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Assessment of feeding preferences and reproductive biology of Indian River shad, *Gudusia chapra*, from the open water of Bangladesh

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Abstract
The feeding preferences of *Gudusia chapra*, locally known as 'Chapila', collected from the open water sources of the Pagla River, a tributary of the Meghna River, showed filter-feeding food habits rich in phytoplankton over zooplankton. Altogether, 17 genera of phytoplankton belong to 4 groups; Bacillariophyta (diatoms), Chlorophyta (green algae), Cyanophyta (blue-green algae), and Dinophyta (dinoflagellates), and 5 genera of zooplankton belonging to 2 major groups, Rotifer and Crustaceans, were examined in the stomach of *Gudusia chapra*. Moreover, the total length of *Gudusia chapra* ranged between 44 mm and 130 mm, and the body weight ranged from 0.5 g to 20.2 g. The gonad weight ranged from 0.0011g to 1.0758 g. The sex ratio of male to female *Gudusia chapra* was found 1:1.12. The high gonado somatic index (GSI) value of *Gudusia chapra* was observed in January for males (1.702) and in February for females (5.966).

Keywords: Open water, Feeding habit, Reproductive biology, *Gudusia chapra*

Introduction
Indian river shad *Gudusia chapra* (Hamilton-Buchanan, 1822), locally known as 'Chapila' in Bangladesh, is an important small indigenous fish, popular for its taste, reasonable price, and high nutritive value [1,2], abundant in rivers, streams, *haors* (seasonal flood plain area), *baors* (small enclosed water bodies), canals, flood plains, and *beels* (shallow seasonal water bodies), contributes a significant role in inland open water catch compositions, is categorically vulnerable in Bangladesh [3] and least concern globally [4], put it a major species of thorough biological research. However, despite its invaluable nutritional importance for women and children [2], very few published articles are available on the feeding habits and reproductive biology of *Gudusia chapra* from Bangladesh open water.
However, Jhingran (1972) [5] worked on the diet composition of *Gudusia chapra* from the Ganga river system. Rahmatullah *et al* (1995) [6] and Alam (1995) [7] reported the feeding behavior of Chapila in the pondwater of the Mymenshing region of Bangladesh, while Imran (1998) [8] worked on the food and feeding habits of *Gudusia chapra* along with some other small fishes in the Kaptai lake, Rangamati. However, fewer reports are available on the feeding preferences and reproductive biology of *Gudusia chapra* in open water, especially in the Pagla River, a major tributary of the Meghna River system. Thus, the present study has been carried out to investigate the food habits and reproductive biology of *Gudusia chapra*.

Materials and methods
A total of 104 stomachs were analyzed to find out the feeding preferences and reproductive indices of *Gudusia chapra*. Fish was collected monthly from the selected Stations of the Pagla River using the set beg net, *Bhorjal*, and *Moiyajal*. The collected fish samples were immediately preserved in the ice box and brought back to the laboratory of the Institute of Marine Sciences, University of Chittagong, to study the feeding habits of Chapila. The digestive tract was carefully removed from the body cavity and preserved in 5% formalin. The stomachs were opened, and the stomach contents were studied under the light microscope (binocular biological microscope, XSZ-107BN). Monthly stomach contents were analyzed by the percentage occurrence method [9].
To determine the sex ratio, we first washed the specimen in the laboratory, then counted the number of males and females, which were then percentage calculated. Before washing the specimens, the excess moisture was dried off with the help of blotting paper and dried in the air for some time to take an accurate weight. The sex of *Gudusia chapra* could not be recognized outside the spawning season, except by dissection, as there was very little external difference between male and female.
A chi-square (χ^2) test was performed to evaluate the male-to-female ratio in Chapila and whether the sex composition was significantly different from the hypothetical ratio of 1:1.
To determine the GSI total length (mm), body weight (g), and gonad weight (g) were recorded. Weights for each individual were measured by an electronic analytical balance (OSK11325A). GSI was calculated from the following equation-

Gonadosomatic index = {Gonad weight (g) / Body weight (g)} × 100

Results and discussion
The feeding habits of *Gudusia chapra* are shown in Fig. 1.

