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Length–weight relations and condition factors of 34 *Oxynoemacheilus* species (Actinopterygii: Cypriniformes: Nemacheilidae) from Turkish inland waters

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Abstract

This study aimed to provide the length–weight relations and condition factors of 34 *Oxynoemacheilus* species from the inland waters of Turkey: *Oxynoemacheilus anatolicus* Erk'akan, Özeren et Nalbant, 2008; *Oxynoemacheilus angorae* (Steindachner, 1897); *Oxynoemacheilus argyrogramma* (Heckel, 1847); *Oxynoemacheilus arsaniasus* Freyhof, Kaya, Turan et Geiger, 2019; *Oxynoemacheilus atili* Erk'akan, 2012; *Oxynoemacheilus banarescui* (Delmastro, 1982); *Oxynoemacheilus bergianus* (Derjavin, 1934); *Oxynoemacheilus* cf. *bureschi* (Drensky, 1928); *Oxynoemacheilus ceyhanensis* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus ciceki* Sungur, Jalili et Eagderi, 2017; *Oxynoemacheilus cilicicus* Kaya, Turan, Bayçelebi, Kalayci et Freyhof, 2020; *Oxynoemacheilus cyri* (Berg, 1910); *Oxynoemacheilus ercisianus* (Erk'akan et Kuru, 1986); *Oxynoemacheilus eregliensis* (Bănărescu et Nalbant, 1978); *Oxynoemacheilus euphraticus* (Bănărescu et Nalbant, 1964); *Oxynoemacheilus evreni* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus frenatus* (Heckel, 1843); *Oxynoemacheilus germencicus* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus hamwii* (Krupp et Schneider, 1991); *Oxynoemacheilus hazarensis* Freyhof et Özuluğ, 2017; *Oxynoemacheilus insignis* (Heckel, 1843); *Oxynoemacheilus kaynaki* Erk'akan, Özeren et Nalbant, 2008; *Oxynoemacheilus mediterraneus* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus namiri* (Krupp et Schneider, 1991); *Oxynoemacheilus nasreddini* Yoğurtçuoğlu, Kaya et Freyhof, 2021; *Oxynoemacheilus paucilepis* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus samanticus* (Bănărescu et Nalbant, 1978); *Oxynoemacheilus seyhanensis* (Bănărescu, 1968); *Oxynoemacheilus seyhanicola* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus simavicus* (Balik et Bănărescu, 1978); *Oxynoemacheilus theophilii* Stoumboudi, Kottelat et Barbieri, 2006; *Oxynoemacheilus tigris* (Heckel, 1843); *Oxynoemacheilus veyselorum* Çiçek, Eagderi et Sungur, 2018. Based on the results, the growth coefficient values (*b*) ranged from 2.770 (*O. argyrogramma*) to 3.285 (*O. theophilii*) with an R^2 estimate greater than 0.91. Fulton's condition factor (K_F) of the studied fishes ranged from 0.598 (*O. insignis*) to 1.07 (*O. nasreddini*). Relative conditions (K_R) were found to have a narrow distribution range (0.856–1.014 with a mean of 1.005). The form factors of these species were calculated between 0.006 and 0.14, with a mean and median value of 0.01. This study represents the first reports of LWRs parameters for 22 species, new maximum total length data were bigger than given in FishBase for 21 species, and first species listing for maximum total length for seven species. The findings of this study provide useful information for further fisheries management and fish population dynamic studies.

Keywords

condition factor, form factor, length–weight relation, loach, Nemacheilidae

Introduction

The Nemacheilidae are small fishes inhabiting the freshwaters of Asia, Europe, and northeastern Africa (Nelson et al. 2016; Sungur et al. 2017). This family has great diversity in Turkish inland waters with 48 species, of which 28 are endemics (Çiçek et al. 2015, 2018, 2020). They do not have commercial value but are important components for aquatic ecosystems (Kottelat 2012; Çiçek et al. 2015, 2018).

The study of the length–weight relation (LWR) of any fish species is a prerequisite for assessing its population characteristics (Le Cren 1951). As a result, LWRs provide fundamental knowledge in fisheries biology, which is required for management and conservation. Few Turkish nemacheilids have LWR data available (Gaygusuz et al. 2012; Erk'akan et al. 2013, 2014; Birecikligil et al. 2016; Özcan and Altun 2016; Yazıcıoğlu and Yazıcı 2016; İnnal 2019; Özdemir et al. 2019); hence, providing such data for these taxa is crucial for their management and conservation (Tabatabaei et al. 2015; Keivany et al. 2016; Jafari-Patcan et al. 2018).

