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Morphometrics, length-weight relationship and ecological factors affecting the habitat of *Pila globosa* (Swainson, 1822) (Mesogastropoda: Pilidae) located in Rajshahi University campus

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Abstract

The investigation was conducted on morphometrics, length-weight relationship and ecological factors of the freshwater apple snail, *Pila globosa* (Swainson,1822) in the habitat of Rajshahi University Campus. The length of shell (SL) (40.09 ± 16.08 mm), length of spire (SPL) (7.63 ± 2.61mm), length of base (LB) (32.52 ± 13.58 mm), width of shell (SW) (37.39 ± 15.72 mm), length of aperture (AL) (27.83 ± 10.42mm) and width of aperture (AW) (16.6 ± 6.46mm) in combined sex were observed. The obesity indices of male were higher than those of female (male =1.10 ± 0.03, female = 1.04 ± 0.01). The total weight in wet condition (TWW) (27.25 ± 25.25g) in combined sex was also recorded. The regression lines between SL/SPL (SL=1.2925+0.1580 SPL), SL/BL (SL = -1.2831 + 0.8432 BL), SL/SW (SL=1.7367+0.9760 SW), SL/AL (SL=1.9303+ 0.6460 AL), SL/AW (SL=0.5239+0.4011 AW), SL/TWW (SL= -3.4225+2.9290 TWW) and SW/TWW (SW=-3.1353+2.8060 TWW) in combined sexes were linear, positive and highly significant. Ecological factors from observed value (*Ko*) of combined sex and from calculated value (*Kc*) of combined sex were 29.53 ± 4.26 and 29.29 ± 0.95, respectively. *Kn* values of combined sex were found to be 1.009 ± 0.137.

Keywords: Morphometrics; Length-weight relationship; Ecological factors; *Pila globosa*; Shell length

Introduction

The Gastropoda constitutes the largest and most diverse group of the Mollusca which has received extensive adaptive radiation with about 40,000 living species (Marshall and Williams, 1972). Although, gastropods are predominantly marine, they are widely represented in freshwater habitats. In many gastropods, changes in the relative growth of various body proportions are known to occur in their different stages of development. This aspect of prosobranchs was made by several investigators like Normura, 1926; Crofts, 1929; Green and Green, 1932; Moorehouse, 1934; Sadasivan, 1948; Berry, 1961; Houbrick, 1974; Goodwin, 1978 and Muley, 1978. Raut and Bhattacharya (1986) worked on growth indices of *Bellamya bengalensis*. Information regarding length-weight relationship is important in the biology, population and management of the mollusc species and their fisheries. Among pulmonates, length-weight relationship studies were carried out by Williamson (1976) on *Cepaea nemoralis* and Rahman (1995) on *Lymnaea acuminata*.

Study on the length-weight relationship of prosobranch snail Melania scabra was done by Muley (1978) and on B. bengalensis by Saha *et al.* (2003).

Pila globosa is a freshwater gastropod found to occur in ponds, ditches, canals, irrigated paddy fields and beels of Bangladesh. It is commonly known as the freshwater apple snail in English and apel shamuk in Bengali. The snail is edible and its flesh is highly proteineous. No published information is available on morphometrics, length-weight relationship and ecological factor of *P. globosa* from Bangladesh.

Therefore, an investigation was conducted to determine some essential aspects of morphometrics, length-weight relationship and ecological factor of the freshwater apple snail, *Pila globosa* from Rajshahi University Campus from January 1995-December 1996.

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Materials and methods

Random sampling of *Pila globosa* was done fortnightly (on the first and the 15th day) during the tenure from January 1995 to December 1996 from the ponds, ditches and irrigated paddy fields of Rajshahi University Campus (Fig.1) in the morning. A total of 1,324 specimens was collected during this tenure of which 1,175 specimens were found suitable in all respects. The snails were collected with the help of cast nets, small hand nets and hand-picking methods.

Shell length (SL), shell width (SW), Spire length (SPL), Base length (BL), Aperture length (AL) and Aperture width (AW) of the shells of *Pila globosa* were measured with the help of Vernier Calipers to the nearest 10th of a millimeter to find out the relations among the morphometric characters of the snails. Weights were taken with the help of an Electronic Balance (Bosch PE 632 Max. 420g, made in West Germany) sensitive to 0.001g.

