Water is the most vital factor for the existence of all living organisms. Water covers about 71% of the earth of which more than 95% exists in gigantic oceans. A very less amount of water is contained in river (0.00015%) and lakes (0.01%), which comprise the most valuable fresh water resources; the remaining being ground water and ice at the pole caps and mountain ranges. Water is a prime natural resource, a basic human need, a precious national asset and therefore its use needs proper planning, development and management. From the dawn do the human civilization; its establishment and development have generally been in close proximity to water viz. the lakes, wetlands and the rivers. In addition to using freshwater for drinking, agriculture and navigation, man has been using fresh water for various other purpose like energy production, industrial growth and waste and effluent disposal. Such human interactions with aquatic ecosystem need to be understood with respect to the physical, chemical and biological characteristics of water body.

Limnology includes the study of all forms of inland waters viz. lentic and lotic. Lentic water bodies include lakes, wetlands, marshes, bogs, tanks, whereas streams, rivers, oceans are the lotic water bodies. Rivers, streams, and their tributaries which pass through villages, towns and cities, receive large amount of contaminants along with surface runoff from fields (agricultural effluents) and industrial effluents. Ponds, lakes and reservoir are equally affected due to human activities. India is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development. Therefore studies related to sustainable development and conservation need to be carried out.

Aquatic ecosystem is the most diverse ecosystem in the world. The first life originated in the water and first organisms were also aquatic where water was principle external as well as internal milieu for organisms. Thus, water is the most vital factor for the existence of all living organisms. Water is a precious natural resource vital for sustaining all life on the planet earth and is in continuous circulatory movement as hydrologic cycle. It is uniformly distributed in time and space and has a unique place, the planet. It is impossible to substitute, difficult to de-pollute, expensive to transport and is truly unique gift to the life from nature. Due to multiple benefits and problems created by its excesses, shortages and quality deterioration, water as a natural resource, requires special attention (NIH, WRI).
Water is also one of the most manageable of all the natural resources as it is capable of diversions, transportations, storage and recycling (Kumar et al., 2005). All these properties impart water its great utility for mankind. A basic feature of the earth is an abundance of water. Freshwater habitats provide food, water, shelter, and space essential for the survival of aquatic organisms and therefore rich biodiversity is observed in them. A freshwater body harbours a variety of plants and animals from primary producers to tertiary consumer. On the global scale, total quantity of water available is 1600 million Cu. Km. The hydrological cycle moves enormous quantities of water around the globe. However, much of the world’s water has little potential for human use because 97.5 % of all water on earth is saline water. Out of remaining 2.5 % of fresh water, most lies deep and frozen in Antarctica and Greenland in the form of continental ice, while only about 0.26 % floats in rivers, lakes, in the soils and in shallow aquifers which can be readily used.

World Water Assessment Programme indicates that, in next 20 years the quality of water available to everyone is predicted to decrease by 30 % (WWDR, 2003). The water scarcity is acting as an obstacle in the continuous maintenance of aquatic ecosystem. Discharge of Industrial effluents, domestic waste and sewage without any treatment into the water bodies has resulted in deterioration of the quality of aquatic habitat. Indiscriminate discharge of industrial effluents is toxic to aquatic environment, creates water pollution, making water unfit for drinking, agriculture and for aquatic life (Tombesi et al., 2000; Quadroset al., 2001; Sukumaran, 2002; Patil and Lohar, 2009). This vast natural resource has turned into a scarce commodity with increased usage catering to the needs of ever-expanding population. Taking into consideration the importance of aquatic habitats, restoration and conservation of the same is now a must for the survival of species on the earth. Alarming signal about deterioration of aquatic ecosystem and scarcity of drinking water made UNESCO to declare 2005-2015: International Decade for Action – “Water for Life”. The priority is given to conservation and efficient use of global water resources. Development has to be both people centred and conservation based. Unless we protect the structure, function and diversity of the world’s natural systems on which we depend, development will be undermined. In many places where lack of food threatens human survival, it is actually the lack of water that limits food production.
In India Freshwater ecosystem, not only support life, and provide direct benefit to mankind but also play an important role in recycling nutrients, carry out purification of water, recharging of ground water, maintain flow of water, and provide environmental stability. The maintenance of a healthy aquatic ecosystem is dependent upon physico-chemical properties of water and the biological diversity. Natural freshwater bodies and man-made reservoirs have been studied all over the world to understand the inter-relationship between the various abiotic and biotic factors.

In India per capita surface water availability in the years 1991 and 2001 were 2309 and 1902 m$^3$ respectively and these are projected to reduce to 1401 and 1191 m$^3$ by the year 2025 and 2050 respectively (Kumar et al., 2005). It is also estimated that by the year 2025, two third population of the world would face water stress. Hence, there is a need for proper planning, development and management of this greatest asset of the country, namely water, for raising the standards of living of the millions of people, particularly in the rural area. Communities were sparsely populated, in past water was capable of self purification by metabolizing the waste, but due to tremendous increase in pollution its self purification capacity has diminished, leading to severe other problems. The restoration, conservation and management of the water resources require a thorough understanding of what constitutes a healthy ecosystem. Monitoring and assessment with the help of water quality analyses techniques, provide basic information on the condition of our water bodies. In a highly populated developing country like India these freshwater resources can play a vital role in food production for human consumption. A reliable and safe water supply is the basic requirement for development and stability. Proper use and management of inland water bodies especially reservoirs, their exact nature and, cause and levels of pollutants, if any. The physicochemical parameters decide the quality of River water.

Limnology helps to decide location specific management strategy for all freshwater bodies. Some of the studies on freshwater bodies in India include studies carried out by SubbaRao and Govind (1967), Sugunan (1980), Johri et al., (1989), Tripathy (1992), and Sharma (2009).
I) PHYSICO-CHEMICAL CHARACTERISTICS OF WATER

Water is an elixir of life. It supports life on earth and around which the entire fabric of life is woven. Water is perhaps the most valuable intake necessary for man’s survival. Water has proved to be the most essential commodity on the earth; it has direct bearing on health of all organisms including man. Water is a vital resource used for drinking, irrigation, fish production, industrial cooling power generation etc.

The fresh water is the basic need of the mankind and is vital to all forms of life. It exist in lentic and lotic habitat. The productivity of the freshwater community that determines the fish growth is regulated by the dynamics of its physicochemical and biotic environment (Wetzel, 1983). Therefore, it is necessary to carry out extensive studies of the physicochemical parameters. Knowledge of basic limnological features is important for the management of reservoirs that supply drinking water need to maintain stringent water quality standards as per the set norms by WHO. For limnological studies understanding physico-chemical factors influencing the tropic dynamics of the aquatic system is fundamental. Each factor plays its unique role in the system but at the same time the final effect is the actual result of the interaction of these factors. All the physico-chemical variables influence gross primary productivity (GPP) of aquatic system but the magnitude of their influence differ significantly (Murugavel and Pandian, 2000). The changes in physico-chemical parameters lead to changes in the plankton density which in turn influences faunal diversity and presence of some immigrant species in the lentic zone of reservoir (Ayoade et al., 2009).