Condition factor is computed using the weight and length of fish species to describe the condition or well-being of fish individuals in a particular water body (Froese 2006). It is assumed that the growth of fish in ideal conditions maintains equilibrium in length and weight and is a useful index for monitoring feeding intensity, age and growth rate, and assessing the status of the aquatic ecosystem where fish live (Radkhah and Eagderi 2015; Zamani-Faradonbe et al. 2015). Based on the above-mentioned background, the presently reported study was conducted to determine the LWRs parameters, condition factors, and form factors of 34 species of the genus *Oxynoemacheilus* inhabiting inland waters of Turkey. The following species were studied: *Oxynoemacheilus anatolicus* Erk'akan, Özeren et Nalbant, 2008; *Oxynoemacheilus angorae* (Steindachner, 1897); *Oxynoemacheilus argyrogramma* (Heckel, 1847); *Oxynoemacheilus arsaniasus* Freyhof, Kaya, Turan et Geiger, 2019; *Oxynoemacheilus atili* Erk'akan, 2012; *Oxynoemacheilus banarescui* (Delmastro, 1982); *Oxynoemacheilus bergianus* (Derjavin, 1934); *Oxynoemacheilus* cf. *bureschi* (Drensky, 1928); *Oxynoemacheilus ceyhanensis* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus ciceki* Sungur, Jalili et Eagderi, 2017; *Oxynoemacheilus cilicicus* Kaya, Turan, Bayçelebi, Kalayci et Freyhof, 2020; *Oxynoemacheilus cyri* (Berg, 1910); *Oxynoemacheilus ercisianus* (Erk'akan et Kuru, 1986); *Oxynoemacheilus eregliensis* (Bănărescu et Nalbant, 1978); *Oxynoemacheilus euphraticus* (Bănărescu et Nalbant, 1964); *Oxynoemacheilus evreni* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus frenatus* (Heckel, 1843); *Oxynoemacheilus germencicus* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus hamwii* (Krupp et Schneider, 1991); *Oxynoemacheilus hazarensis* Freyhof et Özuluğ, 2017; *Oxynoemacheilus insignis* (Heckel, 1843); *Oxynoemacheilus kaynaki* Erk'akan, Özeren et Nalbant, 2008; *Oxynoemacheilus mediterraneus* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus namiri* (Krupp et Schneider, 1991); *Oxynoemacheilus nasreddini* Yoğurtçuoğlu, Kaya et Freyhof, 2021; *Oxynoemacheilus paucilepis* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus samanticus* (Bănărescu et Nalbant, 1978); *Oxynoemacheilus seyhanensis* (Bănărescu, 1968); *Oxynoemacheilus seyhanicola* (Erk'akan, Nalbant et Özeren, 2007); *Oxynoemacheilus simavicus* (Balik et Bănărescu, 1978); *Oxynoemacheilus theophilii* Stoumboudi, Kottelat et Barbieri, 2006; *Oxynoemacheilus tigris* (Heckel, 1843); *Oxynoemacheilus veyselorum* Çiçek, Eagderi et Sungur, 2018.

Material and methods

A total of 1801 specimens of *Oxynoemacheilus* species were collected between May 2009 and September 2019 from Turkish inland water using an electrofishing device (SAMUS MP750). The sampling year of the species is given in Table 1. After anesthesia, the specimens were preserved in 4% buffered formalin and transported to the laboratory.

In the laboratory, the total length (L) and total weight (W) of each individual were determined using a digital caliper to the nearest 0.1 cm and 0.01 g, respectively. The LWRs were calculated by the method of least squares using the equation

$$W = aL^b$$

and logarithmically transformed (Froese 2006) into

$$\mathrm{Log}W = \log a + b \log L$$

where W is the whole-body weight [g], L is the total length [cm], a is the intercept, and b is the slope. Prior to regression analyses, log–log plots of the length–weight pairs were performed to identify outliers (Froese et al. 2011). Outliers perceived in the log–log plots of all species were evacuated from the regression. Fulton's condition factor (K_F) was estimated using the following formula (Ricker 1975; Froese 2006)

$$K_F = 100WL^{-3}$$

The relative condition factor (K_R) was calculated using the equation of Froese (2006)

$$K_R = W(aL^b)^{-1}$$

The mean condition factor (K_M) for a given length is derived from the respective WLR using the formula (Froese 2006)

$$K_M = 100aL^{b-3}$$

The form factor (a3:0) can be used to determine whether the body shape of a population or species differs significantly from that of others. It was calculated using the formula (Froese 2006)

Table 1. Sampling sites and descriptive statistics of length and weight for 34 *Oxynoemacheilus* species in Turkey.

