

Research Article

Study on the Growth Pattern of Four Freshwater Fish Species from the Jialing River Basin, China

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Abstract

The growth pattern of four fish species that inhabit in the Jialing River basin were estimated in the present study. Fishes were collected seasonally from January 2014 to December 2016 at six locations in the Jialing River basin and four times fishing activities were occurred in each season at each location. Fishing tools applied to sampling included creel and stationary gillnets (50 m long × 1.5 m high, mesh sizes: 2, 5 and 8 cm). The growth pattern were estimated using the equation of $W = aL^b$. The constant values of a were ranged from 0.000019 to 0.000075. However, the b values were estimated at 2.8202 to 3.1008. Species of *Liobagrus nigricauda* had a new maximum standard length recorded; the other three species had no previous report for growth pattern in Fish Base. This result could provide primary data for future fish research and conservation regarding these species in the Jialing River basin.

Keywords: Conservation; Ecology; Fish; Growth pattern, Jialing river

Introduction

The equation of $W = aL^b$ is always used to describe the species - specific growth pattern relationships (length - weight relationships)

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for fishes [1,2]. Growth pattern is a useful tool in fish ecology [3,4], e.g. for handling and management tool of water ecosystems [5-7]. Actually, on the one hand, the growth pattern have been widely used to assess stock biomass, population dynamics, and biogeographical relationships [7,8]; on the other hand, the growth pattern is frequently applied to the life - history traits analysis of different fish species or the same species from different localities [9,10]. More specifically, in the laboratory, the parameter a and b are applied to assess whether the fish growth is allometric or isometric, generating discussions about the biology of these species [7]; in the field survey, growth pattern can be used to convert length to weight and vice versa, especially when only length or weight measurements are available [1,11].

Based on a recent ichthyological survey, the growth pattern of four fish species of *Liobagrus nigricauda*, *Saurogobio punctatus*, *Acheilognathus gracilis* and *A. omeiensis* from the Jialing River basin were reported in the present study. *S. punctatus* is a new reported species in 2018 [12], which are distributed in the Yangtze River basin. After careful checking and comparing (Figure 1), it was found that there were large amount of *S. punctatus* settled in the Jialing River, the largest tributary of the upper Yangtze River [13,14]. This is the first time to report that *S. punctatus* is living in the Jialing River. The other three fish species are endemic to China and classified as typical small fishes [13,15]. This study is aim to expand the primary biological knowledge and provide data for future fish research and conservation of the four freshwater fish species.

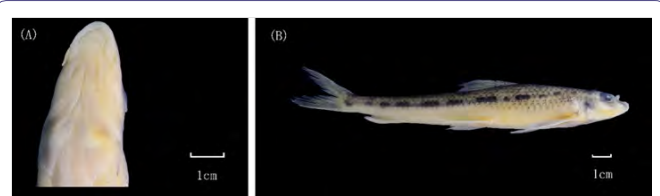


Figure 1: The lateral view (A) and ventral view of the head (B) of *Saurogobio punctatus* collected in the Jialing River.

Materials and Methods

The Jialing River is the largest tributary of the upper Yangtze River [13,14]. *L. nigricauda*, *S. punctatus* and *A. omeiensis* were collected at five sections in the mainstream of the Jialing River, including Guangyuan (32° 24' - 32° 26' N, 105° 46' - 105° 49' E), Cangxi (31° 42' - 31° 44' N, 105° 54' - 105° 56' E), Peng'an (31° 01' - 31° 03' N, 106° 22' - 106° 23' E), Wusheng (30° 19' - 30° 21' N, 106° 14' - 106° 16' E), Hechuan (29° 59' - 30° 00' N, 106° 16' - 106° 17' E) sections. *A. gracilis* was sampled in Sunqing (30° 48' - 30° 49' N, 106° 02' - 106° 04' E) section of the Xihe River (Figure 2), a tributary of the Jialing River. Fish were collected seasonally from January 2014 to December 2016 at each location through creel and stationary gill nets (50 m long × 1.5 m high, mesh size: 2, 5, 8 cm) and four times fishing activities were met in each season at each location. For each sampling, fishing tools were deployed in water for six hours in daytime.

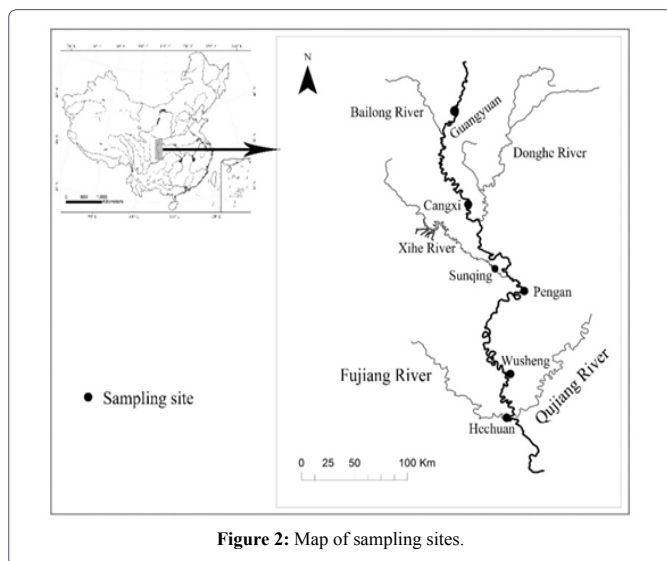


Figure 2: Map of sampling sites.