The physical and chemical properties of a fresh water body are characteristic of the climatic, geochemical, geomorphologic and pollution conditions prevailing in the drainage basin and the underlying aquifer (Ramchandra et al., 2002). The monitoring of the surface water quality by hydrobiological parameters is among fundamental environmental priorities, because it also permits direct estimation of the conditions of the aquatic ecosystems exposed to deleterious anthropogenic factors.

Physicochemical characteristics are highly important with regard to the occurrence and abundance of species. The physical and chemical characteristics of water bodies affect species composition, abundant productivity and physiological
conditions of aquatic organism. Within recent past decades, there has been considerable interest in the relevance of limnological information to the productivity, development and management of aquatic environments. Regular and periodic investigation of various physiochemical and biological characteristics of the water body is useful for its monitoring.

Eutrophication has become a widely recognized problem of water quality deterioration (Kim et al., 2001). Phosphorus and Nitrogen inputs from domestic wastes and fertilizers accelerate the process of Eutrophication (Rao et al., 1994). Discharge of urban, industrial and agricultural wastes have increased the quantum of these chemicals considerably altering physico-chemical characteristics of an aquatic ecosystem. Over the time, many countries have regulated the point sources of nutrients, such as municipal and industrial discharges. However, Non-point sources of nutrients, such as runoff from agricultural or urban lands have replaced point sources as the driver of eutrophication in many regions (Carpenter, 2005). Thus, the anthropogenic activities with sewage and fertilizers used in agricultural fields appear to be the major causes of the eutrophication (Kudari et al., 2006). Whereas among animal biota the rotifer community structure is shaped by a variety of environmental factors that in addition influence the biological parameters such as predation or competition (Anna and Natalia, 2009).

It is necessary to study and manage a water system as a part of broader environment through a system approach. A true ecosystem approach recognizes the individual component as well as the linkages between them. A disturbance of one or the other component of the system may indirectly dampen out the natural reliance. Sometimes the effect is direct, significant and may increase the degree as it moves through the system (Ramchandra et al., 2006). The demand of water requirements has increased with burgeoning human population coupled with agricultural and industrial developments. Hence, the restoration, conservation and management of the water resources require thorough understanding of the system. Understanding of environmental changes is also necessary for the protection for remediation. Thus, monitoring and assessment of a system can provide basic information on the condition of the water bodies. With the help of study, the interaction of all physical, chemical and biological components, one can design restoration methods towards conservation,
management and sustainable use of a habitat. This may be useful in characterizing water bodies and their integrity too.


The physical parameters define those characteristics of water that respond to the sense of sight, touch, taste, odour and temperature; chemical parameters are related to the solvent capabilities like pH, electrical conductivity, temperature, total dissolve solids, suspended solids, ammonia, NO₂+NO₃, phosphate, biological oxygen demand, chemical oxygen demand, total hardness, sodium, chloride, total alkali, total coliforms, fecal coliforms, while biological parameters measure density and diversity of planktons. Though physico-chemical approach to monitor water pollution is most common and plenty of information is available on these aspects, it may not provide all the information required at the local level and thus assessment of water quality of all the water bodies becomes essential. Hence, a study of physical and chemical parameters was carried out at four different stations in Godavari River, Nashik District.

**pH**

pH, the negative logarithm of hydrogen ion concentration, denotes acidic or basic nature of water and is one of the most important and frequently used test in the water chemistry. It is a valuable indicator for the acid alkali balance of water. Practically every phase of water supply and waste water treatment of acid base neutralization and water softening, precipitation, disinfection and corrosion control are pH dependent. In case of pollution by acidic and alkaline wastes, the pH serves as an index to denote the extent of pollution. pH changes in water are governed by the amount of free carbon-dioxide, carbonate and bicarbonate.
Most of the natural waters are of alkaline due to the presence of carbonates and bicarbonates which are formed due to dissolution of atmospheric CO$_2$. In natural water pH also changes diurnally and seasonally due to variation in photosynthetic activity. Photosynthetic activity increases the pH value due to consumption of CO$_2$. The alteration of hydrogen ion concentration of water is accompanied by changes in other physico-chemical aspects. In addition to factors like temperature, salinity atmospheric pressure, disposal of industrial wastes, etc., biological factors such as respiration and photosynthesis also influence pH. The pH of water determines the solubility and biological availability of certain chemical nutrients such as phosphorus, nitrogen, carbon as well as heavy metals like lead, copper, cadmium, etc. It indicates how much and what form of phosphorus is most abundant in water and whether aquatic life can use the form available. Metals tend to be more toxic at lower pH because they are more soluble in acidic water. Measured on a scale of 0 – 14, pH of natural water usually lies in the range of 4.4 to 8.5. The rise in pH parallels with the rise in carbonate alkalinity and percentage of oxygen saturation. It is probably not affected by photosynthetic activity of a water body (Kobbia et al., 1992; Fathi et al., 2001). Further, Sharma et al.,(2008) have described role of pH in formation of algal bloom too. Thus, pH plays important role in controlling biotic community structure of a water body.

**Electrical Conductivity**

Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. Conductivity is reciprocal of resistance and it is the function of ion concentration. As most of the soluble salts in water are present in the ionic forms, able to conduct current, conductivity is rapid measure of total dissolved solids.

Moundiotiya et al., (2004) reported maximum electrical conductivity in summer and minimum in monsoon in JamwaRamgarh wetland. They also stated that conductivity of water depends upon the concentration of ions and its nutrient status and the variation in dissolved solid contents. Dilution of water during the rains causes a decrease in electrical conductance.
Solutions of most of inorganic acids, bases and salts are relatively good conductors. Organic molecules and compounds do not dissociate in aqueous solution and therefore are bad conductors of electric current. Conductivity is expressed in micromhos per centimetre (mhos/cm).

**Dissolved Oxygen**

Dissolved oxygen is the amount of oxygen that is dissolved in water. The major source of oxygen is atmosphere. Dissolved oxygen (DO) is most important parameter which speaks about health of the water body in terms of tropic status and possibly also of biotic status (Tripathy, 1992). Dissolved oxygen reflects physical and biological processes in water. DO is very much essential to maintain the higher forms of biological life in water. Oxygen from air is absorbed by direct diffusion and agitation of surface water by wind action and turbulence. Hence, the amount of oxygen dissolved in water depends on the surface area exposed, temperature and salinity as well as the amount of oxygen derived from the green plants depending upon their density and the duration and the intensity of effective light. Thus dissolved oxygen levels in the natural waters and waste waters depend upon the physical, chemical as well as biochemical activities in the water body. The content of dissolved oxygen brings about various biochemical changes that affect metabolic activities of organisms (David and Roy, 1966, Adebisi, 1981). Dissolved oxygen shows inverse relationship with temperature (Patil and Goudar, 1985; Gurumayum et al., 2000; Agrawal and Thapliyal, 2005). Oxygen is moderately soluble in water. With increasing altitude there is a decrease in atmospheric pressure, implying oxygen saturation to be lower (Murugavel and Pandean, 2000). The percentage saturation of oxygen in water has been studied extensively by many workers (Wetzel, 2006) while studying biotic and abiotic parameters of water body. Dissolved oxygen is a key parameter reflecting the quality of water, particularly water which receives waste. The consumption of Oxygen during decomposition of organic matter may reduce its concentration to zero level and hence reflects the degree of organic pollution in water (Ramchandra et al., 2006).

