Journal of Applied Ichthyology

WILEY

RESEARCH ARTICLE OPEN ACCESS

Length–Weight Relationships of Four Fish Species Belonging to the Genus *Traccatichthys* (Teleostei: Nemacheilidae) in Southern China

Shu Ni | Fengxiang Di | Chuxuan Qiu | Shaofeng Huang

Ecological Environment Monitoring and Scientific Research Center, Pearl River Basin and South China Sea Ecological Environment Supervision and Administration Bureau, Ministry of Ecological Environment, Guangzhou, Guangdong, China

Correspondence: Shaofeng Huang (hsf@zjnhjg.mee.gov.cn)

Received: 31 May 2025 | **Revised:** 6 December 2025 | **Accepted:** 16 December 2025

Academic Editor: Yintao Jia

ABSTRACT

Traccatichthys is a genus of small benthic omnivorous nemacheiline loaches, with limited ecological and biological data available. Here, we described length–weight relationships (LWRs) for four *Traccatichthys* species from southern China. Fishes were sampled using stationary fish cages (10 m in length, mesh size: 0.5 cm) between January and April 2025 at four selected sampling sites. All specimens were transported to the laboratory within 2 days of collection, maintained alive in oxygenated water, and measured for total length (TL) to the nearest 0.1 cm and body weight (BW) to the nearest 0.01 g in the laboratory. LWRs were calculated using linear regression, and the four species-specific models were all highly significant ($p < 0.001$). The allometric exponent b values ranged from 2.875 to 3.196. The LWRs for three species (*T. tuberculum*, *T. zispi*, and *T. taeniatus*) are new to FishBase (as of May 2025). Our results provide essential baseline data for sustainable management and ecological research of these species.

1 | Introduction

Length–weight relationships (LWRs) in fish are crucial for studying growth, life history, and population dynamics, as they reflect individual condition and population-level trends [1, 2]. With growing awareness of ecological protection, non-destructive monitoring technologies for fish—such as hydroacoustics, camera recordings, and Underwater Visual Census (UVC)—have gained increasing application [3]. In this context, LWRs provide partial compensation for the inability of these technologies to obtain body weight (BW) information, typically by establishing empirical equations to estimate weight from length measurements. This information also enables biometric and morphological comparisons across different fish species [1, 4].

Traccatichthys, currently comprising 5 valid species, is a genus of small benthic omnivorous fish in the family Nemacheilidae, primarily distributed in freshwater streams of southeastern Eurasia [5]. The validity of *Traccatichthys* remained controversial for a long time; some species of *Traccatichthys* were synonymized with *Micronemacheilus* [6–10]. Recent studies have described the morphological distinguishing characteristics between *Traccatichthys* and *Micronemacheilus* by examining specimens and further demonstrated the monophyletic nature of both genera through molecular phylogenetic analyses [11–13]. Thus, the validity of *Traccatichthys* as a distinct genus was confirmed.

Loaches in the genus *Traccatichthys* represent a taxonomically contentious, ecologically significant, and economically valuable lineage of freshwater fishes [13]. As one of the world's

biodiversity hotspots, the South China region is also a primary habitat for fish of the genus *Traccatichthys* [14]. However, LWR data for these fishes are scarce and have rarely been updated. This study has described LWRs for four fish species in the genus *Traccatichthys* from southern China. Our results have not only supplied or updated information for FishBase but may also stimulate further research on essential population parameters to facilitate better management and conservation of river ecosystems in southern China.

2 | Materials and Methods

Sampling of fish specimens was carried out between January and April 2025 at four selected sampling sites in southern China. Collection dates and locations varied among the four fish species, with specific details listed in Table 1. Fish specimens of the four fish species were all sampled using stationary fish cages (10 m long, mesh size: 0.5 cm). All fish specimens were sampled using stationary fish cages (10 m long, mesh size: 0.5 cm), which were deployed in river water bodies at dusk (17:00–19:00) and retrieved the following early morning (07:00–09:00). Specimens were transported to the laboratory within 2 days in refrigerated containers and kept alive in oxygenated aquaria in order to conduct more accurate species identification and measurement work. Fishes were identified to species level according to morphological keys [11–13]. Total length (TL) was measured to the nearest 0.1 cm, and BW was recorded to the nearest 0.01 g. All scientific names were verified against FishBase.

