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Some aspects of biology of Chiti kankra, *Varuna litterata* (Fabricius, 1798) from Sundarbans, West Bengal, India

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Abstract

The length-weight relationship and condition factor of Chiti Kankra, *Varuna litterata* (Fabricius, 1798) was studied from Sundarbans part of West Bengal, India during August 2013 to September 2014. A total of 401 specimens of *V. litterata* (241 males and 160 females) were used for the study. The weight of female ranged between 2.22g to 22.53g whereas the weight of male ranged between 1.06g to 41.48g. The exponential values (b) for carapace length/width-weight relationship of male were 3.1367 and 3.2187 respectively which suggests positive allometric growth. But in females carapace length-weight relationship showed negative allometric growth (b=2.8058) and carapace width-weight relationship showed positive allometric growth (b=3.0450). The present study showed that the value of condition factor (K) of the studied male crab was 1.21, female 1.19 and for combined sexes 1.20. The sex ratio was 1 female: 1.50 male. The present study reveals that there was a strong co-relation between various morphometric characters viz. carapace length/width, abdomen length/width, chelar propodus length/height and weight.

Keywords: Biology, Chiti Kankra, *Varuna litterata*, Sundarbans

1. Introduction

In population studies, morphometric analysis provides a powerful complement to genetic and environmental stock identification approaches [1] and length-weight relationships as well as the condition factors are considered to be useful parameters for assessing the well-being of the individuals and for determining possible differences among different stocks of the same species [2]. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition [3]. In crustaceans, as growth progresses, certain dimensions of the animal's body may grow much more than others, resulting in the phenomenon known as relative growth [4]. Work on different biological and ecological aspects of different crabs were done by various workers [5-10] but no such has been done on *Varuna litterata*. The herring bow crab, *V. litterata* is very common in low saline water of Sundarbans and popularly known as chiti kankra. They are usually inhabit in the mangroves, estuarine and freshwater environments, in shallow sub tidal regions and usually found under rocks, logs and dead leaves and lives in burrows along the embankments of ponds, creeks and shallow banks [11]. With its legs shaped as paddles used for swimming, it is sometimes called the paddler crab or ocean paddler crab. It has been recorded as commercially important species in India especially in Bengal, where it is eaten by poor people, and its numbers compensate for its small size. Regarding the size and weight range of this crab no specific data available and also morphometrics study as well as condition factors were not done by any workers on *V. litterata*. The main objective of the current study was to assess the size and weight range of the crab and make a proper relationship between some body dimensions and weight of *V. litterata* at Sundarbans, West Bengal. Additionally, the variations in the condition factor (K = carapace length/weight) was analysed sex wise as well as for combined sexes.

2. Materials and Methods

i) Study area: Sundarbans Biosphere is the largest protruding delta on this planet covering about one million ha in the delta of the rivers Ganga, Brahmaputra and Meghna is shared between Bangladesh (~60 %) and India (~40 %). In the present study we have been working with the Indian Sundarbans (Latitude 21° 32'-22° 40' N, Longitude 88° 22'-89° 0' E).

Sundarbans occupy the north east coast of India (9630 square kilometre area) and are bounded by River Hooghly in the West, River Raimangal in the East, Bay of Bengal in the

South and Dampier Hodges line in the North. The place located map is cited below (Fig. 1).

