CHAPTER-VII

Length-Weight Relationship and Relative Condition Factor (Kn) of *Puntius ornatus*, *Lepidocephalichthy guntea* and *Neotropius atherinoides*
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Length-Weight Relationship and Relative Condition Factor (Kn) of *Puntius ornatus*, *Lepidocephalichthys guntea* and *Neotropius atherinoides*

7.1 Introduction

The length-weight relationship of fishes have significant importance in studying the growth, gonadal development and the general well being of the fish population (Le Cren, 1951; Pauly, 1993 and Nagesh et al., 2004). An overview of literature reveals that the length-weight relationship of fish differs from one species to other. Natarajan et al. (1977) reported the difference in the length-weight relationship of intra-specific populations inhabiting the same water body. Several biological factors like sex (Reddy, 1981), size of fish (Devaraj, 1973), physiological condition and gonadal maturity (Le Cren, 1951; Bashirullah, 1975), feeding (Reddy, 1981) and fatness have significant influence over length-weight relationship of fishes. Environmental conditions also influence this relationship. The changes in weight in relation to length are generally not on the basis of specific gravity but due to changes in the form of volume because the density in the organism and that of the surrounding water. Such changes are analyzed by the condition factor (K) or “Ponderal index” (Le Cren, 1951). Le Cren (1951) further states that condition (K) may be influenced by a number of factors and recommended relative condition (Kn) in preference to the
condition (K) as in the former the effects of the length and correlated factors are eliminated.

A fish can change its weight without changing its length or vice versa. If fish retains the same shape, it grows isometrically and the exponent “b” has the value, b=3.0. But a value significantly larger or smaller than b=3.0 shows allometric growth. A value less than b=3.0 shows that the fish becomes lighter for its length and if greater than b=3.0, indicates that the fish becomes heavier for its length as it grows (Wootton, 1990).

Among the freshwater fishes, different workers in India and abroad have reported length-weight relationship of Puntius sp. Notable works on Puntius stigma (Islam & Hossain, 1991-1992), Puntius denisonii (Annamercy et al., 2002) Puntius sophore (Srivastava and Singh, 2003; Mitra et al., 2005) and Puntius filamentosus (Prasad and Ali, 2007) can be cited in this respect.

Information on length-weight relationship of genus Lepidocephalus / Lepidocephalichthys is scanty. However, length-weight relationship of Lepidocephalichthys guntea was reported by Dhakal and Subba (2003) from Pathri Khola, Morang District of Nepal.

Little information is available on the biology of genus Pseudeutropius / Neotropius. Ramakrishnaiah(1983-1984) worked on Pseudeutropius taakree and reported length-weight relationship of this

Detailed biology on *Puntius ornatus, Lepidocephalichthy guntea* and *Neotropius atherinoides* are not known. Therefore an attempt has been made to observe growth in terms of length and weight by establishing length-weight relationship and also to observe general well being by evaluating relative condition factor "Kn" of the three species as a part of biological study.

### 7.2 Materials and Methods

To study the length-weight relationship of *Puntius ornatus, Lepidocephalichthy guntea* and *Neotropius atherinoides* same procedure was followed. All these species were found during monsoon season in the same habitat. The study was carried out during 2004-2007. During this period, the population of the three species was monitored. Fishes were not abundant in all the three years. The availability of the fishes was affected by total precipitation, early flood, late flood or absence of flood. Therefore during 2004-2005 maximum number of three species could be collected in the landing site as well as in the individual catch. Photographs were taken with a Canon (Model A650) camera before preservation.
Preserved fishes were weighed nearest to three decimal points and measurements were taken with dial vernier calliper nearest to 0.05 mm. Monthly collections were sexed to determine the sex ratio and they were grouped into various size ranges. Maturity stages were identified by dissecting the abdomen and ascertaining the maturity stage of the gonads. Fully mature female fishes were isolated for studying the fecundity.

7.2.a *Puntius ornatus*

A total of 127 specimens were collected during the period of June 2004 to May 2007. The monthly collections were sexed and grouped into 4-size group of 5 mm class interval for male and female. The males were within the range from 28.55 mm to 42.9 mm in total length and total weight was ranged between 0.207 gm to 0.668 gm. In case of female, the total length and weight were ranged from 29.25 mm to 45.5 mm and 0.23 gm to 1.17 gm respectively.

