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Zoology

THE SPECIES COMPOSITION OF MACROZOOBENTHOS IN NAGARAM TANK OF WARANGAL DISTRICT, TELANGANA STATE – A REVIEW

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ABSTRACT Macrozoobenthic community of Nagaram tank has been studied the species composition of benthos with different thermal conditions. The results revealed that the tank differ in the number of species of macrozoobenthic organisms. Quantitative assessments, seasonal variations and distribution of the macrozoobenthic community have been analyzed. There is a slight difference in species number between stations to station, but a considerable difference in species composition between seasons to season.

The total 5 macro benthos species were recorded amongst which, 3 species from gastropod and 2 species from bivalve. Among gastropod, *Indoplanrbis exustus, Bellamya bengalensis* and *Thiara tuberculate* were present. During the study *Lamellidens corrianus* and *Parreysia rugossa* formed the main bulk of bivalve population almost thought the study period. About 54% of Gastropoda and 46% Bivalves were represented. Comparatively Gastropoda represented more population in the study period. In the present investigation, at all the sampling stations the highest population was in winter followed by summer and rainy season. As far as, seasonal abundance of benthos is concerned. It may be concluded that all the physico-chemical parameters are at nearly permissible limit at all stations. The overall tank is not considered as polluted one. The tank having rich diversity of flora and fauna, the tank water is suitable for fish culturing and irrigation purpose.

KEYWORDS : Species composition, Seasonal abundance, Physico-chemical parameters and Fish culture

INTRODUCTION

The organisms living on the bottom of the water bodies are termed as benthos. The benthos, an integral part of the food web is a biosensor of the solid-liquid interface, which has become an important aspect of the limnology. The benthic macro invertebrates may be used as convenient tool to assess overall biodiversity in aquatic ecosystems. Therefore, the 'occurrence or otherwise absence' of particular species could be used as indicator of specific environment and habitat condition.

Many of the benthic forms are detritivores and depend to a large extent on organic detritus as food. As the detritus reach the bottom, it enters a web of energy transfer that sustains the benthic community. Thus, the benthic macro invertebrates play a key role in the mineral recycle and in turn serve as food of fish. The earlier studies have been made on macro benthos by Michael (1968) and Mandal and Moitra (1975). However, a study on the benthic fauna of littoral zone seems to be qualitatively and quantitatively merge (Wetzel and Likens, 1991). Benthic communities have been the best indicators of water quality and organic pollution because of their constant presence and relatively long sedentary habitats, comparatively large size and varying tolerance to stress (Curry 1962; Wass 1967; Myslinski and Ginsburg 1977; Reddy and Rao 1989 and Petridis 1993). Benthological variables are particularly useful in measuring the water quality and such biological monitoring can provide resolution in space and time, (Tittizer and Kothe 1978 and Prince 1978). Literature on limnology of Indian fresh water ecosystem is in replete with a number of in depth studies (Das, 1989), but such studies in relation to benthos are meager (Vasisht and Bhandal, 1979). Although the benthic organisms of Indian inland water bodies were investigated by various researchers (Rajan 1965; Krishnamurthy, 1966; Michael, 1968 and Rai et al., 1981). The benthic macro invertebrate communities in a lake or reservoir fulfill all of these requirements (Wiederholm, 1980). Nandi and Choudhry (1983) identified benthic macro fauna and Subba Rao et al., (1987) on molluscan species in benthos. The species composition especially of the benthic community often reflects the environmental conditions. Degraded water quality affects macro invertebrates including benthic organisms (Bazzanti and Bambaergno, 1987) by eliminating many of them and those which remain become abundant seemingly due to: (i) decreased competition, and (ii) increased tolerance for adverse conditions. Therefore, macro benthic organisms serve as excellent diagnostic indicators for measuring extent of pollution of aquatic ecosystem.

