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Original Article

Unraveling allometric relationships of fish species in streams of southwestern Amazon

Desvendando relações alométricas de espécies de peixes em riachos do sudoeste da Amazônia

R. S. Araújo[a*], F. Corrêa[a], L. P. Oliveira[b], R. S. Silva[c], L. J. S. Vieira[d] and F. P. Ottoni[a,e]

[a]Universidade Estadual do Maranhão – UEMA, Programa de Pós-graduação em Biodiversidade, Ambiente e Saúde, Caxias, MA, Brasil
[b]Universidade Federal do Pará – UFPA, Programa de Pós-graduação em Ecologia, Belém, PA, Brasil
[c]Secretaria do Estado da Educação do Tocantins, Palmas, TO, Brasil
[d]Universidade Federal do Acre – UFAC, Laboratório de Ictiologia e Ecologia Aquática, Rio Branco, AC, Brasil
[e]Universidade Federal do Maranhão – UFMA, Laboratório de Sistemática e Ecologia de Organismos Aquáticos, Chapadinha, MA, Brasil

Abstract

In this study, we analyzed a total of 1,354 individuals belonging to 16 species, distributed across three orders (Characiformes, Siluriformes, and Gymnotiformes), collected bimonthly, between August 2016 and July 2018, at five sampling sites in the Quinoá stream system. We present new weight-length relationship data for nine species (*Triportheus angulatus*, *Bryconops caudomaculatus*, *Holopritis ocellifera*, *Gymnocorymbus thayeri*, *Apteronotus albifrons*, *Sternopygus macrurus*, *Helogenes marmoratus*, *Rineloricaria lanceolata*, and *Gymnorhamphichthys rondoni*) from southwestern Amazonia, Acre State, northern Brazil. Length-weight relationships were estimated through linear regression after logarithmic transformation of the data, and a Student's *t-test* was applied to test the null hypothesis that the allometric coefficient does not differ statistically from $b = 3$. Total length (TL, cm) ranged from 1.2 to 31.5 cm and total weight (TW, g) from 0.02 to 92.5 g. The intercept (a) of the length-weight relationship ranged from 0.0068 to 0.063, the regression slope (b) from 2.46 to 3.28, and the coefficient of determination (R^2) from 0.91 to 0.99. Negative allometric growth was observed in 68.8% of the species, positive allometric growth in 25.0%, and only 6.3% exhibited isometric growth. Elongated species, particularly Gymnotiformes and some Siluriformes, showed a negative allometric pattern, whereas species such as *Steindachnerina guentheri*, *Bario oligolepis*, and *Holopristis ocellifera* exhibited positive allometric growth. Our findings reinforce that environmental variation in Amazonian streams influences the length-weight relationship patterns of fish species, highlighting the importance of considering analytical factors such as sampling methods and temporal scale when comparing studies. Overall, the data generated contribute to the knowledge of the ichthyofauna of the Acre state, as well as provide support for ecological studies, management of forage species, and conservation of Amazonian aquatic ecosystems.

Keywords: Acre, amazonian ichthyofauna, aquatic ecosystems, growth patterns, igarapé Quinoá.

Resumo

Neste estudo, analisamos um total 1.354 indivíduos pertencentes a 16 espécies, distribuídas em três ordens (Characiformes, Siluriformes e Gymnotiformes), coletados bimestralmente entre agosto de 2016 e julho de 2018, em cinco pontos de amostragem no sistema do Igarapé Quinoá. Apresentamos novos dados de relação peso-comprimento para nove espécies (*Triportheus angulatus, Bryconops caudomaculatus, Holopristis ocellifera, Gymnocorymbus thayeri, Apteronotus albifrons, Sternopygus macrurus, Helogenes marmoratus, Rineloricaria lanceolata e Gymnorhamphichthys rondoni*) do sudoeste da Amazônia, estado do Acre, norte do Brasil. As relações peso-comprimento foram estimadas por meio de regressão linear após transformação logarítmica dos dados, e um teste t de Student foi aplicado para testar a hipótese nula de que o coeficiente alométrico não difere estatisticamente de $b = 3$. O comprimento total (CT, cm) variou de 1,2 a 31,5 cm e o peso total (PT) de 0,02 a 92,5 g. O intercepto (a) da relação peso-comprimento variou de 0,0068 a 0,063, a inclinação da regressão (b) de 2,46 a 3,28, e o coeficiente de determinação (R^2) de 0,91 a 0,99. Crescimento alométrico negativo foi observado em 68,8% das espécies, crescimento alométrico positivo em 25,0%, e apenas 6,3% apresentaram crescimento isométrico. Espécies alongadas, particularmente Gymnotiformes e alguns Siluriformes, apresentaram padrão alométrico negativo, enquanto espécies como *Steindachnerina guentheri*, *Bario oligolepis* e *Holopristis ocellifera* exibiram crescimento alométrico positivo. Nossos achados reforçam que a variação ambiental em riachos amazônicos influencia os padrões de relação peso-comprimento das espécies de peixes, destacando a importância de considerar fatores analíticos, como métodos de amostragem e escala temporal, ao comparar estudos. De modo geral, os dados gerados contribuem para o conhecimento da ictiofauna do Estado do Acre, bem como fornecem suporte para estudos ecológicos, manejo de espécies forrageiras e conservação de ecossistemas aquáticos amazônicos.