7.2.b *Lepidocephalichthy guntea*

During study period, a total of 202 specimens were collected. After collection fishes were preserved in 8 % formaldehyde solution. The monthly collections were sexed and grouped into 4-size group of 10 mm class interval for female and 3-size group of 10 mm class interval for male. The females were found to within the range from 42.3 mm to 101.4 mm in total length and total weight was ranged between 0.46 gm to 9.89 gm. In
case of male, the total length and weight were ranged from 50.1 mm to 82.3 mm and 0.75 gm to 3.81 gm respectively.

7.2.c *Neotropius atherinoides*

For the present study, a total of 173 numbers of fish was collected. The monthly collections were sexed and 4-size groups were identified in case of female viz (50-60mm), (60-70mm), (70-80mm) and (80-90mm). In case of males, only three groups were made viz (50-60mm), (60-70mm) and (70-80mm). The females were found to range between 51.2 mm to 89.15 mm in total length and total weight ranged between 0.65 gm to 5.82 gm. In case of male, the total length and weight were ranged between 50.12 mm to 79.3 mm and 0.6 gm to 3.22 gm respectively.

7.2.1 Length-weight relationship

The study of length-weight relationship has its applied value in fish biology. The significance of the studies in fishes is to assess the growth of fishes in different environment (Salam *et al*, 1993). The growth in animal is considered in terms of increase in volume. The volume is represented by weight, which is related to the cube of linear dimensions. It is therefore, true that a relationship exists between length (linear dimension) and weight in animal (kellicot, 1908). Measurement of growth as length quantify axial growth, measurement as weight quantify growth in bulk. These two categories of growth are highly correlated (Wootton, 1990). A fish can change its weight without changing in length.
or vice versa. The relationship between weight and length for fish of a given population can be analysed either by measuring weight and length of the same fish throughout their life or of a sample of fish taken at a particular time (Wootton, 1990). The relationship between length \((L)\) and weight \((W)\) can be represented by the equation in the form

\[
W = a L^b \quad (Le Cren, 1951).
\]

Where,

\[
W = \text{Weight of fish in gram.}
\]

\[
L = \text{Length of fish in cms.}
\]

\[
a = \text{Constant or initial growth index.}
\]

\[
b = \text{an exponential expressing relationship between length weight or coefficient of regression.}
\]

Through the logarithmic transformation, this relationship is expressed as:

\[
\log W = \log a + b \log L.
\]

Length-weight relationship of studied fish i.e \(Puntius ornatus\); \(Lepidocephalichthy guntea\) and \(Neotropius atherinoides\) were established by using this formula.

The relative condition factor \((Kn)\) was observed separately for male and female in different length group. The mean weight for each length group has been computed from this Log formula.
The relative condition factor (Kn) was calculated by using the following formula:

\[ \text{Kn} = \frac{W}{W_1} \]

Where, \( W \) = observed weight.
\( W_1 \) = the calculated weight as determined from the length weight equations.

7.3 Observation

7.3.1 Length-Weight relationship of *Puntius ornatus*

*Puntius ornatus* was found to be rare and comprised a very small percentage in the total catch. Fishes were collected whenever sighed and preserved in 8% formaldehyde solution.

The statistics viz, regression analysis, standard error, ‘t’ test and significance, relative condition factor for *Puntius ornatus* is presented in Table (16). Similarly a linear relationship between the log weight and length was established for both male and female and sexes combined and presented in figure (7.1a, 7.1b, 7.1c). The values of regression coefficient computed are 3.5122 (female), 3.4312 (male) and 3.5504 (male and female combined). The weight of *Puntius ornatus* in the present study increased slightly more than the cube of its length as the values of regression coefficient “b” were found to be more than 3 in all cases. The rate of increase in weight in relation to length was slightly higher in females (b = 3.5122) than in males (b = 3.4312).
7.3.1.1 Kn value of *Puntius ornatus*

In case of female *Puntius ornatus* an increasing Kn value is observed in lower group (25-30mm) and it is highest (1.00000859) at 35-40mm size group. After that a sharp decline in Kn (0.99998263) is observed at 40-45 mm size group of fish. The male *Puntius ornatus* shows an increasing Kn value (1.00000725) upto 30-35 mm size group and after that a slight decrease in Kn value (1.00000003) is observed at 35-40mm size group of fish (Table-16 and Fig. 7.1d, 7.1e).
Table 16: Regression model for length and weight of male, female and sexes combined of *Puntius ornatus*. Level of significance and Kn values are also shown in different size group.

