Introduction

Water is life! It is a precious recourse for driving energy on our planet. Considering its unique nature and composition, the concept of water being the source and abode of life for organisms can be traced back to the ancient times even before the limnological studies took its shape as such. Such a perception transcends the boundaries of science and embraces even myths and literature. Water not only acts as the source of life but also as a condition of possibility of life on Earth. Therefore, the words of Robert G. Wetzel have to be doubtlessly agreed upon; “Water is the essence of life on Earth and totally dominates the chemical composition of all organisms”. Water is nature’s most abundant, wonderful and useful chemical compound and is a precondition for human, animal and plant life as well as an indispensable resource for the economy. It has played a role not only in the history of countries, but in religion, mythology and art. Water has always been perceived as a gift from God as it rained from the heavens. It is the primary need for all the vital life process. Biologists consider water as the medium of life and it is found everywhere on earth. Water is the most abundant compound on Earth’s surface, found in many places on the surface of the planet, within rocks, below the surface and in the atmosphere.

Water covers more than three quarters (71%) of the Earth’s surface and is vital for all known forms of life. On Earth, 96.5% of planet water is found in Oceans, 1.7% of Ground water, 1.7% in Glaciers and the Icecaps, a small fraction in other large water bodies, and 0.001% in the air as vapour, clouds and precipitation. Only 3% of the total water present is freshwater, of this groundwater comprises 95%, surface water is 3.5% and soil moisture is of 1.5%. Out of all the freshwater on the Earth, only 0.36% is readily available to use (Neill, 1990). Water circulates between different areas of the Earth through the human body, transporting, dissolving, replenishing nutrients and organic matter, while carrying away waste material and also it travels through the hydrological cycle of evaporation, transpiration, condensation, precipitation and runoff, usually reaching the sea. Evaporation and transpiration contribute to the precipitation (rain) on terrestrial habitat. Freshwater ecosystems cover 0.8% of the Earth's surface and contain 0.009% of its total water. They generate nearly 3% of its net primary production. Freshwater ecosystems
contain 41% of the world's known fish species and include **Lentic** and **Lotic** ecosystems. Lentic ecosystem is the standing water habitat. In this habitat, the circulation of water is slow and is of vertical type. Example: Ponds, Lakes, Bogs and Swamps. Lotic ecosystem is the running water habitat in which there is a great horizontal movement of water. Example: Springs, Streams and Rivers. Thus, Limnology is the study of inland aquatic ecosystem including the biological, physical, and biochemical, geological, ecological and hydrological aspects of lakes, reservoirs, ponds, rivers, wetland and ground water. There are two types of aquatic ecosystem, marine ecosystem and freshwater ecosystem. Freshwater habitats can be classified by different factors, including temperature, light penetration, tidal movements and vegetation. Most of the fresh waters play a vital role in human health, economic wellbeing, social cultures and healthy habitat for plants and animals. The benefits of these extractive uses of fresh water have traditionally overshadowed the equally vital benefits of water that remains in stream to sustain healthy natural aquatic ecosystems. Many freshwater ecosystems have been seriously degraded and must be rehabilitated or restored for sustained provision of clean water. Thus, exploitation of our precious water resource has put a severe stress on the availability of drinking water. Freshwater biodiversity is essential for maintaining ecosystems, functions and their services such as, primary productivity, nutrient recycling, freshwater and waste water purification. Freshwater ecosystems is experiencing intense physical alteration, habitat loss and degradation, overexploitation and the elimination of ecosystems and introduction of non-native species collectively play a vital role in the decline of the freshwater ecosystems. The significant impacts on freshwater ecosystems are by removing water for other uses, altering flows, and contaminating water with industrial and human wastes. Good quality fresh water is very necessary for good and healthy life. Aquatic communities are represented by phyto - and zooplankton, benthos (bottom organisms) and nekton (fishes). And also primary production is produced by autotrophs (phytoplankton and macrophytes) moreover, secondary production is the result of transformation of organic matter by heterotrophs (zooplankton, zoobenthos and fishes). Freshwater ecosystems are negatively affected by human activity that leads to eutrophication, acidification, contaminantants, sediment inputs and pollution. Freshwater ecosystems can be divided into lentic ecosystems (still water) and lotic ecosystem (flowing water).
1.1. Lentic or standing water ecosystem:

Lentic refers to standing or still water. Lentic ecosystem ranges from a small, temporary rain water pool to a few meters deep lake. A lake can be defined as a body of standing water, which lacks continuity with sea water. The word ‘Lake’ is used loosely to describe many types of water bodies – natural, manmade and wetlands. Lakes are formed as a result of different natural and artificial processes, which are often interlinked resulting in lakes of similar origin, physical and biological characteristics. Lakes are traditionally under – valued resources to human Society. They provide a multitude of uses and are prime regions for human settlement and habitation. Uses include drinking and municipal water supply, industrial and cooling water supply, power generation, commercial and fisheries, boating, and other aesthetic recreational uses. In addition, lake is for agricultural irrigation and for waste disposal. More lakes have an infinite ability to absorbed or dilute industrial and municipal waste, and it is largely as a result of human waste disposal practices that monitoring and assessment are proving to be necessary in many large lakes (Thomas et al., 1992). The quality of surface water is largely affected by natural processes (weathering and soil erosion) as well as anthropogenic inputs (municipal and industrial waste water discharge). The anthropogenic discharges represent a constant polluting source, whereas surface runoff is a seasonal phenomenon largely affected by climate (Latha et al., 2010). Lake and their surrounding are unique assets and valuable ecosystems of society and nature. These are resources of social, cultural, and aesthetic value. Maintaining lake water quality helps maintaining healthy surroundings. But, an excessive introduction of nutrients by humans has led to severe eutrophication of certain freshwater systems worldwide (Abhas and Sing, 2013). Enormous anthropogenic activities make all the water resources unfit for consumption. Eutrophication of water bodies is rapidly increasing due to growing increase of anthropogenic stress, these results in the eutrophication of lakes. Eutrophication and deterioration in the water quality, siltation and shrinking of lakes are the major problems and are assuming alarming proportion in India due to various anthropogenic activities. Lakes are the lung spaces of a city and climate moderators in surroundings. Lakes support aquatic eco systems and conservation of lakes is important to conserve biodiversity of flora and fauna unique to the aquatic ecosystems and also migratory birds depend on these lakes for food.
and perching (Thomas et al., 1992). Based on the origin lakes can be classified into following types-

Glacial Lakes: Lakes are formed by glaciers. The materials incorporated into glaciers are released when ice melts.

**Tectonic Lakes:** Lakes are the one which are created as a result of some kind of deformation in the Earth crust associated with Earth movement during earthquakes and faults.

**Volcanic Lakes:** Lakes are the one which are formed when the mouth of old volcanoes is filled with water.

**Fluvial Lakes:** Lakes formed by fluvial damming due to sediment deposition by tributaries.

**Dammed Lakes:** Lakes created behind rock slides and mud flows. These are lakes of short duration but are of considerable importance in mountainous regions (Thomas et al., 1992).

Lakes can also be classified into three categories, mainly based on productivity and pollution status as **Oligotrophic lakes**, are the one which are characterized by the great depth of water and poor biotic components. The water of these lakes will be transparent, with low pH, negligible Nitrogen and poor organic contents. The depth of the lakes is rich in their faunal contents. **Eutrophic lakes** are shallow in nature and are rich in Phosphorous, organic material and also plankton. They contain rich flora and fauna. The **Dystrophic lakes** may be deep or shallow, but the water will be rich with humus and poor in Oxygen content. So the faunal growth will be poor. These lakes contain insect larvae and few deep water animals. Thus the temperature, salt concentration and Oxygen concentration vary greatly in lakes (Thomas et al., 1992).

### 1.2 Zonation of Lakes:

Vertically, depending upon the availability of light, the lake water can be divided into three major zones:

1. **Euphotic zone:** The euphotic zone refers to the total illuminated stratum of the water and has enough light for photosynthesis. The euphotic zone extend upon the
water depth at which the light intensities is 1 % of the surface called light compensation level, where respiratory loss equalizes the photosynthetic gain and which approximates to the lower limits of the photosynthetic activity (Thomas et al., 1992).

It is subdivided horizontally into two subzones,

a) **Littoral subzone:** It is the euphotic zone at the lake margin which is occupied principally by rooted plants and benthic algae along with other phytoplankton. This zone is further divided into-

i. **Eulittoral region:** A region between higher and lower water marks at the water’s edge, where the beating of the waves is most effective

ii. **Sublittoral region:** A region which extends from the lower limit of wave action to the lower limit of rooted vegetation or euphotic depth.

b) **Limnetic subzone:** It is the open water euphotic zone away from the shore. It contains only phytoplanktons and no benthic plants. This zone may be absent in small, shallow ponds.

2. **Dysphotic zone:** This is a narrow dim light zone immediately below the euphotic zone and has intensities below 1% of the surface. In this zone rate of respiration exceeds to that of photosynthesis (Thomas et al., 1992).