Palavras-chave: Acre, ictiofauna amazônica, ecossistemas aquáticos, padrões de crescimento, igarapé Quinoá.

*e-mail: rebecasilvade@gmail.com
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1. Introduction

Understanding the biology and ecology of species, particularly inconspicuous and cryptic freshwater organisms that help maintain water quality and sustain aquatic food webs, is fundamental to advancing our understanding of aquatic ecosystem processes and supporting effective conservation policies and management strategies (Ottoni et al., 2025).

Studies on length-weight relationships (LWRs) in fishes play a crucial role in understanding bioecological aspects and are fundamental for assessing the nutritional condition and population growth of different species (Gomiero and Braga, 2003; Freitas et al., 2017; Oliveira et al., 2020). Furthermore, understanding LWRs can help evaluate the impacts of environmental degradation, such as dam construction, land expansion and land use, pollution, and climate change, which directly affect fish populations and assemblages (Cella-Ribeiro et al., 2015; Giarrizzo et al., 2015; Rotta and Yamamoto, 2021). For example, Winemiller et al. (2016) highlighted that the expansion of hydropower dams in the Amazon, Congo, and Mekong River basins is a major drive of hydrological disconnection and fish community disruption, compromising ecological processes such as reproduction and growth. In addition, dams of different sizes (large, medium, and small) can block migratory routes, reduce gene flow (Piorski et al., 2008), and negatively affect ecosystem services and community structure (Pelicice et al., 2023; Oliveira et al., 2024).

Riparian deforestation is another threat to freshwater ecosystems. The removal of riparian vegetation alters hydrological flow and the physical structure of aquatic habitats, directly affecting the physiology, morphology, growth, and population performance Jacob et al. (2021). In addition to riparian loss, landscape modifications such as road network expansion can further degrade stream habitats and negatively affect fish assemblages (Oliveira et al., 2024; Camana et al., 2022; Drager et al., 2025). Although the importance of riparian vegetation for maintaining stream biotic integrity is widely recognized Drager et al. (2025), vegetation loss cover promotes an increase in water temperature (Junk et al., 2024), enhances sediment input (Nicomedes et al., 2025), and promotes hydrological homogenization (Leitão et al., 2018). These changes can reduce food resources availability (Corrêa and Smith 2019; Miranda et al., 2025), leading to nutritional losses in species (Zavala-Camin 1996; Drager et al., 2025), and ultimately affecting growth patterns and length-weight relationships (LWRs).

Therefore, understanding LWRs constitutes an essential tool for the conservation of aquatic ecosystems, contributing to the maintenance of fisheries activities across different aquatic environments, such as oceans, estuaries, and freshwater systems, as well as to planning in economic aspects associated with these activities (Froese, 2006; Corrêa et al., 2018; Freitas et al., 2023). Furthermore, estimates of the LWRs parameters *a* and *b* provide relevant information regarding fish body condition, nutritional status, and growth patterns (Froese, 2006; Froese et al., 2014; Luque and Colorado, 2024). The intercept *a* corresponds to the LWRs coefficient, while *b* represents the allometric coefficient, describing the rate of weight increase relative to length and indicating whether growth is isometric or allometric. According to Tavares-Dias et al. (2008) and Benacón et al. (2015), these parameters can vary over food availability, specific morphological characteristics of each species and the biotic and abiotic environmental conditions. Consequently, these variations reflect changes in the physiological condition of individuals, thus, fish of the same length may exhibit greater weight gain, resulting in better body condition and increased accumulation of energy reserves (Le Cren, 1951; Froese, 2006; Almeida et al., 2025). Oliveira et al. (2022) highlight that data obtained from LWR estimates are important for decision-making and the management of fish stocks. In Acre state, located in the western Brazilian Amazon, studies describing fish LWRs are relatively recent (Corrêa et al., 2018; Silva et al., 2019; Silva et al., 2020; Oliveira et al., 2022; Almeida et al., 2025; Fratari et al., 2025), and substantial knowledge gap remain for many species. In light to contribute to filling this gap, we present the LWRs of 16 stream fish species from southwestern Amazonia, providing novel data for nine species, and test the null hypothesis that the allometric coefficients differ significantly from $b = 3$.