<table>
<thead>
<tr>
<th>Size group</th>
<th>Sex</th>
<th>No. of fish Examined</th>
<th>Equation</th>
<th>Std. Error</th>
<th>t</th>
<th>Significance</th>
<th>R^2</th>
<th>Kn</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 – 30</td>
<td>F</td>
<td>2</td>
<td>LogW = -19.33862 LogL - 30.71091</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.00000000</td>
</tr>
<tr>
<td>25 – 30</td>
<td>M</td>
<td>6</td>
<td>LogW = 0.14320 LogL + 2.09391</td>
<td>0.95309</td>
<td>0.15024</td>
<td>0.8878</td>
<td>0.006</td>
<td>1.00000000</td>
</tr>
<tr>
<td>30 – 35</td>
<td>F</td>
<td>45</td>
<td>LogW = 3.27931 LogL - 2.4589</td>
<td>0.4658</td>
<td>7.0396</td>
<td>0.0000</td>
<td>0.538</td>
<td>1.00000039</td>
</tr>
<tr>
<td>30 – 35</td>
<td>M</td>
<td>22</td>
<td>LogW = 3.32995 LogL - 2.58866</td>
<td>0.59116</td>
<td>5.63284</td>
<td>0.0000</td>
<td>0.613</td>
<td>1.00000725</td>
</tr>
<tr>
<td>35 – 40</td>
<td>F</td>
<td>12</td>
<td>LogW = 6.7378 LogL - 7.9234</td>
<td>0.9700</td>
<td>6.9457</td>
<td>0.0000</td>
<td>0.828</td>
<td>1.00000859</td>
</tr>
<tr>
<td>35 – 40</td>
<td>M</td>
<td>10</td>
<td>LogW = 2.04862 LogL - 0.52116</td>
<td>0.42743</td>
<td>4.79279</td>
<td>0.0014</td>
<td>0.742</td>
<td>1.00000003</td>
</tr>
<tr>
<td>40 – 45</td>
<td>F</td>
<td>24</td>
<td>LogW = 5.2970 LogL - 5.7380</td>
<td>0.6674</td>
<td>7.9362</td>
<td>0.0000</td>
<td>0.741</td>
<td>0.99998263</td>
</tr>
<tr>
<td>40 – 45</td>
<td>M</td>
<td>6</td>
<td>LogW = 1.87264 LogL - 0.23156</td>
<td>0.39574</td>
<td>4.73194</td>
<td>0.0091</td>
<td>0.848</td>
<td>1.00000030</td>
</tr>
<tr>
<td>All female</td>
<td></td>
<td></td>
<td>LogW = 3.5122 LogL - 2.8173</td>
<td></td>
<td></td>
<td></td>
<td>0.924</td>
<td></td>
</tr>
<tr>
<td>All male</td>
<td></td>
<td></td>
<td>LogW = 3.4312 LogL - 2.7276</td>
<td></td>
<td></td>
<td></td>
<td>0.933</td>
<td></td>
</tr>
<tr>
<td>Male and female combined</td>
<td></td>
<td></td>
<td>LogW = 3.5504 LogL - 2.8881</td>
<td></td>
<td></td>
<td></td>
<td>0.926</td>
<td></td>
</tr>
</tbody>
</table>
Fig 7.1a: Length-Weight Relationship of Male
*Puntius ornatus*

\[ y = 3.4312x - 2.7276 \]
\[ R^2 = 0.933 \]

Fig 7.1b: Length-weight Relationship of Female
*Puntius ornatus*

\[ y = 3.5122x - 2.8173 \]
\[ R^2 = 0.924 \]

Fig 7.1c: Length-Weight Relationship of male and female *Puntius ornatus*

\[ y = 3.5504x - 2.8881 \]
\[ R^2 = 0.9263 \]
Fig 7.1d: Kn values of male *Puntius ornatus* in different size group.

Fig 7.1e: Kn values of female *Puntius ornatus* in different size group.
7.3.2 Length-Weight relationship of *Lepidocephalichthys guntea*

*Lepidocephalichthys guntea* is a bottom feeder fish and it spends most of its time buried in sandy bottom. The fishes are often seen coming to the surface with swift movement. The fish could be collected throughout the year.

