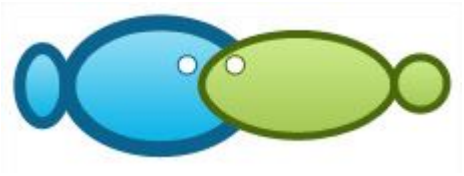

Feeding behaviour of mud crab *Scylla serrata* in north of Sundarbans, Bangladesh

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Abstract. A total of 330 pieces of mud crab (*Scylla serrata*) were sampled from North of Sundarban, Bangladesh for one whole year from February 2014 until January 2015. The average diet item observed in the stomach consisted of bivalves (21%), detritus (12%) and gastropods (5%) with a higher amount of crustaceans (38%). It was also observed that the higher active feeding of *S. serrata* was during July until September while inactive feeding was observed during April until June. Bivalve and gastropod consumption by *S. serrata* was increased and detritus consumption was decreased in the middle of the year. Fish consumption was decreased at the end of the year. The findings of the present study suggest that *S. serrata* showed mostly carnivore behavior rather than being herbivorous, thus justifying the higher composition of other animal in the stomach. The result from this study would aid in the better commercial production of this commercially important mud crab species by providing the information on the feeding of. *S. serrata*.

Key Words: mud crab, Sundarban forest, feeding behaviour, diet.

Introduction. The habitat of *Scylla serrata* is muddy bottoms in semi saline water along the beach area, mangrove areas, and river's mouth, with the name mud crab or mangrove crab (Motoh 1979). This species is distributed across the Indo Pacific region from Philippines, Hawaii, Taiwan, southern Japan, to Australia, Red Sea and East and South Africa (Motoh 1979; Aiyun & Siliang 1991). This crab is commercially important (Arriola 1940; Pattiasina et al 2016) in the Indo-West Pacific region and possesses a high price in both the domestic and export markets (Agbayani & Samonte 1992) with annual landings of over 1,83,852 tonnes (FAO 2016). Thus, *S. serrata* is a subject of continuous research because it constitutes the basis for the development of a successful fisheries management programme on capture and culture (Oronsaye & Nakpodia 2005). Research has been done on the food and feeding habits of *S. serrata* i.e. then Prasad et al (1988) in Sunkeri backwaters, Karwar, Joel & Sanjeeva Raj (1986) in Pulicat lake, Prasad & Neelakantan (1988) in Karwar waters, Mustaquim et al (2001) in Karachi backwaters, and Mamun et al (2008) in Khulna and Satkhira, Bangladesh. Some other recent research have been done by Serrano (2012), Serrano & Traifalgar (2012), Genodepa & Failaman (2016), and Balito & Traifalgar (2017). To date, there is no study on the food and feeding habits of *S. serrata* in the largest mangrove (North of Sundarban, Bangladesh) of the world. Therefore, this study aims to determine the food and feeding habits of the commercially important mud crab species in the North of Sundarban, Bangladesh.

Material and Method

Description of the study sites. Samples of *S. serrata* (330 tails) were collected randomly from February 2014 to January 2015 from the various coastal regions (Khulna and Bagerhat) of mangrove forest, north of Sundarbans, Bangladesh (Figure 1). Dip nets and basket traps were used to capture crabs. Carapace width of the crabs was measured immediately after capture.

