

Studies on plankton and trophic status of Osmansagar Lake water near Tropical Hyderabad City, India

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ABSTRACT

Osmansagar Lake water in Hyderabad city was studied for its trophic status and sources of pollution. Biological indicator parameters showed that the lake was mesotrophic during 2012-14. Anthropogenic activities in its catchment area and on its bank were observed to be responsible for eutrophication of Lake Water. The ecological significance of the plankton diversity and the temporal and special variations in total plankton are discussed in the light of Limnological observations and available literature. Since the main potable water sources of the Hyderabad city are from five impoundments, viz., Osmansagar on River Musi, Himayatsagar on Esi River, Manjiraphase I and II on Manjira Barrage, Manjira phase III & IV on Singur Dam, Krishna water supply phase I & II on Akkampally reservoir, the lake under study is ecologically as well as aesthetically important. The present paper deals with the analysis of diversity of Plankton (*i.e.* Phytoplankton and Zooplankton) and their variations density in the Osmansagar Lake.

Keywords: *Osmansagar Lake, Eutrophication, Limnology, Plankton Diversity, Ecological Significance.*

INTRODUCTION

Hyderabad, the capital of Andhra Pradesh, is situated 20 km from the Osmansagar Lake, and the lake is one of the sources for supplying water for use to the city. Osmansagar was constructed across Musi river during the period 1912-1920 in Gandipet village, Rajendranagar mandal in Ranga Reddy district. The lake is located at latitude 17°22'30" and longitude 80°04'00". The catchment area is 738.14 sq.km. From the Osmansagar and Himayatsagar lakes, there has been a decline in water supply over the years due to reduced inflows. It is reported that there has been a progressive decline in the per cent of rainfall converted into inflows into these two lakes, even though the rainfall pattern has not changed much. Despite copious rains in Hyderabad and its surroundings, the inflows have been very less into these lakes. Barring 2010-14, it is reported that these two lakes were not at full level in earlier 7-8 years. The entire city lies in the Musi river sub-basin, which is a part of the Krishna river basin and is drained mainly into Musi river system. Esi is the main tributary to the river Musi.

The Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) is a statutory authority providing and maintaining water supply and sewerage facilities in Hyderabad and surrounding municipalities. The Board is responsible for supply of potable water including planning, design, construction, implementation, maintenance, operation and management of water supply and sewerage system. The main surface sources of water for the city of Hyderabad is from five impoundments, viz., Osmansagar on River Musi (Fig.1a), Himayatsagar on Esi River, Manjira phase I and II on Manjira Barrage, Manjira phase III & IV on Singur Dam, Krishna water supply phase I & II on Akkampally reservoir. In view of uncontrolled anthropogenic activities, the water characteristics of Osmansagar and Himayatsagar lakes, particularly the former one, have been deteriorated substantially. Since this water is being used as a source of drinking water, the water treatment plant efficiency has

been reduced substantially in recent times. As a result, HMWS & SB often stops taking Osmansagar lake water as a source of drinking water. Hence looking into the shrinkage of drinking water sources, there is a need to undertake monitoring and suggest remedial measures for restoration of these freshwater lakes in the interest of mankind.

Phytoplankton plays a key role in the aquatic ecosystem and has a great ecological importance as primary producers and their work as biological indicators of the aquatic ecosystem because of their quick response of pollution. An estimation of phytoplankton composition and diversity depicts the health state of water ecosystems. Phytoplankton is a fundamental component of many of these aquatic ecosystems, not only in terms of biological diversity but also its contribution to primary productivity that helps to maintain fisheries and other important lake ecosystem attributes. Diversity of phytoplankton helps to enhance the productivity and strongly depicts the water quality (Moss, 1988) as well as corresponds to the biotic factors (Scheffer, 1998). However, the effects of various factors on the seasonal appearance and disappearance of phytoplankton differ significantly across the Lake ecosystem (Divya *et al.*, 2013).

