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Length–weight relations and condition factors of several endemic and native fish species from Anatolian freshwater

by

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Abstract

This study analyzed the length–weight relations and condition factors of 13 species belonging to three highly endemic genera: *Oxynoemacheilus* (6), *Seminemacheilus* (2) and *Cobitis* (5). Fish were sampled in several streams and lakes using a backpack electroshocker. Analyses were based on a total number of individuals, which was $n = 304$. A linear regression model was applied to determine the relationship between fish length and weight. The coefficient of determination (R^2) ranged from 0.950 to 0.980 for all populations ($p < 0.05$). Allometric coefficient *'b'* values ranged from 2.498 to 3.201 for *Oxynoemacheilus*, from 2.970 to 2.127 for *Seminemacheilus*, and from 2.111 to 3.076 for *Cobitis* populations. Fulton's condition factor for *Oxynoemacheilus*, *Seminemacheilus* and *Cobitis* ranged from 0.391 to 3.080. This study addresses gaps in LWR and CF information for a number of ecologically important freshwater fish species. It is expected that the results of this research provide baseline data for further fisheries management studies and may support conservation studies of related species.

Key words: biodiversity, endemic, regression, slope value, *b* value.

1. Introduction

Freshwater plays a very important role for biodiversity due to boundaries and divergent characteristics of habitats (Smith et al. 2014). The diverse large and small closed lake basins and river systems in Anatolia have resulted in a very rich biological diversity, especially for water-dependent organisms such as fish, as they do not allow passage between aquatic systems (Kaya 2019). Çiçek et al. (2023) reported that 427 fish species occur in inland waters of Türkiye. Since then the number of valid fish species continues to change due to the description of new species (e.g. *Oxynoemacheilus chomanicus*, Kaya et al. 2024a; *Phoxinus radeki*, Bayçelebi et al. 2024; *Salmo brunoi*, Turan et al. 2024) or invalidation of some species (*Luciobarbus lydianus*, *L. kottelati*, Freyhof, Yoğurtçuoğlu, 2024). However, a very recent study has been demontrated that total number of freshwater fish species in Türkiye overestimated by earlier researches and the correct number is aproximately 390 (Freyhof et al. 2025). According to the current literature, data on fish biology are still lacking for most of the listed fish species of Türkiye.

The genus *Oxynoemacheilus* belongs to the family Nemacheilidae, whose range spans Europe, Asia and northeastern Africa (Nelson et al. 2016, Freyhof et al. 2025). It is the most diverse genus of the family, comprising more than 60 species (Turan et al. 2023; Kaya et al. 2024a). Recently, the genus *Oxynoemacheilus* from the freshwaters of Türkiye and Iran has been studied in terms of length–weight relationship (LWR) and condition factor (CF) (Çiçek et al. 2022a; Mouludi-Saleh et al. 2023). *Seminemacheilus* is an endemic genus of loaches restricted to central and southern Anatolia. Prior to the recent discovery of *Seminemacheilus lendli*, there was little information on the taxonomy of the genus *Seminemacheilus*. Yoğurtçuoğlu et al. (2020) revised the genus following the finding of *S. lendli*, revealing a total of six species in it. The genus *Cobitis* included in this study is also a very interesting group in terms of distribution, variety and endemism. Thirty species have recently been identified in western Asia (Freyhof et al. 2018), and another new species has been described from the Dalaman River (Eagderi et al. 2022). However, some biological data of the species, such as LWR and CF, are not available yet.

The parameters of population dynamics provide information on the population health of any species, so determining basic biological data of a population is very important for stock sustainability. LWR analysis is fundamental to any kind of fisheries research, such as calculating growth rates, studying age structures and many other population parameters (Sparre, Venema 1998; Froese 2006), and the data can be used in many scientific studies. LWR data on fish species can provide helpful insights into their overall status. Moreover, it allows us to compare population histories in a freshwater area by using these data (Moutopoulos, Stergiou 2002). Estimating population traits is integral to understanding fish biology and working toward better environmental management (Froese et al. 2011).

Anatolia is an excellent area for endemic populations of fish fauna (Freyhof et al. 2014; Çiçek et al. 2018), which should be thoroughly protected in terms of their endemicity. The conservation history of endemic species is highly related to their ecological preferences and biology. A number of studies have recently been conducted in Türkiye on the relationship between length and body weight of fish (e.g. Kurtul, Sarı 2020a; 2020b; Ofluoğlu et al. 2021; Güçlü, Küçük 2021; Çiçek et al. 2022b; 2022a; Seçer et al. 2022; Kurtul et al. 2023; Kaya et al. 2024b). The information from the acquired data is fundamentally important, however, data for the three endemic genera, *Oxynoemacheilus, Seminemacheilus,* and *Cobitis*, in their native habitats in Anatolia are still lacking.

