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A SURVEY FOR DIVERSITY AND SEASONAL ABUNDANCE OF ZOOPLANKTON COMMUNITIES IN TEMPLE TANKS OF PONDA TALUKA, GOA.

Kunja Priolkar and I. K. Pai.

Department of Zoology, Goa University, Goa-403 206

ABSTRACT

In the present studies, qualitative and quantitative analyses of zooplankton from Shri Mahalaxmi temple tank, Bandora and Shri Mahalasa temple tank, Mardol of Goa, was carried out for one annual cycle. (Dec. 2009 to Nov. 2010). Using microscopic, taxonomical studies of zooplankton, investigations revealed that, 18 species of Zooplankton belonging to four major groups i.e., Rotifera (five sps.), Calanoid (five sps.), Cyclopoid (four sps.) and Cladoceran (four sps) were present in these water bodies. Densities as well as diversity of zooplankton were higher at Shri Mahalasa temple tank than Shri Mahalaxmi temple tank. Among zooplankton, Copepod group dominated at both the sites, throughout the study period. In both study sites, Zooplankton diversity was rich during summer compared to other seasons.

Key words: Density, Diversity, Physico-chemical parameters, Temple tank, Water quality, Zooplankton.

INTRODUCTION

Water plays a vital role in human life. The consequence of urbanisation and industrialisation leads to the deterioration of water quality. The fluctuating physical and chemical characteristics of water and their interactions bear an effect on biological features of aquatic ecosystems. The natural and artificial contaminants affecting the physicochemical properties of aquatic ecosystem impart an indirect effect on the stability of the interacting biological resources, apart from degrading the environmental conditions (Chatterjee *et al*., 2010). Without the knowledge of water quality, it is difficult to fully understand the biological phenomenon because the chemistry of water reveals much about the metabolism of ecosystem and explain the general hydro-biological relationship.

The physico-chemical 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 occupies a central position between the autotrophs and other heterotrophs and plays a significant role in transformation of food synthesized by phytoplankton to higher trophic level. Therefore the study of zooplankton plays a pivotal role in knowing biological status of any water body.

Several studies have been made on different types of water bodies in India. However, the information on water bodies of smaller dimensions is needed. With reference to Goa, the state is mainly known as an important tourist destination, famous for its beaches. Apart from this, Goa also has many ancient temples mostly located in Ponda taluka. 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 and Schultz, 1980). Goan temples are unique for its construction, having water tank in almost all temples. Earlier the water from this water tank was used for drinking, temple rituals and other domestic purposes by population surrounding the temple. Nowadays surrounding people have alternate source like municipal water supply, bore wells, open wells etc., to have sufficient potable water for their domestic purposes. So the water from these tanks is used for temple rituals, agriculture and other domestic purposes such as washing clothes, bathing etc.

In Goa, in general, the ecological studies on freshwater bodies are scanty and on freshwater bodies of small dimensions such as, temple tanks in particular is almost non existing. Therefore, in the present investigations, an attempt was made to study the zooplankton species richness, diversity, seasonal abundance and zooplankton composition of sacred temple tanks of Ponda taluka in Goa.

MATERIALS AND METHODS

The study was conducted on two sacred temple tanks viz; site 1 (Shri Mahalaxmi temple tank), Shri Mahalaxmi temple is situated in Bandora village, about four kilometers to the east of Ponda city, Site 2 (Shri Mahalsa temple tank), located at Mardol village in Ponda Taluka, 22.5 kms from Panaji the capital of Goa. Zooplankton samples were collected from these water bodies between 0800hrs and 1100hrs.Study was conducted for a period of one year from Nov. 2009 to Oct. 2010.

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 according to Welch (1948). Zooplanktons were identified using standard literature (Battish, 1992; Edmondson, 1992; Dhanapathi, 2000).

RESULTS AND DISCUSSION

The microscopic taxonomical study of zooplankton revealed that 18 species belonging to four major groups of Zooplankton (Rotifera, Cladocera, Calanoids and Cyclopoids) inhabited these water bodies (Table 6).

