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Length–Weight Relationships and Diversity Status of Fishes in the Midstream of the Jialing River, a Tributary of the Upper Yangtze River, China

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Abstract: The study described the length–weight relationships (LWRs) and diversity status of fishes in the midstream of the Jialing River, which is the largest tributary of the upper Yangtze River, China. A total of 4592 specimens from 53 fish species belonging to three orders and eight families were collected from December 2021 to November 2022. The results showed that *Culter oxycephaloides*, *Xenocypris davidi*, *Hemibarbus labeo*, *Hemiculter tchangi* were dominant fish species in the study region. Twenty-five fish species ($IRI \geq 10$) were subjected to LWR analysis, and the regression parameters a and b for fish species varied from 0.006 to 0.333 and 2.129 to 3.391. Eleven fish species were determined to have isometric growth, and 14 fish species were determined to have allometric growth. The diversity analyses suggested that the diversity status of fishes were kept relatively stable during the sampling period and that the fishes suffered moderate disturbance in the midstream of the Jialing River. The present study provided basic biology data for fish conservation and management after the fishing ban in the Jialing River.

Keywords: biodiversity; length–weight relationships; fish conservation; the Jialing River; the upper Yangtze River

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1. Introduction

The Jialing River is the largest tributary of the upper Yangtze River with a total length of 1120 km long and watershed area about 160,000 km^2 [1,2]. Because of complex topography, climate, and hydrology conditions, the Jialing River provides an ideal habitat for rare and endemic fishes of the upper Yangtze River [3]. Once, the Jialing River sustained highly fish biodiversity and resources, making it an important part of the fishery region in southwest China [4]. Zeng and Zhou [5] reported that there are 156 species of fish in the Jialing River basin, nearly 40 species of which are endemic to the upper Yangtze River. Liu [6] also showed that the total annual fishery resource in the midstream of the Jialing River is more than 37,000 t. However, the Jialing River is a typical canalized and fishery river in the upper Yangtze River basin [7]. The dam projects and overfishing caused habitat fragmentation and a decline in resources, leading to a series of severe challenges to native fishes [8,9]. In order to protect fish diversity and resource, the Jialing River has implemented a ten-year fishing ban since 1 January 2021 [10] (http://www.cjyzbgs.moa.gov.cn/tzgg/201912/t20191227_6334009.htm, accessed on 27 December 2019). In the past, researchers have conducted several studies on fish populations and communities in some sections of the Jialing River, but studies on fish biology and diversity have received little attention after the fishing ban in the Jialing River [11,12].

In case studies, length–weight relationships (LWRs) provide useful growth information that is interconnected with the determination of biological parameters such as age, maturity, and feeding [13,14]. Moreover, LWRs can turn growth curves of length into growth curves of weight, which serve as a key tool for fishery resource assessment and management [15]. LWRs were proposed by Keys [16] and have been widely used in fish growth and stock dynamic studies. For example, Hercos [17] researched the length–weight relationships of ornamental fish species from Amanã Lake, Brazil and proposed that the data not only comprised important information on population and community ecology, but can also serve as a baseline for local ornamental fish trade management. However, fundamental data of the LWRs for fishes in the Jialing River are not available and few fish species (*Gnathopogon herzensteini*, etc.) have been described [18,19]. In the context of the river canalization and the fishing ban, it is essential to conduct a comprehensive survey on the length–weight relationships (LWRs) of fishes in the Jialing River.

Biodiversity is a global reflection of the ecological processes associated with organisms and environments [20,21]. Diversity analysis is an important way to understand the status of fish resources. Generally, Margalef's richness index (D), Shannon's diversity index (H'), and Pielou's evenness index (J') are mostly employed to investigate fish diversity status [22–24]. In addition, the abundance–biomass curve (ABC), as two curves of abundance and biomass established in a coordinate system, is usually used to examine the degree of disturbance and individual size variation of fishes [25]. Nelson [26] conducted a study on *Salvelinus confluentus* and found that dam construction led to a decline in migratory fish diversity. Bianchi et al. [27], Liu and Cao [28] also suggested that disturbances such as overfishing caused the miniaturization of fish individuals, resulting in a significant reduction in fishery stocks. Thus, there is a need to strengthen the monitoring of fish diversity and to keep track of resource dynamics after the fishing ban in the Jialing River.

In this study, the length–weight relationships and diversity status of fishes were analyzed in the midstream of the Jialing River. The results will provide basic data for research on fish biology and ecology, and the study can provide theoretical bases for the conservation and management of fishes in the Jialing River.

2. Materials and Methods

2.1. Study Region

The Jialing River originates from the northern of Qinling Mountain, Shaanxi province [12]. Usually, the Jialing River can be divided into three sections, the upstream reach has meandering watercourses and deep valleys, which range from the source to Guangyuan; the midstream reach holds flat riverbeds and circular channels, which extend from Guangyuan to Hechuan; the downstream reach, with a broad water surface and lower altitude, stretches from Hechuan to the confluence with the Yangtze River in Chongqing [2].

In this study, data were collected from the midstream of the Jialing River (31°39′–31°56′ N, 105°54′–106°02′ E) (Figure 1). This region is located in the northeast of the Sichuan Basin and the landform is dominated by hills and mountains. The study region has a subtropical monsoon climate and the annual average temperature is about 16.7 °C. Moreover, the water-resource supply mainly comes from precipitation, of which 70–85% is concentrated in summer and autumn [29].

