UNIVERSITY GRANTS COMMISSION

Western Regional Office, Ganeshkhind, Pune-07

FINAL PROJECT REPORT

Of

MINOR RESEARCH PROJECT

BY

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FILE NO. - No. 47 – 1871/11 (WRO) 21 / 02/ 2012.

July 2015

INDEX

"ANALYSIS OF WATER QUALITY AND ZOOPLANKTON DIVERSITY OF SANGMESHWAR MEDIUM PROJECT IEET IN OSMANABAD DISTRICT".

INTRODUCTION :

Water in the nature is an essence of life, without it no life can sustain on the earth. No life can sustain without water. Though water is an essence of life it is also used for various purposes including industry, agriculture, washing, sailing, transportation, recreation etc. It is one of the abundantly available substances in nature. It exists in various forms in nature such as clouds, rain, ice, fog etc. It acts as a limiting factor and regulates the diversity and abundance of biotic community.

Global literature survey reveals that 70% of earth surface is covered by water. Although it is surprising but it is true that in spite of such abundance of water, there is shortage of soft pure fresh water in the world because more than 97.3% water is marine, which is unsuitable for human use. Only 2.7% of the total water in the rivers, lakes swamps, dams, and tanks is fresh and soft water which is suitable for human consumption and other uses. It has been also estimated that out of total fresh water 77.2% is in the form of 'cold storage' frozen in ice caps and glaceries. Most of the remaining supplies of freshwater 22.4% are ground water and soil moisture.

The Indian fresh waters are under considerable threat owing to the fast pace of development, the country is going in the past one or two decades. A survey made by National Environmental Engineering Research Institute, Nagpur (NEERI 1986) showed that 70 % of total fresh water bodies of India are polluted.

For the hydrobiological studies APHA (1989) provide the basic methodology for the analysis of different physico-chemical parameters of fresh water. Welch (1948,1952), Golterman (1978), Goldman et. al. (1983), has given various methods for sampling and analysis of different parameters.

(a) Necessity of the work:-

Though water covers 70% of earth surface, now a day's world is facing to its scarcity. According to different surveys, 70 to 80 % of Indian water sources are polluted and millions of peoples affects by different enteric diseases every year. UNO (United Nations Organization) reports have indicated that majority of world population lack reliable sources of drinking water.

Developed countries have esteemed institutions like APHA (American Public Health Association), EPA (Environmental Protection Agency), FBA (Fresh water Biological Association) etc..

The main factors responsible for aquatic pollution are as follows:-

I. Industrial liquid waste.
II. Urban liquid waste i.e. sewage, storm drainage mixed with sewage, human, cattle and kitchen wastes carried by drains.
III. Surface runoff areas on which solid waste is dumped.
IV. Surface runoff areas on which urban and industrial waste is dumped.
V. Surface runoff from the cultivated land on which fertilizers, pesticides and other types of chemicals applied for agriculture.

The physical and chemical pollution of water brings about changes in water with regard to its colour, odor, taste, hardness, acidity, alkalinity, turbidity, conductivity, transparency etc.

Fresh water ecosystems are highly diversified and marked by a wide range of physico-chemical conditions, which greatly influences the life in water. Fluctuations in physico-chemical condition adversely affects the aquatic organisms. Planktons are the basic biotic components of the ecosystem. These organisms play a vital role in aquatic environment. They form an important link in the food chain and are capable of affecting the entire aquatic life. Zooplanktons play an important role in transferring energy to consumers hence they form the next higher trophic level in the energy flow after phytoplankton.

(i) Objectives of present study :

The assessment of water quality is necessary because of many reasons. The principal objectives are as follows :-

i. To help for providing pure water to the public for drinking ,domestic and agricultural purposes.
ii. To study the percentage of contaminants which are hazardous to human health and to agricultural production.
iii. To study pollution status and proper utilization of natural resources.
iv. This study will help to provide data bank for the hydro biological studies and will also play an important role in planning activation and strengthening biodiversity.

Environmental ministry of Govt. of India has also indicated the progaramme for conservation of lakes and reservoirs in 1995. With the help of world Bank financial assistance, Govt. of India also announced the Jalvigyan project (Hydrological project) recently in few states including Maharashtra state.

1) STUDY AREA:-

Considerable work has been done on physico-chemical and biological assessment and their functional dynamics in the aquatic environment.

The water body taken for hydrobiological investigations is located in Bhoom taluka of Osmanabad district. The morphometric details of these water bodies are summarised below.

i. Name	:-	**Sangmeshwar mediumwater project, Ieet**
ii. River	:-	Manjara River
iii Type	:-	Reservoir (medium project)
iv. Location	:-	Latitude -18- 57^0 to 19. 87^0 North
	:-	Longitude – 74. 39^0 to 76.54^0 East.
v. Details of Dam	:-	Type of dam - Earthen
	:-	Max. height - 14.85 mts.
	:-	Length - 2184 mts.
vi. Details of command	:-	a. G. C. A. – 4846 Hect.(11970 Acres)
		b. C. C. A. – 4652 Hect. (11490 Acres)
		c. Irrigation – 3350 Hect. (8275 Acres)
vii. Total Coast (Lakhs)	:-	Rs. 4404. 612
	:-	Live storage - 12.979 mm^3
	:-	Dead Storage - 3.156 mm3

Osmanabad district is one of the eight districts of Marathwada region of Maharashtra state on the Deccan plateau and demarcates boundaries between Solapur, Beed, Latur and Ahmednagar districts. It is located at Latitude-18- 57^0 to 19. 87^0 North & Longitude – 74. 39^0 to 76.54^0 East.

The climate of the district is dry and moderately extreme. The maximum temperature is of nearly 41^0 C during summer and it falls down up to 15^0C during winter season. The relative humidity averages 35 to 48% during summer and 80 to 85 % during monsoon. Average annual rain fall of district is about 765 mm.

HISTORICAL RIVEW:

World is facing an unique crisis in the form of environmental pollution now a days. Due to growing of urbanization, industrialization and development thrust of man pollution is became a global problem. Pollution of fresh water ecosystem is becoming more and more severe problem in the world. The study of physical, chemical and biological properties and features of fresh water lentic & lotic habits are referred as Limnology. A Swiss professor F. A. Forel (1841 – 1912) is considered as father of Limnology. The period of 20th century is considered as the classical area of Limnology, because most important Limnological investigation on its various aspects were now includes study of lotic and lentic habitats.

The notable contributions on Limnological aspects from various Indian fresh water made by Das and Shrivastava (1956), Gulati and Sarkar (1961), Arora (1962), Verma (1967, 1969), Moitra and Bhowmik (1968), Mathew (1975), Zutshi and Vass (1978), Adwant (1981), Nayak (1982), Goldman and Horne (1983), Khatri T. C. (1985), Hegade and Bharti (1985), Angadi (1986), Das (1988), Ahmed Masood (1990), Battish (1992) etc.

Recent Limnological information on tropical fresh water were contributed by Khan A.M. (1992), Ahmed S.H. and Singh A.K. (1993), Rao & Reddy (1995), Chandrashekhar (1996), Salaskar (1996), Arvind Kumar (1997), Trivedy (1998), Kodarkar (1998), Manivaskam (1998), Murugan (1998), Tiwari (1999), Dhanpathi (2000) , Singh (2002), Khare (2002), Prasad (2004) , Pandey et.al. (2004), Sharma et. al. (2004), Hegde et. al. (2005) Roy (2006).

Trivedy and Goel (1988), Subamma and Sharma (1992), Pandey et al. (1994) have studied recently on hydrobiology of fresh water lentic habitats about its physicochemical characteristics and their productivity.

Jhingran V.G. (1982) studied Fisheries in India in the context of aquatic pollution. Limnology of fewfresh bodies in Southern Maharashtra were studied by Goel P.K., Trivedy R. K. et. al.(1985). Ecological studies on zooplankton of freshwater ponds in and around Bhubneshwar was studied by Sharma A.L.N and Pattnayak (1985).

Interrelationship of certain physicochemical factors were studied by Raka Swarnalatha (1997). Das (1996) and Sabu Thoamus et. al. (1999) were studied zooplankton community characteristics in different water bodies. Hiware C.J.and Adhav (1998) studied microzootic fauna of Salim Alisagar lake at Aurangabad, Maharashtra.Physicochemical properties of lake Pokharan were studied by Bharat Mani and Gaikwad (1998)..

Dhanapathi (2000, 2001) has given major contribution in the taxonomic and diversity studies on the rotifers of India. Bhalerao A. P. and Khan (2000) studied fluorine and sulphur content in lakes in tribal area of (MS). Physico-chemical analysis of of Gopalpura tank of Guna district in M.P. have studied by Dushyant Sharma and Renu Jain in 2000.

Ichtyofauna of Jawalgaon reservoir in Solapur district of Maharashtra was studied by Sakhare V. B. (2001). Tamlurkar and Ambore (2006) studied correlation coefficients of some physicochemical characteristics of Alisagar dam water from district Nizamabad, A. P. (2006). The Rotifera diversity of lake Masoonda Thane district Maharashtra was studied by Somani Vaishali and Madhuri Pejawar (2003).

Surve P. R. et. al (2004) studied zooplanktonic population and their correlation with some physicochemical characteristics of Barul dam water district Nanded, Maharashtra. Jaybhaye U. M. and Madlapure U. R. (2004) studied on zooplankton diversity in Parola dam, Hingoli district, Maharashtra. Megha Rai and Srivastava (2004) studied the effect of fertilizer industry on surface and ground water quality, Raghogarh, (M.P.) Seasonal variations of biotic factors of Manjara project water reservoir in district Beed was studied by. Chavan R. J. Mohekar A.D.et. al.(2005). Pawar S. K. and Pulle J. S. (2005) studied the qualitative and quantitative study of zooplankton in Pethwadaj dam, Nanded district of Maharashtra. Zooplankton diversity in Jagtunga samudra reservoir Kandhar, Nanded district was studied by Ugale B. J., Hiware C. J and Jadhav B. V.(2005). Physico-chemical status of Yedshi lake (M. S.) in relation to water pollution was studied by Yeole S. M. And Patil S. G. (2005).Kadam Mali and Ambhore (2005) have studied Ecology of Bhategaon dam district Parbhani M.S.

MATERIAL AND METHODS:

The site selected for the present investigation is present in Bhoom Taluka of Osmanabad district (M.S. India).

The study was carried out with sample collected from water body in the morning between 9.30 to 11.30 am in the first week of each month for two years from March 2012 to February2014. The samples were collected for physical, chemical and biological analysis.

Following precautions were taken at the time of sample collection.

1. Black coloured plastic cans (polythene container) of 2 lit. capacity were used for sample collection. Before collection of sample the cans were thoroughly washed with tap and distilled water and then dried. After collection of sample the cans were closed tightly.

2. For dissolved oxygen BOD bottle of 300 ml capacity were used for sample collection. All possible precautions were taken to avoid air bubbles while sampling. The dissolved oxygen in sample was fixed by adding one ml. of MnSo4 (Winkler's 'A') and alkaline KI (Winkler's 'B') each.3.

3. For the diversity of zooplankton water sample from surface layer was filtered through 25 mm mesh size nylon net.

4. 100 lit. of water sample was filtered through 25 mm mesh size nylon cloth for density of zooplankton. The fish fauna was collected with the help of local fisherman and visiting fish bazaar.

5. The well labeled and tightly packed samples were brought to the laboratory for further analysis.

The parameters such as air temperature, water temperature, pH, transparency were immediately recorded at the sites. While remaining physical, chemical and biological parameters were analyzed in the laboratory by using standard literature methods given by different agencies and scientists like APHA 1985,Trivedy and Goel 1984, IAAB Hyderabad 1998 etc.

BIOLOGICAL ANALYSIS :-

Biological analysis of water includes collection, counting and identification of aquatic organisms.

i. Collection and analysis of zooplankton samples :-

The water samples were collected early in the morning (9.30 am to 10.30 am) twice in the month for two years (Feb.2012 to Mar. 2013). One hundred liters of water was filtered through a bolting silk plankton net number 25 having a diameter of 25 cm and a length 50 cm. Lower end of the cone of the plankton net was fitted to a glass stoppered bottle of 50 ml capacity. Collected samples were preserved with 4 % formalin solution. These replicated samples were observed and identified under research microscope using suitable keys, standard texts and monographs given by Tonapi (1980),) Trivedy (1984), APHA (1989), Battish (1992), Kodarkar (1998) and Dhanapathi (2000).

The Zooplanktons were counted using a counting device like Sedgewick Rafter Cell. (Sedgewick Rafter Cell is a slide of 50 mm long , 20 mm wide and one mm deep The volume of cell is 1 cm^3. The planktons were allowed to settle for some time and the counting is done under the microscope by moving cell horizontally and vertically. This process was repeated by taking another drop and counted till about 10 replicates were counted.

ii. Collection and identification of fish fauna :-

Fishes were collected with the help of local fisherman and fish bazzar. The collected fishes were preserved in 4 % formaldehyde. These were identified by giving stress mainly on stable characters such as shape of the snout, presence or absence of barbells, number of dorsal fin rays, number of scales in lateral line, scale in transverse lines, pre-dorsal scale etc. The latest books such as Day F.S. (1878,1994), Jayram (1981), Menon (1964) Talwar and Jhingran (1991) etc were referred for fish identification.

OBSERVATIONS, RESULTS AND DISCUSSION

PHYSICO-CHEMICAL ENVIRONMENT OF WATER :

The physico-chemical properties of water play an important role in the circulation of materials and growth of microorganisms in water. Therefore, the physico-chemical analysis of water is most important aspect to determine the quality of lentic water ecosystems for its best uses to human and other animal consumption, agricultural purposes and plants. The main object of physico-chemical analysis of water is to determine the status of medium.

The Map A is the location of Osmanabad district in Maharashtra. Map 2 showing location of Bhoom Taluka in Osmanabad district. Map C showing geographical location of water body in Bhoom taluka. Plate 4 shows photographs at sampling site.

