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Food and feeding habit of Bele *Glossogobius giuris* (Hamilton and Buchannan, 1822) Collected from Mithamain *Haor* of Kishoreganj districts, north-eastern Bangladesh

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Abstract
In the present study, an attempt has been made to investigate the food and feeding habits of the Bele *Glossogobius giuris* from Mithamoin Hair, Kishorgonj, Bangladesh. Fish specimens were collected monthly from March 2014 to February 2015. During this study 252 specimens were collected. On the basis of qualitative and quantitative analysis of gut contents, *G. giuris* has been categorized as carnivorous. Food items mainly consist of fish, crustaceans, insects, zooplankton and algae. The main food items in guts were recorded as; fishes (46.7, 53.181%), Insects (3.6, 2.050%), Crustacean (16.2, 14.535%), zooplankton (3, 1.216%), algae (0.5, 0.162 %) by volume and occurrence. The mean value of Gastrosomatic index (GaSI) and active feeding were found to be maximum 3.08 and 0.56 in February 2015 and minimum 1.50 and 0.32 in October 2014 respectively. Highest Gastrosomatic Index and Active feeding occurred during winter (February) prior to breeding season started and lowest Gastrosomatic Index value as well as poorer active feeding occurred during the breeding season.

Keywords: Food and feeding habit, gut contents, carnivores, gastrosomatic index, active feeding, breeding season

Introduction
Glossogobius giuris, widespread species is recorded throughout the Indo-west Pacific region and worldwide recognized as Tank Goby and locally known as *Bele* or *Bailla* belongs to the family Gobiidae of order Perciformes [1-3]. Unique taste, low fat content and high protein content of *G. giuris* has made this species a special item among the small indigenous species [4]. Distribution of this species cover both freshwater and estuaries of Bangladesh [5]. Popularity of *G. giuris* in the recent time in national and international market like Italy, India, Burma, Nepal and France has enhanced several times than the previous instance [6]. Therefore, the possibility of earning huge foreign currency through the potential culture techniques as well as management system of these fish has also increased. Despite of its enormous importance in aquaculture, the food and feeding habits of this valuable species has not been adequately studied in Bangladesh except some observations on the morphometric and meristic characters and reproductive cycle, fecundity, induced spawning, spawning behavior and larvae rearing [7-12]. Other foreign workers who worked on some aspects of its biology and food and feeding habit of this fishes is very limited among which noteworthy contributions are those of Hora, Mookherjee, Alikunhi *et al.*, Das and Moitra, Karamchandrani, Tandon, Bhowmick, Natarajan *et al.*, Datta Munshi, Rao and Rao and Achakzai *et al.* [13-23]. Most of the mentioned studied pertained to food and feeding habits are performed in different regions of India and Pakistan however, not in Bangladesh.
Usually, growth of a fish is influenced by the quality and quantity of food materials available and consumed. Thus, any fluctuation in quality and quantity of food materials will have an effect on growth rate of the fish. The changes of natural food materials in a water body are under the control of several abiotic and biotic factors. These fluctuations could be known by qualitative and quantitative analysis of gut contents of a fish and/or by the estimation of Gastrosomatic Index [24]. Food and feeding habits of fishes have a great importance in aquaculture practice. It helps to choose such species of fishes for aquaculture 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 [25].
Nevertheless, for developing culture technologies, biological studies of this species are indispensable. Therefore, the purpose of this investigation was to identify the food and feeding habits of *G. giuris* to generate the base line information for facilitating the sustainable aquaculture of it in the whole country.

Material and methods: Adult fish of *G. giuris* were collected monthly from Chamra Ghatbazer, Mithamain, Kishoreganj *haor* region of Bangladesh (Fig. 1) from March 2014 to February 2015. After collection, samples were preserved in 10% formalin to stop digestion of food items.

