Biology of Gudusia chapra (Hamilton-Buchanan) from a floodplain wetland in West Bengal

G. K. VINCI, V. R. SURESH AND M. K. BANDYOPADHYAYA
Central Inland Fisheries Research Institute, Barrackpore,
Kolkata-700 120, West Bengal

ABSTRACT
Biology of Gudusia chapra (Hamilton-Buchanan) from a floodplain wetland in West Bengal has been studied during 1999-2001. The fish is an omnivore, feeding mainly on Myxophyceae followed by Bacillariophyceae, Turbellaria and Rotifera. November to March was the most active feeding period. The length weight relationship established for the fish suggested fairly isometric growth, closely following cube low. The regression equation obtained was Log W = 2.8576 Log L – 4.7564 (R² = 0.9176). Fecundity of the fish ranged from 936 to 13,860. The ova diameter ranged from 0.05 to 1.28 mm. The fish has a prolonged breeding season, extending from March to October, during which it releases eggs in batches. The relative condition factor showed well being of the fish.

Introduction
Floodplain wetlands are integral parts of Ganga and Brahmaputra river basins. They are formed by river course changes, leaving behind water bodies with or without connection to the parent rivers. West Bengal has more than 150 such wetlands, locally called beels, spread over an estimated area of 42000 ha forming 22% of the total freshwater area of the state. These beels harbour a large number of native fish species and play a significant role in the inland fish production of the state. Fishery of most of these beels is under management by cooperative societies. The societies undertake stocking of the beels (Indian major carps), liming, macrophyte clearing and eradicating weed fishes. As a result of this, drastic shift in favour of major carps at the cost of some of the prized native fish fauna has been noticed in beels under culture based fishery management (Sugunan et al., 2000).

Gudusia chapra (Hamilton-Buchanan), belonging to the family Clupeidae is a delicious, native species of the beels and fetch good market price (Rs. 50-100 per kg) in West Bengal, Orissa and the northeast. It has now become rare in many of the beels in the state. As part of management of floodplain wetlands, the Central Inland Fisheries Research Institute has initiated efforts to rehabilitate and restore the stock of important native
fishes, in selected beels. *G. chapra* is one among the target species of this programme in West Bengal. Studies on *G. chapra* dates back to Kapoor (1954, 1957). Jhingran (1966) studied the biology and fisheries of the fish in the River Ganga; length weight relationship and condition factor (Jhingran, 1968) and diet composition (Jhingran 1973). Chonder (1973, 1975, 1977) attempted racial separation of *G. chapra* from Keeham and Ganga rivers using various biological parameters of the fish. Length weight relation and condition factor of the fish in Assam has been studied by Devashish (2000). Sarkar et al. (2002) reported growth of the fish in water bodies of Uttar Pradesh. Nevertheless, information on the food habits, length weight relation and reproductive biology of the species in beels, which is a prerequisite in the stock restoration programmes, is lacking. Therefore this work has been taken up during 1999-2001 in Garapota beel, situated at Bongaon, 24 Parganas North district of West Bengal.

**Materials and methods**

Fish samples were collected at monthly basis from Garapota beel, through local fishers. After blotting off water, their total length and weight were measured. The size of the fish ranged from 96 to 130 mm in length and 4.8 to 23.91 g in weight.

**Food habits**

Gut contents of a total of 200 specimens were were dissected out, weighed and preserved in 5% formalin. The gut contents were analyzed through quantitative and qualitative methods (Hynes, 1950; Pillay, 1952). The food items were identified up to major taxonomic groups. Since the items were very small, their volume was estimated by allotting points. For evaluating the importance of these food items or preference, their index of preponderance was worked out following Natarajan and Jhingran (1961). Monthly variations in feeding index were obtained on the basis of fullness of stomach as suggested by Kow (1950) to assess the feeding intensity.

\[
\text{Fish with heavy and medium stomach} = \frac{\text{Feeding index}}{\text{Number of fish examined}} \times 100
\]

**Length weight relationship**

The relation between length and weight common to males and females of the fish was established following the formula of Le Cren (1951) by transforming into a straight line equation, \( \log W = \log a + b \log L \). The regression slope was calculated by the formula of Lagler (1952).

