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Research Article

Growth Performance, Feeding Ecology and Prey Preference of Bagrid Catfish, *Mystus tengara* (Hamilton, 1822) in Low Saline Polyculture Ponds of Indian Sundarbans

Abstract

Growth performances, feeding ecology and prey preferences of *Mystus tengara* (Hamilton, 1822) reared in low saline homestead traditional polyculture ponds in Sundarbans were studied for 12 months. Mixed carp early fingerlings (4.98±0.61 cm, 1.09±0.26 g) @ 14000 nos ha-1 and wild collected mixed bagrid catfish juveniles (5.09±0.48 cm, 1.38±0.11 g) including *M. tengara* were stocked @ 5000 juveniles ha-1. Farm yard manure @ 200 kg ha-1 was applied monthly and household dining wastes (11.37±2.08 kg ha-1 day-1) were thrown in the ponds almost daily following traditional practice. Fishes attained 31.56±2.08 g (13.92±0.88 cm) with specific growth rate of 0.95±0.15 % day-1 and exponent value of Length-Weight Relationship (b=2.99) indicated isometric growth. Numeric order of dominance of prey groups in water were Chlorophyceae, Myxophyceae, Bacillariophyceae, Insect parts and larvae, Copepods, Rotifers and Cladoceran, Fish parts and larvae, unidentified materials and Crustacean parts. Whereas, order of dominance of prey groups in stomach were Insect parts and larvae, Copepods, Myxophyceae, Rotifers and Cladoceran, Fish parts and larvae, Bacillariophyceae, Chlorophyceae, Crustacean parts and unidentified materials. Prey electivity analysis indicated significant active selection of Insect parts and larvae (E= +0.36±0.06) and Copepods (E= +0.30±0.12). Crustacean parts, Rotifers and Cladocera and Fish parts and larvae were also positively selected but were not significant. This study reveals that M. tengara is a carnivorous fish mostly preferring Insect larvae and Copepods. M. tengara can be added in low saline polyculture ponds to improve profitability and can be considered as a biological tool for Insect control.

Background

Owing to its good taste and high nutrient profile with good protein content, the bagrid catfish, *Mystus tengara* (Hamilton, 1822) has good market value as food fish [1] in the Indian subcontinent. *M. tengara*, a freshwater species, occurs in weedy, sandy and muddy places of the pools, streams and river in the rainy season [2]. This fish is very common in ponds all over India as well as widely distributed throughout the Indian subcontinent including Pakistan, Nepal, and Bangladesh [3, 4]. Recently this fish species entered in ornamental fish markets and has reported to be exported from India as indigenous ornamental fish with moderate export price [5-7].

Due to scarcity of usable freshwater in the inhabited areas of Indian Sundarbans, most of the households have one or more homestead ponds to harvest rainwater for daily use round the year. It is a common practice to release some freshwater and brackish water fish seeds including *M. tengara* locally called as ‘chhoto tangra’ in those low saline ponds every year to produce some fish for home consumption without any scientific management and very low input. Being a high value fish, scientific management on the background of knowledge on feeding ecology of *M. tengara* may improve production and economy of those systems.

Feeding is a dominant activity in the entire life cycle of a fish, thus detailed knowledge on food and feeding habit of any fish species is essential to get success in culture of that particular fish species and it helps to select such species of fishes 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 [8, 9]. Study of food and feeding habits of fishes have manifold importance in fishery biology and in fisheries management programme [10, 11]. In fish food during the life span, quantitative and qualitative

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changes are useful tools to define the diet of a particular fish species [12, 13]. The main important factors that determine the type of prey are feeding preference, availability of prey, prey mobility and its distribution in the water column, catching efficiency of the predator, water temperature and turbidity [14-17].Changes in feeding habits of a fish species are a function of the interactions among several environmental factors that influence the selection of food items [18]. Feeding habit at the level of prey preference can have implications at the individual [19], population [20], and community levels [21].

Earlier investigators from India [9] and Bangladesh [22] reported that food and feeding habit of *M. tengara* in freshwater. However, there is scarcity of information on growth performances and feeding ecology of the species from low saline ponds of Sundarbans, in spite of being a highly potential and ecologically important area where *M. tengara* is abundantly available and forms a commercially important species. This study aimed to assess growth performances and feeding ecology along with prey selectivity of *M. tengara* in traditional low saline homestead ponds of Sundarbans.

