Technical contribution

Length–weight relationships of 11 fish species from the Yibin reach of the Yangtze River, southwest China

By L. Li1,2, Q. W. Wei1,2,3, J. M. Wu2, X. Xie1,2, L. Ren1,2 and H. Du1,2,3

1College of Fisheries, Huazhong Agricultural University, Wuhan, China; 2Key Laboratory of Freshwater Biodiversity Conservation, Ministry of Agriculture of China, Yangtze River Fisheries Research Institute, Chinese Academy of Fishery Sciences, Wuhan, China; 3Freshwater Fisheries Research Center, Chinese Academy of Fishery Science, Wuxi, China

Summary
Length-weight relationships (LWRs) were evaluated for 11 fish species from the Yibin reach of the upper Yangtze River, southwest China. Samples were collected from April 2012 to January 2013. Length-weight relationships for 11 species were unknown to FishBase, and new maximum lengths are recorded for five species. Results indicate that parameter b ranged from 2.586 (Sinibotia superciliaris) to 3.164 (Rhinogobio ventralis), and r² values ranged from 0.931 (Sinibotia superciliaris) to 0.996 (Silurus meridionalis).

Introduction
The Yangtze River is the third largest river in the world and the longest river in China. The upper reaches of the Yangtze River have an exceptional aquatic ecosystem, with unique geology, topography, and climate, and particularly abundant fish fauna of some 286 species. The upper reaches of the Yangtze are also the habitat for China’s internationally known rare fish, Psephurus gladius (Martens, 1862), as well as many other endemic fish species (Ding, 1994; Wei, 2012). Our study was conducted in the Yibin reach in the upper reaches of the Yangtze River, southwest China. Although fish diversity is high in these upper reaches, data on length-weight relationships (LWRs) are scarce (Pu et al., 2013; Pan et al., 2014; Waryani et al., 2014).

Length-weight relationships of fish species not only have important implications for the assessments of fisheries (Ricker, 1975), biomass (Martin-Smith, 1996), and yield (Garcia et al., 1998), but also provide data for ecosystem modeling in fishery management (Christensen and Walters, 2004). In addition, LWRs can be used for life-history and morphological comparisons among species and populations (Petrakis and Stergiou, 1995; Goncalves et al., 1997). In our study the LWRs for Rhinogobio ventralis, Leptobotia elongata, Pseudobagrus crassilabris, Tachysurus nitidus, Silurus meridionalis, Coreius heterodon, Psephagus vachelli, Coreius guichenoti, Sinibotia superciliaris, Leptobotia taeniops, Rhinogobio typus were determined in order to provide biological data from the upper reaches of the Yangtze.

Materials and methods
The investigation was carried out in the Yibin reaches (28°45′–28°51′N; 104°38′–105°01′E) in the upper reaches of the Yangtze River. Fish specimens were collected between April 2012 and January 2013, using various fishing gear (drift gillnets, stationary gillnets, and shrimp cages). Species were identified in the field, measured to the nearest 1 mm (total length, TL), and weighed to the nearest 0.1 g (weight, W).

The length-weight relationship is expressed by the equation \( W = aL^b \), where \( W \) = body weight (g), and \( L \) = total length (cm), (Ricker, 1973). Parameters \( a \) and \( b \) are estimated by the logarithmic expression: \( \log W = \log a + \log L^b \), with 95% confidence interval, and log-log plots of total length and weight were used to detect outliers (Froese, 2006).

Results
A total of 1835 specimens from 11 fish species were used in this study. The most abundant species were Leptobotia elongata and Sinibotia superciliaris, with 699 and 365 individuals, respectively. Table 1 shows the LWRs, where parameter \( b \) ranged from 2.586 for Sinibotia superciliaris to 3.164 for Rhinogobio ventralis, and \( r^2 \) values ranged from 0.931 for Sinibotia superciliaris to 0.996 for Silurus meridionalis. The species of concern are: Rhinogobio ventralis, Leptobotia elongata, Pseudobagrus crassilabris, Tachysurus nitidus, Silurus meridionalis, Coreius heterodon, Psephagus vachelli, Coreius guichenoti, Sinibotia superciliaris, Leptobotia taeniops, and Rhinogobio typus (Table 1).