Amount of oxygen that can be held in water body depends on the water temperature, salinity and pressure. Concentration of DO reflect the aerobic and anaerobic process in water bodies, low DO is index of increased organic pollution.
The organic matter undergoes degradation by micro-organisms in presence of Oxygen and deplete dissolved Oxygen. DO and its variation are useful to the analysis and interpretation of biological and chemical processes in water body. The oxygen producing and oxygen consuming processes in natural waters should be balanced so as to keep the dissolved oxygen concentration within a range congenial to all organisms. According to Kumar et al., (2009) higher values of dissolved oxygen in winter and monsoon months may be due to higher solubility of oxygen at relatively lower temperature and churning i.e. circulation and mixing of water due to surface runoff and release of water from upstream, respectively. The lower values of dissolved oxygen during summer months can be attributed to decrease in solubility of oxygen at higher temperature.

The presence of dissolved oxygen in water may be due to direct diffusion from air and photosynthetic activity of autotroph. High temperature was reported to be responsible for the decrease in oxygen holding capacity of water (Moundiotiya et al., 2004).

Water Temperature

Temperature is one of the important abiotic factor that influence physical, chemical and biological properties of water. In general water temperature depend on geographical location and meteorological conditions such as rainfall, humidity, cloud cover, wind velocity, etc. The air and water temperature go more or less hand in hand (Macan, 1958). The measurement of ambient temperature in surface water is of vital importance for calculating the solubility of oxygen, carbon dioxide, bicarbonate and carbonate equilibria (Shivanikaret et al., 1999). It also influences the dynamics of alkalinity, salinity, electrical conductivity, etc. in a water body. In Indian subcontinent, the temperature in most of the water bodies ranges between 7.8 – 38.5 °C (Sinha, 1986).

Temperature regulates self purification capacity of water (Shaikh and Yeragi, 2003). Increased temperature level increases metabolic activity of organism, requirement of more oxygen, but at the same time decreases solubility of oxygen. The variations of temperature are found to affect the periodicity diversity and succession of the zooplankton group. High density of planktonic groups is observed during the
period when temperature is most suitable for growth and reproduction (Bhalla, 2006). It is one of the important factors influencing the structure of the rotifer community too (Miloslav, 1998). Approximately two fold increase in temperature has strong positive correlation with biomass (Meric and Akcaalan, 2003). Thus, there are clear evidences suggesting a casual relationship between summer temperature, conductivity and density of vegetation cover with species composition, species richness, diversity, equitability and the proportion of individuals in the first rank of the macro-invertebrate assemblages (Savage, 2000). The peninsular reservoirs in India are characterized by a narrow range of fluctuation in water and air temperature across seasons, a phenomenon which prevents the formation of thermal stratification (Sugunan, 2000).

**Total Dissolved Solids and Suspended solids**

As per APHA (1998), Solids refer to the matter that is suspended or dissolved in the water or waste water. The total suspended solids(TSS), is retained by a filter while the Total dissolved solids (TDS) are the in filterable solids, mostly inorganic salts and small amount of organic matter dissolved in the water. These have been proved to be very useful parameters in determining the productivity of water, and of biological and physical waste water treatment processes. A limit of 500 mg/L TDS is permissible in drinking water. The concentration of total dissolved solid gives an idea about suitability of this water for various uses including potability of water (Trivedy, 1995).

Suspended solids are pieces of sand, slit and fine inorganic matter of leaves, pieces of wood etc., suspended in stream or lake. The suspended solids in humid areas range from 0 ppm to 100ppm. It increases with increase in flow of stream. The faster flowing water erodes the banks and because the stream is moving so fast, high suspended solids can make the water unsuitable in many ways. Pesticides and bacteria can attach to the suspended solids making it more readily transportable. This can kill off the plants and animals downstream and make the water non potable to humans and wildlife.

In natural waters, Total dissolved solids are mainly composed of Carbonates, Chlorides, Sulphates, Phosphates and Nitrates in combination with metallic
Dissolved solids in pond water vary both quantitatively and qualitatively with the season. Weathering and dissolution of rock and soil, mineral springs, carbonate deposits salt deposits, agricultural runoff, surface runoff are primary sources of Total dissolved solids. Drinking water and other quality standards are concerned with TDS. Higher concentration of TDS gives particular taste to water and reduces its potability and, may induce unfavourable physiological reactions.

TDS may affect the water quality adversely in a number of ways. Waters with highly dissolved solids are generally of inferior potability and may induce an unfavourable physiological reaction in the transient consumer. Highly mineralized water is not suitable for many industrialized applications (APHA, 1985) as it increases hardness and corrosive properties of the water (EPA, 1976) and may create an imbalance for the aquatic life, whereas the suspended sediments are probably key factors controlling the light availability (Fathi and Flower, 2005). The amount of hydro-carbonates and corresponding TDS in the water are positively correlated with zooplankton diversity (Karatayev et al., 2008). The wetlands act as sinks for the nutrient deposition and hence, the high TDS value may also depend on the age of the water body (Anita et al., 2005) as a result of gradual salt deposition.

**Biological Oxygen Demand**

BOD is the amount of oxygen utilized by micro-organism in stabilizing organic matter. It is chemical process which approximates the amount of oxidizable organic matter present in water. Oxygen consumed by organism is proportional to the magnitude of organic matter present in water. BOD is a direct measure for oxygen requirement and an indirect measure of biodegradable organic matter in water. BOD Test measures the molecular oxygen utilized during a specified incubation period for the biochemical degradation of organic material. Types of micro-organism, pH, presence of toxins mineral matter, nitrification process influence the BOD Test. BOD Test is used in water quality management and assessment, determination of degree of pollution in water bodies decrease self purification capacities of streams which measures the quantity of wastes. The BOD contain in river indicated river is free from organic pollution (Saksena and Garg, 2008).
Chemical Oxygen Demand

Chemical oxygen demand is a measure of oxidisable impurities present in water. COD may be defined as amount of oxygen required for the oxidation of biologically oxidisable and biologically inert organic matter such as cellulose. BOD measures only oxygen consumed by living organisms, the COD values are generally higher than BOD values. The advantages of COD are that it takes only about 2 hour’s compared to the larger period of 5 days for the BOD determination. Pure water shows COD values less than 1mg/lit. The COD is used to measuring pollution level of waste water as most of organic compound can be oxidised to carbon dioxide and water by the action of strong oxidising agent, regardless of biological substance. Like BOD, COD test continues to remain very important parameter in management and design of the water treatment plants. This test is useful to find out toxic conditions and presence of biological resistant substances.

