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Biological Studies of the Mud Crab, *Scylla serrata* (Forskal) of the Sundarbans Mangrove Ecosystem in Khulna Region of Bangladesh

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Abstract: Biological studies of the mud crab, *Scylla serrata* (Forskal) collected from the Sundarbans mangrove ecosystem of Bangladesh were conducted during May, 2001 to February, 2002. The overall sex ratio of male to female was found to be 1:0.94. The sex ratio was uneven in most size groups and in most of the months. The modal class size was 81-90 mm Carapace Width (CW) in male and 71-80 mm in female. The monthly size-frequency distribution exhibited some variations. The relationship between carapace width and body weight were estimated as W = -128.25+4.06 CW, log W = -3.73+3.06 log CW or, $W = 0.0078\ CW^{3.06}$ for male and W = -89.59+2.387 CW, logW = -1.6035+1.8928 log CW or, $W = 0.005\ CW^{1.8928}$ for female. The condition factor of male crabs showed two peaks; first in 61-70 mm and second in 121-130 mm size group. In case of female it was highest in 61-70 mm size group. The relative condition factor was maximum at 125.5 mm CW and 65.5 mm CW in male and female, respectively. Gonadosomatic Index showed a single peak during May to July for female crabs.

Key words: Sex ratio, size frequency, carapace width, first maturity, condition factor, gonadosomatic index

INTRODUCTION

The mud crab, *Scylla serrata* (Forskal) occurs in the coastal waters of 15-30 ppt salinity and particularly dominates in the mangrove fauna. In Bangladesh, it is distributed widely in the tidal waters of Cox's Bazar, Chittagong, Noakhali, Barisal, Potuakhali, Satkhira and Khulna up to 40-50 backwaters and around the offshore islands particularly Moheshkhali, Kutubdia, Sandwip and Hatia[1]. It is also available in the coastal shrimp ponds. The mud crab has emerged as one of the most potential export-earning aqua-resources in Bangladesh since 1977 when export of live crab had started[2]. The export value of live mud crab had increased from 2,000US$ in 1977 to 37,80,000 US$ in 1992-93[3].

Due to high demand and good price the species has been being overfished for the last one decade[3]. At present mud crab is largely exported to Singapore, Hongkong and Malaysia. Due to its high demand in the world market in live condition; export of mud crab from Bangladesh is increasing very rapidly. However, the major part of the export is based on the harvest from the wild resources. Thus the continued pressure on the species could lead to ultimate extinction.

For proper conservation and management of mud crab, a proper knowledge on its biology is crucial. At present, there are no management policies or regulations for this species. Any management strategy would require preliminary information on the biological parameters of it. Ahmed[2], Khan and Alam[1], Azam *et al.*[3] reported some aspects of the resource, production, culture potential, bio-economics, ecology and length-weight relation of *Scylla serrata* from Bangladesh. All the reports are the reviews in nature. Bairagi[4] studied the sex ratio, length-weight relationships and condition factor of *S. serrata* from the South-Western region of Bangladesh for limited period. Information on any aspects of the fisheries biology of the mud crab is scanty in Bangladesh. With this consideration, the present study was undertaken to gather some basic information on biology of the mud crab.

MATERIALS AND METHODS

Sample collection and preservation: Samples were collected from different channels of Chalna region of the Sundarbans, Bangladesh. Crab samples were caught by using the gear locally known as 'Don', which is an angling type device.

Samples were collected monthly during May 2001 to February 2002 at high tide. All the crabs caught by one boat during the period of one high tide were taken in to analysis. The samples were carried alive in jute bags to the Laboratory of Fisheries and Marine Resource Technology Discipline of Khulna University.

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The samples were preserved in a deep freeze at -18°C prior to further analysis. Preserved samples were dissected within 24 h and the period between freezing and dissection never exceeded 4 days and generally was 2-3 days.

Analysis

Sex ratio: Sex ratio is the ratio of the males to females of a given population. It was estimated by the formula[5]:

$$SR = \frac{\text{No. of female crab}}{\text{No. of male crab}}$$

Carapace width-weight relationship: The length-weight relationship in *S. serrata* was estimated by the following relationship[6]:

$$W = aL^n \quad (I)$$

Where, a = a constant or intercept; n = an exponent or slope.