2. Materials and Methods

2.1. Study area

The Quinoá stream system (QSS), a tributary of the Acre River, Purus River drainage, Amazon River basin (QSS - 10º06'03.33"S/67°40º11.50"W; Figure 1), is located in the municipality of Senador Guiomard, in the Acre state, northern Brazil, approximately 25 km from the capital Rio Branco. This area includes anthropized environments and forest fragments with different degrees of preservation (Corrêa et al., 2018; Costa, 2024; Oliveira et al., 2024). The main anthropogenic impacts in the QSS are the streams damming for construction of small reservoirs and secondary roads. One of the main preserved ecosystems within the QSS is the Catuaba Experimental Farm (FEC) (10°04´S/67°37´W). The FEC covers an area of approximately 1,200 ha, with gently undulating topography and a predominance of Oxisols (Acre 2006; Medeiros et al., 2013; Oliveira et al., 2024).

2.2. Ichthyofauna sampling and data analysis

Fish were collected bimonthly for two years at five sampling sites in the QSS (see Figure 1), between August 2016 and July 2018 (SISBIO #11778), using different sampling gears according to Corrêa et al. (2015): (i) a seine net ("*rede de arrasto*") measuring 5 m in length, 2.25 m in height, with a mesh size of 5 mm between adjacent knots; (ii) two hand nets ("*puçás*") with 5 mm mesh, 30 cm in width and 50 cm in length; and (iii) two sieves ("*peneiras*") with 5 mm mesh, 50 cm in width and 80 cm in length.

After each sampling event, the individuals were anesthetized with eugenol (CONCEA 2013), subsequently

