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Relaciones longitud-peso de peces ornamentales de lagos de llanuras aluviales en la cuenca del río Solimões (Iranduba, Amazonas, Brasil)

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ABSTRACT

This research reports the LWR of ornamental fish from floodplain lakes of the Solimões River basin. The fish were caught in the Paciência island (a fluvial island) in two lakes Sacambú and Cacau using purse seine 7 m × 4 m and mesh size = 3 mm, once during the flood in June 2017 and dry in January 2018. The specimens captured were anesthetized using eugenol 15 mg·L^{-1}, fixed formalin 10% and stored ethanol 70% after 10 days. This study provides the LWR parameters for the species *Anablepsoides micropus, Anchoviella jamesi*, *Cichlasoma amazonarum, Heros efasciatus, Ctenobrycon hauxwellianus, Copella nattereri* and *Hemigrammus levis.* The parameter a ranged from 0.0092 to 0.0229, *b* ranged from 2.78 to 3.50 and the R^2 ranged from 0.985 to 0.998. The results represent new information about ornamental fish from floodplain lakes, with new LWR for five species that are not present in FishBase data set and probably are new for science. This study is preliminary and much work needs to be done especially in the Solimões River floodplain areas and with our research we hope to encourage new studies in the region.

Keywords: Amazonia, Amazonian floodplains, Freshwater fish, Ichthyofauna.

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RESUMEN

Esta investigación informa el LWR de peces ornamentales de lagos de llanuras aluviales de la cuenca del río Solimões. Los peces fueron capturados en la isla de Paciência (una isla fluvial) en dos lagos Sacambú y Cacau utilizando cerco 7 m × 4 m y tamaño de malla = 3 mm, una vez durante la inundación en junio de 2017 y seco en enero 2018. Las muestras capturadas se anestesiaron con eugenol 15 mg · L^{-1}, se fijaron formalina al 10% y se almacenaron etanol al 70% después de 10 días. Este estudio proporciona los parámetros LWR para las especies *Anablepsoides micropus, Anchoviella jamesi, Cichlasoma amazonarum, Heros efasciatus, Ctenobrycon hauxwellianus, Copella nattereri* y *Hemigrammus levis*. El parámetro *a* varió de 0.0092 a 0.0229, *b* varió de 2.78 a 3.50 y el R2 varió de 0.985 a 0.998. Los resultados representan nueva información sobre peces ornamentales de lagos de llanuras aluviales, con nuevos LWR para cinco especies que no están presentes en el conjunto de datos FishBase y probablemente son nuevos para la ciencia. Este estudio es preliminar y queda mucho trabajo por hacer, especialmente en las áreas de la llanura aluvial del río Solimões y con nuestra investigación esperamos alentar nuevos estudios en la región.

Palabras clave: Amazonia, llanuras aluviales amazónicas, Peces de agua dulce, Ictiofauna.

INTRODUCTION

The Amazon is the source of many species of ornamental fish, extracted from nature, found in the world aquarium market (1). In addition, has the most diversified ichthyofauna in the world (2) which comprises small-sized species living in lakes, floodplain and small streams (3).

Because of this diversity, studies about length-weight relationships (LWR) of ornamental fish have been more frequent, highlighting the studies by Santos et al (4), Gaspar et al (5), Barros et al (6), Freitas et al (7) and Salvador et al (8). Nevertheless, still there is a lack of information and few studies were conducted in the Solimões River basin about the LWR of ornamental fish species from floodplain lakes.

The studies of LWR have a wide application, despite being easily obtained many data were not published for several species. These data become very relevant, especially in the Amazon, where fishes represent a relevant economic source, either commercial or ornamental (9).

The LWR are important in management and conservation because they are helpful for the evaluation of fish populations when only length measurements exist and enable the computation of condition indexes and the comparison of species growth (between sexes, seasons or regions) (10). In addition, relationships of total, standard and fork lengths of fishes are also important for comparative growth studies (11).

Given the information presented, the objective of the research was to determine the LWR of the ornamental fish from floodplain lakes in the Solimões River.

