International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Seasonal Influence on the Diversity of Snails from Nakane Lake in Dhule District of Maharasahtra (India)

Petare R. K[1], Khodake S. P.[2]

Department of Zoology, K. A. M. P. and K. N. K. P. College, Pimpalner, 424306, Dist. Dhule, Maharashtra, India

Abstract: ***Seasonal fluctuations in diversity (diversity indices) of freshwater snails Bellamya bengalensis and Melanoides tuberculata were studied from Nakane Lakein Dhule district during the year 2018-19. It was observed that the diversity and density of both the species was highest in summer, lowest in monsoon and intermediate in winter. The population density of Bellamya bengalensis, was 12, 05 and 08 o/m2 in summer, monsoon and winter season respectively, while population density of snail species, Mellanoides tuberculata, in summer, monsoon and winter season was 18, 07 and 13 o/m2 respectively. The values of Shannon- Wiener diversity index at Nakane Lakewere 0.3664, 0.3647 and 0.3676 during summer, monsoon and winter season respectively. The values of Simpson's index of diversity at Nakane Lakewere 0.50, 0.54 and 0.50 during summer, monsoon and winter season respectively. The species richness at Nakane Lakewas 02. The values of Pielou's index of evenness at Nakane Lakewere 0.97, 0.97 and 0.95 during summer, monsoon and winter season respectively***.

Keywords: Seasonal Diversity, Snails, Nakane lake, Dhule

1. Introduction

Biodiversity is the underpinning of life on Earth. It is crucial for the working of ecosystems which provide us with products and services without which we could not survive. We depend on it for our security and health. It strongly affects our social relations and gives us freedom and choice. Biodiversity is extremely complex, dynamic and versatile like no other feature of the Earth. Its immeasurable components like plants, animals and microbes constitutes the atmosphere, geosphere and hydrosphere into one environmental system which makes it possible for millions of species, including humans, to exist. At the same time, no other feature of the Earth has been so dramatically influenced by man's activities. By changing biodiversity, we strongly affect human well-being and the well-being of every other living creature.

The diversity of freshwater molluscs is massive and their distributions depend on their abilities to colonize a habitat and survive there. It's survival, in turn, is controlled by various physico-chemical factors that ultimately play a major role in determining the ecological characters associated with a particular species. Various detailed qualitative surveys since the 1930s have shown that hardness, pH, altitude, size of water bodies, seasons, temperature, vegetation, and pollution were among the significant aspects influencing the distribution and abundance of molluscs (Dillon, 2000).

Phylum mollusca constitute the second largest invertebrate phylum next to arthropoda (Aravind et al., 2008). It is a large assemblage of animals having diverse shapes, sizes, habits and occupies terrestrial and aquatic habitats (Subba Rao, 2003). Gastropods are common and noticeable elements of the freshwater biota. They are found on the submerged surfaces of any substratum in ponds, streams, lakes and rivers, where calcium concentration is more (Tonapi, 1980). They are the dominant grazers of algae and aquatic plants in many lakes and streams, and can play a vital role in the processing of detritus and decaying organic matter and play an important role in an aquatic food web. The diversity, distribution and abundance of freshwater molluscs in the ecosystem depends up on the availability of food, shelter and safe oviposition sites. Molluscans 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). 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 (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 molluyascan diversity.

Seasonality 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. 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. 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. 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:

1) **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 (pi) is calculated, and then multiplied by the natural logarithm of this proportion (lnpi). 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,Galan et al., 2015)
2) **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).
3) **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).
4) **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 crucial 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. 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 Panzara reservoir of Dhule district is intended to produce data on the distribution and densities of gastropod mollusc. Such studies assist 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 Nakane Lake

The Nakane Lakeis located about 3.8 kms away from Dhule. It is manmade reservoir constructed in 1893 and located geographically at latitude 200 52' 54.82" N and longitude 740 43' 54.09" E. It is the main water reservoir of Dhule city. The water of this Lakeis reserved for drinking and irrigation purposes (Fig. 1).

