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Research Article

Length–Weight and Length–Length Relationships of Six Fish Species From the Middle Section of the Yangtze River Basin, China

Chaoyang Wan,[1] **Fang Dong**,[1] **Xiao Xie**,[2] **Zhiyu Cai**,[3] **Myonghee Kang**,[4] **and Hui Zhang**[1]

[1]*Key Laboratory of Freshwater Biodiversity Conservation, Ministry of Agriculture and Rural Affairs of China, Yangtze River Fisheries Research Institute, Chinese Academy of Fishery Sciences, Wuhan, China*
[2]*Aquatic Biological Resources Monitoring Station of Yuanjiang River and Lishui River, College of Life and Environmental Sciences, Hunan University of Arts and Science, Changde, China*
[3]*Chinese Sturgeon Nature Reserve in Yichang Reach of the Yangtze River, Yichang, China*
[4]*Department of Maritime Police and Production System, The Institute of Marine Industry, Gyeongsang National University, Tongyeong-si, Republic of Korea*

Correspondence should be addressed to Myonghee Kang; mk@gnu.ac.kr and Hui Zhang; zhanghui@yfi.ac.cn

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This study estimated the length–weight relationships (LWRs) and length–length relationships (LLRs) for 6 fish species in the middle Yangtze River basin and its adjacent lakes (*Ochetobius elongatus* (Kner 1867), *Rhinogobio cylindricus* (Günther 1888), *Hemibagrus macropterus* (Bleeker 1870), *Pseudobagrus albomarginatus* (Rendahl 1928), *Siniperca knerii* (Garman 1912), and *Coreosiniperca roulei* (Wu 1930)). All fish specimens were seasonally collected through scientific research monitoring of fishery resources from May 2020 to June 2023. A triple gillnet (with a mesh size of 20–30 mm, a height of 2.0–4.0 m, and a length of 30–50 m) was employed for the capture. The LWRs and LLRs of all specimens were highly significant ($p < 0.05$), featuring high correlation coefficients ($r^2 \geq 0.9511$). These findings not only enriched the data in FishBase but also offered supplementary references for the management of the Yangtze River during its fishing ban period.

1. Introduction

The Yangtze is the longest river in China and the third longest river in the world. It is rich in fish resources and serves as an important germplasm resource repository for freshwater fish in China [1]. Fish length–weight relationships (LWRs) are an important tool for applications in fisheries research. They can be used to determine weight and biomass from length data and for comparisons of species-specific growth between regions and among seasons provided that the same sampling methodology is used [2, 3]. Similarly, length–length relationships (LLRs) possess certain significance in fisheries research for conversion between different body length types [4]. In this study, we gathered length and weight data from six fish species from the middle reaches of the Yangtze River to calculate their LWRs and LLRs. These findings can contribute to or update the data and information on these species in FishBase and also assist in the conservation and management of fish resources.

2. Materials and Methods

The fish specimens in this study were collected from the Yichang section (30°39′10″N, 111°20′12″E), Yueyang section (29°29′56″N, 113°11′43″E), Jiayu section (29°56′16″N, 113°41′29″E), Shishou section (29°45′53″N, 112°35′47″E), Lishui section (29°26′50″N, 110°2′10″E), and Liangzi Lake (30°12′23″N, 114°34′57″E) of the middle Yangtze River basin and its affiliated lakes, China. Specimens were seasonally captured by fishery resources scientific research

Table 1: Descriptive statistics and estimated parameters of length–weight relationships (LWRs) and length–length relationships (LLRs) for 6 fish species in the middle Yangtze river basin, China.

