






## Length–weight relation of fish species occurring on along Auati-Paraná channel in middle Solimões, Amazonas, Brazil


Jomara Cavalcante de Oliveira<sup>1,2</sup>, Jonas Alves de Oliveira<sup>2</sup>, Danielle Pedrociane Cavalcante Rossato<sup>2</sup>, Alexandre Pucci Hercos<sup>2</sup>


1. Secretaria de Estado de Educação e Qualidade de Ensino do Amazonas - SEDUC - Amazonas. Rua Waldomiro Lustoza, 250 - Japiim II - CEP: 69076-830, Manaus, AM, Brasil.  
 [jomaracoliveira@gmail.com](mailto:jomaracoliveira@gmail.com)  <http://lattes.cnpq.br/6749686635482257>  <http://orcid.org/0000-0002-4065-694X>


2. Grupo de Pesquisa em Ecologia e Biologia de Peixes, Instituto de Desenvolvimento Sustentável Mamirauá, Estrada do Bexiga, 2584, Fonte Boa, CEP 69553-225, Tefé, Amazonas, Brasil.


 [jonas.alves@mamiraua.org.br](mailto:jonas.alves@mamiraua.org.br)


 <http://lattes.cnpq.br/8149970433349271>


 <http://orcid.org/0000-0002-4065-694X>


 [danielle@mamiraua.org.br](mailto:danielle@mamiraua.org.br)

 <http://lattes.cnpq.br/4305484803088470>

 <http://orcid.org/0000-0003-4746-1843>

 [alexandre.hercos@mamiraua.org.br](mailto:alexandre.hercos@mamiraua.org.br)

 <http://lattes.cnpq.br/4281657711206903>

 <http://orcid.org/0000-0002-6287-5246>

### ABSTRACT

Length–weight relationships were estimated for 47 fish species for Auati-Paraná channel in Central Brazilian Amazonia. Sampling was carried quarterly during 2013 year, using seine net (3 mm stretch mesh size) for the collections in floating vegetation and hand nets in litter of the littoral zone. This study provides new information on the length–weight relationships for 31 species, in addition, provides the new maximum standard lengths for six species.

**Keywords:** Ichthyofauna; Neotropical fishes; Solimões River Basin.

### Relação peso-comprimento das espécies de peixes que ocorrem ao longo do Auati-Paraná no médio Solimões, Amazonas, Brasil

### RESUMO

As relações peso-comprimento foram estimadas para 47 espécies de peixes do canal Auati-Paraná na Amazônia Central Brasileira. As amostragens foram realizadas trimestralmente durante o ano de 2013, sendo utilizadas redes de arrasto (malha de 3mm) para as coletas em vegetação flutuante e puças em folhicho da zona litoral. Este estudo fornece novas informações sobre as relações de peso-comprimento para 31 espécies, além de apresentar novos registros de comprimento padrão máximo de seis espécies.

**Palavras-chave:** Ictiofauna, Peixes Neotropicais, Bacia do Rio Solimões.

Ecological parameters such as the length–weight relation (LWR), from the first step in obtaining estimates on population growth for fish communities, and form a key element in fish biology and ecology research, potentiating fish species biomass estimations from length observations (FROESE et al. 2011). The relationship between these variables, generates information central to the development of models of fish population dynamics (FROESE, 2006), life histories comparisons between fish species and between regions, and reveals biogeographical relationships, as well as providing baseline information for fish stock management strategies and conservation (FROESE et al. 2011; BARROS et al. 2018; CAMARGO et al. 2018; SILVA et al. 2019).

This paper describes the length-weight relationship (LWR) of the 47 species of the fishes from the Auati-Paraná channel, Middle Solimões Basin.

Sampling was carried quarterly during 2013 year, at Auati-Paraná region (2°03'38"S / 66°19'03" W) that is a complex of lakes of different sizes and habitats, and an important link between Solimões and Japurá rivers, Amazonas State, Brazil. Sampling was conducted with seine net (3 mm stretch mesh size) for the collections in floating vegetation and hand nets in litter of the littoral zone. Fish specimens were later identified to species level by consulting the literature (e.g., GERRY, 1977; QUEIROZ, 2013) and specialists were consulted. All scientific names

authority and year of description follow Fricke et al. (2020), and all species relationships were checked using Fishbase (FROESE; PAULY, 2020).