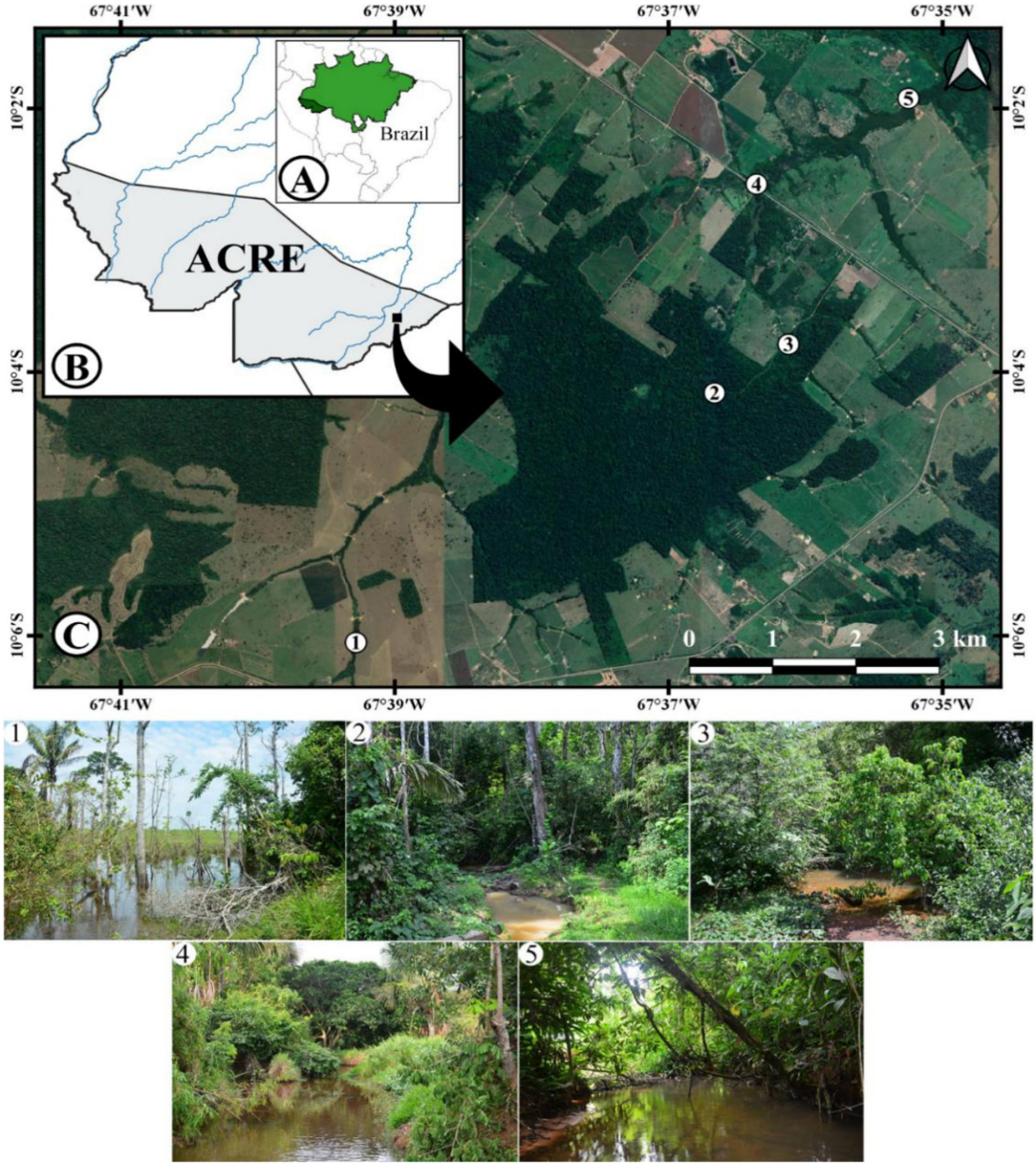

Figure 1. Location of the sampling sites in the Quinoá stream system: (A) Brazil - Green = Brazilian Amazon; Dark green = Acre State; (B) Acre State = light gray; and (C) sampling sites (1-5). Images of the respective sampling sites are presented below.

placed in plastic bags containing 5% formalin, properly labeled, and transported to the laboratory. The specimens were identified using specialized literature (*e.g.*, Queiroz et al., 2013a, b, c), and when necessary, specialists were consulted. Taxa spelling, taxonomic classification, species validity and well as other useful information were checked in Fricke et al. (2025a, b).

In the laboratory, all individuals were washed with running water and their total length (TL, cm) and total weight (TW, g) were measured using a millimeter-scaled ichthyometer. After each sorting, the fishes were transferred to 70% ethanol. Voucher specimens were deposited in the fish collection of the Federal University of Acre (UFAC), Rio Branco, Acre (*see* Table 1). For the estimation of the LWRs, we initially used scatter plots to identify and remove outliers from our analyses. We used the equation $W = aL^b$ (Le Cren 1951; Froese 2006), where W is the total weight and L is the total length, and a and b are the constants of the linear regression model. The parameters a and b of the linear regression model were log-transformed ($\log_{10}$ TW = $\log_{10}$ a + b * $\log_{10}$ TL), and the analyses were performed in the software in R v4.4.3 and RStudio 12.1+563 (RStudio Team 2024), using the package *"vegan"* (Oksanen et al., 2025). Finally, for data visualization, we generated *box plots* to represent the distribution of total lengths of the analyzed species,

Table 1. Parameters of the length–weight relationship of fish species sampled in the Quinoá stream system, Acre State, Northern Brazil.

	N	TL(cm)			TW(gr)			*a*	(±95% CI)	*b*	(±95% CI)	R^2	*p*	Growth type	Fishbase	Voucher	ICMBio
		Mean±SE	Min	Max	Mean±SE	Min	Max										
CHARACIFORMES																	
Erythrinidae																	
Hoplias malabaricus (Bloch, 1794)	48	6.13±0.53	2.0	22.0	5.49±2.04	0.1	92.5	-1.85	(-1.9323, -1.7622)	2.83	(2.7219 - 2.9318)	0.99	**0.002**	b < 3	3.17	MUFAC-IC 955	LC
Curimatidae																	
Steindachnerina guentheri (Eigenmann & Eigenmann, 1889)	18	8.06±0.72	2.0	11.8	12.89±2.46	0.1	30.9	-2.03	(-2.1511, -1.9062)	3.28	(3.1300 - 3.4102)	0.99	**0.005**	b > 3	3.11	MUFAC-IC 997	LC
Triportheidae																	
**Triportheus angulatus* (Spix & Agassiz, 1829)	##	5.89±0.16	1.2	10.0	3.94±0.22	0.1	15.9	-1.85	(-1.9023, -1.8014)	2.97	(2.9115 - 3.0363)	0.99	0.246	b = 3	3.03	MUFAC-IC 953	LC
Iguanodectidae																	
**Bryconops caudomaculatus* (Günther, 1864)	##	4.66±0.19	2.1	9.2	1.55±0.17	0.1	7.6	-1.97	(-2.0090, -1.9311)	2.95	(2.8967 - 2.9946)	0.99	0.112	b = 3	3.08	MUFAC-IC 946	LC
Characidae																	
Phenacogaster pectinata (Cope, 1870)	36	4.23±0.13	2.6	5.7	0.77±0.07	0.2	1.9	-2.15	(-2.2380, -2.0537)	3.16	(2.9989 - 3.3137)	0.97	0.099	b = 3	3.04	MUFAC-IC 948	LC
Acestrorhamphidae																	
Bario oligolepis (Günther, 1864)	##	5.42±0.12	2.4	9.0	3.14±0.23	0.2	15.0	-1.97	(-2.0088, -1.9101)	3.22	(3.1433 - 3.2761)	0.99	**0.001**	b > 3	3.13	MUFAC-IC 940	LC
Brachychalcinus copei (Steindachner, 1882)	45	5.43±0.28	3.0	9.1	4.80±0.69	0.2	16.3	-1-77	(-1.8383, -1.7067)	3.10	(3.0187 - 3.1978)	0.99	0.146	b = 3	3.15	MUFAC-IC 980	LC
Ctenobrycon spilurus (Valenciennes 1850)	##	4.48±0.05	1.7	6.8	1.31±0.03	0.1	4.1	-1.91	(-1.9464, -1.8729)	3.01	(2.9505 - 3.0668)	0.95	0.764	b = 3	3.08	MUFAC-IC 963	LC

