# CHAPTER – IV
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The lentic water habitat i.e. ponds, tanks, and reservoirs occupy relatively small portion of earth's surface as compared to marine and terrestrial habitat. These water reservoirs found either in natural state or man made are useful to mankind in several respects as sources of drinking water, irrigation, washing, bathing etc. Besides, these habitats provide nutritious food items in the form of fish and other organisms. The study of the biotic and abiotic factors and their interrelationship in order to obtain the maximum possible output in terms of anthropogenic use and production of fish and other organism is useful to mankind.

The interrelationship between fish and elements of its biotic and abiotic environment are not isolated. They are interdependent and any change in one system inevitably produces changes in the other. The quality of water is described according to its physical, chemical and biological characteristics.

The study of physico-chemical characters is always useful in determining the quality of water and implementation of the developmental activities as a source of domestic, industrial water

supply, irrigation and for fish production. The scientific management of man made and natural water bodies in order to obtain maximum economic benefit will prove as a significant phenomenon for creation of employment opportunities and food for rural communities of a specific region with this view in mind present investigation on old historical Triputi reservoir was undertaken. The present investigation was formulated to study monthwise the physico-chemical parameters and listing planktons, macrophytes, fish fauna and fishery status of Triputi reservoir.

**Temperature :**

Temperature of water depends up on water depth, solar radiation, climate and topography. Rate of chemical reactions increases due to high water temperature and altimately reduces solubility of gases. The water temperature significantly determines the rate of metabolic processes in fish and also influences physico-chemical, biological behaviour of aquatic ecosystem.

Shashi Kant and Raina (1990) have shown that, temperature of water during winter are under the influence of high specific heat of water and overturn condition of pond. Moderately high temperature of water has been found to favour active

multiplication of plankton resulting in low transparency (Shashi Kant and Anand, 1978).

Jakher and Raut (2003) have recorded fluctuated temperature range from 18.6$^0$C (Feb., 2001) to 32.2$^0$C (Sept. 2000) and 18.8$^0$C (Jan. 2000) to 32.9$^0$C (Sept. 2000) in a tropical lake, Jodhpur.

The temperature is known to play an important role in a productivity of water by influencing the abundance of primary producers, on which the primary consumer feeds. The temperature affects not only the metabolic activities of plankton, but also their proliferation (Shukla *et. al.* 1991). Salaskar and Yeragi (2003) have recorded significant negative correlation with phytoplankton and temperature, and also negative correlation with zooplankton.

Jayabhaje, U. M. *et. al.* (2008) reported that the water temperature ranges from 22.0$^0$C to 31.0$^0$C of a minor reservoir Sawana, Hingoli district, Maharashtra. Seasonal analysis showed that it was highest in pre monsoon and relatively lowers in monsoon and post monsoon. In a similar study, Salve and Hiware (2006) observed that during summer, water temperature was high due to low water level and clear atmosphere which is quite similar with results obtained in the present investigation.

Chingrajpara Pond water in Bilaspur, Chhattisgarh (India), water temperature is largely influenced by local climatic conditions. It is recorded to minimum ($20.40^0$C) in January and maximum ($30.30^0$C) in May (Shastri *et. al.*, 2008).

The temperature of Kharland water of Ratnagiri varied from 26 to $34.5^0$C during first year of the study and 25.7 to $32.7^0$C during second year (D. N. Saksena *et. al.*, 2006). There occurred a gradual decline in the temperature from September to January and thereafter, it increased till May. There was no significant difference between the temperature of various pond. In coastal ponds of Orissa, Das *et. al.* 2000, 2001a & b and Das Saksena (2001) have described water temperature ranging from $20^0$C to $31.5^0$C. The temperature in all the ponds was influenced by the seasonal changes in ambient temperature.

In the Velachery lake (Chennai), the surface water temperature ranged from $25^0$C to $32^0$C, where as, the atmosphere temperature ranged from $24^0$C to $32^0$C. The surface water temperature was found to be higher than that of air during March, July, August, September, November and December. Maximum rainfall was recorded in the month of July (20.8 mm) and minimum rainfall in August (1.3 mm) (Ramalingam *et. al.*, 2004)

Pailwan (2005) observed temperature ranges from 23.5 to 32.5$^0$C with minor variation. The lowest temperature was recorded in wither seasons and highest in summer season in all these tanks.

Jakher and Raut (2003) have recorded fluctuated temperature range from 18.6$^0$C to 32.2$^0$C and 18.8$^0$C to 32.9$^0$C in a tropical lake, Jodhpur.