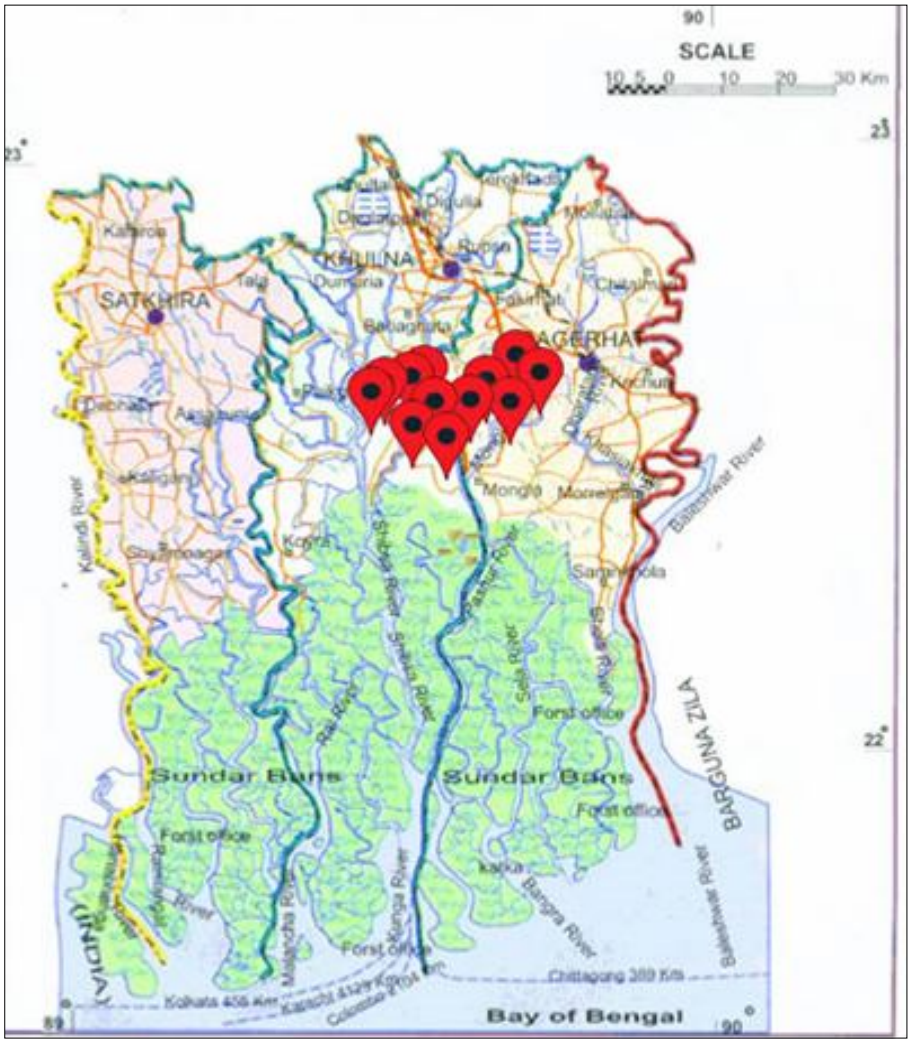

Figure 1. Study area. The red colour pin icons indicates sampling locations.

Laboratory analysis. The crabs were dissected in the laboratory and stomachs were separated and preserved in 5% formalin (Mamun et al 2008) with an individual sample tag in plastic jars for study. A total number of 330 stomachs of different size were examined. The stomach contents were analyzed for individual crabs and attempts were made to identify the types of food ingested by crabs of different size. Stomach contents were identified to the nearest taxon, their number recorded by counting the number of heads in the case of prey.

The stomachs of crabs were then opened and the contents were examined (Hill 1976) under microscope (magnification: x5, x10). The stomach contents of each *S. serrata* were taken and the total weight of the food was weighed. Visual estimation of the fullness of stomach contents of all the specimens was noted and categorized as full, 3/4 full, 1/2 full, 1/4 full, 1/8 full and empty stomach. Food contents were examined by dissecting the stomach. The larger items were identified by eye estimation and then under dissecting microscope whereas smaller items under a compound microscope. Full, 3/4 full and 1/2 full of stomach mentioned as active feeding and 1/4 full and 1/8 full of stomach regarded as inactive feeding.

Data analysis. Various food items were identified depending of the stage of digestion (Wu & Schin 1997). The undigested food materials were separated from the digested part and subsequently these were sorted into different taxonomic groups. Using Microsoft Excel, and Mirocal Origin™ (Version 9), recorded data were graphically analyzed and cross-checked (Simon et al 2009; Simon & Mazlan 2010).

Results and Discussion

Seasonal feeding diversity. The highest stomach fullness (Figure 2) was found in July to October (rainy season) samples, while the lowest number of stomach fullness (0%) was recorded in April-June (summer) samples which is in agreement with Mamun et al (2008). Based on the stomach fullness analysis, the percentage of active feeder was higher in July-September (post monsoon and pre-winter) (Figure 3) and inactive feeder was higher in April-June. Likewise, Mohapatra et al (2005) and Mamun et al (2008) reported the higher feeding rate of *S. serrata* was in winter and lower in summer. Temperature and ecological character may have the influence of these variations. Moreover, empty gut number was found to be higher (26.34%) in present study however, Mamun et al (2008) (35.65%) and Mohapatra et al (2005) (36.41%) reported the active feeder (3/4 full) were higher (Table 1) round the year.