Total Alkalinity

Total Alkalinity is acid neutralizing capacity which refers to the capacity to neutralize strong acids. It accounts for the buffering capacity of carbonates. As CO₂ is relatively abundant in water in a gaseous and dissolved form and carbonates are primary minerals over wide areas of earth, most fresh water contain bicarbonate alkalinity. (APHA, 18th Edition).

The borates, silicates and phosphates along with hydroxyl ions in “free state” also add to alkalinity. Alkalinity values provide guidance in applying proper doses of chemicals in waste water treatment processes, particularly in coagulation, softening and operational control of anaerobic digestion. Alkalinity improves phytoplankton productivity (pond fertility) by stabilizing pH at or above 6.5 and increasing nutrient availability (Wurts and Durborow, 1992). The Total alkalinity concentration should not be less than 20 mg/L, CaCO₃ because pond water pH can swing widely during the day when alkalinity concentrations are below this level (Wurts, 2002).

Alkalinity is also considered as buffering capacity of the water and is important for aquatic life in a fresh water system because it equilibrates the pH changes that occur naturally as a result of photosynthetic activity of aquatic plants.
(Kaushik and Saksena, 1989). It has been reported that the total alkalinity of a lake shows significant direct relationship with carbonate alkalinity and total rotifer counts (Meshram, 1996). A number of workers have reported direct correlation between alkalinity and productivity too (Banerjee, 1967; Bhownic and Utpal, 1994; Jhingran, 1982; Khalil, 1990). but Meshram (1996) did not find such relationship.

**Total Hardness**

The water hardness is a traditional measure of the capacity of water to react with soap. Hard water requires a considerable amount of soap to leather. The hardness (Calcium and Magnesium) is an important parameter in the detection of water pollution. Calcium and Magnesium are the most abundant elements that render hardness to natural surface as well as ground waters. They exists mainly as bicarbonates of Ca++, Mg++ and to a lesser degree in the form of Sulphates and Chlorides. Hardness caused by, bicarbonates and carbonates of calcium and magnesium is called temporary hardness whereas that caused by their sulphates and chlorides is called permanent hardness.

Natural hardness of water depends upon the geological nature of the catchment area. It plays an important role in the distribution of aquatic biota and many species are identified as indicators for hard and soft waters (Ramchandra et al., 2006). In the presence of carbon dioxide, calcium carbonate is dissolved in water. It maintains the pH of the most natural waters between 6.0 to 8.0. However, dissolved magnesium concentrations are lower than calcium for a majority of the natural waters. Because of the high solubility of magnesium salts, this metal tends to remain in solution and is less readily precipitated than calcium. Calcium is an essential nutrient element for animal life that aids in maintaining the structure of plant cells and soils. While, magnesium possesses no major concern with public health or aquatic environment. The hardness may range from zero to hundreds of milligrams per litter depending on the source and treatment to which the water has been subjected.

Total hardness may be temporary, caused by soluble Ca and Mg bicarbonates or it may be permanent caused by soluble Ca and Mg carbonates and salts of inorganic acids (CaCO₃). The World Health organization (WHO, 1996) stated “There does not appear to be any convincing evidence that water hardness causes adverse health effects in humans”. Hardness has been evaluated and correlated by different
workers for different purposes. Kudari et al., (2006) classified water bodies based on the hardness as slightly hard moderately hard and hard. While, Moshood, (2008) states that the utilization of calcium and magnesium ions by organisms probably causes decrease in the concentration of total hardness in the dry season. Higher hardness and conductivity of water in winter has been correlated to more productivity during this season (Ayode et al., 2009). Hardness is very important parameter in decreasing the toxic effects of poisonous elements (Jinwal and Dixit, 2008).

Sodium

Sodium occurs naturally. Industrial and Domestic waste contributes to it. High concentration can be related to cardiovascular diseases. High concentration affects soil permeability and texture. Sodium is the most abundant of the alkali elements also and constitutes 2.6 percent of the Earth's crust. Compounds of sodium are widely distributed in nature. Weathering of salt deposits and contact of water with igneous rock provide natural sources of sodium.

Most soils contain sodium in the range of 0.1 to 1 percent. When the sodium content of the soil solution is high, the sodium concentration in the ground water is also usually high and can increase salinity in rivers and streams. An estimated 25 to 50 percent of salt used on roads for snow and ice control, enters the ground water and can elevate levels of sodium in public water supplies. Other potential sources of sodium contamination of water supplies are sewage and industrial effluents; sodium is ubiquitous in the water environment. Sodium concentrations vary considerably depending on regional and local hydrological and geological conditions, the time of year, and salt utilization patterns. In ground waters, sodium concentrations normally range between 6 and 130 mg/L much higher levels may be associated with saline salts as noted above. Sodium concentrations in Canadian surface waters range from less than 1 mg/L to more than 300 mg/L, depending upon the source of the sodium and the geography of the area. For example, concentrations of 0.7 mg/L at the mouth of the Coppermine River, Northwest Territories, and 305 mg/L for the closed basin waters at Gravelbourg, Saskatchewan, (1969) have been reported. The data accumulated over recent years for the Great Lakes -St. Lawrence River system indicate that sodium levels for the system below Lake Huron have been steadily increasing as a result of
anthropogenic activities. Sodium occurs naturally in all foods. Natural levels vary considerably for different types of food, and food processing can have a marked effect on these levels. Unprocessed, raw vegetables contribute 33 mg of sodium per 100 g of vegetables consumed. It is largely associated with chloride and bicarbonate in regulation of acid-base equilibrium.

**Chlorides**

Chloride, in the form chloride ion (Cl\(^{-}\)), is one of the major inorganic anion in water and waste water (APHA, 1985). Anion is generally present in natural waters. Chloride is widely distributed in nature, generally in the form of sodium (NaCl) and potassium (KCl) salts. It constitutes about 0.5% of earth’s outer crust. The presence of chloride in natural waters can be attributed to dissolution of salt deposits, discharges of effluents from chemical industries, seawater intrusion in coastal areas. Each of these sources may result in local contamination of both surface water and ground water. High chloride level in fresh water indicates pollution from domestic sewage and industrial effluents. The chloride content normally increases as the mineral content increases. The origin of chloride in surface and ground water may be from diverse sources such as weathering and leaching of sedimentary rocks and soils, infiltration of sea water, windblown precipitated sea salt, domestic and industrial waste discharges and ground water inputs etc. (Allen et al., 1999). Human excreta, particularly urine also contain high amount of chlorides (Goel et al., 1980; Sinha, 1986). According to Waluikar (2005), there is great reduction in chlorides during monsoon, which gradually built up from post monsoon to maximum during pre-monsoon. Chloride is essential for maintenance of normal physiological function in aquatic organisms. But high chloride content in water has deleterious effect on aquatic life. Exposure to higher levels of chloride interferes with osmoregulation in aquatic organisms. Chlorides are also important for their significant role in nutrition, neurophysiology and renal functions. Chloride ions are highly permeable across plasma membranes and responsible for maintenance of osmotic pressure, water balance and acid base balance in animal tissues.