The exponential form of relationship in formula (I) can be expressed in the logarithmic from:

$$\text{Log } W = \text{Log } a + n \log \quad (II)$$

This formula has been followed in the present study. The values of 'a' and 'n' were calculated for length-weight relationship using the log-log relationship in formula (II). In the present experiment, carapace width (CW) was regarded as length (L).

Condition factor: Condition factor was estimated by using the following formula[7]

$$a = (W/L^b)*1000$$

Where:

a = condition factor,
W = body weight,
L = Carapace Width and
b = power of the length weight equation

Relative condition factor was calculated by using the following formula:

$$K_n = W / W'$$

Where:

W = Observed weight in the length weight relationship equation
W' = Calculated weight in the length weight relationship equation

Gonadosomatic Index (GSI): The Gonadosomatic Index (GSI) of female was determined by using the following formula:

$$GSI=100*GM/TM$$

Where:
GSI = Gonadosomatic index
GM = Gonad weight
TM = Body weight

RESULTS AND DISCUSSION

Sex ratio: The overall sex ratio of male to female was found to be 1:0.94 (Table 1). The highest occurrence of male was found in June while the lowest was in December. The highest number of female was found in May while the lowest in September. During September the difference in male to female ratio was the highest while in October-November it was minimum.

The highest sex ratio was found in 71-80 mm size group (Male:Female=1:2.63) while the lowest was in 91-100 mm size group (1:0.35) (Table 2).

Aktar[8] found the overall sex ratio 1: 0.81 (M: F).in the mud crab from the Sathkhira region of Bangladesh. The present study agreed with this result.

Cheewasedtham[9] stated that the information on sex ratio is important in the interpretation of the population structure and reproductive performance in crustaceans. The ratio embodies the variation in season and size.

Table 1: Monthly Variation in sex ratio of *S. serrata*

Months	Male	Female	Sex ratio
May	19	36	1:1.89
June	31	33	1:1.06
July	21	15	1:0.71
Aug.	27	16	1:0.59
Sep.	28	10	1:0.36
Oct.	22	23	1:1.05
Nov.	24	25	1:1.04
Dec.	11	17	1:1.55
Jan.	22	19	1:0.86
Feb.	19	16	1:0.84
Total (Overall)	224	210	1:0.94

Table 2: Variation in sex ratio of *S. serrata* by size group

Size-group (mm)	Male	Female	Sex ratio (SR) M:F
0-10	*	*	*
11-.20	*	*	*
21-30	*	*	*
31-40	0	6	-
41-50	4	0	-
51-60	8	0	-
61-70	21	28	1:1.33
71-80	43	113	1:2.63
81-90	65	53	1:0.82
91-100	57	10	1:0.18
101-110	18	0	1:0.00

* Not found

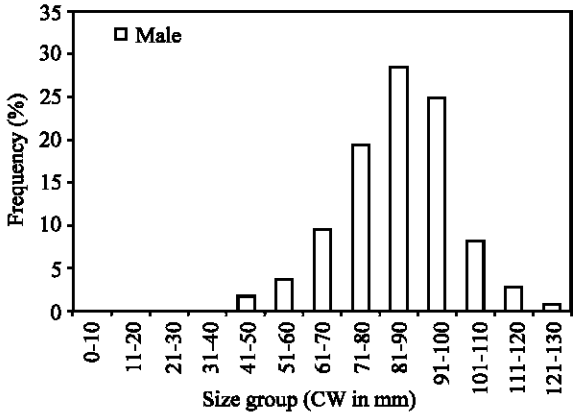

Fig. 1: Average size-frequency distribution by size group of *S. serrata* during study (Male)

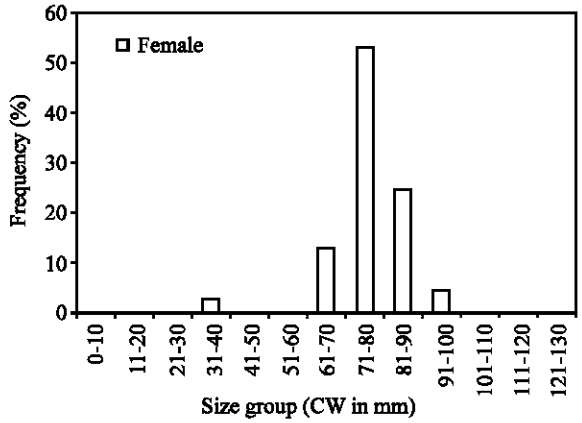

Fig. 2: Average size-frequency distribution by size group of *S. serrata* during study (Female)

