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A study on shell size frequency in freshwater snail *Bellamya dissimilis* collected in monsoon season

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Abstract
The present study was aimed to see the shell size frequency distribution of freshwater snail *B. dissimilis* in monsoon season collected from Godavari River near Kaygaon, Pravara Sangam, Aurangabad, Maharashtra, India. The distributions frequency is calculated on the basis of shell length, shell width, aperture length, aperture width and total body weight and its relation with shell length as in total collection of 208 animals. The average length of snail shell was 2.65±0.42cm. The average shell width was 4.45±2.94cm. The aperture length was 1.05±0.11cm. The aperture width was 0.79±0.12cm and the average of total body weight was 1.60±0.16g. Frequency distribution showed maximum number of snails shell length ranges in the group of 2.7-3.1cm, shell width ranges in the group of 4.1-4.5cm showed maximum number of snails, and maximum number of snails in case of aperture length and aperture width ranges in the size groups of 1.0-1.2cm and 0.7-0.9cm respectively. The size group 1.55-2.13g of Total body weight showed maximum number of snails. Results showed positive correlation significance at 1% level ($p<0.01$). The shell length is highly positively correlated with all body parameters except with shell width it was lowest but positively significant ($p<0.05$) with R value of 0.150.

Keywords: Freshwater snail, *B. dissimilis*, shell length-width, shell aperture-width, total body weight

1. Introduction
The class Gastropoda is the largest group which comprises of shelled animals included in phylum Mollusca, along with other 4 classes [15]. Many freshwater mollusks inhabitants of rivers, ponds, lakes, constitute the dominant members of their communities making them very important ecologically [2-14]. The snails are usually inhabited near thick beds of algae in rivers and it feeds on *Hydrilla* plant and algal material. *B. dissimilis* are commonly found in freshwater streams, rivers, ponds, temporary stagnant water etc. [15]. For the present study the snail, *B. dissimilis* is selected as these snails are abundantly available in river Godavari. The freshwater mollusks play an important role in aquatic ecosystems, and in maintaining water quality and for the purpose of eco-biological features of the animals needs to be recorded at regular intervals. So as in this situation shell size frequency distribution or the morphometric analysis with different parameters of freshwater snail *B. dissimilis* has been done. Genus *Bellamya* (family viviparidae) is proven food for many aquatic animals and aquatic birds. This breeds their adaptability to the environment that reflected in variation in egg size, size at maturity and growth rate [3]. The analysis was done of the shell shape of *Viviparus georgianus* species it was revealed that the intraspecific difference was possibly caused due to the environmental factors [8-17]. Shell structure is a taxonomic information that can be used to interpret evolutionary history, and relationship between molluscan species [22]. because it contact with its habitat, this is true even after death that make shells suitable to us as indicator to record information about snails life histories and environmental habitats [4]. Snails are among the few animals that provide a directly measureable connection to their individual lives, even after death, through their shells. Hence, shell morphometrics is used as primary guideline for species identification in the "general handbooks" and the taxonomic literature of molluscs [22]. The shells of viviparous species show difference between the shapes, its sizes, their banded shells and its embryonic shells [18]. Snail farming is now an enterprising business in most parts of the world. It has many advantages over the conventional domesticated animals. The advantages are; management ease; requirement for small rearing space; source of high quality animal protein [1]. Shells are very useful as calcium salt in animal formulated feeds, making ornaments, ashtrays, scouring powder and ceramic materials [3].
In the classical method [11, 12].

Shells are described with reference to a geometrical model, which is completely determined by model parameters. Morphometric studies were observed. Body measurements were used to see the shell growth pattern in every month. Freshwater snails are very much diversified and occupy various aquatic environments including man-made ponds and ditches throughout the world [20, 19]. Morphometric, the quantitative study of variation of shell shapes and their covariation with other variables [13] has been utilized in a wide range of studies across various disciplines.

2. Materials and methods

2.1. Study area

The Godavari River near Kaygaon toka, Pravara Sangam, Aurangabad, which is located at latitude 19˚37'57.44" N and longitude 75˚14'30.41"E inhabit *B. dissimilis.* (Fig.1).