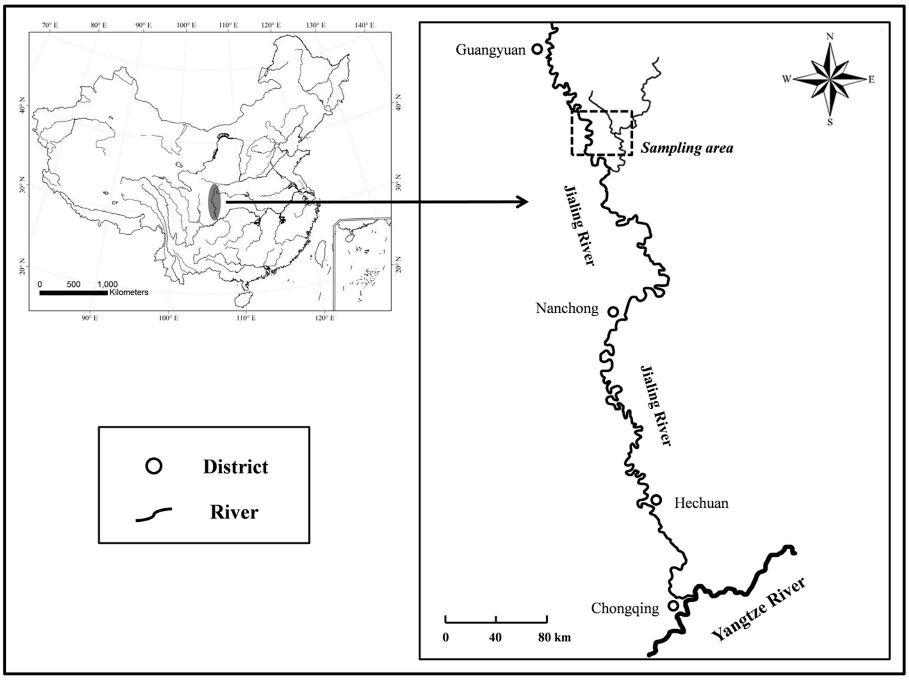


Figure 1. Map of study region in the Jialing River, the shaded part represents the Jialing River basin, the dotted region is the sampling area in the midstream of the Jialing River.

2.2. Sample Collection

The filed surveys were conducted in December 2021 to November 2022. The fish samples were collected biannually by using gillnets (100 m long × 2 m high and 200 m long × 2 m high; 4 cm, 6 cm, 10 cm mesh size) and trap-nets (10 m long; 0.5 cm mesh size). Once captured, specimens were identified at the species level following Ding [1] and Chen [30]. Then, specimens were measured and the standard length (*SL*) was recorded to the nearest 0.1 cm and body weight (*BW*) was recorded to the nearest 0.1 g accuracy in the field. Finally, the specimens were fixed in a 10% formalin solution and stored at the College of Life Science, China West Normal University.

2.3. Data Analysis

The index of relative importance (*IRI*) proposed by Pinkas [31] was used to analyze the fish composition of dominant species in the midstream of the Jialing River. The *IRI* combines abundance, biomass, and occurrence to avoid discriminations in identifying species dominance due to individual differences. The *IRI* was calculated by the following formula: $IRI = (N_i\% + W_i\%) \times F_i\%$, where $N_i\%$ is the quantity percentage of species i, $W_i\%$ is the weight percentage of species i, and $F_i\%$ is the occurrence frequency of species i. $IRI \geq 1000$ were dominant species, $1000 > IRI \geq 100$ were subdominant species, $100 > IRI \geq 10$ were companion species, and $IRI < 10$ were rare species.

The LWRs were calculated by the following formula: $BW = aSL^b$, where BW is the body weight (g), SL is the standard length (cm), a and b are regression parameters, which is quantified by the linear regression equation: $\log BW = \log a + b\log SL$. The 95% confidence interval (*CI*) was determined for the regression parameters and the coefficient of determination was represented by r^2 [13]. To confirm whether the exponent b of regression was significantly different from 3, Pauly's t-test was used to identify the type of growth, where $b = 3$ indicates that fish have isometric growth, $b < 3$ indicates that fish have negative allometric growth, $b > 3$ suggests that fish have positive allometric growth [32].

The Margalef's richness index (*D*), Shannon's diversity index (*H'*), Pielou's evenness index (*J'*), and abundance–biomass curve (ABC) were employed to evaluate the diversity and disturbance status of fishes. The Margalef's richness index (*D*) is a function describing the degree of biological abundance with larger values indicating greater abundance of biological resources [23]; the Shannon's diversity index (H') mainly describes the uncertainty about the occurrence of individuals and reflects the complexity for the community structure of species, with larger values indicating higher uncertainty and higher diversity [22]; the Pielou's evenness index (J') reflects the evenness of species distribution with larger values indicating more evenly distributed of species and higher stability of ecosystem [24]; and the abundance–biomass curve (ABC) is a measure for the degree of disturbance to species, when the organisms are undisturbed, the biomass dominance curve always lies above the abundance–dominance curve, when the organisms are moderately disturbed, the abundance and biomass–dominance curves nearly coincide or partially cross, when the organisms are severely disturbed, the abundance–dominance curve lies above the biomass–dominance curve [25].