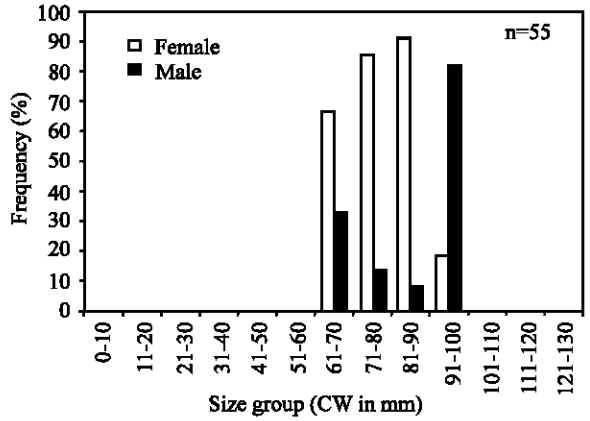

Fig. 3: Size frequency distribution of *S. serrata* (May 2001)

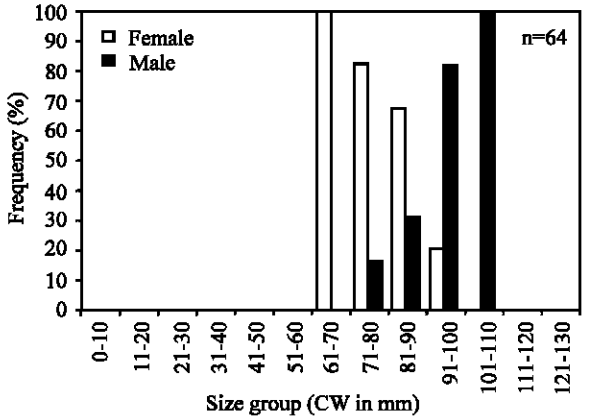

Fig. 4: Size frequency distribution of *S. serrata* (June 2001)

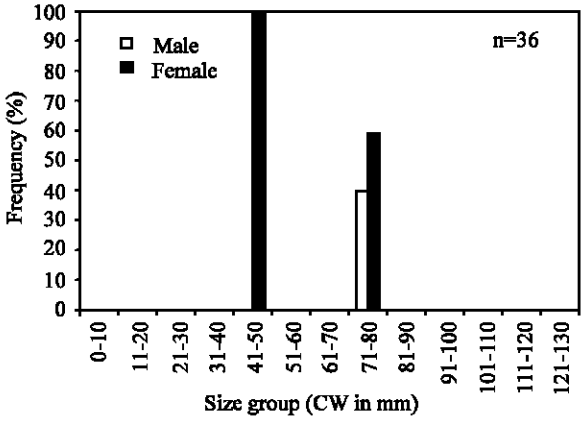

Fig. 5: Size frequency distribution of *S. serrata* (July 2001)

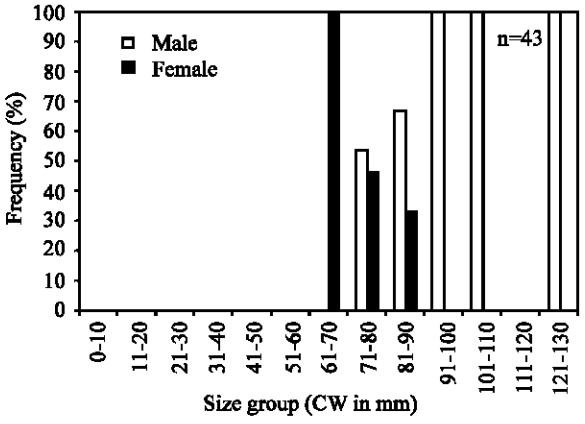

Fig. 6: Size frequency distribution of *S. serrata* (August 2001)

Quinn and Kojis[10] reported a variation in sex ratio of *S. serrata* by size and season.

