

SUMMARY AND CONCLUSION

The overall condition or health of aquatic an ecosystem is determined by the interaction of all its physical, chemical and biological components, which constitute the system. The changes in physico-chemical parameters lead to change in plankton dynamics, faunal diversity and presence of some immigrant species in the reservoir. Hence, to understand an ecosystem assessment of all these parameters becomes essential.

Total seventeen physico-chemical parameters studied. The present study deals with a two year study of a higher altitudinal lake in Western Satpura in Northern Maharashtra. Being in remote area this was an undisturbed lake. However, because of development in ecotourism sector, the area is being develop for tourism hence the baseline data of the area becomes important which includes physical parameters such as Air temperature, Water temperature, Total solids, Total dissolved solids, Total suspended solids, Transparency and Water Cover. Chemical parameters like pH, free CO₂, Dissolved Oxygen, Total Hardness, Acidity, Alkalinity, Chloride, Nitrite, Nitrate and phosphates and biological parameters like phytoplankton, zooplankton, mollusc and bird density and diversity. Various physicochemical parameters show significant seasonal variations.

Physico-chemical parameters (Chapter - 3)

Temperature: During the study period, both water temperature as well as atmospheric temperature, showed a range of fluctuation in accordance to the annual climatic changes. However, YSL being located at higher altitude the range was 1155 msl. Maximum temperature was recorded in summer while minimum in winter months. **Total Solids:** It includes Total Dissolved Solids and Total Suspended Solids which shows seasonal variations maximum in accordance to rainfall in monsoon and minimum with winter. **Transparency:** Which depends on TS, TDS and TSS shows opposing trend to these parameters with maximum in winter and minimum in monsoon. It is also important

parameter which influences photosynthesis and faunal distribution in water body. **Water Cover:** As Yashwant Lake is present independent on Southwest monsoon climate of India, maximum water cover was recorded with maximum in postmonsoon and minimum in summer.

Chemical Parameters:

pH: The pH though fluctuated over the years remained alkaline throughout the study period. It was maximum in summer and minimum in winter. **Free CO₂:** Maximum value of CO₂ were recorded in summer when water was low and decomposition was high and minimum in the winter when productivity was expected to be high as CO₂ and DO show opposing trends. **Dissolved Oxygen** was maximum in winter and minimum in summer. **Total Hardness, Acidity, Alkalinity** and **Chloride** were maximum in summer showing effect of concentration due to evaporation due to summer heat. However, their minimum values were recorded in either monsoon or post-monsoon depending on influence of rain runoff or dilution respectively. **Nitrite, Nitrate and Phosphates** were recorded maximum in monsoon and minimum in winter. These are the nutrients which depend either on geology or biotic use by the ecosystem.

The physico-chemical parameters showed significant seasonal fluctuations at all the three stations. These seasonal fluctuation were either because of the season, geographic location and anthropopressure.

Plankton (phytoplankton) (Chapter-4)

Phytoplankton constitutes the basis of nutrient cycle of an ecosystem. Being primary producers they play an important role in maintaining equilibrium between living organisms and abiotic factors.

Highest phytoplankton density was recorded during summer, when the water level reduces and the plankton get concentrated while minimum during postmonsoon when the water level was high and plankton get more distributed (chapter 4 A). Due to good rainfall during monsoon around the lake, the water

level and resultant water cover were maximum during postmonsoon. This led to the decrease in density of the plankton. The Lake was also overflowing during postmonsoon, the plankton probably also got drifted along with the water. Highly significant seasonal variations of total phytoplankton density and species richness were recorded. The location of the lake falls in the subtropics which receive maximum photoperiod during summer which also invigorates growth of the aquatic autotrophs.

Out of total 49 species of phytoplankton recorded 8 belonged to Cyanophyceae, 10 to Chlorophyceae, 24 were to Diatoms, 4 belonged to Dinophyceae and 3 belonged to Euglenophyta (Annexure- I). The diatoms were maximum qualitatively as well as quantitatively at Yashwant Lake. Maximum species richness was recorded in summer while minimum in winter.

The phytoplankton population is influenced by various physicochemical parameters (Table 13). Temperature, pH and nutrients were found to be more influencing parameters on phytoplankton. Pollution indicator species were also observed but their abundance was low. The phytoplankton were observed quantitatively and qualitatively in the decreasing sequence as Diatoms, Chlorophyceae, Cyanophyceae, Dinophyceae, and Euglenophyta.

Zooplankton

Zooplanktons constitute an important link in food chain as grazers (primary and secondary consumers) and serve directly and indirectly as food for fishes and higher organisms.

Highly significant seasonal fluctuations were recorded in the density and species richness of zooplankton (chapter 4 B). Maximum density and species richness of microcrustaceans (Cladocera, Copepoda and Ostracoda) were observed in summer while they were minimum in postmonsoon. The microcrustaceans are known to be more dominating in the lentic conditions. The higher microcrustacean density can be related to the availability of food, thus reducing the competition. The density of zooplankton is positively correlated with total density of phytoplankton (Table 18). The zooplanktons

were observed qualitatively and quantitatively in the decreasing sequence as Rotifers, Cladocera, Copepoda and Ostracoda. Maximum density of zooplankton in summer corresponds to decrease in water cover hence they are concentrated more densely in water. Moreover, during summer the littoral vegetation is exposed creating the best habitat for zooplankton particularly for rotifers. The density of zooplankton is positively correlated with temperature and negatively correlated with dissolved oxygen.