Individual fish weight was taken before the observation of gut content. The individual fish was cut open and gut was removed on to petridish with the help of very fine forceps for gut analysis. The collected guts were weight for calculating the Gastro somatic index (GaSI). Gut content was analyzed qualitatively as well as quantitatively by eye estimation volumetrically [6] and occurrence method [26] under binocular microscope. For evaluating the relative importance & grading of all food items, index of preponderance [27] was obtained using formula:

$$I = ViOi / \Sigma ViOiX\ 100$$

Where,
I= Index of preponderance
Vi= volume percentage
Oi= Occurrence percentage
∑= Summation

Gastro somatic index (GaSi) was calculated using the formula given by [28]:

GaSI (%) = Weight of gut (g) / Weight of fish (g) X 100

Relative lengths of gut (RLG) of fish were also measured to determine the food habit of fish.
RLG = Length of gut / total length of fish

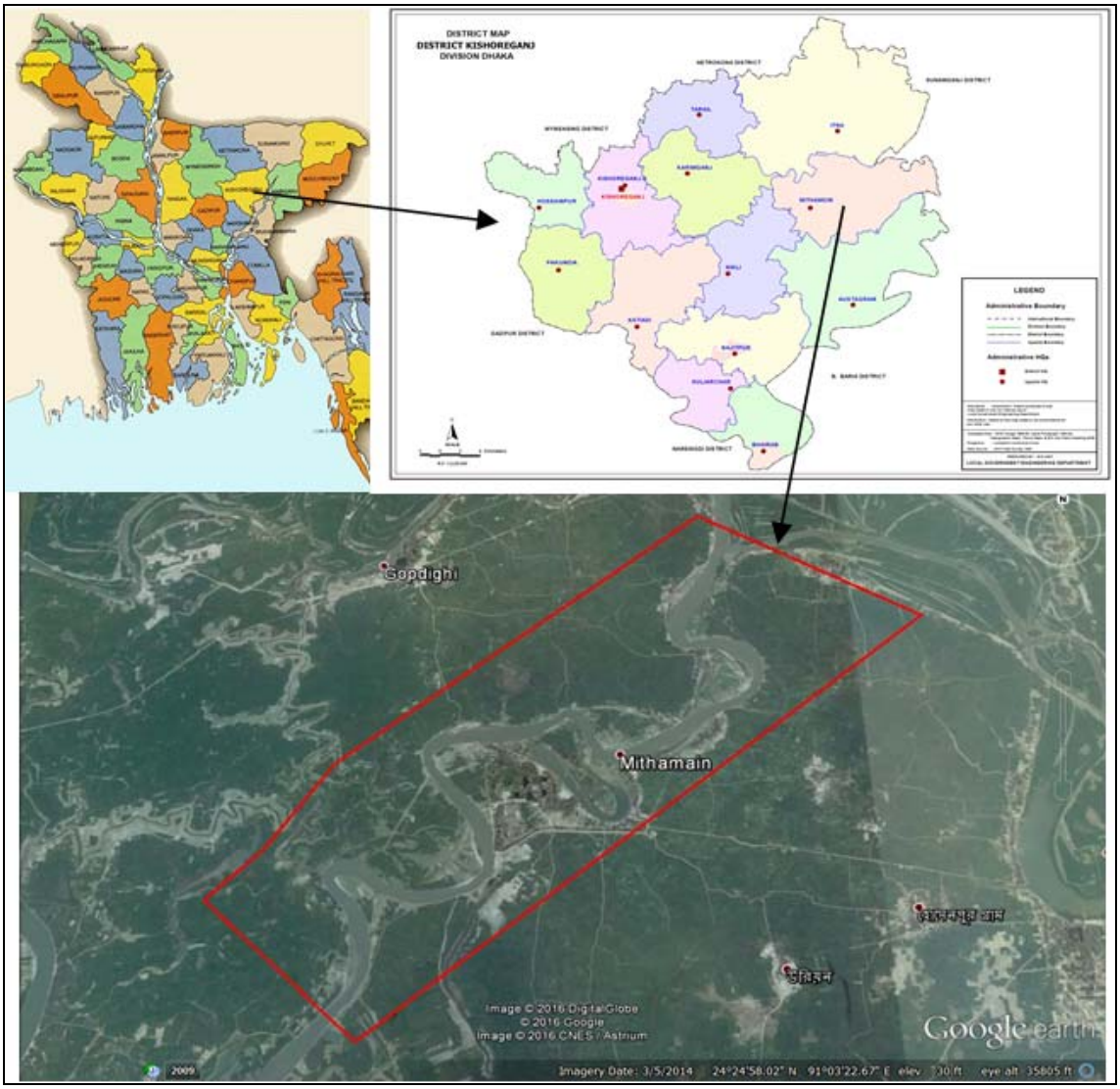

Fig 1: Fish sampling site in the *haor* region of Kishoreganj, northeastern Bangladesh

The average feeding intensity was evaluated by points method and depending on the fullness of stomachs points were assigned as 1.25, 1.0, 0.75, 0.5, 0.25, 0.10 and 0 for gorged, full, 3/4 full, ½ full, 1/4 full, trace and empty stomachs respectively [29]. The fish was considered as an active feeder when stomach was gorged, full and 3/4 full, moderate when 1/2 full and poor when 1/4 full or with traces.

Results and discussion: The index of preponderance of various food items of *G giuris* is presented in Table 1. The gut contents of adults consisted of fry of teleost fishes, prawn along with semi digested material and traces of insects, zooplankton and algae. The fry of teleost fishes formed the important food item forming 46.7% by volume and 26.4 % by occurrence. A mojor portion of fish item composed of *G.*