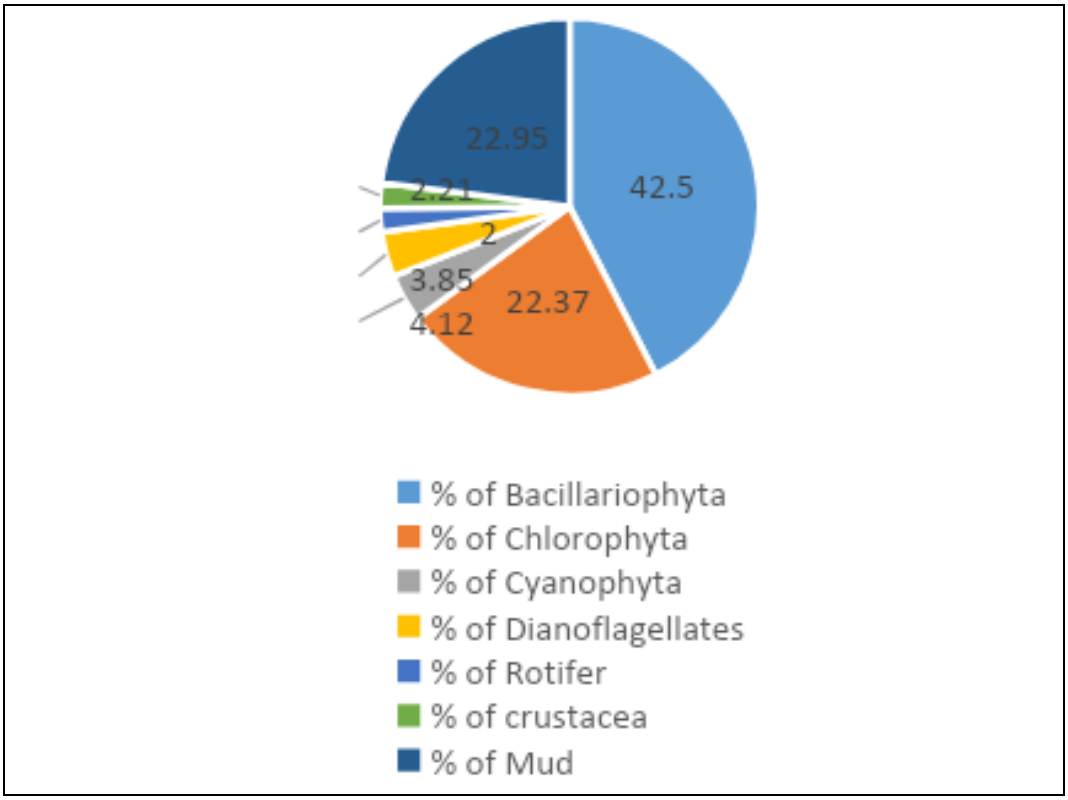

Fig 1: Food habits of *Gudusia chapra* collected from Pagla River, Bangladesh.

Altogether, 17 genera of phytoplankton belonging to 4 groups, such as Bacillariophyta (diatoms), Chlorophyta (green algae), Cyanophyta (blue green algae), Dinophyta (dinoflagellates), and 5 genera of zooplankton belonging to 2 major groups, such as Rotifer and crustaceans, were found in the stomach of Chapila (Table 1).

Table 1: Phytoplankton and zooplankton genus composition analyzed from the stomach of *Gudusia chapra* from Pagla River, Bangladesh.

