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Original Article

Length-weight relationship for *Potamotrygon wallacei* (Carvalho, Rosa and Araújo, 2016) caught in the middle Negro River, Barcelos, Brazilian Amazon

Relação peso-comprimento de *Potamotrygon wallacei* (Carvalho, Rosa e Araújo, 2016) capturada no médio Rio Negro, Barcelos, Amazônia Brasileira

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Abstract

This research aimed to estimate the length-weight ratio (LWR) of the stingray *Potamotrygon wallacei*, known locally as the cururu, which was caught in streams and lakes in the middle Negro River region, Amazonas, Brazil. The stingrays were captured during the night (from 11 pm to 1 am) near the shores of streams and lakes, through active search using wooden canoes, head lanterns and scoop nets. The samplings were carried out in November 2017 (5 days), February (8 days), March (3 days) and April (2 days) of 2018, totaling 18 days of sampling. The total fresh weight was measured to 0.1 g of accuracy and the disc width to 0.1 cm accuracy. The parameters *a* and *b* of the equation $W=a.DW^b$ were estimated. This study provides new maximum length data for the cururu stingray.

Keywords: cururu stingray, potamotrygonidae, ornamental fish, elasmobranch.

Resumo

Esta pesquisa teve como objetivo estimar a relação peso-comprimento (LWR) da arraia *Potamotrygon wallacei*, conhecida localmente como cururu, que foi capturada em igarapés e lagos na região do médio Rio Negro, Amazonas, Brasil. As arraias foram capturadas durante a noite (das 23h-1h) nas margens dos igarapés e lagos, por meio de busca ativa utilizando canoas de madeira, lanternas de cabeça e puçás. As coletas foram realizadas nos meses de novembro de 2017 (5 dias), fevereiro (8 dias), março (3 dias) e abril (2 dias) de 2018, totalizando 18 dias de amostragem. Foram medidos o peso fresco total com precisão de 0,01 g e a largura do disco com precisão de 0,1 cm. Os parâmetros *a* e *b* da equação $W= a.DW^b$ foram estimados. Este estudo prover novos dados de comprimento máximo para a arraia cururu.

Palavras-chave: arraia cururu, potamotrygonidae, peixe ornamental, elasmobrânquio.

1. Introduction

The Neotropical freshwater stingrays belong to the subfamily Potamotrygoninae and are the only group of elasmobranchs that are exclusive to freshwater (Carvalho et al., 2016b). Composed of 38 species distributed in four genera (Silva and Loboda, 2019), Potamotrygoninae are found in almost all major river basins in South America (Carvalho, 2016), with maximum species diversity in the Amazon (28 species). Their fascinating and varied dorsal colors make them desirable highly to aquarists and a target species in the international trade of ornamental fish (Fontenelle and Carvalho, 2016).

Despite their great ornamental potential, this group of stingrays has intrinsic characteristics in common with most elasmobranchs, such as slow growth, late sexual maturation and low fecundity, which make them vulnerable to overfishing (Carrier et al., 2004; Charvet-Almeida et al., 2005). The cururu stingray (*Potamotrygon wallacei* Carvalho, Rosa and Araújo, 2016) is a small species, which is endemic to the middle Negro River and can be found mainly in the areas of shoreline of the flooded forests (igapós); this being its preferred habitat (Duncan et al., 2016; Araújo, 2021).

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The Negro River Basin is the second largest sub-basin of the Amazon basin (Goulding et al., 2003) and possesses 1165 described fish species (Beltrão et al., 2019). Despite this high diversity, most of the work on length-weight ratios (LWR) focuses on Osteichthyes (Lubich et al., 2020, 2021; Olentino et al., 2021, 2023), though for freshwater stingrays this type of study is practically non-existent. Only one publication is known, which is for *Potamotrygon falkneri* Castex and Maciel (1963) that were caught in the Miranda River basin, in the state of Mato Grosso do Sul, Brazil (Vicentin et al., 2012).

The LWR is useful for several purposes, such as estimating indirect growth, body condition and biomass of fish (based on length frequency distribution), in order to understand their life cycle (Camara et al., 2011; Froese, 2006; Le Cren, 1951; Oliveira et al., 2020). Thus, the present study describes the length-weight ratio (LWR) of the cururu stingray (*Potamotrygon wallacei*) caught in streams and lakes in the middle Negro River region, Amazonas, Brazil, where so far, no studies have yet been published on the subject.