The statistics viz, regression analysis, standard error, ‘t’ test and significance, relative condition factor for *Lepidocephalichthys guntea* is presented in Table (17). Similarly a linear relationship between the log weight and length was established for both male and female and sexes combined and presented in figure (7.2a, 7.2b, 7.2c). The values of regression coefficient computed are 3.4216 (female), 3.3189 (male) and 3.4559 (male and female combined). The weight of *L. guntea* in the present study increased slightly more than the cube of its length as the values of regression coefficient “b” were found to be more than 3 in all cases. The rate of increase in weight in relation to length was slightly higher in females (b = 3.4216) than in males (b = 3.3189).

### 7.3.2.1 Kn value of *Lepidocephalichthys guntea*

An increasing Kn value in lower group is observed in case of female *Lepidocephalichthys guntea* and it is highest (1.00000358) at 80-90mm size range of fish. A sharp decline in Kn value (1.00000018) is observed at 90-100mm size group of fish. In case of male *Lepidocephalichthys guntea* an increasing Kn value (1.00000000) is observed in smaller size group (60-70mm) and it is highest (1.00000011) in 70-80 mm size group (Table-17 and Fig. 7.2d, 7.2e).
Table 17. Regression model for length and weight of male, female and sexes combined of *Lepidocephalichthy guntea*. Level of significance and Kn values are also shown in different size group.

<table>
<thead>
<tr>
<th>Size group</th>
<th>Sex</th>
<th>No. of fish Examed</th>
<th>Equation</th>
<th>Std. Error</th>
<th>t</th>
<th>Significance</th>
<th>R²</th>
<th>Kn</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 - 70</td>
<td>F</td>
<td>5</td>
<td>LogW = 2.21335 LogL - 1.81406</td>
<td>0.44678</td>
<td>4.95400</td>
<td>0.0158</td>
<td>0.891</td>
<td>0.99997035</td>
</tr>
<tr>
<td>60 - 70</td>
<td>M</td>
<td>3</td>
<td>LogW = 0.68938 LogL + 0.70579</td>
<td>0.01955</td>
<td>35.25815</td>
<td>0.0181</td>
<td>0.999</td>
<td>1.00000000</td>
</tr>
<tr>
<td>70 - 80</td>
<td>F</td>
<td>38</td>
<td>LogW = 3.9319 LogL - 4.87809</td>
<td>0.32752</td>
<td>12.00491</td>
<td>0.0000</td>
<td>0.800</td>
<td>1.00000008</td>
</tr>
<tr>
<td>70 - 80</td>
<td>M</td>
<td>30</td>
<td>LogW = 3.90042 LogL - 4.83778</td>
<td>0.55249</td>
<td>7.05964</td>
<td>0.0000</td>
<td>0.64</td>
<td>1.00000011</td>
</tr>
<tr>
<td>80 - 90</td>
<td>F</td>
<td>72</td>
<td>LogW = 4.26440 LogL - 5.55223</td>
<td>0.29931</td>
<td>14.24709</td>
<td>0.0000</td>
<td>0.744</td>
<td>1.00000358</td>
</tr>
<tr>
<td>80 - 90</td>
<td>M</td>
<td>7</td>
<td>LogW = 1.29821 LogL + 0.09382</td>
<td>3.47012</td>
<td>0.37411</td>
<td>0.7237</td>
<td>0.027</td>
<td>0.99999744</td>
</tr>
<tr>
<td>90 - 100</td>
<td>F</td>
<td>8</td>
<td>LogW = -1.49755 LogL + 5.98504</td>
<td>5.16860</td>
<td>-0.28974</td>
<td>0.7818</td>
<td>0.014</td>
<td>1.00000018</td>
</tr>
<tr>
<td>All female</td>
<td></td>
<td></td>
<td>LogW = 3.4216 Log L - 5.917</td>
<td></td>
<td></td>
<td></td>
<td>0.9174</td>
<td></td>
</tr>
<tr>
<td>All male</td>
<td></td>
<td></td>
<td>LogW = 3.3189 Log L - 5.7507</td>
<td></td>
<td></td>
<td></td>
<td>0.9179</td>
<td></td>
</tr>
<tr>
<td>Male and female combined</td>
<td></td>
<td></td>
<td>LogW = 3.4559 Log L - 5.9885</td>
<td></td>
<td></td>
<td></td>
<td>0.9245</td>
<td></td>
</tr>
</tbody>
</table>
Fig 7.2a: Length-Weight Relationship of Male *Lepidocephalichthy guntea*

\[ y = 3.3189x - 5.7507 \]
\[ R^2 = 0.9179 \]