3. **Aphotic zone or Profundal zone:** The entire deep water zone beyond the depth of effective light penetration is called Aphotic zone or Profundal zone. This is dark and devoid of any photosynthetic plants, hence any prolong stay of photo planktons in these zone may be harmful. This zone has large amount of organic detritus associated with large number of aquatic bacteria and fungi on the bottom sediment, which decomposes the organic detritus and the released inorganic nutrients will be able to use by primary producer (Agarwal, 1999 and Thomas et al., 1992). Therefore lakes are generally classified based on the productivity into five:

a) Oligotrophic Lakes

b) Eutrophic Lakes

c) Mesotrophic Lakes
d) Hypereutrophic lakes

e) Dystrophic Lakes

a) Oligotrophic Lakes: These have low primary productivity and low biomass associated with low concentrations of nutrients (nitrogen and phosphorous). They tend to be saturated with oxygen in the water column. These lakes are usually over 16 meters depth with steep sloping sides and very little shallow water and vegetation around margin. These waters are clear and transparent. The productivity of lake water is always lower. In Oligotrophic waters, the species diversity is more and phytoplankton bloom is rare (Agarwal, 1999 and Thomas et al., 1992).

b) Eutrophic Lakes: These display high concentration of nutrients, high biomass productivity and low transparency. Oxygen concentrations can get very low (as low as 1 mg/L) in the hypolimnion during summer. These lakes are shallow, usually less than 18 meters in depth with gentle sloping sides and passes an extensive literal zone with more marsh vegetation. The water is turbid due to dense growth of phytoplankton and presence of more suspended particles, with which significantly reduce the light penetration. Thus high rate of phytoplankton production is restricted only to upper waters. The colour of water may be green, yellow or brownish green (Agarwal, 1999).

c) Mesotrophic Lakes: These are lakes in transition from oligotrophic to eutrophic conditions. Some depression of oxygen concentration occurs in hypolimnion during summer stratification. They are intermediate between oligotrophic and eutrophic lakes in nutrients content and productivity. The standing crop of vascular plant is grated in these lakes then in eutrophic lakes (Agarwal, 1999).

d) Hypereutrophic lakes: Lakes at the extreme end of the eutrophication range with high nutrient concentrations. Oxygen deficiency is severely impaird in hypereutrophic lakes.

e) Dystrophic Lakes: These displays organic rich lakes (humic and fulvic acids) with organic materials derived by external inputs from the watershed. They may be deep or shallow water column.
Stratification of lakes:

a) Epilimnion:

- Surface waters of constant temperature (usually warm) mixed throughout by wind and wave circulation. The thickness of the epilimnion may be quite substantial, and it is dependent on the lake surface area, solar radiation, air temperature and lateral circulation and movement of the surface water. Commonly, it extends to about 10 m depth but in large lakes it can extend up to 30 m depth.

b) Hypolimnion:

- The deeper high density water. This is much colder, although in tropical lakes the temperature difference between surface and bottom water may be only 2-3°C.

c) Metalimnion:

- Fairly sharp gradational zone, which is defined as the metalimnion. The name metalimnion is not commonly used and the gradation is normally referred to as the thermocline.

1.3 Plankton

Plankton is microscopic organisms that float freely with oceanic currents and in other bodies of water. The word plankton comes from the Greek word “planktos” which means “drifting.” Plankton consists of any drifting organism (animals, plants, bacteria etc) that inhabit the pelagic zone of oceans, seas or bodies of fresh water plankton are primarily made up of tiny plants called phytoplankton and tiny animals called zooplankton. Phytoplankton are the base aquatic food webs and energy production is linked to phytoplankton primary production i.e., autotrophic, prokaryotic or eukaryotic algae that live near the water surface where there is sufficient light to support photosynthesis. Plankton are essentially non motile organism relative to the water mass, but drift with it, and are therefore easily affected to pollutants in the water. Many species of freshwater algae may proliferate quite intensively in eutrophic (i.e., nutrient-rich) waters. The Phytoplankton-zooplankton abundance of balance depends on a large scale on the presence and absence of active
and on-going grazing. The abundance of zooplankton grows while that phytoplankton is unable to support the zooplankton population (Emmanuel et al., 2008). Man-made lakes have been receiving much attention in the area because they are used for multiple purposes including power generation, drinking, irrigation, agriculture and have been intensively constructed or planned throughout the country. These aquatic environments present ecological features that lead to the establishment of a very dynamic system in which the plankton communities play an important role (Christina et al., 2002). Pytoplankton in coldwater lakes is represented by common doatoms (e.g. Melosira, Asterionella, Cyclotetra) Warm water lakes are inhibited more by green algae (Clossetrium, Scenedesmus, Pediatrium) but blue-green algae (Microcystis, Anabaena, Aphanizomenon). The water quality parameters and plankton diversity showed marked variation in total density, which is because of diverse hydro biological conditions. Water temperature plays an important role in controlling the occurrence and abundance of phytoplankton (Venkateshwarlu et al., 2011).

1.4. Zooplankton

Zooplankton (in Greek “Zoion” means animals and plankton means “wanderer”) are the animal members of the marine and fresh water planktonic community, that drift according to the water currents. They are microscopic animals that eat other plankton. Zooplankton consists of small protozoans or metazoans (e.g. Copepods and some Jelly fish). By contrast, meroplankton are those organisms that are only planktonic, for part of their lives (usually larval stages), and then graduate to either the nekton or a benthic existence. Examples of meroplankton include the larvae of sea urchins, starfish, crustaceans, marine worms and most fishes. Most zooplankton occupies the second or third trophic level at the aquatic food web and they play an important role in aquatic ecosystem. Zooplankton link the primary producers, phytoplankton with higher trophic level organisms and these communities respond to a wide variety of disturbances including high concentration of nutrient loading and play a key role in the aquatic food chains.

Ecological importance of Zooplankton: Zooplankton are one of the most important biotic components influencing all the functional aspects and plays a vital role in food chain, nutrient recycling and energy flow in the aquatic ecosystem (Park and Shin, }
2007; Datta, 2011; Altaff, 2004; Anima and Chandrakala, 2016). Zooplankton constitute important and item of many omnivorous and carnivorous fish (Sharifun, 2007). Light and predation are the important ecological factors regulating zooplankton abundance and distribution (Dina, 2000). Zooplankton are the most valuable indicator of trophic status than generally been realized, since they are larger and easier to identify than phytoplankton (Kovalev et al., 1999). Zooplankton provides the necessary amount of protein required for rapid growth and development of different organs of fishes. Zooplankton communities respond to a wide variety of disturbances including nutrient loading (Pace, 1986; Dodson, 1992; Deepthi and Yamkanamardi 2014; Ganai et al., 2010; Joshi, 2011; Anima and Chandrakala 2016) acidification and contaminants (Luisa et al., 2014; Rajashekhar et al., 2010; Mohan 2013); and sediment inputs (Ekhande et al., 2013). The zooplanktons are resident fauna of aquatic ecosystems which respond to a wide range of water quality changes and monitoring have a very feeble locomotive power. The zooplanktons serve as an important link in the aquatic food chain (Sharma, 1998). Zooplankton plays an important role in the food chain of fish as animal food, which supply amino acids, fatty acids, vitamins, minerals, etc., (Kudari and Kanamadi 2008; Rajashekhar et al., 2010; Sawane et al., 2009 and Joshi 2011). Zooplankton acts as main sources of food for many fishes and plays an important role in early detection and monitoring the pollution of water and this community distribution depends on some of the complex factors viz, change of climatic conditions, physical and chemical parameters and vegetation cover. Most of the planktonic organisms are cosmopolitan in distribution (Sivakumar and Venkataramana, 2013). Zooplankton constitutes the main food of fishery, and the adult fish not only consume them, but also select them as a detectable item. Apart from this, a chemical analysis of Copepoda one of the major zooplankton component, carried out that they are as proteinous as meat and hence could eventually become a useful supplementary diet (Battish, 1992; Vaishali and Madhuri, 2004).

Groups of zooplankton

According to their size zooplankton can be classified into six groups viz., they are pico-, nano-, micro-, meso-, macro-, and mega planktons, their size ranges from 0.2 µm to 20mm. In freshwater habitats, zooplankton are mainly classified on the basis of their morphological characters into four groups viz.,
1. Rotifers

2. Cladocerans

3. Copepods
   i. Cyclopoids
   ii. Calanoids
   iii. Harpacticoids

4. Ostracods

1.4.1. Rotifers

Rotifera also called “Rotatoria” or “wheel animalcules”, are one of the zooplankton belong to phylum Rotifer. The Phylum Rotifera is divided into 3 classes; Seisonidea, Bdelloidea, and Monogononta (Edmondson 1959; Altaff, 2004). Rotifers occur as free-swimming plankton forms, and also on weeds and other aquatic objects as sessile organisms. These are a group of small usually microscopic pseudocoelomate, having a length around 0.4 to 2.5mm (Altaff, 2004). The “Golden period of Rotifer studies” was from 1880 to 1930 with maximum contribution to rotifer taxonomy and was pseudocoelomate groups with the size range between 100 to 1000 micro meters. The body of typical rotifer consists of head, trunk and foot and head bears the rotator organ or the wheel organ called carona which is used for locomotion and food collection and mouth and sense organ (Dhanapathi, 2000). They are ubiquitous, occurring in almost all types of freshwater habitat, from large permanent lakes to small temporary puddle habitat. Rotifers have the shortest life span (12 days) and can reach their peak, reproductive levels in about 3.5 days (Altaff, 2004). They were first studied and described by Leuwenhock in 1703. Some rotifers are free swimmers and suspension feeders (Peter, 1980) while others are sessile (Wallace, 1980) and predacious such as Asplanchna (Gilbert, 2005). They are a group of microscopic organisms coming under minor Phylum Rotifera which comprises of about 2000 species. Their slow swimming habits, ability to tolerate a wide range of salinities, Their slow swimming habits, ability to tolerate a wide range of salinities, parthenogenetic mode of reproduction and ability to get enriched and live feed in their habitat (Molly, 2006). As rotifers zooplankton group in most useful for water quality monitoring and water quality indicator, at least 200 individuals of “indicator species” were recorded (Duggan et al., 2008). They play a major role in
these ecosystems because of extremely fast reproductive rates. Besides, rotifers are
used as indicators for pollution and eutrophication because of their high reproduction
rate and sensitivity to any ecological change in water bodies. The rotifer community
structure depends on a variety of environmental factors that include biological
parameters, such as predation or competition, as well as various physico-chemical
factors (Ekhande et al., 2013). Rotifers play a significant role in the ecology of some
lakes as grazers, suspension feeders, bacteriovores, detritus feeders, predators,
pollution indicators and water quality monitor (Pourriot, 1977; Sladeck, 1983; Herzig, 1987; Seher and Haldun 2009 and Vanjare, 2013). The rotifer community
structure depends on a variety of environmental factors that include biological
parameters, such as predation or competition as well as various physico-chemical
factors (Ekhande et al., 2013). Rotifers are considered opportunistic organisms,
showing high adaptive capacity, colonizing rapidly a wide variety of aquatic habitats
and niches. They can constitute an important link in the food chain between the
primary producers and secondary consumers (Altaff, 2004). The corona or wheel
organ is the most striking feature of the rotifers and is used for the purpose of
locomotion and food collection. The corona may be with anterior and posterior lines
of cilia and the structure of the corona is of basic importance in the classification of
rotifers (Tayade and Dabhade, 2011)