Species	E	Habitat	Basin	Coordinates	SY	*n*	Total length [cm]				Total weight [g]				L_{max} in FishBase
							Min	Max	Mean	SD	Min	Max	Mean	SD	
Oxynoemacheilus anatolicus	+	Dalaman Stream	Western Mediterranean	37°08′17″N, 29°09′21″E	2018	11	4.5	**8.2**	6.04	1.28	0.87	5.03	2.33	1.52	5.20
Oxynoemacheilus angorae	+	Çubuk Stream	Kızılırmak	40°20′38″N, 33°02′21″E	2017	25	3.8	**8.9**	7.44	1.32	0.42	5.89	4.01	1.50	8.5
Oxynoemacheilus argyrogramma		Keysun Stream	Euphrates	37°30′39″N, 38°06′31″E	2009	54	4.5	**7.3**	5.65	0.81	0.74	3.49	1.71	0.69	6.20
Oxynoemacheilus arsaniasus	+	Haçlı Lake	Tigris	39°00′49″N, 42°20′11″E	2018	13	4.6	7.2	5.82	0.55	1.08	3.86	2.03	0.64	—
Oxynoemacheilus atili	+	Eflatun Pınarı	Konya closed	37°49′30″N, 31°40′27″E	2018	47	4.3	**8.3**	6.57	0.94	0.67	5.12	2.66	0.98	7.60
Oxynoemacheilus banarescui	+	Alaçam Stream	Kızılırmak	41°28′21″N, 35°45′57″E	2017	63	4.4	**7.8**	6.04	0.69	0.62	4.03	1.87	0.69	5.30
Oxynoemacheilus bergianus		Handere Stream	Aras	40°07′36″N, 42°14′55″E	2016	43	3.0	**8.4**	5.28	1.25	0.18	4.52	1.28	0.93	7.60
Oxynoemacheilus bergianus		Digor	Aras	40°23′38″N, 43°24′45″E	2016	74	3.3	**8.4**	6.12	1.30	0.26	3.98	1.83	0.93	7.60
Oxynoemacheilus cf. *bureschi*		Uluçay Stream	Sakarya	40°22′56″N, 31°46′06″E	2017	7	5.3	**7.7**	6.86	0.81	1.07	3.36	2.53	0.80	6.50
Oxynoemacheilus ceyhanensis	+	Ceyhan River	Ceyhan	38°05′35″N, 36°59′40″E	2017	50	3.3	7.8	5.56	1.08	0.21	4.56	1.66	0.95	8.80
Oxynoemacheilus ciceki	+	Sultan Marsh	Kızılırmak	38°23′23″N, 35°21′54″E	2009	103	4.3	**7.5**	5.34	0.52	0.42	2.61	0.95	0.34	5.80
Oxynoemacheilus cilicicus	+	Kızıl Stream	Eastern Mediterranean	36°51′27″N, 34°33′13″E	2018	105	3.4	9.9	5.60	1.02	0.45	9.10	1.81	1.38	—
Oxynoemacheilus cyri	+	Kura River	Kura	40°50′32″N, 42°48′57″E	2019	31	3.2	**8.6**	5.85	1.27	0.26	7.33	2.46	1.66	6.80
Oxynoemacheilus ercisianus	+	Ilıca Stream	Van Lake	39°00′15″N, 43°19′17″E	2016	103	2.9	7.7	4.09	0.91	0.21	4.53	0.74	0.76	—
Oxynoemacheilus eregliensis	+	Melendiz Stream	Konya closed	38°19′36″N, 34°14′20″E	2019	123	5.1	9.5	6.83	1.23	1.02	7.66	2.91	1.62	10.30
Oxynoemacheilus euphraticus		Aşkale	Euphrates	39°46′48″N, 40°26′55″E	2017	119	2.8	**9.3**	5.78	0.93	0.17	5.60	1.53	0.81	7.40
