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TECHNICAL CONTRIBUTION

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Length–weight and length–length relationship of *Strongylura strongylura* (van Hasselt, 1823) and *Hyporhamphus limbatus* (Valenciennes, 1847) from Chilika Lake, India

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Summary

Analyzed were the length–weight relationship (LWR) and length–length relationship (LLR) of two fish species, *Strongylura strongylura* (family Belonidae) and *Hyporhamphus limbatus* (family Hemiramphidae) from Chilika Lake, India. A total of 616 specimens were sampled bi-monthly from August 2014 to June 2016 using seine nets and screen barrier nets operated by local fishermen that were used for the present estimates.

1 | INTRODUCTION

A Beloniformes population inhabiting Chilika Lake contributes significantly to the commercial fishery, with two highly-valued species (*Strongylura strongylura* and *Hyporhamphus limbatus*) from a total of 13 species in the lake (Mohanty et al., 2015). The length–weight relationship (LWR) and length–length relationship (LLR) of fishes are important parameters of fishery biology, including fish stock assessment (Chu, Hou, Tsong-Ueng, & Wang, 2012; Ruiz-Campos, González-Acosta, & De La Cruz-Aguero, 2006). However, the main application of the LWRs and LLRs is to convert length data from the field studies into weight data because often in the field, fish weight measurement is difficult, time consuming and inaccurate in moving boats. Biological information pertaining to the Beloniformes fishes within this region is unfortunately limited. Here, we report LWR and LLR for two species, *Strongylura strongylura* and *Hyporhamphus limbatus*, inhabiting in the lake.

2 | MATERIALS AND METHODS

Chilika Lake (19°28′–19°54′ N; 85°05′–85°38′ E), a designated Ramsar Site of International Importance and the largest brackish water lake of Asia, is located at the northwestern Bay of Bengal along the Indian coastline. The water area of the lake ranges between 906 km^2 in the dry season to 1165 km^2 in the monsoon season with a maximum 6.2 m water depth (Mohanty et al., 2015). Chilika Lake supports the livelihood and nutritional security to about 0.2 million local fishermen living in and around the lake (Mohanty et al., 2015). Bi-monthly samplings were carried out during August 2014 to June 2016, with samples collected using nets commonly operated by local fishermen such as the seine net (6, 8 and 10 mm mesh) and the screen barrier net (8–24 mm mesh). After collection, the samples were immediately packed in polythene bags, stored in ice boxes and transported to the laboratory for identification according to Fischer and Bianchi (1984) and Rao (2009). Total lengths (TL) and standard lengths (SL) were measured to the nearest 1 mm with a sliding caliper and weighed (W) to the nearest 0.1 g. In total, 616 specimens (263 *S. strongylura*; 353 *H. limbatus*) were measured and used in the analysis.

Counts of both species, length parameters (minimum and maximum), and weight parameters (minimum and maximum) were determined. The length–weight relationships, $W = a^*L^b$ i.e., log W = log $a + b$ log L were estimated by linear regression analyses where a is the intercept and b is the slope of the linear regression on the log-transformed weight and length data, respectively (Froese, 2006). Prior to linear regression analysis, outliers in the log–log plots were identified and removed from the data (Froese, 2006). The statistical significance, 95% confidence intervals (CIs) of the parameter b and coefficient of determination (r^2) were also estimated. Student's t-test was carried out to establish the growth pattern of fishes based on b values close to 3 (isometric growth) or different from 3 (allometric growth). The length–length relationships (LLRs) between TL and SL were also established using linear regression analyses: TL = $a + b$ SL. All statistical analyses were performed using R (3.3.0) software.

3 | RESULTS

Estimated parameters of LWR, i.e., sample size (N), length range, weight range, a, b, 95% CI of a and b, SE of b, r^2 and growth of the

TABLE 1 Estimated parameters of length–weight relationship for two species from Chilika Lake, August 2014–June 2016

Family	Species	*N*	TL range (cm)	W range (g)	*a*	95% CI of *a*	*b*	95% CI of *b*	*SE* (*b*)	r^2
Belonidae	*Strongylura strongylura* (van Hasselt, 1823)	263	12.5–51.8	2.49–217	−3.146	−3.248 to −3.044	3.173	3.099–3.247	0.037	.964
Hemiramphidae	*Hyporhamphus limbatus* (Valenciennes, 1847)	353	6.6–25.0	0.83–41	−2.484	−2.562 to −2.406	2.945	2.876–3.015	0.035	.952

N, sample size; TL, total length; *W*, body weight; *a*, intercept; *b*, slope of the linear regression; CI, confidence limits; *SE* (*b*), standard error of slope *b*; r^2, coefficient of determination.

TABLE 2 Length-length relationship between total length (TL) and standard length (SL) from Chilika Lake

Species	*N*	TL range (mm)	Equation	r^2
S. strongylura	107	112–314	TL = −0.016 + 1.137SL	.997
H. limbatus	163	66–250	TL = −0.267 + 1.171SL	.996

two species are described in Table 1. The r^2 value for *S. strongylura* was .964 and .952 for *H. limbatus*. Both regression values were highly significant ($p < .001$). The calculated growth coefficients (*b*) were 3.173 and 2.945 for *S. strongylura* and *H. limbatus*, respectively. The estimated parameters of LLR are described in Table 2. The LLR values were also found to be highly correlated ($p < .001$).

4 | DISCUSSION

The estimated *b* values of the regression for both species are within the range of 2.5–3.5 as per Carlander (1969) and Froese (1998). The observed confidence limits were well within the range and overlapped with the Bayesian confidence limits in FishBase (Froese & Pauly, 2016). The results of the present study can be useful for conservation and management of the investigated species.

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