The present study aimed to explore the LWR, CF, and growth type of 13 species belonging to the three cyprinoid genera, 11 of which are endemic to Türkiye, in order to acquire basic information that will help further research on the biology of local fishes. Since *O. eliasi*, *O. axylos*, *O. araxensis*, *O. muefiti*, *O. kentritensis*, *S. ispartensis*, *S. attalicus*, *C. sipahilerae,* and *C. pirii* are microendemic, the status and condition of their populations is of particular importance to biodiversity of Türkiye. However, there is still lack of information on the biology of these fishes, such as their length–weight relationships, condition factors, and growth types.

2. Materials and methods

2.1. Study area

Fish samples were collected from seven different basins in Türkiye, the locations of which are shown on the map in Figure 1. The names of the localities and their coordinates are also provided along with their basins (Table 1). In addition, FFR (Recep Tayyip Erdogan University Zoology Collection of the Faculty of Fisheries, Rize) population codes, sampling dates and sampling frequencies are also provided in Appendix A.

2.2. Sampling procedure and sampling period

Fish were caught using Samus 1000 pulsed DC electro-fishing equipment in lotic habitats

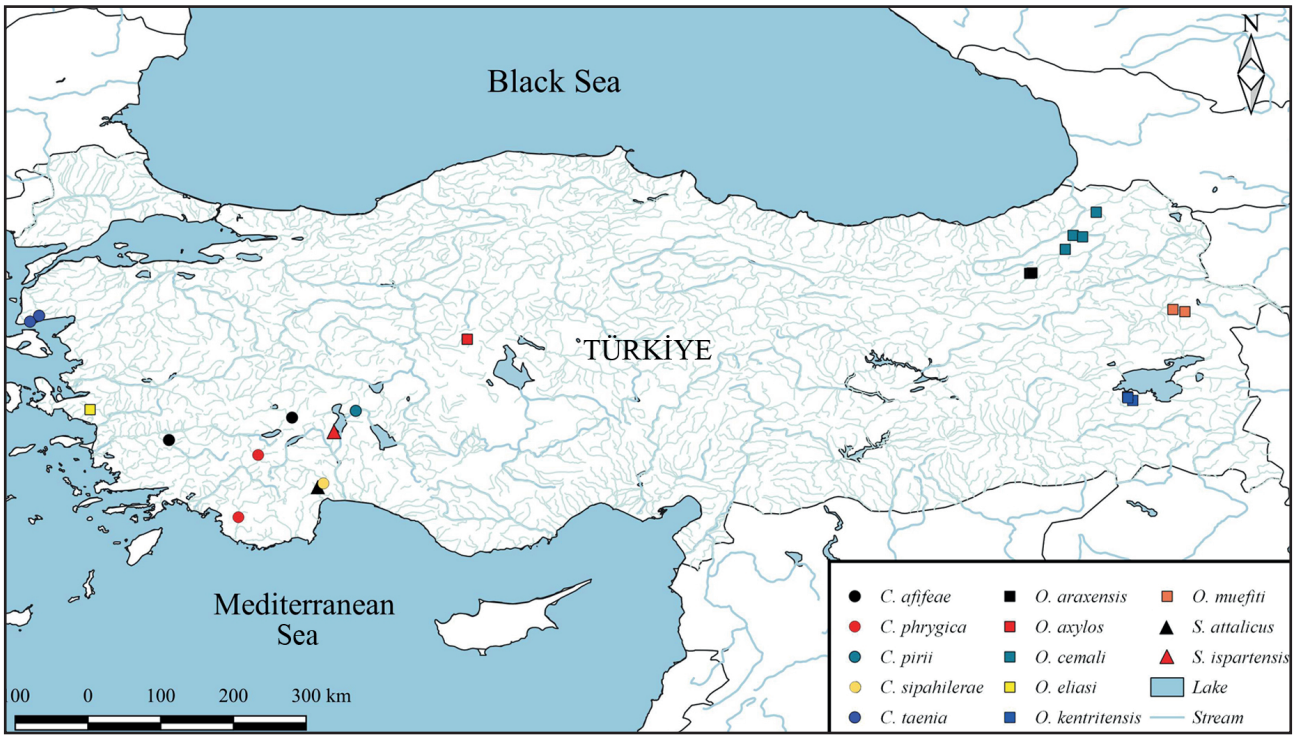

Figure 1

Distribution map for *Oxynoemacheilus*, *Cobitis* and *Seminemacheilus* specimens examined in this study.

