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Research Article

Length-Weight Relationships for Ten Fish Species from Rivers in the Qinling Mountains, China

Yunrong Shi, Jieqing Yang, Xinran Li, Haizhou Li, Jinchen Yu, Lang Chen, and Jin Zhou

East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, Shanghai, China

Correspondence should be addressed to Jin Zhou; zhou_jin@foxmail.com

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Length-weight relationships (LWRs) were reported for ten fish species (*Abbottina rivularis*, *Hemibarbus labeo*, *Hemibarbus maculatus*, *Onychostoma macrolepis*, *Opsariichthys bidens*, *Rhynchocypris lagowskii*, *Schizothorax prenanti*, *Sinibrama macrops*, *Zacco platypus*, and *Siniperca scherzeri*). Fishes were collected from 62 sampling stations covering an area of ~7000 km^2 in the Qinling Mountains, characterized by unique fauna and distribution pattern, using gillnets and ground cages during June to December 2022. The intercept a ranged from 0.013 for *S. prenanti* to 0.060 for *H. labeo*, and the slope b ranged from 2.537 for *H. labeo* to 3.079 for *Z. platypus*.

1. Introduction

Length-weight relationships (LWRs) for fishes have been used extensively as a useful approach to evaluate biomass in fisheries science and ecological research [1–3]. Owing to the LWR, ecologists and managers have access to understand the size, growth status, age class, and other biological characteristics of different fish populations and stocks [4].

The Qinling Mountains extend 400–500 km in an east-west direction through southern Shaanxi Province [5] and are considered as a significantly ecological barrier [6] as well as natural boundary between temperate and subtropical zones [7]. The mountains are rich in fish species, while at least 142 taxa had been recorded [8]; among these, relatively high percent of numbers of those species are of commercial (e.g., *Hemibarbus labeo, Hemibarbus maculatus,* and *Sinibrama macrops*) or/and ecological (e.g., *Onychostoma macrolepis, Schizothorax prenanti,* and *Siniperca scherzeri*) importance [8, 9]; however, the LWR for those taxa in the area remains poorly known. Analysis of LWR is essential to the local fisheries management and conservation [2]. Therefore, the present investigation examines the LWR for ten fish species from rivers in the Qinling Mountains, China, to explore the LWR for these taxa.

2. Materials and Methods

This study was conducted in 62 sampling sites in Hanjiang River, Jianglingjiang River, and Danjiang River and their tributary rivers, located in the south-facing slopes of the Qinling Mountains and draining into the Yangtze River (Figure 1). Fishes were caught monthly by three types of gillnets (two are of 50.0 × 1.0 m with mesh size of 2.0 cm and 50.0 × 2.0 m with 12.0 cm, respectively, and the other one is of 50.0 × 1.2 m with those of 4.0, 6.0, and 8.0 cm) and ground cages (10.0 m length with mesh size of 1.0 cm) from June to December 2022. Standard lengths were measured to the nearest 0.1 cm and body weights to 0.1 g with a fish ruler and an electronic balance, respectively. The regression equation $W = aL^b$ and its linear-transformed model $\log W = \log a + b \log L$, where W is the body weight of the fish, L is the standard length, a is the intercept, and b is the slope of the regression model, were utilized to estimate parameters a and b. All statistical analyses were performed by software Excel 2010 and SPSS Statistics 27.

3. Results

A total of 3,803 fish individuals representing 10 species belonging to 2 families were examined. Table 1 shows the