The taxonomic study of the freshwater molluscs of the Indian subcontinent has been carried out by several workers (Blanford and Godwin-Austen, 1908; Gude, 1914; Preston, 1915; Annandale and Srinivas Rao, 1927; Satyamurthi, 1960; Tonapi and Mulhelker,1963; Dalal and Pandya, 1973; Malhotra and Singh Dutta, 1977). Some notable contributions on molluscs are of Govind (1969) and Krishna Moorthi and Sarkar (1979) worked on the bottom macro fauna of the Tungabhadra reservoir, Gupta (1976) worked on macro benthic fauna of Loni reservoir. According to Brinkhurst (1974) the tropic typology of lakes can also be based on benthic communities. Similarly, Jhingran (1977) compiled information on the bottom biota of the major rivers, lakes and reservoirs of India. Due to population increase and advent of industrialization, the ecosystems are getting adversely influenced by anthropogenic activities (Sharma and Durve, 1982). Rich bottom coupled with conducive physico-chemical conditions encourage fast colonization of the benthic community. The low number of species and density of benthic life is attributed to low bottom oxygen (Moore, 1942). Welcome (1979) stressed on the combination of factors like temperature, dissolved oxygen, nature of substratum, wave action, grazing and predation etc. as major factors for the growth of benthic faunal structures. Patil and Gouder (1989) have done excellent work on fresh water Molluscs of Dharwad. The distribution, composition and abundance of benthic community are biological indicators of water and sediment quality and trophic status at the soil-water interface (Pandey et al., 1983) and Benthic community plays an important role in the energy flow from primary producer to fish (Odum, 1971). The complexity of functional dynamics in the pond ecosystem makes it imperative for a scientific probe to quantity the species diversity and density distribution of benthic organisms with time and space. Several investigators have studied the freshwater benthic community structure (Murugan et al., 1980; Bazzanti and Seminara, 1985; Radhey Shyam and Naik; 1990; Radhey Shyam et al., 1993 and Rosenberg and Resh, 1993) and their seasonal function, but there is a deep study on the composition, fluctuation in their abundance and bio-physico-chemical interaction with time and space of rural fish ponds.

Although, the benthic invertebrates communities are excellent indicators of the health characteristic of fresh water environment and form essential food materials for various commercially important species of fishes in aquaculture, much attention has not been paid to their study, particularly in India. Thus, the knowledge on the composition, distribution and abundance of benthic communities in both time and space is a prerequisite for reservoir fisheries management. A number of investigations are on record on the benthic communities of central and Southern lakes and reservoirs of India (Krishnamurthy, 1966; Govind, 1969; Sugunan and Das 1983). Similar studies were conducted on lakes in and around Hyderabad, Andhra Pradesh (Chandrasekhar, 1994 and 1997; Archana rani, 2003; Anitha et al., 2004 and 2005 and Rayali Srinivas Rao, 2006). Duran and Suiemez (2007) worked on utilization of both macro invertebartes and physico-chemical parameters for evaluating water quality in stream Cekerek. However, similar investigations were carried out on molluscs in the recent years (Tsalolikhin, 2001; Paul and Nandi, 2003;

Khan et al., 2007; Saxena, 2007; Singh et al., 2007; Roy and Gupta, 2010; Hyslop 2012; Kumar and Vyas 2012; Ishaq, 2013; Nautiyal and Mishra, 2012 & 2013; Negi, 2013; and Vyas et al., 2012).

MATERIALS AND METHODS

Collection of Benthos: During the period of investigation, benthic samples were collected with the help of a tray type samples (size 30 x 25 x 50m) with a sliding thin but hard iron plate covering the entire mouth of the tray. After sliding away iron plate the tray of the sample was placed firmly on the bottom by hand and then inserting the plate covered the mouth. Samples transferred into the laboratory in polythene bag. The collected mud was transferred to a measuring cylinder and volume was measured to sort out organism. Sample suspension was prepared in water and was filtered through 2 mm and 0.5 mm mesh size.

The filtrate was transferred into tray and added sugar solution (10 gms in 250 ml). Due to increase in the density of water benthic organisms floats on the surface and were picked-up with the help of dropper and preserved in 4% formalin for identification (Tonapi 1980 and Pennak 1989). The identification is based mainly on the shell characters described earlier (Blanford and Godwin- Austin, 1908; Gude, 1914 and 1921; Preston, 1915; Satyamurthy,1960 and Ward and Whipple, 1992). The organisms were identified species – wise and their abundance was calculated as number of organisms per square meter. (Jhingran *et al.,*1969).

For qualitative analysis of macro invertebrates standard keys were used (Subba Rao, 1989). For quantitative analysis, numbers of benthos per unit area were calculated as follows.

