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Studies on zooplankton diversity in Powai reservoir, Mumbai

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Abstract
Zooplanktons are the smallest organisms present in almost all the water body. They invariably form an integral component for fresh water communities and contribute significant to biological productivity. A study was carried out to examine the diversity and density of zooplankton in Powai (Mumbai, Maharashtra) reservoir, India. In present work, various physico-chemical parameters and zooplankton biodiversity of Powai lake was studied. It was observed that the water quality of the Powai Lake is badly affected by the effluent and untreated sewage from nearby area, which has resulted in inclining the zooplankton biodiversity. The representative species of Rotifers, copepods, Cladocerans, protozoan, and ostracoda in the lakes were also found. Though high number of zooplankton species were recorded from Powai lake. The comparative limnology of these lakes gives new insights into the correlation of physicochemical properties with the zooplanktons biodiversity. The objectives of the present study were to provide a preliminary knowledge on the productivity and diversity of zooplanktons which can be utilized to improve the productivity of the reservoir.

Keywords: powai lake, zooplanktons, physico-chemical, biodiversity

Introduction
Zooplankton acts as main sources of food for many fishes and plays an important role in early detection and monitoring the pollution of water. The study of zooplankton has been a fascinating subject for a long time. In the last two decades much attention has been paid in tropical countries towards the study of biology, ecology and toxicology of zooplankton due to their important role in the rapidly emerging concepts in environmental management like Environmental Impact Assessment (EIA), bio indication of pollution and biological monitoring (Salve and Hiware, 2010) [21].

Zooplankton comprising of rotifers, cladocerans, copepods and ostracods are considered to be most important in terms of population density, biomass production, grazing and nutrient regeneration in any aquatic ecosystem (Omudu and Odeh, 2006; Mukhopadhyay *et al.*, 2007) [15, 14]. Their diversity and density is mainly controlled by availability of food as favorable water quality (Chandrasekhar and Kodarkar, 1997) [6].

Zooplankton is good indicators of the changes in water quality because they are strongly affected by environmental conditions and respond quickly to changes in water quality. The zooplankton constitute an important component of secondary production in aquatic ecosystems that play a key role in energy transfer from primary to higher level in the ecosystem (Wang *et al.*, 2010; Sharma and Tiwari, 2011) [24, 22]. The most significant feature of zooplankton is its immense diversity over space and time. Thus, similar aquatic systems may have dissimilar assemblage of organisms varying in species composition and biomass. Further, in spite of convergent similarities, zooplankton species have different types of life histories influenced by seasonal variations of abiotic factors, feeding ecology and predation pressure (Pathani and Upadyay, 2006) [16].. Zooplankton diversity is one of the most important ecological parameters in water quality assessment. Zooplankton is the intermediate link between phytoplankton and fish. Hence qualitative and quantitative studies of zooplankton are of great importance in Reservoir water body. In the present study an attempt has been made to study zooplankton diversity and populations density from selected reservoir (Adeyemi *et al.*, 2009, Ahmad *et al.*, 2011; Mola, 2011) [1, 3, 3]. The main purpose of this paper is to outline the zooplankton diversity from Powai reservoir. Powai Lake is an artificial lake, situated in Mumbai, in the Powai valley, where a Powai village with a cluster of huts existed. The city suburb called Powai shares its name with the lake. Housing complexes and plush hotels are developed all around the lake periphery. Population around the lake has thus substantially increased over the years. Powai Lake is located downstream of the Vihar Lake on the Mithi River When it was built, the lake had an area of about 2.1 square kilometres (520 acres) and the depth varied from about 3 metres (9.8 ft) (at the periphery) to 12 metres (39 ft) at its deepest (Salaskar and Yeragi, 2003) [20]. The Powai Lake has gone through many stages of water quality degradation. The lake water which used to supply drinking water for Mumbai has been declared unfit to drink. The lake still remains a tourist attraction.

Material and Methods
Study Area
Powai Lake (named after Framaji Kavasji Powai Estate) is an artificial lake, situated in Mumbai, in the Powai valley, where a Powai village with a cluster of huts existed. The city suburb called Powai shares its name with the lake. Indian Institute of Technology Bombay, one of the premier institutions of science and technology in India, is located to the east of the

lake. Another famous institution, the National Institute of Industrial Engineering (NITIE), is also located close to the lake. Housing complexes and plush hotels are developed all around the lake periphery. The Powai Reservoir is perennial and lies between Latitude: 19° 07' 48.00" N and Longitude: 72° 54' 36.00" E