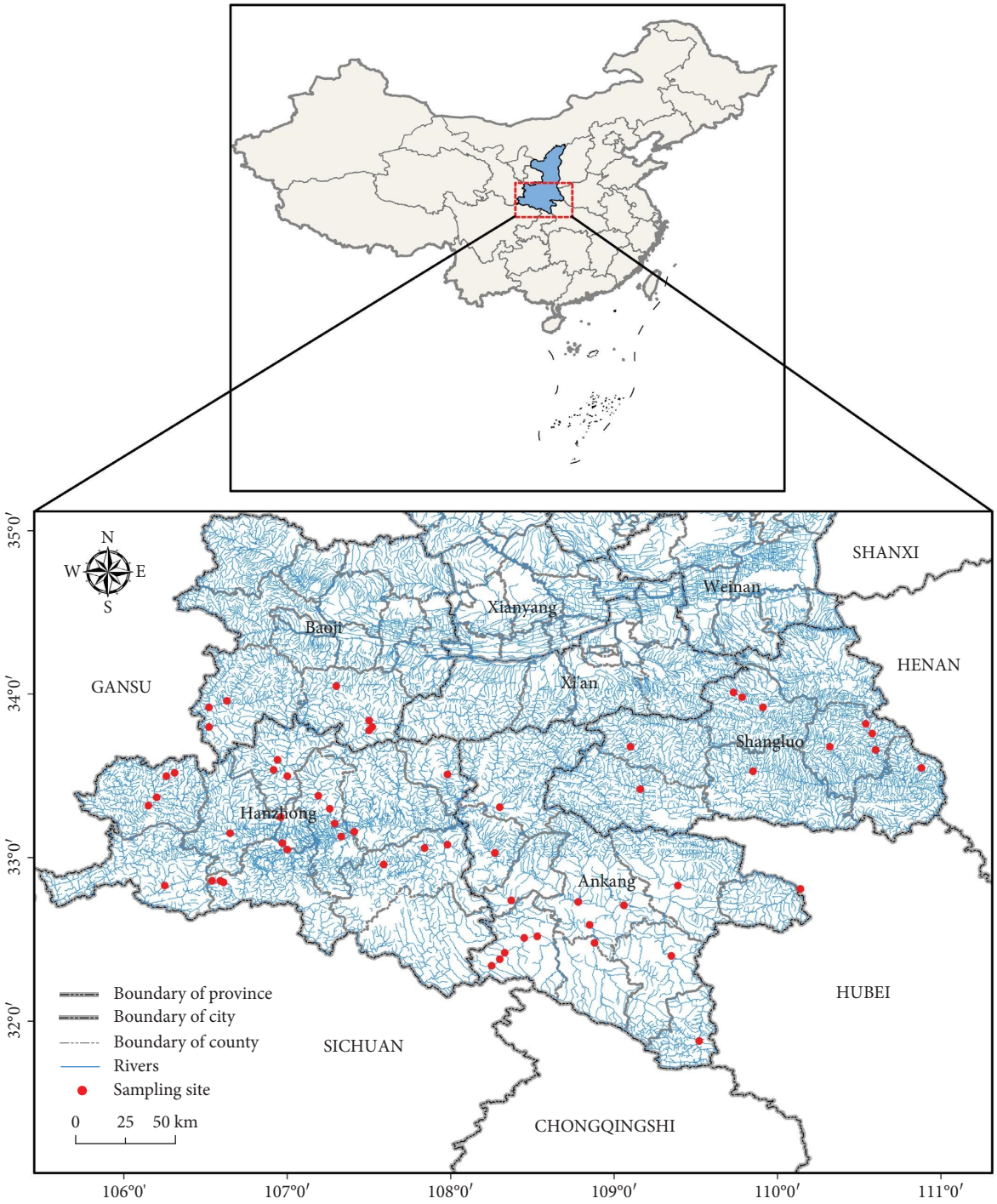

Figure 1: Locations of fish sampling sites from rivers in the Qinling Mountains.

estimated parameters for LWR of those fish species. All ten LWRs were extremely significant ($P < 0.01$) with coefficients of determination ranging from 0.9357 for *Zacco platypus* to 0.9868 for *Schizothorax prenanti*. The intercept *a* varied from 0.013 for *S. prenanti* to 0.060 for *Hemibarbus labeo*, and the slope *b* ranged from 2.537 for *H. labeo* to 3.079 for *Z. platypus*.