The results of the physico-chemical analysis of water samples have been recorded during Mar. 2012 to Feb. 2014 for two years. The results of different physico-chemical parameters are presented in the tables 4.1.1 & 4.1.2 and the figures shows monthly values of physico-chemical parameters. The table 4.1.3 & 4.1.4 shows seasonal minimum, maximum and average values in physico-chemical parameters during study period. The table 4.1.5 shows yearly minimum, maximum and average values in physico-chemical parameters during study period. Table 4.2.1 & 4.2.2 shows monthly diversity of zooplanktons during Mar. 2012 to Feb. 2014. Table 4.2.3 & 4.3.4 shows month wise population dynamics (density) of zooplankton components during Mar. 2012 to Feb. 2014. Table 4.2.5 shows genera wise population density of various zooplankton groups with their percentage during Mar. 2012 to Feb. 2013 and Mar. 2013 to Feb. 2014. Table 4.2.6 shows group wise population density (No./lit.) of zooplankton during study period. Table 4.2.7 shows group wise seasonal percentage of zooplankton during study period. Table 4.2.8 shows yearly population density (No./L) of various zooplankton groups. Table 4.2.9 shows correlation coefficient between different physico-chemical parameters and zooplankton groups during two years of study. Table 4.3.1 shows diversity of fish fauna during study period.

1. **Atmospheric temperature (^{0}C)** : **I**n the present investigation the atmospheric temperature was observed to vary between 16.6 to 31.6 ^{0C} during the first year and 17.8 to 30.6 ^{0C} during the second year of study period. The seasonal mean values of atmospheric temperature are 28.72 ^{0C} during summer, 24.17^{0C}during monsoon & 19.5^{0C} during the winter season in first year of study period. Whereas these are recorded 29.03 ^{0C} during summer, 25.5^{0C}during monsoon & 19.75^{0C} during the winter season in second year of study period.

The atmospheric temperature was found to be having significant positive correlation with other parameters like water temperature (0.17) PH (0.54), Conductivity (0.55), TDS (0.67) and negative correlation with dissolved oxygen (-0.51) and CO_2 (-0.73). The highest significant correlation was observed between air and water temperature.

Temperature regulates the self purification capacity of water bodies. Increasing in atmospheric temperature increases water temperature. Particularly in shallow water bodies the water show close relation with atmospheric temperature. Welch (1952). The temperature affects the biological reactions in water and chemical and biochemical reactions in the organisms within the water. (Trivedy and Goel 1998). Increase in temperature of water body leads to decrease in dissolved oxygen of the water body which adversely affects the aquatic life. Temperature of water body is considered to be of vital significance to physiology, metabolism and biochemical process in controlling respiratory rates, digestion, excretion and overall development of aquatic organisms.

2. **Water temperature (^{0}C) :** In the present investigation the water temperature was found to vary between 19.2 to 28.5 during the two years of study period. It was observed minimum (19.2) in the month of Nov. during first year and in Dec. during second year. The maximum (28.5) water temperature was observed in the month of June 2012. Average mean values of water temperature 23.46^{0}C and 23.75^{0}C during first and second year respectively. The seasonal mean values of atmospheric temperature are 26.6 ^{0}C during summer, 22.9^{0}Cduring monsoon & 20.8^{0}C during the winter season in first year of study period. Whereas the seasonal mean values of atmospheric temperature are recorded 26.93 ^{0}C during summer, 23.7^{0}C during monsoon & 20.58^{0}C during the winter season in second year of study period.

The difference between atmospheric temperature and water temperature was 1.0 ^{0}C to 3.2 ^{0}C throughout study period. Both atmospheric and water temperature were observed least in winter followed by monsoon and maximum in summer of both years. Similar results were obtained by number of workers with slight changes due to sampling time, location and morphometric features of water body. Salaskar Promod (1997), Tamlurkar and Ambore (2006), noticed same trend.

Trivedy and Goel (1988) have reported that the temperature was higher in March and lower in November of few water bodies of Satara district. Kodarkar (1991) observed direct relationship between the duration of bright sunshine and temperature in tropical countries. Chavan R.J. (2002) observed similar range of temperature from Manjra project water reservoir in Beed district.

The water temperature show highest negative correlation with DO (- 0.55) Negative correlation between DO and water temperature was also observed by Goldman & Horne (1983), Bhaura (1998). Water temperature exhibited positive correlation with pH (0.53).

3. **Humidity (%) :** During the present investigation the yearly average relative humidity was observed vary between 53.66 during first year (Mar.2012- Feb.2013) and 55 during second year (Mar.2013- Feb.2014). During the first year of study period it was observed minimum (28) in the month of May and maximum (78) in the month of Aug. During the second year of study period the similar trend was observed.

4. **pH:-** In the present studies it has been found that the pH vary between 8.0 to 8.7. The pH was found to be minimum in winter and maximum in summer season. During the first year of study period it was observed minimum (8.0) during the month of Dec.2012 and maximum (8.7) during the month of Apr. 2013. The mean values of pH were recorded 8.4 in summer and 8.1 in monsoon and winter during first year of study period. Whereas seasonal mean values of pH were observed 8.5 during summer and 8.27 during monsoon and winter season in second year of study period.

   The pH shows positive significant correlation with atmospheric temperature (0.54), water temperature (0.53) and TDS (0.41), while pH shows negative correlation with Dissolved oxygen (-0.36).

   The acidity and alkalinity of water is measured in turns of its pH value of hydrogen ion concentration. The pure water consists of positively charged hydrogen ions or hydrogen ions combined with negatively charged hydroxyl ions. The water become acidic when hydrogen ions are in excess than hydroxyl ions and if the condition is reversed the water become alkaline. pH values ranges from 0 to 14 with 7 as neutral , below 7 being acidic and above 7 as alkaline, The pH of natural water lies in the range of 4.4 to 8.5. Natural waters are usually alkaline due to the presence of high concentrating CO_2, carbonates and bicarbonates. The pH of the natural water changes diurnally or seasonally due to variation in photosynthetic activity. It increases during day time due to photosynthetic activity because of consumption of CO_2 and declines at night time due to respiratory activity. The value of water pH below 4 and above 8.5 produces sour and alkaline taste respectively. Decreasing volume of water due to evaporation was accompanied by progressive charge in pH. Adoni (1985). pH of majority of lakes ranges between 6 to 9. Ganpati (1960), Verma (1969), have observed range of pH from 8 to 9, showed high photosynthetic activity.

5. **Transparency (cm)**:- The penetration of light depend upon the transparency of water. It is mainly depends upon evaporation of water, dissolved oxygen, suspended solids, addition of sewage, influx of rain water, low turbulence, biomass etc. Trivedy R.K. (1998). Transparency of water is determined by Secchi disc.

The transparency of water was ranged between 52 to 132.5 during first year and 66 to 140 during the first year of study period. Over all transparency was observed maximum during the late winter and early summer months, while it was observed minimum during the monsoon month of each study year period. The mean values of transparency were observed 109.3 in summer, 82.8 in monsoon and 127.2 in winter during first year study period. Average values of transparency were recorded 124.5 during summer, 84.5 during monsoon and 129.6 in the second year of study period.

Transparency decrease in monsoon is due to sewage discharge with rain water from the surrounding area., it is in agreement with Dutta (1978), Sharma (1999) and. Such types of results were also observed by Chandrashekhar (1996), Salaskar Promod (1997), and Chavan R.J. (2002) Lendhe and Yeragi (2004), Kadam et. al. (2005), Pawar and Pulle (2005), Abdar M.R. (2007).

6. **Specific Conductivity (µ Mhos/cm):-** Conductivity is a measure of water capacity to convey electric current. It is proportional to the amount of dissolved substances in water. The electrical conductance is an index to represent the total concentration of soluble salts.

The specific conductivity of present investigation were ranging between 252 to 321during the two years study period. During the first year of study it was observed minimum 258 during month of August and maximum 320 during the month of May. During the second year of study period it was recorded minimum 252 in the month of Sept. and maximum 321 in the month of may. The seasonal mean values of Sp. Conductivity was recorded 300 during summer, 264 during monsoon & 274.2 during the winter season in first year of study period. Whereas the seasonal mean values of sp. conductivity were recorded 303.5during summer, 262 during monsoon & 277.5 during the winter season in second year of study period.

The conductivity showed positive correlation with TDS (0.49), water temperature (0.62), pH (0.78), and total alkalinity (0.78). Conductivity showed negative correlation with DO (-0.45).

Mahajan Anjana and Khare (1995) noted maximum conductivity during May. Similar trend was also noted by Wagh Nitin (1999), Chandrashekhar S.V.A. (1996), Chavan R.J

(2002) and many others. Tamlurkar and Ambore (2006) noted minimum conductivity in monsoon and maximum in summer.

7. **Total Dissolved Solids (TDS) (mg/lit):-** Total dissolved solids (TDS) denotes the various types of minerals and other substances in water in the dissolved form. All matter present in water are called solids. Dissolved solids are the part of the total solids in the water along with the suspended solids. TDS is an important parameter in drinking water quality standards. The TDS concentration in water gives an idea about suitability of the water for drinking and other purposes. High TDS elevate density of water and reduce solubility of gases. High concentration of dissolved solids in irrigation water increased the salinity of soil and produces distress in cattle. The TDS also increase with increase in pollution of water. Trivedy R.K. (1998).

   The TDS was ranging from 140 to 210 in the first year and 110 to 196 in the second year of study period. During the first year (2012-13) of study period it was observed minimum (140) in the month of Nov. and maximum (210) in the month of May. During second year TDS was observed minimum (110) in the month of Jan. and maximum (196) in the month May. The yearly mean values of TDS were recorded 175.6 during first year and 162.3 during second year of study period. The seasonal mean values TDS were recorded 198.5 during summer, 160.5 during monsoon & 168 during the winter season in first year of study period. Whereas the seasonal mean values of TDS were recorded 176.8 during summer, 174.3 during monsoon & 136 during the winter season in second year of study period.

   The TDS showed significant positive correlation with pH (0.41), Chlorides (0.55) and Hardness (0.26) and negative correlation with DO (- 0.36).

   Similar results were recorded by Deshmukh and Ambore (2006) Meenakshi Deshmukh et al.(1998) from Kham river. Whereas Sakhare and Joshi (2003), Patil et al (2002), Nisar Patel and Bhadane (2004), Pawar and Pulle (2005), Abdar M.R. (2007) observed lowest TDS in winter and highest in monsoon.

8. **Dissolved oxygen (DO) (mg/lit):-** Dissolved oxygen in water is one of the most important abiotic parameters to indicate water quality and its relation to the distribution and abundance of various algal species an aquatic environment. The presence of O_2 in water is mainly due to diffusion from air and photosynthetic activity of organism like algae and submerged plants. Diffusion of O_2 in water from air depends on various factors like wind action, temperature, salinity etc. The solubility of atmospheric O_2 in fresh water ranges from 14.6 mg/lit. at 0^0C to about 7 mg/lit. at 35^0C under on atmospheric pressure. Its solubility varies with the atmospheric pressure at given temperature. DO is inversely proportional to temperature. DO

in water is greatly influenced by the biological activity such as photosynthesis by green algae and plants or from air due to turbulence of water surface by the wind action which is dissolved in to water surface. Photosynthetic activity leads to internal generation of O_2 and the degradation of organic matter tends to decrease it with concomitant release of CO_2. Bharat Mani and Gaikwad (1998). The variation in DO depends upon temperature and other organic contents of the water body. Angadi (1986), Kadam (1999), Sathe Sanjay et al. (2001).

Dissolved oxygen from the present water body recorded between 2.8 to 7.6. During the first year of study period (2012-13) it was observed lowest (2.8) in the month of June and highest (7.6) in the month of Dec. During second year of study period it was recorded lowest (3.8) in the month of May and highest (7) in Jan. Seasonal average values of DO were recorded 4.2 during summer, 6.3 during monsoon & 5.5 during the winter season in first year of study period. Whereas the seasonal mean values of DO were recorded 4.55 during summer, 6.1 during monsoon &6.55 during the winter season in second year of study period.

DO showed significant negative correlation with atmospheric temperature (- 0.51), pH (-0.36), TDS (-0.35) and, conductivity (-0.45).

High values of DO in winter would be due to low temperature of water. The low DO in summer was because of its enhanced utilization of microorganisms in the decomposition of organic matter and high temperature. Trivedy and Goel (1988), Thorat (2000), Chavan & Mohekar (2005), Yeole and Patil (2005), Abdar M.R. (2007).High values of DO in winter may be due to high solubility at low temperature and less degradation of organic substances. Similar results were observed by Dutta (1978), Sharma et al (1999), Kaushik & Saxsena (1999), Dutta SPS et al (2001), Wagh Nitin (1999) , Ahirrao et al (2001).

9. Free CO_2 (mg/lit):- The CO_2 in water is mainly due to diffusion from air, from inflow ground waters, due to decomposition of organic matters and respiration of aquatic organisms. Welch (1952). Carbon dioxide enters in to chemical combination with water to form carbonic acid. It is also present in the form of carbonates and bicarbonates. The amount of CO_2 in water mainly depends upon temperature, pressure and mineral contents of the water. Free CO_2 is used by algae and aquatic plants for their photosynthetic activity. The concentration of CO_2 differs in different water bodies depends on the basis of pH, temperature and other environmental factors.

In the present investigation the free CO_2 from water body under investigation was observed varied between nil to 11. It was observed nil in the months of Apr.& May in the first year of study period. Free CO2 was recorded minimum (3.3) in the month of Jun. and

maximum (6.8) in the month of Dec. during the second year of study period. Seasonal average values of free CO_2 were recorded 1.82 during summer, 4.78 during monsoon & 7.2 during the winter season in first year of study period. Whereas the seasonal mean values of free CO_2 were recorded 3.75 during summer, 4.2 during monsoon &5.58 during the winter season in second year of study period. Free CO_2 showed negative correlation with pH (-0.48 and conductivity (-0.52).

The absence of free CO_2 may be due to its utilization in photosynthetic activity. Sreenivasan (1974). The inhibition of CO_2 may be because of the formation of appreciable amount of carbonates in water. Bahura (2001), Patil et. al. (2002), Yogesh Shastri (1999), Sakhare (2003). Similar results were noted by Chandrashekhar S.V.A. (1996), Mahajan Anjana (1995), Salaskar (1997) and Chavan R. J.(2004).

