CHAPTER-2

REVIEW OF LITERATURE
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Limnology is the science that can provide improved understanding of Lake Ecosystem dynamics and information that can lead to sound management policies. As more studies are conducted on variety of lakes systems, the accumulated information leads to the development of general concepts about how lakes function and respond to environmental changes. One of the major impediments to the integration of lentic ecosystems into global environmental analysis has been fragmentary data on the extant and size distribution of lakes, ponds. Although lakes are of global importance, most analyses of functional processes in freshwater ecosystems have either emphasized regional similarities Thienemann, A. (1925) or have adopted an ecosystem specific emphasis.

Considerable hydro biological investigation are carried out on manmade impoundments in India SurendraKumar and Sharma (1991); Bahura(1998). Limnological observation on lake and ponds of Maharashtra have been carried out by many workers like Pendse et al., (2000) and Shastri and Pendse (2001). However there are few survey of physical and chemical characteristics and algae of pond water. So the present work was undertaken. Water quality is determined by the physical and chemical limnology of a reservoir Sidnei et al., (1992) and includes all physical, chemical and biological factors of water that influence the beneficial use of the water. Water quality is important in drinking water supply, irrigation, fish production, recreation and other purposes to which the water must have been impounded .Augelo et al., (1984) studied the limnology of Monjolinho reservoir (Brazil) and discussed the relationship between Physico-chemical and phytoplankton density and concluded that alkaline pH coupled with higher concentration of phosphate favours the abundance of cyanophycean members.

Lakes and ponds have played an important role in the water history of Karnataka .As a major part of Karnataka is in the rain shadow region of the Deccan plateau, ponds and lakes were the primary sources of drinking water and irrigation Lakes are also natural habitats for a characteristic flora and fauna including birds, fish and other aquatic life Chandrasheker,H. et al., (2009). Aquatic ecosystems are dynamic systems, in which several biotic and a biotic variables change in space and
time due to different processes. Lentic water bodies have tremendous importance, as they are recharging reservoirs for drinking water domestic use and as infrastructure for pisciculture, Koorosh Jalilzadeh et al., (2009. The realization of the causal changes in time of these complex systems is very restricted.

Although several literature exists on the hydrobiology of the rivers and lakes of Garhwal Himalayas (Singh et al, 1982; Dobriyal, 1983; Nautiyal, 1985; Bisht, 1993; Dobriyal et al 1993); (Negi, 1993; Rawat et al, 1993); with Sharma and Konswal (1987); Sharma (1984, 2003); and Agarwal and Thapliyal (2005), reporting on pre-impoundment studies on Physico-chemical and biological characteristics of Rivers Bhagirathi and Bhilangana which are the two rivers feeding the Tehri dam reservoir.

A lake is a large body of water surrounded by land and inhabited by various aquatic life forms. Lakes are subjected to various natural processes taking place in the environment, such as the hydrological cycle. As a consequence of unprecedented development, human beings are responsible for choking several lakes to death. Storm water runoff and discharge of sewage into the lakes are two common ways that various nutrients enter the aquatic ecosystems resulting in the death of those systems Sudhira and Kumar, (2000). The washing of large amounts of clothes by dhobis, laundry workers, and the continued entry of domestic sewage in some areas are posing pollution problems (Benjamin, Chakrapani, Devashish, Nagarathna and Ramachandra, 1996).

The quality of an aquatic system depends up on the physical and chemical characteristics as well as its biological diversity. Temperature is an important factor, which regulates the biogeochemical activities in the aquatic environment Temperature is one of the most important factors in the aquatic environment that regulates various Physico-chemical activities.Kumar.A. et al., (2006). Water depth as well as transparency is an important Factor for lentic water. The transparency of water was found to be in the range between 24.6 to 81.8 cm. The water transparency depends on the micro organisms present in water bodies and suspended organic and inorganic matter present in water. The reduced level of transparency observed during the present study was mainly due to suspended solids and suspended organic matters, which were
attributed by monsoon showers, addition of nutrients, human activities and other things (Khan M.A. 1996, Khatri.T.C.1985 and Waseemraja et.al., 2008). Phytoplankton growth is dependent on sunlight and nutrient concentrations. An abundance of phytoplankton / algae is indicative of nutrient pollution DeLange, (1994). Moreover algae are sensitive to some pollutants at levels, which may not visibly affect other organisms in the short term or may affect other communities at higher concentrations.