A high chloride content also has a deleterious effect on agricultural plants and metallic structures and pipes. Dissolved oxygen, temperature, presence of other salts in water influence Chloride concentration and its toxicity. The high chlorides, with
potassium and sodium are not preferred for irrigation purpose (Ramchandra et al., 2006). While, according to Trivedi and Goel (1986), the concentration of chloride in water serves as an indicator of sewage pollution. Kudari et al. (2006) noted almost three time increase in the concentration of chlorides due to increased anthropogenic disturbances like bathing, washing and cattle bathing in Unkal Lake which were correlated with pollution load. Further, Venu and Seshavatharam (1984) have reported the significant relationship of chlorides with primary productivity in Lake Kondakarla while Sharma et al., (2008) have reported a negative correlation of chloride with DO and positive correlation with TDS, BOD, Total coliform and Zooplankton.

USEPA (1988) has recommended that the total concentration of Chloride in drinking water should not exceed 250 mg/L, further more it is stated that for protection of freshwater aquatic life from chronic effect, average concentration of Chlorides should not exceed 150 mg/L, and for protection of aquatic life from acute and lethal effects, the maximum concentration of Chlorides (NaCl) should not exceed 600 mg/L.

\[ \text{NO}_2^+ + \text{NO}_3^- \]

Nitrite and Nitrate are an intermediate from of nitrogen produced in denitrification and nitrification reaction in Nitrogen cycle. It is highly unstable ion and gets converted into either ammonia or other form of it, depending upon prevailing conditions of water. A small quantity of nitrite indicates organic pollution and partially oxidized nitrogenous mater. Micro organisms act on Ammonia and nitrogen oxides are produced. Nitrogen oxides are useful for aquatic life, in their metabolic pathways.

There are no mineral sources of nitrite in natural waters. Nitrite is an intermediate unstable oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and reduction of nitrate. Such oxidation and reduction may occur in waste water treatment plants, water distribution systems and natural waters. Man has altered the nitrogen cycle through his agricultural and technological practices. Changing patterns in agriculture, food processing, urbanization and industrialization have major impact on the accumulation of nitrate in the environment. The nitrite form of nitrogen is of concern because of its high water solubility and consequent leaching, diffusion...
and environmental mobility in soil water. Nitrous acid which is formed from nitrite in acidic solution can react with secondary amine (RR’NH) to form nitrosamine (RR’-N-NO), many of which are known to be carcinogens.

Organic waste, when comes in contact with oxygen in water undergoes biodegradation. First product of such biodegradation is ammonia which is converted to nitrite. Therefore, detection of nitrite is a significant indication of large amount of fecal matter coming from domestic waste, while oxidation of ammonia also points to the higher concentration of effluents (Jha and Bharat, 2003). The presence of nitrites along with some toxic aromatic compounds are said to be imparting brown colour and offensive odour to water which becomes unfit for irrigation, (Bhalla, 2006). The significant environmental variables identified by Canonical Correspondence Analysis (CCA) has explained maximum variability in zooplankton species at Old Foot Lake due to abiotic factors such as NO₂⁻, NO₃⁻ and PO₄³⁻ (Arora and Mehra, 2009).

Nitrates are one of the most important nutrients in an aquatic ecosystem. They are the highly oxidized form of nitrogen compounds commonly present in the natural water. They are the products of the aerobic decomposition of nitrogenous matter received from domestic sewage, agricultural runoff and industrial effluents. Nitrates generally occur in trace quantities in surface waters but may attain low levels in ground water. However, the high amounts of nitrates are generally indicative of water pollution. The runoff water coming from intensive agricultural activities (including the use of fertilizers) also contributes to significant nitrate contents in surface waters. Many workers have reported the presence of nitrates, oxide of Nitrogen at higher levels in effluent water compared to fresh water. The presence of nitrates in the water samples is suggestive of some bacterial action and bacterial growth (Narayan et al., 2007). Low levels of nitrates and phosphates are not indicative of low productivity as these nutrients are quickly recycled (Sugunan, 2000). The natural concentration of 0.3 mg/L of nitrate may be enhanced by fertilizer in the runoff, industrial and municipal waste waters up to 5 mg/L. In Lakes, concentration of nitrate in excess of 0.2 mg/L of nitrate nitrogen stimulates algal growth leading to eutrophication (Ramchandra and Solanki, 2007). According to Trevisan and Forsberg (2007) waters up to 5 mg/L. In Lakes, concentration of nitrate in excess of 0.2 mg/L of nitrate nitrogen stimulates algal growth leading to Eutrophication (Ramchandra and Solanki, 2007). According to Trevisan and Forsberg (2007) phytoplankton of Amazonian system of Lakes is
mainly controlled by the availability of nutrients, especially nitrogen, during the dry period. The concentration of nutrients, mainly nitrogen and phosphorus, are the factors which govern the phytoplankton growth and distribution (Naselli-Flores and Barone, 2003). Forbes et al., (2008) could not detect any significant relationship between bioavailable nitrogen (i.e. nitrate) and N2 fixation potentials with the help of both multiple linear regressions and the pruned regression tree analysis. However, the roles of bioavailable nitrogen, as well as temperature are normally revealed in the seasonal N2 fixation (Scott et al., 2008). A relationship between total nitrogen and total phosphate exist which indicates that both zooplankton biomass and phytoplankton biomass increase with the increase of total Nitrogen and total phosphate concentrations (Chun et al., 2007).

**Phosphate**

Phosphates are usually present in small quantities. The presence of phosphate in large quantities in freshwater indicates pollution through sewage and industrial waste. In an aquatic ecosystem phosphorus occurs in inorganic as well as organic forms. It is one of the important nutrients required by the biota. Phosphates occur in natural and waste waters, principally as organic orthophosphates, condensed phosphates and organically bound phosphates. Orthophosphates are applied to agricultural land as fertilizers and carried into surface waters with storm runoff. Orthophosphate, the soluble reactive phosphorus which is also termed as organic phosphate, plays a dynamic role in aquatic ecosystem as it is widely taken up by phytoplankton (Goldman, 1965). However, phosphorus is essential for the growth of organisms and is one of the major factors limiting primary production and has been reported as most critical single element in maintaining aquatic productivity in reservoirs (Das, 2000). The high concentration of phosphate is indicative of pollution (Saksena and Garg, 2008). In most of rivers, phosphorus is the primary nutrient that limits the growth of algae and plants. Excessive phosphorus in a freshwater system increases growth of plants and algae. This can lead to changes in number and type of plants and animals, increase in turbidity. Phosphate concentration of lotic ecosystem for e.g. Panchgangariver, increases towards downstream due to influx of domestic sewage, detergents, agricultural effluents and industrial effluents (Mulani et al., 2009). According to Chun et al. (2007) contents of total phosphates and total nitrates
decrease almost linearly with the increase of macrophytes biomass. Murugavel and Pandian (2000) recorded almost doubled amount of phosphates in the lower Kodayar, as compared to AzhakiaPandipuram ponds of upper Kodayar. Further, Thomas and Azis (1996) have reported higher phosphate contents in the system that receives rain water gushing from adjacent forests and agriculture fields that are moderately fertilized. However, the reservoirs of Rajasthan have particularly high level of phosphates ranging from traces to 0.929 mg/L. Sharma, (1980) and Sugunan, (2000) observed that the phosphate may also be received from the rain washings of the brown hills and the red and yellow desert soils.