10. **Phenolphthalein Alkalinity (mg/lit.) :** The capacity of water to neutralize strong acids is known as the alkalinity. It is characterized by the presence of hydroxyl ions capable of combining with hydrogen ions. It is because of relative abundance of carbonates, bicarbonates and hydroxides. Trivedy (1998). Low alkalinity is not conductive for good productivity since highly productive waters have alkalinity over 100mg/lit. CaCO3. Jhingran (1982). It is found that in general alkaline water is more productive & supports diversity of aquatic life. Chandrashekhar S.V. A.(1996). Alkalinity is important for aquatic life because it acts a buffer, controlling pH fluctuations.

Phenolphthalein alkalinity observed during both years of study were ranged between nil to 15. It was observed only during the month of Apr. and May of first year study period. Whereas it was recorded nil throughout year during the second year of study period.

11.Total Alkalinity (mg/lit):- The total alkalinity of water was due to carbonates and bicarbonates. Total alkalinity investigated during first year study period was ranging from 110 to 160 and during second year (2013-14) it was 115 to 185. It was observed maximum during the months of summer. It was found lowest (110) during month of Oct. and highest (160) during the month of Mar. in the first year of study period, while it was observed lowest (115) in the month of Dec. and maximum (180) in the month of Mar. Seasonal average values of Total alkalinity were recorded 148.7 during summer, 123.7 during monsoon & 142.2 during the winter season in first year of study period. Whereas the seasonal mean values of Total alkalinity were recorded 156.3 during summer, 128.8 during monsoon &141.3 during the winter season in second year of study period.

Total alkalinity showed positive correlation with transparency (0.5), Specific conductivity (0.57) and pH (0.59).

Total alkalinity was observed maximum during summer followed by monsoon and winter. Similar trends were observed in both years of study period. The increase in total alkalinity during summer is due to concentration of nutrients in water and decrease in water level by evaporation. Goel et al.(1980). Similar results were observed by many workers such as Bhatt (1999), Sakhare (2003), Chavan and Mohekar (2005), Lendhe and Yeragi (2004), Abdar M. R (2007). A decline in total alkalinity was observed during monsoon which may be due to dilution effect.

12. Carbonates (mg/lit):- During the present investigation carbonates were observed in the months Apr. and May during the first year of study period. It was observed maximum (30) during May. It was not observed throughout year during second year of study period.

13. Bicarbonates (mg/lit):-

Total alkalinity is mainly due to the bicarbonates of calcium and magnesium. Bicarbonates were observed between 105 to 185 during two years study period. Seasonal average values of Bicarbonates were recorded 136.2 during summer, 123.7 during monsoon & 142.2 during the winter season in first year of study period. Whereas the seasonal mean values of Bicarbonates were recorded 156.3 during summer, 128.8 during monsoon &141.3 during the winter season in second year of study period.

According to Ruttner (1963) accumulation of large quantities bicarbonates during summer may be due to liberation of CO_2 in the process of decomposition bottom sediments with resultant conversion of insoluble carbonates in to carbonates. Munawar (1970) observed higher carbonate contents in the sewage pond. Carbonates showed –ve correlations with CO_2 Tamlurkar et.al. (2006).

14. Total Hardness (mg/lit) :- The hardness of water is the sum of concentration of alkaline earth metal cations present in it or the hardness of water is originally defines interns of its ability to precipitate soap or prevents leather formation. Calcium and magnesium are the principal cations imparting hardness. The anions responsible for hardness are mainly carbonates, bicarbonates , sulphates, chlorides nitrates and silicates. When the hardness is caused because of carbonates and bicarbonates of calcium and magnesium it is ‘ temporary hardness’ which can be reduced by boiling water or it can be softened by adding lime and other methods. Whereas when it is caused due to Sulphates and chlorides it is defined as ‘

permanent hardness'. There is ecological significance of major cations like calcium and magnesium in the biotic dynamics of aquatic organisms. Bharat Mani and Gaikwad (1998).

The total hardness of water was varied between 56 to104 in the first year and 76 to 130 in the second year of study period. It was found highest (130) during the month of Apr.2014 and lowest (56) in the month of Oct. 2012. The hardness of water was observed highest in summer followed by winter and monsoon. Seasonal average values of total hardness were recorded 97.5 during summer, 78.5 during monsoon & 86.5 during the winter season in first year of study period. Whereas the seasonal mean values of Total alkalinity were recorded 124 during summer, 83 during monsoon & 96.5 during the winter season in second year of study period. Total hardness showed positive correlation with conductivity (0.78) and Alkalinity (0.66).

The maximum values of hardness in summer may be due to presence of high concentration of carbonates and bicarbonates. Similar results were observed by Lendhe & Yeragi (2004) in Phirange Kharbhave lake of Thane district M.S. Lendhe and Yeragi (2004), Abdar M.R. (2007). Maximum values of total hardness were recorded in monsoon season by Nisar Patel and Bhadane (2004) from Taddya Nallah pond at Jalgaon district M.S.

15. Calcium (mg/lit):- Calcium is the most common element found in great abundance in most natural waters. Source of calcium in water is the rocks, lime stones, Gypsum & addition of sewage and industrial wastes. It is an important cation imparting hardness to the water.

During the present investigation it was found that calcium hardness ranged between 16.83 to 34.46 in the first year. and 18.43 to 39.27 in the second year of study period. During the first year it was observed minimum (16.83) in the month of Oct. 2012 and highest (34.46) in the month of Apr. 2012. Whereas during the second year it was recorded minimum (18.43) during Oct. 2013. maximum (39.27) during the month of and May 2013. Seasonal average values of calcium were recorded 31.65 during summer, 22.49 during monsoon & 25.17 during the winter season in first year of study period. Whereas the seasonal mean values of calcium were recorded 37.87 during summer, 24.85 during monsoon &32.26 during the winter season in second year of study period.

Similar range (14 to 64 mg/lit.) were observed by Shastry et. al. in upper lake Bhopal. In lower lake calcium ranged between 52 to 102 mg/lit. as reported by Bhatnagar (1984). Chavan R.J. (2002) observed range of calcium 14 mg/ lit to 38.5 mg/lit from Manjra reservoir project in Beed district of M.S.

Total hardness and calcium hardness shows very positive correlation ship. It indicates that total hardness is mainly due to presence of calcium salts in both summer and monsoon. Nalina & Puttaiah (2006). In present investigation Total hardness and calcium hardness also showed positive degree correlation ship (0.89).

16. Magnesium(mg/lit):- Magnesium is common constituent of all kinds of natural water. It is also an important cation imparting hardness to the water. The concentration of magnesium is generally lower than the concentration of calcium in natural waters. The main sources of magnesium are rocks, sewage and industrial wastes in natural waters. Its high concentration gives an unpleasant taste to water but its presence is essential for the growth of chlorophyll containing organisms.

In the present investigation the magnesium hardness was observed maximum in summer followed by monsoon and winter. It was varied from 2.92 to 10.72 throughout study period. During first year it was recorded minimum (2.92) in the month of Oct.2012e and maximum (10.72) in the month of Mar.2012. Near about similar trend was recorded during the second year of study period. Yearly average values of magnesium hardness were recorded 9.86 during summer, 6.93 during monsoon & 5.84 during the winter season in first year of study period. Whereas the seasonal mean values of magnesium hardness were recorded 9.74 during summer, 7.54 during monsoon &7.65 during the winter season in second year of study period.

Higher magnesium values were recorded in summer while relatively lower in winter of each year. Uniformly lowest levels were evident in monsoon as a result of dilution effect . Similar results were observed by Megha Rai & Srivastva (2006) from Chopan River M.P.

17. Chlorides (mg/lit):- Chlorides as chloride ions (Cl^-) are major anions present in natural and waste water. Industrial effluents and domestic sewage are the sources of chloride in water. Beside these it is also added in water by leaching from natural rocks. Trivedy R.K. (1998). The chloride concentration is higher in organic waste and its higher level in natural water is definite indication of pollution from domestic sewage. A number of workers has estimated chloride in lake waters polluted by domestic sewage. Goel et al (1980), Kodarkar et al (1991), Mahajan Anjana (1996), Chavan R.J. (2002).

During the period of investigation chlorides wereranged between 15.62 to 36.92 in the first year More or less uniform range was evident during the second year of study period. Chlorides were recorded minimum (15.62) in the month of Oct.2012 and maximum (36.92) in the month of May 2012 during first year while it was observed minimum (17.04) in the month

of Oct.2013 and maximum (29.82) at in the month of Mar.2013 during second year of study period.

Maximum values of chlorides recorded in summer may be due to increased organic decomposition of animal origin. Yeole and Patil (2005).or it may be due to loss of water by evaporation. The results are on agreement with other workers such as Wagh Nitin (1999), Chavan R.J. (2002).

Chlorides exhibited positive correlation with TDS (0.55), alkalinity (0.48) and Total hardness (0.53).

18. Phosphates (mg/lit):- In natural water phosphates are present small quantities. Excess of phosphate mixed in to natural water through untreated domestic sewage and agricultural runoff. These are important nutrients for the growth of algae in water. Trivedy R.K. (1998). Normally phosphate acts as a limiting nutrient in the process of eutrophiocation. They are main nutrients responsible for the process of eutrophication that leads to ultimate environmental degradation. Kodarkar (1995).

During the present investigation it was revealed that the phosphates were recorded from 0.12 to 0.62. In the first year of study period. It was minimum (0.12) during the month of Apr. and maximum (0.56) during the month of July during first year of study. Whereas during the second year phosphates were recorded minimum (0.09) in the month of Mar. 20013 and maximum (0.62) in the month of Nov. Mean values of phosphates were recorded 0.29 during summer, 0.44 during monsoon & 0.31 during the winter season in first year of study period. Whereas the seasonal mean values of chlorides were recorded 0.26 during summer, 0.36 during monsoon &0.29 during the winter season in second year of study period.

The values of phosphates were observed slightly more in monsoon season. These results are in agreement with Wagh Nitin (1999) and Salaskar Pramod (1997). Chavan R.J. (2002)

19. Nitrates (mg/lit):- The determination of nitrate is very important as it helps in measuring the pollution status of water body. An aquatic ecosystem in urban environment receives excess of nitrates through untreated domestic sewage and along with phosphates are responsible for the process of lake degradation called eutrophication. Kodarkar (1995). Its concentration in water increases due to addition of domestic sewage mixing of agricultural runoff etc.

In the present investigation the nitrates were recorded 0.08 to 0.44 throughout study period. In the first year it was observed minimum (0.08) in the month of Mar. 2012 and maximum (0.44) in the month of Aug. 2012 During the second year it was observed minimum (0.08) in the month of May 2013, and maximum (0.52) in the month of Nov.2013.

Seasonal mean values of nitrates were recorded 0.18 during summer, 0.33 during monsoon & 0.22 during the winter season in first year of study period. Whereas the seasonal mean values of chlorides were recorded 0.2 during summer, 0.32 during monsoon &0.25 during the winter season in second year of study period.

The nitrates present in the water bodies were within permissible limit. Same trend was observed by number of workers including Wagh Nitin (1999), Sharma (1990).

HYDROBIOLOGY OF THE WATER :-

A. Zooplanktons :-

- **Diversity of zooplanktons :-**

Zooplankton is an important group of microorganisms found in aquatic ecosystems. They plays an important role in transferring the energy from producers to consumers and acts as links in the food wed of aquatic ecosystems. They are also indicating the trophic status of water body and some of them are also acting as bio-indicators of organic and inorganic pollution of water body.

With the sense of research on aquatic ecosystem, the knowledge of biotic diversity, density, their abundance and distribution is essential to understand the trophic nature of the water body and succession of different living organisms in them.Various physicochemical factors play an important role in the distribution and abundance of various aquatic organisms in fresh water habitat. Tonapi (1980). Diversity of Zooplankton in different water bodies at the point of time indicates numerous ecological characteristics like physicochemical environment of water interaction among different biotic communities trophic status of water body etc. The various physico-chemical factors such as light, pH, inorganic and organic constituents play an important role in determining the nature and pattern of fluctuations population densities of Zooplankton. Sayestehfer A.(1990).

The study for diversity and density of zooplankton revealed that there are number of species belonging to different groups of zooplanktons such as Rotifera, Cladocera, Copepoda and Ostracoda.

Critical examinations of water samples reveals that near about 17 genera belonging to different groups of zooplanktons are inhabiting in the water body under investigation. There are three genera belonging to Rotifera, nine genera belonging to Cladocera, four genera belonging to Copepoda and single genus belonging to Ostracoda were observed during two years of study period.

Among the total zooplanktonic organisms group Cladocera was observed most diversified including nine genera viz. *Alonella, Bosmina, Ceriodaphnia, Chydorous , Daphnia, Moina, Sida , Simocephalus* and *Diphanosoma.* Three genera observed from group Rotifera were *Brachionus, Filinia and Lecane.* Belonging to Copepoda, *Microcyclops, ,Mesocyclops, Neodiaptomus , and Phyllodiaptomus* these four genera were recorded. Only single genus *Cypris* was observed belonging to the group Ostracoda.

Maximum zooplankton diversity was observed during the winter months. In first year of study period zooplankton diversity was observed highest during winter followed by summer and monsoon. Among the Rotifers *Brachionus* and *Lecane* were dominated whereas *Microcyclops* and *Mesocyclops* were dominant Copepods. Belonging to Cladocera *Chydorous* and *Ceriodaphnia* were observed maximum. Whereas only *Cypris* was observed belonging to Ostracoda throughout study period in all water bodies under investigation.

- **Population density of zooplankton groups :**

A components wise population density study reveals that summer population of Rotifera sharply fells in monsoon and again raises in winter during the two years of study period. Maximum population of Cladocera was observed in winter followed by summer and monsoon. Population density of Copepoda were observed maximum in monsoon followed by winter and summer during second study period. Whereas population of Ostracoda were observed maximum in winter followed by monsoon and summer. Group wise population density (No./L) of zooplankton during two years of study is given in table No. 4.2.6.

In first year (2012-13) of study period seasonal abundance of zooplankton were observed in the following decreasing order.

Summer:- Rotifera > Cladocera > Ostracoda > Copepoda
Monsoon:-Cladocera > Rotifera > Copepoda > Ostracoda.
Winter:- Rotifera > Cladocera > Copepoda > Ostracoda

In second year of study period total zooplankton population was found maximum in winter than other two seasons. Seasonal abundance of zooplankton were observed in the following decreasing order.

