Length-weight relationship and condition factor of *Tetraodon cutcutia* (Ham) from Neematighat, Assam (India)

1P. Karmakar & 2S.P.Biswas
Dept. of Life Sciences, Dibrugarh University,
Assam- 786004, INDIA

**Abstract:** The length-weight relationship and condition factor for *Tetraodon cutcutia* were carried out from Neematighat of Jorhat district of Assam between April, 2011 and March, 2013. This paper throws light on the changes in the ponderal index (K) and growth coefficient (b), (length-wise, month-wise and seasonally). Length-weight relationship and relative condition factor (K) for a sample size of 285 specimens were calculated on monthly basis. A wide fluctuation in growth coefficient (b) in the fishes was observed. The 'b' value ranged from 1.13-2.33 in male and 2.362-7.048 in female; seasonally the b value varied from 0.476 (pre-monsoon) to 1.622 (post-monsoon) in case of male and 0.98 (winter) to 3.086 (monsoon) in female. Similarly, the K value ranged from 3.864 (monsoon) to 6.279 (winter) in male and from 3.196 (pre-monsoon) to 3.628 (winter) in female.

**Key words:** Tetraodon cutcutia, length-weight relationship, condition factor, Assam.

---

**I. Introduction**

The study of length-weight relationship is of paramount importance in fishery science, as it assists in understanding the general well being and growth patterns in a fish population. According to Bashir et al. (1993) the length-weight relationship of fish varies depending upon the condition of life in aquatic environment. The study of the condition factor is thus important for understanding the life cycle of a fish species and contributes to adequate management of the fish species and, therefore, to the maintenance of equilibrium in the ecosystem. Length-weight relationship is of great importance in fishery assessments (Garcia et al., 1998, Haimovici and Velasco, 2000). The mathematical parameters of the relationship between the length and weight of fish furnish further information on the weight variation of individuals in relation to their length (condition factor, K). This factor estimates the general well-being of the individual and is frequently used in three cases: (a) Comparison of two or more co-specific populations living in similar or different conditions of food, density or climate; (b) Determination of period and duration of gonadal maturation and (c) Observation of increase or decrease in feeding activity or population changes, possibly due to modifications in food resources. *Tetraodon cutcutia* (Hamilton-Buchanan) is considered as a trash fish in the Indo-Gangetic basin. It belongs to the family Tetraodontidae under order Tetraodontiformes. Commonly known as *Gangatop* in Assam, the species is widely distributed throughout the plains of N.E. India, region and the fish is utterly neglected as it has no food value. However, this is a potential aquarium fish. It is a small sized fish, measures about 6 to 9.2cm in length (Nath and Dey, 2000). It mainly occurs in riverine habitats but also found in the beels (wetlands). Like other parts of the Brahmaputra basin, *T. cutcutia* has a well established population at Neematighat and its adjoining areas in Jorhat District of Upper Assam. The present communication deals with the length-weight relationship of the species.

**II. Material and methods**

Samples were collected from Neematighat of Jorhat district. Monthly samplings were carried out from April 2011 through March 2013. The specimens were measured to the nearest cm and weighted to the nearest gm. The length-weight relationship was based on 285 specimens collected during the study period. Length-weight relationship of *T. cutcutia* was calculated following Le Cren (1951) - \( W = aL^b \), where \( W \) = weight, \( L \) = length and ‘a’ and ‘b’ are initial growth and growth coefficient respectively. The values of constant \( a \) and \( b \) were estimated from log transformation values of length and weight: \( \log W = \log a + b \log L \). The correlation coefficient (r) was also estimated to determine the degree of linear relationship between the length and weight of samples. For estimation of general well being of the fish, ponderal index or condition (K) factor was used. Condition factor (K) was calculated from the expression (Bagenal, 1978): \( K = 100W/L^3 \) where, \( W \) is the whole body weight in gm and \( L \) the total length in cm.
Table 1: Length-weight relationship and condition factor of *Tetraodon cutcutia*

