Growth, food and feeding habit with prey preference of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) in brackishwater traditional impoundments of Sundarban, India

Asish Mondal* and Abhijit Mitra

Abstract
The present study was aimed to focus on growth, food and feeding habit with prey preferences of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) in brackish water ‘bhery’ for 12 months during August 2014 to July, 2015. Advance fry of *M. gulio* (1.78±1.5g, 5.6±0.54 cm) added to stock fishes @ 10000 fish/ha attained 82.5±3.20 g (20.5±0.98cm) in brackishwater impoundments. The fishes showed isometric growth (*W=0.007 TL 2.996*) and good Condition factor (K=0.98±0.07). Feeding intensity observed lower during intense breeding season (May to June) and higher during the post-spawning season (August to April). *M. gulio* is a carnivorous fish as it used to prey mostly on zooplankton and animal food materials. According to the order of dominance, the major food groups in stomach were Copepods> Insect larvae> Myxophyceae> Rotifers & Cladocera> Crustacean parts> Bacillariophyceae> Chlorophyceae> Fish and prawn larvae> unidentified materials but on prey selectivity analysis, the fish actively selected on positive preference as Copepods> Insect larvae> Fish and prawn larvae> Rotifers & Cladocera> Crustacean parts and negative preference as Myxophyceae> Bacillariophyceae> Chlorophyceae. Electivity analysis observed that Copepods, Insect larvae, Fish and prawn larvae were most preferred food items to the fish.

Keywords: *Mystus gulio*, growth, feeding ecology, prey selection, Sundarban

Introduction
Food and feeding habits of fishes have a great significance in aquaculture practice and it helps to species selection for culture which will utilize all the available potential food of the water bodies without any competition with one another but will live in association with other fishes [1]. Food habits and feeding ecology research are fundamental to understand fish roles within their ecosystems since they indicate relationships based on feeding resources and indirectly indicate community energy flux, which allows inferring competition and predation effects on community structure [2, 3]. Quantitative and qualitative changes of food are useful tools to define the diet of a particular fish species [4, 5]. Determination of the prey type are feeding preference, availability of prey, prey mobility and its distribution in the water column, catching efficiency of the predator, water temperature and turbidity [6-8]. Food habit with prey preference has implications at the individual [9], population [10], and community levels [11].

*Mystus gulio* (Ham. 1822), commonly known as ‘long whiskered catfish’ of family Bagrid is euryhaline catfish, occurring mostly in estuarine tidal brackishwater and also in freshwater [12, 13]. The adults were found in larger water bodies (rivers and streams) with mud or clay substrates, and rarely occurred in smaller streams [14]. The species, *M. gulio* is very common in the ponds, canals and beels of all over India as well as widely distributed throughout the Indian subcontinent including China, Bangladesh, Sri Lanka, Indonesia, Vietnam, Pakistan, Nepal, Java, Thailand, Malaysia and Myanmar [15-21]. In West Bengal, the low-lying lands near estuaries and deltaic areas enclosed by embankments called "bheries" are used for traditional finfish cultivation, especially during rains [22]. This fish species is widely cultured in paddy fields and brackish water areas of deltaic Bengal, where it forms a valuable culture fishery [23]. Owing to its good delicious taste, *M. gulio* has a good market demand as food fish [24, 25]. Recently this fish species entered in ornamental fish markets and exported as indigenous ornamental fish from India [26].
No such documentation has been investigated from Hooghly-Matla estuarine complex, popularly known as ‘Sundarbans’ in spite of being a highly potential and ecologically important area where *M. gulio* is a commercially important catfish in brackishwater aqua farming. The present investigation aims to determine variation in abundance of food of *M. gulio* along with differences in monthly variation in the diet. This culture also assessed to study the growth performance, feeding ecology and food preferences of *M. gulio* in extensive polyculture system in Sundarbans.