Oxynoemacheilus evreni	+	Ceyhan River	Ceyhan	38°15′17″N, 37°31′56″E	2016	17	3.1	6.5	5.07	1.05	0.25	2.72	1.44	0.78	9.40
Oxynoemacheilus frenatus		Arpaçay Stream	Tigris	38°01′21″N, 40°29′25″E	2012	31	4.1	**8.0**	5.56	1.02	0.68	5.83	1.96	1.36	7.50
Oxynoemacheilus germencicus	+	Kadın Stream	Küçük Menderes	38°18′27″N, 28°10′11″E	2017	19	5.1	**7.8**	6.61	0.70	1.18	4.49	2.73	0.86	6.30
Oxynoemacheilus hamwii		Orontes River	Orontes	36°58′33″N, 36°51′51″E	2015	63	3.1	**8.4**	5.14	1.07	0.22	5.36	1.30	0.96	6.20
Oxynoemacheilus hazarensis	+	Hazar Lake	Euphrates	38°27′08″N, 39°18′26″E	2013	13	4.1	**7.2**	5.85	0.88	0.54	3.23	1.88	0.74	6.50
Oxynoemacheilus insignis		Karasu Stream	Euphrates	37°22′35″N, 37°29′22″E	2017	29	3.4	6.5	5.23	0.82	0.18	1.72	0.91	0.38	12.00
Oxynoemacheilus kaynaki	+	Input of Dumluca Lake	Ceyhan	37°25′57″N, 40°06′45″E	2013	82	4.0	**7.5**	5.85	0.82	0.72	3.85	2.01	0.91	6.80
Oxynoemacheilus mediterraneus	+	Input of Sücüllü Dam Lake	Mediterranean	38°23′22″N, 31°07′56″E	2018	144	3.6	**7.6**	6.13	1.00	0.33	3.39	1.92	0.77	5.80
Oxynoemacheilus namiri		Orontes River	Orontes	38°23′22″N, 31°07′56″E	2016	88	4.1	8.7	6.21	1.02	0.50	7.02	2.64	1.43	—
Oxynoemacheilus nasreddini	+	Siyek Stream	Akarçay	38°35′10″N, 30°25′36″E	2009	77	4.7	9.9	6.99	1.01	0.99	9.45	3.88	1.69	—
Oxynoemacheilus paucilepis	+	Mancınık Stream	Euphrates	39°12′25″N, 37°12′04″E	2018	15	4.2	**8.2**	6.65	0.96	0.78	5.68	3.19	1.24	7.00
Oxynoemacheilus samanticus	+	Zamantı Stream	Seyhan	38°44′10″N, 36°24′46″E	2014	21	4.4	6.6	5.31	0.59	0.65	2.43	1.34	0.48	8.60
Oxynoemacheilus seyhanensis	+	Zamantı Stream	Seyhan	38°43′54″N, 36°22′46″E	2015	56	3.3	9.1	4.59	1.10	0.34	8.40	1.20	1.39	—
Oxynoemacheilus seyhanicola	+	Ceyhan River	Ceyhan	38°05′35″N, 36°59′40″E	2015	29	4.2	**9.5**	6.45	1.32	0.51	7.02	2.36	1.64	4.30
Oxynoemacheilus simavicus	+	Yağcılı Stream	North Aegean	39°19′47″N, 27°34′07″E	2017	10	4.8	**8.0**	6.44	0.87	1.13	5.62	2.93	1.32	7.10
Oxynoemacheilus theophilii		Sevişler Dam Lake	North Aegean	39°19′47″N, 27°34′07″E	2017	54	3.5	**7.7**	5.38	0.91	0.33	4.56	1.58	0.88	6.60
Oxynoemacheilus tigris		Seve Dam Lake	Euphrates	36°44′38″N, 37°14′56″E	2019	36	3.0	8.4	4.74	0.93	0.18	4.80	0.88	0.77	8.40
Oxynoemacheilus veyselorum		Bozkuş Stream	Aras	40°37′03″N, 42°47′04″E	2016	46	4.6	12.6	9.27	1.96	1.74	15.88	7.77	4.01	—