**Reproductive biology**

The sex and stage of maturity of the fishes were identified while dissecting. The ovaries were removed and classified into different maturity stages on the basis of morphological observations following Lovern and Wood (1937). After weighing, the ovaries were preserved in 5% formalin. The fecundity was estimated as described by Grimes and Huntsman (1980) by counting the number of mature ova from a known weight of sub sample of ovary (only V – VI stages) and calculating the total number of ova using the following formula

\[
\text{Fecundity} = \frac{\text{Weight of ovary}}{\text{Weight of sample}} \times \text{No. of mature ova in sample}
\]
Biology of Gudusia chapra

by following their diameter progression. (Hickling and Rutenberg, 1936). Eggs were sampled from the middle of the ovary. An ocular micrometer was used for the measurement. The gonado somatic index (GSI) was estimated following June (1953) and expressed as the ratio of the weight of gonad to body weight in percentage, to understand the spawning season.

\[
\text{Weight of gonad} = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100
\]

Relative condition factor (Kn) of female fishes were studied on monthly basis following Le Cren (1951). Males were not subjected for this study.

**Results and discussion**

**Food habit**

The alimentary canal of G. chapra is short, muscular and less coiled. Phytoplankton and other plant matter formed 66.4% of the gut contents and the rest was zooplankton. Algae followed by Turbellaria and rotifera dominated in the stomach contents. The food consisted mainly of algae, rotifers, crustaceans, plant matters and miscellaneous items. Grading the gut contents of fishes give indications of their food preference (Natarajan and Jhingran 1961). The index of preponderance and preference ranking of food items in the gut showed that Myxophyceae followed by Bacillariophyceae, Turbellaria and Rotifera were the preferred food items in the decreasing order of preference (Table 1). Although, algae were the most preferred food item the available

**Table 1.** Index of preponderance (\(I_i = \frac{V_i O_i}{\sum V_i O_i} \times 100\)) of different food items in the gut of G. chapra and their preference ranking