The fishes were measured and weighed nearest 0.01 cm and 0.01 g precision. The weight-length relation species were estimated using the equation  $W = aSL^b$  (LE CREN, 1951), where  $Wt$  is the total weight in grams;  $L$  is the total length in centimeter;  $a$  is the linear coefficient of the equation; and  $b$  is the growth coefficient of each species. The equation ( $Wt = aSL^b$ ) was converted into the natural logarithmic form ( $\ln W = \ln a + b \ln SL$ ) and parameters  $a$  (regression intercept) and  $b$  (slope) were calculated using regression analysis (KING, 2007). Presence of outliers for each species was identified graphically using log TL vs log WT plots (FROESE; BINOHLAN, 2000), and obvious outliers removed.

A total of 3,543 specimens from 47 species in 18 families were analyzed. For *Trachelyopterus porosus* (Eigenmann & Eigenmann, 1888) there no records of maximum standard length. All regressions were significant in all species ( $p < 0.001$ ), with the coefficient of determination ( $r^2$ ) ranging from 0.97 to 0.99. The LWR allometry coefficient ( $b$ ) of the LWR ranged from 2.019 for *Gymnotus jonas* Albert & Crampton, 2001 to 3.562 for *Pyrrhulina semifasciata* Steindachner, 1876. The median value for  $b$  was 3.07, with 50% of the values between 2.86 and 3.27 (Table 1).

**Table 1.** Length – weight relation of 47 fishes species sampled along the Auati-Paraná channel, Amazonas, Brazil. Bold is a new record of the maximum standard length. / **Tabela 1.** Relação peso-comprimento de 47 espécies de peixes amostradas no canal Auati -Paraná, Amazonas, Brasil. Negrito é um novo registro do comprimento padrão máximo.

