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LENGTH-WEIGHT RELATIONSHIPS FOR 14 FISH SPECIES OF NAPO RIVER BASIN, PERUVIAN AMAZON

James Raul GARCIA-AYALA[1], Eduardo Meneguzzi BRAMBILLA[2*], Gianmarco Silva DAVID[3], Homero SÁNCHEZ[4]

1 Laboratório de Ictiologia, Departamento de Zoologia, Universidade Estadual Paulista "Júlio de Mezquita Filho", Botucatu, SP, Brasil.

2 Departamento de Zoologia, Universidade Estadual Paulista "Júlio de Mesquita Filho", Botucatu, SP, Brasil.

3 Agência Paulista de Tecnologia do Agronegócio (APTA/SAA), Jaú, SP, Brasil.

4 Instituto de Investigaciones de la Amazonía Peruana (IIAP), Programa para el Uso y Conservación del Agua y sus Recursos (AQUAREC), Iquitos, Perú.

* Electronic mail: eduardo.brambilla@gmail.com

ABSTRACT

This work presents the length-weight relationships of 14 species of fish of the Napo River basin. Fish collections were carried out between 2012 and 2014, using gill nets and seine. A total of 1896 specimens, belonging to 14 species and five orders were analyzed. The allometric coefficient *b* ranged from 2.69 to 3.78. A new record of length-weight relationship is presented for *Curimata cisandina* (Allen, 1942). The comparisons with other Amazonian studies indicated differences in the parameters *a* and *b* of LWR with this study for the species *Triportheus angulatus* (Spix & Agassiz, 1829), *Mylossoma duriventre* (Cuvier, 1818), *Roeboides myersii* Gill, 1870 and *Pellona castenaena* Valenciennes, 1847 and only parameter *b* for *Psectrogaster amazonica*. The results presented in this work contribute to a better knowledge of fish resources in the region of the Peruvian Amazon, especially in the Napo River basin.

KEYWORDS: conservation, fishery, morphometric parameters, population biology.

RELACIÓN LONGITUD-PESO DE 14 ESPECIES DE PECES DE LA CUENCA DEL RÍO NAPO, AMAZONIA PERUANA

RESUMEN

Este trabajo presenta la relación longitud-peso de 14 especies de peces de la cuenca del río Napo. La colecta de peces se realizó entre 2012 y 2014, utilizando redes de enmalle y cerco. Se analizaron un total de 1896 ejemplares, pertenecientes a 14 especies y cinco órdenes. El coeficiente alométrico b osciló entre 2,69 y 3,78. Se presenta un nuevo registro de la relación longitud-peso para *Curimata cisandina* (Allen, 1942). Las comparaciones con otros estudios amazónicos indicaron diferencias en los parámetros a y b de LWR para las especies *Triportheus angulatus* (Spix & Agassiz, 1829), *Mylossoma duriventre* (Cuvier, 1818), *Roeboides myersii* Gill, 1870 y *Pellona castenaena* Valenciennes, 1847 y único parámetro b para *Psectrogaster amazonica*. Los resultados presentados en este trabajo contribuyen a un mejor conocimiento de los recursos pesqueros en la región de la Amazonía peruana, especialmente en la cuenca del río Napo.

PALABRAS CLAVE: conservación, pesca, parámetros morfométricos, biología de poblaciones.

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INTRODUCTION

One of the main human economic activities in the Amazonian fluvial system is the fishery, consisting of a source of income and food for a great part of its populations (Santos & Santos, 2005). The Peruvian Amazon represents the majority of Peru's freshwater fish diversity, with more than 800 species of fishes (Ortega & Hidalgo, 2008). This factor explains the fish stock of approximately 80 000 ton per year, generating annual incomes of about 80 million USD (Garcia *et al*., 2009), indicating that fishery is one of the most important economic activities of this region (Tello-Martin & Bayley, 2001).

The fishery in the Peruvian Amazon is difficult to manage because of its multi-specific character, scarce biological information on most of the target species, and difficulty in identifying stocks (Tello-Martin & Bayley, 2001; Garcia *et al*., 2009). To improve fisheries management and access fish stocks a useful tool is the length-weight relationship (LWR) (Froese, 2006; Brambilla *et al*., 2015; Garcia-Ayala *et al*., 2017). It can be used for identifying the reproductive cycle and feeding conditions of fish populations (Wootton, 1998; Camara *et al*., 2011; Freitas *et al*., 2014), estimate fish weight based on the length and vice versa and obtain the body conditions of the sampled fish specimens (Froese, 2006; Freitas *et al*., 2017). Thus, this study presents information about the LWR of 14 fish species from the upper Napo River.

