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Research Article

Length–Weight Relationships of 13 Native Fish Species in the Yujiang River Basin

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The Yujiang River, an important tributary of the Pearl River, flows primarily through Vietnam, Guangxi, and Yunnan in China. This cross-border watershed supports a remarkable aquatic biodiversity, especially characterized by its unique fish species. In this study, we reported the length–weight relationships (LWRs) of 13 native fish species within the Yujiang River Basin (22.156N–24.353N, 105.845E–109.608E) sampled from July 2024 to February 2025. A total of 1967 fish specimens representing the 13 species were collected using drift gillnets of various sizes (mesh size: 10–70 mm; height: 2.0–5.0 m; length: 100 m). Nonlinear regression analysis yielded coefficients of determination (r^2) ranging from 0.950 to 0.996 and the parameter b spanning 2.57 to 3.74. According to the records from FishBase database and other studies, the LWRs for these 13 fish species from the Pearl River are provided for the first time in this study. Among them, the LWR of *Beaufortia granulopinna, Paranemachilus genilepis, Opsariichthys duchuunguyeni,* and *Sarcocheilichthys caobangensis* are first reported in FishBase database. The maximum body length of *Ancherythroculter lini* is updated to 26.00 cm. Moreover, *S. caobangensis* is first reported in the Yujiang River Basin in this study. It is expected that the results of this study will provide a basic data for the study of fish ecology, fishery resource management, and hydroacoustic monitoring in Yujiang River Basin.

1. Introduction

The Yujiang River Basin (YRB), a critical part of the Pearl River Basin, forms an ecological hotspot in the Guangxi Zhuang Autonomous Region of southern China. This biodiverse watershed sustains more than 180 documented freshwater fish species, positioning it as one of the most ichthyologically significant drainage systems in the Asian subtropics [1–3]. The basin's unique hydrologic characteristics—shaped by its karst-dominated topography and connection to the Pearl River Delta—create exceptional habitat heterogeneity that supports this remarkable aquatic biodiversity [4], including thirty-nine species endemic to the Pearl River and four protected species under China's second-class conservation status. In recent decades, fishery resources have been drastically reduced as a result of various hydraulic constructions and overfishing, so the study of the biological parameters of fish is of great importance [5–7].

The length–weight relationship (LWR) of fish is not only a critical biological metric for analyzing ontogenetic growth patterns but also serves as reference parameters for studying population dynamics, fisheries resource assessment, and ecological health [8, 9]. Although some previous studies on LWRs of fish from the Pearl River Basin have been reported, even including some cave fish and estuarine fish [10, 11]. Actually, there are still many species remain unreported in the Pearl River Basin, and some differences in ontogenetic

