*Squalius cephalus*, L., 1758) inhabiting a few inland waters of the Middle Black Sea Region. *Ege Journal Fisheries and Aquatic Sciences*, **35**(2), 175-179. DOI: 10.12714/egejfas.2018.35.2.10
- Ricker, W.E. (1975).** Computation and interpretation of Biological statistics of fish populations, *Bull Fish Res. Board. Can.*, **191**, 382.
- Saler, S. & Haykır, H. (2011).** Zooplankton composition of Pulumur Stream (Tunceli-Turkey). *Journal of Animal and Veterinary Advances*, **10**(11),1401-1403. DOI: 10.3923/javaa.2011.1401.1403
- Saler, S., Haykır, H. & Baysal, N. (2014).** Zooplankton of Uzunçayır Dam Lake (Tunceli-Turkey). *Journal of FisheriesSciences.com*, **8**(1), 1-7. (ShortCommunication). DOI: 10.3153/jfscom.2014001
- Suicmez, M., Yılmaz, S. & Seherli, T. (2011).** Age and Growth Features of *Chondrostoma regium* (Heckel, 1843) from Almus Dam Lake, Turkey. *Suleyman Demirel Univ. J. Sci.*, **6**, 82-90.
- URL-1 (2023).** [https://www.google.com/maps/place/Munzur Irmađı](https://www.google.com/maps/place/Munzur+Irmađı), 09.06.2023
- Ünver, B. & Erk'akan, F. (2012).** Population characteristics of *Squalius cephalus* in Lake Tödürge (Sivas). *Ege Journal of Fisheries and Aquatic Science*, **29**, 95-100. DOI: 10.12714/egejfas.2012.29.2.5000156440
- Yakut, Ü. S. (2019).** Keban Baraj Gölü *Alburnus mossulensis* (Heckel, 1843) populasyonunda büyüme parametrelerinin belirlenmesi. Yüksek Lisans Tezi. Munzur Üniversitesi, Fen Bilimleri Enstitüsü, 32s.
- Yılmaz, S., Polat, N. & Yazıcıođlu, O. (2010).** Samsun ili iç sularında yaşayan sazan (*Cyprinus carpio* L., 1758)'ın boy-ağırlık ve boy-boy ilişkileri. *Karadeniz Fen Bilimleri Dergisi/The Black Sea Journal of Sciences*, **1**, 39-47.
- Zar, J.H. (1999).** Biostatistical Analysis, 4th edn. Upper Saddle River, New Jersey: Prentice Hall, 663p.