MATERIAL AND METHODS

The samplings were carried the Napo river and its main tributaries, Arabela and Curaray rivers, Amazon basin, Peru, between coordinates: 01°35'24.36″S, 75°25'11.96″W and 02°26'17.77″S, 73°56'40.17″W. Samples were performed in 2012, 2013 and 2014 during dry and rainy seasons in 18 sampling points located in lentic areas (for more information about sampling points, see Sanchez *et al*., 2013 and García-Vásquez *et al*., 2014). Fish collections were performed using gillnets (mesh size 2.5-5 cm) and seine (mesh size 1 cm). Fish species separation, identification, cataloging and deposition were carried out in the fish taxonomy laboratory of the Instituto de Investigaciones de la Amazonía Peruana (Peruvian Amazon Research Institute), based on reference guides (Nelson, 1994; Reis *et al*., 2003). All information was checked against Froese & Pauly (2018).

Each specimen was measured for total length (TL) and weighed (WT). Voucher specimens were deposited at the ichthyology collection of the Instituto de Investigaciones de la Amazonía Peruana - IIAP (Iquitos-Peru), under the codes: CIIAP 949, CIIAP 950, CIIAP 951, CIIAP 952, CIIAP 953, CIIAP 954, CIIAP 955, CIIAP 956, CIIAP 957, CIIAP 958, CIIAP 959, CIIAP 960, CIIAP 961, CIIAP 962, CIIAP 963. The LWRs were determined by linear regression: log WT = log a + b log SL and outliers were removed using a log SL log WT plot (Froese, 2006).

The parameters *a* and *b* of each species were compared with other studies that have been performed in the Amazon basin (Ruffino & Isaac, 1995; Giarrizzo *et al*., 2011, 2015; Freitas *et al*., 2014; Abdon-Silva *et al*., 2015; Cella-Ribeiro *et al*., 2015).

RESULTS

A total of 1896 specimens representing 14 different species belonging to 12 families and five orders were analyzed in the study. The most frequent order was Characiformes (eight species), followed by Perciformes (two species) and Siluriformes (two species). The orders Clupeiformes and Pleuronectiformes were represented only by one species each.

Table 1. Length-weight relationships for 14 fish species of Napo River, Peruvian Amazon. N: number of individuals; TL: total length; WT: total weight; *a* and *b* refer to equation W = *a*SL*b*, in g and cm with range of 95% confidence limits; R^2: correlation coefficient and published *a* and *b* values.

ORDER/Family/Species	N	TL range (cm)	WT range (g)	Estimated parameters		R^2	Published Values		Source
				a (95% CI)	*b* (95% CI)		*a*	*b*	
CHARACIFORMES									
Triportheidae									
Triportheus angulatus (Spix & Agassiz, 1829)	423	4.5-26.6	1.4-195.0	0.0083 (0.0070-0.0095)	3.05 (3.03-3.07)	0.963	0.0248 - 0.0273	2.88 - 2.92	Cella-Ribeiro et al. (2015)
Curimatidae									
Psectrogaster amazonica Eigenmann & Eigenmann, 1889	264	9.0-21.9	17.0-172.0	0.0311 (0.0236-0.0386)	2.77 (2.67-2.87)	0.921	0.0241 - 0.0283	3.05 - 3.12	Cella-Ribeiro et al. (2015)
Curimata cisandina (Allen, 1942)	83	5.0-22.7	2.6-194.0	0.0155 (0.0128-0.0182)	3.01 (2.94-3.08)	0.989	-	-	-
Erythrinidae									
Hoplias malabaricus (Bloch, 1794)	240	13.5-44.0	25-973.0	0.0110 (0.0084-0.0136)	2.97 (2.89-3.06)	0.953	0.0107 - 0.0128	2.98 - 3.19	Ruffino & Isaac (1995) Cella-Ribeiro et al. (2015)
Prochilodontidae									
Prochilodus nigricans Spix & Agassiz, 1829	278	6.8-33.7	24.0-227.0	0.0102 (0.0081-0.0123)	3.09 (3.01-3.17)	0.955	0.0094–0.0321	2.96 - 3.08	Cella-Ribeiro et al. (2015) Giarrizo et al.(2015)
Serrasalmidae									
Mylossoma duriventre (Cuvier, 1818)	177	7.3-27.0	4.0-620.0	0.0024(0.0017-0.0031)	3.78 (3.65-3.90)	0.955	0.0278 - 0.0307	3.10 - 3.14	Cella-Ribeiro et al. (2015)
Serrasalmus rhombeus (Linnaeus, 1766)	74	8.0-28.0	7.0-497.0	0.0057 (0.0038-0.0076)	3.40 (3.25-3.55)	0.966	0.0034 - 0.0147	3.24 - 3.45	Giarrizo et al.(2011)
Characidae									
Roeboides myersii Gill, 1870	68	5.0-20.0	2.0-86.0	0.0246 (0.0184-0.0308)	2.69 (2.59-2.80)	0.975	0.0100 - 0.0132	3.19 - 3.30	Cella-Ribeiro et al. (2015)