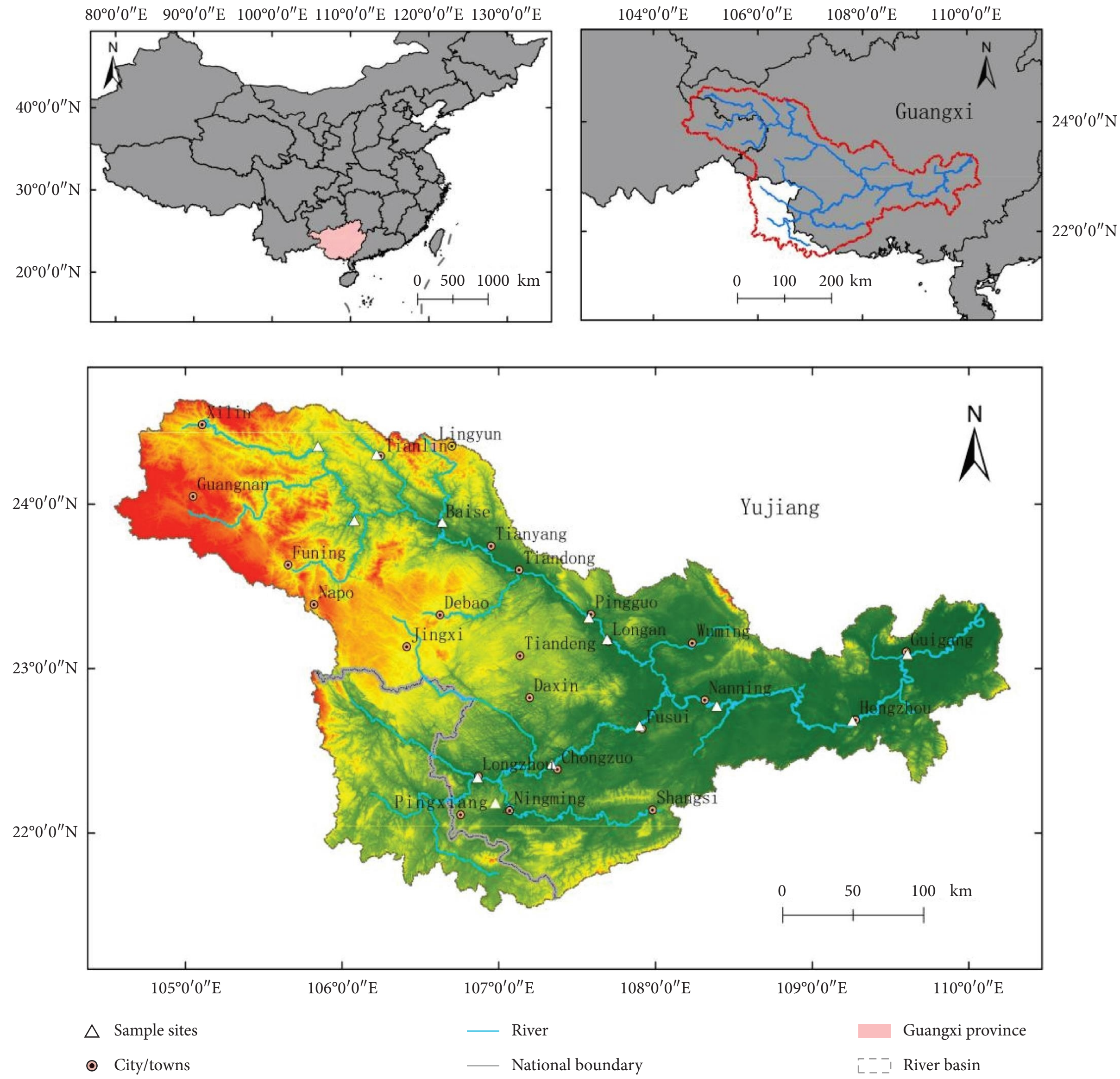

Figure 1: Fish resource survey point map.

development and growth exist among geographic populations of the same species in different rivers [12, 13]. Thus, it is necessary to establish basin-specific high-resolution fish LWR database and long-term monitoring in watershed biodiversity conservation efforts. Thereby further assessing the impact of factors such as hydropower development, environmental pollution, and climate-driven hydrological shifts on fish population viability [14–18].

This study provides the LWRs for 13 freshwater fish species (representing 7 families and 3 orders) inhabiting the YRB in the Guangxi Zhuang autonomous region.

2. Materials and Methods

Thirteen fish species were sampled in 13 locations within the YRB (Figure 1). Fish sampling was conducted from July 2024 to February 2025 in the YRB. Fish specimens were collected using drift gillnets with standardized mesh sizes (mesh size: 10–70 mm; height: 2.0–5.0 m; length: 100 m). Then, the fish specimens were promptly measured and weighed within 1 hour using a vernier scale and an electronic balance [19]. Species identification was conducted in accordance with the taxonomic references “Guangxi Freshwater Fishes” [20] and “Fishes of the Pearl River,” [21] among others. All scientific names were verified through cross-referencing with the FishBase taxonomic reference system [22]. For each fish specimen, standard length (SL) were measured to the nearest 0.1 cm, with total weight (W) recorded to the nearest 0.1 g [23]. All handling procedures were implemented in strict compliance with the Guidelines for Ethical Review of Laboratory Animal Welfare (GB/T 35892-2018) approved by the National Animal Ethics Committee.

LWRs were estimated via log-linear regression, expressed by the equation: $\log W = \log a + b \log L$, where W = total weight (g), L = standard length (cm), a = intercept of the regression, and b = slope of the regression [24].

