



INFLUENCE OF SEASONS ON THE DIVERSITY OF SNAILS FROM DEDARGAON RESERVOIR OF DHULE DISTRICT, (M. S.), INDIA.

Petare R. K.

Department of Zoology,

K. A. M. P. and K. N. K. P. College, Pimpalner, Dist. Dhule, (M. S.) India.

Abstract- Deviations in diversity with several diversity indices of freshwater snails *Bellamya bengalensis*, *Mellanooides uberculata* and *Lymanea acuminata* from Dedargaon reservoir in Dhule district were studied in summer, monsoon and winter seasons of the year. It was perceived that the diversity- density (in the form of Shannon- Wiener index, Simpson's index and Pielou's index) of the three snails species were highest in summer, lowest in monsoon and intermediate in winter. The population density of *Bellamya bengalensis*, was 13, 08 and 10 o/m² in summer, monsoon and winter season respectively. In *Mellanooides uberculata*, population density was found 09, 05 and 07 o/m² of snail species while in *Lymanea acuminata*, it was 06, 04 and 05 o/m² in summer, monsoon and winter season respectively. The values of Shannon- Wiener diversity index at Dedargaon reservoir were 1.0511, 1.0551 and 1.0595 during summer, monsoon and winter season respectively. The values of Simpson's index of diversity at Dedargaon reservoir were 0.6587, 0.6764 and 0.6709 during summer, monsoon and winter season respectively. The species richness at Dedargaon reservoir was 03. The values of Pielou's index of evenness at Dedargaon reservoir were 0.9567, 0.9452 and 0.9604 during summer, monsoon and winter season respectively. A higher count of gastropods recorded during summer may be due to the effect of reproduction, presence of vegetation in the shallow depth, water quality, decaying vegetation, increased levels of organic matter in the sediment and higher abundance of bacteria in the water abundance of decomposers settled organic matter and macrophytes on the bottom of water body and, increased water temperature, activating the process of decomposition of these organic sediments.

Keywords- Impact, seasons, Diversity indices, Dedargaon, *Bellamya bengalensis*, *Mellanooides uberculata*, *Lymanea acuminata* Dhule.

Introduction

The diversity is very complex and exciting 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). Phylum Mollusca 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 conspicuous elements of the freshwater ecosystem. 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 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 like physicochemical parameters of water as well as biological factors such as availability of food, aquatic macrophytes, and competition and predator-prey interactions affect diversity and distribution of snails (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. The basic idea of a diversity index is to obtain a quantitative estimate of biological variability that can be used to compare biological objects. 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). 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 work out 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 work out 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 work out 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 work out 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 Dedargaon 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 Dedargaon reservoir [Plate- 1]

The Dedargaon medium reservoir was constructed at Dedargaon-Tikhi village 10 kms away from Dhule. It is manmade reservoir located at latitude $20^{\circ} 47' 11.07''$ N and longitude $74^{\circ} 46' 35.49''$ E. It is surrounded by agricultural and hilly regions. It harbors rich aquatic vegetation and animals. The water of this reservoir is used for drinking and irrigation purposes.



Plate 1- Satellite map of Dedargaon Reservoir

Observations and Results-

In present study, the seasonal diversity and diversity indices of three snail's species *Bellamya bengalensis* and *Lymnaea acuminata* inhabiting at Dedargaon reservoirs of Dhule district were determined and obtained results were presented in Table No. 1, 2 and 3 and Fig. 1.

The population density of *Bellamya bengalensis*, was 13, 08 and 10 o/m^2 in summer, monsoon and winter season respectively, while population density of snail species, *Mellaniodes tuberculata* was 09, 05 and 07 o/m^2 in summer, monsoon and winter season respectively. In *Lymnaea acuminata*, population density in summer, monsoon and winter season was 06, 04 and 05 o/m^2 respectively. The values of Shannon- Wiener diversity index at Dedargaon reservoir were 1.0511, 1.0551 and 1.0595 during summer, monsoon and winter season respectively. The values of Simpson's index of diversity at Dedargaon reservoir were 0.6587, 0.6764 and 0.6709 during summer, monsoon and winter season respectively. The species richness at Dedargaon reservoir was 03. The values of Pielou's index of evenness at Dedargaon reservoir were 0.9567, 0.9452 and 0.9604 during summer, monsoon and winter season respectively.