Fig 7.2b: Length-Weight Relationship of Female *Lepidocephalichthy guntea*

\[ y = 3.4216x - 5.917 \]
\[ R^2 = 0.9174 \]

Fig 7.2c: Length-Weight Relationship of Male and Female *Lepidocephalichthy guntea*

\[ y = 3.4559x - 5.9885 \]
\[ R^2 = 0.9245 \]
Fig 7.2d: Kn values of Male
*Lepidocephalichthy guntea* in different size group

![Graph showing Kn values for Male Lepidocephalichthy guntea in different size groups.](image)

Fig 7.2e: Kn values of Female
*Lepidocephalichthy guntea* in different size group

![Graph showing Kn values for Female Lepidocephalichthy guntea in different size groups.](image)
7.3.3 Length-Weight relationship of *Neotropius atherinoides*.

*Neotropius atherinoides* is a truly riverine fish but during flood they find entry into the beels. Hence they are found in the beels during monsoon though they are rarely seen during the winter months or post monsoon period.

The statistics viz, regression analysis, standard error, ‘t’ test and significance, relative condition factor for *Neotropius atherinoides* is presented in Table (18). Similarly a linear relationship between the log weight and length was established for both male and female and sexes combined and presented in figure (7.3a,7.3b,7.3c). The values of regression coefficient computed are 3.9565 (female), 3.8513 (male) and 3.8774 (male and female combined). The weight of *N atherinoides* in the present study increased slightly more than the cube of its length as the values of regression coefficient “b” were found to be more than 3 in all cases. The rate of increase in weight in relation to length was slightly higher in females (b = 3.9565) than in males (b = 3.8513).

7.3.3.1 Kn value of *Neotropius atherinoides*

The Kn value (1.00000612) of female *Neotropius atherinoides* is highest at 70-80mm size group of fishes. After that slight decrease in Kn value (1.00000024) is observed at 80-90mm size group. In case of male highest Kn value (1.00001166) is observed at 60-70mm size group of fishes. After that slight decrease in Kn value (1.00000065) is observed at 70-80mm size group (Table -18 and Fig. 7.3d, 7.3e).
<table>
<thead>
<tr>
<th>Size group</th>
<th>Sex</th>
<th>No. of Fish Examined</th>
<th>Equation</th>
<th>Std. Error</th>
<th>Significance</th>
<th>R²</th>
<th>Kn</th>
<th>Significance</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>50–60 F</td>
<td>32</td>
<td></td>
<td>LogW = 3.1770 LogL - 3.88357</td>
<td>0.36057</td>
<td>9.1920</td>
<td>0.0000</td>
<td>0.738</td>
<td>1.00000079</td>
<td>0.99999782</td>
</tr>
<tr>
<td>50–60 M</td>
<td>28</td>
<td></td>
<td>LogW = 3.1859 LogL - 5.42368</td>
<td>0.38144</td>
<td>11.9957</td>
<td>0.0000</td>
<td>0.825</td>
<td>0.99999925</td>
<td>0.99999925</td>
</tr>
<tr>
<td>60–70 F</td>
<td>22</td>
<td></td>
<td>LogW = 3.8850 LogL - 6.14245</td>
<td>0.70453</td>
<td>6.5276</td>
<td>0.0000</td>
<td>0.68</td>
<td>1.00001166</td>
<td>1.00000094</td>
</tr>
<tr>
<td>60–70 M</td>
<td>28</td>
<td></td>
<td>LogW = 3.9110 LogL - 6.13026</td>
<td>0.50885</td>
<td>6.86078</td>
<td>0.0000</td>
<td>0.644</td>
<td>1.00000612</td>
<td>1.00000056</td>
</tr>
<tr>
<td>70–80 F</td>
<td>33</td>
<td></td>
<td>LogW = 3.5957 LogL - 4.25910</td>
<td>0.70188</td>
<td>5.07143</td>
<td>0.0000</td>
<td>0.453</td>
<td>1.00000000</td>
<td>1.00000000</td>
</tr>
<tr>
<td>70–80 M</td>
<td>19</td>
<td></td>
<td>LogW = 3.80820 LogL - 4.70995</td>
<td>0.63767</td>
<td>5.97206</td>
<td>0.0000</td>
<td>0.677</td>
<td>1.00000000</td>
<td>1.00000000</td>
</tr>
<tr>
<td>80–90 F</td>
<td>11</td>
<td></td>
<td>LogW = 1.53323 LogL - 0.31816</td>
<td>1.20268</td>
<td>1.27484</td>
<td>0.0000</td>
<td>0.234</td>
<td>0.153</td>
<td>1.00000024</td>
</tr>
<tr>
<td>All female</td>
<td>All male</td>
<td>100</td>
<td>LogW = 3.9565 LogL - 5.0008</td>
<td>0.9545</td>
<td>0.9694</td>
<td>0.9592</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male and female combined</td>
<td></td>
<td>100</td>
<td>LogW = 3.87741 LogL - 4.8473</td>
<td>0.9592</td>
<td>0.9592</td>
<td>0.9592</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 18: Regression model for length and weight of male, female and sexes combined of Neotropius atherinoides. Level of significance and Kn values are also shown in different size group.
Fig 7.3a: Length-weight Relationship of Male *Neotroplus atherinoides*

