Research Article

Length-weight relationship and condition factor of eight species of the genera *Capoeta*, *Garra*, *Chondrostoma*, *Schizothorax* and *Paraschistura* from Iranian inland waters

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Abstract: The length-weight relationship and condition factor of eight fish species from three basins in Iran were estimated. All specimens were captured from May 2010 to August 2017. Total length and total weight ranged 2.2-39.1cm and 0.14-656g, respectively. The b-value was calculated using $W=AL^b$, which ranged from 2.53 (*Paraschistura turcmenica*) to 3.2 (*Garra rufa*), and condition factor was 0.89 (*P. turcmenica*) to 1.53 (*G. rossica*). This study provided LWR and condition factor of *Chondrostoma cyri* for the first time from Iranian inland waters.

Keywords: LWRs, *Paraschistura turcmenica*, Iranian Inland waters.


Introduction

Length-weight relationships (LWRs) and condition factor of fish species indicate the demographic and biological differences affected by ecological factors of their habitats (Mann 1973; Kovach & Copp 1996). LWR of fishes is applied to estimate the weight of a specimen from its length and vice versa, to estimate the biomass, evaluation of fish stocks, ontogenetic changes and growth studies (Froese 2006; Mouludi-Saleh & Keivany 2018; Jafari-Patcan et al. 2018; Mouludi-Saleh & Eagderi 2019), requiring for their proper management (King 2007). It is influenced by several factors e.g. season, habitat conditions, sex and food availability (Froese 2006; Mommsen 1998; Heidari et al. 2018).

Condition factor can also indicate suitability of a specific water body for growth of fish and environmental differences in ecological conditions such as seasonal changes, nutritional quality and type of aquatic system e.g. rivers or lakes (Nikolski 1996; Alam et al. 2014; Mouludi-Saleh & Eagderi 2019). In this order, this study provides information about length-weight relationships and condition factors of eight fish species viz. *Capoeta heratensis*, *Garra rossica*, *G. rufa*, *Schizothorax pelzami*, *Chondrostoma regium*, *C. cyri*, *Paraschistura cristata* and *P. turcmenica* from Iranian Inland waters, including the Hari River, Caspian Sea and Persian Gulf basins.

Materials and Methods

A total of 736 specimens belonging to eight species were collected by electrofishing device and gill-nets (with mesh sizes of 30, 40 and 50mm) from different rivers of Iran inland waters between May 2010 and August 2017. The specimens of *C. heratensis*,
\begin{table}
\centering
\begin{tabular}{lcccccccc}
\hline
Species & N & Min & Max & Min & Max & \multicolumn{3}{c}{Regression parameters} & Condition factor (Mean±SD) \\
& & & & Total length (cm) & Body weight (g) & \multicolumn{2}{c}{95\% CL of a} & \multicolumn{2}{c}{95\% CL of b} & \multicolumn{2}{c}{r^2} & \\
\hline
C. heratensis & 55 & 20.3 & 39.1 & 83 & 656 & 0.009 & 0.005-0.019 & 3.04 & 2.83-3.2 & 0.951 & 1.12±0.11 \\
G. rossica & 68 & 2.45 & 9.4 & 0.22 & 13.78 & 0.014 & 0.012-0.019 & 3.02 & 2.9-3.14 & 0.974 & 1.53±0.22 \\
G. rufa & 142 & 2.4 & 12.3 & 0.19 & 34 & 0.009 & 0.008-0.011 & 3.2 & 3.13-3.26 & 0.986 & 1.44±0.28 \\
S. pelzami & 54 & 4.4 & 27.1 & 0.98 & 287.9 & 0.009 & 0.008-0.011 & 3.05 & 2.98-3.13 & 0.988 & 1.11±0.15 \\
P. cristata & 120 & 2.6 & 8.1 & 0.16 & 5.1 & 0.011 & 0.009-0.013 & 2.86 & 2.78-2.95 & 0.975 & 0.93±0.13 \\
P. turcmenica & 94 & 2.2 & 4.5 & 0.14 & 0.75 & 0.015 & 0.013-0.02 & 2.53 & 2.34-2.68 & 0.915 & 0.89±0.16 \\
C. regium & 135 & 3.3 & 21.6 & 0.29 & 102.2 & 0.009 & 0.008-0.01 & 3.03 & 2.98-3.08 & 0.992 & 1.01±0.15 \\
C. cyri & 68 & 10.3 & 25.2 & 8.8 & 151.2 & 0.007 & 0.006-0.01 & 3.05 & 2.96-3.15 & 0.981 & 0.92±0.09 \\
\hline
\end{tabular}
\end{table}