In the present investigation the surface water temperature was fluctuated from 24$^0$C to 30$^0$C at Triputi reservoir. The minimum temperature was recorded in the month of December and maximum in May. The seasonal pattern in temperature fluctuations was recorded as low in winter and monsoon season, while high in summer and moderate in post monsoon season. Moreover the temperature range of all the four stations of the reservoir was observed mostly in uniform pattern with slight fluctuations. It shows clear correlation with atmospheric temperature. Considerable fall in temperature in the rainy season may be due to reduced solar radiation, presence of clouds. Whereas low water temperature during winter season may be attributed to the shorter photoperiod and decreased atmospheric temperature.

**Transparency :**

Secchi depth has been used for many years as a limnological characterization tool for measuring water clarity, growth and decay of plankton and suspended detritus in aquatic media. It is a reliable indicator of the trophic state of a water body. Transparency is the light penetration capacity of the water. Transparency is dependent on colour of water, concentration of suspended organic and inorganic particles concentration of phytoplankton and zooplankton of the water.

Light penetration was more in Kalwa lake (Avg. 41.6 cm) than Jail lake (25.4 cm) (Madhuri Pejaver and Minakshi Gurav, 2008). This shows that the water than Kalwa Lake (Thane Maharashtra) to be more clean water from Jail Lake (Thane, Maharashtra). The colour of water was always green with thick mat of *Microcystis* spp. in Jail lake. This also reflects the presence of chlorophyll content in Jail lake.

The light penetration was more in post monsoon month and reduced progressively in further months. The light penetration recorded in different lakes of Thane city at different studies ranges from 4 cm to 105.5 cm. (Somani, 2002, Raut, 2006).

The water transparency values were ranged from 42.5 cm to 98 cm during 2005 – 06 and 47.6 to 105.5 cm during 2006 – 07 by Jayabhaye *et. al.,* 2008 of minor reservoir Sawana, Hingoli district

Maharashtra (Jayabhaye *et. al.*, 2008). The overall means was 73.37 cm. The water was less transparent during monsoon as compared to post monsoon and pre-monsoon. Similar observations are also made by Kadam *et. al.* (2007) from Masoli reservoir of Parbhani district, Maharashtra. The maximum (75.5 cm) turbidity was noticed during April and February months at the sample stations respectively (Ramalingam and Ramarani (2004)).

In the present investigation Secchi disc transparency at single station was varied from 108 cm to 124 cm at Triputi reservoir. The transparency values represented distinct seasonal pattern i.e. the lower transparency values were observed in winter and higher in summer and post monsoon months.

High transparency during summer is attributed to steady state of water. While its lower values in monsoon is due to addition of silt and clay particles along with the run off water from nearby area.

**Total Dissolved Solids :**

The total dissolved solids present in the water is detrmined as a residue left after evaporation of filtered water at $103^0$C. High concentration of total dissolved solids increased water turbidity, decreasing the light penetration and affecting the photosynthesis thereby suppressing the primary producers i.e. algae, macrophytes etc.

In humans, drinking water containing high concentration of total dissolved solids can cause laxative effects. Total dissolved solids elevate the density of water, influence osmoregulation of fresh water animals and affect water use for drinking. The bulk of the total dissolved solids include bicarbonates, sulphates and chlorides of calcium, magnesium, solid and silica.

Padmavathi (2002) has reported lower values of total dissolved solids in summer and higher values during monsoon season in Khaji Kothnoor reservoir in Karnataka. Gowd and Kotaiah (1999) have recorded seasons and low (160 – 170 mg/l) in winter and summer seasons respectively.

Total dissolved solids in the Sawana reservoir ranged from 221 to 270 mg/l during 2005 – 2006 and from 225 to 282 mg/l during 2006 – 2007. (Jayabhaye *et. al.*, 2008). The total dissolved solids values were high in pre-monsoon followed by monsoon and post monsoon months. Sakhare and Joshi (2003) reported high values of total dissolved solids in Yeldari reservoir, Maharashtra. Dhimdhime and Ambore (2004) reported the total dissolved solids values ranged between 337 mg/l to 722 mg/l from Siddeshwar dam Maharashtra.

In four natural lakes located in Northwestern Indiana, Simon *et. al.* (1967) reported that total dissolved solids varied from

48.6 to 67 ppt. In the Kharland ponds of Ratanagiri studied by Saksena *et. al.* (2006) recorded total dissolved solids ranging from 0.89 to 27.55 ppt. The total dissolved solids increased gradually from post monsoon season to pre-monsoon season but decreased in monsoon season in all ponds.

Total dissolved solids is an indicator of water mineralization, showing inorganic salt contents and small amount of organic matter present (Mohan *et. al.* 2007).

In the present investigation the value of total dissolved solids were recorded within the range from 160 mg/l to 280 mg/l as minimum in month of September, November and maximum in month of June. In general the higher values of total dissolved solids, were observed in monsoon and low in winter and moderate in summer season.