**Materials and Methods**

The experiment was carried out at Paschim Dwarakapur village (21.754143–21.755640°N, 88.325473–88.325563°E) of Patharpratima block in South 24 Parganas district of West Bengal, India for the period of one year from August 2014 to July, 2015 (Figure. 1). The selected area is situated within the Hooghly-Matla estuarine complex popularly known as ‘Sundarbans’. Three traditional brackishwater tide-fed impoundments (0.2 ha) locally called as ‘Bhery’ situated at the bank of a creek of ‘Saptamukhi’ river were selected. Estuarine available *M. gulio* seeds of Sundarban area were stocked at 10000 individual/ha in brackish water tide-fed impoundments. About 20-30% water was exchanged in every lunar cycle depending on the tidal amplitude throughout the rearing period following common practice. Fish feed was not applied in the impoundments. Lime Stone Powder was applied at 200 kg/ha during first week of every month. Samplings have carried out during early morning in between 8.00 am to 9.00 am. Fish samples and water were collected from three impoundments to eliminate any possible biasness. Both fish and water samples were preserved in ice and those were carried to laboratory for subsequent analysis.

**Water quality parameters** such as water temperature, pH, dissolved oxygen (DO), alkalinity, nitrite-nitrogen (NO$_2$-N), nitrate-nitrogen (NO$_3$-N), ammonia-nitrogen (NH$_3$-N) and phosphate-phosphorus (PO$_4$-P) were measured following standard methods [27]. Salinity was recorded using a refractometer (ATAGO, Japan). On monthly basis plankton samples were collected by filtering 50L of water through bolting silk plankton net (mesh size 64 μm). Plankton concentrates were immediately preserved in 5% buffered formalin and one ml aliquot were then placed in to Sedgwick-Rafter counting cell for number count. Plankton and suspended constituents were identified and counted following Jhingran et al. [28] and Prescott [29].

Ten fishes from each of three ponds were collected during the 1st week of each month i.e. 30 fish in a month and total 360 fish samples for three ponds were collected and analyzed during the 12 months of culture period. Gravimetric data, such as, total length (TL, cm) was measured using a slide caliper, while body weight (W, g) was measured using a digital electronic balance. Daily weight gain (DWG) was calculated following the formula:

\[
DWG = \frac{W_f - W_i}{t}
\]

Where $W_f$ and $W_i$ are the average final and initial weight at time $t$.

Specific growth rate (SGR) was calculated using the conventional equation:

\[
SGR = \frac{\ln w_f - \ln w_i}{t} \times 100
\]

Where $W_f$ and $W_i$ are the average final and initial weight at time $t$.

The mathematical relationship between length and weight was calculated using the conventional formula [30]:

\[
W = a \cdot TL^b
\]

Where $W$ is fish weight (g), *TL* is total length (cm), ‘$a$’ is the
Means bearing different superscripts indicate statistically significant differences in a row (p<0.05); Values are expressed as mean ± SE (n=10 for each impoundments every month).

### Table 1: Physico-chemical parameters of three traditional brackishwater impoundments used in the present Study.

<table>
<thead>
<tr>
<th>Water parameters</th>
<th>Impoundment 1</th>
<th>Impoundment 2</th>
<th>Impoundment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water temperature (°C)</td>
<td>29.9±1.72</td>
<td>29.9±1.73</td>
<td>29.7±1.94</td>
</tr>
<tr>
<td>pH</td>
<td>8.04±0.23</td>
<td>7.78±0.31</td>
<td>7.92±0.25</td>
</tr>
<tr>
<td>DO (mg L⁻¹)</td>
<td>6.06±0.42</td>
<td>5.98±0.52</td>
<td>5.69±0.52</td>
</tr>
<tr>
<td>Salinity</td>
<td>12.89±5.19</td>
<td>13.33±4.45</td>
<td>12.06±5.34</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>168.9±4.25</td>
<td>165.9±3.51</td>
<td>160.0±5.23</td>
</tr>
<tr>
<td>NO₂⁻N (µg L⁻¹)</td>
<td>16.55±5.83</td>
<td>15.91±5.62</td>
<td>16.91±6.63</td>
</tr>
<tr>
<td>NH₄⁺N (µg L⁻¹)</td>
<td>30.76±5.61</td>
<td>31.19±7.91</td>
<td>34.89±6.27</td>
</tr>
<tr>
<td>NO₃⁻N (µg L⁻¹)</td>
<td>93.12±15.41</td>
<td>92.66±11.14</td>
<td>92.97±8.94</td>
</tr>
<tr>
<td>PO₄⁻P (µg L⁻¹)</td>
<td>32.07±13.43</td>
<td>31.98±11.98</td>
<td>31.97±12.74</td>
</tr>
<tr>
<td>Phytoplankton (numbers/L⁻¹ x 10⁴)</td>
<td>15.89±1.62</td>
<td>15.12±1.94</td>
<td>14.05±1.73</td>
</tr>
<tr>
<td>Zooplankton (numbers/L⁻¹ x 10⁴)</td>
<td>3.49±0.25</td>
<td>2.98±0.23</td>
<td>2.88±0.17</td>
</tr>
</tbody>
</table>