Materials and Methods

The study was carried out at Madhab Nagar village (21.787003–21.7917850N, 88.353365–88.3569380E) of Pathapratima block in South 24 Parganas district of West Bengal, India. This area lies within the Hooghly-Matla estuarine complex popularly known as 'Sundarbans'. Three traditional earthen low saline homestead ponds (0.1-0.2ha) were selected and the study continued for 12 months from July 2014 to June, 2015. On request, household members possessing the selected ponds were agreed to carry on the traditional practice and allowed authors to collect water and fish samples. All the fishes of previous year were observed to be harvested by drag netting during 2nd week of June as water depth of the ponds became as low as 30-40 cm. Hydrated lime @ 200 kg/ ha and farm yard manure @ 500 kg/ ha was applied during pond preparation. With the onset of monsoon during June end, ponds became filled with rain water up to depth of 130 cm within two weeks. Mixed Indian major carp early fingerlings (4.98±0.61 cm, 1.09±0.26 g) containing rohu (*Labeo rohita*), catla (*Catla catla*) and mrigal (*Cirrhinus mrigala*) in almost equal proportions @ 14000 nos/ ha and wild collected mixed bagrid catfish juveniles (5.09±0.48 cm, 1.38±0.11 g) including *M. tengara* were stocked @ 5000 juveniles/ ha during mid-July. Commercial fish feed and fertilizer was not applied; farm yard manure @ 200 kg/ ha was applied monthly and household dining wastes (11.37±2.08 kg/ ha/ day) were thrown in the ponds following traditional practice. Both fish and water samples were collected monthly during morning in between 07.00 to 09.00 hours and carried to laboratory in ice boxes for subsequent analysis.

Water quality parameters were measured following standard methods [23]. Water temperature and pH was determined using a digital multi-meter (model deluxe 191E). Salinity was recorded using a refract meter (ATAGO, Japan). Dissolved oxygen (DO) was analyzed using modified Winkler's method and total alkalinity was determined through titration. Nitrogenous metabolites like nitrite-nitrogen (NO2-N) and ammonia-nitrogen (NH3-N) and nutrients like nitrate-nitrogen (NO3-N) and phosphate-phosphorus (PO4-P) concentrations were determined using a digital double-beam spectrophotometer (model UV2310; Techcomp). Plankton samples were collected monthly during midday by filtering 50 L 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 into Sedgwick-Rafter counting cell. Plankton constituents were identified and counted [24, 25]. Other suspended constituents were also estimated.

Ten fishes from each three ponds were collected during 2nd week of each month i.e. 30 fish in a month and total 360 fish were collected and analyzed throughout the study period. Gravimetric data such as total length (TL, cm) was recorded using a slide caliper and body weight (W, g) was measured using a digital electronic balance. Daily weight gain (DWG) was calculated using the formula:

$$DWG = \frac{W_f - W_i}{t}$$

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

The mathematical relationship between length and weight was calculated using the conventional formula [26]:

$$W = a.TL^b$$

Where W is fish weight (g), TL is total length (cm), 'a' is the proportionality constant and 'b' is the isometric exponent. The parameters 'a' and 'b' were estimated by non-linear regression analysis.

Fulton's condition equation was used to find out the condition factor as [27]:

$$K = \frac{\bar{w}}{\overline{(TL)}^3} \times 10^2$$

Where K is the condition factor, $\bar{w}$ is the average weight (g) and $\overline{(TL)}$ is the average total length (cm)

After gravimetric measurements, the stomach of fish were removed intact by cutting above the cardiac and below the pyloric sphincters and preserved in a vial with 4% formalin. The stomach fullness degree was assessed by visual estimation and classified as gorged, full, 3/4 full, 1/2 full, 1/4 full little and empty [28]. The data have then been used to calculate the monthly fullness index (FI) by determining the percentage of feeding intensity using the following formula:

$$FI = \frac{\text{Numer of gut with same degree of fullness}}{\text{Total number of gut examined}} \times 100$$

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The stomach contents were transferred into fixed volume of 4% formalin solution. From every vial, one ml aliquot was placed into Sedgwick-Rafter counting cell and constituents were identified and counted [24, 25].