Specifically, the Margalef index (D) was calculated by equation: $D = \frac{(S-1)}{lnN}$; Shannon-Wiener index (H') was measured by equation: $H' = -\sum p_i ln p_i$; Pielou index (J') was computed by equation: $J' = \frac{H'}{InS}$; and abundance–biomass curve (ABC) [25] was measured by equation: $w = \sum \frac{(W_i - N_i)}{50(S-1)}$. Where p_i is the proportion of species i to the total quantity (N) of fishes, S is the number of fish species, N_i is the quantity of species i, W_i is the weight of species i. When the biomass–dominance curve lies above the abundance–dominance curve, w has a positive value; conversely, w has a negative value.

The data analyses were performed in the Primer 5.2.9 [33] and SPSS 20.0 [34].

3. Results

In this study, a total of 4592 individuals with total weight 1,446,624.0 g were collected during the survey period in the study region, and 53 species of fish belonging to three orders and eight families were identified (Table 1). Among them, 38 species were Cyprinidae, seven species were Bagridae, two species were Siluridae, two species were Serranidae, and Catostomidae, Cobitidae, Gobiidae, Channidae each had one species. Specifically, seven species, including *Myxocyprinus asiaticus*, *Parabotia bimaculata*, *H. tchangi*, *Megalobrama pellegrini*, *Acheilognathus omeiensis*, *Acrossocheilus monticolus*, *Procypris rabaudi* were rare and endemic fishes of the upper Yangtze River. *M. asiaticus*, *Onychostoma macrolepis*, *P. rabaudi* were listed as class II national protected species.

Table 1. Fish composition in the midstream of the Jialing River sampled from December 2021 to November 2022. N% represents quantity percentage, W% represents weight percentage, F% represents occurrence percentage, *IRI* is the index of relative importance, Dominance is defined according to *IRI* results and ★ represents endemic fishes of the upper Yangtze River.

Species	N_i%	W_i%	F_i%	*IRI*	Dominance
Cypriniformes					
Catostomidae					
Myxocyprinus asiaticus ★	0.00	0.00	0.06	0.79	rare species
Cobitidae					
Parabotia bimaculata ★	0.00	0.00	0.02	0.09	rare species
Cyprinidae					
Ctenopharyngodon idellus	0.01	0.05	0.49	295.22	subdominant species
Squaliobarbus curriculus	0.00	0.00	0.04	0.84	rare species
Pseudolaubuca sinensis	0.00	0.00	0.02	0.05	rare species
Pseudolaubuca engraulis	0.00	0.00	0.04	0.22	rare species
Hemiculter leucisculus	0.00	0.00	0.06	2.12	rare species
Hemiculter tchangi ★	0.22	0.03	0.45	1099.37	dominant species
Culter oxycephaloides	0.15	0.20	0.84	2957.42	dominant species
Cultrichthys erythropterus	0.00	0.00	0.04	0.30	rare species
Culter alburnus	0.02	0.03	0.63	327.94	subdominant species
Culter mongolicus	0.02	0.02	0.45	180.86	subdominant species

Table 1. *Cont.*

Species	N_i%	W_i%	F_i%	*IRI*	Dominance
Megalobrama pellegrini ★	0.00	0.00	0.04	0.63	rare species
Megalobrama amblycephala	0.00	0.00	0.02	0.10	rare species
Xenocypris argentea	0.00	0.00	0.04	0.33	rare species
Xenocypris davidi	0.06	0.14	0.84	1721.03	dominant species
Xenocypris microlepis	0.02	0.07	0.59	536.94	subdominant species
Pseudobrama simony	0.03	0.01	0.37	143.56	subdominant species
Hypophthalmichthys molitrix	0.03	0.14	0.33	570.10	subdominant species
Aristichthys nobilis	0.01	0.07	0.51	425.30	subdominant species
Hemibarbus labeo	0.12	0.07	0.75	1387.33	dominant species
Hemibarbus maculates	0.01	0.01	0.29	43.73	companion species
Sarcocheilichthys sinensis	0.01	0.00	0.22	32.37	companion species
Sarcocheilichthys nigripinnis	0.01	0.00	0.16	11.66	companion species
Squalidus argentatus	0.06	0.00	0.35	202.92	subdominant species
Rhinogobio typus	0.00	0.00	0.14	4.21	rare species
Saurogobio dabryi	0.03	0.00	0.37	124.34	subdominant species
Saurogobio punctatus sp. nov.	0.00	0.00	0.08	2.09	rare species
Rhodeus ocellatus	0.00	0.00	0.02	0.04	rare species
Rhodeus sinensis	0.00	0.00	0.02	0.09	rare species
Acheilognathus omeiensis ★	0.00	0.00	0.06	1.19	rare species
Acheilognathus chankaensis	0.01	0.00	0.16	19.91	companion species
Spinibarbus sinensis	0.01	0.02	0.27	59.50	companion species
Acrossocheilus monticolus ★	0.00	0.00	0.08	1.40	rare species
Onychostoma sima	0.00	0.00	0.16	10.07	companion species
Onychostoma macrolepis	0.00	0.00	0.02	0.06	rare species
Procypris rabaudi ★	0.00	0.00	0.02	0.05	rare species
Cyprinus carpio	0.02	0.07	0.63	543.18	subdominant species
Cyprinu carpio L. *mirror*	0.00	0.00	0.08	2.40	rare species
Carassius auratus	0.04	0.02	0.78	477.21	subdominant species
Siluriformes					
Bagridae					
Pelteobagrus fulvidraco	0.00	0.00	0.06	0.52	rare species
Pelteobagrus vachelli	0.01	0.00	0.25	20.07	companion species
Pelteobagrus nitidus	0.01	0.00	0.16	9.50	rare species
Leiocassis crassilabris	0.02	0.00	0.37	85.83	companion species
Pseudobagrus truncates	0.00	0.00	0.02	0.05	rare species
Pseudobagrus emarginatus	0.00	0.00	0.02	0.06	rare species
Mystus macropterus	0.01	0.00	0.24	30.28	companion species
Siluridae					
Silurus asotus	0.00	0.00	0.14	5.06	rare species
Silurus meridionalis	0.00	0.00	0.02	0.17	rare species
Perciformes					
Serranidae					
Siniperca chuatsi	0.05	0.03	0.33	259.70	subdominant species
Siniperca scherzeri	0.00	0.00	0.02	0.07	rare species
Gobiidae					
Rhinogobius giurinus	0.00	0.00	0.06	0.39	rare species
Channidae					
Channa argus	0.00	0.00	0.08	0.97	rare species

