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DIVERSITY AND SEASONAL ABUNDANCE OF ZOOPLANKTON COMMUNITIES IN TWO SACRED TEMPLE TANKS OF PONDA TALUKA, GOA

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ABSTRACT

Zooplankton are good indicators of the changes in water quality, because they are strongly affected by environmental conditions and respond quickly to changes in water quality. Hence, qualitative and quantitative studies of zooplankton are of great importance. In the present study, qualitative and quantitative studies of zooplankton in two sacred temple tanks of Goa were carried out for one annual cycle. (Dec. 2009 to Nov. 2010). Present investigations revealed that 20 species of Zooplankton belonging to four major groups i.e., Rotifera (four sps.), Calanoid (seven sps.), Cyclopoid (four sps.) and Cladoceran (five sps.) were present. Densities as well as diversity of zooplankton were higher at Site-2 than Site-1. Among zooplankton, Copepod group was dominant at both the sites throughout the study period. Density of zooplankton during different seasons at both sites was as follows: Summer season > Winter season > Rainy season. Zooplankton dominated both the sites in summer season due to favourable growth conditions.

KEY WORDS: Density, Diversity, Seasonal abundance, Temple tank, Zooplankton

INTRODUCTION

The requirements of water in all lives, from microorganisms to man, is a serious problem today, because all water resources have reached to point of crises due to unplanned urbanisation and industrialisation. In India, natural ponds are estimated to have an area of about 0.72 million hectares, most of the ponds are found in the vicinity of villages, places of religious worship and other human inhabitation (Gulati & Schultz, 1980).

They are important part of human civilisation, meeting many crucial needs for life on earth such as drinking water, protein production, water purification, energy, fodder production, food storage, recreation, research, education, sinks and climate stabilizers (Vaishali & Madhuri, 2004).

The aquatic ecosystem covers a vast area and the organisms occurring in this area are under the influence of its physicochemical parameters. The natural and artificial contaminants affecting the physiochemical properties of water impart an indirect effect on the stability of the interacting biological resources, apart from degrading the environmental conditions (Miller & Miller, 2007).

The physicochemical methods are used to detect effects of pollution on the water quality but changes in the trophic conditions in water are reflected in the biotic community structures as shown by occurrence, diversity and abundance pattern of species (Cairns, 1979).

Zooplankton are major trophic link in food chain and being heterotrophic organisms, play a key role in cycling of organic materials in aquatic ecosystems.

Ahmad (1996), Murugan *et al.* (1998) and Dadhich & Saxena (1999) reported that zooplankton plays an integral role and serve as bio-indicators and it is a well suited tool for understanding water pollution. The knowledge of their abundance, species diversity and special distribution is important in understanding trophodynamics and trophic progression of water bodies.

Although a number of studies have been carried out on ecological conditions of freshwater bodies in various parts of India (Michael, 1969; Rama & Bhati, 1982; Sarkar *et al.*, 1985; Rana, 1991; Sinha & Islam, 2002; Singh *et al.*, 2002). In Goa, the ecological studies of freshwater body is very scanty and on freshwater bodies of small dimensions

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Table 1: Population density of zooplankton (org/lit) at Shri Shantadurga temple tank, Kavalem, Ponda (Site-1)

MONTH	CALANOIDS		CYCLOPOIDS		ROTIFERS		CLADOCERA		NAUPLII	
	Density	%	Density	%	Density	%	Density	%	Density	%
Dec 09	4.55	28.34	0	0	0.6	3.73	9.8	61.05	1.1	6.85
Jan 10	0.25	0.12	53.55	26.97	97.35	49.03	0.2	0.10	47.2	23.77
Feb 10	11.5	9.93	13.35	11.52	44	37.99	2.95	2.54	44	37.99
Mar 10	29.1	38.54	12.6	16.68	7.5	9.93	11.8	15.62	14.5	19.20
Apr 10	44.25	36.54	2.25	1.85	0.55	0.45	0.55	0.45	73.5	60.69
May 10	4.05	22.07	0.5	2.72	1.05	5.72	0.9	4.90	11.85	64.57
Jun 10	0.3	12.5	0		0.05	2.08	0.05	2.08	2	83.33
Jul 10	3.85	12.01	0.45	1.40	0.9	2.8	0.35	1.07	26.5	81.53
Aug 10	1.2	30		0	0.6	15	0		2.2	55
Sep 10	0		0		0		0		0.15	100
Oct 10	0		0		0		0		1.5	100
Nov 10	17.5	64.81	0		4	14.81	0		5.5	20.37

Table 2: Population density of zooplankton (org / lit) at Shri Mahalasa temple tank, Mardol, Ponda (Site-2)

