Received: 19 April 2020 | Revised: 7 May 2020 | Accepted: 20 May 2020

DOI: 10.1111/jai.14083

TECHNICAL CONTRIBUTION

Journal of Applied Ichthyology | WILEY

Length–weight relationships for six fish species found in a floodplain lake of the Madeira River, Brazilian Amazon

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Funding information
Foundation for the Development of Technological Actions and Research of the State of Rondônia (Fapero - PAP-INTEC/PISCICULTURA); National Council for Scientific and Technological Development (CNPq)

Abstract

Length–weight relationships (LWR) were estimated for six fish species from the Cujubim lake on the Madeira River. The specimens were sampled between in the months of March and November, 2019 and February, 2020 using gillnets (10 × 5 m, mesh size 40, 60, 80 and 100 mm) which were checked every 6 hr during a 24-hr period and casting nets (1.25 × 2.7 m, mesh size 40 mm) performed three times in this interval. This study reports new maximum lengths for four species and a new tentative LWR for one species.

KEYWORDS

Amazon fish, Cujubim Lake, fisheries, flodplain area

1 | INTRODUCTION

The Amazon Basin possesses a high diversity of freshwater fish, and the Madeira River constitutes the greatest known wealth for a tributary of the Amazon River, with a total of 1,008 species identified so far (Ohara et al., 2015). The floodplain lakes are fundamental components in the sustainability of fish resources and aid the high biological productivity by generating a fish biomass that is intensively exploited by fisheries (Petrere, 1978). However, information regarding length–weight relationships is still scarce. Length–weight relationships (LWRs) are very important in studies on fish ecology and for understanding the pattern of somatic growth (Froese, 2006). When measured together with several additional population parameters they are essential as tools in fishery science and management. This study reports the LWRs for six fish species from the Cujubim floodplain lake, which is localized on the Madeira River, Brazilian Amazon.

2 | MATERIALS AND METHODS

Fish samples were collected in the months of March and November, 2019 and February, 2020 from the Cujubim Lake (8°29′25,49′′S; 63°29′58,48′′W) in Rondônia state, Brazil, using gillnets (10 × 5 m, mesh size 40, 60, 80 and 100 mm) and casting nets (1.25 × 2.7 m, mesh size 40 mm). During 1 day each month, sample collections were performed every 6 hr during a 24 hr period, and casting nets were performed three times in this interval, and the fish species were taken for identification, measured for standard length (SL, to the nearest 0.1 cm), and weighed to the nearest 0.01 g. Fish species identification was done by following the methodology of Queiroz et al., (2013) and Ohara, Lima, Salvador, and Andrade (2017). The LWRs were determined by regular linear regression and Bayesian analysis (Froese, 2006; Froese, Thorson, & Reyes, 2014). In conventional analyses, length-weight function is calculated by the equation $W = aL^b$, where W is the weight (g), L is the standard length (cm), a is a constant and b is the allometric coefficient. In the case of our study, the parameters a and b were determined by linear regression: l $logW = loga + b$, and outliers observed in the length-weight relationship of all species were excluded from the regression. The 95% confidence interval (CI) was determined for parameters a and b. The correlation coefficient of Pearson r-squared (r^2) was estimated. The allometric condition factor K_{rel} was calculated according to the equation $K_{rel} = \frac{W}{aL^b}$ (Le Cren, 1951). The Bayesian analysis was employed with a code-to-use taken from Froese and Pauly (2019) as well as the

TABLE 1 Descriptive statistics and estimated length–weight relationship parameters determined by linear regression and Bayesian analysis for 21 fish species collected between 2019 to 2020 in a floodplain lake of the Madeira River, Brazilian Amazon