Fig.2 shows the schematic diagram of shells of *P. globosa.* Sex of *P. globosa* was determined by dissecting the primary reproductive organs (testis and ovary). The obesity indices for male and female were evaluated using the formula as outlined by DeWitt (1954).

Shell terminology and the range of different parameters were adopted following Subba Rao (1989) (Fig.2). The relationships of linear regressions between different shell parameters were established considering the shell length as the basic index. Statistical analyses (correlation and linear regression) were calculated following Agrawal (1988).

The size frequency distribution was calculated for each length group of 4.00mm class interval by Peterson Polygon method.
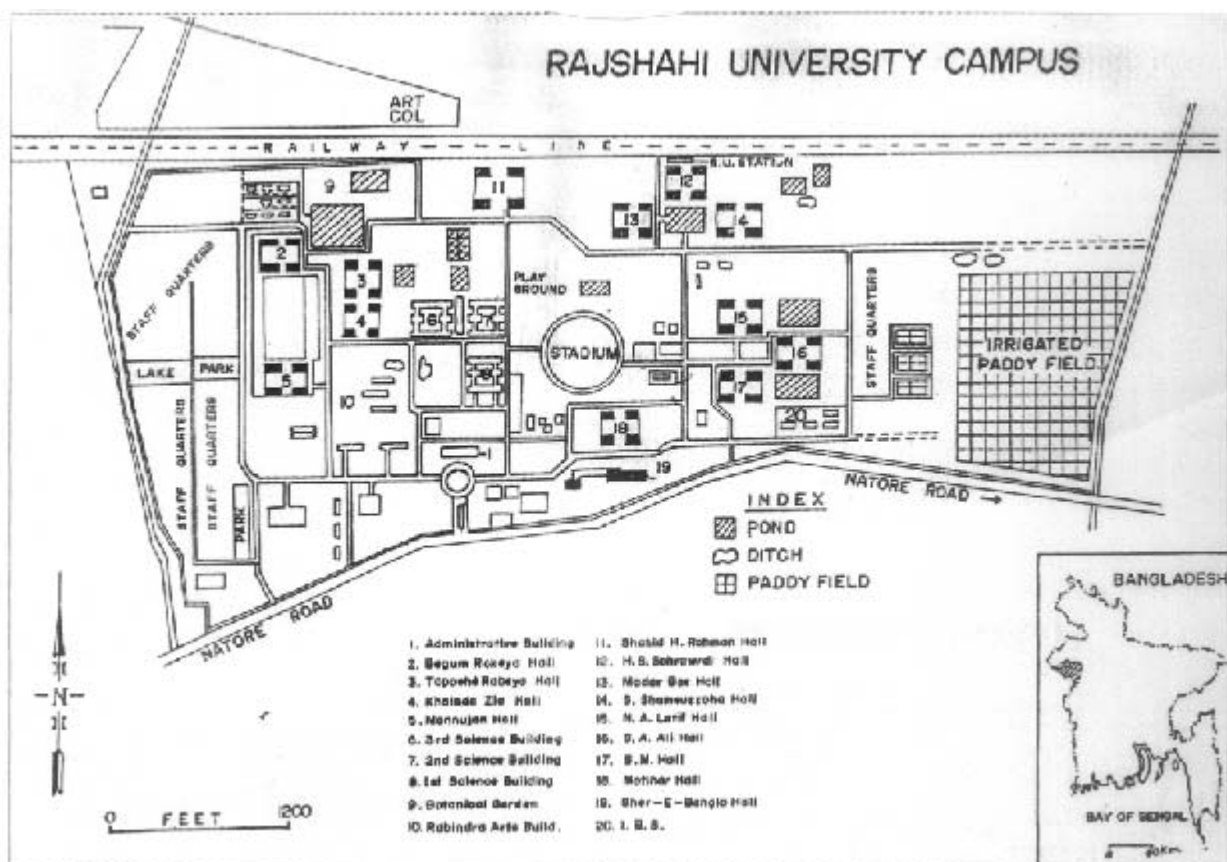

**Fig. 1. Rajshahi University campus showing sampling stations**

The Length-Weight relationship was expressed by using the logarithmic transformation of the formula: $W = aL^n$ (Le Cren,1951), where W= weight, L= length, a is a constant and an exponent. Values of a and n were found emperically. The value of ecological factor (k) was calculated from the cube law equation $W=KTL^3x10^5$ or
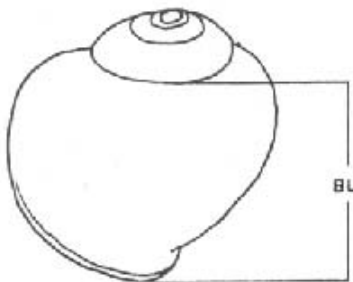
$$K = \frac{TWx10^5}{TL^3}$$

where *TW* = Total Weight (g.), *TL* = Total length (mm) and *K* = the factor of proportion.