E = endemic (plus signs), SY = sampling year, *n* = number of individuals, SD = standard deviation; Values in **bold** font denote maximum length higher than given in FishBase; Text in shaded cells denotes maximum total length not given in FishBase.

$$a3{:}0 = 10^{\log a - S(b-3)}$$

where S is the slope of the log$a$ vs. b regression, the mean slope $S = a - 1.358$ proxy for estimating the form factor (Froese 2006).

The degree of dependence between the variables was computed by the determination coefficient R^2. The significance level of R^2 was estimated by ANOVA. The Student's t-test was used to determine whether parameter b is significantly different from the expected or theoretical value of 3 (i.e., $b = 3$, $P < 0.05$). All statistical analyses were performed in MS Excel 2016 and Past 3.26.

Results and discussion

The presently reported study provides the LWRs and condition factors of 34 *Oxynoemacheilus* species. The descriptive statistics of length and weight with the parameters of the LWR; regression parameters a and b, the 95% confidence limits of b; the 95% confidence limits of a; correlation coefficient (R^2) and type of growth for the studied species are given in Tables 1 and 2. Based on our collected specimens, new maximum total lengths were recorded for 23 species.

The parameter b of the studied species ranged from 2.770 (*O. argyrogramma*) to 3.285 (*O. theophilii*) with the median value of 3.071 (Table 2 and Fig. 1). The value of b generally lies between 2.5 and 3.5 (Froese 2006) though the ideal value of b is 3.0 (Hile 1936). In LWRs, b-values that are higher and lower than 3 indicate positive and negative allometric growth, respectively. According to the b-value, 27 species are isometric; two are negative allometry and five are positive allometry (Table 2). The coefficient of determination (R^2) between length and weight varied from 0.91 for *O. ciceki* to 0.99 for *O.* cf. *bureschi*.

The values of K_F varied from 0.598 (*O. insignis*) to 1.070 (*O. nasreddini*). Clark (1928) showed the relation between K_F and the parameters of the respective WLR (Table 2 and Fig. 1). The K_M for a given length is derived from the respective WLR (Froese 2006) which ranged from 0.856 to 1.014 with a mean of 1.005. Clark (1928) also demonstrates that if b is not significantly different from 3, K_F can be compared directly. Le Cren (1951) proposed the relative condition factor (K_R), which accounts for changes in form or condition as length increases and

Table 2. Estimated parameters of the length–weight relations (LWR), condition factors, and form factor for 34 *Oxynoemacheilus* species in Turkey.