1.4.2. Review of Literature

Internationally several investigative studies have examined and reported
Rotifer zooplankton in different regions of world. Irena (1999) reported the species
diversity and spatial distribution of Rotifer assemblages in Lake Ladoga. Further,
species diversity, spatial distribution and the role of rotifers in the zooplankton
community structure are also discussed in relation to the ecological zoning of the
lake. Telesh (1999) studied about the species diversity of Rotifer reported in Lake
Ladoga in Europe and observed high species diversity and low wet weight biomass of
Rotifer zooplankton. Abdul et al. (1999) carried out some studies on the seasonal
fluctuations of Rotifers in a fish pond at district Bahawalnagar, Pakistan and have
reported 10 species of rotifers belonging to seven genera – Brachionus angularis, B.
calyciflorus, B. caudatus, Keratella valga, Filinia longiseta, Cephalodella species
and Lecane elasma. Patoine et al. (2000) made an attempt to study the influence of
logging and forest fires on zooplankton biomass in Canadian Boreal Shield lakes and
concluded that following these disturbances burned-watershed lakes supported 58% more biomass of the Rotifer size. Ahmet and Sibel (2002) worked on zooplankton Fauna of lake Burdur and have identified and reported new species of rotifers and cladocerans. Weisse and Frahm, (2002) in their study on the direct and indirect impact of Rotifers on two ciliate species on the surface waters of mesoeutrophic Schoehsee and Plussee lakes reported that Rotifers feed efficiently on autotrophic and heterotrophic protists and their population growth rates are always lower in the presence of Keratella species. Hendrik, (2008) studied on Global diversity of rotifers (Rotifera) in freshwater and reported that Rotifers, mostly monogononts, occur in all types of water bodies, worldwide. Abdulhussein et al., (2008) carried out some studies on abundance and diversity of Rotifera in the Garmat Ali Region Ponds, Basrah-Iraq, and found there were 26 species of Rotifera belonging to 20 genera. Frutos, (2009) studied the zooplankton abundance and species diversity in two lakes with different trophic states in Argentina reported that Keratella tecta can be considered a good indicator of eutrophic state in these lakes. Bonecker et al., (2009) investigated the impact of impoundment on the rotifer communities in two tropical floodplain environments and reported that Filinia longiseta, Keratella cochlearis and Lecane proiecta persisted throughout the study and contributed to community stability. Soto et al., (2011) made some studies on the comparative population growth of some Rotifer species with special reference to Lecane and reported an inverse curvilinear relation between peak population densities and body lengths of the Lecane species. Phuripong et al. (2011) in their study on the diversity of sessile Rotifers (Gnesiotrocha, Monogononta,Rotifera) in Thale Noi Lake, Thailand, identified 44 different taxa of sessile Rotifers, including thirty nine fixosessile species and three plankotonic colonial species. Mola, (2011) revealed in the study on the seasonal and spatial distribution of Brachionus a bioindicator of eutrophication in Lake El-Manzalah and have identified Rotifers, especially Brachionus species are the major component of zooplankton in Egyptian eutrophic lakes. Debashri et al., (2012) studied on Rotifer diversity of Mirik Lake in Darjeeling Himalaya, European, and observed total of seventeen varieties of Rotifers were recorded during the whole study period, of which Asplancha and Brachionus sps were the most common genera in the Lake. Rudabeh et, al (2012) in their study on potential to use the natic efreshwater rotifer, Brachionus calyciflorus in feeding Acipenser persicus larvae, which revealed the aim of this study was to use the freshwater Rotifer, Brachionus
*calyciflorus* to feed *Acipenser persicus* larva to improve to survival rates and enhance resistance in these larva at the onset of exogenous feeding. Fella *et al.*, (2013) made some observations on studies on Biodivesity of Rotifera in five Artificial lakes in Algeria systematically and zoogeographical remarks and have reported a total of 110 rotifers species belonging to 19 families. Diversity and distribution of Brachionidae (Rotifera) in Thailand, by (Sujeephon, 2013) reported that the most frequently encountered species was Brachions falcuts (50.7% of the sampling sites), followed by *Keratella cochlearis* (50%), *B.angularis* (49.7%), *K.tropica* (46.3%) and *B.forficula* (45.9%). (Nehad Khalifa, 2014) studied on Population dynamics of Rotifera in Ismailia Canal, Egypt have reported that total of 40 Rotifers’ species and the dominant were *Keratella cochlearis*. Sulehria (2014) studied on Population dynamics of Rotifera in Ismailia Canal, Egypt have reported that total of 40 rotifers species and the dominant were *Keratella cochlearis*. Sulehria, (2014) studied the abundance and composition of rotifers in a pond near Balloki Headworks, Pakistan, which revealed the abundance and composition of Rotifers was highest during the spring season, while lowest abundance and composition of Rotifers was observed during winter season. Space, (2014) observed the Rotifers in the Littoral Zone of Lake Shkodra Skadar (Albania-Montenegro) as a tool for determining water quality of Tirana, Albania, have reported that the rotifer species assemblage was dominated by *Asplanchna priodonta*, *Brachionus diversicornis* and *B. calyciflorus* which comprised 25–30% of total rotifer density. Subhasri and Sustanta, (2016) studied cyclomorphosis of fresh water rotifers from wetlands of contrasting ecological feature – seasonal analysis have reported that two different species of rotifers (*Brachionus* sp. and *Keratella*) was studied from three wetlands having contrasting ecological features over a period of one year.

Many research works have been carried out on the abundance of Rotifer zooplankton by researchers across India. For example, Raut and Pejaver (2003) made some studies on the Rotifer diversity of Ambegasale, Rewale and Makhmali lakes from Thane city, Maharashtra State of India and observed that the macrophytes help to increase the diversity of Rotifers and this population varied between mesotrophic and oligotrophic lakes. Gauravi *et al.* (2003) revealed in their study on the population dynamics of Rotifer sat Sikri pond, Agra, Uttar Pradesh, State of India reported that Rotifers were found maximum in the month of October and minimum in February.
and also reported the dominant species were *Brachionus* and *Keratella*. Zooplanktonic diversity of 6 ponds in Durg-Bhillai city, Chhatisgarh State of India was observed by (Anil Kumar *et al.* 2004) and they found Rotifers and Copepods as the predominant group and thus indicating the nutrient availability in these ponds. Jeelani, *et al.* (2005) reported on the species diversity and seasonal distribution of Rotifers in Dal Lake, Kashmir State of India for two years and a total of 26 Rotifer species were reported. Molly Varghese, (2006) made some investigations on studies on taxonomy, distribution, ecology and reproductive potential of rotifers from selected centers in Cochin backwater system Kerala, have reported that availability of more number of *Brachionus* species from Kerala. Kedar *et al.*, (2008) made some studies on the effect of physic chemical parameters on the seasonal abundance of zooplankton in Rishi Lake, Maharashtra State of India and they recorded highest number of zooplankton during summer months and lowest during rainy season and also they observed Rotifers as the most dominating group throughout the study period. Tijare and Thosar (2008) studied on Rotifer diversity in three Lakes of Godchiroli, a tribal district of Maharashtra, India was carried out the population of Rotifers was maximum in winter months while minimum in the summer months. Sharma (2009) studied diversity of Rotifers (Rotifera, Eurotatoria) of Loktak Lake, Manipur, North – eastern India have identified 120 species belonging to 36 genera and 19 families and represent the richest biodiversity of Phylum Rotifera known from any aquatic ecosystem of the Indian subcontinent. Zannatual *et al.* (2009) studied a review; potentiality of zooplankton as bioindicator observed that zooplankton population size was correlated with biotic and abiotic parameters and also showed species diversity of Rotifers, Cladocerans, Copepods and Ostracods. Verma *et al.* (2011) carried out some studies on the ecology and trophic status of Phutala Lake at Nagpur city, Maharashtra State of India and they concluded that the lake was eutrophic due to the dominance of Rotifera, which is an indicator of organic pollution and this was supported by Shannon Weiner Index and Palmer Pollution Index. Studies on zooplanktons of Rajura Lake of Buldhana district, Maharashtra State of India by Joshi (2011) reported maximum population of Rotifer during winter season and the total zooplankton density was least in monsoon seasons. Tayade and Dabhade (2011) studied on Rotifers in Washim District of Maharashtra, India and 100 Rotifer species, out of 25 families and 63 genera were identified. Sitre (2012) made some observations on biodiversity of Rotifers in the freshwater Lake of Nagpur.
City, India, and have reported that seasonal rotifer biodiversity showed the peak in density and diversity during summer season while lower values were observed in rainy season and also 14 species were recorded in winter, 16 species in summer while lowest 11 species were recorded in monsoon season. Vaishali (2012) studied on the occurrence of Rotifers in Kacharali, Lake, Thane, Maharashtra State of India and observed minimum number of Rotifers was due to the nutrient availability. The study also revealed that the water quality of the eutrophicated lake Kacharali considerably improved with the increase in DO levels and reduction in the CO₂, total hardness, total alkalinity and calcium content. Karuthapandi et al. (2013) made some investigations on freshwater Rotifers of Andhra Pradesh have reported 114 species of freshwater of which 113 species belonging to Monogononta (03 orders, 22 families, 39 genera) and only one species belonging to Bdelloidea, and also identified the family Lecanidae has high species richness with 26 species followed by Brachionidae with 24 species. Ramulu and Banerjee (2013) made some investigations on the plankton biodiversity of Nagaram tank of Warangal, Andhra Pradesh State of India and reported that a total of 39 species of zooplankton in which Rotifers dominated followed by Cladocera, Copepoda and Ostracoda were identified. Vanjare and Pai (2013) in their study on ecology of freshwater Rotifera in a seasonal pond of the university of Pune (Maharashtra, India) recorded that Rotifer richness is positively correlated to rainfall and temperature, whereas a negative correlation between pH and conductivity is observed and also Rotifer abundance is positively correlated with pH, whereas no such correlation is observed with temperature and conductivity. Irfan et al. (2014) studied on Rotifer community in Manasbal Lake of Kashmir have identified 33 species of Rotifera belonging to 17 genera and 7 families were recorded and Rotifer community was characterised by high richness of family Brachionidae. Sudhir (2015) made some investigations on species diversity of Rotifers in lentic ecosystem of Dhukeshwari Temple Pond Deori with Reference to Cultural Eutrophication shows 46 species of rotifers belonging to 15 families from 3 orders were recorded. A Review by Supratim et al. (2015) observed that B. calyciflorus is considerably pollution tolerant species and also they reported that Brachionus calyciflorus can thus be favoured as ‘test organism’in aquatic toxicology. Prospect of Brachionus Calyciflorus, a holoplankton, for its potential bio-indicator property: Zooplankton diversity in Ramkund of Godavari river, Nashik district, Maharashtra by Bhadane (2016) identified in the present study 32 species of zooplankton were
identified, the results of present investigation reveal that Rotifera dominated in the water bodies of Ramkund. Javaid et al. (2016) carried out checklist of Rotifer community from Wular lake of Kashmir Himalaya, twenty six taxa of rotifers were recorded from the nine study sites, belonging to eleven families and among the recorded families, Brachionidae was the dominant, followed by Lecanidae and Lepadellidae.