Table 1

A comparative chart of gut fullness of examined gut samples in *S. serrata* from present study with other researchers

Gut fullness (%)	*Present study*	*Mamun et al (2008)*	*Mohapatra et al (2005)*
Gorged (full)	25.73	16.54	20.34
Active (3/4 full)	18.25	35.65	36.41
Moderate (1/2 full)	7.08	16.13	11.94
Slow (1/4 full)	12.69	-	-
Poor (1/8 full)	13.75	9.68	8.73
Empty (without food)	26.34	22.01	22.59
Area	North of Sundarbans, Bangladesh	Coastal area of Bangladesh	Chilika lagoon, India

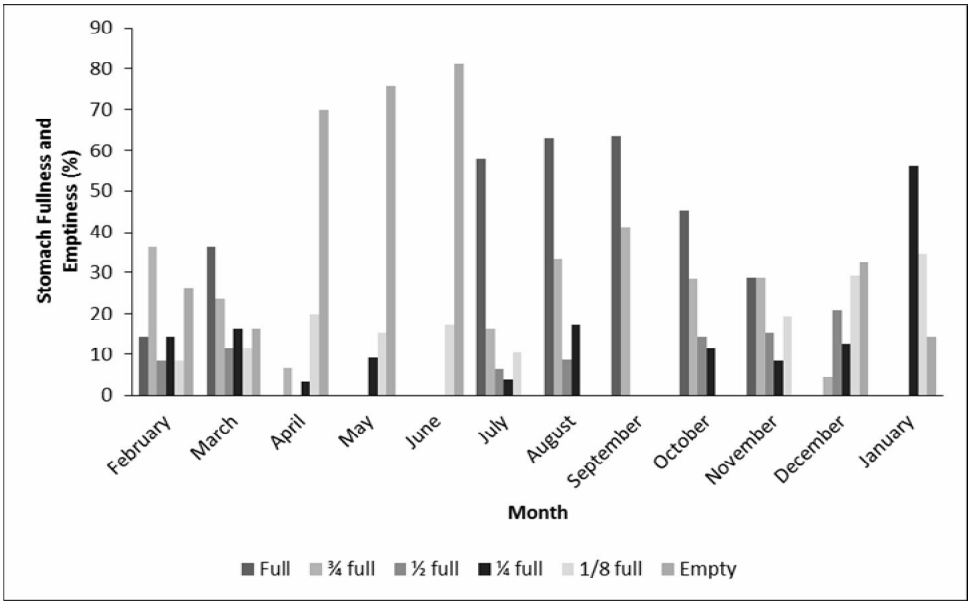

Figure 2. Monthly variation in the percentage of stomach fullness and emptiness of *S. serrata* sampled from February 2014 to January 2015.

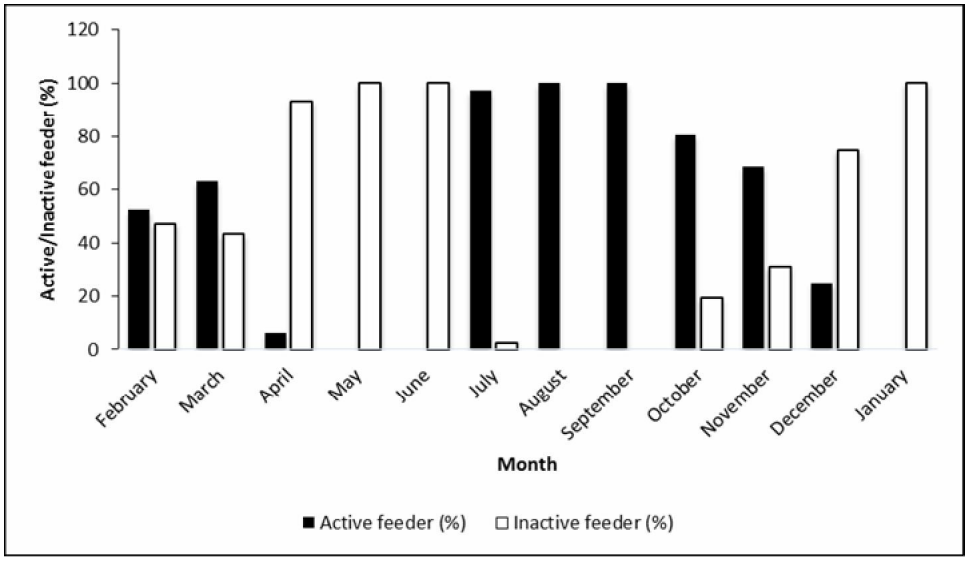

Figure 3. Percentage of active and inactive *S. serrata* sampled from February 2014 to January 2015.