Benthos No/m2 $= \frac{N}{A} \times 10^4$

Where N= Number of organism per sample

A = Biting area of sampler (15 x 15cm)

RESULTS AND DISCUSSION

Benthic macro invertebrates can be used as a barometer of overall biodiversity in aquatic ecosystem. The abundance of benthic fauna greatly depends on physical and chemical property of the substratum (Paul and Nandi, 2003). The study of aquatic ecosystem without the study of its benthos is incomplete. Many benthic forms are detritivores and play a key role in the mineral recycling of organic matter and many benthic insect larvae and Oligochaeta are the major food sources for small and big bottom feeders (Anitha, 2002). Aquatic invertebrate serve as a primary food source for many fishes. They are the preferred indicator of long term water quality due to their limited mobility. Members of the phylum Mollusca second only to Arthropoda a number of species have colonized every possible habitat on the globe and are dominant in benthic communities of all aquatic ecosystems. A perusal of shows a marked paucity of information on the occurrence, distribution, ecology and population density of these molluscan elements from the state save for some reports on their taxonomy from within the state (Annadale 1918; Duda and Verma 1992; Verma and Duda 1996; Gupta and Khajuria 1996).

The monthly, seasonal variation, composition, percentage and species diversity of molluscan population in the Nagaram tank are summarized in Table No. 1 to 5 and Fig. No. 1 to 4. Average value of molluscans collected at different stations of the tank. Two groups of mollusca viz. Gastropoda and Bivalve were indentified during the period of study. Total 3 species were in Gastropoda and 2 species were in Bivalve were identified. Gastropoda of Mollusca contributed the main bulk of the fauna. About 54% of Gastropoda and 46% Bivalves were represented. Comparatively Gastropoda represented more population in the study period.

Gastropoda: Among Gastropoda, *Indolplanrbis exustus*, *Bellamya bengalensis, Thiara tuberculate* were present during the study period. The rainy season of 2007-08, the total gastropoda density varied from 130 to 200 numbers/m2, while for the same season, of 2008-2009 and 2009-2010, it varied between 137 to 189, 136 to 204 numbers/ m2 respectively. They were highest recorded during the month of July of 2009. While for the winter season of 2007-08, the total gastropoda density varied between 222 to 293 numbers/ m2, while for the same season of year 2008-09, 2009-10, it varied between 225 to 293, 230 to 287 no/m2 respectively. They were highest recorded during October of 2007 and 2008. During summer season of 2007-2008 the total gastropoda population varied between 140 to 220 numbers/ m2, while for the same season of year 2008-2009, 2009-2010 it varied between 151 to 232 and 153 to 225 numbers/ m2 respectively. *Bellamya bengalensis, Indoplanrbis* were more dominant species among gastropods (Table No. 1 to 3). As far as seasonal variation, the minimum Gastropoda population was recorded175.25 ± 22.82 during rainy season of the year 2008-09 and maximum 257.75 ± 28.15 during winter season of the same year.

Bivalve: All the two species of mollusca were present in the tank through out the study period. *Lamellidens corrianus* and *Parreysia rugossa* formed the main bulk of bivalve population almost thought the study period. In general at Stations 1 and 2 the bivalves were more dominant and at Station 3 and 4 these were less dominant in the distribution. The total bivalve population density was presented in Table No. 1to 3 composition and percentages were depicted in Table No. 4 and 5, Fig. No. 1 to 4 respectively. Fluctuations of molluscans during the rainy season of the year 2007-2008 varied between 21 to 33 numbers/ m2, while for the same season of 2008-2009, 2009-2010, it fluctuated between 21 to 32, 20 to 30 numbers/ m2 respectively. During winter season of the year 2007-2008 the bivalve population varied between 205 to 280 numbers/ m2, during same season of 2008-2009, 2009-2010 the bivalve population varied between 212 to 275, 210 to 278 numbers/ m2 respectively. While for the summer season of 2007-2008, it varied between 260 to 285 numbers/ m2 and for the same season of the year 2008-2009, 2009-2010 it fluctuated between 255 to 280, 265 to 295 numbers/ m2 respectively. The lowest population density was recorded during rainy season only. As far as seasonal variation, the minimum bivalve population was recorded 25.50 ± 4.43 during rainy season of the year 2009-2010 and maximum 275.50 ± 13.32 numbers/ m2 during summer season of the same year.