giuris fry during the months of May to November which reveals that they are cannibalistic in nature. Crustacean represented prawn spp. and crabling formed the next important food item after semi digested matter. Major part of zooplankton is formed by copepods. Among insects, larvae and immature individuals of dragon flies, chironomids formed the major portion. Algae composed of *Cladophora* and *Spyrogyra*. A mojor portion of fish item composed of *G. giuris* fry during the months of May to November which reveals that they are cannibalistic in nature. The cannibalistic nature of this species has been reported by Bhowmickin the Hooghly estuary and Datta Munshi *et al*. in the river Ganga. Das and Moitraobserved that the *G. giuris* of 20-53 mm size consumed on carp fry [16, 19, 21]. Bhowmick stated that teleost fishes formed the major food item of adults and crustaceans of the juveniles in the Hooghly estuary [19]. Natarajan *et al*. based on the observations made on Konar and Tilayar reservoirs reported that juveniles of *G. giuris* are planktonic feeders but adults gradually become carnivorous, surviving on insect larvae upto certain stage (51-100 mm) and then turn predatory by consuming on fish [20].

Table 1: Grading of various food items of gut contents in *G. giuris* from *haor* region of Kishoreganj, northeastern Bangladesh

Food Item	% composition of items by		$V_I O_I$	'I'= $V_I O_I/\sum V_I O_I$*100	Grading
	Volume (V_I)	Occurrence (O_I)			
Fish	46.7	26.4	1232.88	53.181	I
Crustacean	16.2	20.8	336.96	14.535	III
Semi digested material	29.6	22.6	668.96	28.856	II
Insects	3.6	13.2	47.52	2.050	IV
Zooplankton	3	9.4	28.2	1.216	V
Algae	0.5	7.5	3.75	0.162	VI
		$\sum V_I O_I$=2318.27			

According to Mookherjee the ratio of animal and plant component in the gut of adult fish was 7:3. Whereas, Alikhunhi *et al*. observed that the adult fishes subsist on teleosts [15]. However, juveniles are majorly insectivorous while adults are piscivorous reported by Tandon [18]. Similarly, the present study also revealed the carnivorous feeding habit of fish. In the observation of relative length of gut (RLG) value, found that value is < 1 which indicates its carnivorous habit (Data not shown).

