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Length–Weight relationship of thirteen demersal fishes from the tropical Brazilian continental shelf

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ABSTRACT

This study provides the length-weight relationship (LWR) for 13 demersal fish species belonging to 11 families and 8 orders. Data were collected in the northeast Brazilian continental shelf during two scientific surveys (2015 and 2017) using a bottom trawl net (side length of body mesh: 40 mm, side length of cod-end mesh: 25mm) at 35 stations between 15 and 60 m of depth. We provide novel LWRs for 4 species and expand the size range of 9 relationships previously established.

INTRODUCTION

Length-weight relationships (LWR) can be very important for stock differentiation, ecological modeling, to infer body condition indices, calculate biomass based on length frequency distributions, and for acoustic surveys (R. Froese, 2006; Martins Vaz-dos-Santos & Lúcia Del Bianco Rossi-Wongtschowski, 2013). However, despite its importance and the fact that these relationships are easily obtained, they are usually missing for several species, especially those that are not commercially important (Freire, Rocha, & Souza, 2009).

Along the Brazilian coast, several studies have estimated fish LWRs parameters. However, these studies mainly focused on the South (e.g. Catelani et al., 2017; Martins Vaz-dos-Santos and Lúcia Del Bianco Rossi-Wongtschowski, 2013; Vianna et al., 2004) and Southeast (e.g. Freire et al., 2009; MacIeira and Joyeux, 2009; Passos et al., 2012) regions. In the continental shelf of northeast Brazil, an area of high biodiversity

where many threatened and near-threatened species occur (Eduardo et al., 2018), only a few LWR references are available for estuarine and shallow water (0-30m) species (e.g Aguiar-Santos, Sampaio, Barroso, Nunes, & Piorski, 2018; Joyeux et al., 2009; Viana et al., 2016). Here new LWR information is provided for 13 species of demersal fishes occurring along the Brazilian northeast continental shelf.

MATERIAL AND METHODS

The study area comprises the northeast Brazilian continental shelf, between the states of Rio Grande do Norte (5°0'S; 35°0'W) and Alagoas (9°0'S; 35°0'W). Data were collected during a scientific survey, the Acoustics along the BRAzilian COaSt (ABRACOS) expeditions, on board the IRD R/V ANTEA. Sampling was conducted during two cruises, from August 30th to 20th September 2015 and 9th April – 6th May 2017, using a bottom trawl (side length of body mesh: 40 mm, side length of cod-end mesh: 25mm, entrance dimensions horizontal x vertical: 28 x10 m) at 35 stations. Hauls were performed between 15 and 60 m of depth, for about 5 minutes at 3.2 kt.

Fish individuals were identified, measured (nearest 0.1 cm total length, TL) and weighed (nearest 0.01 g in total weight, TW). The LWR values were estimated using the equation: $TW = a \times TL^b$, where TW is the total weight (in g); TL is the total length (in cm); *a* is the intercept of the regression curve (intercept of TW when TL is zero or initial growth coefficient) and *b* is the regression slope (coefficient indicating isometric or allometric growth) (Rainer Froese, 2006; Rainer Froese, Tsikliras, & Stergiou, 2011). Prior to calculation of the LWR, outliers for each species were graphically identified using TL vs. TW plots (Froese & Binohlan, 2000) and removed. The fit of the model to the data was measured by the coefficient of determination r-squared (R^2).

RESULTS

A total of 13 species belonging to 11 families and 8 orders were analyzed (Table 1). All regressions were highly significant ($P < 0.01$), with the coefficient of determination (r^2) ranging from 0.953 to 0.994 (Table 1). The intercept *a* varied between 0.00002 (*Aulostomus maculatus)* and 0.0119 (*Haemulon squamipinna*), while the value of *b* varied between 2.67 (*Alphestes afer*) and 3.58 in (*Aulostomus maculatus*).