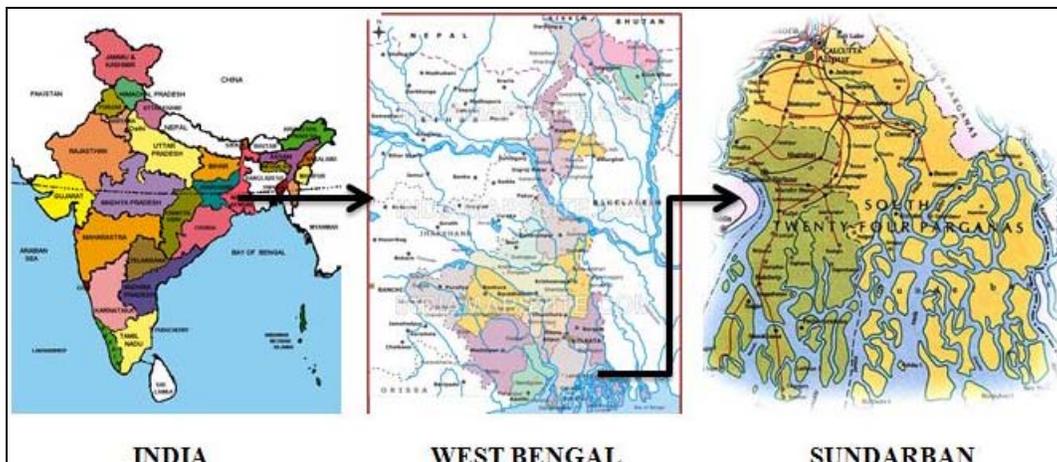


Fig 1: Image showing the actual position of the Sundarbans in India

ii) **Specimen collection:** A total of 401 specimens of *V. litterata* (241 males and 160 females) were collected from Indian Sundarbans throughout the August 2013 to September 2014. The crabs were washed thoroughly to remove all mud,

sand and epizoic forms and were preserved in 4% formalin. The dorsal and ventral views of the male and female crab are shown hereby (Fig. 2).



Fig 2: The identical dorsal and ventral views of male and female *Varuna litterata* (Fabricius, 1798)

iii) **Measurement:** The specimen weighted to the nearest g by using an electrical balance. The measurements used for morphometric studies in *V. litterata* are taken by using an accurate scale to the nearest mm (Fig. 3)

Parts	Male	Female
Carapace		
Abdomen		
Chelar Propodus		

CL- Carapace length; CW- Carapace width; AbL- Abdominal length; AbW- Abdominal width; ChL- Chelar Propodus Length; ChH- Chelar Propodus Height

Fig 3: The measurements used for morphometric studies in *Varuna litterata* (Fabricius, 1798)

iv) **Methodology:** The L-W data were analysed according to the method mentioned by Le Cren [12]. The equation of the parabolic relationship of the form $W = aL^b$ was used where W represents weight of the fish in gram; L being the total length in millimetre; 'a' the constant and 'b' an exponent to which L can be raised. The equation was calculated for male, female and combined sex sample and a linear relationship between the logarithm length, width and logarithm weight was found from the examination of scatter diagram. Condition Factor was calculated by using the following formula $K=100W/L^3$, where 'W' denotes weight of the crab in g and 'L' denotes the carapace length of the crab in mm.

v) **Statistical analysis:** The variation between the regression coefficients (b) in male and female crab was calculated using ANOVA (Analysis of covariance). The coefficient of correlation and the regression line was calculated and drawn from the formula given by Spiegel [13]. All data were analysed by using internationally reputed Software Statistical Package for Social Sciences (SPSS-16.0) and MS Excel.

3. Results

It was observed from the above study, that the female possess a broader abdomen than that of the male. The descriptive statistics i.e. minimum, maximum and mean results for widths (mm), lengths (mm), weights (g) and standard deviation (\pm SD) of carapace, abdomen and chelar propodous used in the

analysis of length/width and weight relationships are given (Table: 1). The weight of female ranged between 2.22g to 22.53g whereas the weight of male ranged between 1.06g to 41.48g. It is observed that male crabs are heavy than the female and it found in wider range.

Table 1: Length weight characteristics of carapace of categories Male, Female, and Combined of *Varuna litterata*

	WT	CW	CL	AbW	AbL	ChL	ChH
Female							
MAX	22.53	47	44	30	36	42	19
MIN	2.22	24	20	14	15	5	3
AVG	7.0578	33.0925	30.1172	20.9012	23.6604	15.7716	6.9876
STDEV	3.5418	4.7658	4.5802	3.4912	3.6677	6.4793	2.0240
Male							
MAX	41.48	54	50	18	37	42	23
MIN	1.06	16	14	3	6	6	3
AVG	7.2437	32.0946	28.9794	8.2386	18.4691	17.2921	9.0370
STDEV	5.9933	5.9574	5.5386	2.1068	3.8207	6.1092	4.0067
Combined							
MAX	41.48	54	50	30	37	42	23
MIN	1.06	16	14	3	6	5	3
AVG	7.2395	32.4789	29.4218	13.2903	20.5210	16.6476	8.2034
STDEV	5.1553	5.5280	5.2016	6.7800	4.5319	6.2982	3.5010

[Legends: WT = Total body weight; CW = Carapace width; CL = Carapace length; Ab W = Abdominal width; Ab L = Abdominal length; Ch L = Chelar propodus length; Ch H = Chelar propodus height.]