The increased demand of water as a consequence of population growth, agriculture and industrial development has forced environmentalists to determine the chemical, physical and biological characteristics of natural water Resources Regina and Nabi, (2003). Temporary ponds are found throughout the world. Though, there are considerable regional differences in their type and method of formation, many physical, chemical and biological properties are quite similar. The worldwide distribution of water body type leads to a large variety of temporary pond type due to climate and geological differences Solanki et al., (2007). Seasonal fluctuations and monthly variations of various physico-chemical factors in an aquatic ecosystem have an important role on the distribution, periodicity, quantitative and qualitative composition of water fungi, bacteria and actinomycetes. However, in India studies dealing with these aspects have been very few (Dayal and Tondon, 1962; Monoharachary, 1979).

Acidity and alkalinity are two independent variables which depend upon the quantity of positive and negatively charged ions present in the medium and interaction of both together determines the pH. Net acidity and net alkalinity are wildly used, poorly defined and commonly misunderstood parameters. Though, these variables are very important, as they affects other physico-chemical properties of medium, which ultimately determine the biotic composition of the systems (Saygideger and Dogan, 2005; Dwivedi and Tirpathi, 2007). Shobha Chaturvedi et al., (1996) made an attempt to assess the water quality of Kolar Dam and recorded low level of dissolved oxygen at the bottom of the dam as compare to surface layer of water indicating the fact that the quality of the bottom water is much degraded as compared to the surface water.

The physico-chemical and microbial characteristics of water depend upon
several factors including the location of water body, type of domestic, municipal and industrial water disposal, recreational and other constructional activities Paliwal, (1985) Water depth as well as transparency is an important Factor for lentic water. The transparency of water was found to be in the range between 24.6 to 81.8 cm. The water transparency depends on the microorganisms present in water bodies and suspended organic and inorganic matter present in water. The reduced level of transparency observed during the present study was mainly due to suspended solids and suspended organic matters, which were attributed by monsoon showers, addition of nutrients, human activities and other things (Khan M.A. 1996, Khatri T.C. 1985 and Waseemraja et al., 2008). Water quality deterioration in reservoirs usually comes from excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution and obnoxious fishing practices. The effects of these “imports” into the reservoir do not only affect the socio-economic functions of the reservoir negatively, but also bring loss of structural biodiversity of the reservoir. Djukic et al., (1994).

Dams are an inextricable element of our society and are built for a multitude of reasons like irrigation, power generation, drinking water supply and flood control at increasing cost Coller et al., (1998). A reservoir also referred to as man-made lake is an artificial water body formed as a result of damming a river. Various studies had been done on changes brought about in a biotic and biotic factors of Parent River as a result of damming, however responses of rivers and river ecosystem to dams are complex and varied as they depend on local sediment supplies, geomorphic constraint, climate, dam structure and operation and key attributes of the biota. Therefore, one-size-fits-all prescriptions cannot substitute for local knowledge in developing prescriptions for dam structure and operation to protect local biodiversity Power et al., (1996). India has more than 1500 large dams. Expanding human population brought about by the opportunities of good water supply, irrigation, fish production recreation and navigation offered by Reservoirs has put enormous pressure and stress on the quality of water impounded by the reservoir. The impact of human activities in and around the reservoir is felt on the unique physical and chemical properties of water on which the sustenance of fish that inhabit the reservoir is built as well as to the functions of the reservoir.
Ponds are favorable habitats for a variety of flora-fauna and also used by the anthropogenic society, so it's regular monitoring is necessary for control. Recently, lot of work has been done on changing ecological behavior of ponds (Mahananda et al., 2005; Kanungo et al., 2006; Gupta et al., 2008; Banerjee and Mandal, 2009). A number of study have been carried out on ecological condition of freshwater bodies in various parts of India (Gulati and Schultz, 1980; Rana, 1991; Sinha and Islam, 2002; Singh et al., 2002; Smitha et al., 2007). According to Murugan et al., (1998) and Dadhich and Sexena (1999) the zooplankton plays an integral role and serves bio indicators and it is a well-suited tool for understanding water pollution status (Ahmad, 1996; Contreras et al., 2009). However, information on relationship between Physico-chemical parameters and planktonic fauna is very limited (Ahmad and Siddiqui, 1995; Choudhary and Singh, 1999). Therefore, the present investigation attempts to study the zooplankton species richness, diversity and evenness in relationship between Physico-chemical parameters of Kunigal Lake. Sreenivasan (1964) reported that excessive flooding is the causative factor of low population of phytoplankton in rainy seasons. Considerable hydro biological investigation has been carried out on manmade lakes, irrigation and reservoir of Maharashtra. The notable among these are of Kamat (1965), Goel et al., (1988), Bhosale et al., (1994)