Percentage occurrences of planktonic and other suspended food components in the studied impoundments are presented in Figure 2. According to the order of dominance, the most abundant phytoplankton groups in three impoundments were...
Chlorophyceae, Myxophyceae and Bacillariophyceae. On the other hand, the dominant zooplankton groups in three impoundments were Copepods, Insect larvae, Rotifers & Cladocera, Crustacean larvae and Fish and prawn larvae. The most abundant genera found under Chlorophyceae were Enteromorpha, Tetraedron, Pediastrum, Chlorella, Ulothrix, Volvox, Cladomorpha and Coelastrum. The other less abundant genera of Chlorophyceae were Ankistrodesmus, Crucigenia, Scenedesmus, Pandorina, Spirogyra and Chaetomorpha. Numeric percentage composition of Chlorophyceae ranged between 12.10 to 37.41% (average 25.97±2.75%) with minimum and maximum during July and March respectively. Anabaena, Nostoc, and Spirulina were also recorded among the other genera of Myxophyceae. Chroococcus, Gloeocapsa, Oscillatoria and Merismopedia were also recorded among the other genera of Myxophyceae. The percentage composition of Myxophyceae constituted between 8.96 to 25.06% (average 17.94±1.63%) throughout the culture period. Among Bacillariophyceae, Coscinodiscus, Navicula, Nitzschia, Basilaria, Cyclotella, Diatoma and Melosira were found to be the most abundant genera. In addition Cymbella, Gyrosigma, cyclotella and Melosira were also measured. Numeric percentage of Bacillariophyceae ranged between 0.55 to 19.52% (average 12.01±1.45%). Percentage of diatom observed to be lowest during March and highest during February. Among Zooplankton groups, Copepods were most dominant in water column. Cyclops, Metis, Microsetella, Harpacticus, Corycaeus and Oithona were found. Copepods were ranged between 5.06 in November to 20.20% in April (average 11.84±1.22). Percentage of Insect larvae was varied between 2.04 in February to 24.88% in June (average 11.49±2.10). Among Rotifers & Cladocera, Asplanchna, Daphnia and Brachionus were dominant genera. Numeric percentage of Rotifers & Cladocera was ranged between 4.21 in December to 20.02% in July (average 9.20±1.57) and 2.50 in May to 21.00% in June (average 8.16±1.64) in Crustacea larvae. The mean percentage of Fish and prawn larvae was 16.56±0.88. Unidentified materials such as Planktonic or non-Planktonic part also considered. The mean percentage of unidentified materials was 1.83±0.44%.

Fish growth of *M. gulio* in terms of weight (w, g) and length (TL, cm) during culture period is presented in Figure 3. After 360 days of rearing, catfishes was grown from 1.78±1.5g (5.6±0.54 cm) to 82.5±3.2g (20.5±0.98 cm). Average daily weight gain (DWG) calculated was 0.24±0.03 g which ranged between 0.10 (October) and 0.37g day⁻¹ (March). Average specific growth rate (SGR) recorded was 1.16±0.29% day⁻¹ which varied between 0.51% (June) and 3.39% day⁻¹ (August). Exponential value (b) of Length-Weight Relationship (LWR) was 2.996 indicating isometric growth for this species (Figure 4). The mean value of the Fulton’s condition factor (K) was 0.98±0.07 (Figure 5).
Fig 3: Growth increment of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) reared in traditional brackishwater impoundments of Sundarban.

\[
y = 0.0115x^{2.9963} \\
R^2 = 0.988
\]

Fig 4: Length-weight relationship of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) cultured in traditional brackishwater impoundments of Sundarban.