Stomach content analysis has been performed following two methods; namely percentage of occurrence [29] and Points volumetric method [30]. The dominant food items of water and stomachs were categorized as Chlorophyceae, Myxophyceae, Bacillariophyceae, Insect parts and larvae, Copepods, Rotifers and Cladocera, Fish parts and larvae, unidentified materials and Crustacean parts. To determinate the dominant food items, numeric percentages of each group were evaluated. Additionally, results of the percentage of occurrence and mean of the points allotted to individual prey encountered in a group were combined to yield the Index of Preponderance (IP) following the equation proposed by Natarajan and Jhingran [30]:

$$IP = \frac{V_1 O_1 \times 100}{\sum V_1 O_1}$$

Where, V1 = Volume of the particular food item, O1 = Occurrence of the particular food item IP = Index of Preponderance

The percentage compositions of food types in the stomach falling under different groups were then compared with that of fish ponds to evaluate prey preferences. Prey preferences were determined by the Ivlev Electivity Index using the formula [31]:

$$E = \frac{r - p}{r + p}$$

Where, r=percentage of dietary item in ingested food, p= percentage of prey in the environment.

Differences in growth parameters of fish and water quality parameters among ponds were determined by analysis of variance with the General Linear Model procedure using SPSS for Windows v.17.0 programme (SPSS Inc Chicago IL USA). Duncan's Multiple Range Test [32] was used for comparison of treatments. All data are expressed as mean ± standard error (SE).

Results

Water quality parameters of the three studied ponds are presented in Table 1. Temperature showed wide variation throughout the study period. Lowest temperature was recorded during December (18.50C) and highest during April (33.50C). Salinity also showed wide fluctuation and was maximum (4.45ppt) during deep summer (May) and minimum (1.5ppt) during full rainy season (August). No significant difference ($p>0.05$) in salinity was observed among ponds. Dissolved oxygen (DO) and pH remained almost steady throughout the study period and ranged between 5.87 to 9.58 ppm and 7.85 to 8.50, respectively. Those were significantly ($p<0.05$) higher in pond 1 than others. Alkalinity was significantly ($p<0.05$) higher in pond 2. Concentrations of nitrogenous metabolites such as nitrite-nitrogen (NO2-N) and total ammonia-nitrogen (NH3-N) ranged between 9.54 to 24.45 and 21.85 to 44.54 µg/l, respectively. Concentrations of nutrients like nitrate-nitrogen (NO3-N) and phosphate-phosphorous (PO4-P) ranged between 70.54– 115.04 and 22.24– 45.77 µg/l, respectively showing no significant difference among ponds. Significantly ($p < 0.05$) higher Planktonic concentration was observed in pond 1 and lower in pond 3.

Numeric percentage occurrences of planktonic and other suspended food materials in pond water are presented in Figure 1. According to the order of dominance the prey groups encountered were Chlorophyceae (25.97±2.24%), Myxophyceae (17.94±1.63%), Bacillariophyceae (12.02±1.45%), Insect parts and larvae (11.84±1.22%), Copepods (11.49±2.10%), Rotifers and Cladoceran (9.20±1.57%), Fish parts and larvae (8.16±1.64%), Unidentified materials (1.83±0.28%) and Crustacean parts (1.56±0.25%).

Dominant genera of planktonic constituents found in pond water under Chlorophyceae were *Chlorella, Volvox, Ulothryx, Pediastrum, Enteromorpha, Cladomorpha, Caetomorpha, Spirogyra, Tetraedron, Coilastrum, Euglena, Chladophora, Crucigenia,*

Table 1: Water quality parameters of three low saline homestead polyculture ponds used for *Mystus tengara* rearing in Sundarban