Rotifers: In the present study rotifer represented by five species, viz *Keratella tropica, Fillina opoloensis, Brachionus budapestinensis, Brachionus calciflorus, Brachionus falcatus..* Rotifers were maximum during the period of rainy season at Site-1 and during winter at Site-2. In general, higher abundance of rotifers was seen at Site-1 in comparison with Site-2. Species like *Brachionus calciflorus* and *Keratella tropica* are often observed

during study period at Site-1. Noguiera (2001) reported that, *Brachionus calciflorus* acts as an indicator of eutrophication,

Copepods: Throughout the study period, copepods were found to be most dominant group, occupying the top position in total zooplankton community, at both the sites (Table-5). Season wise abundance of copepods at both the sites was as follows:

Summer season > winter season > Rainy season

In the present studies, Calanoids are represented by five species viz, *Paradiaptomus greeni, Heliodiaptomus vidus, Heliodiaptomus cinctus, Phylodiatomus annae, Diaptomus gracillus.* . At Site-1, maximum number of calanoids was encountered during summer, while at Site-2, it was during winter.

Cyclopoid are represented by *Pracyclops fimbriatis, Mesocyclops hyalinus, Heliocyclops christiansis, Cyclops viridis.* At both the sites maximum cyclopoid were seen during summer.

Cladocera: In the present study Cladocera are represented by four species viz, *Bosmina longirostris, Ceriodaphnia cornuta, Moina micrura, Diaptomus excisum..* They are common water flea. During monsoon they were in maximum number at Site-1, while at Site-2 they were the prominent group during summer.

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

Both the sites were dominated by copepods throughout study period (Table-5). 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. 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 Site-1 (Table-3):

Summer season > Rainy season > winter season

And at Site-2 (Table-4)

Summer season > winter season > Rainy season

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

The total seasonal density of the zooplanktons from Site-1, as presented in Table-3 shows gradual decrease in rainy season and still comes down in winter. This is due to higher number of cladocerans and rotifers in rainy season. Indeed, even under favourable environmental conditions, zooplanktons such as Cladocera may be monocyclic or dicyclic, with one or two population maxima during the year (Pennak, 1978).

Considering zooplanktons are depending on several physico-chemical factors, in present study of zooplanktons at Site-2, exhibited bimodal pattern with two peaks, one high magnitude in summer followed by winter (Graph-2). Increased population density in summer could be due to low water volume and hence increase in nutrient concentration. Similarly abundance of zooplankton in summer can be attributed to the breeding habits of zooplanktons. This anomaly in present studies is in agreement with the observation of Adholia and Vyas (1993) and Bhagat and Meshram (2010).

Due to dilution effect, the population of zooplankton falls during monsoon, the population again rises to a higher level in winter, as a result of favourable environmental conditions. Similar results have been shown by Bais and Agrawal. (1993), Salve and Hiware (2010), Edmondson (1965) and Baker (1979), Ude *et.al.,* (2011). This is in consonance with Mitsch and 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.

Thus, from this study we can conclude that, the diversity and density of zooplanktons from both the sites (Site-1 and Site-2) exhibited by four major groups (Rotifera, Cladocera, Calanoid and Cyclopoid) with 18 species, showed seasonal variability in density due to different parameters which impact on them. Site-2 is more productive having higher density as well as diversity than that of Site-1 contributed by availability of more food. Copepod is a dominant group at both the sites. Seasonal abundance is seen more in summer season due to favourable growth conditions at both sites as compared to winter and rainy season.