Some systems have naturally very low total phosphorous levels and may be described as oligotrophic (low nutrient status). Other systems naturally have high total phosphorous levels and are described as eutrophic (high nutrient status). If phosphorus levels in the system exceed 50 percent of the baseline level or the upper limit of the trigger range, there may be an environmental problem and further investigation is triggered. The nutrient status labels for these trigger ranges are, in the same order as the ranges above: ultra-oligortrophic, mesotrophic, meso-eutrophic, eutrophic and hyper-eutrophic. Thus increased input of inorganic phosphates to lakes, bays and other surface water causes eutrophication, resulting in excess growth of phototrophs, depletion of dissolved oxygen, degradation of the recreational value of water and foul tastes to the drinking water on addition. Strong positive correlation between altitude and tropic state (total phosphorus) in the reservoirs has been reported by Sharma et al., (2008). Natural waters having phosphates content of more than 0.2 ppm are likely to be quite productive, excess phosphates in open waters indicates organic pollution.

**Ammonia**

The most important source of ammonia is the ammonification of organic matter. Large quantity nitrogenous matter present in sewage tends to increase the ammonia content of water. Presence of ammonia is an evidence of sewage inflow of water body (Saksena, 2008) Ammonia is present naturally in surface and waste water. Ammonia concentration encountered in water varies from less than 10 µg ammoniacal nitrogen/lit. In natural surface ground water is more than 30 µg/lit.
Occurrence of ammonia in water may be accepted as the chemical evidence of organic pollution. Ammonia is produced by microbial degradation of organic nitrogenous matter. If ammonia is present as pollutant it indicates recent sewage pollution and has large quantities of nitrogenous matter. Ammonia in higher concentration is harmful to biota and also toxic to man. According to Bruce,(1958) a high value of ammonia is a sign of pollution. Minimum limit of pollution for ammonia is specified as 0.5 mg/lit (WHO, 1984; Brinely, 1942 b; Butcher, 1949; Loster, 1975).

**Total coliforms and faecal coliforms**

Total and faecal coliform examination of water is direct measurement of deleterious effect of pollution on human health. Coliform bacteria are described and grouped, based on their common origin or characteristics, as either total or fecal coliforms. The total group includes fecal coliform bacteria such as *Escherichia coli* (*E*. *coli*), as well as other types of coliform bacteria that are naturally found in the soil. Fecal coliform bacteria exist in the intestines of warm blooded animals and humans, and are found in bodily waste, animal droppings, and naturally in soil. Most of the fecal coliform in fecal material (faeces) is comprised of *E. coli*, and the serotype *E. coli* 0157:H7 is known to cause serious human illness. The presence of faecal coliform in river water may indicate recent contamination of the groundwater by human sewage or animal droppings which could contain other bacteria, viruses, or disease causing organisms. This is why coliform bacteria are considered “indicator organisms”; their presence potential presence of disease causing organisms and should alert the person responsible for the water to take precautionary action.

Examination of coliform of water ensure the safety of potable water, monitor the water quality for recreational, Industrial and agricultural uses and to evaluate prospective water resources for drinking purpose. Water bodies contaminated by many pathogenic bacteria may cause diseases such as typhoid, fever, dysentery, diarrhoea and cholera. If consume by human beings for drinking purposes. So the quality of drinking water is of immense importance.

The most important aspect of water quality is its freedom from contamination with faecal matter. In keeping with the goal of United Nation Decade Program, developing countries are concentrating on providing adequate quantities of drinking
water for their population. Unfortunately, little attention is being given to protect and monitor water quality. If this trend continues, the long term effect would be a continued high incidence of water borne diseases. The total coliform count procedure provides a standardised means of determining the density of aerobic, facultative anaerobic and heterotrophic bacteria in water Mahanta (1984) showed that the presence of coliform organisms in water is an indicative of the water being contaminated with faecal matter. The primary objective of bacteriological examination of drinking water is thus the detection of faecal pollution indicated by the presence of bacteria of faecal origin. Sources of total and faecal coliforms in groundwater can include contamination of intestinal tract of humans and other warm blooded animal, agricultural runoff, effluents from septic systems or sewage discharges, infiltration of domestic or wild animal faecal matter from soil. Presence of ammonia is an evidence of sewage inflow of water body Saksena (2008). Ammonia serves as indicator pollution was not observe in Narmada River (Nath and Shrivastva, 2001). In winter season the concentration of ammonia in Chambal River is nil (Saksena and Garg, 2008). Total coliforms do not indicate recent water contamination by fecal waste, however the presence or absence of these bacteria in treated water is often used to determine whether water disinfection is working properly. When water is tested for fecal or total coliform, the results are usually given as the number of colony forming units per 100 millilitres (CFU/100ml) of water sampled. No sample should contain coliform or E. coli, and ideally there should be no total coliform in drinking water.

II) ZOOPLANKTONS

Zooplanktons are minute heterotrophic organisms in water bodies that are present at various depths in their own niches in every type of aquatic environment. In spite of having locomotory appendages, their movements are very limited and they are found floating freely in and around eutrophic zone. Compared to phytoplankton, zooplanktons have short life span and they respond more quickly to environmental changes than phytoplankton and are easier to identify. Zooplankton forms an important link in the dynamic ecosystems of estuaries, bays, rivers and lakes. By their heterotrophic activity zooplanktonic organisms transport the organic material of primary and secondary production. The study of fresh water fauna especially
zooplankton, even if of a particular area, is extensive and complicated due to environmental, physical, chemical and geographic variations involving ecological, extrinsic and intrinsic factors (Majagi and Vijaykumar, 2009).

Zooplanktons are important components of aquatic ecosystems and play a role of primary consumer. They feed on primary producer and make them available to higher organism in food chain (Michel 1973). They are important link in food web of fresh water bodies. Copepods from one of the major components of zooplankton a chemical analysis of copepods, has revealed that they are as proteinous as meat and hence could eventually become useful supplementary diet (Battish, 1992).

Zooplanktons have evolved very interesting phenomena such as a diet vertical migration (Slusarzyk, 2003; Dodson, 1990), seasonal and altitudinal variation (Pathani and Upadhyay, 2001). Seasonal variation of zooplankton community in Khajikontnoor reservoir, Karanataka was studied by Rajshekhar et al., (2010) According to Sousa et al., (2008) changes in water quality of water body have significant effect on structure of zooplankton assemblages that can potentially affect the functioning of ecosystem.

According to Rajshekhar et al., (2010), the composition and relative abundance of species in the aquatic communities is influenced by the variation in trophic state and seasonal changes of physicochemical variables of water body. Chattopadhyay and Barik (2009) studied composition and diversity of net zooplankton from Krishnasayar lake and recorded high scores of species diversity and low scores of species richness amongst net zooplankton. They also recorded maximum relative abundance for rotifer and minimum for Decapoda.