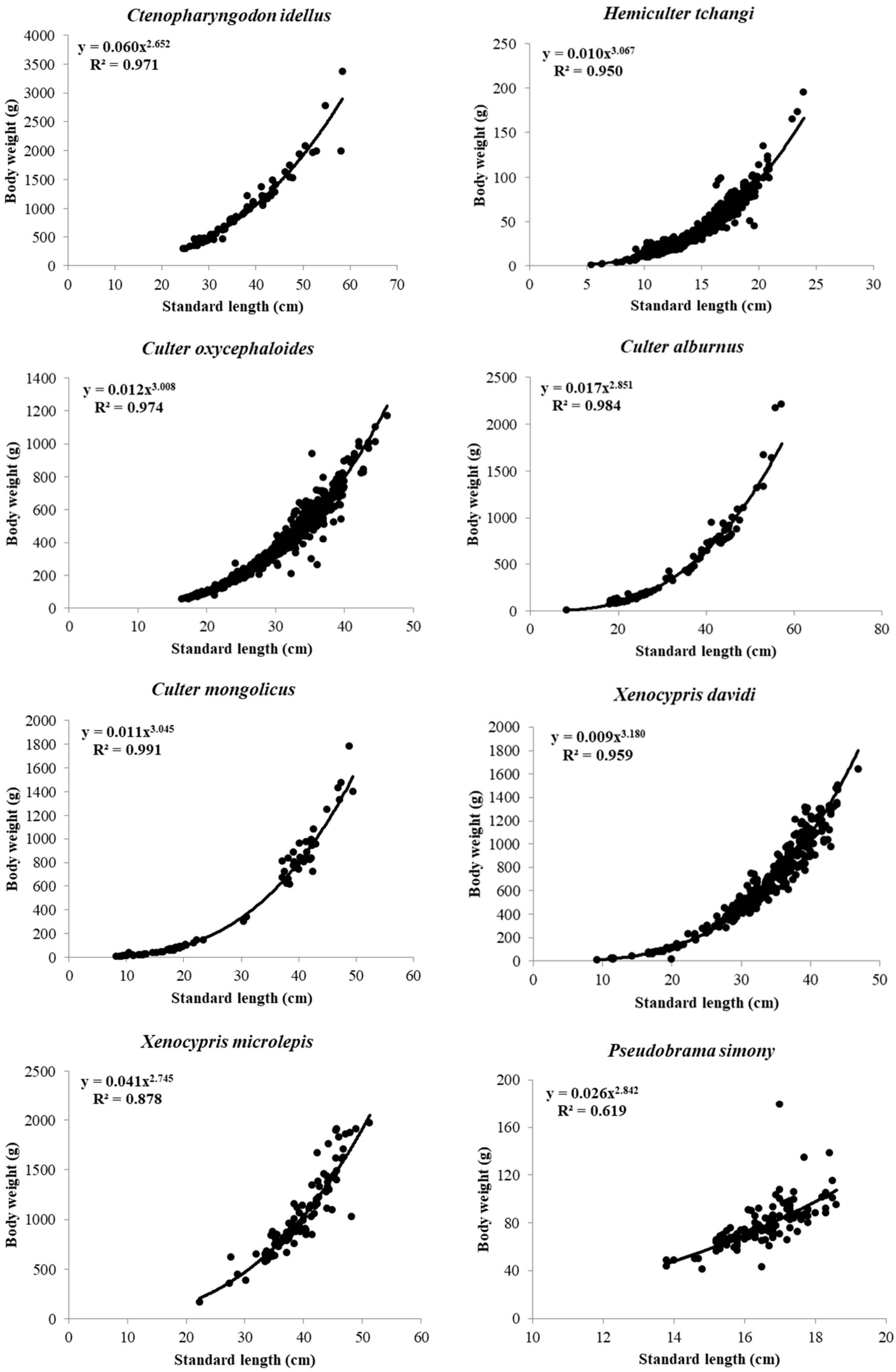
The results of *IRI* showed that *C. oxycephaloides*, *X. davidi*, *H. labeo*, *H. tchangi* were dominant fish species, *Ctenopharyngodon idellus*, *Culter alburnus*, *Culter mongolicus*, *Xenocypris* *microlepis*, *Pseudobrama simony*, *Hypophthalmichthys molitrix*, *Aristichthys nobilis*, *Squalidus argentatus*, *Saurogobio dabryi*, *Cyprinus carpio*, *Carassius auratus*, *Siniperca chuatsi* were subdominant fish species, and others were companion and rare fish species in the midstream of the Jialing River (Table 1). Additionally, in order to ensure the validity of length–weight data and the accuracy of the regression parameters, only $IRI \geq 10$ species of fish were allowed to participate in the LWRs analysis.