Compositional variation of food items. Crustaceans were higher in amount during mid-year while detritus were higher from the beginning of the year (Figure 4). This study showed that crustacean (38%) and molluscans (26%) (Gastropods and bivalves) were comprises the major percentage of the total stomach contents. The consumption of bivalves and gastropod by *S. serrata* was increased in the middle of the year but detritus consumption decreased. Fish consumption was observed in tiny amount (Figure 5) in the middle of year but decreased at the end and starting of the year. Sand, bivalves and crustaceans were the common food item found round the year (Table 2).

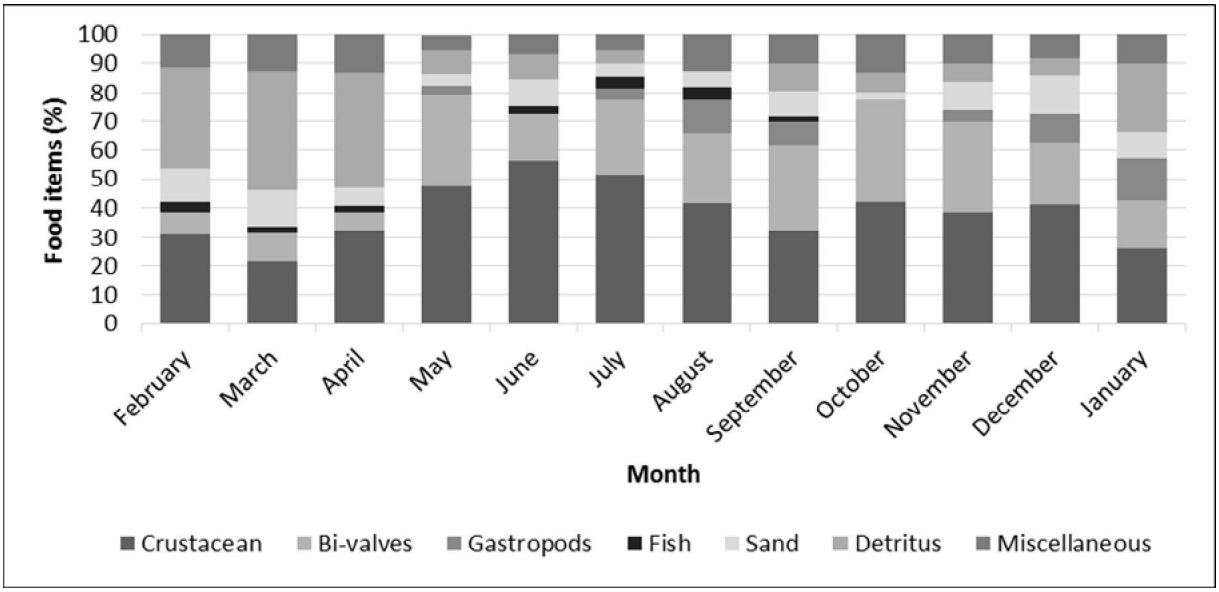

Figure 4. Food items (mean) observed from sampled *S. serrata* during February 2014 to January 2015.