The Correlation coefficient r^2 was used as an indicator of the quality of the linear regressions [14]. It was observed that a high degree of correlation between r and r^2 parameters (Table: 2-4). The result justified the fact that there was a strong significant relationship between length and weight of *V. litterata*. In the present study higher regression coefficient ($b > 3$) were recorded for both the sexes and combined sex and it was an indication of positive allometric growth. The exponential values (b) for carapace length/width-weight

relationship of male which were 3.1367 and 3.2187 respectively showed that is positive allometric growth and there is marked deviation from the isometric growth pattern. But in females carapace length-weight relationship showed negative allometric growth and carapace width-weight relationship showed positive allometric growth. Length-width relationship between chelar propodous and abdomen showed negative allometric growth.

Table 2: Relationship between carapace length, width and weight of *Varuna litterata*

Variation	Sex	Equation	Regression statistics	
			R	R ²
Carapace length/weight	Male	Log W = - 3.7947 + 3.1367 L	0.9477	0.8981
	Female	Log W = - 3.3341 + 2.8058 L	0.9127	0.8330
	Combined	Log W = - 3.6255 + 3.0136 L	0.9418	0.8871
Carapace width/weight	Male	Log W = - 4.0581 + 3.2187 L	0.9463	0.8955
	Female	Log W = - 3.8126 + 3.0450 L	0.9326	0.8697
	Combined	Log W = - 3.9692 + 3.1549 L	0.9358	0.8758
Carapace width/ carapace length	Male	Log W = -0.0404 + 0.9970 L	0.9702	0.9414
	Female	Log W = 0.1918 + 0.8978 L	0.9536	0.9094
	Combined	Log W = -0.0497 + 1.0042 L	0.9654	0.9320

Table 3: Relationship between abdominal length, width and weight of *Varuna litterata*

Variation	Sex	Equation	Regression statistics	
			R	R ²
Abdomen length/weight	Male	Log W = -2.3460 + 2.4767 L	0.8371	0.7008
	Female	Log W = -2.8943 + 2.6999 L	0.9005	0.8110
	Combined	Log W = -1.6120 + 1.8383 L	0.7449	0.5549
Abdomen width/weight	Male	Log W = -0.6968 + 1.6251 L 1.625162073	0.6907	0.4771
	Female	Log W = -2.6112 + 2.5965 L	0.9282	0.8617
	Combined	Log W = 0.3391 + 0.4139 L	0.3859	0.1489
Abdomen width/ Abdomen length	Male	Log W = 0.6991 + 0.6191 L	0.7786	0.6062
	Female	Log W = 0.2375 + 0.8606 L	0.9225	0.8510
	Combined	Log W = 0.9324 + 0.3462 L	0.7965	0.6344

Table 4: Relationship between chelar propodous length, width and carapace length, width of *Varuna litterata*