Size frequency distribution: Size frequency distribution of *S. serrata* in a total is shown in Fig. 1 and 2. The monthly size frequency distribution is shown in Fig. 3-12. It shows that the male and female crabs exhibited some variation.

The maximum size of male was found in August having CW 130 mm, while the minimum size CW 47 mm.

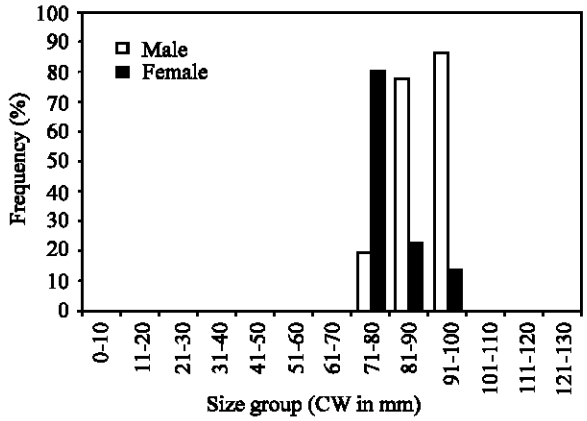

Fig. 7: Size frequency distribution of *S. serrata* (September 2001)

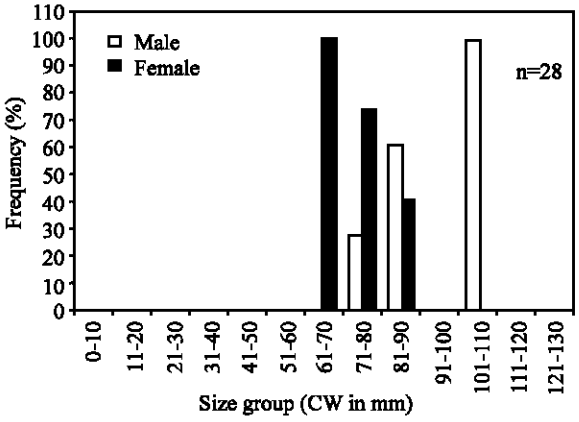

Fig. 10: Size frequency distribution of *S. serrata* (December 2001)

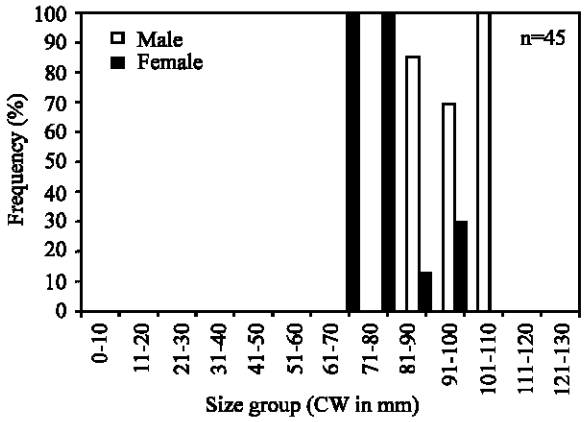

Fig. 8: Size frequency distribution of *S. serrata* (October 2001)

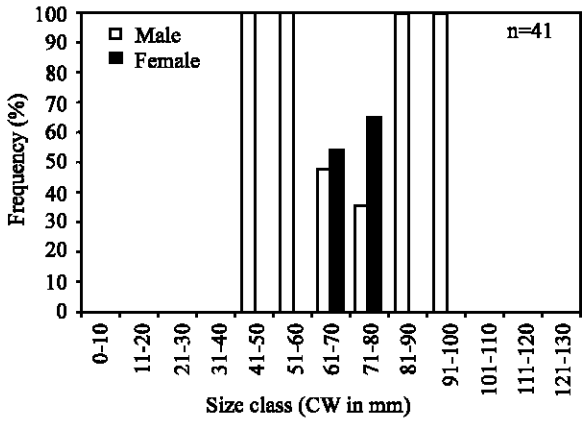

Fig. 11: Size frequency distribution of *S. serrata* (January 2002)