Total 44 species of zooplankton belonging to 26 genera were recorded at Yashwant Lake with 24 species of Rotifera, 11 species of Cladocera, 6 species of Copepoda and only 3 species of Ostracoda (Annexure-II). The temporal variations in the physicochemical parameters influence the seasonal variations in zooplankton density and species richness.

The plankton communities of the high altitudinal Yashwant Lake of semiarid region of Maharashtra is rich and reflects the status of water body. Though some pollution tolerant genera of plankton were observed at Yashwant Lake their number were lower and temporary so the water body is unpolluted.

Molluscs (Chapter-5)

Molluscs form one of the major part of the macroinvertebrates in wetlands and many water birds (waterfowl) feed primarily on aquatic invertebrates like mollusc for their calcium requirements. The density and species richness of molluscs showed significant seasonal variations (chapter 5). Maximum density and species richness of molluscs were observed in postmonsoon when the water level stabilizes and climate is moderate and minimum in winter probably they aestivate in the cold higher altitudinal conditions. During postmonsoon water cover was also high favouring the growth of vegetation and probably the breeding performance of molluscs.

Maximum density of molluscs was recorded at YLC which is dominated by *Lymnaea acuminata* and *Lymnaea luteola*. This area has thick vegetation and less human interference. *Thiara tuberculata* and *Indoplanorbis exustus* are dominated at YLA where vegetation is low and human interference is high.

Total six species of molluscs were recorded at Yashwant Lake. They include above mentioned four species and *Bellamya bengalensis*, *Lamellidens marginalis*.

Avifauna (Chapter-6)

To study any ecosystem the birds serve as important inexpensive bioindicators as they have the ability to fly away and avoid any obnoxious conditions. Hence, they are considered as important health indicators of the ecological condition and productivity of an ecosystem.

In present study of avifauna of Yashwant Lake, the density, species richness, evenness and H' showed significant seasonal variations (chapter 6). It is observed that the density and species richness are maximum during winter (the peak migratory season) when the migratory population of birds arrive to the area and minimum during monsoon when they leave the area and the resident species are engaged in the nesting activities. The overall lower density of birds may be related to altitudinal effect. During present study 58 species of birds (Annexure III) were recorded categorized into three groups as Resident species 27, Resident migratory species 15 and migratory species 16. This comparatively small high altitudinal lake is inhabited mainly by resident species of birds all throughout the year and equally well by resident migratory and migratory species of birds during winter (migratory season). In winter the nutritional requirements of birds were sufficient enough to support the population.

Birds density and diversity may be affected by cumulative effect of physicochemical factors. One of the factor is anthropopressure which must be under the control to sustain the biodiversity and their habitat.

In summary we can say that the physical factor-water temperature, was most influencing factor which varied within 17 °C to 23 °C which is favourable for the biotic components. The water temperature showed positive significant correlation with density of phytoplankton and zooplankton as well as with free Carbondioxide (Table 13 and 18). While it was negatively correlated with

density of birds and dissolved oxygen. Total solids were also positively correlated with plankton. The water cover is positively correlated with density of molluscs while it was negatively correlated with plankton. Transparency establishes positive correlation with total density of birds. The lake remained alkaline throughout the year, a condition that is favourable for the plankton communities. In the present study, the pH is positively significantly correlated with the total density of phytoplankton and zooplankton and water temperature. Free carbondioxide established significant positive correlation not only with phytoplankton and zooplankton but also with the density of molluscs. Dissolved oxygen established significant negative correlation with the density of plankton, molluscs and free CO₂. Phosphate shows significant positive correlation with phytoplankton and zooplankton.

It is the cumulative effect of physicochemical parameters which govern the biotic components of the lake because no single common abiotic parameter could be correlated to biotic parameters studied. To summarize, physicochemical parameters are within the permissible limit as per WHO and ISI standards. The normal treatment at filtration unit makes the reservoir water potable for drinking. On the basis of phytoplankton, zooplankton as well as molluscan density and diversity it can be said that at present Yashwant Lake is not polluted but if chemical parameters under the influence of anthropogenic pressures as observed at YLA are not taken care it has the potential to lead to deterioration of Lake and to eutrophication. A very careful management planning is required to maintain and develop this place as ecotourism center. As many different types of birds are observed here and climate is cooler it is a strong attractant for ecotourists.

To summarize, the Yashwant Lake is an ecosystem with self sustaining capacity as the results of biotic parameters shows seasonal variation which may be influenced by climatic changes, altitudinal effect and slight anthropopressure. The environment is favourable for the phytoplankton which are primary producers as well as for the zooplankton which are primary

consumers their fluctuations are influenced by physicochemical parameters. The molluscs are benthos and macroinvertebrate were well acclimatized to this environment. Phytoplankton serves as important resource for the molluscs. The water dependent birds were categorized into three categories they are resident, resident migratory and migratory. They also shows seasonal variations which are regulated by environmental factors. The birds have the ability to avoid the unfavourable habitat, the Lake which have the presence of the birds are often designated as wetland with healthy ecosystem. In the present study good number of species of various groups of organisms were recorded so it is evident that the Lake has good potential to support biodiversity and yet it is better habitat for them. From biodiversity conservation point of view the prime important is the conservation of habitat and the present study proves that the Yashwant lake is a good habitat to support biodiversity, which is the main goal of many national and international NGO's and Governments.