Fig 5: Fulton’s condition factor (K) of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) reared in studied brackishwater impoundments of Sundarban.

Stomach fullness has been categorized in to seven classes namely: gorged, full, ¾ full, ½ full, ¼ full, little and empty. The results of monthly analysis of stomach fullness have been showed in Table 2.

Table 2: Feeding intensity of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) during the study period.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug</td>
<td>18</td>
<td>2.8</td>
<td>12.6</td>
<td>24.9</td>
<td>7.05</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Sep</td>
<td>12.8</td>
<td>2.1</td>
<td>6.9</td>
<td>25.5</td>
<td>32.2</td>
<td>15</td>
<td>5.2</td>
</tr>
<tr>
<td>Oct</td>
<td>8.9</td>
<td>15.6</td>
<td>6.9</td>
<td>16.5</td>
<td>22.2</td>
<td>19.3</td>
<td>10.5</td>
</tr>
<tr>
<td>Nov</td>
<td>12.7</td>
<td>21</td>
<td>2</td>
<td>22</td>
<td>16.3</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>Dec</td>
<td>21</td>
<td>16.7</td>
<td>16.7</td>
<td>11.1</td>
<td>21.2</td>
<td>11.1</td>
<td>2</td>
</tr>
<tr>
<td>Jun</td>
<td>35</td>
<td>25</td>
<td>0.32</td>
<td>14.35</td>
<td>6.3</td>
<td>14.5</td>
<td>5</td>
</tr>
<tr>
<td>Feb</td>
<td>12.2</td>
<td>37</td>
<td>12</td>
<td>14</td>
<td>24.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mar</td>
<td>15</td>
<td>10</td>
<td>24</td>
<td>20</td>
<td>20</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Apr</td>
<td>22.4</td>
<td>25.5</td>
<td>12.2</td>
<td>12</td>
<td>12.3</td>
<td>8.7</td>
<td>6.9</td>
</tr>
<tr>
<td>May</td>
<td>2.5</td>
<td>5.5</td>
<td>20.31</td>
<td>12</td>
<td>26.64</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Jun</td>
<td>6.5</td>
<td>1.5</td>
<td>1.9</td>
<td>7.6</td>
<td>7.3</td>
<td>28.97</td>
<td>45.89</td>
</tr>
<tr>
<td>Jul</td>
<td>2</td>
<td>2</td>
<td>1.8</td>
<td>17.9</td>
<td>6.9</td>
<td>36.9</td>
<td>32.35</td>
</tr>
<tr>
<td>Feeding intensity</td>
<td>14.1</td>
<td>13.7</td>
<td>9.8</td>
<td>16.5</td>
<td>16.9</td>
<td>16.5</td>
<td>12.4</td>
</tr>
</tbody>
</table>
Food and feeding habit of the fish was studied by examining the gut contents as per standard procedures described by Windell and Bowen [37]. Monthly data of stomach content analysis following percentage of occurrence and points method has been represented in Figure 6 and Figure 7. The dominant phytoplankton groups in the fish stomach according to the order of dominance were Myxophyceae (6.58% in October–16.74% in March; 12.55%±0.94%), Bacillariophyceae (1.64% in September–13.80% in November; average 7.74±1.05%) and Chlorophyceae (0.99% in March–13.47% in July; average 6.06±1.18%). The dominant Zooplankton groups in the fish stomach according to the order of dominance were Copepods (13.84% in July–39.08% in October; average 25.31±2.12%), Insect larvae (4.12% in June–39.87% in May; average 21.36%), Rotifers & Cladocera (3.93% in May–19.58% in June; average 11.95±1.61%), Crustacean larvae (2.94% in August–21.92% in March; average 8.99±1.83%) and Fish & prawn larvae (0.97% in April–8.41% in September; average 3.31±0.68%). Numeric percentage of unidentified materials recorded was 0.00% in June to 7.1% in July (average 2.82±0.68%).