Table 1

Sampling locations in this study.

Species	Sampling Location	Coordinates
*O. eliasi**	A tributary of Tahtalı Dam, Aegean Sea Basin	38.199 N 27.171 E
*O. eliasi**	A tributary of Tahtalı Dam, Aegean Sea Basin	38.199 N 27.171 E
*O. axylos**	Spring in Baltalı, Lake Tuz Basin	39.239 N 32.750 E
*O. axylos**	Spring in Baltalı, Lake Tuz Basin	39.239 N 32.751 E
*O. araxensis**	Sırlı stream, Euphrates River, Persian Gulf Basin	40.213 N 41.069 E
*O. araxensis**	Sırlı stream, Euphrates River, Persian Gulf Basin	40.219 N 41.105 E
*O. muefiti**	Murat River, Euphrates River, Persian Gulf Basin	39.647 N 43.366 E
*O. muefiti**	Murat River, Euphrates River, Persian Gulf Basin	39.679 N 43.189 E
*O. kentritensis**	Pancaz stream, Tigris River, Persian Gulf Basin	38.374 N 42.523 E
*O. kentritensis**	Kesan stream, Tigris River, Persian Gulf Basin	38.334 N 42.595 E
*O. kentritensis**	Kesan stream, Tigris River, Persian Gulf Basin	38.388 N 42.518 E
O. cemali	Oltu stream, Çoruh River, Black Sea Basin	40.774 N 41.713 E
O. cemali	Oltu stream, Çoruh River, Black Sea Basin	40.753 N 41.853 E
O. cemali	Tortum stream, Çoruh River, Black Sea Basin	40.568 N 41.596 E
O. cemali	Cehennem stream, Çoruh River, Black Sea Basin	41.116 N 42.055 E
*S. ispartensis**	Sevinçbey stream, Lake Eğirdir Basin	37.872 N 30.779 E
*S. attalicus**	Kırkgöz spring, Mediterranean Sea Basin	37.109 N 30.581 E
C. taenia	Tuzla stream, Aegean Sea Basin	39.499 N 26.283 E
C. taenia	Tuzla stream, Aegean Sea Basin	39.586 N 26.417 E
*C. sipahilerae**	Kırkgöz spring, Mediterranean Sea Basin	37.109 N 30.581 E
*C. pirii**	Özderesi stream, Eğirdir Lake Basin	38.181 N 31.101 E
*C. phrygica**	Lake Salda, Burdur Closed Basin	37.528 N 29.657 E
*C. phrygica**	Eşen stream, Mediterranean Sea Basin	36.609 N 29.365 E
*C. phrygica**	Eşen stream, Mediterranean Sea Basin	39.826 N 29.561 E
*C. afifeae**	Suçıkan stream, Aegean Sea Basin	38.081 N 30.159 E
*C. afifeae**	Akçay stream, Aegean Sea Basin	37.749 N 28.338 E

*Endemic species of Türkiye

between 2004 and 2021 during different surveys. After anesthesia, fish samples were fixed in 5% formaldehyde and stored in FFR.

2.3. Laboratory process and analysis

Eschmeyer's Catalog of Fishes was the guiding resource for nomenclature and taxonomy (Fricke et al. 2024). Species identification followed Güçlü and Küçük (2015), Freyhof et al. (2018), Bayçelebi (2019), and İlhan et al. (2021). The photographs of the fish are original (Fig. 2). Due to the lack of sexual dimorphism in individuals, data were analyzed for females and males together. Total length (L) and total weight (W) of the preserved individuals were determined to be ± 0.1 cm and ± 0.01 g, respectively. The regression analysis was used to determine the relationship between total length and weight of individuals. The equation $W = aL^b$ was used in the analyses (Ricker 1973), where W is the total weight (g), L is the total length (cm), and a is the intercept and b is the slope (Zar 1999). The standard error (95% confidence limits) of b was calculated. The coefficient of determination (R^2) was calculated (Zar 1999) and a test for the significance of the correlation coefficient was applied. To determine growth types of individuals, the data were tested using Student's t-test (Pajuelo, Lorenzo 1998) and the equation $t_{cal} = b–3/SE_{(b)}$ was used (Sokal, Rohlf 1987). In the equation, t_{cal} is the t-test value, b is the slope and $SE_{(b)}$ is the standard error of the slope. The Fulton's condition factor was determined for all members of the genera using the following equation: $C_F = 100WL^{-3}$ (Froese 2006). All statistical analyses were performed in MS Excel 2016.