\[ y = 3.8513x - 4.7885 \]
\[ R^2 = 0.9694 \]

Fig 7.3b: Length-weight Relationship of Female *Neotroplus atherinoides*

\[ y = 3.9565x - 5.0008 \]
\[ R^2 = 0.9545 \]

Fig 7.3c: Length-weight Relationship of male and female *Neotroplus atherinoides*

\[ y = 3.8774x - 4.8473 \]
\[ R^2 = 0.9592 \]
Fig 7.3d: Kn values of male *Neotropius atherinoides* in different size group

Fig 7.3e: Kn values of female *Neotropius atherinoides* in different size group
7.4 Discussion
7.4.1 Length-Weight relationship

7.4.1.1 *Puntius ornatus*

The exact relationship between length and weight differs among species of fish according to their inherited body shape and within a species according to the condition (robustness) of individual fish. Condition sometimes reflects food availability and growth within the weeks prior to sampling. But condition is variable and dynamic. Individual fish within the same sample vary considerably and the average condition of each population varies seasonally and yearly (Schneider *et al.* 2000). Published report on the length-weight relationship is important for the studies on biology, population and management of species and their fisheries (LeCren, 1951; Shafi and Quddus, 1974). Various workers studied length-weight relationship in different species of *Puntius*. Annamercy *et al.*, (2002) studied on *Puntius denisonii* and recorded an isometric growth in this fish. Srivastava and Singh (2003) studied on *Puntius sophore* and recorded an allometric pattern of growth. Mitra *et al.*, (2005) studied on the same species and recorded fairly isometric growth. Salam *et al.* (2005) studied on *Puntius chola* and recorded an isometric growth in this fish. Prasad and Ali (2007) studied on *Puntius filamentosus* and recorded an isometric pattern of growth in this fish. Hossain *et al.* (2009) studied on *Puntius ticto* and recorded fairly isometric growth in this fish.
In the present study, *Puntius ornatus* shows an allometric pattern of growth, as it does not follow the cube law recommended by Le Cren (1951). During the investigation the value of regression coefficient “b” in male (3.4312), female (3.5122) and sexes combined (3.5504) are found to be higher than 3 in *Puntius ornatus* (Table-16). The weight of fish in the present study increased slightly more than the cube of its length as the values of regression coefficient “b” were found to be more than 3 in all cases. For a fish, which maintains its shape throughout its life, the value of regression coefficient will be “3” (Verghese, 1961; Talwar, 1962). Other than “3” the value indicates allometric growth. The regression coefficient obtained for male and female are in agreement with the report by Hile (1936) and Martin (1949) that the value of exponent “b” usually range between 2.5 and 4.0. Allen (1938) suggested that the value for “b” remains constant at 3.0 for an ideal fish while Tesch (1968) viewed that exponent “b” value of “3” indicates that a fish grows isometrically. But the value of “b” may change with localities, sex. maturity, metamorphosis and specific gravity (Frost, 1945; LeCren, 1951; Rounsefell and Everhart, 1953).