2. Material and Methods

The study was conducted in the middle Negro River, in different streams and lakes in the Mariuá archipelago (Figure 1), which is part of the municipality of Barcelos, Amazonas, Brazil. The samplings were authorized by the Chico Mendes Institute for Biodiversity Conservation (ICMBio, Licence Nº 9324-1) and by the UFAM Ethics Committee on the Use of Animals – CEUA/UFAM (CEUA, Licence Nº 031/2015).

The collections were carried out in November 2017 (5 days), February (8 days), March (3 days) and April (2 days) of 2018, totaling 18 days of sampling. The stingrays were captured during the night (from 11 pm to 1 am) near the banks of streams and lakes, through active search using wooden canoes, head lanterns and scoop nets. The sampling locations are shown in Figure 1.

After the capture, the stingrays were kept in artisanal pens built on the shores of the lakes of the collection site itself. In the morning, the specimens were measured in the field and identified by specialists with the use of ichthyological keys (Carvalho et al., 2016a). The total fresh weight was obtained with an accuracy of 0.01 g and the width of the disc was measured to accuracy of 0.1 cm. All the animals were photo-documented and an exemplary testimony was deposited in the fish collection of the Ichthyology Laboratory of the Federal University of Amazonas (voucher: UFAM-459).

Parameters of the length-weight relationship were estimated using a non-linear regression model with the Levenberg-Marquardt algorithm $W=a.DW^b$ (Le Cren, 1951), where, W= weight (g), DW = disk width (cm), *a*= intercept, and *b*= allometric coefficient. The 95% confidence intervals (CI) were determined for parameters *a* and *b* (Froese,

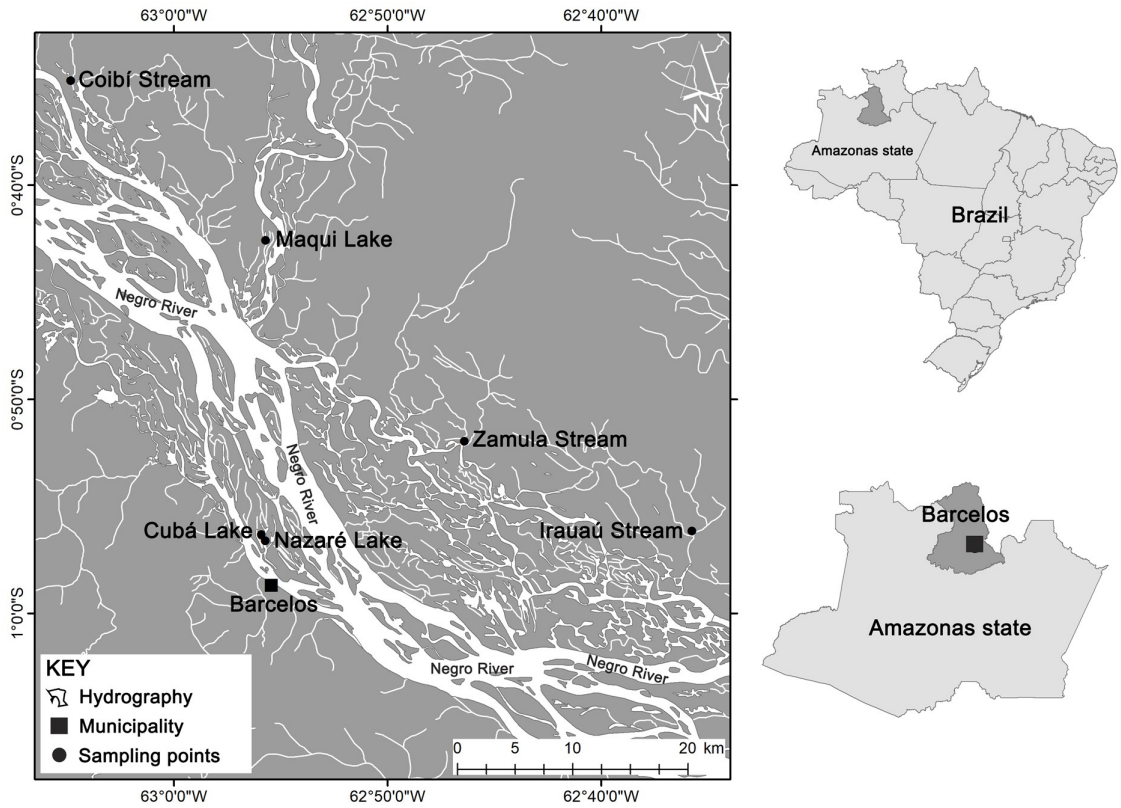

Figure 1. Location map of sampling sites, middle Negro River, in the municipality of Barcelos, Amazonas state, Brazil.