Regionally some studies on Rotifer zooplankton dynamics have been carried out in Karnataka State. For example, Sunkad and Patil, (2004) assessed the water quality of Fort lake Belgaum, Karnataka State of India and they found dominance of Rotifers in the lake due to the continuous supply of food material and high level of phosphate and nitrates. Shivashankar and Venkataramana, (2013) reported the zooplankton Diversity and their Seasonal Variations of Bhdra Reservoir, Karnataka, India found a total of 23 species in this reservoir, among these, rotifers comprise of 8 species (22.78%), Cladocera 5 (22.17%), Copepods 3 (25.13%), Ostracoda 2(14.69 %) and 5 protozoan species (13.25%). Amsha and Suresh (2014) made investigations on the diversity of Rotifer (Rotifera) with special reference to physico-chemical parameters from a tropical reservoir, Kullurchandai, Virudhunagar District, India. They reported 40 species of rotifers with various categories such as, eurythermal, stenothermal, alkalophilic and eutrophic indicators, among these species, the genera Brachionus and Lecane were dominant in their presence. Venkataramana et al. (2015) made some observations on taxonomical study and Diversity of Rotifers in Chikkadevarayana canal of Cauvery , Karnataka, India have identified among 22 genera of rotifers, the maximum of 11 species belonged to family Brachionidae followed by 5 species from family Lecanidae, 2 species of Euchlanidæ, Collurellidæ, Notommatidæ and Philodinidæ respectively.

Mruthyunjaya et al. (2016) in this study on distribution and abundance of zooplankton in Ayyanakere lake, Chikmagalur district, Karnataka have reported that a total of 17 species and 15 genera of zooplankton were recorded and represented by 4 main groups namely Rotifera, Cladocera, Copepoda and Protozoa. Diversity of zooplankton and their seasonal variations of Gogi lake, Shahapur taluk, Yadgir district, Karnataka, India by Imran et al. (2016) have recorded a total of 22 species of zooplanktons, out of which Rotifers 15 species, Cladocera 3, Copepoda 3 and Ostracoda 1 species were found.
Very few studies are available on zooplankton diversity and abundance correlated with water quality parameters in and around Mysore. Padmanabha (2006) made some investigations on population dynamics of Rotifers and WQI of Kamana, Kukkarahalli, Karanji and Dalvoy lakes of Mysore reported that maximum water quality index (WQI), species diversity and Rotifer abundance during summer season and minimum during winter season. Sachidanadamurthy and Yajurvedi (2004) made some investigations on water quality of Yennehole Lake and Bilikere lake of Mysore and they revealed significantly high values of nutrients, ammonia and low plankton diversity in Yennehole lake compared to Bilikere lake. Koorosh et al., (2008) studied the abundance of zooplankton in three contrasting Lakes of Mysore city, Karnataka and reported that quantitative analysis of zooplankton in Bannur, Lingambudi and Hebbal lakes indicated that abundance of Rotifers in Hebbal Lakes is higher than Bannur and Lingambudi Lakes during rainy season, because of higher polluted nature of the site. Padmanabha (2010) studied the diversity of rotifers in the lakes of Mysore city and totally sixteen species of rotifers were documented, out of which 10 sp belong to genus *Branchionus*, 3 sps to genus *Keratella*, 2 sps to genus *Filinia* and 1 sp to genus *Plationus*.

To the best of my knowledge, Rotifera community of Kukkarahally Lake of Mysore has not been studied so far. Hence, the research work was undertaken with the aim of finding season wise (winter, rainy and summer) changes in the abundance, and species diversity of Rotifera in Kukkarahally Lake of Mysore.

1.4.3. Cladocerans

The sub-class Branchiopoda of order Phylopoda includes mainly microzooplankton called cladocerans which are small Arthropod crustaceans commonly found in most freshwater habitats, including lakes, ponds, streams and rivers. The term Cladoceran is useful in describing crustaceans of similar appearance. Cladocerans are commonly known as “water fleas” prefer to live in clear waters and their general appearance as jerky swimming motion (Sivakumar and Altaff, 2004). Cladocerans vary in size from 0.2 to 6.0 mm long and their identification is only possible with the help of a microscope. The head has a single median compound eye, and a carapace covering the apparently unsegmented thorax and abdomen. In most species, the body is not segmented, but it is covered by a secreted shell. The shell has
an appearance like that of an bivalve, however, the shell is one continuous piece, folded in half. Looking at a lateral view of a Cladoceran, the shell may be oval, circular, elongated, or angular. The head of a Cladoceran is a very small, compact structure. It is bent in a down ward position and is easily recognized by the large compound eye. There are 5 or 6 pairs of lobed legs, and each is covered with setae and hairs. Generally males are smaller than females, have larger antennae, and their first pair of legs contains a hook at the end used for grabbing and holding (Figuerola and Green, 2002). Cladoceran body and limbs are covered by a bivalve carapace, which is composed of a single piece and with no hinges dorsally. A few species of Cladocerans are predacious, but most species are herbivorous. The herbivorous mainly feed on phytoplankton, decaying organic material, and bacteria. As a group they constitute a major item of food for fish. Cladocerans are desirable fish prey, they have high energy caloric value, assuming that they can be consumed by fry. Thus, they hold key position in food chain and energy transformation (Uttangi, 2001). About 600 species of freshwater cladocerans have been reported (Korovhinsky, 1996) to occur throughout the world and in India. About 110 species have been recorded (Patil and Gouder, 1989). Cladocerans can play an important role in the recycling of nutrients in aquatic ecosystems. Because of their intermediate tropic position, they often have a critical role in the transfer of energy through aquatic food webs, as well as in regulating the transfer of contaminants and pollutants to higher tropic levels (Hall et al., 1997). They control the algal growth by efficient grazing, therefore, are considered as indicators of water quality (Rajashekhar et al., 1997; Joshi 2011 and Deepthi et al., 2014) and are important diet of zooplaktivorous fish.

1.4.4. Review of literature

Internationally several investigative studies have examined and reported about Cladocera zooplankton in different regions of world. Green et al., (2005) studied on the factors influencing Cladoceran abundance and species richness in brackish lakes in Eastern Spain. They have reported that wetlands for birds is reflected by a similar importance for micro crustaceans and the high density of migratory birds coming from other wetlands has produced a high species richness of cladocera via zoochory. Ahmet and Sibel (2002) worked on zooplankton fauna of Lake Burdur and have reported and identified new species of Cladocerans. Figuerola and Green, (2002) studied on the dispersal of aquatic organisms by water birds has reported that
Cladocera are able to passively disperse between wetlands via birds and it has been suggested that wetlands frequented by more migratory birds should hold a higher species richness of Cladocera. Ayzel, (2003) observed a taxonomical study on the zooplankton of Goksu Dam lake, it has reported a total of 47 species composed of 16 Cladocerans, three copepods and 28 rotifers were identified. Sibel, (2004) made observations about abundance and seasonal variations of Cladoceran and Copepod fauna of Kesikkoprii Dam Lake in Turkey have reported Daphnia longispina was found as the most abundant Cladoceran species and its peak was observed in April 1995 and the highest number of Cladoceran species was recorded in June 1995 and the lowest in January 1996. Rylander and Leticia (2005) made some studies on the diversity and abundance of littoral Cladocerans and Copepods in Ecuadorian highland lakes, and they reported that the important factors determining zooplankton diversity. Jarl Eivind (2003) studied on the long-term changes of the crustacean zooplankton community in lake, Norway, the study revealed that seasonal means of zooplankton biomass were positively correlated with phytoplankton bio volume. Phannee et al. (2005) made some investigations carried out studies on Cladocerans diversity, abundance and habitat in a western Thailand stream and found 40 species of Cladocerans and also reported that the abundance was more in between April and September and was highest in the month of September. Renella and Quiros (2006) studied the relations between planktivorous fish and zooplankton in two very shallow lakes of the Pampa plain it has observed, changes in cladoceran species composition were reflected in the Cladoceran size structure. Korovchinsky, et al., (2008) carried out few studies about the global diversity of Cladocera and revealed that a high diversity of Cladocera was found in littoral zone in temporary water bodies. Seasonal variations and species composition of crustacean zooplankton (Order : Cladocera) in Manchhar Lake, Sindh, Pakistan by Mahar et al. (2008) have reported that 10 species belonging to 9 genera and 4 families of order Cladocera were identified, out of 10 species, 01 species Dunhevedia crassa is a new record from Pakistan. Solomon et al. (2008) studied on population growth of the fresh water Cladoceran, Diaphanosoma excisum, Fed different densities of the alga, Scenedesmus acuminatus have found the D.excisim density increased as the Scenedesmus density increased to 1.5 x 106 cells/ml, in which it peaked at 7345 individuals per liter. Cladocera and copepoda fauna of Aslantas Dam Lake (Osmaniye- Turkey) by Ahmet et al. (2009) have reported the most abundant species was Bosmina longirostris among
cladocerans. Santos et al. (2010) made some investigations on biomass and production of cladocera in Furnas reservoir, Minas Gerais, Brazil have reported mean production of the Cladocerans were about 3-fold higher in the rainy period than in the dry one. Aija et al. (2013) reported that occurrence of Cladocera and the genetic diversity of Daphnia cucullata in the pelagic zone of Latvian salmonid lake and the most dominant species of Cladocera were Diaphanosoma brachyurum, Daphnia cucullata, Bosmina crassicornis, Bosmina longispina, and Bosmina longirostris. Kotov and Reines (2014) in their studies on Cladoceran fauna in the Santa Marta water body, Magdalena in Colombia found a new species of Cladocerans. Taxonomy and distribution of four Cladoceran families (Branchiopoda: Cladocera: Moinidae, Bosminidae, Chydoridae and Sididae) in Philippine inland waters by Jhaydee et al. (2014) their results indicated that the presence of 16 species from families Moinidae, Bosminidae, Sididae and Chydoridae. Zooplankton (Cladocera) density and identification during seven successively months in Anzali wetland and compare with estuarine region and the Caspian sea, Iran by Sara et al. (2014) reported that the maximum Cladocera density was seen during April with 22 numbers per litre.