Rajagopalet al., (2010) revealed the species richness, species diversity and species evenness zooplankton community form three perennial ponds of Virudhunagar, Tamil Nadu. They also indicated that the Zooplankton population shows positive significant correlation with physicochemical parameters like temperature, alkalinity, phosphate, hardness and biological oxygen demand and negative correlation with rainfall and salinity. Sinha and Eslam (2002) studied variation in zooplankton of two lentic Bodies (Zoo cum Botanical Garden lakes) at Assam State and recorded higher density during autumn and suggested that temperatures and transparency plays role in controlling the
zooplankton dynamics. Isaiarasu et al (2001) worked out various indices for species richness, evenness and diversity of zooplankton from seasonal tropical pond near Sivakasi Tamil Nadu. The indices presented dynamics of zooplankton community and the nature of the pond ecosystem.

Zooplanktons are the excellent indicators of the status of a lake and occupy a pivotal position in the food web and top down feedback mechanisms (Christoferson et al., 1993; Jeppensen et al., 1999). Various studies have been conducted worldwide with reference to the species richness, distribution of copepod, rotifer and cladocera and their relation to hydro period (Dagmar et al., 2006), comparison of zooplankton diversity of two fresh water wetland ecosystems of Goa Das et al. (2005), seasonal distribution of the population structure of zooplankton in connection with physicochemical parameters Sarkar and Chaudhary (1999). Hence, Zooplankton communities of numerous reservoirs, lakes and shallow water bodies have been used as indicators for the status of the lake (Christoferson et al., 1993; Jeppensen et al., 1999; Ramchandra et al., 2002) and related with the concentration of total nitrogen, total phosphorus, algal biomass and the density and size of individuals (in the Central American lakes, Giselle and Bruce, 2007). The variability observed in the distribution of zooplankton is due to abiotic parameters (e.g. climatic or hydrological limitation) and biotic parameter (predation, competition) or combination of both (Roff et al., 1988; Christou, 1998; Escribano and Hidalgo, 2000; Beyst et al., 2001). Hence, the use of zooplankton for environmental characterization of water body is potentially advantageous as the quality of water affects the species composition, abundance, productivity and physiological conditions.

Jalilzadehet al., (2008) studied three contrasting lakes of Mysore and Karnataka showed that zooplankton abundance was low during rainy season and it increased during summer season. They also reported that cyclopoids were more tolerant to the environmental parameters in Lingambudi and Hebbal lakes. Study conducted on tropic status and zooplankton diversity of Lake Jaisamand by Sharma et al., (2008) showed mesotrophic status of the water body. They applied Menhinick’s index and Shannon Index to show mesotrophic status of the water body. Ghidini et al., (2009) reported that changes in the nutrients dynamics of water body alter the decomposition and production processes that directly affect the consumption
of nutrients. They supported their observations by studying Zooplankton micro crustaceans. They further added that micro crustacean life cycle, development and reproduction are influenced by biotic and abiotic factors of the environment. Ferdous and Muktadir (2009) reviewed the potentiality of zooplankton as bio-indicator. They concluded that potentiality of zooplankton as bio-indicator is very high. Ramchandra et al., (2006) emphasized role of plankton in aquatic food chain and discussed zooplankton as bio-indicators. They carried hydrobiological investigation in selected Bangalore lakes. Baumgartner et al., (2008) studied micro-invertebrate community structure in the littoral zone of Lake Constance, Germany and indicated that physiological capabilities of a species and competition and predation were influence by water level fluctuations.


Zooplankton communities of fresh water belong two major groups rotifera and the Microcrustaceans (copepoda and cladocera). The water dominance of zooplanktonic rotifers, cladocerans and copepods in river water bodies varies according to the degree of organic pollution (Verma and Munshi, 1983).
**ROTIFERA**

Rotifera, also called rotatoria or wheel animalecules is group of small, usually microscopic, pseudocoelomate animals which have been variously regarded either as a class of phylum Aschelminthes, or as a separate minor phylum. They are ubiquitous, occurring in almost all types of fresh water habitats, from large permanent lakes to small temporary puddles and feed on algae and bacteria. Being prey for plankton feeders, Rotifers play a crucial role in many freshwater ecosystems. They are permanently and obligatorily connected to aquatic habitats in all active stages, only their resting stages are draught resistant (Hendrik, 2007). Rotifer distribution and diversity is influenced primarily by deteriorating quality of water in freshwater ecosystems and secondarily by eutrophication and salinization. The nutrients, primary production, temperature, abundance of predators and competitors, and potential food resources are important factors influencing the structure of rotifer community (Devetter and Sed’a, 2003). George (1961) studied the periodicity, species composition and diurnal migration to rotifers from five fish ponds from Delhi. He pointed out summer periodicity in rotifers, also noted simultaneous occurrence of two or more species of same genus in a single collection and reported more than two species of Brachionus. He concluded that inter specific competition for food in this genus is very little. Gilbert and Stemberger (1985) described mechanical interference competition between Zooplankton.

Population of rotifers is highest in association with submerged macrophytes, especially plants with richly divided leaves. In such conditions the densities may reach up to 25,000 per litre (Edmondson, 1944, 1945, 1946) and vise a versa with reduced sites of attachment and presumably less protection from predation, their density is low (Wetzel, 2001). Even though most rotifers commonly exhibit maximal densities in early summer, in temperate regions they show wide range of temperature tolerance (Berzens and Pejler, 1989). Various rotifer serve as useful bio-indicators of water quality of environments within the limits of Limnosprobity. Their ability to colonize diversified aquatic and semi-aquatic biotopes and inherent quality to build up substantial densities within short time- intervals make them ideal for ecological considerations as well as valuable tool for population dynamic studies.
Arora and Mehra (2002) recorded and identified 110 species belonging to 39 genera, 20 families in backwaters of the Delhi segments of the Yamuna river. Sendacz et al., (2006) stated that the zooplankton communities of most tropical and subtropical lakes and reservoirs are dominated by rotifers regardless of the tropic state, but due to their small size and weight they often contribute little to the biomass. They studied two reservoirs, Ponte Nova and Guarapiranga, Brazil with respect to the zooplankton biomass. According to Dirican et al., (2009) permanent dominancy of rotifer species such as Brachionus and Keratella are indicative of eutrophic condition of lake. They studied Camligoze dam lake, Turkey and stated that rotifer are more abundant than other zooplankton groups and account for major portion of food chain. Contreras et al., (2008) studied seasonal changes in rotifer diversity from valle de Brovo reservoir, Mexico, encountered 23 rotifer species and the highest density was in April. They also indicated combined effects of temperature, dissolved oxygen, water column depth and chlorophyll on the abundance of dominant rotifer species. Obertegger et al., (2010) indicated that water residence time (WRT) affected and related to algal bio-volume and high abundance of rotifer species in spring and summer in Tovel Lake, Italy

Pociecha and Wozniak (2008) monitored diet composition of Asplanchna from Dobczycki dam reservoir (Southern Poland) and indicated that Asplanchna is grazer and predator and opportunistic feeder. TijareanThosar (2008) studied rotifer diversity in three lakes of Gadchiroli and recorded 11 genera and 25 species of rotifer. They suggested that maximum diversity and population of rotifers was due to organic pollution and its eutrophic condition. Sharma (2007) noted rare and interesting rotifers from Loktak lake Manipur. He listed out 11 new and interesting rotifers and made taxonomic notes with systematic list of the examined species, describing them in detail.