N = number of individuals analyzed; TL (cm) = total length; TW (g) = total weight; a = regression intercept; 95% CI = 95% confidence interval; *b* = allometric coefficient; R^2 = coefficient of determination; t-test (t-critical) = t value for testing the hypothesis H_0: b = 3; *p* = significance level; Growth type = type of growth (positive allometric, negative allometric, or isometric); FishBase = reference values available in FishBase; and LC = Least Concern in Instituto Chico Mendes de Conservação da Biodiversidade - IMCBio conservation status. (*) Species for which LWR data are provided for the first time for the State of Acre, Northern Brazil. Values in bold indicate statistically significant results.

Table 1. Continued...

	N	TL(cm)			TW(gr)			*a*	(±95% CI)	*b*	(±95% CI)	R^2	*p*	Growth type	Fishbase	Voucher	ICMBio
		Mean±SE	Min	Max	Mean±SE	Min	Max										
**Gymnocorymbus thayeri* Eigenmann, 1908	28	4.52±0.07	3.3	5.2	1.33±0.06	0.6	2.1	-1.63	(-1.8107, -1.3878)	2.67	(2.3021 - 2.9435)	0.91	0.061	b = 3	3.08	MUFAC-IC 970	LC
**Holopristis ocellifera* (Steindachner, 1882)	##	3.85±0.04	2.0	5.1	0.77±0.03	0.1	1.8	-2.08	(-2.1335, -2.0216)	3.30	(3.2040 - 3.3909)	0.95	**0.001**	b > 3	3.09	MUFAC-IC 944	LC
GYMNOTIFORMES																	
Apteronotidae																	
**Apteronotus albifrons* (Linnaeus, 1766)	21	8.30±0.98	2.7	19.7	4.25±1.18	0.2	22.8	-1.94	(-2.0995, -1.7668)	2.59	(2.3637 - 2.7828)	0.98	**0.001**	b < 3	3.05		LC
Sternopygidae																	
Eigenmannia cf. *virescens*	49	9.04±0.43	3.7	17.9	1.77±1.73	0.2	8.3	-2.50	(-2.5986, -2.3683)	2.75	(2.6104 - 2.8589)	0.98	**0.001**	b < 3	2.89	MUFAC-IC 954	LC
**Sternopygus macrurus* (Bloch and Schneider, 1801)	30	14.37±1.32	6.0	31.5	10.19±2.76	0.7	54.9	-2.68	(-2.8687, -2.4653)	2.95	(2.7769 - 3.1047	0.98	0.518	b = 3	2.82	MUFAC-IC 983	LC
SILURIFORMES																	
Cetopsidae																	
**Helogenes marmoratus* Günther, 1863	15	4.42±0.29	2.8	6.8	0.97±0.18	0.2	2.9	-1.86	(-2.0632, -1.7213)	2.77	(2.5451 - 3.0614)	0.97	0.122	b = 3	3.14	MUFAC-IC 966	LC
Loricariidae																	
**Rineloricaria lanceolata* (Günther, 1868)	34	7.90±0.56	2.8	14.0	1.59±0.30	0.1	5.8	-2.79	(-2.5198, -2.3573)	2.80	(2.7048 - 2.8787)	0.98	**0.009**	b < 3	3.18	MUFAC-IC 956	LC
Rhamphichthyidae																	
**Gymnorhamphichthys rondoni* (Miranda Ribeiro, 1920)	30	12.08±0.50	8.6	18.3	1.35±0.16	0.6	4.1	-2.54	(-2.8791, -2.2563)	2.43	(2.1680 - 2.7553)	0.97	**0.001**	b < 3	3.0	MUFAC-IC 961	LC

N = number of individuals analyzed; TL (cm) = total length; TW (g) = total weight; a = regression intercept; 95% CI = 95% confidence interval; *b* = allometric coefficient; R^2 = coefficient of determination; t-test (t-critical) = t value for testing the hypothesis H_0: b = 3; *p* = significance level; Growth type = type of growth (positive allometric, negative allometric, or isometric); FishBase = reference values available in FishBase; and LC = Least Concern in Instituto Chico Mendes de Conservação da Biodiversidade - IMCBio conservation status. (*) Species for which LWR data are provided for the first time for the State of Acre, Northern Brazil. Values in bold indicate statistically significant results.

and linear regression plots for species that showed statistical significance. For this purpose, we used the package *"ggplot2"* (Wickham 2016) in the RStudio 12.1+563 (RStudio Team 2024).