Family/species	*N*	TL range (cm)	SL range (cm)	BW range (g)	*a*	95% CL of *a*	*b*	95% CL of *b*	r^2 (LWR)	*p*	*q*	r^2 (LLR)
Xenocyprididae												
Ochetobius elongatus Kner, 1867[ab]	14	33.0–47.3	27.9–41.1	188.2–562.8	0.0059	0.0018–0.0189	2.9675	2.655–3.280	0.9728	4.1084	1.063	0.9545
Gobionidae												
Rhinogobio cylindricus Günther, 1888[b]	45	20.5–45.5	17.1–38.8	57.1–578.0	0.0042	0.0022–0.0078	3.1306	2.945–3.316	0.9641	0.679	1.1483	0.9953
Bagridae												
Hemibagrus macropterus Bleeker, 1870[b]	85	24.5–57.8	21.2–51.1	73.0–1130.0	0.0043	0.0025–0.073	3.0532	2.902–3.204	0.9511	1.1464	1.1137	0.9758
Pseudobagrus albomarginatus Rendahl, 1928[ab]	94	6.7–33.2	5.9–29.6	2.9–212.3	0.0175	0.0132–0.0237	2.6949	2.580–2.810	0.9593	0.4325	1.1080	0.9893
Sinipercidae												
Siniperca knerii Garman, 1912[b]	79	13.4–37.3	11.2–32.4	24.9–657.7	0.0071	0.0045–0.0110	3.2035	3.064–3.343	0.9646	0.4393	1.144	0.9905
Coreosiniperca roulei Wu, 1930[ab]	50	11.7–23.5	9.9–20.7	13.0–158.1	0.0044	0.0026–0.0075	3.2909	3.094–3.488	0.9592	1.1705	1.0807	0.9773

Note: N, number of individuals; $\log BW = \log a + b \log TL$; $TL = p + qSL$.

Abbreviations: BW, body weight; SL, standard length; TL, total length.

[a]Species with no LWRs information in FishBase up to June 2024.

[b]Species with no LLRs information in FishBase up to June 2024.

monitoring during the period from May 2020 to June 2023, using triple gillnets (mesh size: 20–30 mm; height: 2.0–4.0 m; and length: 30–50 m). All captured fish were either measured immediately in the field or transported to the laboratory within 24 h of being frozen. Detailed measurements, including total length (TL), standard length (SL), and body weight (BW), were recorded for each fish, with a precision of 0.1 cm for lengths and 0.1 g for weight, following the methods outlined by Ding [5] and Yang [6]. The scientific names of each fish species were determined by referencing FishBase [7].

A linear regression equation, $TL = p + qSL$, was used to construct the relationship between TL and SL. In this equation, p represents the intercept and q represents the slope of the linear regression [8]. In addition, we employed the logarithmic transformation equation $\log BW = \log a + b \log TL$ to establish the relationship between BW and TL [9], where a and b are the intercept and slope, respectively. Log–log plots were utilized to screen out outliers prior to performing the regression analysis [3]. The data were analyzed using the "stats" package in R (Version 4.2.1) [10], with a significance level set at 5% ($p = 0.05$).

3. Results

In this study, 367 samples (representing 6 species in 4 families) were caught from the Yangtze River. Table 1 summarizes the estimated parameters for LLRs and LWRs, along with the descriptive statistics. All regressions were significant ($p < 0.05$), with r^2 (LWRs) ≥ 0.9511 and r^2 (LLRs) ≥ 0.9545. This study has updated the maximum TL record of *H. macropterus* in FishBase. The new measurement is 57.8 cm, whereas the previous record was 54.2 cm.

4. Discussion

In this research, length and weight data were measured for a total of 367 samples of six fish species from four families to estimate LWRs and LLRs. The results showed that the coefficients of determination values (r^2) of LWRS and LLRs for all 6 research objects were > 0.95. The values for b of six fish species ranged from 2.6949 for *P. albomarginatus* to 3.2909 for *C. roulei*, all falling within the acceptable range of $2.5 < b < 3.5$ proposed by Froese [3]. These results contribute to the knowledge on the species from the middle section of the Yangtze River basin, China.

Compared with previous studies, the b values of *R. cylindricus*, *H. macropterus*, and *S. knerii* show some differences [4, 7, 11]. The deviation may be caused by the following environmental factors and biological factors, such as samples numbers, sampling frequency, seasonal differences, length type, gonad maturity, and growth phase [12, 13].

In summary, our results provide new information on the FishBase of the Yangtze River and contribute to further research and management of the species.

Data Availability Statement

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

Conflicts of Interest

The authors declare no conflicts of interest.

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