Table: 1 Shows Seasonal mean Values of Molluscan population during year 2007-2008

S. No.	GROUP and SPECIES	Rainy			Winter			Summer			Yearly		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
	GASTROPODA												
1	*Indoplanorbis exustus* (Deshayes)	14.25	±	1.50	24.00	±	5.88	15.75	±	3.30	18.00	±	2.20
2	*Bellamya bengalensis* (Lamark)	146.25	±	33.50	210.00	±	29.43	153.75	±	31.98	170.00	±	2.05
3	Thiara tuberculata (Muller)	10.25	±	3.30	20.50	±	4.20	14.25	±	4.34	15.00	±	0.56
	Total	**170.75**	**±**	**29.36**	**254.50**	**±**	**29.33**	**183.75**	**±**	**35.29**	**203.00**	**±**	**3.43**
	BIVALVE												
1	*Lamellidens carrianus* (Lee)	20.50	±	4.20	162.50	±	27.53	181.50	±	14.45	121.5	±	11.69
2	*Parreysia rugossa*	8.00	±	1.63	82.50	±	6.45	90.00	±	9.12	60.16	±	3.79
	Total	**28.50**	**±**	**5.19**	**245.00**	**±**	**32.40**	**271.50**	**±**	**10.27**	**181.66**	**±**	**14.46**

Table: 2 Shows Seasonal mean Values of Molluscan population during year 2008-2009

S. No.	GROUP and SPECIES	Rainy			Winter			Summer			Yearly		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
	GASTROPODA												
1	*Indoplanorbis exustus* (Deshayes)	14.75	±	2.62	25.25	±	5.73	15.25	±	4.11	18.41	±	1.55
2	*Bellamya bengalensis* (Lamark)	146.25	±	28.39	212.50	±	31.75	161.25	±	31.19	173.33	±	1.80
3	Thiara tuberculata (Muller)	9.25	±	3.86	20.00	±	4.08	14.75	±	5.25	14.66	±	0.74
	Total	**170.25**		**22.82**	**257.75**		**28.15**	**191.25**		**34.98**	**206.41**	**±**	**6.09**

	BIVALVE													
1	*Lamellidens carrianus* (Lee)	20.75	±	3.77	161.75	±	23.42	179	±	16.24	120.50	±	9.94
2	*Parreysia rugossa*	6.50	±	2.38	85.00	±	5.77	88.75	±	10.30	60.08	±	3.97
	Total	**27.25**	**±**	**4.85**	**246.75**	**±**	**26.31**	**267.75**	**±**	**10.50**	**180.58**	**±**	**11.12**

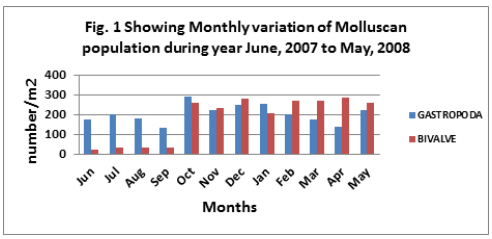
Table: 3 Shows Seasonal mean Values of Molluscan population during year 2009-2010

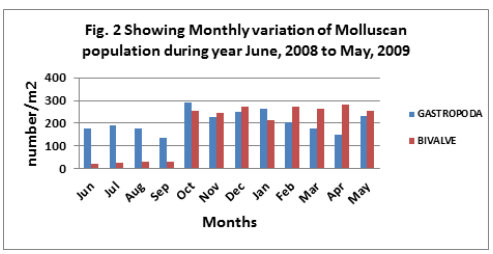
S. No.	GROUP and SPECIES	Rainy			Winter			Summer			Yearly		
		Mean	±	**S.D**	**Mean**	±	**S.D**	**Mean**	±	**S.D**	**Mean**	±	**S.D**
	GASTROPODA												
1	*Indoplanorbis exustus* (Deshayes)	14.25	±	1.50	24.25	±	6.75	17.50	±	2.08	18.66	±	2.87
2	*Bellamya bengalensis* (Lamark)	152.50	±	33.78	211.25	±	24.95	159.75	±	29.50	174.5	±	4.41
3	Thiara tuberculata (Muller)	10.25	±	4.03	21.50	±	4.72	14.25	±	4.34	15.33	±	0.34
	Total	**177.00**	**±**	**28.92**	**257.00**		**23.33**	**191.50**		**31.11**	**208.50**	**±**	**4.01**
	BIVALVE												
1	*Lamellidens carrianus* (Lee)	18.75	±	2.98	162.25	±	27.20	182.50	±	13.22	121.16	±	12.15
2	*Parreysia rugossa*	6.75	±	2.21	84.75	±	5.50	93.00	±	11.22	61.50	±	4.55
	Total	**25.50**	**±**	**4.43**	**247.00**	**±**	**29.14**	**275.50**	**±**	**13.32**	**182.66**	**±**	**12.51**