Nationally many research works have been carried out on the abundance of Cladoceran zooplankton by researchers across India. For example, Sivakumar and Altaf (2004) studied on ecological indices of freshwater copepods and Cladocerans from Dharmapuri district, Tamil Nadu and have reported that 4 copepods and 7 Cladoceran species were identified in the zooplankton samples collected from fifty freshwater bodies. Studies on the Diversity and abundance of Cladocerans in Guntur Pond (Tiruchirappalli, Tamilnadu) by Gulam et al. (2007) reported 10 species of Cladocerans which belonged to four families (Daphnidae, Moinidae, and Chydoridae). Sharma (2012) studied on diversity of zooplankton in a tropical floodplain lake of the Brahmaputra River basin, Assam State of India and observed that the physico-chemical parameters affecting the abundance of Cladocera. A report on the freshwater Cladocera (Crustacea: Branchiopoda) of south Rajasthan (India) by Vipul et al. (2012) have reported that 54 species of cladocerans during the study, belonging to six families viz. the Sididae, Daphniidae, Moinidae, Bosminidae, Macrothricidae, and Chydoridae. Diversity and Abundance of Cladoceran Zooplankton in Wular Lake, Kashmir Himalaya by Javaid and Ashok (2013) have revealed that 23 species of Cladocera belonging to six families were reported during
the entire study, among the six families, *Chydoridae* was numerically dominant and represented by nine species, followed by *Daphnidae* with seven species, *Bosminidae*, *Moinidae* and *Sididae* with two species. Debashri *et al.* (2013) studied on diversity of Cladocerans and Copepods of Mirik Lake in Darjeeling Himalaya have reported that *Bosmina* *sp.* and *Leydigia* *sp.* were found to be the most common Cladoceran species. Mondal (2013) made some investigations on the diversity of Cladocerans and Copepods of Mirik Lake in Darjeeling, West Bengal State of India by) have identified total of six varieties of Cladocera which includes *Bosmina* *sp.* and *Leydigia* *sp.* during the whole study period. Distribution and diversity of zooplanktons in Madhya Pradesh State of India by Sharma *et al.* (2013) have found 9 species of Cladocera among them *Moinidae* was the dominant family. Papia (2013) in his study on zooplankton diversity and physico-chemical parameters of Ramnagar annua, Cachar, Assam State of India have reported the maximum number of Rotifer followed by Cladocera. He also added that high value of specie richness reflects the suitability of the habitat for the organisms on the other hand it is correlated with the ecosystem of the lake. Plankton biodiversity of Nagaram tank of Warangal, Andhra Pradesh State of India by Ramulu and Banerjee (2013) have reported a total of 39 species of zooplankton in which Rotifers dominated followed by Cladocera, Copepoda and Ostracoda. Study of cladocera diversity with reference to *Chydoridae* and *Bosmanidae* family of Nira left bank canal Baramati and Tarangawadi Lake of Indapur, Pune by Ghantaloo *et al.* (2013) have reported that 17 species of Cladocerans. Impact of aquatic macrophytes on crustacean zooplankton population in a vegetated pond at Aligarh, India by Uzma and Saltanat (2014) have reported the highest total number of crustacean zooplankton during June (247 No./L) while the highest macrophytes abundance was reported in July (48 No/m2), among three crustacean groups were recorded. Meshram *et al.* (2016) studied on species diversity of microscopic crustacean in Karmaveer Kannamwar reservoir, Regadi, Chamorshi, District Gadchiroli, India have reported that crustacean species density and diversity correlated with the Physico-chemical characteristics of water reveal the trophic status of water body.

Regionally some studies on Cladocerans zooplankton dynamics have been carried out in Karnataka State. For example, Sayeswara *et al.* (2013) observed the zooplankton biodiversity in Gowrikere tank in Shimoga, Karnataka State of India and recorded a maximum number of Cladocera followed by Copepoda and Rotifera. The
studies on the Abundance of cladocera in Malaprabha river, Karnataka State of India was carried out by Sunkad et al. (2013) and Daphnia carinata was reported the dominant species.

Few studies have been carried out on abundance of Cladocera from our laboratory Koorosh et al. (2008) studied about the abundance of zooplankton in three contrast ing Lakes of Mysore city, Karnataka and reported that quantitative analysis of zooplankton in Bannur, Lingambudi and Hebbal lakes indicated that abundance of Cladocerans in Hebbal Lakes is higher than Bannur and Lingambudi Lakes during rainy season, because of highly polluted nature of the site. Savitha and Yamakanamardi (2012) made some investigations on the abundance of zooplankton in three lakes of Mysore have reported that the total abundance of Cladocera was high in polluted lake (Dalvoy) when compared to the other two lakes (Kalale and Alanahalli) and the study also revealed the Cladocerans abundance was high during winter season. Deepthi and Yamakanamardi (2014) studied about the abundance of Cladocerans in Varuna, Madappa and Giribettethe lakes of Mysore and reported that the abundance of Cladocera was maximum during winter season.

To the best of my knowledge, Cladocera community of Kukkarahally Lake of Mysore has not been studied so far. Hence, the research work was undertaken with the aim of finding season wise (winter, rainy and summer) changes in the abundance, and species diversity of Cladocera in Kukkarahally Lake of Mysore.

1.4.5. Copepods:

Copepod is one of the most important groups of freshwater zooplankton and is one of the most numerous animal groups on the earth, occurring in all types of freshwater bodies. These utilize varieties of food items ranging from detritus, bacteria to a wide array of unicellular and multicellular phytoplankton and they serve as an excellent food for zooplanktivorous fish. Their nutritional value is high. These play vital role in energy transfer from primary producers to secondary consumers in aquatic ecosystem. Freshwater copepods constitute one of the major zooplankton communities occurring in all types of water bodies. Among microcrustacean planktonic, the copepods Cyclopoidea and Calanoidea are one of the most representatives, being the largest biomass of the plankton community (Gunwati et al., 2012). The time required to complete the juvenile stages is highly variable
among species and depends upon seasonal conditions (Wetzel, 2003). Copepods serve as food of several fishes and play a major role in the freshwater ecosystems. Some copepods are the vectors of fishes, tapeworm and nematodes (Patil and Gouder, 1989). The copepods constitute dominant planktonic group of both freshwater and marine habitats. It includes three free living groups viz., Calanoida, Cyclopoidea and Harparticoida. 1200 marine and freshwater species of Calanoides, 1000 Cyclooids and 1200 Harpacticoids have been recorded. About 120 species of freshwater free – living copepods are known from India (Uttangi, 2001). Copepods play major roles in aquatic ecosystems moreover serving as food for small fish, intermediate hosts of fish parasites, and hosts and vectors of human diseases. Copepods are sub divided into three groups viz, Calanoid, Cyclopoid and Harpacticoid. Among the copepod orders, Calanoida is exclusively planktonic and free-living; Cyclopoidea is free – living and parasitic. Herpacticoida is mostly free-living and bottom- dwelling forms.

1.4.5.1. Calanoid – copepods

Calanoid - Copepods are abundant in marine waters. Calanoid-c copepods are good indicators of water pollution as it is present only in good quality of water. The body is divided into head region bearing five pairs of appendages representing antenna and mouth parts and the thorax with six pairs of swimming legs. Calanoids and their larval forms constitute natural food for many larval and adult shell fish and fin fishes (Altaff et al., 2003). These constitutes a major zooplankton communities occurring in almost all the water bodies, which serve food for many fish and play a vital role in ecological pyramids.

1.4.5.2. Cyclopoid – Copepods

Cyclopoid – Copepods are dominated in the freshwater bodies, range from 0.6mn to 3mm in length. Cyclopoid-Copepods play an important role in aquatic food webs as either primary consumers or predators. They can also be an important source of food for larval, juveniles, and adult fishes of many species. Cyclooids are intermediate hosts of many parasitic worms that infect vertebrates. Some Cyclopoid - Copepods are also known to be voracious predators on mosquito larvae and have been used for large-scale mosquito control programs (Marten et al., 1994). By reducing the number of mosquitoes, many of which are known to be vectors of various diseases,
Copepods may be seen as being beneficial zooplankton groups. The order Cyclopoida comprises species in which the last thoracic somite (Th5) is different from the preceding ones and is in fact part of the posterior body. Antennules of the female consist of 9 to 17 segments. Antennae is uniramous, maxilliped is simple without prehensile claw. Two genital pores, situated sub-dorsally on each side of the seminal receptacle are present.