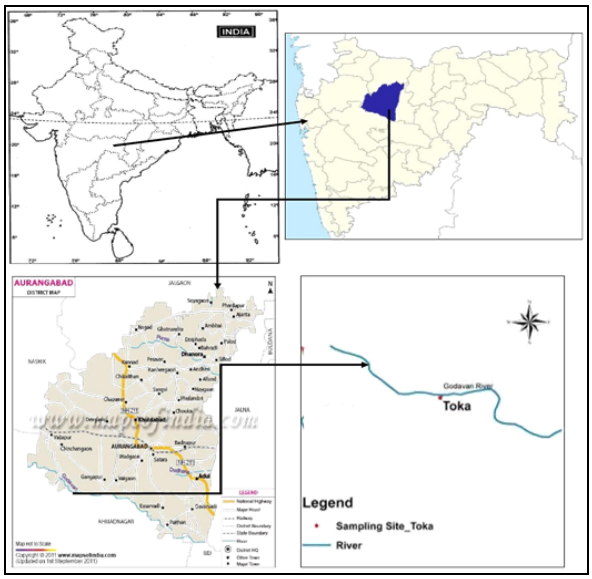

Fig 1: Location map of collection site

2.2. Sampling

Collection of snails was done in the period of monsoon season. The experiment was spanned a period of four months (June-September 2015) and the record was maintained every month. Animals were hand collected from the collection site (Godavari River near Kaygaon Toka) with the help of hand gloves and collected in plastic bottles. The animals were safely brought to the laboratory. The specimens were identified by ZSI Pune. The shells were fully covered with the algal material. It was found that there was lots of debris around the water boundaries, which were polluting the water and it may also effect on the aquatic life. The distribution pattern was noted that this species i.e. *B. dissimilis* are muddy and some other species like *Planorbis* and some bivalves, crabs etc. are also found with them. The collected snails were washed with the river water to get rid-off debris and the algal material attached to its shell, when brought to laboratory the snails were again washed in tap water to remove algal material from its shells, a small toothbrush was also used to remove the algal material and snails were placed in clean water in a trough with aerator (Fig. 2).

Fig 2: Snails *B. dissimilis* maintained in the trough with aerator

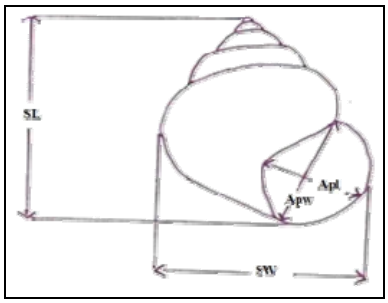

Fig 3: Morphometric parameters of *B. dissimilis* shell

2.3. Morphometric measurements

Morphometric measurements were performed with the help of vernier caliper and live weight was recorded using electronic weigh balance. A total of 208 snails were used in the morphometric measurements during the period of four months. Five measurements were taken; the selected measureable parameters were SL: shell length, SW: shell width, APL: aperture length, APW: aperture width, TBW: total body weight. The raw data was entered into Excel and saved for analysis.

2.4. Statistical Analysis

Statistical analysis was performed with the help of Minitab software as well as Excel 2007. Measured snails were divided into different size groups which were estimated using histogram plots. The relationship of the shell length to shell width, aperture length, aperture width, and total body weight were studied using correlation coefficient.

3. Results

The shell of *B. dissimilis* is brownish or even blackish in colour. The shell is conical and globular in shape, with a

sharp apex and relatively higher spire and distant body whorls. There are usually 5-6 whorls that show increasing in size. Some snails have their coils opening to the right of their shells (dextral coiling), whereas the coils of other snails open to the left (sinistral coiling). As far in the present study the shell of *B. dissimilis* is dextrally coiled and somewhat globular with a large aperture and bluntly pointed spire. The aperture is oval and has narrow black margin. The animal is completely withdrawn into its shell and its aperture is closed by a flat plate called operculum and it shows the lines of growth. The operculum grows in size as the shell grows, such that the operculum remains in proportion to the apertural size. Shells of this species are usually covered with the moss like alga.