4. Discussion

The present research provided new insights into the current knowledge of sizes and LWR for fish. To our knowledge, the present work is the first report on LWR analysis for these ten species except *O. macrolepis* from rivers in the Qinling Mountains, draining into the Yangtze River [10].

Table 1: Statistical values and estimated parameters of length-weight relationships for ten fish species from the Qinling Mountains, China.

Family	Scientific name	N	r^2	Range		a	95% CI of a	b	95% CI of b
				SL (cm)	BW (g)				
Cyprinidae	*Abbottina rivularis*	46	0.9714**	3.1–16.7	0.8–56.0	0.022	0.013–0.038	2.865	2.544–3.186
	Hemibarbus labeo	247	0.9635**	3.7–33.0	2.2–514.5	0.060	0.049–0.073	2.537	2.459–2.615
	Hemibarbus maculatus	645	0.976**	3.2–16.5	0.4–75.6	0.017	0.015–0.018	2.982	2.926–3.037
	Onychostoma macrolepis	169	0.9667**	3.8–27.0	0.9–395.0	0.016	0.012–0.022	3.011	2.889–3.132
	Opsariichthys bidens	649	0.9656**	3.4–20.4	0.6–170.0	0.015	0.014–0.016	3.034	2.998–3.069
	Rhynchocyprislagowskii	907	0.9510**	3.4–14.0	0.4–43.2	0.015	0.013–0.016	2.989	2.940–3.037
	Schizothorax prenanti	94	0.9868**	3.9–17.8	0.6–78.2	0.013	0.011–0.014	3.072	3.000–3.136
	Sinibrama macrops	41	0.9866**	3.2–13.7	0.9–56.1	0.019	0.012–0.030	2.943	2.661–3.225
	Zacco platypus	932	0.9357**	2.9–14.9	0.4–66.4	0.014	0.013–0.015	3.079	3.038–3.120
Percichthyidae	*Siniperca scherzeri*	73	0.9617**	5.2–37.0	2.2–980.0	0.021	0.015–0.029	2.972	2.865–3.079

**$P < 0.01$.

Our results of standard length analyses indicate that each population was represented by both adults and juveniles according to FishBase [9]. In addition, this work reveals a wider range size of length for four species, namely, *Abbottina rivularis*, *Hemibarbus labeo*, *Opsariichthys bidens*, and *Siniperca scherzeri*, in comparison with that outlined in published literature [11, 12] and FishBase [9]. Although the LWRs for fish can be tested via standard length tool or total length method [13], the advantage of the former one is that it may measure fish specimens whose caudal fin is partially or completely lost due to sampling or preying from predators during the investigation or other reasons that remain poorly known. Knowledge of relations (LLR) in the two parameters for fish is also significant to fisheries research and management [14]; thus, our future work will focus on LLR for fish taxa within the Qinling Mountains.

In our investigation, the LWRs for most of the examined species (nine species) have relatively higher good fit (>0.95), suggesting that body weight and length increase proportionally. Moreover, values of slope b and its confidence interval, except for *Hemibarbus labeo*, are in agreement with those reported by Froese [4] who concluded that exponent b for LWR for fish should be between 2.5 and 3.5. Furthermore, such a lower one of slope b for *H. labeo* when compared with that in other reports [12, 15] and FishBase [9], suggesting that the negative allometric growth pattern for the taxon which inhabitats within the Qinling Mountains.

LWR for fish is related to its body shape and further growth rate [14], which may be determined by many mechanisms. Ecologists have outlined that temperature, together with its significant seasonal differences, plays a key role in influencing fish growth [16]; therefore, LWRs for fish tend to change seasonally [17]. However, the present study period only covered May to December 2022 rather than the whole year; as a result, specimens were not collected during the winter and early spring period when temperature was relatively low. Consequently, the estimated LWR parameters reveal herein not the annual average values but study period ones. Other factors such as habitat condition [18], sex [18], sample size [19, 20], stomach fullness [20], section location [21], and feeding [22] are believed to structure the LWR of fish; these aspects, however, are not considered in the present study and should be taken into account in future research studies.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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