Species	LWR parameters in this study						LWRs in FishBase		Fulton's Condition				Relative Condition				*a*3:0
	a	*b*	R^2	SD of *b*	CI of *b*	GT	*a*	*b*	Min	Max	Mean	SD	Min	Max	Mean	SD	
Oxynoemacheilus anatolicus	0.007	3.168	0.981	0.1460	2.779–3.367	I	—	—	0.81	1.15	0.92	0.10	0.90	1.22	1.01	0.10	0.0115
Oxynoemacheilus angorae	0.011	2.903	0.979	0.0997	2.661–3.355	I	0.008	3.0	0.77	1.15	0.91	0.09	0.79	1.22	1.00	0.09	0.0081
Oxynoemacheilus argyrogramma	0.013	2.770	0.949	0.0895	2.607–2.929	–A	—	—	0.75	1.18	0.91	0.09	0.85	1.28	1.00	0.09	0.0065
Oxynoemacheilus arsaniasus	0.012	2.923	0.915	0.2693	2.485–3.360	I	—	—	0.91	1.13	1.01	0.08	0.90	1.13	1.00	0.08	0.0090
Oxynoemacheilus atili	0.011	2.879	0.978	0.0644	2.738–3.060	I	—	—	0.79	1.10	0.89	0.06	0.84	1.21	1.00	0.07	0.0077
Oxynoemacheilus banarescui	0.007	3.113	0.926	0.1130	2.975–3.305	I	—	—	0.64	1.07	0.81	0.09	0.79	1.32	1.01	0.11	0.0094
Oxynoemacheilus bergianus	0.007	3.052	0.983	0.0623	2.933–3.160	I	—	—	0.56	0.98	0.74	0.07	0.76	1.31	1.00	0.10	0.0080
Oxynoemacheilus bergianus	0.008	2.921	0.989	0.0367	2.830–3.013	–A	—	—	0.60	0.92	0.72	0.06	0.86	1.23	1.01	0.08	0.0064
Oxynoemacheilus* cf. *bureschi	0.006	3.095	0.990	0.1398	2.889–3.630	I	—	—	0.72	0.80	0.76	0.03	0.96	1.06	1.00	0.04	0.0085
Oxynoemacheilus ceyhanensis	0.007	3.152	0.950	0.1050	2.971–3.380	I	0.0056	3.13	0.58	1.22	0.86	0.13	0.74	1.41	1.01	0.15	0.0106
Oxynoemacheilus ciceki	0.005	3.129	0.910	0.0980	2.924–3.345	I	—	—	0.46	0.73	0.61	0.06	0.77	1.21	1.00	0.09	0.0073
Oxynoemacheilus cilicicus	0.006	3.274	0.946	0.0772	3.066–3.462	+A	—	—	0.60	1.44	0.91	0.13	0.70	1.69	1.01	0.14	0.0132
Oxynoemacheilus cyri	0.007	3.199	0.974	0.0980	3.045–3.419	+A	—	—	0.79	1.29	1.06	0.14	0.81	1.28	1.01	0.12	0.0138
Oxynoemacheilus ercisianus	0.009	3.041	0.981	0.0420	2.983–3.118	I	—	—	0.75	1.09	0.91	0.07	0.82	1.20	1.00	0.08	0.0098
Oxynoemacheilus eregliensis	0.009	2.961	0.973	0.0045	2.876–3.050	I	0.0050	3.20	0.63	1.01	0.83	0.07	0.76	1.22	1.01	0.09	0.0079
Oxynoemacheilus euphraticus	0.008	2.955	0.960	0.0561	2.821–3.082	I	0.0062	2.97	0.42	1.15	0.74	0.07	0.58	1.58	1.01	0.10	0.0069
Oxynoemacheilus evreni	0.008	3.159	0.988	0.0910	3.023–3.417	+A	0.0128	2.79	0.84	1.15	0.98	0.08	0.86	1.20	1.00	0.08	0.0125
Oxynoemacheilus frenatus	0.008	3.111	0.921	0.1695	2.747–3.529	I	—	—	0.61	1.60	1.02	0.16	0.62	1.64	1.02	0.16	0.0117
Oxynoemacheilus germencicus	0.007	3.114	0.979	0.1117	2.995–3.342	I	—	—	0.85	1.04	0.91	0.05	0.92	1.14	1.00	0.05	0.0106
Oxynoemacheilus hamwii	0.005	3.259	0.913	0.1483	2.939–3.614	I	0.0099	2.66	0.42	1.23	0.81	0.16	0.55	1.56	0.98	0.18	0.0121
Oxynoemacheilus hazarensis	0.011	2.889	0.935	0.2301	2.108–3.500	I	—	—	0.68	1.22	0.90	0.12	0.74	1.32	1.01	0.12	0.0076
Oxynoemacheilus insignis	0.006	3.048	0.915	0.1791	2.709–3.524	I	0.0150	2.95	0.46	0.79	0.60	0.10	0.79	1.33	1.00	0.16	0.0064
Oxynoemacheilus kaynaki	0.007	3.148	0.938	0.0902	2.944–3.335	I	—	—	0.73	1.14	0.94	0.11	0.79	1.27	1.01	0.11	0.0114
Oxynoemacheilus mediterraneus	0.009	2.944	0.974	0.0403	2.870–3.023	I	—	—	0.56	0.96	0.78	0.07	0.73	1.25	1.01	0.09	0.0072
Oxynoemacheilus namiri	0.007	3.188	0.924	0.0985	2.928–3.438	I	—	—	0.55	1.58	1.01	0.15	0.58	1.66	1.01	0.15	0.0128
Oxynoemacheilus nasreddini	0.011	2.981	0.932	0.0932	2.812–3.149	I	—	—	0.79	1.50	1.07	0.13	0.74	1.41	1.01	0.12	0.0104
Oxynoemacheilus paucilepis	0.009	3.048	0.979	0.1233	2.578–3.198	I	—	—	0.87	1.12	1.02	0.07	0.86	1.10	1.01	0.07	0.0108
Oxynoemacheilus samanticus	0.006	3.180	0.972	0.1230	2.824–3.376	I	0.0085	2.92	0.76	0.98	0.86	0.05	0.93	1.13	1.01	0.06	0.0111
Oxynoemacheilus seyhanensis	0.009	3.101	0.977	0.0654	2.962–3.292	I	—	—	0.78	1.28	1.00	0.10	0.79	1.24	1.00	0.10	0.0118
Oxynoemacheilus seyhanicola	0.005	3.239	0.975	0.1001	3.092–3.377	+A	—	—	0.55	0.95	0.76	0.09	0.71	1.22	1.00	0.10	0.0103
Oxynoemacheilus simavicus	0.007	3.239	0.976	0.1811	2.539–3.604	I	0.0044	3.26	0.92	1.15	1.03	0.08	0.91	1.09	1.00	0.07	0.0139
Oxynoemacheilus theophilii	0.006	3.285	0.954	0.0999	3.168–3.405	+A	—	—	0.75	1.33	0.92	0.13	0.83	1.50	1.02	0.13	0.0137
Oxynoemacheilus tigris	0.006	3.143	0.944	0.1318	2.898–3.455	I	0.0046	3.23	0.45	1.03	0.72	0.10	0.62	1.44	1.01	0.14	0.0089
Oxynoemacheilus veyselorum	0.011	2.887	0.972	0.0734	2.756–3.031	I	—	—	0.75	1.79	0.91	0.20	0.85	1.90	1.04	0.20	0.0079