G. rossica, S. pelzami, P. cristata and P. turcmenica were caught from the Kardeh River (59°39'59"N, 36°38'18"E), Hari River basin, G. rufa and C. regium from the Gamasiab River (48°02'01"N, 34°20'14"E), the Persian Gulf basin, and C. cyri from the Aras River (44°56'10"N, 39°28'56"E), the Caspian Sea basin. After anesthetizing, the specimens were fixed into 10% buffered formalin, and transferred to the ichthyology lab of inland waters aquaculture research center, Bandar Anzali, Guilan. Total length (TL) was measured with a digital caliper to the nearest 0.02mm, and body weight (BW) using a digital scale to the nearest 0.01g. The logarithmic length-weight equation was used as follows:

\[ W = aL^b, \quad \log (w) = \log (a) + b \log (L) \]

Where \( W \) is the body weight (g), \( L \) = the total length (cm) and “\( a \)” and “\( b \)” are the intercept and slope, respectively. To identify outliers, a log-log plot of the length–weight pairs was performed (Froese et al. 2011), and the estimation of condition factor was done using \( K=(W/L^3)\times100 \) formula (Fulton 1904), where \( W \) is body weight (g) and \( L \) is total length (cm), and the scaling factor of 100 was used to bring the \( K \) close to the unit. All statistical analyses were performed in Excel 2016 and PAST v 2.1 softwares.

**Results**

The results revealed that eight fish species range 2.2-39.1cm in TL and 0.14-656g in BW. LWRs parameters and condition factor values are presented in Table 1 and Figure 1. Based on the results, the \( b \)-value and condition factor ranged from 2.53 (\( P. turcmenica \)) to 3.2 (\( G. rufa \)) and 0.89 (\( P. turcmenica \)) to 1.53 (\( G. rossica \)), respectively (Tables 1, 2). The calculated correlation coefficient for all specimens were greater than 0.91 (\( r^2>0.91 \)). The \( b \)-values of other species were as 3.04, 3.02, 3.04, 2.86, 3.03 and 3.05 for C. heratensis, G. rossica, S. pelzami, P. cristata, C. regium and C. cyri, respectively.

**Discussion**

The length-weight relationship parameters are important in fish stock assessment and study of their growth pattern (Gonzalez Acosta et al. 2004). Differences in \( b \)-values can be depend on many factors such as sex and sexual maturity, age, season,
nutritional status, environmental conditions, and even the time of catching the specimens in terms of fullness or emptying gut (Yildrim et al. 1998), that did not study in the present study. Zareian et al.
(2018) showed the $b$-value for *C. heratensis* as 3.08, almost similar to our result i.e. 3.04. The reported LWR parameters for *G. rufa* in different rivers of Iran ranged from 2.9 to 3.13 that was lower than the results of present study (3.2) (Table 2). An available data regarding LWR parameters and condition factor of *G. rosica*, *S. pelzami*, *P. turcmenica*, *P. cristata* and *C. regium* are provided in Table 2. However, no LWRs and condition factor data was available for *C. cyri* from Iranian inland waters for comparison purpose. In addition, b-value were between 2.5 and 3.5 (Froese 2006), which all calculated b-values were within this expected ranges in this study.

The condition factor fluctuating is based on the seasonal variations of the gonads and feeding intensity (Biswas 1993). The condition factor in *C. regium, C. cyri* and *P. cristata* was lower compared to the other species, showing poor habitat condition of these species.

In conclusion, this study provides basic information about LWRs parameters and condition factor data for eight fish species from different rivers and basins of Iran, which will be helpful in biological studies and fisheries management, too.