Water parameters	Pond 1	Pond 2	Pond 3
Water temperature (°C)	29.9±1.72	29.9±1.73	29.7±1.94
pH	8.04±0.23[a]	7.78±0.31[c]	7.92±0.25[b]
DO (mg L^{-1})	6.06±0.42[a]	5.98±0.52[b]	5.69±0.52[c]
Salinity	2.96±0.44	3.02±0.34	2.99±0.45
Alkalinity	165.9±4.25[b]	166.9±3.51[a]	160.00±5.23[c]
NO_2-N (µg L^{-1})	16.55±5.83	15.91±5.62	16.91±6.63
NH_4-N (µg L^{-1})	30.76±5.61	31.19±7.91	34.89±6.27
NO_3-N (µg L^{-1})	93.12±15.41	92.66±11.14	92.97±8.94
PO_4-P (µg L^{-1})	32.07±13.43	31.98±11.98	31.97±12.74
phytoplankton (numbers/L^{-1} ×10^3)	15.48±1.62[a]	15.22±1.94[b]	14.75±1.73[c]
Zooplankton (numbers/L^{-1}×10^3)	3.05±0.25[a]	2.91±0.23[b]	2.83±0.17[c]

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)

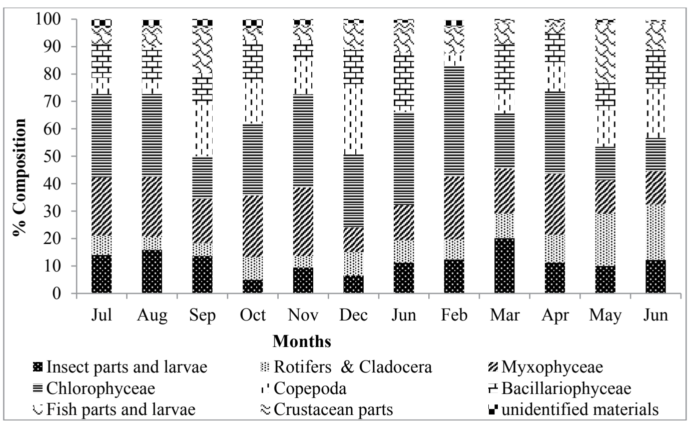

Figure 1: Numeric percentage occurrences of planktonic and other suspended materials in ambient water of low saline homestead polyculture ponds in Sundarban.

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Scenedesmus, Pandorina. Closterium, Cladophora and *Tetraspora*. Dominant genera encountered under Myxophyceae were *Anabaena, Oscillatoria, Chroococcus, Gleocapsa* and *Merismopedia*. Important genera under Bacillariophyceae were *Navicula, Nitzschia, Cyclotella, Gyrosigma, Melosira, Cymbella, Synedra* and *Pleurosigma*. Insect parts and larvae were represented mostly by orthopteran and culicid larvae and parts of various Insects. Genera under Copepods were *Cyclops*, *Calanus and Microsetella*. Rotifers were represented by genus *Brachionus* and *Cladocerans* by *Daphnia* and *Moina*.

Growth of *M. tengara* in terms of weight and length over time is presented in Figure 2. Fishes were grown from 1.38±0.31g (5.09±0.24 cm) to 31.56±2.08 g (13.92±0.88 cm) in 360 days of rearing. Average daily weight gain (DWG) calculated was 0.09±0.01 g day-1 which ranged between 0.03 (August) and 0.18 g day-1 (April). Average specific growth rate (SGR) recorded was 0.95±0.15 % day-1 which varied between 0.41 (May) and 2.12 % day-1 (July). Exponential value (b) of Length-Weight Relationship (LWR) was recorded to be 2.99 indicating isometric growth (Figure 3). The Fulton's condition factor (K) ranged from as low as 0.04 in August to as high as 1.32 in June while the mean value calculated was 1.13±0.03 considering whole study period. During this period catla, rohu and mrigal attained 536.83±39.05, 433.28±31.33 and 269.89±19.33 g, respectively.

Results of monthly analysis of stomach fullness index (FI) are presented in Table 2. Mean stomach fullness ware 13.7, 18.8, 17.5, 16.5, 18.5, 11.1 and 3.9 % for gorged, full, ¾ full, ½ full, ¼ full, little and empty, respectively indicating that most of the fishes were moderately fed. A gradual increase in stomach fullness was observed as the fishes grew.