1.4.5.3. Harpacticoid - Copepods

Harpacticoid - Copepods are almost exclusively littoral, habituating macrovegetation and they are usually less than 1mm in length. They belong to the order Copepoda, in the subphylum Crustacea. Harpacticoid - Copepods normally reproduce sexually, although some species have a capacity to reproduce parthenogenetically. Most harpacticoids feed on organic waste or algae, some species are predators, swarming over small fish and immobilizing them by eating their fins. The mouthparts of harpacticoids are adapted for seizing and scraping particles from the sediments and macrovegetation. Some freshwater copepods acts (Kotwicki, 2002 and Dussart and Defaye, 2001). Harpacticoids play an important role in aquatic food webs. They are primary consumers and can be an important source of food for the juvenile stages of predator fish and for the species of fishes that serve as food for predators.

1.4.6. Review of Literature

Numerous studies have been carried out by different researchers across the world and in India as well, few recent investigations have been mentioned at this study about Cyclopoid- Copepods in different regions of world. Chih (1997) studied on the mesh size of the plankton net and its effect on the result of statistical analyses of the relationship between the Copepod community and water masses. According to him there was an insignificant change in the relationship between the Copepods community and water mass. Martin (1999) studied the ecology of the Cycloploid - Copepods from the Cochin backwater reported that 28 species of cyclopoid copepods have been studied in the present observation. Copepod composition, abundance and diversity in Makupa Creek, Mombasa, Kenya by Osore et al. (2003) have reported that 51 copepod species belonging to 38 genera in the family’s Calanoida (25), Harpacticoida (5), Poecilostomatoida (7) and Cyclopoida (1) were identified.
Zooplanktonic diversity of 6 ponds of Durg-Bhillai city, Chhatisgarh State of India was observed by Anil Kumar et al. (2004) and they found Rotifers and Copepods as the predominant group and thus indicating the nutrient availability in these ponds. Geoff et al. (2008) studied about global diversity of Copepods (Crustacea: Copepoda) in freshwater and reported that Diaptomidae is the dominant family in Calanoid-Copepods, Canthocamptidae is the dominant family in Harpacticoid-Copepods and Cyclopidae is the dominant family in Cyclopoid-Copepods. Koorosh et al. (2008) studied about the abundance of zooplankton in three contrasting Lakes of Mysore city, Karnataka and reported Cyclopoids are more tolerant to the environment parameters in Lingambudi Lake. Savitha and Yamakanamardi (2012) studied the abundance of zooplankton in three lakes of Mysore and reported that the total abundance of Cyclopoid-Copepods were high in polluted lake (Dalvoy) when compared to that of the other two lakes (Kalale and Alanahalli). Distribution, diversity and abundance of copepod zooplankton of Wular Lake, Kashmir Himalaya by Javaid Javaid et al. (2013) have reported that various diversity indices like Shannon-Weaver, Margalef and Fisher_alpha were used to assess the Copepoda diversity in the lake. Shivashankar and Venkataramana (2013) studied about the zooplankton diversity and their seasonal variations of Bhadra river, Karnataka, State of India and observed that Cyclops strenuous was the dominant species. Mondal (2013) made some investigations on the diversity of Cladocerans and Copepods of Mirik Lake in Darjeeling, West Bengal State of India by) have identified three varieties of Copepoda in which Cyclops sp. was the most common representative of Copepoda group during the whole study period. Anandan et al. (2013) investigated on different stages of post embryonic development of Apocyclops dengizicus in Tamil Nadu State of India and found Cyclopoid dominance in the fresh water. Few studies have been carried out on abundance of Cyclopoids from our laboratory. Gunwati and satish (2014) studied on Copepod diversity of Tembhapury Lake Aurangabad Region, India have reported that Cyclopoid density varied from month to month while Calanoid showed bimodal fluctuation pattern with peaks in summer and winter.

1.4.7. Ostracoda

Ostracods are commonly known as “mussel shrimps” or “seed shrimps” which are small crustaceans, usually smaller than a millimetre. They are found in a
wide variety of aquatic habitats like lakes, pools, steams. Ostracods are very numerous in both freshwater and marine environments. There are 2000 species reported so far. They have a laterally compressed body, which is not distinctly segmented and a bivalve carapace is present enclosing the head and the trunk with the limbs. There are three pairs of thoracic appendages which are stout and cylindrical, abdomen is rudimentary, the internal organs like the liver and gonads extend into the values of the carapace (Altaff, 2004). The body of ostracod is entirely enclosed in the cuticle secreted by the epidermis. Ostracods typically have no gills; instead they take in Oxygen through bronchial plates present on the body surface. Moreover, most Ostracods have no heart or circulatory system, as blood simply circulates between the values of the shell. Nitrogenous waste is excreted through glands on the maxillae and antennae. There are two pairs of well-developed antennae, which the animal uses to swim through the water column. In addition, there is a pair of mandibles and two pairs of maxillae. The thoracic region has two pairs of appendages. Some Ostracodes have a light organ in which they produce luminescent chemical (Altaff, 2004; Karanovic, 2012 and Karuthapandi 2014).

Ostracoda is one of the most diverse groups of crustaceans living in all aquatic ecosystems ie, marine, brackish, and freshwater. They are cosmopolitan in distribution and play a vital role in the food chain and energy flow in the aquatic habitat. Ostracoda is considered as a separate class under Crustacea and it has been divided into the subclasses *Myodocopa* and *Podocopa* (Martin and Davis 2001; Horne et al., 2002 and Karuthapandi 2014). The subclass Podocopa has the following three orders ie., *Platycopida*, *Podocopida* and *Palaeocopida*. *Platycopida* which includes marine and a very few brackish water forms. Podocopida which is present in both freshwater and the marine environment; and *Palaeocopida* known only from fossils records (Karanovic 2012 and Karuthapandi 2014).

**1.4.8. Review of literature**

Numerous studies have been carried out by different researchers across the world and in India as well, few recent investigations have been mentioned at this study. Ostracoda I1 - Myodocopa by Erik (1969) made some investigative studies about diversity of Ostracoda. Hussain and Mohan (2000) in their study on ostracods from Adyar river, Chennai, Tamil Nadu State of India, have reported 26 species
belonging to 23 genera. Mohammad (2001) made some studies on ecology of eight species of freshwater ostracods (crustacea) from Qena Governorate, upper Egypt reported that eight species of freshwater ostracods. Ecology of eight species of freshwater ostracods (crustacea) from qena governorate, Upper Egypt. Mohammad et al. (2004) have reported 2324 specimens from the eight different species studied during the whole period of investigation and found most dominant species was Cypridopsis vidua. Kulkoyluoglu (2004) studied on the usage of ostracods as bio-indicator species in different aquatic habitats in the Bolu region, Turkey and found 18 species of Ostracods which serves as bio-indicator of water quality. Padmanabha and Belagali (2008) who investigated Ostracods as indicators of pollution in the lakes of Mysore, Karnataka State of India, reported highest water quality index and population density of Ostracods during summer and least during winter season. Few studies have been carried out on abundance of Ostracods from our laboratory. Higuti et al. (2009) studied on composition and distribution of Darwinulidae (Ostracoda) in the alluvial valley of the upper Paraná river, Brazil and found that the occurrence and distribution of Ostracods were significantly related to biotic variables but not to abiotic variables. Freshwater Ostracoda (Crustacea) of Diyarbakir Province, including a new report for Turkey by Derya and Okan (2011) have reported 23 freshwater ostracods belonging to 14 genera from 50 out of 90 different water bodies in Diyarbakır. New record of some freshwater seed shrimps (ostracoda: podocopida) from lakes of Sindh, Pakistan Mukhtiar and Syed (2012) have reported five species of seed shrimps belonging to five genera Cypris subglobosa, Eucypris virens, Dolerocypris sinensis, Herpetocypris fontinalis and Cypridopsis obesa. Elakkiya (2012) studied on environmental and ecological parameters of recent Ostracods in Cauvery River, Poombuhar, Tamil Nadu State of India and found 17 Ostracods species belongs to 12 genera. Water quality assessment of Godavari river at Parbhani district, Maharashtra State of India was studied by Rankhamb and Rau (2012) who found two species belonging to Ostracod. Ruiz et al. (2013) studied on freshwater Ostracods as environmental tracers have found ostracod carapace serves as a tracer of the water quality. Robin et al. (2014) made some investigations on the freshwater ostracod (Crustacea) genus Notodromas Lilljeborg, from Japan have reported that unusual lifestyle for ostracods (most being benthic, nektobenthic), is facilitated by a highly modified, concave ventral surface of the carapace, which can attach to the underside of the water surface. Contribution to the Freshwater Ostracoda (Crustacea)
fauna of Turkey Hamidreza et al. (2014) have reported three species (Eucypris kerkyrensis, Cyridopsis elongata, Bradley strandesia parva) were new records for the Ostracoda fauna of Turkey. Ramulu et al. (2011) made an investigation on seasonal changes in the Ostracods population in relation to the physico-chemical changes of a perennial tank in Warangal district, Andhra Pradesh State of India and reported five species of Ostracods, whose diversity was highest during summer and lowest during winter season. Kadiam et al. (2014) made an investigation on zooplankton diversity of BrahmaSarovar, Kurukshetra district, Haryana State of India and reported that Ostracods were maximum during summer and minimum during winter season. Seasonal changes in the Ostracod population in relation to the physico-chemical changes of a perennial tank in Warangal District by their present investigation a total of five species of Ostracods such as Cypris spp., Heterocypris spp., Hemicypris fossiculata, Llycypris gibba and Standansia elongata were recorded. Freshwater Ostracoda (Crustacea) of India - a checklist by Karuthapandi et al. 2014) have reported that freshwater habitat exhibits a high Ostracoda diversity.