In the present investigation highest total dissolved solids values obtained during summer, which can be attributed to high rate of evaporation and consequently decreased water level leading to accumulation of dissolved solids. The moderate values of total dissolved solids during monsoon observed in present study may be due to rain and surface run off.

The total dissolved solids in water originate from natural sources and depend upon location, geological nature of pond basin, drainage, rainfall, bottom deposits and inflowing water. Kaushik and Saksena (1999) recorded high values of total dissolved solids during summer and post monsoon seasonal in Motijheel, Swarajkund and Ranital water bodies of central India. Our results agree with the results of Kaushik and Saksena (1999).

The total dissolved solids indicate the general nature of water quality a salinity. The water containing more than 500 mg/l of total dissolved solids is not considerable for drinking purpose. Hence 500 mg/l is the desirable limit and 1500 mg/l is maximum permissible limit for domestic use (ICMR 1975). Beyond the desirable limit palatability of water decreases and may cause gastrointestinal disorders. It is evident that the total dissolved solids value of Triputi reservoir water lie in desirable limit.

**Total Suspended Solids :**

The amount of suspended solids reflects the pollution status of the water body. it may indicate mud, plankton and particulate matter (Pejaver, 1984; Tandel 1986). Excessive amount of suspended solids can harm aquatic organisms and seriously interfere with photosynthesis by preventing light penetration.

The suspended solids observed 0 – 400 mg/l in Kalwa lake and 100 – 150 mg/l in Jail lake (Pejaver and Gaurav 2008). The results indicate Jail lake to be more polluted as the difference is due to the high density of *Microcystis* spp. present in Jail lake. Suspended solids also significant relation with chlorophyll.

Rao and Mahmood (1995) has reported two year average value as 336.0 mg/l in Hubsiguda pond, the values were maximum during summer.

The higher values of suspended solids during rainy season recorded at Vadgaon reservoir can be attributed to surface run off from catchment area which brings in slit particles and other organic material (Hujare, 2005).

In the present investigation of the total suspended solids were recorded within the range from 0 mg/l to 60 mg/l with its minimum in the month of the May and maximum in the month of September. In general the seasonal changes in the values of total suspended solids were observed as minimum in summer, moderate in winter and maximum in monsoon. These observations are similar to the findings of Rao and Mahmood (1995) and Hujare (2005).

**Total Solid :**

The total solid in water are due to inorganic substances, organic matter, suspended particles, silt clay and planktons etc. High total solids reduce the light penetration and affect water quality indirectly and imbalance an aquatic life. Maximum total solid recorded in monsoon season, moderate in winter and minimum in summer in Kagal tank (Pailwan, 2005).

Pandey and Tripathi (1988) have reported average total solids value 2876.72 mg/l ranging between 2150 to 4166.67 mg/l in Chanari pond water. Sathe *et. al.* (2000) has recorded higher total solid values in Siddewadi reservoir ranges from 1880 to 3800 mg/l being maximum in summer season.

In the present investigation the total solids were recorded within the range from 180 mg/l to 280 mg/l with its minimum values in the month of September. In general the seasonal changes in the value of total solids were observed as minimum in summer, moderate in winter and maximum in monsoon.

High monsoon values can be correlated with the leaching of the soil silt carried in the reservoir by the ingressing water from the surrounding. Low summer values of total solids in Triputi reservoir

may be due to low evaporation rate and little fluctuation in water level.

**pH :**

In the aquatic ecosystem estimation of pH indicates the metabolism of $CO_2$ and $O_2$ in water as pH is a function of dissolved $CO_2$ content (Odum, 1971). Many Indian lakes report alkaline pH, which is true even Triputi reservoir. Somani (2002) observed the range between 7.15 and 8.97 for Kacharali lake while between 7 and 8.59 in Masunda lake.

The pH recorded was alkaline in both Jail and Kalwa lake (pH 6.5). The constant transformation process of organic matter accumulated at the bottom into humic substance becomes the buffering factor controlling the changes in reaction (Gorniak, 1996). Such reactions in both the lakes must have maintained the alkaline pH. It does not show any relation with temperature or other parameters except chlorophyll where correlation is significantly positive.

Seasonal variation of pH ranging from 6.73 to 7.28 is considered satisfactory for the production of biomass (Chandanshive *et. al.*, 2008).

The pH values ranged from 7.5 to 8.6 during 2005 – 2006 and from 7.4 to 8.5 during 2006 – 2007 recorded by Jayabhaye *et. al.*

2008 of a minor reservoir Sawana. The low pH value observed during the monsoon was due to heavy fresh water in flow into the water body.