Numeric percentage occurrences of constituents of stomach contents throughout the study period are presented in Figure 4 and 5. Main food categories found in the stomachs according to the numeric order of dominance were Insect parts and larvae (14.90% in June - 40.00% in September, 25.44±2.19%), Copepods (4.12% in May - 40.60% in April, 21.41±2.76%), Myxophyceae (7.73% in March - 18.00% in November, 13.48±0.97%), Rotifers and Cladoceran (4.70% in June - 20.45% in April, 12.52±1.60%), Fish parts and larvae (2.97% in July - 21.92% in February, 9.32±1.81%), Bacillariophyceae (1.73% in August - 13.80% in October, 7.84±1.33%), Chlorophyceae (0.99% in February - 14.50% in June, 6.19±1.23%), Crustacean parts (0.97% in March - 5.94% in July, 2.84±0.47%) and unidentified materials (0.00% in September - 3.40% in March, 0.92±0.32%).

More realistic compared to numeric occurrence method, index of preponderance (IP) is presented in Figure 6. On the basis of IP, the main food items in the stomach according to the order of dominance were Insect parts and larvae (20.2 in December – 40.56 in September, 27.73±2.09), Copepods (9.06 in August – 32.11 in March, 18.43±2.74), Rotifers & Cladoceran (1.80 in May –21.25 in January, 12.27±1.86), Crustacean parts (3.21 in January – 21.11 in June, 11.75±1.92), Fish parts and larvae (1.81 in June – 18.71 in January, 10.25±1.68),Chlorophyceae (2.00 in December – 13.40 in October, 6.86±1.35), Bacillariophyceae (0.89 in April – 12.89 in December, 5.77±1.24), Myxophyceae (0.11 in February – 15.90 in August, 5.75±1.63) and unidentified materials (0.11 in October – 15.90 in March, 1.27±0.35).

Electivity index (E) of different food items is presented in Figure 7. According to the order of dominance, M. tengara

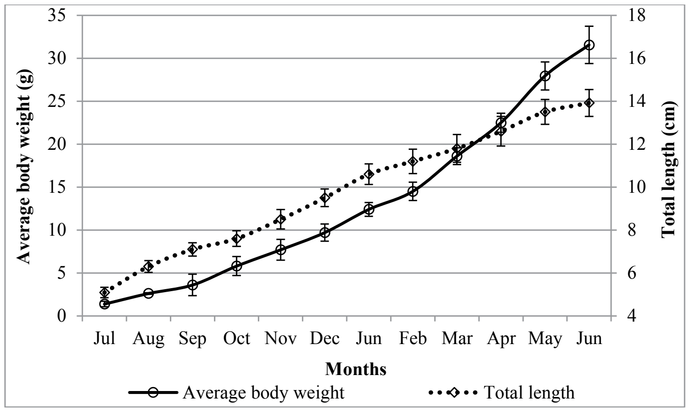

Figure 2: Growth of *Mystus tengara* reared in low saline homestead polyculture ponds in Sundarban.

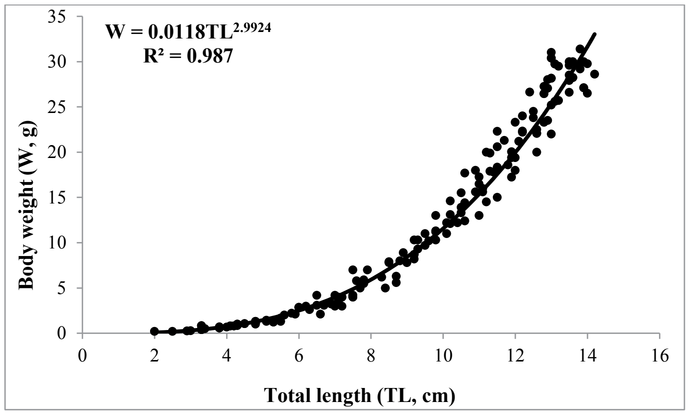

Figure 3: Length-weight relationship of *Mystus tengara* reared in low saline homestead polyculture ponds in Sundarban.

Table 2: Feeding intensity of *Mystus tengara* reared in low saline homestead polyculture ponds

Months	Gorged	Full	3/4 Full	1/2 Full	1/4 Full	Little	Empty
Jul	0	12	12.6	28	24.9	20	2
Aug	1.1	0	6.9	25.5	36.2	15	15.2
Sep	8.9	15.6	6.9	16.5	22	20	10.5
Oct	8.7	21	2	22	16.3	26	4
Nov	21	16.7	16.7	11.1	21.2	11.1	2
Dec	32	0	24	15.35	6	15.5	7
Jan	12.1	37	12	14	24.8	0	0
Feb	15	10	24	20	20	11	0
Mar	28.4	25.5	12.2	12	12.3	8.7	1
Apr	12	15	17	23.31	26.64	5.5	1
May	7.6	55.89	28.97	1.9	5.3	0	0
Jun	17.9	16.35	46.9	7.8	6.9	0	4.26
Average	**13.7**	**18.8**	**17.5**	**16.5**	**18.5**	**11.1**	**3.9**

