

# Length-weight relationships of five fish species from Brazilian Amazon coast hotspot estuaries

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## Abstract

The length-weight relationships (LWR) were estimated for five fish species from the Golfão Maranhense, Brazilian Amazon littoral region. Samplings were performed in August 2016, during the dry season, using trawl net with 6.0 m length by 3.0 m width (trawl mouth opening of 6.0 m<sup>2</sup>) and 1.0 cm mesh size between opposite knots. This study registers LWR for *Anchoviella elongata* and *Gobioides broussonnetii* and the estimated LWR for *Aspredo aspredo* and *Aspredinichthys filamentosus* covers a wider size range. Moreover, it is presented maximum length values for *A. elongata* and *Sphoeroides greeleyi*.

## KEYWORDS

Fish conservation, LWR parameters, small-scale fisheries

## 1 | INTRODUCTION

The length-weight relationships (LWR) have been widely used due to their feasibility of application, enabling to estimate population stock biomass from known body length, also verifies adaptation responses from species allometry and allows comparison of life history between populations from distinct regions, provided all studies in all regions use the same or similar standardized sampling methodology (Froese, 2006; Nunes, Costa, Ribeiro, Costa, & Mendes, 2019). Basic information obtained from LWR combined with further approaches (e.g.: size at first sexual maturity, spawning and recruitment period) bring a wider understanding of species and their environmental conditions, contributing to a more effective support for fisheries monitoring and management actions (Al Nahdi, Leaniz, & King, 2016; Giarrizzo et al., 2015; Morgan, 2018). Despite the socioeconomic importance of fisheries activities, many fish species and their population stock captured in estuarine ecosystems at the North of Brazil

are still little or insufficient monitored (Blaber & Barletta, 2016; Oliveira, Silva, Prestes, & Tavares-Dias, 2020), jeopardizing local fisheries sustainability at medium-long term. Considering the demand for information to support fisheries management, this report presents estimation of LWR parameters of five estuarine fish species from an important Brazilian Amazon littoral region.

## 2 | MATERIALS AND METHODS

The study was conducted at Golfão Maranhense (the segment between 2° 24' 23.184" S, 44° 12' 41.782" W and 2° 30' 36.101" S, 44° 0' 30.092" W), located at the east side of Brazilian Amazon littoral. This hotspot is characterized by fish species high endemism (Stuart-Smith et al., 2013; Vila-Nova, Ferreira, Barbosa, & Floeter, 2014) and singular environmental conditions, such as macro-tidal cycles, which surpasses ranges of seven meters height during

**TABLE 1** Descriptive statistics and regression parameters of length-weight relationships (LWR) for five estuarine fish species caught from Brazilian Amazon Coast by trawl net (1 cm mesh size) at 6 m depth in August 2016

Family	Species	n	Total length (cm)			Weight (g)			Regression parameters			r <sup>2</sup>	
			min	max		min	max		a	95% ci of a	b		95% ci of b
Aspredinidae	<i>Aspredinichthys filamentosus</i> (Valenciennes, 1840)	283	5.0	25.5		0.2	18		0.0029	0.0028–0.0031	2.752	2.7429–2.7643	0.999
		112	6.0	32.0		1.7	54.1		0.0048	0.0044–0.0052	2.711	2.6972–2.7205	0.987
Engraulidae	<i>Anchoviella elongata</i> (Meek & Hildebrand, 1923)	43	4.2	15.9		0.6	17.0		0.0235	0.0222–0.0247	2.366	2.3369–2.3957	0.979
		27	6.1	8.0		0.6	1.9		0.0014	0.0013–0.0015	3.460	3.4387–3.4683	0.976
Tetraodontidae	<i>Sphoeroides greeleyi</i> Gilbert, 1900	28	3.5	22.6		1.1	180.1		0.0219	0.0203–0.0235	2.960	2.9268–2.9922	0.989

Note: Abbreviations: ci, confidence interval of the regression model; n, number of individuals; r<sup>2</sup>, regression coefficient.

the day (González-Gorbeña, Rosman, & Qassim, 2015). Samplings were conducted in 2016, from 16th to 23rd August within the dry season using trawl net with 6.0 m length by 3.0 m width (trawl mouth opening of 6.0 m<sup>2</sup>) and 1.0 cm mesh size. A total of 132 trawlings were performed at 6.0 m depth, with an average distance of 300 m and time of 5 min for each haul. To reduce sampling bias caused by tidal level variation, samplings were performed at low tide (0 m) and high tide (~5 m) at day and night.

Fish were identified consulting specialized literature (Carpenter, 2002a, 2002b, 2002c; Marceniuk, 2005; Marceniuk, Menezes, & Britto, 2012). Total length (Lt) and total weight (Wt) were reported at 0.1 cm and 0.1 g accuracy, respectively. Outliers were detected and removed before adjusting to linear regression (Froese, 2006). The LWR regression model was  $Wt = a(Lt)b$ , where 'a' corresponds to the intercept and 'b' the slope of the curve (Le Cren, 1951). The coefficient of determination (r<sup>2</sup>) and confidence intervals (CI) 95% of 'a' and 'b' were also estimated (Froese, 2011).

### 3 | RESULTS

Five estuarine species belonging to four fish families were sampled from Brazilian Amazon littoral. Aspredinidae accounted for 80% of the total individuals captured. The parameters of sample size (n), total length (Lt), total weight (Wt), values of 'a', 'b' and r<sup>2</sup> from WLR and their ranges are displayed in Table 1.