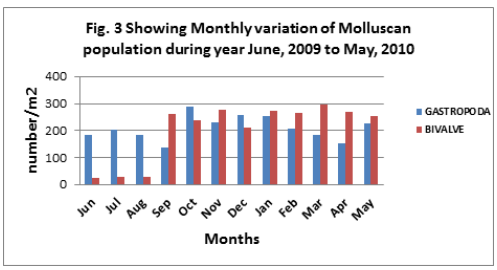
Table – 4 Showing Composition of Molluscan population

Months	Molluscans	
	Gastropoda	**Bivalve**
June - **2007**	**175**	**21**
July	**200**	**30**
August	**178**	**33**
September	**130**	**30**
October	**293**	**260**
November	**222**	**235**
December	**248**	**280**
January – 2008	**255**	**205**
February	**203**	**270**
March	**172**	**271**
April	**140**	**285**
May	**220**	**260**
June - **2008**	**178**	**21**
July	**189**	**26**
August	**177**	**30**
September	**137**	**32**
October	**293**	**255**
November	**225**	**245**
December	**251**	**275**
January – 2009	**262**	**212**
February	**205**	**271**
March	**177**	**265**
April	**151**	**280**
May	**232**	**255**
June - **2009**	**185**	**20**
July	**204**	**24**
August	**183**	**28**
September	**136**	**30**
October	**287**	**260**
November	**230**	**240**
December	**256**	**278**
January – 2010	**255**	**210**
February	**206**	**272**
March	**182**	**265**
April	**153**	**295**
May – **2010**	**225**	**270**
Total	**7640**	**6539**
Grand Total	**14179**	

In the present investigation, total 5 macrobenthic species were recorded among which 03 species from Gastropoda and 02 species from Bivalve. In similar survey done by Vikram Reddy and Malla Rao (1997) on Bhadrakali reservoir in Warangal, Andra Pradesh, 17 species were recorded. Meshram (2003) has described 6 species in Wadali lake Amravati, Maharashtra. Srinivas Rao (2004) recorded 13 species of macrobenthic invertebrates belonging to three major groups. Annelids, Arthropods and Mollusca have been uncounted in the littoral zone of Banjara lake. Giri et al., (2008) recorded 13 Mulluscan species belonging to 11 genera, 8 families and 4 orders were documented during the study period from different stations of Dwarkeswar and Kansai rivers in West Bengal. Rohankar (2009) recorded total 14 macro benthic species among which 07 species from Gastropods, 5 species from insect and only two species from oligochata in rural lake Aheri, Gadchiroli. The diversity and abundance of benthic inhabitants of a particular water body is much influenced by physico chemical status of water body which do show seasonal alternations depends on cascade of events (Kodarkar, 1995). Virbickas and Pliuraite (2002) studied the species composition of macrozoobenthos in 12 small Lithuanian rivers with different thermal conditions. Bequiraj et al., (2007) worked on molluscs and annelids predominant in the species composition of the macrozoobethos of the Albanian lagoon. Molluscs, crustaceans and chironomids have the highest density in the macrozoobenthic community. There is a small difference in total species number between lagoons, but a considerable difference in species composition between Patok and the two other. Ankit Kumar and Vipin Vyas (2014) were investigated a total number of 53 taxa of macrozoobenthic fauna were recorded. Observations revealed that phylum arthropoda acquires dominant position with 55% of total faunal composition while phylum mollusca constitutes 36% and comes on second position whereas, least faunal abundance was found from phylum annelida which contributes 9%.







A composite population of gastropoda and bivalves contributed to the molluscan population in the ecosystems. Viviparidae and Planarbidae were the representative families of Gastropod in the tank. Gastropods contributed 54% of the total population. Bellamya bengalensis belonging to family viviparidae was encountered lesser in winter season. A sizable population of Indoplamarbius exustus under the family planarbidae was observed to be available. Seasonally the species was more abundant during winter in comparism to the summer

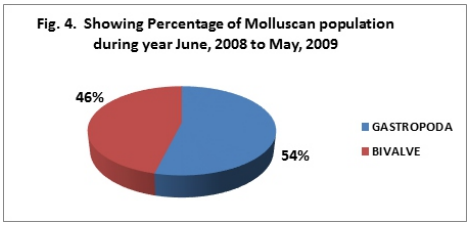
and rainy seasons. The bivalves were available in lesser abundance compared to the Gastropods. The contribution of this group 46% of the total zoobenthic population. Bivalves comprised of Lamellidens carrianus and Perreysia rugossa were more abundant during winter followed by summer and rainy seasons.