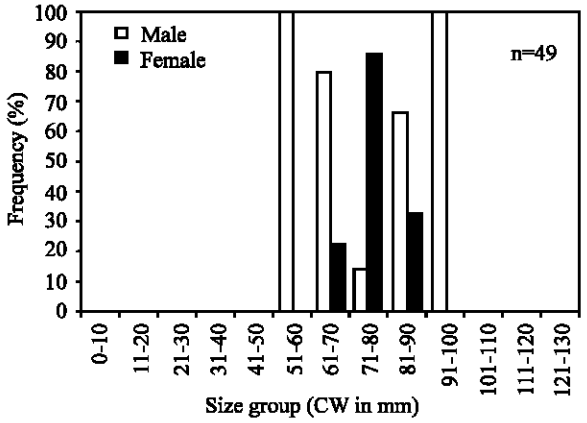

Fig. 9: Size frequency distribution of *S. serrata* (November 2001)

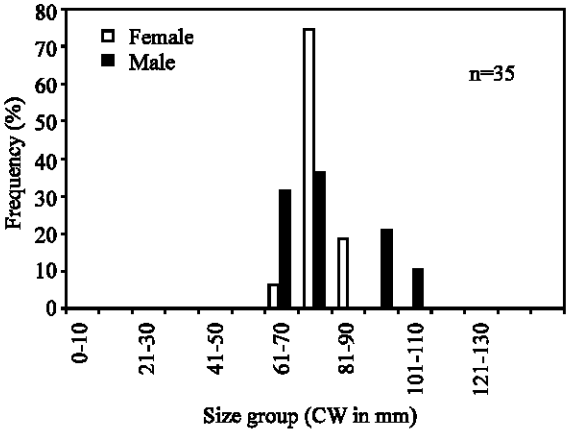

Fig. 12: Size frequency distribution of *S. serrata* (February 2002)

was found in January. The modal class size was found to be 81-90 mm CW. The size class for the male individuals varied from 51-60 to 121-130 mm CW. No male was found with carapace width less than 41 mm and greater than 130 mm. The frequency of male crabs was increased gradually from size class 41-50 up to 81-90 mm. From 81-90 mm it decreased steadily.

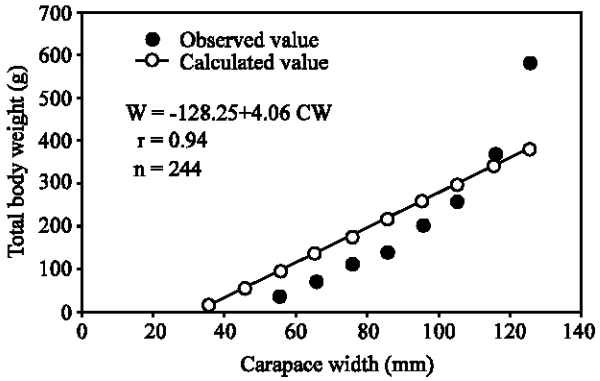

Fig. 13: The arithmetic relationship between Carapace width and weight in male of *S. serrata*

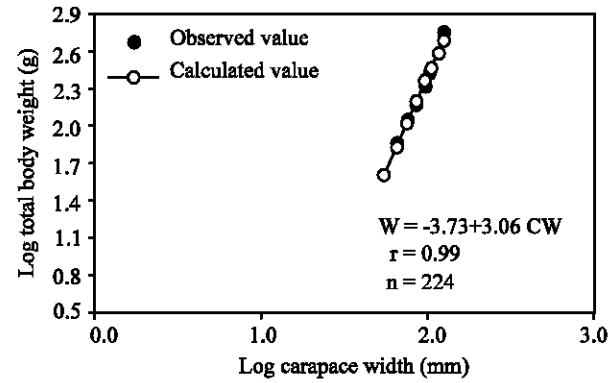

Fig. 14: The logarithmic relationship between Carapace width and weight in male of *S. serrata*

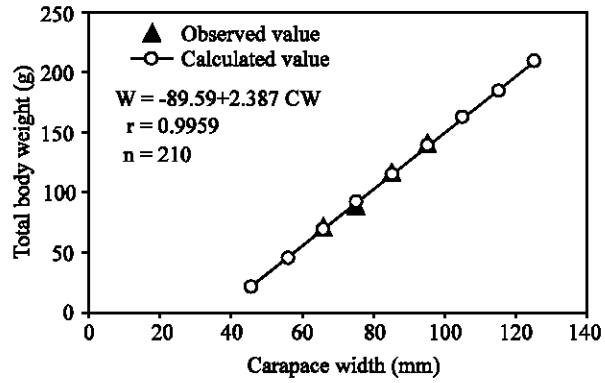

Fig. 15: The arithmetic relationship between Carapace width and weight in female of *S. serrata*