ORDER: Family Species	N	SL (cm)		Wt (g)		a	b	r <sup>2</sup>
		Min.	Máx.	Min.	Máx.			
<b>CHARACIFORMES</b>								
<b>Crenuchidae</b>								
<i>Crenuchus spilurus</i> Günther, 1863	48	1.37	4.24	0.03	1.26	0.0122 (0.0087 - 0.0161)	3.3470 (2.5107 - 3.8362)	0.9712
<b>Erythrinidae</b>								
<i>Erythrinus erythrinus</i> (Bloch & Schneider, 1801)	55	2.28	11.03	0.34	27.77	0.0221 (0.0158 - 0.0300)	2.9863 (2.9142 - 3.6166)	0.9830
<b>Serrasalminidae</b>								
<i>Mylossoma duriventre</i> (Cuvier, 1818)	257	1.30	14.71	0.05	128.20	0.0284 (0.0155 - 0.0547)	3.1058 (1.4974 - 4.8186)	0.9878
<i>Serrasalmus medinae</i> Ramírez, 1965	25	1.46	9.41	0.04	20.70	0.0206 (0.1130 - 0.0308)	3.0659 (1.6051 - 3.9196)	0.9846
<i>Serrasalmus spilopleura</i> Kner, 1858	42	1.35	14.66	0.05	97.50	0.0159 (0.0098 - 0.0350)	3.1486 (2.0968 - 4.1359)	0.9916
<b>Curimatidae</b>								
<i>Curimatopsis microlepis</i> Eigenmann & Eigenmann, 1889	30	1.52	4.40	0.07	2.15	0.0254 (0.0230 - 0.0432)	2.6360 (2.4098 - 2.9953)	0.9701
<i>Potamorhina latior</i> (Spix & Agassiz, 1829)	36	2.46	17.77	0.22	87.93	0.0123 (0.0082 - 0.0157)	3.0681 (2.8084 - 3.2946)	0.9901
<b>Prochilodontidae</b>								
<i>Prochilodus nigricans</i> Spix & Agassiz, 1829	59	1.57	27.04	0.07	550.45	0.0150 (0.0095 - 0.0253)	3.1530 (2.6231 - 3.5399)	0.9944
<b>Lebiasinidae</b>								
<i>Copeina guttata</i> (Steindachner, 1876)	164	1.62	7.08	0.04	6.14	0.0126 (0.0075 - 0.0164)	3.1685 (2.1892 - 3.3703)	0.9829
<i>Pyrrhulina semifasciata</i> Steindachner, 1876	67	1.46	4.44	0.03	1.38	0.0073 (0.0059 - 0.0090)	3.5628 (3.3487 - 3.8279)	0.9819
<i>Pyrrhulina zigzag</i> Zarske & Géry, 1997	63	1.49	3.47	0.03	0.51	0.0089 (0.0075 - 0.0106)	3.2853 (3.0523 - 3.5583)	0.9836
<b>Gasteropelecidae</b>								
<i>Gasteropelecus sternicla</i> (Linnaeus, 1758)	22	1.05	<b>4.64</b>	0.05	2.35	0.0439 (0.0356 - 0.0549)	2.4981 (2.0541 - 3.6252)	0.9839
<b>Characidae</b>								
<i>Aphyocharax alburnus</i> (Günther, 1869)	22	2.97	4.81	0.38	1.14	0.0251 (0.0221 - 0.0273)	2.4494 (2.3478 - 2.5155)	0.9718
<i>Ctenobrycon spilurus</i> (Valenciennes, 1850)	284	1.76	6.45	0.07	4.40	0.0125 (0.0092 - 0.0161)	3.2196 (2.7594 - 3.5066)	0.9803
<i>Gymnocorymbus thayeri</i> Eigenmann, 1908	107	1.48	4.28	0.06	2.14	0.0145 (0.0097 - 0.0192)	3.3410 (2.7077 - 3.7914)	0.9802
<i>Moenkhausia intermedia</i> Eigenmann, 1908	34	1.77	4.90	0.05	2.63	0.0060 (0.0049 - 0.0090)	3.8006 (3.4959 - 4.1821)	0.9837
<i>Moenkhausia melogramma</i> Eigenmann, 1908	20	2.00	<b>4.08</b>	0.14	1.55	0.0141 (0.0123 - 0.0169)	3.2228 (3.0466 - 3.4056)	0.9716
<i>Prionobrama filigera</i> (Cope, 1870)	64	2.57	4.97	0.22	1.18	0.0219 (0.0062 - 0.0108)	2.4461 (2.6823 - 2.9526)	0.9803
<i>Tetragonopterus argenteus</i> Cuvier, 1816	45	2.05	8.72	0.18	19.54	0.0178 (0.0110 - 0.0260)	3.2469 (2.7544 - 3.6234)	0.9878
<b>GYMNOTIFORMES</b>								
<b>Sternopygidae</b>								
<i>Eigenmannia trilineata</i> López & Castello, 1966	35	3.22	17.18	0.08	6.03	0.0038 (0.0030 - 0.0050)	2.5616 (2.4415 - 2.7000)	0.9818
<b>Gymnotidae</b>								
<i>Gymnotus arapaima</i> Albert & Crampton, 2001	38	3.27	30.50	0.15	88.55	0.0046 (0.0034 - 0.0078)	2.8581 (2.7387 - 3.1011)	0.9828
<i>Gymnotus jonasii</i> Albert & Crampton, 2001	44	4.49	11.70	0.35	2.38	0.0190 (0.0166 - 0.0212)	2.0190 (1.9396 - 2.0899)	0.9839
<b>Hypopomidae</b>								
<i>Brachyhypopomus beebei</i> (Schultz, 1944)	20	6.08	17.50	0.51	12.14	0.0022 (0.0018 - 0.0027)	2.9541 (2.8711 - 3.0470)	0.9813