MONTH	CALANOIDS		CYCLOPOIDS		ROTIFERS		CLADOCERA		NAUPLII	
	Density	%	Density	%	Density	%	Density	%	Density	%
Dec-09	126.4	81.65	1.55	1	1	0.64	20.15	13.01	5.7	3.68
Jan-10	2.75	10.89	3.65	14.45	0.6	2.37	3.75	14.85	14.5	57.42
Feb-10	48.55	66.02	3.75	4.99	0.65	0.86	7.3	9.72	13.8	18.38
Mar-10	57	32.84	2.85	1.64	21.6	12.44	60.15	34.65	31.95	18.4
Apr-10	0		0		0		0		0	
May-10	27.2	28.52	1.3	1.36	10.6	11.11	2.7	2.83	53.55	56.16
Jun-10	8.2	12.42	1.2	1.81	0		50.2	76.06	6.4	9.69
Jul-10	20.8	19.9	0.5	0.47	0.35	0.33	0		82.4	78.85
Aug-10	11	65.78	0.22	1.31	1.25	7.47	0		4.25	25.41
Sep-10	4.35	55.76	0.45	5.76	1.5	19.23	0.45	5.76	1.05	13.46
Oct-10	0.75	1.46	0.5	0.97	24.75	48.29	1	1.95	24.25	47.31
Nov-10	21.5	40.83	1.6	3.03	11.5	21.84	6.25	11.87	11.8	22.41

such as temple tanks is nil. Therefore, in the present investigation, attempts were made to study the zooplankton species richness, diversity, seasonal abundance and zooplankton composition of two sacred temple tanks of Ponda taluka in Goa.

MATERIALS AND METHODS

The study was conducted for a period of one year from Nov. 2009 to Oct. 2010 on two sacred temple tanks viz; site 1 Shri Shantadurga temple tank-Kavale Ponda, which is a large temple complex, 33 kms from Panaji at the foothill of Kavalem village in Ponda Taluka, Goa, India and Site 2 (Shri Mahalasa temple tank) situated at six kms away from Site-1 at Mardol village in Ponda Taluka, Goa. Zooplankton samples were collected from between 0800 hrs and 1100 hrs.

Samples were collected by filtering about 20 litres of water through plankton net of mesh size 45 micron. Filtrate was collected in 200ml bottle and 4% formalin was added to preserve the sample for further studies in lab. The concentrate was examined under microscope and zooplankton were counted using Sedgwick Rafter plankton counting cell (Welch, 1948). Zooplankton were identified using standard literature (Battish,1992; Edmondson,1992; Dhanapathi, 2000).

RESULTS AND DISCUSSION

Copepods

Freshwater copepods constitute one of the major zooplankton communities occurring in all types of water bodies and ranging from free living to parasitic forms. They serve as food to several fishes and play major role in ecological food pyramids. Copepods were recorded more at Site-2 than Site-1 (Table 1 & 2). Throughout the study period, copepods, which includes calanoids, cyclopoids and nauplii were found to be most dominant group occupying the top first position in total zooplankton community at both the sites (Fig. 3). Season wise abundance of copepods at both the sites was as follows:

Summer season > Winter season > Rainy season

Copepods (Table-3) were represented by seven species of calanoids and four species of cyclopoids.

Rotifers

The Rotifers also called as rotaria or wheel animalcules are group of small, usually microscopic pseudocoelomate animals, which have been variously regarded as separate phylum. The rotifers have attracted much attention of limnologists because of their wide distribution in water they frequently occur.

Higher abundance of rotifers is seen at Site-1 as compared to Site-2. Species like *B. calciflorus* and *K. tropica* are often observed during study period at Site-1. Noguira (2001) and Sampaio *et al.* (2002) reported that *B. Calciflorus* acts as indicator of eutrophication. Rotifers were represented by *K. tropica, Fillina opoloensis, B. budapestinensis* and *B. calciflorus* (Table 3).

Table 3: Zooplankton diversity from two temple tanks at Ponda, Goa, during the Study period

S.No.	Zooplankton	Species
1	Calanoid	*Diaptomus saltinus* *Diaptomus judayi* *Centropagus hematus* *Heliodiaptomus vidus* *Heliodiaptomus cinctus* *Phylodiatomus annae* *Diaptomus gracillus*
2	Cyclopoid	*Pracyclops poppei* *Paracyclops affinis* *Heliocyclops christiansis* *Cyclops viridis*
3	Cladocera	*Macrothrix laticornis* *Bosmina longirostris* *Ceriodaphnia cornuta* *Moina micrura* *Diaptomus excisum*
4	Rotifers	*Keratella tropica* *Fillina opoloensis* *Brachionus budapestinensis* *Brachionus calciflorus*

Cladocerans

Cladocerance popularly called as "water fleas" prefers to live in deep water and constitute a major item of food chain and energy transformation. The cladocerans are represented by *Macrothrix laticornis, Bosmina longirostris, Ceriodaphnia cornuta, Moina micrura, Diaptomus excisum* (Table 3). Higher abundance of cladocerance is seen at Site-2.