Gastrosomatic Index: The observation on feeding intensity was based on gastrosomatic index (GSI) and gut fullness taken on monthly basis and the results have been summarized in Table 2 and Table 3 respectively. The highest Gastrosomatic Index and gut fullness was observed as 3.08 and 37.44% respectively during the months of February. The values of Gastrosomatic Index and Gut Fulness were higher during winter season compared to summer season. This result showed that feeding intensity was higher in winter compared to summer. The availability of food was good in winter. Percentage of empty stomach and Gastrosomatic Index were 43.30% and 1.50 respectively in the month of October and 35.31% and 1.92 respectively in the month of May which are the two spawning peak season of *G. giuris* observed by Hossain [8]. Therefore the result of Gastrosomatic Index and percentage of empty stomach suggests that during breeding season this species does not prefer to take food. The feeding intensity or the Gastrosomatic Index of the fish was studied by many workers in different species of the fish. *Ompok bimaculatus* and *O. malabaricus* show low feeding intensity during August and June may not be due to shortage of food items but due to the spawning season of the fish [30]. Jaya and Saksena observed lower Gastrosomatic Index during breeding season in case of *Mystus cavacius* [31].Generally in fish feeding intensity low in spawning season [32]. A low Gastrosomatic index was observed during the breeding season from February to June in case of *Tilapia* [33]. Mushahida-Al-Noor *et al* have also observed the maximum number of empty stomachs was in the month of June in *Rita rita* [34]. Rao and Rao stated that in *G. giuris* feeding intensity more in peak breeding season that no inverse relationship existed between feeding intensity and breeding season. Need further study, to identify the actual reason of such variations [22].

Table 2: Gastro somatic index (GaSI) of *G. giuris* in different months from *haor* region of Kishoreganj, northeastern Bangladesh

Months	Average weight of fish (g)	Average weight of gut (g)	Average GaSI
March	40.96	0.79	1.92
April	70.23	1.59	2.26
May	51.60	1.39	2.69
June	73.10	1.51	2.14
July	54.43	1.27	2.33
August	49.28	1.22	2.48
September	39.44	0.95	2.40
October	59.78	0.90	1.50
November	46.23	1.21	2.61
December	59.80	1.57	2.63
January	38.44	1.11	2.88
February	50.46	1.56	3.08

Table 3: Monthly fluctuations in the percentage of feeding intensity in the *G. giuris* during 2014-2015 from *haor* region of Kishoreganj, northeastern Bangladesh

Months	No. of stomachs analysed	Average points assigned	Active%	Moderate%	Poor%	Empty%
March	20	0.37	23.22	13.55	28.22	35.01
April	19	0.38	19.33	22.21	28.65	29.81
May	30	0.51	33.44	17.11	39.00	10.45
June	14	0.34	21.24	8.34	35.11	35.31
July	19	0.35	22.21	10.33	32.55	33.91
August	25	0.40	25.17	14.32	32.88	27.67
September	23	0.41	27.42	15.22	27.66	29.7
October	18	0.32	20.11	12.23	24.36	43.30
November	27	0.50	34.67	13.53	35.54	16.26
December	20	0.48	33.29	8.55	40.00	18.16
January	13	0.52	34.77	16.01	38.44	10.78
February	24	0.56	37.44	19.22	38.76	4.25

Conclusion: From the study of the gut contents of *G. giuris* based on numerical study it was found that this species feeds on animal as well as plant materials which composed of fish, insects, crustaceans, algae and zooplankton. From the volume and percentage of biomass ingested, it can be said that animal proportion is high than the other materials. On the other hand considerable time of the year a recognizable proportion of the biomass composed of juvenile of *G. giuris*. Therefore, it can be concluded that the species is carnivore and cannibalistic in nature. The feeding intensity of the fish was varied in different seasons as the gastro somatic index of fish was observed to be maximum during winter season (January and February) while minimum during two spawning period (March and October). This may be concluded that feeding intensity is maximum during winters as well as off breeding season while minimum in spawning period.

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