Table 1: Population density of zooplankton (org/lit) at

Shri Mahalaxmi temple tank, Bandora, Ponda (Site-1)

MONTH	CALANOIDS		CYCLOPOIDS		ROTIFERS		CLADOCERA		NAUPLII	
	Density	%	Density	%	Density	%	Density	%	Density	%
DEC 09	0.45	21.42	0.10	4.76	0.60	28.57	0.45	21.42	0.50	23.80
JAN 10	0.90	3.67	1.05	4.28	3.50	14.28	11.55	47.14	7.50	30.61
FEB 10	11.1	21.57	2.25	4.37	15.60	30.32	13.05	25.36	9.45	18.36
MAR 10	0.40	2.60	1.70	11.07	7.80	50.81	0.35	2.28	5.10	33.22
APR 10	0.25	0.76	8.00	24.57	21.65	66.51	1.15	3.53	1.50	4.60
MAY 10	3.10	5.90	3.75	7.14	1.80	3.42	1.75	3.33	42.10	80.19
JUN 10	1.25	1.49	0.50	0.59	61.50	73.65	13.00	15.56	7.25	8.68
JUL 10	1.25	18.24	0.10	1.45	0.50	7.29	4.15	60.58	0.85	12.40
AUG 10	0.60	5.91	0.20	1.97	2.10	20.68	6.00	59.11	1.25	12.31
SEP 10	0.15	3.12	2.00	41.66	1.15	23.95	0.25	5.20	1.25	26.04
OCT 10	0.90	15.00	0.30	5.00	0.90	15.00	0.20	3.33	3.70	61.66
NOV 10	2.25	18.75	1.50	12.50	1.60	13.33	0.65	5.41	6.00	50.00

Table 2: Population density of zooplankton (org / lit) at

Shri Mahalsa temple tank, Mardol, Ponda (Site-2).

MONTH	CALANOIDS		CYCLOPOIDS		ROTIFERS		CLADOCERA		NAUPLII	
	Density	%	Density	%	Density	%	Density	%	Density	%
Dec-10	126.4	81.65	1.55	1.00	1.00	0.64	20.15	13.01	5.70	3.68
Jan-10	2.75	10.89	3.65	14.45	0.60	2.37	3.75	14.85	14.50	57.42
Feb-10	48.55	66.02	3.75	4.99	0.65	0.86	7.30	9.72	13.80	18.38
Mar-10	57.00	32.84	2.85	1.64	21.60	12.44	60.15	34.65	31.95	18.40
Apr-10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May-10	27.20	28.52	1.30	1.36	10.60	11.11	2.70	2.83	53.55	56.16
Jun-10	8.20	12.42	1.20	1.81	0.00	0.00	50.20	76.06	6.40	9.69
Jul-10	20.80	19.90	0.50	0.47	0.35	0.33	0.00	0.00	82.40	78.85
Aug-10	11.00	65.78	0.22	1.31	1.25	7.47	0.00	0.00	4.25	25.41
Sep-10	4.35	55.76	0.45	5.76	1.50	19.23	0.45	5.76	1.05	13.46
Oct-10	0.75	1.46	0.50	0.97	24.75	48.29	1.00	1.95	24.25	47.31
Nov-10	21.5	40.83	1.60	3.03	11.50	21.84	6.25	11.87	11.80	22.41

Table 3: Season wise population density of zooplankton (org / lit) at

Shri Mahalaxmi temple tank– Bandora, Ponda (Site-1).

Season	Calanoids	Cyclopoids	Rotifers	Cladocera	Nauplii	Total
Summer	14.85	3.93	11.71	4.08	14.54	49.11
Monsoon	0.81	0.70	16.31	5.81	2.65	26.28
Winter	1.13	0.74	1.65	3.21	4.43	11.16
Average	5.60	1.79	9.89	4.37	7.21	0.00