Summer:- Rotifera > Cladocera > Copepoda > Ostracoda
Monsoon:- Copepoda > Cladocera > Rotifera > Ostracoda.
Winter:- Cladocera > Rotifera > Copepoda > Ostracoda

Rotifers were dominating in the month of May in both the years. While these were observed minimum in the month of Sept. Cladocera were observed maximum in winter. Whereas copepods observed maximum in monsoon. Maximum Ostracoda were found in the months of late monsoon and early winter while its population was observed least in summer months.

- **Seasonal Population Density of Zooplankton Components:**

Population density of zooplankton components was observed maximum in winter season followed by summer and monsoon of both years of study period. Maximum numbers of Rotifers (208 No./L) were observed in May 2012and minimum (29 No./L) in the month of Sept. 2013. Cladocera population was observed maximum (178No./L) during Nov. 2013 and minimum (41 No./L) during Aug. 2013. Population density of Copepoda was recorded maximum (125 No./L) during July 2013 and minimum (Nil) during Apr. & May 2012. Ostracods were observed minimum in the summer months. (Table 4.2.3 & 4.2.4).

Population density of Rotifera was observed maximum among whole population of zooplankton. Average population of Rotifers accounts for about 41.43% & 27.20%, Cladocera accounts for about 28.69% & 35.45%, Copepoda accounts for about 18.28% & 25.54% and Ostracoda accounts for about 11.6% & 11.79 % of total zooplankton population during 2012-2013 and 2013-2014 respectively.

Maximum density of Rotifers was observed during summer season (57.58% & 57.30%) followed by winter (34.35% & 28.07%) and monsoon (29.38% & 18.01%). Maximum population density of Cladocera were observed during winter (29.98% & 43.16 %) followed by monsoon (31.36% & 28.79 %) and summer (25.38 0% & 18.8 %). Seasonal density of the Copepods were observed maximum in monsoon (27.52 % & 38.96 %) then in winter (24.05 0% & 17.93 %) and least in summer (5.54 % & 16.15 %). Population density of Ostracoda was observed maximum in monsoon (11.74 0% & 14.24 %) followed by winter (11.62 0% & 10.84 %) & summer (11.5 0% & 7.69%) during two years of study period.

Seasonal percentage of various groups of zooplankton components is given in table number 4.2.6 for two years.

The seasonal variation of these organisms observed dependent on physicochemical and biological parameters. The seasonal variation of various zooplantonic forms have been studied by many workers. Saha R.L. et al (1984), Singhal et al. (1986), Khatri T. C. (1992), Dhanapathi (2000), Singh shivesh Pratap (2002), Chavan R. J. (2002), Salaskar and yeragi (2003), Sharsma and Sarang (2004). Abdar Mohan (2007) noted that the group Cladocera was highly rich diversified & heterogeneous. According to Ravi Kumar (1996), Bairagi & Goswami (1992), Hegde et al. (2005) the abundance of Rotifers & Copepods it self is an indication of eutrophication under high enrichment of nutrients and alkalinity in water. Singh (2000) and Prasad (2004) reported that the Rotifers have versatile capacity to survive in polluted conditions, particularly in summer. The parameters like temperature, transparency, TDS functions as complexes influencing the zooplankton diversity. Temperature brings out marked influence on multiplication, reproduction and metabolic activities of zooplankton. The occurrence of *Ceriodaphnia*, *Moina* indicates best conditions of temperature for their development. Beside physicochemical parameters, seasonal changes in zooplankton density also depends partially on availability of food supply and predatory pressure exerted by the carnivorous fishes, zooplanktons and other organisms.

Rotifers showed significant positive Correlations with water temperature (0.32), transparency (0.26), alkalinity (0.22) while it showed negative correlations with dissolved oxygen (-0.41), CO_2 (-0.36). Cladocera group showed significant positive correlations with dissolved oxygen (0.26), CO_2 (0.31) and negative correlations with TDS (-0.53), pH ((-0.29), and Chlorides (-0.46). Whereas Copepods showed positive correlation with DO (0.28), CO_2 (0.26) while it showed negative correlation with pH (-0.27), transparency (-0.36) and alkalinity (-0.29). Ostracods showed negative correlations with pH (-0.4), and chloride (-0.46).

- **Genera wise population dominance of Zooplankton:**

The studies for the analysis of monthly abundance of zooplankton components reveals that the Rotifers are the major contributors in whole population of zooplankton during both years of study period with 41.42 % population during 2012-13 and 27.20 % population during 2013-14. *Brachinous* Sp. was observed dominant throughout study period among the Rotifers. It accounts for about 52.01 % and 64.95 % population within the total Rotifers population.

Lecane accounts for about 28.45% and 24.79%, *Filinia* accounts for about 19.54% & 10.25% during 2012-13 and 2013-14 respectively of the total Rotifer population.

Followed to Rotifers, group Cladocera accounts for about 28.69 % and 35.45 % among the whole population of zooplanktons. The population density of Cladocera was mainly due to Species of nine genera. Among the group Cladocera *Alonella* accounts for about 12.31% & 12.22 %, *Bosmina* 13.41 % & 10.83 % , *Ceriodaphnia* 14.49% & 12.53 % , *Chydorous* 16.74% & 19.34% , *Daphnia* 14.7 % & 19.34 % *Moina* 12.84% & 17.14 % , *Sida* 7.83 & 4.56% , *Simocephalus* 2.56% & 6.48 % and *Diphanosoma* 5.15 % & 5.98 % during 2012-13 and 2013-14 respectively.

The Copepods also present in abundant quantity. Population density of Copepoda group was observed 18.28 % and 25.54 during study period among whole population zooplankton. The present investigation reveals that four genera were observed from Copepoda group among which *Mesocyclops* and *Microcyclops* were major contributors . The *Microcyclops* accounts for about 42.08 % & 38.79 % and *Mesocyclops* accounts for about 36.2 % & 28.46 % during 2012-13 and 2013-14 respectively. *Neodiaptomus* observed 9.77 % and 16.81 % within total population of Copepoda. Generally it was observed in monsoon season. *Phyllodiaptomous* accounts for about 11.95 % & 15.92 % during 2012-13 and 2013-14 respectively.Belonging to Ostracoda only *Cypris* Sp. was observed during both years of study period and it accounts for about 11.62 % and 11.79 % during 2012-13 and 2013-14 among the whole population of zooplankton.

B. Fish Fauna:-

Diversity of Fish Fauna :

Fishes are abundantly found in lentic water bodies such as ponds, dams, lakes etc. It is largest group of vertebrates. Most of the fishes are found in Inland waters are restricted by their physiology to life in fresh water like ponds, lakes, rivers streams etc.

During the present study fish fauna was studied for their diversity. Only 13 species of fishes belonging to five orders were observed during study period. Order Cypriniformes was dominant with seven species including *Labeo rohita, L. calbasu, Catla catla, Cirrhinus mrigala, Cyprinus carpio , Puntius sarana sarana and Puntius ticto ticto.* Order Siluriformes includes *Wallago attu , Mystus seenghala ,* and *Clarius batrachus.* Order Channiformes represents *Channa marulius,* order Osteoglossiformes and Mugiliformes represents *Notopterous notopterous and Rhinomugil corsula* species respectively.

The above species observed under investigation were vary considerable in size, shape and their life span. The maximum size and age are specific for every species. The growth of particular fish species is dependent on its environment. The fishes which gets favorable and optimum pH, temperature, DO, and availability of food in water results in better growth and attains proper weight. Major carps are fast growing fishes. Each species has an inherent temperature range within which it survive , grow and reproduce comfortably. Natural water supports the fish life. The temperature of water bodies under investigation ranges between 19.2 ^{0}C to 28.5 ^{0}C during both years of study, indicates favorable conditions for growth of fishes. Some species of fishes prefer temperature below 30^{0}C. Major carps tolerates range of temperature between 18.3^{0}C to 37.8 ^{0}C.

The tolerance of fishes to changes in temperature is variable and it depends on the environment in which they have been living but also on the rapidity of the change the duration of temperature extremes. Changes in temperature beyond the normal survival range of fishes may cause thermal trauma. The upper lethal temperature limit of air breathing fishes like *C. punctatus, C. batrachus* lies between 39 ^{0}C to 41 ^{0}C. The aquarium species like *P. ticto,* can grow better at 24 ^{0}C to 29 ^{0}C range of temperature. Common carp, Cyprinus carpio grows best at temperature range between 20 ^{0}C to 25 ^{0}C. Pandey and Shukla.(2007).

pH of water also plays an important role in the development and growth of fish. Many species of fishes lives better comfortable in the range of pH between 7 to 8.6. The result of present investigation showed that the pH range was observed between 8 to 8.7 which was favorable for growth. The range of pH between 6 to 8 is preferable to aquarium species like *P. ticto, P. sarana etc.*

Dissolved oxygen is one of the most important factor for the aquatic life. The fishes requires adequate concentration of DO for survival and growth. The maximum concentration for fish survival varies with time of exposure. Fish may tolerate a particularly low concentration of DO for a few hours without in effect. Pandey and Shukla (2007). The need of DO is vary according to fish species. For cyprinid its range is favorable between 6 to 7 mg/lit. The present study showed the wide range of DO from 2.8 mg/lit. to 7.6 mg/lit. Maximum values of DO were observed in winter which was favorable for growth of carps. Present study reveals that the DO was always with a favorable range with few exceptions. During unfavorable supply of oxygen , food intake is reduced, weight of fish reduces and total health becomes poor.

Presence of CO_2 is considered as an indicator of biogenic condition of water, especially its suitability for the fish. Presence of more than 20 ppm of CO_2 might be injurious

to the health of fish. Alikunhi (1952). During present study no significant effect of CO_2 was observed because all the time it was ranged below the toxic limit.

Dissolved nutrients play an important role in fish production. Low water level and high rate of evaporation also affects fish production. The food species like *Catla catla, Labeo rohita, Wallogo attu* etc. were observed abundantly due to favorable conditions.

The species diversity reported in the present study shows marked similarity with earlier studies on reservoirs from same geo-climatic region of the Maharashtra State. Sakhare V. B. (2001) have observed 23 fish species belong to seven orders from Jawalgaon reservoir in Solapur district of Maharashtra. Sakhare and Joshi (2001) have identified 28 fish species from Pallas- Nilegaon reservoir in Osmanabad district of Maharashtra. Kadam and Gaikwad (2006) observed 23 fish species from Masooli reservoir in district Parbhani (M.S.). They reported that out of 23 fish species 18 have food value as they form food for peoples of this region. Three species are suitable for aquarium. Sakhare and Joshi (2003) reported the ichthyofauna of Bori reservoir in Maharashtra.

Water Quality:

The following table shows the range of different physico-chemical parameters important for deciding quality criteria for drinking purpose proposed by as esteemed institution like WHO, ISI and the range of these parameters of the water body selected for study.

TABLE : Comparison of different physico-chemical parameters with surface water standards suggested by WHO & ISI.

Criteria	**General permissible level**	**Desirable standard**		**Range in water body under investigation**
		WHO	**ISI**	
Temperature (^{0}C)	Narrative	---	---	24.46
pH	6.0 to 8.5	7.0to8.5	6.5to8.5	8.32
Sp.Conductivity (µ Mhos/cm)	200 to 250*	----	----	280.2
T.D.S.	500 to 1500*	1000	5000	168.5
D.O.	>4.0*	>4.0*	>4.0*	5.56
Total Alkalinity	30 to 500	----	200	140
Hardness	100 to 500	500	300	94.35
Calcium	75 to 200	200	200	29.05
Magnesium	30 to 50	50	25	7.92
Chlorides	25 to 250*	200	250	24.55
Phosphates	25 to 50	----	----	0.32
Nitrates	10 to 100	45	25	0.25
T. Coliform (No./L)	10,000	>10	>10	NA
FaecalColiform(No./L)	2,000	Nil	Nil	NA

NA- Not analysed, * Also important criteria for irrigation.

The present study showed that the water from this water body under investigation was acceptable for drinking after some simple treatments. The investigations showed that the permissible limit of water for pH is 6.0 to 8.5. In the present study pH was observed within permissible limits with few exceptions throughout study. Only in summer season (particularly in Apr.& May) it was observed slightly more (8.6 to 8.7). T.D.S. values were observed within permissible limit of drinking water standards suggested by ISI (1992) and WHO (1984) which is 500 to 1500 mg/lit. In the present study TDS was ranged 110 to 210 mg/lit. DO was observed in sufficient amount during most of the study period. However it was observed lowest during summer months. DO was observed with an average of more than 5 mg/lit during study period indicating sufficient aerated state of water. Total alkalinity ranges between 110 to 185 mg/lit. in all water bodies under investigation which is within the permissible limits of both WHO (1984) and ISI (1992) standards . Similar results were observed by Chavan et al.(2004). Total hardness of the water is very important parameter determining softness and hardness of the water. It was very much below than the permissible level (100 to 500). It was observed 56 to 122 mg/lit. in different water bodies throughout study period. This denotes that water was very soft and acceptable for drinking purposes. Similar results were noted by Salaskar (1997) and Chavan (2004). Parameters like calcium and magnesium hardness were also observed lower than the permissible limits. Average values of chlorides were observed 25.32 & 23.79 mg/lit in the present water bodies which is lower than the permissible level of Who and ISI standards. Phosphates and nitrates which are important nutrients were observed in very minute amount preventing algal growth and keeping water body healthy. Similar results were also reported by Salaskar (1997), Chavan et.al.(2002)etc.

Thus with the some exceptions all other parameters are within permissible limits as per WHO and ISI. After normal treatments like filtration and boiling water makes potable for drinking.

TABLES

Table 4.1.1 Monthly values of Physico-chemical parameters of Sangmeshwar water project Mar.2012 Feb.2013 (Ist Yr).