Index of preponderance (IP) is presented in Table 3 & 4. The dominant phytoplankton groups in the fish stomach according to the order of dominance were Chlorophyceae (average 6.86±1.35%), Bacillariophyceae (average 6.11±1.32%) and Myxophyceae (5.76±1.62%) and zooplankton groups were Copepods (27.45±2.06%), Insect larvae (average 17.58±2.49%), Rotifers & Cladocera (average 13.84±2.7%), Fish & prawn larvae (average 11.15±1.82%) and Crustacean parts (average 10.17±1.68%). The mean percentage of unidentified materials was 1.27±0.35% during culture period.

**Table 3:** Monthly variation in composition of different food items following percentage of points method in the gut content of long whiskered catfish, *Mystus gulio* (Hamilton, 1822) in brackishwater impoundments of Sundarban.

<table>
<thead>
<tr>
<th>Months</th>
<th>Copepods</th>
<th>Rotifers &amp; Cladocera</th>
<th>Myxophyceae</th>
<th>Bacillariophyceae</th>
<th>Chlorophyceae</th>
<th>Insect larvae</th>
<th>Crustacean larvae</th>
<th>Fish parts &amp; prawn larvae</th>
<th>unidentified materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug</td>
<td>28</td>
<td>12.9</td>
<td>3.9</td>
<td>10.9</td>
<td>10.9</td>
<td>9.06</td>
<td>1.23</td>
<td>3.39</td>
<td>9.32</td>
</tr>
<tr>
<td>Sep</td>
<td>30.98</td>
<td>19.9</td>
<td>15.9</td>
<td>8.9</td>
<td>9.06</td>
<td>1.23</td>
<td>3.39</td>
<td>9.32</td>
<td>0.9</td>
</tr>
</tbody>
</table>
According to Ivlev’s equation \[^{[38]}\], the values of electivity index (E) are between +1 and –1. Positive value indicates a positive selectivity of a type of food while negative value ones indicates a negative selectivity. Electivity index (E) of different food constituents is presented in Figure 8. Among Zooplankton groups, E value for Copepods was ranged between +0.10 to +0.73 with minimum range during July and maximum range during November. The average E value of Copepods was +0.37±0.06. E value for Insect larvae was ranged between –0.52 to +0.75 with minimum range during June and maximum range during February. The mean E value of Insect larvae was +0.31±0.12. Electivity index value of Fish and prawn larvae was varied between –0.18 to +0.69 with lowest value during February and highest value during March. The average E value of Fish and prawn larvae was +0.30 ±0.08. E for Rotifers & Cladoceran ranged –0.43 to +0.40 with lowest during May and highest during February. The mean E value of Rotifers & Cladoceran was +0.15±0.07. E value for Crustacean parts was +0.05±0.08. All Zooplankton groups were positively selected. Among Phytoplankton groups, E value for Myxophyceae ranged between –0.41 to +0.10 with low during October and high during July. The average E value of Myxophyceae was –0.15±0.08. Electivity index value of Bacillariophyceae varied was between –0.75 to +0.71 with lowest value during September and highest value during March. The mean E value of Bacillariophyceae was –0.57±0.10. All Phytoplankton groups were negative selection.

**Fig 8:** Prey electivity index (E) of suspended food materials consumed by long whiskered catfish, *Mystus gulio* (Hamilton, 1822).