Bold font indicates the first reported LWR value; *a* = intercept, *b* = slope, R^2 = correlation coefficient, SD = standard deviation CL = confidence intervals, GT = growth type, *a*3:0 = form factor; I = isometric growth; –A = negative allometric growth, +A = positive allometric growth.

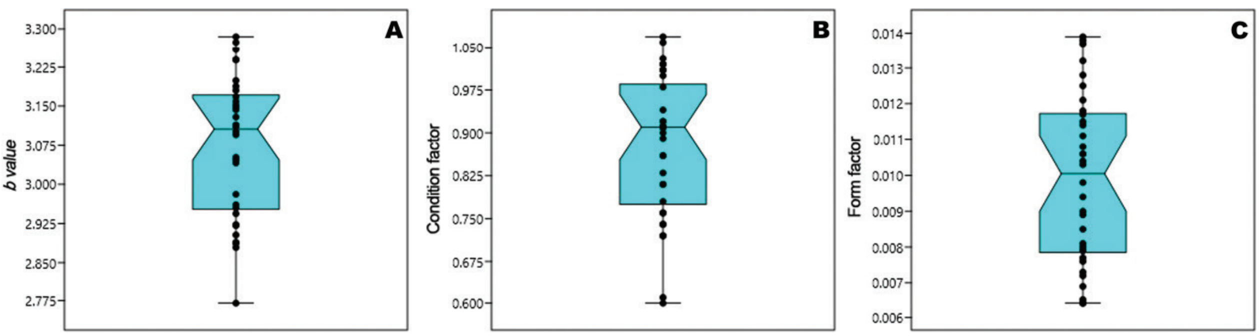

Figure 1. Box plot of (**A**) allometric co-efficient *b* values, (**B**) Fulton's condition factor (K_F), (**C**) form factor for 34 *Oxynoemacheilus* species from Turkey.

therefore assesses an individual's divergence from the sample's mean weight for length. To facilitate such comparisons, Le Cren (1951) introduced the relative condition factor, which compensates for changes in form or condition with an increase in length and thus measures the K_R. The values of K_R varied from 0.985 (*O. hamwii*) to 1.041 (*O. veyselorum*) (Table 2).

The condition factor is an index reflecting interactions between biotic and abiotic factors on the physiological condition of the fishes. Therefore, it can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene 2005). The results of the K_R value indicated good health and better environmental conditions for all the studied species.

The form factor *a*3:0 can be used to determine whether the body shape of a given population or species is significantly different from others (Froese 2006). The form factor varied from 0.006 to 0.014 for 34 species showing the fishes in the range of the elongated body shape (Table 2 and Fig. 1).

The LWRs of 22 species, provided in this paper, have not hitherto been available in FishBase (Froese and Pauly 2021). The results of this study provide useful information for fisheries management, fish population dynamic studies, and comparisons in future studies.

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