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LENGTH–WEIGHT AND LENGTH–LENGTH RELATIONS OF THE SEVEN ENDEMIC *ALBURNUS* SPECIES (ACTINOPTERYGII: CYPRINIFORMES: CYPRINIDAE) IN IRAN

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Abstract. The length–weight (LWR) and length–length (LLR) relations were estimated for the first time for the seven endemic species of the genus *Alburnus* Rafinesque, 1820 inhabiting Iranian rivers namely *Alburnus atropatenae* Berg, 1925; *Alburnus caeruleus* Heckel, 1843; *Alburnus chalcoides* (Güldenstädt, 1772); *Alburnus filippii* Kessler, 1877; *Alburnus hohenackeri* Kessler, 1877; *Alburnus mossulensis* Heckel, 1843; and *Alburnus zagrosensis* Coad, 2009. A total of 178 specimens were caught by electrofishing during 2010–2012. The *b* values of the LWR ($W = aL^b$) ranged from 2.672 for *A. chalcoides* to 3.313 for *A. atropatenae*. The r^2 values ranged from 0.85 to 0.997 and the intercepts were between 0.0041 and 0.0190. All LLRs were highly significant ($r^2 > 0.96$).

Keywords: LWR, LLR, Bleak, Shemaya, Caspian Sea

Thirty-eight species are presently recognized in the European and Western Asian genus *Alburnus* Rafinesque, 1820 (see Kottelat and Freyhof 2007). The cyprinid genus *Alburnus* has seven confirmed species recorded from Iranian waters, namely *Alburnus atropatenae* Berg, 1925; *Alburnus caeruleus* Heckel, 1843; *Alburnus chalcoides* (Güldenstädt, 1772); *Alburnus filippii* Kessler, 1877; *Alburnus hohenackeri* Kessler, 1877; *Alburnus mossulensis* Heckel, 1843; and *Alburnus zagrosensis* Coad, 2009 (see Coad 2014).

Length–weight (LWR) and length–length relations (LLR) are widely used for fish stock assessment (Ricker 1968). The LWR is also used for estimating the average weight at a given length group and thus converting length observations into weight to provide some measure of biomass (Froese 1998, Froese et al. 2011).

In the presently reported study, the estimates of the LWR and LLR parameters for the seven endemic species of the genus *Alburnus*, inhabiting the rivers of Iran are presented. Among the seven studied species, only *Alburnus*

Table 1

Descriptive statistics and estimated parameters of the length–weight relations for the seven *Alburnus* species in Iran

Species	*n*	Total length [mm]		Body weight [g]		LWR parameters				
		Range	Mean ± SD	Range	Mean ± SD	*a*	*b*	r^2	SE_b	±95% CI of *b*
A. atropatenae	30	75.45–97.44	84.93 ± 5.44	3.68–8.49	5.88 ± 1.31	0.0048	3.313	0.851	0.292	2.650–3.860
A, caeruleus	13	66.10–82.12	72.60 ± 6.49	2.83–5.40	3.71 ± 1.08	0.0082	3.072	0.977	0.290	2.417–3.908
A. chalcoides	30	124.60–184.74	157.28 ± 11.76	14.88–41.70	30.45 ± 5.82	0.0190	2.672	0.932	0.160	2.355–3.013
A. filippii	30	78.50–107.79	95.80 ± 7.48	3.65–9.02	6.82 ± 1.67	0.0058	3.115	0.894	0.259	2.592–3.681
A. hohenackeri	30	48.88–65.41	56.56 ± 5.05	1.35–3.22	2.14 ± 0.56	0.0158	2.822	0.943	0.140	2.487–3.064
A. mossulensis	30	100.94–156.88	127.66 ± 14.30	8.00–28.23	17.77 ± 5.74	0.0041	3.279	0.965	0.125	3.044–3.558
A. zagrosensis	15	53.27–129.72	84.81 ± 31.43	1.40–23.04	8.65 ± 8.33	0.0078	3.102	0.997	0.890	2.864–3.356

SD = standard deviation, *n* = sample size, *a* = intercept, *b* = slope, SE_b = standard error, r^2 = the coefficient of determination, CI = confidence interval.

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Table 2

Length–length relations between total length, fork length, and standard length for the seven *Alburnus* species in Iran

Species	Equation	*n*	r^2
A. atropatenae	TL = –0.074 + 1.0178FL	30	0.990
	FL = –0.1142 + 1.0386SL		0.979
	SL = –0.2278 + 0.9205TL		0.976
A. caeruleus	TL = –0.0173 + 1.0702FL	13	0.985
	FL = – 0.2669 + 1.1239SL		0.993
	SL = 0.4011 + 0.8216TL		0.998
A. chalcoides	TL = –0.0488 + 1.0021FL	30	0.972
	FL = 0.0383 + 0.9688SL		0.979
	SL = 0.0775 + 0.9979TL		0.986
A. filippii	TL = 0.0057 + 0.9773FL	30	0.962
	FL = –0.1134 + 1.0358SL		0.978
	SL = 0.2307 + 0.9221TL		0.960
A. hohenackeri	TL = –0.0795 + 1.0246FL	30	0.985
	FL = 0.0501 + 0.9436SL		0.987
	SL = –0.0339 + 0.972TL		0.982
A. mossulensis	TL = –0.1369 + 1.0459FL	30	0.989
	FL = –0.08301 + 1.0233SL		0.997
	SL = 0.2333 + 0.9221TL		0.988
A. zagrosensis	TL = –0.0819 + 1.0258FL	15	0.999
	FL = 0.0823 + 1.0166SL		0.997
	SL = 0.1641 + 0.9533TL		0.997

n = number of individuals, r^2 = coefficient of determination; TL = total length, FL = fork length, SL = standard length.

mossulensis had been previously studied in terms of the length–weight relation (Mousavi-Sabet et al. 2013).

A total of 178 specimens of the seven *Alburnus* species (i.e. *Alburnus atropatenae*, *Alburnus caeruleus*, *Alburnus chalcoides, Alburnus filippii*, *Alburnus hohenackeri*, *Alburnus mossulensis*, and *Alburnus zagrosensis*) were collected by electrofishing from seven localities in Iran (Mahabad-Chai River 36°48′56″N, 45°44′15″E; Sarabele River 33°41′34″N, 46°42′56″E; Babolrud River 36°39′21″N, 52°38′22″E; Baleqlu-Chai River 38°02′21″N, 48°02′58″E; Miriseh River 36°29′56″N, 45°33′54″E; Gamasiab River 34°05′53″N, 48°25′21″E; and the Gandoman Wetland 31°50′09″N, 51°06′03″E; respectively) during 2010–2012. Specimens were preserved in 10% formaldehyde and their total length (TL), fork length (FL), and standard length (SL) were measured to the nearest 0.01 mm, and body weighed (*W*) to the nearest 0.01 g.

The parameters of the LWR $W = aL^b$ (Le Cren 1951), were calculated by the least squares method using the logarithmic form:

$$\log W = \log a + b \log \mathrm{TL}.$$

Moreover, TL vs. FL, FL vs. SL, and SL vs. TL relations (LLR) were estimated with linear regression.

Descriptive statistics and estimated parameters of the LWR are given in Table 1 and the LLR in Table 2. All r^2 values were highly significant ($r^2 > 0.96$ for LLR, $r^2 > 0.85$ for LWR).

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