Similarly zooplanktons are the free floating and microscopic animal found in aquatic ecosystem and they are major source of live fish food. Zooplankton are classified in various taxonomic groups *viz.* Cladocera, Copepoda, Rotifer, Ostracoda *etc.* that play an important role in biomonitoring of water pollution (Tyor *et al.*, 2014). The study of zooplankton is necessary to evaluate the fresh water lake in respect to their ecological and fishery status (Goswami and Mankodi, 2012). The objective of the study is to assess the comprehensive seasonal assessment of plankton diversity of Osmansagar Lake water, and to suggest remedial measures to retard the contamination process, thereby restoring water quality for sustainable drinking water source.

MATERIALS AND METHODS

Limnological survey of the lake was carried out during winter, summer and monsoon seasons from 2012 to 2014 to study the status of Lake Ecosystem and evaluate various impacts that are responsible for deterioration of lake water quality. Monitoring was undertaken with special reference to plankton population, which is best indicator of water quality. Twelve sampling locations were selected for water sampling in Osmansagar Lake (Fig.1b). Water samples from Osmansagar Lake were collected for biological analysis following standard limnological methods (APHA, 20th ed.(1998). Phytoplankton flora was microscopically analysed by Lackay Drop Count Method while zooplankton fauna was microscopically analysed by using Sedgwick Rafter Cell.

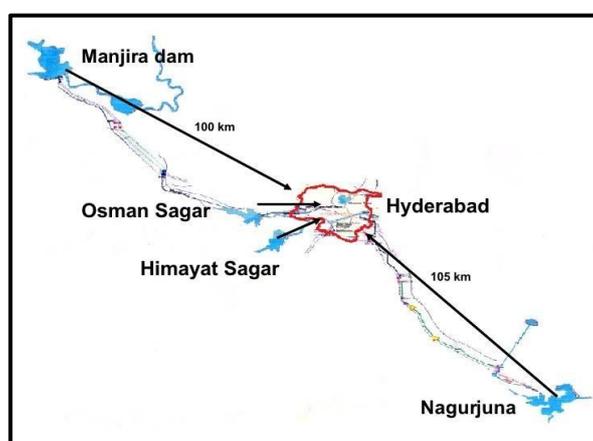


Fig. 1a: Schematic Map of Hyderabad city and surrounding water sources.



Fig. 1b: Schematic Map of Osmansagar Lake– Location of Sampling Stations

RESULTS AND DISCUSSION

The lake water was observed to be slightly turbid with greenish shade due to dominance of algal bloom along with slight murky odour. The highest count of phytoplankton was observed at station 7 and that of zooplankton was at station 6. Comparative representation of phytoplankton and zooplankton between 2012 and 2014 is showing Figs.2a and 2b. A total of 40 phytoplankton genera were observed during the survey and 26 varieties of zooplankton were observed during 2012-2014. Survey revealed that Cyanophyceae and Chlorophyceae groups of algae and Rotifera, Copepoda and Cladocera groups of zooplankton were dominant. Abundance of phytoplankton groups was indecreasing order of Cynophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae and that for zooplankton was observed as Copepoda, Rotifera and Cladocera (Figs.3a and 3b). Presence of pollution indicator algal genera like *Euglena*, *Microcystis*, *Oscillatoria*, *Ankistrodesmus*, *Chlorella*, *Navicula* and *Nitzchian* and zooplankton like *Brachionus*, *Keratella* and *Asplanchna* indicated contamination of organic pollution in the lake. In general, Chlorophyceae, Cyanophyceae (algal groups) and Ciliata, Rotifera (zooplankton groups) dominate eutrophic waters. *Diaptomus* sp. (Carter 1971, Patalas1972 and Rigler1967) and *Daphnia* sp. (Wells *et al.*, 1960), known to be associated with oligotrophic conditions, were absent in the lake. The relatively high concentration of indicator groups and plankton genera indicates increased level of eutrophication due to organic pollution during the study period. This observation is supported by decreased Shannon's species diversity and increased Palmer's Pollution Index values. Environmental survey of Osmansagar lake surroundings showed that the major sources of pollution to the lake are solid waste disposal, religious activities, domestic washing, bathing, cattle wading, run off water from catchment area and death and decay of macrophytes. Two pollution indicator genera *Anabaena* and *Oscillatoria* that produce neurotoxins (characterized as contact irritants) were recorded at Osmansagar Lake in high density. According to Mischke and Nixdorf 2003, presence of *Oscillatoria* and *Anabaena* indicate beginning of biological pollution. Members of Cynophyceae family are known to tolerate the combination of intermittent nutrient deficiency and low light conditions. Such conditions are produced by frequent but irregular mixing of water in