### 4 | DISCUSSION

The estimated values of 'b' for five species are within the expected range 2.5–3.5 (Froese, 2006). It is presented the first record of LWR for *A. elongata* and *G. broussonnetii*. In addition, this study presents a LWR estimation for *A. aspredo* and *A. filamentosus*, covering a wider size range than previously reported at FishBase (Froese & Pauly, 2019) and new maximum total length values for *A. elongata* and *S. greeleyi*. The LWR information provided in the study, as an input parameter for regulation of catches and estimation of biomass, is useful for further studies on fisheries management and conservation (Froese et al., 2011).

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### CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.


### DATA AVAILABILITY STATEMENT

No Data Availability Statement.

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## REFERENCES

- Al Nahdi, A., Leaniz, C. G., & King, A. J. (2016). Spatio-temporal variation in length-weight relationships and condition of the ribbon-fish *Trichiurus lepturus* (Linnaeus, 1758): Implications for fisheries management. *PLoS One*, 11, 1–14. <https://doi.org/10.1371/journal.pone.0161989>
- Blaber, S. J. M., & Barletta, M. (2016). A review of estuarine fish research in South America: What has been achieved and what is the future for sustainability and conservation? *Journal of Fish Biology*, 89, 537–568. <https://doi.org/10.1111/jfb.12875>
- Carpenter, K. E. (2002a). *The living marine resources of the Western Central Atlantic: Bony fishes part 1 (Acipenseridae to Grammatidae)*. Roma, Italy: FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication.
- Carpenter, K. E. (2002b). *The living marine resources of the Western Central Atlantic: Bony fishes part 2 (Opistognathidae to Molidae), sea turtles and marine mammals*. Roma, Italy: FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication.
- Carpenter, K. E. (2002c). *The living marine resources of the Western Central Atlantic: Introduction, mollusks, crustaceans, hagfishes, sharks, batoid fishes, and chimaeras*. Roma, Italy: FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication.
- Froese, R. (2006). Cube law, condition factor and weight-length relationships: History, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22(4), 241–253. [0426.2006.00805.x](https://doi.org/10.1007/s00771-006-0080-5)
- Froese, R., & Pauly, D. (2019). *FishBase, version 05/2019*. World Wide Web electronic publication. Retrieved from [www.fishbase.org](http://www.fishbase.org)
- Froese, R., Tsikliras, A. C., & Stergiou, K. I. (2011). Editorial note on weight-length relations of fishes. *Acta Ichthyologica Et Piscatoria*, 41(4), 261–263. <https://doi.org/10.3750/AIP2011.41.4.01>
- Giarrizzo, T., de Sena Oliveira, R. R., Costa Andrade, M., Pedrosa Gonçalves, A., Barbosa, T. A. P., Martins, A. R., ... Melo de Sousa, L. (2015). Length-weight and length-length relationships for 135 fish species from the Xingu River (Amazon Basin, Brazil). *Journal of Applied Ichthyology*, 31(2), 415–424. <https://doi.org/10.1111/jai.12677>
- González-Gorbeña, E., Rosman, P. C. C., & Qassim, R. Y. (2015). Assessment of the tidal current energy resource in São Marcos Bay, Brazil. *Journal of Ocean Engineering and Marine Energy*, 1, 421–433. <https://doi.org/10.1007/s40722-015-0031-5>
- Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology*, 20, 201–218. <https://doi.org/10.2307/1540>
- Marceniuk, A. P. (2005). Chave para identificação das espécies de bagres marinhos (Siluriformes, Ariidae) da costa brasileira. *Boletim do Instituto De Pesca.*, 31, 89–101.
- Marceniuk, A. P., Menezes, N. A., & Britto, M. R. (2012). Phylogenetic analysis of the family Ariidae (Ostariophysi: Siluriformes), with a hypothesis on the monophyly and relationships of the genera. *Zoological Journal of the Linnean Society*, 165, 534–669. <https://doi.org/10.1111/j.1096-3642.2012.00822.x>
- Morgan, J. M. (2018). Understanding biology to improve advice for fisheries management. *ICES Journal of Marine Science*, 75(3), 923–931. <https://doi.org/10.1093/icesjms/fsx229>
- Nunes, J. L. S., Costa, M. S., Ribeiro, M. F. R., Costa, M. S., & Mendes, M. B. P. (2019). Length weight relationship for freshwater fish species from Brazilian Cerrado. *Journal of Applied Ichthyology*, 35, 1–3. <https://doi.org/10.1111/jai.13889>
- Oliveira, M. S. B., Silva, L. M. A., Prestes, L., & Tavares-Dias, M. (2020). Length-weight relationship and condition factor for twelve fish species from the Igarapé Fortaleza basin, a small tributary of the Amazonas River estuary. *Acta Amazonica*, 50(1), 8–11. <https://doi.org/10.1590/1809-4392201900702>
- Stuart-Smith, R. D., Bates, A. E., Lefcheck, J. S., Duffy, J. E., Baker, S. C., Thomson, R. J., ... Edgar, G. J. (2013). Integrating abundance and functional traits reveals new global hotspots of fish diversity. *Nature*, 501(7468), 539–542. <https://doi.org/10.1038/nature12529>
- Vila-Nova, D. A., Ferreira, C. E. L., Barbosa, F. G., & Floeter, S. R. (2014). Reef fish hotspots as surrogates for marine conservation in the Brazilian coast. *Ocean & Coastal Management*, 102, 88–93. <https://doi.org/10.1016/j.ocecoaman.2014.09.00>

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