Season	**Summer**				**Monsoon**				**Winter**			
Parameter	**Mar. 2012**	**Apr. 2012**	**May. 2012**	**Jun. 2012**	**Jul. 2012**	**Aug. 2012**	**Sept. 2012**	**Oct. 2012**	**Nov. 2012**	**Dec. 2012**	**Jan. 20 13**	**Feb. 13**
Atmospheric Temp.	25.6	27.2	31.6	30.5	27.8	25.5	23.8	19.6	17.7	16.6	20	24
Water Temp	24.7	24.8	28.4	28.5	25.4	23.5	22	20.8	19.2	19.5	21.2	23.6
Humidity	42	36	28	54	74	78	74	68	48	52	46	44
pH	8.3	8.6	8.5	8.2	8.2	8.1	8.2	8.2	8.3	8	8.2	8.2
Transparency	120	115	106	96.5	52	76.5	93	110	117.5	129	132.5	130
Sp. Conductivity	296	303	320	281	272	258	264	262	272	266	268	291
TDS	186	200	210	198	172	162	158	150	140	176	180	176
Dissolved Oxygen	4.2	4.6	5.2	2.8	6.6	4.8	6.8	7.2	3.3	7.6	5.8	5.4
Free CO_2	3.4	0	0	3.9	3.74	3.52	5.06	6.8	11	6.6	6.8	4.4
Phe. Alkalinity	0	10	15	0	0	0	0	0	0	0	0	0
T. Alkalinity	160	155	135	145	130	125	130	110	125	140	145	155
Carbonates	0	20	30	0	0	0	0	0	0	0	0	0
Bicarbonates	160	135	105	145	130	125	130	110	125	140	145	155
Total Hardness	104	100	98	88	84	86	88	56	80	84	90	92
Calcium	32.86	34.46	28.85	30.46	27.25	22.66	23.24	16.83	27.25	23.24	21.64	28.55
Magnesium	10.72	9.74	8.77	10.23	9.74	9.25	5.84	2.92	3.41	5.84	6.33	7.79
Chlorides	29.82	31.24	36.92	29.82	22.72	29.82	26.98	15.62	18.46	19.88	21.3	21.23
Phosphates	0.29	0.12	0.42	0.34	0.56	0.32	0.42	0.34	0.32	0.26	0.34	0.32
Nitrates	0.08	0.34	0.09	0.24	0.32	0.44	0.34	0.24	0.3	0.34	0.09	0.16

Table 4.1.2 Monthly values of Physico-chemical parameters of Sangmeshwar water project Mar.2013 Feb.2014 (II nd Yr).

Season	Summer				Monsoon				Winter			
Parameters	**Mar-2013**	**Apr. 2013**	**May-2013**	**Jun. 2013**	**Jul. 2013**	**Aug. 2013**	**Sept. 2013**	**Oct. 2013**	**Nov. 2013**	**Dec. 2013**	**Jan. 2014**	**Feb. 2014**
Atmospheric Temp	26.8	***	***	***	28.4	26.6	26.8	20.2	19.5	17.8	19.2	22.5
water Temp	24.4	***	***	***	26.2	24.4	23.6	20.8	20.6	19.2	21.3	21.2
Humidity	48	***	***	***	78	76	80	60	54	48	42	46
pH	8.6	***	***	***	8.3	8.3	8.2	8.3	8.2	8.1	8.3	8.5
Transparency	140	***	***	***	66	72	96	104	118.5	131	133	136
Sp. Conductivity	298	***	***	***	280	256	252	260	268	268	282	292
TDS	168	***	***	***	186	165	178	168	140	122	110	172
Dissolved Oxygen	5.8	***	***	***	6.4	6	5.8	6.41	6.8	6	7	6.4
Free CO_2	4.8	***	***	***	4.8	4.4	4.2	3.74	5.7	6.8	6.1	3.74
Phe. Alkalinity	0	***	***	***	0	0	0	0	0	0	0	0
Total Alkalinity	180	***	***	***	120	135	125	135	120	115	145	185
Carbonates	0	***	***	***	0	0	0	0	0	0	0	0
Bicarbonates	180	***	***	***	120	135	125	135	120	115	145	185
Total Hardness	122	***	***	***	98	80	76	78	82	94	102	108
Calcium	39.27	***	***	***	33.66	23.24	24.06	18.43	23.24	33.66	33.66	38.47
Magnesium	10.72	***	***	***	7.79	7.3	7.3	7.79	5.8	7.3	7.3	10.23
Chlorides	29.82	***	***	***	26.98	25.56	18.46	17.04	19.88	18.46	24.14	28.4
Phosphate	0.09	***	***	***	0.34	0.22	0.44	0.46	0.62	0.34	0.09	0.12
Nitrate	0.34	***	***	***	0.3	0.34	0.34	0.32	0.52	0.14	0.12	0.22

*****Samples not analysed due to water scarcity**

Table 4.1.3 Seasonal min. ,max. and average values of physico-chemical parameters during March 2012to Feb.2013

Season	**Summer**			**Monsoon**			**Winter**		
Parameter	**Mini.**	**Maxi.**	**Average**	**Mini.**	**Maxi.**	**Average**	**Mini.**	**Maxi.**	**Average**
Atmospheric Temp	25.6	31.6	28.72	19.6	27.8	24.17	16.6	24	19.5
Water temp	24.7	28.5	26.6	20.8	25.4	22.9	19.2	23.6	20.8
Humidity	28	54	40	68	78	73.5	44	52	47.5
PH	8.2	8.6	8.4	8.1	8.2	8.1	8	8.3	8.1
Transparency	96.5	120	109.3	52	110	82.8	117.5	132.5	127.2
Sp. Conductivity	281	320	300	258	272	264	26.6	291	274.2
TDS	186	210	198.5	150	172	160.5	140	180	168
Dissolved Oxygen	2.8	5.2	4.2	4.8	7.2	6.3	3.3	7.6	5.5
Free CO_2	0	3.9	1.82	3.52	6.8	4.78	4.4	11	7.2
Phe Alkalinity	0	15	6.25	0	0	0	0	0	0
Total Alkalinity	135	160	148.7	110	130	123.7	125	155	142.2
Carbonates	0	30	12.5	0	0	0	0	0	0
Bicarbonates	105	160	136.2	110	130	123.7	125	155	142.2
T. Hardness	88	104	97.5	56	88	78.5	80	92	86.5
Calcium	28.85	34.46	31.65	16.83	27.25	22.49	21.64	28.55	25.17
Magnesium	8.77	1072	9.86	2.92	9.74	6.93	3.41	7.79	5.84
Chlorides	29.82	36.92	3.95	15.62	29.52	23.78	18.46	21.3	2021
Phosphate	0.34	0.42	0.29	0.32	0.56	0.44	0.26	0.34	0.31
Nitrate	0.24	0.34	0.18	0.24	0.44	0.33	0.09	0.34	0.22

Table 4.1.4 Seasonal min. ,max. and average values of physico-chemical parameters during March 2013to Feb.2014.

Season	Summer			Monsoon			Winter		
Parameter	**Mini.**	**Maxi.**	**Average**	**Mini.**	**Maxi.**	**Average**	**Mini.**	**Maxi.**	**Average**
Atmospheric Temp	26.8	***	***	20.2	28.4	25.5	17.8	22.5	19.75
Water temp	24.4	***	***	20.8	26.2	23.7	19.2	21.3	20.58
Humidity	32	***	***	60	80	73.5	42	54	47.5
PH	8.4	***	***	8.2	8.3	8.27	8.1	8.5	8.27
Transparancy	106	***	***	66	104	84.5	118.5	136	129.6
Sp.Conductivity	290	***	***	252	280	262	268	292	277.5
TDS	148	***	***	165	186	174.3	110	172	136
Disolved Oxygen	3.8	***	***	5.8	6.4	6.1	6	7	6.55
Free CO_2	3.3	***	***	3.74	4.8	4.2	3.74	6.6	5.58
Phe Alkalinity	0	***	***	0	0	0	0	0	0
Total Alkalinity	145	***	***	120	135	128.8	115	185	141.3
Carbonates	0	***	***	0	0	0	0	0	0
Bicarbonates	145	***	***	120	135	128.8	115	185	141.3
T. Hardness	118	***	***	76	98	83	82	108	96.5
Calcium	34.46	***	***	18.43	33.66	24.85	23.24	38.47	32.26
Magnesium	9.25	***	***	7.3	7.79	7.54	5.8	10.23	7.65
Chlorides	24.14	***	***	17.04	26.98	22.01	18.46	28.4	22.72
Phosphate	0.09	***	***	0.22	0.46	0.36	0.09	0.62	0.29
Nitrate	0.08	***	***	0.3	0.34	0.32	0.12	0.52	0.25

*****Samples not analysed due to water scarcity**

Table 4.1.5 Yearly minimum ,maximum and average values of physico-chemical parameters during Mar. 2012 to Feb. 2014

	Mar. 2012 to Feb. 2013			Mar. 2013 to Feb. 2014		
Parameter	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**	**Average**
Atmospheric Temp	16.6	31.6	24.16	17.8	30.6	23.08
water Temp	19.2	28.5	23.46	19.2	28.4	22.41
Humidity	28	78	53.66	32	80	59.11
pH	8	8.6	8.28	8.1	8.7	8.31
Transparency	52	132.5	106.5	66	140	110.72
Sp. Conductivity	258	320	279.4	252	321	272.88
TDS	140	210	175.6	110	196	156.55
Dissolved Oxygen	2.8	7.6	5.36	3.8	7	6.29
Free CO_2	0	11	4.6	3.3	6.8	4.92
Phe. Alkalinity	0	15	2.08	0	0	0
Total Alkalinity	110	160	137.9	115	185	140
Carbonates	0	30	4.2	0	0	0
Bicarbonates	105	160	133.7	115	185	140
Total Hardness	56	104	87.5	76	130	93.33
Calcium	16.83	34.46	26.44	18.43	39.27	29.74
Magnesium	2.92	10.72	7.54	5.8	10.72	7.94
Chlorides	15.62	36.92	25.32	17.04	29.82	23.19
Phosphate	0.12	0.56	0.33	0.09	0.62	0.30
Nitrate	0.08	0.44	0.25	0.08	0.52	0.29

Table 4.2.1 Monthly diversity of zooplankton components from Sangmeshwar water project during Mar. 2012 to Feb. 2013.

Zooplankton group	Mar. 2012	Apr. 2012	May. 2012	Jun. 2012	Jul. 2012	Aug. 2012	Sept. 2012	Oct. 2012	Nov. 2012	Dec. 2012	Jan. 2013	Feb. 2013
ROTIFERA												
Brachionus sp.	√	√	√	√	√	√	√	√	√	√	√	√
Filinia	√	√	√	×	√	√	√	√	√	√	×	×
Lecane	√	√	√	√	√	√	√	√	√	√	√	√
CLADOCERA												
Alonella	×	×	×	×	√	√	√	√	√	√	√	√
Bosmina	√	√	√	√	×	×	×	×	×	×	√	√
Ceriodaphnia	√	√	√	√	√	√	√	√	√	×	√	×
Chydorus	√	√	√	√	√	×	×	√	√	√	√	×
Daphnia	×	√	√	√	√	√	√	√	√	√	√	√
Moina sp	×	×	×	×	√	√	√	√	√	√	√	√
Sida	×	√	√	√	×	×	×	√	×	√	√	√
Simocephalus	×	×	√	×	√	√	×	×	×	×	×	×
Diphanosoma	×	×	×	×	×	√	√	√	√	√	×	×
COPEPODA												
Microcyclops	×	×	×	√	√	√	√	√	√	√	√	√
Mesocyclops	×	×	×	√	√	√	√	√	√	√	√	√
Neodiaptomus	×	×	×	×	√	√	√	×	×	×	√	√
Phylodiaptomus	√	√	×	√	√	√	×	×	×	×	×	√
OSTRACODA												
Cypris sp.	√	√	√	√	√	√	√	√	√	√	√	√

√→ present X → Absent

Table 4.2.2 Monthly diversity of zooplankton components from Sangmeshwar water project during Mar. 2013 to Feb. 2014

Zooplankton group	Mar. 2013	Apr. 2013	May. 2013	Jun. 2013	Jul. 2013	Aug. 2013	Sept. 2013	Oct. 2013	Nov. 2013	Dec. 2013	Jan. 2014	Feb. 2014
ROTIFERA												
Brachionus sp.	√	**	**	**	√	√	√	√	√	√	√	√
Filinia	√	**	**	**	×	×	√	√	√	×	×	×
Lecane	√	**	**	**	√	√	×	×	√	√	√	√
CLADOCERA												
Alonella	×	**	**	**	√	√	√	√	√	√	×	×
Bosmina	√	**	**	**	√	×	×	×	×	√	√	√
Ceriodaphnia	×	**	**	**	×	×	×	√	√	√	√	√
Chydorus	×	**	**	**	×	×	×	√	√	√	√	×
Daphnia	√	**	**	**	√	√	√	√	√	√	√	√
Moina sp	×	**	**	**	√	√	√	√	√	√	√	√
Sida	√	**	**	**	√	×	×	×	√	√	×	√
Simocephalus	×	**	**	**	√	√	√	√	√	×	×	×
Diphanosoma	×	**	**	**	×	√	√	√	√	√	√	×
COPEPODA												
Microcyclops	√	**	**	**	√	√	√	√	√	√	√	√
Mesocyclops	×	**	**	**	√	√	√	√	√	√	√	√
Neodiaptomus	√	**	**	**	√	√	√	√	√	×	×	√
Phylodiaptomus	√	**	**	**	√	√	√	×	×	×	√	√
OSTRACODA												
Cypris sp.	√	**	**	**	√	√	√	√	√	√	√	√

√→ present X → Absent ***Samples not analysed due to water scarcity

Table 4.2.3 Month wise population dynamics (density) of zooplankton components during Mar. 2012 to Feb. 2013.