Discussion
Length-weight relationships of 11 species were not yet recorded in FishBase and new maximum lengths are recorded for five species. The \( b \) values remain within the range of 2.5–3.2, which is consistent with the expected range of Tesch (1971). Differences in LWRs of fishes may be attributed to several factors, such as the number and length range of the sampled specimens, gonad maturity, sex, diet, stomach.
fullness, and growth phase (Bagenal and Tesch, 1978; Wootton, 1990; Froese, 2006); however, these factors were not considered in the present study. In conclusion, the results could provide valuable information for the FishBase database and contribute to fishery research, management and conservation in the upper reaches of the Yangtze River.

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References


Author’s address: Qiwei Wei, Yangtze River Fisheries Research Institute, Chinese Academy of Fisheries Science, No.8, 1st Wudayuan Road, Donghu Hi-tech Development Zone, Wuhan 430223, China. E-mail: weiqw@yfr_ci.cn

### Table 1

<table>
<thead>
<tr>
<th>Species</th>
<th>n</th>
<th>Length range (cm)</th>
<th>Weight range (g)</th>
<th>a</th>
<th>b</th>
<th>r²</th>
<th>a CL95%</th>
<th>b CL95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinogobio ventralis</td>
<td>89</td>
<td>8.7–28.5</td>
<td>6.1–205.7</td>
<td>0.0056</td>
<td>3.164</td>
<td>0.988</td>
<td>0.0045–0.0069</td>
<td>3.090–3.238</td>
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<tr>
<td>Leptobotia elongata</td>
<td>699</td>
<td>7.7–45.5</td>
<td>3.7–877.2</td>
<td>0.0065</td>
<td>3.021</td>
<td>0.969</td>
<td>0.0058–0.0073</td>
<td>2.980–3.061</td>
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<tr>
<td>Pseudobagrus crassilabi</td>
<td>35</td>
<td>4.8–23.4</td>
<td>2.6–83.8</td>
<td>0.0219</td>
<td>2.646</td>
<td>0.961</td>
<td>0.0133–0.0361</td>
<td>2.457–2.834</td>
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<tr>
<td>Tachysurus nitidus</td>
<td>83</td>
<td>5.2–23.5</td>
<td>1.1–105.2</td>
<td>0.0062</td>
<td>3.101</td>
<td>0.971</td>
<td>0.0047–0.0082</td>
<td>2.982–3.220</td>
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<tr>
<td>Sillurus meridionalis</td>
<td>54</td>
<td>8.3–61.5</td>
<td>5–1408.4</td>
<td>0.0077</td>
<td>2.943</td>
<td>0.996</td>
<td>0.0066–0.0091</td>
<td>2.894–2.992</td>
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<tr>
<td>Coreius heterodon</td>
<td>60</td>
<td>25.9–37</td>
<td>145.7–422.5</td>
<td>0.0164</td>
<td>2.816</td>
<td>0.954</td>
<td>0.0095–0.0286</td>
<td>2.654–2.978</td>
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<td>Pseudobagrus vachelli</td>
<td>152</td>
<td>5–32.3</td>
<td>1–1–245.1</td>
<td>0.0083</td>
<td>3.035</td>
<td>0.984</td>
<td>0.0070–0.0097</td>
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<tr>
<td>Coreius guichenoti</td>
<td>159</td>
<td>11.2–34.1</td>
<td>13.3–419.2</td>
<td>0.0078</td>
<td>3.075</td>
<td>0.980</td>
<td>0.0064–0.0096</td>
<td>3.006–3.145</td>
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<tr>
<td>Simboria supercilialis</td>
<td>365</td>
<td>7.9–16.4</td>
<td>4–43.1</td>
<td>0.0238</td>
<td>2.856</td>
<td>0.931</td>
<td>0.0199–0.0285</td>
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<td>Leptobotia taeniops</td>
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<td>11.5–18.2</td>
<td>12.7–48</td>
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<td>2.757</td>
<td>0.966</td>
<td>0.0107–0.0239</td>
<td>2.606–2.908</td>
</tr>
<tr>
<td>Rhinogobio typus</td>
<td>89</td>
<td>7.2–28.6</td>
<td>2–159.3</td>
<td>0.0053</td>
<td>3.080</td>
<td>0.988</td>
<td>0.0040–0.0069</td>
<td>2.987–3.173</td>
</tr>
</tbody>
</table>

n, number of individuals; a and b, LWR parameters; r², coefficient of determination; CL, confidence limits.

*No LWR reference in FishBase.

*bNew maximum length record in FishBase.