Directly fitting the inherent nonlinear relationship between variables often leads to significant estimation errors. Thus, we first linearized the relationship via logarithmic transformation before performing regression analysis. The association between BW and TL was calculated using the log-transformed power function equation: $\log BW = \log a + b \log TL$, where BW is the body weight (g), TL is the total length (cm), a is the regression intercept, and b is the slope [15]. All statistical analyses were performed using the lm() function in the "stats" package of R (Version 4.3.2; [16]) at a significance level of 5% ($\alpha = 0.05$). Prior to regression analysis, outliers were identified and removed using log-log plots with standardized residuals [1].

3 | Results

Descriptive statistics and estimated LWR parameters were summarized in Table 2, including sample sizes, minimum and maximum TL (cm) and BW (g) for each species, as well as regression parameters a and b with their 95% confidence intervals (CIs). The coefficient of determination (r^2) for each species was also presented.

4 | Discussion

Traccatichthys was initially erected by Freyhof and Serov [6] to include two species: *T. pulcher* [7] and *T. taeniatus* [8]. *Traccatichthys zispi* was first described by Prokofiev [9] as a new species from Hainan Island, with morphological comparisons to *T. taeniatus*. However, since Prokofiev was reluctant to accept the validity of *Traccatichthys*, he described *T. zispi* as *Micronemacheilus zispi* at the time. Prokofiev [10] later treated *Traccatichthys* as a valid genus distinct from *Micronemacheilus*. In the present study, we recognize *T. zispi* as a valid species within *Traccatichthys* rather than *M. zispi*, based on combined morphological and molecular evidence [11–13].

This study provides the first LWR data for *T. tuberculum*, *T. zispi*, and *T. taeniatus*, which lacked such records in FishBase [17]. While LWRs for *T. pulcher* exist on FishBase, our results report a new maximum TL for this species [17]. The estimated b values (2.875–3.195) for all four species fall within the expected range of 2.5–3.5 [1]. *T. pulcher* exhibited a b value > 3, indicating positive allometric growth (faster weight gain relative to length), consistent with prior studies [2, 18, 19]. In contrast, *T. tuberculum* and *T. taeniatus* had b values < 3, suggesting energy allocation toward somatic (length) growth over biomass accumulation, which may enhance locomotor efficiency for predator avoidance and foraging [18]. Notably, LWRs are influenced by the growth stage, sex, gonadal maturity, and environmental conditions [1, 20, 21], which were not controlled for in this study. Additionally, b values may vary with season and habitat [1, 4], and our sampling was limited to a narrow temporal and geographic scope, potentially limiting generalizability to populations in other river systems or climatic zones. Nevertheless, our findings

TABLE 1 | Sample sources of four fish species belonging to the genus *Traccatichthys* used in this study.

Species	Sampling months	City	River	Position
Traccatichthys pulcher (Nichols and Pope, 1927)	March	Guangzhou, Guangdong	Liuxi River	23.659816°N 113.673735°E
Traccatichthys tuberculum [11]	January and February	Nanning, Guanxi	Qingshui River	23.451441°N 108.606672°E
Traccatichthys zispi [9]	March	Qionghai, Hainan	Wanquan River	19.139366°N 110.263419°E
Traccatichthys taeniatus (Pellegrin and Chevey, 1936)	April	Fangchenggang, Guangxi	Beilun River	21.752923°N 107.790964°E

TABLE 2 | Descriptive statistics and estimated length–weight relationship (LWR) parameters for four fish species of *Traccatichthys* were derived from samples collected in the southern China between January and April 2025 using stationary fish cages (10 m long, mesh size: 0.5 cm).

