GENERAL CONSIDERATIONS

Water is a precious natural resource vital for sustaining entire biota on the earth. Water is in continuous circulator movement as, hydrologic cycle. It is uniformly distributed in time and space. Of all the planet's renewable resources, water has a unique place. It is impossible to substitute for most of its uses, difficult to depollute, expensive to transport and it is truly a unique gift to mankind from nature. Due to its multiple benefits and problems created by its excesses, shortages and quality deterioration, water as a source require special attention (NIH, WRI). Water is also one of the most manageable of the natural resources as it is capable diversion, transport, storage and recycling (Kumar *et al.*, 2005). All these properties impart to water its great utility for human beings.

By the year 2025, two third population of the world is provided to be under water stress. Hence, there is a need for proper planning, development and management of this greatest assets of the country for raising the standards of living of the millions of people, particularly in the rural area. Water is a resource shared community and has already started becoming cause of conflict.

Yashwant Lake, located at North latitude 21° 52' 49" and East longitude 74° 27' 44" is one of the oldest manmade lake of British time, constructed by damming the deep gorge and has a average depth of 10 meters. The gravel embankment of 400 meter on the North-East side arrest the flow of the stream. It has 2.75 Km. perimeter and spreads over 39 hactars of the land.

It is the only perennial water body in the Toranmal plateau. It forms a major life supporting system in the area. It fulfills the domestic requirement of water of Toranmal village. Hence, it was felt necessary to monitor abiotic and biotic components of this undocumented lake and its surrounding area. The Government of Maharashtra is giving attention to develop Toranmal as a tourist centre. This is expected to increase human interference in future and

may create adverse impact on biodiversity due to deterioration and it neglected. Hence to generate scientific baseline data set the present work was undertaken.

The consideration of the physicochemical factors in the study of limnology is basic to the understanding of trophic dynamics of the waterbody. Each factor does play its individual role but at the same time the final effect is the actual result of the interaction amongst these factors. All the physicochemical variables influence gross primary productivity; however the magnitude of their influence differ significantly (Murugavel and Pandian, 2000). The changes in physicochemical parameters lead to increase in plankton density, faunal diversity and presence of some immigrant species in the lentic zone of the reservoir (Ayoade *et al.*, 2009). The metabolic activities of phytoplanktons depend on the physicochemical factors of the aquatic environment (Hulyal and Kaliwal, 2009) so considering the overall influence of the physicochemical parameters on shaping the biotic communities of aquatic ecosystem the physicochemical analysis is carried out which is discussed detailed in chapter 3.

Physical parameters define those characteristics of water that respond to the sense of site, touch, taste, odour and temperature fall under this category. Chemical parameters are related to the solvent capabilities of water. Total dissolved solids, Alkalinity, Hardness, Chlorides, pH and nutrients are chemical parameters of concern in water quality assessment. Total seventeen physicochemical parameters were studied their correlation with themselves as well as biotic components like plankton, mollusc and birds. Biweekly surveys carried out at Yashwant lake were considered for four seasons (Winter, Summer, Monsoon and postmonsoon) as per climate of Central India. The physicochemical parameters showed significant seasonal variations. These temporal fluctuations were either because of the climatic changes, geographic location and anthropopressure. Various physicochemical parameters were positively or negatively correlated with each other and on the other hand with the biotic components too indicating the cumulative influence of the

physicochemical parameters to govern the biotic components of the lake. No single common abiotic parameter could be correlated to biotic parameters studied. However, at Yashwant Lake the physico-chemical parameters are within the permissible limit as per WHO and ISI standards of drinking water.

The chapter 4 (A and B) considers details about the study of plankton-their density and species richness and their correlations with abiotic and other biotic components.

The species is regarded in many quarters as the fundamental unit of biodiversity, species richness as the fundamental meaning of biodiversity, and the high level of species extinction as the main manifestation of the biodiversity crisis. Species richness is at best a measure of one aspect of biodiversity.

Accelerating rates of biodiversity loss and the signing of international agreements, such as convention on Biological Diversity and Agenda 21, have called for the world's biodiversity to be inventoried and monitored. Yet, to date, so few organisms have been collected named and their distributions recorded that the scale of the task is enormous. A number of considerations are important prior to investment in inventorying and monitoring. How well these are considered reflect on the statistical and biological validity and reliability and comparability of the resulting data. Particular consideration has to be deciding which taxa may be examined as keystone, indicator, threatened, umbrella, flagship, agriculture, medical or commercial species or what level (e.g. gene, species, population, ecosystem).

Monitoring of biological diversity aims to develop a strategic framework for predicting the behavior of key variables in order to improve management, increase management options and provide an early warning of system change. Success in monitoring depends on various factors too (Castri *et al.*, 1992). In present study the taxa studied includes plankton, molluscs and birds which are sensitive enough to environmental changes which reflects in their density, species richness and temporal variation.

The present study was carried out using standard methods for sampling (e.g. APHA for physicochemical analysis) and Prism graph pad software and SPSS 7.5 software for window statistical analysis like ANOVA and correlation of various variables.

Hydrobiological studies of Yashwant Lake with special reference to selected biodiversity includes the study of phytoplankton, zooplankton, molluscs and birds. These may be considered as a baseline data. The fundamental units of basic inventory information that are crucial for biodiversity conservation planning and management. They usually include 1. The presence and or abundance of species or other units. 2. Other dependent biotic data (e.g. phytoplankton and microcrustacea). 3. The appropriate influential abiotic variables and 4. Human variables, inventories and monitoring of biodiversity should be carried out in the areas in which the biological diversity is conserved. It is essential for providing information necessary for the sustainable management of natural resources, understanding ecosystem processes so that the ecological services essential for human survival can be maintained. Defining the impact of human activities on biodiversity so as to help reduce undesirable effects on the environment. Determining the aesthetic benefits of diversity so as to preserve the quality of human life.

