DISCUSSION

The investigation on the Shiroli reservoir, near Kolhapur ,have for the first time studied to reveal the limnological status of the representative small water body. There are many tanks in and around the Kolhapur city. Present investigation on Shiroli reservoir, gives some information regarding the biotic and abiotic factors and their influence on the status of the tank will be of great value for greater utilization of such water body.

Though some work has been done on the limnological study of lakes, thnks, reservoirs and small tanks in India. It has been found always difficult to compare between two water bodies. The influence of abiotic factors on water body and its interrelationship with plankton productivity. This is mainly because of the differences in water masses, their size, shape, depth, climatic conditions and the region to which they belong. Macroflora, fauna and pollution problems in these waters also play an important role, making it difficult to compare the characteristic of individual water body with another. Therefore the information about important Physical, Chemical and Biological characteristics of the reservoir and their seasonal changes were studied.

This tank is a perennial water body (mean depth 2.85 meters) with about four inlets bringing surplus water from the catchment area. The water from this reservoir is mainly used for washing purpose. The Water level can be maintained by the lift system from Panchaganga river during summer season when water level drops down, While the excess water flows out through spill way, during monsoon.

The heat transmitted with light is responsible for establishing the thermal stratification in water bodies, and it influences the respiration of both plants and animals. Phytoplankton exhibits higher respiration and hence, slightly lower efficiency at high temperature. The air temperature fluctuates from season to season in the range of 16.65°c to 31.8°c, while in monsoon it was moderate. The fluctuations in surface water temperature were in the range of 21°c to 31°c. The increasing water temperature during summer months were observed. After the monsoon, temperature drops down in both air and water.

The percentage of relative humidity was studied from August 1994 to July, 1995. The lowest relative humidity was recorded on 14th March 1995 while, highest was recorded on 11th October, 1994. The relative humidity has direct correlation with the monsoon

rainfall, which can be evidenced from fig - 5. The relative humidity values though decreased in September, it reaches to the highest in the month of October 1994 and again it decline subsequently and reach to the lowest in March, 1995, from where it again slowly increased considerably till August 1995. Low humidity in the summer months, causes a great loss to surface water due to evaporation.

The water level fluctuations coincides with the seasonal pattern of temperature. The gradual fall in the water level in the post monsoon period and reaches to minimum (1.7 meters) level in the month of June - July 1995. Premonsoon rain cause little increase in water level. Wirth (1970) have dealt with the different aspects of level fluctuations in fresh water masses, and in India Pantulu et.al (1966) tried to find out its relation with fisheries in Damodar Valley reservoir. During the summer months (April - May) the water level being decreased considerably in tanks, makes the fish harvesting easier in less man efforts to get maximum harvest. This season also coincides with the maturity period of the weed fishes from the tank and they can be eradicate before the release of their eggs.

Colour of the water is due to the scattered light rays from suspended particulate matter. It is

generally blueish in lakes and reservoir but, in Shiroli reservoir it was brownish in rainy season due to the silt carried down by run off. Later on the water colour changes to brown - green and greenish in successive months. Greenish colour to water in the month of March is due to the increasing chlorophyll content of phytoplankton.

The turbidity of natural water may be due to the suspended inorganic substances such as silt, clay or due to any planktonic organisms. It is important limiting factor in the productivity of reservoirs, tanks and ponds. Turbidity also depends upon the type of the bottom, if it is rocky with sand or gravel then there will be low turbidity (Jhingran, 1983). Turbidity plays an important role in productivity of the reservoir. The data on the turbidity at different stations though varies in different season, but the pattern of fluctuations is somewhat uniform. At station D and E turbidity was comparatively higher than other three stations. This may be due to human activities in this part of the reservoir. Turbidity was maximum at all stations in the months of August - 1995, whereas it was minimum in August - 1994.

The turbidity and transparency has shown negative co-relation, as the water transparency drops gradually after September, 1994, and again it gradually

increased and reached to maximum in May - 1995. This might be due to wave action, algal blooms, and fishing activity in the tank made the water more disturbed.

In Chemical analysis parameters like pH, dissolved oxygen, free carbon dioxide, Chlorinity, hardness, phosphates and nitrates from the surface water were studied.

pH values recorded at all five stations showed almost similar pattern of fluctuations. Minimum pH was recorded in the month of March, 1995 at all the stations, whereas it was maximum at the end of January, 1995 except station E, where it was maximum in July, 1995.