The general formula of relative condition factor is

$$K_n = \frac{K_0}{K_c}$$
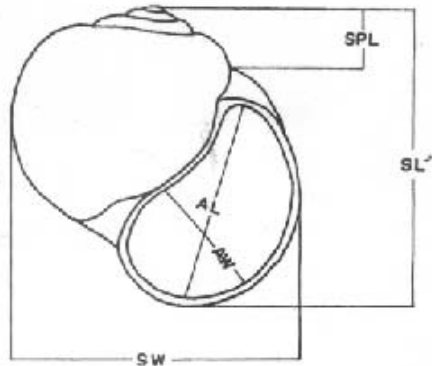
Fig. 2. Shells of *Pila globosa* (Schematic diagram)

Results and discussion

Morphometrics

Size frequency distribution

The data on size frequency distribution of 1,175 individuals of *P. globosa* are presented in Fig. 3. The individuals were grouped into 14 size groups of 4.00 mm class intervals. Minimum number of male was observed in size group 60.0-64.0 mm, while maximum number of male was found in 40.0-44.0 mm size group. Minimum number of female was found in 64.0-68.0 mm size groups while maximum number of female was recorded in 36.0-40.0 mm size group. *Saha et al.* (2003) recorded the maximum number of male in 24.0-28.0 mm size group and maximum number of female in 32.0-36.0 mm size group in the banded pond snail, *B. bengalensis* collected from Rajshahi University Campus.

Estimation of lengths

The shell length (SL) of male *Pila globosa* was found to be varied from 12.85 mm to 61.65 mm with an average of 37.06 ± 14.34mm; SL of the female from 13.75mm to 67.25 mm with the mean of 40.13 ± 16.1mm and in combined sex, the mean value was 40.09 ± 16.08mm. The shell width (SW) of the male snails ranged from 9.65mm to 58.0 mm with the mean of 34.08 ± 13.82mm ; SW of the female 12.8mm to 66.5mm having an average of 37.51 ± 15.69mm and in combined sex, the mean being 37.39 ± 15.72mm. The spire length (SPL) of the male was found to vary from 2.4mm to 17.3mm with an average of 8.65 ± 3.24mm; SPL of the female ranged from 2.3mm to 12.0mm, the mean being 6.85 ± 2.71mm and in combined sex of *P. globosa,* the average was 7.63 ± 2.61mm. The base length (BL) of the male showed a wide range of 10.0mm to 48.o mm with the mean of 28.45 ± 11.29mm ; BL of the female varied from 10.8mm to 56.3mm with an average of 33.31 ± 13.47mm and in combined sex, the mean was 32.52 ± 13.58mm.The aperture length (AL) of the male *P. globosa* was in the range of 8.5mm to 41.omm with a mean of 27.83 ± 10.42mm; AL of the female ranged from 9.75mm to 47.4mm with an average of 28.24 ± 10.23mm and in combined sex,
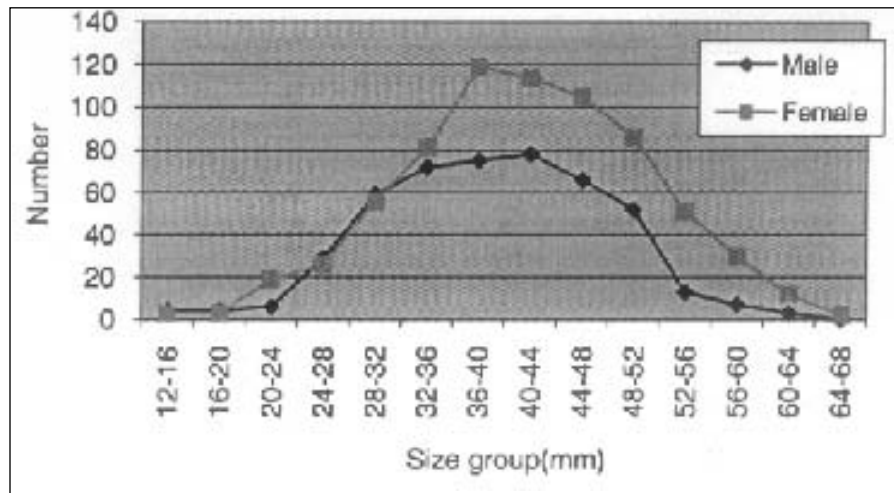
Fig. 3. Size frequency distribution of male and female Pila globosa sample from sRajshahi University campus of 1995-1996

