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Length–weight relations of 14 fish species (Actinopterygii) from the Chalakudy River, Western Ghats, India

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Abstract

Length–weight relations of 14 fish species caught by small-scale fishery from the Chalakudy River of the Western Ghats biodiversity hotspot, India were analyzed from April 2018 to March 2019. The following species were studied: *Amblypharyngodon microlepis* (Bleeker, 1853); *Dawkinsia filamentosa* (Valenciennes, 1844); *Puntius mahecola* (Valenciennes, 1844); *Osteobrama bakeri* (Day, 1873); *Labeo dussumieri* (Valenciennes, 1842); *Channa marulius* (Hamilton, 1822); *Channa striata* (Bloch, 1793); *Horabagrus brachysoma* (Günther, 1864); *Mystus armatus* (Day, 1865); *Pangasianodon hypophthalmus* (Sauvage, 1878); *Heteropneustes fossilis* (Bloch, 1794); *Etroplus suratensis* (Bloch, 1790); *Megalops cyprinoides* (Broussonet, 1782); *Parambassis thomassi* (Day, 1870). The main fishing gear that was used in the data collection were gill nets, seine nets, and cast nets. The *b* values in the LWRs ranged from 2.649 (*L. dussumieri*) to 3.023 (*P. hypophthalmus*). This study reports the first LWR reference for five species and new maximum total lengths for five species. The results provide baseline information for the sustainable management and conservation of the studied species.

Keywords

LWRs, regression coefficients, maximum length, conservation

Introduction

Information on length–weight relations (**LWRs**) of fishes in a given geographical region is helpful in fisheries management and monitoring of environmental programs (Froese 2006; Hossain et al. 2019). LWRs plays a significant role in fishery research having a wide range of uses in fishery biology, ecology, fish stock and population assessments (Le Cren 1951; Froese 2006). It provides information on growth, life history, survival, as well as the overall condition of the fish (Le Cren 1951; Christensen and Walters 2004). It is widely used as a tool to calculate the biomass from the length data, converting individual lengths or mean lengths of a group of fishes to weights (Froese 2006; Baitha et al. 2018). Length–weight relations are also used to compare the well-being of individuals within the specific stocks or separate stocks of the same species (King 2007). The LWRs differ among fish species depending upon body shape and biological factors such as maturity and spawning (Schneider et al. 2000). The information regarding the LWR of fishes from the Western Ghats biodiversity hotspot of India is scarce. Therefore, the presently reported study aimed to provide the LWRs of 14 species representing 8 families, collected from small-scale fishery in the Chalakudy River flowing through the Western Ghats biodiversity hotspot in India. To our best knowledge, no LWRs are reported in FishBase (Froese and Pauly 2020) for five of the selected species.

Materials and methods

The Chalakudy River (10°10′–10°33′N, 76°17′–77°4′E) is the fifth-longest among the 44 perennial rivers of state of Kerala, India that originates from the Anamalai Hills of the Western Ghats biodiversity hotspot and empties in the Arabian Sea (Myers et al. 2000). The river harbors a rich and diverse fish fauna of 98 species, and many of them are endemic (36%) and threatened (33%) (Biju et al. 2000; Raghavan et al. 2008). Fish specimens were caught by gill nets (mesh, 1.5–12.0 cm), seine nets (mesh, 1.5–3.0 cm), and cast nets (mesh, 1.0–1.5 cm) operated in the river during the period of April 2018–March 2019. All specimens were identified following Talwar and Jhingran (1991) and Jayaram (2009) and scientific names were confirmed with FishBase (Froese and Pauly 2020). The total length (TL) was measured to the nearest 0.1 cm using a vernier caliper, and body weight (BW) was taken in the field to an accuracy of 0.01 g using an electronic balance. LWR was determined using the equation:

$$W = aL^b$$

and logarithmically transformed in to

$$\log W = \log a + \text{b} \log L$$

where W is the whole body weight [g], L is the total length [cm], and parameters a and b are the regression parameters (Le Cren 1951; Froese 2006). The 95% of confidence limits for the parameters of a and b and co-efficient of determination (r^2) were estimated. Extreme outliers were removed from the regression analysis. (Froese 2006).