1.4.9. Total Zooplankton

Zooplankton groups are a characteristic indicator of water quality, eutrophication, pollution levels, and important source of food chain. Because of their short life cycle they respond quickly to environmental changes in water surrounding eg., water quality, such as pH, temperature, colour, taste etc. Therefore they used as indicator of overall health or condition of their habitat. The zooplanktons are resident fauna of aquatic ecosystems which respond to a wide range of water quality changes and monitoring have a very feeble locomotive power. The zooplankton serves as an important link in the aquatic food chain (Sharma, 1998). Zooplankton plays an important role in the food chain of fish as animal food, which supply amino acids, fatty acids, vitamins, minerals, etc., (Kudari and Kanamadi 2008; Rajashekar et al., 2010; Chattopadhyay and Barik 2009; Sawane et al., 2009; Joshi 2011). Zooplankton communities are highly sensitive to environmental variations, such as water temperature, light, chemistry particularly pH, Oxygen, organic nutrients, toxic contaminants and food availability such as algae and bacteria and predation by fishes as well as invertebrates. Zooplankton comprises an important constituent of fresh water ecosystems and their central place in food chain and webs. They transfer energy and matter from primary producers (algal biomass) to higher trophic levels such as
fish etc., and zooplankton plays an important role in the food chain of fish as animal food, which supply amino acids, fatty acids, vitamins and minerals (Bhadane, 2016).

1.4.10. Review of Literature

Internationally several investigative studies have examined and reported about total zooplankton in different regions of world. For example, Mary (1997) made some observations about experimental assessment of the influence of zooplankton size and density on gizzard shad recruitment reported that interactions among zooplankton size, zooplankton density. Patoine et al. (2000) made an attempt to study about the influence of logging and forest fires on zooplankton biomass in Canadian Boreal Shield lakes and concluded that following disturbances burned-watershed lakes supported 58% more biomass of the Rotifer size. Augustus (2001) made some observations on the zooplankton diversity in Philippine Lakes and reported that the survival of the young of herbivorous fishes such as tilapia may depend on the availability of abundance of zooplankton in eutrophic conditions. Sinha (2002) reported that zooplankton plays an integral role and serve as bio-indicators and it is a well suited tool for understanding water pollution studies. Ayzel (2003) observed a taxonomical study on the zooplankton of Goksu Dam Lake, it has reported a total of 47 species composed of 16 cladocerans, three copepods and 28 rotifers were identified. Magalhaes et al. (2004) studied the spatial and temporal distribution in density and biomass of two species; it has observed that spatial and temporal distribution patterns in terms of density and biomass of two species of planktonic copepods. Claps et al. (2004) made some investigations on the zooplankton biomass in Pampean lake in Argentina and have reported that the annual biomass distribution showed peaks during winter and summer seasons. Jolanta (2006) reported that the role of zooplankton (ciliata, rotifera and crustacea) in phosphorus removal from cycling: lakes of the river Jorka watershed (Masuria lakeland, Poland) showed that in most lakes the role of small Cladocerans, copepods, rotifers and protozoans in the consumption of algal food and nutrient regeneration was more important. Stefanova et al. (2007) observed the zooplankton community changes along the eutrophication gradient of Varna Lake and reported that statistical methods revealed out dissimilarities between the stations, due to the presence or absence of species abundance and biodiversity indices. Meral (2010) carried out some studies on the zooplankton fauna of lake Bursa, Turkey, a total of
54 taxa which including 35 taxa from rotifers, 14 taxa from cladocerans and 5 from copepods were identified in their study. Iskender (2010) studied about the zooplankton seasonal abundance and vertical distribution of highly alkaline lake Burdur, Turkey and reported that six zooplankton taxa were recorded. Mustapha (2010) observed the influence of limnological variables on plankton dynamics of a small tropical African Reservoir and categorized the water quality as excellent based on the physico-chemistry of the reservoir and also recorded the zooplankton composition as moderate; dominated by Rotifera followed by Cladocera and Copepoda. Sherbiny (2011) identified a total of 32 taxa of zooplankton species in their study on the seasonal population density of zooplankton in Lake Timsah, Egypt. Lusia (2014) observed zooplankton and diatoms of temporary and permanent freshwater pans in the Mpumalanga Highveld region, South Africa which reported that differences among the compositions of zooplankton and diatom communities. Population dynamics of Rotifera in Ismailia Canal, Egypt was reported by Nehad (2014) studied seasonal trophic dynamics affect zooplankton community variability in Canada. Azma et al. (2015) who studied a comparative study of zooplankton diversity and abundance from three different types of water body, were reported that the average of total diversity of zooplankton. Dipankar et al. (2015) in their studies on zooplankton diversity indices: assessment of an ox-bow lake ecosystem for sustainable management in west Bengal reported that three major groups of zooplanktons Rotifera, Copepoda and Cladocera were identified.

Nationally many research works have been carried out on the abundance of total zooplankton by researchers across India. For example, Rezai et al. (2002) studied on zooplankton biomass in the straits of Malacca and this study has reported that the zooplankton biomass might be slightly overestimated in the present study. Das et al. (2002) observed the dynamics of net primary production and zooplankton diversity in brackish water shrimp culture pond in northern part of Ganjam district, Orissa State of India and he found Copepods and Rotifers were the dominant groups among zooplankton. Sadguru et al. (2002) carried out seasonal study on the dynamics of zooplankton in a fresh water pond from waste land of Brick Kilns; Gujarat State of India reported that zooplankton population density was maximum in April and minimum in January. Maruthanayagam et al. (2003) in their study on zooplankton diversity in Thirukkulum pond, Mayiladuthurai, Tamil Nadu State of
India observed higher density of zooplankton during rainy season, with Copepods forming the dominant group followed by Cladocera, Rotifera and Ostracoda. Sharma and Sarang (2004) revealed the decline in zooplankton population in the lake was due to the predatory effect of Tilapia fish. Awasthi and Tiwari (2004) studied seasonal trends in a biotic factors in Govindgarh lake, Madhya Pradesh State of India have reported that an inverse relationship between dissolved oxygen and temperature and the study also revealed that the lake was polluted. Pandey and Verma (2004) in their study on the influence of catchment on chemical and biological characteristics of Baghdara Lake and Udai Sagar Lake in Southern Rajasthan reported that the physico-chemical and biological analysis of both the lakes reveals that Udai Sagar lake. A total of 42 species of zooplankton have been recorded Patil and Auti (2005) who observed seasonal variations of zooplankton from Salim Ali Lake of Aurangabad. Abdullah et al. (2006) studied on physico-chemical conditions and plankton population of two fish ponds in Kheelna has reported that maximum diversity and abundance of zooplankton were in the months of August and September. Sadhana and Pratiba (2006) in their study on the physic-chemical status of upper lake, Bhopal, Madhya Pradesh State of India observed that Phosphate and Nitrate were high in these lakes which lead to eutrophication. Dhembare (2011) revealed that the diversity and density of zooplankton in Mula Dam, Rahuri, Maharashtra State of India, recorded that the diversity and density of zooplankton depends upon the nutrient condition of water body. Sharma and Sumita (2011) studied the assessment of zooplankton diversity of Loktak lake, Manipur, India, this study showed limited influence of individual abiotic factors on zooplankton. Sitre (2012) in his study revealed that the seasonal variation of zooplankton in a perennial urban lake of Nagpur city, Maharashtra State of India concluded that the lake harbours a rich and bio diverse fauna which fluctuate according to physic-chemical conditions. Shinde (2012) made investigations on seasonal variations and biodiversity of zooplankton in Harsool-savangi dam, Aurangabad, India have recorded a total of 25 genera of which 10 were Rotifers, 8 Cladocerans, 5 Copepods, 2 Ostracods. Zooplankton diversity indices of Dharmasagar lake, Warangal district (A.P) by Balakrishna et al. (2013) shows that all the four major groups of zooplanktons were identified in this study. Srivastava and Sanjeev (2013) studied on the zooplankton occurrence and their monthly variations in Ramgarh lake, Gorakhpur, Uttar Pradesh State of India observed that the zooplankton production in the lake was minimum during monsoon
season and maximum during winter season. Ramulu and Banerjee (2013) made some investigations on the plankton biodiversity of Nagaram tank of Warangal, Andhra Pradesh State of India and reported that a total of 39 species of zooplankton in which Rotifers dominated followed by Cladocera, Copepoda and Ostracoda were identified. A study on micro faunal diversity in two aquatic habitats of Washim district, Maharashtra State of India by Patil (2013) reported that the two water bodies are nutrient rich and suitable for pisciculture practices. Study on zooplankton composition and diversity of Umdasagar lake, Hyderabad, in Telangana State of India by Karuthapandi et al. (2013) reported that the lake is mesotrophic during winter and eutrophic during monsoon. Srivastava and Sanjeev (2013) made investigations on the monthly variations in the occurrence of zooplankton in a freshwater body, Ramgarh lake, Gorakhpur, U.P reported that zooplanktons are good indicators of changes in water quality. Analysis on zooplankton diversity in Pangdi lake, Gondia, Maharashtra State of India by Gunwant (2014) revealed that the total zooplankton density was more in winter season. Species diversity indices of zooplankton from Sadatpur reservoir, Ahmednagar, Maharashtra State by Avinash and Gholap (2014) identified that a total of 25 species of zooplankton belonging to different taxonomic groups were identified. Gayathri et al. (2014) made observations about studies on population dynamics and seasonal abundance of zooplankton community in Doddavoderahalli lake, Bangalore and they have reported that Rotifers species have showed a high magnitude of biodiversity. Pradhan (2014) studied on zooplankton diversity in freshwater Wunna lake have reported that the quantity of zooplanktons was found to be more during winter season. Zooplankton distribution in coastal of the North-Western Bay of Bengal, off Rushikulya estuary, east coast of India by Srichandan et al. (2015) have reported presence of 186 species of holoplankton and 23 different types of meroplankton. Zooplankton diversity in Ramkund of Godavari river, Nashik district, Maharashtra by Bhadane (2016) found that in the present study 32 species of zooplankton were identified, the results of present investigation reveal that Rotifera dominated in the water bodies of Ramkund. Rahul et al. (2016) made some investigations on zooplankton diversity indices and seasonal variations in Kadwai reservoir, Ratnagiri District, Maharashtra, India. The results showed that, species diversity of zooplankton was determined by using diversity indices. Zooplankton diversity and seasonal variation of Majalgaon Reservoir, Maharashtra State, India by Rajkumar and Pawar (2016) have reported 23 species from the reservoir, among
these, rotifers comprise of 8 species (28.92%), Cladocera 6 (19.638%), Copepods 5 (20.09%), Ostracoda 2 (19.317 %) and Protozoa 2 (12.02) were identified. Manikandan et al. (2016) studied that zooplankton diversity and seasonal variation of three Lakes in Coimbatore, Tamil Nadu, and India have reported that 30 of genera of zooplankton composed of 8 genera of protozoa, 9 genera of Rotifer, in which 7 genera belonged to Cladocera and 6 to Copepod were recorded in all the three lakes. Diversity of Zooplankton in some lentic water bodies of Karwar, Karnataka by Vasanthkumar et al. (2015) have reported that zooplankton diversity in different selected sites and their relation with hydro biological parameters.