To test the null hypothesis that the allometric coefficient does not differ statistically from the value expected under isometric growth (H_0: $b = 3$), we applied a Student's *t-test*. The *t* value was calculated using the formula $(b - 3)/SE(b)$, where *b* is the regression coefficient of the length-weight relationship and $SE(b)$ is the standard error of the coefficient. A significance level of $p = 0.05$ was adopted. Species presenting *b* values significantly greater than 3 exhibited positive allometric growth ($b > 3$), whereas values significantly lower than 3 indicated negative allometric growth ($b < 3$). When the absolute value of t did not exceed the critical value, *b* was considered not significantly different from 3 ($b = 3$), indicating isometric growth (Zar 2010; Ragheb 2023). Finally, we assessed the conservation status of the studied species according to ICMBio (2026). These categories provide a standardized framework for evaluating species conservation status in Brazil.

3. Results

We analyzed a total of 1,354 individuals belonging to 16 species (10 Characiformes, three Siluriformes, and three Gymnotiformes). Total abundance ranged from 15 individuals of *Helogenes marmoratus* Günther, 1863 (TL = 4.42 ± 0.29 cm; TW = 0.97 ± 0.18 g) to 422 individuals of *Ctenobrycon spilurus* (Valenciennes, 1850) (TL = 4.48 ± 0.05 cm; TW = 1.31 ± 0.03 g). Overall, TL ranged from 1.2 to 31.5 cm (Figure 2), and TW from 0.02 to 92.5 g. For the intercept *a*, values ranged from 0.0068 to 0.0630, and the slope *b* ranged from 2.46 to 3.28. Regarding the coefficient of determination (R^2), the lowest value recorded was $R^2 = 0.91$ for *Gymnocorymbus thayeri* Eigenmann, 1908, whereas the highest value ($R^2 = 0.99$) was recorded for the following species: *Steindachnerina guentheri* (Eigenmann & Eigenmann, 1889), *Hoplias malabaricus* (Bloch, 1794), *Brachychalcinus copei* (Steindachner, 1882), *Bryconops caudomaculatus* (Günther, 1864), *Bario oligolepis* (Günther, 1864), and *Triportheus angulatus* (Spix & Agassiz, 1829). A total of 31.3% of the analyzed species showed negative allometric growth ($b < 3$), whereas 18.8% showed positive allometric growth ($b > 3$), and only 50.0% exhibited isometric growth ($b = 3$) (*see* Table 1), and all relationships are shown in the Figure 3.

For nine species, we present novel LWRs data for southwestern Amazonia: four Characiformes [*Holopristis ocellifera* (Steindachner 1882), *Gymnocorymbus thayeri*, *Bryconops caudomaculatus*, and *Triportheus angulatus*], two Siluriformes (*Helogenes marmoratus* and *Rineloricaria lanceolata* (Günther 1868)], and three Gymnotiformes [*Gymnorhamphichthys rondoni* (Miranda Ribeiro 1920), *Sternopygus macrurus* (Bloch & Schneider 1801), and *Apteronotus albifrons* (Linnaeus 1766)] (see Table 1). Regarding their conservation status, all recorded species are classified as Least Concern (LC) according to the criteria established by ICMBio.