CLUPEIFORMES									
Pristigasteridae									
Pellona castelnaeana Valenciennes, 1847	76	26.0-66.6	112.0-3095.0	0.0021 (0.0012-0.0030)	3.37 (3.22-3.53)	0.962	0.0042-0.0112	3.08-3.21	Ruffino & Isaac (1995) Cella-Ribeiro et al. (2015)
PERCIFORMES									
Cichlidae									
Cichla monoculus Spix & Agassiz, 1831	37	11.3-39.0	17.0-834.0	0.0080 (0.0053-0.0108)	3.17 (3.04-3.30)	0.986	0.0085	3.15	Ruffino & Isaac (1995)
Sciaenidae									
Plagioscion squamosissimus (Heckel, 1840)	54	17.0-41.0	64.0-786.0	0.0136 (0.0085-0.0187)	2.96 (2.82-3.10)	0.972	0.0053-0.0374	2.86-3.25	Ruffino & Isaac (1995) Freitas et al. (2014) Abdon-Silva et al. (2015) Cella-Ribeiro et al. (2015) Giarrizo et al. (2015)
SILURIFORMES									
Auchenipteridae									
Ageneiosus ucayalensis Castelnau, 1855	57	15.0-39.9	24.0-390.0	0.0068 (0.0039-0.0096)	2.92 (2.75-3.10)	0.955	0.0044-0.0223	2.68-3.10	Cella-Ribeiro et al. (2015) Giarrizo et al. (2011. 2015) Freitas et al.. 2014
Doradidae									
Oxydoras niger (Valenciennes, 1821)	40	17.4-72.5	70.0-4300.0	0.0269 (0.0130-0.0407)	2.77 (2.57-2.97)	0.954	0.0024-0.0246	2.89-3.48	Cella-Ribeiro et al. (2015) Giarrizo et al. (2015)
PLEURONECTIFORMES									
Achiridae									
Achirus achirus (Linnaeus, 1758)	25	8.9-25.9	3.0-315.0	0.0037 (0.0015-0.0060)	3.51 (3.18-3.83)	0.956	-	-	-

N: number of individuals; TL: total length; WT: total weight; *a* and *b* refer to equation W = *a*SL*b*, in g and cm with range of 95% confidence limits; R^2: correlation coefficient.

Table 1 summarizes the LWRs. According to Froese & Pauly (2018) this study reports new maximum total lengths for two species (*Curimata cisandina* (Allen, 1942) and *Ageneiosus ucayalensis* Castelnau, 1855), new maximum total weight for one species (*A. ucayalensis*), a new record of weight for one species (*C. cisandina*) and new LWR records for one species (*C. cisandina*).

DISCUSSION

Normally fish species presenting values of parameter *b* between 2.5 and 3.5 (Froese, 2006). In this study, only *Mylossoma duriventre* (Cuvier, 1818) (b = 3.78) and *Achirus achirus* (Linnaeus, 1758) (b = 3.51) had estimated values for *b* above this range, probably because of their rounded shape.

The comparisons with Ruffino & Isaac (1995); Giarrizzo *et al*. (2011, 2015); Freitas *et al*. (2014); Abdon-Silva *et al*. (2015); Cella-Ribeiro *et al*. (2015) indicated differences in the parameters *a* and *b* of LWR with this study for the species *Triportheus angulatus* (Spix & Agassiz, 1829), *M. duriventre*, *Roeboids myersii* Gill, 1870 *and Pellona castenaena* Valenciennes, 1847 and only parameter *b* for *Psectrogaster amazonica* Eigenmann & Eigenmann, 1889*.* These differences can be explained by several factors: environmental conditions; food availability (Fulton, 1904); spatial and temporal variation; biological factors and also to the characteristics of the sampling (number of individuals sampled, size ranges, presence of juveniles, preservation techniques, etc.) (Torres *et al*., 2012).

Therefore, this study constitutes background information useful for fishery management and conservation of Peruvian Amazon ichthyofauna, complementing Garcia-Ayala *et al*. (2017) who analyzed other seven fish species of Napo river.

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