		SL (cm)		TW (g)		LW Regression parameters				Bayesian analyses	
Order/Family/ Specie	*N*	Min	Max	Min	Max	a (95% CI)	b (95% CI)	r^2 (95% CI)	K_{rel} (*SD*)	Mean $\log_{10}$ a (*SD*)	Mean b (*SD*)
Characiformes/Curimatidae											
Curimata inornata Vari, 1989	24	11.7	**24.5**	33.1	252.4	0.0418 (0.0191–0.0914)	2.7458 (2.4709–3.0206)	0.975 (0.943–0.989)	1.010 (0.144)	−1.380 (0.0018)	2.750 (0.0013)
Potamorhina latior (Spix & Agassiz, 1829)	84	11.0	**27.3**	26.0	348.0	0.0068 (0.0035–0.0132)	3.2357 (3.0060–3.4654)	0.953 (0.926–0.969)	1.014 (0.165)	−2.160 (0.0018)	3.310 (0.0013)
Psectrogaster rutiloides (Kner, 1858)	56	11.1	**22.5**	19.4	222.0	0.0188 (0.0087–0.0407)	3.0289 (2.7507–3.3072)	0.948 (0.912–0.969)	1.018 (0.184)	−1.70 (0.0065)	3.010 (0.0052)
Clupeiformes/Engraulidae											
Anchovia Surinamensis (Bleeker, 1865)	357	6.3	11.8	3.0	14.4	0.0220 (0.0180–0270)	2.7122 (2.6173–2.8070)	0.946 (0.934–0.955)	1.004 (0.092)	−1.900 (0.0535)	2.860 (0.0496)
Jurengraulis juruensis (Boulenger, 1898)	21	13.6	**19.9**	25.8	92.4	0.0124 (0.0044–0.0351)	2.9583 (2.5966–3.3200)	0.969 (0.924–0.987)	1.004 (0.0891)	−1.910 (0.0035)	2.960 (0.0025)
Siluriformes/Loricariidae											
Loricariichthys maculatus (Bloch, 1794)[a]	8	20.5	27.7	49.2	105.9	0.0237 (0.0051–0.1098)	2.52897 (2.0453–3.0140)	0.9821 (0.901–0.997)	1.001 (0.0468)	−1.630 (0.0032)	2.530 (0.0023)

Note: *N*, sample size; SL, standard length; TW, total weight; LW, length-weight; SL max in bold indicates the new maximum length recorded; CI, confidence interval; r^2, Pearson *r*-squared for log–log regression; *SD*, standard deviation; K_{rel}, allometric condition factor; *a* and *b*, parameters of the relationship.

[a]Tentative estimate.

necessary information for combining existing knowledge (prior probabilities) with the new data from this study (likelihood function). The prior probabilities were taken from data provided for the Madeira River and in cases of non-occurrence, other locations in Brazil were used. The package R2jags (Su & Yajima, 2015) and the JAGS sampler software (Plummer, 2017) were used for Bayesian analyses. All the analyses were done using the software R Statistical Environment (R Core Team, 2019).

3 | RESULTS

A total of six species from three families, and three orders were analyzed by linear regression and Bayesian analysis (Table 1). The most diverse order and families were the Characiformes and the Curimatidae with three species. Although the samples were small for some estimates, as well as presenting small size range, the regressions showed significative differences for all species ($p < .001$). The allometric coefficient (b) for the LWRs ranged from 2.529 and 3.029, while for Baysian analysis, it was between 2.530 and 3.310 for the species *Loricariichthys maculatus* (Siluriformes/Loricariidae) and *Potamorhina latior* (Characiformes/Curimatidae), respectively.

4 | DISCUSSION

Of the six species in the present study, *three* from the Madeira River were studied. *C. inornata*, *A. Surinamensis* were obtained and studied in other Brazilian regions and *L. maculatus* has new tentative length-weight data. Furthermore, new maximum lengths for four species were recorded (Froese & Pauly, 2019). The value of *b* for all the species were within the expected range of 2.0–4.0, as suggested by Le Cren (1951). This result emphasizes the importance of LWR studies and represents an additional contribution to the knowledge of ichthyofauna in floodplain lakes of the Madeira River in the Amazon basin. Thus, this new information is useful for management strategies in the area.

ACKNOWLEDGEMENTS

This research was supported by Fundação Rondônia de Amparo ao Desenvolvimento das Ações Científicas e Tecnológicas e à Pesquisa do Estado de Rondônia (Fapero - PAP-INTEC/PISCICULTURA) and Universidade Federal de Rondônia (UNIR). The authors also appreciate the PIBIC Grants from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

No Data Availability Statement.

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How to cite this article: Lima SADO, Sousa RGC. Length–weight relationships for six fish species found in a floodplain lake of the Madeira River, Brazilian Amazon. *J Appl Ichthyol*. 2020;00:1–3. https://doi.org/10.1111/jai.14083