Phytoplankton	
1	Bacillariophyta (diatoms): *Coscinodiscus, Fragillaria, Melosira, Rhizosolenia, Nitzschia, Navicula, Synedra, Thalassiothrix, Cymbella,* and *Pleurosigma*
2	Chlorophyta (green algae): *Desmidium, Spirogyra,* and *Pediastrum*
3	Cyanophyta (blue-green algae): *Nostoc, Aphanizomeon,* and *Oscillatoria*
4	Dinophyta (dinoflagellates): *Peridinium*
Zooplankton	
1	Rotifera: *Keratella, Conochilus,* and *Madhuri*
2	Crustacea: *Calanoid, Cyclopoid, Amphipod*

In the present study, the food items found in the stomach of *Gudusia chapra* indicated an herbivory feeding preference.

According to Mondal and Kaviraj (2010) [10], the bulk of the gut content of *Gudusia chapra* is constituted by algae and other plant matter, followed by crustaceans, rotifers, protozoa, insects, and miscellaneous materials. Kumari *et al* (2021) [11] found herbi-omnivorous food habits of this species collected from the open water of West Bengal, India, as revealed by the qualitative estimation of stomach contents for juveniles and adults.

Haque (2004) [12] reported five groups of plankton such as Chlorophyceae, Cyanophyceae, Bacillariophyceae, Euglenophyceae, and Dinophyceae, and two zooplankton groups of Crustacean and Rotifer from a beel in Netrokona, Bangladesh. In the present study, the stomach contents of the Chapila from Pagla River were almost similar to the Chapila collected from the beel, except for the group Euglenophyceae.

(41.38%) and detritus (19.66%) dominancy in the juvenile gut, while Cyanophyceae (47.39%) and Chlorophyceae (20.71%) in adult *Gudusia chapra*. Notwithstanding, they confirmed various genera of Cyanophyceae (*Microcystis*, *Nodularia*, *Merismopedia*), Bacillariophyceae (*Aulacoseira*, *Cyclotella*, *Synedra*, *Nitzschia*), Chlorophyceae (*Coelastrum*, *Scenedesmus*, *Pediastrum*), Dinophyceae (*Peridinium*), and Rotifera (*Brachionus*, *Keratella*, *Polyarthra*) in the stomach of *Gudusia chapra* sampled from a reservoir in West Bengal, India.

The analysis of the sex ratio was based on 104 specimens. It was found that the total number of male and female fish from the investigation were 45 and 59 respectively, i.e., about 46.95% males and 53.05% females, indicating a sex ratio of 46.95: 53.05 (1: 1.12). The difference between observed rations 1:1 had been examined by the chi-square (χ^2) test. The present study showed that the sex distribution of the two sexes did not occur in the same proportion throughout the study period (Table 2; Fig. 2).

Table 2: Percentage occurrence of male and female *Gudusia chapra* and their ratios during the sampling months collected from Pagla River, Bangladesh.

Name of the month	Number of samples	Number of males	Male (%)	Number of females	Female (%)	The ratio of male to female	Chi-square value
Aug	10	4	40	6	60	1:1.50	0.4
Sep	10	3	30	7	70	1:2.33	1.6
Oct	10	5	50	5	50	1:1	0
Nov	10	6	60	4	40	1:0.67	0.4
Dec	10	7	70	3	30	1:0.43	1.6
Jan	10	6	60	4	40	1:0.67	0.4
Feb	3	1	33.33	2	66.67	1:2	0.32
Mar	1	1	100	0	0	0	0
Apr	10	5	50	5	50	1:1	0
May	10	2	20	8	80	1:4	3.6
Jun	10	3	30	7	70	1:2.33	1.6
Jul	10	2	20	8	80	1:4	3.6
Total	104	45	46.95	59	53.05	1:1.12	1.52

