

SEASONAL FLUCTUATIONS IN THE DIVERSITY OF SNAILS FROM MALANGAON RESRVIOR OF DHULE DISTRICT, (M. S.), INDIA.

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Abstract-

Changes in diversity indices of freshwater snails *Bellamya bengalensis* and *Lymanea acuminata* from Malangaon reservoir in Dhule district were studied in three seasons of the year. It was observed that the diversity, density in the form of Shannon- Wiener index, Simpson's index and Pielou's index of both the species were highest in summer, lowest in monsoon and intermediate in winter. The population density of *Bellamya bengalensis*, was 10, 06 and 08 o/m² in summer, monsoon and winter season respectively, while population density of snail species, *Lymanea acuminata*, in summer, monsoon and winter season was 04, 02 and 03 o/m² respectively. The values of Shannon- Wiener diversity index at Malangaon reservoir were 0.5983, 0.5624 and 0.5860 during summer, monsoon and winter season respectively. The values of Simpson's index of diversity at Malangaon reservoir were 0.4396, 0.4286 and 0.4364 during summer, monsoon and winter season respectively. The species richness at Malangaon reservoir was 02. The values of Pielou's index of evenness at Malangaon reservoir were 0.8631, 0.8114 and 0.8454 during summer, monsoon and winter season respectively.

Keywords- Seasonal fluctuations, Diversity, Diversity indices, Malangaon reservoir, Dhule.

Introduction

The biological diversity is very complex and vibrant feature of the Earth. It is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part (UNEP, 1992). The biological diversity provides foods, medicines and industrial products to human population. Next to arthropoda, mollusca constitute the second largest invertebrate phylum (Aravind et al., 2008). It is a large group of animals having diverse shapes, sizes, habits and occupies terrestrial and aquatic habitats (Subba Rao, 2003). Molluscs are considered the most diverse and dominant benthic fauna both from lentic and lotic region which are mainly represented by the two major classes namely Gastropods and Pelecypods (Mackie, 1998). Gastropods are common and noticeable elements of the freshwater biota. They are found on the submerged surfaces of substratum in ponds, streams, lakes and rivers. Usually they are found in the water where calcium concentration is more (Tonapi, 1980). They are the dominant grazers of algae and aquatic plants and plays an important role in an aquatic food web as well as in the processing of detritus and decaying organic matter.

The diversity of freshwater molluscs in the ecosystem depends up on the availability of food, shelter and safe oviposition sites. Their abundance might be affected due to the presence of vegetation in the shallow depth, which emerged when the stream was dry during the post monsoon period and formed a good feed leading to their multiplication (Manoharan et al., 2006).

Several factors affect diversity and distribution of snails. These include physicochemical parameters of water as well as biological factors such as availability of food, aquatic macrophytes, competition and predator-prey interactions (Horsák et al., 2007, El-Khayat et al., 2011). Temperature (Kazibwe et al., 2006), pH (Owojori et al., 2006), electrical conductivity (Nyman et al., 2005), alkalinity (Pennak 1989), dissolved oxygen, and Hardness (Kobayashi and Wada; 2004) are related to molluscan diversity.

Seasonality also affects the diversity and distribution of snails. El-Kady et al., (2000) studied the effect of season on snails from Saini peninsula. Similar study was done by Rathore (2003), Karimi et al., (2004), Garg (2009), Tusharkumar Ganghi (2010), Ali Suliman Al-Akel and El Amin Mohamed Suliman (2012), Dhembre (2012), Sharma et al., (2013), Rai and Jauhari (2016) studied effect of seasonality on the distribution of mollusca.

Diversity indices:

A diversity index is a mathematical measure of species diversity in a community. It is common practice among ecologists to complete the description of a community by one or two numbers expressing the "diversity" or the "evenness" of the community. Diversity indices provide more information about community composition than simply species richness (i.e., the number of species present); they also take the relative abundances of different species into account. Many different measures (or indices) of biodiversity have been developed, and compared with one another (Magurran 2004). The basic idea of a diversity index is to obtain a quantitative estimate of biological variability that can be used to compare biological entities. In present study, following diversity indices were studied:

I) Shannon- Wiener diversity index (H):

It is commonly used to characterize species diversity in a community. Shannon's index accounts for both abundance and evenness of the species present. The proportion of species *i* relative to the total number of species (*p_i*) is calculated, and then multiplied by the natural logarithm of this proportion (ln*p_i*). The resulting product is summed across species, and multiplied by -1.