In the present investigation the pH of the samples was alkaline throughout study period in the reservoir. The pH was recorded with the range from 7.8 to 8.2. Low pH was recorded in March and maximum pH was recorded in June.

The annual fluctuations were small, indicating good buffering capacity. The water having pH range of 6.5 to 9.0 are most suitable for pond aquaculture (Jhingran, 1982).

The present water body show pH range suitable for aquaculture and can be used for freshwater fish culture.

**Dissolved oxygen (DO) :**

Dissolved oxygen (DO) plays an important role in maintaining the presence and distribution of aquatic life. Aquatic macrophytes, benthic algae and phytoplankton add to the DO during photosynthesis in addition to wave action, turbulence or surface water agitation. At the same time, the zooplankton and other animal fauna may utilize this DO for respiratory activity. Hence, large variation is seen in DO levels, at different times or in different seasons.

DO variation is seen in the range of 0.7 mg/l to 2.9 mg/l in Kalwa lake while 0.7 to 7.8 mg/l in Jail lake (Pejaver and Gurav

2008). Thus variation in DO was remarkable in Jail lake. This can be attributed to the bloom of *Microcystis* spp. photosynthetic activity of which might have released more DO.

According to Arumugam and Furtado (1979) higher level of DO is indicator of eutrophication while Salakar and Yerag (1997) stated that persistent low DO value in the lake indicate a very high degree of organic pollution. DO level can be lowered down during phytoplankton blooms, as the dead plankton are degraded by bacteria utilizing DO or Do can be used by organic waste (Trivedi and Goel 1984). This may lead to anoxic conditions. The DO levels in both the lakes were always below the critical value except in two months in Jail lake September 7.8 mg/l and October 4 mg/l.

According to the findings of various researchers, the DO in different lake of Thane city ranged between 0 – 12.7 mg/l (Nene 1985, Somani 2002, Raut 2006). During the present study both lakes showed higher DO in September and October 2002 than the remaining months.

Somani (2002) commented that in Kacharali lake high DO values were in winter, while in Masunda lake they were high in rainy season. During the study in both the lakes high DO values were observed in post rainy season.

During summer season DO level was lowest (0.8 mg/l and 0.8 mg/l) showed of river in Pune (Chandanshive *et. al.*, 2008). This could be due to overloading concentrations of organic and industrial wastes with receding water level in this season. The fluctuations indicated an inverse relationship between temperature and dissolved oxygen. The free oxygen is used up in the oxidation of organic matter. Which consumed a part of oxygen and that leads to decreasing its concentration in water. The value of dissolved oxygen increased as much as 4.6 mg/l during monsoon. The heavy rains over flooded the river and thus the concentration of pollution gets diluted. The rain water is always rich in oxygen. This is conformity with earlier finding of Bath and Shing (1998) and Saxena and Chauhan (1993). Desai *et. al.* (1995) opined that DO might fluctuate due to the alteration in water temperature.

Dissolved oxygen ranged from 4.48 mg/l to 7.14 mg/l (Shastri *et. al.* 2008). The minimum value was recorded in the month of April and maximum in December. It might be due to higher water temperature and greater consumption of oxygen in the summer month April as compared to December.

In the present investigation dissolved oxygen was recorded within the range from 11.67 mg/l to 14.08 mg/l. Minimum

dissolved oxygen was recorded in summer season and maximum dissolved oxygen was recorded in monsoon season.

Zutchi *et. al.* (1980) has given the range of oxygen content from 8.96 mg/l to 14.00 mg/l in a man made lake. The amount of oxygen dissolved in water depends up on the partial pressure of the gas in air close to the water surface, rate of photosynthetic activity in the ecosystem, decomposition and mineralization of organic matter and the oxygen holding capacity of water. The temperature of water determines the oxygen holding capacity of water, which reduces at higher temperature (Welch 1952).

It is generally believed that the minimum DO limit for fish growth is 4.0 mg/l. According to APHA (1985) the lowest DO for maintaining fish in healthy conditions is 5.0 mg/l and the critical value is 3.0 mg/l. In the present study the range of DO was found optimum for fish production.

**Free Carbon Dioxide :**

Carbon dioxide is one of the essential constituent of aquatic ecosystem. The abundance of carbon dioxide exerts certain specific effects on aquatic biota. The river in Pune exhibited maximum carbon dioxide value of 24.3 mg/l during summer season, whereas, the lowest concentration of carbon dioxide i.e. 8.3 mg/l was

recorded during monsoon season (Chandanshive *et. al.* 2008) Free $CO_2$ helps in the buffering the aquatic environment against rapid fluctuation sin the acidity or alkalinity and also regulates biological process of aquatic communities (Prasannakumari *et. al.* 2003).