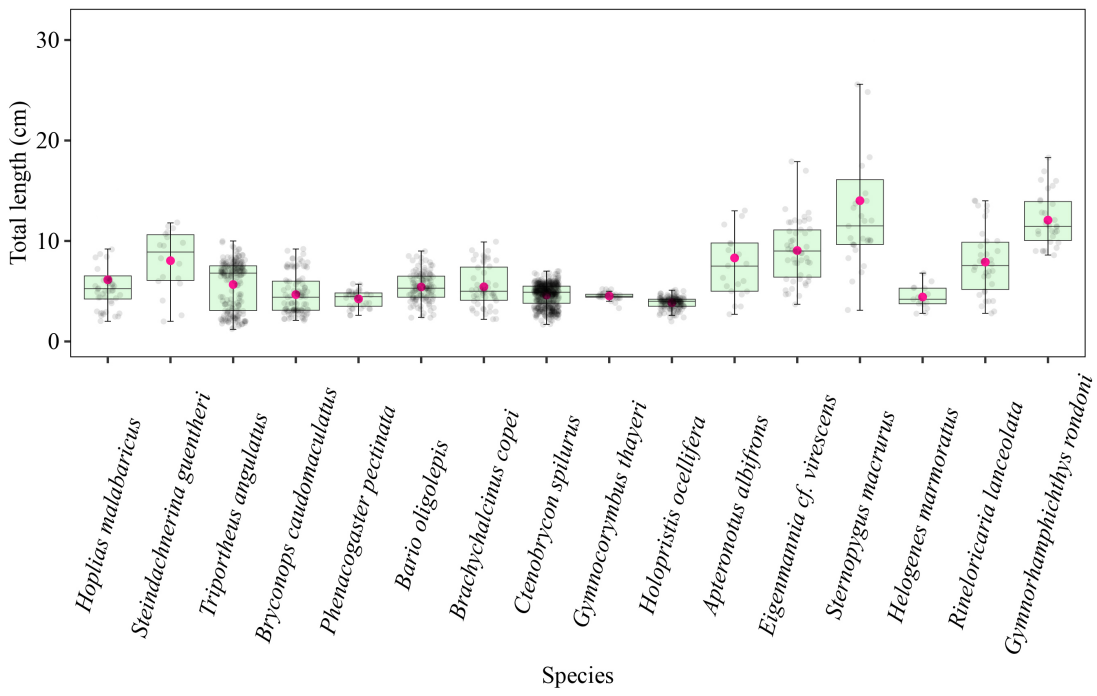

Figure 2. Representation of the biometric data of total length (cm) for the 16 fish species collected in the Quinoá stream system, Acre State, Northern Brazil. The pink circles represent the mean total length for each species, and the light gray circles represent the individuals of each species.

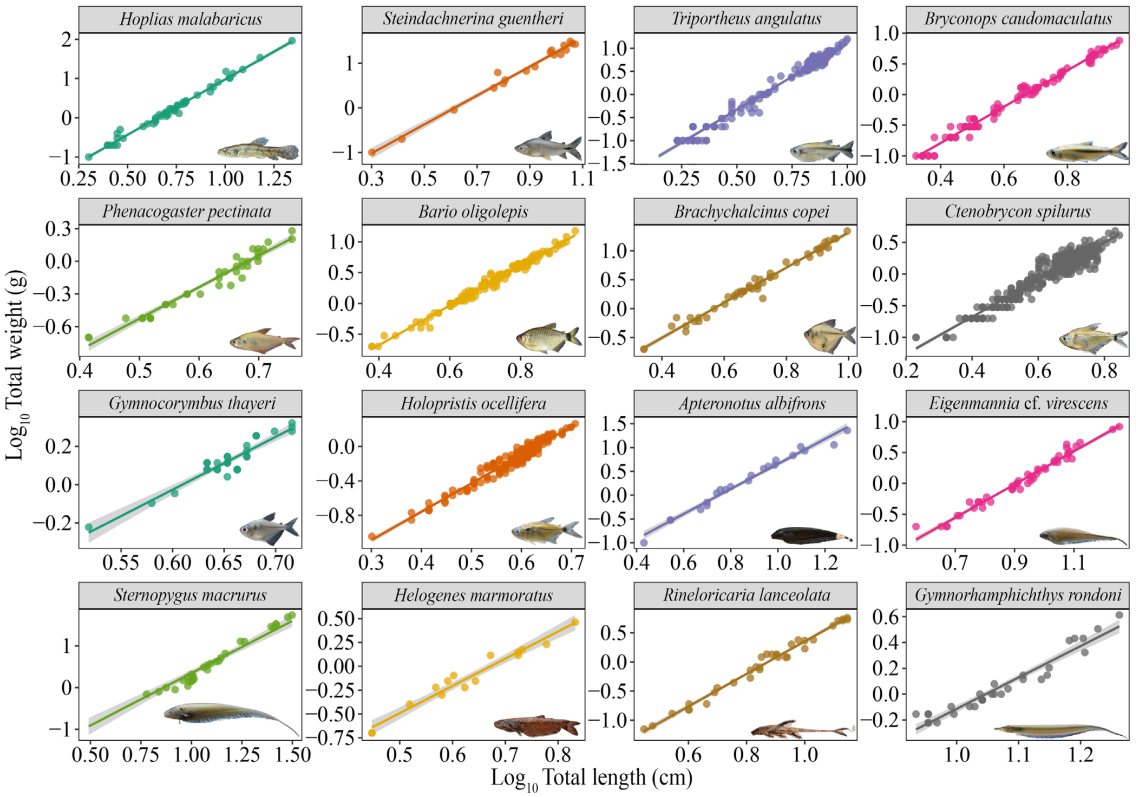

Figure 3. Length-weight relationships of the eight fish species that showed statistically significant allometric values, collected in the in the Quinoá stream system, Acre State, Northern Brazil, with fitted linear regressions and confidence intervals (light gray).