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preferred Insect parts and larvae, Copepods, Crustacean parts, Rotifers and Cladoceran, Fish parts and larvae, Myxophyceae, Bacillariophyceae and Chlorophyceae. E for Insect parts and larvae ranged between +0.10 (June) and +0.73 (October) with higher values during early months and a gradual decreasing trend afterwards, however, mean value (+0.36±0.06) indicated significant positive selection. Electivity for Copepods varied from −0.52 (May) to +0.75 (August) and followed the trend similar to Insect parts and larvae showing significant positive selection indicated by mean value of E (+0.30±0.12). E for Crustacean parts varied from −0.18 in January to +0.69 in February with decreasing trend as *M. tengara* grew. Although mean value (+0.26±0.08) indicated positive selection, being less than +0.3, it cannot be considered significant. Insignificant positive selection was also observed for Rotifera and Cladocera (E=+0.17±0.07) with lowest value of −0.36 during April and highest value of +0.40 in January, and Fish parts and larvae (E=+0.05±0.04) ranging between −0.27 during December and +0.63 during April. Insignificant negative selection was observed for phytoplankton groups, Myxophyceae (E=−0.12±0.04, −0.35 during March to +0.10 during June) and Bacillariophyceae (E=−0.18±0.12, −0.75 during August to +0.71 during February) while significant negative selection was observed for Chlorophyceae (E=−0.57±0.08). E for Chlorophyceae varied between −0.97 during January to −0.05 during June.

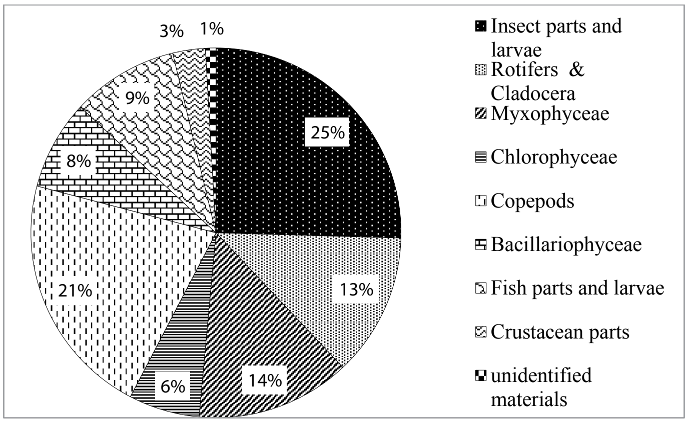

Figure 4: Proportions of food items in stomach of Bagrid catfish, *Mystus tengara* (Hamilton, 1822) were showed.

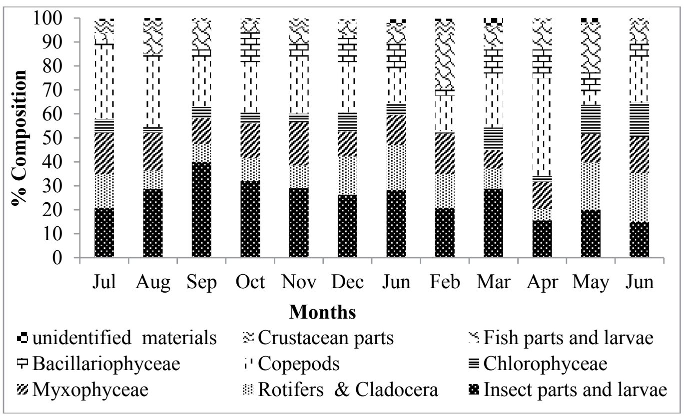

Figure 5: Percentage occurrences of food items in Bagrid catfish, *Mystus tengara* (Hamilton, 1822) stomach reared in low salinewater pond of Sundarban.