$CO_2$ is added to aquatic ecosystem by directly being mixed from atmosphere. In addition to this, the other sources are rain water, inflowing ground water and the respiration of aquatic flora and fauna. The decomposition of organic matter from (Datta Munshi and Datta Munshi, 1995) but as it gets constantly released in air the amount of free $CO_2$ is kept low in water. The photosynthetic activity of aquatic flora also reduced the free $CO_2$ in water.

Free $CO_2$ was 0 mg/l for three months in Kalwa lake, while it was in the range of 1.03 to 5.70 mg/l in remaining three months (Pejaver and Gurav 2008). The low free $CO_2$ in most of the months can be attributed to the large surface area and the movements of water due to it's usage by the nearby inhabitants. Similarly, fishing activity also goes on this lake.

The distribution of free carbon dioxide an pH in surface water varies, both seasonally and vertically in lakes and reservoirs in relation to loading from physical conditions, biotic inputs and consumption (Saxena 1998).

Bandela *et. al.* (1998) have recorded maximum $CO_2$ level (7.48 ppm) in summer and minimum (3.08 ppm) in winter with pH values of (8.3) in summer and (7.00) in the winter.

Free $CO_2$ may present throughout the year (Ganapati 1956, Verma 1969, Singh *et. al.* 1986) or in few successive months of a year (Verma and Shukla 1968, Kaushik *et. al.* 1989, and Prasad 1990, Ganpati (1960) has reported its complete absence in certain tropical waters.

In the present investigation the free $CO_2$ content in water samples of Triputi reservoir was recorded within the range from 0.0 mg/l to 13.2 mg/l. The maximum concentration of free carbon dioxide was noted in summer and minimum concentration of free carbon dioxide recorded in monsoon.

The concentration of $CO_2$ is crucial for the growth of the fish. Well aerated waters with little pollution usually have no or very little free $CO_2$ (Goel and Chavan 1991). Through the limit for free $CO_2$ has been kept as 25.0 mg/l, generally its concentration should be 4 mg/l in ponds used for fish culture.

Triputi reservoir has free carbon dioxide range is within the limits hence it is suitable for fish culture.

**Hardness :**

Hardness to water is imparted predominantly by alkaline earth metal cations mainly calcium and magnesium present in it, with minor contributions by barium, zink, aluminum and iron. An aquatic ecosystem receives calcium from limestone, dolomite and gypsum deposits in the catchment area. The level of hardness may range between zero to several hundred mg/l. Based on hardness, water may be classified as soft water with hardness range from 0.0 mg/l to 75 mg/l, moderately hard water with hardness range from 75 mg/l to 150 mg/l and hard water with hardness range between 150 mg/l to 300 mg/l (Sawyer 1960).

The total hardness of a water quality parameter from the prawn production point of view has been studied by several workers (Adhikari, 2000, Mohanti and Subramaniyan, 2000, Chand, 1999). The total hardness of water varied from 265 mg/l to 5945 mg/l of Kharland ponds of Ratnagiri recorded by Saksena *et. al.* (2006). It was found that the total hardness of water depends upon the soil characteristics of ponds. The analysis of variance also indicates that the total hardness of water in different ponds was very much similar.

The total hardness of Velachery lake were within the unobjectionable range (200 – 600) and ranged from 392 mg/l to 620 mg/l (K. Ramalingam and S. Ramarani 2004).

The total hardness ranged from 145 mg/l to 188 mg/l during 2005 – 2006 and 139 mg/l to 194 mg/l during 2006 – 2007 of Sawana reservoir (Jayabhaye *et. al.* 2008). The total hardness values were maximum during pre monsoon and minimum during post monsoon months. Similar result also reported by Rajashekhar *et. al.* (2007) from a minor reservoir Nadergul. The higher values of total hardness in pre monsoon were also reported by Sakhare and Joshi (2001) from Yeldari reservoir, Maharashtra.

In the present investigation the hardness was fluctuated from 100 mg/l to 152 mg/l. Minimum hardness was recorded in the month of June and maximum in the month of November. The seasonal variations in hardness were represented as minimum in summer and maximum in post monsoon period.

Total hardness of water is not a pollution parameter but indicated water quality mainly in terms of $Ca^{++}$ and $Mg^{++}$ content.

**Total Alkalinity :**

The total alkalinity of water is mainly due to the cations of calcium, magnesium, sodium, and potassium an in the form of carbonate or bicarbonate or occasionally as hydroxide. Alkalinity of water is its capacity to neutralize the acid and is a measure of buffering capacity of water. Natural water bodies in the tropics usually show wide range fluctuations in total alkalinity values depending upon the location, season, plankton population, rainfall and washerman's activity etc. Alkalinity is a vital parameter for aquatic life in fresh water because, it equilibrated pH changes, which occur due to photosynthesis. The range of total alkalinity in Indian waters may be found from 40 mg/l. to over 1000 mg/l (Jhingran 1982).