The maximum size of female was found in June having CW 100 mm, while the minimum size CW 32 mm was found in July. The maximum frequency of females was observed at 71-80 mm CW (Fig. 2). No female was found with carapace width less than 31 mm and greater than 100 mm. Above and below the size group 71-80 the frequency of female decreased gradually.

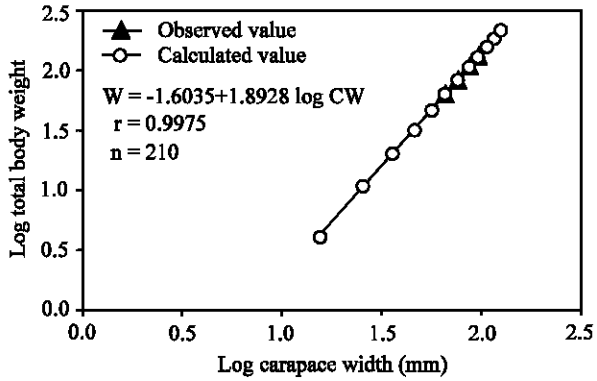

Fig. 16: The logarithmic relationship between Carapace width and weight in female of *S. serrata*

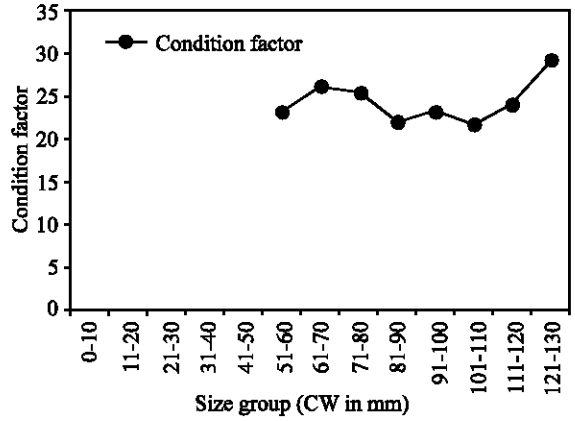

Fig. 17: Condition factor of male *S. serrata* at different size groups

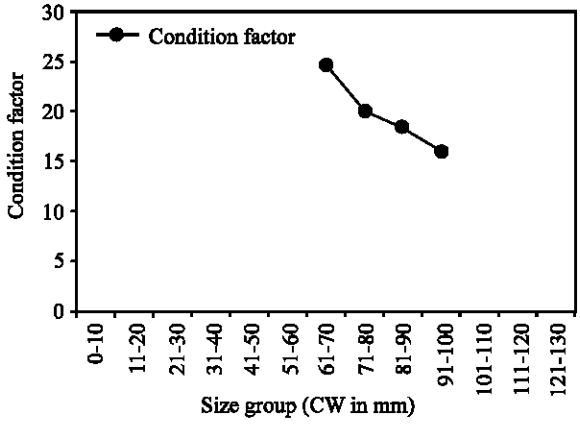

Fig. 18: Condition factor of female *S. serrata* at different size groups

Carapace width (CW)-body weight (BW) relationship: The equations for carapace width and body weight in male crabs were found as W=-128.25+4.06 CW or LogW= -3.73+3.06log CW or $W = 0.0078\ CW^{3.06}$ (Fig. 13 and 14).