The water velocity was nearly nil in the lentic portions of the reservoir compare to faster Current in lotic. This can affect distribution of phytoplankton; since phytoplanktons are largely restricted to lentic waters and phytoplankton of rivers are reduced because of abrasive action of turbulence and of the substrata (Wetzel, 1975b; Chandler, 1937). The total alkalinity recorded in winter can be due to biological activity in water and lower alkalinity in monsoon may be due to effect of rainfall in decreasing it as suggested by Mookherjee and Bhattacharya (1949). According to FWPCA (1967), temperature, a catalyst, a depressant, an activator, a stimulator, a controller, a killer is one of the most important and influential water quality characteristics to life in water. Later Sreenivasan et al., (1964) worked on hydro biological featuers and plankton of Bavani sagar reservoir (Madras state). Again Sreenivasan (1965) studied the limnological aspects of the reservoir of Madras state that include Stanley reservoir and Mettur reservoir.

Looking at the scarcity of water, such natural water bodies and reservoirs
should be judiciously and hygienically handled so that water existing in such reservoir could be used for domestic purpose. Hence limnological studies on the existing reservoirs are of utmost importance. Similar studies have been made by various workers like Ganpati 1955, Krishnamurthy et al., 1965, Unni 1984, Saran and Adoni 1985.

Beeton (2002) predicted that climate change and pollution are global problems that will affect all lakes, large or small. Diversion of water out of or away from large lakes will become more of a threat as global human population growth continues and water supplies from river sand groundwater become depleted. Most of the aquatic ecosystems of varying characters worldwide receive regular inputs of a range of nutrients in varying quantities. High amounts of nutrients are unloaded into water bodies from human settlements via sewage. These nutrients result in the extensive growth of aquatic flora. Eutrophication is a kind of nutrient-enrichment process of any aquatic body, which results in an excessive growth of phytoplankton’s. This undesirable overgrowth of aquatic plants and their subsequent death form a greenish slime layer over the surface of the water body. The slime layer reduces light penetration and restricts reoxygenation of water through air currents. The death and decay of aquatic plants produces a foul smell and makes the water more turbid (Beeby, 1995; Rao, 1998).

In surface waters, phosphorus concentrations exceeding 0.05 mg/L may cause eutrophic conditions Hinesly and Jones, (1990). Nitrogen and phosphorus are essential elements required by plants and animals for maintaining their growth and metabolism. Small amounts of nitrates and phosphates occur in all aquatic ecosystems and maintain a balanced biological growth in such ecosystems. Fresh water habitats are of much importance to mankind but they occupy a relatively small portion of the earth’s surface as compared to the marine and terrestrial habitats (Santra, 2001). The fresh water ecosystem cover only 0.2% of the earth’s surface with a volume of $2.04 \times 10^5 \text{ km}^3$ Lieth, (1975). Algal biodiversity in fresh water and related Physico-chemical factors were studied by Veereshakumar and Hosmani (2006), which dealt substantially for the organic production of waters ways. They will give information about the productivity of the environment. $P^{\text{H}}$ is one of the most important factors that serves as an index of the pollution. The water body registered an alkaline $P^{\text{H}}$ with the
values ranging from 7.45 to 8.1. Ranjan et al., (2007). $p^H$ value of majority flakes and reservoirs in India has been found between 6 to 9. The higher range of $p^H$ indicates higher productivity of water (Khan and Khan 1985). Chidobem (1987) investigated on the Sen Reservoir and concluded that the cyanophycean members are dominated over all other groups of algae.