Total alkalinity ranged from 168 mg/l to 240 mg/l during 2005 – 2006 and 179 mg/l to 264 mg/l during 2006 – 2007 (Jayabhaye *et. al.* 2008) of Sawana reservoir. The total alkalinity values were maximum during pre monsoon and minimum during post monsoon months. In the present study, the total alkalinity values were high, which indicates the productive nature of the reservoir. Similar result were also reported by Sing D. N. (2000).

Minimum total alkalinity values were recorded in winter months, moderate in summer and gradually increased in monsoon and reach its peak in post monsoon months at Kagal tnak (Pailwan 2005).

Bahura (2001) has recorded an inverse relationship to total alkalinity with pH and positive relationship with total hardness.

Total alkalinity higher values during non-rainy season (V. Sulbha and V. R. Prakasan (2006)). Higher productivity of non rainy season might be due to the comparatively higher total alkalinity.

The alkalinity of pond water was maximum during summer followed by monsoon and winter season (Mahima Chaurasia and G. C. Pandey 2007).

The total alkalinity of water recorded by Saksena *et al.* (2006) of Kharland pond of Ratnagiri ranged from 5.00 mg/l to 142.00 mg/l during the period of study. It was low during monsoon. Rajyalakshmi *et. al.* (1988) reported the total alkalinity values fluctuated from 35.2 mg/l to 210 mg/l Gupta *et. al.* (1993) reported total alkalinity values ranged from 16.0 mg/l to 203.0 mg/l in low productive rainfed brackish water ponds along the periphery of Chilka lake, Orissa.

In the present investigation the total alkalinity in the water samples of the reservoir varied from 275.00 mg/l to 295.00

mg/l. The minimum alkalinity was recorded in the month of February and maximum in post monsoon season.

Many workers believe that alkalinity is measure of productivity. Moyle (1946) noticed that most of the water bodies having total alkalinity greater than 200 mg/l where highly productive.

Total alkalinity in the present investigation at Triputi reservoir ranges between 275 mg/l to 295 mg/l which is greater than 100 mg/l which can be said as nutrient rich and highly productive.

The maximum to moderate alkalinity is in monsoon and summer and minimum in winter could be correlated with the increased and decreased oscillations of the photosynthesis activities in different seasons.

**Chloride :**

The chloride control the salinity of water and osmotic stress on biotic communities (Salaska and Yeragi 1997). The most important source of chloride in the fresh water is the discharge of domestic and industrial sewage. The concentration of chloride is thus the indicator of pollution. They also indicate presence of organic matter in the water body (Thresh *et. al.*, 1994).

The chlorides were present in the range of 87 mg/l to 120 mg/l in Kalwa lake and 42 mg/l to 56 mg/l in Jail lake. Among the two

Kalwa lake showed higher chlorides than Jail lake, which might be due to position of lake as it is near to Thane creek (Pejaver and Gurav 2008).

The chlorides ranged between minimum of 38.5696 mg/l and maximum of 60.48 mg/l at river of Pune during monsoon and summer respectively (Chandanshive *et. al.* 2008). A decrease in the chloride during monsoon could be related to the dilution of water in monsoon, while the summer peak in the value could be linked to catchment run off and sewage disposal. In earlier studies similar observations were made by Bhatt *et. al.* (1992); Bath *et. al.* (1998) and Desai *et. al.* (1995). High chloride content indicates deterioration of water quality usually linked with increased sewage load (Mini *et. al.* 2003).

Chloride content ranged between 37.22 mg/l to 51.13 mg/l during 2005 – 2006 and 35.50 mg/l to 49.40 mg/l during 2006 – 2007 (Jayabhaye *et. al.* 2008). The higher values of chlorides were recorded in pre monsoon and lower in post monsoon. Similar results were also reported by Rajshekhar *et. al.* (2007) from Nadergul reservoir. The high value may be attributed to low water levels during summer, Gonzalves and Joshi (1946) are also of the same opinion.

Chloride is one of the important indicators of pollution. Chloride are present in sewage and farm drainage. Highest chloride level (146.94 mg/l) found in Tungabhadra river near Harihar, Karnataka (Manjappa *et. al.* 2008). Chloride increase the degree of eutrophication, but low level of chloride suggests reduction in eutrophication (Goel *et. al.*, (1980)).

In the present investigation the chloride concentraton in the water of Triputi reservoir ranged from 11.36 mg/l to 25.56 mg/l. Minimum chloride content was recorded in the month of January and maximum in April with its moderate range from July to November. In general the seasonal variations in the values of chloride content was represented as minimum in winter, maximum in summer and moderate in monsoon and post monsoon season.