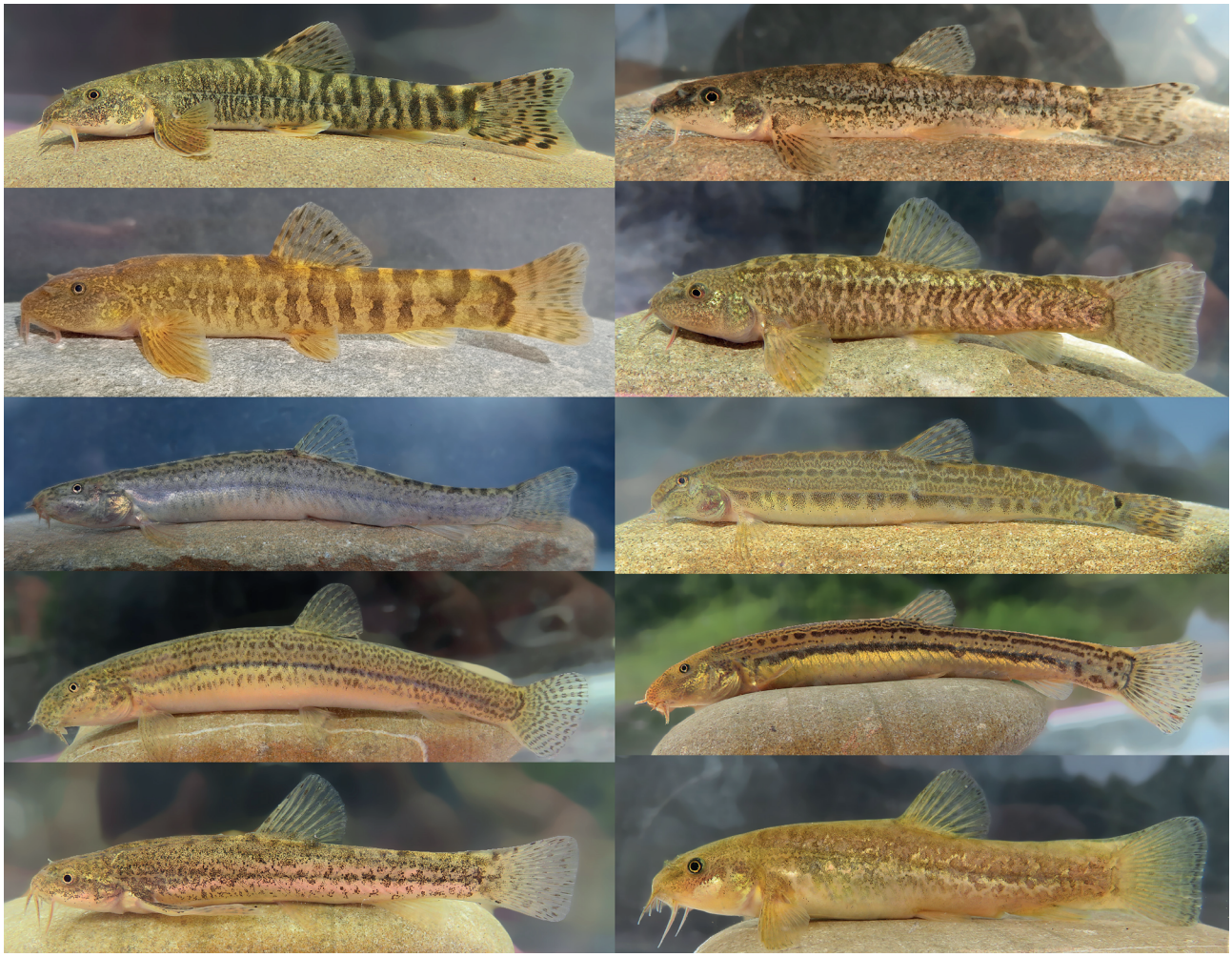

Figure 2

Live appearance of some of the species investigated in the study: Left column from the top: *O. cemali, O. kentritensis, C. phrygica, C. pirii, S. ispartensis*. Right column from the top: *O. eliasi, O. muefiti, C. taenia, C. sipahilerae, S. attalicus* (all photos were taken by C. Kaya).