Further, in present investigations, it was observed that, the zooplankton mainly comprises copepods, cladocerans and rotifers. Copepods are the largest contributors in terms of density (70%) and diversity at both sites followed by rotifers and cladocera at Site-1, and cladocera and rotifera at Site-2 (Fig. 3).

Tropical and temperate limnological comparative studies have demonstrated that oligotrophic systems are dominated by copepods, whereas more eutrophic systems are dominated by rotifers and cladocerans (Guevara *et al.*, 2009). Nevertheless, the work by Pinto-Coelho *et al.* (2005) established that cladocerans and cyclopoids are associated to the more eutrophic lakes and reservoirs, which support greater crustacean abundances in most latitudes.

In this study the seasonal abundance (no/l) zooplankton was in the following order at both the sites (Fig.1 & 2):

Summer season > Winter season > Rainy season

Zooplankton of all major groups were observed in summer season at both the sites (Fig. 1 & 2). The summer population maxima of zooplankton were co-related with higher temperatures, lower transparency and high standing crop of primary producers leading to greater availability of food (Priolkar & Pai, 2010). Similar results have been reported by Ganpati (1943), Ramakrishna & Sarkar (1982), Bhati & Rana (1987), Kumar & Datta (1994), Surana *et al.*, (2005), Salve & Hiware (2010), Joshi (2011) and Jadhav *et al.* (2012).

The population falls during monsoon, due to dilution effect. The population again rises to a higher level in winter, as a result of favourable environmental conditions. Normally, the monsoon is associated with lower population densities due to its dilution effect and decrease in photosynthetic activity by primary producers. Similar results have been shown by Edmondson (1965), Baker (1979), Bais & Agrawal (1993), Salve & Hiware (2010), and Ude *et al.* (2011). This is in consonance with Mitsch &

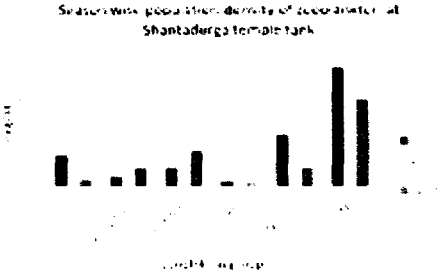

Fig.1: Season wise population density of zooplankton (org / lit) at Shri Shantadurga temple tank– Kavalem Ponda (Site-1).

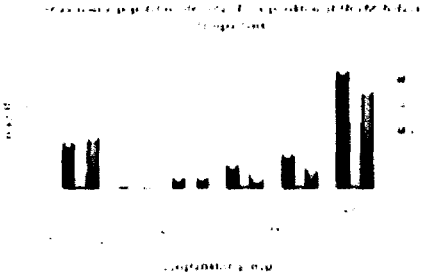

Fig. 2: Season wise population density of zooplankton (org / lit) at Shri Mahalasa temple tank, Mardol, Ponda (Site-2).

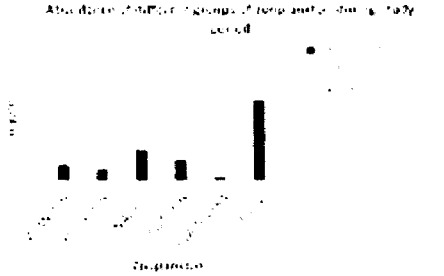

Fig.3: Abundance of various groups of zooplankton (org/lit) during study period

Gosselink (2000) who reported that the biodiversity of ecosystem depends upon and is determined by their hydrological characteristics and to a great extent on nutrient status.

Density and diversity (13 species at Site-2 and 9 species at Site-1) of zooplankton is more at Site-2 than Site-1 (Fig. 3). This can be correlated to physico-chemical parameters which are on much higher side at site-2 as compared to Site-1 shown in the studies as reported by Priolkar & Pai (2010). Welch (1952) reported that the diversity and density or distribution of plankton is affected mainly by wind flow, inflowing streams, dilution, qualitative variation of water, physico-chemical alteration of water, depth of water, current plankton swarms and action of predators and diurnal migration of plankton. Thus study has determined that, abundance of zooplankton has been governed by the cumulative effect of physico-chemical and biological variables.

Thus, from this study we can conclude that the diversity and density of zooplanktons from both the sites (Site-1 and 2) exhibited by four major groups (Rotifera, Cladocera, Calanoid and Cyclopoid) with 20 species, showed seasonal variability in density due to different parameters which impact on them. Site-2 is more productive than site-1 having higher density and diversity, which is probably attributed by availability of more food. Copepod is a dominant group at both the sites. Seasonal abundance is seen more during summer season due to favourable growth conditions at both sites, in comparison with Rainy and winter seasons.

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