The values of species diversion in the present study clearly indicated that the ecosystem was favourable for barbouring balanced population of the benthic fauna. During the year 2007-08 the minimum values in rainy (200.80 ± 44.13 no/m2) season where as maximum in winter (499.50 ± 73.49 no/m2) season. During the year 2008-09 the minimum values in rainy (197.75 ± 44.13 no/m2) season, where as maximum in winter (504.50 ± 73.49 no/m2) season. During the year 2009-10 the minimum values in rainy (202.50 ± 44.52 no/m2) season where as maximum in summer (504.00± 69.12 no/m2) season. However, the influence of winter environment on the benthic diversity was conspicuous for the tank. Rainy values are not very significant were observed to be lower compared to the other seasons. (Sugunan, 1980).

In the present investigation, at all the sampling stations winter population was highest and was followed by summer and rainy seasons, while in the second and third year at all the four sampling stations the highest population was in winter followed by summer and rainy season. As far as, seasonal abundance of benthos is concerned. The benthic population depicted a bimodal pattern of fluctuation during the period of investigation with two distinct peaks, primary maxima in winter (October - January), secondary maximum in summer (February – May) corroborating the finding of Vasisht and Bhandal (1979) and Kaushal and Tyagi (1989) on Gobindsagar reservoir. The minimum observed in rainy season. The period of maximum rainfall adversely affected the abundance of benthic organisms as was evident by their minimum population in rainy season. It could be dislodging of the benthic organisms as a result of turbulent inflow of flood waters. Further, the reservoir level had an inverse relation with the density of benthos which is similar to the observations of Marshal (1978). Edaphic factors like inflow and outflow affects the benthos (Rawson, 1955). The secondary succession takes place as soon as the disturbances due to water movements mean away. This is evident from the increase in the abundance of fauna in post-monsoon period.

Table – 5 Showing Percentage of Molluscan Population during year June, 2007 to May, 2010

MOLLUSCAN GROUP	PERCENTAGE (%)
GASTROPODA	54
BIVALVE	46



As far as seasonal abundance of benthos is concerned Mandal and Moitra (1975) have reported maximum benthic fauna during winter and minimum is summer. The seasonal variations in the quantum of benthic fauna in streams depend upon the interplay of various environmental factors such as temperature and dissolved oxygen. It is well known that the solubility of dissolved oxygen increases with lowering the temperature (Mathew, 1978). The statement is supported to present investigation. Anitha et al., (2004) recorded the total benthic macro benthos was maximum in August 2000 in site II and minimum in April 1999 in Mir Alam lake, Hydrabad (A.P.). Kaushal (2008) studied on benthic macro fauna of Pong reservoir, Himachal Pradesh. Radheyshyam and Damayanthi Sahoo (2008) worked on sediment characteristics and macro zoo benthic fluctuation in different aged rural fish ponds in Sarakana, district Khurda, Orissa. In the present investigation, Bellamya bengalensis and Thiara tuberculata were observed on all the stations. Barbosa et al., (2001) used-benthic macro invertebrates as indicator of water quality and health of ecosystem. Many studies have established that the diversity and seasonal variation in macro zoo benthic fauna of different water bodies in India (Bijukumar et al., 2001; Anitha, 2002; Paul and Nandi, 2003; Dey, 2007; Duran and Suicmez, 2007; Sarma et al., 2007; Marchase et al., 2008; Sarminstha Jana et al., 2009; Ojha et al. 2010; Abida et al., 2012 and Vyas and Bhawsar, 2013; Lonkar et al., 2015)

The higher abundance of Molluscs was an indicator of unproductive character of the ecosystem. It also suggests the possibility of the waters moving towards high alkalinity. Higher production of mollusks leads to the increase in calcium content of the habitat and when the precipitation of calcium is on the increase the alkalinity goes up leading to state undesirable for a number of phytoplanktaters as it pave way for the phenomenon of Calcifobis (Sinha,2002). The present findings of the tank is within the permissible limits of the growth and useful for increasing the productivity of the tank.

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