Most workers have reported such allometric pattern of growth being significant by more than 3 (b>3) under Cyprinidae family. Chakraborty and Singh (1963) observed that the value of ‘b’ in *Cirrhinus mrigala* was considerably higher than 3. Khan (1972) observed that value of ‘b’ in *Labeo rohita* of river to be 3.17 and 3.06 respectively.
Chatterji et al., (1980) reported higher value of “b” in both sexes of *Labeo calbasu* from river Kali. Azadi and Naser (1996) reported the value of “b” as 3.16 for males and 3.20 for females in *Labeo bata* from Bangladesh. Baishya et al. (2010) reported a higher “b” value in both sexes of *Amblyparyngodon mola*.

Carlander (1977) demonstrated that values of b< 2.5 or > 3.5 are mostly caused by samples with narrow size ranges. This finding is in agreement with the present study where availability of fish was found to be rare. Serajuddin (2005) reported that the departure from the cube law may be due to ecological factors particularly availability of forage organisms to the fish. However in our study this may not be the case as the fish is herbivorous in habit.

7.4.1.1.1 Kn value

The relative condition factor (Kn) is an indicator of the general well being of the fish (Pandey and Sharma, 1997). This value fluctuates between different size groups of fish. It may be due to several reasons, such as feeding intensity, gravid condition of female, due to smaller sample size or different stage of maturity or spawning or difference in weight of food content in the stomach (Shafi and Quddus, 1974; Das et al., 1997). Similar observations were made by Quddus (1993) for *Gudusia chapra* and Azadi and Naser (1996) for *Labeo bata*.
In the present study the value of kn showed fluctuations between different size group of the sexes of *Puntius ornatus*. In case of female *Puntius ornatus* the highest Kn value (1.00000859) was observed at 35-40mm size group, which coincides with the findings of size at first maturity of the fish (chapter VIII). After that a sharp decline in Kn in 40-45 mm size of fish (Fig.7.1e) may be associated with spawning. The Kn value in case of male *Puntius ornatus* shows an increasing trend upto 30-35 mm size group (Fig.7.1d) and after that a slight decrease in Kn value was observed at 35-40mm size group of fish. This may be due to spent condition of the fish. In both male and female *Puntius ornatus* the Kn value remains very close to 1 indicating general well being of the fish.

It also indicates that the fertility and food supply of the beel is good and it is an ideal habitat for the fish.

The length-weight relationship and relative condition factor shows that the growth of fish is satisfactory.

### 7.4.1.2 *Lepidocephalichthys guntea*

Information regarding length-weight relationship of family Cobitidae can be found following publications. Mortuza and Mokarrama (2000) reported the length-weight relationship of *Botia lohachata*. However length-weight relationship of *Lepidocephalichthys guntea* was reported by Dhakal and Subba (2003) from Pathri Khola, Morang District,
Nepal. Hossain et al. (2009) studied length-weight relationship of *Lepidocephalichthy guntea* from the lower part of Ganges in Bangladesh.

The present study will provide information about the population in Brahmaputra drainage.

In the present study b value recorded as 3.4216 for female, 3.3189 for male and 3.4559 for male and female combined (Table-17). From the study it is clear that, ‘b’ values of present investigation are higher than 3. It has been observed that ‘b’ value of the female were higher than the value for male in which may be due to the enormous increase in weight of ovaries in females. Similar findings were also reported by Dhakal and Subba (2003), when they estimated the ‘b’ value 3.18 for female and 2.6 for male of *Lepidocephalichthy guntea*. The value of exponent ‘b’ differs not only in different species but in same species also due to sex, maturity stage, feeding intensity, etc. (Dhakal et al 2003). Apart from this, there also occurs interplay of many factors like locality, season, maturity, age and water quality that affect the departure from the cube law (Jhajhria, 2003).

The present findings are in accordance with the range of values of this parameter usually encountered in fishes, which lies between 2 and 4 according to Bagenal and Tesch (1978). Recently, Froese (2006) confirmed the suggestion of Carlander (1969) that the exponent “b” should normally fall between 2.5 and 3.5. Hossain et al. (2009) confirmed their findings with these values when they studied 10 small fish species.
including *Lepidocephalichthys guntea* from the lower part of Ganges in Bangladesh.

From the above discussion it can be concluded that the exponent "b" value obtained from the present study are in agreement with the findings of Froese (2006) and Hossain *et al.* (2009).