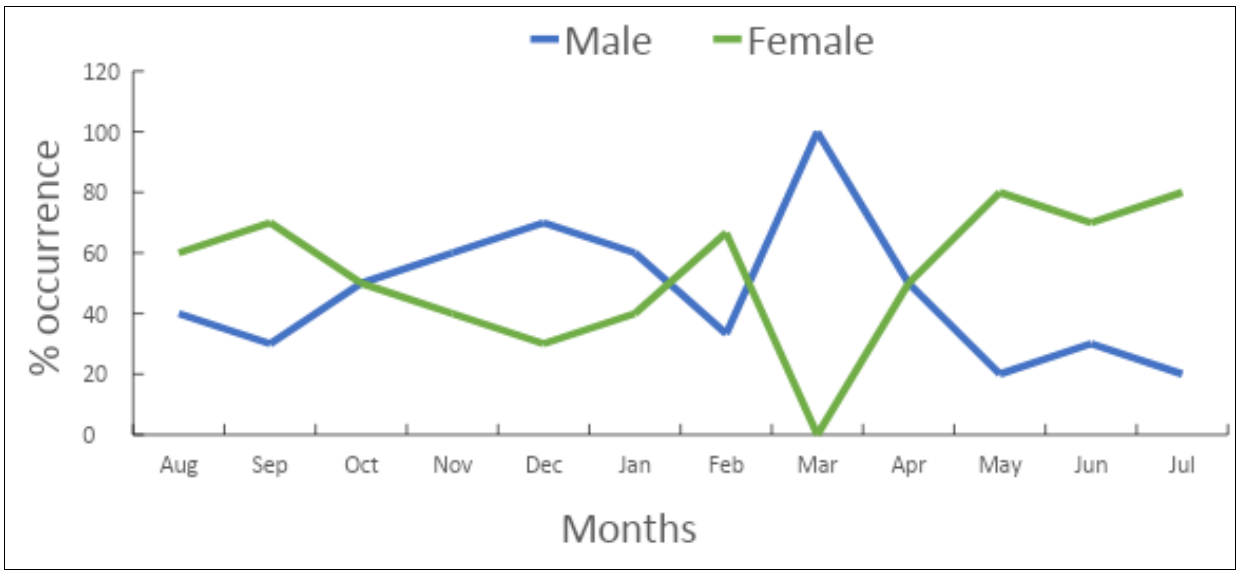

Fig 2: Monthly percentage composition of male and female *Gudusia chapra.*

Afroz (2000) [13] observed a male-to-female ratio of 1:6.2 for *Gudusia chapra* from 2336 specimens in the pond water of Savar, Dhaka. Ahmed (2022) [14] also observed a monthly variation in the sex ratio of *Gudusia chapra* from 458 specimens collected from an open water beel in Assam, India. The observed ratio was tested against a 1:1 hypothetical ratio of male to female using the Chi-square test for (n-1) degrees of freedom at a 5% level of significance. The ratio between the male and female ranged from 1:1.26 (April) to 1:2.53 (December). The ratio significantly departed from the expected 1:1 ratio in January, March, May, June, July ($P < 0.05$), and December (<0.01). However, in the present study, monthly variation in the sex ratio of the *Gudusia chapra* showed variation from the natural 1:1 ratio, and the difference between the two sexes showed insignificant values ($P > 0.05$), indicated the sex ratio available in the present study is not representative of the population. Notwithstanding, the females were higher in number than the males of *Gudusia chapra* ($P > 0.05$).

GSI (Gonadosomatic index) is used as an indicator of gonadal development as marked by maturity, indicates the phase of the reproductive cycle, and also assesses the ripeness of the ovary [15,16]. A low GSI suggests that the fish is in a non-reproductive or immature state. A higher GSI indicates a higher investment in reproduction, suggesting the fish is in a mature or reproductive stage [17]. The GSI was taken as a measure for determining the spawning season. In the present study, the total length of *Gudusia chapra* ranged between 44 mm and 130 mm, and the body weight was between 0.5 g and 20.2 g. The gonad weight ranged from 0.0011 g to 1.0758 g. Table 3 and Table 4 show the month-wise GSI values of males and females of *Gudusia chapra*, respectively, which range from 0.315 and 1.702 for males and 0.1965 and 5.966 for females.

Table 3: Month-wise GSI distribution of male *Gudusia chapra* collected from Pagla River, Bangladesh.