3. Results

A total (n_{total}) of 304 individuals representing 13 different species were analyzed in this study. Length and weight distributions and statistical results of the studied species are presented in Table 2, Table 3 and Table 4.

In this study, the maximum length and weight in the genus *Oxynoemacheilus* were found for *Oxynoemacheilus cemali* (specimens collected from Çoruh River and its tributaries (Oltu, Tortum and Cehennem streams), Black Sea Basin): L_{max} = 10.50 ± 0.153 cm, W_{max} = 9.96 ± 0.22 g. For the genus *Seminemacheilus*, the maximum length and weight were measured for *Seminemacheilus attalicus* collected from the Kırkgöz Spring (Mediterranean Sea Basin): L_{max} = 10.2 ± 0.742 cm, W_{max} = 12.8 ± 1.326 g. For the genus *Cobitis*, the maximum length and weight were measured for *Cobitis sipahilerae* also collected from the Kırkgöz Spring: L_{max} = 13.8 ± 0.912 cm, W_{max} = 15.94 ± 1.544 g.

In our study, the coefficient of determination R^2 ranged from 0.95 to 0.98, indicating that all populations were highly correlated. The highest *b* value was calculated. The *b* value varied in the three genera from 2.498 (*O. araxensis*) to 3.208 (*O. kentritensis*) for the genus *Oxynoemacheilus*; from 2.127 (*Seminemacheilus ispartensis*) to 2.970 (*S. attalicus*) for the genus *Seminemacheilus*; from 2.111 (*C. pirii)* to 3.076 (*C. afifeae*) for the genus *Cobitis*.

Table 2

Length–weight relationship parameters of 13 species belonging to three genera, along with the number of individuals (*n*), minimum length (L_{min}), maximum length (L_{max}), mean length (L_{mean}), minimum weight (W_{min}), maximum weight (W_{max}), and mean weight (W_{mean}) and standard deviation (SD) of the total length and weight of measured individuals.

Species	*n*	L_{min}	L_{max}	L_{mean}	SD	W_{min}	W_{max}	W_{mean}	SD
*Cobitis afifeae**	33	5.6	9.1	7.28	0.148	1.37	5.88	3.03	0.184
*Cobitis phrygica**	29	5.4	11.8	7.62	0.330	0.85	8.99	3.06	0.422
*Cobitis pirii**	17	6.5	10.6	8.57	0.241	2.03	5.39	3.46	0.218
*Cobitis sipahilerae**	11	2.8	13.8	8.95	0.912	0.39	15.94	6.63	1.544
Cobitis taenia	13	6.2	9.3	7.87	0.236	1.43	4.64	3.07	0.253
*Oxynoemacheilus araxensis**	18	8.2	10.5	9.37	0.160	4.75	8.90	7.08	0.295
*Oxynoemacheilus axylos**	33	2.8	8.6	6.59	0.209	0.12	4.66	2.28	0.193
Oxynoemacheilus cemali	83	4.5	10.5	8.04	0.153	0.81	9.96	4.90	0.22
*Oxynoemacheilus eliasi**	21	4.3	6.6	5.06	0.097	0.55	1.75	0.88	0.052
*Oxynoemacheilus kentritensis**	12	5.3	8.8	6.97	0.312	1.5	7.43	3.72	0.517
*Oxynoemacheilus muefiti**	13	3.6	7.5	6.02	0.33	0.48	3.78	2.36	0.317
*Seminemacheilus attalicus**	11	3.6	10.2	7.2	0.742	0.51	12.58	5.69	1.326
*Seminemacheilus ispartensis**	10	5.7	7.6	7.13	0.169	1.73	3.21	2.87	0.131

*Endemic species of Türkiye

Table 3

Length–weight relationship parameters of 13 species belonging to three genera along with the regression coefficient (R^2), 95% confidence interval b(±SE) of measured individuals, *t*-test results.