The basic information related to the morphometry of the snail *B. dissimilis* collected from Godavari River near Kaygaon Toka is presented in (Table 1). The average length of snail shell was 2.65±0.42cm; the average width was 4.45±2.94cm, aperture length 1.05±0.11cm, aperture width 0.79±0.12cm, and total body weight 1.60±0.16g. The frequency distribution of shell length, shell width, and total body weight of the collected snails signifies the presence of six groups. (Table 3. a-e) shows the size distribution of collected snails i.e. of shell length were in different range groups viz. 1.2-1.6cm, 1.7-2.1cm, 2.2-2.6cm, 2.7-3.1cm, 3.2-3.6cm and 3.7-4.1cm has been depicted in (Fig. 4-a) and maximum number of snails ranges in the group of 2.7-3.1cm. Shell width ranges from 2.6-3.0cm, 3.1-3.5cm, 3.6-4.0cm, 4.1-4.5cm, 4.6-5.0cm and 5.1-5.5cm which has depicted in (Fig. 4-b) and maximum number of snails ranges in the group of 4.1-4.5cm. Frequency distribution of aperture length and aperture width signifies presence of three groups. Aperture length ranges from 0.7-0.9cm, 1.0-1.2cm, 1.3-1.5cm which has been depicted in (Fig.4-c) and maximum number of snails ranges in the group of 1.0-1.2cm. Aperture width ranges from 0.4-0.6cm, 0.7-0.9cm, 1.0-1.2cm which has been depicted in (Fig.4-d) and maximum number of snails ranges in the group of 0.7-0.9cm. Total body weight ranges from 0.37-0.95g, 0.96-1.54g, 1.55-2.13g, 2.14-2.72g, 2.73-3.31g and 3.32-3.90g which has depicted in (Fig.4-e) and maximum number of snails total body weight ranges in the group of 1.55-2.13g. (Table 2) shows the results of correlation between the parameters. In almost all cases of the parameters a positive and high significant (p<0.01) correlations was obtained between the shell length and all other parameters. A positive correlation implies that whenever there is an increase in the values of the variables, it also shows increase in value for the other variable. While that of negative correlation shows that an increase in value of one of the variables is accompanied by a decrease in value of the other variable [16]. The snail shell length is highly positively correlated with all body parameters except with shell width (r=0.150) it was lowest but positively correlated. positive and high significant correlation was obtained between the parameters such as shell length-aperture length (r=0.712), shell length-aperture width (r=0.707), shell length-total body weight (r=0.760), shell width-aperture length (r=0.175), shell width-aperture width (r=0.214), shell width-total body weight (r=0.171), aperture length-aperture width (r=0.803), aperture length-total body weight (r=0.809), aperture width (r=0.833).

4. Discussion

Gastropods species *B. dissimilis* are known to be ecological indicators of eco toxicology in an aquatic environment [9]. From the evolutionary point of view, the shells have much more taxonomic data which is useful for interpreting the evolutionary data or the relationships among the species [22]. Throughout the world in freshwater and marine water mollusca are the important part of the invertebrate animals [19]. Positive and high significant correlation values obtained in this study were also noted by [15]. In most of the parameters it showed high and positive correlation at 0.01 level, the values (r=0.844), (r=0.806), (r=0.808) between shell length and shell width and this was from three sites Nagavara lake, Hebbal lake, Ranchenalli lake, Bangalore respectively. But in the present study the correlations between shell length and shell width (r=0.150) was lowest but positively significant at 0.05 level. The results of Correlation between shell length and aperture length (r=0.712) of the present study were somewhat relevant with the results of [15] i.e. correlations between shell length and aperture length (r=0.677), (r=0.616), (r=0.831) from Nagavara lake, Hebbal lake, Ranchenalli lake, Bangalore respectively. Correlations between shell length and aperture width (r=0.707) and that of [15] Study was (r=0.867), (r=0.563), (r=0.655) from Nagavara lake, Hebbal lake, Ranchenalli lake, Bangalore respectively. This result shows highly and positively significant correlation at 1% level (p<0.01).In the study of [6] shows that the mean snail length was 8.29±0.31cm and 7.84 ± 0.20cm in *Archachatina marginata* and *Achatina achatina* respectively. The mean snail width of *Archachatina marginata* (2.38±0.12cm) was wider than *Achatina achatina* snail (2.31± 0.07cm). The shell length of *A. marginata* snail was not significantly different (P>0.01) from *A. achatina*. The shell width and height of snail *A. marginata* was significantly different (P<0.01) from the *A. Achatina*. The mean of the snail live weight of *A. marginata* was significantly different (P<0.01) from *A. achatina*. The snail live weight is highly positively correlated with all body parameters.