Every water body shows the seasonal and diurnal variation in pH. According to Jhingran (1983), pH is alkaline in the afternoon and acidic in the dawn. The pH of the water samples from Shiroli reservoir ranged between 6.3 to 8.7 during the period of investigation. According to Swingle (1967) water having pH range of 6.5 to 9.0 are most suitable for pond culture. In low pH values fishes get prone to attacks of parasites and diseases. As the pH increases above 9.5, there will be absence of CO_2, which is required for the growth of phytoplankton.

Dissolved oxygen (DO) is one of the most important parameters of the water quality, directly affecting survival and distribution of flora and fauna in an ecosystem. The two main sources of D.O. are diffusion from air and photosynthesis, while major factors responsible for its depletion are biochemical oxidation and respiration by flora and fauna. The quantity of dissolved oxygen in water is directly or indirectly dependent on water temperature, partial pressure of oxygen in the air, concentration of dissolved salts, amount of chlorophyll content ect. (Welch, 1952) , and temperature and hydrogen ion concentration (Wetzel, 1975). In the Shiroli reservoir the entire basin is partially eutrophicated due to which the euphotic zone has been reduced. When there is low temperature, solubility of oxygen in water increases considerably, which further reduce when water temperature becomes high. Oxygen concentration in water Samples of Shiroli reservoir shows fluctuations between 0.56 to 4.83 ml/lit. Lowest D.O. recorded in the month of Sept.-October, might be due to short photo period, and low wave action.

Though there was increase in the D.O. values during winter, it gradually decrease during summer, which may be attributed to high air and water temperature which prevents diffusion of oxygen from air.

During the period of investigation free carbon dioxide values ranged from 1.65 to 43.94 mg/liter. Maximum value was recorded at station A, while minimum value at station C. Though there was great fluctuations in carbon dioxide in different seasons, the pattern of changes was almost uniform. In general the free carbon dioxide content at five station was in the order of A, B, D, E, and C due to the unstable state of free CO_2, it escapes as the saturation level is attained. Therefore no correlation with other abiotic or biotic factor could be established.

The amount of carbon dioxide depends on the decomposition of top soil and chemical nature of the underlying rocks. In the day time it is utilized by plants for photosynthesis. Hence in the early morning it will be in maximum quantity than that of the evening (Mann,1958).

Natural water normally contains low chloride than bicarbonates and sulfates. Large contents of chloride in fresh water is an indication of organic pollution (Thrash et. al. 1944) Though chloride level as high as 250 mg/liter is safe for human consumption, a level above this imparts salty taste to potable water. In the present study,the chloride content was minimum in the month of August 1994, while it was maximum in June-July

1995 at all stations. The highest chloride content was 308.0 mg/liter at station D in June,95 whereas the lowest volue recorded was 16.5 mg/lit at station B in August, 1994. August Though there are fluctuations in chloried content, the pattern of changes was almost uniform.

Hardness to water is imparted by alkaline earth metal cations , mainly calcium and magnesium present in it. Ecologically temporary hardness plays a key role in buffering capacity thus, neutralising an offset in pH due to addition of acidic products. This has great effect on biotic diversity of an ecosystem. Hardness of water also restricts water uses. In the present study the hardness ranges from 51.21 to 120.65 mg $CaCO_3$/ liter at station E, in the month of November, 1994 and July 1995 respectively. High values of hardness in the month of July 1995 is due to the concentration of carbonates and bicarbonates through run off from rain water. Though there were fluctuations in the hardness from March to August 1995, the pattern of changes was almost similar, particularly from August, 1994 to February, 1995.

Pond or tank waters having hardness of 15 ppm or above are satisfactory for the growth of fishes. While hardness less than 5 ppm gives slow growth, distress and leads to death (Swingle,1967; Goldman et at,1963). Sreenivasan,(1964) also correlated the hardness of water

with organic productivity. From the present study on hardness it is clear that the water is more suitable for aquaculture practices.

The phosphates (PO_4) in natural waters occur in very small quantities. It is an important nutrient in the maintenance of fertility of the pond. In an aquatic ecosystem phosphorus occurs both, in inorganic and organic forms. Of the two, the inorganic phosphorus plays an important role as a nutrient along with nitrates. In Shiroli reservoir phosphate (Phosphorus) content recorded was minimum (0.48 mg/liter) in the month of October, 1994 and maximum (2.94 mg/liter) in May 1995. Though phosphate content in water at five stations were low from August to November, 1994, there was remarkable increase in the content from December, 1994 onwards and reached to the maximum in May 1995 and again decline slowly till August 1995. The phosphate more than 2 mg/liter in open water gives a sign of organic pollution (Pomeroy et.al; 1965) As a nutrient, excess of phosphate stimulates development of algal blooms, such blooms of blue green algae like Microcystis are toxic in nature.

