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Length-weight relationships of six fish species from São Marcos Bay, Northeastern Brazil

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Abstract

Length-weight relationship parameters were calculated for six fish species from São Marcos Bay, in Northeast Brazil (the segment between 02°35′55″S and 44°20′58″W; 02°34′53″S and 44°21′48″W; 02°42′25″S and 44°26′46″W). The specimens were caught quarterly from April 2010 to February 2013, using monofilament gillnets (2, 4 and 6 cm between knots) from 100 m to 3,000 m long and 4 m to 6 m high. The present study covers a much wider size range for four species and adds new information for the maximum length of *Notarius bonillai*.

1 | INTRODUCTION

Length-weight relationship (LWR) is a tool used in the study of fisheries biology (Froese, 2006). LWR helps to predict the ideal length and adequate time for collecting a particular species of fish (Abobi & Ekau, 2013). Despite this, in the São Marcos Bay few studies provide information regarding LWR parameters (Gonçalves, Dourado, Castro, & Tavares, 2003; Silva, Castro, & Gubiani, 2008; Silva-Júnior, Castro, Soares, & França, 2007). This area contains the second largest port complex, in respect to cargo movement, in the Brazil. In this study, LWR parameters of six estuarine fish species from São Marcos Bay are reported.

2 | MATERIALS AND METHODS

The study was conducted on the São Marcos Bay, in Northeastern Brazil (the segment between 02°35′55″S and 44°20′58″W; 02°34′53″S and 44°21′48″W; 02°42′25″S and 44°26′46″W). This region is characterized by semi-diurnal tides. In addition, it has a macro-tide that can reach more than 8 m during equinoctial spring tides (González-Gorbeña, Rosman, & Qassim, 2015). Sampling was conducted quarterly from April 2010 to February 2013 in three estuaries. The fishes were collected using monofilament gillnets (2, 4 and 6 cm between knots) from 100 m to 3,000 m long and 4 m to 6 m high and identified based on specific keys (Carpenter, 2002a, 2002b, 2002c). The LWR parameters estimated were compared with the Bayesian LWR predictions estimated by Froese, Thorson, and Reyes (2014). Reference material for each species was incorporated into the Fish Collection of the Federal University of Maranhão, São Luís, Maranhão.

All captured specimens were measured (total length, TL) and weighed (total weight, WT) with a precision 0.1 cm and 0.1 g, respectively. The parameters of LWRs were estimated by the non-linear regression, using the algorithm of Levenberg-Marquardt (Myers, 1990) in the equation: $WT = a \times TL^b$ (Le Cren, 1951), where WT is the total weight, TL is the total length, a is the intercept and b is the allometric coefficient. Prior to regression analysis, plots of WT and TL were used to detect and exclude outliers (Froese, 2006). The 95% confidence limits (CL) of a and b were calculated.

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TABLE 1 Descriptive statistics and length-weight relationship of six fish species from the São Marcos Bay, Northeastern Brazil

Family	Species	*n*	TL range	WT range	a ($CI_{95\%}$ a)	b ($CI_{95\%}$ b)	r^2
Ariidae	*Bagre bagre* (Linnaeus, 1766)	328	7.8–29.8	5.0–435.0	0.0077 (0.0063–0.0090)	3.19 (3.13–3.45)	0.9867
Ariidae	*Notarius bonillai* (Miles, 1945)	1,266	7.0–20.3a	5.78–160.0	0.0210 (0.0185–0.0237)b	2.90 (2.85–2.95)	0.9586
Auchenipteridae	*Pseudauchenipterus nodosus* (Bloch, 1794)	153	6.1–17.2	5.15–98.03	0.0699 (0.0332–0.1067)b	2.51 (2.31–2.71)c	0.9526
Batrachoididae	*Batrachoides surinamensis* (Bloch & Schneider, 1801)	66	11.0–49.6	35.0–3,280	0.0042 (0.0027–0.0058)b	3.46 (3.36–3.56)b	0.9950
Carangidae	*Oligoplites palometa* (Cuvier, 1832)	91	7.6–31.5	6.4–429.0	0.0137 (0.0113–0.0161)	3.00 (2.95–3.06)	0.9970
Mugilidae	*Mugil incilis* Hancock, 1830	645	6.9–25.6	5.0–298.5	0.0273 (0.0240–0.0306)b	2.86 (2.82–2.90)	0.9845

The specimens were caught between April 2010 and February 2013.
n, sample size; range, minimum and maximum size; *a* and *b*, parameters of the equation; CI, confidence limits; r^2, coefficient of determination.
[a]New maximum length
[b]Value above 95% confidence limits of Bayesian prediction
[c]Value below 95% confidence limits of Bayesian prediction

3 | RESULTS

In total 2,549 specimens were captured, representing six species. The coefficient of determination (r^2) ranged from 0.9526 to 0.9970, *a* values ranged from 0.0042 to 0.0699, and *b* values ranged from 2.51 to 3.46. This study covers a much wider size range for *Bagre bagre*, *Pseudauchenipterus nodosus* and *Batrachoides surinamensis* than previous estimates and adds new information for the maximum length of *Notarius bonillai*. LWR results are shown in Table 1.

4 | DISCUSSION

In this study, all *a* and *b* values estimated fell within the expected range predicted by (Froese, 2006). Thus, the estimated parameters can be used within the referred length range.

In regards to the Bayesian LWR predictions available in FishBase, four species had *a* values and just two species had *b* values outside the 95% confidence limits shown in database. This is because the LWR estimates were based on data of similar body shape taxon (Froese et al., 2014). Furthermore, many factors can influence these values including sex, sexual maturity, environmental conditions, food availability, geographic region and climatic changes (Correia, Siqueira-Souza, & Freitas, 2015; Freitas, Almeida, Montag, & Rocha, 2011; Froese, 2006; Hossain et al., 2006).

In general, the present study provides LWRs for six fish species from São Marcos Bay in Northeastern Brazil. The new estimates includes a much wider size range than any other previously published LWR and thus can representing a species-specific LWR. Additionally, this study offers a new total length for *N. bonillai*.

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