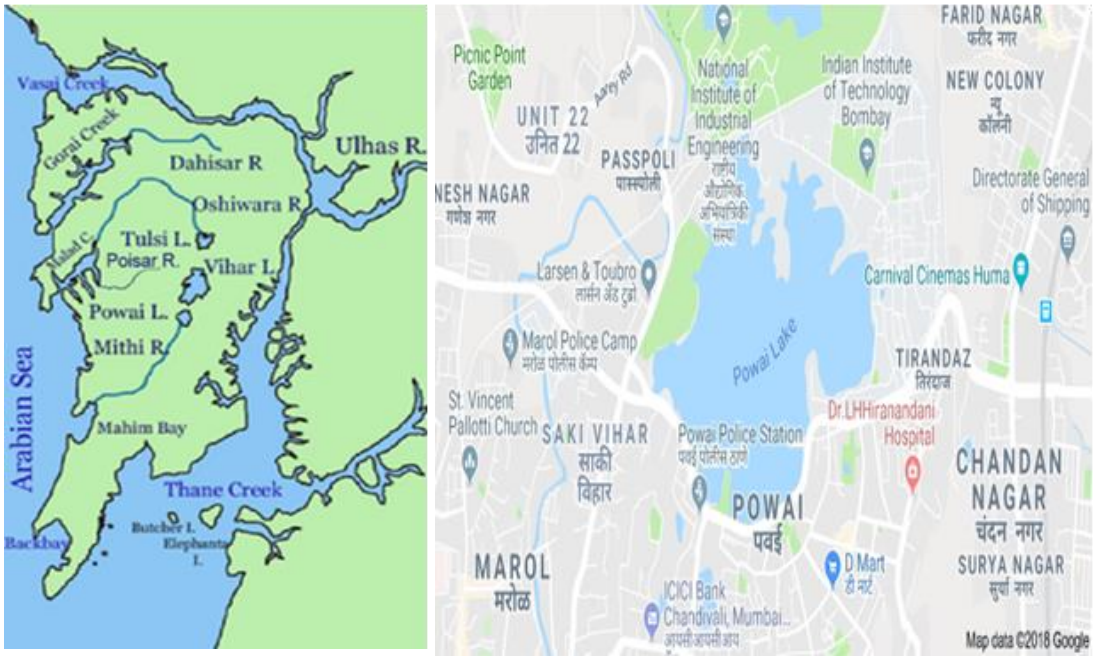

Fig 1: Map of Mumbai map of Powai reservoir

Collection of sample

The water samples were collected monthly, for Six months (July 2017 to December 2017). Collection of Zooplankton was carried out by using plankton net. Sampling was made between 8.00 am to 10.00 am. By Plankton net (mesh size 25 mm) was swept through surface water. 100 lit of surface water were sieved through the plankton net and filtered sample were transferred to plastic containers and 4% formalin was added for sample preservation. These samples were then brought to laboratory for further studies. The systematic identification of plankton was made by using standard keys of Adoni (1985) [2], IAAB (1998) [9], Michael and Sharma (1988) [12], Krishnaswamy (1973) [11], Edmondson (1959), Pennak (1968) [17], Dhanapathi (2000) [7], Altaff (2004) [4].

Zooplankton sampling and preservation

For collecting zooplankton a net with mesh size 40µm was used. Two hundred litres of water was filtered through the net and filtrate was taken in another tube. This filtrate contains phytoplanktons, algae, and zooplanktons along with some debris. Further the filtrate was fixed in 5% formaldehyde solution and was taken to the lab for further analysis. At a time a drop of this solution was observed under binocular microscope on Sedgwick-Rafter cell. The identification of zooplanktons was done by using standard keys of Dhanapathi (2000) [7] and Altaff (2004) [4].

Analysis of the water sample

The water samples were analysed for following physicochemical parameters.

a. **Water and air temperature:** Air and water temperature was measured by calibrated digital thermometer.
b. **pH:** The pH of the water was measured by digital pH meter.
c. **Salinity and Conductivity:** Water conductivity was measured by digital portable calibrated pen conductivity meter.
d. **BOD and COD:** The protocols for BOD and COD were followed as per the guideline of APHA (2005) [5].

Results and Discussion

The physicochemical properties Powai lakes were studied and are given in table 1.

Table1: The physicochemical properties of Powai lakes

Physicochemical Parameter	July	August	September	October	November	December
Temp (in ^{0}C)	35.0	34.3	30.5	28.7	26.8	23.7
pH	7.47	7.41	7.56	7.67	7.61	7.50
Salinity (in ppm)	195.6	198.8	213.7	221.7	2280.1	233.5
Conductivity	423.5	428.7	445.3	478.7	498.8	512.5
BOD (in mg/l)	44.5	43.2	42.1	40.3	38.7	35.6
COD (in mg/l)	80.3	83.5	85.4	87.4	90.4	94.7

Table 2: Monthly variation of zooplankton density (no. / lit) during July 2017 – Dec 2017

Order/Month	July	August	September	October	November	December	Mean
Rotifers	217	195	188	179	167	176	1122
Copepods	154	145	143	139	130	122	833
Cladocerans	310	289	277	259	245	215	1595
Ostracoda	143	135	126	123	115	103	745
Protozoa	102	97	89	77	67	64	496
Crustacea	145	134	128	112	103	98	720
Mollusca	26	24	14	6	4	0	74
Fish larvae	123	112	105	98	94	88	620