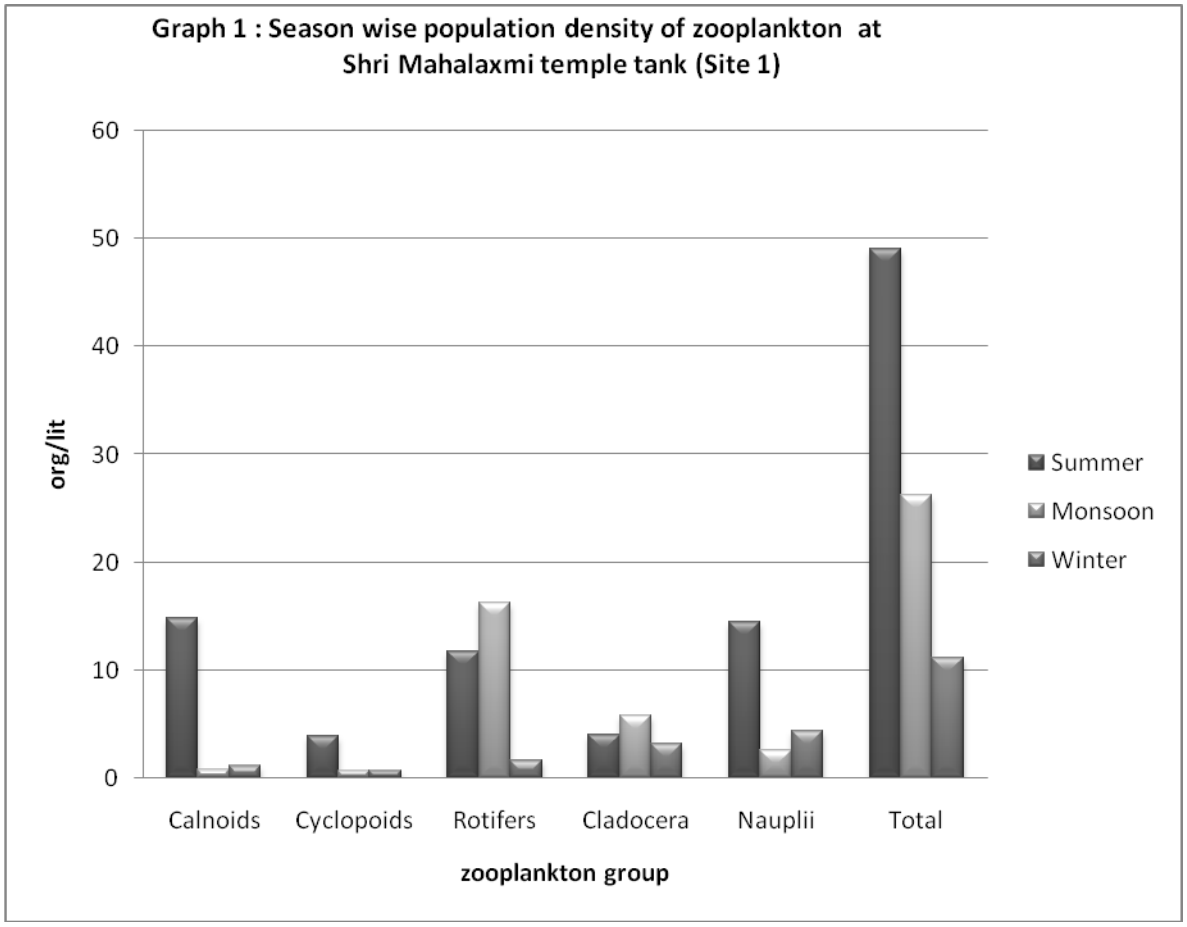

Table 4: Season wise population density of zooplankton (org / lit) at Shri Mahalasa temple tank, Mardol, Ponda (Site-2).