### 7.4.1.2.1 Kn value

In the present study the values of Kn showed significant fluctuation for both male and female *Lepidocephalichthys guntea*. The highest Kn value (1.00000358) of female *Lepidocephalichthys guntea* was recorded at 80-90mm size range of fish, which coincides with the findings of size at first maturity of the fish (chapter-viii). In case of male *Lepidocephalichthys guntea* the smaller size group (60-70mm) shows high Kn (1.00000000) value which may be due to high feeding intensity of the fish. This finding is also reported by Shafi and Quddus (1974) for *Cirrhina mrigala* and Narejo *et al.*, (2002) for *Monopterus cuchia*.

The relative condition factor (Kn) corresponding to different size groups of *Lepidocephalichthys guntea* showed that in case of female, Kn < 1 in smaller size group (60-70mm). Sarkar *et al* (1997) mentioned this type of observation in case of *Catla catla*. After that the value increases gradually and stabilized above 1 (Fig.7.2e). In case of male, Kn value is greater than 1 in 70-80mm size group. After that the value declined
slightly in size group 80-90mm but remained close to 1 (Fig. 7.2d). In both male and female *Lepidocephalichthys guntea* Kn value remains very close to 1 indicating well being of fish.

It also indicates that the fertility and food supply of the beel is good and it is an ideal habitat for the fish.

The length-weight relationship and relative condition factor shows that the growth of fish is satisfactory.

7.4.1.3 *Neotropius atherinoides*

The parameters of length-weight relationship may vary significantly due to biological and environmental conditions or geographical, temporal and sampling factors (Bagenal and Tesch, 1978; Froese, 2006). There is lots of example that fish do not follow cube law and hence their growth is allometric type rather of isometric. According to Roundsfell and Everheart (1953) the specific gravity or outline of the fish are subject to significant deviation from the cube law in case of different fishes. The seasonal changes and notably the period during and immediately after spawning affect the length-weight relationship (Sunil, 2000). There are also reports of significant deviation of length-weight relationship from the cube law in the fishes. Sultan (1981) noticed such deviation in *Mystus vittatus*; Sivakami (1987) in *Ompok bimaculatus*; Gowda *et al.* (1987) in *Valamugil sebeli*; Kulshreshta *et al.* (1993) in *Catla catla*; Pandey (1998) in *Cirrhinus mrigala*. 
During present investigation the value of regression coefficient “b” was found to be higher than 3 in male (3.8513), in female (3.9565) and sexes combined (3.8774). The value of regression coefficient showed a clear departure from the cube law in *Neotropius atherinoides*. It is well known that the functional regression “b” value represents the body form and it is directly related to the weight affected by ecological factors such as temperature, food supply, spawning condition and other factors, such as sex, age, fishing time and area and fishing vessels (Ricker, 1973). Total weight of fish may also be altered by the weight of the stomach content depending on the food ingested just before weighing (Muth and Smith, 1974).

Ramakrishnaiah (1983-84) performed similar investigation on *Pseudeutropius taakree* a schilbeid catfish from Nagarjunasagar reservoir and recorded “b” value between 2.5-3.5. Hossain *et al.* (2009) studied length-weight relationship of *Ailia coilia, Clupisoma atherinoides, Eutropiichthys vacha* under the family of Schilbeidae from Bangladesh. The values of “b” in these fishes were within the limits of 2.5-3.5 as reported by Froese (2006) for most fishes. Dhasmana and Lal (1993) reported that in *Garra gotyla gotyla*, value of “b” ranged from 2.5-3.9.

Thus in the present study, weight in relation to total length of fish follow allometric growth pattern.
7.4.1.3.1 Kn value

The values of Kn of *Neotropius atherinoides* showed fluctuation in all size groups of males and females during the present investigation.

The Kn value of female *Neotropius atherinoides* is highest (1.00000612) at 70-80mm size group and in case of male it is (1.00001166) at 60-70mm which coincides with the findings of size at first maturity of the fish (chapter VIII). The coincidence of peak condition with maturity cycle in inland fishes has been demonstrated by earlier workers (Pantulu, 1961 and 1963; Gupta, 1967; Ramakrishnia, 1972). Ramakrishnia (1983-84) reported similar findings in *Pseudeutropius taakree*.

In both male and female *Neotropius atherinoides* the kn value decreases (Fig. 7.3d,7.3e) after attaining maturity level may be due to spawning or spent condition. In both male and female *Neotropius atherinoides* Kn value remains very close to 1 indicating well being of fish.

It also indicates that the fertility and food supply of the beel is good and it is an ideal habitat for the fish.

The length-weight relationship and relative condition factor shows that the growth of fish is satisfactory.