Many researchers workout Shannon diversity index (H) in molluscs (Sharma et al., 2011; Anuradha David, 2013; Jerry, 2015; Galan et al., 2015)

II) Simpson's Index of Diversity (SID):

Since evenness and dominance are simply two sides of the same coin, their measures are complimentary. Simpson's index is based on the probability of any two individuals drawn at random from an infinitely large community belonging to the same species. Many researchers workout Simpson's index of diversity (SID) in molluscs (Aneta Spyra et al., 2007; Sharma et al., 2011; Anuradha David, 2013; Jerry, 2015).

III) Richness (S):

It is simply the number of species in a community. Many researchers workout species richness(S) in molluscs (Aneta Spyra et al., 2007; Sharma et al., 2011; Anuradha David, 2013; Jerry, 2015)

IV) Evenness (J):

The relative abundance of species is called evenness. It makes sense to consider species richness and species evenness as two independent characteristics of biological communities that together constitute its diversity (HEIP, 1974). Many researchers workout evenness in molluscs (Anuradha David, 2013; Sharma et al., 2011; Jerry, 2015)

Importance of diversity study:

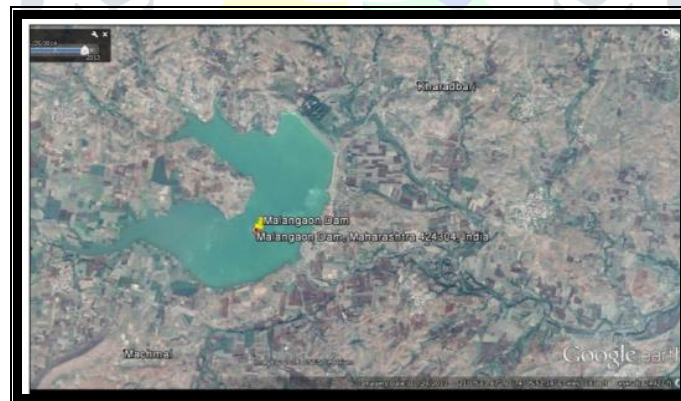
Biodiversity provides the most valuable and numerous ecosystem services which are essential for well-being of human at present and also in the future. The data of good biodiversity are fundamental to biodiversity research, natural resource management and conservation.

Wetlands are important sites for biological conservation because they support a rich biodiversity and present high productivity (Mitsch and Gosselink, 2000). However, biodiversity in wetlands is being reduced in most of the world by agricultural, urban and industrial development and anthropological activities. Almost half of the world's wetlands have disappeared over the last century due to agricultural and urban development (Shine and Klemm, 1999).

Though a lot of work has been done on the hydrological and macro benthic faunal aspects on lotic freshwater bodies by earlier workers, but no work has been done on the molluscan diversity. This study of gastropod diversity from Malangaon reservoir of Dhule district is intended to produce data on the distribution and densities of gastropod mollusc. Such studies contribute to predict where and how many species go extinct so that certain effective measures may be taken to preserve them (Reise and Bartsch, 1990).

MORPHOMETRY OF MALANGAON RESERVOIR –

The Malangaon Reservoir is situated on Kan River near Malangaon villege. It is 14 km away from Pimpalner. It is manmade reservoir constructed in 1967. Geographically it is located at 21^o 05' 13.87" N and 74^o 05' 52.39" E. The storage capacity of the reservoir is 11.33 million sq.meter. The Reservoir is earthen type and the length of it is 1091 meters. The maximum height is 23 meter. The average area of the reservoir is 1587 hectares. It has left canal of 25 kms long which covers about 9 villages. The water of this reservoir is reserved for drinking and irrigation purposes.



Satellite map of Malangaon reservoir

MATERIALS AND METHODS

The gastropod specimens were seasonally collected during June 2015 to May 2016 from Malangaon reservoir. The shells were cleaned by putting them in dilute solution of oxalic acid for few minutes. Then the specimens were preserved in 70% alcohol. The shells were dried at room temperature and preserved for future studies. Selected specimens were photographed on graph paper for measurement. The freshwater snails are identified with the help of books like, 'Field Guide to Fresh Water Mollusc of Western Ghats' (Madhyastha, 1988) Fresh Water Animals of India (Tonapi, 1963), Molluscan series (Hyman, 1967), Fauna of British India (Preston, 1915 and 1916) and verified from Zoological Survey of India, Pune.