For each specimen, the identification refer to “The fishes of Sichuan” and “Fauna sinica: Osteichthyes” [13,16]. The standard length (SL, 0.1 cm) and body weight (BW, 0.1 g) were measured immediately after capture. The growth pattern was expressed by the equation $BW = aSL^b$, where the parameters a and b was estimated by linear regression analyses based on logarithms: $\text{Log}(BW) = \text{log}(a) + b \text{ log}(SL)$. The 95 % Confidence Interval (CI) was determined for the regression parameters a and b . additionally, coefficient of determination (r^2) was estimated. Outliers were eliminated by using $\text{log}(TL) - \text{log}(BW)$ plots before regression analyses [1].

Statistical analyses were conducted using SPSS 20.0 (SPSS Inc. Ltd.) and Excel 2016 (Microsoft Office, 2016). All statistical analyses were considered significant at the 0.05 significance level.

Results

L. nigricauda belongs to Amblycipitidae (Siluriformes), *S. punctatus* comes from Gobioninae (Cypriniformes), *A. gracilis* and *A. omeiensis* belong to Acheilognathinae (Cypriniformes). Statistical analysis

demonstrated that growth patterns of the four fish species were significant ($p < 0.05$). Detailed descriptive statistics and estimated parameters of growth patterns for the four fish species are displayed in (Table 1). The constant parameter of a ranged from 0.000019 (*L. nigricauda*) to 0.000075 (*S. punctatus*). The parameter of exponent b were determined as 2.8202 for *A. omeiensis* (95 % CI: 2.5810 - 3.0594) to 3.1008 for *S. punctatus* (95 % CI: 2.9861 - 3.2156). The coefficient of determination (r^2) values ranged from 0.9390 for *S. punctatus* to 0.9846 for *L. nigricauda*. Particularly, the growth pattern for *S. punctatus*, *A. omeiensis*, *A. gracilis* are the first time reported in Fish Base [17], however, the *L. nigricauda* had a new maximum standard length recorded in Fish Base compared to previous study in the Wujiang River [18].

Discussion

By the parameters of the growth patterns, we can know whether the fish growth is allometric or isometric [8]. Previous study indicated fish costs more energy to axial growth than to biomass when parameter b is small than 3, this could help fish to elude predators and to seek food [19]. On the contrary, when the parameter b is great than 3, it signifies fish grows faster in weight than length [19]. In this study, the values of the parameter b for both of the four fish species were extremely close to 3, which indicates that the four species may belong to isometric growth pattern.

Existent studies indicated that growth pattern parameters may be influenced by many factors such as diet, habitat, health, maturity status, preservation techniques, season and sex [20,21]. The new maximum standard length record for *L. nigricauda* appears to be 9.7 cm comparing with 8.9 cm which was previously described for this species [18]. The Jialing River is larger than the Wujiang River [13], *L. nigricauda* in the Jialing River may have more adequate food supply and appropriate habitat than it in the Wujiang River, and those factors may be the reason for this phenomenon. In conclusion, this study is the first reference on the growth pattern for the species of *S. punctatus*, *A. omeiensis*, *A. gracilis* and the new maximum standard length recorded for *L. nigricauda* in the Fish Base. Our results can provide an important database for future studies of the ecological dynamics in related to the four fish species and the conservation of the Jialing River ecosystem.

Specie	N	SL (cm)		BW (g)		Regression parameters				
		Min	Max	Min	Max	a	95 % CI of a	b	95 % CI of b	r ²
Siluriformes										
Amblycipitidae										
<i>Liobagrus nigricauda</i> Regan, 1904	93	4.8	9.8	1.8	13.7	0.000019	0.000011 - 0.000032	2.9400	2.8163 - 3.0637	0.9846
Cypriniformes										
Gobioninae										
<i>Saurogobio punctatus</i> [12]	188	7.8	20.9	5.0	118.2	0.000075	0.000043 - 0.000132	3.1008	2.9861 - 3.2156	0.9390
Acheilognathinae										
<i>Acheilognathus gracilis</i>	73	2.3	7.2	0.3	10.7	0.000023	0.000016 - 0.000033	3.0380	2.9487 - 3.1274	0.9810
<i>Acheilognathus omeiensis</i>	36	4.1	7.0	1.9	8.9	0.000052	0.000020 - 0.000138	2.8202	2.5810 - 3.0594	0.9803

N- Sample size; min- Minimum; max- Maximum; SL- Standard Length; BW- Body Weight; a- intercept; b- slope; r²- coefficient of determination.