Table 1: Some morphometric measurements (*Mean±SD*) of the shell of freshwater snail collected from Godavari River near Kaygaon Toka**.**

	June		July		August		September		Mean±SD
	Min	Max	Min	Max	Min	Max	Min	Max	
Shell length(cm)	1.2	3.8	2.0	3.8	1.8	3.4	1.7	3.8	2.65±0.42
Shell width(cm)	3.0	5.3	3.0	5.4	2.7	5.2	2.6	5.5	4.45±2.94
Aperture length(cm)	0.8	1.4	0.8	1.3	0.8	1.3	0.7	1.3	1.05±0.11
Aperture width(cm)	0.6	1.1	0.5	1.1	0.5	1.0	0.4	1.1	0.79±0.12
Total body weight(g)	0.650	3.850	0.560	2.850	0.370	2.810	0.370	3.310	1.60±0.16

Table 2: Correlations between Morphometric parameters of *B. dissimilis*

Parameters	SL	SW	APL	APW	TBW
SL	1	0.150*	0.712**	0.707**	0.760**
SW		1	0.175**	0.214**	0.171**
APL			1	0.803**	0.809**
APW				1	0.833**
TBW					1

SL: Shell length, SW: Shell width, APL: Aperture length, APW: Aperture width, TBW: Total body weight

Table 3(a): Shell length frequency distribution of *B. dissimilis.*

Shell Length group	Number. of specimens
1.2-1.6	1
1.7-2.1	29
2.2-2.6	72
2.7-3.1	80
3.2-3.6	22
3.7-4.1	4

Table 3(b): Shell width frequency distribution of *B. dissimilis.*

Shell width group	Number. of specimens
2.6-3.0	8
3.1-3.5	17
3.6-4.0	40
4.1-4.5	78
4.6-5.0	52
5.1-5.5	13

Table 3(c): Aperture Length frequency distribution of *B. dissimilis.*

Aperture Length	Number. of specimens
0.7-0.9	30
1.0-1.2	170
1.3-1.5	8

Table 3(d): Aperture Width frequency distribution of *B. dissimilis.*

Aperture Width	Number. of specimens
0.4-0.6	21
0.7-0.9	172
1.0-1.2	15

Table 3(e): Total Body Weight frequency distribution of *B. dissimilis.*

Total body weight group	Number. of specimens
0.37-0.95	30
0.96-1.54	66
1.55-2.13	75
2.14-2.72	27
2.73-3.31	9
3.32-3.90	1

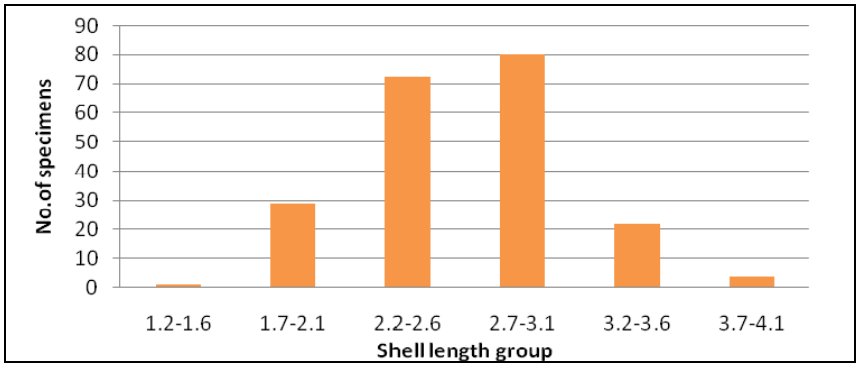

Fig 4 (a): Frequency distribution of estimated shell length group of *B. dissimilis*

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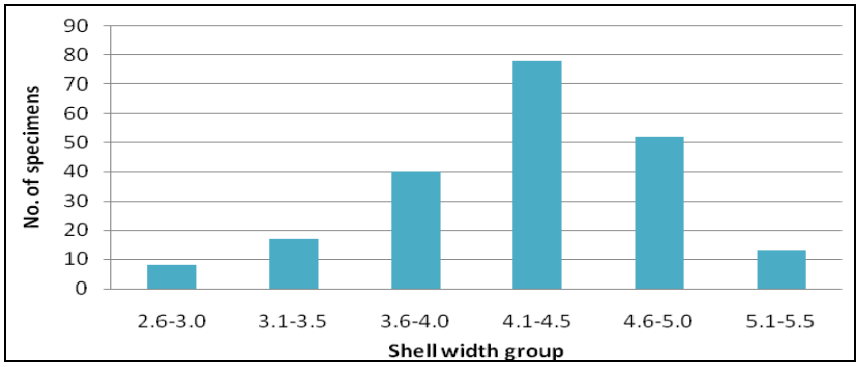