MATERIALS AND METHODS

The Paciência island is a fluvial island located in the rural area of the city of Iranduba, in lower Solimões River, far away about 45 km from the confluence with the Negro River, Amazonas, Brazil (Figure 1).

The samples were obtained in two lakes: Sacambú and Cacau. The fish were caught in mixed floating meadows during the flood in June 2017 and dry in January 2018, once in each season, using purse seine (7 m × 4 m, mesh size = 3 mm). The definition of the hydrological cycle seasons followed Bittencourt and Amadio (12).

The specimens captured were anesthetized using eugenol (15 mg·L^{-1}), fixed (formalin 10%) and stored (ethanol 70%) after 10 days. The Biometry (Standard Length and Total Weight) was realized at the Fishery Ecology Laboratory of the Federal University of Amazonas, using precision balance (0.001 g) and ichthyometer (0.1 cm).

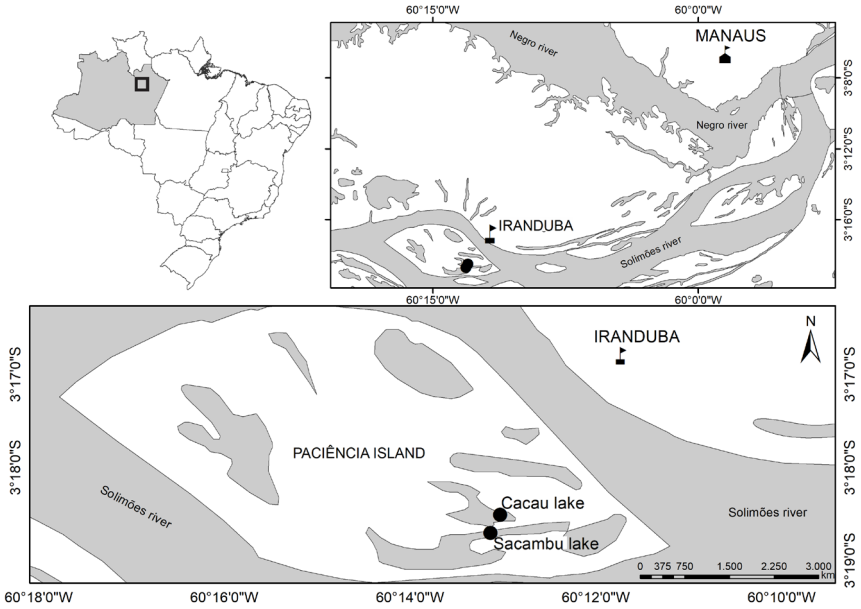

Figure 1. Map of Paciência Island, Iranduba - Amazonas.

The values were determined by non-linear estimation using the algorithm of Levenberg-Marquardt, a technique widely adopted in a broad spectrum of disciplines and that provides solution to problem called Nonlinear Least Squares Minimization (13), in the equation: $TW = a \times SL^b$ (14), TW (total weight), SL (standard length), *a* (intercept) and *b* (allometric coefficient). Plots of TW and SL were used to exclude outliers (10). After that the values of *a* and *b* were compared to know if they were within the confidence limit of Bayesian LWR available on Fishbase. (15). The species was stored in the Fishery Ecology Laboratory/UFAM. The ethics committee on the use of animals of the Federal University of Amazonas (Nº 038/2017) approved the study.

RESULTS

The species examined were *Ctenobrycon hauxwellianus* and *Hemigrammus levis* (Characidae), *Cichlasoma amazonarum* and *Heros efasciatus* (Cichlidae), *Anchoviella jamesi* (Engraulidae), *Copella nattereri* (Lebiasinidae) and *Anablepsoides micropus* (Rivulidae). The coefficient b varied from 2.78 from *Copella nattereri,* to 3.50 for *C. amazonarum* and *H. efasciatus*. Coefficient of determination (R^2) varied from 0.985 *C. hauxwellianus, H. levis and A. jamesi*, to 0.998 for *C. amazonarum*. The table 1 summarizes the LWR parameters for all species.

Table 1. Sample size (N), Total weight (TW) and Standard length (SL) ranges, LWR parameters (*a* and *b*), 95% confidence Limits (CL) of each parameter and coefficient of determination (R^2) of the studied species.