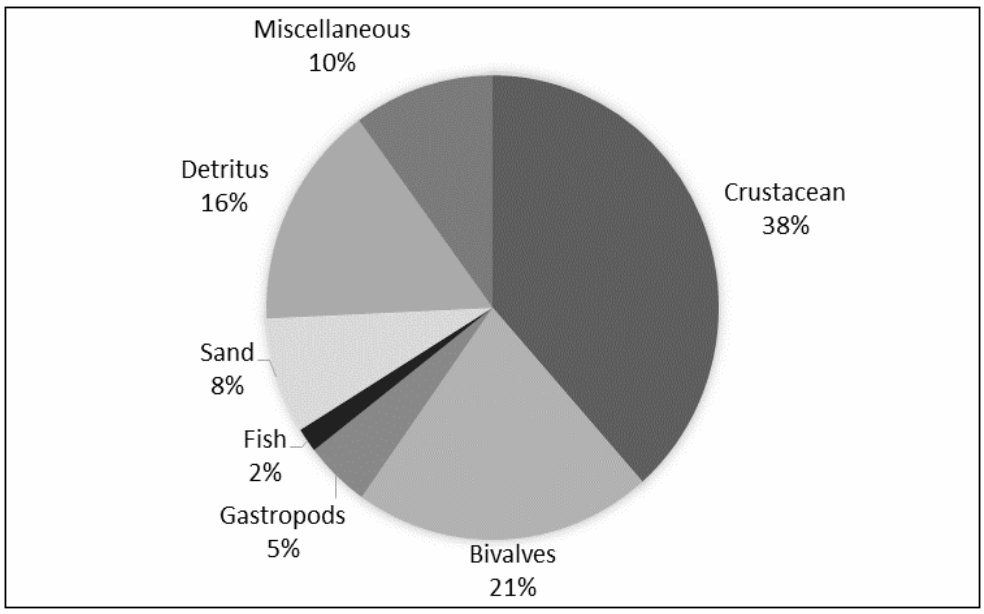

Figure 5. Mean composition of different food items collected from sampled *S. serrata* during the sampling period February 2014 to January 2015.

Past studies from India (Kathirvel 1981; Jayamanne 1992; Kathirvel & Srinivasagam 1992) reported a higher amount of crustaceans as food item in *S. serrata* (Table 2) which is also supported by Jayamanne et al (1992) from Sri Lankan's water and Mamun et al (2008) and our study (38.49%) from Bangladesh waters. On the other hand, Jayamanne (1992) (50%) and Mohapatra et al (2005) (51.85%) reported the gastropods (mollusks) while Prasad et al (1988) reported the detritus (41.3%) was higher food items found in the stomach of of *S. serrata* from Indian waters. Nevertheless, only Jayamanne et al (1992) reported bivalves (32.93%) as food item in *S. serrata,* which is also documented in the present study (21.37%). This might be due to the different ecosystem and availability of food in the water bodies. The dead or freshly molted tiger shrimps and other small shrimp might have been eaten by mud crabs (Mamun et al 2008), which might have exhibited as crustacean food (Figure 4). Past studies has showed that lower consumption of gastropods and fishes but higher consumption of crustaceans by *S. serrata* in Sri Lankan waters, lower consumption of crustaceans but higher consumption of gastropods and fishes in Bangladesh waters while higher predation on crustaceans, gastropods and fishes in Indian waters. This suggested that the geographical condition and habitat richness may have influence on the feeding behavior of *S. serrata*.

Table 2

A comparative study of mean food composition *in S. serrata* from current and past study

Food item (%)	*Location*								
	North of Sundarbans	*Cochin backwater, India*	*Ennore estuary, India*	*Pulikate lake, India*	*Hoogly Matlah estuary, India*	*Chilika lagoon, India*	*Coastal area of Bangladesh*	*Karwar, India*	*West Coast, Srilanka*
Crustacean	38.49	78.4	46.3	46.6	38.5	10.19	44.48	6	50.70
Gastropods	4.66	3.5	25	20.3	3.9	51.85	26.67	8.3	7.12
Fish	1.70	15.2	19.7	21.2	19.2	22.22	15.22	33	3.06
Bivalves	21.37	-	-	-	-	-	-	-	32.93
Detritus	15.67	-	0.7	0.5	19.2	4.63	0.67	41.3	-
Sand	8.09	2.5	6.9	9.2	19.2	3.7	10.11	-	9.95
Miscellaneous	10.07	0.4	1.4	2.2	-	7.41	2.8	11.4	-
Reference	This study	Kathirvel (1981)	Kathirvel & Srinivasagam (1992)	Kathirvel & Srinivasagam (1992)	Kathirvel (1981)	Mohapatra et al (2005)	Mamun et al (2008)	Prasad et al (1988)	Jayamanne et al (1992)

Conclusions. To the best of authors knowledge this study is the first study reported the feeding behavior of *S. serrata* collected from North of Sundarbans, Bangladesh. The diet items observed consisted of crustaceans (38%), bivalves (21%), gastropods (5%) and detritus (12%). It was also observed that the higher active feeding of *S. serrata* was during July until September while inactive feeding was observed during April until June. Bivalve and gastropod consumption by *S. serrata* was increased and detritus consumption was decreased in the middle of the year. Fish consumption was decreased at the end of the year. Based on the results, it is suggested that *S. serrata* showed mostly carnivore behavior rather than being herbivorous. The result from this study would aid in the better commercial production of this commercially important mud crab species by providing the information on the feeding of *S. serrata*.

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