Species	*N*	TL range (cm)	BW range (g)	*a*	95% CI of *a*	*b*	95% CI of *b*	r^2
Traccatichthys pulcher (Nichols and Pope, 1927)[M]	137	3.6–11.7	0.30–13.17	0.0052	0.0045–0.0062	3.196	3.108–3.284	0.9745
Traccatichthys tuberculum[R] [11]	78	5.3–10.6	1.29–9.81	0.0097	0.0070–0.0133	2.909	2.756–3.061	0.9492
Traccatichthys zispi[R] [9]	56	4.5–8.9	0.77–6.88	0.0062	0.0046–0.0084	3.179	3.020–3.337	0.9671
Traccatichthys taeniatus (Pellegrin and Chevey, 1936)[R]	35	6.9–10.0	2.70–8.13	0.0104	0.0065–0.0166	2.875	2.653–3.097	0.9532

Note: *a*, regression intercept of LWR; *b*, slope of LWR; $\log BW = \log a + b \log TL$. *N*, number of individuals; r^2, coefficient of determination.
Abbreviations: BW, body weight; CI, confidence intervals; TL, total length.
[M]: new maximum total length record reported, updating FishBase data [17].
[R]: no LWR information in FishBase as of May 2025 [17].

update FishBase [17] with critical baseline data, supporting efforts to characterize growth patterns and develop targeted conservation strategies for these fish resources.

5 | Conclusion

In summary, we have ascertained LWRs for four *Traccatichthys* species from southern China. Notably, this is the first record of LWRs for three species (*T. tuberculum*, *T. zispi*, and *T. taeniatus*) in the FishBase database, which enriches the essential information pool for fish research in this region and addresses the previous gaps in understanding the growth patterns of these species. These LWRs can be used for the conversion between TL and BW in relevant fish stock assessment, which is conducive to conducting in-depth investigations into population parameters, and thus we anticipate our results will provide robust support for the sustainable utilization and management of fish resources, as well as ecosystem management practices.

Acknowledgments

The authors thank the colleagues and fishermen who participated in the survey. This study was funded by the Construction and Operation of the National Ecological and Environmental Monitoring Network (102144210500020009001).

Funding

This study was funded by the Construction and Operation of the National Ecological and Environmental Monitoring Network (102144210500020009001).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

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

References

1. R. Froese, "Cube Law, Condition Factor and Weight–Length Relationships: History, Meta-Analysis and Recommendations," *Journal of Applied Ichthyology* 22, no. 4 (2006): 241–253, https://doi.org/10.1111/j.1439-0426.2006.00805.x.

2. J. Y. He, Z. Q. Wu, Y. S. Li, et al., "Length-Weight Relationships of Twenty-Nine Native Fish Species From Hongshui River, Southern China," *Journal of Applied Ichthyology* 1 (2023): 1744641, https://doi.org/10.1155/2023/1744641.

3. J. P. Egerton, A. F. Johnson, J. Turner, L. LeVay, I. Mascareñas-Osorio, and O. Aburto-Oropeza, "Hydroacoustics as a Tool to Examine the Effects of Marine Protected Areas and Habitat Type on Marine Fish Communities," *Scientific Reports* 8, no. 1 (2018): 47, https://doi.org/10.1038/s41598-017-18353-3.

4. J. Shao, J. Y. Li, H. Zhang, et al., "Length-Weight and Length-Length Relationships of Four Endemic Fish Species From the Middle Reaches of the Yangtze River Basin, China," *Journal of Applied Ichthyology* 32, no. 6 (2016): 1329–1330, https://doi.org/10.1111/jai.13158.

5. M. Kottelat, "Conspectus Cobitidum: An Inventory of the Loaches of the World (Teleostei: Cypriniformes: Cobitoidei)," *Raffles Bulletin of Zoology* 26 (2012): 1–199.

6. J. Freyhof and D. V. Serov, "Nemacheiline Loaches From Central Vietnam With Descriptions of a New Genus and 14 New Species (Cypriniformes: Balitoridae)," *Ichthyological Exploration of Freshwaters* 12 (2001): 133–191.