Sugunan (1980) also studied the seasonal fluctuation of plankton in Nagarjuna sagar (Andrapradesh), and recorded the standing crop of plankton peaks one in summer and other in winter. There have extensive laboratory studies to evaluate effects of environmental factors on Microcystins production, such as the incidence of light on Microcystins biosynthesis (Hesse and Kohl 2001) and the production of Microsystems under nutrient limitation, mainly P and N restriction (Hesse and Kohl 2001; Long et al., 2001). Microcystins, which are secondary metabolites and are produced by some cyanobacteria Carmichael (1992), are health hazards to livestock, wildlife and human Carmichael (2010).

Diatoms are considerably important biological organisms because they are one of the sources of oxygen, like other algal divisions, and the first ring of food chains in aquatic systems. A complete picture of the lake ecosystem is necessary to understand the mechanisms regulating the nutrient content and biomass of benthic algae, because they can be dominant primary producers and are an important food resource Wetzel, (1996).

Maruthanayagam et al., (2003) studied the season specific zooplankton diversity in Thirukkulam pond, Mayiladuthurai, Tamilnadu, India. This study showed that community size of zooplankton was the highest in rainy season while the lowest density of zooplankton was in summer due to the higher temperature. Among the all zooplankton copepods forming the dominant group followed by cladocera, rotifera and ostracoda. Community size of selected major zooplankton can indicate the trophic status of lakes and also can help to understand the shifts in tropic state. Many scientists worked with community sizes of Rotifera and Copepoda to show the different trophic states.

The rotifers play a vital role in the trophic tiers of fresh water impoundments and they serve as living capsules of nutrition Suresh Kumar et al., (1999). Macro
benthic organisms occupy the bottom of water body. The functional role of macro
benthic communities in the trophic dynamics of reservoir ecosystems is well
acknowledged. The composition, abundance and distribution of benthic organisms
over a period of time provide an index of the ecosystem. In recent years, there is a
greater emphasis world over for better understanding of benthic environment, its
communities and productivity and this has led to increased exploitation of many
inland water bodies. Clarke (1979) attempted to show the utility of mollusca in
primary classification of the lakes in their various trophic status stages. Choubisa
(1992) has collected 22 species of mollusca from various freshwater habitats of
southern Rajasthan and considered these as indicator for oligotrophic lakes based on
their distribution and relative abundance. Harman (1974) has also pointed out that
mollusca are bio-indicators of freshwater.

Zooplankton species have different types of life histories influenced by
seasonal variations of biotic factors, feeding ecology and predation pressure.
Zooplankton forms a major link in the energy transfer at secondary level in aquatic
constitutes the second trophic level of food chain and forms the food for most of the
pelagic fishes. They occupy an intermediate position in the aquatic food webs
between autotrophs and heterotrophs. The distribution and diversity of zooplankton in
aquatic ecosystem depend mainly on the physic-chemical properties of water. Studies
on the distribution and abundance of zooplankton in the back water and estuaries of
Kerala have been well investigated Nair. et al., (1984).

Due to tremendous development of industry and agriculture, the water
ecosystem has become perceptibly altered in several respects in recent years and as
such they are exposed to all local disturbances regardless of where they occur.
Venkatesan, (2007). The increasing industrialization, urbanization and developmental
activities, to cope up the population explosion have brought inevitable water crisis.
The health of lakes and their biological diversity are directly related to health of
almost every component of the ecosystem Ramesh et. al., (2007). The increased
demand of water as a consequence of population growth, agriculture and industrial
development has forced environmentalists to determine the chemical, physical and
biological characteristics of natural water resources (Regina and Nabi, 2003).