For calculating the population density of snails, rectangle or quadrate method was used. To understand a particular biotic community it is very important to work out certain diversity indices. For this Shanon-Weiner (H) (Shannon-Weiner, 1949), Marglef's index (d-) (Marglef, 1958), Simpson's index (dSimp) (Simpson, 1949) and Pielou's evenness index (Pi) (Pielou, 1966) were calculated using the following equations.

1. Shannon-Weiner Index (H):

It depends on both the number of species present and the abundance of each species.

$$H = -\sum P_i (\ln P_i), \text{ where } P_i \text{ is the proportion of each species}$$

$P_i = A/T$ where A is number of each species in the sample, and T is the total number of individuals of all species in the sample.

2. Simpson's Index of Diversity:

"SID" is determined using the following equation-

$$SID= 1-D$$

Where,

$$D= \frac{n_1 (n_1 - 1) + n_2 (n_2 - 2) + \dots + n_{20} (n_{20} - 1)}{N (N - 1)}$$

Where “n” is the total number of individual of a particular species and “N” is the total number of individuals of all species.

3. Richness:

It is simply the number of species in each study reservoir.

$$S= \text{No. of species.}$$

$$4. \text{ Pielou's evenness Index (J)} = \frac{H'}{\ln(S)}$$

Where ‘H’ is the Shannon - Weiner Index and ‘S’ is the number of species.

OBSERVATIONS AND RESULTS

The population density of *Bellamya bengalensis*, was 10, 06 and 08 o/m² in summer, monsoon and winter season respectively, while population density of snail species, *Lymanea acuminata*, in summer, monsoon and winter season was 04, 02 and 03 o/m² respectively. The values of Shannon- Wiener diversity index at Malangaon reservoir were 0.5983, 0.5624 and 0.5860 during summer, monsoon and winter season respectively. The values of Simpson’s index of diversity at Malangaon reservoir were 0.4396, 0.4286 and 0.4364 during summer, monsoon and winter season respectively. The species richness at Malangaon reservoir was 02. The values of Pielou’s index of evenness at Malangaon reservoir were 0.8631, 0.8114 and 0.8454 during summer, monsoon and winter season respectively.

In present study, the seasonal diversity and diversity indices of three snail’s species *Bellamya bengalensis* and *Lymnaea acuminata* inhabiting at Malangaon rservoirs of Dhule district were determined and obtained results were presented in Table No. 1, 2 and 2 and figure No. 1.

Two snail species, *Bellamya bengalensis* and *Lymnaea acuminata* were found at Malangaon reservoir. The population density of *Bellamya bengalensis*, was 10, 06 and 08 O/m² in summer, monsoon and winter season respectively, while population density of snail species, *Lymanea acuminata*, in summer, monsoon and winter season was 04, 02 and 03 O/m² respectively. The values of Shannon- Wiener diversity index at Malangaon reservoir were 0.5983, 0.5624 and 0.5860 during summer, monsoon and winter season respectively. The values of Simpson’s index of diversity at Malangaon reservoir were 0.4396, 0.4286 and 0.4364 during summer, monsoon and winter season respectively. The species richness at Malangaon reservoir was 02. The values of Pielou’s index of evenness at Malangaon reservoir were 0.8631, 0.8114 and 0.8454 during summer, monsoon and winter season respectively.

Table 1: Seasonal variation in diversity of snails from Malangaon reservoir of Dhule district.

Sr. No.	Reservoir	Snail species	Diversity		
			Summer	Monsoon	Winter
02	Malangaon	<i>Bellamya bengalensis</i>	++	++	++
		<i>Lymnaea acuminata</i>	++	++	++

++ = Present, -- = Absent

Table 2: Seasonal variation in density of snails from Malangaon reservoir of Dhule district.