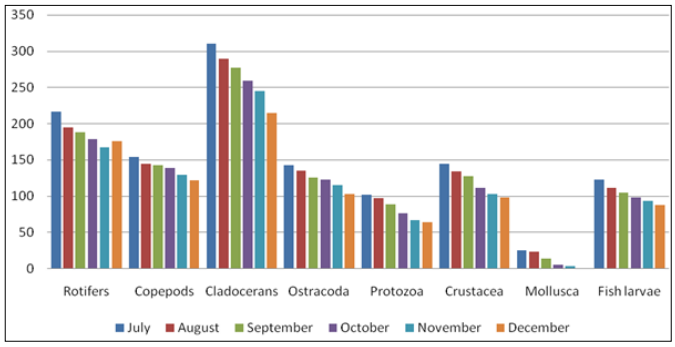

Fig1: Diversity of zooplankton in Powai Lake

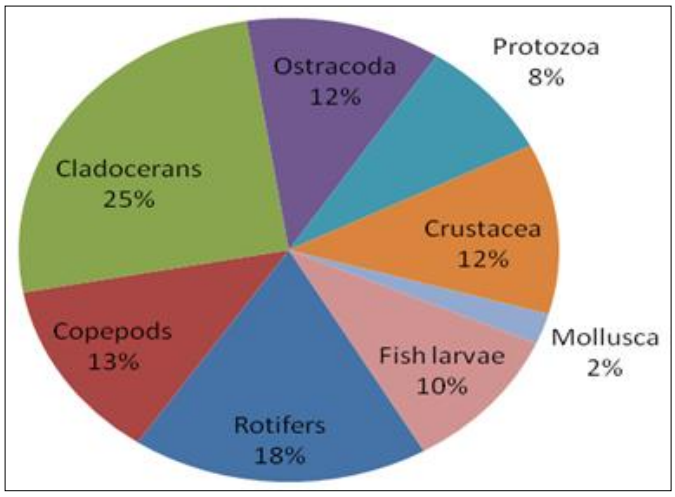

Fig 2: Diversity of zooplankton in Powai Lake in Percentage

The physico-chemical properties of Powai lake gave important insights into variation due to seasonal changes affect these parameters. Correlation of these physicochemical parameters with the number of zooplanktons proves that the zooplankton biodiversity is largely affectede by these parameters. In comparison the air and water temperature of Powai lake does not vary significantly as these lake are located close to each other. Other water parameter like pH of water shows significant difference in Powai lake. The water of Powai lake is more alkaline (pH ranging from 7.47 to 7.50). Salinity of water body is due to presence of chloride salts; as the salinity increases the number of freshwater organisms find it difficult to tolerate it (Jeppesen *et. al.* 2002) [10]. The salinity of Powai lake is more than three times to that of vihar lake. Thus high salinity may one of the factor which makes the Powai water more suitable for the survival of zooplanktons. Water conductivity is determined by the presence of number of ions Na+, K+, HCO3-, Mg2+, Cl- etc. These ions interfere with the survival of zooplanktons (Thirumala *et. al.* 2007) [23]. Thus the Powai water becomes more suitable for the survival of zooplanktons. Biological oxygen demand (BOD) and chemical oxygen demand (COD) are interlinked parameters. It is well known that higher the organic waste, higher would be the BOD and COD (Kumar 2001). The COD values comprises of BOD and non-biological oxidisable organic material (Saksena *et. al.* 2008) [19]. The ratio of BOD to COD says a lot about the water quality, according to standards of WHO, BOD/COD for fresh water lies below 0.3, whereas as for sewage mixed high organic contaminated water has this ratio >0.3. The BOD and COD of Powai lake is many times higher than that of vihar lake. This property also makes the Powai water unfit for the survival of zooplanktons.

Zooplanktons are small microscopic organisms, typically 100 to 500 um (microns) in length, with two distinctive features. First, they have a ciliated region at the apical or head end called a corona. This is used for locomotion and for gathering of food particles from the water. In the water samples, we found the representatives of four classes zooplanktons. Though the number of species found in Powai water. List of zooplanktons identified from Powai lake has proved that it has many more species of zooplanktons. We believe that, various factors like high values of conductivity, salinity, BOD and COD in Powai water interferes with the survival of zooplanktons.

Conclusion

The present study reveals seasonal variation in the diversity and distribution of zooplanktons in Powai Reservoir. All groups of zooplanktons were recorded throughout the study period. The number was highest during summer and lowest during winter. The study indicates that temperature has important role in the distribution of zooplanktons in a fresh water habitat. Powai lake gave important insights into the correlation of physico-chemical parameter and zooplankton biodiversity. We believe that, due to high organic content of Powai lake, the low zooplankton biodiversity was seen.

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