Variation	Sex	Equation	Regression statistics	
			R	R ²
Chelar propodous length/width	Male	$\text{Log W} = -0.4121 + 1.0972 \text{ L}$	0.8856	0.7844
	Female	$\text{Log W} = 0.3653 + 0.3939 \text{ L}$	0.5049	0.2549
	Combined	$\text{Log W} = -0.0888 + 0.8123 \text{ L}$	0.7437	0.5531
Carapace length/Chelar propodous length	Male	$\text{Log W} = -0.9210 + 1.4679 \text{ L}$ 1.625162073	0.8608	0.7410
	Female	$\text{Log W} = -0.7592 + 1.3068 \text{ L}$	0.5674	0.3220
	Combined	$\text{Log W} = -0.7884 + 1.3566 \text{ L}$	0.7064	0.4990
Carapace length/Chelar propodous height	Male	$\text{Log W} = -1.7400 + 1.8288 \text{ L}$	0.8657	0.7494
	Female	$\text{Log W} = -1.1762 + 1.3580 \text{ L}$	0.7557	0.5712
	Combined	$\text{Log W} = -1.4256 + 1.5782 \text{ L}$	0.7524	0.5662
Carapace width/ Chelar propodous length	Male	$\text{Log W} = -1.0417 + 1.5045 \text{ L}$	0.8585	0.7371
	Female	$\text{Log W} = -0.9369 + 1.3884 \text{ L}$	0.5676	0.3222
	Combined	$\text{Log W} = -0.9403 + 1.4183 \text{ L}$	0.7100	0.5041
Carapace width/ Chelar propodous height	Male	$\text{Log W} = -1.9119 + 1.8888 \text{ L}$	0.8700	0.7570
	Female	$\text{Log W} = -1.4203 + 1.4820 \text{ L}$	0.7766	0.6031
	Combined	$\text{Log W} = -1.6448 + 1.6783 \text{ L}$	0.7692	0.5918

Scatter diagrams each for carapace length/width, abdominal length/width and chelar propodus length/height in respect to *V. litterata* was obtained of male, female and combined crabs (Fig. 4-7). From the closeness of the scatter diagram and from

the parabolic nature of the plot, it was clear that there is a good relationship between every variables of the crab and also the suitability of fitting the exponential formula, $W=aL^b$ to the data.

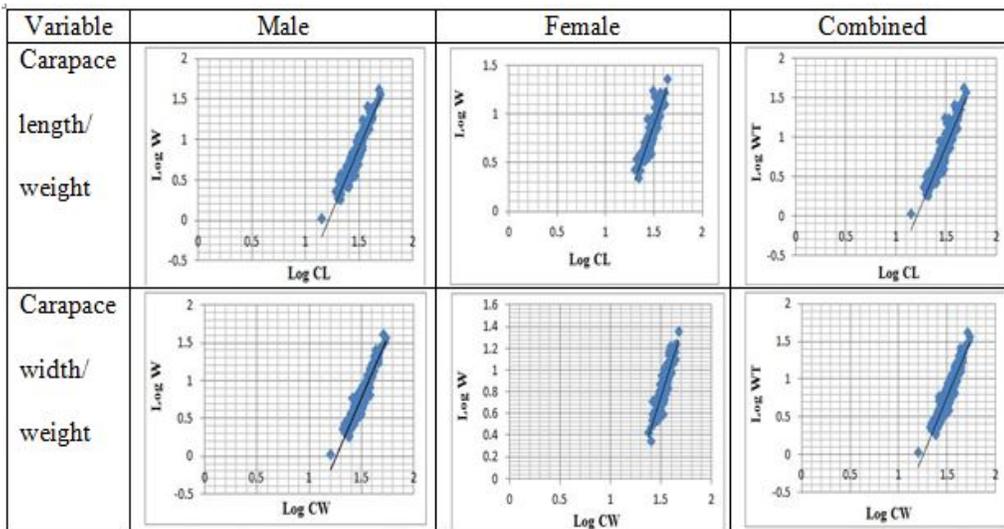


Fig 4: Logarithmic relationships between carapace length/width–weight of *Varuna litterata*