Species	a	b	R^2	SE(b)	95% (b)	t_{test}	GT
*Cobitis afifeae**	0.0065	3.0758	0.96	0.009	2.87–3.26	$t_{cal} = 8.44 > t_{0.05,\ n=32} = 2.042$	A(+)
*Cobitis phrygica**	0.0055	3.0332	0.98	0.003	2.90–3.16	$t_{cal} = 11.07 > t_{0.05,\ n=28} = 2.048$	A(+)
*Cobitis pirii**	0.0364	2.1114	0.95	0.016	1.83–2.38	$t_{cal} = -2.98 > t_{0.05,\ n=16} = 2.120$	A(-)
*Cobitis sipahilerae**	0.0214	2.5018	0.98	0.023	2.15–2.84	$t_{cal} = -21.66 > t_{0.05,\ n=10} = 2.220$	A(-)
Cobitis taenia	0.0066	2.9579	0.95	0.024	2.61–3.29	$t_{cal} = -1.75 < t_{0.05,\ n=12} = 2.179$	I
*Oxynoemacheilus araxensis**	0.0262	2.4976	0.96	0.013	2.25–2.74	$t_{cal} = -38.64 > t_{0.05,\ n=17} = 2.110$	A(-)
*Oxynoemacheilus axylos**	0.0055	3.1438	0.95	0.009	2.94–3.34	$t_{cal} = 15.97 > t_{0.05,\ n=32} = 2.042$	A(+)
Oxynoemacheilus cemali	0.0110	2.8899	0.95	0.002	2.79–2.98	$t_{cal} = -55.05 > t_{0.05,\ n=82} = 1.990$	A(-)
*Oxynoemacheilus eliasi**	0.0102	2.7328	0.95	0.024	2.40–3.06	$t_{cal} = -11.1 > t_{0.05,\ n=20} = 2.086$	A(-)
*Oxynoemacheilus kentritensis**	0.0068	3.2009	0.96	0.041	2.74–3.65	$t_{cal} = 4.9 > t_{0.05,\ n=11} = 2.201$	A(+)
*Oxynoemacheilus muefiti**	0.0215	2.8635	0.96	0.011	2.57–3.14	$t_{cal} = -12.40 > t_{0.05,\ n=12} = 2.179$	A(-)
*Seminemacheilus attalicus**	0.0121	2.9703	0.98	0.007	2.77–3.16	$t_{cal} = -4.24 > t_{0.05,\ n=10} = 2.228$	A(-)
*Seminemacheilus ispartensis**	0.0437	2.1274	0.96	0.013	1.79–2.45	$t_{cal} = -67.12 > t_{0.05,\ n=9} = 2.262$	A(-)

A(+) – positive allometric growth; A(-) – negative allometric growth; I – isometric growth; *Endemic species of Türkiye

Table 4

Minimum, maximum and mean CF of 13 species belonging to three genera.

Species	n	CF_{min}	CF_{max}	CF_{mean}	SD
*Cobitis afifeae**	33	0.859	1.159	1.001	0.011
*Cobitis phrygica**	29	0.885	1.165	1.005	0.013
*Cobitis pirii**	17	0.913	1.089	1.001	0.014
*Cobitis sipahilerae**	11	0.736	1.386	1.020	0.059
Cobitis taenia	13	0.940	1.143	1.007	0.016
*Oxynoemacheilus araxensis**	18	0.945	1.053	1.001	0.007
*Oxynoemacheilus axylos**	33	0.845	1.319	1.006	0.021
Oxynoemacheilus cemali	83	0.850	1.231	1.000	0.009
*Oxynoemacheilus eliasi**	21	0.904	1.104	1.005	0.012
*Oxynoemacheilus kentritensis**	12	0.846	1.206	1.009	0.029
*Oxynoemacheilus muefiti**	13	0.823	1.145	1.007	0.025
*Seminemacheilus attalicus**	11	0.844	1.158	1.005	0.031
*Seminemacheilus ispartensis**	10	0.954	1.033	0.999	0.008

*Endemic species of Türkiye

In addition, the highest CF value for all three genera was determined for *C. sipahilerae* at 1.386. For the other two genera, the CF value was 1.319 for *O. axylos* and 1.158 for *S. attalicus* (Table 4).

4. Discussion

The regression constant in our study, i.e. the *b* value, ranged from 2.111 to 3.201 for all populations of 13 species, a noteworthy deviation from the expected range (2.5 to 3.5) (Froese 2006). Froese (2006) pointed out that when $b = 3$, specimens in a sample are expected to have isometric growth (the form and conditions of small specimens are identical to those of large specimens). As a rule (although there are some exceptions), $b < 3$ indicates that fish have become leaner and longer (negative allometric growth), while $b > 3$ indicates that fish have become heavier (positive allometric growth). Variations in *b* values can be due to several factors, such as methodology and effort of fishing, geographic region, seasonality, habitat health, diet, sex, species, etc. (Froese, Pauly 2024).

