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Research Article

A Study and Availability Assessment of Freshwater Crabs in the Hill Streams of Bangladesh

Abstract

A study of crabs was conducted at eight hill streams, located in three different districts of Bangladesh, during January to December, 2012 with a view to assess the availability and to study the taxonomy of freshwater crabs. The study investigated species diversity which includes their taxonomic description, biometric data, habitat, ecological note, distribution, and ecological role. The specimens were collected in different times covering the major seasons rounded the year by using various fishing gears such as cast net, push net, dip net, seine net and trap. A total four species of freshwater crabs under two families (Potamidae and Grapsidae) were recorded. The identified four crabs were *Sartoriana spinigera*, *Sartoriana trilobata*, *Labothenphusa wood-masoni* and *Pyxidognathus fluviatilis*. Among these the first three were under the family Potamidae and the last one under the family Grapsidae. *Sartoriana trilobata* was the dominant species in the hill streams of Bangladesh.

Introduction

Bangladesh is a country which is mostly low in elevation and the hill areas occur in the Khagrachari, Rangamati, Bandarban, Chittagong, Cox's Bazar, Mymensingh, Netrokona, Sylhet, Moulavibazar and Habiganj districts. These regions include a remarkable area of hilly rivers, lakes and streams and waterfalls that are identified to be an excellent playground of biodiversity. Various small and moderately large streams have been found all over the country which are very rich of ecologically important species. So streams of hilly areas are predicted to be the biodiversity hot spots in the country containing a high diversity of crab species that have yet to discover.

Freshwater crabs are found throughout the tropical and sub-tropical regions of the world. They live in a wide range of water bodies, from fast-flowing rivers to swamps, as well as in tree boles or caves. The majority of species are narrow endemics, occurring in only a small geographical area. This is at least partly attributable to their poor dispersal abilities and low fecundity [1] and to habitat fragmentation caused by the world's human population [2]. Freshwater crabs of Bangladesh can distinguished from false crabs by not having 5th pair of pereopods totally or partly having concealed beneath the carapace, the antennae were always placed between the inner margin of orbit and fused pterygostomial region with endostome [3]. In most decapods, the gonopores (sexual openings) are found on the legs. However, since crabs use the first two pairs of pleopods (abdominal appendages) for sperm transfer, this arrangement has changed. As the male abdomen evolved into a narrower shape, the gonopores have moved towards the midline, away from the legs, and onto the sternum [4]. The hilly crab faunas of Bangladesh have never been broadly surveyed by researchers. It is necessary to know the biodiversity of freshwater crabs in hilly region of Bangladesh for conservation purpose. So the present study was focused to identify crab species in the selected waterfalls, rivers and

streams in the hilly areas as well as to assess the status and diversity of crabs in relation to their habitats.

Materials and Methods

Study sites and period

The research was conducted in eight selected sites of three hilly districts of Bangladesh such as Sangu River in Bandarban, Shailopropat Waterfall in Bandarban, Rijuk Waterfall in Bandarban, Boga Lake in Bandarban, Himchori in Cox's Bazar, Barachara in Cox's Bazar, Kudung Cave in Cox's Bazar and Madhobkunda Waterfall in Moulvibazar (Figure 1). The study was conducted from January 2012 to December 2012 followed by the various seasons of Bangladesh with four times of Crabs collection.

Collection and preservation of specimens

Crab specimens were collected by the help of cast net (Khepla Jal), seine net, push net, dip net, and trap from above mentioned areas. After collecting the crabs, photographs were taken immediately and preserved in the plastic container with 4% alcohol. The specimens were finally preserved in 5-10% formalin in plastic container. About 100 specimens were collected from all the areas and 30 matured or adult specimens were chosen for morphometric and meristic study.

Crabs identification

All the specimens were measured carefully at the Laboratory and also were identified by using the crab identifying keys [5,6], the guidelines and descriptions [7,8], were also used for crab identification.

Measurement

All morphometric measurements were taken by using scale, tape and 'Vernier Slide Calipers'. The color and presence or absence of setae noted in live condition. Body length, width, depth were measured by



Figure 1: Map showing the geographic location of three sampling hill stream districts of Bangladesh (Bandarban, Cox's Bazar and Moulvibazar).



Figure 4 : *Sartoriana spinigera*.



Figure 5 : *Sartoriana trilobata*.