Fig 4 (b): Frequency distribution of estimated shell width group of *B. dissimilis*

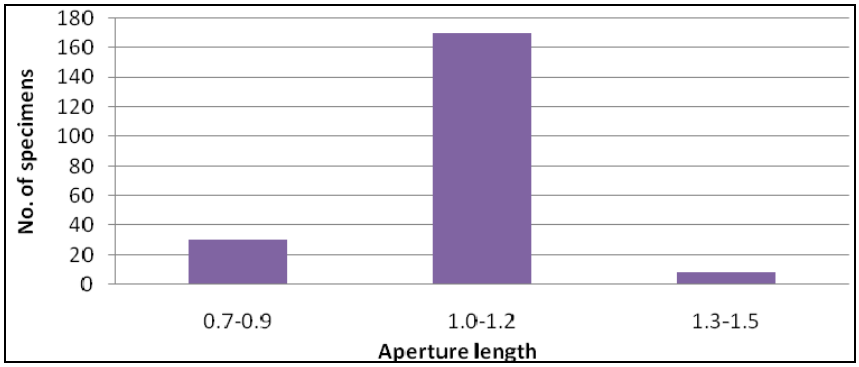

Fig 4 (c): Frequency distribution of estimated Aperture Length group of *B. dissimilis.*

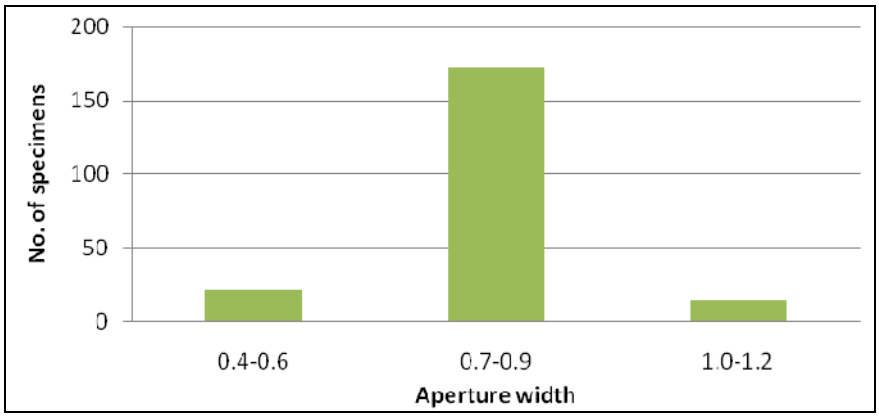

Fig 4 (d): Frequency distribution of estimated Aperture width group of *B. dissimilis.*

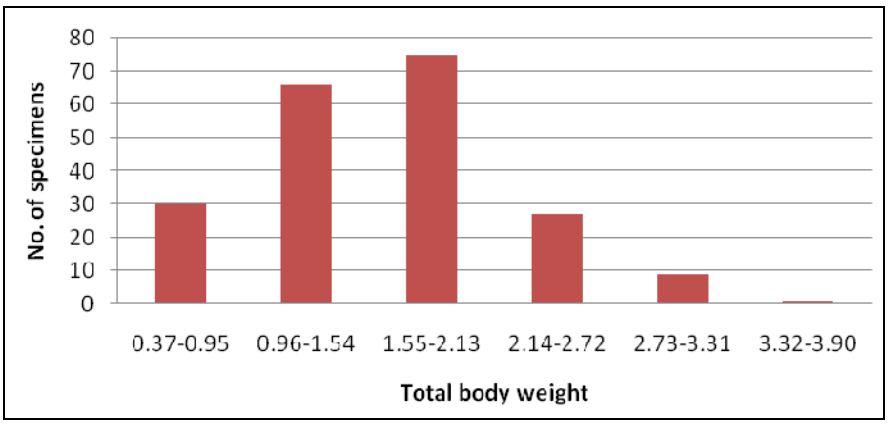

Fig 4 (e): Frequency distribution of estimated Total body weight group of *B. dissimilis*

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