Regionally some studies on total zooplankton dynamics have been carried out in Karnataka State. For example, Sukumaran et al. (1984) studied on zooplankton and a few physico chemical features of Milghatta and Hutcharyangere tanks in the Malanad region of Karnataka State of India observed that the zooplankton populations in the Hutcharayankere tank. Diversity and seasonal fluctuation of zooplankton in fish pond Bhadra fish farm, Karnataka by Kiran et al. (2007) reported that the density of zooplankton showed distinct seasonal variations. Zooplankton diversity of three freshwater lakes with relation to tropic status, Gulbarga district, North-East Karnataka, South India by Rajashekhar et al. (2010) studied on seasonal variations of Zooplankton community in freshwater reservoir Gulberga District, Karnataka, South India have recorded 24 species of zooplanktons, in which, 10 species belongs to rotifer, 6 species belongs to Cladocera, 5 species belongs to Copepod and 3 species of Ostracoda were identified. Zooplanktons, in which, 10 species belongs to Rotifera, 6 species belongs to Cladocera, 5 species belongs to copepod and 3 species of Ostracoda were identified. A comparative hydro biological study of santhekadur and Sogane ponds in Shimoga distric, Karnataka State of India were studied by Venkateshwarlu et al. (2011) and they reported that Copepoda and Cladocera were the dominant group of Zooplankton in their study. Sadashivappa et al. (2011) carried out a study on Zooplankton biodiversity of Kundavada Lake of Davengere district Karnataka State of India revealed that ten genera of zooplankton and they also observed that zooplankton and water quality parameter relationships varied according to the status of lake water. Shivashankar and Venkataramana (2013) reported that zooplankton diversity and their seasonal variations of Bhadra Reservoir, Karnataka, India, found a total of 23 species in this reservoir, among these, rotifers comprised of
8 species (22.78%), Cladocera 5 (22.17%), Copepods 3 (25.13%), Ostracoda 2 (14.69%) and 5 protozoan species (13.25%). A study on the influence of physic chemical parameters on zooplankton diversity in four wetlands of Tipur Taluk of Tumkur District, Karnataka State of India by Jagadeeshappa and Vijaykumar (2013) observed more diversity and density of zooplankton during premonsoon (summer) period and gradually decreased during monsoon. Studies on population dynamics and seasonal abundance of zooplankton community in Doddavoderagalli Lake, Bengaluru, Karnataka State of India by Gayathri et al. (2014) found that zooplankton species exhibited significant seasonal changes and species diversity was maximum during summer and minimum during rainy and winter seasons. Ramakrishna (2014) made some investigations on Zooplankton abundance in Yelahanka lake, Bengaluru, Karnataka State of India and reported a high peak of phosphate and nitrate concentrations and also Zooplankton abundance. Meiofauna diversity in freshwater Lake, Kalaburagi district, Karnataka by (Reshma, 2015) have reported 19 species from 07 different families of Rotifera during the study period, among these, Lecanidae family comprises of 05 secies Brachionidae represented by 04 species, Lepadellidae family composed of 03 species. Ashok et al. (2015) made some studies on zooplankton diversity in Heroor Reservoir, Kalaburagi District, Karnataka have reported 5 genera of Rotifera, 4 genera of Cladocera, 3 genera of Ostrocoda. Zooplankton diversity in freshwater reservoir of Yadigir district, Karnataka state by Baswarajeshwari et al. (2015) recorded 23 genera of zooplankton, of which 13 genera belong to Rotifera, 5 genera of Cladocera, 4 genera belong to copepod and 2 genera were belong to ostracoda. Mruthyunjaya et al. (2016) in their study on distribution and abundance of zooplankton in Ayyankere Lake, Chikmagalur district, Karnataka have reported that a total of 17 species and 15 genera of zooplankton represented by 4 main groups namely Rotifera, Cladocera, Copepoda and Protozoa. Diversity of zooplankton and their seasonal variations of Gogi lake, Shahapur Taluk, Yadgir district, Karnataka, India by Imran et al. (2016) have recorded a total of 22 species of zooplanktons, out of which Rotifer 15 species, Cladocera 3, copepod 3 and Ostracoda 1 species were found. Zooplankton study and some physico chemical parameters analysis of madikoppa and benachi ponds in Alnavar, dist., Dharwad of Karnataka, India by Hemalatha et al. (2016) have reported that the different groups of zooplanktons have their own peak periods of density which is affected by local environmental conditions prevailing at that time.
Very few studies are available on zooplankton diversity and abundance correlated with water quality parameters in Mysore. Hydrobiology of Kukkarahalli lake Govindappa et al. (1998) carried out nutrient enrichment in the lake led to eutrophication. Padmanabha (2006) made some investigations on population dynamics of Rotifers and WQI of Kamana, Kukkarahalli, Karanji and Dalvoy lakes of Mysore and reported maximum water quality index (WQI), species diversity and Rotifer abundance was found during summer season and minimum during winter season. Ostracods as the indicators for pollution in the lakes of Mysore district by Padmanabha and Belagalli (2008) observed that highest water quality index and population density of Ostracods during summer and least during winter. Sachidanadamurthy and Yajurvedi (2004) made some investigations on water quality of Yennehole lake and Bilikere lake of Mysore and found that significantly high values of nutrients, ammonia and low plankton diversity in Yennehole lake compared to Bilikere lake. Padmanabha (2010) made some studies on diversity of Rotifers in lakes of Mysore city observed, sixteen species of rotifers were documented, out of which 10 sps belong to genus *Branchionus*, 3 sps to genus *Keratella*, 2 sps to genus *Filinia* and 1 sp to genus *Plationus*. Water quality assessment of dalvoy lake water, Mysore, Karnataka, India by Anima and Chandrakala (2016) recorded presence of very high bicarbonate hardness in the lake water studied.

From our laboratory, Koorosh et al. (2008) studied about the abundance of total zooplankton in three contrasting Lakes of Mysore city, Karnataka and reported that quantitative analysis of zooplankton in Bannur, Lingambudi and Hebbal lakes indicated that abundance of Rotifers and Cladocerans in Hebbal Lakes is higher than Bannur and Lingambudi Lakes during rainy season, because of higher polluted nature of the site. Savitha and Yamakanamardi (2012) studied the abundance of zooplankton in three lakes of Mysore and reported that the total abundance of Cladocera was high in polluted lake (Dalvoy) when compared to the other two lakes (Kalale and Alanahalli) and the study also revealed the Cladocerans abundance was high during winter season. Assessment of water quality index of Cauvery and Kapila rivers and at their confluence by Jomet and Yamakanamardi (2013) revealed that all the three sampling sites were severely polluted during rainy season as the WQI ranged from 76-100. Seasonal variations in the abundance of zooplankton groups in relation with physico-chemical parameters in three lotic ecosystems of Mysore reported by Jomet
and Yamakanamardi (2014) have reported total zooplankton (Rotifer, Cladocera, Copepod and Ostracod) abundance was significantly more in Cauvery river with the mean abundance of 18 Org/L compared to Kapila river (15 Org/L) and at their confluence site (14 Org/L). Water quality index and abundance of total zooplankton in Varuna, Madappa and Giribettethe lakes of Mysore, Karnataka State, India by Deepthi and Yamakanamardi (2014) found that the abundance was maximum during summer season and least during rainy season. Deepthi and Yamakanamardi (2014) carried out some studies on abundance of cladoceran zooplankton in Varuna, Madappa and Giribettethe lakes of Mysore, Karnataka state; India found that the abundance was relatively maximum during winter season and minimum during summer season.

Thus, from the above Literature survey, I found that there is a gap in the knowledge, especially in the species diversity of four groups of Zooplankton in Kukkarahalli Lake of Mysore, Karnataka State of India. Hence, the present investigation was taken up to fill up the gap in the knowledge of species diversity of four groups of zooplankton and to know this relationship, if any with 14 water - quality parameters.

1.5 Objectives

1. To study monthly variations, if any, in the species diversity of Rotifer, Cladocera, Copepod and Ostracod groups of Zooplankton for two consecutive years.

2. To study the seasonal distribution of Rotifer, Cladocera, Copepod and Ostracod Zooplankton groups with special reference to their qualitative and quantitative distribution.

3. To investigate the relationships, if any, between species diversity and diversity indices of Rotifer, Cladocera, Copepod and Ostracod Zooplankton groups with that of 14 water - quality parameters studied in Kukkarahalli Lake.

4. To know, changes in the temporal variations in 14 water-quality parameters and this correlations with species diversity indices of four groups of Zooplankton.