According to some studies, formalin-induced shrinking and dehydration affect LWR parameters, possibly distorting the metrics (Buchheister, Wilson 2005; Nordeide 2020). However, this bias is unavoidable in stream fish studies due to the distance between sampling sites and the laboratory, as taking measurements in the field is not an easy task (Campos et al. 2020; Machado et al. 2020; Teixeira da Silva et al. 2021). Since our sampling dates are very recent, formaldehyde had only a minimal effect on the results obtained in this study.

Although biological characteristics of fish vary from species to species, these characteristics vary according to the physical, chemical, geological and hydrological structure of the aquatic system (Doğan 2019). Both abiotic and biotic factors play a critical role in the physiological condition of stocks. Their overall condition is determined by the environment itself, the availability of food, stress, sex and sexual maturity, and age (Anibeze 2000; Liang, Cai 2020).

A total of 180 *Oxynoemacheilus* specimens belonging to seven species were examined in the present study. There are still no LWR data for *O. axylos*, *O. cemali*, *O. kentritensis*, and *O. muefiti* available in FishBase (Froese, Pauly 2024). In the present study, the maximum length was observed in the *O. cemali* population (L_{max} = 10.5 cm), while the minimum length was observed in the O. *muefiti* population (L_{min} = 3.6 cm). The maximum length determined in the *O. cemali* population is likely due to the larger sample size applied in this study (n = 83).

Recently, most members of the genus *Oxynoemacheilus* from freshwaters of Türkiye and Iran have been extensively researched in two comprehensive studies, including their LWR and CF (Çiçek et al. 2022a; Mouludi-Saleh et al. 2023). One of the endemic members analyzed in this study, *O. eliasi*, was also studied by Çiçek et al. (2022a), but was reported as *O. germencicus* in their study. Because a very recent study has described the Küçük Menderes loach populations as *O. eliasi* (Yoğurtçuoğlu et al. 2022), these data are discussed here. In a study by Çiçek et al. (2022a), C_F of individuals from the population found in the Kadın stream (one of the tributaries of the Küçük Menderes River) varied in the range of 0.85–1.04 (C_{Fmean} = 0.91). In this study, CF ranged from C_{Fmin} = 0.904 to C_{Fmax} = 1.104 (C_{Fmean} = 1.005) for *O. eliasi* from the Upper Tahtalı Dam, the Aegean Basin.

A very recent study by Seçer et al. (2021) involved *Seminemacheilus attalicus* and *S. ispartensis* along with four other members of the genus *Seminemacheilus* studied in 2017–2019. In the aforementioned study, the regression constants *a* and *b* of the studied fishes were $a = 0.0045$ and $b = 3.480$ for *S. attalicus*, and $a = 0.0187$ and $b = 2.620$ for *S. ispartensis*. In the present study, the parameters *a* and *b* of the studied species were $a = 0.0121$ and $b = 2.970$ for *S. attalicus* (Kırkgöz Spring), and $a = 0.0437$ and $b = 2.127$ for *S. ispartensis* (Sevinçbey Stream). In the present study, while the *b* value for *S. attalicus* is very close to 3, the *b* value for *S. ispartensis* is well below 3.

Seven species of the genus *Cobitis* were investigated in this study. With the exception of *C. afifeae*, the other four members of the genus, i.e. *C. phrygica*, *C. pirii*, *C. sipahilerae* and *C. taenia* discussed

in this study have not yet been analyzed for LWR parameters in any previous studies. The *a* value also varied from 0.0065 to 0.0364. The regression constant *b* for the genus *Cobitis* ranged from a minimum of 2.112 for *C. pirii* (Özderesi Stream, the drainage basin Lake Eğirdir) to a maximum of 3.076 for *C. afifeae*. The maximum CF_{mean} was determined for *C. sipahilerae* at 1.020.

In the present study, isometric growth was determined only for *C. taenia*. Positive allometric growth was observed in *C. afifeae*, *C. phrygica*, *O. axylos* and *O. kentritensis*, while negative allometric growth was observed in the remaining species (eight species).

Several factors can affect the *b* value and growth type, however, these factors were not considered in detail in the scope of this study. Based on the results and due to the very low *b* value, it is recommended that the populations of *S. ispartensis* in the Sevinçbey Stream and the populations of *C. pirii* in the Özderesi Stream be investigated in further detailed studies. With further comprehensive research, it will be possible to understand whether the low *b* value is due to the small number of samples or habitat conditions.

