

Research Article

Length-Weight Relationships of Four Fish Species of the Upper Yangtze River, Sichuan, China

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In this study, the length-weight relationships were determined for four fish species of the upper Yangtze River, Sichuan province, China. The fish were collected by drift net (mesh size: 4 cm × 4 cm) and ground bamboo cages (1 cm × 1 cm) from Yalong River, Laixi River, Pingtung River, and Baoxing River. Samples were collected from March 2017 to December 2022. According to the length-weight function equation ($W = aL^b$), r^2 values ranged from 0.960 to 0.991 and the b values of LWRs ranged from 2.916 (*Megalobrama pellegrini*) to 3.095 (*Claea dabryi*).

1. Introduction

Yangtze River, the longest river in Asia, is the habitat of more than 400 species of fish [1]. The upper reaches of the Yangtze River are rich in fish resources and have a complex ecological environment. There are more than 240 species of fish distributed here [2], including more than 40 species of rare and protected fish [3], such as *Acipenser sinensis* (Gray, 1835), *Acipenser dabryanus* (Duméril, 1869), *Hucho bleekeri* (Kimura, 1934), and *Procypris rabaudi* (Tchang, 1930) and some unique species such as *Schizothorax sinensis* (Herzenstein, 1889), [4] and *Claea dabryi* (Sauvage, 1874) [5]. Keys [6] proposed an equation describing the relationship between the length and weight of fish, and Froese [7] further elaborated on the LWRs for specific fish. Therefore, this method of analyzing fish population characteristics has been recognized widely and used as a fundamental tool for fishery research and management [8]. To compare the relationship between standard length and body weight of fish from March 2017 to December 2022, four fish species distributed in the upper reaches of Yangtze River were collected and the relationships between body weight and standard length were analyzed.

2. Materials and Methods

Fish samples were collected twice a year from March 2017 to December 2022. The sampling tools included drift nets (mesh size: 4 cm × 4 cm) and ground bamboo cages (1 cm × 1 cm). The sampling area includes the Yalong River, Laixi River, Pingtung River, and Baoxing River (Table 1). The collected fish were firstly classified according to the morphology by referring to the fishes of Sichuan (Ding, 1994) and then verified by mitochondrial DNA marker. The standard length is accurate to 0.1 cm and body weight accurate to 0.1 g. During data analysis, a simple linear regression model was used to fit each species data with logarithmically converted data to determine the 95% confidence interval (CI) of parameters a and b , and the length-weight function equation ($W = aL^b$) [7].

3. Results

The descriptive statistical results of sample number (N), length range, weight range, parameters a , b , 95% confidence interval, and correlation coefficient (r^2) of the four fish species were shown in Table 2. r^2 values ranged from 0.960 to

TABLE 1: Sampling sites of the four fish species from the upper Yangtze River, China.

Species	Sampling sites	Sampling river/sampling time(year)
<i>Claea dabryi</i> (Sauvage, 1874)	30°23′–30°43′N; 102°45′–102°48′E	Baoxing river, 2017-2018
<i>Megalobrama pellegrini</i> (Tchang, 1930)	28°57′–29°16′N; 105°21′–105°28′E	Laixi river, 2021-2022
<i>Schizopygopsis malacanthus</i> (Herzenstein, 1891)	26°36′–29°27′N; 101°17′–101°48′E	Yalong river, 2019-2020
<i>Schizothorax sinensis</i> (Herzenstein, 1889)	31°3′–32°28′ N; 104°31′–105°10′E	Pingtung river, 2021-2022

TABLE 2: Length-weight relationships (LWRs) for four fish species in the upper Yangtze River.

Species	N	Length range (cm)	Weight range (g)	a	95% CI of a	b	95% CI of b	r ²
<i>Claea dabryi</i> (Sauvage, 1874)	96	3.8–16.2	0.9–60.1	0.0102	0.0074–0.0142	3.095	2.942–3.247	0.960
<i>Megalobrama pellegrini</i> (Tchang, 1930)	572	6.6–33.8	7.9–713.6	0.0242	0.0180–0.0325	2.916	2.819–3.013	0.961
<i>Schizopygopsis malacanthus</i> (Herzenstein, 1891)	115	2.8–28.1	0.3–269.3	0.0134	0.0123–0.0154	3.003	2.946–3.060	0.991
<i>Schizothorax sinensis</i> (Herzenstein, 1889)	187	8.3–45.8	17.4–1602.7	0.0191	0.0125–0.0292	2.999	2.863–3.136	0.976

0.991. The b value of LWRs were ranged from 2.916 (*Megalobrama pellegrini*) to 3.095 (*Claea dabryi*).

4. Discussion

Studies have shown that the standard length-weight equation ($W = aL^b$) reflected the living environment and growth rate of fish. It is generally believed that the larger a value is, the better the conditions such as feed and water quality the living environment [9]. b value reflects the growth type of fish, and the parameter b was usually between 2.5 and 4.0 in the natural environment [7]. $b = 3$ indicated that the growth of the population's length and body weights was constant; $b > 3$ indicated that the body weight of fish was accelerated growth; otherwise, the standard length of fish was accelerated growth [9]. Based on this theory, two of the four fish species in this study were in a natural state ($b > 3$), indicating that the body weights were increasing rapidly. The b value suggested their living environment was relatively stable. In contrast, the other two fish species were more or less exposed to environmental disturbance. The a value ranged from 0.0102 to 0.0242, which also confirmed that the fish were significantly affected by their living environment. This was in agreement with the previous research result [9].

The recent report on *Claea dabryi* (Sauvage, 1874) demonstrated that the standard length ranged from 4.3 to 6.4 cm and the body weight ranged from 1.0 to 3.6 g [10]. The range of standard length and body weight of our study exceeds previously reported maximum or minimum values for this species. *Megalobrama pellegrini* (Tchang, 1930) was recently reported to have the standard length of 19.6–48.5 cm and the body weight of 80.77–1726.8 g [8]. The result of this study exceeds previously reported minimum values for this species. Similar situation was observed in *Schizopygopsis malacanthus* (Herzenstein, 1891) in which reported that the standard length of this fish was 5.8–52.8 cm, and the body weight was 1.4–442.7 g [11]. The length-weight relationships of *Schizothorax sinensis* (Herzenstein, 1889) have not been reported. The present results are of great significance for the protection of endemic fish

and the scientific management of the ecosystem in Yangtze River.

Data Availability

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

Ethical Approval

The study protocol was approved by the Animal Care and Use Committee of the Fishery Institute of the Sichuan Academy of Agricultural Sciences (20170301001A) and was performed in compliance with the guidelines for the care and use of laboratory animals.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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