Season	**Summer**				**Monsoon**				**Winter**				
Zooplankton group	**Mar. 2012**	**Apr. 2012**	**May. 2012**	**Jun. 2012**	**Jul. 2012**	**Aug. 2012**	**Sept. 2012**	**Oct. 2012**	**Nov. 2012**	**Dec. 2012**	**Jan. 2013**	**Feb. 2013**	**Total**
ROTIFERA													
Brachionus sp.	52	74	88	88	22	14	15	40	55	74	84	94	**700**
Filinia	22	41	43	0	24	24	12	36	43	18	0	0	**263**
Lecane	58	80	77	53	18	26	10	12	13	14	16	6	**383**
Total	**132**	**195**	**208**	**141**	**64**	**64**	**37**	**88**	**111**	**106**	**100**	**100**	**1346**
CLADOCERA													
Alonella	0	0	0	0	21	17	21	17	13	12	7	6	**114**
Bosmina	8	35	20	22	0	0	0	0	0	0	17	23	**125**
Ceriodaphnia	22	7	15	26	8	12	8	10	6	0	21	0	**135**
Chydorus	16	8	25	23	18	0	0	13	12	14	27	0	**156**
Daphnia	0	9	6	19	9	5	6	12	15	15	26	15	**137**
Moina sp	0	0	0	0	11	7	12	22	23	11	22	12	**120**
Sida	0	8	7	14	0	0	0	7	0	9	18	10	**73**
Simocephalus	0	0	8	0	10	6	0	0	0	0	0	0	**24**
Diphanosoma	0	0	0	0	0	4	5	9	18	12	0	0	**48**
Total	**46**	**67**	**81**	**104**	**77**	**51**	**52**	**90**	**87**	**73**	**138**	**66**	**932**
COPEPODA													
Microcyclops	0	0	0	12	30	26	18	21	41	45	35	22	**250**
Mesocyclops	0	0	0	21	29	14	20	23	34	34	23	17	**215**
Neodiaptomus	0	0	0	0	15	11	8	0	0	0	15	9	**58**
Phylodiaptomus	13	8	0	11	16	6	0	0	0	0	0	17	**71**
Total	**13**	**8**	**0**	**44**	**90**	**57**	**46**	**44**	**75**	**79**	**73**	**65**	**594**
OSTRACODA													
Cypris sp.	**40**	**21**	**26**	**48**	**18**	**12**	**42**	**29**	**37**	**51**	**30**	**23**	**377**

Table 4.2.4 Month wise population dynamics of zooplankton components during Mar. 2013 to Feb. 2014.

Season	Summer				Monsoon				Winter				
Zooplankton group	**Mar. 2013**	**Apr. 2013**	**May. 2013**	**Jun. 2013**	**Jul. 2013**	**Aug. 2013**	**Sept. 2013**	**Oct. 2013**	**Nov. 2013**	**Dec. 2013**	**Jan. 2014**	**Feb. 2014**	**Total**
ROTIFERA													
Brachionus sp.	92	**	**	**	41	19	13	28	33	58	95	90	**469**
Filinia	21	**	**	**	0	0	16	22	15	0	0	0	**74**
Lecane	36	**	**	**	23	15	0	0	24	25	30	26	**179**
Total	**149**	**	**	**	**64**	**34**	**29**	**50**	**72**	**83**	**125**	**116**	**722**
CLADOCERA													
Alonella	0	**	**	**	13	13	23	22	28	16	0	0	**115**
Bosmina	23	**	**	**	6	0	0	0	0	14	33	26	**102**
Ceriodaphnia	0	**	**	**	0	0	0	20	22	26	29	21	**118**
Chydorus	0	**	**	**	0	0	0	28	32	25	17	0	**102**
Daphnia	10	**	**	**	8	7	11	26	29	42	34	15	**182**
Moina sp	0	**	**	**	5	12	16	23	33	24	30	24	**167**
Sida	7	**	**	**	4	0	0	0	7	9	0	16	**43**
Simocephalus	0	**	**	**	8	9	12	17	15	0	0	0	**61**
Diphanosoma	9	**	**	**	0	0	0	0	12	11	7	12	**51**
Total	**49**	**	**	**	**44**	**41**	**62**	**136**	**178**	**167**	**150**	**114**	**941**
COPEPODA													
Microcyclops	22	**	**	**	38	26	20	34	38	36	31	18	**263**
Mesocyclops	0	**	**	**	22	32	17	35	29	24	26	8	**193**
Neodiaptomus	8	**	**	**	28	12	14	20	12	0	0	20	**114**
Phylodiaptomus	12	**	**	**	37	26	22	0	0	0	5	6	**108**
Total	**42**	**	**	**	**125**	**96**	**73**	**89**	**79**	**60**	**62**	**52**	**678**
OSTRACODA													
Cypris sp.	**20**	**	**	**	**28**	**22**	**42**	**48**	**59**	**42**	**34**	**18**	**313**

*****Samples not analysed due to water scarcity**

Table 4.2.5 : Genera wise population density of various zooplankton groups with their percentage during Mar. 2012 to Feb. 2013 & Mar. 2013 to Feb. 2014

Year	**Mar. 2012 to Feb. 2013**		**Mar. 2013 to Feb. 2014**	
Zooplankton Comp.	**Org./L.**	**Percentage**	**Org./L.**	**Percentage**
ROTIFERA				
Brachionus sp.	700	52.01	469	64.95
Filinia	263	19.54	74	10.26
Lecane	383	28.45	179	24.79
Total	**1346**	**100**	**722**	**100**
CLADOCERA				
Alonella	114	12.31	115	12.22
Bosmina	125	13.4	102	10.83
Ceriodaphnia	135	14.47	108	12.53
Chydorus	156	16.74	102	10.83
Daphnia	137	14.7	182	19.34
Moina sp	120	12.84	167	17.14
Sida	73	7.83	43	4.56
Simocephalus	24	2.56	61	6.48
Diphanosoma	48	5.15	51	5.41
Total	**932**	**100**	**941**	**100**
COPEPODA				
Microcyclops	250	42.08	263	38.79
Mesocyclops	215	36.2	193	28.46
Neodiaptomus	58	9.77	114	16.81
Phylodiaptomus	71	11.95	108	15.92
Total	**594**	**100**	**678**	**100**
OSTRACODA				
Cypris sp.	**377**	**100**	**313**	**100**

Table 4.2.6 Group wise seasonal population density (No./L) of Zooplankton during 2012 - 2013 and 2013-2014

Sr. No.		Mar.2012 to Feb. 2013				Mar.2013to Feb. 2014			
	Zooplankton Group	Summer	Monsoon	Winter	Total	Summer	Monsoon	Winter	Total
1	**Rotifera**	676	253	417	**1346**	149	177	396	**722**
2	**Cladocera**	298	270	364	**932**	49	283	609	**941**
3	**Copepoda**	65	237	292	**594**	42	383	253	**678**
4	**Ostracoda**	135	101	141	**377**	20	140	153	**313**
	Total	**1174**	**861**	**1214**	**3249**	**260**	**983**	**1411**	**2654**

Table 4.2.7 Group wise seasonal percentage of zooplankton groups during 2012 - 2013 and 2013-2014

	Mar.2012 to Feb. 2013				Mar.2013to Feb. 2014			
Zooplankton Group	Summer	Monsoon	Winter	Total	Summer	Monsoon	Winter	Total
Rotifera	57.58	29.38	34.35	**41.43**	57.30	18.01	28.07	**27.20**
Cladocera	25.38	31.36	29.98	**28.69**	18.8	28.79	43.16	**35.45**
Copepoda	5.54	27.52	24.05	**18.28**	16.15	38.96	17.93	**25.54**
Ostracoda	11.5	11.74	11.62	**11.6**	7.69	14.24	10.84	**11.79**

Table 4.2.8 Yearly population density (No./L) of various zooplankton groups .

Year	Mar.2012 To Feb. 2013		Mar. 2013 to Feb. 2014	
Zooplankton group	Total org. No./L	Percentage	Total org. No./L	Percentage
Rotifera	1346	41.42%	722	27.22%
Cladocera	932	28.68%	941	35.45%
Copepoda	594	18.28%	678	25.54%
Ostracoda	377	11.62%	313	11.79%
Total	**3249**	**100%**	**2654**	**100%**

Table 4.3.1 Diversity of fish fauna observed during Mar. 2012 to Feb. 2014.

Sr. No.	**Order**	**Species**
1	**Cypriniformes**	
	a.	*Labeo rohita*
	b.	*Labeo calbasu*
	c.	*Cirrhinus mrigala*
	d.	*Catla catla*
	e.	*Cyprinus carpio*
	f.	*Puntius sarana sarana*
	g.	*Puntius ticto ticto*
2	**Siluriformes**	
	a.	*Wallago attu*
	b.	*Mystus seenghala*
	c.	*Clarius batrachus*
3	**Channiformes**	
		Channa marulius
4	**Osteoglossiformes**	
		Notopterus notopterus
5	**Mugiliformes**	
		Rhinomugil corsula

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Fig. 4.2.1 Yearly population dynamics (NO./Lit) of various Zooplankton groups during Mar. 2012 to Feb. 2013.

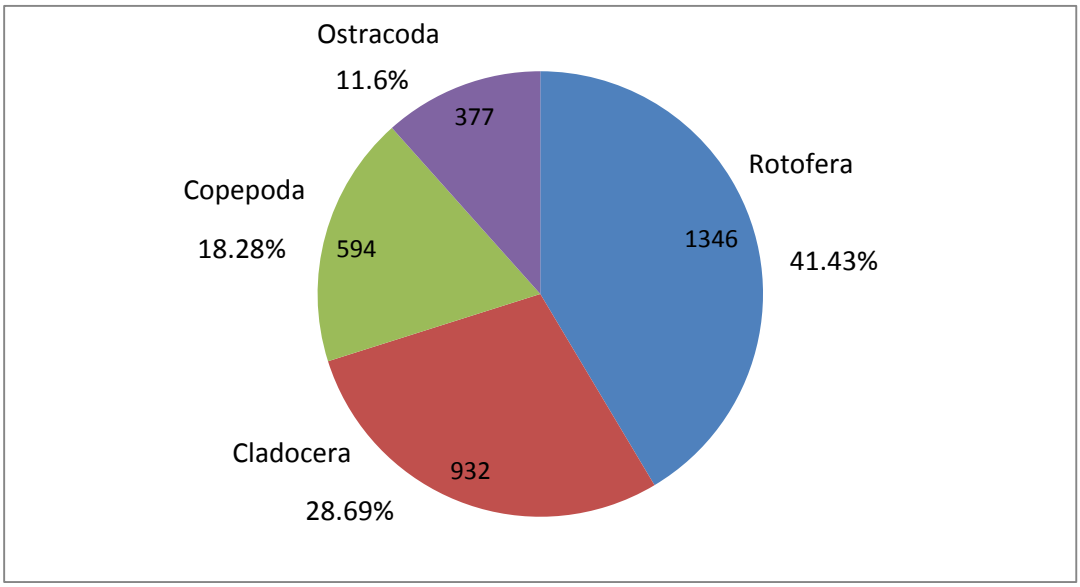


Fig. 4.2.2 Yearly population dynamics (NO./Lit) of various Zooplankton groups during Mar. 2013 to Feb. 2014.

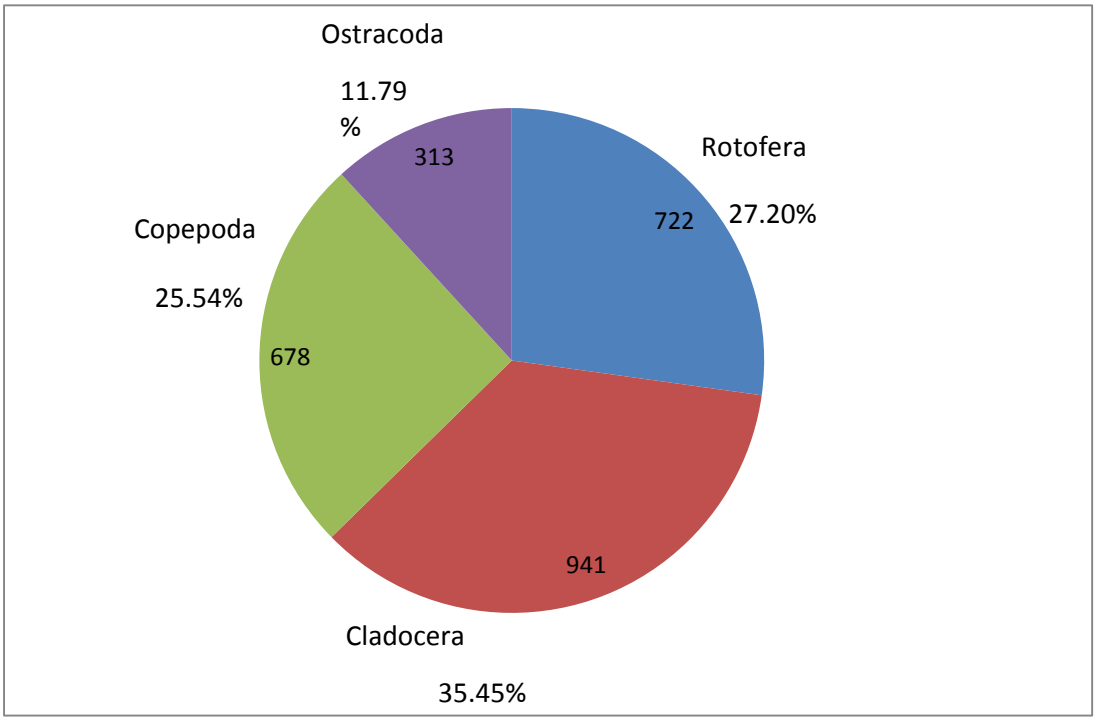


Fig 4.2.3 Seasonal population density (No./L) of group Rotifera during 2012 - 2013

and 2013-2014.