Month	Total number of samples	Number of male samples	Mean GSI
Aug	10	4	1.223
Sep	10	3	1.206
Oct	10	5	0.434
Nov	10	6	0.3178
Dec	10	7	0.586
Jan	10	6	1.702
Feb	3	1	0.6583
Mar	1	1	0.5667
Apr	10	5	0.543
May	10	2	0.3538
Jun	10	3	0.4749
Jul	10	2	0.315

Table 4: Month-wise GSI distribution of female *Gudusia chapra* collected from Pagla River, Bangladesh.

Month	Total number of samples	Number of female samples	Mean GSI
Aug	10	6	2.82
Sep	10	7	0.741
Oct	10	5	0.236
Nov	10	4	0.454
Dec	10	3	0.685
Jan	10	4	0.666
Feb	3	2	5.966
Mar	1	0	0
Apr	10	5	2.538
May	10	8	2.308
Jun	10	7	0.346
Jul	10	8	0.1965

Kabir *et al* (1998) [18] determined the GSI of Chapila, collected from earthen ponds, and observed that the male fish attain sexual maturity at a length of 7.7 cm and an average weight of 7.41 g, and that of the female at 9.3 cm and 14.64 g. In pond condition, the fish was found to spawn for several months, with two spawning peaks, one in April and another in August, indicated by the peaks of GSI. In the present study, the male fish attain sexual maturity at 111 mm and 9.1 g and the female at 130 mm and 20.2 g. In addition, the Chapila of the Pagla River showed their peak spawning time two months earlier than that reported by Kabir *et al* (1998) [18].

Haque (2004) [12] reported that the GSI of *Gudusia chapra* ranged from 0.83 to 11.77 and also showed one spawning peak in March. Moreover, they observed increased GSI values in February and March, then started to decline and continued up to October during the sampling year. However, in the present study, the high GSI value for male *Gudusia chapra* was encountered in January. The GSI value of female *Gudusia chapra* was found to increase gradually from November to February and attained a peak in February. Ahmed *et al* (2022) [14] revealed that the GSI value of *Gudusia chapra* coupled with the spawning season were prolonged from March to October with two distinct peaks for both sexes, one in April (5.06 for males and 5.98 for females) and another in August (6.03 for males and 8.13 for females). The GSI value increases with maturation, reaching its peak before changing dramatically [19]. Vinci *et al* (2005) [20] reported that the spawning season of *Gudusia chapra* extended from March to October, as sampled from floodplain wetlands in West Bengal. Conversely, Ahamed *et al* (2014) [21] reported higher GSI values from March to September, with a single peak in April indicating this was the main spawning season. Rahman and Haque (2008) [22] observed two spawning peaks of *Gudusia chapra*, one in March and the other in July, as indicated by the peaks of the GSI.

So, in light of the above discussion, it may be concluded that the sex ratio, the spawning season, and its duration may vary spatially, which might imply preferences of water quality and nutrient availability optimal for *Gudusia chapra*.