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

Sr. No.	Reservoir	Snail species	Diversity		
			Summer	Monsoon	Winter
01	Dedargaon	<i>Bellamyia bengalensis</i>	++	++	++
		<i>Mellaniodes tuberculata</i>	++	++	++
		<i>Lymanea acuminata</i>	++	++	++

++ = Present, -- = Absent

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

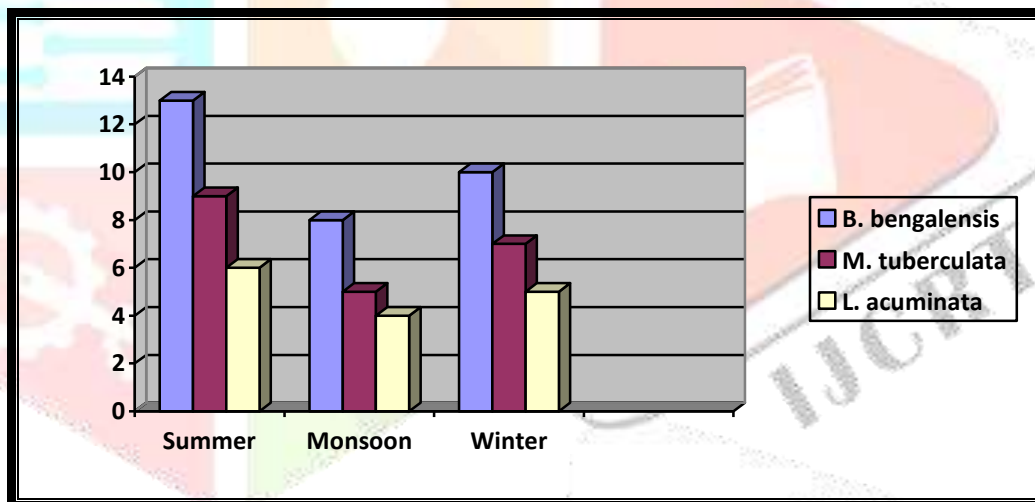
Sr. No.	Reservoir	Snail species	Density O/m ²		
			Summer	Monsoon	Winter
01	Dedargaon	<i>Bellamyia bengalensis</i>	13±0.21	08±0.23	10±0.17
		<i>Mellaniodes tuberculata</i>	09±0.36	05±0.18	07±0.14
		<i>Lymanea acuminata</i>	06±0.11	04±0.12	05±0.11

(±) Indicates standard deviation

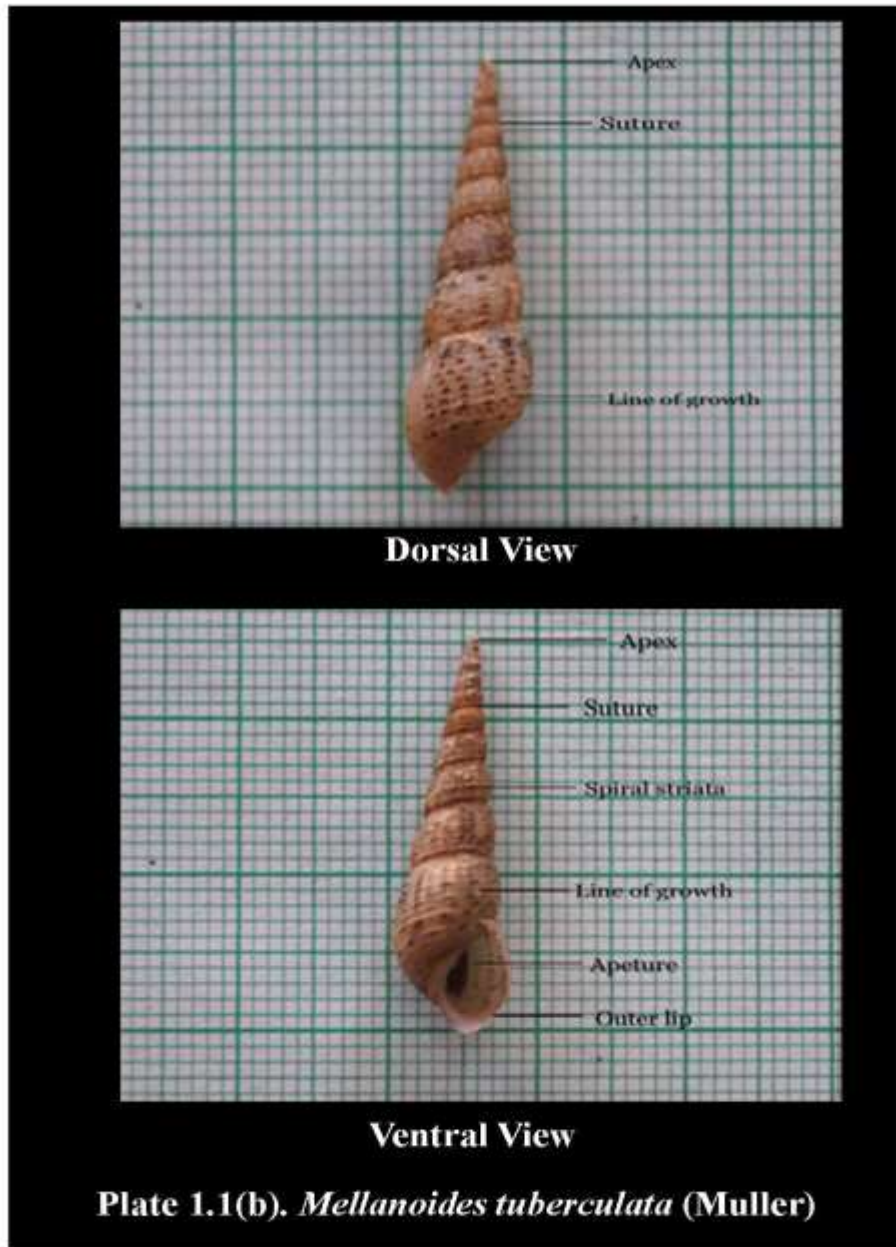
Table No. 3: Diversity Indices of freshwater snails from Dedargaon reservoir of Dhule District