2. Materials and Methods

The gastropod specimens were seasonally collected during Jan 2018 to Dec.2018 from Nakane Lake. 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 were 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.

Diversity measurement

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.

$H = -\Sigma Pi\ (lnPi)$,

Where ***Pi*** is the proportion of each species,

$Pi = A/T$

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,

$$D = \frac{n1\,(n1-1) + n2\,(n2-2) + \text{———} + n20\,(n20-1)}{N\,(N-1)}$$

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= No. of species. = ***H`***

4) Pielou's evenness Index (J)

$$J = Ln\ (S)$$

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

3. Observations and Results

In present study, the seasonal diversity and diversity indices of two snail's species *Bellamya bengalensis* and *Mellanoides tuberculata* inhabiting at Nakane Lake of Dhule district were determined and obtained results were presented in Table No. 1, 2 and 3 and figure No. 1 and 2.

The seasonal population density of *Bellamya bengalensis*, was 12, 05and 08 o/m2 in summer, monsoon and winter season respectively, while population density of snail species, Mellanoides tuberculata, in summer, monsoon and winter season was 18, 07 and 13 o/m2 respectively. For *Bellamya bengalensis*, the values of Shannon- Wiener index, were 0.3664, 0.3647 and 0.3676 while for *Mellanoides tuberculata* were 0.3064, 0.3143 and 0.2968 during summer, monsoon and winter season respectively. The values of Simpson's index of diversity were 0.50, 0.54 and 0.50 during summer, monsoon and winter season respectively. The species richness of Nakane Lake was 02. The values of Pielou's index of evenness at Nakane Lake were 0.97, 0.97 and 0.95 during summer, monsoon and winter season respectively

4. Discussion

The most important parameter to understand the health status of the ecosystem is species diversityduals in a community are distributed. The various diversity indices like diversity, density, richness, evenness were determined from two snail species of Nakane Lake 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 small sized 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 phenomenons. (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 Gujarath. Zahoor Pir (2010) observed maximum diversity of Molluscans 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.

Petare (2018) observed maximum density of snails Bellamya bengalensis and Mellanoides tuberculata in summer as compare to monsoon and winter season in Panzara reservoir of Dhule district.

5. Acknowledgement

The author is highly grateful acknowledged the Principal and Department of Zoology, K. A. M. Patil and K N. K. P. College, Pimpalner Dist. Dhule, for providing research laboratory.

References

[1] Afshan, Mirza Azhar Beg, Iftikhar Ahmad, M. Maqbool Ahmad and Mazhar Qayyum, 2013. Freshwater Snail Fauna of Pothwar Region, Pakistan. Pakistan J. Zool., (45),1: 227-233.
[2] Ali Suliman Al-Akel and El Amin Mohamed Suliman, 2012. Snail abundance in freshwater canals in the eastern province of Saudi Arabia and acute toxicity studies of copper sulphate in Biomphalaria arabica and Lymnaea auricularia. African Journal of Biotechnology, (11), 58: 12256-12261.
[3] Amrutsagar, M. V. and Prakash S. Lohar, 2011. Diversity of Mollusca and Fish in Gondoor and Nakane Lakes in Dhulia, Northwest Maharashtra, India. Journal of Ecobiotechnology, 3(6): 16-20.
[4] Aneta Spyra, Włodzimierz Serafiński, Małgorzata Strzelec, 2007. The Species Diversity of Freshwater Snails (Gastropoda) In Differently Managed Fish Ponds In South-Western Poland. Ekológia (Bratislava), (26),1: 83–89.
[5] Anuradha David, 2013. Biodiversity and distribution of marine gastropods (Mollusca) during pre- and post-monsoon seasons along the Goa coastline, India. Journal of the Marine Biological Association of India., (55),1:17-24.O.