Table 1. Parameters of length-weight relationships (LWR) and weight and disk width ranges for the cururu stingray (*Potamotrygon wallacei* Carvalho, Rosa and Araújo, 2016) collected in streams and lakes in the middle Rio Negro, Brazilian Amazon.

Sex	N	Weight range (g)	Disk width range (cm)	LWR parameters			Bayesian LWR	
				a **(95% CL)**	***b*** **(95% CL)**	R^2	***a*** **(95% CL)**	***b*** **(95% CL)**
Female	75	110-1.203	13.2-28.6	0.0586* (0.0394-0.0778)	2.9285 (2.8223-3.0346)	0.996	0.0100 (0.0024-0.0410)	3.04 (2.81-3.27)
Male	36	57-682	10.8-24.5	0.0409 (0.0133-0.0685)	3.0323 (2.8067-3.2578)	0.981		
Both	111	57-1.203	10.8-28.6	0.0431 (0.0276-0.0585)*	3.0225 (2.9051-3.1399)	0.989		

Key: N = sample size; *a* = intercept; *b* = slope; R^2 = coefficient of determination of the length-weight relationship; 95% CL = 95% confidence limits. *Value above 95% confidence interval of Bayesian prediction.

2006). Since nonlinear estimation yields more consistent estimates than least squares regression (Bitar et al., 2016; Tribuzy-Neto et al., 2018). Disk width and weight data were plotted for visual inspection of outliers (Froese, 2006) and extreme outliers were removed from the analyses.

3. Results

The length-weight relationships calculated for cururu stingray (*P. wallacei*) (Table 1), showed the coefficient of determination (r^2) ranged from 0.981 to 0.996, *a* values ranged from 0.0586 to 0.0409, and *b* values ranged from 2.9285 to 3.0323. In the present study, maximum expected disk width new maximum disk width for female were recorded (28.6 cm) and male (24.5 cm). Thus, we obtained LWR data for males, females and both sexes. The allometric coefficient (*b*) for males and females of cururu stingray ranged from 2.9285 to 3.0323.

4. Discussion

There are few reports on the LWRs of freshwater stingrays (Vicentin et al., 2012; Duncan et al., 2016; Freire, 2015). According to Duncan et al. (2016) and Freire (2015), females reach larger sizes, due to the coelomic space, to accommodate the embryos. As expected, our data also show that adult females reach larger sizes than males, in agreement with Sabinson et al. (2014) for *Pimelodus maculatus*, where females seem to have a greater investment in reproductive tissue. Therefore, within the range found by Froese (2006) i.e., between 2.70 to 3.40, however, smaller than for *Potamotrygon falkneri* (3.41 to 4.13) as reported by Vicentin et al. (2012), and close to the values found by Freire (2015) and Duncan et al. (2016), ranging from 2.863-3.0488, for individuals of the species captured in the same region.

The values of *a* and *b* did not vary within the range available in the FishBase database (www.fishbase.org), whose estimates are made using Bayesian prediction (Froese et al., 2014). However, the *a* value obtained for males was the only one that showed itself within the available range. This difference can be explained, since the estimate available in FishBase is performed using the total length and based on all LWR estimates for species of similar body shape (Froese and Pauly, 2021; Froese et al., 2014). These differences were also indicated for teleost fish of the Negro River Basin (Olentino et al., 2023; Lubich et al., 2020, 2021; Olentino et al., 2021; Barros et al., 2018; Corrêa et al., 2016; Quara de Carvalho Santos et al., 2012). The studies by Duncan et al. (2016) and Freire (2015), which provide information on the *a* and *b* parameters for *P. wallacei*, do not show the confidence intervals, and comparison is not possible, however the integer values were close.

It is important to highlight that, in the case of stingrays, it is very common for them to present intentional mutilations on the tail caused during fishing, as well as those caused by predators (Araújo, 2021; Duncan et al., 2016). Therefore, total length is not a recommended linear measure for length-weight ratio estimates in Potamotrygoninae.

The data reported in this work are essential for future studies regarding the management, conservation and ecology of natural resources (Lubich et al., 2021), since this work brings new information about the LWR of a species of stingray that is endemic to the Negro River basin. As such, when associated with other information, such as age and growth, they can help in the management of fisheries of these species, which have high vulnerability (90 out of 100) (Cheung et al., 2005; Froese and Pauly, 2021)

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