Season	Calanoids	Cyclopoids	Rotifers	Cladocera	Nauplii	Total
Summer	33.19	1.98	8.21	17.54	24.83	85.75
Monsoon	11.09	0.59	0.78	12.66	23.53	48.65
Winter	37.85	1.83	9.46	7.79	14.06	70.99
Average	27.38	1.47	6.15	12.66	20.81	0.00

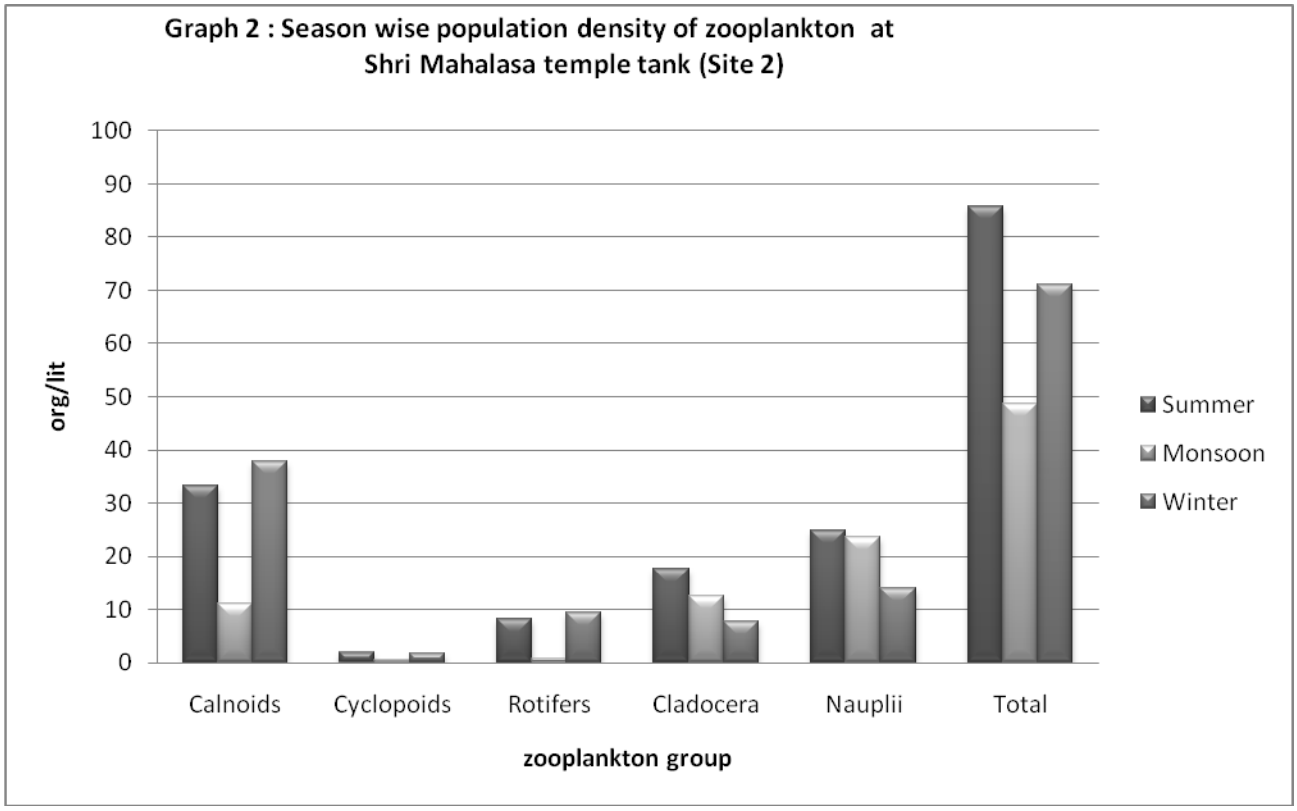

Table 5: Abundance of various groups of zooplankton (org/lit) during study period.