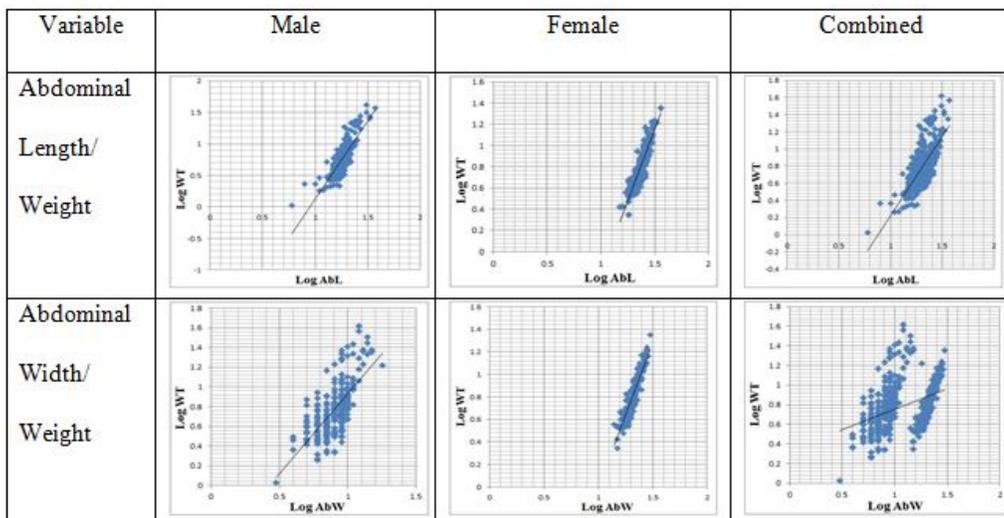


Fig 5: Logarithmic relationship between abdominal length/width–weight of *Varuna litterata*

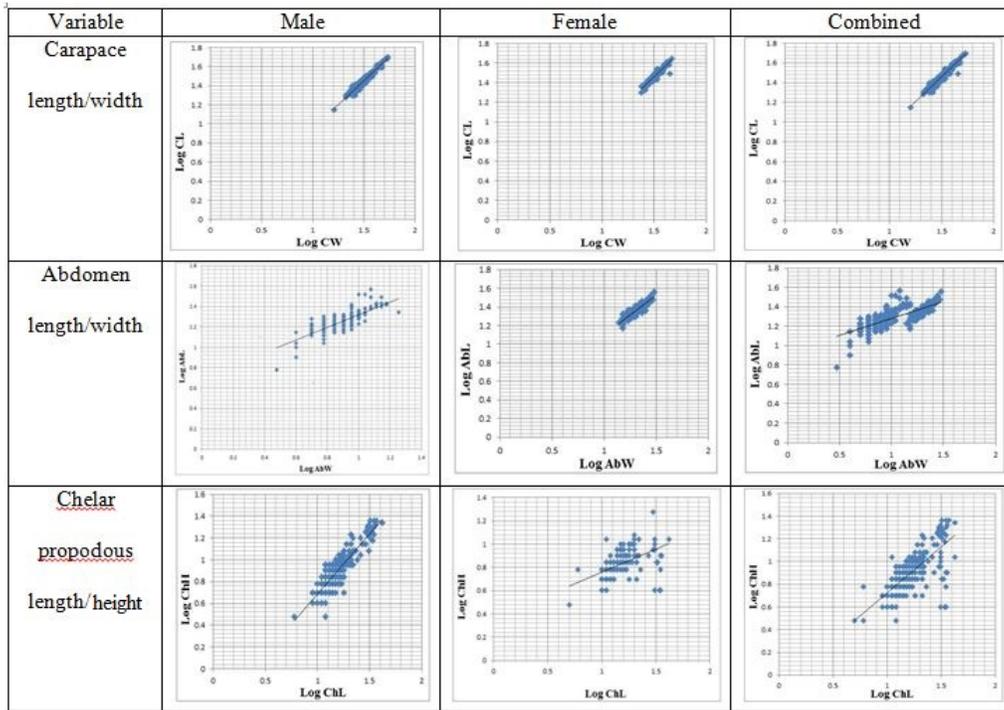


Fig 6: Logarithmic relationship between length/width relationship of abdomen, carapace and chelar propodous of *Varuna litterata*