the mean being 27.83 ± 10.42mm. The aperture width (AW) of the male exhibited a range of 5.4mm to 26.omm with an average of 15.31 ± 5.81mm ; AW of the female varied from 5.6mm to 38.1mm with an average of 16.68 ± 8.44mm and in combined sex, the mean being 16.6 ± 6.46mm. In course of the present study on *P. globo sa*, the shell length was taken as the basic index of actual size. Green and Green (1932) worked on *Littorina littorea* taking the length of the shell as the basic index of size. McCraw (1961) considered the length of shell as the basic index of size in *Lymnaea humilis*. Saha *et al.* (2003) took the length of shell as the basic index of size in *B. bengalensis.* The determined obesity indices of male *P. globosa* varied from 1.05-1.23 with an average of 1.10 ± 0.03; in female, it was found to range from 1.01-1.07, the mean being 1.04 ± 0.01. Saha *et al.* (2003) recorded the obesity indices of the banded pond snail, *B.bengalensis* which agrees with this report.

The total weight in wet condition (TWW) of the male *P. globosa* was found to vary from .57g to 72.47g with an average of 19.41 ± 15.5g; TWW of the female were found to be ranged from 0.58g to 103.69g having an average of 27.55 ± 26.37g and in combined sex, the mean being 27.25 ± 25.25g.

Correlation

The results of correlation and linear regression studies between the respective shell parameters of *P. globosa* are presented in Table I. Table I shows that the correlation co-efficient (r) in all pairs of shell parameters considered are positively significant (P<0.01). But the rates of influence are moderate between SL / BL, SL / SW, SL / AL and SL /AW, whereas the rates of influence are considerable between TWW / SL and SW. Muley (1978) worked on *Melania scabra* where shell length / spire length and shell length / peristome width showed linear relationships. Saha *et al.* (2003) agrees with this finding except SL / SPL and SL /AW in *B. bengalensis.*

Length-weight relationship

The length-weight relationships for 1,175 individuals of *Pila globosa* ranging in size from 12.85-67.25mm and in total weight in wet condition from 0.57-103.69g throughout the study period were determined as Log TWW=Log -2.6872+2.4678 Log SL, Log TWW=Log -3.6897+3.0869 Log SL and Log TWW=Log-3.4225+2.9290 Log SL in male, female and combined sex, respectively.The results of different lengths (SL, SW) with respect to total weight in wet condition (TWW) of P. globosa show curvilinear relation-ship (Table1). In the shell length-weight relationship study, the values of b are lower than 3 in male (2.4678) and com-bined sex (2.929) but in female (3.0868) higher than 3 (Table I). In the shell width-weight relationship study, the values of b are lower than 3, that is, 2.3789 in male, 2.9854 in female

Table I. Results of correlation and linear regression studies between different pairs of shell parameters of *Pila globosa*

Factors	Sex	Value of a	Value of b	Correlation Coefficient (r)	Remarks (+/-)
SL/SPL	Male	0.6225	0.2165	0.9591	+
	Female	0.2651	0.1641	0.9747	+
	Combined	1.2925	0.1580	0.9732	+
SL/BL	Male	-0.6261	0.7846	0.9966	+
	Female	-0.2249	0.8357	0.9990	+
	Combined	-1.2831	0.8432	0.9989	+
SL/BW	Male	-1.5277	0.9607	0.9965	+
	Female	-1.5204	0.9727	0. 9985	+
	Combined	-1.3767	0.9760	0.9988	+
SL/AL	Male	1.7964	0. 6359	0.9970	-
	Female	2.8418	0.6330	0.9961	-
	Combined	1.9303	0.6460	0.9972	-
SL/AW	Male	0.3158	0.4045	0.9980	-
	Female	0.6489	0.3995	0.9987	-
	Combined	0.5239	0.4011	0.9988	-
SL/TWW	Male	-2.6872	2.4678	0.9464	-
	Female	-3.6897	3.0868	0.9337	-
	Combined	-3.4225	2.290	0.9326	-
SW/TWW	Male	-2.4445	2.3789	0.9394	-
	Female	-3.4352	2.9854	0.9424	-
	Combined	-3.1352	2.8067	0.9388	-