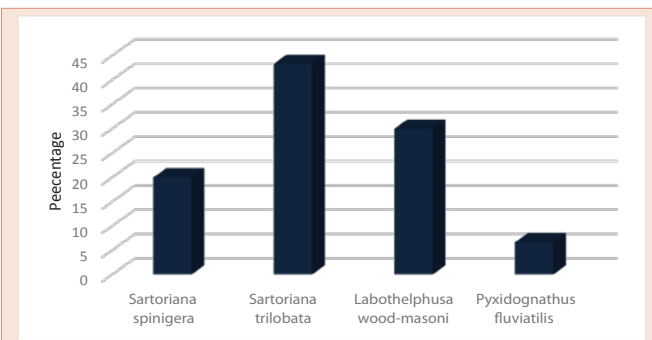


Figure 2 : Diagram showing the percentage of four different crabs found in hill stream of Bangladesh.



Figure 6 : *Pyxidognathus fluviatilis*.



Figure 3 : *Labothenphusa wood-masoni*.

slide calipers and scale. The units of the measurement were taken in cm. The selected morphometric or morphological characteristics for identifications of specimens were taken from the fresh and preserved specimens.

Statistical analysis

To estimate the mean value and standard deviation as well as to determine the correlation among carapace length (CL), carapace width (CW), data were subsequently analyzed. Correlation was calculated by using Pearson correlation equation

$$r = \frac{1}{n-1} \sum \left[\frac{(x_i - \bar{X})}{s_x} \times \frac{(y_i - \bar{Y})}{s_y} \right]$$

Where Carapace length X represents the values of independent variable and Carapace width Y represents the values of dependent variables. \bar{X} And \bar{Y} denotes the average values.

The value of r ranges between +1 and -1:

- $r > 0$ indicates a positive relationship of X and Y : as one gets larger, the other gets larger.
- $r < 0$ indicates a negative relationship: as one gets larger, the other gets smaller.
- $r = 0$ indicates no relationship

However if two variables are positively associated, then positive values of $(x_i - \bar{X})$ will match up with positive values $(y_i - \bar{Y})$, and negative values with negative values. The sum of $(x_i - \bar{X})(y_i - \bar{Y})$ will produce a positive r . In a negative relationship, positive values of $(x_i - \bar{X})$ will match up with negative values of $(y_i - \bar{Y})$, and vice versa. Then the sum of $(x_i - \bar{X})(y_i - \bar{Y})$, and r , will be negative. If we calculate the Pearson correlation of X with itself, the result will be 1.

If there is no association between X and Y , there will be no systematic relationship between $(x_i - \bar{X})$ and $(y_i - \bar{Y})$. Therefore

the positive values of one will match up with positive and negative values of the other randomly, and the same with negative values of the first variable. Therefore when we take the sum of $(x_i - \bar{X})(y_i - \bar{Y})$, all these positive and negative results will tend to cancel each other out, making r close to 0.

Results and Discussion

The present study recorded total 4 species of crabs from the studied hill streams area. They are *Sartoriana spinigera* (Wood-Mason, 1871), *Sartoriana trilobata* (Alcock, 1909), *Labothenphusa wood-masoni* (Rathbun, 1905) and *Pyxidognathus fluviatilis* (Alcock, 1900). The *S. spinigera*, *S. trilobata* and *Labothenphusa wood-masoni* belongs to the family Potamidae and *P. fluviatilis* is under the family Grapsidae.

The greatest percentage of crabs found in hill streams was *Sartoriana trilobata* and which was 43.33% and dominant species in the hill streams of Bangladesh. The lowest abundance recorded was 6.67% for *Pyxidognathus fluviatilis* of the total specimens. Also the figure shows that *Labothenphusa wood-masoni* was 30% and *Sartoriana spinigera* was 20% of the studied specimens. (Figure 2).

S. spinigera (Figure 4), and *S. trilobata* (Figure 5), are closely related species under same genus. There are some dissimilarities present in their morphology; *S. trilobata* is more robust than

Table 1: Observation of crabs in different hilly areas of Bangladesh.

Family	Species	Place of occurrence							
		Bandarban				Cox's Bazar			Moulavibazar
		Sangu River	Shailopropat waterfall	Rijuk Waterfall	Boga Lake	Himchori	Barachara	Kudung Cave	Madhabkunda Waterfall
Potamidae	<i>Sartoriana spinigera</i>	-	-	-	-	+	-	+	-
	<i>Sartoriana trilobata</i>	-	-	-	+	+	+	-	+
	<i>Labothenphusa wood-masoni</i>	-	+	-	-	+	+	-	+
Grapsidae	<i>Pyxidognathus fluviatilis</i>	+	-	+	-	-	-	-	-

“+” is denoted for the status found. “-” is denoted for the status not found

Table 2: Habitat diversity of the selected study sites of hill streams.