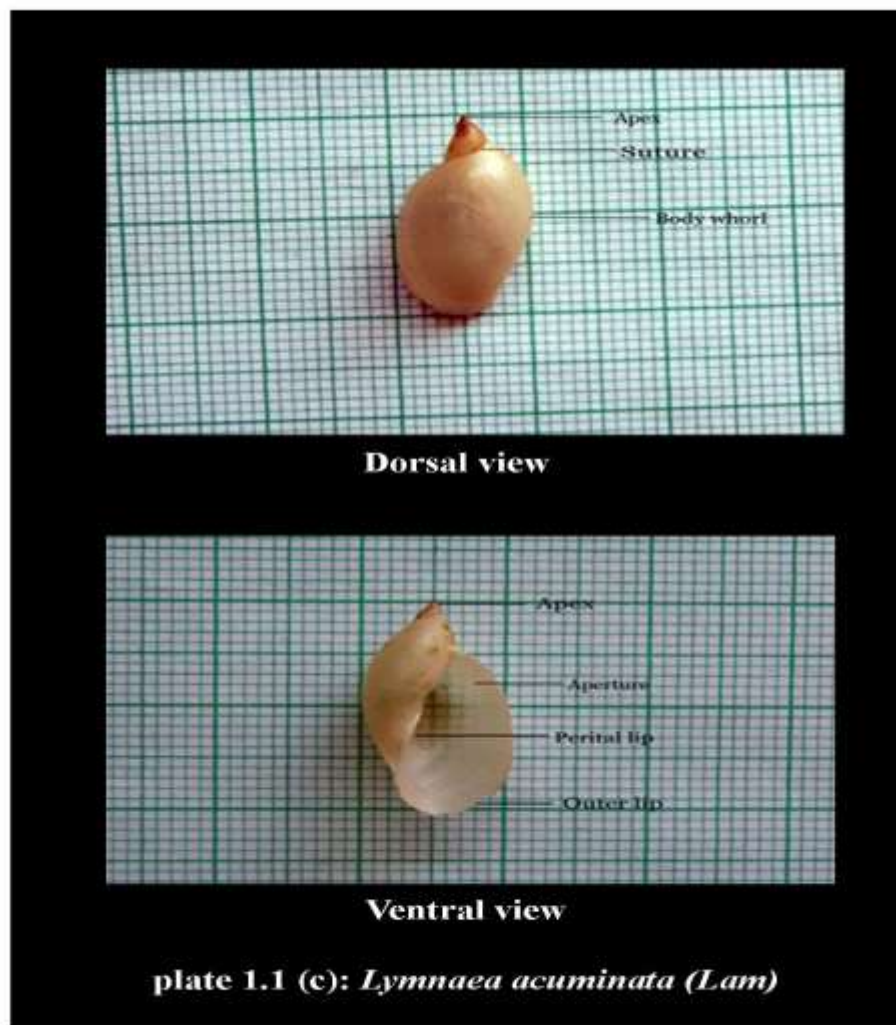
Sr. No.	Reservoir	Summer				Monsoon				Winter			
		SW	SID	SR	EV	SW	SID	SR	EV	SW	SID	SR	EV
01	Dedargaon	1.0511	0.6587	03	0.9567	1.0551	0.6764	03	0.9452	1.0595	0.6709	03	0.9604

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 Dedargaon reservoir 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 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.

Many researchers studied effect of seasonality on the diversity of 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.

CONCLUSION-

From the above results, it is concluded that various diversity indices like diversity, density, richness, evenness of three snails' species, *Bellamya bengalensis*, *Mellanoides tuberculata* and *Lymnaea acuminata* were found highest during summer, lowest in monsoon and intermediate in winter season of the year.