[6] Aravind, N. A., Rajashekhar, K. P. and Madhyastha, N. A., 2008. Micro mollusks of the Western Ghats: Distribution and Threats. Zoosymposia. 1: 281-294.
[7] Burdi, G. H., W. A. Baloch, F. Begum, A. N. Soomro, and M. Y. Khuhawar, 2008. Ecological studies on freshwater Gastropods (Snails) of Indus River and its canals at Kotri barrage Sindh, Pakistan. Sindh Univ. Res. J. (Sci. Ser.) 40 (2):37-40.
[8] Comman, F. E., Connolly, R. M., Preston, N. P., 2003. Aqua. Res., 34, 359.
[9] Dhembare, Anant J., 2012. Distribution Variables in Macroinvertebrates from Ashvi Reservoir, Sangamner, Maharashtra, India. Euro. J. Exp. Bio., 2 (2):436-439.
[10] Dillon Jr., R. T., (2000): The Ecology of fresh water Mollusca. Cambridge: University Press.
[11] El-Kady, G. A., Shoukry, A., Reda, L. A. & El-Badri, Y. S., 2000. Survey and population dynamics of freshwater snails in newly settled areas of the Sinai Peninsula. Egyptian Journal of Biology, (2): 42-48.
[12] El-Khayat, H. M., Ismail, N. M., Mahmoud, K. M., Ragb, F. M., El-Said, K. M., Mostafa, B. B., El-Deeb, F. A. and Tantawy, A. A., 2011. Evaluation of some chemical parameters as potential determinants of freshwater snails with special reference to medically important snails in Egypt. World Acad. Sci., Eng. Techn., 59: 1313-1326.
[13] Galan, Gloria L., Marilou M. Ediza, Marife S. Servasques, and Heidi C. Porquis, 2015. Diversity of Gastropods in the Selected Rivers and Lakes in Bukidnon, International Journal of Environmental Science and Development, (6), 8: 615-619.
[14] Garg R. K, Rao R. J. and Saksena D. N., 2009. Correlation of molluscan diversity with physicochemical characteristics of water of Ramsagar reservoir. India. Int. J. Biodivers. Conserv.: Vol. 6, 202-207.
[15] Hyman L. H., 1967. The invertibrate Vol. VI Mollusc. Mc Graw Hill, New York.
[16] Jerry T. Cuadrado, 2015. Preliminary Assessment of Freshwater Gastropods in the Selected Rivers in Esperanza, Agusan del Sur, Philippines. The Journal of Zoological Studies, 2(4): 13-20
[17] Karimi, G. R., Derakhshanfar, M. and Paykari, H., 2004. Population density, trematodal infection and ecology of Lymnaea snails in Shadegan, Iran. Arch. Razi Inc., 58: 125-129.
[18] Kazibwe, F., Makanga, B., Rubaire-Akiiki, C., Ouma, J., Kariuki, C., Kabatereine, N. B., Booth, M., Vennervald, B. J., Sturrock, R. F. and Stothard, J. R., 2006. Ecology of Biomphalaria (Gastropoda: Planorbidae) in Lake Albert, Western Uganda: snail distribution, infection with schistosomes and temporal associations with environmental dynamics. Hydrobiologia, 568: 433-444.
[19] Khodake S. P., 2009. Diversity of mollusk fauna in Sakri taluka lakes and rivers in relation to heavy metal pollution. M. Phil. thesis submitted to Dr. B. A. M. University, Aurangabad.
[20] Kobayashi, Y. and Wada, K. (2004): Growth, reproduction and recruitment of the endangered brackish water snail Iravadia (Fairbankia) sakaguchii (Gastropoda: Iravadiidae). Moll. Res. 24: 33-42.
[21] Mackie G. L., 1998. Applied Aquatic Ecosystem Concepts. University of Guelph Custom Course pack. 12 Chapters.
[22] Madhyasta, 1998. Field guide to fresh water mollusc of Western Ghats, Centre for ecological science. Indian Institute of Science, Banglore.
[23] Magurran A. E, 2004. Measuring biological diversity. Blackwell Publishing, Oxford, U. K.
[24] Manoharan, S., Murugesan, V. K. and Palaniswamy, R., (2006): Numerical abundance of benthic macroinvertebrates in selected reservoirs of Tamil Nadu. J. Inland Fish. Soc. India. 38(1): 54-59.
[25] Manoharan, S., Murugesan, V. K. and Palaniswamy, R., 2006. Numerical abundance of benthic macroinvertebrates in selected reservoirs of Tamil Nadu. J. Inland Fish. Soc. India. 38(1): 54-59.
[26] Margalef, R., 1958. Information theory in ecology. General Systems, 3, 36–71.
[27] Mitsch, W. J. and Gosselink, J. G., 2000. Wetlands. New York: John Wiley and Sons.
[28] Nyman, M., Korhola, A. and Brooks, S. J., 2005. The distribution and diversity of Chironomidae (Insecta: Diptera) in western Finnish Lapland, with special emphasis on shallow lakes. Global Ecology and Biogeography, (14), 2:137-153.
[29] Owojori, O. J., Asaolu, S. O. and Ofoezie, I. E., 2006. Ecology of freshwater snails in Opa Reservoir and research from ponds at Obafemi Awolowo University Ile-Ife, Nigeria. Journal of Applied Sciences, 6 (15): 3004-3015.
[30] Pennak R. W., (1989): Freshwater Invertebrates of the United States. A Wiley Inter science publication. John Wiley & Sons Inc. p. 628.
[31] Petare R. K., 2018. Seasonal diversity of freshwater Snails from Panzara resrvior of Dhule District, (M. S.), India., IJRAR January 2019, Volume 06, Issue 1 PP 149-155.
[32] Pielou, E. C., 1975. Ecological diversity. Wiley Interscience, New York, pp. 76–80.
[33] Preston H. B. F. Z. S., 1915. Mollusca, gastropoda and pelicepoda, Fauna of British India, (I): 14-36, 106-226.
[34] Preston H. B. F. Z. S., 1916. Mollusca, gastropoda and pelicepoda, Fauna of British India, (II): 267-268.
[35] Rai, Rakesh and R. K. Jauhari, 2016. Distribution Of Pulmonate Snail Indoplanorbis Exustus In Relation To Variant Abiotic Factors In And Around Water Bodies Of Doon Valley, Uttarakhand. International Journal of Applied Biology and Pharmaceutical Technology, (7), 2: 15-24.
[36] Rathore N. S., 2003. Bio-ecological studies on the banded pond snail Bellamya bengalensis Lamarck (Gastropoda: Viviparidae) in some desert waters. Ph.D.Thesis, Maharishi Dayanand Sarswati University, Ajmer. pp. 100.
[37] Reise K. , Bartsch I., 1990. Inshore and offshore diversity of Epibenthos degraded in North sea . Neth. J. Sea. Res. 25:175179.
[38] Shannon, C. E. and Weaver, W. , 1949. The mathematical theory of communication. University Illinois Press, Urbana IL, pp. 54–59.