Sampling site	GPS coordinates and elevation	Habitat
Sangu River	12°10'58.00"N, 92°13'54.00"E Elevation: 56 ft.	Silted with sand and pebbles. Turbid flowing water.
Shailopropat Waterfall	22°09'05.34"N, 92°12'59.00"E. Elevation: 303 ft.	Rocky with boulders in clear cold running water.
Rijuk Waterfall	22°00'53.85"N, 92°24'07.42"E. Elevation: 127 ft.	Rocky with Boulders, cobbles and sand in clear cold water pool under a large fall.
Boga Lake	21°58'49"N, 92°28'11"E. Elevation: 1216 ft.	Rock stone in clear cold water.
Himchori	21°21'18.36"N, 92°01'31.68"E Elevation: 93 ft.	Cobble and gravelly bottom in a clear cold water small pool at the base of a waterfall.
Barachara hill stream	21°23'45.82"N, 92°00'02.39" E Elevation: 32 ft.	Sandy-clay with cobbles in a muddy water stream.
Kudung Cave	21°05'31.8"N, 92°10'10.08"E. Elevation: 70 ft.	Rocky hill forms a cave pool with sandy-clay bottom.
Madhabkunda Waterfall	24°33'17.00"N, 92°13'26.40"E Elevation: 265 ft.	Rocky with Boulders, cobbles and sand in clear cold water pool under a large fall.

Sartoriana spinigera and carapace of *S. spinigera* having only one antero-lateral spine which is absent in *S. trilobata*. *Labothenphusa wood-masoni* (Figure 3), differs from congeners by a combination of following characters: having 4 spines on antero-lateral side, cheliped equal in both sexes. *Pyxidognathus fluviatilis* (Figure 6), is clearly remarked by having some characteristics: antero-lateral margin having two spines (3 when eye groove consider as spine), upper and lower margin of propodus and dactylus having setae. They are found in freshwater ecosystem of Rujuk Waterfall and Sangu River.

The habitat of the crabs in the study sides are greatly varied from transparent clear water to turbid flowing water. The water qualities were measured and it was fine according to the accepted standard. The basic water qualities of seven sites such water temperature 20-28°C, pH was 6.5-6.7, Total dissolved solids (TDS) was 225-227 (µs) and dissolved oxygen (DO) 10-12.4 mg/L. Water was slightly turbid and acidic and pH near 4 at the Kudung cave. In winter clear water flows and in rainy season turbid water flows in Sangu River. Rock stones dominated the core gene of the soil at Boga Lake which is composed of small and hard rocks. The water color of this lake is blue-green and it is important habitat of freshwater organisms. The streams of Barachara were mostly shallow but deep in some areas and the water was crystal clear (Tables 1,2).

Biometrical study such as Carapace length and Width, Abdominal length, Telson length, Merus length, Carpal length and Palm length of 4 studied crabs were measured (Tables 3-6). Correlation of Carapace length and Carapace width were measured. The value of correlation coefficient (r) is 0.848 for *Sartoriana spinigera*, 0.996 for *Sartoriana trilobata*, 0.989 for *Labothenphusa wood-masoni* and 1.00 for *Pyxidognathus fluviatilis* which implies that there is a strong positive linear association between the variables, carapace length

Table 3: Biometric measurements of *Sartoriana spinigera*.

Measurement	Min. (cm)	Max. (cm)	Mean (cm)	Std. deviation
Carapace length	1.89	2.40	2.08	0.2
Carapace width	2.50	3.28	2.77	0.29
Abdominal length	1.25	1.75	1.48	0.17
Telson length	0.30	0.50	0.4	0.09
Merus length	0.93	1.27	1.14	0.12
Carpal length	0.60	1.00	0.78	0.16
Palm length	1.50	2.26	1.89	0.26

Table 4: Biometric measurements of *Sartoriana trilobata*

Measurement	Min.(cm)	Max.(cm)	Mean (cm)	Std. deviation
Carapace length	0.93	3.82	2.42	0.84
Carapace width	1.14	4.88	3.1	1.083
Abdominal length	0.68	2.89	1.75	0.66
Telson length	0.23	0.85	0.52	0.17
Merus length	0.48	2.32	1.26	0.51
Carpal length	0.41	1.89	1.03	0.41
Palm length	0.85	3.90	2.26	0.87

Table 5: Biometric measurements of *Labothenphusa wood-masoni*.