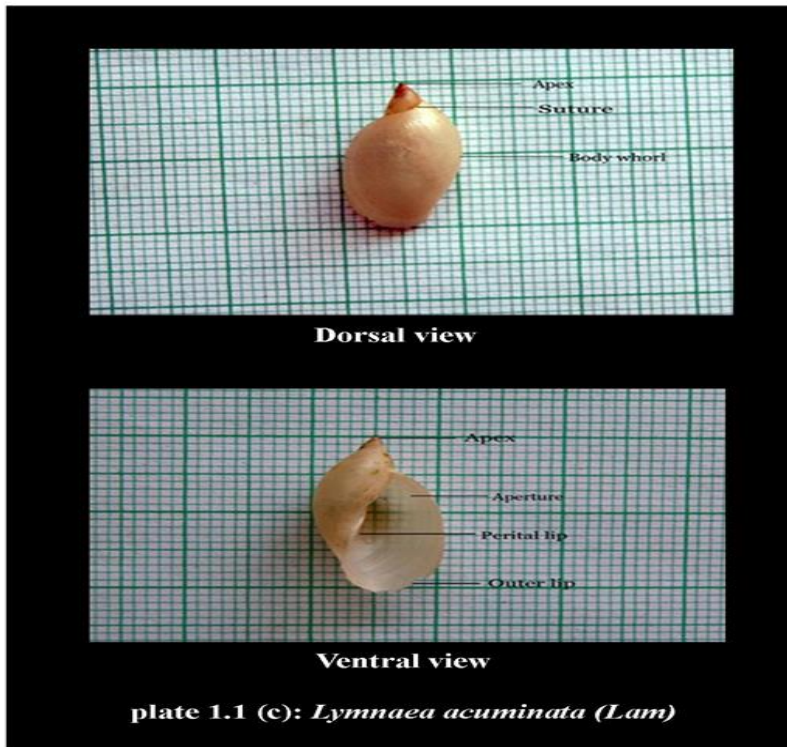
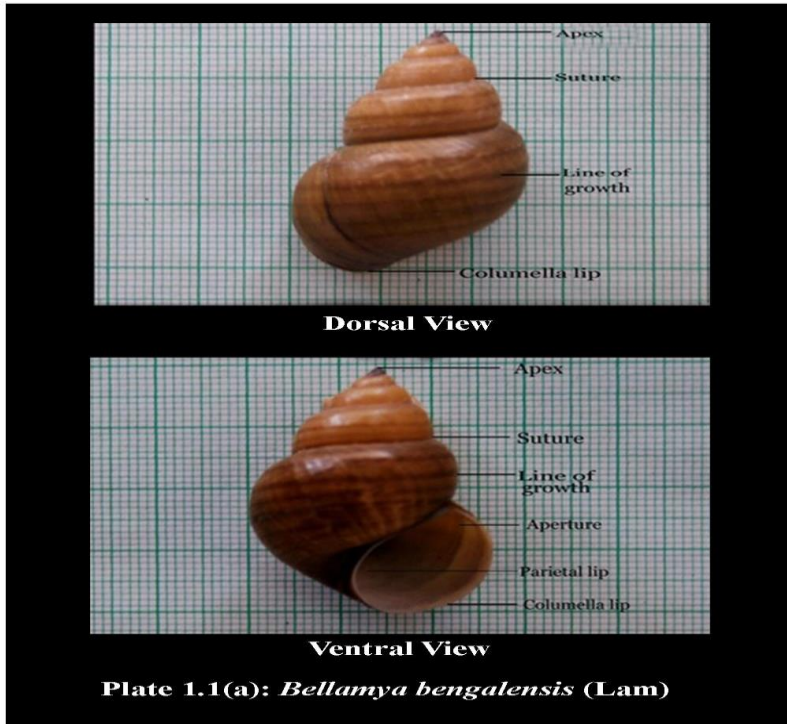
Sr. No.	Reservoir	Snail species	Density O/m ²		
			Summer	Monsoon	Winter
02	Malangaon	<i>Bellamya bengalensis</i>	10±0.24	06±0.21	08±0.32
		<i>Lymnaea acuminata</i>	04±0.18	02±0.25	03±0.18

(±) Indicates standard deviation

Table No. 3: Diversity Indices of freshwater snails from Malangaon reservoir of Dhule District

Sr. No.	Reservoir	Summer				Monsoon				Winter			
		SW	SID	SR	EV	SW	SID	SR	EV	SW	SID	SR	EV
01	Malangaon	0.5983	0.4396	02	0.8631	0.5624	0.4286	02	0.8114	0.5860	0.4364	02	0.8454

SW- Shannon Wiener Index, SID- Simpson Index of Diversity, SR- Species Richness, EV- Evenness