[39] Sharma K., 2009. Macrobenthic fauna of some desert waters: A comparative study. M. Phil. Dissertation, Dungar College, Bikaner. pp-52.
[40] Sharma, K. K. Samita Chowdhary and Arti Sharma, 2011. Malacofuana Diversity of River Chenab Fed Stream (GhoManhasan). The bioscan, 6(2): 267-269.
[41] Sharma, Poonam Lata, N. S. Rathore and Richa Thakur, 2013. A Study on Variations in Population Density of Gastropods in a Village Pond Near Bikaner, Rajasthan. Journal of Experimental Biology and Agricultural Sciences; (1): 181-185.
[42] Shine, C. and Klemm, C., 1999. Wetlands, water and the law: using law to advance wetland conservation and wide use. Gland: IUCN.
[43] Simpson, E. H., 1949. Measurement of diversity. – Nature 16: 688–696. [42] Singh Y., 2000. A malacological study on a freshwater pond in the Indian desert. Ph.D. Thesis, Maharishi Dayanand Sarswati University, Ajmer. pp. 123.
[44] Singh Y, Rathore N. S. and Saxena M. M., (2006): Gastropods diversity and its population ecology in a desert pond in Bikaner. Aquatic Biodiversity Management and Conservation, Nature Conservators Publication, Muzaffarnagar, pp.165-174.
[45] Subba Rao, (2003): Indian sea shells Polyplacophora and gastropods, Zoological Survey of India, Kolkata, 1-337.
[46] Subba Rao, 2003. Indian sea shells Polyplacophora and gastropods, Zoological Survey of India, Kolkata, 1-337.
[47] Tonapi G. T., 1980. Fresh water animal of Indian Ecological approach. Oxford and IBH Publishing Co., New Delhi, India p.341.
[48] Tonapi G.T. and Mulherkar Leela, 1963. On the fresh water mollusc of Poona. J. of Bombay Natural History society., (60), 1:103-120.
[49] Tusharkumar Gandhi, 2013. Species richness and abundance of Macro invertebrates in Sabarmati river, Gujarat. International Journal of Advancements in Research & Technology, (2), 2: 1-11.
[50] Zahoor Pir, Imtiyaz Tali, L. K. Mudgal, Anis Seddique, 2010. Distribution of Molluscans in Narmada River, India. Researcher; 2 (10).