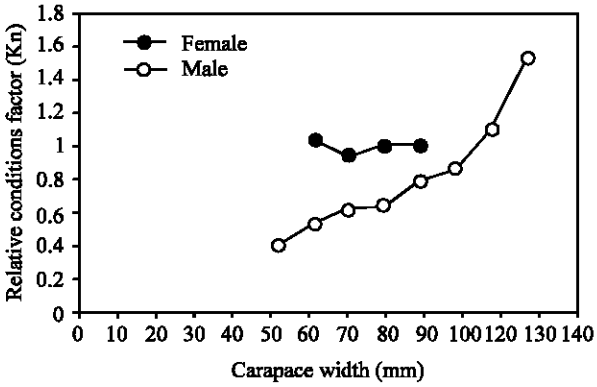

Fig. 19: Relative condition factor (Kn) of male and female of *S. serrata* in relation to carapace width

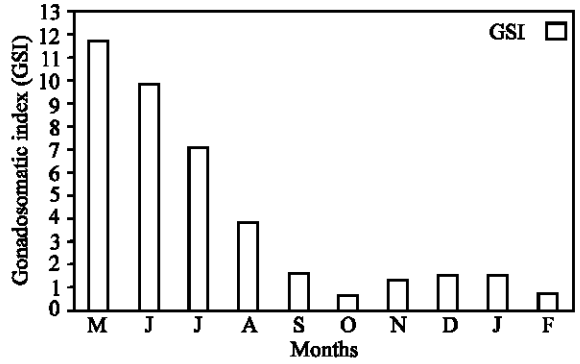

Fig. 20: Monthly variation in gonadosomatic index of female *S. Serrata*

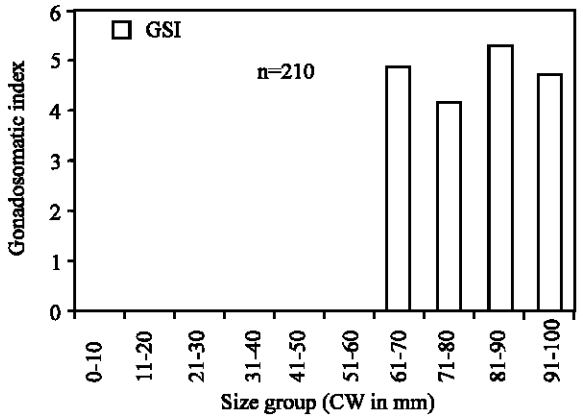

Fig. 21: Gonad indices of female *S. serrata* by size from May 2001-Feb 2002

The equations for carapace width and body weight in female crabs were found to be:

W=-89.59+2.387 CW or LogW=-1.6035+1.8928 log CW or, $W=0.005\ CW^{1.8928}$ (Fig. 15 and 16).

Cheewasedtham[9] reported that the relationship between CW (mm) and W (g) was $0.097131L^{3.369}$ and $0.559879\ L^{2.559}$ for males and females, respectively. According to Poovachiranon[11], the CW weight relationship was $0.0423L^{3.726}$ and $0.3357L^{2.726}$ for males and females, respectively from Thailand. Khan and Alam[1] estimated the relationship between CW and weight for males and females separately as well as combined. The combined relationship was reported at $0.00033L^{2.92}$ for males it was $0.00158\ L^{2.62}$ and for females it was $0.00071\ L^{2.73}$[1].

Condition factor: The condition factors of male and female *Scylla serrata* are shown in Fig. 17 and 18.

The condition factor in males was maximum at two size groups first in the 61-70 mm CW and second in 121-130 mm CW. The values of condition factor (K) were 26.35 and 29.6 for 61-70 mm and 121-130 mm size group, respectively (Fig. 17).

It was found that the condition factor was peak at 61-70 mm size group only and after it gradually decreased. The value of condition factor (K) was 24.65.The first peak of K could be the minimum length at first maturity for both the sexes.

The relative condition factor was computed sex-wise in different sizes and the results are shown in (Fig. 19). The relative condition factor was found to fluctuate at different size group in both sexes. The Kn values ranges from 0.41to1.53 and 1.03741711 to 1.00746021 in male and female, respectively.

It is found that the condition factor was peak at 125.5 mm CW and 65.5 mm CW in male and female, respectively.

Gonadosomatic index (GSI): The maximum GSI was found in May (2001) and which gradually decreased up to February (Fig. 20). The gonadosomatic indices of different size groups are shown in Fig. 21.The maximum GSI was found in 81-90 mm size group.

From the above study it may be concluded that the biology of *Scylla serrata* changes with the seasons and environments. Detailed study on the biology of mud crab is necessary in the Sundarbans mangrove ecosystem of Bangladesh to implement any conservation or management programme.

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