4. Conclusion

This study provides basic information on the population parameters of endemic fish stocks that would be useful for fisheries research over a large area. The methodology employed, using limited data, is straightforward, and the results of the study will be useful for further research on fish fauna conservation of the above-mentioned stocks. Continued research in this field is important to help identify new species and monitor parameters across the populations, such as growth, mortality, age, and reproductive biology (size at sexual maturity, spawning time, fecundity, etc.). These and other regularly monitored parameters can help develop fishery management plans (Oliveira et al. 2014). This type of strategic environmental engagement will prove beneficial in developing fishery management systems that reflect the health of ecosystems. Further research may address the pressure of invasive species on these species and anthropogenic factors that affect the stocks.

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Appendix A

Species	Sampling location	Date	FFR	N
*Oxynoemacheilus eliasi**	inflow of Tahtalı Dam at Cumaovası, Aegean Basin	14 July 2018	15581	21
*Oxynoemacheilus eliasi**	inflow of Tahtalı Dam at Cumaovası, Aegean Basin	14 July 2018	15619	
*Oxynoemacheilus axylos**	a spring at Baltalin, Tuz Lake Basin	9 Oct. 2015	15616	33
*Oxynoemacheilus axylos**	a spring at Baltalin, Tuz Lake Basin	9 Oct. 2015	15602	
*Oxynoemacheilus araxensis**	Sırlı stream, Euphrates River, Persian Gulf Basin	3 Aug. 2007	1354	18
*Oxynoemacheilus araxensis**	Sırlı stream, Euphrates River, Persian Gulf Basin	3 Aug. 2007	1357	
*Oxynoemacheilus muefiti**	Murat River, Euphrates River, Persian Gulf Basin	16 July 2012	1432	13
*Oxynoemacheilus muefiti**	Murat River, Euphrates River, Persian Gulf Basin	17 May 2018	15507	
*Oxynoemacheilus kentritensis**	Oraniz stream, Tigris River, Persian Gulf Basin	17 Oct. 2021	15617	12
*Oxynoemacheilus kentritensis**	Kesan stream, Tigris River, Persian Gulf Basin	27 May 2016	1573	
*Oxynoemacheilus kentritensis**	Kesan stream, Tigris River, Persian Gulf Basin	2 May 2016	1572	
Oxynoemacheilus cemali	Oltu stream, Çoruh River, Black Sea Basin	23 Aug. 2017	1588	83
Oxynoemacheilus cemali	Oltu stream, Çoruh River, Black Sea Basin	23 Aug. 2017	1587	
Oxynoemacheilus cemali	Tortum stream, Çoruh River, Black Sea Basin	23 Aug. 2017	1586	
Oxynoemacheilus cemali	Cehennem stream, Çoruh River, Black Sea Basin	23 Aug. 2017	1590	
*Seminemacheilus ispartensis**	Sevinçbey stream, Eğirdir Lake Drainage, Mediterranean Basin	9 May 2018	15565	10
*Seminemacheilus attalicus**	Kırkgöz spring, Mediterranean Sea Basin	11 May 2018	15555	11
Cobitis taenia	Tuzla stream, Aegean Sea Basin	12 July 2018	5555	11
Cobitis taenia	Tuzla stream, Aegean Sea Basin	2 Sept. 2014	5566	
*Cobitis sipahilerae**	Kırkgöz spring, Mediterranean Sea Basin	11 May 2018	5560	11
*Cobitis pirii**	Özderesi stream, Eğirdir Lake Drainage, Mediterranean Basin	14 Nov. 2018	5556	17
*Cobitis phrygica**	Lake Salda, Burdur Endorheic Basin	10 May 2018	5554	29
*Cobitis phrygica**	Eşen stream, Mediterranean Sea Basin	7 July 2007	5512	
*Cobitis phrygica**	Eşen stream, Mediterranean Sea Basin	23 Aug. 2014	5536	
*Cobitis afifeae**	Suçıkan stream, Büyük Menderes River, Aegean Sea Basin	9 Nov. 2016	5551	33
*Cobitis afifeae**	Akçay stream, Büyük Menderes River, Aegean Sea Basin	25 Aug. 2014	5535	

*Endemic species of Türkiye; FFR, Recep Tayyip Erdogan University Zoology Museum of the Faculty of Fisheries, Rize