summer and they build up very dense algal population that causes deficiency in light penetration. Zafar, 1994 observed that the presence of diatoms was due to concentration of phosphates as it was observed during present investigation. Other factors that regulate Cyanophyceae are high water temperature, stable water column, low light availability, high pH, low dissolved CO₂ and low total N to P (TN:P) ratio (Welch,1992 and Paerl,1988). Considering present ecological status of the lake and problems faced during last years comprehensive studies were initiated.

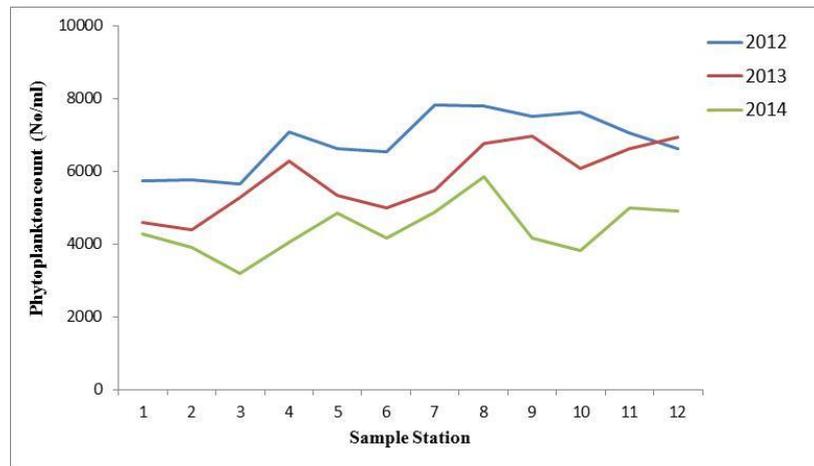


Fig.2a: Average Phytoplankton counts observed in Osmansagar Lake during 2012-2014