4. Discussion

For the State of Acre, Northern Brazil, studies describing length–weight relationships of fishes in streams and large rivers remain scarce. This situation may be associated with the high species diversity and environmental heterogeneity of the region, as well as the limited number of researchers and the lack of governmental investment (Carvalho et al., 2023). The first studies on LWRs for the Acre State were carried out by Corrêa et al. (2018), who analyzed four cichlid species. Subsequently, Silva et al. (2019) studied 14 fish species on sandy beaches of the Acre River, and Silva et al. (2020) investigated 16 species in lakes of the middle Purus River drainage, Amazon River basin. Oliveira et al. (2022) analyzed six species of Characiformes in oxbow lakes of the same river. In the present study, we provide novel data for nine species collected in the BHIQ, whose allometric coefficients (b) remained within the expected range of 2.5 to 3.5, according to Froese (2006), and approximately 50% of the analyzed species showed agreement between the estimated length–weight relationship b values and the Bayesian estimates available in FishBase (Froese et al., 2014; Froese and Pauly, 2015), also considering that some values reported in FishBase are estimates for genus levels.

Some factors may explain differences in the allometric coefficients reported in the literature, such as sampling method, fixation of individuals in formalin, nutritional condition, reproductive period, environmental heterogeneity, and the range of total lengths of the specimens. Our discussion focuses on species that showed statistical significance for the value of b according to the *t-test*. The top predator, the trahira *Hoplias malabaricus*, exhibited negative allometric growth (b = 2.83), a value lower than those reported by Oliveira et al. (2013) and Mereles et al. (2017). This variation may be related to the number of individuals analyzed and to the range of total lengths sampled. For the iliophagous species *Steindachnerina guentheri*, we observed positive allometric growth (b = 3.28), higher than the value available in FishBase, but partially corroborating the allometric coefficient reported by Almeida et al. (2025), who evaluated the length–weight relationship and condition factor of 11 species in a protected area of the Acre River drainage.

The tetra *Bario oligolepis* exhibited positive allometric growth (b = 3.22), a value higher than those reported by Luque and Colorado (2024) in the Colombian Amazon (b = 3.01) and by Almeida et al. (2025) in a protected area of the Acre River drainage (b = 3.04). These differences suggest variations in the species' growth pattern across different Amazonian aquatic environments, possibly associated with environmental factors, resource availability, and local ecological conditions. Similarly, the tetra *Holopristis ocellifera* showed positive allometric growth in this study (b = 3.30), with values close to those reported by Hercos et al. (2021) in Lake Amanã

(b = 3.48). The species demonstrates a consistent pattern of good body condition in heterogeneous Amazonian aquatic ecosystems.

On the other hand, some species exhibited statistically significant negative allometric growth, indicating greater increases in length than in body mass, a pattern characteristic of elongated species such as those belonging to the order Gymnotiformes, popularly known as ituis, tuviras, knifefishes, including *Apteronotus albifrons*, *Eigenmannia* cf. *virescens*, and *Gymnorhamphichthys rondoni*, as well as siluriforms such as the whiptail catfish *Rineloricaria lanceolata*. For *R. lanceolata*, the value obtained differs from the positive allometric growth reported by Tobes et al. (2016) and Oliveira et al. (2013), suggesting a strong influence of local habitat characteristics, such as substrate type and hydrological regime. In the case of *G. rondoni*, the negative pattern reinforces the morphological tendencies of the group, with greater investment in total length; we also highlight that there are currently no studies focusing on allometric relationships for this species.

Among the species with intermediate values, the catfish *Helogenes marmoratus* exhibited isometric growth in this study (b = 2.77), because it was not statistically different from b = 3, contrasting with the slightly positive value reported by Allard et al. (2015) (b = 3.21) in French Guiana. This difference may be associated with variations in environmental characteristics between the systems studied, availability of food resources, vegetation cover, and hydrological regime, factors capable of influencing the growth pattern of populations. The knifefish *Sternopygus macrurus* also showed isometric growth (b = 2.95), a finding similar to that reported by Allard et al. (2015) (b = 2.79), possibly because the growth pattern of *S. macrurus* is relatively stable in Neotropical streams. Finally, the freshwater sardine *Triportheus angulatus* exhibited isometric growth (b = 2.97) because it was not statistically different from b = 3, slightly lower than the value reported by Giarrizzo et al. (2015) in the Xingu River drainage, Amazon River basin, a variation that may be associated with the narrower range of total lengths analyzed and the predominance of juvenile individuals.

In summary, our findings reinforce that environmental variation among Amazonian stream systems strongly influences the length-weight relationship patterns of species belonging to different fish orders. In addition, 50% of our fidings showed values significantly different from b = 3, and nine species had their LWRs data calculated for the first time in southwestern Amazonia. Thus, caution is recommended when comparing studies, particularly with respect to sampling methodology and broad temporal scales, as well as the importance of statistically testing the obtained allometric coefficient values.

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Data Availability Statement

The research data are only available upon request to the corresponding author.

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