Results and discussion

In total, 927 specimens from 14 fish species representing 13 genera and eight families were examined (Table 1). The following species were studied: *Amblypharyngodon microlepis* (Bleeker, 1853); *Dawkinsia filamentosa* (Valenciennes, 1844); *Puntius mahecola* (Valenciennes, 1844); *Osteobrama bakeri* (Day, 1873); *Labeo dussumieri* (Valenciennes, 1842); *Channa marulius* (Hamilton, 1822); *Channa striata* (Bloch, 1793); *Horabagrus brachysoma* (Günther, 1864); *Mystus armatus* (Day, 1865); *Pangasianodon hypophthalmus* (Sauvage, 1878); *Heteropneustes fossilis* (Bloch, 1794); *Etroplus suratensis* (Bloch, 1790); *Megalops cyprinoides* (Broussonet, 1782); *Parambassis thomassi* (Day, 1870). The sample size ranged from 25 (*M. cyprinoides*) to 134 (*P. mahecola*) individuals. Estimated parameters of length–weight relation including sample sizes (N), regression parameters a and b and their 95% confidence limits (CL), and the coefficient of determination (r^2) are given in Table 1. For all analyzed species LWRs were highly significant ($P < 0.001$), while r^2 values ranged from 0.950 (*P. mahecola* and *O. bakeri*) to 0.994 (*M. cyprinoides*) therefore suggesting a strong relation between total length and body weight. The values of coefficient a ranged from 0.006 (*O. bakeri*, *P. hypophthalmus*, and *M. cyprinoides*) to 0.018 (*E. suratensis*) and the values of exponent b ranged from 2.649 (*L. dussumieri*) to 3.023 (*P. hypophthalmus*). After comparing the results against the Bayesian approach, a parameters were within the probable range for all the species except *C. striata* ($a = 0.014$) possibly due to narrow length ranges (Froese and Pauly 2020). For all species, the estimated b values were within the normal range of 2.5 to 3.5, as suggested by Froese (2006). Variations in the b values are usually attributed to several factors such as sample size, habitat, season, sex, diet, and gonadal maturity (Bagenal and Tesch 1978; Froese 2006; Hanif et al. 2020). The size range covered for some species was narrow. Hence, the LWR for these species should be considered preliminary and need to be verified in future studies using larger sample sizes. Considering the somatic type of growth, two species showed isometric growth ($b = 3$) and twelve species exhibited negative allometric growth ($b < 3$). During the presently reported study LWR estimates of five species, *A. microlepis*,

Table 1. Descriptive statistics and estimated length–weight relation parameters of 14 fish species from the Chalakudy River, India.

Family	Species	*N*	TL range [cm]	TW range [g]	*a*	95% CI of *a*	*b*	95% CI of *b*	r^2
Cyprinidae	*Amblypharyngodon microlepis**	65	8.6–**12.6**	6.70–20.70	0.007	0.006–0.009	2.960	2.848–3.071	0.977
	Dawkinsia filamentosa	108	8.5–14.5	8.40–35.30	0.008	0.006–0.010	2.944	2.838–3.050	0.966
	*Puntius mahecola**	134	7.8–**12.6**	6.00–24.00	0.008	0.006–0.010	2.952	2.846–3.058	0.958
	*Osteobrama bakeri**	61	10.3–**15.3**	9.50–27.30	0.006	0.004–0.008	2.989	2.825–3.153	0.958
	*Labeo dussumieri**	78	12.8–35.0	22.00–422.00	0.017	0.014–0.020	2.649	2.579–2.719	0.986
Channidae	*Channa marulius*	88	23.9–61.2	90.00–1800.00	0.014	0.012–0.018	2.658	2.577–2.739	0.980
	Channa striata	46	16.0–42.1	35.00–520.00	0.014	0.011–0.017	2.684	2.593–2.774	0.988
Bagridae	*Horabagrus brachysoma*	56	18.1–32.5	65.00–345.00	0.008	0.006–0.010	2.962	2.863–3.061	0.985
	*Mystus armatus**	26	10.1–12.6	8.90–17.00	0.012	0.007–0.019	2.697	2.469–2.925	0.963
Pangasiidae	*Pangasianodon hypophthalmus*	28	20.7–68.0	70.00–2300.00	0.006	0.004–0.008	3.023	2.898–3.148	0.990
Heteropneustidae	*Heteropneustes fossilis*	54	16.4–**41.2**	28.00–400.00	0.007	0.005–0.010	2.946	2.792–3.101	0.965
Cichlidae	*Etroplus suratensis*	83	10.4–31.6	18.00–41.40	0.018	0.014–0.022	2.701	2.603–2.800	0.973
Megalopidae	*Megalops cyprinoides*	25	19.4–37.0	60.00–394.00	0.006	0.005–0.008	2.978	2.884–3.072	0.994
Ambassidae	*Parambassis thomassi*	75	8.0–**13.6**	5.50–25.00	0.011	0.009–0.013	2.761	2.680–2.843	0.984

N, number of individuals; TL, total length, TW, total weight; *a*, intercept; *b*, slope; CL, confidence limits; r^2, coefficient of determination; first LWR report in FishBase (*); TL in bold, new maximum length observed in the FishBase.

P. mahecola, *O. bakeri*, *L. dussumieri*, and *M. armatus* are described the first time (Froese and Pauly 2020). Further, it has been found that *A. microlepis* (12.6 cm), *P. mahecola* (12.6 cm), *O. bakeri* (15.3 cm) *P. thomassi* (13.6 cm) and *H. fossilis* (41.2 cm) have a highest total length not previously reported in FishBase (Froese and Pauly 2020). To conclude, these results provide useful information for the conservation and sustainable management of these fishes.

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