	CALANOIDS	CYCLOPOIDS	NAUPLII	COPEPODS%	ROTIFERS	%	CLADOCERA	%	TOTAL
Site 1	5.6	1.79	9.89	59.87	4.37	15.14	7.21	24.98s	28.86
Site 2	27.38	1.47	20.81	72.53%	6.15	8.98%	12.66	18.48%	68.47

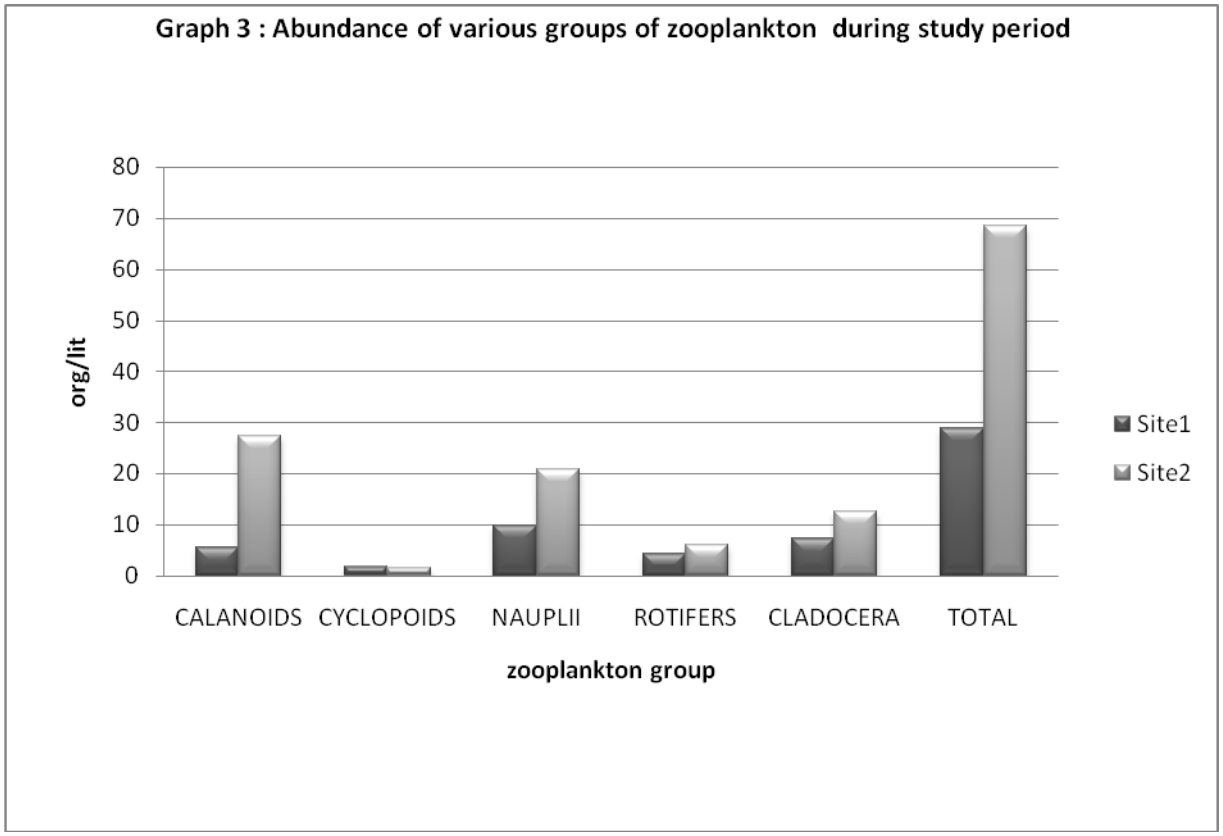

Table 6: Zooplankton diversity from two temple tanks at Ponda, Goa, during Dec 2009 to Nov 2010

Sr. no	Zooplankton	Species
1	Calanoid	*Paradiaptomus greeni, Heliodiaptomus vidus Heliodiaptomus cinctus,Phylodiatomus annae Diaptomus gracillus*
2	Cyclopoid	*Pracyclops fimbriatis, Mesocyclops hyalinus Heliocyclops christiansis, Cyclops viridis*
3	Cladocera	*Bosmina longirostris, Ceriodaphnia cornuta Moina micrura, Diaptomus excisum*
4	Rotifers	*Keratella tropica, Fillina opoloensis Brachionus budapestinensis, Brachionus calciflorus Brachionus falcatus*

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