<i>Brachyhypopomus bennetti</i> Sullivan, Zuanon, Cox & Fernandes, 2013	77	3.01	21.40	0.11	12.10	0.0060 (0.0041 - 0.0104)	2.5092 (2.2913 - 2.9235)	0.9824
<i>Brachyhypopomus regani</i> Crampton, de, Santana, Waddell & Lovejoy, 2016	26	2.84	6.88	0.54	5.28	0.0236 (0.0206 - 0.0278)	2.8391 (2.7417 - 2.9944)	0.9822
<b>SILURIFORMES</b>								
<b>Callichthyidae</b>								
<i>Callichthys callichthys</i> (Linnaeus, 1758)	48	2.69	10.10	0.51	34.05	0.0204 (0.0169 - 0.0256)	3.1323 (2.9987 - 3.3315)	0.9842
<i>Corydoras elegans</i> Steindachner, 1876	23	2.59	4.48	0.72	3.03	0.0687 (0.0636 - 0.0734)	2.5161 (2.4388 - 2.5802)	0.9866
<i>Corydoras zygatus</i> Eigenmann & Allen, 1942	23	3.10	<b>6.00</b>	1.16	7.88	0.0577 (0.0430 - 0.0577)	2.9535 (2.7537 - 2.9566)	0.9829
<i>Dianema longibarbis</i> Cope, 1872	80	4.59	<b>8.45</b>	2.23	20.09	0.0115 (0.0010 - 0.0135)	3.4645 (3.3954 - 3.5649)	0.9834
<i>Megalechis thoracata</i> (Valenciennes, 1840)	67	1.70	10.77	0.11	41.19	0.0265 (0.0199 - 0.0330)	3.1248 (2.6050 - 3.3060)	0.9905
<b>Loricariidae</b>								
<i>Hypoptopoma gulare</i> Cope, 1878	20	4.29	7.80	0.87	6.50	0.0057 (0.0051 - 0.0064)	3.4494 (3.3872 - 3.5213)	0.9806
<i>Hypostomus carinatus</i> (Steindachner, 1881)	33	1.54	9.22	0.03	14.32	0.0108 (0.0062 - 0.0155)	3.2391 (2.3590 - 3.7661)	0.9831
<i>Rineloricaria phoxcephala</i> (Eigenmann & Eigenmann, 1889)	45	5.03	12.26	0.33	11.93	0.0008 (0.0006 - 0.0010)	3.7790 (3.6499 - 3.9184)	0.9872
<b>Auchenipteridae</b>								
<i>Trachelyopterus galeatus</i> (Linnaeus, 1766)	85	3.23	12.50	0.70	65.34	0.0181 (0.0127 - 0.0291)	3.2114 (2.9681 - 3.6084)	0.9816
<i>Trachelyopterus porosus</i> (Eigenmann & Eigenmann, 1888)	20	4.26	<b>16.20</b>	1.48	132.14	0.0156 (0.0115 - 0.0208)	3.2512 (3.0941 - 3.4115)	0.9804
<i>Tympanopleura atronatus</i> (Eigenmann & Eigenmann, 1888)	32	5.20	11.91	1.72	27.61	0.0070 (0.0059 - 0.0081)	3.3117 (3.2228 - 3.3887)	0.9826
<b>Doradidae</b>								
<i>Amblydoras affinis</i> (Kner, 1855)	28	2.74	5.19	0.48	2.85	0.0355 (0.0328 - 0.0391)	2.6672 (2.5884 - 2.7615)	0.9915
<i>Anadoras grypus</i> (Cope, 1872)	293	1.19	14.99	0.04	88.08	0.0264 (0.0179 - 0.0409)	2.9706 (2.4358 - 3.4103)	0.9808
<i>Ossancora punctata</i> (KNER, 1855)	21	3.24	7.30	0.75	7.38	0.0280 (0.0240 - 0.0316)	2.7736 (2.6970 - 2.8558)	0.9814
<b>SYNBRANCHIFORMES</b>								
<b>Synbranchidae</b>								
<i>Synbranchus marmoratus</i> Bloch, 1795	195	6.99	52.00	0.18	155.24	0.0001 (0.0003 - 0.0007)	3.3023 (2.9262 - 3.6732)	0.9838
<i>Synbranchus madeirae</i> Rosen & Rumney, 1972	37	3.90	27.70	0.03	24.63	0.0002 (0.0001 - 0.0002)	3.5781 (3.6720 - 3.9739)	0.9924
<b>CICHLIFORMES</b>								
<b>Cichlidae</b>								
<i>Aequidens tetramerus</i> (Heckel, 1840)	64	1.62	12.97	0.05	109.51	0.0281 (0.0164 - 0.0399)	3.2321 (2.7591 - 3.6691)	0.9913
<i>Apistogrammoides pucallpaensis</i> Meinken, 1965	37	0.90	2.50	0.02	0.60	0.0307 (0.0260 - 0.0392)	3.1815 (2.554 - 4.5208)	0.9817
<i>Astronotus ocellatus</i> (Agassiz, 1831)	24	2.20	19.24	0.20	391.52	0.0146 (0.0099 - 0.0461)	3.4903 (3.3157 - 4.0827)	0.9880
<i>Cichlasoma amazonarum</i> Kullander, 1983	600	1.12	11.95	0.04	78.20	0.0285 (0.0154 - 0.0416)	3.2692 (2.5564 - 3.6090)	0.9903
<i>Pterophyllum scalare</i> (Schultze, 1823)	47	2.39	6.37	0.61	9.71	0.0401 (0.0342 - 0.0448)	3.0013 (2.8883 - 3.1182)	0.9901
<b>CYPRINODONTIFORMES</b>								
<b>Rivulidae</b>								
<i>Anablepsoides micropus</i> (Steindachner, 1863)	37	1.36	6.70	0.03	4.93	0.0124 (0.0085 - 0.0161)	3.0936 (2.3359 - 3.5638)	0.9942