Table 1: Descriptive statistics and estimated parameters of length–weight relationships (LWRs) for 13 fish species, Yujiang River Basin, China.

Order	Family	Species	n	SL (cm)	W (g)	WLR parameters				
				Min–max	Min–max	a	95% CL of a	b	95% CL of b	r^2
Cypriniformes	Balitoridae	***Beaufortia granulopinna* Chen and Tang, 2024***	52	4.37–6.17	2.13–5.14	0.0481	0.0322–0.0640	2.57	2.37–2.77	0.955
	Nemacheilidae	***Paranemachilus genilepis* Zhu, 1983**	129	3.13–6.23	0.46–4.09	0.0218	0.0193–0.0243	2.88	2.81–2.95	0.974
	Danioninae	***Opsariichthys duchuunguyeni* Huynh & Chen, 2014**	33	5.66–8.18	2.98–9.19	0.0095	0.0062–0.0127	3.29	3.11–3.46	0.980
	Cyprinidae	*Toxabramis houdemeri* Pellegrin, 1932	186	4.30–11.60	1.00–22.70	0.0134	0.0110–0.0158	2.99	2.92–3.07	0.980
		Ancherythroculter lini Luo, 1994	103	10.30–26.00	11.40–274.10	0.0069	0.0051–0.0087	3.22	3.13–3.30	0.973
		Hemiculter leucisculus Basilewsky, 1855	349	6.40–25.00	2.20–263.50	0.0015	0.0012–0.0018	3.74	3.67–3.81	0.950
		Culter alburnus Basilewsky, 1855	140	8.90–38.00	6.00–528.30	0.0086	0.0069–0.0103	3.02	2.97–3.08	0.996
		Squalidus argentatus Sauvage and Dabry de Thiersant, 1874	38	4.70–8.90	1.00–9.30	0.0137	0.0091–0.0184	2.97	2.81–3.14	0.991
		***Sarcocheilichthys caobangensis* Nguyen and Vo, 2001**	45	5.30–7.30	2.40–5.60	0.0270	0.0097–0.0443	2.87	2.53–3.20	0.950
Perciformes	Cichlidae	*Coptodon zillii* Gervais, 1848	183	4.10–19.90	2.00–247.27	0.0498	0.0408–0.0587	2.85	2.79–2.92	0.991
		Parachromis managuensis Günther, 1867	568	1.40–20.40	0.50–221.00	0.0346	0.0320–0.0373	2.94	2.91–2.97	0.986
	Eleotridae	*Oxyeleotris marmorata* Bleeker, 1852	42	11.00–22.00	31.90–233.60	0.0302	0.0065–0.0539	2.90	2.64–3.16	0.978
Siluriformes	Bagridae	*Pelteobagrus vachelli* Richardson, 1846	99	7.90–26.30	8.40–252.10	0.0423	0.0280–0.0566	2.66	2.55–2.77	0.969

Note: n, number of specimens; SL, standard body length; W, body weight; Min, minimum; Max, maximum; r^2, coefficient of determination; a and b: intercept and slope in equation $\log W = \log a + b \log L$. Bold labels indicate FishBase for the first time. Species name* (recently published new species).
Abbreviation: CL, confidence limit.

Prior to conducting linear regression analysis, outliers were eliminated from log-transformed data plots before subsequent analytical procedures. All statistical analyses were performed using OriginPro 2024 software [25].

3. Results

A total of 1967 fish specimens from 13 species in the YRB were analyzed. The descriptive statistics and the estimated LWR parameters are summarized in Table 1, providing the values of regression parameters "*a*" and "*b*" along with the estimated 95% confidence intervals, and the coefficient of determination r^2 values. The r^2 values for these species ranged from 0.950 to 0.996, with all $r^2 > 0.95$ ($p < 0.01$), demonstrating highly significant correlations.

LWR data for four species (*Beaufortia granulopinna, Paranemachilus genilepis, Opsariichthys duchuunguyeni,* and *Sarcocheilichthys caobangensis*) are first reported in FishBase. Among them, *B. granulopinna* as a novel species was described in 2024. In this study, *S. caobangensis* is first recorded in the YRB (Chongzuo city), which extends its known distribution beyond the originally reported Liujiang River Basin (Guangxi, China) and Cao Bang Province (Vietnam) [26]. The maximum total length of *Ancherythroculter lini* is updated to 26.00 cm. The remaining 9 species were not recorded in the Pearl River Basin.