Fresh water contains 8.3 mg/l of chloride content. Slightly higher values of chloride contents in the present investigation may be due to some anthropogenic activities.

**Phosphate ($PO_4$) :**

Phosphate concentration ranged between 1.60 mg/l to 2.90 mg/l of Sawana reservoir (Jayabhaye *et. al.* 2008). The phosphate values were maximum during pre monsoon and minimum during post monsoon months. Similar results were also reported by Lendhe and

Yeragi (2004) from Phirange Kharbav lake, Maharashtra. During monsoon and pre monsoon period high values of phosphate were recorded, this was contributed by the surface run off, draining the agricultural fields and mixing with the influent water of the reservoir.

The concentration of phosphates ranged between 85 mg/l during monsoon season and 15.4 mg/l in summer at river in Pune. Maximum phosphate values were recorded during summer. Phosphate is the most critical and limiting factor in the maintenance of water fertility (Pandey *et. al.*, 2000). Domestic sewage and agricultural run off containing nutrients contribute to the bio availability of phosphate in an aquatic ecosystem (Desai *et. al.*, 1995). High phosphate values during summer could be due to lowered quantity of water in the river and discharge of waster water containing detergent and sewage (Chandanshive *et. al.*, 2008).

In the present investigation the phosphate content of the Triputi reservoir fluctuated between 0.02 mg/l to 0.15 mg/l. Minimum phosphate content recorded in the month of February and maximum in the month of July. The seasonal variations in the values of phosphate content was represented as minimum in post winter, maximum in monsoon and moderate in summer. However phosphate values

showed its increasing trend from summer and reached its peak in monsoon.

Phosphate is considered as the most critical single element for biological productivity (Banerjee, 1967). Increased concentration of phosphate is taken up by the phytoplankton, which leads to algal blooms. As per the previous studies on lakes of Thane city, the phosphates are reported in the range of 0.01 mg/l to 0.79 mg/l (Pejaver *et. al.,* 2002, Pejaver and Somani, 2002).

The inverse relation was found in the phytoplankton density and phosphate. The same observation was done by Olsen and Sommerfield (1977). Many algae including diatoms utilize this vital element when available in excess than their actual requirement and draw upon the same during the subsequent period of scarcity. Phosphates also show negative correlation with chlorophyll a and b (Pejaver & Gurav 2008).

**Nitrate :**

The nitrogen is important in aquatic ecosystem and its level is regulated through precipitation, atmospheric solution volatilization under meteorological process, sedimentation influence, effluents and ground water movement under geologic process, nitrogen fixation, denitrification uptake growth, decay, hydrophytes,

pumping and fish and week removal under biological process. Nitrates are products of oxidation of organic nitrogen by the bacteria present in soil and water, where sufficient oxygen is present (Who 1984). High concentrations of nitrates are useful in irrigation but, their entry into the water resources increase the growth of nuisance algae and trigger eutrophication and pollution (Trivedy and Goel 1986).

Most of the unpolluted source of water are deficient of nitrates because it exists only in few natural sources (Trivedy and Goel, 1984). Biological oxidation of organic nitrogenous substances present in domestic and industrial sewage and nitrifying bacteria add nitrates to water body. while utilization by green plants and denitrifying bacteria help in reduction of nitrates. The range of the nitrates recorded in different lakes of Thane is 0.06 mg/l to 0.270 mg/l in Kalwa lake and 0.120 mg/l and 0.210 mg/l in Jail lake, which do not differ much from other lakes in Thane city (Pejaver and Gaur 2008).

Minimum value of nitrates recorded in the river of Pune was 0.085 mg/l at summer. While maximum of 0.34 mg/l during monsoon season. Increasing values of nitrate were recorded during monsoon season at all the three stations. In an earlier study similar increasing concentrations of nitrates was registered by Mini *et. al.*

(2003). The observed increasing trend could be attributed to heavy rainfall and consequent drainage of sediment followed by the influx of allothonous material as well as excess decomposition activity in the river (Desai *et. al.*, 1995, and Mahapatra and Padhy, 2001, Chandanshive *et. al.*, 2008)

The nitrates ranged from 1.8 mg/l to 3.4 mg/l of Sawana reservoir (Jayabhaye *et. al.*, 2008). According to Jhingran and Sugunan (1990), the water with 0.2 ppm to 0.5 ppm of nitrates is of high productive reservoirs and in low productive reservoirs, the nitrates are negligible. According to the above classification present reservoir belongs to high productive level in Sadatpur lake, Maharashtra. Lendhe and Yeragi (2004) reported high value of nitrates in Phirange Kharbar lake, Dist. Thane, Maharashtra.