DISCUSSION

This study provides novel LWRs for four species (Bothus ocellatus, A. afer, H. squamipinna and Scorpaena bergii) and expands the size range of nine other relationships (Table 1). For two species, Hypanus marianae and H. squamipinna, we also present record values of maximum total length. The LWR allometric coefficient (b) for all species were within the expected range of 2.5–3.5 (Rainer Froese, 2006), with exception of A. maculatus (b= 3.58). This positive allometric coefficient was obtained from a species with an unusual and elongated body shape. Further, factors as differences across populations, gonadal maturity, sample size, range of specimens size, and techniques of preservation might also have influenced the LWR parameters presented here (Rainer Froese, 2006).

In conclusion, this study provides new LWRs information for thirteen demersal fish species that may be a useful tool in future studies aimed at monitoring and understanding fish populations.

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	Family	Species	N	Total length (cm)		Weight (g)		Regression parameters		
				Min	Max	Min	Max	a (95% CI)	b (95% CI)	R^2
Myliobatiformes	Dasyatidae	*Hypanus marianae* Gomes, Rosa & Gadig, 2000	52	16.5	65	1	1930	0.0048 (0.0032 -0.0064)	3.08(2.98-3.28)	0.9532
Pleuronectiformes	Paralichthyidae	*Syacium micrurum* Ranzani, 1842	70	6.5	25	2.4	163.2	0.0065 (0.0055-0.0075)	3.15(3.09-3.20)	0.9942
	Bothidae	*Bothus ocellatus* (Agassiz, 1831) ††	154	5.2	16	1.9	55.3	0.0108 (0.0085-0.0136)	3.03(2.93-3.12)	0.9633
Syngnathiformes	Aulostomidae	*Aulostomus maculatus* Valenciennes, 1841	37	15.3	31.5	3.6	57	0.0002(0.0001-0.0005)	3.58(3.34-3.82)	0.9673
Labriformes	Scaridae	*Cryptotomus roseus* Cope, 1871	25	5.6	10.7	1.8	16.4	0.0051 (0.0039-0.0063)	3.41(3.31-3.504)	0.9857
		Sparisoma radians (Valenciennes, 1840)	50	5.1	20	1.38	132.4	0.0095 (0.0084-0.0108)	3.21(3.16-3.26)	0.9962
Perciformes	Gerreidae	*Ulaema lefroyi* (Goode, 1874)	44	9.5	19.5	7.8	87	0.0037 (0.0019-0.0055)	3.4(3.23-3.567)	0.9832
	Serranidae	*Alphestes afer* (Bloch, 1793) ††	38	13.5	21.4	32.5	136	0.0045 (0.0023-0.0089)	2.67(2.55-2.79)	0.9569
	Haemulidae	*Haemulon squamipinna* Rocha & Rosa, 1999 ††	100	11.1	19.5	18.3	110.9	0.0119 (0.0083-0.0170)	3.05(2.92-3.18)	0.9724
Scorpaeniformes	Scorpaenidae	*Scorpaena bergii* Evermann & Marsh, 1900 ††	11	5	8.5	2	8.2	0.0085 (0.0069-0.0101)	3.41(3.21-3.619)	0.9898
Spariformes	Sparidae	*Calamus calamus* (Valenciennes, 1830)	25	6.5	27.5	5.3	391.4	0.0306(0.0203-0.0460)	2.81(2.68-2.95)	0.9877
Tetraodontiformes	Monacanthidae	*Cantherhines macrocerus* (Hollard, 1853)	15	6	38.6	2.7	1042.4	0.0156(0.0064-0.0725)	3.20(3.03-3.337)	0.9924
		Stephanolepis hispidus (Linnaeus, 1766)	73	7.1	36.9	5.6	364.2	0.0292(0.0199-0.0430)	2.75(2.59-2.91)	0.9862

Table 1- Descriptive statistics and parameters of LWRs for 13 demersal fish species from the northeast Brazilian continental shelf. (††) Novel length-weight relationships.