and 2.8067 in combined sex. Saha *et al.* (2003) determined the values of b in shell length- weight relationship of *B. bengalensis* as 2.8102 in male, 2.7880 in female and 2.7433 in combined sex which is in conformity with this finding. In the shell width-weight relationship of *B. bengalensis* studied by Saha *et al.*(2003), the value of b is higher than 3. The length-weight relationships in shell fishes show curvilinear relationship with the value of b=3 (Hossain, 1982). According to Roycee (1972), an exponent of 3 is an exception, however, values from 2 to 3.5 are commonly found in fish. Muley (1978) found the cube law in length and weight relationship of the freshwater prosobranch *Melania scabra.*

Ecological factor from observed value (Ko)

The value of *Ko* in male *P. globosa* was found to be varied from 26.973- 62.266, the mean being 32.09± 8.32 (Fig.4a). In female, the mean of *Ko* was determined as 27.97±2.224 with a range of 22.142- 34.093 (Fig.4b) and in combined sex, the average being 29.53± 4.26 (Fig.4c).

Ecological factor from calculated value (Kc)

The male *P. globosa* exhibited the mean of *Kc* as 32.35 ± 7.95 and the range as 23.085-50.813 (Fig.4a). In female, it was found to be varied from 25.530-29.420 with an average
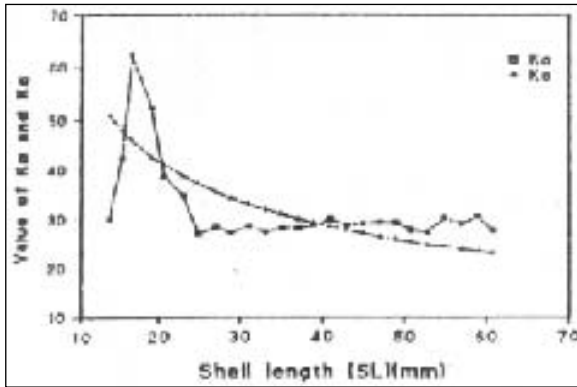
Fig. 4a. Relationship between shell length (SL) and ecological factor for observe weight (Ko) and calculated weight in male. *P. globosa*
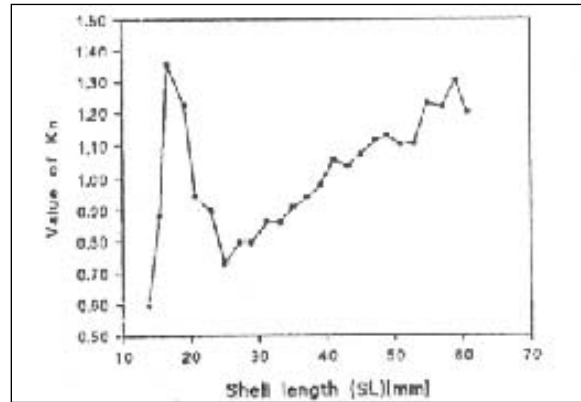

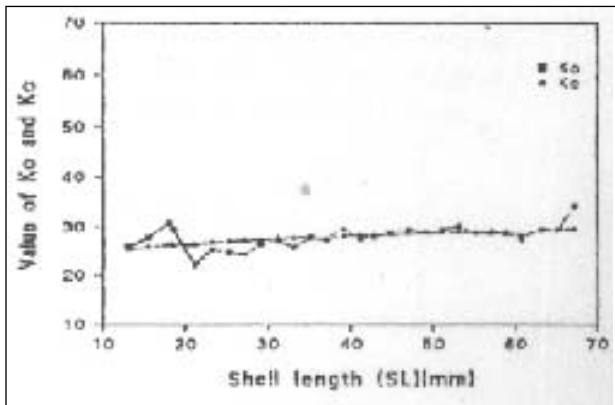**Fig. 5a.** Relationship between shell length (SL) and relative ecological factor (Kn) in male *P. globosa*