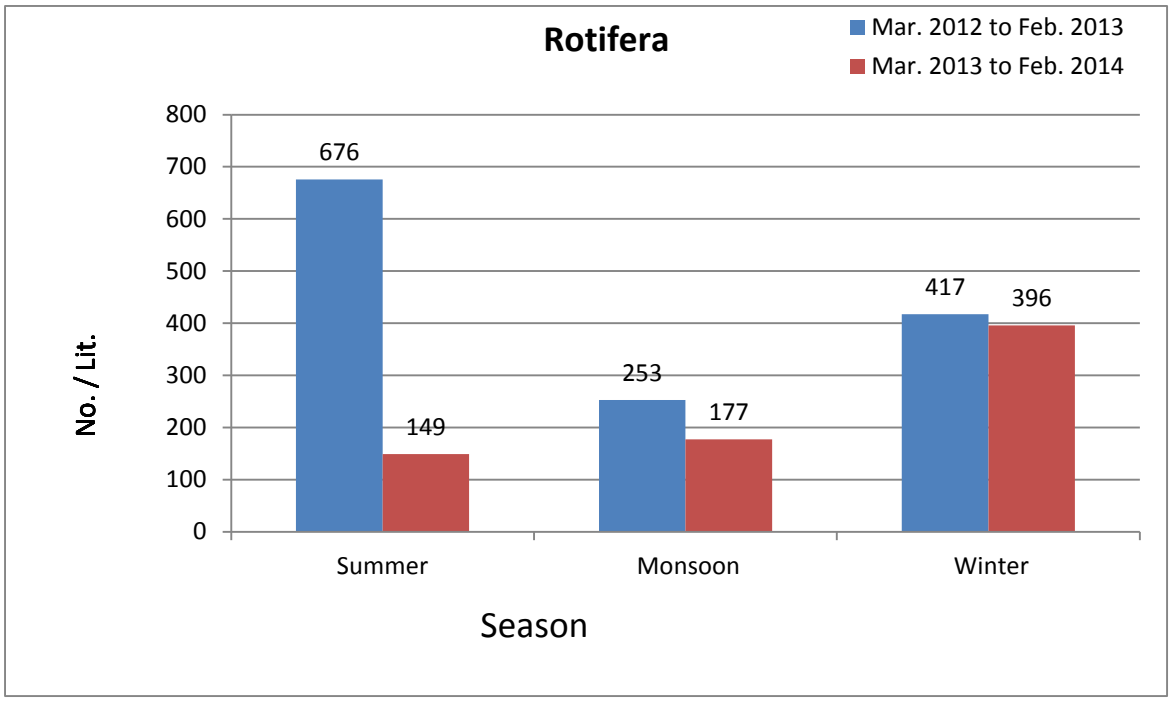


Fig. 4.2.4 Seasonal population density (No./L) of group Cladocera during 2012 - 2013 And 2013-20

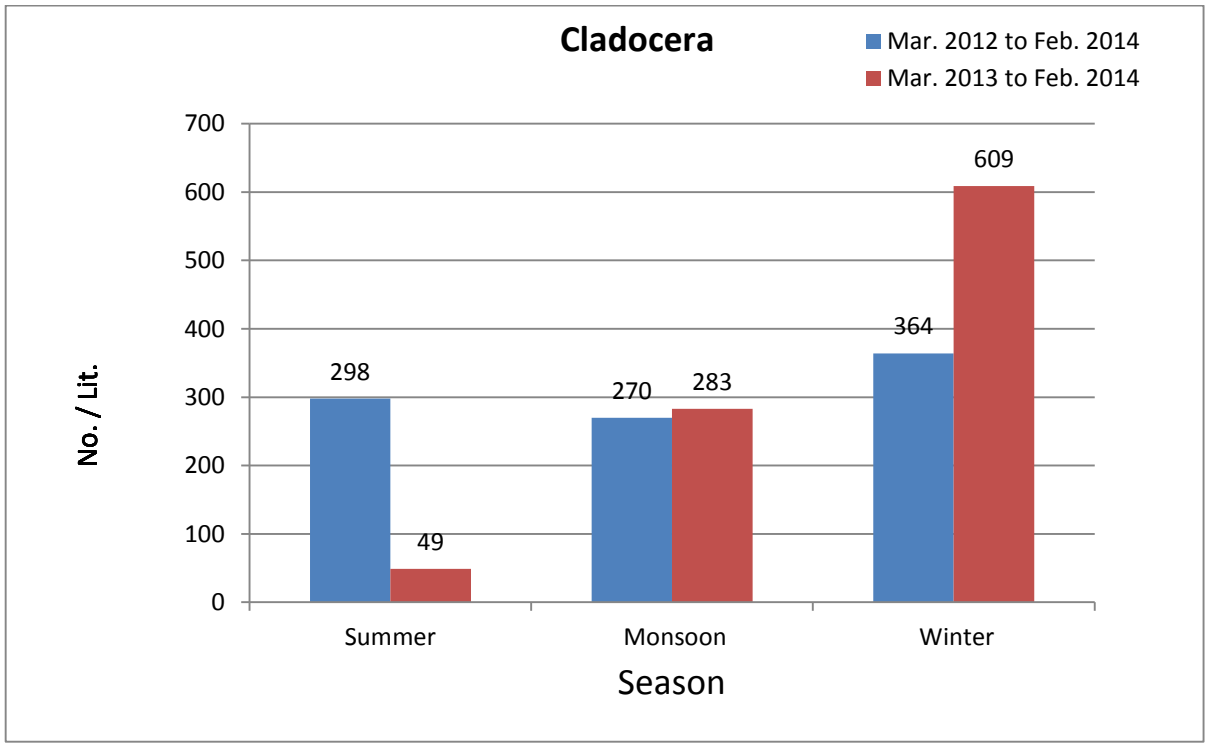


Fig. 4.2.5 Seasonal population density (No./L) of group Copepoda during 2012 - 2013 and 2013-2014.

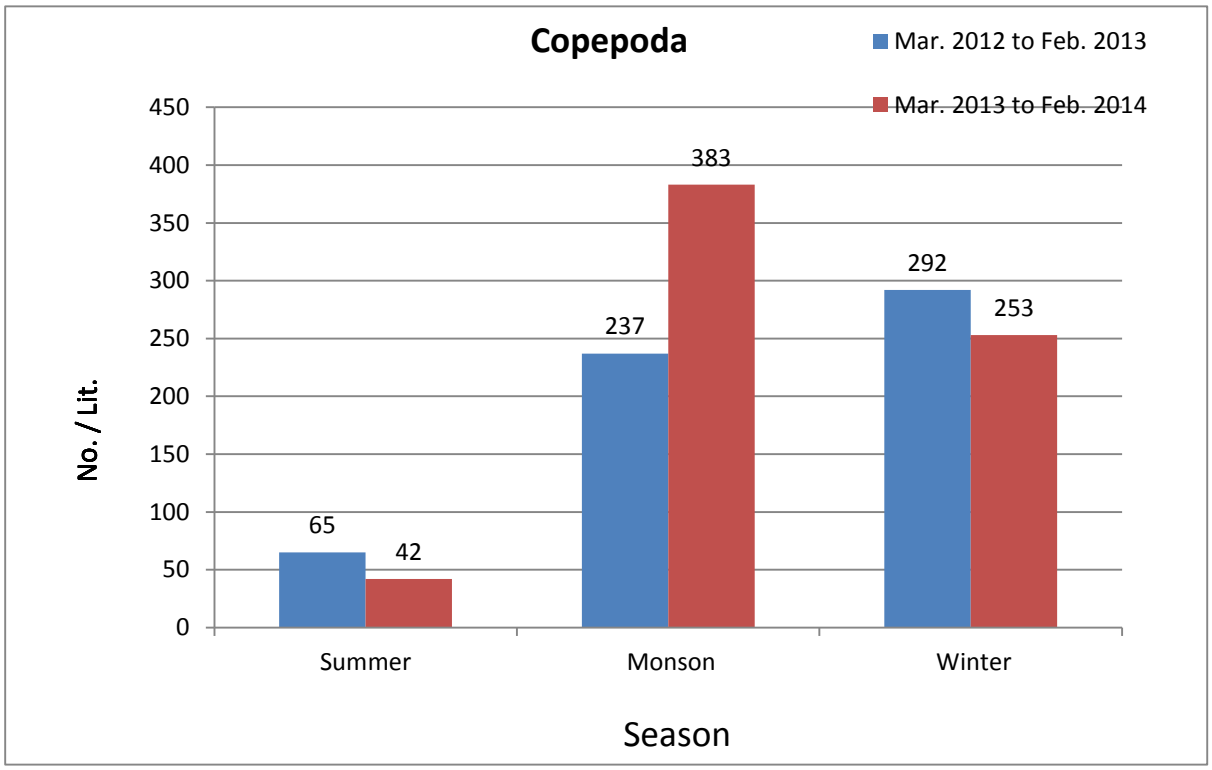


Fig. 4.2.6 Group wise seasonal population density (No./L) of group Ostracoda during 2012 - 2013 and 2013-2014.

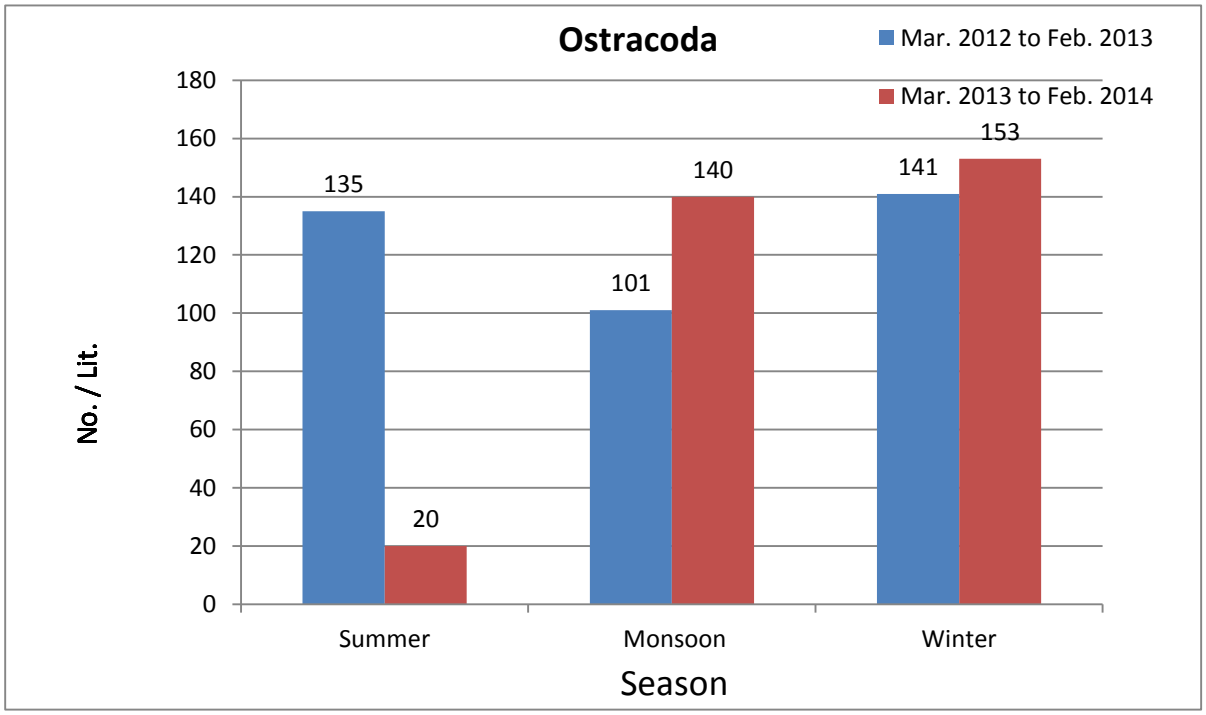
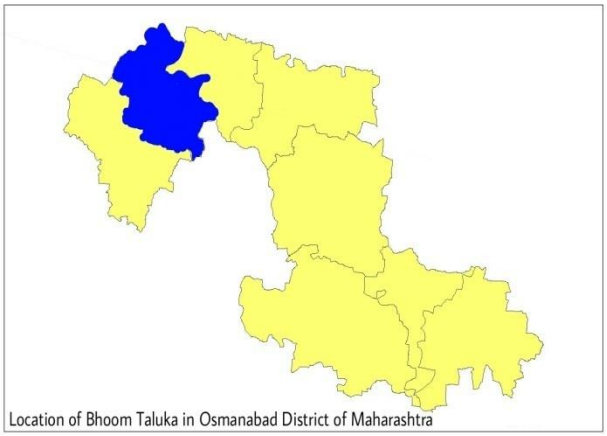


PHOTO PLATES

Location of Osmanabad district in Maharashtra

1

2



Location of Bhoom Taluka in Osmanabad District of Maharashtra

3

Location of Sangameshwar Project in Bhoom Taluka

PLATE-4

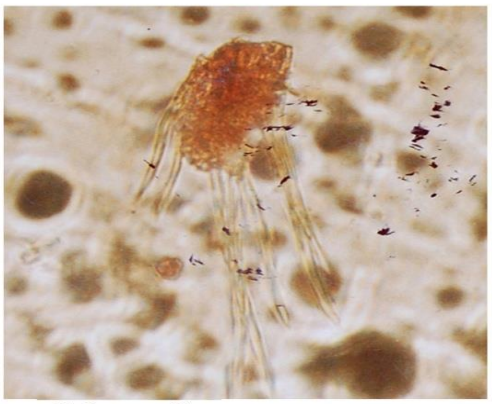
Visit at sampling sites

PLATE -A

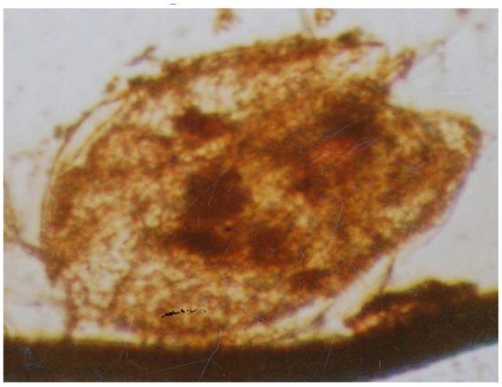
Zooplankton

Group - Rotifera

Brachionus Sp.



Filinia Sp.

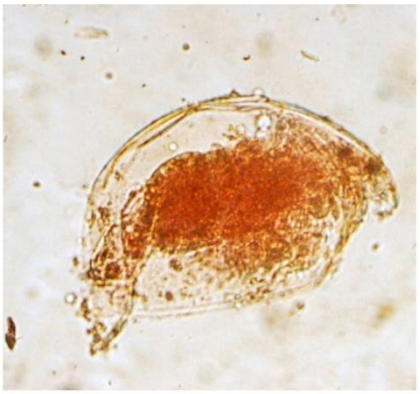


Lecane Sp.