Measurement	Min.(cm)	Max.(cm)	Mean(cm)	Std. deviation
Carapace length	1.30	3.00	2.33	0.46
Carapace width	1.55	3.55	2.89	0.56
Abdominal length	0.84	2.50	1.82	0.48
Telson length	0.36	1.15	0.54	0.24
Merus length	0.55	1.13	0.97	0.17
Carpal length	0.21	.96	.79	0.23
Palm length	0.61	2.85	2.15	0.67

Table 6: Biometric measurements of *Pyxidognathus fluviatilis*.

Measurement	Min.(cm)	Max.(cm)	Mean(cm)	Std. deviation
Carapace length	1.90	2.10	2.00	0.14
Carapace width	2.60	2.90	2.75	0.21
Abdominal length	1.50	1.60	1.55	0.07
Telson length	0.25	0.30	0.28	0.04
Merus length	1.15	1.20	1.18	0.04
Carpal length	0.50	0.60	0.55	0.07
Palm length	1.20	1.30	1.25	0.07

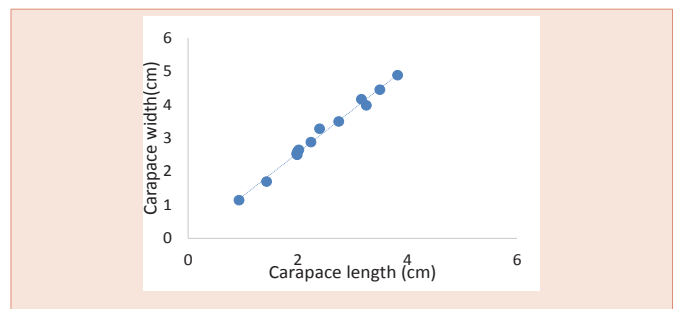


Figure 7: *Sartoriana trilobata*.

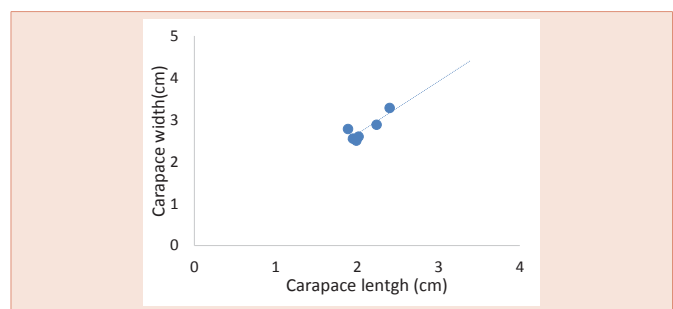


Figure 8: *Sartoriana spinigera*.

and carapace width (Figures 7-10). Correlation is significant at the 0.05 level (2-tailed) for *S.spinigera* while 0.01 level (2-tailed) for *S. trilobata*, *Labothenphusa wood-masoni* and *Pyxidognathus fluviatilis*.

Conclusion

There was no sufficient previous information of crabs in hill streams and thus the comparison of the present findings with

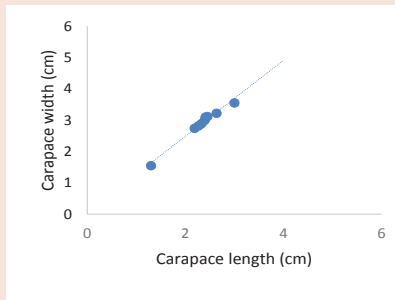


Figure 9: *Labothenphusa wood-masoni*.

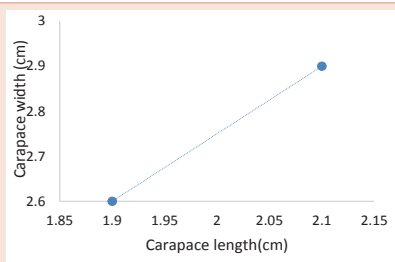


Figure 10: *Pyxidognathus fluviatili*.

previous one was not possible. Total 4 species of crabs were found in this study. Among the 4 species, *Sartoriana trilobata* (Alcock, 1909) is an IUCN [9] red listed species and this species is under data deficiency conservation rank. Moreover the present study mainly focused on morphological characteristics and habitats of crab species. The hill streams of Bangladesh are regarded as hot spot of biodiversity

and Crabs have enhanced this biodiversity. Moreover, tribal people of Bangladesh depend on crabs for food. The present study signals that the hilly area contains a rich biodiversity which are usually less known than other parts of the country and it strongly suggests the further extensive survey of all hilly districts of Bangladesh by long term basis.

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