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Vi</th>
<th>Oi</th>
<th>ViOi</th>
<th>Index</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacillariophyceae</td>
<td>13.50</td>
<td>10.80</td>
<td>145.80</td>
<td>15.96</td>
<td>2</td>
</tr>
<tr>
<td>Myxophyceae</td>
<td>32.70</td>
<td>10.80</td>
<td>353.16</td>
<td>38.68</td>
<td>1</td>
</tr>
<tr>
<td>Microsporaceae</td>
<td>1.88</td>
<td>2.70</td>
<td>5.07</td>
<td>0.55</td>
<td>12</td>
</tr>
<tr>
<td>Hydrodictyaceae</td>
<td>0.58</td>
<td>5.40</td>
<td>3.13</td>
<td>0.34</td>
<td>14</td>
</tr>
<tr>
<td>Zygnemataceae</td>
<td>4.91</td>
<td>6.70</td>
<td>32.89</td>
<td>3.63</td>
<td>6</td>
</tr>
<tr>
<td>Tribonemataceae</td>
<td>0.39</td>
<td>2.70</td>
<td>1.05</td>
<td>0.11</td>
<td>15</td>
</tr>
<tr>
<td>Scendesmaceae</td>
<td>1.14</td>
<td>6.70</td>
<td>7.63</td>
<td>0.84</td>
<td>7</td>
</tr>
<tr>
<td>Chaetophoraceae</td>
<td>2.75</td>
<td>2.70</td>
<td>7.42</td>
<td>0.81</td>
<td>8</td>
</tr>
<tr>
<td>Volvocaceae</td>
<td>8.53</td>
<td>8.10</td>
<td>69.09</td>
<td>7.56</td>
<td>5</td>
</tr>
<tr>
<td>Euglenaceae</td>
<td>2.00</td>
<td>6.70</td>
<td>13.40</td>
<td>1.47</td>
<td>10</td>
</tr>
<tr>
<td>Desmidiaeae</td>
<td>0.08</td>
<td>2.70</td>
<td>0.21</td>
<td>0.02</td>
<td>16</td>
</tr>
<tr>
<td>Turbellaria</td>
<td>15.02</td>
<td>9.40</td>
<td>141.18</td>
<td>15.45</td>
<td>3</td>
</tr>
<tr>
<td>Rotifera</td>
<td>11.83</td>
<td>9.40</td>
<td>111.20</td>
<td>12.17</td>
<td>4</td>
</tr>
<tr>
<td>Copepoda</td>
<td>0.71</td>
<td>5.40</td>
<td>3.83</td>
<td>0.42</td>
<td>13</td>
</tr>
<tr>
<td>Cladocera</td>
<td>2.24</td>
<td>5.40</td>
<td>12.09</td>
<td>1.32</td>
<td>11</td>
</tr>
<tr>
<td>Nauplii</td>
<td>1.61</td>
<td>4.00</td>
<td>6.44</td>
<td>0.70</td>
<td>9</td>
</tr>
<tr>
<td>Plant matter</td>
<td>0.13</td>
<td>0.40</td>
<td>0.05</td>
<td>0.005</td>
<td>17</td>
</tr>
<tr>
<td>Σ</td>
<td>100</td>
<td>100</td>
<td>913.64</td>
<td>100</td>
<td>—</td>
</tr>
</tbody>
</table>
data suggested that the fish is an omnivore, feeding on zooplankton as well. Decaying organic matter of plant origin was also observed in the gut. Fishes of all sizes showed almost the same food preference.

The feeding intensity monitored monthly showed that the most active feeding period was November to March. April to June was the period of less active feeding and July to October was the period of low feeding (Fig. 1). November to March was the period when spawning took place and after spawning the fish needed to feed actively for revitalization and re-maturing of ova.

Length weight relationship

Establishing the relationship between length and weight is useful in fishery management by helping prediction of potential yield and determination of size at capture for obtaining MSY as these management parameters are directly related to weight of the fish. The relationship is also useful in differentiating small taxonomic units, as variations might occur within populations of different localities (Le Cren, 1951; Chonder, 1972). A common length weight relationship established for G. chapra from the beel showed a straight-line equation. The regression equation derived is Log W = 2.8576 Log L – 4.7564 (R² = 0.9176). The equation and the correlation coefficient suggested a close relation between the length and weight. The species do not follow the cube law, as the weight of the fish increases slightly less than the cube of its length. The scatter diagram of the length and weight is given in Fig. 2. The value of regression coefficient computed was 2.8576. For a fish, which maintains its shape throughout its life, the value of regression coefficient will be ‘3’ (Verghese, 1961; Talwar, 1962). This value may change with locality, sex, and maturity (Le Cren, 1951) besides environmental conditions. Under these circumstances the value other than “3” indicated allometric growth. According to Hile (1936) the values usually fluctuate between 2.5 and 4.0 and in majority of cases the value was not equal to “3”. Devashish (2000) reported that the cube law held good (n=3.0798) for the species from a floodplain wetland in Assam. Although G.chapra from Garapota beel in West Bengal did not precisely follow cube law, the closeness of the value to ‘3’ and the possible influence of internal and external factors, as described by Le Cren (1951), it may be considered that the fish followed fairly isometric growth.