**Table 4:** Index of preponderance (IP) of food items in the gut content of *Mystus gulio*.

<table>
<thead>
<tr>
<th>Food classes</th>
<th>Total points (V), %</th>
<th>Occurrence (O), %</th>
<th>V×O</th>
<th>∑VO</th>
<th>IP</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect larvae</td>
<td>27.45</td>
<td>25.31</td>
<td>694.52</td>
<td>1432.0</td>
<td>48.50</td>
<td>I</td>
</tr>
<tr>
<td>Rotifers &amp; Cladocera</td>
<td>13.84</td>
<td>11.95</td>
<td>165.29</td>
<td>11.54</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>Myxophyceae</td>
<td>5.76</td>
<td>12.55</td>
<td>72.22</td>
<td>5.04</td>
<td>V</td>
<td></td>
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<tr>
<td>Chlorophyceae</td>
<td>6.86</td>
<td>6.06</td>
<td>41.59</td>
<td>2.90</td>
<td>VII</td>
<td></td>
</tr>
<tr>
<td>Copepods</td>
<td>17.58</td>
<td>21.36</td>
<td>375.44</td>
<td>26.22</td>
<td>II</td>
<td></td>
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<tr>
<td>Bacillariophyceae</td>
<td>6.11</td>
<td>7.47</td>
<td>47.30</td>
<td>3.30</td>
<td>VI</td>
<td></td>
</tr>
<tr>
<td>Fish and prawn larvae</td>
<td>10.17</td>
<td>8.99</td>
<td>91.39</td>
<td>6.38</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Crustacean parts</td>
<td>11.15</td>
<td>3.31</td>
<td>36.88</td>
<td>2.58</td>
<td>VIII</td>
<td></td>
</tr>
<tr>
<td>unidentified materials</td>
<td>1.27</td>
<td>2.82</td>
<td>3.58</td>
<td>0.25</td>
<td>IX</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

Good water quality is very essential to maintain optimum growth and survival of aquatic organism under the culture. Recorded water quality parameters were within optimum ranges for brackish water aquaculture \[^{[39]}\] which differed significantly (P<0.05) with time. Water temperature is an
important component, which greatly influences and directly affects the pond dynamics. Temperature has a pervasive controlling effect on the rates of both food consumption and metabolism and so has effects on growth [40]. In Hooghly-Matla estuarine system as well as Sundarban, salinity and temperature have been found to be the most significant abiotic factors determining the fishery resources of this system [41]. Concentrations of toxic metabolites like nitrate-nitrogen (NO₂-N) and ammonia-nitrogen (NH₃-N) remained lower than the critical level and concentrations of nutrients like nitrate-nitrogen (NO₂-N) and phosphate-phosphorous (PO₄-P) was much lower than fertilized ponds reported from Sundarban [42]. Estuarine and coastal regions are extremely productive because they receive inputs from several primary production sources and detritus food webs [43]. Being non-fed natural farming system depends only on the natural productivity and commercial feed or fertilizer is not applied, such non-fed farming system can be considered as representative of the natural environment and co-existence of Planktonic community structure resembling the natural environment is expected.

Food types as well as feeding habits of a specific species are significant in relation to their growth and propagation under specific biological conditions. In brackishwater earthen nursery ponds, \textit{M. gulio} attained average body weight up to 460.02±4.54 mg (31.15±1.62 mm) with 89.25±5.41% survival during 42 days of rearing at fed system where initial ABW and stocking density were 3.33 mg (4.53±0.83 mm) and 200 individual/sqm respectively [44]. Stocking density is critical factor for many aquatic animals for their growth and survival [45]. Siddiky et al. [46] have observed that growth increment of \textit{M. gulio} up to 12.42±0.11 with 64.41% survival during 150 days rearing where stocking density was 8/sqm. The fish growth was might be better than earlier observations. When the b parameter is equal to 3, growth is isometric and when it is less than or greater than 3, it is allometric [47]. More specifically, growth is positive allometric when organism weight increases more than length (b>3), and negative allometric when length increases more than weight (b<3) [48]. The isometric exponent (b) of length weight relationship in the present study indicated isometric growth of Bagrid catfish. From West Bengal isometric growth pattern of \textit{M. gulio} has been reported by Pantulu [23] and Begum et al. [25]. Higher feeding frequency in bigger fishes than smaller ones may be attributed to the fear of potential predators by the smaller fishes while feeding as they are more vulnerable and would rather feed more cautiously than their bigger counterpart [49]. Large fish may require more food to obtain the necessary more energy for reproductive activity than smaller ones require for growth. Moreover, a wider mouth opening in larger fish helps to ingest relatively large quantity food items at a time [50].