Family	Species	N	TW (g) (min-max)	SL (cm) (min-max)	a ($CL_{95\%}$ a)	b ($CL_{95\%}$ b)	R^2	Bayesian length-weight	
								a	b
Characidae	*Ctenobrycon hauxwellianus* (Cope, 1870)	67	0.309–2.76	2.6–5.0	0.0173 (0.0134–0.0213)	3.20* (3.04–3.35)	0.985	0.0120 (0.0063–0.0229)	3.02 (2.85–3.19)
	Hemigrammus levis Durbin, 1908	28	0.022–0.404	1.2–3.2	0.0104 (0.0070–0.0138)	3.20 (2.89–3.51)	0.985	0.0128 (0.0060–0.0275)	3.05 (2.87–3.23)
Cichlidae	*Cichlasoma amazonarum* Kullander, 1983	15	0.096–5.37	1.6–4.7	0.0228 (0.0165–0.0292)	3.50* (3.32–3.69)	0.998	0.0195 (0.0086–0.0441)	3.07 (2.88–3.26)
	Heros efasciatus Heckel, 1840	48	0.035–0.498	1.1–2.4	0.0229 (0.0214–0.0243)	3.50* (3.42–3.59)	0.997	0.0316 (0.0143–0.0696)	3.00 (2.82–3.18)
Engraulidae	*Anchoviella jamesi* (Jordan & Seale, 1926)	12	1.22–1.58	4.8–5.2	0.0092 (0.0036–0.0148)	3.12 (2.74–3.50)	0.985	0.0052 (0.0024–0.0111)	3.13 (2.96–3.30)
Lebiasinidae	*Copella nattereri* (Steindachner, 1876)	11	0.114–0.483	2.4–3.8	0.0118 (0.0076–0.0160)	2.78** (2.49–3.07)	0.992	0.0046 (0.0018–0.0121)	3.14 (2.91–3.37)
Rivulidae	*Anablepsoides micropus* (Steindachner, 1863)	17	0.021–1.13	1.6–4.4	0.0100 (0.0060–0.0141)	3.22 (2.93 - 3.52)	0.992	0.0102 (0.0041–0.0252)	3.05 (2.83–3.27)

* = Value above of the Bayesian limits. ** = Value below of the Bayesian limits.

DISCUSSION

The *b* values were according with the limits suggested by Froese (2.5 to 3.5) (10). When *b* values are out of range (2.5 to 3.5) it means that, the samples have narrow size ranges and that the mean *b* values do not show a normal distribution (16).

The species *C. hauxwellianus, C. amazonarum* and *H. efasciatus* presented values of *b* above of the confidence limit of Bayesian estimates, and *C. nattereri* presented value of *b* below of the confidence limit of Bayesian estimates.

The difference between the values obtained and Bayesian estimates occurs because the values present in FishBase arise from estimates of different species belonging to the same family or genus and with the same body shape (17).

These differences also may be explained by environmental and physiological factors such as seasonality, gonadal maturity, degree of stomach fullness and even the preservation technique and sample size (18,19).

Gaspar et al (5) presented the value of *b* = 3.003 for the species *C. hauxwellianus* which is different from our study *b* = 3.20. The sample size (N = 67) and the length class (2.6–5.0 cm) may explain the difference between the values, since in our study these values were better distributed.

The species *H. levis* in our study had *b* = 3.20, very similar to the value found by Salvador et al (8) *b* = 3.179. One possible explication may be that the length class of the studies present very similar values, our study (1.2–3.2 cm) and (1.3–4.0 cm) (8).

The data used were collected from formalin fixed samples (20,21), this occurred because of the difficulty of the identification of small fishes correctly in the field. Following Barros et al (6), we suggest that this information is very necessary for future research about ornamental fish from floodplain lakes, since there is few information available in the literature.

The results represent new information about ornamental fish from floodplain lakes, with new LWR for five species that are not present in FishBase data set and probably are new for science. This study is preliminary and much work needs to be done especially in the Solimões River floodplain areas and with our research we hope to encourage new studies in the region.

Conflict of interest

No conflicts by the authors

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