Reproductive biology

The fecundity of the fish ranged from 936 to 13,860. The relative fecundity (number of ova per gram body) ranged from 191 to 1918 with an average of 894. The fecundity was lower for the size groups examined from the beel when compared to those reported (Chonder, 1977) for similar size groups from rivers. This may be due to the confined nature of the beel ecosystem. The ovaries were grouped into seven stages as stage I (Immature) to stage VII (spent). The mature ovaries of the fish were paired, yellow in colour and occupied the entire body cavity. The monthly progression of ova diameter showed that immature ova (0.05-0.13 mm) were present in all the months along with other stages of ova. The percentage occurrence of maturing ova (0.21-0.71 mm) was higher from March to October. March to June and September to October was the period when the percentage of occurrence of ripe ova (0.71-1.28 mm) was at its peak. During July to August and November to December, the percentage of ripe ova was
Biology of Gudusia chapra

low, indicating the months of shedding of ova. This shows that the species spawns more than once in a year (Fig. 3). The monthly variations in the gonad weight and gonado somatic index (GSI) of the fish (Fig. 4) also showed peaks during March, April to June (0.79-0.85 g and 4.77-6.04% respectively) indicating development of ovary and thereafter these values begin to drop, indicating spawning, which corroborated the spawning period inferred from ova diameter progression. The lowest values of GSI were during November to January.

It is well known that fishes exhibit various types of spawning, which are closely related to the development and distribution of the eggs (Hickling and Ruthenberg, 1936; Prabhu, 1956). Separate polygons drawn for individual fishes in the same stage of maturity showed no difference in ova diameter frequency, indicating the absence of any variation in the spawning periodicity between individuals. Hence a common polygon was made. The ova diameter distribution showed that in addition to the mode ‘a’ formed by immature ova (between 0.05 and 0.21 mm) there are two other modes; mode ‘b’ at 0.79 mm and mode ‘c’ at 0.95 mm (Fig. 5). The modes ‘a’ and ‘b’ are dearly separated and the modes ‘b’ and ‘c’ are closely set. It is likely that the ova ranging from 0.46

$y = 2.8576x - 4.7564$

$R^2 = 0.9176$

Fig. 2. Length weight relationship of G. chapra

Fig. 3. Monthly changes in percentage occurrence of ova of different diameter.

Fig. 4. Monthly variations in the gonad weight and GSI of G. chapra

Fig. 5. Frequency of occurrence of eggs of different diameter in ripe ovaries

Fig. 6. Monthly variations in relative condition factor of G. chapra
to 1.11 mm are the stock of eggs to be shed during the next spawning season. The mode 'a' indicates the recruitment stock, which is usually present in the ovaries throughout the year (Fig. 3). It is generally known that the spawning period of a fish will be short and definite if the mature ova are sharply separated from the stock of immature ova (Hickling and Rutenberg, 1936). Two modes (b and c) in the mature class of ovary indicated that there may be more than one spawning by releasing eggs in batches as indicated in Fig. 3.

The values of relative condition factor Kn, a measure of the well being of the fish (Le Cren, 1951), ranged from 1 to 1.3 indicating a general well being of the fish. The Kn value depends on the physiological factors like maturity and spawning as well as food availability (Brown, 1957). The Kn values did not show marked variations except minor peaks in July, October and March, corresponding to the periods of gonad maturity and spawning. These peaks are not prominent, probably due to the close breeding period and releasing of eggs in batches.

G. chapra is a surface feeder. Algae, especially Myxophyceae were the preferred food item. The spawning period was from March to October in which the fish release eggs in batches. Fecundity ranged from 936 to 13,860 and the fecundity factor was 894 eggs. The species from Garapota beel in West Bengal does not precisely follow cube law, yet the closeness of the value to '3' indicated fairly isometric growth.

Acknowledgements

The authors are grateful to the Director, Central Inland Fisheries Research Institute, Barrackpore and Dr. V. V. Sugunan, Head, Floodplain Wetland Division for their encouragement and assistance. The authors are also indebted to the staff of the Floodplain Wetlands Division, Barrackpore, especially to Ms. Suvra Saha for technical assistance.

References


Hile, R. 1936. Age and growth of the cisc Leucichthys artedi (Le Sucer) in the
Biology of Gudusia chapra