References

1. Gupta SA. A review on *Sperata aor* (Hamilton, 1822), a popular food fish of Indian subcontinent. Sains Malaysiana,2015:44:1217-1222.
2. Basumatary S, Talukdar B, Choudhury H, Kalita HK, Saikia DJ, Mazumder A, Sarma D. Female gonadal histology of Indian river shad, *Gudusia chapra* (Hamilton, 1822)–A tactic of reproductive biology. Poult. Fish Wildl. Sci,2016:4:173.
3. IUCN (International Union for Conservation of Nature), Bangladesh. Red list of Bangladesh. 2015. Volume 5: Freshwater fishes. Dhaka, Bangladesh.
4. Chaudhry S. *Gudusia chapra*, The IUCN Red List of Threatened Species. 2010. e.T166523A6227899. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T166523A6227899.en
5. Jhingran AG. Diet-composition of *Gudusia chapra* (Hamilton) from the Ganga river system. Proc. Nat. Acad. Sci., India (B),1972:38:94-105.
6. Rahmatullah SM, Alam MT, Hossain MM, Amin MR, Hoque MJ. Study on the food and feeding habit of young Chapila, *Gudusia Chapra* Bangladesh J. Fish,1995:15-18:91-100.
7. Alam MT. Food and feeding habit of young Chapila, *Gudusia Chapra*. M.S. Thesis, Department of Aquaculture and Management, Faculty of Fisheries, BAU, Mymenshing, 1995, 53.
8. Imran A. Food and feeding habit of some small fishes (*Gudusia Chapra*, *Mystus tengura Channa Punctatus*) in Kaptai reservoir Rangamati. M.Sc thesis, Department of Zoology. University of Chittagong, 1998.
9. Hynes HB. The food of fresh-water sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*), with a review of methods used in studies of the food of fishes. J. Anim. Ecol,1950:19:36-58.
10. Mondal DK, Kaviraj A. Feeding and reproductive biology of Indian shad *Gudusia chapra* in two floodplain lakes of India. Elect. J. Biol,2010:6:98-102.
11. Kumari S, Sarkar UK, Karnatak G, Mandhir SK, Lianthuamluaia L, Kumar V, *et al*. Food selectivity and reproductive biology of small indigenous fish Indian river shad, *Gudusia chapra* (Hamilton, 1822) in a large tropical reservoir. Environ. Sci. Poll. Res,2021:28:11040-11052.
12. Haque MM. Biology and population study of Chapila, *Gudusia Chapra* in Rajdhala Beel, Netrokona, Bangladesh. DFID, Mymenshing, Bangladesh, 2004.
13. Afroz T. Breeding biology of 'chapila' fish *Gudusia chapra* (Ham.) studied in pond.J. Asiat. Soc. Bangladesh Sci,2000:26:245–252.
14. Ahmed AM, Nath BB, Ali A, Sarma J, Phukan B, Ahmed I, *et al*. Length-Weight Relationship and Reproductive Biology of the Indian River Shad, *Gudusia chapra* (Hamilton, 1822) from Central Brahmaputra Valley of Assam, North-East India. J. Zool,2022:54:1869-1876.
15. Nandikeswari R, Sambasivam M, Anandan V. Length weight relationship of *Terapon jarbua* (Forsskal, 1775) from Puducherry waters. Intern. J. Bioeng. Life Sci,2014:8:281-285.
16. Ghaffari H, Ardalan AA, Sahafi HH, Babaei MM, Abdollahi R. Annual changes in gonadosomatic index (GSI), hepatosomatic index (HSI) and condition factor (K) of Largescale tonguesole *Cynoglossus arel* (Bloch & Schneider, 1801) in the coastal waters of Bandar Abbas, Persian Gulf. Aus. J. Basic Appl. Sci,2011:5:1640-1646.
17. Jan M, Jan U, Shah GM. Studies on fecundity and gonadosomatic index of *Schizothorax plagiostomus*

(Cypriniformes: Cyprinidae). J. Threat. Taxa,2014:6:5375-5379.
18. Kabir AK, Hossain MA, Rahmatullah SM, Dewan S, Islam MS. Studies on the gonadosomatic index and fecundity of Chapila (*Gudusia chapra* Hamilton). Ban. J. Fish. Res,1998:2(2):195-200.
19. Parween S, Begum N, Rahman MH, Hossain MA. On the breeding periodicity of *Esomus danricus* (Hamilton). Univ. J. Zool. Rajshahi University,1993:12:31-34.
20. Vinci GK, Suresh VR, Bandyopadhyaya MK. Biology of *Gudusia chapra* (Hamilton-Buchanan) from a floodplain wetland in West Bengal. Ind. J. Fish,2005:52(1):73-79.
21. Ahamed F, Ahmed ZF, Hossain MY, Ohtomi J. Population Biology of the Indian River Shad, *Gudusia chapra* (Clupeida) in the Old Brahmaputra River, North-Eastern Bangladesh. Sains Malaysiana,2014:43:1645-1655.
22. Rahman MA, Haque MM. Beel fishery and livelihood of the local community in Rajdhala, Netrokona, Bangladesh, 2008.