This study provides the first biological information for 31 species from the middle Amazon basin, including *Apistogrammoides pucallpaensis* and *Pyrrhulina zigzag* species that had their first occurrence in Brazil registered in this research (OLIVEIRA et al. 2019), and with potential for exploitation in ornamental trade. Besides *Gymnotus arapaima* and *Gymnotus jonasii* two species of electric fish described in the region (ALBERT; CRAMPTON, 2001). All the values of  $r^2$  fell within the expected value 95%, as suggested by Froese (2006).

Data for seven species are should be treated with caution due to the small sample size (< 20 individuals).

However, the inclusion of this species in the present paper is justified because the individuals showed a broad length range, enough to obtain the length-weight relationships since the sample was composed of individuals with a length broad enough to obtain robust statistical relationships.

This study provides new information on the length-weight relationships of the ichthyofauna from of the central region Amazon, as well as comprising important baseline data for future studies focused on the management, conservation, and ecology of natural resources within the region.

## Acknowledgements

We thank the Ministério da Ciência, Tecnologia, Inovação e Comunicação which, via the Instituto de Desenvolvimento Sustentável Mamirauá supported the present study. We are grateful to Conselho Nacional de Desenvolvimento Científico e Tecnológico for research grant (Process: 300019/2017-3).

## References

- ALBERT, J.; CRAMPTON, W. Five new species of *Gymnotus* (Teleostei: Gymnotiformes) from an Upper Amazonian floodplain, with descriptions of electric organ discharges and ecology. **Ichthyological Exploration of Freshwaters**, v. 12, p. 241-266, 2001.
- BARROS, T. F.; ALTHOFF, B. B.; PEREIRA, D. C.; LAZZAROTTO, H.; CARAMASCHI, E. P. Length-weight relationships in seven ornamental freshwater species of Characiformes from the Unini River basin (Brazilian Amazon). **Journal of applied ichthyology**, v. 34, n. 5, p. 1188-1191, 2018.
- CAMARGO, M. P.; ARANHA, J. M. R.; MENEZES, M. S. Length-weight relationship (LWR) of fish species in the Morato River, Paraná, Brazil. **Journal of Applied Ichthyology**, v. 34, p. 1186-1187. 2018.
- FRICKE, R.; ESCHMEYER, W. N.; VAN DER LAAN, R. 2020. Catalog of fishes: Genera, Species, References. Disponível em <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>. (Acessada em 10/05/2020.).
- FROESE, R.; BINOHLAN, C. Empirical relationships to estimate asymptotic length, length at first maturity and length at maximum yield per recruit in fishes, with a simple method to evaluate length frequency data. **Journal of Fish Biology**, v. 56, p. 758-773. 2000.
- FROESE, R. Cube law, condition factor and weight-length relationships: History, meta-analysis and recommendations. **Journal of Applied Ichthyology**, v. 22, p. 241-253. 2006.
- FROESE, R.; TSIKLIRAS, A. C.; STERGIU, K. I. Editorial note on weight-length relations of fishes. **Acta Ichthyologica et Piscatoria**, v. 41, n. 4, p. 261-263. 2011.
- FROESE, R.; PAULY, D. 2020. FishBase. Disponível em <http://www.fishbase.org/> (Acessada em 10/05/2020).
- GERY, J. **Characoids of the world**. Neptune City: T.F.H. Publications, 1977.
- KING, M. **Fisheries biology, assessment and management**, 2nd ed. Oxford: Blackwell Scientific Publications, 2007.
- LE CREN, E. D. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). **Journal of Animal Ecology**, v.20, p. 201-219. 1951.
- OLIVEIRA, J. C.; OLIVEIRA, J. A., ROSSATO, D. P. C. Primeiro registro de *Apistogrammoides pucallpaensis* Meinken, 1965 (Perciformes, Cichlidae) para o Brasil, além de informações de fecundidade. **Acta Limnologica Brasiliensia**, v. 31, n. 8. 2019.
- QUEIROZ, L. J.; TORRENTE-VILARA, G., OHARA, W. M., PIRES, T. H. S., ZUANON, J., & DORIA, C. R. C. **Peixes do rio Madeira**, vol. 1, 2 e 3. São Paulo: Santo Antônio Energia, 2013.
- SILVA, R. S.; CORRÊA, F.; DE OLIVEIRA, L. P.; VIEIRA, L. J. Length-weight relation of the 14 fish species occurring on sandy beaches along a tropical river in the Amazon. **Journal of Applied Ichthyology**, v. 35, n. 2, p. 622-624. 2019.