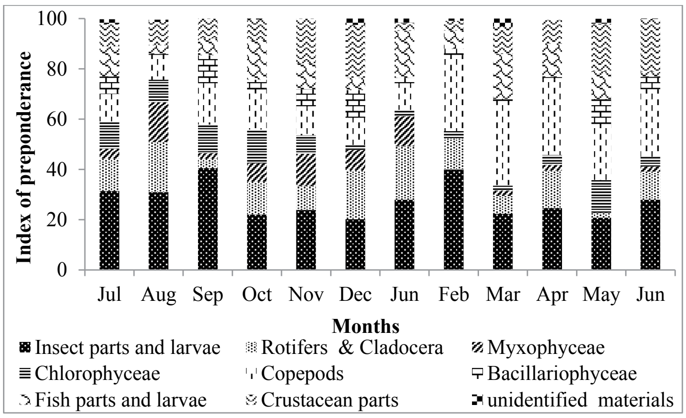

Figure 6: Monthly variations in index of preponderance of food items in *Mystus tengara* stomach reared in low saline homestead polyculture ponds in Sundarban.

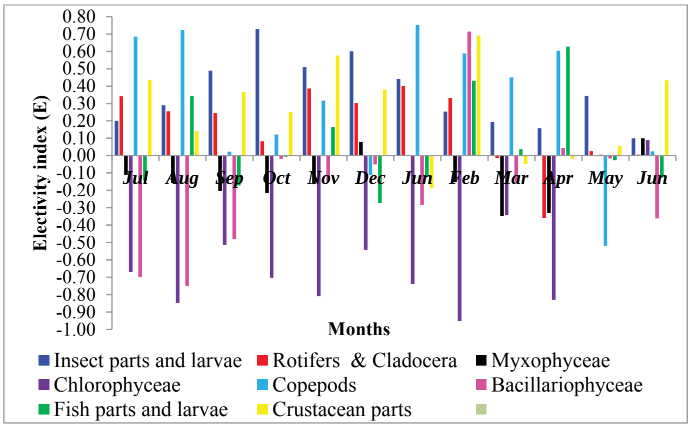

Figure 7: Electivity index (E) of prey groups consumed by *Mystus tengara* in low saline homestead polyculture ponds in Sundarban.

Discussion

Good water quality is essential to maintain optimum growth and survival of aquatic organism under culture. Recorded water quality parameters except salinity in the present study were within optimum ranges for freshwater [33] and brackish water [34] aquaculture and differed significantly (P<0.05) with time. In Sundarban, salinity and temperature have been found to be the most significant abiotic factors determining the fishery resources of this system [35]. In spite of having no connection with brackish water sources, low salinity of water in the studied ponds might have derived from saline soil or seepage from nearby brackish water impoundments. Although considered as freshwater species, *M. tengara* could survive and grow well in such salinity regime as several freshwater species including carps [36] are capable to tolerate salinities up to varied ranges. Concentrations of toxic metabolites like nitrite-nitrogen (NO_2-N) and ammonia-nitrogen (NH_4-N) remained lower than the critical level and concentrations of nutrients like nitrate-nitrogen (NO_3-N) and phosphate-phosphorous (PO_4-P) was much lower than fertilized ponds reported from Sundarban [37, 38]. Lower nutrient concentrations in the studied ponds may be attributed to low nutrient input in the system.

Order of dominance of Planktonic groups in the ambient water in the present study corroborated with that reported

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from Sundarban [39]. Estuarine and coastal regions are extremely productive because they receive inputs from several primary production sources and detritus food webs [40]. Being low input rearing system depending mostly on the natural productivity, such low input 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 species are significant in relation to their growth and propagation under specific biological conditions. As no information is available on growth of M. tengara in low saline water, it is not possible to compare the present findings on growth with previous reports. However, growth of *M. tengara* in the present observation can be compared with earlier studies reported on different freshwater dwelling species of the genus *Mystus*. In Semi-intensive monoculture trials of gulsha (*Mystus cavasius*) higher growth was reported at stocking density of 40000 nos/ ha where fishes were grown from 4.06±1.11g to 41.42±6.20g (ADG: 0.20 g/ day) in 180 days in earthen freshwater ponds of Bangladesh [41]. Poor growth of carps may be attributed to insufficient food in such low input system.