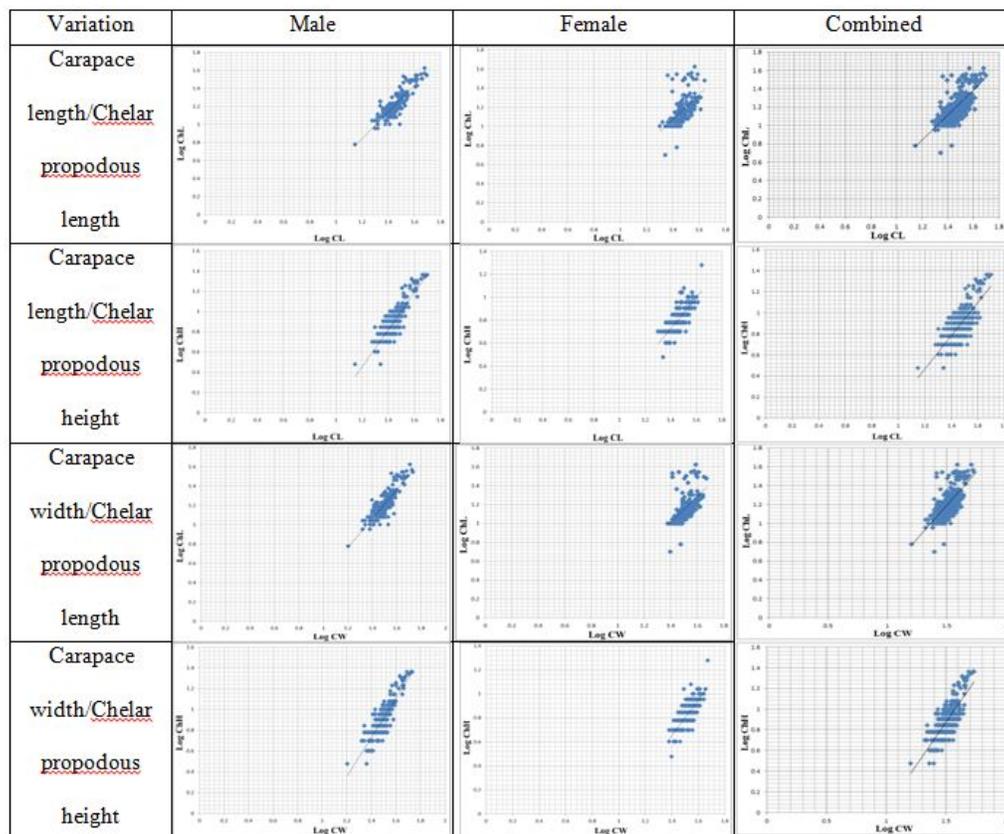


Fig 7: Logarithmic relationship between length/width relationship between carapace and chelar propodous of *Varuna litterata*

The variation of condition factor reflects information on the physiological state of the fish. The mean K value was calculated of male, female and combined sex for carapace length/weight (Table: 5). The condition factor indicates the good physiological condition like well growth, good L-W relationship of the crab. It was observed that the mean K value of male crabs were little better than female crabs.

Table 5: K value for carapace length/weight of *Varuna litterata*

Variation	Sex	K value
Carapace length-weight	Male	1.21
	Female	1.19
	Combined sex	1.20

4. Discussion

In studying spiny crab species, such as the herring bow crab, measuring the length of the crabs is often somewhat difficult, and during attempts to measure them, sometimes the extremities of the crab can be broken. It is therefore convenient to be able to convert into length (width) when only the weight is known or length-weight regression may be extensively used to estimate length from weight. An overview of literature reveals that the length–weight relationship of crab differs from one species to another in a particular population. Several biological factors like sex, size, physiological condition, seasons, food intensity, gonadal maturity and fatness have significant influence over length-weight relationship on crab [15]. In this study maximum 54mm carapace width and 50mm carapace length are observed in *V. litterata*. Males presented a higher regression coefficient than females, similar to other brachyuran crabs [16, 17]. The study on the sex ratio showed 1 female: 1.50 male. From the present study it is observed that the allometric relationship between the set of characters studied which is consistent with general scaling trends with body size of animal [18]. Like brachyuran crabs *V. Litterata* males are larger and heavier than females [19]. In most cases the relationship was positive and highly significant which indicates the good ecological condition of the crab in the Sundarbans Mangrove area. The condition factor of the studied male crab was 1.21, female 1.19 and for combined sexes 1.20 revealed that the good physiological condition of the crabs and male grow better than female [20]. From the data presented, a distinct relationship was found between length, width and total weight, as judged from the closeness of the scatter dots, as well as from the parabolic nature of the plot.

5. Conclusion

The result of the study will be useful to the researchers and policy planners. The condition factor of the fish proved that the physiological condition of the crabs of Sundarban area were quite good. The present study also helpful for the fishery managers to implement adequate adaptation-centric regulation for sustainable fisheries management of *V. litterata*.

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