Eventually, 25 fish species were studied to determine the LWRs. Descriptive statistics and regression parameters of LWRs are shown in Figure 2 and Table 2. The standard length (*SL*) ranged from 4.3 cm for *Sarcocheilichthys sinensis* and *Acheilognathus chankaensis* to 85.6 cm for *A. nobilis*, and the body weight varied from 1.4 g for *H. tchangi* to 15980 g for *A. nobilis*. The regressions for all species were significant ($p < 0.05$), with the coefficient of determination (r^2) varying from 0.619 for *P. simony* to 0.991 for *C. mongolicus*. The parameter *a* changed from 0.006 for *Spinibarbus sinensis* to 0.333 for *Onychostoma sima*. The exponent *b* ranged from 2.129 for *O. sima* to 3.391 for *S. sinensis*. The Pauly's *t*-test indicated that 11 fish species were isometric growth ($b = 3$), three fish species were positive allometric growth ($b > 3$), 11 fish species were negative allometric growth ($b < 3$) (Table 2).

Additionally, the present study recorded the length–weight relationships and maximum length of fish species for the first time in FishBase (https://fishbase.mnhn.fr/search.php, accessed on 27 December 2019). The length–weight relationships of *X. davidi* (b = 3.09 and ranged from 3.05 to 3.13 in FishBase), *P. simony* (b = 3.11 and ranged from 3.07 to 3.15 in FishBase), *X. microlepis* (b = 3.08 and ranged from 2.94 to 3.22 in FishBase), *C. alburnus* (b = 3.09 and ranged from 2.97 to 3.21 in FishBase), *H. labeo* (b = 3.10 and ranged from 3.05 to 3.15 in FishBase), etc. were reported for the first time, and the new maximum standard length of *X. davidi* (max *SL* = 42.3 cm in FishBase), *C. oxycephaloides* (max *SL* = 41.6 cm in FishBase) were also recorded in the study (Table 2).

Table 2. Descriptive statistics and regression parameters of length–weight relationships (LWRs) based on the formula: $BW = aSL^b$ for 25 fish species ($IRI \geq 10$) in the midstream of the Jialing River sampled from December 2021 to November 2022. *n* represents sample size, *a* and *b* are regression parameters, *CI* is the confidence interval for parameters, r^2 is the coefficient of determination, Type of growth is determined by comparing the significance of exponent *b* with 3, I represents isometric growth, A- represents negative allometric growth, A+ represents positive allometric growth.

Species	*n*	Standard Length Range (cm)		Body Weight Range (g)		Regression Parameters					Type of Growth
		Min	Max	Min	Max	*a*	95% *CI* of *a*	*b*	95% *CI* of *b*	r^2	
Ctenopharyngodon idellus	68	24.5	58.4	295	3370	0.060	0.040–0.090	2.652	2.539–2.766	0.971	A-
Hemiculter tchangi	1002	5.4	23.9	1.4	195.3	0.010	0.009–0.011	3.067	3.023–3.110	0.950	A+
Culter oxycephaloides	691	16.4	46.2	53.7	1171.1	0.012	0.011–0.014	3.008	2.972–3.045	0.974	I
Culter alburnus	95	8.2	57.2	6.3	2210	0.017	0.014–0.023	2.851	2.777–2.925	0.984	A-
Culter mongolicus	79	8.3	49.5	6.2	1785	0.011	0.009–0.013	3.045	2.979–3.111	0.991	I
Xenocypris davidi	296	9.2	46.9	11.2	1639.5	0.009	0.007–0.011	3.180	3.105–3.255	0.959	A+
Xenocypris microlepis	97	22.3	51.3	164.6	1968.2	0.041	0.019–0.089	2.745	2.536–2.954	0.878	I
Pseudobrama simony	142	13.8	18.6	40.9	179.5	0.026	0.009–0.075	2.842	2.469–3.215	0.619	I
Hypophthalmichthys molitrix	120	7.3	73.5	7.2	9140	0.018	0.012–0.027	3.038	2.929–3.146	0.963	I
Aristichthys nobilis	53	24.9	85.6	205.6	15980	0.015	0.007–0.033	3.078	2.862–3.293	0.941	I
Hemibarbus labeo	543	12.2	28.5	27.7	355.5	0.020	0.016–0.024	2.951	2.887–3.016	0.937	I
Hemibarbus maculates	35	16.8	36	80	845.3	0.011	0.006–0.020	3.129	2.943–3.315	0.973	I
Sarcocheilichthys sinensis	60	4.3	24.2	1.6	190.3	0.027	0.020–0.035	2.933	2.823–3.043	0.980	A-
Sarcocheilichthys nigripinnis	33	4.5	12.5	1.5	38.1	0.009	0.005–0.016	3.325	3.052–3.597	0.952	A+
Squalidus argentatus	254	4.7	14.3	1.5	33.9	0.026	0.020–0.034	2.760	2.639–2.881	0.889	A-
Saurogobio dabryi	142	4.7	19.4	3.2	98.8	0.056	0.039–0.081	2.372	2.227–2.516	0.883	A-
Acheilognathus chankaensis	57	4.3	10.1	2.2	25.2	0.028	0.020–0.039	2.892	2.715–3.068	0.952	A-
Spinibarbus sinensis	25	7.3	49.3	3.2	2430	0.006	0.003–0.013	3.391	3.172–3.610	0.978	I
Onychostoma sima	16	16	39.9	122.7	762.5	0.333	0.080–1.386	2.129	1.668–2.590	0.875	A-
Cyprinus carpio	89	14.8	55.8	92.4	4285	0.044	0.029–0.068	2.840	2.715–2.966	0.959	I
Carassius auratus	165	13.6	27.3	59.8	878.6	0.028	0.017–0.047	3.024	2.847–3.201	0.875	I
Pelteobagrus vachelli	30	8.8	28.2	9.1	192	0.027	0.011–0.067	2.742	2.408–3.075	0.910	A-
Leiocassis crassilabris	86	4.7	29.4	2.3	338.1	0.059	0.043–0.082	2.453	2.339–2.568	0.956	A-
Mystus macropterus	49	6.5	36	3.5	344.2	0.032	0.022–0.047	2.576	2.442–2.710	0.970	A-
Siniperca chuatsi	233	9.9	27.1	20.3	469.3	0.035	0.024–0.051	2.856	2.730–2.981	0.897	A-