ACKNOWLEDGEMENT-

The author is highly gratefully 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. Ekologia (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.
- [6] 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.
- [7] Comman, F. E., Connolly, R. M., Preston, N. P., 2003. Aqua. Res., 34, 359.
- [8] Dhembare, Anant J., 2012. Distribution Variables in Macroinvertebrates from Ashvi Reservoir, Sangamner, Maharashtra, India. Euro. J. Exp. Bio., 2 (2):436-439.
- [9] 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.
- [10] 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.
- [11] 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.
- [12] Gandhi, Tusharkumar, 2013. Species richness and abundance of Macro invertebrates in Sabarmati River, Gujarat. International Journal of Advancements in Research & Technology, (2), 2: 1-11.
- [13] 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.
- [14] Horsák, M., 2006. Mollusc community patterns and species response curves along a mineral richness gradient: a case study in fens. Journal of Biogeography, (33), 1: 98- 107.
- [15] Hyman L. H., 1967. The invertebrate 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] Mackie G. L., 1998. Applied Aquatic Ecosystem Concepts. University of Guelph Custom Course pack. 12 Chapters.
- [21] Madhyasta, 1998. Field guide to fresh water mollusc of Western Ghats, Centre for ecological science. Indian Institute of Science, Bangalore.
- [22] Magurran A. E., 2004. Measuring biological diversity. Blackwell Publishing, Oxford, U. K.
- [23] 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.
- [24] Margalef, R., 1958. Information theory in ecology. General Systems, 3, 36–71.
- [25] Mitsch, W. J. and Gosselink, J. G., 2000. Wetlands. New York: John Wiley and Sons.
- [26] Mohamed A. Hussein, Ahmad H. Obuid-Allah, Amal A. Mahmoud and Heba M. Fangary, 2011. Population dynamics of freshwater snails (Mollusca: Gastropoda) at Qena Governorate, Upper Egypt. Egypt. Acad. J. Biolog. Sci., 3(1): 11 -22.
- [27] 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.
- [28] 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.
- [29] Pielou, E. C., 1975. Ecological diversity. Wiley Interscience, New York, pp. 76–80.
- [30] Preston H. B. F. Z. S., 1916. Mollusca, gastropoda and pelicepoda, Fauna of British India, (II): 267-268.
- [31] Preston H. B. F. Z. S., 1915. Mollusca, gastropoda and pelicepoda, Fauna of British India, (I): 14-36, 106-226.

- [32] 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.
- [33] 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 Saraswati University, Ajmer. pp. 100.
- [34] Reise K., Bartsch I., 1990. Inshore and offshore diversity of Epibenthos degraded in North Sea. *Neth. J. Sea. Res.* 25:175-179.
- [35] Shannon, C. E. and Weaver, W., 1949. *The mathematical theory of communication*. University Illinois Press, Urbana IL, pp. 54–59.
- [36] Sharma K., 2009. Macro-benthic fauna of some desert waters: A comparative study. M. Phil. Dissertation, Dungar College, Bikaner. Pp-52.
- [37] Sharma, K. K. Samita Chowdhary and Arti Sharma, 2011. Malacofauna Diversity of River Chenab Fed Stream (Gho-Manhasan). *The bioscan*, 6(2): 267-269.
- [38] 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.
- [39] Shine, C. and Klemm, C., 1999. *Wetlands, water and the law: using law to advance wetland conservation and wide use*. Gland: IUCN.
- [40] Simpson, E. H., 1949. Measurement of diversity. – *Nature* 16: 688–696.
- [41] Singh Y., 2000. A malacological study on a freshwater pond in the Indian desert. Ph.D. Thesis, Maharishi Dayanand Saraswati University, Ajmer. pp. 123.
- [42] Subba Rao, 2003. Indian sea shells Polyplacophora and gastropods, *Zoological Survey of India, Kolkata*, 1-337.
- [43] Tonapi G. T., 1980. Fresh water animal of Indian Ecological approach. Oxford and IBH Publishing Co., New Delhi, India p.341.
- [44] Tonapi G.T. and Mulherkar Leela, 1963. On the fresh water mollusc of Poona. *J. of Bombay Natural History society*. (60), 1:103-120.
- [45] UNEP, 1992. *Convention on Biological Diversity, United Nations Environment Programme NA 92-7807*. Seddon M.B. (1998) – Red list for mollusc: A tool for conservation. *J. of Concology: London special publication*.
- [46] Zahoor Pir, Imtiyaz Tali, L. K. Mudgal, Anis Seddique, 2010. Distribution of Molluscans in Narmada River, India. *Researcher*; 2 (10).