Nitrogen occurring in the fresh water is in the form of an element or nitrogenous compounds. Nitrogen is mostly derived from atmosphere and denitrifying bacteria

giving nitrates, nitrites and ammonia. Nitrogenous compounds may be derived from outside sources like rain, surface run off and seepage. In Shiroli reservoir nitrate values ranged between 0.4 mg/lit in August, 1994 to 3.6 mg/lit in May, 1995. Nitrate values increases considerably from August to October - 1994 and decline slowly till January, 1995, but again it increased remarkably and reached to its maximum in May, 1995, giving a peak value and then decreased in preceding months.

Increasing levels of nitrates and phosphates leads to eutrophication, a phenomenon linked with nutrient enrichment, leading to initial higher productivity, abundance of undesirable plants and animal species and finally destruction of an ecosystem. The values of phosphates and nitrates in Shiroli reservoir showed correlation and almost similar trend in the periodic fluctuations. The high values of phosphates and nitrate during May, 1995, was perhaps due to high temperature enhancing degradation of organic matter from the reservoir.

Among biotic communities phytoplankton constitutes the first stage in trophic level by virtue of their capacity to fix radiant energy into biological energy through photosynthesis, referred as ' primary

productivity.' The plankton plays a vital role in regulating the atmospheric level of O_2 and CO_2 gases and biogeochemical cycles.

In present study, the biota of the reservoir was surveyed during the period of investigation and listed in results. The phytoplankton was represented by 35 species whereas, zooplankton consists of 29 species. In the macro-organism, 9 plant species and 42 animal species were recorded, including fishes, amphibians and aves. Marginal aquatic weeds consist of 76 types of plants around the reservoir. The species of Nymphaea and Nelumbo occupied the southern half of the reservoir. Plankton studies were carried out for qualitative and quantitative estimation. The plankton volume gradually increase, from November 1994 to Febuary, 1995 and then decrease slowly till June, 1995 and again it increased slowly till August, 1995. The volume of plankton probably depends upon seasonl variations in light penetration and temperature fluctuations.

During the period of investigation though the percentage composition of phytoplankton was always dominant in the sample, but in the month of May and June, 1995 zooplankton dominated over phytoplankton. The percentage composition of phytoplankton ranged between 45.4 to 98.7 % , whereas percentage composition of

zooplankton ranged between 1.5 to 55 % . It appears that the impact of water temperature was more predominant on the phytoplankton population.

The average values of nutrients (phosphate and nitrate) and phytoplankton showed inverse correlation, as low values were recorded in the month of May - June 1995. This may be due to the shallower depth of the reservoir during this period.

An accumulation of metals occurs at all levels in the food chain, including the phytoplankton (Riley and Roth 1971;, Bentley et al; 1977;, Button and Hosteter, 1977;, Sakaguchi et al; 1977) and high levels of Heavy metals may persist in sediments and be reintroduced into the water column by the activities of the benthic borrowers and other bioligical, chemical and geological processes.

From the survey of the study area during the period of investigation it appears that the domestic sewage from Shiroli Village and industrial waste coming from M.I.D.C. area affecting the water body at different levels, particularly during rainy days, When large amount of silt with nutrients runoff from the catchment area, which accelerate the process of eutrophication. Further studies on metal analysis showed that the metal ions like calcium, lead, nickel and iron were present in the water

samples collected during winter season. This indicates metal pollution in the reservoir water at low level. These metals could accumulate in large quantity in the sediments and may affect the biota of the water body.

Considering the shallowness of the water body and its small size; this perennial tanks seems to have almost all basic requirements for intensive fish culture practices. With the application of advance techniques the inflow of silt and domestic sewage from the nearby area can be checked. The fish production from this reservoir can be increased by many fold. The selection of the commercial fish varieties to be introduced in the tank should be based on scientific information about the littoral biota, benthic fauna, primary and secondary productivity which help to increase the productivity of the tank.

The efficient management techniques like optimum stocking of try and fingerlings of suitable exotic fish species, irradication of weed fish & cat fishes and addition of organic manure from the local sources will increase the fish yield of the reservoir. This will set an example before the local population, to take the advantage of such water bodies. Such fishery will provide cheap source of animal protein in nutrition and employment apportunity to the local fishermen and farmers.