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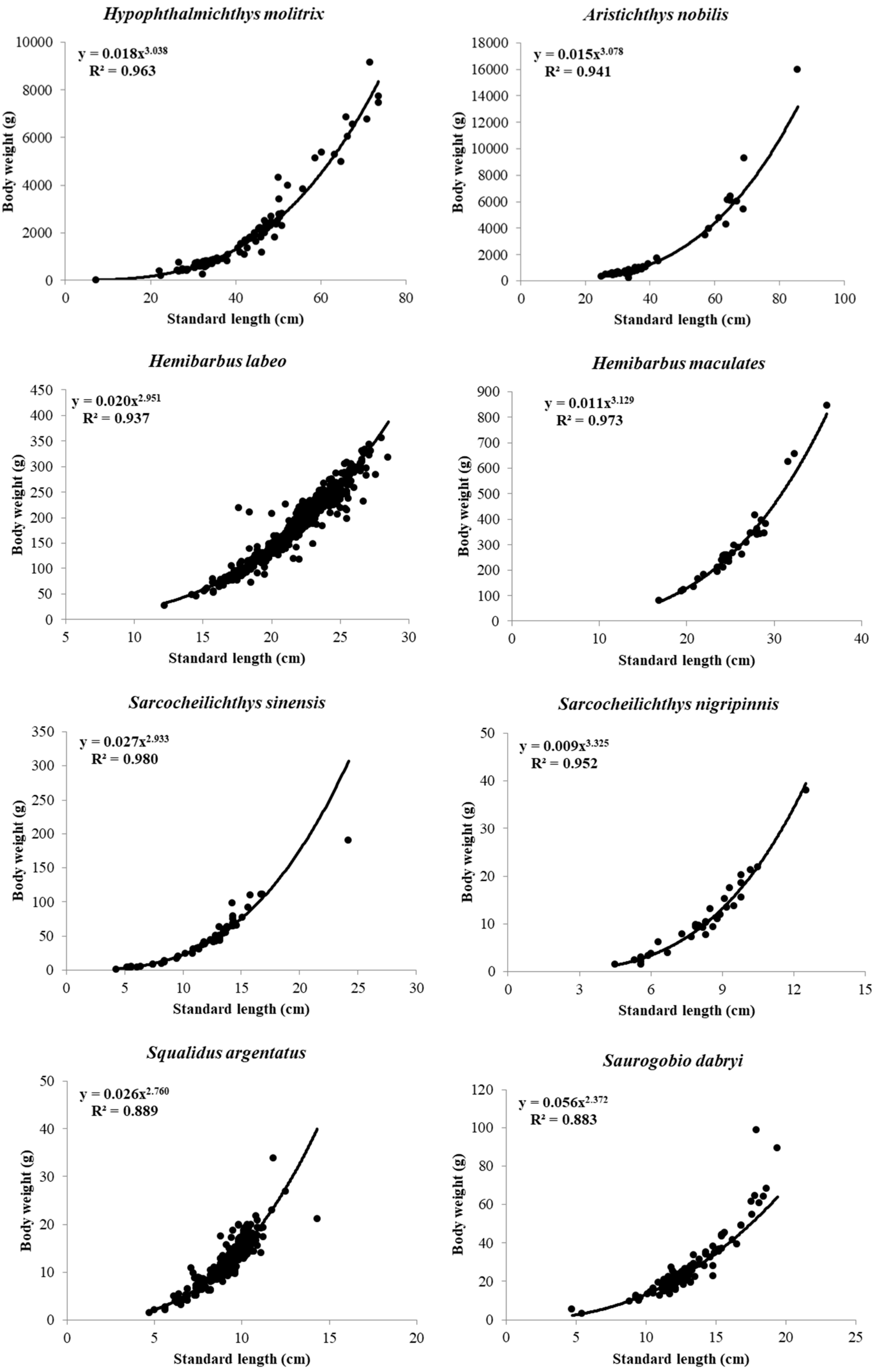