<table>
<thead>
<tr>
<th>Length group (cm)</th>
<th>Sex</th>
<th>K</th>
<th>b</th>
<th>Log W=Log a+b log L</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5-3.5</td>
<td>M</td>
<td>5.271</td>
<td>1.13</td>
<td>Log -3.642+1.13 log L</td>
<td>0.65</td>
</tr>
<tr>
<td>3.5-4.5</td>
<td>M</td>
<td>6.722</td>
<td>1.83</td>
<td>Log -2.962+1.83 log L</td>
<td>0.65</td>
</tr>
<tr>
<td>4.5-5.5</td>
<td>M</td>
<td>4.38</td>
<td>1.70</td>
<td>Log -2.134+1.7 log L</td>
<td>0.32</td>
</tr>
<tr>
<td>5.5-6.5</td>
<td>M</td>
<td>3.227</td>
<td>2.33</td>
<td>Log -1.027+2.329 log L</td>
<td>0.62</td>
</tr>
<tr>
<td>6.5-7.5</td>
<td>M</td>
<td>2.66</td>
<td>1.88</td>
<td>Log -2.561+1.879 log L</td>
<td>0.04</td>
</tr>
<tr>
<td>3-4.5</td>
<td>F</td>
<td>7.048</td>
<td>1.19</td>
<td>Log -0.325+1.19 log L</td>
<td>0.69</td>
</tr>
<tr>
<td>4.5-6</td>
<td>F</td>
<td>4.071</td>
<td>3.25</td>
<td>Log -1.183+3.252 log L</td>
<td>0.60</td>
</tr>
<tr>
<td>6-7.5</td>
<td>F</td>
<td>3.09</td>
<td>2.74</td>
<td>Log -0.944+2.74 log L</td>
<td>0.44</td>
</tr>
<tr>
<td>7.5-9</td>
<td>F</td>
<td>2.326</td>
<td>3.32</td>
<td>Log -3.525+3.32 log L</td>
<td>0.53</td>
</tr>
<tr>
<td>9-10.5</td>
<td>F</td>
<td>2.611</td>
<td>2.93</td>
<td>Log -0.923+2.932 log L</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Table 2: Seasonal variation of length-weight relationship and K-factor of *T. cutcutia*

<table>
<thead>
<tr>
<th>Season</th>
<th>Sex</th>
<th>K</th>
<th>b</th>
<th>Log W=Log a+b log L</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter (Dec-Feb)</td>
<td>M</td>
<td>6.279</td>
<td>0.986</td>
<td>Log -1.173+0.986 log L</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.628</td>
<td>0.98</td>
<td>Log -0.223+0.98 log L</td>
<td>0.95</td>
</tr>
<tr>
<td>Pre-monsoon (Mar-May)</td>
<td>M</td>
<td>4.221</td>
<td>0.476</td>
<td>Log -3.101+0.476 log L</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.196</td>
<td>1.297</td>
<td>Log -0.142+1.297 log L</td>
<td>0.72</td>
</tr>
<tr>
<td>Monsoon (Jun-Aug)</td>
<td>M</td>
<td>3.864</td>
<td>1.307</td>
<td>Log -0.985+1.307 log L</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.859</td>
<td>3.086</td>
<td>Log -3.31+3.086 log L</td>
<td>0.82</td>
</tr>
<tr>
<td>Post-monsoon (Sept-Nov)</td>
<td>M</td>
<td>4.452</td>
<td>1.622</td>
<td>Log -2.584+1.622 log L</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.357</td>
<td>2.837</td>
<td>Log -9.358+2.837 log L</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Table 3: Month-wise length-weight relationship and K-factor in *T. cutcutia*

<table>
<thead>
<tr>
<th>Month</th>
<th>Sex</th>
<th>K</th>
<th>b</th>
<th>Log W=Log a+b log L</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>M</td>
<td>6.095</td>
<td>0.822</td>
<td>Log -0.856+0.822 logL</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4.502</td>
<td>1.082</td>
<td>Log -0.328+1.082 logL</td>
<td>0.95</td>
</tr>
<tr>
<td>Feb</td>
<td>M</td>
<td>6.36</td>
<td>1.028</td>
<td>Log -0.14+1.028 logL</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2.984</td>
<td>0.024</td>
<td>Log -5.857+0.024 logL</td>
<td>0.91</td>
</tr>
<tr>
<td>Mar</td>
<td>M</td>
<td>4.67</td>
<td>2.872</td>
<td>Log -8.686+2.872 logL</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.08</td>
<td>1.75</td>
<td>Log -3.245+1.75 logL</td>
<td>0.92</td>
</tr>
<tr>
<td>Apr</td>
<td>M</td>
<td>3.81</td>
<td>1.196</td>
<td>Log -0.65+1.196 logL</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.099</td>
<td>1.026</td>
<td>Log -1.207+1.026 logL</td>
<td>0.79</td>
</tr>
<tr>
<td>May</td>
<td>M</td>
<td>4.35</td>
<td>1.09</td>
<td>Log -0.364+1.09 logL</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.485</td>
<td>1.976</td>
<td>Log -4.031+1.976 logL</td>
<td>0.69</td>
</tr>
<tr>
<td>June</td>
<td>M</td>
<td>3.68</td>
<td>1.285</td>
<td>Log -0.938+1.285 logL</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.166</td>
<td>2.854</td>
<td>Log -9.521+2.854 logL</td>
<td>0.86</td>
</tr>
<tr>
<td>July</td>
<td>M</td>
<td>3.82</td>
<td>1.28</td>
<td>Log -0.814+1.28 logL</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.845</td>
<td>3.386</td>
<td>Log -11.374+3.386 logL</td>
<td>0.82</td>
</tr>
<tr>
<td>Aug</td>
<td>M</td>
<td>3.14</td>
<td>1.771</td>
<td>Log -3.04+1.77 logL</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.42</td>
<td>2.598</td>
<td>Log -7.51+2.598 logL</td>
<td>0.83</td>
</tr>
<tr>
<td>Sept</td>
<td>M</td>
<td>3.96</td>
<td>1.57</td>
<td>Log -2.44+1.57 logL</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.669</td>
<td>2.485</td>
<td>Log -5.506+2.485 logL</td>
<td>0.93</td>
</tr>
<tr>
<td>Oct</td>
<td>M</td>
<td>4.36</td>
<td>1.32</td>
<td>Log -0.91+1.32 logL</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.338</td>
<td>1.054</td>
<td>Log -0.40+1.054 logL</td>
<td>0.59</td>
</tr>
<tr>
<td>Nov</td>
<td>M</td>
<td>5.37</td>
<td>4.74</td>
<td>Log -6.29+4.74 logL</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2.579</td>
<td>1.185</td>
<td>Log -0.204+1.185 logL</td>
<td>0.91</td>
</tr>
<tr>
<td>Dec</td>
<td>M</td>
<td>5.77</td>
<td>1.17</td>
<td>Log -0.58+1.17 logL</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.539</td>
<td>1.082</td>
<td>Log -0.40+1.082 logL</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Legend: r = Coefficient of correlation, K= condition factor, a =initial growth; b =growth coefficient