Exponent (b) value of length weight relationship in the present study indicated isometric growth of *M. tengara*. When the b parameter is equal to 3, growth is isometric and when it is less than or greater than 3, it is allometric [42]. 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) [43]. Isometric growth (b=2.99) and good condition factor (K=1.04±0.07) of *M. tengara* in the present study indicated no severe competition for food and space in spite of being cultured with carps. Exponent value (b) of LWR and condition factor in the present study corroborated with that reported from freshwater wetland in India [44] indicating almost equal health status in freshwater and low saline environment.

Higher feeding intensity in terms of stomach fullness in bigger fishes than smaller ones in the present study 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 [45]. Large fish may require more food to obtain the necessary 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 [46]. Highest feeding activity of *M. tengara* during the pre-spawning season (March to May) and lowest feeding activity during the intense breeding season (June to August) has been reported from freshwater environment [47, 9].

Abundance of Insect parts and larvae, Copepods, Rotifer, Cladoceran, Crustacean parts and Fish parts and larvae in stomachs depicted by IP values indicate that *M. tengara* is a carnivorous fish. Although some plant materials belonging to Bacillariophyceae, Chlorophyceae and Cyanophyceae were encountered in the stomachs, viewing their low IP values, those might be considered as accidental entry during engulfment of preferred prey. Carnivorous food habit of *M. tengara* has been reported in earlier studies based on low relative gut length (RGL=0.90±0.07) and dominance of animal materials in stomach [9]. RLG values for carnivorous (0.5–2.4), omnivorous (1.3–4.3) and herbivorous (3.7–6.0) fishes were enlisted [48]. RLG value is generally low in carnivorous fish, higher in omnivorous fish and highest in herbivorous fish [49]. Although dominance of animal materials in the stomachs of M. tengara reported earlier from freshwater [9, 22] corroborated with the present study, the order of dominance of prey groups differed significantly. In a freshwater wetland of West Bengal, zooplankton was the basic food component and Rotifera was the mostly preferred food class for this fish species [9], however, the most dominant group of prey of *M. tengara* reported from Tanore wetland of Bangladesh was Insects [22]. Differences in dominance of prey group in different environment might be an important adaptive feature of *M. tengara*.

Dissimilar orders of dominance of prey groups in the environment and the stomach, in the present study, indicate that *M. tengara* is a selective feeder. Considering the complex nature of fish feeding ecology, electivity index (E) analysis is necessary to throw some light on food preferences. As per Ivlev's equation, E ranges from -1 to +1, where -1 to 0 stands for negative selection, while values 0 to +1 can be interpreted as positive selection of that prey item. Subsequent investigation [50] suggested that a true positive or negative prey selection can be interpreted only at values >+0.3 or <-0.3 respectively. *M. tengara* in the present study actively selected Insect parts and larvae (E= +0.36±0.06) as most preferred as well as most dominant food material in stomach although it ranked 4th in numeric order of dominance in the water column (Figure 7). Copepods (E= +0.30±0.12) were found to be the truly selected second most preferred as well as second most numerically dominant prey group in stomach in spite of ranking 5th in the numeric order of dominance in ambient water. Crustacean parts, Rotifers and Cladocera and Fish parts and larvae were also positively selected but cannot be considered as true selection having E values between +0.03 and 0. Among phytoplanktonic constituents, Bacillariophyceae and Myxophyceae were not at all selected (0>E<-0.3) but cannot be considered as true negative selection, however, Chlorophyceae (E= -0.57±0.10) was truly avoided by *M. tengara* in the present study. Regarding the basis of selective feeding, El-Marak by [51] suggested that the organization of the alimentary system of a particular species, as for example in the relative concentrations of its digestive enzymes, may be such as to obtain maximum advantage for only a limited part of the range of material which the animal is actually capable of ingesting. *M. tengara* in the present study might have selected those prey items which its digestive system supports best.

Conclusion

It may be inferred from the present study that Mystus tengara can be reared along with carps in low saline ponds of Sundarbans for profitable aquaculture and to improve fish production in homestead ponds. As *M. tengara* feeds on small fish also, those should be stocked with bigger carps or when

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carps grow big enough to avoid being a prey item. Liming, fertilization and feeding with scientific management can be taken up to improve productivity and profitability from this system. As *M. tengara* preferred Insect parts and larvae, this fish can be considered as a biological tool for insect control.

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