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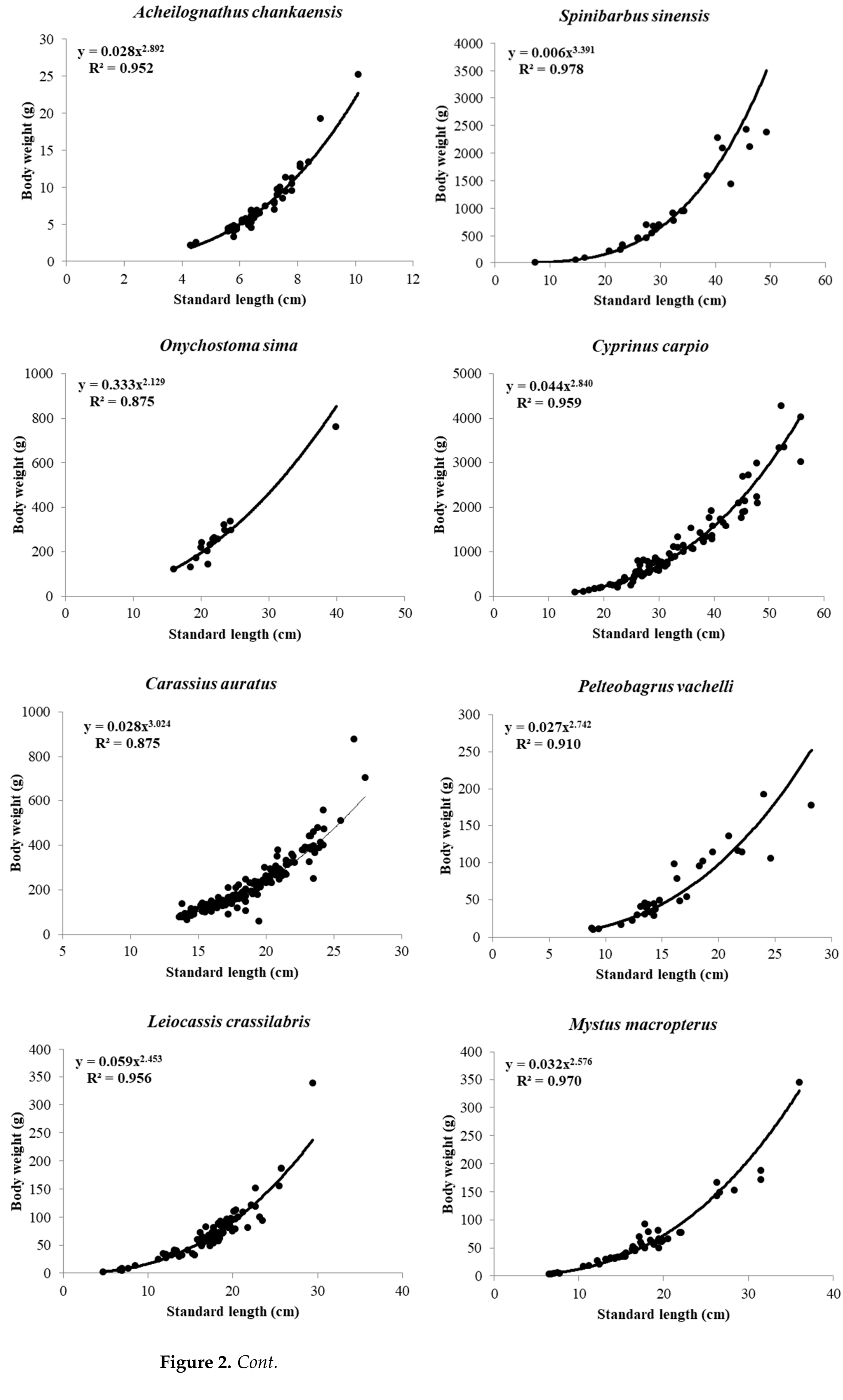

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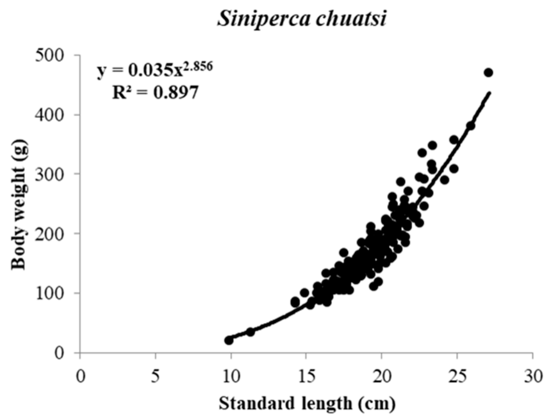

Figure 2. Curves of length–weight relationships (LRWs) based on the formula: $BW = aSL^b$ for 25 fish species in the midstream of the Jialing River sampled from December 2021 to November 2022, R^2 represents the coefficient of determination.

As the diversity analyses have shown, the Margalef's richness index (*D*) was 6.167, Shannon's diversity index (*H*′) was 2.781, Pielou's evenness index (*J*′) was 0.700. The abundance–biomass curve (ABC) showed that the *w* had a positive value (w = 0.052), the biomass–dominance curve was generally above the abundance–dominance curve, but the abundance–dominance curve and biomass–dominance curve nearly overlap and intersect with each other at the start, indicating that the fishes suffered a moderate disturbance (Figure 3).