III. Results

The growth coefficient (b) values showed seasonal fluctuation. In case of male, it ranged from 1.13-2.33 and in female it varied from 1.19-5.32 (Table-1). The b value was found lowest (0.476) in pre-monsoon and highest (1.622) in post-monsoon for male (Table 2) whereas in female it ranged from 0.986 (winter) to 3.086 (monsoon). The value in male was recorded minimum (0.822) in January and that of maximum (4.74) in November in male while in female the minimum value (0.024) was observed in February and that of maximum (3.386) in July (Table3). The condition factor (K) value, growth coefficient (b) and coefficient of correlation (r) value were calculated sex wise and seasonally. The K value ranged from 2.66-6.722 in case of males whereas it ranged from 2.362-7.048 in female specimens (Table 1). Seasonally, the value ranged from 3.864 (monsoon) to 6.279 (winter) in male and from 3.196 (pre-monsoon) to 3.628 (winter) in female (Table 2). Incidentally, K value was recorded highest in January in both the sexes (Table 3).
The coefficient of correlation (r) ranged from 0.04-0.65 in males and from 0.43-0.69 in females (Table 1). Seasonally, r varied from 0.81 (monsoon) to 0.95 (winter) in male specimens (Table 2) and that of female, it fluctuated between 0.72 (pre-monsoon) and 0.95 (winter). The coefficient was very high in December for both males and females (Table 3).

IV. Discussion

Arslan et al. (2004) stated that it is usually easier to measure length than weight and weight can be predicted later on using the length-weight relationship. In this study variability was found between the exponent (b) and condition factor. These differences might have been caused by the methods of measurement, and/or seasonal fluctuations, or variability in sampling. According to Le Cren (1951) the variation in ‘b’ value is due to environmental factors, seasons, food availability, sex, life stage and other physiological factors. The length-weight relationship of T. cutcutia exhibits highly positive correlation. A characteristic of length-weight relationship in fishes is that the value of the exponent (b) is 3 when growth is isometric (without changing shape). If b value is different from 3, growth is said to be allometric (fish changes shape as it grows larger). The variations in fish sizes indicate that the fish population ranged from immature specimens to fully matured ones. This also suggests differences in their growth (Forta et al., 2004). Fish specimens of a given length, exhibiting higher weight are said to be in better condition (Anyanwu et al., 2007). The ‘b’ values of T. cutcutia exhibited allometric growth. Allometric growth may be negative (b<3) or positive (b>3). According to Wooton (1992) allometric growth is negative if the fish gets relatively thinner as it grows larger and positive if it gets plumper as it grows. In biological studies, L-W relationships enable seasonal variations in fish growth to be followed and the calculation of condition indexes (Richter et al. 2000). In the present study, a high correlation value (r) between length-weight of T. cutcutia indicate a strong associationhip between these body parameters. The condition factor is an indicator of the environmental suitability for the resource. In this study variability was found between the exponent (b) and means of condition factors (K). These differences might have been caused by the methods of measurements, and/or seasonal fluctuations or variability in sampling (Safran 1992). The condition factor helps in the study of functional relationship between length and weight and the well-being of the fish. The condition factor of fishes influenced by a number of factors such as the onset of maturity (Hoda, 1987), spawning (De-Silva and Silva, 1979; Al-Daham and Wahab, 1991), sex and maturity (Gowda et al., 1987; Doddamani and Shanbouge 2001) and pollution (Bakhoum, 1999 and Devi et al., 2008). The condition factor (K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare. However, condition factor also showed variability that might have been caused by several environmental and physiological factors. Bakare (1970) and Fagade (1979) opined that condition factor decreased with increase in length. Similarly, Welcome (1979) viewed that K- factor influenced the reproductive cycle in fish.

V. References


VI- Acknowledgement

Authors are grateful to the Head, Dept. of Life Sciences, Dibrugarh University, Assam, India for giving necessary permission to carry out the study.