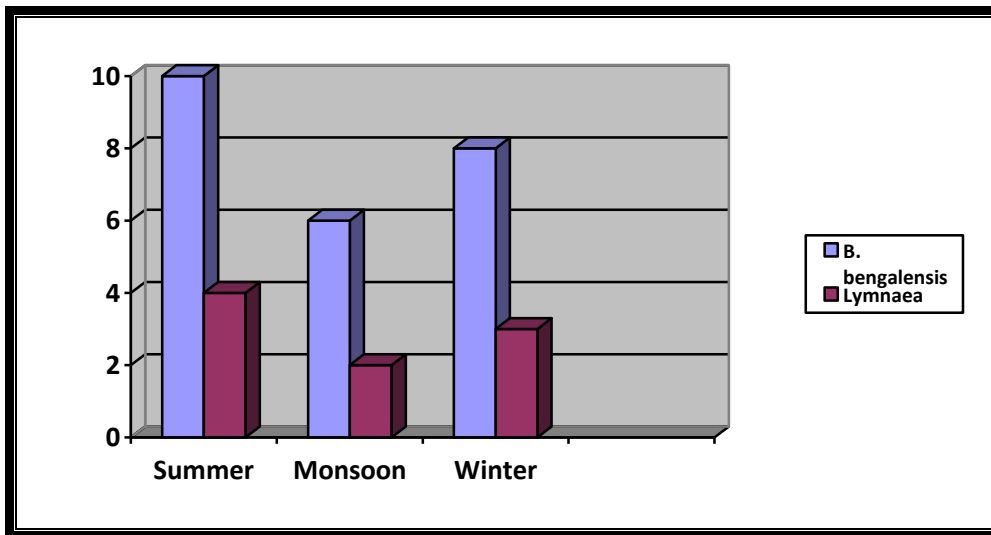


Figure 1 : Density of snail's species in three seasons of the year at Malangaon reservoir of Dhule district.

DISCUSSION

Species diversity is a basic measure of community structure and organization and is the most important parameter to understand the health status of the ecosystem. The diversity index gives a measure of the way on which individuals in a community are distributed.

During summer, monsoon and winter season, the various diversity indices like diversity, density, richness, evenness were determined from three snail species of four reservoirs of Dhule district.

The results of seasonal study indicated that, the various diversity indices like diversity, density, richness, evenness were found highest during summer and lowest in monsoon and intermediate in winter season. Our results are also supported by findings of Singh (2000) and Rathore (2003), Sharma (2009), Garg (2009).

A higher count of gastropods recorded during summer may be due to the effect of reproduction of these macro benthic invertebrates, as juvenile molluscs were observed in collection during this period (Sharma et al., 2011). The abundance of gastropods might be attributed to the presence of vegetation in the shallow depth, which emerged when the stream was dry during the summer period and formed a good feed leading to their multiplication and has also been observed by Manoharan et al., (2006). The species increased their abundance during summer probably corresponding to the water quality, decaying vegetation, increased levels of organic matter in the sediment and higher abundance of bacteria in the water during this time (Comman, 2003). According to Amrutsagar and Lohar (2011), the availability of maximum molluscs during summer months could be related to two important ecological phenomena. (a) The maximum abundance of decomposers settled organic matter and macrophytes on the bottom of water body and, (b) increased water temperature, activating the process of decomposition of these organic sediments.

Several researchers studied seasonality in gastropods. Our results agrees with Karimi et al., (2004), where they found that late Summer and Autumn had the optimal temperature required for breeding and reproduction of snails, and partially agrees with El-Kady et al., (2000), they stated that April, May and June showed the highest number of snails in Sinai Peninsula, while the lowest number was recorded during January and February. Burdi et al., (2008) investigated the population density of gastropods from Indus River and its canals at Kotri barrage Sindh, Pakistan and it was highest during June that showed a strong positive relationship with temperature. Khodake (2009) observed maximum density of gastropod from Sakri taluka of Dhule district and it was maximum in summer, minimum in monsoon. Tusharkumar Gandhi (2010) observed maximum number of gastropods during summer months in Sabarmati river of Gujarat. Zahoor Pir (2010) observed maximum diversity of Molluscs from the river Narmada in summer season. Similar results were obtained by Dhembare (2012) in Ashvi reservoir, Sangamner, Maharashtra, India. Afshan et al., (2013) observed that freshwater snails were more prevalent in summer rainy season as compared to winter season. Sharma et al., (2013) found maximum density of gastropods in summer, minimum in monsoon from village pond near Bikaner, Rajasthan.

CONCLUSION-

From the above results, it is concluded that various diversity indices like diversity, density, richness, evenness were found highest during summer, lowest in monsoon and intermediate in winter season of the year.

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