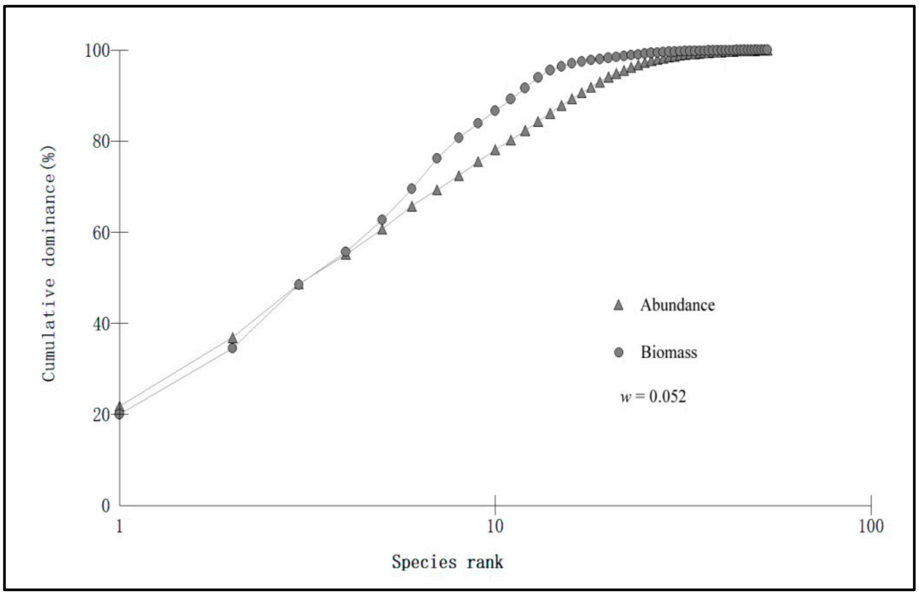

Figure 3. The abundance-biomass curve (ABC) of fishes in the midstream of the Jialing River sampled from December 2021 to November 2022.

4. Discussion

In this study, it was found that the fish species are relatively plentiful and *C. oxycephaloides*, *X. davidi*, *H. labeo*, and *H. tchangi* are dominant species in the study region. The results of this study are consistent with the fish resource investigation in the 1980s in the midstream of the Jialing River. Previous surveys showed that there are 286 fish species distributed in the upper Yangtze River and 156 fish species lived in the Jialing River, and the fish species richness is higher than that in other tributaries such as the Minjiang River (116 fish species) and Tuojiang River (122 fish species) in the upper Yangtze River [1]. In present study, 53 fish species were sampled from the study region. But Qing [11] conducted a survey at 2008 in this region and found that fish resources of dominant species such as *C. oxycephaloides* and *X. davidi* had a significant reduction owing to overfishing. Thus, the study implied that the dominant species of fish in midstream of the Jialing River have been effectively restored after the fishing ban.

Moreover, the LWRs of fish species estimated in the present study in the midstream of the Jialing River provides important information and fills numerous gaps lacking in the literature and FishBase. Previously, there were few studies on LWRs in the Jialing River, only Zhang et al. [18] and Zeng et al. [19] reported a few fish species, such as *Gnathopogon herzensteini*, *Schizothorax prenanti*, *Schizopygopsis kialingensi*. Thus, the study on LWRs of fish species supplies key data for fish biology. Specifically, the exponent *b* of regression correlating with growth styles has received a lot of attention from researchers [35–37]. Tesch [38] suggests that the *b* value for length and weight regression is usually within the expected range of 2.5 to 4.0. In this study, the exponent *b* values of regression varied from 2.129 to 3.391 for 11 fish species with isometric growth and 14 species of fish with allometric growth, which represents a deviation from early studies on fish length and weight regression analyses. Salvador [39] conducted a study on fish species from Rio Doce River basin, Brazil and found that the allometric coefficient of *b* values for fish species were corroborated with the expected values of 2.5 to 4.0. Froese [40] then suggested that the sample size for LWR analysis was an important limitation in the estimation of allometric coefficient of *b* and other parameters. Mehanna and Farouk [41] determined the LWRs of fishes in Eastern Mediterranean Sea, Egypt and proposed that parameters of LWRs for fishes may change significantly with physiological factors and habitat conditions. Therefore, combining with actual situation of the study region, the variations of *b* values in our study may be attributed to physiological factors such as sex, maturity, age, size, diet and habitat conditions such as hydraulic properties, and river connectivity [41,42]. In addition, other parameters, such as the *SL* range, *BW* range, *a*, and r^2, provide important knowledge related to LWRs, which in turn supplies reliable reference for fish biology and ecology studies.

The biodiversity of fishes in the midstream of the Jialing River were represented by Margalef's richness index (*D*) with a value of 6.167, by Shannon's diversity index (*H*′) with a value of 2.781, and by Pielou's evenness index (*J*′) with a value of 0.700, which reflects the complexity and stability of the fish community structure [43]. In comparison with an earlier study, the diversity status is similar to the status observed in 2017–2019 in the midstream of the Jialing River, indicating that the diversity status remained relatively stable at the beginning period of the fishing ban [11]. The abundance–biomass curve (ABC) showed that the biomass–dominance curve was above the abundance–dominance curve and that w was greater than 0, indicating that fishes in the study region were mainly dominated by larger and mature individuals. However, the abundance–dominance curve and biomass–dominance curve nearly overlap and intersect with each other, denoting that disturbance has weakened the dominance of some species [25]. Yan et al. [44] also suggested that human activities such as cascade development, water pollution, and overfishing caused serious disturbances in fish diversity and increased pressure on fish resources. Thus, the present study was conducted to better understand the diversity status of fishes in order to promote the protection of fishery resources in the Jialing River.

5. Conclusions

In summary, the present study on length–weight relationships and diversity status of fishes in the midstream of the Jialing River supplies basic data in the composition, dominance, LWR parameters, and types of growth for fishes in the midstream of the Jialing River. The study also provides evidence that the diversity status of fishes was relatively stable at the sampling period and the fishes suffered from moderate disturbance in the midstream of the Jialing River. The results of the present study provide clear information on fish resource status and also provide scientific strategies for fish conservation and management after the fishing ban in the Jialing River.

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