Table 1: Descriptive statistics and estimated the growth pattern of four fish species from the Jialing River basin, China. Fish were collected during January 2014 to December 2016 through creel and stationary gillnets (50 m long × 1.5 m high, mesh size: 2, 5, 8 cm).

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References

1. Froese R (2006) Cube law, condition factor and weight-length relationships: History, meta-analysis and recommendations. *Journal of Applied Ichthyology* 22: 241-253.
2. Zhang FB, Xiong XQ, Wu NC, Zeng Y, Fohrer N (2018) Length-weight relationships of two fish species from the Jialing River, the largest tributary of the upper Yangtze River, China. *Journal of Applied Ichthyology* 34: 1373-1375.
3. Zeng Y, Huang YY, Chen YB, Li ZJ (2014) Length-weight relationships of fishes in the Wu Jiao nature reserve and adjacent areas, China. *Journal of Applied Ichthyology* 30: 1099-1100.
4. Martínez-González CC, González-Daza W, Mojica JI (2018) Length-weight relationships of fishes in the Mira basin, Colombia. *Journal of Applied Ichthyology* 34: 1216-1219.
5. Xiong W, Tao J, Zhang DC, Liu CL, He DK, et al. (2015) Length-weight relationships for four small fish species caught in wetlands of central Yangtze River, China. *Journal of Applied Ichthyology* 31: 219-220.
6. Wu LY, Lan JR, Cheng C, Tan QS (2016) Length-weight relationships of two fish species from the Yangtze River, China. *Journal of Applied Ichthyology* 32: 742-743.
7. Camargo MP, Aranha JMR, Menezes MS (2018) Length-Weight Relationship (LWR) of fish species in the Morato River, Paraná, Brazil. *Journal of Applied Ichthyology* 34: 1186-1187.
8. Cella-Ribeiro A, Hauser M, Nogueira LD, Doria CRC, Torrente-Vilara G (2015) Length-weight relationships of fish from Madeira River, Brazilian Amazon, before the construction of hydropower plants. *Journal of Applied Ichthyology* 31: 939-945.
9. Wang J, Liu F, Gong Z, Lin PC, Liu HZ, et al. (2016) Length-weight relationships of five endemic fish species from the lower Yarlung Zangbo River, Tibet, China. *Journal of Applied Ichthyology* 32: 1320-1321.
10. Hossain MY, Hossen MA, Ahmed ZF, Hossain MA, Pramanik MNU, et al. (2017) Length-weight relationships of 12 indigenous fish species in the Gajner Beel floodplain (NW Bangladesh). *Journal of Applied Ichthyology* 33: 842-845.
11. Zhang F, Wu HH, Yang CX, Li CL, Wang YF, et al. (2018) Length-weight relationships of 5 Gobioninae species from the Yellow River basin and Huaihe River basin in Henan Province, China. *Journal of Applied Ichthyology* 34: 1320-1323.
12. Tang QY, Li XB, Yu D, Zhu YR, Ding BQ, et al. (2018) *Saurogobio punctatus* sp. nov., a new cyprinid gudgeon (Teleostei: Cypriniformes) from the Yangtze River, based on both morphological and molecular data. *J Fish Biol* 92: 347-364.
13. Ding RH (1994) The fishes of Sichuan, China. Chengdu: Sichuan Publishing House of Science and Technology 50-486.
14. Zeng Y (2012) Study on ecological structure of fish community in Jialing River. *Resources and Environment in the Yangtze River Basin* 21: 850-857.
15. He YF, Wang JW, Lek S, Cao W, Lek-Ang S (2011) Structure of endemic fish assemblages in the upper Yangtze River Basin. *River Research & Applications* 27: 59-75.
16. Chen YY, Chu XL, Luo YL, Liu HZ, He MJ, et al. (1998) Fauna sinica: Osteichthyes (Cypriniformes II), Vol., Science Press, Beijing, China.
17. Froese R, Pauly D (2019) Fish Base. World Wide Web electronic publication. Kiel, Germany.
18. Yang Z, Tang H, Que Y, Xiong M, Zhu D, et al. (2016) Length-weight relationships and basic biological information on 64 fish species from lower sections of the Wujiang River, China. *Journal of Applied Ichthyology* 32: 386-390.
19. Islam M, Siddik M, Hanif M, Chaklader M, Nahar A, et al. (2017) Length-weight relationships of four small indigenous fish species from an inland artisanal fishery, Bangladesh. *Journal of Applied Ichthyology* 33: 851-852.
20. Bagenal TB, Tesch AT (1978) Conditions and growth patterns in freshwater habitats, Vol., Blackwell Scientific Publications, Oxford, UK.
21. Alavi-Yeganeh MS, Seyfabadi SJ, Keivany Y, Kazemi B, Wallis GP (2011) Length-weight relationships in some populations and species of Iranian toothcarps. *Journal of Applied Ichthyology* 27: 1401-1403.



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