7. J. T. Nichols and C. H. Pope, "The Fishes of Hainan," *Bulletin of the American Museum of Natural History* 54 (1927): 321–394.

8. J. Pellegrin and P. Chevey, "Poissons Nouveaux ou Rares du Tonkin et de l'Annam," *Bulletin de la Société Zoologique de France* 61 (1936): 291–231.

9. A. M. Prokofiev, "A New Species of the Genus *Micronoemacheilus* Rendahl 1944 (Balitoridae: Nemacheinae) From Hainan (China) With Notes on Its Status," *Journal of Ichthyology* 44 (2004): 191–198.

10. A. M. Prokofiev, "Morphological Classification of Loaches (Nemacheilinae)," *Journal of Ichthyology* 50, no. 10 (2010): 827–913, https://doi.org/10.1134/S0032945210100012.

11. C. X. Du, E. Zhang, and B. P. L. Chan, "*Traccatichthys tuberculum*, A New Species of Nemacheiline Loach From Guangdong Province, South China (Pisces: Balitoridae)," *Zootaxa* 3586, no. 1 (2012): 304–312, https://doi.org/10.11646/zootaxa.3586.1.28.

12. L. N. Du, J. Yang, R. Min, X. Y. Chen, and J. X. Yang, "A Review of the Cypriniform Tribe Yunnanilini Prokofiev, 2010 From China, With an Emphasis on Five Genera Based on Morphologies and Complete Mitochondrial Genomes of Some Species," *Zoological Research* 42, no. 3 (2021): 310–334, https://doi.org/10.24272/j.issn.2095-8137.2020.229.

13. L. N. Du, S. J. Li, F. Xu, et al., "Clarification of Phylogenetic Relationships Among Chinese Nemacheilids With Tube-Shaped Anterior Nostrils, With a Description of a New Genus and Two New Species," *Journal of Zoological Systematics and Evolutionary Research* 1 (2023): 3600085–11, https://doi.org/10.1155/2023/3600085.

14. S. Q. Zhu, in *The Loaches of the Subfamily Nemacheilinae in China (Cypriniformes: Cobitidae) (in Chinese)* (Jiangsu Science and Technology Press, 1989).

15. M. Y. Hossain, Z. F. Ahmed, P. M. Leunda, et al., "Condition, Length–Weight and Length–Length Relationships of the Asian Striped Catfish *Mystus vittatus* (Bloch, 1974) (Siluriformes: Bagridae) in the Mathabhanga River, Southwestern Bangladesh," *Journal of Applied Ichthyology* 22, no. 4 (2006): 304–307, https://doi.org/10.1111/j.1439-0426.2006.00803.x.

16. R Core Team, *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, 2023), https://www.r-project.org.

17. R. Froese and D. Pauly, eds., *Fishbase. World Wide Web Electronic Publication* (2025), http://www.fishbase.org.

18. M. Islam, M. Siddik, M. Hanif, M. Chaklader, A. Nahar, and I. Ilham, "Length-Weight Relationships of Four Small Indigenous Fish Species From an Inland Artisanal Fishery, Bangladesh," *Journal of Applied Ichthyology* 33, no. 4 (2017): 851–852, https://doi.org/10.1111/jai.13374.

19. C. G. Wang, H. Liu, L. Zhu, L. L. Huang, and Y. Q. Huang, "Length-Weight Relationships of Seven Fish Species From Guijiang River in Guangxi Region, China," *Journal of Applied Ichthyology* 37, no. 3 (2021): 497–499, https://doi.org/10.1111/jai.14181.

20. E. D. Le Cren, "The Length-Weight Relationship and Seasonal Cycle in Gonad Weight and Condition in the Perch (*Perca fluviatilis*)," *Journal of Animal Ecology* 20, no. 2 (1951): 201–219, https://doi.org/10.2307/1540.

21. F. W. Tesch, "Age and Growth," in *Methods for Assessment of Fish Production in Fresh Waters*, ed. W. E. Ricker (Blackwell Scientific Publications, 1971).