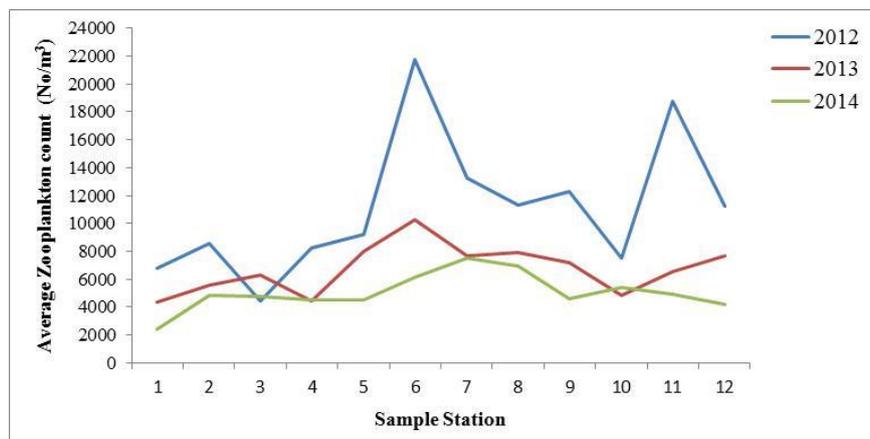


Fig.2b: Average Zooplankton counts observed in Osmansagar Lake during 2012-2014

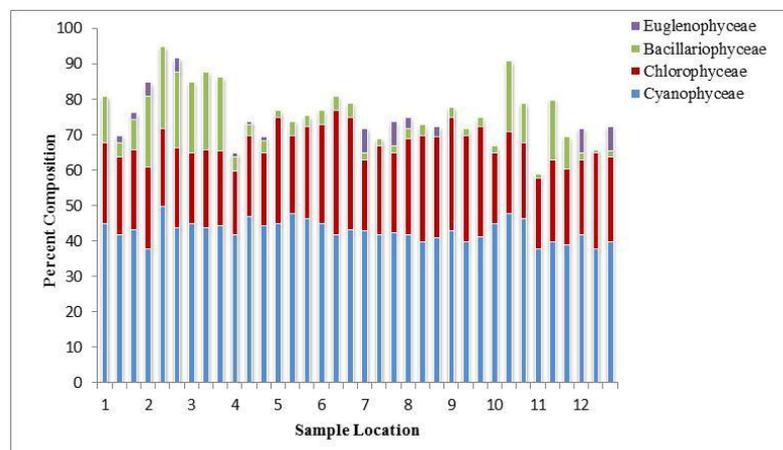


Fig.3a: Average Phytoplankton composition in Osmansagar Lake during 2012-2014

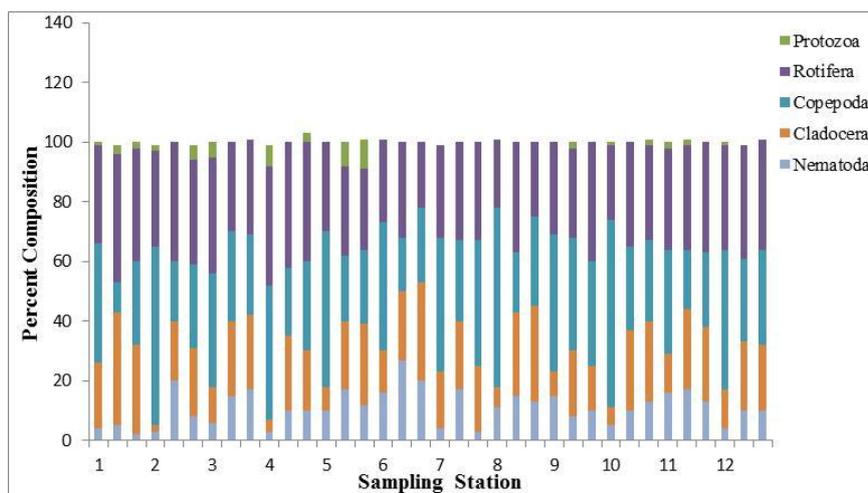


Fig.3b: Average Zooplankton composition in Osmansagar Lake during 2012-2014

CONCLUSION

The Osmansagar Lake water was fairly eutrophic in 2012 due to anthropogenic activities. The phytoplankton showed decreased number of Bacillariophyceae, which are indicators of unpolluted water. However, indicators of organic pollution viz. Cyanophyceae and Chlorophyceae groups were increased during this time. Similarly, amongst zooplankton, Rotifera and Cladocera were dominant. These observations were also supported by Shannon Wiener Index and Palmer Pollution Index indicating the range of eutrophic water in 2012. In 2014 water quality of Osmansagar Lake was marginally improved from medium to good, because of proper management for restoration and conservation of this lake by adoptive macrophyte removal, demarcation of boundaries to protect the area of lakes, arresting encroachments, deepening of shallow areas by remove accumulated sludge, regular water analysis, banning of solid wastes disposal and tree plantation in catchment area.

It is also suggested to HMWS & SB that the Action Plan for improvement of lakes could be divided into three components viz. short term, medium term and long term. Under short-term plan, the issues relating to growth of trees, fishes, and other human related activities could be addressed; under the medium-term plan some of the issues pertaining to sanitation of catchment areas could be taken up in the villages concerned and for the long-term plan, protection of lakes to create sustenance as drinking water source for Hyderabad.

ACKNOWLEDGEMENT

The authors are thankful to the Principal, Sevadal Mahila Mahavidyalaya, Nagpur and Director of National Environmental Engineering Research Institute (NEERI), Nagpur for providing all necessary facilities to carry out this work.

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