### Table 2. Length-weight relationship parameters and condition factor data about species in pervious study from Iranian Inland waters.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Species</th>
<th>Sex</th>
<th>$a$/log $a$</th>
<th>$b$</th>
<th>$r^2$</th>
<th>Condition factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zareian et al. (2018)</td>
<td><em>C. heratensis</em></td>
<td>-</td>
<td>0.0096</td>
<td>3.08</td>
<td>0.996</td>
<td>-</td>
</tr>
<tr>
<td>Esmaeili &amp; Ebrahimi (2006)</td>
<td><em>G. rufa</em></td>
<td>-</td>
<td>0.011</td>
<td>3.13</td>
<td>0.992</td>
<td>-</td>
</tr>
<tr>
<td>Abedi et al. (2011)</td>
<td><em>G. rufa</em></td>
<td>Female</td>
<td>-5.306</td>
<td>3.08</td>
<td>0.981</td>
<td>-</td>
</tr>
<tr>
<td>Abedi et al. (2011)</td>
<td><em>G. rufa</em></td>
<td>Male</td>
<td>-5.092</td>
<td>3.13</td>
<td>0.989</td>
<td>-</td>
</tr>
<tr>
<td>Keivany &amp; Zamani-Faradonbe (2017)</td>
<td><em>G. rufa</em></td>
<td>-</td>
<td>0.0092</td>
<td>3.11</td>
<td>0.99</td>
<td>-</td>
</tr>
<tr>
<td>Patimari et al. (2010)</td>
<td><em>G. rufa</em></td>
<td>Female</td>
<td>0.014</td>
<td>2.92</td>
<td>0.91</td>
<td>-</td>
</tr>
<tr>
<td>Keivany &amp; Zamani-Faradonbe et al. (2018)</td>
<td><em>G. rosica</em></td>
<td>-</td>
<td>0.004</td>
<td>2.7</td>
<td>0.97</td>
<td>-</td>
</tr>
<tr>
<td>Nowferest et al. (2014)</td>
<td><em>G. rosica</em></td>
<td>-</td>
<td>0.0067</td>
<td>3.19</td>
<td>0.969</td>
<td>-</td>
</tr>
<tr>
<td>Badri et al. (2015)</td>
<td><em>S. pelzami</em></td>
<td>Female</td>
<td>$5 \times 10^{-5}$</td>
<td>3.1</td>
<td>0.96</td>
<td>-</td>
</tr>
<tr>
<td>Mouludi-Saleh &amp; Eadgderi (2019)</td>
<td><em>S. pelzami</em></td>
<td>Male</td>
<td>0.21x10^-4</td>
<td>2.8</td>
<td>0.937</td>
<td>-</td>
</tr>
<tr>
<td>Jamali et al. (2015)</td>
<td><em>P. turcmenica</em></td>
<td>-</td>
<td>0.012</td>
<td>2.87</td>
<td>0.908</td>
<td>0.96±0.09</td>
</tr>
<tr>
<td>Sayyadzadeh &amp; Esmaeili (2016)</td>
<td><em>P. turcmenica</em></td>
<td>-</td>
<td>0.01</td>
<td>2.63</td>
<td>0.976</td>
<td>-</td>
</tr>
<tr>
<td>Sayyadzadeh &amp; Esmaeili (2016)</td>
<td><em>P. cristata</em></td>
<td>-</td>
<td>0.0033</td>
<td>3.05</td>
<td>0.979</td>
<td>-</td>
</tr>
<tr>
<td>Nowferest et al. (2015)</td>
<td><em>P. cristata</em></td>
<td>-</td>
<td>0.0079</td>
<td>3.37</td>
<td>0.95-0.97</td>
<td>-</td>
</tr>
<tr>
<td>Keivany et al. (2016a)</td>
<td><em>C. regium</em></td>
<td>-</td>
<td>0.007</td>
<td>3.086</td>
<td>0.98</td>
<td>-</td>
</tr>
<tr>
<td>Keivany et al. (2015)</td>
<td><em>C. regium</em></td>
<td>Female</td>
<td>0.0082</td>
<td>3.1</td>
<td>0.854</td>
<td>-</td>
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<tr>
<td>Keivany et al. (2018)</td>
<td><em>C. regium</em></td>
<td>Male</td>
<td>0.0089</td>
<td>3.04</td>
<td>0.955</td>
<td>-</td>
</tr>
<tr>
<td>Keivany et al. (2018)</td>
<td><em>C. regium</em></td>
<td>All</td>
<td>0.0107</td>
<td>3.00</td>
<td>0.92</td>
<td>-</td>
</tr>
<tr>
<td>Beyraghdar Kashkooli et al. (2018)</td>
<td><em>C. regium</em></td>
<td>-</td>
<td>0.009</td>
<td>3.21</td>
<td>0.97</td>
<td>-</td>
</tr>
<tr>
<td>Mahboobi Soofiani et al. (2014)</td>
<td><em>C. regium</em></td>
<td>Female</td>
<td>0.023</td>
<td>2.768</td>
<td>1.26±0.17</td>
<td>-</td>
</tr>
<tr>
<td>Mahboobi Soofiani et al. (2014)</td>
<td><em>C. regium</em></td>
<td>Male</td>
<td>0.012</td>
<td>2.993</td>
<td>0.962</td>
<td>1.25±0.11</td>
</tr>
</tbody>
</table>

References


Mouludi-Saleh, A. & Keivany, Y. 2018. Length–weight and length–length relationships for three species of Squalius (Cyprinidae; Leuciscinae) from the Caspian


مقاله پژوهشی

رابطه طول-وزن و شاخص وضعیت هشت گونه از جنس‌های Paraschistura و Schizothorax Chondrostoma از آب‌های داخلی ایران

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چکیده:
رابطه طول-وزن و شاخص وضعیت هشت گونه مربوط به سه حوضه آبریز در ایران محاسبه شد. نمونه‌ها از ماه می 2010 تا آگوست 2017 صید شدند. طول و وزن کل هر گونه در دامنه‌ای از 3.2 (Paraschistura turcmenica) تا 14.0 سانتی‌متر و 65.1 (G. rufa) تا 140.6 گرم بود. مقادیر پارامتر b با استفاده از فرمول $W=aL^b$ محاسبه شد. مقدار شاخص وضعیت از شاخص وضعیت از 89/0 (P. turcmenica) تا 53/1 (G. rossica) متغیر بود. این مطالعه برای اولین بار رابطه طول-وزن از گونه Chondrostoma cyri از آب‌های داخلی ایران ارائه می‌شود.

کلمات کلیدی: رابطه طول-وزن، جویبارماهی تاجدار ترکمنی، آب‌های داخلی ایران.