Fig. 4b. Relationship between shell length (SL) and ecological factor for observe weight (Ko) and calculated weight in female. *P .globosa*
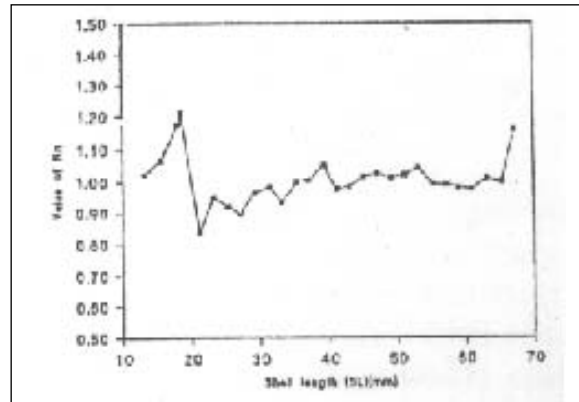

Fig. 5b. Relationship between shell length (SL) and relative ecological factor (Kn) in female *P. globosa*
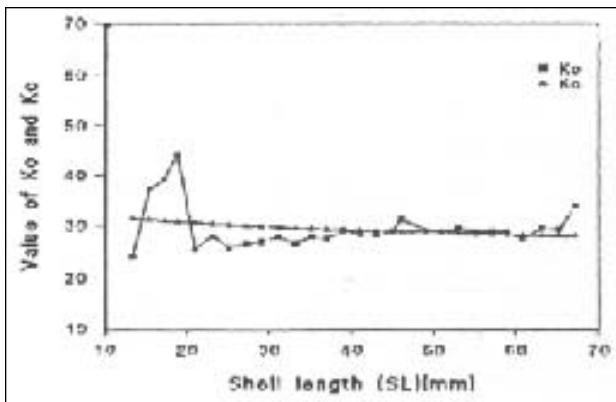

Fig. 4c. Relationship between shell length (SL) and ecological factor for observe weight (Ko) and calculated weight in combined sex of *P. globosa*
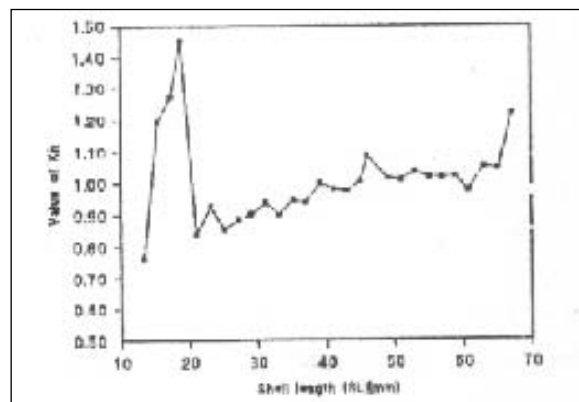

Fig. 5c. Relationship between shell length (SL) and relative ecological factor (Kn) in combined sex *P globosa*

of 27.86 ± 1.09 (Fig.4b) and in combined sex, the mean being 29.29 ± 0.95 (Fig.4c).

Relative ecological factor (Kn)

Mean values of *Kn* were determined as 1.013± 0.187 for male, 1.004± 0.07 for female and 1.009 ± 0.137 for combined sex *P. globosa* (Fig.5abc). The value of *Kn* ranged from o.592- 1.356 in male; 0.835-1.176 in female and 0.763-1.449 in combined sex (Fig.5abc). The report with respect to relative ecological factor of *B. bengalensis* stated by Saha *et al.* (2003) is in conformity with the present findings.

Conclusion

The freshwater apple snail *Pila globosa* is an edible mollusc and its flesh is highly proteineous. It is available in our closed water bodies and can be utilized as a source of protein to our poor people. From the commercial standpoint, it may not, therefore, be economical to catch these snails below this stage (57.13 mm in male and 57.92 in female). Thus, it will help in getting rapid gain in the weight of P. globosa. At present, this type of work is being applied in identifying molluscs upto species level. So, this study is utmost needed to a researcher in the field of Zoology, specially Fisheries.

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