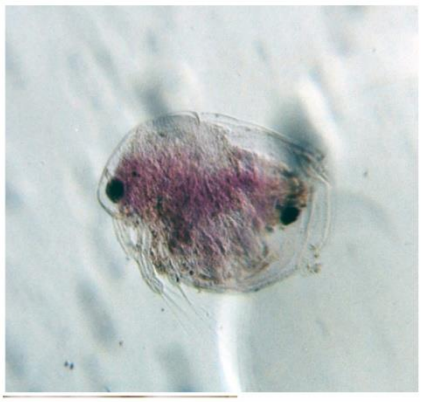
PLATE - B

Zooplankton

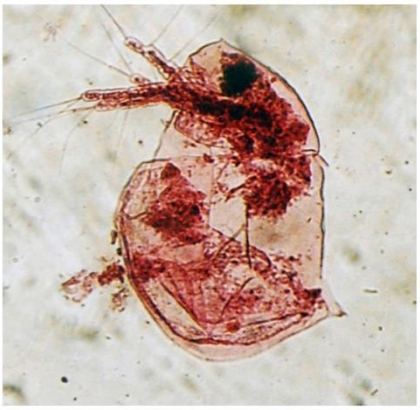
Group - Cladocera



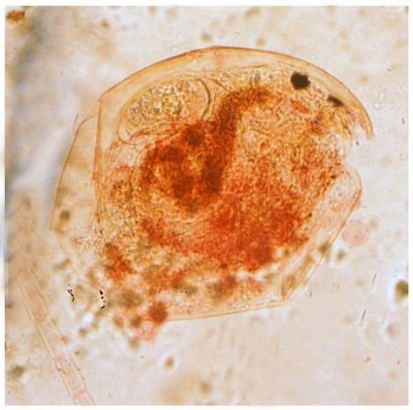
1. *Alonella Sp.*



2. *Bosmina Sp.*



3. *Ceriodaphnia Sp.*



4. *Chydorus Sp.*

PLATE- C

Zooplankton

Group - Cladocera

Daphnia Sp.

Moina Sp.

Sida Sp.

Simocephalus Sp.

Diaphanosoma Sp.

PLATE -D

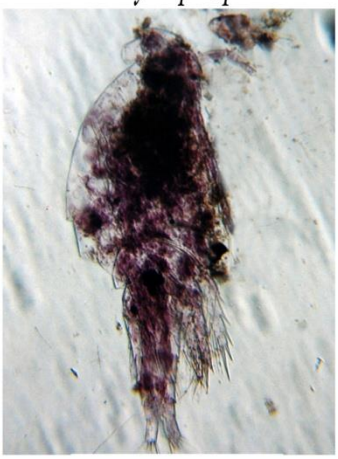
Zooplankton

Group - Copepoda

Microcyclops Sp.

Mesocyclops Sp.

Neodiaptomus Sp.



Phyllodiaptomus Sp.

Group-Ostracoda

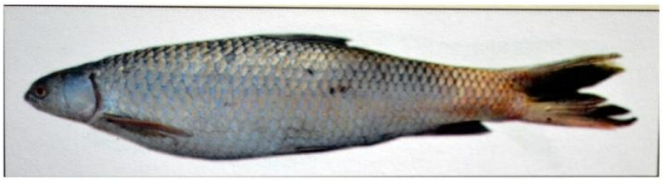
Cypris Sp.

FISH DIVERSITY

PLATE - E

Labeo rohita

Labeo calbasu



Cirrhinus mrigala

Catla catla

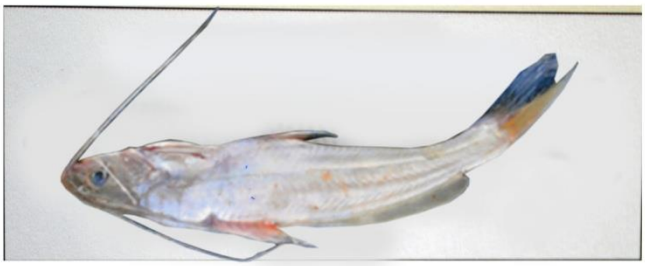
PLATE - F

Cyprinus carpio

Puntius sarana

Puntius ticto

PLATE -G

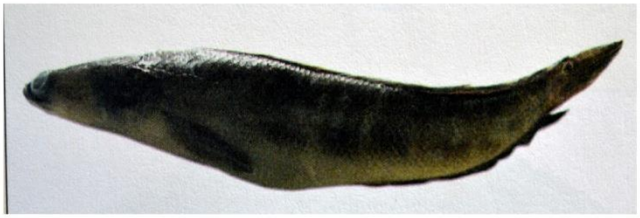


Wallago attu

Mystus seenghala

Clarius batrachus

PLATE -H



Channa marulius

Notopterus notopterus

Rhinomugil corsula

SUMMARY AND CONCLUSION

The water body taken for hydrobiological investigations is located in Bhoom taluka of Osmanabad district (M. S.). Considerable work has been done on the physico-chemical and biological assessment, their correlations and quality of water.

Monthly variations in abiotic and biotic factors of above water body have been studied for a period of two years. The physico-chemical parameters includes atmospheric temperature, water temperature, humidity, pH, transparency, conductivity, TDS, dissolved oxygen, free carbon dioxide, Total alkalinity , bicarbonates, total hardness, calcium hardness, magnesium hardness, chlorides, phosphates & nitrates. Biotic factors includes different groups zooplanktons studied for diversity and density up to genera level. Diversity of fish fauna also studied.

The atmospheric temperature ranged between 16.6 ^{0}C to 31.6 ^{0}C where as water temperature was ranged between 19.2 ^{0}C to 28.5 ^{0}C throughout study. Water temperature was observed higher in summer and monsoon as compare to winter. Summer increase and winter decline of surface water temperature indicates close parallel relation between air and water temperature. A rise in temperature of water leads to the spreading up of the chemical reactions in winter, reduces the solubility of gases like O_2 and CO_2.

The pH of water bodies under investigation ranged between 8 to 8.7. pH showed minor seasonal variations. It was recorded maximum during summer and is associated high photosynthetic activity in water. Present studies showed pH range favorable for aquatic life, irrigation and domestic use.

In the present study the transparency ranged between 52 cm to 140 cm throughout study. Overall transparency was observed maximum during late winter and early summer at all sites. It was observed minimum during monsoon due to sewage contamination from rainwater from surrounding area. Low values of transparency indicates high trophic status of water bodies . Reduced transparency in later summer in the water body saturated with more planktons.

The conductivity of present water bodies varied between 252 µMhos/cm to 321 µMhos/ cm . The conductivity values were high in summer and least in winter. Conductivity values were high due to contamination of water by sewage, domestic waste and high built of salts. Rise in conductivity is due to increased chlorides and TDS because of evaporation of water resulting in increased concentration salts.

In the present study TDS values were observed maximum during summer followed by monsoon and lowest in winter. TDS values recorded in summer due to evaporation of water resulting in increased concentration of salts and in monsoon due to addition of sewage, domestic waste with the influx of monsoon runoff from surrounding area.

Dissolved oxygen ranged between 2.8 mg/lit. to 7.6 mg/lit. at all water bodies under investigation throughout study. Peak values of DO were high in winter might be due to low temperature of water. Whereas low DO observed during summer because of its enhanced utilization of micro organisms in the decomposition of organic matter.

In the present study the free CO_2 values varied between nil to 11 mg/lit at all three water bodies under investigation. The CO_2 values were recorded maximum during winter. High CO_2 level indicates higher organic load which might be due to incorporation of fertilization and organic manure in water. The absence of CO_2 might be due to its utilization in photosynthetic activity.

Phenolphthalein alkalinity values were recorded nil to 15 mg/lit. throughout study. It was recorded during summer months only. Whereas total alkalinity values were recorded 110 mg/lit. to 185 mg/ lit. throughout study period. The alkalinity values generally remains higher than 110 mg/ lit. which denotes slightly polluted status of water bodies due to domestic sewage and agricultural runoff. Total alkalinity remains higher in summer is due to concentration of nutrients in water and decrease in water level by evaporation. A decline in total alkalinity was observed during monsoon which may be due to dilution effect. Hydroxide alkalinity was not observed throughout study. Large quantities of bicarbonates were observed in summer months, it may be due to liberation of CO_2 in the process of decomposition of bottom sediments with resultant conservation insoluble carbonates in to carbonates. Carbonate alkalinity was recorded in summer months.

Total hardness was ranged between 56 mg/lit. to 130 mg/ lit. Total hardness was observed maximum in summer followed by monsoon and least in winter. The maximum values of hardness in summer might be due to presence of carbonates and bicarbonates. Calcium hardness ranged between 16.83 mg/lit. to 39.27 mg/lit. throughout study period. Its values were observed high in summer and lowest in winter. Total hardness and calcium showed very positive correlation ship, which indicates that the total hardness is mainly due to presence calcium salts. The concentration of magnesium was observed lower than the concentration of calcium in all water bodies under investigation. It is also an important contributor of total hardness. In present investigation magnesium hardness ranged between 2.92 mg/lit. to 10.72 mg/lit.

High values of chlorides were recorded during summer and monsoon. High values of chlorides recorded in summer may be due to increased organic decomposition of animal origin or it might be due to loss of water by evaporation. High chloride contents recorded in monsoon because of highly contaminated domestic sewage with influx or water from surrounding area.

In the present investigation phosphates and nitrates were recorded in minute quantities. Their concentration in water increases sue to untreated domestic sewage and mixing of agricultural runoff. The values of phosphates recorded slightly more in monsoon.

The study of diversity revealed that there are 17 genera observed belonging zooplankton groups Viz. Rotifera, Cladocera, Copepoda and Ostracoda. Among the total zooplanktonic organisms group Cladocera was observed more diversified including nine genera viz. *Alonella, Bosmina, Cerodaphnia, Chydorus, Daphnia, Moina, Sida, Simocephalus* and *Diphinosoma.* Group Rotifera was represented by three genera including *Brachionus, Filinia,& Lecane.* Belonging to Copepoda *Microcyclops, Mesocyclops, Neodiaptomus, and* these four genera were recorded where as only single genus Cypris was observed belonging to group Ostracoda.

Maximum Zooplankton diversity was observed during winter months. Among the Rotifers *Brachionus* and *Lecane* were dominated in all water bodies under investigations throughout study. Meso*cyclops* and *Microcyclops* were dominant Copepods. Belonging to Cladocera *Chydorus* and *Ceriodaphnia* were recorded dominantly.

The seasonal variation of zooplanktonic organisms observed dependant on physico-chemical and biological parameters. A component wise population density of Rotifers were observed maximum in summer. Cladocerans were observed maximum in winter where Copepods were recorded maximum in monsoon. Ostracods were observed dominantly in winter season.

The Rotifers have versatile capacity to survive in polluted conditions of water, particularly in summer. Higher temperature, less nutrients and low oxygen contents would have favored the growth of Rotifers. Population density of Rotifers increased in summer sharply fells in monsoon period due to reflection of environmental stress. High population of Rotifers during summer may have indicated the pollution because of organic matter from direct entry of untreated domestic sewage. Presence of *Brachionus* and *Lecane* indicate pollution.

Maximum density of Cladocera was observed during winter might be due to favorable temperature conditions and availability of abundant food in the form of bacteria. Favorable range (8 to 8.7) of pH also positively affects the population of Cladocerans.

Mesocyclops and *Microcyclops* in summer indicates the polluted nature of water body. Decrease in count of Copepods in winter indicates that water body is unpolluted in this season.

The temperature of water and availability of food affect the population of Ostracoda. Peak number of *Cypris* was observed in winter indicates unpolluted nature of water body. Whereas their least count in summer indicates polluted water quality.

Annual population density of Zooplankton components observed with decreasing order of abundance during 2012-13 was Rotifera (41.43%) > Cladocera (28.69 %) Copepoda (18.28 %) > Ostracoda (11.6 %). Rotifers observed dominantly during summer and they accounts for about 57.58 % and 57.29% during 2012-13 and 201314 respectively. Rotifer population was observed least (29.38% and 18.01%) in monsoon. Cladocera accounts for about 25.38 % and 28.79 % among the whole population of Zooplanktons during 2012-13 & 2013-14 respectively. Maximum density of Cladocera was observed during winter and it accounts for about (43.16 % during 2013-14.. The peak number of Copepods were observed during monsoon. Ostracods accounts for about 11.62 % and 11.34% during among whole population of zooplankton during study period. Only *Cypris* was observed belonging to group Ostracoda and it was observed throughout study period.

The diversity of fish fauna recorded during present study is due to 13 species belonging to five orders and seven families. Order Cypriniformes was observed most diversified including seven fish species viz. *L. Rohita,* L. *calbasu, C. catla, C. mrigala, C. carpio, P. sarana, and P. ticto.*. Order Siluriformes includes *W.attu, M. seenghala,* and *C. batrachus*. Order Channiformes represents *C. marulius* where as order Osteoglossiformes represents *N. notopterus.* The order Mugiliformes represents *R.. corsula.*

The present investigation showed that the water from all the water bodies under investigation was acceptable for drinking after some treatments. The majority of parameters were observed within the permissible limit. The pH was within permissible limit and it was ranged between 8 to 8.7 , but it was observed slightly more (8.6 to 8.7). TDS values ranged between 110 to 210 which were within permissible limit. DO was observed slightly lower than the permissible limit of ISI and WHO in summer months . Total hardness and alkalinity were observed much below than the permissible limit of WHO. Average values of calcium.

Magnesium and chlorides were also within the permissible limit. Phosphates and nitrates which are important nutrients were observed in very minute quantity.

With few exceptions all the parameters were within the permissible limit as per WHO and ISI. The parameter like DO and pH observed in summer were objectionable regarding quality criteria.

SUGGESTIONS

The present investigations suggest that there is a need to study the physico-chemical status of water for the assessment of quality in future. Though the water bodies under investigation are not severely polluted, requires careful monitoring in the future to maintain quality of water by proper means. Supervision of experts and remedial measures are essential for rehabilitation and conservation of water bodies in Bhoom taluka for long duration.

In order to reduce the incidence of heavy pollution following suggestions have been recommended.

1. Bathing, washing of clothes, vehicles, domestic animals etc. should be avoided.
2. Continues disposal practices of the agricultural and domestic effluents should be strictly avoided.
3. Adequate water supply schemes must be implemented for the residents to avoid unlimited misuse of water.

4 Preliminary treatment should be performed before using the water for drinking.

5. Recycling of waste waters through proper methods of purifications should be applied for saving water.
6. Frequent practices of arranging and cleaning harmful aquatic flora and fauna programme should be encouraged.
7. 8. Villagers should be educated about the advantages of conservation and its scarcity.
9. Legislative measures should be enforced to restrict the misuses for maintaining the natural eco-balance of the lakes.

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