Table 1: Density and Density of Freshwater snails in from Nakane Lake in Dhule District

Sr. No.	Name of Parameter	*B. bengalensis (Organisms/m^2)*					*M. tuberculata(Organisms/m^2)*				
		STN.A	STN.B	STN.C	STN.D	Total/Mean	STN.A	STN.B	STN.C	STN.D	Total/Mean
01	Diversity	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +	+ +
01	Density	16	11	14	07	48(12)	20	17	12	23	72(18)

Table 2: Seasonal Variation in density of freshwater snails from Nakane Lake in Dhule District

Sr. No.	Snail Species	Summer (Organisms/m^2)					Monsoon (Organisms/m^2)					Winter (Organisms/m^2)				
		A	B	C	D	Mean	A	B	C	D	Mean	A	B	C	D	Mean
01	*Bellamya bengalensis*	16	11	14	07	12	07	06	04	03	05	11	09	05	07	08
02	Mellanoid tuberculata	20	17	12	23	18	12	09	05	02	07	16	12	15	09	13

Table 3: Diversity indices of freshwater snails in Nakane Lakeof Dhulia District

Sr. No.	Snail Species	Summer					Monsoon					Winter				
		O/m^2	SW (H)	SID	S	J	O/m^2	SW(H)	SID	S	J	O/m^2	SW (H)	SID	S	J
01	*Bellamya bengalensis*	12	0.3664				05	0.3647				08	0.3676			
02	Mellanoid tuberculata	18	0.3064				07	0.3143				13	0.2968			
	Total	30	0.6728	0.50	02	0.97	12	0.6790	0.54	02	0.97	21	0.6644	0.50	02	0.95

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

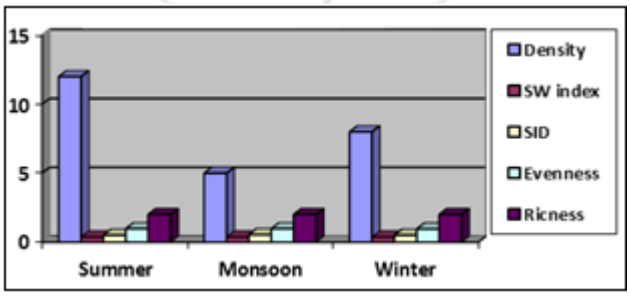

Figure 1: Diversity of *Bellamya bengalensis* from Nakane Lake

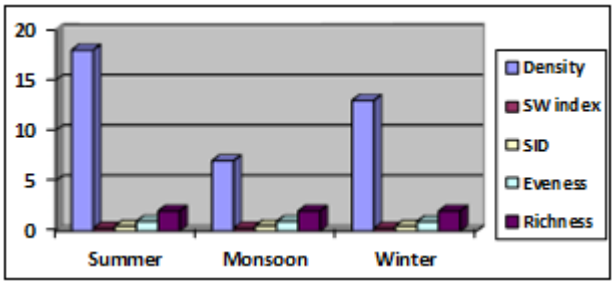

Figure 2: Diversity indices of *Mellanoides tuberculata* from Nakane Lake