**CLADOCERA**

Cladocerans are small crustaceans, filter feeders, algae users, and particulate matter users, pray of vertebrates and invertebrates, important link in food chains and play important role in trophodynamics in aquatic ecosystem. Cladocerans (water fleas) are primary freshwater small sized (0.2 – 6 mm) brachiopod crustaceans inhabiting
pelagic, littoral and benthic zones. The cladocerans are found in all sorts of fresh waters with higher densities in lotic than lentic systems and comprise about 87 genera. Pachuaa (2008) documented 18 species of Cladocera from different fresh water bodies in Mizoram, Shrama and Sharma (2009) showed qualitative dominance of Cladocera (45 species) from DeeporBeel Lake of Assam. They further demonstrated inverse correlation of Cladocera with water temperature and rainfall and positive correlation with specific conductivity and dissolved oxygen. They also act as the link in the food chain. Most of them are herbivorous, feeding on phytoplankton and in turn, are preyed upon by certain invertebrates and fish, thus, involved in the transfer of energy from primary producers to secondary and tertiary consumers within the aquatic food web (Dodson and Frey, 2001). They inhabit diverse habitats and are at times exposed to great variety of harsh and extreme environmental conditions.

Jaramillo and Pinto (2010) provided good evidence that rotifer species are differentially influenced by crustacean predation and competition. They further added that cladocerans are considered to be the most effective grazers among the crustaceans and there is an inverse and antagonistic relationship between Rotifers and Caldocerans. The Canonical Correspondence Analysis of cladocerans and environmental variation in the cladoceran species has shown strong positive correlation between size of cladocerans and vegetation cover (Dagmar et al., 2006). Cladoceran actively select their food, with preference for large particles, and are unselective filter feeders (Claes et al., 2004). It has been reported that the life history strategies of tropical and temperate cladoceran taxa differ in response to several abiotic (temperature, light and oxygen saturation percentage) and biotic factors (predation and inter and intraspecific competition).

Sakamoto and Hanazato (2009) studied factors controlling morphologic plasticity of Bosminalongirostirs. They found that lower temperature can be effective in helping to detect severe predation threat by Cyclopoid Copepods. The comprehension of the relationship between Cladocerans assemblages and environmental conditions are important to the development of ecological tools used in management technique and environmental restoration of eutrophic reservoirs (Ghidini et al., 2009)
The water fleas (the cladocerans) are important component of the fauna of freshwaters; particularly significant in the food web of stagnant waters (Forro et al., 2007). Most species are filter feeders and usually reproduce by cylindrical parthenogenesis. Thus their population are mainly dominated by females. However, sexually produced diapausng eggs are common and resistant to desiccation and other unfavourable conditions, Cladocerans have also gained certain economic importance as they are widely used in aquaculture.

**COPEPODA**

Copepods are small, microscopic crustaceans found in both fresh and marine water environments. They are minute (0.3 to 2.5 mm) crustaceans lacking a distinct shell fold and having a simple median eye. They pass through a series of naupliar stages during their development. The three suborders of free living copepods found in fresh and other inland water bodies. They are free living and makeup a large major component of zooplankton population in water bodies. They are very important source of food because of their large numbers and high nutritional value. Copepoda are a group of lower crustacean. They have occupied all salinity regimes form fresh water, marine water, hyper saline inland water, subzero polar waters to hot spring and all the depths of water body. The copepods are important contributors of zooplankton population dynamics and are universally distributed. They are primary food source of planktivorous fish and constitute essential link in aquatic food chain.

Geoff and Danielle (2007) have reported zoogeographic distribution of 2,814 species of copepods form fresh waters. They also studied key human related issues, such as role of copepods as vectors for human parasites and the losses caused by parasitic copepods in commercial aquaculture. The presence of copepods has been reported to improve the feeding condition of Daphnia-Cladocera (Claes et al., 2004) because during copepod larvae grazing, the nutrients released are taken by phytoplankton which favours the population of Daphnids.

According to Ramchandra et al., (2006), Copepods also form important organisms for fish and are influenced by environmental factors like excessive human interference in water bodies but to less extent than Cladocera. They have further stated that Copepods are much hardier and strongly motiel than any other zooplankton, they have complex life history which includes egg, six nauplius stages,
five copepodid stages and the adult. Copepods are dominant invertebrate predators in tropical freshwater ecosystems (Hwang et al., 2009). They studied impacts of predation by the copepod Mesocyclops and population dynamics of four cladocera species and concluded that presence of the copepod severely suppressed the population on growth of cladocera species. Sivakumar et al., (2001) reported more number of copepods and cladocera occurrence during winter \((22^\circ C – 29^\circ C)\) than in summer \((24^\circ C – 30^\circ C)\) and suggested that decrease in copepods and cladocerans population in summer may be attributed to the higher temperature. They also added that the higher productivity of ponds during winter is through the nutrients enrichment.

Islam and Bhuiyan (2008) also reported that temperature plays an important role in the vertical distribution of cylops spp. Mesocycloppsspp, Mercycloppsspp and Diaptomus spp. Each type of copepods was found abundant near the surface during morning and evening. Copepods found to be in lesser number in the noon samples. A number of studies have demonstrated that most of adult cyclopoid copepods are carnivorous and their predatory activities play a significant role in the population dynamics of other copepods (Confer, 1971). Various, adult Cyclops prey heavily on naupli of Diaptomus species and its own species, while some species are herbivorous which feed on a variety of algae ranging from unicellular algae to long strands of filamentous species. Cyclomorphosis, the means of rapid, evaising swimming movements is lacking in copepods (Kerfoot, 1980).

Bhuiyanet al., (2008) studied seasonal succession of copepods and observed the most abundance of copepods in spring followed by winter summer and autumn. They further related the occurrence and abundance of copepod to the physico-chemical conditions of water body.

**CYCLOPOIDEA**

These are small, capable of rapid movement and are distinguished form other copepods by having first antennae shorter than the length of head and thorax and uniramous second antennae. They have single central eye, which is light sensitive. Cyclopoid copepods have a T shaped shrimp like body that tapers towards the rear and bear six pairs of swimming limbs. They exhibit Jerky movements of its limbs.
sweep food particular efficiently toward mouth. Females carrying egg sacs attached to their abdomen. The main joint lies between the fourth and fifth segments of the body.

**CALANOIDA**

This order comprises of 2000 species. They can be distinguished from other planktonic copepods by having first antennae at least half the length of the body and biramous second antennae. The main joint is the joint between fifth and sixth body segment. In the present study the calanoids occupied second position among the copepods in both water bodies.

**Nauplii**

These are meroplankters and early copepodite stages of copepods.