4. Discussion

Except for *Hemiculter leucisculus* ($b = 3.74$), the regression parameter *b* values for all 12 fish species fell within the anticipated range of 2.50–3.50 [27]. This study did not account for various factors in the following three key areas: (i) organismal traits such as body length dynamics, sexual dimorphism, and gonadal maturation status; (ii) environmental context, including sampling geography and seasonal variability; and (iii) methodological constraints such as sample size adequacy, specimen size distribution, and ontogenetic stages [28–32].

Comparison with FishBase data revealed that the growth coefficient *b*-values of three species (*Toxabramis houdemeri*, *Culter alburnus*, and *Parachromis managuensis*) fell within estimated ranges, while the other species exhibited deviations in their growth parameter b-values. These discrepancies are probably attributed to variations in habitat types, geographic regions, and seasonal conditions [33, 34].

The *b*-values for *T. houdemeri*, *P. managuensis*, *C. alburnus*, *Squalidus argentatus*, and *Oxyeleotris marmorata* did not significantly deviate from 3, indicating an isometric growth pattern based on statistical analysis. In contrast, *A. lini*, *H. leucisculus*, and *O. duchuunguyeni* and their b-values were significantly greater than 3, reflecting higher perimeter-to-width ratios in larger-bodied specimens. Notably, the *b*-values of *H. leucisculus* and *A. lini* were markedly elevated compared to other literature [35], which may be attributed to various reasons. Specifically, the construction of 12 stepped hydropower stations in the YRB, driven by the demand for hydraulic and hydropower infrastructure, had a substantial impact. The resultant larger water level drop and accelerated flow rate have notably affected large carnivorous species occupying the upper echelons of the food chain, leading to a significant decline in the top predator population. This decline, in turn, alleviates predation pressure and enhances resource availability, enabling omnivorous fish with lower nutritional requirements to access more abundant nutritional resources, thereby facilitating their accelerated growth [36, 37].

The growth patterns of fish species can be altered, leading to changes in biological parameters [38, 39]. The regression parameters *a* and *b* for fish species in this basin differ from those reported in previous studies, For example, according to the previous studies, the parameter *b* of *S. argentatus* in the Qiantang River basin was 2.64, with a 95% CL ranging from 2.36 to 2.92 [24]. However, it was 3.245 (95% CL: 2.81–3.14) in our study, which may be attributed to the higher water temperature in the YRB, which promotes fish growth, or more sample sizes. Similar results have also been observed in other fish species, possibly due to unique basin-specific environmental conditions. Furthermore, these fish growth parameters can be influenced by various external factors, including but not limited to trophic resource availability, climate, microenvironmental conditions, and biogeographical distributions [40, 41].

Future research should include consistent monitoring of fish populations and enhancement of related biological datasets to accurately assess fishery resources in the YRB [42]. Additionally, it is essential to continue gathering more length–weight data for these species, including sex-specific measurements on female and male specimens to update the LWRs established in the current study. This systematic methodology aims to thoroughly clarify the complex relationships between ecological factors and individual growth patterns [43].

5. Conclusions

This study established LWR parameters for 13 freshwater fish species in the YRB. It is the first submission of LWR data for four species (*B. granulopinna, P. genilepis, O. duchuunguyeni,* and *S. caobangensis*) to the FishBase database. These contributions significantly enrich the basin's ichthyological database, emphasizing morphometric variations among geographically distinct populations of conspecific taxa. The data of LWR provide valuable insights for advancing biometric interconversion, from fundamental baselines for comprehensive fishery resource assessments, and offer theoretical frameworks for optimizing fishery management policies in the YRB. Future, fishery research in the YRB should utilize LWR data as a cornerstone for investigating population dynamics of biotic communities, thereby establishing a scientific basis for sustainable fishery resource utilization, enhancing aquatic productivity, and informing ecosystem conservation strategies across the Pearl River Basin.

Data Availability Statement

The data that support the findings of this study are available from the corresponding authors upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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