In the present study ‘empty’ stomach of \textit{M. gulio} had during April to June (pre-spawning months). After July, the fish fed intensively; higher percentages of the fishes were observed either "full" or "gorged" stomachs. Feeding activity of \textit{M. gulio} corresponds to its breeding season while lowest feeding activity is observable in the intense breeding season (May to June), highest feeding activity is in correspondence to the post-spawning season (August to April). Such an inverse relationship between feeding and breeding cycles has been reported by Homans and Vladykov [51]. Pantulu [23] has reported a similar observation from his studies on the feeding intensity of \textit{M. gulio} in the Hooghly estuary. \textit{M. gulio} is a carnivorous fish [13, 23, 52, 53].

The adults prefer to feed insects and crustaceans where the immature and juveniles prefer to feed on diatoms, copepods, cladocera and rotifers [1]. Yusuf and Majumdar [54] have reported \textit{M. gulio} as omnivorous fish with inclination towards carnivore as animal foods cover 79% of the overall diet of this fish; among animal food, nauplius larvae and \textit{Brachionus sp.} have been reported as the main food items with higher frequency of occurrence. Debris, zooplanktons, zoobenthos, other benthic organisms, fish eggs and larvae were the food items of juveniles and adults of \textit{M. gulio} [55]. Similarly the present study in backwater traditional impoundments of Sundarban observed that the stomach content of this fish was abundant on the basis of numeric occurrences with Copepods> Insect larvae, Myxophyceae> Rotifers & Cladocera> Crustacean parts> Bacillariophyceae> Chlorophyceae> Fish and prawn larvae> unidentified materials. Overall animal food items were more in amount than plant food items.

Regarding the complex nature feeding ecology of \textit{M. gulio} in brackishwater impoundments, electivity index (E) analysis is essential to throw some light on fish’s food preference. According to Ivlev’s equation [38] \( E \) values ranged from -1 to +1, where -1 to 0 stands for negative selection, while values 0 to +1 can be indicate as positive selection of that prey item. In Subsequent investigation Lazzaro [56] has suggested that a true positive or negative prey selection can be interpreted only at values >0.3 or < -0.3 respectively. In the present experiment, \textit{M. gulio} actively selected Copepods as most preferred prime food material (Figure 8). Being 5th dominant Planktonic constituent in water body, insect larvae ranked second according to the prey electivity analysis. In spite of ranking 9th in the order of dominance in the water and 8th rank in stomach fish and prawn larvae was 3rd consuming food items on the basis of prey selection. Though 6th in the order of dominance in the water column and 4th rank in stomach content, Rotifers & Cladocera was 4th ranked consuming food items but non-significantly positive prey selective item (non-significant positive selection; <0.30) to the fish. Crustacean parts were 5th preferred prey types though 7th ranked in water column. It was positively selected but non-significant (<0.30). Rotifers & Cladocera and Crustacean parts were not at all actively selected and probably swallowed mechanically during intake of other foodstuffs. In the phytoplankton groups, Myxophyceae, Bacillariophyceae and Chlorophyceae were totally negative prey items to the fish. Being 1st dominant Planktonic constituent in water body, Myxophyceae ranked 6th to the prey electivity analysis (non-significant <0.30). According to the numeric order of dominance in water, Bacillariophyceae was 3rd in water but 7th position of prey selection (non-significantly<0.30). Chlorophyceae was significantly negative prey item to the fish.

**Conclusion**

Present investigations suggest that long whiskered catfish has good growth potential and can be considered for brackishwater poly farming. \textit{M. gulio} is a carnivorous fish as it used to prey mostly on zooplankton and animal food materials. Stomach contentment analysis indicates that long whiskered catfish fed on Copepods> Insect larvae> Myxophyceae> Rotifers & Cladocera> Crustacean parts> Bacillariophyceae> Chlorophyceae> Fish and prawn larvae> unidentified materials. Order of positive preference of different food items by the species is as Copepods> Insect larvae> Myxophyceae> Rotifers & Cladocera> Crustacean parts> Bacillariophyceae> Chlorophyceae> Fish and prawn larvae> unidentified materials.
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