For a nation, knowing the identity and geographical distribution of its species is perhaps the most important information available in its attempts to preserve and use its biodiversity. Government agencies use information on biodiversity and species distribution to determine gaps in protected area coverage and to prepose new area for protection.

In order to consider the conservation and management of any ecosystem it is vital to study its structure and functions because ecosystem results from the integration of all the living and nonliving factors of the environment.

The structure of ecosystem also comprises the biological communities including species (plants, animals and microbes), numbers, biomass distribution in space, trophic stand point. Considering biological community

the plankton were studied which includes phytoplankton and zooplankton (chapter 4 A and B). The phytoplankton are the primary producers showing different patterns of distribution in the wetland. Phytoplankton constitute the basic of nutrient cycle of an ecosystem. Being primary producers they play an important role in maintaining equilibrium between organisms and biotic factors. Highest phytoplankton density was recorded in 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. Highly significant seasonal variations of total phytoplankton density and species richness were recorded. The location of Yashwant Lake fall in the subtrophic which receives maximum photoperiod during summer invigorating growth of the aquatic autotrophs.

Total 49 species of phytoplankton (Annexture I) were recorded of which 24 belonged to family Bacillariophyceae (Diatoms), 10 to Chlorophyceae, 8 to Cyanophyceae, 4 to Dianophyceae and 3 to Euglenophyta. The diatoms were recorded maximum qualitatively and quantitatively at Yashwant Lake. Maximum species richness was recorded in summer while minimum in winter.

The phytoplankton population was influenced by various physico-chemical parameters (chapter 4 A, Table 13). Temperature, pH and nutrients were found to be more influencing parameter. Pollution indicator species were observed but their abundance were minimum.

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 so its density and diversity also considered (chapter 4 B).

Highly significant seasonal fluctuations were recorded in the density and species richness of zooplankton. This major groups: Rotifers and microcrustacea occurred in YSL. 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. The zooplanktons observed qualitatively and quantitatively in the decreasing sequence 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 exposed vegetation created the best habitat the zooplankton particularly for rotifers increasing their density. The density of zooplankton was positively correlated with temperature and negatively correlated with dissolved oxygen at YSL.

Total 26 genera and 44 species of zooplankton (Annexture II) were recorded at Yashwant Lake which again divided into 4 groups Rotifera (24 species), Cladocera (11 species), Copepoda (6 species) and Ostracoda (3 species). The temporal variations in the physicochemical parameters influence the seasonal variations in zooplankton density and species richness. Though pollution tolerant species of zooplankton were observed at Yashwant Lake, their population was lower and temporary.

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

Molluscs form one of the major part of the macroinvertebrates in wetlands (chapter 5) and many water birds (waterfowl) feed primarily on aquatic invertebrates like mollusc for their calcium requirements. The density and species richness of molluscs shows significant seasonal variations. Maximum density and species richness of molluscs were observed in postmonsoon and minimum in winter when the water level stabilizes, while minimum density in winter due to their aestivating habit in the cold higher altitude conditions. During postmonsoon water cover is also high favouring the growth of

vegetation and probably the breeding performance of molluscs. Moderate temperatures of postmonsoon may also be favourable for molluscs.

Maximum density of molluscs was recorded at YLC which is dominated by *Lymnaea acuminita* 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. I. exustus that is known to harbour the parasitic pathogens. Total six species of molluscs were recorded at Yashwant Lake. They includes above mentioned four species and *Bellamya bengalensis*, *Lamellidens marginalis*.

To study any ecosystem the birds serve as important 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 at Yashwant Lake the density, species richness, evenness and H′ showed significant seasonal variations (chapter 6). It is observed that the density and species richness of birds were maximum during winter the peak migratory season and minimum during monsoon when the migratory population of birds leave the area and the resident species are enganged in the nesting activities. The overall lower density of birds may be due to altitudinal effect. During present study 58 species of birds (Annexture III) were recorded which were categorized into three groups: Resident birds (27 species), Resident migratory birds (15 species) and migratory (16 species). 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. In winter the nutritional requirements of birds was sufficient enough to support the population.

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

Water scarcity problem is becoming serious day by day including Toranmal plateau, the Yashwant Lake is the only perennial water body which forms a major life supporting system in the area. This Lake fulfils the domestic requirement of water of Toranmal village.

Though the population of the village is very low but their washing and bathing activities are carried out on the eastern bank of the Lake. Though the results of present study are positive it has been felt that few pollution tolerant species are inhabiting the lake. If the load of pollution and anthropogenic activities increases in the area due to activities in coming future, proper steps needs to be taken to maintain and manage the ecosystem and to develop sustainable ecotourism.

The baseline information so collected in the study of Yashwant Lake can be utilize in the conservation and management of the Lake. In the light of information and to understand the Yashwant Lake as a holistic ecosystem, following studies/measures should be undertaken.

- The study of physico-chemical parameter with respect to vertical and diurnal variations.
- To study benthos biota mollusc and the study of physicochemical analysis of soil can be undertaken.
- Macroinvertebrates such as arthropods which form food for higher animals (fishes, amphibians and birds).
- The sediment of Lake can be traced for certain phytoplankton such as diatoms which evaluate changes in chemical composition of the drainage basin and water as well as trophic structure in past.
- As the Toranmal is developing hill station and the Yashwant lake is the main attraction from ecotourism point of view multidisciplinary work can be undertaken for conservation of biodiversity and management of water quality.