In the present investigation at Triputi reservoir nitrate content in the surface water samples was recorded within the range of 0.15 mg/l to 0.50 mg/l. Minimum nitrate content recorded in the month of November and maximum in the month of August and September. Low nitrate content with fluctuation trend was noticed in winter and vary high in monsoon season.

Maximum nitrate contents in monsoon are linked with heavy run off of deposited organic matter during summer in the

catchment (Golterman, 1995). The World Health Organization (WHO) limits for the nitrates in the drinking water in 50 mg/l and above this concentration the water is unsuitable for drinking. Methamoglobianemia as well as even fatality may occur among the children on consumption of such water (Todd, 1970).

**Phytoplanktons :**

Phytoplankton are floating microscopic autotrophs whose movements are more or less dependent on water currents. These consists of algae (mainly member of Chlorophyceae, Cyanophyceas. Bascillariophyceae) and algae like green flagellates.

Based on their size phytoplanktons are classified as

i) Ultra plankton -- 0.5 to 10 µm

ii) Nannoplankton – 10 to 15 µm

iii) Micrplankton – (Net plankton) – 50 – 500 µm

iv) Macroplankton - > 500 µm

Phytoplanktons because of their role as primary producer in an aquatic ecosystem are the subject of great interest, their qualitative and quantitative estimates provides good indices of water quality and capacity of water to sustain heterotrophic communities.

Phytoplankton also plays a vital role in a biological treatment of organic wastes in water, as during mineralization of

organic matter by bacteria they supply the oxygen. Therefore evaluation of population, diversity, periodicity an succession, biomass and productivity of phytoplankton is very important in monitoring of a water body. In the present investigation the phytoplanktons were identify and recorded by Sedgwick – Rafter cell method from the water bodies under study and they are expressed in checklist.

The phytoplankton includes *Volvex sp., Pediastrum sp., Hydrodictyon sp., Characium sp., Spirogyra, Cosmarium sp., Desmidium sp., Staurastrum sp., Characiposis sp., Fragellaria sp., Synendra sp., Pinnularia sp., Cymbella sp., Amphora sp., Surirella Sp., Cyclotella sp., Microcystis sp., Merismopedia sp., Coleosphaerium sp., Anabena sp., Spirulina sp., Goleolricha sp., Euglina sp.*

In the present investigation, all above mentioned species were observed frequently and rarely, supporting the mesoeutrophic nature of these tanks. Prescott (1969) has recorded in famous nature of *Microcystis* because of the ability of at least some species to produce toxins which are lethal to animals and birds consume water, where dense bloom deteriorates. The extra metabolites produced by *Microcystis* seems to inhibit the development of many other blue green algae. When *Microcystis*, *Anabena* are present along with a

source of vitamin $B_{12}$ super abundant growth of blue green planktons appear.

The pollution indicating genera not recorded except *Microcystis* during the investigation.

**Zooplanktons :**

The chief groups of zooplankton consists of Protozoa, Rotifera, Crustacea and larval insects. Protozoans are represented by *Arcella* sp., *Difflugia* sp., *Euglena* sp. *Verticella* sp. Among the rotifers most common species were *Asplancha sp., Keratella trpica, Branchinous gngularis, Branchinous falcalus, Dicranophorus sp., Filinia terminals.* Crustacease includes *Diaptomus sp., Nauplius sp., Macrothrix spinasa, Alonella exisa, Alona sp., Daphnia sp.* Ostracoda includes *Cypris, Stenocypris,* Protista includes *Arcella, Difflugia lobostoma, Centropyxis, Vorticella sp.*

Biological indicators like *Paramoecium, Euglena* sp. And *Arcella* sp. Were rarely observed beside some pollution indicator species of Rotifers were collected during course of study.

**Fish Fauna :**

Triputi reservoir is meticulously maintained pollution free by the temple management. Anthropogenic activities are restricted. Satara Municipality release seedlings of some fresh water

fishes regularly. The temple management catches the fishes, once in a year and auction it on the spot and some money is earned.

Studies on hydrobiological parameters indicate that condition of the Triputi reservoir is extremely helpful for fishery culture. As this reservoir is the only source of water for about 3000 population of Triputi it is judiciously used for dual purpose i.e. human use and fish culture.

Following fish fauna was observed in the water of Triputi reservoir –

1) **Indigenous species :**

*Catla catla, Labeo rohita, Cirrhinus mrigala*

2) **Exotic species :**

*Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix, Cyprinus carpio*

The results of the experiments on mixed farming of the above six ecological balance species have been spectacular. The average yield of indigenous and exotic species cultured together was satisfactory even though the reservoir is not fully utilized for aquaculture purpose.