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 \( L. nigricauda \) 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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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), Pengan (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 Xibe 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.
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: Log (BW) = log (a) + b log (SL). The 95 % Confidence Interval (CI) was determined for the regression parameters a and b. Additionally, coefficient of determination (r²) was estimated. Outliers were eliminated by using log (TL) - 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 was 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 (r²) 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.

Existant 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.

<table>
<thead>
<tr>
<th>Specie</th>
<th>N</th>
<th>SL (cm)</th>
<th>BW (g)</th>
<th>Regression parameters</th>
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<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
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<td>7.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>

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


